SESSION I

PEST DYNAMICS AND SURVEYS OF THEIR NATIVE NATURAL ENEMIES

Survey on indigenous parasitoids of the invasive exotic pest *Tuta absoluta* in southern Italy

Lucia Zappalà[1], Umberto Bernardo[2], Antonio Biondi[1], Arturo Cocco[3], Salvatore Deliperi[3], Gavino Delrio[3], Massimo Giorgini[2], Paolo A. Pedata[2], Carmelo Rapisarda[1], Giovanna Tropea Garzia[1], Gaetano Siscaro[1]
[1]Department of Agri-food and Environmental Systems Management, University of Catania, Via Santa Sofia 100, 95123 Catania, Italy; [2]CNR, Institute for Plant Protection, UOS of Portici, Napoli, Italy; [3]Department of Agriculture, University of Sassari, Italy

The tomato borer, *Tuta absoluta*, is an invasive pest native to South-America and since its arrival in Europe the tomato production has faced severe yield loss. The composition of the indigenous parasitoid complex of the leafminer was monitored in southern Italy (Campania, Sardinia and Sicily) during 2009-2011. The parasitoid collection was carried out by exposing sentinel tomato infested plants and by sampling open field and protected greenhouse crops, as well as *Solanum nigrum*, a *T. absoluta* wild host. The parasitoids found developing on the leafminer were mostly generalist idiobionts belonging to 12 genera and 6 families (Ichneumonidae, Braconidae, Eulophidae, Elasmidae, Pteromalidae and Trichogrammatidae). A prompt shift of native parasitoids to the new invasive host was observed and the parasitoid complex recovered on *T. absoluta* seems to follow the typical pattern of parasitisation on exotic pests, being characterized by a relatively low number of species mostly represented by generalist idiobionts, performing low levels of parasitisation in open field. This study highlighted the suitability of sentinel plants for indigenous parasitoid surveys in case of heavily treated crops, since the majority of the species were collected on sentinel plants (16 out of 23 totally recovered). The data recorded up to now lead to be rather optimistic with reference to the perspective of *T. absoluta* natural biocontrol in the Mediterranean basin.

Promising native candidates for biological control of *Tuta absoluta* in Italy

Chiara Ferracini[1], Barbara L. Ingegno[1], Marco Mosti[2], Paolo Navone[1], Luciana Tavella[1], Alberto Alma[1]
[1]DIVAPRA – Entomologia e Zoologia applicate all'Ambiente, Via L. da Vinci 44, 10095 Grugliasco (TO), Italy; [2]BIOPLANET, Strategie di Controllo Biologico, Via Masiera prima, 1195, 47521 Cesena (FC), Italy

Tuta absoluta (Lepidoptera: Gelechiidae), native to central America, has been first reported in Europe in Spain in 2006 and in southern Italy in 2008, and by now it has become one of the major pests on tomato, its main host plant. In the two-year period 2009-2010, nine species of indigenous parasitoids emerged from tomato leaves infested by *T. absoluta* collected in horticultural areas of Liguria, Sardinia and Sicily (Italy). The most abundant species were *Necremnus* near *artynes* and *N.* near *tidius*, which appeared to be promising as biological control agent. Furthermore, in tomato plantations infested by *T. absoluta* in Piedmont (Italy), a generalist predator, *Dicyphus errans* (Heteroptera: Miridae), was largely found. Therefore, the two parasitoids and the mirid bug were tested in controlled conditions to evaluate their effectiveness in controlling the exotic pest. Both *Necremnus* species proved to control efficiently first- and second-instar larvae by host feeding and parasitism. Also *D. errans* revealed to be an effective biocontrol agent of the tomato borer, preying mainly on eggs and first-instar larvae. Further investigations are needed to evaluate their potential role as biological control agents in commercial tomato plantations.

Can recently found Brazilian hemipteran predatory bugs control *Tuta absoluta*?

Vanda H. P. Bueno[1], Flavio C. Montes[1], Ana M. C. Pereira[1], Juracy C. Lins[1] Jr., Joop C. van Lenteren[2]
[1]Department of Entomology, Federal University of Lavras, P.O. Box 3037,CEP 37200-000, Lavras, MG, Brazil; [2]Laboratory of Entomology, Wageningen University, P.O. Box 8031, 6700 EH, Wageningen, The Netherlands

The tomato borer *Tuta absoluta*, native to western South America, is an extremely devastating pest in tomato crops in most of South America, Europe and Africa North of the Sahel and the Near East (Asia). Without control, the pest causes yield losses up to 100% and decreases fruit quality in open field and greenhouse crops. In Brazil two other serious lepidopteran pests occur in tomato, as well as thrips, whiteflies, mites and aphids. For control of these pests, frequent applications of pesticides of up to 5 times per week are needed, and these resulted in the appearance of resistant populations to a number of active ingredients and caused a strong reduction of natural enemies. Biological control may offer a better opportunity for pest management. Mirid predatory bugs are currently used with success in Europe to control *T. absoluta* and other pests. In Brazil, three mirid predators of *T. absoluta* have been found and are now evaluated together with two other hemipteran predators, *Geocoris punctipes* and *Orius insidiosus*.

Tomato leafminer, *Tuta absoluta*, and insecticide resistance: a new challenge for control strategies

Khalid Haddi[1,2], Madeleine Berger[2,4], Pablo Bielza[3], Dina Cifuentes[3], Linda M. Field[2], Kevin Gorman[2], Martin S. Williamson[2], Chris Bass[2], Carmelo Rapisarda[1]
[1]Dipartimento di Gestione dei Sistemi Agroalimentari e Ambientali, Sezione Entomologia applicata, Università degli Studi di Catania, Italy; [2]Centre for Sustainable Pest and Disease Management, Rothamsted Research, Harpenden AL5 2JQ, United Kingdom; [3]Departamento de Producción Vegetal, Universidad Politécnica de Cartagena, Spain; [4]School of Biology, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom

The tomato leaf miner, *Tuta absoluta* (Lepidoptera), is a significant pest of tomatoes that has undergone a rapid expansion across Europe, North Africa and parts of Asia during the past six years. One of the main means of controlling this pest is through the use of chemical insecticides. In the current study leaf-dip bioassays were used to determine the susceptibility of *T. absoluta* strains established from field collections to several insecticides. Additionally, the *para*-type sodium channel and acetylcholinestaerase gene from *T. absoluta* were cloned and sequenced. This revealed the presence of three kdr/super-kdr-type mutations (M918T, T929I and L1014F) in the sodium channel gene and mutation (A201S) in the acetylcholinesterase gene. To assess the prevalence of these mutations in 27 field strains from 12 countries high-throughput TaqMan diagnostic assays were developed. The results showed the presence of these mutations at high frequency in *T. absoluta* populations worldwide and suggest pyrethroids and organophosphates are likely to be ineffective for control. These results also support the idea that the rapid expansion of this species over the last six years may be in part mediated by the resistance of this insect to chemical insecticides hence adding new challenges to control strategies for this pest.

The cotton bollworm *Helicoverpa armigera* (Lepidoptera: Noctuidae) – is it becoming a serious pest on pepper and tomato in Montenegro?

Sanja Radonjić, Snježana Hrnčić
University of Montenegro, Biotechnical Faculty, Department of Plant Protection, Mihaila Lalića 1, 81000 Podgorica, Montenegro

In the last few years, increases in the damage to pepper and tomato fruits caused by the cotton bollworm *Helicoverpa armigera* have been noticed in the southern part of Montenegro, the country's main pepper and tomato production area. This includes the area around the city of Podgorica (Zeta and Bjelopavlići) and the Montenegro seacoast (Ulcinj) where these two cultures are grown both in greenhouses and outdoors. From July to September in 2010 and 2011, eight tomato and six pepper greenhouses in the Zeta and Bjelopavlići area were visually inspected. Two tomato greenhouses, one open-field tomato crop and one open-field pepper crop were visually inspected in 2011 in the Ulcinj area. As well as a visual inspection, the intensity of attack was also calculated for the pepper and tomato crops. The results of this study showed that larvae of *H. armigera* were found on pepper and tomato fruits in most of the inspected greenhouses and also on tomato fruits in the open field. More damaged pepper and tomato fruits were observed in 2011 than in 2010.

Natural parasitism of *Bemisia tabaci* (Hemiptera: Aleyrodidae) by native Aphelinidae (Hymenoptera) parasitoids in tomato greenhouses in Mersin, Turkey

Kamil Karut[1], Cengiz Kazak[1], **İsmail Döker**[1], Amir Abdullahi, Yousif Malik[2]
[1]Çukurova University, Agricultural Faculty, Department of Plant Protection, Adana, Turkey; [2]Agricultural Research Corporation (ARC), Wad Medani, Sudan

The survey study was conducted to determine natural parasitism of *Bemisia tabaci* in tomato greenhouses in Adanalıoğlu, Kazanlı and Kocahasanlı counties of Mersin in 2008-2010. Samples were collected on commercial tomato greenhouses in spring and autumn seasons. Most of the surveyed greenhouses (≥95%) were infested with *B. tabaci*. Overall, population densities of *B. tabaci* were higher in Adanalıoğlu and Kazanlı than in Kocahasanlı. Also, *B. tabaci* infestation rates were higher in autumn than in spring, in both years. Similarly, *Eretmocerus mundus* was more abundant in autumn than in spring in all locations, and more abundant than *Encarsia lutea*. Parasitism rates of *E. mundus* varied between 12.3 and 37.1% throughout the survey.

Survey of host plants and natural enemies of *Drosophila suzukii* in an area of strawberry production in Catalonia (northeast Spain)

Judi Arnó, Jordi Riudavets, Rosa Gabarra
IRTA. Entomology. Ctra. Cabrils km 2 Cabrils (Barcelona), Spain

A new invasive pest, the fly *Drosophila suzukii*, is threatening several fruit crops in Europe. This pest is native to Asia and was first recorded in Europe in 2008. The first documented damage in our area occurred in 2011, mainly affecting cherries and strawberries. In this study, we aimed to determine which cultivated and non-cultivated plants host *D. suzukii* in an area in which heavy infestations on protected strawberry crops have occurred. Strawberries, raspberries, *Arbutus unedo* and *Solanum luteum* have been infested with *D. suzukii.* To our knowledge, the last two species had not previously been described as hosts of this fly. Evidences of the presence of the pest in unripe fruits were recorded. Some potential biological control agents in the local area were also identified. Four Hemiptera predator species were found in infested fruit samples: *Orius laevigatus*, *Cardiastethus nazarenus, C. fasciventris* and *Dicyphus tamaninii.* Further research is needed in the role of these natural enemies in the control of this pest.

Detection of *Tuta absoluta* (Lepidoptera: Gelechiidae) in Iran

Ahmad Cheraghian
Plant protection Organization, Tehran, Iran

T. absoluta attacks almost exclusively tomato (*Lycopersicon esculentum*) although there is some area in Iran that is reported in potato (*Solanum tuberosum*) and eggplant (*Solanum melongena*). There are references to other hosts in the family Solanaceae (*Lycopersicon hirsutum*, *Solanum lyratum* and *Solanum* sp.). In 2011, the tomato growing area in Iran covered about 150000 ha, mostly located in the South of the country (Bushehr, Hormozgan, Kerman, Khorasan razavi). Therefore *T. absoluta* is the serious threat of Iranian tomato crops. The Iranian Plant Protection Organization and inspection service (IRIPP) developed a monitoring program to detect this pest by using pheromone trap, monitoring systems and visual inspection. In October 2010 this pest was identified in West of Iran (Azarbaijan gharbe) near Turkey. However, outbreaks of *T. absoluta* occurred in most of the provinces in 2011 (Azarbaijan gharbe & Markaze) and in 2012 (Hormozgan & Bushehr). Immediately after the identification of the pest, official pest management guidelines were issued, insecticides were officially registered in the national catalogues exclusively for *T. absoluta* control, and public awareness campaigns were organized. Despite these actions, management of the pest was extremely problematic in the first period. Today, management of the pest has been incorporated in IPM schemes and successful control has been achieved in most cases. In greenhouse crops, prevention of the infestation has proven a key component for an efficient pest management (i.e. use of insect-proof exclusion nets on the opening, double doors, insect free plant material). In open field crops, pheromone traps are used mainly for pest monitoring. Mass trapping of males and mating disruption have relatively limited adoption. Finally, numerous highly efficient insecticides are available on the market.

A three-year survey of *Tuta absoluta* (Lepidoptera: Gelechiidae) population trends in Sardinian tomato greenhouses

Mauro Nannini, Fabrizio Atzori, Michele Coinu, Riccardo Pisci, Francesco Sanna
AGRIS Sardegna - DIRVE, V.le Trieste 111, 09123 Cagliari, Italy

Since 2008 *Tuta absoluta* has established in Sardinia (Italy) as the key pest of greenhouse tomatoes. With the aim of monitoring tomato borer population trends after its introduction in one of the most important fresh market tomato production areas of the island, from February 2009 to January 2012 we surveyed ten to fifteen commercial greenhouse crops per year. In each crop we assessed monthly the mean number of live *T. absoluta* larvae per tomato plant, the percentage of plants infested by larvae, the mortality and parasitism of 2^{nd}-4^{th}-instar larvae, and noted the treatment schedules. The highest levels of tomato borer infestation were observed in spring of 2009 (averaging 86 larvae/plant) and, to a lesser extent, in spring of 2010 and 2011 (55 and 41 larvae/plant respectively). While pest density generally declined in summer, it increased moderately during autumn, not exceeding on average 8 larvae/plant, and was maintained in winter. In most cases the highest levels of larval mortality were recorded between May and July. Except in a few cases, the contribution of larval parasitism to tomato borer mortality was poor. The insecticides most commonly used by growers for pest management were initially abamectin, azadirachtin and spinosad, but during the survey period the latter two products were gradually replaced by *Bacillus thuringiensis*-based insecticides and emamectin benzoate.

Implementation of a biological control program in greenhouse crops in Iran

Vali Baniameri[1], Ahmad R. Mohandessi[2], Shahram Farrokhi[1]
[1]Iranian Research Institute of Plant Protection, Tehran; [2]Gyah Bazr Alvand Co. Iran

Greenhouse crops are currently grown on 7500 ha mainly in southern and central parts of Iran where about 5350 ha are vegetables. Growers have to use conventional methods and chemical application to reduce the damage. However, in most cases, due to pest resistance, insufficient knowledge of pest life cycle and low quality pesticides used, their effort results only in loss of money, lower yield and crops containing pesticides residues more than defined MRLs. To tackle the obstacle, the Iranian Research Institute of Plant Protection (IRIPP), with the cooperation of Gyah Bazr Alvand, carried out a project to evaluate 16 imported biological control agents in 93 ha cucumber, tomato, strawberry, eggplant and bell pepper greenhouses for two cropping seasons in 4 provinces. The findings revealed that the biocontrol agents were able to control the related pests satisfactory. Therefore, the implementation of biological pest control program could prevent the frequent chemical applications and assist production of pesticide free crops. The present manuscript discusses the sustainable development of an integrated pest control based on biological methods and also proposes some suggestions on production and release of native species of natural enemies.