IOBC
OILB

International Organisation for Biological and Integrated Control of Noxious Animals and Plants
Organisation Internationale de Lutte Biologique et Integrée contre les Animaux et les Plantes Nuisibles

WPRS / SROP West Palaearctic Regional Section / Section Régionale Ouest Paléarctique

Working Group
"Pesticides and Beneficial Organisms"

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A B S T R A C T S

(in alphabetical order)

WG Convenor: Dr. Heidrun Vogt
Local Organisers: Prof. Dr. Remigiusz Olszak
Dr. Darek Gajek

Research Institute of Pomology and Floriculture

(1) Effects of Imidacloprid on *Poecilus cupreus* larvae depending on the mode of application

Barbara Baier, Claudia Norr, Detlef Schenke and Tanja Scharnhorst

Institute for Ecotoxicology and Ecochemistry in Plant protection, Federal Research Centre for Agriculture and Forestry, Königin-Luise-Straße 19, D-14195 Berlin, Germany, e-mail: b.baier@bba.de

Imidacloprid can be applied as seed treatment (seed dressing and pelleting) or it can be sprayed. The aim of the laboratory investigations was to evaluate the effects of imidacloprid on *Poecilus cupreus* larvae: experiment 1) applied as seed dressing (winter wheat) and pelleting (sugar beet); and experiment 2) applied as seed dressing compared to spray application.

Winter wheat seeds were dressed with Gaucho 350 FS and Gasur (both 350 g imidacloprid/100 kg seeds), respectively. Sugar beets were pelleted with Gaucho WS (91 g imidacloprid/100000 seeds). Confidor 70 W was sprayed (63.5 g imidacloprid/ha). The tests were carried out with glass tubes used for the standard test for soil-surface-applied plant protection products with 5 cm^2 surface and larger containers (winter wheat 92 cm^2 surface, sugar beet 92, 188 and 384 cm^2 surface). Larger containers were selected to achieve a more realistic exposure regarding seed density in the field. Lufa 2.1 was used as substrate. One larva of 24 to 48 hours age was released into each test unit. In addition to the biological investigations, the imidacloprid amount on seeds with mean corn weight and the imidacloprid concentration in the soil were determined.

Chemical analyses indicated that only a zone of approximately 2.4 cm in diameter around the coated seed was exposed to higher imidacloprid concentration. The field winter wheat seed density (app. 4.5 million seeds/ha) and the 2fold field seed density with sugar beets (260000 seeds/ha) led to an effect of 58% and 6% (corrected mortality) on *Poecilus cupreus* larvae. Therefore the effect of Imidacloprid applied as seed treatment on larvae of *Poecilus cupreus* was dependent on the number of coated seeds/ha primarily.

100% mortality of the *Poecilus cupreus* larvae was observed when imidacloprid was sprayed.

(2) How much precision does a regulatory field study need?

Kevin Brown[1] and Mark Miles[2]

[1] *Ecotox Limited, Tavistock, Devon, PL19 0YU, UK*
[2] *Dow AgroSciences, European Development Centre, 3 Milton Park, Abingdon, Oxon, OX14 4RN, U.K.*

A regulatory field study is designed to determine which species are affected and whether recovery occurs within the season. Taxonomy is a time-consuming and expensive component of such studies and not all arthropod groups can be identified with equal ease. With many thousands of specimens it is not usually possible or sensible to identify all specimens to species level.

This paper looks at analysis of the results from large-scale field studies conducted in cereals in Devon, UK, using univariate techniques at family level and at species level for carabid beetles, staphylinid beetles, linyphiid spiders and Collembola. The conclusions of this analysis are compared with those from made using Principal Response Curves.

When data is summarised at the family level genuine effects on arthropod species are often overlooked. PRC analysis indicates that some non-target arthropods may be more important indicators of treatment effects than others.

(3) Effects of toxins in transgenic crops on natural enemies

Zbigniew T. Dąbrowski and Julia Górecka

Department of Applied Entomology, Warsaw Agricultural University, Nowoursynowska 159, 02-787 Warsaw, Poland. E-mail: dabrowskiz@alpha.sggw.waw.pl; julia2@wp.pl

First successes in introduction of transgenic crops in the USA, Argentina, Canada and other countries brought a hope of their potential beneficial effects as follows: increased flexibility in crop management; decreased dependency on synthetic pesticides and season long protection; enhanced yields and considerable financial savings. First reports in the late 1990-ties showed that there was 30 – 50% reduction of pesticide usage on maize in the USA. At the same time some scientific reports gave evidences of negative side effects of genetically modified plants (GMP). In 2002 Entomological Society of America (ESA) released its position statement on transgenic insect-resistant crops: potential benefits and hazards <http:/www.entoc.org/publicaffairs/position papers/gm-crops.htm>. The statement emphasizes that the evaluation of hazards connected with the release of GMP should consider procedures previously developed for pesticides as follows: human health, environmental impacts, insect resistance to transgenic plants, management of resistance. At the same time the wisdom of using a specific-resistant crop should be evaluated relative to the long-term goals of reducing pesticide use and fostering sustainable crop production systems. The challenge facing entomologists and pest managers is to ensure that these crop varieties are used properly and that scientific information remains a cornerstone of debate regarding their deployment.

Genetically modified plants (GMP) may soon be commercially cultivated in several countries of the European Union (EU). According to the UE Directive 2001/18/EC, pre-release risk assessment and post-market monitoring for commercial GMP cultivation has to be implemented, which allows for detection and prevention of adverse effects on human health and environment. Currently there is neither EU or even between scientists wide consensus on how relevant procedures have to be designed to provide sound scientific data. Already some European authors have carried out large scale field experiments on the effect of transgenic cultivars on natural enemies. The data interpretation should however separate a direct effect of GMP toxins on natural enemies from an indirect effect through reduced abundance of phytophagous prey.

The paper reviews methods and techniques used by various authors in studies of GMP effects on natural enemies. The initiatives of members of the IOBC working group "GMO in integrated plant production" in studies on ecological impact of genetically modiefied organisms and their wide differences in opinion on selection of species as bio-indicators in risk assessment and post-release monitoring are presented.

(4) The loss of earwig populations in Belgian orchards: testing side-effects on orchard management

Bruno Gobin

Department of Zoology, Royal Research Station for fruitgrowing at Gorsem, Belgium.
E-mail: bruno.gobin@pcfruit.be +32 11 67 43 18

Earwigs are key generalist predators to a variety of orchard pests. However, the once held believe that earwigs damage and spoil fruits led to control strategies and eventually the loss of large earwig populations in Belgian orchards. In recent years, Integrated and Organic fruit growers have tried to re-establish earwig populations, thus far with little success. We started a study linking various components of orchard management and the earwig life history to identify potential factors hazardous to earwigs. We investigate effects in both short term (e.g. knock down of pesticide use) and long term (e.g. introduction of populations). The goal of this study is to adapt management to allow optimal development of the earwig population.

Studying side-effects on this univoltine organism, especially at the population level, revealed some intrinsic problems. First of all there is a strong variation within orchards, even at the tree level at a given site within the orchard, requiring larger sample sizes. Second, there appears to be a considerable effect of niche occupation (tree and soil) during larval stages, the most sensitive life stages. Third, Spatial distribution patterns seem to change during life history, from clumped nests to patchy larval distribution and continuous adult presence. In addition to this, transplants of large earwig populations to previously unoccupied orchards are seldom successful, limiting clear-cut experimental design. These issues need to be properly addressed to limit their impact on the outcome of side-effect testing in field tests.

(5 Side effects of insecticides used in cotton and vineyard areas of Aegean Region of Turkey on the green lacewing, *Chrysoperla carnea* (Steph.) (Neuroptera: Chrysopidae) under semi field conditions

Bilgin Güven, M.Ali Göven

Bornova Plant Protection Research Institute, Gençlik Street 6, 35040, Izmir, Turkey, *e-mail*: *bilginguven@yahoo.com, mehmetaligoven@hotmail.com*

The side-effects of insecticides used in cotton and vineyards areas on the predator *Chrysoperla carnea* (Steph.) were studied under semi field conditions. The tests were performed according to the standard semi field test method of the IOBC/WPRS Working Group “Pesticides and Beneficial Organisms”.

As a result of these tests Ekalux (a.i. Quinalphos), Korvin (a.i. Carbaryl), Deltanet (a.i. Furathiocarb), Flashed and (a.i. Profenofos+Cypermethrin) were classified as high toxic and Cascade (a.i. Flufenuxuron) as moderately toxic products. Dimethoate (reference item) showed high toxicity resulting in a death rate above 75 % .

Key words: *Chrysoperla carnea*, insecticides, side-effects, semi-field

(6) Does implementation of a selective blueberry insect control program enhance biological control?

Rufus Isaacs[1], Keith Mason[1] and Matthew O'Neal[2]

[1]Department of Entomology, Michigan State University, East Lansing, MI 48824, USA, email: isaacsr@msu.edu; [2]Department of Entomology, 117 Insectary, Iowa State University, Ames, IA 50011, USA, email: oneal@iastate.edu

Highbush blueberry (*Vaccinium corymbosum*) fields in Michigan, USA contain a diverse community of natural enemies. This includes parasitic hymenoptera, ground beetles, and generalist predators such as lacewings and ladybeetles. As legislated changes and societal opinion increase the registration of selective insect control strategies, blueberry producers are adopting insecticides expected to have lower toxicity to natural enemies. A four-year research project is examining whether natural enemy abundance increases when blueberry producers transition to more selective insecticides, rather than using broad-spectrum insecticides, and the potential benefit in pest control that can be expected. On each of six blueberry farms, two adjacent 2-4 Ha fields were studied, one managed under a conventional insecticide program and the other with selective insecticides. Using pitfall traps, 34 species of ground beetle were collected, with *Harpalus pensylvanicus* representing 70.7% of the total beetles collected. The greatest amount of ground beetle activity occurred in August and September, due mostly to increased captures of the autumn breeding species *H. pensylvanicus* and *H. erraticus*. In the first two years of this study, only *H. erraticus* responded to the different insecticide programs, with eight-fold greater captures in reduced-risk compared to grower standard fields. Parasitism of the blueberry aphid, *Illinoia pepperii,* was higher in fields receiving selective insecticides compared to conventional fields, and aphid populations were lower. Generalist natural enemies sampled on the bushes through the growing season were not significantly affected by management regime, suggesting that the population of these mobile insects is operating at larger spatial scales than the fields studied. Overall, adoption of the selective insecticide program provided greater abundance of some members of the predatory arthropod fauna, while many did not respond. Further efforts are underway to determine the extent to which increases in natural enemies may provide measurable economic benefits in terms of pest control for blueberry growers.

(7) Comparative sensitivity of four ladybird species to five pesticides

Jean-Pierre Jansen[1], Louis Hautier[1]

[1]Department of Biological control and Plant genetic ressources, Agricultural Research Centre, Chemin de Liroux, 5030 Gembloux – Belgium, labecotox@cra.wallonie.be

Since 2003, four ladybird species are currently encountered in open field: the three native species *Coccinella septempunctata* (L.), *Adalia bipunctata* (L.), *Propylea quatuordecimpunctata* (L.), that were also found before, and the invasive species *Harmonia axyridis* (Pallas). As this last species could be a problem in the future for native species,

experiments were carried out to assess its sensitivity to pesticides compared to native species, to determine if the presence of *H. axyridis* in agricultural ecosystems and the use of pesticides can give a supplementary advantage or not to *H. axyridis*. Results can also provide information on the sensibility of the four species, in order to determine if it could be possible to extrapolate data obtained with one species to another one.

For this, the LR50 of five pesticides (three insecticides :imidacloprid, zeta-cypermethrine, triazamate and two fungicides : spiroxamine and metalaxyl-M + fluazinam) was assessed on glass plates. Products were tested on basis of a screening test (5 doses in a dilution range 5-10x + control, 10 larvae per object) and a final test (5 doses in an adapted range to ideally cover 0-100 % mortality + control, 20 larvae per object). The larvae used for the tests were 2-3 day old and were confined 7 days on glass plates. Mortalities were recorded daily and final assessment was made at day 7 of exposure.

The results can be summarised as follows:

LR50, in ml of formulated product/ha of five pesticides to four ladybird species

	Impulse	Epok	Aztec	Fury	Confidor
C. 7-punctata	1155.5 ± 79.0	681.2 ± 158.8	54.1 ± 8.7	0.4766 ± 0.064	300.5 ± 56.7
P. 14-punctata	810.0 ± 54.8	211.6 ± 51.2	75.7 ± 8.5	0.0279 ± 0.0032	1.26 ± 0.27
A. bipunctata	1123.4 ± 74.5	36.1 ± 9.9	21.8 ± 2.9	0.0118 ± 0.0014	0.54 ± 0.11
H. axyridis	1584.4 ± 111.6	68.3 ± 17.7	143.4 ± 18.4	0.0437 ± 0.0058	0.49 ± 0.11

Results show, that there is no clear relation between species and sensitivity to the different tested pesticides. *A. bipunctata* was most of the time the most sensitive species, but there were exceptions, as for Impulse (*P. 14-punctata*) and Confidor (*H. axyridis*), and it was not possible to generalise. However, if the results obtained with *C. 7-punctata* are omitted, the sensitivity of the three other species is more or less comparable, with LR50 ratio from the less sensitive to the most sensitive in a range of 1 –6x.

C. septempunctata was most of the time the less sensitive species. For Confidor, LR50 of *C. 7-punctata* was up to 600x higher than *H. axyridis*, the most sensitive species. These results are suggesting a possible resistance mechanism for this species.

(8) Building selectivity lists of plant protection products on beneficial arthropods in open field: a concrete example with potato crop

Jean-Pierre Jansen[1], Louis Hautier[1], Nicolas Mabon[2], Bruno Schiffers[2]

[1]*Department of Biological control and Plant genetic ressources, Agricultural Research Centre, Chemin de Liroux, 5030 Gembloux – Belgium, labecotox@cra.wallonie.be*
[2]*Phytopharmacy Laboratory, Gembloux Agricultural University, Passage des Deportes, 2, 5030 Gembloux, Belgium*

In order to promote IPM and the use of selective pesticides in open field, a program was initiated to provide selectivity lists to pesticide users. The first approach was with potato crop, because of intensive use of pesticides and interest of IPM in this crop in Belgium.
For this, the following beneficial arthropods species were selected: *Aphidius rhopalosiphi* (De Stefani-Perez) (Hym.; Aphidiidae), representative of parasitic hymenoptera, *Adalia*

bipunctata L. (Col.; Coccinellidae) and *Episyrphus balteatus* (Degeer) (Dipt.; Syrphidae), both representative of leaf dwelling predators. They are all aphid specific enemies, the main pest problem in potato in Belgium.

The toxicity of 20 fungicides and 12 insecticides used in potato during exposition period of these beneficial species was assessed according to methods previously developed. The tests included a glass plate test on inert surface according to IOBC standard and an extended-lab test on natural substrate (barley seedlings for *A. rhopalosiphi* and French bean seedlings for *E. balteatus* and *A. bipunctata*). The spray apparatus was calibrated to deliver a pesticide residue deposit similar to a field application. A chemical dosage of residue was realised at each test on natural substrate to validate the application and follow pesticide degradation during exposure.

According to results of both test, products were rated as "Green" (selective), "Yellow" (moderately selective), "Orange" (Poorly selective) and "Red" (non selective). Lists were build-up according to toxicity results of product and split in 4 periods of use, in parallel of aphid natural enemies presence and their importance in the field: period one (until 10 june) and four (after 31 july), no or limited exposure of beneficials, period 2 (10-30 june) exposure of Aphidius and period 3 (july), exposure of leaf dwelling predators. These periods were based on field observations of aphids and natural enemies carried out since 1994 in the context of potato pest advisory systems.

A first list was compiled and distributed to farmers in 2004 and a new list was build up and distributed in 2005, with new compounds. It is now intended to extend these lists to others crops, as field vegetables (onions, carrots,....), with new compounds and other beneficial species, as the ground dwelling predators *Bembidion lampros* (Herbst) (Col.; Carabidae) and *Aleochara bilineata* (Gyll.) (Col.; Staphylinidae).

(9) **Harmful and beneficial entomofauna in apple orchards grown under different management systems**

Radoslav Andreev[1], Remigiusz Olszak[2], <u>Hristina Kutinkova[3]</u>

[1] *Department of Entomology, Agricultural University, 12 D. Mendeleev str., 4000 Plovdiv, Bulgaria, e-mail: rado@au-plovdiv.bg;*

[2] *Department of Plant Protection, Research Institute of Pomology and Floriculture, 18 Pomologiczna str., 96-100 Skierniewice, Poland, e-mail: rolszak@insad.pl;*

[3] *Fruit Growing Institute, 12 Ostromila str., 4004 Plovdiv, Bulgaria, e-mail: kutinkova@abv.bg*

During the period 1996-2004, on the Experimental Field of the Agricultural University – Plovdiv, Bulgaria, the harmful and beneficial insects were observed in apple orchards grown under different management systems: biological, integrated and conventional (chemical). A total of 43 pests, belonging to 27 families and 5 orders were recorded in the orchard under biological pest management (BPM). The species of the orders *Hemiptera* – 16 and *Lepidoptera* – 17 were the most common. In the orchards under IPM and chemical pest management (CPM) 35 and 26 species were found, respectively. Codling moth, *Cydia pomonella*, is the main pest of apple in Bulgaria. This species has two generations per year and causes damage to fruits from May till harvest time. The population density of codling moth is permanently extremely high in all orchards and it is necessary to control it using

insecticides and other plant protection tactics as well. Other pests with a high population density in the BPM-orchard are the apple sawfly *Hoplocampa testudinea*, the pear lace bug *Stephanitis pyri,* tortricid-moths, the apple clearwing *Synanthedon my opaeformis,* the leopard moth *Zeuzera pyrina* and the weevils: *Phyllobius oblongus, Rhynchites bacchus* and *R. aequatus.* The populations of aphids, leafminers, chafer *Epicometis hirta* and leaf-eating caterpillars increase occasionally. The harmful insects in IPM-orchard were controlled with 6 to 9 insecticide treatments. The populations of aphids, leafminers, leopard moth, goat moth *Cossus cossus,* apple clearwing and scale insects increase occasionally. The harmful insects in CPM-orchard were controlled with 10 to 14 insecticide treatments. At the same orchard a high population density of leafminers (especially pear leaf blister moth *Leucoptera scitella*) was observed. An increase in the population densities of aphids, scale insects, *Epicometis hirta*, leopard moth, goat moth and apple clearwing was periodically observed. Beneficial insects were very abundant in the BPM-orchard. A total of 29 predators were found, belonging to 4 orders and 7 families. The ladybirds presented the highest population density and were significant as natural regulators of pests. Important natural regulators were also parasitoids from the order *Hymenoptera*. They refer to 7 families and control aphids, scale insects, leafminers, tortricids and apple blossom weevil, *Anthonomus pomorum.* The population density of beneficial insects was lower in the IPM-orchard, but their importance as natural regulators of pests was still significant. In the CPM-orchard they were found occasionally.

(10) Effects of botanical insecticides on two natural enemies of importance in Spain: *Chrysoperla carnea* (Stephens) and *Psyttalia concolor* (Szépligeti)

Pilar Medina, Flor Budia, Benjamín Rodríguez, Manuel González, Aurelio Díaz, Arturo Huerta, Nelson Zapata, Elisa Viñuela.

Unidad de Protección de Cultivos. Escuela Técnica Superior de Ingenieros Agrónomos. Ciudad Universitaria, s/n. 28040. Madrid. España. e-mail: pilar.medina@upm.es

Insecticidal properties of some plant extracts are known from ancient times. Despite their use has been basically limited to subsistance crops in underdeveloped countries, adverse environmental effects on nontarget organisms and the build up of resistance caused by the abuse of pesticide use in developed countries, have contributed to the increase of research on plant-derived pesticides. Nowadays, among plants with a higher potential to be used for the development of active products against insects, there is an increasing number of species from the families Meliaceae and Lamiaceae, rich on secondary metabolites. The bioassay-guided fractionation of *T. havanensis* (Meliaceae) extracts lead to the purification of two limonoids: azadirone (F12) and 1,7+3,7-di-O-acetylhavanensin (4:1) (F18) whereas two compounds (M1 and M9) were extracted from *Teucrium viscidum* (Lamiaceae). All these compounds have antifeedant properties against some important pests.

In the current study, effects of these compounds have been evaluated on two natural enemies, the generalist predator *Chrysoperla carnea* (Neuroptera: Chrysopidae) and the olive fruit fly parasitoid, *Psyttalia concolor* (Hymenoptera: Braconidae). Ingestion bioassays at concentrations of 1000 mg a.i./l were carried out on adults of both beneficials to study potential antifeedant effects as it was observed on phytophagous pest. Results have

demonstrated that these bioinsecticides are nearly innocuous for both natural insects at the conditions tested.

(11) Mancozeb: A profile of effects to beneficial and non-target arthropods

Mark Miles

Dow AgroSciences, European Development Centre, 3 Milton Park, Abingdon, Oxon, OX14 4RN, U.K.

Mancozeb is a dithiocarbamate fungicide with multisite modes of action against economically important fungal diseases and is the active substance in Dithane* fungicides. It is a broad spectrum contact fungicide with high protectant activity. To date there are no recorded incidences of resistance despite many years of use on high resistance risk diseases. Due to this, mancozeb is a key strategic fungicide in resistance management programmes and is registered for use in a wide range of crops globally. Mancozeb is well known for its side-effects on certain phytoseiid mites, however during the use of the product a wide range of other important beneficials may also be exposed. This paper will review a wide range of studies on the effects of predatory and parasitic arthropods and provides the first opportunity to see the findings from new studies with soil mites, spiders and predatory heteroptera.

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(12) The effects of spinosad on beneficial insects and mites used in integrated pest management systems in greenhouses

Mark Miles

Dow AgroSciences, European Development Centre, 3 Milton Park, Abingdon, Oxon, OX14 4RN, U.K.

A wide range of studies have been conducted under laboratory, extended laboratory and semi-field (glasshouse) conditions to assess the impact of spinosad on predatory and parasitic insects and mites used in glasshouse IPM programmes. Spinosad may be used to control thrips, dipterous leaf miners and caterpillars on a range of economically important greenhouse crops and ornamentals. Findings from a wide range of studies have shown that when used according to good horticultural practice, spinosad was compatible with predatory mites (*Phytoseiulus persimilis, Amblyseius californicus, Amblyseius cucumeris, Hypoaspis aculeifer* and *Hypoaspis miles*), predatory Heteroptera (*Orius laevigatus* and *Macrolophus caliginosus*), Coccinellidae (*Hippodamia convergens* and *Coccinella septempunctata*), Neuroptera (*Chrysoperla carnea* and *Chrysoperla rufibularis*) and Diptera (*Aphidoletes aphidimyza*). Parasitic Hymenoptera were sensitive to spinosad; however toxic effects were short lived due to the low persistence of spinosad and species such as *Aphidius colemani, Encarsia formosa* and *Trichogramma brassicae* can be introduced to protected crops within 2 weeks of after application. It can be concluded that spinosad is highly selective to beneficials making it an ideal insect control product for use within greenhouse IPM programmes.

(13) Side effects of various pesticides on *Feltiella acarisuga*

Koen Altena[1], Ed Moerman[1]

[1]*Koppert Biological Systems, PO Box 155, 2650 AD Berkel en Rodenrijs, the Netherlands, email: kaltena@koppert.nl, emoerman@koppert.nl*

Biological control of two-spotted spider mite *Tetranychus urticae* (Koch) in cut roses has largely contributed to the increasing use of the predatory gall midge *Feltiella acarisuga* (Vallot). This required a better understanding of the impact of the application of various pesticides. Laboratory trials with direct application of these pesticides on *F. acarisuga* larvae on sweet pepper leaves on agar in Petri dishes, followed by counts and qualitative observations helped to improve the understanding ànd the success rate of commercial introductions.

Key words: *Feltiella acarisuga,* side effects, abamectine, bifenazate, hexythiazox, imidacloprid, milbemectin, pymetrozine, pyridaben, pyriproxifen, spinosad, tebufenpyrad.

(14) Side effects of various pesticides on *Amblyseius swirskii*

Pilar Vanaclocha Arocas[1], Hans Hoogerbrugge[1], Ed Moerman[1]

[1]*Koppert Biological Systems, PO Box 155, 2650 AD Berkel en Rodenrijs, the Netherlands, e-mail: hhoogerbrugge@koppert.nl, emoerman@koppert.nl*

The unique feature of a beneficial that contributes to the control of both thrips and whitefly has generated a wide interest in the predatory mite *Amblyseius swirskii.* In the first year of commercial availability, the product SWIRSKI-MITE has been introduced in hundreds of hectares of protected sweet pepper, aubergine and cucumber, first in the Netherlands and then in other European countries. This publication describes the results of laboratory trials of dry residue on adults and direct spraying on eggs with 12 insecticides/acaricides and 6 fungicides as well as the first field experiences with the side effects of some pesticides.

Key words: *Amblyseius swirskii,* side effects, abamectin, azoxystrobin, *Bacillus thuringiensis,* bifenazate, bitertanol, boscalid, bupirimate, carbendazim, cyromazin, fenarimol, fenbutatinoxide, imazalil, imidacloprid, kresoximethyl, milbemectin, pirimicarb, potassiumsalts of fatty acids, pymetrozine, pyridaben, spinosad, sulphur, tolylfluanide, triflumizole, vegetable oil, *Verticillium lecanii*

(15) Side-effects of IGR on development of an aphid-parasitoid *Aphidius colemani* (Hymenoptera: Braconidae) Viereck

Delphine Juan and Jean Baptiste Ferré

[1]*Enigma, Hameau de St. Véran, F-84190 Beaumes de Venise, poullot.enigma@wanadoo.fr*

ENIGMA, Hameau de St. Véran, F-84190 Beaumes de Venise

Four insect growth regulators and one neurotoxic insecticide were tested to evaluate their effects on several life history parameters of the aphid parasitoid *Aphidius colemani* Viereck. The standardised laboratory methods were used. The neurotoxic compound (organophosphate) was toxic on adults. The organophosphate and pymetrozine increased host mortality, reduced mummification and emergence rate when sprayed during all the steps of parasitoid development. All the IGR tested were slightly toxic for adults. However, Fenoxycarb increased host mortality when sprayed on young instars of the parasitoid, and decreased mummification when the application was done when the parasitoid was realising its first or second moulting. Flufenoxuron increased host mortality when it was sprayed on parasitoids during their first moulting, or sprayed when the parasitoid was at its two first larval instars, or when it was doing its nymphosis. Flufenoxuron reduced mummification when it was sprayed on parasitoids before nymphosis. Buprofezin had no effect either on host mortality, mummification or emergence at all the steps of parasitoid development. Consequently in spite of their low toxicity on adults of aphid parasitoids, IGR have to be used carefully in integrated pest management strategies considering susceptible instars of beneficials which depend on their respective modes of action.
Keywords : IGR, aphid parasitoids, host mortality, emergence, mummification, mode of action.

(16) Protection of beneficial Organisms in Research and Practice in Poland

Stefan Pruszyński

The Institute of Plant Protection, Miczurina 20, 60-318 Poznań, Poland
e-mail: s.pruszynski@ior.poznan.pl

The problem of natural environment and beneficial organisms protection connected with chemical plant protection treatments appeared in Poland very early. Mass invasion of Colorado potato beetle (*Leptionotarsa decemlineata* Say.) at the beginning of fifties and the necessity of protection of potatoes grown at that time on the area of above 2 millions hectares, mainly using DDT, demonstrated very clearly all negative effects of unreasonable use of chemical plant protection products.

Parallel to administrative activities research units belonging to Ministry of Agriculture, higher education and Polish Academy of Science developed research programmes concerning:

- occurrence and biology of most important beneficial organisms
- selectivity of plant protection products to beneficial organisms
- effect of chemical treatments on various components of agrocenosis

- protection of beneficial organisms during chemical treatments
- elaboration of integrated protection of agriculture and horticulture crops.

Obtained results led to implementation to the practice integrated production technology of several horticulture crop, biological and integrated protection of glasshouses crops and recommendation for integrated protection of some agriculture crops.

Estimate the present situation it is necessary to underline the presence in polish plant protection scientifically based recommendation of chemical treatment with special attention to protection of beneficial organisms. reach and beautiful agriculture landscape and very low usage of chemical active substances (less than 0,7 kg/ha) should be also mentioned. The negative aspects are very low on research programmes and advisory service.

(17) Influence of plant protection measures on the Carabidae fauna in sugar beet and potato fields

Katarzyna Nijak & Stefan Pruszyński

Department of Ecology and Agricultural Environmental Protection
Institute of Plant Protection, Miczurina 20, 60-318 Poznań
e-mail: K.Nijak@ior.poznan.pl

Beetles belonging to the family *Carabidae* are soil dwelling arthropods which inhabit natural and anthropogenic modified environments. This group of insects is very often called bioindicators for changes in the environment. Analysis of number and species composition of the *Carabidae* population can be used as an indicator for changes occuring in the environment and for the degree of its degradation.

Our investigations concerned side-effects of pesticides applied in sugar beet and potato fields. The aim of the experiments conducted in 2000 and 2004 was to determine changes arising among the fauna of useful arthropods in agrocoenosis in case of using agrochemicals recommended for the protection of crops.

Field experiments were conducted in the Experimental Station of the Institute of Plant Protection in Winna Góra, near Środa Wielkopolska. Experimantal productive fields of sugar beet and potato were divided in two parts: one intensively protected and one control part. Fields were separated from each other by insulating belts.

During the vegetation season, barber traps were used constantly for catching the soil dwelling fauna. The most numerous group of arthropods were beetles, mainly predators belonging to the family of *Carabidae*. Seasonal changes in the number of insects were similar on protected and control fields of the particular crop. Comparison of the number of *Carabidae* population for different terms of observations was carried out regarding weather conditions and plant protection treatment.

Obtained results showed, that chemical treatment of the fields did not always influence the number of discussed arthropods.

(18) A method to prove long term effects of neonicotinoids on whitefly parasitoids

Ellen Richter

Biological Research Centre for Agriculture and Forestry, Institute for Plant Protection in Horticulture, Messeweg 11/12, D-38104 Braunschweig, Germany, email: e.richter@bba.de

Controlling whiteflies with the parasitoid wasp *Encarsia formosa* in poinsettia (*Euphorbia pulcherrima*) has been a successful example for biological control programmes for many years. However, some years ago this was questioned by growers and plant protection services because of its reduced efficacy. The objective of this work was to find reasons for the reduced efficacy of *E. formosa* in poinsettia.

From literature it is known that many insecticides have a repellent impact on *E. formosa*. They do not approach treated plants. That is why the influence of insecticides belonging to the new class of synthetic neonicotionids, esp. Confidor® WG 70 (active ingredient: imidacloprid) was examined on the parasitation behaviour of the parasitoid. The systemic active substance imidacloprid shows a long-term effect against pests in many crops which leads to the assumption that either the active ingredient and/or metabolites remain in the plant for a long time. Although it is known that spraying imidacloprid has a negativ effect on *E. formosa*, drenching plants was supposed to be harmless, because the insect is not exposed to the substance. For an exact valuation of persistent effects of pesticide treatments no adequate test system exists until now.

Fortunately an imidacloprid resistent line of *Bemisia tabaci* was available for this investigations. Four poinsettia plants each were put in three insect safe cages in a climatic chambre. In the first cage plants were sprayed with imidacloprid, in the second they were drenched and in the third cage they were left untreated. Weekly after the treatment one infested leaf was removed from a plant of each cage. Its stalk was put into a test tube with water and then the leaf was placed together with an „*Encarsia*-card“ into a transparent dish. Each following week, leaves were checked for *Bemisia*-larvae, parasitised larvae and empty cases of parasitised larvae. Although separated from the plant the leaves in this test system remained alive for four to seven weeks, long enough for white flies and parasitoids to develop. On untreated leaves, parasitised white fly larvae were found after two to three weeks and first wasps emerged after three to four weeks onwards. When treated with imidacloprid, white flies could well develop on the leaves, while parasitoids did not. After spraying the plants, the repellent effect of imidacloprid lasted approx. 16 weeks, after drenching the effect lasted even longer. This result means that Confidor 70 WG, frequently used in stock plants, has a long lasting repellent and lethal effect on *E. formosa*.

Additionally, the effect of imidacloprid was tested on another wasp species, *Eretmocerus mundus*. Afterwards this test system was also used to test the effect of the new neonicotinoids acetamiprid and thiacloprid on *E. formosa*.

(19) Consideration of side effects on beneficial organisms during product development in the agrochemicals industry

Hans-Jürgen Schnorbach

Bayer CropScience AG, Agronomic Development Insecticides, Monheim, Germany, e-mail: hans-juergen.schnorbach@bayercropscience.com

Specificity and selectivity are important prerequisites of a modern, IPM compatible plant protection product (PPP). The identification of a selective compound in the early research/screening process favours its development. Preliminary tests on the predatory mite *Typhlodromus pyri* and ladybird beetle larvae *Coccinella septempunctata* are performed for an early differentiation of the spectrum of activity. During the early development process side effects of products on foliar dwelling beneficial arthropods are investigated in semi-field cage tests. Representative beneficial insects like ladybird beetles (*C. septempunctata*), parasitoids (*Aphidius colemani*), predatory bugs (*Anthocoris nemoralis*), predatory midges (*Aphidoletes aphidimyza*) and hover flies (*Episyrphus balteatus*) are chosen for these tests. Effects on eggs, larvae, pupae and adults are examined to quantify the possible specificity of a compound with respect to the developmental stage. Insects are either directly treated, exposed to treated surfaces or are fed with contaminated prey. Hatching of parasitoids is investigated after treatment of the mummies.

In the course of the main development of a compound a wide range of field tests is conducted with various beneficial organisms in the most relevant crops (e.g. apple, pear, citrus, wine, cereals, rice, vegetables, cotton). Important parameters like prey-predator ratio, parasitisation rate, residual efficacy and time to recovery are determined under practical conditions.

Knowledge on the selectivity of a PPP allows to design treatment strategies involving a combination or succession with commercial beneficials. In case any adverse effects are observed, the waiting period until beneficial organisms may be released is investigated. Recommendations with regard to alternative application methods like drench or seed dressing can also contribute to a safe use for beneficial organisms.

Trial results from various field research stations throughout the world give a representative overview of local situations with regard to the interaction of climatic conditions, crops, pests and beneficials.

All information gathered on the side effects of a PPP on beneficial arthropods contributes to the definition of an use pattern in compliance with national IPM rules.

(20) Influence of the treated media on the residual toxicity of several insecticides to *Chrysoperla carnea* and *Chrysoperla externa* in laboratory

Gladys Contreras, Pilar Medina, Elisa Viñuela

Protección de Cultivos. E.T.S.I.Agrónomos. Polytechnic University of Madrid. E-28040-Madrid. Spain. elisa.vinuela@upm.es

Laboratory and extended laboratory studies were performed to ascertain the susceptibility to pesticides of two predator species of the genus *Chrysoperla* (Neuroptera, Chrysopidae)*:* the cosmopolitan *C. carnea* (Stephens) and the widely distributed in America *C. externa* (Hagen).

The residual toxicity of fresh residues of several commercial insecticides applied at the maximum field recommended concentrations registered in Spain or at that recommended by the manufacturer for caolin, were evaluated following IOBC guidelines: Volk Miscible® (83% summer mineral oil, Agrodán, 1.5 l/hl), Surround® (95% caolin, Agrovital, 5 kg/hl), Sistematon 40® (40% EC dimethoate, Agrodán), Karate King® (2,5% lambda-cyhalothrin, Syngenta,150 ml/hl) and Juvinal® (10% pyriproxyfen, EC, Kenogard, 80 g/l). Individualised young larvae (L_2) of the two predator species were exposed to pesticides residues deposited either on glass or on olive leaves. Glass plates (11.8 x 1.8 cm) or leaves were treated under the Potter precision spray tower at 55 kPa pressure (deposit 1.4 and 1.6 mg/cm^2 for *C. externa* and *C. formosa*) and seven prism plastic containers (3.5 cm diam in the bottom and 2.5 cm in the top; 4 cm high) previously coated with talc to prevent larvae from climbing the walls, were placed on each glass plate. The petiole of each leaf was introduced in an eppendorf with a nutritive solution and placed in a ventilated plastic cage (9cm in diameter, 2 cm high, cover with a 4 cm in diam ventilation hole covered by a mesh). Eggs of *Ephestia kuehniella* Zeller were always provided *ad libitum* as food. Larval mortality as well as percentages of pupae and adult emergence were recorded, and insecticides were classified in the four IOBC toxicity ratings for the total effect.

Results show that the two *Chrysoperla* species were equally susceptible to the studied pesticides. Mineral oil and caolin were harmless, dimethoate and lambda-cyhalothrin harmful and pyriproxyfen harmless on leaves but harmful on glass because totally prevented pupae formation.

(21) Side effects of pesticides on *Aphelinus mali* and other antagonists of the woolly apple aphid

Heidrun Vogt & Pia Ternes

Federal Biological Research Centre for Agriculture and Forestry (BBA), Institute for Plant Protection in Fruit Crops, Schwabenheimer Str. 10, D-69221 Dossenheim, e-mail: H.Vogt@bba.de

In the last years an increase in infestations of the woolly apple aphid, *Eriosoma lanigerum*, has been observed in organic as well as in integrated apple production. In order to enhance the biological control of this pest, the safe-guard of its natural antagonists, especially the parasitoid *Aphelinus mali,* but also earwigs, coccinellids and lacewings is a main objective. For this reason, investigations were carried out on the side effects of pesticides used in organic apple production and trials were started with the neonicotinoids Confidor (a.i. imidacloprid, 700g/kg) and Calypso (a.i. thiacloprid, 480g/l) used in integrated apple production. The tested organic pesticides were *Quassia* extract and its active ingredients Quassin and Neoquassin, Kumulus WG (sulphur, 800 g/kg), Funguran (756 g cupperoxychloride/kg) und lime sulphur (a.i. Calciumpolysulfid 80%, sulphur 23 %). As the active ingredients of *Quassia* extracts vary depending on the origin of the *Quassia* wood, a defined extract, produced by Trifolio-M GmbH (Lahnau, Germany), was used. The parasitoids came from an own rearing.

Fresh residues of Quassin, Neoquassin and *Quassia* – extract in rates as recommended in practice (up to 18 g/ha) were harmless for the parasitoid adults. When applied via the food, i.e. mixed in fructose solution, Quassin and *Quassia*-extract resulted in dose dependent effects, though not exceeding 30% at the highest rate of 18g/ha. Neoquassin applied via the food was harmless at the highest rate of 18 g/ha. Quassin and Quassia extracts did not harm the parasitoids during their development within the woolly apple aphid mummies and did not affect reproduction of the subsequent generation. Furthermore Quassia was harmless for *Forficularia auricularia*, *Coccinella septempunctata* and *Chrysoperla carnea* (direct spraying and oral application).

Residual contact of fresh residues of Kumulus (0,4 - 2 kg/ha)and Funguran (0,2 – 0,5 kg/ha) resulted in low mortalities (≤ 10%), whereas lime sulphur (6 l and 15 l/ha) caused 80-100% mortality. In the field, 5 applications of Kumulus (2,5 kg/ha each) and 2 applications of lime sulphur (15 and 20 l/ha) did not cause reductions in parasitization compared to the control.

In the lab (residual contact), even very low rates of Confidor resulted in high mortalities of *Aphelinus mali* adults, whereas Calypso, applied in rates as used in practice caused mortalities between 10 and 40 %. Both neonicotinoids did not affect the protected stage of the parasitoid within the woolly apple aphid mummy, when the mummies were directly sprayed. Further investigations aim to check sublethal effects and potential influence on the behavior of the parasitoid.

(22) Natural enemies of plum brown scale *Parthenolecanium corni* Bouche (*Homoptera*: *Coccidae*) in plum orchards in the region of Plovdiv

Vesselin Arnaoudov[1], Remigiusz Olszak[2], Hristina Kutinkova[1]
[1] *Fruit Growing Institute, kv. "Ostromila" 12, 4004 Plovdiv, Bulgaria;*
e-mail: kutinkova@abv.bg
[2] *Research Institute of Pomology and Floriculture, Pomologiczna 18, 96-100, Skierniewice, Poland; e-mail: rolszak@insad.pl*

Parthenolecanium corni Bouche (*Homoptera: Coccidae*) is considered as a serious pest of stone fruits and some ornamental plants in Bulgaria. In the years 2002-2004, a survey was conducted in the region of Plovdiv, Bulgaria, aimed at determining the species composition and density of the parasitoid and predatory insects associated with *P. corni.* Seven species of hymenopterous parasitoids were found in association with *P. corni,* including 4 primary parasitoids – *Coccophagus lycimnia* Walk., *Blastothrix confusa* Erd., *Metaphycus insidiosus* Merc., *Metaphycus punctipes* Palm. and 3 secondary ones – *Pachyneuron concolor* Forst., *Pachyneuron solitarium* Andre and *Marietta picta* Andre. Out of predatory insects attacking *P. corni*, 10 species of predators were found, belonging to 3 orders: Coleoptera, Heteroptera and Neuroptera. In the region of Plovdiv, *Coccophagus lycimnia* Walk. and *Blastothrix confusa* Erd. were the most common and the most effective parasitoids, reducing the population of *P. corni*.