OLIVICULTURA

4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops

Córdoba, Spain, 1 to 4 June 2009

JUNTA DE ANDALUCIA
CONSEJERÍA DE AGRICULTURA Y PESCA

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4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops

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4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops
Córdoba, Spain, 1 to 4 june 2009

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Dear Colleagues,

It is with great pleasure that we invite you to participate in the **4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops**. This meeting, which has been organized on behalf of the International Organization for Biological Control of Noxious Animals and Plants, West Palaeartic Regional Section, will be held in Córdoba, Spain, from June 1 to 4, 2009.

We have reserved a splendid venue at the University of Córdoba and assembled an attractive and up-dated scientific program, which we truly hope will be of your interest. We anticipate having around 150 attendees and we have organized a program to present state-of-the-art research in a manner that would encourage dialogue and debate among junior and senior faculty—*bringing together olive crop entomologists and pathologists with the aim of providing an overall Olive Crop Protection approach*. For that, our aim was to cover, through five sessions of oral communications and their corresponding poster sessions the key aspects of the knowledge currently available above pests and diseases affecting olive crops worldwide. We acknowledged, however, the difficulty of predicting what new developments and hot topics might emerge in the coming months.

This conference is being held in Córdoba, an historical inland city located in Andalusia (at the Southern part of Spain), with a privileged climate and very well connected via high-speed train with some of the major Spanish airports, such as Madrid, Seville and Malaga. We are certain that the unique combination of the Roman, Arabic and Jewish heritage, together with the facilities of a modern city, will make your stay at Córdoba pleasant and enjoyable. We, at the Organizing Committee, have worked to provide attendants not only with a top scientific program, but also with a quite interesting technical visit that will allow getting knowledge on how olive crop technology is evolving in Andalusia.

We invite you and your colleagues to join us in Córdoba in the spring of 2009 and participate in the **4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops**. We are certain that your attendance would foster a fruitful exchange of scientific ideas, forge new friendships, and encourage future collaborations in this active and field of olive crop protection. We look forward to seeing you in Córdoba in June of 2009.

Enrique Quesada Moraga

President of the Organising Committee of the 4th European Meeting of the IOBC/wprs working Group Integrated Protection of Olive Crops.

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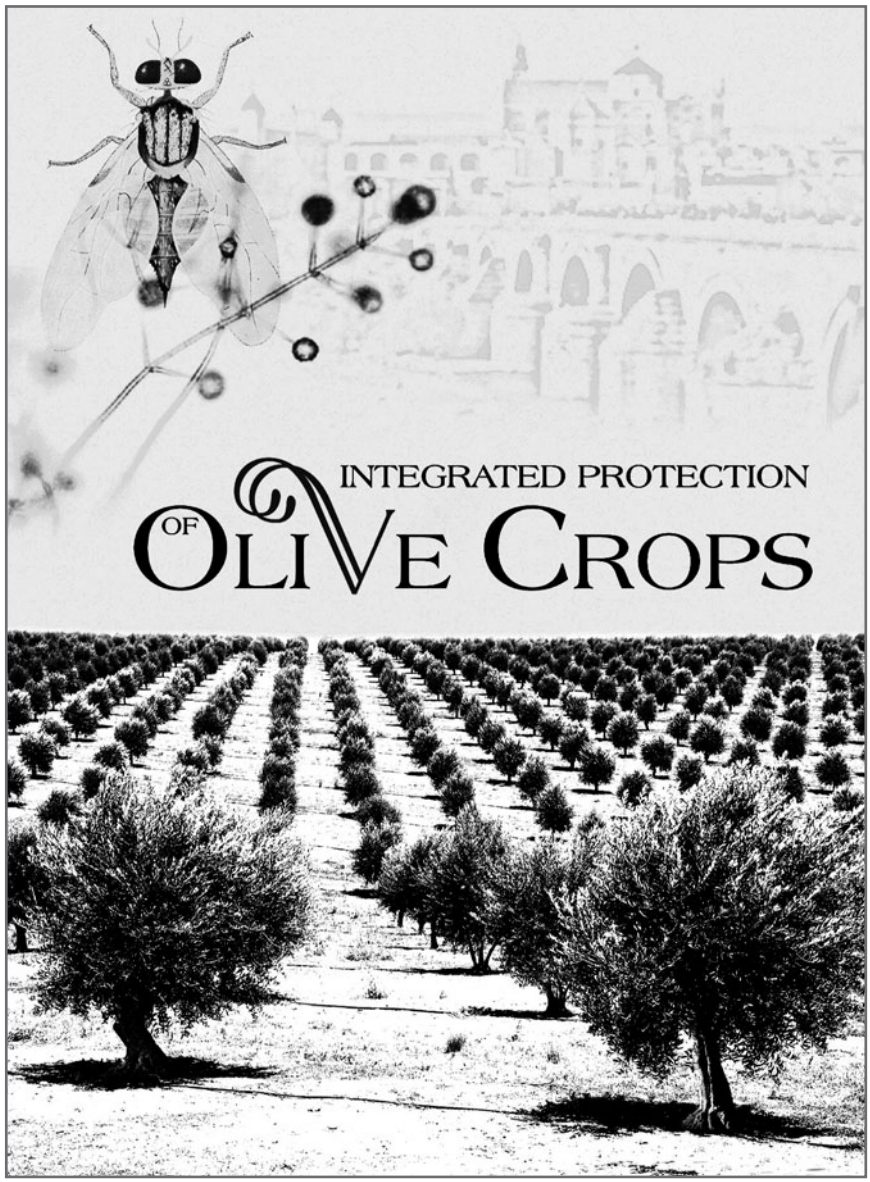

PROGRAMME

PROGRAMME OF THE 4TH EUROPEAN MEETING OF THE IOBC/WPRS WORKING GROUP "INTEGRATED PROTECTION OF OLIVE CROPS"

Monday 1 June 2009

17:00 – 19:00	Registration

Tuesday 2 June 2009

08:30-09:15	Registration
09:15-10:00	Opening Ceremony
10:00-10:15	IOBC Organization and Aim
10:15-11:00	**Keynote address:** **Can climate change have an influence on the occurrence and management of olive pests and diseases?** *Speaker: Andrew Paul Gutiérrez* *Chairman: Cándido Santiago Álvarez*
11:00-11:30	Coffee break
11:30-13:45	**Session 1:** **The olive pest and disease status around the world** *Chairmen: Blanca Landa del Castillo and Antonio Belcari*
11:30-12:15	**Plenary lecture:** VERTICILLIUM WILT OF OLIVE: PROBLEMS AND PROSPECTIVES *Speaker: Rafael M. Jiménez Díaz*
12:15-12:30:	**O 01.** FACTORS DETERMINING THE INCIDENCE OF *VERTICILLIUM DAHLIAE* VEGETATIVE COMPATIBILITY GROUPS AND PATHOTYPES IN OLIVE ORCHARDS AT SOUTHERN SPAIN *Navas Cortés, J.A.; Olivares, C.; Trapero Casas, J.L.; Landa, B.B.; Jiménez Gasco, M.M.; Jiménez Díaz, R.M.*
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13:15-13:30	**O 05.** THE ISSR USEFUL MOLECULAR TOOLS FOR OLIVE FLY STUDIES *Ochando, M.D.; Rodríguez, S.; Hernández, S.; Callejas, C.*
13:30-13:45	**O 06.** STUDY ON THE EFFECT OF OLIVE FRUIT FLY ON SOME QUALITATIVE AND QUANITATIVE CHARACTERISTICS OF OLIVE OIL IN DIFFERENT STORAGE DURATION *Nouri, H.; Darbehaniha, Z.*
14:00-15:30	Lunch
15:30-17:00	**Session 1: The olive pest and disease status around the world** *Chairman: Esmat Hegazi and María Dolores Ochando*
15:30-16:00	**Plenary lecture:** OLIVE DISEASES AND DISORDERS IN AUSTRALIA *Speaker: Robert Spooner-Hart*
16:00-16:15	**O 07.** ENDOPATHOGENIC LIFESTYLE OF *PSEUDOMONAS SAVASTANOI* PV. *SAVASTANOI* IN OLIVE KNOTS *Rodríguez Moreno, M.; Jiménez, A.J.; Ramos, C.*
16:15-16:30	**O 08.** PESTS THAT AFFECT THE OLIVE ORCHARDS AT TERCEIRA ISLAND, AZORES *Horta Lopes, D.J.; Pimentel. R.; Macedo, N.; Martins, J.T.; Zorman, M.; Ventura, L.B.; Aguiar, M. H.; Mumford, J.; Mexia, A.M.M.*
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17:30-19:00	**Poster exhibition and general discussion (Session 1)** *Chairmen: Maria Pappas and Patricia Sacchetti*
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21:00	Córdoba Town Hall reception at "Alcázar de los Reyes Cristianos"

Wednesday 3 June 2009

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18:30-20:00:	**Poster exhibition and general discussion (Sessions 2, 3 and 4)** *Chairmen: Antonio Ortíz and Mario Porcel*
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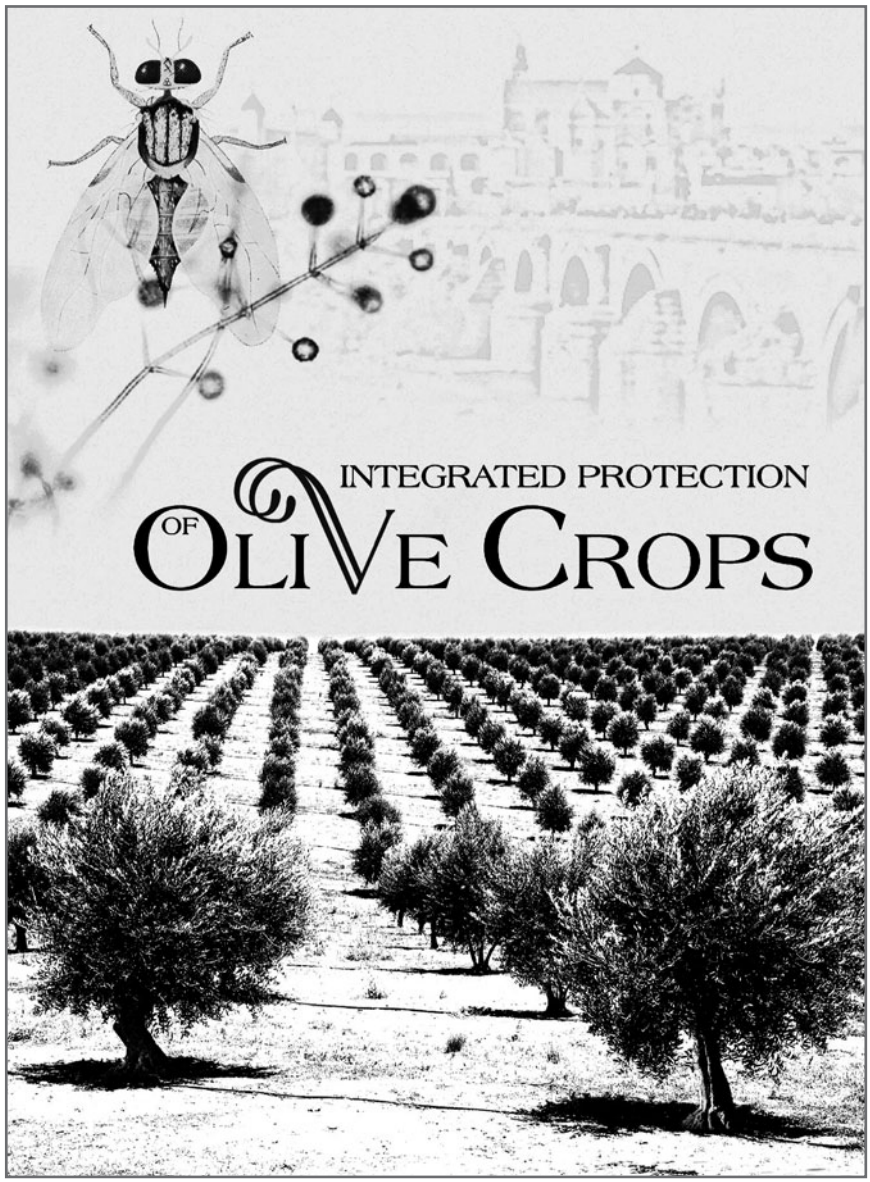

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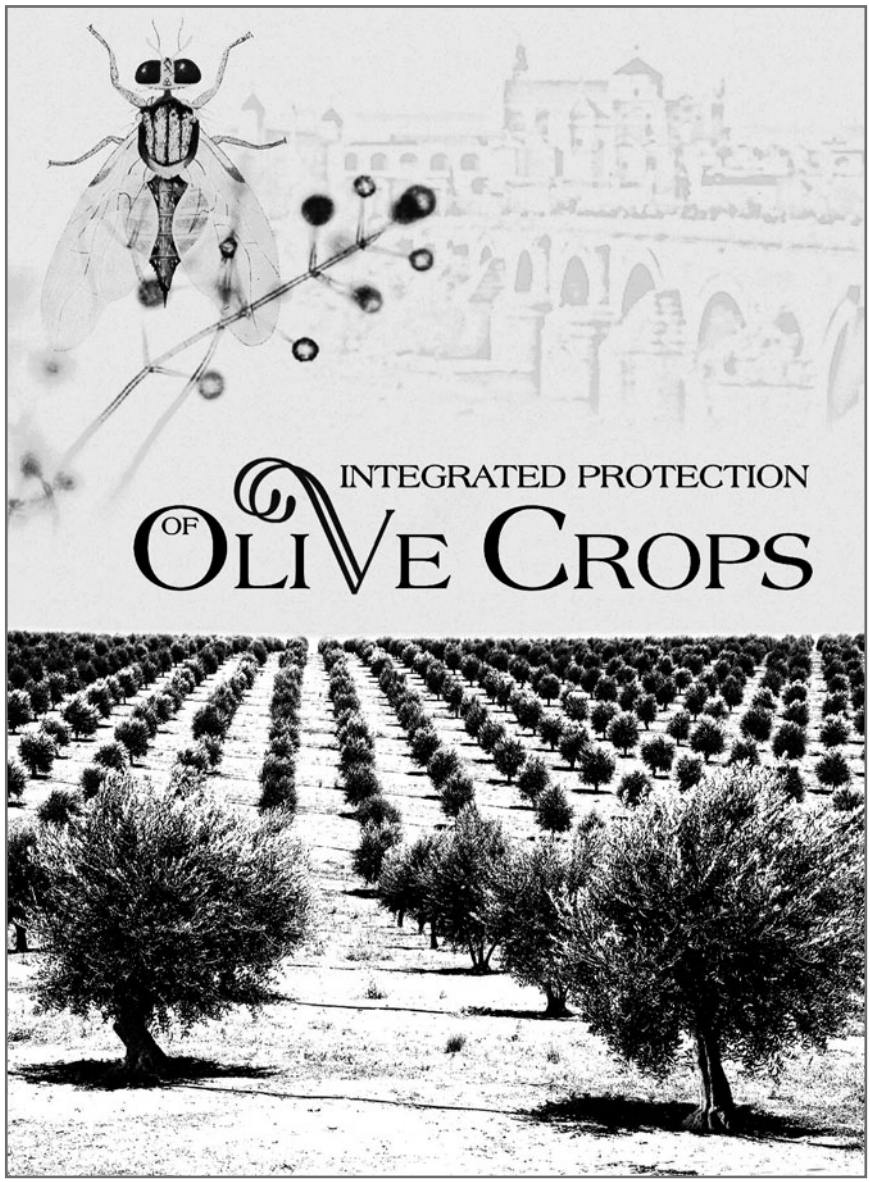

KEYNOTE ADDRESS ABSTRACTS

CAN CLIMATE CHANGE HAVE AN INFLUENCE ON THE OCCURRENCE AND MANAGEMENT OF OLIVE PESTS AND DISEASES?

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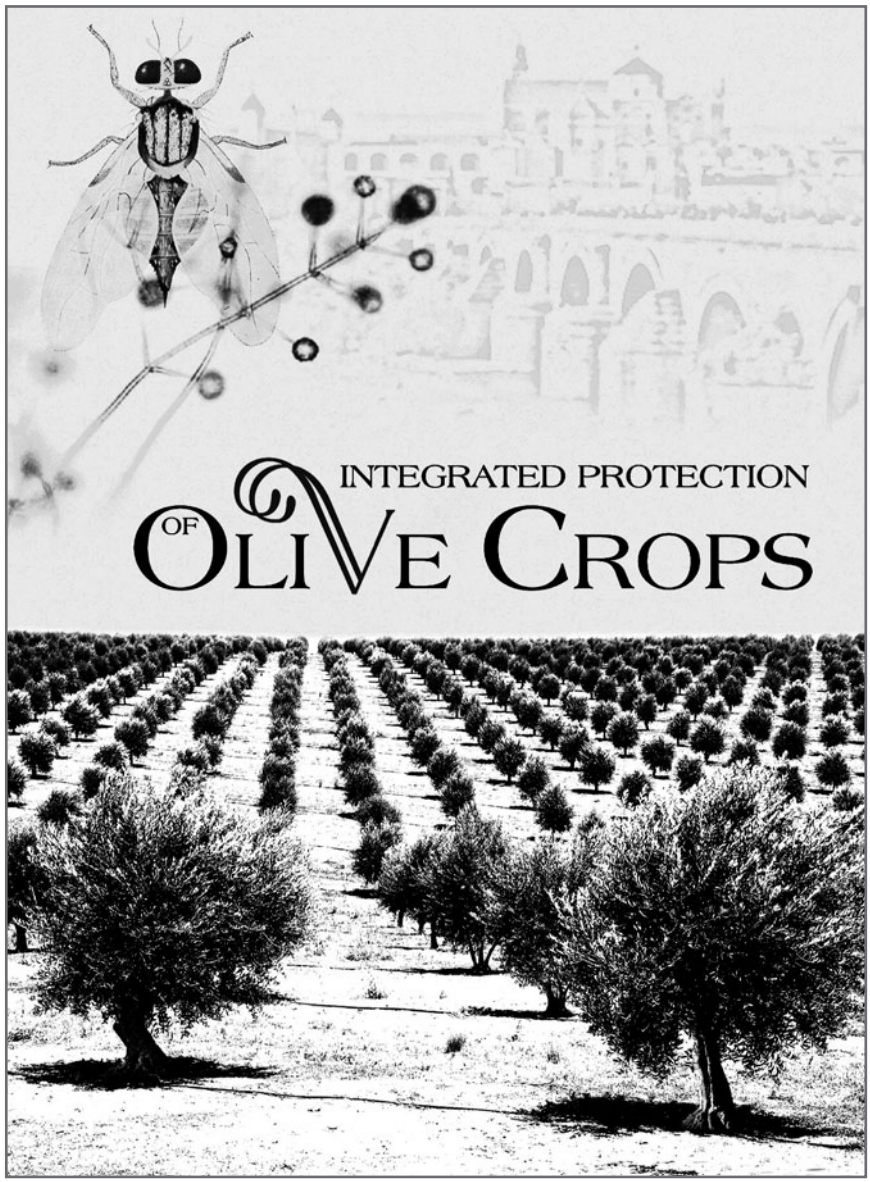
Climate change will make the Mediterranean Basin vulnerable to desertification, and this will affect many species such as olive (*Olea europaea*) in largely unknown ways. Olive was domesticated in the Mediterranean region where it has immense eco-social importance that has spread to other Mediterranean climates worldwide. Olive is drought-resistant and heat tolerant and it is the base of a tri-trophic food web that includes pest, disease and their natural enemy species, each of which will be affected differently by climate change. Among these species are the olive fly (*Bactrocera oleae*), oleander scale (*Aspidiotus nerii*), olive scale (*Parlatoria oleae*), and the disease "verticilosis" caused by *Verticillium dahliae*. Here, the effects of extant weather and climate change scenarios on the tri-trophic interactions are examined using biologically rich physiologically based demographic model developed from field and laboratory data. The system model of olive, soil-water balance model, and the dynamics of the pests and natural enemies is used to examine the effects of observed weather and/or projected climate warming scenarios on the geographic distribution and abundance of system components. The simulation results are mapped using geographic information system (GRASS GIS), while marginal analysis of multivariate regression models of regional data on bloom dates, and pest and natural enemy levels are used to capture the large trends and interactions of the system.

Studies from Sardinia, Italy and California show how the same model can be applied to these, and by inference, to other areas of the Mediterranean basin and elsewhere globally. Specifically, the model enables the examination of climate change on the range extension of olive into higher altitudes and more northern climes, and the contraction in hotter areas. Similarly, the range of olive fly will extend into previously unfavorable cold areas, but will contract in warm where temperatures approach its upper thermal limits. The effect of climate change on natural enemies will be illustrated using the olive scale/parasitoid interactions. We will show how the same system can be used to examine the distribution and abundance of diseases. Last, no model is complete, and we will discuss areas requiring improvements that can serve as a basis for interdisciplinary regional IPM research.



PLENARY LECTURE-ABSTRACTS

VERTICILLIUM WILT OF OLIVE: PROBLEMS AND PROSPECTIVES

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Verticillium wilt caused by *Verticillium dahliae* is the most important soilborne disease of olive worldwide. In Spain, the disease severely affects young, irrigated orchards in Andalusia, the main olive-producing region. Control of the disease is made difficult by: (i) the long survival of the pathogen in soil ant its ability to infect hundreds of plants and grow confined within the xylem during its parasitic phase; (ii) the genetic and virulence diversity of *V. dahliae* population, including a highly virulent, defolianting (D) pathotype of cotton and olive; and (iii) the means for spread of the pathogen within and among orchards, including: (i) infected planting material; (ii) dispersal of infested soil.; (iii) dissemination of infected debris from cultivated and alternative hosts; (iv) irrigation with infested water; and (v) spread of leaves fallen from trees infected with the D pathotype. Research in Spain showed that *V. dahliae* from olive in Andalusia comprises four vegetative compatibility groups (VCG): VCGs1A, 2A, 2B, and 4B; VCG1A being the most prevalent. VCG1A isolates are of D pathotype whereas VCGs2A; 2B, and 4B are of the nondefoliating (ND) one. Sequence analysis of a *V. dahliae*-specific DNA marker indicated that only three (*seq1*, *seq2*, and *seq4*) of the seven previously identified sequences (*seq1* through *seq7*) occur among olive *V. dahliae* isolates. The predominance of the D pathotype in Andalusia has strong implications for the management of Verticillium wilt of olive since: (i) the threshold of inoculum density for disease with D isolates is much lower compared with that of ND; (ii) fallen, infected olive leaves are efficient source of inoculum for spreading the pathogen within orchards and giving rise to secondary infections; and (iii) olive cultivars of commercial interest are highly to moderately susceptible to D *V. dahliae*. An intriguing feature of olive wilt is the plant ability to recover from disease expressed by decreasing disease incidence and/or severity over time. This phenomenon has been observed under natural conditions in different countries and reproduced by artificial inoculations by different laboratories. As a consequence, new infections through the root system are needed for disease to develop in a tree over successive years. These infections can be enhanced by inoculum in leaves infected with the D patotype and/or infested irrigation water. Therefore, management of the disease could be based on disease recovery by reducing the potential for severe disease in young trees and protecting the root system of recovered trees from new infections next season. This management should be based on an integrated approach using preventive control measures prior to planting, including: (i) site selection to avoid use of soil infested with the pathogen and/or proximity to herbaceous crops susceptible to Verticillium wilt, mainly cotton; (ii) desinfestation of planting sites infested with the D pathotype or high inoculum density of the ND one; (iii) preferable use of cultivars moderately susceptible to the D pathotype; (iv) use of planting stock certified free from *V. dahliae*; and (v) protection of the planting stock root system from infection by residual or incoming inoculum. The use of molecular protocols for the *in planta* detection and identification of *V. dahliae* pathotypes, as well as root treatment with biological agents demonstrated efficient in reducing the severity of infections by the D one, may help in achieving success in that strategy.

OLIVE DISEASES AND DISORDERS IN AUSTRALIA

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The main aim of our research is to contribute to the knowledge on diseases and disorders, in particular fungal pathogens, of olives in Australia. Our studies have resulted in several new records of fruit rots and of fungi on leaves, trunk and root diseases. This research has also resulted in new evidence of flower infection by anthracnose pathogen leading to fruit rot. Several fungi, some of pathogenic importance, were observed on olives from different olive growth regions of Australia during a six-year period from 2002-2008. Samples of olive leaves, flowers, fruits, roots and woods were received from olive groves in New South Wales, Australian Capital Territory, Victoria, Queensland, Western Australia and South Australia. Conventional methods of detection, such as incubation of surface-sterilised and non-sterilized tissues in moist chambers and growth on common culture media (e.g. potato dextrose agar), were used. The major diseases of olive in Australia are anthracnose, *Colletotrichum acutatum*, *C. gloeosporioides*; cercosporiose, *Pseudocercospora cladosporiodes*, and peacock spot, *Fusicladium oleagineum*. Minor diseases of olives are *Phytophthora*, *Rhizoctonia*, *Verticillium dahliae*, Charcoal rot *Macrophomina phaseolina, Neofusicoccum luteum* and olive knot *Pseudomonas savastanoi*. Cercosporiose has been considered a minor disease of olives until recently, although fruit is occasionally infected. Fruit damage by fungal pathogens is equally as important as leaf infection. Infection of flowers leading to fruit rot may be of economic importance, as anthracnose results in significant losses in yield and reduced oil quality. Olives in Australia are also subject to non-pathogenic disorders, such as damage by heat and sun and other weather conditions, water-logging and irregular watering or nutrient imbalances, all of, which affect the normal physiological processes in trees.

KEYWORDS: OLIVE, DISEASES, DISORDERS

CHEMICAL CONTROL OF OLIVE PESTS: BLESSING OR CURSE?

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The world olive tree (*Olea europea*, Oleaceae) cultivation amounts to about 805 million trees 98% of which are grown in the Mediterranean countries. Its cultivation is of great economical, social and environmental importance. The olive products, olive oil and table olives, are basic constituents in the Mediterranean diet providing health benefits. The olive tree has a large number of pests some of which are causing considerable damage to the olive crop. Main pests of the olive tree are few insect species, the most important being the olive fruit fly, *Bactrocera oleae,* Tephritidae, fungi and weeds. The protection of the crop against these pests relies mainly on chemicals due to certain advantages such as fast and effective control when insect populations reach the economic threshold, the cost benefit ratio is favourable and they have a large variety of applications. Their use, however, is associated with major problems related to the environmental pollution, such as in the ground water by herbicides, disruption of ecological balance, like the adverse effects on beneficial insects, and the development of resistance as has been recorded in insecticides used against the olive fruit fly. Strong resistance to organophosphates has been reported especially in regions where these products have been used extensively for many decades. The resistance mechanism has been well characterized and involves a modification of the achetylocholinestarase, the target of the organophosphates. Recently, low to moderate resistance to pyrethroids has been found in a few olive fruit fly populations from Greece. During the long history of products used against the olive pests a rich literature of the grave side effects of the chemicals used has been accumulated. Research has shown that the environmental impact of many of them was important and their registration was revoked (e.g. OP's, certain herbicides). Presently, advances have been made toward the use of new compounds (e.g. Spinosad), application methods (e.g. bait sprays, traps) and techniques (e.g. mass trapping) that they cause less damage and some of them are compatible to organic growing. Others can be used in IPM programs. The chemical control can be a blessing to the olive producer, because he can save his crop, that in certain cases is in danger of reaching up to 80% (olive fly), but it can be a curse if used unwisely leading to environmental pollution and product contamination with residues. Scientific developments can lead to the rational use of pesticides in IPM systems and more advanced to organic growing.

GENETIC RESISTANCE: A PART OF INTEGRATED CONTROL OF OLIVE DISEASES?

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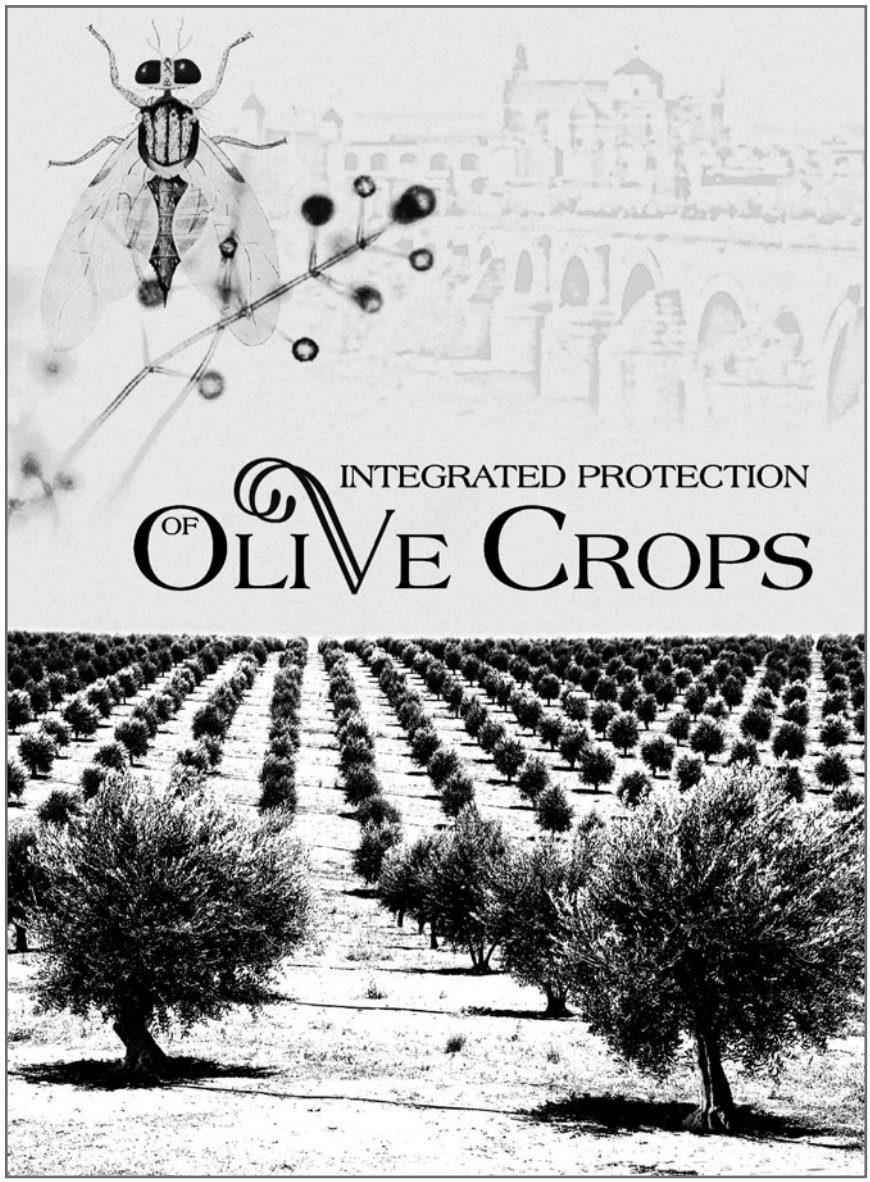
Olive (*Olea europaea*) is the most extensively cultivated fruit crop in the world with about 10 million ha and more than 2,000 cultivars. The great intra-specific diversity is the key to its good adaptation to the many different areas with a Mediterranean climate. Although variability of olive cultivars is being studied currently in 102 collections from 54 countries including 5,356 accessions, information on susceptibility or resistance to major diseases is very scarce and contradictory. For this reason, disease resistance has not been considered traditionally as a component of the integrated control of olive diseases. This work summarizes the published results on disease resistance in olive and the research carried out on this topic over the past 15 years by the research group "Patología Agroforestal" of the University of Córdoba, Spain.

In recent years, evaluation of olive cultivars for resistance to major diseases in Spain has been carried out in field trials and in artificial inoculations. Disease resistance has been studied on peacock spot (*Fusicladium oleagineum*), cercosporiose (*Pseudocercospora cladosporioides*), anthracnose (*Colletotrichum* spp.), verticillium wilt (*Verticillium dahliae*), phytophthora root rot (*Phytophthora megasperma, P. inundata*), and bacterial knot (*Pseudomonas savastanoi* pv. *savastanoi*).

Results from evaluations allowed characterizing the resistance level to these diseases in a high number of cultivars, as well as in cloned selections, wild olives, and genotypes from the breeding program carried out jointly by the IFAPA and the University of Córdoba. These researches, which currently are in progress, demonstrated a great variability among olive cultivars and genotypes. Some cultivars showed multiple resistance to several diseases, whereas other common cultivars, like 'Hojiblanca' or 'Picudo', were highly susceptible to all diseases tested. Results are being used to select cultivars or genotypes for planting when a disease is the limiting factor (e.g. new olive plantations in soil infested by *V. dahliae*) or to estimate the risk of new cultivars (e.g. 'Barnea' highly susceptible to bacterial knot, or 'FS-17' highly susceptible to alternaria fruit rot). Even the application of some control measures (e.g. chemical treatments) may be changed according to disease resistance level of cultivars. Although knowledge on nature of disease resistance, heritability, mechanisms, pathogen variability or induction of systemic acquired resistance still is limited, the advances on disease resistance should be considered to include it as an important part of integrated control of olive diseases.



ORAL COMMUNICATIONS-ABSTRACTS

SESSION 1

THE OLIVE PEST AND DISEASE STATUS AROUND THE WORLD

O 01. FACTORS DETERMINING THE INCIDENCE OF *VERTICILLIUM DAHLIAE* VEGETATIVE COMPATIBILITY GROUPS AND PATHOTYPES IN OLIVE ORCHARDS AT SOUTHERN SPAIN

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Verticillium wilt, caused by *Verticillium dahliae*, has become the main threat for the Andalusia olive industry. Severity of attacks by *V. dahliae* is associated with the spread of a highly virulent, defoliating (D) pathotype of vegetative compatibility group 1A (VCG1A). This study was conducted to determine the effect of factors associated with olive production on the prevalence of *V. dahliae* VCGs and pathotypes in the five most important olive-growing provinces in Andalusia (southern Spain). Genetic diversity in 637 *V. dahliae* isolates from 433 trees in 65 olive orchards was studied by VCG typing using nit mutants of the international OARDC reference strains and local testers, as well as by PCR assays that differentiate the olive-defoliating and -nondefoliating (ND) *V. dahliae* pathotypes, and DNA sequence analysis of a 539/523-bp *V. dahliae*-specific PCR amplicon. Four VCGs were identified: VCG1A (78%), VCG2A (20%), VCG2B (0.6%) and VCG4B (1.4%). VCG1A isolates were typed as D pathotype by molecular markers, while all other VCGs isolates were of the ND pathotype according to those markers. Three sequences of the *V. dahliae*-specific amplicon were identified among the isolates (seq1, seq2, and seq4) that correlated to VCG (seq1/VCG2B; seq2/VCG2A, VCG4B; seq4/VCG1A). A single VCG prevailed among isolates within an orchard. The association VCG1A/VCG2A occurred in 15% of the orchards, and 8% of them included some other VCGs associations. VCG1A was the most prevalent genotype in all provinces except Granada. Also, VCG1A prevailed in orchards established with un-rooted olive sticks at low to medium planting density in virgin soil, or soil previously cropped to host of V. dahliae, and irrigated with underground water. In contrast VCG2A (ND pathotype) was the most prevalent VCG in Granada (south-east Andalusia) but its prevalence was not influenced by crop age, cropping history or plant density. Plant density, crop age and geographic location of olive orchards were used as predictors in discriminant analysis for classifying occurrence of VCGs or pathotype in olive orchards. These variables correctly classified 100% of olive orchards where VCG1A (D pathotype) was present, as well as most orchards where VCG2A (ND pathotype) or the association VCG1A/VCG2A were identified. A linear discriminant-function model was developed that can be of use to predict occurrence of *V. dahliae* VCGs or pathotypes in an orchard based on estimates of the agronomic features or location of the orchard.

KEYWORDS: VERTICILLIUM WILT – EPIDEMIOLOGY

O 02. DISTRIBUTION OF *VERTICILLIUM DAHLIAE* THROUGH WATERING SYSTEMS IN IRRIGATED OLIVE ORCHARDS IN ANDALUCIA

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Verticillium dahliae, causal agent of Verticillium wilt of olive (VWO), produces 35 to 150 µm in size infective propagules named microsclerotia (MS). Pathogen dispersion can occur by several ways contributing to the local and long-distance spreading of the disease. MS dispersal by irrigation water has been always considered very probable, although few cases of direct experimental evidences are available. The aim of this research was determine the presence of *V. dahliae* MS in water, soil or plant debris particles carried by water, along the infrastructures of an important Irrigation Community (Genil-Cabra) in Córdoba (Central Guadalquivir Valley), that irrigate 9.350 ha, many of them cropped by olive orchards. Results showed that the pathogen is present in all irrigation structures involved in water transporting to irrigated plots. Present study starts in Cordobilla reservoir, from which water is pumped to the water main channel. Analyses of samples collected from the soil pellet decanted in this channel showed mean ID of V. dahliae that reached 2.24 MS/g of pellet. Pathogen ID also reached 1.28 Ms/g in the pellet settled down inside the reception tank, where water is initially gathered in the station after being taken up from the main channel. During watering season, the pumping station continuously delivers water to fields, previously rough-filtered by mean of gravity or an underground pressure watering pipe network Farmers use in the watering pipe connection in plots different kind of filters, such as sand filters, that are commonly used in drip irrigated olive orchards. Sand filters usually retain particles bigger than 120 mm. We have found the pathogen in the sand of filters of olive orchards affected by VWO with a mean of 0.007 MS/g of sampled sand. Moreover, fungus MS were also found in the pellet decanted in stored water pond at these olive fields. Finally, for determining the amount of *V. dahliae* MS directly delivered in soil of plots through the drippers during irrigation, a similar situation was reproduced in the pumping station installations. The simulation consisted of inserting between the main station water a filtering system that allowed to retain particles suspended in water 35 to 120 µm in size, to explore large water volume, and detect little amounts of inoculum per m3. Monthly analyzes of mean water volumes of 20 m3 allowed to detect the fungus in variable amounts that reached 0.041 and 0.94 MS/m3 during November and April, respectively. Results demonstrated that *V. dahliae* is distributed through irrigation system, which can provide to the pathogen a long-distance spreading in wide cultivation areas. This fact could increase the spread of high virulent defoliating isolates of V. dahliae and increase VWO disease incidence and severity in Andalucía.

KEYWORDS: VERTICILLIUM WILT OLIVE, *VERTICILLIUM DAHLIAE* DISTRIBUTION, MICROSCLEROTIA

O 03. AN INVESTIGATION ON DURATION OF INJURIOUS GENERATIONS OF *BACTROCERA OLEA* GMEL. (DIP.: TEPHRITIDAE) IN TAROM CITY OF ZANJAN PROVINCE (IRAN)

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Olive fruit *Bactrocera olea* is one of the most important tephritid flies damaging on olive orchards throughout the word. Although main damage occurs by larvae which feed exclusively on mesocarp of the olive fruits but adult feeding may be observed in other fruits too. This insect is a multivoltine pest and its damage happens from late October till late November over the region.To determine damaging generation, this study was conducted in 2007 by using the following method. In late July, months before infestation, 20 branches, each covering 15 olive fruits were randomly selected and enclosed in cages of 40 „e 15 cm in size. To obtain adult flies, on October 7th, infested olives were collected from olive growing area of Ghazvin province and transfered to the laboratory for other process. On October 26 th, five healthy female adult were released in to the each cages to egg laying for 24 hours. On Nov. 20th , first 3rd instart lasvae of the pest came out of the fruit and this trend lasted up to December 12th. Based on this finding it could be concluded that in the last injurious generation egg-larval period needs 35.8 days to be completed.

O 04. EFFECT OF HEAT STRESS ON SURVIVAL AND REPRODUCTION OF THE OLIVE FRUIT FLY *BACTROCERA (DACUS) OLEAE*

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The olive fruit fly *Bactrocera* (*Dacus*) *oleae* Gmelin is a major olive pest in Greece and other Mediterranean countries. Population density of the olive fruit fly and respective olive infestation is usually low in many areas of northern Greece during hot and dry summer months which may be due to the prevailing high temperatures and low relative humidity. We investigated the effects of short term exposure at high temperatures of *B. oleae* pre-imaginal stages and adults on survival and fecundity under laboratory conditions. Infested green olive fruits bearing certain larval stages, pupae and adult females of the fly were exposed for 2 hours to a series of different high temperatures ranging from 34 to 42ºC and survival percentages were subsequently determined. At temperatures up to 38 ºC high survival percentages of larvae and adults were observed whereas pupae displayed a relatively increased heat tolerance up to 40ºC. Fecundity and longevity of adult females were substantially reduced after heat stress. Prior acclimation at 33ºC for 1 and 3 days resulted in increased adult survival following heat stress. We discuss the results with respect to the ability of the fly to survive and reproduce under high summer temperatures.

KEYWORDS: *BACTROCERA OLEAE*, HEAT STRESS, SURVIVAL, REPRODUCTION

O 05. THE ISSR USEFUL MOLECULAR TOOLS FOR OLIVE FLY STUDIES

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Although the need to develop and implement more effective strategies of combating pests and pathogens has always been dire, the urgency of this challenge has increased sharply in recent years due in part to the spread and bioinvasions of many species. The olive fruit fly is widespread throughout the Mediterranean and Middle East, and records of infestations go back some two thousand three hundred years. The pest is also found along the east coast and south of Africa, India and Pakistan and was first detected in California in 1998. Its control relies mainly on chemical treatments, sometimes applied over vast areas by aircraft, with the subsequent ecological and toxicological side effects such practices entail. Actually, more rationales and safe methods of use of pesticides are going on, and administrations try to enhance the development and current acceptance of integrated pest management and biological control programs. And, there is consensus that an increase in the scientific knowledge of insect pests and their natural enemies will lead to a higher and more effective biological control. In this sense, molecular methodologies can provide us with new characters of study in fields such as taxonomy, identification of biotypes, structure and dynamics of populations of pests, etc. In the present work the ISSR technique was applied for the first time to the olive fly, *Bactrocera oleae*, in order to test the suitability of this molecular methodology to this species. The ISSR technique amplify inter-simple sequence repeats i.e. inter-microsatellites, trough the use of the Polymerase Chain Reaction (PCR) The results confirm the usefulness of the ISSR molecular information for this pest discrimination, and indicate the possibility of its use in the analysis of the population structure, of the within and between populations genetic variability that can help to understand the history of the species and monitoring the origin and spread of invading populations. Such information could be crucial to define appropriate strategies for eradication or control, or at least, their reduction to subeconomic injury levels.

KEYWORDS: ISSR, MOLECULAR MARKERS, *BACTROCERA OLEAE*

O 06. STUDY ON THE EFFECT OF OLIVE FRUIT FLY ON SOME QUALITATIVE AND QUANITATIVE CHARACTERISTICS OF OLIVE OIL IN DIFFERENT STORAGE DURATION

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[1] ***QANRRC***

Olive Fruit fly is one of the important and major olive pests in the world .It became widespread in olive growing regions of our country in 2004 and damaged economical injury to the olive orchards of these regions. This pest larvae causes olive oil qualitative and quantitative reduction because of entering pathogenic fungus and quality reduction in olive oil specially after harvesting and in fruit storing time until oil extracting as well as fruit falling before harvesting. This research purpose is study the effect of infected and uninfected olive fruits by olive fruit fly larvae storage duration on some qualitative and quantitative characteristics of olive oil. This experiment was conducted in RCBD with six treatments and three replications on Zard olive cultivar. Treatments included: 1- control: (uninfected fruits, immediately after harvesting) 2- Infected fruits immediately after harvesting. 3- Infected fruits, a week after storing 4- Infected fruits, two weeks after storing 5- Infected fruits, three weeks after storing 6- Infected fruits, four weeks after storing oil was extracted centrifuge after sampling and splitting flash from fruit stone and was sent to oil seed laboratory for measuring qualitative characteristics. Obtained data were analyzed by MSTATC statistical programs and LSD procedure used for means comparing. Acidity mean comparison showed that there wasn't any significant difference between control and second and third treatments and it had low acidity and good quality. Highest oil acidity was observed in fifth and sixth treatments (5.070%, 7.627% respectively), that shows sever reduction in oil quality after three or four weeks of storing fruits.

KEYWORDS: OLIVE FRUIT FLY, OIL, QUALITATIVE AND QUANTITATIVE CHARACTERISTICS, STORAGE DURATION

O 07. ENDOPATHOGENIC LIFESTYLE OF *PSEUDOMONAS SAVASTANOI* PV. *SAVASTANOI* IN OLIVE KNOTS

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Pseudomonas savastanoi pv. savastanoi, causing olive knot disease, is the most important bacterial pathogen affecting the olive crop. The endophytic phase of this pathogen in olive stems and the structural and ultrastructural histogenesis of olive knots have been studied. Construction of a stable plasmid vector expressing the green fluorescent protein, in combination with the use of in vitro olive plants, allowed real-time monitoring of *P. savastanoi* pv. *savastanoi* infection. The infection process was also examined by bright field and epifluorescence microscopy as well as by scanning and transmission electron microscopy. Hypertrophy of the stem tissue was concomitant with the formation of bacterial aggregates, microcolonies and multilayer biofilms, over the cell surfaces and the interior of plasmolysed cells facing the air-tissue interface of internal opened fissures, and was followed by invasion of the outer layers of the hypertrophied tissue. Pathogenic invasion of the internal lumen of newly formed xylem vessels, which were connected with the stem vascular system, was also observed in late stages of infection. Ultrastructural analysis of knot sections showed the release of outer membrane vesicles from the pathogen surface, a phenomenon not described before for bacterial phytopathogens during host infection. This study represents the first real-time monitoring of *P. savastanoi* disease development and the first illustrated description of the ultrastructure of *P. savastanoi*-induced knots (Rodríguez-Moreno et al., Microb. Biotechnol., in press). Financed by Spanish grants AGL2005-02090 and AGL2008-05311-C02-02 to C.R., cofinanced by FEDER.

KEYWORDS: OLIVE KNOT, *PSEUDOMONAS SAVASTANOI*, GFP

O 08. PESTS THAT AFFECT THE OLIVE ORCHARDS AT TERCEIRA ISLAND, AZORES

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The olive tree is cultivated in Azores Archipelago only in two islands: Terceira and Pico. In Terceira Island, the occupation area is about 8 acres and it is confined to Porto Martins area, in Southeast of Terceira Island, where there are about 1.743 trees. All the production is only for fresh consumption.

The main phytosanitary problems identified damaging the olive trees are: olive fly (*Bactrocera oleae* Gmelin.), olive moth (*Prays oleae* Bern.), black scale (*Saissetia oleae* Oliv.) and now the new pest that has emerged in this area at the beginning of June 2008, the olive psylla (*Euphyllura olivina* Costa).

The field methodology used for monitoring and making the risk estimative for the mentioned pests was: for the olive moth, one Delta trap with a specific sexual pheromone to capture adults and one yellow chromotropic trap also with a specific sexual pheromone in each one of the five olive orchards selected to be studied. During all the survey period, these five olive orchards were visited every fifteen days. For the black scale the visual observation was performed over 20 samples of branches and leafs collected randomly all over the surveyed orchards. For the fruit damage evaluation caused by the olive fly, 250 fruits were collected from 5 trees (50 fruits in each tree) and for the evaluation of the affected area, by olive cotton, 3 inflorescences or branches with leafs were analyzed in each of the 826 trees inside of the production area in a range of 500 meters from the detected infestation focus.All the collected data were then analyzed in Excel and from there exported to Arcgis 9.1, which enabled the development of olive cotton GIS distribution maps from all the olive production area.

The obtained results, allow us to conclude that the olive fly is the main pest of this culture, having it highest population abundance in June, August and October, being in October the month with the top captures. The olive moth reaches high population densities in July. Beyond that, it was possible to get some better knowledge about the olive cotton infestation focus, where it was registered two generations (one at the beginnings of June and the other at the endings of October) and geographic distribution all over the production area, based on the GIS maps analysis.

From the olive fly fruit damages analysis, there was an average of 83% of infestation all over the five surveyed orchards. Even in some orchards, where there was no treatment, the infestation reached the 98%, meaning that all production was lost.

KEYWORDS: FLY, OLIVE MOTH, OLIVE COTTON, BLACK COCHINEAL, MONITORING, GIS

O 09. CONTRIBUTION TO THE KNOWLEDGE OF *EUZOPHERA PINGÜIS* HAWORTH BIOLOGY IN ALENTEJO (PORTUGAL)

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The pest, *Euzophera pingüis* Haworth is an enemy of the olive grove whose attacks have, in the last years, caused preoccupation concern some Portuguese areas, namely in Alentejo. The recent available of the sexual pheromone of synthesis for this species constitutes a relevant aspect in the protection of the olive grove, for the potentialities in the identification of the risk periods. With the aim of acquiring information on these periods, it was studied the curve of flight of the insect, obtained through funnel traps, in an olive grove of Baixo Alentejo. The study occurred from 2004 to 2006, in an olive grove located in Lameirões. The analysis of the data display variations in the plan of the curve, during the Spring even middles of the Summer, with picks of captures of variable intensity in different periods (beginning or end of May, middle of June, middle of July and beginning of September), suggesting overlap of different generations. However, in any of the analysed situations there was a pick of captures in beginning of September.

KEYWORDS: *EUZOPHERA PINGÜIS*, MONITORING, SEXUAL PHEROMONE, OLIVE GROVE

O 10. EVALUATION OF *CALOCORIS TRIVIALIS* DAMAGE POTENTIAL ON OLIVE CROPS

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Calocoris trivialis Costa (Hemiptera: Miridae) is commonly present on olive crops in the Mediterranean region. This is a univoltine. At the end of the winter, nymphs feed on the weeds but later nymphs and adults move on the olive trees and feed mostly on the flower buds. *C. trivialis* has been considered as being responsible for highly reduced production of olive trees. The damage potential of this pest was investigated in association with different stages of flower development of olive trees. Similarly, the damage potential of the close related species *Aphanosoma italicum* Costa that is also commonly recorded on the olive trees was searched. The experiments were conducted in a grove of the oil variety "Koroneiki" in the area of Pylos, in south-western Peloponnesus. Shoots on the trees were enclosed in cages. In each cage 3 or 6 adults in spring 2007 or 8 nymphs or adults in spring 2008 were introduced. In 2007 the introduction took place on 29 March. In 2008, the damage potential was investigated in 3 periods extending from early flower emergence to the start of the blooming period (placement of the cages on 7 and 27 March and 18 April). Records showed that in the cages where *C. trivialis* or *A. italicum* had been enclosed a high percentage of the fruiting organs dropped (99 and 91%, in each species, respectively). In the controls, the respective percentages were 63 and 64%. This high reduction in fruit setting was mostly attributed to bud abortion. The damage potential of both species was affected by the time of the infestation. Damage of *C. trivialis* can be severe from the early period of inflorescence development until start blooming, whereas in *A. italicum* in the period when the inflorescence are developed but before start blooming. In any case, at the period of blooming damage does not seem to be important. Thus, *C. trivialis* and *A. italicum* can cause serious fruit abortion that may ultimately result in serious reduction of production. This knowledge can substantially contribute to the development of appropriate control programs of these pests in olive grooves.

SESSION 2

SUSTAINABLE OLIVE PRODUCTION AND CHEMICAL CONTROL OF PESTS AND DISEASES: OPPONENTS OR COMPONENTS?

O 11. DETECTION AND MONITORING OF INSECTICIDE RESISTANCE IN *BACTROCERA OLEAE* FROM GREECE

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Background: The control of *Bactrocera oleae* in Greece has been based on organophosphate (OP) insecticides for many decades. As a result, insensitive acetylcholinesterase-based OP resistance was selected in the field. There has been a progressive switch towards Pyrethroids and Spinosad. Recent studies identified moderate pyrehroid resistance associated with elevated levels of CytP450 activities, but not significant levels of spinosad resistance as yet in field populations. Monitoring and detection of insecticide resistance is essential for its effective management. Classical bioassays remain a central tool, while biochemical and molecular markers prompts a move away and allows the detection of incipient resistance (emergence and spread of resistance alleles before there is an effect on the phenotype). Methods: Field populations were collected from different geographical regions and/or areas with distinct control programs. Dose response bioassays were performed by topical application to adult flies. The frequency of biochemical and molecular resistance markers (P450, COE and GST activities; iAChE mutations) was recorded. Results: During the first period of the survey (2007–2008), 12 populations were collected. Variable resistance levels were identified in the majority of populations for dimethoate (RF: 7–48x) and á-cypermethrin (RF: 7–17x). Relatively low resistance levels (RF < 10) were observed for spinosad. The application of molecular diagnostic tests showed the high abundance of the iAChE resistance mutations due to the heavy OP spray history. The most striking insecticide resistance phenotypes and the highest frequencies of resistance markers were observed in the island of Crete. Significant correlation was observed among the P450-dependent monoxygenase activity, the pyrethroid resistance levels and the number of pyrehroid applications in Crete. Conclusion: Although resistance development in *B. oleae* didn't keep pace with that in other insects, it now evolves differently in each of the insecticides tested. Continues monitoring should inform program control managers for the compilation of optimum and sustainable management tactics. Acknowledgements: The project is funded by the Hellenic Ministry of Rural Development and Food.

O 12. STUDY OF THE RESIDUAL ACTIVITY OF INSECTICIDES AND BAITS USED FOR *BACTROCERA OLEAE* (GMELIN) (DIPTERA: TEPHRITIDAE) CONTROL

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The residual activity of commercial formulations of several insecticides against the adults of *Bactrocera oleae* was determined when these were applied to olive tree foliage under field condition at the recommended concentration used for bait and cover sprays. The insecticides lambda-cyhalothrin 10%, a-cypermethrin 10%, spinosad 0.24 and dimethoate 40% applied at the concentration used for bait sprays, were tested. In another experiment lambda-cyhalothrin 10%, a-cypermethrin 10% and dimethoate 40% were tested at the concentration used for cover sprays. Shoots from the treated trees were transported to the laboratory 1, 10, 20, 30 50, 70, 90 and 110 days after bait spraying application and 1, 10, 20, 30 40, 50, 65, 85 and 105 days after cover spraying application and were placed individually into plexiglass cages (24oC, 60% RH, and 14h light photoperiod). In each cage 12 newly emergent adults of *B. oleae* were inserted and mortality in each cage was assessed every 24h for 5 days. Another field experiment evaluated the level and length of attractiveness of various baits to *B. oleae*. From the insecticides tested at the concentration for bait sprays, a-cypermethrin caused mortality, 3 days after the insertion of the adults into the cages, of 93.7%, 87.5% and 93.7% 10, 50 and 90 days after treatment (DAT), respectively. At the same time interval lambda-cyhalothrin caused a mortality of 93.7%, 65.6% and 66.25% and dimethoate 57.1%, 56.2% and 43.7%, respectively. Success caused a mortality of 71.4%, 50.8% and 61.4% 1, 10 and 20 DAT respectively while in the untreated control mortality was 18.7%. From the insecticides tested at the concentration for cover sprays, a-cypermethrin caused a mortality of about 93% providing 40 days of adequate activity. Lambda-cyhalothrin caused 96% mortality 20 DAT but by 40 DAT gave about 61% mortality. Dimethoate resulted in shorter residual activity than the other treatments caused a mortality of 60% 20 DAT. The residual activity of some tested baits lasted 20 days, greater than of the commercial bait used currently which lasted only 5 days. Bait sprays, when properly and timely applied, are very effective and more friendly to olive agro-ecosystems compared to cover sprays. One bait spray application of a long residual insecticide combined with one of a prolonged residual activity bait may be able to reduce the number of applications against *B. oleae*.

O 13. GF-120® (SPINTOR® CEBO, SUCCESS® 0.24CB) AN INNOVATIVE BIOLOGICAL SYSTEM FOR THE CONTROL OF OLIVE FRUIT FLY (*BACTROCERA OLEAE*) IN ORGANIC AND IPM FARMING

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Bactrocera (Dacus) oleae (Gmelin), the olive fruit fly is the most destructive pest of olive trees in the Mediterranean region. Crop losses, quantitative and qualitative, due to this pest can reach up to 80%, if no control measures are taken. In the last forty years a variety of methods have been used to control this pest and protect against significant economic yield losses. Current control methods include full cover and protein-based bait sprays. Bait applications have proven to be much safer to the crop and environment than the full cover sprays. GF-120® (SPINTOR® CEBO, SUCCESS®) is a newly developed pre-mixed concentrated fruit fly bait containing a reduced risk toxicant to both mammals and non-target insects (Thompson et al 1). GF-120® attracts and controls multiple species of tephritid fruit flies and contains an optimized blend of feeding attractants and the active ingredient, spinosad; an insect control product derived from a naturally occurring soil bacterium, *Saccharopolyspora spinosa*. GF-120® provides improved consistency, attractiveness, selectivity, pre-harvest intervals and overall better efficacy when compared to current bait-toxicant mixes. It is approved for use in organic farming (under European regulation 404/2008 - amending the organic regulation EEC No 2092/9 and is organically certified by several organic bodies such as OMRI, USDA NOS, Mayacert, BCS OKO and others) and conventional production systems in many countries. Application is done by ultra low volume with large droplets (4-6 mm of diameter) that help the product remain viable in the field for extended periods of time when compared to other baits. GF 120® has an excellent environmental profile and has been demonstrated under laboratory, and field conditions to be an ideal product for use in IPM programs. The impact of GF 120® on Non Target Organism (NTOs) was evaluated by ground and by air application in the field in several countries, compared with fenthion+bait and alpha-cypermethrin+bait. Overall, it was found that GF 120® did not have a detrimental impact on a wide range of beneficial species. Transient effects were noted on Hymenoptera parasitoids (Chalcidoidea) but with recovery observed 20 days after application. GF 120® applied twice at 1 l/ha within a 9 day interval showed no negative impact on honeybees, *Apis mellifera* in a trial covering 800 hectares of olive trees in Spain. In conclusion, GF 120® is highly selective to beneficials and pollinators whilst delivering outstanding control of tephritid fruit flies. These attributes make GF 120® an ideal fruit fly control product for use within IPM programs in olives.

KEYWORDS: SPINOSAD, GF-120, INSECTICIDE, SPINOSAD, *BACTROCERA OLEAE*, OLIVE FRUIT FLY, SIDE-EFFECTS, BEES, *APIS MELLIFERA*, IPM, BENEFICIAL INSECTS, PARASITIC INSECTS, INSECT BAITS

O 14. SUSTAINABLE PEST AND DISEASE MANAGEMENT IN AUSTRALIAN OLIVE PRODUCTION: WITHOUT OLIVE FLY, BUT WITH OLIVE LACE BUG

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With the rapid expansion of the Australian olive industry since the 1990s, plantings have occurred in many parts of Australia. While most of these have been in areas with a typically Mediterranean climate, a number have been in warm temperate and sub-tropical regions, where summer-dominant rainfall may present production problems. Australia is free of a number of cosmopolitan olive pests and diseases, particularly olive fly, *Bactrocera oleae*, and olive moth, *Prays oleae*, although some species such as black scale, *Saissetia oleae*; peacock spot, *Fusicladium oleagineum*; cercosporiose, *Pseudocercospora cladosporiodes* and anthracnose, *Colletotrichum* spp., are widely distributed. Australia also has several native pests of cultivated olive, including olive lace bug, *Froggattia olivinia* and Queensland fruit fly, *Bactrocera tryoni*, with the former species a serious pest in eastern Australia, where it can defoliate, and sometimes kill, trees. In addition, there are a number of region-specific pests. The industry has identified sustainable pest and disease management as a key priority, and is actively developing IPDM programs. However, there are currently limited options for legal use of IPM-compatible pesticides for some pests, particularly olive lace bug. This paper discusses the current status of sustainable management of the key Australian pests and diseases and future options for what is a unique world olive production situation.

KEYWORDS: IPDM, OLIVE LACE BUG, AUSTRALIA

O 15. CONTROL OF THE OLIVE MOTH, PRAYS OLEAE (BERN.), IN ORGANIC OLIVE GROVES

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Olive tree is an important crop in Trás-os-Montes region (northeast of Portugal), where about 75 000 ha of surface are cultivated. In this region, 85% of the crop is conducted in traditional system, with low intensification and productivity, but with high quality of the olive oil produced. The organic production is one way to increase sustainability of this important agroecosystem. In this region, the olive surface certified in organic production has high potentiality of increasing. The olive moth, *Prays oleae* (Lep.: Plutellidae), which is one the most serious pests of olive trees in the Mediterranean basin, is the key pest of the crop in Trás-os-Montes region. This moth develops three generations per year, attacking successively the leaves (phyllophagous), olive flowers (antophagous) and the fruits (carpophagous) and causing significant damage and crop loss. In this communication, we summarize the work developed by our research group during the last 15 years, to control olive moth in the northeast of Portugal. The implementation of indirect measures (e.g. the conservation and maximum use of naturally occurring biological control agents and active augmentation of natural enemies), and direct measures (e.g. sprays with the microbial insecticide *Bacillus thuringiensis* (Berliner) against the flower generation, the use of inundative releases of tricogramma and chrysopids, and on the use of the mating disruption technique and chemical control, with authorized pesticides) are presented and discussed.

KEYWORDS: *PRAYS OLEAE*, NATURAL CONTROL; *BACILLUS THURINGIENSIS* (BERLINER); INUNDATIVE RELEASES; *TRICHOGRAMMA*, CHRYSOPIDS, MATING DISRUPTION

O 16. SEARCH FOR ALTERNATIVES TO COPPER FOR THE CONTROL OF OLIVE LEAF SPOT CAUSED BY *FUSICLADIUM OLEAGINEUM*

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Leaf spot or peacock spot caused by *Fusicladium oleagineum* is a widespread disease, causing defoliation and yield loss in all olive growing regions. Copper compounds are extensively used for the control of major foliar and fruit diseases of olive, mainly peacock spot, but also anthracnose incited by *Colletotrichum* spp., and cercosporiose due to *Pseudocercospora cladosporioides*. Nowadays, there is a tendency towards the reduction of the total amount of copper applied per ha and year in several crops in the E.U., so the research on new and alternative products to control this disease is becoming a crucial objective. Organic commercial products, plant extracts, including extracts of leaves of resistant and susceptible olive cultivars, and antagonist microorganisms isolated from olive leaves, were evaluated *in vitro* and *in planta*. In the *in vitro* assays, inhibition of conidial germination referred to a control was determined. Potted olive plants and olive trees of susceptible cultivar 'Picual' were used in the in plant trials. Potted plants were treated with the products being evaluated before and after inoculation, except for antagonist microorganisms, that were applied only before inoculation. Inoculations were performed with a local pathogen population obtained from naturally infected olive leaves. Plants were sprayed with a conidial suspension (10^5 conidia/ml). Inoculated and control plants were incubated in a moisture chamber for 48 hours and then in the greenhouse for symptoms development. In the olive orchard, selected products were applied in spring and in autumn. Disease incidence and severity were assessed in all experiments. Several commercial products and the extract of *Inula viscosa* inhibited the conidial germination of *F. oleagineum*. In plants, two *Thymus* sp. extract based commercial products and a citric extract based product showed 60-90% reduction in disease severity. A leaf extract of the resistant olive cultivar 'Frantoio' showed a significant preventive effect, whereas leaf extracts from *Inula viscosa* and *Pistacia lentiscus* showed a curative effect. Antagonist microorganisms did not reduce the disease incidence in olive plants. Copper compounds showed the highest efficacy in controlling the disease in potted plants and in olive trees in the field.

KEYWORDS: PEACOCK SPOT, BIOLOGICAL CONTROL, PLANT EXTRACTS, *FUSICLADIUM OLEAGINEUM*

O 17. CONTROL OF OLIVE ANTHRACNOSE CAUSED BY COLLETOTRICHUM SPP

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Anthracnose caused by *Colletotrichum acutatum* and *C. gloeosporioides* is the most serious disease of olive (*Olea europaea*) in the humid areas where susceptible cultivars are grown. Over past 3 years, we have evaluated the effect of different fungicides (copper, organic protective, and systemic) and calcium salts for the control of this disease. Effect of fungicide concentration on mycelial growth, conidial germination, and infection of detached olive fruit was evaluated in controlled conditions. Effect of selected fungicides, calcium salts, and application timing was assessed on 30-years-old olive trees of susceptible cv. Hojiblanca under field conditions. Systemic fungicides were the most effective inhibiting mycelial growth of the pathogen. These fungicides showed a low IC50 (3-6 ppm), standing out difeconazole and flusilazol. Protective fungicides showed an IC50 from 110 to 234 ppm, except folpet that had an IC50 = 6-8 ppm. On the contrary, copper fungicides were not effective in controlling mycelial growth of Colletotrichum spp. (IC50 > 250 ppm). When conidial germination was evaluated, copper compounds (mainly hydroxide and oxychloride) and two protective fungicides (captan and folpet) were the most effective. In this trial, systemic compounds were not effective inhibiting conidial germination. In detached olive fruit, disease severity was lower in fruit treated with copper oxide, copper sulphate, folpet, or copper hydroxide plus folpet, than in non-treated fruit (control). In olive orchard during 2006, one application of fungicides did not show any effect in controlling olive anthracnose. This was due to the high level of latent infection in drupes (46.5%) when the treatment was carried out. In the second year, olive trees treated two times during autumn using copper hydroxide or copper sulphate showed a lower number of affected fruit per tree. In this trial, calcium salts (calcium chloride and hydroxide) and other organic compounds were not effective in controlling olive anthracnose. According to these experiments, control of anthracnose is best achieved with applications of copper compounds during early autumn, before the first affected fruit are observed. In regions favoring olive anthracnose, recommended control practices include early harvesting of fruit, planting slow maturation or resistance cultivars, and the application of fungicides. However, the application of organic fungicides in olive orchards is limited during the autumn in Spain. Currently, we are evaluating alternatives to copper compounds, such as plant extracts, calcium salts, and antagonist microorganisms in order to get an integrate control of olive anthracnose.

KEYWORDS: OLIVE ANTHRACNOSE, *COLLETOTRICUM*, *GLOEOSPORIUM OLIVARUM,* CHEMICAL CONTROL

SESSION 3

SUSTAINABLE OLIVE PRODUCTION THROUGH CROP MANAGEMENT

O 18. VARIATION OF SUSCEPTIBILITY TO OLIVE FLY *BACTROCERA OLEAE* (GMELIN) ATTACK IN TEN OLIVE SPANISH COMMERCIAL OIL CULTIVARS UNDER DRY AND IRRIGATED CONDITIONS

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The olive fly *Bactrocera oleae* (Gmelin) is the major pest in all Mediterranean olive-growing countries reducing both yields and olive oil quality. The control of olive fly has largely relied on the use of chemical insecticides. However, there is an urgent need of new environmentally sound pest control approaches feasible to be applied either in conventional oliviculture or in organic production. This aim can be got through the management of the olive fly free living stages, adults and pupae, whose abundance or scarcity in an olive-growing area is clearly dependent to the cultivar appropriateness for fly rearing. Our objective has been to evaluate how cultivar appropriateness may influence *B. oleae* damage. For that, the susceptibility of 10 Spanish olive oil cultivars to the olive fly *B. oleae* managed using identical agronomic practices was investigated under dry and irrigated conditions. This research has been carried out in the experimental olive orchard at the IFAPA farm located at Córdoba in Southern Spain. In order to characterize seasonal abundance and annual population cycles, the olive fly population was monitored from May to December 2008 using plastic McPhail traps bated with ammonium phosphate plus hydrolisate protein. Ten trees from each cultivar randomly selected and 20 drupes were collected at random around the tree canopy (1.6 m above the soil) from each tree on each sampling date. There were 8 sampling dates, 10-12 days apart, which covered the ripening period. Drupes were transferred in plastic bags to the laboratory and then they were examined for the presence of oviposition punctures (percentage of attacked fruits), sized, weighted and the oil and water content determined. In both irrigation conditions (IC), there were significant differences between cultivars on susceptibility to olive fly attack. In both irrigation conditions, the most susceptible cultivar was “Nevadillo Blanco de Jaén” followed by either “Picudo” and “Lechin de Sevilla” under dry conditions or by “Picudo” and “Hojiblanca” under irrigated conditions. In both IC, the least susceptible cultivar was “Arbequina” followed by “Empeltre”. On the overall, for each cultivar, susceptibility to *B. oleae* was higher under irrigated conditions than under dry conditions. In general, percentage of fruits damaged by *B. oleae* increased throughout the season reaching a steady position at the end of it, which occurred earlier under irrigated than under dry conditions. Likewise, it was observed an anticipated cultivar receptiveness period under irrigated than under dry conditions. From the agronomic point of view, we conclude that irrigated conditions promote the olive fly populations, with control measures being needed earlier in the season while at dry conditions the control advice may be extended later on during the season. On the other hand, on those areas where Nevadillo Blanco de Jaén is present an accurate attention is required in order to avoid the potential on the increase of the tephritid population density and infestation dispersion. The possible factors responsible for the observed differences in susceptibility to *B. oleae* among cultivars are discussed.

KEYWORDS: GENETIC RESISTANCE, IRRIGATION, OLIVE FLY

O 19. SUSCEPTIBILITY TO *BACTROCERA OLEAE* OF ADVANCED SELECTIONS FROM A CROSS-BREEDING PROGRAM

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In the last years, the need for more suitable cultivars promoted the development of olive breeding programs in the main olive-producing countries based in intraspecific cross-breeding between cultivars of known merit aiming at combining the good qualities of the genitors in some of the genotypes of the progenies. Pest and disease resistance are usually cited among the breeding objectives in these programs. However, despite the economic importance of olive fruit fly in the Mediterranean basin, there are not reports about the susceptibility of new genotypes to this parasite. The selections evaluated in this work come from the crosses between 'Arbequina', 'Frantoio' and 'Picual' olive cultivars carried out in 1997. After a first selection step at the seedling stage, 6 genotypes were selected from the initial population mainly on the basis of their early crop (short juvenile period) and high oil content. Selected genotypes were propagated and planted in open field in 2005 together with 'Arbequina' and 'Picual' in a randomised block design with 12 replications and one tree per elementary plot. Despite not being considered initially one of the breeding objectives, the development of high populations of olive fruit fly due to ideal temperature conditions in summer 2008 lead us to include the susceptibility to fruit fly in the agronomical evaluation of fruit characters. Initial, middle and end of the ripening period were recorded according to the ripening index of fruits based on colour changes of peel and pulp. Samples of 50 fruits collected at the end of the ripening period were used for determining fruit characters (size, moisture and oil content) and the total infestation percentage by fruit fly. Significant differences between genotypes were obtained for all the evaluated traits. The percentage of infestation varied from 6.5 to 58.4 % between selections with five genotypes showing percentage of infestation lower than 15 % (including 'Arbequina') and three of then higher than 20 % (including 'Picual'). A positive correlation was found between infestation and ripening dates (mainly initial ripening date) and fruit size but not with fruit moisture or oil content. The most susceptible genotypes showed both large fruit size (>3.5 g) and late ripening (initial ripening time in October). On the contrary, smaller fruit size, earlier ripening or both were associated with much lower percentages of infestation. The results obtained in this work suggest that new olive cultivars with enhanced levels of resistance to fruit fly could be obtained through cross breeding. Further experimentation is needed to clarify the inheritance of this character and to determine the best breeding strategy to obtain genotypes gathering both low susceptibility and good agronomic behaviour.

KEYWORDS: BREEDING, FRUIT FLY, FRUIT CHARACTERS, OLIVE, RIPENING

O 20. OLIVE GROVE IN HEDGE MANAGEMENT: FERTILIZATION, PLAGUE, DISEASE AND WEED CONTROL. 10 YEARS OF PRACTICAL EXPERIENCE

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[1] ***TODOLIVO, S.L.***

In the beginning of the 90's a revolutionary olive cultivation system emerged, changing the way of growth olives by producing higher yield and quality and decreasing operational costs. It mainly consists in place a high density of trees per hectare, trying to increase the canopy per hectare by forming tree hedges in order to make better use of the light and soil and taking advantage of the over-the row machines used in the vineyard, for the harvest. Now a day the total world's surface of this modern technique rises quickly and it is around 80.000 hectares. The varieties more commonly used are "Arbequina", "Arbosana" and "Koroneiki", characterized by their short vigour, minimum yield alternancy and medium tolerance to some diseases such as *Verticillium* and *Cycloconium* and overall because their oil is well valuated in the market. In terms of fertilization, the main nutrients contribution belongs to the annual prune rests grinded (from the third year) and also from a mineral fertilized applied just in the plantation operation with high capacity of water and mineral retention. Finally, the plagues and diseases control is based on a rigorous observation of the damage economic threshold, using respectful measures with the environment also the use of traps to the insects or the use of the bacterium *Bacillus thuringiensis*. Todolivo has more than 10 years of practical experience in managing Olive Grove orchards planted and assisted all over Spain, Portugal and Morocco, and it has a R&D that works searching for new pest, disease, weed and fertilization of Olive Grove orchards. Along the presentation Todolivo will try to show its methods and results.

KEYWORDS: OLIVE, SUPERINTENSIVE, HIGH DENSITY, HEDGE, PLAGUE, DISEASE; WEED CONTROL, FERTILIZATON

O 21. SOIL TYPE AND MANAGEMENT SYSTEM DETERMINES THE STRUCTURE AND DIVERSITY OF SOIL BACTERIAL COMMUNITIES IN ORGANIC OLIVE GROVES IN SOUTHERN SPAIN

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Spain is the world leading country for olive production, with more than 2.4 million ha, of which 63% are located in Andalusia, southern Spain. Olive cropping systems include agroforestry stands (in marginal soils and hills), traditional groves and new intensive orchards. During the past two decades several major technological innovations have occurred in olive production in Spain including i) substitution of rain fed orchards by new intensive drip irrigated plantations, ii) introduction of alternative soil management systems to minimize soil erosion, and iii) promotion of use of environmentally friendly management practices including integrated production and organic farming. There are various reports concerning the influence of soil management (including use of cover crops) on soil erosion, physicochemical properties, and water availability and nutrient losses in olive orchards in different Mediterranean areas. However, until now no studies have evaluated the effects of soil management practices on microbiological characteristics of olive orchards soils in Spain. This study assess the effect of soil management systems [SMS: conventional light tillage (LT) or normal tillage (T), vegetative ground cover controlled by grazing (G), intensive grazing (IG) or mowing (M)] on some soil biological properties (including bacterial population structure and soil microbial community composition) in organic olive orchards located in mountainous or rolling landscapes in southern Spain. For this purpose, 46 olive orchards were sampled in Córdoba province in four Cambisol and Regosol soils, two of each in 'Sierra Morena' region (mountainous landscape, 26 orchards representative of agroforestry stands) and in 'Campiña' region (rolling landscape, 20 orchards representative of traditional groves). Additionally, three soils from undisturbed areas with natural vegetation were sampled in each soil type (12 in total) near the orchards to serve as benchmarks of undisturbed soils. The population structure of the bacterial communities in the soils was investigated by a molecular approach using terminal restriction fragment length polymorphism (T-RFLP) analyses of amplified 16S rDNA sequences from total DNA extracted from soils and subsequent digestion with *Rsal* and *MspI* restriction enzymes. Principal Component Analysis of T-RFLP revealed main changes in the relative abundance of bacterial terminal restriction fragments (TRF) in relation to the landscape of origin (mountainous *versus* rolling). Also, a transition strategy was observed from 'Sierra Morena' soils to 'Campiña' soils and from Natural areas to cultivated ones. In the mountainous landscape no clear distinction was observed between the SMS, G, IG or LT, whereas in the rolling landscape this transition was evident for T *versus* M. Natural areas in 'Campiña' region presented an intermediate situation between cultivated orchards in 'Campiña' and 'Sierra Morena' regions. Finally, in each landscape and SMS, a different subset of TRFs that substantially contributed to the variation along the first two principal components or discriminate among SMS in Discriminant Function Analysis was identified. In silico analysis of the bacterial 16S rDNA sequence database is being performed to identify well-characterized genera of bacteria that may be associated with and be an indicator of different SMS. Research funded by Projects AGL2008-00344/AGR and C03-058.

KEYWORDS: MICROBIAL DIVERSITY, PHYTOSANITARY SOIL STATUS, SOIL MANAGEMENT, BACTERIAL BIODIVERSITY

O 22. MANAGEMENT OF VERTICILLIUM WILT IN OLIVE ORCHARDS, USING THE SOIL SOLARIZATION METHOD AND SOIL APPLICATION OF MICRO-ORGANISMS

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The soil-borne fungus *Verticillium dahliae* represents one of the most difficult controlling diseases and a limiting factor in olive production in the Mediterranean countries. In Greece, the disease is now widespread in main olive-growing zone, where it causes serious damage, and this is related with the intensifying of olive tree culture. Disease incidence and severity increased during winter–spring and decreased during summer. The control of *V. dahliae* is difficult because of the absence of specificity of host. For the management and restriction of the pathogen, the last four-year period extensive field experiments were conducted in the region of Chalkidiki, Central Macedonia, Greece, evaluating the method of soil solarization (use of transparent polyethylene – PE) with or without soil treatments of beneficial micro-organisms that are competitive of *V. dahliae*. The experiments were conducted in different geographical areas and in different type of soils. The soil treatments of micro-organisms (commercial products consisting of the: endomycorrhizae *Glomus coronatum*, *G. caledomium*, *Bacillus subtilis*, *Pseudomonas borealis* and *Trichoderma harzianum*) were used in an attempt to improve the defence of olive trees against *Verticillium dahliae*. The results showed that the soil application of micro-organisms after the soil solarization was more successful and promising comparing with the soil solarization method alone and the control treatments.

KEYWORDS: *VERTICILLIUM DAHLIAE*, SOIL SOLARIZATION, ENDOMYCORRHIZAE

O 23. ATTEMPTS TO CONTROL VERTICILLIUM WILT ON OLIVES IN ISRAEL

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Verticillium dahliae represents one of the main limiting factors in intensively irrigated olive production in Mediterranean countries. Economic damage caused by the disease has increased during the last twenty years, due to extensive irrigation and intercropping with *V. dahliae*-susceptible hosts, such as potato and cotton. The most efficient means of controlling the disease is to simply prevent it. However, when outbreaks in the orchard do occur, it is necessary to look for potential ways to minimize the damage by reducing the disease. The objectives of the present study were to evaluate soil and seedlings treatments and application of fungicides to reduce the disease. Field trials were conducted in an infested orchard located at Revivim in the southern part of Israel. Three types of trials were conducted in parallel. 1) Soil treatment trial: soil solarization, solarization combined with cattle manure compost (6 kg/m2), solarization combined with soy meal (2 kg/m2) and solarization combined with cabbage residues (5 kg/m2). 2) Fungicide treatment trials that involved injection under pressure into the tree trunks of: Miraz (prochloraz), Canon (phosphoric acid), TOG (8-hydroxyquinoline sulphate) and Bavistin (carbendazim). 3) Inoculating olive seedlings at the nursery with mycorrihzae. The effect of these treatments is discussed in detail. Following the first two trials, however, the differences between treated trees and untreated control trees were not significant. With amendments of mycorrihzae is too early to summarize. The major conclusion is that the best way to overcome Verticillium wilt on olive is to prevent it, by avoiding planting on infested soil, by using tolerant-resistant cultivars and by maintaining optimal management conditions.

SESSION 4

SUSTAINABLE OLIVE PRODUCTION THROUGH SIT AND SEMIOCHEMICAL-BASED MANAGEMENT STRATEGIES

O 24. MODIFICATION OF MASS-REARING PROCEDURES FOR OLIVE FLY, *BACTROCERA OLEAE* (ROSSI) (DIPTERA: TEPHRITIDAE) IN SUPPORT OF THE STERILE INSECT TECHNIQUE

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The olive fly, *Bactrocera oleae* (Rossi) (OLF), is a major pest of olives growing in Mediterranean regions from Spain to Turkey, and through the Middle East to Morocco. It also exists in Central and Southern Africa. This insect has also invaded Californian olive crops and has spread into nearby Arizona. OLF causes significant losses to olive producers and to the economy of olive production regions. Olive fly damage adversely impacts olives grown for both their oil and for the table. Economic thresholds for olive fly in table olives are extremely low. Generally an infestation threshold of less than 1% is required for high quality production of table olives. For oil production the problems include secondary contamination with bacteria and fungi, oil acidification and the development of off-flavours. Also OLF causes major fruit drop in the field sometimes causing up to 100% fruit loss. Currently there are no alternatives to insecticide applications to suppress olive fly populations although research to find other methods such as biological control, resistant cultivars, improved cultural methods and others are showing promising results. Insecticide applications result in residues that taint and devalue table olives and oil resulting in market losses, damage to the environment, a threat to the health of growers, pickers and sorters and a build up of pesticide residues in the water table. A combination of the Sterile Insect Technique (SIT) and Integrated Plant Protection practices can result in the suppression of olive fly to economically sustainable levels. However, if suppression of the OLF with the incorporation of SIT into OLF management programmes is to be achieved a simple, efficient and cost-effective mass-rearing, sterilisation and sterile insect release system needs to be developed. The following components of laboratory rearing OLF have been targeted for improvement. a) Larval diet: partial, or total, replacement of cellulose fibres with corn cob grits; b) Egg collection: replacement of egg collection cones with cage-length egg collection panels; c) Egg handling: replacement of propionic acid with water on filter paper during egg incubation and shortening the incubation period from 48h to 0h (i.e. no incubation period prior to diet seeding); d) Handling of larvae: improved escape of pupating larvae from the diet into external pupation medium; e) Feeding adults: possible removal of streptomycin and egg yolk from adult diet. The results from these experiments and their implications for SIT against olive fly will be discussed.

KEYWORDS: OLIVE FLY, *BACTROCERA OLEAE* (ROSSI), STERILE INSECT TECHNIQUE, SIT, AREA-WIDE MANAGEMENT, BIOLOGICAL CONTROL

O 25. DISPERSAL OF MARKED-IRRADIATED OLIVE FRUIT FLIES IN ISRAEL

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The olive fruit fly is usually the single key pest of olive cultivation around the Mediterranean area, and more recently in America. Extensive research has been undertaken on the application of the Sterile Insect Technique against the olive fruit fly. Aim of the present study was to estimate the dispersal ability of marked-irradiated olive fruit flies under local environmental conditions in South Israel. Also, to evaluate and improve the capture abilities of different trapping systems, and to estimate local wild population density-distribution by release-recapture techniques of marked olive flies. Finally, to elucidate the role of the pre-release diet quality into the dispersal-survival of irradiated olive flies. For this reason 9 releases of ~5000 insects each were conducted during summer-fall of 2008. Results showed that marked and irradiated olive fruit flies can survive in the field for ~3 days after release, with an average dispersal distance of 45 m.Vital parameters like flight ability proved to be negatively affected by the irradiation-marking procedure. Also, the orientation of dispersion showed a distinct pattern with the majority of the insects following a North-West direction. The above findings can be used in pilot field applications of SIT against the olive fruit fly under similar geographical and climatic conditions.

KEYWORDS: OLIVE FLY, DISPERSAL ,SIT

O 26. DEVELOPMENT AND EVALUATION OF IMPROVED OLIVE FLIY ATTRACTANTS

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Bactrocera oleae (Rossi) is the most important pest of olive tree in all the Mediterranean Basin, causing severe losses to the olive production and impairing the quality of olive oil. Although pheromone traps are commonly used for monitoring olive fly adult population, a more efficient attractant for both sexes is needed, especially in order to develop control strategies based on biotechnical methods. This research was aimed at improving the attractiveness of bacterial filtrates obtained from the activity of a bacterium associated with the olive fly. Field tests were carried out to evaluate the attraction of a nitrogen bait consisting of a bacterial filtrate (BF). The BF was obtained inoculating a strain of *Pseudomonas putida* isolated from the olive fly oesophageal bulb into a liquid culture medium, Tryptic Soy Broth (TSB). The medium fermented for 9-10 days at 30±2°C, in an orbital shaker; then bacterial cells were removed by centrifugation (10,000 rpm for 10 minutes) and sterile filtration (0.45?m filters). Different field experiments were performed. The first experiment was aimed at comparing bacterial filtrate (5 and 10%), TSB (5 and 10%) and two commercial protein baits, Buminal® and Nu Lure (both used at 1%). All the baits were prepared with deionized water; Elkophon transparent traps for liquid baits were used for all the experiments. For each treatment, six traps were positioned in the orchard following a Latin square design (36 traps in total). Traps were removed after 24 hours approximately and 12 replications were done. In the second experiment three baits were compared with the same concentration: BF, TSB and Nu Bait® at 10% in water solution. Traps were positioned according to the replicated Latin square design. Three traps for each treatment were positioned per Latin square and the latin square was replicated four times (36 traps in total). Traps were removed after 24 hours approximately and 6 replications were done. The effect of concentration on the attractiveness of BF was evaluated comparing traps baited with water solutions of BF at 5, 10, 20 and 40%. Field tests similar to those described above were performed. In both experiments where BF was compared to different protein baits (TSB, Buminal®, Nu Lure and Nu Bait®), it attracted significantly more flies than the other treatments, regardless the concentration. All of the baits caught more females than males, anyway captures performed by bacterial filtrates showed the highest attractiveness toward females. The number of flies trapped by BF increased gradually as the bait concentration increased from 5% up to 10 and 20%. 40% BF did not catch significantly more flies than 20% BF. Volatiles emitted by bacterial filtrates and other baits tested in the experiments were analyzed using solid phase micro extraction (SPME) technique coupled with GC-MS. Differences among chromatograms were highlighted and discussed.

KEYWORDS: OLIVE FLY, BACTERIAL FILTRATES, PROTEIN BAITS, FIELD TRIAL, CHEMICAL IDENTIFICATION

O 27. A NEW ADVANCED STEP TO MAKE A USEFUL "MASS TRAPPING METHOD" TO CONTROL THE OLIVE FRUIT FLY *BACTROCERA (DACULUS) OLEAE* GMEL. COMPARATIVE STUDY OF A NEW ATTRACTANT

Ros, J.P.[1]; *Seris, E.*[1]; *Castillo, E.*[1]; *Cobo, A.*[1]; *González Núñez, M.*[1]

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This paper describes the development of an experiment carried out in an organic olive grove located in Villarejo, province of Madrid from May to November 2008's. The efficiency of four models of traps against *B. oleae* was studied: Tephri, Ecological, Easy and Olipe baited each, but separately, with three kinds of attractants: Ammonium phosphate, Nulure (Miller.Co) and a new one Tephri Lure (www.sorygar.com). About 540 observations were made in the all period, counting *B.oleae* and others arthropods (data of non *B. oleae* flies will be reported in another publication). Regarding olive fly, the results show a high variability between traps and attractants. Easy trap was the best trap. Tephri Lure captured 56% of the total amount of flies, Nulure 34% and Ammonium phosphate the 10%. It is very important to keep in mind these results to know, with a high degree of security, the density of adult population in order to make the insecticide treatment calendar (commercial oil farms). Of course, we need the best trap and the best attractant. In the case of organic olive groves, we have now a powerful attractant against *B. oleae* which surely will allow a better "Mass Trapping" control of the pest.

KEYWORDS: TRAP, *BACTROCERA*, ATTRACTANT, TEPHRILURE

O 28. CAPTURE OF NATURAL ENEMIES BY DIFFERENT DEVICES USED IN MASS TRAPPING OF *BACTROCERA OLEAE* (ROSSI)

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Mass trapping can be an alternative to insecticides to control agricultural pests, including *Bactrocera oleae*, the olive fruit fly. This method does not pollute or leave residues in the fruits and insects do not develop resistance, but it can have an effect on non-target insects. The attractants currently used in mass trapping are not specific, and a large number of non-target arthropods are captured. Among these arthropods are predators and parasitoids which are very important in the balance of the ecosystem and can play an important role in controlling pests which are, at present, secondary. Therefore, the best device for mass trapping should catch as many olive flies as possible but limit the number of non target insects captured. In this study we compared several traps and attractants in field trials to establish whether there are significant differences in the number of non-target arthropods caught, particularly predators and parasitoids. Four traps of different designs were evaluated: Tephri-trap®, Easy trap®, Tephri-trap Ecological® and Olipe. Each trap was baited with one of three different attractants: diammonium hydrogen phosphate and two protein hydrolysates, Nulure® and Tephri-lure®. Specimens captured by traps were collected from Jun to November with a total of 14 "sampling dates". Predators belonging to 35 different families and parasitoids of 26 families were captured. Only a few collected spiders and mites belonged to undetermined families. Chrysopidae and Vespidae were the most abundant predators captured, accounting for 37% and 40%, respectively. Amongst parasitoids, 80% of the captures belonged to the family Tachinidae. Tephri-trap® captured the highest numbers of natural enemies (26.0 specimens per trap and sampling date) and Olipe was the one capturing the lowest numbers (20.0 specimens per trap and sampling date). Regarding the lures, Nulure® was the one giving the highest captures (37.7 specimens per trap and sampling date), followed by Tephri-lure® (22.0 specimens per trap and sampling date) and diammonium hydrogen phosphate (16.5 specimens per trap and sampling date). Amongst the captured groups of natural enemies, chrysopids are the most relevant in the control of olive pests. Tephri-trap Ecological® captured the lowest numbers of chrysopids (1.2 specimens per trap and sampling date) and the lure Tephri-lure® captured the highest numbers of chrysopids (62.4 specimens per trap and sampling date). Data reported in this work have to be taken into account, together with information on efficacy of traps and lures for olive fly, when designing a mass- trapping programme.

KEYWORDS: *BACTROCERA OLEAE*, EASY TRAP®, DIAMMONIUM HYDROGEN PHOSPHATE, MASS-TRAPPING, NATURAL ENEMIES, NULURE®, OLIPE, PARASITOIDS, PREDATORS, TEPHRI-LURE®, TEPHRI-TRAP®, TEPHRI-TRAP ECOLOGICAL®

O 29. EFFECT OF DIFFERENT ATTRACTANTS USED IN OLIPE TRAPS FOR OLIVE FLY MASS-TRAPPING ON PARASITOIDS IN THE NORTHEAST OF PORTUGAL

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The hymenoptera parasitoids represent and important beneficial group in olive agroecosystem. Their action maintains certain olive pest species numbers lower than the economic threshold. In this context, to improve their activity and increase the sustainability of the olive agroecosystem it is necessary to know the negative effect of different agronomic practices in their populations. In ecological production, mass-trapping is an important control method against the olive fruit fly, *Bactrocera oleae* Gmel., the most serious pest of olives in the Mediterranean countries.The aim of the present work was to study the effect on parasitoids of different attractants used combined with Olipe traps.

The experimental work was carried out in Trás-os-Montes region (Northeast of Portugal) during 2005 and 2006 in an organic olive grove. Four plots of about a surface of 2 ha were constituted, and in each plot, in mid-August, Olipe traps with different attractants [biammonium phosphate 4% (BaP), ammonium phosphate 5% (AP), endomosyl 5% (End.) and urea 5% (Ur.)] were installed. Monthly in 2005, and biweekly in 2006, 15 traps per attractant were replaced, collecting the parasitoids for further count and identification.

Combining the different attractants and the complete sampling period, a total of 132 and 67 parasitoids were captured respectively in 2005 and 2006. The specimens belonged to 5 different superfamilies and 14 families being Scelionidae the most abundant family recorded. In 2005, no statistically differences were observed among attractants, however, in 2006, the total number of captures were significantly higher in AP and lower in End. The phosphate based attractants should be the most harmful for parasitoids among those tested.

KEYWORDS: OLIVE FRUIT FLY, OLIPE TRAPS, ATTRACTANTS, PARASITOIDS

O 30. DEVELOPMENT OF ATTRACT AND KILL TECHNOLOGY FOR THE CONTROL OF OLIVE FLY

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The Olive Fruit Fly is the most serious olive pest with damage potentially reaching 100%. With increasing pressure for residue free product and the loss of active ingredients there is now considerable pressure to develop effective alternatives for the control of Olive fly. Attract and Kill offers a new approach acceptable even in organic production. The AgriSense Magnet Oli device is a hand applied system combining long life attractant and insecticide formulations on a target device for season long control. The device attracts the olive fly to the insecticide treated target, minimising the need for insecticide sprays and controlling the pest without the risk of insecticide contamination and damage to the environment. The presentation will present the technology and discuss the performance of the system.

KEYWORDS: OLIVE FLY, MAGNET OLI, ATTRACT AND KILL

O 31. CHEMICAL DIFFERENCES OF SEX PHEROMONE BLEND OF TWO SYMPATRIC PYRALID MOTHS SPECIES PRESENT IN OLIVE CROPS

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Many sympatric species have sex pheromones consisting of related mixtures of components but that species specificity appears to depend upon the accurate pheromone blend (Cardé and Baker, 1984). The female sex pheromones of two sympatric Pyralidae species present in olive crops, *Euzophera pinguis* Haw and *Euzopherodes vapidella* Man (Lepidoptera: Pyralidae) were investigated. The chemical composition of the two sex pheromones was compared by analysis of pheromone gland extracts, and in addition airstream volatiles released from *E. pinguis* and *E. vapidella* were also analyzed. The two common components, identified as (Z,E)-9,12-tetradecadienyl acetate (Z9E12-14:OAc) and (Z,E)-9,12-tetradedien-1-ol (Z9E12-14:OH), were found in the extract of females of two sympatric pyralid moths, but these two pheromone components were present in the two species in roughly inverse ratios. The blend ratio of the olive pyralid moth, *Euzophera pinguis*, shows a 15:1 mixture of Z9E12-14:OH and Z9E12-14:OAc according with previous results (Ortiz y col. 2001, Ortiz y col. 2004). The pheromone gland of *Euzopherodes vapidella* was found to contain Z9E12-14:OAc as the main pheromone component, (Z)-9-tetradecen-1-ol (Z9-14:OH) plus (Z)-9-tetradecen-1-al (Z9-14:Al) as minor ones and only trace amounts of Z9E12-14:OH were detected. Behavioral studies in the wind tunnel indicate that females of each of the two Pyralidae species utilize a species-specific blend of chemicals, consisting of attractive and antagonistic components, to attract conspecific males. Electroantennogram (EAG) recordings revealed significant responses from antennae of male moths of both species to Z9E12-14:OAc at dosages ranging from 0.1-100 ?g. However, *E. vapidella* male antennae response to Z9E12-14:OH was unclear. Field test showed that blends attractive to *E. pinguis* did not attract the opposite one. This demonstrated that different ratios of shared pheromone components could provide species specific cues for critical mate location in the two sympatric pyralid moths and it is suggested that directional selection probably occurs in the pheromone blends in opposite directions in both species. But further field investigations will need to be conducted to test this hypothesis.

KEYWORDS: PYRALIDAE, SEX PHEROMONE, SYMPATRIC SPECIES

O 32. SEASONALITY IN THE OCCURRENCE OF TWO LEPIDOPTEROUS OLIVE PESTS AT TWO DIFFERENT OLIVE GROWING ZONES, IN EGYPT

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Prays oleae Bern., the olive moth (OM) and *Palpita unionalis* Hub., the jasmine moth (JM) are two of the most important pests in the commercial densely planted olive orchards in Egypt. A 3-year monitoring study using pheromone traps containing (Z)-7-tetradecenal for OM and (E)-11-hexadecenal and (E)-11-hexadecenyl acetate for JM at both of semi-arid and arid growing zones was performed. At semi-arid zone, flight pattern of the OM was the same like in the other Mediterranean countries The moth completes three generations annually: the first flight is in March/April,the second is in May/June and the third occurs in August/October. The first flight was significantly shorter than the others and the second one was longer than the third one. At the arid zone, amazing flight pattern was observed. The first flight always was very close or overlapped with the second one with no male catches during August-October. However, eggs were present most of the season, indicating unusual high female presence and oviposition activity of the OM. The moth densities were significantly lower in low fruiting year than in the higher one and at the arid olive grove than at the semi-arid one. In contrast, JM males were present all season, exhibiting 6 to 7 and 3 to 4 overlapping flight beaks in arid and semi-arid zones ,repectively. Also, moth densities were significantly higher at the arid olive grove than those at the semi-arid one. The study shows that: a) trapping area and year of fruit bearing are characteristics that strongly affect the orchard-specific information needed to correct estimates of adult emergence and timing of the control measures, b) the all season presence of JM eggs may provide a sustainable reservoir for egg wasps during the absence or low densities of OM.

O 33. EFFICIENT MASS-TRAPPING METHOD AS AN ALTERNATIVE TACTIC FOR SUPPRESSING THE POPULATION OF THE LEOPARD MOTH, *ZEUZERA PYRINA*

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The leopard moth, *Zeuzera pyrina* L. (ZP) (Lepidoptera: Cossidae), is a xylophagous species that has become a serious pest in the olive orchards, in Egypt. Both chemical and biological control have scored poorly against this pest and additional methods are needed. A simple, but efficient UV-light-pheromone sticky trap ("Hegazi model") was devised for ZP mass trapping. Activity of ZP and efficiency of pheromone-baited, light and pheromone and light traps were evaluated. Combination of light and sex pheromone was optimally attractive to ZP population in olive orchards. A comparison between light trap baited with sex pheromone in mass-trapping method and conventional controls (insecticidal and physical removal of larvae) in heavily infested plots have been carried out between 2002 and 2005. ZP moths have long flight period, starting from mid-May and lasting until early November. Females of ZP moths were rarely trapped, but all had eggs. In mass-trapping plot, the seasonal captures and active galleries diminished from one year to the next which may indicate the effectiveness of the method. From May 2003 to October 2005 greater reduction in total counts of active galleries was observed in mass-trapping plot compared with those recorded in the control field, where chemical sprays and manual killing were performed. Yield from trees in mass-trapping field was significantly increased in comparison to control trees. The study strongly recommends the use of mass-trapping method instead of pesticides against the ZP moths, not only to control them but also to mass-trap and monitor other lepidopterous pests of olive trees. Acknowledgments: We especially want to thank Dr. J. Castella (SEDQ) for providing the sex pheromone.

SESSION 5

SUSTAINABLE OLIVE PRODUCTION AND BIOLOGICAL CONTROL OF PESTS AND DISEASES

O 34. A NOVEL REARING TECHNIQUE FOR THE OLIVE FRUIT FLY PARASITOID *PSYTTALIA LOUNSBURYI* (HYMENOPTERA: BRACONIDAE) ON *CERATITIS CAPITATA* (DIPTERA: TEPHRITIDAE) IN ARTIFICIAL DIET

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The olive fruit fly, *Bactrocera oleae*, is the most important pest of olive in the Mediterranean region and also in California where *B. oleae* was discovered in 1998. *Psyttalia lounsburyi*, a specific solitary larval endoparasitoid, was imported from Kenya and South Africa beginning in 2002 for evaluation under a classical biological control program. Initial trials showed that *P. lounsburyi* was a good candidate for trials in California. The main objective was to develop a sustainable and user-friendly rearing technique. Rearing attempts using infested olives proved unsuitable for continuous rearing since fresh olives are not available year round. We then focused on a way to reproduce the parasitoid on a factitious host, the Mediterranean fruit fly, *Ceratitis capitata*. Methods used to rear other Opiinae species were ineffective with *P. lounsburyi*. A novel technique was successfully developed in 2005 and consists principally of a ball-shaped device containing *C. capitata* larvae and diet enclosed within stretched Parafilm™ for exposure to adult parasitoids. After two years and nearly 20 generations, this rearing method has proved to be sound, continuously maintaining separate colonies of *P. lounsburyi* from South Africa and Kenya. Some differences in production and offspring sex ratio were observed depending on host age. The optimal results were obtained by using third instar host larvae. Mean production is 0.6 and 1.3 progeny per female per day (7 to 24 hours exposure time) for South Africa and Kenya strains, respectively. In 2007, 27,300 parasitoids were produced, with 15,000 shipped to cooperators in California for biological studies and field releases.

KEYWORDS: BIOLOGICAL CONTROL, *BACTROCERA OLEAE*, MEDITERRANEAN FRUIT FLY, REARING TECHNIQUE, *P. LOUNSBURYI*, PARASITOID

O 35. RELEVANCE OF MOLECULAR GENETICS FOR CLASSICAL BIOLOGICAL CONTROL OF THE OLIVE FRUIT FLY, *BACTROCERA OLEAE* (ROSSI) (DIPTERA: TEPHRITIDAE) USING THE ENDOPARASITOID *PSYTTALIA LOUNSBURYI* (SILVESTRI) (HYMENOPTERA: BRACONIDAE)

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New molecular approaches could lead to increased adoption and success of biological control agents, as they provide taxonomic accuracy and a more thorough understanding of evolutionary patterns and population genetics of both the pest and its natural enemies. The application of these principles at the onset of a biological control effort is illustrated in this paper through a U.S. biological control program for olive fruit fly. The olive fruit fly, *Bactrocera oleae* (Rossi) (Diptera: Tephritidae) was discovered first in southern California, U.S.A. in 1998 and it spread throughout the state within four years to pose a serious threat to the state olive industry. A classical biological control program has been initiated by the California Department of Food and Agriculture (CDFA). From the literature, the koinobiont endoparasitoid *Psyttalia lounsburyi* (Silvestri) (Hymenoptera: Braconidae) is more of a specialist on *B. oleae* than other parasitoid species and its known geographic range is contained within that of the pest. Therefore, extensive explorations and collections of olive flies and *P. lounsburyi* in particular have been made since 2000 in wild (*Olea europaea* L. subsp. *cuspidata*) and cultivated (*Olea europaea* L. subsp. *europaea*) olives in Kenya, South Africa and Namibia. Over 50,000 olive fly pupae were shipped from Kenya to the USDA-ARS European Biological Control Laboratory (EBCL) quarantine facility beginning July 2002 through September 2008. Although emerging parasitoids were primarily destined to be reared as lab-colonies and/or directly shipped to quarantine facilities in California for further testing and potential releases, such extensive collections provided the basis for monitoring species and population diversity of both olive flies and natural enemies over years and locations. *B. oleae* and related sympatric congeneric species and parasitoids including *P. lounsburyi* that emerged there were counted and taxonomically identified. Concurrently, molecular species identification of the flies following a DNA barcoding approach was initiated at the onset; this was systematically matched with co-occurring *P. lounsburyi* populations. Later in the program, microsatellite neutral markers of *P. lounsburyi* were developed under the aegis of the French National Research Institute of Agronomy (INRA) in order to assess the parasitoid population diversity. These markers proved to be transferable to *P. concolor*, another candidate biological control agent of the olive fruit fly, and are instrumental for ensuring the purity of the quarantine cultures. Ultimately, they will be the essential means for documenting the presence and establishment of both *Psyttalia* species populations in the field in California.

KEYWORDS: *BACTROCERA*; DNA BARCODING; POPULATION GENETICS

O 36. INTRODUCTIONS OF THE AFRICAN PARASITOID *PSYTTALIA LOUNSBURYI* IN SOUTH OF FRANCE FOR CLASSICAL BIOLOGICAL CONTROL OF *BACTROCERA OLEAE*

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The scientific aim of this project is to use replicated introductions of an exotic parasitoid to test the effect of intra-specific hybridization on population establishment, growth and spatial spread (Malausa et *al.*, 2007). For this, we introduced *Psyttalia lounsburyi* (Hymenoptera: Braconidae) an African parasitoid of the olive fruit fly *Bactrocera oleae* (Diptera: Tephritidae). The introduction in France of this new biocontrol agent - initially provided by the European Biological Control Laboratory (USDA/ARS–Montpellier, France) - is also obviously a hope to control olive fly populations. Two parental strains of *P. lounsburyi* originating from a unique geographic origin (Kenya or South Africa) as well as a hybrid strain resulting from their crosses were used. The overall objectives was to estimate during several years in natura the demography of each of these strains as well as the population dynamics of the olive fruit fly. In this paper, we present the two first years of research and progress toward these objectives. During 2007, laboratory experiments have largely increased our knowledge on the *P. lounsburyi* biology, allowing for a significant improvement in rearing methods, and offering a first evidence of phenotypic differences between strains. Intensive field surveys have also been carried out to locate the 60 suitable release sites (20 replicates for each parasitoid strain). During Fall 2007, samples of 1000 olives have been collected on each site and brought back to the laboratory. We assessed the density of *B. oleae* and the diversity of indigenous natural enemies before the introduction of *P. lounsburyi*. The first half of 2008 was dedicated to the mass production of parasitoids. During the summer, more than 60 000 *P. lounsburyi* have been produced and a total of about 43 000 individuals have been introduced in the 60 sites. As in 2007, olives were sampled in each site during the Fall 2008, allowing us to assess the presence of *P. lounsburyi* as well as the density of the olive fly and its natural indigenous enemies. Additionnally, sticky traps containing virgin *P. lounsburyi* females were used in order to increase the probability of detecting adult males in small populations. Several individuals of *P. lounsburyi* have been found during the fall in some sites. These first observations show the possibility for the wasps to find the targeted hosts and to complete its development. Such surveys will be conducted over two years more (2009 and 2010) to assess the succcess of the establishment of the biocontrol agent (particularly after overwintering) and the population dynamics and genetics of established populations.

O 37. CURRENT STATUS OF BIOLOGICAL CONTROL OF *SAISSETIA OLEAE* IN SARDINIA (ITALY)

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During 1992-1994 and 2007-2008 the parasitoid complex of black scale, *Saissetia oleae* (Olivier), was studied in olive groves of Sardinia after the introduction of encyrtids *Metaphycus helvolus* (Compere) and *M. lounsburyi* (Howard) (= *M. bartletti* Ann. & Mynh.) in the period 1979-1992. Black scale females were parasitized by the encyrtids *M. lounsburyi* and *M. anneckei* Guerrieri & Noyes and by the pteromalid *Scutellista coerulea* (Fonscolombe). The total parasitism rate was about 50% and *M. lounsburyi* was the dominant parasitoid. Second and third instar of black scale were mainly parasitized by *M. helvolus* and secondarily by *Coccophagus lycimnia* (Walker) and *M. flavus* (Howard) with percentages of parasitism ranging from 10 to 20%. *M. helvolus* and *M. lounsburyi*, introduced for the first time 30 years ago, are well established and provide biological control of black scale together with other natural enemies. M. lounsburyi may be considered the most important and spread parasitoid of black scale in Sardinia.

KEYWORDS: *SAISSETIA OLEAE*, PARASITOIDS, BIOLOGICAL CONTROL

O 38. INFLUENCE OF THE DAY PERIOD ON THE ABUNDANCE AND DIVERSITY OF SOIL ARTHROPODS IN OLIVE GROVE ECOSYSTEM

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On soil food webs, arthropods are part of important functional groups. Recognize these arthropods and understand its function in the ecosystem as well as the period of the day in which they are actives, is essential to understand their roles. In the present work we intend to study the soil arthropods diversity as well as the period of the day that are actives in three olive groves from the Northeast of Portugal. Particular emphasis was given to the generalist predators that can attack olive fruit fly pupae in soil. The work was carried out during the spring of 2006 and at a bi-weekly basis 25 pitfall traps/grove were put during 12 hours both on day period (from 7:00am to 7:00pm) and on night period (from 7:00 pm to 7:00 am). The collected individuals were sorted and identified. Five classes of arthropods were found: Chilopoda, Malacostraca, Entognatha, Insecta and Arachnida. Captures were numerically dominated by springtails. Arachnida and Insecta classes represented about 20.4% and 9.0% respectively from the total captures. Among the predatory arthropods, the most representative groups were Aranea and Opiliones from arachnids and Formicidae, Carabidae and Staphylinidae from insects. On Formicidae, *Tetramorium semilaeve* Andre 1883, *Tapinoma nigerrimum* (Nylander 1856) and *Crematogaster scutellaris* (Olivier, 1792) were the most representative ant species. Arthropods have demonstrated preference for the day, with 74% of the total individuals recovered in this period although richness and similarity have been similar between periods.

KEYWORDS: OLIVE GROVE, SOIL ARTHROPODS, DIVERSITY, DAY PERIOD, PREDATORS

O 39. EFFECT OF SOIL TREATMENTS WITH ENTOMOPATHOGENIC FUNGI ON OLIVE GROVE ANT COLONIES

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Recent studies have shown the potential of entomopathogenic fungi (EF) for the biocontrol of tephritid puparia in soil treatments beneath the tree canopy. The soil is the natural ecosystem of these fungi, and the soil environment provides protection against UV. In addition, the fungi may recycle in the soil, providing a long term control of the puparia. However, such soil applications could have a negative impact on non target soil arthropod fauna. In particular, ants play an important role in olive grove soil fauna, because they are biological indicators of soil condition. *Tapinoma nigerrimum* Nylander is a dominant species in olive groves in southern Spain. Thus, the aim of this study has been to determinate the effect of soil treatment with *Metarhizium anisopliae* and *Beauveria bassiana* on T. nigerrimum colonies. Ants collected from field populations were divided into 28 groups of 100 ants per experimental nest. Ten of them were used for each fungal treatment, which was made with a suspension of 108 conidia per ml on olive grove soil. No significant differences in mortality were found between fungal treatments and control, which mean values ranging between 41.0% and 64.7%, whereas a significant reduction in average survival time was observed (from 16.9 days in control to 15.6 days in treatment with *B. bassiana* and 14.8 days in treatment with *M. anisopliae*). In addition, the activity of the ants was observed before and after the treatment. For that, the actual number of ants going across the link tube of both sides of experimental nest was observed for 5 minutes. There were no significant differences in ant activity before and after treatment activity. Finally, the potential of these ants to disseminate conidia from treated soil to non treated one was evaluated. For that, an annex with sterile soil was linked to treated experimental nests, and ants were allowed to cross from one side to the other. Soil samples were taken and the absence of EF in non treated soils was ascertained by conidial forming units method on selective medium.

KEYWORDS: *BEAUVERIA BASSIANA*, *METARHIZIUM ANISOPLIAE*, *TAPINOMA NIGERRIMUM*, OLIVE ORCHARD, BIOLOGICAL CONTROL, DISSEMINATE

O 40. TEMPERATURE AND HUMIDITY RELATED EFFECTS ON VIRULENCE OF *METARHIZIUM ANISOPLIAE* AGAINST TEPHRITID PUPARIA IN SOIL

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Entomopathogenic fungi (EF) have been successfully used against adult tephritids in adult sprays, and they show promise for the control of tephritid puparia in the soil. However, the effectiveness of EF in soil depend on abiotic factors (temperature, moisture and physicochemical properties of the soil) and biotic factors (fungistasis by soil microflora). The goal of the present study has been to evaluate the activity of two isolates from *Metarhizium anisopliae* (EAMa 01/58-Su and EAMa 01/158-Su) and one from *Beauveria bassiana* (Bb 1333) against *Ceratitis capitata* puparia (as model for olive fly puparia) in the soil at different temperature and moisture conditions. The isolates were assayed against *C. capitata* puparia treated as late third instars in sterilized soil at 25 ºC under five temperatures (15, 20, 25, 30 and 35 ºC) and five moisture conditions (-2.4, -0.5, -0.47, -0.28 and -0.23 Mpa). In general, *B. bassiana* isolate Bb 1333 was the least virulent. For the most virulent isolate, *M. anisopliae* EAMa 01/58-Su, a direct relationship between temperature and puparia mortality was observed. Conversely, *M. anisopliae* isolate EAMa 01/158-Su caused higher mortalities at intermediate temperatures. Even if the soil moisture had a significant effect on the mortality of C. capitata puparia, there were significant interactions moisture*temperature and moisture*isolate. In general, lower mortalities were observed in extreme moisture values (-2.4 and -0.23 Mpa) for temperatures between 15 and 25 ºC, even though this tendency was not observed at 30 and 35 ºC.

KEYWORDS: *BACTROCERA OLEAE*, *CERATITIS CAPITATA*, *BEAUVERIA BASSIANA*, *METARHIZIUM ANISOPLIAE*, BIOLOGICAL CONTROL, SOIL FACTORS, PUPARIA, SOIL INOCULATION

O 41. USE OF THE FUNGAL FORMULATION BIOTEN® FOR PROTECTING OLIVE PLANTING STOCKS FROM VERTICILLIUM WILT CAUSED BY DEFOLIATING *VERTICILLIUM DAHLIAE*

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Olive cultivation has expanded significantly in Andalusia, southern Spain, mainly through establishment of high-density, irrigated orchards using nursery-propagated, self-rooted planting stocks of cultivars susceptible to Verticillium wilt caused by *Verticillium dahliae*. Prevalence, incidence and severity of this disease has increased significantly in the last decade associated with those management practices, as well as the widespread occurrence of a highly virulent, defoliating (D) *V. dahliae* pathotype within that region. Use of planting stocks certified free from *V. dahliae*; and protection of their root system from infection by residual soilborne or incoming inoculum would be a suitable strategy for reducing the potential for severe disease in young trees. This would allow for the disease recovery phenomenon to express and contribute to control of the diseases if new infections do not take place thereafter. We have tested that hypothesis using a cocktail formulation of biocontrol fungal strains (Bioten®) in artificial-inoculation experiments of self-rooted 'Picual' olive plants with D *V. dahliae*, to which this cultivar is highly susceptible. Repeated experiments were carried out in growth chambers under environmental conditions optimal for disease development, both by transplanting treated plants (3.2x106 cfu/g root) to soil infested with 2x106 *V. dahliae* /g soil or by root dip inoculation in a 107 conidia/ml for 20 min. Results indicated a consistent and significant reduction in the severity of symptoms after 2 month of incubation at 25ºC. The reduction in symptoms severity lasted for additional 6 moths when plants were further incubated under natural environment in a shelter. Additionally, Bioten®-treated plants were transplanted into a solarized soil in microplots under natural environment, and their root system was inoculated with D *V. dahliae* inoculum in corn meal-sand (approximately 500 cfu/g soil) and treated again with Bioten® just after transplanting as well as 1 year later. After 2 years, disease reached 91% incidence in the treated plants compared with 100% in the non-treated controls ($P > 0.05$), but both disease severity and the area under disease progress curve were reduced by 60% ($P < 0.05$) by the biological treatment. This reduction in symptom severity over time is of significance, taking into account that affected plants were further exposed to new D *V. dahliae* natural inoculum from infected, fallen leaves, over the 2 years of the experiment.

KEYWORDS: BIOCONTROL, COMMERCIAL FORMULATION, DISEASE SUPPRESSION

O 42. INTRASPECIFIC VARIATION OF THE ENTOMOPHATOGENIC FUNGI *BEAUVERIA BASSIANA* COLLECTED IN OLIVE GROVES FROM DIFFERENT GEOGRAPHIC ORIGIN

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The fungus *Beauveria bassiana* is a well-recognised entomopathogen known to infect hundreds of host species from most of the insect orders. Therefore, the use of this fungus as a biological control agent against insect pests is very promising and several commercial products have already been developed. The natural occurrence of *B. bassiana* has been reported throughout Spain. Recently, its presence has been also verified in Portugal, specifically in the Trás-os-Montes region. In the present study, we have investigated the intraspecific variation of 21 *B. bassiana* isolates, 9 of which sampled in olive trees located in Portugal (Trás-os-Montes region) and the remaining 12 in Spain (Córdoba). After the identification of fungal isolates by sequencing of the amplified internal transcribed spacer (ITS) region of rDNA, the isolates were compared by random amplified polymorphic DNA (RAPD). The average sequence lengths of ITS1, 5.8S rDNA, and ITS2 of *B. bassiana* were 215, 170, and 214 pb, respectively. When compared with the ITS region from other fungal species, all the ITS sequences from the fungal isolates showed 99.0% of identity with *B. bassiana*. Among a total of 40 arbitrary 10-mer primers, 10 primers produced polymorphic RAPD profiles. The RAPD patterns showed considerable genetic variation between isolates from different geographic origin. The significance of the findings for the genetic variability of *B. bassiana* is discussed.

KEYWORDS: *BEAUVERIA BASSIANA*, ENTOMOPHATOGENIC FUNGI, RAPD, INTRASPECIFIC VARIATION

O 43. DIVERSITY AND BIOCONTROL POTENTIAL OF BACTERIAL COMMUNITIES IN THE RHIZOSPHERE SOIL AND ROOTS OF WILD OLIVES (*OLEA EUROPAEA* L. SUBSP. *SYLVESTRIS*) IN ANDALUSIA, SOUTHERN SPAIN

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Olive trees are long-living, oil-producing plants and one of the oldest agricultural crops in the world. For millennia, the cultivated olive tree (*Olea europaea* L.) has been culturally and economically the main oleaginous crop in the Mediterranean Basin, where circa 9.5 million ha are grown nowadays. Many studies support the assumption that *O. europaea* derives from domestication of wild olive trees, namely oleaster (*O. europaea* L. subsp. *sylvestris*), which is considered its wild ancestor. Until now, few studies have focused on the diversity and structure of microbial populations associated with woody plants, including olive trees. Moreover, no research has been carried out so far on bacterial communities inhabiting the rhizosphere of wild olives. The objective of the present study was to examine the structure and diversity of bacterial communities in rhizosphere soil and roots of wild olives in the Andalusia region at southern Spain. Samples of oleaster roots and rhizosphere soil were obtained from oleaster havens in non-cultivated and cultivated areas at 10 locations in Cadiz and Huelva provinces, and from two centenary olive orchards in Jaén and Cádiz provinces. The genetic diversity of bacterial communities on the rhizosphere soil and roots was investigated by a molecular approach using terminal restriction fragment length polymorphism (T-RFLP) analyses of amplified 16S rDNA sequences and digestion with *RsaI* and *MspI* restriction enzymes. Results of T-RFLP analyses indicate that each oleaster haven is a unique reservoir of bacterial diversity compared to centenary cropped olives for which bacterial populations in the rhizosphere soil and roots are more similar to each other. In addition to that, we investigated the in vitro antagonistic activity of 539 of the bacterial isolates obtained against the defoliating pathotype of *Verticillium dahliae*, the olive wilt pathogen, as well as potential biocontrol mechanisms that might be involved including production of cell wall-degrading enzymes and antifungal secondary metabolites. Out of the 539 bacterial isolates, 84 (16%) showed a strong antagonistic activity against *V. dahliae*. Most of these antagonists showed proteolitic (76%) and lipolitic (73%) activity, and produced antifungal secondary metabolites including siderophores (77%), pyoverdines (15%), and 2,4-diacetylphloroglucinol (7%). Sequence analysis of the 16S rDNA region indicated that most bacterial antagonists belong to genera *Bacillus* and *Pseudomona*s. Also, several bacterial species have been identified that had not been reported in olive before, including *Duganella violaceinigra*, *Chryseobacterium vyrstaatense*, *Rhodococcus wratislaviensis*, *Acinetobacter* sp., and *Arthrobacter* spp. The biocontrol potential of these antagonistic bacteria against Verticillium wilt in olives is currently in progress. Research funded by grant AGL2008-00344/AGR.

KEYWORDS: MICROBIAL ECOLOGY

O 44. MONITORING THE COLONISATION OF OLIVE TISSUES BY *VERTICILLIUM DAHLIAE* AND ITS INTERACTION WITH THE BENEFICIAL ROOT ENDOPHYTE *PSEUDOMONAS FLUORESCENS* PICF7

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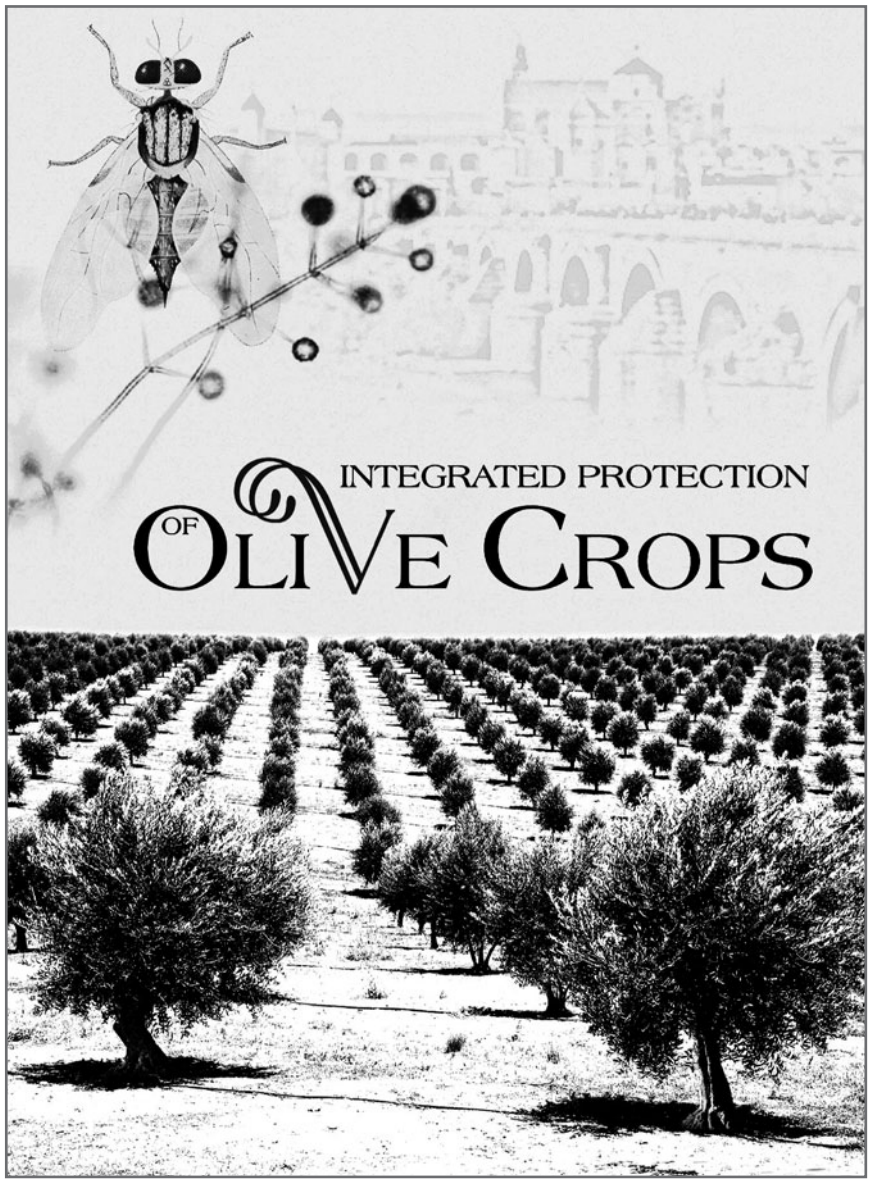
Among the biotic constraints affecting olive, verticillium wilt (*Verticillium dahliae Kleb.)* poses the most serious threat for the cultivation of this tree worldwide. Three phases can be distinguished in the parasitic phase of *V. dahliae* life cycle: 1) infection of the root, 2) colonisation of the vascular system, and 3) symptom development. In addition, *V. dahliae* can survive in soils for a prolonged period of time by means of resistant structures (microsclerotia) which upon exposure to appropriate stimuli may germinate. Germinating hyphae can then penetrate into root tissues initiating the infection process. Efficient control of this disease should be primarily by means of an integrated management strategy, with emphasis in before-planting measures. An interesting element of such a preventive strategy is the protection of pathogen-free planting material from early infection during plant propagation and/or at transplanting. This could be accomplished by the use of biocontrol agents (BCAs). Some *Pseudomonas* spp. strains are known to be beneficial to plants because of their ability to promote plant-growth and/or act as BCAs against a number of plant diseases and pests. Previous studies have revealed that *Pseudomonas* spp. strains native to olive roots antagonize *V. dahliae in vitro* and effectively suppress disease caused by the most aggressive (defoliating [D]) pathotype. The objectives of this work were to: 1) monitor by confocal laser scanning microscopy (CLSM) the infection and colonisation of the entire olive plant by an enhanced yellow fluorescent protein (EYFP)-tagged transformant of the *V. dahliae* D pathotype; 2) assess the biocontrol activity of an enhanced green fluorescent protein (EGFP)-tagged *P. fluorescens* PICF7 derivative in young olive plants against the D pathotype; and 3) analyse the interaction between the EYFP-tagged *V. dahliae* isolate and the *P. fluorescens* EGFP-tagged PICF7 strain on/in olive roots. An EYFP-tagged *V. dahliae* derivative (VDAT-36I) was obtained by *Agrobacterium tumefaciens*-mediated transformation. The colonisation process of 'Arbequina' plantlets by VDAT36-I, and the *in planta* interaction with the endophytic strain PICF7 (EGFP-tagged) have been determined on/in olive tissues during 60 days using a nongnotobiotic system, CLSM and vibratome-tissue sectioning. Isolate VDAT-36I quickly colonised olive root surface, successfully invaded root cortex and vascular tissues via macro- and micro-breakages, and progressed to the aerial parts of the plant through xylem vessel cells. Strain PICF7 used root hairs as preferred penetration site, and once established on/in root tissues, hindered to some degree pathogen colonisation. Early and localised root surface and root endophytic colonisation by *P. fluorescens* PICF7 is needed to impair full progress of verticillium wilt in olive.

KEYWORDS: BIOCONTROL, ENDOPHYTE, *PSEUDOMONAS FLUORESCENS*, *VERTICILLIUM DAHLIAE*



POSTER-ABSTRACTS

SESSION 1

THE OLIVE PEST AND DISEASE STATUS AROUND THE WORLD

P 01. IS THE FECUNDITY OF *BACTROCERA OLEAE* (ROSSI) DEPENDENT ON NITROGENOUS SOURCES?

Marzaro, M.[1]*; Savio, C.*[1]*; Martínez-Sañudo, I.*[1]*; Mazzon, L.*[1]*; Girolami, V.*[1]

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Bactrocera oleae (Rossi) is the worst olive tree pest in the Mediterranean basin. Previous studies report that high levels of fecundity are induced by vitamins and nitrogenous sources, even on articificial oviposition media. If oviposition occurs on olives up to 20 eggs per days may be obtained if adults are fed with sugar and yeast autolysate. If, however, only sugar is offered to adults, and artificial ovipositional beds are used, a drastic reduction in fecundity is observed. When olives are offered as an ovipositional media and the diet is based on sugar, then female fecundity can be in the order of 4 to 5 eggs per female, per day; and can last for many weeks. This suggests that olive fly females enhance fecundity if a balanced diet is offered, nevertheless, they are still able to produce a large number of eggs without a specific intake of vitamins, proteins or other nutrients, in addition to sugar. It should be noted that oviposition on olives allows olive fly adults to feed on the olive juice that runs from the oviposition wounds. Thus, the nutrients present in the juice may be a good addition to the nutrition of adult flies. As olive juice is readily available to laying females, it seems that the olive fly can achieve good fecundity without the consumption of vitamins, aminoacids, proteins, etc; and that sugar only, for example honey dew or fruit sugar is sufficient. It seems also that the assumption of bacterial or yeast colonies are not strictly necessary for a good reproduction in the wild. It is probable that the symbiotic bacteria "*Candidatus Erwinia dacicola*" plays an important role in nutrional supply. This topic will be discussed.

KEYWORDS: OVIPOSITION, DIET

P 02. STUDY ON THE EFFECT OF SAMPLING TIME AND DIRECTION ON OLIVE FRUIT FLY, *BACTROCERA OLEAE* GMELIN (DIPTERA:TEPHRITIDAE) INFECTION AMOUNT

Nouri, H.[1]*; Darbehaniha, Z.*[1]

[1] ***QANRRC***

Olive fruit fly, *Bactrocera oleae* Gmelin is one of the key pest in the world. This pest larva is monophagous and feed only on fruit mesocarp. Research on this pest is essential considering its non-nativity and the strategic role of olive crop. It is the major research goal to get sampling information for integrated pest managing. It was carried out in 2007, five orchards were selected and sampling was done weekly from10 trees and 10 fruits from each geographical directions. The collected fruits were taken to the laboratory and their infection amount was recorded. Variance analyzes showed that the effect of sampling time and direction on infection level was significant in 1% probability level, it means different sampling times and directions were different from the point of infection amount. For comprising the infection level in different sampling times and directions Duncan method in 5% probability level was used. Sampling times located in four classes. Mean comparison of infection level in different directions showed that infection in Southern and Eastern directions were more than infection in the other ones.

KEYWORDS: *BACTROCERA OLEAE* GMELIN, SAMPLING TIME, DIRECTION, INFECTION

P 03. COMPRISING QUALITATIVE AND QUANTITATIVE CHARACTRISTICS OF OLIVE OIL IN INFECTED AND UNINFECTED FRUITS BY OLIVE FLY IN VARIOUS MATURING DATES

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Plants oils are basic energy sources and food substance that supply Lipoasids , vitamins and antioxidants. The set of changes occur in olive fruit maturing stages can help us in better understanding of improving fruit oil qualitative and commercial characteristics process. This research has conducted to investigate changes rate of some qualitative and quantitative characteristics in olive oil that have been obtained from infected or uninfected fruits by olive fly in various maturing dates. This trial was in factorial RCBC with three replications on Zard olive cultivar. Factor A- fruit (in two levels, 1-infected 2- uninfected) B- various maturing dates (in six levels, 1- 19 Nov, 2- 26 Nov, 3-3 Dec, 4- 10 Dec, 5- 17Dec, 6- 24Dec) Oil was extracted by centrifuge after sampling and splitting flesh from fruit stone and was sent to Oil seeds Institute for measuring qualitative characteristics. Obtained data were analyzed by statistical program and Duncan. Procedure used for means comparing. Obtained results the on some qualitative characteristics such as Oleic Acid, Acidity an peroxide, but it wasn't significant for Linoleic Acid, uninfected fruits had lower Acidity and peroxide but higher Oil and Oleic Acid than infected fruits, there for had better quality, too.

KEYWORDS: OLIVE FRUIT FLY, OIL, QUALITATIVE AND QUANTITATIVE CHARACTERISTICS, MATURING DATES

P 04. THE SCALE INSECTS (HEMIPTERA: COCCOIDEA) AND THEIR NATURAL ENEMIES IN CROATIAN OLIVE GROVES

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The insect fauna of olive is very rich, and in the Mediterranean basin alone, there are more then 60 species known to live on the olive tree. About 15-20 of them are permanent or occasional pests, and approximately 10 of those, belong to the scale insects (Pellizzari, 1997). The scale insects can devastate olive fruits and olive trees. They thrive on nearly all parts of host plants, sometimes settle under bark, and cause a variety of plant deformities. Some of them excrete large amount of honeydew and by the subsequent development of sooty mould fungi, they severely reduce photosynthesis and transpiration. They disperse passively with the aid of wind, water, soil, humans and domestic and wild animals. Global trade has been a major factor in their spread worldwide. Faunistic investigation of the scale insects of olive trees and their natural enemies in Croatia were carried out in 6 coastal counties over a 4 year period (2005 – 2008) by visual inspections of potentially infested host plants with the help of a magnifying lens of 10x magnification, collecting of host plant material infested with scale insects in plastic bags, labelling each sample with collection data, observation of field characteristics of collected specimens under the dissecting stereo microscope, slide mounting, microscopic identification on the basis of morphological characteristics according to relevant keys and marking the localities of finding according to UTM system. Inspections have resulted in 9 identified scale species, namely from family Asterolecanidae: *Pollinia pollini* (A. Costa, 1857); Coccidae: *Filippia follicularis* (Targioni Tozzetti, 1867), *Lichtensia viburni* Signoret, 1873, *Saissetia oleae* (Olivier, 1791); Diaspididae: Epidiaspis leperii (Signoret, 1869), *Lepidosaphes flava* (Signoret, 1870), *Lepidosaphes ulmi* (Linnaeus, 1758), *Parlatoria oleae* (Colvée, 1880) and *Pseudaulacaspis pentagona* (Targioni Tozzetti, 1886). Species *L. flava* is a newly recorded species in Croatia. Within faunistic investigation, beside scale insects on olive trees, 7 predator species from family Coccinelidae were established (*Adalia decempunctata L.*, *Chilocorus bipustulatus* L., *Chilocorus renipustulatus* S., *Coccinella septempunctata* L.), *Exochomus quadripusulatus* L., *Scymnus frontalis* F. and *Scymnus subvillosus* G. In the body of scale insects on olive trees, 7 different parasitic wasps from superfamily Chalcidoidea were found, namely *Aphytis proclia* Walker, *Blastothrix hungarica* Erdös, *Coccophagus lycimnia* Walker, *Coccophagus palaeolecanii* Yasnosh, *Metaphycus* Mercet sp., *Pachyneuron muscarum* Linnaeus and *Scutellista caerulea* Fonscolombe. They belong in families Aphelinidae, Encyrtidae and Pteromalidae.

KEYWORDS: SCALE PESTS, NATURAL ENEMIES, CROATIAN OLIVE GROWES

P 05. DAMAGE POTENTIAL OF RHYNCHITES *CRIBRIPENNIS* (COLEOPTERA: ATTELABIDAE) IN OLIVE CROPS

Perdikis, D.[1]; Garantonakis, N.[1]; Giatropoulos, A.[1]; Paraskevopoulos, A.[2]; Lykouressis, D.[1]; Kitsis P.[1]

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The adults of *Rhynchites cribripennis* Desbrochers (Coleoptera: Attelabidae) firstly appear on the olive trees in early to mid May and their population peaks in June. They feed on olive fruits causing feeding holes. This kind of damage can lead to significant fruit drop of young fruits. The association between the density of this weevil and the damage severity was investigated in trees of the oil variety "Koroneiki" in the area of Kyparissia, in south-western Peloponnesus. Under this aim, olive shoots were enclosed in mouslin cages. In each cage 2 or 4 adults of the pest were introduced. The introduction took place in the initial stage of the olive fruit development. In average, the shoots in each cage bore 357 fruits. The percentage of fruits dropped and the damage level on the fruits were recorded in about 1 month intervals. At harvest, the fruits that remained on the shoots were individually weighted to evaluate possible reduction on the fruit weight. According to the data collected, this pest can cause a significant damage due to the fruit drop (54±0.06%, 38±0.04% and 16±0.02% in the cages with 4, 2 and 0 adults, respectively). Young fruits were more severely damaged considering that a single feeding hole per fruit could cause its drop. Finally, the high percentage of dropped fruits caused a significant decrease on the weight of the olives at harvest. These results show the that *R. cribripennis* can cause serious damage on the olive production and offer useful information for qualifying its damage potential and developing a more rationale control strategy of this pest.

P 06. IMPROVEMENT OF INOCULATION METHODS FOR SCREENING OLIVE GENOTYPES FOR RESISTANCE TO *VERTICILLIUM DAHLIAE*

Trapero, C.[1]*; Rallo, L.*[1]*; Blanco López, M.A.*[1]*; López Escudero, F.J.*[1]

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Control of Verticillium wilt of olive (VWO), caused by the fungus *Verticillium dahliae*, should be approached through an integrated control strategy, in which the use of resistance is one of the most important measures. Olive shows a wide source of genetic variability that can be explore for finding resistance. Nevertheless, developing effective inoculation methods that allow to differentiate resistant from susceptible reactions, to short incubation period of infections, and to reduce space and time is necessary. The objective of this research was to develop rapid, reliable and effective methods for screening a great number of olive genotypes for resistance to *V. dahliae* in young plants. Three inoculation methods (transplanting to a naturally infested soil, bare-root dip and direct dipping of plant cultivation trays) were tested using a conidial suspension of a cotton defoliating isolate. Moreover, three types of olive plant material (nine-month wild olive seedlings, and nine and two-month rooted olive cuttings of 'Picual') were assessed. After inoculation, plants were grown in controlled conditions, where disease severity was weekly evaluated by assessing symptom severity (defoliation, wilt, chlorosis and necrosis) using a 0-4 rating scale. Wild olive seedlings and nine-months rooted olive cuttings, both inoculated by root dip, showed similar disease development, exhibiting symptoms from the 4th week after inoculation up to the end of experiment 15 weeks after inoculation where all plants showed symptoms. Final disease severity and percentage of dead plants were 3.3/68% and 3.9/90% for seedlings and rooted cuttings, respectively. On the contrary, two-month rooted olive cuttings inoculated by root-dip did not show symptoms during the recording period. Moreover, disease symptoms were not observed in any plant inoculated by dipping of cultivation trays. Plants growing in infested soil have not showed wilt symptoms yet, and they are currently being evaluated. It has been demonstrated that young olive seedlings can be successfully infected by V. dahliae showing consistent VWO symptoms. Therefore, root dip inoculation of seedlings could be an effective and useful method for identifying resistance in olive. This method also saves time and space in comparison with standard inoculation methods of older plants, such as nine-moths rooted cuttings, commonly used up to now in routine inoculation experiments. Finally, additional trials currently conducted, have preliminarily demonstrated that seedling age for succesful infection by the pathogen, using root dip or stem puncture inoculation, could be reduced to 5 weeks.

KEYWORDS: OLIVE, RESISTANCE, INOCULATION METHODS, *VERTICILLIUM DAHLIAE*

P 07. AN OUTBREAK OF VERTICILLIUM WILT IN HEDGEROW OLIVE ORCHARDS IN ANDALUCÍA (SOUTHERN SPAIN)

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Verticillium wilt of olive (VWO), caused by *Verticillium dahliae*, is nowadays the most destructive olive disease in the Guadalquivir Valley in Andalucía. In last years, some growers are establishing a new olive intensive cultivation system, based on high tree densities with 2000 tree/ha arranged in hedgerows. 'Arbequina' is the better-adapted olive cultivar to hedgerow system, but in some cases 'Picual' (major Spanish cultivar) has been used. Both cultivars are highly susceptible to the Defoliating pathotype of the pathogen in controlled conditions, although 'Arbequina' seems to be less susceptible than 'Picual' under field conditions. In this work, several agronomical and phytopathological parameters has been studied in six hedgerow olive orchards affected by VWO planted with 'Arbequina' (5 fields) or 'Picual' (1 field). In each field, inoculum density of *V. dahliae* in soil was determined before orchard establishment by wet sieving method. Thereafter, fields were inspected, from 14 to 64 months after planting, and disease incidence scored in two separate subplots (5 rows, 100 trees/row) of each field. Inoculum density in field soils before planting ranged from <0.4 to 35.5 microsclerotia per gram of soil and disease incidence ranged between 2.8 and 30.4% after a period from 19 to 64 months after planting in 'Arbequina' orchards. However, the field planted with 'Picual', reached 77.1% of wilted trees in observations carried out 14 months after planting, with an initial inoculum density in soil of 2.4 ppg. Results suggest that hedgerow cultivation system produces a shortening of disease onset period, favoring VWO, with more severe and faster disease development than those observed in traditional and intensive olive orchards planted with 'Arbequina'. It is also remarkable that epidemics can become devastating when very susceptible cultivars such as 'Picual' are used instead of 'Arbequina' in infested soils even with low inoculum density in soil. Among other agronomical factors favoring WVO development, higher density of superficial roots in the hedgerow system comparing with traditional or intensive systems, may account for a homogeneous exploration of the soil profile, increasing root infection by *V. dahliae*.

KEYWORDS: OLIVE, VERTICILLIUM WILT, *VERTICILLIUM DAHLIAE*, HEDGEROW CULTIVATION SYSTEM

P 08. DETECTION AND IDENTIFICATION OF *PHYTOPHTHORA* SPECIES OF OLIVE SEEDLINGS IN SOUTHERN ITALY

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The aim of the present work was the monitoring of *Phytophthora* spp. in the soil and roots of olive plantlets growing in the main olive nurseries in Southern Italy. Traditional (plating on selective medium) and molecular (PCR) methods were used to detect the pathogen both in soil and rootlets samples. *Phytophthora* spp. were identified in 37% of the collected samples (about 500). Primers Ph2-ITS4 immediately revealed the presence of the genus *Phytophthora*, whereas the sequences of the amplicons generated by the primer pairs ITS4-ITS5 and COXF4N-COXR4N unambiguously identified *P. palmivora*, and P. *citricola.* Results obtained from nurseries located in Apulia and Calabria regions indicated that *P. palmivora* was the most predominant species (85.72%), followed by *P. citricola* (14.28%), either in the soil and rootlets samples. The molecular tool applied in this work confirmed the morphological identification of the *Phytophthora* species involved in the root rot of olive plantlets.

P 09. PRESENCE AND SPATIAL DISTRIBUTION OF VIRUSES IN CROATIAN OLIVE GROWES

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During 2005. and 2006. year, the testings of the olive plant material on the presence of olive viruses were conducted for the first time in Croatia. The samples for testing were collected from twenty five locations in commercial olive orchards, from traditional olive growing areas. All samples were teseted on presence of eight virus types: ArMV, CMV, CLRV, OLV-1, OLV-2, OLRV, OLYaV and SLRV. The results which were conducted by using of the RT-PCR method, confirmed the presence of viruses from 25% of samples, and four virus types were confirmed: OLYaV - *Olive leaf yellowing-associated virus*, CMV - *Cucumber mosaic virus*, OLV-2 - *Olive latent virus* 2 and SLRV – *Strawberry latent ringspot virus*. Presence of CMV was confirmed on Istarska bjelica and Lastovka samples, SLRV was confirmed on Levantinka and Oblica samples, OLV-2 was confirmed on Lastovka samples, OLYaV was confrimed on Bjelica, Istarska bjelica, Lastovka and Levantinka samples. Samples of Bu_a, Peri?iæeva mastrinka and Rosulja cultivars were free from tested viruses.

KEYWORDS: CMV, OLIVE, OLV-2, OLYAV, SLRV, VIRUSES

P 10. EVALUATION OF NECROVIRUSES OCCURRENCE BY SPECIFIC RT-PCR IN OLIVE

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Three necroviruses are presently known to infect *Olea europaea* L., *Olive latent virus 1*(OLV-1), *Tobacco necrosis virus* D (TNV-D) and *Olive mild mosaic virus* (OMMV), the latter having properties of being a recombinant between the other two viruses. Their presence was surveyed in a field collection of the olive cv. 'Galega vulgar' ecotypes, in Portugal, by means of virus specific RT-PCR assays. Field samples taken from 54 olive trees consisted of 2-year old stems collected in spring, and of fruits collected in fall. Double stranded (ds) RNAs were extracted from ca. 35 g of stem scrapings or fruit pulp, subjected to cellulose cromatography, elution and ethanol precipitation prior to their denaturation, and used as template in reverse transcription (RT) and polymerase chain reactions (PCR) amplification. Extraction and use of dsRNA preparations as template although time consuming, was here preferred over that of total plant RNAs, as it uses a larger size sample easily obtained from different parts of the tree, as compared to the 0.1 g usually taken for total RNAs extraction and thus restricting sample representativity. This is important because viruses tend to be unevenly distributed in woody plants and we have experienced that necroviruses occur in very low amounts in olive tissues. In this study each virus specific set of primers used in RT-PCR resulted in the amplification of products sized 760 nt for OLV-1, 278 nt for TNV-D, and 934 nt for OMMV, visualized in agarose gels following separation by electrophoresis. The application of this sensitive diagnostic molecular technique to the different olive ecotypes under study showed that ca. 31% trees were necrovirus infected and of which 59% were multiple infected. Interestingly, OMMV was the most abundant virus and TNV-D the least frequent. At this point it should be emphasized that previous data on TNV-D infections need to be taken with great reservations as the primers then used, complementary to sequences within the coat protein gene, do not distinguish it from OMMV as both share a high homology in that region. Work is now in progress to understand the epidemiology of each of these necroviruses in nature, which is expected to contribute for a more successful limitation of the diseases they may cause.

SESSION 2

SUSTAINABLE OLIVE PRODUCTION AND CHEMICAL CONTROL OF PESTS AND DISEASES: OPPONENTS OR COMPONENTS?

P 11. INTEGRATED PRODUTION IN OLIVE CROP IN PORTUGAL

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In Portugal, the first of olive crop integrated pest management (IPM) manual was elaborated in 1999. This document contained information on cropping techniques for the practice of this production mode, including plant protection products used in IPM, the selection criteria, risk assessment and economical thresholds to be used for the key enemies in this crop. The need for standardization of a set of similar document´s for several crop´s, already published, triggered, ten years later, the update of this document, and new IPM olive crop manual was published. In this second edition, new IPM selected criteria for plant protection products were establish, as well as, new risk assessment techniques, for new enemies. New economic thresholds were set and existing ones were adjusted, if needed. Key information on the new pest was also included. This poster presents relevant information that can be consulted in the Portuguese “Olive IPM Manual”.

KEYWORDS: IPM, INTEGRATED PRODUCTION, OLIVE, PLANT PROTECTION PRODUCTS

P 12. EFFECT OF SOIL MANAGEMENT SYSTEMS AND PHYTOSANITARY TREATMENTS IN THE CONTROL OF MAIN OLIVE PESTS AND DISEASES

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Two soil management systems (naked soil maintained with herbicides and soil covered with strips of wild plants) and two phytosanitary treatments (conventional and supervised) were evaluated for their effect on major pests and diseases in five olive orchards in southern Spain during 4 years (2001-2004). Three cultivars were assayed: Hojiblanca, Picual, and Picudo. Conventional treatments were those habitual in the area, while supervised treatments differed on the product used and timing. Insecticides or fungicides were applied after checking the level of pest populations or leaf infections by fungal pathogens. Pests included in this study were olive fly (*Bactrocera oleae*) and prays (*Prays oleae*); while diseases evaluated were peacock spot (*Fusicladium oleagineum*), cercosporiose (*Pseudocercospora cladosporioides*), and anthracnose (*Colletotrichum* spp.). A split-plot design with four complete randomized blocks was used in all orchards, being main plot the soil management system and subplot the phytosanitary treatment. The experimental unit was a subplot with 12 (3?4) trees, and periodic observations were made on the two central trees of each subplot. An additional experiment with larger main plots separated 50 m was conducted in 2004-2005. The soil management system did not show a consistent and significant effect on pests and diseases during the 4 years, probably due to the small size of plant covers and interplot interference. Also, the incidence and diversity of parasitoid species complex of *P. oleae* did not differ between both systems. However, in the additional experiment, damage caused by two first generations (phylophagous and anthophagous) of *P. oleae* was lower and incidence of peacock spot was higher in covered soil than in naked soil. In this experiment, there was not effect of soil management systems on population and damage levels of *B. oleae*, and on the other two diseases evaluated. Supervised insecticide treatment (*Bacillus thuringiensis* or Dimetoate in some years) reduced damage of third generation (carpophagous) of *P. oleae* with respect to the conventional treatment (Dimetoate), but differences were consistently significant only in the cultivar Picudo. Supervised fungicide treatments showed a significant reduction on disease incidence of peacock spot and cercosporiose, but the number of applications was a little higher than in conventional treatments for most orchards and years. There was no interaction between soil management systems and phytosanitary treatments in all experiments.

KEYWORDS: OLIVE PESTS AND DISEASES, INTEGRATED CONTROL, SOIL MANAGEMENT, PHYTOSANITARY TREATMENTS

P 13. REPELENT/DETERRENT EFFECT OF KAOLIN AND COPPER ON *BACTROCERA OLEAE* OVIPOSITION IN THE LABORATORY

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Choice and non-choice laboratory assays were carried out to test the effect of kaolin (Surround, WP (50 gïl-1)) and copper (Q Bordelés (10 g•l-1)) on *B. oleae* oviposition. These two products are gaining relevance in the control of the olive fruit fly because of their good environmental /toxicological properties. A better knowledge on their mode of action will help in their implementation as control measures for the olive fruit fly. Twenty olives were offered to seven 7-d-old females for 24 hours, half of which were treated in choice tests. In non-choice tests the twenty olives were treated or left untreated (control). Olives and flies were kept in plastic cages in a growth chamber at 22ºC, 16:8h light:dark photoperiod and 75% relative humidity. In choice tests, kaolin had a repellent/deterrent effect, shown by a reduction in both the number of attacked olives (4.0-fold reduction and 63.5 oviposition deterrence index I) and the number of oviposition stings per olive (9.8-fold reduction and 83.1 oviposition deterrence index II). On the other hand, copper treatment resulted in a reduction in the number of oviposition stings per olive only (1.2-fold reduction and 23.4 oviposition deterrence index II). In non-choice tests results were similar: percentage of attacked olives was reduced by kaolin treatment (2.4-fold reduction) but not by copper treatment, and the number of oviposition stings per olive was lower for either of the two treatments (kaolin: 4.9-fold reduction, copper: 3.6-fold reduction) than for untreated control olives. These results agree with the expected mode of action of kaolin, which mainly has a repellent/deterrent activity. Copper had a lower repellent/deterrent oviposition activity, but copper products probably interfere with other later developmental stages of the olive fruit fly.

KEYWORDS: *BACTROCERA OLEAE*, COPPER, KAOLIN, OVIPOSITION TEST

P 14. EXPERIMENTS FOR THE CONTROL OF OLIVE FLY USING A "PUSH-PULL" METHOD

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Push-pull strategies involve the use of stimuli that act to make the protected crop unsuitable to the insect pest while luring him toward an attractive source. An experiment to control the olive fly was carried out during 2007 and 2008 in an olive grove of 4 ha in Sassari (Sardinia). The field was divided in 2 plots, one treated with Dimethoate and the other protected with a kaolin-based formulation (2-3 applications) and lure and kill traps. In the push-pull plot, the rows of trees were treated alternatively, two by two, with kaolin (oviposition deterrent) and with traps (attractant). Olive fly adults were monitored with yellow traps and the olive infestation was recorded in the insecticide-treated plot and in rows treated with kaolin and with traps. In both years, captures of adults were higher in plants with lure and kill traps than in those treated with kaolin or in Dimethoate-treated plot. The number of oviposition stings was lower in the push-pull plot than in the insecticide treated plot. At harvest the percentage of wormy olives was 1.2 and 0.5% in 2007 and 10.2 and 7.5% in 2008 in push-pull and Dimethoate plots, respectively. Olive infestation was always greater in plants protected with lure and kill traps than in the kaolin sprayed trees.

KEYWORDS: *BACTROCERA OLEAE*, PUSH-PULL METHOD

P 15. THE IMPORTANCE OF APPLICATION TIME FOR THE CONTROL OF ERIOPHYID MITES19 IN OLIVE ORCHARD

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Many species of Acari: Eriophyidae have been found in Greek olive orchards. Olive Eriophyid mites are extremely small. They average in length from 0.1 to 0.2 mm and are yellow in colour, flattened and pear-shaped. Seven Eriophyid species, make damage the olive trees in Greece, and four of these (Aceria oleae. *Oxycenus maxwelli*, *Tegalophus hassani* and *Ditrimacus athiasellus*) are common in almost all olive-growing regions of Greece. It is difficult to estimate the amount and type of injury which is caused by each different species because they occur in mixed populations and have similar feeding habits. In this work it is confirmed that the sulphur, and abamectin are effective means against olive eriophyid mites. Also the effectiveness of these means depends on the time of application (timing). The effectiveness of used plant-protection products was increased in the first application, at the time of the emergence of flower buds than the beginning of the blossoming and in the second application, at the time of the end of blossom than the time of the young fruits (0.5 mm of diameter).

KEYWORDS: ERIOPHYID MITE, OLIVE MITE CONTROL, APPLICATION TIME

P 16. SIDE-EFFECTS OF BASED-COPPER PRODUCTS ON *CHYSOPERLA CARNEA* (STEPHENS) (NEUROPTERA: CHRYSOPIDAE)

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Traditionally, copper has been a product used in olive canopies to control fungi. During the last few years the efficacy of copper sprays controlling olive fly has also been demonstrated. It was already known as a deterrent or repellent for egg laying but more recent studies seem to indicate that its action is also based on a bactericide effect on symbiont microorganisms of *Bactrocera oleae*, ingested by the adult and neccesary for the larvae to digest olive proteins. In these studies, not only a lower egg laying frequency on copper treated olives was shown, but also a highly significant increase in the frequency of sterile eggs and dead larvae. In the same work, it is also concluded the need to widen these studies and to analyze the effect that a long-term application of this strategy may have on useful insect species. In Sustainable Agriculture, protection and augmentation of natural enemies of pest is a priority. *C. carnea* larvae are major oophagous predators of the olive moth, *Prays oleae* (Bernard). Therefore, for the improvement of pest protection in olive orchards, natural chrysopid populations should be conserved, and their biotic potential should be increased. In this context, six different formulations of copper, three of them with fungicide and bactericide properties, and three foliar fertilizers were tested at their maximum field rates, according to the IOBC's criteria for running ecotoxicological experiments on beneficial arthropods. L3 were exposed to a fresh and 7-days-old residue of the corresponding compound applied with a Potter Tower until pupation. Mortality at 24, 48 and 72 h, time needed to pupate, percentages of pupation and adult emergence and reproduction parameters (fecundity and fertility) were recorded. There were not high differences in toxicity among the compounds, being most of them harmless or slightly toxic, according to IOBC classification.

KEYWORDS: COPPER, *CHRYSOPERLA CARNEA*, SIDE EFFECTS

SESSION 3

SUSTAINABLE OLIVE PRODUCTION THROUGH CROP MANAGEMENT

P 17. PHYSIOLOGICAL DIFFERENCES EXPRESSED BY SUSCEPTIBLE AND RESISTANT OLIVE CULTIVARS INOCULATED WITH *VERTICILLUM DAHLIAE*

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The progress of several physiological parameters has been investigated in nine-months-old olive cuttings of 'Frantoio' (moderately resistant to Verticillium wilt of olive) and 'Picual' (highly susceptible) after being inoculated with a cotton defoliating isolate of *Verticillium dahliae* under controlled conditions. For each cultivar, the plants were inoculated by dipping their bare root system in a conidial suspension of the pathogen. The control plants were treated similarly without the pathogen. Disease progress was evaluated by assessing symptom severity (defoliation, wilt, chlorosis and necrosis) using a 0-4 scale. Susceptibility of 'Picual' was confirmed by the high values of final severity (3.95), area under the disease progress curve (66.7%) and percentage of dead plants (90%), with symptoms appreciable from the 4th week after inoculation. In contrast, 'Frantoio' was moderately resistant, showing values of 1.1, 18.8% and 10% for the respective parameters. The chlorophyll content in leaves was estimated by a non destructive method (SPAD). Basal leaves had similar content in inoculated and control plants. However, the content in apical expanded leaves showed a light but significant reduction in inoculated respect to the control plants, effect that was similar for both cultivars and that appear from 8th week after inoculation. Water consumption was lower in inoculated than in control plants after inoculation. However from the 3rd to the 6th week, in coincidence with the first phase of symptom development, the effect was similar for both cultivars, and could be related to the concentration of gums and tyloses in xylem vessels to avoid colonization by the pathogen. From the 9th week after inoculation, the effect was more prevalent in 'Picual' and could be related to the high defoliation it suffered. This defoliation was associated with an increase in ethylene. Plant growth was reduced in the inoculated plants of both cultivars, but the reduction was much more important in 'Picual'. The fresh weight of inoculated plants of 'Picual' was 66.5% less than control, due to a lower growth of plant root, absence of new shoot growth and severe defoliation and desiccation. On the contrary, weight plant reduction in 'Frantoio' was only light (21.7%), and mainly due to differences in the production of new twigs that were 83.3% lower in inoculated plants than in control.

KEYWORDS: OLIVE, RESISTANCE, PHYSIOLOGICAL FACTORS, *VERTICILLIUM DAHLIAE*

P 18. EFFECT OF AGRONOMICAL FACTORS ON THE IMPORTANCE OF VERTICILLIUM WILT OF OLIVE IN THE GUADALQUIVIR VALLEY IN ANDALUCÍA (SOUTHERN SPAIN)

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Verticillium wilt of olive (VWO) is nowadays the most destructive olive disease in the Guadalquivir Valley in Andalucía (Southern Spain), the largest olive cultivation area in the world, where 1.5 million ha of olive orchards are concentrated. Disease surveys were conducted throughout the valley with the aim to update the importance and distribution of VWO, and to assess the influence of agronomical and geographical factors in the current spread of the disease. Disease incidence (DI) was recorded in 90 olive orchards affected by VWO (27, 33 and 30, in Jaén, Córdoba and Seville provinces, respectively) in a one-hundred-tree rectangular plot, chosen arbitrarily inside plantations. In those orchards, the influence of several geographical, edaphical and agronomical factors on DI was studied for the whole set of results. VWO was widely distributed in the Guadalquivir Valley, with a mean DI reaching the 20.4% of 9000 inspected trees, but with significant differences between provinces (25.7, 23.7 and 12%, for Jaén, Córdoba and Seville, respectively). DI was significantly higher in irrigated (20.7%) than in dry-farming (18.3%) olive orchards, being differences particularly important in the central and the upper Valley. Also, non-tilled orchards showed higher DI (25.6%) than those regularly tilled (16.3%). DI was lower when the number of trees per ha in orchards was higher than 200. Moreover percentage of wilted plants was higher (21.5%) with the proximity of neighboring V. dahliae host crops to olive orchards, than if non-susceptible hosts surrounded them (11.9%). Finally, differences of DI were more stressed in plots where less than 25-year-old trees were grown and in those plantations closer to the Guadalquivir River (less than 10 km). 'Picual' was identified as the most susceptible cultivar to the disease, reaching 41.9% of DI in the plots in which this cultivar was identified. PCR-based molecular pathotyping of V. dahliae isolates recovered from wilted olive trees showed that defoliating (D) highly virulent isolates were presented at surveyed plantations in percentages significantly higher (67.7%) than non-defoliating isolates (32.3%), specially in lower (Seville province) and upper (Jaén province) valley. This fact could explain the important increasing of incidence and severity of VWO observed in the valley during the last decade.

KEYWORDS: OLIVE, VERTICILLIUM WILT, *VERTICILLIUM DAHLIAE*, ANDALUCIA, AGRONOMICAL FACTOR

P 19. WEED FLORA IN INTENSIVE OLIVE CULTURE GROWING IN BAIXO ALENTEJO (PORTUGAL)

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In intensive olive culture growing in Baixo Alentejo, the weed flora between rows is a common agronomical procedure suitable to Integrated Production. Four to eighteen years old intensive olive culture was studied in Baixo Alentejo region. It was considered three types of soils – vertissols, luvissols and vertic luvissols. In springtime it was done some weed surveys in rows and between rows. The weed variability in rows affected by herbicides was compared as well as the weed variability affected by natural overcrop between rows. It was analysed the different type of weeds according the different types of soils and its properties (pH, m.o., P and K content), and herbicides used in rows– glyphosate, glyphosate+linuron+terbutilazine, oxifluorfen, oxifluorfen+glyphosate. One hundred and twenty three taxas from fifteen families were identified.

KEYWORDS: OVERCROP; SOIL PROPERTIES; HERBICIDES; WEEDS

P 20. *COLLETOTRICHUM ACUTATUM* INFECTION ON TOLERANT VS SENSITIVE OLIVE TREE CULTIVARS

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Olea europaea L. infected by *Colletotrichum acutatum* cause significant economical loses, being a concern for olive producing countries. However, very little is known about *C. acutatum*-olive interaction. The aim of this work was to relate olive levels of tolerance to *C. acutatum* with histological parameters of the olive fruit (genotype). In order to better understand this interaction, tolerant and susceptible olive cultivars infected (0, 6, 24, 48, 72 and 192 hours after inoculation) were studied using light, fluorescent and scanning electron microscopy. At the ultrastructural level, temporal differences, such as mesocarp colonization, between tolerant and susceptible cultivars were observed. The pre-penetration events are similar between three olive cultivars under study. However, major differences become visible after pathogen penetration, when two types of infection strategy in olive drupes tissue can distinguish: intracellular hemibiotrophy and subcuticular intramural necrotrophy. It was observed that intracellular hemibiotrophy infection strategy predominates in moderate and tolerant olive cultivars. Pathogen ultrastructures, such as conidia, germ tube, appressoria and acervuli were clearly observed by fluorescent and scanning electron microscopy. While the organism's phytopathogenic potential has been well documented, the adhesion and colonization process of this pathogen in olives, remain poorly understood. The cuticle thickness, perimeter and area of epidermal cells were measured and observed by microscopy. Significant differences ($P < 0.05$) were observed among olive cultivars for the parameters studied. The tolerant cultivar showed highest mean values for each parameter (cuticle thickness: 23.27+ 0.3 µm, perimeter: 74.37+ 1.7 µm and, area: 229.26+ 9.7 µm2) than the susceptible olive cultivar (cuticle thickness: 16.08+ 0.4 µm, perimeter: 55.95+ 2.7 µm and, area: 166.38+ 14.4 µm2) revealing that tolerance can be related to these features. Supported by: Project POCTI/AGR/57817/2004 and PhD grant SFRH/BD/25384/2005 (Fundação para a Ciência e Tecnologia –Portugal).

P 21. COMPETITION BETWEEN GRASS WEEDS AND MUSTARD COVER CROPS FOR SUSTAINABLE WEED CONTROL

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Several brassica species are being introduced as alternative to grass cover crops mainly they have characteristics for erosion control, such us rapid growth and production of abundant biomass. In addition they have a powerful root system, which helps to relieve soil compaction and they show a high potential for controlling soilborne diseases, weeds and nematodes due to their high glucosinolate contents. Among the different brassica cover crops evaluated in previous studies, common mustard (*Sinapis alba* subsp. *mairei*) was the better adapted to olive crops pedoclimatic conditions in Andalusia and which showed the higher inoculum reduction percentages of *Verticillium dahliae* in controlled conditions. The competitive capacity between cover crops and weed has great relevance due to the flora in the olive orchards is varied and abundant, furthermore the success of the installation and development of common mustard cover crops depend on their capacity for competing with the grass cover crops present in the soil. Exploiting the competitive capacity of common mustard cover crops could be reduced the use of herbicides and could be a new strategy for the integrated weed control in olive orchard. A field trial was conducted during two years for studying the competitive capacity between common mustard and the grass compact brome (*Bromus madritensis*). The emergence, ground cover and biomass of the common mustard cover crops sowed at the same rate (643 seed m-2) respect to seven different and increasing sowing rate of compact brome: 0, 2, 8, 32, 128, 520, 2048 seed m-2 were evaluated. The experimental design was a randomised complete blocks with six replications. In addition an experiment in greenhouse was conducted to determine the effect of compact brome emergence moment on the emergence and biomass common mustard cover crops. Treatments were different sowing date of compact brome with respect to common mustard sowing date: 14 days before, 7 days before, at the same moment (0), 7 days after, 14 days after. The experiment was realized in containers of 25 cm2 where both species were sowed to rate of 500 seed per containers and there was five replications. The common mustard cover crop was very competitive even to higher sowing rate of compact brome. Relations between compact brome sowing rate and common mustard emergence and ground cover were not found. However there was a exponential relation (y = 2670,4e-0,0005x, R2= 0,75*) between common mustard biomass and compact brome sowing rate; consequently the common mustard biomass was lightly affected in the treatment with the higher sowing rate of compact brome. In greenhouse experiment was observed that the compact brome seedlings born after the common mustard sowing did not affect to the common mustard emergence nor the biomass, however there was a reduction of these parameters when compact brome was sowed before than common mustard. These results evident that common mustard is a competitive cover crop which can be used in rotation with grass cover crops in olive orchards; however for obtaining success in its installation is important to remove the grass seedlings born before the common mustard cover crops sowing.

KEYWORDS: CRUCIFER COVER CROPS, INTEGRATED WEED CONTROL, COMMON MUSTARD, COMPACT BROME, WEED COMPETITION

P 22. USE OF ENVIRONMENTALLY-FRIENDLY STRATEGIES FOR MANAGEMENT OF PLANT-PARASITIC NEMATODES INFECTING OLIVE TREES

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The most important and widespread nematode pathogens of olive trees include root-knot (*Meloidogyne* spp.), root-lesion (*Pratylenchus* spp.), spiral (*Helicotylenchus* spp.), and reniform nematodes (*Rotylenchulus* spp.). Other species such as the citrus (*Tylenchulus semipenetrans*) and the cyst-forming (Heterodera mediterranea) nematodes have been reported with limited distribution. The economic importance of those nematodes in olive cultivation has increased in the last few years as most chemicals for the control of plant-parasitic nematodes have been banned because of environmental and health concerns. Exclusion is the first control principle that must be considered for management of plant-parasitic nematodes on olive. For this purpose modern molecular approaches used in conjunction with traditional morphological identification can provide a fast way to prevent introduction of nematodes to new areas. Concerns about the eventual environmental impacts from pesticides have promoted the development of a number of non-chemical strategies for disinfesting olive nursery substrates from plant pathogens. From those, soil solarisation is probably the most successful of them. Under conditions prevailing in summertime in Andalusia, southern Spain, solarisation of small piles of nursery substrates used as potting mixtures for glasshouse-grown plants is a novel approach for optimizing production of olive planting stocks free from nematodes (such as *Meloidogyne* spp.). Use of organic amendments is another environmentally-friendly approach for substrate disinfestation, and different agricultural and industrial by-products have been assayed for this purpose. Amendments of olive nursery substrates with dry cork compost at different rates have been tested for the control of *M. incognita*. Nematode population on the amended substrate decreased exponentially as the rate of compost increased; interestingly, the lowermost rate of amendment provided a sufficient degree of control although the highest suppression level was obtained using pure compost as substrate. Also, the use of arbuscular mycorrhizal fungi (AMF) in planting material during olive plant propagation in nurseries may be a useful practice for minimizing the effects of root-knot nematode infections in olive planting stocks, as well as to protect these plants against eventual nematode infections in commercial olive orchards. The effectiveness of AMF *Glomus intraradices*, *G. mosseae* and *G. viscosum* in conferring protection against plant-parasitic nematodes has been documented in olive cvs. Arbequina and Picual. The mycorrhizal symbiosis favoured plant growth and conferred protection against *M. incognita* race 1 and *M. javanica* by inhibiting nematode reproduction, reducing the severity of root galling and, probably, enhancing olive plant nutrition. Research partially funded by grants: AGR-136, AGL2008-00344, and P08-AGR-03528.

KEYWORDS: PLANT PARASITIC NEMATODES, INTEGRATED CONTROL, EXCLUSION, MYCORRHIZA, COMPOST ADMENDMENTS

P 23. EVALUATION OF SUSCEPTIBILITY TO OLIVE FLY *BACTROCERA OLEAE* (GMELIN) ATTACK IN THE OLIVE WORLD GERMPLASM BANK OF CORDOBA

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The differences in susceptibility to the olive fruit fly, *Bactrocera oleae* (Gmelin), among olive cultivars could be useful for short as much as long term olive fruit fly pest management. The search of genetic resistance to the olive fruit fly, in the existent large olive germplasm seems to be a promising control method for the key pest in the Mediterranean olive growing areas. The aim of the present research is to assess the susceptibility of the most divers olive cultivars present at the Olive World Germplasm Bank of Córdoba located at IFAPA farm, Córdoba, Southern Spain. Infestation levels in drupes of 239 cultivars representing every one of the World olive growing areas were recorded. The olive fly population was monitored from May to December 2008 to characterize seasonal abundance and annual population cycles, using plastic McPhail traps bated with ammonium phosphate plus hydrolisate protein. The existing trees from each cultivar (usually two) were randomly selected and 20 drupes at the green/reddish ripening phenological stage were collected at random around the tree canopy (1.6 m above the soil) to be inspected for oviposition punctures (percentage of attacked fruits). Six levels of susceptibility were assigned to the trees: 0, 0 %; 1, 1 to 20 %; 2, 21 to 40 %; 3, 41-60 %; 4, 61 to 80 % and 5, 81-100 % fruits attack. Only a few number of cultivars, 1.7 % (4 cv) entry on the first level 0, but a range of susceptibility among the different cultivars was found: 25.5% (61 cv) on level 1, 22.6 % (54 cv) on level 2, 15.5 % (37 cv) on level 3, 23.0 % (55 cv) on level 4 and 11.7 (28 cv) on level 5. These results indicate the high potential of the Olive World Germplasm Bank of Córdoba to found genetic resistance to the olive fly *B. oleae*.

KEYWORDS: GENETIC RESISTANCE, OLIVE GERMPLASM, OLIVE FLY

SESSION 4

SUSTAINABLE OLIVE PRODUCTION THROUGH SIT AND SEMIOCHEMICAL-BASED MANAGEMENT STRATEGIES

P 24. EFFICACY OF TWO ATTRACT BAIT ON OLIVE FRUIT FLY (*BACTROCERA OLEAE* GMEL.) AND IMPACT ON ARTHROPODS COMMUNITY

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In 2007 was compared efficacy of attracted and catched on olive fruit fly *Bactrocera oleae* (Gmel.) of a bait composed of 9% of Nu-Lure® protein and 3% of 19.8% sodium borate in two models of traps (Easy-trap® and Tephri-Ecológica®) and 4% biamonic phosphate in McPhail trap (used for monitoring olive fruit fly populations). In 2008 was compared this bait and other commercial product (Tephri-Lure®) at 12% concentration, with Easy-trap® and Tephri-Ecológica® trap. In this years are placed four traps of every model with each bait in consecutives trees, in hazard place. Study zone is a olive orchard of Los Villares municipium (Jaén province, Spain) that has a strong olive fruit fly attack every years. In 2007, traps was placed from 7th september until 30th november. In 2008, from 30th july until 12th november. Traps has reviewed with a time space that has varied among five and sixteen days, with change bait and count olive fruit fly and other arthropods catches, clasiffied at Family level. For to value impact of each bait and trap model, it has considered the total number of olive fruit fly catched, the total number of hunters and parasitics arthropods and diversity value with Shannon-Weaber index, measured without olive fruit fly catches. Thus, with greater diversity value, smaller select catches and greater impact. Statistics study has realiced with ANOVA method, with (x+1)1/2 data transformation. Results are that Tephri-Lure® in Easy-trap® or Tephri-Ecológica® catch more *Bactrocera oleae*. Biamonic phosphate in McPhail trap are smaller effective. Tephri-Lure® bait catch smaller hunters number in relation of olive fruit fly catches. In general, impact on parasitic community is insignificant. Diversity values is smaller in Easy-trap®, like that a smaller impact on arthropod community.

KEYWORDS: *BACTROCERA OLEAE*, BAIT TRAP, NU-LURE® PROTEIN, TEPHRI-LURE®, EASY-TRAP®, TEPHRI-ECOLÓGICA®

P 25. A NEW READY-TO-USE MASS TRAPPING SYSTEM FOR THE CONTROL OF OLIVE FRUIT FLY *BACTROCERA OLEAE* (DIPTERA TEPHRITIDAE)

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The olive fruit fly *Bactrocera oleae* is the most damaging pest for the olive production in the Mediterranean basin where the majority of olives are produced. Its larvae are monophagous and develop and feed exclusively on olive fruit, causing damage to fruit with repercussion on the olive oil quality. The traditional control of this pest in Spain has been based mostly on bait sprays with organophosphate insecticides through aerial and terrestrial treatments. Recently the experimentation with natural origin products has been the focus of the research for new strategies against the *Bactrocera oleae* pest, searching for a more selective action and less risk of secondary harmful effects. We present here Dacus Trap®, an attractant formulation of natural origin, free of pesticides and based on a liquid protein obtained by an exclusive method of enzymatic hydrolysis, with a strong attraction capacity for fruit fly adults in a ready-to-use mass trapping system which is quick and easy to handle. Dacus Trap® consists of a terephthalate polyethylene trap baited with a sufficient quantity of liquid to maintain the attraction over the whole campaign and ready to be hung on the tree thanks to a built-in cable tie on its cap. The only handling needed is to remove the adhesive seal, from the holes practised on the bottle through which the flies enter into the trap, making it a clean, quick and simple system to install. The system functions thanks to regular emissions of volatile organic compounds. Due to this, the fly strongly attracted enters into the trap and being unable to escape, drowns in the liquid and dies. Coupled gas chromatography – mass spectrometry were used in order to isolate and identify the volatile and semi-volatile components. The main compounds identified in Dacus Trap® were piperazindiones with different substituents. Many trials were carried out over the last three years in Spain comparing the effectiveness of this mass trapping system against the local standard practices. In this work we describe field trials conducted in Girona, Granada and Jaen (Spain) in the cv Arbequina and Picual. The results show that Dacus Trap® keeps the rate of affected fruit by *Bactrocera oleae* at least like in the traditional method plots where several insecticide treatments were required.

KEYWORDS: *BACTROCERA OLEAE*, MASS TRAPPING, LIQUID PROTEIN, ATTRACTANT

P 26. CONTROL OF *BACTROCERA OLEAE* OLIVES WITH MASS TRAPPING

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[2] ADV de Producció Ecològica del Montsià-Baix Ebre

[3] ADV Soldebre SC

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[5] ADV de l'Olivera al Baix Ebre-Montsià

Objective: To test the mass trapping technique of the olive tree, to reduce the rate of bitted fruit.

Traps and attractants: The traps used over the years have been: McPhail of Flycacher mod Russel, Probodelt, IPM, Olipe 4x1, Olipe 3x1, 5, Olipe 3x1, 5 (2 traps/tree). We also tested strategies of control with attract and kill: Vioryl and Magned oil.

During all the years, except 2004, the attractant used in the traps was technical 4% diammonium phosphate. In 2004 was used 9% Nulure + 3% borax.

For two years at Olipe 3x1,5 hypothesi, surround treatments were added.

Design and evaluation: All research was made in the area of Baix Ebre-Montsià (Tarragona), with plots of native varieties: 50% of Morruda, 20% of Sevillenca and 10% of Farga. Plantations were older than 50 years in dried fields or with irrigation system support. The distribution of trees and the varieties in the fields were irregular.

The mass trapping installation was carried out when the first population was detected. Surround treatment was done before bite detection.

The criterion for the evaluation was the estimated percentage of bitted fruit for the whole period of risk in each strategy.

Conclusions: The following conclusions can be made based on the previous research:

The reduction of bitted fruit is different depending on the traps used.

Commercial traps with small capacity (0.4 l) were difficult to work with as they were more susceptible to evaporation and wind.

The utilization of attracting liquid means: moving large volumes of product and the difficulty of its homogenization.

The liquid attractant doesn't need insecticide because the flies suffocate.

For mass trappings farms with large square fields are preferable.

The outside part of the parcel presents the highest percentage of bitted fruit.

The combination of mass trapping and treatments with kaolin or other pesticides, give better results than only mass trapping.

KEYWORDS: *BACTROCERA OLEAE*, MASS TRAPPING

P 27. TRAP AND ATTRACTANT TEST FOR *BACTROCERA OLEAE* CAPTURE IN OLIVE

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Objective: To determine the capture rate of *Bactrocera oleae*, and the predator *Crysopa sp*. by using different traps and bait/attractants.

Results and conclusion.

Traps: During the tests, PROBODELT trap has offered the best results statistically. The Dome-trap and the Olipe trap 3x1, 5 (with and without colored lines) get good results, however they never reach the same level as the Probodelt trap.

The commercial traps (Afa, McPhail mod, Easy-trap) have not reached the capture rate to continue working with them.

The Olipe trap has been tested with multiple variations over many years. The results of which do not support the use of inserting tubes into the holes, coloring of traps or placing colored lines in the middle. The main reason for this is because theses changes are expensive and do not increase significantly the capture rate.

Another model which is currently being studied is Olipe 3+1 (3 holes of 0.6 cm and 1.5 cm 1) because it reduces the bait/attractant evaporation and the capture rate doesn't fall significantly.

At the moment we are unable to determine the best design of Olipe trap. The largest captures were obtained with traps that have 3 or 4 holes from 1.5 to 2 cm of diameter. It is interesting to continue working with these kind of traps, because of the low cost and less maintenance.

Attractants: The most effective bait is the technical diammonium phosphate 4%. It is also the solution which is easier to prepare, to handle and to record the number of captures. This is also the cheapest solution.

Only during 2003, with a very low level of captures, Nulure + Borax and Starce obtained better results with 4% technical diammonium phosphate.

During 2007, the Entomela bait/attractant, showed a similar result with the 4% technical diammonium phosphate.

The addition of Polikore in the liquid bait/attractants didn't show significant differences between the volume of captures. But its addition raised the proportion of females.

Ammonium Tablet with DDVP within trap Probodelt obtains a similar capture rate to Olipe with 4% diammonium phosphate, the results of these combinations are lower than those obtained with Probodelt and 4% diammonium phosphate technical. The other solid bait/attractants have not shown enough effectiveness to replace liquid bait/attractants.

Crisopas: In general, *Crysopa* capture index goes with the capacity of the traps and the attractants for fly captures.

KEYWORDS: *BACTROCERA OLEAE*, TRAP, ATTRACTANT

P 28. GENETIC ENGINEERING OF THE OLIVE FRUIT FLY, *BACTROCERA OLEAE*, FOR USE IN THE STERILE INSECT TECHNIQUE (SIT)

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The olive fruit fly, *Bactrocera oleae*, is an invasive pest of olive fruit, causing considerable crop damage world-wide. At present control is largely based on the intense use of insecticides. The sterile insect technique (SIT) is a highly effective, species-specific and environmentally non-polluting method of pest control that involves the mass release of sterilized insects. Sterile insects reduce the reproductive potential of the wild population through infertile matings, causing a rapid decline in population density. However, past SIT attempts targeting *B. oleae* have achieved limited success. These relied on the release of irradiated mixed-sex insects, which resulted in the released sterile males mating with released sterile females, instead of dispersing and seeking the wild-type females. A genetic sexing system to allow male only release is therefore seen as essential for olive fly SIT. Oxitec has successfully developed a genetic engineering approach to improve the utility of SIT called Release of Insects with Dominant Lethality (RIDL®). RIDL® provides a highly effective genetic sexing system, and additionally provides easy monitoring of the released insects in the field by a heritable fluorescent transformation marker. This technology has already been effectively applied to several important pest species, including the Mediterranean fruit fly, *Ceratitis capitata*, and the Mexican fruit fly, *Anastrepha ludens*. We are currently in the process of transferring, and optimising this technology for use in the olive fruit fly.

SESSION 5

SUSTAINABLE OLIVE PRODUCTION AND BIOLOGICAL CONTROL OF PESTS AND DISEASES

P 29. A SURVEY OF NATURAL AND INTRODUCED PARASITOIDS OF THE OLIVE FRUIT FLY, *BACTROCERA OLEAE* (DIPTERA: TEPHRITIDAE) IN ISRAEL

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Olive cultivation occupies eight million hectares worldwide, with over ten million tons of olives annually (90% in the Mediterranean Basin). The olive fruit fly, *Bactrocera oleae* (Diptera: Tephritidae) is a key pest of olive fruit, causing up to 50% in crop loss. Increasing biological control by natural enemies is a major goal of a regional effort to improve the yield, quality and income from olives in the eastern Mediterranean. For this project, a survey of natural enemies attacking *B. oleae* larvae in Israel was conducted during 2006-2008. Fruits were sampled whenever present at sites throughout the country, brought to the lab and held for emergence of flies and wasps, which were identified, sexed and counted. The total apparent parasitism rate over the survey was 11% (range 0-100%). Six taxa of parasitoid wasps emerged from olive fruits. The braconids *Psyttalia concolor* and *Diachasmimorpha kraussii* were the most abundant species. Not previously recorded from olive fly, *D. kraussii* was released during a biological control project against *Ceratitis capitata* (2004-2007). Four species of Chalcidoidea were found only during the early season, before autumn. *Psyttalia concolor* had a wide geographic distribution, while *D. kraussii* was found in a narrower distribution, suggesting its origin in the planned releases. The sex ratio of *P. concolor* and *D. kraussi* was slightly male biased (55% and 70% respectively). The data show that the activity of indigenous parasitoids is limited, which, together with the importation of new natural enemies, is the subject of further investigations.

KEYWORDS: *PSYTTALIA CONCOLOR*, NATURAL ENEMIES, PARASITOIDS, SURVEY, OLIVE FRUIT FLY

P 30. COMPATIBILITY OF KAOLIN AND COPPER WITH THE PARASITOID *PSYTTALIA CONCOLOR* IN A SEMIFIELD TEST

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There are 94.250,60 ha of organic olive farming in Spain, and the lack of effective products able to kill *Bactrocera oleae* Rossi immature stages is a great problem. In the last years, cooper products and kaolin have been tested because of their repellent and antiovipositional mode of action. Copper has traditionally been used to control fungi on olive canopies, but it has been demonstrated that copper salts also have an antibacterial action and make fruits less attractive to oviposition because of the lack of some bacterial compounds on the surface of fruits. These microorganisms are ingested by the adult fly and are necessary for the larvae to digest olive proteins. Kaolin, used to protect crops of sunburns and thermal stress, limits olive fly harmful infestation because disrupts olive fly orientation within the grove. Some studies have shown that products containing copper and kaolin are effectively able to limit olive fruit fly infestation to very good levels. *B. oleae* has some natural enemies and it is important to evaluate the side effects of the products applied to control it. *Psyttalia concolor* Szèpligeti adults parasitize the third instar larvae of the olive fly and they have been used in some biological control programs by inoundative releases, although it has been demonstrated that the parasitoid can only control the pest at low pest infestation level. Kaolin and two different formulations of copper have been tested at their maximum field rates, according to the IOBC´s criteria for running ecotoxicological experiments in beneficial arthropods. A semi-field test was carried out in a greenhouse. Adult females were exposed to a fresh residue of the corresponding compound applied with manual spray over one year old olives. Mortality at 24, 48 and 72 h, and reproduction parameters (% attacked hosts and % parasitoid emergence) were recorded. There were no high differences in toxicity among the compounds, being all of them harmless, according to IOBC classification.

KEYWORDS: *PSYTTALIA CONCOLOR*, KAOLIN, COPPER, SEMIFIELD

P 31. FIELD TEST FOR THE PARASITOID *PSYTTALIA CONCOLOR* (SZÉPLIGETI) IN TUSCAN OLIVE GROVES (ITALY)*

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Psyttalia concolor (Szépligeti) (Hymenoptera Braconidae) is a koinobiont, endophagous solitary parasitoid of larvae of Tephritidae (Diptera). This parasitoid can be found spontaneously - during late autumn - on the olive fruit fly (*Bactrocera oleae*) in some coastal Italian regions, including the coastal Tuscany. *P. concolor* has been used for a long time in several Mediterranean areas for biological control of olive fruit fly, with unsatisfactory results. Factors affecting the effectiveness of *P. concolor* under laboratory conditions have been abundantly investigated. In contrast, scanty are bibliographical data on the ability of this parasitoid to parasitize - after its release - *B. oleae* under field conditions in Tuscany. Therefore, field-controlled releases of *P. concolor* were made in some Tuscan olive groves, during 2007 and 2008. In detail, single branches of olive trees, each containing 100 olive fruits, were isolated by a flexible plastic-holed sheath covered by a nylon mesh net, so making a field cage. Seven days-old mated naïve *P. concolor* females (originating from Pisa lab rearing) were released into each cage and maintained for 24 hrs. After this period, the olive fruits were collected and transferred to the laboratory (20 ± 1 °C , 50 ± 10 R. H.) to attend the parasitoid emergence. Two parasitoid densities were tested, 10 and 20 females/cage, and 5 replicates were made, considering a field cage as a replicate. Simultaneously, a large number of olive fruits (500) were randomly collected and dissected, to characterize the olive fruit fly infestation. In order to exclude the presence of a *P. concolor* wild population in the same olive-growing area, about 2000 drupes were also collected and transferred under laboratory conditions to attend a possible emergence of parasitoid. Results showed that *P. concolor* can successfully parasitize olive fruit fly larvae under field- controlled conditions, and the mean parasitization rate ranged from a minimum of about 19% (in 2007, treatment 10 females/cage) to a maximum of about 44% (in 2008, treatment 20 females/cage). During the 2nd year of trial, the olive fruit fly preimmaginal population consisted mostly of 1st and 2nd instar larvae, so confirming our previous laboratory observations on the ability of *P. concolor* to locate and successfully parasitize young larval host instars. *Research financially supported by project SIDIO - Arsia (Regione Toscana).

KEYWORDS: OLIVE FRUIT FLY, BIOLOGICAL CONTROL

P 32. THE LADYBEETLE COMMUNITY (COL., COCCINELLIDAE) IN SOUTHERN OLIVE AGROECOSYSTEMS OF SPAIN

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Most of the adults and larvae of ladybeetle species are primarily predators and are found in many Mediterranean agroecosystems. However the abundance and distribution of many ladybeetles depend on habitat destruction and the use of pesticides. Ladybeetle population samples were collected from olive canopies in two of the biggest commercial olive producing areas in southern Spain (Granada and Córdoba provinces), with different land use tradition and agricultural intensity. Moreover, olive orchards under different farming systems were sampled from March to October in 1999 and 2000, and from May to June in 2003. Ordination (canonical correspondence analysis CCA) and classification (two-way indicator species analysis TWINSPAN) methods were applied in order to characterize the ladybeetle community composition, taking into account the land use types and the geographical location. The aim of this survey is to describe the ladybeetle assemblages in olive orchards in these provinces in three ways: i) evaluating the ecological importance of the predatory ladybeetle species in olive orchards, ii) explaining the variability in ladybeetle community composition in relation to landscape configuration; and iii) identifying the most representative indicator ladybeetle species in each region. The total number of collected individuals was 481, belonged to 9 genera and 13 species, being polyphagous the most captured species. The CCA showed a clear separation between orchards from Granada and Córdoba, taking into account ladybeetle species, environmental variables and sampled orchards. The land use type and the geographical location revealed that *Scymnus mediterraneus* lablokoff-Khnzorian 1972 and *Platynaspis luteorubra* (Goeze, 1777), captured in higher latitudes (Córdoba location), were more favoured by larger organic olive surfaces and by the presence of holm oak forests in the nearby of the orchards. Coccinella septempunctata Linnaeus, 1758 and Hippodamia variegata (Goeze, 1777) were found in a lower latitude and higher longitude (Granada location). Furthermore the presence of these two species could be determined by larger non-irrigated fruit orchards surfaces and non-organic olive surfaces. Finally, applying the TWINSPAN method, these species resulted to be the indicator species for most of the orchards sampled in Córdoba and Granada. Ladybeetle species assemblages vary responding to the type of farming system, especially to pesticide use, and to landscape configuration. Comparing Granada and Córdoba orchards, it seems difficult to use uniform indicator species to evaluate the farming systems in larger areas with different land use histories. Nevertheless, the evaluation of the species composition might help to identify the conservation state of these agroecosystems, mainly by the presence of Sc. mediterraneus, which could be used to test the landscape sustainability, in order to increase the presence of coccinellids and their ecological function in olive pest control.

KEYWORDS: COCCINELLIDAE; CÓRDOBA AND GRANADA PROVINCES; CANONICAL CORRESPONDENCE ANALYSIS (CCA); TWO-WAY INDICATOR SPECIES ANALYSIS (TWINSPAN)

P 33. WHICH PREDATORS USE THE OLIVE PSYLLID, *EUPHYLLURA OLIVINA* (COSTA), AS FOOD?

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The presence of arthropod predators on the olive tree canopy has been noticed by various authors mostly during the last century. Nevertheless, their role against olive pest populations is still unclear, especially when concerning secondary pests, such as the olive psyllid *Euphyllura olivina* (Costa) which populations can undergo annual fluctuations mediated by unknown factors. In order to contribute for clarifying this subject, a study was done by using predators collected by the beating technique in organic groves located at Alentejo region (south of Portugal). Collections were done on a fortnightly basis between March and July, when *E. olivina* proved to be more active. Then an *E. olivina* polyclonal specific antiserum was produced on two rabbits after their immunization with an extract obtained by macerating *E. olivina* nymphs and adults. To reduce the occurrence of cross reactions, that antiserum was pre-absorbed with an *Saissetia oleae* antigen, following initial observations of cross reactions between *E. olivina* antiserum with non-homologous *Bactrocera oleae* and *S. oleae* antigens. The pre-absorbed specific antiserum was used on indirect ELISA to test 139 potential predators belonging to Aranea (Araneidae, Linyphiidae, Philodromidae, Salticidae, Tetragnatidae, Theridiidae and Thomisidae) Neuroptera (Chrysopidae and Hemerobiidae), Coleoptera (Carabidae, Coccinellidae and Melyridae), Hymenoptera (Formicidae) and Heteroptera (Anthocoridae and Miridae) orders. Eleven ELISA positives were found, from which eight with Aranea (five with Linyphiidae, two with Theridiidae and one with Thomisidae) and three with Anthocoridae (two adults and one nymph). These results suggest that these families could play a role in limiting *E. olivina* populations worthwhile to exploit further.

KEYWORDS: *EUPHYLLURA OLIVINA* PREDATORS, ELISA, LINYPHIIDAE, THERIDIIDAE, THOMISIDAE, ANTHOCORIDAE

P 34. ABUNDANCE AND DIVERSITY OF HETEROPTERAN SPECIMENS IN PORTUGUESE OLIVE GROVES

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The olive tree canopy is a habitat for phytophagous and predaceous Heteropteran specimens whose biodiversity is important to be characterized. The aim of this work was to study the abundance and diversity of Heteropteran specimens in Portuguese olive groves with different plant protection systems (conventional, integrated protection and organic farming groves). Therefore, data were obtained in olive groves located in the main olive Portuguese regions (Alto Alentejo and Trás-os-Montes). Sampling occurred in 1999, 2000, 2002 and 2003 and samples were obtained through the beating technique, on a weekly or fortnight basis from March to November of each year. The captured heteropteran specimens were identified to family level and, when possible, to genera or species level. Experimental results showed that specimens belonged to six families that were, for order of importance: Anthocoridae, Miridae, Lygaeidae, Tingidae, Pentatomidae and Nabidae. Beneficial predaceous specimens like *Anthocoris* sp. and *Deraeocoris lutenscens* (Schilling, 1837) were the most abundant of the Anthocoridae and Miridae families, respectively. These families were more abundant from the beginning to the middle of June which coincided with the antophagous larval stage of the olive moth, *Prays oleae* (Bernard).

KEYWORDS: HETEROPTERA, BIODIVERSITY, PREDATORS, *ANTHOCORIS* SP., *DERAEOCORIS LUTENSCENS*

P 35. *CHRYSOPERLA CARNEA* AS POTENTIAL PREDATOR OF THE OLIVE MOTH *PRAYS OLEAE*: EFFECTS OF PREY ON BIOLOGICAL PARAMETERS OF THE PREDATOR

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Laboratory experiments were conducted to determine the effect of alimentation on development, mortality, and fecundity of the predator *Chrysoperla carnea* (Stephen) when fed on *Prays oleae* (Bernard) (third instar larvae of the antophagous generation). The evaluation of *C. carnea* prey suitability is useful to establish the nutritional ecology and prey preference in the field. These parameters were compared to those of *C. carnea* fed on *Ephestia kuehniella* Zeller eggs, a high quality prey used in laboratory cultures and mass rearing. A 46.9 % of the *C. carnea* larvae died when fed on *P. oleae* larvae, against only a 13.3 % of the *C. carnea* larvae fed on *E. kuehniella* eggs. However, the higher mortality occurred in newborn *C. carnea* larvae (42.0 %) fed on *P. oleae*, whereas it was fairly low, and similar to *E. kueniella* fed larvae, in the remaining stages. *C. carnea* larvae showed a quicker development when fed on *P .oleae* (17.0±1.3 days; mean±SD) than on *E. k*uehniella eggs (18.4±0.8 days). Mean development time of the surviving first instar *C. carnea* larvae was similar in *P. oleae* and *E. kuehniella* reared larvae, yet, statistically significant differences were observed in the rest of the stages (second and third instars and pupae C. carnea) and in total development time ($p<0.05$). Adult fecundity did not show statistically significant differences ($p=0.30$) even though *E. kuehniella* fed females laid a higher number of eggs and started oviposition 1.7 days earlier in average. Regarding demographic parameters such as intrinsic rate of natural increase, similar values were obtained in both treatments. High mortality rates in *C. carnea* first instars fed on *P. oleae* could be explained due to the limitations of lacewings of small size to predate on a considerably bigger larva such as the tested prey. Nonetheless, *P. oleae* larva is a suitable prey for later instars, fulfilling the necessary nutritional requirements for an optimal development and reproduction.

KEYWORDS: BIOLOGICAL CONTROL, LACEWING, ORGANIC MANAGEMENT, PREY SUITABILITY

P 36. RELATIONSHIP BETWEEN THE TYPE OF MANAGEMENT OF OLIVE GROWING AND ITS ENTOMOLOGICAL FAUNA

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The importance of the olive growing in Spain, the enormous richness of arthropods registered in the olive groves and the need to develop agronomic practices which are respectful with the environment makes necessary the evaluation and the adjustment of skills to allow the characterization of the entomological fauna of the olive grove as a bioindicator of its quality. The aim of this work is to study the condition of the diversity of the entomological fauna of the olive grove depending on the type of management system, to verify if the study of the diversity at taxonomic level of order serves as an indicator of this type of management system. Four orchards with different agronomic practices (organic and conventional) were selected, making sure that there were substantial differences among them with regard to the use of phytosanitary products and the management of the soil. Samples of the canopy by beating, of the soil by pitfall traps (under the canopy and between rows) and of the herbaceous stratum by sweep netting were taken. The data were analyzed as far as the abundance of orders is concerned and consistent differences were found. In addition, in terms of diversity, the indexes of richness, dominance and diversity alpha, Hurlbert"s PIE and Simpson were calculated for the different orchards and sampling strata and significant differences were detected. The organic orchard turned out to be the one with a major abundance of arthropods. It is also this type of orchard the one that presents a major index of richness with reference to the taxonomic level of order in the majority of the analyses; these results were not reflected in all the indexes of diversity and dominance for different reasons related to the effort of sampling and the different abundances. On the contrary the orchard under strictly conventional olive grove was the one that has registered lower indexes of abundance and richness. The taxonomic level of order has turned out to be sufficient to discriminate among the different types of managing in olive grove for the samples taken in the soil stratum. However it was not sufficient, with the intensity of sampling of this study, for the canopy and the herbaceous stratum of the olive groves.

KEYWORDS: OLIVE, TYPE OF MANAGEMENT, ORDER, ENTOMOLOGICAL FAUNA

P 37. ASSESSING THE EFFECT OF SOIL TREATMENTS WITH THE ENTOMOPATHOGENIC FUNGUS *METARHIZIUM ANISOPLIAE* (METCHNIKOFF) SOROKIN AGAINST PUPARIA OF *BACTROCERA OLEAE* (DIPTERA: TEPHRITIDAE) ON SOIL DWELLING NON TARGET ARTHROPODS

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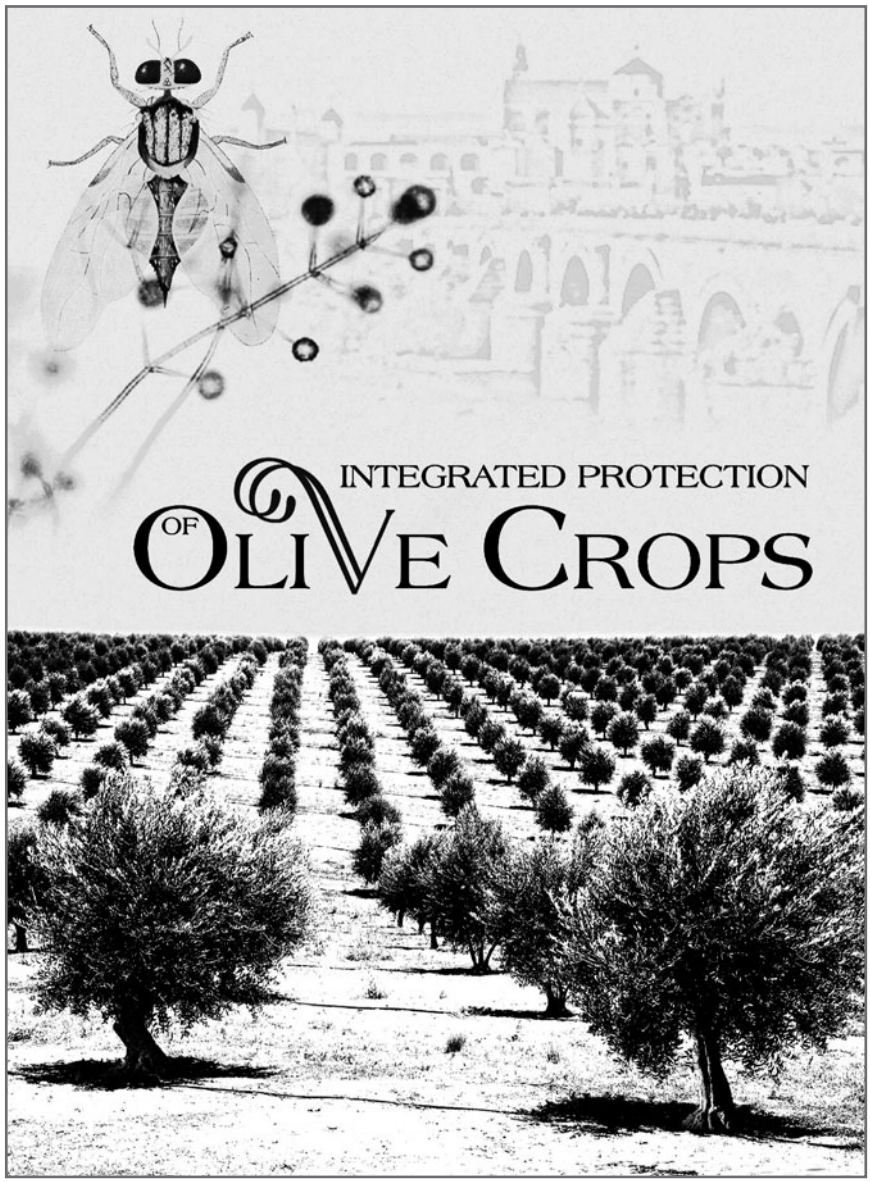
The objective of this study was to determine the persistence of the autochthonous *Metarhizium anisopliae* EAMa 01/58-Su isolate in the soil when applied beneath olive trees for controlling olive fly puparia and to elucidate its possible effect on non-target soil dwelling arthropod communities. For that, we selected 200 olives trees in an organic olive orchard at the province of Málaga (Spain) to be sprayed either with a 2.5 xo107 conidia m-2 suspension of the fungus on the ground beneath the tree canopy (100 trees) or with the blank formulation as controls (100 trees). Before fungal treatments, we selected 10 trees from the treated ones for evaluating both the possible presence of indigenous entomopathogenic fungi in the soil by using the Galleria Bait Method and the evolution of the conidial densities in the soil after spraying. The entomopathogenic fungus Beauveria bassiana (Balsamo) Vuill. was the most common species, being found in all the samples, while M. anisopliae was found only in one sample. After spraying the 100 treated and 100 control trees, soil samples beneath the 10 selected trees from the top 10 cm were taken to calculate the number of conidial forming units per gram of soil weekly during 2 months and ones a months during 2 years after treatment. Our data indicate that the soil ecosystem favours the persistence of this autochthonous isolate, which could allow long term protection of the crop against olive fly puparia. In order to assess the possible effect of the fungal treatment on soil arthropod populations, 40 pitfall traps (7.5 cm diameter by 10 cm deep) placed beneath the tree canopy of randomly selected 20 treated and 20 controls trees, were sampled every two weeks. Our data indicate that formicidae species are the most abundant arthropods trapped, but no infected insects have been found in field as a result of the treatment to now.

KEYWORDS: *BACTROCERA OLEAE*, *BEAUVERIA BASSIANA*, *METARHIZIUM ANISOPLIAE*, FUNGAL PERSISTENCE, BIOLOGICAL CONTROL, NONTARGET ORGANISMS



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