SESSION VII

OTHER TOOLS FOR IPM PROGRAMS

The effect of trap colour and aggregation pheromone on trap catch of *Frankliniella occidentalis* and associated predators in protected pepper in Spain

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In a greenhouse experiment, there was a strong effect of colour on sticky trap catch of *Frankliniella occidentalis* in a sweet pepper crop. Blue traps attracted more thrips than yellow traps (×2.4), clear traps (×9.3), or black traps (×34.7). The *F. occidentalis* aggregation pheromone, neryl (*S*)-2-methylbutanoate, increased trap catch in inverse proportion to the attractiveness of the trap colour (blue ×1.3, yellow ×1.7, clear ×1.9, black ×3.4). It is proposed that in greenhouse crops, the most visually attractive trap colours are already catching a large proportion of the thrips present in the area surrounding each trap, so the addition of scent cannot increase trap catch by as much. The predatory bug *Orius laevigatus* was caught in low numbers on traps and showed no attraction to specific trap colours, the predatory thrips *Aeolothrips tenuicornis* was most frequent on yellow and blue traps and the staphylinid beetle *Oxypoda exoleta* was only found on black and clear traps. None of these predatory species were attracted to the *F. occidentalis* aggregation pheromone which can therefore be used to enhance *F. occidentalis* trap catch without affecting natural enemy establishment.

Potential of mass trapping for *Tuta absoluta* management in greenhouse tomato crops using light and pheromone traps

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The effectiveness of mass trapping using light and pheromone water traps to control tomato infestations of *Tuta absoluta* (Lepidoptera: Gelechiidae) was investigated in southwestern Sardinia. Trials were carried out in commercial plastic greenhouses equipped with insect-proof nets in both winter-summer and summer-winter tomato growing seasons. Light traps were tested at the density of 1 trap/1000 m^2, 1/700 m^2, 1/500 m^2, or 1/350 m^2 while pheromone traps were evaluated at the density of 1 trap/350 m^2, 1/250 m^2 or 1/100 m^2. The efficacy of mass trapping was evaluated by comparing weekly the damage on leaves and fruits in treated and untreated greenhouses. Pheromone traps at the tested densities were not effective in reducing leaf and fruit damage in both seasons. On the other hand, light traps reduced significantly the leaf damage at low/moderate *T. absoluta* population density during the summer-winter season, while they were ineffective in winter-summer, when the tomato leafminer density soared at the end of the tomato cultivation.

Mating disruption of the tomato leaf miner *Tuta absoluta* (Lepidoptera: Gelechiidae) in greenhouse cultivation by Isonet® T

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In the last few years the tomato leaf miner (*Tuta absoluta*) has become a major pest of field and greenhouse tomato crops, causing up to 80-100% yield losses. Plant protection heavily relies on chemical insecticides, so alternative means of containment are needed in order to reduce chemical residues in the product and to slow the selection of insecticide resistant biotypes. On a summer cycle tomato crop under plastic greenhouse, insecticide based protection schedule was compared with a mating disruption scheme based on the Isonet® T pheromone product and half of the insecticide applications made with the standard farm schedule. The strategy including mating disruption performed much better than the standard farm one, reducing to nearly zero the captures of flying adults and fruit attacks and to about 15% the percentage of leaflets mined, compared to 8% of fruits and 47% of leaflets attacked for the insecticide alone control.

Manipulating nitrogen fertilization for the management of diseases in the tomato greenhouse: what perspectives for IPM?

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Although controlled condition studies have shown that nitrogen nutrition can affect the susceptibility of tomato to certain pathogens, fertilization schemes for disease management at crop level remain to be designed. With this aim, a study has been conducted in an experimental greenhouse with cultural practices similar to those of commercial soilless production. The heated greenhouse was equipped with drip irrigation networks allowing the comparison of up to three different fertigation solutions (containing 4, 8 or 16 mmol of NO_3^- per litre). In the first two years of the study (2010 and 2011), plants were inoculated with known spore concentrations of either *Botrytis cinerea* or *Oidium neolycopersici*, and disease incidence and severity were recorded. Although variability was higher than in controlled conditions, these crop-level studies generally confirmed the influence of nitrogen fertilization on both diseases. Low nitrogen levels resulted in higher severity of *Botrytis* stem lesions while they decreased that of powdery mildew. In contrast, fruit yield from un-inoculated control plants did not differ significantly among the three nitrogen levels. More results should become available from similar studies conducted by other partners of a national collaborative project. For the design of health-enhancing fertilization schemes, further information will be needed on possible effects of nitrogen nutrition on the susceptibility of tomato to other pests and diseases and on the efficacy of various control methods used in IPM.

Combined application of soil solarization and organic amendment in the control of corky root and *Fusarium* wilt in greenhouse tomato

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Two-year greenhouse experiment (2010-2011) was carried out with the aim to study the efficacy of integration of soil solarization and organic amendment. Organic amendment was made using compost (15 t ha^{-1}) from organic fraction of urban waste applied after 35 days of soil solarization. The amendment was applied after soil solarization in order to mitigate the drastic effects produced by solar heating on microbial community and to reduce mineral fertilization. Disease severity, incidence and yield were evaluated. The experiments were performed in the South Italy at Poggiomarino (Campania region) using the ecotype known as "Pomodoro di Sorrento" much appreciated by the market, but that has no resistance to *Pyrenochaeta lycopersici* and *Fusarium oxysporum* f.sp. *lycopersici*. These two pathogens infect tomato later reducing the harvest season and the grower income. Soil solarization alone had the same efficacy of metham sodium and was effective in reducing diseases giving efficacies of 81.1 and 64.7% (mean of the two years) for *Fusarium* and *Pyrenochaeta*, respectively. The application of organic amendment increased efficacy against *P. lycopersici* (98%) conversely significantly reduced the control of *F. oxysporum* (55.3%). Yield was higher in solarized soil than in solarized plus compost amendment due to the higher level of incidence of *Fusarium*. This approach gave different results in relation to the ecological features of the pathogen, in the present work some considerations on this topic are reported. For fresh tomato under greenhouse, biological and integrated management is not only applied in order to reduce the ecological impact of the crop, but mainly for technical and economic reasons. As a matter of fact, the reduced availability of fumigants, the difficulties to apply fungicides against these two pathogens and the cost of many scheduled fungicide applications render the integrated and/or the biological disease management the best choice for this crop.

Contribution to integrated pest management against the tomato leafminer *Tuta absoluta* (Lepidoptera: Gelechiidae) in tomato greenhouse in the Sahel of Algeria

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In Algeria, *Tuta absoluta* (Lepidoptera: Gelechiidae), a serious pest of tomato, was reported in the spring of 2008. In order to implement an integrated control strategy against this insect, a study was done by combining the methods of cultivation, bio technology (sexual trapping) and chemical-based insecticides with different modes of action, to better govern resistance problems. Nearly 500 adults were collected at the beginning of June in a pheromone trap and mortality rate of 65-85% of larval populations of *T. absoluta* were obtained using insecticides.

Four-year flight dynamics of *Tuta absoluta* in Sicily and implications for IPM strategies

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The South American tomato pinworm, *Tuta absoluta* (Lepidoptera: Gelechiidae), was first recorded in Sicily during fall 2008, on tomato and eggplant protected crops. Soon after this report, several control measures were defined in the framework of Integrated Pest Management (IPM) strategies. To this aim, investigations have been carried out to acquire data on the pest population dynamics in open field through the study of the male flight trends. From April 2009 to May 2012, pheromone traps (Delta type) and digital temperature and humidity loggers were installed in six horticultural areas located in western Sicily, Catania and Ragusa provinces. The selection of the monitoring sites was based on the presence of tomato cultivations and on the different ecological traits of the neighbouring areas. In the meantime, periodical surveys were also performed on nearby tomato crops in order to evaluate the pest infestation levels and the presence of natural enemies. The data showed that the flight activity of *T. absoluta* males throughout the four-year investigation period was continuously observed in all the monitoring stations and it showed typical peaks of high and low capture levels during late summer and late winter, respectively. The trend on the captures are not homogeneous among the studied sites and they varied significantly in function of the thermal extremes, the neighbouring ecological conditions and the availability of more susceptible plants, particularly tomato crops. Indeed, the moth flights, recorded in one site characterized by open field horticulture (Catania), were significantly lower, likely owing to the higher level of crops diversity and of biocontrol agent's activity, notably by the mirid predator *Nesidiocoris tenuis*. Overall, the obtained data show that the flight activity has slightly decreased during the four years of investigation and it is noteworthy that the pest infestation level on tomato cultivations in open field and even in protected crops is considerably declining. This tendency, recently observed also in the Western Mediterranean countries, can be attributed both to the adaptation of indigenous natural enemies as well as to the improved IPM strategies against the exotic pest. These latter are currently based on pest monitoring and they include mass-trapping techniques, application of highly selective insecticides, such as microbial products and rational habitat management aimed to enhance conservation biocontrol. The information acquired during the four-year observations provides useful indications for the correct understanding of male captures allowing to adapt the data to the different agro-ecological conditions.

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