

SESSION V
MACROBIALS FOR IPM PROGRAMS

Failure of the biological control of *Tuta absoluta* using the predator *Nesidiocoris tenuis* in a protected tomato crop: analysis of factors

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Many attempts have been made to biologically control the tomato leafminer *Tuta absoluta* in Tunisia using the predator *Nesidiocoris tenuis* in nurseries, greenhouses and open field tomato crops. However, several assays involving the biological control of this pest failed, particularly in greenhouses. The main reasons for these failures were identified by the authors as the over use of insecticides and fungicides, de-leafing after mirid bug introductions and the probable absence of prey when predators were released.

A successful method for whitefly and *Tuta absoluta* control in tomato. Evaluation after two years of application in practice

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The tobacco whitefly, *Bemisia tabaci* and the tomato borer *Tuta absoluta* are major pests of tomato. The mirid bug *Nesidiocoris tenuis* is an effective natural enemy of whiteflies and recently it has been shown to be also a potential biological control agent of *T. absoluta*. In addition, some parasitoids from the Mediterranean basin have been found attacking *T. absoluta* and *Necremnus artynes* is particularly promising. The present study presents the results from experiments conducted to develop a biologically-based management strategy in tomato for whitefly and *T. absoluta* control and its application in practice thereafter. It first shows the results evaluating an alternative release method for *N. tenuis* and its combination with *N. artynes*. It was demonstrated that this alternative release method (pre-plant application) increased control capacity of *N. tenuis*, provided good control of whiteflies and *T. absoluta* and reduced control costs and the addition of *N. artynes* did not increase its effectiveness. Although, supplementary releases of this parasite increased the effectiveness of after planting releases of *N. tenuis* (standard application). Thus, the pre-plant application of *N. tenuis* alone would be the most efficient method due to its reduced control costs and complexity. Implementation of this strategy has greatly increased the use of biologically-based management strategies in tomato in Spain, and would likely have the same effect in other production areas around the world.

IPM strategies in tomato crops in Spanish greenhouses: effects of cultivars and the integration of natural enemies

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The use of *Nesidiocoris tenuis*, the main released predator, has contributed to the establishment of biocontrol programmes in more than 50% of the protected tomato crops in the South-East of Spain. Three predator releasing strategies (standard, refuge plants and bio-propagation) were according to the season of the year. The development of the predator on different cultivars was monitored and its combination with *Trichogramma achaeae* in different seasons discussed.

Mechanical release of *Phytoseiulus persimilis* and *Orius laevigatus* on protected crops

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Mechanical releases of the predatory mite *Phytoseiulus persimilis* (Acarina: Phytoseiidae) and the predatory bug *Orius laevigatus* (Heteroptera: Anthocoridae) were carried out in cultivated protected crops (sweet pepper and *Chrysanthemum*) to control the two-spotted spider mite *Tetranychus urticae* and the western flower thrips *Frankliniella occidentalis*. Natural enemies were distributed using a newly developed mechanical device and compared with manual distribution. In all experimental trials carried out with the device the results showed a greater uniformity of distribution, a reduction of release time and ease of application. In most of the mechanised plots the predators were regularly recovered reducing the percentage of leaves infested and their density, so controlling pests sooner than in the manually released ones.

The use of a mix of parasitoids to control all aphid species on protected vegetable crops

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Viridaxis is a Belgian company which developed a new, plant-less way of mass-rearing aphid parasitoids. Due to its innovative and unique technology, Viridaxis has been able to add one new selected parasitoid species every year. A parasitoid is a wasp able to parasitize aphids in a relatively host-specific way. These natural enemies of aphids are used in organic and/or Integrated Pest Management (IPM) strategies. In order to apply the matching parasitoid against a given aphid species, the aphid has to be detected in the crop and subsequently identified. By the time the aphids are spotted by the grower and then identified by himself or a specialist, it is usually more difficult to gain control over an increasing aphid population. Viridaxis developed a new concept of aphid control, based not on the species identified but on the crop treated. To protect vegetables against their main aphids, VerdaProtect contains six different species of natural aphid enemies. When used preventively, it is able to control all commonly appearing aphids attacking vegetable crops. Here, we show the results of trials conducted in sweet pepper crops in 2011. In Germany, the comparison of the VerdaProtect strategy with the “traditional” biological strategy based on single species release showed that the VerdaProtect strategy was as efficient as the traditional strategy in controlling aphids but it was much easier, less time consuming and also much cheaper. The trial in a company growing sweet pepper in a IPM large scale hydroponic greenhouse in The Netherlands showed a high efficacy of the parasitoid mix and contrary to the widely used banker plants strategy, it did not encounter the widespread hyperparasitoid problem.

Potential of tomato colonization by mirid bugs in Roussillon area (southern France): effect of crop management and landscape features in crop surroundings

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Enhancing insect pest control by their natural enemies is considered a promising crop protection strategy to reduce pesticide use. In Mediterranean areas, native natural enemies such as mirid bugs (Heteroptera: Miridae) settle spontaneously in protected tomato crops and can play an important asset for pest regulation, which remains however hardly predictable. The present study aims at identifying key factors of colonization of crops by mirid bugs and more specifically agronomical practices and landscape features in the tomato crop surroundings. Data on land-use proportions, crop management and mirid populations were collected for 34 tomato crops in Roussillon area (South of France) and analysed using multivariate methods. Exploratory analyses show correlations between crop management, proportions of certain land-uses and abundance of mirids in tomato. This is the first step of a whole study aiming to assess the potential of protected crop colonization by beneficials in order to manage crops and their surroundings and enhance this process.