INSTITUTE OF PLANT PROTECTION
NATIONAL RESEARCH INSTITUTE

INRA SCIENCE & IMPACT

PURE

IPM Innovation in Europe

Poznań, Poland
January 14–16, 2015

Book of Abstracts

Ministry of Science and Higher Education

IOBC-WPRS

endure diversifying crop protection

WOJEWODA WIELKOPOLSKI

MARSZAŁEK WOJEWÓDZTWA WIELKOPOLSKIEGO MAREK WOŹNIAK

POZnan Eastern energy. Western style

psor

Institute of Plant Protection – National Research institute

INRA – French Agronomic Research Institution

European project "Pesticide Use-and-risk Reduction in European farming systems

with Integrated Pest Management" – PURE

in collaboration with:

Ministry of Agriculture and Rural Development

Ministry of Science and Higher Education

Polskie Towarzystwo Ochrony Roślin

International Organisation for Biological Control of noxious animals and plants (IOBC-WPRS)

International Organisation for Biological Control of noxious animals and plants (IOBC-EPRS)

ENDURE

Wielkopolski Urząd Wojewódzki w Poznaniu

Urząd Marszałkowski Województwa Wielkopolskiego w Poznaniu

Urząd Miasta Poznania

Polskie Towarzystwo Ochrony Roślin

CONGRESS SCIENTIFIC COMMITTEE

Aubertot JN., Begg G., Bruce T., Dachbrodt-Saaydeh S., Delval P., de Rijk N., de Wolf P., Fiedler Ż., Heijne B., Hommes M., Jensen J.E., Kierzek R., Kudsk P., Lescourret F., Messéan A., Pertot I., Poncet C., Riemens M.M., Sattin M., Sosnowska D.E., Urbaneja A., vander Werf W.

CONGRESS TECHNICAL ORGANISING COMMITTEE

Krawczyk D., Kwiatkowski A., Roth M., Wojciechowska R.

Sponsors:

Media Partner:

IPM for Protected crops

IPM IN SOUTHERN EUROPEAN GREENHOUSES: STRENGTHS AND WEAKNESSES

C. Poncet[1], R. Suay [1], A. Urbaneja [2], M. Ruocco[3], M. Giorgini[3], N. van der Velden[4]

[1] Sophia Agrobiotech Institute, UMR INRA (1355), CNRS (7254), University of Nice, F-06903 Sophia Antipolis,
France

[2] Unidad Asociada de Entomología UJI-IVIA, Centro de Protección Vegetal y Biotecnología,
Instituto Valenciano de Investigaciones Agrarias, IVIA, Spain

[3] Istituto per la Protezione Sostenibile delle Piante, (CNR-IPSP), Via Università133, Portici, (NA), Italy

[4] LEI Wageningen UR, The Hague, The Netherlands

christine.poncet@sophia.inra.fr

This work analyzes information gathered from two surveys carried out in 2011 and 2014 within the framework of the European PURE program subsidized by FP7 KBBE funds.
Various stakeholders, i.e., suppliers, advisers, growers, cooperative managers, from Spain, France and Italy have been interviewed in order to give their input on the main opportunities and setbacks of Integrated Pest Management in greenhouse horticulture production according to their relevant technical and socio-economic surroundings.
The information gathered during the first survey showed really contrasting situations among the selected regions regarding both the greenhouse production system and the IPM strategies. Furthermore, this study highlighted a strong correlation between the main pests and diseases observed locally coupled with specific strategy management and environmental conditions.
By the same token, real IPM management promoting biological control appeared to be highly related to differing local factors such as greenhouse technical level, growth and rotation calendars, availability of biological control agents as well as target markets.
The second survey showed that the use of IPM is spreading in Southern European greenhouses and has extended to become the general rule for tomato production. Nevertheless, many issues remain in specific situations namely fungi diseases and soil-born pathogens.

GREENHOUSE CLIMATE INVESTIGATIONS FOR ADVANCED IPM MANAGEMENT

H. Fatnassi, R. Brun, J. Pizzol, C. Metay, C. Bresch, P. Parolin, C. Poncet

INRA – UMR ISA 1355 TEAPEA, 400 Route des Chappes, BP167, 06903, Sophia Antipolis Cedex, France

hicham.fatnassi@sophia.inra.fr

Gaining knowledge's on the biophysics mechanisms underlying protected climate setting and more particularly the conditions prevailing at leaf level is crucial because air humidity considerably increases close to leaf surface and can promote the damages caused by pests (fungi and insects). It is interesting to control the distributed climate in the ecological niche sheltering the pests, diseases and BCAs threatening the crops and thus to implement more efficiently the various alternative methods (climate, physical, etc.) to the use of chemical products.

The main research activity for this work concerns the Computer Fluid Dynamics (CFD) based modeling and characterization of the distributed climate in the greenhouse.

We have focused on a crucial issue concerning the novel numerical coupling of radiative and convective transfers within the CFD software, together with the coupling between crop activity and the distributed microclimate. Both improvements have more precisely allowed (i) studying pest occurrence distribution with respect to climate patterns and (ii) modeling the microclimate in the leaf boundary layer in the ecological niche of pests. (iii) evaluating the substitute materials to leaf domatia presents on Viburnum tinus to identify which material can "mimic" the climatic characteristic of leaf domatia to ensure the stability of the beneficial insects. (iv) characterizing and modeling of microclimate heterogeneity at the plant level, in relation to the repartition of biocontrol agents (*Neoseiulus cucumeris* and *Amblyseius swirskii*) used to control thrips on greenhouse crops.

The results evidenced that (i) the microclimate (air temperature and humidity) at leaf and plant levels is very heterogeneous. Mapping together climate conditions at this level and the distribution of beneficial insects and pests can provide new information about their climate preferences and suggest control strategies allowing for a wiser control of greenhouse pest infestations.

(ii) The observed discontinuities between the climate in the leaf boundary layer and the ambient air prove that for improving the crop pest's control, the boundary layer micro climate conditions must be directly targeted rather than controlling the ambient air climate. More specifically, air humidity, the crucial parameter controlling pest activity, must not be considered in the air at the center of the greenhouse near the growing point but in the leaf boundary layer.

The resulting model could be used to test a climate control strategies to fight against pests by modifying the temperature and the humidity by deploying techniques and strategies, such as localized heating or ventilation aiming at directly controlling the microclimate inside the boundary layer of leaves to make it unfavorable for pests. It may also be used to identify the risk areas and to save time and money for growers by releasing biocontrol agents in small areas surrounding these risk zones.

INTEGRATED PEST MANAGEMENT BASED IN THE USE OF MIRIDS IN GREENHOUSE TOMATOES OF SOUTHERN SPAIN

Meritxell Pérez-Hedo, Francisco Beitia, Alberto Urbaneja

Unidad Asociada de Entomología UJI-IVIA, Centro de Protección Vegetal y Biotecnología, Instituto Valenciano de Investigaciones Agrarias, IVIA, Spain

aurbaneja@ivia.es

During the last decade pest management in protected tomato crops in southern Spain has evolved from a purely chemical management to a strategy based on biological control of pests where pesticides against pests are rarely used. The appearance of the invasive pest *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in 2006 in Spain, prompted to develop strategies to control this threatening tomato pest, based on the use of mirid predators (Hemiptera: Miridae). The use of the predatory mirid bug *Nesidiocoris tenuis* Reuter (Hemiptera: Miridae) resulted very effective in controlling tomato key pests: *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) and *T. absoluta*. In addition, due to the high polyphagy of this predator, most tomato pests are under control, with the exception of *Aculops lycopersici* (Masse) (Acari: Eriophydae) which escapes to the control of this predator. The success of the use of *N. tenuis* has minimized the use of pesticides in tomato and the specific treatments conducted are currently mainly targeted to control *A. lycopersici* with selective acaricides.

INCREASE OF BIODIVERSITY OF THE FIRST TROPHIC LEVEL AS A NEW IPM TOOL

Cécile Bresch, Louise Van Oudenhove, Hicham Fatnassi, Christine Poncet, Léa Carlesso, Pia Parolin

Sophia Agrobiotech Institute, UMR INRA 1355 – CNRS 7254 – University of Nice Sophia Antipolis, F-06903 Sophia-Antipolis, France

cecile.bresch@sophia.inra.fr

Research has documented the importance of tri-trophic interactions in IPM systems but rarely from an "arthropod" point of view. The employment of biocontrol plants has proven to be efficient in IPM. These are intentionally added to a crop system in order to enhance crop productivity through predator attraction and/or pest regulation. Understanding the effects of particular plant structures on tri-trophic interactions appears essential to improve the efficiency of biocontrol systems. The present paper describes the results of experiments testing two species of biocontrol plants as potential banker plants in tomato crops using the predatory mirid bug *Macrolophus pygmaeus* to control whitefly pest *Trialeurodes vaporariorum* in IPM greenhouses in South-Eastern France. Basil (*Ocimum basilicum*) is an efficient intercrop in pest management known for its repellence effect. However its function as banker plant to help the presence of the predatory mirid bug *Macrolophus pygmaeus* for biological control of whiteflies remains unstudied. In this context we investigated the effect of basil as banker plant in an IPM greenhouse to enhance the presence of the predatory bug *M. pygmaeus* in tomato crop system. In a 6 week experiment, we evaluated simultaneously three plant combinations composed by basil and/or tomato in dicultures (two-crop mixtures) or monoculture of the same species. We compared incidence of the pest *T. vaporariorum* (whitefly) and the predatory bug on the yield of tomato plants. We counted the number of individuals of *M. pygmaeus* and *T. vaporariorum* on basil and tomato. At the end of the experiment, a destructive sampling showed that pests were significantly less numerous in the diculture or when basil was present. However, number of predators, crop yield and leaf health were not statistically different between plant combinations. Basil had an effect on whitefly control as there was a good predation success but with the present experiment we could not define basil as an efficient banker plant.

Dittrichia viscosa, which is a Mediterranean entomophilous plant, is known to enhance beneficial arthropod populations. Our second study assessed the population development of *M. pygmaeus* and *T. vaporariorum* on *D. viscosa* and on tomato. The results were negative in that the predators did not install on *D. viscosa*, and the combination of *D. viscosa* + tomato induced an increase of the pest population. On *D. viscosa* grown with tomato, 2246 individuals of *T. vaporariorum* (adults and larvae) were identified after eight weeks, compared to 241 on the treatment with only tomato plants and 34 with only *D. viscosa*. Although *D. viscosa* is efficient for other species combinations, it is not suitable for the protection of tomatoes against *T. vaporariorum* in greenhouse, and does not act as banker plant for *M. pygmaeus*.

APPLICATION OF PHEROMONE-BASED CONTROL OF *TUTA ABSOLUTA* IN GREENHOUSE TOMATO IPM IN CAMPANIA, SOUTHERN ITALY

Elena Manco[1,2], Nadia Lombardi[1,2], Pasquale Cascone[1], Simona Carpenito[1], Roberta Panza[1], Roberta Quarto[1], Leo Poleij[2], Willem Jan de Kogel[2], Emilio Guerrieri[1], Michelina Ruocco[1], Massimo Giorgini[1]

[1] Istituto per la Protezione Sostenibile delle Piante, (CNR-IPSP), Via Università133, Portici, (NA), Italy

[2] Dipartimento di Agraria, Via Università 130, Portici (NA), Italy

[3] Plant Research International, Wageningen UR, Wageningen, The Netherlands

giorgini@ipp.cnr.it

Greenhouse tomato in Campania is cultivated mainly during the spring-autumn season when different pests, including the borer *Tuta absoluta*, the whiteflies *Trialeurodes vaporariorum* and *Bemisia tabaci*, and the thrips *Frankliniella occidentalis*, can injury the crops simultaneously. While *T. absoluta* and whiteflies can be controlled effectively by inoculations of biocontrol agents, the most effective of which is the predator *Nesidiocoris tenuis*, and natural populations of parasitoids and predators, the efficacy of *F. occidentalis* biological control on tomato remains elusive. Farmers use frequent insecticide sprayings to control thrips, so disrupting the biological control of other pests, with the consequence that additional insecticides must be applied to control borers and whiteflies. In a three-years field trial (2012–2014) we used the false trail following techniques (FT) to control *T. absoluta* in combination with a) insecticides applied specifically to control thrips or b) biocontrol agents. We found that: *T. absoluta* male ability to respond to calling females is inhibited by the pheromone dispensers distributed within the greenhouses; FT in combination with *Bacillus thuringiensis* and chemical control of thrips is effective in reducing the number of chemical insecticide applications by 40% compared with the farmer chemical control strategy and preventing yield losses due to *T. absoluta*; FT in combination with the predator *N. tenuis* and other biocontrol agents is effective in preventing yield losses due to *T. absoluta* as the farmer chemical control strategy; fruit injury by thrips (direct damage) and whiteflies (indirect damage) did not differ between the FT-based IPM and the farmer chemical control strategy. Our data suggest the use of FT as a mean to improve Integrated Pest Management and sustainability of greenhouse tomato production at least in Southern Italy.

TRICHOGRAMMA ACHAEAE AS AN IPM TOOL IN TOMATO GREENHOUSES

Marion Giraud

INVIVO AGROSOLUTIONS, Route de Biot 1306, 06560 Valbonne, France

mgiraud@invivo-group.com

Trichogramma wasps are endoparasitoids of Lepidoptera eggs. They are used as biological control agents against Lepidoptera pests.

The species Trichogramma achaeae is used against the invasive Tomato leafminer Tuta absoluta.

As part of the European project PURE, on-farm trials of integrated pest management were conducted in the south of France, based on the use of two BCA : Trichogramma achaeae and Macrolophus pygmaeus.

These on-farm trials have shown the value and effectiveness of the use of Trichogramma achaeae as an IPM tool against Tuta absoluta.

ARTEMIA AS SUPPLEMENTARY FOOD FOR THE PREDATORY MIRID *NESIDIOCORIS TENUIS*: IMPLICATIONS FOR BIOLOGICAL CONTROL IN TOMATO CROPS

Óscar Molla, Miquel Alonso, Ricardo Suay, Francisco Beitia, Alberto Urbaneja

Unidad Asociada de Entomología UJI-IVIA, Centro de Protección Vegetal y Biotecnología, Instituto Valenciano de Investigaciones Agrarias, IVIA, Spain

aurbaneja@ivia.es

Nesidiocoris tenuis (Reuter) (Hemiptera: Miridae) is a zoophytophagous predator widely used in integrated pest management programs in both, greenhouse and open-field, tomato crops.
Mass rearing of *N. tenuis* is greatly dependent on *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) eggs as food source. Moreover, the addition of this factitious prey after the inoculative releases of *N. tenuis* under field conditions is recommended to facilitate establishment of this mirid. However, *E. kuehniella* eggs are expensive and availability is limited. Some alternative foods as decapsulated *Artemia* cysts have given very good results in terms of biological development and reproduction of other Hemiptera predators. In this work, our objective was to evaluate the development of the juvenile stages of *N. tenuis* and the fecundity of females emerged from the assay of development, when subjected to a strict diet of decapsulated *Artemia* cysts, on tomato leaf in laboratory conditions. Moreover, we assessed the effectiveness of this alternative food (factitious prey) to improve the establishment of *N. tenuis* in a greenhouse tomato crop conditions. Our results may have practical implications of interest in mass rearing systems of *N. tenuis* and its management in greenhouse and field crops as a part of biological control programs.

INNOVATIVE DECISION SUPPORT SYSTEM FOR IPM IN GREENHOUSES

C. Poncet[1], B. Paris[1], S. Doise[1], R. Suay[1], M. Giraud[2], C. Bresch[1], J. Bazzano[1], H. Fatnassi[1],
L. Mailleret, P. Parolin[1]

[1] Sophia Agrobiotech Institute, UMR INRA (1355), CNRS (7254), University of Nice, F-06903 Sophia Antipolis,
France

[2] InVivo AgroSolutions, 1306 Route de Biot, 06360 Valbonne, France

christine.poncet@sophia.inra.fr

Since biological control is a real part of IPM strategy, an important shift in attitude is needed on behalf of the growers to monitor the culture and the pest and natural enemy communities. As a matter of fact, contrary to conventional chemical pesticides, biological control tools are much more targeted, although they induce a delayed effect and are more dependent on biotic and abiotic factors. In addition, the main objective is not to eradicate pests but to maintain an accurate balance between them and the natural enemies.

These changes require, *de facto*, accurate monitoring of the various biotic elements in the cropping system as well as new tools to analyze the huge amount of data generated.

To undertake this, our laboratory has designed a large database called S@M, i.e. “Sophia Data Market” which includes a wide selection of tools aiming at providing effective help for growers to take relevant decisions.

This intelligent system encompasses: i) training tools to identify pests and natural enemies, ii) monitoring tools adapted to each pest, natural enemy and crop, iii) forecasting models for the main pests and diseases, iv) traceability tools for IPM management.

The system has been created to allow the grower to record the sanitary status of crop straightaway in the greenhouse on a tablet, to obtain real time risk analyses and a pool of information regarding potential decisions.

TRAINING EXPERIENCES FOR TOMATO GREENHOUSE FARMERS

Ricardo Suay[1], Miquel Alonso[2], Francisco Beitia[2], Alberto Urbaneja[2]

[1] Centro de Agroingenieria. Instituto Valenciano de Investigaciones Agrarias, IVIA. Spain.
Present address : UMR 1355 ISA-INRIA-UNICE, INRA-ISA, Sophia-Antipolis. France

[2]Unidad Asociada de Entomología UJI-IVIA. Centro de Protección Vegetal y Biotecnología.
Instituto Valenciano de Investigaciones Agrarias, IVIA. Spain.

aurbaneja@ivia.es

The European Directive 128/2009 for the sustainable use of pesticides pleads for the reduction of use and dependence on pesticides of the European agricultural production. It fosters the use of integrated pest management (IPM) strategies and supports the training of pesticides users as a key element for the success in the application of this Directive. In this context, the PURE European R&D program has been developed and devoted to the pesticide's use and risk reduction of key farming systems in Europe. Within this project, the Valencian Institute of Agricultural Research (IVIA, Spain) has participated in the development of IPM solutions for protected crops, particularly in the greenhouse tomato system in the Mediterranean basin. The appearance of the invasive pest *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in 2006 in Spain, prompted to develop strategies to control this threatening tomato pest, based on the use of mirid predators (Hemiptera: Miridae). The use of the predatory mirid bug *Nesidiocoris tenuis* Reuter (Hemiptera: Miridae) has resulted extremely effective in controlling tomato key pests: *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) and T. *absoluta*. Therefore, the objective of this work has been twofold: first, to train farmers in the use of *N. tenuis* as key biological control agent for greenhouse tomato production; and second to accompany them in the application of this new control strategy. The first objective was accomplished with several training days, in which participants (more than 50 in 3 sessions) learn the basics of the *N. tenuis* bioecology, as well as for the main tomato pests (*T. absoluta, B. tabaci*) both in laboratory with the use of binoculars and in the field with magnifying lens. We also presented how to set up and implement this strategy in practice in a real tomato crop in a greenhouse especially grown for this purpose where participant learned the traps they need, the monitoring frequency, the pests to monitor, etc.) The second objective consisted in giving weekly support to several growers of protected tomato producers in Valencia. These growers served as an example. The good results obtained (pest control, ease of use and much cheaper strategy) fostered the acceptance and spread out of the release of *N tenuis* strategy for IPM protected tomato. In addition, we participated in several seminars and workshops in which we presented the practical solution developed as well as the results of our on-station trials.

"THE HEALTHY GREENHOUSE": HEALTHY FOR PLANTS, MAN, AND THE ENVIRONMENT

Carolien Zijlstra, Piet Boonekamp

Business Unit 'Biointeractions & Plant Health', Wageningen UR, Wageningen, The Netherlands

piet.boonekamp@wur.nl

Conditioned crop production as in greenhouses form an ideal system for the most innovative IPM-approach. However as the sizes of greenhouses increase, manual monitoring and taking appropriate measures are getting more difficult in practice, limiting the potential of using alternative control methods in time. The development, use and integration of early diagnostics and precise application technologies of (bio)pesticides, would facilitate large greenhouses being the most sustainable production system. And this has been established in the recently finished (2011–2014) INTERREG Program 'Healthy Greenhouse', supported by the EU and the Dutch and German provinces close to their joint border. About 10 research groups and 22 high-tech companies joint, to develop about 20 products and test them in one IPM cropping system 'Healthy Greenhouse' on two crops, tomato and potted plants.

'Healthy Greenhouse' comprises of 4 building blocks: healthy start, monitoring, taking appropriate measures, and a farmers dashboard for control.

Healthy start, a multiplex detection system (antibody- and DNA based Luminex equipment) was developed to certify plant material, topsoil/substrate, irrigation water and the environment for being free of pests.

For *Monitoring*, 2-steps methods have been developed. Macro-monitoring was performed with vision technologies (CF-camera or Multispectral Imaging Sensor) mounted on a cart running through the whole greenhouse, giving real time images and locations of plant parts showing stress. Those parts were inspected by human and if not clear, a second micro-method was used by sampling and testing on the occurrence of a pest with Luminex-multiplex .

Appropriate *Measures* were started with e.g. a combination of endophytes and predatory insects for synergistic pest control. If not fully successful crop adapted precision spraying was applied using the same carts as for monitoring in which the vision devices are coupled to robotised spraying equipment, only spraying the suspected area of the leaf or stem of tomato (vertical system) or cyclamen (horizontal system).

All data generated from the building blocks, come together in the *dashboard*: a SCOT database for data containment, data exchange. The dashboard shows notifications for the grower in a traffic light manner. The grower may see the hot spots of pests in his greenhouse, translate the data into action, and evaluate the efficacy of various measures.

This whole integrated 'Healthy Greenhouse' system has been built and demonstrated in the experimental greenhouse in Straelen, Germany, showing optimal IPM control in the two crops, with a reduction of 35–50% of the chemical pesticide use. The results of this just finished project will be presented (including a video of operations in the experimental greenhouse), showing state-of-the-art possibilities for sustainable crop protection in green houses in the 21st century.

INNOVATIVE SUSTAINABLE TOOLS FOR IPM OF TOMATO IN PROTECTED CULTURE

Michelina Ruocco[1], Nadia Lombardi[1,2], Stefania Lanzuise[2], Sheri Woo[1,2], Francesco Vinale[1], Rosaria Varlese[2], Roberta Quarto[1], Roberta Panza[1], Roberta Marra[1,2], Alberto Pascale[2],
Gelsomina Manganiello[2], Federica Lacatena[2], Massimo Giorgini[1], Matteo Lorito[1,2]

[1] Istituto per la Protezione Sostenibile delle Piante, (CNR-IPSP), Via Università133, Portici, (NA), Italy
[2] Dipartimento di Agraria, Via Università 130, Portici (NA), ITALY

ruocco@ipp.cnr.it

Tomatoes are one of the most popular and widely grown vegetables in the world either in the field or under greenhouse conditions. In Europe, tomatoes are produced mainly under protected conditions by using an extremely intensive cultivation method, with yields that can reach 700 tonnes/ha. Despite the EU Directive (2009/128/EC) on sustainable use of pesticides, which promotes Integrated Pest Management (IPM) and the implementation of biological alternatives for pest control, the use of chemical pesticides is still very important for crop protection in greenhouse horticulture including tomato cultivation. *Trichoderma* spp. are widely studied fungi and among the most commonly used microbial biological control agents (MBCAs) in agriculture. They are considered as "generalist" MBCAs because are capable of controlling a large spectrum of taxonomically diverse pathogens by using a variety of mechanisms mediated and non-mediated by the plant. For instance, some strains are capable of systemically "prime" and/or activating plant defense responses. This is now considered a very significant mechanism of crop protection as compared to direct antagonism of the pathogen. Moreover, the list of positive effects of *Trichoderma* on plants includes improvement of growth, development, and yield. In the frame of the PURE project, the activity carried out in WP7 has demonstrated that not only some *Trichoderma* strains can be positively combined with other IPM applications, but also *Trichoderma*-produced bioactive compounds (i.e. enzymes and other proteins or secondary metabolites) can be used as an effective alternative to the living fungus. The application of selected bioactive compounds produced by MBCAs may represent an innovative IPM tool because: i) the constrains associated with the production, application and establishment of the living microbe may be overcome; ii) the efficacy of the treatment may be more precisely dependent on the dose of the active principle used; iii) some applications are more effective or possible, such as control of foliar pathogens, as many MBCAs are root-associated; iv) beneficial effects on the plant may be improved and more consistent; v) it is possible to develop highly active synergistic mixtures of bioactive compounds and the living MBCAs.

THE INFLUENCE OF GREY MOULD (*BOTRYTIS CINEREA*) ON DEVELOPMENT OF THE SPIDER MITE POPULATION AND ITS NATURAL ENEMIES IN TOMATO GREENHOUSE CROPS

Żaneta Fiedler, Danuta Sosnowska, Marek Korbas

Institute of Plant Protection – National Research Institute, Węgorka 20, 60-318 Poznań, Poland

z.fiedler@iorpib.poznan.pl

Several species of spider mites occur on ornamental plants and vegetables cultivated in greenhouses. The most important are: the two-spotted spider mite *Tetranychus urticae* (Koch.) and red spider mite *Tetranychus cinnabarinus* (Boisd.).

According to the Polish Directives, biological methods should be used prior to any application of chemical products. Biological control is a priority in plant protection, particularly for vegetable crops in greenhouses. Biological agents such as macroorganisms are not subject to registration requirements in Poland. Thus, there are natural enemies commercially available in Poland. A great many mites in the family *Phytoseiidae* are predators of spider mites. In addition to the *Phytoseiidae* family of mites, Integrated Pest Management (IPM) is often used in greenhouses vegetable crops, mainly in tomato.

The aim of greenhouse studies was to determine the efficacy of the predators: *M. melanotoma*, *A. limonicus* and *A. andersoni* for the control of red spider mite (*Tetranychus urticae*), as well as the effect of grey mould on the pest level and its natural enemies in tomato greenhouse crops. A series of experiments on the efficacy of natural enemies (*Macrolophus melanotoma, Amblyseius andersoni, Amblydromalus limonicus*) against spider mites in greenhouse grown tomatoes were carried out under the laboratory and greenhouse conditions. It was shown a high efficacy (82%) of the joint use of two predatory species *M. melanotoma* and *A. andersoni* in reducing the population level of the red spider mite (*Tetranychus urticae*). Both predatory mite species can be applied jointly without any advertise effects (a phenomenon of neutralism). The joint use of the species *A. limonicus* and *A. andersoni* caused a high mortality (72%) of the pest. However, the efficacy of this treatment was not statistically different as compared to the treatment with a separate use of the predator *A. limonicus*. The result of the studies on joint use of *A. limonicus* and *A. andersoni* revealed a phenomenon of interspecies competitiveness, and as a consequence the species *A. limonicus* dominated. Therefore, their joint application should not be recommended as a biocontrol agent in integrated plant protection programmes. The greatest increase in the number of spider mite was shown in all treatments with tomato plants infected by grey mould (*Botrytis* cinerea). The number of spider mites increased by fivefold in the treatments with tomato plants infected by grey mould (*Botritis cinerea*), and all those treatments showed a lowered efficacy of the applied predators *A. limonicus* and *A. andersoni* in reducing the pest level. The efficacy of the predatory mite species *M. melatonoma* against the red spider mite was not affected by the infection of tomato plants with grey mould. The pathogen didn't influence on efficacy of *M. melanotoma* in controlling of spider mites.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007–2013) under the grant agreement n°265865-PURE

THE ROLE OF ADJUVANTS IN THE EFFICACY OF ENTOMOPATHOGENIC FUNGI: *I. FUMOSOROSEA* AND *L. LECANII* IN CONTROLLING WHITEFLY (*TRIALEURODES VAPORARIORUM* WESTWOOD)

Henryk Ratajkiewicz[1], Żaneta Fiedler[2], Renata Wojciechowska[2], Jagoda Strzelińska[1], Mateusz Szymańczyk[2]

[1] University of Life Sciences, Wojska Polskiego 28, 60-637 Poznań, Poland

[2] Institute of Plant Protection – National Research Institute, Władysława Wegorka 20, 60-318 Poznań, Poland Z.Fiedler@iorpib.poznan.pl

The effectiveness of entomopathogenic fungi applied foliarly depends on different factors in open field and in greenhouse crops. The optimal level of relative humidity for tomato is lower than needed for infection caused by fungi. Several species of entomopathogenic fungi are known, which are used in controlling whitefly in greenhouse tomato crops. The rich waxes on the surface of the insect significantly hinder its wetting during spraying an aqueous suspension. The possibility of improving the effectiveness of entomopatogens is seen in modifying the suspension properties. The aim of the study was to evaluate the role of adjuvants (humectant and surfactant) in the effectiveness of *L. lecanii* and *I. fumosorosea* in controlling whitefly (*T. vaporariorum*).

In the studies were used $CaCl_2$, glycerin like humectants and cocoglucoside (Glucopon 650 EC – BASF) and a commercial adjuvant Addit (Koppert) that acted as wetting agent. Under the microscope the diametr of a droplet on leaf and parafilm were measured. The wetting of nymph on the surface of the liquid was also evaluated. Biological tests were carried out with *I. fumosorosea* and *L. lecanii* at a concentration of $5 \cdot 10^6$ and $1 \cdot 10^7$ in a mixture with adjuvants. Scanning (SEM) observations showing the deposit of substances and the development of fungus after application of drops of liquid on individual insects were made. The germination of spores on PDA culture medium was rated. Spraying indicators for leaf and parafilm under conditions corresponding to the application of spore suspensions were also taken.

Addition an adjuvant to a suspension of the entomopathogenic fungi increased mortality of whitefly. Insect mortality was the highest after application of a liquid containing cocoglucoside and humectant. When *I. fumosorosea* was applied, the addition of $CaCl_2$ and cocoglucoside increased mortality more than cocoglucoside and glycerin. When *L. lecanii* was applied insect mortality didn't depended on the type of the humectant. Droplet spreading was not significantly differentiated on tomato leaf and parafilm when liquid mixtures contained cocoglucoside and Addit. Similarly, the wetting of insects on the surface of the liquid did not differ. While the best humectant was $CaCl_2$, drying time of droplets did not differ from glycerol. The spores germination ability after addition of cocglucoside and humectants did not differ of spore only in water. Deposit of substances on the surface of nymph differed morphologically. It is possible that $CaCl_2$ could cause greater stress of insects than glycerol. Cocoglucoside caused significant mortality of insects even without fungal insecticide. Cocoglucoside caused more than a double coverage of sprayed surface compared to water. The mortality of whitefly depended on the coverage of leaf and insects, fungal pathogenicity and physical impact of adjuvants on insects.

The research was financed by National Science Center, project no: N N310 781340