Spatial decision support system for Medfly control in citrus

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A spatial decision support system (SDSS), designated MedCila was developed for controlling Medfly on citrus in Israel. The development involved four main phases: 1. acquisition of relevant expert and domain knowledge; 2. identification of the relevant criteria and modeling each criterion and the overall decision making procedure; 3. integration of the MedCila into a GIS environment; and 4. evaluation of MedCila performance. The criteria found to be most relevant for control decision making were: the number of flies and the presence of a ‘blue eye’ in the nearest trap, the host species susceptibility, the relative development of the Medfly based on accumulative day-degree model, the history of trapping, and the Medfly population in the nearby traps. Binary, linear, logarithmic and biological-based models were developed for the criteria identified. The overall decision making procedure of the MedCila was based on the Stanford Certainty Theory integrated with a rule-based decision tree. Initial evaluation of the MedCila performance was by retrospective comparison between the MedCila recommendations and the coordinator decisions. It was shown that the MedCila provides recommendations that are generally accepted by the coordinators; it reduces the number of unnecessary spray actions in the absence of a Medfly threat in space and in time; and it reduces the number of plots for which the coordinator needs to make a decision.

ORAL SUBMISSION

Key: 1827
Symposium: Landscape Ecology of Fruit Flies in Africa, Europe and the Middle East
Status of Medfly Infestation in Tunisia and Impact on Applying SIT in an Area Wide Basis

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In spite of sterile fly releases in an area wide basis in Beni Khaled orchards situated in the middle of the Citrus production at the Cap Bon peninsula, the medfly wild population was still high and there was no significant reduction compared to the witness area without sterile male releases. The encountered problems were insufficient number of released flies per hectare, never reaching the standard values requested by the project (1500 fly per hectare), but principally the non efficient suppression of the wild population. The aerial treatment carried out before the sterile male releases and the cultural control, were not enough to reduce the population to acceptable levels (0.05 FTD) for SIT as established in many control programs. The winter season is not strong enough; mean minimum temperatures don’t allow to completely suppress wild flies. Moreover, sampling shows continuous numbers of infested fruits by medfly larvae. The life cycle of medfly is only enlarged and the movement of adults is reduced. Medfly is overwintering, waiting for optimal conditions such as better temperatures and hosts availability.

As an alternative to improve the efficiency of the program, there should be efficient actions to reduce the wild population such as bait spays, bait stations; to prevent migrations and reinfestations from the neighbourhoods. Furthermore, to improving quantities and quality of the produced flies that should reach 12 million as a minimum average per week with 80% of fliers.

ORAL SUBMISSION
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Symposium: Landscape Ecology of Fruit Flies in Africa, Europe and the Middle East
Environmental and Management Determinants of Olive fly (*Bactrocera oleae*)
Spatio-Temporal Patterns

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The spatio-temporal patterns of the olive fly were followed during 2005 in a managed olive region in the area of Chalkidiki, Northern Greece. The trapping grid consisted of more than 700 traps. Throughout the season, traps were inspected at 5 days intervals. Trapping data was analyzed using Getis-Ord local spatial statistics, and results were related to elevation, climatic patterns and management activities. Clustering of trapped flies where significantly related both, to elevation and pest control management. Effect of elevation upon clustering depended on seasonal climatic pattern: during summer, hot spots were located in high elevations, while during fall, hot spots were detected in lower elevations. Hot spots were also affected by pesticide treatments: spraying disrupted clusters of olive fly. This data, together with results obtained in an Israeli regional management project, are used to discuss the application of the spatio-temporal concept in the management of the olive fly and other Tephritidae pests.

ORAL SUBMISSION
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Symposium: Landscape Ecology of Fruit Flies in Africa, Europe and the Middle East
Species-specific factors affecting fruit fly field populations: a review with emphasis on the role of host plants

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A number of fruit fly species-specific factors have been identified, which potentially affect fruit fly field population levels and as consequence, their impact on both natural vegetation and cultivated crops. In this work we collated, through literature search, information focused on such factors related with host plants for their relevance to natural vegetation fruit plants health and implication to orchards management based on informed decision making tools. Factors associated with aspects of host plant abundance, kairomones, host plant phenology in relation to fruit fly population dynamics, crop type such as cover, monoculture or diversified vegetation, and grouped per colonization pattern of fruit fly species were included. Comparisons are made with regards to fruit fly abundance trends as affected by the factors between polyphagous and oligophagous and between invasive or non-pest fruit fly on their hosts.

ORAL SUBMISSION
Key: 1808
Symposium: Landscape Ecology of Fruit Flies in Africa, Europe and the Middle East
The importance of spread surveys on the behaviour knowledge of medfly sterile males (*Ceratitis Capitata* Wiedemann) (Diptera: Tephritidae) released over Biscoitos and Angra urban area, in Terceira island, Azores

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The biotechnical control could be the more practical and ecological mean against plagues over the alternative of using chemical products. With this point of view the SIT control using sterilized males of *Ceratitis capitata* Wiedemann (Diptera: Tephritidae) produced on the Madeira-Med program facilities could be applied on Terceira Island. Therefore, in 2007 two dispersal tests were conducted to evaluate the sterile male dispersion over two areas in Terceira Island, one on an apple orchard (Biscoitos) and another on the urban area (backyards of Angra city). These tests were made in September 2007 with a release of 75 and 150 thousand on Biscoitos and Angra areas, respectively. All these dispersal tests were firstly projected in computer using ArcGIS 8 software and placed in action using a Garmin GPS. In ArcGIS 8, were projected the release points in a line crossing the inner circle with 7 points spaced by 50 meters and the two concentric circles of 30 traps at 100 and 200 meters from the central release point that were putted on the field after the *C. capitata* sterile adult male release. All the adults (wild and sterile) captured on these traps were collected 24h, 72h and 8 days after the release. The major goal was to know the dispersal behaviour of the sterile males on the orchard environment and the same near an urban area. In this test were analysed the wild males captured on the two concentric traps (100 and 200 meters). In both tests the sterile adult males showed a distribution after release similar to the wild one and covered all the area very quickly and stayed there for almost a week competing with the wild *C. capitata* adult males. The results obtained showed a good spread capability of the sterile flies produced on Madeira Island in the Terceira Island climatic conditions and that the use of SIT can be a possibility to limit the Mediterranean fruit fly action in Terceira and Azores.

POSTER SUBMISSION
Key: 1581
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Landscape effects on the community of *Bactrocera oleae* parasitoids

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While a growing number of entomological studies provides several evidences for the beneficial effects of natural and seminatural vegetation in favouring the natural enemies of intensively managed annual crops, very little is known about the importance of non-crop areas for pest regulation in low-input perennial crops. Our purpose was to investigate the effects of landscape composition and configuration on the community of the parasitoids (*Pnigalio agraules* Walker, *Eurytoma martellii* Dom., *Eupelmus urozonus* Dalman) of the olive fruit fly (*Bactrocera oleae* Rossi). Olive fruits were sampled in 6 olive groves, and incubated in the laboratory for insect emergence, thus allowing the calculation of parasitoid emergence rates. The landscape analysis was performed in 5 concentric buffers, ranging from 250 to 1000 m radius from the sampled olive trees. As concerning forest/shrubland vegetation, we used the percentage of landscape and the splitting index to quantify landscape composition and configuration respectively. The correlation between the parasitoid emergence rate and the splitting index of forest/shrubland was stronger at the 750 m buffer, while no significant effect of landscape composition on parasitism was detected. These findings suggest that landscape characteristics affect functional biodiversity also in well-structured agroecosystems like the olive groves. In particular, the fragmentation of woodland, rather than its abundance per se, seems to favour olive fruit fly parasitoids.

**POSTER SUBMISSION**
Key: 1744
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Landscape ecology of species from subfamily Tephritinae (Tephritidae, Diptera) along north-east Adriatic lowlands

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North east coast of Adriatic sea was area of interest for dozen faunistic researchers from almost two hundred years ago. First world findings of numerous unknown species from subfamily Tephritinae (Frauenfeld, 1855, 1857, 1861, 1868, Schiner, 1864, Hering, 1939 etc.), confirms importance of this area in view of faunistic research and large numerousness of fruit flies and other insects (Nonveiller, 1999).

Today, more than fifty species from subfamily Tephritinae are known to ocure in the littoral and insular regions of east Adriatic sea (Bjeliš, 2007). Those belong to more than twenty genuses (Bjeliš, 2007, 2008), which are represent with different number of fruit fly species. Basic research confirm significant difference between distribution and density of theese species, with significan qualitative and quantitative difference between insular and littoral areas and between different landscape.

Two years of research on over eighty different macrolocations showes that significantly quantitative represented species belongs to the genus Tephritis and genus Myopites. In the same time, genus Tephritis as a dominant genus group is represent with significantly highest number of fourteen fruit fly species, while other genuses are represent with lower number of species, for example Terellia with five, Urophora with four, Myopites with three and other twenty genuses with two or only one fruit fly species.

POSTER SUBMISSION
Key: 1771
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Field infestation and host utilization of the invasive fruit fly, *Bactrocera invadens* Drew Tsuruta & White (Dipt., Tephritidae) in Sudan

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Field infestation rates of an invasive fruit fly species, *Bactrocera invadens* Drew Tsuruta & White on mango was determined at different localities in Sudan during 2007. *B. invadens* was permanently present at low altitudes. The level of infestation varied with location ranging from 26 to 207.3 flies per kg of fruit. There was a significant inverse relationship between numbers of flies per kg of fruit and elevation at which fruit was collected. Rearing results showed mango (*Mangifera indica*), guava (*Psidium guajava*) and grapefruit (*Citrus x paradisi*) were represented commercial host fruits. Other Citrus species, cucurbits, papaya (*Carica papaya*) and tomato (*Lycopersicon esculentum*) were not infested. Susceptibility of some mango cultivars grown in the Sudan to *B. invadens* was also tested.

POSTER SUBMISSION
Key: 1766
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Search in plant-insect relationships: the case of *Argania spinosa* - *Ceratitis capitata*

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Mediterranean fruit fly, *Ceratitis capitata* (Wied.) is very well established in argan forest, an endemic tree in Morocco, and from which adults migrate to invade neighboring host plants such as citrus and apricot. It has been observed that *C. capitata* were quickly attracted by odors emanating from wounded Argan fruit, and start feeding on latex secretions. Even, the attracted females tried to lay eggs in the wound. Fruit volatile extraction was carried out in order to identify the chemical mediator.

The fruit extract components were analysed by GC / MS and 48 compounds were found in the chromatograms.. Among these compounds, 5 fatty acids, present in a significant percentage, have been identified: among them the stearic acid, oleic acid and linoleic acid. Other compounds such as zingiberene, farnazene and limonene were found in smaller quantities. Further studies are needed to identify the rest of the chemical constituents of the fruit volatile as well as their potential role in the attraction of the *Ceratitis capitata*.

POSTER SUBMISSION
Key: 2230
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Influence of nearby fig trees on medfly captures of traps located in citrus orchards

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Non cultivated, isolated fig trees are usually present in a large number in the landscape of citrus crops in the island of Ibiza, like in other Mediterranean areas. Mature fig fruits are usually heavily attacked by the medfly (Ceratitis capitata (Diptera: Tephritidae)) and constitute a reservoir for infestation of citrus fruits located in theirs vicinity. The aim of this work was to study the influence of adjacent fig trees on captures of medfly adults on the traps located in citrus orchards and to determine the amount of increase along the year in trap captures considering the distance ranges to the fig trees. Twenty three citrus orchards cultivated were selected in the island of Ibiza (eastern Spain) and ten traps (tephi-trap with the attractant Tripack) were placed per orchard. Populations of medfly have been counted weekly on the 230 traps between April and November for three years, 2005 to 2007, making on each trap the number of flies captured with the distance to the fig trees. Twenty three citrus orchards cultivated were selected in the island of Ibiza (eastern Spain) and ten traps (tephi-trap with the attractant Tripack) were placed per orchard. Populations of medfly have been counted weekly on the 230 traps between April and November for three years, 2005 to 2007, making on each trap the number of flies captured with the distance to the fig trees. The traps located within a distance of 10 meters from a fig tree got a two to three-fold increase in the number of flies during one year. The traps located within 10 and 50 meters significantly increased the average yearly captures by 80% (2005), 35% (2006) or 110% (2007). There were no significant differences for traps located at more than 50 meters of fig trees. The increase in captures is observed during most of the year but is especially important, in absolute values, in September and October. The increase has been observed in similar amount in males and females.

POSTER SUBMISSION
Key: 2232
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective
Field distribution of *Ceratitis capitata* Wied. in peach orchards in the northeast of Spain

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The improvement of mass trapping technique as a control method for *Ceratitis capitata* Wiedemann, needs to know the orchard colonization by the pest. In this process, several factors are involved, such as the orchard location, fruit species sensitivity, plants species inside and outside of orchard, insecticides application and other difficult quantifiable factors.

With the aim of studying the colonization process at plot level, four mass trapping trials in peach commercial orchards with acreage from 0.72 to 2 hectares, were conducted. One orchard had the Early O’Henry cultivar and the three remaining had Merryl O’Henry, in which harvest takes place 15 days later. In three of those orchards, Maxitrap ® (Probodelt) traps baited with Ferag ® CC DDD TM (SEDQ) were distributed homogenously at the dose of 50 per hectare. In the other orchard the dose was 65 per ha. Traps were spatially identified to follow their captures evolution. Adult captures were weekly reviewed, quantified and sexed. Traps were kept hanged in the orchard until 15 days after harvest and until the non-commercial fruits were grinded.

The results showed that the field colonization by the pest, usually starts by one, or more, plot edges, and from there, it spreads over the orchard. In three cases, captures level at the edges was always higher than in the inner part of the orchard while in the other case, for several weeks the captures were higher at the inner part. When we compared the colonization process of two adjacent studied plots of different varieties but with the same size (2 hectares), we found that in both orchards capture levels were similar during the first three weeks, but later, captures and damage levels increased considerably in the earliest cultivar. During the harvest of the latest cultivar, captures level was 39 times lower comparing to the earlier one and, the total damage level was almost 3 times lower. The results obtained under the study conditions and its conclusions on the success of the method and the accuracy of the monitoring, are discussed.

POSTER SUBMISSION

Key: 1754
Panel: Landscape Ecology of Fruit Flies & the Spatial Perspective