Side effect of preparations used in organic farming on *Forficula auricularia* and *Chrysoperla carnea*

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Abstract

*The side effects of selected botanical insecticides (*Quassia amara*, Rock Effect, Prev-B), spinosad (SpinTor) and other preparations used in organic farming (Alginure, Aqua-Vitrin, Myco-Sin, Vitisan) on* Forficula auricularia *and* Chrysoperla carnea *were tested in the laboratory bioassay. The most of preparations allowed or intended for organic growing were harmless to the tested species with the exception of spinosad which caused moderate mortality and a dramatic change in behaviour of earwigs. For the comparison, several synthetic pesticides or their combinations were tested too. Negative effects of bifenthrin, chlorpyriphos-m, thiacloprid and dodine were confirmed in the study.*

Keywords: organic fruit growing, pesticides, natural enemies, side effects

Introduction

Effective pest control in organic fruit growing is based on the presence of a sufficient biodiversity of natural enemies in orchard. It has been known from IPM or conventional regimes that use of not selective pesticides (pyrethroids, organophosphates, neonicotinoids) can cause the outbreaks of pests such as aphids, spider mites, psyllids etc. However, similar situations can be expected even in organic farming if not suitable practices used. The examples of pyrethrins (Jansen *et al*. 2010) or of spinosad (Cisneros *et al*., 2002, Arthurs *et al*., 2007) shows that side effects of products must be also here taken into consideration to prevent failures of pest control.

Material and Methods

Forficula auricularia individuals were collected in experimental apple orchard in Prague in July 2011. The corrugated paper belts placed on the trees were used to this purpose. The adults and nymphs were separated and in the groups of 10 individuals they were placed into cylindrical plastic containers with perforated lids. The piece of apple as a food for earwigs was placed on the filtration paper in the bottom of each container. Close before the treatment the earwigs were exposed to high CO_2 concentration to lower their activity to make the application possible. Earwigs were tested in two different ways: 1μl of the pesticide dissolved in acetone was applied by micropipette on the abdomen of insects as a topical treatment (i), cca 0.25 ml of a water solution of the pesticide was applied with hand sprayer on earwigs, filtration paper and piece of apple placed on the bottom of containers (ii). The mortality and the change in the behaviour of insects were evaluated 24, 48 and 96 hours after application. I addition, LD_{50} and LD_{90} of spinosad (topical application) was calculated (0.0125, 0.25, 0.5 and 1.25 of the base concentration) using probit analysis.

Chrysoperla carnea nymphs were obtained from commercial resources (Koppert Biological Sytems, Netherlands). 4x10 nymphs for each variant were separately placed into cells in plastic boxes (IWAKI & CO., Ltd., Tokyo, Japan).The filtration paper treated with water solution of pesticides was placed under the lid of boxes.

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The boxes were placed into environmental chamber at temperature 20°C and they were turned over to ensure the contact of nymphs with treated filtration paper. Evaluations were performed 1, 2, 5, 12, and 24 hours after treatment. On the base of mortality/change of behaviour the preparations were classified as follows (www.koppert.com): < 25 % = harmless (1), 25-50% = slightly harmful (2), 51-75% = moderately harmful (3), > 75% very harmful (4).

Table 1: Products used in the trial

Product name	Active ingredients	Concentration [%]	Tested species*
Alginure	extract from seaweed	1.00	E, Ch
Calypso 480 SC	thiacloprid	0.025	E
Insegar 25 WG	fenoxycarb	0.06	E
Mospilan 25 SP	acetamiprid	0.025	E
MycoSin	Aluminium sulphate, deactivated yeast cell components, plant extract from horsetail (*Equisetum arvense*)	1.00	E, Ch
PREV-B	orange oil	0.30	Ch
Quassia amara chips	quassin, neoquassin	6.00	E
Reldan 40 EC	chlorpyrifos-methyl	0.15	E
Rock Effect	*Pongamia pinnata* oil	1.00	E, Ch
SpinTor	spinosad	0.06**	E
Syllit 400 SC	dodine	0.17	E
Talstar	bifenthrin	0.04	Ch
Thiram Granuflo	thiram	0.74	E
Vitisan	potassium bicarbonate	0.50	E, Ch
Calypso 480 SC+Syllit 400 SC	thiacloprid+dodine	0.025+0.17	E
Calypso 480 SC+Syllit 400 SC	thiacloprid+dodine	0.0125+0.085	E
Thiram G.+Mospilan 20 SP	thiram+acetamiprid	0.74+0.025	E

*) E=earwigs, C=chrysops **) basic spinosad concentration

Results

The mortality of tested products on *earwigs* is shown in table 2. Reldan 40 EC caused mortality of nymphs 85% and 100% after 24 and 48 hours, respectively. Mortality of adults was 10% and 85% after 24 and 96 hours, respectively. Surviving insects showed dramatically changed behaviour (reduced mobility, convulsions) in comparison with control. Although the earwigs recovered in the end of the trial they seemed to die during the first hours. This effect is a very serious handicap for the survival of animals in nature conditions and it must be considered when preparations classified. Insecticides Calypso 480 SC and Syllit 400 SC did not cause mortality. However, the both pesticides significantly changed behaviour of earwigs. The both insecticides were classified as very harmful. Although the synergic effect of thiacloprid and dodine was not confirmed their combination influenced behaviour of earwigs even in half concentration variant. The similar situation was observed in the case of SpinTor which showed acute toxic effect on earwig behaviour (reduced mobility, convulsions) in 61.7% of individuals after 24 hours exposition. SpinTor was classified as moderately harmful on adults from the same reasons as Reldan

40 EC, Syllit 400 SC and Calypso 480 SC. LD_{50} and LD_{90} of spinosad was 0.349 and 4.494, respectively (table 3). Other tested products were classified as harmless to earwigs. The mortality of *chrysops* is presented in table 4. All tested products with the exception of inseciticide Talstar (100% mortality) were classified as harmless.

Table 2: Mortality of *Forficula auricularia* after treatments and classification of products.

Treatment	Stage	Mortality [%]					Toxicity (1-4)
		24 hours		48 hours		96 hours	
		topical	spray	topical	spray	topical	
Control	adults	0	0	1.1	0	0	-
	nymphs	0	0	0	0	-	-
Alginure	adults	0	0	2.8	0	-	1
Calypso 480 SC	adults	0	-	-	-	0	4*
Insegar 25WP	adults	0	0	-	-	0	1
Mospilan 20 SP	adults	0	-	0	-	-	1
Myco.Sin	adults	0	0	0	0	-	1
PREV-B	adults	0	-	0	-	-	1
Quassia amara	adults	-	0	-	0	-	1
Reldan 40 EC	adults	10	-	-	-	85	4
	nymphs	-	85	-	100	-	4
Rock Effect	adults	0	0	-	0	0	1
SpinTor	adults	61.7*	-	15.4	-	-	3*
Syllit 400 SC	adults	0	0	-	0	0	4*
Thiram Granuflo	adults	0	-	0	-	-	1
	nymphs	3.3		6.7	-	-	1
VitiSan	adults	2.5	0	2.5	0	-	1
Calypso 480 SC +Syllit 400 SC	adults	2.5	3.3	4.8	3.3	-	4*
Calypso 480 SC +Syllit 400 SC	adults	-	3.3	-	3.3	-	4*
Thiram Granuflo. +Mospilan 20 SP	adults	0	-	3.3	-	-	1

*) behaviour of insects dramatically changed

Table 3: Calculation of LD_{50} and LD_{90} in earwigs

Probability	Log(factor)	Lower bound 95%	Upper bound 95%
0,01	-	-	-
0,05	0,004	0,000	0,016
0,10	0,019	0,002	0,050
0,20	0,059	0,014	0,117
0,30	0,117	0,043	0,204
0,40	0,207	0,099	0,339
0,50	0,349*	0,199	0,581
0,60	0,582	0,357	1,097
0,70	1,002	0,599	2,372
0,80	1,883	1,018	6,245
0,90	4,494**	2,004	25,044
0,95	9,193	3,429	80,085
0,99	35,044	9,176	718,464

*) LD_{50} **) LD_{90}

Table 4: Mortality of *Chrysoperla carnea* in the trial variants.

Treatment	Mortality [%]	Toxicity (1-4)
Control	0	1
Alginure	0	1
Myco-Sin	0	1
PREV-B	0	1
Rock Effect	0	1
Talstar	100	4
Vitisan	0	1

Discussion

The most of products allowed or intended for organic fruit growing were harmless to earwigs and chrysops. The only exception was spinosad showing signifficant negative effect on earwigs. It confirmes that spinosad cannot be considered to have an environmental safety profile similar to most established biological insecticides (Cisneros *et al*., 2002). As was expected the reference chemical insecticides chlorpyriphos-methyl and thiacloprid were toxic to earwigs and bifenthrin to chrysops. Observed negative effect of dodine must be considered in IPM as well as the more frequent use of spinosad in IPM and organic farming.

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