



**CIHEAM
BARI**

Master of Science Theses



SUSTAINABLE WATER AND LAND MANAGEMENT IN AGRICULTURE



INNOVATIVE APPROACHES FOR INTEGRATED PEST MANAGEMENT
OF MEDITERRANEAN FRUIT CROPS



MEDITERRANEAN ORGANIC AGRICULTURE





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FRUIT AND VEGETABLE CROPS**

MEDITERRANEAN ORGANIC AGRICULTURE

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SUSTAINABLE WATER AND LAND MANAGEMENT IN AGRICULTURE

L&W - A.Y. 1989-1990 (July session) – 1-9ter

1. FAKHEUR Samet (Tunisia)

Supervisor: N. Katerji

Title: Étude comparé des méthodes d'estimation de l'évapotranspiration potentielle en climat Méditerranéen du sud de l'Italie (Région de Bari). - 80 p.

Abstract: Connaître le degré de précision des formules les plus couramment utilisées dans la pratique pour l'estimation de l'évapotranspiration potentielle en région méditerranéenne du sud de l'Italie (Rutigliano) est d'une importance notable pour une utilisation rationnelle des ressources hydriques. Notre étude propose de tester des formules de l'évapotranspiration potentielle à partir des références (évapotranspiration maximale du gazon, évaporation du bac classe "A") en se basant sur des mesures climatiques journalières effectuées à la station agroclimatique (ISA Bari) de Rutigliano, sur une période de trois années (1987-1989). Les résultats obtenus montrent que: parmi les formules étudiées (Penman, Blaney et Criddle, Turc), la formule de Turc est celle qui donne les valeurs les plus proches de l'ETP de référence. La formule de Penman est adaptée aux caractéristiques du climat local sous réserve qu'une révision des relations empiriques utilisées dans l'estimation des différents termes qui la compose soit réalisée pour tenir compte des conditions locales. Les mesures du bac classe "A" sont un moyen intéressant pour estimer l'évapotranspiration du moment où on applique à ces mesures un coefficient déduit de l'étude d'Allen et Pruitt (1990). Enfin, et compte tenu que l'évapotranspiration est avant tout un phénomène énergétique, on a cherché une approche du type de Priestley et Taylor à partir du rayonnement net mesuré et de la durée d'insolation. Cette approche s'est révélée intéressante dans la mesure où elle conduit à des résultats satisfaisants et qu'elle utilise des paramètres météorologiques moins nombreux.

2. NEJIB Bouzid (Tunisia)

Supervisor: N. Katerji

Title: Fonctionnement hydrique et production de la fève (*Vicia faba* L.) en relation avec la salinité de l'eau d'irrigation. - 71 p.

Abstract: Cette expérience réalisée sur une culture de fève et en présence de deux types de sol a permis d'étudier les effets de la salinité de l'eau d'irrigation sur le fonctionnement hydrique, la croissance et le rendement de la plante. Les trois critères d'étude du fonctionnement hydrique se sont révélés sensibles à la salinité de l'eau d'irrigation: le potentiel hydrique de base diminue, la résistance stomatique et la température radiative foliaire augmentent. Le critère le plus sensible et le plus simple à déterminer est cependant le potentiel de base. La croissance normale de la plante est compromise et son rendement s'est réduit en conditions de salinité de l'eau d'irrigation. Tous les effets observés sont plus intenses sur le sol limoneux-argileux comparé à celui limoneux-sableux.

3. El-Sayed Mahrous Samira (Egypt)

Supervisor: J. W. van Hoorn

Title: Lysimeter experiments with saline water: salt balance and salt movement. - 38 p.

Abstract: This investigation was undertaken to study salt balance and movement in soils. The experiment was conducted in drainable lysimeters in silt loam and silty loam soil; broad bean was used as an indicator plant under irrigation with saline water of 4 and 8 ds/m for the first soil and 2,4 ds/m for the second one beside a control treatment irrigated with fresh water (0.9 ds/M). The conclusions which may be drawn from the results could be summarized as follows: the salt accumulation depends on the salt concentration of the irrigation water and the leaching fraction; it becomes less pronounced and even decreases when the leaching fraction increase. The highest salt concentration in the soil profile gradually changes towards greater depth, showing the highest value in the bottom layers. Comparison between the measured increase in salt concentration of the soil water after irrigation and the values calculated from the difference between input from irrigation water and output from drainage water, suggests an exchange of sodium against calcium at the soil complex and precipitation of calcium carbonate.

4. KADRIBASIC Muriz (Yugoslavia)

Supervisor: A. Castorani

Title: Equivalent pipeline methodology in computation of water hammer. Effects in branched irrigation network. Analysis and possibilities. – 2 vol. - 59 p. + annexes

Abstract: The feasibility of unsteady flow effects computations in branched water supply schemes applying equivalency methods in the goal of the thesis. The idea of the research work is to establish the range of error when computing extreme values of pressure due to water hammer in equivalent pipeline related to the original scheme. The equivalency method refers to substitution of the branched network by an equivalent pipeline. The method of Virtual Piezometric Heads is used for solution of water hammer. Three equivalency criterions applied in the work considered kinetic energy, elastic potential energy and frictional head losses. Performed analysis treated three types of water supply schemes (w.s.s.1,2,3). Schemes of type 1 are typical irrigation schemes with hydrants as a final point. In schemes of type 2 and 3 hydrants were replaced with reservoirs of infinite volume. Analysis of the simulated data for w.s.s.1 showed that in general the differences in pressures computed in real scheme and equivalent pipelines are in the limits of ± 2 m. Safety level attained when applying equivalency criterions for protective device design is quite high, and can be used for that purpose. Analysis proved that the equivalency methodology can be satisfactorily applied for air chamber design in w.s.s.2, application of the equivalency methodology enables, when w.s.s.3 are considered, valve closure time computation in relation to pressure variation, and can be used for feasibility study design.

5. KOSSONOU Yao (Yvory Coast)

Supervisor: V. A. Copertino

Title: Analyse régionale des basses eaux à travers la courbe de "durée d'écoulement". - 66 p.

Abstract: This study is based on the idea that a long term runoff on a area can be considered as more dependent on the physical and climatic characteristics of the catchment area than on the quantity of precipitations, and that low flow rate extracted from data could be related statistically to these characteristics to generate low flow forecasting formulas at ungauged sites. The aim of this study is to enable engineers to draw the flow duration curve when hydrological data are missing, relying only upon physical and climatic characteristics of the catchment area for the design of hydraulic works (operational discharge determination) and for water resource management: The application to Apulia provided satisfactory results and, contrary to the conclusions of the Institute of hydrology Wallingford, showed that the catchment area is the major parameter for arid and semiarid regions.

6. KOFFI Germain Akoubia (Yvory Coast)

Supervisor: G. Grittani

Title: Évaluation économique à posteriori du réseau d'irrigation du projet Sinni-Salento. - 49 p.

Abstract: Cette étude s'est intéressée à l'évaluation économique à posteriori du réseau d'irrigation du projet Sinni-Salento en utilisant la technique de l'analyse avantage-cout référée à Bergman et Boussard. Après avoir explicitement défini les paramètres essentiels qui interviennent dans ce genre d'étude nous avons choisi comme indicateurs de rentabilité la valeur actuelle nette (V.A.N.), le rapport avantage-cout actualisé (R.A.C.A.) et le taux interne de rentabilité (T.I.R.). Selon les hypothèses de calcul que nous avons élaborées le projet Sinni, du point de vue de l'irrigation, comporte des problèmes très sérieux qui peuvent compromettre la rentabilité économique envisagée lors de sa conception. Les plus importantes sont : la programmation des investissements publics ; la durée des investissements publics. Mais, il est clair qu'un projet aussi complexe et a buts multiples (irrigation, industrie, potable) comme celui-ci doit être considéré dans son ensemble a fin de ne pas faire de jugement assez déplacé.

7. SAAD ABBASS Mohamed (Egypt)

Supervisor: A. Caliendo

Title: Residual effect of irrigation regimes and water quality on soil fertility and wheat yield. - 55 p.

Abstract: This investigation was directed to an evaluation of soil productivity and grain yield production with respect to the residual accumulated salts in a soil subject to continuous irrigation with variable irrigation regimes and saline water of EC value 5 ds/m for three successive season (1987-89) growing maize-sunflower-maize. The data obtained demonstrated the possibility of using lower water quality in irrigation for summer crops in semiarid region.

The autumn precipitation showed its high efficiency in leaching the accumulated salts. For the use of such water for irrigation to be successful, crops should be selected in view of the salt content in irrigation water. Moreover, the irrigation requirement should be determined very carefully, abundant irrigation volumes could lead to a greater salt accumulation rather than its removal.

8. MILETIC Predrag (Yugoslavia)

Supervisor: C. De Marzo

Title: Landsat thematic mapper data application for agricultural resources surveying in Mediterranean region. - 126 p.

Abstract: Satellite remote sensing has been employed for almost two decades in agricultural resources inventory management and monitoring, especially in the areas of the world where extensive agriculture production is practiced. In the case of Mediterranean regions, which are specific in many ways compared to other parts of the world, special methods are needed to extract information from the remotely sensed images. Landsat TM data were used for large area vegetation cover mapping. The extensive remotely sensed data set was abridged using an appropriate transformation-tasseled cap TM transformation keeping 95% of data variation in the reduced data set. A method for discrimination of land cover types was designed, profiting as much as possible of the multitemporal character of the available satellite images. The resulting thematic map was compared with the actual vegetation development cycle superimposing it over the multitemporal images of the study area. The map was also confronted with the information obtained by the work previously carried out in the region. Finally, the general land cover distribution pattern was checked during the field work. The direct application on a test site in Puglia has demonstrated that land cover mapping by means of satellite digital imagery processing proved to be a powerful and useful tool both from the classification precision and time consumption point of view. This verification proved that the applied classification procedure suggested in the thesis achieved a high degree of cover type discrimination on lands which can hardly be classified with other methods. These land cover types are mainly olives and almonds and to a lower degree vineyards which in earlier works had been confused among themselves.

9. MELANO Carlos Alberto (Argentina)

Supervisor: A. F. Piccinni

Title: Open-channel irrigation networks. - 51 p.

Abstract: A proper administration of water resources requires adequate knowledge of water management modalities. When considering open-channel networks, it is difficult to precise the system's answer to the operation of regulation structures. Predicting the evolution of flow parameters renders it possible a non-casual but controlled management of the scheme, thus preserving such an absolutely vital resource as water. To this purpose, a FORTRAN language computer program was developed to simulate the hydraulical behaviour of an elementary (three-branched) network due to manoeuvres of control structures (such as gates). Because of its simple mathematical formulation an explicit finite difference scheme was used to

solve Saint-Venant's non linear partial differential equations ruling unsteady flow in open channels. Particular attention was drawn to nodal resolution, i.e. definition of flow parameters (mainly water stages and discharges) in the junction. Five application cases were studied: three of them concerning operation of sluice gates at the downstream terminal sections, and the other two including automatic downstream constant-level gates (of "AVIO" or "AVIS" type).

9bis. YANLING Zhao (*China*)

Supervisor: A. Petrillo

Title: Planning and management of water resources. - 77 p.

Abstract: In this paper, the planning and management of complex water resources are studied and a simulation model is presented. The model can be used to both independent and dependent management systems. The model has been thoroughly examined by applying model are quite close to reality. In the appendix book, the model and its application to three water resource systems of southern Italy are reported.

9ter. UJER Ajami Mohamed (*Somalia*)

Supervisor: S. Troisi

Title: Metodologie di valutazione dell'infiltrazione verticale mediante lisimetri. - 126 p.

Abstract: L'obiettivo di questo lavoro è di effettuare una raccolta di metodologie sperimentali più idonee alla ricerca in corso e di effettuare un collegamento con studi di qualità e agronomici in corso sulla stazione lisimetrica.

L&W - A.Y. 1990-1991 (July session) – 12-25

12. EL MOUJABBER Maroun (Lebanon)

Supervisor: N. Katerji

Title: Étude et modélisation de l'évapotranspiration: cas particulier de la référence gazon. - 71 p.

Abstract: Les analyses théoriques de Monteith et Perrier en introduisant les notions de résistances aérodynamique et du couvert, fournissent les outils nécessaires au calcul de l'évapotranspiration en général et le gazon en particulier à partir d'une approche du type analytique. De ces analyses découlent deux modèles : le premier proposé par Allen et al. (1989) suppose que la résistance du couvert est constante au cours du temps est fonction uniquement de l'indice foliaire. Le deuxième proposé par Katerji et Perrier (1983) admet que la résistance du couvert est variable. Pour rendre compte de cette variabilité ces auteurs soulignent la nécessité de modéliser cette résistance en relation avec les facteurs du milieu. Dans le cadre de cette étude réalisée à l'Institut expérimental Agronomique de Bari à Rutigliano, les valeurs de l'évapotranspiration calculées par ces deux modèles ont été confrontées à différentes échelles du temps à celles mesurées par une évapotranspiromètre pesable. Nous avons observé que le modèle de Allen et al. (1989) sous-estime les valeurs mesurées de l'évapotranspiration alors que le modèle de Katerji et Perrier (1983) conduit à des valeurs proches de cel-ci. L'analyse a montré également que la manque de performance du modèle de Allen et al. (1989) est due essentiellement à l'introduction d'une résistance du couvert constante dans ce modèle.

13. JOVANOVIĆ Nebojsa (Yugoslavia)

Supervisor: N. Katerji

Title: Estimation and analysis of evapotranspiration of a soybean crop. - 45 p.

Abstract: On the basis of measurements carried out in a Mediterranean region in Southern Italy (Rutigliano, Bari, 1990), actual evapotranspiration (ET) was estimated from a soybean crop during 3 cycles of soil desiccation and wetting up. The comparison between ET values obtained by direct method (a couple of floating evapotranspirometers) and two indirect methods (Bowen ratio and simplified aerodynamic methods) is carried out in order to point out simple and precise ET measuring methods to be applied in field conditions. The results show a good agreement between direct and indirect ET estimation in good water supply conditions. Evapotranspirometers overestimated ET during soil desiccation periods. Error analysis shows that Bowen ratio method is more precise than simplified aerodynamic method. We also compare and test the sensitiveness of several crop water stress indicators (manual and automatic) in order to suggest valid and rapid criteria which could be applied to schedule irrigation on farm level. Both criteria related to plant water status (leaf water potential, stomatal resistance, canopy radiative temperature, sensible heat flux-net radiation ratio, relative evapotranspiration) and criterion related to soil water conditions (soil water content) have shown to be

sensitive to crop water stress. Among the other indicators, predawn leaf water potential appears the most sensitive and easily determined.

14. STRICEVIC Ruzica (Yugoslavia)

Supervisor: M. E. Venezian

Title: Ecophysiological indicators of sweet sorghum water status as criteria for irrigation scheduling. - 50 p.

Abstract: Sweet sorghum is a new plant in Mediterranean area and it still needs to gain its ground in traditional agriculture. Many agrotechnical problems haven't been solved so far. One of them and certainly a crucial one, is the crop water requirement and the irrigation scheduling in order to obtain optimal yield. The aim of this thesis was to test some sensitive and simple ecophysiological indicators of the water status of sweet sorghum, grown in an area of potential cultivation, for them to be used to optimize irrigation management for higher yield and better water use efficiency. The comparison among measured indicators, relative water content of leaf tissue, leaf water potential, stomatal conductance and parameters based on canopy radiative temperature shows that all of them are sensitive to the soil water shortage. Taking into consideration not only sensitivity to drought but also the practical applicability, we can refer, to the leaf water potential and stomatal conductance as the most suitable parameters of sweet sorghum water status to be used for irrigation scheduling. Analysis of growth pattern was carried out well watered conditions and under temporary droughts of the same degree. We observed great recovery capacity in different growth stages when sweet sorghum was re-watered. It is a droughts resistant plants, with very high water use efficiency either in well watered or dry land conditions, consuming around 170 Kg of water to produce 1 Kg of stalk dry matter.

15. BOUMHIDI Mohammed (Morocco)

Supervisor: G. Grittani

Title: Evaluation économique a posteriori des projets d'irrigation, cas d'application : projet d'irrigation de Tara a Taranto. - 49 p.

Abstract: Nous avons dans ce travail abordé l'évaluation a posteriori du projet d'irrigation de Tara dans la province de Taranto en Italie, par l'utilisation de la méthodologie monétaire macroéstimative et particulièrement sa technique cout-avantage. Nous avons dans une première partie mis en exergue les objectifs recherchés, la méthodologie employée et le choix des différents paramètres nécessaires à son utilisation. Dans la dernière partie, on a appliqué la dite méthodologie au cas concret du projet de Tara, et le travail se termine par les critiques, tant des résultats obtenus que de la méthodologie employée.

16. ABDEL-GHAFAR NASSAR Aatef (Egypt)

Supervisor: A. Hamdy

Title: Saline irrigation practices and management: modes of water application and leaching. - 62 p.

Abstract: Wheat is semitolerant plant to salinity but continuous irrigation with relatively high salty water (9 dS/m) imposed its negative effect on the grain

yield production by provoking a notable reduction as compared with the treatment when irrigation was permanently practiced with fresh water. The cyclic use of low and high salinity water resulted not only in improving the grain yield production but also in reducing the total salt load and thus preventing the soil from becoming too saline.

17. ZHOU Rong (China)

Supervisor: A. Hamdy

Title: N fertigation: vegetable crops. - 46 p.

Abstract: A trial was carried out in the greenhouse to find how the fertigation frequency and N rate influence crop yield, dry weight production, nutrients uptake as well as N use efficiency. The conclusions are: N rate significantly influences crop yield and dry matter production. N rate of 140 Kg/ha or more didn't show significant increase of crop yield with respect to 70 Kg/ha. Under prevailing conditions, 70 Kg/ha of N level could be recommended; fertigation frequency significantly influenced fruits yield and dry weight production. In general, short intervals are more favourable than long ones; in general, P.K uptake increased with increments of N rate; fertigation with a rate of 70 Kg/ha and a frequency of permanent could lead to high N use efficiency and could be recommended.

18. HASNAOUI Jalel (Tunisia)

Supervisor: not available

Title: Étude du bilan des sels et des propriétés chimiques du sol sous différents régimes d'irrigation avec des eaux saumâtres. - 59 p.

Abstract: L'expérience a été conduite dans des lysimètres à drainage en présence de deux types de sols. Le blé a été choisi comme plante indicatrice sous deux régimes d'irrigation avec trois niveaux de salinité de l'eau. La salinité du sol a été évaluée à l'aide de trois méthodes différentes : la méthode du bilan des sels ; échantillonnage de l'eau du sol ; le calcul de la distribution des sels par une méthode numérique selon un modèle simple. En conclusion on peut dire que ces méthodes simples peuvent être utilisées pour estimer et prévoir le niveau moyen approximative de salinité du sol sous différents régimes de lessivage au champ. Pour le blé on peut réduire les apports d'eau lors de la période de croissance et retarder le lessivage jusqu'au moment où il y a d'avantage d'eau disponible.

19. BELKHIRI Farouk Eddine (Algeria)

Supervisor: N. Katerji

Title: Influence de la salinité de l'eau et de la dose d'irrigation sur le fonctionnement hydrique et la production du blé. - 77 p.

Abstract: Cette étude a permis d'étudier le fonctionnement hydrique, la croissance et le rendement du blé cultivé sur deux types de sols, irrigué selon deux régimes d'irrigation et soumis à trois niveaux de salinité de l'eau d'irrigation. On a pu observer qu'en analysant les critères liés au fonctionnement hydrique de la plante, les différences existent toujours entre le témoin et le traitement soumis à un niveau de salinité élevé est à un régime d'irrigation restreint. Quant à la croissance, l'analyse de ce critère a

montré des différences appréciables entre les traitements des deux sols et au niveau de chaque sol. Concernant le rendement, la nouveauté a été de trouver que sur le sol argilo-limoneux, une chute en rendement (paille et grain) de 4% alors qu'en comparaison avec le même traitement du sol limono-sableux, elle a été de 10% et cela pour les traitements les plus défavorisés.

20. BOUNADI Mohamed (Morocco)

Supervisor: A. Petrillo

Title: Étude expérimentale sur la stabilité de la dalle de protection du bassin de dissipation à ressaut. - 56 p.

Abstract: Après l'examen des paramètres qui influencent les pulsations de pressions sous le ressaut hydraulique, on présente les résultats d'une enquête expérimentale dédiée à l'examen des conditions de stabilité des dalles de revêtement de fond des bassins de dissipation à ressaut de Bidone. Ces résultats mettent en évidence la dépendance des conditions de stabilité de certains indices individualisés au niveau de l'analyse dimensionnelle du phénomène, et montre la nécessité d'expérimentations supplémentaires pour évaluer les effets combinés des conditions cinématiques du courant incident, de la structure de turbulence dans le ressaut et des caractéristiques géométriques des dalles sur la stabilité complexe de l'ouvrage.

21. HEDHILI Kamel (Tunisia)

Supervisor: C. Constantinidis

Title: Evaluation comparative de la performance hydraulique d'asperseurs de différentes grandeurs. - 85 p.

Abstract: Les pertes d'eau par évaporation du jet dépendent des facteurs climatiques et des conditions de fonctionnement. Les grands espacements réduisent considérablement l'efficacité d'application et l'uniformité de distribution. D'après le travail expérimental qui a été mené dans les mêmes conditions, dans chaque essai et pour chaque degré de pulvérisation du jet (R/P), on a observé que tant l'efficacité d'application (E_a) que l'uniformité de distribution (U_c) diminuaient lorsque l'espacement entre les asperseurs augmentait. Il est évident que les pertes par évaporation directe du jet sont dues à la majeure longueur de celui-ci. L'interprétation des données nous révèle que dans les cas de grands espacements, par installation des asperseurs plus grands, les pertes d'eau par évaporation directe du jet ont été supérieures à 100%, par rapport à celles des premiers cas. Pratiquement les mêmes différences ont été observées entre l'espacement des asperseurs et l'efficacité de distribution, ce qui a été confirmé par l'analyse de Dan. Les différences susdites, vérifiées par l'analyse statistique (analyse factorielle) se sont avérées significatives à 1% et 1 pour dix mille. Du point de vue technique et agronomique nous affirmons que les asperseurs petits et moyens s'adoptent au système collectif sous pression de distribution de l'eau avec fonctionnement au tour d'eau ou à la demande.

22. EL-KELLOUTI Mostafa (Morocco)

Supervisor: L. S. Pereira

Title: Analyse de certains indicateurs de performances des systèmes d'irrigation de la région des Pouilles (Italie). - 73 p.

Abstract: L'insuffisance du financement et l'échec de plusieurs projets d'irrigation rendent impérative l'évaluation de ces projets dans le but de leur réhabilitation. L'évaluation de la performance des systèmes d'irrigation est posée mettant en évidence les facteurs limites du succès de ces systèmes. Ce travail illustre une méthodologie qui consiste à définir certains indicateurs d'évaluation en se basant sur les caractéristiques des systèmes d'irrigation de la région des Pouilles en Italie. A travers le modèle statistique de la régression linéaire, on aboutit à un choix d'indicateurs adaptés pour mesurer la performance des systèmes d'irrigation.

23. EL-MADANI Mohammed (Morocco)

Supervisor: M. Ait Kadi

Title: Optimisation des réseaux ramifiés de distribution d'eau sous pression dans le cas de plusieurs régimes de débits. - 49 p.

Abstract: Le calcul des réseaux collectifs sous pression consiste essentiellement en la détermination du tracé ainsi que le dimensionnement du réseau. Il existe de nombreuses solutions satisfaisant aux contraintes techniques, mais il convient de chercher la solution optimale. Initialement on optimise le dimensionnement du réseau tout en considérant que le tracé est une donnée, par la suite on approche l'optimisation simultanée du tracé et du dimensionnement. Mais toutes ces méthodes n'ont considéré qu'un seul régime du débit, ce qui n'est pas conforme à la réalité ; en effet aussi bien la simulation que l'enregistrement de débits ont montré que les réseaux fonctionnent à plusieurs régimes de débits. Donc rien n'assure que la considération d'un seul régime de débit conduit au système le plus performant en terme hydraulique, est économique. Ait Kadi *et al.*, ont proposé un modèle dit, MAK3, qui optimise des réseaux collectifs sous pression pour plusieurs régimes de débits, il s'agit d'une extension de la méthode itérative discontinue de Labaye, Y. Dans le cadre du présent travail, on développe un logiciel qui met en oeuvre le modèle MAK3.

24. RAJCIC Veroslav (Yugoslavia)

Supervisor: A. Castorani

Title: Experimental research of valve closure laws in irrigation systems. - 103 p.

Abstract: This work gives a contribution to better comprehension of a gate valve closure law pointing out the significance of its variation in accordance with the characteristics of a particular system where the valve is installed. Precise laboratory test of a gate valve is necessary at valve full open (due to closure law expression) as well as at so-called effective valve positions in last cca 15 of closure time. Other measurements at intermediate positions are needed only for attain a continuous experimental curve. Its good approximation was found in polynomial function of high order obtained by standard program packages. Mathematical expression of this law was a base for the numerical prevision of surges in the real system applying the referent system model. The model is based upon the computer program of virtual piezometric heads disregarding the effects of transmission and reflection at the system junctions and bifurcations. Calculated surges confrontation with

measured one indicates their rather good concordance. Most influential parameters causing herein before discrepancy are submitted and commented.

25. BELAID Adel (Tunisia)

Supervisor: N. Ficco

Title: Évaluation au champs de l'irrigation par sillons par deux modalités d'application: continue et par vagues. - 81 p.

Abstract: La modernisation des méthodes d'irrigation de surface est une mesure d'importance capitale dans le contexte du développement des technologies de la production agricole. Elle exige le maximum d'efficience d'utilisation de l'eau, de la main d'oeuvre et du capital. Le travail réalisé sur l'irrigation par vagues a permis d'étudier la technique du cut-back afin de rendre possible le contrôle du ruissellement, d'évaluer la performance de cette nouvelle technique et de la comparer à celle de l'irrigation continue. L'utilisation d'un modèle de simulation nous a permis de comparer trois techniques de gestion. Les résultats obtenus ont montré que : la qualité de l'irrigation s'est révélée très sensible à la technique du cut-back ; la durée des cycles durant la phase de post avancement devrait être comprise entre 70 et 80% du temps nécessaire au front d'avancement pour atteindre l'extrémité aval du sillon ; la différence entre les deux techniques proposées par l'USDA-SCS (1986) est pratiquement nulle et le nombre optimal de cycles est de 3 à 5.

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31. DIKER Kenan (Turkey)

Supervisor: A. Hamdy

Title: Saline irrigation management: modality of water application. - 61 p.

Abstract: This work was conducted to investigate one of the multisource water management technique, namely alternation technique, in comparison with leaching conducted according to crop growing stages, having four salinity levels of irrigation water. Corn was chosen as an indicator plant. Results shown that corn was tolerate to salinity up to 3 dS/m without any big deterioration in its yield and alteration technique was a big potential both to have good crop yield and relatively salt free root zone or fresh water saving under highly saline water irrigation. Results also indicated that both leaching and alternation techniques needed a throughout knowledge of crop growing stages which were sensitive to salinity. It is advisable under alternation technique to alternate waters more frequent under salinities exceeding 6 dS/m and try to apply same quality water up to certain stage then change it to other one to have good salt distribution in the soil profile.

32. ALOUI Brahim (Tunisia)

Supervisor: N. Katerji

Title: Sensibilité du sorgho à grain à la contrainte hydrique. - 71 p.

Abstract: On a étudié la réponse des cultures aux déficits en eau dans les aires où l'eau disponible pour l'irrigation est limitée. Le comportement du sorgho à grain vis-à-vis de déficits d'alimentation hydrique a été étudié au moyen d'une expérimentation réalisée en conditions de plein champ. L'application de la contrainte hydrique consiste à la diminution du potentiel de base. On a étudié l'effet de la contrainte appliquée sur le fonctionnement hydrique de la plante. Les données obtenues nous ont permis de conclure qu'il y a bien une contrainte hydrique au cours d'un stade végétatif donné lorsque le potentiel de base mesuré au cours de ce stade devient, inférieur à - 0.4 MPa. En outre, le sorgho à grain a montré un caractère anisohydrique. On s'est intéressé en outre à l'effet de la contrainte hydrique sur la croissance et le rendement du sorgho à grain. L'évolution de la sensibilité des stades phénologiques soumis à la contrainte hydrique a été obtenue en comparant les rendements en matière sèche finale ainsi que les trois composantes du rendement en grain par rapport à un témoin bien irrigué. Malgré des possibilités de compensation importantes par augmentation du poids de 1000 grains, la période de gonflement est la plus sensible. La sécheresse agit en causant surtout la formation incomplète des panicules et des éventuels nombres réduits des grains formés réduisant ainsi le rendement en grain.

33. BILGIC Kani (Turkey)

Supervisor: A. Hamdy

Title: Saline irrigation practices: leaching management. - 61 p.

Abstract: This work investigates on the way salt affected crops, on their distribution and accumulation under irrigation and leaching with waters of different quality. The trial was carried out using the semi tolerant crop wheat (*Triticum durum*) and it can be divided into two major parts. The first part tries to establish the effects on the general growth characteristics of wheat by irrigating and leaching with water containing different salt concentrations. The second part is devoted to characterizing the salt accumulation and distribution within the different soil layers, at variable depths under both unleached and leached treatments. The conclusions drawn from our result can be summarized as follows: wheat is semi tolerant plant to salinity; the data and result obtained clearly showed that the wheat is producing higher yield production in the light saline conditions; under leached treatments, the increase in the yield production varies according to the salinity levels of the irrigation and leaching waters.

34. KARAM Fadi (Lebanon)

Supervisor: N. Katerji

Title: Influence du niveau de salinité des eaux d'irrigation sur le comportement hydrique, la croissance et la production de la pomme de terre (*Solanum tuberosum*). - 81 p.

Abstract: Ce travail expérimental a permis d'étudier le fonctionnement hydrique, la croissance et le rendement de la pomme de terre (*Solanum Tuberosum* - variété spunta) en présence de deux types de sol et de trois niveaux de salinité pour chacun. Les deux paramètres de caractérisation de l'état hydrique -le potentiel de base et la résistance stomatique- se sont révélés sensibles à la salinité de l'eau d'irrigation ; le potentiel de base diminue, la résistance stomatique augmente entraînant ainsi une réduction de l'ouverture stomatique et une diminution de la surface foliaire et de la matière sèche. Concernant la production finale, la texture du sol a induit un effet sur le rendement quantitatif et qualitatif dont le sol limoneux à texture légère a gardé la priorité sur le sol argileux à texture fine tandis que le niveau de salinité a effectué de plus la quantité de tubercules que leur qualité.

35. EL-SAYED Habib Emad Honsy (Egypt)

Supervisor: A. Petrillo

Title: Experimental study on scour downstream of hydraulic jump. - 118 p.

Abstract: The present study is an experimental investigation of the phenomenon of scour of loose sand bed downstream of hydraulic jump used as energy dissipator formed over a rigid apron. The following conclusions were formulated. The maximum scour depth was found to increase with time until it reaches an equilibrium state. Regarding the features of the scouring process, the shape and dimensions of the measured scour holes were seen to be dependent upon the flow condition downstream of the jump. This flow condition was quantified by introducing a flow parameter called "bed shear stress ratio Tr " defined as the ratio of the dimensionless critical bed shear stress value $(T^*)_{cr}$ obtained from Shield's diagram to the corresponding actual value T^* . The variation of the maximum scour depth with the apron length was studied and two global relationships were found to describe the experimental data reasonably well. The turbulence intensity parameter Kv downstream of the jump was measured by the use of a Laser Doppler

Anemometer (LDA) which made it was possible to measure the high pulsative velocity components downstream of the jump. The large-scale eddy features of the roller zone in the jump were investigated using a video camera where periods of vortex pairing and immigration were observed causing oscillation of the location of the toe of the jump with a remarkable travel of broken vortices into the tailwater causing the instability of the sand particles.

36. HABASHY Nader Ramzy (Egypt)

Supervisor: A. Hamdy

Title: Tomato crop response to nitrogen fertigation. - 51 p.

Abstract: That research on nitrogen fertigation in order to evaluate tomato plant response to different nitrogen sources at different rates, and the impact of nitrogen concentration on the final yield and plant uptake of phosphorus and potassium for selecting proper nitrogen concentration for maximum yield. The conclusions obtained summarized in the following: nitrogen application significantly and positively influenced on the plant; a greater improvement was obtained by shortening interval between application; data declared that the uptake of the P and K was increased under nitrogen fertigation; as for the analysis of N, P, and K nutrient uptake, the data indicated that: the variation in application doses applied at different frequencies with different nitrogen sources to some extent, directly influenced the N uptake its indirect influence on the dry matter production; nitrogen use efficiency (NUE) clearly confirmed that short fertigation frequencies applied at that 100 Kg/ha N rate resulted in the highest efficiencies. In the light of the above mentioned result, we come up to the conclusion that under N fertilization, tomato yield is not only a function of the N sources and doses but equally so of its distribution an the variable growing stages. By fertigation technique, great losses of the applied nitrogen could be saved and seems to be economically sound and results in a better use efficiency of the fertilizer applied.

37. HEZA Mohamed Yehia Barakat (Egypt)

Supervisor: A. Castorani

Title: Earth dam failure and flood hydrograph due to overtopping. - 114 p.

Abstract: The proposed model by A. Castorani which assumes a gradual earth dam failure was considered in this study. The model was calibrated by using historical data from Teton and Litle Deer Creek dams failure, it could be seem that the accuracy of the model is relatively high comparable to the historical data and the error is less than 5%, so it could be recommended to use this model for prediction purposes, which can be used for dam safety, land use and evacuation planning. Also the sensitivity and parametric studies were carried out to study the behaviour of the model under change of different parameters. From this study it could be seen that, the model is not so sensitive to the chosen number of elements, while it appear to be sensitive to the chosen time intervals the precise data must obtained to define the reservoir characteristics. The model was applied on some of the existing dams South Italy to predict the flood hydrograph. From this study it could be seen that, the maximum discharge is relatively occurred when the breach reaches its terminal bottom elevation which is considered as the foundation level of the dam. Also the routing of the expected flood due to Cillarese dam was

carried out, and it could be seen that, the flood hydrograph very steep and acts like a shock wave.

38. CHATRI Abdelwahab (Morocco)

Supervisor: M. Ait Kadi

Title: Analyse du fonctionnement d'un réseau collectif sous pression d'irrigation à la demande : cas d'un réseau du périmètre "Sinistra Ofanto" (Italie). - 79 p.

Abstract: A travers ce travail, on s'est intéressé à l'analyse du fonctionnement d'un réseau d'irrigation à la demande du périmètre Sinistra Ofanto (Capitanata) en Sud d'Italie. Cette analyse a été conduite d'une part, sur la demande des agriculteurs via l'examen de l'hydrographe des débits enregistrés en tête et qui a servi également à l'ajustement de la loi de Clément, et d'autre part, sur la réponse du réseau à cette demande via des modèles de simulation visant l'identification des défaillances en pression. Enfin, diverses solutions envisageables ont été exposées pour remédier aux défaillances constatées sinon pour en alléger l'ampleur.

39. EL-HAJJAJI M'Barek (Morocco)

Supervisor: L. S. Pereira

Title: Indicateurs de performance et de conception des systèmes d'irrigation : application aux systèmes de Pouilles (Italie). - 63 p.

Abstract: A l'heure actuelle, la réussite difficile des systèmes d'irrigation et, par la même, la nécessité d'intervenir pour utiliser au mieux les ressources en eau, ont mis en évidence plus clairement les lacunes des activités liées aux fonctionnement, entretien et gestion. Afin d'analyser ces problèmes, il est nécessaire de développer des indicateurs et/ou comparateurs de performance des systèmes d'irrigation. Suite à une première phase d'étude (El-Kellouti, 1991), plusieurs indicateurs et/ou comparateurs de performance ont été définis et appliqués à plusieurs systèmes d'irrigation en Pouilles (Italie). Sur la base d'une analyse de régression plus approfondie et de l'analyse des composants principales, les indicateurs et/ou comparateurs choisis correspondent à des sujets prioritaires pour améliorer la gestion des systèmes d'irrigation dont l'approvisionnement en eau, le fonctionnement du réseau de transport et de distribution, le système service et le système OM&M (Operation Maintenance and Management). Les indicateurs ainsi sélectionnées peuvent être utilisées par les organismes de gestion ou par les concepteurs des systèmes pour des améliorations futures, ainsi bien pour d'autres professionnels intéressés à la gestion de l'eau en agriculture.

40. LI Yonhjan (China)

Supervisor: C. Constantinidis

Title: Response of mathematical models proposed to correlate surface irrigation parameters. - 59 p.

Abstract: The low efficiencies of the surface irrigation are mostly due to the poor design and management. For determining the better design methods, 8 proposed mathematical models were analysed in this study in order to check their response to the reality. For this purpose, 3 sets of experimental data

(Policoro-Italy, Parthenio-Greece, Sindos-Greece) were applied in the verification of different models. Finally, it was found that the most important parameters for surface irrigation is the soil infiltration characteristics and the best mathematical models proposed up to now for surface irrigation are the Hydrodynamic model, the Zer-Inertia model and the Kinematic-Wave model.

41. DJULYAKOVIC Vladan (Yugoslavia)

Supervisors: A. Caliendo and P. Steduto

Title: Partial sensitivity analysis of a crop productivity model. - 96 p.

Abstract: A generalized and comprehensive cropping-system model named EPIC (Erosion-Productivity-Impact-Calculator) was used to simulate wheat growth under the prevailing pedo-climatic conditions of Southern Italy. Two types of soils (clayly and loamy) under the same climate (typical Mediterranean of Apulia and Basilicata regions) were considered to partially analyzed the sensitivity of EPIC. Responses of biomass, yield, and appearance of water and nutrient stresses of the model simulations were investigated relatively to changes in input variables such as field capacity, wilting point and bulch density. The results showed that: EPIC has generally low sensitivity to the input variables examined with the two classes of soils considered; it resemble reasonably well the water and nutrient stresses that may occur relatively to the sensitiveness of the crop; it's better to always set the soil-layer subdivision at the maximum number allowable by the model. Overall, good qualitative responses were obtained by the model. Though, a more accurate quantitative analysis is needed to complete the sensitivity test and generalize the results.

42. POCUCA Vesna (Yugoslavia)

Supervisors: A. Caliendo and P. Steduto

Title: Partial validation of a crop productivity model. - 74 p.

Abstract: Partial calibration and validation of the crop-growth submodel of a general comprehensive cropping-system model named EPIC (Erosion-Productivity-Impact-Calculator) was undertaken to investigate the model simulative capability under some of the prevailing pedo-climatic conditions of Southern Italy. Simulated and experimental results of leaf area index (LAI), crop-growth (above-ground biomass) and yield were compared for different years (1985-1990), for different crops (wheat, faba beans, sugarbeet, etc.), and for two different locations (Policoro and Valenzano). The results showed that: EPIC is not able to represent the winter growth of the Mediterranean climate because of problems related to the winter dormancy implementation, which has a reference temperature of 5 deg C; an apparent mismatched computation of the LAI appears during senescence, when LAI decline should start. This problem seems not to have a significant impact on the biomass and yield simulation; the model tend to over-estimate growth under drought conditions, by underestimating the water-stress impact. Overall, with the appropriate corrections and adjustments, EPIC can be also a useful tool for farm management and yield predictions. However, additional validations are needed before generalizing some of its applications.

43. KAABI Nouredine (*Tunisia*)

Supervisor: J. W. van Hoorn

Title: Étude comparative du bilan des sels dans deux types de sol cultivé en pomme de terre (*Solanum tuberosum* cv. Spunta). - 67 p.

Abstract: L'utilisation des eaux salées entraîne dans le sol une évolution de la salinité qui dépend de la concentration de l'eau d'irrigation et du lessivage. Il y a une migration du sodium de l'eau du sol vers le complexe adsorbant en échange avec le calcium et le magnésium qui se précipitent avec le bicarbonate. La salinité du sol provoque chez la plante une diminution de l'évapotranspiration, une accumulation du chlore dans les jeunes feuilles et une réduction qualitative et quantitative du rendement en tubercules.

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48. ABOU-SAWAN Ibrahim (Lebanon)

Supervisor: N. Katerji

Title: Productivité potentielle du sorgho sucrier dans la région méditerranéenne. - 59 p.

Abstract: Cette étude a pour objectif d'apprécier le risque d'introduction du sorgho sucrier dans la région méditerranéenne. Cette analyse a été réalisée à partir des éléments suivants : i) l'étude de la productivité potentielle du sorgho sucrier (à partir du modèle de Monteith, 1972), puis la comparaison de cette productivité avec les cultures sensibles (soja, tournesol) et résistante (sorgho à grain) à la sécheresse, cultivées normalement dans la région ii) la comparaison des besoins en eau et l'efficacité de l'utilisation de l'eau du sorgho sucrier par rapport aux cultures citées précédemment. L'ensemble des observations obtenues indique que le sorgho sucrier semble bien adapté aux conditions climatiques de la région méditerranéenne. Une synthèse des résultats obtenus a conduit à l'élaboration d'un modèle agrométéorologique simple pour la prévision du rendement du sorgho sucrier en condition hydrique non limitante.

49. ALAOUI Lalla Meriayme (Morocco)

Supervisor: L. S. Pereira

Title: Approche à la simulation de l'irrigation par aspersion en quadrillage au niveau de la parcelle. - 83 p.

Abstract: L'objectif de l'irrigation est d'apporter l'eau uniformément sur une superficie donnée afin de satisfaire les besoins des cultures. Dans la méthode d'irrigation par aspersion faisant l'objet de mon travail, on applique l'eau sous pression à travers des asperseurs, on prétend donc que toutes les plantes reçoivent la même hauteur d'eau, c'est à dire, que l'arrosage soit uniforme. L'uniformité d'application de l'eau d'un asperseur dépend des caractéristiques de l'asperseur -débit, pression, portée, courbe pluviométrique- en rapport avec sa disposition sur le terrain (écartement) et la pression de fonctionnement disponible. En conditions de vent, la distribution est modifiée, ce qui oblige à changer les dispositions des asperseurs sur le terrain. Le calcul des systèmes d'irrigation par aspersion requiert la connaissance, au moins approximative, du diagramme de distribution de l'eau en absence du vent. Les systèmes d'irrigation étudiés dans notre cas correspondent à des installations en quadrillage, soit mobiles ou semi-fixes, soit en couverture intégrale ou totale, conçus pour utiliser des asperseurs de moyen ou faible débit et de basse à moyenne pression. L'étude consiste à développer un programme sur ordinateur pour : i) le calcul de dimensionnement et la simulation d'un système, des diamètres des rampes et conduites, des débits et pressions, en considérant la topographie et des indicateurs d'uniformité de pression. ii) la simulation de l'uniformité d'application et vérification des écartements en absence du vent, soit en utilisant des hauteurs d'arrosage mesurées sur le terrain, soit des grandeurs obtenues des caractéristiques des

asperseurs. Pour permettre le fonctionnement de ce logiciel, on a établi aussi des fichiers concernant les caractéristiques des asperseurs et des conduites, ainsi que des fichiers d'entrée et sortie. Le logiciel contient plusieurs menus qui aident l'utilisateur à faire le meilleur usage du programme.

50. **BOUZOU Mourad Lazhar (Algeria)**

Supervisor: J. W. van Hoorn

*Title: Évolution de la salinité sur l'essai de la germination de deux cultures: le tournesol (*Helianthus annuus*) et le maïs (*Zea mays*). - 46 p.*

Abstract: Ce travail expérimental permet d'étudier l'évolution de la salinité dans le sol, ainsi que son effet sur deux cultures, l'une est moyennement tolérante à la salinité : le tournesol, l'autre moyennement sensible : le maïs. L'expérience a été conduite sur des pots remplis avec deux différents types de sol, le premier à texture argilo-sableuse, le second sablo-argileux. L'ensemble des pots est placé dans la serre du dispositif expérimental de l'IAM de Bari. Avec deux régimes d'irrigation, un avec lessivage et l'autre sans lessivage, cinq qualités d'eau d'irrigation à concentration différente d'ion de chlorure (3.7, 15, 30, 45, 60 meq/l) ont été disposées afin d'étudier les impacts que peuvent subir leur utilisation sur le sol et sur les cultures. La salinité du sol a été déterminée par deux méthodes : la première consiste à prélever des échantillons de l'eau de drainage après chaque irrigation pour mesurer la conductivité électrique (ds/m) et la composition ionique de cette eau ; la deuxième consiste à prélever des échantillons du sol à des niveaux différents (0-5, 5-10, 10-15 cm). Après être séché, un extrait 1:1 a été préparé pour mesurer la conductivité électrique et la concentration en chlorure et des autres ions. Le bilan de sel a été calculé pour le régime avec lessivage, en calculant la différence entre l'apport et l'évacuation en milléquivalent par litre, puis en divisant cette différence par la capacité au champs de chaque sol (meq/l). Les résultats montrent que la salinité du sol n'a pas beaucoup évolué dans les deux sols et dans les deux cultures avec le régime sans lessivage ; alors que pour le régime avec lessivage l'apport de sel dans le sol était plus importante à cause de la dose d'irrigation plus élevée. Ceci est dû à la présence de chlorure à l'origine dans le sol. Pour le tournesol, la concentration en sel après irrigation s'est doublé entre la première et la troisième irrigation ; pour le maïs, s'est à peu près triplé entre la première et la quatrième irrigation. Les paramètres de l'état hydrique de la plante ainsi que la teneur en chlore dans les feuilles ont montré que le maïs était plus sensible à la salinité par rapport au tournesol.

51. **EL-MARAGHY Amro (Egypt)**

Supervisor: A. Petrillo

Title: Fully developed turbulent flow throw smooth concentric annular pipe. - 83 p.

Abstract: After extensive study of mean-velocity profile measurements in incompressible turbulent flows, it is proposed to present the profile by a linear combination of two universal functions. One is the well-known law of the wall.

The other, called the law of the wake is characterized by the profile at point of separation (in the outer region). This work present experimental study for the turbulent flow profile in smooth annular pipe, using Laser Doppler Anemometer. This required to use transparent plexiglas tube in the measuring station. The radius ratio of the annular was 30/75. The refraction problems for the laser beams were solved analytically as well as the position of the reference point, in order to get a relation between the laser sender movements and the intersection of laser beams inside the conduit. The analysis of the results shows the validity of the wall-law in the inner region. In the outer region it was noted that, the wake function was different than this one of the pipe. Statical analysis for the velocity fluctuation in different position in the profile were done. The clear phenomena were: the influence of the wall made the fluctuation in this region anisotropic. In the other region the distribution of the fluctuation became isotropic particularly in the point of maximum deviation from the log-law.

52. ABD EL MONEM Salam Gamal (Egypt)

Supervisors: A. Castorani and A. F. Piccinni

Title: Analysis and control of unsteady free-surface flow. - 121 p.

Abstract: The use of numerical solution of the Saint-Venant equations to determine the propagation of unsteady free surface flow has been validated by many researchers during the previous two decades. Amongst the many numerical techniques which have been developed for the analysis of unsteady flows in open channels is the LAXWND technique, which uses the Lax-Wendroff scheme for the interior grid points and the characteristic scheme for the boundary grid points. The LAXWND technique was applied in this study because of simplicity and the treatment of the external and internal boundaries has been made by means of the method of characteristics. This technique is the only correct one if we want to incorporate the true information in every problem. A Fortran program was developed to simulate the Saint-Venant equations in the two forms, a general divergence form at the interior grid points and a characteristic form at the boundary grid points. The main purpose was to study the hydraulic behaviour of the canal when confronted by overflow problems faced by, for example, raining, lateral inflow or raising of the water table, and look for the best solution for the problems which we may have.

53. JAMMOUL Samar (Lebanon)

Supervisor: N. Katerji

Title: L'effet de différents niveaux de salinité de l'eau d'irrigation sur la germination et le fonctionnement des plantes en phase d'installation. - 75 p.

Abstract: Ce travail expérimental a pour objectif d'étudier l'effet de différents niveaux de salinité sur la germination, le fonctionnement hydrique, la croissance de deux espèces végétales : le tournesol (*Heliantus annus*-hybride ISA) et le maïs (*Zea mays*-variété A88), en présence des deux types de sols et de cinq niveaux de salinité pour chacun. On a trouvé que la germination de deux cultures est affectée par les différents niveaux de salinité des eaux

d'irrigation. On a remarqué un retard et l'apparition d'un taux entre les différents traitements, et par suite une perte de densité dans les deux cultures. Les deux paramètres de caractérisation de l'état hydrique, le potentiel de base et la résistance stomatique se sont révélés sensibles à la salinité de l'eau d'irrigation, constituant des outils intéressants pour caractériser l'état hydrique des plantules cultivées en milieu salin. La croissance de la plantule est diminuée en fonction du niveau de salinité de l'eau d'irrigation entraînant une diminution de la surface foliaire et de la matière sèche qui peut atteindre 50% par rapport au témoin.

54. LAMOUCI Sami (Tunisia)

Supervisors: L. S. Pereira, A. Hamdy, N. Ben Mechlia and N. Lamaddalena

Title: Experimental study on methods for injection and mixing of nitrogen for surface irrigation fertigation. - 86 p.

Abstract: The present work on fertigation under a surface irrigation method represents the beginning of a long term research being conducted at the IAM of Bari. Chemicals and fertilizers injected, directly into the irrigation water and applied through surface systems, are subject to the low uniformity of water application. The recent achievements in surface irrigation have enabled achieving a high irrigation efficiency as pressurized systems. A kind of farm irrigation canal has been constructed for the purpose, in order to evaluate the applicability of furrow irrigation, as an example of surface method, for fertigation. Results showed a high efficiency in the distribution of fertilizer in addition to its independence of the hydraulic characteristics of flow. Moreover, in the application of fertigation, special emphasis is to be given to the modes of fertilizers mixing, taking into account the chemical and physical characteristics of the fertilizers and of irrigation water.

55. NAGAZ Kamel Eddine (Tunisia)

Supervisors : A. Hamdy and N. Ben Mechlia

Title: Pratique et gestion de l'irrigation saline : modes d'application de l'eau. - 118 p.

Abstract: Le présent travail s'inscrit dans le cadre des études de la pratique et la gestion de l'irrigation saline dans les régions où l'eau disponible pour l'irrigation est limitée. Le comportement du blé vis-à-vis des modalités d'application de l'eau a été observé en serre sous des conditions climatiques contrôlées. L'objectif de ce travail est d'étudier l'influence de l'irrigation saline, selon diverses modalités d'application, sur la germination et l'établissement des plantules en présence de trois types de sol ; sur la croissance et la production du blé ; sur l'accumulation et la distribution de sels dans le sol. Dans la première partie, les résultats obtenus montrent un meilleur développement des plantules lié à la réduction de sels accumulés si on utilise l'eau douce à la germination, et que le type de sol et sa texture jouent un rôle très important dans la réduction éventuelle des effets négatifs sur la croissance aux stades initiaux ; toutefois, une eau de salinité de 4 dS/m peut être utilisée à ces stades. Dans la deuxième partie, les résultats indiquent que les traitements d'alternance ne mène à aucune amélioration de la production en matière sèche, mais son impact se manifeste nettement sur le rendement en grain. Le mélange eau-sel doit être tel que la salinité n'exécède pas 3 dS/m, salinité à laquelle la production en grain sera similaire à celle du témoin.

56. TODOROVIC Mladen (Yugoslavia)

Supervisors: P. Steduto and A. Caliendo

Title: Grass canopy resistance response to climatic variables and reference evapotranspiration estimate: analysis by means of the Penman-Monteith equation. - 96 p.

Abstract: This thesis describes the crop canopy resistance r_c as a function of weather variables, and discuss some modeling techniques that can be used to estimate reference evapotranspiration ETo . The basic framework to make the various analysis is the Penman-Monteith equation. The study is limited to reference grass community and to daily meteorological data. These data, for a period of 8 years (1982-1989), are derived from the Agrometeorological Station of the Bari University experimental field "E. Pantanelli", located in the area of Policoro (Southern Italy). The results showed that in the process of evapotranspiration, scaling up from leaf to canopy -spatial scale- and from short time basis (few minutes to 1 hour) to 24 hours -temporal scale- the importance of climatic (macro scale) variables arises and they are typically defined as the variables that drive the system. Introducing nondimensional concepts in the Penman-Monteith approach, it is possible to derive two critical r_c values corresponding to two specific values of the ratio between available energy (A) and latent heat flux of evapotranspiration (LET). These two critical values of the ratio (A/LET) properly define two boundaries and three ranges within which r_c differently responds to environment. The models for evapotranspiration (ET) estimate, which use critical resistance values of r_c , have the advantage of adjusting ET estimates to the local environment, as opposed to models which use fixed r_c value. In the present analysis, the

critical canopy resistance corresponding to the ratio $A/LET=1$, improves the ET estimates on daily basis, as compared to all the other models tested.

57. YAGOUBI Samir (Tunisia)

Supervisor: A. Caliendo ; co-advisors : N. Ben Mechlia and A. Hamdy

Title: Irrigation d'appoint et efficience d'utilisation de l'eau : cas de la pomme de terre. - 116 p.

Abstract: Ce travail, réalisé sur culture de pomme de terre, rentre dans le cadre de l'étude des potentialités de l'irrigation d'appoint comme technique pour corriger les déficits hydriques dans les régions où l'eau disponible pour l'irrigation est limitée. Le comportement de la pomme de terre vis-à-vis du déficit hydrique a été étudié en conditions contrôlées sous serre à l'IAMB. L'expérimentation a consisté en l'application d'une contrainte hydrique à deux niveaux d'intensité préfixés. Les stades d'application de la contrainte sont : l'initiation de stolonisation, l'initiation de tubérisation et le début de grossissement des tubercules. Un témoin bien irrigué tout au long du cycle cultural, a été retenu pour comparer la sensibilité de ces stades à la contrainte hydrique. Les critères retenus pour évaluer l'état hydrique de la plante sont : le potentiel de base, la conductance stomatique, la différence de température entre feuille et air, et l'évapotranspiration relative. Tous ces indicateurs ont montré une bonne sensibilité vis-à-vis de l'arrêt de l'irrigation. Les analyses des productions finales ont montré que le début du stade grossissement des tubercules est la période la plus sensible à la contrainte hydrique. En effet, le stress hydrique à ce stade a accéléré la sénescence foliaire et a réduit considérablement l'activité photosynthétique et le rendement. Par contre, à l'initiation de stolonisation, la contrainte hydrique a eu un effet particulier. Lorsque Φ_b est passé de - 4.1 bar à - 5.2 bar, le rendement final et l'efficience de l'utilisation de l'eau ne se sont même améliorés. Etablissant qu'une valeur de p_b de - 4.5 bar est un seuil de déclenchement de l'irrigation de la pomme de terre, des apports en eau complémentaire seraient surtout conseillés en début de la phase de grossissement des tubercules.

58. YARDIMCIOGLU Tunay (Turkey)

Supervisor: A. Hamdy

Title: Maize response to nitrogen fertigation. - 82 p.

Abstract: A greenhouse experiment was conducted using two type of fertilizer and maize as an indicator crop to investigate the interactive effects of nitrogen source, dose and timing on crop yield development and soil nitrogen contents during an irrigated crop season. Experiment was conducted with completed randomized block design which included two type of fertilizer (urea and ammonium nitrate) four nitrogen doses (0, 50, 100 and 150 kg/ha) and four application timing (two times, four times, eight times and permanent). Statistical analysis showed that application doses and application timing have highly significant effect on leaf area, dry weight of aerial part and yield. The obtained results showed that whatever the N source or rate at which it was applied, a greater improvement was obtained by shortening interval between application, i.e. permanent (P) and 8 times (8x) fertigation frequencies. The status of nitrogen concentration in the soil solution during the cropping period indicate that maize has a small demand during the successive growth stages.

The most effective time for N-application is in period covering both fast growing and flowering stage.

59. EL-AALLOUMI Kaltoum (*Morocco*)

Supervisor: M. Ait Kadi ; advisor : N. Lamaddalena

Title: Application de la méthode d'optimisation des diamètres en cas de plusieurs régimes de débits au dimensionnement. - 77 p.

Abstract: Cette étude a été effectuée sur un réseau collectif sous pression fonctionnant à la demande du périmètre Sinistra Ofanto, au Sud de l'Italie. Le dimensionnement du réseau de distribution de cet aménagement a été fait moyennant l'approche probabiliste de Clément et en se basant sur des résultats extrapolés de la conception d'autres réseaux voisins et similaires. L'évolution au cours des années de la mise en valeur et des techniques d'irrigation ont conduit à une diminution de la qualité du service de l'eau se traduisant par des chutes de pression aux niveaux des prises, et par conséquent, un mauvais fonctionnement de l'installation d'irrigation en aval. Cette étude vise la recherche d'une solution optimale du système de conduites permettant l'amélioration de la qualité du service de ce réseau. Pour cela, on a adopté une nouvelle approche de dimensionnement qui, au lieu de se baser sur des débits fictifs probabilisés, se base sur la génération des débits réels suivant les configurations des prises ouvertes. C'est dans ce cadre qu'on a procédé à l'application de la méthode d'optimisation des diamètres avec plusieurs régimes de débit au réseau étudié. Ensuite, on a fait une comparaison entre le dimensionnement par cette méthode et la méthode classique de Clément à travers le modèle d'analyse (AKLA). Les résultats d'analyse ont montré que le dimensionnement par cette méthode permet d'envisager le système de conduites le moins cher et le plus compatible avec les performances souhaitées du réseau.

60. XU Di (China)

Advisor: C. Constantinidis

Title: Comparative calculation of models of a runoff system by open channels in flat areas. - 108 p.

Abstract: In agricultural areas, the study and construction of a runoff system is absolutely necessary. In this thesis, the comparative calculation of the runoff system on a real area of 2284 ha is completed, section by section, by the models and methods as below: the cinematic original method of Turazza-Pasini; the continuity original method of Puppini; the two mentioned original methods using the modifications by Prof. Constantinidis; the synthetic hydrograph method of the S.C.S. The thesis contains the processing of real rainfall data to obtain the reduced rainfall curves and the critical cases of rainfall, and the complete mathematical analysis of the models and methods proposed. Having chosen the critical case, the separate calculation of the evacuation capacity of each section of the runoff system has been performed by applying the above mentioned methods. From the calculation data the following conclusions can be drawn: 1) The values of Q_{max} obtained by the first two classical methods are considerably high and notably different between them. 2) The values of Q_{max} obtained by the first two classical methods are lower, reasonable and similar to each other going toward the terminal section, by using the modifications introduced by Prof. Constantinidis. It is suggested to use the two original methods (cinematic and continuity) but with the modifications introduced by Prof. Constantinidis, verified, on the other hand, with the results obtained by the method of synthetic hydrograph of the S.C.S. (USA).

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68. KAMBERI Halit (Albania)

Supervisors: C. Constantinidis and A. Sigliuzzo

Title: Comparative design of a pressurized pipeline irrigation system working "by rotation" and "on demand". - 44 p.

Abstract: The area studied is 340 ha, part of Durres district in the centre of Albania, as a particular zone of the Scorana Schem, which is chosen by an intervention programme designed by the FAO and the World Bank on the rehabilitation and widening of irrigation, and was defined of most priority. This is a comparative design of pressurized pipeline sprinkler irrigation system working by rotation and on demand. Agrometeorological data are taken from the Xhafzotaj station, which is located in the proximity of our area; the observation time covers 40 years (1951-1990). From economic analyses and the Albanian condition, the conclusion drawn is the best solution can be the rotation system.

69. LAHMER Fadhila Zehor (Algeria)

Supervisor: A. Hamdy

Title: Utilisation des halophytes en agriculture. Étude de la germination et de la mise en place de *Atriplex halimus*. - 79 p.

Abstract: Dans l'objectif de déterminer le seuil critique de germination d'une plante halophyte (*Atriplex halimus*) et le moyen d'améliorer sa germination en milieu salin, plusieurs niveaux de salinité allant de 1 à 20 dS/m, et des prétraitements avec l'eau douce et l'eau salée ont été appliqués. De même, nous avons évalué l'effet de deux types de sols (sableux et limono-argilo-sableux) et de 5 niveaux de salinité ainsi que l'addition de la tourbe à un substrat sableux irrigué par deux niveaux de salinité sur la croissance (surface foliaire et matière sèche). Les graines d'*Atriplex halimus*, présentent une grande habilité à germer sous des conditions fortement salines, avec un seuil critique qui se situe aux environs de 10 dS/m. L'effet des prétraitements avec l'eau douce ainsi que l'eau saline améliore surtout le temps moyen de germination dans les milieux fortement salins. La mise en place des plantes d'*Atriplex halimus* est nettement plus importante dans un substrat argileux que dans un substrat sableux. De même, l'addition de tourbe dans le substrat sableux améliore considérablement la mise en place de la culture. La stimulation de la croissance dans le sol argileux et dans les mélanges sable-tourbe est directement liée à leur capacité de réduire l'accumulation des sels dans la solution du sol.

70. MOHAMED Abdel Ghafar Mohamed Alaa ed-Din (Egypt)

Supervisor: A. Petrillo

Title: Scour from flow downstream of a sluice gate after a horizontal apron. - 87 p.

Abstract: The present experimental study investigated the local scour of loose sand after a horizontal apron caused by flow from a sluice gate. The experiments concerned with this study were conducted in the hydraulic laboratory of the Mediterranean Agronomic Institute of Bari, in a flume 7.72 m long having a rectangular section of 0.30 m width by 0.40 m depth. The following conclusions are formulated: the maximum scour depth, for all the experimental test runs, was found to increase with time until it reaches an equilibrium state where its rate of increase becomes relatively slow. This great scour in a short time is due to the formation of the jump on the sand bed and this short time is needed for the tailwater depth to increase and for the flow to develop from the initial attached jet. This phenomenon is very important in the initial of flow in channels downstream of irrigation and other hydraulic control structures. To study the type of the formed jump, the obtained experimental results were plotted on the regime chart obtained by Mohamed et al. (J. of Hydr. Res., IAHR, v.30, no. 5, 1992) which relates the flow regime to the relative tailwater depth and the initial Froude number. It was found that the jump tended to repeat itself in a periodic form starting from wave jump and this wave jump dig the sand particles towards the upstream of the flume until the level of the sand bed directly after the apron became approximately equal to the apron level. Muller and Valentin formulae which enable the calculation of the maximum scour depth were used for the comparison between the calculated and measured maximum scour depths for the test runs of the second part.

71. AL-RASHDAN Jamal Ahmad Salim (USSR)

Supervisor: A. Hamdy

Title: Potato response to nitrogen fertigation. - 77 p.

Abstract: Potato yield production in relation to N application dose and distribution rate during the growing cycle clearly demonstrated that by keeping N-application dose constant, a better yield production was achieved when N was distributed in proper proportions at the early vegetative tuberization and early stage tuber bulking. This was true under both the N-application modes, indicating that those three stages are the most critical ones where nitrogen should be applied in the appropriate portions for the achievement of a more favourable potato yield. N-application significantly and positively influenced all the growing parameters; however fertilization at relatively little doses (50Kg/ha) seems to be insufficient to meet plant requirements for a better development and a satisfactory yield production; whereas the intermediate dose (100 Kg/ha) is the one to be recommended as it resulted in the highest yield production; excessive N-application (150 Kg/ha) is not recommended at all since it didn't lead to any improvement in yield production, but rather to excessive increments in tuber maturity and a reduction in the final yield production. Comparing the plant growing parameters and yield production under fertigation and top dressing N techniques, the data obtained all in all proved that both N-application modes are effective when N is applied in proper doses and distributed in the appropriate rates with respect to the critical growth stages.

72. FILOMENO Oronzo (Italy)

Supervisor: P. Steduto

Title: Évolution de la biomasse racinaire et aérienne du sorgho sucrier (*Sorghum bicolor* Pers.) en conditions d'alimentation hydriques optimale et déficitaire. - 62 p.

Abstract: Cette étude relève des recherches menées par la CE pour substituer les cultures actuellement excédentaires par les alternatives. Le sorgho sucrier, du fait de la versatilité d'utilisation de sa biomasse (fourrage, bio-combustibles, cellulose) est la plus intéressante et il fait l'objet de ce travail. La recherche a été menée en 1993, au Sud de l'Italie sur le cv. Keller soumis à deux régimes d'irrigation : a) parcelle témoin irriguée à 100% de l'ETP de la culture pour tout le cycle cultural ; b) parcelle stressée irriguée jusqu'à 67 jours depuis l'émergence comme l'a) et successivement, lorsque le potentiel foliaire de base atteignait -1 MPa. Le but de ce travail a été de comparer, pour les deux régimes d'irrigation, la biomasse racinaire totale, la biomasse racinaire par couche, la densité racinaire, la longueur spécifique, l'indice partie racinaire/partie aérienne, R/S, et le rendement de transformation du rayonnement photosynthétiquement absorbé (PARa) en biomasse totale (Ms), y compris la racinaire. Les paramètres étudiés ont montré une nette différenciation entre les parcelles quoique l'écart n'ait pas été statistiquement significatif. La biomasse racinaire totale a diminué, à la fin du cycle, de 11% pour la parcelle stressée. L'évolution du profil de la biomasse et de la densité racinaire par couche a été similaire entre les parcelles, mais celle irriguée a été supérieure (30%) sur les 30 premiers centimètres. La longueur racinaire spécifique de la parcelle irriguée a été en moyenne supérieure à celle stressée (13%), mais au niveau de chaque couche de sol, la différence a été moins évidente. Le rapport R/S a été généralement supérieur dans la parcelle stressée et il variait de 0,22 au début du cycle à 0,09 à la fin. L'addition de la biomasse racinaire et aérienne n'a pas réussi à expliquer complètement l'écart du Ms/PARa réel par rapport à celui prévu.

73. ABOU-REJAILI Elias (Lebanon)

Supervisor: J. W. van Hoorn

Title: Influence de la qualité de l'eau d'irrigation sur la salinité du sol et sur le rendement du maïs (*Zea mays*). - 58 p.

Abstract: Les problèmes posés par l'utilisation des eaux salines pour l'agriculture irriguée sont relativement complexes en raison des impacts qu'elles ont aussi bien sur le sol que sur la plante. C'est dans ce sens que cette étude a été conçue et elle s'est déroulée sur le dispositif-lysimètre IAM-Bari en été 1993. Le maïs à grains (*Zea mays*) a été choisi comme plante indicatrice en présence de deux types de sol et trois niveaux de salinité d'eau d'irrigation. L'évolution de la salinité du sol a été étudiée en combinant entre elles deux méthodes : échantillonnage de la solution du sol par pots poreux et le bilan des sels. Un niveau croissant de la salinité de l'eau d'irrigation fait accumuler plus de sels dans le sol. Ceci est d'autant plus vrai que la salinité de départ de ce dernier est faible. Dans ces conditions, le lessivage après la période de pointe s'est avéré plus efficace. Un échange du calcium et du magnésium du complexe adsorbant du sol contre le sodium de la solution du sol a été signalé avec la précipitation dans cette dernière du calcium et du magnésium sous forme de bicarbonate et de sulfate. Des modèles simples décrivant la distribution des sels dans le profil du sol peuvent servir comme

instrument pour suivre l'évolution de la salinité des sols affectés par les sels. Egalement, la salinité de l'eau d'irrigation et par la suite du sol a engendré des réductions aussi bien de la consommation en eau du maïs que de son rendement final.

74. EL-TAWM Lamya (Lebanon)

Supervisor: N. Katerji

Title: Effet de l'enrichissement en CO₂ sur le fonctionnement et la productivité du maïs: conséquences résultant de l'application d'une contrainte hydrique. - 78 p.

Abstract: Des plantes de maïs (*Zea mays*, variété DEA) ont été cultivées à 4 reprises (1992, 1993 (2 cultures) et 1994) dans deux compartiments d'une serre ventilée. Dans un compartiment, l'air provenant de l'extérieur a été enrichi de façon à doubler la concentration en CO₂ à l'intérieur du compartiment et les plantes y sont mises depuis le semis jusqu'à la récolte. Des mesures continues de la transpiration ont été faites et une diminution de 17-18% dans le compartiment enrichi a été notée. L'enrichissement en CO₂ n'a eu d'effet ni sur la croissance (surface foliaire totale) ni sur le développement (dates d'apparition des organes) de la plante. Cependant, une augmentation de la matière sèche totale et de l'efficacité de l'eau a été observée. L'effet combiné d'un doublement en CO₂ et d'une application simultanée d'une contrainte hydrique a été étudié après la floraison de l'année 1994. Une diminution du rapport ETR/ETM dans les deux compartiments ainsi que la conductance stomatique des plantes enrichies stressées ou non par rapport aux témoins a été observée. En revanche, pour des valeurs proches de ETR/ETM, des valeurs de photosynthèse plus élevées des plantes enrichies stressées par rapport aux témoins stressés ont été obtenues.

75. EL YACOUBI Zakariae (Morocco)

Supervisors : M. Ait Kadi and N. Lamaddalena

Title: Développement d'un modèle de génération des régimes de débit dans un réseau d'irrigation fonctionnant à la demande. Cas d'un réseau du périmètre Sinistra Ofanto (Italie). - 79 p.

Abstract: La présente étude consiste à élaborer un modèle de génération des régimes de débit dans un réseau d'irrigation fonctionnant à la demande, desservant un secteur irrigué avec des champs à différents assolements et dans différentes conditions. Cette étude est appliquée au cas d'un réseau collectif d'irrigation sous pression du périmètre irrigué Sinistra Ofanto, projeté pour fonctionner à la demande, où le modèle a été calé au préalable. Le modèle effectue un suivi du bilan hydrique sur chacun des champs desservis par le réseau. Le modèle considère les variables suivantes : données climatiques, caractéristiques des champs (superficie, type de culture, date de semis, type de sol, efficacité d'irrigation), et la loi de distribution de probabilité des irrigations dans la journée. Les hydrographes de demande et les régimes de débit qui en résultent durant la période de pointe, ont été étudiés à l'aide d'un modèle de simulation. Sur le réseau, on a aussi étudié les prises défaillantes à l'aide du modèle AKLA ainsi que le déficit de pression correspondant. On a évalué la performance individuelle, appréciée en terme de fiabilité et de résilience. Les régimes de débit simulé dans le réseau sont

utilisés pour l'analyse et le choix de la solution optimale d'un système de conduites permettant l'amélioration de la qualité du service de ce réseau.

76. EL KASSIMI Abdessamad (Morocco)

Supervisor: L. S. Pereira ; co-supervisors : N. Lamaddalena and J. L. Monteiro Teixeira

Title: Approche à la modélisation de l'irrigation localisée : aspects hydrauliques et de performances. - 83 p.

Abstract: En micro-irrigation, la distribution de l'eau est effectuée par des distributeurs de façon localisée, prétendant que toutes les plantes reçoivent la même quantité d'eau, c'est-à-dire que l'arrosage soit uniforme. En fait, l'uniformité de distribution et l'efficacité d'application, en tant que critères de performance du système, ne sont pas facilement maîtrisés. Elles dépendent de divers facteurs en relation avec la conception, la variation de fabrication et des problèmes de maintenance. En micro-irrigation, les distributeurs constituent, probablement, l'élément le plus important et le plus délicat des systèmes d'irrigation localisée et le calcul des systèmes nécessite la connaissance, au moins approximative, des paramètres de l'équation du flux et une indication sur la variabilité de fabrication du distributeur. Cette étude consiste d'abord à caractériser les aspects fondamentaux des systèmes d'irrigation localisée et à analyser les aspects qui déterminent les performances. Ensuite, à développer un programme à l'ordinateur pour le dimensionnement en tenant compte des indicateurs de performance et pour l'évaluation et la simulation de la distribution et de la variation des charges et débits des systèmes en fonctionnement à partir de fichiers d'input et des conditions hydrauliques de l'installation.

77. PUERTO MOLINA Herminia (Spain)

Supervisor: P. Steduto

Title: Water use efficiency response of sweet sorghum under progressing water stress conditions. - 67 p.

Abstract: Interest in sweet sorghum raised from its high efficiency in water use, and the lack of specific information about its response to water stress. This work aimed to characterize the water use efficiency (WUE) response of sweet sorghum at leaf (WUE_l), and partially at canopy (WUE_c), levels under progressing water stress, and to compare such response with maize, to infer the features explaining its apparent higher WUE. The field trial took place during summer 1993 at Rutigliano (BA), Italy. Field grown sweet sorghum was subjected to two water stress cycles, along which water vapour and CO_2 fluxes were measured, at noon, on upper fully expanded leaves, with a portable photosynthesis apparatus operating as closed system. Predawn leaf water potential (Ψ_b) was monitored as a measure of soil water status. Canopy gas exchanges were estimated using the Bowen-Ratio/Energy Balance/ CO_2 gradient (BREB+) method. Under water stress, WUE_l remained almost constant around a value of $5 \text{ mmolCO}_2 \cdot \text{molH}_2\text{O}$, showing a dependence on leaf-to-air vapour pressure deficits (VPD) but not varying sensibly with decreasing Ψ_b along the two stress cycles. Leaf conductance (g_l) showed curvilinear responses to VPD and Ψ_b , and a shift of the curve g_l vs Ψ_l towards lower values of Ψ_b on the second stress cycle probably due to osmotic adjustment. Internal leaf CO_2 concentration (C_i) remained constant with

variations in VPD and Ψ_b . Parallel evolution of gas exchange parameters at leaf and canopy scales indicated an effective stomatal control over the whole canopy. WUE_c remained roughly constant at about $6.5 \text{ mmolCO}_2 \cdot \text{molH}_2\text{O}$, a value higher than those of other crops confirming results found on biomass WUE. Reasons proposed to explain the sweet sorghum higher WUE are: stomatal response to VPD, ability to adjust osmotically, capability to maintain a high carboxylation capacity under water stress, and limited senescence within the productive season.

78. HARUN IBRAHIM Ahmed (Somalia)

Supervisor: A. Hamdy

Title: Saline irrigation management: irrigation techniques. - 75 p.

Abstract: The work was carried out to investigate the way salts affect crops, on their distribution and accumulation in soils under three irrigation methods namely subsurface, surface, and drip irrigation water of different salt concentrations, between 0,9-8 dS/m, on maize. Generally, with the progressive increase in the salt concentration level of irrigation water, there was a gradual increment in the accumulated salts through the entire soil profile and in the individual soil layers of different depths. However, the evolution of salt accumulation and the rate of distribution within variable depths in the course of irrigation greatly varied with the variation in irrigation methods. Evaluating evolution of the different investigated irrigation methods in terms of salt accumulation through the entire soil profile and the variability in the rate of salt accumulation with the different soil depths, as a recommended irrigation method under saline irrigation practices, our choice is confined between drip and/or subsurface irrigation due to the very close similarity in the results obtained for both systems. However, the disadvantages and difficulties in operation and management of subsurface will give priority to drip irrigation as an irrigation method to be recommended. Considering plant growing parameters, the relatively high EC_i value of 8 dS/m did not result in drastic reduction in the studied parameters thus indicating that corn could resist a salinity concentration in irrigation water up to this level during its vegetative cycle, it can be satisfactorily irrigated with waters of salinity level within this range. The data also indicated that the highest grain yield production was always found under the non saline control treatment, yet the grain yield at saline irrigation saline water levels applied remained quite acceptable with only 12% losses at the highest EC_i value of 8 dS/m as compared with the control fresh water treatment. The obtained data demonstrated that saline water caused more damage on the biomass production, with a greater reduction in its dry weight than on grain yield, thus indicating that grain could resist salinity of a relatively high grade rather than the biomass.

79. ENNASSAOUI Essaied (Tunisia)

Supervisor: A. Hamdy

Title: Comparaison des méthodes de mesure de l'évapotranspiration réelle sur une culture à développement vertical important: cas du sorgho sucrier. - 92 p.

Abstract: La mesure de l'évapotranspiration est fondamentale pour quantifier correctement les besoins en eau d'irrigation d'une culture, mais elle est

difficile à déterminer directement. Dans une zone caractérisée par une demande évapotranspirative élevée (Pouilles, Sud de l'Italie) et sur une culture de sorgho sucrier, ont été confrontées les méthodes suivantes : rapport de Bowen, aérodynamique simplifié, corrélations turbulentes, évapotranspiromètre flottant et bilan hydrique du sol. Toutes les méthodes ont été confrontées avec la méthode du rapport de Bowen. Cette confrontation a conduit aux résultats suivants : 1) La méthode des corrélations et celle du rapport de Bowen se sont montrées les plus aptes à déterminer l'évapotranspiration des cultures à développement vertical important, mais aussi celles demandant les plus grandes précautions ; 2) La méthode aérodynamique simplifiée, beaucoup plus simple par rapport aux précédentes, s'applique à des cultures plus basses de 1,5 m ; 3) La méthode directe (évapotranspiromètre flottant) trouve des limites dans des conditions extrêmes de stress hydrique et de développement vertical important ; 4) Le bilan hydrique s'est avéré largement imprécis.

80. ABDELMALEK Mohamed (Morocco)

Supervisors : L. S. Pereira, A. Hamdy and N. Lamaddalena

Title: Comportement d'un canal de distribution à la parcelle à l'application de l'azote pour l'irrigation de surface. - 67 p.

Abstract: Cette étude consiste à déterminer les conditions hydrauliques et de distribution de l'eau à la parcelle, qui assurent un bon mixage du fertilisant et par la suite, l'uniformité de distribution du nutritif N le long d'un canal. Il ressort de l'expérience réalisée sur un modèle de canal de distribution installé à l'IAM, Bari, ainsi que des analyses chimiques, pour la détermination de l'azote total selon la méthode de Kjeldahl que : la loi de distribution des fertilisants le long d'un canal est régie par le processus de transport par diffusion turbulente et dispersion longitudinale. Par conséquent, celle-ci est caractérisée par une longueur où le mixage complet doit être atteint. Au delà de cette distance la distribution du nutritif est uniforme et est conforme à la loi de dilution. Le système d'injection se comporte conformément au principe du vase de Mariotte, c'est-à-dire une injection constante et continue. Egalement, l'injection doit être au centre du canal pour minimiser la longueur de mixage complet. Les résultats expérimentaux montrent que la longueur de mixage complet est de 7 m en aval du point d'injection pour des vitesses amont de 0.3m/s et de 5 m pour des vitesses de 0.5m/s. Cette distance se réduit encore pour des vitesses supérieures.

81. ABIDLI Abdelkhalek (Tunisia)

Advisor : N. Katerji

Title: Influence de la salinité du milieu sur l'état hydrique, la croissance et le rendement du maïs (*Zea mays*). - 86 p.

Abstract: Cette étude s'inscrit dans le cadre de l'utilisation et de la gestion de l'eau saline, elle a fait l'objet d'une analyse des effets de la salinité du sol provoquée par des apports d'eaux salines, et de la texture sur le comportement hydrique, la croissance et le rendement d'une céréale : le maïs à grains (*Zea Mays*). Cette analyse, réalisée au moyen du dispositif lysimètre de l'IAMB, a fourni des éléments qui permettent une identification de l'impact de la salinité de l'eau, de la texture et de la salinité du sol sur le comportement physiologique de la plante et sur son rendement. Les

premières conséquences de l'utilisation de l'eau saline apparaissent au niveau de l'état hydrique de la plante et de ses échanges gazeux. Par conséquent, plus l'eau d'irrigation est saline, plus le potentiel de base, la conductance stomatique et le potentiel hydrique foliaire au midi solaire sont faibles. Ceci montre bien l'importance des paramètres retenus dans le diagnostic de la contrainte hydrique sous les conditions salines. D'autre part, la salinité induit des impacts sur la croissance et le développement de la plante. Les traitements salins ont montré une réduction significative de la surface foliaire et de l'accumulation de la matière sèche par comparaison à ceux à l'eau douce. Enfin, nous avons remarqué, comme conséquence des effets de la salinité du sol et de l'eau d'irrigation sur l'état hydrique et la croissance, une chute du rendement en grains et en biomasse totale. Les taux de réduction sont similaires à ceux signalés dans la littérature (FAO 1985). En ce qui concerne la texture du sol, à part son effet sur le rendement final, elle n'a pas montré d'effets significatifs sur les paramètres hydriques et de croissance.

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86. ABOU NEHME SAWAYA Sana (*Lebanon*)

Supervisor: not available

Title: Effets des stress hydriques édaphiques et atmosphériques et de l'enrichissement en CO₂ sur l'efficacité de l'eau du maïs (*Zea mays*). - 60 p.

Abstract: Les effets de la sécheresse édaphique et atmosphérique et de l'enrichissement en CO₂ sur l'efficacité de l'eau du maïs ont été étudiés sur des plantes de maïs : *Zea mays* var. DEA. Ces plantes ont été exposées à un stress hydrique édaphique simultanément avec différentes combinaisons de CO₂ atmosphérique et d'humidité relative (grâce au dispositif l'Aurore). Des mesures instantanées de la transpiration et de la photosynthèse à l'échelle de la plante ont permis de calculer l'efficacité de l'eau à chaque traitement. Le stress hydrique édaphique a été mesuré par le potentiel de base. Pour un potentiel de base inférieur à -0.3 Mpa, et en conditions normales de CO₂ la transpiration et la photosynthèse à l'échelle de la plante ont diminué avec le développement du stress hydrique édaphique. Les effets associés des stress hydriques édaphique et atmosphérique sur l'efficacité de l'eau du maïs ont montré que pour un potentiel de base supérieur à -0,3 Mpa la diminution de l'humidité relative de l'air en conditions normales de CO₂ a provoqué l'augmentation de la transpiration et la diminution de la photosynthèse, par conséquent l'efficacité de l'eau a diminué. Pour un potentiel de base inférieur à -0,3 Mpa, c'est l'effet du stress hydrique édaphique qui domine l'effet du stress atmosphérique. La réponse des plantes au stress hydrique édaphique combiné avec l'enrichissement en CO₂ a consisté en une diminution de la transpiration et une augmentation de la photosynthèse, et par conséquent une augmentation de l'efficacité de l'eau.

87. AKL Khalil (*Lebanon*)

Supervisor: A. Hamdy

Title: La lutte à la sécheresse par l'utilisation et la gestion de l'eau saline. - 71 p.

Abstract: Le présent travail porte sur le problème de l'utilisation durable et du rôle de l'eau saline pour l'irrigation afin de compenser la pénurie des ressources en eau de bonne qualité et de faire face aux conditions de la sécheresse particulièrement dans les régions arides et semi-arides. Cette expérience comprend deux parties : a) La première étudie l'influence de la sécheresse sur les paramètres de croissance et de rendement des cultures céréalières (blé) et les effets positifs de l'utilisation de l'eau saline avec différents niveaux de salinité en régime complémentaire pour faire face aux conditions de la sécheresse. b) La deuxième porte sur les techniques de gestion avec l'eau saline pour parvenir à une utilisation durable de ces ressources à travers l'apport de ressources en eau de différentes qualités et la technique du lessivage. Les résultats obtenus révèlent l'utilité de l'apport de l'eau saline ayant une concentration en sels tolérée par la plante en régime complémentaire, pour alléger les conditions de la sécheresse,

l'utilisation de l'eau ayant une EC jusqu'à 3 dS/m a donné lieu à une augmentation de 90% au niveau du rendement et en augmentant la salinité de l'eau jusqu'à 6 dS/m, l'amélioration du rendement a été légèrement réduite en atteignant une valeur de 70%. Les techniques de gestion durant les stades critiques de croissance de la culture, ont prouvé leurs efficacité en réduisant les sels accumulés dans le sol et améliorant le rendement. L'eau saline, même celle qui a une concentration en sels relativement élevée, peut être utilisée d'une manière durable pour l'irrigation pourvu que l'on pratique une gestion raisonnée de la culture, de l'eau, et du sol.

88. ALY Diao Abdel Wahab Abdel Fattah (Egypt)

Advisor : A. Petrillo

Title: Experimental study on the scour downstream of a grade control structure. - 117 p.

Abstract: The problem of scour downstream of the hydraulic structures is of great importance that much to affect the stability of whole structure rather than its effect on the efficiency of the conveyance of the canal due to excessive erosion in the canal regime, especially in the foundation zone. The current study is titled to deal experimentally with the scour downstream of a grade control structure to get better understanding of the problem, in order to develop a safe design and proper protection works. The experiment was held in Hydraulic Laboratory of IAM Bari through applying three configurations of the structure models. The configurations were chosen to provide free jet and wall jet cases. The maximum scour depth was found to be in the direct proportionality with the discharge passing through the canal for the same configuration, and inversely proportional to the high tail water depth. The structure model with gentle slope was found to be more safe from the stability point of view, but it had one economical disadvantage due to the need of long protection work. A technique was proposed to reduce the maximum scour depth by inserting three plates in proper locations downstream of the structure model. The insertion of a basin downstream of the structure model represented by the insertion of the initial tail water depth was compared with the technique mentioned above. Both techniques provided approximately the same ratio except one disadvantage in the latter where a relatively high deposit was developed. An economical approach must be considered to decide the best solution.

89. BEN-ABDELLAH Driss (Morocco)

Supervisor: M. Ait Kadi ; co-advisor : N. Lamaddalena

Title: Extension de la programmation linéaire à l'optimisation des réseaux d'irrigation sous pression fonctionnant à la demande dans le cas de plusieurs régimes de débit. - 85 p.

Abstract: Le présent travail consiste à utiliser la formulation par la programmation linéaire proposée par Ait Kadi et Labye et à comparer la solution exacte obtenue avec celle de MAK3. La résolution du modèle linéaire est effectuée par le code commercial LINDO. Pour cela un logiciel d'interface a été élaboré. Il permet de générer les données nécessaires au programme linéaire et la présentation des résultats obtenus selon un format adéquat. Par ailleurs, l'optimisation des diamètres dans le cas de plusieurs régimes de débits a été couplée avec l'analyse du fonctionnement du réseau ainsi dimensionné. Trois critères ont été utilisés dans cette analyse pour rendre compte de la performance du réseau. Il s'agit de la fiabilité, la résilience et la vulnérabilité. En fin, cette approche a été mise en oeuvre sur une situation concrète représentée par le secteur 25 du district 4 du périmètre Sinistra Ofanto (Foggia-Italie).

90. BEN NOUNA Béchir (Tunisia)

Supervisor: N. Katerji

Title: Caractérisation et modélisation du bilan hydrique parcellaire pour une culture du sorgho sucrier. - 112 p.

Abstract: Cette étude a pour objectif de tester la technique de la réflectométrie dans le domaine temporel (TDR), comme une nouvelle instrumentation pour l'estimation de la variation du stock d'eau d'un sol cultivé en sorgho sucrier et soumis à des cycles de dessèchement successifs en région méditerranéenne. La comparaison des résultats des mesures obtenues à partir de la TDR, avec des mesures directes indique que la TDR est un outil fiable pour mesurer le stock d'eau dans le sol en conditions hydriques déficitaires. Les variations du stock d'eau mesurées par la TDR ont été utilisées pour calculer l'évapotranspiration réelle (ET) de la culture étudiée. Les résultats obtenus de l'évapotranspiration sont déterminés par la méthode du rapport de Bowen. Nous avons cherché enfin à confronter les mesures obtenues dans notre étude avec les variations du stock d'eau dans le sol et de l'évapotranspiration réelle obtenues par simulation d'après le modèle du bilan hydrique proposé par Lhomme-Katerji. Les résultats de cette confrontation, montrent que le modèle Lhomme-Katerji est performant comme un outil de modélisation dans nos conditions expérimentales avec une erreur inférieure à 10%.

91. BENSENOUCI Tayeb (Algeria)

Supervisors : L. S. Pereira, J. L. Monteiro Teixeira and N. Lamaddalena

Title: Modélisation de la dispersion-diffusion en écoulement à surface libre. Application à la fertigation gravitaire. - 125 p.

Abstract: Le problème de la dispersion-diffusion d'un traceur en écoulement à surface libre est très important aussi bien pour les études de la qualité des eaux que pour la fertigation gravitaire. Les processus sont décrits par des équations différentielles et souvent on utilise des formules basées sur des hypothèses simplificatives dont l'utilisation peut, dans certains cas, conduire à des erreurs au niveau des applications pratiques. Ainsi, pour résoudre ces équations, un modèle mathématique a été développé, puis appliqué à la fertigation gravitaire. La modélisation consiste à étudier le mouvement d'un traceur en général, ou d'un fertilisant liquide en particulier, dans un canal. On a donc élaboré le programme machine MODD-Modélisation de la Dispersion-Diffusion en mesure de résoudre les deux problèmes suivants : a) Au cas de la concentration constante : déterminer la longueur de mixage ; b) Au cas de la concentration variable : simuler la variation de la concentration du traceur dans le temps et dans l'espace. L'analyse des résultats a montré que : dans le premier cas, la longueur de mixage dépend du régime d'écoulement imposé et des caractéristiques hydrauliques et géométriques du canal. Dans le second cas, toutes les méthodes implicites peuvent donner de bons résultats lorsqu'elle sont appliquées dans les limites précises qu'on a analysées. Quant à l'application de ce modèle à la fertigation gravitaire, des résultats montrent que, lorsque la fertilisation est injecté directement dans le canal, les conditions de mixage sont favorables seulement pour une injection dans l'axe de l'écoulement, des débits faibles et des vitesses relativement fortes.

92. JOMAA Ihab (Lebanon)

Supervisors: A. Hamdy and M. Hamze

Title: N-fertigation: maize response to ammonium nitrate fertilizer applied at different crop growth stages. - 82 p.

Abstract: This work was carried out to elucidate the N-application dose and distribution frequencies, in different quantities with respect to the crop growth stages, resulting in a more efficient N-fertilizer use and minimizing pollution potentials. The experiment was conducted under controlled conditions in the greenhouse of the MAI-Bari, using maize as an example under the fertigation technique using 4 N-application rates (0,50, 100 and 150 Kg/ha) distributed with 5 variables frequencies. In view of the results obtained, it was concluded that a better N-use efficiency with the improvement in plant growth parameters and yield is not only governed by the N-application rate but, also its distribution in proper quantities at the growth stages is of primary importance. For maize, fertigation with N-dose up to 100 Kg/ha is the one to be recommended; fertilization with excessive N-doses is not at all justified. The evolution of N-concentration in the soil extracts at the different growth stages, showed that the fast vegetative growth stage and the flowering one are very critical ones with a relatively higher N-demand with respect to the others and that the presence of N in adequate concentration is also essential at the yield formation stage. The best N efficiency use and yield improvement were achieved when N was distributed in quantities that maintained adequate

N-concentration level in the soil with respect to the crop growth stages. Conclusively, when adequate N doses are added and distributed at proper timing and quantities with respect to the growth stage N-demand, it is possible to achieve the goal: major benefits from fertilization with minimum wastes and greater saving.

93. MOUKARZEL Emil (Lebanon)

Supervisor: N. Katerji

Title: Influence de la salinité du milieu sur le comportement hydrique, la croissance et le rendement de la betterave sucrière (*Beta vulgaris* L.). - 94 p.

Abstract: Cette étude a pour objectif l'analyse des effets de la salinité et de la texture du sol sur le comportement hydrique, la croissance et le rendement d'une culture de betterave sucrière (*Beta vulgaris*) cultivée sur le dispositif lysimétrique de l'IAM-Bari. L'augmentation de la salinité dans le sol provoque un changement du comportement hydrique de la plante. Ce changement résulte d'un ajustement osmotique dans les feuilles et se traduit par une aptitude de la plante à maintenir une ouverture stomatique importante en condition de stress hydrique. Les études menées ont permis également d'analyser les effets de la salinité du milieu sur l'état hydrique de la plante et ses échanges gazeux. Les effets de la salinité et de la texture du sol sur la croissance en surface foliaire et en matière sèche et sur le rendement ont été identifiés. Les traitements salins ont montré une réduction de ces trois paramètres par comparaison à ceux irrigués à l'eau douce. Enfin il a été démontré que la texture du sol affecte d'une façon importante le fonctionnement de la culture. En effet quelque soit le paramètre étudié (état hydrique, croissance et rendement) il a été démontré que les plantes cultivées sur le sol limoneux se trouvent dans une situation plus favorable que celles cultivées sur le sol argileux.

94. SAMTI Habib (Tunisia)

Supervisor: A. Hamdy

Title: Interaction salinité-fertilisation et son influence sur la production de la pomme de terre (*Solanum tuberosum* L.). - 93 p.

Abstract: La tolérance des plantes à la salinité est souvent étudié sous des conditions de fertilité optimales. Cependant, quelques travaux de recherche indiquent que cette tolérance est variable selon la fertilisation. L'objectif de ce travail est d'étudier la relation salinité-fertilisation et voir à quel niveau les fertilisants, et l'azote en particulier, peuvent compenser les pertes de rendement causées par la salinité. L'expérience a été menée sous serre, à l'IAM de Bari, en prenant la pomme de terre comme plante indicatrice, pratiquée dans un sol sablo-argileux et irrigué au goutte à goutte. L'expérience comprenait trois niveaux de salinité de l'eau d'irrigation (0.8, 3 et 6 dS/m) et trois niveaux de fertilisation azotée (0, 60 et 120 Kg/ha). Les paramètres de croissance de la plante, représentés par la hauteur de la plante, la surface foliaire et la matière sèche des feuilles, a diminué graduellement avec l'augmentation de la salinité de l'eau d'irrigation. La fertilisation a amélioré la croissance, mais elle n'a pas pu compenser complètement les pertes causées par la salinité de l'eau d'irrigation. Cette étude a montré, aussi, que la salinité agit par une diminution de la disponibilité de l'eau à la plante qui a ainsi donné lieu à une moindre

absorption des éléments nutritifs en général et de l'azote en particulier. D'autre part, les doses d'azote qui sont adéquates quand on irrigue avec une eau ayant concentration en sels faible ou modérée, ne sont pas recommandées quand on dispose d'une eau d'irrigation ayant une salinité relativement élevée. Maintenir un niveau optimal de fertilité dans le sol est très important pour la croissance et la production d'une culture qui se développe dans un milieu salin.

95. SNOUSSI Jalel (Tunisia)

Supervisor: J. W. van Hoorn

Title: Influence de la qualité de l'eau d'irrigation sur la salinité du sol et sur le rendement de la betterave sucrière (*Beta vulgaris*). - 80 p.

Abstract: Cette étude s'inscrit dans le cadre de l'utilisation et la gestion de l'eau saline. Son objectif est l'analyse des effets de la qualité de l'eau d'irrigation sur l'évolution de la salinité et sur les changements ioniques dans le sol, et par la suite sur l'évapotranspiration, l'absorption d'azote et le rendement de la betterave sucrière. Elle a été réalisée au moyen du dispositif lysimètre de l'IAM Bari, dans deux types de sol et en utilisant trois niveaux de salinité d'eau d'irrigation. Deux méthodes ont été utilisées pour étudier la salinité du sol : a) l'échantillonnage par pots poreux et b) le bilan de sels. La comparaison entre l'augmentation de la concentration ionique mesurée et celle calculée a montré que le complexe absorbent du sol a atteint un équilibre avec les eaux d'irrigation environ trois ans après le début de l'expérimentation. La précipitation des carbonates de calcium et de magnésium et du gypse continue. La comparaison entre la méthode du bilan d'azote et la mesure directe sur la plante montre une bonne correspondance, avec une légère différence en faveur du bilan. La texture a un effet clair sur la production de la betterave sucrière, ce qui confirme ce qu'on trouve dans la littérature que la betterave se prête mieux au sol limoneux bien drainé et aéré qu'au sol argileux (FAO, 1986). La salinité du sol, dans le trajet entre 0.8 et 6 dS/m pour E_{Ce}, a montré un léger effet sur le limon, mais pas significatif sur l'argile. Ceci confirme la classification de la betterave sucrière comme culture tolérante (FAO, 1986).

96. TIZAOUI Chrif (Morocco)

Supervisor: L. S. Pereira ; co-supervisor: N. Lamaddalena

Title: Approche à la modélisation des effets de la variation de la pression à la borne sur les performances d'une installation d'irrigation à la parcelle. - 73 p.

Abstract: En apportant l'eau le plus uniformément possible, les systèmes d'irrigation sous pression peuvent contribuer à la conservation des ressources précieuses. Cependant, les différents critères de performance d'un tel système ne sont pas facilement maîtrisés surtout lorsque l'installation à la parcelle est soumise à des conditions hydrauliques instables assurées par une borne en tête. Ainsi, la présente étude consiste d'abord à définir la méthode de calcul des critères de performance à savoir, l'uniformité, l'efficacité, le pourcentage relatif de la production optimale ainsi que le pourcentage de la variation du débit et de la pression. Ensuite, on a développé un programme de simulation à l'ordinateur permettant de calculer la distribution des charges et des débits ainsi que la distribution pluviométrique à la borne en se basant essentiellement sur l'équation du flux du distributeur. Pour cette raison, deux fichiers de données sur les distributeurs actuellement commercialisés ont été créés pour être utilisés avec le programme. Ce dernier permet de tracer les graphiques de variation des différents paramètres de performance en fonction de la pression à la borne. En parallèle, on a développé un second programme permettant, en cas d'aspersion, de calculer la distribution pluviométrique et l'uniformité pour différents espacements et différents points de calcul entre les asperseurs et les faire apparaître en figures. Enfin, on était amené à une interprétation des résultats d'une application du modèle proposé à des exemples de données.

97. TOPALOGU Fatih (Turkey)

Supervisors: G. Ciollaro, A. Hamdy and N. Lamaddalena

Title: Effect of tillage systems on soil hydraulic properties through ponded infiltration tests. - 86 p.

Abstract: This work was conducted to determine the response of the field saturated hydraulic conductivity (Kfs) to applied tillage systems through ponded infiltration tests. The field trial took place during the 1994-1995 season in Policoro (MT), Italy. The field was divided into three equal parts in which 50 cm chiseling (CH), 40 cm plow-till (PT40) and 20 cm plow-till (PT20) were applied. Ponded infiltration rates were measured to obtain the Kfs using single ring infiltrometers on six dates with six replication in three sites. The field soil is typically vertisol and is classified as sandy clay loam. In both PT20 and CH sites, Kfs after tillage increased temporarily to a value of about 4 and 9 times greater than that observed before tillage, respectively. However, late in the season, it tended to be not significantly different from the one before tillage for both. In the PT40 site, Kfs remained relatively constant during the year showing insignificant differences among the all measurements except May. The highest Kfs increase after tillage was observed both in the CH and in the PT20 site. At the end of the year, the PT40 had the greatest Kfs and the CH had the lowest. In addition to this, Kfs in all sites were not different from each other in May, they were greater than 1.7 mm/h in the CH and the PT20, and it was 3.43 mm/h in the PT40 site. As a result, it was found that the tillage techniques used do not have appreciable effect on the Kfs for this type

of soil. Although tillage recreates transmission pores in increasing Kfs, such pores were temporary, and tillage-created cracks may have collapsed within the season as a result of raindrop impact and wetting-drying cycles.

98. ÜNLÜ Mustafa (*Turkey*)

Supervisor: P. Steduto

Title: Water use efficiency of sweet sorghum under progressing water stress conditions : the canopy scale. - 93 p.

Abstract: Given its high efficiency in water use, sweet sorghum has raised interest in the Mediterranean region. Little is known about its response to water stress, therefore this work is aimed at characterizing sweet sorghum physiological water use efficiency (WUE) under progressing water stress conditions, with emphasis on the canopy scale. Sweet sorghum biomass WUE was also compared with that of maize in order to infer the main features accounting for the difference in WUE. The trial was carried out in the summer of 1994 at Rutigliano (BA), in Southern Italy. Sweet sorghum was subjected to two water stress cycles. Energy, water vapor, and CO₂ fluxes were estimated at the canopy scale by means of Bowen-ratio/energy-balance/CO₂ gradient method (BREB+), and at the leaf scale using a portable photosynthesis system. Predawn (Ψ_b) and noon-time leaf water potential (Ψ_n) were measured by a pressure chamber. Daily reference evapotranspiration and typical weather variables were measured at a nearby weather station. Comparative data for maize were taken from previous trials and literature. Leaf conductance (g_{sw}), leaf photosynthetic WUE, and canopy photosynthetic WUE showed a parallel behavior. They decreased following an increase in leaf-to-air vapor deficit (VPD) and a decrease in Ψ_b . Mean values of noon-time photosynthetic WUE were around 5 and 4.3 mmol·mol⁻¹ for leaf and canopy scale, respectively. Internal leaf CO₂ concentration (c_i) remained fairly constant with variations in VPD Ψ_b . Sweet sorghum leaf dark respiration and nitrogen concentration were found to be about 5 and 1/4 times less than maize, respectively. By contrast, the slope the relationships was the same for both species.

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106. ABDELMALEK Mounir (Morocco)

Supervisor: N. Katerji

Title: Influence de la salinité du milieu sur le comportement hydrique, la croissance et le rendement du soja (*Glycine max* (L.) Merr.). - 109 p.

Abstract: Cette étude s'inscrit dans le programme de recherche sur l'utilisation et la gestion de l'eau saline réalisé à l'IAM de Bari. Elle a pour objet l'analyse des effets de la salinité du sol provoqué par des apports d'eaux salines et de la texture, sur le comportement hydrique, la croissance et le rendement d'une culture oléagineuse, le soja (*Glycine Max* Merr (L)). Cette analyse a été réalisée sur le dispositif expérimental des lysimètres, en adoptant un schéma expérimental factoriel : trois qualités d'eau d'irrigation (eau douce/eau saline à 15 meq/Cl/l, eau saline à 30 meq/qCl/l) par deux types de sols (argileux et sableux) par cinq répétitions. Les premières conséquences de l'utilisation de l'eau saline apparaissent au niveau de l'état hydrique de la plante et de ses échanges gazeux. Par conséquent, plus l'eau d'irrigation est saline, plus le potentiel de l'eau dans la plante et la conductance stomatique et le potentiel hydrique foliaire à midi solaire sont faibles. Ceci montre bien l'importance des paramètres retenus dans la contrainte hydrique sous les conditions salines. La salinité affecte également la croissance en surface foliaire et en biomasse. Les traitements salins ont montré une réduction significative de la surface foliaire et de l'accumulation de la matière sèche par comparaison à ceux irrigués à l'eau douce. En ce qui concerne le rendement, il a été noté que les taux de réduction étaient bien en corrélation avec l'augmentation de la salinité dans le sol, et que les plantes cultivées sur le sol limoneux sont plus favorisées que celles cultivées sur le sol argileux.

107. BOUABE Zoubida (Morocco)

Supervisor: M. Ait Kadi and N. Lamaddalena

Title: Étude des possibilités d'économie d'énergie à travers la conversion de la régulation d'une station de pompage par réservoir surélevé à la vitesse variable. - 116 p.

Abstract: Ce travail évalue le gain de l'énergie apporté par la substitution du système de régulation par réservoir surélevé par un système de régulation avec des pompes à vitesse variable. L'étude concerne la station de pompage de Tououssous, périmètre de Sous-Massa (Maroc), équipé pour l'irrigation par aspersion. La courbe caractéristique du réseau est déterminée par la méthode des caractéristiques indicées en supposant celle-ci avec les courbes caractéristiques des pompes à vitesse variable. Le gain apporté est de 17% de la facture énergétique totale payée par l'Office Régional de Mise en Valeur Agricole. Le total des gains d'énergie pour le même secteur reconverti à la microirrigation, s'élève à 55% de la facture énergétique.

108. BOUNOUA Rachid (Morocco)

Supervisor: L. S. Pereira ; co-supervisors : N. Lamaddalena and P. L. Sousa

Title: Modélisation des réseaux d'irrigation basse pression en vue de la modernisation de l'irrigation de surface. - 85 p.

Abstract: La diminution des ressources en eau rend nécessaire l'amélioration des systèmes de transport et de distribution. Les systèmes basse pression peuvent être une alternative pour la conservation des ressources en eau et en énergie. La présente étude consiste tout d'abord à faire apparaître de l'impact de la modernisation de l'irrigation de surface à la parcelle sur le projet, la modernisation et la gestion d'un réseau basse pression. Pour cet objectif deux alternatives ont été proposées pour le cas du réseau basse pression de la vallée de Sorraia, Coruche, Portugal. La première consiste au renforcement des bornes d'irrigation en termes de débit. La deuxième alternative propose un autre tracé du réseau, mais qui ne diffère pas beaucoup du tracé existant. Ensuite, on a proposé une méthodologie pour la génération des régimes de débit par la technique de simulation du mode de distribution arrangée. Le calcul des réseaux d'irrigation est fait par la méthode d'optimisation à plusieurs régimes de débit. En plus, l'analyse de fonctionnement du réseau actuel ou optimisé est faite en utilisant trois critères de performance. Il s'agit de la fiabilité, l'équité et la dépendabilité, développés dans le but d'une analyse effective du mode de distribution de l'eau d'irrigation en vue de l'évaluation, la gestion et la conception des réseaux basse pression.

109. BITAR Hassan (Lebanon)

Supervisor: N. Katerji

Title: Effets de l'enrichissement en CO₂ sur l'efficacité de l'utilisation en eau du maïs. Modélisation à l'échelle de la culture. - 79 p.

Abstract: La version standard de CERES-Maize (Jones et Kiniry, 1986) a été appliquée pour simuler le développement, la croissance, ainsi que la transpiration des plantes de maïs (*Zea mays*, variété DEA) cultivées en serre et soumises à deux concentrations en CO₂, normale et double. Des résultats provenant de quatre expérimentations réalisées en 1992, 1993 et 1994 dans une serre à Grignon-Paris ont été exploités dans ce but. Ces résultats montrent que la résistance stomatique est augmentée de 40%. Ceci provoque une diminution de 17% de la transpiration maximale calculée par CERES-Maize. La production primaire est augmentée de 5%. Cependant l'accroissement de cette dernière reste non significatif et difficilement modélisable, si bien qu'aucune modification n'a été apportée sur le module de la production dans CERES-Maize. Les résultats de simulation pour les deux cultures printanières sont satisfaisants, tandis que pour les cultures précoces des écarts apparaissent entre les valeurs calculées et les mesures de rendement, de croissance et de transpiration, révélant ainsi la sensibilité du modèle aux faibles températures.

110. GHATTAS Medhat Maurice Boulos (Egypt)

Supervisor: J. W. Van Hoorn

Title: Effect of saline water use on soil salinity, crop growth (soybean), leaching fraction and drainage criteria. - 65 p.

Abstract: A lysimeter experiment was carried out at the MAI-Bari(Italy), in which soybean was irrigated with waters of three different salt concentrations on loam and clay. Soil salinity was determined in soil water samples taken by porous cups and calculated from the salt balance. Moreover, soil samples were taken at the end of the irrigation season to check the two other methods. Soil water samples always indicated too low values for soil salinity, whereas a good agreement was obtained between salt balance and soil samples. The low values of soil water samples can be attributed to preferential flow, by which irrigation water apparently flows through macropores along the porous cups and does not mix completely with soil water. This preferential flow also appeared from the calculation with a numerical model. Salinity and soil textures affected the development of the plant, the nitrogen absorbed by the plant, and the water use efficiency.

111. GUEDES Nabila (Tunisia)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Fertigation azotée d'une culture de pomme de terre (*Solanum tuberosum* L.) dans des milieux salins impact sur la fertilité du sol et la composition chimique de l'eau de drainage. - 75 p.

Abstract: Les effets de la salinité et de la fertilisation azotée et leur interaction sur une culture de pomme de terre ont été étudiés afin de déterminer leur impact sur les propriétés chimiques du sol. Cette culture a été irriguée par trois eaux à différents niveaux de salinité et en appliquant 4 niveaux d'azote. Les résultats ont montré que la salinité de l'eau d'irrigation augmente la salinité du sol et de l'eau de drainage, ce qui a influencé la consommation en eau de la culture et l'absorption des différents éléments minéraux (en particulier l'azote), augmente le risque de pollution de la nappe phréatique. Il serait nécessaire de bien gérer la fertilisation azotée en milieu salin. La dose d'azote de 140 Kg/ha est à recommander pour une culture de pomme de terre dans les conditions de l'expérimentation. Le rendement en tubercules est très influencé par la salinité de l'eau d'irrigation et par la fertilisation azotée.

112. HAFIANE Rachid (Morocco)

Supervisors : F. Lebdi and N. Lamaddalena

Title: Simulation du fonctionnement hydraulique du réseau par aspersion à la parcelle et optimisation de l'apport d'eau: cas d'irrigation par les eaux usées traitées. - 103 p.

Abstract: Ce travail consiste en une étude des performances d'un système d'irrigation par aspersion à la parcelle, lorsque le réseau fonctionne à la demande. L'objectif est de simuler le fonctionnement hydraulique du réseau avec un couple (débit-pression) à la borne variable, tenant compte des emplacements, des postes d'arrosage et des caractéristiques hydrauliques des équipements. Mantovani et al. (1995) ont proposé une étude d'impact de la non-uniformité d'arrosage sur le rendement de la culture, en supposant que la distribution cumulée des hauteurs

d'eau suit la loi uniforme. Un modèle d'optimisation de l'allocation de l'eau a été appliqué en considération de la loi normale. Un travail expérimental nous a permis de montrer que la loi normale s'ajuste mieux que la loi uniforme aux distributions pluviométriques. L'étude de cas concerne le secteur organisé de Mornag (Tunisie), irrigué à partir des eaux usées traitées. L'intérêt pratique de cette étude est d'une part, l'analyse diagnostic du secteur organisé en adoptant le système d'information géographique et d'autre part, l'application du modèle des caractéristiques du réseau et du modèle d'optimisation de l'apport d'eau. Les résultats de la loi normale sont comparés à ceux du modèle de Mantovani et al. Les programmes réalisés sont développés en Turbo-Pascal 6.0.

113. JABBES Naouel (Tunisia)

Supervisor: R. Choukr-Allah and A. Hamdy

Title: Effet de l'interaction salinité-fertilisation azotée sur une culture de pomme de terre (Solanum tuberosum). - 91 p.

Abstract: L'objectif de ce travail est d'étudier la relation salinité-fertilisation azotée et de voir son effet sur le rendement d'une culture de pomme de terre. L'expérience a été menée en plein champ au sud du Maroc sur un sol limono-argileux, au cours de laquelle on a pratiqué une fertigation journalière à l'aide d'un système goutte à goutte. L'expérience comprenait 4 niveaux de fertilisation azotée et 3 niveaux de salinité de l'eau d'irrigation. Les paramètres de croissance de la plante (hauteur, surface et matière sèche des feuilles), ont diminué avec l'augmentation de la salinité de l'eau d'irrigation. Les analyses chimiques ont montré un déséquilibre nutritionnel dû à la salinité. La fertilisation azotée a amélioré les paramètres de croissance et a montré son efficacité pour maintenir un niveau adéquat des éléments minéraux dans la plante. Maintenir un niveau adéquat de fertilité azotée en présence de sels est primordial pour optimiser le rendement de la pomme de terre.

114. JOUINI Kamel (Tunisia)

Supervisor: N. Katerji

Title: Analyse et modélisation de la productivité d'une culture du maïs cultivée en région méditerranéenne. - 87 p.

Abstract: Cette étude s'inscrit dans le cadre de la recherche de la gestion de l'eau pour des grandes cultures en condition méditerranéenne. L'objectif de la thèse est d'analyser la productivité d'une culture de maïs (Zea mays) en différentes conditions d'alimentation hydrique. Les paramètres étudiés sont : le comportement hydrique, la croissance, la consommation en eau et le rendement et ses composantes. Cette expérience a été réalisée sous trois régimes d'irrigation différents : un bien irrigué et deux stressés avec deux degrés d'intensité. Les variations du stock d'eau dans le sol mesurées par la méthode de la réflectométrie dans le domaine temporel (TDR) ont été utilisées pour calculer l'évapotranspiration réelle (ET) de la culture étudiée dans les trois conditions hydriques. Les premières conséquences de l'effet de stress apparaissent au niveau de l'état hydrique de la culture. En effet, plus la diminution de l'état hydrique dans le sol augmente, plus la croissance en matière sèche et surface foliaire sont réduites. Le rendement et ces composantes diminuent également par rapport au traitement bien irrigué. Les relations entre le stock d'eau dans le sol et la conductance stomatique et le potentiel hydrique foliaire, montrent bien qu'il existe une synchronisation entre la teneur en eau dans le sol et la réponse de la culture à ce phénomène. Les données disponibles, nous ont permis

de vérifier et de valider le modèle CERES-Maïs (Crop Environmental Resource Synthesis) dans les conditions Méditerranéenne. Nous avons donc confronté le module phénologique, le module du bilan hydrique, et la croissance simulée par le modèle CERES avec les mesures faites au champ. Les résultats montrent que le modèle CERES s'adapte bien et offre des résultats fiables et acceptables (une erreur inférieure à 10%) que ce soit dans les conditions de bonne alimentation hydrique ou en condition de stress hydrique. En ce qui concerne la mise en place de la surface foliaire et le nombre de feuille, le modèle nécessite un travail supplémentaire afin d'affiner les résultats expérimentaux obtenus.

115. NERILLI Enrico (Italy)

Supervisors: G. Ciollaro and N. Lamaddalena

Title: Analisi del funzionamento di un sistema irriguo collettivo in pressione durante periodi di limitata disponibilità idrica. - 53 p.

Abstract: In order to emphasize the consequences of the variations in the delivery schedule of a pressurized irrigation system on the volumes applied and on the hydraulic performances, the withdrawn discharges were measured on a continuous basis in two irrigation districts of Southern Italy and in one of their representative sectors. The daily weather and the existing crops data were also collected. The surveys was carried out from 1991 to 1995. The daily specific discharges were calculated and compared for both districts. The analysis pointed out that in the periods of poor water supply, when the on-demand delivery schedule is modified into restricted-frequency demand, no reduction in the volumes supplied but only a change in the hydrograph of upstream withdrawals were observed. From a hydraulic point of view, by applying a model of analysis on the operating hydrants' configurations (ICARE model), during the periods of restricted frequency demand, the hydraulic performances of the system are considerably reduced and the proper operation of the farm network jeopardized. Moreover, the variation in the delivery schedule leads both to a reduction in heads upstream of the sectors and to an increase in the frequency of higher discharges. The application of an analysis model on the operating hydrants (AKLA model) has shown the poor performance of the system with such discharges. Moreover, the application of the above models has allowed to identify the most critical areas of the network and subsequently the areas that need to be enhanced both in terms of performances and operating conditions.

116. OUAHI Abdelhak (Morocco)

Supervisors : A. Debbarh and N. Lamaddalena

Title: Contribution à l'étude de la qualité chimique des eaux souterraines de la nappe phréatique dans le périmètre des Béni-Amir (Plaine du Tadla). - 76 p.

Abstract: Le périmètre des Béni-Amir, objet de la présente étude, a connu depuis sa mise en eau une remontée excessive de la nappe dans la zone centrale et l'aval hydraulique du périmètre ce qui s'est traduit par une salinisation progressive de la nappe. Le présent travail a étudié la dynamique de la nappe par l'établissement du bilan hydrique couplé avec le bilan du sel, et de contribuer à la proposition des scénarios de gestion optimale de la ressource en eau dans le but de la préserver en quantité et en qualité. Ainsi, des données hydrologiques, hydrogéologiques, climatiques et agropédologiques ont été recueillies sur une série de 21 années (1975-1995) et organisées dans une base de données. Les résultats du calcul du bilan de sel ont mis en relief trois périodes à tendance d'évolutions différentes (24.700 T/an, 94.800 T/an, 57.400 T/an). La zone centrale et l'aval hydraulique du périmètre sont impropres à l'irrigation pour plusieurs cultures si elles sont utilisées seules. Finalement, l'étude de quelques stratégies de gestion a révélé que la diminution de la salure de la nappe ne peut être réalisée que si on rationalise le pompage des eaux souterraines pour l'irrigation là où la qualité est encore acceptable avec l'amélioration de l'efficacité des systèmes d'irrigation et le renforcement du drainage.

117. OUARZANE Saida (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par des eaux usées épurées par infiltration-percolation et par épuvalisation sur une culture de melon (*Cucumis melo*) sous serre. - 91 p.

Abstract: La présente étude vise à déterminer l'impact de l'irrigation par des eaux usées épurées sur une culture de melon sous serre. L'expérimentation est réalisée dans une station expérimentale à Agadir (sud du Maroc). Les analyses chimiques du sol ont permis de dévoiler l'effet de l'irrigation des eaux usées épurées sur la salinisation du sol. L'irrigation par de l'eau potable complémentaire en éléments fertilisants peut provoquer une contamination des eaux souterraines; de même les eaux usées épurées par infiltration-percolation peuvent avoir les mêmes effets si la gestion de l'irrigation n'est pas bien maîtrisée. Par contre, l'irrigation par des eaux usées épurées par épuvalisation ne présente aucun risque de contamination de la nappe par les nitrates. Les eaux usées épurées permettent de satisfaire les besoins nutritionnels d'une culture de melon tout en réduisant le coût de production relatif aux engrais. Ce type d'irrigation ne présente aucun risque de contamination microbiologique ou parasitologique du sol de la nappe et des fruits produits. L'utilisation du goutteur linéaire est déconseillée surtout lorsque l'eau d'irrigation est très chargée en matières en suspension.

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123. ABDEL-AFEZ Mohamed Ahmed (Egypt)

Supervisor: A. Petrillo ; advisor: M. Mossa

Title: Instability of hydraulic jump. - 122 p.

Abstract: In the present study, a physical modelling had been done to study the oscillating phenomena which means that the formed hydraulic jump is periodically repeated by itself between two types of hydraulic jump. The experimental work was divided into 2 series. Series (A) was carried out in order to study the oscillating phenomena, the oscillation of the hydraulic jump toe with time and the scour in the sand layer downstream the wooden plate. Series (B) was carried out to study the variation of the downstream wave height with different types of jump configurations. In series (A) the experimental results were plotted on the regime chart which relates the flow regime to the relative tailwater depth and the initial Froude number in order to estimate the type of the formed jump. There was a good agreement with this chart especially in the runs with high initial Froude number. In series (B) the variation of the downstream wave height was studied according to the variation of jump configurations. By analyzing the output data of these runs, it was found that for the jump type when it changed from B-jump to wave jump or vice versa, this type of jump will affected the wave height downstream of the jump with a peak period equals to the same peak period of the jump type to change.

Keywords: hydraulics, hydraulic jump, jump toe, oscillation, scour, waves.

124. ABDEL-NABY Magdy Mohamed (Egypt)

Supervisor: A. Hamdy

Title: Saline irrigation management: alternation techniques and leaching scheduling. - 107 p.

Abstract: This work was carried out to investigate the use of 4.0 and 8.0 dS/m saline water in irrigation, for the production of wheat. Emphasis was given on saline water management, particularly alternating the saline water with good quality water, and leaching practices on soils of different textures. Results of the work showed that EC_i of 4.0 dS/m could be used safely for wheat irrigation. Both saline water management techniques are very beneficial when practiced at proper time at the critical growth stages. Particularly at relatively high salt concentration levels not only they improved the yield production but reduced the salt accumulation in soils. There is high potentiality to use saline water in irrigation and save more fresh water provided a proper soil, water and crop management is ensured. On one hand, this can furnish a yield of an acceptable production level, on the other one, it can prevent the deterioration of soil productivity.

Keywords: irrigation, salinity, leaching, wheat, alternation.

125. AISSI Abdelaziz (Morocco)

Supervisor: R. Choukr-Allah ; co-supervisor: A. Hamdy

Title: Impact de l'irrigation par des eaux usées épurées par infiltration-percolation et par épuration sur une culture de melon (*Cucumis melo*) sous-serre. - 87 p.

Abstract: L'objectif de cette étude expérimentale conduite sur un sol sableux à la station expérimentale de l'ORMVA à Ben Sergao (Sud Est d'Agadir), est d'évaluer l'effet de l'irrigation avec les eaux usées épurées, sur une culture de melon sous-serre. Trois types d'eau irrigation sont utilisées : eau usée épurée par épuration (EUE), eau usées épurée par infiltration-percolation (EUI) et eau potable complémentée en éléments fertilisants (EPF). L'irrigation par l'EPF et l'EUI provoque une contamination de la nappe phréatique, alors que l'EUE ne présente aucun risque de contamination des eaux souterraines par les nitrates. Le diagnostic foliaire nous permettent de conclure qu'il n'existe pas de différence significative des teneurs en éléments minéraux entre le trois types d'eau d'irrigation. L'utilisation des eaux usées épurées présente un avantage d'ordre agro-economique, du fait qu'ils permettent de satisfaire les besoins nutritionnelles de la culture et de réduire les coûts de production.

Keywords: waste waters, infiltration-percolation, epuration, melon, mineral nutrition.

126. AL-AGHBAR Ra'ed Wasif Qasim (Palestine)

Supervisor: A. Hamdy

Title: Using saline water in drought period as an alternative water source for supplementary irrigation. - 90 p.

Abstract: A lysimeter experiment was carried out in the greenhouse at MAI-Bari (Italy) in which wheat was planting in a clayey soil. Four water levels of different quality were used in irrigation after the flowering stage, whereas, before that stage, fresh water was used. One of the treatments had been left without irrigation and considered as a semi-arid nature expression treatment. The other treatments which used four water qualities were divided into two types for each treatment, without and with leaching fraction of 15%. Soil salinity was determined in soil water samples taken by porous cups and drainage water samples. As the final results, drought was affecting the plant development as well as the final yield production drastically, i.e. grain yield dropped by about 80% with respect to the control. Irrigation even with highly saline water mitigates the drought effect; from the economic view point, using even highly saline water in irrigation is better than leaving plants without irrigation. As for the ecological effect, using saline water in irrigation raises the soil salinity to a value around that of the EC_i , applying leaching fraction of 15% mitigates the increment of salts in the soil profile, so, it is promising to irrigate with low quality water, but, on the other hand, it's better to leach with water of low salt content.

Keywords: drought, salinity, wheat, lysimeter, irrigation, leaching.

127. ALBRIZIO Rossella (*Italy*)

Supervisor: P. Steduto

Title: Stomatal and non-stomatal limitations to photosynthesis of field-grown wheat and sunflower, under nitrogen deficit and salinity conditions, respectively. - 90 p.

Abstract: Insight in the physiological water-use efficiency of agricultural crops can be achieved through investigations on the degree of optimum stomatal behavior. Theoretically stomata are expected to control the gas-exchange so that water loss is minimized while carbon gain is maximized (photosynthetic WUE). Such optimal behavior can be tested by analyzing: the degree of leaf-internal CO₂ partial pressure variation (c_i) and the quantitative contributions of stomatal (g_{sc}) and non-stomatal (g_m) conductances to photosynthesis. The aim of the present work was to observe the variation of these variables (c_i , g_{sc} , g_m), along with photosynthetic WUE, of wheat and sunflower grown under different nitrogen and salinity levels, respectively, in open field. A methodology based on the CO₂ assimilation response to different CO₂ partial pressures (the A/ c_i response curve) allowed the determination of various gas-exchange parameters necessary for investigating the optimum stomatal behavior. Results indicated that c_i values were maintained about constant for both crops with average values typical of C₃ species (200-220 $\mu\text{mol mol}^{-1}$). The metabolic conductance (g_m) dominated the stomatal conductance (g_{sc}) as limiting factor to photosynthesis. Both crops optimized their photosynthetic WUE that, when normalized for VPD, maintained similar mean values of about 4.5 $\mu\text{mol mmol}^{-1} \text{ kPa}$.

Keywords: stomatal limitation, non-stomatal limitation, c_i , photosynthetic WUE, wheat, sunflower.

128. BELHOUCLETTE Hatem (*Tunisia*)

Supervisor: A. Hamdy ; co-supervisor: R. Choukr-Allah

Title: Stratégie d'utilisation des eaux saumâtres sur une culture de maïs doux (*Zea Mays*). - 79 p.

Abstract: L'intérêt de cet essai est d'étudier l'impact de la salinité sur une culture de maïs doux (*Zea mays*). En fonction de l'évolution de la culture au cours du temps le maïs a reçu une eau de 1,25; 3 ou 6ds/m. Une fraction de lessivage de 10% ou de 25% selon le stade a été ajoutée. Les résultats des analyses chimiques du sol ont montré que la salinité de l'eau d'irrigation augmente la salinité du sol et de l'eau de drainage. Cette augmentation était suivie par une réduction de la consommation minérale en particulier la potasse et le nitrate. L'absorption minérale augmente avec la substitution de l'eau saumâtre par de l'eau douce. Les paramètres de la croissance végétative représentés par la surface foliaire, le poids de la matière sèche ainsi que la hauteur de la plante ont été réduits sous l'influence de la salinité de l'eau d'irrigation. Cette réduction a été confirmée par les analyses chimiques de la composition minérale foliaire montrant une insuffisance nutritionnelle. Le rendement en grains/m² et en Kg/ha a été plus important dans le cas du témoin que dans les autres traitements. On note également que la substitution de l'eau saumâtre par de l'eau douce a entraîné une augmentation nette du rendement suite à une consommation hydrique ainsi que minérale plus importante.

Keywords: sweet maize, salinity, growth stages, irrigation, mineral composition, water composition, yield.

129. BOUSLIMI Mohamed Ali (Tunisia)

Supervisors : M. Ait Kadi and N. Lamaddalena

Title: Examen des conditions de mise en oeuvre d'une conversion de la régulation d'une station de pompage par réservoir surélevé à la vitesse variable pour le gain d'énergie. - 118 p.

Abstract: On a étudié la faisabilité technique et économique et les conditions de mise en oeuvre d'une conversion de la régulation d'une station de pompage par réservoir surélevé à la vitesse variable. Cela a été fait à travers une étude de cas de la situation du périmètre irrigué du Massa au sud du Maroc. Pour analyser le fonctionnement de la station, on a fait : 1) un suivi pendant novembre et décembre 1996 ; 2) un traitement des relevées du nombre d'heures de fonctionnement des groupes motopompes de 1981 à 1996. Le suivi a permis de dresser les hydrographes de la demande. Le fonctionnement de la station par pompe à vitesse variable a été simulé en se basant sur les hydrographes de la demande. Après avoir déterminé les courbes caractéristiques du réseau actuel et du réseau amélioré, on a des gains qui varient de 25-30% de la consommation par réservoir surélevé et le réseau actuel et entre 42-47% pour le réseau amélioré. Les gains énergétiques annuelles varient entre 24-29% de la consommation annuelle moyenne pour le réservoir surélevé et le réseau actuel et entre 40-44% pour le réservoir surélevé et le réseau amélioré.

Keywords: energy, elevated reservoir, variable speed pump, network characteristic curve, hydrographs, flow rate variations, gains, feasibility, profitability.

130. BOUZIANE Abdelkhalek (Morocco)

Supervisor: A. Debbarh ; co-supervisor: A. Hamdy

Title: Fonctionnement hydraulique et hydrologique d'un réseau de drainage par tuyaux enterrés: cas des sols lourds du Gharb (Maroc). - 80 p.

Abstract: L'expérimentation menée sur le drainage agricole sur sols lourds du Gharb vise deux objectifs principaux : 1) Tester la faisabilité d'un drainage moins profond ; 2) tester la faisabilité du taupage associé au drainage à remblai gravillonné. La station expérimentale de 18 ha. est située à Souk-Tlet, au périmètre du Gharb (Maroc). Le présent travail a permis de : a) faire un suivi piézométrique dans les différentes parcelles de la station ; b) réaliser des mesures in situ de la conductivité hydraulique ; c) collecter les données de base de suivi des réseaux de drainage. Après deux années les résultats dégagés sont comme suit : 1) les sols sont difficile à drainer ; 2) les débits drainés sont différenciés en 4 groupes du faible à très forts ; 3) les réseaux profonds ont maintenu le plan d'eau hors de la zone racinaire ; 4) la profondeur de drains a un rôle déterminant sur les performances des réseaux de drainage ; 5) pour les sols lourds l'assainissement superficiel est autant important que le drainage souterrain.

Keywords: drainage, heavy soils, hydraulic conductivity, performance, stagnation, water table, piezometry, discharges, restitution, drains, buried pipes, mole, runoff, porosity.

131. DOUIEB Adil (Morocco)

Supervisor: L. S. Pereira ; co-supervisors : N. Lamaddalena and P. L. Sousa

Title: Modèle de calcul des réseaux d'irrigation basse pression et évaluation des alternatives du projet. - 113 p.

Abstract: L'analyse du comportement des réseaux d'irrigation soit dans la phase de leur conception soit dans la phase de leur exécution s'est avérée nécessaire pour la prévision effective des défaillances de fonctionnement ou la gestion du réseau en vue d'une amélioration objective. La présente étude porte sur la modélisation et l'analyse de fonctionnement des réseaux d'irrigation basse pression projetés sur un mode de distribution arrangée et un modèle de simulation a été élaboré. L'approche consiste à simuler selon les lois probabilistes déterminées, la distribution des cultures et le choix de la méthode d'irrigation en tenant compte de son pourcentage d'automatisation souhaité et à établir le scénario du calendrier des arrosages durant la période de pointe. Suivant les conditions de disponibilité du débit en tête, les régimes de débit sont générés et vont servir à l'optimisation du réseau et à son analyse hydraulique. L'analyse est effectuée grâce à quatre critères de performance, le rapport de satisfaction du débit à la borne, la fiabilité, l'équité et la dépendabilité. La modèle à été mis en oeuvre sur la situation concrète d'un réseau basse pression du périmètre de la vallée de Sorraia, Coruche, Portugal; pour laquelle on a proposé la modernisation du tracé du réseau et l'introduction de l'automatisation à la parcelle.

Keywords: modelling, analysis, low pressure network, arranged distribution mode, hourly demand discharged, flow regimes, optimisation, performances, modernisation, field-level automation.

132. EL-HADDAD Monique Joseph (Lebanon)

Supervisor: A. Hamdy

Title: Protected soilless culture and cucumber production. - 99 p.

Abstract: Le travail a été mené pour évaluer les paramètres de croissance du concombre ainsi que la quantité et la qualité de rendement en différents substrats (sable, perlite, pouzzolane), pour les cultivars Apollo et Egnazia. Les résultats ont montré que la culture hors sol appliquée au concombre est une pratique prometteuse qui donne une production 10 fois plus grande qu'en plein champ et qui permet de raccourcir le cycle de croissance d'environ 3 mois. Elle s'est avérée avantageuse par rapport à la culture sous-abri-serre dans le sol et a donné une production de 2 à 3 fois plus grande et de meilleure qualité. La production a varié suivant le substrat et la cultivar. Avec la technique de culture hors sol, le choix du substrat, la cultivar, la solution nutritive et sa gestion, ainsi que le contrôle de la salinité et du pH du milieu au cours du cycle cultural, sont des paramètres majeurs dont il faut absolument tenir compte.

Keywords: soilless culture, substrates, nutrient solution, cucumber, yield.

133. JERATE Karim (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par des eaux usées épurées par infiltration-percolation et par épuvalisation sur une culture d'oeillet (*Dianthus caryophyllus* var. Scarlett) sous-serre. - 102 p.

Abstract: La présente étude vise à déterminer les effets de l'irrigation par des eaux usées épurées sur une culture d'oeillet sous abri-serres. L'essai en question a été dirigé au sein de la station expérimentale de Ben Sergao (Agadir). Les eaux utilisées sont respectivement l'eau potable complémentée en éléments fertilisants (EPT), l'eau usée épuré par le système d'infiltration-percolation (EUI) et l'eau usée épurée par le système épuvialisation (EUE). L'irrigation par l'ETP et l'UEI induisent

une contamination plus sévère des eaux souterraines par les nitrates contrairement à l'EUE qui ne présentent aucun risque de pollution de la nappe. Sur le plan nutritionnelle l'oignon consomme des quantités de nitrates et d'azote plus élevées dans le cas de l'ETP et de l'EUI. Le rendement aussi bien quantitatif que qualitatif est légèrement inférieur dans le cas de l'irrigation par les eaux usées épurées. Sur le plan sanitaire, l'irrigation par les eaux usées épurées ne présente pas de risques de contamination. L'analyse économique de la campagne a permis de montrer que les taux de rentabilité de la production ont été approximativement similaires en appliquant les trois (différents) types d'eaux d'irrigation.

Keywords: treated waste waters, infiltration-percolation, epurization, greenhouse grown carnation, localized irrigation.

134. KLILICH Salah (Morocco)

Supervisor: F. Lebdi ; *co-supervisor:* N. Lamaddalena

Title: Modélisation de l'optimisation du dimensionnement et du fonctionnement de l'irrigation localisée. - 124 p.

Abstract: L'irrigation localisée peut jouer un rôle primordial en matière d'économie d'eau. Le présent étude s'appuie sur les travaux de Hassanly et Dandy (1996) qui ont développée un modèle non linéaire pour l'optimisation du dimensionnement et du fonctionnement de la micro irrigation, en considérant le coût du système de pompage et le coût de fonctionnement ramené à sa valeur actualisée. La procédure générale consiste à définir : culture et sol ; loi débit pression du distributeur ; variabilité dans la fabrication du matériel requis au niveau de l'installation. Pour rendre l'optimisation plus pertinente, il s'est avéré nécessaire d'identifier d'autres contraintes et d'autres variables d'état ou de décision qui peuvent être incorporées dans le modèle. Ainsi le nombre des rampes par rangée de cultures et la position de station de tête sont considérés comme des variables de décision. Les résultats de cette approche sont la position optimale de la station de tête, le nombre de postes et d'unités par poste, les diamètres optimum des canalisations. Une analyse de sensibilité de ces résultats aux variables d'état est effectuée.

Keywords: drip irrigation, optimization, objective function, shift patterns, decision variables, subunits, design.

135. MNAJJA Abdelhamid (Tunisia)

Supervisor: N. Katerji

Title: Effet du niveau de salinité des eaux d'irrigation et du sol sur le comportement hydrique, la croissance et la production de la tomate (*Lycopersicon esculentum*). - 69 p.

Abstract: Cette étude s'inscrit dans le cadre d'un projet de recherche sur l'utilisation et la gestion raisonnée de l'eau saline. Elle a pour objectif l'analyse des effets de la salinité du sol et de la texture du sol, sur le comportement hydrique, la croissance et le rendement de la tomate. Les principaux résultats fournissent des éléments qui permettent l'identification de l'impact de la salinité de l'eau, de la texture du sol sur le comportement physiologique de la tomate et sur son rendement. Les premières conséquences de l'eau saline apparaissent au niveau de l'état hydrique de la plante et de ses échanges gazeux. En effet, plus l'eau d'irrigation est saline, plus le potentiel de base et la conductance stomatique sont faibles. Toutefois, on a constaté une aptitude des traitements plus salins à maintenir une ouverture stomatique plus importante, lorsque le stress est

prolongé. Ceci est le résultat de l'ajustement osmotique mis en évidence au cours de cette expérience. En condition de stress salin, la tomate semble privilégier le maintien d'une croissance foliaire élevée sur le traitement le plus salin au détriment de la production en fruit. Cela explique la chute élevée du rendement, alors que la réduction de la surface foliaire était limitée.

Keywords: tomato, salinity, soil texture, water status, osmotic adjustment, growth, yield.

136. OYLU Mustafa (Turkey)

Supervisors: R. Kanber and A. Hamdy

Title: Comparison of different furrow irrigation managements for water and soil losses in Harran Plain (South eastern Anatolia project area-GAP). - 88 p.

Abstract: In this study, the effects of different furrow irrigation management techniques on the soil and water losses were investigated. The study was carried out in 1996 in Harran Plain characterized by heavy textured and deep soils on cotton plant. Four different furrow irrigation management techniques were tested in the experiment. Continuous furrows (CF), surge flow furrows (SF), alternate flow furrows (ACF) and cutoff furrows (COF). According to the results, the calculated water saving was 45% for ACF and 25% for COF and 5% for SF as compared to steady low. Surge flow irrigation increased tailwater runoff losses. Cutoff flow techniques decreased by 30% runoff losses as compared to CF. There were no measured deep percolation losses in surge flow application. The largest soil losses were measured in surge flow with a total value of 4.10 Mg/ha. The smallest one was 0.663 Mg/ha in ACF. The highest yield was obtained in cutoff flow furrow and surge flow furrow. Since the highest yield was obtained from COF and SF, the two management techniques can be potentially used to irrigate Harran plain. Meanwhile, notable runoff losses have occurred in the storage phase because of the decreasing infiltration rate. This is why surge flow furrow method must be utilized together with cutoff low furrow management techniques.

Keywords: soil losses, water losses, surface irrigation, surge furrow.

137. RAAD Renata Hamid (Lebanon)

Supervisor: A. Hamdy

Title: Tomato production under protected soilless culture. - 118 p.

Abstract: The trial was conducted to evaluate the tomato growing parameters, water consumption and yield quantity and quality under the substrates (sand, pozzolana and perlite) for the two tomato cultivars: Fanta and RS 90171. Experimentally, the results showed that soilless cultivation of tomato is very promising giving yield 3 to 5 times greater than protected soil culture, shortening the cropping period by nearly one month, notable reduction in fertilisers needs, eliminating many of the problems encountered in open field cultivation. It also showed its advantages on protected soil cultivation giving better quality fruits. The success or the failure of the system is a function of several parameters that must be carefully considered: particularly the choice of the substrate, the cultivar, the nutrient solution as well as the control of both salinity and pH during the cropping cycle.

Keywords: tomato, soilless culture, substrate, sand, pozzolana, perlite, nutrient solution, yield, growth.

138. ROUPHAEL Youssef (Lebanon)

Supervisor: N. Katerji

Title: Bilan d'azote d'une culture de tomate en relation avec la disposition du système d'irrigation. - 43 p.

Abstract: Cette étude s'inscrit dans le cadre d'un projet de recherche sur le bilan d'azote d'une culture de tomate en relation avec la disposition du système d'irrigation. Les objectifs sont: 1) l'analyse du système d'irrigation sur l'efficacité de l'eau, le rendement et la qualité de la tomate; 2) la détermination de l'azote absorbé et stocké dans les différents organes de la plante au cours du cycle végétatif et de faire une comparaison entre la quantité d'azote absorbé par les plantes et celle déterminée par calcul d'après la méthode du bilan d'azote. La mise en profondeur du système d'irrigation n'a pas apporté des résultats satisfaisants au niveau du rendement et la qualité des fruits. Les résultats concernant la composante du bilan d'azote perdue par voie aérienne confirment que sur le plan purement quantitatif, les émissions de N₂O ne concernent qu'une partie assez mineure du pool d'azote mis en jeu dans les systèmes de cultures. La teneur en azote est plus élevée dans les fruits que celle présente dans les feuilles et les tiges tout au long du cycle végétatif, de plus les teneurs en azote -relativement constantes- nous conduisent à estimer les besoins en azote par la simple détermination de la biomasse aérienne. Enfin, les quantités d'azote déterminées expérimentalement, sont voisines au légèrement différentes des valeurs calculées par le bilan d'azote ce qui nous permet de mieux doser la quantité de fertilisant nécessaire à la culture de tomate.

Keywords: balance, nitrogen, tomato, nitrogen protoxyde, irrigation, biomass.

139. SARACI Ardian (Albania)

Supervisors: A. Castorani and U. Fratino

Title: Sediment transport analysis : the Shkumbini river in Albania. - 128 p.

Abstract: The present work was undertaken to study the Shkumbini river in terms of sediment load evaluation to compare with experimental suspended-sediment data, available for over 35 years of observations in five measuring stations. The relationship between yearly suspended load and water discharge for the four principal stations of Shkumbini river are determined by means of a polynomial equation with correlation coefficients varying between 0.63 and 0.87. A computer procedure, for computing the vertical concentrations and total sediment discharges using point-sampled suspended-sediment data is presented and tested with field data. The FORTRAN program was found to provide suspended-sediment discharge estimates that are in agreement, in magnitude, with the field data of suspended-sediment discharges. The comparison of predicted and measured data, shows good results for all methods. In fact, in terms of discrepancy ratio (R), defined as the ratio of the predicted and measured transport rate, it was found that about 90% of predicted transport rates are within a factor two of the measured values.

Keywords: not included.

140. SLIMI Hmida (Tunisia)

Supervisor: N. Katerji

Title: Conséquences écophysologiques de la conjonction d'une attaque de rouille brune (*Puccinia recondita*) et d'une contrainte hydrique sur le blé. - 89 p.

Abstract: Les effets simples et combinés du stress hydrique et du stress biotique provoqué par la rouille brune ont été étudiés sur des plants de blé. L'étude concerne l'état hydrique de la plante et les échanges gazeux et a été conduite à l'unité de recherche en bioclimatologie de Grignon (INRA, France). Des mesures à l'échelle de la feuille et de la plante entière de la conductance stomatique, de la transpiration et de la photosynthèse ont permis d'analyser l'efficacité d'utilisation de l'eau à différentes échelles de temps. L'état hydrique de la plante a été caractérisé à partir des mesures du potentiel de base. Les résultats montrent : une augmentation des lésions chez les plantes stressées ; une diminution de la conductance stomatique par les effets associés de la rouille brune avec le stress hydrique ; une diminution de l'assimilation nette et une diminution de l'efficacité de l'eau à cause d'une augmentation de la concentration interne en CO₂. Ces observations mettent en évidence un effet additif des stress hydrique et biotique sur les échanges gazeux. Ces observations à l'échelle foliaire sont transportables à l'échelle de la plante entière.

Keywords: wheat, water stress, biotic stress, brown rust, photosynthesis, transpiration, stomatic conductance, water use efficiency, pre-dawn water potential.

141. ALI YOUNES Mohamad (Lebanon)

Supervisor: J. W. van Hoorn

Title: Influence de la qualité de l'eau d'irrigation sur la salinité du sol, sur le rendement de la tomate et l'absorption de l'azote. - 62 p.

Abstract: Cette étude s'inscrit dans le cadre de l'utilisation et la gestion de l'eau saline. Son objectif est l'analyse des effets de la qualité de l'eau d'irrigation sur l'évolution de la salinité dans le sol et par la suite sur l'évapotranspiration, l'absorption d'azote et le rendement de la tomate. Elle a été réalisée au moyen du dispositif lysimètre de l'IAM-Bari, dans deux types de sol en utilisant trois niveaux de salinité d'eau d'irrigation. Deux méthodes ont été utilisées pour étudier la salinité du sol, d'une part l'échantillonnage de la solution du sol par pots poreux et d'autre part le bilan de sels calculé par les quantités d'eau apportées et drainées et leurs concentrations. La consommation d'eau par la plante a été calculée comme la différence entre la quantité d'eau apportée et celle drainée. L'absorption d'azote a été calculée en faisant un bilan d'azote dans le sol et mesurée par l'analyse de la plante. La comparaison entre la méthode d'échantillonnage par pots poreux et celle par le bilan de sels a montré, comme pour les deux années passées, une différence systématique et notable : la salinité obtenue par le bilan de sels est environ deux fois plus élevée. La quantité d'azote absorbée par les tomates montre un effet prononcé de la salure et un effet plus léger de la texture. Les résultats du rendement ont montré une dépendance nette entre l'accroissement de la salinité du sol et la chute du rendement de la tomate.

Keywords: salinity, texture, lysimeter, tomato, evapotranspiration, nitrogen, salt balance, yield.

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146bis. SLEIMAN Ihab (*Lebanon*)

Supervisors: not included

Title: A comparative feasibility study of a pressurized pipeline irrigation system covering an "Intensive perimeter" and an "Intensive-extensive perimeter". - 67 p.

Abstract: The Shaath-Rasmel Hadath valley has not been irrigated by a public project since 1970. It was irrigated by the Ahla spring which was utilized to irrigate 60 hectares in the area. For better use of the Ahla spring water, two alternatives for an irrigation project are proposed for the area based on three criteria: 1st Introduction of the supplementary irrigation concept in the project area, 2nd Increasing the water use efficiency and 3rd Maximizing the net project return. The first alternative is an intensive-extensive cropping pattern and the second alternative is - an intensive cropping pattern. The two alternatives has an irrigation water distribution that consist of: 1. Conveying the water from the Ahla spring throughout a solid network system of 25 Kms as total length; 2. The network is operating by gravity; 3. The delivery schedule will be on supply and/or modified demand ; 4. The network design respected a residual pressure at the farm gates permitting the use of on-farm modern irrigation systems. 5. The water i s flowing all the time since its coming from a natural water source.

Keywords: not included.

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147. ABDEL-FATTAH Hamed (Egypt)

Supervisors: P. Steduto, D.-E. El Quosy

Title: High-precision weighing-lysimeter measurements of daily alfalfa evapotranspiration in Egypt : comparison with the Penman-Monteith estimates. - 55 p.

Abstract: Tests world-wide have shown how the FAO Penman-Monteith equation (FAO-PM) has the most behavior, under many environmental conditions. Nevertheless, in the Mediterranean region the FAO-PM showed to underestimate the reference evapotranspiration (ET_o). Different hypotheses have been formulated to explain such underestimation: data quality, time-scale problem of the data (Hourly, daily); difference in adjusted boundary between ET_o estimated by the FAO-PM (using weather data obtained from calibrated brand-new sensor installed in the agro-meteorological station) and ET_o measured by a high-precision weighing lysimeter (cropped with alfalfa *Medicago sativa* L.), in Egypt. ET_o was estimated also using the Kimberly-Penman equation (KP). The results showed that the FAO-Penman, as well as the KP, underestimated the lysimeter ET_o up to about 30%. The hypotheses on the data quality, boundary layers, canopy resistance and time-scale problems are not sufficient to explain the underestimation observed. The remaining hypothesis to test is the possible impact of the regional advection.

Keywords: evapotranspiration, ET_o, Penman-Monteith.

148. ABOU-HAMAD Nassim Georges (Lebanon)

Supervisor: J. W. van Hoorn

Title: Effect of saline irrigation water on soil salinity, yield, and nitrogen uptake of broadbeans. - 45 p.

Abstract: Broad beans (*Vicia faba*) was grown in tanks filled with loam and clay, and was irrigated with water of three different salinity levels. The effect of irrigation water quality on soil salinity, evapotranspiration, nitrogen uptake and yield was investigated. Soil salinity was studied by a combination of soil water sampling from porous cups and the salt balance, calculated as difference between the input from irrigation water and the output from drainage water. The evapotranspiration was calculated as the difference between applied and drained water. Nitrogen uptake was measured by plant analysis. Nitrogen supply by bacterial activity was calculated as difference between nitrogen uptake of the plant and nitrogen input minus output from fertilizer, irrigation, drainage and soil water. Soil water sampling and salt balance show a slight rise of the salinity during the season but there appears a strong difference between the two methods, as in the three past years. Salinity shows a clear effect on water consumption of broadbeans: the higher the salinity, the lower the evapotranspiration. Nitrogen uptake was affected by salinity from 130 days after sowing onwards. Nitrogen supply from bacterial activity decreased, especially at the highest salinity level. A significant effect of salinity and soil texture on the yield of broadbeans was registered.

Keywords: not included.

149. AJMI Mourad (Tunisia)

Supervisors : F. Lebdi and N. Lamaddalena

Title: Irrigation goutte à goutte: optimisation du rendement, de l'efficience et de l'équité de distribution. Cas du district 4 de la Capitanata (secteur 25). - 86 p.

Abstract: Le concept de satisfaction relative des besoins en eau des cultures ou de fraction d'aire irriguée est très efficace, particulièrement en périodes de pénurie. Sur la base de ce concept, Indra et Al. (1994) proposent une méthodologie pour la sélection d'une règle de distribution d'eau appropriée dans les périmètres irrigués, compte tenu à la fois des objectifs d'efficience et d'équité de distribution d'eau. Les recherches qui ont fait l'objet de ce travail ont pour objectif l'élaboration d'un modèle susceptible d'être utilisé pour choisir une règle de gestion des irrigations. Ce modèle rend compte simultanément des objectifs d'optimisation des rendements, de l'efficience d'application et de l'équité de distribution d'eau. La méthodologie a été appliquée dans le cas de l'irrigation goutte à goutte dans le secteur 25 de la Capitanata (Pouilles). Etant donné l'aspect conflictuel des différents objectifs (production prévisible, efficience d'application et équité de desserte), on montre, moyennant une analyse multi-objective, que l'irrigation de 70% des superficies dans chaque parcelle expérimentée, représente une solution de compromis qui semble la plus satisfaisante. Ce résultats a été montré pour les trois cultures étudiées (olivier, vigne et tomate).

Keywords: not included.

150. BENCHARKI Hicham (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par les eaux usées épurées par infiltration-percolation et par épuvalisation sur une culture de fleur-coupée: statice (*Limonium sinuatum*) sous serre. - 92 p.

Abstract: La présente étude vise à évaluer l'impact agronomique et environnemental de l'irrigation pour des eaux usées épurées par infiltration-percolation (EUI) et par épuvalisation (EUE) en comparaison avec une eau potable complétée en éléments fertilisants (EPF) sur une culture florale *Limonium sinuatum* sous serre. L'expérimentation a été conduite sur sol sableux dans la station expérimentale de Ben Sergao au Sud du Maroc. Les résultats ont montré que la croissance des plants du *Limonium* n'a pas connu de différences notables entre les trois types d'eaux. Toute fois des différences significatives du poids frais des tiges sont enregistrées entre les trois types utilisés en faveur de l'EPF. L'apport des eaux usées épurées a entraîné un accroissement des concentrations du sol en sels, ainsi que le système de l'EUI présente un risque de contamination des eaux sous terrain par les nitrates. Du point de vue sanitaire, l'irrigation par les eaux usées épurées n'a pas présenté aucun risque de contamination microbiologique du sol, de la nappe ou des tiges de *Limonium*. L'analyse économique a montré une alternative économiquement justifiable pour la réutilisation des eaux usées épurées.

Keywords: wastewater, infiltration, epuvalisation, greenhouse-grown, *Limonium sinuatum*, growth, water consumption, salts, nitrates, drip irrigation.

151. CAINARCA Carlo Gaitán (Colombia)

Supervisors: non included

Title: Verifica dell'applicabilità delle funzioni di pedotrasferimento per la determinazione delle caratteristiche idrauliche dei suoli. - 92 p.

Abstract: The study of water flow in the soil, in particular the definition of its hydraulic properties through retention curves, is essential for complete water balances. On the other hand, the determination of such properties necessitates time-consuming and expensive field and laboratory analysis. It becomes thus necessary to estimate water contents for different potentials using simplified methods such as the Pedo-Transfer-Functions (PTF), that require simple determinations including texture, bulk density and organic matter content. The present work includes six PTF reported in literature for the estimate of water content relative to five soil types. The estimated data were compared with the values measured on the same soils in the laboratory. The results confirmed what is drawn from the literature, i.e. some PTF can adequately estimate the water contents at pre-established potential values, although the use of such PTF should be limited to large-scale investigations, where you can lose in accuracy but you can acquire a very high representative number of data.

Keywords: not included.

152. EL ZEIN Mahmoud (Lebanon)

Supervisors : N. Katerji

Title: Effet du niveau de salinité des eaux d'irrigation et de la texture du sol sur le comportement hydrique, la croissance et la production de la fève. - 64 p.

Abstract: Cette étude s'inscrit dans le cadre d'un projet de recherche sur l'utilisation et la gestion raisonnée de l'eau saline. Elle a pour objectif l'analyse des effets de la salinité du sol, et de la texture du sol, sur le comportement hydrique, la croissance et le rendement de la fève (*Vicia faba* L.). Les principaux résultats fournissent des éléments qui permettent l'identification de l'impact de la salinité de l'eau d'irrigation et de la texture du sol sur le comportement physiologique de la fève et sur son rendement. Les premières conséquences de l'eau saline apparaissent au niveau de l'état hydrique de la plante et de ses échanges gazeux. En effet, plus l'eau d'irrigation est saline, plus le potentiel de base et la conductance stomatique sont faibles. Toutefois, on n'a pas constaté une aptitude de traitements plus salins à maintenir une ouverture stomatique plus importante, lorsque le stress est prolongé. Ce fait s'explique par l'inaptitude de la fève à réaliser un ajustement osmotique efficace. En condition de stress salin, le rendement de la culture présente une sensibilité élevée à la salinité du sol dans les deux types de sol étudiés. Les réductions du rendement observées résultent d'un effet de la salinité sur la croissance foliaire la mise en place des gousses et le remplissage des grains.

Keywords: broad bean, salinity, soil texture, water status, osmotic adjustment, growth, yield.

153. HADDAD Ashraf Abd el Megid (Egypt)

Supervisors: A. Castorani and U. Frattino

Title: Water flow over stepped spillway. - 109 p.

Abstract: In the present study a physical modelling has been done to study the characteristics of water flow over stepped spillways which is the one of the most important hydraulic structures to dissipate the energy of water behind the dams. The goal of the study is to identify the location of the transition region that exists

between the nappe and the skimming flow regimes, to quantify the energy dissipation rate for the two flow regimes and compare the experimental results with the empirical analytical formulas. The experimental work has been carried out in the Laboratory of the Dipartimento di Ingegneria delle Acque of Politecnico di Bari (Apulia). In the experimental work three different step configurations has been investigated with different lengths and fixed height of step. Besides the value of friction factor (f) used to evaluate the dissipation rate of the skimming flow regime appears to be not constant, as Chanson (1994) recommended. At the end the experimental observations indicated that the Garcia equation (1977), useful to estimate the position of air inception point, it is overestimated and Chanson one has a better behaviour.

Keywords: not included.

154. HAMMAMI Ali (Tunisia)

Supervisor: N. Katerji

Title: Étude microclimatique et écho-physiologique de la vigne de table couverte par des matériaux plastiques. - 84 p.

Abstract: Cette étude réalisée sur la vigne de table cultivée dans la région des Pouilles répond à deux principaux objectifs : - l'analyse des modifications microclimatiques induites par deux types de couverture plastique appliquée sur la vigne conduite en "haute pergola" par rapport à un témoin non protégé; - l'étude de l'incidence de ces variations microclimatiques sur le comportement éco-physiologique de la plante. Les deux types de couverture provoquent une modification importante du microclimat notamment chez le film plastique : ces modifications se traduisent par l'atténuation des rayonnement global et net, la diminution de la température et l'augmentation de l'humidité relative de l'air. Ces modifications ont une incidence majeure sur le comportement éco-physiologique de la plante et précisément au niveau du potentiel de base et du comportement stomatique. Par ailleurs il est avéré qu'en bonne conditions d'alimentation hydrique, la lumière est le facteur prépondérant pour le contrôle de la conductance stomatique ce qui explique le dessèchement rapide de la vigne découverte.

Keywords: not included.

155. HAMMOUDA Hedi (Tunisia)

Supervisor: A. Castorani

Title: Un modèle mathématique pour l'étude du débordement dans les canaux à surface libre. - 66 p.

Abstract: Après une étude bibliographique, on a constaté qu'il y a plusieurs méthodes de résolution des équations de Saint Venant qui régissent l'écoulement non permanent dans les canaux à ciel ouvert. Parmi ces méthodes, la méthode des différences finies implicite est adoptée vu sa simplicité dans la formulation mathématique des conditions aux limites du système à étudier. Un programme de calcul (MIKE 11) a été développé à l'Institut Hydraulique Danois afin de simuler le régime transitoire généré suite aux manoeuvres faites sur les structures de contrôle. L'étude de cas concerne le canal du Cillarese à Brindisi (Pouilles), situé dans la partie aval de la digue. Pour détecter les zones d'inondation le long du canal on a réalisé, d'abord, une étude avec l'ouverture de l'écoulement de fond de la digue, ensuite, avec le débordement de l'évacuateur de crue.

Keywords: not included.

156. KESER Ayse (Turkey)

Supervisor: R. Kanber ; co-supervisor: A. Hamdy

Title: Determination of the effect of irrigation intervals and nitrogen doses on the yield and quality of greenhouses roses. - 63 p.

Abstract: The experiment was carried out in 1997-1998 between October and February at the Research and Productionn Farm Fields of Agricultural Faculty, Cukurova University in Adana (Turkey). This study was conducted for determination of the effects of irrigation interval and nitrogen doses on the quality and yield of the large hybrid tea rose variety of Sandra under greenhouse condition. The treatment used were designed by strip plot experimental method with three replications. Three nitrogen levels and three irrigation intervals were investigate. At the beginning of the experiment, an equal amount of irrigation was applied to all plots with further applications of two, four, and six day intervals. The effects of nitrogen doses and irrigation intervals were found statistically significant. Some roses quality critarions such as flower number, stem length, stem diameter, sepal diameter, flower length and width were different either at nitrogen doses, irrigation intervals and interaction of both or at months.

Keywords: not included.

157. KHANFIR Raoudha (Tunisia)

Supervisor: A. Hamdy

Title: Production de la fraise par la technique de culture hors sol. - 103 p.

Abstract: Les essais ont été conduits afin d'évaluer le rendement du fraisier et la qualité de sa production dans les substrats inertes sables, pouzzolane et perlite, pour les deux variétés Tudla et Théhis. Les résultats ont montré que la culture de fraise en hors sol est très prometteuse. Le système permet de produire des fruits tout le long de l'année, en particulier en hiver et à la fin de l'été, où les fraises ne peuvent pas être produites en plein champs. Cet avantage, à coté de celui des énormes croissances du rendement par rapport à la culture en plein champ, ainsi que les autres facteurs tels que la conservation des eaux et des sols et la protection de l'environnement, favorisent l'expansion et la large diffusion du système dans la production des cultures horticoles. Le succès ou l'échec de ce système est fonction des plusieurs paramètres qui doivent être considérés avec attention : le choix des substrats et des variétés, les solutions nutritives, le contrôle de la salinité et du pH ainsi que les contrôles phytosanitaires.

Keywords: strawberry, perlite, pozzolana, sand, nutrient solution, yield.

158. MENISY Said Said Ahmed (Egypt)

Supervisor: A. Petrillo ; advisor: M. Mossa

Title: Transition from supercritical flow to subcritical flow on an abrupt drop. - 152 p.

Abstract: In the present study a physical modelling had been done to study the different flow configurations which can be formed on an abrupt drop. The experimental work had been carried out on the hydraulic laboratory of the Mediterranean Agronomic Institute of Bari (Italy). In the experimental work three step heights had been used 5.3 cm, 10 cm and 16 cm respectively to have the different flow configurations. We had studied all the flow configurations which can be formed on high and low drop, and the oscillating phenomena which means that

the formed hydraulic jump, and estimated the limiting values of y_2/y_1 in which each type of hydraulic jump was formed at given entering flow condition i.e. estimate the region in which each type of hydraulic jump will occur. We have studied the pressure under different types of hydraulic jump to estimate the worst case of pressure which we have to consider it in the designing of the slab thickness beneath the hydraulic jump.

Keywords: not included.

159. MOUNZER Oussama H. (Lebanon)

Supervisor: N. Katerji

Title: Fonctionnement écophysologique du blé sous contraintes hydrique et fongique (*Puccinia recondita*) en conditions contrôlées : modifications du rayonnement intercepté et du rendement biologique. - 63 p.

Abstract: Les paramètres d'utilisation de l'éclairement par la photosynthèse ont été étudiés sur des jeunes plantes de blé (*Triticum aestivum*, cultivées en conditions contrôlées et sous contraintes hydrique et fongique. Les plantes ont été inoculées par les spores de la rouille brune (*Puccinia recondita*) après l'apparition de la cinquième feuille sur la tige principale. Le stress hydrique (arrosage avec 50% de l'évapotranspiration maximale du témoin) a été appliqué dès le deuxième jour après inoculation. Des mesures, à l'échelle foliaire comme à l'échelle des plantes, des propriétés optiques et des échanges gazeux, ont permis d'analyser la quantité de rayonnement intercepté et le rendement biologique. Les résultats expérimentaux montrent que le nombre de lésions, produites par la rouille brune augmente par unité de surface en présence d'une contrainte hydrique. Ces lésions sont responsables d'une augmentation de la contrainte hydrique indiquée par la diminution importante du potentiel de base. Sur des feuilles inoculées, les effets associés de la rouille avec le stress hydrique diminuent l'absorption du rayonnement; sur les feuilles saines des plantes malades, la rouille brune augmente la quantité du rayonnement absorbée; sur l'ensemble de la plante, la participation des talles et de la sixième feuille indemne de maladie a compensé les diminutions provoquées par les deux stress hydrique et fongique sur les paramètres de production primaire.

Keywords: wheat, water stress, biotic stress, *Puccinia recondita*, optical properties, photosynthesis, biological yields.

160. SHATANAWI Fadi (Jordan)

Supervisor: L. S. Pereira ; *co-supervisor:* P. G. Matias

Title: Testing methodologies to characterize droughts using historical rainfall time series. - 121 p.

Abstract: The drought affected areas in the region of Alentejo (Portugal) were identified through the use of the historical rainfall time series of several selected rainfall recording stations in the region. The stations were selected to give a good coverage of area of the region and to have a sufficient time extent. The quality of the data was controlled by applying several homogeneity tests and correcting the records in estimated by two methods. The missing records in the homogeneous series were then estimated by two methods. The complete and homogeneous time series were then used to calculate several point and regional drought indices on two different time units, these indices were compared among each other in the same time and each among its self calculated at the two time units of the

hydrological year and the three spring months. The drought affected points were then considered to be those with rainfall in the considered time below 80% of the mean, and the regional droughts were considered to occur when more than 30% of the area is under drought. The results were analysed and compared with the results obtained when applying the methods on each of four sub-regions inside Alentejo and the results were analysed to detect the behaviour of the different parts of the region.

161. SKOURI Khalid (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par les eaux usées épurées sur la production du concombre. - 97 p.

Abstract: Le présent travail vise à évaluer l'impact de l'irrigation par les eaux usées épurées sur la production du concombre sous-serre. L'essai s'est déroulé à la station d'épuration des eaux usées de Ben Sergao (Agadir, Maroc). Trois types d'eau sont utilisés : l'eau potable complémentée en éléments fertilisants (EPF), l'eau usée épurée par épuvalisation (EUE) et l'eau usée épurée par infiltration-percolation (EUI). La croissance végétative était similaire pour les plantes irriguées par les eaux usées épurées par infiltration-percolation et ceux irriguées par l'eau potable complémentée en éléments fertilisants. Le rendement a montré des différences hautement significatives. La composition chimique des trois types d'eau d'irrigation diffère essentiellement en ce qui concerne la conductivité électrique et la teneur en azote sous forme nitrique qui est très élevée dans le cas des EUI. Un enrichissement en phosphore et en potassium pour satisfaire les besoins de la plante, améliorera leur impact sur la production. Sur le plan épidémiologique, l'irrigation par les eaux usées ne présente aucun risque sanitaire.

Keywords: wastewater, infiltration, epuvalisation, cucumber, drip irrigation.

162. ZACCARIA Daniele (Italy)

Supervisor: N. Lamaddalena

Title: Reliability criteria for rehabilitation and modernization of large scale irrigation systems. - 93 p.

Abstract: For the present study, an irrigation system located in the province of Taranto (Southern Italy) and run by the Consorzio di Bonifica Stornara e Tara has been considered. The irrigation system was designed to operate with rotation delivery schedule. Nevertheless, changes in cropping patterns occurred and progresses in irrigation have been achieved. As a results, the actual operating conditions and farmers' requirements are now very different from those assumed in the design and, therefore, the performance of the system has greatly decreased. For this reason, the quality of the irrigation service provided by the Consortium is quite poor. In this view, the rehabilitation and modernization of the system are strongly required in order to improve the system performance. For doing that, the failures of the system and the causes of the malfunctioning first have been identified. Subsequently, all the changes in the actual operation and the works requires to make the system operate with a high performance level have been indicated.

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168. LARBI Asouileh Mohammed (Morocco)

Supervisors : B. Essafi and N. Lamaddalena

Title: Étude de possibilité de reconversion de l'irrigation par aspersion à l'irrigation gravitaire basse pression dans le périmètre du Gharb (Maroc). - 134 p.

Abstract: The excess use of energy by pump station in the Moroccan's hydro agricultural projects is still generating the enormous constraints for the public budget, so this case of -study analyze the technical and economical feasibility of conversion the sprinkler irrigation system to the low pressurized pipelines for surface irrigation. It was tested through a case study of GHARB irrigation scheme in the Nord of Morocco. To assess the performance of sprinkler irrigation system, the diagnosis of the operation system was shown that water consumption is similar in sprinkler as well as in surface irrigation, moreover, the energy cost is three times more important and the global efficiency is near of 70%. In addition to that the whole equipment in this area is affected, as matter of fact, 20% of hydrants was damaged, the majority of flow limiting device and pressure regulating device were removed leading so to the great hydraulic-disturbance on the network as well as on pump station, at the same time, the irrigation practice at the farm level was completely not adapted, so it shows a net refusal of this model on this area.

Keywords: conversion, sprinkler irrigation, feasibility, surface irrigation Gharb.

169. ATTARI Rabiaa (Morocco)

Supervisors : M. Ait Kadi and N. Lamaddalena

Title: Suivi de la maîtrise de l'eau au niveau d'une exploitation agricole alimentée par un réseau fonctionnant à la demande dans le périmètre du Loukkos (Maroc). - 122 p.

Abstract: La raréfaction de l'eau et la concurrence entre les différents utilisateurs de cette ressource rendent sa maîtrise et sa gestion rationnelle des nécessités impérieuses pour en améliorer l'efficacité de l'utilisation. La présente étude a consisté en un suivi de la maîtrise de l'eau au niveau d'une exploitation agricole alimentée par un réseau fonctionnant à la demande. Le suivi a concerné trois parcelles cultivées en pomme de terre, en canne à sucre et en blé. Les résultats montrent que les apports d'eau effectués par l'irrigant dépassent les besoins en eau des cultures calculés sur la base du référentiel de Panman Monteith. La gestion de l'eau d'irrigation, a généré, en outre, des pertes par drainage, ce qui n'a pas été sans effets sur le niveau de la nappe. L'analyse de l'organisation du chantier d'arrosage a révélé que l'empirisme de l'agriculteur ne suffit pas dans une situation où les sols sont sableux avec une faible réserve utile qui impose une plus grande maîtrise des arrosages. L'étude a mis en évidence la nécessité d'assurer un service conseil aux agriculteurs pour améliorer les systèmes d'irrigation.

170. BERMAN Manti (Turkey)

Supervisor: A. Yazar ; co-supervisor: A. Hamdy

Title: Evaluation of crop water stress by infrared thermometry technique for differentially irrigated corn under Mediterranean region of Turkey. - 65 p.

Abstract: This study was designed to evaluate crop water stress development using thermometer and to develop empirical CWSI (Crop water stress index) parameters for furrow irrigated corn and to evaluate water use and water use efficiency of corn under Mediterranean climatic conditions in Southern Turkey. The experiment was conducted in 1997 at the experimental farm Department of Agricultural Structures and Irrigation of the Faculty of Agriculture, University of Cukurova in Adana (Turkey). The experimental design was a complete randomized block with four replications. CWSI as calculated from measurements of infrared canopy temperatures, ambient air temperatures, and vapor pressure deficit values were evaluated for the six irrigation levels. A threshold CWSI value of 0.18 was estimated under Mediterranean conditions in Southern Turkey. However, this method has some shortcomings in irrigation scheduling.

171. BOZZO Manlio (Italy)

Supervisors: not available

Title: Riforestazione come strumento per la protezione del suolo in aree soggette ad erosione. Linee guida per un piano di ripristino della vegetazione delle isole maltesi : temi generali e caso di studio. - 174 p.

Abstract: This research is an effort to analyse and provide a solution to the specific problem of the Maltese islands, which concerns the protection of the environment by means of restoring the vegetation. The presence of marginal areas creates the need to utilise managerial models which guarantee the protection of the environment. The object of this research is to provide a detailed plan for intervention to recreate the vegetation of a specifically chosen area (It-taflija). It has been therefore possible to carry out a project which adopts systems of naturalistic forestry considered most suitable for the proposed aims. The criteria used for the species chosen are based upon the experience and observation of environments with similar ecological conditions. An effort has also been made to carry out objectives required by Malta's natural environment: restoration of greenery; creation of a habitat with elevated biodiversity; creation of a place which favours both public use and for the purpose of scientific divulgation, by means of pre-established routes and the construction of visitor centres; requalification of a territory whose value is seen in its uniqueness on the island. The success of such a project should stimulate the creation of similar projects, in the hope of recreating a greener environment, as was present in the past.

172. ÇETINKÖKÜ Özlem (Turkey)

Supervisors: P. Steduto and R. Kanber

Title: Automated canopy chamber for determination of field crops evapotranspiration. - 73 p.

Abstract: In experimental agriculture, one of the most appropriate methods of actual ET determination is represented by the canopy chamber, i.e. a valid alternative to the soil-water balance method and the lysimeter. The present work has dealt with such a methodology developing a new ventilated chamber, featuring simplicity, low cost and full automation for unattended continuous measurements. A series of tests showed that: the effects of variation in barometric pressure, the leaks, and the enhanced turbulence during the fan stirring are absolutely negligible; the walls transmittance for solar radiation and photosynthetic active radiation (PAR) was reduced by 14 and 10% respectively, as a whole, the chamber tended to reduce the PAR by about 20% and to increase the net radiation by 10-

20%; the temperature increased of 2-3 degrees during measurements; even the cheapest relative-humidity sensor can give excellent results. When ET by the chamber was compared with ET of other methods, the deviations ranged between 1.6% and 16.5%, with most of the values around 5%. Concluding, the canopy-chamber developed in this work is highly reliable for ET determination of many field crops. For the distinctive features characterizing the chamber, it is in the process of being commercialized by a private company.

173. EL-ALAMI Maria (Morocco)

Supervisor: A. Debbarh ; co-supervisor: A. Hamdy

Title: La gestion participative de l'irrigation dans le projet Moyen Sabou et Inaouene Aval : cas du secteur II. - 109 p.

Abstract: Le projet Moyen Sebou et Inaouène Aval concerne l'irrigation d'un nouveau périmètre de 15000 ha. La gestion, la maintenance et l'exploitation des infrastructures seront assurées par les Associations d'Usagers de l'Eau Agricole (AUEA) regroupées en fédération. Le présent travail a pour objectif d'analyser les conditions de la mise en place des AUEA dans le Moyen Sebou, leur mode d'organisation et l'impact de cette structure sur les usagers. L'étude de l'AUEA dénote une solide assise juridique mise en place. Cependant, les règlements intérieurs de la fédération et de l'AUEA ne précisent ni les modalités de paiement de la redevance ni les pénalités encourues en cas d'enfreintes des lois établies. En outre, un programme de formation solide des membres de bureau et des représentants du tertiaire est indispensable pour les crédibiliser vis-à-vis des usagers. Enfin, l'analyse de la capacité contributive des usagers a révélé la nécessité de renforcer le soutien de l'État durant les premières années du projet, et en parallèle diversifier, intensifier la production et trouver des débouchés pour sa commercialisation pour atténuer l'impact négatif du prix de l'eau sur le revenu des usagers.

174. HASNI Fatma (Tunisia)

Supervisor: A. Hamdy

Title: Production de la fraise par la technique de cultures hors sol. - 149 p.

Abstract: Ce travail a été effectué dans le but d'évaluer les paramètres de croissance, la consommation en eau, l'absorption des éléments N, P, K, le rendement et la qualité de la production sous trois substrats et pour deux variétés : Tudla et Thetis. Les résultats expérimentaux, montrent que la culture hors sol du fraisier a des grandes potentialités. En effet, ce système de culture permet de produire des fruits sur toute l'année même en hiver et en fin d'été, périodes pendant lesquelles les fraises ne peuvent pas être produites en plein champs. Les avantages inhérents au système, notamment la possibilité d'avoir 4 cycles de production successifs couvrant toute l'année l'augmentation appréciable du rendement par rapport au plein champ et au système traditionnel des cultures protégées. En plus des autres aspects liés à la consommation de l'eau du sol et la protection de l'environnement favorisant l'expansion de ce système de production dans le système horticole. La durabilité du système et sa viabilité économique sont toutefois, gouvernées par plusieurs facteurs qui doivent être soigneusement observés ; notamment, le choix du substrat et de la variété. La solution nutritive et sa gestion, le contrôle de la salinité et du pH, les conditions climatiques ainsi que le contrôle phytosanitaire.

175. MALIKI Mohamed (Morocco)

Supervisor: A. Debbarh ; co-supervisor: A. Hamdy

Title: Fonctionnement hydrologique des réseaux du drainage souterrain et d'assainissement de surface dans la station expérimentale de Souk-Tlet (périmètre irrigué du Gharb, Maroc). - 111 p.

Abstract: Le drainage des sols lourds dans la plaine du Gharb est d'une importance primordiale. Les réseaux installés souffrent d'un certain nombre de problèmes liés, essentiellement, à la difficulté d'entretien des émissaires à ciel ouvert. Pour faire face à cette situation, l'Office Régional de Mise en Valeur Agricole du Gharb a lancé un programme de recherche en drainage en partenariat avec le CEMAGREF et l'IAV Hassan II. Ce programme recherche une technique de drainage adaptée à la zone. L'évaluation des variantes analyse la chronologie des profondeurs de la nappe, les débits drainés ou ruisselés, la détermination de la période du fonctionnement intense des réseaux, le calcul des coefficients de restitution et des termes du bilan hydrique de surface et la représentation schématique des écoulements de surface. L'analyse des résultats a prouvé que : la durée du séjour de la nappe dans la zone racinaire a été la plus faible au niveau des parcelles nivelées ; les ruissellements sont importants lors du choix du débit du projet ; le drainage de surface à travers le nivellement du terrain présente une solution technique pour drainer le Gharb ; le taupage constitue une bonne solution pour éviter le remontée des sels vers l'horizon racinaire.

176. SENYIGIT Ulas (Turkey)

Supervisor: R. Kanber ; co-supervisor: A. Hamdy

Title: The effects of different irrigation methods and different nitrogen doses and forms on the yield and quality on water-melon. - 60 p.

Abstract: Different irrigation methods, nitrogen forms with various amounts and two varieties of watermelon was studied. Generally, plant were irrigated with 5-12 day intervals. Three different nitrogen levels were formed providing gradient situation during the irrigation season. Based on the results, the most irrigation water amount was applied in the middle of June when the fastest growth was observed. Total yield changed between 1325 Kg/da and 5013 Kg/da depending on year and treatments. Although the highest yield was obtained from treatments where liquid fertilizers were applied for both of the varieties in the first year of the experiment, response of varieties to nitrogen form and amounts was found different in the second year.

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184. KHADRA Roula (*Lebanon*)

Supervisor: N. Lamaddalena

Title: Performance analysis of on-demand large-scale irrigation systems: GIS-modeling integration. - 72 p.

Abstract: For the present study, the analysis of the hydraulic operation of an Italian irrigation district has been carried out. It is located in the province of Foggia (Southern Italy) and was designed to operate on-demand. Nevertheless, changes in cropping patterns and progresses in irrigation have been achieved, resulting in operating conditions and farmers' requirements very different from those assumed at the design stage. Therefore, the performance analysis of the system was essential, for identifying its critical areas and the solution that can be adopted to rehabilitate and/or modernize it. In this view, a simulation model (AKLA) has been used, allowing the accuracy of the analyses up to the hydrant level. The information gained is highly precise, however, the interpretation of the results is complex and reserved to researchers. In order to surpass this impediment, an assertive and easy interpretable tool had to be created. Therefore, the integration of AKLA in a GIS has been achieved as a first passage of a global DSS, allowing a clear representation of the system reality and the access of the managers and the decision makers to the information, and hence, an immediate decision. Moreover, solutions for the improvement of the system performance were suggested.

Keywords: performance analysis, irrigation systems, on-demand operation, modeling, GIS.

185. HMIDI Ezzeddine (*Tunisia*)

Supervisors : N. Katerji and A. Hamdy

Title: Effet de la salinité du milieu sur l'émergence, le comportement hydrique, la croissance, et le rendement chez deux variétés de lentille (*Lens culinaris*). - 83 p.

Abstract: Cette étude s'inscrit dans le cadre d'un projet de recherche en collaboration entre l'INRA (France), l'IAM-Bari (Italie) et l'ICARDA (Syrie) et a été réalisée sur le dispositif lysimétrique de l'IAM-Bari. Elle a pour objectif l'analyse des effets de la salinité du sol sur la germination, l'émergence, le comportement hydrique, la croissance et le rendement chez deux variétés de lentille (*Lens culinaris*): l'une résistante (variété 6796) et l'autre sensible (variété 5582) à la salure, d'après une étude précédente de Ashraf et al. (1990). Nous avons noté d'abord un effet variétal dès les stades de germination et d'émergence. Il se traduit par de taux de germination, d'émergence, de croissance et de production nettement plus élevés chez la variété 5582. L'augmentation de la salinité dans le sol provoque un changement du comportement hydrique de la plante chez les deux variétés. En effet, plus le niveau de salinité est élevé, plus les potentiels hydriques foliaires et de base sont faibles. Les deux variétés présentent une aptitude identique à maintenir un potentiel osmotique plus faible et un potentiel de turgescence plus élevé. Ceci est le résultat de l'ajustement osmotique mis en évidence au cours de cette étude. Les effets de la salinité sur la croissance et sur le

rendement ont été identifiés. Les traitements salins ont montré une réduction de ces paramètres par comparaison à ceux irrigués à l'eau douce.

Keywords: lentil, variety, salinity, water stress, osmotic adjustment, growth, yield.

186. EDDIB Mustapha (Morocco)

Supervisor: R. Choukr-Allah and A. Hamdy

Title: Impact de l'Irrigation par des eaux usées épurées par infiltration-percolation et par épuvalisation sur une culture de Pélargonium sous-serre. - 65 p.

Abstract: La présente étude vise à évaluer l'impact de l'irrigation par des eaux usées épurées par infiltration-percolation (EUI) et par épuvalisation (EUE) en comparaison avec une eau de puits complémentée en éléments fertilisants (EPF) sur une culture de Pélargonium zonale (var. Alex) et lierre (var. Decora). Les résultats ont montré que l'EUI est la plus consommée par les plantes suivie par l'EPF et que la variété lierre a absorbé plus d'eau que la variété zonale. La croissance en hauteur et en diamètre du massif est plus importante chez les plantes irriguées par l'EUI et chez les plantes du Pélargonium lierre. L'apport en eaux usées et en EPF constitue une source de salinisation du sol. L'EUI et l'EPF contribuent considérablement à la contamination des eaux souterraines par les sels et les nitrates. Du point de vue nutrition minérale, les exportations en N, P et K de la variété Decora sont plus élevées que celles de la variété Alex. Enfin, les résultats de l'analyse bactériologique et parasitologique ont montré qu'il n'y a aucune restriction de l'utilisation des eaux usées dans l'irrigation de la culture du Pélargonium.

Keywords: pelargonium, waste waters, infiltration-percolation, epuvalization, growth, water use, salts, nitrates, mineral nutrition.

187. MASSAAD Randa (Lebanon)

Supervisors : N. Katerji and A. Hamdy

Title: Conséquence de la contrainte hydrique appliquée à des différents stades phénologiques sur le rendement de l'aubergine. - 63 p.

Abstract: Cette étude s'inscrit dans le cadre de recherche sur le comportement de l'aubergine vis à vis d'une contrainte hydrique. L'objectif est l'étude de l'influence du stress hydrique imposé à différents périodes du cycle végétatif sur le rendement quantitatif et qualitatif des aubergines. La méthodologie utilisée est celle proposée par Katerji et al. (1991, 1993). La première conséquence de la contrainte hydrique apparaît au niveau de l'état hydrique de la plante. En effet, en cas de contrainte hydrique, le potentiel de base et la conductance stomatique diminuent. Par la suite, nous avons noté une modification importante de la croissance en surface foliaire et en matière sèche. Lorsque la contrainte est appliquée d'une façon identique à trois stades de croissance végétative : croissance-floraison, croissance-apparition du fruit et production de fruit, nous avons noté que le stade croissance-floraison présente une sensibilité élevée à la contrainte hydrique. Cette sensibilité se traduit par une baisse de rendement de 54% par rapport au témoin. Cette baisse résulte de l'effet combiné de deux facteurs : la diminution du poids moyen de fruit/plante et du nombre de fruit/plante.

Keywords: eggplant, water stress, predawn stomatal conductance, growth, yield.

188. LAHKIM BENNANI Khadija (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: L'impact de l'irrigation par des eaux usées sur la production de deux variété d'aubergine (*Solanum melongena* L.) sous serre. - 74 p.

Abstract: Deux variété d'aubergine (*Solanum melongena* L.) Tania et Rima ont été cultivées sous serre et irriguées par trois types d'eau : eau de puits et eau usée épurée par infiltration-percolation fertilisées (EPF, EUIc) et eau usée épurée par épuration. Cette étude vise à déterminer l'impact de l'irrigation par des eaux usées épurées sur la production d'aubergine sous serre, Les eaux d'irrigation sont salines et ont augmenté la salinité du sol et risquent de contaminer et de saliniser les eaux souterraines. L'EPF et l'EUIc ont couvert les besoins de la plante. Ce qui n'est pas le cas pour l'EUE qui a présenté un manque en azote, phosphore et potassium. La consommation en eau pour EPF et EUI sont presque égales mais sont supérieures à celle de EUE. Le rendement par stade quantitatif est différent pour les trois types d'eau et pour les trois stades. Cependant, pour le poids moyen il n'y a pas des différences entre les types d'eau à part le premier stade.

Keywords: eggplant, localized irrigation, treated wastewater, infiltration-percolation, epuvalization.

189. M'SEHLI Dhafer (Tunisia)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation de complément par les eaux usées épurées par infiltration-percolation sur une culture de blé dur (*Triticum durum*) variété Karim. - 75 p.

Abstract: La présente étude vise à déterminer les effets de l'irrigation de complément par les eaux usées épurées par le procédé d'infiltration sur une culture de blé dur (*Triticum durum* variété Karim). L'essai s'est déroulé à la station d'épuration des eaux usées de Ben Sergao (Agadir, Maroc). Les eaux utilisées sont respectivement l'eau de puits complétée en éléments fertilisants (EPF) à 120% d'ETM et l'eau usée épurée par le procédé d'infiltration-percolation (EUI) sous différentes fractions de lessivage. La croissance végétative était plus importante pour les plantes irriguées par le EUI que celles irriguées par l'EPF. La consommation en eau des plantes irriguées par l'EUI était supérieure à celle irriguées par l'EPF. Les rendements ont montré des différences très hautement significatives entre les deux types d'eau. Les analyses chimiques du sol et des solutions drainées ont permis de montrer l'effet de la salinisation des eaux sur le milieu récepteur. Ainsi l'irrigation par l'EUI et l'EPF induisent une contamination sévère des eaux souterraines par les nitrates. Sur le plan sanitaire, l'irrigation par les eaux usées épurées par infiltration ne présente pas des risques de contamination par les germes indicateurs de la pollution fécale ni des épis, ni de la paille.

Keywords: hard wheat, irrigation of complement, purified used water, infiltration-percolation.

190. LOUETI Adel (Tunisia)

Supervisors : J. W. van Hoorn and A. Hamdy

Title: Effet de la salinité de l'eau d'irrigation sur le sol, la germination, l'absorption de l'azote et le rendement de la lentille. - 56 p.

Abstract: Cette étude s'inscrit dans le cadre de l'utilisation et la gestion de l'eau saline. Son objectif est l'analyse des effets de la qualité de l'eau d'irrigation sur l'évolution de la salinité et sur les changements ioniques dans le sol, et par la suite sur l'évapotranspiration, l'absorption d'azote et le rendement de la lentille. Elle a été réalisée au moyen du dispositif des lysimètres de l'IAM-Bari, en utilisant deux variétés de lentille et trois niveaux de salinité du sol. Deux méthodes ont été utilisées pour étudier la salinité du sol, d'une part l'échantillonnage de la solution du sol par pots-poreux et d'autre part le bilan de sels calculé par les quantités d'eau apportées et drainées et leurs concentrations. L'absorption d'azote a été calculé à partir de la teneur en azote de la plante et la matière sèche à la récolte. La méthode d'échantillonnage par pots-poreux a tendance à surestimer légèrement la salinité du sol ; cependant, elle est utile du fait qu'elle nous informe sur la distribution des sels le long du profil du sol, et sur la composition ionique dans le sol. La comparaison entre l'augmentation de la concentration ionique mesurée et celle calculé a montré une différence, ceci est due probablement à la précipitation des carbonates de calcium et du magnésium. La salinité affecte nettement la germination, l'évapotranspiration, l'absorption de l'azote ainsi que le rendement de la lentille.

Keywords: salinity, lysimeter, evapotranspiration, nitrogen, absorbing complex, precipitation, yield, tolerance.

191. AWWAD Ameen (Egypt)

Supervisors: A. Hamdy and N. Katerji

Title: Saline irrigation practices and salt tolerance of lentil varieties. - 106 p.

Abstract: This study is part of a research project carried out by the IAM-Bari, the INRA (France) and ICARDA (Syria). It is aimed at analysing the effects of soil salinity on growth, development and yield of 6 Lentil varieties (*Lens culinaris*) selected at ICARDA. The experiments were performed in the greenhouse of the IAM-Bari. The surveyed crops were cultivated in pots and were subjected to 4 water quality salinity levels (fresh water, water of 3, 6 and 9 dS/m). To classify the salt tolerance of the surveyed varieties, several parameters were analyzed: leaf area, dry matter, the number of flowers; the straw and grain yield and water efficiency. The results obtained highlight the special performance of two varieties: 5845 and 6796 that seem to be better adapted to produce in a saline medium.

Keywords: lentil, yield, water efficiency, varieties.

192. SFEIR Patricia (Lebanon)

Supervisor: A. Hamdy

Title: Wheat production under saline irrigation practices : role of soil conditioner. - 118 p.

Abstract: This paper deals with the wheat (*Triticum durum*) response to 4 levels of saline irrigation treatments (0.9 dS/m, 3 dS/m and 9 dS/m) and with the presence of a soil conditioner "Barbary-Plante G2" at 4 different proportions (Control, 10g/l, 20 g/l and 30 g/l). The plant development was greater with the increase in the proportion of BP but was slowed with the concentration of the saline water. This was also reflected in the final yield where the highest Barbary-Plante Ratio (30 g/l) produced a yield three times greater than the control treatment where no soil conditioner was present and irrigation was done using the fresh water.

Keywords: soil conditioner, Barbary-plante G2, wheat, growth, saline water.

193. MEZHER Zeina (Lebanon)

Supervisors: H. Lieth and A. Hamdy

Title: Halophytes performance under high salinity levels : Aster tripolium et Kosteletzkya virginica. - 98 p.

Abstract: The paper deals with the performance of the two halophytic species Aster tripolium and Kosteletzkya virginica under saline irrigation treatments. Germination trials were conducted for Kosteletzkya virginica seeds up to 8 dS/m after breaking dormancy with a water bath of 53 deg C for 10 minutes. Aster tripolium germination was unsuccessful due to the difficulty in breaking dormancy. Growth analyses under saline irrigation up to 50 dS/m on Aster tripolium are reported for three different substrates: pure sand, sand+10% organic matter, sand+1,3% Barbary-Plante G2. Aster tripolium could tolerate salinity levels up to 10 dS/m. The incorporation of soil conditioners improved its performance under higher salinity levels.

Keywords: saline irrigation, aster tripolium, Kosteletzkya virginica, soil conditioners, organic matter, Barbary-plante G2, growth.

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194. AL-NABHANI Sadek (South Yemen)

Supervisors: V. Sardo and A. Hamdy

Title: Irrigating with urban wastewater treated in constructed wetlands. – 53.

Abstract: A research was conducted to assess the possibility and the effect of irrigating pepper plant with biodepurated urban wastewater. Four widely different soils (clay, sand, sandu-clay and calcareous loam) were irrigated with treated wastewater, freshwater enriched with a soluble fertilizer and pure freshwater. Results demonstrated that irrigation with biodepurated wastewater is technically easy, even with low-flow drippers, provided that a sufficient filtration is ensured. Treated wastewater superior in enhancing plant development, both in the aerial and root parts, and in stimulating yield; soil influence was very limited on plant development and had no statistical significance on production. Na accumulation at root level in wastewater irrigated plants did not affected Na content in fruits.

Keywords: wastewater irrigation, pepper, drip irrigation, wastewater reuse, biodepuration.

195. AL TUMAIZA Mohammed Taha (Palestine)

Supervisors: V. Sardo and A. Hamdy

Title: Constructed wetlands for the treatment of urban wastewater. - 52 p.

Abstract: Field experiences were conducted in Sicily through six months to assess the biodepurating ability of constructed wetlands. The research was conducted with six ponds where plants of vetivergrass (*Vetiveria zizanioides* L.) and common reeds (*Phragmites australis* L.) were planted. Additionally, one more unvegetated pond was left as control. Investigations included the research of variations in water EC, pH, temperature, COD, bacterial load and content in various elements (N, P, K, Na) in dependence of plants and daily inflow rates; also the influence of wastewater on depurating plants was investigated. Results in the first few months after plant establishment showed that EC and pH were unaffected, but COD was reduced to about 50% and bacterial load was reduced to about 30%. Plants were able to absorb significant amounts of potentially pollutants elements, particularly Na.

Keywords: Constructed wetlands, biodepuration, vetivergrass, reeds, wastewater, wastewater reuse.

196. CHARFEDDINE Monia (Tunisia)

Supervisors : A. Hamdy and G. Mimiola

Title: Production de poivron par la technique de culture hors sol. - 129 p.

Abstract: Les essais ont été conduits afin d'évaluer le rendement du poivron et la qualité de sa production dans les substrats inerts sable, pouzzolane et perlite. Les résultats ont montré que la culture du poivron hors sol est très prometteuse. En effet, le système permet de produire des fruits tout le long de l'année. Cet avantage, à coté de celui des énormes croissances du rendement par rapport à la culture en plein champs, ainsi que les autres facteurs tels que la conservation des

eaux et des sols et la protection de l'environnement, favorisent l'expansion et la large diffusion du système dans la production des cultures horticoles. Le succès ou l'échec de ce système est fonction de plusieurs paramètres qui doivent être considérés avec attention particulièrement le choix des substrats et la culture, les solutions nutritives adéquates, le contrôle de la salinité et du pH ainsi que les contrôles phytosanitaires.

Keywords: pepper, perlite, pozzolana, sand, nutrient solution, yield.

197. GAAFAR Ibrahim Abdel Naby (Egypt)

Supervisors: D.-E. El Quosy and P. Steduto

Title: Penman-Monteith reference evapotranspiration. Comparison with daily lysimeter measurements of Alfalfa in Egypt. - 64 p.

Abstract: Estimation of evapotranspiration is the base for any sound irrigation management. Among the equations for estimating evapotranspiration (ET_o), the FAO Penman-Monteith (FAO-PM) is recommended as a standard. Despite the good behavior of this equation in many States in America and some Countries in Europe, there is a clear underestimation under Mediterranean climatic conditions. Preliminary experiments in Egypt tested the effect of using constant canopy resistance, the fetch mismatch between the agro-meteorological station and the lysimeter, and the time scale on the calculation of evapotranspiration. It was found that all those factors have minor impact on the observed underestimation. Then, the objectives of this thesis were (i) to compare the estimated FAO-PM ET_o with measured ET_o using high-precision weighing-lysimeter, (ii) to check the quality and integrity of both the agro-meteorological station and lysimeter sensors and data and (iii) investigate on one of the major hypothesis not yet tested: the impact of the regional advection on ET_o. The results indicated that the FAO-PM equation underestimated the reference evapotranspiration. The reason of such ET_o underestimation was due to the prevailing state of atmospheric stability. In fact, the assumption of neutral state, used in derivation of the FAO-PM equation, is invalid under Egyptian conditions.

Keywords: evapotranspiration, Penman-Monteith, lysimeter, advection.

198. MOUSSA Ahmed Moustafa Ahmed (Egypt)

Supervisors: M. R. Abdel-Bary and A. Hamdy

Title: Environmental auditing for high Aswan dam. - 141 p.

Abstract: Egypt is the source of life, the Greek historian Herodotus said. Thousand of years ago, Egyptians considered the river as a holy issue. They made sacrifices for the river god. River Nile is the vessel of life for the whole Egypt. It was so thousand of years ago and it is now and it will continue till the day of judgement. Old Egyptians started to control the river 3000 years ago. During the pharaohs' era there were structures on the river such as gauges on canals and irrigation structures. In the modern Egypt and since 1820, Egyptians has started to get real control of the river. In 1839, the first main barrage had been constructed 25 km north of Cairo. In 1956 it was decided by the government to build the sixth high dam in the world with the biggest lake reservoir in the world. Several studies had been conducted to study the impact of the HAD on the surrounding environment. However, the studies are usually conducted on scattered matter, i.e., there was no integration of all the different impacts. The present study aims at introducing the integration and evaluation of all impacts. The aim is to verify the HAD as one of the

most important projects that affect the Egyptian environment with positive versus negative impacts. A general evaluation of the HAD project has been drawn out.

Keywords: Aswan dam, environmental impact.

199. TEKIN Servet (Turkey)

Supervisors: V. Sardo and A. Hamdy

Title: Inter-relationships between biodepurated wastewaters on various soils. - 77 p.

Abstract: The interrelations between the wastewater treated in a biodepurating systems and four different soils were investigated. Soils were packed in columns with a diameter of about 18 cm and a height of 120 cm, and an amount of about 70 mm of wastewater was daily added over one month. Results showed that wastewater had a leaching action on solution of the soils and on their organic matter content; conversely, soils impacted EC, N and Na content in drained water. Some simple empirical models were elaborated based on soil field capacity bulk density and soil content in Ca, clay+silt and organic matter; such properties were sufficient to model the EC, N and Na in drained waters and EC, organic matter and N in leached soils.

Keywords: wastewater, leaching action, soil depurating, soil pollution.

200. YOUAKIM Berthe Jean (Lebanon)

Supervisors: A. Hamdy and G. Mimiola

Title: Tomato-cherry grown in substrate culture : a threat or a challenge? - 103 p.

Abstract: This work was carried out to elucidate the performance of a new tomato-cherry variety E30150 grown in the soilless technique on three different substrates: perlite, pozzolana, sand. Evaluating the growing parameters, the water consumption and the yield were the main objectives of the trial. Experimentally, the results reveal to be promising: a production 2 to 3 times greater in 40 days of advance, in confront to the traditional greenhouse culture. Also, noteworthy were the reduction in the quantity of fertilizers used and in the phytosanitary treatments adopted. Quality tests was conducted giving the optimal results in term of the fruit nutritional value. The soilless techniques is not a static method and the decision making must be well studied in order to properly choose the substrate, the cultivar, the nutritive solution and the efficient control and management.

Keywords: tomato, growing media, soilless culture, fertilizer application, crop yield.

201. JANOUANE Hakima (Morocco)

Supervisors : N. Ben Mechlia, A. Hamdy and R. Choukr-Allah

Title: Étude des efficacités de l'irrigation et de l'utilisation de l'eau en relation avec la technique d'apport d'eau sur une culture de pomme de terre (*Solanum tuberosum*). - 71 p.

Abstract: Ce travail étudie l'influence de la méthode d'irrigation sur la croissance, la production et l'efficacité d'utilisation de l'eau de trois variétés de pomme de terre : Spunta, Asterix et Mondial. L'essai a été mené au Centre Technique de Pomme de Terre d'Essaïda en Tunisie. Sous irrigation goutte à goutte, on peut obtenir de bons rendements malgré les conditions thermiques défavorables observées en fin de cycle. Ce rendement dépasse de 47% et 76% ceux obtenus respectivement sous

irrigation à la raie avec un débit faible et avec un débit élevé. Avec l'irrigation goutte à goutte on a obtenu également la meilleure efficacité d'utilisation de l'eau (0.0098 T/mm). Celle-ci représente le double de l'efficacité observée à la raie avec un débit faible, et le triple de celle observée avec un débit élevé. Il n'y a pas d'interaction des effets entre la variété et la méthode. Il paraît donc qu'un système d'irrigation s'il est convenable pour une variété il le sera aussi pour les autres.

Keywords: solanum tuberosum, irrigation, application efficiency, water use efficiency.

202. ABD EL AAL Ahmed Talaat (Egypt)

Supervisors: A. Hamdy and H. Fahmy

Title: Multi-criteria analysis of alternative strategies for using treated wastewater in agriculture. - 84 p.

Abstract: Recycled wastewater is a source of additional water for agriculture industry and may be domestic uses in arid regions. Several criteria should be considered when treated wastewater is used in irrigation. This study introduces the Multi-criteria as an approach that could help decision-makers in selecting the best strategy based on environmental balance. Through an application on a pilot project at El-Saff region in Egypt, the study proves the inconveniences of using anaerobic criteria in planning and management of similar projects. Some of post construction problems like violation physical constraint, farmer's acceptability, health and environmental risks could have been avoided if good strategies for treated wastewater formulated and analyzed carefully.

Keywords: treated wastewater, environmental impact, arid regions.

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203. SERTAN Sesveren (Turkey)

Supervisors: A. Yazar and A. Hamdy

Title: LEPA and trickle irrigation of cotton in GAP (Southeastern Anatolia Project) Region. - 63 p.

Abstract: This study was carried out to determine the applicability of LEPA (Low Energy Precision Application) and trickle system for irrigation of cotton under GAP conditions in Southeast Anatolia region of *Turkey*. The experimental design was a complete randomized block design with three replications for LEPA system and split plot design with three replications for trickle irrigation system. The research result revealed that both trickle and LEPA irrigation system can be used successfully for irrigation cotton crop under the mild climatic conditions of Southeast Anatolia project area in *Turkey*. The yield levels attained from the trickle irrigated plots are by far the highest yield obtained in either experiment or by farmer in their region. Thus, although the initial investment cost of the system is higher in comparison to furrow method, as far as the water savings, less labor requirements and high yields probably justify for its higher costs.

Keywords: LEPA, micro-irrigation, fertigation.

204. SERAP Soyergin (Turkey)

Supervisors: R. Kanber and A. Hamdy

Title: The effects of different irrigation intervals and nitrogen levels on the yield and quality of green bean under greenhouse conditions. - 85 p.

Abstract: The experiment was carried out in 1999 from 18th April to 16th July at the "Ataturk Horticultural Central Research Institute in Yalova, Turkey". The experimental design was strip plot with three replications. Three nitrogen level and three irrigation intervals were investigated. Free water surface evaporation was used to determine irrigation water amount. According to the results, the interaction between nitrogen doses and irrigation intervals was found to be statistically significant. The dry matter of pods reduced by increasing amount of water applied. On the other hand the nitrate content of pod increased with increasing the nitrogen doses. Protein content of pods was also affected by the irrigation interval and nitrogen interaction. Water use efficiency was greater with four day irrigation interval as compared to the others.

Keywords: irrigation interval, nitrogen doses, green bean, greenhouse.

L&W - A.Y. 1999-2000 (July session) – 205-212

205. TALEB AHMAD Fattouma (Morocco)

Supervisors: A. Hamdy and G. Mimiola

Title: Muskmelon production in soilless culture under saline irrigation practices and soil conditioner application. - 126 p.

Abstract: This work deals with the muskmelon response under soilless culture using inert substrates: sand, pozzolana and perlite, with and without the use of the soil conditioner "Barbary-Plante G2" at a rate of 15%. Saline water with electrical conductivity of around 6.4 dS/m was applied for irrigation during the whole experiment. The results of this work confirm that saline water could be used successfully for irrigation of muskmelon under soilless conditions. In average, the muskmelon total water consumption was about 5066.25 m³/h. Moreover, the obtained values of yield and biomass water use efficiency along with the results of measurements of plant growth parameters, indicated that both sand and perlite are more appropriate than pozzolana for growing muskmelon in soilless conditions. Considering the substrates treated with soil conditioner, the presence of Barbary-Plant did not result in significant improvement of yield and biomass production for both sand and perlite, while a notable increase of 52.32% of yield and 47.00% of biomass was observed for pozzolana substrate.

Keywords: muskmelon, soilless culture, substrates, sand, pozzolana, perlite, saline water, Barbary-plante G2.

206. EL KHOURY Afif (Lebanon)

Supervisors: J. W. Van Hoorn and A. Hamdy

Title: Effect of saline irrigation water on soil salinity, germination, nitrogen uptake and yield of chickpea (*Cicer arietinum* L.). - 72 p.

Abstract: Two varieties of chickpea were grown in tanks filled with clay soil at the experimental site of the IAM Bari and irrigated with water of different salinity levels: 0.8, 2.5, and 3.8 dSm. Three methods were used to study the development of soil salinity: salt balance, soil water sampling and soil sampling. The concentration of the major ions, obtained from soil water sampling, were corrected according to the chloride comparison between salt balance and soil water sampling and showed an exchange of calcium by sodium at the adsorption complex, a precipitation of lime and a dissolution of gypsum. The germination test showed a slight effect of salinity on variety ILC. The emergence also showed a delay of variety ILC compared with variety FLIP. The decrease of the nitrogen supplied by biological activity in the soil at increasing salinity was stronger than the decrease in plant growth. The more drought resistant variety FLIP showed as irrigated crop to be less salt tolerant, its threshold value corresponding with an ECe of about 1 dS/m against 2.5 dS/m for variety ILC. Salinity reduced yield of both varieties by about 70% at an ECe of 3.8 dS/m.

Keywords: chickpea, salt balance, soil water sampling, germination, emergence, nitrogen supply, chloride, yield.

207. SWELAM Atef (Egypt)

Supervisors: A. Hamdy and N. Katerji

Title: Saline irrigation management and salt tolerance of chickpea varieties. - 171 p.

Abstract: This study is a part of a research project carried out by IAM-Bari, the INRA (France) and ICARDA. It aimed at analysing the effects of water and soil salinity on growth development and yield of six chickpea varieties (*Cicer Arietinum* L.) selected and supplied by ICARDA. The experiment was performed in the greenhouse of the IAM-Bari. The surveyed crops were cultivated in cylindrical plastic drainable lysimeters and were subjected to four water quality salinity levels. The work is divided into two parts, the first, the germination part to identify the proper salt level which leads to a high germination percentage and healthy seedling establishment and to elucidate the possible impact of the salt concentration level could have on the growing parameters of seedlings of the chickpea varieties under study; the second one to classify the salt tolerance degree of the surveyed varieties. Several plant parameters were analysed: water use efficiency, leaf area, dry matter, the number of leaves, plant height, number of shoots, number of flowers, number of pods, leaf senescence, grain yield and weight of 100 seeds.

Keywords: salt concentration, chickpea varieties, water use efficiency, saline irrigation.

208. CHAABANE Ramzi (Tunisia)

Supervisors : N. Katerji and A. Hamdy

Title: Effet de la salinité du milieu sur le fonctionnement hydrique et la productivité chez deux variétés de pois chiche (*Cicer arietinum*). - 81 p.

Abstract: Cette étude s'inscrit dans le cadre d'un projet de recherche entre l'IAMB (Italie), l'INRA (France) et l'ICARDA (Syrie). L'objectif est l'analyse des effets de la salinité du sol sur la germination, l'émergence, le comportement hydrique, la croissance et la productivité des deux variétés de pois chiche l'une résistante et l'autre sensible à un régime pluviométrique déficitaire. Les deux variétés présentent le même comportement hydrique et la même production lorsqu'elles sont cultivées sur des sols non salés. Dans les sols argileux modérément salés, la variété ILC 3279, présente une aptitude à améliorer considérablement l'efficacité de l'eau par rapport au témoin irrigué avec l'eau douce. La variété FLIP 87-59C en revanche maintient une efficacité de l'eau voisine du témoin. L'aptitude à améliorer l'efficacité de l'eau est associée à l'apparition des feuilles et des fleurs tardives et au ralentissement de la sénescence. Lorsque le niveau de salinité dans le sol augmente, les deux variétés se comportent de façon identique, mais l'efficacité de l'eau est plus élevée chez la variété FLIP 87-59C à cause de son aptitude à raccourcir le cycle végétatif. L'ensemble des observations obtenues apporte des éléments de réflexion pour apprécier une stratégie d'apport d'eau salée sous forme d'un supplément d'irrigation pendant les années sèches.

Keywords: chickpea, salinity, water stress, growth, flowering, yield.

209. KALAI Helmi (Tunisia)

Supervisors : N. Katerji and A. Hamdy

Title: Test de validation d'un modèle opérationnel de calcul du bilan hydrique en conditions hydriques contrastées. - 57 p.

Abstract: L'étude a pour but de tester et valider, dans des conditions hydriques variables, un modèle simple et opérationnel de calcul des besoins en eau des cultures, basé sur le concept du bilan hydrique du sol. Ce modèle, proposé par Lhomme-Katerji a été préalablement testé dans les conditions hydriques favorables de la région parisienne. Le test et la validation concernent les deux fonctions remplies par le modèle, à savoir : la fonction de gestion de l'évolution de la réserve en eau du sol au cours du temps; la fonction de calcul de l'évapotranspiration réelle. Le test s'appuie sur un jeu de données obtenu au cours d'une expérimentation conduite sur le Mais durant les années 1996 et 1997 dans le champ expérimental de l'Institut Agronomique de Bari. Le protocole prévoit trois situations hydriques du sol différentes : optimale, contrainte hydrique modérée et sévère. La validation du modèle a été réalisée en comparant les données expérimentales et simulées de variation de la réserve d'eau et de l'évapotranspiration réelle au cours de six cycles de culture du maïs. Les résultats de cette comparaison montrent que le modèle choisi conduit à des simulations très acceptables pour les deux fonctions retenues. Son utilisation en conditions d'alimentation hydrique variables nous semble raisonnable.

Keywords: modeling, simulation, water balance, evapotranspiration, soil moisture

210. CHOUAIB Wafaa (Lebanon)

Supervisors: A. Hamdy and G. Mimiola

Title: Egg plant production in soilless culture under saline irrigation practices and soil conditioner application. - 105 p.

Abstract: This work investigates the egg plant variety response to saline irrigation practice in soilless culture. Three inert substrates, sand, pozzolana, and perlite, are utilized, in the absence and with the presence of soil conditioner Barbary-Plante G2. Saline water with electrical conductivity of around 6.0 dS/m was used for irrigation. The results of this work confirmed that saline irrigation practice could be successfully applied for egg plants in soilless culture. The average water consumption of egg plants was about 2853 m³/ha. The average yield, gained from five harvests, was about 66.2 t/ha, while the average dry matter production was about 8.45 t/ha. In average, the yield water use efficiency was about 23.5 g/L and the biomass water use efficiency was about 3.0 g/L. The results of this work indicated that both sand and perlite are more appropriate than pozzolana for growing the egg plants in soilless conditions under saline irrigation practice. In general, the presence of Barbary-Plante in inert substrates did not result in significant improvement of yield water use efficiency of 28% was observed for pozzolana substrate while the increment for perlite and sand was lower of 14 and 8%, respectively.

Keywords: eggplant, soilless culture, substrates, saline water, Barbary-Plante G2.

211. SLIMANE Abdelkrim (Tunisia)

Supervisors : N. Lamaddalena and F. Lebdi

Title: Analyse des performances d'un réseau maillé-ramifié d'irrigation à la demande. - 62 p.

Abstract: Le présent travail consiste à étudier les performances d'un réseau maillé ramifié d'irrigation à la demande. Le système étudié alimente le district 12 du périmètre irrigué du sud Fortore (sud de l'Italie) et couvre une superficie totale de 4700 ha. Le système est composé d'un réseau principal qui forme une maille

limitée par deux réservoirs, et des réseaux secondaires distribuant l'eau au sein des 45 secteurs du district. On a défini et étudié trois indicateurs de performance : le déficit relatif, la fiabilité et la vulnérabilité. L'analyse est subdivisée en deux différentes phases : a) simulation d'un nombre aléatoire de débits de pointe sur les différents secteurs, équilibrage du réseau maillé et calcul des charges en tête de chaque secteur, b) simulation d'un nombre important de configurations possible au niveau de chaque secteur et, pour les différents couples débit-pression déjà calculés, calcul des indicateurs de performances de chaque borne du système. La performance du système d'irrigation est jugée bonne, mais elle présente quelques défaillances locales. Les résultats de l'analyse ainsi que les caractéristiques physiques et hydrauliques du système ont été intégrés dans le Système d'Information Géographiques (Arc View) afin d'aider les gestionnaires à prendre les décisions sur les mesures de réhabilitation pour éliminer telles défaillances.

Keywords: performance analysis, hydraulic networks, looped network, branched network, geographic information system.

212. HAMZA Hesham (Egypt)

Supervisor: A. Hamdy, H. Leith and V. Sardo

Title: Atriplex production under saline soil-conditions and saline irrigation practices. - 63 p.

Abstract: Two different varieties (atriplex halimus and atriplex nummularia) from Egypt and Morocco were analysed for germination and growth under irrigation with water of different salinity levels and fresh water as control. Two sets of 64 containers were used, one was flushed with saline water at the beginning of the experiment, the second set was irrigated with saline water under two different regimes. The parameters investigated were the following: A) Plant germination percentage, plant height, number of shoots and lateral shoots, fresh and dry weight production, leaf area, xylem water potential, Na and Cl ions content in plants. B) Soil and water soil salinity through electrical conductivity measurements at various depths, Na and Cl content in the soil water. Evaluating these data files gained the following results: the germinability of fresh seeds is linearly correlated to the water EC for both species. The best result was obtained with non-freshwater treatment. Plants showed a good potential of taking up salt from the soil water contributing to its desalinisation. It is concluded that atriplex can be profitably grown in saline environments where no conventional plants can grow. The use of atriplex species for soil reclamation appears to be possible.

Keywords: halophytes, atriplex, sustainability, saline irrigation, germination, fodder production, water balance.

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220. ABD EL SALAM Amgad Saleh (Egypt)

Supervisors: A. Hamdy and K. Khair

Title: Amalgamation of GIS and environmental indicators for decision making in water resources management. - 100 p.

Abstract: Free cropping pattern is considered a major problem for the water distribution engineers. The difficulties issued from the randomize crop distribution along the network canals, with their different degrees. GIS has been used as a technique to study the impact of free cropping pattern on the water distribution system. An integrated evaluation approach has been applied to evaluate water resources plans. This approach includes the environmental, social, and economic issues. Accordingly, a case study has been applied on Egypt where an area at the northern delta has been selected. GIS in accordance with integrated indicators has been used to present different hypothetical scenarios. Multi criteria evaluation has been applied to evaluate and rank the different scenarios. The study shows the powerfulness of GIS in calculating water requirements for canal network. Also, through GIS the problem of calculating the discharges of a canal network has been successfully solved. The results show a great interest in estimating water shortage with the area under investigation and how the cropping pattern can be redistribution until satisfactory is achieved.

Keywords: performance analysis, vulnerability, irrigation systems, on-demand operaton, modelling, GIS, DSS.

221. ABD EL TAWWAB Amr Ramadan (Egypt)

Supervisors: A. Hamdy and T. A. Tawfic

Title: Wastewater treatment: comparison between conventional and soil filtration systems. - 100 p.

Abstract: The emphasis of this research is on the use of soil columns as a filtration system to remove contaminants from wastewater drains, and reuse them as a source of irrigation water. The lab experiment was carried using various soil textures, that are: light, medium, heavy, and sandy to study their physico-chemical characteristics and their filtration capacity. Soils as well as water quality before and after treatment were also investigated.

Keywords: soil texture, heavy soil, medium soil, light soil, sandy soil, irrigation water.

222. LAGOUN Mohamed Salah Bey (Algeria)

Supervisors : N. Lamaddalena and M. Vurro

Title: Prototype d'outil d'aide à la décision pour les grands systèmes d'irrigation. - 85 p.

Abstract: A travers cette étude, on s'est intéressé à l'analyse du fonctionnement hydraulique d'un périmètre irrigué italien situé dans la province de Foggia (sud de l'Italie), il a été conçu pour opérer à la demande. Néanmoins, les changements des assolements et des techniques d'irrigation ont résulté des conditions de fonctionnement et des exigences de la part des agriculteurs différents de celles adoptées au niveau de la conception. Pour cela, l'analyse des performances du système à été essentielle, pour identifier ses zones critiques et les solutions qui peuvent être adoptée pour sa réhabilitation et/ou modernisation. Le modèle de simulation (AKLA) à été utilisé, permettant une exactitude des analyses au niveau de la borne. L'information gagnée est très précise, mais, l'interprétation des résultats est complexe et réservée aux chercheurs. Pour surpasser cet obstacle, la création d'un outil fiable s'est avéré indispensable. L'intégration de AKLA dans un Post-Processor Graphique Géoréférencié (SIG) a été accompli, comme un prototype d'outil d'aide à la decision globale permettant une représentation claire de la réelle

du système. En addition, des solutions pour l'amélioration des performances du système ont été suggérées.

Keywords: performance analysis, vulnerability, irrigation systems, on-demand operation, modeling, GIS, DSS.

223. EL-NAGGAR Hossam El-Din Mohamed Ahmed (Egypt)

Supervisors: A. Hamdy, S. T. Abd El-Gawad and M. Tawfek

Title: Irrigation water management under drought condition. - 80 p.

Abstract: This work is dealing with the potentiality of using saline water, as a source for irrigation to complete drought conditions studies concentrated on the mode of application through alternation of fresh water with saline water by surface and subsurface irrigation techniques. The mode of water application and the salinity levels in irrigation water in relation to salt accumulation in soils and crop yield production was studied using a two-year crop rotation including wheat, maize, berseem. Data showed that drainage water could be successfully used for irrigation without any notable yield reduction as compared to fresh water irrigation. Fresh water should be used at the critical growth stages of germination and seedling establishment; moreover, the surface and ground water should have a salinity level not exceeding the threshold crops can tolerate. Among the application water modes, we considered the one where the one where drainage water is directly supplied from ground water and extracted by plants, then collected, conveyed, diluted or pumped, thereby saving engineering and energy costs.

Keywords: drought conditions, drainage water, reuse, crop rotation, alternation.

224. AL-KHAYER Iyad (Syria)

Supervisors: A. Hamdy and V. Sardo

Title: Constructed wetlands an appraisal of design, efficiency and economy. - 72 p.

Abstract: The work was conducted during the summer months of 2000 in an existing structure, deriving urban sewage water from a conventional treatment system of sedimentation and screening. The constructed wetlands included eight ponds sized m. 18.05x 1.5x1.0; three were planted with common reeds, three with vetiver grass, one was unplanted and was used to collect treated water. Three analysis has been done; efficiency, engineering and economic. The first evidenced a good efficiency; the second evidenced some problems, the last showed that constructed wetlands are a cheaper solution than most other treatments and that some advantages can be expected from water reuse.

Keywords: constructed wetlands, reeds, vetiver grass, biotreatment, water reuse.

225. RAHAIL Mahmoud (Palestine)

Supervisor: R. Choukr-Allah

Title: Supplementary irrigation using treated sewage effluent on bread wheat (*Triticum aestivum*). - 90 p.

Abstract: A field experiment was carried out on a sandy soil texture in the experiment station of Ben Sergao (Agadir, Morocco), to study the effect of supplementary irrigation with treated sewage effluent by infiltration percolation on the plant growth, dry matter, grain yield, and straw yield of bread wheat (*Triticum aestivum*). Five irrigation depth were applied to the crop during its sensitive growth

stages. The results of our experiment that, wheat irrigated with 300 mm produced more spikes per unit area, heavier seeds, higher grain yield, higher straw yield, and higher dry matter. Plant grown under rain fed conditions could finish its growing cycle and no grain yield; adding 100/200 mm as supplementary irrigation, produced a total grain yield similar to the average main yield in Morocco. As for as the impact on the soil, using 400 mm as supplementary irrigation under dry condition raise the soil salinity and reduce the production of wheat.

Abstract: wastewater, supplementary irrigation, bread wheat, *Triticum aestivum*, infiltration-percolation.

226. MAJIDI Ahmed (Morocco)

Supervisors : A. Hamdy and R. Choukr-Allah

Title: L'irrigation d'une culture de courgette par une eau usée épurée par infiltration-percolation: impact sur la croissance et le rendement. - 80 p.

Abstract: Deux variétés de courgette "Black jack" et "Consul R" ont été cultivée sous serre et irriguées par deux types d'eau : eau de puits fertilisée et une eau usée épurée par infiltration-percolation (EUI) avec deux doses a savoir 100% et 120% d'évapotranspiration maximale (ETM). Cette étude vise l'étude de l'effet des deux doses d'eau usée épurée en comparaison avec l'eau de puits fertilisée sur la croissance et le rendement de la culture de courgette. L'EUI 120% ETM a donné une bonne croissance et le meilleur rendement par rapport à l'EUI 100% et l'eau de puits fertilisée (EPF). Les deux types d'eau ont augmenté la salinité du sol et un risque de salinisation et de contamination des eaux souterraines ne peut être exclu pour l'EPF et l'EUI 120% ETM. La qualité épidémiologique du sol, des eaux d'irrigation et de drainage ainsi que des fruits des plants irrigués par les eaux usées ne présentent aucun risque de contamination.

Keywords: squash, treated wastewater, infiltration-percolation.

227. TELBANI Ahmed (Morocco)

Supervisor: A. Hamdy and B. Essafi

Title: Économie d'eau et d'énergie dans les périmètres modernes publics du Souss-Amont (Maroc). - 142 p.

Abstract: Le présent travail contribue à l'étude et l'analyse du problème de gestion de l'eau d'irrigation tant sur le plan de la disponibilité de la ressource que sur sa distribution et son utilisation dans le périmètre moderne public du Souss-Amont (Maroc). L'utilisation des ressources en eau se heurte actuellement à des difficultés potentielles dues au déséquilibre entre l'offre et la demande et à des difficultés relatives aux frais d'énergie de pompage qui continuent à générer de lourdes conséquences sur le budget de l'Etat et des agriculteurs. De l'irrigation par aspersion plus coûteuse, les agriculteurs ont adopté la microirrigation qui demande une charge minimale au niveau des bornes d'irrigation. De même le nouveau système "Tarif vert" de tarification de l'énergie électrique, a permis une économie d'énergie de 15% par rapport à l'ancien système de tarification "MT4".

Keywords: leaks, efficiency, sprinkling, trickle irrigation, green tariff, souss-upstream.

228. ZEMMOURI Mohammed (Morocco)

Supervisors : A. Hamdy and A. Debbarh

Title: La gestion participative de l'irrigation dans le projet moyen sebou et inaouen aval: cas du secteur II (Maroc). - 94 p.

Abstract: Le projet Moyen Sebou et Inaouen Aval concerne l'irrigation d'un nouveau périmètre de 15000 ha. Un nouveau mode de gestion instituant un partenariat entre l'Etat et les Associations d'usagers de l'eau agricole regroupées en Fédération est mis en place pour confier aux usagers l'exploitation, la gestion et la maintenance des infrastructures hydro-agricoles. L'étude de l'organisation des Associations des Usagers de l'Eau Agricole (AUEA) dénote une solide assise juridique mise en place; cependant des amendements sont nécessaires et surtout une formation solide des membres des bureaux AUEA et de techniciens pour lever les contraintes aussi bien au niveau de l'utilisation efficiente de l'eau que d'ordre agronomique. L'analyse de la capacité contributive des usagers a révélé, enfin, la nécessité de renforcer le soutien de l'administration durant les premières années du projet et, en parallèle, de diversifier et intensifier les productions agricoles et de trouver des débouchés pour leur commercialisation.

Keywords: partnership, WUA, federation, water demand application, invoicing, recovery, financial analysis.

229. KRIEM Abdallah (Morocco)

Supervisor: R. Choukr-Allah

Title: Irrigation d'une culture de chrysanthème par une eau usée épurée : effet de différentes doses d'irrigation sur le rendement et la croissance. - 82 p.

Abstract: La présente étude vise à étudier l'impact d'une eau usée épurée par infiltration-percolation (EUI) et une eau de puits (EP), appliquées à différentes doses d'irrigation, sur une culture d'Anthémis (*Chrysanthemum frutescens*). Les résultats ont montré que l'utilisation d'une espèce consommatrice en éléments fertilisants et tolérante à la salinité, tel que le chrysanthème, est une alternative certaine pour mieux valoriser les eaux marginales. Le rendement en nombre de fleurs par plant était plus important chez les plants irrigués par les EUI, avec un surplus de 12%. Les traitements à lessivage présentent un risque de contamination des eaux souterraines par les sels et les nitrates. Les traitements sans fraction de lessivage induisent la salinisation de la couche racinaire. Le traitement EUI avec 80% de l'ETM a bien résisté au stress hydrique et minérale.

Keywords: *Chrysanthemum*, wastewater, infiltration-percolation, irrigation depth, salts, nitrates, mineral nutrition.

230. BOUHAMIDA Naïma (Morocco)

Supervisors : M. Ait Kadi and N. Lamaddalena

Title: Modélisation et SIG pour l'analyse des performances des systèmes collectifs d'irrigation sous pression fonctionnant à la demande (cas du sous-secteur «A» du Loukkos – Maroc). - 77 p.

Abstract: Dans le sous-secteur "A" du périmètre du Loukkos (Maroc), une analyse du fonctionnement hydraulique du réseau a été effectuée à l'aide du modèle de simulation AKLA. Parallèlement, les consommations en eau ont été analysées et comparées aux besoins en eau théoriques des cultures, calculés sur la base du référentiel Blanney Criddle. Les résultats de la simulation ont permis d'évaluer le système à travers des indicateurs de performance liés à la pression, dont le déficit relatif de pression, et la fiabilité, tandis que l'examen des consommations en eau a révélé l'existence d'un phénomène de sur-irrigation au niveau du sous-secteur. La

superposition dans le SIG des thèmes représentant les résultats des deux analyses précipitées a révélé que les parcelles accusant une sur-consommation en eau sont localisées au niveau des bornes avec excès de pression. La présentation des résultats sur SIG a permis d'illustrer ce qui suit : une schématisation claire de la situation actuelle; une identification visuelle des zones critiques; un accès facile des gestionnaires à l'information.

Keywords: irrigation system, on-demand distribution, pressure, water consumption, modeling, GIS.

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231. BENHOUMMANE Bouchra (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Optimisation des apports et de l'irrigation par les eaux usées épurées par infiltration-percolation sur une culture de chrysanthème (*Chrysanthemum coronatum*) sous serre. - 86 p.

Abstract: Trois types d'eau d'irrigation ont été combinées avec deux régimes hydriques (100% et 120% ETM) de la manière suivante: a) eaux usées épurées (par infiltration-percolation)(EUI); b) eau de puits enrichie de fertilisants (EPF); c) alternance des deux types d'eau d'après les besoins en azote de la plante (AE). On a obtenu les résultats suivants: a) Les paramètres agronomiques et les composantes du rendement ont été meilleurs pour le traitement EUI. b) La consommation d'eau a été un peu plus élevée pour le traitement avec l'alternance (3769 m³/ha), suivi par le traitement EUI (3743 m³/ha) et EPF (3741 m³/ha). c) L'évaluation des nitrates a révélé que les apports d'eau contribuent dans une mesure importante à la contamination de la nappe par les nitrates: les nitrates laissés pendant le cycle cultural s'élèvent à environ 51 kg de NO₃/ha pour EPF; 186,37 kg de NO₃/ha pour AE et 347,07 kg de NO₃/ha pour EUI. d) Le traitement de l'alternance des deux eaux a montré son efficacité dans la ré-utilisation de l'eau usée. e) L'alternance des deux eaux a été le meilleur traitement. On peut réduire de 50% les nitrates laissés vers la nappe tout en assurant la croissance et un rendement adéquat de la plante.

Keywords: Chrysanthemum coronarium, infiltration-percolation, wastewater.

232. MOJTAHID Abdelhakim (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Optimisation des apports d'azote et de l'irrigation par les eaux usées épurées par infiltration-percolation sur une culture de poivron sous serre. - 103 p.

Abstract: Trois catégories d'eau se différenciant par les vertus liées à chacune d'elles, ont été mises à l'épreuve, à savoir l'eau usée épurée par infiltration-percolation, l'eau de puits et une alternance des deux tenant compte des stades et des exigences de la culture en azote. Ces trois types d'eau corrigées en éléments fertilisants ont été combinés à deux régimes hydriques: 100% ETM et 120% ETM.

Keywords: treated waste water, infiltration-percolation, green pepper, plastic tunnels, crop evapotranspiration

233. RASSAA Mahmoud Walid Tarek (Tunisia)

Supervisor: N. Katerji and A. Hamdy

Title: Effet de la salinité sur le stress hydrique, la croissance et le rendement de la fève. - 66 p.

Abstract: Une expérimentation a été faite sur deux variétés de fève. Sur le sol non salé, la variété Giza Bianca présente une capacité de production nettement plus élevée que la variété ILB1814. L'aptitude à accumuler plus de matière sèche pendant un cycle de croissance nettement plus long explique la productivité élevée chez cette variété. Lorsque le niveau de salinité du sol augmente dans une gamme allant de 0 à 4,3 dS/m, le comportement des traitements salins chez la variété ILB1814 reste identique à celui du témoin cultivé sur un sol non salé. Cette variété semble insensible donc à l'augmentation de la salinité dans la gamme de salinité du sol étudiée. En revanche, les traitements salins de la variété Giza Bianca adoptent un comportement différent de celui du témoin. Ils présentent d'abord un cycle de croissance plus réduit, une accumulation de matière sèche et un rendement systématiquement inférieurs au témoin. Ces écarts ne sont pas toutefois significatifs compte tenu d'une dispersion particulièrement élevée autour des moyennes déterminées.

Keywords: broad bean, salinity, water stress, growth, flowering, production.

234. RIZK Gerges (Lebanon)

Supervisor: J. W. van Hoorn and A. Hamdy

Title: Effet de la salinité de l'eau d'irrigation sur le sol, l'absorption de l'azote et le rendement de la fève. - 89 p.

Abstract: Cette expérience a permis d'étudier l'effet de la salinité de l'eau d'irrigation sur le sol, l'absorption de l'azote et le rendement des deux variétés de fève A (ILB1814) et B (Giza Blanca). Trois méthodes ont été utilisées pour étudier l'évolution de salinité du sol: bilan de sels, échantillonnage de la solution du sol et l'échantillonnage du sol. La consommation d'eau par la plante a été calculée comme la différence entre la quantité d'eau apportée et celle drainée par lysimètre. La teneur en azote des feuilles et des tiges augmente jusqu'à l'apparition des gousses puis elle diminue. L'absorption de l'azote a été calculée en tenant compte de l'apport apporté par les engrais et l'eau d'irrigation ainsi que la quantité lessivée par le drainage afin d'identifier l'activité biologique du sol. La variété A est une variété précoce, qui diminue déjà sa consommation d'eau à partir de début Avril. A cause de sa précocité cette variété est probablement préférable sous des conditions de sécheresse, mais comme culture irriguée son rendement reste inférieur au rendement des autres variétés, même si ces derniers sont affectés par la salinité à un niveau d'ECe d'environ 4,5 dS/m. Il serait intéressant de comparer les variétés A et B à une salinité plus élevée.

Keywords : faba bean, evapotranspiration, water salinity, nitrogen.

235. ZBAKH Sanaa (Morocco)

Supervisors : A. Hamdy and G. Mimiola

Title: Production du poivron par l'irrigation à l'eau salée en culture hydroponique et en plein sol. - 162 p.

Abstract: Cet essai a été conduit sur deux variétés de poivron. En milieu hydroponique la salinité de l'eau a été introduite progressivement au long du cycle jusqu'à atteindre une conductivité électrique de 7 dS/m. Dans le sol, les deux variétés de poivron sont irriguées sur deux parcelles, l'une à l'eau douce (EC=2dS/m) et l'autre à l'eau saline, avec le même niveau de salinité qu'en culture hydroponique. L'effet de la salinité sur la croissance végétative n'a pas été décelé en culture sur substrats, par contre dans le sol, les plantes ont été moins vigoureuses. Après l'atteinte d'une conductivité électrique moyenne dans les substrats d'environ 5 dS/m; le rendement est sévèrement affecté. Les fruits présentaient des déformations et une pourriture apicale assez prononcée. D'autre part, l'accumulation des sels dans le sol, dépourvu de système de drainage, a conduit à l'apparition de ces mêmes symptômes. Par la suite, le changement du niveau de salinité de la solution nutritive à 2dS/m, en hydroponie, a conduit à la disparition des symptômes cités auparavant, et à l'amélioration de la quantité et la qualité des fruits.

Keywords: pepper, salinity, gravel, pozzolana, soil.

236. AL-HAI HUSSEIN Muhannad (*Palestine*)

Supervisors: L. S. Pereira and N. Lamaddalena

Title: A methodology for assessing regional irrigation water demand. - 72 p.

Under the growing water crisis, the development of new approaches in planning and management of water resources becomes highly important. For irrigated agriculture these include the computation of the irrigation water requirements under different irrigation scheduling strategies that minimize the water supply with acceptable impact on yields. In this paper the irrigation scheduling simulation model ISAREG was used to simulate these strategies, which include the irrigation with a management allowable depletion fraction (MAD) higher than the soil water depletion fraction for no stress (p); i.e. ($MAD > p$) and irrigation frequency higher than the optimal frequency. These simulations were applied on the existing crops in the irrigation scheme of "Stornara and Tara" (southern Italy), which represents the case study area. The results show that the total irrigation supply of 82.6 Mm³, 94.0 Mm³ and 108.9 Mm³ respectively for the average, high, very high climatic demand, could be significantly reduced to 63.9 Mm³, 73.7 Mm³ and 88.6 Mm³, with acceptable levels of yield reduction (close to 10%), which means to have 22.6%, 21.6% and 18.7% as water saving for the average, high, very high climatic demand respectively. The percentage of water saving for fruit tree crops was higher with respect to vegetables, and higher for the average climatic demand than that of the high and very high climatic demand, depending on the accepted level of yield reduction.

Keywords: irrigation water requirements, irrigation scheduling, simulation model, irrigation water supply.

237. SKAYEM Paul (*Lebanon*)

Supervisors: A. Hamdy and N. Katerji

Title: Salt tolerance degree of faba bean varieties at the critical growth stages. - 152 p.

Abstract: This study falls within a research project carried out by MAI-Bari, INRA (France) and the ICARDA. It aims at analyzing the effects of irrigation water salinity and soil types on the seedling stage and vegetative growth of six faba bean

varieties (*Vicia faba*). The experiment was performed in the greenhouses of the MAI-Bari. The surveyed crops were cultivated in pots in two soil types and were subjected to eight water salinity levels (fresh water, 2, 4, 6, 8, 10, 15, and 20 dS/m). The work is divided into two parts. The first part covers the germination process where the objective is to identify the proper salt level of irrigation water that leads to a high germination percentage and healthy seedling establishment. The second part is aimed at elucidating the possible impact of the salt concentration levels on the growing parameters during the seedling stage till full development of the vegetative growth. Several plant parameters were analyzed (plant height, number of green leaves, number of lateral shoots, leaf area, leaf senescence, and dry matter of leaves, stems, shoots and roots). The results obtained highlight the special performance of the two varieties V1 and V6 that seem to be better adapted to produce at medium salinity level at the investigated growth stages.

Keywords: faba bean, varieties, germination, seedling, salinity.

238. ABDEL Rahman Ahmed (Egypt)

Supervisors: A. Hamdy and N. Katerji

Title: Effect of water salinity on irrigation faba bean crops by gated pipe under green house. - 169 p.

Abstract: Six faba bean varieties (*Vicia faba major*) were selected. The surveyed crops were cultivated in cylinder plastic drainable lysimeters and were subjected to four water quality salinity levels (fresh water as control, water of 3, 6 and 9 dS/m) using surface irrigation system (gated pipe). The work was done to classify the salt tolerance degree of the surveyed varieties. Several plant parameters were analyzed: water use efficiency (WUEb and WUEg) leaf area, dry matter for leaves, shoots and roots, the number of leaves, plant height, number of shoots, the number of flowers, the number of pods per plant, number of grains per pods, leaf senescence, leaf water potential, stomatal conductance, grain yield and weight of 1000 seeds. The results obtained highlight the special performance of three varieties: R-40, Giza-2 and Giza 3 that seem to be better adapted to produce at medium salinity level. While ILB 1814 was sensitive one.

Keywords: salt concentration, Faba bean, varieties, water use efficiency, saline irrigation, salt tolerance.

239. KIYMAZ Sultan (Turkey)

Supervisors: A. Yazar and A. Hamdy

Title: Performance evaluation of lower seyhan Irrigation project after turnover of management to irrigation association. - 68 p.

Abstract: Private costs have increased and are likely to further increase as more and more responsibility is transferred to local agencies. DSI O M staff levels have fallen marginally, though more dramatic declines will depend on resolving issues of transfer and termination with the powerful unions representing DSI support staff. Associations have gained control over many operational decisions and secured the opportunity to stabilize and improve system performance. The main benefit from the transfer, for the State, is to remove the O M financial burden from DSI and thus from the Government. The transfer of each ha of irrigated land to users substantially reduces the need for the government O M expenditures and the related cost recovery. The farmers' feeling of a sense of ownership in transferred schemes has resulted in a better protection of the irrigation infrastructures which eventually leads to reduced maintenance and repair requirements. Water User Organizations (WUOs) have generally demonstrated the ability to operate and maintain the systems satisfactorily through recruiting required staff, buying urgently needed transportation and communication equipment, assessing and collecting water fees, equipping their offices and substantially improving water delivery at a cost generally lower than that incurred by DSI.

Keywords: irrigation management transfer, irrigation association, PIM.

L&W - A.Y. 2000-2001 (October session) – 248-253

248. HASSAN Ahmed Mahrous (Egypt)

Supervisors: A. Hamdy and V. Sardo

Title: A procedure to develop an expert system for micro irrigation systems design. - 129 p.

Abstract: A procedure for designing micro irrigation systems through three modules was derived based on the emitter characteristics, number and shape of subunits, and distribution pipe sizing and location. The module of emitter characteristics was intended to help in the selection of emitters according to their flow rates, operating pressure, exponent of discharge, manufacturer's coefficient of variation, number of emitters per plant and emission uniformity. The module of number of subunits was made to determine the potential number of subunits and the area and shape for each subunit. The module of distribution pipes was developed to help in the design of lengths and diameters of pipes used in the distribution system as well as in their location in the field. A design evaluation part was included, based on the comparison of the design emission uniformity with absolute emission uniformity. Suggestions are given for the field evaluation of the operating system. Finally, considerations are reported to assist in the selection of the most appropriate uniformity coefficient, based on economic, agronomic and environmental parameters.

Keywords: microirrigation system, expert system, design, emission uniformity, emitter characteristics, network, coefficient of variation, economy, hydraulic characteristics, evaluation.

249. IBRAHIM Mohamed (Egypt)

Supervisors: A. Hamdy and A. El Naby Gadalla

Title: Effect of saline water and nitrogen fertilization on maize production under drip irrigation. - 137 p.

Abstract: The experiment was performed in the greenhouse of the IAM-Bari; the corn crop was grown with four water salinity levels (fresh water as control, water of 3, 6 and 9 dS/m) and four nitrogen levels (no fertilizer, 50, 100 and 150 kg N/ha). The work was divided into three parts. The first analyses the irrigation system to identify the suitability of the system (distribution uniformity, clogging ratio for drippers and relation between them and salt distribution). The second one is aimed to assess the salt tolerance degree of maize and its response to nitrogen fertilization; to this purpose several plant parameters were analysed. The third analysis made use of N15 isotope, to identify the Fertilizer Use Efficiency (FUE) by calculating the nitrogen derived to the plant from the fertilizer and that from the soil. The results obtained show the suitability of drip irrigation to distribute the fertilizer and for using marginal water. The depression in fertilizer use efficiency under high salinity levels and N rate (150 Kg N/ha) confirmed the fact that high levels of added N may be harmful to maize plants. The key to the effective use of saline irrigation waters and salinity control is to provide the proper amount of water to the plant at the proper time (irrigation scheduling) with the correct amount of N-fertilizer.

Keywords: drip irrigation, salt concentration, nitrogen fertilizer, fertilizer use efficiency, maize, water use efficiency, saline irrigation.

250. ZIADI Tahia (Tunisia)

Supervisors : A. Hamdy and G. Mimiola

Title: Étude comparative d'une culture de concombre et de carosello en hydroponie et en plein sol avec irrigation saline. - 150 p.

Abstract: Ce travail a été mené pour évaluer l'impact de l'irrigation par l'eau saline sur les paramètres de croissance et de la production quantitative et qualitative d'une culture de concombre (*Cucumis sativus* L) et de carosello (*Cucumis melo*). Cet essai a été conduit aussi bien dans trois substrats inertes (perlite, gravier et pouzzolane) qu'en plein sol. On a utilisé une eau d'irrigation salée ayant une conductivité électrique de 6 à 7 dS/m. Dans le sol, l'épreuve consiste à utiliser une eau d'irrigation avec deux niveaux de salinité de 2 dS/m et 7 dS/m. L'irrigation avec une eau de 7 dS/m a causé l'avortement des fleurs du carosello. Le changement du niveau de salinité de la solution nutritive à 2 dS/m, en hydroponie, a donné une production prometteuse. Les fleurs du concombre ont pu résister à ce haut niveau de salinité et ont donné un haut rendement. Ainsi, le concombre en hydroponie a pu tolérer une conductivité électrique de 7 dS/m, cependant pour le carosello, il est conseillé de le cultiver avec ce même niveau de salinité seulement pendant le stade de développement végétatif, afin de pouvoir économiser l'eau de bonne qualité pendant les premiers stades de croissance en utilisant une eau de moindre qualité.

Keywords: cucumber, carosello, electrical conductivity, substrates, perlite, gravel, pozzolana.

251. MOUJABBAR Hamid (Morocco)

Supervisors : F. Lebdi and N. Lamaddalena

Title: Optimisation de la gestion de barrage en milieu semi-aride. Cas de Barrage Ghezala. - 96 p.

Abstract: Le contexte de la gestion des ressources en eau est par nature aléatoire, les phénomènes hydrologiques étant ainsi. Le paramètre primordial est la variabilité des apports d'eau et non l'apport moyen. Le réservoir est appelé à jouer aussi bien le rôle d'organe de stockage que de régulateur en absorbant la variabilité des apports. Si le réservoir est construit et sa capacité fixée, il y a, selon les règles de gestion adoptées, divers niveaux de performance (déficits ou défaillances dans la satisfaction des besoins en eau)." (LEBDI F., 1996). L'approximation des niveaux de gestion optimum sera bien meilleure en tenant compte des incertitudes et notamment celle de l'aléa hydrologique. C'est l'objet des méthodes d'optimisation en avenir incertain. La programmation dynamique stochastique a été choisie comme outil de résolution mathématique pour l'aide à la décision de gestion du barrage. Cet algorithme d'optimisation permet de tenir compte de variabilité des apports d'une longue série d'observations à travers leurs probabilités d'occurrence. L'analyse du risque de gestion est appréhendée à travers la définition des incidents éventuels et des indices de performance relatifs à ces incidents. L'étude de cas a été réalisée sur le barrage Ghezaia situé dans le nord ouest de la Tunisie.

Keywords: dam, reservoir, management, optimisation, simulation, stochastic dynamic programming, hydrological balance.

252. EL BOUANANI Omar (Morocco)

Supervisors : M. Ait Kadi and N. Lamaddalena

Title: Mise en place d'un système de suivi-évaluation des performances hydrauliques d'un réseau d'irrigation sous pression : application d'un modèle COPAM (FAO 59). - 95 p.

Abstract: Au Maroc, la superficie aménagée par l'Etat en infrastructures d'irrigation est d'environ 1.004.000 Ha, dont 130.000 Ha irrigués par aspersion. Ces aménagements sont actuellement sujets à des mutations en termes d'assolements, des techniques d'irrigation à la parcelle ainsi que des contraintes de disponibilité en eau. Ces évolutions font que les systèmes hydrauliques ne peuvent plus satisfaire les besoins en eau de pointe, ce qui se traduit par des pertes d'efficacité de ces systèmes. L'objectif visé à travers cette étude, menée au niveau du secteur Aït Amira du périmètre irrigué du Massa, a consisté en la mise en oeuvre d'une méthodologie d'aide à la décision dans la gestion des réseaux d'irrigation sous pression, qui consiste à suivre et à évaluer le niveau de performance technique d'un système et d'analyser sa réponse à différents scénarios de fonctionnement. Pour ce faire il a été utilisé le Model COPAM-FA059. Les analyses menées ont permis de constater une amélioration des performances du réseau et qui devient plus pertinente dans le cas de la généralisation de la micro-irrigation à l'échelle de tout le secteur. Cette étude a permis de concevoir une base de données sur le secteur étudié qui peut être utilisée par l'office en vu de suivre et évaluer le comportement du réseau à l'aide du modèle COPAM.

Keywords: performance analysis, irrigation network, pressure, distribution on demand, COPAM-FA059 model.

253. MOEZ Sakka (Tunisia)

Supervisors : F. Lebdi and N. Lamaddalena

Title: Analyse des performances d'un réseau maille-ramifié d'irrigation à la demande. - 48 p.

Abstract: Le présent travail consiste à modéliser le comportement hydraulique et à étudier les performances de fonctionnement d'un réseau d'irrigation à la demande, comportant une ossature maillée. Il consiste à coupler les méthodes d'équilibrage hydraulique de l'ossature maillée et celles des sous réseaux ramifiés, branchés sur cette ossature. Il s'agit de formuler le fonctionnement hydraulique du système et de préciser cette approche méthodologique, permettant à chaque scénario de bornes ouvertes ou non, de déterminer le service hydraulique à la borne, donné par le couple (débit-pression). Des critères de performance fixant la qualité de fonctionnement du système seront ensuite définis et calculés par analogie avec les critères de performance employés dans la gestion optimale des réservoirs barrages, permettant de localiser les points défaillants du réseau, d'identifier les causes et de proposer les solutions hydrauliques. Une étude de cas est effectuée sur le périmètre irrigué de sud Fortore (sud de l'Italie), qui couvre 27610 ha de superficie en incluant une interface S.I.G. (ArcView) en vue de mieux gérer les données et mieux visualiser les scénarios de fonctionnement hydraulique du réseau après correction des défaillances. Le système étudié est composé d'une ossature principale qui forme trois mailles limitées par deux réservoirs et des sous réseaux ramifiés branchés sur les différentes mailles et desservant 92 secteurs en totalité.

Keywords: hydraulic networks, loop, modeling, performance criteria, scenarios, simulation, resolution, GIS.

L&W - A.Y. 2000-2001 (November session) – 254

254. THAFER Mosab (*Palestine*)

Supervisors: R. Choukr-Allah and A. Hamdy

Title: The use of treated wastewater as supplementary irrigation for bread wheat (*Triticum aestivum*) production. - 78 p.

Abstract: This study is aimed at determining the impact of treated wastewater irrigation on plant growth, dry matter, grain yield and straw yield of bread wheat (*Triticum aestivum*), and on the soil characteristics. The field experiment was carried out on a sandy soil in Agadir region, southern part of Morocco. Two types of water were used: the rainfall supplemented with treated wastewater irrigation of which five treatments were tested - D1 (250 mm), D2 (275 mm), D3 (300 mm), D4 (350 mm) and D5 (400 mm), applied during the critical growth stages. Leaf, root content of nitrogen, phosphorus, potassium, calcium and magnesium was increased proportionally to the irrigation doses. The electrical conductivity of the soil increased from the start to the end of the experiment, respectively, with all the doses of irrigation. pH was kept basic during the whole experiment with little decrease at the end. The evaluation of soil nutrients (N, P, K, Ca, Mg, and Na) for the three soil layers, indicated their accumulation with increasing irrigation dose. - As a result, we found that the wheat crop could complete its growing cycle using supplementary irrigation. Adding 350 mm of treated wastewater as a supplementary irrigation to bread wheat gave us the highest grain yield in comparison to the other doses. The lower doses didn't satisfy the water and nutrient requirements, and the highest dose (400 mm) caused an excess of nitrogen as well as an increase in the electrical conductivity and created a periodic water saturation of the soil, creating stress conditions for the crop and therefore reduced crop productivity

Keywords: wastewater, supplementary irrigation, bread wheat (*Triticum aestivum*), infiltration-percolation.

L&W - A.Y. 2001-2002 (July session) – 262-271

262. BENHELIMA Nour-Eddine (Algeria)

Supervisors : J. W. van Hoorn and A. Hamdy

Title: Effet de la salinité de l'eau d'irrigation sur le sol, l'absorption de l'azote et le rendement de la fève. - 82 p.

Abstract: The aim is to study the effect saline water on soil salinity, absorption of nitrogen and yield of the two varieties of broad bean A (ILB 1814) and B (Giza Blanca). The experiment was carried out on a lysimètre set-up, using three waters of increasing salinity. Three methods were used to study soil salinity: salt balance, soil water sampling with porous cups and soil sampling. The comparison between the salt balance and the sampling by porous cups reveals the exchange between calcium and sodium at the absorption complex and the precipitation of calcium bicarbonate. Variety B, slightly earlier than variety A, is much more sensitive to salinity, which corresponds with the pronounced salinity effect on the biological nitrogen contribution. The difference between both varieties could be attributed to a difference in salt sensitivity between the rhizobia of the two varieties.

Keywords: broad bean, évapotranspiration, lysimetre, chlorine, variety B (Giza Blanca), variety A (ILB 1814), sampling of soil water, salt balance, nitrogen balance, yield.

263. VINTERFELD Snezana (Bosnia and Herzegovina)

Supervisors: L. S. Pereira and N. Lamaddalena

Title: Assessment of regional irrigation requirements considering water scarcity: application to Stornara and Tara Consortium. - 101 p.

Abstract: The effects of water scarcity and drought are particularly severe on irrigated agriculture. This work aims both at assessing regional irrigation requirements under water scarcity conditions through the estimate of crop water requirements for characteristic years of average, high and very high water demand, and at evaluating different water saving strategies based on deficit irrigation. The irrigation scheduling simulation model ISAREG was used to simulate deficit irrigation strategies. The results of simulation are integrated by using a GIS for the irrigation consortium "Stornara e Tara" (Southern Italy) on an agricultural surface area. The overall results demonstrated that the strategy based on a fixed MAD, with irrigation starting at 30% below optimal yield threshold, provided very satisfactory results allowing an average water saving of more than 25% with 10% yield reduction. By applying this strategy at the regional scale it is possible to save 96,78.25 and 97.4 Mm³ of water.

Keywords: irrigation water requirements, deficit irrigation scheduling, simulation modelling, water saving.

264. RADWAN Mahmoud Zaki Kamel (Egypt)

Supervisors: A. Hamdy and N. Katerji

Title: Saline irrigation, management and salt tolerance of wheat varieties. - 184 p.

Abstract: This work is aimed at the analysis of the effect of water and soil salinity on the growth development and yield of seven wheat cultivars selected and supplied by ICARDA. This experiment was performed in the greenhouse of IAM-Bari and it was divided into two major parts: The first on germination using sand as a media and irrigation salinity levels lying between 1 to 10 dS/m to identify the proper salt level which leads to a high germination percentage and healthy seedling establishment. The second, the biological part, was conducted in cylindrical plastic drainable lysimeters, where the investigated wheat varieties were grown and subjected to irrigation with three water quality salinity levels. The results obtained revealed that the varieties Gidara -2, Waha-Cham-1 and Belike -2 are tolerant to salinity; Hagla and Jennah Khetifa are moderately tolerant, whereas Om-rabi-5 and Haurani are sensitive. The management technique practiced at the flowering and seed filling stages through the use of additional fresh water 10% of the total, improved the plant growing parameters with an average 10% increase in yield and reduced the accumulated salts in soils by nearly 30%.

Keywords: wheat varieties, saline irrigation, leaching practices, alternation, growth stages.

265. ISMAIL Hossam (Egypt)

Supervisors: A. Hamdy and A. Gadalla

Title: Effect of saline irrigation water on soil salinity, and nitrogen fixation by leguminous plants using ¹⁵N-tracer technique. - 119 p.

Abstract: This study is aimed at analyzing the effects of water and soil salinity on growth, yield and nitrogen fixation by three leguminous plants (chickpea, faba bean and lentil) selected and supplied by ARC, Cairo, Egypt. The experiment was carried out under the greenhouse conditions of MAI, Bari - Italy. Crops were cultivated in PVC lysimeters and were irrigated with four water salinity levels. The work was divided into two parts. The first is on germination. The second part evaluates the contribution of N² -fixation. The results obtained prove that the application of the suitable Rhizobium bacteria strains could be beneficial for both plant growth and soil fertility via N² -fixation under salinity condition. Faba bean has the ability to accumulate and utilize more N than chickpea and lentil plants.

Keywords: salt concentration, leguminous plants, N₂ fixation, saline irrigation ¹⁵N - tracer technique.

266. BOU JAOUDE Maher (Lebanon)

Supervisors : N. Katerji and A. Hamdy

Title: Effet de la salinité sur le fonctionnement hydrique et la productivité de deux variétés de fève de tolérance variable à la sécheresse. - 81 p.

Abstract: In the non-saline soil, both varieties showed the same water behaviour and identical water consumption. Only the biomass yield of ILB1814 variety was 23% higher, thus reflecting the growth vigour of this variety during the cropping cycle. The difference was, however, small in terms of grain yields (8%). As a result, water use efficiency values were very close to each other: 0.92 and 0.87 Kg/m³ respectively for ILB1814 and Giza Blanca. The variety ILB1814 seems to be more salt tolerant than variety Giza Blanca. Resistance to drought does not necessarily correspond to salt-resistance. The dry matter accumulation ability of the ILB1814 variety has been deeply discussed in this study. We recommend carrying on future studies aimed at verifying the assumptions suggested for.

Keywords: faba bean, water behaviour, growth, production.

267. SAYDE Chadi (Lebanon)

Supervisors: F. Lebdi and N. Lamaddalena

Title: Operation and performance analysis of a pseudo-looped irrigation scheme. - 65 p.

Abstract: The study was carried out on a Lebanese irrigation system composed of a pseudo-loop, between a pumping station and a storage reservoir, and a branched distribution network. The complexity of the hydraulic operation imposes hydraulic pressure head constraints related to the water surface elevations of the reservoir, the hydraulic characteristics of the pumping station and the water demand of the distribution network. A simulation model was developed to compute the hydraulic parameters at the upstream end of the distribution network. To carry out the performance analysis of the distribution network, the AKLA model was used, and the performance indicators at the hydrant level, i.e. the relative pressure deficit and the reliability were computed. The model was used under different upstream conditions of pressure head and discharge resulting from the output of the above mentioned pseudo-loop model.

Keywords: hydraulic networks' analysis, pseudo-loop, modeling, performance criteria.

268. LEMTINE Bouchra (Morocco)

Supervisors : A. Hamdy and G. Mimiola

Title: Production de deux variétés de tomate en culture hors sol et en culture traditionnelle irriguées à l'eau salée. - 179 p.

Abstract: This work was conducted in the greenhouse of the MAI of Bari to evaluate the response of two hybrid tomato cultivars to irrigation with saline water of an EC value lying. Two cropping techniques were used: soilless technique with gravel, pozzolana and perlite as inert growing media, and the traditional cultivation technique in soil medium. The soilless culture technique proved its advantages in eliminating the problems caused by saline irrigation on soils, doubling the production for both the investigated tomato varieties, improving both physical and chemical tomato quantities, increasing the efficient use of fertilisers as well as anticipating the time needed for full maturity. One of the interesting points studied is the quantity and quality of tomato production in relation to the number of bunches the plant bears. The results were in favour of the plants with lower numbers of bunches.

Keywords: cultivars, soilless culture, salinity, yield quantity, yield quality.

269. ZERRAK Tarik (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par les eaux usées épurées sur la productivité d'une culture d'haricot vert de plein champ, le bilan d'azote et la salinité du sol. - 97 p.

Abstract: Our trial was carried out at the pilot station of Drarga. Two water regimes were adopted, and a plant density of 105000 plants/ha. The results of our trial show that: Water use of French bean crop is 200 mm and the low content of major nutrients in treated waters caused a reduction in most of them in the soil. The

120% ETM regime affects less crop growth, plant height, fresh weight, yield and discarded product. The high electrical conductivity of irrigation water caused an increase in the soil electrical conductivity. Nitrogen balance of the crop showed that under the 100% ETM, nitrogen uptake by French bean was 74 kg/ha of nitrogen, the supply was of 49 kg/ha of nitrates and 2.8 kg/ha of ammonium, and this caused a decrease in the soil of 102 kg/ha of nitrates and 4 kg/ha of ammonium.

Keywords: waste waters, French bean, 100% ETM, 120% ETM, water use, growth, yield, electrical conductivity, and nitrogen balance.

270. AGHAI Omar (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par les eaux usées épurées sur la productivité d'une culture de tomate de plein champ, le bilan d'azote et la salinité du sol. - 78 p.

Abstract: This work is aimed at assessing the impact of irrigation with treated wastewaters on growth, production and nitrogen balance of a tomato crop in the field, as well as the chemical characteristics of the soil. The trial was carried out at the treatment station of Drarga. Two water regimes were used. The results obtained show that water use of tomato was equal to 1937.7 m³/ha. The agronomic parameters were similar for the two treatments but the yield components were better for the 120% ETM treatment. Electrical conductivity of the soil increased from 2.32 dS/m to 5.24 dS/m and 4.30 dS/m respectively, for the 100% ETM and 120% ETM treatments; this difference between the two treatments is the result of the 20% leaching fraction applied on the second treatment that ensures leaching of salts in depth. The soil was depleted in nitrogen, phosphorus and potassium.

Keywords: treated waste waters, tomato, 100% ETM and 120% ETM treatment, production, soil nitrogen balance, electrical conductivity, nitrate, leachates.

271. AL ARAWI Shafeeq Ismail (Palestine)

Supervisors: R. Choukr-Allah and A. Hamdy

Title: Wheat production under supplementary irrigation with treated sewage water. - 94 p.

Abstract: This experiment is aimed at evaluating the effects of treated wastewater reuse on soil characteristics, plant growth and development, grain yield, and straw yield of bread wheat, but the main objective is to define the most critical growth stage. The field trial was carried out at Drarga wastewater treatment plant (Agadir -Morocco), on a loamy soil. The idea is to use supplementary irrigation by applying two doses of irrigation water. The variation in irrigation schedule took place when the plant approached flowering. The experimental units that received a higher amount of water at the flowering stage produced the highest grain yield and number of spikes per m² that means that the flowering stage is the most critical growth stage in bread wheat. One of the conclusions is that, bread wheat crop must receive at least 50 mm of water at the flowering stage.

Keywords: wastewater, supplementary irrigation, critical growth stages, bread wheat, *Triticum aestivum*, and irrigation schedule.

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287. EL SAYED Ahmed Bakry Abd El Samie (Egypt)

Supervisors: T. Tawfik and A. Hamdy

Title: Effects of metal pollution on water quality in Shoubra El-Khiema Qalubia Governorate in Egypt. - 157 p.

Abstract: The geochemical Model MINTEQ was used to estimate metal ion-activities in collected soils and water samples. The model was also used to determine whether the metals are present as complex species or as simple ion and to examine the solid phases that might control metal-ion solubility. The result indicated that, the studied drains have high salinity content hazard, while the irrigation water samples were found to be of moderated salinity. Additionally, drainage water exceeded the permissible limits, while levels of the irrigation water were within permissible limits. Analysis of plant grown in the studied area showed levels of Al, Cu, Fe and Mn that exceeded the permissible limits.

Keywords: Shoubra El-Khiema, Qalubia Governorate, Egypt, evaluation, metals, irrigation water, drainage water, soil samples, plant samples, MINTEQ model.

288. KANDIEL Mohamed Elsaid Attia (Egypt)

Supervisors: A. Hamdy and M. Toufik

Title: Evaluation of large-scale irrigation structures. - 64 p.

Abstract: The Nile River is the main source of water in Egypt. It provides the country with about the 95% of its water requirements. There are about 18.000 irrigation structures controlling the flows through the network, including seven major dams on the Nile. These dams are old, there is an urgent need to rehabilitate or replace the deteriorated ones. Therefore, the water managers who are faced with the problem needed to evaluate few alternatives. Few alternatives are considered. Multi-criteria analysis provides an efficient tool for dealing with such problems. It can accomodate social, economic, environmental as well as technical aspects. An MS/EXCEL program has been developed to solve multi-criteria problem by comparing different feasible alternatives. It uses several MCA techniques and presents the results in simple graphs to show the rank of each alternative. The application of the MCA framework through the develop program proved to be a good aid to the water managers who need to select the best alternative.

Keywords: multicriteria analysis, barrages, evaluation criteria.

289. BOU SAMRA Bassam (Lebanon)

Supervisors: M. El Moujabber and A. Hamdy

Title: Monitoring of groundwater salination by seawater intrusion on the Lebanese coast. - 132 p.

Abstract: The results obtained from this study showed that the regions of Choueifat, Jiye and Rmeyle (Lebanon) are subject to seawater intrusion. This intrusion is directly and simultaneously related related to the pumping period and intensity but poorly related to the amount of rainfall. It also depends on the geologic nature of the study area. Furthermore, the actual intrusion in the study zone aggravates the existing salinity problems. Indeed the salinity rates of well water ranged between 0.7mS/m and 5.5 mS/m (the majority being above 2 dS/m9

resulting in salinity rates not tolerable for crops, thus threatening their growth and production. Moreover, the correlation analysis has highlighted the problem of seawater intrusion through the data that accompanied the study.

Keywords: groundwater, seawater intrusion, salinity, Lebanon.

290. MAHERZI Khalef (Tunisia)

Supervisors: M. Abd El Motaleb, A. Afify and A. Hamdy

Title: A (GIS) platform for the evaluation of a water resources system (Case study from Egypt). - 80 p.

Abstract: This work is divided in two parts: the first one involves a description of a water resource system through some socio-economic, agricultural and water indicators. It gives to the decision-maker the possibility to have a clear idea about the actual situation by showing different maps of all Governorates in Egypt. Each map represents a specific indicator. This is done by using a GIS interface. The second part is a tool that uses the multi-criteria analysis to develop a single index based on the previous indicators to determine the most suitable projects sites, for example for an irrigation system. For this index, the decision-maker will have just to pick up from the list of the previous indicators some of them, and then give to each one a weight. The program will apply all the normalisation rules and will run all the necessary computations to plot a new map with the new index.

Keywords: indicators, multi-criteria analysis (MCA), GIS.

291. KAPUR Burçak (Turkey)

Supervisors: P. Steduto and M. Todorovic

Title: Climate change, climatic water balance and crop water requirements: investigation on the next 100 years for the Apulia Region. - 123 p.

Abstract: The overall results indicated that an increase of temperature, in the range between 1.3 and 2°C, is expected in the next 100 years. The reference evapotranspiration (ET_o) variations would follow a similar trend; as averaged over the whole region, the ET_o increase would be about 15.4%. The precipitation should not change significantly on yearly basis although a slight decrease in summer months and a slight increase during the winter season are expected. The climatic water deficit (CWD) is largely caused by ET_o increase, and it would increase over the whole Apulia region, on average, by more than 200 mm. The greatest increase of CWD (for more than 300 mm in 100 years) is foreseen for the Capitanata, one of the most important agricultural zones of the Apulia region. According to Thornthwaite climate classification, the moisture index will decrease in the future, with a subsequent decrease of humid areas and increase of arid zones. The subhumid/subarid areas that are found in the Peninsula of Salento and between Bari and Brindisi provinces, including Castellana Grotte, Locorotondo, San Pietro Vernotico etc., would be characterized as semiarid zones by the end of 21st Century. The net irrigation requirements (NIR), calculated for ten major crops in the Apulia region, would increase significantly in the future. By the end of the 21st Century, the expected increase of NIR, as compared to the present situation, will be maximum for olive tree (65%), wheat (61 %), grapevine (49%), and citrus (48%), and slightly lower for maize (35%), sorghum (34%), sunflower (33%), tomato (31 %), and winter and spring sugar beet (both 27%).

Keywords: climate change, climatic water balance, climate classification, crop water requirements.

292. OZMEN Selcuk (Turkey)

Supervisors: A. Kanber and P. Steduto

Title: Pistachio response under different irrigation and fertigation practices in South East Anatolia Region (GAP) of Turkey. - 66 p.

Abstract: The obtained results showed that irrigation increased the pistachio yield by about 67 % as compared to traditional practice. The maximum yield was obtained from If2N³ treatment. The average cover percentages value for irrigated treatments was 32%, which shows that the 30% wetting used to calculate irrigation water amount in the experiment was correct. Furthermore, yield periodicity appear to be reduced.

Keywords: irrigation, pistachio, drip irrigation, fertigation, periodicity.

293. KIRKAYAK Basak (Turkey)

Supervisors: A. Yazar and A. Hamdy

Title: Wheat yield response to irrigation with saline water under the Mediterranean climatic conditions in Turkey. - 80 p.

Abstract: The response of wheat to different salinity levels of irrigation water under the Mediterranean climatic conditions was investigated in a field study at the experimental station of Cukurova University in Adana, during the 2001-2002 growing season. Saline waters with electrical conductivity values of 0.5, 3.0, 6.0, 9.0 and 12.0 dS/m were used for irrigation of wheat. The average grain yields ranged from 5940 to 6484 kg/ha in different treatments. Variance analysis of the grain yield data showed that the effect of salinity levels of irrigation water used in the study on grain yields was not significantly different. Saline irrigation water can safely be used for irrigation of wheat crop in the Mediterranean region because of effective winter rainfalls that leach the salts out of the root zone as long as an efficient drainage system is provided.

Keywords: wheat, salinity, development, yield.

294. KESSAI Abla (Algeria)

Supervisors : A. Hamdy and G. Mimiola

Title: Production de deux variétés de tomate en culture hors sol et en culture traditionnelle irriguées à l'eau salée. - 162 p.

Abstract: This work was conducted in the greenhouse of the Mediterranean Agronomic Institute of Bari to evaluate (quantitatively et qualitatively) the response of two tomato varieties, IRS 1868719 and Neely F1. Two cropping techniques were used: Soilless technique using perlite, gravel and pozzolana as inert growing media, irrigated with saline water of an EC value lying between 5 and 6 dS/ and the traditional cultivation technique in soil medium using two types of water with an EC of 2 and 6 dS/m, respectively. Thanks to the efficient leaching of substrates, in the Soilless culture technique, the increase in EC of the nutrient solution from 2 to 6 dS/m didn't affect the yield but double the production of the plants topped at 5 and improved the proportion of fruits graded as high quality (Class 1) from plants topped at 3. For soil medium technique, the increase in the EC from 2 to 6 dS/m in saline water, progressively reduced the yield of the variety IRS 1868719 and did not significantly affect the yield of the variety Neely F1, but it improved the quality of the fruit in terms of Vitamin C and Brix degrees for both varieties.

Keywords: tomato varieties, soilless culture, technique in soil medium, salinity, topping, yield quantity, quality.

295. BEN MEFTAH Mouldi (*Tunisia*)

Supervisors: A. Petrillo, M. Mossa, N. Lamaddalena

Title: Experimental study of the scour hole downstream of bed sills. - 91 p.

Abstract: The main objectives of this study are the determination of the scour hole dimensions, specially its maximum scour depth, at the equilibrium stage and the investigation of the influence of the sill on the distribution of the three-components flow velocity through the scour hole at the same stage. Four experimental configurations were tested, the main difference between them being the distance between sills. It was observed that, the distance between sills more than the Froude number influences the scour hole dimensions. The three-dimensional measurements of flow velocity by using the Acoustic Doppler Velocimeter show that in the scour hole, at the equilibrium stage, the three-components of turbulence intensities of flow are very high.

Keywords: scour, bed sills, channel, turbulence, velocity.

296. MAHER Khalid Ali (*Egypt*)

Supervisors: V. Sardo and A. Hamdy

Title: Vetivergrass tolerance to salinity and its potential in saline soils reclamation. - 84 p.

Abstract: A research has been carried out in order to assess vetivergrass tolerance to salinity and its ability in the reclamation of saline soils. The research was conducted for about 9 months in a greenhouse in 48 lysimeters filled with a sandy soil; treatments included 3 levels of irrigation water salinity plus a control and 3 levels of fertilizers plus a control. Due to plant starvation treatments had to be modified with water salinity of 30dS/m; plants were substituted and the evolution of soil salinity was monitored irrigating the new plants at intermediate salinity levels. The main results concerned the maximum salinity levels for plant survival; the reduction in plant fresh and dry weight, height and LAI as influenced by salinity; the extent of plant ability in reducing salt content in soil; the action of KNO in balancing salinity effects; the unbalances in K, CA and M due to increasing Na applications.

Keywords: vetivergrass, salinity tolerance, saline soils reclamation, vetivergrass, erosion protection.

L&W - A.Y. 2002-2003 (July session) – 303-315

303. FARRAG Karam Ahmed (Egypt)

Supervisors: A. Hamdy and V. Sardo

Title: Non-conventional water resources, the saline water, as supplemental irrigation for cereal crops under rainfed agriculture. – 82 p.

Abstract: This work focuses on the possibility of applying brackish water (3 to 9 dS/m) as supplemental irrigation to wheat, barley and corn. The trial was conducted at IAMBari greenhouse over 36 pots per each of the three crops; the fully fresh-water irrigated treatment gave the best biomass and yield, the drought-simulating treatment from flowering gave the worst results and the other treatments with supplemental irrigation as a fraction of full irrigation, either with fresh or brackish water gave a rather uniform, homogeneous response. Wheat and barley showed higher crop water productivity as compared to the fully irrigated control: this points to the possibility of reducing drought-risk through applying small quantities of brackish water, without seriously impairing soil fertility since the quantities of added salts are however very small. Corn showed reduced drought-tolerance in the late vegetative and following stages, which makes the solution not applicable to this crop.

Keywords: rainfed agriculture, supplemental irrigation, non-conventional water resources, saline water, cereal crops.

304. AWAD Ayman El Sayed Mohamed (Egypt)

Supervisors: J. W. Van Hoorn and A. Hamdy

Title: Effect of saline irrigation water on soil salinity, nitrogen uptake, water consumption and yield of wheat. – 95 p.

Abstract: This work studies the saline water effect on soil salinity, nitrogen uptake, water use and yield of two wheat varieties (Hurani and Cham-1) grown in tanks filled with clay soil at the IAMBari experimental site, and irrigated with water salinity of 3.7, 15 and 30 meq Cl/l. Soil water sampling and salt balance methods were used. Average chloride concentration obtained from soil water sampling, was almost stable, but its distribution markedly differed with depth. The chloride concentration pattern in the salt balance method was almost stable during the growing season. Soil water sampling by porous cups underestimates soil salinity due to preferential flow through large pores. Salinity significantly affected grain and straw yield. The early variety B showed a higher grain yield and an almost equal straw yield than variety A. Salinity had almost the same effect on evapotranspiration as on yield and therefore no effect on water use efficiency.

Keywords: wheat, saline water irrigation, chloride, soil water sampling, salt balance, nitrogen uptake, yield.

305. EL BABLY Walid Farouk Hussein (Egypt)

Supervisors: A. Hamdy and N. Katerji

Title: Saline irrigation, management and salt tolerance of Barley varieties.

Abstract: This work, developed at the IAMB-Bari greenhouse, studies the water and soil effect on growth development and yield of seven Barley cultivars grown in cylindrical, plastic drainable lysimeters and subject to three irrigation water salinity levels (0.9 dS/m, 5 and 10 dS/m). Grain yield and shoot and root development changes were taken as indicators in classifying the salt tolerance degree. The experimental classification was validated through Passioura economic model and the modified one. The trial assesses irrigation alternated with different quality waters and leaching at sensitive growth stages on plant growing parameters, yield and soil accumulated salts. Varieties Arta/3/Hml, WI2737/4/A and Melusine/A are salinity-tolerant, CalMr and Zanbaka moderately tolerant, whereas PI243590 and Arar/H.spo are sensitive. Applying additional fresh water, 51% of the total, at the flowering and seed filling stages improved plant-growing parameters with an average 13% increase in yield and reduced accumulated salts in soils by nearly 82%.

Keywords: barley varieties, saline irrigation, leaching practices, alternation, growth stages.

306. EL SAYED ABUARAB Mohamed (Egypt)

Supervisors: V. Sardo and A. Hamdy

Title: The rough set theory applied to the evaluation irrigation systems design and management. – 96 p.

Abstract: This work focuses on sixteen drip or spray irrigated citrus groves in Sicily, to critically analyze the irrigation systems in their economic and practical aspects of management. Next the hydraulic aspects, to work out a set of information to be used as a guideline in the irrigation system design and management. The "rough sets" technique was applied. Some "conditional" criteria, corresponding to independent variables, were applied and elaborated against the Farmers' Satisfaction "decisional" parameter. The rough set analysis evidenced those threshold values to be respected to achieve a "medium" or a "high" level of farmers' satisfaction; the considerable influence of the water content of Ca, Mg and Na on emission uniformity was highlighted through multiple regression analysis. Useful information was given on the optimization of direct and indirect energy input, which translates into the possibility of associating environmental to economic aspects in the optimization process of design and management.

Keywords: localized irrigation systems, design and maintenance, rough set, conditional criteria, decisional parameter, optimization.

307. ABDEL-AZEM Mahamoud Mohamed Ali (Egypt)

Supervisors: A. Gadallah and A. Hamdy

Title: Response of lupine plants to the Rhizobium inoculation under drip irrigation with saline water, using ¹⁵N isotope dilution. – 126 p.

Abstract: This study aims at analysing water and soil salinity effects on growth, yield and nitrogen fixation by lupine (*Lupinus albus* L.) Giza 1 grown at IAMBari greenhouse. The first part on germination identifies the proper salt level leading to high germination percentage and healthy seedling establishment, and elucidates any salt level impact on seedling growing parameters. The second part evaluates the contribution of N₂-fixation by lupine (using ¹⁵N technique) under gradual increase in irrigation water salinity, and checks how bio-fertilizers (inoculants) could help plant growth under salinity stress. Irrigation water salinity negatively

affected the germination percentage. Dry matter, leaf area and plant height drastically reduced at high water salinity. Growth parameters varied depending on salinity level, N-fertilizer and bacterial inoculation. As from 15N analysis data, small nitrogen portions used by lupine came from fertilizers and were similarly affected by the irrigation water salinity level, N-fertilizer additions and bacterial strains.

Keywords: drip irrigation, salt concentration, nitrogen fixation, fertilizer use efficiency, lupine, saline irrigation.

308. IMAD Elie (Lebanon)

Supervisors : M. El-Moujabber and A. Hamdy

Title: Prévention de l'intrusion de l'eau de mer par la recharge artificielle de la nappe phréatique sur la côte libanaise. – 125 p.

Abstract: The Lebanese coast is subject to a massive exploitation that affects the natural resources. The aim of this study is to assess the quality of groundwater on the Lebanese coast affected by seawater intrusion, and to study artificial groundwater recharge as a remedy to intrusion. The region stretching from Choueifat to Rmaylé in Southern Lebanon was selected for the study. Chemical analyses, pumping tests and the measures of piezometric heads were carried out on a sample of 44 wells. Ten geological and hydro-geological maps were also worked out. This has been useful for modelling the seawater intrusion with a theoretical recharge of groundwater. The results of water chemical analyses showed a severe intrusion of seawater in the region of Jiyé and Choueifat. Lastly, two types of recharge are proposed as solution to the problem, by means of small ponds and through a fresh water injection barrier.

Keywords: seawater intrusion, artificial recharge, groundwater, salinity, Lebanon.

309. AL CHAMI Ziad (Lebanon)

Supervisors: U. Fratino and N. Lamaddalena

Title: Hydraulic interface between on-farm and distribution network. – 77 p.

Abstract: In an on-demand pressurized distribution network, the different hydrants simultaneously operating cause variation of pressure and discharge; the performance of the on-farm system depends of the possible variations of the discharge and pressure at the hydrant. In order to analyze and compute the on-farm network performance, the interface between the distribution network and the on-farm network was developed, and to identify the operating point and the hydraulic performance of the on-farm network for different operating conditions of the distribution system, two typical irrigation systems were analyzed, trickle irrigation and sprinkler irrigation. For each system, different operating scenarios were simulated, in order to evaluate the trend of the operating point of the on-farm network and the effects of the variation of the hydraulic characteristics at the hydrant level on the farm network.

Keywords: performance analysis, on-demand systems, sprinkler systems, trickle systems

310. AYOUIJIL Ali (Morocco)

Supervisors : N. Katerji and A. Hamdy

Title: Effet de la salinité sur le fonctionnement hydrique et la productivité de deux variétés de blé dur de tolérance variable à la sécheresse. – 67 p.

Abstract: This study, carried out at the lysimeter station of IAM-Bari, is aimed at analysing the effects of soil salinity on water status, growth, productivity and efficiency of two durum wheat varieties, a local one (variety Haurani) and a selected one (variety Cham-1) by ICARDA. In the non-saline soil, the two varieties exhibit the same leaf area and final biomass yield. Grain yield water efficiency is definitely greater in Cham-1. This result is ascribed to a shorter growing cycle and higher harvest index. In saline soils, Haurani variety shows water efficiency close to the control, whereas Cham-1 variety improves its efficiency. This improvement is associated with several drought-adaptation mechanisms observed in this variety, such as: accelerated growing cycle, osmotic adjustment and maintaining a high number of productive tillers under water stress conditions. The observed results indicate that the Cham-1 variety is better adapted to salinity than variety A.

Keywords: durum wheat, salinity, water efficiency, production, evapotranspiration.

311. KACHKACH Naima (Morocco)

Supervisors : A. Hamdy and G. Mimiola

Title: Production de deux variétés de salade en culture hors sol et en culture traditionnelle irriguées à l'eau salée. – 115 p.

Abstract: This work was carried out at IAM- Bari greenhouse to assess the response of two salad varieties to saline irrigation of EC 4 dS/m and three crop techniques: soilless crop using perlite, gravel and pozzolana as inert substrata, field crop grown in greenhouse with two EC 1,1 dS/m and EC 4 dS/m, and conventional field crop using fresh water of EC 1,1 dS/m. The trial on field-grown Marly variety showed that climatic conditions are a limiting factor for lettuce production; if grown in the greenhouse, it has a short crop cycle and better production. With soil-less technique, salinity increase in the nutrient solution from 1,1 dS/m to 4 dS/m, didn't affect output but gave a yield exceeding 66,3% for Marly variety and 63% for Love variety, higher than the one obtained in the field. In the presence of conventional crops, salinity affected the variety yield more significantly than Love variety.

Keywords: climatic conditions, salad varieties, soil-less crop, conventional crop, salinity.

312. ABOUATALLAH Ataâ (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de différents régimes d'irrigation par les eaux usées épurées sur une culture de courgette de plein champ. Réponses agronomiques et physiologiques. – 73 p.

Abstract: This work was carried out at Drarga pilot-station: i) to assess the different treated wastewater irrigation regimes (60%, 80%, 100% and 120% ETM) impact on the agronomic and physiological responses of field-grown winter-spring zucchini crop, under trickle irrigation and plastic mulching, ii) to estimate the possible negative effects on soil and environment. Treatment T80% improved total and marketable yield and reduced rejects by 6%. The 1% increase in water application improved leaf area by 75 cm²; T80% and T60% showed the highest dry

matter rates. T60% instead of T120%, gave 56% lower biomass at the end of the cropping cycle. Photosynthesis rate of T120% was 49% higher than T80%; under-irrigated treatments transpired 25% less. T80% induced the least negative osmotic potential. The soil ECe increased and major major nutrients decreased, notably in T80%. Nitrogen increased, except in T60%. Leached nitrates in T120% were 58 Kg/ha; their use efficiency was 80%.

Keywords: wastewater, zucchini, ETM, water consumptive use, ECe, photosynthesis, transpiration, osmotic potential, marketable yield, electrical conductivity.

313. ALAOUI Sidi Mohammed (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Impact de différentes doses d'irrigation par les eaux usées épurées par infiltration percolation sur une culture de pomme de terre: *Solanum tuberosum*. Réponses physiologiques et agronomiques. - 100 p.

Abstract: This work took place in the experimental plot of the wastewater treatment station of DRARGA to investigate the eco-physiological and agronomic responses of potato crop to four irrigation regimes: 120%ETM, 100%ETM, 80%ETM and 60%ETM. The crop adapted to each irrigation regime. The EC of the saturation extract increased from 1.86 dS/m respectively to 1.93; 1.96; 1.98 and 2.12 dS/m for the treatments 120%, 100%, 80%, and 60% ETM. The soil was richer in nitrogen and potassium but poor in phosphorus. The wastewater use reduced net photosynthesis rate and the transpiration rate. The osmotic potential reduced from -18,58 ±0,61bar in 120%ETM treatment to -23,74±2,25 bar in 60%ETM treatment. The increased water application yielded larger leaf area, high fresh weight and greater water use efficiency. For 120% ETM regime, the quantity of leached nitrates was about 20 Kg/ha, thus representing a low potential hazard of groundwater pollution.

Keywords: wastewater, eco-physiology, potato, ETM, conductivity, saturated paste, nitrogen, net photosynthesis, transpiration, osmotic potential, nitrates, efficiency.

314. BSHARAT Mahmoud (Palestine)

Supervisors: A. Hamdy and N. Katerji

Title: Salt tolerance degree of *Hordeum volgare* varieties at the critical growth stages. – 139 p.

Abstract: This study analyses the saline irrigation effects on seedling and critical growth stages of seven Barley varieties (*Hordeum volgare*) grown in the greenhouse in two pot experimental sets: set A, fresh water irrigation at seed germination followed by different saline water levels during seedling establishment and vegetative growth until flowering; set B, the same but saline water as unique source of irrigation from germination to flowering. The first part on the germination process aimed at elucidating the salt level leading to high germination percentage and healthy seedling establishment; the second one at elucidating any salt level impact on the following parameters at seedling stage till flowering: plant height, number of green leaves, percent of yellow leaves, leaf area and dry matter of leaves, stems, shoots and roots. Varieties V3 (Arta/3/Hml), V6 (WI2737/4/A) and V7 (Melusine/a) were superior and best adapted to produce at medium salinity level (8 dS/m).

Keywords: barley varieties, germination, seedling, salinity.

315. KAF ALGHAZAL Rouba (Syria)

Supervisors: A. Hamdy and G. Mimiola

Title: Green salad production in soilless culture and traditional technique under saline irrigation practice. – 108 p.

Abstract: This work was conducted in greenhouse and in open field at MAI-BARI on yield and quality of lettuce (winter variety) and endive (spring variety). Three cropping techniques were used: Soilless culture with perlite, gravel and pozzolane and saline irrigation of EC 4 to 4.5 dS/m, protected traditional cultivation in soil and two water types (EC 1.1 and 4 dS/m), and traditional open field technique with fresh water. Saline water up to 4 dS/m could be used safely. Winter variety yield is superior to the spring one. The traditional fresh water cultivation gave the best yield. At the end of the cropping period, EC values of the investigated substrates in soilless culture were relatively similar to the initial ones. Whereas, under traditional cultivation technique, salts accumulation was of relatively high value with EC of 4.5 dS/m and a greater value of 5.3 dS/m by the end of the growing season.

Keywords: lettuce, endive, soilless culture, soil medium, open field, salinity, yield.

L&W - A.Y. 2003-2004 (June session) – 330- 338

330. ALY Adel Z. S. (Egypt)

Supervisors: A. Hamdy and A. Gadalla

Title: Sugar beet production and nitrogen fertilizer efficiency under different irrigation regimes with saline water, using ^{15}N tracer technique. - 145 p.

Abstract: The experiment included two major parts: the first was on seed germination and seedlings establishment, and the second was a biological trial germination and seedlings establishment, and the second was a biological trial leading to the final production. The germination stage is very sensitive to the salinity level; soaking seeds in the investigated saline water 12 hours before seeding resulted in an appreciable increase in the number of germinated seeds even with relatively high salinity level (12 dS/m), and in an improvement of the seedling establishment. The gradual increments in the salinity level of irrigation water resulted in a gradual reduction in root fresh weight, but led to gradual increments in the sugar content percentages. Concerning the nitrogen fertilization, the data of ^{15}N analysis show that splitting the nitrogen and its distribution through the cropping cycle did not significantly affect the sugar beet growth parameters. Most nitrogen was derived from the applied nitrogen fertilizer with minimum supply from the soil.

Keywords: salt concentration, fertilizer use efficiency, ^{15}N tracer technique, sugar beet, saline irrigation, irrigation regimes.

331. DACCACHE André (Lebanon)

Supervisors: N. Lamaddalena and U. Fratino

Title: Hydraulic interface between distribution network and on-farm irrigation system. - 100 p.

Abstract: The distribution network has been analyzed using the AKLA model so as to identify the relative pressure deficit of the hydrant under study. In this work the characteristic curves of the network and of the hydrant have been combined for identifying the working pressure and discharge of the system. According to the sprinkler characteristics and spacing, the network has been evaluated using uniformity and efficiency parameters. Graphical analysis using the GIS environment allows the identification of the failure areas in space and time. Lastly, such model could be used for design purposes since it reflects all the hydraulic variations in the water distribution uniformity. It could also be used for evaluating the existing networks under different working conditions, and for irrigation management (time and volume) order to improve the water application efficiency.

Keywords: hydrant pressure, characteristic curve, working parameters, distribution efficiency, graphical analysis.

332. CHALLITA Charble (Lebanon)

Supervisors : N. Katerji and A. Hamdy

Title: Effet de la salinité sur le fonctionnement hydrique et la productivité de deux variétés d'orge. - 62 p.

Abstract: In the case of irrigation with fresh water, the ISABON03 variety shows a higher growth in leaves and tillers. The final grain and straw yields and the water use efficiency in this variety are significantly higher. The ability of the ISABON03 variety to develop ears containing a high number of seeds as compared to the S.Pare03 variety is at the origin of the performance observed in this variety. On saline soils, the two varieties experienced more or less the same yield reduction thus showing a similar salt tolerance. The observations made on both varieties in relation to the pre-dawn leaf water potential, stomatal conductance and osmotic potential confirm this assumption. All observations lead to consider the ISABON03 variety more suitable for salinity conditions than the S.Pare03 variety. On saline soils, the two varieties experienced more or less the same yield reduction thus showing a similar salt tolerance. The observations made on both varieties in relation to the pre-dawn leaf water potential, stomatal conductance and osmotic potential confirm this assumption. All observations lead to consider the ISABON03 variety more suitable for salinity conditions than the S.Pare03 variety.

Keywords: barley, salinity, water use efficiency, production, evapotranspiration.

333. MAACAROUN Antoun (Lebanon)

Supervisors : J. W. van Hoorn and A. Hamdy

Title: Effet de la salinité de l'eau d'irrigation sur le sol, l'absorption de l'azote et le rendement de l'orge. - 61 p.

Abstract: Varieties of barley ISABON03 (A) and S.Pare03 (B) were grown in lysimètres and irrigated with water of different salinity, corresponding to 3.7, 15 and 30 meq Cl/l. Two methods were used to study the composition of soil water and the development of soil salinity : soil water sampling by porous cups and salt balance. The comparison between net nitrogen supply and nitrogen uptake by the plant shows that the latter is higher than the nitrogen supply in all treatments of variety A and in variety B irrigated with fresh water. On the contrary, saline treatments of variety B absorb smaller nitrogen amounts than the supply. Apparently, a part of the nitrogen stored in the soil from the previous year was mobilized to meet crop requirements. Salinity has a significant effect on grain and straw yield. Variety A is, however, more productive than B, this reaching about 50% of variety A yield. Water use of variety A is slightly higher than variety B because of a longer growing cycle. The result is a higher water efficiency, of the order of 2.7 kg/m³, in variety A.

Keywords: barley, water balance, salt balance, nitrogen balance, yield.

334. BENNANI Amina (Morocco)

Supervisors : A. Hamdy, R. Choukr-Allah and G. Mimiola

Title: Production sous serre de la fraise irriguée par l'eau saline en culture hors sol: comparaison avec la technique traditionnelle. - 149 p.

Abstract: The results have shown that soilless strawberry crop is very promising. One of the advantages inherent to the system is the chance of extending the calendar over two production cycles: autumn (150 days) and spring (90 days). Moreover, it is more advantageous to cultivate during the autumn cycle (off-season) due to a higher price of sale. The sustainability of the system and its cost-effectiveness are however related to several factors, in particular the choice of the media, the management of the nutrient solution and a more detailed nutrition control. The collected drainage water can equally be used for irrigating other crops or adopting a closed system allowing recycling it, nevertheless the work should be continued to optimise nutrient solutions.

Keywords: strawberry variety, soilless culture, traditional technique, salinity, autumn cycle, perlite, gravel, pozzolana, production.

335. KNEZEVIC Mirko (Montenegro)

Supervisors: M. Todorovic and A. Hamdy

Title: Use of GIS and modelling for selection of appropriate crops under different soil, climatic and hydrological conditions : the case study of Bjelopavlicka plain in Montenegro. - 83 p.

Abstract: Three possible cropping patterns are investigated: field crops, horticultural crops and tree crops. Climatic conditions are related to the probability of occurrence of precipitation of 20%, 50% and 80% corresponding to wet, normal and dry year, respectively, while the soil conditions are considered by means of six soil types presented in the study area. Hydrological conditions are investigated by means of monthly discharges of Zeta river, whereas the management conditions are related to the rainfed and irrigated agricultural practices (with and without drainage system). The estimation of crop water requirements and relative yield was performed on a daily basis by using the soil water balance model, while the presentation of results over the whole study area and estimate of gross water requirements were carried out in GIS environment.

Keywords: soil water balance modelling, crop water requirements, rainfed vs. Irrigated agriculture, GIS, Montenegro.

336. BARAKAT Ashraf (Palestine)

Supervisors: J. A. Sagardoy and N. Lamaddalena

Title: Developing monitoring and evaluation systems for Water Users Organizations. The case study of District 4 « Sinistra-Ofanto » irrigation system (Consorzio per la Bonifica della Capitanata). - 139 p.

Abstract: The main objective of this thesis is to develop a framework to monitor and evaluate the management performance of WUOs. For this purpose, a set of indicators has been developed to assess the operation, maintenance, finance, technical assistance, management and environmental activities of WUOs. Such system should improve the management capacity of WUOs and contribute to the

development of better decision-making processes. The results show that this tool has a high potential to improve the operation, maintenance and financial management of the irrigation system.

Keywords: Water users organization, irrigation systems, monitoring, evaluation, management performance, benchmarking, indicators, operation, maintenance, finance.

337. AL-NATSHEH Basel (Palestine)

Supervisors: A. Hamdy and N. Katerji

Title: Salt tolerance degree of lentil (*Lens culinaris* Medic) varieties at the critical growth stages. - 153 p.

Abstract: The experience was carried on five lentil varieties (*Lens culinaris* Medic) supplied by ICARDA, and included two major experimental trials. The first was intended to investigate the influence of irrigation with saline water (with EC values lying between 1 dS/m . fresh water . and 12 dS/m) on the germination percentage, germination time, and the development of seedlings focusing on the beneficial effects of conducting germination using fresh water rather than the investigated saline water at such sensitive growth stages. The second trial focused on the evaluation of the vegetative growth and its changes as a function of the variables of lentil variety, irrigation salinity level and soil texture variation. All experimental findings indicate that to prevent any germination risk, it is recommended to use fresh water at seed germination. Varieties V1 (ILL4400), followed by V2 (ILL5582) and V4 (ILL5883) are the most tolerant and can produce till a medium salinity level (6 dS/m) in the investigated growth.

Keywords: lentil varieties, germination, seedling, salinity.

338. SELLAMI M. Houssemeddine (Tunisia)

Supervisors : A. Hamdy and N. Katerji

Title: Etude comparative de la croissance et du rendement de cinq variétés de lentille (*Lens culinaris*) en relation avec la salinité du sol : les conséquences sur la gestion des eaux salées. - 76 p.

Abstract: The two classification criteria adopted in our study are agronomic yield and water efficiency. The second criteria is to minimize saline water supply to reduce environmental pollution as much as possible. The resulting classification highlights a tolerant variety (the variety ILL 4400) and a sensitive variety 8variety ILL 8006). Varieties ILL 5883, ILL 5582 and ILL 5845 are intermediate between the two previous groups. The application of the alternation technique at the sensitive growth stages didn't affect yield and water efficiency, except in the case of the treatment with 6 dS/m where a slight improvement in water efficiency was observed. The previous conclusions are certainly of interest of the specialists concerned with saline water management.

Keywords: lentil, salinity, alternation, water efficiency, yield, tolerance.

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354. RAHMAN Alaa Ibrahim Abdel (Egypt)

Not available

Title: Tomato production under protected agriculture using saline water: soil less versus traditional technique

355. HUSSIAN Mohamed Helmy Radi (Egypt)

Not available

Title: Effect of agriculture drainage water resuse on soil and plant

356. KHATER Shaimaa Abdel Maniem Awad (Egypt)

Supervisors: T. A. Tawfic and A. Hamdy

Title: Effect of in-stream wetland on drainage water quality. Case study in Egypt.

Drainage water is now considered as a main additional source for irrigation. However, its quality is degraded and shows relatively high concentration values of trace elements, due to the direct or indirect discharge of domestic wastewater. This research work was conducted to evaluate the in-stream wetland technique using different wetland species as a tool for reducing the pollution sources, particularly the trace elements. Results from pilot in-stream treatment system testing demonstrate that passive wetland water treatment technology can be applied to effectively improve drain water. Water quality monitoring demonstrated that passive in-stream wetland drain water treatment systems effectively and consistently reduced the load of pollutants. Data sets from Faraa AI Bahow drain sites show not only a significantly reduced variability of effluent water quality data but also improved quality of the effluent bringing it within the discharge limits of Law 48 under highly varied flow conditions. In the case of the sediment, the maximum level of heavy metals concentration (Cu, Fe and Ni) reached the highest values upstream the drain. As for the plant species in the two studied groups, the most efficient plants in accumulating heavy metals are: *Eichhornia crassipes* (floating plant), *Canna indica* and *Cyperus alopecuroides* (emergent plant) with major accumulation in the roots with respect to the vegetative part.

Keywords: natural wetland, water quality, drainage water, natural treatment, heavy metals.

357. BENDAHMANE Mohamed (Morocco)

Supervisors: R. Choukr-Allah and A. Hamdy

Title: Irrigation d'une culture de pomme de terre en plein champ par alternance des eaux usées traitées et des eaux de puits fertilisées. Effets sur la croissance, le rendement, les aspects physiologiques de la plante et le sol. - 93 p.

Abstract: A field test was carried out to test the effect of irrigation by alternation of treated wastewater and fertilized well water on a potato crop through four growth stages. This resulted in the determination of the best combination enabling the maximum yield while ensuring a minimal effect on the environment and a saving of good quality water. The yield, nitrogen use efficiency and dry matter allocation towards the tubers favoured the treatments receiving fertilized water at tuber

initiation. All treatments contributed to the increase in the electrical conductivity and soil pH and to the reduction in the SAR. The monitoring of the concentrations of soil nutrients revealed an increase in nitrates, ammonium, sodium, magnesium and calcium, and an impoverishment in phosphorus and potassium. Photosynthesis and transpiration knew a reduction during the cycle for all treatments, whereas the leaf osmotic potential experienced a gradual increase.

Keywords: treated wastewater, potato, agro-physiological parameters, soil properties, irrigation, water consumption, radiation use efficiency, nitrogen use efficiency.

358. EL YUSFI Fatima (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Effet de l'irrigation par alternance d'eau usée épurée et eau de puits fertilisée sur une culture de courgette : réponses agronomiques et physiologiques. - 97 p.

Abstract: Four irrigation treatments were adopted: T1 (control) treated wastewater was used at all growth stages. The fertilised well water was introduced at different growth stages for the other treatments: T2 at the second growth stage from the first flowering until the first harvesting, T3 at the third growth stage from the first harvesting to the 12th harvesting and the T4 at the second and third Zucchini growth stages. Higher yield is obtained for the treatment receiving the good quality water at the third growth stage (T4 e T3), the increase in yield was respectively 27,5 and 37% compared to the control treatment. All treatments showed a decrease in nitrogen content of the soil; a decrease in phosphorus and potassium content was observed for the treatments T2 and T4. Treatment T2 presents the lowest nitrate content in drainage water, equal to 95 mg/l.

Keywords: zucchini, alternation, treated wastewater, well water, water consumption, growth, yield, photosynthesis, transpiration, osmotic potential.

359. YILDIZ Mehmet Fatih (Turkey)

Supervisors: O. Tekinel and N. Lamaddalena

Title: Management, operation and maintenance of large scale distribution systems in the GAP Region (Southeastern Anatolia Project). - 48 p.

Abstract: This study was carried out to evaluate the performance of the Water User Associations (WUA) in Harran Plain as compared to the management and operation of the irrigation systems run by the State before 1995. The results show that the WUAs have achieved better results than the state in the management of irrigation systems. The WUAs have shown higher values for most performance indicators such as the collection rate of water fees, irrigation ratio, budget allocation for maintenance and staff expenditures, farmers' satisfaction, etc. Although the WUAs demonstrate a good ability of managing the systems, some important problems need to be solved such as the chairmanship election system, transparency, farmers' participation in decision-making process, etc. The model proposed by Southeastern Anatolia Project Regional Development Administration (GAP RDA) could be followed during the establishment and afterwards to ensure the farmers' participation, which is essential for the sustainability of irrigation systems.

Keywords: Water User Associations, participation, irrigation management transfer, sustainability.

360. UZUN Özlen (Turkey)

Supervisors: A. Yazar and A. Hamdy

Title: Evaluation of SALTMED Model using field data of Turkey. - 43 p.

Abstract: Simulated yields of corn from the SALTMED model were compared with experimentally measured yields obtained from the experiment, in which irrigation water with electrical conductivities (ECs) of 0.5, 3.0, 6.0, 9.0 and 12.0 dS/m and irrigation intervals 7 day was used. The simulated and observed corn grain yields were significantly different in all treatments except the treatment irrigated with fresh water. The simulated and observed yield values for the treatment irrigated with fresh water were in close agreement. The model predicted a yield value of 9.5 t/ha while the observed yield was 8.89 t/ha. The model predicted lower yields as the salinity level of irrigation water increased. In conclusion, the agreement between the simulated and measured results on crop yield and soil salinity values strongly suggest that the model should be calibrated for field crops under the Mediterranean climatic conditions. Reliable input data, however, are also required.

Keywords: saline water, model, water management, integrated generic approach.

361. GUELLOUBI Raouf (Tunisia)

Supervisors: A. Hamdy and V. Sardo

Title: Maize production under supplemental irrigation with saline water in rainfed agriculture. - 61 p.

Abstract: This work has involved two experiments: in the first, maize response (two varieties) to eight salinity levels under two soil types and three treatments. Results showed stem dry matter and rooting depth as the only difference between the two varieties; irrigation water salinity increase affected negatively all parameters, except germination percentage till water salinity of 10dS/m; trend more evident in sandy-loam soil. Soaking seeds did not improve the germination rate, accelerated the seedling emergence; treatment B (first irrigation with freshwater) improved germination percentage and seedling tolerance to salinity. In the second, deficit irrigation proved to be a non viable option under the specific experimental conditions; with supplemental irrigation it resulted that fresh water could be replaced by saline water till EC values of 3 dS/m without any yield loss; in short it seems reasonable to propose the integration of the practice of supplemental irrigation with the use of brackish water.

Keywords: maize, soil type, saline water, seedling establishment, deficit irrigation, supplemental irrigation.

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369. Al-KHALDI Abdul Ghani (Syria)

Supervisors: A. Hamdy and T. Oweis

Title: Response of selected wheat varieties to different levels of supplementary sprinkler irrigation

Abstract: This work has involved two experiments conducted in a green house of the Mediterranean Agronomic Institute of Bari: the former concerned the response

of two maize varieties in two soils (sandy-loam and sandy-clay), eight salinity levels (FW, 2, 4, 6, 8, 10, 12 and 15 dS/m) and three treatments at seedling time (A = control, B = application of fresh water at the first watering and C = soaking seeds); the latter continued till the end of maize life cycle and involved the application of saline water for supplemental irrigation, combined with deficit irrigation. In the first experiment, results did not show any difference between the two varieties except for stem dry matter and rooting depth; the increase in irrigation water salinity affected negatively all parameters, except the germination percentage; this trend was more evident in the sandy-loam soil. Soaking seeds did not improve the germination rate; it accelerated the seedling emergence and, above the water salinity level corresponding to 10 dS/m, it reduced the germination percentage. Treatment B improved the germination percentage and the seedling tolerance to salinity. In the second experiment involving the fresh water treatments, deficit irrigation proved to be a non viable option under the specific experimental conditions; with supplemental irrigation it resulted that fresh water could be replaced by saline water till EC values of 3 dS/m without any yield loss; in short it seems reasonable to propose the integration of the practice of supplemental irrigation with the use of brackish water.

Keywords: maize, soil type, saline water, seedling establishment, deficit irrigation, supplemental irrigation.

L&W - A.Y. 2004-2005 (October session) – 370-389

370. JANUSHAJ Alban (Albania)

Supervisors: A. Hamdy and V. Sardo ; co-supervisor: F. Z. Lahmer

Title: Investigation on soil erosion: evaluation of the protective action of Vetiver grass hedges. – 160 p.

Abstract: A research was conducted to assess the potential of Vetiver grass in protecting soils against runoff and erosion in the area of Bari, Southern Italy. Eight plots of m 3 x 1 in size with slopes of 5%, 10%, 15%, 20%, alternatively protected downhill by Vetiver grass hedges, were equipped with a rain simulator. The generally recommended protocol was adopted with one dry run followed by a wet and a very wet run, for a total of 81 runs; only data referring to the 27 very wet runs were elaborated. Results showed the paramount influence of kinetic energy and precipitation intensity on runoff and solid transport. The presence of Vetiver grass reduced runoff to 1/5 - 1/8 and solid transport to 1/3 . 1/10 compared to unprotected plots. A number of empirical models were elaborated through the multiple regression analysis, which permitted to get better insight into the complex inter-relationships of the variables.

Keywords: soil erosion, vetiver grass, rain simulators, surface runoff, kinetic energy.

371. CHERFOUH Rabia (Algeria)

Supervisors: N. Katerji and A. Hamdy

Title: Effet de la salinité sur le développement, le fonctionnement hydrique et la productivité de deux variétés de blé tendre. - 85 p.

Abstract: This study is part of a research project on the varietal tolerance with salinity of soil jointly managed by MAIB-Italy, INRA-France and ICARDA-Syria. Two experiences were carried out on the common wheat (*Triticum aestivum*). The study of germination showed that the Cham-8 variety is more salt tolerant than Sakha-8. The second on a lysimètre set-up is aimed at analysing the effect of soil salinity on water status, the growth, the productivity and water efficiency of these varieties, considered by the preliminary observations of ICARDA, as respectively tolerant and sensitive to salinity. The lysimeter experience shows that under no-saline conditions, these varieties present the same water behaviour and biomass. In saline soil these varieties reduce their yields to the same extent. The reason of this reduction is in both cases related to the number of ears per seedling. The observed results indicate that the tolerance of these varieties is similar.

Keywords: common wheat, salinity, germination, water behaviour, yield, water efficiency.

372. LUKAJIC Sretenka (Bosnia and Herzegovina)

Supervisors: A. Hamdy and G. Mimiola

Title: Cauliflower and melon production under the soilless and traditional technique using different water qualities. – 126 p.

Abstract: This work was conducted in the greenhouse of IAMB to evaluate the variation in the growing parameters and the yield production of cauliflower (winter crop) and melon (spring crop) using both soilless culture and traditional soil cultivation technique. The presented data indicate that for cauliflower crop using inert substrates as growing media is more advantageous than the traditional soil cultivation, not only in increasing the crop production but also equally in the cropping period as well as improving the quality. This also holds true for the melon under irrigation with water of 4 dS/m. Under soilless technique there is a high potentiality of using saline water for irrigation avoiding most of the problems. Characterizing the use of such water in soils concerning not only losses in the crop production, but also the deterioration in the physical and chemical properties.

Keywords: soilless culture, melon, cauliflower, saline water, nutritive solution.

373. ABD EL AZIM Khaled Gaber Ahmed (Egypt)

Supervisors: J. W. Van Hoorn and A. Hamdy

Title: Effect of saline irrigation water on germination percentage, soil salinity, nitrogen uptake, water consumption and yield of bread wheat. – 116 p.

Abstract: The study consisted of two parts: a germination experiment and a lysimeter experiment. The germination experiment, carried out in pots with 7 wheat varieties of bread wheat provided by ICARDA, showed that water of 3 dS/m could be used for all varieties, but water of 6 dS/m could be used only for two varieties and water of 9 dS/m was unsuitable. In the lysimeter experiment two methods were used for determining soil salinity : soil water sampling and salt balance. Salinity affected water consumption and yield of both varieties. Moreover, a difference in water consumption appeared between the varieties, corresponding to a difference in leaf area. No difference appeared between the salt tolerance of both varieties in contrast to the information from ICARDA.

Keywords: wheat, germination percentage, salt balance, soil water sampling, saline irrigation, nitrogen uptake, chloride, yield.

374. SALAMA Mohamed Abdelaal Ahmed (Egypt)

Supervisors: A. Hamdy and A. M. Gaddalla

Title: Response of potato growth, yield and nutrients to saline water and organic conditioning using ¹⁵N-Tracer techniques. – 209 p.

Abstract: The experiment was carried out under the controlled greenhouse conditions at the MAIBari, Italy, and included two major parts; the first was on seed germination, and the second was a biological trial leading to the final production. It seems that the tubers of both varieties germinated on clay soil could combat the depressive effect of water salinity and kept higher germination even at the higher water salinity level (10 dS/m). Concerning the nitrogen fertilization, data of ¹⁵N analysis show that water salinity levels combined with organic addition rates affected the nitrogen derived from fertilizer and hence the fertilizer use efficiency. Most nitrogen was derived from the applied nitrogen fertilizer with the greatest accumulation in tuber rather than in shoots or roots of both potato varieties.

Keywords: germination, salt concentration, fertilizer use efficiency, ¹⁵N tracer technique, potato, saline irrigation, organic addition rates.

375. KHALAFALLA Hamdy Mahmoud (Egypt)

Supervisors: M. Abd El Motaleb and A. Hamdy

Title: The impacts of drainage water reuse on soil and crop characteristics. – 108 p.

Abstract: This work was conducted in Maruit Experimental Station of the Water Management Research Institute (WMRI, Delta Barrage, Egypt) to evaluate the response of three crops (clover, wheat and potato) to irrigation with drainage water. The three crops were grown both in the pot and in the field using two types of water quality: canal water with an EC between 1 and 2 dS/m and drainage water with an EC ranging from 5 to 6 dS/m. The results of this work indicated that drainage water up to 5 dS/m could be used safely and successfully without any deterioration in the yield production of clover, wheat and potato. Experimental data show that comparing the yield production, plant growth parameters, germination, heavy metals and soil properties under low water quality, the best results were obtained with canal water. The sustainability of drainage water reuse is related to several factors, notably the choice of suitable crops, the soil type and the management of this technique.

Keywords: wheat, clover, potato, drainage water reuse, pot culture, yield, soil properties, heavy metals.

376. ABD EL AAL Ayman Gaber Abd El Rahman (Egypt)

Supervisors: T. Tawfic and A. Hamdy

Title: Salinity measurements in newly reclaimed soils using electromagnetic-induction technique. – 104 p.

Abstract: This research presents the use of the electromagnetic induction by the EM-38 to measure the soil salinity. The EM-38 device is used to measure soil salinity in the three pilot areas at South El- Husseinia. A number of readings were taken in the three pilot areas. Samples were collected and sent to the laboratory for the salinity measurement. The EC_{sube} values were done on saturated soil paste extracts. Different correlations were developed between the laboratory data and EM38 readings. Four models were tested and the correlation between lab soil salinity and the EM38 readings was presented.

Keywords: em-38, soil salinity, newly reclaimed land.

377. ZEDAN Abdl-Tawab Metwally Ibrahim (Egypt)

Supervisors: A. Hamdy and A. N. M. Gadalla

Title: Study of soil moisture and chemical fertilizers distribution under drip irrigation system by using the neutron scattering meter. – 145 p.

Abstract: Three of applied irrigation rate (100, 75 and 50%ETc) and five sites (0,12.5 and 25-cm distances from emitter along emitter line, 12.5 and 25-cm distances from emitter between laterals) were used to measure the soil moisture content and salt distribution (horizontal direction and vertical within the soil depths). The best location for installing the neutron access tube, which represented the whole wet area was at 12.5 site between laterals (12.5- cm distance from the emitter). Salt accumulation was noticed at the surface layer and the salt concentration was affected by direction of soil water movement (horizontal and vertical motion). The highest salt concentration was at 75 and 50 % ETc treatments between emitters and laterals. As for the squash yield, the first treatment produced high yield but there is no significant differences between yield of the second treatment, so, 75%ETc treatment is considered the best one for saving water.

Keywords: neutron scattering meter, drip irrigation, squash, soil moisture distribution, salt tolerance, water use efficiency.

378. ABI SAAB Marie Thérèse (Lebanon)

Supervisors: A. Hamdy and G. Mimiola

Title: Comparison study on yield production in winter and spring crops under soilless culture and traditional technique. – 137 p.

Abstract: In the Mediterranean region, soilless culture technique and the use of non-conventional water resources can be adapted as a strategy to guaranty food security if an integrated management is done. This work was conducted in IAMB, where, for the first time, broccoli was grown under soilless culture irrigated with fresh water. It was also grown in greenhouse soil (fresh water and 4 dS/m treatments) and in open field. Also, the greenhouse season was completed by planting tomato under soilless and traditional technique using 4dS/m water. Results showed that soilless culture could be valid for broccoli where the production was higher than in traditional technique. In protected soil, salinity up to 4dS/m could be used safely. The lowest yield was obtained in the open field. Tomato crop was grown successfully in soilless culture technique with higher yield and better fruit quality in comparing with the traditional technique.

Keywords: soilless culture, nutrient solution, salinity, broccoli, tomato.

379. JANHO Rima (Lebanon)

Supervisors : A. Hamdy and M. El Moujabber

Title: Initiation d'un outil pour l'aide à la décision en cultures sous serre au Liban. – 79 p.

Abstract: The Lebanese farmers have adopted the greenhouse crops because they insure a high productivity and an important added value for their products. The major problem is in the commercialization aggravated by the competition with the neighboring countries. The objective of this study is the concept of a tool for the

help in crop making decisions. Three crops were used, spring tomato, autumn and spring cucumber all in Lebanon. Development and growth measures were done. Water salinity and soil texture effect were studied. The importance of the temperature and radiation in the development is shown by the positive and significant correlations between these factors and the factors of development (number of nodes, fruits, weight). The accomplished work will help in making a system of representation of crop rotations which permits to estimate the harvest dates, the yield and water consumption.

Keywords: protected agriculture, decision-making, harvest date, temperature, radiation, crop development.

380. AMRANI Imane (Morocco)

Supervisors: A. Hamdy and A. Bamouh

Title: Effet de la salinité de l'eau d'irrigation sur la germination, la croissance et le rendement de la fève et du pois chiche. – 126 p.

Abstract: This study is aimed at assessing the impact of irrigation with saline water on the germination, growth and yield of broad bean and chick pea. Using a full randomisation design in the greenhouse, the test measured the degree of tolerance of two broad bean and chick pea varieties irrigated with increasing doses of NaCl. Salinity reduced growth parameters, especially the height, leaf area, total dry matter. Similarly the yield of the two broad bean and chick pea varieties was reduced when using saline irrigation water, particularly in chick pea. The leaf osmotic potential at full turgidity of broad bean was not affected by salinity ; this reveals the absence of osmotic adjustment. The chick pea seems to tolerate salinity at germination more than broad bean.

Keywords: salt tolerance, broad bean, chick pea, germination growth, yield, water status.

381. EL HAM Abdelkrim (Morocco)

Supervisors: R. Choukr-Allah and A. Hamdy

Title: Effet de l'irrigation par les eaux usées épurées et les eaux de puits fertilisées sur la production d'une culture de melon conduite sur trois substrats. Bilan minéral et cinétique d'absorption des éléments nutritifs. – 72 p.

Abstract: This work was carried out in the greenhouse of IAV of Agadir to evaluate mineral nutrition and yield of a melon crop GAL 52 variety grown on three substrates (sand, perlite + coconut fiber and blond peat + perlite) and irrigated with treated waste waters and fertilized well waters. Treated wastewaters allowed getting nitrogen fertilizers, and sand favored good absorption of mineral elements. Sand showed high electrical conductivity and this explains the high sugar content of plants grown on this substrate, equally so, it showed the lowest percentage of drained mineral elements that didn't exceed 19%. Melon plants grown on sand gave the highest yield, i.e. 1.8 kg/plant against 1.6 kg/plant on coconut + perlite and 1.5 kg/plant on blond peat + perlite.

Keywords: waste waters, substrates, yield, soilless, melon, temperature, sand, blond peat, coconut fiber, perlite, mineral absorption, electrical conductivity.

382. HAMAOUI Addi (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: L'effet de trois substrats sur une culture de melon irriguée par les eaux usées épurées et par les eaux de puits fertilisées sous abris serre. – 95 p.

Abstract: The impact of three substrates (sand, coconut fibre + perlite and blonde peat + perlite) on a melon crop variety Gal 52, irrigated by treated wastewater and fertilised well water in the greenhouse has been studied at the IAV Hassan II in Agadir. The objective of this study is to determine the water consumptive use and to establish the water balance and its relation with melon growth and development. The substrates have definitely influenced the plant growth rate, leaf area and photosynthesis rate in favour of sand. The water consumptive use was 87 for sand, 83 for coconut fibre + perlite and 80 l/plt for peat + perlite. Sand showed the highest water use efficiency that peaked 19.7g/l. In conclusion, sand shows both technical and economic advantages as soilless substrate.

Keywords: melon, substrate, wastewater, well water, water balance, leaf area, photosynthesis, efficiency, soilless culture.

383. ZIVOTIC Ljubomir (Serbia and Montenegro)

Supervisors: M. Todorovic, R. Albrizio and A. Hamdy

Title: Deficit irrigation of sunflower under Mediterranean environmental conditions: on-field experiment and modelling application. – 127 p.

Abstract: This work aims at: (i) analysing crop response of sunflower to several irrigation water regimes; (ii) evaluating the suitability of sunflower to deficit irrigation strategies; (iii) investigating the applicability of CropSyst and WOFOST models in simulation of sunflower growth. A field experiment on hybrid Sanbro_MR was carried out at Valenzano (Bari, Italy). The experiment includes five irrigation regimes: optimal water supply, application of 100% of water requirements up to flowering and 70% thereafter, application of 70% of water requirements through the whole season, application of 70% of water requirements up to flowering and rainfed conditions thereafter, and rainfed conditions during the whole season. Measurements comprise leaf area index, radiation interception, biomass and yield. The overall results indicate deficit irrigation as an acceptable strategy for sunflower highlighting the importance of irrigation between flowering and maturity. Crop growth models provide similar results emphasising the necessity for re-calibration when deficit irrigation strategies are modelled.

Keywords: sunflower, deficit irrigation, water use efficiency, radiation use efficiency, CropSyst, WOFOST, crop growth modelling.

384. ABUAYASH Aly (Palestine)

Supervisors: N. Katerji and A. Hamdy

Title: Bread wheat production under water stress and saline irrigation practices. – 129 p.

Abstract: This study is aimed at analyzing the response of seven winter bread wheat varieties selected by ICARDA to two types of water stress caused by saline irrigation water and its association with soil dryness, and then classifying the investigated varieties according to their tolerance to the imposed water stress. It was carried out on pot-grown crops in the greenhouse of MAI-Bari. The investigated parameters concern growth (height, leaf area, dry matter), reproductive organs appearance, yield and yield components, as well as the environmental balances (water and salt yield components, as well as the environmental balances (water and salt balance in the soil). For each of the

investigated biological parameters, varieties were classified under the two imposed water stress conditions. The classification of the cultivated varieties under saline water stress versus grain yield and water use efficiency gave consistent results.

Keywords: salinity, soil dryness, water stress, cereals, salt balance, water balance.

385. SIHEM Helali (Tunisia)

Supervisor: A. Petrillo ; *co-supervisors:* N. Lamaddalena and F. Lebdi

Title: Experimental study on open channel flow in the presence of submerged vegetation, with special focus on flexible vegetation. – 84 p.

Abstract: Over the last few years, the understanding of the impact of vegetation on flow conditions has become important in river restoration, and better knowledge on the impact of plants on flow conditions is needed. Laboratory experiments were carried out on unvegetated and vegetated channels. The Acoustic-Doppler Velocimeter system was used to measure the three components of flow velocity. Profiles of velocity, turbulence intensity and Reynolds-stress were determined in vegetated and unvegetated open-channel flow. It was observed that the velocity profile shows an inflection near the top of the vegetated layer. The mean velocity in the vegetated region is considerably lower than that in the surface-flow layer above vegetation. On the contrary, the turbulence intensity and the Reynolds stresses are higher near the top of the vegetation. All the hydrodynamic flow characteristics analyzed show a local behavior, due to the low density that does not allow the channel to be studied under uniform flow.

Keywords: hydrodynamic, open-channel flow, vegetated channel, velocity profiles, turbulence distribution, vortex.

386. OUECHTATI Sami (Tunisia)

Supervisor: A. Petrillo ; co-supervisors : N. Lamaddalena and F. Lebdi

Title: Etude expérimentale d'un écoulement à surface libre en présence de végétation submergée et rigide en particulier. – 115 p.

Abstract: The effects of vegetation growing in rivers on flow hydrodynamic structures are not clarified yet, in spite of their importance for hydraulics and river engineering. For better understanding these effects, an experimental study of an open channel flow in the presence of artificial submerged vegetation was conducted in two horizontal rectangular channels. Velocity profiles and turbulence intensity as well as Reynolds-stress profiles were measured during several configurations differing in water depth, vegetation type and corresponding distribution density. It was found that vegetation caused a relatively considerable flow deceleration, accompanied by vortex generation downstream each stem. Turbulence intensity was characterized by high values in the vicinity of the vegetation stems, and by spatial anisotropy. The Reynolds stress had revealed a predominance inversion of its components, compared with the case of unvegetated channel. Finally, the variation in density had an impact in terms of interference of "iso-velocity" and "iso-intensities" contours.

Keywords: hydrodynamic, open channel flow, submerged vegetated channel, turbulence, vortices, shear stress, drag force.

387. NAZIHA Affi (Tunisia)

Supervisor: R. Choukr-Allah and A. Hamdy

Title: Impact de l'irrigation par les eaux usées épurées par lagunage aéré et les eaux de puits fertilisées sur une culture de haricot vert pratiquée en plein sol et sur substrat sableux. – 83 p.

Abstract: The trial consists in assessing the effects of irrigation using wastewater purified by aerated lagoons and fertilised well water on field and soilless-cultured French bean. The ultimate goal of this work is to determine the advantages of soilless culture and treated wastewater in terms of water and fertiliser saving, as well as their impacts on the environment and production. The yield, water and fertiliser use efficiency, growth and development parameters have all been in favour of soilless culture and fertilised well water. The soilless culture technique has resulted in a yield increase. Treated wastewater has caused a reduction of the above parameters, due to its high chlorine content. Soilless culture has resulted in a reduced drainage of nitrates, hence a less severe impact on the environment.

Keywords: treated wastewater, French bean, agronomic parameters, environment, irrigation water and fertiliser use efficiency.

388. BARUTÇU Fatih (Turkey)

Supervisor: N. Lamaddalena and U. Fratino

Title: Energy saving criteria for optimal design of a pumping station serving an on-demand irrigation system. – 93 p.

Abstract: A new approach combining new technologies and simulation tools to identify potential energy savings was set up and tested in a pilot on-demand irrigation system in order to reduce expenditures for electrical energy. The characteristic curves of the pumps were computed under field conditions. Demand curves of the irrigation network were determined with the Indexed Characteristic Curve model. Variable Speed Drive (VSD) was used to match pump characteristic curves and irrigation system demand curve. Discharge hydrographs were simulated for the irrigation season 2005. Energy consumptions of the variable speed pump operation were compared with classic pump operation. Total energy saving of 32.9% was achieved compared to constant speed pump operation. The average of 0.116 kilowatt-hours of energy was saved per unit cubic meter water pumped. All the results and economical analysis showed that the given methodology is efficient in terms of energy saving.

Keywords: energy saving, pumping cost, on-demand irrigation system, variable speed drive.

389. ALAGÖZ Burcu (Turkey)

Supervisor: M. Unlu and A. Hamdy

Title: Evaluation of water users' associations performance in the Aksu irrigation project area. – 87 p.

Abstract: This study was aimed at evaluating the performance criteria in AKSU irrigation scheme before and after the irrigation management transfer. The evaluation data concerned the period from 1998 to 2004 for the WUAs and for the performance criteria. Field surveys involved the assessment of irrigation groups' and irrigators' performance in operating and maintaining the schemes. For this purpose data were collected through individual interviews with farmers. The performance of many irrigation systems was dramatically low due to inadequate financial resources, poor design, construction, operation and maintenance. However, after irrigation management transfer many positive impacts have been realized in Turkey. The impacts of the performances were calculated in terms of irrigation costs, financial self-sufficiency of irrigation districts, quality of irrigation operations/maintenance and crop yields in water schemes.

Keywords: Water Users' Associations, performance evaluation, operation and maintenance, irrigation scheme.

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412. OMURI Alfred (Albania)

Supervisor: R. Albrizio ; co-supervisor: M. Todorovic

Title: Water use efficiency of barley grown under different water and nitrogen conditions. – 106 p.

Abstract: This work aims at: i) investigating water use efficiency of barley grown under different water and nitrogen regimes; ii) verifying the validity of deficit irrigation to improve water use efficiency; iii) analysing the interaction of water and nitrogen input. A field experiment on barley was carried out at Valenzano (Bari). The experiment includes three irrigation regimes (optimal water supply, application of 50% water requirements, rainfed conditions), two levels of nitrogen supply (0 and 50 kg ha⁻¹) and three replicates. The results were affected by the high seasonal precipitation regime (420 mm) that allowed a mild water stress only during grain milk maturity. The results showed that nitrogen affected crop growth, development and water use efficiency much more than water application. No significant differences emerged for biomass and yield under three water regimes and the same nitrogen level. This confirms the adaptability of barley to semi-arid climatic conditions.

Keywords: *Hordeum vulgare* L., water use efficiency, deficit irrigation, water stress, nitrogen shortage, yield.

413. KERRAD Fadhila (Algeria)

Supervisors : D. Saidi and A. Hamdy

Title: Etude expérimentale de l'influence d'un conditionneur organique sur la stabilité structurale des sols salés du Cheliff : conséquences sur la battance et l'érosion hydrique. – 55 p.

Abstract: Soil slacking and the sensitivity to degradation of cultivated soils are mainly due to the disaggregation of soil clods and the separation of particles under the action of rainfall and irrigation. The measure of structural stability should enable a rapid assessment of the sensitivity of Chéiff soils to soil slacking and water erosion. The method is suggested by Le Bissonnais, 1988 & 1995, who points out the disaggregation mechanisms that depend on the physico-chemical conditions of the water-soil interaction and on soil properties. Four soil types have been chosen with different salinity and sodicity levels. They all belong to the category of soils very unstable to unstable. The example of application of this method to the study of the effect of a PVA (PolyVinylAlcool) soil conditioner on the structural stability shows clearly its effectiveness in the soil structure preservation. The applied treatments make the Chéiff soils stable to very stable.

Keywords: degradation, soil slacking, structure, unstable, erosion, salinity, disaggregation.

414. KOUIDRI Mokhtaria (Algeria)

Supervisors : A. Douaoui and A. Hamdy

Title: Dégénération des couches de surface des sols du périmètre de Hmadna (plaine du bas-Chéliff) : salinité et état structural. – 76 p.

Abstract: The present work is aimed at studying the degradation in the HAMADNA plain (Bas-Chéliff plain) to better assess the interactions between the physico-chemical soil properties and the sensitivity of top layers to structural degradation. The results of laboratory and statistical analyses resulting from a systematic sampling on a plot extending over 1600 ha have shown that fine particles (clay and fine silt) favor soil salinisation and contribute to reduce permeability. The use of geostatistics in mapping has revealed four homogeneous areas in terms of degradation (salinisation and impermeability). The results of the second sampling and the high SAR values, closely related to a high salinity, are the main causes of the structural degradation that is reflected on the surface by severe crusting, especially in the most degraded zone.

Keywords: degradation, structure, crusting, salinity.

415. BARBARIC Miro (*Bosnia and Herzegovina*)

Supervisor: A. Hamdy ; *co-supervisor:* G. Mimiola

Title: Potential use of saline water in the production of some winter crops using soilless culture technique. – 118 p.

Abstract: This trial was conducted to evaluate the potentiality of using saline water in the production of some winter crops using soilless culture technique and compare our results with those of protected traditional cultivation technique using fresh and saline water (4 dS/m). Emphasis was given to the gravel substrate to improve its physical properties through mixing at different proportions with pozzolana and perlite giving a total of 7 substrates. The whole research was carried out using broccoli and cauliflower. The presented data indicate that under soilless culture technique there is a high potentiality of using saline water for irrigation since both for both crops yield was twice greater than that in traditional cultivation. Inert substrate prevents excess accumulation of salts, these being easily washed out, whereas the reverse is true in soil culture. Inert substrate and irrigation with saline water prevent most of the problems occurring in traditional cultivation technique, i.e. yield losses and soil productivity deterioration.

Keywords: gravel, substrates, soilless culture, traditional cultivation technique, salinity, saline water, fresh water, broccoli, cauliflower, nutritive solution, production.

416. FAHMY Ahmed El Sayed (*Egypt*)

Supervisors: A. El Naby Gadalla ; *co-supervisor:* A. Hamdy

Title: Soil water movement in sandy soil cultivated with Snap Bean under drip irrigation system using neutron scattering gauge. – 121 p.

Abstract: This work aimed at studying soil water movement under drip irrigation in sandy soil cultivated with snap bean. Neutron moisture meter was used to measure horizontal and vertical water movement using three irrigation regimes 100, 75 and 50% ETc. Data indicated that soil moisture distribution and values of total hydraulic potential depend on soil moisture contents. One single curve characterizing water movement for all sites and for the different soil depths is not recommended at all, as it could lead to misleading data due to the non-homogeneity of the neutron calibration curves with the variable soil depths. Moreover, water movement and water flow direction are greatly affected by root development and penetration in

the soil, which varied with the variation of the investigated water regimes. Concerning the different irrigation regimes, the 75% ET_c treatment gave a remarkable yield and pronounced water saving; therefore, it is technically and economically recommended.

Keywords: neutron moisture meter, water movement, irrigation regimes, Snap bean, water saving.

417. NASRALLA Noha (Egypt)

Supervisors: M. Abd El Motaleb and A. Hamdy

Title: Integrated water resources management: a case study for Northern – Eastern Sinai Peninsula in Egypt. – 95 p.

Abstract: Sinai Peninsula is considered one of the most important targets for development of the successive Egyptian governments. Water resources are the main issue for development and settlements or creation of new communities. Sinai Peninsula has three water resources components, rainwater and surface runoff, groundwater, and desalinated water. The aim of the research is to introduce a decision-support tool to support the decision makers in their decisions for solving the water resources problems and settling. The study area covers about 2,000 km² at the northeastern part of Sinai, where the estimation of the hydrographs of runoff was carried out beside those for various return periods (25, 50, and 100 years), using the WMS software. Technically speaking, many types of civil works were recommended to harvest the surface runoff, beside the socio-economic studies that recommended a great national project including further activities and provide better job opportunities to the Bedouins in the area.

Keywords: water resources management, decision-support system, communities settlements, socio-economic aspects, water harvesting.

418. MOHAMED Mostafa Abdel Aziz Ali (Egypt)

Supervisors: A. El Naby Gadalla and A. Hamdy

Title: Maize (*Zea mays* L.) production under saline irrigation practice and nitrogen fertilization using ¹⁵N tracer technique. – 115 p.

Abstract: This study aimed at investigating the effects of irrigation with saline water and nitrogen fertilization practices (rates and distribution frequencies) on maize production, using ¹⁵N tracer technique. Data indicated that germination stage is more tolerant to salinity level than the seedling one. The gradual increments in the irrigation salinity level up to 12 dS/m did not stop germination but delayed the mean time of germination. Oppositely, the seedlings showed higher reductions in their growing parameters even at low levels of water salinity (6-8 dS/m). ¹⁵N analysis data show that, nitrogen derived from fertilizer as well as that derived from soil, the nitrogen accumulation in the different plant components and the nitrogen use efficiency were affected not only by the N application rate and its distribution during the cropping cycle but equally by the salinity level of the irrigation water.

Keywords: germination, fertilizer use efficiency, ¹⁵N tracer technique, maize, saline irrigation, nitrogen rates, fertilizer distribution frequency.

419. AL SAYED MOHAMED Khaled Abdel Basset (Egypt)

Supervisor: J. W. van Hoorn ; co-supervisor: A. Hamdy

Title: Effect of saline irrigation water and drought on soil salinity, nitrogen uptake water consumption, and yield of durum wheat. – 127 p.

Abstract: Soil water sampling and salt balance were used for determining soil salinity. Soil water sampling underestimates soil salinity, as soil water is mainly extracted from large pores immediately after irrigation and does not correspond with average soil water. However, the ion concentrations obtained from soil water sampling can be corrected and compared with those of the salt balance. The comparison indicated precipitation of calcium, magnesium carbonate and sodium adsorption. Nitrogen concentration of soil water decreased with depth and with time. The same was observed for stems and leaves of the investigated durum wheat but not for the grains as it increased. The nitrogen balance showed lower plant uptake than the net nitrogen supply. Salinity affected significantly the yield of grain and straw above ECe threshold value of 5.8 dS/m. In addition drought resulted in further reduction with nearly equal values like salinity in both straw yield and grain production.

Keywords: durum wheat, salt balance, soil water sampling, saline irrigation, drought, nitrogen uptake, chloride, yield.

420. AYOUB Charbel (Lebanon)

Supervisor: N. Karterji

Title: Simulation de la réponse du maïs cultivé en région méditerranéenne dans des conditions hydriques contrastées aux changements climatiques. – 105 p.

Abstract: The objective of the present work is to analyse by simulation, using the STICS model, the consequences of the climate change expected during the years 2070 - 2099 on the behaviour of maize grown in southern Italy. The study is based on two climate scenarios (IPCC): pessimistic (A2) and optimistic (B2), and two water supply conditions: adequate and deficit. The period 1984-2004 has been taken as control to compare maize behaviour during the climate change. Maize grain yields would show a major drop as compared to the controls grown under the above water conditions. For the biomass yield this drop would be sharply lower. The reduction of the flowering-harvest phase would be the main cause of the grain yield reduction. The water consumption in maize would decrease, whereas agronomic and irrigation efficiencies would not be affected.

Keywords: climate change, climate scenarios, STICS, maize yields, water requirements.

421. EL CHAMI Daniel (Lebanon)

Supervisor: M. El Moujabber ; *co-supervisor:* A. Scardigno

Title: Use of regional water balance and economic assessment as a tool for water management in Lebanon. – 116 p.

Abstract: The Lebanese coast is highly subject to seawater intrusion and deterioration of its quality. The study is carried out in Jbeil Caza. 35 Km north of Beirut. Our objective is to investigate the seawater intrusion and estimate, in parallel, the water balance of the region to find out if any relation exists between the 2 factors, and the final objective is to estimate the economic value of that water for agricultural use. The monitoring results show that the coastal part of the region is slightly contaminated by seawater intrusion although the annual water balance calculated through GIS techniques is positive, which means that the region is rich in water. Seawater intrusion is due to the excess of pumping from the

aquifer. In the economic evaluation we adopted the contingent valuation method to estimate the willingness to pay of farmers to contribute to the improvement of groundwater quality. To know the WTP, 2 alternative scenarios were proposed and compared with the current situation. The farmers would contribute by 102 US\$.yr-1 for the first proposal and 166.67 US\$.yr-1 for the second.

Keyword: Lebanon, seawater intrusion, water balance, GIS, economic evaluation, contingent valuation method.

422. ABOUABDILLAH Aziz (Morocco)

Supervisors : N. Katerji and A. Hamdy

Title: La réponse de la variété de blé dur Cham-1 aux effets associés des stress hydriques et salins. – 89 p.

Abstract: The present study is framed in a research project associating MAI-Bari, INRA-France and ICARDA. The objective is to analyse the combined effect of salinity and drought on the water behaviour of durum wheat variety Cham-1 identified as tolerant to these two types of stress. Under salt stress, the saline treatments show a reduction in the cropping cycle and leaf area. Grain and straw yields are significantly affected when the soil salinity exceeds 5.8 dS/m. Water use efficiency for grain yield is higher under saline conditions. In salt stress associated with drought, the reductions in cropping cycle and leaf growth are much more severe. Lastly for the same soil salinity level the treatments submitted to drought show lower grain and straw yields than the treatments not submitted to drought. Under drought conditions, the grain and straw yield reduction coefficients show stable values in a wide range of soil water salinity.

Keywords: durum wheat, salinity, drought, water behaviour, yield, water efficiency.

423. ASSISSEL Nabil (Morocco)

Supervisors: R. Choukr-Allah and A. Hamdy

Title: Effet de deux substrats (sable et fibre de coco) sur le bilan hydrique et minéral de la courgette noire irriguée par les eaux usées épurées. - 104 p.

Abstract: This work is aimed to test the response of a courgette variety, irrigated by treated wastewater of 3dS/m, cultured by the soilless technique (sand, coconut fiber) and compared in the field and in the greenhouse. The objective is to determine the water and mineral balance, as well as the impact of the two substrates on the growth and production potentials under the effect of treated wastewater. The water consumption in the field exceeds 34% and 39.3% respectively for sand and coconut fiber. The total yield is respectively 38.7; 35.4; 32.4 t/ha for sand; field and coconut fiber. The maximum chlorine concentration on sand has been lower than 1 meq/l whereas in the field it reached 7.1 meq/l. The profitability rate is respectively 49.4%; 34.9%; 0% for sand; field and coconut fiber.

Keywords: courgette, substrate, wastewater, soilless, salinity, sand, coconut fiber.

424. ELOMARI Moulay Hicham (Morocco)

Supervisors : R. Choukr-Allah and A. Hamdy

Title: Comportement d'une culture de courgette sous serre irriguée par les eaux usées épurées et cultivée en hors sol sur du sable amendé : Effets des différents types et doses de matière organique. – 131 p.

Abstract: This work has been conducted in the greenhouse of the IAV in Agadir to test the effect of different types of organic matter (blond peat and coconut fibres) at different percent rates (10 and 20%) on a courgette crop variety «BLITZ F1» irrigated with treated wastewater and grown in the glasshouse and by soilless culture on sand substrate. The substrates have sharply affected the water and mineral consumptive use as they have shown different electrical conductivity and pH conditions. The courgette seedlings grown on sand +10% blond peat have shown the highest yield, i.e. 39.3 T/Ha as compared to 38.0 T/Ha for 100% sand, 37.7 T/Ha for sand +10% coconut, 35.6 T/Ha for sand +20% blond peat and 34.2 T/Ha for sand +20% coconut fibre. Sand conditioning with 10% blond peat shows some technical and economic benefits for courgette irrigated with treated wastewater.

Keywords: courgette, wastewater, substrates, yield, soilless culture, sand, blond peat, coconut fibres, mineral uptake, electrical conductivity, organic conditioning.

425. ABU-KHALAF Motasem (Palestine)

Supervisors : N. Lamaddalena ; co-supervisor: J. A. Sagardoy

Title: A comparative analysis between simulated and measured water deliveries at farm level in an irrigation district managed by the water users association. – 66 p.

Abstract: The purpose of this study is to estimate the crops water demand by using appropriate methodologies and to compare them with the values measured during an observation period. Therefore, the main objective of this study is to provide information, on one hand, on the soundness of the parameters usually used in calculations and, on the other hand, on farmers' behaviour in the use of water. A piece of software called Win-Genera was used to estimate the crop water demand, and an electronic device was used to measure the hydrants delivered volumes of water at farm level. The analysis was carried out in one of the irrigation districts of Sinistra Ofanto irrigation system. Our case study covers the year 2005. The results of the analysis gave adequate information about the system operation and farmers behaviours. Some solutions for improvement were suggested. Key words: Irrigation System, On-demand Operation, Estimated Crop Water Demand, Water Delivered, AquaCard, Water User Association.

Keywords: irrigation systems, on-demand operation, estimated crop water demand, water delivered, AquaCard, water user association.

426. DAYYOUNG Ammar Khaled (Syria)

Supervisor: A. Hamdy ; co-supervisor: N. Katerji

Title: Salt tolerance and drought resistance of durum wheat varieties. – 131 p.

Abstract: This work was conducted in the greenhouse of the Mediterranean Agronomic Institute of Bari, aiming to have further information on the response of different durum wheat varieties to saline irrigation practices (5 and 10dS/m) using different irrigation regimes (100%, 60% and 40% of ETc). Data indicate clearly that the resistance to salt and water stresses varies greatly due to the variation in

the studied wheat varieties. The findings show also that vegetative growth and grain yield can tolerate salinity up to 5ds/m, which could be raised up to 10ds/m resulting in 10% losses in grain yield. As a result, the apparent losses in the yield production under deficit irrigation using saline water are mostly attributed to the water stress. However, deficit irrigation with appropriate ETC percentage and irrigation salinity levels, is a win-win game as it provides good fresh water saving, acceptable yield besides maintaining the soil salinity relatively low.

Keywords: durum wheat, deficit irrigation, water saving, saline irrigation, wheat growing parameters, grain yield.

427. DAROUICH Hanaa (Syria)

Supervisors: L. S. Pereira and N. Lamaddalena ; *co-supervisor:* J. M. Gonçalves

Title: Surface irrigation for cotton and wheat at Ras El Ain: assessment and issues for improvement. – 50 p.

Abstract: Ras Al Ain irrigation district is located in the north of Syria, an area with serious problems of water scarcity and agriculture sustainability. The actual irrigation practices have very low application efficiency and high labour requirements. Farmers apply less than appropriate irrigation schedules, creating water losses and crop water stress. To contribute to improve irrigated agriculture, field experimentation and modelling were carried out. Field evaluation of furrow irrigation with different conditions and irrigation scheduling modelling proved that surface irrigation has a high water saving potential and allows farmer.s income to increase. The application of a decision-support system to build up and select improved solutions shows that, for cotton irrigation, furrow and border methods give the best results with the slope-length combinations of 0.5% - 50 m and 0.8% - 100 m, for flat area, or 150-200m, for sloping areas. For wheat irrigation, several options are feasible, being the level furrowed basin the best performing system for flat fields, but also the flat level basin is an acceptable solution, and the graded borders, with 0.5 and 0.8% slope, for sloping fields.

Keywords: Ras El Ain, irrigation schedule strategies, furrow irrigation, multicriteria analysis, decision-support system (DSS).

428. LUKIC Danijela (Serbia)

Supervisor: M. Todorovic ; *co-supervisor:* R. Albrizio

Title: Water use efficiency of wheat grown under different water and nitrogen conditions. – 116 p.

Abstract: A field experiment on local durum wheat variety Quadrato was carried out in Valenzano (Bari) to investigate water use efficiency (WUE) under different interactions of water (rainfed, 50% of full irrigation requirements and full irrigation) and nitrogen (0 and 120 kg/ha) regimes. Due to unusually high precipitation, the overall results indicated that nitrogen supply affected durum wheat and development much more than different water regimes. The level of water stress reached in the rainfed treatment was slight-to-moderate during the most sensitive stages (e.g. flowering) and it has become more severe only during the grain milk stage when it slightly affected yield. The results pointed out that both biomass and yield WUE could be satisfactorily applied to measure the validity of different management practices. However, there is a clear difference in terms of WUE between fertilized and non-fertilized treatments. Robustness of normalized WUE approach has been confirmed.

Keywords: *Triticum durum* Desf., water use efficiency, deficit irrigation, nitrogen application, radiation use efficiency, Mediterranean climate.

429. OUESLATI Ines (Tunisia)

Supervisors: M. Vurro and V. Auricchio ; *co-supervisor:* N. Lamaddalena

Title: Assessment of vulnerable zones to pollution caused by nitrate and sea water intrusion over an example of Apulia Region. – 131 p.

Abstract: The aim of this thesis is the implementation of a vulnerability assessment methodology of a zone to nitrate pollution and seawater intrusion. The Sinistra Bradano, situated on the western part of Taranto is the case study. Tools involved were: First, the DRASTIC model used with GIS to obtain the aquifer vulnerability map, characterized by high to very high vulnerability. Second, analyses were made on groundwater to measure nitrate and salinity concentrations and other water quality and soil fertility parameters. The maximum nitrate concentration detected didn't exceed the limit of 50 mg/l. Finally, the ISAREG model through which, by generating irrigation schedule simulations, a groundwater exploitation map was built. A correlation between over pumping and high salinity was noted on the right side of the zone. Therefore, recommendations were proposed.

Keywords: nitrate pollution, seawater intrusion, aquifer vulnerability, irrigation schedule, groundwater exploitation.

430. GHARSALLAH Olfa (Tunisia)

Supervisors: N. Lamaddalena and F. Lebdi

Title: Algorithme génétique pour l'optimisation de régulation des réservoirs d'eau dans un système d'irrigation à la demande. – 123 p.

Abstract: This study presents a Genetic Algorithm (GA) developed for flow optimisation in on-demand irrigation systems and for regulating the operation of buffer reservoirs. The aim is to regulate reservoir.s operation. The model was used to calculate the optimal inflows for the five reservoirs of the studied water distribution system. The regulation scenario proposed by the model is characterised by two inflow values. This scenario reduces the maximum produced flow by 10.65% and the maximum violations of tolerable water levels to acceptable values. The optimal solution guarantees inflows, making it possible to satisfy the daily requirements, minimize the maximum flow of the source and to have reservoirs full at the beginning of each cycle of distribution. In fact, the optimal solution proposes water demand hydrographs, which avoid draining the reservoirs and prevent the restricted-frequency irrigation.

Keywords: optimisation, gentic alghorithm, regulation, reservoir, conveyance, on-demand irrigation system.

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454. HAMMAM Amany (Egypt)

Supervisor: M. Todorovic ; co-advisor: R. Albrizio

Title: Growth, development and resources use of field grown durum wheat under different water and N regimes. - 134 p.

Abstract: Field experiment on durum wheat, carried out in Valenzano (Bari), aims to evaluate resources use efficiency (water, nitrogen and radiation) under three water (rainfed, 50% and full irrigation) and two nitrogen (0 and 120 kg/ha) regimes and to determine carbon dioxide and water vapour exchange at canopy scale. The effects of N supply on wheat growth and development were much more evident than those of water due to high precipitation (395 mm) distributed almost regularly during the growing season. Water stress has become severe only during the dough maturity stage and it does not cause significant biomass and yield reduction. Positive effects of N were: increased LAI, maintenance of green canopy duration, higher biomass and yield that resulted in improved radiation and water use efficiencies. Gas exchange data (carbon and water vapour) at canopy scale obtained from canopy chamber measurements, confirm the findings obtained from traditional measurements.

Keywords: *Triticum durum* Desf., water use efficiency, radiation use efficiency, nitrogen, canopy gas exchange, Mediterranean climate.

455. KASSAB Mohamed Fathy Hassan Ahmed (Egypt)

Supervisors: A. Coppola and N. Lamaddalena

Title: Spatial variability of solute transport mechanisms based on time domain reflectometry and generalized transfer function model. - 84 p.

Abstract: The flexible generalized transfer function model (GTF) and TDR based time normalized resident concentrations were combined in order to characterize solute transport mechanism both at local and field scale. A leaching experiment was carried out in a plot under greenhouse, where TDR probes were installed at three different depths at 37 sites along a 40 m transect. The field plot was brought to steady-state water content; a pulse application of 3.87 mm of KCl solution was applied. Measurements of water content (.) and impedance (Z) were simultaneously taken to follow the KCl solution propagation through the soil profile. Time series of relative resident concentrations for each site were effectively interpreted in terms of GTF model. The field scale behavior was described by calculating a local average and an integral average, by averaging local scale parameters and local scale original measurements, respectively. The two different averaging schemes resulted in two significantly different field scale solute transport behaviors.

Keywords: soil water content, solute transport models, time domain reflectometry (TDR), spatial variability.

456. OMAR El Sherif Omar (Egypt)

Supervisor: R. Albrizio ; co-advisor: M. Todorovic

Title: Growth, development and resources use of field grown barley under different water and N regimes. - 108 p.

Abstract: A field experiment on winter barley (*Hordeum vulgare* L., cv Ponente) under three water regimes (full irrigation, 50% and rainfed) and two nitrogen levels (0 and 120 kg/ha) has been carried out in Valenzano (Bari), in order to investigate resources use efficiencies in terms of water, nitrogen and radiation. During the whole season, N supply affected growth, development and yield much more than water applications. It was due to high precipitation regime (395 mm) with important rainfall events occurred at the most sensible phenological stages. Consequently, water stress occurred only between milk and dough maturity stages, without significant effects on yield production. Both radiation and water use efficiencies have been improved by N supply. Results from a simplified N balance indicated that the amount of N supplied to barley exceeded the effective N fertilization requirement for optimizing marketable yield.

Keywords: water use efficiency, resources use efficiency, nitrogen use efficiencies, Mediterranean environment.

457. HEFNY Ahmed Sabry Mohamed (Egypt)

Supervisor: M. Abd El Motaleb

Title: Groundwater quality and its impacts on soil and crop production in the Delta of El-Arish Wadi, North Sinai, Egypt. - 155 p.

Abstract: The study deals with the groundwater suitability for irrigation in relation to the permissible limits of FAO. The results reveal that the groundwater quality in the Delta of El-Arish Wadi differs from a well to another. The EC measured for all samples ranged from less than 2.9 dS/m to over 11.0 dS/m. Heavy metals were within the allowable limits established by the Egyptian law 48/1982, except well N° 2. In all wells NO₃ did not exceed the allowable limit of FAO (1979). The study includes the impact of irrigation water quality on the soil EC, SAR, NO₃, and on heavy metals. There were no significant correlations between them, as shown in the fitting curves relations. The study includes the virtual water content (VWC) for different areas and crops. The results indicate that the best VWC was shown by lemon and tomato, whose values were higher compared to the same crops cultivated in Nile Delta, Middle and Upper Egypt. The study includes the impact of some heavy metals contained in the irrigation water on the above parameters in lemon and tomato, which have the best VWC values, and on olive that is the dominant crop. The results indicate that there is no highly significant correlation between the studied Heavy Metals contained in water and plant.

Keywords: water quality, suitability of ground water, crop production, virtual water content.

458. ABI SAAB Gilbert (Lebanon)

Supervisor: N. Katerji

Title: Simulation directe de l'évapotranspiration maximale à partir des données climatiques standards : validation sur quatre cultures de tailles contrastées cultivées en région Méditerranéenne. - 89 p.

Abstract: The objective of this thesis is to simulate maximum crop evapotranspiration ET by using direct methods based on standard climatic data. To that end, a model of Penman-Monteith type was applied. In addition, an analytical approach to simulate the climatic variables above the investigated crops based on standard measurements taken in an agro-meteorology station was elaborated. It was validated on two crops of different height at the maturity stage. Soybean and Sweet Sorghum. The evaluation of the consequences using standard climatic values instead of the measured values for estimating ET was carried out on different time scales (hour, day, and growing period). The tests initially concerned Soybean and Sweet Sorghum, subsequently Sunflower and Grain Sorghum in order to check the general applicability of the proposed approach. The results of the tests were compared with ET measured by the Bowen ratio method. The quality and accuracy of the obtained ET estimates depend on the height of the crop and the time scale considered. Generally, the suggested approach allows to correctly estimate the ET for the different time scales considered. Estimate accuracy is however weak, on hourly scale, in case of very tall crops. The suggested approach seems to fit to the objective laid down in this study. It allows a precise evaluation of the crop water requirements in the Mediterranean region by using standard climatic measurements.

Keywords: Penman-Monteith, crop water requirements, Bowen ratio, soybean, sunflower, sorghum.

459. ALGHARYANI Emad (Lybia)

Supervisor: J. W. van Hoorn

Title: Effect of saline irrigation water and drought on soil salinity, nitrogen uptake water, consumption and yield of barley. - 110 p.

Abstract: The comparison between soil water sampling and salt balance showed that soil water sampling underestimates soil salinity. Soil water is mainly extracted from large pores immediately after irrigation and does not correspond with average soil water, but with diluted soil water. Soil water, however, gives an indication about soil salinity distribution with depth. Moreover, the ion concentrations can be corrected by multiplying with the ratio between the chloride concentration of the salt balance and that of the soil water. The corrected concentrations of soil water can be compared with those of the salt balance. The comparison showed precipitation of calcium and magnesium carbonate and calcium sulphate and exchange of calcium and magnesium against sodium on the adsorption complex. The nitrogen content of stems and leaves decreased during the growing season whereas that of grains remained stable. The -7 bar drought treatment showed lower nitrogen content in stems and leaves during spring time owing to earlier senescence. Salinity affected significantly the yield of straw but not for the grains. Drought had a significantly effect on grain and straw yield, the effect being the same at the three salinity levels.

Keywords: barley, salt balance, soil water sampling, saline irrigation, drought, nitrogen uptake, chloride and yield.

460. SMADI Hadeel (Jordan)

Supervisor: M. Shatanawi

Title: Urban wastewater : problems, risks and its potential use for irrigation. - 97 p.

Abstract: In Mediterranean countries, there is a potentiality of using treated wastewater as an additional water source. However, wastewater reuse poses a risk for public health. Extensive treatments don't reach the minimum quality standards; consequently, there is need for tertiary treatments (intensive) which is of relatively high cost. It well recognized that Irrigation with treated wastewater is a continuation of treatment process that could lead to an improvement of the effluent quality. In this regard, this work was carried out using three soil types of variable textures were subjected to six successive irrigations for duration of three months with sewage effluents generated from primary treatment, secondary treatment, and disinfection with chlorine. By the objectives of characterizing the changes in soil properties, beside identifying the differences between the investigated effluent qualities before and after the irrigation period. The presented data give the evidence that treated wastewater should return back to the soil through irrigation, hence the produced effluent the end of irrigation was characterized with nutrients and microbial content below the limits enforced by Jordanian and international guidelines, beside notable improvement in organic matter and nutrients content of the soil.

Keywords: wastewater, effluent irrigation, soil texture, primary treatment, secondary treatment, disinfection treatment, nutrients, microbial.

461. EL ATMANI Mhamed (Morocco)

Title: L'effet combiné de la salinité et de la sécheresse sur le fonctionnement hydrique, le développement, la croissance et la productivité de l'orge. - 79 p.

Abstract: This study is framed within a joint research project of MAI-Bari, INRA-France and ICARDA. Its objective is to test the joint effect of salinity and drought on the broad bean variety ILB 1814 identified as salt tolerant and drought sensitive. The analysis concerns the water behaviour, growth, development, yield and its components, and the water use efficiency. Under salt stress only, saline treatments show some changes in the plant water status and a reduction in leaf area, evapotranspiration and yield. These different effects are more pronounced as soil salinity increases. Under salt stress combined with drought, the effect of salinity is actually null. In saline treatments the water behaviour, leaf area, cumulative evapotranspiration and yield values are close to the control. Moreover for the same soil salinity level, treatments subject to drought show lower grain and straw yields than un-stressed treatments. The observed reduction coefficients show variable values that decrease as soil salinity rises. The effect of drought seems in our study an additional stress to salinity effect, whose action on the water behaviour and yield of legumes is weaker as salinity increases. This conclusion is not in agreement with the conclusions drawn from the works conducted on durum wheat and barley.

Keywords: barley, salinity, drought, water behaviour, yield, water efficiency.

462. AJNAOU Imad (Morocco)

Supervisor: P. Santamaria and R. Choukr-Allah ; co-advisor: F. Montesano

Title: Subirrigation vs. drip-irrigation: effects on yield, fruit quality and nutrients concentration into the substrate and nutrient solution of soilless grown salad tomato. - 127 p.

Abstract: A soilless experiment was conducted in the MAI-B greenhouse to determine the influence of subirrigation and drip-irrigation with open (D.O) and close system (D.C), on substrate electrical conductivity (EC), yield, fruit quality (caliber class, dry matter, TSS, total acidity, Vitamin C), water use efficiency (WUE), nutrient solution (NS) management and the possibility to reduce NS concentration (30%) with subirrigation, of salad tomato (cv. Naxos). Plants grown with subirrigation showed high EC in the upper part of the substrate. Total and marketable yield were 22% lower with subirrigation referred to D.O, but with high fruit quality and WUE (48.8 L of NS per kg of fresh tomato with subirrigation vs. 55.5 L/kg with D.O). The nutrients reduction affected the marketable yield and WUE positively (14% and 15.8 % more, respectively). Furthermore, major stability of the chemical characteristics of the recirculated NS (management simplicity) was obtained with subirrigation respect to D.C.

Keywords: soilless, subirrigation, drip-irrigation, substrate electrical conductivity, fruit quality, nutrient solution management, tomato.

463. WAHBI Abdallah (Morocco)

Supervisor: R. Choukr-Allah

Title: Effet de cinq substrats sur une culture d'haricot vert irriguée par les eaux usées épurées sous serr : aspect nutritionnels, agronomiques et physiologiques. - 99 p.

Abstract: L'effet de cinq substrats (100% sable, sable+10% tourbe blonde, sable+20% tourbe blonde, sable+10% fibres de coco et sable+20% fibre de coco) sur une culture d'haricot vert nain (variété VENDA), conduite en hors sol et irriguée par les eaux usées épurées, a été étudié dans la serre expérimentale du complexe horticole d'Agadir. Les substrats ont affecté différemment la consommation en eau et en éléments minéraux suite aux différentes conditions de conductivité électrique. Le substrat sable+10% tourbe blonde a permis une meilleure croissance végétative et un taux de photosynthèse élevé, et a accusé une réduction du taux d'accumulations des sels dans le substrat. Ceci lui a permis d'avoir le meilleur rendement, soit 23,02 t/ha contre 22,13 t/ha pour le sable+10% fibre de coco, 21,65 t/ha pour le 100% sable, 20,13 t/ha pour le sable+20% tourbe blonde et 19,08 t/ha pour sable+20% fibres de coco. Le substrat sable+10% tourbe blonde a présenté la meilleure efficience d'utilisation de l'eau, soit 11,12 kg/m³ et le meilleur taux de rentabilité économiques.

Keywords: wastewater, soilless culture, substrate, gree bean, sand, blond peat, coconut fibre, salinity, yield.

464. ALI ALKILANI Nidal Mohamed (Palestine)

Supervisor: R. Choukr-Allah

Title: Effect of treated wastewater on green bean plants cultivated under soilless technique and soil condition. - 106 p.

Abstract: The use of treated municipal wastewater effluent for irrigating green bean crops grown under soilless technique and soil condition was evaluated under the greenhouse in south of Morocco. The objective of this work is to determine the impact of the sand and coconut fiber substrate on the growth and yield of green beans and compare it with plants grown under soil condition, in order to evaluate the cost benefit of these different substrates. Green bean plants grown under soilless substrate consumed more water (49.9 L/plant) which represented 6.9% more than one grown under soil. Sand substrate accumulated less salts, allowing the plants to produce the highest vegetative growth and the highest yield (21.2 Ton/ha), and increased the yield by 27.5% in comparison to the one grown under soil condition. Our results confirm that soilless technique is more appropriate than the soil for growing the green bean under saline conditions. On the other hand, sand substrate allowed the best income value (5497 € /ha) and present the highest water unit returns 4.8 €/m³ compared to 2.6 €/m³ in the soil.

Keywords: green bean, wastewater reuse, substrate, soilless, soil condition, water balance, mineral balance, salinity, sand, cocounut fibre.

465. HALLWM Solaf (Syria)

Supervisor: P. Zdruli

Title: Integrated ecosystem approach for sustainable natural resources management in the Ras Al-Ain district in Syria. - 94 p.

Abstract: Land degradation is a worldwide problem, which leads to poverty, hunger and migration. Syria is a country that suffers from it too. The Ras Al-Ain district is located in the northwest of Syria. Its main economic activities rely on agriculture and most typically in the cultivation of wheat, cotton, barley, vegetables, fruits and fodder crops. This study dealt with identification of main land degradation processes in the area through on-the-ground data collection and systematic analyses that permitted a first hand assessment of the sustainability of economic development of Ras Al-Ain. The study included both socio-economic analyses and agricultural surveys. We found that the main problems affecting long-term sustainable agricultural production were salinity, landslides and loss of soil fertility. These problems derive as result of inappropriate land use types, failure of existing agricultural polices, population growth and pressure, social contrasts, water use efficiency, and natural conditions such as geological and climatic factors. The area faces water insecurity, poverty, migration and reduced agricultural productivity. We suggest that changes in land use polices and cropping patterns, development of sustainable land use planning strategies, and encouragement of long-term land tenure titles could be some of the solutions that could contribute to mitigate land degradation in Ras Al-Ain region.

Keywords: Syria, Ras Al-Ain, land degradation, desertification, sustainable agriculture, salinisation, landslides.

466. AZAÑA LABRADOR Leonor (Spain)

Supervisors: N. Lamaddalena and J. A. Sagardoy

Title: Modeling water balances and assessing scenarios in the Candelaro basin (Apulia, Italy). - 108 p.

Abstract: The present study assesses the current situation and the future perspectives of the water resources of the Candelaro basin (Apulia, Italy). With this purpose the soil-water balance for the main land cover classes, the water demand

and supply status for the agriculture, urban and industrial sectors and the assessment of the impacts of future assumptions on crop parameters, climate and land use change were determined using the WEAP21 model. The model has demonstrated a considerable potential to improve the planning and management of the water resources. Four scenarios were developed for the period 1999-2003. The reference scenario illustrates the soil-water balance parameters variation by land cover class due to climate and land characteristics and furthermore it shows that during dry years the highest water demand of irrigated agriculture causes high groundwater exploitation. The reduction coefficient scenario shows equilibrium between demand-supply. The climate change scenario indicates unmet demand for irrigation, while with the Climate change plus land use change scenario shows a slight unmet demand and smaller contributions to the water sources of the basin.

Keywords: modelling, soil-water balance, water demand, water supply, scenarios.

467. ABDERRAOUF Elferchichi (Tunisia)

Supervisors : N. Lamaddalena and F. Lebdi

Title: Optimisation du fonctionnement des réservoirs dans les systèmes d'irrigation à la demande par l'emploi des algorithmes génétiques. - 83 p.

Abstract: This paper presents an optimization stochastic methodology based on real coded genetic algorithms for optimizing the reservoirs operation in an on-demand irrigation systems. The methodology analyses the adequacy between the supply and the demand taking into account the reservoirs storage capacity and subsequently determines the adequate supply hydrograph that ensures the optimal reservoirs regulation during peak periods. To take into account the variability of the farmers' demand, demand hydrographs were randomly generated within a pre-fixed confidence interval. A weighting objective function, including violations of the admissible reservoir water levels (maximum, minimum and target reservoir water level), are proposed. To solve the above-said optimization problem, an executable computer program was developed. The model was applied and tested on the *Sinistra Ofanto* irrigation scheme (Italy), composed of five reservoirs fed with water from an upstream dam, each of them serving different irrigation districts. Results show that the model is efficient and robust.

Keywords: genetic algorithms, optimization of the reservoirs operation, on-demand irrigation system, objective function.

468. OUESLATI Ons (Tunisia)

Supervisors: M. Vurro, V. Auricchio and N. Lamaddalena

Title: Assessment of zones vulnerable to pollution caused by nitrate and seawater intrusion: an example of Apulia region. - 136 p.

Abstract: The area investigated is "Palagiano" and is located in the province of Taranto (Italy). In the examined area there are two different aquifers: the deep and shallow one. Tools involved were: First DRASTIC methodology within GIS was used to assess the vulnerability to potential contamination of groundwater. The aquifer vulnerability map show very high and extremely high degree of vulnerability. The second part consists in the control of the current groundwater quality and soil fertility by making analysis on some physical and chemical parameters. The maximum nitrate concentration detected did not exceed the limit of 50 mg/L. The third part consists in the drawing of the salinity and nitrate maps using SURFER. We found that: (a) In the basic aquifer, the salinity is function of

the distance from the coast and the distribution of nitrate is heterogeneous. (b) In the upper aquifer, the salinity is an increase from winter to summer and the nitrate concentrations are high. Finally MODFLOW was used for simulating groundwater flow and transport contaminant. Results show that by the year 2018 the nitrate concentrations in some location in the shallow aquifer would be more than 100 mg/L.

Keywords: nitrate pollution, seawater intrusion, aquifer vulnerability, groundwater modelling.

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490bis. PUSTINA Gert (Albania)

Supervisor: U. Fratino; advisors: F. M. Renna, N. Lamaddalena

Title: Experimental analysis on hydraulic jump in irrigation open channels. - 82 p.

Abstract: Although hydraulic jump was discovered five centuries ago and despite the numberless papers and experiments through the years, there still persist some gaps describing the hydrodynamic effects and implication of hydraulic jump in irrigation open channels. A great deal of data were collected by means of electric transducers during laboratory tests on a free surface channel for variable step heights in both sub and supercritical flow conditions. The set of data applied by analytical and empirical approaches has provided new information and tools for better understanding the effect of hydraulic jump in irrigation open channels in terms of energy dissipation and jet impacts on the downstream section. As to self-aeration, it has been found that the impact forces are reduced and less energy is dissipated. This study demonstrates that self-aeration can reduce the risk of erosion and overflows recently experienced in sloping land.

Keywords: hydraulic jump, open-channel flow, air entrance, energy dissipation.

491. MOURAD Rais (Algeria)

Supervisor: J. W. van Hoorn ; advisor: F. Z. Lahmer

Title: Effet de l'irrigation à l'eau salée et de la sécheresse sur la salinité des sols, l'absorption de l'azote, la consommation en eau, et le rendement de la fève. - 92 p.

Abstract: The comparison between the sampling of soil water and salt balance showed that the former underestimates soil salinity. Soil solution is mainly extracted from macro-pores immediately after irrigation and doesn't correspond to soil solution, but to diluted solution. Soil solution gives an indication of the salt distribution in the soil profile. Moreover, ionic concentrations can be adjusted through multiplying by the ratio between chlorine concentration of the salt balance and the soil solution. Adjusted concentrations can be compared with those of the salt balance. The results show the precipitation of calcium and magnesium carbonates and calcium sulphate, and that sodium is exchanged by calcium and magnesium of the absorbing complex. Nitrogen content in stems and leaves has decreased during the growing season, and the nitrogen content in seeds has remained relatively constant. Treatments subject to salt and water stress (- 6 bars) have shown smaller nitrogen content in stems starting from April, later in seeds+ pods and then in pods beyond 15 meq/l. Drought effect on nitrogen uptake adds up to salinity. Salinity affects grain yield and biomass beyond 15 meq/l. In our study, drought is an additional stress that adds up to salt stress, but is not constant, contrary to previous observations on cereals: durum wheat (2006) and barley (2007).

Keywords: broad bean, soil sampling, salt balance, salinity, drought, nitrogen balance, yield.

492. ČEREKOVIĆ Nataša (Bosnia and Herzegovina)

Supervisors: R. L. Snyder and M. Todorovic

Title: Evaluation of crop coefficients for tomato and melon crops grown in a Mediterranean climate. - 141 p.

Abstract: The objective of this research was to make better estimates of crop evapotranspiration (ET_c) by improving seasonal crop coefficient (K_c) curves. A review of K_c values for tomato and melon crops showed important differences between the data measured under different climate conditions. The relationship between K_c values and some growth parameters (leaf area index LAI, temperature, and mulching) was investigated using lysimeter-measured ET_c data from the Bari University and CNR-Bari experimental station located in Policoro (Southern Italy). The results indicated that the seasonal K_c can be modelled satisfactorily for either crop using a linear relationship between K_c and cumulative growing degree days or a logarithmic relationship between K_c and LAI. The initial growth stage can be neglected under Mediterranean arid and semi-arid conditions. Mulching increases the peak K_c of melon but reduces the length of the growing season.

Keywords: crop coefficient, crop evapotranspiration, Mediterranean, tomato (cv. Dracula), melon (cv. Campero), management, irrigation practices, mulching, growing degree days, leaf area index.

493. MOHAMED Nashwa Fawzy Abd El Fattah (Egypt)

Supervisor: G. Enne ; advisor: C. Zucca

Title: A methodological approach to the development of integrated coastal zone management indicators for Port Said area (Egypt). - 79 p.

Abstract: Sustainable management of Egypt's coastline through the introduction of a process of integrated coastal zone management (ICZM) is a strategic issue for the Country. The objectives of the present study are to analyse the main issues related to the sustainable development of the Port Said coastal zone (Egypt) and to develop suitable methodological approaches to represent them and to identify appropriate bio-physical and socio-economic indicators for monitoring the current environmental and socio-economic system and the ICZM future implementation. The use of indicators should contribute to the monitoring and assessment of the ICZM process. The DPSIR framework was applied to the case study and suitable criteria to define and compare the indicators. relevance and performance were developed and tested. The results obtained should be a methodological contribution to the identification of an indicator system to be used as a tool for monitoring the major ICZM issues and to provide to the local competent agencies the means to assess the future impacts of the measures related to the concrete implementation of the ICZM.

Keywords: ICZM, indicators, monitoring system, sustainability.

494. AHMED Magdy El-Hossiney Attya Sayed (Egypt)

Supervisor: A. Hamdy ; advisor: A. Gadallah

Title: Effect of water regime on squash yield and soil water characteristics using neutron scattering technique. - 92 p.

Abstract: Actual Evapotranspiration (ET_a) as affected by water regime under drip irrigation system was the target. Combination between neutron scattering technique and soil moisture retention curves was followed. Effect of irrigation water

regime (40%, 60%, 80% and 100% ETc) on squash yield, and water use efficiency were also included. (ETa) values weren't constant within the wetting area around the dripper. The highest value of (ETa) was under the dripper, the second one at 25 cm distance from the dripper, and the lowest at 12.5 cm distance from the dripper. The maximum (ETa) for 100%, 60% and 40% (ETc) treatments was recorded after 50, 47 and 35 days from sowing, respectively. Gross Production Water Use Index (GPWUI), Crop Water Use Index (CWUI), Gross Production Economic Water Use Index (GPEWUI), and Crop Economic Water Use Index (CEWUI) are different means for evaluating the relationship between yield and applied irrigation water. Generally, the water use efficiency decreased with increasing applied irrigation water. Fresh weight of squash fruits significantly decreased with increasing water stress. N uptake by fruits was frequently and dramatically affected by harvesting time. In general, significant differences between harvesting periods fluctuated depending on water regime treatments. The total average N uptake by squash fruits showed a decrement trend as affected by increasing water stress.

Keywords: actual evapotranspiration, water regime, direction of water movement, distribution of soil water, squash yield, nitrogen uptake, water use efficiency.

495. ALI Yasser Mohamed Ahmed (Egypt)

Supervisor: A. Hamdy ; *advisor:* T. A. Tawfic

Title: The impact of pesticides use on newly reclaimed soils. - 70 p.

Abstract: Pesticides that have become essential elements of modern agriculture, are considered major sources of diffuse pollutants that cause health implications upon living organisms. The objective of this research was to study the impact of Imidacloprid on the physical and chemical characteristics of newly reclaimed soil in Toshka area. Water and soil (successive depths 0-25, 25-50 cm) samples were collected from Nasser Lake and Toshka area. Before any addition, complete analyses of soil and water were carried out. The experiment was carried out using PVC columns filled with the soil samples. Three cylinders were used for the different concentrations of Imidacloprid prepared in the lab 1/2X, X, and 2X. Three volumes were added weekly and drained water was subjected to complete analysis. The results showed that Imidacloprid percentage in leachate increased gradually after the 5th addition. The rate of Imidacloprid adsorption decreased while degradation percent increased with soil depth.

Keywords: reclaimed soils, pesticides, Toshka, imidacloprid.

496. RAWABDEH Hala Abdur-Rauf (Jordan)

Supervisor: M. Shatanawi ; *advisors:* M. Todorovic and A. Scardigno

Title: Optimization of the cropping pattern in Jordan Valley under different climatic conditions and water availability: environmental and socio-economic aspects. - 125 p.

Abstract: This work investigated some specific management options for the improvement of the performance of the irrigated agricultural systems in Jordan Valley in terms of farmer's income, water supply/demand balance and economic water productivity. A mathematical programming model was developed, calibrated and applied to maximize expected annual income through the selection of the most favorable cropping pattern and irrigation practices under the main constraints of land, water availability and crop rotation. Both, Northern and Southern parts of the

Valley are studied considering normal and dry years. The overall results indicated that water productivity is lower in the southern than in the northern part of the Valley. The improvement of agricultural production in the region can be achieved through the modification of the cropping pattern (cultivating date palm and tomato instead of banana in the South) and the introduction of regulated deficit irrigation (for citrus in the North and for barley in the South).

Keywords: Jordan Valley, water management, regulated deficit irrigation, optimization model, cropping pattern, water productivity.

497. CHARARA Racil (Lebanon)

Supervisor: P. Zdruli ; *advisor:* T. Darwish

Title: Nitrate accumulation in the soil/groundwater system as affected by land use and agricultural practices in Central Bekaa Valley. - 119 p.

Abstract: The central Bekaa valley in Lebanon is a region of intensive agricultural practices. Farmers are being highly applying fertilizers, especially nitrogen. Large amounts of nitrate are being leached to the soil and groundwater systems, leading to ecological and health hazards. For this reason, this thesis will characterize the amounts of nitrate in the soil and asses groundwater as affected by agricultural practices. This was done through soil and groundwater sampling and analysis in relation to four different cropping patterns from the Terbol area in the central Bekaa Valley. The study also focuses on the hazard of nitrate from food consumption. The results showed high amounts of nitrate in both, soil and groundwater. The current ecological status reveals a great health danger for a large public and land degradation issue. For this reason a nitrogen management plan should be initiated in order to reduce and stop the contamination of the ecosystem.

Keywords: nitrogen cycle, nitrate, Bekaa Valley, groundwater, fertilization.

498. ADIL Atif (Morocco)

Supervisor: N. Katerji

Title: L'effet combiné de la salinité et de la sécheresse sur le fonctionnement hydrique, le développement, la croissance et la productivité de la fève. - 79 p.

Abstract: This study is framed within a joint research project of MAI-Bari, INRA-France and ICARDA. Its objective is to test the joint effect of salinity and drought on the broad bean variety ILB 1814 identified as salt tolerant and drought sensitive. The analysis concerns the water behaviour, growth, development, yield and its components, and the water use efficiency. Under salt stress only, saline treatments show some changes in the plant water status and a reduction in leaf area, evapotranspiration and yield. These different effects are more pronounced as soil salinity increases. Under salt stress combined with drought, the effect of salinity is actually null. In saline treatments the water behaviour, leaf area, cumulative evapotranspiration and yield values are close to the control. Moreover for the same soil salinity level, treatments subject to drought show lower grain and straw yields than un-stressed treatments. The observed reduction coefficients show variable values that decrease as soil salinity rises. The effect of drought seems in our study an additional stress to salinity effect, whose action on the water behaviour and yield of legumes is weaker as salinity increases. This conclusion is not in agreement with the conclusions drawn from the works conducted on durum wheat and barley.

Keywords: broad bean, salinity, drought, water behaviour, yield, water efficiency.

499. EL YOUSSEFI Lahcen (Morocco)

Supervisors: P. Santamaria and R. Choukr-Allah

Title: Soilless closed cycle production of green bean using subirrigation: effects on yield, fruit quality, substrate and nutrient solution parameters. - 144 p.

Abstract: A soilless closed system experiment was conducted at M.A.I.B. greenhouse during the 2008 spring using subirrigation (trough bench system) for growing green bean. The effects of two substrates (peat+perlite and peat+sand 1:3, v/v) and two nutrient solution (NS) concentrations (100% and 50% of the macro-elements concentration normally used for growing this crop in soilless conditions) on yield, pod quality (categories, mineral composition), water use efficiency, and nutrients concentration into substrate and NS of two cultivars (Saporro and Venda) were evaluated. Trough bench technique allowed the realization of a continuous closed system with a major stability of the chemical parameters of the NS. It proved to be more effective than open soilless system since it saved water and fertilizers, allowing to obtain yield comparable to that obtained with traditional techniques (22 t/ha, on average). The reduction of the NS concentration (50% of the fertilizer concentration) reduced plant growth and consequently the total production by 15%. The use of different substrates did not affect the cultivars productivity. Concerning quality, Saporro plants produced a high percentage of pods in the category Extra than Venda plants (92 % vs. 89%, respectively). Sand can be an alternative of perlite given that it reduced the cost by 70 %.

Keywords: soilless, closed system, subirrigation, substrate, peat, perlite, sand, growth, yield, pods quality, nutrient solution management, green bean.

500. ABU HAYKAL Marwa Abdel-Aziz Rateb (Palestine)

Supervisors: A. Coppola and N. Lamaddalena

Title: Field-scale spatial variability of hydraulic properties estimated by infiltrometry and time domain reflectometry. – 77 p.

Abstract: Field-determined hydraulic properties are important not only for the design but also for the scheduling and management of irrigation systems. In this study, we applied a multidripper-TDR field method that allows the measurement of hydraulic parameters at multiple field locations within a short time period. The hydraulic parameters were determined by applying three discharge rates of drippers and measuring the resultant steady-state flux densities at the soil surface beneath each dripper. Soil hydraulic properties were described by the Gardner and van Genuchten-Mualem models. This enabled obtaining a large spatial data set useful to study the spatial variability of hydraulic properties and to estimate the same variables taking into account their stochastic nature. These data can be used as inputs in Richards. equation (Monte Carlo simulations). In this way, the average behaviour of the whole field can be predicted for different boundary conditions, along with the uncertainty.

Keywords: soil water content, capillary length, time domain reflectometry (TDR), spatial variability, Monte Carlo simulations.

501. MATIĆ Tatjana (Serbia)

Supervisor: R. Albrizio ; advisor: M. Todorovic

Title: Comparison between wheat and barley crops grown under Mediterranean environments and different water and nitrogen supply. - 107 p.

Abstract: A field experiment has been carried out in Valenzano (Bari) to compare the responses of durum wheat and barley submitted to different water regimes (100%, 50%, rainfed) and nitrogen supply levels (0, 120 kg/ha). Since heading, an interaction between water and N deficiencies was found in both crops. Biomass and yield were significantly affected by water and N for both crops, although wheat showed significantly higher values than barley. At the flowering stage, leaf gas exchanges of both crops were significantly affected by water regimes, while at canopy scale they were affected also by nitrogen levels. Normalized biomass Water Use Efficiency (WUE) and yield WUE values were not significantly different for the two crops, although both parameters were higher for wheat than for barley, thus demonstrating the ability of wheat to cope with harsh environments. Barley had higher Nitrogen Utilization Efficiency, despite a lower N uptake than wheat, thus indicating a higher ability to transform absorbed nitrogen in grain.

Keywords: *Triticum durum* Desf., *Hordeum vulgare* L., gas exchanges, water use efficiency, nitrogen use efficiency, Mediterranean climate.

502. ASSAF Wajeih (Syria)

Supervisor: M. Todorovic ; advisor: R. Albrizio

Title: Assessment of AquaCrop and CropSyst models in the simulation of wheat and barley growth under different water and nitrogen regimes. – 107 p.

Abstract: The performances of two crop growth models, AquaCrop and CropSyst, have been compared in the simulation of durum wheat and barley grown in a Mediterranean environment (Southern Italy) for three years (2006-2008). The experimental data included three water (rainfed, 50% and full irrigation) and two nitrogen (0 and 120 kg/ha) regimes. The models have been calibrated for both crops on the data of 2007, and validated on all treatments in both 2006 and 2008. Although AquaCrop required less input information than CropSyst, both models have shown convincing performances. In general, CropSyst simulated better biomass growth during the growing season, while AquaCrop was finer in matching biomass and yield at harvesting, particularly for water deficit and rainfed conditions. As compared to CropSyst, AquaCrop uses a more elaborated routine module to simulate the biomass development under water stress conditions: it makes AquaCrop more suitable for arid and semi-arid Mediterranean conditions.

Keywords: AquaCrop model, CropSyst model, calibration, validation, *Triticum durum* Desf., *Hordeum vulgare* L., Southern Italy, deficit irrigation.

503. CHERNI Housseem Eddine (Tunisia)

Supervisor: N. Katerji

Title: Analyse des différentes stratégies d'irrigation destinées à optimiser l'efficacité de l'eau chez le maïs cultivé dans des conditions pédoclimatiques contrastées dans la région des Pouilles. – 90 p.

Abstract: Water efficiency in maize grown under different conditions has been simulated for 25 years, through a STICS model, in three locations of Apulia region. These locations are characterized by a wide range of soil water storage. First of all, our study allowed testing for 2 years the suitability of STICS model to give account of the productivity of maize grown under the investigated conditions. It also allows clarifying the link and coherence between the different definitions used in the literature to express on-farm water efficiency. The obtained simulation data led to analyse the spatial variability of water efficiency in maize with respect to different conditions of crop water supply. Such variability, particularly high under water stress conditions, has been interpreted by taking into account the role of soil evaporation and the localization of water stress during the reproduction stage of the crop. This analysis shows that soil water storage and soil texture are the soil factors responsible for a high variability of water efficiency. Practically speaking, the study allowed examining appropriate irrigation strategies under various pedoclimatic conditions in the study area.

Keywords: water efficiency, soil and climate conditions, water stress, simulation, STICS.

504. JEMAI Amel (Tunisia)

Supervisors: N. Lamaddalena and M. Vurro ; advisor: D. Zaccaria

Title: Assessment of potential water scarcity and water delivery performance in large-scale pressurized irrigation scheme. – 144 p.

Abstract: The aim of this thesis is improving the capability to diagnose the operation of the pressurized irrigation scheme of Sinistra Bradano and to address issues related to the modernization process of large scale delivery networks. Simulating soil water balance proved that the potential water supply is enough to satisfy crop needs in an average year. Then, the application of Regulated Deficit Irrigation allowed water saving about 0.82 Mm³ with minimal yield reduction. A primary objective was to develop a procedure for assessing the performance of pressurized irrigation systems. Three main performance indicators were developed and tested in order to characterize the adequacy of water deliveries, in terms of supplied volume, irrigation frequency and vulnerability to water stress. Application of this method on the study area indicates that there may be difficulties meeting peak water demand, as shown by the poor values of the selected indicators. Therefore, improvement options were proposed.

Keywords: water balance, Regulated Deficit Irrigation, pressurized irrigation system, performance indicators, adequacy, frequency, vulnerability.

505. KHILA Sami (Tunisia)

Supervisors: N. Lamaddalena and F. Lebdi

Title: Energy saving through variable speed pumping in on-demand irrigation systems. – 92 p.

Abstract: In this work we were interested to investigate variable speed devices for energy saving in a pumping station equipped with pumps in parallel supplying an irrigation network operating on demand. The objective is to optimize energy consumption, i.e to meet exactly the flow and pressure required by the network at any time while consuming minimal energy. Several types of regulation based on the speed variation were identified and tested; the difference between these operation modes focuses on how to start pumps when demand increases. The power required by the pumping station was calculated for each type of regulation and applied to districts 1a and 1b that fall within the .Consorzio di Bonifica della Capitanata.. The determination of the best operating mode for the pumping station was based on the use of the network demand curve calculated by the indexed characteristic curves model. This would allow saving 14% of the currently consumed energy, corresponding to a saving of 10840 euros per year.

Keywords: energy, pumping cost, on-demand irrigation system, regulation, variable speed pumps.

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532. HAMED Lamy Mamdoh Mohamed (Egypt)

Supervisors: A. Hamdy ; advisor A. Gadala

Title: Nitrogen use efficiency by spinach plant (*Spinacia oleracea* L. Virginia) in sandy soil with drip irrigation system using ¹⁵N tracer technique. - 82 p.

Abstract: The effect of water regime and fertilizer-N application rate and modality of application were studied in order to identify the most proper and effective combination of the above-studied variables that provides a satisfactory spinach yield and minimizes the use of chemical nitrogen fertilizers, to save the surrounding environment and to achieve good water saving. In this direction, the obtained results indicated that reasonable production of spinach crop could be achieved by using 75% of the recommended rate of nitrogen fertilizer combined with 80% of the required water. It means that 20% of the required water as well as 25% of the required quantity of N fertilizer could be saved. Similarly, the splitting of N fertilizer into equal doses prevents the excess of nitrate to be moved to the underground water and lowers its concentration in the plant leaves. Drip irrigation system together with proper water regime and good fertilizer application practices is considered to be a useful management practice that could be applied to improve the sandy soil productivity.

Keywords: fertilizer application strategies, N fertilizer rates, nitrogen use efficiency, ¹⁵N tracer technique, nitrate accumulation, spinach yield, water regime.

533. AHMED Ahmed Moustafa (Egypt)

Supervisor: A. Coppola ; advisor N. Lamaddalena

Title: Analyzing spatial and temporal variability of soil water content in the IAMB experimental field for irrigation management. - 61 p.

Abstract: In this study, the data on soil surface water content measured in the MAI-B experimental field were analyzed by spatial and temporal statistical techniques. Firstly, spatial autocorrelation was explored using isotropic variograms. The temporal persistence of the spatial pattern was verified by calculating Pearson's correlation coefficients. Secondly, a temporal analysis technique was tested in view of identifying sites with time-invariant statistical properties of the probability density function. These locations provided water content measurements that were consistent with the mean or the given percentile values for the whole field. The results showed two different behaviours of the soil surface water content, the first one referred to drier soil conditions, both with no and low rainfall, and the second one for wetter conditions, after more significant rainfall. In both cases, no significant spatial dependence was found. Anyway, under dry conditions, the experimental semivariance calculated for each spatial lag was in the range of $0.0002 \div 0.0004$, whereas under wetter conditions, the range turned into $0.0002 \div 0.0008$. Also, a reversed pattern of the water content was observed in both conditions, with relatively drier zones becoming relatively wetter and vice versa. For each soil condition, a significant temporal stability of the water content pattern was proved, which was confirmed by calculating Pearson's correlation coefficients. The percentile taken by each measurement location varied over time,

with more significant changes between drier and wetter soil conditions. Nevertheless, for a few sites, the percentile was quite stable under both dry and wet conditions. The site 34 was steadily in the range of 0.4÷0.6 and it was representative of the average water content in the investigated field for both the dry and the wet period. This was confirmed by calculating Spearman's rank correlation coefficients.

Keywords: spatial autocorrelation, temporal stability, Time domain reflectometry (TDR), spatial variability, Variograms.

534. MOURSY Mohamed Anter Mohamed (Egypt)

Supervisor: A. Hamdy ; *advisor* T. A. Tawfic

Title: Maize crop yield and possible water saving under deficit irrigation and saline irrigation practices. - 84 p.

Abstract: This study was carried out to investigate the impact of deficit irrigation practices as a water saving option on maize yield, as well as to evaluate the potentiality of using saline water as additional source for irrigation to meet the increasingly fresh water demand and to enhance water saving in this field. Data indicated that under deficit irrigation treatments there was a gradual decrease in both vegetative and grain yield of maize by the gradual reduction in the volumes of water applied at the vegetative growth stage, but, with appreciable water saving of nearly 25% of the applied one. Regarding irrigation with saline water, the data showed the effectiveness of this approach in water saving; hence, up to 80% of the added water was saved by using water of salinity level not exceeding the one the crop could tolerate. The findings of this research support the idea that deficit irrigation and saline irrigation practices are both economically viable tools due to the high economic return the saved water could provide.

Keywords: deficit irrigation, fresh water, saline water, maize, yield, economic return.

535. AL NABER Majd Azzam Fadian (Jordan)

Supervisor: M. Shatanawi ; *advisors:* M. Todorovic and G. Flichman

Title: Water allocation strategies under scarcity and specific socio-economic and environmental conditions in the Central Jordan Valley. - 122 p.

Abstract: This work aims at improving the agricultural production in the Central Jordan Valley by means of more efficient land and water use and the optimization of the cropping pattern under limited water supply and existing environmental and socio-economic constraints. The ISAREG model was used to estimate crop water requirements, net irrigation requirements and the curves of crop response to water supply under open field and greenhouse conditions, taking into account actual soil and water salinity level. A non linear mathematical socio-economic model was developed in order to optimize the cropping pattern, water productivity, land use and the farmer's profit using different restriction scenarios about water availability and the increase in water prices. The overall results indicated that the reduction of water availability, rather than the increase in water tariffs, is the most limiting factor of the agricultural production in the region which might lead to the reduction of the cultivated land. Also, it favors the cultivation of permanent crops, like less water demanding and more salt tolerant vegetables, as well as the application of deficit irrigation strategies. The introduction of restrictions to the agricultural production does not affect water productivity significantly.

Keywords: Central Jordan Valley, ISAREG model, irrigation requirements, curves of crop response to water supply, salinity, open field, greenhouse, mathematical socio-economic model, water productivity, water availability, water tariffs.

536. EL-SAKKA Houssein Ali (Lebanon)

Supervisor: P. Zdruli ; *advisors:* T. Darwish and T. Atallah

Title: Investigating the risk of nitrate pollution in the soil/groundwater system of the central Bekaa valley in Lebanon. - 117 p.

Abstract: Agriculture in Lebanon is concentrated in the fertile Bekaa Valley, where intensive agriculture practices take place. Due to the lack of appropriate legislation and Governmental control, at present farmers apply excessive chemical fertilisers especially nitrate based ones. Consequently, health and ecological problems were found due to nitrate leaching into the soil and groundwater system. Our study area is included in the Terbol region in central Bekaa Valley. Soil and water samples were taken between August 2008 and July 2009. The aim was to study soil and groundwater exposure to nitrate pollution and to relate these risks to soil properties and vulnerability to nitrate leaching. This was done by taking water samples from 25 wells whose water is used for different purposes. Soil samples were taken in four representatives plots under different agricultural practices. The area was previously surveyed in details and a soil map at a scale of 1:50,000 was available for consultation. Water and soil samples were analysed at the laboratories of the Lebanese University, Agriculture Faculty in Beirut, Lebanon and the map elaboration was done at the National Centre of Remote Sensing (CNRS Lebanon). Analytical water results show alarming levels of nitrate concentration in a number of wells, while soil data show high percentage of nitrates in the beginning of the crop-growing season in the first topsoil layer, then with time due to nitrate leaching higher amounts are registered also at deeper layers. An appropriate map was developed to show the vulnerability of leaching. Results show very high to high vulnerability and risks in the larger area from the foot slopes towards the internal part, especially north of the plain. The current ecological status reveals excessive health dangers for the local population, fresh vegetable consumers and public at large. For these reasons, a nitrogen management plan should be initiated in order to stop and reduce further contamination of the whole fragile ecosystem.

Keywords: Bekaa Valley, nitrate, soil, groundwater and leaching.

537. FAHED Salim (*Lebanon*)

Supervisor: N. Katerji

Title: Détermination directe de l'évapotranspiration des cultures irriguées à partir de deux modèles de calcul de la résistance du couvert : validation sur des cultures présentant des tailles contrastées cultivées en région méditerranéenne. - 93 p.

Abstract: Two models to calculate hourly evapotranspiration, ET, using Penman Monteith equation, were used to evaluate hourly ET of 5 irrigated crops (grass, soya bean, grain sorghum, sweet sorghum and vigne) with a height varying between 0.1 and 2.2 m at the maturity stage. In the first model (KP Model), canopy resistance r_c was parameterized following a semi-empirical approach proposed by Katerji and Perrier in 1983. In the second model (TD Model), r_c resistance was parameterized following a mechanistic approach proposed by Todorovic in 1999. Average slopes between measured values and calculated values through the KP model on hourly and monthly bases are of 1.02+/- and de 1.03 +/-, respectively. However, the observed deviations, ranging from 0.96 to 1.07, with respect to the average values, are not associated to the crop height. In the case of the TD model, slopes vary between 0.79 and 1.34 on hourly basis and between 0.8 and 1.42 on daily basis. Small values of the slope are always observed on grass, whereas high values are observed on the 4 other crops. For cumulated values of ET during the whole period of observation, deviations between measured cumulated values and calculated cumulated values vary between -1 and 9% in the case of the KP model and between -20% and + 42% in the case of the TD model. Conclusively, the KP model seems to be well adapted to all the investigated cases, whereas the TD model underestimates ET in the case of low crops and overestimates ET in the case of tall crops.

Keywords: Penman Monteith, evapotranspiration, KP model, TD model, semi-empirical, mechanistic, canopy resistance.

538. MATARRESE Angela Maria Stella (*Italy*)

Supervisor: A. Caliendo ; advisors: M. Stelluti and N. Lamaddalena

Title: Study on the evaluation of crop irrigation water requirements in the Apulia region (Southern Italy) with the aim to optimize water use in agriculture. - 73 p.

Abstract: This study has focussed on the assessment and quantification of irrigation water requirements (IWRs) in the Apulia region (Southern Italy) for the optimization of water use in agriculture. Regional climatic, pedologic and land use data have been applied to a computational model that has performed a monthly water balance for an average climatic year and has been implemented on a GIS platform with a view to estimate maximum IWRs and the requirements under regulated deficit irrigation (RDI). Estimates have been compared with the farmers' actual supplies, previously determined for some areas and then extended to the entire region. A distributed approach has been used to take into account the spatial variability of climate and landscape features, and depletion coefficients (K_d) have been utilised to take account of the applied deficit. Results show that maximum IWRs are reduced by 19.4% with RDI and by 25.9% with the actual supplies. In conclusion, the strategy of RDI allows optimizing water use with respect to maximum requirements and to farmers' actual supplies.

Keywords: irrigation water requirements, water balance model, deficit irrigation, Geographical Information System (GIS), water use optimization, Apulia region.

539. MAHMOUD Badr (Morocco)

Supervisors: P. Santamaria and R. Choukr-Allah ; advisor F. Montesano

Title: Subirrigation vs. drip-irrigation : effects on yield, quality, substrate and nutrient solution characteristics of soilless grown green bean. - 133 p.

*Abstract: A soilless experiment was conducted in the MAI-B greenhouse. Green bean (*Phaseolus vulgaris* cv. Saporro) was grown during the spring 2009 with the aim of comparing two of the most used and promising irrigation systems, drip-irrigation with open (D.O) and closed system (D.C), with the subirrigation (trough bench technique) with 100 and 70% of nutrient solution (NS) strength in terms of growth, yield, fruit quality (pods class, dry matter, mineral composition, Vitamin C), water use efficiency (WUE), substrate and NS electrical conductivity (EC). The reduction of the NS concentration (70%) affected the plant growth and caused a 15% yield reduction. Green bean yield (total and marketable) was 14% lower with the subirrigation than with the D.O, but the fruit quality and WUE were higher (to produce 1 kg of marketable fruit 85 L of NS were necessary with subirrigation and 116 L with D.O). Plants grown with D.C showed high substrate EC. Moreover, with the trough bench system, less variation of element concentration in the recirculated NS was observed leading to a simplification of the closed loop management as compared with D.C.*

Keywords: soilless, subirrigation, drip-irrigation, nutrient solution management, yield, fruit quality, green bean.

540. MORAD Anouar (Morocco)

Supervisor: N. Katerji ; advisors: F. Z. Lahmer and M. Mastrorilli

Title: La réponse des cereals et des légumineuses à l'effet combine salinité-sécheresse: synthèse et analyse des mecanismes en cause. - 95 p.

Abstract: Based on the observations of 2009 on the water behaviour, growth and yield of broad bean submitted to the joint effect of salinity and drought, and from a synthesis of previous works carried out under the same experimental conditions on the same species and on durum wheat, this study confirms that there are two different crop response models to the joint effect of salinity and drought : The first model concerns cereals (durum wheat and barley). In these species, soil salinity affects yield regardless of the drought level observed in the plant. The second model concerns the broad bean and maybe the legumes in general, subject to future experimental tests. In these species, soil salinity affects yield to a varying extent according to the drought level observed in the plant. We have also demonstrated that the specific behaviour observed in the broad bean actually reflects the lack of the salinity effect on the plant water behaviour and its yield under dry conditions. To interpret this result, we have assumed a sharp action of drought on nitrogen symbiotic fixation that may have nullified the additional effect of salinity. This assumption seems to be verified based on a nitrogen balance carried out during the two years of the test.

Keywords: broad bean, salinity, drought, joint effect, water behaviour, yield, salt balance, nitrogen balance.

541. GRAIB Rafat Adel Abed-Alrahman (Palestine)

Supervisor: U. Fratino ; advisor: F. M. Renna

Title: Experimental analysis on gabion-stepped weirs in irrigation open channels. - 74 p.

Abstract: Over the last two decades, many scientific papers have been published, following experimental tests that were carried out on horizontal smooth stepped weirs. The latter proved to be effective in terms of dissipation efficiency. This study deals with gabion-stepped weirs which are characterized by the presence of gabions filled with stones. The use of gabions is particularly interesting above all in river restoration, because they are resistant, flexible and environmentally-friendly. From the hydraulic point of view, these structures show two flow components: a base flow, through the voids between the stones, and the main flow on the steps. The energy dissipation efficiency has been investigated over three geometrical models having different slopes: 14°, 30° and 45°. The hydraulic parameters, such as the length of the jet impact, the water pool depth and the depth at the impact section, are reported along with the pressure distribution on the spillway base. The experimental results show that the void fraction of the stones does not affect greatly either the energy dissipation or the hydraulic parameters, whereas the slope exerts greater influence. Also, the pressure field is affected by the slope; actually, as the slope increases, the maximum mean pressure value goes up starting from the center of the step horizontal face.

Keywords: open-channel flow, gabion weir, energy dissipation, pressure field.

542. ALROMEED Alaa Aldin (Syria)

Supervisors: L. S. Pereira ; *advisors:* M. Todorovic and N. Lamaddalena

Title: Assessment of irrigation scenarios for cotton and wheat in North-Eastern Syria. - 78 p.

Abstract: This work is aimed to assess crop water and irrigation requirements for wheat and cotton grown under different environmental conditions in north-eastern Syria. Several scenarios regarding different irrigation methods and strategies for full and deficit irrigation were tested. The corresponding crop parameters, including root depth, were adapted to the various conditions. Weather data were obtained on a monthly basis in 10 locations that showed the conditions of an average, dry and wet year. The ISAREG irrigation scheduling model was applied to each location to compute water and irrigation requirements as well as yield impacts of deficit irrigation. A GIS spline interpolation function was used for the spatialization of results. The overall results highlighted that the irrigation requirements of wheat can be described as a logarithmic function of precipitation whereas irrigation requirements of cotton can be expressed through a quadratic equation of reference evapotranspiration. Deficit irrigation is recommended for wheat cultivation especially in rainy areas, due to significant water saving (more than 50% compared to full irrigation) and relatively low yield losses (up to 10% compared to full irrigation). However, in the case of cotton, the benefits of deficit irrigation are less significant, due to the lack of precipitation during the growing cycle.

Keywords: wheat, cotton, north-eastern Syria, deficit irrigation, irrigation methods, model ISAREG, GIS.

543. CHOUAIEB Wafa (Tunisia)

Supervisor: F. Gentile ; *advisor:* T. Bisantino

Title: Evaluation of annualized Agricultural Non Point Source model (AnnAGNPS) for runoff, peak flow and sediment yield estimations in the Carapelle watershed, Puglia Region (Southern Italy). - 142 p.

Abstract: A study was undertaken to determine the predictive capability of Annualized Agricultural Non Point Source (AnnAGNPS) model with respect to runoff volume, peak flows, and sediment yield from a 50 000 ha watershed, in southern Italy. AnnAGNPS simulations have been compared with two years of field observations in the concerned watershed, 2007-2006. The model predicted the runoff volume with an acceptable accuracy for both calibration and validation. The peak flows were over-predicted by 26.6% (average error) with a poor model efficiency of 0.43 during calibration, and by 28.56% (average error) with 0.55 efficiency during validation. Similarly, the model over-predicted the sediment yield by 7.9% average error and 0.93 efficiency during calibration, and by 18.17% and 0.90 efficiency during validation. These results show that the model performs well in simulating runoff volumes compared to peak flows and sediment yields. It is also necessary to modify or improve the estimation methods of peak flow and sediment yield to increase the efficiency of the model, which can aid watershed management under the local conditions.

Keywords: AnnAGNPS evaluation, surface runoff, peak flow, sediment yield, watershed management, Southern Italy.

544. TLILI Youssef (Tunisia)

Supervisor: N. Lamaddalena ; *advisors:* R. Khadra and F. Lebdi

Title: Optimisation des réseaux d'irrigation avec les critères de fiabilité. - 146 p.

Abstract: Water supply systems are the key element of the hydraulic infrastructure and play a major role in modern civilization. The main component in the hydraulic works used for the irrigation water supply is the pipe whose diameter optimisation is an essential step in any hydraulic work to determine the minimum cost and achieve a good degree of reliability of the system. Our study was focused on the optimisation of three irrigation networks of different size following the variation of reliability as a function of the cost of each network through a new and better optimisation technique than that of Clément and FAO methods. On the other hand this case study has shown how important is to correlate the degree and frequency of the deficit at the hydrant and their impact on the reliability of the system. Two reliability criteria have been developed to select the optimal network among several irrigation networks. Hence this study is still an important step for the sustainable management of water resources and a strategic plan to apply under the current economic conditions of crisis.

Keywords: optimisation, diameters, reliability, cost, irrigation, deficit.

545. WASSAR Fatma (Tunisia)

Supervisor: R. Albrizio ; *advisor:* M. Todorovic

Title: Faba bean and potato agronomic responses to different water regimes in a Mediterranean environment. – 86 p.

Abstract: Two independent field experiments have been carried out in Valenzano (Bari) on a winter-spring crop (faba bean) and a spring-summer crop (potato) to evaluate the agronomic responses, in terms of leaf area and biomass development, yield and water productivity, under different water regimes (100%, 50%, rainfed). No significant difference has been observed among water treatments for growth,

yield and water productivity (WP) parameters of faba bean due to huge precipitation (740 mm) during the growing cycle. On the contrary, growth parameters and yield of potato were significantly affected by water supply. Full irrigation increased the yield by 228 and 30.7%, as compared to rainfed and 50% irrigation treatments, respectively, even if full irrigated and 50% treatments did not differentiate in terms of WP. However, both irrigated treatments of potato were significantly different in terms of normalized yield WP as compared to the rainfed treatment. Thus, normalized WP should be recommended for the evaluation of crop performances under different water supply regimes.

Keywords: *Vicia faba* L., *Solanum tuberosum* L., water productivity, deficit irrigation, Mediterranean climate.

546. ORS Selda (Turkey)

Supervisors: U. Sahin and R. Kanber ; *advisor* R. Khadra

Title: Effect of different quantities mixed fly ash and sewage sludge on some physical and chemical properties of saline-sodic soils. – 84 p.

Abstract: In this study, fly ash and sewage sludge were used on saline sodic soils for two purposes, that is soil reclamation and environmentally-friendly waste recycling. A column leaching experiment on disturbed soils with three different levels of electrical conductivity and exchangeable sodium percentage (soil I: 4.27 dS m⁻¹, 6.09%; soil II: 73.20 dS m⁻¹, 51.03%; soil III: 38.2 dS m⁻¹, 86.2%) was conducted. A 1:1 soil improver mixture was applied at 4 different doses, i.e. 0, 40, 80, and 120 t ha⁻¹. At the end of the leaching process, soil columns were divided into two layers and some soil physical and chemical properties were evaluated. Also, infiltration and chemical characteristics of leachates were registered. The leaching process failed on soil III as well as on the control of soil II, since they are heavy soils with high exchangeable sodium percentage (ESP). Saturated hydraulic conductivity, soil water retention at field capacity, porosity and infiltration generally improved in both soils I and II whereas bulk density decreased. As the doses of soil improvers increased, the EC slightly increased, the available heavy metals increased whereas ESP and pH decreased significantly. The results have indicated that the reclamation of barren saline sodic soils by means of sewage sludge and fly ash could be a new environmentally-friendly and even cheaper procedure.

Keywords: Reclamation, saline sodic soils, sewage sludge, fly ash, soil physical and chemical characteristics, environment.

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576. CAUSHAJ BEQAJ Blerina (Albania)

Supervisor: A. Coppola ; advisor: N. Lamaddalena

Title: The effect of alternative spatial averaging schemes of soil hydraulic properties on simulated deep percolation (recharge) at field scale. – 85 p.

Abstract: Estimation of groundwater recharge is one of the most difficult tasks in hydrology, as it may substantially vary in space because of spatial variations in soil hydraulic properties, as well as vegetation and climate forcing. In this study, the spatial pattern of soil hydraulic properties variability was based on laboratory measurements of both $K(h)$ and $\theta(h)$. This allowed obtaining a large spatial data set useful for estimating ensemble hydraulic properties to be used as inputs in the Richards' equation both in stochastic (Monte Carlo simulation) and deterministic approaches. An investigation was carried out on how well average hydraulic characteristics obtained according to alternative averaging schemes and numerical models produce effective simulated soil water contents averaged between 0-15 cm, closely representing those measured in the soil investigated. The effect of the averaging approach on the simulated recharge fluxes (deep percolation fluxes below the root zone at 150 cm) without and with root uptakes has been thoroughly discussed by simulating the water flow process for a bare soil or assuming the presence of a barley crop during the whole growing season.

Keywords: Soil hydraulic properties; groundwater recharge; spatial variability; Richards' equation; Monte Carlo simulation.

577. LULI Ketil (Albania)

Supervisor: P. Zdruli ; advisor: F. Sallaku

Title: Assessment of heavy metal pollution in the areas surrounding the Elbasani metallurgical complex in Albania and proposed mitigation actions. – 72 p.

Abstract: The study area of this MS thesis is located in the surrounding zones of the Metallurgical complex of Elbasan in central Albania, affected by heavy metals more than 30 years ago. The aim was to evaluate the total concentration (Al, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, P, Pb, S, Si, Ti and Zn) in different types of soils. 51 GPS referenced soil samples were collected from the agricultural topsoil (0-30 cm) in an area of about 2,000 ha. Samples were analysed according to ISO methods. Heavy metals were determined by spectroscopy of atomic absorption treated with strong acids and distillate water. Results show that soils are highly polluted with Ni, Cr and Cd that are higher than the EU maximum permissible thresholds. Environmental problems were clearly identified by severe increase in cancer and asthma cases, confirmed also by the field interviews. Attention should be given to the delineation of contaminated areas that should off limits to humans, livestock and urban/rural development. Mitigation techniques such as bio and phytoremediation, rehabilitation of drainage system and environmental policies must be applied.

Keywords: Heavy metal, soil pollution, metallurgical complex of Elbasan, permissible EU limits, mitigation, remediation.

578. ABDELWAHAB Osama Mohamed Mahmoud (Egypt)

Supervisor: B. Abdallah El Amin; advisors: A. Hamdy and A. Gadallah

Title: Assessing soil moisture content and its distribution under surface and sub-surface drip irrigation systems using neutron moisture technique. – 104 p.

Abstract: This study was carried out at the experimental field station of the Atomic Energy Authority in Inshas, Egypt, to assess soil moisture status under surface and subsurface drip irrigation systems, as a function of the variation in the distance between drippers along and between laterals at different measuring times. Moisture measurements were taken using neutron moisture meter technique, and water distribution uniformity was assessed by applying Surfer Model. The presented data indicate that under surface drip, soil moisture distribution and its uniformity within the soil profile are to a great extent affected by the distance between drippers rather than that between laterals. Generally, better distribution was found when using 30 cm dripper spacing than 50 cm spacing. Under subsurface drip irrigation, the installation of the irrigation system was the factor that dominantly affected the moisture trend under the studied variables. Installation of the system at 30 cm from the soil surface is the one to be recommended as it represents the active root zone for most vegetable crops, and also leads to better water saving in sandy soils in comparison with 15 cm depth.

Keywords: Drip Irrigation, water movement, distribution uniformity, subsurface drip irrigation, measuring times.

579. NEGM Amro Sayed Ramadan Mohamed (Egypt)

Supervisor: V. Iacobellis ; advisor: N. Lamaddalena

Title: Coupling hydrological and crop models for surface water balance assessment in ungauged basin. – 70 p.

Abstract: Hydrological models are recognized as valid scientific tools to assess water balance and provide support for the integrated management and planning of water resources. Calibrating and validating hydrological models in ungauged basins are complex due to the lack of reliable data, uncertainty in representing the hydrological processes and the physical features of a river catchment in a simulation model. In the present study an innovative approach is presented which couples a semi-distributed hydrological model called Distributed model for Runoff, Evapotranspiration, and Antecedent soil Moisture simulation (DREAM) with the FAO's Crop Water Productivity Simulation Model (AQUACROP). The main objective of the study is to calibrate and validate the Dream model by assessing an accurate estimation of soil water content using AquaCrop model. The study area is "Lama San Giorgio", a basin located in a wadi area in the central part of the Apulia region. The calibration process regards a specific parameter of the water balance: the subsurface flow coefficient that controls the lateral flow and assumes a constant value in time and space.

Keywords: water balance, dream model, Aquacrop model, ungauged basin, Lama San Giorgio.

580. FRANCIS Roger (Lebanon)

Supervisor: P. Zdruli ; advisor: T. Darwish

Title: Integrated analysis of water use and water demand in Lebanon: the special case of the Upper Litani watershed. - 55 p.

Abstract: This study presents the analysis of water use and water demand of the Upper Litani River Basin in Lebanon. The overall aim is to assess the state of the art and to critically evaluate farmers' attitude towards water use, and to outline water use-efficiency measures. A field survey involving 49 farmers from the Litani district was conducted to determine current farm practices and the role of best management irrigation practices on the environmental quality and sustainability of crop production. Results show an overuse of water that has led to severe water drop in many wells, especially during dry years in the Bekaa region. Other findings indicate the low efficiency of "on-farm" irrigation techniques and losses in the domestic water network. These results demonstrate the importance of taking immediate actions to curb this abuse on freshwater resources. Finally, a number of recommendations are given to improve water use efficiency. However the involvement of farmers, especially through water user associations, is still the best approach to obtain successful results.

Keywords: Water demand, integrated water management, Upper Litani river, Lebanon, irrigation efficiency, extension

581. AMMAR Youssef (Morocco)

Supervisor: P. Santamaria ; advisor: F. Montesano

Title: Effects of silicon supply on the agronomic performance and physiological traits of soil-less green bean (*Phaseolus vulgaris*) under salt stress conditions. – 79 p.

Abstract: A greenhouse experiment was conducted to investigate the effects of silicon application on soilless green bean (*Phaseolus vulgaris* L.) under salt stress conditions. Two NaCl concentrations (0 and 25 mM) and two Si concentrations (0 and 2 mM) were used. Salinity significantly reduced growth, stomatal conductance and net photosynthetic rate, and increased Na⁺ content in leaves. Compared with the plants treated with salt alone, added Si significantly enhanced the activity of APX and phenols in salt-stressed leaves of green bean. There was no significant difference in CAT activity between the "NaCl" treatment and "Si+NaCl" treatment. Si addition enhanced antioxidant defense systems in salt-stressed green bean plants mitigating salt toxicity, but it did not restore the growth of plants. The supply of 2 mM of Si into salty nutrient solution mitigated the inhibitory effect of salinity on net photosynthesis, and this effect was associated with lower Na⁺ concentration in plant tissues. The results of the present experiment coincided with the conclusion that Si may be involved in metabolic and physiological changes in green bean plants.

Keywords: green bean, antioxidant enzymes, net photosynthesis, salt stress, silicon.

582. HIRICH Abdelaziz (Morocco)

Supervisor: R. Choukr-Allah ; advisor: A. Hamdy

Title: Production de quinoa, pois chiche et maïs doux sous une irrigation déficitaire par les eaux usées traitées. – 111 p.

Abstract: The effect of deficit irrigation by treated wastewater has been tested on three crops in southern Morocco. The highest water use efficiency was achieved in the plots stressed at vegetative growth stage with a yield of 7.2 tons of grains/ha for quinoa, i.e. 3% less than the control; this yield was maximised for pea with 13.1 tons of grains/ha with a 34% increase as compared to the control and for

sweet maize with 93.8 tons of fresh ears/ha (260,000 ears/ha), 28% higher than the control. These yield reductions were correlated with the physiological parameters (net photosynthesis and stomatal conductance) and agronomic traits (leaf area, root growth), Flowering and grain filling are the most sensitive stages to water stress; hence it is recommended to meet crop water requirements in these stages to prevent yield drop.

Keywords: deficit irrigation, wastewater, water stress, salinity, water use efficiency, quinoa, pea, sweet maize.

583. ABU-IZIAH Itissam (*Palestine*)

Supervisor: F. Gentile ; *advisor:* T. Bisantino

Title: Modelling soil erosion and sediment transport under different land management options in a semi-arid watershed of southern Italy. – 139 p.

Abstract: In the present study the predictive capability of the Annualized AGricultural Non Point Source (AnnAGNPS) model was tested in a semi-arid basin of southern Italy (Candelaro watershed 2300 km²). AnnAGNPS was calibrated and validated in two sub-watersheds (Vulgano and Salsola). The model has been applied for a period of 25 years to evaluate the effects of three different land management options on the sediment yield. The first scenario regarded the use of vegetation in the stream network. The effect is the reduction (11.78%) of the sediment yield at the watershed outlet. The second scenario regarded the use of hydraulic structures (impoundments) within the watershed. The effect is the reduction (10.71%) of the sediment yield at the watershed outlet. The third one regarded the implementation of agricultural practices (tillage). Tillage results in a notable increase (27%) of the sediment yield at the watershed outlet. These results show that AnnAGNPS model performs well in simulating runoff and sediment yields, and the model is an efficient tool for assessing the best management practices (BMPs) at the watershed scale under local conditions.

Keywords: AnnAGNPS model, soil erosion, surface runoff, sediment yield, watershed management options.

584. KARIC Biljana (Serbia)

Supervisor: L. S. Pereira ; advisor: M. Todorovic

Title: Estimation of Reference Evapotranspiration in the Mediterranean with Limited Weather Data. Comparing Temperature Methods and Spatial Analysis using CLIMWAT Database. – 135 p.

Abstract: This work is focused on the performance of Penman-Monteith equation with only temperature data (PM-T) and Hargreaves-Samani method (HS) for the estimation of reference evapotranspiration (ET_o) compared with the FAO-PM method with full climate data. The analysis was performed using monthly weather data of CLIMWAT database for 577 meteorological stations located in the Mediterranean countries. Data were grouped according to climate: hyper-arid, arid, semi-arid, dry sub-humid, moist sub-humid and humid zones. For almost all zones, the statistical parameters indicate slightly better performance of PM-T than HS method. Both methods tend to underestimate ET_o in hyper arid areas and to overestimate ET_o in humid areas. The reduction of either minimum air temperature or dew temperature by 2°C under arid conditions (when the ratio between precipitation and ET_o is smaller than 0.4) improves ET_o estimation especially for interior locations and in hyper-arid and arid regions.

Keywords: Hargreaves-Samani equation, Penman-Monteith equation, aridity zones.

585. ATAOUI Raefet (Tunisia)

Supervisor: N. Lamaddalena ; advisor: F. Lebdi

Title: Optimisation d'un système d'irrigation fonctionnant à la demande selon le critère de fiabilité: une nouvelle approche. – 118 p.

Abstract: The optimal design of distribution systems is a multi-objective process involving cost and performance. Reliability is one of the indicators used to quantify the performance of water distribution systems. In on-demand pressurized irrigation systems, different groups of hydrants operate simultaneously, generating variability in flow regimes, and can lead to uncertainties in water demand and in the pressure head available at the nodes. Based on these considerations, a new approach for computing the optimal irrigation network is presented considering: i) the stochastic variability of the discharges flowing into each section of the network; ii) the reliability of the pressure head at each hydrant, as performance indicator, iii) the variation of the on-farm uniformity distribution, and iv) the cost of the network. The model was applied to three Italian irrigation networks of different size (large, medium and small) and the results were compared with the same networks computed using the Clément and FAO models. The new approach showed an important cost reduction without any significant decrease in the system reliability.

Keywords: optimization, reliability, distribution uniformity, on-demand irrigation.

586. GHARBI Raoudha (Tunisia)

Supervisor: F. Lebdi ; advisor: N. Lamaddalena

Title: Le bilan hydrologique à l'échelle nationale : Etude de cas de la Tunisie. – 120 p.

Abstract: The shortage of water resources in Tunisia, their fragility and unequal distribution originate a scarcity hazard that increases conflicts between the different uses of a resource, which is already limited. Assessing the hydrologic balances of all large catchments of Tunisia is an essential step in a process directed towards a better and more efficient management of water resources. In this framework, the rainfall supply is determined using two methods (isohyetal lines and Thiessen) ; potential evapotranspiration is calculated by Hargreaves' equation. Lastly, crop water requirements are determined based on soil properties using the pedo-transfer function (PTF). Results have shown that evapotranspiration increases in the North-South direction. It ranges from 25% of rainfall supply in the North to 80% in the South where it is associated with low rainfall. This results in an overall water deficit all over the country.

Keywords: hydrologic cycle, supply (inflow), hydrologic balance, catchment, Tunisia, scarcity, modelling.

587. YAMAC Seda Sevim (Turkey)

Supervisor: R. Albrizio ; advisor: M. Todorovic

Title: Impacts of kaolin-based particle film technology on potato crop under different water regimes. – 96 p.

Abstract: A field experiment has been carried out in Valenzano (Bari) to study the response of potato crop to different water regimes (100%, 50%, rainfed) and kaolin applications. Growth and yield parameters of potato were significantly affected by water supply. Marketable yield reached 35 t/ha under full irrigation. It was reduced by 23% and 51% in the case of 50% irrigation and rainfed treatments, respectively. Marketable normalized water productivity values were 11% and 3% higher in fully irrigated and 50% irrigated treatments, as compared to rainfed. No significant difference has been observed among kaolin treatments for growth, yield and efficiencies in the use of resources (water and radiation). Leaf gas exchange was significantly reduced by water deficit and, to a lower extent, by kaolin application in two irrigated treatments. Accordingly, at canopy scale, assimilation and evapotranspiration were reduced by kaolin treatments up to 15 and 5%, respectively. This behavior is explained by the increase in plant temperature at both leaf and canopy scales: it increased by 1-2°C after kaolin application in irrigated treatments. The opposite behavior was observed for rainfed treatments.

Keywords: Solanum tuberosum L., kaolin, deficit irrigation, Mediterranean climate

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608. ILUNGA MWENZE Jean (Congo)

Supervisor: F. Montesano ; advisors: P. Santamaria, F. Z. Lahmer and G. Mimiola

Title: Agronomic evaluation of three composts for greenhouse tomato production. – 108 p.

Abstract: A soilless experiment was conducted in the MAIB greenhouse to evaluate the effects of three composts (Food waste, Green waste and Posidonia Oceanica debris-based compost), used as growing substrate component at different proportions, on tomato (*Solanum Lycopersicum*, cv Antonella F1) growth and yield. Four growing media (treatments) were compared: PE-TO (perlite 50% + peat 50%), used as control treatment; COM-FOOD (food waste compost 50% + perlite 25% + peat 25%); COM-GREEN (green waste compost 50% + perlite 25% + peat 25%); COM-PO (Posidonia debris compost 50% + perlite 25% + peat 25%). Plants grown on compost-based substrates showed adequate performance in terms of growth. Growth parameters showed, in general higher values in compost-based treatments. Total marketable yield was 22% lower with PE-TO as compare to COM-FOOD. Elemental leaf tissue composition was similar in control and compost treatments, as for the principal macro and micro nutrients. However, plants grown on Posidonia compost showed very high levels of boron, as a result of the high concentration of the elements in the substrate. In conclusion, use of compost with adequate properties could represent a good low cost alternative for soilless substrates composition.

Keywords: soilless, compost, yield, plant growth, fruit quality, water retention capacity.

609. MONGA ILUNGA DIKOSHI Robert (Congo)

Supervisor: G. Gerosa ; advisors: D. Spano, S. Mareu and M. Todorovic

Title: Combined effect of irrigation water salinity and ozone concentration on wheat growth and yield

Abstract: Agricultural production is constrained by different factors among which ozone and water salinity play an important role. However, the sensibility of crops to these oxidative stresses largely depends on species and variety. In this work the sensitivity of two cultivars of durum wheat (Neodur and Virgilio) to ozone, water salinity and their combination was tested in an Open Top Chambers experiment. A split-plot design was used with two levels of salinity in the irrigation water (tap water and 75 mM of NaCl) nested in two levels of ozone concentrations (ambient air -50% and +35%). Virgilio resulted to be sensitive to ozone in terms of leaf damage while Neodur is tolerant. Nevertheless ozone did not have any significant effect on grain production. Virgilio revealed to be more tolerant to water salinity than Neodur. The two factors never interacted significantly, but an antagonistic interaction is suggested for most measured parameters.

Keywords: *Triticum durum*, ozone, water salinity, yield, leaf visible symptoms.

610. MOHAMED Youssef Abdelkader Heba (Egypt)

Supervisor: T. Tawfic ; advisor: A. Hamdy

Title: Treated wastewater in agriculture: use and impacts on the soil and crop environments. – 89 p.

Abstract: Recognizing wastewater as an additional water resource is mandatory to emphasize its beneficial opportunities, taking into consideration its potential risks. In this regard this study was divided into two trials: the first was carried out in the laboratory to investigate the impact of wastewater irrigation on the characteristics of three different soil textures and to elucidate the role that could be played by the soil in improving the treated effluent quality taking the chemical characteristics of the collected drained effluents as an indicator. The results showed that the finer the soil texture, the better the effluent quality. The second trial was a comparative study aimed to characterize the effect of irrigation with treated wastewater as compared to the irrigation with fresh water supplied with the optimum fertilizing levels, on maize growth and yield. The results favored much more irrigation with treated wastewater resulting in better quantitative and qualitative maize production.

Keywords: wastewater irrigation, soil textures, drained effluents, fresh water, maize, yield production.

611. JARRAR Heba Abd Alkarim Muhammad (Jordan)

Supervisor: N. Lamaddalena ; advisors: R. Khadra, R. Wahaj and M. Shatanawi

Title: Mapping System and Services for Pressurized Irrigation "MASSPRES": Modeling performance indicators of sensitivity and capacity analysis for modernization process. – 139 p.

Abstract: Indicators to assess sensitivity at hydrant and network level were developed, modeled and integrated in MASSPRESS, -an approach being worked out by FAO and MAIB - aiming at Mapping System and Services for Pressurized Irrigation. The hydraulic behavior of each hydrant (relative pressure deficit; reliability; sensitivity) and the sensitivity and capacity of a pressurized irrigation network in the Jordan valley were assessed and analyzed using AKLA model integrated with the new indicators. The applied methodology allowed to diagnose the bottlenecks of the network hydraulic performance and to propose and test scenarios for its operational improvement.

Keywords: Sensitivity, capacity, performance, pressurized irrigation, hydraulic behaviour, MASSPRES.

612. SALIBA Ramy (Lebanon)

Supervisor: T. Darwish ; advisor: P. Zdruli

Title: Desertification risk assessment in Lebanon: present status and the implications of climate change. – 72 p.

Abstract: The present state of desertification sensitivity and the implications of climate change were assessed for Lebanon, a Mediterranean country threatened by land degradation and overexploitation of resources. The model is based on the European Environment Agency (EEA) methodology by adapting indicators to account for site-specific environments, and incorporating socio-economic parameters. GIS data elaboration was done using the new soil map of Lebanon (1:50 000), historical climate data from 15 weather stations, land cover map and

socio-economic conditions at governorate level, and by assigning scores to different sensitivity range(s) and exposure(s). Climate change impact was assessed using future precipitation and temperature so that the only dynamic layer in this work is climate. Results showed the spatial distribution of zones with very low and low sensitivity decreasing from 16% at present to 6% in 2090, while the areas with moderate, high and very high sensitivity increase from 37 to 42% and from 34 to 39%, respectively.

Keywords: desertification, climate change, Mediterranean region, sensitivity, Lebanon, GIS.

613. LECHKAR Ouassima (*Morocco*)

Supervisor: R. Albrizio ; advisors: V. Cantore and M. Todorovic

Title: Effects of Strobilurin application on tomato crop grown under different water regimes. – 73 p.

Abstract: The effects of Strobilurin fungicide application on the improvement of water status of tomato crop grown under different water regimes (100%, 50%, rainfed) was investigated at the experimental field of CIHEAM-IAMB in Valenzano (Bari). Growth, yield and quality of tomato varied significantly in relation to the amount of available water: marketable yield reached 64 t/ha and it was reduced by 48% and 70% in the case of 50% ET_c and rainfed treatments, respectively. Only a trend ($p=0.1062$) was observed for marketable yield (14% average increment) in the case of Strobilurin application, while all the other parameters were not affected. Both leaf water potential and stomatal conductance were significantly reduced by water stress, but slightly improved by Strobilurin application. At canopy scale, the assimilation and transpiration were slightly reduced by Strobilurin up to 3% and 5%, respectively.

Keywords: *Lycopersicon esculentum*, deficit irrigation, fungicides, yield, gas exchange.

614. RAMI Abdellatif (*Morocco*)

Supervisor: R. Choukr-Allah ; advisor: A. Hamdy

Title: Sweet corn production under deficit irrigation regimes using treated wastewater. – 93 p.

Abstract: Deficit irrigation with treated waste water was tested on sweet corn crop in southern Morocco. The highest yield was achieved by T2 treatment where we applied 75% of ET_m during the vegetative stage with 33.2 tons of fresh ears/ha giving 20% more than full irrigation T1. Treatments T3, T4 and T5 where volume of applied water corresponded to 50%, 25% and zero % of ET_m, respectively, at the vegetative stage, gave more or less the same yield production around 27 tons of fresh ears/ha due to providing the sensitive growth stages (flowering and grain filling) with their water requirements to prevent the same drastic drop in yield as that which occurred under the rainfed treatment T0. Regarding water saving, T5 showed to be the best with a saved water amount equal to 30% during the whole cycle of the crop. The SALTMED model proved to be successful in predicting yield and biomass production.

Keywords: deficit irrigation, wastewater, water stress, crop water productivity, sweet corn, yield, water saving, treatment.

615. TANASIJEVIC Lazar (Serbia)

Supervisor: L. S. Pereira ; advisor: M. Todorovic

Title: Assessing impacts of climate change on crop water and irrigation requirements in the Mediterranean. – 107 p.

Abstract: This study aims at assessing potential effects of climate change on crop water (CWR) and net irrigation requirements (NIR) over the whole Mediterranean. Climatic data were derived from the ENSEMBLES RCM simulations for the present situation (1991-2010) and the future conditions (2036-2065) under the SRES scenario A1B. Five important Mediterranean crops (olive trees, winter wheat, sunflower, maize and tomato) were considered. In general, a decrease of CWR and NIR for most crops (except olives) is expected due to shorter growing season. Therefore, the air temperature increase could have a dominant role in shortening the growing season rather than increasing CWR. The impact of precipitation decrease may be limited only to the perennial and winter crops because most of spring-summer agricultural production in the Mediterranean is performed in a period of very low rainfall. Thus, NIR also only increases for perennial crops.

Keywords: crop water requirements, net irrigation requirements, climate change, Mediterranean, olives, winter wheat, sunflower, tomato, maize.

616. INOUBLI Nesrine (Tunisia)

Supervisor: N. Lamaddalena ; advisors: R. Khadra and F. Lebdi

Title: Reliability and on-farm yield-based pipe size optimization in on-demand irrigation systems. – 89 p.

Abstract: The variability of flow regimes in on-demand pressurized irrigation systems leads to uncertainty in head at the nodes affecting the system performance. However, the on-farm networks operating downstream are designed for a fixed pressure head at the nodes that usually corresponds to the best on-farm irrigation performance. These aspects and the interaction between the off- and on-farm systems should be considered when designing/rehabilitating water distribution systems. To this purpose, a new optimization approach considering the occurrence of different flow regimes, the interaction between the reliability of the pressurized irrigation system, the uniformity of distribution of on farm sprinkler system, and the relative effect on yield was developed. The new methodology was applied to an irrigation sector operating on demand in Southern Italy. The cost of the optimal network calculated by applying the new approach was reduced by more than 30%, with slightly decrease in the system reliability and without any significant reduction of the system performance (Relative Yield) at the on farm level.

Keywords: on-demand pressurized systems, hydrant pressure variation, sprinkler irrigation, optimization, reliability, uniformity, yield.

617. OUAZAA Sofiane (Tunisia)

Supervisor: A. Coppola ; advisor: N. Lamaddalena

Title: Time-Domain Reflectometry (TDR) Methodology for simultaneous monitoring of water content, salinity and root density in soil profiles. – 71 p.

Abstract: Irrigation scheduling based on the field monitoring of soil water status must consider the influence of the RWU pattern on the soil-water dynamics, which is mainly governed by the density and distribution of the roots. This study has investigated the possibility to develop, by laboratory and lysimeter-scale

experiments, a methodology for monitoring simultaneously and continuously water content, electrical conductivity and root density along the soil profile and during the growing season under different irrigation water salinity conditions. In the presence of roots, the TDR-measured composite dielectric constant ϵ_c values result from the contribution of solid particles, air, water and root phases in the porous system. The contribution of root and water components of the TDR-measured permittivity was separated by applying the composite dielectric model of root-mixed soils. Laboratory-scale experiments were carried out for calibrating the parameters of the model. These parameters were then used for estimating - by an optimization procedure - the complete series of the bulk soil water content θ_b and the root volume fraction V_r in lysimeter-scale experiments. The TDR methodology allowed demonstrating that osmotic stresses influence both the physiological and morphological characteristics of the roots.

Keywords: Time-Domain Reflectometry, roots, soil water content, salinity, dielectric constant.

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640. KOÇI Spartak (Albania)

Supervisors: P. Zdruli, F. Sallaku and C. Karydas

Estimating actual soil erosion risk in the Ishmi Erzeni watershed in Albania using the G2 model. – 102 p.

Abstract: Soil erosion is a growing problem in Albania and is a threat to soil quality and its productive capacity. This thesis aimed at assessing the actual soil erosion risk caused by water erosion in the Ishmi-Erzeni watershed in Albania using a new modeling approach, the G2 model, inspired by the Universal Soil Loss Equation (USLE) family models. Furthermore, the thesis identified critical seasons, erosion hot spots (risky areas) and high-risky land uses, and evaluated the spatial distribution of soil loss rates under different biophysical conditions. This study emphasizes the seasonality in soil erosion mapping by using monthly-step rainfall erosivity data and biophysical time series data derived from remote-sensing, at 1:500,000 scale. Digital elevation (DEM) data, detailed soil maps, and land cover maps (Biopar data) were used as primary data sources, and Geographic Information System (GIS) and remote sensing (RS) techniques were applied to produce thematic maps. Despite overall high rainfall rates and rugged terrain on the eastern part of the watershed, thanks to its vegetation cover, the study area is affected by low to moderate water soil erosion with a mean annual erosion rate of 8.043 t/ ha/yr. Winter and autumn months seem to be more at risk than spring and summer, considering the amount of rainfall and especially the protective role of vegetation.

Keywords: Albania, modeling, soil erosion, GIS, remote sensing.

641. ABD-ALLAH Ahmed Mohammed El-Sayed (Egypt)

Supervisors: T. Tawfic and A. Hamdy

Studies on the influence of deficit irrigation and antitranspirants application on tomato yield and water use efficiency. – 97 p.

Abstract: The main aim of this study is to compare deficit irrigation and antitranspirant application as a means to increase water use efficiency under the Mediterranean conditions. Two deficit irrigation treatments were applied during the vegetative growth of tomato crops: 50% ETC treatment under severe water stress and 75% ETC treatment under moderate stress. On the other hand, three groups of foliar antitranspirants were applied at first fruit set stage, namely reflecting materials such as kaolin 3% and 5%, film-forming materials: linseed oil and triethanolamine 1% and 2%, and metabolic inhibitors, such as fulvic acid 0.001% and 0.002%. The presented data showed the superiority of antitranspirants that resulted in improved tomato yields and quality as well as significant water saving with up to 28% reduction in irrigation volumes. Concerning the impact of the investigated antitranspirant materials on tomato water use, fulvic acid metabolic inhibitor at 0.002 % concentration is to be recommended among investigated antitranspirants.

Keywords: water use efficiency, antitranspirants, deficit irrigation, yield, fruit quality, tomato.

642. NITTA Kanako (Japan)

Supervisors: K. Inosako and M. Todorovic

Irrigation effects on water status indicators of olive trees under the Mediterranean conditions. – 63 p.

Abstract: The physiological response of olive trees (*Olea europaea* L.) under different water regimes (irrigated and rain-fed) was monitored through selected indicators (soil water content, tree stem water content, sap flow and leaf conductance) from March to August 2012, at the experimental field of the CIHEAM-IAMB. The difference in response of olive trees under two water regimes was significant in terms of the selected water status indicators and crop parameters (leaf area and fruit development). The corresponding values of water status indicators were clearly correlated with each other, following similar paths and trends for both water regimes until a critical value of soil water content was reached. Tree stem water content and/or sap flow indicators could be effectively used to evaluate the occurrence of water stress in olive trees, even more so in relation to additional data on soil water content and/or the evaporative demand of the atmosphere. The effectiveness of irrigation strategies to avoid water stress can be confirmed by the use of such indicators.

Keywords: soil water content, tree stem water content, sap flow, leaf conductance, water stress, soil-plant-atmosphere continuum.

643. HIJAZEEN Dana George (Jordan)

Supervisors: A. Coppola, R. Albrizio and M. Todorovic

Using of remote sensing, ecophysiological analysis and soil measurements to investigate tomato crop response to different saline irrigation treatments under open field conditions. – 117 p.

Abstract: A field experiment was performed in Southern Italy (Valenzano, Bari) under open field conditions to assess the effect of saline irrigation treatments on tomato crop using remote sensing, eco-physiological and soil water measurements. Three irrigation water salinity levels (S0, S1 and S2) with electrical conductivity (EC_w) of 0.6, 4 and 8 dS m⁻¹, respectively, were applied with a seasonal irrigation input of 390 mm. Soil water content measurements and electrical conductivity allow distinguishing among salinity treatments and determining salt stress threshold. Accordingly, the osmotic potential measured on leaves strictly reflected these differences almost throughout the growing cycle. Because of salt stress, stomatal conductance and canopy cover were significantly reduced since the flowering stage. Marketable yield was reduced by about 50 and 25% in S2 and S1, respectively, as compared to the control. Fruit qualitative parameters were significantly ameliorated by using saline water. Excessive salts in irrigation water significantly increase canopy temperature, thus, crop water stress index (CWSI) could be applied to detect the salinity-affected plants. Some vegetation indices, such as normalised difference vegetation index (NDVI), difference vegetation Index (DVI), modified soil-adjusted vegetation index (MSAVI) and water index (WI) demonstrated their applicability to investigate the plant salinity stress.

Keywords: saline irrigation water, *Solanum lycopersicum*, canopy conductance, canopy temperature, crop water stress index, vegetation spectral reflectance, and vegetation indices.

644. EL ASMAR Emile (Lebanon)

Supervisors: N. Lamaddalena, R. Khadra, A. Scardigno and M. Todorovic

Pipe size optimization in on-demand pressurized irrigation systems: interfacing hydraulic performance and yield. – 96 p.

Abstract: A new approach is presented for optimizing on-demand irrigation systems, considering: i) the stochastic variability of the discharges flowing into each section of the network; ii) the reliability of the pressure head at each hydrant, as performance indicator; iii) the uniformity of distribution of on-farm sprinkler system, and iv) the net income of the served area. The model was applied to an Italian irrigation scheme and results were compared with the optimal network computed by using the Clément model and the cumulated random generated discharges model (FAO model). The optimization algorithm used for all the cases is the Labye iterative discontinuous method, which is a formulation of the dynamic programming. The function of yield response to water at different growth stages was applied to evaluate the sprinkler distribution uniformity impact on crop yields. Optimum crop spatial distribution maximizing net income was determined for the typical cropping pattern of the region. The analysis highlighted that crop yield is strongly affected by the distribution networks performance (it increased with increasing uniformity) and demonstrated that the three optimization approaches can be considered for pipe-sizing depending on the objective to be achieved and the amount of initial investment required to equip the irrigation network.

Keywords: on-demand network optimization, flow/pressure head variability, reliability, net income, crop yield, sprinkler uniformity, dynamic programming.

645. JELLOUL Ahmed (Morocco)

Supervisors: R. Choukr-Allah and A. Hamdy

Quinoa and Chickpea responses to salinity stress. – 98 p.

Abstract: Chickpea (*Cicer arietinum* L.), the third most important food legume grown in the world and Quinoa (*Chenopodium quinoa* Willd.), a new halophyte recently cultivated in the Mediterranean region were tested under different irrigation salinity levels. A pot experiment was conducted in southern Morocco to evaluate the response of Chickpea and Quinoa to different water salinity treatments (1, 4, 7 and 10 dS/m) for Chickpea (1, 10, 20 and 30 dS/m) and Quinoa. The crossover experimental design was adopted with 8 replicates for each treatment. Differences in water uptake, growth, yield, stomatal conductance, proline and soluble sugars accumulation, photosynthetic pigments, Na⁺ and K⁺ content were tested in order to understand the relative mechanisms of chickpea and quinoa to cope with salt-induced damage. Our results showed a negative relationship between water salinity and most of measured plant growth parameters of both crops. Increasing irrigation water salinity has negatively affected germination and seedling rate, growth and biomass accumulation and caused early senescence of Chickpea. Increasing water salinity up to 4 dS/m reduced the Chickpea grain yield by 47%, while using 30 dS/m reduced the Quinoa final yield by only 34% compared to the control. Increasing salinity reduced water uptake and water use efficiency as well as stomatal conductance and photosynthetic pigments, while increasing leaves proline, soluble sugars, Na⁺ and Na⁺: K⁺ ratio. The findings

highlighted the role of proline and soluble sugars as osmotic compounds to cope with salinity stress.

Keywords: quinoa, chickpea, saline water, seedling establishment, growth parameters, yield production, proline, soluble sugar.

646. RADDAH Faïçal (Morocco)

Supervisors: V. Iacobellis and N. Lamaddalena ; *advisor:* D. D'Agostino

Flood analysis and prediction under climate change scenarios. A case study in Apulia region: Celone river basin. – 103 p.

Abstract: In the present study, flood analysis and prediction under the climate change impact are investigated by combining the distributed hydrological model DREAM, the hydraulic model HEC-RAS, and also the Generalized Extreme Value (GEV) distribution with the method of L-moments. The study area is the Celone river basin, located in the northern part of Apulia Region, in Italy. The climate change data used in the study are referred to the A1B scenario from the CIRCE project simulations. The DREAM model was run for simulating the future stream hourly flow over the period 2001-2050 at San Vincenzo station, downstream the Celone river basin. Then, GEV with L-moments method was used for flood frequency analysis performed on both the peak annual discharges of the historical period (1967-1981) and those simulated by DREAM model for the future scenario (2001-2050) to calculate peak flood discharges (Q_T) for 30-year, 200-year and 500-year return periods. Finally, different flood peaks calculated through flood frequency analysis for a given return period (30 years, 200 years and 500 years) for the historical period and the future scenario, were used as input to the hydraulic HEC-RAS model to simulate water levels and flooded area in the downstream floodplain of the catchment. The results obtained from this investigation proved the ability of the hydrological and the hydraulic models to analyze flood and assess flood risks in the Celone river basin. In addition, the results showed that, as an impact of climate change, the variability of Celone river flow and the risk of flooding will increase, despite a decrease in the average river flow. They also show that the flooded area downstream of Celone river may increase by 111% and by 214 for the return periods of 200 years and 500 years respectively.

Keywords: DREAM model, HEC-RAS model, flood frequency analysis, climate change, Celone river basin.

647. GEORGES Yamen (Syria)

Supervisors: M. Todorovic and A. Arslan ; advisor: V. Cantore

Assessing the performance of two durum wheat varieties under different water regimes. – 92 p.

Abstract: A field experiment was carried out in Valenzano (Bari), by applying three water regimes (full and 50% irrigation, and rainfed) on two durum wheat varieties (Pietrafitta and Vendetta), to evaluate resource use efficiency and to test the applicability of the Crop Water Stress Index (CWSI) in irrigation management. The effects of different water regimes on crop growth parameters were much more evident than those on the varieties. Water stress became severe at the flowering stage for the rainfed regime, and during yield formation for the deficit treatment, causing a significant yield reduction with respect to fully irrigated crops. The CWSI followed the same daily trend for the two varieties, but it changed significantly for different water regimes. Thus, CWSI appeared to be a good indicator of plant water stress and could be effectively used in irrigation scheduling. A clear increase of average RUE was observed moving from rainfed to fully irrigated crops. On the other side, average Biomass WUE appeared to be more conservative moving slightly from rainfed to full irrigation treatments, while yield WUE had shown an opposite trend.

Keywords: *Triticum durum*, water use efficiency, radiation use efficiency, Mediterranean climate, Crop Water Stress Index, thermal camera.

648. CHAALI Nesrine (Tunisia)

Supervisors: A. Coppola and N. Lamaddalena

Coupling TDR technique and modeling of Soil-Plant-Atmosphere Continuum for field-scale analysis of crop response to salinity. – 163 p.

Abstract: This study has investigated the possibility to monitor simultaneously and continuously the relationship between the macroscopic crop response and the evolution of water content, electrical conductivity and root density along the soil profile during the whole growing season of a tomato crop under different salinity treatments. Water storages measured by TDR sensors were used for calculating directly the actual water uptake by the root system along the soil profile under different salinity levels. During irrigation with saline water the salt content increased along the whole profile but tended to accumulate quite uniformly below 20 cm in the case of the 4 dS/m treatment and at a depth between 15 and 25 cm in the 8dS/m treatment. Compared to the reference freshwater treatment, the evapotranspiration under saline treatments started to decrease at a threshold value of soil water EC of about 3dS/m. Based on soil and plant monitoring, the root uptake process was simulated by using a model for water and solute flow in the soil-plant-atmosphere continuum. Hence, the root activity reduction at each depth-node was calculated as a function of the salt (and/or water) stress. This enabled relating the distribution of higher/lower activity of root uptake along the soil profile in response to the actual salt distribution.

Keywords: Time domain reflectometry (TDR), soil water content, electrical conductivity, salinity, sink term, soil hydraulic properties, and simulation model.

649. CHERNI Salwa (Tunisia)

Supervisors: N. Lamaddalena, F. Lebdi, R. Khadra and D. Zaccaria

Assessing sensitivity in pressurized irrigation delivery networks using the MASSCOTE/MASSPRES rationale. – 64 p.

Abstract: In the present study, we were interested to assess the sensitivity at hydrant level of a pressurized irrigation network in the Province of Taranto (Southern Italy). The water scarcity, the lack of methodological frameworks and the poor-performing irrigation project are the main reasons for applying a process of modernization in large-scale irrigation schemes in order to improve the system performance. The hydraulic behavior of each hydrant is assessed and analyzed using the relative pressure deficit (RPD) from AKLA model and combined with a new statistical indicator which is the expected value (EV). Moreover, different scenarios have been simulated to figure out the behavior of hydrants under certain operational conditions using the operational index (OI). The indicators modeled and integrated in MASSPRES methodology allow the identification of the critical areas within the network through the diagnosis of the hydrants.

Keywords: sensitivity, performance, hydraulic behavior, pressurized irrigation system, modeling, operational index, MASSPRES methodology.

650. SAADI Sameh (Tunisia)

Supervisors: L. S. Pereira and M. Todorovic

Assessing the impact of climate change on water productivity in the Mediterranean agriculture. – 134 p.

Abstract: The main objective of this study was to assess the potential impacts of climate change on water productivity (WP) in the Mediterranean region considering different water inputs. Climate data were derived from the ENSEMBLES RCM simulations for the present (1991-2010) and the future situation (2036-2065) under the SRES scenario A1B. Expected changes of crop water requirements (CWR), net irrigation requirements (NIR), relative yield loss (RYL) and water productivity between baseline and future scenarios, under optimal and limited water supply, were estimated for two important Mediterranean crops: winter wheat and tomato. In general, a decrease of CWR and NIR for both crops and for all simulated irrigation scenarios is expected due to shorter growing season. Therefore, the air temperature increase could have a dominant role in shortening the growing season rather than increasing CWR. The impact of climate change on CWR and NIR would be greater under optimal rather than limited water supply. Under limited water supply, RYL would slightly decrease due to expected change in rainfall pattern. In general, a slight increase of WP is expected for both crops due to the combined effect of temperature, precipitation and CO₂.

Keywords: climate change, water productivity, crop water requirements, net irrigation requirements, Mediterranean, winter wheat, tomato.

651. KARABULUT Emre (Turkey)

Supervisors: R. Kanber, M. Todorovic and R. Albrizio

Assessing the tomato response to water stress by using the vegetation indices. – 78 p.

Abstract: This study was carried out to investigate the applicability of remote sensing and vegetation indices in the detection of tomato crop response to different

water regimes under semi-arid conditions of Southern Italy. Three water regimes corresponding to full irrigation (I100), deficit irrigation (150) and rainfed conditions (10) were applied. Crop growth, yield and marketable yield water use efficiency (WUE) of tomato were significantly affected by different water regimes. Marketable yield reached 68.1 t/ha under 1100 and decreased by 58.5% and 91.0% in the case of 150 and 10, respectively. Canopy temperature was significantly affected by different water inputs indicating Crop Water Stress Index (CWSI) as a valuable tool for the detection of plant water stress and irrigation scheduling. Likewise, the spectro-radiometer data and vegetation indices from red and NIR waveband provided valuable results to discern tomato response to different water regimes. Second-order polynomial regression between CWSI and soil water depletion in the root zone was observed ($R^2=0.86$). Similarly, the Water Band Index (WBI) was related to the soil water depletion in the root zone with $R^2=0.66$.

Keywords: crop water stress index (CWSI), spectro-radiometry, soil water balance, vegetation indices, drip irrigation.

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673. LIKA Alban (Albania)

Supervisor: D. Viaggi ; advisors: P. Zdruli and A. Scardigno

Title: Pricing unmetered irrigation water under asymmetric information and full cost recovery. – 89 p.

Abstract: The objective of this study is to define an efficient price scheme for irrigation water in condition of unmetered consumption. This study is based on principal-agent model and identifies a menu of contracts, defined as a set of payment (p) and quota of irrigated land (q), able to provide incentives toward an efficient use of the resource that maximize social welfare. The model was applied to a case study in the Çukas province in Albania where conditions of asymmetric information characterized the irrigation sector. The results show that the first best solution is not achievable and that using a menu of contracts allows to define a second best solution that may improve the overall social welfare derived from irrigation water use. Furthermore, the results also suggest that the irrigation water pricing policy should take into account the different farm types and that the definition of appropriate incentives plays a crucial role and influences the choice for a proper agreement.

Keywords: adverse selection, asymmetric information, incentives, menu of contracts, principal-agent model, water pricing.

674. MEHMETI Andi (Albania)

Supervisor: L. S. Pereira ; advisor: M. Todorovic

Title: Assessing eco-efficiency of Sinistra Ofanto irrigation scheme. – 92 p.

Abstract: This work focuses on the assessment of the eco-efficiency of a large irrigation scheme covering about 39,000 ha in Apulia region (Southern Italy). The eco-efficiency was estimated as the ratio of the economic performances of the system to the environmental impacts produced. Economic performances were expressed in terms of Value Added from the agricultural land use and the applied management practices, whereas the environmental performances were referred to water withdrawal, groundwater abstraction, energy consumption and CO₂ emission. The analysis was performed by using the Environmental Analysis Tool (SEAT) and Economic Value chain Analysis Tool (EVAT) developed in the EcoWater project. The overall results indicated that the system performs well in normal hydrologic years, whereas its performances drop significantly in dry years causing environmental impacts. The system performances can be improved by combining the extensive use of drip and subsurface irrigation methods and variable speed pumps.

Keywords: meso-scale assessment, water management, EcoWater project, water saving technologies, environmental impacts.

675. FOUIAL Abdelouahid (Algeria)

Supervisor: N. Lamaddalena

Performance analysis of looped pressurized irrigation distribution networks. – 121 p.

Abstract: The use of the proposed approach has demonstrated the effectiveness of localized loops to improve the network's overall performance with a cost saving of 82% compared to the classical diameter increase solution. This approach also proved to be a robust solution by sustaining a 25% increase in upstream demand and still providing better performance than the existing network under actual demand. This study also confirmed that, relative pressure deficit and reliability are insufficient to indicate the overall behavior of a network as they only provide the state of hydrants and not the state of water conduits. Consequently, other parameters were introduced to better assess the system performance as flow velocity and probability of occurrence, which provided valuable information about hydraulic risks and mechanical failures. Additionally, a computer model has been developed to provide detailed analysis of the aforementioned indicators. This model can be used as a platform for future developments using the analysis strategy and findings of this research.

Keywords: network rehabilitation, localized loops, performance indicators, computer model.

676. OWANEH Osama (Jordan)

Supervisor: D. Zaccaria ; *advisors:* M. Shatanawi and N. Lamaddalena

Assessing the impacts of changes in flow conditions to the water delivery service in pressurized distribution systems. – 107 p.

Abstract: In the present work a new synthetic performance indicator named Hydrant Performance Index (HPI) was developed and validated to be used for characterizing the water delivery service of pressurized irrigation systems under different flow scenarios. Specifically, the HPI was used to describe how changes in network flow conditions affect the water delivery service at hydrants with respect to the minimum pressure head and discharge conditions required by users for appropriate on-farm irrigation. The HPI was developed on the basis of other performance indicators, i.e. the Relative Pressure Deficit and the Reliability at hydrants, through their combination into a synthetic analytical combined index. Also, the applicability of HPI was tested for mapping the level of fulfillment of delivery conditions required by farmers at the different hydrants. Results from the applications showed the usefulness of this newly-developed index for achieving a better characterization of delivery service in pressurized irrigation systems with respect to existing performance indicators.

Keywords: hydrant performance index, delivery service, pressurized irrigation system, hydraulic response, flow conditions.

677. SAQALLAH Sagedah (Jordan)

Supervisor: I. Portoghese ; advisors: M. Vurro and T. Darwish

Modeling climate change impact on the water balance of a coastal watershed in Lebanon. – 79 p.

Abstract: This study aimed at assessing the potential impacts of climate change on the water balance of the Nahr Ibrahim river in Lebanon which is strongly affected by seasonal snowmelt. The assessment was based on analyzing the watershed hydrological regime in terms of mean values and their variability as a response to the climate change scenarios (CCS) for the 21st century that was specifically developed at the basin scale. The output of a state-of-the-art regional climate model (RCM) named PRECIS was used as climate forcing for a conceptual daily water balance model (NIWaB). The adopted CCS resulted in significant future changes corresponding to a decrease in snow-covered areas, anticipated and fastened snow melting, shorter snow periods, hence alteration in the discharge seasonality and peak flow with an estimated 40% reduction of the discharge volume by the end of this century.

Keywords: Climate change impact, Climate change scenarios, Mideastern water resources, Water balance model.

678. AL-BAYATI Uday Taha Abd Alkarem (Iraq)

Supervisor: N. Lamaddalena ; advisors: A. Coppola and A. Comegna

Distribution uniformity and application efficiency of sprinkler irrigation based on catch-can data and analysis of soil moisture patterns. – 63 p.

Abstract: This work analyzed the variability of sprinkler irrigation application over a bare soil, both in terms of water application efficiency and uniformity, by integrating and comparing the information on the irrigation depth data (ID), as measured by catch cans, and soil water storage in the upper root zone, as measured by TDR probes. Three irrigation tests were performed at three different pressures. A lateral water redistribution was observed after each irrigation event by comparing spatial distributions of site-specific water application efficiency (AEs), as well as ratios of site-specific actual water storage increase (SWEs) and irrigation depth (IDs) to the available porosity at field capacity before irrigation. Because of soil water redistribution processes, distribution uniformity based on soil storages was systematically higher than the catch can uniformity. The obvious consequence of lateral water redistribution processes was that the soil smoothing action on non-uniformity observed at the surface increased both with depth and over time. At a given depth the uniformity of soil water storages always attained the same value, whatever the pressure considered and the catch can-based uniformity coefficient. It was concluded that, for the case of random distribution of ID, the uniformity of water storages is driven by the soil behavior rather than by the irrigation system.

Keywords: Application Efficiency (AEs); Uniformity Distribution; Soil Water Storage (SWEs); Time Domain Reflectometry (TDR).

679. AJEEL Ali Tamween Ajeel (Iraq)

Supervisor: A. Coppola ; advisors: N. Lamaddalena and D. Zaccaria

Identifying the spatial correlation scale between root zone salt distribution, root density and evapotranspiration fluxes of green bean at transect –scale. – 100 p.

Abstract: This thesis illustrates the results of experiment carried out in soil treated with different irrigation water salinity levels, to evaluate the scale at which the local processes of salt accumulation and transport mainly control the evapotranspiration fluxes and the root density under different salinity levels. Monitoring was carried out along transects in 24 sites and was mostly based on Electromagnetic Induction (EM), as non-destructive and fast technique for measurements of soil electrical conductivity with the desired space-time details. Simultaneous TDR readings were used for calibration of the EM sensor and for the subsequent validation of the calibration equations. In the same sites, crop monitoring involved measurements of Leaf Area Index (LAI), Osmotic Potential (OP), Leaf Water Potential (LWP) and Root Density (RD). Water storage measured by TDR and a Diviner sensor were coupled for calculating directly the evapotranspiration fluxes along the whole soil profile under the different salinity levels imposed during the experiment. The soil and crop databases were analyzed by both classical and Fourier's transform statistical techniques. Compared to the classical site-by-site correlation analysis, Fourier's analysis of the transect scale experiments allowed a clear identification of the spatial scale at which the local soil water salinity level and distribution and the crop response are actually correlated.

Keywords: Soil salinity, Root density, Evapotranspiration; Electromagnetic induction; Time domain Reflectometry (TDR); Fourier's analysis

680. SAEED Ali Isam Saeed (Iraq)

Supervisor: A. Coppola ; advisor: N. Lamaddalena

Evaluating the salt spatial patterns at transect-scale in soils irrigated with saline water by electromagnetic induction and time Domain Reflectometry. – 67 p.

Abstract: This study aimed to develop a non-destructive and fast methodology for measurements of soil electrical conductivity mostly based on Electromagnetic Induction (EM). Simultaneous Time-Domain Reflectometry (TDR) readings of bulk electrical conductivity (EC_b) and water content by TDR probes were used as ground-truth data for calibration of the EM sensor and for the subsequent validation of the calibration equations. Calibration and validation of the EM sensor were carried out on three transects irrigated with water at three different salinity levels (FW, $3dSm^{-1}$ and $6dSm^{-1}$), allowing exploring a wide range of salinity values and distributions. Different calibration equations were obtained for the depth intervals of 0-20, 20-40 and 40-60 cm, respectively. In the first case, it was observed that the calibration parameters obtained for the transect irrigated with a water salinity corresponding to $6dSm^{-1}$ were suitable even to describe salinity behavior in the other two transects, thus implying that along that transect the EM and TDR sensors explored all the possible salinity variability existing in all the three transects. Validation was carried out for the depth interval 0-20 cm with direct EC measurements and EM readings in the same sites used for calibration but for different times and proved the predictive effectiveness of the calibration parameters. Finally, a calibration was also carried out for translating EC_b values estimated by EM to the corresponding EC_w (soil water EC) values.

Keywords: Electromagnetic Induction (EM), Time Domain Reflectometry (TDR), Soil salinity; Soil electrical conductivity (EC)

681. BOUCHAABA Zakaria (Morocco)

Supervisor: F. Montesano ; advisor: R. Choukr Allah

Low cost and sustainable green bean soilless production in greenhouse using closed cycle sub irrigation. – 122 p.

Abstract: A greenhouse experiment was carried out during the spring season 2013 to determine the influence of two irrigation methods (drip irrigation open cycle and subirrigation closed cycle) and two nutrient solution (NS) concentrations (100 and 80% of the macro-elements concentration normally used for soilless cultivation) on substrate EC, plant growth, gas exchange, yield, fruit quality, water and nutrient use efficiency of green bean (*Phaseolus vulgaris* L., cv. Saporro). The total fresh and dry biomass of the drip irrigated plants were higher than those grown with subirrigation, while the whole plant dry matter percentage was lower. Differences in terms plant growth and gas exchange have been recorded, with higher values in drip irrigated plants. With subirrigation the yield was reduced by 33% compared to drip irrigation but with better fruit quality. Using NS 80% resulted on 8% higher yield compared to NS 100%, both in drip and subirrigation. Higher WUE and NUE were obtained with subirrigation.

Keywords: ZRS, through bench system, drip-irrigation, yield, fruit quality, *Phaseolus vulgaris* L.

682. HAMMAOUI Aicha (Morocco)

Supervisor: R. Albrizio ; advisor: M. Todorovic

Application of proximate sensing techniques to evaluate physiological and biometric parameters of potato (*Solanum tuberosum* L.) under different water regimes. – 80 p.

Abstract: A field experiment was conducted to evaluate the use of proximate sensing techniques for monitoring physiological and biometric parameters of potato (*Solanum tuberosum* L.) under different water regimes: full irrigation, deficit irrigation and rainfed. Soil water content and irrigation scheduling were simulated by an Excel-based tool, besides direct measurements in the field. Different irrigation treatments significantly affected canopy temperature, thus stomatal conductance (g_s) and yield. At leaf scale, the crop water stress index detected the level of stress and was strongly correlated with g_s ($R^2 = 0.89$), while water index was highly correlated with transpiration rate ($R^2 = 0.80$). At canopy scale, although the Normalized Difference Vegetation Index (NDVI) is affected by soil background and was less sensitive to higher values of leaf area index ($LAI \geq 3$), a high correlation was recorded between these two parameters ($R^2 = 0.85$) with respect to soil adjusted vegetation index which required a better estimation of the adjustment factor.

Keywords: vegetation indexes, crop water stress index, stomatal conductance, *Solanum tuberosum* L., irrigation treatments, and yield.

683. ALMOQAYAD Zuhair (Palestine)

Supervisor: E. Trulli

Options for wastewater treatment and reuse in Palestine: modeling analysis of a municipal treatment plant in the Gaza Strip. – 109 p.

Abstract: This study has two major purposes: (1) to analyze and document the wastewater system and reuse pilot projects in the Gaza strip (GS); (2) to analyze

BOD and TSS removal efficiency in each single treatment unit in Rafah WWTP, and propose alternative layouts for improving the effluent quality to meet the standards for reuse in agriculture. The documentation and analysis activities were conducted using the data collected by the institutions responsible for management of water and wastewater sectors in GS (PWA and CMWU). Two alternative layouts were proposed to upgrade Rafah WWTP; the first alternative was to replace the aerated lagoon with oxidation ditch; the second one was to install a new treatment train based on conventional activated sludge process combined with filtration. GPS-X model was used to simulate and evaluate BOD and TSS removal efficiency of the two proposed layouts. The simulation results of the second proposed layout, based on conventional activated sludge process, produce effluent with BOD and TSS concentrations that comply with the normative standards for reuse in agriculture.

Keywords: wastewater treatment, wastewater reuse, Rafah WWTP, upgrading WWTP, GPS-X model.

684. ZOABI Abdalrahman (Syria)

Supervisor: Awadis Arslan ; advisors: V. Cantore and M. Todorovic

Resources use efficiency of two durum wheat varieties under different sowing dates and water regimes. – 102 p.

Abstract: A field experiment was carried out in Valenzano (Bari) to investigate the performances of two durum wheat cultivars (Vendetta and Pietrafitta) grown under combined effects of different sowing dates (December and February) and three water regimes (full irrigation, 50% deficit irrigation and rainfed). Both sowing practices resulted in very good yield although the winter wheat gave higher yield (5.42t/ha) and yield water productivity (WPy) (1.50kg/m³) than the spring wheat (4.20t/ha and 1.27kg/m³). RUE was greater for spring than for winter cultivation but no differences were observed between cultivars. A clear increase of average RUE was observed moving from rainfed to fully irrigated crops. Full irrigated wheat provided highest yield (6.13t/ha), but reduced the WPy (1.39kg/m³) with respect to deficit irrigated wheat (5.15t/ha and 1.50kg/m³). Precipitation (229 and 128mm for winter and spring cultivation, respectively) supports a reasonable yield for rainfed crop (3.16t/ha) which had the lowest WPy (1.29kg/m³). 'Vendetta' was more productive than 'Pietrafitta' (5.09 against 4.53t/ha). The CWSI changed significantly for different water regimes and appeared to be a good indicator of plant water stress.

Keywords: triticum durum, water productivity, radiation use efficiency, crop water stress index, Mediterranean climate, thermal camera.

685. FEKI Mouna (Tunisia)

Supervisor: R. Khadra

Optimization of on demand pressurized distribution networks and on farm constraints. – 87 p.

Abstract: An on demand irrigation system was optimized using Clément, FAO and Reliability based models. The interaction between the variability at hydrant and the uniformity of downstream on farm sprinklers was analyzed, generating 50 configurations of operating hydrants. The relative yield was calculated accounting for the deficit coefficient and the uniformity at 90% probability of occurrence. The Reliability based optimal network has registered a significant reduction of cost of respectively 15 and 24% and of reliability of respectively 10 and 13% as compared

to Clément and FAO. However the relative pressure deficit at hydrant demonstrated the non significance of reliability reduction as the registered failure at hydrants was minimal. The relative yield at sectoral level was reduced by only 1% as compared to the other two approaches. However, this reduction should be assessed at farm scale, especially that a typical cropping pattern was considered annulling any agronomic and/or economic features of crops.

Keywords: optimization, on demand schedule, sprinkler irrigation, performance, uniformity, yield, modernization.

686. ZOUGHLAMI Khawla (*Tunisia*)

Supervisor: V. Iacobellis ; advisor: D. D'Agostino

The model assessment using NSE (Nash Sutcliffe Efficiency) and KGE (Kling Gupta Efficiency). – 98 p.

Abstract: The evaluation of hydrologic model behavior is made through comparison of simulated and observed variables, and efficiency criteria (EC) are used to provide an objective assessment of such closeness. In this study, the utility of two different EC, NSE (Nash-Sutcliffe Efficiency) and KGE (Kling Gupta Efficiency), is investigated. In the study area of Celone (Italy) an updating of the Krause et al. (2005) method is proposed by adding the KGE and by modifying the length of the dry season. In the study area of Oued Chiba (Tunisia) the model SWAT (Soil and Water Assessment Tools) is applied to assess the water balance, and SWAT Cup to calibrate the outputs using both NSE and KGE. Results show that KGE is the best EC in evaluating the performance of the model and NSE_{mod} can be considered as an intermediate solution. Moreover, there is no impact of the variation of the basin's characteristics on the behavior of the EC.

Keywords: Efficiency criteria, KGE, NSE, Celone, Oued Chiba, SWAT, SWAT Cup.

687. ATEs Alim Can (Turkey)

Supervisor: R. Kanber ; advisors: M. Unlu and M. Todorovic

Winter wheat response to different water supply under Mediterranean conditions. – 61 p.

Abstract: A field study on bread wheat (*Triticum aestivum* L.) was carried out from 30 November 2012 to 28 May 2013 in the Cukurova Region, Eastern Mediterranean, Turkey. Wheat response was assessed under three water supply regimes (I_{100} : full irrigation, I_{50} : 50% of full irrigation and I_{00} : rainfed). The evapotranspiration of wheat was measured by Bowen ratio energy balance and lysimeter methods and estimated by the soil-water balance model. The evapotranspiration of full irrigated wheat was 416 mm, 423 mm and 419 mm for the lysimeter, Bowen ratio energy balance method and model, respectively. The evapotranspiration of I_{50} and I_{00} was estimated by the model as 403 and 347 mm, respectively. The average grain yields ranged from 5650 to 5880 kg/ha, biomass values ranged from 1.51 to 2.01 kg/m² and harvest index values ranged from 0.37 to 0.29 in different treatments. There is no significant difference between rainfed and irrigation conditions for yield, biomass and harvest index values due to high precipitation (560 mm) during the growing season and heavy clay soil with water holding capacity of 264 mm/m.

Keywords: wheat, deficit irrigation, Mediterranean, Bowen Ratio, evapotranspiration, lysimeter.

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713. ROUANE Mustapha (Algeria)

Supervisor: L. S. Pereira ; advisors: M. Todorovic and D. Assimacopoulos

Eco-efficiency assessment of the Sinistra Ofanto irrigation scheme under wet, normal and dry climatic conditions. – 100 p.

Abstract: This study aims at the eco-efficiency assessment of the SinistraOfanto irrigation scheme under different climatic conditions. The concept is based on the ratio between the product added value and the environmental impacts in terms of water, energy and fertilizer inputs and of outputs/emissions to water, soil and air. Economic data included production costs and market prices. The methodology applied 11 midpoint environmental impact categories selected as being the most representative for the system environmental assessment and divided into 2 processes: background, including the resources production (water, fertilizers and energy), and foreground, including those stages where resources are used. Wet, normal and dry climatic conditions were defined through the frequency analysis done by ISAREG for each crop with monthly climatic data, while simulations were based on daily weather data recorded for 11 years. Yield estimation was done by applying different irrigation strategies and factors. The analysis was performed by using Systemic Environmental Analysis Tool (SEAT) and Economic Value Chain Analysis Tool (EVAT) developed within the EcoWater project. The best system eco-efficiency was obtained during rainy years due to the lowest irrigation input. Water and corresponding energy consumption mainly affected the system performance under different climate conditions while fertilizers impact remained unchanged.

Keywords: crop water requirements, irrigation strategies, ISAREG model, Systemic Environmental Analysis Tool (SEAT), Economic Value Chain Analysis Tool (EVAT), EcoWater project.

714. ELNAGGAR Ahmed Galal Ibrahim (Egypt)

Supervisor: A. Daccache ; advisor: N. Lamaddalena

Potential energy saving in sprinkler irrigation with sectoring management technique. – 68 p.

Abstract: The main objective of this study is to investigate potential on-farm energy saving with sectoring management and with different pumping systems (fixed speed pump/variable speed pump/small parallel pumps). The study was conducted on a solid set sprinkler system designed using the Labye's iterative discontinuous method to irrigate 10 hectares of potato crop under arid conditions of Egypt. The operational parameters (pressure/discharge) of the system were obtained from the intersection of the network/sector and pump characteristic curves. Using the pump efficiency curves and the total volume of water applied, energy consumption for any management and design scenario is obtained. The analysis revealed that sectoring with the system operating with 2 pumps in parallel or with a variable frequency drive (VFD) pump reduced the energy consumption by 26% and 15% respectively when compared to the conventional operation. Energy saving resulted from the lower friction losses in the main pipes (lower volume of water flowing in the pipes) and from the better water application uniformity (more

uniform pressure). Also the cost of using two pumps in parallel was lowered by 35% and 54% with respect to one fixed speed and to VFD pumps, respectively.

Keywords: System design, network analysis, energy cost, pump.

715. AWADA Hassan (Lebanon)

Supervisor: R. Khadra ; *advisors:* M.A. Moreno; A. Scardigno and N. Lamaddalena

Energy consumption and performance optimization of large scale pressurized irrigation systems. – 126 p.

Abstract: A multi-step methodology was defined and applied to an on-demand pressurized irrigation system that operates through a pumping station in the Sinistra Ofanto irrigation scheme of Foggia, Italy. The methodology combined sectoring, according to the pressure requirements of the network hydrants, with the optimal regulation of the pumping station, which accounted for fixed and variable head control and for the performance achieved, at hydrant level, in each generated scenario. To this end, EPANET, COPAM, WINGENERA, RDCC and the Pumping Station Simulated models were integrated. The optimal modernization scenario showed 48.81% energy saving together with an adequate recovered performance at hydrant level, as compared to the actual operation of the system. The monetary assessment demonstrated that the achieved energy saving amounted to 23.636, 00 euro per irrigation season, among which 10.573, 00 euro are due to sectoring, thereby setting the study feasibility threshold to 1.% in terms of affordable yield reduction. The defined methodology shows promising results as to energy saving and performance enhancement but recommends a detailed assessment of the impact of reduced flexibility on the yield production at farm level, as a result of the applied sectoring.

Keywords: energy saving, performance, sectoring, pressurized irrigation systems, regulation, fixed and variable head control, flexibility, feasibility.

716. TISSOUDAL Mina (Morocco)

Supervisor: R. Choukr Allah ; *advisor:* A. Hamdy

Interactive effects of nitrogen and calcium on growth and yield of sweet corn (*Zea mays sacharata*) under saline conditions. – 80 p.

Abstract: The aim of our study was to identify the important role that appropriate nitrogen and calcium applications could play by reducing the expected negative effects of saline irrigation water on sweet corn growing parameters and yield. The experiment was conducted in southern Morocco using two nitrogen application rates of 120 and 240 kg/ha in the presence and absence of CaO (90 l/ha) and with irrigation water EC-values of 1, 4 and 8 dS/m. Results showed a negative relationship between the irrigation water salinity levels and most of the measured plant growth parameters. Increasing water salinity up to 8 dS/m reduced the sweet corn yield by 58% compared to the one obtained with fresh water irrigation. By contrast, the appropriate nitrogen application at 240 kg/ha with addition of calcium showed its positive effects in alleviating the salt-induced damages, increasing the photosynthesis activity, and in giving a yield 1.3 times higher than the one recorded at the nitrogen rate of 120 kg/ha. Calcium showed a beneficial role in reducing sodium concentration by 30% in leaves and by 20% in the substrate, and in ameliorating stomatal conductance and proline accumulation in both leaves and roots under the high salinity level of 8 dS/m.

Keywords: sweet corn, saline water, nitrogen, calcium, growth parameters, yield, proline.

717. TALAHMA Mohammed (*Palestine*)

Supervisor: M. Mastrorilli

Assessing the impact of climate change on crop water requirements: the case of "Capitanata plain". – 101 p.

Abstract: The aim of this study was to assess the effects of climate change on crop water requirements. Two periods were compared in the area of Capitanata, i.e., the past time (1951-2000) and the near future (2021-2050). The comparison concerned seasonal and daily evapotranspiration (ET) of durum wheat and tomato. The ET was estimated by AquaCrop and CRITERIA models after their calibration and validation. During the crop seasons, the main effect of climate change resulted in daily temperature increase and effective rainfall decrease. On the seasonal scale, the crop ET value was expected to be lower than in the past, following the reduction of the crop cycle (7 days shorter in the case of tomato and 8 days in the case of wheat). However, average daily evapotranspiration in the subsequent scenarios proved to be higher than in the past on a daily scale (from 12.0 to 17.3 % for tomato and from 6.4 to 9.2 % for wheat, according to AquaCrop and CRITERIA models, respectively). With a view to adapt the Mediterranean cropping systems to the constraints deriving from climate change, the recourse to agro-techniques was suggested in the final section.

Keywords: daily evapotranspiration, seasonal evapotranspiration, mitigation, durum wheat, tomato, crop water requirements, AquaCrop model, CRITERIA model.

718. BEN CHARFI Imen (*Tunisia*)

Supervisor: R. Albrizio ; *advisor:* M. Tododrovic

Application of ground based remote sensing techniques to evaluate physiological and biometric variables of potato (*Solanum tuberosum* L.) grown under different water treatments. – 67 p.

Abstract: This study assessed the applicability of ground remote sensing techniques to evaluate the variation of physiological and biometric variables of potato grown under three water treatments: rainfed, 50% and 100% of irrigation requirements. An open field experiment was conducted in 2014 at MAIB (Valenzano, Bari, Italy). Results confirmed that, on leaf scale, the Crop Water Stress Index (CWSI) correlated better to stomatal conductance, transpiration rate and net assimilation with respect to Simple Ratio Index (SR) and Normalized Difference Vegetation Index (NDVI). On canopy scale, the Soil Adjusted Vegetation Index (SAVI), especially when using the variable L, performed better than NDVI in relation to the crop biometric variables (LAI and biomass). A CWSI of 0.2 could be recommended as threshold for non-stressed irrigation of potato, whereas the upper limit of the difference between canopy and air temperature was fixed at 9.5°C. Water use efficiency measured on leaf scale increased by passing from the most irrigated treatment to the rainfed one. No significant difference in yield between the three treatments was found due to abundant precipitation (ca. 242 mm) occurred throughout the cropping cycle.

Keywords: vegetation indices, CWSI, SAVI, deficit irrigation, water use efficiency, leaf scale vs canopy scale.

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736. INAGAKI Misaki (*Japan*)

Supervisors: K. Inosako and M. Todorovic

Water status indicators of olive crops grown under water stress conditions.

Abstract: The physiological responses of olive trees (*Olea europaea* L.) under two deficit irrigation strategies ('Deficit irrigation 50%' and 'Deficit irrigation 25% + Rainfed') were monitored through selected indicators (sap flow, stem water content, soil water content and leaf conductance) from June to September 2014, at the experimental field of the CIHEAM-IAMB. The main objectives of this study are: 1) to clarify the main features of the response of selected water status indicators to the level of plant water stress, 2) to evaluate possible relationships among different indicators through their continuous field monitoring, and 3) to identify the most sensitive indicator to water stress to be used to support water saving strategies in olive crop management. The difference in responses of olive trees under two water treatments was significant in terms of the selected water status indicators. The difference between two treatments clearly and rapidly appeared in sap flow. Soil water content has shown also the possibility to be used for practical purposes to evaluate "critical" threshold values, specific for a given crop. The effectiveness of irrigation strategies to avoid water stress can be confirmed by the use of such indicators.

Keywords: deficit irrigation, sap flow, stem water content, soil water content, leaf conductance.

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755. SIAD Si Mokrane (Algeria)

Supervisor: P. Zdruli; advisor: V. Iacobellis

Continuous land use/land cover changes impacts on stream flow discharge modeling and driving factors investigation. – 90 p.

Abstract: Given the complexity of the land use/land cover changes problem in which are involved different parameters (Environmental, Social, Economical...etc.), a multidisciplinary approach is mandatory to reach the state-of-the-art understanding. The DREAM model: Distributed model for Runoff, Evaporation and Antecedent soil Moisture simulation, is optimised and applied to model the effect of (LULCC) on water budget and to estimate stream flow discharges. With particular emphasis for the model parameters optimization and the spatio-temporal changes pertaining to LULCC. Processed LANDSAT images are used to analyse the changes in the land use, and MODIS Leaf Area Index images are used for model input to simulate the effect of land cover dynamic. In addition, a thorough investigation for the driving factors leading to LULCC. It includes Physical (climatic) and Human (economics and governance) driving factors. The study is conducted in the Celone at San Vincenzo sub-basin of Candelaro watershed in the Apulia region, Southern Italy. An area, as expected, offers great conditions for such study. Indeed, the watershed soil components demonstrate a high dynamicity. Synthesise linking and causals relations were mad for the different components involving within the Celone to drawn recommendations for the future governance and management of the area.

Keywords: DREAM, Land use/Land cover changes, CAP, LAI, MODIS, Celone, Italy.

756. STOJAKOVIC Nevena (Bosnia & Herzegovina)

Supervisor: R. Stricevic ; advisor: M. Todorovic

Impact of climate change on water requirements and yield of maize grown under different pedo-climatic conditions in Bosnia and Herzegovina. – 81 p.

Abstract: The impact of climate change was investigated on three main maize production zones (Banjaluka – northwest, Bijeljina – northeast and Mostar – south). Four climatic scenarios were used (A1B, A2, A1B>CO₂, A2>CO₂) for 20's (2010-2039); 50's (2040-2069) and 80's (2070-2099). The reference period for comparison was 1961-1990. AquaCrop model was applied to consider joint effect of precipitation, temperature and CO₂ concentration. The model was calibrated using the data from various experimental trials carried out in the target areas during the period 2004-2013 for different fertility, planting density, water regime (rainfed and supplemental irrigation) and sowing dates. The results differed from one study area to another, for different projection scenarios and timing periods under consideration. The anticipation of sowing from 10 days in 20's to 30 days in 80's was observed for all areas and it was greater for A2 than for A1B scenarios. Yield was greater for the scenarios with enhanced CO₂. For Bijeljina, yield reduction was observed with a progressive increase from 33% in 20's to 53% in 80's. For Banjaluka, a slight yield increase is possible in 20's and 50's while yield reduction up to 14% is expected in 80's. For Mostar, yield reduction up to 17% and 7% is

expected for 20's and 50's, respectively, while an increase from 2 to 20% is foreseen for 80's. For the same period, the irrigation requirements are foreseen to increase up to 64, 93 and 32% for Bijeljina, Banjaluka and Mostar, respectively. The increment was lower for the scenarios with increased CO₂ concentration due to more favorable precipitation pattern.

Keywords: AquaCrop, sowing period, irrigation, A1B SRES, A2 SRES, simulation.

757. MOHAMED Abdelmoneim Zakaria (Egypt)

Supervisor: A. Al Sayed ; *advisor:* T. Tawfic

In-stream wetland as a sustainable wastewater treatment technology in rural communities of Egypt. – 85 p.

Abstract: Treating and recycling drainage water in irrigation is a strategic Egyptian target to face water scarcity. For this reason, it is essential to seek a low-cost alternative wastewater treatment that is convenient for large quantities of water. Among the natural treatment systems, in-stream wetland has high potential applications in rural communities of Egypt, as the treatment process takes place within the drain. Thus, it needs much less land, is easily maintained, can adsorb shock loads and requires relatively less capital and lower operational cost. This research work was conducted to evaluate in-stream wetland in treating polluted wastewater to the limit that ensures its safety for irrigation, in compliance with Law 48/1982. The site selection criteria, hydrology and sustainable management plan of in-stream wetland have been investigated. Moreover, a wetland treatment performance model (PREWet 2.4) has been applied to determine the pollutant concentrations in the treated water, based on the plug flow and mixed flow hypotheses. Results of the study demonstrate that in-stream wetland can treat wastewater to the limit that ensures its safety for irrigation. The results of PREWet 2.4 model based on plug flow assumption are relatively close to the field-measured data of most pollutants at wetland outlet.

Keywords: In-stream wetland, Wastewater treatment, PREWet 2.4, Heavy Metals, Rural communities, Egypt.

758. AL-AYADI Fares (Jordan)

Supervisor: M. Shatanawi ; *advisor:* N. Lamaddalena

Improving water management and efficiency in the Jordan Valley's Water Users Associations. – 131 p.

Abstract: A Water User Association (WUA) is established by a group of water users to participate in the operation and maintenance and to improve on-farm irrigation efficiency and delivery. This study involved the following steps: collecting data on JVA (Jordan Valley Authority) farming systems and WUAs; conducting a survey through questionnaires and meetings with stakeholders; evaluating WUA operating regime using Epanet model; discussing the Epanet output with stakeholders to improve water delivery; and checking the economic feasibility of the suggested technical solutions. Management of the network by WUAs was based on experience rather than hydraulic principles leading to low pressure and flow rate in FTAs (Farm Turnout Assembly) on one line. This would lead to operating a large number of farm units compared to the original pipe capacity. The current operating regime has caused loss of water and energy. To solve these problems, an improved rotational operating system was simulated using Epanet. The simulation results showed that the network can satisfy good operational conditions of flow rate and

pressure. For improved operation the regime should be automated and monitored remotely. The automated solution, ready-made, is easy to operate and maintain, and would ensure long sustainability with low operation and maintenance costs and high efficiency.

Keywords: WUAs, water management, water efficiency, Epanet, JVA, automation system, FTA.

759. GAZAL Osama (Jordan)

Supervisor: M. Shatanawi ; advisor: N. Lamaddalena

Groundwater contamination of shallow aquifer due to irrigation activities in Dhuleil and Khalidiyyeh area in Jordan. – 147 p.

Abstract: Groundwater contamination is considered a top priority study at Ministry of Water and Irrigation of Jordan. Its importance stems from the need to develop a clear vision for decision makers and leaders toward water quality and scarcity.

The rapid increase in population, both by natural growth and unpredicted fluxes of refugees from Syria, and not just from there, at a very quick rate during the past decades, and related anthropogenic activities have produced several environmental problems especially nitrate contamination. The refugees exceed the Jordanian residents in the study area as it is close to Zatari Refugee camp. It is an example of the semi-arid high land areas where the irrigated agricultural activities need to be controlled and the effects in the aquifer need to be studied. All the available historical data were collected and analyzed and water sampling was carried out from several production wells, from the shallow aquifer located at a minimum depth of 100 m, to evaluate the nitrate concentration. The results show a high nitrate contamination in the southeastern part of the study area because of intensive fertilizers use, whereas the nitrate concentrations are acceptable near the populated part as an indicator that the septic tanks are not the cause for contamination.

Keywords: fertilizer use, nitrate, groundwater, contamination, water scarcity, refugees, septic tanks, irrigated agriculture.

760. SHABEEB Ahmed Saad (Iraq)

Supervisor: A. Coppola ; advisor: N. Lamaddalena

Analysing application efficiency and distribution uniformity under drip irrigation by monitoring and modeling soil water dynamics. – 64 p.

Abstract: Using the traditional performance index of Emission Uniformity (EU) as an indicator of the irrigation performance may be misleading, as it implicitly assumes that water application uniformity immediately leads to a similar uniformity of the water stored in the root zone. Due to the heterogeneity of soil hydrological properties, the same EU might correspond to a different distribution of water stored in the soil root zone. In order to overcome this problem, a methodology has been developed to introduce an EU index which accounts for the actual distribution of pressure heads (and thus of water contents) in the upper layer of the soil, under drip irrigation. The methodology includes TDR measurements and 3D modeling of the pressure head (and thus of water contents) distribution inside the wetted bulb, under drip irrigation. As the 3D modeling requires soil hydraulic properties to be known in all the sites needed to calculate the uniformity index, hydraulic property measurement methods have been adopted using the same drippers as those used for determining the uniformity index. TDR measurements have allowed for reproducing, during simulations, the water content actually measured under drip irrigation.

Keywords: soil water, Time Domain Reflectometry (TDR), irrigation efficiency, distribution uniformity.

761. ASSIF El Mahdi (Morocco)

Supervisor: L.S.Pereira ; advisors: D. D'Agostino and M. Todorovic

Modeling water use, transpiration, yield and water productivity prediction for various sowing dates of wheat and potato using the dual crop coefficient approach. – 82 p.

Abstract: Several experimental data on wheat and potato crops grown under rainfed, deficit and full irrigation at IAM-Bari were used to model the partitioning of evapotranspiration, yield prediction and water productivity for various sowing dates. To this purpose, the SIMDualKc water balance model, that adopts the dual crop coefficient approach, was used to evaluate the transpiration and soil evaporation component of those crops under the referred water management alternatives. Transpiration estimates were then used with the Stewart's water-yield model to predict wheat and potato yields under different irrigation schedules. SIMDualKc model was first calibrated and validated to obtain the basal crop coefficients and the depletion fraction for no stress relative to all crop stages. The calibrated parameters, particularly the basal crop coefficients, were close to expected ones. Modelling results showed a good agreement with the observed soil water content data. The yield prediction through combining SIMDualKc and the Stewart's model was successful for all treatments leading to a small RMSE of 407 kg ha⁻¹ for wheat and 620 kg ha⁻¹ for potato, which compared well with the values reported in literature. The seasonal analysis of SIMDualKc was used to determine the optimum sowing dates for wheat and potato under the local conditions using long-term historical weather data. The sowing dates showed a significant effect on yield and water use, and the highest values were obtained when sowing wheat by early January and planting potato by early March.

Keywords: wheat crop, potato crop, SIMDualKc model, evapotranspiration partitioning, yield prediction, water productivity, sowing dates.

762. BOURAY Moussa (Morocco)

Supervisor: R. Choukr Allah ; advisor: A. Hamdy

Effects of humic acid and calcium nitrate on potato (*Solanum tuberosum* L. cv. *Desiree*) response to irrigation water salinity. – 86 p.

Abstract: A field experiment was conducted in southern morocco in order to investigate the effects of salinity on yield, growth and biochemical parameters of *Solanum tuberosum* L. as well as on the soil parameters. A split plot experiment with six replicates was adopted. The trial included two variables: irrigation with saline water of 1.5, 4 and 6 ds/m and two soil amendments treatments: calcium nitrate and humic acid. Results showed a negative relationship between the irrigation water salinity levels and most of the measured parameters. The raise of the irrigation salinity level up to 6 ds/m reduced the yield by 32.1% compared to the control (1.5ds/m). The soil amendments showed a positive effects in alleviating the salinity damages by reducing the salt accumulation in soil, enhancing the leaf growth and increasing its photosynthetic pigments content, and as a result the total yield production was increased by an average 28% of that recorded under saline irrigation treatments where no soil amendments were applied. Humic acid played an important role as soil conditioner while calcium nitrate was more efficient in promoting proline accumulation in leaves. Economic analysis pointed that the humic acid was not feasible. Whereas, the calcium nitrate gave an interesting profitability.

Keywords: potato, saline water, humic acid, calcium nitrate, yield, proline, net income.

763. MEZZANE Soufiyan (Morocco)

Supervisors: R. Khadra and A. Scardigno ; advisor: N. Lamaddalena

Framing Water-Energy-Food nexus in the modernization process of on-demand pressurized irrigation systems. – 93 p.

Abstract: A multi-step methodology which optimizes energy consumption and performance of large scale pressurized irrigation systems was defined, to modernize an on-demand system operating through a pumping station. First, the interaction between the Off and On farm systems was characterized: using AKLA and DripNet models, Relative Pressure Deficit at hydrant and Distribution Uniformity at field were assessed under different operating conditions, , and achieved crops' yields were quantified. Second, these outputs were integrated into an optimization model for network sectoring. The model, encoded in GAMS language, maximizes farmers' income while minimizing energy consumption. Third, the upstream discharges and their frequency of occurrence throughout the irrigation season were generated: using WINGENERA calibrated for the study area, both the network as a whole and the resulting sectoring were considered. Finally, the optimal configuration of the pumping station was identified by computing the energy consumption of 5 scenarios, combining differently sectoring, pumping station regulation and fixed or dynamic head control. The results show that, per irrigation season, up to 49% of energy saving and 84 €/ha of farmer income increase can be achieved, and associating performance enhancement with sectoring, can avoid crop yield reduction that can be provoked by loss of flexibility.

Keywords: nexus, modernization, optimization, energy saving, performance, sectoring, pumping station regulation, farmers' income.

764. ALNAJAJREH Abedelkareem (*Palestine*)

Supervisor: M. Todorovic ; advisor: D. D'Agostino

Assessing the impact of climate change on water demand and supply management strategies in the West Bank. – 75 p.

Abstract: This study compared the current water supply-demand scenario, referring to year 2010, with the year 2050 based on the climate change data for A1B SRES (Special Report on Emission Scenarios) and actual population growth of 2.7%. Water Evaluation and Planning System (WEAP) was used to generate different scenarios and management options for the future. The model was calibrated using the available data for the current situation with the aim of achieving water balance between supply and demand for each province while taking into account both the agricultural and urban sector. The agricultural water requirements were elaborated for the province-specific cropping pattern. Then, the model was calibrated fixing the irrigation inputs for each crop. For 2050, an increase of water demand by 131.2 million m³ is foreseen mainly due to population growth. The analysis demonstrated that this deficit could be partially counterbalanced by the use of treated wastewater (62.6 million m³), rainwater harvesting from rooftops of greenhouses (15.5 million m³) and reduction of urban water losses (7.8 million m³). The rest could be recovered by the aquifers provided that pumping will be possible. An alternative solution could be the reduction of population growth by 50% in 5 out of 11 provinces. Therefore, the recovery of water deficit in the future is mainly through the solution of the political situation in the region.

Keywords: Water resources management, WEAP model, water balance, treated wastewater use, rooftop water harvesting, groundwater.

765. BEN HASSINE Mortadha (*Tunisia*)

Supervisor: O. Boussadia ; advisor: I. Oueslati

Water Use Efficiency (WUE) of two olive tree cultivars (*Olea europaea* L. cv. Koroneiki and Chemlali) under three water treatments. – 66 p.

Abstract: Despite the immense potential for olive production, Tunisia is known as an underprivileged country in water resources and water scarcity is evident in certain regions. This work aims to determine the reliable combination between olive cultivar and water treatment that allows the best water use efficiency. For this reason, two experiments were applied: Under greenhouse condition (three water treatments, 100%, 50% and 0% Available Water Content (AWC) on 'Koroneiki' and 'Chemlali') and in Field Condition (three water treatments, 100%, 50% AWC and farmer irrigation on 'Chemlali'). The green house results showed that Chemlali plants irrigated at 50% AWC present the most efficient combination comparatively with the Koroneiki cultivar for the same treatment. Indeed, Chemlali plants recorded (I) a progressive osmotic adjustment; (II) the best intrinsic and extrinsic Water Use Efficiency; (III) a regular biomass and (IV) the best root/shoot ratio. These results indicate that Chemlali cultivar valorizes better low quantities of water (T50%) rather than high quantities (T100%) comparatively to Koroneiki cultivar. (V) Field results, confirm that Chemlali cultivar presents the best fructification rate at T50% treatment compared to T100% and farmer irrigation. Chemlali T50% seems to be the most efficient water treatment.

Keywords: *Olea europaea* L., water use efficiency, water status, Ecophysiological behavior, biomass accumulation, soil moisture, fructification rate.

766. MZID Nada (Tunisia)

Supervisor: R. Albrizio ; *advisors:* M. Todorovic and V. Cantore

Comparison of satellite and ground-based remote sensing methods for the estimation of wheat crop physiological and biometric parameters. – 80 p.

Abstract: Nowadays, the comparison between sensing techniques is becoming a necessity because of the increase of sensors and methods for data acquisition. This study compared two remote sensing techniques (satellite and ground-based) as approaches describing the variation of physiological and biometric parameters of durum wheat grown under different water conditions (rainfed, deficit irrigation and full irrigation). The experimental work was carried out in Policoro (Matera) from February to June. The Landsat 8 images and ground-based remote sensing data were acquired regularly in April, May and June together with plant bio-physiological parameters. The overall results indicated no significant differences in terms of both biomass and yield among the irrigation regimes because of the abundant precipitation (355 mm) which limited the irrigation supply. Water Deficit Index (WDI) was strongly related to plant water status, compared to Crop Water Stress Index (CWSI). Soil Adjusted Vegetation Index (SAVI) showed slightly better performance than Normalized Difference Vegetation Index (NDVI) when plotted against the Leaf Area Index (LAI) with $R^2=0.90$ and 0.84 , respectively. The best performance was obtained for the Enhanced Vegetation Index (EVI) derived from satellite data with $R^2=0.98$. Therefore, the satellite data could provide reasonable indication about the crop growth especially if applied with higher resolution.

Keywords: NDVI, SAVI, CWSI, WDI, EVI, LAI, deficit irrigation.

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792. CANAJ Kledja (Albania)

Supervisor: P. Zdruli ; advisors: F. Sallaku and R. Khadra

Title: Evaluating the performance of Participatory irrigation management in Albania: The case study of Çukas water user association. 73 p.

Abstract: In recent decades, Participatory Irrigation Management (PIM) programs and Irrigation Management Transfer (IMT) policies have become the most popular management patterns to ensure the sustainability of irrigation systems. However, monitoring and evaluation tools must be used to guarantee their ongoing implementation, adequate development and the maintenance of their capacities over time. The present study aims to assess the performance of Cukas Water User Association (WUA) located in Lushnja district in Albania following the transfer of irrigation management from government structures to local entities. The analysis was performed using MONEVA software, an innovative decision making tool developed by IAM-Bari in the framework of "Sustainable Water Integrated Management – Support Mechanism" (SWIM-SM) project. Overall, the Cukas WUA is functioning adequately by well maintaining and operating the irrigation scheme; however, future agricultural development will require profound changes to the present operation of the services at all levels in order to achieve a better performance. Under current conditions, the financial long-term sustainability of the WUA remains questionable; especially if a suitable water pricing mechanism with the goal of cost recovery is not adopted in the near future. Currently, Albania is performing institutional changes in irrigation management and PIM policies, consequently accentuating the need for continuous monitoring and evaluation of irrigation performance. Thus, assessment tools such as MONEVA could assist the stakeholders and policy makers to analyze the performance of irrigation management and to identify the best strategies towards mutual interests. In this context, the utilization of the system shall be incentivized at the national level particularly by the Ministry of Agriculture, Rural Development and Water Administration.

Keywords: Albania, Irrigation management, WUA, Monitoring and Evaluation, MONEVA.

793. DERARDJA Bilal (Algeria)

Supervisor: N. Lamaddalena ; advisors: R. Khadra and M. A. Moreno

Title: Perturbation indicators for the pressurized irrigation system. – 73 p.

Abstract: The perturbation in pressurized irrigation systems is created when changes in flow rates occur in the pipes. This is mainly due to the hydrants manipulation, leading to a phenomenon called "water hammer". Such phenomenon may lead to a very important pressure increase in pipes and may be the cause of their break. FAO has developed a methodology, called MASSCOTE, for assessing the performance of open canal irrigation systems. A perturbation indicator was defined in MASSCOTE. Recently, FAO and CIHEAM-Bari are adapting the MASSCOTE methodology to pressurized irrigation systems (MASSPRES) and a perturbation indicator needs to be developed for such systems. Therefore, a

software program has been written in the framework of the present thesis to understand unsteady flow in pressurized irrigation systems. Three indicators have been set up: 1) the Hydrant Risk Indicator (HRI), providing the hydrant degree of danger of the system; 2) The Relative Pressure Variation (RPV) and 3) the Relative Pressure Exceedance (RPE), giving the variation of the unsteady state pressure with respect to, respectively, the steady state pressure and the nominal pressure. On-demand irrigation systems have been taken into consideration in this study; 500 different hydrant configurations have been simulated.

Keywords: Pressurized irrigation systems, on-demand, perturbation indicators, hydrants manipulation, water hammer, MASSPRES.

794. ABDALLA Mohamed Ahmed Ibrahim (Egypt)

Supervisor: A. Coppola ; *advisors:* P. Zdruli and A. El Sadek

Title: A rainfall-runoff model for water management in wadi systems based on hydropedological studies. – 123 p.

Abstract: The main aim of this thesis was to make a water balance in the Agarma sub-basin of the Wadi Kharouba - Egypt. The study area includes a 13 ha area that was reclaimed into cultivated terraces from a previously heavily eroded, abandoned and degraded landscape thanks to the Matrouh Rural Sustainable Development Project (MARSADEV). The study mostly focused on the evaluation of the water volume that can be stored in the soil terraces after reclamation. The first step was to collect rainfall, water content data and soil hydrological characteristics in high temporal-spatial resolution to be used as input for a distributed model. In the study period (October 2015 – February 2016, the rainy season for the area), a total of 230 mm of rain was recorded. Results shows that up to 50,000 m³ of rainwater were stored into the soil terraces after land reclamation. As a second step, the rainfall-runoff responses in the basin were predicted by applying the Kineros2 distributed model to four rainfall-runoff events. The first two events were used for a calibration of the model based on a comparison of measured and simulated total water stored in the soil profile of the reclaimed terraces. Model water storage predictions were mostly affected by both the saturated hydraulic conductivity, K_{sp} , and the maximum saturation of hillslopes, S_{max} . Once the most sensitive parameters of the model were calibrated, a validation was carried out by using the best parameter vector obtained and two independent data sets coming from the two rainfall events not used in the calibration procedure. Overall, validation results were quite satisfactory by considering the short historical series used in the calibration and validation procedure, which is likely not to include enough information for robust calibration. However, it is expected that by integrating the set of storage measurements with discharge measurements coming from a recently installed ultrasonic instrument to measure the amount of water leaving the watershed, the model predictions will improve significantly.

Keywords: Rainfall-runoff model, water balance, kineros2, hydrological model, water management, soil water content, GIS, Egypt.

795. ABDELMONEIM Ahmed Ali Ayoub (Egypt)

Supervisor: T. Tawfic ; *advisors:* R. Khadra, A. Scardigno and N. Lamaddalena

Title: Integrated irrigation improvement & management program in Egypt: a comparative assessment of the design criteria. – 61 p.

Abstract: In the late 70's, the Integrated Improvement Irrigation and Management Program (IIIMP) was launched in Egypt to increase the efficiency of irrigated agriculture water use and services.

This study evaluates the main impacts of the program in El-Wassat command area through three indicators: Water Use Index, Energy Consumption and Land Saving. Moreover, it simulates and analyses a further enhancement of the improved tertiary canal through irrigation network optimization and outlets recalibration, by using an ad hoc software model, and upscales this enhancement to all tertiary canals of the case study. Uniformity, Energy Consumption and Total Costs of the enhancement were estimated, and comparison with the system improved through IIIMP was performed. The results show that i) the impact of the improvement process by IIIMP in terms of equity and adequacy mainly depends on the cropping pattern and farmers' behavior and ii) by optimizing the network and re-calibrating the outlets, the total cost of the improved system can be reduced and a maximum distribution uniformity (equity) ensured.

Keywords: Comparative assessment, irrigation improvement, Egypt.

796. MAHMOUD Sobhy Mohamed Abdelmonem (Egypt)

Supervisor: M. Todorovic ; advisors: R. Albrizio and V. Cantore

Title: Simulation of melon growth and yield under different water regimes and mulching practices. – 71 p.

Abstract: AquaCrop model was calibrated using the results of an experimental work on melon cultivated under different water regimes (full, deficit irrigation and rainfed) and non-mulching condition in Valenzano (Southern Italy) during the 2016 season. Model validation was done on the mulching treatments of the same experiment and the experimental data of melon growth under full irrigation and mulching and non-mulching cover in Policoro (Southern Italy) for 1999 and 2001 seasons. The statistical indicators confirmed good performance of AquaCrop in simulating melon growth under different water regimes without mulching. The model adequately simulated the impact of mulching in terms of soil evaporation, transpiration and final biomass. However, AquaCrop does not consider the impact of temperature increase under plastic mulching. Accordingly, the model does not predict faster crop development, reduction of growing season and increased growth rate under mulching. Therefore, a module for the consideration of temperature below mulching cover is recommended to improve the model performance. The use of GDD (growing degree days) mode instead of calendar-days does not improve the simulation results at the location of Policoro. A more complex GDD function should be adopted to take into consideration the high variability of air temperature during the growing season.

Keywords: Crop growth modeling, AquaCrop, irrigation, plastic mulch, growing degree days, Mediterranean climate.

797. AL-NABER Sama Azzam Fadian (Jordan)

Supervisor: L. S. Pereira ; advisor: D. D'Agostino

Title: Assessing water use and demand in the Sinistra Ofanto irrigation district. – 102 p.

Abstract: This research aims to assess and partition the evapotranspiration under different irrigation scenarios of the main crops (olive, vineyard, wheat, potato, cantaloupe, watermelon, etc..) cultivated in an irrigation district located in Apulia

region (Southern Italy). The SIMDualKc model, which performs the soil water balance adopting the FAO-56 dual crop coefficient approach, was used to evaluate the crop transpiration and soil evaporation components of those crops. The parametrization of the crops has been derived from field visits and previous studies conducted on the same crops, cultivated in the Mediterranean areas. The results obtained showed irrigation depth (ID) values for table grapes, wine grapes, olives, peach and Tomato of 325mm, 175mm, 175mm, 300mm and 240mm for full irrigation, respectively. Meanwhile, ID of 250mm, 100mm, 100mm, 175mm and 180mm were obtained for the same crop sequence for moderate deficit. The comparison between the volume supplied in *Capitanata* and the volume simulated by the model confirmed that irrigation schedule plan was necessary. In order to upscale the results obtained and represent them directly as maps, the water balance model has been integrated with a geographic information system (GIS), implementing a toolbar, specially created for the scope, in ArcMap 10. The accurate and straightforward estimation of the spatial and temporal variation of irrigation requirement for different crops in the studied area has been the starting point for a precise management of water resources.

Keywords: Sinistra Ofanto, SIMDualKc, dual crop coefficient, evapotranspiration, GIS.

798. MAWAT Abbas Jabbar (Iraq)

Supervisor: A. Coppola ; advisor: N. Lamaddalena

Title: Evaluating the effects of emitter discharges on water and salt distribution under drip-irrigated crops by coupling field measurements and a 2D model for soil water and solute dynamics. – 103 p.

Abstract: A methodology was developed based on a combination of field monitoring and simulations of water contents and solute concentrations, to determine the degree to which management practices can be used to affect horizontal water spreading and solute distribution from drip irrigation emitters. A specific aim of the study was to evaluate the effect of the application rate on the water and solute distribution in the wetted bulb under transient flow conditions. The motivation was mostly to minimize leaching for optimal water and nutrient availability and uptake, as well as to reduce risk of groundwater pollution. The database used was from experiments carried out at the experimental fields of IAM-Bari. Four plots of 7m x 5m area were irrigated with drippers delivering water at a rate of 2, 4, 8 and 12 l/h, respectively. An electrical conductivity of 6 dSm⁻¹ was artificially induced in the irrigation water by adding a corresponding amount of calcium chloride. Water and solute distributions were monitored by TDR probes and direct soil sampling in three selected bulbs for each plot after 8 irrigation cycles. Results were also analyzed by a 2D model for water flow and solute transport in soil under transient conditions. Results suggest that the common assumption that the solute would move at the periphery of the bulb during the irrigation is not verified in the soil investigated. This may be observed for all the sections and for all the discharges examined.

Keywords: Time Domain Reflectometry (TDR), 2D model, soil water content, solute concentration.

799. BEN BRAHIM Mohamed (Morocco)

Supervisor: R. Albrizio ; advisor M. Todorovic and V. Cantore

Title: Impact of irrigation and mulching practices on growth, development and yield of melon. – 69 p.

Abstract: The experimental work was carried out in Valenzano (Southern Italy) under open field conditions. Three water regimes (full irrigation, deficit irrigation - 50% of full irrigation, and rainfed) and two mulching treatments (black plastic mulching and non-mulching) were compared utilizing a split plot design with three replications. The use of mulching has reduced the crop cycle by 8 days and crop evapotranspiration by 17%. The impact was especially relevant during the initial growing period. Significant differences between water treatments were found for biomass and marketable yield which increased under full irrigation in respect to rainfed by 100 and 210%, respectively. Mulching has increased marketable yield under rainfed 3 times and by 30% in the case of deficit irrigation. However, no significant trend was observed in the statistical analysis except for the mean fruit weight. Most of quality parameters were improved in rainfed treatment, while morphological parameters were the highest in full irrigated treatment. Intrinsic WUE under rainfed was higher than for both irrigated treatments – the increase of water stress in the root zone resulted in a greater reduction of stomatal conductance than of assimilation rate. Crop Water Stress Index can be applied to monitor melon water stress and manage irrigation.

Keywords: *Cucumis melo* L., plastic mulching, deficit irrigation, crop water stress index, water use efficiency.

800. DAHAMOU El Hassan (Morocco)

Supervisor: A. Daccache ; advisor: N. Lamaddalena

Title: A GIS based model for design and analysis of on-demand pressurized water distribution systems. – 70 p.

Abstract: Pressurized water distribution systems plays an important role in water saving due to their high conveyance efficiency and the quality of the service provided. A new GIS based hydraulic tool was developed to design and analyse stochastically complex systems with on-demand operation. The novelty of this tool is the integration of several analysis and optimisation methods as well as the automatic generation of input files from GIS layers. The performance analysis can be performed at system level using the network characteristic curve model or at hydrant level. A new performance improvement algorithm was also included and consists of using localized loops to improve network performance. Labye iterative discontinuous method is used for pipe size optimization using single flow regime, multiple flow regime and Pareto front (Reliability based) design discharge method. The GIS based model was tested on a simple network where different optimization techniques were applied and compared. The reliability based method proved to be the cheapest design option without big compromises on performance. Localized loops also proved to be a prominent solution for performance enhancement. The presence of flow regulators in the hydrants has also proved to be crucial for the entire performance of the system. The model was also applied on a very complex network with multi-loops, reservoirs.

Keywords: Pressurized systems, GIS, complex network, optimization model, characteristic curve, looped, computational tool.

801. EL AMINI Bouchra (Morocco)

Supervisor: R. Choukr-Allah ; advisor: A. Hamdy

Title: The effect of phosphorus fertilization on potato crop growth and production under saline condition in different soil texture (Clay and sandy soil). – 69 p.

Abstract: The aim of our study was to identify the effect of phosphorus fertilization on potato response to irrigation water salinity in different soil textures. An open field experiment was carried out in southern Morocco using three levels of saline irrigation water (1.5, 4 and 6 ds/m) and three P application rates (P120kg, P150kg/ha and P180 kg/ha). The experiment was done in two soils of different texture: loamy and sandy. Results showed a negative relationship between the irrigation water salinity levels and most of the measured parameters. Compared to the control (1.5ds/m), the raise up of the irrigation salinity level to 6 ds/m reduced the yield by 28% in loamy soil and by 12% in sandy soil. This indicates clearly that under saline irrigation practices, the coarse textured soil is the one to be recommended. Concerning the P application at different doses, data indicate that the intermediate one, i.e. 150kg/ha, is to be recommended, as it improved the vegetative growth, giving a better yield under the investigated EC values, lowering the accumulated salts as well as increasing the photosynthetic pigments to combat the toxic effects of salinity.

Keywords: Potato, saline water, phosphorus rates, yield, proline, soil texture.

802. ALZEERALHOUSEINI Omar (Palestine)

Supervisor: F. Pirozzi ; advisor: D. Spasiano

Title: Comparison of CAS vs MBR in Hebron City wastewater treatment plant for the reuse of the effluents in agriculture. – 79 p.

Abstract: In this study, a design was made of secondary treatment plants using the conventional activated sludge system and the membrane bioreactor system. A comparison between both systems was done in order to identify the most cost-effective treatment system of urban wastewater for agricultural reuse in Hebron city (Palestine). Therefore, both systems were designed under various water quality and flow rate scenarios in accordance with the Palestinian regulations to achieve an effluent quality suitable for irrigated agriculture. An Excel-based tool was developed to design the treatment plants while the costs of both systems were estimated using CAPDETWorks v3.0 software. The results demonstrated that the MBR system, for Hebron city, is more cost-effective compared to CAS system except in the case where high flow rate has to be treated and low effluent quality is required. The total cost is strongly affected by the land and electricity cost as these two elements have a high relative weight in the wastewater treatment plants cost estimation. Further examination of the software results showed that the comparative capital and overall lifecycle costs of CAS versus MBR systems are strongly influenced by local construction costs. The methodology followed in this study could be suggested as a model to be implemented in wastewater treatment in Palestine.

Keywords: Wastewater treatment plant, Conventional activated sludge (CAS), Membrane bioreactor (MBR), cost effectiveness.

803. BEN HAMOUDA Ghaieth (Tunisia)

Supervisor: A. Daccache ; advisor: D. D'Agostino

Title: Mapping weather data and assessing climate variables in Apulia region. – 72 p.

Abstract: Apulia Region (Southern Italy) lacks reliable historical and spatial reference evapotranspiration (ET_o) and precipitation records that are crucial for any water resources planning study. Hence, 63 years of historical climate data (1950-2012) were collected from 126 and 83 pluviometric and thermometric weather

stations respectively. Out of which, only 96 and 34 pluviometric and thermometric weather stations passed the quality and homogeneity tests. ETo using the empirical equation of Hargreaves-Samani (HS) was calibrated and validated against Penman-Monteith (PM) method at five different locations. Statistically a better estimation of monthly ETo could be obtained using the HS calibrated equations for February and for the period from April to June and from October to December. To determine the spatial distribution of monthly ETo and rainfall, three different interpolation techniques (inverse distance weighting (IDW), thin-plate spline (TPS) and ordinary kriging (OK)) were compared. The cross validation results were analyzed using the Root mean square error (RMSE) and the mean absolute error (MAE). Results showed that, for rainfall, IDW gave better results for July and for the period from November to May while OK performed better for September and October. Both methods performed better than TPS in August. For ETo, OK yielded better results from September to April while IDW had better prediction from May to July. Both methods outperformed TPS in August.

Keywords: Reference evapotranspiration, precipitation, interpolation, homogeneity tests, quality check, climate.

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822. BENDOUHENE Kenza (Algeria)

Supervisor: M. K. Mihoubi ; advisor: N. Lamaddalena

Title: Experimental study of wastewater irrigation influence on soil parameters evolution and tomato crop.

Abstract: The influence of irrigation water quality on soil physical and chemical properties and tomato crop yield was assessed in this study. Two types of soil (sandy loam and clay loam) and three types of water (Fresh water FW, Raw wastewater RWW and treated wastewater TWW) were used to irrigate tomato crop cultivated in 6 PVC columns. During the experiment, laboratory analysis and measurements for irrigation water, soil, drainage water and tomato crop were performed. The results showed that the application of wastewater increased soil salinity and soil bulk density, decreased pH and soil porosity. High concentration of copper was measured in RWW used for irrigation. The analysis of copper in drainage water and tomato crop showed that it was absorbed by soil particles and not by plant. Irrigation with wastewater was beneficial in increasing tomato yield without affecting the fruit with heavy metals. From this study, we concluded that the real effect of irrigation with wastewater on soil and crops will appear in long term period.

Keywords: wastewater, fresh water, sandy-loam, clay-loam, salinity, tomato, copper.

823. MOGHRANI Siham (Algeria)

Supervisor: A. Coppola ; advisor: G. Dragonetti

Title: Assessing field spatial variability of soil hydraulic properties by combining a multiple dripper system, 2D soil water flow numerical modeling and Time Domain Reflectometry (TDR)

Abstract: Knowing soil hydraulic properties is crucial for predicting soil water flow and thus for water resources management and protection. The main objective of this study was to develop a methodology to rapidly assess the spatial variability of soil hydraulic properties at field scale. The methodology combines time domain reflectometry (TDR) measurements and 2D modeling of the water content distribution and dynamics within the wetted bulb under drippers. Compared to other consolidated field hydraulic characterization methods, the proposed approach allows for rapid estimation of soil hydraulic properties simultaneously at multiple locations, so that the spatial variability of these properties may be obtained from a single fast field irrigation experiment. The experimental setup consists of an irrigation system equipped with drippers delivering in sequence three different discharges. A 2D analytical solution of the Richards' equation, based on the Russo-Gardner water retention and hydraulic conductivity functions, was used for predicting the water content distribution evolution beneath a dripper. The evolution over time of the TDR-based average water content measured in the wetted bulb under each dripper was used as input for inverting the 2D analytical solution of Richards' equation. The goodness of the hydraulic property estimations obtained through the proposed method was established by comparing them to the

measurements made by tension infiltrometers in the same sites. In general, the proposed method provided hydraulic properties estimations not significantly different from the measurements obtained by the tension infiltrometer. This was also verified by carrying out numerical simulations of some selected functional properties (deep percolation fluxes, water content, transpiration fluxes,...) simulated alternatively by the parameters obtained using the proposed methodology and those coming from the tension infiltrometer data analysis. The inversion method, on which the proposed method is mostly based, is especially sensitive to the alpha parameter in the Gardner-Russo model for soil hydraulic properties.

Keywords: Soil hydraulic properties, Water flow modeling, Time Domain Reflectometry (TDR), Inverse parameter estimation, Multidripper system, Tension infiltrometer measurements.

824. ELFAHL Mustafa Youssif (Egypt)

Supervisor: S. Borin ; advisors: G. Dragonetti and N. Lamaddalena

Title: Assessment of inoculation with plant growth promoting bacteria (PGPB) on potted tomato plants under optimal and limited irrigation: effects on soil-water storage, plant physiology and productivity

Abstract: Inoculation of plants with selected beneficial bacteria has the potential to improve sustainability in agriculture. The influence of bacteria on plant-water relations remains, nevertheless, poorly explored. In this study Plant Growth Promoting (PGP) bacteria were inoculated on tomato plants to evaluate their influence on plant physiological parameters, fruit yield, soil water storage and water productivity. In a greenhouse experiment, PGP strains previously isolated from the plants adapted to drought conditions were tested (*Micrococcus yunnanensis* M1, *Bacillus simplex* RP26, *Pseudomonas stutzeri* SR7-77, *Arthrobacter aureus* 2-T30 and *Arthrobacter nitroguajacolicus* 2-50). Three water regimes were applied: full irrigation (100%) and two deficit regimes at 75% and 50%, based on crop water requirements. Time Domain Reflectometry (TDR) was used to monitor the changes of soil water stored for irrigation management. Overall, all the strains showed a significantly positive influence on one or more parameters compared with the non-inoculated control plants. Most of the strains showed PGP activity only under the most stressed conditions (50%). The strains M1, RP26 and 2-50 showed an average fruit yield larger than the non-inoculated control plants, only at 50% irrigation. The results indicate that PGP bacteria have the potential to improve the response of tomato to drought. The effects are strain-dependent and putatively related to bacterial influence on plant water-use efficiency, especially under water limitation.

Keywords: Plant Growth Promoting Bacteria (PGPB), soil water fluxes, Time Domain Reflectometry (TDR), water productivity, physiological parameters.

825. SALLAHU Sokol (Kosovo)

Supervisor: X. Elezi; advisor: P. Zdruli

Title: Heavy Metal Contamination of Soils in the Kastriot Municipality of the Prishtina region in Kosovo

Abstract: The study area is located in the Municipality of Kastriot, Prishtina region near the Power Plants Kosovo A and B. The aim was to evaluate the total concentration levels of heavy metals (As, Cr, Cd, Co, Cu, Mo, Ni, Pb, Sr, Zn, and V) causing pollution in different types of soil. Soil samples were collected at the depth of 0-30 cm in an agricultural area of about 5,000 ha divided in three circles (2, 4, and 6 km from the Power Plants). A total of 40 geo-referenced samples were collected, 35 in the study area and 5 in the control zone at 25 km from the plants. The method for the determination of heavy metals was based on the spectroscopy with plasma-ICP-OES, EPA 12914: 2012. Results showed that contamination is higher at the third circle, thus indicating that pollution is spreading in larger areas. These results were compared with the allowed limits and the intervention threshold values of the EU. Special attention was devoted to the delineation of contaminated areas that should be off limits to humans, livestock, and urban/rural development. Mitigation technologies need to be applied to decontaminate the polluted areas. Local and national governmental structures are advised to pay careful attention to legislation and enforcement to avoid any further negative environmental consequences.

Keywords: Heavy metals, soil pollution, contamination, permissible EU limits, mitigation, remediation.

826. BELABHIR Afaf (Morocco)

Supervisor: R. Choukr Allah ; advisor: A. Hamdy

Title: Effect of treated wastewater on the growth and yield of two sweet corn varieties: impact of doses and systems of irrigation

Abstract: The feasibility of using treated wastewater for growing sweet corn in Souss-Massa region, under different systems and doses of irrigation, was investigated. An open field experiment was carried out in southern Morocco using two sweet corn varieties Prime-plus and SF681; and two irrigation systems (SSD, sub-surface drip irrigation) and (SD, surface drip irrigation) also two irrigation doses regime 100% and 120% ETM calculated by Lysimeters. Results showed a positive relationship between the irrigation doses and most of the measured agronomic parameters. Adding the leaching fraction of 20% ETM, improve growth and yield of both sweet corn varieties. The highest yield was achieved by SF681 variety with 20 T/ha, under (SD) irrigated with 120% ETM. Reducing water application by 20% decreases yield production up to 24.4% under (SD), and the same yield for both 100% and 120% ETM under (SSD), therefore we can save 20% of water under (SSD). Despite that (SSD) saves water, it increased soil salinity, even in sandy soil, due to the accumulation of salts in the root zone. The sweet corn water consumption was 186 mm, by using treated wastewater, allowing a saving of conventional water. In addition, it generated an economic gain in term of fertilizers: 240 kg/ha of N; 23 kg/ha of P2O5; 80 kg/ha of K2O.

Keywords: Treated wastewater, sweet corn, varieties, irrigation system, irrigation doses, behavior, growth parameters, yield, water saving, salts accumulation, soil.

827. MANSOURI Anas (Morocco)

Supervisor: A. Hammani ; advisor: M. Todorovic

Title: Assessment of performance of drip irrigation at plot and farm scale in a pilot sector in Tadla region (Morocco)

Abstract: This study assessed the performance of drip irrigation in Tadla region after the conversion from surface irrigation in 2015. It represents the first collective conversion experience at the national level. The analysis was based on a multi-disciplinary approach using engineering, agronomic, weather, soil and economic data collected at 23 farms selected within a pilot sector of 4045 ha. The engineering performance of the system was high since it is a newly constructed system: the application efficiency was greater than 80% for 86% of the plots while the uniformity coefficient was greater than 80% for 94% of the plots. However, inadequate operating pressure was observed in most plots due to the non-respect of the sectorial water distribution plan and the lack of pressure regulators. The yield increase was up to 50% for sugar beet, up to 200% for maize and cereals and up to 300% for alfalfa. The revenue was increased up to 80%. Water consumption increased in most of the farms and for almost all crops due to greater water availability (shifting from rotation to restricted on-demand water supply) and low technical capacity (experience) of farmers to use drip irrigation. Training of farmers is needed to save water and improve agricultural water efficiency.

Keywords: collective conversion project, drip irrigation, engineering performance, agro-economic performance, irrigation management, irrigation practices, water saving.

828. OUKETTOU Oualid (Morocco)

Supervisor: A. Bamouh ; advisors: A. Scardigno and R. Khadra

Title: Collective conversion to drip irrigation of Bittit scheme (Saïs region-Morocco)

Abstract: This research study aims to elaborate a methodology of collective conversion from surface to drip irrigation in the small and medium irrigation scheme of Bittit, located in Saïs region, Morocco. The Bittit scheme, covering a total area of around 6118 ha, is one of the first experiences of conversion to drip irrigation launched by the Ministry of Agriculture within the Project of Rainfed Areas Development and the PNEEI to improve farmers' socio-economic conditions. Through a stakeholder-driven process, based on interviews and exchanges with farmers, a pilot district has been selected by multi-criteria analysis and two collective pressurized alternative networks have been proposed and evaluated in terms of water tariffs, amount of saved water, farmers' income and economic value of water. The results obtained demonstrate that the conversion process doubled farmers' income, allowing 25% water saving and an increase in water value by 5.49 Dh. This approach could be adopted in other irrigation schemes to accomplish a conversion process to drip irrigation, by taking into account appropriately the technical and socio-economic aspects.

Keywords: conversion to drip irrigation, small and medium irrigation scheme, Water Users Associations, participatory approach, alternative scenarios, water value.

829. DROUBI Rahma (*Palestine*)

Supervisor: M. Hadad ; advisors: L. Sbailhat and M. Todorovic

Title: Effect of complementary irrigation with treated wastewater on almond yield, quality and soil chemical properties

Abstract: Prolonged summer drought in Palestine is the main limiting factor that affects almond production and has influence on fruit load, kernel quality and alternate bearing. This study aims to investigate the effect of using limited complementary irrigation (CI) with treated wastewater on almond fruit yield and quality. The study has been done during the spring-summer 2017 in Jenin district. Adult almond trees were subjected to three water regimes: CI with treated wastewater (TWW), CI with freshwater (FW), and non-irrigated rain-fed (RF). Irrigated trees have received five irrigations with 200 l/tree each during the period from April to August. Results showed that CI had no remarkable effects on fruit yield during the 'heavy crop year'. However, yield quality was affected positively by CI. Fruit weight and size were increased in the CI treatments compared to control treatment. Results of short term effect of TWW on soil indicated a significant increase in soil fertility in terms of OM and macronutrients in TWW irrigated plots. These plots also showed a significant increase in EC and slight decrease in soil PH. High Na concentration caused the increase of soil SAR, but it did not cause problems in the present study.

Keywords: drought stress, kernel quality, leaf physiology, soil salinity, soil PH, soil fertility.

830. ALOBID Mohannad (*Syria*)

Supervisor: N. Lamaddalena

Title: Impact of flow regulators in pressurized irrigation systems

Abstract: In pressurized irrigation systems, discharges and pressures vary strongly in time and space throughout the network. Performance analysis under different operational conditions is therefore needed in order to assess the variation of pressure head and discharge at hydrants. Performance analysis models usually assume a constant hydrants' discharge (i.e.: FAO – COPAM software, 2000) and do not consider effects of installed pressure and discharge regulation devices within the hydrants and at the upstream end of the system. These aspects can be considered using pressure-driven models. In this study, the FLUCS model (Lamaddalena and Pereira, 2007) was used. Such model considers two performance indicators applied to every hydrants: the relative pressure deficit and the reliability. In the framework of this thesis, a new performance indicator was developed: the hydrant internal sensitivity. Four different types of networks were analyzed considering the characteristic curves of the most common hydrants and upstream flow regulators. Results show that performance highly depends upon the characteristic curve of the selected combination of flow and pressure regulators installed at the upstream end of networks and at the hydrants. In addition, it was recognized that when the number of operating hydrants exceeds the designed one, as it often occurs during peak demand periods, best results are obtained with upstream flow limiters that allow some discharge flexibility and produce relatively low head losses. Under these conditions, proportional discharge regulators at hydrants perform better than hydrants having a constant discharge.

Keywords: pressurized irrigation systems, performance analysis, relative pressure deficit, reliability, hydrant internal sensitivity, flow regulator.

831. BEN ABDELKADER Ahmed (*Tunisia*)

Supervisor: R. Albrizio ; advisors: M. Todorovic and V. Cantore

Title: Application of satellite (Landsat 8 and Sentinel 2A) and ground based remote sensing data methods for the estimation of wheat physiological and biometric parameters under three water treatments

Abstract: Remote sensing technique has become an important tool for monitoring the response of crops to water management practices. This study investigated the performance of two remote sensing approaches (satellite and ground-based) to estimate the variation of bio-physiological parameters of durum wheat grown under different water regimes (rainfed, deficit irrigation and full irrigation). The experimental work was carried out in Policoro (Matera) during the 2016-2017 season using the data from two satellites (Landsat 8 and Sentinel 2A) and ground-based measurements with spectro-radiometer. Water Index (WI) was strongly related to the plant water status when correlated with gas exchanges measurements. In turn, the normalized difference infrared index (NDII) showed tolerable correlations mainly with the photosynthesis and transpiration rate. Both Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI) showed high performance when plotted against the Leaf Area Index (LAI) with $R^2=0.86$ and 0.82 , respectively. Concerning the dry ground biomass, the best performance was obtained for the satellite-derived Enhanced Vegetation Index (EVI) with $R^2=0.8$. Sentinel 2A performed better than Landsat 8 due to its higher spatial resolution. Therefore, satellite data could provide reasonable indication about the crop growth especially if applied with higher resolution sensors.

Keywords: NDVI, SAVI, WI, NDII, EVI, LAI, dry biomass.

832. BENYAHIA Fadwa (*Tunisia*)

Supervisor: L. S. Pereira ; advisors: D. D'Agostino and P. Paredes

Title: Modeling water demand using the dual Kc approach in the Sinistra Ofanto irrigation scheme (Italy)

Abstract: The SIMDualKc soil water balance model, that adopts the dual crop coefficients approach, was used to assess water use and evapotranspiration process of all crops cultivated in District 10 of Sinistra Ofanto irrigation scheme (Apulia region, Italy) aiming at improving knowledge on water use and irrigation scheduling. The model was parameterized for 3 years (2014-2016) based on field visit and previous studies. The simulation of two irrigation management scenarios was conducted in order to better understand water use and its impact on irrigation requirements. As the model partitions ET_c into transpiration and soil evaporation, the modified version of the Stewart's relation was adopted, using the transpiration deficit to determine the relative yield losses for each crop. In order to upscale from the various fields to the system level, the integration of GIS technique with the SIMDualKc model was performed for a spatial explicitness of irrigation requirements under the referred management scenarios. Results could be used by farmers and/or water managers as an indicator or support for irrigation advising and scheduling.

Keywords: SIMDualKc model, dual crop coefficients, evapotranspiration portioning, irrigation requirements, soil water balance components, GIS-SIMDualKc.

833. AKTÜRK Seyithan (Turkey)

Supervisor: A. Yazar ; advisor: N. Lamaddalena

Title: Comparison of various deficit irrigation strategies on yield, yield components and water productivity of surface and subsurface drip-irrigated quinoa under Mediterranean climatic conditions

Abstract: The field experiment aiming at the determination of optimal irrigation strategies for surface and subsurface drip irrigated quinoa (*Chenopodium quinoa* Wild. cv. Titicaca) under the Mediterranean climatic conditions has been carried out in the experimental field of the Irrigation and Agricultural Structures Department of the Cukurova University in Adana, Turkey. Crop water use (ET) values ranged from 169 mm in RF to 282 mm in FI in surface drip, and varied between 169 mm in RF and 271 mm in FI in subsurface drip plots. Quinoa under surface drip plots used slightly more water than subsurface drip pots for the same treatments. Greatest quinoa grain yield was obtained from the FI plots in surface drip and subsurface drip plots. There was no significant difference in grain yields between the drip irrigation systems. Irrigation method and irrigation treatment interaction was significantly different with regards to dry matter yield. FI under Subsurface drip produced significantly greater dry matter yield than other treatments followed by FI under surface drip plots. The use of DI strategies (PRD and RDI) combined with highly technological irrigation techniques (e.g. sub-surface drip irrigation system), proved to be very effective for improving the efficient use of irrigation water in semiarid regions.

Keywords: quinoa, deficit irrigation, regulated deficit irrigation, partial rootzone.

834. SHINODA Moeko (Japan)

Supervisor: Koji Inosako ; advisor: M. Todorovic

Title: Effects of different irrigation management strategies on the fluctuation of water status indicators of olive trees

Abstract: The physiological response of olive trees (*Olea europaea* L.) under two water regimes ('Irrigated' and 'Rainfed') was monitored through four water status indicators (sap flow, stem water content, stem water potential and soil water content) from March to September 2017 at the experimental field of CIHEAM Bari. The main objectives were: *i)* to study the behavior of water status indicators under different water strategies, *ii)* to establish the relationships between different irrigation regimes and water status indicators under different water availability conditions (water stress) and *iii)* to understand which indicator shows the most sensitive response to water stress for water-saving irrigation of olive. The difference in responses of olive trees under two water regimes was significant in terms of the selected water status indicators. Sap flow and stem water content showed a good performance, indicating clearly and rapidly the difference between irrigated and rainfed regimes, and the onset of water stress. Sap flow was shown to be especially sensitive to water stress. Stem water potential reacted to water stress but it was also affected by vapor pressure deficit under well-watered conditions. The effectiveness of irrigation strategies to avoid water stress can be confirmed by the use of such indicators.

Keywords: Olive tree, sap flow, stem water content, stem water potential, soil water content

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854. SENGOUGA Asma (Algeria)

Supervisor: A. Coppola ; advisors: N. Lamaddalena and G. Dragonetti

Title: Identifying optimal irrigation water needs at district scale by using a physically based agro-hydrological model

Abstract: This thesis illustrates an irrigation management tool simulating district-level irrigation water scheduling. The tool is based on a daily model for simulating flow of water and solutes in heterogeneous agri-environmental systems (named FLOWS-HAGES). The model simulates the daily evolution of: soil water contents and pressure heads in the soil profile; water uptake and actual evapotranspiration; stress periods for each crop; return fluxes to the groundwater and their quality in terms of solute concentrations (e.g. nitrates). For specific input data (LAI, Potential Evapotranspiration...), the model may interact with remote sensing maps. FLOWS-HAGES provides a list of hydrants to be operated daily according to some water or crop-based criteria. The daily optimal sequence of hydrants opening may be thus established by passing the volumes to be delivered to a model for simulating the hydraulics of the irrigation network (the COPAM model, for example), in order to guarantee that the discharges flowing inside the distribution pipes network are delivered under optimal pressure head distribution. To illustrate the potentiality of the modeling tool, the methodology has been applied to establish irrigation scheduling over the irrigation season for a selected sector of the Irrigation District 10 in the "Sinistra Ofanto" irrigation system (Apulia region, Italy).

Keywords: district-scale irrigation, Soil hydrological properties, soil water flow modeling, irrigation networks modeling, stochastic simulations.

855. ABOODA Majid Hameedi Mnadee (Iraq)

Supervisor: A. Coppola ; advisors: N. Lamaddalena and G. Dragonetti

Title: Monitoring and modelling water and salt infiltration and redistribution in soils irrigated with saline water.

Abstract: The purpose of this study was monitoring spatio-temporal distributions of water and salt during an infiltration process at plot-scale. Monitoring of the temporal wetting front during water and salt infiltration into soil was done by using Time Domain Reflectometry (TDR) technique. The main aim was to develop a practical and relatively simple methodology to regulate farm practices for salinity management based on coupling: 1) field data of water contents and salinity concentrations observed in a soil plot irrigated with saline water by using TDR sensors; 2) a physically based agro-hydrological model (FLOWS-HAGES) for simulating water flow and solute transport in the soil-plant-atmosphere system. Simultaneous Time-Domain Reflectometry (TDR) readings of bulk electrical conductivity (σ_b) and water content were used for converting TDR measurements to soil water electrical conductivity (σ_w) estimations to be used for assessing salt leaching and the actual distribution of salts with depth along the whole soil profile for calibration of the model. Once the model has been properly calibrated and validated, it may be used extensively to simulate field conditions for understanding

both the actual and long-term effects of various management and application alternatives on the distribution of salts at either farm or district-scale.

Keywords: Soil water content and salinity distribution, Time Domain Reflectometry, Agrohdrological models.

856. IZZADDIN Aras Botan (Iraqi Kurdistan)

Supervisor: V. Iacobellis ; *advisor:* N. Lamaddalena

Title: Probabilistic regional evaluation of monthly flow duration curves In Iraqi Kurdistan Region.

Abstract: Prediction of hydrological variables in ungauged catchments is getting a lot of attention from hydrologists and researchers around the world; it is a fundamental and recurrent hydrological task for addressing problems related to hydropower generation, river and reservoir sedimentation, water-use assessment, water allocation and habitat suitability. A regional hydrologic model developed for estimating flow duration curves (FDCs) at ungauged and unregulated basins in Iraqi Kurdistan Region, FDC often exhibits complex shapes, requiring probability density functions with three or more parameters. This research evaluated monthly FDCs using two parameters lognormal probability density function. Annual FDCs approach has been adopted with the evaluation of Intrannual and interannual frequency. Fitting lognormal density functions to the observed FDCs at sixteen watersheds. Regional model is developed to describe the lognormal model parameters regarding measured basin characteristics. The resulting regional model requires estimates of catchment characteristics and climatic index which have been obtained by using GIS techniques and data from catchment characteristics and climate. The validity of the regional model has been checked by using Jack- Knife method. The validation experiment reveals that the resulting regional hydrologic model can provide remarkably precise estimates of an FDCs at an ungauged site in Iraqi Kurdistan region, considering the simplicity of the model and its ease of application.

Keywords: Iraqi Kurdistan Region, Regional model, Probabilistic flow duration curve, Annual flow duration curve, local model.

857. CHBIB Nabil (Lebanon)

Supervisor: L. S. Pereira ; *advisors:* D. D'Agostino and P. Paredes

Title: Effective management of irrigation water under water scarcity conditions in the Sinistra Ofanto irrigation scheme (Southern Italy)

Abstract: The present research aims to assess the soil water balance (SWB), adopting the FAO-56 dual crop coefficient approach, and the behavior of the farmers in relation to irrigation scheduling. The SIMDualKc model was used to evaluate the crop transpiration and soil evaporation components of three crops (olive, peach, and grapevine), cultivated in an irrigation district located in Apulia region (Southern Italy) and was parametrized for 5 years (2013-2017) based on field visits and previous studies. Crop transpiration was 8 mm for olive, 9 mm for peach and 10 mm for grapevine during the initial crop stage, 18 mm, 27 mm and 12 mm respectively for the vegetative growth period, 239 mm, 163 mm and 167 mm respectively for the mid-season, and 49 mm, 12 mm and 10 mm for the end season. Soil evaporation represented 24%, 37% and 25% of ET_c for olive, peach and grapevine respectively. Models' results of evapotranspiration were used to assess the effectiveness of farmers' irrigation plan, by comparing it with the

volume of water supplied by the consortium. The comparison pointed out that farmers, in most cases, are applying less water than required due to different conditions that can occur.

Keywords: SIMDualKc model, FAO-56 dual crop coefficients, irrigation requirements, soil water balance, crop evapotranspiration.

858. MJALLAL Mohammad (Lebanon)

Supervisor: M. Todorovic ; Advisor: V. Cantore

Title: Water Footprint of winter wheat grown under different precipitation regimes and irrigation and Nitrogen practices in a Mediterranean environment.

Abstract: The aim of this study was to assess water footprint of winter wheat crop using daily weather data collected from 1997 to 2017 in Valenzano (Southern Italy). The study considered different precipitation regimes, water and nitrogen (N) inputs. AquaCrop growth model was used to estimate biomass, yield, and water balance components. The statistical parameters indicated a very strong relationship between measured and simulated canopy cover, dry aboveground biomass, and soil moisture content. Crop evapotranspiration (green, blue, total) and yield obtained under N were greater than without N for different water practices. WFgreen demonstrated to be particularly linked to the precipitation in December whereas WFblue showed a relevant correlation (R^2 around 0.60) with the precipitation availability in March, April, and May. WF results under different water management practices and N scenario were improved in respect to scenarios without N. Total WF for RF was 6.5% greater than FI if N was applied and around 7.0% if not. WP confirmed the total WF results. However, as WP does not recognize the irrigation input, it is less suitable to compare irrigation strategies. This study reveals that WF promotes the effective use of green water. Moreover, it allows the identification of the best management practices for providing the most efficient irrigation scheduling addressed to a sustainable use of water resources.

Keywords: green water footprint, blue water footprint, green crop evapotranspiration, blue crop evapotranspiration, Yield, Full irrigation, deficit irrigation, rainfed cultivation, Nitrogen management, water productivity, AquaCrop growth model.

859. CHERRADI Soumiya (Morocco)

Supervisor: S. Borin ; advisors: G. Dragonetti and R. Choukr Allah

Title: Plant Growth-Promoting Bacteria (PGPB) inoculation: assessment of soil and tomato plant responses under water stress and greenhouse conditions.

Abstract: Plant Growth Promoting Bacteria (PGPB) may establish close associations with plant to protect it from abiotic stresses and enhance its growth. This study evaluated the effect of PGPB on plant's physiological and growing parameters as well as on soil physical properties, under different water stress levels. The experiment has been conducted in experimental greenhouse, inoculating two bacteria strains (*Micrococcus yunnanensis* (M1); *Pseudomonas stutzeri* (SR7-77)) on tomato plants and applying three water regimes: full irrigation (100% Pot Capacity - PC) and two deficit regimes at 75% and 50% PC. Overall, the two strains showed a significance decrease in soil permeability comparing to the control, but they made soil water availability (AW) more efficient under water stress periods, besides increasing root surface density, especially for SR7-77. Furthermore, the combination of bacteria and specific water regimes had a significance response on shoot and root dry weight ratio and on leaf water use efficiency (WUE), whereas, they did not show positive effect on other parameters as yield but in terms of water regime it shows a slight effect of (M1) at 75% and 50% PC comparing to the control. Due to uncontrolled factors, the bacteria's tests compared to the control showed a high variability that often influences the significance. Once the two variability (control and bacteria) were made comparable such parameters as AW and WUE showed a high significance.

Keywords: Plant Growth Promoting Bacteria (PGPB), pot capacity, physiological and growing parameters, soil physical properties, greenhouse variability.

860. EL YAIKOURI Salah Eddine (Morocco)

Supervisor: A. Hammani

Title: Performance assessment and enhancement of a sprinkler irrigation district converted to drip irrigation during the transition phase.

Abstract: Recently converted to drip irrigation, the C3 district in the perimeter of Gharb Morocco is home to two irrigation modes operating simultaneously. During this transition phase, the on-farm drip equipment is not yet installed on all farms, some farmers still irrigating by sprinklers using either the old existing hydrants or the new farm outlets. This study has a double aim. firstly, is to assess the irrigation system performances under different operational conditions by means of hydraulic simulation models in COPAM and AKLA using relative pressure deficit and reliability as performance indicators. Secondly, is to enhance the service quality to conduct the on-farm irrigation in an appropriate way. Five scenarios were prepared according to the spatial-temporal evolution of the on-farm drip and sprinkler equipment also structural improvements were tested. Fields measurements and surveys were conducted to compare between experimental and simulation results. Different levels of pressure drop were noticed at some critical zones of the network. Reinforcing pipe size or increasing the total piezometric elevation at the pumping station showed satisfactory results.

Keywords: AKLA, critical zones, drip, farm outlets, Gharb, hydrant, performance indicators, reinforcing, relative pressure deficit, reliability, satisfactory, service quality, simultaneously, sprinkler, transition phase.

861. OUBELKACEM Abdellah (Morocco)

Supervisor: R. Choukr Allah ; advisors: A. Scardigno, G. Dragonetti and R. Khadra

Title: Treated wastewater use on citrus in morocco: assessing the economic feasibility of irrigation and nutrient management strategies.

Abstract: Treated wastewater (TWW) reuse for irrigation represents one strategy for Mediterranean countries to overcome pressure on fresh water resources. However, an appropriate irrigation and nutrient management must be determined and the economic feasibility must be assessed to promote its use. In this work, the assessment of the economic feasibility of irrigation and nutrient management with TWW reuse has been carried out on Citrus in Souss Massa region, Morocco, identifying appropriate scenarios predicted by two models. The first model, Safe Irrigation Management (SIM), was used to simulate the effect of TWW reuse on yields and on water and fertilizers requirements. The second one, a non-linear mathematical optimization model, was used to assess the economic feasibility of TWW reuse. Different scenarios of water pricing and irrigation technology policies have been simulated. The overall results indicated that TWW reuse has no significant effect on yield, but helps to preserve considerable amounts of fertilizing elements. Results also demonstrate that TWW reuse has to be subsidized in order to be proposed as a convenient alternative for irrigation. Subsidizing the price of TWW, rather than the irrigation equipment, enhances the switch of areas from fresh water to treated wastewater with considerable savings in freshwater.

Keywords: Souss Massa, Citrus, treated wastewater reuse, irrigation and nutrient management, SIM model, optimization model, water policy.

862. AL SHAWA Izziddin M.I. (Palestine)

Supervisor: H. Al-Najar ; advisor: M. Todorovic

Title: Assessment of climate change impact and seawater intrusion on the agricultural water demand in Gaza strip.

Abstract: This study investigated the expected change of the crop water requirement due to possible impact of climate change and seawater intrusion in Gaza Strip [GS]. The elaborations were performed in ArcGIS through the integration of climate data, agricultural classification and water quality maps. Crop evapotranspiration, Net Irrigation Requirements [NIR] and Leaching Requirement [LR] were estimated following the standard FAO methodology. These data were compared by the effectively applied irrigation volumes [AIV], acquired on the field at more than 300 locations, to estimation Irrigation Efficiency [EI]. The analysis considered the baseline of (1990-2010) and the climate data projection (2025-2035) corresponding to the A1B scenario. The water quality data were obtained from on field measurements and a groundwater quality model. The results revealed that NIR would increase by 14.2% from 56.81 to 64.93 Mm³/year. LR is expected to increase by 58% from 7.69 to 12.11 Mm³/year due to worsening of water quality. An overall increase of NIR and LR would be 19.5% from 64.494 to 74.044 Mm³/year. The actual AIV of 97.25 Mm³/year indicated an overall EI of 66% (for Olive, Citrus, Fruits, GH-Vegetables and Open field vegetables was 59%, 60%, 68%, 65%, 72%, respectively). EI should increase in the future to 79% to keep unchanged AIV and to respond to NIR and LR increase.

Keywords: Salinity, Leaching Requirement, Crop Water Requirement, Irrigation Efficiency, GIS, Reference Evapo-transpiration.

863. HAMOUDA Fatma (*Tunisia*)

Supervisor: O. Boussadia ; advisors: I. Oueslati and R. Khadra

Title: Olive tree water use efficiency under Tunisian abiotic stresses conditions (drought and salinity).

Abstract: In Tunisia, irrigated olive trees are cultivated mostly in semi-arid regions where orchards face the big problem of climate change that affects negatively the water quantity (Drought) and quality (Salinity). This work aims to optimize the water use efficiency of olive trees "*Olea europaea* L; cv Koroneiki", a Greek introduced cultivar, under Tunisian abiotic stresses conditions (Drought and salinity). In this context, experimentation was conducted (three water treatments, 100%, 50% and 0% Available Water Content (AWC) compared with the farmer treatment). The results confirmed that, at canopy scale, olive trees irrigated at 100% AWC present the best intrinsic and extrinsic Water Use Efficiency, the best results for the chlorophyll index, and the best fructification rate. At the soil scale, the results confirmed that olive trees irrigated at 100% AWC present the most efficient treatment, indeed, we recorded the best results for the soil sodium and potassium analysis and a relationship between soil electrical conductivity and leaf electrical conductivity ($R^2=0.93$). These results indicate that the Koroneiki cultivar requests high quantities of water (T100%) rather than low quantities (T50%) and that it tolerates the highly saline irrigation water.

Keywords: Koroneiki cultivar, drought, water salinity, Water Use Efficiency, leaf electrical conductivity, fructification rate, soil characteristics.

864. MOUJAHED Hazar (*Tunisia*)

Supervisor: M. Todorovic ; advisor: R. Albrizio

Title: Application of remote sensing techniques for monitoring the growth of potato (*Solanum tuberosum* L.) crop under different water regimes.

Abstract: The aim of this study was to apply two remote sensing techniques (satellite and ground-based) for monitoring the growth of potato crop under three water regimes: rainfed, deficit irrigation and full irrigation. The study was carried out at the CIHEAM-Bari experimental fields (Valenzano, Italy) in the spring of 2018. The results indicated a significant difference in yield and biomass between the two irrigated treatments and the rainfed one. Water deficit index (WDI) was well correlated with the leaf gas exchanges measurements whereas the normalized difference infrared index (NDII) showed tolerable correlations with the gas exchanges measurements. Four satellite-derived vegetation index (NDVI, EVI, SAVI and OSAVI) demonstrated good performance when plotted against the satellite derived LAI. The best performance was obtained with EVI with $R^2=0.89$. Both ground based and satellite VIs showed a significant difference between the two irrigated and rainfed treatments. The ratio between NDVI of potato field and NDVI of grass grown at the nearby agro-meteorological station resembled well the crop coefficient (K_c) behavior of potato for three different water regimes. Therefore, it is expected that Sentinel 2 could permit further investigations in this direction in the future.

Keywords: irrigation, NDVI, EVI, SAVI, OSAVI, LAI, crop coefficient.

865. SAWASSI Aymen (Tunisia)

Supervisor: R. Khadra ; advisor: N. Lamaddalena

Title: Addressing the gaps and opportunities of the re-modernization program in Tunisia: The case of Manouba irrigation scheme.

Abstract: The Tunisian government embarked in the re-modernization of the irrigation schemes in the lower basin of Medjerda, foreseeing their on-demand operation. In this context, the Mediterranean agronomic institute of Bari was assigned the technical assessment of Manouba scheme, implemented in 2013. The modernized scheme is facing the challenge of the inadequacy of the service reported by the users and thus, their refusal to respect the technical and financial terms of the contract signed with the Government, and posing a threat to the continuity of the program. To this aim, a semi-quantitative assessment based on the Rapid Appraisal Procedure was performed in the field, followed by a thorough study of the design criteria and an analysis of performance of the designed system. The results of all the studies were aligned, reporting on a restrictive use of the following parameters of the first formula of Clément used to compute the discharges: the hydrants' elasticity, the coefficient of use of the network and the probability of occurrence of the discharges. The main objective of this study is to assess the correlation between these parameters and their impact on the network performance and cost. The results demonstrate that assigning higher flexibility at hydrant and network level insures a higher performance level, with a minor impact on the cost, the main cause lying behind the restrictive choice of design criteria. It is recommended to apply the same methodology on other on demand pressurized systems to generalize and thus, mainstream the findings into the modernization program.

Keywords: modernization, on-demand schedule, Tunisia, flexibility, cost, service quality.

866. ARTIRAN Murat (Turkey)

Supervisor: S. Asik ; advisor: N. Lamaddalena

Title: Evaluation of Izmir Province Treated Municipal Wastewater as an Irrigation Water Sources.

Abstract: In this study, usage possibilities of treated municipal wastewater for irrigation purposes was investigated. In this scope, the outlet water parameters of the Menemen, Kemalpaşa, Torbalı, Havza and Bayındır wastewater treatment plants were evaluated according to technical procedures of the Official Gazette of the Turkish Government, March 20, 2010, Issue 27527 and international guidelines for wastewater treatment plants compliance in terms of irrigation water quality criteria. Parameters were included pH, electrical conductivity (EC), basic cations (Na⁺, K⁺, Ca²⁺, Mg²⁺), basic anions (Cl⁻, SO₄²⁻, CO₃²⁻, HCO₃⁻) and boron (B) during irrigation season. As a result, the outlet waters of Menemen Wastewater Treatment Plant exceeded the tolerance limit of many plants especially in terms of salinity. The outlet waters were not convenient using for irrigation purposes. On the other hand, Kemalpaşa, Bayındır, Havza and Torbalı Wastewater Treatment Plant's outlet waters were possible to use for irrigation purposes.

Keywords: municipal wastewater, treated wastewater, irrigation water quality.

867. ÖNCEL Çayan Sabahattin (Turkey)

Supervisor: H. Orta ; advisor: M. Todorovic

Title: Irrigation scheduling based on Crop Water Stress Index (CWSI) for cool and warm season turfgrass under sub-drip irrigation method.

Abstract: This study was conducted to determine the irrigation scheduling based on the Crop Water Stress Index (CWSI) of cool (CS) and warm-season (WS) turfgrass species under sub-drip irrigation method in Turkey. Field experiment was carried out during the summer period of 2018 in the Agricultural Production and Research Centre (TURAM) of Silivri municipality, Istanbul, -Turkey (41°03'N; 28°00'E; 46 masl). Three irrigation strategies [I1:30%, I2:50%, and I3:70%) were tested in a split-plot randomized complete block design with three replications. These strategies corresponded, respectively, to 30%, 50% and 70% of total available soil moisture depletion at 0-30 cm of effective root zone and returning soil moisture back to field capacity. The results indicated that colour, quality, fresh yield, dry matter yield, irrigation water use efficiency, water use efficiency and vegetation height and mowing were significantly different in terms of irrigation strategies for both species. The most appropriate irrigation strategies were I2:50% for CS and I3:70% for WS turfgrass which corresponded to the CWSI of 0.47 and 0.45, respectively. The amount of applied irrigation in WS turfgrass was 53% less than in CS turfgrass. Actual evapotranspiration was 26% lower for WS than for CS turfgrass.

Keywords: Landscape irrigation, irrigation scheduling, actual evapotranspiration, canopy temperature, water use efficiency.

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889. BELKACEMI Bouchra (Algeria)

Supervisors: C. Masciopinto and N. Lamaddalena

Title: Climate change impact at Mitidja Plain (Algeria): increasing sea water intrusion into the groundwater. – 91 p.

Abstract: This study analyses the impact of the sea level rise due to climate change and overpumping on the groundwater of Mitidja Plain (Algeria). According to the forecast performed under scenarios RCP 8.5 of the maximum sea level rise of 2.0 meters along the coast of the Algiers Bay, we estimated the new coastline positions during the years 2050, 2100 and 2200 by the Digital Terrain Model (DTM). The sea water intrusion that occurred in the Mitidja coastal aquifer was then studied by flow simulations using MODFLOW and applying the Ghyben–Herzberg theory to determine the freshwater/saltwater interface position along the coast of Algiers Bay. In particular, the flow simulations were carried out, initially, during 1983, when no overpumping from the Mitidja groundwater was recorded. Then, MODFLOW was applied again to study the groundwater flow during 2010 under overpumping conditions. During MODFLOW simulations, the groundwater measurements carried out by the *National Agency for Hydraulic Resources* (NAHR) were used as boundary conditions. Resulting maps of piezometric contour heads and velocity vectors of the groundwater flow field during overexploitation were obtained. Groundwater velocity achieves the maximum value of 0.38 m/d in the area of the pumping-well station near Hamiz, where pumping caused groundwater depressions up to 12-14 m below sea level. The thesis results suggested the implementation of artificial soil barriers in some places along the coast, and management actions, i.e. pumping flowrate limitations, wastewater reuse for irrigation and managed aquifer recharge in order to restore the Mitidja groundwater.

Keywords: climate change, sea level rise, overexploitation, groundwater modeling, seawater intrusion, Modflow/Ghyben-Herzberg simulations.

890. BOUAROUR Ouiza (Algeria)

Supervisors: C. Karydas and P. Zdruli

Title: Estimating actual soil erosion loss in the Candelaro watershed of Apulia region in Italy using the G2 model. - 64 p.

Abstract: Soil erosion is a global problem with severe consequences for soil quality and crop production capacity. This research aimed at assessing the risk of actual soil erosion caused by water in the Candelaro watershed using a new model approach known as the "G2 model", which is inspired by previous long-term research on soil erosion. However, the novelty of the G2 model is that it can provide erosion maps and statistical figures at monthly intervals using several primary data sources such as monthly-step rainfall erosivity data, biophysical time series data derived from remote sensing, digital elevation model (DEM) data, detailed field soil data and land cover maps. The research identified the critical erosion seasons and the high-risk land use types of the study area. Furthermore, in addition to the evaluation of the spatial distribution of the soil erosion rate under

different biophysical conditions, this research identified the seasonality in soil erosion mapping. Based on these results, it was found that autumn-winter months were the most erosive, with an average erosion rate reaching the maximum of 0.12 t/ha in September, while the mean annual erosion rate was estimated at 0.87 t/ha/yr. Such value is by far less than Italy's average erosion rates equal to or higher than 11 t.ha⁻¹.y⁻¹, but this does not mean that the risk of soil erosion should be underestimated. The burnt areas and land principally occupied by agriculture seem to be the riskiest land cover for the major part of the year.

Keywords: modeling, remote sensing, GIS, soil degradation, empirical models, risk assessment.

891. ABOUZIED Gamal Abdelnasser Allam (Egypt)

Supervisors: R. Khadra and N. Lamaddalena

Title: Sustainable regulation of on-demand pressurized irrigation systems operating with pumping stations. – 119 p.

Abstract: Improving energy and hydraulic performance of large-scale pressurized irrigation system is now perceived as a very pressing need, after large budgets have been allocated into systems modernization. This research tackles this priority area by developing a management oriented multi-step methodology, that integrates different existing techniques and models, to sector the system according to the pressure requirements of the hydrants, and to regulate the pumping station for: i) a fixed and a variable pressure head control, and for ii) enhanced performance. When applied to an on-demand system in the Sinistra Ofanto irrigation scheme of Foggia (Italy), this integrated approach showed potential for energy saving under the optimal scenario of 39.4 %, and noticeable improvement in the system performance in terms of hydrant pressure heads, as compared to the actual conditions. However, the study recommends a detailed assessment of the impact of reducing system flexibility, as a result of the applied sectoring.

Keywords: energy saving, performance, sectoring, pressurized irrigation systems, regulation, fixed and variable head control, flexibility, hydrant.

892. HASSAN Shawkat Basel Mostafa (Egypt)

Supervisors: A. Coppola and G. Dragonetti

Title: A physically-based pedotransfer function accounting for soil structure to determine soil hydraulic properties. – 72 p.

Abstract: The data needed for soil hydrological models to be used for large scale applications are frequently difficult or impossible to obtain directly from detailed field measurements, since it is costly and time-consuming to gather them. A different approach is to estimate soil hydraulic properties for a representative set of soils by using associated physical descriptions and measurements that are readily available from field and/or laboratory observations. This approach leads to estimations of the soil hydraulic properties by the so-called pedotransfer functions (PTFs). However, most of the existing PTFs are empirical, which makes their use limited to particular applications. Also, empirical PTFs usually result in high variability between the measured and the modelled hydraulic properties. More importantly, the existing PTFs do not account for soil aggregation, which frequently induces large under/overestimations of the soil hydraulic conductivity function. Accordingly, the main purpose of the study is to develop a new physically-based PTF that uses readily measurable soil properties including particle size distribution,

as well as aggregate size distribution, in order to obtain the water retention and hydraulic conductivity curves by accounting for the soil structure. The goodness of PTF hydraulic properties estimations was evaluated by comparing PTF-based simulations to simulations carried out by using measured hydraulic properties as input in an agro-hydrological model. The proposed PTF approach showed better accuracy in predicting the hydraulic properties and in capturing the variability of those properties in the field. The new PTF-based hydraulic properties will be used to simulate optimal allocation and scheduling of irrigation water at district scale as an input in an agro-hydrological model.

Keywords: bimodal, hydraulic properties, aggregates, texture, structure, physically-based model.

893. ELALAM Razane (Lebanon)

Supervisors: M. T. Abi Saab and M. Todorovic

Title: Irrigation management of winter wheat through the Earth observations and AquaCrop model. – 72 p.

Abstract: Coupling remote sensing technology and crop growth models is an effective tool to support crop yield prediction and irrigation management. In this study, five vegetation indices were derived from the Copernicus-Sentinel 2 satellite. Among those indices, the fraction of canopy cover was assimilated into AquaCrop model to simulate crop biomass and yield grown under different water regimes. The experiment was conducted in the Bekaa valley of Lebanon for a winter wheat crop. A number of field measurements were collected during three consecutive growing seasons and were used for AquaCrop calibration, validation and testing to predict irrigation requirements and its performance when coupled with remote sensing canopy cover. In general, the results showed that there was a good fit between measured canopy cover and LAI data, and those derived from S2 images. Moreover, regressions were fitted to relate biomass with S2 vegetation indices. Particularly, CC and LAI were highly correlated with biomass. The results of AquaCrop calibration showed that the modeling efficiency values were respectively 0.99 for well-watered treatments and 0.95 for rainfed conditions, thus confirming the goodness of fit between measured and simulated values. The R² in validation results were 0.72 and 0.99, respectively, for biomass and yield. After assimilating the canopy cover into AquaCrop, the % of deviation of simulated and measured variables were reduced particularly under rainfed conditions. However, this result confirmed that the assimilation framework has to be further tested before being applied on a larger scale with limited field data.

Keywords: wheat, remote sensing, Sentinel 2, AquaCrop model.

894. ELIAS Christelle (Lebanon)

Supervisors: N. Amacha and R. Khadra

Title: Treatment efficiency of two different surface flow constructed wetlands in Lebanon: Bcharre (North) and Kherbit Kanafar (West Bekaa). – 80 p.

Abstract: Constructed wetlands have been recently adopted in Lebanon to remediate water pollution. This thesis aims to evaluate the efficiency of two constructed wetlands in removing contaminants from the horizontal wetland at Kherbit Kanafar (West Bekaa) and the vertical wetland at Bcharre (North Lebanon) in a dry and in a wet season, and to compare the suitability of the effluent water for irrigation. To this purpose, a comparative analysis of the mean values of BOD,

DO, NO₃, PO₄, SO₄, Metals, TDS and EC of the inflow and outflow water for both wetland systems was carried out. The results show the following percentage of removal of contaminants: phosphate 97%, sulfate 69% and iron 62% for Kherbit Kanafar, and 47%, 53% and 31% respectively for Bcharre. In conclusion, both constructed wetlands are efficient, well performing and suitable for the Lebanese context especially because they have low energy demand and maintenance requirements. In fact, vertical systems are well adapted for mountains, while horizontal systems are well adapted for flat areas. These preliminary results are of importance to the authorities who are updating the Lebanese Irrigation Standards. In addition, further comprehensive studies for better illustrating and understanding the constructed wetland efficiency are recommended.

Keywords: wastewater, pollution, constructed wetlands.

895. COLOVIC Milica (*Montenegro*)

Supervisor: M. Todorovic ; *advisors:* R. Albrizio and V. Cantore

Title: Application of RGB and multispectral (ground-based and satellite) images for the evaluation of sweet maize (*Zea mays* convar. *saccharata* var. *rugosa* L.) response to water and nitrogen inputs. – 84 p.

Abstract: Remote sensing non-destructive methods provide valuable results about canopy coverage, plant growth and development, and the detection of many abiotic stresses. The aim of this study was to evaluate the performance of remote sensing techniques (ground-based, satellite and RGB) for the assessment of sweet maize growth under water and nitrogen inputs. The study was carried out at the CIHEAM-Bari experimental field (Valenzano, Italy) in the spring/summer season of 2019. Sweet maize was grown under three water regimes (full irrigation, deficit irrigation, and rainfed) and two nitrogen levels. The Multispectral and RGB images were acquired regularly during the growing season together with biometric and physiological parameters. The results indicated that all biometric, physiological parameters and multispectral vegetation indexes (VIs) by both ground-based equipment and satellite were significantly affected by the amount of applied water, but not by the amount of nitrogen, although a clear trend was observed. Conversely, many RGB indices significantly varied with water and nitrogen. Five satellite-derived vegetation indices (VIs) (NDVI, EVI, SAVI, OSAVI and GNDVI) demonstrated good performance when plotted against the VIs from the ground. The best performance was obtained with OSAVI ($R^2=0.77$). The a^* index, derived from RGB images, showed the best correlation with biomass ($R^2=0.77$). The ratio between satellite NDVI of sweet maize and NDVI of grass grown at the nearby agrometeorological station resembled well the crop coefficient (K_c) behaviour of sweet maize.

Keywords: Sentinel 2, RGB, ground-based RS, sweet maize, crop coefficient.

896. MARKOC Marija (*Montenegro*)

Supervisors: M. Knežević, M. Todorovic and P. Zdruli

Title: Impact of soil properties on soil moisture mapping and irrigation requirements in Montenegro: the case of ancient olive groves in the coastal Mediterranean region. – 93 p.

Abstract: Rainfed olive growing has always been an ingrained tradition in southern Montenegro. However, due to extensive agricultural practices, insufficient quantities of olive fruit and oil are obtained annually. Furthermore, stakeholders'

awareness about soil properties impact for the overall well-being of the olive groves is still low. Therefore, soil moisture mapping is crucial for sustainable land and water management and is a valuable tool for cropping pattern determination, soil water balance monitoring and irrigation scheduling. This research was conducted on both large (country) scale and small (experimental site) scale. Available soil water capacity was computed for 5030 soil horizons distributed within 2347 soil profiles in Montenegro, testing the performance of six pedo-transfer functions. Furthermore, two spatial interpolation techniques (Inverse Distance Weighting and Ordinary Kriging) were used for soil moisture mapping at the country level and at the level of soil subtype Eutric Cambisol on phlich. The performance of each method was assessed through the four statistical indicators: absolute (ΔA) and relative (RE) error; mean absolute error (MAE) and root mean square error (RMSE). The results showed good performance of both interpolation techniques, while the pedo-transfer functions of Rawls and Brakensiek (1985) and Saxton and Rawls (2007) proved to be the most suitable ones for the soils of Montenegro. The prediction model for irrigation management at the field scale confirmed satisfactory results of soil moisture estimations and relative yield under the irrigated and rainfed treatments.

Keywords: soil moisture mapping, pedo-transfer functions; Spatial interpolation, Ancient olives, *Olea europaea*, water requirements.

897. BAREKALLAH Sid Ahmed (Morocco)

Supervisors: A. Bamouh and M. Todorovic

Title: Performance of the cropping systems under drip irrigation in Souss-Massa basin. – 82 p.

Abstract: One of the major challenges of Morocco's water policy is water saving and the rationalization of the use of irrigation water. Conversion to drip irrigation with the aim of improving water use efficiency at farm level is one of the key instruments of the National Program of Water Economy in Irrigation. The present work consists of an assessment of conversion to drip irrigation in the scheme of Souss Massa. The objectives of this work were to identify and characterise the cropping systems currently practiced on farms, to assess the impacts of the introduction of drip irrigation on rotation, yield, labor, satisfaction rate of water needs, the agro-economic performances of different crops and cropping systems (water consumption, yield, etc.). Methodologically, a survey was carried out on a sample of 32 farms which converted from sprinkler to drip irrigation system. The introduction of the drip irrigation system is being carried out gradually and is accompanied by significant changes in the cropping patterns. Farmers are moving towards more profitable crops such as tomato. The new irrigation technology has led to a reduction in the labor force for irrigation and an improvement in yields with a subsequent increase in the overall gross margins generated by the crop production system. However, farmers expressed the need to have continuous technical guidance in order to achieve an effective water saving and increase their income.

Keywords: drip irrigation, water use efficiency, conversion, cropping systems, agro-economic performances, Souss-Massa.

898. EL HYANI Nohaila (Morocco)

Supervisors: A. Scardigno, M. Todorovic and A. Mehmeti

Title: Eco-efficiency analysis of irrigation with treated wastewater: the case of citrus cultivation in Souss-Massa region (Morocco). – 59 p.

Abstract: Water is a scarce resource and a limiting factor for economic development in the Souss-Massa region, one of the most important agricultural areas in Morocco. Treated wastewater reuse (TWR) has the potential to alleviate water scarcity problems, provided it is sustainable. This study adopted an integrated methodological life cycle framework to analyse the eco-efficiency of TWR for irrigation of three citrus varieties: MarocLate, Nadorcott and Clemetines. The novel life cycle impact model ReCiPe 2016, covering 21 indicators, was used to generate a full-fledged multi-impact environmental life cycle assessment (LCA), while the economic system value was evaluated in terms of total value added (TVA). The eco-efficiency indicators were estimated per 1 ha of orchard and 1 ton of yield at the farm gate, combining TVA and LCA. The comparison with current conditions (Fresh water use) demonstrated that TWR leads to a significant decrease of product environmental footprint due to the saving in fertilizers, energy and water, which is not offset by a lower TVA generated as a result of the higher water fees to cover the cost of water treatment and distribution. Eco-efficiency indicators show that TWR remains advantageous and Nadorcott is the most efficient variety as a result of the highest TVA generated.

Keywords: wastewater reuse, life cycle assessment, total value-added, eco-efficiency indicators.

899. RAHALI Lamia (Morocco)

Supervisors: A. Hammani and N. Lamaddalena

Title: The impact of the modernization project on the exploitation of groundwater in Tadla irrigation scheme-Morocco. – 92 p.

Abstract: This study aims to determine and analyze the impact of the modernization project on groundwater exploitation across the pilot area of 4045 ha on the Tadla irrigation scheme. The fieldwork was essential for the collection of data on water withdrawal from surface and groundwater. It has been also essential to demonstrate the presence of pumping at the sector level. This fieldwork allows us to assess the performance of the groundwater use at the farm level, thanks to surveys on pumping and irrigation practices, as well as to temperature sensors and flow measurements. An exhaustive census was also made in the pilot sector. These surveys showed that 74% of farmers have their groundwater catchment structure. However, the exploitation of this resource started to decrease (7% use only groundwater) compared to the situation before the project. The results prove the presence of pumping at the sector level with less than 1800 m³/ha/yr. However, the contribution of percolation, of both irrigation water and precipitation, to the recharge of the aquifer is estimated at 1810 m³/ha/yr. In conclusion, this project helps to better assess the groundwater-farmer relationship. Thus, it has a positive impact on the groundwater future and its sustainability.

Keywords: large irrigation scheme, cropping pattern, groundwater, drip irrigation, modernization project, pumping.

900. ANAS Jarrar M. H. (Palestine)

Supervisors: M. Todorovic and N. Lamaddalena ; advisor: V. Cantore

Title: Performance analysis of the irrigation network: treated wastewater use and management practices. – 121 p.

Abstract: Cultivation of more input demanding crops coupled with water-related hazards and climate change is leading to difficult water-efficient management practices in Trinitapoli, an important on-demand agricultural district located in the area of Foggia, Southern Italy. To address these challenges a wastewater reuse scheme is implemented by Consorzio per la Bonifica della Capitanata. This study used the Crop Water and Irrigation Requirements Program of FAO (CROPWAT), geographic information system (GIS) and Combined Optimization and Performance Analysis Model (COPAM) to analyze the level of performance and related improvements when different sources of water are adopted. CROPWAT was used to simulate irrigation requirements for each crop based on soil, climate and crop data for average and dry year conditions. GIS was used for the spatial distribution and visualization of the data. Finally, COPAM was used to assess the hydraulic performance of the irrigation system at the global and hydrant level under different operating conditions and management practices. The analysis shows that using only freshwater and full irrigation strategy the performance of the system is unsatisfactory. Treated wastewater coupled with deficit irrigation would contribute to enhance the system performance and thus achieve more sustainable management of the water resources and irrigation scheme.

Keywords: performance analysis, treated wastewater, on-demand operation, GIS.

901. ALALI Qotada (Syria)

Supervisor: N. Lamaddalena

Title: Generation of discharge hydrographs in large-scale pressurized irrigation systems. – 83 p.

Abstract: A deterministic-stochastic model named Win-Genera was used to simulate daily volumes and hourly discharge hydrographs during the peak periods in pressurized irrigation systems operating on-demand based on the soil water balance approach. Deterministic components are denoted by the equation of soil water balance, and stochastic components are function of the uncertainties related to the sowing date of the crops, the initial water reserve and the farmer's management strategy. Applied on different scales, from district to sector level, the results obtained from different simulations were compared with the historical datasets of irrigation volumes and discharges recorded at the upstream end of large and small scale irrigation distribution networks in southern Italy. The results showed that the model was capable of forecasting with good accuracy the timing of peak-demand periods, monthly and daily volumes demanded by farmers during the season, as well as hourly discharge hydrographs during peak periods, especially when applied at the level of large scale. Concerning the small scale, daily volumes are not fully reliable due to strong impact of stochastic component of farmer's behavior. Nevertheless, the model is capable of getting reliable 10-day peak period water volume which could be useful for planning irrigation management, analyzing existing systems and designing new ones.

Keywords: hydrograph, discharge, demand, pressurized irrigation systems, Win-Genera, Peak period, soil water balance.

902. MASTOURI Amel (*Tunisia*)

Supervisors: R. Khadra and N. Lamaddalena

Title: Modernization of on-demand pressurized irrigation systems in Tunisia: Assessment of the flexibility impact on the cost effectiveness. – 112 p.

Abstract: The Tunisian government embarked in the modernization of the irrigation schemes in the lower basin of Medjerda, foreseeing their on-demand operation. The modernized scheme of Manouba is facing the challenge of the inadequacy of the service provided. This situation implied the refusal of the users to comply with the terms of the agreement signed with the Government, and is threatening the continuity of the program. Sidi Thabet's irrigation scheme, which is the subject of this research, will not be exempted from these disagreements. A thorough study of the design criteria and an analysis of performance of the designed network showed an incorrect understanding of the sensitive parameters of Clément's first formula used to compute the discharges. The main objective of this study is to assess the correlation between these parameters and their impact on the network performance and cost, in order to develop a guideline that provides a firm technical foundation aiming to sustain and guarantee the continuity of the modernization approach. The results demonstrate that assigning higher flexibility at hydrant level insures a higher performance level, with a minor impact on the cost. It is recommended to expand the application of the developed methodology to further validate the results and to assess the impact on the pumping station and on the operation and cost of the whole system, thus mainstreaming the findings into the modernization process.

Keywords: modernization, on-demand schedule, flexibility, cost effectiveness, service delivery.

903. SAIDI Ahmed (*Tunisia*)

Supervisors: S. Morardet, F. Khamassi and R. Khadra

Title: Characterization of household multiple water uses and simulation of development strategies in a vulnerable rural territory of Tunisia. – 150 p.

Abstract: This research, developed under the framework of the PACTE (Adaptation to climate change of vulnerable rural territories) project funded by AFD (The French Development Agency) aims to assess and characterise water uses in the Rihana area, Sidi Bouzid Governorate in Tunisia. The findings will inform the planning phase on how to improve the water supply systems to better meet the population's needs through a multiple water use system. The rapid and participatory systemic diagnosis method and the sustainable livelihood approach are the basis of the current work. The Principal Component Analysis and cluster analysis identified two typologies of households according to people's livelihoods and their access to and uses of water. Results show that livelihoods are heavily influenced by their natural and physical capital assets while their water uses depend on irrigation practices, water consumption per livestock unit and water supply sources. Moreover, the comparison of the two typologies shows that livelihoods are heavily influenced by their access to water. Finally, the impact of an imposed water tariff on farmers' gross margin was compared with the present situation, and results show the positive effects on vulnerable farmers and negative ones on those owning illicit private wells.

Keywords: sustainable livelihoods, evaluation, households, water access, water uses, rural area, participation.

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933. MALLUTA Desara (Albania)

Supervisors: P. Zdruli and E. Gjinali

Title: Challenges to improve efficiency and performance of an existing irrigation network: case study of Shirgjan in the Municipality of Elbasan, Albania. - 84 p.

Abstract: This study focused on the quantification of irrigation water requirements (IWRs) to improve water use efficiency in agriculture. The CropWat software based on FAO Penman - Monteith (FAO-PM) model was used to estimate reference evapotranspiration, ETo , using climate data for a period of 25 years (1995-2020). For 6 different crops grown in the study area, the NIR (Net Irrigation Requirement) and GIR (Gross Irrigation Requirement) were calculated through Ea (application efficiency) method. Modelling work was complemented with field experimentation. Results show that in the case of olives, when converting from gravity to drip irrigation, production increased by 56%. Instead, for greenhouse cultivated tomatoes productivity increased by 67%. The results obtained were examined with local farmers.

Keywords: water use efficiency, open channel, drip irrigation, yield, net irrigation requirement.

934. HAROUN Housseem Eddine (Algeria)

Supervisors: P. Zdruli P. and C. Karydas

Title: Using the G2 model to estimate sediment yield in the Candelaro watershed of Apulia region in Italy. - 63 p.

Abstract: Erosion by water is a serious environmental problem not only due to wearing away the topsoil and depletion of fertile land, but also because of its off-site detrimental consequences, including the deposition of sediments in reservoirs as well as damage to water life. In this context, this research aims to map sediment yield at month-time intervals in the Candelaro river basin, Apulia region, Italy, using the G2 erosion model. G2 follows the fundamentals of USLE and EPM models. A digital elevation model of 90-m resolution was used to extract the hydrographic and topographic characteristics of the basin in order to compute the sediment delivery ratio. The sediment yield figures in Candelaro were produced at watershed scale (6.6 km² mean size). The results indicate a mean sediment delivery ratio (SDR) of 0.06. The mean annual specific sediment yield (SSY) rate was found to be 0.09 t ha⁻¹ y⁻¹, with September and November being the most productive months. The analysis indicated that the major part of the erosion-prone land area (98%) has very low or low sediment yield predictions. The annual sediment yield of the entire basin was found to be 20,054 t y⁻¹. The study complemented a previous soil loss assessment, with a view to providing complete and detailed erosion maps for the Candelaro basin.

Keywords: sediment yield; G2 model; sediment delivery ratio.

935. MEDOUKALI Dawoud (Algeria)

Supervisors: A. Fouial and A. Scardigno

Title: Development of an Integrated Decision Support System for Solar Powered Irrigation Systems. - 84 p.

Abstract: The objective of this research is to develop a Decision Support System (DSS) to ease the decision-making process related to the use of solar energy in irrigation. The DSS assesses the economic and environmental viability of Solar Powered Irrigation Systems (SPISs) in comparison to the conventional energy sources such as power grids and diesel. The user friendly DSS can be used by farmers and irrigation managers for the optimization of SPISs by evaluating their feasibility under different scenarios. The latter consider energy and water storage, energy source (solar, grid and diesel) as well as the hybridization between fuel-solar and/or grid-solar energy, taking into account the financial, technical and environmental aspects. The optimization process is based on the minimization of the total Life Cycle Cost (LCC). The matching between water demand, irrigation scheduling and daily solar radiation, considered as the technical reliability of the system, is imposed and the economic feasibility (LCC) and environmental impacts (CO₂ emissions) of the system are evaluated. The DSS has been tested in a case study and the obtained results have shown that the stand-alone SPIS scenario where the total energy moves from solar modules directly to the pump is the best solution in terms of both LCC (13,572.7 €) and CO₂ emissions (zero emission). The fuel-hybridized system (80% of energy from fuel and 20% from solar modules) is the least favourable solution in terms of LCC, with a total cost of 41,792.8 €, and the scenario of fuel-powered system is the least environmentally friendly solution with a total CO₂ emission of 6,583.2 Kg over the project lifetime.

Keywords: DSS; Solar Powered Irrigation Systems; Life Cycle Cost, CO₂ emissions.

936. ABDELMOTELEB Kareem Hamde Ahmed (Egypt)

Supervisors: M. El Kholy, K. Abu Zeid and R. Khadra

Title: Evapotranspiration assessment using remote sensing for sustainable agricultural water use in Egypt. -105 p.

Abstract: Remote Sensing (RS) based Actual Evapotranspiration (ET_a) estimated during a two-year period with two models, i.e. Operational Simplified Surface Energy Balance (SSEBop-v4) as a readily available RS ET_a product and Surface Energy Balance Algorithm for Land (SEBAL) a manually calculated ET_a from raw RS data, was assessed for validation and estimation of Irrigation Water Use Efficiency (IWUE). The study is implemented on a 2.1 ha pilot farm located on Cairo-Alexandria desert road Km-74. Local meteorological data from Wadi El-Natroun station and available crop coefficients (K_c) were used to calculate FAO Penman-Monteith based Crop Evapotranspiration (ET_c) in the absence of any possible ground measurements. When compared to ET_c, SSEBop-v4 ET_a and SEBAL ET_a estimates showed: a Coefficient of Determination (R²) equal to 0.88 and 0.99 in 2018 and 0.69 and 0.97 in 2019, and a Root Mean Square Error (RMSE) of 103.8 mm/month and 13.3 mm/month in 2018 and 115.2 mm/month and 34.35 mm/month in 2019 respectively. The RMSE for SEBAL corresponds to 9% of the average Monthly ET_c, while the RMSE for SSEBop-v4 corresponds to 70% of the average Monthly ET_c. SEBAL also showed better correlation with IWUE calculated based on farm actual management and irrigation scheduling. 2018/2019 Average Annual ET_c volume/Annual Applied Irrigation volume resulted in an IWUE of 78.4%, compared to Average ET_a volume (SEBAL) / Annual Applied Irrigation volume

resulted in an IWUE of 73 %. While Average ETa volume (SSEBop-v4)/ Annual Applied Irrigation volume resulted in an IWUE of 25.6%.

Keywords: actual evapotranspiration, remote sensing, SSEBop, SEBAL, irrigation water use efficiency.

937. HEBESH Abdelmonem Mahmoud Eldesouky (Egypt)

Supervisors: T. Tawfic and N. Lamaddalena

Title: Basic soil moisture measurements to reduce water loss and cost for urban development: Case study of Madinaty city in Cairo. - 69 p.

Abstract: Egypt is an arid region country. The River Nile is the main water source for Egypt with 55.6 billion cubic meters per year, which represents 94% of the limited water resources. With the fast population growth accompanied by intensive irrigation schemes for agriculture development and urban development projects, Egypt suffers from severe water problem. Most urban landscape project areas are irrigated, often overirrigated, with potable water. In fact, irrigation application efficiency for such green areas appears to be under 50%. This research was carried out in one of the large urban development projects in the suburbs of Cairo. To increase application efficiency and consequently save water and reduce water cost, measurements of soil moisture parameters (field capacity - wilting point - bulk density) were used as determinant factors to improve irrigation application efficiency. Two simple operational techniques were tested: 1) manually operated valves (MOV), 2- Automatic timer connected to the valves (ATV). The research findings indicated that both operational techniques gave better application efficiency with 69.5% in case of (MOV) and the (ATV) allowed 74.8% improvement. When both were compared to current application techniques, the results also indicated a large reduction in the irrigation cost. The (MOV) allowed saving 69.5% of the water cost while the ATV enabled saving 74.8% of the total cost. Treated wastewater was also tested using the ATV technique for the purpose of water cost comparison. When treated wastewater was applied, a 91% reduction in water cost was achieved. The overall study findings recommend that: 1. Soil physical characteristics must be determined and used for irrigation scheduling; 2. Treated wastewater is highly recommended to irrigate green areas in urban development projects; 3. The use of timer is also highly recommended for water-saving.

Keywords: irrigation, turf grasses, landscape, sprinkler irrigation, moisture content, efficiency, irrigation scheduling.

938. SUBAH Maysa Ali Mohammad (Jordan)

Supervisors: J. Al-Bakri and N. Lamaddalena

Title: Water productivity of crops in the Northern Jordan Valley. - 87 p.

Abstract: Since irrigated agriculture is the main consumer of water in Jordan, it is important to maximize agricultural water use efficiency by adopting suitable cropping patterns and scheduling water amounts according to these patterns especially in areas with limited water resources. This research was carried out to assess present and future water productivity in the northern Jordan Valley (NJV), which represents a part of the most important irrigated area in the country. The work aimed to provide possible solutions to improve water productivity based on the water productivity of the existing cropping pattern, which was dominated by citrus. The work was based on the analysis of ground data of cropped areas that were verified using remote sensing images and GIS maps, climate, soil, and crop

management data. All data were utilized to run the AquaCrop model to calculate the water productivity of the main irrigated crops in the NJV under present and future climate. Results showed variation in water productivity among different crops, with a decreasing water productivity trend for citrus in the future. For vegetable crops, variations in water productivity were low, which may enforce farmers to replace citrus with vegetable crops. The research calculated the possible amounts of water that can be saved by improving water efficiency and productivity and the possible water deficit resulting from climate change in the area.

Keywords: Northern Jordan valley, irrigation, water productivity, climate change, AquaCrop, remote sensing, GIS.

939. HAMZE Mohamad (Lebanon)

Supervisors: R. Albrizio, V. Cantore and M. Todorović

Title: Evaluation of sweet maize performance under different water and nitrogen regimes using Remote Sensing approach. - 86 p.

Abstract: This study, carried out in Valenzano (Southern Italy), focused on the suitability of remote sensing (RS) and AquaCrop model to assess the effects of different water and nitrogen regimes on sweet maize growth and yield. The model was calibrated using 2019 data and validated during the 2020 growing season. The performance of the model, evaluated through statistical indicators, showed a good fitting between measured and simulated data, confirming AquaCrop as a valuable tool for determination of on-farm water management strategies and improved water use in agriculture. The evaluation of Vegetation Indices (VIs), derived from RGB images, ground-based and SENTINEL-2 spectral data, and water status traits (WST), using crop water stress index -CWSI- derived from canopy temperature using thermography, and leaf gas exchanges, was assessed during the 2020 growing season under three water (full, 50% deficit and rainfed) and two nitrogen (50 and 300 kg ha⁻¹ N) regimes. Differences among the treatments were reported through VIs and WST. Both approaches showed significant correlation with grain yield, dry biomass, and leaf area index, reporting the lowest correlations under rainfed conditions. CWSI was highly affected by the amount of water applied. Conversely, under low N input, RGB indices were the main factors predicting crop performance; the greener canopy area (GGA) was the main factor correlated with biometric parameters. The overall results have confirmed that RS can be considered as a suitable non-destructive and cost-effective method to detect stress/deficiency conditions and assist farmers to optimize water and Nitrogen use

Keywords: Vegetation Indices, CWSI, RGB, AquaCrop, spectral images, thermography, Sentinel-2.

940. BENBIHI Chaimae (Morocco)

Supervisors: N. Lamaddalena, Z. El Yacoubi and A. Scardigno

Title: Groundwater management, case study of Chtouka Ait Baha-Morocco. - 77 p.

Abstract: The aim of this study is to improve the groundwater management through technical and institutional approaches in order to maintain the water resource sustainability in the study area of Chtouka Ait Baha located in the Souss Massa region in Morocco. This agricultural area of primary importance supplies most of the national exports of early vegetables and currently exploits two irrigation water resources: groundwater and surface water; a third one is expected to be available after the implementation of a desalination project aimed at lowering

the pressure on the conventional water resources. A mathematical nonlinear optimization model was used to identify the optimal water demand from the different sources, the associated cropping pattern and the impacts on the economic performance of the agricultural sector. Different scenarios of water availability and water tariffs were simulated and, finally, a technical tool to implement the optimal solution and control groundwater pumping was proposed. When maximizing an objective function and setting resources availability constraints, the optimal solution is mainly determined by the crop net margin, the climate and market risk, the irrigation water requirements, and the fixed land constraint for permanent crops. Results showed that the area allocated to irrigated crops and the profit increase after the implementation of the desalination project. Obtained results also proved that the irrigation water demand is quite rigid, and the water price policy is not effective; therefore, fixing a quota for each farmer can be the best way to manage irrigation water. In order to implement the quotas policy, a metering tool called "Water Card" was proposed, allowing the farmers to use irrigation water whenever they need by respecting the quotas fixed by the operator who is able to collect all the data about the farmers' operations and consumption. The quotas for groundwater can change every year depending on the water table situation, while, thanks to the optimization model, threshold values can be set for the demand of surface and desalinated water that makes the economic performance of farmers compatible with the sustainable use of water resources.

Keywords: groundwater, Chtouka Ait Baha, desalination project, quotas.

941. ER-RAMI Meriem (*Morocco*)

Supervisors: N. Lamaddalena and G. D'Urso

Title: Integrated monitoring approach for irrigation system management. - 74 p.

Abstract: Improving the performance of irrigation systems plays a fundamental role in increasing their efficiency in the aim of reaching a sound use of irrigation water. COPAM has proven its usefulness in the performance evaluation of on-demand irrigation systems; however, in many cases input data, such as the water volumes delivered at hydrants, are not easily available. To support a wider application of COPAM, we tested the possibility of using irrigation volumes estimated by means of space-borne remote sensing. The Sentinel-2 constellation provides high spatial resolution images with a temporal frequency between 2 and 5 days, which is compatible with the input requirements of COPAM. In the present thesis, an irrigation sector in the Capitanata irrigation network (Foggia Province, no. 6 of district 10) was chosen to assess its performance by using COPAM with volumes estimated from Sentinel-2 data. As an input of COPAM, the upstream discharge was determined after a proper transformation of the estimated irrigation water requirement volumes and the recorded volumes into flowrates. The estimation of the irrigation water requirement volumes was accomplished through the estimation of crop evapotranspiration, ET_{crop} , and effective precipitation, P_n , by combining crop parameters (Leaf Area Index - LAI, fractional vegetation cover f_c and Albedo) derived from Sentinel-2 images and the meteorological data from the atmospheric model ERA5 collected for the whole study period, from June 1st to September 30th, 2019. The study comprised a comparison of the estimated irrigation water volumes and the corresponding recorded volumes. The results showed a good agreement between the estimated and the registered volumes in a large time scale for 10 days and one-month period, while a large difference was observed in a daily time scale. The performance analysis was carried out at the global and hydrant level. The estimated discharge was lower than the registered discharge and it reflected better

performance. Last but not least, some recommendations were proposed for improving performance in the critical zones.

Keywords: performance analysis, on-demand irrigation system, COPAM, irrigation water requirement, crop evapotranspiration, crop parameters, Sentinel-2 images.

942. NAJI Yassine (Morocco)

Supervisors: R. Choukr-Allah and A. Scardigno

Title: Irrigation of olive trees by treated wastewater: evaluation of the feasibility of innovative irrigation practices and technologies in the region of Souss Massa, Morocco. - 99 p.

Abstract: The use of treated wastewater represents a strategic perspective for sustainable agricultural development in water-scarce countries. However, technological and management innovations are required to make it feasible and effective. The objective of the present research is to evaluate the feasibility of adopting an innovative calibrated nozzle and an irrigation scheduling model, SIM, in the irrigation of olive trees by treated wastewater. A cost-benefit analysis was conducted to assess the economic performances after one year of treated wastewater irrigation. The results show that neither the agronomic nor the physiological parameters are affected by the irrigation with treated wastewater, while the nozzle distribution uniformity is higher (89%) than drippers (85%). SIM allowed 13% of water savings compared to the standard ET_c single crop coefficient method which equals 167 and 128 €/ha respectively compared to the actual quantity of freshwater used. The gain in fertilizers is 403 € using the SIM model and 456 € without it. Results demonstrate that the adoption of the two innovations generate additional benefits amounting to 44,000 €, while the introduction of the nozzle with treated and freshwater generates additional benefits of 42,000€ and 7,100€, respectively. A minimum yield increase of only 0.6% is required to cover investment costs over the 30-year project lifetime and the investment could be profitable even with 48% yield decreases.

Keywords: treated wastewater, irrigation scheduling, water saving, olive irrigation, cost benefit analysis.

943. ISLEEM Nabeeh (Palestine)

Supervisors: R. Khadra and G. Dragonetti

Title: Evaluating the effects of long-term irrigation with treated wastewater on the soil: a case study in Beit Dajan-Palestine. - 72 p.

Abstract: Irrigation with Treated Wastewater (TWW) is a well-known agricultural practice in Palestine. Being a source of water and nutrients, long term use of TWW can lead to imbalances that affect plant development, soil, and groundwater quality. Consequently, irrigation frequency and interval should be properly scheduled, especially when Fertilizers and Salts (FS-TWW) cannot be separated from water. A case study in Beit Dajan cultivated with citrus and irrigated with TWW was selected to assess TWW effects on the soil and on root uptake. To this purpose, two-year (2018-2019) simulations were performed using Hydrus- 1D physically-based model and generating two FS-TWW irrigation scenarios: 1) non-optimized salt supply (NONOPT-FS-TWW) where irrigation volumes fully satisfied crop evapotranspiration demand: 2) optimized salt supply (OPT-FS-TWW) accounting for crop evapotranspiration and respecting allowable thresholds of soil solution electrical conductivity (EC_e) by assuming an average soil salinity tolerance

in the root zone. Soil water movement, ECe and $[(N-NO_3^-) - (N-NH_4^+)]$ concentrations were simulated considering averaged ten-yearly climate data and using soil and water quality analyses. Under OPT-FS-TWW scenario, the effects of salinity stress on water and nutrient uptake decreased, improving soil nitrate adsorption by 36% and reducing by 30% soil salinity in the root zone and by 13% water and nutrient fluxes at 60cm depth as compared to NON-OPT-FS-TWW scenario. The results obtained when considering ECe as an additional variable to schedule irrigation with TWW encourage the validation of Hydrus-1D model using an evolution of water and salt distribution measurements.

Keywords: 1D-HYDRUS model; FS-TWW irrigation management, citrus crop, root water uptake, soil solution, electrical conductivity.

944. SARR Aminata (Senegal)

Supervisors: L. Diop, L. Mateos, N. Lamaddalena

Title: Technical and economic feasibility of solar pump irrigation in the north-Niayes region in Senegal. - 196 p.

Abstract: The objective of this study is to assess the technical and economic feasibility, and the environmental impact of using solar irrigation pumps in Nguethiouro lowland. Surveys were conducted with suppliers, service providers, and users of solar pumps to have knowledge on the situation of the use of solar irrigation pumps in the Niayes area. Pump sizing was carried out in 15 plots in the Nguethiouro lowland on the basis of irrigation management (use of solar pumps for farmer individually or for groups of farmers), irrigation techniques (manual, drip or sprinkler irrigation techniques), and water distribution (with or without reservoir). Net Present Value, Benefit Cost Ratio, Payback Period, Internal Rate of Return, and Life Cycle Cost are used to evaluate the profitability of solar pumps. The environmental impact is studied through an impact assessment and determination of the amount of CO₂ released. Results show that all solar irrigation components are present on the market and pumps of different brands with different characteristics are available. The investment cost is variable in Nguethiouro (between 669 euros and 21,400 euros), depending on cultivated area, on pumps brands and characteristics, and on irrigation techniques used. In addition, the use of solar irrigation pumps in combination with sprinkler irrigation technology with PVC pipes and drip irrigation are more economically profitable. However, from an environmental point of view, the use of solar pumps with drip irrigation technology is more efficient. Diesel pumps have negative environmental impact with release of 6.9 tons/ha in contrast to solar pumps.

Keywords: irrigation, solar energy, feasibility studies, Technical-economic, Niayes, Senegal.

945. BELLIL Dorra (Tunisia)

Supervisors: A. Coppola, G. Dragonetti

Title: Assessing soil water content evolution during a drainage process using an EMI sensor. - 95 p.

Abstract: Irrigation management may be carried out using agro-hydrological, physically based models predicting water flow, root uptake and solute transport in soils and allowing irrigation scheduling both at farm and district scale. Model validation at large scale requires the water content time evolution to be known at several sites, which can be done by Electromagnetic Induction (EMI) sensors.

Accordingly, the main objective of this thesis was to calibrate an EMI sensor to characterize the soil water storage distribution at field scale. The study was carried out at the experimental field of MAI-BARI from July to August 2020. The soil profile was firstly saturated by continuous irrigation lasting 3 days; then, the drying process by drainage and evaporation was monitored by an EMI sensor (CMD mini-explorer). The calibration procedure was based on the comparison of apparent electrical conductivity (ECa) readings coming from the EMI and direct measurements of water content at 36 sites and at three different depths (15 cm, 30 cm and 60 cm) taken by Time Domain Reflectometry (TDR) and the thermogravimetric method during 7 monitoring campaigns. A highly significant correlation was obtained, especially after removing noises by a moving average (MA) method. The calibration also allowed to establish differences between water content distributions taken by the EMI sensor along and between the irrigated lines. The results demonstrate that EMI sensors may be effectively used to rapidly characterize water content distributions at large scale, this being crucial for evaluating agro-hydrological model predictions.

Keywords: soil water content, EMI sensors, apparent electrical conductivity, soil water storage, Time Reflectometry Domain.

946. BOUDHRAA Marwa (Tunisia)

Supervisors: A. Mehmeti and N. Lamaddalena

Title: Performance assessment of efficient energy management in large-scale irrigation systems using a nexus modeling framework. - 32 p.

Abstract: The provision of water and energy services could cause significant negative environmental impacts in large-scale pressurized irrigation systems. Exploring this complex triangular relationship known as water-energy-environmental (WEEN) nexus is an initial step in sustainable natural resource management and improvement of governance outcomes. This study quantified the synergistic benefits of efficient energy management through pumping station regulation in the overall WEEN nexus performance of on-demand irrigation systems. Irrigation district 1-a in the *Sinistra Ofanto* irrigation scheme (Southern Italy) was selected as a case study. The novelty of this study was to explore the "hidden" linkages between water, energy, and the environment by the use of a physical and monetized life cycle assessment (LCA). The Environmental Prices, a novel life cycle impact assessment method, was used for evaluation including the effects of direct and indirect resource consumption for crop production. The constant speed operation resulted in the highest water-energy-environmental nexus. On average, implementing variable speed the operation could reduce by 30% electricity consumption which is translated into a 10.6% reduction in cumulative energy demand. The results show that overall environmental effects are reduced from 0.5% (land occupation) to 18% (water depletion). The financial benefit of these environmental impacts (avoided costs imposed on society and the environment) is up to 31 euro/ha. Considering environmental and energy costs the overall benefits from energy management become 337.2 euro/ha. The analysis shows that energy saving in numerical terms is more important to farmers and water user associations than to society (non-customers). The contribution of this work was mainly methodological rather than numerical. By looking at monetized LCA impacts, a new perspective was added to the nexus sustainability of irrigation schemes. We recommend further similar research works to explore the impact of the conjunctive use of water resources and crop-fertilizer interactions.

Keywords: large-scale irrigation systems, energy efficiency, water-energy-environment nexus, life cycle assessment, monetary valuation.

947. HMAIDI Housseem (Tunisia)

Supervisors: I. Martin and R. Khadra

Title: Assessment, evaluation and upgrading of major wastewater treatment plants for irrigation reuse in Tunisia. - 102 p.

Abstract: The reuse of wastewater, after treatment, is part of Tunisian water resources mobilization and development strategy. The contribution of treated wastewater to irrigation remains low, and concerns less than 5% of irrigated areas, despite the incentives. This is mainly due to its mediocre quality. In order to improve the quality of treated wastewater and contribute to its use for agricultural purposes, the efficiency of 4 wastewater treatment plants in Tunisia (Choutrana II, Borj Touil, Korba, Kelibia) were evaluated under the framework of MENAWARA – ENI CBC Med project. Based on the analyses of the global conditions of the WWTPs current quality of the effluents and the Tunisian standards for reuse in agriculture, pre- and post- complementary treatment trains were designed according to the “fit for purpose” principle in a stakeholder-driven process, and accounting for the implications of COVID-19 virus on the wastewater sector. More precisely, the upgrade of the 4 plants includes: In Choutrana II, a post-treatment based on a filtration process using pressure sand filters and a subsequent disinfection applying an ultraviolet radiation in conjunction with the existing secondary clarifiers; In Bourj Touil, a sedimentation tank to eliminate the sludge that flows from the existing storage basin upstream of the Constructed Wetlands and produces clogging in the filter beds ahead the existing Constructed Wetlands; A complementary treatment line in Korba composed by a filtration treatment through pressure sand filters, after the existing maturation pond; For Kelibia, the existing secondary treatment (secondary clarifiers) will be upgraded by installing a pressurized sand filter, rehabilitating the existing UV system and the existing pumping system.

Keywords: water reuse, wastewater treatment, Irrigation, Covid-19, Tunisia.

948. KÖKSAL Daniyal Durmuş (Turkey)

Supervisors: Y. Ahi and M. Todorovic

Title: Evaluation of treated domestic wastewater reuse for agriculture using artificial intelligence methods. - 77 p.

Abstract: Estimation of treated wastewater quality is a non-linear problem and cannot be solved statistically. In this respect, it is of great importance to create a new method for predicting treated wastewater quality and usability rate. The main objective of the study is to evaluate the suitability of machine learning modelling as a valid input-output tool to predict some outlet parameters in Kırklareli Advanced Biological Wastewater Treatment Plant (K-WWTP), Thrace Region of Turkey, where water scarcity is an important issue. Accordingly, several machine-learning techniques were tested to assess the usability of wastewater quality for irrigation in the case study area. This target combined three artificial intelligence models (Artificial Neural Network - ANN, Adaptive Neuro-Fuzzy Inference System – ANFIS, and Fuzzy Logic-Mamdani - FLM) using various scenarios based on inlet and outlet water quality parameters of K-WWTP measured daily during the last three years. At the same time, an agricultural projection was realized to assess reuse potential of municipal treated wastewater for each selected crop. The best performances were

observed with the ANNs model with R² of 0.83, 0.96, 0.94, 0.80, 0.80, 0.74 and 0.85, and mean squared error (MSE) of 0.001020, 0.000591 $\mu\text{S}/\text{cm}$, 0.000526%, 0.004606 mg/l, 0.007718 mg/l, 0.009034 mg/l, 0.006684 mg/l for pH, Conductivity, Salinity, COD, Total N, Total P, TSS, respectively. The usability of wastewater quality varied between 69% and 72% during the irrigation season, depending on the artificial intelligence models. It was found that approximately 35% of the 20-thousand hectares of agricultural area can be irrigated with treated wastewater. Therefore, the presented method may provide a reliable and effective reference to assess the usability of wastewater use in agriculture.

Keywords: agriculture, machine learning, artificial neural network, fuzzy logic, wastewater quality.

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961. BAAZIZ Mohammed Djalil (Algeria)

Supervisors: A. Scardigno, A. Mehmeti and T. Hartani

Title: A water-energy-environment nexus approach to evaluate the environmental sustainability of irrigated agriculture: the case study of wheat production in eastern Algeria. – 48 p.

Abstract: Irrigated agriculture is an important source of food production being about twice as productive as rainfed. However, irrigation impacts the environment through the on-farm overuse of water and energy and new infrastructure investments. Integration of energy, water, and the environment is essential in supporting sustainable food production. Using a water-energy-environment nexus approach, this research evaluated the environmental sustainability of wheat cultivation in Ksar-Sbahi (North-East of Algeria). The Life Cycle Assessment (LCA) methodology was used to compare cradle-to-farm gate environmental performance of rainfed and irrigated cultivation systems. For a consistent comparison, two functional units (FU) were defined: 1 ha and 1 ton of wheat cultivation. The results were interpreted based on a comprehensive set of indicators: 18 midpoints (e.g. climate change, eco-toxicity but also impacts due to the use of water, land, and energy resources), 2 endpoints (human health and ecosystem quality), and 1 monetized single indicator (environmental costs). The impact methodology is IMPACT World+. The midpoint analysis revealed the trade-off between increased water and energy consumption and reduction of other environmental impacts. Endpoint and single score analysis demonstrated that the irrigated system could compensate for the negative impact on crop production and eventually lead to a reduction of total environmental impact and environmental costs. The sensitivity analysis of input parameter variability and methodological choices confirmed the advantages of irrigation compared to the rainfed practices.

Keywords: Irrigation, Nexus, Life Cycle Assessment, Monetization, Wheat.

962. NACRO Sadya Roseline (Burkina Faso)

Supervisors: G. Dragonetti, and I. Serme

Title: The effect of smart irrigation and fertility management practices on rice cultivation in Burkina Faso. – 38 p.

Abstract: Climate change and declining water resources are threatening rice production in Burkina Faso. Alternate wetting and drying (AWD) irrigation system is a promising water-saving technology to integrate appropriate soil fertility practices and has application potential for rice. Hence, a field experiment was carried out at Bagré, located in the central-eastern area of Burkina Faso during the dry season of 2021, to assess the effects of AWD and Urea deep placement (UDP) system on rice production. A randomized complete block design was applied with 2 experimental units: AWD and Continuous Flooding (CF), combined with 4 fertilization treatments: T0 = control; T1= 72 kg/Ha as urea (broadcast); T2 = 113kg/Ha as urea (broadcast); T3 = 112.5 kg/Ha as urea super granules (UDP); and T4 = 72 kg/Ha

as urea super granules (UDP), and grouped into three replicates. AWD and CF treatments showed no significance on plant growth, grain yield, leaf nitrogen (N), and chlorophyll content. On the contrary, the interaction effect of the AWD irrigation system and the fertilizer treatments showed a significant impact on plant growth and grain yield. T4 trial, one with the lowest rate of urea super granule (72 kg/Ha), provided a higher yield under AWD than the CF system. The N leaf significantly increased by combination with UDP treatment and AWD compared to that with CF. Leaves chlorophyll content also increased dramatically under fertilizer treatments and T2 showed the highest value under the two irrigation systems. AWD combined with the UDP system effectively increases grain yield and reduces environmental risks to paddy fields.

Keywords: Alternating wetting and drying (AWD), Continuous Flood (CF), Urea Deep Placement (UDP), paddy rice, grain yield, leaf nitrogen content.

963. ABDELMAQSoud Mostafa Saeed Mohamed (Egypt)

Supervisors: P. Zdruli, G. Dragonetti, I.S. Al Zayed and A. Coppola

Title: Retrieving soil moisture content by using satellite data: a case study of Wadi Kharouba, Egypt. – 70 p.

Abstract: Soil Moisture Content (SMC) estimates are essential for many scientific disciplines as Meteorology, hydrology, and agriculture. SMC varies spatially on soil type and land cover/use and temporally on the time of day and season of the year. The direct measurement of SMC is costly, time-consuming, and impractical for continuous spatio-temporal coverage. This study aims to propose a simple and robust methodology for the SMC estimates in spatio-temporal scales for different land cover/use areas for the Wadi system. Wadi-Kharouba in North Egypt is taken as a case study. The study evaluated the Optical Trapezoidal Model (OPTRAM) by using Sentinel-2 data from Nov 2015 to Nov 2016. SMC values were compared with in-situ derived measurements data from 20 locations. To attribute the SMC with different land cover/use, a supervised machine learning, namely Smile Cart classification, was used between 2015 and 2021. All data processing was done using the high-performance cloud computing platform of Google Earth Engine. The results showed that the Root Mean Square Error (RMSE) is 0.059 and 0.067 cm³/cm³ at 10 and 20 cm depth, respectively. The overall accuracy of Land Use/Cover (LULC) Classification is 91%. In conclusion, processing remote sensing data with GEE (Google Earth Engine) is efficient for quantitative spatial and temporal analysis. The established approach for this study can be reused and expanded for future research with different regions in a sustainable way.

Keywords: Soil Moisture Content, OPTRAM model, Sentinel-2 MSI, land use land cover, Google Earth Engine.

964. APUSEYINE Elizabeth (Ghana)

Supervisors: A. Lopez, S.J. Cobbina and N. Lamaddalena

Title: Agricultural reuse of domestic wastewater by constructed wetlands using indigenous Ghanaian plants: a pilot-scale field investigation. – 64 p.

Abstract: In Ghana, at Zagyuri, a community close to the Tamale Metropolis area, irrigation with untreated raw wastewater is regularly practiced by local farmers. A field investigation has been carried out in that area on eight pilot vertical-flow constructed wetlands to assess the effectiveness of two indigenous macrophytes

(*Cynodon dactylon* and *Portulaca oleracea*), planted separately and together, for treating and reusing domestic wastewater in agriculture. During four weeks, fifteen physical, chemical and biological wastewater water quality parameters were monitored for influent and effluent of all eight wetlands. The results have demonstrated that the pollutant removal efficiencies of the two macrophytes, regardless of whether planted singly or together, ranged between 65 and 99% depending on the pollutant considered. When planted together, *Portulaca* disappeared proving the invasive ability of *Cynodon*. Such plants' incompatibility was ascribed to their different growth cycles (annual and perennial). Referring to the health concern commonly associated with the poor quality of domestic wastewater reused for irrigation, the results were encouraging as they showed that the concentrations of all the parameters analysed, except for TSS and *E.coli*, had values lower than the limits provided in the regulations issued by several countries and international institutions, such as WHO and FAO, for agricultural wastewater reuse.

Keywords: Wastewater reuse, constructed wetlands, macrophytes, wastewater pollutants, *Cynodon dactylon*, *Portulaca oleracea*.

965. ISLEEM Hamza O.N. (*Palestine*)

Title: Assessment of treated wastewater flows to curb the deep percolation based on vadose zone monitoring and modelling. – 69 p.

Supervisors: R. Khadra, A. F. R. Hasan, M. N. Almasri, G. Dragonetti

Abstract: Treated wastewater (TWW) is a key source to secure agriculture in Palestine. Achieving a good water quality does not only imply its immediate reuse in irrigated agriculture but also a long-term conservation of soil and groundwater quality, marked by the complex mechanisms that correlate the soil, water, plant and atmosphere. Therefore, monitoring and modeling are combined in this study that primarily aims at the estimation of the soil water and nitrate fluxes, with a view to reducing deep percolation fluxes in a case study in Beit Dajan-Palestine. The investigated area (0.349Ha) cultivated with citrus, was irrigated with TWW in the last 5 years. Soil nitrogen concentration and water content data were collected from March to August 2021 to calibrate Hydrus-1D model, then the water and nitrate fluxes were retrieved for 2019 and 2020 under two TWW irrigation scenarios: 1) farmer demand (F) where irrigation volumes are delivered twice per week; 2) model demand (M) based on an irrigation frequency of 1 event per week

scheduled in order to balance a dual nitrate source: i) nitrified ammonium $N - NH_4^+$;

and ii) nitrate $N - NO_3^-$, both simultaneously supplied with TWW. For 2021, the measured soil electrical conductivity, σ_w , showed no salinity risk with an average value of 1.07 dS/m (low salinity < 2dS/m). However, a high level of total N in the soil exceeding 0.5% (standard value 0.1-0.2%) and a low concentration of N in the leaves (below 1%) suggesting a low assimilation, are observed. In addition, the comparison between simulated and measured soil variables show that 1D-Hydrus model was able to follow the temporal variation of the monitored data, with some overestimation of the measured data during the simulation period. M scenario also showed a decrease of nitrates leaching by 33% as compared to F scenario.

Keywords: 1D-Hydrus model, TWW irrigation management, citrus, soil salinity, nitrate leaching.

966. BEN DAHMEN Mohamed Montassar (*Tunisia*)

Supervisors: M. Todorovic, R. Albrizio, V. Cantore and N. Mzid

Title: Assessment of sweet maize performance under different water and nitrogen regimes using the AquaCrop model. – 75 p.

Abstract: For economic and logistic reasons, integrating high-resolution remote sensing data with a crop growth model would be a robust methodology to guarantee sustainable management of crop healthiness. This study was carried out at Valenzano, southern Italy. It aims to assess the response of sweet maize growth and development under three Irrigation scheduling treatments and two nitrogen regimes and evaluate the suitability of Sentinel-2 satellite data with the AquaCrop model to simulate the crop biomass and yield. After collecting field measurements, the AquaCrop model was calibrated using 2020 data and validated using 2021 data. An atmospheric correction was applied on the Copernicus Sentinel-2 satellite images using SNAP Toolbox, followed by using Semi-automatic Classification Plugin for QGIS to calculate the vegetation indices. The overall results indicated that irrigation regimes had greater impact on crop biometric parameters than different nitrogen levels. Moreover, the results of statistical analysis revealed a good fit between the measured crop growth parameters and those simulated by the AquaCrop model. Therefore, the AquaCrop model is a valuable tool to assess the response of sweet maize crop to different water and nitrogen regimes. It is important for evaluating sweet maize growth at other semi-arid locations in the Mediterranean region as well as for the climate change studies.

Keywords: sweet-maize, AquaCrop model, Sentinel-2 imagery, yield, biomass.

967. GARRAWI Afraa (*Tunisia*)

Supervisors: A. Fouial, B. Douh, S. Kammoun and N. Lamaddalena

Title: Impact of solar-powered irrigation systems on groundwater resources: a case study of Tunisia. – 75 p.

Abstract: Nowadays, water-demand for agriculture is increasing especially in rural and remote areas, where access to surface water and conventional energy is difficult or impossible. Solar energy can play an important role as a new affordable and clean energy source to promote agricultural operations, especially irrigation. The Tunisian government has set strategies that have enabled the use of solar energy in various applications, particularly in isolated environments, by setting up solar-powered pumps. In this context, Tunisia was selected as a case study to analyse the impact of solar-powered irrigation systems (SPIS) on the management of groundwater resources, considering the environmental and the socio-economic aspects. This study was based mainly on farmers' surveys that aimed to collect information related to farmers' activities and perspectives on SPIS technologies and sustainability. Most of the surveyed farmers use water excessively since they consider that using SPIS will not be sufficient to draw the amount of water needed to satisfy water demands for their farms. Hence, they tend to use illicit wells and/or to connect illegally to the grid for night irrigations. This study highly recommends increased awareness among farmers about the potential impact of SPIS on the sustainability of groundwater resources and the reinforcement of regulations related to groundwater exploitation.

Keywords: solar-powered irrigation systems, water resources, groundwater, environmental impact, sustainability.

W&L - A.Y. 2021-2022 (November session) – 994-1002

994. ZERROUGUI Meriem (Algeria)

Supervisors: A. Coppola and G. Dragonetti

Title: Simplified soil hydraulic characterization methods for large-scale agro-hydrological simulations: Assessment of the TDR-2D-Mod Method. – 86 p.

Abstract: Knowledge of soil hydraulic properties is crucial to use agro-hydrological models in planning proper irrigation management. Unfortunately, these inputs are often not available, and their measurement is time-consuming. Hence, it is attractive to identify an expeditious method which predicts them at multiple field locations within a short time. Accordingly, the main aim of the study was to validate a simplified method for soil hydraulic characterization called TDR-2Dmod using a large database of soil hydraulic parameters obtained from 19 Sectors belonging to District 10 of Capitanata Consortium (Apulia Region, Italy). TDR-2Dmod integrates Time Domain Reflectometry (TDR) measurements and 2D modeling of water content distribution and dynamics within the wetted bulb under drippers based on Richards' equation. The goodness of the hydraulic properties estimated by TDR-2Dmod was assessed by comparing them to the measurements obtained by classical Tension Infiltrometer Method (TIM method) performing a statistical t-test and sensitivity analysis. The main results showed no significant differences. This was confirmed by running numerical simulations of some selected functional properties with parameters obtained using alternatively data obtained by the proposed methodology and those coming from TIM method. The inversion procedure related to TDR-2D modeling and used to deduce the hydraulic parameters is especially sensitive to the parameter α_{GRD} and K_0 in the Gardner-Russo model for water hydraulic properties.

Keywords: soil hydraulic properties, time domain REFLECTOMETRY (TDR), tension infiltrometer (TIM), 2D modeling, inverse method, dripper.

995. BOUDEF Sabrina (Algeria)

Supervisors: P. Zdruli, M. Meddi and C. Karydas

Title: Soil erosion assessment in Oued El Hachem watershed in Tipaza region in Algeria using the G2 model. – 68 p.

Abstract: One of the nations most impacted by water erosion is Algeria. This phenomenon causes the removal of topsoil which results in a deteriorating soil. This study uses the G2 model, remote sensing and GIS to estimate water erosion in Oued El Hachem watershed in Tipaza region in Algeria. The average annual erosion rate in this watershed is projected to be 16.8 t/ha. The parts with very steep slopes are where severe and extremely severe erosion mostly occurs. Though, very small-scale erosion is occurring in depressions and flat lands. The validation of the results of a field survey consisting of a topography evaluation along with a granulometry analysis in the laboratory, gave a satisfactory output. As a result, the G2 model was successfully used to predict the soil loss rate identifying the months most at risk and providing a clear picture of areas where erosion risk is most likely in the study area. This study provides detailed predictions of erosion which is important

and helps in the feasibility studies, planning and management of water resources. Moreover, these results can clearly assist in implementing measures for soil and water conservation to reduce erosion in Oued El Hachem watershed. Finally, the G2 model might be used in areas with similar biophysical and climatic traits to Algeria like North Africa and the Mediterranean regions.

Keywords: erosion, Oued El Hachem, G2 model, Remote sensing, GIS.

996. ELGAMMAL Ahmed Moutaz Ahmed Abdelrahman (Egypt)

Supervisors: A. Coppola, N. Lamaddalena and Islam Sabry Al Zayed

Title: Impact of change in land use and land cover on the hydrological behaviour of a wadi basin in Egypt. – 77 p.

Abstract: The impact of change in land use/cover (LULC) has attracted the interest of many researchers since its multi-directional impacts on natural and human systems. LULC changes may have significant effects on rainfall-runoff relationship of a hydrological system. This study aims to estimate and evaluate changes in the hydrological behaviour of a wadi system due to reclamation by implementing rainwater harvesting. The study area is in Matruh governorate, Egypt. The evaluation process was carried out by using a semi-distributed hydrological model using HEC-HMS by comparing two scenarios: 1) involving the natural wadi before reclamation, and 2) including the reclaimed wadi. The model was calibrated by using rainfall data and discharges measured at the outlet during 6 rainy events in the 2018-2020 period. The LULC maps for the years 2014 and 2020 were detected using analysis satellite imagery. The results revealed that by changed LULC by reclamation, terraces attenuated the peak flow discharge by 73% at the wadi outlet. The time to peak flow was delayed by 183 min. The volume of water stored in the wadi was increased by 54%. The approach developed in this research has good potential to be applied and extended for future rainwater harvesting studies to count the impact of LULC change on wadi system.

Keywords: rainwater harvesting, land use/cover, hydrological models, basin hydrological behaviour, watershed modeling system, rainfall-runoff models.

997. HACHEM Ali (Lebanon)

Supervisors: M. Todorovic, R. Albrizio, N. Mzid, V. Cantore

Title: Integrating multispectral Sentinel-2 data, Google Earth Engine and Machine Learning techniques for the assessment of bean growth under different irrigation supplies. – 79 p.

Abstract: Bean crop was grown in 2022 at the experimental fields of CIHEAM Bari (Southern Italy) to assess its response under full and deficit (50%) irrigation, and rainfed cultivation. Crop biophysical parameters (leaf area index, dry aboveground biomass, fraction of green canopy cover, chlorophyll content index and relative water content) were measured four times during the season in combination with satellite remote sensing data acquisition. Google Earth Engine (GEE) was applied to acquire Sentinel 2 spectral bands and integrate them with machine learning algorithms. Measured and estimated crop parameters were statistically compared and analysed inside the machine learning toolbox (ARTMO). Bean growth was strongly affected by reduction of water supply with a significant difference of crop biophysical parameters between irrigated and non-irrigated treatments. Satellite vegetation indices were able to detect crop response to different water regimes even with a low number of measurements. The highest correlation was observed

for chlorophyll content index with a correlation coefficient R of 0.83 coupled with the best performing algorithm which is Random Forest (TreeBagger). The overall results affirmed the advantage of integrating remote sensing data, GEE and machine learning algorithms for the real time monitoring and assessment of crop growth.

Keywords: bean (*Phaseolus vulgaris* L.), precision agriculture, remote sensing, Automated Radiative Transfer Models Operator (ARTMO), machine learning algorithms.

998. AZIZ Rodolphe (Lebanon)

Supervisors: R. Khadra and G. Dragonetti

Title: Combining Field Experiments and Modeling for a No Harm Irrigation Management with Treated Wastewater: Case Studies from Jordan and Palestine. – 91 p.

Abstract: Water shortage, rising demands, and sectoral conflicts have prompted the use of treated wastewater (TWW) in agriculture. However, the long-term use of TWW - which is also a source of nutrients - if not properly addressed, would have adverse effects that may compromise soil tilth and crop growth. Accordingly, irrigation volumes and frequencies should be carefully planned. To this end, two case studies from Jordan and Palestine, where respectively alfa-alfa and citrus crops are continuously and exclusively irrigated with TWW, were selected to generate appropriate irrigation schedules and predict the potential adverse impacts of its use on crops and soils. The Safe Irrigation Management (SIM) model was used to simulate the irrigation schedules of the 2021 season, considering water parameters related to quality and quantity. Two scenarios were identified: 1) FARMOD referring to the model calibration based on FARMER planning, 2) ON-DEMAND referring to the schedule suggested by SIM. The results show a significant difference in terms of irrigation frequencies and volumes between the two scenarios. Moreover, better nitrogen and phosphorus uptakes, lower soil solution electrical conductivity ($EC_w < 1.5$ DS/m) and E coli values ($< 4 \log_{10}$ CFU/g) were achieved in scenario 2. The sensitivity analysis showed that EC_w and nitrogen are the most sensitive water quality parameters and thus require careful monitoring. Systemic agro-hydrological practices might be coupled to improve initial soil conditions for sustainable long-term TWW reuse.

Keywords: irrigation scheduling with TWW, SIM model, alfa-alfa, citrus, monitoring and modeling, soil tilth.

999. CHEBLI Hiba (Morocco)

Supervisors: A. Fouial and G. Dragonetti

Title: A comparison of two Agrivoltaic Systems to assess their impact on Arugula production (*Eruca Vesicaria*): A case study in southern Italy. – 63 p.

Abstract: An agrivoltaic system (AV) is an integrated solution based on the combination of energy and agricultural production on the same land, within the framework of the Water-Energy-Food nexus concept. However, this approach does not always provide advantages, particularly to the potential crop yield. Rather, AV generates different shading degrees, which may affect the ability of the crop to absorb light, thus its biomass production. In this regard, an experimental field was set up to assess the impact of two AV systems on the yield of the Arugula crop (*Eruca Vesicaria*), cultivated from August to October 2022, under three conditions:

1) semitransparent solar panels (ST), 2) conventional panels (CON), and 3) open field (REF). Daily parameters were monitored: soil temperature and soil water content, with scattered bio-physiological measurements. The results showed that global solar radiation decreased under ST and CON by 70% and 80%, respectively, compared to the REF. Although transpiration and photosynthesis decreased under ST and CON, no significant differences were observed in terms of leaf water use efficiency compared to the REF. In contrast, a significant yield reduction of around 50% under the AV compared to the REF was obtained due to Photosynthetically Active Radiation (PAR) reduction. Finally, the AV systems induced a positive impact on soil water uniformity distribution by 90% and 94% under ST and CON, respectively, compared to 85% under REF.

Keywords: agrivoltaic, semi-transparent and conventional panels, arugula, bio-physiological parameters, Water-Energy-Food nexus.

1000. EL GHAILASSI Abdelouahed (Morocco)

Supervisors: R. Choukr-Allah, S. Boularbah and G. Dragonetti

Title: A pulsed drip irrigation management to improve soil water dynamics in sandy soils and the production of cultivated blueberries in Morocco. – 67 p.

Abstract: Water scarcity poses serious threats to agriculture and efficient irrigation practices are essential for mitigating this impact. Such practices should not only consider optimization of crop water consumptions but also the type of soils: sandy soils, in particular, are characterized by low water holding capacity, thus rapid movement of water below the root zone. Short-duration and more frequent (pulsed) irrigation events have been shown to result in better soil water distribution and more efficient crop water uptake. Therefore, a study was conducted in Morocco on blueberry in the greenhouse to assess the performance of pulsed drip irrigation technique (PLS) on soil characteristics, soil water dynamics, as well as yield. Within a plastic tunnel (34x30m) 10 strips were selected: 5 strips operated under PLS and 5 strips under continuous drip irrigation practices (NON-PLS) to measure soil water contents and soil electrical conductivity (ECe) and pH. The results indicated that PLS drip irrigation using on average 8 pulses/day increased yield by 10% and fruit size by 8%, and Water and Nutrient Use Efficiency of blueberry by 9%, as compared to NON-PLS irrigation (one-two times/day). Flow pulses followed by breaks also improved water redistribution in the root zone by better controlling soil ECe pattern and maintained pH values within the blueberry soil pH optimal range.

Keywords: blueberry crop, pulse irrigation, sandy soils, water use efficiency, soil characteristics.

1001. ALKHAROUBI Ahmad (Palestine)

Supervisors: A. Carletti and R. Khadra

Title: Mitigation of nitrate groundwater contamination through a Forested Infiltration Area (FIA): the case study of a Nitrate Vulnerable Zone in Arborea (Sardinia, Italy). - 71 p.

Abstract: Even though nutrient export to downstream systems from agriculture is believed to be high, implementation of management plans has not been as effective as desired. The objective of this research was to evaluate the Managed Aquifer Recharge (MAR) system based on the Forested Infiltration Area (FIA) as a good practice for mitigating nitrate contamination in the sandy phreatic aquifer (SHU) of Arborea, where agricultural practices have seen an intensive input of

animal effluents (slurry and manure) used to enhance soil productivity. Arborea is a reclaimed area in central-western Sardinia (Italy), defined as Nitrate Vulnerable Zone (NVZ) in 2005. To this end, an *ante-operam* monitoring phase (August 2020 to October 2021) of the groundwater and drainage water to be used for recharge was performed, and samples were monthly collected around the FIA pilot site of approximately 9 Km² and tested for bulk chemistry. Moreover, flow-through tests at different rates enabled the selection of the organic material for recharging the trenches of the Passive Treatment System of drainage water. The results confirmed the high nitrate concentrations in the aquifer, up to 170 mg L⁻¹, and the effectiveness of Eucalyptus wood chips as organic material, to promote the denitrification process in the recharge water, enabling the executive design of the FIA system. These results, obtained under the MENAWARA project, are of interest for future development and long-term planning of groundwater protection management.

Keywords: Nitrate Vulnerable Zones, Managed Aquifer Recharge, Forested Infiltration Areas, flow-through experiment, woodchips of eucalyptus, Passive Treatment System.

1002. NAWAR Bechir (Tunisia)

Supervisors: A. Scardigno and J. A. Sagardoy

Title: Assessing the economic viability of treated wastewater reuse for irrigation and determining sustainable water pricing policies: Ouardanine irrigation district case. – 86 p.

Abstract: Treated wastewater reuse represents a valuable water source in water scarcity conditions. However, if the technical feasibility of this option is demonstrated, less attention is paid to its economic assessment. By applying an ex-post Cost-Benefit Analysis to 'Ouardanine irrigation compound 2', in eastern Tunisia, the economic feasibility of wastewater treatment and reuse in irrigation was assessed. After an extensive field campaign for data collection, costs and benefits were identified and evaluated throughout the lifespan of the project. Four scenarios - no treatment, only treatment, treatment with reuse, and treatment with reuse without considering the environmental benefits - were considered. The results prove that the project is highly profitable for all scenarios except the first and that it is still profitable with a decrease in costs or an increase of benefits up to 30%. Farmers are the main beneficiaries of the project which, on the other hand, proves to be economically impracticable both for the treatment plant company and for the public body responsible for the distribution of water. Finally, the simulation of the effects of different water pricing policies shows that farmers would be able to pay the total costs of the project when we consider them as a single group, but that the affordability of the water price depends on the specialization model of the farm.

Keywords: Cost-Benefit Analysis, wastewater reuse, wastewater treatment plan, economic feasibility, water pricing.

**INNOVATIVE APPROACHES FOR INTEGRATED
PEST MANAGEMENT OF MEDITERRANEAN FRUIT
AND VEGETABLE CROPS**

IPM - A.Y. 1989-1990 (July session) – 10-11

10. OUERTANI Riadh (Tunisia)

Supervisor: G. P. Martelli

Title : Caractérisation d'un virus parasphérique isolé par voie mécanique de vignes tunisiennes. - 71 p.

Abstract: A partir de vigne d'origine tunisienne, un virus parasphérique a été isolé par voie mécanique. Le virus, bien qu'il n'ait montré aucune réaction sérologique avec 17 nepovirus, il porte les majeures propriétés de ce groupe. En effet, il infecte plusieurs hôtes expérimentaux en induisant surtout des lésions locales et des taches annulaires. Ses propriétés "in vitro" sont: (a) température d'inactivation : 65 deg C, (b) dilution limite : $10E2$, (c) longévité "in vitro": 4 à 5 jours. Les préparations du virus purifié sont constituées de particules isométriques à contour hexagonal et de diamètre de l'ordre de 30 nm. Les particules constituent 3 composantes T, M et B contenant 0,35 et 42 d'RNA. Suite à la centrifugation à l'équilibre dans un gradient de chlorure de césium (CsCl) les composants précipitent. Les densités de flottaison du (M) et (B) sont respectivement 1.45 et 1.49 g/ml. La composante (M) n'est pas infectieuse. Deux RNA monocaténares ayant des poids moléculaires de l'ordre de $2.0 \cdot 10E6$ (RNA-2) et $2.4 \cdot 10E6$ (RNA-1) déterminés sous des conditions partiellement dénaturantes, ont été extraits. La capside protéique contient un seul polypeptide de poids moléculaire d'environ 59.000 d. Les deux protéines capsidales du GTRV et du GFLV ont montré une différence de poids de l'ordre 3000 d. Toutefois, ces deux virus ont apparemment une même densité de la composante (B) et un même poids moléculaire de l'RNA-1.

11. OUERFELLI Ridha (Tunisia)

Supervisor: G. P. Martelli

Title: Relation entre closterovirus et tissu de vigne en fonction de leur détection. - 55 p.

Abstract: Des variétés de vigne indexées positivement pour l'enroulement foliaire et/ou le bois strié sur un indicateur Européen (Mission) et sur d'autres Américains ou hybrides, sont utilisées dans notre travail. La comparaison entre les méthodes de détection des closterovirus, à savoir la micropurification à partir des feuilles ou du phloème, l'ELISA et l'extraction des dsRNA, nous a permis de ressortir l'efficacité d'utilisation du tissu corticale de vigne. En effet la micropurification à partir des feuilles ne permet la détection des closterovirus que dans 6% des cas de vigne malade d'origine Américaine ou hybride. Alors qu'à partir du phloème on peut détecter la présence des mêmes virus chez les mêmes variétés avec un taux d'efficacité de 67%. Il existe une corrélation assez consistante entre les maladies, d'enroulement foliaire et du bois strié et la détection des bandes de dsRNA de poids moléculaire élevé, non présente chez les variétés de vigne saine. La dominance du GLRVIII chez nos échantillons de vigne enroulées ou atteintes de bois strié est corrélée avec l'abondance des bandes de dsRNA de poids moléculaire de l'ordre de 11 millions de dalton.

IPM - A.Y. 1990-1991 (July session) – 26-30

26. Aslaoui Ezzedine (*Tunisia*)

Supervisor: not available

Production, caractérisation et emploi d'anticorps monoclonaux spécifiques du virus A de la vigne (GVA). - 46 p.

Abstract: Une fusion entre les cellules myélomateuses SP20Ag14, et les cellules spléniques de souris Balb/c immunisée contre l'isolat PA3 de GVA maintenu sur *Nicotiana benthamiana*, a été réussie, et quatre lignées d'hybridomes stables, produisant des anticorps monoclonaux contre ce virus ont été obtenues. Les quatre antisérums monoclonaux ainsi produits ont été caractérisé par ELISA et par microscopie électronique, et comparés à l'antisérum polyclonal. Alors que trois lignes (B9, C6 et D11), des quatre produites, sont caractéristiques pour des cryptotopes, une seule ligne (F5) correspond à un épitope situé sur la surface externe de la protéine virale. Chacun des antisérums monoclonaux a reconnu les six isolats de GVA transmissibles mécaniquement, ce qui permet de penser que ce virus a une faible variabilité sérologique. De même, ce résultat indique la possibilité d'employer ces antisérums pour les dépistages du GVA à grande échelle. Différents procédés ELISA ont été essayés pour un meilleur diagnostic sur la vigne. Parmi ceux-ci le meilleur est celui employant l'antisérum polyclonal pour la sensibilisation des puits (coating). La reconnaissance du virus est ensuite assurée par les anticorps conjugués à la phosphatase alcaline de la ligne F5.

27. LUPO Rossella (*Italy*)

Supervisor: G. P. Martelli

Studies on grapevine fleck virus and its diagnosis. - 60 p.

Abstract: *Agrobacterium rhizogenes* has been applied to grapevine to obtain "transformed" roots to be in vitro cultured as source of grapevine fleck virus (GFkV). Transformation techniques have been applied also to grapevine virus A (GVA) and virus B (GVB) on their herbaceous hosts: *Nicotiana benthamiana* and *Nicotiana occidentalis*, respectively. *A. rhizogenes* strains and different inoculation conditions were tested to optimize the production of transformed roots. Transformation was successfully achieved for grapevine and *Nicotiana* spp. In transformed *N. benthamiana* roots, GVA replicated and reached higher concentrations compared to GVA-infected *N. benthamiana* seedlings. Based on these observations and on preliminary results on grapevine trials, transformed roots seemed to be a good source of virus. Work is still in progress to assess whether in vitro grown grapevine transformed roots can be a satisfactory material for the purification of GFkV. DAS-ELISA assays and indexing on *Vitis rupestris* were applied to six GFkV-infected vines and compared for GFkV detection. DAS-ELISA gave apparently more reliable and earlier results and showed to be more effective than indexing. DOT-ELISA and SPOT-ELISA were also carried out for GFkV detection, but no one showed better performances than DAS-ELISA.

28. **TUZOVIC Jasmine (Yugoslavia)**

Supervisor: G. P. Martelli

Comparative biological, serological and electrophoretic behaviour of some isolates of prunus necrotic ringspot ilarvirus. - 52 p.

Abstract: A study was carried out to characterize the different symptomatological expressions caused by Prunus Necrotic Ringspot Ilarvirus (PNRV) in stone fruit species in Southern Italy and Yugoslavia and to compare the serological and electrophoretic behaviour of different viral strains. PNRV isolates, used in the comparative study, induced well-distinguished symptomatologies in the field on different apricot, cherry, almond, peach, plum and rose varieties. The biological behaviour was assessed with field surveys, graft-transmission tests to almond, apricot, peach and plum indicators and mechanical inoculation to a host range made up of 22 species belonging to seven different families. The serological characterization was carried out by using gel double diffusion tests and ELISA, whereas the electrophoresis of purified preparation of different isolates was made in 2% agarose gel. The isolates under study showed remarkable differences in their biological properties, but were serologically indistinguishable when tested in gel double diffusion test by using antisera against three of the isolates examined. Electrophoresis in agarose gel showed differences in the migration rates of intact viral nucleoproteins, which was also confirmed by immunoelectrophoresis tests.

29. **MESKAT Abdelaziz (Morocco)**

Supervisor: G. P. Martelli

Caractérisation biologique et physico-chimique d'un virus filamenteux isolé d'amandier. - 48 p.

Abstract: A partir d'un amandier qui présentait des nécroses au point de greffe, un virus a été isolé mécaniquement sur des plantes herbacées. Les observations au microscope électronique ont montré qu'il s'agit d'une particule virale de forme filamenteuse de longueur moyenne de 630 nm. L'immunomicroscopie électronique n'a pas révélé de relation sérologique entre ce virus et les autres virus filamenteux dont les antisérums sont disponibles au laboratoire. D'après les tests biologiques réalisés sur des plantes herbacées il s'avère que la présence du virus chez certaines plantes infectées, se manifeste par l'apparition de lésions locales nécrotiques, tandis que pour d'autres le virus est latent. Parmi les différentes espèces et variétés qui appartiennent à la gamme des hôtes, *Vigna unguiculata* est adopté comme meilleure plante indicatrice et *Nicotiana benthamiana* est choisie comme meilleure plante source de virus pour la purification. La longévité du virus in-vitro est de 20h, son point d'inactivation thermique est de 42 deg C et le point de dilution limite est situé entre 10 puissance -4 et 10 puissance -5. Par confrontation des ces caractères avec les données bibliographiques relatives à la classification des virus filamenteux, il s'agit d'un nouveau carlavirus. Le virus en question est d'une faible concentration dans la plante et les particules virales sont très instables et ont une tendance à l'agrégation. La purification partielle du virus est assurée par l'utilisation du tampon Tris 0,1 M de pH 8,0+0,1% d'acide thioglycolique, le gel phosphate du calcium à la clarification et le polyéthylène glycol pour la précipitation des particules virales. L'antisérum produit reste jusqu'à présent le seul moyen de diagnostic du nouveau virus.

30. WADJINNY Jamila (Morocco)

Supervisor: G. P. Martelli

Analyse électrophorétique des profils différentiels d'arn bicatenaire des vignes infectées par des clostérovirus. - 59 p.

Abstract: Une extraction de dsRNA a été faite à partir de clones de vigne présentant des symptômes d'enroulement foliaire ou de bois strié préalablement testés sérologiquement et par la microscopie électronique pour quelques clostérovirus de la vigne. L'analyse électrophorétique sur gel de polyacrylamide des extraits de dsRNA montre une variation de profil aussi bien entre clones infectés différemment qu'entre clones infectés par le même virus. Le profil électrophorétique du dsRNA extrait à partir de quelques plantes mères n'a pas été toujours parfaitement reproductible chez les plantes indicatrices respectives; seulement la plante indicatrice "Mission" a montré un profil identique à celui de la plante mère. Quatre isolats de GVA et un isolat de GVB ont été mécaniquement transmis respectivement sur *Nicotiana cavicola*, *N. clevelandii*, *N. occidentalis*, *N. benthamiana*, sur *N. rotundifolia*, et *N. occidentalis*. Le profil électrophorétique du dsRNA du GVA se présentait de la même façon indépendamment de l'isolat et de la plante hôte et consistait en 5 bandes majeures de PM exprimés en 10 puissance 6 Da: 8,8; 5,3; 5,1; 4,4 et 4, celui du GVB consiste par contre en 4 bandes pesantes (7,8; 5,5; 4,3 et 3,5) et une bande légère (0,6). Les bandes 5,3 et 5,5 x 10 puissance 6 Da correspondraient aux dsRNA génomiques respectivement de GVA et de GVB.

IPM - A.Y. 1991-1992 (July session) - 44-47

44. GRAYAA Jameleddine (*Tunisia*)

Supervisor: G. P. Martelli

Title: Analyse de l'état sanitaire du cerisier dans la région des Pouilles (Italie). - 95 p.

Abstract: La situation virologique du cerisier dans les Pouilles s'est révélé très préoccupante. Les données obtenues des tests ELISA, montrent que la fréquence des infections est de l'ordre de 65% dans les vergers représentatifs et de 47% dans le champ d'une collection variétale situé à Conversano (Bari). Le PDV résulte le virus le plus diffus dans la région avec 60% et dans la collection variétale avec 45%. Divers cadres symptomatologiques ont été mis en évidence. Les plus fréquents sont : la tâche annulaire chlorotique et/ou nécrotique, la tâche annulaire jaune, la tâche linéaire, la feuille râpeuse et la tâche foliaire chlorotique. La présence des virus PDV, PNRSV, ApMV, et ACLSV, dans un matériel infecté conservé à froid (4 deg C) a été vérifiée par test ELISA, pendant une période dépassant les quatre mois ; ce qui constitue l'utilité de cette expérience dans un éventuel programme de certification.

45. LAGHA Mondher (*Tunisia*)

Supervisor: G. P. Martelli

Title: Caractérisation sérologique de trois souches du virus du court-noué de la vigne (GFLV). - 54 p.

Abstract: Une caractérisation biologique, électrophorétique et sérologique de trois isolats du virus du court noué de la vigne (GFLV) a été réalisé. Ces isolats sont originaires de trois ceps présentant respectivement les symptômes de malformation et déformation (fanleaf), panachure (yellow mosaic) et la panachure réticulée (vein banding). Il s'est révélé impossible de différencier ces isolats entre eux soit par la caractérisation biologique et électrophorétique que sérologique utilisant les trois antisérums polyclonaux homologues. On a fait recours, enfin, à la production des anticorps monoclonaux. De ce fait, une fusion entre les cellules myélomateuses de type NSO/1 et les cellules de la rate de souris de type BALB/c immunisé contre l'isolat JOR 1 de GFLV a été effectuée. On a obtenu une lignée d'hybridomes stable productrice d'anticorps. L'anticorps monoclonal ainsi produit a été caractérisé, mais son utilisation dans des techniques telles que Western Blot, DAS ELISA indirect et en double diffusion en gel d'agar n'a montré aucune distinction entre les trois souches. Seulement le virus de la mosaïque de l'arabette (ArMV) a été totalement discriminé par cet anticorps.

46. POPOVIC Bezdrob Maja (Yugoslavia)

Supervisor: not available

Title: Study of correlation between grapevine virus A (GVA) and complex of rugose wood of grapevine. - 30 p.

Abstract: Objective of the present study is the observation of field symptoms of rugose wood and their correlation with the presence of grapevine virus A (GVA). White and red fruited cultivars from different districts in Apulia were selected and samples (mature canes) were collected in late autumn. Serological investigations were done by standard DAS-ELISA, through the following steps: purification of gamma-globuline with protein A-Sepharose column; conjugation of gamma-globuline with enzyme (alkaline phosphatase). For routine test a polyclonal rabbit antiserum to GVA was used for coating and the monoclonal antibody conjugate for the detection GVA in phloem tissue extract of grapevine. ELISA was also used for the detection of the following viruses: Grapevine leafroll associated virus I (GLRaV I); Grapevine leafroll associated virus III (GLRaV III); Grapevine fanleaf virus (GFLV); Grapevine fleck virus (GFkV).

47. CHOUEIRI Elia (Lebanon)

Supervisor: G. P. Martelli

Title: Enquête sur l'état sanitaire du pêcher dans les Pouilles. - 43 p.

Abstract: La recherche a concerné l'étude de l'évaluation sanitaire du pêcher dans la région des Pouilles. Le protocole du travail expérimental était le suivant : étude symptomatologique au champ ; étude sérologique à travers l'ELISA contre les virus : Plum Pox (PPV) ; Apple Mosaic (ApMV) ; Prunus Necrotic Ringspot (PNRSV) ; Apple Chlorotic Leaf Spot (CLSV) et Prune Dwarf (PDV) ; transmission mécanique sur plantes herbacées ; indexage biologique (Protection croisée) sur les semis du pêcher GF 305 pour la détection du viroïde Peach Latent Mosaic (PLMVd) ; mise au point de la technique de diagnostic du PLMVd au moyen de l'électrophorèse. On a pu à la fin isoler la bande du viroïde par électrophorèse bidirectionnelle sur fruits et sur feuilles en appliquant la méthodologie de Flores avec une légère modification en utilisant le citrus exocortis viroid (CEVd) et le coconut cadang-cadang viroid (CCCVD).

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61. AL BITAR Lina (*Lebanon*)

Advisor : M. Conti

Title: Tomato yellow leaf curl virus: transmission, purification et diagnostic. - 43 p.

Abstract: Vu l'importance économique du tomato yellow leaf curl virus (TYLCV), un géminivirus transmis par l'aleurode *Bemisia tabaci*, des études ont été faites à l'Istituto di Fitovirologia Applicata, Turin (Italie), pour étudier certains aspects de transmission, purification et diagnostic de ce virus. Pour évaluer la présence éventuelle des différences de transmission entre la souche de *Bemisia tabaci* induisant le "Silver-leaf of squash" (ligurienne) et celle qui ne l'induit pas (sarde), des preuves de transmission, faites avec une souche virale sarde, n'ont montré aucune différence de transmission entre ces deux souches, tandis que des différences significatives étaient relevées entre les mâles et les femelles, l'efficacité de ces derniers étant plus élevée. D'autres tests ont révélé que le phénomène "d'acquisition périodique" (Cohen et Harpaz, 1964) n'existe pas dans la combinaison TYLCV-*Bemisia*, tous les deux provenant de la Sardaigne. TYLCV a été purifié à partir de *Nicotiana benthamiana*, *Lycopersicon esculentum* et *Datura stramonium*, récoltés 48 jours après le greffage ; les résultats de l'ELISA indirecte et de la microscopie électronique ont montré que la *N. benthamiana* est l'hôte qui donne le meilleur rendement après incubation de l'homogénéisant pendant 24 heures à 37 deg avec driselase. Deux méthodes d'extraction d'acides nucléiques (Standard et TLES), ont été testées sur des isolats de TYLCV provenant de la Sicile, la Sardaigne et l'Espagne. Les résultats des "dot-blot" et "Southern-blot" ont montré que la méthode Standard est adéquate dans le cas d'un simple "dot-blot", alors que la méthode TLES est nécessaire pour des études plus approfondies. Des dot-blot des isolats de TLCV provenant de l'Italie, de l'Espagne et du Liban utilisant une sonde spécifique du TYLCV sarde, ont révélé que la souche libanaise diffère des souches italienne et espagnole.

62. ABOU-GHANEM Nina (*Lebanon*)

Supervisor: G. P. Martelli ; advisor : V. Savino

Title: Étude comparative entre divers isolats du virus B de la vigne (GVB). - 82 p.

Abstract: Une étude comparative a été faite entre huit différents isolats du virus B de la vigne (GVB) et l'isolat type du même virus, récemment décrit et associé à la maladie de l'écorce liégeuse. Ce travail a consisté en : a) une caractérisation biologique, soit symptomatologique par une transmission mécanique sur divers hôtes herbacés, que cytopathologique par observation des sections ultrafines au microscope électronique ; b) une caractérisation physico-chimique à travers des analyses des profils de sédimentation des préparations virales purifiées, de la migration électrophorétique des sous-unités protéiques de la capside et des acides nucléiques ; c) une caractérisation sérologique à travers la production des antisérums polyclonaux et l'évaluation des réactions sérologiques avec les divers isolats par Western blot et par Immunomicroscopie électronique. Ce travail a été fait pour vérifier le degré éventuel de variabilité existant entre les divers isolats du virus. Les caractéristiques de ceux-ci ne sont guère connues ou, au moins, les

informations actuelles ne concernent que l'isolat type. D'après les résultats obtenus, l'existence d'une variabilité des caractéristiques diverses biologiques, physico-chimiques et sérologiques, a été mise en évidence. Ceci confirme les résultats de l'hybridation moléculaire faite parallèlement à ce travail, en analysant les acides nucléiques totaux extraits des différents isolats viraux par une sonde à cDNA de l'isolat type. Sur la base de cette variabilité, la présence de deux types de GVB a été identifiée.

63. BOUCHOUR Allal (Morocco)

Supervisor: G. P. Martelli ; co-supervisors : V. Savino and B. Di Terlizzi

Title: Caractérisation biologique et essais de purification des virus filamenteux isolés de l'abricotier et du cerisier. Étude de la diffusion du Plum Pox Virus dans des vergers d'abricotier de la Pouille (Italie). - 60 p.

Abstract: Des virus ont été isolés à partir de l'abricotier et du cerisier par transmission mécanique sur *Nicotiana Occidentalis*. Des observations au microscope électronique des jus bruts des feuilles infectées séparément par les trois isolats ont montré qu'il s'agit de virus filamenteux. Les isolats ont la même gamme d'hôtes herbacés sur lesquels ils induisent les mêmes symptômes : systémiques et locaux sur *N. Occidentalis* et *N. Cavicola*, et des lésions locales sur *Gomphrena Globosa*. Les virus ont été partiellement purifiés par l'extraction avec le tampon Tris HCl 0,1M, pH 7,5, MgCl₂ 0,03M, 0,1% d'acide mercaptoacétique et 0,1% de NaCl et une clarification par le gel phosphate de calcium à raison de 6 ml/10 gr de feuilles. En outre, une étude a été entreprise dans quatre différents vergers d'abricotier cv. *Tirynthos* des Pouilles, afin d'évaluer la diffusion de la Sharka (PPV) au champs. Une augmentation graduelle mais constante de plantes infectées (de 0,6% à 4,8%) a été observée dans toutes les plantations examinées. La présence des pucerons, même si limitée, a évidence une augmentation croissante au fur et à mesure que la saison avance. L'accroissement constant et progressif du nombre de plantes infectées, l'identification de nouvelles infections de PPV sur les plantes d'abricotier cv. *Errani* et cv. *Tirynthos* et la localisation sectorielle des symptômes sur la frondaison, semble confirmer l'hypothèse d'une diffusion de la maladie au champs par les vecteurs naturels.

64. DIMOU Dimitrios (Greece)

Supervisor: G. P. Martelli ; co-supervisors: V. Savino and A. M. D'Onghia

Title: Characterization of two isometric grapevine viruses of Austrian and Hungarian origin. - 47 p.

Abstract: A study was undertaken to compare two nepovirus isolates, F3 and H6 respectively of Austrian and Hungarian origin, that elicited yellow chrome mosaic symptoms in grapevine. The two isolates were compared with the type (H15) isolate of grapevine chrome mosaic virus (GCMV) of Hungarian origin. Biological and physico-chemical properties of the two isolates were determined. Infected *Chenopodium quinoa* and *Nicotiana occidentalis* were the best sources for virus purification. The in vitro properties of the three isolates, were substantially similar with the exception of the slightly lower longevity of H6 isolate. The three isolates lost their infectivity after dilution to 10⁻³/10⁻⁴ heating for 10 min at 60-62°C and storing for 10 days (7 for H6 isolate) at room temperature. In the electron microscope, the virus particles showed an angular profile and had a diameter of about 30 nm. No serological differences were observed between the three isolates in ELISA, ISEM and agar diffusion tests. No differences were observed in the

number, type (ssRNA) and molecular weight of nucleic acids of F3 and H15 isolates, neither in the number and molecular weight (54 KDa) of coat protein subunits. F3 and H6 were recognised serologically as GCMV isolate. Therefore, this represents the first report of the presence of GCMV in Austria. The F3 isolate did not differ from H15 isolate of GCMV. By contrast, isolate H6 showed differences in biological properties and behaviour during purification which distinguished it clearly from the other two GCMV isolates under study.

65. GEHA Mariane (*Lebanon*)

Supervisor: G. P. Martelli ; co-supervisors : V. Savino and M. Digiaro

Title: Caractérisation d'un virus à particules allongées isolé du cerisier. - 64 p.

Abstract: Une étude a été effectuée sur la caractérisation biologique et physico-chimique d'un virus à particules allongées (probablement un carlavirus), isolé d'un cerisier, apparemment sans symptômes, dans la région des Pouilles. Le virus, nommé PLV est sérologiquement corrélé à un virus isolé d'amandier de la même région et transmissible mécaniquement en provoquant des lésions nécrotiques locales. Les hôtes herbacés les plus sensibles sont : *Nicotiana benthamiana* Domin., *Vigna unguiculata* Walp. et *Phaseolus aureus* Roxb. La longévité in vitro du virus dans les extraits végétaux bruts est de 12 heures, la dilution limite est de 1:10000 et le point d'inactivation thermique est de 45°C. Le PLV a une longueur moyenne de 550-600 nm. et sa purification se fait en utilisant des tampons à haute molarité. L'antisérum produit a comme titre 1:32 et décore spécifiquement le virus. Le poids moléculaire de la protéine virale est de 33000 daltons, tandis que celui des acides nucléiques, mono et bicaténaires, reste douteux considérant la basse concentration du virus dans les tissus infectés. Dans la cellule le virus se trouve sans forme de bande et provoque des altérations au niveau des chloroplastes. Des tentatives d'isolement du virus sur d'autres plantes de cerisier, pêcher et amandier ont été effectuées par la transmission mécanique sur des hôtes herbacés. Le PLV n'a pas été isolé, ce qui indique que ce virus est peu répandu dans la nature et qu'il n'est probablement pas impliqué dans l'étiologie des altérations virus-similaires examinés.

66. GUGLIELMI MONTANO Helena (*Brazil*)

Supervisor: G. P. Martelli ; co-supervisors: V. Savino and P. Saldarelli

Title: Non-radioactive probes for the study and detection of grapevine closterolike viruses. - 70 p.

Abstract: The application of non-radioactive hybridization in the detection of the three major grapevine closteroviruses, grapevine virus A (GVA), grapevine virus B (GVB) and grapevine leafroll associated virus III (GLRaV III), was tested in the present work. RNA probes, complementary to fragments of the three viral genomes, were successfully applied to virus detection in grapevine and herbaceous tissues extracts. Complementary RNA (cRNA) probes were produced by SP6 or T7 transcription in the presence of Digoxigenin-11-UTP. Total nucleic acids (TNAs) were obtained from grapevine tissues (phloem shavings or leaves and petioles) and from herbaceous hosts by phenol-chloroform extraction, followed by treatment with cellulose CF 11 and 35% ethanol. All the three Digoxigenin-labeled probes specifically detected homologous viral sequences in infected grapevine TNA extracts spotted onto nylon membranes. No hybridization signals were observed in healthy control extracts, with any of the three probes. Hybridization signals in dot blot assays were in agreement with those of ELISA test (for GVA and GLRaV III) and

with former indexing results on LN 33 (for GVB). In Northern hybridization, GLRaV III - RNA sequences were identified in grapevine tissues extracts. GLRaV III banding pattern was clearly distinguishable from those of GVA and GVB obtained from artificially infected herbaceous tissues. Chemiluminescent detection is a reliable technique which can be adopted in certification programme schemes, as a complement or alternative to serological diagnosis, in the case of GVA and GLRaV III. As for GVB, which so far can be detected only by means of indexing and sap transmission, chemiluminescence is a promising alternative diagnostic method.

67. SABANADZOVIC Sead (Bosnia and Herzegovina)

Supervisor: G. P. Martelli ; co-supervisors: D. Boscia and V. Savino

Title: An isometric non-mechanically transmissible virus associated with asteroid mosaic of grapevine and characterization of a carmovirus isolated from grapevine roots. - 60 p.

Abstract: Assuming that the possible agent of the asteroid mosaic disease of grapevine could be a virus, investigations (which are part of this thesis) were initiated testing infected *V. rupestris* plants of Californian origin, referred as: USA 9 (H1, H2, H4), USA 11 (L1, L3, L4) and USA 12. Objectives of the investigations were: a) search for a possible association of a virus with asteroid mosaic, b) identifying the most suitable plant tissue for virus extraction, c) developing an appropriate purification procedures. Virus particles of two types: empty shells and intact virus particles with a rounded outline, c. 30 nm in diameter, were observed from young roots or cortical scrapings applying essentially the same purification procedure used for grapevine fleck virus. Mechanical transmission trials of this virus failed. Virus particles are morphologically similar to those of GFkV, but tests with antisera to GFkV, grapevine ajinashika associated virus and GFLV shown no relationships. These results indicate that, probably, a novel non-mechanically transmissible isometric virus is associated with asteroid mosaic of grapevine. During these experiments a surface contamination of grape roots by a mechanically transmissible virus was observed. Another set of investigations was initiated for the biological, physico-chemical and serological characterization of this virus, and the results obtained strongly indicate it as to be a new carmovirus, for which the name of Pothos latent virus (PoLV) is proposed.

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82. MYRTA Arben (*Albania*)

Supervisor: G. P. Martelli ; co-supervisor: V. Savino

Title: Sanitary status of plum, peach and apricot in Albania and characterization of some Albanian plum pox virus isolates. - 49 p.

Abstract: Surveys were carried out in plum, peach and apricot orchards and varietal collections of stone fruit trees in Albania, for assessing the presence and distribution of virus and virus-like diseases. Biological assays consisting in mechanical inoculation to herbaceous hosts from glasshouse-forced cutting or field samples and graft transmission to GF 305 were made in winter and spring 1994. The following viruses are present: Plum Pox Potyvirus (PPV), Prunus Necrotic ringspot (PNRSV), Apple Mosaic (ApMV), Prune Dwarf (PDV) Ilarviruses, Apple chlorotic leaf spot trichovirus (ACLSV), Tomato ringspot (ToRSV), Tomato black ring (TBRV), Arabis mosaic (ArMV), Raspberry ringspot (RRV), Cherry leaf roll (CLRV) and Strawberry latent ringspot (SLRV) nepoviruses. The prevailing viruses were PPV, ACLSV, PDV and PNRSV. PPV infections were rare in apricot and peach. No infection by ApMV or any of the nepoviruses was detected. To date, none of the graft-inoculated GF 305 seedlings has shown any symptomatological reaction. The preliminary characterization of Albanian PPV isolates from plum and apricot showed that they have a similar biological behaviour but a wider host range than M and D strains. Based on the symptomatology and timing of expression in *Chenopodium foetidum*, the Albanian PPV isolates were tentatively identified as belonging to the so-called intermediate biological strain, although the behaviour in *Nicotiana clevelandii* sap showed the Albanian PPV isolates to be closer to Yellow biological strain.

83. BONAVIA Marica (*Malta*)

Supervisor: V. Savino ; co-supervisor: M. Digiario

Title: Sanitary status assessment of vines affected by a particular aspect of rugose wood, named "Legno riccio suberoso" and its correlation with corky bark disease. - 64 p.

Abstract: A study was undertaken to establish the possible correlation between closterolike viruses and an atypical corky-like production of the bark, observed in the field, at the graft union of vines, for which the name "legno riccio suberoso" (LRS) was proposed. This study was based on: 1) field surveys in commercial Apulian vineyards for symptom observation and identification of vines showing LRS symptoms; 2) mechanical transmission to herbaceous hosts; 3) direct and indirect enzyme linked immunosorbent assays (ELISA) to assess the presence of grapevine A (GVA) and grapevine B (GVB) trichoviruses, grapevine-leafroll associated virus I (GLRaV I), grapevine leafroll closteroviruses, grapevine fanleaf nepovirus (GFLV) and grapevine fleck virus (GFkV); (iv) immunoelectron microscopy (IEM) tests; (v) PAGE electrophoresis of nucleic acids amplified by reverse transcription-polymerase chain reaction (RT/PCR) for GVB detection; (vi) electrophoresis analysis of double stranded RNA (dsRNA) of ELISA-negative samples and (vii) graft transmission to LN 33 indicator plants. A high percentage of ELISA-tested LRS-affected vines

proved to be infected with at least one of the seven viruses tested. Particularly widespread was GLRaV III, followed by GFKV, GVA, GCBaV, GLRaV I and GVB. GFLV infections were completely absent, except for one plant in cv. Michele Palieri vineyard. Considering infections by each single virus, no significant differences were observed in the percentages of infection between vines showing LRS symptoms and symptomless vines used as controls, apart from GVB. A new filamentous viral agent was mechanically transmitted to *N. occidentalis*, starting from an in vitro cultured LRS-affected vine material. The very first indications obtained from these trials confirm the existence of a clearcut correlation of GVB with corky bark reactions of LN33.

84. SOUKRAT Sakina (Morocco)

Supervisor: not available

Title: Essais de microgreffage pour l'assainissement de la vigne. - 49 p.

Abstract: Pour l'amélioration de la technique du microgreffage d'apex de vigne, plusieurs essais ont été menés en étudiant : la production de bons porte-greffes issus de semis et de microboutures dans une courte durée, le type de greffe, ainsi que certains facteurs influençant la reprise des greffes, tels que l'obscurité, le milieu de culture et le greffon. Par semis, l'hybride Kober 5 BB a donné un taux de germination élevé, avec une homogénéité de levée optimale, ceci en plaçant les grains dans des boîtes de Petri, puis sur du sable stérile dans des tubes. Par microboutures, celles de LN33 prélevées in vitro, non initiées, ayant un ou deux bourgeons, ont été utilisées comme porte-greffes prêts pour être greffés après 15 jours. Dans le microgreffage, les apex in vitro sont les seuls utilisés avec succès que ce soit sur hypocotyle ou sur microbouture. Le type de greffe optimal est horizontal sur hypocotyle et latéral sur microbouture, ceci ayant été confirmé à travers l'étude histologique effectuée au niveau de la zone de greffe. Pourtant, un bon succès a été obtenu par le microgreffage sur des microboutures avec des apex in vitro.

85. ANSI Imed (Tunisia)

Supervisors : V. Savino and D. Boscia

Title: Etude comparative entre divers isolats du virus de la mosaïque du pommier (ApMV) ilarvirus. - 49 p.

Abstract: Le but de cette étude est la caractérisation et la comparaison de différents isolats du virus de la mosaïque du pommier provoquant des tableaux symptomatologiques divers sur des espèces du genre Prunus provenant de la région des Pouilles (Sud de l'Italie). Les isolats du virus de la mosaïque du pommier choisis dans l'étude proviennent de plusieurs variétés d'amandier, cerisier, pêcher et abricotier. Dix lignées d'hybridomes sécrétant des anticorps monoclonaux à l'ApMV ont été adoptés pour la caractérisation sérologique. Dans cette étude, ont également été introduits des isolats du PRNSV provenant des espèces du genre Prunus afin d'identifier des isolats sérologiquement corrélés à l'ApMV. Le comportement biologique a été analysé par transmission sur des hôtes de différentes familles botaniques. La caractérisation physico-chimique a été effectuée par comparaison de la migration de leur acides nucléiques ainsi que de leurs protéine capsidiale. Les isolats étudiés ont montré des différences significatives dans leur comportement biologique aussi bien au niveau des symptômes induits sur les hôtes herbacés que de la gamme des hôtes, ce qui a permis de diviser les isolats viraux en quatre groupes distincts. Un comportement particulier a été

montré par un isolat d'amandier (ApMV-Am5) présentant une gamme d'hôtes herbacés plus large par rapport aux autres isolats viraux. Aucune différence sérologique n'a été mise en évidence en testant les isolats viraux d'ApMV avec les lignées d'anticorps monocloaux, alors que ces lignées sont capables de reconnaître un isolat du PNRSV présentant un épitope en commun avec l'ApMV. La caractérisation physico-chimique n'a pas montré une différence significative dans la migration des protéines de la capsid et des principaux acides nucléiques génomiques du virus. En revanche, le même isolat d'amandier (ApMV-Am5) a montré la présence d'un RNA de bas poids moléculaire absent chez les autres isolats et dont l'origine est encore indéfinie.

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99. DJELOUAH Khaled (*Algeria*)

Supervisors : M. Conti, R. G. Milne and E. Luisoni

Title: Essai de caractérisation du citrus ringspot virus (CtRSV). - 74 p.

Abstract: Un essai de caractérisation du virus des taches annulaires des agrumes (CtRSV), a été réalisé par l'établissement de sept isolats associés au CtRSV et à la psorose, sur une série de plants d'agrumes indicateurs de ces maladies. Ces isolats avaient une provenance diverse, à savoir les isolats Américains CtRSV4 et P 209, les isolats Espagnoles RS-SR, RS-SOR, Spagna 1 et 2, et l'isolat Italien Italia 1, cependant les isolats P209, Spagna 1 et 2 sont considérés comme des isolats associés à la psorose. Ces isolats transmis mécaniquement sur une gamme de plantes herbacées, ont induit une réaction symptomatologique se manifestant par l'apparition de lésions locales chlorotiques et nécrotiques sur *Chenopodium* spp. La purification du CtRSV4 nous a permis d'obtenir des préparations virales partiellement purifiées à travers lesquelles furent observées au microscope électronique les deux formes diverses de particules virales. L'observation par coloration négative de préparations virales provenant de lésions locales chlorotiques induites sur *C. quinoa* par les isolats RS-SOR et RS-SR ainsi que du symptôme oak leaf pattern apparu sur citronnier rugueux *C. jambhiri* L. associé à l'isolat Spagna 2, ont montré une similarité morphologique de la particule virale avec celles du CtRSV4. L'étude du génome par l'établissement d'un profil électrophorétique de dsRNA sur gel PAGE 6% à des conditions natives a montré 2 bandes estimées à 1546 et 1358 bp. Enfin, un antisérum spécifique au CtRSV a été produit pour l'isolat CtRSV4.

100. EL-BAKKOURI Ahned (*Morocco*)

Supervisors : M. Conti and G. Boccardo

Title: Diagnostic moléculaire et épidémiologie des phytoplasmes associés aux jaunisses de la vigne dans la région Ligurienne. - 64 p.

Abstract: Ces dernières années, une maladie sévère présentant des symptômes de jaunissement et de dépérissement, similaires à ceux des jaunisses de la vigne, associée aux phytoplasmes a été observée dans la Région Ligurienne. (Italie). Dans le souci de comprendre la nature et le cycle épidémiologique de cette maladie, deux objectifs subdivisés en deux parties (épidémiologie et diagnostic moléculaire) ont été tracés dans le cadre de cette thèse. Deux vignobles situés dans la région de Sestri Levante, dont les localités, les cépages et les stades phénologiques sont différents, ont fait l'objet de deux échantillonnages, au début et à la fin du printemps 1995. Parmi les espèces collectées, trois sont des vecteurs potentiels de phytoplasmes, le Cercopide *Philaenus spumarius* et les Cicadellides *Macrosteles quadripunctulatus* et *Euscelis incisus*. Les deux Cicadellides sont des vecteurs connus des phytoplasmes appartenant au groupe des jaunisses Européennes de l'aster (EAY). En hybridation dot blot des extraits de jus brut ou d'ADN de tissu de la vigne et de plantes spontanées, aucune hybridation n'a été enregistrée avec une sonde spécifique pour l'EAY marqué avec la digoxygénine. Dans les essais dot blot des extraits d'ADN enrichi de tissu foliaire, les hybridations enregistrées sont plus

importantes en deuxième vignoble. Tous les échantillons d'ADN total des racines de vigne et quatre arbustes spontanés ont réagi positivement avec la sonde spécifique pour l'EAY radioactive. Les analyses du polymorphisme de la longueur de restriction du fragment amplifié par les amorces 16S rDNA révèlent la présence de deux sites de restriction Alu I très rapprochés et d'un site de restriction Rsa I. Les profils des analyses de la longueur de restriction sont identique à ceux de l'EAY.

101. EL BOUHDIDI Mohammed (*Morocco*)

Supervisor: G. P. Martelli ; co-supervisor: A. M. D'Onghia

Caractérisation d'un virus isométrique de l'olivier (*Olea europaea* L.). - 50 p.

Abstract: Le contrôle virologique de l'olivier dans la région des Pouilles a révélé la présence d'un virus transmissible mécaniquement sur des arbres apparemment sains. Les réactions symptomatologiques et les propriétés in vitro de stabilité du jus des plantes hôtes infectées, la morphologie des particules, les propriétés physico-chimiques et sérologiques ont permis de classer ce virus comme étant une souche du virus de l'enroulement foliaire du cerisier. L'isolement du virus a été effectué par inoculation du jus des fleurs de l'olivier à une série de plantes herbacées appartenant à des familles botaniques différentes. Le virus a été purifié avec un rendement de 5 à 6 mg de nucléoprotéines par 100 g de tissu infecté. Les tests de double diffusion dans le gel d'agar ont montré que seul le antisérum contre le CLRV, sur les 26 virus isométriques testés, ont réagi avec l'isolat CLRV-X. De même, l'analyse des protéines de la capsid a révélé la présence d'une seule sous-unité protéique ayant un poids moléculaire de 54 Kd et qui a comigré avec celle de l'isolat CLRV-WYM. Une autre étude comparative des propriétés de l'isolat CLRV-X a été menée par les deux isolats du CLRV (CLRV-G et CLRV WYM).

102. HAIDAR Mohamed Moussa (*Lebanon*)

Supervisor: V. Savino ; co-supervisor: W. Khoury and M. Digiario

Title: Evaluation of the sanitary status of grapevine in Lebanon. - 57 p.

Abstract: Surveys were carried out in commercial vineyards in the main grapevine-growing areas of Lebanon to assess the presence and incidence of virus and virus-like diseases. Biological assays by mechanical-graft-transmission on six different woody indicator plants were made on 20% of samples. All samples were tested by direct and indirect ELISA for the presence of the viruses. Rugose wood-symptoms were observed in vines of all varieties and areas surveyed, whereas those of leafroll were observed only in some of the vineyards, in particular in the Bekaa valley and to a lesser extent in South Lebanon, on cvs. Tfaifihi, Cinsaut and Cardinal. The prevailing viruses were GVA, GFKV, and GLRaV-3. Less widespread were the other 3 viruses considered in this study, in particular GFLV, which, unexpectedly, was almost completely absent in the local table grape varieties, thus suggesting its recent introduction with infected propagative materials. No nepoviruses other than GFLV were recovered by mechanical transmission to herbaceous hosts.

103. JAWHAR Jocelyne (*Lebanon*)

Supervisor: V. Savino ; co-supervisors : B. Di Terlizzi and W. Khoury

Title: Évaluation de l'état sanitaire des essences à noyau au Liban. - 72 p.

Abstract: Cette étude a été faite pour évaluer l'état sanitaire de l'abricotier, de l'amandier, du cerisier, du pêcher et du prunier au Liban, pour définir l'incidence et

la distribution des infections virales. 1700 échantillons ont été prélevés à partir de cinq espèces et ils ont été soumis à des tests sérologiques et biologiques au laboratoire. On a trouvé une incidence virale de 25% sur le total testé, où le prunus necrotic ring spot virus domine avec un pourcentage de 45,6% par rapport au nombre total d'échantillons infectés. Le cerisier est l'espèce la plus infectée avec un pourcentage de 45%, suivi du pêcher, l'amandier et le prunier. Le PPV, l'ApMV et les Népovirus n'ont pas été trouvés. L'indexage biologique a confirmé les résultats de l'ELISA. Toutefois neuf échantillons résultant négatifs à l'ELISA ont manifesté des symptômes sur les indicateurs ligneux, dont les feuilles, testés en ELISA, ont révélé la présence du PDV et de l'ACLSV. Deux pêchers, provenant de 2 régions différentes du Liban, greffés sur GF305 sont probablement infectés par le peach latent mosaic viroid. Neuf cerisiers ont extériorisé sur Shirofugen des symptômes semblables à ceux de la maladie du cherry green ring mottle. A partir d'un abricotier qui montrait des symptômes foliaires en fin d'été, on a transmis mécaniquement sur *Nicotiana glauca* et *Chenopodium quinoa* un virus à particules filamenteuses. Des essais préliminaires de purification et de dsRNA ont eu lieu.

104. MERDIECA Vanessa (Malta)

Supervisor: V. Savino ; co-supervisor: D. Boscia

Title: The characterization of five isolates of olive latent virus 1 (OLV-1) and its relationship with tobacco necrosis virus (TNV). - 60 p.

Abstract: Four new isolates of olive latent virus 1 (OLV-1) which was first recorded from Apulia, were recovered from other geographical regions -Tuscany, Sicily, Jordan and Turkey. The Turkish isolate was obtained from Mexican lime, a different host for this virus, other than olive. Preliminary work also indicated that OLV-1 is related with tobacco necrosis virus (TNV). Thus the objectives of this work were: a) to carry out a comparative study of the five viral isolates; b) to identify the extent of correlation between OLV-1 and the two serotypes of TNV; c) to identify serological diagnostic techniques which can give rapid and reproducible results. Biological, physicochemical and serological characterization indicate that the five isolates of OLV-1 are identical. Main differences between TNV and OLV-1 were the type of infection caused by TNV on *N. benthamiana*, a lighter coat protein and the presence of a satellite virus with both TNV-A and TNV-D. A distant serological correlation between OLV-1 and TNV was evidenced in immunodiffusion tests, ELISA and electron microscopy. The results indicate the possibility that OLV-1 is a possible member of the necrovirus group and not a sobemovirus as previously indicated. Polyclonal and monoclonal antibodies were produced, however an attempt to identify a suitable serological technique for reliable diagnosis of OLV-1 in woody plants failed. Further work is necessary to characterize the produced monoclonal antibodies and to try to set up an appropriate serological diagnostic technique for this virus.

105. ZERAMDINI Hamda (Tunisia)

Supervisor: V. Savino ; co-supervisor: B. Di Terlizzi

Title: Analyse virologique de l'amandier et de l'abricotier en Tunisie et utilisation de méthodes sensibles pour le diagnostic du virus de la sharka (PPV). - 64 p.

Abstract: L'évaluation virologique de l'amandier et de l'abricotier en Tunisie a été réalisée sur des échantillons collectés dans les principales zones de culture. Les analyses ont été effectuées moyennant le test ELISA pour les Ilarvirus de la

mosaïque du pommier (ApMV), du nanisme du prunier (PDV) et des taches annulaires nécrotiques des prunus (PNRSV), pour le Trichovirus des taches chlorotiques foliaires du pommier (ACLSV) et les Nepovirus. Les échantillons d'abricotier ont été aussi testés pour la Sharka du prunier (PPV). Les échantillons collectés dans les collections variétales et 10% des échantillons collectés dans le parc à bois et négatifs à l'ELISA ont été testés par la transmission mécanique. Les résultats ont montré que 34,2% des échantillons d'amandier et 4,7% des échantillons d'abricotier étaient infectés par au moins un virus. Le PNRSV et le PDV étaient les plus présents. Un antisérum polyclonal a été réalisé à partir d'un isolat Albanais et a été utilisé pour la préparation d'un kit ELISA. La production d'anticorps monoclonaux a abouti à la sélection d'une seule lignée positive au PPV produisant des IgG2a spécifiques pour la souche Marcus. L'hybridation moléculaire pour le diagnostic du PPV a été réalisée par une sonde à ARN marquée par la DIG. Le test ELISA dans le temps a été conduit sur l'ApMV, le PNRSV et le PPV avec conservation des plaques après sensibilisation et après addition des échantillons pour des périodes de 1 à 8 semaines à la température ambiante.

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118. BUZKAN Nihal (*Turkey*)

Supervisor: G. P. Martelli ; co-supervisor: A. Minafra

Title: Use of PCR for the diagnosis and epidemiology of grapevine tricotiviruses. - 54 p.

Abstract: PCR techniques was used to investigate the presence of grapevine tricotivirus A (GVA) in mealybugs, transmission parameters of GVA and diagnosis of grapevine virus D (GVD) in order to define the incidence of virus infections and correlate it to a possible disease. Transmission mechanism of GVA was worked out with *Pseudococcus longispinus* (Pseudococcidae) at early stages based on the parameters of acquisition, infectivity retention with and without feeding and inoculation access time. Total RNAs were extracted from mealybugs to amplify the target sequence by PCR. GVA was successfully detected by PCR in viruliferous mealybugs. It was concluded that the virus is transmitted in a semi-persistent manner, supported by short acquisition time (15 min), infectivity retention time in fasting mealybugs up to 42 h and with following serial transfer up to 15 h, inoculation access time from 30 min to 3 h and absence of a latent period in the mealybugs. DNA primers for GVD were designed from the 3 terminal regions of the viral genome. The size of amplified DNA through PCR was 700 bp. The virus incidence was 4.88% in the grapevine with rugose wood (RW) and 8% in cv. Primus. Neither registered nor RW-free vines proved to be infected by GVD. These results suggest that there is some correlation between GVD and RW. The specificity of GVD DNA bands was confirmed hybridizing PCR products in Southern plot with a digoxigenin-labelled DNA probe.

119. EDHIB Shiraz (*Tunisia*)

Supervisor: V. Savino ; co-supervisor: B. Di Terlizzi

Title: Achevement de l'évaluation de l'état sanitaire des essences à noyau en Tunisie. - 57 p.

Abstract: Pour évaluer l'état sanitaire du pêcher, prunier, et cerisier en Tunisie, 1800 échantillons ont été collectés à partir des différentes catégories de matériel. Les échantillons ont été contrôlés par des tests sérologiques et biologiques sur des indicateurs herbacés et ligneux. Le taux d'infection virale a atteint 13% du matériel total, où le Prunus Necrotic Ring Spot Virus (PNRSV) a dominé avec 7%, suivi par le Prune dwarf Virus (PDV) avec un taux de 6% et l'Apple Chlorotic Leaf Spot Virus (ACLSV) avec un taux de 2% du total des échantillons; également, des infections simples de ces virus étaient présentes. L'indexage biologique des échantillons négatifs en test ELISA sur indicateur ligneux (GF305, Prunus avium Bing et Sam et P. serrulata Shirofugen) étaient négatifs. Les échantillons de pêcher, collectés dans un verger au centre ouest et dans les oasis, et qui montraient des symptômes de mosaïque diffuse, résultent négatifs en tests ELISA ; par contre, le test PCR a révélé la présence du viroïde Peach Latent Mosaic (PLMVd), et l'électrophorèse a montré la présence d'une bande de 330 bp.

120. MOUFTI Mohamed (Morocco)

Supervisors : G. P. Martelli, V. Savino and A. Minafra

Title: Caractérisation biologique, physico-chimique et sérologique d'un virus filamenteux associé à un jaunissement de l'olivier. - 51 p.

Abstract: L'étude a porté sur une maladie de l'olivier dite Marbrure jaune et Dépérissement, observée dans la région de Trabia en Sicile sur des oliviers 'Nostrana' et caractérisée par des symptômes de jaunissement foliaire. D'un olivier malade (échantillon Trabia 1) montrant en plus un fort dépérissement, il a été isolé un virus filamenteux jusque là inconnu, pour lequel le nom : virus de la marbrure jaune et dépérissement de l'olivier (OYMDV : Olive Yellow Mottling and Decline Virus) a été proposé. Ce virus a été mécaniquement transmis à une gamme d'hôtes appartenant principalement à la famille des Solanaceae. L'OYMDV a des particules virales allongées et flexueuses d'environ 650x12 nm, une protéine capsidique d'environ 27 kDa et un génome constitué de trois molécules d'acide ribonucléique (ARN) monocaténares d'environ 2.0, 0.8 et 0.6 millions de Da. Le profil des ARN bicaténares à partir de l'olivier Trabia 1 contient une seule bande d'environ 4 millions de Da. A partir des hôtes herbacés, ce profil contient deux autres bandes d'environ 1.6 et 1.8 millions de Da. Un antiserum polyclonal, avec un titre de 1/1000 en décoration, a été produit ainsi qu'un kit ELISA qui a donné une réaction positive avec l'échantillon Trabia 1. L'OYMDV n'a pas montré de corrélations sérologiques avec 14 virus testés des genres Trichovirus, Closterovirus, Potexvirus et Potyvirus. La maladie a été transmise par greffage sur des oliviers sains du cultivar 'Leccino'. L'étude des résultats obtenus indique que le dépérissement observé pourrait être attribué à l'OYMDV.

121. ROUAG Nourredine (Algeria)

Supervisors : M. Conti, E. Luisoni and R. G. Milne

Title: Étude de quelques gents viraux ou virus similaires associé aux maladies de psorose et de ringspot sur citrus. - 64 p.

Abstract: Les Citrus Psorosis et Citrus Ringspot ont été étudiés biologiquement, sérologiquement, et morphologiquement par la comparaison de 14 isolats de Psorosis et 4 isolats de Ringspot. Le symptôme choc typique était induit sur les Citrus indicateurs par 11 isolats de Psorosis et tous les Ringspots. Six Psorosis et tous les isolats de Ringspot ont produit des lésions locales sur Chenopodium Quinoa. En utilisant l'antiserum produit contre l'isolat type de Citrus Ringspot Virus (CtRSV-4), 11 Psorosis et 3 Ringspot étaient positifs en DAS-ELISA. Un isolat de Ringspot (Italia 1) induisait des lésions locales, mais aucune particule virale n'a été trouvée, et résulte négative en test ELISA. Un nouveau protocole a été développé pour la purification du CtRSV-4 à partir des lésions locales sur C. Quinoa. Deux bandes de virus sont obtenues après une centrifugation sur un gradient de densité, correspondant à des particules virales filamenteuses et flexueuses de différentes tailles et avec deux formes : un filament circulaire ouvert de 3 nm de diamètre, un double filament linéaire replié de 9 nm de diamètre. En Western blot des protéines totales de 4 isolats de Psorosis et de 2 ringspot, est obtenue une bande -protéine capsidique- estimée à 52 kd. Les préparations de CtRSV-4 purifiées donnent une bande de 48 kd.

122. YURTMEN Melike (Turkey)

Supervisor: V. Savino ; advisor: D. Boscia

Title: Characterization of prunus dwarf virus (PDV) isolates. - 59 p.

Abstract: The present study was on eight isolates of Prune Dwarf Ilarvirus (PDV) to characterize the different symptomatological expressions in stone fruit species (Almond, Cherry, Peach and Prunus mahaleb) of Apulian origin. Therefore, the study was based on: i) the characterization of PDV isolates by using biological, physico-chemical and serological procedures, ii) the investigation of the best diagnostic techniques for detecting PDV with the reagents produced. Beside these, since PDV is seed-transmissible, iii) the determination of the virus transmission through seed by using *P. mahaleb* seeds. Differentiation of the eight isolates was not possible by using physico-chemical and biological procedures. The only possibility to differentiate isolates was through serological procedure where three serotypes were determined. When a wider survey was conducted, serological variations were found among the 90 PDV isolates in the field. There were 25 tentative serological patterns unevenly distributed within these isolates. Among them, B type was found nearly almond specific. Eight PDV specific monoclonal antibodies were produced and a screening among seventeen different polyclonal antibodies available was done in order to select the best for virus detection. Different ELISA procedures were compared in herbaceous and woody plant extracts. One procedure of cocktail-ELISA was selected as more sensitive and specific for the diagnosis of the virus. The seed transmission of PDV through *P. Mahaleb* seeds was determined as 30%.

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142. ALKOWNI Ra'ed (Palestine)

Supervisor: G. P. Martelli ; co-supervisor: M. Digiaro

Title: Evaluation of the sanitary status of grapevine in Palestine. - 62 p.

Abstract: Surveys were carried out in vineyards in the main grapevine-growing areas of Palestine to assess the presence and the incidence of virus and virus-like diseases. Field inspections and collection of samples were made during autumn and winter. Biological assays were made by mechanical transmission onto a range of herbaceous hosts and graft transmission onto woody indicator plants. All samples were tested by Elisa to detect the presence of the grapevine virus A (GVA) and B (GVB), grapevine leafroll associated viruses (GLRaV-1,-2,-3,-7), grapevine fanleaf virus (GFLV) and grapevine fleck virus (GFkV). One tenth of samples was tested by ELISA for presence of arabis mosaic (ArMV) and raspberry ringspot (RRV) viruses. Leafroll and rugose wood symptoms were widely observed in most vineyards while fanleaf symptoms were rarely observed. 463 out of 566 (82%) ELISA tested vines were infected by at least one virus. GVA was the prevailing virus (66.1%), followed by GLRaV-1 (45.6%), GLRaV-3 (21.7%), GFkV (15.7%) and GLRaV-2 (8.3%). GVB and GFLV were ranging between 3.7% and 1.2%, whereas GLRaV-7 was detected in a single vine of cv. Sultanina. Damaged resulted vineyards in Bethlem area (97.5%). The Elisa test on 69 young rootstock mother plants showed virus infection of 20.3%. Vein necrosis and vein mosaic were ascertained by preliminary observation of symptoms onto graft-inoculated 110R and Vitis riparia plants, whereas no mechanically transmissible viruses different than GFLV were recovered onto inoculated herbaceous hosts.

Keywords: not included.

143. BEN-ABDELHAFIDH Chiraz (Tunisia)

Supervisors : G. P. Martelli and A. M. D'Onghia

Title: Caractérisation d'un virus des agrumes sérologiquement corrélé au grapevine Bulgarian Latent Virus (GBLV). - 73 p.

Abstract: Un essai de caractérisation d'un virus isolé à partir d'un citronnier localisé dans les Pouilles et présentant des symptômes d'incompatibilité de greffage, des déformations et bollosités sur feuilles et fruits, a été réalisé. Ce virus s'est avéré sérologiquement corrélé au Grapevine Bulgarian latent virus (GBLV). La transmission par greffage sur des plants d'agrumes indicateurs a induit une réaction symptomatologique caractérisé essentiellement par des déformations et bollosités foliaires. L'inoculation mécanique sur divers hôtes herbacés s'est traduite par des lésions locales et systémiques sur Chenopodium spp et des déformations et bollosités sur quelques Nicotiana spp. L'observation au microscope électronique a mis en évidence des similarités morphologiques entre ce virus et le GBLV. En outre, l'analyse de la protéine capsidiale en SDS-PAGE a montré la présence d'une bande à 54 KDa. Par contre, l'étude du génome viral du 60x a montré deux bandes relativement étroites supérieures à celles du GBLV et estimé à plus de 6600 nt. Le profil des ds-RNA à partir d'hôtes herbacés a confirmé la présence de ces deux

bandes, et la différence entre ces deux virus. Enfin, un antiserum a été produit suite à une série d'injections de préparations virales purifiées.

Keywords: not included.

144. BENZAKOUR Amine Saad (Morocco)

Supervisors : V. Savino and D. Boscia

Title: Caractérisation biologique, physico-chimique et sérologique d'isolats du virus de la tache chlorotique du pommier (ACLSV). - 38 p.

Abstract: Seize isolats du virus des taches chlorotiques foliaires (ACLSV) isolés de plants naturellement infectés d'amandier, pêcher, prunier, cerisier et pommier d'origines diverses, ont montré des différences biologiques sur *Chenopodium quinoa*. Deux isolats, B et C, du virus respectivement isolés d'amandier (Italie) et de pommier (Chine), ont été choisis pour la production de deux antisérums polyclonaux et pour une caractérisation plus complète. Le poids moléculaire de la protéine capsidiale de l'isolat B est inférieur à celui de l'isolat C. Le poids moléculaire des acides nucléiques monocaténares des deux isolats reste constant. La comparaison entre deux protocoles de purification du virus a montré que l'excès de l'ion magnésium fait agréger les particules virales avec le matériel végétal. L'antiserum à l'isolat C a un titre de décoration au microscope de 1 : 200. Son affinité sérologique testée en DAS-ELISA et par Western Blot a montré qu'il est faible envers ces hétérologues.

Keywords: not included.

145. MAHFOUDI Naima (Tunisia)

Supervisors : G. P. Martelli and M. Digiaro

Title: Évaluation de l'état sanitaire de la vigne en Tunisie. - 57 p.

Abstract: Durant les prospections effectuées dans les différentes régions viticoles de la Tunisie, 1100 échantillons ont été collectés dans les principales aires viticoles, intéressant les parcs à bois et les vignobles commerciaux. Tous les échantillons ont été soumis à des contrôles sérologiques et biologiques. Les infections virales dans les vignobles commerciaux se sont avérées assez importantes, atteignant 96.5%. Les infections les plus élevées sont rencontrées dans les régions de Bizerte (100%) et Cap Bon (99.2%), et dans les vignobles âgés de plus de vingt ans (98.5%). Les porte-greffes des champs de pieds mères se sont révélés pratiquement exempts des virus testés. Des infections importantes chez les pieds mères des variétés de *Vitis vinifera* ont été notées pour la vigne de table (93%) par rapport à celle de cuve (47.4%). L'application de diverses techniques de diagnostic a permis l'identification de particules filamenteuses de GLRaV-2 isolées à partir du cv de vigne de table Red Globe présentant des symptômes d'enroulement foliaire et de dépérissement. Dans les mêmes échantillons, on a observé des particules virales sphériques, ayant des protéines capsidaires de 30 KDa, ce qui nous incite à soupçonner qu'il s'agit d'un nouvel agent viral.

Keywords: not included.

146. SAADE Pauline (Lebanon)

Supervisors : V. Savino, A. M. D'Onghia and W. Khouri

Title: Évaluation de l'état sanitaire des agrumes au Liban. - 71 p.

Abstract: La détermination de l'incidence du virus de la tristeza (CTV) dans des vergers infectés et l'étude de l'état sanitaire des agrumes au Liban, ont été réalisées suite aux tests effectués dans les Laboratoires de Protection des Plantes de l'Université Libanaise, de l'institut Agronomique Méditerranéen et de l'Université de Bari (Italie). Le test ELISA servant à la détermination du CTV a été appliqué sur 5356 arbres. Ainsi, l'incidence déterminée par ELISA sur 2200 arbres atteint 32% au Liban Sud et 8% au Liban Nord. Quant à la présence du CTV dont la souche est celle du dépérissement rapide, elle atteint les 23% sur la quasi totalité des variétés d'agrumes et particulièrement, sur l'oranger Washington Navel. Les arbres sont asymptomatiques, exception faite pour un seul O. Shammouti. On a observé en outre une fréquence de : 33% pour la cachexie, 31% pour l'exocortis, de 26% pour la psorose, de 10% pour le *spiroplasma citri*, de 9% pour les maladies à OLP, de 1% pour la panachure infectieuse.

Keywords: not included.

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163. AL-TAMINI Naser (*Jordan*)

Supervisor: V. Savino ; co-supervisor: M. Digiaro

Title: Evaluation of the sanitary status of grapevine in Jordan and biological, serological and physico-chemical comparison of some Gflv isolates. - 63 p.

Abstract: Surveys were carried out in commercial vineyards and in mother plots in the main grapevine growing areas of Jordan (High land, Jordan Valley, Desert areas) to assess the presence and the incidence of virus diseases. Field inspections for the collection of samples were conducted in winter 1997. Biological (sap inoculation herbaceous plants and graft-transmission on woody indicators) and serological (different ELISA procedures) tests were performed to this aim. About 60% of the ELISA tested vines were infected by one or more viruses (GFLV, GVA, GVB, GFkV, GLRaV-1, -3, and -7). Vein necrosis symptoms were also observed on graft-inoculated 110R plants, whereas no mechanically transmissible viruses other than GFLV were recovered in inoculated herbaceous hosts. In a comparative study of some GFLV isolates, no serological differences were observed in double diffusion tests in agar gel. Similarly, there was an apparent uniformity in the molecular weights of their RNAs, except for one Turkish isolate that showed the presence of a satellite. Slight differences in the CP molecular weights were shown by two Italian isolates in comparative migration rate in SDS-PAGE.

164. AMARI Khalid (*Morocco*)

Supervisors : G. P. Martelli, V. Pallás, B. Di Terlizzi

Title: Approches moléculaires pour améliorer la détection du viroïde du Nanisme de Houblon et la caractérisation des nouveaux isolats de la région Méditerranéenne. - 69 p.

Abstract: La viroïde du nanisme du houblon (HSVd) infecte une large gamme d'hôtes, tels que, le houblon, le concombre, la vigne, les agrumes, le prunier, le pêcher, le poirier et récemment l'amandier et l'abricotier. Les tests de dépistage du HSVd, dans les échantillons d'abricotiers et pruniers provenant de cinq pays de la région Méditerranéenne (Albanie, Chypre, Grèce, Maroc et Turquie), ont révélé sa présence dans le matériel d'abricotier provenant de deux pays (Maroc et Turquie). Vu qu'on visait la mise au point d'une technique pour la détection routinière du HSVd dans des échantillons de champs d'abricotier, sensible et rapide, avec le minimum de manipulation des échantillons, l'hybridation moléculaire non radioactive de type de tissue printing s'est révélée être une méthode très satisfaisante. La technique RT-PCR est très sensible et rapide, par contre dans certaines combinaisons hôte-virus, la réaction peut être inhibée par des substances présentes dans l'extrait végétal telles que les polysaccharides. Dans le présent travail une évaluation a été réalisée pour la détection du HSVd dans l'abricotier, en utilisant une extraction non phénolique d'acides nucléiques.

165. DAGHER Manar Mounzer (Lebanon)

Supervisors: V. Savino and A. Minafra

Title: Analyse comparative de l'assainissement de deux virus de la vigne (GLRaV-3, GFkV) par Elisa et la PCR. - 43 p.

Abstract: Au sein de la sélection sanitaire, les tests ciblés appliqués après l'assainissement ont été effectués jusqu'à maintenant par les méthodes biologiques et sérologiques. L'application des techniques moléculaires pour la détection du GLRaV-3 et du GFkV n'est devenue possible que récemment. Ainsi, on a tenté d'appliquer la PCR, moyen rapide et très sensible pour une détection précoce de ces virus. Le matériel de la thèse (apex méristématiques) a été prélevé à deux intervalles de temps différents pour pouvoir suivre toutes les étapes, de l'établissement de la culture jusqu'à l'acclimatation. En effectuant une étude comparative entre l'ELISA et la PCR sur le matériel in vitro, on a noté que les tests PCR ont montré une incidence d'infection moyenne de 20% pour le GLRaV-3, tandis que l'ELISA a rarement montré un résultat positif. L'analyse des produits amplifiés par l'hybridation dot spot s'est avérée plus sensible.

166. FRASHERI Dajana (Albania)

Supervisor: V. Savino ; co-supervisor: D. Boscia

Title: Improvement of serological tools for the detection of closteroviruses and vitiviruses of the grapevine. - 38 p.

Abstract: The present study was based on the improvement of serological tools for detection of closteroviruses and vitiviruses of the grapevine. In the first part the following objectives were pursued: (i) checking the suitability of available antibodies for ELISA detection of GLRaV-6; (ii) obtaining preliminary data on GLRaV-6 incidence surveys on grapevines of different varieties and geographical origin; (iii) searching pure grapevine GLRaV-6 sources and (iv) producing new polyclonal antisera and monoclonal antibodies. A total of 408 vines belonging to 120 different varieties and from 19 countries were tested. Only 4 (about 1%) were infected with GLRaV-6. The low incidence of GLRaV-6 is indicative of the low importance in the aetiology of LR disease. No pure GLRaV-6 source were found. The second part of the present study was based on: (i) the production of a new polyclonal antiserum specific to GVA and (ii) the comparative evaluation of the ELISA performance of currently used reagents, new antisera raised against recombinant MP and CP of GVA and GVB, and late bleeding of the newly produced traditional antiserum.

167. KÖKLÜ Gassan (Turkey)

Supervisors: G. P. Martelli ; co-supervisor: M. Digiaro

Title: Improvement of the serological diagnosis of grapevine leafroll-associated virus 2 (GLRAV-2) and evaluation of sanitary status of some grapevine varieties grown in Trakya region in Turkey. - 63 p.

Two GLRAV-2 antisera were raised utilising infected *N. benthamiana* leaves (USA-9) and grapevine phloem tissues (RG-40/5-9/22) as virus sources. USA-9 antiserum was more effective in testing grapevine material. Two different labelling systems were used, one based on biotin, the other one on alkaline phosphatase. More satisfactory and reliable results in virus detection were obtained with DASI-ELISA compared with DAS-ELISA. Mature canes were collected in grapevine growing areas of Trakya region (*Turkey*) to assess the presence of virus and virus-like diseases. Mechanical transmission to herbaceous hosts and serological tests by ELISA (for GFLV, GVA, GVB, GFrV, GLRAV-1, -2, -3, -6, and -7) were used for virus detection. ELISA showed that 92.7% of the 165 vines tested were infected, most of them (75%) by at least two viruses. GVA was the most widespread virus (52.1%). An apparently new mechanically transmissible virus, afterwards identified as a strain of Cucumber mosaic virus (CMV), was found in two grapevine accessions of cv. Yapincak. A CMV specific antiserum was raised.

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177. JARRAR Samer (*Palestine*)

Supervisor: G. P. Martelli ; co-supervisors: V. Savino and A. M. D'Onghia

Title: Sanitary status of stone fruits, olive and citrus in Palestine. - 40 p.

Abstract: This study in the first attempt to evaluate the sanitary status of stone fruits, citrus and olives in Palestine. A total of 1420 samples from commercial orchards, collection plots and nurseries, of the main crop-growing areas, were collected in January 1999. ELISA, immunoprinting, mechanical inoculation, graft transmission and dsRNA techniques were used for the detection of the main graft transmissible pathogens. 900 of stone fruits trees were tested in ELISA. 18.7% were infected by at least one virus. The most common viruses were apple chlorotic leaf spot virus (ACLSV), Prunus necrotic ringspot virus (PNRSV) and Prune dwarf virus (PDV). Plum pox virus (PPV), Apple mosaic virus (ApMV) and the main six nepoviruses were not detected. A spherical virus isolated from a plum tree, induces local ring lesions and deformations in *Nicotiana occidentalis* leaves. A total of 140 trees of citrus were tested for the presence of citrus tristeza (CTV), citrus psorosis (CPV), citrus variegation (CVV), and citrus vein enation (CVEV) viruses and *Spiroplasma citri*. 63% of the 22 olive samples analysed by dsRNA showed multiple bands, indicating infections of viral origin.

Keywords: plant viruses, ELISA, dsRNAs, citrus, olive, stone fruits, Palestine.

178. DRIQUECH Nouredin (*Morocco*)

Supervisor: G. P. Martelli ; co-supervisors : F. Grieco and S. Sabanadzovic

Title: Évaluation de l'état sanitaire de l'olivier dans des Pays du bassin méditerranéen. - 53 p.

Abstract: Au cours de cette étude et en vue d'évaluer l'état sanitaire de l'olivier, on a réalisé un test de dsRNA sur 392 sujets d'olivier provenant de neuf pays méditerranéens (Italie, Grèce, Liban, Espagne, Malta, Palestine, Egypte, Tunisie et Chypre). Les résultats obtenus ont montré que 253 échantillons étaient positifs avec un taux d'infection de l'ordre de 64%, indiquant ainsi une situation sanitaire de l'olivier très dégradée dans la région méditerranéenne. L'application des techniques moléculaires n'est devenue possible que récemment par la PCR, à l'aide des amorces sélectionnées et/ou par hybridation dot-blot au moyen des sondes virus-spécifiques. Ainsi, on a tenté d'appliquer la PCR pour une détection des infections provoquées par sept virus : OLV-1, CMV, OLYaV, CLRV, SLRV, ArMVet et OLV-2. Les résultats obtenus ont montré d'une part que le CLRV est présente dans plusieurs pays méditerranéens (Italie, Liban, Tunisie, Chypre), d'autre part l'ArMV et l'OLV-2 sont absents. Par ailleurs, sur 144 échantillons testés par PCR, 62 se sont révélés positifs avec une incidence d'infection de l'ordre de 43%. En fin, l'analyse des dsRNAs par l'hybridation moléculaire a pu identifier l'OLV-1 et l'OLYaV. Par conséquent, elle s'est avérée plus sensible, spécifique et simple par rapport aux gels de polyacrylamide.

Keywords: olive viruses, dsRNAs, PCR, molecular hybridisation, Mediterranean region.

179. PARADIES Fabrice (France)

Supervisor: G. P. Martelli ; co-supervisors : D. Gallitelli and M. Digiaro

Title: Caractérisation biologique et moléculaire de trois isolats du virus de la mosaïque du concombre (CMV) provenant de vigne et d'orangers. - 57 p.

Abstract: Trois virus transmissibles mécaniquement, un découvert sur vigne d'origine turque (YA-200), les autres sur orangers d'origine turque (R43) et italienne (OR) ont été identifiés comme isolats nouveaux du sous-groupe IA du virus de la mosaïque du concombre (CMV). La morphologie des particules, le profil électrophorétique des acides nucléiques viraux, l'hybridation moléculaire et la gamme d'hôtes herbacés expérimentales, ont tous été caractéristiques du CMV. Cependant les CMV R43 et OR n'induisent pas de symptômes typiques de filimorphisme des feuilles chez la tomate, mais peuvent infecter de façon généralisée *Chenopodium quinoa* et *Vigna unguiculata*. Une particularité des deux isolats d'agrumes a été l'incapacité à infecter localement *P. aureus*, hôte typique du CMV. Les trois isolats ont pu soutenir la réplication d'un satellite nécrogène attendu sur tomate. Contrairement au CMV-YA-200, les deux isolats d'orangers se révélèrent instables à la purification avec les solvants organiques. Les trois isolats de CMV étudiés ont certaines caractéristiques communes; les isolats d'orangers ont une grande similitude indiquant que malgré leur origine géographique différente, ils sont un même virus distinct du CMV-YA-200. Ces trois isolats sont donc considérés comme deux souches de CMV inconnues pour lesquelles les noms de CMV-Gr et CMV-Or sont proposés respectivement pour les isolats de vigne et d'orangers.

Keywords: CMV, biological characterisation, Northern blot, grapevine, orange.

180. ÇAKALLI Adriatik (Albania)

Supervisor: V. Savino ; co-supervisor: F. Grieco and A. Myrta

Title: Sanitary assessment of Albanian olive and stone fruit varieties. - 45 p.

Abstract: Candidate clones of olive and stone fruit Albanian varieties, mainly coming from the conservation olive center of the Pomology Institute in Vlore and several commercial orchard, were sanitarily assessed by biological, serological and molecular way. A total of 37 candidate clones belonging to 15 olive varieties were tested by dsRNA. 8 resulted infected: 3 showed the presence of a clostero-like patterns and the others the presence of low molecular weight dsRNAs. The presence of olive leaf yellowing associated clostrovirus (OLYaV) in the first three samples was confirmed by PCR analysis. No other virus was detected by mechanical transmission. A total of 64 samples of 7 cherry and plum varieties were singularly tested by ELISA and mechanical transmission to herbaceous hosts. The following viruses were identified: Apple chlorotic leaf spot trichovirus (ACLSV), Prunus necrotic ring spot (PNRSV) and Prune dwarf virus (PDV) ilarviruses. Plum pox potyvirus (PPV), Apple mosaic virus (ApMV) and other six nepoviruses tested were not detected. Eight of 13 cherry clones were ELISA-negative, but all 10 plum clones were infected at least from one virus. No infection by peach latent mosaic (PLMVd) and hop stunt (HSVd) viroid was encountered in the stone fruit samples by molecular hybridisation.

Keywords: stone fruit viruses, olive viruses, plant viroids, ELISA, dsRNAs, molecular hybridization, Albania.

181. ZONGSHAN Zhou (China)

Supervisor: G. P. Martelli ; co-supervisors: D. Boscia and N. Abou-Ghanem

Title: Production and characterisation of monoclonal antibodies specific to GLRaV-2, GLRaV-6 and GVD. - 46 p.

Abstract: Monoclonal antibodies specific to GLRaV-2 (18), GLRaV-6 (3), and GVD (6) were produced to improve the immunoenzymatic detection of these viruses. Six out of 18 Mabs specific for GLRaV-2 proved to be elicited by surface epitopes. The other twelve were evidently elicited by cryptotopes, because they did not decorate virus particles (IEM), but could detect virus coat protein in western blot membranes. Interestingly, when viruses were detected by TAS-ELISA, using extracts of mature canes, all six surface epitope specific Mabs were more sensitive than cryptotope specific Mabs. Among them Mab R19, was the most sensitive and was selected as suitable for routine ELISA detection. The use of newly produced Mabs in the comparative analysis of four GLRaV-2 isolates propagated in *N. benthamiana* revealed the existence of differences in a South-African isolate (93/955), not detected with TAS-ELISA by Mab R6. In a survey carried out in Apulia region, GLRaV-6, appeared to be heavily spread in cvs. Early-Cardinal and Cardinal no GLRaV-6 pure source were identified. Six specific GVD-Mabs were selected, whose use in TAS-ELISA allowed to detect GVD in both *Nicotiana* and grapevine tissues. Serological relationship between GVA and GVD were confirmed.

Keywords: monoclonal antibodies, GLRaV-2, GLRaV-6, GVD, ELISA, western blot, grapevine.

182. SIPAHIOGLU Hikmet Murat (Turkey)

Supervisor: G. P. Martelli ; **co-supervisors:** D. Boscia and B. Di Terlizzi

Title: Sanitary status of stone fruits in East Anatolia (Turkey) and characterisation of a Turkish apple chlorotic leaf spot (ACLSV) isolate. - 43 p.

Abstract: Field surveys were carried out in the main stone fruit, especially apricot growing areas of East Anatolia to assess the sanitary status of varietal collection, mother blocs and commercial orchards. A total number of 1019 samples were tested by ELISA belonging to 75 different cultivars. The following viruses were identified: ACLSV, PDV, PNRSV. A Turkish isolate of ACLSV from a native apricot variety, differed from the known isolates in its biological properties by not infecting *Chenopodium quinoa* L. The virus was purified successfully and a polyclonal antiserum was produced by immunising a rabbit. The production of monoclonal antibodies was also started. Protein preparation of ACLSV-EA was separated on 12% SDS-PAGE, then analysed by Western blotting with polyclonal antiserum produced against isolate. A kit ELISA was prepared for double antibody sandwich immunosorbent assay with a titre of 1:500 determined by dilution series test. Immunoelectron microscopy tests demonstrated the decoration of homologous isolate at the dilution of 1:60.

Keywords: stone fruit viruses, ACLSV, ELISA, plant viroids, molecular hybridization, Turkey.

183. SAADE Mostafa (Lebanon)

Supervisor: V. Pallás ; **co-supervisors:** A. Minafra and B. Di Terlizzi

Title: Simultaneous detection of ilarviruses affecting stone fruits by molecular approaches. - 51 p.

Abstract: Apple mosaic virus (ApMV), prune dwarf virus (PDV) and *Prunus* necrotic ringspot virus (PNRSV), members of the ilarvirus genus are world-wide spread in stone fruits causing important economical damages. The aim of this study is to set

up a simultaneous detection of these ilarviruses by molecular approaches (molecular hybridisation and polymerase chain reaction), and validate the developed techniques on naturally infected stone fruit species. For the simultaneous detection by molecular hybridisation, specific RNA probes were mixed in the hybridisation solution and used for the detection of three viruses. Simultaneous detection of the three viruses was carried out also using a cocktail of a degenerated antisense and three specific sense primers in the RT-PCR. Sensitivity limit of molecular hybridisation and PCR was determined too. In the second part of the thesis, the developed molecular hybridisation and PCR for the simultaneous detection of stone fruit ilarviruses were checked on several stone fruit trees. Simultaneous detection of the three viruses by molecular hybridisation was to successful with satisfactory sensitivity and can be used for the large scale detection. For the large scale application, improvement of the simultaneous detection by PCR is recommended.

Keywords: ilarviruses, stone fruits, simultaneous detection, molecular hybridization, PCR.

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213. AL RWAHNIH Maher (Jordan)

Supervisor: V. Savino ; co-supervisors: A. Myrta and D. Boscia

Title: Sanitary status of stone fruits in Jordan and production of monoclonal antibodies to Apple chlorotic leaf spot virus (ACLSV). - 30 p.

Abstract: Field surveys were carried out in the main stone fruit growing areas of Jordan to assess the sanitary status of varietal collection, mother blocks and commercial orchards. The presence of virus and virus-like diseases was tested by ELISA, sap transmission to herbaceous hosts, graft transmission, and molecular hybridisation. A total of 1312 samples was tested by ELISA. The following viruses and viroids were detected for the first time in the country: PPV, ApMV, ACLSV, and PLMVd; and PNRSV, PDV. Aiming to identify healthy mother trees in the varietal collection and mother blocks belonging to the Ministry of Agriculture, 381 trees belonging to 57 imported and 6 local varieties were singularly tested for virus and viroid infections. 40 imported and 4 local varieties were negative in all laboratory tests. One line on monoclonal antibody against ACLSV was produced using as routine detection of the virus, since it was able to detect only 8 out of 27 isolates from different geographical origin.

214. SAFI Mazen (Lebanon)

Supervisor: V. Savino ; co-supervisors : M. Digiario and D. Boscia

Title: Contribution à l'étude du rôle étiologique du virus D de la vigne. - 37 p.

Abstract: Une investigation a été effectuée sur des échantillons de vigne provenant de la région des Pouilles et de la Sardaigne, dans le but de vérifier l'incidence du grapevine virus D ainsi que son rôle étiologique dans le complexe du bois strié. Un protocole ELISA a été mis au point. La meilleure combinaison a été le Pab brut dilué à 1:1000 et le Mab D8 dilué à 1:100000. Le tampon PBS à pH 7-8 a été utilisé pour l'extraction du phloème. Le kit ELISA a été validé à travers la transmission mécanique du virus. La difficulté de la transmission a été surmontée en utilisant les explants provenant de culture in vitro. Aucune association du GVD avec les 4 syndromes du bois strié n'a été notée. Une possible compétition semble émerger de l'interférence entre le vitivirus et le GRSPaV qui se traduit par l'atténuation des symptômes de stem pitting sur V. rupestris et de stem growing sur Kober 5 BB lorsque les 2 groupes de virus sont présents en infection mixte. Au cours des expérimentations, une nouvelle entité virale a été isolée sur N. benthamiana. L'incidence du GVD s'est élevée à 31%.

Keywords: grapevine, GVD, etiology, rugose wood complex, ELISA, monoclonal and polyclonal antibodies, vitivirus, foveavirus.

215. HASSAN Mohamed (Egypt)

Supervisor: G. P. Martelli ; co-supervisors: M. Digiario and V. Savino

Title: Assessment of the sanitary status of olive in Egypt. - 33 p.

Abstract: Surveys were carried out in different olive orchards in the main olive growing areas of Egypt to assess the presence and the incidence of virus and virus-like diseases. A new simplified procedure samples using MN 301 cellulose, was performed to extract dsRNAs from about 120 samples. These extracts were tested, by using specific cold riboprobes, in dot blot hybridization for the presence of the following viruses: olive leaf yellowing associated (OLYaV), olive latent 1 and 2 (OLV-1 and OLV-2), olive latent ringspot (OLRSV) cucumber mosaic (CMV), strawberry latent ringspot (SRLSV), cherry leaf roll (CLRV) and arabis mosaic (ArMV). Fifty-five out of 120 olive samples (46%) tested by dot blot hybridization were infected by at list one virus. OLYaV was the prevailing virus (27.5%) followed by CLRV (10.8%), and OLV-2 (10%). CMV, ArMV, SLRSV, OLRV and OLV-1 were less represented, their incidence ranging from 8.3% to 4.2%. Five out of 35 negative samples in molecular hybridizatón showed consistent dsRNAs bands when analyzed in PAGE electrophoresis, thus revealing the presence of an additional 14% infections by other viruses not included in molecular tests.

Keywords: olive, Egypt, dsRNA, PCR, hybridization, OLYaV.

216. FAHMY Hesham M. (Egypt)

Supervisor: G. P. Martelli ; **co-supervisors:** A. M. D'Onghia and A. A. Abou-Zeid

Title: Monitoring the main graft-transmissible diseases and sanitary selection of citrus in Egypt. - 51 p.

Abstract: A survey was carried out in the main citrus-growing areas of Egypt for monitoring CTV, CPsV, CVV viruses and selecting candidate stocks for the certification program. A total of 2857 trees were sampled. Monitoring activity was based on symptoms observation in field and serological tests. The assessment of the sanitary status of the selected citrus stocks was carried out by laboratory and biological assays. Honeycombing and general decline, severe psorosis-bark scaling and wood staining, concave gum-like, stubborn-like, gummy bark and bud union symptoms were observed. 42 out of 2109 monitored trees were CTV-positive. CTV-infected plants were found in 2 citrus variety collections, in a nursery and in 3 plants of cv. Valencia in commercial orchards. Egyptian sources were not CTV-seedling-yellow strains. The incidence of CPsV was 49.4% in variety collections. All the Egyptian CPsV sources were serologically close to Italian CPsV sources. Most of them induced characteristics symptoms on woody of herbaceous indicator plants. CVV was only detected in 1 Minneola tangelo of a commercial orchard. 54 selected candidate stocks were free from S. citri and HLB while 48% were infected by one or more pathogens: 15% by psorosis, 35% by viroids, 2% by CTV and 2% by CVV. CPsV was successfully detected by immunoprinting using flower styles and stigmas as infected sources.

Keywords: certification, citrus, Egypt, immunoprinting, monitoring, viruses, viroids, sanitary status.

217. MAHBOUBI Mohammed (Morocco)

Supervisor: G. P. Martelli, **co-supervisors :** N. Abou-Ghanem and B. Di Terlizzi

Title: Mise au point des méthodes de diagnostic moléculaire d'un clostérovirus et étude de son association à la maladie des cannelures du bois (stem pitting) des essences à noyau. - 41 p.

Abstract: En 1992, dans le sud-est des Pouilles, une maladie de cannelures du bois de l'abricotier a été observée dans deux vergers d'abricotier, cv. Tyrinthos greffé

sur Myrobalan avec le cv. Stanley comme intermédiaire. Un suivi d'observation pendant 5 années, a montré une diffusion de la maladie. Les essais de transmission par greffage sur plusieurs variétés des fruits à noyau, n'ont révélé aucun symptôme foliaire mais à partir de la troisième année, la plupart des variétés d'abricotier ont montré une incompatibilité au point de greffe et une légère cannelure sur le bois. Un extrait de dsRNA a été obtenu d'une plante stem pitting positive avec un poids moléculaire élevé rappelant le groupe des closterovirus. Une RT-PCR d'une portion de la HSP70 avec les amorces dégénérées a permis l'amplification d'un fragment d'ADN de 590 paires de bases, dont la détermination et l'analyse de sa séquence nucléique a confirmé que le virus nommé Apricot stem pitting associated virus (ASPaV), est différent du little virus le seul clostérovirus reporté sur les essences à noyau jusqu'à présent. L'application de la RT-PCR a montré que l'ASPaV a été transmis à 89% des échantillons induisant une symptomatologie de stem pitting à 50% des échantillons ce qui laisse penser à une probable association du virus à cette maladie.

Keywords: ASPaV, stem pitting, symptomatology, viruses, degenerate primers, RT-PCR, molecular hybridization.

218. ELBEAINO Toufic (*Lebanon*)

Supervisor: G. P. Martelli ; co-supervisors : S. Sabanadzovic and M. Digiario

Title: Développement de techniques moléculaires pour le diagnostic des virus sphériques phloématiques de la vigne. - 38 p.

Abstract: Trois sets d'amorces dégénérées MTR, RD et HEL désignés et utilisés en PCR pour le diagnostic de GFkV, GAMaV, et GRGV de la vigne. Les amorces MTR et RD ont démontré une bonne efficacité amplifiant des préparations d'acides nucléiques totaux purifiées des trois virus. HEL ont pu diagnostiquer le GFkV et le GRGV et pas le GAMaV. Pour une détection simultanée et discriminante sur large échelle des trois virus, trois autres amorces antisens virus-spécifiques ont été désignées de la région MTR avec une amorce sens dégénérée commune MTR1. Cette technique appelée Mutlplex-PCR, s'est révélée très efficace à détecter les trois virus dans les cas d'une infection singulière ou mixte. Deux sondes anti-GAMaV et anti-GRGV marquées avec la digoxigénine et appartenant à la région MTR et RdRp ont été utilisées avec efficacité en hybridation moléculaire sur des préparations purifiées d'acides nucléiques totaux. GRGV était détecté dans 12 variétés diverses de 50 testées représentatives de la région des Pouilles. Les tests moléculaires ont démontré que le marafi-like virus reporté dans la vigne américaine est un isolat de GRGV. La présence d'une probable nouvelle entité virale GFkV-similaire était mise en évidence dans une vigne d'origine grecque.

Keywords: grapevine, sperical phloem-limited virus, detection, degenerate primers, multiplex-PCR, hybridisation

219. HAJJEH Hajaj Ramadan (*Palestine*)

Supervisor: F. Faretra ; co-supervisors: V. Piglionica and S. Sabanadzovic

Title: Genetic variability in *Uncinula necator* (Schw.) Burr. (*Oidium tuckery* Berk.). - 41 p.

Abstract: Two hundred and five clonal isolates of *U. necator* were sampled in 28 different vineyards located in 11 different provinces in South Italy. Samples of naturally infected tissues were collected during May to September. Fungal isolates were derived and maintained in pure culture under aseptic conditions by growing

them on leaves from in vitro grown grapevine plants. The mating-type of all isolates was determined by pairing each of them with two reference strains (MAT1-1 and MAT1-2). Crosses were considered fertile when cleistothecia were differentiated. The two mating types resulted present at similar frequencies: 51.7% isolates were MAT1-1 and 48.3% were MAT1-2. Both mating types were detected within isolates collected from single vineyards. Hence, separation of mating types does not occur, and meiotic recombination can be an important source of genetic variation. Genetic variation in *U. necator* populations was assessed using RAPD-PCR analysis. DNA was extract from each isolate and amplified with 20 different 10-mer random primers. Eletrophoretic analysis of amplification products yielded a total of 105 markers, and 35 of them were polymorphic. Phylogenetic analysis revealed the existence of two different biotypes in the pathogen's population. One included isolates sampled from flagshoots early in the season; the other group consisted of isolates sampled later from bunches or leaves. Ten markers unique for each biotypes as well as markers specific for the fungal species was detected. Observations on cleistothecia differentiation were carried out in the field as well as on artificially inoculated plants grown in greenhouse or in vitro. As a result a technique suitable for detection of cleistothecia was set up.

Keywords: grapevine, *Uncinula necator*, mating system, RAPD markers, genetic variability.

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240. BOUYAHIA Hassen (*Tunisia*)

Supervisor: D. Boscia ; co-supervisor: P. La Notte

Title: Amélioration des méthodes de diagnostic sérologique pour les virus de la court-noué (GFLV) et du clostérovirus associé à l'enroulement foliaire de vigne (GLRaV-7). - 39 p.

Abstract: Un antisérum polyclonal a été produit pour améliorer le diagnostic immunoenzymatique du septième clostérovirus associé à l'enroulement foliaire de la vigne (GLRaV-7). Une méthodologie d'échantillonnage a été établie afin d'améliorer les performances du diagnostic sérologique pour le virus du court-noué. En partant de dix-huit clones de vignes infectées par le GLRaV-7, ont été identifiées deux sources pures du virus (deux clones albanais AA41 et AA42) qui ont été utilisées pour la production du nouvel antisérum polyclonal. Le kit préparé à partir de cet antisérum s'est révélé de loin plus performant que celui utilisé précédemment. La deuxième partie de cette thèse a été consacrée à l'étude de la distribution du GFLV dans la plante et à la variation saisonnière de sa concentration, afin de mettre au point une méthodologie d'échantillonnage adéquate. On a montré que le seul moyen d'atteindre une efficacité supérieure à 90% pour le diagnostic du GFLV à partir de feuilles, consistait à considérer un échantillon mixte de portions terminales prélevées à partir d'un minimum de trois feuilles recueillies dans deux parties différentes du cep. Quant aux sarments aoûtés, l'échantillon doit être composé d'au moins deux entre-nœuds basaux, prélevés de différents sarments appartenant à leur tour à différents secteurs de la végétation.

Keywords: grapevine, ELISA, leafroll fanleaf.

241. MRANI Naima (*Morocco*)

Supervisor: G. P. Martelli ; co-supervisor: A. M. D'Onghia

Title: Etude de l'incidence et de la distribution du virus de la psorose des agrumes (CPV) au Maroc par "DTBIA" et caractérisation partielle de quelques souches locales de CPV. - 60 p.

Abstract: Avant d'effectuer un diagnostic massif du CPV au Maroc, la technique de DTBIA a été standardisée et un protocole type pour l'échantillonnage et l'application de cette méthode de diagnostic a été établi en utilisant l'ovaire des fleurs fraîches ou congelées. Le diagnostic a été établi à travers le DTBIA utilisant les fleurs, mais si ces dernières n'étaient pas présentes, on a eu recours au test ELISA sur les feuilles. Le DTBIA s'est montré plus sensible que le test ELISA, révélant la présence du virus dans certains échantillons qui se sont avérés négatifs au test ELISA. En parallèle, une caractérisation biologique et sérologique a aussi été effectuée sur quatre sources Marocaines considérées comme infectées par le CPV. Trois souches (CPV2, CPV3, CPV4) de celles-ci ont réagi positivement avec les anticorps monoclonaux utilisés, alors que la souche CPV1 s'est avérée infectée seulement par l'une des maladies appartenant au groupe des "Oak leaf pattern". La comparaison sérologique avec d'autres isolats de psorose de diverses origines a

montré que les trois souches marocaines peuvent être regroupées par similitude avec celles provenant du Liban.

Keywords: Morocco, citrus, CPV diagnosis, flower, DTBIA, ELISA.

242. HUSSEIN Ali (Somalia)

Supervisor: G. P. Martelli ; *co-supervisor:* A. M. D'Onghia

Title: Characterisation of a citrus collection showing leaf infectious variegation or crinkle-like symptoms. - 37 p.

Abstract: By observing the symptoms in the emerging young flushes of the indexed woody indicators, 7 out of the 17 citrus sources showed probably mixed infections of CIVV and CiLRV, whereas others could be infected by only one of the 2 infections, was revealed by epinasty and variegation symptoms in Etrog citron leaves at high temperatures, whereas boat shaped leaves, resembling those of Satsuma dwarf (SDV) and citrus chlorotic dwarf (CCD), appeared only in few indicators. Five sources appeared to be mechanically transmissible into herbaceous hosts, but only 2 of them induced systemic symptoms in Chenopodiaceae, Leguminosae and Solanaceae. Apart the Turkish lemon, which infected 11 out of the 17 herbaceous hosts, the other sources induced local lesions mainly in Chenopodiaceae and one only in Cucumis sativus.

Keywords: citrus, virus, variegation, crinkle leaf, indexing, serology.

243. ISMAEIL Faiz (Syria)

Supervisor: V. Savino ; *co-supervisor:* A. Myrta

Title: Sanitary status of stone fruits in Syria and characterisation of Syrian *Prunus necrotic ring spot virus* (PNRSV) isolates. - 37 p.

Abstract: Field surveys were carried out in the main stone fruit growing areas of Syria to evaluate the sanitary status of mother blocks, varietal collections and commercial orchards. The presence of virus and virus-like diseases was tested by ELISA, sap transmission to herbaceous hosts, woody indexing onto *Prunus persica* cv. GF 305 and *P. serrulata* cv. Kwanzan and dot-blot hybridisation. For identifying "healthy" candidate mother trees in the mother blocks and varietal collections belonging to the Ministry of Agriculture and Agrarian Reform, a total number of 128 varieties (88 imported and 40 local) was tested for the sanitary status also. Thirty local varieties (73%) and 50 imported ones (57%) were found negative in all laboratory tests (ELISA, sap transmission and molecular hybridisation for viroids). The woody indexing results have to be assigned after completion of the woody indexing. The presence of these "healthy" candidate trees will be reported to the Syrian Ministry of Agriculture and Agrarian Reform to be used as the initial propagation source for both governmental and private nurseries. The third objective of the study was aimed to characterise PNRSV isolates. Fifteen isolates were characterised serologically by monoclonal antibodies (MAbs) and by molecular approaches (PCR followed by RFLP). These isolates have shown serological differences among them, confirming the high diversity of this virus with other reported elsewhere. Comparing the Syrian PNRSV isolates with other recently studied isolates in the Mediterranean, they were belonging to four different serogroups; two out of them were identified as new serogroups.

Keywords: Syria, stone fruits, viruses, ELISA, dot-blot hybridisation, PLMVd, HSVd, PNRSV.

244. **WARDAN Rania (Lebanon)**

Supervisor: F. Faretra ; co-supervisor: S. Pollastro

Title: Wine contamination by Ochratoxin A. - 62 p.

Abstract: The objectives of the present thesis are: I) identification and characterisation of the fungi associated with secondary rots, with particular regard to Ochratoxin A (OTA) production; ii) evaluation on OTA contamination of grapes, must and wine in the field as well as during winemaking; iii) evaluation on the biological activity of some fungicides against *Aspergillus carbonarius*; iv) searching for molecular markers specific for *A. carbonarius* in order to establish molecular diagnostic tools. OTA was detected in all analysed samples of red grapes (cvv. Aglianico, Bombino nero, Gaglioppo, Montepulciano, Negroamaro, Primitivo, Sangiovese, Uva di Troia) . OTA concentration increased during the winemaking process, reaching generally maximum values at the end of tumultuous fermentation. Due to the different winemaking procedures, white wine was less prone to OTA contamination than red wine. All tested fungicides, i.e. fenhexamid, pyrimethanil and especially cyprodinil+fludioxonil, proved effective in reducing *Aspergillus* propagules on bunches and OTA contamination in wine. OTA detection methods were compared, and as a result it was observed that Thin Layer Chromatography (TLC) is a simple, rapid, inexpensive and reliable technique suitable for qualitative estimation of OTA contamination at levels as low as 1 ng ml⁻¹ . RAPD (Random Amplified Polymorphic ON-A) analyses were carried out on isolates of different species of the genus *Aspergillus* in order to design SCAR (Sequence Characterized Amplified Regions) markers specific for *A. carbonarius*. At present, work is progress for evaluating the sensitivity and reliability of PCR detection of the fungus and for developing a method for quantitative PCR.

Keywords: Bunch rots, *Aspergillus carbonarius*, Ochratoxin A, Detection, SCAR markers.

245. **KUKHUN Wajdi (Palestine)**

Supervisor: M. Salerno ; co-supervisor: A. Ippolito

*Title: Development and application of a PCR-based method for a rapid detection of *Phytophthora nicotianae* and *P. citrophthora* from naturally infected citrus soils. - 44 p.*

Abstract: An alternative approach based on the Polymerase Chain Reaction (PCR) for specific detection of *Phytophthora nicotianae* and *P. citrophthora* was developed using nucleotide sequence information of the internal transcribed space regions (ITS1 and ITS2) of 16 different species of *Phytophthora*. Two different primer pairs were designed specifically to amplify DNA from *P. nicotianae* (Pn5B-Pn6) and *P. citrophthora* (Pc2B-Pc7). Moreover, two primer pairs (Ph2-ITS4 and Ph4-Ph5) were developed to identify isolates belonging to the genus *Phytophthora*. All primer pairs were assessed for specificity and absence of cross reactivity, by using 119 different isolates of *Phytophthora* and other 87 fungal isolates, commonly present in the rhizosphere. A simple unexpensive and rapid procedure for direct extraction of DNA from soil was developed. The method yielded DNA of a purity and quality suitable for PCR within 2 hours. DNA extracted from soil was amplified by nested PCR utilising the genera-specific primers Ph2-ITS4 in the first step. In the second step the primer pairs Pn5B-Pn6 and Pc2B-Pc7 were utilised to detect *P. nicotianae* and *P. citrophthora*, respectively. Comparison between the molecular method and fungal isolation by means of selective medium did not show any significant difference in sensitivity.

Keywords: *Phytophthora* spp, detection, PCR, citrus, soil.

246. ALAYASA Nasser (*Palestine*)

Supervisor: V. Savino ; co-supervisor: A. Minafra

Title: Identification and partial characterization of an American plum line pattern virus (APLPV) isolate from Palestine. - 52 p.

Abstract: A quasi spherical viral entity was isolated from the Japanese plum (*P. salicina*) cv. Beauty in Palestine (PL27) resulting negative to all tests specific for the viruses known to occur on stone fruit trees in the area. This study was undertaken to identify and characterize this virus on biological, serological and molecular bases, for producing diagnostic reagents and to assess the occurrence of the virus in the Mediterranean germplasm. Two useful diagnostic tools were produced in the course of this study. A cloned fragment of viral RNA was sequenced and it was used to synthesize a probe that specifically recognized its viral target in a small amount of total nucleic acid extracted from woody hosts. Polyclonal antiserum was produced which was successfully used in the preparation of an ELISA kit. These tools detected the virus in the indexing plot with correlated results in terms of sensitivity. After the collection of this characterizing information, and partial characterization of the virus, the sequence obtained was used to search for sequence similarities in the Gene Bank database. The result was about 98% identity with the American plum line pattern virus (APLPV). With the produced antiserum, the virus was detected by ELISA in a plum sample from the USA known to be infected with the (APLPV). ELISA for selected samples from Mediterranean germplasm was negative. The virus was isolated from a Japanese plum variety. It is concluded that it was imported into Palestine due to the absence of appropriate quarantine measures and certification program that is indispensable in the long run. Since it is the first time that the virus is reported in Palestine, with only another case in France, it is recommendable to check its occurrence in the Mediterranean using the diagnostic tools produced in this study.

Keywords: APLPV, liarvirus, plum, Palestine, characterization, diagnosis.

247. CIGSAR Ilyas (Turkey)

Supervisor: G. P. Martelli ; co-supervisor: M. Digiaro

Title: Sanitary status of grapevine in South-Eastern Anatolia and Nevsehir province and characterization of an *Arabis mosaic virus* (ArMV) isolate from Turkey. - 59 p.

Abstract: Surveys were carried out in commercial vineyards in the main grapevine growing areas of south-eastern (Adiyaman, Diyarbakir, Merdin, Sanliurfa, Elazig) and central (Nevsehir) Anatolia to assess the presence and the incidence of virus and virus-like diseases. Field inspections and collection of samples were carried out in Autumn 2000. Biological (sap inoculation onto herbaceous plants and graft-transmission onto woody indicator plants) and serological detection (ELISA) methods were applied. A total of 55.3% of the ELISA tested vines (296 out of 535) were infected by one (11,4%) or more (38,5%) viruses. GVA was the most widespread virus (42,4%), followed by GLRV-1 (38,5%), GFLV (10,7%) and GFkV (7,1%). Surprisingly low (2.4%) was the infection rate of GLRRaV-3, and even lower (less than 1%) that of the other viruses tested, i.e. GLRaV-2, GVB, GLRaV-6 and ArMV. No. GLRaV-7 infected plants were detected. Symptoms of vein mosaic and vein necrosis diseases were also observed during field investigations and analysis onto graft-inoculated plants.

Keywords: Turkey, grapevine, ELISA, Arabis mosaic virus, nepovirus, characterisation.

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255. LARBI Djamila (Algeria)

Supervisor: A. M. D'Onghia ; co-supervisor: K. Djelouah

Title: Détection des principaux virus des agrumes dans le matériel végétal de multiplication Algérien et mise au point de la technique DTBIA pour identification di CVV. - 39 p.

Abstract: A survey was carried out in the main groves producing citrus propagating material in Algeria to detect psorosis (CPsV) and infectious variegation (CVV) viruses. The detection technique applied was DTBIA, using citrus flowers. The DTBIA protocol included the use of closed fresh flower ovaries, ovalbumin for the saturation of aspecific sites on the nitrocellulose membrane and a longer membrane incubation in the antibody and anti-mouse. The results highlighted a worrying situation in all tested groves given the broad spread of the two viruses. CPsV was widespread in the varietal collection and in the foundation block. As for CVV, its presence was more significant in the seed-plant block (9%). The biological and serological characterisation of four sources of Algerian psorosis showed the homogeneity of these strains and their similarity, to some extent, with other Mediterranean strains. The virus was isolated from Chenopodiaceae and purified, producing five distinct bands on a caesium sulphate gradient; only two bands reacted positively to ELISA test.

Keywords: citrus, citrus viruses, ELISA, indexing, purification, Algeria.

256. DONG Yafeng (China)

Supervisor: P. Saldarelli ; co-supervisor: A. Minafra

Title: Genetic variability among isolates Grapevine leafroll associated virus 3 and evaluation of degenerate primers for vitiviruses diagnosis and identification. - 42 p.

Abstract: The genome variability of grapevine leafroll-associated virus 3 (GLRaV-3) was analyzed in three domains: RNA-dependent RNA polymerase, heat shock protein 70, and coat protein gene. RT-PCR with primers targeted to these domains, followed by SSCP analysis, was carried out in this study. SSCP results demonstrated that the majority of the GLRaV-3 isolates tested have an intraisolate variability, composed of one predominant variant in the three genes analyzed. These isolates always showed a "simple" pattern and their population structure perfectly complied with the concept of quasispecies. No correlation between SSCP profiles and the geographic origin of the isolates was found since this virus affects a perennial crop, mainly propagated vegetatively. Six to eight SSCP patterns were observed in the three regions of the analyzed GLRaV3 isolates, thus proving a high variability among isolates. A higher number of patterns (9) were observed in the coat protein region. If this indicates a higher variability of the CP gene with respect to the two other genes analyzed, still remains an unanswered question, because more sequence data are needed. Based on the analysis of the HSP70 and CP amplified fragments, a population structure deviating from the 'quasispecies' was observed for the isolate AUS G5, which revealed the presence of different variants in the same isolate, likely originating from mixed infections of two GLRaV-3 isolates. Mixed infections are frequent in grapevine plants, due to the long life of

the plants and the possibility of repeated inoculations by mealybugs in the plants' life span. Degenerate primers used for RT-PCR diagnosis of vitiviruses. Fifty-two isolates were analyzed by RT-PCR with a new set of degenerate primers. Results show that these degenerate primers do not allow amplification of all GVA and GVB isolates, detected by RT-PCR with specific primers or ELISA. A protocol was also developed to use total nucleic acids for RT-PCR amplification, a substrate that can be applied with both specific and degenerate primers. Therefore, this set of degenerate primers could be used in the preliminary screening for the presence of vitiviruses in a large number of samples, thus allowing to save time and to reduce costs.

Keywords: GLRaV-3, genome variability, SSCP, vitiviruses, degenerate primers, quasispecies.

257. DERDARI Rachid (*Morocco*)

Supervisor: A. Ippolito ; co-supervisor: L. Schena

Title: Diagnostic en temps réel de *P. nicotianae* et *P. citrophthora* à travers la Scorpion PCR. - 41 p.

Abstract: The aim of this work was to diagnose *P. nicotianae* and *P. citrophthora*, agents of citrus root rot, by developing an alternative approach, based on real-time Polymerase Chain Reaction, using two pairs of primers i.e. Scorpion (PnSB-Pn6 Scorpion) and (Pc7-Pc2B Scorpion). 50 different isolates belonging to the genus *Phytophthora* and 65 more isolates of different fungi were tested, demonstrating that the two pairs of Scorpion primers are specific and have no cross activity. The sensitivity of both pairs was assessed through a series of 10-times dilutions of the DNA template extracted from a pure culture. In Scorpion PCR, the detection limit was of 1 pg/μl for both primer pairs. In nested Scorpion PCR, using the PH2-ITS4 primer pairs, in the first amplification, the detection limit equalled 1 fg/μl for both primer pairs. At the same time, Scorpion PCR sensitivity for *Phytophthora* diagnosis from soil extracts was determined through a series of dilutions of infected and healthy soil.

Keywords: *P. citrophthora*, *P. nicotianae*, Scorpion PCR, citrus, soil, roots.

258. JETTIOUI Samir (*Morocco*)

Supervisor: F. Faretra ; co-supervisor: S. Pollastro

Title: L'ochratoxine A dans le moût et développement des outils moléculaires pour le diagnostic d'*Aspergillus carbonarius*. - 47 p.

Abstract: Ochratoxine A (OTA) is a toxic substance contaminating several foodstuffs. Recently, it has been found in grapevine products. The aim of this work was to monitor toxigenic fungi in several commercial vineyards, representative of vine growing in Southern Italy and of Apulia. The results showed a higher contamination of musts by these fungi compared with the past. They belong mainly to the genera *Aspergillus* and *Penicillium*. These fungi are responsible for secondary rots of the grapevine. The *Aspergillus* population was predominant on *Penicillium*, whilst *A. niger* prevailed on *A. carbonarius*. The presence of OTA in the musts was more widespread and significant than in the past years. The OTA must contamination was assessed by HPLC, showing values which frequently exceeded the provisional maximum admissible limit.

Keywords: ochratoxine A, grapevine, wine, *Aspergillus carbonarius*, detection, Scorpion-PCR.

259. ABBADI Hisham (Palestine)

Supervisor: A. Myrta ; co-supervisor: N. Abou Ghanem Sabanadzovic

Title: Identification of Apricot latent virus (ApLV) in Palestine and survey for the presence of ApLV and American plum line pattern virus (APLPV) in Southern Italy. - 41 p.

Abstract: A study was carried out to identify and characterise a virus isolate, originated from apricot cv. Mistikawi in Palestine and associated with "asteroid spot disease" induced in GF305 graft-inoculated plants. DsRNA analysis of Apr-47 showed an electrophoretical pattern of different bands with a major one of about 9,500 bp. An elongated virus was isolated by sap transmission to Nicotiana occidentalis showing vein clearing and yellowing. Cytopathology, using thin sectioning, evidenced the presence of bundles of elongated particles in cytoplasm of infected N. occidentalis plants. RT-PCR, carried out with ApLV-specific primers using Apr-47 dsRNA as a template for cDNA synthesis, amplified a DNA product of about 200 nt, as described for ApLV. Biological characterization with 14 herbaceous species, belonging to 5 families, indicated that N. occidentalis was the only virus host. Peach and cherry woody indicators showed asteroid to yellow spots and rusty rings to rusty mottle, respectively for peaches and cherries.

Keywords: Palestine, Southern Italy, apricot viruses, plum viruses, virus detection, virus characterization.

260. DRIDI Mohamed Ali (Tunisia)

Supervisor: D. Boscia ; co-supervisor: O. Potere

Title: Détection et caractérisation des virus 4 et 5 associés à l'enroulement foliaire de la vigne (GLRaV-4 et GLRaV-5). - 52 p.

Abstract: Two polyclonal antisera were produced against a Mediterranean GLRaV-4 isolate and a GLRaV-5 isolate. A RT-PCR protocol was standardised for the two viruses. Two diagnostic methods i.e. ELISA and RT-PCR were comparatively applied for their validation and to provide information about the dissemination of both viruses. The antiserum developed against GLRa V-5 may be used for immune electron microscopy, whereas it is not reliable for routine application in ELISA. When the antiserum produced to GLRa V-4 was compared with an American antiserum to the type strain of the same virus, the two antisera reacted in a different and unexpected manner: The isolate LR106 was not recognised by As-LR4/BA and KOUDSI Y252 was not identified by the American antiserum; moreover, the analysis of a higher number of samples confirmed the different reactivity of the two antisera. IEM partially confirmed ELISA results.

Keywords: grapevine, ELISA, leafroll, GLRaV-4, GLRaV-5.

261. GOKALP Kadir (Turkey)

Supervisor: M. Digiario ; co-supervisor: N. Abou Ghanem Sabanadzovic

Title: Characterization of two nepoviruses isolated from Turkish grapevines. - 45 p.

Abstract: Two unidentified viruses were mechanically transmitted to herbaceous hosts from Turkish grapevines with infectious degeneration symptoms. With a preliminary study, the two viruses, named Tr-N66 and Tr-A34, were identified as possible members of the Nepovirus genus. For their biological characterization, the two viruses were inoculated to a standard set of twelve herbaceous hosts belonging to four different families. The inoculated plants were observed daily for symptom

expression. ELISA test and/or back-inoculation to assay hosts were used to check possible latent infections. Tr-A34 and Tr-N66 induced clear-cut symptoms, 5-15 days after inoculation, on 9 and 4 tested hosts, respectively. After immunization of rabbits, polyclonal antisera and ELISA kits were produced against both viruses. The results obtained in this study clearly show that Tr-N66 and Tr-A34 are two new nepoviruses infecting grapevine. For their biological, serological, physico-chemical and molecular characteristics, their respective inclusion in subgroup Nepovirus A and B of the genus is therefore proposed.

Keywords: grapevine, nepovirus, characterization, serology, RT-PCR, Phylogenetic tree.

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316. AHMED Hoda Mohamed Hussein (Egypt)

Supervisor: M. Digiario ; co-supervisor: A. Minafra

Title: Preliminary evaluation of the sanitary status of grapevine in Egypt with reference to virus diseases. – 38 p.

Abstract: Some surveys were conducted in the main grapevine-growing areas of Egypt to assess the presence and the incidence of virus and virus-like diseases. Field inspections and sample collection were carried out in Autumn 2002. The sanitary assessment in laboratory was done by mechanical transmission to herbaceous hosts and by Elisa. Since the survey was done in December, the only symptoms observed and identified with reasonable confidence were those typical of the leafroll disease. No virus was transmitted to a standard series of herbaceous hosts by inoculating the leaf extracts of about 300 vines forced under greenhouse. A total of 78.2% of the ELISA-tested European vines were infected by one or more viruses. GVA was the most widespread virus, followed by GLRaV-3 and GLRaV-1. All the other tested viruses were only scarcely represented or completely absent. The infection rate was higher in the native varieties than in the imported varieties and in the rootstocks.

Keywords: grapevine, Egypt, ELISA, leafroll.

317. PAPIC Tatjana (Montenegro)

Supervisor: P. Saldarelli ; co-supervisor: D. Boscia

Title: Characterization of two grapevine leafroll-associated virus 4 isolates: Koudsi Y252 and Koussan DD85. – 27 p.

Abstract: 270 and 486 nucleotides were obtained for the GLRaV-4 isolates Koudsi Y252 and Koussan DD85, respectively, by RACE PCR cloning in the HSP-70 gene. Comparison between these two sequenced regions showed a high similarity (98.45%) at nucleotide level. More distantly related was the American isolate LR 106, which demonstrates 83.76% identity with Koussan DD 85 and 90.10% with Koudsi Y 252 at nucleotide level. This finding corroborates the already known serological differences among these isolates, since an antiserum produced to Koudsi Y 252 recognised the homologous isolate and Koussan DD 85, but not LR 106. Conversely an LR 106- generated antiserum reacted neither with Koussan DD 85 nor with Koudsi Y 252. These findings induce to suppose the existence of different strains of GLRaV-4.

Keywords: grapevine, leafroll, dsRNAs, strain.

318. FADEL Charbel (Lebanon)

Supervisor: M. Saponari ; co-supervisors: M. Digiaro and E. Choueiri

Title: Sanitary status of olive in Lebanon. – 31 p.

Abstract: Some field surveys were conducted during March 2003 in four different Lebanese regions, involving 76 commercial olive orchards in 31 different locations. A total of 300 olive samples, representative of the main varieties and growing areas of the country, were collected. All samples were tested by RT-PCR to assess the presence of the following five viruses: ArMV, CLRV, SLRV, OLV-1 and OLYaV. All these viruses, singly or in mixed infection, were detected in about 31,3% of the samples. The ArMV detection in olive represents in absolute the first report of this virus in Lebanon. Out of 55 samples tested in dsRNAs analysis, about one third showed visible bands in electrophoresis. SSCP technique was used to compare some Lebanese and Italian OLYaV isolates. The range of patterns showed in the HSP 70 gene suggests the existence of a high sequence variability. This work represents a first step for the establishment of a sanitary improvement program in Lebanon.

Keywords: Lebanon, olive, sanitary status, RT-PCR, dsRNA, SSCP.

319. HOBEIKA Charbel (Lebanon)

Supervisor: A. Minafra ; co-supervisor: T. Amenduni

Title: Molecular diagnosis and variability of Plum Bark Necrosis and Stem Pitting-associated Virus on stone fruits. – 29 p.

Abstract: Stem pitting symptoms were observed in Apulian apricot, peach, cherry and prune plants showing severe symptoms and reduced yield. Plum bark necrosis and stem pitting-associated virus was detected in symptomatic plants by RT-PCR. The possible virus variability was investigated by graft-inoculating different PBNSPaV isolates on several Prunus species. PCR tests confirmed the successful transmission and replication of the virus in the indexed plants. The sequenced amplicons of some isolates had about 90% homology with the corresponding areas of the American isolate. Different diagnostic techniques were compared for PBNSPaV detection. Nested-PCR showed the highest sensitivity, followed by RT-PCR and hybridization. However, RT-PCR was the most suitable for large-scale surveys. Filamentous clostero-like particles from micropurified plant extracts were observed at electron microscopy. An artificial transcript mimicking the viral target determined a sensitivity level of the RT-PCR up to 50 fg, and served for estimating the virus titer in plant tissues.

Keywords: stem pitting, RT-PCR, nested PCR, stone fruits.

320. BOUANI Anouar (Morocco)

Supervisor: A. Myrta ; co-supervisor: A. Minafra

Title: Sanitary status of stone fruit trees in Morocco. – 32 p.

Abstract: Surveys were carried out in Morocco to evaluate the sanitary status of stone fruit crops. The presence of virus and virus-like diseases was tested by ELISA, sap transmission, woody indexing and molecular assays. A total of 1211 samples were tested by ELISA, showing an average level of infection of 16.4%. The sanitary status of single species was: almond (23%), plum (18%), peach (15%),

cherry (10%) and apricot (3%). The following viruses were detected: PNRSV, PDV, ACLSV and ApMV. No PPV infection was found in the tested samples. The prevailing virus was PNRSV. Forty-eight out of 565 samples tested by molecular hybridization were infected by viroids. PLMVd was more frequent than HSVd. In addition, two samples of almond stem pitting-infected trees amplified in Nested PCR a product of 191 bp similar to that described for PBNSPaV, representing the first report of this virus in the country.

Keywords: Morocco, stone fruits, viruses, viroids, almond stem pitting, ELISA, molecular hybridization, nested PCR.

321. BARHAM Hazar (*Palestine*)

Supervisor: A. Ippolito ; co-supervisor: F. Nigro

Title: Comparison between real-time Scorpion PCR and traditional methods for the detection and quantification of *Verticillium dahliae* in soils and in infected olive trees. – 38 p.

Abstract: A technique based on the real-time Scorpion polymerase chain reaction for the detection of *Verticillium dahliae* in soil and xylem of infected olive trees was developed. Two specific primer pairs (Ver2 -Ver3 and Vd7b-Vd10), previously designed by comparing sequences from the ribosomal DNA intergenic spacer of *V. dahliae* and related species, were used. A nested-PCR protocol was applied to detect the pathogen by using Ver2-Ver3 in the first step and Vd7B-Vd10 in the second step. Primers specificity and detection limit were assessed by using genomic DNA from *V. dahliae* isolates and other species of the same genera. Specific Scorpion-PCR amplification, using modified Vd7b primer (Vd7b-FAM), was successful in detecting *V. dahliae* from soil and infected olive wood. The reliability of the entire procedure was assessed using both artificially and naturally infested soils and woody materials. Compared to traditional methods the molecular approach proved to be rapid, sensitive, and enabled a large-scale analysis.

Keywords: *Verticillium dahlia*, real time PCR, nested PCR, olive, isolation techniques.

322. KHLIJ Anis (*Tunisia*)

Supervisors: A. Ippolito and M. R. Hajlaoui ; co-supervisors: A. M. D'Onghia, K. Djelouah and A. Najjar

Title: Prospection des principaux champignons (*Phytophthora* spp. et *Phoma tracheiphila*) et du virus de la psorose des agrumes dans la région du Cap Bon, Tunisie. – 41 p.

Abstract: The incidence and distribution of *Phytophthora* spp., *Phoma tracheiphila* and citrus psorosis virus (CPsV) was evaluated in the area of Cap Bon regarding a severe defoliation of citrus plants. *Phytophthora* spp. colonies obtained on selective media were identified as *P. citrophthora* and *P. nicotianae* by morphological characteristics and PCR. Significantly higher values of root infection (RI) and inoculum density (ID) were found in plants showing symptoms of decline and defoliation; RI was significantly lower under drip irrigation than under furrow irrigation. The highest incidence of *P. tracheiphila* was obtained in the oldest orchards (100%). Laboratory analysis revealed that only chromogenic isolates of *Phoma tracheiphila* were associated with the disease. CPsV infection rate by DTBIA using ovary (20,3%), was mainly affecting Clementine (38,1%). Systemic discolorations were observed on *Chenopodium amaranticolor* inoculated with a

Tunisian CPsV infected source which showed serological similarities with Italian CPsV isolates.

Keywords: Tunisia, citrus, phytophthora, phoma, CPsV, DTBIA.

323. BIRISIK Nevzat (Turkey)

Supervisor: A. M. D'Onghia ; *co-supervisor:* D. Boscia and K. Djelouah

Title: Preliminary study on citrus Tristeza virus (CTV) in Apulia. – 38 p.

Abstract: Two CTV foci were firstly reported during 2002 from citrus growing areas of Apulia in Italy. The first focus was located in Castellaneta, whereas the second was identified in Massafra. Clear-cut tristeza symptoms were only observed in the 2nd focus. DTBIA using the Mabs from Agritest-Italy showed to be more sensitive than ELISA. In the second CTV focus 730 out of a total of 1750 trees were CTV-infected (41.7%). The infection rates of two neighboring orchards were 3.7% and 31%. The characterization of 12 CTV sources from the two Apulian foci showed in some sources mixed infections with other pathogens and differences among sources of the 2 CTV foci by serological and biological means. Virus purification by leaf midveins from trees showing mild decline gave the highest virus content and closterovirus particles were observed by electron microscopy. A polyclonal antiserum was produced and successfully used in the CTV IAMB/UBA collection.

Keywords: Apulia, citrus, CTV, ELISA, DTBIA, characterization, antiserum.

324. DALCI Koray (Turkey)

Supervisor: F. Faretra ; *co-supervisor:* S. Pollastro

Title: Variation in *Phomopsis viticola* and development of molecular diagnostic tools. – 49 p.

Abstract: Vegetative compatibility was used as a marker to investigate the genetic structure of *Phomopsis viticola* populations. In single vineyards, only a few Vegetative Compatibility Groups (VCGs) represent over 70% of the fungal population. This stems from the multiplication of a few isolates introduced with the grapevine propagation material. Survival of *P. viticola* on pruning debris in the soil was confirmed. Molecular diagnostic methods were developed starting from available species-specific RAPD markers. SCAR primers and primers for Nested-PCR were designed and tested for their specificity and sensitivity. Methods of DNA extraction from grapevine tissues were tested. A protocol for molecular detection of *P. viticola* in grapevine tissues was established. A preliminary comparison between DNA amplification method and the traditional isolation of the fungus on agar media showed that PCR-based techniques are advantageous because allows a rapid and sensitive analysis, and do not require any special expertise in fungal taxonomy.

Keywords: grapevine, *Phomopsis cane*, leaf spot, vegetative compatibility, molecular diagnosis, PCR, SCAR, nested PCR.

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339. OUKACI Ghania (Algeria)

Supervisor: A. Bazzoni

Title: Evaluation du comportement de quelques plants d'abricotiers vis à vis de la Sharka.

Abstract: Apricot plants obtained by crossing between varieties or selections recognized as resistant to PPV, and the varieties or selections of an agronomic interest were inoculated for the PPV-M (isolate Gr 0019) and evaluated according the protocol of Amenduni and al. (2003) by observing the symptoms, serological test ELISA and molecular diagnosis RT-PCR. The results of the test showed that 10 selections showed symptoms and gave positive results with the ELISA test, while five selections were asymptomatic and ELISA results were negative but were proved to be infected by PPV when tested by RT-PCR.

Keywords: PPV, prunus, resistance, symptoms, ELISA, PCR.

340. ALLOUCH Awatef (Tunisia)

Supervisor: P. Saldarelli

Title: Use of degenerate primers and asymmetric RT-PCR hybridization for the detection of leafroll and rugose wood related viruses

Abstract: RT-PCR parameters were optimized for the detection of GLRaV-4 and GLRaV-5 infections with clostero-ampelovirus degenerate primers and for the detection of all GVA, GVB, GVD and GRSPaV infections with viti-foveavirus degenerate primers. The specificity of viti-foveavirus degenerate PCR products were confirmed by Southern hybridizations. Viti-foveavirus degenerate primers demonstrated a high sensitivity (97%) and specificity (95%) in large scale diagnosis and a great ability to detect multiple infections in the same grapevine. Membrane hybridization showed to be a very suitable tool for a fast and sensitive screening of the Dig labelled degenerate PCR products. Concerning the asymmetric RT-PCR, the best forward: reverse primer ratios for GVA, GVB, GRSPaV and GLRaV-3 were determined. Three sets of specific probes were selected for their use in the asymmetric RT-PCR hybridization for GVA, GVB and GLRaV-3. These probes allowed successfully the direct hybridization of the corresponding Dig labelled asymnmetric PCR products without any additional denaturation step. However, the asymmetric RT-PCR seems to be less reliable in large scale analysis.

Keywords: grapevine, leafroll, rugose wood, RT-PCR, degenerate primers, asymmetric RT-PCR, hybridization.

341. BENSADOK Dehili Fatma (Algeria)

Supervisor: F. Faretra

Title: Le brunissement du bois de la vigne : mise au point des méthodes de diagnostic moléculaires pour *Phaeomoniella chlamydospora*. – 40 p.

Abstract: Wood browning of grapevine is one of the symptoms associated to esca disease on the young plants and propagating material. *Phaeomoniella chlamydospora* is one of the fungi usually isolated from brown wood. A DNA extraction protocol was set up for *Phaeomoniella chlamydospora* molecular detection in the plant tissues and in the soil that allowed, through Nested PCR, to detect the pathogen at a concentration of 1 pg DNA for plant material and of 1.6×10^2 conidia/gram in the soil. The application of this technique to grafted and ungrafted rootstocks (776 plants) taken in different nurseries (Algeria and Italy) enabled to detect the presence of *Phaeomoniella chlamydospora* with a frequency of 40 and 20% respectively. The pathogen was also detected in the soil samples. These techniques are not knowledge-demanding in terms of fungal taxonomy; they are fast and applicable to a large number of samples. It is therefore recommended to apply them for a large-scale monitoring with a view to assessing the health status of the propagating material.

Keywords: grapevine, *Phaeomoniella chlamydospora*, wood browning, diagnosis, nested-PCR.

342. AL-ABDULLAH Adbulkader (Syria)

Supervisor: M. Digiario

Title: Preliminary evaluation of the sanitary status of olive in Syria. – 51 p.

Abstract: Field surveys were conducted in autumn 2003 in four different Syrian regions, involving 80 commercial olive orchards. A total of 478 olive samples, representative of the main varieties, were collected. In dsRNAs analysis, 54 (c.43%) out of 125 samples showed visible bands in electrophoresis. 269 samples were tested by RT-PCR to assess the presence of the following viruses: ArMV, CLRV, SLRV, OLRV, OLV-1, OLV-2, CMV and OLYaV. All these viruses, singly or in mixed infection, were detected in about 46% of the samples. CMV was the prevailing virus (24.5%) followed by CLRV (15.6%), OLYaV (14.5%) and OLRV (11.5%). Less represented were the other 4 viruses tested. PCR was also applied for the detection of phytoplasmas in 100 olive samples. Positive reactions were obtained in 25% of them, both in symptomatic (bushy growth, yellowing) and asymptomatic plants. According to the preliminary results of nested PCR and RFLP, the Syrian phytoplasmas showed similarities to the 16SrX group.

Keywords: Syria, olive, sanitary status, RT-PCR, dsRNA, RFLP, phytoplasma.

343. ABD-ELBACKI Ashraf Mousa Mahmoud (Egypt)

Supervisor: K. Djelouah ; co-supervisor: R. Milano, A. M. D'Onglia

Title: Improvement of Citrus exocortis viroid (CEVd) and Citrus cachexia viroid (CCaVd) detection. – 41 p.

Abstract: Citrus exocortis viroid (CEVd) and Citrus cachexia viroid (CCaVd) detection was improved by setting up a new biological indexing method and comparing different molecular assays (molecular hybridisation, RT-PCR, sPAGE). Selected CEVd and CCaVd - infected sources, previously tested by sPAGE, were inoculated to Etrog citron cuttings, treated for rooting and kept in plastic bag at 35°C. Plants showed leaf epinasty 20 days after inoculation and reacted positively to dot-blot tests. This method proved to be reliable, time and space saving, easy and low cost. Comparing molecular assays in field diagnosis, RT-PCR showed to be the most sensitive method for CEVd and CCaVd detection from January to June, while dot-blot, tissue print and sPAGE were limited by the low viroid concentration in winter months. May can be considered the best month for starting viroid field detection, under Apulia conditions. Moreover, flowers showed to be a promising explant for viroid mass detection, mainly by tissue print.

Keywords: exocortis, cachexia, RT-PCR, sPAGE, dot-blot, flowers, citrus.

344. MATIC Slavica (Bosnia and Herzegovina)

Supervisor: A. Myrta ; co-supervisor: M. Al Rwahnih

Title: Sanitary status of stone fruit trees and typing of Plum pox virus isolates in Bosnia and Herzegovina. – 53 p.

Abstract: Field surveys and laboratory tests were carried out to assess the sanitary status of stone fruit trees in Bosnia and Herzegovina. Forty-four out of 410 (11%) samples, tested by tissue printing hybridization, were infected by viroids (PLMVd and HSVd). A total of 1080 samples were tested by DAS-ELISA, showing an average infection level of 36%. The following viruses were detected: PPV, PNRSV, PDV and ACLSV. No ApMV infection was found. The prevailing virus was PPV. Sixteen PPV isolates were serologically (Mabs) and molecularly (PCR-RFLP) typed. Half of them were PPV-D, 4 were PPV-M and 4 were recombinants (PPV-Rec). Five isolates of PPV were also sequenced. Nucleotide sequence alignment confirmed that the same recombination event was present in the NIb gene in all the recombinants. The present study showed a deteriorated sanitary status for the local stone fruit industry, because of the high incidence of virus diseases, Sharka in particular. Finally, a high variability of the Bosnian PPV isolates was found, which fits well with the long presence of the virus in the country.

Keyword: Bosnia and Herzegovina, stone fruits, viruses, viroids, detection, virus recombination, sequence analysis.

345. OUBAKI Lahoucine (*Morocco*)

Supervisor: A. Ippolito

Title: Ecological and biological investigations on *Aureobasidium pullulans*, *Penicillium* spp. and their interaction on citrus fruits. – 61 p.

Abstract: Oranges were collected from organic and conventional farms located in Basilicata (Italy) to study the effect of the farming system on epiphytic microbial population on citrus fruit surface. The populations of filamentous fungi, *Aureobasidium pullulans*, and yeasts were higher in organic orchards without any treatment in comparison with conventional ones. Whereas, no significant differences in terms of this population were observed between conventional and organic orchards treated with copper. The effectiveness of the antagonist *Aureobasidium pullulans*, strain L47, in controlling green and blue moulds, was evaluated when applied in preharvest, both in preharvest and postharvest, or only on postharvest. Treated fruits were kept at 20.C for 30 days. When applied as postharvest treatment, the antagonist was more effective in controlling green and blue moulds than preharvest one. Techniques based on random amplified polymorphic DNA (RAPD) and arbitrarily primed polymerase chain reaction (AP-PCR) were used to determine the genetic variability among populations of *Penicillium* spp. collected from Italy and Morocco, both in orchards and packinghouses. With the tested primers, cluster analysis using UPGMA showed a higher genetic variability in *P. italicum* isolates than *P. digitatum*. The pathogen *P. ulaiense*, was not found among isolates collected from packinghouses and fields in Morocco.

Keywords: citrus, postharvest disease, biological control, preharvest treatment, postharvest treatment, *Aureobasidium pullulans*, RAPD, AP-PCR.

346. DACCHACHE Georges (*Lebanon*)

Supervisor: A. M. D'Onghia ; co-supervisor: K. Djelouah

Title: A study on Citrus infectious variegation virus (CVV) in Citrus from Gargano promontory, Italy. – 42 p.

Abstract: Leaf variegation and crinkle-like symptoms were observed in most of the local citrus species on Gargano promontory in Italy. Therefore, 30 accessions from Gargano and 3 CVV isolates were selected for biological, serological and molecular characterization of citrus infectious variegation virus (CVV). Inoculated woody plants showed mainly leaf crinkling and blister-like symptoms. High CVV transmissibility to herbaceous hosts was observed and *Nicotiana glauca* was a new virus host. TAS-ELISA, using the commercial kit, and 4 monoclonal antibodies revealed high CVV infection and variability, which clustered the 23 CVV-infected sources in 5 serogroups. The CVVa/CVV4 couple of primers could detect a higher number of CVV isolates than CVVa/CVVb and serological assays; heterogeneity was observed by SSCP results. Seed coats were highly infected unlike the progeny. Slice inoculations from citrus to indicators highly transmitted the virus. DTBIA using ovaries proved to be more effective than ELISA. The Southern side of the tree was chosen for sampling and CVV incidence in Gargano was 30%.

Keywords: citrus, CVV, DTBIA, ELISA, RT-PCR, Gargano.

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391. DELIC Duska (*Bosnia and Herzegovina*)

Supervisor: L. Carraro and A. Myrta

Title: Phytoplasmas of fruit trees and grapevine in Bosnia and Herzegovina. – 49 p.

Abstract: Symptoms of apple proliferation (AP), pear decline (PD), European stone fruit yellows (ESFY) and Grapevine yellows (GY) were observed in apples (25), pears (30), stone fruit species (42) and grapevine (33). In the same orchards, in spring, the presence of *Cacopsylla costalis*, *C. melanoneura*, *C. pyri* and *C. pruni* . vectors of AP, PD and ESFY respectively . was ascertained. Laboratory analyses showed the presence of phytoplasmas belonging to: i) 16SrX group, subgroup A (*Candidatus Phytoplasma mali*) in apples, *C. costalis* and *C. melanoneura*; ii) 16SrX group, subgroup C (*Candidatus Phytoplasma pyri*) in pears and *C. pyri*; iii) 16SrX group, subgroup B (*Candidatus Phytoplasma prunorum*) in apricots, peaches and *C. pruni*; iv) 16SrXII, subgroup A (Bois Noir phytoplasma). In addition, four AP-subtypes were identified in 23 AP-positive samples. The subtype AP/rpXA prevailed with 60%, AT-2/rpXA with 27%, AT-1/rpXA 9% and AT-1/rpXB 5%.

Keywords: Bosnia and Herzegovina, fruit trees, grapevine, phytoplasmas, PCR/RFLP, ELISA, AP-subtypes.

392. AMIN Tarek (*Egypt*)

Supervisor: F. Faretra

Title: Observation on the epidemiology and control of grapevine Powdery mildew. – 65 p.

Abstract: This study deals with some aspects of the genetic variability of *Erysiphe necator*, the causal agent of powdery mildew in grapevine. In Egyptian vineyards, the presence of the two mating types MAT1-1 and MAT1-2 and "ascospore" and "flagshoot" biotypes, already found in European populations, was verified. In southern Italian *E. necator* populations, the distribution of the two biotypes during the season was monitored. Fungal samples from untreated vineyards were subjected to direct PCR with biotype-specific SCAR primers. In some vineyards, a shift from a prevalent "flagshoot" to "ascospore" population was noticed, whereas in others, the populations were made up exclusively of one biotype. A protocol to detect quiescent mycelium in grapevine buds by nested PCR was devised and applied to 133 bud samples. Only five buds resulted infected by "flag shoot" isolates. Field trials for assessing the efficacy of new fungicides against powdery mildew took place in four vineyards in Apulia region.

Keywords: powdery mildew, genetic variability, PCR, overwintering, chemical control.

393. EL SAYED Tarek (Egypt)

Supervisor: H. Fahmy and A. M. D.Onghia

Title: Setting up of biological indexing of Citrus tristeza virus (CTV) and Citrus infectious variegation virus (CVV) using inoculated indicator cuttings. – 23 p.

Abstract: The use of indicator plants for the detection of most citrus graft transmissible agents is still compulsory for the production of a primary source in the framework of a certification programme. Space, time, skills and costs needed for the production of indicator seedlings can be highly reduced by the use of indicator inoculated cuttings in Jiffy pots. This method was successful in the detection of citrus tristeza virus (CTV) and citrus infectious variegation virus (CVV) using mature fresh cuttings of the specific indicators (Volkameriana lemon, Etrog citron, Mexican lime) which were graft-inoculated and placed in Jiffy pots after a short IBA treatment. All indicators rooted with a different capacity and in a different period of time. Clear-cut infectious variegation and tristeza symptoms were observed after 20 days from inoculation on the new emerging leaves of the specific indicators. Results of biological indexing were confirmed by ELISA.

Keywords: biological indexing, citrus, cutting, CTV, CVV, Egypt, ELISA.

394. PACE LUPI Timothy (Malta)

Supervisor: A. Ippolito and F. Nigro

Title: Incidence of olive verticillium wilt and molecular characterization of *Verticillium dahliae* isolates within the Maltese archipelago. – 76 p.

Abstract: Objectives of this study were: i) data collection on the incidence and distribution of Verticillium wilt on olive and on the occurrence of Verticillium dahliae microsclerotia in the soil of major Maltese olive-growing localities, by using classical and molecular detection methods; ii) analysis of the genetic variation of 55 V. dahliae isolates by RAPD-PCR; iii) screening for the occurrence of defoliating and non-defoliating pathotypes and analysis of virulence of six selected isolates by pathogenicity tests on potato seedlings. V. dahliae was detected in all three islands of the Maltese archipelago. A significant correlation between classical and molecular methods to detect microsclerotia in the soil was found. Molecular analysis showed little or no genetic variation and all isolates belonged to the non-defoliating pathotype. A certain degree of virulence variation was also noted. On the whole, results suggest that appropriate prophylaxis and diagnostic tests, both for the soil and propagative material, are mandatory to limit the spread of Verticillium wilt of olive in the Maltese archipelago.

Keywords: Malta, Verticillium dahliae, olive, soil inoculums, genetic variation, pathotype, virulence.

395. EL SAKHI Salwa (Morocco)

Supervisor: M. Digiario e M. Saponari

Title: Further molecular characterization and study on the genomic variability of Olive leaf yellowing-associated virus (OLYaV). – 55 p.

Abstract: Molecular studies by SSCP and sequence analysis carried out on the HSP70 gene of thirty OLYaV isolates of different origin showed a wide variability within OLYaV species. This variability was put in evidence by analysing the multiple alignment of the HSP70 nucleotide sequences of 13 isolates with different SSCP pattern by using a Clustal program. Based on the statistical nucleotide divergence analysis, three distinct groups of OLYaV isolates were distinguished. The purified IgGs produced from recombinant HSP70 proteins were able to detect the virus in Western blot and Dot blot, opening the way for their use in large scale surveys. The cloning technique RACE-PCR succeeded in amplifying a 650 bp, extending the region close to the HSP90 gene. The sequenced clone contained one ORF potentially encoding a portion of the CP of OLYaV which was classified in the Ampelovirus genus.

Keywords: olive, closteroviridae, OLYaV, HSP70, SSCP, sequence analysis, coat protein, western blot.

396. EL AIMANI Ali (Morocco)

Supervisor: M. Achouri and K. Djelouah

Title: Assessment of the sanitary conditions of certified nurseries production in Souss Massa Valley (Morocco). – 49 p.

Abstract: Biological, serological and molecular assays were applied and the basic material proved to be free from the virus and virus-like pathogens tested (CTV, CPsV, CVV, oak leaf pattern agent, CEVd, CCaVd, *S. citri*). Furthermore, the survey of 1054 citrus trees, carried out around the nurseries using DTBIA test, indicated an infection rate of 10% for CPsV and 2% for CVV, whereas CTV and *S. citri* were not reported. The inoculum density (ID) of *Phytophthora* spp. was determined in two rootstocks (Citrango Carrizo and sour orange) and in the nursery soil. In July, the ID was also estimated in different components of the soil mixture and in water. High values of ID and root infection (RI) were observed in July and the sour orange rootstock was more tolerant to *Phytophthora* root rot than Carrizo citrange. Only *P. nicotianae* was identified by molecular assay (PCR) thus demonstrating that it was the causal agent of *Phytophthora* root rot.

Keywords: Morocco, Sous Massa, citrus, nurseries, viruses, *Phytophthora*.

397. MANDIC Bojan (Serbia and Montenegro)

Supervisor: A. Myrta

Title: Study on viruses and viroids of stone fruits in Serbia. – 48 p.

Abstract: A total of 917 samples from plum, cherries, peach, apricot and wild *Prunus* spp. (representing 555 cultivars) was tested by DAS-ELISA for PPV, PNRSV, PDV, ACLSV, and ApMV. The average infection level was 53%. PPV was prevailing in plum (37%) and peach (35%). High infections of CVA (69%), CNRMV (30%) and CGRMV (27%) were detected in cherries. An unidentified filamentous virus was isolated in *N. occidentalis* from peach cv. Sinokuba and an unusual necrotic crook

observed in Kwanzan could not be ascribed to any of the tested viruses, thus suggesting that one or more unidentified graft-transmissible pathogens were involved. Some 871 stone fruit samples (representing 602 cultivars) were tested by tissue printing hybridization for the presence of PLMVd and HSVd. PLMVd was detected in 185 peaches (50%) and HSVd in 2 apricots (2%).

Keywords: Serbia, stone fruits, viruses, viroids, detection, viroid recombinant sequence analysis.

398. **TALAS Firas (Syria)**

Supervisor: P. Saldarelli

Title: Improving molecular and serological diagnosis of vitiviruses and characterization of a Grapevine leaf roll associated virus-4 (GLRaV-4) variant. – 65 p.

Abstract: Degenerate primers in the replicase domain of Flexiviridae detect GVA, GVB, and GRSPaV in samples with mixed infection although they preferentially amplify a given sequence. cRNA probes were optimised and the sensitivity was determined with amplicon dilutions. In artificial multiple infections, there is a higher tendency to amplify GRSPaV. In 15 infected grapevines, the hybridization of PCR products gave the same results. A GVA synthetic antigen, not captured by polyclonal antisera in ELISA, was used as control in DIBA. Extraction buffers, blotting membranes and blocking reagents were compared by colorimetric and chemiluminescent detection. A preliminary protocol gave a limited improvement, not able to be proposed as an alternative to ELISA. On the four available isolates of GLRaV-4, primers in HSP70 showed 94% homology between Koussan DD85 and the American isolate LR106. DD85 and Y252 are serologically different from LR106. ELISA with a French antiserum confirmed that DD85 and Y253 are the same isolate. CP gene sequences of Y253, Y252, and LR106 appear to be the same and differences between Y253 and LR106 are located in the 5'. Y253 is a variant of GLRaV-4.

Keywords: DIBA, GLRaV-4, GVA, GVB, GRSPaV, grapevine, hybridization.

399. **MSLMANIEH Thraya (Syria)**

Supervisors: sup. M. Digiario and D. Boscia

Title: Preliminary evaluation of the sanitary status of grapevine in Syria. – 32 p.

Abstract: GFLV, ArMV and GVA were detected by mechanical inoculation onto herbaceous plants, vein necrosis and vein mosaic on graft-inoculated indicators. 520 out of 736 (70.7%) *V. vinifera* plants resulted infected by ELISA. In commercial vineyards, GVA was the prevailing virus (54.7%), followed by GLRaV-1, GfKV and GLRaV-3. The other viruses tested were only scarcely present (GLRaV-2, GFLV and ArMV, GVB). Heavily infected (77.8%) were the vineyards at As Suwayda, in the south of Syria, and, among the varieties, cv. Hellwany (90.6%). Less infected (25%) were the rootstocks in the nurseries, almost exclusively by GfKV (22.0%). Only 10% of 75 vines tested in the collection plot were ELISA negative, with GfKV (76.0%) and GVA (61.3%) as prevailing viruses. GRSPaV was widespread (72.3%) and its presence was highly correlated to vein necrosis in 110R.

Keywords: grapevine, Syria, ELISA, RT-PCR, degenerate primers, ArMV.

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431. MEZIANE Malika (Algeria)

Supervisors : A. M. D'Onghia and F. Carimi ; advisor: D. Frashëri

Title: Improvement of protocols for citrus psorosis virus (CPsV) elimination and in-vitro virus conservation. – 59 p.

Abstract: An improved thermotherapy protocol at 40°C was developed for CPsV elimination. In the method applied in vivo, preconditioning was eliminated and the whole procedure was reduced to 13 weeks instead of 24, using chip budding of pretreated buds. Pretreated budsticks of the same infected sources were successfully grown in vitro at the same temperature. Serological and biological assays showed no infection from 9 weeks (in vivo) and 1 month (in vitro) after heat treatment. In vitro conservation of CPsV sources was obtained using 1 mm shoot-tip grafted in vitro onto T. citrange. The infected rootstock was micro- propagated for shoot proliferation without losing the infection. STG and SE of some citrus genotypes were not successful. Flowers for somatic embryogenesis from stigma and style culture were successfully stored at 4°C for 2 weeks inducing embryo formation, whereas only lemon cuttings were successfully stored at the same temperature for 2 months.

Keywords: citrus, citrus psorosis virus, thermotherapy, sanitation, conservation, diagnosis, in vitro culture.

432. MEZIOUD Djamila (Algeria)

Supervisor: A. Ippolito ; advisor: L. Schiena

Title: Evaluation of time-course degradation of R. necatrix DNA in soil by real-time Scorpion PCR. – 48 p.

Abstract: A major limitation in using PCR to detect plant pathogens is the lack of discrimination between living and dead material. The risk of false positive results due to the detection of DNA from dead cells was evaluated in natural or sterilized soils, artificially inoculated with living or heat-devitalised mycelium of *Rosellinia necatrix*. A real-time Scorpion PCR detection method was used to quantify target DNA and to evaluate the time-course of degradation. In non sterile soils inoculated with living mycelium the amount of R. necatrix DNA moderately increased or remained unchanged from 0 to 6 DPI (Days Post Inoculation). In contrast, in soils inoculated with dead mycelium DNA decreased at 2 DPI and was not detectable at 4 or 6 DPI. In sterile soils, amended with living mycelium, the amount of DNA significantly increased with time, whereas in soils amended with devitalised mycelium DNA remained detectable even after 12 DPI.

Keywords: *Rosellinia necatrix*, real-time Scorpion PCR, false positive results, quantitative PCR.

433. LOLIC Biljana (Bosnia and Herzegovina)

Supervisors: A. Myrta and F. Di Serio

Title: Viruses and viroids of pome fruit trees in Bosnia and Herzegovina. – 44 p.

Abstract: Field surveys and laboratory tests were carried out to assess the sanitary status of pome fruit trees in Bosnia and Herzegovina. A total of 65 apple and 51 pear cultivars were tested for the presence of pome fruit viruses and viroids. Biological indexing was more reliable than ELISA for virus detection. The most frequent viruses of apple were ACLSV (72%) and ASPV (69%), whereas for pear ASGV (69%) and ACLSV (64%). Multiplex RT-PCR results of 20 randomly selected apple cultivars were in line with biological indexing. Tissue-printing hybridization proved to be successful in large-scale survey to detect pome fruit viroids. PBCVd was detected, for the first time in the country, in 10 pear cultivars. ASSVd and ADFVd were not found. Finally, six PBCVd variants were sequenced from a native pear cv. Rancica, with 5 new polymorphic positions and clustered into one group.

Keywords: Bosnia and Herzegovina, pome fruits, viruses, viroids, detection, sequence analysis.

434. EL MAGHRABY Ibrahim Mohammed Kamal (Egypt)

Supervisors: A. Myrta and H. Fahmy

Title: Sanitary status of stone fruits and characterization of *Plum pox virus* isolates in Egypt. – 57 p.

Abstract: Field surveys and laboratory tests were carried out to assess the sanitary status of stone fruit trees in Egypt. A total of 716 samples were tested by DAS-ELISA, showing an average infection level of 15%. The following viruses were detected: PNRSV, PPV, PDV and ACLSV. PPV was found only in old lands, with traditional old orchards. No ApMV infection was found. RT-PCR done in 39 representative samples recorded the presence of PBNSPaV (21%) and ApLV (8%), whereas APLPV testing was negative. Some 101 out of 693 samples (15%), tested by tissue printing hybridization, were infected with PLMVd or HSVd. Sixteen PPV isolates were serologically typed using monoclonal antibodies (MAbs). All Egyptian isolates were PPV-EA. There was evidence of a low serological variability inside the PPV-EA population, indicating a newly established virus population and/or a single introduction event in the country. The serological analysis using MAbs represents a reliable preliminary method for the characterization of PPV isolates.

Keywords: Egypt, stone fruits, viruses, viroids, detection, Mabs, characterization.

435. HABIB Wassim (Lebanon)

Supervisor: S. Pollastro ; advisor: R. M. De Miccolis Angelini

Title: Observations on the variability of *Botryotinia fuckeliana*. – 74 p.

Abstract: *Botryotinia fuckeliana*, teleomorph of *Botrytis cinerea*, is the causal agent of grey mould inducing heavy yield losses on several crops. The fungus is well-known for its wide adaptability and easily acquires resistance to fungicides. 142 monoconidial isolates collected in Lebanon from tomato, strawberry, cucumber and eggplant confirmed the wide variability of the pathogen related to the presence of transposable elements, dsRNAs and sensitivity to fungicides. Resistant mutants to Boscalid, a new anilide fungicide, were obtained in vitro and genetic characterization revealed that mutations occurred in single nuclear genes which segregate at 1:1 ratio. Sequencing of Daf1 gene, responsible for the resistance to dicarboximides and phenylpyrroles, demonstrated its wide polymorphism and multiallelism. Evaluation on the fitness of transposon and vacuole isolates disclosed that their fluctuation in the same growing season could be related to their different capacity to produce sclerotia and colonize mature berries of grapevine.

Keywords: *Botryotinia fuckeliana*, variability, resistance, transposable elements, dsRNA, Boscalid, Daf1 gene.

436. HANNA Elias (Lebanon)

Supervisors: M. Digiario and E. Choueiri ; **advisor:** J. Jawhar

Title: Incidence of viruses and nematodes vectors in the Lebanese vineyards. – 38 p.

Abstract: Field surveys were conducted in 95 commercial vineyards in Lebanon. A total of 915 samples were collected and tested by ELISA. 55.8% vines were infected with one or more viruses. GVA (30.8%) and GLRaV-3 (23.8%) were the prevailing viruses, followed by GFkV (15.1%), GLRaV-1 (10.6%) and GLRaV-2 (8.7%). The other viruses checked were absent (ArMV) or less represented (GFLV and GVB). No other virus was detected by mechanical transmission. In RT-PCR, GRSPaV was detected in 89% of the samples by using specific primers, while three closterovirus agents, different from those tested by ELISA, were recorded by testing 69 vines with degenerate primers. No other nepovirus was detected in any of the 89 samples tested by using three different sets of degenerate primers. X. index was found in 23 out of 89 soil samples collected from vineyards, and in 3 out of 15 samples collected in the fields where grapevine was absent.

Keywords: Lebanon, nematode, vineyards, sanitary status, ELISA, RT-PCR.

437. DADEN Mounia (Morocco)

Supervisor: K. Djelouah

Title: Characterization and strain typing of Mediterranean *citrus tristeza virus* (CTV) isolates. – 68 p.

Abstract: This study was conducted for serological, biological, molecular characterization and strain differentiation of 72 CTV isolates selected from different countries, mostly from the Mediterranean area. Serological selectivity, mediated by a set of Mabs, divided them into 9 serogroups. Moreover, hybridization of amplicons from the coat protein gene (CPG), with strain specific probes, gave an insight into their strain composition ranging from mild to severe. Biological indexing using cuttings was successful compared to seedlings. Most of the isolates inducing SP on Mexican lime were from both Group 3 and 5, specific for the most severe isolates. Great conformation differences were found between isolates by SSCP. CPG nucleotide sequences, first reported for an Algerian and a Palestinian isolates, were compared to isolates from the Genbank and grouped in different clusters. Most of the Italian isolates were mild except Q21 and Q32, already eradicated and originated from imported ornamental plants.

Keywords: coat protein, CTV, cuttings, Mediterranean, PCR-ELISA, strain typing, sequence analysis.

438. HOSNI Taha (Morocco)

Supervisors: M. Fatmi and R. Buonauro

Title: The olive knot disease in Morocco. Economic importance and distribution, characterization of the bacterial strains, and cultivars susceptibility. – 72 p.

Abstract: A field survey was conducted in the main olive growing regions of Morocco to assess the geographic distribution and the incidence/severity of olive

knot disease. The disease proved to be widespread with significant incidence/severity variation. Biochemical, pathological, and molecular characterization identified the isolates from Morocco as belonging to *Pseudomonas savastanoi* pv. *savastanoi*. Investigation of genomic variability of 32 strains, including the reference strain, by rep-PCR revealed a relatively high degree of genetic heterogeneity. Five major olive commercial cvs grown in Morocco were screened for tolerance using two pathogenic P.s. pv. *savastanoi* predominant strains. The data obtained allowed to rate the cultivars susceptibility to olive knot disease as high, medium, or low. Efficacy of Oxosâ, a chemical product, was evaluated as a method to control olive knot disease. Results accurately show the effectiveness of Oxos either in vitro or on P. s. pv. *savastanoi* survival in olive leaves.

Keywords: Morocco, olive knot, *Pseudomonas savastanoi* pv. *Savastanoi*, geographic distribution, incidence/severity, rep-PCR, Oxos.

439. ABOU KUBAA Raied (Syria)

Supervisors: M. Digiario and A. Minafra ; *advisor:* T. Elbeaino

Title: Assessment on the presence of *citrus tristeza virus* (CTV) and relative vectors in Syria. – 52 P.

Abstract: Syrian citrus growing areas (Lattakia and Tartous) were firstly surveyed to assess citrus tristeza virus and the relative vectors. Eight nurseries, 2 budwood sources fields and 19 groves of the main citrus varieties were visually inspected and tested. A total of 89 CTV-infected plants out of 2653 samples were detected by DTBIA in 2 nurseries (13), 2 budwood sources fields (16) and 6 groves (60). Serological results were confirmed at IAMB. Based on the reactions with 9 MABs and 2 Pabs, CTV sources were serologically included in 4 serogroups. Only one Valencia CTV-source induced severe symptoms on M. lime (vein clearing, leaf cupping, stunting and stem pitting). *A. spiraecola* (50%), followed by *A. gossypii* (27%) were the most common aphids, whereas no evidence of *T. citricidus* was found. This is the first report of CTV in Syria, but apparently, the virus is not spread by the vectors probably due to the presence of less efficient aphid spp.

Keywords: citrus, citrus tristeza virus, aphids, diagnosis, Syria.

440. NAHDI Sabrine (Tunisia)

Supervisors: A. M. D'Onghia, R. Addante and F. Azmeh

Title: Study of the sanitary status of fig in Tunisia and further characterisation of Fig leaf mottle associated virus. – 54 P.

Abstract: From a total of 156 fig samples collected during a survey in Tunisia, 66 (42.3%) were positive in RT-PCR for FLMaV-1 (36.4%) and FLMaV-2 (13.3%). Furthermore, out of 40 samples tested by dsRNA analysis, 4 PCR-negative samples were positive. For PCR and molecular hybridization tests, TNA extraction with Silica and Mini-dsRNA procedures were the most suitable methods. Specific and degenerate primers for Multiplex-PCR were designed and proved to be efficient for the simultaneous and differential detection of both viruses in infected fig plants. A specific probe for FLMaV-2 detection in dot blot hybridization was successfully developed. DOP and RACE-PCR allowed to identify five additional new genome fragments of FLMaV-1 belonging to methyltransferase, helicase and HSP70 genes. The phylogenetic tree constructed with sequences from HSP70 and helicase genes placed this virus into two different genus clusters (Closterovirus and Ampelovirus,

respectively). In graft-inoculated "healthy" fig plants both viruses induced vein clearing and blotching symptoms.

Keywords: Ficus carica, survey, closteroviridae, dsRNA, molecular hybridization, multiplex-PCR.

IPM - A.Y. 2006-2007 (October session) – 469-480

469. MUSA Arnolda (Albania)

Supervisors: J. Mercuri, A. Santomauro ; advisor: K. Djelouah

Title: Phytosanitary status of stone fruits nurseries and mother plants in Albania. – 70 p.

Abstract: Investigations were carried out for the monitoring of the main viruses (PPV, PNRSV, ACLSV, PDV), viroid (PLMVd) and main fungal pathogens attacking stone fruit nurseries and mother plants in Albania. All collected samples were tested by Elisa for viruses detection, Dot blot hybridization for viroid detection and isolations on PDA for fungal pathogens detection. The selected plants showed to be highly infected by PPV (nurseries 29%, mother plants 14% and orchard 12%) and PLMVd particularly for peach in all selected areas. The presence of PPV, PNRSV and PDV was lower compared to others. *Taphrina deformans*, *Rosellinia necatrix* and *Va/sa cincla* are the fungal pathogens detected in plants from different origins: nurseries, mother plants and orchards. The sanitary status of the stone fruit crops in Albania is highly deteriorated and urgent actions need to be taken!

Keywords: stone fruit, PPV, PNRSV, PDV, ACLSV and PLMVd, *Taphrina deformans*, *Armillaria mellea*, *Rosellinia necatrix*, *Neclria galligena*, *Phylophthora*, *Chondrostereum Verlicillium dahiae*.

470. CUNHA Aderito Tomas Pais da (Angola)

Supervisor: A. Minafra ; advisor: M. Digiaro

Title: Production of a polyclonal antiserum against recombinant LChV-1 coat protein. – 53 p.

Abstract: The coat protein gene of Little cherry virus-1 (LChV-1) was amplified by RT-PCR, cloned into expression vectors pSyn and pET. One third of the coat protein was amplified by specific primers and inserted into pSyn. The entire coat protein of approximately 1205 bp was cloned into pET. The LChV-1 coat protein was expressed as recombinant protein containing a his-tag. Bacteria cells were disrupted by sonication and the LChV-1 CP/histidine fusion protein was purified by NI-NTA agarose resin affinity chromatography. Purified protein was then injected into a New Zealand rabbit to raise polyclonal antisera to be used in serological tests. These antisera were successfully tested in DIBA (Dot Immuno Binding assay), using a titre of 1:1000, after cleaning by incubation with a healthy plant extract. This method represents an additional tool for mass detection of LChV-1 in the field and in nursery certified material and a complement to biological and molecular techniques.

Keywords: LChV-1, fusion protein, recombinant protein, antibody, polyclonal, serology.

471. NUMIC Fadila (*Bosnia and Herzegovina*)

Supervisor: M. Digiario ; advisor: T. El Beaino

Title: Characterisation of a putative new ampelovirus associated with grapevine leafroll disease. – p. 51.

Abstract: Filamentous viral particles (Cyp 1) were observed in grapevine leafroll-affected vines from Cyprus, which were not identified by any of the available GLRaVs antisera. The production of a polyclonal antiserum was hindered by the low concentration of the virus in infected grapevine tissues. Three different portions of its HSP70 (610 nt), CP (820 nt) and CPm (650 nt) ORFs were sequenced using degenerate and specific primers designed during this study. The sequence analysis of the above three ORFs allocated Cyp 1 in the *Ampelovirus* genus, in a group including five other grapevine leafroll-associated viruses. In a comparative analysis with comparable genes of the same GLRaVs species, Cyp 1 showed amino acids sequence homology ranging from 88% to 72% (HSP70) and 66% to 69% (CP and CPm). In experimental trials, Cyp 1 was transmitted by *P/anococcus ficus* from infected to healthy vines. In a small scale survey carried out on Mediterranean vines, Cyp 1 was detected by PCR in 5 out 120 vines tested.

Keywords: grapevine, leafroll disease, ampelovirus, HSP70, coat protein, *Planococcus ficus*.

472. KHAMIS Youssef Youssef Ahmed (*Egypt*)

Supervisor: A. Ippolito ; advisor: T. Yaseen

Title: Epidemiology and control of *Penicillium* rot of citrus and development of a molecular detection method for pathogen diagnosis. – 71 p.

Abstract: For a more rational utilization of alternative control means a better understanding of the epidemiology and the evaluation of different strategy of their application, is required. The population of *Penicillium* spp. on fruit surface fluctuated along the different control points of the packing line, with the highest value recorded during "bin emptying". In a first trial with postharvest application of salts and natural substances to control *Penicillium* decay of Clementine "Commune", sodium carbonate, sodium and potassium bicarbonate, calcium chloride and chitosan provided a significant reduction of rot as compared to the control. In a second trial conducted on Hernandina clementine and Valencia late, substances were applied simulating practical commercial conditions by spray before harvest, by dipping fruit after harvest and by the combination of the two treatments. In both varieties, preharvest application and the combination of preharvest and postharvest application were more effective than post harvest dipping; sodium and potassium carbonate and bicarbonate proved to be the salts with the highest activity in suppressing *Penicillium* rot. Partial sequencing of IGS regions of rDNA was obtained only for *P. digitatum* and *P. ulaiense*.

473. SEBAALY Claudine (Lebanon)

Supervisors: S. Pollastro and T. Yaseen

Title: Identification of critical points for *Phaeomoniella chlamydospora* infection of grapevine propagation materials in nursery. – 64 p.

Abstract: Esca is considered one of the most complexes grapevine diseases. the most observed fungi in young vineyards is *Phaeomoniella chlamydospora*. This study aimed at verifying the presence of pathogen in plant propagation material and identifying critical points in the production process of grapevine propagation material in nurseries. Nested-PCR was used to detect *P. chlamydospora* in 99 grafts and 200 cuttings. 99 and 519 grafted-cuttings before and after callusing. 319 grafted rootstocks. 98 and 150 water samples from 28 and 41 tanks used for pre-grafting and pre-callusing hydration. respectively; and 155 samples of plant debris from blades and benches of 39 grafting machines. In plant materials. an increase in the frequency of pathogen detection was observed during the production process: pathogen. no detected in grafts. was found in 1.5% of cuttings. 1 % and 5.4% of the grafted-cuttings before and after callusing. respectively; and in 57% of grafted rootstocks. Water samples, from pre-grafting and pre-callusing hydration tanks. Were contaminated with an incidence of 39% and 24%. respectively; 33% of debris samples. from grafting machines. were contaminated. Critical points (grafting. hydration and growth in the nursery) have been identified that should be investigated in deeper details and kept under appropriate control to prevent transmission of the disease in young vineyard.

Keywords: grafting machines, grapevine, hydration water, nested-PCR, *Phaeomoniella chlamydospora*, propagation materials.

474. DAWALIBI Victoria (Lebanon)

Supervisors: F. Nigro and A. M. D'Onghia

Title: Biological approaches to the control of olive *Verticillium* wilt in the nursery. – 60 p.

Abstract: *Trichoderma harzianum* Fv 178, *Clonostachys rosea* Fv114, *Bacillus licheniformis*, *B. subtilis* and two commercial products, based on a combination of these microorganisms, were used to evaluate their effect on vegetative parameters of olive plantlets and on the inoculum density of *Verticillium dahliae* microsclerotia in the soil mixture. The effects of organic amendments (Guanito and Ecos plus Guanito), alone or in combination with commercial bioproducts (Clonotri and Sublic) on plant growth and *V. dahliae* infection in grafted olive plantlets (cv Leccino) were also evaluated. Soil mixture was treated with a suspension of antagonists and inoculated with *V. dahliae* (microsclerotia or conidial suspension). A significant increase in plant height was observed with 1% Guanito treatment as compared to the untreated control and the fungibased commercial bioproduct. Moreover, Guanito and Sublic induced a significant reduction in microsclerotia inoculum density in the soil mixture compared to the untreated control and the fungal antagonists.

Keywords: *Olea europea* L., biological control, *Verticillium* wilt, nursery.

475. AFECHTAL Mohammed (Morocco)

Supervisor: F. Di Serio ; advisor: K. Djelouah

Title: Viruses and viroids of pome fruits in Morocco and characterization of pome fruit viroid isolates from Mediterranean area

Not available

476. KARORI Kaoutar (Morocco)

Supervisors: J. Wadjiny and P. Barberi ; advisors: J. Calabrese and M. Chrif Smaili

Title: Interaction between wild plants, arthropods and their natural enemies in citrus orchards in Morocco. – 61 p.

*Abstract: Of utmost important is to define strategies of plant management in order to allow a close interaction between IPM and IWM. The aim of this work was to investigate the relationship between pests, their natural enemies and wild plants in differently managed citrus orchards. The study was conducted in 6 citrus orchards in the Gharb area in Morocco. Plant species richness and entomological diversity were assessed in selected orchards. Results show that the wild plant species represent an important reservoir of diversified entomofauna. The entomofauna supported by wild plants gathers pests (*Aphis spp.*, *Myzus persicae*, *Panonychus citri*, *Tetranychus urticae*, and *Aleurodidae*), beneficials (*Euseius stipulatus*, *Adalia bipunctata*, *Aphidius spp.*, *Coccineffa septempunctata*, *Hippodamia variegata*, *Pseudophonus rufipes*, *Chrysoperfa* cam ea, *anthocoridae*, and *Episyrphus balteafus*) and neutrals (*Apis rneffifica*, *Lygaeidae*, *Reduviidae*, *Nitidulidae*, and *Carabidae*). It was therefore possible to make a preliminary assessment of the relationship between some key pests of citrus and wild plants.*

Keywords: citrus, interaction, IPM, IWM, natural enemies, pests, wild plants.

477. CHANAN Kamil (Syria)

Supervisors: M. Jamal, E. De Lillo ; advisor : A. M. D'Onghia

*Title: Biology, behaviour and control of the Leopard moth (*Zeuzera pyrina*) (*Lepidoptera: Cossidae*) in apple orchard in Syria. – 65 p.*

Abstract: The leopard moth infests several fruit, wood and ornamental plants distributed worldwide, including Syria. The objectives of the present work were to: i) compare the effectiveness of different attractive devices in adult capture, ii) ascertain the larval pest distribution on apple. The study was carried out in Sweida and in the countryside of Damascus provinces (Syria). As for trapping, the devices used greatly varied in terms of shape, size, and amount of pheromone and the traps were placed on the canopy. The leopard moth was monitored by pheromone traps for the first time in Syria, showing different results according to the device applied and the location. Bioplanet traps captured the highest amount of males thus proving to be, together with Isagro traps, more effective than light traps. Indeed, a significant difference was observed. Larval distribution and density matched the flight trend and size. In the highest sites a bi-annual cycle is suspected to occur, whereas assumedly, an annual cycle is completed in the lowest areas. Larval removal induced a considerable reduction in the infestation rate.

*Keywords: Syria, *Zeuzera pyrina*, Apple, pheromone traps.*

478. YAHIAOUI Dorsaf (*Tunisia*)

Supervisors: K. Djelouah, R. Addante ; advisor: R. Viti

Title: Monitoring of Citrus tristeza virus (CTV) aphid vectors in Apulia region and experimental trials on the transmissibility of Mediterranean CTV isolated by aphids

Abstract: The Mediterranean citrus industry is seriously threatened by the occurrence of *citrus tristeza virus* (CTV) and the presence of CTV vectors. In the present study, the aphid monitoring in the Apulian citrus groves proved the prevalence of *Aphis spiraecola* (45%) and *A. gossypii* (41.6%) over *Toxoptera aurantii* (12.8%) and other species (0.6%) including *Myzus persicae*. Further characterization of some Mediterranean isolates, maintained at the IAMB facilities, confirmed the great epitopic and genetic diversity with respect to the CTV strain composition and suggested the occurrence of severe infections. Experimental transmission trials using local aphid biotypes and Mediterranean isolates confirmed the low efficiency of *A. spiraecola* and *T. aurantii* in CTV transmission, in contrast to *A. gossypii* which could transmit a Syrian CTV isolate. The phylogenetic analysis of the target p25 gene sequence of the donor and recipient infected plants showed some slight specific changes in the nucleotide sequence which need to be further investigated.

Keywords: aphids, citrus, monitoring, tristeza, vector, Mediterranean.

479. JENDOUBI Hanen (*Tunisia*)

Supervisor: K. Lebdi, A. Russo ; advisor: A. M. D'Onghia

Title: Scale insect fauna on citrus in Tunisia and biological study of citrus mealybug *Panococcus citri* Risso. - 78 p.

Abstract: Scale insects, especially the citrus mealybug *Planococcus citri* (Risso), have recently become one of the most serious constraints for citrus production in Tunisia. Nonetheless, little is known about their distribution and the infestation degree. The aim of this study was to investigate the scale insect fauna and its distribution in most infested citrus groves of Cap Bon region, focusing on *P. citri* population dynamics and its beneficial insects. Eleven scale species belonging to four families were detected. Diaspididae was the most numerous family, comprising 46% of the detected species. *C. pseudomagnoliarum* proved to be a new species recorded in Tunisia. Scale species incidence and dispersal seemed to be significant. The highest density reached was 13 individuals/leaf. *P. citri* had 4 overlapping generations from March to August. The summer generations were the most dangerous ones. As for the male flight high capture levels (345 males/trap/week) were recorded. Nine parasitoids and two predators were detected. Survey should be continued in the whole governorate and in the new citrus-growing areas. Biological control assays for *P. citri* should be started.

Keywords. Tunisia, citrus, *Coccidea*, fauna, citrus mealybug, biological study.

480. KHOUJA Radhouane Hassine (*Tunisia*)

Supervisors: Mohamed Cherif ; Antonio Ippolito ; advisor: Anna Maria D'Onghia

Title: Study of dry root rot of citrus caused by *Fusarium* spp. in Tunisia. - 59 p.

Abstract: *Fusarium* spp. is commonly found in the soil of citrus orchards and in citrus nurseries. Symptomless infections can occur during seedling production in

the nursery and progress until plant production in the field, causing dry root rot. Since no chemical control is available, agronomic and biological control measures should be evaluated to prevent dry root rot incidence. Studies were carried out to assess *Fusarium* spp. population and its seasonal variation in Tunisian citrus nurseries. Monitoring was also carried out in field conditions to study the incidence of dry root rot in Tunisian orchards. Three *Fusarium* species were isolated from Tunisian citrus nurseries and identified as *F. solani*, *F. oxysporum* and *F. proliferatum*. *Fusarium* spp. population and the seasonal variation varied according to the variety, the season and the nursery management. A positive correlation ($r=0.74$) was observed between the pathogen population in the soil and the degree of feeder root infection. Specific symptoms of dry root rot were observed on very few citrus trees. The two biocontrol products evaluated (Clonotri and Sublic) and the organic fertilizer (Guanito) prevented the increase of *Fusarium* spp. population in the soil which can be conducive to feeder root infections. Clonotri was generally more effective than Sublic, but Guanito at doses higher than 1% reduced plant growth and root development.

Keywords: biological control, citrus, dry root rot, *Fusarium* spp., monitoring, seasonal variation.

IPM - A.Y. 2007-2008 (October session) – 506-519

506. ALI AROUS Samir (Algeria)

Supervisors: P. Barberi and R. Addante ; advisor: J. Calabrese

Title: Interactions between wild flora, crop, aphids and their natural enemies in citrus orchards. - 69 p.

Abstract: In order to study the relationships between wild flora, crops, aphids and their natural enemies in citrus orchards, a survey was carried out in some citrus orchards in the area of Bernalda, in the region of Basilicata, south Italy. Aphids and their natural enemies were sampled from citrus tree canopies and spontaneous plants in four citrus orchards differently managed (organic and conventional with and without herb layer), monthly and spontaneous plant surveys carried on four weed species (*Rumex crispus*, *Sonchus oleraceus*, *Euphorbia peplus* and *Vicia sp*) were reported as host of four non-pest aphids on citrus (*Myzus persicae*, *Aphis pisum*, *Hyperomyzus lactucae*, *Aphis rumicis*), serving as preys for natural enemies; at the same time, three aphid species (*Aphis spiraecola*, *Aphis gossypii*, *Aphis fabae*) and some aphid natural enemies were recorded on citrus canopies. The Statistical analysis study showed significant differences between the effect of organic and conventional management on the spontaneous plant species. Hence, this work is a further step towards the investigation of the interaction between plants, crop and arthropods in citrus orchards in the Mediterranean Basin.

Keywords: citrus, wildflora, aphids, Basilicata, natural enemies, survey.

507. MEZIANI Samia (Algeria)

Supervisors: M. Kheddam and K. Djelouah

Title: Assessment of the main stone fruits viruses and viroids in Algeria. - 51 p.

Abstract: A field survey was conducted to asses the sanitary status of stone fruit crops in the main stone fruit growing areas of Algeria. Serological assays were carried out to detect Plum pox virus (PPV), Prunus necrotic ring spot virus (PNRSV), Prune dwarf virus (PDV), Apple mosaic virus (ApMV) and Apple chlorotic leaf spot virus (ACLSV); moreover, tissue-print hybridization was performed to detect Peach latent mosaic viroid (PLMVd) and Hop stunt viroid (HSVd). Of the 741 tested trees (177 almonds, 82 apricots, 99 cherries, 241 peaches, 142 plums), none was infected with either PPV or ApMV, while 3.77% reacted positively to at least one virus. The highest infection rate was reported in variety collections and PNRSV was the most detected virus (2.16%), followed by ACLSV (1.08%) and PDV (0.54%). Almond was the most infected species (12,42%). Seven PNRSV isolates detected in the almond were serologically characterized and no variation of local isolates was observed. As for viroids, a high infection rate was recorded for HSVd (15.77%) and PLMVd (6.41%) and the highest infection rate was reported in mother blocks and on the peach cultivar "Montclar".

Keywords: Algeria, ELISA, tissue-print hybridization, stone fruits, viruses, viroids.

508. Abd Elmonim Ali Ahmad (Egypt)

Supervisors: N. S. Farag, A. A. Galal and R. Buonauro ; advisor: F. Valentini

Title: Occurrence of the olive knot disease in Egypt. - 61 p.

Field surveys were carried out in the main Egyptian olive growing regions to verify whether olive knot disease, caused by *Pseudomonas savastanoi* pv. *savastanoi*, was present and to determine its geographic distribution and incidence/severity. The presence of typical disease symptom i.e. knots on olive branches and trunk was observed in EI-fayoum region, with low disease incidence and severity. The isolation of the pathogen from the olive knots was difficult to perform due to the massive and constant presence of a bacterium overgrowing in vitro, which we identify as *Brevundimonas diminuta* on the basis of its 16S rDNA sequence. However, 4 bacterial isolates whose colonies resembling those of the pathogen were isolated from olive knots. Morphological, biochemical, physiological, pathogenicity and molecular tests, showed that Egyptian isolates belong to *P. savastanoi* pv. *savastanoi*. Molecular characterization of these isolates performed with rep-PCR demonstrated 97-100% of similarity with the pathovar reference strain LMG 2209T of *P. savastanoi* pv. *savastanoi*. This is the first report of olive knot disease in Egypt.

Keywords: Egypt, Olive knot, Pseudomonas savastanoi pv. *savastanoi*, rep-PCR.

509. ISMAIL Ahmed Mahmoud (Egypt)

Supervisors: F. Nigro and A. M. D'Onghia ; advisor: T. Yaseen

Title: Biological control of soil-borne diseases of olive in the nursery. - 58 p.

Abstract: The effects of different growing media (organic MAIB, organic MAIB-ECOS, conventional MAIB), alone or in combination with bio-products (Clonotri or Sublic), on vegetative parameters (plant height, plant weight and root weight) of olive plantlets (cv Leccino) and on *Verticillium dahliae* were evaluated. Olive plantlets grown in the uninoculated media showed a significant increase of all vegetative parameters. The two organic media significantly increased all vegetative parameters, but the best results were obtained using the organic MAIB-ECOS in combination with the bio-products. The organic MAIB medium induced a significant reduction of *V. dahliae* infection in the root and the soil. In the validation trials conducted in a commercial olive nursery, the organic MAIB-ECOS and the nursery soil mixture, amended with a bio-product, significantly reduced *Phytophthora* spp. inoculum density in both self rooted and grafted olive plantlets. The best plant height results were induced by the nursery soil mixture. Phytotoxic effects were observed on olive seedlings, at the first transplanting, with Sublic treatment.

Keywords: olive, Verticillium dahliae, Phytophthora spp., organic medium, *Trichoderma harzianum*, *Clonostachys rosea*, *Bacillus* spp., nursery.

510. SHERIF Mohammed Said Zaki (Egypt)

Supervisors: H. Fahmy and R. Milano

Title: Assessment of viruses, viroids and Spiroplasma citri infections in two Egyptian nurseries according to the management conditions to the management conditions and location. - 50 p.

Abstract: Two Egyptian citrus nurseries, selected for their location and different citrus budwood management, were considered as a case study to highlight the outstanding importance of nurseries in a citrus certification programme. Surveys were conducted in both nurseries for the presence of the main graft transmissible diseases (CTV, CIVV, CPsV, S. citri, CCEVd and CCaVd.) and in the surrounding orchards for the presence of the main vector-borne diseases (tristeza and stubborn). CTV was never reported from the two nurseries, while CIVV, CPsV and S. citri infections reached 4.16% of the tested material; moreover, viroid infection (CCaVd, CEVd) was considerably higher (18.33%). Comparing the results obtained in both nurseries, the management and origin of the plant material proved to be fundamental, since mother plants kept under the greenhouse were less infected (13.92%) than mother plants grown in the open field (30%). Certified and tested materials performed much better than the material of unknown origin, the latter representing 71.85% of the total infected material. Around the two nurseries, only one orchard was infected with CTV, whereas no S. citri was detected.

Keywords: citrus, dot blot hybridization, DTBIA, ELISA, graft-transmissible diseases, Egypt, nursery.

511. ABDUL RAHEEM Hasanein Yousif (Iraq)

Supervisors: F. Porcelli and I. Al Jboory ; advisor: A. M. D'Onghia

Title: Management of the red palm weevil, Rhynchophorus ferrugineus Olivier 1790 (Coleoptera curculionidae), in Italy a an introduction to its control in Iraq. - 68 p.

Abstract: The Red palm weevil (RPW), Rhynchophorus ferrugineus Olivier (1790), is a lethal pest of palms worldwide. In Italy, RPW severely damages Phoenix canariensis. Infested palms can recover if treated at an early stage of infestation. Therefore the aim of this study was to describe an IPM programme for RPW control by endotherapy as a safe measure in urban and periurban area. A new apparatus was developed to inject insecticides (Imidacloprid, Dimethoate and Fenthion) into the threes. The residue analysis was carried out to detect the presence of a.i. on the palm canopy. The palm water content was also a useful tool to determine the precise amount of insecticide needed. Imidacloprid and Dimethoate residues were detected in all replicates but Fenthion gave no residue at sampling time. The lethal dose for RPW is discussed. The IPM programme suggested to control RPW combines preventive and curative injections with pheromone traps to detect wide areas of RPW infestation.

Keywords: chemical control, introduced insect, Arecaceae, control cost, monitoring trapping.

512. BACHIR Balech (*Lebanon*)

Supervisors: C. Saccone and A. M. D'Onghia ; advisors: S. Vicario and M. Santamaria

Title: An integrated molecular and morphological study to design a DNA barcode discrimination protocol for Fusarium species involved in Dry root rot disease of citrus. - 81 p.

Abstract: Fusarium solani is always associated to dry root rot disease of citrus. However other species such as F. oxysporum and F. proliferatum are also found in citrus rhizosphere and diseased tissues. Unfortunately, the complex species determination process limits the scope of association studies. Fusarium morphological determination and molecular characterization based on ND6, COX1, tub-2 and tef1 were carried out in this study to set up a molecular identification protocol in a barcode framework. Bayesian phylogenetic analyses using MCMC were applied to construct consensus trees from dataset sequences based on the above markers. Results showed a low discrimination capacity for ND6 and COX1 markers; in contrast, tef1 and combined tef1+tub-2 proved to be good candidates for Fusarium DNA barcoding due to their ability to discriminate between the three tested species. Tub-2 could resolve intra-specific variation of F. solani and tef1 that of F. oxysporum. All the markers used could not give any ecological clustering relationship between root, soil and wood sample categories.

Keywords: citrus, Fusarium molecular identification, Fusarium barcoding, ND6, COX1, tub-2, tef1.

513. ABUKRAA Hatem (*Lybia*)

Supervisors: A. Kafu and K. Djelouah

Title: Monitoring of the main citrus graft-transmissible diseases in Libya and characterization of a local citrus tristeza virus source. - 50 p.

Abstract: Some Libyan citrus growing areas were surveyed to assess the presence of citrus graft-transmissible diseases. Two variety collections, six orchards, and four nurseries including mother blocks were selected and surveyed. Symptom observation, serological and molecular tests were used as a tool to monitor the main citrus graft transmissible diseases. During monitoring, symptoms associated to several specific diseases were observed, while 39 out of the 1440 surveyed trees reacted positively to CTV by DTBIA. CTV was found in three commercial orchards, one variety collection and one mother block; all the infected trees were sweet oranges. Serological and molecular characterization of selected CTV sources clustered the local isolate in the Mediterranean group, including the Algerian CTV isolate, 7 out of the 532 tested trees (1.3%) reacted positively to CPsV test, while 2 out of the 401 tested trees (0.49%) reacted positively to CIVV test. These findings represent the first report of the presence of CTV, CPsV, CIVV, S. citri in Libya by the use of laboratory tests and confirm their wide distribution in the most important Libyan citrus-growing areas.

Keywords: citrus, CTV, DTBIA, ELISA, graft-transmissible diseases, Lybia.

514. IKHRICHI Mohamed (Morocco)

Supervisor: A. M. D'Onghia ; advisors: S. Gualano and F. Santoro

Title: Development of the main citrus vegetation indices associated to citrus tristeza virus-infected trees using the ground-based sensor technique. - 98 p.

Abstract: In the Southern region of Apulia, the monitoring of Citrus tristeza virus is annually conducted where the virus outbreaks have been reported over the last 5 years. Therefore, it is necessary to promptly identify suspected infected trees on a large scale by the use of satellite imaging. To this aim, the vegetation indices of citrus trees, CTV-infected and CTV-free, was preliminary investigated in order to provide the tree spectral signature detected in the field by the HandHeld Post Dispersive Spectrometer. The study was carried out in 2 selected commercial groves (clementine and sweet orange) located in the CTV foci area, showing different infection rates. The trees were previously tested by serological (ELISA, DTBIA) and molecular (PCR) tools to assess the virus presence. The preliminary results highlighted a difference in the spectral signatures of CTV-infected and CTV-free trees, allowing a discrimination of the canopy stress level based on the vegetation indices (Chl NDI, WBNI, NDVI, mCAI, PRI) properly estimated. Further variation was recorded according to the species. In the light of these results, the use of vegetation indices for citrus trees could be suggested in combination with satellite imaging.

Keywords: Citrus tristeza virus, ELISA, DTBIA, PCR, ground-based sensors, spectral signature, reflectance, vegetation indices.

515. AL MANOUFI Adel (Syria)

Supervisor: M. Jamal, E. De Lillo and E. Marasco

Title: *Zeuzera pyrina* in apple orchards in Syria : trap application comparison and preliminary survey of its natural enemies. - 75 p.

Abstract: Leopard Moth *Zeuzera pyrina* (L.) (Lepidoptera: Cossidae) is considered a destructive borer in Syria, mainly on apple trees. Experiments were conducted to evaluate capture efficiency in relation to different types of traps. The analysis demonstrated that there was high significantly difference between the trap devices, and Capta trap gets the best results. At the same time, the occurrence of entomopathogenic fungi and nematodes was assessed in soil samples collected from different orchards habitats in southern Syria, included those utilized for trapping. Nematodes and fungi were isolated from soil samples by "baiting" with larvae of the Wax Moth, *Galleria mellonella* (Lepidoptera: Galleriidae). A total of 157 soil samples were collected from different orchard habitats during 2008. Two positive samples of entomopathogenic nematodes (1.27% occurrence) were identified as *Steinernema* spp., and 26 positive samples of entomopathogenic fungi (16.56% occurrence) were identified as *Beauveria* spp., *Paecilomyces* spp., *Aspergillus* spp. and *Nomurea riley*.

Keywords: Syria, apple tree, *Zeuzera pyrina*, trap devices, entomopathogenic nematodes, entomopathogenic fungi, occurrence.

516. HEINOUN Khaled Jamal (Syria)

Supervisor: T. El Beaino ; advisor: M. Digiaro

Title: Further molecular and biological characterization of fig leaf mottle-associated viruses (1 and 2), and mealybug-vector transmission. - 46 p.

Abstract: FLMaV-1 and FLMaV-2 are still two unclassified viruses in the family Closteroviridae. Cloning and sequencing of DOP and RT-PCR amplifications, identified additional genes, of which the CP and CPM classified FLMaV(1 and 2) as two Ampelovirus species. Both viruses, shared the same genome organization as LChV-2, where the CPM is upstream the HSP70, while the CP is downstream the HSP90 gene. Biological indexing of both viruses on several fig varieties for symptoms expression induced the same range of symptoms, and there was no definite difference in symptomatology. *P. ficus* succeeded to transmit FLMaV-1 to healthy fig materials, but not FLMaV-2. It seems that *P. ficus* is not the specific vector of FLMaV-2. Further sequence analysis showed that the fig plant (accession F4) hosted a putative new Closterovirus sharing the same symptomatology with FLMaV(1 and 2), for which the name of Fig leaf mottle-associated virus (FLMaV-3) is proposed.

Keywords: *Ficus carica*, FLMaV-1, FLMaV-2, DOP-PCR, Ampelovirus closterovirus.

517. ALABDALLA Nael (Syria)

Supervisors: M. Abu Ghorra and R. Buonauro ; advisor F. Valentini

Title: Incidence, distribution and characterization of *Pseudomonas savastanoi* pv. *savastanoi* in Syria and identification of tolerant-resistant olive varieties. - 67 p.

Abstract: Field surveys were carried out in the main Syrian olive growing regions to estimate the severity and incidence of the olive knot disease, caused by *P. savastanoi* pv. *savastanoi*. The highest disease incidence (68%) was recorded in the Coastal region, while the lowest (10%) in the South. Based on morphological, biochemical, and pathogenicity tests as well as on *iaaL* and *ptz* gene amplifications, we established that 105 bacterial isolates obtained from the disease samples belonged to *P. savastanoi* pv. *savastanoi*. When an arbitrary 92% similarity cut-off level was considered, cluster analysis revealed that 60 out of the 69 selected isolates submitted to ERIC-PCR were present in a big cluster, which included the reference strains LMG 2209^T, CFBP 6012 and CFBP 6013. The other 9 strains did not cluster with the outlier *Pseudomonad* strains included in the fingerprinting. Among the 14 major commercial olive cultivars used in Syria and tested in open-field experiments, Sourani was tolerant, while Al-Dou'aybli was the most susceptible one to two Syrian isolates of the pathogen.

Keywords: ERIC-PCR, *Olea europaea*, olive knot, *P. savastanoi* pv. *Savastanoi*, Syria.

518. EL AIR Manel (*Tunisia*)

Supervisors: A. Najar and M. Digiario

Title: Sanitary assessment of olive candidate clones for the certification program of plant propagation material in Tunisia. – 44 p.

Abstract: In order to start a certification programme of olive plant propagative material in Tunisia, a total of 174 olive samples of 19 different olive varieties were selected from two mother blocks at Sfax (IO) and manouba (ONH). These plants were checked by RT-PCR for the presence of Arabis mosaic virus (ArMV), Cherry leaf roll virus (CLRV), Cucumber mosaic virus (CMV), Olive latent ringspot virus (OLRSV), Olive latent virus 1 (OLV-1), Olive latent virus 2 (OLV-2), Olive leaf yellowing-associated virus (OLYaV) and Strawberry latent ringspot virus (SLRSV). DsRNA and mechanical transmission tests were applied to the PCR-negative samples. PCR results indicated that about 76% of the trees were infected, whereas visible bands were shown by 3 out of 30 samples in dsRNA analysis. This study allowed to identify at least one virus free or virus tested candidate clone of 14 different olive varieties that can represent the potential primary sources for the current certification programme in Tunisia.

Keywords: olive, certification, viruses, PCR, dsRNA, sanitary selection.

519. WAFA Rouissi (*Tunisia*)

Supervisors: M. Cherif and A. Ippolito ; advisor: T. Yaseen

Title: Penicillium rot on citrus fruit in Tunisia : epidemiology, control and molecular identification. - 64 p.

Abstract: At a time of increased public awareness about chemical treatments and development of fungicide resistance of post-harvest pathogen populations, the adoption of alternative control means seems to be essential. However, an effective way to reduce losses requires knowing the epidemiology and the complex interactions between host, pathogen and control agents. The results of the present study revealed that the population of *Penicillium* spp. on fruit surface and in the packinghouse atmosphere fluctuated along the packingline, reaching a peak at "bin emptying". In semi-commercial trials, organic and inorganic salts and natural substances were applied to Maltaise (postharvest treatment) and Valencia late (pre-harvest, post-harvest and their combination) fruits. On Valencia late, Na carbonate and Na bicarbonate were as effective as imazalil in reducing *Penicillium* rot and pathogen population on fruit surface. Pre-harvest spraying proved to be the best application strategy. *P. ulaiense* and *P. digitatum* identification was confirmed by the use of specific sets of primers, designed on IGS regions of rDNA.

Keywords: Valencia late, Maltaise, *Penicillium* rot, epiphytic population, alternative control means, molecular identification.

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547. MORTADA Christina (*Lebanon*)

Supervisor: T. El Beaino ; advisor: M. Digiario

Title: Further molecular characterization and production of polyclonal antisera for the fig mosaic virus. – 64 p.

Abstract: Three additional RNA segments (RNA4 to RNA6) of the Fig mosaic virus (FMV) multipartite genome were sequenced. These segments showed no homology with any other known viral protein in GenBank. Two polyclonal antisera (anti FMV-P2 and -P3) were obtained by using synthetic peptides designed on amino acid sequences encoded by RNA2 and RNA3 respectively. In Western blot (WB) these two antisera detected respectively a 73 kDa band, corresponding to the Glycoprotein, and a 35 kDa band, corresponding to the Nucleocapsid protein. A third polyclonal antiserum (anti-FMV-Ig), obtained by injecting purified virus preparations in rabbit, recognized both the above-mentioned proteins in WB. Anti-FMV-Ig and anti-FMV-P2 also decorated the typical Double membranes bodies (DMB) of FMV in electron microscopy. These results suggest to include the still unclassified viruses FMV, Pigeon pea sterility mosaic virus (PPSMV), Maize red stripe virus (MRSV) and European mountain ash ringspot-associated virus (EMARaV) in a new separated genus of the *Bunyaviridae* family.

Keywords: Fig (*Ficus carica*), Fig mosaic virus (FMV), double membranes bodies (DMB), polyclonal antisera, recombinant protein, ISEM, *Bunyaviridae* family.

548. FALLANAJ Frida (*Albania*)

Supervisor: M. Digiario ; advisor: T. El Beaino

Title: Complete genome characterization of grapevine Bulgarian latent virus (GBLV). – 41 p.

Abstract: The complete genome of a Serbian isolate of the *Grapevine Bulgarian latent virus* (GBLV) was determined. The viral genome is made up of two single-stranded RNA segments, 7451 nt (RNA1) and 5972 nt (RNA2) in length respectively. RNA1 has a single open reading frame (ORF) of 6374 nt encoding a polyprotein of 235 kDa. Its coding region shows significant amino acid homology with Blackcurrant reversion virus (BRV) (48%) and *Tomato ringspot virus* (ToRSV) (39%). GBLV-RNA2 contains a single ORF of 4691 nt encoding a polyprotein of 167 kDa, where the conserved motifs of the movement protein (MP) and coat protein (CP) have been identified. Both RNAs show the presence of polyadenylated untranslated regions (UTR) at their 3' termini. The amino acids sequence of the GBLV CP shows high homologies with *Blueberry leaf mottle virus* (BLMoV) (67%) and BRV (36%), two nepoviruses of the subgroup C. In this study, GBLV confirmed to be a distinct nepovirus species different from BLMoV.

Keywords: Grapevine Bulgarian latent virus; cloning and sequencing, genome organization, Nepoviruses.

549. AYOUB Fatima (Morocco)

Supervisors: A. Ricelli and T. Yaseen

Title: Table grapes and ochratoxin A contamination : an emerging issue. – 99 p.

*Abstract: This work is aimed at evaluating the susceptibility of three varieties of table grapes, i.e. Red Globe, Italia and Crimson Seedless, to the attack by the ochratoxigenic strains of *Aspergillus carbonarius* and *A. niger*, studying the correlation between ochratoxin A (OTA) production, resveratrol biosynthesis and lipoxygenase activity, and setting up a real-time PCR method for the quantification of the fungi under investigation. Experiments were performed during forty days of storage at 4°C. The HPLC analyses show that OTA was present in all samples, including those without visible symptoms at harvest. OTA content seems to be correlated with resveratrol concentration and lipoxygenase activity. Crimson Seedless variety presents the highest OTA contamination. The real-time PCR analyses allow the quantification of OTA-producing fungi even in unrotten grapes. These results underline the need to establish a legal limit of OTA contamination in table grapes and to define a "quality label" in order to improve consumer safety.*

Keywords: table grapes, ochratoxin A, resveratrol, lipoxygenase, real-time PCR.

550. CALIĆ Irina (Serbia)

Supervisors: F. Porcelli, I. Al Jboory and A. M. D'Onghia

*Title: Key factors in the preventive and curative control of *Rhynchophorus ferrugineus* Oliver on *Phoenix canariensis* Hort ex. Chabaud. – 63 p.*

*Abstract: The Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* Olivier (1790), is the most dangerous pest of palms in the Mediterranean basin where it has a lethal impact on the growth of palms. This study presents the key factors in the preventive and curative chemical control. The larval feeding behaviour is reported together with the calculation of the larval feeding volume seen as indicator of the daily quantity of food required by larvae. These results are useful to calculate the proper lethal dose in the chemical larval control by tree injection. The palm water content was also measured to calculate the dilution factor of the insecticide to inject into the trunk. Water flow and water pressure were observed while it exits from tourniquet. In Italy, RPW control via trunk injection is a promising modality of insecticide distribution in palms.*

*Keywords: *Rhynchophorus ferrugineus*, larval feeding volume, chemical control, water pressure; palm water content.*

551. DEGHICHE-DIAB Nassima (Algeria)

Supervisors: F. Porcelli, M. Belhamra and N. Saouli

Title: Inventory of insects in the oases of Ziban (Biskra, Algeria). – 82 p.

*Abstract: An inventory was carried out in five stations in the oases of Ziban, characterized by the high quality of their dates, in order to study the relationships between the oasis ecosystem and insect fauna inhabiting it. Specimens were sampled through pitfall traps made with half plastic bottles containing Ethylene preservative solutions. A total of 115 species were collected, during 5 months of survey, belonging to 61 families and 17 orders in different classes: 12 falling into *Insecta*, 3 into *Arachnida*, one into *Chilopoda* and one into *Isopoda*. The most represented insect orders are *Coleoptera* (44.42%), *Hymenoptera* (20.86%) and the *Lepidoptera* (7.87%), all in the 3 major ecological groups of phytophagous*

(48.98%), zoophagous (26.75%) and omnivorous (24.26%) insects. Among the most important beneficial zoophagans collected in our oasis ecosystem, there are predators (*Coleoptera*) and parasitoids useful in the biocontrol of *Diptera* or *Hymenoptera*. Despite the large number of species collected and the relationship existing between the various ecological groups, our study is just the first step in the description of the oasis entomofauna.

Keywords: ecosystem, insects, oases of Ziban, inventory, ecological groups.

552. SERMANI Samer (Syria)

Supervisor: K. Djelouah ; **advisor** R. Milano

Title: Improvement of biological indexing for the detection of the main stone fruit viruses. – 40 p.

Abstract: Biological indexing on woody indicator plants remains compulsory in most of the certification programmes of plant propagation material. The high cost due to the management and conservation and the time needed to produce indicator plants and observe induced symptoms are the main limiting factors to this technique. This study is aimed at setting up a reliable, rapid and low-cost method for biological indexing in order to detect the main stone fruit viruses (PPV, PNRSV, PDV, ApMV) on inoculated *Prunus persica* cv. GF305 stem cuttings instead of seedlings. Due to their earlier and easier rooting, fresh cuttings were preferred to stored cuttings. Anyway, stored cuttings proved to increase their rooting capacity after being treated with 2000 ppm IBA (hormone treatment). Symptoms induced in inoculated stem cuttings appeared earlier than the ones appearing in seedlings. The results obtained were all confirmed by serological (ELISA test) and molecular (PCR) techniques.

Keywords: stone fruits, virus, biological indexing, stem cuttings, GF 305, IBA, ELISA, PCR.

553. AHMED Yosra (Egypt)

Supervisors: H. El-Shimi, A. Ippolito and A. M. D'Onghia

Title: Etiology, epidemiology and biological control of *Phytophthora* and *Fusarium* root rot in Egyptian citrus nurseries. – 101 p.

Abstract: *Phytophthora* and *Fusarium* root rot diseases in citrus are considered the most destructive diseases to citrus production in Egypt. The aim of this work was to monitor the seasonal variation of *Phytophthora* spp. and *Fusarium* spp. in soil and feeder roots in two Egyptian citrus nurseries and to test the effect of two bio-products, BioArc and Clonotri, in addition to an organic soil amendment, Guanito. The results showed the presence of different species of *Phytophthora* and *Fusarium* isolated in both soil and feeder roots. According to morphological and molecular identification, *Phytophthora nicotianae* was the predominant species, followed by *P. citrophthora*; *P. palmivora* was occasionally found. Among *Fusarium* species, *F. solani*, *F. oxysporum*, and *F. proliferatum* were identified. Population of *Phytophthora* spp. and *Fusarium* spp. varied according to the season, the rootstock (sour orange and Volkameriana lemon), environmental conditions, and nursery management. The tested bio-products induced significant increase in plant growth parameters and reduced pathogen population in soil. The positive effect of both bio-products was further enhanced when applied in combination with Guanito at 1 %.

Keywords: Citrus, *Phytophthora* spp., *Fusarium* spp., monitoring, seasonal variation, biological control, Guanito, BioArc, clonotri.

554. HUSSEIN Ahmed (Egypt)

Supervisors: C. Saccone and A. M. D'Onghia ; **advisors:** S. Vicario and T. Yaseen

Title: Phenotypic pathogenicity characters of *Fusarium* spp. On citrus and correlation with phylogenetic effect. – 74 p.

Abstract: Many *Fusarium* spp. have been associated to citrus dry root rot, but their identification is problematic. The aim of this work was to study the phylogenetic effect on pathogenicity characters of *Fusarium oxysporum* and *F. solani* strains grouped according to the position of the sequences of β -tubulin and elongation factor 1- α . Three trials were carried out on Carrizo citrange plants. Wilting symptoms were assessed as the effect of *Fusarium* culture filtrate. During in vitro and in vivo trials, the ability of the pathogen to induce host alterations and colonize host tissues was evaluated on inoculated plantlets. The phylogenetic signal and correlations between characters were estimated using the contrast method. Results highlighted the significant correlation between phytotoxic excretions and other characters, which could help using strains phytotoxic excretions as a simple method to assess the *Fusarium* strains aggressiveness. This study also revealed the considerable variations of severity among *Fusarium* strains and the stronger aggressiveness of *F. oxysporum* isolates. No significant phylogenetic signal was detected, thus implying the fast evolution of the aggressiveness.

Keywords: citrus, *F. solani*, *F. oxysporum*, pathogenicity, phylogenetic signal.

555. YAICH Malika (Morocco)

Supervisors: M. Fatmi and G. Cirvilleri ; **advisor:** F. Valentini

Title: Fire blight disease in Morocco (*Erwinia amylovora* (Burrill) Winslow). Geographical distribution and characterization of Moroccan isolates. – 89 p.

Abstract: This study was carried out in 2009 in the main pome fruit-growing areas in Morocco to evaluate the current situation of the fire blight disease by *Erwinia amylovora* in the country, particularly in the El Hajeb region, where important losses due to this pathogen were recorded. Samples showing symptoms associated to the disease were collected from affected apple (*Malus domestica*), pear (*Pyrus communis*) and quince (*Cydonia oblonga*) trees and processed for the isolation and purification of the causal agent. Other isolates collected in the period 2006 - 2008 were also included in this assay. All isolates were identified at the genus and species level using morphological, biochemical and serological tests. Confirmation tests were carried out using classical PCR and Real Time PCR. 48 isolates were confirmed to belong to *E. amylovora* species and fingerprinting methods (rep-PCR and fAFLP) were executed to further characterize these isolates. This study allowed the assumption of the multiple geographical origins of these isolates.

Keywords: *Erwinia amylovora*, fire blight, fingerprinting, Rep-PCR, fAFLP, Morocco.

556. AL-ABDALLAH Osama (Palestine)

Supervisor: M. Digiario ; **advisors** T. El Beaino and F. Valentini

Title: Sanitary assessment of olive varieties in a collection plot at the University of Perugia (Italy). – 49 p.

Abstract: A survey was carried out for assessing the sanitary status of olive plants in a collection plot at the University Perugia (Italy). A total of 95 olive samples were tested by RT-PCR to check for the presence of *Arabis mosaic virus* (Ar-MV), *Cherry leaf roll virus* (CLRV), *Cucumber mosaic virus* (CMV), *Olive leaf yellowing associated virus* (OLYaV), *Olive latent ringspot virus* (OLRSV), *Olive latent virus-1* (OLV-1), *Olive latent virus-2* (OLV-2), and *Strawberry latent ringspot virus* (SLRSV). About 83% of plants were infected by at least one virus. All tested viruses were present, with the prevalence of CMV and OLRSV (more than 30% of infection). DsRNA and mechanical transmission tests were applied to all PCR-negative samples. Eight out of 17 samples showed different dsRNA patterns, thus suggesting the presence of infection by viruses other than those previously checked by PCR. This study allowed to identify 9 *virus free* and 39 *virus tested* candidate clones potentially useful as mother plants to be used in certification programmes.

Keywords: olive, sanitary status, RT-PCR, dsRNA, certification programme, Italy

557. MKAOUAR Rim (*Tunisia*)

Supervisors: K. Lebdi and A. Russo ; **advisors:** P. Suma and K. Djelouah

Title: Scale insect fauna of olive in Tunisia. – 56 p.

Abstract: Field surveys of scale insect fauna on olive trees in northern Tunisia were carried out in 2009 showing the presence of six species mainly: two belong to the *Coccidae* family, three to *Diaspididae* and only one to *Pseudococcidae*. The analysis results show that *Saissetia oleae* is the dominant species and, in the northern-eastern area under investigation, it is responsible for high levels of damage to the cultivations. By contrast, in the northern-western part of the country, *Peliococcus cycliger* is the most common species with mainly a low population density. Moreover, *Parlatoria oleae*, *Aspidiotus nerii*, *Lepidosaphes fava*, and *Phillipia follicularis* do not have a significant economic importance in spite of their abundance. Monitoring the auxiliary fauna reported the presence of the moth *Eublemma scitula* and of *Chilocorus bipustulatus*, occasional predators of soft scales. Many parasitoids attack the olive black scale; the species collected from the majority of the sites are *Scutellista cyanea* and *Metaphycus spp.* to be considered important parasitoids of *S. oleae*.

Keywords: olive, scale insects, parasitoids, predators, Tunisia.

558. ONDERCI Rukiye (*Turkey*)

Supervisors: S. Baloglu and K. Djelouah

Title: Survey of the main citrus graft-transmissible diseases in the Eastern Mediterranean region of Turkey. – 56 p.

Abstract: Seven commercial orchards and one nursery for budwood production, located in three Turkish citrus-growing areas, were selected and surveyed. Symptom observation, serological and molecular tests were used as tool to monitor the main graft-transmissible diseases. Out of the 455 surveyed citrus trees, three sweet oranges positively reacted to CTV. CTV infection was reported only in commercial orchards located in Mersin. The sequence analysis of the partial CP gene clustered the local isolate in a group including several Mediterranean CTV strains. The highest infection rate (46.6%) was reported on the viroid-infected trees, while the other pathogens were less distributed, reaching an infection rate of 12.5% and 3.5% for *Spiroplasma citri* and CIVV respectively. No CPsV infected tree was detected. The Turkish CIVV isolate showed a high serological variability in

comparison with other Mediterranean CIVV isolates. These findings confirmed the presence and wide distribution of CTV, CIVV, *S. citri*, CEVd and CCaVd in Turkey.

Keywords: citrus, DTBIA, ELISA, dot blot hybridization, graft-transmissible diseases, Turkey.

559. SALLEH Wided (*Tunisia*)

Supervisors: N. Mahfoudhi and K. Djelouah

Title: Sanitary assessment of stone and pome fruit candidate clones in the framework of the Tunisian certification programme of plant propagating material. – 85 p.

Abstract: In order to start a certification programme for fruit trees in Tunisia, a total of 915 samples of stone and pome fruits were selected. These plants were tested by ELISA for the presence of PPV, PNRSV, PDV, ACLSV, ApMV and ASGV. The most infected species were almond (44.7%) and peach (43.9%), and pear infections (10.2%) were higher than apple. All viruses were detected, with the exception of PPV and ASGV, with dominance of PNRSV (17.9%) followed by PDV (8%). Concerning the viroid diagnosis, the applied tissue print hybridization technique indicated that peach was the only species being infected with PLMVd and HSVd whereas no pome fruit viroids were detected. Moreover, the diagnosis of APLPV and PBNSPav by PCR was executed because of new findings in the Mediterranean areas. Nested PCR tests allowed detecting a few phytoplasma infections. This study allowed the identification of at least 2 virus-tested candidate clones of different varieties of stone and pome fruits that can be used as primary sources for the current certification programme in Tunisia.

Keywords: stone fruit, certification, sanitary selection, viruses, viroids, RT-PCR.

560. BOUNEB Mabrouk (*Tunisia*)

Supervisor: A. M. D'Onghia ; *advisors:* S. Gualano and F. Santoro

Title: The potential of spectroradiometry and multispectral satellite imagery for the assessment of citrus tristeza infection. – 63 p.

Abstract: Monitoring Citrus tristeza virus (CTV) is important for preventing the development of disease outbreaks. Remote sensing proved to be able to early identify areas suspected to be infected. To evaluate the feasibility of detecting tristeza in orchards, a preliminary trial was conducted in greenhouse by collecting leaf spectral signatures from CTV-free and CTV-infected Mexican limes grafted onto a tolerant rootstock. The spectral reflectance of CTV-infected plants was higher in the visible region and lower in the near-infrared region. Better results were obtained by measuring leaf and canopy spectral reflectance of infected and uninfected orange trees in four Apulian orchards located in CTV-contaminated areas. Based on these results, a satellite image, acquired during the period of field data collection, was implemented through an algorithm based on specific vegetation indices. The elaborated image allowed the assessment of different rates of correlation with canopy stress: 98% in severe declining trees; 80% in chlorotic trees; and 58% in trees showing a mild chlorosis or being apparently symptomless.

Keywords: citrus, CTV monitoring, remote sensing, reflectance, satellite image.

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588. LEKIKOT Karim (*Algeria*)

Supervisors: T. El Beaino, H. Sahraoui ; advisor: D. Frasheri

Title: Screening of viral diseases for the evaluation of the sanitary status of grapevine in Algeria. – 67 p.

Abstract: In order to start a certification programme of grapevine propagating material in Algeria, a total of 736 woody samples were collected from 5 ITAFV collection plots (Skikda, Tassala El Merdja, Medea, Tighennif, Ain Temouchent) and 1 nursery (Blida), on which the presence of virus and virus-like diseases was investigated. Based on ELISA test results, GLRaV-3 proved to be the most widespread virus (51%), followed by GFkV (37.8%), GFLV (30.7%), GVA (18.3%), GLRaV-1 (7.9%), GLRaV-2 (7.5%), GVB (2.7%) and ArMV (1.8%). RT-PCR did not show the presence of additional closterovirus infections whereas the RSPaV infection rate in 76 tested samples was equal to 41.8 %. No viral infection was reported from any inoculated herbaceous hosts or any grafted indicators plants. This study allowed to obtain 39 samples, representing 8 varieties and 4 types of rootstocks, negative to all grapevine viruses, which could be considered as putative candidate clones for the current certification programme in Algeria.

Keywords: Algeria, grapevine, viruses, ELISA, RT-PCR, mechanical transmission and indexing.

589. BOULEKBACHE-MEHENNI Malika (*Algeria*)

Supervisors: M. Mokrane, K. Djelouah ; advisor: D. Frasheri

Title: Preliminary sanitary assessment of citrus candidate clones for the Algerian certification program of plant propagating material. - 57 p.

Abstract: A field survey was conducted to assess the sanitary status of citrus trees in the main groves producing propagating material in Algeria in the framework of the Algerian certification programme. One varietal collection (Boufarik), two budwood stocks (Skikda, Guelma) and a greenhouse (Algiers) including mother blocks were selected and surveyed. Besides symptom observation, serological, molecular and biological tests were applied as a tool to monitor the main citrus graft transmissible diseases. Furthermore, of the 1583 citrus trees surveyed, 37 reacted positively to CTV when DTBIA test was performed. CTV was found in the varietal collection and budwood stock of Skikda and it mainly affected the most widespread varieties such as Sweet orange and mandarin. 28 out of the 502 tested trees (5,57%) reacted positively to CPsV test, followed by CIVV (4,45% rate infection). Multiplex RT-PCR was performed to detect CEVd, HSVd, CBLVd, CVdIII and CVd IV; a high infection rate was recorded for HSVd (52,6%) and reported in all budwood sources. These findings represent the first report of the presence of HSVd and CVd III in Algeria by the use of laboratory tests. In many of the surveyed trees, stubborn associated symptoms were observed in the monitored areas whereas the presence of *S. citri* was not confirmed by serological testing.

Keywords: Algeria, certification, Citrus, CTV, CVd III, graft transmissible disease, HSVd, multiplex RT-PCR.

590. HASSAN Amira (Egypt)

Supervisors: A. M. D'Onghia, S. Gualano ; advisor: F. Santoro

*Title: Spectral discrimination of palms (*Phoenix canariensis*) infested by the red palm weevil (*Rhynchophorus ferrugineus* Olivier, 1790) and palm localization by aerial photo-interpretation. - 54 p.*

Abstract: Phoenix canariensis palms are of great ornamental importance in the Mediterranean but they are treated to death by the Red Palm Weevil, which is now largely spread in the region. Large scale pest monitoring by remote sensing and preventive control measures by chemical endotherapy are highly desired. A preliminary spectral discrimination, which was conducted in palms at 'Fiera del Levante' in Bari, was achieved as (i) male and female individuals at all wavelength ranges, due to the orange cluster color in females; (ii) infested and non infested palms at the 'plateau range' only in palms of the same sex and severely damaged. The efficacy of the 2006 endotherapy treatment on IAMB palms in Valenzano was assessed by photo-interpretation on RGB image of 2006 which was compared to visual inspections in 2010. The total number of missing palms was fifty-one, whereas twenty-three were the infested palms.

Keywords: Rhynchophorus ferrugineus Oliv., Phoenix canariensis, spectral signatures, aerial photo-interpretation, endotherapy.

591. DIDA Lumta (Kosovo)

Supervisors: M. Digiario, V. Elicio ; advisor: D. Frasheri

Title: Sanitary status of grapevine in Kosovo and setting up of a Multiplex ELISA for the simultaneous detection of grapevine viruses. - 51 p.

Abstract: Field surveys were carried out in the main grapevine growing areas of Kosovo to assess the incidence of virus diseases. A total of 174 out of 276 (63.5%) ELISA tested vines were infected with at least one virus. GFKV was the prevailing virus (52.5%), followed by GLRaV-3 (17.1%), GLRaV-1 (13.5%) and GVA (11.3%), while the other viruses tested (GLRaV-2, GVB and GFLV) were scarcely present (from 0.4% to 1.8%) or completely absent (ArMV). In RT-PCR, GRSPaV was detected in 80% of the vines, while clear-cut bands amplified in 16 out of 46 ELISA-negative samples by using degenerate primers for closteroviruses. This study allowed to identify at least one virus-tested candidate clone of 18 different grapevine varieties, that can represent potential primary sources for the certification programme in Kosovo. The Multiplex ELISA procedure adopted in this study showed comparable results in terms of sensitivity with those obtained by traditional ELISA using single antibody kits, but with the advantage to allow reducing the test time and costs.

Keywords: Kosovo, grapevine, ELISA, RT-PCR, multiplex ELISA.

592. NASSAR Elsy Elias (Lebanon)

Supervisors: E. Choueiri, F. Di Serio, K. Djelouah

Title: Assessment of pome fruit viruses and viroids in Lebanon and characterization of the local isolates of Apple dimple fruit viroid (ADFVd). - 54 p.

Abstract: In order to detect 4 Viruses (ACLSV, ApMV, ASPV and ASGV) and 3 Viroids (ASSVd, ADFVd and PBCVd) on Apple, Pear and Quince in Lebanon, a combination of biological (Woody indexing and Mechanical inoculation), serological (ELISA) and molecular (Tissue printing hybridization and RT-PCR) assays was used.

Two preliminary results were determined: ACLSV, ASPV and ASGV were present in apple trees with an infection rate equal to 27.2% whereas ACLSV was found on pear trees with a 1.1% infection rate. No infection was reported on Quince. ACLSV was the most predominant virus (15.8%) followed by ASPV (13.2%) and ASGV (2.6%) while no ApMV infection was reported. In contrast, tissue printing of apple samples indicated an infection rate of 5.8% only when hybridized with ADFVd probe. RT-PCR testing confirmed the first natural and asymptomatic ADFVd infection of cv. "Golden Delicious". Furthermore, molecular characterization of three ADFVd local isolates was carried out.

Keywords: Lebanon, pome fruits, ACLSV, ApMV, ASPV, ASGV, ASSVd, ADFVd, PBCVd, Golden Delicious.

593. BROUZIYNE Youssef (Morocco)

Supervisors: G. Siscaro, A. Mazih ; advisor: K. Djelouah

Title: Studies on citrus fruit scars in Morocco: Monitoring and field evaluations. – 42 p.

Abstract: Fruit scarring represents a serious economic downgrading factor of citrus production in Morocco; many hypotheses have been proposed by technicians and researchers about the precise causes of this damage. The aim of the present study was to acquire preliminary data on the main agents inducing citrus fruit scarring in one of the biggest growing regions in Morocco (Gharb region) on two common varieties. As a result, during March-September 2010, four plots of "Maroc late" and "Marisol" were selected according to the wind protection level (presence or lack of windbreaks); then climatic conditions and citrus plant phenology were monitored; arthropod pests, especially thrips, were also monitored by means of different methodologies. The occurrence of high speed wind during petal fall and consequently, the low level of wind protection were found to be the major scarring factors followed by the presence of some biotic agents (especially thrips). Maroc late proved to be more susceptible than Marisol. During the field surveys *Pezothrips kellyanus* and *Frankliniella occidentalis* were the predominant thrips; specimens belonging to the genera *Megalurothrips*, *Thrips* and *Aeolothrips* were reported as well.

Keywords: Surveys, Morocco, fruits scars, windbreak, thrips, Maroc late, Marisol.

594. FRAIHA Houda (**Morocco**)

Supervisors: A. Ricelli, T. Yaseen

Title: Molecular identification of black Aspergilli and occurrence of Ochratoxin A in table grapes. – 98 p.

Abstract: The objective of this study was to assess the frequency of ochratoxin A (OTA) producer strains of *A. carbonarius* and *A. niger* in some table grapes varieties from Apulia region (Victoria, Michele Palieri and Italia) and to investigate the presence of OTA in asymptomatic grapes. An amount of 55 black Aspergilli isolates from grape berries were identified by PCR. The results showed that about 40% of the collected isolates were OTA producers, most of them were *A. carbonarius* (63%) and *A. niger* (27%). OTA contamination was also assessed for asymptomatic berries by using HPLC coupled with Mass Spectrometry and a possible OTA translocation was hypothesized probably due to a passive translocation from contaminated grapes or to a transport in which plant tissues are involved. The amount of OTA contamination seems to be correlated with sugar content of berries, which is in turn correlated with the variety and climatic conditions. Hopefully, these results might contribute to assess a tolerable limit for OTA contamination in table grapes in order to protect consumer health.

Keywords: Ochratoxin A, table grapes, *A. carbonarius*, *A. niger*, PCR, HPLC, translocation.

595. MOHAMMED ALKADOUR Zilal (**Syria**)

Supervisors: M. El Bouhssini, F. Porcelli ; advisor: A. M. D'Onghia

Title: Tree injection in Date Palm (*Phoenix dactylifera* L.) as means to control the RPW (*Rhynchophorus ferrugineus* Olivier, 1790). – 79 p.

Abstract: The Red Palm Weevil (RPW) is the key pest of date palm, *Phoenix dactylifera* L.: the most important fruit crop in the Middle East. Today *R. ferrugineus* is seriously damaging date palm in the coastal area of Syria. Conventional RPW chemical control by pesticides is in general protective but very pollutant on the environment while wide-area mass trapping proved to be ineffective against the weevil. The aim of this research was to test chemical control by tree injection in order to preserve palms without polluting the environment. Two active ingredients, namely Dimethoate and Thiametoxam, were injected into the trees in a dosage based on palm water content. Results show that Dimethoate protects the palm trees up to 30 days while Thiametoxam is still active up to 70 days. The two active ingredients behave differently in the plant and this behavior is discussed. Tree injection is an interesting means to control RPW protecting date palm in Syria, given the results already provided by this technique on *Phoenix canariensis* in Italy and Malta.

Keywords: Near East Insect Pests, Aleppo, Lattakia, urban palms, actara, Rogor Neonicotinoids and organophosphate insecticide.

596. ABDELLATIF Emna (Tunisia)

Supervisors: J. Janse, S. Chebil, F. Valentini

Title: Occurrence of crown gall in grapevine (*Vitis vinifera*) in Tunisia and characterisation of Tunisian *Agrobacterium vitis* and *A. tumefaciens* strains in comparison with strains of different origin. – 76 p.

Abstract: The aim of this work was to investigate the occurrence of crown gall disease in Tunisian vineyards and to describe the isolation and characterization of different *Agrobacterium* species and biovars. The bacterial isolates characterized came mainly from crown gall-infected grapevines in Tunisia. Crown gall was detected in several vineyards in the Northern and Central regions, but with a low incidence. Morphological, biochemical and molecular assays were conducted to identify *Agrobacterium* isolates. A collection of 380 isolates was obtained from diseased vines and rhizospheric soils. Eighty isolates were chosen as representative of the collection for further analysis. Following the growth on three different semi-selective media and some biochemical tests, the isolates were separated into three groups corresponding to biovars 1, 2, and 3. Molecular analysis by BOX1AR primers revealed that fifteen isolates were identified as *A. tumefaciens* and four as *A. vitis*. *RecA* allele analysis of some *A. tumefaciens* strains showed the presence of three different genomic groups (G1, G4 and G7). Four virulent strains were detected by *vir*-PCR. Two of these strains showed to be tumorigenic on tomato and tobacco indicator plants.

Keywords: Crown gall, grape, *Vitis vinifera*, *Agrobacterium vitis*, *Agrobacterium tumefaciens*, Tunisia.

597. INCE Suleyman Sahin (Turkey)

Supervisor: F. Porcelli ; advisors: F. Valentini, F. Santoro

Title: Egg laying and egg laying behaviour of the Red Palm Weevil (*Rhynchophorus ferrugineus* Olivier, 1790) (*Coleoptera: Curculionoidea*). – 67 p.

Abstract: Red Palm Weevil is the main pest of palms worldwide. Various studies were conducted to probe into the life cycle and behavior of RPW but some key points in egg laying behavior still remain obscure. The purpose of this study was to investigate egg-laying timing by the number of egg/day/female, the time lapse between egg laying events and the female bio-ethological needs while ovipositing. Hence, the behavior of more than 60 insects was recorded by 12 PC-driven video cameras equipped with natural bright and artificial IR light source. RPW was bred and allowed to lay eggs on *Phoenix canariensis* Hort. Ex Chabaud petiole. This study shows that the number of eggs per day is variable according to time and female age and the average number of eggs per event is 4.13. Moreover, egg laying timing and the time of deposition are quite variable while eggs can be laid at anytime on the day and night. The average egg-laying time was 54.52 sec. Finally, the observations made reveal that females fly, feed and mate during the egg laying event.

Keywords: Date palm pest, *Phoenix canariensis*, urban ornamental plants.

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618. BOZIC Jovana (Bosnia)

Supervisor: F. Porcelli ; advisors: F. Valentini, F. Santoro

*Title: Red Palm Weevil (*Rhynchophorus ferrugineus* Olivier, 1790) (Coleoptera: Curculionoidea) egg-laying: repellence of injected palms and their use as trap-plants. – 63 p.*

*Abstract: Imidacloprid tree injection can be effective to control *Rhynchophorus ferrugineus* (Olivier, 1790) (RPW). This means of control raises doubts about its potential repellence at egg-laying since females reject treated plants. Repellence was assessed by a behavioural study carried out to propose the potential use of injected palms as trap-plants. Data were collected by observing adult pairs acting on treated (three months and 14 DAT) vs untreated palm leaf midribs, processed by a computer-based time lapse recording system and evaluated by means of T-test and ANOVA. Our examination on Imidacloprid repellence gave overall negative results. We can propose tree injection on asymptomatic palms to control RPW by attract and kill. This perspective should be considered as an effective preventive chemical control strategy of *R. ferrugineus*. Trap-plants and tree surgery are two methodologies of the IPM strategy to control pest population in wide areas while preserving the plants from pest damages.*

Keywords: Phoenix canariensis, ornamental palms, behavioral study.

619. ABDALLAH Ali Mohammed Ali (Egypt)

Supervisors: T. El Beaino, A. Shalaby ; advisor: S. Youssef

Title: Investigation on fig-infecting viruses in Egypt and development of a Real-time RT-PCR (TaqMan) for their detection. – 42 p.

Abstract: An account is given on the prevalence of fig-infecting viruses in Egypt. RT-PCR assays were conducted on 100 fig samples collected from three main fig varieties distributed in five Egyptian fig-growing provinces. The infection rates of Fig leaf mottle-associated virus 1 (FLMaV-1), Fig leaf mottle-associated virus 2 (FLMaV-2), Fig mild mottle-associated virus (FMMaV), Fig mosaic virus (FMV), Fig cryptic virus (FCV), Fig latent virus 1 (FLV-1) and Fig fleck-associated virus (FFkAV) were 14%, 32%, 4%, 62%, 7%, 30%, and 59%, respectively. FMV was the most widespread virus found. During this study, a Real-time RT-PCR (TaqMan) was developed and found to be a reliable technique to detect single and multiple infections of fig viruses. This technique proved to be more sensitive than the conventional RT-PCR and a first choice methodology when dealing with large numbers of samples. Eventually, by analyzing the different extent of infections by different viruses, fig mosaic disease was also observed in FMV-free mosaic-diseased plants. Accordingly, it is highly presumable that a complex of viral infections can induce mosaic disease symptoms.

Keywords: Egypt, Ficus carica, viruses, detection, RT-PCR, Real-time RT-PCR, mosaic disease.

620. KAMEL Mohamed Abdallah Mohamed (Egypt)

Supervisors: S.M. Abdel-Monem, T. Yaseen ; advisors: A. Salama, F. Valentini

Title: Assessment of the pathological status of Mango in Egypt focusing on fungal and bacterial diseases. – 65 p.

Abstract: In the last five years, the mango harvested area increased from 40,000 Ha in 2005 to 125,000 ha in 2009, but the production per hectare dropped. This led us to carry out this study in order to search for the reasons by monitoring all diseases and causal agents that attack mango. This work aims to evaluate the sanitary status of mango in Egypt focusing on fungal and bacterial diseases, and morphologically and molecularly identify the collected pathogen. Furthermore, we wanted to assess the disease incidence and severity. This work is the first organized survey covering more than 6 governorates in Egypt. The obtained results confirmed what we supposed and showed that Mango Malformation disease had the greatest severity (18.88%) and ranked second for its incidence after leaf spots, accounting for 28.5%. Low disease incidence was found in the outside valley area (Nubaria), due to to new modern farming. We found 280 fungal isolates, of which 30 were selected to undergo molecular tests that confirmed the results of the morphological identification not only at genus but also at species level.

Keywords: mango, Egypt, monitoring, fungal diseases, bacterial diseases, malformation, leaf spots, disease incidence, disease severity.

621. MANNAH Mohamed Ibrahim (Egypt)

Supervisor: K. Djelouah ; advisors: M. Saponari, F. Valentini

*Title: Efficiency evaluation of different techniques used for the detection of *Spiroplasma citri*, the causal agent of citrus stubborn disease, and genetic diversity assessment of the *S. citri* Mediterranean isolates. – 64 p.*

*Abstract: Different techniques were applied for the diagnosis and detection of *Spiroplasma citri*, the causal agent of citrus stubborn disease, on infected samples coming from several Mediterranean countries. The efficiency of detection methods, such as biological indexing, culturing, serological and molecular assays, was evaluated. In the molecular assays, several primer pairs were tested for their specificity to the Mediterranean isolates. A specific primer pair for the detection of the Mediterranean isolates of *S. citri* was confirmed on several samples belonging to the Mediterranean area where stubborn is widespread. The molecular characterization of these local isolates based on SSCP and sequencing of the P89 gene, showed a genetic diversity between Mediterranean and American isolates. Moreover, the results obtained on the specificity of the primer pairs used were validated by a preliminary survey of Stubborn disease in the main citrus production areas in Egypt.*

*Keywords: stubborn, *Spiroplasma citri*, PCR, Egypt, Mediterranean region.*

622. HAGOS Saba Gebremeskel (Eritrea)

Supervisor: T. El Beaino ; advisor: M. Digiario

Title: Complete nucleotides sequencing and molecular characterization of Grapevine deformation virus (GDefV) RNA1. – 33 p.

Abstract: The complete nucleotide sequence of the RNA1 of Grapevine deformation virus (GDefV) has been determined. This segment (7,386 nts in length) contains a single ORF of 6,855 nts, encoding a polyprotein with conserved motifs,

characteristic of the viral protease cofactor (Pro-cof), the NTP-Binding protein (NTB), the viral genome linked protein (VPg), the cysteine-like protease (Cyst-Pro) and the RNA-dependent RNA polymerase (RdRp) of the order *Picornavirales*. GDefV RNA1 shows the highest amino acid sequence identity with *Grapevine fanleaf virus* (GFLV) (88%) and *Arabid mosaic virus* (ArMV) (74%). The putative cleavage sites are similar to those of GFLV. In phylogenetic tree constructed on the RNA1 coding region, GDefV is allocated in one cluster together with nepoviruses of subgroup A, close to GFLV. The analysis of the GDefV genome indicates a possible evolutionary path from GFLV and ArMV.

Keywords: Grapevine deformation virus, RNA1, cloning and sequencing, genome organisation, Nepovirus.

623. MENGEDE Teshale Jifare (*Ethiopia*)

Supervisor: M. Digiaro ; *advisors:* D. Boscia, D. Frasheri

Title: Evaluation of molecular and serological diagnostic techniques for a large scale detection of *Plum pox virus* (PPV). – 39 p.

Abstract: *Plum pox virus* (PPV), the agent of sharka, is the most devastating virus infecting stone fruits. The PPV control is mainly based on prevention, and its quick and reliable detection is considered crucial in this strategy. In this study DAS-ELISA and Real-time PCR were compared for evaluating their potentialities and limits for large scale surveys. Different hosts (apricot and peach), plant organs (phloem, buds, flowers, leaves and fruits) and parts of them, different periods of the year, presence or absence of symptoms were considered for comparison. No significant differences were observed between the two techniques when the titre of the virus in the plant is high (on spring). Conversely, Real-time is preferable to ELISA when the concentration in the tissues is lower (such as in the early stages of infection or during summer). Moreover, the accurate and careful observation of symptoms in the field remains crucial in the application of the disease monitoring and eradication programs.

Keywords: *Plum pox virus*, Real-time PCR, DAS-ELISA, detection, stone fruits.

624. HANAN Rafik (*Morocco*)

Supervisors: A. M. D'Onghia, S. Gualano ; *advisors:* F. Santoro, T. Yaseen

Title: Validation of remote sensing application to large scale detection of *Citrus tristeza virus* (CTV) and spectral discrimination of CTV with *Phytophthora* spp. infections in citrus plants. – 71 p.

Abstract: After the first CTV findings, legislative measures were adopted in Italy for the mandatory control of this virus and strengthened in the Apulian region, through an intensive monitoring and eradication programme. To support the official programme, which is time-consuming and expensive, remote sensing was applied through an algorithm of CTV recognition for the rapid identification of suspected infected groves on a large scale. The algorithm was validated in this study by investigating (visual observations and laboratory assays) suspected CTV-infected citrus groves as identified on the prediction map. Apart from two CTV foci, *Phytophthora* spp. were the main stress causal agents. Interestingly, an old CTV focus located in the uncontaminated area was also detected. Vegetation indices implemented in the Algorithm succeeded in recognizing *Phytophthora*. Moreover, a spectral discrimination was observed between CTV and *Phytophthora* infections in

the field and under greenhouse, in the VNIR for Navel orange and in the near infra-red for Mexican lime.

Keywords: citrus, remote sensing, Citrus tristeza virus, *Phytophthora*, algorithm, spectral signature, diagnosis, Italy.

625. RAHIM Youssef (Morocco)

Supervisors: A. Ricelli, T. Yaseen

Title: Ozone application for postharvest treatment on orange and cherry fruits. – 47 p.

Abstract: In this work the effect of ozone treatment during post-harvest period on the development of fungi, yeasts and bacteria present on the surface of orange fruit cv. Valencia Late and of cherry fruit cvs. Bigarreau and Ferrovia was investigated. Moreover the effect of ozone treatment on the activity of some Pathogenesis Related Proteins (PRPs), namely glucanase, chitinase, peroxidase and phenylalanine ammonia-lyase, was studied. The aim of the work is to investigate if ozone can control the development of the microorganisms present on the surface of the considered fruits in order to extend their shelf life. Furthermore, a correlation between the eventual antimicrobial effect showed by ozone and the activity of the considered PRPs was studied. The results show that ozone treatment plays a control effect on microorganism contamination and an increase of PRPs activity. These results suggest a correlation between the intrinsic antimicrobial effect of ozone and plant ability to counteract a pathogenic attack or in general a stress event.

Keywords: storage, citrus, cherry, microorganisms, chitinase, peroxidase, glucanase, phenylalanine ammonia-lyase.

626. SALEH Sherin (Syria)

Supervisors: S. Kumari, K. Djelouah ; **advisor:** R. Abou Kubaa

Title: Assessment of the main virus diseases and molecular characterization of local CTV and CPsV isolates in Syria. – 53 p.

Abstract: Citrus is still one of the most important fruit crop in Syria, unfortunately little is known on the sanitary status of the main virus diseases of this crop. A survey was carried out in the main Syrian citrus mother block located at Al Hannadi center and some commercial citrus orchards. 550 samples were collected for the laboratory detection of *citrus tristeza virus* (CTV), *citrus infectious variegation virus* (CVV) and *citrus psorosis virus* (CPsV). The results obtained confirmed the presence of CTV and its wide distribution, meanwhile further molecular characterization of the local CTV isolates, confirmed their high similarity with the Syrian and the VT isolates obtained from the GenBank. No CVV was detected during this survey; while, first authentication of the natural occurrence of CPsV in citrus orchards was reported in Syria. Additionally, first investigations on CPsV characterization of the local isolates clustered the virus in a group including several Mediterranean CPsV isolates.

Keywords: *citrus tristeza virus*, *citrus psorosis virus*, *citrus infectious variegation virus*, DTBIA, ELISA, PCR, Syria.

627. ELIGHRISSI Nader (Tunisia)

Supervisors: M. Digiario, N. Mahfoudhi ; advisor: T. Elbeaino

Title: Investigation on the presence of grapevine nepoviruses in Tunisia. – 50 p.

Abstract: The presence of nepoviruses was investigated in 232 grapevines showing fanleaf-like symptoms in Tunisian vineyards. Cortical scrapings and young leaves were used in DAS-ELISA to detect the presence of Grapevine fanleaf virus (GFLV). After testing, 128 samples were found positive. Of the remaining 104 samples tested by RT-PCR, 57 amplified a band when the degenerate primers for the subgroup-A nepoviruses detection were used. The subsequent tests using specific primers detected GFLV and Arabis mosaic virus (ArMV) in 55 and 4 vines, respectively. Degenerate primers for the detection of nepoviruses of the subgroups B and C were applied for the remaining 47 negative samples. No specific amplicon was obtained in electrophoresis for the subgroup B, while one putative viral amplicon was observed for the subgroup C, which needs to be further investigated. SSCP analysis of 55 GFLV-infected samples showed no correlation between different SSCP profiles and each syndrome of "infectious degeneration".

Keywords: nepoviruses, grapevine, Tunisia, RT-PCR, degenerate primers.

628. YALÇIN Cem (Turkey)

Supervisor: E. De Lillo ; advisor: F. Valentini

*Title: Intraspecific Interactions in *Capnodis tenebrionis* (L.) (Coleoptera: Buprestidae) adults. – 64 p.*

*Abstract: Management of *Capnodis tenebrionis* is mainly based on chemical treatments and it is affected by lack of information about population levels and by monitoring inefficiency. This study aimed to analyse the sexual communication and the involvement of pronotum. Morphological examinations of pronotum (male/female) showed the presence of holes on inner and outer sides evidencing no perfect symmetry, a certain variability and proportionally larger secretive areas in males than females. Olfactometry demonstrated the release of a weak airborne pheromone by females. Mating behaviour assays revealed the rituals of males at mating and the role of female pronotum secretion in male recognition/acceptance. Assays were approached sheltering the female pronotum by a biological inert resin which allowed collecting cuticular compounds. The preliminary chemical analysis of the resin copies showed quantitative differences in the cuticular compounds of each sex. Morphological measurements proved no correlation between beetle size and copulation duration. Parts of these results are preliminary and require further confirmations.*

Keywords: pheromones, pronotum, olfactometer, mating behaviour, cuticular compounds.

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652. MESSAOUDI Zakarya (Algeria)

Supervisors: F. Porcelli and F. Valentini

Title: Monitoring of insect vectors of Citrus tristeza virus, Plum pox virus and Candidatus phytoplasma vitis in Apulia. – 63 p.

Abstract: Tristeza, Sharka and Flavescence dorée are quarantine vector-transmitted diseases of citrus, stone fruit and grapevine, respectively. To deepen our knowledge on the epidemiology of these diseases in Apulia, vector monitoring was conducted in the main growing areas from May to September 2012. The aphid population was monitored in 5 citrus and 7 stone fruit orchards, randomly collecting about 15 twigs/orchard. Sweep nets and yellow sticky traps (3/vineyard) were used for capturing leafhoppers in 22 vineyards. After examination under the microscope, aphid specimens were divided into larval stages, apterae and alatae. The species identification was performed by using a key by Blackman and Eastop (2004). Toxoptera citricidus (Kirkaldy), the most efficient aphid vector of CTV, and Scaphoideus titanus (Ball), the only natural vector of Flavescence dorée, were not found. Aphis spiraecola (Patch), A. gossypii (Glover), and less frequently T. aurantii (Boyer de Fonscolombe) were found in citrus orchards. Myzus persicae (Sulzer) was the most frequent aphid identified in stone fruit orchards. Several species of leafhopper vectors of phytoplasmas were captured, including Hyalesthes obsoletus (Signoret), i.e. the vector of Bois Noir.

Keywords: aphids, Apulia, monitoring, Toxoptera citricidus, Scaphoideus titanus, vectors.

653. ABDELFAH AHMED (Egypt)

Supervisors: K. Djelouah and F. Valentini

Title: Setting up and evaluation of new primer sets for the detection of Spiroplasma citri and further investigations on the genetic diversity among the Mediterranean S. citri isolates. – 65 p.

Abstract: Citrus stubborn disease caused by Spiroplasma citri is a limiting factor for citrus production in countries with desert or semi arid conditions in the Mediterranean basin. Several polymerase chain reaction (PCR) assays have been previously developed but most of them lacked specificity or sensitivity for Spiroplasma citri detection. In order to develop a PCR assay specific and sensitive for detecting Mediterranean S. citri strains, three PCR primers were designed on the basis of repetitive sequences annotated "Hypothetical proteins"; a BLAST of the selected genes on the GeneBank showed no homology with genes of other organisms, spiroplasmas plasmids, or known spiroplasma virus sequences. The primer pairs were annotated as ScX 6, ScX7, ScX8, ScX9 and ScX 10, their sensitivity was evaluated by PCR with serial dilutions of positive S. citri cultures and DNA extracted from S. citri infected plants, while the specificity was determined by PCR using the DNA extracted from cultures of other Spiroplasma species. The ScX7 was selected, owing to its high specificity and sensitivity when compared with all other primers. Furthermore, investigations on the genetic diversity among S. citri Mediterranean isolates, carried out on collected sources from Egypt, Turkey, Syria

and Algeria, targeting the TraG and spiralin genes, showed a noticeable diversity among them.

Keywords: *Spiroplasma citri*, citrus, primer designing, genetic diversity, detection, Mediterranean.

654. EL-KENAWY Ahmed (Egypt)

Supervisors: A. H. El-Heneidy and K. Djelouah

Title: Management of some economic olive insect pests with emphasis on their biological control in two agro-ecosystems in Egypt. – 49 p.

Abstract: The Mediterranean basin is the largest olive production area worldwide; more than 125 arthropod species attack olive plants and cause quantitative and qualitative losses of yield. This study aimed to survey the economic olive insect pests in Egypt and to evaluate the role of bio-control agents in suppressing their populations in olive orchards. The survey was carried out at two olive orchards, located at two different agro-ecosystems (Middle-Egypt and Coastal region). Samples were collected weekly; number of pests' individuals and rate of infestation/ sample/ date/ site /leaf (shoot) was counted and recorded. Parasitoid species found associated with the pests were identified and their percentages of parasitism were estimated. The survey revealed the presence of five insect species; *Euphyllura straminea*, *Phloeotribus scarabaeoides*, *Saissetia oleae*, *Prays oleae* and *Palpita unionalis* on leaves and shoots of olive trees. The month of May revealed the highest populations for the five pest species in Egypt. Six hymenopteran parasitoid species, 4 primary and 2 secondary species were recorded associated with the first 3 pests. Furthermore, agricultural practices showed a great impact on suppressing the insect pests' populations in Egyptian olive orchards.

Keywords: olive, insect pests, parasitoids, survey, Egypt.

655. KRASNIQI Naim (Kosovo)

Supervisors: K. Djelouah and F. Valentini

Title: Assessment of the sanitary status of pome fruit crops in Kosovo, with particular emphasis on virus, viroid and bacterial diseases. – 66 p.

Abstract: Pome fruits represent very important fruit crops in Kosovo, covering around 50% of the total fruit production. Economic losses induced by viruses, viroids and *Erwinia amylovora* were reported in neighbouring countries. In order to understand the phytosanitary situation of pome fruits in the Kosovo, assessment of pome fruit crops was carried out for detecting 4 viruses (ACLSV, ASGV, ApMV, ASPV), 3 viroids (ADFVd, ASSVd, PBCVd) and 3 bacteria (*Erwinia amylovora*, *Pseudomonas syringae* pv. *syringae*, *Pseudomonas syringae* pv. *papulans*) on apple and pear; serological technique (ELISA) and molecular (RT-PCR) for detection of viruses and (RT-PCR) for detection of viroids were used, while for bacteria, morphological, biochemical (LOPAT test) and molecular (rep-PCR) tests were performed. This survey showed that ASPV (48%), ACLSV (5%), ASGV (5%) and ApMV (1%) are present, in the main apple producing areas of Kosovo, while no pear trees were found infected by these viruses. ADFVd (18%) was detected on apple. Moreover, *Erwinia amylovora* was widely distributed on apple and pear in different cultivated areas. This study showed that several viruses and viroids are present and in some cases widely distributed and that this current status could be worsened due to the wide distribution of *Erwinia amylovora*.

Keywords: Kosovo, pome fruits, viruses, viroids, *Erwinia amylovora*, ELISA, RT-PCR, rep-PCR.

656. FREIJI Ajaj (Lebanon)

Supervisors: T. El Beaino and M. Digiario

Title: Sanitary assessment of Italian olive varieties of local interest using traditional and novel advanced molecular techniques. – 48 p.

Abstract: A survey was carried out for assessing the sanitary status of Italian local varieties of olive. A total of 160 samples of different varieties were collected from commercial orchards of six Italian regions (Liguria, Toscana, Emilia Romagna, Umbria, Molise, Puglia) and from the Varietal Collection Plot at Mirto (Calabria). All samples were tested by RT-PCR for the presence of the following viruses: *Arabis mosaic* (ArMV), *Cherry leaf roll* (CLRV), *Cucumber mosaic* (CMV), *Olive latent ringspot* (OLRSV), *Olive latent 1* (OLV-1), *Olive latent 2* (OLV-2), *Olive leaf yellowing* (OLYaV) and *Strawberry latent ringspot* (SLRSV). DsRNA and mechanical transmission tests were applied to ten and forty PCR-negative samples, respectively. PCR results showed that about 63% of samples were infected by at least one virus, with the prevalence of OLYaV (32.5%) and OLRSV (26.1%). DsRNA bands were detected from 2 samples, while no virus was mechanically transmitted onto herbaceous hosts. Based on PCR results, potential 58 *virus free*- and 34 *virus tested*-candidate clones for the national certification program were identified. One positive dsRNA sample was sequenced using the Illumina Genome Analyzer technology, from whose application the partial nucleotide sequence (3807 nts) of a putative new virus distantly related to OLYaV was obtained (54% identity).

Keywords: Italian olive varieties, viruses, sanitary status, RT-PCR, dsRNA, deep sequencing.

657. AIT FRIHA Abdelmoughit (Morocco)

Supervisors: T. Yaseen, F. Valentini and F. Santoro

Title: Evaluation of biotic and abiotic disorders in citrus plants under insect-proof screenhouses. – 68 p.

Abstract: The objectives of this study were the detection and identification of biotic or abiotic stress factors which could be associated with the symptoms of dieback, severe leaf necrosis, and various chlorosis of citrus trees grown under screenhouse at Mediterranean Agronomic Institute of Bari. Virus infections were excluded because annual assays are carried out by IPM staff whereas tests were carried out to detect pathogenic viroids, fungi and bacteria. Growing media, salinity and pH were studied. To evaluate light deficiency, the old fiberglass cover sheet of the screenhouse was partially substituted with a polyethylene cover sheet. Irradiance and photosynthetic activity were measured by spectroradiometer. No pathogenic fungi or bacteria were isolated from the tested plants. HSVd was detected only in few tested clementine plants whereas mandarin-like species showing evident symptoms did not react to any viroid tested. Old growing media were associated with symptomatic plants, whereas plants in new growing media didn't show symptoms. No symptoms were observed under the new polyethylene cover sheet, although, Photochemical Reflectance Index (PRI) of these plants shows a significant increase in photosynthetic activity. Therefore, we can assume that the symptoms observed are possibly correlated with light deficiency and growing media quality.

Keywords: dieback, fungus, bacteria, viroids, saprophytic, light deficiency, growing media.

658. AL NAASAN Yaseen (Syria)

Supervisors: A. M. D'Onghia and F. Santoro ; **advisors:** S. Gualano and B. Figorito

Title: Evaluation of sampling methods for assessing *Citrus tristeza virus* incidence in Apulian citrus groves. – 72 p.

Abstract: In Apulia region, large-scale monitoring of *Citrus tristeza closterovirus* (CTV) is regulated by a Regional Decree, which has introduced the Hierarchical Sampling method scheme by Gottwald and Hughes (HS) with some modifications (MAIB-S) relating to the use of DTBIA individual testing instead of ELISA grouped testing. The use of an efficient sampling method is important for the estimation of the pathogen incidence, presence and distribution patterns; therefore, HS and MAIB-S were evaluated with the simple random sampling method (SRS). Advanced spatial and statistics analyses were used: automatic tree extraction, Moran's *I*, Ripley's *K*-function, *R_{citrus}* and a MATLAB-based simulation (*CTVSimula*). In the surveyed groves CTV incidence ranged from 0.46% to 16.21%, when testing 100% of the trees by DTBIA. By simulating the different sampling methods the infection rate was underestimated by HS, more accurate with MAIB-S, but the optimum was achieved by random sampling. Noticeable reduction in estimation accuracy for CTV incidence was observed with HS (0.1% to 65%). MAIB-S can be improved following a different systematic sampling scheme. According to three spatial aggregation indices, CTV spatial patterns proved to be remarkably aggregated in nearly 60% of the groves.

Keywords: *Citrus tristeza virus*, Hierarchical sampling method, DTBIA, ELISA, Point pattern analysis, *CTVSimula*, Moran's *I* index, Ripley's *K*-function, Apulia.

659. BOUAGGA Sarra (Tunisia)

Supervisors: A. Jammazi, M. Ben Halima and M. N. Hassan ; **advisor:** K. Djelouah

Title: Evaluation of various attractant-mediated systems to combat the Mediterranean fruit fly *Ceratitis capitata* on peach in Tunisia. – 78 p.

Abstract: The effectiveness of two techniques, Ceranock attract and kill and mass-trapping using the female food-attractant Femilure, were evaluated against Mediterranean fruit fly (Med-fly), *Ceratitis capitata* (Wiedemann). Treatments were carried out in two peach orchards of 3 hectares: one highly infested, located in Borj-Touil, the other moderately infested in Mornag, Northern Tunisia. Ceranock is a specialized system based on hydrolyzed proteins and alpha-cypermethrin. Femilure contains dry food volatiles: ammonium acetate, and tri-methylamine chloride. During this study, 400 Ceranock bait stations were placed in every hectare, four weeks before fruits colour changes. When mass trapping strategy was applied, Femilure baited McPhail traps were placed at a density of 60 traps/ha. Femilure and Ceranock systems were found to be effective in reducing the number of *C. capitata* population to 50% and 70% respectively. Moreover, Femilure proved to be very selective for Med-fly, capturing an average of 80% females. Fruit damage assessment showed significant differences between treatments in fruit infestation decrease. Therefore, Femilure and Ceranock baited treatments were able to reduce dropped and softened fruits, respectively by 4 and 7 times compared to control plots. In contrast, damages were limited to 9% and 5%, compared to 33% recorded in control fields. Nevertheless, Ceranock system gave more satisfactory results than Femilure mass-trapping in the Med-fly control.

Keywords: med-fly, femilure attractant, mass trapping, ceranock, attract and kill, peach, fruit damages, Tunisia.

660. MOUJAHED Rihem (Tunisia)

Supervisors: A. M. D'Onghia, F. Carimi and D. Frasheri ; **advisor:** A. Carra

Title: Elimination of *Spiroplasma citri* by somatic embryogenesis from stigmas and styles and from undeveloped ovules of aborted seeds. – 66 p.

Abstract: *S. citri* elimination by somatic embryogenesis, from stigmas/styles (SES) and from undeveloped ovules of aborted seeds (SEO), was evaluated using DAS-ELISA and PCR. Different organs of the infected citrus species were tested for the presence of *S. citri*, which was detected in ovaries (100%), leaves (66.66%), columella (32.22%), non viable seeds (22.68%) and stigmas/styles (16.66%). Stigmas/styles (Navel orange) and undeveloped ovules (Navel and Valencia oranges) were cultured in MS medium supplemented with BAP and sucrose. The SES medium included also malt extract. Somatic embryos were produced with no callus formation from undeveloped ovules, 1 to 3 months after culture initiation, whereas later on callus surface in SES. The embryogenic response of Navel was 100% in SEO and 34.66% in SES. No significant difference was observed in the embryogenic response of Navel and Valencias using SEO. Despite the low infection rate of *S. citri* in stigmas/styles and callus, no infection resulted in regenerants from SES. Same results were obtained in regenerants from SEO. Considering the 22.68% of seed infection, viable seeds of infected fruits, belonging to lime, lemon and orange from Egypt were sown for seedling production. No transmission of *S. citri* was detected in the seedlings after 6 months of growth.

Keywords: *Spiroplasma citri*, somatic embryogenesis, stigma and style, undeveloped ovules, seed transmission, PCR, ELISA.

661. KIYI Hulusi (Turkey)

Supervisors: M. Digiario and T. El Beaino ; **advisor:** A. Minafra

Title: Investigation on possible fingerprints in RNA2 of *Grapevine fanleaf virus* associated to yellow mosaic or infectious malformation syndromes in grapevine. – 44 p.

Abstract: Sequences from the Homing Protein (2A^{HP}) domain encoded by RNA2 of GFLV were analyzed to identify differential molecular areas in GFLV-infected isolates with yellow mosaic (YM) and infectious malformation (MF) syndromes. The study was based on a comparison of the partial sequences of the 2A^{HP} region of 36 isolates from 7 different countries and of 40 isolates recovered from Genbank. Sequence analysis showed a very high variability between GFLV-isolates (up to 44% at nucleotide level) and the phylogenetic tree showed three main clusters of isolates. All MF isolates identified were clustered in group 1, while the YM isolates and some isolates with unknown symptoms were clustered in the other two groups. Six GFLV-isolates shared in 2A^{HP} a high similarity to ArMV rather than to GFLV and potential interspecific recombination events were predicted in them by the RDP3 program. Sequences here obtained showed in 2A^{HP} the presence of amino acids stretches highly conserved uniquely in MF or YM isolates. One set of primer pair specific to both MF and YM strains were thus designed and applied in RT-PCR for the detection and discrimination between MF or YM strains of GFLV.

Keywords: GFLV, RNA2, homing protein, infectious malformation, Yellow mosaic, recombination, RT-PCR.

662. TURAN Burak (Turkey)

Supervisors: A. Ricelli and T. Yaseen

Title: Use of ozone for post-harvest treatment of apple fruits. – 55 p.

Abstract: In this work the effect of ozone treatment on the development of *Penicillium expansum* infection and Patulin biosynthesis during storage period of apple fruit varieties "Golden Delicious", "Royal Gala" and "Fuji" was investigated. Moreover the effect of ozone treatment on the activity of some Pathogenesis Related Proteins (PRPs): β -1,3-Glucanase, Peroxidase, Phenylalanine ammonia-lyase (PAL) was also studied. The aim of the study is to evaluate if ozone can control the development of *Penicillium expansum* present on the surface of apple fruits and the eventual production of Patulin in order to extend the shelf life of apple fruits. The results show that ozone treatment plays a significant inhibiting effect on fungal contamination and Patulin biosynthesis, if used at the appropriate concentrations. However a clear correlation between the activity of the considered PRPs and the inhibiting effect exercised by ozone did not emerge and further studies are needed to verify the correlation between ozone application and PRPs activity. The results achieved lead to suggest that ozone treatment can constitute a valuable support to conventional treatment in the management of post-harvest stage of apple fruits.

Keywords: apple fruit, ozone, post-harvest, *Penicillium expansum*, Patulin.

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688. BOUTARFA Mohamed Réda (Algeria)

Supervisors: T. El Beaino, M. Digiario and A. Minafra

Title: Evidence of interspecies recombination events in the Homing protein domain (2A^{HP}) of *Grapevine fanleaf virus* (GFLV) chromogenic strains in grapevine. – 45 p.

Abstract: This study was aimed at determining the complete RNA2 nucleotide sequences of seven *Grapevine fanleaf virus* (GFLV) isolates from infected vines showing symptoms of yellow mosaic (YM). Sequenced RNA2 showed 84% to 91% nucleotide identity with the corresponding segments of other GFLV isolates from GenBank, and confirmed the high genetic variability at the 2A^{HP} level. Based on the partial nucleotides sequence of this domain, the phylogenetic tree allocated all the seven isolates in group 2, which encompasses GFLV isolates associated with YM syndrome. Analysis with the RDP3 program detected the presence of potential interspecific recombination events with ArMV in the 2A^{HP} domain in five out of 7 isolates. These recombinant isolates were grouped in the phylogenetic tree into two distinct subgroups (B and C), closer to *Arabis mosaic virus* (ArMV) than to GFLV. This study has provided an insight into the possible involvement of the 2A^{HP} in symptom regulation in GFLV infection.

Keywords: grapevine, GFLV, yellow mosaic, RNA2 sequencing, homing protein, phylogenetic tree, recombination.

689. SI-AMMOUR Melissa (Algeria)

Supervisors: T. Yaseen and F. Santoro

Title: Development of LAMP-PCR methodology for *Monilinia* spp. detection and the correlation with environmental parameters. – 45 p.

Abstract: In this study a loop-mediated isothermal amplification (LAMP) assay was developed for *M. laxa*, *M. fructigena* and *M. fructicola* based on IGS (rDNA) sequence. Specificity and sensitivity of LAMP primers were determined. LAMP amplification was checked through quantitative real-time PCR or turbidity test. Two extraction methods were developed for potential use in the field. Similar results were obtained with the two trapping methods in terms of spore detection ($R^2=0.633$). A heterogeneous inoculum distribution was revealed by the plate trap method, especially during cherry full bloom and fruit setting. A high spore concentration was recorded using a Burkard spore trap, which matches rainfall (5mm), cumulative temperature (10-14°C) and a high cumulative RH values (70 - 90%) observed during pink bud stage and early flowering. This study represents a preliminary step in the implementation of a Decision Support System (DSS) for *Monilinia* spp. detection and timing of fungicidal applications.

Keywords: *Monilinia* spp., LAMP PCR, Real-time PCR, DNA extraction, spore density, field sensors.

690. ALJAZZAR Ramy (Egypt)

Supervisors: A. H. El-Heneidy, M. N. Hassan and K. Djelouah

Title: Evaluation of Zonatrak Bait-Based Male Annihilation and Ceranock Attract & Kill techniques for the control of mixed populations of *Bactrocera zonata* and *Ceratitis capitata* on Apricot and Mango in Egypt. – 69 p.

Abstract: Two bait-based techniques, Zonatrak Male Annihilation and Ceranock Attract and Kill, were used for the control of mixed populations of the Medfly *Ceratitis capitata* (Wiedemann) and peach fruit fly *Bactrocera zonata* (Saunders) on apricot and mango in Egypt. Treatments were carried out in an apricot orchard in Al-Beheira and later in a mango orchard in Al-Sharqiyah. Both techniques have proved to be successful in substantially reducing infestation on mango, where fruit damage assessment revealed infestation rates at 4.92% and 3.28% in two treatment plots, as opposed to 27.87% in an untreated control plot. The apricot trial witnessed a relatively high infestation rate in both treatment plots, as well as the control plot, due to an unexpectedly overwhelming Medfly population surpassing the application rate capacity. Apricot fruit damage assessment resulted in 51.92% and 42.72% infestation rates in the two treatment plot, and 44.55% infestation rate in the pesticide-treated control plot.

Keywords: *Bactrocera zonata*, *Ceratitis capitata*, apricot, mango, male annihilation technique, attract & kill.

691. MOHGA Wagdy Yehia (Egypt)

Supervisors: H. Fahmy, A. Mamoun, R. Abou Serie and K. Djelouah

Title: Preliminary study on the emerging disease of Citrus Volkameriana rootstock in Egypt. – 52 p.

Abstract: Citrus, the main fruit crop in Egypt, is grafted onto Volkamer lemon (*Citrus volkameriana*) under desert conditions. In the last years this rootstock has proved to be affected by a new disease, inducing cachexia-like symptoms. A Spring survey, carried out in four Governorates by visual observations, allowed detecting 28.2% of symptomatic trees in 7 young citrus plantings, primarily of sweet oranges. Symptomatic and symptomless trees were sampled to assess the causal agent/s and an information sheet on each citrus grove was filled in to collect useful data (e.g. first symptom observation etc.). Results of laboratory assays for viroid detection indicated that HSVd, the agent of cachexia disease, was the most represented one (77%), followed by CEVd (32.7%), CBLVd (26.5%) and CVd-III (22.9%). Viroids were also found in symptomless trees. CBLVd and CVd-III were reported for the first time from Egypt. The investigation extended to CTV and CPsV indicated an infection rate of 11% and 9%, respectively.

Keywords: Volkamer lemon, Hop Stunt viroid, Citrus viroids, Citrus tristeza virus, Egypt.

692. ALAWAMLEH Mahmoud Amani (Jordan)

Supervisors: A. K. Bader and M. N. Hassan

Title: Ecological and biological studies of the African fig fly *Zaprionus indianus* (Diptera: Drosophilidae) in Jordan. – 93 p.

Abstract: *Zaprionus indianus* is a widely distributed polyphagous drosophilid fly of tropical origin. Studies on ecological, biological and some morphological aspects of the fly were carried out in Jordan under field and laboratory conditions. A survey showed that *Z. indianus* was present in different ecosystems on many hosts. Colorless and red plastic bottle traps with *Torula* yeast bait solution were found to be the most efficient traps to capture *Z. indianus* in date palm and fig orchards,

respectively. The eight local fig varieties showed variable susceptibility to *Z. indianus*; Hmaree was the most susceptible variety and Esalee was the least susceptible one. Biological studies showed that larva had the highest mortality followed by pupa and egg, and females had lower longevity than males, but the number of emerged females was greater than that of males. The life cycle was completed in 16-19 days. Our data indicated the importance of sound fly management programmes.

Keywords: *Zaprionus indianus*, survey, baited color traps, torula yeast, fig varieties, susceptibility, life cycle.

693. AL-KHAFAJY Yasan Basim (Iraq)

Supervisors: S. Gualano, F. Santoro and F. Porcelli

Title: Application of IAM-B Semiautomatic Insects Screening (ISIS) on yellow sticky traps: preliminary results. – 58 p.

Abstract: Monitoring insects population by yellow sticky traps (YST) is very important in the IPM strategy. The conventional insect identification approach requires a long time and does not allow data storage of YST. During Spring a new developed semiautomatic insect screening system on YST was applied in an olive grove and evaluated with the conventional pest identification (at Order level) under stereomicroscope. Results showed the great difference in the total number of counted insects by conventional approach (7612) in about 31h compared to the number counted by ISIS (1420) in 5h. ISIS could detect and count insects ≥ 3 mm in a very short time and store YST digital data. As for film-coated and uncoated YST, ISIS showed a significant difference in reducing the number of errors only in film-coated YST.

Keywords: insect monitoring, yellow sticky traps, QR Code, Matlab, olive.

694. AL-RUBAYE Laith Adil (Iraq)

Supervisors: K. Djelouah, F. Valentini and L. Varvaro

Title: Survey of the main citrus graft-transmissible diseases in Baghdad region (Iraq). – 51 p.

Abstract: In order to evaluate the real situation of the main citrus graft-transmissible pathogens in Iraq, a wide survey was carried out in Baghdad region, considered to be the most important citrus- growing area in the country. More than 1000 citrus trees belonging to 3 commercial orchards and 1 nursery located in this region were individually inspected for symptom expression; 300 samples, in the material collected, were also processed for biological, serological and molecular tests. Fortunately neither CTV nor *Candidatus Liberibacter asiaticus* infectious agents, which pose today a major threat to the citrus industry worldwide, were reported in the surveyed citrus areas. However, this survey confirmed the wide distribution of *S. citri* in both commercial orchards and nurseries and allowed reporting for the first time the presence of citrus infectious pathogens such as CPsV, CEVd and HSVd from the most important Iraqi citrus-growing area.

Keywords: citrus, Baghdad, DTBIA, ELISA, graft-transmissible pathogens, Iraq, PCR

695. MOUBARAK Peter (*Lebanon*)

Supervisors: C. Sebaaly, F. Valentini and L. Varvaro

Title: Survey of bacterial diseases on stone fruits in Lebanon. – 71 p.

Abstract: Stone fruits cover 10% of the total cultivated lands in Lebanon and are distributed across the country. These crops are infected with several bacterial pathogens that cause critical problems and economic losses due to the absence of efficient control methods. This study was aimed at assessing the presence of these pathogens in Lebanon and a survey was therefore conducted in fourteen different regions where 303 samples were collected. Pathogen identification and characterization were performed by carrying out morphological, physiological, biochemical and molecular tests. The results showed that 38% of the collected samples were infected and that, considering the host species and the regions, the most widespread bacterium was *Pseudomonas syringae* pv. *syringae*, followed by *P.s.* pv. *morsprunorum* race 1 showing host and region specificity. Furthermore, two isolates of *Agrobacterium tumefaciens* and one of *P.s.* pv. *morsprunorum* race 2 were detected, while 3 isolates suspected to be *Xanthomonas arboricola* pv. *pruni* were not confirmed by molecular tests.

Keywords: stone fruits, bacterial disease, *Pseudomonas syringae* pv. *morsprunorum*, survey, biochemical tests, molecular tests.

696. ES-SATTE Imane (*Morocco*)

Supervisors: M. Achouri and T. Yaseen

Title: Soil-borne fungal diseases of olive nurseries and orchards in Marrakech region. – 60 p.

Abstract: A survey was conducted in Marrakech region, Morocco, to check for the presence of olive soil-borne diseases. Samples were collected from 5 orchards (18 samples each) and 3 nurseries (15 sample each). Inoculum density of *Phytophthora* spp. and *Verticillium* spp. were assessed using plate dilution method in appropriate selective media. Isolated pathogens were identified according to their morphological characteristics and using PCR molecular methods. All *Verticillium* spp. isolated were identified as *V. dahliae* and they belonged to the non-defoliating pathotype. The *Phytophthora* population was found to be represented by *P. citrophthora* and *P. cryptogea*. A significant correlation between intercropping and nitrogen fertilization and soil-borne disease inoculum density was determined in traditionally managed orchards. Surface irrigation and soil texture played an important role in increasing *Phytophthora* spp. inoculum density. Cultural practices seem to be the main factor conducive to both *Phytophthora* and *Verticillium* olive soil-borne diseases in Marrakech region.

Keywords: olive, verticillium wilt, phytophthora disease, non defoliating pathotype, inoculum density.

697. DAMARA Eyad (*Syria*)

Supervisors: T. Yaseen and A. Ricelli

Title: Effect of electrolyzed water and ozone applications in pre- and postharvest on cherry, table grapes and citrus. - 65 p.

Abstract: The aim of this work was to investigate the effect of ozone (O₃), electrolyzed water (EW) in combination with passive refrigeration conservation system (PRS) on fruit quality in the postharvest period. The amount of Colony Forming Units (CFUs) on fruit surface, shelf-life (McKinney index), firmness and sugar content were evaluated during storage of Citrus (cv. Navel orange and cv. Clementine commune), cherry (cv. Ferrovia) and table grapes (cv. Redglobe, Crimson and Italia). O₃ and EW dose and exposure time were experimentally determined *in vitro*. O₃ was added to washing water or applied as gas during storage. Results indicated that the combination of O₃, EW and PRS treatments reduced microorganism contamination and increased fruit hardness and sugar content. An extension of fruit shelf-life was also demonstrated. This leads to suggest fruit washing with EW storing in PRS under ozonized atmosphere to counteract a pathogenic attack or in general a stress event.

Keywords: storage, citrus, cherry, table grapes, passive refrigeration, microorganisms, shelf-life, ozone, electrolyzed water.

698. YAHYAoui Emna (Tunisia)

Supervisors: M. Digiario and T. El Beaino

Title: Sequencing and molecular analysis of *Tomato black ring virus* and *Grapevine chrome mosaic virus* isolates from grapevine. – 41 p.

Abstract: The complete RNA2 sequences of three *Grapevine chrome mosaic virus* isolates (GCMV-H6, -H15, -H27), together with the full genome sequence of *Tomato black ring virus* isolate (TBRV-Mirs) from grapevine were determined. All sequenced RNA2 of GCMV isolates were slightly longer than the unique one reported in the Genbank (NC_003621), differing by 1-4 nts, while RNA1 and RNA2 of TBRV-Mirs were longer than those available in Genbank by 8 nts and 7-20 nts, respectively. TBRV-Mirs RNA2-encoded polyprotein showed the highest homologies with MJ- and ED-TBRV isolates (89%-85%), followed by BRSV (65%), GCMV (58%) and GARSV (57%). The homing protein (2A^{HP}) of GCMV isolates was found to be the most variable (86%-98%), followed by the movement protein (2B^{MP}, 89%-98%) and the capsid protein (2C^{CP}, 94%-99%). Recombination analyses showed that GCMV-H6 encompasses putative intra- and inter-species recombination sites deriving from GCMV-H27 and GCMV-NC_003621, and GARSV and TBRV, as parents respectively. In both cases recombination occurred at the movement protein (2B^{MP}) domain level.

Keywords: grapevine, TBRV, GCMV, RNA1/RNA2-sequencing, phylogenetic and recombination analyses.

699. KHALDI Najwa (Tunisia)

Supervisors: B. Bouamama-Gzara, D. Yahyaoui, A.M. D'Onghia and D. Frasheri

Title: Sanitation of Tunisian *Vitis vinifera* cultivars by somatic embryogenesis from flower explants. – 55 p.

Abstract: Anther and bud flower cultures were established *in vitro* in Tunisia following two different protocols (1 and 2) for grapevine regeneration by somatic embryogenesis. Five native grapevine cultivars (Asli, Hencha, Beldi, Amokrane and Chaouech), Cabernet Sauvignon and the rootstock 110 Richter were used as flower sources. Both protocols were evaluated for callus and embryo production. Protocol 1 showed the highest callus potential only in 110R (62.7%) and Cabernet Sauvignon (55.7%). In both protocols bud flowers showed the highest callogenesis with respect to anthers. First embryos appeared 3 months after anther culture

initiation in both protocols. No chilling effect was observed on callogenesis and embryogenesis. ELISA results on calli from anthers and bud flowers indicated the presence of most of the viruses tested, primarily GVA, GFLV, ArMV, GFkV. As for the sanitary status of Arich and 110R, all plants regenerated in 2008 proved to be infected with one or more viruses. GLRaV3 reached a 100% infection rate.

Keywords: somatic embryogenesis, sanitation, bud flower, anther, ELISA.

700. SLIMANI Takoua (*Tunisia*)

Supervisors: M. N. Hassan and K. Djelouah

Title: The effectiveness of Ceracon Attract and Kill (AK) was evaluated against Evaluation of pheromone mediated Attract and Kill control strategy for important pomegranate pest, Carob Moth, *Ectomyelois ceratoniae* in Tunisia. – 58 p.

Abstract: Carob moth, *Ectomyelois ceratoniae*. Ceracon is a specialized AK system based on combination of insect pheromone and abamectine. The trial was run in pomegranate orchards in Zerkine biotope, southern Tunisia. Two rates of Ceracon were tested, R1 (330 dollops/ha in sub-plot A1) and R2 (660 dollops/ha in sub-plot B1). Ceracon proved to be quite effective and allowed a higher population reduction (TR) and fruit protection when applied as R2. The registered TR in A1 and B1 sub-plots was respectively 32.38% and 44.41%, while the seasonal fruit damage percentage was 27.55% and 17.72% compared to 35.58% in the control plot. Ceracon Attract and Kill technique was found to be very efficient and cost-effective to reduce carob moth damages. This novel system can be successfully applied as AK to fight against *Ectomyelois ceratoniae* in large-scale control programmes.

Keywords: *Ectomyelois Ceratoniae*, Ceracon (AK), pomegranate, fruit damages, Tunisia.

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719. FODIL Sihem (Algeria)

Supervisors: A. Ricelli, T. Yaseen ; advisor: Y. Oussaid

Title: Facing the problem of ochratoxin A contamination of fresh grape and raisins in Algeria. – 74 p.

*Abstract: Ochratoxin A (OTA) in grape is related to the presence of black *Aspergilli*. In this work fresh table grape and raisin samples collected from different regions in Algeria were tested for the presence of OTA and OTA-producing black *Aspergilli*. No black *Aspergillus* species was found in fresh table grape, while in raisins black *Aspergilli* were found in all the tested varieties, with differences between varieties and sampling regions. Generally *Aspergillus carbonarius* was the most frequently isolated species among black *Aspergilli*. 85% of *A. carbonarius* isolates and 75% of *A. niger* isolates were OTA producers. We investigated the effect of ozone (O₃) treatment at 0.3 ppm on conidia germinability. O₃ significantly controls conidia germinability of both OTA producer and non-producer isolates. These results underline the need to establish a limit for OTA contamination in grapes in Algeria and highlight O₃ potential to control fungal contaminants, especially those responsible for OTA production.*

*Keywords: Ochratoxin A, Table grapes, Raisin, *Aspergillus carbonarius*, *Aspergillus niger*, ozone.*

720. GIBRIEL Hesham Ahmed Yousef (Egypt)

Supervisors: K. Djelouah, G. Loconsole ; advisors: D. Frasher, M. Saponari

*Title: Setting up of a rapid and innovative approach for the differentiation of *Citrus tristeza virus* (CTV) variants. – 38 p.*

*Abstract: *Citrus tristeza virus* (CTV), the causal agent of devastating epidemics, has induced so far the loss of almost 40 million citrus trees across the Mediterranean countries. Dramatic losses have been caused by the interaction of severe CTV variants with different scion-rootstock combinations, leading to the discrimination of three distinct syndromes known as quick decline, stem pitting and seedling yellows. In order to optimize the CTV strain identification methods, an efficient and innovative technique, "High resolution melting" analysis (HRM), was developed to differentiate the genotype(s) of 17 CTV sources derived from the MAI-B CTV collection. The method was compared with validated procedures like multiple molecular markers assays. The HRM assay proved to be rapid and highly reproducible. Therefore it could be applied in a high-throughput screening for economically important CTV mild and severe genotypes and help reduce the need for bio-indexing and sequencing analysis in monitoring programmes.*

Keywords: CTV, high resolution melting, genotypes, characterization, Mediterranean.

721. AHMED Marwa Mohammed Rashad (Egypt)

Supervisors: A. H. El-Heneidy, K. Djelouah ; advisor: M. N. Hassan

*Title: Study of biology and bio-rational strategies to control peach fruit fly *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) in Egypt. – 60 p.*

*Abstract: The present study was carried out to study, in laboratory conditions, the efficiency of entomopathogenic nematodes and fungi against *Bactrocera zonata*, (Saunders) (Diptera: Tephritidae). Selected entomopathogenic nematodes (*Heterorhabditis bacteriophora*, *Steinernema riobrave* and *S. carpocapsae*) and fungi (*Beauveria bassiana* and *Metarhizium anisopliae*) were tested at different concentrations against immature stages of *B. zonata* under laboratory conditions, by contact and/or soil inoculation techniques. Results showed that both *Steinernema* species were more effective on full-grown larvae than *H. bacteriophora* whereas *H. bacteriophora* was more effective on pupae with soil inoculation technique. As regards the two fungal species, *B. bassiana* induced a higher mortality of *B. zonata* pupae with both techniques. Results suggested that entomopathogenic nematodes and fungi can be an alternative to the use of pesticides for the integrated control of *B. zonata* after validating protocols in field conditions.*

*Keywords: *Bactrocera zonata*, entomopathogenic nematodes, entomopathogenic fungi, biological control.*

722. EL AMMOURI Farid (Lebanon)

Supervisors: F. Santoro, F. Valentini ; advisors: S. Gualano, D. Frasheri

*Title: The Potential of Spectroradiometry in the detection of *Xylella fastidiosa* associated to "Complesso del disseccamento rapido dell'olivo". – 78 p.*

*Abstract: Remote sensing, a successful methodology in early identification of suspected *Citrus tristeza virus* outbreak areas, was applied for the first time in Italy to monitor the presence of *Xylella fastidiosa* associated to 'Complesso del disseccamento rapido dell'olivo'. Combining multivariate statistical methods (Principal Component Analysis and Discriminant Analysis), serological and molecular laboratory assays and leaf spectral reflectance data, it was possible to detect specific wavelengths (500- 800[nm] and 1100-1400 [nm]) and vegetation indices related to chlorophyll absorption (ARI, SRPI, PSRI, BIG2, Viopt, RVSI, PRI, SIPI, PSNDcar, YI, PSNDb, Index_SPAD, NDVI, MSRI, MCARI) and water absorption (WI). Spectral information showed a discrimination of *X. fastidiosa* infections in asymptomatic olive branches. Moreover, high spatial resolution satellite imagery was used to update the olive covered land in the main outbreak areas in order to apply a more accurate sampling procedure and to carry out epidemiological studies.*

*Keywords: *Xylella fastidiosa*, remote sensing, spectral reflectance, olive covered land.*

723. TABET Dania Hanna (Lebanon)

Supervisors: W. Habib, T. Yaseen

Title: Survey of soil borne fungal pathogens of citrus and olive in Lebanese nurseries. – 74 p.

Abstract: Samples of soil and roots were collected in Lebanon from 21 nurseries and 3 mother plots of citrus and olive nurseries. Thirty-four soil samples were assayed by plating on a selective medium to quantify the pathogen inoculum

density. Real time PCR was used to detect *V. dahliae*. The percentage of infected plantlets was assessed by isolation on semi-selective media. Results indicated that Lebanese nurseries were free from *V. dahliae* whereas the frequency of *Phytophthora* and *Fusarium* was respectively 72.7 % and 63.6 %. *Phytophthora nicotianae*, *F. oxysporum* and *F. solani* were the predominant species in citrus nurseries, whereas *P. palmivora* and *F. oxysporum* were the most common species in olive nurseries. These results represent the preliminary reports of soil-borne fungal pathogens from Lebanese citrus and olive nurseries.

Keywords: *Phytophthora* spp., *Fusarium* spp., *Verticillium dahliae*, inoculum density, roots.

724. CHAKRANI Soukayna (Morocco)

Supervisors: T. Yaseen, F. Santoro

Title: Development of LAMP detection method for *Botrytis cinerea* the causal agent of grey mould disease of grapes. – 51 p.

Abstract: Loop-mediated isothermal amplification (LAMP) was applied to develop a reliable and rapid real time method, for specific detection and quantification of *Botrytis cinerea*. Six LAMP primers were designed based on the IGS (rDNA) sequence. The assay sensitivity, specificity and speed were evaluated. A DNA extraction from two different spore traps was developed for on-site LAMP application. The assay allowed to amplify a DNA concentration with sensitivity down to 1pg/μl in a short time period (12 min) with high specificity. The developed DNA extraction method combined with a Smart-Dart device made it possible to quantify airborne conidia from spore traps and to rapidly detect 10 conidia in less than 15 min. This method could be a valuable tool to quantify *B. cinerea* inoculum in the open field and contribute to the improvement of a decision support system for timing fungicidal applications.

Keywords: *Botrytis cinerea*, real-time LAMP, spore quantification, DNA extraction, Smart-Dart device, spore trap.

725. BEN MOUSSA Issam Eddine (Tunisia)

Supervisors: M. Digiario, L. Varvaro, V. Mazzoni ; **advisors:** T. El Beaino, F. Valentini

Title: Investigation on the presence of *Xylella fastidiosa* in putative insect vector(s) in Apulia. - 42 p.

Abstract: *Auchenorrhyncha* insects, potential vectors of *Xylella fastidiosa* (Xf), were collected from highly infected Apulian olive orchards. DNA extracted from the adults of 3 out of 6 species (*Philaenus spumarius*, *Neophilaenus campestris* and *Euscelis lineolatus*), were Xf positive in PCR tests. The detection of *X. fastidiosa* in the above species suggests their potential vectoring role in Apulia. In order to substantiate this hypothesis, further investigations and infectivity trials should be performed. The nucleotide sequences of PCR amplicons from each insect species were 99.3-99.4% identical whereas 99.6%-99.7% identity was found with sequences of *X. fastidiosa* isolates from Apulian olive trees. This result indicates that a single bacterial strain is probably present in the region. *X. fastidiosa* was successfully detected by PCR in "spy insects" of *Auchenorrhyncha* captured in a buffer zone, 1 km far from the outbreak area, thus confirming the value of this approach for monitoring the bacterium in Xf-free areas.

Keywords: *Philaenus spumarius*, *Neophilaenus campestris*, *Euscelis lineolatus*, PCR detection, buffer zone.

726. TURGUT Fatma (Turkey)

Supervisors: M. Gumuz, T. El Beaino

Title: Investigation on the presence of *Strawberry latent ringspot virus* in Turkey and its role in the aetiology of Fig Mosaic Disease. – 52 p.

Abstract: A survey was carried out to assess the sanitary status of fig in the Aegean region (Turkey) and to study the etiological role of *Strawberry latent ringspot virus* (SLRSV) in mosaic disease (MD). A total of 145 samples of different varieties were collected and tested by RT-PCR for the presence of *Fig leaf mottle-associated virus 1* (FLMaV-1), *Fig leaf mottle-associated virus 2* (FLMaV-2), *Fig mild mottling-associated virus* (FMMaV), *Fig latent virus 1* (FLV-1), *Fig mosaic virus* (FMV), *Fig cryptic virus* (FCV), *Fig fleck-associated virus* (FFkaV), *Fig Badnavirus* (FBV) and SLRSV. PCR results showed that about 91% of the samples were infected with at least one virus, with the prevalence of FBV (91%), FMV (89%) and SLRSV (71%). The high FMV infection did not allow to study the etiological role of SLRSV in MD. Based on PCR results, 5 potential virus-tested candidate clones were identified.

Keywords: Turkey, fig, viruses, RT-PCR, survey.

IPM - A.Y. 2014-2015 (June session) – 737-747

737. SEFA Valdete (Albania)

Supervisor: V. Mazzoni; advisor: F. Valentini and D. Lorusso

Title: Ecological investigations on the Entomofauna of Olive orchards in Apulia region, with a particular focus on Hemiptera (*Fulgoromorpha* and *Cicadomorpha*). – 35 p.

Abstract: An investigation on entomofauna of olive orchards, with a particular focus on Auchenorrhyncha species (Hemiptera), was carried out from summer 2014 to spring 2015 in two areas (Provinces of Lecce and Bari) of Apulia region, southern Italy. The research aimed to investigate the presence of potential vector species of the bacterium *Xylella fastidiosa* in the olive trees of infected (Lecce) and uninfected (Bari) orchards, and to reveal the differences between them, in order to have a preliminary estimation of potential spread in case of an outbreak in Bari. An ecological analysis was performed to define the composition of insect populations occurring in the olive groves throughout the year. A total of 1641 specimens (17 species, six sites) were captured in Lecce, and 912 (10 species, two sites) in Bari. Comparison of the specimens from the two areas showed that the most relevant difference was the greater abundance of xylem-feeders (spittlebugs *Philaenus spumarius* and *Neophilaenus campestris*) found in Lecce, whereas their occurrence in Bari was much lower. In particular, *P. spumarius*, a recognized *X. fastidiosa* vector, was found to be the most abundant species in the Lecce area. However, despite the relatively low number of spittlebugs collected in Bari, the possibility of the bacterium spreading in Bari should not be neglected.

Keywords: Auchenorrhyncha, vector, *X. fastidiosa*, *P. spumarius*, abundance.

738. DRAIS Mounira Inas (Algeria)

Supervisors: K. Djelouah and L. Varvaro; advisor: C. Ghezli

Title: First molecular identification and characterization of *Spiroplasma citri* in Algerian citrus groves and setting up of a Direct Tissue Blot Immunosorbent Assay (DTBIA) protocol for the mass detection of *S. citri*. – 48 p.

Abstract: In order to assess the presence of *Spiroplasma citri*, the causal agent of citrus stubborn disease, a field survey was carried out during the summer on two citrus varietal collections and one primary source greenhouse located in the main Algerian citrus growing area. Of the 112 collected samples, only two infected trees were identified by molecular techniques in both varietal collections. The partial spiralin gene nucleotide sequence retrieved from the Algerian isolate (Accession N°LN713947.1), revealed a high percentage of nucleotide homology (99%) with the Iranian Fasa strain isolated from a leafhopper vector (GenBank Accession No.FJ755921.1) and 94 % identity with the strain from Corsica, France (GenBank Accession N° U13995.1). Interestingly, the Algerian isolate also reacted positively with the primer pairs, targeting the TraG gene, which is essential for insect transmission and predicts a natural diffusion of the pathogen in the case of the presence of insect vectors in the infected area. Furthermore, in order to overcome the inconsistencies and limitations of some *S. citri* detection techniques available for large-scale detection of *S. citri*, a Direct Tissue Blot Immunosorbent Assay

(DTBIA) protocol was developed, thus allowing the mass detection of the causal agent of Citrus stubborn disease.

Keywords: Algeria, citrus, PCR, DTBIA, stubborn.

739. GODA Nizar Fahmi Mohamed Salem (Egypt)

Supervisors: A. H. El-Heneidy and M. N. Hassan ; *advisor:* K. Djelouah

Title: Integrated pest management of the tomato leaf miner *Tuta absoluta* (Meyrick) in tomato fields in Egypt. – 37 p.

Abstract: Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops worldwide. In Egypt, tomato is cultivated in 3 annual plantations. The tomato leaf miner, *Tuta absoluta* (Meyrick), (Lepidoptera: Gelechiidae) is a recent devastating pest of tomato crops worldwide and a new and exotic pest in Egypt. The efficacy of integrated control methods against the pest was evaluated in 2014 (September – December) on the Nili tomato plantation in Fayoum Governorate, Egypt. The best rate of infestation reduction was given by the release of egg parasitoid *Trichogrammatoidea bactrae* + mass trapping (plot B), followed by application of Biotrine and Fytomax + mass trapping (plot A), and the use of insecticides (control plot C). The respective seasonal rates of infestation were 9.2, 11.1 and 29.3%, respectively. The highest yield and cost benefits were recorded for plot (B).

Keywords: tomato, *Tuta absoluta*, IPM, cost benefit, Egypt.

740. MOUSSA Abdelhameed Moussa Elmaghawry (Egypt)

Supervisors: A. S. Abdel-Razek and S. Colazza ; *advisors:* K. Djelouah and N. Abd El-Ghany

Title: Efficacy of different eco-friendly bio-rational insecticides for sustainable management of *Tuta absoluta* (Meyrick) & *Bemisia tabaci* (Gennadius) on greenhouse tomatoes. – 63 p.

Abstract: The global invasion of *Tuta absoluta* (Meyrick) and *Bemisia tabaci* (Gennadius) as insect pests infesting tomato was the main reason for this study. The experiment involved Shifa and Savera F1 hybrid tomato varieties cultivated under greenhouse in Nubaria Governorate, Egypt and ran from mid-August 2014 to mid-May 2015. Infestation suitability assessment of *B. tabaci* and *T. absoluta* between tomato varieties was carried out as a preliminary measure. The experiment tested the efficacy of different concentrations (LC100, LC50 and LC25) of commercial eco-friendly bio-rational insecticides, including Nimbecidine EC, Tracer, Dipel®2x, Bio-Magic and Bio-Power, for the control of *B. tabaci* and *T. absoluta* based on the number of adults and of larvae, respectively. Productivity assessment was carried out for each bio-insecticide at different concentrations. Spinosad showed very promising efficacy on *T. absoluta* and *B. tabaci*, with 85.52–97.04% and 83.97–94.61% infestation reduction, respectively. Dipel®2x and Nimbecidine EC showed great efficacy, followed by Bio-magic and Bio-power.

Keywords: microbial and botanical insecticides, *Tuta absoluta*, *Bemisia tabaci*, infestation suitability, efficacy, productivity assessment.

741. RAHI Yaseen Jundi (Iraq)

Supervisors: T. Yaseen and F. Valentini

Title: Survey of the fungi associated with Olive quick decline syndrome (OQDS) and assessment of the efficacy of some chemicals as control method. – 60 p.

Abstract: Olive Quick Decline Syndrome (OQDS) has recently been recorded in the Gallipoli and Lecce areas of Apulia Region (Italy), and the disease is associated with several pathogenic bacteria (*Xylella fastidiosa* subsp. *pauca* strain CoDiRO) and fungi (*Phaeoacremonium* spp., *Neofusicoccum parvum* and *Pleurostomophora richardsiae*). The aim of this work was to carry out a survey of fungal pathogens associated with OQDS, and to assess the effect of some chemicals (fungicides and fertilizers) on controlling the disease. Three monthly treatments (January – March) with Fenbuconazol, Fosetyl-Al, Mancozeb and a fertilizer (copper + zinc complex + citric acid) were sprayed or injected to treat diseased fifty to seventy-year-old Ogliarola salentina var. olive trees, and samples were collected for analysis. The isolated fungi were subjected to morphological and molecular identification. In molecular assay the obtained DNA was a cluster comprising D1/D2 regions, actin and β -tubulin genes. The results showed no differences between the trees treated with the tested compounds and the control. Sixty-five percent of the isolated fungi were identified as *Penicillium* spp. (23.57%), *Pleurostomophora richardsiae* (12.14%), *Paraconiothyrium* spp. (9.28%), *Phaeomoniella* spp. (7.14%) and *Cosmopora* sp. (3.7%). The sequenced genes were unable to identify 35% of the fungi. Further studies are needed in order to evaluate new chemical compounds and to identify unidentified fungi.

Keywords: CoDiRO, ITS, D1/D2, actin, β -tubulin.

742. MUSTAFA Majid Hassan (Iraq-Kurdistan)

Supervisors: M. Digiario and V. Mazzoni ; advisors: T. El Beaino and T. Yaseen

Title: Investigation into *Auchenorrhyncha* species, putative vectors of "Bois noir" and "Flavescence dorée", in Apulian vineyards using different molecular techniques. – 48 p.

Abstract: Flavescence dorée (FD) and Bois noir (BN) are the two most important phytoplasma diseases of grapevine in Italy. Their agents, Ca. Phytoplasma vitis and Ca. P. solani, are mainly vectored by *Scaphoideus titanus* (FD) and *Hyalesthes obsoletus* and other Auchenorrhyncha species (BN). To date, in Apulia region, only BN has been sporadically reported, but little is known about its putative vectors. In order to fill this gap, a total of 429 leafhoppers and froghoppers were captured from two different areas and identified and 190 of them were tested by nested-PCR and real-time PCR. Twenty-one individuals tested positive to phytoplasma infections, but none of them to BN or FD. Sequencing of 10 PCR-amplicons (1,250 bp) highlighted the presence of phytoplasmas of two different groups: elm yellow (16Sr V) and pigeon pea witches' broom (16Sr IX), probably acquired from infected wild plants in the vineyards. Eighty-two *S. titanus* individuals from a FD-infected vineyard in the region of Trentino (north Italy) were submitted to a comparative analysis by nested PCR, Real-time PCR and Real-Time LAMP. Ca. P. vitis was detected in 3 samples by RT-PCR, and only in 2 samples by the two other techniques.

Keywords: phytoplasma, grapevine yellows, PCR assays, sequencing, Ca. Phytoplasma vitis, Ca. Phytoplasma solani.

743. XHEMALI Bekri (Kosovo)

Supervisor: E. Stefani; advisor: F. Valentini

Title: Phytosanitary quality of seed: initial investigations in Kosovo and problems related to the detection of regulated *Xanthomonas* affecting pepper seeds, and first seed disinfection trials. – 76 p.

Abstract: Seed production and quality in Kosovo was studied by interviewing public institutions, agropharmacies, agronomists and farmers with a questionnaire. The results highlighted that there is no vegetable seed production in Kosovo, and very little knowledge or concern about bacterial and viral diseases. In addition, there are no specialized labs for seed analysis and analytical capacity is poor. Pepper seeds were collected from Serbian districts neighboring Kosovo to check for the presence of *Xanthomonas euvesicatoria*, and several seed samples tested positive using ELISA. Two kinds of DNA extraction procedures were attempted: heat shock and the DNeasy Plant Mini Kit. Differences in detection sensitivity were seen from analyzing samples after both different extraction procedures. A set of *Xanthomonas euvesicatoria* isolates was obtained through direct isolation, and these were subjected to genotyping with rep-PCR. Seed sanitation was attempted using three common chemicals: chlorine, hydrogen peroxide and peroxy-acetic acid. Germination of seeds after chemical treatments showed that the chemicals used affected the germination rate.

Keywords: seedborne pathogens, molecular detection, *Xanthomonas euvesicatoria*, rep-PCR, genotyping.

744. EL-HAJJI Mariam (Morocco)

Supervisors: F. Santoro, D. Frasheri and F. Valentini; advisors: G. Cataldi and S. Gualano

Title: Serological and hyperspectral assessment of *Xylella fastidiosa* distribution in the canopy of olive cvs Cellina di Nardò and Leccino. – 68 p.

Abstract: *Xylella fastidiosa* has received much attention after its outbreak in the olive groves of Puglia region, (southern Italy) in 2013. Effective sampling and detection methods are an essential priority to determine and delimitate the infected areas; moreover, the wide host range and the abundance of insect vectors suggest that appropriate management such as the use of resistant cultivars is the strategy to prefer. Our study aimed to compare the distribution of *Xylella fastidiosa* infection in canopies of different olive cultivars, using DTBIA technique, and to evaluate a set of vegetation indices that could be the indicators of *Xylella fastidiosa* presence. Sampling was performed in a small commercial orchard in the outbreak area in four different periods. Ten plants belonging to two Italian cultivars were investigated. Results showed a highly significant difference in the infection rate according to the cultivar. Cv. Cellina Di Nardò was the most infected one with 88% of positive results compared to cv. Leccino with only 7% of positive samples. In cv. Leccino, the infection was concentrated in the basal part of the canopy with 48% of total positive results; in contrast, in cv. Cellina di Nardò, the infection was homogeneously distributed throughout the canopy. The WI and Index-SPAD were the best indicators to detect *Xylella fastidiosa* infection regardless of the cultivar and the sampling time.

Keywords: olive, vegetation indices, *Xylella fastidiosa*, cultivar, DTBIA.

745. OUSSOUQE Tarik (Morocco)

Supervisors: A. Mazih and M. N. Hassan; advisor: K. Djelouah

Title: Development of integrated control programs using Ceranock "Attract and kill" system and *Metarhizium anisopliae* to prevent *Ceratitis capitata* damages in Citrus orchards. – 59 p.

Abstract: This study investigated the potential of Ceranock "attract and kill" system and the entomopathogenic fungus *Metarhizium anisopliae* to control *Ceratitis capitata* (Med-fly) infestation. Two control strategies were evaluated under field conditions in two citrus orchards located in the Souss Massa region of south-eastern Morocco. The first control strategy (S1) used 100 Ceranock female bait stations and 100 g of Ceranock male gel per hectare, while the second strategy (S2) used 50 Ceranock female bait stations, 50 g of Ceranock male gel and a ground application of *M. anisopliae* KN14. Results indicated that both strategies restricted fruit infestation to 0.7% and 0.72%, respectively. In addition, they proved to be successful in substantially reducing the Med-fly population to 44.9 % and 41.7%, respectively. On the other hand, a laboratory bioassay was used to assess the pathogenicity of *M. anisopliae* KN14 against different life stages of *C. capitata*, and mortality rates were 70.53%, 60.91% and 15.29% of the 3rd instar larvae, pupae and adults, respectively.

Keywords: entomopathogenic fungus, biocontrol, bait station, med-fly, Morocco.

746. KHEDHER Jihene (Tunisia)

Supervisor: T. El Beaino; advisor: M. Digiario

Title: Investigation of viral diseases in an Apulian fig germplasm collection. – 51 p.

Abstract: A field survey was carried out during Sept-Oct 2014 in an Apulian fig germplasm collection plot in order to evaluate the sanitary status of 74 fig varieties for the presence of eight viruses infecting fig in nature. RT-PCR assays were conducted on reverse-transcribed TNA extracted from all the varieties and showed that 97% of plants were infected at least by one virus. The most prevailing viruses in the tested material were Fig Badnavirus (FBV, 88%) and Fig mosaic virus (FMV, 69%), whereas the others, i.e. Fig leaf mottle-associated virus 1 (FLMaV-1), FLMaV-2, Fig mild mottling-associated virus (FMMaV), Fig latent virus 1 (FLV-1), Fig cryptic virus (FCV) and Fig fleck-associated virus (FFkaV) were present to a lesser extent. In addition, seventeen fig accessions from different varieties were subjected to different sanitation techniques (thermotherapy and/or tissue culture) with the aim of producing healthy fig plantlets for use in a future certification program. After sanitation, repeated RT-PCR tests showed that FLV-1 and FBV resisted the sanitation attempts, whereas a high sanitation rate was obtained for FLMaV-2, FMMaV, FMV and FFkaV. In contrast, FLMaV-1 was still present in some samples.

Keywords: *Ficus carica*, Apulia, viruses, RT-PCR and sanitation.

747. AKIN Mehmet Ali (Turkey)

Supervisor: P. Kinay; advisors: T. Yaseen and A. Ricelli

Title: Ozone as post-harvest treatment to control fungal contamination and mycotoxins in Sultana seedless raisins. – 56 p.

Abstract: Raisin production has a significant role in Turkey. Unfortunately, climatic conditions in the production areas are suitable for fungal contamination. Fungal contaminants include black *Aspergilli* (BA), which are an important problem since some can produce ochratoxin A (OTA), a toxic metabolite. Several methods have been used to control the growth of fungal infections (e.g. chemical treatments), but none has proved decisive. In recent years the use of ozone has aroused great interest, since ozone has a high antimicrobial activity and is generally recognized as safe. BA isolates at three production sites in Turkey were surveyed and their potential for OTA production was verified. Tentative morphological methods and unambiguous molecular techniques were used to identify BA isolates belonging to *A. carbonarius* and *A. niger*, and the effect of gaseous ozone treatment of raisins on fungal development was investigated. The results obtained showed that ozone doses of 50, 100 and 150 mg/l applied during 2 hours significantly reduced fungal growth and OTA production in comparison to untreated raisins. However, there was no significant difference between treatment doses.

Keywords: grape cultivation; Black *Aspergilli*, ochratoxin A control.

IPM - A.Y. 2015-2016 (July session) – 778-791

778. KOKICI Hysen (Albania)

Supervisors: R. Uka and D. Frasheri

Title: Preliminary results on olive entomofauna in Albania, with a particular focus on Hemiptera (Fulgoromorpha and Cicadomorpha). – 41 p.

Abstract: An investigation on the entomofauna of olive orchards, with a particular focus on *Auchenorrhyncha* species, was carried out in two regions of Albania (Vlora and Tirana) between summer 2015 and spring 2016. The research aimed at investigating the evolution of olive entomofauna focusing on the presence of potential vector species of the bacterium *Xylella fastidiosa* in olive orchards in order to have a preliminary estimation of a potential spread in case of an outbreak in Albania. An ecological analysis was performed to define the composition of insects population in the two study areas. A total of 525 specimens (11 species, 7 sites) were captured in Vlora and 930 (11 species, 7 sites) in Tirana. The species were much more widespread in Vlora. Most of the *Auchenorrhyncha* species collected were present in both study areas. In addition, *E. exitious* (Cicadellidae) was only found in Tirana whereas *Cercopis* spp. (Cercopidae), was only present in Vlora. According to the spread rate, the presence of the xylem feeder, *P. Spumarius*, and of the phloem feeder, *Euscelus* spp., was slightly higher in Tirana compared to Vlora, whereas *N. campestris* and *C. vulnerata* were equally present in both areas.

Keywords: *Auchenorrhyncha* vector, *Xylella fastidiosa*, *Philaenus spumarius*, spread rate.

779. AIT MOHAMED Mohamed (Algeria)

Supervisor: T. Yaseen

Title: Study on the effect of ozone on the expression of genes related to plant defence mechanisms in Citrus fruits. – 53 p.

Abstract: Decay is an important limiting factor in post-harvest. Among a number of new strategies to control postharvest decay, natural resistance defense becomes a promising issue to investigate. Indeed, elicitors are agents that can induce a range of defense mechanisms in plant tissue. This characteristic results in a broad spectrum of metabolic modifications such as Systemic Acquired Resistance (SAR), Induced Systemic Resistance (ISR) and production of Reactive Oxygen Species (ROS). In this study we evaluate the expression level of genes that encode Beta-1,3 Glucanase (GNS1), Chitinase (CHI1), Phenylalanine-Ammonia Lyase (PAL1) and Peroxidase (POD1) in Navel sweet orange treated with two elicitors: ozone and *Penicillium digitatum*. Gene expression, evaluated by Quantitative Reverse Transcriptase PCR (qRT-PCR), showed that ozone increased the transcription of GNS1 gene (22 times), and CHI1 gene (21 times) as compared to the control after 24 and 48 hours of treatment. Unexpectedly, the inoculation by *P. digitatum*, followed by ozone treatment, was less effective in expressing the tested genes. Overall, we consider that ozone can enhance the genes related to SAR (CHI1 and GNS1) in non-inoculated fruits. Therefore, ozone can be used as post-harvest treatment immediately after picking, before the exposure of fruits to pathogens.

Keywords: ozone, *Penicillim digitatum*, post-harvest, gene expression, SAR, RT-qPCR.

780. LAIDANI Meriem (Algeria)

Supervisors: T. Yaseen and A. Carlucci

Title: Amplification and sequencing of the Intergenic spacer region (IGS) of *Phaeoacremonium* spp. and *Pleurostomophora richardsiae* for the development of specific a PCR-based detection method. – 43 p.

Abstract: The Olive Quick Decline Syndrome (OQDS) in Southern Italy is associated with *Xylella fastidiosa* and a set of aggravator fungi, such *Phaeoacremonium* spp. and *Pleurostomophora richardsiae*. Distinguishing between these fungi, using conventional molecular methods, is very difficult and time-consuming requiring the sequencing of several target genes. The aim of this study was to simplify the detection of four *Phaeoacremonium* spp. and *Pl. richardsiae*, by amplifying, cloning and sequencing the intergenic spacer (IGS) rDNA region. 3000bp was amplified and cloned of *Pl. richaradsiae* and *Pm. sicilianum*, and ~1500bp for the other species. Sequencing results show high homology of 28S and 18S rDNA regions of all the sequenced fungi. *Pl. richardsiae* sequences revealed a homology with *Pleurostomophora* spp. 28S and 18S regions, respectively with 89% and 95% similarity. Likewise, *Pm. sicilianum* sequences revealed a homology with *Phaeoacremonium* spp. 28S and 18S regions, respectively with 90% and 95% similarity. New partial IGS sequence was obtained (907bp) of *Pm. sicilianum* and (937bp) of *Pl. richardsiae*. Sequencing is still ongoing, internal primers were designed for *Pl. richardsiae* and *Pm. sicilianum* to recover the whole IGS region using primer-walking. This region represents an interest in the development of a PCR specific detection of OQDS associated fungi.

Keywords: OQDS, *Phaeoacremonium* spp., *Pleurostomophora richardsiae*, IGS rDNA region, sequencing, PCR specific detection.

781. AL-ZUHAIRI Inas Mudhafar Noori (Iraq)

Supervisor: R. Buonauro ; **advisors:** C. Moretti and F. Valentini

Title: Molecular characterization of Italian populations of bacterial endophytes isolated from olive knots caused by *Pseudomonas savastanoi* pv. *Savastanoi*. – 53 p.

Abstract: Olive knot disease caused by *Pseudomonas savastanoi* pv. *savastanoi* is considered one of the most serious diseases affecting olive in most olive-growing countries worldwide and especially in Mediterranean countries. Recent studies have shown that knots caused by the pathogen contain a multispecies bacterial community and that bacterial species of this microbiome collaborate with the pathogen in modulating the disease severity. Among these bacteria, those belonging to *Pantoea*, *Pectobacterium*, *Erwinia*, and *Curtobacterium* genera are prevalent. The aim of my MSc thesis is to characterize endophyte populations, especially those belonging to *Pantoea* and *Erwinia* genera isolated from olive knots collected in some Italian regions. The molecular characterization of endophyte populations will be facilitated by information obtained from genomes of three olive knot endophytes (*Pantoea agglomerans*, *Erwinia toletana* and *Erwinia oleae*), which have been recently sequenced. At the moment, I obtained about 80 bacterial isolates, which have been partially characterized through basic microbiology tests: cultural morphology, KOH solubility and oxidative/fermentative metabolism. Many other traditional and molecular tests are necessary to correctly identify the

endophytes. When the identification of isolates will be concluded, the objectives of my thesis will be: i) characterizing the isolates at molecular level by rep-PCR; and ii) verifying the presence of specific genes (e.g. hrp cluster) by PCR and Southern blot.

Keywords: *Pseudomonas savastanoi* pv. *savastanoi*, microbiome, endophytes, PCR, Southern blot.

782. ARIF Mokhtar Abdulsattar (Iraq)

Supervisor: S. Colazza ; **advisors:** S. Guarino and K. Djelouah

Title: Host plant volatile compounds for the management of *Bagrada hilaris* Burmeister (Heteroptera: Pentatomidae). – 72 p.

Abstract: *Bagrada hilaris* is an herbivorous insect native of Asia and Africa that invaded Southern Europe and North America where it causes major damage to cole crops. Laboratory experiments were conducted by using *Brassica oleracea* as host plant to quantify the damage caused by 15 or 40 individuals/plant. Olfactometer bioassay was undertaken to assess the role of VOCs attraction of *B. hilaris* individuals to the *B. oleracea* healthy or damaged by 15 or 40 individuals of *B. hilaris*. Other experiments were done in olfactometer by using synthetic chemical compounds previously identified as host plant VOCs: octanal, nonanal, benzaldehyde and acetic acid, tested in blend and individually. Furthermore, the VOCs produced from healthy and bug damaged plants were collected by SPME fiber and analyzed by GC/MS. Feeding damages of *B. hilaris* were more abundant at 40 individuals/plant rather than 15 individuals/plant. *B. hilaris* were attracted to volatiles of healthy and bug damaged plants, in particular showing preference for heavy damaged plants. Attraction response was determined also by to the blend of chemical compounds at 100 µg and individually to benzaldehyde while nonanal determined repellency. VOCs analysis didn't show any statistical difference; however, the higher amounts of benzaldehyde in damaged plant confirm olfactometer results.

Keywords: painted bug, visual damage, volatile organic compounds (VOCs), olfactometer.

783. FENJAN Saleh Falih (Iraq)

Supervisor: E. Conti ; **advisors:** G. Rondoni and K. Djelouah

Title: Molecular detection of trophic interactions among lady beetles and aphids in Melon crops. – 49 p.

Abstract: Molecular tools that describe the complex food webs and identify trophic interactions in the field have become widely adopted in recent years. In this study, we used PCR as a tool to detect prey remains in the guts of predators. The main objectives were to evaluate the predation and intraguild predation (IGP) among the coccinellid species *Coccinella septempunctata* and *Hippodamia variegata*, predators of *Aphis gossypii* under field conditions, and to check whether intraguild predation is likely to reduce biological control. Species-specific primers were developed targeting the COI gene region in mtDNA of the investigated insects. The primers were specifically designed for *A. gossypii* and *H. variegata*, whereas already published primers were used to amplify the ITS-1 region in rDNA of *C. septempunctata* and the COI region of Aphididae. Primers detectability was tested using feeding trails, and was 13.41 ± 1.99 for *H. variegata* and 9.0 ± 1.7 for *C. septempunctata*. Predation rate of coccinellids feeding on aphids was 71.53% for *C.*

sempunctata and 60.61% for *H. variegata*. The IGP was significantly higher for *C. septempunctata*, as 26% of this species preyed on *H. variegata*, while 13.63% of *H. variegata* preyed on *C. septempunctata*. Effects of intraguild predation on biological control are discussed.

Keywords: molecular techniques, predation, intraguild predation, species-specific primers, *Coccinella septempunctata*, *Hippodamia variegata*, *Aphis gossypii*.

784. ALSAHELI Zeinab (Lebanon)

Supervisor: T. Elbeaino ; **advisor:** F. Valentini

Title: MultiLocus Sequence Typing of *Xylella fastidiosa* infecting different plant host species in Apulia. – 38 p.

Abstract: The recent emergence of *Xylella fastidiosa* (Xf) in Italy raised several concerns for risks and impacts of this pathogen on the EU agriculture. Accordingly, an urgent research dealing with biological, molecular and epidemiological features of Xf is required. A MultiLocus sequence typing analysis (MLST) were applied to the plant pathogen (Xf) using an initial set of sequences for 7 housekeeping genes (cysG, gltT, holC, malF, leuA, nuoL, and petC) of six isolates from six different host plants in Apulia, Italy: almond (*Prunus dulcis*), oleander (*Nerium oleander*), lavender (*Lavandula angustifolia*), Mediterranean buckthorn (*Rhamnus alaternus*), golden wattle (*Acacia saligna*) and pelargonium (*Pelargonium odoroso*), in order to ascertain whether another Xf strain is cohabiting olive, different from that previously identified on olive (CoDiRO) in Apulia. The sequences of seven housekeeping genes, normally used in MLST, showed that all the six isolates were indistinguishable from strain CoDiRO, with a sequence type (ST53), and assigned to Xf subsp. *pauca*. Furthermore, this study showed that *Pelargonium odoroso* is a novel plant host species for Xf, never reported before in the epidemic area of Apulia.

Keywords: *Xylella fastidiosa*, MLST, sequence analysis.

785. MALEK Robert Nehme (Lebanon)

Supervisor: E. Conti ; advisors: G. Rondoni and K. Djelouah

Title: Direct and indirect responses of *Vicia faba* to oviposition and feeding by the Brown Marmorated Stink Bug, *Halyomorpha halys* (Heteroptera: Pentatomidae). – 81 p.

Abstract: The Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), is an invasive pest in the U.S. and Europe, attacking over 100 hosts of fruit trees, vegetables and ornamentals. To evaluate indirect plant responses, behavioral bioassays were conducted in a Y-tube olfactometer with two generalist egg parasitoids, *Trissolcus basalis* (Wollaston) and *Trissolcus brochymenae* (Ashmead). Our findings revealed that faba bean (*Vicia faba* L.) volatiles induced by *H. halys* feeding, or feeding and ovipositing, failed to attract the wasps when compared with clean plants. However, *T. basalis* positively responded to synomones induced through feeding and oviposition by the native Green Stink Bug, *Nezara viridula* (L.). The aforementioned confirms the lack of adaptability between the invasive *H. halys* and native wasps. In contrast, faba bean exhibited direct responses to *H. halys* attack. In fact, *H. halys* nymphs developing on plants challenged by feeding and oviposition, weighed significantly less than nymphs developing on feeding treated plants. Thus, we report for the first time the priming of direct defenses of *V. faba* by *H. halys* oviposition. Finally, the relative expression of trypsin inhibitory genes was investigated. qRT-PCR analysis displayed considerable expression of "STCI" and "iaTI" in *V. faba*, when exposed exclusively to feeding, or feeding plus oviposition.

Keywords: *Halyomorpha Halys*, Tri-Trophic Interaction, plant memory, direct defense, protease inhibitors, co-evolution, indirect response.

786. BIBI Imane (Morocco)

Supervisors: M. Afechtal and K. Djelouah ; advisor: A. Remah

Title: Survey and molecular characterization of *Pepino Mosaic virus* (PepMV) infecting tomato crops in Morocco. - 75 p.

Abstract: *Pepino mosaic virus* (PepMV) is currently causing great concern in the Moroccan greenhouse tomato industry, where it produces important economic losses. A survey was conducted from October 2015 to April 2016 on PepMV in seven different regions throughout Morocco. In a few plants, severe symptoms which could be associated to the virus were observed. A total of 315 samples of different varieties were collected and tested by DAS-ELISA for the presence of PepMV using a commercial kit. The obtained results showed that PepMV was widely distributed in the country with an infection rate of 21%, especially in the region of Souss Massa where 70% of the tested plants were infected. Representative samples from each region were selected and submitted for additional RT-PCR testing; 40% of the 83 tested samples were infected. Five isolates were selected for molecular characterization by sequencing the coat protein gene; all the isolates showed high nucleotide similarity with the Chilean CH2 strain (DQ000985), with a sequence homology ranging from 99.2% to 99.8%. These results should be considered for the development of control strategies for PepMV based on cross-protection using mild strains. Furthermore, the present study allowed the first report of Tomato torrado virus in the country.

Keywords: tomato, Pepino mosaic virus, survey, DAS-ELISA, RT-PCR, characterization, Morocco.

787. JLILAT Asmae (Morocco)

Supervisors: F. Santoro and F. Valentini ; **advisors:** D. Frasheri and S. Gualano

Title: Assessment of trees suspected to show Olive Quick Decline Symptoms from photointerpretation of high resolution aerial images of a *Xylella*-free area. – 55 p.

Abstract: Since the disastrous introduction of *Xylella fastidiosa* (XF) in Italy, severely affecting olive trees, an early detection of new infected areas has become compulsory. In fact, the IAMB laboratory has developed a monitoring model for the rapid detection of suspected Olive Quick Decline Syndrome (OQDS)-infected plants. Through the use of the photointerpretation technique of aerial images and a field application "XylApp" for data acquisition, it was possible to inspect different aspects of stress visualised on the trees recognized by a phototypes key. "XylApp" allowed to localise all the photointerpreted plants. The results showed that no symptoms of OQDS were found in the study area and all the inspected plants tested by DTBIA resulted negative. The inspected trees were classified on the basis of perceived symptoms in the field; 68.29% displayed OQDS-like symptoms, 10.07% with biotic and abiotic stress, 11.74% of pruned plants with mild forms of stress, 6.54% of pruned plants in excellent condition and 2.18% without problems. The statistical analysis demonstrated that there is no correspondence between the OQDS-photointerpretation levels and the phytosanitary status of the plants, while there is a significant relationship between the cultural conditions of the field and the agro-phytosanitary status of the inspected plants.

Keywords: *Xylella fastidiosa*, OQDS-like, detection, photointerpretation, aerial images, XylApp.

788. MRICH Adil (Morocco)

Supervisor: Z. Ferji ; **advisor:** K. Djelouah

Title: Anti-nematode effect assessment of some medicinal plants against *Meloidogyne* spp. on tomato in Morocco. – 90 p.

Abstract: Two experiments were carried out to evaluate the nematicidal potential of aqueous extracts of three plants species in vitro, and of oils of two others plants species in vivo against *Meloidogyne* spp. In the first experiment, aqueous extracts were prepared from olive leaves (*Olea europea*), eucalyptus leaves (*Eucalyptus globulus*) and kurrajong seeds (*Brachychiton populneus*); concentrations of 10%, 1%, 0.1%, 0.01% and 0.001% of each aqueous extract were applied in Petri dishes containing newly hatched second stage larvae of *Meloidogyne* spp. Significant nematostatic effect is provided by the 10% concentration which induces immobility rate of 91.66%, 88.33% and 68.33% for *Brachychiton populneus*, *Eucalyptus globulus* and *Olea europea* respectively after 72 hours of exposure. However, the lethal effect of these extracts did not exceed 64% after 96 hours of exposure. In the second experiment, oils were extracted from *Artemisia herba-alba* and *Artemisia absinthium*; three oil concentrations (200, 500 and 1000 ppm) plus the most used chemical in Souss-Massa region (Rugby 10ml/pot) were applied on potted tomato plants following completely randomized block design. All concentrations contributed to decrease the presence of *Meloidogyne* larvae and root damages compared to positive control; chemical control with oils of *Artemisia herba-alba* and *Artemisia absinthium* at the concentration of 1000 ppm provided

the highest nematicidal effect with a reduction rate reaching 84%, 81.1% and 79% respectively.

Keywords: *Meloidogyne* spp, nematostatic, nematicidal effect, *Olea europea*, *Eucalyptus globulus*, *Brachychiton populneus*, *Artemisia herba-alba*, *Artemisia absinthium*.

789. ALSABAWI Fatma M. M. Faten (Palestine)

Supervisors: V. Mazzoni and F. Valentini ; **advisor:** D. Lorusso

Title: Investigation on the *Xylella fastidiosa* dispersal ability through the vector *Philaenus spumarius* (L.) and other potential vectors: *Neophilaenus campestris* and *Euscelis lineolatus*. – 58 p.

Abstract: *Xylella Fastidiosa* (Xf) is a bacterium that colonizes the xylem vessels of numerous plants and is transmitted by hemipteran insects of the Cicadomorpha suborder. In Apulia region, the presence of Xf has been associated with a disease called Olive Quick Decline Syndrome. The management of vectors is essential to limit the spread of the disease but neither information about their mobility nor about the distance range through which they can carry the Xf bacterium are known. Therefore, this research aimed at studying the Xf dispersal due to vector mobility between infected and buffer zones. Three Cicadomorpha can be infected by Xf, that is *Philaenus spumarius* (Aphorophoridae), *Neophilaenus campestris* (Aphorophoridae) and *Euscelis lineolatus* (Cicadellidae), which were sampled. Potential vectors of Xf specimens were collected in olive orchards in three different seasons (October 2015, February and April 2016). The samples were inspected to detect Xf infection by means of Real Time-LAMP protocol. Based on the results obtained 44% of the collected individuals were found positive in the buffer zone, 55% of them at 4 km distance from the infected zone. Data showed that monitoring the presence of spy insects (i.e. potential vectors) can be a useful approach to provide, indirectly, an indication of the presence of Xf in asymptomatic areas.

Keywords: spy insect approach, Apulia region, Real Time-LAMP Detection, ICegene device, buffer zone.

790. BELGACEM Imen (Tunisia)

Supervisor: T. Elbeaino ; **advisors:** D. Gallitelli and M. Digiaro

Title: Sequence completion and molecular analyses of RNA-1 and RNA-2 of *Artichoke Italian latent virus* from grapevine and RNA-2 of gladiolus and artichoke isolates. – 39 p.

Abstract: The complete sequences of *Artichoke Italian latent virus* (AILV) from grapevine isolate (AILV-V) (RNA-1, 7,338 nts and RNA-2, 4,630 nts) and the RNA-2 sequences (4,629 nts) of two AILV isolates recovered from gladiolus and artichoke (AILV-G and AILV-C, respectively) were determined. All RNAs contained a single open reading frame encoding polyproteins of 255,76 kDa for AILV-V RNA-1, and 149.62 KDa, 149.58 kDa and 149.58 kDa for AILV-V, AILV-C and AILV-G RNA2, respectively. P1 of AILV-V showed the highest amino acids (a.a) identity with Tomato black ring virus, TBRV (79 %), whereas p2 of the three AILV isolates showed the highest a.a identity with TBRV and *Grapevine Anatolian ringspot virus* (GARSV). Among the three isolates, P2 of AILV-C and AILV-G were the closest, sharing 90% of identity. The phylogenetic tree analysis confirmed the close relationship of AILV isolates with members of subgroup B of the genus Nepovirus.

All recombination programs used highly predicted putative inter- and intra-species recombination events between AILV and nepoviruses of subgroup B [(GARSV, TBRV and *Grapevine chrome mosaic virus*, GCMV)] and AILV isolates, respectively. This study reports for the first time the full genome sequences of AILV from grapevine and AILV RNA-2 from gladiolus and artichoke.

Keywords: *Artichoke Italian latent Virus*, nepovirus, RACE-PCR, RT-PCR, cloning, sequencing, recombination.

791. BOUKHILI Naziha (Tunisia)

Supervisors: N. Mahfoudhi and M. Digiario ; **advisor:** T. Elbeaino

Title: Incidence and molecular variability of Tunisian *Grapevine virus D* isolates. – 34 p.

Abstract: In autumn 2015, 353 grapevine samples were collected from Tunisian vineyards and assayed in RT-PCR for the presence of *Grapevine virus D* (GVD), a vitivirus associated with Rugose wood disease complex. RT-PCR showed that GVD was present in almost all cultivars analyzed. The highest infection rate was in table grapes (52.9%), with peaks in cv. Muscat d'Italie (82.6%). All wine cultivars tested had GVD infection levels ranging from 22.7% to 27.5%. Among rootstocks significant was the infection in 1103P (30%). GVD was also detected in 3 out of 63 (4.8%) spontaneous grapes of *Vitis sylvestris*. The analysis of partial nucleotide sequences of the coat protein genomic region (474 nt long) of 14 GVD isolates obtained in this study, and of other 13 isolates (11 from a previous study in Tunisia and 2 from Italy and Brazil, respectively, recovered from Genbank), showed a nucleotide identity ranging from 82.4% to 100%, except for the isolate GVD-Tun7, whose identity with all the other isolates was always below 80%. The phylogenetic tree designed on the same RNA segment revealed the presence of 7 different groups of GVD isolates, without apparent correlations with the geographic origin or category of grapes.

Keywords: *Vitivirus*, rugose wood, Tunisia, grapevine, RT-PCR, phylogenetic tree.

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804. SADALLAH Abderraouf (Algeria)

Supervisor: T. Elbeaino

Title: Molecular, biological and epidemiological analyses of a novel Caulimo-like virus infecting olive (*Olea europaea* L.). – 56 p.

Abstract: The full-length genome sequence of a novel olive-infecting virus, for which the provisional name Olive latent virus 4 (OLV-4) is proposed, was determined by Next-generation and conventional sequencing. Its genome comprises 8940 nt, covering four open reading frames (ORFs), i.e. the putative coat protein (CP), movement protein (MP), Reverse-transcriptase (RT) and Translational transactivator (TAV) proteins, with an estimated molecular weight of 52.7, 51.5, 77.3 and 45 kDa, respectively. All genes shared the highest identity (ca. 35%) with members of Solendovirus and Cavemovirus genera of the family Caulimoviridae. The phylogenetic tree constructed with the amino acids of RT\RNase H domains sequences allocated OLV-4 close to both genera but in a single clade as a distinct species of a new putative genus. Based on PCR assays results, OLV-4 was found (i) to be prevalent in ca. 67.5% of olive trees, without being associated to any apparent symptom in infected trees, (ii) to be present in the outer membrane of the exine of pollen (iii) to be carried by five different insects species and (iv) to be transmissible to progeny olive seedlings and mechanically to an herbaceous host, i.e. *Nicotiana occidentalis*.

Keywords: Olive latent virus 4, Olive-infecting virus, Caulimoviridea, PCR.

805. AMER Iman (Egypt)

Supervisors: A. Hussien, N. Moussa Balabel and Th. Yaseen

Title: Assessment of Real Time Loop-Mediated Isothermal Amplification (LAMP) assay for the detection of *Ralstonia solanacearum*. – 72 p.

Abstract: *Ralstonia solanacearum* is the causal agent of bacterial wilt disease and considered as one of the most economic destructive plant pathogenic bacterium. *R. solanacearum* enlisted on most of quarantine plant pathogens worldwide. Therefore, rapid and accurate detection methods are significant factor to prevent the entrance and reduce the risk of spread of the bacterium in healthy regions. Several serological and molecular detection methods have been developed for *R. solanacearum*. The objective of this study was to assess the sensitivity of an innovative Real time LAMP method in comparison to standard serological (IFAS) and molecular methods (conventional PCR and RT-PCR). In addition, we evaluated the efficiency of three DNA extraction protocols from different matrixes (potato extract, soil extract and irrigation water). Results showed higher analytical sensitivity of Real time LAMP method as compared to IFAS, PCR and Real time PCR. Real time LAMP seems to be more tolerant against inhibitors presented in natural matrix, with detection limit 10-fold more sensitive than PCR methods. BioSprint 15 and CTAB DNA extraction methods improve the sensitivity of RT-LAMP and PCR assays respectively. Real time LAMP is a promising technique for rapid and high sensitivity detection of *R. solanacearum* in environmental samples.

Keywords: real-time LAMP, *Ralstonia solanacearum*, DNA extraction, bacterial wilt disease.

806. BADRA Zaid (Jordan)

Supervisors: L. Maistrello and K. Djelouah

Title: Potential and effectiveness of Mediterranean native generalist predators on the invasive alien species *Halyomorpha halys* (Heteroptera, Pentatomidae). – 54 p.

Abstract: *Halyomorpha halys* (Stål) was detected in Italy in 2012 and since then it has spread rapidly, causing severe economic losses on fruits and vegetables. However, little is known about the potential predators of *H. halys* in its invaded range. Laboratory trials were conducted on six taxa of predatory or omnivorous insects to evaluate their capacity to consume eggs, 1st, 2nd instar and one predator against the adults of *H. halys*. Survival rate of control preys in predator-excluding cages was compared to predator treatment groups to determine the effect of predator presence. Findings suggest that none of the predators was able to significantly decrease the survival rate of eggs and of 1st instar nymphs, although in some cases occasional predations on the 1st instar nymphs by few predators was observed. Only the reduviid *Rhynocoris iracundus* was able to decrease significantly the survival rate of the 2nd instar nymphs and of the adult stage. Our results demonstrated that predation tests on egg masses alone may underestimate the impact of generalist predators on other *H. halys* life stages. This is the first study performed in the European and Mediterranean areas on screening ability of some native species to predate eggs and younger nymphs of *H. halys*.

Keywords: biological control, arthropods, pest, prey, predation.

807. AKASSOU Imane (Morocco)

Supervisors: Th. Yaseen and F. Nigro

Title: Development of Real time Loop-Mediated Isothermal Amplification assay for the detection of *Verticillium dahliae* in plant material as compared with Real time PCR and conventional PCR. – 38 p.

Abstract: The use of pathogen-free planting material is a key control measure for the efficient management of *Verticillium wilt* caused by the soil born pathogen *Verticillium dahliae*, in order to prevent the spread of the disease and the introduction of the pathogen into disease-free soils. Phytosanitary certification of plant propagative material depends on the availability of specific, and sensitive diagnostic tools. Loop-mediated isothermal amplification (LAMP) technique emerged as one of the simplest, fast, and accurate in diagnosing plant pathogens. The main aim of this work was the development of LAMP protocol, for on-site real time detection, of *V. dahliae*, in host plants. The use of infected plant sap as a template in LAMP reaction, amplified before the DNA sample extracted from the same infected plant stem samples. Furthermore, a comparison of LAMP and real time PCR demonstrated that LAMP is better than the real-time PCR protocol used, in terms of detecting a higher percentage of positive results from artificially infected plants with *V. dahliae*, moreover, LAMP was able to detect the pathogen starting from 7 days after the inoculation; which makes implementation of this technique suitable for early detection of *V. dahliae* and appropriate for certification schemes of pathogen-free planting material.

Keywords: Verticillium wilt, diagnosis, specificity, defoliating, non-defoliating.

808. GHANEM Mohamed (Morocco)

Supervisors: A. Mazih, M. N. Hassan and K. Djelouah

Title: Laboratory and field studies on biorational control strategy of tomato leaf miner Tuta absoluta Meyrick (Lepidoptera: Gelechiidae), in Morocco. – 53 p.

Abstract: Tuta absoluta causes serious damages on tomato crop in Morocco, particularly where the natural enemies' populations are weakened by the heavy use of broad-spectrum insecticides. Instead of resolving the problem, these sprayings further complicate the management of this pest. As a result, in order to develop a biorational strategy against the tomato leaf miner in Morocco, laboratory studies were carried aimed at assessing the efficacy of 0.1% azadirachtin and 5% abamectin on the larvae and of 2% Metarhizium anisopliae on the pupae. The efficacy of these biopesticides was also comparatively validated on the tomato variety Prystila under greenhouse conditions. Statistical analysis of laboratory findings proves a highly significant difference between the treatments and indicate that 5% abamectin % mixed with 0.1% azadirachtine ensures 100% mortality as against 84.8% and 77.3 % respectively, with only abamectin or azadirachtine. In contrast, M. anisopliae reduces emergence by 26.7% and causes a 65.2% pupae mortality. Under greenhouse conditions, soil applications of M. anisopliae does not show any effect on the foliar damage induced by T. absoluta. In contrast, abamectin can keep damage to a level between 4% and 8%, compared to the azadirachtin/abamectin mixture, which can keep damage to a level between 1 and 3%.

Keywords: azadirachtin, abamectin, Metarhizium anisopliae, emergence.

809. HANANI Arafat (Palestine)

Supervisor: K. Djelouah

Title: Further investigations on the putative causal agent/s of the emerging Volkamer lemon disease threatening the citrus industry in Egypt. – 51 p.

Abstract: Volkamer disease is an emerging serious rootstock disease appeared to affect Volkamer lemon rootstock in the Mediterranean basin when tolerant rootstocks were introduced to control citrus tristeza disease. The disease is devastating citrus grown in the Egyptian newly reclaimed land. Diseased trees are usually stunted, and scraping the bark reveals gum deposits, phloem discoloration, and stem pitting. These symptoms resemble those of cachexia on mandarin and gummy bark disease on sweet orange. The disease incidence was correlated with hot climate and transmission potency, which has drawn the attention to consider citrus viroids and/or phytoplasmas as a putative causal agent. Molecular detection and characterization of several citrus viroids were performed on previously collected samples belonging to the newly reclaimed land in Egypt. Meanwhile, a biological assay of infected material was included in this investigation. Interestingly, all the assays disclosed and confirmed the absence of phytoplasmas. Whereas, HSVd and CBCVd were the most prevalent detected viroids in the symptomatic samples. Molecular characterization and biological indexing confirmed the severity of both viroids, indicating that the volkamer disease could be associated with single or mixed infection involving HSVd and CBCVd.

Keywords: CBCVd, HSVd, Molecular assays, biological indexing, rootstock.

810. CIUBOTARU Ramona (Romania)

Supervisors: M. Digiario and T. Elbeaino

Title: Development and comparative analysis of RT-PCR and Real-Time (TaqMan®) PCR techniques for the detection of olive viruses. – 57 p.

Abstract: Real-time- and Multiplex-TaqMan RT-PCR assays were developed to detect single and multiple infections of five olive viruses, i.e. Arabis mosaic virus, Cherry leafroll virus, Strawberry latent ring spot virus, Olive latent ring spot virus and Olive leaf yellowing-associated virus. The newly designed primers and probes were constructed upon viral nucleotide sequences alignments of different isolates from Genbank, taken into consideration all degeneracies encountered at probes and primers sites. After validating the new techniques on 20 different isolates, both assays showed to be highly efficient and more sensitive than conventional RT-PCR (from 103 to 106 times, according to the virus). The quantitative real-time RT-PCR assay developed in this study to quantify RNA-targets of the five viruses in infected crude sap material was able to detect 0.25 fg up to 75pg viral RNA. In Multiplex-Real Time PCR all the five viruses in study were efficiently detected simultaneously. These two diagnostic techniques can be useful to control and limit olive virus spread and for supporting quarantine and certification programs.

Keywords: *Olea europea*, diagnosis, RNA transcript, real-time multiplex.

811. STANCIC Marko (Serbia)

Supervisor: F. Valentini

Title: Isolation and molecular characterization of *X. fastidiosa* from different hosts present in Apulia region (Italy). – 41 p.

Abstract: In 2013 a severe disease induced by *Xyllella fastidiosa* caused huge damages in the olive orchards of Apulia region, South Italy. CoDiRO strain, belonging to subspecies *pauca*, was found to be the only agent of the infection, and 30 plant species were confirmed to be susceptible to this pathogen. Unlike Italy, in France 2 different subspecies, comprising several strains, were detected. *Olea europaea* is commonly used for the pathogen isolation from plant tissues. The aim of this study was to identify suitable host species, besides the olive, for the bacterial isolation, in terms of growth time and culture purity, using different approaches. Isolations were carried out from 29 different host species which were found positive by ELISA and PCR tests. Samples were collected throughout the year, once or twice per month. Pure cultures were obtained from: *Olea europaea*, *Polygala myrtifolia*, *Nerium oleander* and *Lavandula angustifolia*. For most host plant species spring and early summer proved to be the best seasons for *X. fastidiosa* isolation. Subsequently, Multilocus Sequence typing (MLST) performed from the obtained isolates of *Lavandula angustifolia* and *Polygala myrtifolia* confirmed that all sequences have the same profile as CoDiRO strain, with no variation.

Keywords: *bacterium*, CoDiRO, infected zone, axenic culture.

812. CHAMMEM Hamza (Tunisia)

Supervisor: T. Elbeaino ; advisor: M. Digiario

Title: Developing molecular diagnostic tools for large-scale detection of Vitiviruses and study on their genetic population structure and transmission in grapevine. – 29 p.

Abstract: Eight sets of degenerate primers from the RdRp gene were developed for qualitative RT-PCR simultaneous detection of Grapevine vitiviruses GVA, GVB, GVD, GVE and GVF. Other species-specific primers were designed from two different genes for an accurate identification of isolates to test their genetic variability. The first were developed from the RdRp gene, whereas the second from different sequences of the entire CP of several isolates that are present in the gene bank. Moreover, trials of transmission of GVD, GVE and GVF were performed under screen house conditions to test their transmissibility by *Planococcus ficus*. The study has shown that the developed RdRp primers were able to detect up to 100% of the positive control samples, proving their reliability in preliminary first screening of vitiviruses in general. However, species-specific primers from the same gene were less successful. The use of specific primers from the CP gene provided information on the high genetic variability of GVA, GVB and GVE, while GVD and GVF had the most conserved CP sequences of the isolates. They also demonstrated that the clusters obtained from the phylogenetic trees' analyses present a geographical grouping of isolates. The transmission trials resulted in the transmission of GVE by *P.ficus*.

Keywords: simultaneous detection, genetic variability, phylogenetic tree, *Planococcus ficus*.

813. JERBI Nihed (Tunisia)

Supervisor: Th. Yaseen

Title: Innovative Postharvest Management to control Citrus sour rot. – 81 p.

Abstract: Sour rot of citrus fruit, caused by *Galactomyces geotrichum*, can cause important economic losses for postharvest citrus industry. Nowadays, no efficient control method against this pathogen is available. This work aims to evaluate the efficacy of some innovative control methods as ozone (O₃), electrolyzed water (EW), potassium sorbate (KS) and passive refrigeration system (PRS). *G. geotrichum* inoculated and non-inoculated citrus fruit were used to evaluate disease incidence, severity, pathogen sporulation, colony forming units (CFU), fruit hardness and sugar content. Results showed that 0.3 µl L⁻¹ of O₃ reduce disease incidence, severity and sporulation. Washing citrus with EW eliminates *G. Geotrichum* population and reduce disease severity under PRS. Moreover, mandarin fruit stored under PRS, EW +O₃, EW+KS+O₃ and KS display a better quality and a significant control of sour rot as compared to the control. In addition, treating Marzaiolo mandarino fruit with KS under PRS can reduce disease severity, incidence, sporulation and CFU of *G. geotrichum* by 82.02%, 57.89%, 94.12% and 90.69% respectively, without affecting the quality of the fruit stored. These results show that it is possible to control sour rot without affecting the quality of citrus fruit by low cost and easy to use strategies.

Keywords: *Galactomyces geotrichum*, passive refrigeration system, GRAS compound, electrolyzed water, washing process.

814. YILMAZ Salih (Turkey)

Supervisors: B. Kemal and K. Djelouah

Title: Detection and molecular characterization of Phytoplasmas affecting pepper in the Southeast region of Turkey. – 35 p.

Abstract: A wide survey was carried out in the Autumn time in intensive pepper (*Capsicum annum* L.) growing areas, including four provinces belonging to the

Southeast Region of Turkey, i.e. Sanliurfa, Kahramanmaras, Adana and Mersin, in order to identify pepper plants exhibiting phytoplasma-like symptoms, (yellowing, small leaf, chlorosis, short internodes and stunting) and detect/characterize the causal agent of these symptoms. DNA amplification by PCR and RFLP analysis using EcoRI restriction enzyme, confirmed the expected correlation between the symptoms observed and the presence of phytoplasmas in Sanliurfa and Mersin provinces. Sequencing and phylogenetic analysis revealed that Sanliurfa-TR isolate displayed 99% sequence identity with '*Candidatus phytoplasma trifolii*' (16SrVI) and fell within the Clover proliferation group (16SrVI-A). In contrast, the Mersin-TR isolate showed 96% sequence identity with '*Candidatus phytoplasma asteris*' (16SrI). Interestingly, this Mersin-TR isolate showed less than 97.5% similarity with any previously described '*Ca. Phytoplasma*' species. Consequently, the phytoplasma detected in Mersin may represent a new '*Candidatus Phytoplasma*' species and to our knowledge, this is the first report of asteris-like disease associated phytoplasma on pepper in Turkey.

Keywords: clover proliferation, phytoplasma disease, PCR, Mersin, *Candidatus phytoplasma trifolii*.

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844. SEVARIKA Milos (*Bosnia and Herzegovina*)

Supervisors: S. Colazza, E. Peri and K. Djelouah

Title: Measuring intrapopulation genetic variation of several behavioural traits in an egg parasitoid. – 38 p.

Abstract: The parasitoid females' ability to find their hosts is related to adopted searching behaviour strategy based on specific host-derived kairomones while foraging on a patch with the potential presence of a host. Phenotypic variation of behavioural response is associated with variation in the environmental factors. However, it is unclear whether this variation could be mediated by a genetic factor. In this study, we analysed this hypothesis by quantitative genetic methods, mother-daughter regression analysis and family analysis in the population of *Trissolcus brochymenae* (Hymenoptera: Platygasteridae), the main egg parasitoid of the harlequin bug, *Murgantia histrionica* (Heteroptera: Pentatomidae). Twenty-one families were established, within which 424 daughters' behaviour was analysed. Searching behaviour was analysed with 4 parameters: residence time; linear and angular speed, turning rate and parasitoids size. We demonstrated the existence of a statistically significant degree of intra-population genetic variation in analysed traits within the studied population. The ecological and evolutionary aspects of these results are discussed.

Keywords: Intra-population genetic variation, *Trissolcus brochymenae*, searching behaviour, parasitoids size.

845. ALASADI Ghazwan Jalil (*Iraq*)

Supervisors: F. Valentini, D. Frasheri, M. Gallo ; *advisor:* S. Minutillo

Title: Evaluation of the use of Sap extraction method for detection of *Xylella fastidiosa* & endophytic pathogens (Fungi) associated with Olive Quick Decline Syndrome. – 63 p.

Abstract: The finding of *X. fastidiosa* (Xf) in Puglia and in other areas of the European Union encouraged the necessity to investigate the presence of this pathogen in different host plants, through the application of serological and molecular techniques. Due to the fastidious behaviour of this bacterium to be isolated and/or extracted from infected plants, the detection remains one of the critical points for a successful diagnostic. Therefore, it has been necessary to use several approaches different from those used till now in conventional analysis. One of these approaches is the patented extraction method (CIHEAM/MAIB Patent number WO2017017555A1) for which the bacterium can be isolated and/or detected in the crude sap of infected plants. The patented extraction method of plant sap was evaluated during this thesis to investigate both the presence of *X. fastidiosa* and other endophytic microorganisms associated with this bacterium in olive, i.e. the tracheomycotic fungi (*Phaeoacremonium* spp., *Neofusicoccum parvum*, *Pleurostomophora richardsiae*, *Phoma* spp.), all found to be associated with CoDiRO. One hundred forty-one samples collected from different host species were assayed for the presence of *X. fastidiosa*, while the isolation of endophytic microorganisms associated with this bacterium was performed only in olive plants.

Plant sap extracted by conventional methods (crushing and print) and patented method was used for the diagnosis of the bacterium by DAS-ELISA and RT-LAMP as well as for the isolation of *X. fastidiosa* and endophytic microorganisms. Furthermore, conventional PCR assays and DTBIA were used to support positive sample confirmation.

Keywords: *Xylella fastidiosa*, Tracheomycotic fungi, PCR, RT-LAMP, DTBIA, DAS-ELISA, CIHEAM patent.

846. MASHA Rreze (Kosovo)

Supervisors: F. Santoro, V. Verrastro and K. Djelouah ; advisors: A. Proscia and S. Gualano

Title: Evaluation of a predicting model to control *B. oleae* in Taranto province (South Italy) condition. – 91 p.

Abstract: An effective and sustainable management of *B. oleae* is a challenge, particularly in zones where high quality oil is pursued and environmental standards are practiced. The principal aim of this study was to evaluate the conditions and pest lifecycle as a first step for adapting Petacchi's phenology dependent model (applied in Liguria), in Taranto province (South Italy). Four-year historical data (2015 - 2018), at the province level, were analyzed (infestation and agroclimate), and confronted with the data collected in a specific area in Maruggio. The degree-day of daily average temperature with the threshold of 9 °C (November - February) in South Italy resulted to be four times higher (~550), than in Liguria (~140). This indicates that the cumulative degree-day (CDD) model of Petacchi (379.01°C are needed for the simulation of the insect cycle, starting from October oviposition till the complete development), cannot be applied to our region. However, the period of the adult emergence based on the trap male catches complies with that of the model (middle of April). Analysis of collected data of juvenile form infestation showed an earlier attack, compared with the provincial database (at least 15 days). ANOVA test was used to evaluate the total infestation in the seven fields of the studied area. Statistical analysis indicated no significant difference between them (p-level = .43270), showing a relatively homogeneous infestation condition. The work will proceed by extending the infestation and weather data in the next seasons, to better analyse the relationships between temperature pattern and insect development in the winter.

Keywords: *Bactrocera oleae*, phenology model, predicting *B. oleae*, CDD model.

847. MAACHI Ayoub (Morocco)

Supervisors: T. Elbeaino and D. Gallitelli ; co-advisors: R. Spanò and T. Mascia

Title: Construction of a synthetic infectious cDNA clone of Artichoke Italian latent virus for RNA silencing studies. – 41 p.

Abstract: Samsun tobacco plants, infected by the grapevine strain of artichoke Italian latent virus (AILV-V), recover from severe disease symptoms by three weeks after inoculation. Recovery is thought to be a feature of the ability of the virus to suppress the plant defence response based on RNA silencing. A recent study showed that AILV-V is able to interfere with the cell-to-cell movement of the RNA silencing but no evidence has been provided for long distance movement of the silencing signal. In order to investigate if AILV-V codes for any viral suppressor of RNA silencing protein, an infectious clone has to be constructed. The ds-cDNA of RNA1 and RNA2 were synthesised and cloned into pUC19 and pGEMT-Easy vector

based on the AILV-V sequence available on the GenBank. Then, a screening was carried out in order to identify the clones of interest. Two clones covered the 5' and the 3' of the RNA 2 of AILV-V, which was placed under T7 and SP6 promoters that are necessary for the *in vitro* transcription of a biologically active viral RNA. The sequence of the putative full-length clone of AILV-V RNA-2 fragments was deduced from eleven overlapping fragments and found to be 99% similar to the sequence under the accession number LT608396.1. Despite the several attempts done, cloning of RNA-1 was unsuccessful.

Keywords: *Artichoke Italian latent virus*, full genome cloning, biologically active transcript, viral suppressor of RNA silencing.

848. MOJAHID Hajar (Morocco)

Supervisors: M. Digiario, K. Djelouah and T. Elbeaino ; advisor: D. Frasheri

Title: Set-up and evaluation of different molecular and serological techniques for the detection of plum pox virus (PPV) in different phenological stages. – 45 p.

Abstract: The ability to detect the presence of *Plum pox virus* (PPV) in stone fruit trees was evaluated over a period of six months (from February to August) using four different diagnostic techniques, namely DAS-ELISA, real-time PCR, real-time LAMP and DTBIA. To this aim, 25 infected samples from commercial orchards and 24 samples (of which only 18 were actually infected) from a collection of PPV strains stored in screenhouse were analysed monthly. Of the 4 methods, the real-time LAMP proved to be the most sensitive and reliable, followed in turn by real-time PCR, ELISA. DTBIA seemed to be not very suitable for PPV diagnosis from stone fruit tissues. The high number of false negative results obtained in July and August (7% and 30.8% with LAMP, 38.5% and 69.2% with real-time PCR, and 69.2% and 84.6% with ELISA, respectively) confirmed the poor reliability and effectiveness of the PPV diagnostic analyses carried out in the hottest months of the year. Due to the uneven distribution of PPV in the plants, especially in those recently infected, samples to be tested should be composed of tissues from different parts of the canopy. Finally, the promising results highlighted with LAMP technique open the possibility for its use during the winter period, to allow diagnosis also on nursery material ready for trading.

Keywords: Plum pox virus, detection, real-time PCR, real-time LAMP, DTBIA.

849. OUALGUIRAH Lahsen (Morocco)

Supervisors: M. Gallo, A. Ippolito, F. Santoro and F. Valentini ; advisors: S. Gualano and S. Piazza

Title: Evaluation of forecasting models for *Monilinia fructicola* in stone fruits and monitoring of *Erwinia amylovora* using RT-LAMP in Sicily. – 48 p.

Abstract: Brown rot and fire blight diseases cause enormous losses for pome and stone fruit crops. Chemical treatments generally fail without predicting the infection risk, and understanding the inoculum dynamic and its relationship with the environmental variables. In this study fire blight and brown rot diseases caused by *Monilinia fructicola* were respectively monitored from March until August in pear and peach orchards located in Maniace and Bronte (Catania province, Sicily, Italy) using rt-LAMP. Two different trapping methods (Gravitational spore trap and Burkard spore trap) were used to capture the airborne conidia of *M. fructicola*. Two risk infection models (Tate brown rot model and *Monilinia fructicola* infection risk criteria) were applied in the study area. A meteorological station provided the

climate data needed for their evaluation. Fire blight disease was detected in July and August. Brown rot was observed on flowers and shoots. The gravitational spore trap was more efficient than the volumetric trapping method. A temporal heterogeneous distribution of conidia was observed during the growing season. Correlation between the inoculum presence, and the weather parameters was obtained (e.g. soil moisture: $R^2 = 0.82$, active radiation: $R^2 = 0.29$, etc.). *M. fructicola* infection risk criteria were close to predict the disease occurrence in the peach orchards.

Keywords: Fire blight, Brown rot, *Monilinia fructicola*, monitoring, trapping method, models, climate data.

850. MUJAHED Sami (*Palestine*)

Supervisors: F. Santoro, D. Frasheri and S. Gualano

Title: Analysis of variables of DTBIA-processed membranes for developing an automatic reader. – 54 p.

Abstract: Serological tests are a simple and rapid method for the detection of many plant viruses and bacterial diseases. ELISA and DTBIA have been used to perform screening of a large number of samples. In this work, an analysis of the five main components of variability detectable by membranes processed with standard EPPO protocols DTBIA (CTV and *X. fastidiosa*) was conducted, useful for the development of an algorithm for the recognition of positive print, through the use of normalized images. Statistical analyses of "brand" variability showed a significant influence of the media used in microscopic reading, also highlighted through optical characteristics. CTV Plant-Print membranes express warmer and more defined colors. Similarly, for the variable "background", the results show a significant difference between laboratory and field operating conditions, highlighting the possibility of coding false positives. Membranes containing var-3 (duration of membrane staining) showed significantly clearer and more evident impressions than the control, while those processed after 1, 2 and 3 months (storage) showed no significant statistical change. Finally, the variability "sampling period" for CTV print confirmed the experimental evidence in which the perception of positivity increases linearly from the coldest month, while for *Xylella* the statistical analysis did not detect any upward trend of positives towards the hottest periods. The optical tests carried out on the normalized images have always confirmed the statistical results highlighted by the variability introduced.

Keywords: DTBIA standard protocols, membranes variability, normalized images, automatic recognition procedure.

851. BEN SLIMEN Amani (*Tunisia*)

Supervisor: T. Elbeaino ; co-supervisor: A. Minafra

Title: Frequency of occurrence and genetic variability of Grapevine fanleaf virus satellite RNAs in isolates associated with 'yellow mosaic' and 'infectious malformation' syndromes in grapevine. – 30 p.

Abstract: In this study, an investigation has been carried out on the occurrence of satellite RNAs of GFLV, supposed to have a role in the yellow mosaic (YM) and/or malformation (MF) symptoms caused by the two chromogenic and distortion strains of GFLV, respectively. The serological and molecular investigations conducted on samples collected from naturally infected grapevines, based on YM and/or MF symptoms, showed that 58% of the samples were GFLV-positive. In particular,

eight samples were with satRNA out of 19 YM-diseased grapevine and, more importantly, none was found in those with MF. This was considered as a preliminary indication on the possible association between the presence of satRNA and symptoms differentiation. At the diagnostic level, the newly designed primers had faithfully amplified the satRNAs in GFLV-YM plants despite the molecular variations found in their sequences. The genetic analysis of the satRNA showed the appearance of a new group (subclade V) containing sequences obtained only from two infected grapevines analyzed in this study. Based on the outcome of this study, it seems more than legitimate to include GFLV-YM isolates with satRNA molecules in future analyses for their potential role in symptoms differentiation.

Keywords: *Grapevine fanleaf virus*, yellow mosaic, malformation, satellite RNA, sequences and phylogenetic analyses.

852. MOUROU Marwa (Tunisia)

Supervisors: A. Giampetruzzi and F. Valentini ; **advisor:** G. Cavallo

Title: Isolation and molecular characterization of *Xylella fastidiosa* from different host plant species in Apulia region (Italy). – 48 p.

Abstract: The identification of one single strain, De Donno ST53, in southern Italy and the continuous spread of the bacterium to new areas prompted the necessity to isolate and further ascertain if we still have the same sequence type ST53 in the region. Additionally, population variability is poorly understood in the epidemic area. Thus, highly discriminative typing methods such as Variable Number of Tandem Repeat analysis (VNTR) are needed. In this thesis, isolation throughout six months from different host species was performed using printing and patented sap extraction methods. Subsequently, Multilocus Sequence Typing System (MLST) was conducted for four olive isolates obtained from samples collected from the latest outbreak area. Besides, PCR amplification for eleven VNTRs loci was performed in 4 olive isolates and amplicons were sequenced by Sanger sequencing. All the sequences sizes of VNTR loci were validated and compared to the expected size of VNTR already predicted in silico. Results indicate that besides *Olea europaea*, *Nerium oleander* and *Polygala myrtifolia* seem to have a great potential for isolation and the successful isolation rate was achieved in the late spring time. Printing method has presented significantly better results with 26 isolates. Whereas, only 12 isolates have occurred using patented sap extraction method. MLST results have confirmed genetic commonality with De Donno (ST53) strain. After the validation of VNTR loci sequences, discrepancies were observed between our experimentally derived amplicon size and the predicted sizes in silico. Only around 50% of the expected results screened in silico proved to be correct after validation by Sanger sequencing.

Keywords: *Xylella fastidiosa*, Isolation, MLST, ST53, VNTR.

853. TOUMI Oumayma (Tunisia)

Supervisors: K. Djelouah and F. Di Serio

Title: Investigations on further or other causal agent/s of viral citrus diseases expressing leaf symptoms in the main Mediterranean countries. – 38 p.

Abstract: Most of the virus and virus-like diseases in the Mediterranean region express a particular type of leaf symptoms, which are often considered as an indicator of specific diseases affecting the citrus trees. However, the mixed infections of plant viruses are common in nature, and a number of important viral

diseases of plants are the outcomes of interactions between causative agents. Consequently, the mixture of synergistic and antagonistic interactions usually creates unpredictable biological consequences. Relatively and in consideration of the new findings on the putative agents of citrus diseases in the Mediterranean area, an investigation on the presence of four citrus viruses CVV, CCGaV, CCDaV and SDV was performed in citrus plants from several Mediterranean countries. In this context, molecular detection (RT-PCR) and characterization (nucleotide sequences) were conducted on citrus samples selected from citrus varietal collection and field. This investigation showed a prevalence of CVV among the Mediterranean sources. Among these citrus samples, SDV was also identified for the first time in Palestine and Syria. Moreover, as expected CCDaV was detected only in Turkish samples. Interestingly, albeit the absence of CCGaV in the citrus samples belonging to different countries, this virus was detected for the first time in Apulia Region (South Italy).

Keywords: Citrus viruses, Mediterranean, Apulia, RT PCR, Nucleotide sequences.

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879. AHDOUGA Meriem (Algeria)

Supervisors: K. Djelouah and R. Abou Kubaa

Title: Survey and molecular characterization of the main honey bee viruses in Apulia region. – 48 p.

Abstract: During the spring-summer 2019, the presence and prevalence of the *Black Queen Cell Virus* (BQCV), *Chronic Bee Paralysis Virus* (CBPV), *Deformed Wing Virus* (DWV), *Kashmir Bee Virus* (KBV), *Israeli Acute Paralysis Virus* (IAPV), *Lake Sinai Virus 1* (LSV1), *Lake Sinai Virus 2* (LSV2) and *Sacbrood Virus* (SBV) were investigated in 125 Apulian honey bee colonies. A total of 10 honey bees were sampled from each colony and were pooled as 1 sample, then analyzed by using Reverse Transcription Polymerase Chain Reaction (RT-PCR). The obtained RT-PCR results showed that the most prevalent virus was DWV, present in 88% of the tested samples, followed by CBPV, LSV1, LSV2, BQCV, and SBV (33%, 27%, 26%, 23%, and 10% respectively). Whereas, KBV and IAPV were not detected in any of the surveyed apiaries. Interestingly, most of the detected viruses were reported in multiple infections. The phylogenetic analyses of the detected viruses confirmed the high sequence identity at the nucleotide level with other isolates distributed worldwide. In addition, this study reports the first detection of LSV1 and LSV2 in Apulia region, and the first molecular characterization of CBPV, LSV1, LSV2, BQCV and SBV in *Apis mellifera* colonies of this area.

Keywords: Apis mellifera, honey bee, viruses, Apulia, Italy.

880. BOUAICHA Oussama (Algeria)

Supervisors: F. Santoro and V. Cavalieri ; advisor: G. Cavallo

*Title: The dynamic population in Italy (Taranto province, South Italy) of *Philaenus spumarius* (L.) and *Neophilaenus campestris* (Fallén.): principle vectors of *Xylella fastidiosa*. – 75 p.*

Abstract: The disaster caused by the spread of *X. fastidiosa* in Italy has enforced the ecological study of its main vectors, *Philaenus spumarius* and *Neophilaenus campestris* (Hemiptera: Aphrophoridae). Here, we present the results of a one-year survey carried out in seven olive groves in Maruggio. A visual inspection was the only method used to investigate the abundance of nymphs on herbaceous ground vegetation within the olive groves, while two monitoring techniques were tested and compared to estimate the population levels of spittlebugs adults. Our results show clearly that *Philaenus spumarius* were more abundant than *Neophilaenus campestris*. Moreover, at the time when sweep nets were the most effective sampling method from ground herbaceous, both the yellow sticky traps and the sweep nets were effective on the tree canopies. The population density showed that spittlebugs adults were more abundant in ground vegetation when present than on olive canopies. In late spring Spittlebugs disperse to olive trees and non-cultivated hosts that act as transient hosts and natural reservoirs, respectively. However, an early removing of vegetation cover just before adults' emerge, affect negatively the population abundance.

Keywords: *Philaenus spumarius*, *Neophilaenus campestris*, vectors, population dynamic, monitoring.

881. AHMED Elhussein Mohamed Fouad Mourad Hussein (Egypt)

Supervisors: F. Santoro, F. Valentini and M. Gallo

Title: Evaluation of weather-based forecasting models for *Monilinia fructicola* in stone fruits. – 42 p.

Abstract: Prediction of disease outbreaks indirectly reduces the production costs and the impact of fungicides/pesticides on the environment. In this thesis, a multidisciplinary-approach was carried out to evaluate two weather-based disease risk forecasting models, Tate brown rot and *Monilinia fructicola* infection risk models, for the brown rot disease of stone fruits in 4 peach orchards in Maniace and Bronte of Sicily. An automatic weather-station (AWS) and 6 data loggers were used to monitor weather and microclimatic conditions, respectively. Burkard volumetric and plate gravitational spore traps were analysed by real-time LAMP to monitor the conidia presence. Culture collection of *Monilinia* isolates was characterised morphologically, identified molecularly, and used for the identification of symptomatic samples during the disease periodic monitoring. Isolates belonged to *M. fructicola*, *M. fructigena*, and *M. laxa* with high prevalence of the second. Burkard accuracy was compared to the gravitational trap, with 69 vs 66% and 91 vs 80% for the first and the second model, respectively. Generally, Tate brown rot model seemed less accurate than the *M. fructicola* infection risk model. Moreover, the low-cost gravitational trapping-system is a challenging candidate to replace the expensive AWS and Burkard trap for the evaluation of disease-forecasting models and recommendations are provided to increase its accuracy.

Keywords: *Monilinia fructicola*, disease-forecasting models, brown rot of stone fruits, Sicily, real-time LAMP.

882. ORABY Ahmed Yehia Saad (Egypt)

Supervisors: K. Djelouah and N. Hassan; advisor: M.K. Abbas

Title: New approach for controlling Red Palm Weevil through push-pull strategy. – 62 p.

Abstract: The Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* is a destructive pest on palms and difficult to control. The pheromone and kairomone based traps are widely used in date growing countries for mass-trapping; however, they are found inadequate in controlling the weevil. Therefore, an improvement in semichemical based system is urgently needed. In this context, a push-pull strategy was investigated in two date palm grooves located in the Bahariya oasis, Giza. In this area, two grooves were selected, the first with high infestation with RPW (HIG); whereas, the second was low infested (LIG). The HIG consisted of two plots, both of them included traps in the borders. Only the treated plot includes two repellent formulation, solid and sprayable formulations. The LIG include the same type of plots, and a third one treated with only solid repellent formulation. Interestingly, in HIG the number of trap catches was higher in treated plots comparing to the control plot. Nevertheless, statistical analysis showed no significance between treated and control plot results in both grooves. Beside this, the use of repellent seemed promising in enhancing trap catches, considering that the Egyptian farmers are willing to rationalize insecticides usage and substitute them with innovative and biological products.

Keywords: Egypt, push-pull strategy, Red Palm Weevil, semiochemicals, repellents.

883. DAKROUB Hiba (Lebanon)

Supervisors: T. Elbeaino and Ch. Ritzenthale

Title: Development of advanced and innovative diagnostic assays for the detection of *Xylella fastidiosa* in plants and insect-vectors. – 49 p.

Abstract: Although DNA- and protein-based methods have revolutionized *Xylella fastidiosa* diagnosis, in some cases they are not very reliable due, on one hand, to the peculiarities of this pathogen, i.e. (i) irregular distribution inside the plant, (ii) xylem-limited localization making its extraction difficult, (iii) latency in some species that can affect accurate sampling; (iv) low concentration in some hosts; (v) genomic variance between subspecies; and, on the other hand, the poor performance of some serological and molecular techniques to sensitively and differentially detect and discriminate between subspecies and strains of *Xylella fastidiosa*. Accordingly, the aim of this study was to develop advanced serological (Nanobodies) and molecular (Real-time TaqMan PCR, LAMP and FTSP-LAMP) assays able to detect *Xylella fastidiosa*, especially the CoDiRO strain present in Apulia, in an easy, sensitive, accurate and discriminating manner. The hemagglutinin gene, found solely in the CoDiRO genome, together with two universal genes of *Xylella fastidiosa*, were used for the construction of protein- and DNA-based techniques, respectively. These three recombinant proteins were bacterially expressed, purified and quantified for future injections in rabbit and Llama for the production of polyclonal and monoclonal antibodies against *Xylella fastidiosa*. Real-time TaqMan PCR, LAMP and FTSP-LAMP assays here developed in singleplex and multiplex approaches were found highly sensitive, specific and discriminant to detect *Xylella fastidiosa* in infected plants and insect-vectors.

Keywords: *Xylella fastidiosa*, CoDiRO, nanobodies, Real-time TaqMan PCR, LAMP.

884. EL HATIB Oumaima (Morocco)

Supervisors: G. Loconsole and F. Valentini

Title: Implementation of diagnostic tools for the detection of *Xylella fastidiosa*. – 59 p.

Abstract: The alarming spread of *Xylella fastidiosa* in EU territory and the rising susceptibility of host plants have mandated surveys and inspections in nursery and at consignments. Thus, the urge is prompted to develop robust and rapid diagnostic tests suitable for screening different host plant species and large number of samples. To this end, an alternative automated protocol for recovering total DNA for identifying *X. fastidiosa* in qPCR was validated on 8 different, artificially inoculated, plant matrices and on olive field samples. The results showed high quality of DNA templates with standardized yields and elevated efficiency levels. In addition, experiments were carried out, by simulating composite samples of *Xylella*-infected plant tissues pooled at different ratios with healthy materials and processed by qPCR. The results stated that a minimum of 2 to 4 infected units can be pooled with up to 20 to 40 gr of healthy tissue and processed, generating 100% of diagnostic sensitivity using the standard extraction procedures. Finally, an approach of high-resolution melting (HRM) analysis coupled with qPCR, was validated on a large panel of isolates. This procedure proved efficient and identified genotypes in 3 main clusters associated to the most abundant and widespread strains: *fastidiosa*, *multiplex* and *pauca*.

Keywords: *Xylella fastidiosa*, automated protocol, composite sample, HRM analysis.

885. CHTIOUI Wiem (*Tunisia*)..

Supervisors: A. Carlucci and F. Valentini

Title: Characterization of Botryosphaeriaceous fungi associated with Olive Quick Decline Syndrome in Apulia. – 39 p.

Abstract: *Xylella fastidiosa*, a devastating xylem-restricted quarantine bacterium was found to be the cause of OQDS. However, surveys conducted in Apulia region starting from 2013 have shown that symptomatic olive trees are often infected by a complex of complementary pests, including a number of vascular fungi species. This research has as purpose to investigate the vascular fungi especially those belonging to *Botryosphaeriaceae* spp. occurring in olive tree showing OQDS. A survey was conducted throughout six months in Apulia region to put the light on vascular fungi; samples were collected from the base of the trunk, the trunk and the branches of olive trees infected with *Xf*. Isolation and morphological of vascular fungi was performed from previously collected samples. Further morphological and molecular characterization by amplification and sequencing of 5.8S rDNA gene followed by phylogenetic analysis were performed on *Botryosphaeriaceae* isolates to characterize them to species level. Results indicate that besides *Xylella fastidiosa* 21 group of vascular fungi were isolated from olive trees showing OQDS with dominance of *Phaeoacremonium*, *Botryosphaeriaceae* and *Acremonium* species. Both morphological and molecular identification approaches carried out on a sub-collection of 150 of *Botryosphaeriaceae* isolates has shown that all of them resulted to belong to one genus which is *Neofusicoccum*, and to three species with dominance of *Neofusicoccum mediterraneum* (91 isolates) over *Neofusicoccum parvum* (34 isolates) and *Neofusicoccum luteum* (25 isolates). To assess the disease severity and to confirm the involvement of vascular fungi in wilt and decline of olive trees, pathogenicity assays should be performed on shoots of young olive plants.

Keywords: *Xylella fastidiosa*, vascular fungi, *Botryosphaeriaceae*, *Neofusicoccum parvum*, Olive Quick Decline Syndrome.

886. MOUSSAOUI Nouha (*Tunisia*)

Supervisors: M. Digiario and T. Elbeaino ; **advisors:** D. Frasheri and V. Elicio

Title: Development of molecular diagnostic tools for the specific detection of grapevine leafroll associated virus-4. – 42 p.

Abstract: The prevalence of *Grapevine leafroll associated virus 4* (GLRaV-4) was assessed by ELISA in 872 samples taken from two collection plots at the Mediterranean Agronomic Institute of Bari and at CRSFA of Locorotondo (Apulia, South Italy). GLRaV-4 was detected in 115 out of 570 Italian samples (20.2%), with a slight prevalence in table grapes (23.2%) rather than in wine grapes (17.2%). GLRaV-4 was more spread in vines from foreign countries (27.5%), especially in those coming from Balkan area (ca. 50%), the Maghreb (ca. 30%) and the Middle East (ca. 30%). The level of infection was below 20% in vines from central and northern European countries and even lower in those from East Asian countries, Australia and USA. Universal sets of primers were designed for the GLRaV-4 detection by RT-PCR. The primer pair LR4dCP2-F/ LR4dCP2-R designed on the coat protein gene was the most performing and its efficacy was comparable with that of ELISA that used a mixture of monoclonal antibodies to different GLRaV-4 strains. Multiplex RT-PCR assay was developed and applied for the simultaneous detection of single and multiple infections with different GLRaV-4 strains (-4, -5, -6, -9). The

graft-inoculation of different GLRaV-4 strains induced leafroll and reddening symptoms onto LN33 and *Vitis vinifera* cv. Cabernet franc indicators, showing symptoms severity comparable to those induced by GLRaV-1 and -3.

Keywords: GLRaV-4, prevalence, RT-PCR, biological indexing, universal primers, Multiplex-PCR.

887. OUADHENE Mohamed Ali (Tunisia)

Supervisors: T. Caffi and S. Gualano

Title: Elaboration of a mechanistic model prototype for olive anthracnose caused by *Colletotrichum* spp. – 52 p.

Abstract: The available knowledge on olive anthracnose caused by *Colletotrichum* spp. was retrieved from literature, analyzed and synthesized following the system analysis approach, in order to develop a mechanistic model prototype able to simulate the life cycle of the pathogen. An analysis of published information was conducted to develop a set of mathematical equations expressing the relationships between weather, host and the pathogen. Three main stages of the life cycle have been divided into: I) release of conidia from acervuli formed on mummified, overwintering, drupes; II) primary infection of leaves, flowers and immature drupes by released conidia after latent period; and III) establishment of secondary infection with symptoms onset and production of new overwintering inoculum. The model prototype was tested using weather data (i.e. temperature T, rainfall R, relative humidity RH, leaf wetness LW) from four different locations in two growing seasons (2017-2018). The model outputs allowed describing the dynamic of the release of primary inoculum dose from mummified drupe, conidial dispersal, first and secondary infection, latent period and infectious period. A model evaluation was not possible because of the lack of observed disease data. Thus, the validation of the internal coherence of the model and an overview of model outputs were carried out here. The future perspectives were also discussed, including the enhancement of available knowledge about this pathosystem and the possible improvement of the model prototype. Further research is needed to get insight on the duration of the infectious period and its relationship with the external factors. Finally, model validation in the field with real data about the disease is required before an operational use of the model to support farmers decisions.

Keywords: mechanistic model, olive anthracnose, *Colletotrichum* spp, pathosystem, model output, model simulation, model validation.

888. YAZMIŞ Efekan (Turkey)

Supervisors: Ç. Ulubaş Serçe and T. Elbeaino

Title: Presence and molecular analyses of newly emerged vitiviruses in Turkey. – 31 p.

Abstract: Vitiviruses are associated with rugose wood complex diseases in grapevine. In the last two years, Vitivirus genus has gained new species, i.e. Grapevine virus E (GVE), GVF, GVG, GVH, GVI, GVJ, GVK, GVL, owing to the application of Next Generation Sequencing technology. Except GVA, GVB and GVD, there are no information about the presence of newly identified vitiviruses species in Turkey. Therefore, the newly identified vitiviruses were investigated in different Turkish vineyards and studied for their incidence, genome variability and genetic population structure. RT-PCR assays, using CP-specific primers for each species, were applied on 186 samples collected from different varieties and locations.

Results showed that only GVE, GVF and GVL were present in the tested samples, with infection rates of 6.4%, 16.1% and 18.2%, respectively. The highest nucleotide (nt) sequence variations found in the genomic CP of GVE, GVF and GVL isolates, compared with those reported in the GenBank, were 23%, 13.91%, 14.2%, respectively; whereas the intra-variabilities found among the Turkish isolates were 0.9%, 7.9% and 3.7% for the three viruses, respectively. Constructed phylogenetic trees with GVE, GVF and GVL sequences of the CP gene allocated, in general, the Turkish isolates with those from Mediterranean origins. This is the first information on the presence and sequence variations of GVE, GVF and GVL in Turkey.

Keywords: vitiviruses, RT-PCR, sequencing, variability, phylogenetic analysis.

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918. CHELIHI Aya (Algeria)

Supervisors: M. Digiario and T. Elbeaino ; advisor: O. Incerti

Title: Grapevine leafroll-associated virus 4: universal and specific detection of its strains by multiplex RT-PCR. - 35 p.

Abstract: Multiplex RT-PCR was applied to test 100 different GLRaV-4 positive vine samples in ELISA to validate its efficacy to selectively detect 4 different strains of GLRaV-4 (strains 4, -5, -6 and -9). The test showed the presence of at least one of these GLRaV-4 strains in 79 samples, 13 of which in mixed infections. The absence of bands in 12 samples and the presence of bands with different molecular weights than expected in 9 samples suggested the presence of genetic variants of GLRaV-4. Sequencing of some of these amplicons confirmed this hypothesis. GLRaV-4 strain 4 was the most common (43%), followed by strains 6 (25%) and 5 (22%), while strain 9 (3%) was much rarer. No significant differences were found in the comparison between RT-PCR, using a universal primer pair, and ELISA in the diagnosis of 20 different infected vines tested at different times of the year. For both techniques, the diagnosis was more effective as the growing season progressed. Cabernet Franc and LN 33 vines graft-inoculated with different GLRaV-4 infected sources showed marked leafroll symptoms 18 months after inoculation, although less severe than those induced by GLRaV-3 and GLRaV-1 used as controls.

Keywords: GLRaV-4, Multiplex RT-PCR, prevalence, specific primers, universal primers, biological indexing, sequencing.

919. DJENANE Ferialle (Algeria)

Supervisors: S.M. Sanzani and A. Ippolito; advisor: N. Admane

Title: Characterization and alternative control of mycotoxigenic fungi causing postharvest diseases of tomato fruit. – 54 p.

Abstract: Tomato fruit represent a valuable but perishable commodity, due to fungal spoilage even after harvest. In the present investigation, greenhouse-grown tomatoes from Apulia (southern Italy) were analysed, particularly for the contamination by mycotoxigenic genera. Isolates were characterized by morphological features and sequencing of barcoding genes. *Penicillium* (37%), *Aspergillus* (34%), and *Alternaria* (18%) were the most represented genera. *Alternaria* strains mostly belonged to species *alternata* morphotype *alternata* and were able to produce alternariol. *Aspergillus* was divided in yellow (76%) and black (24%) strains: the former included species *westerdijkiae*, *ochraceus*, and *occultus*, able to produce OTA; the latter included a *welwitschiae* strain, able to produce OTA and fumonisins. *Penicillium* strains were mostly species *olsonii*, not able to produce regulated mycotoxins. Commercial Generally Recognized As Safe (GRAS) and biostimulant formulations were tested for controlling postharvest decays. In vitro, potassium bicarbonate and peracetic acid+hydrogen peroxide prevented fungal growth, whereas a reduction up to 50% was obtained by zinc chelated and fermented fulvic acids formulations. In vivo trials against *Alternaria*, by wound and dipping application, confirmed potassium bicarbonate, peracetic acid+hydrogen

peroxide and zinc chelated as the most effective formulations for fungal sporification (up to -92%), disease incidence (up to -74%) and severity (up to -91%).

Keywords: tomato, postharvest, mycotoxins, *Alternaria*, *Penicillium*, *Aspergillus*, alternative control.

920. MELLIKECHE Wanissa (Algeria)

Supervisors: A. Ricelli and M. Gallo

Title: Survey of fungal contamination of Bronte pistachios with particular reference to aflatoxin B1 and ochratoxin A-producing *Aspergilli*. – 54 p.

Abstract: Contaminations by black *Aspergilli* represent a significant problem for pistachios, both for the loss of product that they cause and for the possible presence of mycotoxins, in particular ochratoxin A (OTA) and aflatoxin B1 (AFB1). This research enabled the creation of the first collection of black and green *Aspergilli* isolates from Bronte pistachios (cv Bianca) and the determination of their ability to synthesize OTA or AFB1. Morphological observations of the colonies were conducted on MEA-Boscalid, a selective medium for *Aspergillus carbonarius*, on CYA and MEA. Significant differences among different isolates emerged between mycelial growth and sporulation in CYA and MEA. Although only *Aspergillus carbonarius* isolates sporulated on MEA-Boscalid after one week of incubation at 25°, extending the incubation for further 7 days allowed more black *Aspergilli* species to sporulate. Molecular means revealed that *A. niger* accounts for 63.6% of all isolates, (74% of black isolates), whereas *A. flavus* accounts for 14% of all isolates but represents the total of green *Aspergilli*. Concerning mycotoxin production, 7% and 14% among *A. niger* isolates are OTA- and AFB1-producing respectively. All *A. flavus* isolates can produce AFB1. It is noteworthy that the percentage of AFB1-producing *A. niger* isolates is twice that of OTA-producing ones.

Keywords: pistachio, *Aspergillus*, mycotoxins, Aflatoxin B1, Ochratoxin A.

921. SAADA Keltoum (Algeria)

Supervisors: S. Speranza and F. Santoro

Title: Evaluation of three predicting models to control *Bactrocera oleae* in south Italy (Taranto province) conditions. – 62 p.

Abstract: *Bactrocera oleae*, commonly known as olive fruit fly, arouses a growing interest due its significant economic losses. The aim of this work is the evaluation of three forecasting models for *B. oleae*, using experimental data from seven orchards located in the area of Maruggio in Taranto province, collected in 2018 and 2019. The first model is based on Cumulative Degree Days (CDD) and empirical data referring to catches of males of *B. oleae* and drupe infestation, throughout two reference periods of the fruit fly annual cycle. The second model, expressed through a canonical correlation analysis, links the average number of males captured and the average temperature recorded between two capture moments with a group of infestation variables. The third model simulates the population density of adult males over time. Overall the results were interesting; the CDD model was incompatible with the microclimate of Maruggio area. The second model was able to predict the infestations occurred in the experimental conditions especially those of 2019 while the third model, applied only in an orchard, provided

an experimental population in line with the real adult population detected by the data.

Keywords: *Bactrocera oleae*, Integrated Pest Management, olive, forecasting model, sex-pheromone trap.

922. MOHAMED Nesma Zakaria Mahmoud (Egypt)

Supervisors: G. Calabrese, M. Fracchiolla and M. Vurro; **advisor:** A. Boari

Title: Exploitation of *Dittrichia viscosa* (L.) Greuter allelopathy in sustainable weed management practices. – 39 p.

Abstract: *Dittrichia viscosa* is a perennial Mediterranean plant species having invasive and allelopathic features. Its biomass contains and releases several secondary metabolites, which are the reason of its phytotoxicity effects. The present study aimed at evaluating the possible application of *D. viscosa* dried biomass to control weeds. For this purpose, several tests were conducted to determine: (a) the optimal herbicide dose, (b) its effect on different plant and weed species, (c) the influence of soil typology on biomass effectiveness, (d) its impact on seedling growth and plant development and, finally; (e) its effectiveness over time. Thanks to the several experiments carried out, it was possible to observe that: (a) the emergence of most of the species tested was influenced starting from 10 g of dried biomass l⁻¹ of soil; (b) some plant species (e.g. *Lepidium sativum* and *Beta vulgaris*) were more sensitive than others; (c) the soil type and characteristics had no impact on biomass effectiveness; (d) the effect of dried biomass was more severe on seed germination than the other phases; (e) dried biomass effectiveness declined gradually over time. In the end, *D. viscosa* dried biomass proved to have a potential herbicidal activity and it could be a promising tool to be used in IWM strategies.

Keywords: *Dittrichia viscosa*, dried biomass, allelopathy, herbicidal activity, sustainability, weed management.

923. SALIM Amira Salim Abdelmenam (Egypt)

Supervisors: F. Porcelli and Y. Ahmed; **advisors:** F. Garganese and K. El-Shaarawy

Title: Screening of the guild of microorganism symbionts associated with red palm weevil. – 38 p.

Abstract: Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier, 1790) is a destructive invasive pest that has caused extensive loss of palm trees worldwide. Moreover, recent studies have shown that the intestinal microbes residing in the gut have potential roles in pest fitness and nutrition assimilation. Nevertheless, experimental evidence on the relationships between RPW and its gut microbiota in addition to the exact effects of gut microbiota on the RPW phenotype and the underlying mechanisms remain elusive. This study used Illumina HiSeq next-generation sequencing analysis focusing on clarifying the taxonomic profiles of gut microbiota in RPW larva and pupa. The study revealed that RPW harbours a rich and diversified microorganism assemblage that mainly includes bacteria belonging to *Enterobacteriaceae*, *Lactobacillaceae*, *Erysipelotrichaceae*, and *Leuconostocaceae*. Moreover, the bacterial community associated with the two weevil developmental stages differs, whereas the bacterial diversity and richness remarkably decreased at the transition from larva to pupa. As well isolation and sequencing of bacteria from field-caught specimen weevils were conducted, whereas, 27 bacterial species in 21 genera including *Klebsiella*, *Serratia*,

Salmonella, *Citrobacter*, *Enterobacter*, *Providencia*, *Pseudacidovorax*, *Pseudomonas*, and *Stenotrophomonas* were detected. However, all these genera included species capable of cellulose degradation. All considered our results provide initial information for the characterization of RPW gut microbiota, cellulolytic bacterial species, and RPW functional association with a guild of symbiotic microorganisms.

Keywords: invasive pest, *Rhynchophorus ferrugineus*, economic palm, insect symbiosis, Illumina HiSeq NGS.

924. **SENOUSY Fatmaalzahraa Ahmed Saber (Egypt)**

Supervisors: A. El-Heneidy and K. Djelouah ; **advisor:** N. Hassan

Title: Evaluation of the pathogenicity of selected entomopathogenic fungi strains against economically important insect pests in Egypt. – 50 p.

Abstract: The present study was carried out to evaluate the efficacy of some entomopathogenic fungi (EPF), against a number of sucking insects that cause significant damage to main Egyptian crops. In this context, the 'Galleria bait method' was used as a model insect and a promising technique for screening EPF isolates. *In vitro* bioassays showed the efficacy of two fungal strains, the commercial one, *Metarhizium anisopliae* (ITCC- 7895) and the local isolate strain, *Beauveria bassiana* (EG4-20), against different piercing-sucking insects: aphids (*Aphis gossypii* Glov., *A. craccivora* Koch. and *Myzus persicae* Sulz.), thrips (*Thrips tabaci* Lind.), and whitefly (*Bemisia tabaci* Genn.). Results indicated that ITCC-7895 *M. anisopliae* isolate was more efficient against *A. craccivora* adults (LC_{50} 2.25×10^5 conidia ml^{-1}) and against *A. gossypii* (LC_{50} 1.05×10^5 conidia ml^{-1}), compared to EG4-20 *B. bassiana* isolate with LC_{50} of 4.02×10^6 and 1.28×10^6 conidia ml^{-1} , respectively. Moreover, *Thrips tabaci* nymphs were more susceptible to *M. anisopliae* (LC_{50} 2.87×10^8 conidia ml^{-1}). *B. bassiana* was instead more efficient against *B. tabaci* nymphs than *M. anisopliae* with LC_{50} 1.02×10^6 and 4.76×10^7 conidia ml^{-1} , respectively.

Keywords: entomopathogenic fungi, aphids, thrips, whitefly, virulence, *in vitro* bioassay.

925. **KHALIL Jack (Lebanon)**

Supervisors: W. Habib and S. M. Sanzani; **advisor:** A. Mincuzzi

Title: Survey of postharvest of fungal contamination and characterization of mycotoxigenic fungi of table grapes in Lebanon. – 59 p.

Abstract: Table grapes are exposed to fungal infections both before and after harvest, in particular, the genera *Aspergillus*, *Penicillium*, and *Alternaria* can cause decays and contaminations by mycotoxins. In this study, the main fungi affecting Lebanese table grapes after harvest were assessed in terms of epiphytic populations, latent infections and rot incidence. Furthermore, the effect of storage with/without SO_2 generating pads was evaluated. Representative isolates were molecularly identified and their toxigenic potential was established, with particular reference to regulated mycotoxins as OTA and patulin. The epiphytic population was found to harbour mainly wound pathogens (*Aspergillus* spp. and *Penicillium* spp.), whereas latent infections and rots were mostly caused by *Botrytis* spp.. SO_2 generating pads caused a significant reduction of the epiphytic population and rots, whereas they were less effective against latent infections. The characterization of *Aspergillus*, *Penicillium* and *Alternaria* isolates showed that *A. tubingensis*, *P.*

glabrum and *A. alternata* were the most represented species, respectively. Interestingly, strains of *A. welwitschiae* and *P. expansum* were also found, and produced OTA and patulin, respectively. These data evidenced the need of effective measures to prevent postharvest losses caused by toxigenic fungi in terms of quality and safety issues.

Keywords: table grapes, *Aspergillus*, *Penicillium*, mycotoxins, HRM.

926. AIT MANSOUR Soukaina (**Morocco**)

Supervisors: A. Novelli and F. Santoro; **advisor:** S. Gualano

Title: Evaluation of the use of "Sentinel-2" satellite images for the classification of areas affected by OQDS (Olive Quick Decline Syndrome) and for the monitoring of control measures against *Xylella fastidiosa* in Apulia. – 52 p.

Abstract: The fast and wide spread of the bacterium *Xylella fastidiosa* in EU territory, Italy in particular, and the rise of the number of host species urged to introduce strict emergency measures and mandatory surveys, inspections and diagnostic tests. The use of remote sensing to monitor the distribution of plant diseases has been widely used. Detecting spatial changes, mapping the spread of the disease, helps to take the right decision at the right timing. To this end, from July 2015 until July 2020, olive plantations were analysed using Sentinel-2 (Copernicus mission) satellite images of two municipalities in the region of Puglia: Maruggio (Taranto province) and Ugento (Lecce province), with respectively less and more severe presence of *Xf* symptoms (Olive Quick Decline Syndrome - OQDS). The images have provided their usefulness in the detection of the spatial and temporal evolution of *Xf* infected areas with the use of "ad hoc" combination of vegetation Indices (VIs): MCI-RI-Slope. Similarly, images elaborated in the winter-spring period of the same areas (2018-2020) helped to conclude that the combination of mYI, MCI and Slope indices gives a representative idea of the ground-situation of the application of agronomical practices e.g. removal of weeds, which are the control measures against *Xf* vectors. Based on the VIs used, two possible global ecological indicators have been defined for the identification and control of *Xylella* in the Apulia territory.

Keywords: *Xylella fastidiosa*, OQDS, Copernicus satellite images, vegetation index.

927. JABRI Badr-Eddine (**Morocco**)

Supervisors: K. Djelouah, S. M. Sanzani and R. Abou Kubaa

Title: Development of smart detection tools for some honey bee pathogens and preliminary survey on the sanitary status of honey bees in Morocco. – 40 p.

Abstract: In the last decade, the loss of the honey-bees population has been continuously increasing worldwide; this phenomenon is referred to as colony collapse disorder. Several causes are associated with this situation, including *inter alia* honey-bee infections by various pathogens. In the present study, protocols for rapid and sensitive diagnosis of some pathogens were set up and tested during a preliminary survey in three Moroccan regions. In this context, new primer pairs were designed and validated in qPCR for *Nosema ceranae*, *Aspergillus flavus*, *Paenibacillus larvae* and Black queen cell virus (BQCV). Preliminary monitoring of the main honey-bee pathogens in Moroccan apiaries was performed using the newly developed protocols and the already reported RT-PCR for the detection of Bee macula-like virus (BeeMLV), Deformed wing virus (DWV) and Slow bee paralysis virus (SBPV). Interestingly, *N. ceranae* was detected in all the surveyed

beehives, followed by BQCV (94%), *A. flavus* (81%) and BeeMLV (38%). In contrast, *P. larvae*, DWV and SBPV were not detected. No difference was observed among the regions in terms of prevalence and infection intensities of the detected pathogens. Finally, the present study reports for the first time the presence of *A. flavus*, BQCV and BeeMLV in Moroccan apiaries.

Keywords: *Apis mellifera*, *Nosema ceranae*, *Aspergillus flavus*, *Paenibacillus larvae*, Black queen cell virus (BQCV), Bee macula-like virus (BeeMLV), Deformed wing virus (DWV), Slow bee paralysis virus (SBPV), qPCR.

928. TAIBI Othmane (Morocco)

Supervisors: T. Caffi, S. Gualano and M. Gallo; **advisor:** F. Santoro

Title: Isolation and characterization of *Colletotrichum* spp. in the olive growing area of Maruggio (Apulia Region) for the epidemiological modeling of olive Anthracnose disease. – 37 p.

Abstract: Olive (*Olea europaea* L.) is one of the major crops in the Mediterranean basin. However, effective and timely disease management continues to pose a challenge to olive growers, and disease outbreaks remain a drawback for the advancement of this sector. Therefore, an improvement of plant protection strategies through advanced monitoring technologies and methodologies is urgent. In this study, many olive orchards in Maruggio and Manduria areas, south Italy, were surveyed on 10 February 2020 for the presence of olive anthracnose disease. A total of 14 *Colletotrichum* spp. isolates were collected from leaves, branches, and mummies of symptomatic and asymptomatic plant organs of 12 olive orchards. DNA extraction and amplification of ITS, b-tubulin, and GADPH genes through PCR showed high similarity to *C. acutatum* s.s, and particularly to isolates obtained from *Feijoa sellowiana* in the Basilicata region, Italy. A prototype disease prediction model was used to simulate the pathogen dynamics according to environmental factors like temperature, relative humidity, leaf wetness, and rainfall. Olive anthracnose was simulated according to weather conditions in 2019 and 2020. Despite the required improvement, with experiments regarding the pathogen latent period and the infectious period, the model correctly simulated the main steps in the pathogen infection cycle. Surveys in August 2020 confirmed the presence and development of the disease.

Keywords: Anthracnose, plant organs, prediction model, pathogen dynamics

929. KHASIB Motasem A.A. (Palestine)

Supervisor: T. Elbeaino

Title: Comparison of conventional and novel molecular diagnostic methods for detection of *Xylella fastidiosa* from insect vectors. – 46 p.

Abstract: The efficiency of PCR, real-time PCR and LAMP assays for detection of *Xylella fastidiosa* (Xf) genomic DNA from *Philaenus spumarius* (Ps, 100 specimens) and *Neophilaenus campestris* (Nc, 50 specimens) insect vectors was evaluated using three DNA extraction methods (EM). In addition, a new real-time LAMP technology, i.e. Fluorescence of Loop Primer Upon Self Dequenching-LAMP (FLOS-LAMP) was optimized and applied on DNA extracted with the three EM. EM1 consisted of entire insects heated in an extraction buffer (EB), EM2 consisted of excised heads heated again in the EB of EM1, whereas EM3 consisted of grinding the entire insect, head and body recuperated from EM2, with a CTAB buffer. The comparative analyses showed that EM3 is the most efficient for extracting Xf

genomic DNA from insect vectors, of which 44 specimens were positive for Xf in each of the diagnostic methods used, including FLOS-LAMP assay. In general, real-time PCR and LAMP assays were more competent than PCR for detecting Xf in insect vectors, independently from the EM used. The newly optimized FLOS-LAMP technique had a detection limit of 1 fg\µL of Xf genomic DNA, compared to the 10 fg\µL for LAMP. FLOS-LAMP, being a more sensitive and specific assay, together with EM3, were the most appropriate approaches for an accurate detection of Xf in insect vectors.

Keywords: *Xylella fastidiosa*, *Philaenus spumarius*, *Neophilaenus campestris*, detection, PCR, Real-time PCR, lamp, flos-lamp.

930. GHALLEB Yosr (Tunisia)

Supervisors: K. Grissa and H. Nayem : **advisor:** S. Gualano

Title: Identification and evaluation of an IPM strategy against the fly species (*Dacus frontalis* and *Dacus ciliatus*) on cucurbits. – 42 p.

Abstract: *Dacus frontalis* and *Dacus ciliatus* are among the most economically damaging pests of cucurbits in Africa. This study aims to make surveys in order to detect the presence of these pests in northern Tunisia and to evaluate Ceranock attract and kill system against these flies. The lesser melon fly *Dacus ciliatus* is reported in this paper for the first time in Tunisia, where it was found in the region of Tekelsa (Nabeul). It is a pest of cucurbits of economic importance and is common especially in the eastern and southern parts of Africa. *D. ciliatus* and *D. frontalis* was collected by MacPhail traps. The traps used to catch flies, in Zucchini and cucumber fields, are baited with the fertilizer diammonium phosphate (DAP) and the hydrolyzed protein Ceratrap©. Results indicated that DAP and Ceratrap© can be used as effective attractant for monitoring against these *Dacus* species. On the other hand, Ceranock attract and kill strategy restricted significantly the number of flies, in the different plots of zucchini (Z1 and Z2) and cucumber, compared to the control. This strategy has also proved to be successful by giving respective reduction rates equal to 89.5%, 92.6% and 96.3% in Z1, Z2 and cucumber plot.

Keywords: cucurbits, IPM, *Dacus frontalis*, *Dacus ciliates*, Ceranock.

931. HNAIEN Safa (Tunisia)

Supervisors: N. Mahfoudhi and T. Elbeaino

Title: A preliminary investigation on the etiology of Brittle Leaf Disease of Date palm in Tunisia. – 47 p.

Abstract: Brittle Leaf Disease (BLD) of date palm, of unknown etiology yet, has assumed epidemic proportions since the 1980's in Tunisia and recently in Algeria and Lybia. A search for the presence of phytoplasma, viroids and viruses, possibly involved in the disease was conducted. Seventy-five samples (leaves\fronds) were collected from symptomatic (25) and asymptomatic (50) date palms (June-July 2019) of three different orchards with trees affected with BLD in Tozeur region (South of Tunisia). RT-PCR assays performed on these samples, using degenerate- and species-specific primers for viruses and viroids detection, respectively, showed no infections with these pathogens. The search for phytoplasma using Nested-PCR assays showed that only 6 symptomatic trees (out of 25 tested, i.e. 8%) were infected, whose sequencing analyses of their PCR amplicons in BALSTn showed 99.44% of similarity with the Candidatus phytoplasma solani (Ca. P. solani

16SrXII-A, stolbur group). RFLP and *in-silico* characterization of this phytoplasma clone (33-5) showed that it deals with a new subgroup. The discovery of *Ca. P. solani* for the first time in the date palm, together with its' new subgroup, makes the novelty of this investigation. More studies are needed to determine the etiology of the BLD in Tunisia, although the finding of the *Ca. P. solani* in six symptomatic palms is intriguing at the etiological level.

Keywords: Brittle Leaf Disease, PCR, Nested-PCR, new *Ca. P. solani* 16SrXII subgroup, RFLP, in-silico characterization.

932. OMRI Ghofrane (*Tunisia*)

Supervisors: F. Valentini, S.A. Minutillo, F. Nigro

Title: Preliminary results in the development of a rapid detection tool for *Verticillium dahliae* in olive orchards. – 48 p.

Abstract: The use of healthy planting materials is of paramount importance for an effective management of *Verticillium wilt*, a vascular disease caused by the soil-borne pathogen *Verticillium dahliae*. Moreover, the use of pathogen-free propagative materials is crucial to prevent the introduction of the fungus into disease-free areas. The certification of healthy plant propagative materials depends on the availability of sensitive and specific diagnostic tools. Fluorescence of Loop Primer Upon Self Dequenching loop-mediated isothermal amplification (FLOS LAMP), is an emerging diagnostic real time LAMP technique initially developed for the diagnosis of human viruses. Recently, it has been successfully applied for the detection of a plant pathogenic bacterium in its insect vector. The main objective of this work was therefore to develop a FLOS LAMP essay to detect *V. dahliae* in infected olive plants. Two previously described LAMP primer sets were evaluated in order to select the most efficient ones for use in routine testing. Genomic DNA extracted from 41 isolates of *V. dahliae* was used during the trial. Thirty-six isolates were specifically detected but a non-specific signal was also recognised in the negative control. Preliminary results of this study highlighted the need to design a new set of primers, targeting the conserved IGS genomic sequence in order to develop an effective real time LAMP essay for *V. dahliae* detection.

Keywords: *Verticillium wilt*, lamp, flos lamp, detection.

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949. TOSKA Mirela (*Albania*)

Supervisors: M. Cara, S.M. Sanzani and D. Frasheri

Title: *Alternaria* species causing pomegranate and citrus fruit rots in Albania and their alternative control. – 45 p.

Abstract: *Alternaria* is a relevant pathogen for several commodities including citrus and pomegranate fruits. On citrus, it mainly causes brown spot on fruits and leaves, whereas on pomegranate, it causes a fruit heart rot. The aim of this study was to assess the presence of *Alternaria* rots on citrus and pomegranate fruits cultivated in Albania. Representative fruits were collected from different regions. Nineteen and thirteen *Alternaria* isolates were obtained from pomegranate and citrus samples, respectively. The isolates were characterized at species and morphotype level. Micro- and macroscopic features separated isolates into four morphotypes. BLAST and phylogenetic analysis using the SCAR Marker OPA1-3 confirmed the isolate identity. All 32 isolates proved to be *Alternaria alternata* and belonged mainly to morphotype *alternata*, followed by *limoniasperae* and *tenuissima*. All *Alternaria* strains proved to possess the *pkSI* gene of alternariol biosynthesis. Citrus isolates were tested for the presence of ACT and ACR toxins' genes, which, however, were never found. Representative strains, one per commodity, proved to be sensitive to the compounds gallic acid and umbelliferone, constituents of pomegranate and citrus fruit, respectively. Nevertheless, further tests are still required. Finally, *Alternaria* might represent a threat to pomegranate and citrus production in Albania, and therefore effective control means are needed.

Keywords: *Alternaria*, citrus, pomegranate, mycotoxins, phytotoxins, alternative control.

950. BANOUH Meriem (*Algeria*)

Supervisors: S. Laala and F. Valentini

Title: Survey of bacterial potato diseases in Algeria. – 56 p.

Abstract: The documentation available on the phytosanitary status of potato bacterial diseases in Algeria is not consistent. We therefore conducted a round of surveys on potato bacterial diseases occurring in three Algerian regions (Algiers, Bouira, Ain-defla) in 2021. The dry weather this year allowed only a few symptomatic plants to be found in seven of the seventy-three plots inspected. One hundred and thirty-one catalase-positive bacterial isolates were obtained from 16 samples. These isolates all reacted positively to tobacco hypersensitivity test and nitrate reductase test. Other biochemical and biological (Gram stain, pathogenicity, oxidase, oxidative/fermentative, levan, indole and indigoidine) and molecular tests (PCR amplification using Y1/Y2 primers for detection of the genus *Pectobacterium*) were variable. The combination of all test results allowed us to assume the presence of three bacterial groups: *Pectobacterium* spp, *Pectobacterium carotovorum* subsp. *carotovorum* and *Dickeya* spp. This work was severely hampered by the laboratory closure and the lockdown following the COVID-19 emergency. Therefore, further characterisation (using specific primers) and a large-

scale survey are needed to confirm the results and ascertain the general phytosanitary status of potato bacterial diseases in Algeria.

Keywords: Potato, Bacteria, Black leg, Soft rot, Ring rot, Brown rot, Algeria.

951. BENELHADJ-DJELLOUL Mouna (Algeria)

Supervisors: S. Ali Arous and K. Djelouah

Title: Influence of different citrus cropping systems on insect diversity, and preliminary survey of Citrus tristeza virus and its aphid vectors in Mina and Chlef valleys (North-West Algeria). – 68 p.

Abstract: Over the last few decades, the Algerian citrus industry has received considerable public subsidies for the renewal of old plantations. As a result, some growers have turned to a new intensive production system instead of conventional extensive cropping. The management systems adopted have a significant impact on insect diversity and abundance and they therefore affect ecological stability and biodiversity. In this context, a comparative study was conducted on two citrus orchards in the Mina and Chlef Valleys to assess insect diversity and abundance in those areas. Analysis of recorded data revealed that extensive cropping systems preserve a greater insect diversity and allow different functional groups of insects such as predators and parasitoids to live and interact, (e.g., *Coccinella septempunctata*, *Harmonia axyridis*) in contrast to intensive systems. 717 insects belonging to 62 species were identified in the extensive orchard with a Shannon diversity index of 2.93. On the other hand, only 394 insects belonging to 32 species were reported from the intensive orchard. As regards the flora, 10 species were identified in the extensive orchard, allowing several insect species to become established as opposed to the intensive orchard. Finally, the preliminary monitoring of CTV and its vectors in the same orchards led for the first time to detect CTV in the Mina Valley.

Keywords: Citrus, extensive, intensive, insect diversity, CTV, Algeria.

952. SEFAH Ayoub (Algeria)

Supervisors: Z. Bouznad, T. Caffi and S. Gualano

Title: Elaboration of a mechanistic model prototype for Verticillium wilt on olive trees. – 34 p.

Abstract: Verticillium wilt is a vascular disease caused by a soil-borne pathogen, *Verticillium dahliae*. It is a major disease affecting olive production worldwide. Control of this pathogen is very difficult because it can inhabit contaminated soils as microsclerotia in for many years. It is therefore necessary to urgently improve plant protection strategies through advanced monitoring technologies and methodologies. The main aim of this work was to develop a mechanistic model prototype on *Verticillium dahliae* in olive trees. The literature was the main source of data concerning the quantitative relationships between weather variables, the host, and the pathogen. Based on the system analysis approach, the collected data were analysed and synthesised to develop a set of mathematical equations expressing the relationships between microsclerotia germination, development, and survival as a function of temperature (C°). Additional parameters were considered such as the effect of roots on microsclerotia germination (mm) and the effect of soil moisture (%) on microsclerotia survival. In order to use the model as a predictive tool, it will be necessary to validate it by comparing the model output with real-life observations over several years. It will also be necessary to compare the control

level achieved by fungicidal applications based on the model vs. those carried out according to the calendar or grower's schedules. Once validated, the model could finally be integrated into a decision support system for olive wilt management.

Keywords: Olive, model, *Verticillium dahliae*, wilt, microsclerotia

953. ABDELMOATY Fatma Mohamed Emam (Egypt)

Supervisors: D. A. Barakat and I. Cavoski; **advisor:** S.I. El-Desoki

Title: Cyantraniliprole Use-and-Risk Reduction in Faba Bean by White Mustard. – 57 p.

Abstract: Cyantraniliprole (CYANO) is a new insecticide in the ryanoid class that has been approved for use since 2013, but data on risk are still lacking. The aim of this study was to assess CYANO risks and the potential of white mustard oil (WMO) as a botanical alternative to reduce these risks in faba beans. Specific objectives included investigating the efficacy of CYANO and WMO against *Aphis craccivora* Koch, assessing CYANO and WMO toxicological effects on *Apis mellifera* and the presence of residues in honey, and exploring CYANO environmental fate and behaviour. Therefore, several trials were run aiming to determine : CYANO and WMO Lethal dose (LD50) on aphids and % reduction of infestation; CYANO and WMO (LD50) on honeybees and histological evaluation; quantification of CYANO residues in pods, leaves, soil and honey. Results showed that WMO provided an excellent 84.06% aphid reduction compared to 95.7% for CYANO. CYANO (LD50 29.7mg/L) was toxic to honeybees while WMO (1627.2mg/L) showed very low toxicity. CYANO caused vacuolation, necrosis and pyknosis of midgut tissues, hypopharyngeal and mandibular glands. CYANO residues in the pods reached 0.2 mg/kg after 7 days of application. In honey, after CYANO and WMO treatment, the residues reached 0.00089 mg/kg. In conclusion, WMO has proved to be a promising botanical for risk mitigation.

Keywords: *Vicia faba*, *Aphis craccivora*, Cyantraniliprole, *Apis mellifera*, Residue analysis, White mustard oil, Ecotoxicology, Botanical extracts

954. FAHMY Salma Mostafa Anwar (Egypt)

Supervisors: M. F. El Wakkad, V. Rossi and F. Santoro

Title: Calibration and evaluation of a prediction model for *Ceratitis capitata* in Egypt. – 76 p.

Abstract: A physiology-based demographic modelling framework was adapted to model the population dynamics of the life stages of *Ceratitis Capitata*, the Mediterranean fruit fly. The model was calibrated using the Marquardt-Levenberg algorithm with data collected from the literature on the insect's biodemography as a function of temperature. Model calibration led to the selection of Medfly pre-imaginal stages development and mortality functions showing the highest goodness-of-fit. Lactin-2 function was used to represent the developmental rate of all pre-imaginal stages, Wang-2 function for the mortality rate of the egg and larval stages, and the quadratic function to represent pupal stage mortality. The calibrated model provided the percentage of the population of each life stage to the total population of each Medfly generation and its progression over time. The model was validated by comparing its predicted adult stage peak time with that of field samples of the adult population from different regions in northern and central Egypt, both collected for this research work and derived from published sources. Validation showed that the model needs to be further tuned to allow for improved

accuracy in predicting the peak time of the different adult generations. The model was compared to an empirical degree-day model, the PBDM model, which was found to be more accurate

Keywords: Physiologically based demographic model, *Ceratitis capitata*, Integrated pest management, Calibration, Validation

955. QASQAS Razan (Jordan)

Supervisors: A. Katbeh Bader and D. Frasheri

Title: Screening of cactus resistant varieties for the cochineal scale *Dactylopius opuntiae* (Cockerell) (Hemiptera: Dactylopiidae) and observations on its predator *Hyperaspis trifurcata* (Coleoptera: Coccinellidae) in Jordan. – 51 p.

Abstract: Out of 47 visited locations in northern Jordan, this study showed that after the first report of the cochineal scale in 2018, the distribution continued to spread southward. The highest infestation being in Al-Suleikhat area in 2021. This study also highlighted the importance of resistant varieties in IPM measures against the cochineal scale. Therefore, 125 different cactus accessions obtained from the International Center for Agricultural Research in Dry Areas (ICARDA) were assessed for their resistance against the pest. All the accessions (Unknown 120 and Unknown 122 from Syria, *Opuntia robusta* 1280 from Argentina and *Opuntia robusta* 200146 from Brazil) have shown 0% infestation rate both in vivo and under controlled conditions. On the other hand, the highest susceptibility was recorded for Zastron 4 and M3 Bianca di Macomer from Italy and 40-Tronzar and GS from Tunisia with an infestation rate > 90%. Additionally, the predator *Hyperaspis trifurcata* lifecycle duration took an average of 29.3 days in vitro (first larva to adult). *H. trifurcata* larvae and adults were aggressive feeders; they consumed up to 150 *D. opuntiae* nymphs in two days. Furthermore, the generation duration of the pest was equal to 36.3 ± 2.59 days under a temperature of 27°C and 70-80% of RH.

Keywords: Cochineal, distribution, IPM, resistant varieties, prickly pear.

956. BILEN Christine (Lebanon)

Supervisors: E. Choueiri and T. El Beaino

Title: New emerging viruses and phytoplasmas of Grapevine in Lebanon. – 63 p.

Abstract: A search for new emerging viral (GVCV, GRBaV, GGVA, GKSV, GGDV, GMRV, GaIV, GaJV-1, GaJV-2, GaCV-1, GaCV-2 and GaCV-3) and phytoplasma diseases was conducted in 52 commercial vineyards in Bekaa and Batroun regions in Lebanon. Sampling, which consisted of collecting leaves from 252 vines showing various symptomatic (leaf mottling, red blotch, vein clearing and yellowing, leafroll and unmaturing canes) and asymptomatic aspects, was conducted in late summer 2020. All collected samples were tested with RT-PCR and PCR assays, whose results showed grapevine infections solely with GGVA (9.27%) and GGDV (12.7%). Sequence analyses of PCR amplicons obtained from these two viruses showed that the Lebanese isolates of GGVA and GGDV were both 100% identical to their homologue reported in the GenBank. RT-PCR results also showed that 0.7% were infected by one pathogen and 0.35% had mixed infection. GGDV (12.7% of total samples) was detected in both table (9.27%) and wine (17.82%) varieties, followed by GGVA (9.5%) including 11.25% within table grapes and 6.93% within wine varieties. *Candidatus Phytoplasma solani* (Ca. *P. solani*) was found in 8 samples and their sequence analysis showed that the Lebanese isolates (LebA3,

B2) share 100% of identity at the nucleotide level, and LebB1, C4, E7 and H5 share 99% with their homologue isolate reported in the GenBank, which belong to the 16SrRNA XII-A. Additionally, a new putative subgroup of the 16Sr group XII was discovered in one of the Lebanese samples, which is an intriguing finding that deserves further consideration. This preliminary study is also considered as the first report of GGVA and GGDV in Lebanon.

Keywords: Lebanon, grapevine, GGVA, GGDV, *Candidatus Phytoplasma solani*, PCR, Nested PCR, sequence analysis.

957. NOUERE Sara (Morocco)

Supervisors: M. Zemzami and S.M. Minutillo

Title: Production of CTV-free propagative material through shoot-tip grafting and real-time LAMP protocol application. – 59 p.

Abstract: The early detection of the *Citrus tristeza virus* (CTV) in Citrus is crucial and is conducted using numerous techniques. Its elimination is reached through thermotherapy combined with shoot-tip grafting which is presently considered the most effective. The current study is enshrined in this context and aims to (i) optimize the STG technique for the elimination of CTV on infected Satsuma Mandarins cultivar Okitsu, (ii) evaluate the health status of STG treated plants by comparing real-time LAMP, DTBIA, ELISA, and biological indexing and finally (iii) develop a system for CTV detection based on the combination of plant tissue-print on nitrocellulose membrane coupled to real-time LAMP. The used STG protocol yielded a low plant survival rate of 5% in Satsuma Mandarins cv. Okitsu. It required 70 days instead of 182 days as reported in literature. Real-time LAMP was rated most accurate and rapid since the time dedicated was 2 hours instead of 30, 34, 1460 hours for DTBIA, ELISA and Biological indexing, respectively. CTV detection tests using membranes indicated that 20 µl of extraction buffer with 10 minutes of incubation period gave the best results. This study, being the first report on the application of real-time LAMP using plant prints on nitrocellulose membrane, shows that the test is promising and that further research should be conducted to optimize the protocol.

Keywords: *Citrus tristeza virus*, early detection, optimization, thermotherapy, shoot-tip grafting, CTV elimination, Satsuma mandarins, real-time LAMP, DTBIA, ELISA, biological indexing, plant prints

958. ADAWI Amer A. A. (Palestine)

Supervisors: S. Jarrar, F. Famiani and M. Gallo; advisor: R. Alkowni

Title: Evaluation of fungicides and of a self-defense inducer compound to control olive leaf spot (*Venturia oleaginea*) disease in olive. 76 p.

Abstract: In 2021, an experiment was conducted on the Nabali Baladi cultivar in an olive grove in Palestine. The aim was to evaluate the effectiveness of fungicides with a low copper content or no copper and of a self-defense inducer to control olive leaf spot (OLS - *Venturia oleaginea*). The following compounds were evaluated: Copper complexed with lignosulphonate and gluconate, Dodine and a Self-defense inducer. They were compared with Copper hydroxide, traditionally used, and an untreated Control. Treatments were performed in March, July and August. In March 2021, leaves grown in 2020 were present and were 100% infected. Defoliation increased in all treatments, but with varying levels of intensity: the Control had the most defoliation, followed by Copper hydroxide and

Copper complexed with lignosulphonate and gluconate, whereas Dodine and, in particular, the Self-defense inducer had the least. All treatments reduced symptomatic leaves but their efficacy varied significantly: Copper hydroxide was the least effective, Copper complexed with lignosulphonate and gluconate was intermediate, Dodine and, mainly, the Self-defense inducer compound were the most effective. Overall, the results are promising since the three tested compounds were able to significantly reduce OLS damage and the amount of copper used for treatments.

Keywords: copper fungicides; dodine; *Olea europaea* L.; olive leaf spot (OLS); olive peacock eye disease; self-defense inducers; *Venturia oleaginea*.

959. BESBES Fatma Ezzahra (*Tunisia*)

Supervisors: S. Boukhris Bouhachem, H.M. Nayem and S. Usmani; **advisor:** K. Djelouah

Title: Early detection and effect of semiochemicals on the management of *Rhynchophorus ferrugineus* Olivier on *Phoenix canariensis* Chabaud in Tunisia. – 78 p.

Abstract: *Rhynchophorus ferrugineus* Olivier is the most serious pest of Canary Date palms in the Near East and North Africa region. In Tunisia, this pest was recently introduced and is still under control in the northern part of the country. However, its threat to the dates' sector is still prominent. Our study aimed to assess the efficiency of semiochemical-mediated technologies (pheromone trapping and Push and Pull strategy) and evaluate behavioural responses of the *R. ferrugineus* insect through laboratory assays. The pheromones tested did not show differences in the attractiveness of weevils; however, the formulation type influenced their durability and handling. Push and pull assays seem to be promising. As for attract and kill gel dispensers, the formulation needs to be re-assessed. Overall, the repellency laboratory assessment of *P. halepensis* and *T. capitatus* showed repellent potential towards *R. ferrugineus* with similar rates at doses of 20uL and 50uL, whereas, *M. communis* then *E. citriodora* were the least repellent at both doses. Females and males did not show any significant difference in reacting to the volatiles. These findings project us into interesting research areas as the improvement of the integrated pest management programs based on early detection and semiochemical-based techniques.

Keywords: Red Palm Weevil, Canary palms, pheromones, repellency, essential oils

960. CHOUK Ghada (*Tunisia*)

Supervisors: N. Mahfoudi and M. Digiaro

The presence of virus and virus-like diseases of pistachio (*Pistacia vera*) in a varietal collection plot. – 50 p.

Abstract: A survey was conducted to assess the sanitary status of pistachio plants in a varietal collection plot in Mornag (Tunisia). A total of 130 pistachio samples were analysed by RT-PCR for the presence of viral agents [i.e. Pistachio ampelovirus A (PAVA), Pistachio virus B (PiVB), viruses of *Closteroviridae* and the genera *Sobemovirus* and *Begomovirus*], viroids (hop stunt viroid, HSVd and Citrus bark cracking viroid, pistachio strain, CBCVd-pis) and phytoplasmas. PAVA was identified in fifteen samples (11.5 % of the total). Sequence analysis of the RT-PCR amplicons of three PAVA-infected accessions showed 99.1% identity with the US isolate W10. No cases of PiVB infection were observed in any of the samples tested.

Visible amplified bands from possible *Closteroviridae* infections other than PAVA, *Sobemovirus* and *Begomovirus* agents were observed in 6.7%, 33.8% and 2.3% of the samples, respectively, using genus/family-universal primers. The viral nature of these bands and their specific identification is not definitive and can only be ascertained after their PCR amplified products are sequenced. HSVd and CBCVd-pis were detected in 50 (38.4%) and 33 (25.4%) of the 130 samples, respectively, PCR amplicons from three CBCVd-pis infected accessions showed 100% nucleotide sequence identity with US isolate W11. The sequences of six HSVd showed 95-100% nucleotide identity with each other and clustered in two of the five distinct groups that compose this species (plum-hop/citrus and hop groups). Nested-PCR revealed the presence of phytoplasma agents in two of the 60 pistachios tested (3.3%), both of which had severe witches' broom symptoms. BLAST analysis of their sequences showed 95-99% nucleotide identity with *Ca. phytoplasma mali* isolates of the 16Sr X-A group. No virus was mechanically transmitted on herbaceous hosts from any pistachio tree showing virus-like symptoms of dwarfing, rosette, witches' broom, leaf deformation and chlorosis. This is the first report of PAVA and CBCVd-pis on pistachio in Tunisia.

Keywords: *Pistacia vera*, RT-PCR, Nested-PCR.PAVA, HSVd, CBCVd-pis, *Phytoplasma mali*.

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982. CARA Orges (Albania)

Supervisor: T. El Beaino ; advisor: A. Ben Slimani

Title: Study of the sanitary status of *Abelia grandiflora* and *Lantana camara* plants to establish healthy plant source material for future certification program of ornamentals. – 50 p.

Abstract: Floriculture has a large production value in Italy, with 30,000 hectares of plantation and more than 100 thousand employees. *Abelia grandiflora* and *Lantana camara* are two ornamental species cultivated for decorative purposes; however, unlike other crops, very few reports report the presence of viruses and viroid infections. Furthermore, the EU legislation includes *Lantana* and *Abelia* species, as well as many other species, in its certification program description. This situation necessitated an investigation to seek for known and unknown pathogens (viruses and viroids) infecting these species and for identifying healthy plants that could be used as candidate mother plant material for future certification program of ornamentals in Italy. PCR assays and High-Throughput Sequencing technology had identified 4 novel viruses belonging to *Caulimoviridae*, and *Geminiviridae* families, for which one full virus genome sequence was determined. None of the known viruses that infect these species have been detected in the surveyed samples except for apple chlorotic leaf spot virus found for the first time in *Lantana* species. 17 *Lantana* and 20 *Abelia* plants were found free of viral infections and can be used as a candidate plant material in the future certification program of ornamentals.

Keywords: *Abelia grandiflora*, *Lantana camara*, viruses, PCR, HTS, *Geminiviridae*, *Caulimoviridae*.

983. BEDDANE Mohammed (Algeria)

Supervisors: S. Ali-Arouss and K. Djelouah

Title: Studies on insect diversity occurring in olive trees in two orchards differently managed in an arid climate in Mecheria district, Algeria. – 69 p.

Abstract: This study investigated the insect diversity of olive (*Olea europaea* Linnaeus (Oleaceae)) groves grown in an arid climate in Algeria. In this context, several sampling methods were used within two orchards differently managed. Fifty arthropod species belonging to diverse orders and families were recorded. Hymenopteran species were quantitatively the most abundant, followed by species associated with Heteroptera, Aranea, Coleoptera and Homoptera orders. Regarding functional feeding groups, phytophagous species were dominant in both the weeded and the unweeded orchard; however, higher abundance was recorded in the weeded site. Predators were ranked second, and pollinators were more frequent in the unweeded olive orchard. The Hutcheson t-test revealed a positive correlation between the weed management system and arthropod diversity ($P < 0.05$), however, it did not show a significant effect of the weeding management system on the diversity of beneficial occurred in both agroecosystems. Overall, calculated diversity and similarity indices were greater in the unweeded orchard than in the weeded orchard, demonstrating spontaneous flora's key role in entomofaunal diversity. Principal Component Analysis (PCA) has confirmed the

evident correlations between arthropod species abundance and naturally occurring plants in olive orchards, including beneficial arthropods.

Keywords: Algeria, olive, insects, diversity, wild plants.

984. BOUAICHA Dounya (Algeria)

Supervisors: S. Laala and F. Valentini

Title: Assessment of the antimicrobial activity of some plant extracts against *Erwinia amylovora*. – 70 p.

Abstract: The development of sustainable, effective, eco-friendly compounds for containing and counteracting the development of pathogens is one of the goals being pursued by phytopathological research to identify natural molecules or compounds that are effective in control. There are several research activities in the bibliography on extracts and/or compounds of plant origin that are effective in counteracting pathogens and pests that have subsequently been used in the open field in integrated pest management programs. The present study researches the possible efficacy of plant extracts, organic and aqueous, for the control of *E. amylovora*, which was evaluated under in vitro and in vivo conditions. Four plant extracts were used in this research: pomegranate, onion, eucalyptus and garlic, collected from different areas in Algeria. From the results obtained, it was found that pomegranate ethanolic extract showed increased and remarkable antimicrobial activity against the pathogen during the biological test (disk diffusion test, well diffusion test and agar paper test) and bioassay (immature pear fruit and detached pear leaves) on the Algerian *E. amylovora* isolates used in this study. Pomegranate extract contains a high concentration of bioactive compounds, and chemical studies are underway to identify compounds that played a role in this antimicrobial activity by Nuclear Magnetic Resonance (NMR) spectroscopy.

Keywords: plant extracts, control, pomegranate, *E. amylovora*.

985. ZAIDAT Sabri Ala Eddine (Algeria)

Supervisors: K. Djelouah and R. Abou Kubaa ; **advisor:** S. M. Sanzani

Title: Monitoring of the main pathogens affecting honey bee colonies in Apulia region by using molecular diagnostic tools. – 66 p.

Abstract: Colony collapse disorder (CCD), a serious threat phenomenon affecting bee colonies, has been reported worldwide during the last decades, associated with several causes, particularly the widespread pathogens that can act individually or in synergy. In the present study, thirty apiaries located in different provinces of Apulia region (southeast Italy) were assessed during spring-summer 2022 to monitor the presence of common pathogens: Black queen cell virus (BQCV), Deformed wing virus (DWV), *Nosema ceranae* and less known or emerging pathogens in honeybees such as Bee macula-like virus (BeeMLV), Slow bee paralysis virus (SBPV), *Aspergillus flavus* and *Peanibacillus* larvae. These pathogens were monitored using molecular tests from foraging honeybees and both adults and larvae inside the hives. Droplet Digital PCR (ddPCR) method was also assessed for virus detection and quantification. This study evidenced that BQCV, DWV, BeeMLV, and *N. ceranae* are widespread in this region, in contrast, *P. larvae* and *A. flavus* were not detected. Despite being asymptomatic, many investigated hives had different degrees of co-infection in apiaries, hives and samples. Furthermore, this study allowed us to report the presence of SBPV in the Apulia region for the first

time. Furthermore, the validated ddPCR protocol showed a higher sensitivity for early detection of BQCV and DWV.

Keywords: Honeybee, Colony Collapse Disorder, Pathogens, dd PCR, qPCR, Apulia.

986. SALEM Mostafa Mohamed Fahmy (Egypt)

Supervisors: K.A. Abd-Elsalam and S.M. Sanzani

Title: Biological control agents and GRAS compounds as a control strategy for postharvest rots on tomato. – 59 p.

Abstract: Fungal pathogens are the main cause of losses in terms of fruit and vegetable yield in the field and product after harvest. Given the low number of treatments allowed after harvest, for overcoming losses there is a growing interest towards the use of eco-friendly means as biocontrol agents and/or food additives, also known as Generally Recognised as Safe (GRAS) compounds, which are low-toxicity substances having minimal toxicological effects on animals and negligible environmental impact. This study assessed the presence of *Alternaria* rots on tomato fruit commercialized in Egypt, highlighting the occurrence of *Alternaria arborescence* but mainly *Alternaria alternata* strains. Furthermore, this investigation presented the result of *in vitro* and *in vivo* laboratory assays using new antagonistic bacterial strains and GRAS compounds against for postharvest tomato fruit rots by *Alternaria* spp. Two *Pseudomonas* spp. strains were selected and combined with the GRAS substances that showed antifungal activity to evaluate the putative improved effect. Results proved that the two *Pseudomonas* spp. strains almost completely prevented the disease onset independently if used singly or in combination with GRAS. These results although preliminary seem promising and need to be confirmed in large-scale trials.

Keywords: *Alternaria*, Alternative control, GRAS compounds, biological control agents, tomato.

987. MEKONNEN Melkamu (Ethiopia)

Supervisors: F. Nigro and M. Gallo ; **advisor:** F. Valentini

Title: Evaluation of essential oils for the management of *Verticillium* wilt (*Verticillium dahliae* Kleb.) under controlled conditions. – 64 p.

Abstract: *Verticillium* wilt (*V.dahliae* Kleb.) is a serious biotic threat to a wide range of economically important crops. Since the banning of soil fumigants, the management of *Verticillium* wilt relies on IPM strategies. This study investigated the antifungal activities of thyme, oregano, sage, and rosemary essential oils both *in vivo* and *in vitro* against *V. dahliae*. The result of the *in vitro* study demonstrated that 3% concentrations of thyme and oregano essential oils are effective (100%) in controlling the mycelial growth of *V. dahliae* after five and seven days of incubation. 3% concentration of thyme and oregano essential oils were also effective in reducing the conidial germination of *V. dahliae* by 77.8% and 74.5%, respectively. The results of the *in vivo* study demonstrated that thyme and oregano essential oils were effective in reducing disease severity in olives, eggplant, and tomato. Thyme essential oil reduced the disease severity of *V.dahliae* by 50%, 46.5%, and 28% in tomato, olive, and eggplant, respectively whereas oregano essential oil reduced the disease severity of *V.dahliae* by 46.7%, 32.7%, and 20% in tomato, olives, and eggplant, respectively. Therefore, oregano and thyme essential oils could be used as natural fungicides for the management of *V. dahlia*.

Keywords: Antifungal activity, essential oils, *Verticillium dahliae*, disease severity, disease incidence.

988. ABI SAAD Charlie (Lebanon)

Supervisors: A. Moretti and S.M. Sanzani; **advisors:** A. Susca and W. Habib

Title: Studies on *Fusarium* spp. isolates from a wide range of agri-food and ornamental crops in Lebanon. - 65 p.

Abstract: Lebanon, with its soil and climatic conditions, is a country with a wide variety of crops. The genus *Fusarium* is one of the most detrimental pathogens for the quality and yield of these crops. Furthermore, it produces mycotoxins whose deleterious effects are reported both on plants and on humans and animals. In this study 134 *Fusarium* isolates from agri-food and ornamental crops in different Lebanese regions were studied. They were identified morphologically and molecularly using the barcoding translation elongation factor gene, proving to belong to 9 species complexes (SCs): *Fusarium oxysporum* SC (FOSC), *F. solani* SC, *F. fujikuroi* SC, *F. sambucinum* SC, *F. incarnatum-equiseti* SC, *F. tricinctum* SC, *F. lateritium* SC, *F. burgessii* SC, and *F. redolens* SC. Some of the SCs were reported for the first time in Lebanon. Then the FOSC strains were phylogenetically studied by a multi-locus approach, allowing to identify the prevalence of *F. oxysporum* strains, and the presence also of *F. algeriense*, *F. citricola*, *F. redolens*, and 5 strains that need further characterization. Finally, primer pairs from the literature were used for detecting biosynthetic genes of the emerging mycotoxin beauvericin in *F. oxysporum* strains, without positive results. As such, the design of species-specific primers is in progress.

Keywords: *Fusarium*, agri-food crops, ornamental crops, Lebanon, beauvericin.

989. SWEIDAN Zeinab (Lebanon)

Supervisors: F. Santoro, N. Baser and G. Anfora

Title: Calibration and evaluation of a prediction model for *Drosophila suzukii* in the Apulian region of southern Italy. – 74 p.

Abstract: A physiologically-based demographic model (PBDM) was used to predict the population dynamics of *Drosophila suzukii* immature stages in the Apulia region in the South of Italy. In this work, the model was calibrated by data coming from experimental observations on the development rates of 50 eggs of *D. suzukii* to adults at different temperatures (5°C, 10°C, 16°C, 28°C, 32°C, 34°C), describing each step of juvenile development (L1, L2, L3, and pupa). Calibration was carried out by using the Marquardt-Levenberg algorithm by which experimental data, obtained in a growth chamber (life table) were sorted out as functions of temperature (range 5.6-32.4°C). Lactin-1 function was selected as appropriate for representing the development rates of egg, larval and pupal stages of *D. suzukii*. In contrast, Wang-2 function represented at best the mortality rates of *D. suzukii* immature stages. The calibrated model provided reliable functions of the variation in time of *D. suzukii* population dynamics within the above-mentioned temperature range. This model is the first PBDM that would predict population dynamics of the pest in Apulia, in which the average range annual temperature falls approximately between 5 and 32° C. Experimental data at 24°C were satisfactorily congruent with the model curve, thus confirming the evaluation of calibration. Thereafter, the validation of the model will be achieved by proving its match with open field I data.

Keywords: Physiologically-based demographic model, *Drosophila suzukii* prediction, calibration, evaluation, validation.

990. YAZBECK Reem (Lebanon)

Supervisors: M. Digiario and T. El Beaino; **advisor:** A. Ben Slimen

Title: High-throughput sequencing and RT-PCR for detecting viruses and viroids of *Bougainvillea* and *Viburnum* spp. ornamental plants. – 57 p.

Abstract: A survey was conducted to assess the phytosanitary status of *Viburnum* and *Bougainvillea* plants in six ornamental plant nurseries in Apulia region. A total of 117 samples (59 *Viburnum* and 58 *Bougainvillea*) were analyzed by RT-PCR against all known viruses and viroids for these species (BCVBV, INSV, TYRSV, CIYMV, CMV and HSVd for *Bougainvillea*, and AMV, SDV, TRSV and HSVd for *Viburnum*). Only AMV was detected in 25.4% of the *Viburnum* samples, and, for the first time in Italy, BCVBV in 8.6% of the *Bougainvillea* samples. The HTS was also applied to two pools of 20 PCR-negative samples for each of the two species. In the *Bougainvillea* samples, this technique revealed the presence of at least two BCVBV isolates, whose complete genome sequence was determined. These two Italian isolates showed the highest identity in BLASTn with isolates of Malaysian BCVBV-UKM (97%) and Brazilian BCVBV-UNB-01 (80%), respectively. For the latter virus, a specific primer set was designed that allowed detection of the BCVBV-UNB-01-like isolate in other 7 out of 58 (12.1%) *Bougainvillea* samples. The HTS also revealed the presence in *Bougainvillea* of another new viral entity of the family *Caulimoviridae*, genus *Soymovirus*, whose sequencing is currently being completed. A specific primer set designed in the reverse transcriptase region allowed the presence of this new virus, for which the name of *Bougainvillea Soymovirus 1* was proposed, to be detected in 13.8% of the plants.

Keywords: *Bougainvillea*, *Viburnum*, High-throughput sequencing, Badnavirus, Soymovirus, Alfalfa mosaic virus.

991. ACHTEBI Hassan (Morocco)

Supervisors: S. García Andrés and M. Gallo

Title: Sudden death of melon (*Cucumis melo*): Diagnosis and control methods. – 67 p.

Abstract: This study focuses on the sudden death problem of melon. It aims to identify the phytopathogenic agents and to evaluate the effect of certain fungicides and varieties. Diseased plants were collected from 3 fields in the northern and central region of Morocco. Three fungi, *Fusarium oxysporum*, *Macrophomina phaseolina* and *Phytophthora* sp., were the species most frequently isolated from the root systems of wilted melon. *F. oxysporum* and *Phytophthora* sp. were detected by morphological observation and molecular characterization while *M. phaseolina* was detected by microscopic observation. Field trials showed significant effects of fungicide applications on disease incidence. The disease incidence reduction was significant with an efficacy of 80%, especially with the Fluopyram fungicide. The damage in the treated elementary plots was minimal compared to the untreated plots. These results show the importance of using certain chemicals and bio-fungicides in controlling *Fusarium* and root rot of melon. The setting up of varietal trials allowed to compare the behavior of different varieties in the same environment with a particular fungal pressure. Results showed the importance of *Fusarium* 1.2 resistance in reducing the disease incidence and severity. Cultivar

resistance remains therefore an optimal solution to consider in terms of control of these pathogens.

Keywords: Melon, Sudden death, *Fusarium oxysporum*, *Phytophthora* sp., *Macrophomina phaseolina*, molecular characterization, varieties, fungicide.

992. MGHARI Hamza (Morocco)

Supervisors: S. Gualano, F. Santoro and A. Novelli

Title: Evaluation of the Use of MODIS-Terra and Sentinel-2 data to survey the epidemic effects of *Citrus Tristeza Virus* (CTV) infected areas in Apulia region. – 100 p.

Abstract: Monitoring and surveillance of plant pathogens and pests is an essential step in integrated pest management. However, the conventional field monitoring of diseases and pests is labor-intensive and generally not very effective. Remote sensing (RS) techniques could play an essential role in large-scale monitoring of plant diseases and pests. Citrus tristeza virus (CTV) is the most important citrus virus in the world. In 2002 two epidemics of the virus were reported in Apulia region, Italy. To survey the epidemic effects of the virus in Apulia region, a remote sensing approach using time series analysis was applied. *Moderate Resolution Imaging Spectroradiometer* MODIS-Terra *Normalized Difference Vegetation Index* time series and Sentinel-2 multispectral satellite imagery were evaluated to study the fluctuations related to the infection, in nine citrus fields by MODIS-Terra for a period of 21 years, and in four citrus orchards by Sentinel-2 for a period of 5 years. Phenological parameters were extracted from MODIS-Terra NDVI and Sentinel-2 NDVI by applying asymmetric curve fitting methods. Then their evolution was analyzed using linear regression. The approach evaluated demonstrate its high potential in monitoring the infected citrus fields. MODIS-terra with his medium spectral resolution provides a large time period of assessment. Moreover, Sentinel-2 enables the monitoring of small orchards due to its high spectral resolution. Statistical analysis has demonstrated the correlation between the incidence of the infection to the trends of seasonal parameters, notably the peak value parameter, the seasonal amplitude, and the seasonal integral in the summer period.

Keywords: NDVI, Curve Fitting, Time series analysis, Remote Sensing, Satellite Imagery, CTV.

993. ATAWNEH Wesam (Palestine)

Supervisors: A.J. Hamdan and F. Porcelli ; **advisors:** F. Valentini and A. Hanani

Title: Investigating the abundance and diversity of xylem sap-feeders Hemiptera in Palestinian fruit tree orchards. – 68 p.

Abstract: Cicadomorpha and Fulgoromorpha (Hemiptera: Auchenorrhyncha) include over 40,000 species worldwide. Xylem feeders are mainly represented in the sub-order Cicadomorpha. Xylem-sap feeders are less known to affect overall plant health. However, these insects can transmit xylem-inhabiting pathogens and are considered as dangerous as the pathogens themselves. *Xylella fastidiosa* can infect many plants, including economically important crops (olive, grapevine, citrus, and stone fruits). *Philaenus spumarius* (L.), *P. italosignus*, and *Neophilaenus campestris* demonstrated an attitude to vector Xf ST53 in Italy. Given that the area infected by Xf is located very close to Palestine (Zecharia et al., 2022), the risk of its introduction remains high; therefore, knowing its candidate vectors is fundamental to developing containment strategies. This thesis aims to build a repertory of the

Xylem-sap feeder guild abundance in available habitats and scrutiny for the CXfV through a multi-access identification key. The specimen collection was conducted in the West Bank region between April 2022 and June 2022, collecting 165 total specimens. Afterwards, the multi-access key permitted the finding of 41 specimens from Palestinian samples as candidate vectors of *X. fastidiosa*: Aphrophoridae (35 individuals) related to the genera *Aphrophora*, *Neophilaenus* and *Philaenus*, and Cercopidae (6 individuals) related to the genus *Cercopis*.

Keywords: Auchenorrhyncha, vector, *X. fastidiosa*, xylem sap-feeders

MEDITERRANEAN ORGANIC AGRICULTURE

MOA - A.Y. 2001-2002 (July session) – 272-280

272. ZIANE Djamila (*Algeria*)

Supervisor: F. Eyhorn ; co-supervisor: J. Calabrese

Title: Setting up a control and certification system for organic farming in developing countries: the case of Algeria. - 137 p.

Abstract: The main objective of this work is to define the steps and the procedures to set up an effective control and certification system for Algeria, that is compatible with local peculiarities and realities and which complies with the International Regulations. The aim of this initiative is to offer a cost-efficient and credible inspection and certification for organic products to farmers, processors and traders. A study of the experience of another developing country in setting up a certification program was carried out. This case study is intended to present some key experiences in the field, and to extract lessons learnt which could serve as support for new initiatives. An action plan is proposed with the main steps and actions to undertake in order to reach the main objective of this work.

Keywords: Action plan, Algeria, case study, control and certification, organic farming.

273. LI Zhifang (*China*)

Supervisor: F. Caporali ; co-supervisor: N. Dubla

Title: New eco-compatible technologies of Durum wheat production: a case study on winter wheat living mulch by sub clover in Southern Italy. - 66 p.

Abstract: This paper reports the trial comparing N management in two crop systems: winter wheat (*Triticum aestivum* L.) living mulch with subclover (*Trifolium subterraneum* L.) (field 1), and winter wheat pure standing with organic N fertilization (field 2). Subclover is supposed to fix N₂ and to release a part of it to wheat plants. Wheat grain yield in field 1 is 2227kg/ha, in field 2 is 2272kg/ha, with no statistically-significant difference (95% level). However, the wheat biomass accumulation at the start of heading in field 1 (2635kg/ha) is significantly lower than that in field 2 (3100kg/ha). NPK content in wheat plant tissue is also obviously lower in field 1 than in field 2 during the stem extension stage. Soil soluble N content in field 1 is also lower than that in field 2 in the same period. DRIS (Diagnosis and Recommendation Integrated System method) is applied to illustrate N deficiency in field 1. Although after heading soil N availability in field 1 is higher than that in field 2, final N accumulation in wheat biomass is still 15% lower than in field 2. Subclover grows slowly during the early spring, while after winter wheat heading, it grows fast from 137.2kg/ha dry weight to 508.7kg/ha in 15 days. Soil soluble N content in field 1 is also higher than in field 2 during this period. However, when wheat plants start heading, the biomass accumulation is already nearly 90% of maximum biomass yield. Evidence shows that the effect from sub clover fixed N₂ is lower.

Keywords: winter wheat, subclover, living mulch, organic farming, N management.

274. EL NAGGAR Ahmed Hamdy (Egypt)

Supervisor: T. Miano ; co-supervisor: C. Sigliuzzo

Title: Effect of using water extracts of compost and organic materials on soil fertility and plant nutrition. - 109 p.

Abstract: The aim of this work is to obtain a number of complete soluble compost extracts rich in macronutrients which can be used for fertigation safely through modern irrigation systems and to evaluate their effects on soil fertility and potato (c.v. Sieglinde) growth under organic farming system. Three materials were treated with water to obtain the following dilution ratios: Farm Compost 1:5 (FC5); Farm Compost 1:20 (FC20); Farm Compost + Guano 0.75: 0.25: 5 (FCG); Guano 0.25:5 (G) and Commercial Compost 1: 10 (CC). Results revealed a general increase in macronutrients (N, P and K) in potato plant leaves, stems and roots, as well as in the growth parameters. The treatment FCG shows the highest tuber yields (49.78 ton/ha) for potato plant with respect to the control (16.44 ton/ha) whereas treatments FCG and G also promote an increase in tuber nitrates content (198, 243 mg kg⁻¹ F.W., respectively). Analysis of soil organic matter and soil available nutrients was not significantly affected by the various treatments.

Keywords: organic farming, compost tea, compost extract, guano, potato, soil, nutrients, fertigation, soil fertility.

275. BTEICH Marie Reine (Lebanon)

Supervisor: N. Scialabba ; co-supervisor: P. Pugliese

Title: Towards a strategy for organic agriculture development in Lebanon. - 137 p.

Abstract: Organic agriculture aims at developing self-reliant and environmentally-sound farming systems, which can improve the economic and social situation of those who participate in the production, processing and marketing processes. This study was based upon a survey conducted in Lebanon in March-April 2002. The survey covered the different interest groups involved, or likely to become involved, in the organic sector, namely: organic farmers, consumers, shop owners and institutions. The identification of requirements, strengths and weaknesses throughout the organic production, processing and marketing chain allowed proposing options for the development of the sector over the short, medium and long-term. Results essentially showed that while public institutions were neither interested nor equipped to promote organic agriculture, a number of pioneer and educated farmers and a few non-governmental organizations were quite active in the sector.

Keywords: organic agriculture, Lebanon, consumers, institutions, organic farmers, shop owners.

276. EL KHOURY HANNA Youssef (Lebanon)

Supervisor: T. Moleas ; co-supervisor: V. Simeone

Title: Biological control of *Frankliniella occidentalis* table grapevine using predation and plant association. - 71 p.

Abstract: This present work aims on one hand to verify the damage of *Frankliniella* in the presence of attractive blue flowers of *Phacelia tanacetifolia*, and on the other to evaluate the predation efficiency of the predator *Orius*. In that context, *Phacelia tanacetifolia*, intercropped between rows in the vineyard, blooms at the same time as the vine and can limit a possible increase of *F. occidentalis* population up to 50-

70% as the experiment has shown by trapping or attracting the plant pest. If the population is not numerous during the season, *Phacelia* could be alone a reliable practical way to control this pest and can decrease the population below the threshold level. *Orius* has succeeded in decreasing *F. occidentalis* population by limiting the damage up to 7 berries per cluster while *Orius* reared in the Biofactory laboratories has shown a lower predation efficiency leading to a higher damage up to 14 berries per cluster. In a general way, *Orius* endogenous population could decrease *F. occidentalis* damage to a certain level, but it is not so efficient as *Phacelia tanacetifolia* in our conditions.

Keywords: table grape, bio-control, *Frankliniella occidentalis*, *Orius* spp *Phacelia tanacetifolia*.

277. EL MALOUI Hamid (Morocco)

Supervisor: F. M. Santucci ; co-supervisors: V. Fersino and A. Antonelli

Title: Production and marketing of organic fruit and vegetables in Morocco. - 77 p.

Abstract: The aim of this study is to identify the opportunities and constraints facing the organic production and marketing, to provide an understanding of the limitations of the existing production system and exports' strategies. This study was based upon a survey conducted in Morocco and Europe. Interviews were drawn from the whole spectrum of those involved in the production, marketing and assistance of Moroccan organic horticultural products: producers, exporters, processors, importers, public and private institutions. Results show that the sector avails of great potential in terms of production adequacy and diversity, which provides stakeholders various opportunities in the coming years. Yet, there exists a series of weaknesses, which limit the producers' ability to take full advantage from these potentialities. Public institutions are still far from fully supporting the organic sector, whilst, farmers' associations and NGO's are making many efforts for the sector development. Results have allowed to set up the main actions that should be undertaken for the promotion of the sector, the responsibility of the involved actors, and the actions' time scale feasibility.

Keywords: Trade, organic fruit and vegetables, stakeholders, European markets, domestic market, Morocco.

278. IYED Kacem (Tunisia)

Supervisor: V. Savino ; co-supervisors: P. F. La Notte and M. Desantis

Title: Phytosanitary protocol for the establishment of grapevine certified organic mother plant fields. - 69 p.

Abstract: In organic agriculture, considering the low availability of means to control virus and virus-like disease vector populations and potential virus sources (herbaceous species) it is important to evaluate and prevent all risks of vine reinfection. In three potential suitable fields the following risks have been analysed and evaluated: a) presence of transmissible viruses in spontaneous herbaceous flora (by ELISA and biological assays) and in the surrounding vineyards (by ELISA); b) presence of virus and phytoplasma vectors through monitoring of populations. The three fields selected for the absence of vector populations and alternative grapevine virus sources, resulting free from grapevine virus and phytoplasma reinfection risks are suitable to establish grapevine certified organic mother blocks. Only rotenone and mineral oil showed a limited efficiency, in controlling mealybug populations and neither significant differences nor phytotoxic effects have been observed between the recommended dose and the double dose.

Keywords: organic propagating materials, phytosanitary protocol, certified organic grapevine mother plant field, survey of vectors, Survey of grapevine virus and virus-like diseases, bio-pesticides efficiency.

279. CHEHIDI Hatem (Tunisia)

Supervisor: E. Raso ; co-supervisor: D. Petruzzella

Title: New methodology to design, test and improve organic agroecosystem prototyping under Mediterranean conditions. Case study: application to a pilot farm in the South of Italy. - 77 p.

Abstract: The sustainability of farming system is related to the agroecosystem equilibrium. "Agro-designing" or EAFS prototyping is one methodology that can be used to assess and monitor organic farming agroecosystem. However, methods (MCR, ENM, EIM, EEPS, ECP, FSO and MSC) and parameters chosen for monitoring must be adapted to the specific agricultural conditions to design a suitable prototype. The single farm is the nucleus of agricultural production and the main starting point not only for identifying and reducing negative environmental impacts but also to promote and develop strategies to achieve long-term agroecosystem equilibrium. The "State of the Art" of the agroecosystem "Serra del Bosco" farm, located in Gravina di Puglia (Apulia-Southern Italy) and one of the pilot farms of the Regional Apulia Organic Farming Network, is presented as a case study for the application of EAFS methodology.

Keywords: sustainability, agroecosystem, ecological arable farming system methodology (EAFS), assessment system, organic farming.

280. KOÇ Fulya (Turkey)

Supervisor: G. Nuzzaci ; co-supervisor: F. Baldacchino

*Title: Rearing and releasing of *Opius concolor* in organic olive orchards. - 77 p.*

Various experimental tests on the biological control of the olive fruit fly have given encouraging results regarding the mass introduction of the endoparasite *Opius concolor* reared in laboratory conditions. For the releasing of *Opius concolor* two fields in the province of Bari (IT) were tested in order to check the effect of two different climates on the populations of *Opius concolor* and also of *B. oleae*. It is concluded that the coastal area is more favorable than the inland for *Opius concolor* for a good parasitization.

*Keywords: rearing, releasing, *Opius concolor*, biological control, *Bactrocera oleae*, organic olive.*

MOA - A.Y. 2001-2002 (October session) – 281-286

281. ELGHARABLY Ahmed Galal (Egypt)

Supervisor: A. El-Araby

Title: Improving compost quality for organic vegetable production. - 66 p.

Abstract: The aim of this research is to improve the quality of organic farm compost, in order to satisfy soil fertility status required for reasonable organic vegetable production. Field experimental trial has been conducted on ALHODA organic farm, Ismaillia Governorate, Egypt. This experiment study the effect of some plant and animal residues, in addition to natural mineral sources. Three treatments C1, C2 and C3 were composed of 40% crop residues + 20% chicken manure + 40% cow manure (control), control + 500 kg rock phosphate + 300 kg orthoclase + 500 kg bone meal and control + 500 kg rock phosphate + 300 kg orthoclase + 200 kg animal hoof, respectively. Data obtained revealed that treatment C3 was the superior treatment. Also, EM proved significant results with all treatments; however, C3 + EM treatment recorded the highest squash yield among all treatments (8.12 tons/fed.).

Keywords: cow manure, chicken manure, crop residues, animal hoof, bone meal, rock phosphate, orthoclase, effective microorganisms (EM), squash crop, sandy soils.

282. LAÂNAYA Rachid (Morocco)

Supervisor: L. Kenny

*Title: L'effet de l'association du haricot vert (*Phaseolus vulgaris* L) avec la courgette (*Cucurbita pepo*) et d'une fertilisation organique à base de farine de poisson sur le rendement de la courgette dans un système de production biologique. - 69 p.*

Abstract: The experiment was carried out on snap bean to study the effect of organic fertilizers on seed yield and quality and soil chemical properties. The crop was trained under low tunnels. We studied the effect of three organic fertilizers

(compost, cow manure and sheep manure) on the seed yield and quality of two snap bean varieties (Xera and Paulista). The effect on soil chemical properties was also investigated. The results obtained showed that the organic fertilizers have an effect on seed production and soil fertility. The fertilizer which gave the highest number of pods per plant is the compost (27 pods per plant).

Keywords: organic agriculture, organic fertilisation, crop association, green bean, squash.

283. HAFID Hicham (Morocco)

Supervisor: L. Kenny

Title: Effet de la fertilisation organique sur la production de semences biologiques de deux variétés de haricot vert et sur les propriétés chimiques du sol. - 71 p.

Abstract: This research was carried out under two delta 9 plastic sheets on the experimental farm of the Complexe Horticole of Agadir. The goal was to study the effect of three green bean varieties and an organic fertilisation based on fish powder on a squash crop (ROBERTA variety) in an organic system. The results showed a decrease in the plant height specially in association, a decrease in the dry matter (a loss of 72,86%), a delay of three days for flowering for associated plants. Concerning squash production, it was lower for association plants (loss of 10,77% for Paulista association, 25,32% for Xera association and 38,35% for Donna association).

Keywords: compost, cow manure, sheep manure, soil fertility, green bean, organic seeds.

284. HALLAÇ Filiz (Turkey)

Supervisor: Not available

Title: Comparison of biodynamic, organic and conventional fig farms under rainfed conditions in Turkey. - 50 p.

Abstract: Not available.

285. JAOUADI Imen (Tunisia)

Supervisor: M. Ben Khedher

Title: Adaptation de la pomme de terre au mode de production biologique en relation avec le compost et l'aspect variétal. - 118 p.

Abstract: In this study on potato adaptation to organic agriculture, two experiments were made. The first trial aims to study the varieties' adaptation. Twenty varieties were tested on the basis of agronomic parameters such as yield, plant height, the number and diameter of the stems, vegetative vigor, growth cover and the sanitary status. The varieties Arinda, Safrane, Obelix and particularly Atlas gave satisfactory yield. The yield was in general well correlated with agronomic criteria such as the quick emergence, the high number of stems, the good vegetative growth and the tolerance to the late and early blights. In the second trial, four compost types of different composition and a fresh manure were used for the fertilization, and compared to a non-fertilized control, in order to characterize the effects of these treatments on potato Spunta variety. Regarding yield, there is not a significant difference between the treatments.

Keywords: organic agriculture, potato, variety adaptation, agronomic parameters, organic fertilization, compost, manure, nutrients.

286. ZNAIDI Ibrahim El Akram (*Tunisia*)

Supervisors : M. Ben Khedher

Title: Etude et évaluation du compostage de différents types de matières organiques et des effets des jus de composts biologiques sur les maladies des plantes. - 94 p.

Abstract: The study of composting parameters of different organic mixtures which constitute four different treatments: 100% Cattle manure; 80% Cattle manure + 20% Sheep manure; 70% Cattle manure + 20% Sheep manure + 10% Poultry manure; 50% Cattle manure + 20% Sheep manure + 20% Poultry manure+ 10% crushed wheat straw; showed a difference of behavior at the level of the temperatures which were higher for T4 rich in carbon than for other treatments. The initial basic pH decreases for all treatments and approaches neutrality at the end of composting process, essentially for T1. Also, there's a decrease in the nitrogen percentage during composting probably due to a low level of C/N ratio in the beginning.

Keywords: composting parameters, organic mixture, plant pathogens, compost tea, *in vitro*, *in vivo*, storage.

MOA - A.Y. 2002-2003 (July session) – 297-302

297. DJURIC Branko (*Bosnia and Herzegovina*)

Supervisor: T. Moleas ; co-advisor: V. Simeone

Title: Bioethology differences between *Orius laevigatus* and *Orius niger* (Hemiptera: Anthocoridae) in Mediterranean region. - 48 p.

Abstract: Several characteristics of *Orius laevigatus* (Fieber) and *Orius niger* (Wolff) (Hemiptera : Anthocoridae) are investigated in the laboratory and in the vineyards. Indigenous *O.laevigatus*, *O. niger* and *O.laevigatus* from biofactory are compared as for the following characteristics: morphological differences among these three insects, life duration, length of the oviposition period, number of laid eggs, number of hatched eggs, percentage of hatched eggs, population dynamics of *O.laevigatus* and *O.niger* in the region of Apulia, population density of *Frankliniella occidentalis* and *Orius* spp. in the vineyard at flowering, presence of *Orius* spp. in South Bosnia and Herzegovina. Indigenous *Orius laevigatus* has a longer life than *Orius laevigatus* from biofactory and than *Orius niger*. The same order applies to the duration of the oviposition period, number of laid eggs and number of hatched eggs. The percentage of hatched eggs is higher for the indigenous *O.laevigatus* than that of *O.niger* followed by *O.laevigatus* from biofactory. In Apulia *O.niger* was prevailing in the wintertime and *O.laevigatus* in May when the temperature exceeds 15°C. The population density of *Frankliniella occidentalis* at the grapevine flowering time was very high and the number of *Orius* spp. very low. *Orius* spp. are present in South Bosnia and Herzegovina an area which is close to the sea, with favorable climatic conditions. Indigenous *Orius laevigatus* should be used for the biological control of *Frankliniella occidentalis* because of its characteristics and for its presence in the vineyards when this plant pest must be controlled. Results are discussed in relation to significant bioethology differences among the three *Orius* spp.; the importance of *Orius* spp. in the control of *Frankliniella occidentalis* is also emphasized.

Keywords: *Orius laevigatus*, *Orius niger*, *Frankliniella occidentalis*, Apulia, Bosnia and Herzegovina, life characteristics, predators.

298. SFEIR Thérèse (*Lebanon*)

Supervisor: A. R. Malacrida ; co-advisors: F. Baldacchino and V. Simeone

Title: Quality control of reared parasitoids: preliminary study on the application of RAPD Molecular Marker technique to the model *Opius concolor*. - 47 p.

Abstract: The scope of evaluating field efficiency of reared *Opius concolor* released to control the olive fly, in the presence of indigenous populations interfering with releases results rendering them unreliable, RAPD (Random Amplified Polymorphic DNA) molecular marker technique was proposed to differentiate between indigenous and reared populations. Indigenous samples were collected from several regions in Puglia-Basilicata- Sardegna. Reared populations were brought from the insectarium of Cagliari -Sardegna. The initiation of a biomolecular work lead to the setting of a starting protocol, with an adequate extraction method, elements concentration, and primers applied. The preliminary observations on laboratory population in comparison with collected indigenous ones have shown diagnostic

markers with NP4 primer of 620 bp, and with A10 of 260bp-760bp. The latter could be considered important in monitoring the released insect field efficiency. These findings assure the reliability of the RAPD methodology in evaluating quality of reared *Opius* at field level.

Keywords: Insect quality control, biological control, RAPD, primers, *Opius concolor*, *Bactrocera oleae*, South Italy.

299. EI GHARRAS Youssef (Morocco)

Supervisor: A. M. D'Onghia ; **co-advisors:** V. Simeone and M. Desantis

Title: Preliminary study on organic citrus nursery management. - 74 p.

Abstract: A preliminary trial on citrus nursery management by organic means has been conducted with the aim of seed treatment for conservation, soil fertility management and spider mite control. The seed treatment was performed by a combination of thermotherapy and a comparison between different allowed fungicides (Copper, Equisetum, and Bordeaux mixture). Fifty percent copper solution protected the seeds for at least two months. The soil fertility management considered the rootstocks production (Citrange troyer, Sour orange, Rough lemon and Trifoliate orange) and took into account the major ingredients, macronutrients and micronutrients. In the major ingredients, the soil was found to be essential and the combination of the peat moss sand and soil with equal quantities gave a suitable mixture. When the macronutrients were studied, a poultry manure-based fertilizer gave the best growth when applied at different rates, depending on the rootstock type. Also the micronutrients performed the best when incorporated in the mixture. The phytosanitary management study tested three approved products to control spider mites (pyrethrins, sulphur and mineral oils). The three treatments were found to be efficient in the control of the mites and showed specificity toward the controlled species.

Keywords: citrus, organic nursery, rootstocks, seed conservation, soil fertility, spider mites.

300. AYOUB Mohamed (Morocco)

Supervisor: F. Caporali ; **co-advisor:** L. Al-Bitar

Title: Agronomic performances of self-reseeding legumes on alkaline soils under Mediterranean climate. - 76 p.

Abstract: Self-reseeding legumes are an essential component of the Mediterranean natural resources. Germplasms collected from the Mediterranean region were introduced in Australia and subjected to an extensive breeding. Species were then re-introduced in their original habitat where they were object of different important researches. Despite all the efforts made to select appropriate species and varieties, well-adapted cultivars have not been yet identified for all situations. At the experimental farm of the Mediterranean Agronomic Institute of Bari, Italy, agronomic performances of 15 cultivars of self reseeding legumes were compared on an alkaline soil to evaluate their possible use in organic agriculture systems. 10-m² plots were used in a complete randomised block design with three replicates. The growing cycle extended over six months with high rainfall. Cultivars WCT36, Hykon, Caprera, Casbah and York showed high production potential concerning biomass, ground covering, weed control, plant nitrogen content, seed production and soil fertility. Medicago sphaerocarpa cv. Orion was more precocious in flowering, in pods production and maturation. Cultivars Cefalu, Prima, Mauro,

despite having medium production potential, appear especially promising in the study area while all tested cultivars of the genus *Ornithopus* exhibited very low performances for all tested parameters. Cultivars Paradana and Bolta of *Trifolium michelianum* were very sensitive to *Orobanche* attack. Thus, the first group is apparently better adapted to the pedo-climatic conditions existing in the Apulia region.

Keywords: Self-reeding legumes, nitrogen fixation, organic agriculture, Mediterranean region, climate.

301. NIKOLIC Jovan (*Montenegro*)

Supervisor: T. Miano ; co-advisor: C. Sigliuzzo

Title: Overall study of compost water extract application through fertigation system in organic farming. - 69 p.

Abstract: The aim of this work was to obtain a number of complete soluble compost extracts rich in micronutrients, which can be safely used for fertigation through modern irrigation systems in organic farming system. Evaluation of their effects was conducted on potato crop var. Draga and soil fertility. During the extraction experiment two different compost (Farm compost and Commercial compost) were treated with water to obtain following dilution ratios: 1:5, 1:10, 1:20. Most chemical parameters of the compost extracts generally reflect the chemical composition of the starting material. These six dilutions were applied during the growing season. The control shows the highest tuber yield (22.1 tons/ha,) followed by FC20 treatment (21.03 tons/ha). The number of tubers per plant was not significantly different between treatments, meanwhile the leaf surface was the lowest exactly in the treatment FC20 (1.941cm²) and control (1.250cm²) which had the highest yield. Seeds of *Triticum durum-durum* wheat were treated with different compost extract dilutions and results revealed, that only CC10 and CC20 dilutions achieved germination index 104.7% and 81.44%, meanwhile all the other concentrations showed phytotoxic effect. Analysis of soil organic matter and available nutrients showed that, the major changes observed as a function of the applications and affecting somewhat the soil fertility were organic C, K and P content. The results are discussed in relation to significant differences between six dilutions obtained from two compost.

Keywords: organic farming, compost extract, potato, seeds, phytotoxicity, fertigation, soil fertility.

302. OZTURK Emel (*Turkey*)

Supervisor: R. Zanolli ; co-advisor: A. Antonelli

Title: Socio-economic impact of organic farming in rural Turkey : the case of Rapunzel Turkey Project. - 70 p.

Abstract: In recent years, organic farming in the Mediterranean has shown an important growth. In Turkey, organic production started with the demand of European companies interested in traditional Turkish export products. Rapunzel, a German company, has been working on organic projects in Turkey since 1985. Relating to the increasing organic production in Turkey and the intensive demands for healthy food, in 1989 Rapunzel established in Izmir the first official office with 3 member staff. Today Rapunzel Turkey Project has got more than 870 contracted farmers and 50 member staff, producing more than 70 product categories. In some villages the constructive collaboration between Rapunzel and the organic farmers

had the effect to transform the entire village from conventional to organic and all people living in them are involved in activities in order to support, in a conscious way, organic farming. Using a qualitative ethnographic approach with in-depth face-to-face interviews the case study aims: to assess the factors of success of the company, both internal and external; to scrutinize the actual problems faced in the past; to build up its network of relations among the different stakeholders involved; to investigate its impact on the rural development of the region and its influence in the evolution of the domestic market, to identify elements of replicability for similar initiatives in other Mediterranean countries.

Keywords: organic farming, rural development, case study, marketing, *Turkey*, Mediterranean.

MOA - A.Y. 2002-2003 (mobile) - 325-329

325-329. *Not available*

325. FARES Roula (Lebanon)

Supervisor: R. Khoury

Title: Study and assessment of organic potato production in relation to fertilization and varietal aspect. - 74 p.

326. BOUSSAAD Latifa (Morocco)

Supervisor: L. Kenny

Title: Etude comparative des principaux ravageurs des agrumes et leurs ennemis naturels en vergers bio, sous protection intégrée. – 78 p.

327. KHORCHANI Slaheddine (Tunisia)

Supervisor: M. Ben Khedher

Title: Comparison between the effect of compost teas and cupper on potato crop protection. – 95 p.

328. KOCHBATI HÉla (Tunisia)

Supervisor: M. Ben Khedher

Title: Effects of compost tea and organic fertilizers on organic potato. – 119 p.

329. BEJI Sadreddine (Tunisia)

Supervisor: M. Ben Khedher

Title: Effet de la fertilisation organique à base de farine de poisson sur 3 types de tomate conduite selon le mode biologique. – 71 p.

MOA - A.Y. 2003-2004 (June session) – 347-353

347. MAMEN Nassima (*Algeria*)

Supervisor: L. Rossi ; advisor: V. Verrastro

Title: Production of compost of a high quality from bovine wastes and organic olive and vineyard wastes. - 57 p.

Abstract: The aim of the thesis was to prepare high quality compost in two different piles from a basis of bovine animal manure addicted one time with olive wastes and the second time with viticulture residues. All the raw materials have been selected from a group of organic farms in Puglia region. The plant residues have been crushed and the bovine animal manure has been prepared before preparing the mixture. Two piles of about 30 tons have been prepared with different composition. The first heap had the following composition: 60 % of bovine animal manure and 40% olive wastes. The second heap had the following composition: 70 % of manure and 30% vineyard wastes. The compost cycle (90 days) has been monitored during the two main phases (active and curing phase) through measurements of temperature, pH, moisture, oxygen and C/N ratio. At the end of the cycle, the quality of compost has been evaluated by doing analysis of manure.

Keywords: raw material, active phase, maturation, compost, biomass, heavy metals, soil fertility.

348. ALBAKRI Mamoun (*Jordan*)

Supervisor: A. R. Malacrida ; advisors: N. Baldacchino, V. Simeone

Title: RAPD markers for the characterization of the olive fruit fly parasitoid *Opius concolor* (Spzel.) used in biological control programs. - 39 p.

Abstract: The endoparasitoid *Opius concolor* (Spzel.) have been used as a biological control agent in the biological control programs of the olive fruit fly, which consists of massive releases of parasitoid infields where indigenous wild ones are present. Field differentiation between the released and the indigenous parasitoids, and the estimation of the proportion of released individuals in the over all field population are a prerequisite to estimate the efficiency of the biological control programs. Because wild and released parasitoids are morphologically indistinguishable, a DNA molecular technique, based on Polymerase chain reaction (PCR), the Random Amplified Polymorphic DNA (RAPD-PCR) was used to differentiate between five different populations of this parasitoid, two populations from Jordan, two populations from South Italy and reared strain population. The polymorphism generated by RAPD-PCR method showed that, it is highly possible to differentiate between strains of *Opius concolor* from distinct geographical areas of different countries (Jordan, Italy), between strains of distinct geographical areas of the same country and between wild indigenous and reared strains.

Keywords: *Opius concolor*, olive fruit fly, biological control, RAPD-PCR, polymorphism, geographical strains.

349. SALAME Nadine (Lebanon)

Supervisor: R. Zanolì ; advisor: P. Pugliese, S. Naspètti

Title: Motivations towards farming in Lebanon: a comparison between organic and conventional farmers. - 42 p.

Abstract: The research work focuses on Lebanese farmers' behaviour, attitudes and beliefs with regards to farming activity, and specifically investigates the motivations that lie behind their choices. The work also aims to explore AUB-assisted conventional farmers' barriers or risks for not converting to organic farming. The study applied the Means-End Chain theory paired with the laddering methodology, adopting the hard laddering approach. During a four-week fieldwork in Lebanon, collective, in-depth interviews were carried out with two groups of farmers (one of 16 HB organic farmers and one of 17 AUB-assisted conventional producers) by administering a self-completed questionnaire. The "Mecanalyzer Software" was used for the analysis of the data collected through the laddering interviews. The software constructs an implication matrix that indicates how often concepts have been mentioned and linked to each other, both directly and indirectly. Results show that organic farmers have two paths of reasoning while conventional farmers have just one path. Love for family is the most important value for both groups, and to have a satisfactory income is central in the cognitive structure of Lebanese conventional farmers.

Keywords: Lebanon, farmers' motivations, barriers, means-end chain, values.

350. JAMEA El Mostafa (Morocco)

Supervisor: F. Caporali ; advisor: L. Al-Bitar

Title: Integration of annual self-reseeding legumes into Mediterranean organic cropping systems. - 74 p.

Abstract: In this experiment, performances of 15 cultivars of annual self-reseeding legumes were compared in order to evaluate the ability of their seeds to germinate in laboratory, their potential to regenerate in their second cropping cycle, their contribution to soil nitrogen enrichment and their role in a rotation programme. Cultivars T.s. Cv. York, M.s. Cv. Orion, T.s. Cv. Dalkeith, T.i. Cv. Caprera and T.h. Cv. Hykon regenerated well. Germination test confirmed the results of the self-establishment on the field, except for cultivars of the genus Ornithopus, M.s. Cv Orion and T.h. Cv. Hykon. Well self-established cultivars were also those that produced the highest biomass, dry matter and plant nitrogen content. Soil nitrogen enrichment by cultivars in their second cropping cycle was generally lower in the previous year. The marketable yield as well as all growth parameters of lettuce were significantly increased by the effect of the preceeding legumes in average 52% higher than the control. The yield was significantly increased when T.s. Cv York, T.g. Cv Prima, B.p. Cv Mauro, O.s. Cv Cadiz, T.i. Cv Caprera, O.c. Cv Santorini, T.s. Cv WCT36, M.s. Cv Orion, T.m. Cv Bolta preceeded lettuce.

Keywords: biological nitrogen fixation, self-reseeding legumes, germination test, plant nitrogen content, nitrogen uptake, rotation programme, green manure.

351. EL TOUBAJI Said (Syria)

Supervisor: F. M. Santucci ; advisor: A. Antonelli

Title: Potential of organic agriculture in Syria : the case of olive and olive oil sub-sector. - 56 p.

Abstract: The main objective of this study is to evaluate the feasibility of the introduction of organic agriculture in Syria through the current situation of the olive oil sub-sector. A field survey has been carried out in two Syrian regions, Aleppo and Idleb, submitting a structured questionnaire to some representative olive farmers and to some key experts working in the olive and olive oil field in the country. The results show that in spite of some constraints that hamper the work, partial conversion of this sub-sector to organic is possible, taking into consideration the current practices, the present economic results and the adequate technicians and even farmers' educational level, their attitude to innovation and the increasing awareness for environment conservation and food safety by the Government and other public bodies. Organic agriculture can contribute to increasing the olive farmers' income, through decreasing costs, because of the relatively low external inputs needed and giving Syrian olive oil good marketing opportunities in the domestic and international markets.

Keywords: organic agriculture, Syria, field survey, questionnaire, olive oil, Aleppo, Idleb.

352. CAVOSKI Ivana (Serbia and Montenegro)

Supervisor: T. Miano ; advisor: C. Sigliuzzo

Title: The effects of compost and compost extract on lettuce growth and soil properties. - 88 p.

Abstract: The work was conducted at the experimental field on the Mediterranean Agronomic Institute of Bari, Italy in 2004. The aim was to study the effects of compost and compost extract on soil properties and lettuce growth. The chemical, biological and phytotoxic test of compost extract proved its high selected soil properties (pH, EC, Organic matter, available nutrients, cations and anions contents) markedly with depth and time, the most prominent changes showed by compost extract application. The applications of compost and compost extract significantly increased growth, yield, yield components and storage, all were highly significant influenced by compost. The relation between chlorophyll-meter readings and nitrogen concentration showed highly significant linear regression and provided evidence that the chlorophyll-meter could be used to determine side dress N requirements. The benefits of the compost and compost extract without chemical fertilizer demonstrated the validity and possibility of sustainable agronomic performance of lettuce using available recycled organic materials.

Keywords: compost, compost extract, soil properties, growth, nitrogen nutrition diagnosis, yield, storage.

353. MUDERRISZADE Mahir (Turkey)

Supervisor: V. Bianco ; advisor: N. Dubla

Title: Performance of broccoli cultivars grown under organic nitrogen fertilisers. - 54 p.

Abstract: The aim of this work is to evaluate the effect of three rates of Nitrogen (0, 13.2 and 26.4 kg/ha) coming from organic fertilisers applied by fertigation as side-dressing, on yield and quality of four broccoli cultivars grown in organic farming Chevalier, Iron, Lord, Marathon, Marathon OS. The organic nitrogen fertiliser given by side-dressing did not influence the head and plant characteristics taken into consideration. The plants Marathon produced by organically-grown seeds Marathon OS, gave similar results for almost all traits taken into account. The

highest yield of heads for fresh market and for freezing purpose was observed in Chevalier, while the lowest in Iron. Chevalier, Marathon and Marathon OS had the largest and heaviest heads. Chevalier was the earliest cultivar and was harvested ten days before Marathon.

Keywords: organic farming, plant growth, development, yield components, ascorbic acid, nitrate, chromatic parameters.

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362. DULJA Xhevaire (*Albania*)

Supervisors: C. Vazzana, G. C. Pacini ; *advisor:* J. Calabrese

Title: An integrated environmental accounting framework to evaluate the sustainability of olive production systems in Apulia region: a field and farm scale analysis. - 86 p.

Abstract: Politicians, through the monitoring activity, can evaluate payments to farmers, farmers can check their costs for agricultural practices and environmental investments and the advisors can orient their farmers to the practices more sound to the environment and less costly for their budget. In this thesis work, a measuring method including environmental and financial indicators is introduced. The environmental indicators used in this method is called Environmental Accounting Information System (EAIS). Some economic indicators are integrated within EAIS. This can be a good tool for the evaluation of the externalities on the environment. The framework is implemented in the South of Italy, in Apulia region. It considers the Integrated Environmental Accounting Information System in the pedo-climatic conditions of olive-groves of Ostuni municipality. The study is performed on two olive-growing farms, one organic and the other conventional, situated in the same place. An on field and farm scale analysis, is performed. Outcomes concern a tool to assess the level of sustainability in South Italy conditions and the analysis of sustainability assessment on compared farm systems.

Keywords: sustainability assessment, Environmental Accounting Information System, indicator, organic and conventional farm.

363. EL BILALI Hamid (*Morocco*)

Supervisor: I. Pertot ; *advisor:* V. Simeone

Title: Copper use reduction in the Mediterranean environment for the management of *Plasmopara viticola* under organic management. - 220 p.

Downy Mildew (DM) is the most dangerous grapevine disease. Copper-based fungicides are the only effective products allowed in organic viticulture. Copper (Cu) use will be limited to 6 kg/ha/year as from 2006. Oospores germination test showed that Apulian oospores germination occurs earlier and is faster than in Trentino. The most phytotoxic formulation on Uva di Troia leaves was Cu peptidate followed by Cu hydroxide (Kocide 2000) and Cu sulphate (Bordeaux mixture). All formulations allowed a good control on Uva di Troia leaves but not on bunches. The sole effective strategy on both organs was Potassium phosphonate (Kendal). Bordeaux mixture (5.5 kg Cu/ha/year) seemed more effective on bunches than on

leaves. Naturam 5/400 (1.3 kg Cu/ha/year) was the other way round. Kocide 2000 (2.5 kg Cu/ha/year) permitted a satisfactory disease management on both leaves and bunches. Naturam 5/200 (0.9 kg Cu/ha/year) insured an acceptable control on leaves but not on bunches. The most sensitive cultivar to DM was Primitivo. Copper phytotoxicity is influenced by climatic conditions, Cu formulations, use doses, and the concerned cultivar. Cu phytotoxicity is higher on wet leaves in hot weather. It seems that there is an interaction between the cultivar and the Cu formulation that determines its efficacy and the extension and the severity of its damages. Kocide 2000 can be used for the first treatments while Kendal would be reserved for the intermediate ones whereas Bordeaux mixture can be utilised at the end of the season especially in the case of severe infections. Naturam 5 can be used in the mid and at the end of the growing season whenever phytotoxicity risk is low.

Keywords: organic viticulture, *Plasmopara viticola*, copper alternatives, phytotoxicity, copper peptidate, potassium phosphonate.

364. BEN MOUSSA Hajra (*Tunisia*)

Supervisor: T. Moleas ; advisor: V. Simeone

Title: Importance of the genus *Orius* (Heteroptera: Anthocoridae) in the biological control of *Thripidae* in organic grapevine particularly in Apulia region (Italy) and Tunisia. - 97 p.

Abstract: In the current work, a field survey in thirty-two localities in Apulia region and twenty localities in Tunisia was done in order to identify the different species of the genus *Orius* (Wolff), their presence during the period of the study. In addition to this, we identified the different Thysanoptera species found in table vineyards in Apulia and studied their impact on this agro-ecosystem. *F. occidentalis* (Pergande) deserved our attention, along with its most important host plants. In Apulia, six *Orius* spp. were found, four of them common to Tunisia where we reported nine species. In both countries, *O. laevigatus* (Fieber) was the most abundant, although in Tunisia *O. albidipennis* (Reuter) was the most distributed. For the most abundant *Orius* spp. found, with several generations from the winter till the summer, *Chrysanthemum coronarium* has been the most important herbaceous host plant in both countries especially during the springtime. In Apulia table vine-growing agro-ecosystem, seven Thysanoptera species were found.

Keywords: agro-ecosystem, *Orius* spp., *F. Occidentalis*, host plant, Apulia region, Tunisia.

365. EL SAID Mohamed El Said (*Egypt*)

Supervisor: A. El-Araby

Title: Integrated crop organic management of garlic under semi-arid conditions. - 74 p.

Abstract: A field experiment was conducted on an organic farm in Khatatba desert, Menofia Governate, in order to evaluate the effect of plant extracts on organic garlic production. The aim of this study was to obtain natural extracts rich in nutritional value to supply plants with adequate nutrients and maintain soil fertility under arid and semi-arid Egypt. Evaluation of these extracts was conducted on Chinese garlic (*Allium sativum* L) plants var. Seds 40. Extracts were tested for garlic growth parameters, yield and soil fertility conservation. In most arid and semi-arid areas around the Mediterranean basin, localized irrigation systems are widely used in organic agriculture. Therefore liquid fertilizers are needed to be

injected through the irrigation systems or for foliar application, so that we can use fresh plant extracts or partially composted plant extracts as day-to-day fertilizer in both open fields and greenhouses.

Keywords: organic agriculture, soil fertility, compost extracts, garlic, semi-arid conditions.

366. MOUSA Sami Abdel Kariem (Palestine)

Supervisor: L. Kenny

Title: Effect of blood meal on soil fertility, growth and yield of organic zucchini grown under greenhouse in South of Morocco. - 83 p.

Abstract: Organic vegetables is one of the major sectors of organic agriculture. Organic fertilizers are among the organic means that can supply nutrients to vegetable crops, and improve soil fertility. One of the organic fertilizers is blood meal which is a good source of nitrogen (12%) and phosphorous (2%). The present experiment aimed to study the effect of blood meal on zucchini crop, soil fertility, and to determine the suitable concentrations that can be used. The experiment was conducted in south of Morocco; three concentrations of blood meal were used namely 10kg/ha, 15kg/ha, 20kg/ha. Parameters related to plant growth, soil and vegetative characteristics were collected. Results showed that blood meal increased the crop yield, the number of leaves and the plant height more than in the control. Analyses showed that nitrate and ammonium concentrations in the soil were more available than in the control treatments. The C/N ratio decreased with blood meal application over time.

Keywords: soil fertility, organic fertilizer, blood meal, agriculture, vegetables management, zucchini.

367. HIZEM Amel (Tunisia)

Supervisor: M. Ben Khedher

Title: Effect of compost and compost tea on fertilization and protection of potato crop production. - 82 p.

Abstract: Two experiments were carried out to study the effect of different compositions of composts and their compost teas on potato crop in relation to growth, development, plant nutrition, disease control, yield and soil fertility under organic farming. On the experimental farm of the Technical Centre of Organic Agriculture in Tunisia, we studied the effect of six compositions of compost tea compared to three commercial fertilizers as supplementary fertilizers on potato crop production and also compared to copper for late blight control according to a completely randomized bloc design. The treatments increase the copper content in the leaves and stems. Regarding soil fertility, there is a tendency towards an increase in the electrical conductivity and nitrogen content and a decrease in the soil pH.

Keywords: compost tea, compost, fertilization, late blight control, potato growth, yield.

368. COLAK Aysegul (Turkey)

Supervisor: C. Can

Title: Effect of plant extracts on in-vitro development of *Fusarium oxysporum f. sp. Radicis-lycopersici* and *Alternaria solani* that restrict tomato production grown under plastichouses in the Cukurova Region of Turkey. - 71 p.

Abstract: In this study, the effect of extracts of onion (*Allium cepa*), garlic (*Allium sativa*), eucalyptus (*Eucalyptus* sp.), mint (*Mentha piperita* L.), oleander (*Nerium oleander* L.), radish (*Raphanus raphanistrum*), laurel (*Laurus nobilis* L.), nettle (*Urtica dioica* L.) and thyme (*Thymus spicata* L.) on in vitro development of *Fusarium oxysporum f.sp. radicis-lycopersici* and *Alternaria solani*, that restrict tomato production grown under plastic houses in Cukurova Region of Turkey, was determined. Two different extract concentrations (25% and 50%) were tested to identify the effect on in vitro growth of the fungal biomass and disease development. Statistical results showed that garlic had a higher inhibitory effect compared to the other plant extracts on both diseases on day12. Garlic extract reduced by 99.5% the mycelial growth of *A. solani* with both 50% and 25% concentrations. Also for *F. oxyporium f.sp. radicis lycopersici*, 99.5% and 97.1 % reduction occurred at 50% and 25% concentrations, respectively. In vivo experiments reduced by 60.6% and 57.0% the growth of *A. solani* and *F. oxysporum f.sp. radicis-lycopersici*, respectively.

Keywords: plant extracts, tomato, *Fusarium oxysporum*, *Alternaria solani*, organic agriculture.

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390. DANO Stefan (Albania)

Supervisor: R. Uka ; advisor: V. Simeone

Title: The status of *Lobesia botrana* (Lepidoptera: Tortricidae) in Albania and its management with *Bacillus thuringiensis* var. *kurstaki* & *aizawai*. – 82 p.

Abstract: *Lobesia botrana* is the key pest of grape in Albania. On 2005 we started a study which aims in knowing the status of pest and evaluation of its management with two varieties of *Bacillus thuringiensis*, *kurstaki* & *aizawai* in several grape cultivars in four farms in 3 different climatic areas. Pheromone Traptest traps were used to monitor the male flight for the best moment of interventions and 400 clusters per ha were sampled to estimate the infestation. Four complete generations appear in all the farms. In three of them, infestation level was under the economic threshold, so treatment were not justified. Bt shows a very good efficacy (75 . 100%), whereas not significant differences are observed between two varieties. The cultivars Black magic, Cabernet sauvignon, Shesh i Zi (autochthon) showed a good resistance or tolerance to pest, while Shesh I Bardhë was the most susceptible one.

Keywords: *Lobesia botrana*, *Bacillus thuringiensis*, *kurstaki*, *aizawai*, pest management, biological control, Albania.

400. DIMITRIJE Markovic (Bosnia and Herzegovina)

Supervisor: C. Vazzana ; advisor: J. Calabrese

Title: Influence of new socio-political forces on land use, and on farm and landscape biodiversity in Bosnia and Herzegovina (study areas: Banja Luka and Derventa). – 73 p.

Abstract: Socio-political forces during and after the war are the main external factors affecting land use changes at farm and regional scales that are among the most important drivers of species diversity. The aim of this study is to analyze these changes and their impact on biodiversity in two municipalities in Bosnia and Herzegovina, one (Banja Luka) not directly, and other one (Derventa) directly affected by the war. To develop these analysis, statistical data referring to land use situation before and after the war were compared and on site investigation were performed. Interviews to farmer allowed us to investigate the farm organization and structure. Biodiversity at field level was assessed. and-use changes occurred in both municipalities, mainly in Derventa, due to abandoned land. Present state of biodiversity was assessed indicating direct and indirect negative impact of war on biodiversity loss both at farm and municipality level.

Keywords: abandoned land, biodiversity, farm structure diversity, land use, war.

401. SALEM Assem (Egypt)

Supervisor: A. M. D'Onghia ; advisor: A. Ippolito

Title: Biological control of phytophthora nicotianae and organic media standardization in citrus nurseries. – 57 p.

Abstract: Investigations were carried out for the biological control of Phytophthora nicotianae (citrus root rot) on two citrus rootstocks (Sour orange and Troyer citrange) transplanted in organic and conventional substrate, treated with the semi-commercial product Clonotri (Trichoderma harzianum and Clonostachys rosea) and Metalaxyl-M as a chemical control. Clonotri was more efficient than the chemical treatment increasing plant high and weight. Organic products (Chitosan, Quillaia, Equiseto and Clonotri) were evaluated for seed treatments as alternative to copper, for the control of P. nicotianae and Rhizoctonia solani during seed storage and germination. Clonotri (10, 20 ml/l), Chitosan (10 g/l) and Equiseto (20g/l) showed the best results. A standardization of the organic substrate based on Guanito fertilizer (poultry manure) was carried out on Sour orange and Troyer citrange seedlings and its use was also extended to Volkameriana lemon seedlings. The organic substrate with 1.5% (v/v) of Guanito was the best for the both rootstocks.

Keywords: citrus rootstock, *Phytophthora nicotianae*, *Trichoderma harzianum*, *Clonostachys rosea*, *Chitosan*, *Equisetum arvense*, organic fertilizer.

402. AL DAMRAT Rasha (Jordan)

Supervisor: C. S. Bledsoe

Title: The role of ectomycorrhizal fungi in nitrogen acquisition in California Oak Woodlands. – 34 p.

Abstract: In northeastern California oak woodland, we measured Nitrogen uptake by ectomycorrhizal (ECM) oak roots (*Quercus douglasii*, blue oak, *Quercus wislizenii*, live oak). In February 2005, after sampling fine roots of 5 blue and 5 live oaks, we added $^{15}\text{NH}_4^+$ to soils, waited one month then resampled. ECM root tips were separated into 21 morphotypes and analyzed for ^{15}N . Blue oak ECM diversity was higher than that in live oak. Few morphotypes (33%) were common to both oak species. More abundant morphotypes took up less ^{15}N than less abundant morphotypes. We hypothesized that ECM species more "active" in N uptake would be more frequent in soil cores. However, our data did not support our hypothesis; and ECM species present in few cores were more enriched in ^{15}N than species present in many soil cores. We believe our data are the first to demonstrate functional biodiversity of ECM fungi for N uptake.

Keywords: Ectomycorrhizae, *Quercus douglasii*, *Quercus wislizenii*, Morphotypes, N acquisition, ^{15}N natural abundance and ^{15}N enrichment.

403. WEHBE Elias (Lebanon)

Supervisor: F. Caporali ; **advisor:** L. Al-Bitar

Title: Effect of annual self-reseeding legumes on subsequent crops (Particularly Durum Wheat) into a long-term rotation program under organic farming. – 85 p.

Abstract: Soil nitrogen fertility management is a major concern in organic farming. Nitrogen fixation by legumes is a potential solution especially in multi-annual crop rotation program. This study aims at assessing the effect of fifteen legume cultivars on wheat as third subsequent crop and at identifying the most efficient and suitable cultivars for a long-term rotation program. T. subterraneum cv. York and T. glanduliferum cv. Prima induced the best effects on wheat, particularly on total biomass, number of grains, dry matter production and increased yield by 670%

and 567% respectively more than the control. They showed also, together with *Trifolium subterraneum* cv. Dalkeith and *Trifolium incarnatum* cv. Caprera, to be the most efficient over the whole rotation experiment proving the important role that legumes can play into sustainable organic cropping systems.

Keywords: nitrogen fertility, crop rotation, T.s. York, T.g. Prima, T.s. Dalkeith, T.i. Caprera, subsequent crops.

404. KARAM Nisrine (Lebanon)

Supervisor: A. R. Malacrida ; advisors: N. Baldacchino and V. Simeone

Title: Genetic characterization of Apulian wild population of the parasitoid *Psyttalia* (*Opius*) *concolor* (Szepligeti) for biological control of *Bactrocera oleae* (Gmelin). – 33 p.

Abstract: Given the morphological similarity between the released *Psyttalia* (*Opius*) *concolor* and the wild Apulian ones, the biological control program against the olive fruit fly *Bactrocera oleae* is faced with problem of evaluating the efficacy of the release using the released reared endoparasitoid. A DNA molecular technique, the Random Amplified Polymorphic DNA (RAPD) was used to define eventual molecular markers and to assess the genetic variability between seven wild Apulian populations and one reared strain of *P. concolor*. A RAPD approach highlights a high genetic similarity among the populations from Puglia, suggesting a common evolutionary history. It also revealed a high genetic homogeneity between the reared and the Apulian samples, ruling out the possibility of detecting diagnostic markers which may differentiate between the populations. Principal coordinate analysis (PCO) and cluster analysis provided an estimate of the degree of differentiation between the populations. They indicate a low genetic differentiation among them.

Keywords: *Psyttalia* (*Opius*) *concolor*, olive fruit fly, biological control, RAPD-PCR, genetic variability, molecular markers.

405. EL HANAFI SEBTI Kawtar (Morocco)

Supervisor: T. Miano ; advisors: V. Verrastro and C. Coccozza

Title: Compost tea effects on soil fertility and plant growth of organic tomato (*Solanum lycopersicum* Mill) in comparison with different organic fertilizers. – 67 p.

Abstract: Over the last years, organic agriculture has attracted much attention in the Mediterranean countries for both environmental reasons and market opportunities. Composts and derived materials match closely with the organic farming approaches because of the beneficial effects on soil properties and functions, on plant nutrition and pathogens suppression, and on several environmental concerns. This study compares the effects of compost tea (applied through fertigation and foliar application) on soil fertility, plant growth and food quality of two varieties of tomatoes (Vespro and Multiplo) in comparison with the effect of compost and commercial biofertilizer (Guanito) according to a split plot design. Compost, compost tea and Guanito revealed significant positive effects on yield, biomass, number of fruits and root weight in comparison to the control. On the other hand, compost tea increased vitamin C content for both varieties, while a limited nitrates fruit accumulation was induced by compost applications in Multiplo and by compost tea in Vespro.

Keywords: compost, compost tea, soil drench, foliar application, soil fertility, food quality, tomato, biofertilizer.

406. AZIM Khalid (Morocco)

Supervisor: L. Kenny

Title: The nematicidal and the fertilizing effect of argan, castor and neem cake on cucurbits (cucumber and melon) grown under greenhouse in Agadir region (South of Morocco). – 74 p.

Abstract: The aim of this work is to evaluate the impact of oil cakes amendments (argan, neem, castor cake and ground castor) on control of *Meloidogyne* spp., soil fertility; and the growth and yield of cucumber grown under greenhouse in south-western Morocco. The results show that oil cakes induce a reduction in gall formation, soil nematodes density, root rot infestation, and an improvement of plant height and yield as compared to the control. Argan cake improved yield by 112% compared to the control. Generally, argan cake gave better results compared to the other treatments. In pots experiment on melon, maximum suppression (100%) of root knots and soil larvae population were found with argan; castor cake and ground argan shoot. While neem cake was less effective. Argan cake resulted in 24% increase in fresh weight compared to the infested control, while ground argan shoot enormously decreased both height and weight.

Keywords: preventive measures, *Meloidogyne* spp., fertilizing effect, argan, castor, neem cake, cucurbits.

407. AHMED Abdel Munem (Palestine)

Supervisor: R. Zanolli ; advisor: R. Callieris

Title: Attitudes towards organic foods among consumers from the Mediterranean Arabic Countries living in Italy. – 79 p.

Abstract: This study investigates food habits in general and attitudes towards organic food products of consumers from the Mediterranean Arabic Countries (MACs) living in Italy. Organic food markets are still emerging in the consumers' countries of origin. The questionnaire-based interview was administered to 211 consumers during Spring 2005. The results show that knowledge about organics is weak. Level of education has a strong influence on knowledge of organic food products. Workshops, universities and schools are the most effective sources for the real knowledge about organic agriculture. Consumption of organic foods slightly increased after immigration in Italy. Health and environmental concern are the main reasons to buy organics. High price and low availability of organic food products are the main obstacles to consumption.

Keywords: organic food, consumption, Italy, questionnaire, immigrant, attitude, food habit.

408. BOURGOL Akram (Syria)

Supervisor: L. Kenny

Title: Effect of foliar fertilization on growth and yield of organic vegetables grown under plastic house in South of Morocco. – 69 p.

Abstract: Organic vegetables constitute one of the major sectors of organic agriculture in the Mediterranean basin. Farmers in Morocco, which is one of the leading countries in export of organic vegetable, are facing a serious problem in terms of fertilisation and nutrition since deficiencies are frequently reported. The present study was conducted in order to investigate the effect of foliar fertilisation on growth and yield of bean, eggplant, tomato and melon. The trial was conducted

in an organic farm in south of Morocco. Three different treatments were tested: seaweeds, mixture of compost tea and argan by product, and mixture of seaweeds and Argan by-products, in a completely randomised block design. No organic fertilizers were applied to soil. As the result shown, the foliar application did not induce any effect on the quantity production of the abovementioned crops. For the quality the different treatments have induced a positive effect for all crops in comparison with the control except melon.

Keywords: organic vegetables, foliar fertilization, tomato, bean, eggplant, melon, seaweed.

409. BEN MOSBAH Amira (Tunisia)

Supervisor: T. Moleas ; advisor: V. Simeone

Title: Presence of predators and parasitoids of *Lobesia botrana* Den. & Schiff. (Lepidoptera: Tortricidae), in the Mediterranean vineyard. – 63 p.

Abstract: *Lobesia botrana* is the key pest of vineyard, it presents two to five generations per year which cause a direct damage to grapes by perforating berries and an indirect damage by favoring the installation of rot fungi like *Botrytis cinerea*. In organic vineyard, *L. botrana* is biologically controlled by means of predators and parasitoids. For this purpose, field survey, monitoring and sampling were conducted in five different farms in Apulia region as in Tunisia in order to identify the predators and parasitoids of *Lobesia botrana*. The continuous sampling of nests and infested berries showed in Apulia farms the presence of predators that belong to the order of: Neuroptera, Dermeptera, Orthoptera and Arachnida. The parasitoids found belong to the Diptera order, family of Tachinidae and the order of Hymenoptera, family of Braconidae, subfamily of Aghatidinae.

Keywords: *Lobesia botrana*, predators, parasitoids, organic viticulture, Apulia region, Tunisia.

410. YILDIZ Levent (Turkey)

Supervisor: I. Pertot ; advisor: V. Simeone

Title: Advanced control strategies against grapevine powdery and downy mildew in the Mediterranean organic vineyards. – 68 p.

Abstract: The most destructive and widespread grapevine diseases are powdery (PM) and downy mildew (DM). The purpose of this thesis was to evaluate the efficacy of strategies that include alternatives to copper and sulphur in Mediterranean organic vineyards. *Ampelomyces quisqualis* (AQ10), a PM mycoparasite, and Myco-Sin, which is effective against DM, were used. In 2005 weather conditions were more conducive to PM than to DM. All the used strategies gave a good protection against PM, compared to the untreated control. The strategies based on the use of sulphur and Mycosin did not differ from the Farm Standard strategy, based on sulphur and copper. AQ10 provided moderate control on the leaves compared to the untreated; however the efficacy on bunches was far from the expectations. Using strategies integrating alternative products, a reduction in the use of copper and sulphur can be obtained, but further studies are necessary to optimize the timing of treatments.

Keywords: *Uncinula necator*, *Plasmopara viticola*, *Ampelomyces quisqualis*, MycoSin, hyperparasite.

411. ÇENGİZ Tuğçe (Turkey)

Supervisor: U. Aksoy

Title: Comparison of Ochratoxin-A occurrence in organically and conventionally grown sultana raisins. – 55 p.

Abstract: Ochratoxin A (OTA) is a mycotoxin produced by several fungi mainly of the genera *Aspergillus* and *Penicillium*. OTA has been associated with Balkan Endemic Nephropathy and reported to possess carcinogenic, teratogenic and immunotoxic effects. The aim of this study is to verify the occurrence of OTA, to determine the frequency and level of contamination in organically and conventionally grown Sultana raisins, and to evaluate the potential risk that occurs due to the farming system applied. 143 raisin samples were collected from different packing houses before processing from the Aegean Region. OTA contamination was determined by using Rhone Diagnostics method and quantified by HPLC. The results rendered demonstrate that, in general, 24.4 % of the samples had no OTA formation and 54.3 % of the samples had OTA levels below 1 ng/g. The frequency of OTA in various ranges of contamination was found to be similar in organically or conventionally grown raisins.

Keywords: Sultana raisins, Ochratoxin A, Organic management, Immunoaffinity columns, HPLC.

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441. ABDELLAOUI Houria Hadjira (*Algeria*)

Supervisor: O. Bessaoud ; advisor: P. Pugliese

Organic agriculture in Algeria: recent development and future prospects in a changing institutional setting. – 139 p.

Abstract: In Algeria agriculture is going through a deep transformation. The governmental and private interest in quality products with great export opportunities has recently emerged. Organic agriculture is a new activity but it still lacks organisation. Information about the sector is fragmented. The aim of the present research work is to illustrate the state of the art of this sector, to assess its potential and provide recommendations for its development. The research strategy adopted is based on the "action research" approach. Semi-structured questionnaire-based interviews were conducted with different types of stakeholders. Taking into account the collected data, a SWOT and a stakeholder analysis were performed and, eventually, short/medium- and long-term recommendations were drawn up. Results were presented and discussed at a national workshop. Organic agriculture in Algeria displays two main paths of development: on the one hand the private actors, the pioneers, on the other to the most recent public sector's initiatives. The agricultural professional is still a crucial missing actor.

Keywords: Organic agriculture, organic policy, institutions, Algeria.

442. AMULIĆ Dubravko (*Bosnia and Herzegovina*)

Supervisor: A. R. Malacrida ; advisors: V. Simeone and F. Baldacchino

Title: Molecular characterization of *Psytalia concolor* populations and strains by RAPD and SCAR molecular markers for their use in biological control programs of *Bactrocera oleae*. – 54 p.

Abstract: *Psytalia concolor* is a parasitic wasp reared and released for the biological control of *Bactrocera oleae*. The biological control program using this endoparasitoid has to face the problem of evaluating the release activities because of the morphological similarities between released and indigenous *Psytalia concolor*. A DNA molecular technique, the Random Amplified Polymorphic DNA (RAPD) was used to define molecular markers and to assess the genetic variability between 4 reared strains from Italy, Turkey and Guatemala and 11 wild populations of *P. concolor* from Italy (Apulia), Lebanon and Jordan. RAPD approach revealed a genetic homogeneity between the reared and the Apulian samples and demonstrated the presence of diagnostic bands which discriminate the Lebanese and Jordan populations from the reared strains. Based on these markers, SCAR (sequence characterized amplified regions) primers can be developed and designed. SCARs are more advantageous than RAPD markers since they detect a single locus and are, therefore, more specific.

Keywords: *Psytalia concolor*, *Bactrocera oleae*, biological control, RAPDPCR, genetic variability, SCARs markers.

443. RAMADAN Mohammed Hewidy Mahmoud (Egypt)

Supervisor: M. Ben Kheder ; advisor : C. Coccozza.

Title: Different organic fertilization effects on organically cultivated broccoli (Brassica oleracea var. italica). – 83 p.

Abstract: The aim of this study was to gain an insight into the fertilization of organically cultivated broccoli (Brassica oleracea var. Italica). Seven fertilization schemes were applied to check the complementing effects of compost tea, to evaluate the exhausted compost, to assess the synergy and differences between compost and the commercial organic fertilizer and their economic sustainability. The best agronomic results were attained by the commercial organic fertilizer alone and combined with compost. Compost tea applications did not complement the effects of compost alone since they provided almost the same agronomic results. It was not possible to evaluate the exhausted compost because it did not show any significant difference compared to the control. The compost application enhanced soil bacteria, total N and organic matter content, while compost tea increased soil fungi. The commercial organic fertilizer, alone and combined with compost, gave the best results related to the high yield and income and low production costs.

Keywords: compost, compost tea, exhausted compost, commercial organic fertilizer, broccoli, soil fertility.

444. EL-SAYED Maha Lotfy Mohammed (Egypt)

Supervisors : F. Intrigliolo, A. M. D'Onghia ; advisor : V. Verrastro

Title: Compost use in organic media production for growing citrus rootstocks in container. – 82 p.

Abstract: In the organic citrus nursery production, peatmoss (a non-renewable natural resource) is the major component (45%) of the standardized IAMB organic growing medium. In this work other composts i.e. ECOS (commercial) and Pastazzo (citrus residues) have been tested as substitutes and compared with IAMB mix (control) on Volkamer lemon, Troyer Citrange and Sour orange. When the first mixture with both composts was applied, all rootstocks showed lower growth than the control, due to the high pH values (>8) and the heavy media texture. Adding 20% of peatmoss to the inert materials and 1.5% of Guanito in the second mixture, the plant growth significantly increased up to the control level, reducing the pH value to 7.4. The rootstock response to the tested media was different, the best-performing being Volkamer lemon. Addition of elemental sulfur to Pastazzo-Guanito mixture reduced pH to 6.6 and improved the Sour orange performance.

Keywords: organic, citrus rootstock, nursery, compost, growing media, peatmoss.

445. ABD ALLA Abd El-Aziz Reda (Egypt)

Supervisor: S. Eid Salem ; advisor: L. Al Bitar

Title: Effect of legume cover crops on citrus orchards, case study: Toshka Project (South Egypt). – 65 p.

Abstract: This study was conducted in organic Valencia orange orchard under Toshka conditions, south Egypt. Three cultivation methods; between rows (BR), within rows (WR) and between and within rows (BWR) and two legumes cover crop (Egyptian claver and Fenugreek) plus the fallow as control were applied in a RCDB experimental design. Tree growth, weed competition and some soil properties were measured. The results showed that fruit set, tree vegetative growth, soil organic matter, soil moisture content, soil pH and the tree root extension are enhanced with the caver crop treatments while fruit drop, weed density and soil EC are decreased. However, the (BR and BWR) cultivation methods both with the Egyptian clover gave the best result without significant differences between them.

Keywords: cover crop, Valencia orange, Toshka, fruit set, weed density, organic matter, vegetative growth.

446. ABOU FAYAD Fady (Lebanon)

Supervisors: F. Caporali, R. Mancinelli ; advisors: L. Al-Bitar, N. Driouech

Title: Agronomic performance of annual self-reseeding legumes under Mediterranean climate in Southern Italy. – 53 p.

Abstract: Soil biological activity and fertility in organic agriculture should be maintained or increased by the cultivation of legumes, according to the ECC regulations 2092/91. In the Mediterranean areas, native ecotypes are more persistent and better adapted than commercial varieties. This study aimed at assessing the agronomic responses of seven native accessions of self-reseeding legumes and to discuss their adaptability and integration into Mediterranean cropping systems. Trifolium performed better than Medicago and of the seven tested species, five were more suitable to the site conditions. These could be used for managing soil fertility and enhancing biodiversity in the orchards. Trifolium angustifolium and M. polymorpha were the best-performing species. The former fixed 132 kg ha⁻¹ of nitrogen (using 15N isotope dilution method), produced 1976 kg ha⁻¹ of seeds and 8,7 t ha⁻¹ of dry biomass followed by the latter. Medicago radiata and M. rigidula were the worst-performing species.

Keywords: Trifolium, Medicago, ¹⁵N isotope dilution method, nitrogen fixation, full-flowering stage, seed production, soil fertility.

447. ROUPHAEL Souzi (Lebanon)

Supervisor: C. Vazzana ; advisors: J. Calabrese and G. Lazzerini

Title: Efficiency in the conversion of productive factors and energy consumption on organic farms. – 101 p.

Abstract: Efficient energy use in the agricultural system is one of the conditions for sustainable agriculture. It allows fossil resources preservation, air pollution decrease and money saving. In the present work, the productive process of wheat crop was studied comparing four organic farms and four conventional farms located in two different Italian regions (Gravina in Apulia and Val d'Orcia in Tuscany).

Energy inputs, outputs and balance with efficiency in terms of energy output/input and energy input MJ/production kg were determined based on specific energy equivalents. Organic farms proved to be more energy-efficient and closer to sustainability than conventional farms. Machine energy inputs had a great impact on the energy balance. No striking difference was reported for fossil energy and consumption between organic and conventional farms. However conventional farms showed a higher energy consumption due to the application of fertilizers.

Keywords: energy efficiency, energy balance, energy cost, pollution, wheat productive process, sustainability.

448. AÏT BATAHAR Hind (Morocco)

Supervisor: L. Kenny, advisor: A. R. Antonelli

Title: Feasibility study on the introduction of organic agriculture in the oasis systems : case of the Drâa Valley in South East Morocco. – 114 p.

Abstract: The Drâa valley, in South East Morocco, exhibits an exceptional natural context and offers an attractive landscape. In spite of the dry climate of the region, the oasis agricultural systems represent a major asset since they are still healthy and traditional and include the original oasis crops such as the date palm along with fruit trees and special crops as henna and roses. Unfortunately, these original products of high commercial value are underexploited. The present study aims to assess the feasibility of applying organic concepts to these systems in order to promote the region development and exploit its potential. To this end a diagnosis of the agricultural sector is outlined taking into account the agro-ecological, socio-economic and institutional aspects. This diagnosis allows to make some suggestions for conversion to organic agriculture in order to support a sustainable transition.

Keywords: oasis, original products, traditional, healthy systems, organic agriculture, Drâa valley, Morocco.

449. CHLAIKHY Siham (Morocco)

Supervisor: L. Kenny ; advisor: R. Addante.

Title: Pest management comparison among biodynamic, IPM and conventional citrus groves in South Morocco. – p. 105.

Abstract: A comparative pest management study on three citrus groves was carried out in the region of Souss, South Morocco, to compare the effectiveness of different control methods as integrated pest management (IPM), biodynamic and chemical strategies and to evaluate their impact on beneficial arthropods. *Aonidiella aurantii*, *Ceratitis capitata*, *Phyllocnistis citrella* and *Panonychus citri*, the key pests in the Moroccan citrus industry, were the species investigated in this study along with their natural enemies. Samples were weekly collected to follow up the population trend of the four pests and their natural enemies as well as the parasitisation and predation rates. The chemical strategy showed little effect against *C. capitata* and *P. citrella*, was polluting and expensive, whereas IPM controlled effectively the above pests and proved to be environment-friendly and healthy. Finally the total lack of treatments on the biodynamic farm made *A. aurantii* and *C. capitata* infestations exceed the economic threshold, despite the highest population density of predators such as the *Phytoseiid mites Euseius* sp. and lots of parasitoid species as *Aphytis melinus* and *Comperiella bifasciata*.

Keywords: Morocco, citriculture, key-pest, control strategies, natural enemies.

450. MAHMOUD Rola Sameer (Palestine)

Supervisors: F. Nigro, A. M. D'Onghia ; advisor: T. Yaseen

Title: Effect of bacterial and fungal antagonists on the growth of olive plantlets and on the inoculum density of *Verticillium dahliae* Kleb. microsclerotia in the nursery. – 55 p.

Abstract: *Trichoderma harzianum* Fv178, *Clonostachys rosea* Fv114, *Bacillus licheniformis*, *B. subtilis*, two semi-commercial products based on a combination of these microorganisms, and the organic amendments Guanito (1%, 2%, 3%v/v), were used to evaluate their effect on vegetative parameters of olive plantlets and on the inoculum density of *Verticillium dahliae* microsclerotia in the soil. Trials were carried out on both self-rooted and grafted olive plantlets. The soil mixture was treated with a suspension of antagonists, and inoculated with *V. dahliae* microsclerotia. A significant increase in the plant height was observed on plantlets treated with bacteria. A phytotoxic effect was recorded in the plantlets growing on 2% and 3% Guanito mixture. Significant effects were reported on the number of microsclerotia detected with both bacterial and fungal antagonists. Antagonistic activities against *V. dahliae* were evaluated in vitro. *T. harzianum* significantly inhibited *V. dahliae* growth in dual culture, and *B. subtilis* and *B. licheniformis* culture filtrates (30%) prevented the formation of *V. dahliae* microsclerotia.

Keywords: *Bacillus subtilis*, *Bacillus licheniformis*, *Trichoderma harzianum*, *Clonostachys rosea*, *Verticillium wilt*, *Olea europaea* L., nursery.

451. ABOU ASSAF Haya (Syria)

Supervisor: I. Pertot ; advisor: V. Simeone

Title: Screening and identification of new biocontrol agents (BCAs) against grapevine powdery mildew. – 88 p.

Abstract: Grapevine powdery mildew is a widespread disease under dry warm climates as in the Mediterranean Basin. Sulphur is the most effective treatment against this disease in Organic Agriculture. Due to sulphur drawbacks, many studies are under way to find alternatives. In this study we isolated natural microorganisms (bacteria, yeasts and filamentous fungi) from leaf surface and soil and tested for their activity against powdery mildew. Microorganisms were sprayed on plants, powdery mildew was artificially inoculated and, after symptom appearance, disease severity and incidence were assessed. Sulphur, used as standard, confirmed its good activity against the disease, but some microorganisms proved to be promising as biocontrol agents (BCAs) against grapevine powdery mildew. Future studies are needed to test those BCAs in different field conditions with preliminary formulations at different disease stages.

Keywords: organic viticulture, Mediterranean area, *Erysiphe necator*, BCAs, yeasts, bacteria, filamentous fungi, sulphur.

452. MRAD Meriem (Tunisia)

Supervisor: M. Ben Kheder, advisor: V. Verrastro

Title: Effects of compost and compost tea on potato and zucchini crops. – 111 p.

Abstract: Two field experiments were conducted at the Technical Center of Organic Agriculture in Sousse, Tunisia, to study the effects of different combinations of organic matter (manure and olive mill solid waste and waste water), used as compost and compost tea, on growth, development, yield, nutrition and soil fertility

of potato (cv. Spunta) and Zucchini (cv. Jedida) crops. For both potato and zucchini crops, a higher agronomic effectiveness was reported when applying composts and compost teas made up of a combination of manure and olive wastes, with or without olive mill waste water, mainly on vegetative growth, production and yields. The product quality was also improved through mineral nutrition. However, compost teas were not as effective as the commercial bio-fertilizer against Powdery Mildew disease. The production cost was not reduced, yet, benefits were similar to the control, thus suggesting the use of compost and compost tea in substitution for commercial bio-fertilizers.

Keywords: compost, compost tea, manure, olive mill waste, potato, zucchini, commercial bio-fertilizer.

453. DURUKAN Cevahir (Turkey)

Supervisor: U. Aksoy and R. Zanolli ; *advisor:* R. Callieris

Title: Consumer perception of food safety and organic agriculture in Turkey. – 58 p.

Abstract: Organic food production displays a steady increase in Turkey, but the domestic market is still at the initial stage due to various reasons as the limited product range, the lack of demand on the domestic market, the consequent lack of consumer awareness and the lack of trust in organic products. Since two years some food safety cases have widely been announced by the media. In general, there is greater publicity for organic agriculture throughout the country following the enforcement of the new framework law. This research is aimed at outlining strategies to enhance the domestic market for organic products and to emphasize the "organic=safe" food concept. The results reveal that even though organic products are well-known by the consumer, the knowledge of the organic logo is still poor. Television has proved to be the most effective channel to heighten awareness of both food safety and organic agriculture.

Keywords: consumer perception, food safety, organic agriculture, domestic market, Turkey.

MOA - A.Y. 2006-2007 (October session) – 481-490

481. MAMOÇI Erjon (*Albania*)

Supervisor: I. Pertot ; advisor: V. Simeone

Title: The use of antagonistic microorganisms and natural compound in the grapevine powdery mildew control. - 55 p.

Abstract: The aim of this work is to evaluate the survival of a yeast and a bacterium on grapevine phylloplane and the efficacy of the two strains and of a lactoperoxidase-based product against grapevine powdery mildew (PM), under field conditions in southern Italy. The survival of the bacterium was tested under controlled conditions at different temperatures and relative humidity (RH). It survived at 15, 22 and 30 °C but, temperatures higher than 22 °C were detrimental. The bacterium tolerated low RH (up to 35±5%), but it could not survive in the southern Italian environment. The yeast could survive in field conditions up to seven days after the treatment and it also tolerated low RH. These results indicate that the yeast is a promising candidate for biocontrol of PM in southern Italy, even though no hypothesis can be advanced on its efficacy against grapevine PM, since in 2007 field conditions were not favourable to the disease.

Keywords: powdery mildew, south Italy, biocontrol, lactoperoxidase, yeast, bacterium, survival.

482. ISLAM Kamrul Md. (*Bangladesh*)

Supervisor: M. Ben Kheder ; advisor: C. Cocozza

Title: Influence of compost water ratio, extraction time, storage duration and storage temperature on compost tea quality. - 172 p.

Abstract: The rising popularity of compost tea as organic fertilizer or pesticide has lead many researchers to evaluate its performance without standardizing its quality. Consequently, so far experimental results have proved to be inconsistent and controversial. In order to standardize the compost tea quality, some trials were conducted at the Mediterranean Agronomic Institute of Bari, Italy, during 2006-07. A factorial design was adopted to evaluate the effect of compost water ratio, extraction time, storage duration and storage temperature on physical, chemical and microbiological characteristics of compost tea. Results indicated that compost tea nutrients and microbes were significantly affected and predictable, particularly based on compost water ratio and extraction time. Significant effects of storage duration and storage temperature were recorded only on compost tea microbial populations. Results suggest that optimum quality of compost tea can be obtained from fresh extracted compost tea with lower compost water ratio while extraction time should be shorter or longer according to the maturity of the compost.

Keywords: compost tea quality, compost water ratio, compost tea extraction time, compost tea storage duration, compost tea storage temperature, physicochemical and microbial characteristics of compost tea.

483. EL-SHOKARY Mahmoud (Egypt)

Supervisor: M. Ben Kheder, V. Verraastro

Title: Effects of soil buildings crops and fertilizers on potato crop under Mediterranean organic farming system: Tunisian case. - 107 p.

Abstract: A Field experiment was conducted at the Technical Centre for Organic Agriculture in Sousse, Tunisia, during 2006-07 to study the effect of three soil building crops on potato (cv.spp) in the Mediterranean organic farming system. Faba bean, peas, and fennel were grown as soil building crops while natural weeds were used as control. Potato was grown as main crop after incorporation of soil building crops. Compost tea and a commercial fertilizer (Molex) were applied to potato plots as fertigation. Results showed that the effect of soil building crops and fertigation on potato yield and yield contributing characters were not significant. However, striking effects of compost tea on the potato tuber number were recorded. Higher late blight attacks were reported in compost tea applied plots, which limited the yield. A significant correlation between infection and tuber quantity and compost tea application were also observed. Higher gross margins were obtained with commercial fertilizer application.

Keywords: Organic farming, crop rotation legumes, biodiversity, potato, compost - compost tea, commercial fertilizer, gross margin.

484. GHANEM Alaá (Jordan)

Supervisor: F. Caporali ; advisors: N. Driouech and L. Al-Bitar

Title: Integration of annual self-reseeding legumes into a rotation programme under Mediterranean organic cropping systems. - 80 p.

Abstract: Soil fertility management is a major concern in organic farming and should be maintained by legumes cultivation according to the ECC regulations 2092/91. Native Mediterranean legumes ecotypes are more persistent than commercial varieties but, their use in cash crop sequences is still unknown. This study aimed at assessing the self-establishment capacity and the agronomic performances of seven native accessions of annual self-reseeding legumes in their second cropping cycle and their green manuring effect on zucchini as first subsequent crop under rotation programme. Trifolium performed better than Medicago. Regenerated species sustained optimum level of soil available nitrogen and induced positive effects on zucchini growth parameters. Zucchini marketable yield was significantly increased affected by preceding legumes in average 53% over the control. *T. angustifolium* was the best performing; it produced the highest dry biomass (7.74 t/ha) and fixed nitrogen (138 kg/ha) and induced the best effect on all zucchini parameters including crop yield (42.66 t/ha).

Keywords: Rotation programme, green manure, self-reseeding legumes, *Trifolium*, *Medicago*, soil fertility, nitrogen fixation.

485. HAMADE Kanj (Lebanon)

Supervisor: P. Midmore ; advisor: P. Pugliese.

Title: Institutions and policy development for organic agriculture in Western Balkans Countries. A comparative analysis. - 103 p.

Abstract: Michelsen *et al.* (2001)'s theoretical path for a successful growth of organic agriculture was developed for West European countries. Then, in a context of EU enlargement it was extended by Moschitz *et al.* (2004) to new member

states. In continuity with these works, the present research, carried out within the framework of a Cooperazione Italiana project, describes and analyzes the institutional setting in Western Balkans countries. Using a comparative qualitative approach, it studies the dynamic of the institutional changes that occurred in the organic movement, the State agricultural institutions and policies, and in the organic supply chain. Research findings show that Michelsen *et al.*'s path, though originally developed for the old EU member States, is currently identifiable also in Western Balkans, but with a different sequence resulting from distorting factors slowing down or speeding up the accomplishment of the steps. Additionally, a number of common features and trends were identified in the organic sector of the studied countries leading to a converging trajectory in institution and policy development for organic agriculture.

Keywords: Europeanization, rural development, organic support policy, institutional setting, qualitative research.

486. MILENKOVIC Iva (Macedonia)

Supervisor: R. Zanolli ; *advisor:* R. Callieris.

Title: Organic market development in the Republic of Macedonia. - 89 p.

Abstract: The organic sub-sector in Macedonia follows an industrial model of agriculture and its development is mostly based on expectations of market price premiums. The organic farming community is very small and at the very beginning of the learning curve. In these circumstances supply is seen as the biggest problem of developing a market. The research involved a prospective analysis of the state of the art of the sub-sector from the marketing point of view. It focused more closely on potential for export market development, increasing of supply in terms of any products with potential to reach an export market and the opportunity of developing a domestic market. Farmers are not ready for export yet and any potential initiative should be taken with organization of collective capacities. The success of any endeavor highly depends on the increase of transparency within the organic community. Development of the domestic market should be given more priority at this point as it has more chances of short term success and would serve as a foundation for eventually accessing an export market.

Keywords: Macedonia, organic, potential, market, agriculture, supply, export, domestic.

487. EL KHASSAL Ahmed (Morocco)

Supervisor: L. Kenny ; *advisor:* M. Sarehane

Title: Effects of seaweed extracts on citrus growth, yield and pests. - 78 p.

Abstract: This study was carried out in Taroudant region, in southern Morocco, to test the effect of seaweed extracts on vegetative growth, yield and pests of two citrus varieties, Nour and Navel. The target pests are the citrus leaf miner and citrus mites. Three doses were tested: D1: 0.25l/hl; D2: 0.50l/hl and D3: 0.75l/hl in addition to the control D0, where only tap water was used for foliar treatment. The product was applied five times during the experimental period from February to June 2007. The application of seaweed extracts, as foliar fertilizer was efficient in these two varieties; in fact, it improved vegetative growth, flowering, fruit set and yield, which increased by almost 33 % in Nour variety. Regarding pest repulsion, the collected results showed that seaweed extracts affected negatively the leaf miner population. Application of seaweed extracts increased the number of

infested shoots by 11.8 %. However, seaweed extract reduced the incidence of mites by reducing the number of mites per leaf and the number of infested leaves respectively by 29.6% and 47.9 %.

Keywords: seaweed extracts, citrus, growth, yield, pest.

488. ABDELHAMID Ibrahim (Palestine)

Supervisor: L. Kenny ; *advisor:* J. Calabrese

Title: Effect of rotation and soil building crops on tomato crop and soil fertility. - 92 p.

Abstract: This experiment was conducted at Hassan II institute experimental station, located in the South west of Morocco. The experiment aimed to study the long-term effect of crop rotation on soil fertility and tomato growth and yield. The experimental design adopted was split plot with four trials and four replicates. Four rotations were applied, tomato after zucchini, tomato after bean, tomato after pea and tomato after fallow. Two organic commercial fertilizers were applied to all crop: compost and alter orga, used as solid and liquid forms. Results showed that the highest yield and income were obtained when tomato was grown after zucchini and treated with alter orga fertilizer. As for soil fertility parameters, an improvement in soil organic matter and total nitrogen was noticed with a decrease in pH. The remaining parameters (P, K, Ca, Mg and micro element) did not show significant variation in this first year of experiment.

Keywords: rotation, long-term, soil building crops, fertility, vegetables, tomato, Morocco

489. NAZIK Ceren Ayse (Turkey)

Supervisor: U. Aksoy ; *advisor:* L. Al-Bitar

Title: Effect of rotation and fertilization on tomato in the Mediterranean organic farming system : case of Turkey. - 54 p.

Abstract: Technical and economic feasibility of rotation programs have significant impact on the success of organic production. This study was designed to test the effect of different soil building crops including legumes to be used as green manure (*Vicia sativa*), for grain production (*Vicia faba*) and a commercial crop broccoli (*Brassica oleracea* var. *Italica*) on tomato yield and quality under organic management. A fallow control was used. During the tomato growth, fertility was maintained by a commercial compost supplied in two forms: compost alone and compost complemented with compost tea. Treatments were arranged in a split plot design with four replicates and two factors having as main factor the soil building crops and as second factor the fertilization. Compost alone increased tomato yield significantly. The highest yield was obtained in the interaction faba bean and compost. Both factors did not have any marked effect on tomato fruit quality and on soil total N and available P and K contents in the first year. Common vetch and compost application gave the highest gross margin due to a combination of high yield and low production costs.

Keywords: organic, rotation, soil building crops, compost/compost tea, tomato, gross margin.

490. MOHAMED Youssef (Egypt)

Supervisor: U. Aksoy ; advisor: V. Simeone

Title: Effects of different soil building crops and different fertilization programs on zucchini in Mediterranean organic farming : South Italy case. - 104 p.

Abstract: Crop rotation is the central tool that integrates the maintenance and development of soil fertility with different aspects. Under organic vegetable production, nutrient supply to crops depends on the use of legumes to add nitrogen to the system and soil amendment inputs for supplementary nutrients, added in acceptable forms. This research aimed to characterize the most suitable crop rotation scenario for vegetable in south of Italy. The effect field bean, narrow leaf crimson clover, fennel and incorporation of spontaneous weeds were tested on zucchini (main summer crop) performance planted as subsequent crop. Two fertilization treatments, commercial fertilizer and compost tea, were tested on zucchini by analysing quantitative and qualitative parameters. Treatments were arranged in a split plot design with four replicates. The two factors were the soil building crops as the main factor and fertilization as the second factor. Soil building crops showed significant difference in respect to number of leaves, female, and male flowers and soil cover and the yield of the last three harvests. However no significant differences were recorded on fruit macro and micronutrients, and fruit quality parameters. Zucchini fertilized with compost tea after field bean gave the highest gross margin due to a combination of high yield and low production cost.

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520. ZEQIRI Alketa (*Albania*)

Supervisors: I. Pertot and V. Simeone

Title: Interaction among insects, microorganisms and plant in organic vineyard: host location by grapevine moth. – 59 p.

Abstract: Grapevine moth (GM), *Lobesia botrana*, and grey mould, *Botrytis cinerea*, can cause high economic losses to grape. Behavior-modifying chemicals and microbial biocontrol agents (BCA) are nowadays used instead of pesticides to control GM and grey mould. This thesis work was designed to explore (1) the role of volatile compounds from grape inoculated with microorganisms in manipulating the behavior of egg-laying GM females and (2) to evaluate the effectiveness of a BCA (*Metschnikowia fructicola*) against grey mould. Oviposition experiments with dual choice were done to examine the behavioral response of mated GM females. Moths exhibited a preference for grape inoculated with a pool of yeasts over a healthy grape. The odor emitted by grape with single yeast species was attractive, indifferent or repellent to GM females. Females of *L. botrana* preferred to lay their eggs onto the support releasing the odor of a healthy grape compared to a grape inoculated with *M. fructicola*. Females exhibited a preference for the odor emitted by a grape co-inoculated with both microorganisms compared to a grape inoculated only with *M. fructicola*. *M. fructicola* showed both a significant antagonistic effect on *B. cinerea* and a repellent effect on GM egg-laying females.

Keywords: grapevine moth, grey mould, yeast, biocontrol, oviposition bioassays.

521. ABDELRAHMAN Hamada Mohamed (*Egypt*)

Supervisors: F. Tittarelli and V. Verrastro

Title: Evaluation of compost as peat substitute in growing media for organic melon seedlings production. – 86 p.

Abstract: Two types of compost were produced: green waste compost (GWC) and mixed waste compost (MWC). GWC was composed of green wastes while MWC was composed of green wastes and animal manure. Both composts have alkaline pH, acceptable salinity content, low C/N ratio. Humification indices and IsoElectroFocusing (IEF) were used to describe the evolution of organic matter during composting. Humified carbon has increased for both compost but with a higher percentage for GWC. IEF profiles for both composts were similar and they did not provide further interpretation. A greenhouse trial was carried out to evaluate peat substitutability at 30, 50 and 70% compost on melon seedlings growth. Compost addition has affected chemical and physical properties of the mixes. Biometric parameters and shoot content of nutrients were measured. The results obtained showed that peat could be substituted with 30% of both composts. Moreover MWC could successfully replace peat with a percentage up to 70%.

Keywords: compost, peat substitution, growing media, humic-like substances, humification.

522. AL KHREISAT Areej (Jordan)

Supervisors: N. Lamaddalena, J. Calabrese and G. Mimiola ; advisor: A. Daccache

Title: Organic and conventional farms: comparison of sustainability. - 89 p.

Abstract: Nowadays sustainability is a very important issue. In agriculture it is linked to the farm activities and management because farms are the bottleneck for a sustainable agro-ecosystem. In this research sustainability of two different farming systems applying organic and conventional management methods and sharing the same environmental conditions was compared. A set of indicators was chosen and applied. Under the Mediterranean conditions, farm sustainability strongly depends upon water and the way it is applied and delivered even at farm level. Therefore, emphasis was laid on the two farm management practices. Evaluation of drip irrigation systems was performed using simulation models (DSA software) and direct field measurements. All the indicators applied are compared for their performance with thresholds found in the literature. At the end, a performance assessment for the farm sustainability is done. Organic farm is closer to sustainability and to agro-environmental protection than the conventional farm.

Keywords: sustainability assessment, organic farm, agro-environmental indicators, indicator, organic agriculture, irrigation performance analysis, DSA model.

523. BEAINY Georges (Lebanon)

Supervisors: M. Ben Kheder, V. Verrastro and C. Coccozza

Title: Effect of compost tea and commercial fertilizer on organic spinach crop. - 82 p.

Abstract: Some issues of organic agriculture, that are still in question, concern how to reduce agricultural Nitrogen losses in the environment and how to minimize human health threat. With the aim of comparing farm compost tea to commercial biofertilizer, field experiment and laboratory analyses were conducted at Mediterranean Agronomic Institute of Bari, Italy, during winter-spring 2008 in complete randomized block design to identify the optimal application method of compost as sole source of fertility, compost combined with compost tea and compost combined with commercial biofertilizer on quantity and quality of spinach organic crop. Results indicated that compost amendment combined with compost tea fertigation provided similar spinach vegetative growth and 20 % less Total Nitrogen in plant (31.0 g.kg⁻¹) as well as seven times less Nitrate accumulation in spinach edible green parts (103.3 mg.kg⁻¹ of d.w.) with respect to compost combined with commercial fertilizer. Results suggested that optimum quality of organic spinach can be obtained from compost combined with compost tea without yield reduction.

Keywords: spinach, compost, compost tea, seaweed extract, nitrate.

524. FAWAZ Hiba (Lebanon)

Supervisors: M. Schermer and P. Pugliese

Title: Social capital in the organic sector of Lebanon: case studies from women cooperatives. - 80 p.

Abstract: A beneficial interaction between organic farming and social capital is reported by several authors in the literature. The present work aims to verify this relationship in the Lebanese context. Using a qualitative approach, it investigates the social capital and its interactions with organic farming in three Lebanese

women cooperatives working in organic food processing. The research findings show that the relationship can be verified in the three case studies. Such interactions are more evident in some specific fields i.e. group work trust, information dissemination and women empowerment. These successful collective initiatives are considered as a good example to build up a more collaborative approach especially in the case of the Lebanese organic sector where there is a dominance of scattered farmers working individually instead of being gathered in cooperatives.

Keywords: organic farming, social capital, rural development, women cooperatives, qualitative research.

525. ROUINI Imadeddine (Morocco)

Supervisors: N. Iannotta, E. Perri and V. Simeone

Title: Olive fly management with allowed formulations in organic agriculture. - 87 p.

Abstract: The olive fly is a serious pest in the Mediterranean. Copper is used to manage it in organic groves, but its use is restricted. Therefore alternative products should be utilized. This work carried out in 2007-2008 in three Apulian olive groves on Coratina and Termite di Bitetto cultivars aimed at testing: i) copper oxichloride, kaolin and propolis effectiveness, ii) their influence on oil quality, and iii) their residues of trace elements in olive fruits and oil. Infestation level and quality criteria such as acidity, peroxide index, K232, K270, .K, and panel test were evaluated. Trace elements were determined by Inductively Coupled Plasma Mass Spectrometry. Results showed that tested products were able to limit infestation and to produce high quality olives and oils. Aluminum, copper and silicon contents monitored in the fruits and oil did not show any significant risk for consumers.

Keywords: olive fly, organic farming, copper, kaolin, propolis, quality, trace elements.

526. SBAIHATH Layth (Palestine)

Supervisors: L. Kenny and J. Calabrese

Title: The effect of soil-building crops and fertilization programs on organic melon culture (case of Morocco). - 113 p.

Abstract: The present study is part of a medium-term experimental series launched in 2006 and aimed at developing a suitable cropping system for organic vegetables under the Mediterranean climate. A split plot design was adopted for testing the effect of three soil building crops (bean, pea and zucchini) and of two types of organic fertilizer (FertiCompost and AlterOrga) on the growth, yield, and fruit quality of melon as the main crop. Organic fertilizers were applied as liquid and solid forms. Zucchini, bean, and pea yielded 40, 6, 3.5 ton/ha respectively, and melon about 32 tons/ha with no significant difference between SBCs and organic fertilizers. Leaf mineral analysis showed higher calcium concentration in melon tissues when preceded by pea as soil-building crops. Higher potassium content was also found in residues of melon after zucchini and fertilized by AlterOrga, and lower nitrogen in those after bean. At the end of the 30-week rotation, soil nitrogen level increased by 0.02% in pea plots. In addition, lower pH was associated with AlterOrga. Zucchini reduced weed emergence by 48%, while bean reduced by 45% and pea by 25% throughout the two cropping seasons. The highest gross margin

was gained from zucchini-AlterOrga (55.06 euro/subplot), and the lowest from pea-AlterOrga (5.64 euro/subplot).

Keywords: organic agriculture, soil fertility, crop rotation, soil-building crops, fertilization, organic vegetables, melon, weed management, gross margin.

527. AMER Nasser (Syria)

Supervisors: U. Aksoy and L. Al-Bitar ; *advisor:* Z. Chami

Title: Evaluation of pre-crops and fertilizations on organic tomato production under Mediterranean conditions: The case of South of Italy. – 58 p.

Abstract: Using pre-crops and cash crops can be the main mechanism for nutrient supply and soil fertility improvement within organic farming systems. The present study was conducted in southern Italy to investigate the effect of different pre crops (Vetch, field bean, broccoli) compared to a fallow control, and organic fertilizers (compost tea, commercial organic fertilizer) on the main crop (tomato) and soil fertility. Split plot design was used with four replicates and two factors having the pre crop as the main factor and the fertilizers as sub-factor. Both factors did not have any significant effect on tomato quantitative and qualitative parameters except vetch that induced significant effect on marketable yield and compost tea which affected significantly the average fruit weight. Soil fertility was slightly improved at the end of the experiment. The results suggest that vetch green manure can supply tomato with all its N requirements. Fallow-Tomato (CF) gave the highest gross margin due to low production costs.

Keywords: green manure, organic fertilizer/compost tea, soil fertility.

528. AL NAYEF Mohammad (Syria)

Supervisors: J. Calabrese and G. Mimiola; *advisor:* A. Aly

Title: Introducing energy crop (*Brassica carinata*) in organic: comparing organic and conventional practices. – 82 p.

Abstract: Energy crops are becoming an important topic also for their contribution to their producers in the framework of new energy production systems in the EU and Mediterranean countries. *Brassica carinata* is a well-known alternative winter crop in areas devoted to herbaceous crops and even in organic agriculture in sites where *B. napus* has some environmental constraints. This study conducted in IAM-Bari experimental field aimed to investigate crop nutrients uptake, organic and conventional fertilizer effect on the crop and oil contents, and crop/weed competition under organic and conventional management. Results indicated that in our environmental conditions delaying sowing date had a negative effect on the crop growth and yield, and that weeds were found to be important as competitors for available nutrients, which led to a significant yield reduction. Both conventional and organic fertilizers significantly and positively affected plant density, height, dry biomass, pods number per plant, 1000-seed weight, production, oil contents, and nutrient uptake, as compared to the control.

Keywords: *Brassica carinata*, *Brassica napus*, biodiesel, organic agriculture, weed, fertilizer.

529. ZRAIK Mohanad (Syria)

Supervisors: C. Vazzana, J. Calabrese and G. Mimiola

Title: Agro-biodiversity: from the field level assessment to a landscape cropping system analysis. – 62 p.

Abstract: In order to test a method to assess and compare biodiversity, four different sites and four farms in Apulia were analyzed from the field to the landscape level. The investigation of four different areas, differently characterized by herbaceous crops and by permanent crops, was performed together with the investigation into the differences in biodiversity at farm level due to different management strategies (organic versus conventional). At farm level, floristic survey was performed together with structural analysis and landscape analysis of the diversity by applying remote sensing tool. Results showed that flora on farm biodiversity was affected by landscape diversity and organic management can improve the species richness at farm and field level.

Keywords: biodiversity, GIS, floristic, indicators, landscape, remote sensing.

530. BAHOUAOUI Mohamed Ali (Tunisia)

Supervisors: M. Ben Kheder and V. Verrastro

Title: Effects of soil-building crops and fertilizers on zucchini crop under Mediterranean organic farming system: The Tunisian case. – 111 p.

Abstract: A good crop rotation is typically based on a long-term plan. It does not need be inflexible. It may vary in details from year to year, and modifications can be made without disturbing the essential rotation plan. This research was aimed to evaluate, in the second year of a 4-year rotation program, the effect of different soil-building crops including legumes, to be used as green manure (field bean), pea and fennel, as commercial crop, on zucchini performance. Two fertilization treatments, commercial fertilizer and compost tea, were tested on zucchini by analyzing quantitative and qualitative parameters under organic management. Treatments were arranged in a split block design with four replicates; the soil-building crops and fertilization were the main and the second factor, respectively. Results showed significant difference among soil-building crops concerning most soil parameters. However, no significant differences were recorded on zucchini agronomic parameters except for soil cover. Zucchini fertilized with commercial fertilizer after fennel gave the highest gross margin due to a combination of high yield and low production cost.

Keywords: crop rotation, soil-building crops, compost tea, commercial fertilizer, gross margin.

531. BILEN Emre (Turkey)

Supervisors: U. Aksoy and L. Al-Bitar

Title: Evaluation of pre-crops and fertilizations on organic zucchini under Mediterranean conditions: the case of Turkey. – 67 p.

Abstract: Soil fertility is fundamental in determining the productivity of all farming systems. The main tools utilized in organic farming to increase soil fertility are rotation, green manuring and organic fertilizers and soil amendments allowed. A field experiment was conducted at Ege University in Izmir, Turkey, to study the effects of pre-crops used as green manure - including vetch, faba bean, broccoli and spontaneous weeds - and fertilization (compost tea, commercial fertilizer) on

zucchini (the main crop in the rotation program) and on soil fertility. The main aim of the experiment was to identify the most suitable rotation program in organic farming for *Turkey* under the prevailing conditions. Tested treatments had no marked effect on yield or quality of zucchini except inorganic matter content of the fruits. There were significant differences among tested pre-crops for N, P, K, OM and C values of the soil. Zucchini after broccoli fertilized with compost tea gave the highest gross margin due to the higher income derived from two different crops complemented with lower production costs compared to the commercial fertilizer.

Keywords: organic agriculture, soil fertility, crop rotation, green manure, organic fertilizers, zucchini, gross margin.

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561. LUARASI Marsela (Albania)

Supervisors: P. Midmore, P. Pugliese and I. Tarelli ; advisor: S. Dano

Title: The characteristics of organic farms and operators in Albania : Indications for the organic sector development. - 85 p.

Abstract: There are three main driving forces in the development of the organic agricultural sector in Albania: first pioneers, cooperation projects and government. Cooperation projects are the main stakeholders, but nowadays the sector needs to become sustainable and government has to learn more about it. The two main objectives of this study are filling the gap of knowledge in organic production and giving indications for the development of the organic sector in Albania. Both quantitative and qualitative research is carried out. Quantitative and qualitative analysis are complementary and provide more detailed information on the Albanian organic farmers profile and farms characteristics. Rich conversational face-to-face interviews, using a semi-structured interviewed guide tool composed by open and closed questions, were conducted with 57 out of 61 certified organic operators. The field work was divided into three phases: preparation, testing and working. The findings show the small size of the organic sector and the presence of young and well-educated organic operators; the main organic production chains concern fruit and vegetables, grapes, olives and wild collection. Despite all the technical and marketing problems, organic operators have a positive attitude towards organic agriculture.

Keywords: organic sector, Albania, organic market, organic operators, qualitative research.

562. ARAAR Hakima (Algeria)

Supervisors: P. Caboni and V. Simeone ; advisor: I. Cavoski

Title: Cinnamon plant extracts: a comprehensive physico-chemical and biological study for its potential use as biopesticide. - 61 p.

Abstract: Cinnamon is a widely used herbal remedy and it has many applications in perfumery, flavouring and pharmaceutical industries. The aim of the study is to examine the biological activity of different cinnamon extracts and major active constituents against a series of fungal strains and weeds. The extracts were obtained from two types of cinnamon quillings and essential leaf oil supplied from the local markets. Four different extracts were obtained: i) oleoresins, ii) essential oils, iii) water and iv) ethanol. Chemical composition, total phenols content and antioxidant activities of extracts were examined. The extracts were tested by *in vitro* bioassays. The antifungal activity was evaluated against *Botrytis cinerea* and *Phytophthora capsici* and the phytotoxic effect was assessed on seeds of *Lolium perenne*, *Licopersicum esculentum* and *Lepidium sativum*. Extracts exhibited significant inhibitory effect on mycelial growth, conidia and zoospore germination and root elongation for plant seeds. Both cinnamaldehyde and eugenol significantly contribute to the biological activities together with several other components.

Keywords: cinnamon extracts, eugenol, cinnamaldehyde, phenolic compound, biological activities.

563. ABDEL HAMEED Emad (Egypt)

Supervisors: C. Coccozza, V. Verrastro and N. Sasanelli ; *advisor:* F. Erriquens

Title: Fertilizing and nematicide effects of chicken manure, fresh and composted olive wates on organic melon. – 59 p.

Abstract: The study evaluated the effect of different organic amendments on soil fertility, melon growth and on the root knot nematode *Meloidogyne incognita* suppression in southern Italy. The soil amendments were: fresh olive pomace (OP), composted olive pomace (OC), chicken manure plus *Paecilomyces lilacinus* (CMB) and chicken manure alone (CM). Open-field and pot trials were performed in randomized complete block design. The open-field trial was conducted on the basis of five treatments with four replications each, whereas the pot trial was carried out with nine treatments and ten replications per treatment. In the open-field trial, results showed that plant growth and total yield of melon significantly ($p < 0.05$) increased with CM and CMB treatments. OP and OC treatments significantly reduced root knots and soil nematode population when compared to the other treatments. In the pot trial, CM and CMB applications showed the best results in root-knot reduction and plant growth in comparison to all the other treatments ($p < 0.05$).

Keywords: nematicidal effect, *Meloidogyne incognita*, chicken manure, olive pomace, *Paecilomyces lilacinus*, melon, organic agriculture.

564. EL SHAFIE Hazem (Egypt)

Supervisors: F. Tittarelli and V. Verrastro ; *advisor:* F. G. Ceglie

Title: Compost utilization as a peat substitute for organic tomato transplants production. – 64 p.

Abstract: Compost-based substrates for organic tomato seedlings production were evaluated in a peat substitution experiment. Two types of compost made from olive mills (OMC) and green wastes (GWC) were used at four rates (20%, 45%, 70%, 90% v/v) and their performances compared to sphagnum peat-moss growing media. During plant growth, nitrogen was added as blood meal. Tomato seeds were sown in 4 replications per treatment under greenhouse conditions. Plants were collected 36 days after sowing; biometrics (leaf, steam and total biomass), qualitative roots parameters (density, kind, color, distribution) and plants NPK content were measured, and statistically analyzed. Treatments GWC 20%, 45% and OMC 20% had the highest biomass and the best developed roots (Tukey, $P < 0.05$). The highest macronutrients resulted for OMC 70%. We can affirm that GWC is a good peat substitute up to 70% for organic tomato transplant production, while OMC cannot be utilized at a rate higher than 20%.

Keywords: growing media, peat substitution, compost, organic tomato seedlings.

565. ABBAS Sadek (Iraq)

Supervisor: F. M. Santucci and P. Pugliese ; *advisor:* M. R. Bteich

Title: Iraq agriculture... today prospects for the National Centre for organic agriculture. – 69 p.

Abstract: In Iraq, the agricultural sector has experienced a progressive decline that ended in a total collapse. After fatal wars, an unstable political situation and mismanagements, demographic growth, climatic conditions and water scarcity are the main factors explaining for that collapse. Nowadays, Iraq is catching up. Governmental interests and efforts have been recently growing up. The recent setting up of the National Centre for Organic Agriculture (NCOA) represents this new governmental trend. This study is aimed to give a clear picture of the Iraqi agriculture today, explore possibilities to develop organic agriculture in the current scenario and give prospects for the national centre for organic agriculture. The research strategy applied was based on the stakeholder consultation approach, mainly focused on the public sector that still controls all agricultural functions but production. The final SWOT was obtained after a tentative SWOT had been experimented with the stakeholder consultation. Through this study, we realized that there are good possibilities to develop organic agriculture in Iraq through the NCOA.

Keywords: Iraq agriculture, organic agriculture, SWOT analysis.

566. DEBS Philippe (Lebanon)

Supervisors: F. M. Santucci and R. Callieris

Title: The participation of Italian organic firms in the international trade fair Biofach. – 78 p.

Abstract: Participating in trade fairs is still an important marketing and promotional activity for many companies. They are motivated to be present in international fairs to search for external markets and new clients. This study, based on a survey questionnaire of two sections, was conducted on 100 Italian organic companies participating in BioFach (Germany). These companies have initially increased in number from 2006 to 2007, but then they have steadily decreased. This year, the majority came from northern Italy. Sales-related activities were the major reason to participate, with building the company's image as main objective. Forty percent were financially supported by public entities covering the travel and stands costs. Almost 80% of the companies were satisfied with their attendance, because they achieved their overall goals and gained new clients, which lead to take decision to participate in the next edition 2010.

Keywords: Trade fair, Organic companies, Survey, Satisfaction, BioFach.

567. EL HACHEM Nidale (Lebanon)

Supervisors: N. Iannotta, S. Scalercio and V. Simeone ; advisor: G. Cesari

Title: Preliminary study of characterization of entomofauna in olive groves in Apulia. – 90 p.

Abstract: Facing the increasing interest towards biodiversity and its ecological services, the EU encourages environmentally-friendly farming. Insects represent the most important functional unit and the largest part of diversity in agroecosystems. The importance of olive groves in the Mediterranean basin is strategic also for conservationists. Insects were often utilized as bioindicators due to their ecological plasticity. This research was carried out in four olive groves of Apulia. Insects were sampled by pitfall and malaise traps. Data were submitted to various statistical analyses in order to evaluate diversity and compare the entomofauna sampled in each experimental plot. Very interesting results arose from the 115,021 insects collected. This study was successful in increasing (1) the faunistic data for Apulia since two new species for the region were found: *Microlarinus lareynii* (Coleoptera, Curculionidae) and *Dichochrysa prasina* (Neuroptera, Chrysopidae) which are promising candidates in biological control strategies; (2) the availability of insects as bioindicators for olive groves management regimes.

Keywords: biodiversity, olive groves, entomofauna, Apulia, bioindicators, species diversity, faunistic data.

568. AL HAJJ Salem (Lybia)

Supervisors: G. Trisorio Liuzzi and J. Calabrese ; advisor: G. Ladisa

Title: Biodiversity assessment in protected area : a comparison between conventional and organic farms and landscape analysis for PA management of biodiversity. – 86 p.

Abstract: The work is addressed to assess biodiversity and investigate the reasons behind its levels in the agricultural areas (Regional Natural Park of Porto Selvaggio and Palude Del Capitano) in Apulia. Four farms having the most widespread cropping system in the park area were selected and the effect of their management (conventional and organic) on biodiversity compared by using biodiversity indicators. Taking into consideration that surrounding landscapes are very supportive to the biodiversity of fields, a landscape analysis was performed and diversity indicators calculated in the context of the protected area. Results show that the level of biodiversity in the investigated farms was different according to the management. Given the landscape diversity conditions, the biodiversity level appears higher in organically managed farms. Suggestions and corrective actions can be proposed in the frame of the Protected Area Management Plan in order to decrease the impact of agricultural practices on biodiversity and support the biodiversity of the territory.

Keywords: biodiversity, protected area, indicators, floristic analysis, landscape, GIS.

569. EL FARTASS Badr (Morocco)

Supervisors: L. Kenny and J. Calabrese

Title: Effect of pre-crops and fertilization program on organic cucumber under Mediterranean conditions (case of Morocco). – 91 p.

Abstract: The present study is the third of a series of Master's Theses started up in 2006 and aimed at developing a suitable cropping system for organic vegetables under Mediterranean climatic conditions. A split plot design was adopted for testing the effect of three pre-crops (beans, peas and zucchini) and two types of feeding programs (compost and compost tea + organic fertilizer) on the main crop (cucumber) and on soil fertility. Zucchini, beans and peas yielded 44, 11.3 and 10 tons/ha respectively accounting for 80, 102, and 90% of the average yield obtained in conventional production under Agadir conditions. The main crop (cucumber) yielded 92 tons/ha while, under conventional conditions, the yield is about 110 tons/ha. A feeding program based on compost tea and organic fertilizer induced a significantly higher cucumber yield. N, P, K and OM of the soil were improved after two years of crop rotation. Zucchini provides the highest amount of biomass (35.9 tons/ha) and has induced a strong competition with weeds. The weakest crop-weed competition was observed with peas. The highest total gross margin was gained from zucchini-compost (389.79€/100m²), and the lowest from fallow-compost tea + organic fertilizer (203.89€/100m²).

Keywords: cucumber, beans, zucchini, peas, soil fertility, crop rotation, pre-crops, organic fertilizer, compost tea, weed competition, gross margin.

570. MOHAMAD Ramez Saeid (Syria)

Supervisors: A. Marchini ; advisor: G. Cardone and M. R. Bteich

Title: Microeconomic analyses in organic olive farms : the case of "Ancient olive trees in the rural parkland in Apulia". – 81 p.

Abstract: The regional law on the protection and enhancement of monumental olive trees landscape in Apulia represents a key action for the protection of the area and of its agricultural production. This study conducted a microeconomic analysis based on the case study approach to evaluate the performance and profitability of 5 organic farms in the "Rural Parkland of Ancient Olive Trees". This work assessed the economic sustainability of ancient olive orchards in relation to other existing types of olive orchards. Results showed that ancient olive orchards have a positive net margin, although lower than the thickened and intensive ones. However, a better management and an optimization of agricultural practices of ancient trees can reduce production costs, produce more extra-virgin olive oil than lampant, and decrease the net margin gap in the ancient orchards compared to the other ones. Governmental subsidies can help improving mechanization and promoting the denomination "Extravirgin oil from Apulian ancient olive trees".

Keywords: organic farms, olive oil, ancient olive trees, rural parkland, microeconomic analysis, profitability.

571. TARRAF Waed (Syria)

Supervisors: C. Coccozza and V. Verrastro ; advisor: A. Aly

Title: Analytical characterization study of different compost extracts. – 87 p.

Abstract: The synchronization between nutrients release and plant demands even in organic agriculture is a major challenge to provide the plant with the necessary nutrients at critical stages. Compost has a "slow release" over a longer period, compared to the immediate availability of chemical fertilizers. The experiment tried to develop a procedure to extract more OM from compost by alkaline solutions instead of water in compost tea to get compost extract richer in nutrients. Two extraents KOH, KHCO₃ were applied in three concentrations namely 0.25, 0.50, 1.00 N on composts from different raw materials, N₂PLUS, PULA, at three ratios 1:10, 1:20, 1:40 for two periods 24h, 48h. The comparison among the treatments depended on OC and TN content. The best result was obtained by using with the highest concentration (1 N) with N₂PLUS compost, when the solution was more concentrated (1:10 ratio), for a longer time (48 hours).

Keywords: compost, organic matter, organic carbon, total nitrogen, compost extraent ratio, alkaline extraction.

572. GUENICHI Hasnia (Tunisia)

Supervisors: M. Ben Khedher and V. Verrastro

Title: Evaluation of pre-crops and fertilizations on organic production under Mediterranean condition : case of Tunisia. – 82 p.

Abstract: The study evaluated the effect of pre-crops (fennel, peas, broad beans and control) and organic fertilizers (compost tea and commercial organic fertilizer) on soil properties and on qualitative-quantitative tomato fruit production. A crop rotation including a mix of leguminous fertility building-crops, as pre-crops and cash crops, is the main mechanism for nutrient supply within the organic systems. Additionally, the use of adequate organic fertilization proved necessary to promote the organic crop production. After the pre-crops incorporation, soil organic matter (SOM), organic carbon (OC) and nitrogen content has increased. Pea plots expressed the highest SOM, OC and K content. After the main crop cycle, and after peas and broad beans cultivation, plots showed the highest P content. Compost tea showed the highest tomato cumulative yield. The highest marketable yield was recorded in plots grown after fennel. The highest gross margin was recorded with the pea-tomato rotation on soils fertilized with commercial organic products.

Keywords: soil fertility, compost tea/commercial fertilizer, pre-crops, tomato.

573. MRAlHI Mohamed (Tunisia)

Supervisors: I. Pertot and V. Simeone ; advisor: M. Tassin

Title: Microbial volatiles affect grapevine moth (*Lobesia botrana*) oviposition. – 42 p.

Abstract: The oviposition response of the grapevine moth females to volatile compounds released by grape-borne micro-organisms was evaluated through a laboratory choice assay. Females were allowed to choose between non-inoculated grapes and grapes inoculated with one or more micro-organisms collected and isolated from the vineyard. In some cases, the odour released by a set of grape-borne yeasts showed a positive effect on the oviposition. By contrast, volatile compounds from the phytopathogenic fungus *Botrytis cinerea* had a deterrent effect on the female oviposition (35% oviposition compared to 65% on non-inoculated grapes). The stimulus to lay eggs could be restored by inoculating *B. cinerea* together with the yeasts. Behavioural assays were subsequently carried out. In this study, volatile compounds released by micro-organisms proved to act

as semiochemicals for the grapevine moth oviposition. The confirmation of this behavioural effect will be obtained through additional semi-field and field experiments.

Keywords: *Vitis vinifera*; *Lobesia botrana*, grey mould, yeasts, semiochemicals.

574. BAYSAL Damla (Turkey)

Supervisors: U. Aksoy and L. Al-Bitar ; *advisor:* Z. Al Chami

Title: Evaluation of pre-crops and fertilizations on organic lettuce production under Mediterranean conditions : case of South of Italy. – 95 p.

Abstract: Soil fertility-building crops have been reported as a way to reduce inputs and increase soil quality. The aim of this experiment was to study the effects of pre-crops (faba bean, vetch and broccoli) and fallow and of two different fertilizers (commercial fertilizer and compost tea) on soil fertility and on main crop (iceberg-lettuce). Results showed that vetch was able to satisfy the N requirement of lettuce without any fertilizer application. Pre-crops significantly improved the soil chemical characteristics such as nitrogen and available phosphorus content. Higher total N content in the soil was obtained with pre-crop treatments compared to fallow and the highest available P content was obtained with broccoli. Pre-crops significantly affected lettuce production: vetch gave the highest total and marketable yield, whereas broccoli induced a better quality in lettuce especially in terms of ascorbic acid and nitrate content. Vetch together with compost tea gave the highest gross margin.

Keywords: organic; fertility; pre-crop; compost tea; commercial fertilizer.

575. UNAL Mehmet (Turkey)

Supervisors: U. Aksoy and L. Al-Bitar

Title: Evaluation of pre-crops and fertilizations on organic pepper production under Mediterranean conditions : case of Turkey. – 67 p.

Abstract: Organic farming systems rely on the soil fertility management in order to enhance the chemical, biological and physical properties of the soil for the optimization of the final crop production. In this study, effects of different pre-crops (vetch, faba bean and broccoli) and fallow with two different fertilization strategies (compost tea and commercial fertilizer) on organic pepper production and soil physical and chemical properties were evaluated. The highest pepper yield and gross margin were obtained in subplots previously cultivated with faba bean as pre-crop and fertilized with compost tea. During 2008-2009, soil physical and chemical properties did not present significant differences. Results obtained during the three-year experiment were evaluated with respect to soil nitrogen (N), phosphorus (P), potassium (K) and organic matter (OM) contents. Soil OM and N contents displayed an increase in all treatments in opposition to soil P and K contents that showed a slight decrease from one year to another.

Keywords: Organic agriculture, soil fertility, crop rotation, green manure, organic fertilizers, pepper, gross margin.

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598. LUARASI Linda (*Albania*)

Supervisors: R. Callieris and E. Leksinaj

Title: Consumer analysis and organic olive oil sector in Albania. - 85 p.

Abstract: Nowadays consumers are interested in ecologically-safe products due to health and environmental reasons as well as increasing concern about food quality. According to market research studies, olive oil is the most preferred organic product in the EU. Although in Europe and in the USA many studies focus on the organic sector, little is known about this topic in Albania. This research provides an insight into the Albanian organic consumers' attitude, a description of their perception of the organic olive oil, and a general overview of the organic olive oil sector. A market survey, including an investigation on organic consumers and interviews to the main organic olive oil processor, was conducted in the main cities of Albania. The survey's main results show the profile of the average Albanian organic olive oil consumers who are young, female and well educated, prefer to buy healthy products directly from the producers, even without having a good knowledge of organic products.

Keywords: Organic olive oil, market, consumer behaviour, supply chain.

599. BOUZEBOUDJA Fatima (*Algeria*)

Supervisors: P. Caboni, N. Sasanelli and V. Simeone ; advisor: I. Cavoški

Title: Pot experiment to assess the nematicidal activity of *Melia azedarach* L. fruits on the root-knot nematode *Meloidogyne incognita* infecting *Cucumis sativus* L. plants. - 55 p.

Abstract: The present study demonstrates the effect of *Melia azedarach* fresh fruits on the root-knot nematode *Meloidogyne incognita* infecting roots of susceptible cucumber (*Cucumis sativus*) plants, hybrid Sakamari F1, in glasshouse condition. The amendment of *M. azedarach* crushed fruits at rates of 30 and 60 g/Kg soil (CF1 and CF2, respectively) or soil treatment with aqueous extracts at 2.85 (AEF1) and 4.83 g/Kg soil (AEF2) were compared with neem extract (AZD) at 0.03 g a.i./Kg soil and fenamiphos (FEN) at 0.11 g a.i./Kg soil and untreated control. Pots were arranged according to a randomized block design with five replications per treatment. Treatments were applied at transplant. Two months later morphological and nematological parameters were recorded. The best plant growth was obtained with (CF1 and CF2). All treatments significantly reduced root gall index and nematode population density in roots and soil. No significant differences in nematode control were observed between (CF1 = CF2) while suppression of *M. incognita* increased with the extract concentrations (AEF1 < AEF2). Cluster analysis showed that CF2 was similar to FEN and even better than AZD treatments. *M. azedarach* could be suggested in the control of root-knot nematode populations.

Keywords: *Melia azedarach*, *Meloidogyne incognita*, aqueous extracts, azadirachtin, nematode control.

600. AWAD Fatma Alzhraa (Egypt)

Supervisors: F. G. Ceglie and F. Tittarelli

Title: Effect of different substrates and fertilizers on organic tomato seedlings production. – 69 p.

Abstract: Compost-based growing media mixtures made of C1 (vegetable residues compost) and C2 (food residues and vegetable Compost) were prepared in three proportions (20, 45, 70% v/v) with peat and perlite. The substrates were amended by rock phosphate and potassium sulphate. A greenhouse experiment was conducted to study the effect of these mixtures on organic tomato seedlings and their interaction with three organic fertilizers (BM: blood meal, HP: protein hydrolyzed and AE: algae extract). The seedlings were evaluated 34 days after sowing for: plant height, stem diameter, fresh and dry shoot weight, sturdiness index, leaf area, specific leaf area, N, P, K content in shoot, and qualitative scale of roots (density, color, thickness). The mixtures provided better results in seedlings than in controls. C2 showed the best performance in all the ratios. The substitution of peat with compost must be associated with a modified fertility management suitable for the new growing media formulation.

Keywords: growing media, compost, organic tomato seedlings, fertility management.

601. RAGAB Tarek Sayed (Egypt)

Supervisors: M. Fayed Fouad and L. Al-Bitar

Title: Biocontrol of Potato Brown Rot disease by *Ralstonia solanacearum* via multifunctional rhizobacteria combined with organic amendments. – 46 p.

Abstract: Brown rot caused by *Ralstonia solanacearum* is a quarantine disease of economic importance for which no effective means of control has been found so far. The present work aimed to biocontrol *R. solanacearum* by multifunctional endophytic bacteria, which are characterized by antagonistic activity, N₂-fixation and P-solubilization, together with organic amendments. Out of 80 bacterial isolates, 33 were identified and grouped into four clusters of which two multifunctional isolates (*Bacillus thuringiensis* and *Pseudomonas* spp.) were selected to be evaluated in greenhouse experiments. Results showed that soil suppressiveness was not enough to eradicate the pathogen population within two months, compost negatively affected soil suppressiveness while bioagents were successfully able to reduce the pathogen population in the soil without altering other microbial communities. Compost negatively affected the performance of *Bacillus thuringiensis* but not of *Pseudomonas* spp. In planta biocontrol showed that tubers inoculated with the bioagents were significantly able to reduce the amount of *R. solanacearum* in the rhizoplane and only the effect of *Pseudomonas* spp. was extended to the endorhizosphere. Moreover, bioagents inoculation increased the population of diazotrophs and P-solubilizers associated with the different plant spheres.

Keywords: Potato brown rot disease, *Ralstonia solanacearum*, organic amendments, compost, endophytes, PGPR, biocontrol, diazotrophs, P-solubilizers, *Pseudomonas*, *Bacillus thuringiensis*.

602. ATALLAH Oussama (Lebanon)

Supervisors: C. Zanasi and P. Pugliese

Title: Organic agriculture and local foods in Lebanon: the consumers' perspective on scope and opportunities for their interaction. - 87 p.

Abstract: The concepts of 'organic' and 'local' are receiving a lot of attention worldwide. They are often interconnected in international events, values, products and scientific literature. This interaction was investigated and mapped in Lebanon, adopting semi-structured interviews involving 19 key informants. The organic consumers' perspective was analyzed: 146 questionnaires were administered at the most popular farmers' market and specialized shops in Beirut selling organic and local foods together. The information collected from key informants were coded and interpreted. The data collected from the questionnaire were analyzed using descriptive and inferential statistical analysis. The results showed an interaction between 'organic' and 'local' in products, places, people and projects. Their integration seems to be at an early stage, involving different attitudes from consumers and stakeholders: concern on possible competition among organic and traditional emerged. The most educated, better off Lebanese consumers seem to be relatively more in favour of the integration.

Keywords: Lebanon, organic products, local foods, organic consumers, interaction, qualitative and quantitative research.

603. HECHMEH Nada (Lebanon)

Supervisors: C. Coccozza and V. Verrastro

Title: Influence of water and alkaline compost extracts on organic greenhouse tomato production. - 51 p.

Abstract: Synchronization between plant needs and fertilization is crucial. Since fertigation is an efficient method for fertilizer application, compost nutrient extraction was one of the aims of this study. Compost was extracted using water (T2) and two alkaline solutions (KHCO₃, T3, KOH, T4) to compare their effects to a commercial organic fertilizer (T1) when applied to tomato cultivated in greenhouse. T1 and T2 showed the highest quantitative parameters whereas T3 and T4 showed the best qualitative ones. T2 was easily produced on farm level whereas T3 and T4 could be stored: nevertheless they had to be diluted at least 1:50 to reduce the phytotoxicity. According to their physical and chemical features, T2 could be applied during the first crop stage till the fruit setting, while T3 and T4 should be used during the maturity stage to supply the crop with fresh and humified organic matter that improve the fruit quality.

Keywords: Organic agriculture, compost, compost tea, alkaline extracts, greenhouse, tomato, fruit quality.

604. EZZAHI Bahcine (Morocco)

Supervisors: I. Pertot and V. Simeone ; advisor: M. Perazzolli

Title: Effect of grapevine cultivar and abiotic stresses on the resistance induced by *Trichoderma harzianum* T39 against *Plasmopara viticola* under controlled conditions. - 75 p.

Abstract: Downy mildew caused by *Plasmopara viticola* is one of the most dangerous and destructive diseases affecting grapes and causing significant damages and yield losses. In order to improve the biological control against the

disease based on the induction of grape resistance by *Trichoderma harzianum* T39, 14 grapevine varieties were pretreated and inoculated with the pathogen. Results showed that pretreatment with *T. harzianum* provided protection to 011 varieties by activating induced systemic resistance (ISR) against *P. viticola* similarly 10 Benzothiadiazole (BTH) and copper. In order to characterize the efficacy of ISR under abiotic stress conditions, plants of *V. vinifera* cv Pinol Noir were exposed to different stress, then pretreated and inoculated with the pathogen. Results demonstrated that the exposure of plants to high temperatures, drought or both can slightly affect the level of ISR, causing a reduction of local and systemic efficacy of *T. harzianum* T39 and BTH against downy mildew.

Keywords: Biocontrol grapevine, ISR, SAR, *Plasmopara viticola*, *Trichoderma harzianum*, BTH, abiotic stress.

605. HMID Amine (*Tunisia*)

Supervisors: U. Aksoy and L. Al-Bitar

Title: Effect of soil-building crops and fertilization on organic radish production under Mediterranean conditions: the case of Southern Italy. - 65 p.

Abstract: Crop rotation, including the use of leguminous fertility-building crops as pre-crops, is the main mechanism for nutrient supply within the organic systems. Furthermore, the use of adequate organic fertilization is necessary to promote the organic crop production. This research aims to characterize the most suitable crop rotation scenarios for vegetables in southern Italy. The effect of pre-crops (faba bean, vetch, broccoli and fallow) and organic fertilizers (compost tea and commercial fertilizers) were tested on radish performances planted as subsequent crop. Treatments were arranged in a split plot design with four replicates. The two factors were the soil -building crops as primary factor and fertilization as secondary factor. Soil building pre-crops showed significant effects on soil electrical conductivity, available phosphorus, C/N ratio, exchangeable potassium and radish yield. Radish fertilized with compost tea after fallow gave the highest gross margin due to the lowest variable costs.

Keywords: crop rotation, soil-building crops, commercial fertilizer, compost tea, gross margin, radish.

606. MECHRI Mouna (*Tunisia*)

Supervisors: M. Ben Khedher and V. Verrastro

Title: Effect of pre-crops and fertilization on organic onion production under Mediterranean conditions: the case of Tunisia. - 78 p.

Abstract: This research was carried out to study the effects of pre-crops (fennel, pea, faba bean, and fallow as control) on onion crops fertigated with commercial fertilizer and compost tea. After the pre-crops incorporation, soil organic matter (SOM), organic carbon (OC) and nitrogen content increased. Pea plots expressed the highest SOM, OC and P content. After the main crop cycle, both thermophilic and mesophilic bacteria proved to be significantly affected by the interaction between pre-crops and fertilization, with the highest number of colonies obtained with faba bean plots fertigated with compost tea. Plant growth parameters and chemical analysis did not differ significantly between treatments. The highest gross margin was registered with faba bean-onion rotation fertilized by commercial organic fertilizers.

Keywords: Soil fertility, compost tea/commercial fertilizers, pre-crops, onion, gross margin.

607. OZSOY Nazire (Turkey)

Supervisors: U. Aksoy and L. Al-Bitar

Title: Effect of pre-crops and fertilization on organic eggplant production under Mediterranean conditions: the case of *Turkey*. - 50 p.

Abstract: Organic agriculture feeds the soil by different operations which have their main effects generally on the long term. Organic practices, including crop rotation, are expected to enhance soil life and soil health. In this study, effects of different pre-crops (vetch, faba bean and broccoli) and fallow with two different fertilization strategies (compost tea and commercial fertilizer) on organic eggplant production and on soil fertility were evaluated. The main aim of the experiment was to identify the most suitable rotation program in organic farming for *Turkey*. The highest eggplant yield was obtained following vetch in pre-crop cycle and in the subplots with commercial fertilizer. Results obtained during four years of the experiment were evaluated in respect to soil nitrogen (N), phosphorus (P), potassium (K), and organic matter (OM) content. Soil total N contents displayed an increase in all treatments in opposition to soil aM, P and K contents that showed a slight decrease over four years. Eggplant after faba bean fertilized with commercial fertilizer gave the highest gross margin due to higher total revenues.

Keywords: organic agriculture, soil fertility, crop rotation, organic fertilizers, eggplant, gross margin.

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629. ISMAILI Klodian (*Albania*)

Supervisors: R. Lovino, V. Simeone and F. Lamaj

Title: Postharvest treatment and quarantine procedure on organic table grapes (*Vitis vinifera* L.) cv Italia to control *Botrytis cinerea* (De Bary) Whetzel and *Ceratitis capitata* (Wiedemann) during shelf life. – 60 p.

Abstract: The export of organic table grapes to new potential markets is limited by the presence of *Ceratitis capitata* (Wiedemann). Application of cold treatment at $1 \pm 0.5^{\circ}\text{C}$ for 11 days was performed as quarantine treatment against MFF; unfortunately, cold storage is not able to control postharvest diseases caused by *Botrytis cinerea*. In order to control the grey mould, grapevines of Italia cultivar were treated with continuous O_3 (0.8 - 1.2 ppm) and high concentration of CO_2 (30% for 48 hours), and stored at $0 \pm 0.5^{\circ}\text{C}$ for 27 days and at 12°C for 2 more days. Our results show that it takes more than 11 days to achieve complete mortality, first-instar larvae are the most tolerant to cold treatment and pupae are the most susceptible. The development of *B. cinerea* showed no differences among treatments; whereas, O_3 significantly reduced the micro-flora on the berry skin and CO_2 increased the volatile contents without damaging the quality.

Keywords: *Ceratitis capitata*, *Botrytis cinerea*, quarantine cold treatment, cold storage, ozone, carbon dioxide.

630. MAGHAWRY Ghadir Abd El-Aziz (*Egypt*)

Supervisors: C. Coccozza and V. Verrastro

Title: Influence of different organic substrates on the growth of citrus rootstocks (Troyer Citrange and Sour Orange). – 62 p.

Abstract: Organic nursery production is based on growing media allowed in organic farming. An organic substrate for citrus seedlings has been developed mixing commercial "organic" compost (C1 ECOS) with several other components at MAI-Bari. The aim of this thesis has been the substitution of C1 ECOS compost with composts based on farm residues. Thus, compost made of manure and olive pruning (C3) and another coming from food and green residues (C4) were compared with C1 ECOS. A greenhouse experiment was done to investigate the effect of these substrates on two citrus rootstocks seedlings production (Troyer Citrange and Sour Orange). Citrus plants have been checked for growth parameters (plant height, stem diameter, chlorophyll level, leaves number, root, aerial and total dry weights) and the substrates have been investigated for physical and chemical characteristics. According to results, C4 can be considered a good substitute of C1 ECOS in the growing media preparation for citrus nursery.

Keywords: organic farming, citrus, troyer citrange, sour orange, nursery, compost, growing media.

631. MOHAMED Mohamed Sayed Mostafa (Egypt)

Supervisors: A. Abdel Aziz, F. M. Santucci and G. Cardone

Title: Technical and economic aspects of chamomile under organic and conventional management in Fayoum region (Egypt). – 96 p.

Abstract: Egypt has an appropriate environment for the cultivation of many medicinal and aromatic plants of vast economic potential all over the world. A very important crop is German Chamomile, *Matricaria chamomilla*. This study compares the economic aspects of chamomile organic and conventional farms in Fayoum governorate over the growing season 2010 - 2011 in terms of productivity, land use, labor use, production costs, net income and profitability. As indicated in the conclusions further researches have to be done in the future. This study reveals that there is hardly any difference between the agricultural practices applied to the chamomile production in large and small conventional farms or in organic farms in Fayoum area (Egypt). Some minor differences have been only found in both large conventional and organic farms, regarding pest control, machinery use, irrigation times, etc. Large conventional farms achieve higher yields than small conventional farms, because of the better organization and the solid experience in chamomile production. Despite lower yield and slightly higher variable costs for the organic farms, the output, gross margin and profit for organic farms are higher than for conventional farms, mainly because of the premium prices paid for organic chamomile and other by-products.

Keywords: medicinal and aromatic plants, organic chamomile, conventional chamomile, labor demand, gross margin, profitability.

632. MIHRETEAB Habte Tsehaye (Eritrea)

Supervisors: F. G. Ceglie and F. Tittarelli

Title: Rock phosphate enriched compost as a component of growth media for organic tomato (*Solanum lycopersicum* L.) seedling production. – 59 p.

Abstract: Organic nursery production is facing problems related to peat substitution and sustainability of fertilization pattern allowed under organic rules. A three factorial greenhouse experiment was conducted to investigate the performance of tomato seedling on different compost-based growing media. The factors were: doses of compost (0%, 30% and 60% v/v), source of phosphorus (rock phosphate enriched compost or rock phosphate) and three levels of phosphorus (0g, 0.59g, and 1.18gP/kg). Different tomato seedling growth parameters were evaluated. Acceptable results were recorded till higher compost doses (60%). However, growth substrates with 30% compost showed the best seedling growth parameters regardless of the source and level of phosphorus enrichment. In addition growth substrates with 60% rock phosphate enriched compost produced better tomato seedlings than rock phosphate amended growth media with 60% green waste compost. Thus, at high compost doses, phosphorus, in rock phosphate enriched compost, become more available to tomato seedlings than direct rock phosphate application.

Keywords: rock phosphate enriched compost, growth media, rock phosphate, tomato seedlings, green waste compost.

633. SEBAALY Zeina (Lebanon)

Supervisors: B. De Gennaro and R. Callieris

Title: Market opportunities for organic olive oil in Lebanese restaurants. – 84 p.

Abstract: Dining out organically has become a global popular trend. Studies on consumers of organic food in restaurants as well as on the restaurateurs' perspectives on the adoption of organic food are still very limited in literature. In order to study the market opportunities of organic olive oil in Lebanese restaurants, an exploratory survey was conducted on 20 restaurants located in the city of Beirut, Lebanon, which investigated the consumers and managers' behavior regarding the use and consumption of organic olive oil. The results have shown a promising potential future for organic olive oil in Lebanese restaurants. Almost all managers are interested in using organic olive oil in their restaurants and 73% of consumers want to consume it and are willing to pay more for it.

Keywords: organic olive oil, consumer behavior, willingness to pay, restaurants.

634. BANANI Houda (Morocco)

Supervisors: I. Pertot, V. Simeone and M. Perazzolli

Title: Molecular characterization of defence mechanisms activated by resistance inducers against downy mildew in different grapevine cultivars. – 89 p.

Abstract: Downy mildew caused by *Plasmopara viticola* is one of the most destructive grapevine diseases worldwide. The biocontrol agent *Trichoderma harzianum* (T39) was previously shown to activate the induced systemic resistance (ISR) mechanisms in grapevine against *P. viticola*. T39 treatments caused a significant disease reduction in different grapevine varieties with different level of efficacy. The aim of this project is to improve the biological control against downy mildew based on induction of resistance on grapevine, by understanding the molecular mechanisms activated by the biological inducer T39 in comparison to the chemical inducer Benzoethiadiazole (BTH). Gene expression analysis of four defence-related genes (*PR-1*, *PR-2*, *PR-4* and *OSM-1*) demonstrated the effect of genetic variability on the molecular mechanism activated in response to the pathogen (*P. Viticola*), to the microbial T39 and chemical BTH inducers, in four grapevine cultivars. Different cultivars showed different levels of T39-induced resistance and specific expression profiles of the defence-related genes, demonstrating that T39 is a promising strategy in organic viticulture but should be applied on a highly responsive cultivar to maximize its effect.

Keywords: biocontrol, grapevine, *Vitis vinifera*, downy mildew, *Trichoderma harzianum* T39, gene expression, genetic variability.

635. MEHDI Mourad (Morocco)

Supervisor: L. Kenny

Title: The effect of compost and commercial organic fertilizer on soil fertility and zucchini growth and yield under greenhouse in Souss-Massa region (Morocco). – 42 p.

Abstract: The big challenge in organic vegetable growing under arid conditions is to solve problems linked to the lack of synchrony between crop needs and amount of nutrients released through fertilization. The aim of this experiment was to investigate the effect of compost and organic commercial fertilizer on soil fertility, growth and yield of zucchini grown under greenhouse in Souss-Massa, southern Morocco. By applying compost, we significantly decreased the soil pH and improved the soil organic matter content thanks to high organic supply by compost. According to obtained results, the highest yield of zucchini was 35.75 t/ha recorded under treatment T2 (50% of zucchini need as compost (C) + 50% of need as organic commercial fertilizer (CF)) followed by T1 (100% compost) with 33.49 t/ha, T3 with 32.01 t/ha (25% compost + 75% Commercial fertilizer) and T4 (100% Commercial fertilizer).

Keywords: zucchini, compost, commercial fertilizer, soil fertility, arid, vegetable crop.

636. JARRAR Mohammad (Palestine)

Supervisors: S. Dumontet and I. Civoski

Title: Short-term effects of organic amendments and fertilizers application on soil bacterial functional diversity, soil properties and tomato production. – 61 p.

Abstract: In this work, experimental field activities were divided into two phases. During the first phase, the functional capacity of soil microorganisms was evaluated. Seven different treatments were set up: unamended soil as control (CON), biochar (BCH), organic fertilizers (OF), combined application of biochar and organic fertilizers (BCH+OF), cattle manure and vineyard wood compost (MVC), dairy industry wastes and vineyard wood compost (DVC), and solid poultry slaughterhouse wastes and vineyard wood compost (SVC). After 80 days, soil samples were analyzed by *Biolog* technique using a new approach of sample dilutions with the objective of identifying the most conservative treatment in terms of biochemical activities of soil microflora. Results showed that MVC and DVC turned out to be the best performing treatments, as they were able to keep functional capacity of soil microorganisms at different dilutions. In the second phase, organic and/or mineral fertilizers were incorporated into the previous treatments (except CON and BCH) in order to achieve balanced N, P₂O₅, K₂O application rates for tomato production. Different fertilization scenarios significantly increased the yields over CON and BCH, maintaining fruit quality. Main soil chemical parameters remained invariable.

Keywords: carbon substrates, soil functional diversity, Biolog technique, fertilization scenarios, tomato production.

637. CRISOSTOMO Catarina (Portugal)

Supervisors: H. Moschitz, P. Pugliese and M. R. Bteich

Title: Organic farming policy network in Portugal. – 110 p.

Abstract: This study examines the network responsible for organic farming policy making in Portugal, using a formal network analysis approach based on a sociometric survey. The quantitative measures obtained are interpreted in light of a comprehensive overview of the organic sector development and its policy system, gathered purposely from official documents, academic and grey literature, and key informants. Results show that: (i) the network as a whole is relatively loose and not specially interested in organic farming policy; (ii) organic farming policy is markedly influenced by state institutions, while major organic farming organizations lack constituency support to be more influential in the policy making process; and (iii) organic and general farming are two different policy domains. Besides EU policies, the main factors influencing the current policy network are the dominant regime and interest of the state, the nature of policy and policy actors' strategies and resources. Finally, political strategies for key stakeholders with regard to further development of organic farming policy are outlined.

Keywords: organic farming policy, social network analysis, quantitative and qualitative approach, Portuguese organic sector.

638. DHAKER Hlayem (Tunisia)

Supervisors: M. Ben Kheder and V. Verraastro

Title: Effect of soil-building crops and fertilization on organic potato production under Mediterranean conditions at farm level: the case of Tunisia. – 69 p.

Abstract: Crop rotation, including the use of leguminous fertility-building crops as pre-crops, is a valuable mechanism for nutrients supply within organic systems. Additionally, the use of adequate organic fertilization is necessary to promote organic crop production. This research work aimed at testing a selected model of crop rotation for vegetables at farm level in Tunisia. The effect of pre-crops (faba bean, pea and fennel) and organic fertilizers (compost tea and commercial fertilizer) was tested on potato planted as subsequent crop. Treatments were arranged in a split block design with four replicates. The two factors taken into consideration were the soil-building crops as primary factor and fertilization as secondary factor. Soil-building pre-crops showed significant effects regarding soil pH, soil electrical conductivity and organic matter. However, no significant effects on potato yield and tuber commercial quality were recorded. Potato fertilized with a commercial product after fennel pre-crop gave the highest gross margin due to the lowest variable costs.

Keywords: crop rotation, soil-building crops, commercial fertilizer, compost tea, gross margin, organic potato.

639. ASLAN Hüsnü Burçay (Turkey)

Supervisors: U. Aksoy and L. Al-Bitar

Title: Effect of vetch – wheat mixture and broccoli as pre-crops on organic summer vegetables: on-farm trial in western Turkey. – 47 p.

Abstract: Organic farming requires the use of practices such as crop rotation, green manure and compost application instead of chemical compounds to enhance farm productivity. In this study, the effects of two pre-crops (vetch-wheat mixture and broccoli) and additional fertilization (AF) strategy (compost and commercial fertilizer) were tested on organic production of two main crops (tomato and zucchini) and on soil fertility. The main aim of this on-farm trial is to evaluate the applicability of the results obtained over four years study under experimental conditions. Pre-crops and AF strategy had no significant effect on zucchini yield; highest tomato yield was recorded after the application of vetch-wheat mixture and AF. At the end of the cycle soil organic matter statistically increased in vetch-wheat mixture with AF plots. Soil nitrogen (N) levels increased slightly in all treatments but this increase was not significantly different from the initial level of N. Vetch-wheat mixture and tomato rotation with AF provided the highest gross-margin due to a higher yield.

Keywords: organic agriculture, soil fertility, crop rotation, organic fertilizers, pre-crop, tomato, zucchini.

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663. ADMANE Naouel (*Algeria*)

Supervisors: S. Dumontet, V. Verrastro and D. Mondelli

Title: Short-term effects of organic amendments on soil chemical and biochemical indicators. – 70 p.

Abstract: The management of soil quality in organic agriculture is of paramount importance to preserve those soil functions that are able to sustain crop productivity and maintain environmental quality. This study was performed to investigate the short-term effects of different management strategies on soil quality. The experiment consisted of seven treatments: control mineral fertilizers (COV), residues of mushroom cultivation (MUS), olive mill wastewater (OMW), coffee chaff (COF), compost (COM), cow manure (MAN), and a legume (LEG). The soil quality was assessed before and after the application of treatments, through biological (microbial biomass carbon and nitrogen, soil respiration and metabolic quotient), biochemical (soil enzymatic activities: β -glucosidase, alkaline phosphatase (AP), urease, fluorescein diacetate (FDA) hydrolysis), and chemical (pH, soil organic carbon, soil organic matter, total nitrogen, available phosphorous, exchangeable potassium, dissolved organic carbon, total dissolved nitrogen) indicators. Interestingly, biochemical indicators showed the highest significant differences within treatments. β -glucosidase significantly increased in all treatments; AP was at its highest level in the LEG treatment; FDA significantly increased to reach the same level in COF, LEG and OMW; urease considerably increased in OMW. The highest total and marketable zucchini yields were obtained in COV followed by OMW. The soil chemical indicators remained unvaried. These results confirmed the importance of soil enzymatic activities as main sensitive indicators of soil quality changes.

Keywords: organic agriculture, soil quality, soil quality indicators, enzymatic activities, residues of mushroom cultivation, coffee chaff, olive mill wastewater.

664. SOLOMON Tesfamichael Mulugheta (*Eritrea*)

Supervisors: A. Benedetti, G. Calabrese and G. Ladisa

Title: Short-term effects of green cover on soil quality and biodiversity of Mediterranean organic olive orchards. – 108 p.

Abstract: Environmental quality can be positively or negatively affected by agricultural practices depending on cropping systems and farm conditions. Low-impact and cost-effective agricultural practices are required especially for monumental olive orchards, which represent a Mediterranean cultural heritage and are now under threat due to high costs of production. This work regards the impact analysis of organic and conventional soil management systems and the evaluation of two different grassing types: a commercial mixture and a natural cover in monumental olive orchards in Torre Guaceto (South Italy). The report contributes to achieve and collect further information about the short-term effects of grassing application on soil quality and biodiversity. Information on short-term effects of the grassing typology was achieved and a set of indicators and/or indexes, usually thought to be more sensitive to variations in soil parameters and biodiversity, were

tested in order to be used to monitor trends in similar surveys. Only a few physical and chemical parameters were found to be sensitive to variations in such a short time and almost all biological parameters showed differences between the management systems and the two grassing types. More time is needed to analyze the impact of grassing practices on soil quality and biodiversity and to test the set of indicators.

Keywords: grassing, organic olive orchards, sustainability, indicators, biodiversity.

665. AL-HORANI Ahmad (Jordan)

Supervisors: M. Schermer and P. Pugliese

Title: The role of National Action Plan in the development of the organic sector in Jordan. – 119 p.

Abstract: The recent growth of organic farming in Jordan highlighted the need to investigate what is happening now in Jordan. Thus, it was crucial to study the national action plan (NAP) for organic farming and its influences on the sector development. This study aimed to analyse the development of the organic sector and in addition to study the role of the national action plan on the organic sector. This study was based upon 20 semi-structured interviews with relevant stakeholders, a focus group with two groups of farmers, document and SWOT analysis. In this research it has been revealed that the NAP was not fully adopted and executed due to many obstacles and drawbacks. It has been realized that even though such an initiative was not fully adopted, organic farming has evolved and developed, but not up to the expectations and the ambitions of the proponents. Furthermore, it has been also discovered that the NAP had a limited role on the development of the organic farming sector, which has been pushed mainly by the royal family support and individual and institutional interest. However, this study goes beyond the NAP to the level of understanding how the entire sector works and how the different stakeholders act and interact with each other. The study has uncovered the different pitfalls and barriers that hampered the execution of the NAP. Therefore, this study can be used to reinstate and renaissance the implementation of the NAP in Jordan. Furthermore the results and recommendations can help to avoid barriers to the future implementation by providing a better understanding of supporting and hampering factors.

Keywords: Jordan, organic agriculture, action plan.

666. JASIM Shuhub (Iraq)

Supervisors: G. Anfora and I. Pertot

Title: Reproductive behaviour of *Drosophila suzukii* (Matsumura) and the potential innovative and safe control techniques. – 72 p.

Abstract: *Drosophila suzukii* is a highly polyphagous invasive pest native of Southeast Asia that has recently invaded western countries and Europe. Since its serrated ovipositor allows it to lay eggs on healthy, unwounded ripening fruits, it is considered to be a serious threat to fruit production. *D. suzukii* presence in Europe is rapidly spreading and has now been reported in nine countries. The development of environmentally-safe control methods is of paramount importance to protect the fruit industry concerned. Hence, the aim of this study was to characterize and identify the volatiles of the host plants of *D. suzukii*, which influence its olfactory behaviour, in order to set up management strategies based on the use of semiochemicals. Moreover, the insect biology was observed under laboratory

conditions, showing the presence of a vibrational communication coupled with the influence of food odours on sexual activity. The olfactory responses of adult flies to the odour released by whole host fruits in behavioural assays were evaluated. *D. suzukii* females showed to be attracted by the volatiles emitted from tested fruits. Volatile compounds released by host fruits were extracted and identified (GC-MS), and their biological activity on *D. suzukii* females was screened through electrophysiological analysis (GC-EAD).

Keywords: spotted wing *drosophila*, semiochemicals, kairomones, GC-EAD, mating behaviour.

667. BOU ZEIN ELDEEN Sereen (Lebanon)

Supervisors: T. Atallah, L. Al Bitar and Z. Al Chami

Title: Decomposition of olive mill waste compost, goat manure and *Medicago sativa* in Lebanese soils using the litterbag technique. – 74 p.

Abstract: Organic amendments, green manure and plant residues incorporated into the soil are the main source of organic carbon and nutrients in organic farming. Their decomposition rate is crucial for accumulation and long-term storage of organic matter in soils. The decomposition rate is strongly regulated by the chemical composition of the organic materials and the pedoclimatic conditions. In this study, the decomposition of compost from olive mill waste, goat manure and *Medicago sativa* (Alfalfa) was followed in Lebanese soils using the litterbag technique. Mass losses, carbon turnover and nutrients release were evaluated through winter and springtime in three Lebanese soil types on the basis of the decomposition rates. A rapid mass loss was found in Alfalfa shoots and roots 30 days after incorporation. Manure and compost were more persistent. Labile forms of carbon and nitrogen were released during the first few weeks after incorporation. Moreover, C/N ratio cannot be used as unique parameter to predict the decomposition rate. Other parameters should be determined such as the humification rate. Pedoclimatic conditions played an important role in the organic matter decomposition, with a greater release in well-drained soils.

Keywords: organic amendments, carbon turnover, nutrients release, humification index, Lebanese pedoclimatic conditions

668. AZZI Loubna (Morocco)

Supervisors: R. Di Cagno and I. Cavoski

Title: Exploitation of the health-promoting and sensory properties of organic pomegranate (*Punica granatum* L.) juice through lactic acid fermentation. – 75 p.

Abstract: Two strains of *Lactobacillus plantarum* (POM1, C2), which were previously isolated from tomatoes and carrots, and another commercial strain of *L. plantarum* (LP09), were selected as starters to singly ferment organic pomegranate juice (PJ) under standardized protocol. PJ was further stored (4°C, 30 days). Filtered PJ, without starters (unstarted PJ), was used as control. All starters grew after fermentation. Viable cells of LP09 sharply decreased during storage while the two other strains survived. Lactic acid bacteria consumed glucose, fructose, malic acid, and amino acids. The concentration of free fatty acids increased for all started PJ. Compared to unstarted PJ, color and browning indexes of fermented PJ were preferable. The concentration of total polyphenolic compounds and antioxidant activity were the highest for started PJ. Fermentation increased the concentration of ellagic acid, and enhanced the antimicrobial activity. Fermented PJ scavenged the reactive oxygen species generated by H₂O₂ and modulated the synthesis of immune-mediators from peripheral blood mononuclear cells. Unstarted and fermented PJ inhibited the growth of K562 tumor cells. The sensory attributes of fermented PJ were preferred. The fermentation of PJ would represent a novel technology option which joins health-promoting, sensory and preservative features to exploit the potential of pomegranate fruits.

Keywords: organic pomegranate, lactic acid bacteria, ellagic acid, antioxidants, PBMC cells

669. WIECZYNSKA Justyna (Poland)

Supervisors: R. Lovino and F. Lamaj

Title: Pre and post-harvest treatments to complement the standard cold treatment against *Ceratitis capitata* (Wiedmann) and their effects on marketable quality of organic table grapes (*Vitis vinifera* L.) cultivar Italia. – 64 p.

Abstract: *Ceratitis capitata* is one of the most destructive agricultural pests worldwide. The establishment of a quarantine protocol for organic table grape cv Italia is essential to have access to foreign markets. An experiment for mortality assessment of *Ceratitis capitata* was carried out in a container at 0°C. Results showed that it took 9 days in total to achieve complete mortality of *Ceratitis capitata*, while it took 8 days when cold treatment had been combined with CO₂ (30% for 48h) and O₃ (0.8-1.2 ppm) application. Since during shipping the grape quality might decrease due to the development of *Botrytis cinerea*, in order to control it, table grapes were stored in a cold room (0° C and 90-95% RH) for 28 days and treated with continuous O₃ (0.8 - 1.2 ppm), or with a combination of CO₂ (30% for 48 hours) and O₃ after field treatment with KHCO₃ and packaging in perforated polypropylene bags. Pre-treatments with KHCO₃, CO₂ and O₃ prevented the development of *B. cinerea* and preserved the good commercial quality up to 28 days of storage plus 1 day of shelf-life (12° C).

Keywords: quarantine, post-harvest treatments, *Botrytis cinerea*, ozone, carbon dioxide, organic farming

670. DIAB Ahmed (Syria)

Supervisors: B. De Gennaro and R. Callieris

Title: Export potential for the Syrian organic olive oil. – 72 p.

Abstract: Despite a significant increase of the supply and demand of organic extra virgin olive oil in the world, still there are few studies investigating the export potential of this product in the developing countries. In order to study the possibility of exporting the Syrian organic extra virgin olive oil to international markets, exploratory interviews were conducted with the main Syrian exporters of conventional and organic extra virgin olive oil by using the case study methodology. In addition, data about the Syrian position in the international market were collected from international trade statistics databases (Faostat, Uncomtrade, Ioc and Eurostat). Results showed there is export potential for Syrian organic olive oil. Syrian exporters expect a significant increase in the production of organic extra virgin olive oil and they are strongly motivated to export this product mainly to Germany, Gulf States, Venezuela, India, and China. Main problems are the cost of certification and lack of marketing experience. Further efforts by the Syrian government are necessary to support the development of the organic sector as a key factor for improving both domestic food security and food trade balance.

Keywords: organic olive oil, case study, export potential, Syria

671. BEN AMARA Mouna (Tunisia)

Supervisors: F. Tittarelli and F. G. Ceglie

Title: Alternatives to peat in growing media for organic vegetable seedlings production: an analysis by mixture design experiment. – 77 p.

Abstract: Compost (C) and palm fiber (F) were mixed with peat moss (P) to formulate ten mixtures for organic vegetable seedlings production. Mixture design experiment (Simplex-lattice) was used to define the substrates (C90F0P0, C0F0P90, C0F90P0, C45F45P0, C45F0P45, C0F45P45, C15F60P15, C60F15P15, C15F15P60, C30F30P30). Before blending, raw materials were analyzed for chemical parameters and were tested for phytotoxicity. Mixtures were prepared with 90% organic component (C, F, P) and 10% perlite on volume basis and they were characterized physicochemically. Three trials were carried out in the experimental greenhouse of the Mediterranean Agronomic Institute of Bari (MAIB) on three crops: melon (*Cucumis melo* L.), tomato (*Solanum lycopersicum* L.) and lettuce (*Lactuca sativa* L.). Thirty days after sowing, seedlings biometric parameters were measured to investigate each species performance. The root qualitative characteristics (color, density, thickness) were assessed and the shoot nutrient content (N,P,K) was also determined. Results showed the best growth performance for tested species grown in mixtures with an organic component rate of 15%- 30% for C, 15%-60% for F and 15%-60% for P. Moreover, a peat-free growing medium (C45F45P0) gave satisfactory results for melon and tomato seedlings.

Keywords: palm fiber, compost, peat substitution, seedlings performance.

672. KON Halil Ibrahim Firat (Turkey)

Supervisors: S. Naspetti, U. Aksoy and M. R. Bteich

Title: Analysis of the organic data collection system in Turkey: a focus on trade data quality. – 100 p.

Abstract: Valid, accurate and up-to-date statistical data are indispensable for agricultural policies and strategies development. Since 1995 in *Turkey*, organic data collection has become a task of the competent authority for organic agriculture, the Ministry of Food, Agriculture and Livestock (MFAL). In 2005 MFAL implemented an Internet-based software, organic farming information system (OFIS), to collect data through direct entries from inspection and certification bodies. The Aegean Exporters' Association (AEA) has been involved since 1996 in organic export data collection through E-BIRLIK software. Despite the available data, there is a gap between the two sources' export data and local market data still lack. This work describes and analyses the current Turkish organic data collection system (DCS) by identifying its actors and their roles, and assesses the quality of the existing datasets. Semi-structured interviews have been conducted to investigate and study the DCS. EUROSTAT quality dimensions are used to assess the system data quality. Despite the easy access, timeliness and punctuality of data, the Turkish organic DCS shows poor quality data mainly at trade level. Accuracy, comparability and reliability are the main proven weaknesses of the system.

Keywords: data collection system, export data, data quality, accuracy, comparability.

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701. ÇURRI Nertila (*Albania*)

Supervisors: I. Cavoški and R. Di Cagno

Title: Exploitation of Albanian *durum* and *aestivum* wheat flours for sourdough fermentation. – 64 p.

Abstract: This study aims at characterizing the biochemical, rheological and microbiological composition of the Albanian *Triticum aestivum* (cultivars Dajti, Progresi, Linja 7, Shumzim 21 and LVS) and *Triticum durum* (STF 24) flours and at exploiting their potential for sourdough fermentation. The main chemical composition and the rheological properties of Albanian wheat flours were similar to other common wheat cultivars. As shown by a two-dimensional electrophoresis analysis, *durum* wheat cultivar STF24 differed from the others for the abundance of polypeptides higher than 46 kDa (ω -gliadins). STF24 flour was also different due to its biochemical and rheological properties. Wheat flours were back-slopped for 10 days (25° C for 8h) and spontaneous sourdoughs were obtained. *Lactobacillus plantarum*, *Leuconostoc citreum*, *Leuconostoc mesenteroides*, *Pediococcus pentosaceus* and *Lactococcus lactis* were the dominant species. Based on the protechnological properties of the isolated lactic acid bacteria, two mixed starters for *durum* and *aestivum* wheat flours were selected. With respect to spontaneous sourdough (without bacterial inoculum), the sourdough pre-fermented with selected starters showed better nutritional, functional and sensory properties. As demonstrated by the Principal Component Analysis, started sourdoughs are clearly differentiated; especially those produced with STF 24, LVS and Progresi flours.

Keywords: Albanian wheat flours, sourdough, lactic acid bacteria, autochthonous starters.

702. MADZARIC Suzana (*Bosnia and Herzegovina*)

Supervisors: J. Calabrese, G. Ladisa and A. Aly

Title: Effects of different soil cover management practices on plant biodiversity and soil properties in Mediterranean ancient olive orchards. – p. 109.

Abstract: The Mediterranean basin is one of the thirty-four biodiversity hot spots on Earth characterized by the presence of Ancient Olive Orchards (AOOs). Natural value, environmental quality and cultural heritage linked to extensive farming practices would allow characterizing them as "High Natural-Value Farmlands". Due to the simplification of agricultural practices aimed at decreasing production costs, the practice of leaving the soil bare is widespread in Mediterranean AOOs. Consequently, degradation of soil quality and reduction of plant biodiversity are increasing. Since 2009, some of these monumental olive groves have been under survey and some alternative practices have been proposed to protect soil and biodiversity. "Grassing" is one of these practices based on covering the soil with selected autochthonous plant species. This research, started in 2011, aims (1) to further investigate whether organic farming practices are able to improve soil quality and plant biodiversity in Mediterranean AOOs and (2) to define a minimum indicators' set to evaluate the effectiveness of different agricultural practices in environmental performance (MDS). A comparison was done over two years of

survey (2011-2012 and 2012-2013) considering two management systems (conventional vs. organic) and three agricultural practices: conventional with bare soil (CON), organic with soil covered with selected native species (MIX) and organic left with native vegetation (NAT). 2013 results confirmed the indicators selected in 2012. A few soil quality indicators showed responsiveness in describing the effects of management systems and practices on biodiversity and soil properties. In general, a clear positive influence of the organic management system was appreciated. No clear differences resulted between the two organic practices of soil management (natural cover and grassing).

Keywords: organic agriculture, ecological indicators, agricultural practices, sustainability, olive groves.

703. HASHEM Shadi (Egypt)

Supervisors: P. Pugliese, C. Rota and C. Zanasi

Title: Supply chain collaboration. Analysis of the relationship between the lead company and its contracted farmers in the organic and fair trade cotton supply chain in Egypt. – p. 111.

Abstract: The aim of this paper is to propose an instrument to measure the extent of collaboration between garment producers and contracted farmers within an organic and fair-trade cotton supply chain based on the conceptual framework proposed by Simatupang and Sridharan's (2005) "collaboration index". The index incorporates collaborative practices in three main dimensions: information sharing, decision synchronization and incentive alignment. The study has been carried out in Egypt and focuses on the Egyptian organic and fair-trade garment supply chain, led by "Naturtex" which belongs to the holding "Sekem". Qualitative and quantitative surveys were conducted. The qualitative survey, based on documentary analysis and semi-structured interviews, was conducted with the "Sekem" company managers to explore the company business relations with its contracted farmers. As regards the quantitative survey, the contracted farmers (16 farmers who account for 64% of the total) were interviewed through a structured questionnaire to assess the validity and reliability of the newly modified instrument; furthermore, a factor analysis was performed to this end. Results show that: (i) the study has developed a reliable and valid instrument to measure the extent of collaboration between the company and its contracted farmers; (ii) The company "Naturtex" has an average level of collaboration with its contracted cotton farmers.

Keywords: supply chain collaboration, qualitative & quantitative organic approach, fair-trade, Sekem, Naturtex, Egypt.

704. DAGNACHEW Ababu Yirga (*Ethiopia*)

Supervisors: D. Mondelli and S. Dumontet

Title: Short-term effects of different organic amendments on soil chemical, biochemical and biological indicators. – p. 70.

Abstract: Field experiments were carried out to investigate the effects of common and alternative soil amendments on soil quality by using chemical, biochemical and biological soil indicators. A complete randomized block with four replicates was chosen as experimental design. Treatments included alternative organic amendments (olive mill wastewater, residues from mushroom cultivation and coffee chaff), common soil amendments (compost, faba bean and cattle manure) and a mineral fertilizer as reference. Results showed all treatments were able to improve some of the soil chemical properties (pH, EC, organic C content, total N, available P and exchangeable K) compared to control soil. The incorporation of coffee chaff and olive mill wastewater seemed to be more effective in improving soil total N and exchangeable K, while cattle manure significantly increased available P. Both groups of soil amendments enhanced dissolved organic C, soil respiration and microbial biomass metabolic quotient. Results concerning soil enzymes revealed that phosphatase and β -glycosidase were significantly reduced, while urease activities and fluorescein diacetate (FDA) hydrolysis were improved in all amended soils with respect to the control, regardless of the amendment type. In conclusion, both groups of soil organic amendments similarly behave in enhancing some of the soil properties described by the soil quality indicators used here. The alternative soil organic amendments could be candidates to replace some commonly used ones, which are showing supply shortage and quality reduction.

Keywords: organic amendments, soil quality indicators, soil enzymes, soil microbial biomass.

705. ALTAWARAH Sahim (*Jordan*)

Supervisors: F. Lamaj and F. Baldacchino

Title: The vine mealybug *Planococcus ficus* (Signoret) on organic table grapes and possibility of rearing the parasitoid *Anagyrus pseudococci* (Girault). – p. 81.

Abstract: The vine mealybug *Planococcus ficus* (Signoret) has recently been recognized as the most destructive pest on organic table grapes. To develop optimal monitoring systems for supporting control programs also based on the action of natural enemies, in 2012/2013, at MAI-Bari (Southern Italy), the bioethology and distribution of *P. ficus* were monitored and the presence of its natural enemies was detected. *P. ficus* and its parasitoid *Anagyrus pseudococci* (Girault) were reared at MAIB insectarium. *P. ficus* was found to be the dominant mealybug in the experimental field, where it overwintered as fertilized female. Until the end of August 2013, observations clearly showed the presence of 3 generations. These observations were confirmed by flight performance of males and by the presence of different stages during the year. The pest was found to infest the host in its crawling stage during 3 specific periods (mid-April to mid-May, mid-June to mid-July, all August). As this particular stage is the most sensitive to control measures, such a finding may help organize pest management schedules. Moreover, *Anagyrus pseudococci* was the only parasitoid found. The pest and parasitoid rearing at MAI-Bari will be carried out to set up future biological control programs.

Keywords: bioethology, vine mealybugs, *Anagyrus pseudococchi*, biological control, organic table grape, rearing.

706. AL-FADHEEL Sadeq Hanoon Bayesh (Iraq)

Supervisors: V. Verrastro and L. Tarricone

Title: Effects of irrigation management practices on quantitative and qualitative characteristics of organic table grapes. – 82 p.

Abstract: Irrigation management is considered a key element contributing to enhance and sustain plant health and improve crop water productivity (CWP) and crop quality. This is especially true in organic agriculture where preventive methods are crucial. Regulated Deficit Irrigation (RDI) strategy can help improve the microclimate of vineyards, through the control and reduction of the vegetative growth, providing good air circulation and sunlight penetration. Thus because organic table grape faces many difficulties with pest and diseases that obstacles the conversion to organic farming. The present study evaluates the effects of two different water regimes (V1 and V2) on vine eco-physiological leaf functioning, berries growth and quality of organic table grape (cv. "Victoria"); corresponding respectively to 100% and 75% of restitution of water lost by evapotranspiration (ET_c) from berry set to harvest. Results showed that (V1) favored canopy development and induced an increase in vegetative and productive growth, while (V2) appeared to be sufficient to achieve a complete organic table grape development. The best balance among vegetative growth, grape yield, berry quality and crop water productivity, was obtained in (V2) vines, with a significantly higher berry total soluble solids (°Brix) content and water productivity compared to (V1) vines.

Keywords: organic farming, regulated deficit irrigation (RDI), "Victoria", berry quality, evapotranspiration, water productivity.

707. AL-KHAFAJI Ahmed Abdulhamza Kadhim (Iraq)

Supervisors: G. Cardone and F.M. Santucci

Title: Technical and economic feasibility of organic dates production in Iraq. – 122 p.

Abstract: Date palm is the major crop in Iraq and it is linked with the history of this country. This study investigates the potential conversion of Iraqi palm farming to organic agriculture. There are five major producing provinces. Nevertheless, we focused on three provinces only, i.e. Baghdad, Babylon and Karbala, and excluded the other two for communication difficulties and safety problems not allowing us to conduct our study there. This study collects data to explain the present conventional (traditional) date palm management in Iraq and advises changes to boost conversion to organic agriculture. Then we estimated the crop budget of each agricultural system (conventional and organic) and made comparisons. We also conducted an experts' survey to identify the main technical, economic, ecological and social constraints that are currently affecting the sector. This step gave us a clear idea of the existing problems and the extent of their impact on our work in the perspective of conversion. Furthermore, an experts' survey was carried out to implement the SWOT analysis identifying strengths and weaknesses of the current status of the Iraqi date palm sector and their impact on the potential conversion. This thesis revealed conversion from conventional to organic could be technically easy, applicable and profitable. The SWOT analysis showed this conversion is socially accepted by Iraqi stakeholders. This thesis provides a quite exhaustive

review of date palm in terms of origin, global geographical distribution, climatic needs, national and international statistical data and domestic conventional management in Iraq.

Keywords: date palm, organic agriculture, feasibility of organic date, crop budget, SWOT analysis.

708. OUANTAR M'barek (Morocco)

Supervisors: N. Baser and G. Anfora

Title: A survey of parasitoids of *Drosophila suzukii* in Italy for the development of biological control strategies. – 59 p.

Abstract: Unlike most other *Drosophila* species, the invasive pest *Drosophila suzukii* (Matsumura), from Southeast Asia, shows a remarkable destructive behaviour on its host fruits. *D. suzukii* was reported for the first time in Trentino in 2009, whereas we found it for the first time in Apulia in October 2012. Afterwards, a survey of indigenous parasitoids of *D. suzukii* was carried out in Trento and Bari (Northern and Southern Italy, respectively) for the development of biocontrol strategies. In Bari, the highest densities of *D. suzukii* population were recorded in autumn when adults showed a peak of presence (23%) among samples individuals. In Trento, such peak occurred at the end of July and August, when captures of *D. suzukii* individuals were nearly 100%. The parasitoids *Pachycrepoideus vindemiae* (Rondani) and *Leptopilina heterotoma* (Thomson) were collected from both *D. suzukii* and *D. melanogaster* pupae in the field. This finding represents the first identification in Europe of parasitoids having *D. suzukii* as target. Subsequently, experiments done under controlled conditions tested the parasitism efficacy. These tests confirmed that both *P. vindemiae* and *L. heterotoma* are able to successfully parasitize *D. suzukii* (50% and 24% parasitism, respectively).

Keywords: biological control, *Drosophila suzukii*, *Drosophila melanogaster*, *Leptopilina heterotoma*, *Pachycrepoideus vindemiae* (Rondani), parasitoids.

709. KULLAB Yazan (Palestine)

Supervisors: F. G. Ceglie and F. Tittarelli

Title: Organic farming systems comparison for strawberry production in Mediterranean greenhouses. – p. 50.

Abstract: A crop rotation experiment under organic greenhouse conditions is ongoing at MAIB (South of Italy) to evaluate three organic farming production systems based on different fertility management strategies. The present research focused on the first year of rotation (June 2012 – May 2013). Mixtures of cover crops were introduced in summer and then followed by strawberry (*Fragaria × ananassa* L., var. 'Festival'). Strawberry was cultivated according to three different organic production systems: (1) SUBST, where nutrient requirements are met by 100% off-farm organic fertilizers; (2) AGROMAN, which is based on animal manure and cover crops (MIX2); (3) AGROCOM, which is based on on-farm compost and cover crops (MIX3). Soil was sampled at transplant, flowering, harvesting, and at the end of cycle to analyze soil mineral nitrogen. Nitrate concentration was determined from the soil solution sampled below root level to assess nitrate leaching. Simplified nutrient (N, P, K) budgets were calculated based on inputs and outputs of each system. No significant difference yield was obtained by each systems. SUBST showed significantly higher N use and recovery efficiency than in both AGROMAN and AGROCOM. In AGROMAN and AGROCOM, soil organic carbon

content significantly increased at the end of the strawberry productive cycle respect to the beginning of the experiment.

Keywords: organic greenhouse production, crop rotation, cover crops, compost, animal manure, organic commercial fertilizers.

710. ALWANNEY Deaa (Syria)

Supervisors: Z. Al Chami and F. P. Fanizzi

Title: Bio-effectors from waste materials as growth promoters: an agronomic and metabolomic study. – 88 p.

Abstract: Nowadays, improving plant performance by providing efficient growth promoters is a major concern for organic agriculture. Agro-food industry residues are promising materials as bio-effectors. Three plant materials, i.e. brewer's spent grains (BSG), fennel processing residues (FPR), and lemon processing residues (LPR) were chosen as bio-effector candidates. Raw materials were characterized, solvent choice was defined using yield as main factor, and optimum extraction ratios were determined using the phytotoxicity test as main constraint. Furthermore, selected extracts were characterized, metabolite profiling was done using nuclear magnetic resonance (NMR), and extracts were applied on tomato in a growth chamber at different doses in comparison to humic-like substances as positive control (Ctrl+) and Hoagland solution as negative control (Ctrl-). NMR-metabolomic profiling was conducted on tomato. Results are summarized as follows: (i) raw materials are rich in nutrients, (ii) aqueous extraction resulted in a higher yield than other solvents used; (iii) at a high extraction ratio extracts are not phytotoxic; (iv) all aqueous extracts are differently rich in nutrients, aminoacids, sugars and low molecular weight molecules; (v) all extracts exhibited growth promotion properties at low application doses; (vi) regarding plant metabolomics, all treatments showed different metabolites with respect to Ctrl-treatment. BSG, LPR and Ctrl+ treatments had a similar metabolic profile.

Keywords: bio-effectors, metabolomics, nuclear magnetic resonance, barley, fennel, lemon, tomato.

711. BRAHIM Sahar (Tunisia)

Supervisors: R. Callieris, B. De Gennaro and R. Roma

Title: The profile of Tunisian organic food consumers. – 81 p.

Abstract: Although organic farming has witnessed a big evolution in the last decade in Tunisia, this sector is still in its infancy at local level because most organic production is export-oriented towards Europe and there are no reliable statistics on domestic organic demand. The purpose of this research was to analyze organic food consumption in Tunisia and carry out market segmentation to identify marketing strategies that satisfy organic food consumers' needs. To that end, in March-April 2013, a quantitative and descriptive study was carried out among 447 people in Tunis and Sousse. Data were analyzed using descriptive statistics and K-means clustering. Four clusters were identified: "Organic consumers", "Careful organic consumers", "Sporadic organic consumers" and "Non-organic buyers". Implications for marketing strategies to promote organic food include: focusing on quality, health and safety, family care, advertising and product availability in conventional food stores for "Organic consumers", and emphasizing the quality/price ratio and product availability in specialized organic shops for "Careful organic consumers". By contrast, for "Sporadic organic consumers", it is necessary to improve organic knowledge, price and quality.

Keywords: consumer, cluster analysis, Tunisia.

712. ŞAHİN Meltem (Turkey)

Supervisors: M. R. Bteich, U. Aksoy and S. Naspetti

Title: Towards better organic exports data in Turkey: an analysis of the Aegean region. – p. 101.

Abstract: Access to accurate and up-to-date information is crucial to become efficient and competitive in international markets. In Turkey, the Aegean Exporters' Association has been collecting official organic export data since 1996 and organizing them through E-BİRLİK software since 2009. However, released data do not reflect the real export of organic goods in Turkey. This study analyzes the major bottlenecks. The main causes of the presence of unreliable data and of the non-declaration of organic exports were investigated by surveying a group of organic exporters in the Aegean region. The barriers and the end-users demands on the Data Collection System were identified to help decision-makers improve the system. The main reasons explaining for the non-declaration of organic exports are the structural complexity and ambiguity of E-BİRLİK software. Besides, neither bonus nor fines exist for declaration or non-declaration. The most important barrier is the "insufficiency of state aids and incentives for organic export".

Keywords: Data Collection System, data quality, export barriers, Turkish organic products, control and certification bodies.

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727. TURK Jelena (*Bosnia and Herzegovina*)

Supervisors: R. Di Cagno and I. Cavoski

Title: How durum wheat (*Triticum turgidum* spp. *durum*, cultivar Senatore Cappelli) production systems affect overall quality, sourdough biotechnology and bread properties. – 63 p.

Abstract: The main goal of organic farming is the “production of high quality products”. Integrity and vital quality of products should be preserved along the entire production chain. In order to evaluate the effect of organic vs. conventional production systems on wheat flour characteristics, sourdough (leaving agent) biotechnology and on bread properties, the “from field to fork” experiment has been carried out. As expected, production systems influenced the protein quality and the rheological and functional properties of wheat flour. In particular, the organic method assured higher overall quality compared to the conventional one. Sourdough was used as traditional leavening agent for bread-making. Microbial diversity of sourdough was also affected by production systems. Pyrosequencing of the 16S rRNA targeting RNA showed that lactic acid bacteria belonging to Firmicutes phylum prevailed in mature sourdough, with the highest species diversity under organic treatments. Yeast community did not differ between production systems and during sourdough propagation. Sourdough improved nutritional and biochemical properties of the dough and differences between systems were highlighted. The bread texture was also affected by production systems. Results of this study represent a clear example of how new omics approaches and natural biotechnology in bread-making may ensure the integrity of organic products.

Keywords: *Durum wheat*, production systems, pyrosequencing, overall quality.

728. ZAID Ne'ma Mahmoud Ahmed (*Egypt*)

Supervisors: L. Tarricone L. and V. Verrastro

Title: Strategies for minimizing poor coloration and gray mold infection to improve red organic table grapes quality. – 61 p.

Abstract: Skin poor coloration and gray mold (*B. cinerea*) can negatively affect the marketability of organically-grown red table grapes. This trial investigated rutin effect (quercetin-3-rhamnosyl glycoside) as a co-pigment with a natural antimicrobial agent, potassium bicarbonate, and a physical treatment with Modified Atmosphere Packaging (MAP), on grape quality. Rutin was sprayed on clusters as a pre-harvest treatment of *Vitis vinifera* cv “Sugranineteen” at 1000 and 500 mg. L-1. KHCO_3 at 1% was sprayed on clusters 7 and 1 day before harvest. Grapes were packaged with and without passive MAP. Efficiency of pre and postharvest treatments was evaluated at harvest and after storage at 0°C. Results are summarized as follows: (i) rutin treatment at 1000 mg. L-1 14 days before harvest improved red color and anthocyanin content; (ii) the use of rutin can be a possible “organic” alternative to improve red color; (iii) the application of KHCO_3 at 1%, 7 and 1 day before harvest maintained a lower trend of gray mold infection (2.0%

McKinney index) after 21 days at 0°C, with negative effect on berry skin color; (iv) MAP was not effective to control *B. cinerea* decay for the “Sugranineteen” at 0°C.

Keywords: organic red table grapes, rutin, poor coloration, gray mold (*B. cinerea*), Modified Atmosphere Packaging (MAP), potassium bicarbonate (KHCO₃).

729. MUHADRI Luarza (Kosovo)

Supervisors: F. Tittarelli F., F. G. Ceglie and A. Aly

Title: Organic greenhouse tomato production in the Mediterranean: a comparison among systems at different levels of eco-functional intensification. – 59 p.

Abstract: An experiment on organic greenhouse vegetable production was carried out in Apulia (southern Italy). The aim of this research was to study tomato under three organic production systems with different soil fertility management practices, by comparing their yields and environmental impacts. Production systems under comparison were: SUBST, which ‘mimics’ conventional production: bare soil and 100% off-farm organic fertilizers; AGROMAN, based on animal manure incorporation and cover crops cultivation to be flattened as dead mulch; AGROCOM, based on green compost and cover crops for green manuring. The experimental design used was a complete randomized block with triplicates. Yield, water consumption and nutrients (N,P,K) input and uptake were measured to evaluate the three systems performances, while nitrate concentration below root zone was measured to evaluate potential leaching. Organic carbon input and soil total organic carbon (TOC) were also assessed. Both tomato yield and nitrate concentration in all systems showed no significant differences. SUBST showed a balanced nutrients budget indicating a short-term fertility approach, while AGROMAN and AGROCOM resulted in N and K surplus balance contributing to long-term fertility. Since the beginning of the experiment (18 months ago), AGROMAN has significantly increased OC with respect to SUBST.

Keywords: organic greenhouse, crop rotation, cover crops, carbon stock, off-farm input.

730. TLEIS Malak (Lebanon)

Supervisors: R. Roma and R. Callieris

Title: Organic food market segmentation in Lebanon. – 75 p.

Abstract: Organic production is limited in Lebanon but the organic market is growing fast. The local market mainly depends on imports and it is quite developed in comparison to neighboring countries. A few research was addressed to organic food consumption in Lebanon without dealing with organic consumers. Therefore, our objectives were to identify the profiles of Lebanese organic and non organic consumers and to propose appropriate strategies for each segment of consumer. A survey based on the use of closed-ended questionnaires was addressed to 400 consumers in the capital, Beirut, from the end of February till the end of March 2014. Data underwent descriptive analyses, principal component analyses (PCA) and cluster analyses (k-means method) through the statistical software SPSS. Four clusters were obtained based on psychographic characteristics and willingness to pay (WTP) for the principal organic products purchased. Localists and health-conscious clusters seem to be the most critical to be addressed by specific marketing strategies to set value on the combination of local and organic food and on the healthy properties of organic products, with the final aim of developing the Lebanese organic market.

Keywords: Lebanese organic consumer, consumer segmentation, multivariate analyses, WTP, marketing strategies.

731. SHAABAN Ahmed Youssef (Lybia)

Supervisors: S. Dumontet S. and D. Mondelli

Title: Biochar colonization by soil microorganisms. – 50 p.

Abstract: Soils with low organic matter and modest biological activity show a reduced capacity to produce goods and services. The use of biochar as soil amendment improves physical and chemical fertility and has positive effects on soil microbial communities acting as structural habitat for microorganisms. This study investigates the capacity of biochar to support inoculation of the microbial biomass in low-fertility soils. Biochar was produced from olive pomace by a slow pyrolysis process under N₂ (450° C for 1h) using an experimental reactor. Microbial biomasses from a fertile soil and from a commercial compost were extracted by glycerol (1%) and sodium pyrophosphate (0.1%) solution and incubated in 1/10 strength Tryptic Soy Broth (TSB). Biochar was then added to TSB to allow microbial colonization. The degree of colonization was checked by SEM and quantified by plate count. The inoculated biochar was incorporated into a sandy soil at doses of 10 and 30 t/ha. The increase of the microbial biomass in the sandy soil was measured by plate counting and fumigation-extraction method. Despite the short residence time, the microbial biomass significantly increased, confirming the potential use of biochar as microorganism carrier to improve soils characterized by poor biological parameters.

Keywords: biochar, soil microbial colonization, soil microflora, olive pomace, microorganism carrier.

732. VASILEVA Brankica (Macedonia)

Supervisors: F. Fanizzi F. and Z. Al Chami

Title: Waste materials derived bio-effectors used as growth promoters for strawberry plants. An agronomic and metabolomic study. – 75 p.

Abstract: Recently, a novel concept of bio-effectors has emerged to describe a group of products that are able to improve plant performance more than fertilizers. In this study, three different agro-industrial residues, i.e. brewers' spent grain (BSG), fennel processing residues (FPR) and lemon processing residues (LPR) were chosen as potential bio-effectors. A greenhouse soilless pot experiment was conducted on strawberry plants (*Fragaria x ananassa* var. Festival) in order to study the effect of BSG, FPR and LPR water extracts, at different concentrations, on plant growth and fruit quality. Their effect was compared with humic-like substances as a positive/reference control (Ctrl+) and with Hoagland solution as a negative control (Ctrl-). Agronomic parameters and the nutrient uptake were measured on shoots, roots and fruits. Metabolomic profiling tests were carried out on leaves, roots and fruit juices through the NMR technique. Plants treated with the FPR extract showed better vegetative growth, while plants treated with the BSG extract gave higher yield and better fruit size. Metabolomic profiling showed that fruits and roots of plants treated with FPR and LPR extracts had higher concentrations of sucrose, malate and acetate, while BSG treated plants had higher concentrations of citrate and β -glucose. In conclusion, according to the results achieved, the bio-effectors used in this study promote plant growth and fruit quality regardless of their nutritional content.

Keywords: bio-effectors, agro-industrial waste, Nuclear Magnetic Resonance (NMR), strawberry, growth promotion, fruit quality.

733. BROUTOU Oussama (Morocco)

Supervisors: F. Porcelli and N. Baser

Title: Studies on table grape damages due to *Drosophila suzukii* (Diptera Drosophilidae) and pest overwintering in Apulia. – 73 p.

Abstract: *Drosophila suzukii* or Spotted Wing Drosophila (SWD) has an important and invasive behaviour on soft fruits. The work investigated pest population dynamic and its ability to overwinter in Apulia region including morphological details to distinguish last instars of SWD maggots from different fruit-infesting drosophilas, and the effect of the alien pest on five different table grape varieties under organic and conventional farming system. In Mediterranean climatic conditions SWD is abundant in Winter-Autumn season, with a population peak in November. The SWD population drop down in summer when hot-dry environment appears unfavourable to the pest. Moreover, *D. suzukii* overwinters in Apulia in all instars on wild/semi-wild fruits and in anthropic environment also, being the conditions not so severe to stop its activity. As the SWD maggots are very similar to others fruit-frequenting Drosophila, it is useful to distinguish last instar maggots mainly by the presence of a secondary anal area. The pest cause heavy damage on table grape varieties in laboratory conditions: Crimson variety was the least resistant while Victoria the most. The resistance seems to be a skin firmness-related parameter and this character shall be an important trigger of the SWD infestation.

Keywords: vineyard, fig, jujube, wild bramble, rough bindweed, alien pest.

734. BEN OUADA Hind (Tunisia)

Supervisors: M. Schermer, M. Lahmar and P. Pugliese

Title: Sustainable livelihoods and territorial development through organic agriculture in Tunisia. An analysis in the area of Hazoua. – 99 p.

Abstract: One innovative aspect of Organic Agriculture (OA) is its ability to bring positive changes to rural territories. In this framework, a specific interest is given by the Tunisian government to OA for the role that it may have to play on the livelihoods of people. A qualitative research study based on documentary analysis, semi-structured interviews and workshops has been carried out in Hazoua (South-west Tunisia) to analyze the impact of OA growth on the livelihood assets of different stakeholders, on their relationships and to identify possible options for the future development of OA with a territorial perspective in Hazoua. Research findings indicate that: (i) from the perspective of the sustainable livelihood approach, the main impacts were guaranteed market, improved income and new projects which, however, were not affecting all farmers of Hazoua. (ii) Using value chain analysis, most relations were found revolving around the supply chain of organic dates, and particularly, the constellation analysis, as a zooming tool on the value chain relations, highlighted hampered and conflicting relations between farmers and companies. (iii) Finally the findings suggest that a further development of the organic dates supply chain and the integration of OA with other economic sectors (tourism, handicrafts and culture) could be a good option for a successful future development in Hazoua.

Keywords: organic agriculture, Hazoua, territorial development, sustainable livelihoods, constellation analysis.

735. TASKIN Eren (Turkey)

Supervisors: F. Baldacchino and F. Lamaj

Title: Efficacy of several natural substances on *Planococcus ficus* (Signoret) and their impact on its two natural enemies *Anagyrus* sp. near *pseudococci* (Girault) and *Cryptolaemus montrouzieri* (Mulsant). – 56 p.

Abstract: Management of *Planococcus ficus* (Signoret) infestations is a challenge for organic table grape producers. Insufficient knowledge on the efficacy of natural insecticides against vine mealybugs makes control difficult. The principal aim of this study was to improve the sustainability of control, using natural substances against *P. ficus*. The lethal and repellent efficacy of natural substances on *P. ficus* and their impact on parasitoid *Anagyrus* sp. near *pseudococci* (Girault) and predator *Cryptolaemus montrouzieri* (Mulsant) were evaluated in laboratory bioassays. Natural insecticides containing potassium salts of fatty acids (49%), paraffinic oil (98.8%), sulphur (95%), spinosad (11.6 % and 44.2 %) and pyrethrin (1.4%) were tested using maximum label doses. Two commercial formulations containing seaweed and plant extracts were also used. At 24 hours, mortality of *P. ficus* was statistically significant ($p \leq 0.05$) for potassium salts of fatty acids (68%) and paraffinic oil (42%), and only sulphur was found to be repellent. Potassium salts of fatty acids and paraffinic oil showed similar impacts on *A. pseudococci* and were categorized as harmless. *C. montrouzieri* resulted sensitive to potassium salts of fatty acids and pyrethrin, which were categorized as harmful for the predators. Although the use of natural insecticides is considered eco-sustainable, their effects on natural enemies should also be carefully evaluated.

Keywords: organic agriculture, pest management, natural insecticide, bioassay, vine mealybug.

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748. ABDELLATIF Omar Mohamed (Egypt)

Supervisors: G. Calabrese and E. Perrino

Title: Correlations between organic and conventional management, on-field biodiversity and landscape diversity, in olive groves in Apulia (Italy). – 77 p.

Abstract: Intensified land use, landscape changes and fragmentation of habitats are major factors in the global decline of biodiversity. Also current agricultural practices are regarded as one of the most significant drivers of biodiversity loss. Aim of the present research work was to investigate the correlation existing between the biodiversity at field level in the Mediterranean olive groves, the agricultural practices performed to achieve production and the landscape asset characterizing the agricultural systems around the fields. In this conceptual frame the following steps were performed: 1) Monitoring and assessment of the on-field biodiversity in organic and conventional olive groves; 2) Description (by using GIS tools) and analysis of the agroecosystem diversity (cropping system diversity) around the field areas (by using a set of indicators); 3) Investigation of the correlations between the on-field biodiversity of flora, the agro-biodiversity at landscape level and the agricultural practices, using statistical methods. Results of the statistical analysis showed that flora diversity is highly correlated to organic management options; agronomic practices to prevent pests and adversities are highly correlated to the level of flora diversity and the natural capital of the ecological focus areas; some correlation was found between the presence of water bodies in the landscape and biodiversity indexes.

Keywords: biodiversity, agricultural practices, landscape changes, multivariate analysis, olive groves, ARCGIS, ecological focus areas.

749. AHMED El Nady Kamel Mai (Egypt)

Supervisors: P. Pugliese, M.H.A. Nawar, C. Rota and C. Zanasi

Title: Factors influencing farmers' decision to stay in organic farming. An exploratory analysis in Fayoum Governorate, Egypt. – 80 p.

Abstract: The factors affecting the farmers' decision to stay in organic farming were investigated and compared with the factors which influenced the farmers' conversion to organic agriculture; this was the purpose of this study, carried out in Sakran village in Fayoum Governorate. A mixed research approach was adopted; qualitative data were obtained via semi-structured interviews involving the representatives of local farmers' associations; quantitative data were collected from 232 organic farmers in the study area, using structured questionnaires. Descriptive statistics were performed to describe organic farmers and farms' characteristics. Factor analysis identified 8 factors affecting farmers' decision to stay in organic farming, namely: "environmental & human health protection", "association/buyer's services", "export market", "independence", "knowledge, resources & farming conditions", "people around", "need to be different" and "domestic market". Thematic analysis was also used to go deeper into the matter for understanding and describing the foregoing factors. In addition, content analysis showed that the reasons to stay in organic production are not so different from the reasons that

originally pushed farmers to convert to it. Awareness of factors affecting farmers' decision to stay under the organic certification scheme is useful to orient strategies and action of stakeholders operating for the development of the organic sector in Egypt. Specific recommendations in this regard are addressed to the government.

Keywords: organic agriculture, Fayoum, mixed research approach, factor analysis.

750. VOCA Hana (Kosovo)

Supervisors: G. Anfora and N. Baser

Title: Unveiling the role of a liquid released over the fruit surface by ovipositing *Drosophila suzukii* females: a fruit-marking pheromone or a food source for larvae? – 51 p.

Abstract: After its rapid invasion of both Europe and US in 2008, *Drosophila suzukii* (Matsumura) has caused huge economic damage worldwide. Thereafter, information on this pest has been based on its biology and management techniques. This study started from preliminary observations of the release of a liquid on the surface of fruits by females after oviposition. The released liquid was supposed to be either a pheromone (attractant or deterrent) or an additional source of food for developing larvae, since it probably contained nutritionally important gut microorganisms. Therefore, laboratory experiments were performed to test the nature of the released liquid in *D. suzukii* oviposition behavior, thus one of the three hypotheses would be verified. Results suggested that females deposit a deterrent marking pheromone which would prevent repeated ovipositions in already infested fruits. Findings of this study may be useful in the development of environmentally friendly management methods by interfering with *D. suzukii* post-oviposition communication using the isolate of deterrent marking pheromone. Moreover, development of useful management method may eventually contribute to food safety by reducing the current and common practice of use of pesticides near harvest for this pest.

Keywords: oviposition attractant, oviposition deterrent, pheromone, gut microorganisms, larval development.

751. ABOU CHEHADE Lara (Lebanon)

Supervisors: Z. Al Chami and F. P. Fanizzi

Title: Bio-effectors from waste materials as growth promoters and quality enhancers for tomato plants: an agronomic and metabolomic study. - 74 p.

Abstract: Three agro-industrial wastes - Lemon Processing Residues (LPR), Fennel Processing Residues (FPR) and Brewer's Spent Grain (BSG) - were further investigated as sources of bio-effectors, following two previous trials in MAIB. Their corresponding aqueous extracts, applied individually or in association, were used to assess their single/synergistic effects on agronomic and quality performance of soil-grown pot tomatoes. Seven treatments (BSG, FPR, LPR, BSG-FPR, BSG-LPR, FPR-LPR and BSG-FPR-LPR) were compared accordingly with both a control and humic acid applications. Metabolite profiling of tomato fruits via the Proton Nuclear Magnetic Resonance (NMR) spectroscopy complemented fruit quality evaluation. Results proved the stimulating effect of FPR extract on vegetative growth (shoot length), and showed a significant increase in tomato yields and nutrient uptake under all treatments. Moreover, bio-effectors enhanced some tomato organoleptic (titratable acidity) and nutraceutical (vitamin C) properties, while did not affect lycopene and β -carotene contents. Single extracts were able to compete with

combined treatments in stimulating production and quality attributes. The metabolomic profile of tomato juice showed an interesting tendency of FPR extract to increase fruit citric acid content. In conclusion, waste-derived bio-effectors could be demonstrated as potential candidates of plant growth, yield and fruit quality promoters.

Keywords: bio-effectors, agro-industrial wastes, metabolomics, fruit quality, growth promotion, tomato.

752. HAFIDI Salaheddine (Morocco)

Supervisors: F. G. Ceglie and F. Tittarelli

Title: Comparison of three organic greenhouse production systems of Kohlrabi (*Brassica oleracea* var. *gongylodes*) under Mediterranean conditions. – 55 p.

Abstract: Since 2012, a long-term experiment has been performed at the Mediterranean Agronomic Institute of Bari (South-Italy) to evaluate three different soil fertility management systems for organic vegetable production under unheated tunnel. One organic simplified system named SUBST (short-term fertilization strategy that substitutes mineral fertilizers with the organic ones authorized by the EU Regulation) and two organic agroecological systems named AGROCOM (cover crops mixture as green manure and green compost amendment) and AGROMAN (manure amendment and the same cover crops mixture of AGROCOM flattened by a roller crimper and used as dead mulch). The Master thesis objective was to compare the effects of these systems on kohlrabi (*Brassica oleracea* L. var. *gongylodes*) cultivation. Yield, nitrogen and phosphorus budgets, water consumption and nitrate concentration below the root zone (35 cm) were taken into consideration to compare performances and potential impacts. The best kohlrabi yield was registered in SUBST (22.72 t ha⁻¹), which also required less water and showed neutral nutrient budgets. Agroecological systems (AGROMAN, AGROCOM) had a strong surplus in N-budget; AGROMAN showed the lowest nitrate leaching. In conclusion, the agroecological approach provides organic matter and nutrients for a long-term soil fertility improvement, while a simplified approach (SUBST) is mainly oriented towards yield enhancement in a short-term perspective.

Keywords: Agro-ecological approach, soil fertility, cover crop mixture, nutrients budgets, soil organic carbon, nitrate leaching.

753. ABU IKHMAISH Siham (Palestine)

Supervisors: R. Roma, F. Srouji and G. Cardone

Title: Microeconomic analysis of organic olive farms in the North of West Bank-Palestine. – 66 p.

Abstract: Organic olive cultivation as an emerging and promising system in Palestine lacks the relevant studies and evaluation, particularly in economic terms. This research was conducted with the aim of being the first microeconomic analysis of organic olive oil farms compared with conventional ones in the north of West-Bank. Following the case study approach, two groups of 16 organic and 16 conventional olive oil farms were economically evaluated through the cost-benefit analysis by measuring the gross margin and other economic indicators. Results showed that the group of conventional olive oil farms had a higher gross margin per ha and per unit of production whereas the group of organic olive oil farms had higher labor and variable costs and revenues per ha. Moreover, the second part of this research was done to assess the organic olive oil sector through the SWOT

analysis. Data was collected using bibliographic sources and feedback results of the preliminary SWOT list from 39 stakeholders of the olive oil sector. The results obtained highlighted that, although the Palestinian organic olive oil sector is affected by several shortages and problems, many good strengths and opportunities are available and can be maximized, which indicates that the sector might be improved, especially in its economic and marketing aspects.

Keywords: organic olive oil, organic and conventional farming, SWOT analysis, economic comparative analysis, gross margin, profitability.

754. THLIGENE Nadia (*Tunisia*)

Supervisors: I. Cavosky and R. Di Cagno

Title: Mediterranean organic prickly pear (*Opuntia ficus indica* (L.) Mill.): Characterization of plant associated microbiota and their exploitation through lactic acid fermentation. – 79 p.

Abstract: Organic prickly pear production in the Mediterranean basin is constantly increasing, due to its high ecological adaptability to extreme conditions, and the growing demand for its food and non-food products. Fruits are characterized by pronounced flavor and high nutritional properties, whereas cladodes are less exploited for human consumption. The present study aimed at exploring the endophytic and epiphytic cladodes and fruits associated microbiota and to evaluate the capacity of selected lactic acid bacteria to enhance the functional properties of cladodes pulp. Fruits and cladodes of 12 cultivars were collected from Italy and Tunisia. The structure of the microbiota was characterized through culture-dependent and independent methods. Young cladode's pulp was fermented with lactic acid bacteria previously isolated from plant materials. The antioxidant activity was evaluated through *in vitro* assays, further confirmed through *ex vivo* analysis on intestinal human Caco-2/TC7 cells, and the profile of flavonoids was characterized. Microbial diversity and community structure showed variability in fruits versus cladodes, and cultivars versus locations; whereas functional properties were more in relation to the plant part and cultivars. The use of selected functional lactic acid bacteria, through enhancing health-promoting features of cladodes, may contribute to exploit the cultivation of prickly pear with the perspective of producing a functional ingredient or dietary supplement.

Keywords: *Opuntia ficus indica* (L.) Mill., plant associated microbiota, lactic acid fermentation, antioxidant activity, immune-modulatory, Caco-2/TC7 cells.

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767. ZHORI Alba (*Albania*)

Supervisors: V. Verrastro, N. Baser and E. Isufi

Title: Investigation on the presence of *Drosophila suzukii* (Matsumura) and its potential parasitoids in organic farming in Albania. – 70 p.

Abstract: *Drosophila suzukii* Matsumura (Diptera: Drosophilidae), an invasive pest native of Southeast Asia, had never been reported in Albania until 2015. In order to investigate its presence, traps baited with apple cider vinegar were used in single and mixed orchards in different locations (Vlore, Divjake and Hamallaj), from June 2015 to May 2016. Traps were placed in fig, persimmon, pomegranate, medlar, and jujube orchards as well as on citrus, blackberry and raspberry evergreen trees. Trap monitoring was performed weekly. The first finding of *D. suzukii* was in a jujube orchard in Vlore, on 18 September 2015. Afterwards, *D. suzukii* was found in all the other orchards with the highest presence on soft fruits in two distinct periods of trap capture: fall and spring. All fruit orchards had no trap captures during the summer months (June-August 2015) and most of them had low captures during the coldest winter months (January-February 2016). The fruit infestation was observed on raspberry and blackberry during the monitoring period. In traps, 3 species of parasitoids were found in all fruit blocks. This first occurrence report of the invasive species *Drosophila suzukii* in Albania should motivate further surveys of this potential pest and its parasitoids.

Keywords: SWD, Albania, first finding, alien invasive pest, multiple crops.

768. EL DEEB Asmaa Mohamed Ahmed Abdelhamid (*Egypt*)

Supervisors: R. Callieris and R. Roma

Title: An application of Means-End-Chain analysis on organic food purchase in Egypt. – p. 53.

Abstract: Only few studies exist on organic food consumption in Egypt and for suppliers to sustain their business performance and innovate, a deeper understanding of existing and potential consumers is essential. This research attempts to gain insights on organic consumers in Cairo and to investigate their motivational cognitive structure in order to design the hierarchical value map linking the attributes of organic foods to the benefits or consequences of experiencing organic food consumption and the personal values they satisfy. The means-end-chain (MEC) is proposed as the theoretical base of the study and a convenience sample was used to conduct 230 laddering interviews. Results showed that the main values influencing the final purchase choice of consumers were "own health" and "children's health and family protection". Thus, marketing communication should pay attention to these self-related priorities although deeper consumer behavior research is needed to formulate appropriate marketing strategies to stimulate organic food consumption in Egypt.

Keywords: laddering interview, cognitive structure, consumer behavior, hierarchical value map, consumer involvement, organic food consumption, Egypt, means, end chain approach.

769. HASSAN Bahaaaldin Mamdouh Mohamed Hassanin (Egypt)

Supervisors: I. Cavoski and R. Di Cagno

Title: Exploitation of organic palm date (*Phoenix dactylifera* L. cultivar Siwi) fruits collected from Bahariya Oasis (Egypt) through bioprocessing technology. – 56 p.

Abstract: Date palm fruit, one of the most nutritive and comprehensive fruit regarding health benefits is becoming an ideal substrate for deriving a range of value added products. The aim of this study was to develop the biotechnological protocol in order to exploit the functional properties of dates. Autochthonous lactic acid bacteria were isolated through culture-dependent methods and typed through Random Amplified Polymorphic DNA-Polymerase Chain Reaction (RAPD-PCR) analysis. Sixteen isolates representative of RAPD-PCR clusters were identified by partial 16S rRNA gene sequence and were screened based on the kinetics of growth on date palm juice used as model. Five autochthonous *Lactobacillus plantarum* strains were selected as the best performing strains. Nutritional and functional properties of fermented samples were compared with unfermented (raw) and chemically acidified one used as control, after freeze drying. Developed protocol enhanced nutritional and functional properties of date fruits. Total polyphenols, flavonoids content, antioxidant activities were significantly higher in fermented samples, compared to the controls. Our study reported, for the first time, genotypic diversity of the lactic acid bacteria microbiota associated with dates and provided the basis to exploit the potential of fermentation as novel bioprocessing in order to develop new functional food and supplements.

Keywords: Autochthonous lactic acid bacteria, functional food, nutritional, antioxidant, lactic acid fermentation.

770. IBRAHIM Mahmoud Mohamed Said Mohamed (Egypt)

Supervisors: L. Guarrera and A. Abdelaziz

Title: A new framework law on organic agriculture in Egypt: a proposal. - 262 p.

Abstract: In the European Union, demand for high quality organic food is increasing, and imports are trying to satisfy more and more this demand. Studies underlined the importance of technical trade barriers in the agricultural sector. For organic products, national differences in legislations and control systems could act as a major non-tariff barrier for exporting countries, particularly the developing ones, which could fail to benefit from the increasing organic market opportunities in developed countries. This study explores the obstacles faced by the organic farming sector in Egypt due to the absence of a proper legislation on organic agriculture. It also reports the impact of the EU import scheme on the Egyptian organic trade mechanism, where the absence of an equivalent system forces Egyptian organic exports to enter the EU through particular import procedures. This work proposes a new law on organic farming in Egypt, following the structure of the EU Regulation No. 834/2007 on organic agriculture and its evaluation against international organic standards. The purpose is dual: to provide the Egyptian organic farming sector and operators with a national law to develop the domestic market and to create a new, alternative trade route with the EU, in an attempt to reach a future equivalency of regulations.

Keywords: Egypt, European Union, equivalency, organic regulations, trade barriers, export.

771. PANEL Aurore, Danièle, Claudine (France)

Supervisors: N. Baser and G. Anfora

Title: Development of strategies for biocontrol of the invasive pest *Drosophila suzukii* in Italy by means of Hymenopteran parasitoids. – 87 p.

Abstract: *Drosophila suzukii* or Spotted Wing *Drosophila* (SWD) is a pest which has recently spread in western countries. It threatens several profitable fruit crops and is also known to develop on a wide range of natural host plants. Current control methods rely on the application of insecticides but this strategy proves to be poorly effective, polluting and unsustainable. This study, conducted in Italy, investigates the efficacy of endemic and commercially available parasitoids on SWD, under laboratory conditions. It also reports on life-history traits of three species of resident parasitoids of SWD and finally assesses the efficiency of two of them in the field. Two commercially available pupal parasitoids were proved to be unable to develop on the pest whereas *Trichopria drosophilae*, a resident pupal parasitoid showed a high parasitization rate. Lifetime fecundity experiments gave information on parasitoids reproductive strategies. Field trials successfully showed the parasitoids ability to locate and parasitize the pest. The augmentorium technique, set up in one of the field trials, proved to be partly effective and therefore needs to be further improved. This study contributes to the development of the pest biocontrol strategies which may become an important management tool in the near future for an area-wide control of SWD.

Keywords: *Drosophila suzukii*, Biological control, Parasitoids, Augmentorium technique

772. MOHAMMED Raheem Ngjim (Iraq)

Supervisors: F. Ceglie F., Mimiola G. and F. Tittarelli F. ; advisor: S. Madzaric

Title: Agronomic performance of zucchini (*Cucurbita pepo* L.) cultivated in a Mediterranean organic greenhouse. – 54 p.

Abstract: The present work is focused on the fourth year of a crop rotation established in June 2012 in the experimental greenhouse of MAI-Bari (Italy). The aim is to study the yield performance in relation to organic matter input and nitrogen budget assessed for three organic production systems adopting a different soil fertility management approach. Two systems (AM, AC) are based on a long-term approach to soil fertility relying on agro-ecological services crops (ASC) grown in the summer season as green manure, and on the application of organic amendments such as manure (AM) or green compost (AC). The third system (SB) includes a substitution approach based on an organic commercial fertilizer and no ASC cultivation. In all the systems, zucchini (*Cucurbita pepo* L. 'Striata di Puglia') was the cash crop cultivated from September 2015 to January 2016. SB gave the highest yield (18.66 t ha⁻¹) and the lowest N budget (deficit of -75.4 kg ha⁻¹) whereas a surplus was reported with both AC and AM. Significantly, the soil organic carbon in AC and AM has increased since the beginning of the experiment, while in SB it has remained constant. The effect of long-term systems (AM and AC) on soil carbon proved to be positive at the cost of zucchini yield reduction.

Keywords: agro-ecological services crops; nitrogen budget; crop rotation; green manure; compost; soil organic carbon; nitrate leaching.

773. IBRAHIM ALI Aya (Lebanon)

Supervisors: F. Lamaj and F. Baldacchino

Title: Valorization of the predator Green Lacewing, *Chrysoperla carnea* s.l., in organic vineyards. – 76 p.

Abstract: The aim of this study was to understand the behavior of the Common Green Lacewing, *Chrysoperla carnea* s.l., in an Apulian organic vineyard in 2015/2016. The efficiency of a "Lacewing Egg Concentrator" (Csalomon®) on the oviposition performance and its effect on the control of Vine Mealybug, *Planococcus ficus*, was evaluated. Entomofauna diversity inside and nearby the vine agroecosystem was also assessed to verify the incidence of *C. carnea*'s potential preys. Results showed a significantly higher number of eggs laid on grapevines with synthetic attractant-based concentrators than those laid on control. However, no significant difference was observed between these treatments with respect to *P. ficus*. On yellow sticky traps, *Chrysoperla pallida* was the dominant species, and Homoptera was the dominant order (56%). Within the latter, the most abundant families were Cicadellidae (96%) and Aphidoidae (2.5%), which are potential preys of *C. carnea*. On spontaneous vegetation growing under vines and at the borders, nearly half of the collected insects belonged to Cicadellidae. Predators belonging to Nabidae, Miridae, and Arachnida were also present to a lesser extent. On *Phacelia tanacetifolia*, a trap plant, Heteroptera (65%) and Thysanoptera (22%) were dominant. Predators belonging to Anthocoridae and to Miridae constituted the major families.

Keywords: Lacewing Egg Concentrator, entomofauna diversity, vine agroecosystem, potential preys, biological control.

774. SKAF Ludmila (Lebanon)

Supervisors: G. Calabrese and S. Rouphael

Title: Comparison of organic and conventional farms/wineries in Batroun region-Lebanon: sustainability case study. – 108 p.

Abstract: Numerous reports and scientific papers have emphasized the impacts of organic agriculture on the farms sustainability, but only a few studies have been conducted in Lebanon so far. For this reason, in Batroun region, Lebanon, three organic and three conventional grapevine farms and wineries were compared to assess their sustainability. A French model called 'IDEA' (Indicateurs de Durabilité des Exploitations Agricoles) was used to compare the sustainability between and within the selected farms/wineries. The IDEA method assigns a sustainability score to each farm/winery on the basis of three different dimensions (agro-ecological, socio-territorial and economic), which are in turn subdivided into three or four related components. Hence, a total of 10 components were assessed for each farm/winery and subdivided into forty-one indicators. Data were collected through field visits and questionnaires. The results showed a better performance of the organic farms/wineries as for the agro-ecological dimension. 'Farming practices' appeared to be a relevant component with higher scores for the organic management; the organic farms/wineries achieved better results with the indicators; "Quality of foodstuffs produced" and "Measures to protect the natural heritage".

Keywords: organic farming, sustainability, IDEA Model, winery.

775. LAARIF Yassine (*Morocco*)

Supervisors: A. Aly and G. De Mastro

Title: Combined effect of partial root zone drying and compost tea fertigation on Solanaceae crops. - 60 p.

Abstract: Field experiment was carried out in order to investigate the effects of compost tea fertigation combined with partial root zone drying irrigation system (PRD) on the production and quality of eggplant under organic agriculture. The experimental design was set as a split plot with four replications. Fertilization treatments (main plots) included: 1) commercial organic fertilizers CF, 2) compost tea fertigation CT. While the irrigation treatments (sub-plots) included: 1) 100% of irrigation requirement, 2) 50% of irrigation requirement and 3) 50% of irrigation requirement with PRD technique. The results demonstrated that saving 50% of water requirement using PRD technique combined with compost tea fertigation, a higher yield was obtained without any significant decrease in the fruit quality parameters like total soluble polyphenols, micro element content, chlorogenic acid content and percentage of antioxidant activity (AA%) of ascorbic acid solution (AAcidS) assessed by 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) free radical assay.

Keywords: compost tea, organic fertilizers, partial root zone drying, solanaceae, eggplant.

776. TAHREER A. K. Issa (*Palestine*)

Supervisors: M. Tucci, S. Jarrar and F. Famiani

Title: Evaluation of factors which affect *Spilocaea oleagina* infections and definition of the effects of the disease on vegetation, inflorescence development and fruiting of olive on Palestinian organic farms. – 48 p.

Abstract: An evaluation of peacock eye disease (*Spilocaea oleagina*) on olive trees was carried out in organic olive orchards in Palestine (Asira, Cannan, Narc and Sir). In each orchard, 6 plants were randomly chosen (3 pruned and 3 not pruned). Attack evaluation was determined based on the percentage of infected leaves in different portions of the canopy: upper, middle and lower portions. Infection level was determined every 20 days, by monitoring the percentage of symptomatic leaves and the early-infected ones (using NaOH test). In spring, the inflorescence size was determined just before flowering (white stage) along with the percentage of fruit-set of labelled small branches. Strong differences in infection level, related to climatic conditions, were observed among the different sites investigated. Pruning reduced the tree susceptibility to the disease. Infection was higher in the lower parts of the canopy than in the upper portions. Peacock eye strongly affected the size of inflorescences and fruit set: a negative relationship between peacock-eye attack and inflorescence development and fruit set was observed after defoliation caused by the disease. Based on the effects on fruit set, we may conclude that the disease can reduce the production up to one fourth with respect to healthy trees.

Keywords: control strategy, flower biology, fruiting, *Olea europaea* L., organic olive growing, *Spilocaea oleagina*, Palestine.

777. JOUINI Amira (*Tunisia*)

Supervisors: G. Cardone and R. Roma

Title: A comparative analysis on economic sustainability and carbon footprint of organic and advanced integrated table grape farming in Apulia Region. – 116 p.

Abstract: Apulia is Italy's largest table grape producing and exporting region where table grape has considerable economic and environmental impacts. The aim of this study is to describe the organic and advanced integrated seeded and seedless table grape farming in Apulia region and to assess its sustainability comparing the economic performances and environmental impacts of three varieties, namely *Italia* (seeded), *Crimson* and *Sugraone* (seedless). Furthermore, the study proposes some suggestions on the most profitable and environmentally friendly varieties and growing systems to farmers and policy makers. The methodological tools applied include: the SWOT analysis to describe the characteristics of the sector, the Cost benefit analysis to compare different gross margins and other economic indicators and the Life cycle assessment to calculate the carbon footprint as an indicator for different environmental performances of the three varieties and the two farming systems. Results show that organic farming systems are the most profitable and the less harmful for the environment, especially for *Sugraone*. These results may be improved through better marketing strategies for organic products both in terms of demand and supply. From the environmental point of view, an increase in organic yields and the improvement of farming techniques may reduce land and fossil fuel use so as to make it more sustainable.

Keywords: table grape, Apulia region, SWOT analysis, sustainability, cost benefit analysis, life cycle assessment, seeded, seedless, farming systems.

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815. NASER EL DEEN Somaya (*Lebanon*)

Supervisors: F. Lamaj and F. Baldacchino

Title: The effect of weed management on Vineyard agroecosystem complexity: assessment through arthropods. - 65 p.

Abstract: This work aimed to study the complexity level of three vineyards managed differently (Organic, Un-weeded and Weeded conventional) through arthropod assessment. Entomofauna diversity was assessed on the most abundant weed species and on *Phacelia tanacetifolia* to verify the presence of predators and their potential preys. The entomofaunal diversity of the soil was assessed by pitfall traps and of the vines by collecting the subcortical arthropods. Results showed that *Stellaria media*, which is the most abundant weed species under organic management, didn't host big number of arthropods (3.4%) whereas *Cirsium vulgare* hosted the most (60.5%). Within the later, 98.2% belonged to Aphididae family, potential prey for several predators. On *P.tanacetifolia*, Thysanoptera (42.6%) and Heteroptera (27.7%) were dominant; predators belonged mostly to Miridae (40.5%) and Anthocoridae (28.8%) families. Within the subcortical arthropods, detritivores (Psocoptera and Collembola) were significantly associated to the organic management system and the predators Dermaptera, Rophidioptera and Araneae were significantly associated to the conventional un-weeded management system. Among the soil dwelling arthropods, predators belonging to Carabidae and Staphylinidae families were the most abundant under organic and conventional management systems respectively. The floristic abundance in organic and un-weeded conventional vineyards has favored the complexity with higher presence of beneficial entomofauna.

Keywords: Agroecosystems, organic farming, organic foods, quality, vineyards, weed control, weed management.

816. IBOUH Khalid (*Morocco*)

Supervisors: N. Baser, G. Anfora and M.V. Rossi-Stacconi

Title: Performance evaluation of biological control agents for managing the invasive pest *Drosophila suzukii*. - 66 p.

Abstract: *Drosophila suzukii* Matsumura (Diptera: Drosophilidae) is an invasive pest which has recently spread worldwide. The damage of this pest to fruit production is concentrated in the immediate pre-harvest period thus making insecticides application unsuitable. Sustainable management strategies suffer from the lack of specialized biological control agents that suppress population outbreaks in the invaded areas. This study tested the host specificity and effectiveness of a number of bio-control agents in restricting *D. suzukii* infestation. The adaptability and efficacy of the pupal parasitoid *Trichopria drosophilae* Perkins were assessed in open field conditions. Moreover, the possibility of improving *T. drosophilae* preference towards *D. suzukii* through the manipulation of parasitoid learning ability was evaluated and confirmed in controlled conditions by rearing the

parasitoid on different drosophilids. In laboratory conditions, we found that autochthonous and commercial strains of entomopathogenic fungi and nematodes were effective against different life stages of *D. suzukii* and harmless to *T. deosophilae* emerged from *D. suzukii* pupae. Furthermore, grape berries treated with conidial suspensions of entomopathogenic fungi tested were much less preferred by pest adults for egg laying. These results can be proposed as new guidelines for an effective biological control strategy against *D. suzukii* by means of parasitoids and entomopathogens.

Keywords: Biological control, biological control agents, control methods, diptera, parasitoids.

817. ALMADI Leen A.R. (Palestine)

Supervisors: M. Tucci, F. Famiani and S. Jarrar

Title: Effects of peacock eye disease (*Spilotea oleaginea*) on Palestinian olive orchards and evaluation of some fungicides for its control. - 101 p.

Abstract: The peacock eye disease represents a major constraint for the olive in Palestine since it causes defoliation and yield reduction. Studies on the use of fungicides for its control are still limited. Therefore, in 2017, a study was carried out in Qufra-Qod area (Palestine), to evaluate the efficiency of some synthetic and organic copper fungicides, characterized by different formulas and concentrations, to control the peacock eye disease. Untreated trees were used as control. Treatments were applied in the field in three different periods (February + April + August). The infected leaves and defoliation percentage was determined on different canopy portions. Fruit-set along with fruit growth and the inflorescence size determined. Fungicidal treatments, compared to control, reduced leaf infections and defoliation and tended to increase fruit-set, whereas, they did not affect substantially inflorescence development and fruit weight. Some of the tested fungicides seem to be more effective than others, but further studies are necessary to provide conclusive results.

Keywords: Fungicides, olive orchards, organic farming, Palestine, *Spilotea oleaginea*.

818. ROUIFI Anass (Morocco)

Supervisors: A. Aly and G. De Mastro

Title: Partial root zone drying and compost tea fertigation effects on soil fertility, plant growth and fruit quality of organic cucumber (*Cucumis Sativus*). - 63 p.

Abstract: The effects of compost tea fertigation (CT) combined with partial root zone drying irrigation system (PRD) on the production and quality of organic cucumber was addressed. Compost tea and PRD revealed similar effect on yield and fruit quality as commercial organic fertilizers (CF) and 100% irrigation respectively. On the other hand, the lowest biomass was obtained by 50% irrigation followed by PRD. Moreover, potassium, calcium and magnesium content in roots were significantly affected by the fertilization factor and higher amounts were observed in CT treated plots. Whereas Potassium content in the shoots was increased by 13% in CT compared to CF. Soil available phosphorous content was reduced by 14% in CT treated plot, while soil total nitrogen and exchangeable potassium were similar among the treatments. Thus, compost tea fertigation and partial rootzone drying irrigation are two promoting techniques in the development of global sustainable agricultural practices.

Keywords: compost tea, cucurbitaceae, organic farming, organic fertilizers, plant growth, soil fertility.

819. GHEDIRA Meriam Khadija (Tunisia)

Supervisors: L. Guarrera and S. Maamer

Title: International trade of organic agricultural products: a proposal for equivalence between Tunisian organic legislation and U.S.A. National Organic Program (NOP). - 61 p.

Abstract: This study outlines as a first step the current situation of the Tunisian organic legislation, together with its successful inclusion in the EU's "third-country list" as equivalent country in organic farming. Suggesting the elaboration of other nation-to-nation equivalences, the study then analyzes the historical bilateral "organic" agreement signed between US, the world largest organic market, and EU, which has expanded organic trade, making Tunisia a ghost exporter. The core part of the study aims at proposing guidelines to introduce a similar agreement between Tunisian and American organic legislations, excluding the animal production sector: a trilateral-comparative table has thus been developed including the two countries' organic standards, covering rules applied to certification, crop production, processing and labelling. As a result, 72% of the 420 compared standards were assessed as equivalent by the expert panel. Where non-compliances were found, the EU common equivalent standards were integrated as a strategic tool solving 23% of the variations and pointing-out main divergences between the European legislation and NOP. Finally, the work proposes corrective actions towards Tunisian organic standards to solve 5% of the non-compliances aiming at meeting NOP technical requirements. It also provides recommendations to be used as leverage points while negotiating the equivalency.

Keywords: international trade, legislation, organic farming, organic markets, organic products, organic standards.

820. TLAIS Ali Zein Alabiden (Lebanon)

Supervisors: I. Cavoski and R. Di Cagno

Title: Lebanese organic exotic fruits (avocado and sugar-apple): exploitation as new fermented food and natural products. - 63 p.

Abstract: Organic tropical and sub-tropical fruits consumption in the world is constantly increasing, due to growing interest for fruits characterized by pronounced flavor and aroma and high nutritional and functional properties. One of the main constraints of these fruits is to be the highly perishable. Processing options are needed to ensure their exploitation as new food and/or natural products. In this study, organic avocado (*Persea americana* Mill.) and sugar apple (*Annona squamosa* L.) fruits were collected from Tyre (Lebanon) to investigate their microbial diversity and to evaluate their exploitation as natural products through bioprocessing technology. A low diversity of lactic acid bacteria and yeasts associated with fruits was highlighted. Microbes were identified by partial 16S rRNA and 26S rDNA gene sequences, respectively. Fermentation protocol was set up depending on the fruit. Avocado fruits were fermented with autochthonous lactic acid bacteria, whereas sugar apple fruits were exploited for antimicrobial activities through in vitro assays. Fermented avocado powder had improved functional properties with high antioxidants in comparison to control. Sugar apple peel extract demonstrated strong antimicrobial activities due to the high content of catechins

derivatives. Our study highlighted, that valuable and novel strategies may exploit the intrinsic features of tropical fruits providing a benefit important for human diet.

Keywords: food quality, fruits, human health, human nutrition, organic farming, organic foods, organic products.

821. VOCA Narta (Kosovo)

Supervisors: I. Cavoški and I. Livieratos

Title: Chemometric approach to study authenticity of organic and non-organic honeys from Western Balkan region. - 60 p.

Abstract: Organic honey production in Western Balkan countries is becoming an important sector; however there is a lack of studies regarding general quality of honey produced in this region. A total number of 40 honey samples, organic (21) and non-organic (19), from Albania (10), Kosovo (10), FYR Macedonia (10) and Montenegro (10) were subjected to melissopalynological analysis, physicochemical and bioactive properties determination and phenolic profiling. The aim of study was to investigate the authenticity of honey samples regarding botanical origin, geographical origin and different production systems. Melissopalynological analysis classified the samples into five botanical groups: clover (9), honeydew (4), lavender (1), multifloral (19), and Christ's thorn (7). Except for one, all the honey samples presented a good quality level, meeting the legislative requirements. Multivariate analysis applied on dataset allowed classification and discrimination of honey samples and identification of characteristic markers for each class. This approach gives a solid basis for further valorization of honey through product differentiation and development of organic beekeeping sector in the region.

Keywords: Balkans, food quality, honey, honey production, organic farming, organic foods.

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835. ALLALI Tarek (*Algeria*)

Supervisor: Guarrera L.

Title: A New organic legislation for Algeria: a proposal. – 125 p.

Abstract: In recent years, interest of governments and farmers' associations about organic farming has rapidly increased worldwide, so that it has become one of the fastest growing agricultural sectors. Studies about organic agriculture in Algeria are very few, but interest about it is rising in the country, and - as a response to this need - we have prepared a proposal based on the new Regulation (EU) 2018/848. This study first outlines the situation of legislation on organic farming in the world. It then describes the local conditions in Algeria and the need of having a national legal framework concerning organic production. As an innovation, it includes a number of environmentally-friendly practices and labour "ethical rules" to make the proposal more compliant with the original "philosophy" of organic agriculture. As a result, the Law proposal includes 52 Articles divided into 9 Chapters inspired by the EU Regulation with additional requirements related to environment sustainability and workers' rights. An adaptation that we believe would be helpful also for a possible, future negotiation for equivalence with the EU legislation. Finally, this work is just the starting point for a series of studies and research projects to help the growth of the organic farming sector in the largest African country.

Keywords: organic regulation, Algeria, European Union, adaptation, sustainability.

836. ZYBA Fitim (*Kosovo*)

Supervisors: R. Callieris and R. Roma

Title: Value chain analysis for organic medicinal and aromatic plants in Kosovo. – 59 p.

Abstract: Kosovo has rich resources of organic Medicinal and Aromatic Plants (MAPs). Emerging markets of organic MAPs are typically suffering from inefficiencies and ineffectiveness, resulting in supply and demand mismatches. The objectives of the study are to map the value chain of Kosovo's organic MAPs, and to explore factors that could contribute to higher value chain integration (VCI) and value chain performance (VCP). This study is based on field survey with 40 chain actors in April-May 2018. Based on scientific literature, three conceptual value chain subjects contributing to VCI were proposed. Qualitative analysis was used to measure the level of importance and agreement of the MAP chain's actors with regard to factors allowing value chain integration and performance. First, the organic MAPs sector was mapped to illustrate product flows and relationship dynamics. Most important requisites for achieving better VCI are: 'Goal alignment' and in particular risk sharing; hybrid 'governance structures which tend to be most suitable, minimizing transaction costs and enable strong relationships; and high level of 'Information sharing' which improves the coordination between chain partners and leads to higher levels of VCI. Finally, VCI is confirmed to be a vital contributor to the overall VCP improvement.

Keywords: Organic Medicinal and Aromatic Plants (MAPs), Value Chain Analysis, marketing, Kosovo.

837. DAHER Elissa (Lebanon)

Supervisors: M. Tucci, V. Verrastro and V. Mazzoni

Title: Use of vibrational signals to interact with the mating behaviour of *Philaenus spumarius*, vector of *Xylella fastidiosa*. – 46 p.

Abstract: Following the devastating consequences of *Xylella fastidiosa* outbreak in Europe, the need for novel strategies to control its insect vectors has grown. Accordingly, the aim of this study is to unveil some aspects of the vibrational communication of *Philaenus spumarius* L. (Hemiptera: Aphrophoridae), the key vector of *X. fastidiosa*, mainly those related to its mating behaviour. The trials consisted on stimulating males of *P. spumarius* with playbacks of his naturally emitted calls, in order to elicit responses. Trials were done in two different periods. Signals were recorded with a laser Doppler Vibrometer, and analysed with Raven 1.2 for an advanced understanding of their typology and composition. Results show a higher percentage of emitted signals in October compared to June suggesting a higher activity and interest in mating in October. Moreover, the analysis reveal four types of signals constantly emitted for two purposes: advertisement and interaction. Signals are composed of two elements (Pulses and harmonics) arranged in different configurations. They construct a complex language adopted by *P. spumarius* to accomplish its main biological functions. To conclude, by succeeding to stimulate *P. spumarius* with playbacks, this study showed a possibility to manipulate the vibrational channel of *P. spumarius* in order to develop, in the future, a tool to disrupt its mating system.

Keywords: *Xylella fastidiosa*, *Philaenus spumarius*, Vibrational communication, Pest management.

838. HAMIE Najwane (Lebanon)

Supervisors: V. Verrastro and L. Tarricone

Title: Extend storage period and maintain quality of organic table grapes produced in Apulia region. – 75 p.

Abstract: Table grapes are perishable and non-climacteric fruits with low physiological activities. During postharvest period, they are susceptible to severe quality loss. Although the application of sulphur dioxide proved to be an effective control method, this is not allowed in organic agriculture. The focus of this study is on maintaining the quality of organic table grapes and extending their storage period, using safe alternative control strategies. The effect of CO₂ pre-treatment at 50%, combined with active Modified Atmosphere Packaging (MAP) with different gas mixtures (18% O₂ - 8% CO₂ and 10% O₂ - 10% CO₂), and improved package with Blow®, smart breathing device, was tested on organic early and late-season table grape varieties, Superior seedless® and Scarlotta seedless®, respectively. Results showed that Blow® was more effective on Scarlotta® than Superior® in terms of O₂/CO₂ gaseous exchanges. Blow® combined with MAP (10% O₂ -10% CO₂) extended the storage period of Superior® till 60 days, with 10% decay incidence, 14.4 (°Brix) sugar content, and 37:1 sugar to acid ratio. In parallel, better effect of Blow® was detected on Scarlotta®, with an extended storage life till 75 days, 6% decay incidence, 16.4 (°Brix) sugar content, and 41:1 sugar to acid ratio, without significant differences between MAP treatments.

Keywords: organic table grapes, quality, storage period, CO₂ pre-treatment, MAP, Blow®.

839. FENNINE Chaymae (Morocco)

Supervisors: N. Baser, G. Anfora and G. Tait

Title: Evaluation of entomopathogenic fungi and sterile insect technique as effective managements of the invasive pest *Drosophila suzukii*. – 75 p.

Abstract: *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) is an alien invasive pest that threatens soft fruits production. To date, it is a key economic pest, which requires urgently, the development of sustainable efficient strategies for its management, considering consumer safety, producers' income and environmental challenges. This study tested the effectiveness of foliar application of *Metarhizium anisoplia*, *Beauveria bassiana*, pyrethrin and potassium silicate, against *D. suzukii* oviposition in tunnel (organic strawberry) and field conditions (organic cherry), as they have been previously proved effective in laboratory conditions in CIHEAM Bari. Moreover, this study evaluated via re-mating experiments, the last sperm precedence in *D. suzukii*, for the development of Sterile Insect Technique (SIT) program. The results showed that *M. anisopliae*, pyrethrin and potassium silicate were not effective against *D. suzukii* in tunnel and field conditions, while *B. bassiana* has significantly reduced *D. suzukii* infestations in tunnel and field conditions. However, it is recommended to study different application methods of these treatments. Furthermore, *D. suzukii* females showed the capability to select and use sperms obtained from previous mating over the sperms gained from the last mating, which is a new finding for this species. Therefore, further research is needed to support evidence-based decision making to integrate SIT in *D. suzukii* management.

Keywords: Spotted Wing *Drosophila*, entomopathogenic fungi, last sperm precedence, biological control.

840. SABRANE Fatima Zohra (Morocco)

Supervisors: P. Pugliese, M.R. Bteich, C. Rota and E. Veen

Title: Assessing vulnerability of urban and Peri-Urban Agriculture (UPA) projects in Morocco - a focus on organic initiatives. – 76 p.

Abstract: Urban and Peri-urban agriculture (UPA) is as old as imperial cities in Morocco. Today, UPA is threatened in Morocco by different pressures and neither acknowledged nor supported by the authorities. The literature reveals that multiple synergies may exist between UPA and organic agriculture (OA) concepts and practices. The aim of the present work was to (i) investigate the origin and degree of vulnerability of UPA projects by assessing the exposure, sensitivity and resilience level and; (ii) to understand the added value of OA in these projects in Morocco. A quantitative and qualitative analysis was performed on four organic UPA projects selected as case studies, using a semi-structured interview which featured the main perturbations found in literature. Hypothesis and Magnitude coding were used and the "NVivo" software helped to code qualitative data. Results show that: (i) 16 out of the 19 original perturbations are confirmed and five new emerged from the field work; (ii) projects vulnerability scores range from 2.5 to 4.1; (iii) OA can bring added value to UPA projects in terms of marketing opportunities and support through networking, but it can also make projects vulnerable when inputs, technical knowledge and marketing skills are lacking. Finally, recommendations are made for policy makers to encourage UPA projects.

Keywords: urban agriculture, organic agriculture, vulnerability, resilience, perturbations, qualitative, quantitative.

841. MOHAMED HUSSEIN Abdi (Somalia)

Supervisors: F. Lamaj and F. Baldacchino

Title: Bioassay of natural substances as alternatives to paraffinic oil for the control of *Planococcus* spp. and their impact on beneficial arthropods. – 50 p.

Abstract: The aim of this study was to evaluate alternative natural substances to paraffinic oil for sustainable control of *Planococcus* spp. and their impact on natural enemies. The repellent and lethal effects of paraffinic oil (a.i. 98.8%), potassium salts of fatty acids (PSFA) (a.i. 47.8%), orange oil (a.i. 5.8%), powder sulfur (a.i. 95%), and zeolite (a.i. 100%) were tested in laboratory bioassays on *Planococcus ficus*, *Cryptolaemus montrouzieri* (Mulsant) and *Anagyrus pseudococci* (Girault). The products with best performance on *P. ficus*, extract of *Chenopodium ambrosioides* (a.i. 16.7%) and black soap (a.i. 100%), were evaluated on *Planococcus citri* as a case study on sour orange plants. In laboratory conditions, paraffinic oil, PSFA and orange oil were effective against *P. ficus* but PSFA was the most effective comparing to the others. Although the orange oil efficacy was lower than paraffinic oil, it was effective against pest and harmless to natural enemies. The results obtained from sour orange plants showed that the products were effective against *P. citri*. However, there were no significant differences between them. These results can propose that, between tested substances, orange oil, PSFA, extract of *C. ambrosioides* and black soap may be good alternatives of paraffinic oil for the control of scale insects.

Keywords: paraffinic oil, mealybugs, essential oils, orange oil, natural enemies.

842. AMEUR Hana (Tunisia)

Supervisors: I. Cavoski, P. Filannino and R. Di Cagno

Title: Date seed flour as value-added ingredient for organic sourdough bread-making. – 51 p.

Abstract: Organic dates production and processing continuously increase in the world generating different by-products such as seeds that have a high potential for the exploitation as novel functional ingredient. This study aimed at setting up a protocol based on sourdough biotechnology to exploit the organic date seeds flour (DSF) as an ingredient for bread-making. Autochthonous lactic acid bacteria (LAB) and yeasts were isolated and identified from DSF, spontaneously fermented DSF dough, and DSF type I sourdough. Among 110 isolates based on their technological performances, *Leuconostoc mesenteroides* DDL1, *Lactobacillus plantarum* DCL9 and *Saccharomyces cerevisiae* DSNc1 and DDNd10 were selected for DSF sourdough bread-making. A novel bread type was developed, which included 20% (w/w) of DSF as substitution of durum wheat flour using selected starters (SDB-DSF). Features of this novel bread were compared to the common counterpart. The combined use of DSF and sourdough biotechnology improved nutritional, texture and sensory features of breads. Based on findings of this study, SDB-DSF bread may be defined as a "high fibre content, source of protein, no added salt and sugar; and traditional bread". These characteristics encourage further development of this, novel and healthy, functional leavened bread.

Keywords: date seed flour, sourdough, by-product, functional bread, organic food.

843. ZAABAR Rihem (Tunisia)

Supervisors: J. Calabrese and A. Scardigno

Title: Evaluation of agroecosystem services: analysis of organic and conventional Apulian farms. – 90 p.

Abstract: Over the last decades the concept of Ecosystem Services has become more and more important as they contribute to human wellbeing thanks to the interactions among biotic and abiotic components of the ecosystems. For this reason, there is growing interest in identifying quantitative indicators and evaluation methods to inform decision-makers and stressing the importance of ESs for long-term sustainability. Agriculture is a major driver of land use change and of degradation of Ecosystem Services. Organic farming relies on natural capital and on Ecosystem Services to achieve sustainable production. The present research identified, quantified and evaluated eleven ESs - among provisioning, regulating and cultural one - delivered by six farms located in Puglia region (Southern Italy) under different management systems, i.e. organic and conventional. By considering only the structure of the farms, their size and the applied specific agricultural practices did not affect our results. Results showed that the value of ESs from organic farms is equal to 6,078.35 euro/ha while the value of ESs from conventional farms is equal to 13,759.19 euro/ha although organic farms performed better in some regulating services such as Pollination, Air Quality regulation and Water purification.

Keywords: ecosystem services; provision, evaluation, farm level, Puglia.

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868. PREBIBAJ Moltine (Albania)

Supervisors: G. Cardone and F. Bottalico

Title: Assessment of the economic sustainability of an organic olive oil farm in Puglia Region (Italy) under the voluntary regional quality scheme. – 77 p.

Abstract: Puglia region is the most important producer of organic olives in Italy. This study mainly aims at assessing the economic sustainability of a selected organic olive oil farm by adopting and testing the methodology of Puglia Region, based on a scientific approach, under the regional Programme "Agricoltura&Qualità". SWOT-analysis of quality schemes' system in Puglia is drawn. The case study concerns an Apulian farm producing olive oil and table olives, and almonds. The results prove the feasibility of the methodological approach to assess the economic sustainability. The farm is economically sustainable and can use the "Economic sustainability" logo, in addition to the organic and PDO logos. Per hectare, almond is the more profitable crop with higher revenue, the variable costs are higher in table olives and inputs are higher in olives for oil. The SWOT analysis highlights that Puglia has not a fully functioning system to ensure the sustainability. The awareness on sustainability, particularly for consumers and policymakers, is still limited. The growing interest in sustainability is an important opportunity to develop the agro-food sector, faced with the economic crisis and the small size of farms. The main recommendation is to apply the methodology on a larger scale for economic sustainability, and also for environmental, socio-cultural and health-nutrition dimensions.

Keywords: Sustainability guidelines; organic farming; olive oil farm; economic indicators; SWOT analysis.

869. MOKRANE Selma (Algeria)

Supervisors: V. Verrastro and K. Djelouah

Title: Alternatives to mineral oils in organic Citrus. – 55 p.

Abstract: Plant derived active compounds are currently receiving an increasing attention for pest management in organic and conventional agriculture, due to their overall reduced impact on the environment and apparently limited or none side effects. Furthermore, research on recently discovered botanically-derived pesticides could open new perspectives for reducing or replacing contentious inputs in organic agriculture, such as the commonly applied mineral oils. The objective of this study was to test the suitability of some plant derived active compounds, such as orange essential oil and Clitoria ternatea extract, beside products commonly used in organic agriculture as mineral oils, azadirachtin, and pyrethrin, for the management of three of the main Citrus spp. pests, namely *Planococcus citri*, *Aonidiella aurantii*, and *Aleurocanthus spiniferus*. Here we report the results of the experiments, further discussing: i) the efficacy of the screened substances; ii) their possible application in Citrus pests management either alone or combined with other products; iii) the immediate and future perspectives for the replacement of contentious inputs as mineral paraffin oils in organic agriculture.

Keywords: organic agriculture, contentious inputs, pest management, botanical pesticides, citrus pests.

870. AHMED Manal Moustafa Hamed (Egypt)

Supervisors: N. Baser, N. Admane and G. Anfora

Title: Preventing postharvest injuries caused by *Drosophila suzukii* on freshly harvested sweet cherries. – 59 p.

Abstract: Effective strategies are required to control spotted wing drosophila (SWD), *Drosophila suzukii*, in sweet cherry fruits due to its adverse economic impact for farmers. Cold treatment and high carbon dioxide (CO₂) treatment are environmentally friendly pest control methods for stored fresh fruits. They are effective in controlling a wide range of insect species without leading to an accumulation of toxic residues. The present study aimed to establish the efficacy of postharvest application of CO₂ treatment at 50% CO₂ level, cold treatment at 4°C (CT), and a combination of both (CO₂-CT) in controlling early stages of SWD on freshly harvested cherry fruits. Additionally, an evaluation of cherry quality attributes (skin firmness, berry firmness, solid soluble content (SSC) and titratable acidity TA) was conducted at harvest and during the storage period after 10 and 20 days. All treatments significantly reduced the emergence rate of SWD compared to the control (untreated cherry at 24 °C) and a 100% mortality of SWD was achieved after 48h with the application of the combined treatment (CO₂-CT). Moreover, quality parameters were maintained during the whole storage period in the samples stored at 4°C and the one with combined treatment compared to the control.

Keywords: High CO₂, cold storage, spotted wing drosophila, quality, sweet cherry, emergence rate.

871. FOUANI Jalal (Lebanon)

Supervisors: V. Verrastro and V. Mazzoni

Title: A Study on *Halyomorpha halys* Parasitoids for the Development of Biological Control Strategies. – 41 p.

Abstract: The brown marmorated stink bug (BMSB), *Halyomorpha halys* Stål, is an invasive, herbivorous insect species that was detected in Italy in 2012, in Emilia Romagna region. It is considered a major threat to European agriculture because it damages many crops. Due to its high mobility, chemical control is considered inefficient. Thus, biocontrol could be a valuable alternative. The aim of this research work was to investigate the occurrence of parasitoids' activity in an area of Trentino region, to assess which species can parasitize BMSB eggs, and to evaluate their potential parasitization rates. The study was conducted from April to August 2019 covering the area from Mezzocorona to Besenello. In a first experiment, fourteen sentinel egg traps were positioned in seven sites. In another experiment, egg masses were directly attached to tree leaves in four sites. The total was 255 exposed egg masses. We found that the second method was more efficient to attract parasitoids. Moreover, besides finding the indigenous generalist parasitoid *Anastatus bifasciatus*, we detected, for the first time ever in Trentino, the alien wasp *Trissolcus mitsukurii*, a species-specific parasitoid of BMSB, native to Asia. This wasp showed a remarkable parasitism rate (73%), suggesting that its employment for classical biocontrol on BMSB would reduce the latter's damages

Keywords: *Halyomorpha halys* Stål, brown marmorated stink bug, parasitoids, biocontrol, *Trissolcus*.

872. MARTINOVIĆ ANĐELA (Montenegro)

Supervisors: I. Cavoski, P. Filannino and R. Di Cagno

Title: Novel organic fermented cornelian cherry smoothie as a potential probiotic beverage. – 76 p.

*Abstract: Various organic non-dairy probiotic foods are available on the market, which are lacking in scientific evidence for health claims. Here, we aimed to provide a novel approach towards the development of potential organic probiotic beverage by fermentation biotechnology instead of "black-box" approach of simply adding probiotic cells. Probiotic potential of ten autochthonous/allochthonous yeast strains isolated from organic fruits was evaluated. *Pichia kudriavzevii* DCNa1 and *Wickerhamomyces subpelliculosus* DFNb6 were selected as best performing starters for setting up the protocol for cornelian cherry smoothie (CCS) fermentation. Yeast viability, the microbiological and physical-chemical stabilities and in vitro functionality were evaluated after the fermentation and during 21 days of storage at 4°C. Final microbial cell density was ca. 8.0logCFU/ml. The fermentation positively affected viscosity (51.5mPa) and color stability of the smoothie. Vitamin C (33.5mg/100ml) and radical scavenging activity (2.7mmolBHT) remained constant, whereas loganic acid and cornuside decreased (7 and 16%, respectively). Alcohols (59%) and esters (33%) were the predominant volatile compounds. Fermented CCS modulated the growth of several cultivable microbial taxa under the in vitro gastrointestinal digestion assay, demonstrating the potential positive effects on human gut microbiota. Overall, the proposed approach might be applied for the future development of several organic potential non-dairy probiotics.*

Keywords: organic fruits; probiotic yeast; fermentation; viability; gut microbiota.

873. EL HILALI Ghita (Morocco)

Supervisors: N. Baser, M. Gallo and A. Bamouh

Title: Efficacy of different bio-fungicides to control Botrytis cinerea: the causal agent of grey mold disease of strawberry in Morocco. – 73 p.

Abstract: Grey mold, caused by Botrytis cinerea, is one of the most important plant diseases of strawberry in Morocco. The aim of this study was to evaluate the efficacy of four bio-fungicides, Orange essential oil, Bacillus amyloliquefaciens D747, Bacillus subtilis IAB/SO3 and Pythium oligandrum M10, against Botrytis cinerea, tested in the laboratory and field conditions. In the laboratory phase, the bio-fungicides significantly reduced the mycelial growth and the conidial germination of the pathogen. The field experiment was carried out on strawberry cv. Fortuna, managed under two management systems (organic and conventional) in Morocco. The objectives of the investigation were to determine the effect of the preparations on the yield, Botrytis cinerea disease control, products persistency and the shelf life of the harvested fruits. Preparations did not show any positive effect on the yield for both cultivation systems. Concerning the conventional system, the products did not significantly reduce the disease incidence compared to the control. Moreover, this parameter was below 1% in the organic system due to the low seedling quality. Therefore, the treatments effect could not be underlined. Regarding the post-harvest parameters, the biofungicides did not have a significant effect on the assessed variables.

Keywords: Fragaria x annanasa, Prev-Am Plus, Amylo-X, Fungisei, Polyversum

874. EL MAHDI Jihane (Morocco)

Supervisors: A. Aly, L. Piscitelli, G. De Mastro

*Title: Bio-herbicidal potential of the essential oils from different *Rosmarinus officinalis* L. chemotypes. – 106 p.*

*Abstract: The current study aimed to assess the allelopathic effect of *Rosmarinus officinalis* L. essential oils (EOs) for utilization in sustainable weed management. The EOs from eight accessions were characterized. Their components were identified by gas chromatography, and four chemotypes were defined; C1 (α -Pinene), C2 (Camphor), C3 (α -Pinene/1,8 Cineole), C4 (α -Pinene/1,8 Cineole/Camphor). Four concentrations of the EOs (400, 800, 1200 and 2400 μ l/L) and the main compounds of each chemotype were tested in laboratory and greenhouse experiments against *Amaranthus retroflexus* and *Lolium perenne* in pre and post-emergence. The most performing EOs were applied in a field experiment at 2400 μ l/L. In the laboratory EOs significantly affected all the tested parameters (germination, early growth, physiological and histological parameters of the weeds under study) in a dose, chemotype and species dependent manner. These effects were considerably reduced under greenhouse and field conditions; C2 and C3 mostly affected weeds and soil microbial biomass under greenhouse, and C3 significantly reduced the weed biomass in post-emergence in the field. The results suggest an important bio-herbicidal potential of *R. officinalis* EOs that can constitute an alternative weed control tool, although further investigations are required under field conditions.*

Keywords: Rosemary, post-emergence, pre-emergence, mechanisms of action, organic weed management.

875. HAMDAN Moheeb H.A. (Palestine)

Supervisors: L. Guarrera and S. Jarrar

Title: Organic farming sector in Palestine: a legislative proposal. – 177 p.

Abstract: The present study aims to propose an organic farming legislation in Palestine that will follow the structure of the new Regulation (EU) 2018/848 of the European Union with some modifications that take into consideration the local Palestinian situation. This will be an attempt to give the Palestinian organic sector and the operators a national law that will allow the development of domestic markets and trade routes with the strategic European market, the second largest organic market in the world and the closest to Palestine. The study will attempt to outline the situation of the Palestinian organic farming sector and explore the obstacles it faces due to the absence of legislation related to the organic farming sector. Additionally, the proposal will analyse the different International standards that could act as a major barrier for exporting third countries, particularly the developing ones that could fail to benefit from the increasing organic market opportunities in developed countries. The results are proposed in a bilateral-comparative table that includes the new EU Regulation and the Palestinian law, proposes a good code of practice and fair trade, and provides recommendations to facilitate the issuing of the Palestinian Organic Law.

Keywords: Palestine, European Union, (EU) 2018/848, legislation, organic regulations, trade barriers, export

876. BAGHDADI Syrine (Tunisia)

Supervisors: R. Callieris and R. Roma

Title: A constant market share analysis of Tunisian olive oil export to EU. What's the contribution of organic olive oil? – 70 p.

Abstract: This study employs constant market share analysis method to examine the competitive position of Tunisian olive oil exports to the European Union market with Spain, Italy, Greece, Portugal, Morocco and Turkey during the two sub-periods of 2008-2012 and 2013-2017. Results indicate that despite the positive overall change in the second period compared to a negative one for the first, in both phases, Tunisia experienced a decrease in its market share adversely affected by a loss of competitiveness and a decrease in the export market size. These two effects showed to be sensitive to the organic olive oil export contribution, the country's political situation, olive oil marketing strategy and trade policies agreements between Tunisia and EU. The analysis of this research concluded that to achieve a sustainable and positive competitiveness for the olive oil exports, Tunisian export strategy should focus first on the development of the product processing and branding to introduce a new image for its national production, and second on new fast growing international markets as Germany, USA and Japan.

Keywords: olive oil, constant market share, competitiveness, organic.

877. GHANNOUCHI Ahmed (Tunisia)

Supervisors: E. Perrino and F. Valerio

Title: Officinal wild Lamiaceae species in Apulia region: Ecology, functional and antimicrobial properties. – 100 p.

Abstract: Four taxa of the Lamiaceae family growing in Apulia (*Clinopodium suaveolens*, *Satureja montana* subsp. *montana*, *Thymbra capitata* and *Salvia fruticosa* subsp. *thomasii*) were analyzed for their ecology, functional and antimicrobial properties against *Aspergillus niger* and *Bacillus subtilis*. Two different sites were surveyed for each species and a phytosociological study was conducted to evaluate the effect of different ecosystems on the composition and bioactivity of essential oils (EOs). A total of 57 compounds were identified, mostly belonging to the terpene group. Among the studied species, the strongest site-dependent differences were observed between *S. montana* samples which had different EOs profiles, phenolic amounts, antioxidant and antimicrobial properties, followed by *T. capitata* samples showcasing different antioxidant and antimicrobial activities. *S. fruticosa* EOs had different chemical profiles depending on the ecological characteristics but similar functional and antimicrobial properties. *C. suaveolens* was the least affected species by ecological conditions and showed no significant changes between EOs. Overall, *T. capitata* and one sample of *S. montana* had the best antioxidant activity, antimicrobial properties and phenolic content. Results indicated that ecological contexts influence the EOs bioactivity. Additionally, *T. capitata* and *S. montana* present promising sources of bioactive compounds that can be exploited in active food packaging.

Keywords: phytosociology, essential oils, antioxidant properties, antimicrobial properties, GC-MS analysis, hydro-distillation.

878. NAJAR Ons (Tunisia)

Supervisors: F. Lamaj, M. Tucci and F. Baldacchino

Title: Vineyards resilience: analysis of biodiversity in cortex of vines cultivated under different management systems. – 43 p.

Abstract: Resilience, which is the ability of an agroecosystem to overcome disturbances, is positively influenced by the complexity of its biodiversity. This study aimed to investigate the potential resilience by analysing arthropod and snail biodiversity on cortex in organic and integrated vineyards. A database was constructed with 30 Apulian vineyards; sixteen organic and fourteen integrated. Firstly, farmers were interviewed to acquire information related to farming practices, followed by arthropods and snails assessment from February to April 2019. Individuals were collected from the vine cortex, identified and organized in three functional groups (herbivores, natural enemies and detritivores). Data were analyzed with Shannon's Index, General Linear Model (GLM), Principal Component Analysis (PCA) and Index Species Association (ISA). Results indicated that the overall insect density was slightly higher under organic than integrated management system. Natural enemies were positively correlated with organic farming system, and detritivores with integrated one. Based on ISA, four taxa, belonging to two functional groups (herbivores and detritivores), were associated with organic, and one taxon with integrated management system. The weed presence had instead a positive influence on the complexity of the trophic web. Thus, potential resilience was more influenced by weed management than the type of farming system itself (organic or integrated).

Keywords: functional groups, complexity, organic farming, integrated management, subcortical arthropods.

904. EMADELDIN Yasmin Mohamed Aboushehata (Egypt)

Supervisors: R. Mohamad, A. Dragotta, R. Roma and A. Abd El-Aziz

Title: Economic and environmental assessment of organic and conventional Fennel production in Fayoum governorate. – 75 p.

Abstract: Agriculture is an important income source in Fayoum governorate particularly for medicinal and aromatic plants. Agriculture is also directly related to the atmospheric CO₂ concentration levels. A comparative study was conducted to assess the economic and environmental performance of organic and conventional fennel production systems. Through a preliminary survey, four farms of each system were identified and were subjected to detailed questionnaires for data collection. Gross margin was used as indicator for profitability, and Greenhouse Gas emissions (GHGs) as environmental indicator. One hectare was used as functional unit and the system boundary was limited to farm gate. Results showed higher profitability in the organic system compared to the conventional one mainly due to the higher revenue thanks to higher premium prices particularly when seeds are oriented to external markets. On the other hand, the organic system showed higher GHGs mainly due to the higher use of compost for fertilization. In both systems, fertilization activity was the main contributor to production costs (45.4% to 51.6% of the total variable costs). It was also the main contributor to GHGs emissions with 80% to 92% of the total, followed by soil preparation and harvesting. However, complete manual harvesting may reduce emissions without compromising the related costs.

Keywords: organic and conventional systems, gross margin, profitability, Greenhouse Gas emissions (GHGs)

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905. ARFA Yasmina (Algeria)

Supervisors: N. Admane, S. Sanzani and S. Babahani

Title: Preliminary research on packaging solutions to maintain postharvest quality of Algerian date fruit (cv. Deglet Noor). – 96 p.

Abstract: The Algerian date cultivar Deglet Noor (DN) is widely consumed and known for its distinctive taste and light translucent colour, meeting high local and international demand. However, DN fruit is seasonal, highly perishable after harvest and exposed to severe quality loss during storage and shipping, which impacts economic value and marketability. The aim of this study was to test the effectiveness of two types of polypropylene film packaging (micro-perforated and non-perforated film) in maintaining the fresh properties of DN fruit collected in three different locations in Algeria. The main quality attributes were measured at harvest time and monthly during four months of cold storage at 4 °C, followed by four days of simulated shelf-life at 25 °C. The results obtained showed a substantial difference in the quality preservation of packed date fruit regardless of film porosity compared to conventional unpacked samples. The application of film packaging prior to storage effectively reduced water loss and preserved Algerian DN physical, chemical, and sensory characteristics. These preliminary results represent the first step towards the development and implementation of an effective packaging solution in Algerian storage facilities.

Keywords: Deglet Noor, packaging solution, quality loss, cold storage.

906. KECIRI Sonia (Algeria)

Supervisors: V. Verrastro, K. Djelouah and D. Cornara

Title: Side effect of new pesticides on natural enemies in organic citrus: a case study. – 51 p.

Abstract: To maintain and boost biodiversity that plays a fundamental role in agriculture production through ecosystem services delivered such as pollination and biological control, organic agriculture is relying on active compounds that are considered environmentally friendly. However, recent studies raised the possible negative impact of allowed pesticides in organic agriculture on natural enemies. In the framework of the European H2020 RIA project RELACS, two products, Orange Essential Oil (OEO) and *Clitoria ternatea* extract (CT), which showed their efficacy against *P. citri* and *A. spiniferus*, were proposed to replace mineral oil in organic citrus orchards. Relatively, this study aimed to assess the lethal and sublethal effect of these new pesticides on the main natural enemies of citrus mealybug, *Cryptolaemus montrouzieri*, and *Leptomastix dactylopii*. During the experimental trials it was demonstrated that OEO had no negative effect on the natural enemies studied, and CT reduced the predation rate of adult and larvae predator ladybeetle without causing any other side effect. Whereas, when OEO was combined with CT, a probable synergistic effect between D-limonene present in OEO and Cycloides Flavonoids in CT, induced lethal and sublethal effects on the ladybeetle and the parasitoid.

Keywords: organic agriculture, biological control, natural enemies, *Cryptolaemus montrouzieri*, *Leptomastix dactylopii*.

907. BJELJAC Marko (Bosnia and Herzegovina)

Supervisors: F. Lamaj and F. Baldacchino

Title: The predator Snakefly (Raphidioptera) on vineyards: bio-ethology and rearing possibility. – 65 p.

Abstract: Snakeflies (Raphidioptera) are generalist predators with long lifecycle and huge numbers of prey. This study is designed to fulfill deficiencies found in the literature related to possible benefits of this predator in viticulture and its use as biological control agent. Bio-ethological aspects of snakefly larvae and specifically their distribution and the structure of overwintering larval population were investigated. The field observations were done in two organic experimental vineyards at CIHEAM Bari that in previous surveys have shown the presence of snakefly larvae and also infestation by *Planococcus ficus*. Results showed homogeneous distribution of larvae, with 2.39 ± 0.37 and 1.79 ± 0.20 larvae/plant in table grape and grapevine, respectively. Moreover, diverse larval stages structure during the overwintering period proved stable population present from several years. The Raphidioptera community found under the bark was dominated by *Parainocellia bicolor* (93.14%) and less by *Raphidia mediterranea* (6.86%) which is found for the first time in vineyards during this study. A small-scale rearing was performed to explore the use of both of them as a biological control agent. Big cages with continuously available food resulted sustainable and effective. Furthermore, snakefly larvae showed a good predation capacity, where *R. mediterranea* performed slightly better than *P. bicolor*. The presence of snakeflies in vineyards contributes to their resilience against pest.

Keywords: Inocelliidae, Raphidiidae, sampling, biological control, resilience.

908. AHMED Islam Mohamed Kamel (Egypt)

Supervisor: H. El Bilali

Title: Sustainability transitions in the Egyptian agri-food system: Analysis of organic agriculture niche through the lens of the Multi-Level Perspective on socio-technical transitions. - 117 p.

Abstract: The agri-food sector plays a significant socio-economic role in Egypt; it represents the main source of income for about 40% of the population. The deterioration of the socio-economic and environmental indicators is increasing pressure on the Egyptian agri-food system (EAFS) to move towards sustainability. The present thesis tackles the dynamics of transition towards sustainability in the EAFS using organic agriculture as a case study. The analysis was performed through the lens of the Multi-Level Perspective on socio-technical transitions (MLP; niche, socio-technical regime, and socio-technical landscape). Data were collected through a systematic literature review and semi-structured interviews with different Egyptian stakeholders. The results show that organic farming is a prominent, yet slow-growing niche in Egypt, which accounts for 2.82% of the total agricultural land. Therefore, there is no genuine transition from the current dual agri-food regime (cf. traditional and intensive agriculture). However, the landscape factors (e.g. climate change, water scarcity, health problems, social unrest) are expected to put pressure on the agri-food regime and create opportunities for organic agriculture niche. Evidence shows that the ongoing transition towards organic,

sustainable agri-food system might be lengthy and slow, and political support results essential for the breakthrough and takeoff of organics in the country.

Keywords: sustainability transitions, multi-level perspective, agri-food system, organic farming, Egypt.

909. ISMAJLI Egzon (Kosovo)

Supervisors: S. Madzaric and E. Gjokaj

Title: Exploring farmers' willingness to convert to organic agriculture in Kosovo – Gjilan region case study. – 53 p.

Abstract: Organic agriculture in Kosovo started back in 2002; however, progress made so far in terms of production area and number of operators is not at a satisfactory level. In general, there are several challenges, such as land ownership, land fragmentation and overall not proper finance, preventing farmers to reach better agricultural outputs. The aim of this thesis is to explore farmers' willingness to convert to organic agriculture and understand their awareness and attitude towards organic agriculture, having the region of Gjilan as case study. Primary data were collected face to face from 170 farmers in Gjilan region through structured questionnaire, using the random sampling technique. Furthermore, in this thesis, evaluation framework "Theory of Change" was used to better describe inputs, outputs, and outcomes, and move to the next steps that would impact further development of the organic sector in Kosovo. The results show that 72% of farmers are willing to convert to organic agriculture. While, regarding awareness, 53% of farmers declared that they know what organic agriculture is. Findings also highlight that personal health (44% agree) and financial viability of the farm (41% agree) are likely reasons to convert to organic agriculture.

Keywords: conversion to organic agriculture, awareness about OA, theory of change.

910. MAZEH Mona (Lebanon)

Supervisors: M. Tucci and F. Famiani

Title: Use of biostimulants to promote growth of young olive trees. – 39 p.

Abstract: In 2019-2020 trials were carried out to evaluate the effects of an organic fertilizer (Grena "olivo special") and two biostimulants ("Idrogrena" and "Idrogrena Energy") on the growth and physiology of young olive trees. Growth was estimated in terms of increase in diameter of the main stem and of the total height of the trees. The experiments were carried out using both potted and field grown trees. The effects of the organic fertilizer, also reported to have a biostimulant action, and the two biostimulants were evaluated with respect to trees treated with urea used as the control. The organic fertilizer was applied entirely at the beginning of the experiment. Urea and biostimulants were applied weekly through fertigation and the latter also through foliar treatments in potted trees and on the soil and through fertigation in field grown trees. The organic fertilizer resulted more effective than urea in promoting the growth of young olive trees. The addition of biostimulants, through fertigation and foliar treatments, to trees treated with the organic fertilizer caused further growth of the trees in the latter part of the season. The effects of the organic fertilizer and biostimulants on the photosynthetic activity were also evaluated.

Keywords: biostimulants, *Olea europaea* L., organic fertilizer, photosynthesis, plant nutrition.

911. ABOU ALI Asma (Morocco)

Supervisors: L. Lamberti and U. D'ambrosio

Title: Social enterprises for Organic Agriculture: Lessons learnt in Morocco. – 81 p.

Abstract: Smallholders in Morocco face several challenges, for instance, the lack of technical knowledge, the inaccessibility of loans, and finally the difficulties to reach the market. The literature reveals that social enterprises are proven effective at supporting smallholders' integration in the formal organic value chain. This study aimed to explore the extent to which social enterprises support the integration of small farmers in the organic value chain in Morocco. A qualitative analysis was performed on four agricultural social enterprises selected as case studies, using an in-depth interview, followed by a thematic synthesis. Results show that: (i) defining what an agricultural social enterprise is in Morocco appears to be tough since the field of social entrepreneurship is at its embryonic stage; (ii) Business Models guidelines seem to be absent in the Moroccan context; (iii) the impacts revealed vary from economic to social and finally environmental impacts; (iv) the challenges identified are financial, human resources challenges, lack of support, cultural challenges, and difficulties to make partnerships; (v) the perspectives of social enterprises working with smallholders are both promising and inconspicuous. Finally, recommendations are made for different actors to help the social entrepreneurship field in the organic sector to grow.

Keywords: Morocco, organic agriculture, social entrepreneurship, smallholders.

912. BENNANI Zineb (Morocco)

Supervisors: L. Piscitelli and D. Mondelli

Title: Valorization of food processing by-products in organic farming to increase soil phosphorous availability. – 54 p.

Abstract: This study covers the use of Food Processing By-products (FPBs) to increase Phosphate-Rock (PR) solubility and soil phosphorus availability. Brewer's Spent Grain (BSG), Citrus-Pomace (CP) and Olive-Pomace (OP) were selected for their abundance, chemical characteristics, economic value and potential alternative use. Treatments BSG, BSG+PR, CP, CP+PR, OP, OP+PR and PR were tested in a bench experiment to study the effect of FPBs and PR on P-release in a simplified system. Subsequently, the above-listed treatments were compared with negative control and commercial fertilizer in soil-plant system. The trials lasted 30 days; the P-water solubility (WSP), pH and matter loss, were periodically measured in the bench experiment, while agronomic performance of rocket salad and soil-P availability was measured in pot experiment. In the simplified system, BSG+PR showcased high WSP probably due to the high content in BSG, while CP+PR and OP+PR presented a significant correlation between WSP, pH and decomposition rate, respectively. Both CP+PR and OP+PR show the best performance for marketable yield and soil available-P and no-significant differences with the commercial fertilizer. Despite the short period of test, the results reveal the good agronomic potentiality of combined FPBs and PR, further study should involve the use of others FPBs and other crops.

Keywords: brewer spent grain, citrus pomace, olive pomace, phosphate rock, rocket salad.

913. ELHORRI Hafsa (Morocco)

Supervisors: P. Pugliese, M. R. Bteich and C. Rota

Title: Developing Group Certification in Morocco: Case study approach. – 93 p.

Abstract: Group Certification (GC) is an approach that facilitates access of smallholders to organic certification. The application of the new EU rules may significantly impact the existing groups of small farmers in developing countries. With reference to the experience of two farmers group projects, the research work aims to i) analyse the target group's characteristics in relation to the new EU Regulation and ii) investigate factors affecting farmers' group participation. Adopting a case study approach, two different methodologies were in parallel used. An assessment was conducted to describe groups with reference to new EU rules on GC, whereas a systematic literature review and an exploratory factor analysis were performed in order to identify factors affecting farmers' participation. Two tools were developed respectively: a checklist detailing new EU requirements for GC and a closed questionnaire. Data were collected by phone interviews with key informants and farmers. According to the first research objective, the two investigated farmers' groups are not mature for an immediate switch to organic group certification. According to the second research objective, several key factors emerged as influencing farmer's group participation. Finally, conclusions and recommendations are drawn for Moroccan organic sector and in methodological terms for further research improvements.

Keywords: group certification, participatory guarantee system, internal control system, exploratory factor analysis, cross case comparison.

914. JABARI Basel F.S. (Palestine)

Supervisors: R. Roma and S. Jarrar

Title: Attitude and behavior of consumers towards organic product: an exploratory study in Palestine. – 61 p.

Abstract: The aim of this study is to know the Palestinian consumer attitude and behavior towards organic product to discover the potential international markets available to Palestinian organic products. A statistical analysis of the data collected from the questionnaires distributed to a sample of 200 consumers of organic products in six Palestinian cities was performed from July to September 2020. The descriptive approach relied on this research to study the relationship between variables. The program SPSS v. Statistician 20 was used to analyze the data and draw conclusions. After data processing using various statistical methods, the results indicate that more than 90% of the Palestinian consumers are aware of organic products and also Palestinian consumers would buy organic products in the future. Several factors would help this choice, including a rise in their income and lower prices of these products. The health factor is one of the most important factors in the purchasing decision. On the other hand, the majority of consumers are not aware of the existence of local standards and certification bodies for organic products, of a logo or mark used to identify Palestinian organic products.

Keywords: organic food, consumer behavior, economic factors, purchasing decision.

915. IBN AMOR Abir (*Tunisia*)

Supervisors: N. Baser, G. Anfora and V.R. Stacconi

Title: Improvement of biological control strategies against invasive *Drosophila suzukii* (Matsumura) by investigating the interactions between its parasitoids. - 42 p.

Abstract: *Drosophila suzukii* threatens soft fruits production. The short generation time of this pest requires several pesticide applications at pre-harvest, which may increase the risk of residues in fruits and remain limited to the crop area. An efficient wide-area biocontrol strategy with specialized agents in invaded areas is therefore required. The aim of this study was to detect the possible occurrence of exotic effective parasitoids of *D. suzukii* by performing a survey in Puglia Region. Moreover, interactions between *Pachycrepoideus vindemiae* and *Trichopria drosophilae*; their efficacy on *D. suzukii* and adaptability when used alone or together on different crops (cherry, strawberry and grapes) were analyzed. The survey confirmed the presence of several pupal and larval indigenous parasitoids. However, no newly introduced exotic parasitoids were recorded in Puglia Region. This result will be useful in risk assessment as well as further studies of parasitoids for application in augmentative biological control programmes. Results from the interaction study showed that *P. vindemiae* and *T. drosophilae* are more efficient against *D. suzukii* when used together. However, in this case, the emergent parasitoids percentage was very low. This result is important to decide whether to release the parasitoids since this practice will not only affect diversity of natural enemies but will also represent an extra-cost for growers.

Keywords: biological control, exotic larval parasitoids, *Pachycrepoideus vindemiae*, *Trichopria drosophilae*, laboratory conditions.

916. JALLALI Shaima (*Tunisia*)

Supervisors: E.V. Perrino, G. Mezzapesa and F. Valerio

Title: Ecology and biological properties of some wild Lamiaceae species of conservation interest: *Satureja cuneifolia* Ten., *Thymus spinulosus* Ten. and *Sideritis italica* Mill. - 76 p.

Abstract: Three taxa of Lamiaceae family, endemic to Puglia region (*Satureja cuneifolia*, *Thymus spinulosus* and *Sideritis italica*) were analyzed for their ecological and antioxidant properties. Two sites were surveyed for *Satureja cuneifolia* and *Sideritis italica* and three for *Thymus spinulosus*. A phytosociological study was conducted to evaluate the effect of plant communities and soil characteristics on the composition and bioactivity of essential oils (EOs). 90 compounds were identified, mostly belonging to the terpene group. The highest antioxidant activity and total phenolic compounds were recorded in *Thymus spinulosus*, which makes it an interesting species for organic agriculture. *Sideritis italica* had different chemical profiles but similar antioxidant property. *Satureja cuneifolia* was highly abundant in both sites despite the different vegetation and topographic data and it had similar chemical composition profiles and low antioxidant activity. The correlation between the EOs antioxidant properties and the EOs composition demonstrated that only the monoterpenoid phenols were responsible for the antioxidant activity. Moreover, results suggested that the ecological context influences the EOs composition and their biological activity, even if a few sites were considered in the study. In particular, the micronutrient composition of the soil resulted to be relevant in the EOs composition and bioactivity.

Keywords: phytosociology, soil characteristics, essential oils, hydro-distillation, GC-MS analysis, antioxidant properties.

917. KHALFI Bassem (Tunisia)

Supervisors: F. Lamaj and F. Baldacchino

Title: Insects as Food and Feed: Sustainable production of yellow mealworms (*Tenebrio molitor* L.) using organic by-products and consumers' behavior study. – 88 p.

Abstract: The objective of this study is to evaluate the effects of organic by-products on the growth performances, reproduction, and nutritional value of *Tenebrio molitor*. Four experiments were assessed. In experiment 1, the effects of 6 pupal weights on adults' reproduction were evaluated. In experiment 2, the effects of 6 diets with different protein levels on larvae, pupae and adults were studied. In experiment 3, the effects of orange peels, dates seeds and olive pomace on larvae were examined. In experiment 4, the consumers' behaviour towards insects as food and feed was evaluated via a survey. Results showed that the progeny production was not significantly affected by the pupal weights nor by the diets protein levels. However, the larval weight gain, the feed conversion ratio and the development time were influenced by the protein contents. Besides, the larval weight gain was significantly higher for the control diet (wheat bran) compared with the experimental diets, and the survival rate was negatively affected by the orange peels diet. High larval protein contents were found for the dates' seeds and orange peels diets. Finally, the survey showed that consumers would accept insects as feed more than food and that they would prefer processed insects.

Keywords: *Tenebrio molitor*, organic by-products, growth performances, reproduction, nutritional value, consumers.

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968. BOUKHALFA Rym (Algeria)

Supervisors: G. Calabrese, M. Vurro, A. Boari, M. Fracchiolla, S. Messgo-Moumene

Title: Assessing the herbicidal activity of some Mediterranean plant species extracts. – 87 p.

*Abstract: Weeds are a major threat for crop production and their control is mostly based on the use of synthetic herbicides that pose environmental risks, result in herbicide-resistant weeds, and are forbidden in organic agriculture. Natural compounds with herbicidal activity could provide suitable solutions and the Mediterranean basin is a partially unexplored source of plants producing bioactive compounds. A screening was performed considering eleven plant species, still scarcely studied for herbicidal properties, common in the Mediterranean area, known for allelopathy or source of bioactive compounds. Investigations aimed at: 1 obtaining plant extracts containing different classes of compounds using three solvents; 2 identifying herbicidal effects on several indicator species for seed germination, seedling growth, direct contact, plantlet uptake; 3 obtaining preliminary indications on application mode; 4 obtaining first information about classes of bioactive compounds in the extracts. Eight species provided active extracts. Extracts from *Artemisia absinthium*, *Cynara cardunculus*, *Dittrichia viscosa* and *Ruta graveolens*, most active on seed germination, underwent fractionation and in vivo bioassays, confirming their potential herbicidal activity. First information about extract composition was achieved. This preliminary study opens the way to further research and applicative investigations of selected species confirming the feasibility of the approach for organic weed management.*

Keywords: Allelopathy, bioherbicides, germination, growth parameters, plant extracts, phytochemical screening.

969. MOUSSAOUI Ahmed (Algeria)

Supervisors: F. Bottalico, G. O. Palmisano, H. El Bilali, K. Abbas

Title: Analysis of the possibility of improving the pastoral milk production system in Setif region, Algeria. – 70 p.

Abstract: The development of dairy production in the semi-arid agro-pastoral zone of Algeria is taking place in a particular environment of public subsidies coupled with the oversized use of concentrated feeds. In this context, the present thesis contributes to a better understanding of the current situation in which pastoral milk production systems in the Setif region are evolving and could be developed, with a particular reference to conversion to organic agriculture. A total of 20 holdings were included in a field survey that was complemented by an online survey with 19 experts. The statistical analysis allowed constructing a typology consisting of three classes of pastoral milk producers; the sources of variation are mainly the farm area, herd size, crops and practices, surface area of pastures, and opinion towards potential conversion to organic agriculture. Both field and online surveys reported socioeconomic and environmental issues that are profoundly modifying the Algerian pastoral systems. This study highlights certain strengths and weaknesses of these

pastoral milk systems and provides diagnostics and recommendations mainly in relation to organic agriculture. The results can be used by decision-makers as well as stakeholders in the agricultural sector at different levels to design strategies from a sustainable development perspective.

Keywords: Algeria, pastoral milk production, semi-arid areas, organic agriculture, sustainable development.

970. ALQADY Rufaida Saber Kamel Hassan (Egypt)

Supervisors: R. Mohamad and R. M. Hamouda

Title: Effect of bio-dynamic, organic and conventional management scenarios on wheat production under Egyptian conditions: an agronomic and economic study. – 70 p.

Abstract: Recently, Egypt is supporting sustainable production systems in the agricultural sector particularly for strategic crops like wheat. A field experiment of three management scenarios, i.e., biodynamic, organic and conventional, was conducted to compare their effect on wheat production in terms of soil fertility, productivity, grain quality and profitability. This study is part of a long-term trial started in 2015 at Sekem, Egypt. Results showed over time significantly higher levels of soil fertility indicators under biodynamic and organic scenarios compared to the conventional one as a result of higher organic matter, bulk density, cation exchange capacity, total and available nutrients, respiration, microorganism population and lower pH and electrical conductivity. Although the yield was significantly higher by 9.5-9.9% in the conventional scenario, grain quality under biodynamic and organic scenarios was significantly higher in terms of size (first class category), total antioxidant capacity, energy and protein contents with lower moisture content. There were no stable significant differences over time between biodynamic and organic scenarios for soil fertility indicator. However, energy and protein contents were significantly higher in the biodynamic scenario. Furthermore, wheat production in the biodynamic scenario was the most profitable followed by organic and conventional scenarios. Finally, the application of biodynamic and organic practices provides significant agronomic and economic benefits for wheat production.

Keywords: Soil fertility, grain quality, yield, gross margin, profitability.

971. FARAG Dalia Hosameldin Mahmoud Ahmed (Egypt)

Supervisors: F. Lamaj, H. Hosny and H. Abou Bakr

Title: The potential of frass derived from the rearing of *Tenebrio molitor* as a fertilizer for organic horticulture. – 62 p.

Abstract: The industrial rearing of insects as food and feed can lead to massive amounts of frass production. This study aimed to valorize the *Tenebrio molitor* frass, as fertilizer in organic horticulture. Four experiments were implemented. In the first two experiments, the amount of frass produced and the impact of the feeding diet on frass nutrient content were evaluated. In the third experiment, a pot trial was implemented to test the effect of frass on green pepper and basil plant growth performance. In the fourth experiment, the frass aqueous extract effect was tested on seed germination. Results showed that 1.4kg of frass was produced per 1kg of collected larvae. The composition of the tested diets mainly influenced the potassium content of the frass. In fact, diets with date seed powder showed

significantly lower potassium content. Application of frass on peppers generally provided better results (SPAD, height, leaf area index, fruit weight) than compost and urea, with the same nitrogen dose. However, all frass treatments on basil gave the highest results only in fresh weight and oil content. Potentially, the frass aqueous extract can promote the early development of seedlings. Therefore, the frass represents a promising fertilizer for organic horticulture.

Keywords: Mealworm, frass, fertilizer, organic by-products, circular economy.

972. MUHAMMED Yasmin Muhammed Refaie (Egypt)

Supervisors: I. Cavoski and T. El-Arabi

Title: Design and development of novel organic yogurt based on medicinal and aromatic plants. – 103 p.

Abstract: The organic Medicinal and Aromatic Plants (MAP) value chain requires the development of novel food products in Egypt. This study aimed to develop novel organic yogurts with added values by using a design thinking approach that includes 5 steps (empathize, design, ideate, prototype, and tests) and involves several actors of the value chain. Anise, fennel, and black seeds were selected during the ideate phase. Based on the results of the prototypes' sensory analysis, the best candidates, yogurt with anise (A1%, w/v) and fennel (F2%, w/v), were selected for optimization in the test phase. Nutritional and functional quality, sensory analysis, and shelf-life were evaluated. Yogurt with MAPs had significantly high fat (A1%+0.3%; F2%+0.5%), carbohydrates (A1%+0.4%; F2%+0.8%), and protein (A1%+0.3%; F2%+0.7%) contents. Moreover, MAPs addition affected the fatty acids and volatiles profile, showing the increase in linoleic and palmitoleic acids, alcohols, esters, and alkanes compared to the control. Moreover, polyphenolic contents and bio-accessibility significantly increased in A1%: +3.3 mg GAE/100gm; +42.5%, and F2%: +5.8 mg GAE/100gm; +52.2%. Consumer sensory analysis showed high overall liking and acceptance of MAP's yogurts. Yogurt enriched with MAPs had extended shelf-lives of 14 days. Overall results encourage further product development of novel yogurts.

Keywords: organic food, design thinking approach, yogurt enrichment, bioaccessibility, sensory analysis.

973. CENA Gjylisha (Kosovo)

Supervisors: S. Madzaric, L. Lamberti and E. Mahmuti

Title: Innovations systems of smallholder farmers for the organic medicinal and aromatic plant sector development in Kosovo. – 65 p.

Abstract: Smallholder farmers in Kosovo represent more than 80% of the farmers' population. They provide important services in terms of food production and natural resource management, but they are struggling for gaining livelihoods. In many areas of the country, farmers are growing their business mainly through organic Medicinal and Aromatic Plant (MAPs) cultivation. It is a growing sector in Kosovo. Understanding the manner these farmers are getting knowledge, information, inputs, and access to markets in the MAPs sector, in particular in the organic segment, is important to orient governmental, non-governmental, and private efforts in terms of policies, programmes, and projects. The present research work, using a case study approach, explores the innovation systems that are supporting smallholders in the MAPs cultivation, processing, and marketing in three regions in Kosovo. Results indicated that smallholders increase their business in the MAPs

sector by adopting a range of innovations at the cultivation, processing, and marketing stages. International companies and organizations, local NGOs, local entrepreneurs, processing/collection points, and other farmers are the actors interested to work with or for smallholders, and they are identified as key drivers of these innovations. On the contrary, in Kosovo, there is an absence of governmental and/or research actors impacting the innovation systems.

Keywords: smallholder farmer, agricultural innovations, agricultural innovation systems, innovation process, support mechanisms.

974. KARI Zeina (Lebanon)

Supervisors: V. Verrastro, L. Tarricone and E. Choueiri

Title: Evaluation of the effectiveness of innovative organic formulations against powdery and downy mildew in Lebanese viticulture. – 90 p.

Abstract: Today Lebanese viticulture ranks eighth in the agricultural sector where powdery and downy mildew are the most economically significant diseases of grape varieties. In fact, due to the lack of technical know-how in controlling these diseases under organic regulation, winegrowers use a wide range of phytosanitary products regardless their ecological cost in order to reduce any loss of harvest. Therefore, the objective of this work was to assess the efficacy of using micronized sulfur, copper hydroxide, potassium bicarbonate, *Bacillus pumilus* and *Bacillus amylolequeficiens* in preventing and controlling powdery and downy mildew infection with the usual behavior of the farmers. The experiment was conducted in the season 2021, in two vineyards located in the Bekaa Valley planted with varieties susceptible to powdery mildew namely Chardonnay and Tempranillo. Three different treatment programs from leaf development until the harvest were evaluated for their effectiveness against powdery and downy mildew. Among these three treatments, two were compared to the standard farmer program. All the three spray programs did not show any incidence on the severity of powdery and downy mildew on the leaves or on the grapes. To be precise, the 2021 vintage was a year with very low mildew pressure given the weather conditions unfavorable to the development of the fungus.

Keywords: Lebanese viticulture, powdery mildew, downy mildew, organic formulations.

975. OTHMAN Nadine (Lebanon)

Supervisors: L. Piscitelli, T. Atallah and B. Sukkariyah

Title: Assessment of chemical indicators of soil quality in Lebanon: A preliminary study about the impact of organic farming. – 60 p.

Abstract: Organic farming has proven its efficiency in the enhancement of soil quality and the amelioration of its parameters. The deterioration of Lebanese soil quality due to the adoption of conventional farming practices promoted this investigation of the role of organic farming in its recovery. Soil samples were collected from conventional and organic farms, cultivating annual and perennial crops, situated in Bekaa valley, and Mount Lebanon. Soil analysis revealed that organic-perennial samples had significantly higher amounts of organic matter, and mineral-associated organic matter compared to organic-annual ones. On the contrary, no significant difference was observed in exchangeable cations between organic-perennial and organic-annual crops. Furthermore, no significant effect was observed neither for farming, cropping systems nor for their interaction on soil

quality indicators. In fact, organic farming enhanced soil quality; yet further research work that considers a higher number of soil samples is needed for better comprehension of the effects of cropping systems on soil quality. This study coincided with the peak time of the financial crisis in Lebanon and demonstrated some abandonment of organic farming. This aspect was rapidly investigated through a discussion about the sustainability of organic farming in times of severe crisis.

Keywords: Perennial crop, annual crop, farming system, soil organic matter, mineral-associated organic matter.

976. EL GHMARI Hamza (Morocco)

Supervisors: H. El Bilali and R. Harbouze

Title: Pathways of transition to organic agriculture in Morocco. – 59 p.

Abstract: Agriculture is a vital sector in Morocco, contributing 13% of the gross domestic product and employing around 70% of the workforce in rural areas. Moroccan agricultural development programmes aim to improve farmers' livelihoods by encouraging the valorisation of small farms and rural areas through the development of geographical indications, cooperatives, and organic farming. This thesis describes the dynamics and development process of the organic farming niche in Morocco through the lens of the Multi-Level Perspective (MLP) on socio-technical transitions. The analysis is based on the MLP framework while secondary data are collected from the available literature and primary data from semi-structured interviews with key actors in the Moroccan organic farming sector. Results show that although the organic niche is established, it is still developing at a slow pace due to a variety of obstacles, namely organisation weakness, lack of organic inputs and misinformation around the topic of organic farming. In addition, the transition to organic agriculture in Morocco is likely to follow a 'transformation pathway' due to the niche/regime synergy and the type of external pressures. Overall, organic agriculture is in its early stages and has to overcome multiple challenges before it can achieve its full relevance in the current agri-food system.

Keywords: sustainability transitions, multi-level perspective, agri-food system, organic farming, transformation pathway.

977. EL TOUSY Salah-Eddine (Morocco)

Supervisors: R. Callieris, D. Gasc and R. Harbouze

Title: Organic wheat supply-chain in Morocco: State of affairs, market opportunities and challenges. – 74 p.

Abstract: The organic wheat supply chain in Morocco is still at an early stage of development. Moreover, most organic food products on the national market are imported, while local supply is atomised and scarce. This study aims to explore the current state of development of the organic wheat supply chain, to map goods and information flows and to discuss market opportunities and challenges. The literature on organic agriculture in Morocco has not focused enough on organic wheat and field crops in general, as other high added value crops are more developed in the country. Therefore, semi-structured interviews were conducted with key stakeholders regarding seeds and agricultural inputs, production, processing, distribution and finally consumption of organic wheat products. A qualitative analysis of the responses helped identify the different levels of complexity of the organic wheat supply chains in the country, highlight the need to

increase local supply to meet the growing national demand, and outline the opportunities and challenges facing the supply chain. Finally, recommendations for further development of the wheat supply chain were provided targeting the different relevant operators.

Keywords: organic agriculture, wheat, supply chain, Morocco.

978. ESSADKI Wail (**Morocco**)

Supervisors: N. Baser and A. Bamouh

Title: Screening of pest and disease management strategies for controlling *Botrytis cinerea* and *Tetranychus urticae* in organic strawberry cultivation in Morocco. – 77 p.

Abstract: The fungus *Botrytis cinerea*, the causal agent of grey mold, and the mite *Tetranychus urticae* are the most important disease and pest of strawberry in Morocco. This study tested the efficacy of commercial bio-fungicides (Polyversum, Prev-Am Plus, Ovalis Rhizofertil, Fungisei, granulated Silica and Amylo-X) against *Botrytis cinerea* and bio-acaricides (Prev-Am Plus, Nettle manure), as well as predator (*Phytoseiulus persimilis*), against *Tetranychus urticae*. A field experiment was carried out to test a few management strategies on strawberry against *Botrytis cinerea* (cv. Fortuna) and against *Tetranychus urticae* (cv. Sabrina). Both cultivars were managed under organic system in Morocco. The objectives of the investigation were to determine the effect of the preparations against grey mold and red mites on strawberry yield, on the control of the disease and pest and on products persistency. Treatments did not show any positive effect on the yield, except for granulated silica. Treatments with *Bacillus subtilis* significantly reduced disease incidence with respect to control and showed to be a persistent product. The first-year experiment validated the efficacy of *Bacillus subtilis* under laboratory conditions. Moreover, treatments with all products against *Tetranychus urticae* significantly reduced infestation compared with control. In particular, treatment with *Phytoseiulus persimilis* was the most effective.

Keywords: Grey mold, red mite, *Fragaria x annanasa*, bio-fungicide, bio-acaricide.

979. JARRAR Enas B. A. (**Palestine**)

Supervisors: M. Tucci, F. Famiani, S. Jarrar and R. Alkowni

Title: Evaluation of the effects of different biostimulants on olive: growth of young potted trees and *in vitro* explant proliferation. – 63 p.

Abstract: *In-vivo* and *in-vitro* experiments were carried out to evaluate the effect of biostimulants on olive growth. In the *in-vivo* experiment, two biostimulants based on peptides/amino acids were used on young potted olive trees. The control trees received the same amount of nitrogen as contained in the biostimulant. The stem diameter, tree height and biomass (at the end of the experiment) and photosynthetic activity of the leaves were determined. There was no significant difference between the trees treated with the biostimulants and the control ones. Further studies would be useful to test other concentrations and application times. In the *in-vitro* experiment a biostimulant based on protein hydrolysates was applied by soaking the explants in a solution containing different concentrations: 1.5, 3.0 and 6.0 g/L. The effects of treatments were evaluated by determining the number, length and weight of proliferated shoots and their multiplication rate. The most effective concentration of the biostimulant was 3.0 g/L, which also gave better results than the control. The control solution had received the same amount

of nitrogen as the biostimulant, demonstrating that the effects were due to the biostimulant and not to the nitrogen.

Keywords: in-vitro culture, biostimulants, olive tree growth, *Olea europaea* L, propagation, protein hydrolysates.

980. ABDELKEFI Fatma (Tunisia)

Supervisors. E. V. Perrino, G. Mezzapesa and K. Ben Mahmoud

Title: *Beta macrocarpa* Guss. in Tunisia: nutritional properties, *in-situ* investigations, and *ex-situ* conservation, with prospects for organic agriculture. – 89 p.

Abstract: The aim of this study is to valorise and preserve the Tunisian *Beta macrocarpa* taxon. This species is an endangered Mediterranean crop wild relative (CWR). The valorisation of this taxon entails the determination of nutritional and functional properties of the plant's edible parts. Therefore, soil and plants samples have been collected from three different bioclimatic sites in Tunisia: Enfidha (Centre), Kerkennah island (South) and Sijoumi (North). The proximate composition analysis showed that *Beta macrocarpa* shoots collected in Sijoumi had the highest carbohydrates, crude fibres contents as well as the highest energetic value. Analysis of minerals revealed that plants sampled in Kerkennah displayed the highest mineral accumulation, especially as regards Na, K, Ca and Mg. Based on the functional properties analysis, Kerkennah proved to be the site with the highest polyphenol and flavonoid contents and the highest antioxidant activity. The research was further completed with *ex-situ* conservation of some *B. macrocarpa* accessions. To that end, seeds were collected in August 2021 in Sijoumi, and their germination ability was tested before storage at the INRAT seed bank.

Keywords: *Beta macrocarpa*, crop wild relative, valorisation, conservation.

981. BOUKHRIS Nacer Mehrez (Tunisia)

Supervisors: F. Bottalico, G. O. Palmisano, H. El Bilali, M. Tarhouni, M. Fetoui

Title: Sustainability of pastoral systems in the collective rangeland of El Ouara Tataouine, southern Tunisia. – 101 p.

Abstract: The cultural, economic, and environmental benefits of pastoralism have been largely underestimated. This research aims to emphasize pastoralists' contributions to social welfare and economic performance. The socio-economic status of pastoral systems in the collective rangeland of El Ouara Tataouine, southern Tunisia, was investigated using a semi-structured survey schedule constructed on PESTLE (Political, Economic, Social, Technological, Environmental and Legal) analysis of the literature review. Furthermore, a number of provisioning services and recreational opportunities were also assessed. A wealth index was developed using the principal component analysis (PCA). The wealthiest category, which is limited to the age groups between 40 and 60 years, is mostly considered to be livestock owners. In addition, herds' association proves to be an ideal consensus for wealth accumulation. A cluster analysis revealed three classes: (i) owners and not-practicing association with large goat herds (ii) herders with large-sized sheep and camel flocks (iii) large breeders owning diverse livestock herds. Owners are well-versed in agroecology. As a result, land privatization and training of young pastoralists in sustainable pastoralism and agriculture may reduce excessive rangeland use. However, pastoralists expressed concern about the lack of value chains for wool, milk and other products and recreational opportunities.

Keywords: Socio-economics, pastoralism, rangeland, Wealth index, ecosystem services.

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1003. MAHMOUD Zuhair Nabil Abdelhady (Egypt)

Supervisors: E.V. Perrino, A. Trani, F. Valerio, R. Wagensommer

*Title: Ecology, conservation, metabolomics, potential use and valorisation of *Lagoecia cuminoides* L. and *Stachys italica* Mill. from Italy. – 71 p.*

*Abstract: Two species growing in Apulia belonging respectively to the *Apiaceae* family (*Lagoecia cuminoides*) and to the *Lamiaceae* family (*Stachys italica*), never studied before for their potential use in the food sector, were analysed for their ecology and biological activity. A phyto-sociological and ecology study was conducted in two different sites for each species followed by antioxidant activity assessment and chemical characterisation of their constituents. Results indicated that they grow in rocky habitats in peculiar environments, and showed significant antioxidant activity, with particular regard to *S. italica*. Twenty non-volatile compounds of high antioxidant activity and 79 volatile compounds were identified in both taxa, mostly belonging to the terpenes and flavonoid groups. Both species are characterized by compounds known for health effects and then can have potential applications in the pharmaceuticals and nutraceutical industries. *S. italica* can be used as a tea for the interesting high antioxidant capacity of its water infusion extract. Moreover, these two species have the potential to be organically grown in rural areas. Their valorisation plays an important role in enhancing native territories for any community development program in the future.*

Keywords: Development, phytosociology, Antioxidant, LC/MS, GC/MS.

1004. HAMOUCHE Zeinab (Lebanon)

Supervisors: V. Verrastro, K. Djelouah, S. Avosani and D. Cornara

Title: Effects of biopesticides on aphid feeding behavior and potential consequences for plant virus transmission. – 78 p.

*Abstract: Aphid-borne plant viruses represent a major concern for agricultural production systems worldwide. Effective management of these viruses requires in-depth investigations of insect vector behaviors, i.e., stylet activities conducive to virus transmission. The residual effect of 11 biopesticides, including plant extracts, entomopathogens and fungicides, on *Aphis gossypii* (Glover) feeding behavior was monitored using the Electrical Penetration Graph technique (EPG). Aphid feeding behavior was recorded for 8 hours on the treated zucchini plant, and aphids were then transferred onto the untreated plant for an additional EPG-assisted observation period (8h). EPG recordings showed that *Bacillus thuringiensis*, the mixture of orange essential oil (OEO) and *Clitoria ternatea* (CT), mineral oil, potassium salts and pyrethrin altered aphid feeding behaviors related to plant recognition and acceptance. Overall, considering the known behavioral patterns conducive to aphid-borne virus transmission, *B. thuringiensis*, OEO+CT mixture, and pyrethrin might play an important role in limiting the transmission of non-persistent and semi-persistent non-phloem-restricted viruses. Moreover, *B.**

thuringiensis, mineral oil, and pyrethrin treatments could effectively reduce the transmission of semi-persistent phloem-restricted and persistent viruses. Results suggest that, even if not acutely toxic, biopesticides alter aphid-feeding behaviors conducive to virus transmission and might affect virus epidemiology.

Keywords: Electrical Penetration Graph technique (EPG), biopesticides, *Aphis gossypii*, feeding behavior, virus transmission.

1005. SFEIR Rita (Lebanon)

Title: Smart biological pest management: *Tuta absoluta* in Lebanese tomatoes. – 60 p.

Supervisors: V. Verrastro and M. Frem

Abstract: Since 2010, Lebanese tomatoes production has been threatened by the tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). In this context, this study aimed to evaluate the effect of six safe biological treatments (*Bacillus thuringiensis*, orange essential oil, pepper & garlic extract, pepper extract, garlic extract, and olive soap) in the management of *Tuta absoluta* on Lebanese tomatoes in organic open field conditions. Plants were treated after the first mines of this pest appeared on leaves. We then compared the significant ability of the six treatments to reduce infestation on leaves and weight loss of tomatoes fruits, in comparison with the untreated control. The results revealed that *Bacillus thuringiensis* treatment presented the lowest impact on tomato leaf infestation reduction and, was the most effective treatment in protecting the tomatoes plants, with at least reduction in weight loss of tomatoes fruits. The orange essential oil resulted as the second most effective treatment, followed by pepper and garlic extract mixed with organic olive oil soap, pepper extract mixed with organic olive oil soap, garlic extract mixed with organic olive oil soap, and organic olive oil soap. Therefore, the first two treatments are relatively effective and economically viable to organically control *Tuta absoluta*.

Keywords: Lebanon, organic agriculture, organic pest control, sustainable agriculture, *Tuta absoluta*.

1006. JRAIFI Chaimae (Morocco)

Supervisors: N. Baser, G. Anfora, M.V. Rossi Stacconi

Title: Laboratory and field experiments to improve classical biological control of *Drosophila suzukii* using *Ganaspis brasiliensis*. – 89 p.

Abstract: *Drosophila suzukii* (Matsumura) is an invasive pest that causes significant losses on fruit crops. The most common control method, insecticide application, has many limitations. In contrast, classical biological control through the introduction of specific co-evolved parasitoids from the host's native area is one of the best strategies to ensure sustainable and durable pest management. In this study, the adaptability and establishment of the introduced larval parasitoid, *Ganaspis brasiliensis* (Ihering) (G1 lineage), were evaluated in open field conditions in Apulia, Italy. Two other experiments were conducted under laboratory conditions to investigate the effect of host density on parasitoid parasitization and to provide information concerning developmental parameters and parasitization efficacy at different temperatures. *Ganaspis brasiliensis* was absent in sentinel traps and in sampled fruits. Meanwhile, *Leptopilina* spp. emerged from fresh fruits. Furthermore, host densities did not affect the parasitization performance of *Ganaspis brasiliensis* or the proportion of emerged wasps. Regarding the effect of

temperature, the parasitoid range of activity was [10; 30] °C, with best performances at 24° and extreme inactivity at 5°. Based on these findings, further investigations on the climatic effects on parasitoid activity as well as the biological parameters that influence the parasitoid activity are essential to improve biological control against *D. suzukii*.

Keywords: Exotic biocontrol agent, Figitidae, G1 lineage, Temperature effect, Host density effect.

1007. MEJBRI Zina (Tunisia)

Supervisors: F. Lamaj and F. Baldacchino

Title: Application of frass as fertilizer in organic viticulture: effects on the plant growth and on soil microarthropods. – 72 p.

Abstract: Soil fertilization is critical for achieving the high yields required to feed an ever-increasing human population. Frass, a by-product of insect farming, may have a great potential as organic biofertilizer. This study aims to evaluate the fertilizing effect of *Tenebrio molitor* (L.) frass on organic vineyard. A field trial was implemented to compare the effect of mealworm frass and organic fertilizer (Phenix) with the same nitrogen dose, and control (unfertilized), on soil microarthropods and plant growth. Results showed that frass application gave QBS_ar value higher than the other treatments; however, it is not significantly different. Although not statistically significant, frass applications increased SPAD and shoots growth in general. Only one variety, Uva di Troia, demonstrated that frass significantly performed better than control and Phenix. Primitivo and Chardonnay varieties showed significantly better results than Phenix only for chlorophyll content parameter. Regarding sugar content and berries weight, frass resulted similar to Phenix. Despite the difficulty of detecting a short-term impact for an organic fertilizer, the results indicate that frass has a faster mineralization and high nitrogen availability, making it a promising fertilizer for vineyards. However, long-term experiments may quantify the significant positive effect of frass on plant growth and soil microarthropods.

Keywords: Frass, mealworm, biofertilizer, grapevine, QBS_ar.

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