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RESULTS OF THE SIXTH JOINT PESTICIDE TESTING PROGRAMME OF THE IOBC/WPRS-WORKING GROUP « PESTICIDES AND BENEFICIAL ORGANISMS »

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The side effects of 5 insecticides, 8 fungicides and 6 herbicides on 24 species of beneficial organisms were tested by members of the Working Group « Pesticides and Beneficial Organisms » of the International Organization for Biological Control (IOBC), West Palaearctic Regional Section (WPRS). The tests were conducted by 24 members in 11 countries according to internationally approved guidelines.

The insecticide buprofezin (Applaud), the fungicides triforine (Saprol), procymidone (Sumisclex), anilazine (Dyrene), triadimenol (Bayfidan), hexaconazole (Anvil), tridemorph (Calixin) and the herbicides tralkoxydim (Grasp), bentazone (Basagran) were harmless to nearly all the beneficial organisms. Diflubenzuron (Dimilin) affected spiders and the larvae of predatory insects. The remaining 10 preparations were more toxic and should therefore be further tested in semi-field and field experiment on relevant organisms.

KEY-WORDS : pesticides, side effects, beneficial arthropods, natural enemies, parasitoids, predators, entomopathogenic fungi, IOBC, International Organization for Biological Control.

Selective pesticides suitable for use in integrated control programmes are urgently needed. One of the major aims of the Working Group « Pesticides and Beneficial Organisms » of the IOBC, West Palaearctic Regional Section (WPRS) was therefore to coordinate international activities to develop standard methods to test the side effects of pesticides on the most important natural enemies. Testing the side effects of pesticides on beneficial organisms has become obligatory in several countries and this made the development of internationally approved guidelines even more important. The use of standard methods will allow the exchange of results from one country to another and save the cost of repeated testing. Laboratory, semi-field and field test methods are therefore being developed according to standard characteristics. Standard guidelines to test the side effects of pesticides on natural enemies were published by Hassan *et al.* (1985, 1988 & 1992).

Testing the side effects of pesticides within joint programmes provides valuable information to users of integrated control and gives the testing members opportunity to improve

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testing techniques and develop better testing guidelines. Joint programmes, each including 20 chemicals were organized every two years since 1977. This work presents the results of the sixth programme involving 24 natural enemies. Results of testing the side effects of pesticides on beneficial organisms within the previous five joint programmes were published by Franz *et al.* (1980), Hassan *et al.* (1983, 1987, 1988, 1991). Information on the effect of pesticides on greenhouse natural enemies was published by Hassan & Oomen (1985).

Information on rearing and testing methods for the following natural enemies have been published : *Trichogramma cacoeciae,* initial toxicity (Hassan, 1974 ; 1977), persistence (Hassan, 1980) ; *Encarsia formosa* (Hoogcarspel & Jobsen, 1984 ; Oomen, 1985) ; *Leptomastix dactylopii* (Viggiani & Tranfaglia, 1978) ; *Phygadeuon trichops* (Plattner & Naton, 1975 ; Naton, 1983) ; *Coccygomimus turionellae* (Bogenschütz, 1975, 1984 ; Bogenschütz *et al.,* 1986) ; *Pales pavida* (Huang, 1981) ; *Chrysoperla carnea* (Suter, 1978 ; Rumpf *et al.,* 1992 ; Vogt, 1992) ; *Aphidoletes aphidimyza* (Helyer, 1991) ; *Amblyseius potentillae* (Overmeer & Van Zon, 1982) ; *Phytoseiulus persimilis* (Samsøe-Petersen, 1983 ; Stolz, 1990) ; *Typhlodromus pyri* (Boness *et al.,* 1982 ; Duso *et al.,* 1992), different phytoseiid mites (Bakker & Calis, 1989) ; Carabidae (Heimbach, 1988) ; spiders (Mansour & Nentwig, 1988 ; Wehling & Heimbach, 1991 ; Mansour *et al.,* 1992) ; *Verticillium lecanii* (Tuset, 1975, 1988) ; *Coelotes terrestris* (Albert & Bogenschütz, 1984) ; *Anthocoris nemoralis* (Stäubli *et al.,* 1984) ; *Aleochara bilineata* (Samsøe-Petersen, 1987) effects on soil-dwelling invertebrates (Samsøe-Petersen *et al.,* 1992) pathogenic fungi (Keller & Schweizer, 1991), field, naturally occurring organisms (Gendrier & Reboulet, 1992 ; Fournier *et al.,* 1992). Methods to rear 16 different beneficial insect and mite species were discussed in working group meetings and published by Samsøe-Petersen *et al.* (1989).

Among the 102 pesticides tested till now, the following compounds were found to have a relatively low toxicity to and/or a limited persistence on the natural enemies tested : Bacillus thuringiensis (Dipel), fenbutatin oxide (Shell Torque), benzoximate (Azomate), diflubenzuron (Dimilin) toxic to predatory larvae, tetradifon (Tedion V 18), dicofol (Kelthane), pyrethrum and piperonylbutoxide (Spruzit-Nova-flüssig) short lived, pirimicarb (Pirimor Granulat) short lived, bupirimate (Nimrod), clofentezine (Apollo SOSC), hexythiazox (Cesar S.L.), triadimefon (Bayleton), vinclozolin (Ronilan), captan (Orthocid 83), thiophanate-methyl (Cercobin-M), captafol (Ortho Difolatan), carbendazim (Derosal), chlorothalonil (Daconil 500), ditalimfos (Plondrel), thiram (Pomarsol forte), mancozeb (Dithane Ultra), bitertanol (Baycor), dithianon (Delan), copper-oxychloride (Vitigran), flutriafol (Impact), iprodion (Rovral PM), diclofop-methyl (Illoxan), desmetryn (Semeron), phenmedipham (Betanal), propyzamid (Kerb 50 W), chlormequat (Cycocel Extra), naphthyl acetic acid (Rhodofix), 2,4-D aminesalt (Luxan 2,4-D amine), metsulfuron-methyl (Ally) and alphanaphthyl-acetamid (Dirigol-M).

The present joint testing programme included 20 pesticides, 20 beneficial arthropods, three entomopathogenic fungi and the nematode *Steinernema feltiae.* All pesticides tested were registered in at least one of the IOBC member countries. This testing programme is meant to provide information on the side effects of pesticides on beneficial organisms and to give an opportunity to improve testing techniques, compare results and exchange experience between members of the Working Group.

MATERIALS AND METHODS

The pesticides included in this programme, the concentration tested (active ingredient - compound) and information on the area of use (crop or group of crops) are given in table 1.

TABLE 1

IOBC-Working Group "Pesticides and Beneficial Organisms".
Pesticides tested within the 6th joint pesticide testing programme

	Active ingredient		Brand name	Company	Conc. to be tested			Vegetables		Fruit orch.	Root Forage	Cereals Corn	Vine-yards	Forest
					a.i. %	product %	g(ml)/ha	field	glass-house					
I	buprofezin	250 g/l	Applaud	ICI	0.0075	0.03	180 ml	X	X	X				
I	diflubenzuron	25 % WP	Dimilin	Duphar	0.0125	0.05	300 g	X	X	X		X		X
I	cyromazine	75 % WP	Trigard	Ciba-Geigy	0.05	0.067	400 g	X						
I	fenpropathrin	10 % WP	Rody	Shell Agrar	0.005	0.05	300 g			X			X	
I	Kali-Seife	51 %	Neudosan	Neudorff	0.958	2.0	12,000 g	X		X				
I	methamidophos	600 g/l	Tamaron	Bayer	0.09	0.15	900 ml	X		X	X		X	X
F	triforine	190 g/l	Saprol	Shell Agrar	0.0285	0.15	600 ml	X	X	X		X	X	
F	sulphur	80 % WP	Netzschwefel	Bayer	0.32	0.4	1,600 g	X	X	X	X	X	X	
F	procymidone	50 % WP	Sumisclex	Bayer	0.075	0.15	600 g	X		X	X		X	
F	anilazine	480 g/l	Dyrene flüssig	Bayer	0.192	0.4	1,600 ml					X		
F	triadimenol	250 g/l	Bayfidan	Bayer	0.0125	0.05	200 ml	X		X	X	X		
F	hexaconazole	50 g/l	Anvil	ICI	0.0015	0.03	120 ml	X		X			X	
F	tridemorph	750 g/l	Calixin	BASF	0.0563	0.075	300 ml	X				X		
F	lime-sulphur	7 %	Nevikén	PVV	0.21	3.0	12,000 g			X			X	
H	ioxynil	240 g/l	Exp. 30004 A	Rhône-Poulenc	0.0576	0.24	960 ml	X				X		
H	sethoxydim	133 g/l	Fervinal Plus	Schering	0.105	0.79	3,160 ml	X			X			X
H	clopyralid	100 g/l	Lontrel 100	Schering	0.012	0.12	480 ml	X			X	X		
H	quizalofop-ethyl	100 g/l	Targa	Rhône-Poulenc	0.03	0.3	1,200 ml	X		X	X		X	
H	tralkoxydim	100 g/l	Grasp	ICI	0.05	0.5	2,000 ml					X		
H	bentazone	480 g/l	Basagran	BASF	0.192	0.4	1,600 ml	X			X	X		

Tests were carried out in the laboratory (7 parasites, 3 predatory mites, 1 spider, 8 predatory insects, 3 fungi), 7 under semi-field conditions (5 initial toxicity, 3 persistence) and 4 in the field.

A combination of laboratory, semi-field and field methods were used to test the side effect of pesticides. The methods were developed by members of the IOBC/WPRS Working Group according to standard characteristics.

STANDARD CHARACTERISTICS OF TEST METHODS

Laboratory

(a) *Laboratory, susceptible life stage* (e.g. adult parasites, developmental stages of mites, larval predators) :

1. exposure of organisms to fresh pesticide deposit applied on glass plate, leaf, sand, sandy soil ; 2. exposure of beneficial fungi, nematodes and collembolans in contaminated standard medium (e.g. based on broth, agar or soil) ; 3. even film of pesticide, standard amounts of 1,5 to 2 mg fluid/cm^2 on glass or leaf and 2 to 6 mg fluid/cm^2 on sand are used ; 4. highest recommended application rate of pesticide ; 5. laboratory reared or field collected organisms of uniform age ; 6. adequate exposure period before evaluation ; 7. adequate ventilation ; 8. water treated control in each experiment, toxic standard at least in one experiment per year ; 9. assessment of the reduction in beneficial capacity (egg laying, parasitism) beside mortality ; 10. four evaluation categories : 1 = harmless (< 30 %), 2 = slightly harmful (30-79 %), 3 = moderately harmful (80-99 %), 4 = harmful (99 %).

(b) *Laboratory, less susceptible life stage* (e.g. parasites within their hosts, adults of mites, adults of predatory insects) : 1. direct spray of organisms and substratum. Points 3 to 10 of test (a) are applicable.

(c) *Laboratory, duration of harmful activity (persistence) :*

1. exposure to pesticide residues applied on plants or soil at intervals after treatment ; 2. weathering in the field under rain cover with periodical exposure to direct sunshine or under simulated field conditions (summer day) ; 3. pesticide application according to Good Agricultural Practice ; 4. experiments and assessment of toxicity as in test (a, points 4 to 10) ; 5. repeating of test at intervals until loss of toxicity (category 1 result) or up to one month after treatment ; 6. four evaluation categories : A = short lived (< 5 days), B = slightly persistent (5-15 days), C = moderately persistent (16-30 days), D = persistent (30 days).

(d) *Laboratory, extended laboratory :*

1. experiments are carried out under rain cover or in the laboratory under standard simulated field conditions (fluctuating temperature, air humidity and light to simulate a summer day). 2. a susceptible life stage of organism is used ; 3. adequate ventilation and air exchange to prevent the accumulation of pesticide fumes. Points 4 to 12 of the semi-field test are applicable.

Semi-field

1. experiments are carried out in the field with climatic factors to be left unaffected as much as possible ; where necessary, rain cover can be used ; 2. appropriate time, crop and season for the chemical, but choosing conditions to represent the worst case ; 3. experiments to be repeated under different weather conditions when considered necessary ; 4. beneficial organisms (possibly a susceptible life stage) to be present on the crop during

spraying — if practical — or to be released as soon as possible after spraying ; 5. laboratory reared or field collected organisms of uniform age ; 6. highest recommended application rate of pesticide ; 7. application according to Good Agricultural Practice ; 8. adequate exposure period before evaluation ; 9. water treated control and toxic standard in each experiment ; 10. assessment of the reduction in beneficial capacity (egg laying, parasitism, prey intake, population changes) beside mortality ; 11. four evaluation categories : 1 = harmless (< 25 %), 2 = slightly harmful (25-50 %), 3 = moderately harmful (51-75 %), 4 = harmful (75 %).

Field

(a). *Field, naturally occurring organisms :*

1. crops or soil inhabited by naturally occurring beneficials are directly sprayed ; 2. experiment to be repeated at different locations ; 3. no release of beneficial organisms in the same year of the experiment ; 4. sampling is carried out at intervals before and after treatment(s) ; 5. highest recommended dose rates and number of treatments following Good Agricultural Practice ; 6. experiments are carried out at the appropriate time and season for the chemical ; 7. adequate exposure period before evaluation ; 8. water treated control and toxic standard in each experiment ; 9. mortality, survival, population changes may be monitored ; 10. plot design and number of individuals to exceed a certain limit to allow statistical analysis ; 11. four evaluation categories : 1 = harmless (< 25 %), 2 = slightly harmful (25-50 %), 3 = moderately harmful (51-75 %), 4 = harmful (75 %).

(b). *Field, released organisms :*

1. laboratory reared or field collected beneficial organisms of uniform age are released in field plots and are directly sprayed ; points 4 to 11 of the field test are applicable. Categories as under field (a).

ORGANISMS TESTED AND TESTING MEMBERS

The testing on the different beneficial organisms is being carried out by the following members of the Working Group who would be glad to give more information :

1. *Trichogramma cacoeciae* (Trichogrammatidae, Hym.)

S. A. Hassan, Biologische Bundesanstalt für Land- und Forstwirtschaft, Institut für biologischen Pflanzenschutz, Heinrichstr. 243, D-64287 Darmstadt, Germany.

2. *Encarsia formosa* (Aphelinidae, Hym.)

M. van de Veire, Faculty of Agricultural Sciences, State University of Gent, Coupure 653, B-9000 Gent, Belgium.

3. *Leptomastix dactylopii* (Encyrtidae, Hym.)

G. Viggiani, Istituto di Entomologia Agraria, Universita di Napoli, I-80055 Portici, Italy.

4. *Cales noacki* (Aphelinidae, Hym.)

A. G. Vivas, Centro Regional de investigaciones Agrarias, (Crida-07), Apartado Official, Moncada, Valencia, Spain.

5. *Aphidius matricariae* (Aphidiidae, Hym.)

L. Polgar, Research Institute of Plant Protection of the Hungarian Academy of Sciences, H-1525 Budapest, P.O. Box 102, Hungary.

6. *Phygadeuon trichops* (Ichneumonidae, Hym.)

Moreth, Bayerische Landesanstalt für Bodenkultur und Pflanzenbau, Abteilung Pflanzenschutz, Postfach 38 0269, D-80638 München, Germany.

7. *Coccygomimus turionellae* (Ichneumonidae, Hym.)

H. Bogenschütz, Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Abteilung Waldschutz, Wonnhaldestraβe 4, D-79100 Freiburg, Germany.

8. *Phytoseiulus persimilis* (Phytoseiidae, Acari)

J. N. M. Calis, F. Bakker, A. Grove, Department of Pure and Applied Ecology, Section Population Biology, University of Amsterdam, Kruislaan 302, Nl-1098 SM Amsterdam, The Netherlands. S. Blümel, M. Stolz, Bundesanstalt für Pflanzenschutz, Trunnerstr. 1-5, A-1020 Wien, Austria. G. Sterk, Gorsem (see 10).

9. *Amblyseius andersoni* (Phytoseiidae, Acari)

J. N. M. Calis, see Nr. 8, C. Duso, Instituto di Entomologia Agraria, Universita di Padova, Via Gradenigo 6, Padova, Italy.

10. *Amblyseius finlandicus* (Phytoseiidae, Acari)

G. Sterk, Zoology Department, Research Station of Gorsem, Brede Akker 3, B-3800 Sint-Truiden, Belgium.

11. *Typhlodromus pyri* (Phytoseiidae, Acari)

J. N. M. Calis, see Nr. 8. W. D. Englert, Biologische Bundesanstalt für Land- und Forstwirtschaft, Institut für Pflanzenschutz im Weinbau, Brüningstr. 84, D-54470 Bernkastel-Kues, Germany. E. Boller, Eidgenössische Forschungsanstalt für Obst-, Wein- und Gartenbau, CH-8820 Wädenswil, Switzerland. G. Sterk, Gorsem, see above.

12. *Chrysoperla carnea* (Chrysopidae, Neur.)

F. Bigler, Eidgenössische Forschungsanstalt für landwirtschaftlichen Pflanzenbau Zürich-Reckenholz, Postfach, CH-8046 Zürich, Switzerland (laboratory and semi-field). H. Vogt, Biologische Bundesanstalt für Land- und Forstwirtschaft, Institut für Pflanzenschutz im Obstbau, Schwabenheimer Straβe 101, D-69221 Dossenheim, Germany (field).

13. *Aphidoletes aphidimyza* (Cecidomyiidae, Dipt.)

Neil Helyer, Entomology Dept., Horticulture Research International, Worthing Rd, Littlehampton, West Sussex, BN17 6LP, UK.

14. *Syrphus vitripennis* (Syrphidae, Dipt.)

W. Rieckmann, Pflanzenschutzamt Hannover, Wunstorfer Landstraβe 9, D-30453 Hannover, Germany.

14. *Semiadalia 11-notata* (Coccinellidae, Col.)

J. Brun, I.N.R.A., Laboratoire de Biologie des Invertébrés, Insectarium E. Biliotti, F-06560 Valbonne, France.

16. *Coccinella septempunctata* (Coccinellidae, Col.)

J. Brun, see Nr. 14.

17. *Aleochara bilineata* (Staphylinidae, Col.)

Lise Samsoe-Petersen, Statens Plantevaernscenter, Lottenborgvej 2, DK-2800 Lyngby, Denmark, and L. Moreth, see Nr. 6.

18. *Pterostichus melanarius* (Carabidae, Col.)
G. B. Lewis, ICI Agrochemical, Ecology and Soil Science Section, Jealott's Hill Research Station, Bracknell, Berks. RG12 6EY, United Kingdom. *Poecilus cupreus* - U Heimbach, Biologische Bundesanstalt für Land- und Forstwirtschaft, Institut für Pflanzenschutz im Gartenbau, Messeweg 11/12, D-38104 Braunschweig, Germany.

19. *Forficula auricularia* (Forficulidae, Derm.)

B. Sauphanor, Station de Zoologie - INRA, Domaine St., Paul B.P. 91, 84143 Montfavet Cedex, France.

20. *Anthocoris nemoralis* (Anthocoridae, Het.)

A. Stäubli, L. Schaub, Station Fédérale de Recherches Agronomiques de Changins, Route de Duillier, CH-1260 Nyon, Switzerland.

21. *Chiracanthium mildei* (Clubionidae, Aranea)

F. Mansour, Agricultural Research Organization, Newe Ya'ar P.O., Haifa 31-999, Israel.

22. *Verticillium lecanii* (Moniliaceae, Hyphomycetes)

J. J. Tuset, see Nr. 4, Valencia, Spain.

23. *Beauveria bassiana* (Moniliaceae, Hyphomycetes)

H. Hokkanen, Department of Applied Zoology, P.O. Box 27 (Vilkki C), FIN-00014 University of Helsinki, Finland. *Beauveria brongniartii* - Jacqueline Coremans-Pelseneer, Laboratoire de Parasitologie U.L.B., boulevard de Waterloo, 115, B-1000 Bruxelles, Belgien.

24. *Metarhizium anisopliae* (Moniliaceae, Hyphomycetes)

H. Hokkanen, see Nr. 23.

25. *Steinernema feltiae* (Steinernematidae, Nematodes)

A. Vainio, see nr. 23.

RESULTS

The effects of 20 pesticides on 20 beneficial arthropods, 3 entomopathogenic fungi and *Steinernema feltiae* are given in table 2. Among the 6 insecticides tested. "Buprofezin (Applaud)" was found to be harmless to nearly all the beneficial organisms tested. "diflubenzuron (Dimilin)" affected the *Chiracanthium* spider, the larvae of the predatory insects *Chrysoperla* and *Forficula.* Neudosan was harmless to most of the parasites, predators and entomopathogenic fungi, but harmful to *Steinernema* and moderately harmful to predatory mites. The remaining three insecticides were toxic to most of the natural enemies tested.

The fungicides "triforine (Saprol)", "procymidone (Sumisclex)", "anilazine (Dyrene flüssig)", "triadimenol (Bayfidan)", "hexaconazole (Anvil)" and "tridemorph (Calixin)" were harmless or slightly harmful to nearly all the beneficial arthropods tested, but the last two preparations were harmful to the fungi *Verticillium, Beauveria* and *Metarhizium.* "sulphur (Netzschwefel Bayer)" was harmless to the three beneficial fungi and moderately harmful or harmful to a large number of beneficial insects and mites. In some cases sulphur was less harmful in the semi-field than in the laboratory (*Coccinella, Chrysoperla*). In a field test with *Trichogramma dendrolimi,* sulphur was harmless.

TABLE 2

Results of the 6th IOBC/WPRS joint pesticide testing programme

	(a) Trichogramma	(b) Trichogramma	(a) Encarsia	(b) Encarsia	(a) Aphidius	(b) Aphidius	(b) Leptomastix	(b) Cales	(b) Phygadeuon	(b) Coccygomimus	(b) Phytoseiulus	(b) Amblyseius	(b) Amblyseius (R)	(b) Typhlodromus pyri	(b) Typhlodromus p (R)	(b) Chiracanthium	(b) Chrysoperla	(a) Forficula	(b) Forficula	(a) Semiadalia 11not	(b) Semiadalia	(a) Anthocoris	(a) Aleochara	(a) Aphidoletes	(b) Aphidoletes	(b) Pterostichus	(b) Poecilus	(b) Steinernema	Verticillius	Beauveria bass.	Beauveria brongn.	Metarhizium	(e) Coccinella	(d) Phygadenon	(e) Phytoseiulus	(d) Aleochara	(e) Chrysoperla	(c) Trichogramma	(c) Encarsia	(c) Coccygomimus	(f) Amblyseius	(f) Typhlodromus	(f) Amblyseius ander.
Applaud	1	–	1	–	1	–	1	1	1	1	1	1	1	3	1	1	1	1	1	2	2	1	1	2	2	1	–	1	1	1	1	1	2	–	2	–	–	–	–	–	1	–	–
Dimilin	1	–	1	–	1	–	1	1	1	1	1	1	1	1	1	3	4	4	1	3	2	1	1	1	1	1	–	1	1	1	1	1	2	–	1	1	4	–	–	–	1	1	1
Trigard	1	–	1	–	1	–	4	1	2	1	4	4	4	4	4	1	4	1	2	3	2	2	1	–	–	1	–	1	1	1	1	1	1	–	–	3	3	–	–	–	1	–	–
Rody	4	1	4	1	4	2	4	3	1	1	4	4	4	4	4	4	4	2	1	4	3	4	4	4	2	1	4	2	1	1	1	1	2	–	4	2	3	4	4	–	4	–	4
Neudosan	1	–	1	–	1	–	1	3	1	1	1	3	3	3	3	1	1	1	1	2	2	1	1	2	1	1	1	4	2	1	–	1	1	–	–	1	–	–	–	–	–	–
Tamaron	4	4	4	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	1	3	–	–	1	4	3	1	2	1	1	3	4	4	2	4	4	4	3	4	–	2
Saprol	1	–	1	–	1	–	1	2	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1	–	2	3	2	1	2	1	–	1	1	–	–	–	–	2	–	1
Netzschwefel Bayer	3	1	4	1	3	2	1	1	1	4	2	3	2	4	3	1	3	1	1	4	3	3	–	–	–	1	–	4	–	1	1	1	1	–	2	1	1	4	4	4	1	4	3
Sumisclex	1	–	1	–	1	–	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	1	–	2	2	2	1	2	2	–	1	1	–	–	–	–	1	1	3
Dyrene flüssig	1	–	2	–	1	–	1	1	1	1	1	1	1	1	1	2	1	1	–	2	2	2	1	–	–	1	–	3	2	2	2	3	1	–	1	1	–	–	–	–	1	–	–
Bayfidan	1	–	1	–	1	–	1	1	1	1	1	1	1	1	2	1	1	1	2	3	2	1	1	–	–	1	–	1	4	3	2	3	1	–	1	1	–	–	–	–	1	1	–
Anvil	1	–	–	–	1	–	1	1	1	1	1	1	1	1	–	1	1	1	1	2	2	1	1	1	1	1	–	1	4	4	2	4	2	–	1	1	–	–	–	–	1	–	–
Calixin	1	–	1	–	1	–	1	–	1	1	2	1	1	1	1	–	–	1	1	3	2	1	1	2	1	1	–	2	3	3	2	3	2	–	–	1	–	–	–	–	–	–	–
Nevikén	4	2	4	1	4	2	–	–	1	2	4	4	4	4	4	1	4	1	2	4	3	4	1	–	–	1	–	–	–	2	2	–	2	–	–	1	–	3	–	–	–	–	–
Exp. 30004 A (ioxynil)	1	–	–	–	1	–	1	–	2	–	4	4	4	4	2	1	1	1	1	2	2	1	1	–	–	1	–	1	–	3	3	4	1	–	–	1	–	–	–	–	–	–	–
Fervinal Plus	4	1	–	–	4	2	–	–	1	1	1	3	4	2	3	–	2	–	–	3	2	2	–	–	–	–	–	4	–	–	–	–	2	–	–	1	1	1	–	–	–	–	–
Lontrel 100	1	–	–	–	1	–	–	–	1	1	1	1	1	1	1	–	1	–	–	2	1	2	–	–	–	–	–	1	–	–	–	–	1	–	–	1	2	–	–	–	–	–	–
Targa	1	–	1	–	1	–	1	–	1	1	1	1	1	4	4	1	2	1	1	2	1	1	1	–	–	1	–	4	–	3	1	3	1	–	–	1	–	–	–	–	–	–	–
Grasp	1	–	–	–	1	–	1	3	1	1	1	1	1	2	1	1	2	1	1	2	2	1	1	1	1	1	–	4	4	3	1	3	2	–	–	1	–	–	–	–	–	–	–
Basagran	1	–	1	–	1	–	–	–	1	1	1	1	1	1	1	4	1	1	1	2	2	2	1	–	–	1	–	1	–	3	1	3	1	–	–	1	–	–	–	–	–	–	–

(a) Laboratory, susceptible life stage ; (b) = Laboratory, less susceptible stage ; (c) = persistence ; (d) = Extended Laboratory ; (e) = semi-field ; (f) = field ; (R) = resistent ; – = test not required. *Laboratory,* initial toxicity : 1 = harmless (< 30 %), 2 = slightly harmful (30-79 %), 3 = moderately harmful (80-99 %), 4 = harmful (> 99 %). *Field, Semi-field, Extended Laboratory :* 1 = harmless (< 25 %), 2 = slightly harmful (25-50 %, moderately harmful (51-75 %), 4 = harmful (> 75 %). *Persistence :* 1 = short lived (< 5 days), 2 = slightly pers. (5-15 days), 3 = moderately pers. (16-30 days), 4 = persistent (> 30 days).

The herbicides "tralkoxydim (Grasp)" and "bentazone (Basagran)" were harmless to slightly harmful to nearly all the beneficial arthropods tested, but moderately harmful to entomopathogenic fungi. Grasp was moderately harmful to the whitefly parasite pupae and harmful to *Steinernema.* "Ioxynil (Exp. 30004 A)" and "quizalofop-ethyl (Targa)" were harmless to insect parasites and predators but toxic to predatory mites, entomopathogenic fungi and *Steinernema.* "Clopyralid (Lontrel 100)" was harmless to insect parasites and predatory mites but unfortunately due to technical problems (missing samples) was not tested on several predatory insects and entomopathogenic fungi.

Four preparations were tested on *Chrysoperla* in laboratory and semi-field tests, Dimilin and Tamaron were harmful in both cases. Rody was harmful in the laboratory test and moderately harmful in the semi-field test. Netzschwefel Bayer was moderately harmful in the laboratory and harmless in the semi-field test. Dimilin was tested in a field test (b) and was found to be moderately harmful to *Chrysoperla carnea* larvae.

Table 2 shows good agreement between the results of the laboratory, semi-field and field experiments with predatory mites. Nine preparations were harmless to slightly harmful in all three types of tests and three were mostly moderately harmful to harmful. Trigard was harmful in the laboratory and harmless in the field.

Although the results of the experiment with the Coccinellid species *Semiadalia* that was tested in the laboratory and that on *Coccinella 7-punctata* in the semi-field test can not be directly compared. In these tests, less toxicity was observed in the semi-field compared to the laboratory.

The persistence test on *Trichogramma* with five pesticides showed that Fervinal Plus was short lived (duration of harmful activity of < 5 days), Nevikén was moderately persistent (16-30 day) and Neudosan, Tamaron and Netzschwefel Bayer were persistent (30 days).

DISCUSSION AND CONCLUSIONS

The insecticide "buprofezin (Applaud)", the fungicides "triforine (Saprol)", "procymidone (Sumisclex)", "anilazine (Dyrene)", "triadimenol (Bayfidan)", "hexaconazole (Anvil)", "tridemorph (Calixin)" and the herbicides "tralkoxydim (Grasp)", "bentazone (Basagran)" were harmless to most of thebeneficial organisms tested and can be recommended for use in integrated control programmes. The remaining preparations were more toxic and should therefore be further tested on relevant organisms. The crops on which the pesticides are registered for use, in at least one European country, can be seen in table 1. The harmful effect of "diflubenzuron (Dimilin)" on *Chiracanthium, Chysoperla* (laboratory, semi-field test and field), *Forficula* and *Semiadalia* larvae was due to its chitin inhibitor mode of action (inhibition of moulting). The adults of parasites and predators as well as the developmental stages of parasites (protected within their hosts) were not affected by this insecticide. When adults of *Chrysoperla carnea* were treated topically with Dimilin the fertility was affected (Vogt, 1992).

AIMS OF THE DIFFERENT TESTS

Laboratory :
prove the harmlessness of pesticides, - screen out harmless or low toxicity preparations (harmless pesticides are not tested any further)

(a) Laboratory, less susceptible life stages :
differentiate between toxic preparations

(b) Laboratory, duration of harmful activity (persistence) :
help estimate hazard. The impact of pesticides in the fields is greatly affected by its persistence. Short lived pesticides can often be successfully used in integrated control programmes.

(c) Laboratory, extended laboratory :
help estimate hazard under simulated field conditions.

Semi-field, and field :
assess the hazard of pesticides, - provide information relevant to practice.

NEED FOR INTERNATIONAL COOPERATION

The Working Group aims at developing further standard testing methods, particularly of the semi-field and field types. Recognizing that no single test method would provide sufficient information to assess the side effects of pesticides on a beneficial organism, a combination of tests that include laboratory, semi-field and field methods to be carried out in a particular sequence is recommended. Through international cooperation, number and range of tests used could be increased. Experience from the joint pesticide testing programme using five different types of tests will make it possible for the group to recommend useful combination of methods for testing side effects of pesticides. The choice of different tests will be made on the basis of needs and available means concentrating on semi-field and field methods.

RÉSUMÉ

Résultats du 6e programme coordonné d'essais pesticides conduit par le groupe de travail OILB/SROP : "Pesticides et organismes utiles."

Les effets secondaires de 5 insecticides, 8 fongicides et 6 herbicides sur 24 espèces auxiliaires ont été étudiés par les membres du Groupe de travail « Pesticides et Organismes utiles » de l'OILB, Organisation Internationale de Lutte biologique, Section Régionale Ouest Paléarctique (SROP). Les tests ont été effectués par 24 participants appartenant à 11 pays, et selon des directives internationalement approuvées.

L'insecticide buprofézine (Applaud), les fongicides triforine (Saprol), promycidone (Sumisclex), anilazine (Dyrène), triademinol (Bayfidan), hexaconazole (Anvil), tridémorphe (Calixin) et les berbicides tralkoxydime (Grasp), bentazone (Basagran) se sont révélés sans danger pour presque tous les auxiliaires. Le diflubenzuron (Dimilin) avait un effet néfaste sur les araignées et les larves d'insectes prédateurs. Les 10 préparations restantes étaient plus toxiques et doivent donc faire l'objet d'autres essais sur les organismes utilisés.

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