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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

Abstract: Polish research units belonging to Ministry of Agriculture, higher education and Polish Academy of Science developed in the second half of nineteenth century research programmes concerning the occurrence and biology of important beneficial organisms, selectivity of plant protection products to beneficial organisms, effects of chemical treatments on various components of agrocenosis, protection of beneficial organisms during chemical treatments and elaboration of integrated protection of agriculture and horticulture crops. The results of this work led to the implementation of integrated production of several horticultural crops, biological and integrated protection of glasshouse crops and recommendations for integrated protection of some agricultural crops.

Does implementation of a reduced-risk blueberry insect control program enhance biological control?

Rufus Isaacs, Keith S. Mason, Michael Brewer, Takuji Noma, and Matthew O'Neal*
Department of Entomology, Michigan State University, East Lansing, MI 48824, USA.
**Present address: Department of Entomology, Iowa State University, Ames, IA 50011, USA.*

Abstract: A reduced-risk insect control program was implemented at commercial blueberry farms in Michigan, USA and the side effects on two important groups of natural enemies was monitored. The aphid parasitoid community responded after two years of implementation, with parasitism rates approx. 30% higher in the fields receiving reduced-risk insecticides. Total ground beetle captures were not statistically different between programs, but two dominant species, *Harpalus erraticus* and *Amara aenea*, increased in abundance in the reduced-risk program fields. Results are discussed in terms of the benefits growers may expect from adopting insect control programs based on new insecticides.

Harmful and beneficial entomofauna in apple orchards grown under different management systems

Radoslav Andreev[1], Remigiusz Olszak[2], Hristina Kutinkova[3]
[1] *Agricultural University, 12 D. Mendeleev str., 4000 Plovdiv, Bulgaria*
[2] *Research Institute of Pomology and Floriculture, 18 Pomologiczna str., 96-100 Skierniewice, Poland*
[3] *Fruit-Growing Institute, 12 Ostromila str., 4004 Plovdiv, Bulgaria*

Abstract During the period 1996-2004, the harmful and beneficial insects were observed in apple orchards of the Agricultural University – Plovdiv, Bulgaria, 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). In the orchards under IPM and chemical pest management (CPM) 35 and 26 species were found, respectively. The codling moth, *Cydia pomonella*, is the main pest of all apple orchards in Bulgaria. Other pests with a high population density in the BPM-orchard were the apple sawfly *Hoplocampa testudinea*, the pear lace bug *Stephanitis pyri,* tortricid-moths, the apple clearwing *Synanthedon myopaeformis,* the leopard moth *Zeuzera pyrina* and the weevils: *Phyllobius oblongus, Rhynchites bacchus* and *R. aequatus.* The populations of aphids, leafminers, *Epicometis hirta* and leaf-eating caterpillars increased occasionally. The populations of harmful insects in the IPM-orchard (aphids, leafminers, leopard moth and apple clearwing) increased occasionally. A high population density of harmful insects in the CPM-orchard (leafminers, aphids, *Epicometis hirta*, leopard moth and apple clearwing) was periodically observed. Beneficial insects were very abundant in the BPM-orchard. A total of 30 predators were found, belonging to 4 orders and 7 families. The ladybirds presented the highest population density and were significant as natural regulators of the small pests. Parasitoids from 7 families of *Hymenoptera* were important natural regulators of aphids, scale insects, leafminers, and tortricids. 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.

Building a selectivity list of plant protection products on beneficial arthropods in open field: a clear example with potato crop

Hautier, L.[1], Jansen, J-P.[1], Mabon, N.[2], Schiffers, B.[2]

[1] *Department of Biological Control and Plant Genetic Resources, Walloon Centre of Agricultural Research, Chemin de Liroux, 2, 5030 Gembloux, Belgium*

[2] *Analytical Chemistry and Phytopharmacy Unit, Agricultural Faculty of Gembloux, Passage des Déportés, 2, 5030 Gembloux, Belgium*

Abstract: In order to promote IPM and the use of selective pesticides in open fields, a program was initiated to provide a selectivity list 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* (De Geer) (Dipt.; Syrphidae), both representative of leaf dwelling predators. These 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 the period of potential exposure of these beneficials were assessed on these species 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 realized at each test on natural substrate to validate the application and follow pesticide degradation during exposure.

According to results of both tests, products were rated as "Green" (harmless), "Yellow" (slightly harmful), "Orange" (moderately harmful) and "Red" (harmful). List were build-up according to toxicity results of the products and split in 4 periods of use depending on, aphid natural enemies presence and their importance in the field: period one (until 10 June) and four (after 31 July), no or limited, period 2 (10-30 June) exposure of aphid parasites 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 updated in 2005 with new compounds. The results show that it is currently possible to combine throughout the growing season an effective plant protection program with pesticides that are selective to main aphid natural enemies.

Influence of plant protection measures on the carabid fauna of sugar beet and potato fields in Poland

Katarzyna Nijak & Stefan Pruszyński
Department of Ecology and Agricultural Enviromental Protection,Institute of Plant Protecion, Miczurina 20, 60-318 Poznań, Poland. E-mail: K.Nijak@ior.poznan.pl

Abstract: Beetles belonging to the family Carabidae are surface-active arthropods found in both natural and anthropogenic modified environments. This group of insects is very often considered as bioindicator of changes in the environment. The aim of these experiments was to determine changes arising among fauna of useful arthropods in agrocenosis due to agrochemicals recommended in accordance with good agricultural practice. Field experiments were conducted on commercial fields of sugar beet and potato which were divided in two parts: one intensively protected and one an untreated control part. Barber traps were used for catching fauna during the growing season. The most numerous group of arthropods were beetles, mainly predators belonging to the family Carabidae. Seasonal changes in the quantity of insects showed similar trends on both treated and control fields. Comparison of carabid abundance was carried out with respect to weather conditions and plant protection product treatments. Results showed that chemical treatment did not always influence carabid abundance.

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.*

Abstract: Regulatory field studies with Plant Protection Products are designed to determine which species are affected by simulated commercial use and whether their numbers recover within the season. Such studies involve large scale applications of products to replicated experimental plots with a water treated control and a positive reference treatment included in the experimental design. Taxonomy is a time-consuming and expensive component of these 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 a large-scale field study conducted in winter wheat 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 made using Principal Response Curves (PRC).

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

The effects of Spinosad on beneficial insects and mites used in integrated pest management systems in greenhouses

M. Miles
Dow AgroSciences, European Development Centre, 2nd Floor, 3 Milton Park, Abingdon, OX14 4RN, UK

Abstract: When used according to good horticultural practice, spinosad was shown to be compatible with the use of 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 but species such as *Aphidius colemani, Encarsia formosa* and *Trichogramma brassicae* can be introduced to protected crops within 2 weeks after application. The findings showed that spinosad is highly selective to beneficials and pollinators making it an ideal insect pest control product for use within greenhouse IPM programmes.

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, e-mail: e.richter@bba.de

Abstract: It is well known that many insecticides have a repellent impact on *E. formosa*. Currently, there is little information on the persistence of this effect. Although it is known that a spray application of the neonicotinoid imidacloprid is detrimental to *E. formosa*, soil applications were thought to have little impact. It is believed that soil applications resulted in a minimal exposure. But it is also assumed that either the active ingredient and/or metabolites remain in the plant for a long time. This is evidenced by the long term effects that this systemically active substance has on insect pests in many crops. An accurate evaluation for the persistent effect has not been previously made, as up till now, no adequate testing method has been available.

That is why the long term influence of neonicotionid insecticides (imidacloprid, acetamiprid, thiacloprid) on parasitoid behaviour was examined in extended laboratory tests. This type of investigation became possible due to an imidacloprid resistent line of *Bemisia tabaci* becoming available. The results show that imidacloprid in particular, frequently used in poinsettia stock plants, has a long lasting repelling and lethal effect on *E. formosa*, whereas acetamiprid had a minor effect and thiacloprid showed no persistent effect. Apart from this, none of the substances were efficient against the used *B. tabaci* line.

Mancozeb: A profile of effects on beneficial and non-target arthropods

M. Miles
Dow AgroSciences, European Development Centre, 2nd Floor, 3 Milton Park, Abingdon, OX14 4RN, UK

Abstract: Mancozeb is an ethylene bisdithiocarbamate (EBDC) fungicide with multi-site modes of action against economically important fungal diseases and is the active substance in Dithane[1] 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 reviews a wide range of studies on the effects of mancozeb on predatory and parasitic arthropods and provides new information from studies with soil mites, spiders and predatory Heteroptera. Overall mancozeb was shown to have low toxicity to parasitic Hymenoptera, Coccinellidae, Chrysopidae, Syrphidae, Carabidae, Aranea and Laelapidae. Effects were seen on certain species of predatory mite (Phytoseiidae) however, use patterns compatible with Integrated Pest Management programmes and the conservation of predatory mites have been developed which cause minimal impact on naturally occurring populations of predatory mites.

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

Abstract: The side-effects of insecticides used in cotton and vineyards areas on predator *Chrysoperla carnea* (Steph.) were tested 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 (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%.

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

Pilar Medina, Flor Budia, Manuel González, Benjamín Rodríguez, 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. Spain. e-mail: pilar.medina@upm.es

Abstract: Insecticidal properties of some plant extracts are known from ancient times. Despite, their use has been basically limited to subsistence crops in underdeveloped countries. Adverse environmental effects on nontarget organisms and the build up of resistance caused by the abuse of pesticides 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 are an increasing number of species from families Meliaceae and Lamiaceae, rich in secondary metabolites. The bioassay-guided fractionation of *Trichilia havanensis* (Meliaceae) extracts led to the purification of two limonoids: azadirone (F12) and 1,3+1,7-di-O-acetyl-havanensin(4:1) (F18) whereas two compounds (M1 and M9) were hemisynthesized 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 with adults of both beneficials to study potential antifeedant effects as it was observed on phytophagous pests. Results have demonstrated that these bioinsecticides are nearly innocuous for both natural insects at the conditions tested.

Comparative sensitivity of four ladybird species to five pesticides

Jansen, J-P. & Hautier, H.
Department of Biological control and Plant genetic resources, Agricultural Research Centre, Chemin de Liroux, 5030 Gembloux – Belgium, labecotox@cra.wallonie.be

Abstract: Since 2003, four ladybird species have been found in open fields in Belgium: the three native species *Coccinella septempunctata* (L.), *Adalia bipunctata* (L.), *Propylea quatuordecim-punctata* (L.) 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 whether the use of pesticides in agricultural ecosystems could give an advantage to *H. axyridis*. The results also provide information on the sensitivity of the four species and whether it is possible to extrapolate data obtained for one species to another. The LR_{50} of 5 pesticides (three insecticides: imidacloprid, zeta-cypermethrin, triazamate and two fungicides: spiroxamine and metalaxyl-M + fluazinam) was assessed on glass plates. Products were tested on basis of a range-finder test (5 doses in a dilution range 5-10x + control, 10 larvae per test unit) and a definitive test (5 doses in an adapted range to ideally cover 0-100 % mortality + control, 20 larvae per unit). The larvae used for the tests were 2-3 day old and were confined for 7 days on glass plates. Mortalities were recorded daily and final assessment was made after 7 days of exposure.

The LR_{50} results (ml of formulated product/ha ± sd) after 7 days of exposure can be summarised as follows:

	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

Comparison of LR_{50} values show no clear relationship between species tested and sensitivity to the different pesticides. *A. bipunctata* was most of the time the most sensitive species, but there were exceptions, for example in the case of Impulse (*P. 14-punctata*) and Confidor (*H. axyridis*). However, if the results obtained with *C. septempunctata* are omitted, the sensitivity of the three other species is more or less comparable, with LR_{50} ratio from the least sensitive to the most sensitive in a range of 1–6fold. *C. septempunctata* was most of the time the least sensitive species. For Confidor, the LR_{50} of *C. 7-punctata* was up to 600 times higher than that of *H. axyridis*, the most sensitive species. These results suggest a possible resistance mechanism for this species.

Natural enemies of plum brown scale *Parthenolecanium corni* Bouché (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*

Abstract: *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 of parasitoid and predatory insects associated with *P. corni* and their density. 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 – *Pachyneuron concolor* Först., *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 *C. lycimnia* and *B. confusa* were parasites of the greatest importance in regulating population density of *P. corni. C. lycimnia* was more important as a parasite of over-wintering larvae and *B. confusa* was the most important parasite of adult females.

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

Abstract: 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.

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

Abstract: 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.

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

Abstrcat: 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.

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, Polan. E-mail: dabrowskiz@alpha.sggw.waw.pl; julia2@wp.pl

Abstract: 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 empha-sizes 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 EU 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.

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. E-mail: elisa.vinuela@upm.es

Abstrcat: 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: Volck Miscible® (83% summer mineral oil, EC, Agrodán, 1.5 l/hl), Surround® (95% caolin, WP, Agrovital, 5 kg/hl), Sistematon 40® (40% dimethoate, EC, Agrodán, 150ml/hl), Karate King® (2.5% lambda-cyhalothrin, WG, Syngenta, 80 g/hl) and Juvinal® (10% pyriproxyfen, EC, Kenogard, 30 ml/hl). 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 11.8 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. carnea*) and seven prism plastic containers (3.5 cm diameter 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 (9 cm 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 slightly or moderately harmful and pyriproxyfen harmless on leaves but harmful on glass because totally prevented pupae formation.

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, e-mail: kaltena@koppert.nl, emoerman@koppert.nl*

Abstract: 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.

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*

Abstract: 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 with 12 insecticides/acaricides and 6 fungicides as well as the first field experiences with the side effects of some pesticides.

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

Delphine Juan and Jean Baptiste Ferré
ENIGMA, Hameau de St. Véran, F-84190 Beaumes de Venise

Abstract: 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.

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
bruno.gobin@pcfruit.be +32 11 67 43 18

Abstract: 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.