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## **The olive growing and olive oil sector in Tuscany**

**L. Zoppi**

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In this paper I will try to briefly outline the main characteristics of olive growing and olive oil in Tuscany, and its importance for the region, and to describe the initiatives that are being taken to safeguard and promote a product that is so closely bound up with the region and its image.

## **Arsia activities in the field of olive crop protection**

**M. Ricciolini & M. Toma**

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The ARSIA is the Regional Agency for Development and Innovation in Agriculture and Forestry. It is a technical unit set up by the Region of Tuscany to mediate between the fields of agricultural production, research and specialised technology. The agency encourages innovation and helps provide technological support for the growing, processing and sale of agricultural products. It operates through a service network for technicians, manufacturers and rural farming areas.

The ARSIA is engaged in numerous activities in a wide range of sectors. The agency promotes research and experimentation into issues regarding the development of olive growing in Tuscany, by inviting the submission of proposals. Two studies have been financed: the first one concerned the natural enemy of *Saissetia oleae* in Tuscany and the increase of the *Metaphycus bartletti* (ISZA) population, the second studied the effect of *Azadiracta indica* extracts on the female fertility of *Bactrocera oleae* (Siena University). At the preliminary meeting of the consultation groups for the next call for proposals, new studies were announced regarding *Bactrocera oleae*, *Saissetia oleae*, *Pseudomonas syringae* pv *savastanoi* and *Cicloconium oleaginum*.

In the field of training, the ARSIA has funded three scholarships for the olive and olive oil Master's course at Pisa University. Numerous courses have also been organized for teachers and technicians working in the olive and olive oil chains.

As far as technical innovation is concerned, the agency conducts trials of organic and chemical protection techniques in its testing centres, testing new insecticides or technology developed for use against *Bactrocera oleae* infestation. Since 1993, with the collaboration of the region's olive growers' associations (AIPROL and OTA) and with scientific assistance from the S. Anna School of Advanced Studies in Pisa, the ARSIA has carried out several trials in different areas of the region, using the mass trapping method to provide protection against *B. oleae* attack.

The agency has built up a modern and friendly service called Agroambiente.info, which provides assistance to technicians and olive farmers. The service is based on a network of over 260 control points monitored each week by 20 technicians. A weekly report for each area is published on the internet, in the press, via teletext and, in the eventuality of an alert, directly on the mobile phone of growers with text messages.

# Chemical Ecology of Bacterial Relationships with Fruit Flies

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**Abstract:** The nature of relationships between fruit flies (Diptera: Tephritidae) and bacteria has been controversial. Theories of obligate symbioses have given over to facultative mutualism, accidental, and predator-prey depending on circumstances. Fruit flies are attracted to bacteria to quench drive states including protein hunger and others that are poorly understood. Following chemical functional group characterizations indicating attractive principals were mostly chemicals containing ionizable nitrogen, a novel technique was devised to identify ammonia, 1-pyrroline, acetic acid, and several amines, pyrazines, and alcohols from bacterial odors. Mixtures of these chemicals in the same concentrations as in bacterial odors were about 80-90% as attractive as the odors to Mexican fruit flies. Volatiles produced by bacteria attractive to fruit flies were found to vary with bacteria taxon at all levels of classification and with culturing medium. Interactions of attractiveness of the chemicals are consistent with the need for fruit flies to forage for various bacteria species on various substrates. The information obtained in these studies is useful for development of fruit fly lures, improvement of fly cultures, and understanding of our natural world.

## Effect of age and mating status on the antennal sensitivity of *Bactrocera oleae* (Rossi) (Diptera Tephritidae) male and female

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The olive fruit fly [*Bactrocera oleae* (Rossi) (Diptera Tephritidae)] control is really difficult; as a consequence, studies to set up alternative control methods (i.e. use of semiochemicals) were undertaken. While several researches were carried out on the sex pheromone, only few investigations have been focused on the compounds emitted by the host plant or associated bacteria and their possible use in modifying olive fruit fly behaviour.

In order to correctly address future bioassays, in the present paper, preliminary to the study of the role and perception of plant and bacterial volatile compounds, EAG technique was used to determine the olfactory sensitivity of virgin and mated males and females of different age (1-3; 10-15; 27-32; 57-62; 87-92 days old) to 28 synthetic substances identified in olive leaves and fruits. EAG responses were submitted to ANOVA and cluster analysis. Responses of the different insect categories were compared using the *t*-test ( $P=0.01$ ;  $P=0.05$ ). Both sexes, independently from age and mating status, were able to perceive a wide variety of odours emitted by the olive plant.

Considering the mean EAG response to all compounds, the olfactory sensitivity decreases with age advancement in virgin males and females while it is quite constant in mated ones. Virgin insects showed a higher number of EAG response groups than mated ones, with a tendency to decrease with the age. Contrary to mated females, a clear reduction of the EAG response groups was observed in mated males. The persistent olfactory sensitivity and selectivity of mated females might be related to the necessity of the oviposition site location.

In addition, some electrophysiologically-active terpenes [(+)- $\alpha$ -pinene, (-)- $\beta$ -pinene, R-(+)-limonene, L-(-)-limonene] were able to attract both sexes of *B. oleae* in preliminary wind-tunnel experiments. In an open field study, using sticky tablet traps baited with rubber septa dispensers containing different doses (0.1, 1.0, 10 mg diluted in mineral oil) of a synthetic compound, R-(+)-limonene showed the higher catch potency, trapping Olive fruit fly males and females in a 1:1 sex ratio.

Researches focused to a practical utilization of the identified kairomone, alone or mixed with other compounds, like bacterial volatile compounds, in *B. oleae* monitoring and control (mass trapping, lure and kill) techniques, are still in progress.

## **Relationship between olive fly adults and epiphytic bacteria of the olive tree**

**Aurelio Granchietti,<sup>1</sup> Alessandra Camèra,<sup>1</sup> Serena Landini,<sup>1</sup> Marzia Cristiana Rosi,<sup>1</sup> Michele Librandi,<sup>1</sup> Patrizia Sacchetti,<sup>1</sup> Guido Marchi,<sup>2</sup> Giuseppe Surico,<sup>2</sup> Antonio Belcari<sup>1</sup>**

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**Abstract:** Culturable epiphytic bacteria were isolated in 2004 and 2005 from the twigs, leaves and fruits of olive trees, and their number compared with captures of *Bactrocera oleae*. The results obtained show a certain degree of correlation between the presence of bacteria on the phylloplane of the olive tree and the size of the *B. oleae* population in the olive grove. This suggests that olive epiphytic bacteria may play an essential role for fly fitness on the olive.

## **Field assessment of different combinations of ammonia-based attractants and a synthetic female sex pheromone for the monitoring and control of the olive fruit fly, *Bactrocera oleae* Gmel. (Diptera: Tephritidae) in Apulia, southern Italy**

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Olive fruit fly, *Bactrocera oleae* (Gmelin), is a very serious pest of olives in the Mediterranean basin, where the majority of the world's olives are produced. This is particularly true for the Italian region of Apulia which alone produces about 12% of the total world olives and olive oil.

Aim of the work was to evaluate the efficacy of six different combinations of ammonia-based fruit-fly attractants, ammonium acetate (AA), putrescine (PT), and trimethylamine (TMA) on the wild *B. oleae* population as a part of a FAO/IAEA Coordinated Research Program.

Proposed treatments were compared with the widely used protein-based attractant Nu-Lure and with a synthetic female sex pheromone. The experiment took place in an olive plantation at Serracapriola, Apulia in autumn 2003; the tests were repeated in the same location during fall 2004 due to the scarce *B. oleae* population in 2003.

Olive fruit fly males and females clearly showed to prefer NuLure, when compared to the different combinations of AA, PT and TMA. Between them, treatments E and F (respectively 4AB+PT and 2AB+PT) showed significantly higher scores. Female sex pheromone showed an extremely high performance even when compared with Nu-Lure, allowing its use for earlier detection of olive fruit fly male population.

## **Inhibitory effect of water assumption on attraction to ammonia, protein baits and bacteria in *Bactrocera oleae* (Gmelin)**

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**Abstract:** The influence of water and food availability on the attraction to ammonia and protein baits in *Bactrocera oleae* (Gmelin) has been investigated. Flies deprived of water for at least 48 hours frenetically respond to ammonia sources; no such response is observed in adults that have quenched their thirst with water or sugar solution. Crystalline sugar has no influence. It is probable that ammonia odors are utilized to search for puddles where bacterial fermentation occurs.

## **Attractiveness to the olive fly of *Pseudomonas putida* isolated from the foregut of *Bactrocera oleae*<sup>1</sup>**

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**Abstract:** On the basis of laboratory bioassays, in 2003 and 2004 field trials aimed at evaluating the attractiveness of a bacterial filtrate to olive fly adults were performed in olive orchards in the Tuscan countryside. *Pseudomonas putida* isolated from the foregut of the olive fly was cultured in a liquid medium (Tryptic Soy Broth, TSB) in order to prepare a bait for testing. Elkofon-type traps were baited with different protein compounds diluted in water. The nitrogen baits consisted of commercial hydrolyzed protein (Buminal®), filtrates of the bacterial cultures and the TSB medium.

Despite the low population density of the olive fly recorded in 2003 and 2004, the results show that bacterial cues attracted *B. oleae* adults to a comparable degree with respect to the commercial bait. Males and females were both attracted by bacterial filtrates.

## **Preliminary notes on the gall midges (Diptera: Cecidomyiidae) associated with the olive fly, *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae)**

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**Abstract:** A morphological and biological study of the gall midges associated with olive fruits infested by *Bactrocera oleae* (Gmelin) in Central and South Italy started in 1999. Beside *Lasioptera berlesiana* Paoli, widespread in the Mediterranean countries, other species were detected. The most common gall midge has been tentatively identified *Clinodiplosis* sp. The female deposits more eggs, commonly 6-8, mostly near, externally or internally, the emerging hole of the mature larva of *B. oleae*. The larvae develop in general gregariously in the olive fly tunnels as saprophagous species. An interesting lasiopterid, near the genus *Lasioptera* and apparently undescribed, is rather common. This species, which is also gregarious, appears strictly mycophagous. Another species, belonging to the Oligotrophidi, is under study. Finally, *Asynapta furcifer* Barnes has been obtained only from olives collected in Sicily. Several behavioral and phenological aspects of *L. berlesiana* were investigated. The observations carried out showed that the gall midge reproduces commonly on lentisk (*Pistacia lentiscus* L.) associated with leaf galls produced by *Aceria stefanii* (Nalepa), feeding on undetermined fungi, from end May to September, with a maximum of reproduction in July. Starting from the latter month, *L. berlesiana* is the only gall midge which reproduces on olive fruits of early cultivars, where the olive fly makes the first ovipositing wounds. In this narrow microhabitat, mostly occupied by the egg or by the very young larva of *B. oleae*, *L. berlesiana* oviposits, probably attracted by fungus or host plant tissue semiochemicals. In this peculiar situation the young gall midge larva can not avoid to prey the egg or the young larva inhabiting the same niche, and then continues her development, feeding on the invading fungi (commonly *Camarosporium dalmaticum*) and probably also on the decaying plant tissues. Subsequently during summer and fall the gall midge can oviposit in any other opening on the olive fruits. In conclusion, *L. berlesiana*, as the other gall midges associated with olive fruits infested by *B. oleae*, appears normally a mycophagous and/or a saprophagous species. The activity of the gall midges associated with the olive fruits may interfere with the oil quality.

## **Augmentative releases of *Eupelmus urozonus* Dalm. against the olive fruit fly and observations on its facultative hyperparasitism**

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Experiments on biological control of the olive fruit fly (*Bactrocera oleae*) with augmentative releases of *Eupelmus urozonus* (lab-reared on pupae of the factitious host *Ceratitis capitata*) were carried out in two olive groves in Sardinia. In a grove of one hundred olive oil trees, manifesting low production and high infestation of olive fruit fly, 100 mated females of *E. urozonus* were released in August 1993. The olive fly parasitism, estimated by dissecting samples of infested fruits, showed a high activity of *Pnigalio agraulis* in the first weeks of August (max 20% of parasitism), whereas *E. urozonus* prevailed later reaching 60% of parasitism in September. Despite the high rate of parasitism, at harvest all the olives were infested. In 1994, in another olive grove of 200 trees, showing high production and low initial infestation, a total of 3480 *E. urozonus* mated females were released weekly during September and October. The rate of *P. agraulis* parasitism was very low in September and increased to a maximum of 10.5% in November, whereas *E. urozonus* was found sporadically. In these experiments *E. urozonus* behaved mainly as a hyperparasitoid of *P. agraulis*, as an autoparasitoid of its own species, and only occasionally as a primary parasitoid of *B. oleae* pupae. Given the negative results on the biological control, observations were carried out in various olive groves between 1995-2004, in order to verify the parasitism behaviour of *E. urozonus*. In this case, only the data on the parasitoid ovipositions found in olives was taken into account. The eggs were found deposited in galleries of *B. oleae* containing preimaginal stages of *P. agraulis*, *E. urozonus* and *Eurytoma martellii* (59%), recently dead (4%) and rotten (13%) larvae of *B. oleae*, live larvae of *B. oleae* (4%), and in *B. oleae* pupae (19%). These observations suggest that *E. urozonus*, in the olive agroecosystem, acts essentially as a hyperparasitoid and partly as a primary parasitoid of olive fly pupae. However, further research must be conducted to verify the primary parasitism on *B. oleae* larvae.

# On the use of the exotic oo-pupal parasitoid *Fopius arisanus* for the biological control of *Bactrocera oleae* in Italy

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**Abstract:** With the aim to broaden the natural enemies complex available for the biological control of key tephritid fruit flies (Diptera) of the Mediterranean Basin, the South-East Asiatic oo-pupal parasitoid *Fopius arisanus* (Sonan) (Hymenoptera: Braconidae) was imported in Italy in 1999.

Laboratory studies allowed to develop effective low cost rearing techniques of this parasitoid on the secondary host *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) using artificial devices. Moreover, we ascertained the suitability of a new host to the parasitization by *F. arisanus*: the olive fruit fly *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae), key pest of olive groves in all the Mediterranean region. Preliminary field cage tests were carried out in 2000 to evaluate the survival and the parasitization ability in a typical olive area of central Italy. Results evidenced better performances of the parasitoid during autumn, rather than in summer. The parasitoid showed the shortest longevity in early summer (in average, 2d in July August and 8-10d in the period September-November). In 2001, and 2004 investigations were carried out in Central Italy to verify the capability of *F. arisanus* to mate and increase its population in open field. In 2001, about 10000 *F. arisanus* specimens were released in a 1ha olive grove in July, while 2000 specimens were released in a 0.5ha olive area in September 2004. In 2004, quality control tests have been also performed to ascertain the preservation of the performances in parasitizing *B. oleae* in field of the laboratory reared *F. arisanus* population. Finally, results from intrinsic competition with the autochthonous parasitoid *E. urozonus* were also evaluated to test the effects from the release of the exotic parasitoid on local *B. oleae* antagonists.

The periodical recovery of olives during field tests allowed us to verify that the parasitoid was able to reproduce and gradually increase its population in field: in particular, we estimated parasitoid population to increase in field from 51.7 to 96.3 emerged specimens per 1000 olives in average from late September to late October 2004. Percent parasitism increased as well: the average level was in fact about 20% in September and 25% in October, with highest daily levels of 68 and 71% respectively. *F. arisanus* also maintained a sex ratio not significantly different from that obtained in laboratory (F/M=0,85). Quality control tests evidenced that the rearing conditions did not seem to affect *F. arisanus* ability in searching and parasitizing *B. oleae* in field. Furthermore, *E. urozonus* was consistently superior than *F. arisanus* in intrinsic competition (only 4% of the multiparasitized hosts emerged as the latter).

Both field cage and open field tests have pointed out that hot-dry climatic conditions limit the activity of *F. arisanus*, while under higher humidity levels, normally recorded from early September, the parasitoid show a remarkable efficiency in parasitizing *B. oleae* being also able to establish in field until the end of the olive cropping season.

## Presence of a symbiotic bacterium in the olive fly *Bactrocera oleae* (Gmelin)

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**Abstract:** The taxonomic identification of “*Candidatus* Erwinia dacicola”, the hereditary prokaryotic symbiont of the olive fly *Bactrocera oleae*, suggests the reported consideration. To avoid microbial contaminants, flies were surface-sterilized at larval stage and reared under aseptic conditions until adult emergence. *B. oleae* flies originating from different geographical areas and collected at different times of the year were tested. Bacteria were isolated from the cephalic oesophageal bulb, which is known to be a specific site of symbiont multiplication in the adults. Attempts at cultivation of the isolated bacteria *ex situ* were not productive at any stage. PCR amplification and sequencing of the entire 16S rRNA gene yielded a single sequence similar (97%) to *Erwinia persicina* and *Erwinia rhapontici* yet different from *Pseudomonas savastanoi* and, to a lesser extent, from “fruit flies associated bacteria”. Morphological differences exist among the pharyngeal bulbs of the olive fly and other fruit flies (belonging to Dacinae and Trypetinae) in which the presence of hereditary symbionts has not yet been demonstrated.

## Histopathological observations in the midgut and behaviour of olive fruit fly (*Bactrocera oleae* Gmelin.) adults treated with a strain of *Bacillus thuringiensis* Berliner

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**Abstract:** Ultrastructural changes are usually observed in the midgut of various insect species after feeding on diets containing specific toxins from different *Bacillus thuringiensis* strains.

A spore-crystal suspension of a *Bacillus thuringiensis* strain, previously known to be toxic against Olive Fruit Fly adults, was used to study the post-ingestion effects on the midgut ultrastructure of treated flies compared to untreated ones. Observations were carried out at different time intervals, until 72 h after feeding the bacterial suspension. Transmission electron micrographs showed a typical symptomatology involving a general disruption or disorganization of the midgut epithelial cells often ending in the cell lysis.

Similar pathological changes in the intestine are known for other insect species belonging to the orders Lepidoptera, Coleoptera and Diptera.

Behavioural observations were also carried out comparing treated to untreated flies. In the post feeding period, treated adults went through a progressive symptomatology which involved a general reduction in the activity, sluggish and shaky behaviour until general paralysis and death. The behavioural symptoms of intoxication paralleled the histopathology observed in the midgut of treated flies. Untreated adults looked healthy and did not show any pathological symptoms.

## **Some biological aspects of the *Bactrocera oleae* (Rossi) rearing**

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**Abstract:** An olive fruit fly adults caging and egging system was proposed. This system of adult rearing facilitates eggs collection and reduces the labour requirements. In order to search for the optimal population density/cage, a comparison among three different densities (100, 250 and 400 specimens/cage) was performed. The density of 250 specimens/cage allowed the collection of about 150 eggs/day/cage, a number relatively higher than that obtained at the remaining two densities tested.

## **Bait stations field test for *Bactrocera oleae* (Gmelin) in the Balearic islands (Spain)**

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During the year 2004 it was concluded the last phase of the FAO/IAEA Co-ordinated Research Programme on *Development of Improved Attractants and their Integration into Fruit Fly SIT Management Programmes*. This project targeted on several economic species of fruit flies including *Bactrocera oleae* (Gmelin.). An important part of the research was focused in developing bait stations for the olive fly based on chemical and visual stimuli.

A one-month field test was conducted in 2004 in an olive groove located in Palma of Majorca (Balearic Islands). The bait station was based in a plastic red sphere baited inside with an Ammonium Bicarbonate tablet (AB). Glue and two insecticides, Imidachloprid and Methomyl, were used separately as a killing agent. Two control treatments based on Multilure traps (MLT) baited with Nu Lure and Ammonium Bicarbonate were also included in the experiment.

The results obtained showed that the best treatment for the males of *B. oleae* was Red sphere plus glue, followed by the MLT- NuLure; Red Sphere- AB- Methomyl; MLT- AB and Red Sphere- Imidachloprid. In the case of females, the treatments ranked as follows: Red Sphere with glue; Red Sphere Methomyl and MLT- NuLure, Red Sphere Imidachloprid and finally MLT- AB. In general, it seems that the red sphere coated with glue outperformed even the MLT baited either with NuLure or AB. These results suggest that the round shape combined with red colour and ammonia acts as an important synergistic stimuli, and is as effective as the ammonia released by hydrolysed proteins placed on yellow traps.

## **Molecular markers as useful tools for population genetics of the olive fly, *Bactrocera oleae***

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**Abstract:** In pest populations, the distribution of genetic variability can reveal not only their history but also the direction and patterns of their evolution. An understanding of the within- and between-population genetic variability is crucial in the study of crop pests. Recently, molecular genetics is providing us with new and much more sensitive tools to face different questions related to the appropriate strategies for eradication or control. The tephritid *Bactrocera oleae* (Gmelin) is a harmful pest of olive crops; its larvae are monophagous and feed exclusively on olive fruits. Despite the economic importance of this species, very little is known about the genetic structure of its populations. In the present work, the genetic variability within and among different geographic populations was assessed using RAPD-PCR. A considerable level of intraspecific diversity was detected but the genetic differentiation among the populations was low. These results might be explained by the length time that has elapsed since *B. oleae* became established in the Mediterranean region, the large effective sizes expected of its populations, and gene flow among populations. The results suggest the existence of a single, large Mediterranean olive fly population and show the need for integrated control programs coordinated between different geographical areas.

## **Susceptibility to *Bactrocera oleae* (Gmelin) of some Sicilian olive cultivars**

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**Abstract:** Genetic resistance of olive germplasm could be an important tool in the control of *Bactrocera oleae* (Gmelin), the key pest in Mediterranean Basin olive groves. Up to now, no study carried out on olive varieties stressed a complete resistance to the attack of *B. oleae*, although differences among olive cultivars in the susceptibility to olive fruit fly could be usefully considered both in organic and conventional olive cultivation, to obtain quality productions and to reduce insecticides use.

The present study was carried out at Castelvetro (Trapani province, Sicily), in the olive germplasm collection of Ente di Sviluppo Agricolo of the Sicilian Region. From 2002 to 2005, the assessment of susceptibility was made recording infestation levels on 18 cv, representing the most widely cultivated in Sicily. Samplings were carried out every 11-20 days, starting from the second half of August to the end of October. Moreover, from 2003 to 2005 infestation levels were correlated with hardness and size of the olives, while in 2004-2005 further data on olive colouration were collected at different ripening stages. A positive correlation between infestation and olive sizes was found, resulting in higher infestation levels recorded on the cultivars producing larger olives. A negative correlation between hardness and infestation was found in the early olive growing, until they reached almost definitive sizes. *B. oleae* showed to have a clear preference for green drupes, instead of reddish or blackish ones. Among the cultivars producing larger olives, Nocellara del Belice resulted the susceptible to the olive fly attacks, while Nocellara messinese was the less infested. Among cultivars with medium and small-sized fruits Moresca, Vaddarica, Nasitana frutto grosso, Minuta and Bottone di gallo were the less susceptible.

## **Behavioural responses of the olive fly, *Bactrocera oleae*, to chemicals produced by *Pseudomonas putida* in laboratory bioassays**

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**Abstract:** The behavioural responses of the female olive fly, *Bactrocera oleae* (Rossi), to bacterial odours were studied in laboratory bioassays with a Y-tube olfactometer and a wind tunnel. In both experiments females showed a significant response to odours emitted by bacterial filtrates compared to a commercial bait usually employed in the field as an attractant for adult fruit flies.

## **Sterile insect technique (SIT) – an environmentally friendly approach to controlling major fruit-fly pests**

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The sterile insect technique (SIT) developed in the 1950s has since been successfully used for many insect key pests worldwide. The area wide approach is one of the most important prerequisite for successful application of SIT programme. SIT control strategies include release of male insects mass produced in specialized facilities that have been sterilized by irradiation. Mass production of males can be accomplished most effectively through genetic sexing strains of the pest. Genetic sexing strains GSS are based upon selectable characters linked to the male sex by using Y-autosome translocation. In the case of medfly, temperature sensitive lethal strain (*tsl*) is used which include temperature sensitive lethal (*tsl*) mutation in addition of recessive pupal colour mutation (*w<sup>p</sup>*). To avoid of the occurrence of recombinants during the mass rearing, the filter rearing system (FRS) has been developed. The FRS consists of small colony, physically cleaned of recombinants, which is “bridged” to a large operational colony via a short series of colony amplifications, called an amplification bridge. The operational colony provides rearing material to much larger colony – release stream – which is dedicated to providing all the flies for sterilization and field release.

The first SIT program to control fruit flies (medfly) in Europe was running by Italian National Agency for New Technology, Energy and Environment in Italy, with experimental campaigns at Capri and Procida islands. Since 1993, European Union is supporting Madeira-Med program using SIT as the control strategy for medfly control to level below the economic threshold in Madeira and Porto Santo Islands. Madeira-Med has operational units for field activities, Medfly mass production, quality control, fly handling and releases, public relations and administration.

In last four decades, several successful SIT programmes to eradicate or control fruit flies were running all over the world. The melon fly, *Bactrocera cucurbitae*, has been completely eradicated from Okinawa, Japan in 1993. Following the expansion of target areas during the eradication campaign, the number of flies produced was increased from 5 million to 280 million per week. The Moscamed programme in Guatemala began in 1975. Since then, the programme has evolved into the largest medfly control and eradication effort in the Americas, if not even the world. The Mendoza medfly programme started in 1990 with the aim to eradicate Medfly in Mendoza province and subsequently from the whole territory of Argentina. The production of sterile males grew continually from 70 to 200 million per week. Shortly after initiation of the Programme, substantial degree of Medfly suppression was achieved.

Beside of numerous SIT programmes dedicated to control medfly in different parts of the world, this insect pest area-wide control technique is used also against several other fruit fly pests. One of the perspective candidates for SIT control is also olive fruit fly. In last decade, substantial progress was achieved in the development of rearing technology to produce sterile flies.

## Tests on the effectiveness of kaolin and copper hydroxide in the control of *Bactrocera oleae* (Gmelin)

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**Abstract:** Repellent and antiovipositional products in the control of *Bactrocera oleae* (Gmelin) finds a great interest in organic farming, because of the lack of effective products able to kill the olive fly immature stages. In 2003 in Castelvetro (Trapani province, Sicily), tests on the effectiveness of Surround WP, a product containing 95% of kaolin, were carried out on three table olive cultivars, Nocellara del Belice, Moresca and Tonda Iblea. In 2004, in the same field and on the same cultivars, BPLK kaolin was tested too. In the second year the two products containing kaolin were also tested on Cerasuola cultivar in an organic olive grove located in Trapani, comparing them with copper hydroxide.

At Castelvetro both in 2003 and in 2004 *B. oleae* infestation levels of the plots treated with the two products containing kaolin were statistically lower than those of the control plots. In this site, in 2004 Surround WP protected olives significantly better than BPLK kaolin, limiting olive fly harmful infestation up to 17-23% vs. 68-87% of BPLK plots. At Trapani in 2004, the two products containing kaolin and copper hydroxide showed statistically significant differences from the untreated control, but not among themselves, limiting the harmful infestation up to 3-37% vs. 87% of the control.

The different results of 2004 recorded by Surround WP and BPLK kaolin in the two olive groves seems linked to the different rainfall of the period after the last treatment, 64 mm in three rainy days at Castelvetro and 41 mm in eight rainy days at Trapani; BPLK kaolin was probably washed away more than Surround WP.

The tested products containing kaolin and copper hydroxide are effectively able to limit *B. oleae* infestation to a very good level for olive oil production, moreover, considering the earlier harvesting of table olives, these products give a new opportunity for controlling the olive fly also in the organic olive groves for table olives production.

## Resistance to organophosphates in *Bactrocera oleae* in Greece and Cyprus

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**Abstract:** The control of the olive fruit fly *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae) in Greece has been based mostly on bait sprays with organophosphate insecticides for more than 40 years. In the present study, a two-year survey to monitor the development of resistance to dimethoate in *B. oleae* field populations collected from Greece and Cyprus was performed. A laboratory susceptible strain was used as the reference population. Considerable variation in the resistance ratios to dimethoate was recorded ranging from 6.3 to 61.9. The highest levels of resistance were observed in populations from Crete, while the lowest in those from Cyprus. In mainland Greece moderate to high resistance was recorded. This variation could be attributed to different insecticide pressure but also to migration.

## **A *Beauveria bassiana*-based bioinsecticide for the microbial control of the olive fly (*Bactrocera oleae*)**

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**Abstract:** In 2003-2004, different certified Italian testing facilities conducted several GEP trials on the efficacy of the *B. bassiana*-based bioinsecticide Naturalis against Tephritid flies (*Ceratitis capitata*, *Rhagoletis cerasi*, and *Bactrocera oleae*). In this paper we report the results of the 6 efficacy trials conducted against *B. oleae*. The efficacy of weekly applications of the product at 125-130 ml/hl in reducing the percentage of fruits damaged by *B. oleae* at harvest was comparable to or higher than that of the chemical reference treatment in 5 out of 6 trials. The efficacy of 14-day-interval applications at 125 and 250 ml/hl was comparable to that of the chemical standard in 4 out of 6 trials. Furthermore, promising results were obtained when Naturalis was used in an integrated strategy. The bioinsecticide can therefore be considered a new and reliable tool for the control of olive flies.

## **Bait applications effect of Spinosad Success<sup>tm</sup> 0.24CB (GF-120)" formulation, on *Bactrocera oleae* Gmel. (Dacuol), and impact on other non target organisms in olive trees**

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In 2002, two field studies were organized to evaluate the effect of spinosad bait treatments on beneficial arthropods and to compare them with the standard organophosphate bait treatments of fenthion and dimethoate. Success<sup>TM</sup> (GF-120, a prepackaged bait which contains 0.24g spinosad/L), was tested in North Greece by Thessaloniki University on olive trees to evaluate the effect on the whole range of non target insects present in the field. It was also tested on caper plants by the State Tunisian Research Institute to evaluate the effect on the parasitoid *Opius concolor*. In the North Greece in olive trial, GF-120 at 1250 mL/ha was statistically equal to the untreated to *Chilocorus* sp., *Chrysopa* sp., *Coccinella* sp., Coccinellidae predators and Hymenopteran parasitoids. All GF-120 treatments were safer and statistically different than fenthion to *Chilocorus* sp., *Coccinella* sp., *Chrysopa* sp., Coccinellidae predators and Hymenoptera parasitoids, while statistically equal to fenthion on Syrphidae predators. In Tunisia in caper plants, GF-120 was safe to *Opius concolor* and equal to the untreated. The standard, dimethoate bait treatment, was toxic to *Opius concolor*. It was concluded that GF-120 ready made bait, at its proposed recommended use rates, was safe to a wide range of non target beneficial arthropods.

## Effect of several insecticides for control of *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae) to arthropods fauna of olive grove

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In 2002-2004 field studies have been organized to evaluate the effect of bait sprays with several insecticides, for control of *Bactrocera oleae* (Gmelin), on arthropods fauna of the olive grove. The experiments have been carried out in Chania (Crete, Greece), by the Institute of Olive Tree and Subtropical Plants on 96.000 olive trees in Glossa region. The insecticides that were used were the pyrethroids: deltamethrin 2.5% (Decis flow 2.5), b cyfluthrin 2.5% (Bulldock 025 SC), b cypermethrin 10% (ATO 10 EC), l cyhalothrin (Karate), a cypermethrin 10% (Fastac 10 SC), z cypermethrin 10% (Fury 10 EW), the organophosphate insecticides: dimethoate 40% (Dimethoate 40 EC) and fenthion 50% (Fenthion 50 EC) and the selective insect control product produced by the fermentation of the naturally occurring soil bacterium *Saccharopolyspora spinosa* (Spinosad) (NAF 85 and GF-120).

The results showed that more than 170 different arthropod species were recorded, which belongs to 50 insects families and 12 orders of arthropods. Heteroptera species were found to be the most abundant. From the recorded species 23 were beneficial of the families Braconidae (*Praon* sp., *Opius concolor* Szepf., *Apanteles* sp., *Dacnusa* sp., *Chelonus eleaphilus* Silv.), Eupelmidae (*Eupelmus urozonus* Dalm.), Scelionidae (*Telenomus* sp.), Eulophidae (*Pnigalio* sp.), Syrphidae (*Syrphus* sp.), Coccinelidae (*Lindorus lophanthae* (Blaisdell), *Chilocorus bipustulatus* L., *Adalia bipunctata* L., *Coccinella septempunctata* L., *Scymnus* sp.), Chrysopidae (*Chrysoperla carnea* Stephens) and Anthocoridae (*Orius leavigatus* Fieber).

Among the tested chemicals, spinosad had the lowest toxicity on the Hymenoptera species than the other chemicals. Pyrethroids group had the highest toxicity on Hymenoptera followed by the organophosphate insecticides. All the tested chemicals had the same effect on the Diptera species. On the Lepidoptera were not found differences among the tested insecticides and their toxicity on them was very low. On Coleoptera only pyrethroids group showed high toxicity.

## **Mass trapping experiments with two different “Attract and Kill” devices for *Bactrocera oleae* (Gmelin)**

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**Abstract:** Different experiments using mass-trapping performed over the last years have shown good efficacy for the control of olive-flies, thus providing a potential solution to active infestation and a consequent reduction in olive damage. However, the substantial cost of the attract and kill system, and especially their installation and employment in large areas where they show the maximum efficacy, has rendered their commonplace use impractical. In the present report, we compared the efficacy of two different types of traps (type 1, already commercially available, and type 2, which is in an experimental phase), both produced by Agrisense that were used in smaller numbers than usually employed per hectare (150 and 100, respectively, instead of 400). The traps were primed by sexual attraction (Spiroketal) and by olfactory attraction (ammonium salts). Lambda-cyhalothrin, which is allowed under organic farming legislation, was used as an insecticide. The two types of traps were compared to an untreated plot. There were no significant differences in the adult population present in the field in the different treatment groups. However, examination of the active and total infestation showed that the type 1 trap was more efficacious. This improved efficacy was evident until October, when the harvesting time is generally considered optimal.

## **Tests on the effectiveness of mass trapping by Eco-trap (Vyoril) in the control of *Bactrocera oleae* (Gmelin) in organic farming**

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**Abstract:** Tests on the effectiveness of mass trapping by Eco-trap (Vyoril) in the control of *Bactrocera oleae* (Gmelin) in organic farming were carried out in 2003 and 2004. The tests took place into two organic olive groves located in Agrigento and Trapani (Sicily); in both years the olive cultivar was Cerasuola. In Agrigento, it was considered the effectiveness of Eco-trap vs. bottle traps baited with diammonium phosphate; while in Trapani the effectiveness of Eco-trap added to other products admitted in organic farming (two products containing kaolin and one containing copper) was evaluated. In 2003, year with a low *B. oleae* population density, no statistically significant difference resulted among Eco-trap, bottle traps with diammonium phosphate and control. In 2004 *B. oleae* infestations were high; although some statistically significant differences among plots with Eco-traps and plots without them emerged, the additional power of Eco-trap in controlling *B. oleae* resulted very limited in plots sprayed with kaolin products and more consistent in the plot with copper hydroxide. The economic advantage of the use of Eco-trap, also in comparison with repellent and antiovipositional products, still remains doubtful.

## **Control trials of *Bactrocera oleae* (Gmel.) (Diptera Tephritidae) in the district of Bar in Montenegro**

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**Abstract:** The aim of this paper was an evaluation of the efficacy of bioinsecticides based on Spinosad for olive fly control.

The investigations were carried out in olive-grove (Žutica variety), under agroecological condition of Bar (Montenegro), during 2004. The following insecticides were applied as bait spray: Success<sup>TM</sup>, GF 120 fly bait<sup>TM</sup> and Decis<sup>TM</sup>.

From the beginning of September five treatments were administered on average intervals of 7-10 days. First treatment was applied when the gravity index Z exceeded the threshold level ( $Z > 0.10$ ).

Efficacy of applied insecticides was evaluated weekly and expressed as to their effect on level of infestation.

Obtained results show that insecticides based on Spinosad aren't sufficient for control of olive fly.

## **Kaolin protects olive fruits from *Bactrocera oleae* Gmelin infestations unaffacting olive oil quality**

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The efficacy of the processed kaolin "Surround WP" to control olive fruit fly, *Bactrocera oleae* Gmelin, field infestations was investigated in east Calabria. The preliminary results showed that fruit infestation levels were significantly reduced on kaolin-treated trees compared with untreated trees. The promising results of these experiments points to the feasibility of using particle film technology composed of a non-toxic material, to avoid olive fly damage as an alternative to the applications of rotenone in organic orchards.

Finally, kaolin treatment unaffected the nutritional and sensory quality parameters of the corresponding virgin olive oils obtained by a laboratory scale olive mill, thus satisfying the present quality requirements.

## Spinosad treatment for *Bactrocera oleae* (Gmel.) control and olive oil quality in the Montenegrin cv Žutica

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**Abstract:** Nowadays the experimentation of natural origin products assumes the first role in the researches aimed to focus on *B. oleae*'s new check strategies, more selective in their action and with less risk of secondary harmful effects. This issue tested the effect of treatments made with Spinosad and Deltamethrin added to proteinic fly bait in a high infestation year (2004). The olive grove, made of cv Žutica trees, was divided in 5 sections, so organized: 1. one tested with GF 120 Flybait; 2. one with Success + Buminal; 3. one with Deltamethrin + Buminal; 4. one with Dimethoate; 5. witness. The treatments were made to exceeding of  $Z > 0.1$ , with Z calculated by the expression  $Z = 0.039 (F_m - 9.7) - 0.186 (T_m - 22.1)$  where  $F_m$  is the average number of females/week captured by means of a yellow chromo tropic trap and  $T_m$  represents the mean temperature of the capture week. Excluding the one treated with Dimethoate, which was submitted to a single intervention in the middle of September, for the other four 5 interventions each have been made. In each of the 5 plots, 3 olive – trees have been chosen at random. On the 26/10/2004, from the canopy were randomly withdrawn samples of 1.5 kg of olives, which were submitted to oil extraction made by pressure after 24-48 hours from the harvest. The obtained oil samples have been analyzed pointing out following parameters: free acidity, peroxides number, phenols and ortho – diphenols. From the Analysis of the obtained results it appears that the oil coming from the olives treated with GF 120 Flybait is an extra-virgin with qualitative levels like the one made of Deltametrina and Dimethoate treated olives. This has to be related to the experimentation year, a loss of production occurred, due to more than 30% dropped olives, except the Dimethoate treated part, where the dropped olived results neared 5% even if the oil qualitative properties in all treated thesis, seem to allow the classification as extra-virgin oil.

## **Effect of the olive fruit fly and the olive anthracnose on oil quality of some Portuguese cultivars**

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The olive fruit fly, *Bactrocera oleae* (Gmelin), and the olive anthracnose, *Colletotrichum* sp., cause damage on fruits with repercussion on olive oil quality. The aim of this work was to examine the effect of olive fruit fly and olive anthracnose on oil quality of five Portuguese olive cultivars (Galega vulgar, Cordovil de Castelo Branco, Cobranosa, Madural and Verdeal Transmontana). In Galega vulgar and Cordovil de Castelo Branco three groups of olives were constituted, one with olives infested by olive fly (FO), another with olives attacked by anthracnose (AO) and other with health olives (HO). In the other cultivars HO and OF are compared. Fat content (in dry matter), acidity, specific extinction coefficients (232 and 270 nm) and fatty acid composition were determined. Our results showed that HO had the highest fat content. AO oil presented the worst quality, presenting acidity values twice as much as HO. FO oils showed an increase in acidity 50% higher than HO. No differences were observed concerning fatty acid composition of HO and FO oils. However, the oil produced with AO showed the lowest percentage of monounsaturated fatty acids and the greatest value of saturated fatty acids. Oleic acid was higher on oil produced with HO. Work partially financed by demonstrative project AGRO 482 “Protecção contra pragas do olival numa óptica de defesa do ambiente e do consumidor”.

## **Biological control of olive fruit fly in California by *Psytalia* cf. *concolor* (Szepligeti) from Moscamed, Guatemala**

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The larval parasitoid, *Psytalia* cf. *concolor* (Szepligeti), was imported into California, USA, from Moscamed, Guatemala, and shown to have potential for biological control of olive fruit fly, *Bactrocera oleae* (Gmelin). Calculated percentage parasitism of olive fruit fly 3<sup>rd</sup> instars in field cage tests ranged from 4% in a dry and warm inland valley area, to 29% in a humid and cool coastal area. Small field releases of the parasitoid resulted in 5% parasitism based on the number of parasitoid adults reared from olive fruit fly infested olives collected 1 wk after releases in a coastal area. In laboratory tests at constant temperature, parasitoid adult survival decreased with an increase in temperature and correlated decrease in humidity when provided with water (48 d at 15°C and 12 d at 35°C) or with no water (4 d at 15°C and 0 d at 35°C). In greenhouse tests, at fluctuating diurnal and nocturnal temperatures, parasitoid adult survival with food and water was 21 d at ≈26°C and 4 d at ≈36°C, and was 4 d at ≈26°C and ≤1 d ≈36°C without food and water.

## ***Psytalia concolor* (Szépligeti) mass-rearing: new acquisitions**

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**Abstract:** *Techniques of *Psytalia concolor* mass-rearing utilised in Entomology laboratories at University of Pisa are described. A synthesis of a pluriannual study on parameters that play an essential role in optimising the rearing technique, as well as ensuring more correct utilization of the parasitoid in field conditions, is also reported.*

## **The effects of treatments against *Bactrocera oleae* (Gmelin) on the entomo-fauna of the olive ecosystem**

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**Abstract:** Only a limited number of studies have examined the efficacy and environmental effects of treatments against *Bactrocera oleae* in organic production of olives, especially in terms of the insect community present in these ecosystems. Herein, we compared the effects of a conventional insecticide (dimethoate) with a plant protection system allowed by organic legislation (mass trapping plus rotenone), and an untreated, control field against *B. oleae*. The experiments were performed in the Calabria region in Italy (on the Ionic side of Cosenza), in a grove (Mirto-Crosia) with extensive active insect infestation. In two conventionally treated fields with a surface area of 2 hectares each, two treatments were performed (in August and September) utilizing dimethoate (150 gr in 100 lt water). In another 2 hectare area, mass-trapping devices (attract and kill) were installed and treatment with rotenone (Rotena 300 gr in 100 lt water) was performed in September. The entomo-fauna present in the different areas was evaluated by insect capture utilizing cromotropic traps. The integrated protection system (mass-trapping plus rotenone treatment) led to a reduction in the total number of insects in comparison to the traditional method (dimethoate treatment). It proves the negative effect of organic system on the olive ecosystem entomo-fauna.

## **Inventory and role of the third generation parasitoids of *Prays oleae* Bern. (Lepidoptera, Yponomeutidae) in Sfax region (South of Tunisia)**

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**Abstract:** The olive moth *Prays oleae* Bern. (Lepidoptera, Hyponomeutidae) is considered as the most important olive pest in the coastal regions of the center and the south of Tunisia. However, abiotic factors such as droughtiness and biotic factors such as parasitoids and predators play a great role in the reduction of *P. oleae* population. The follow-up of the pest adults and its parasitoids emergence is achieved by the installation of trap bands in undulating cardboard (10 X 20 cm) infested branches at the rate of 25 cardboards per tree. Fifty trees were examined for the collection of *P. oleae* larvae and chrysalids that are isolated individually in hemolyses tubes closed with an absorbent cotton to facilitate the aeration to follow the emergence of *P. oleae* adults and its parasitoids. The emergence of *P. oleae* adults is spreading on about thirty days in the laboratory (month of March) and forty days (second week of March until the end of April) on the field. However, the emergence of parasitoids spreading on all the flight period of the insect with temporary cadences of emergencies especially during the maximum of the flight, coinciding with the presence of *P. oleae* larvae and as consequence a relatively high rate of parasitism in the nature (61.33%). The daily follow-up of emergencies in laboratory has permitted to establish the curves of *P. oleae* and its parasitoids flight and to compare them to those in the field. The inventory of the third generation parasitological fauna of *P. oleae* has been composed of 4 known species: *Chelonus eleaphilus* (67.39%), *Angitia armillata* (17.45%), *Apanteles xanthostigmus* (0.25%), *Ageniaspis* (14.12%) and of 6 new species: 1 species of the genus *Apanteles*, 2 species of the genus *Itopectis* and 2 species of the genus *Dibrachys*. The predators captured are essentially spiders, ants and larvae of *Chrysoperla carnea*.

## **Mating disruption of the olive pyralid moth, *Euzophera pinguis***

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A two years field experiment were conducted to determine efficacy in disrupting sexual communication of the olive pyralid moth (OPM) *Euzophera pinguis* Haworth (Lepidoptera: pyralidae) in infested olive groves. Shin-Etsu pheromone Rope-type dispensers were placed at the beginning of 2004 and 2005 first flight periods at a rate of 500 dispensers per hectare, about 2-3 ropes per tree, in two 3 ha olive plots. A total of 50 g pheromone of a blend of (Z)-tetradecen-1-ol (Z9-14:OH) and (Z,E)-9,12-tetradecadien-1-ol acetate (ZETA) was applied/ha.

Under field conditions, pheromone release-rates from dispensers were measured in laboratory weekly over 7 months. Pheromone was trapped on Tenax TA from an air stream, thermally desorbed and quantified by gas chromatography.

The success of mating disruption was evaluated using two parameters: inhibition of males capture in pheromone traps and reduction of infestation in susceptible infestation sites (bark crevices and wounds).

In pheromone-treated blocks, captures of *E. pinguis* were reduced from 95% to complete shut-down of pheromone trap catch in all of the plots for at least 180 days. In addition, a reduction of 40-70% was recorder in the infestation levels on wounds during pheromone treatment.

## **Effect of chemical control on over-wintered population of olive psyllid *Euphyllura olivina* Costa (Homoptera, Aphalaridae) in Iran (Tarom-Sofla region, Qazvin province)**

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**Abstract:** Chemical control is one of the most important strategies in Integrated Pest Management (IPM). Studies on the chemical control with emphasis on effectiveness of emulsifiable oil on dormant olive psylla, *Euphyllura olivina* Costa, were carried out in Tarom-Sofla region (Qazvin province) during 1996-1997. Emulsifiable oil (1 and 2%), Azinphos methyl 0.002 with oil 1% and without, Etrifos 0.001/5 with oil 1% and without compared to control treatment were tested in randomized complete block design in 3 replications. Results showed that emulsifiable oil 2% is preferred to control olive psylla especially on preoviposition period, because of economic aspects and its stability and less because of its side effect on environment and natural enemies.

## **Factors affecting male *Prays oleae* (Lepidoptera: Yponomeutidae) captures in pheromone-baited traps in olive orchards**

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The effects of trap design, height and site of trap placement on the olive tree, pheromone doses in the dispensers, aging of the dispensers in the field and secondary pheromone components were evaluated for the development of an effective pheromone monitoring system for the olive moth *Prays oleae* (Bernard) Lesne in olive orchards. Field trials showed that trap design, pheromone dose and trapping side, affected male captures, while dispenser age, trap height and secondary components had no influence. Pherocon 1C and Delta traps baited with 1 mg of (Z)-7-tetradecenal captured more male moths than Pherocon II or Funnel traps. Placement of traps at different cardinal directions significantly affected captures, but this trend was not consistent and varied with flight period and trap position internal or external to the tree canopy. Moth phenology as determined by pheromone traps from early April to mid October was consistent with published field data. Results indicate that Pherocon 1C or Delta traps baited with 1 mg of (Z)-7-tetradecenal provide an effective tool for monitoring the flight activity of *P. oleae* and the time of application of control measures.

## **Mating disruption trials for the olive moth, *Prays oleae* (Bern.), (Lep.: Yponomeutidae) in Trás-os-Montes olive groves (northeast of Portugal)**

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The olive moth, *Prays oleae* (Bern), is one of the most serious olive pests in the Mediterranean basin. The objective of the present study was to integrate environmentally safe methods for the control of the pest. Trials were carried out for three consecutive years (2002-2004) in an olive grove about 20 ha, in the ecological production region at Romeu (North of Mirandela). The trees were of medium size, about 60 years old and mainly of the Cobranosa and Verdeal Transmontana cultivars. In the flower generation when 10% of the flowers were open, the entire grove was sprayed with *Bacillus thuringiensis*, (var. *kurstaki*) to reduce the larvae population. Within the grove, two 7 ha plots, one treated with pheromone during the fruit generation (MD-plot) and the other used as control, untreated (CO-plot), were selected. The distance between the two plots was approx. 300 m. Pheromone dispensers were installed at the onset of the fruit generation (3 June 2002, 5 June 2003 and 8 June 2004) in the MD-plot, and the dose of pheromone applied was 40 g/ha. Results were evaluated by fruit injury and by capture of male *P. oleae* in Delta traps baited with polyethylene vials, loaded with 1 mg of synthetic pheromone. The *P. oleae* pheromone is a single component the Z-7 tetradecenal; in mating disruption treatments the pheromone was formulated in  $\alpha$ -cyclodextrin and dispensed from polyethylene vials.

During the flower generation, either male captures in pheromone traps or flower infestation were similar in both plots. However, during the fruit generation, male catches were higher at the CO-plot, with a maximum of 497.0 $\pm$ 97.20 and 259.2 $\pm$ 81.16 individuals per trap and per week, respectively in 2003 and 2004, than on the MD-plot (18.8 $\pm$ 4.60 and 4.4 $\pm$ 3.17). The rate of male disorientation was between 73.77 - 97.04% in 2003 and 96.21 - 97.42%, in 2004. Fruit infestation was significantly different between plots, with a maximum of 82.9% - 54.7% and 20.7 $\pm$ 12.7 - 16.7 $\pm$ 8.81 of infested fruits in the CO and MD plots, respectively for 2003 and 2004. The overall crop yield was similar in both plots. The results obtained suggest that the mating disruption method applied against the fruit generation of *P. oleae* has the potential to reduce the moth population and to minimize losses due to the pest.

## **Resistance of olive cultivars to carpophagous generation of *Prays oleae***

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During 1999-2005, the resistance of 3 olive cultivars to the carpophagous generation of olive kernel borer (*Prays oleae* Bern.) was studied in a grove in Sardinia. At the end of June the infestation level, determined as percentage of olives with penetrating larvae, varied between 4.1% and 75.2%. In the large drupe variety “Manna” the infestation level was constantly higher than in the smaller drupe varieties “Bosana” and “Semidana”. The autumn olive fall caused by the mature larvae varied from 0.5% to 25.5%, depending on variety and year. The reduction of June infestation was due to both the high fall in the post-setting stage, that occurred with greater frequency in infested olives, and to intrinsic factors not yet identified which caused larval mortality. The percentage of larvae eliminated by physiological fruit drop in post setting was higher in the cv Bosana (average value 77.97%) compared to the cv Semidana (61.59%) and the cv Manna (54.79%). On the contrary, the summer reduction of infestation due to larval mortality inside of the drupe was higher in the cv Manna (average value 30.01%) and the cv Semidana (25.10%) compared to the cv Bosana (11.86%). However, the overall reduction of infestation was higher in the cv Bosana, whereas in the other two varieties no differences were found. The observations made, highlight the fact that the damage caused by the olive kernel borer to the cv Bosana and the cv Semidana is very limited whereas, in certain cases, in the Manna losses of over 10% in autumn production were recorded. Heavier damage to the cv Manna is attributed to two factors: higher attacks, due to the olive kernel borer’s preference for the large drupe variety, and secondarily its lower varietal resistance.

## **Optimization of the field performance of released *Trichogramma* spp. in olive groves, in Egypt**

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The dose and daily emergence patterns of three endemic species, *Trichogramma cordubensis* (TC), *T. euproctidis* (TEU) and *T. bourarachae* and the commercial available species, *T. evanescens* (TE) were monitored under lab and field conditions. Peaks of adult emergence varied according to the species and date of testing. The results suggested that TB and TC were the most adapted species for warm field weather than the other test species. The pattern of adult emergence and duration of adults availability of TB and TC seem to be more suitable for utilization in inundative releases in olive farms of arid area. The results suggest the importance of such studies to select and management of available endemic wasp species to achieve successful control of the target pests.

## **Distribution and spatial pattern of *Saissetia oleae* (Olivier) on the olive tree in the northeast of Portugal**

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The black scale, *Saissetia oleae* (Olivier), is a major olive tree pest throughout Portugal. In order to improve the knowledge on the pest population dynamics, as a basis for its optimal control, a study was conducted in the northeast region of the country on the within-plant distribution of the various insect stages and the spatial pattern of these stages on the host tree. The experimental work was carried out from April 1997 to December 1999, on two olive groves located near Mirandela, unsprayed for several years and non-irrigated. In each grove, ten trees were randomly selected and eight twigs about 30 cm in length were collected from each tree, on a biweekly basis from April to November and monthly from November to April. Twigs were taken from the four cardinal points and inside and outside of the tree canopy. A sub-sample of 20 leaves and 20 cm of branch was obtained from each of such samples and the scales present were counted, distinguishing the various stages of development and their position on the leaf (lower and upper side). Taylor's power law and Iwao's patchiness regression technique were used to analyse the spatial pattern of the insect. The results showed that the immatures were located mainly on the lower side surface of the leaves, whilst the adults were preferentially located on the branches. In general, the number of scales was higher inside the tree canopy, but no preference was shown in respect to the cardinal points. The spatial pattern of *S. oleae*, which could be adequately described by Taylor's power law and Iwao's regression methods, was generally aggregated. Also it was shown that the degree of aggregation decreased with the development of the insect and, in general, was higher in the inside of the tree canopy and in the lower side surface of the leaves.

## **Twig dieback in olive trees associated with *Resseliella oleisuga* (Targioni Tozzetti) (Diptera Cecidomyiidae) and *Libertella* sp.**

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**Abstract:** Twig dieback has been observed in olive trees growing in the Euganei and Berici hills. Dieback was related to the presence of the gall midge *Resseliella oleisuga* and fungi causing canker. The biological cycle of the cecidomyiid and the presence of associated fungi has been observed for two years. The occurrence of the fungus *Libertella* sp. and larvae of *R. oleisuga* on wounds resulted correlated, suggesting a close insect-fungus association.

## **Bionomics of *Resseliella oleisuga* (Targ.-Tozz.) in Tuscany (Diptera Cecidomyiidae)**

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Research carried out during different years in various olive-growing areas allowed deeper knowledge on ethology and ecology of *Resseliella oleisuga* (Targ.-Tozz.) (Diptera Cecidomyiidae) in Tuscany.

From weekly examination of olive branches artificially wounded emerged that adult presence and oviposition are practically continuous from April to October. Under suitable laboratory conditions preimaginal development period averages 25-30 days whereas in the field the duration of the life-cycle, even for population from eggs laid in the same period, varies considerably. This is predominantly due to the length of the larval instar and to the time the mature larva spends before inside the branch and then in the soil.

The life-cycle and specially larvae behaviour are very affected by weather conditions. During the spring-summer period a part of the population completes its life-cycle (egg to adult) in 35-50 days. Thus between April and October there can be until three-four generations overlapping. Two main peaks of adult presence are usually observed: the first in July and the second in September. From laboratory rearing data sex ratio appears greatly unsettled in favour of females (as far as 10:1) that show a potential fecundity of over 100 eggs per individual. Every solution of continuity of the bark in twigs with a diameter of 3-15 mm can be used by females for laying eggs. At the same time *R. oleisuga* females can exploit pruning cuts and oviposition hurts of Auchenorrhyncha. One wound can be used by different females for successive ovipositions. In Tuscany the frequency and the seriousness of the species infestations seem tight associated with hail storms. Larval population of *R. oleisuga* are usually subjected to attack of the predator *Pyemotes ventricosus* (Newport) (Acari Pyemotidae), the ectoparasite *Eupelmus* sp. (Chalcidoidea Eupelmidae) and the endoparasites *Platygaster* sp. and *Leptacis* sp. (Proctotrupoidea Platygasteridae).

## **Effect of eriophyides mites on the sensitivity of some olive tree varieties**

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In the framework of the integrated protection concept or more recently the integrated production, a big attention is allowed to the preventive measures to control pests and diseases, among them, the choice of resistant or tolerant varieties to the destructives and diseases attacks. In this context we have studied the resistance to the eriophydes mites attacks of 15 olive trees varieties in the collection of the experimental station of Taous (Sfax- Tunisia).

These varieties were composed of 7 table olive tree cultivars (Meski, Picholine, Manzanille, Zarrazi, Touffahi, Lucque and Blanquette) and 8 oils olive tree varieties: Chemlali (clones C 236 and C 340), Chemlali, Zalmati, Chemlali Zarzis, Chemlali Ontha, Ouslati, Koroneiki and Azeitira. The trees are 4 years old and planted 6 x 6 meters with drip irrigation.

The resistance to the mites was apprehended by the eriophydes density by mm<sup>2</sup> of leaves, which is estimated with an uniform sampling on threes at the rate of five branches/ tree each 15 days during the year 2004.

According to the maximum density of eriophydes mites /mm<sup>2</sup> of leaves and depending on their degree of resistance, we were able to classify the mites varieties in three varieties can be classified on tree categories:

- Category n° 1: Resistant varieties when the density is inferior to 3 mites/ mm<sup>2</sup> of leaf. The varieties were: Oueslati (oil variety) and Touffahi, Lucque and Blanquette (table varieties).
- Category n°2: moderately resistant varieties when the density is between 3 and 12 individus/mm<sup>2</sup> of leaf. The varieties included in this category were: Zalmati, Chemlali (clone 340) and the table varieties Manzanille, Picholine and to fine double Zarrazi and Azeitira.
- Category n°3: sensitive varieties when the density is superior to 12 mites/ mm<sup>2</sup> of leaf. This category contains the majority of oils varieties such as: Chemlali, Chemlali Zarzis, Chemlali Ontha Chemlali (clone c 236), Koroneiki and the table olive variety Meski.

This work shows the less sensitivity to mites of the local variety Oueslati and a high sensitivity of certain local varieties particularly the Chemchali of Gafsa, the Chemlali Ontha of Tataouine, the Chemlali of Zarzis, the Meski and the foreign variety Koroneiki. It shows equally a different sensitivity between clones of the same variety (Chemlali).

## Effect of cereal cover crops on Araneae population in olive orchard

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Spiders, Araneae, are one of the most common predator orders in olive orchards. The potential bioindication of spiders as indicators of soil management was tested in field trials on olive orchards of south Spain. Field trials were carried out in five olive zones: two with cereal cover and three without cover and ploughed. In all zones 4 plots of 5 trees per plot were sampled. Each tree was sampled by beating method and by pitfall traps. The study was carried out during two years, 1999 and 2000, from April to October.

The total captures were greater in zones with cereal cover and the results showed that there was a signification tendency in Kruskal-Wallis test for total number of spiders between covered and ploughed olives zones. Nevertheless, only in 2000 these differences were significant. The analysis of the samples per plots showed no significant differences for plot 1, significant differences at plot 2 for the family Linyphiidae, with more captures in zones with cover, and it was the same for *Loxocelles rufescens* (Sicariidae) at plot 4. There was a signification tendency for *Thyene imperialis* (Salticidae) at plot 3.

The spider taxonomic composition was very similar, including 16 families and 63 species represented at the three ploughed zones and 17 families and 61 species represented at the two cereal covered olives zones.

These results indicated the important role of cereal covers in the abundance and diversity of spiders in olives orchards. These cover crops play an important role as a shelter of spiders and for their alternative preys and this management makes possible a faster potential answer opposite to pests increase.

## **Coccinellidae communities: diversity and dynamics in organic and integrated olive groves from Trás-os-Montes (northeast of Portugal)**

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Coccinellidae are well known predators in agroecosystems. In olive groves they may exert control against scales, such as the black-scale, *Saissetia oleae* (Olivier) and other minor pests. The aims of this work were *i*) to study the diversity of Coccinellidae species in two olive groves with different plant protection systems (integrated plant protection – Paradela grove, and organic growing guidelines – Valbom-dos-Figos grove); *ii*) to analyse the dynamics of these predators, and *iii*) to compare the differences between groves. The experimental work was carried out from April 2002 to November 2003. Weekly, in each grove, five plots of ten olive trees per plot were randomly selected and one branch was sampled per tree using the beating technique. The captured Coccinellidae were identified to species level. Experimental results showed the existence of differences between olive groves and years. A total of 17 species belonging to nine genera were identified. In Paradela, *Rhyzobius chrysomeloides* (Herbst.) was the most abundant species representing 40%, followed by *Scymnus (Pullus) mediterraneus* Khnz., with 17%, *Scymnus (Pullus) subvillosus* Gze. and *Stethorus punctillum* (Ws.), both with 10% of total captured individuals. In Valbom-dos-Figos, the community of Coccinellidae was more diversified and *Scymnus (Scymnus) interruptus* Gze. was the dominant species with 56% of total captures, followed by *Rhyzobius chrysomeloides* (Herbst.), with 19% and *Chilocorus bipustulatus* L., with 10%.

## Coccinellids associated with olive groves in north-eastern Portugal

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In order to point out quantitatively and qualitatively the main species of Coccinellidae present in olive groves in north-eastern Portugal, six groves were sampled from August to October, in 2002, and three of these groves were sampled again, from March to July, in 2003. Samples were collected on a weekly or fortnightly basis, by beating two branches per tree, from each of 25 trees, randomly selected per grove and date. A total of 710 individuals belonging to 12 species were captured: *Chilocorus bipustulatus* L., *Exochomus nigromaculatus* (Gze.), *Exochomus quadripustulatus* L., *Scymnus* (*Sc.*) *interruptus* Gze., *Sc.(Pullus) subvillosus* (Gze.), *Hyperaspis reppensis* Herb., *Oenopia lyncea* (Oliv.), *O. conglobata* (L.), *Coccinella septempunctata* (L.), *Sospita oblongoguttata* (L.), *Rhyzobius chrysomeloides* Herb. and *R. lophantae* (Blaisdell). *Sc.(Pullus) subvillosus* predominated (50,6%), followed by *R. chrysomeloides* (23,9%), *Sc. interruptus* (13,4%), *E. quadripustulatus* (6,8%) and *C. bipustulatus* (1,8%). The other species were scarcely represented (less than 1%). Captures were obtained over the whole period of the trial, although in greatest numbers during August and September (89,7%), in 2002, and from the middle of March to the middle of April and from the end of June to the end of July (88,9%), in 2003. *Sc.(Pullus) subvillosus* was present mainly (94,7%) from the beginning of August to the end of October and during July, while *S. interruptus* occurred in greatest numbers (91,6%) from the beginning of August to the end of September and during July. *R. chrysomeloides* predominated (83,4%), from the beginning of August to the end of October and from the middle of March to the middle of April. *E. quadripustulatus* occurred mainly (97,9%) from the beginning of March to the end of July, while *C. bipustulatus* was captured principally (92,3%), from the beginning of August to the middle of October.

## Current problems related to olive diseases in the Mediterranean basin

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Verticillium wilt constitutes the main olive disease problem in the Mediterranean basin with severe symptoms usually in irrigated groves. The situation has been made more complex by the appearance of a defoliating strain initially in the USA and currently in the Mediterranean region with emphasis in Spain. Recent screening of olive germplasm for selecting resistant cultivars or rootstocks provided promising data. Various cultural measures, soil solarization or chamber solarization have been suggested. Studies on chemicals show that currently available fungicides are unable to control the disease regardless of references that post fruit-setting foliar treatments of phosetyl-Al may be beneficial. As for olive scab disease, chemical control includes copper fungicide during the main infection seasons of spring and autumn. Strobilurin-based fungicides, less effective as protective are more efficient as curative compared to organocupric fungicides. As for *Mycocentrospora cladosporioides* it has been widely spread among several Mediterranean countries. The fungus frequently appears on the lower surface of the older leaves, while green or mature olives are also occasionally attacked. Preliminary trials with different copper oxychlorides in Italy indicated that four treatments (February, April, end of August and late September) in cv Leccino are required to effectively reduce severity of the disease.

We believed that *Clitocybe olearia* and to a lesser extent *Armillaria mellea* were the main root rot and wood decay agents but recently *Phomitiporia punctata* (*P. mediterranea*) is spreading in old olive orchards causing symptoms similar to esca of grapevines.

As for olive knot the disease is widespread all over the Mediterranean basin with severity directly related to the susceptibility of the varieties, to the degree of wounding from frost, hailstorm and harvesting injuries accompanied by rainy or wet weather.

Concerning phytoplasmas several authors in Italy have characterized phytoplasmas in olive trees showing symptoms of yellowing, shortening of internodes, witches' broom, bud abortion, little leaf, hypertrophied inflorescences, decline and fasciation. DNAs extracted from leaf veins were amplified in PCR reactions using universal or group-specific primers constructed on 16S rRNA phytoplasma sequences and restricted with five different enzymes. It appears that phytoplasmas are ubiquitous in the areas surveyed, but a clear correlation between a given syndrome and the presence of one or more phytoplasmas did not emerge. As for olive viral diseases olive is hosting up to 13 different viruses while other viruses, which are either non mechanically transmissible or occur in low concentration in plant tissues, may be also present. This is supported by the widespread occurrence of double-stranded RNAs (dsRNAs) in plants negative to biological tests. Molecular hybridization tests on dsRNA-positive samples collected in Italy (Apulia), revealed the presence of the three nepoviruses (Arabis mosaic virus (ArMV), Cherry leaf roll virus (CLRV) and Strawberry latent ring spot virus (SLRSV), plus Olive leaf yellowing associated virus (OLYaV) and Olive latent virus-1 (OLV-1). The most common virus in southern Italy is OLYaV, the main virus in central Italy is SLRSV whereas CLRV was detected in five samples from Latium, Umbria and Sicily.

Problems related to the dispersal of pathogens by exporting olive plant material in southern hemisphere countries will be also discussed.

## Olive viruses and strategies for producing virus-free plants

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Surveys carried out in a number of Mediterranean olive-growing countries have disclosed a high incidence of viral infections, mostly in symptomless trees (Felix *et al.*, 2002; Saponari *et al.*, 2002; Faggioli *et al.*, 2005; Fadel *et al.*, 2005). Although the impact of these infections on the crop is largely unknown, they affect marketing of propagating material (rooted plants, budsticks, seedlings, seeds), because, according to the *Conformitas Agraria Communitatis* (CAC) enforced in the European Union, nursery productions must be free from a number of detrimental “pests”, including viruses. It means that only virus-tested or virus-free mother plants can be used by nurserymen for propagation. Implementation of preventive measures in the framework of certification schemes, such as sanitary selection and sanitation, represents the only strategy currently available to restrain spreading of olive viruses. In Italy, sanitary improvement programmes are underway for the production virus-tested and virus-free mother plants. Selected plants fitting the requirements of a legislative decree issued in June 1993 by the Ministry of Agriculture represent “primary sources” (nuclear stocks) which, following registration by a Technical Committee of the Ministry of Agriculture, enter the certification system. Sanitary selection, development of diagnostic tools and sanitation treatments are the main objectives of our studies. As to laboratory testing our aim was to set up a simple and sensitive protocol for the simultaneous detection of olive-infecting viruses from field plants and *in vitro*-grown explants. Multiplex hybridisation of crude sap proved useful for the detection of *Cherry leaf roll virus* (CLRV), *Strawberry latent ringspot virus* (SLRV), *Arabidopsis mosaic virus* (ArMV), *Olive latent ringspot virus* (OLRV) and *Olive latent virus 1* (OLV-1). As to sanitation, trials are underway to determine the behaviour of different cultivars towards *in vitro* culture and different temperatures, i.e. (i) exposure of infected *in vivo* plants to low temperature (5-6 °C) followed by heat therapy (35-38 °C for 2-3 months), excision of shoot tips and their transfer to a growth medium; (ii) *in vitro* heat therapy (35-38 °C for 15-20-25 days) followed by meristem tip culture; (iii) meristem tip culture directly from *in vitro*-grown plantlets. The combined use of these techniques can efficiently eliminate virus infections, especially those by Olive leaf yellowing-associated virus (OLYaV), one of the most widespread viruses found so far.

## Fungal agents responsible for olive dieback in Iran

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Olive dieback is prevalent in most olive orchards of Iran. Symptoms produced is different from those which has been reported sofar from the country. In this disorder, both young and old grove twigs are affected and there is a distinguished border between healthy and affected areas. In all, 416 samples collected from Golestan province showing disease symptoms were collected and examined. Three species of fungus belonging to *Sphaeropsis*, *Fusicoccum*, and *Phoma* were isolated from the infected tissue and their pathogenicity were approved by stem wounding method. The morphometric characteristics of first isolate is similar to *Sphaeropsis malorum* which was isolated from grapevines. However, the measured characteristics for identification of the other two genus up to species level of the fungus is not enough and needs futher studies. *S. malorum* was the most frequent isolate which produced dark colony on PDA, with brown mycelium. Pycnidia with one cavity, round or flask shaped to elongate, with neck and ostiole, light brown which turne darker, 140-200 x 150-250 µm. Picnidial wall consists of 3-4 layers of deeply pigmented angular cells, with thick-walled cells on the outside and thin-walled, rounded cells on the inside. Conidiogenous cells holoblastic, hyaline, elongated and smooth. Conidia clavate, usually one end thiner than the other, unicellular, hyaline, 4-7 x 15-24 µm, which produced 1-2 septa at germination.

## Comparison between real-time PCR and semi-selective medium in monitoring *Verticillium dahliae* microsclerotia in the olive rhizosphere and suppression of the pathogen by compost

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**Abstract:** Trials were conducted on young olive plants grown in soil artificially contaminated by different inoculum density (0, 5, 30, 60 and 100 microsclerotia/g of soil) of *Verticillium dahliae*. In blind trial experiments, the pathogen was monitored in the contaminated soil up to 100 days by both semi-selective medium and real-time nested Scorpion PCR. Linear regression analysis revealed significantly high correlations ( $R^2 > 0.8$ ;  $P < 0.01$ ) between the two diagnostic methods. The molecular technique was very reliable and accurate and drastically reduced the time of the diagnosis. In the rhizosphere of plants contaminated with 30 microsclerotia/g of soil, the incorporation of 15% (w/w) of a compost obtained from cured olive oil by-products significantly reduced the inoculum density of *V. dahliae*. The suppressive activity was improved adding a *Trichoderma viride* based biofungicide to the compost. The real-time Scorpion PCR as well as composts from olive by-products seem interesting tools for potential application in eco-compatible agriculture systems.

## **Foliar application of phosetyl-al for controlling olive verticilliosis: Realistic goal or false hope?**

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The results of field treatments to assess the efficacy of foliar application of Phosetyl-Al for controlling verticillium wilt of olive are reported. Field experiments were established on three different olive groves, naturally infected by *Verticillium dahliae* (Kleb.), in the three years 2001–03. In the first two fields, located at Torre S. Susanna and Taranto (Apulia, Southern Italy) there were 5-year old plants, cv Picholine, grown under an intensive farming system; in the third field, located at Ostuni (Apulia, Southern Italy), there were mature plants (20-year old) of the cv Leccino. On the whole, treatments included two (February and August), three (February, June, and October) and four (February, June, August, and October) applications of Phosetyl-Al (3000 ppm) which were repeated for each year of the trial by using a normal motorized sprayer. In each field there were five replications arranged in a randomized complete block design; in the field located at Torre S. Susanna and Taranto each plot consisted of 80 plants, whereas in the third field (Ostuni) there were six plants per plot. Untreated plants were used as controls. Plants were chosen among those showing wilting symptoms on the 50% of the canopy. Infection was ascertained by traditional isolation procedure and by molecular methods, using a nested Scorpion-PCR protocol. Visual scoring of verticillium wilt severity was done by means of an empirical scale at four months intervals for each plot. To summarize the progress of disease severity, the area under the disease progress curve (AUDPC) was calculated and used to compare the effect of different treatments. Analysis of variance was computed over four years to determine the main effect of each treatment, as well as interactions among them for AUDPC. At two of the three locations, Torre S. Susanna and Taranto, where young plants were grown, four Phosetyl-Al sprays decreased AUDPC by 16.7%, and 22.8%, respectively, as compared with untreated control plants. At the third location (Ostuni), on mature plants, disease severity was significantly more restricted as compared to the untreated control. The application of fungicide (4 sprays) reduced the AUDPC by 44.5%. However, the combined effect treatments/reading date calculated over the four years trial, resulted significant, indicating a general lowering of disease severity also in the untreated control. Therefore, it seems that Phosetyl-Al sprays can speed up the symptoms remission, a natural phenomenon already described in literature. In addition, no differences in the presence of the pathogen in the xylem, as determined by nested Scorpion-PCR and traditional techniques, were observed. Based on our data, Phosetyl-Al foliar sprays resulted scarcely effective on young plants and insufficient to meet a good control of verticilliosis on mature olive plants.

## Host-derived resistance for biological control of verticillium wilt of olive

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Fifty seven wild olive accessions collected from the Mediterranean basin were screened under greenhouse conditions for resistance to Verticillium wilt caused by *Verticillium dahliae* Kleb. Plants were inoculated at thirteen months after their emergence by dipping the root system in a conidial suspension of the fungus ( $4 \times 10^6$  conidia/ml) after shaking off the soil from roots and washing them under running water. One defoliating and one non-defoliating *V. dahliae* isolates, both obtained from diseased plants in southern Italy, were used. Plants of the highly susceptible cv Cima di Mola, frequently used as rootstock in Apulia, were included as control in this experiment. Disease reaction of tested accessions was evaluated on the basis of external symptoms, vascular browning and by calculating the area under disease progress curve (AUDPC). On the basis of AUDPC values and severity of external symptoms, the tested accessions were grouped into four phenotypic groups: highly resistant, moderately resistant, susceptible and highly susceptible. Most accessions showed different levels of resistance/susceptibility to both *V. dahliae* pathotypes. A minor part was resistant/susceptible to one of the two pathotypes only. Three accessions showed high type resistance to both *V. dahliae* pathotypes. Forty resistant plants were selected from accessions that had shown the highest levels of resistance. From each of these plants, clones were obtained by *in vitro* micro-propagation. The M-1 clones were inoculated with the defoliating pathotype using the same procedures adopted to test the original accessions. Ten M-1 clones, showed the high type resistance characteristics of their original mother plants, while the other ones showed different levels of disease severity. This research provided the identification of new olive rootstocks highly resistant to Verticillium wilt which could be included in breeding programmes for resistance of olive to *V. dahliae*.

## Characterization of *Colletotrichum* species causing olive anthracnose in Italy

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Over 300 *Colletotrichum* isolates from a wide range of hosts and geographical origins, including 220 isolates from drupes and leaves of olive with symptoms of anthracnose collected in various regions of southern and central Italy, were examined for morphological, cultural and physiological characters as well as for electrophoretic banding patterns of eight mycelial isozymes and RAPD profiles obtained with 16 decamer primers. Most of the isolates had been previously identified as either *C. gloeosporioides* (Penz.) Penz. & Sacc. or *C. acutatum* Simmonds. Isolates of other species of *Colletotrichum*, such as *C. musae* (Berk. & M. A. Curtis) von Arx, *C. coccodes* (Wallr.) Hughes and *C. circinans* (Berk.) Vogl., were included in this study as out-group isolates. Cluster analysis of RAPD and isozyme profiles was performed with the UPGMA algorithm and was supported by bootstrap analysis. RAPD and electrophoretic profiles identified the same discrete groups. All the isolates from strawberry produced fusiform conidia, grew slowly on agar-media, showed an optimum growth temperature of about 24 °C, were benomyl-resistant (MIC  $\geq 102 \mu\text{g ml}^{-1}$ ) and formed a distinct molecular group (*C. acutatum sensu stricto*). This group comprised also olive isolates from Portugal and Spain. A group, identified as *C. gloeosporioides sensu stricto*, comprised isolates from diverse hosts, including olive isolates from various Italian regions. Most olive isolates from Sicily were in this group. Other olive isolates from various regions of southern and central Italy were in three separate groups, genetically distinct from *C. gloeosporioides sensu stricto*, but conformed to a broad concept of this species (i. e. cylindrical conidia, fast growth, optimum growth temperature  $\geq 27^\circ\text{C}$ , benomyl MIC  $\leq 1 \mu\text{g ml}^{-1}$ ). Olive isolates from regions of southern Italy where olive anthracnose is endemic (i.e. Calabria and Apulia) clustered together and probably represent a species genetically and biologically distinct from both *C. acutatum* and *C. gloeosporioides*. Surprisingly, this molecular group included also rhododendron isolates from Italy and northern Europe as well as sweet cherry isolates from Norway, previously identified as *C. acutatum* by other Authors.

## **A symbiotic relation found between *Pseudomonas savastanoi* and *Pantoea agglomerans* in the knots formed on olive**

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We report a case of symbiosis that can be interpreted in different ways (mutualism, commensalism, or inquilinism), of *Pantoea agglomerans* (ex *Erwinia herbicola*) with *Pseudomonas savastanoi* in the knots (or tubercles) formed by the latter on olive. *P. agglomerans* is known as one of the most common components of the saprophytic prokaryote microflora on both the phylloplane and the rhizoplane of many plant species. Nevertheless, some sets of strains of this bacterium were also described as primary pathogens on some agricultural crops, e.g. the pv. *gypsophilae* on *Gypsophila paniculata*, the pv. *milletiae* on *Wisteria sinensis*, and the pv. *betae* on *Beta vulgaris*, all of which cause galls on their respective hosts, while for other strains of this bacterium it has been supposed that they operate as secondary pathogens in some pathogenic processes, either because they enhance the predisposition of a host to infection, or because they change the virulence of certain plant-pathogenic bacteria.

In the present case it was ascertained first of all that *P. agglomerans* occurs in intact tubercles of olive knot sometimes in even greater numbers than the primary pathogen itself, and that it occurs in a high proportion of tubercles. When some isolates of this bacterium were inoculated on healthy olive, they multiplied in olive tissues and remained vital for a long time but did not lead to the formation of tubercles. By contrast, when *P. agglomerans* was co-inoculated with *P. savastanoi* in ratios of 1:1 or 1:100, its multiplication was abundant, and equal or indeed even superior to that of *P. savastanoi*. Moreover, the tubercles that formed at these co-inoculation sites were larger than those formed by *P. savastanoi* when inoculated alone. It thus appears that the presence of *P. agglomerans* at plant sites where tubercles of olive knot are forming and developing hinders, at least in the initial phases of bacterial reproduction, the multiplication of *P. savastanoi* (possibly as a result of competition for space or for nutrients) but at the same time makes the tubercles larger, so that more space and more nutrients are available for both bacteria. This last could be explained by the fact, ascertained in our laboratory, that the olive isolates of *P. agglomerans* produce indolacetic acid in culture.

## **Epidemiological study of olive scab in Calabria**

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**Abstract:** Olive scab caused by *Spilocaea oleagina* (Cast.) Hughes, is a widespread disease in all olive-growing areas of the Mediterranean region. A study was carried out in the years 2000-2001 and 2001-2002 in Calabria (southern Italy) with the aim of clarifying some epidemiological aspects of this disease. Disease incidence and severity were assessed in different olive-growing areas and on different cultivars. Early infections were detected in laboratory according to the method proposed by Loprieno and Tenerini (1959). A different degree of susceptibility to olive scab among cultivars was found. Both intensity and period of maximum incidence of the disease varied in each year and among locations indicating a strong effect of climatic and environmental conditions. In both years results showed that disease incidence increases from late autumn to a maximum in late winter and early spring. Independently on the period of infection, intensive defoliation occurs during spring, with warm weather condition. Results suggest that the treatments to prevent olive scab should be scheduled according to the periods of infection that may vary on the basis of the annual climatic course, with particular regard to rainfall. In southern Italy, with dry autumns and mild winters, seem useful to move the usual autumnal treatments on winter.

## **Non-conventional chemical control of olive anthracnose**

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**Abstract:** Chemical control of olive anthracnose in the Gioia Tauro plain in Calabria (southern Italy) traditionally requires a high numbers of sprays in autumn. In 2002 and 2003, field trials were conducted on the cvs Cassanese and Ottobratica respectively, with the aim of comparing the traditional copper fungicides with alternative compounds. In the first year, we tested azoxystrobin, heliocuivre (a terpenic formulate of copper hydroxide), sodium bicarbonate and the electrolytic chlorine oxidant amuchina. Sodium bicarbonate and amuchina were also tested in addition with pinolene, a water-emulsifiable organic concentrate obtained from pine resin, to increase both adherence and persistence. In the second year we tested azoxystrobin, trifloxystrobin, heliocuivre and a copper peptidate formulation (Peptiram 5). In both trials a tetra-cupric copper oxychloride formulate was used as reference product. Azoxystrobin proved to be the most effective product in both years. All the compounds tested, with the exception of trifloxystrobin, reduced significantly the incidence of fruit rot. The addition of pinolene enhanced the effectiveness of copper formulates and sodium bicarbonate. The low dosage copper formulates were comparable to copper oxychloride in reducing the incidence of olive anthracnose.

## Control olive powdery mildew (*Leveillula taurica*) with the use of soft fungicides

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Olive powdery mildew caused by the fungus *Leveillula taurica* (Lev.) Arnaud. could cause, under favourable conditions, serious damages in young vegetation. Infection is more severe at the leaves of new vegetation of rejuvenated olive trees, young nursery trees and olive leaf-cuttings. This work studies the possibility to control the pathogen with the use of soft fungicides. Wetting sulphur in the dose of 400 g/hl of the commercial product Thiovit 80 WP and sodium bicarbonate in the dose of 300 g/hl with the wetting agent Agral 90 in the dose of 25 ml/hl were used. These products could be also used in organic oliveculture after authorisation from the organization for control and certification of organic products. The fungicide pyrifenoxy in the dose of 20 ml/hl of the commercial product Dorado 20 EC was used as reference product. The trial took place at rejuvenated olive trees of Koroneiki cultivar. Estimation of the effectiveness was based on the measurement of infected leaves as well as on the percentage of leaf fall. Taking as criterion leaf infection, sulphur as well as sodium bicarbonate controlled, under the conditions of the experiment, the pathogen with an effectiveness ranged from 99.4 to 99.7% that did not differ statistically significant from reference product (99,7%) while infection at the control plots increased at 89,4-91,5%. Regarding the criterion of leaf fall, effectiveness ranged at 97.1% for sulphur and from 98 to 98.1% for sodium bicarbonate.

## *Phytophthora* species associated with root rot of olive in Sicily

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*Phytophthora* root and crown rot of olive trees has been recognized as an emerging phytopathological problem in many olive-growing areas in the Mediterranean region, probably as a consequence of the increasing use of irrigation. A survey aimed at determining both the diffusion of root and crown rot in commercial orchards and the *Phytophthora* species associated to these diseases is being carried on in Sicily. The species of *Phytophthora* were identified by using traditional morphological as well as biochemical (polyacrylamide gel electrophoresis of total mycelial proteins and isozymes) and molecular (ITS sequences of rDNA) criteria. The following species of *Phytophthora* were recovered from both young and mature (10- to 12-year-old) olive trees with symptoms of chlorosis, defoliation and wilting: *P. inundata*, *P. megasperma*, *P. nicotianae*, and *P. palmivora*. The last two species were found associated with root rot of fine roots on both nursery plants and mature trees originated from rooted cuttings. *P. palmivora* was more common than *P. nicotianae*. There are other recent reports of this tropical species on olive in southern Italy and Spain. *P. megasperma*, which has been previously reported in other olive-growing countries including Greece and Spain, has been recovered from roots and basal stem cankers of young plants. All Sicilian isolates of this species were referred to the BHR (Broad Host Range) group on the basis of DNA sequencing. *P. inundata*, a species formally described only recently, has been found associated with root rot on trees subjected to flooding. This is the first report of *P. inundata* on olive in Italy, where this species has already been recovered from roots of ornamental palms and peach.

## **Susceptibility of olive genotypes to *Pseudomonas savastanoi* (Smith)**

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**Abstract:** Previous studies have found that different olive genotypes have different susceptibility to *P. savastanoi*. In the present report, we have examined a large number of other olive varieties for their susceptibility to *Pseudomonas*. The study was performed using a collection of varieties from Mirto in Cosenza (Italy), where all of the genotypes tested were subjected to the same environmental and agronomic conditions. The stage of infection was estimated on the basis of the quantity of tubercles present on branches. The results showed a different behavior among the various cultivars and displayed varying severities of disease. Of the 262 cultivars tested, 15 Italian cultivars were highly damaged; of the 43 non- Italian cultivars, 9 showed extensive damage. Eighty- six Italian varieties showed no signs of infection, while the remaining genotypes were partially damaged.

## **Detection of *Verticillium dahliae* in irrigation water**

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The surface of irrigation olive orchards have extended considerably in the last years. The spread and increase of Verticillium wilt (*Verticillium dahliae* Kleb.) in olive crop is associated, among other causes, to the transformation of great surfaces of unirrigated land into irrigated one. The relationship between watering and the increase of Verticillium wilt in soil is well documented; nevertheless the dispersion of the pathogen by water is not well known.

Nowadays our studies about the incidence of Verticillium wilt in olive crop in southern Spain point to water as an effective source of dissemination of the disease. Therefore the objective of this work is to detect and quantify the propagules of the pathogen in irrigation water in olive grove.

For this purpose water samples were collected from rivers and drippers to be assayed for *V. dahliae* content using a nested PCR assay. This PCR assay uses sets of primer pairs that produce specific markers for the cotton-defoliating (D) and nondefoliating (ND) pathotypes of the pathogen.

The results have shown that nested PCR assay is an accurate procedure for detecting the fungus in irrigation water.

## Olive fruit fly biology and cultural control practices in California

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**Abstract:** Olive fruit fly, *Bactrocera oleae* (Gmelin), first found in California, USA in 1998 was investigated in laboratory and field studies. Mortality of 1-5, 6-8, 9-11, and 12-14 d-old immature insects in olives was 19-75, 13-58, 5-27, and 0-7% when exposed to 15°C and 65% relative humidity (RH), and was 14-31, 8-32, 16-38, 4-22% when exposed to 25°C and 35% RH, respectively. Mortality decreased with an increase in age except for 9-11 d-old larvae exposed to 25°C and 35% RH and 6-8 d-old larvae exposed to 15°C and 65% RH. Mortality was 100% in all immature stages in fruit exposed to 5°C and 85% RH and 35°C and 25% RH. The pre-ovipositional period for adult females was  $13.0 \pm 4.0$  d; peak oviposition occurred at  $19.7 \pm 1.8$  d; and, egg laying ended after  $63.7 \pm 3.8$  d (mean  $\pm$  SEM) at 23°C. Olive fruit fly completed development from the egg to the adult stage from fruit with a mean volume of  $0.17 \pm 0.01$  cm<sup>3</sup> (mean  $\pm$  SEM). The number of adults trapped in baited yellow panel traps with male attractant was higher in olive trees with irrigation water at the base ( $39.9 \pm 8.7$  adults per trap per week) than in olive trees without irrigation water ( $27.7 \pm 6.4$  adults per trap per week) (mean  $\pm$  SEM) in the absence of fruit in the canopy. The highest numbers of adults were collected between 2 and 9 October. The daily mean temperature ( $\approx 15^\circ\text{C}$ ) and relative humidity ( $\approx 74\%$ ) was similar in trees with and without water at the base. Percentage mortality of olive fruit fly 3<sup>rd</sup> instars was greater than young (0-4 d-old) and old (9-12 d-old) pupae after immersion in water and sand for 1-5 d, and young pupae were in general more susceptible than old pupae.

## **Studies towards an enhanced food attractant for fruit flies, especially for the olive fruit fly *Bactrocera oleae* (Gmelin)**

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Hydrolyzed vegetable proteins are the most common lures used in large scale programs for the management of various fruit flies, especially for the olive fruit fly *Bactrocera oleae* (Gmelin) and Mediterranean fruit fly *Ceratitidis capitata* (Weidemann). Most of the commercial lures are produced by chemical or enzymatic hydrolysis of corn or soy gluten, (NuLure, Buminal, Dacus Bait etc) but also various other vegetables proteins are used. Among the volatiles present in proteinaceous lures ammonia appears to play an important role in attracting the fruit flies. It has been reported that raising the pH of the standard lure preparation, the attractiveness of the product increases significantly. The increase of the attractiveness of the lures at higher pH, is not solely attributed to the corresponding increase in the ammonia release. Some other volatiles released on basification are also involved in the increase of the attractiveness of the lures. In the search for more effective lures several papers reporting studies for the characterization of the volatile components of the proteinaceous lures have been published. The aim of all these studies was the identification of the volatiles that might be responsible for the attractiveness of the hydrolyzed proteins and potentially could be added to the commercial products to boost their efficiency or to be the base for the development of new more efficient lures.

In the present work, a) very mild techniques for the isolation of the volatiles are used in order to avoid the formation of artefacts and the decomposition of the biologically active compounds and b) the evaluation of the attractiveness of the identified compounds is made in combination with solid ammonium bicarbonate as a source of ammonia. The commercial lures analysed during the present study are a) Dacus bait and Alma Dacus from the Greek market, b) Buminal from Italian and Spanish market and c) Mazoferm (corn steep liquor) in liquid and solid form mainly used in USA and South America for the attraction of other fruit flies. Several new compounds have been identified for the first time in the above products. The main feature of all the analyses was the presence in high percentage of various pyrazines and sulphur compounds.

New solid dispensers were then prepared using compressed solid ammonium bicarbonate in which the new compounds were incorporated by a special technique. The effectiveness of these dispensers to attract olive fruit flies (*Bactrocera oleae*) was evaluated in an olive orchard 40 Km in the North of Athens using a) Yellow sticky panels (20 X 30 cm) loaded with the above dispensers and b) Dry yellow bottom MacPhail traps, loaded with one DDVP dispenser and one new dispenser. As control the same type of traps loaded with only ammonium bicarbonate dispenser, were used. Results on the use of the new dispensers as attractants for the olive fruit fly (*Bactrocera oleae*) will be presented in details.

## **New technology for auto-dissemination of pheromones and pesticides: potential for control of olive fly and olive moth**

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**Abstract:** ExoSex technology utilises inert particles of materials that have the ability to adhere to the arthropod cuticle. The ExoSex Autoconfusion™ system has been developed as an insect control method that differs from all other mating disruption systems in contaminating the target pest with electrostatically chargeable powder formulated with pheromone. This technique can be used for control of most moth pests. The ExoLure™ system utilises adhesive particles as carriers for synthetic or biological pesticides and can be used as a lure & kill technique for insect pest control. Lure & kill systems using slow-acting insecticides or mycopathogens have proved efficient in control of tephritid fruit flies including *Ceratitis capitata* and *Bactrocera* species.

## **Effectiveness of different copper products against the olive fly in organic olive groves**

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**Abstract:** Different copper products were tested against the olive fly in organic olive groves during the 2004 and 2005 growing season. The active infestation level was reduced in all treated experimental plots with comparable effectiveness for all products. Furthermore, the results indicate a higher level of young larvae mortality as an effect of the copper treatment. This supports the hypothesis that copper acts as a symbioticide as well deterring oviposition.

## **Establishment of TEAM (Tephritidae of Europe, Africa and Middle East), a new international working group on fruit flies of economic importance**

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The Family Tephritidae includes 194 taxa: among them, numerous fruit flies species of tremendous economic importance can be found. Olive fruit fly (*Bactrocera oleae*) is considered the most damaging pest in olives. Mediterranean fruit fly (*Ceratitis capitata*) is oligophagous damaging the fruits from more than 300 plant species and varieties. In addition, several other species mainly restricted to the genera *Ceratitis* and *Bactrocera* are considered target pests in the majority of tropical and subtropical regions worldwide. Most of those species are very well studied, and some of them (like *C. capitata* and *B. oleae*), due to their relevant economic importance, allow a wide range of multidisciplinary research approaches.

For this reason, during the Meeting of the Working Group on Fruit Flies of the Western Hemisphere, held in Florida in May 2004, a group of scientists from 10 countries (8 Mediterranean, Kenya and Reunion Island for France) developed the idea of establishing the Fruit Fly Scientific Group. The first meeting of the group TEAM (Tephritidae of Europe, Africa and the Middle East) was held on 11th of May 2005 in the facilities of the IAEA in Vienna, Austria.

The main goals of TEAM are:

- (a) to set up an independent scientific group dealing with fruit flies research and management in Europe, Africa and Middle East;
- (b) to provide a platform for interaction promoting collaboration and communication among scientists, growers and companies from different Countries with common interests on fruit flies;
- (c) to increase funding possibilities through cooperative research inputs;
- (d) facilitate the divulgation of TEAM activities setting up a web site and periodical newsletters; and
- (e) organize scientific meetings every 2-3 years.

## **Application of forecasting models of olive fly (*Bactrocera oleae* Gmel.) (Diptera, Tephritidae) infestation in Montenegro**

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**Abstract:** In the paper has been investigated the possibility of application of two forecasting models for olive fly infestation. The first model was based on one hand on the number of caught females by means of yellow sticky traps and average weekly temperature and on the other hand it was based on infestation levels. The second model has considered male captured on pheromone traps. Obtained results indicate that both methods are applicable.

## **Application of internet and mobile technologies in pest management: a case study of *Bactrocera oleae* control in Tuscany**

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Sustainable agriculture integrates three main goals of environmental health, economic profitability, and socio-economic equity. In particular, consulting companies and extension services at Regional level play an important role in pest prevention, implementing new research findings into ordinary agricultural practices. This work can greatly be facilitated by software systems that can process large amounts of data and perform numerous combinations of a variety of factors, which affect agriculture management planning. Decision Support Systems (DSS) is a special type of such systems and can support sustainable agriculture, particularly pest control, when farmers are assisted by specialized consults. The application of technical assistance services, based on Short Message Service (SMS) and aimed to assist farmers in pest management, may help in reducing chemical treatments against olive fruit fly (*Bactrocera oleae* Gmelin). Different communication strategies have been tested in different Italian regions. From 2003 to present, a partnership among Aedit s.r.l., Scuola Superiore Sant'Anna and ARSIA (the Regional Agency for Development and Innovation in Agriculture and Forestry of Tuscany), has tested an SMS service on a large number of farmers. Dedicated software was developed for assisting technical advisors in editing personalized messages, with the final objective to guide pest management strategies at farm level. Here we discuss how integrate spatial information, biological and meteorological data from monitoring networks, and DSS with a human supervised SMS generation. Continued development will focus on improving olive responses to biotic and abiotic stresses and testing the model's functionality as a decision support tool for strategic and tactical farm management.

## **Integrated protection system against *Bactrocera oleae* (Gmelin) in organic production**

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**Abstract:** Organic olive farming has gained a large success in Italy and immense surface areas have converted traditional production into organic techniques. In such practices however, the regions of southern Italy must cope with numerous olive fruit fly attacks without the use of chemical pesticides. In this study we estimated the efficacy of an organic control system consisting in the use of a mass-trapping supplement and rotenone treatment in areas highly infested by dipterous. The system was compared to traditional methods of control that utilize dimethoate and to untreated groves. Experiments were conducted in the Ionic region of Cosenza in 2004 in a field with several olive cultivars. The integrated organic system showed a good efficacy in control of olive fruit flies. The efficacy was more apparent in untreated groves compared to those treated with dimethoate in terms of both active and total infestation.

## **Differences in insects within the olive orchard agroecosystem under integrated management regime in south Spain**

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Interactions between insects (Class Insecta) and plants involve three quarter of the global biodiversity and they are crucial elements for the agroecology. Andalusian Legislation has established practices for the integrated management regime in the olive orchard. The obligatory practices are carried out by farmers; nevertheless there are suggested practices, which can be applied voluntarily to help reducing the impact on the agroecosystem. These significant differences among irrigation treatments, ploughed intensity, insecticide use and presence of a vegetal cover could be responsible for substantial variation in the structure of the insect community between the sampled olive orchards.

The principal aim of our study is to compare the presence and abundance of insects in the canopy in the olive orchards under integrated management regime. The sampling was conducted in May and July 2003 in six commercial olive orchards with different cultural methods under integrated management regime in south Spain. In each olive orchard, 20 trees were distributed aleatory on 4 blocks. Each tree was sampled in the canopy by beating branches.

Our results showed that the different management practices affect the relative abundance of the insect orders. In the canopy, Homoptera, Hymenoptera and Diptera were the most abundant, although showed significant differences in abundance among orchards during the two samples. The most important observation is the abundance of Homoptera, and principally the psyllid *Euphyllura olivina* (Costa), which was majority during the two sampling in the orchards with soil tillage, without vegetal cover and in some case insecticide use. However, other orchards under less intensive farming showed better balanced abundance of insects.

## **New biodegradable controlled-released pheromone dispenser for *Bactrocera oleae* (Gmelin)**

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A new type of eco-friendly, hand-applied pheromone (1,7-dioxaspiro[5.5]undecane) dispenser for monitoring and controlling *Bactrocera oleae* has been developed. Several types of dispensers, based on microporous and mesoporous materials and with different additives, in changing proportions, were designed and evaluated in order to obtain that possessing the optimal pheromone emission. Dispensers were subjected to a procedure of accelerated aging in a temperature and wind speed controlled chamber. Residual pheromone remaining in the dispensers was periodically evaluated by gas-liquid chromatography and release rates were determined. In addition, a comparative study between our dispensers and the commercial *B. oleae* Long Life Lure from Agrisense (Pontypridd, UK) was also carried out in laboratory.

## **Increased olive oil yield and quality in Montenegrin cv Žutica by *Bactrocera oleae* Gmel. (Diptera Tephritidae) control and improved harvest techniques**

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**Abstract:** The present inquiry represents the basis for wider research into the qualitative and quantitative characterization of the typical olive oil of Montenegro. In the considered biotope the 65% of plants is composed of cv Žutica. The key insect is *B. oleae*, which is, in some years, able to nullify quantitatively the entire production because of the olives dropping off the trees. However the entire production is usually harvested and the product is the clear oil, both because of the infestation and elevated temperature and the long storage periods of olive that cause a remarkable increase in degrees of acidity.

The work, carried out in 2004, consisted of studying the inolation on weekly samples of healthy olives harvested from the canopy and processed for olive oil extraction after 24-48 hours. This has allowed us to identify that the right moment for harvest is the third week of October. Finally the qualitative Analysis of the oil drawn from the plant are presented in comparison to the qualitative characteristics of the output usually obtained by Montenegrin olive-growers after different stock periods. The results obtained represent the first and basic stage for the realization of research projects aimed to improve the techniques of production and protection of oil yield.

## **Integrated olive pest management in Iran**

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Olive black scale and olive psyllid were key pests on olive groves, the olive fruit fly was first recorded in October 2004 in Iran. Chemical treatments still prevail for *S. oleae* and *E. olivina* are also applied. In the most regions native parasites and predators are capable of maintaining *S. oleae* and *E. olivina* populations at low levels if they are not destroyed by hazardous chemical treatments. Based on researches results in Iran and Mediterranean countries, we provided a time table including major treatments such as biological control and accessory treatments such as pruning, moderate use of nitrogen fertilizers, using moderate irrigation and cover spray at the end of winter with emphasis using emulsifiable oils.

## **Can spring-preventive adulticide treatments be assumed to improve *Bactrocera oleae* (Rossi) management?**

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**Abstract:** We used pheromone traps network for monitoring adult's behaviour from January to July until the beginning of the infestation. In this work our aims was: 1) to identify those areas where *B.oleae* infestation can be dangerous since early summer and define a regional map of infestation risk level during the early summer; 2) to put in evidence the relationship between spring adult's captures with captures occurred in the previous autumn (backward) and with captures occurred at the infestation beginning during the following July (forward).

On the base of our results we can hypothesize to carry out spring-preventive adulticide treatments in order to decrease the population density before the infestation starts.