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Effect of Chemicals on Aphidophagous Insects

RESPONSE OF ADULTS OF COMMON GREEN LACEWING *CHRYSOPERLA CARNEA* TO PESTICIDES

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INTRODUCTION

The role of biological control in IPM programs grows steadily. The value of natural enemies such as insect and mite predators, hymenopterous parasitoids and pathogens for regulating arthropod pests is generally appreciated. However, the maintenance of biological control agents may be difficult in practice where pesticides must be used, because beneficial organisms are often very sensitive to pesticides. Possible solutions to this question are:

(1) selective use of broad-spectrum pesticides,

(2) collecting or selecting of pesticide-resistant strains of beneficial species for release (Grafton-Cardwell and Hoy, 1985a),

(3) use of pesticides which are harmless to natural enemies.

With increasing interest in integrated control procedures, attention has been directed towards the last method, namely the study of the side-effects of pesticides on beneficial species in order to assess their susceptibility and to identify more selective preparations.

The common green lacewing (GLW), *Chrysoperla carnea* has undergone extensive pesticide testing because it is a good candidate for use in IPM programs. It is distributed worldwide (Zeleny, 1984), has a wide host plant and prey range (Principi and Canard, 1984), can be mass cultured (Ridgway et al., 1970) and manipulated using food sprays (Hagen and Tassan, 1970), and pesticide tolerant populations have been identified (Plapp and Bull, 1978; Shour and Crowder, 1980; Grafton-Cardwell and Hoy, 1985a). It is important to note here, that only the larvae of GLW are predators, the adults feed on honeydew, pollen, nectar and other sweet secretions. This is the reason why the greater part of the studies deals with the tolerance of the larvae to insecticides and there is little information on adult tolerance (Table 1.). Studies on tolerance of adult GLW may indirectly contribute to an increase in the usefulness of GLW larvae. This paper reports on toxicity of widely used chemicals to individuals of GLW.

Key words: *Chrysoperla carnea*, adult-toxicity, pesticides.

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Table 1. Number and type of chemicals tested on *Ch. carnea* larvae and adults.

larvae					adults					REFERENCES
I	A	F	H	R	I	A	F	H	R	
41	9	7			41	9	7			Bartlett 1964
5										Lingren and Ridgway 1967
12										Wiackowski 1968
8			1		8			1		Wilkinson et al.1975
10	5									Sokhoruchenko et al. 1977
18										Plapp and Bull 1978
26	1	14								Suter 1978
10		6	4							Franz et al. 1980
4										Shour and Crowder 1980
					6					Tolstova and Burkova 1980 in Jeremina 1984
5										Grapel 1981
3					1					Ishaaya and Cassida 1981
6										Sokhoruchenko et al. 1981
3										Nasseh 1982
4										Rajakulendran and Plapp 1982a
6										Rajakulendran and Plapp 1982b
3										Chang and Plapp 1983
38	4	6								Kovalska 1983 in Baicu 1986
10		6	4							Hassan et al. 1983
					2					Grafton-Cardwell and Hoy 1985a
6					6					Grafton-Cardwell and Hoy 1985b
27	4									Novoshilov et al. 1985
7										Singh and Varma 1986
9	1	5	4	3						Hassan et al. 1987
9		8	4							Hassan et al. 1988
11										Pree et al. 1989

I = insecticides, A = acaricides, F = fungicides, H = herbicides R = plant growth regulators.

MATERIAL AND METHODS

GLW adults were collected in 1985 in an uncultivated area in Gödöllő (30 km north-east of Budapest). Specimens were obtained by sweep netting. Table 2. contains a list of the chemicals and also the concentrations used. Most of the chemicals were a gift from Budapest Chemical Works and others such as Microthiol Special and Zineb S 80 were purchased.

Leaves of *Philadelphus coronarius* were immersed in the test solutions and then air dried for 1 hour. The treated leaf, and a small plastic dish with food (1:1:1 mixture of honey, yeast and pollen) and wet cotton wool were placed into a glass Petri dish (10 cm diameter). 10 GLW adults were placed in each dish. There were 2 replicates per concentration. The number of paralyzed or dead individuals was recorded after 1, 5, 10, 20, 40 minutes, 1, 2, 4, hours, 1, 2,...days. Data were analyzed by probit analysis with a program that incorporates Abbott's (1925) correction for natural mortality.

Table 2. Chemicals and their concentrations used in screening

Preparation	Registered concentrations %	Test concentrations %
INSECTICIDES		
Decis 2.5 EC (25 g/l deltamethrin)	0.05 – 0.07	0.0125 – 0.025 – 0.05
Decisquick EC (25 g/l deltamethrin + 400 g/l heptenophos)	0.03	0.0125 – 0.025 – 0.05
Ditrifon 50 WP (50 % trichlorphon)	0.20	0.0500 – 0.100 – 0.20
Ravyon FW (480 g/l carbaryl)	0.35	0.1250 – 0.250 – 0.50
Thiodan 33 EC (33 % endosulphan)	0.11 – 0.20	0.025 – 0.050 – 0.100 – 0.20
Ultracid 40 WP (40 % methidathion)	0.075 – 0.1	0.003 – 0.009 – 0.027
Zolone 35 EC (35 % phosalone)	0.175	0.100 – 0.200 – 0.400
ACARICIDES		
Mitac 20 EC (20 % amitraz)	0.30 – 0.60	0.125 – 0.250 – 0.500
FUNGICIDES		
Microthiol Special (80 % sulphur)	0.30 – 0.50	0.500 – 1.000 – 2.000
Orthocid 50 WP (50 % captan)	0.20 – 0.30	0.250 – 0.500 – 1.000
Quinolate V-4-X (50 % carboxin + 15 % copper oxyquinolate)	0.20	0.250 – 0.500 – 1.000
Rézoxiklorid 450 FW (450 g/l copper oxychloride)	0.25	0.250 – 0.500 – 1.000
Ridomil Plus 50 WP (15 % metalaxyl + 35 % copper oxychloride)	0.25 – 0.30	0.250 – 0.500 – 1.000
Ridomil Zineb 72 WP (8 % metalaxyl + 64 % zineb)	0.25 – 0.30	0.250 – 0.500 – 1.000
Rubigan 12 EC (120 g/l fenarimol)	0.003 – 0.05	0.025 – 0.050 – 0.100
Rubigan Plus (35 % dodine + 4 % fenarimol)	0.10	0.100 – 0.200 – 0.400
Tilt 250 EC (250 g/l propiconazole)	0.40	0.025 – 0.050 – 0.100
Topsin Metil 70 WP (70 % thiophanate-methyl)	0.08 – 0.16	0.250 – 0.500 – 1.000
Zineb S 80 (80 % zineb)	0.20 – 0.30	0.250 – 0.500 – 1.000
PLANT GROWTH REGULATORS		
Bercema CCC (500 g/l chlormequat)	0.30 – 0.60	0.250 – 0.500 – 1.000
Ethrel (40 % ethephon)	0.08	0.250 – 0.500 – 1.000

RESULTS AND DISCUSSIONS

The detailed effects of 7 insecticides are summarized in Table 3. Table 4. shows the effects of all the preparations assessed in different ways.

Table 3. Effects of 7 insecticides on adult *Ch. carnea*

INSECTICIDES (time of evaluation)	LC 50 (95% FL) %	LT 50 days	% mortality at the registered concentration
Ultracid 40 WP (3 days)	0.008 (0.002-0.027)	0.42	100
Ditrifon 50 WP (3 days)	0.038 (0.002-0.310)	1.22	99.9
Ravyon FW (4 days)	0.120 (0.026-0.555)	2.07	99.7
Decisquick EC (6 days)	0.011 (0.002-0.066)	2.87	99.0
Decis 2.5 EC (6 days)	0.029 (-)	6.18	68.7
Thiodan 33 EC (9 days)	0.127 (0.050-0.324)	6.32	65.0
Zolone 35 EC	–	27.23	21.5

– LC 50 could not be computed.
(-) 95% FL could not be computed.

All fungicides, plant growth regulators and the acaricide, amitraz were classified as harmless to adult *Ch. carnea*. Zolone was slightly harmful, Decis and Thiodan moderately harmful and Ultracid, Ditrifon, Ravyon and the Decisquick very harmful.

The effects of Quinolate, Rézoxikloridé, Ridomil Plus, Ridomil Zineb, Rubigan, Rubigan Plus, Tilt, Topsin Metil, Ethrel, Bercema €€€, Mitac, Ultracid, Decisquick and Zolone on adult GLW have not been previously reported.

The effects observed for Ravyon, Orthocid and Zineb are consistent with the findings of earlier studies (Bartlett, 1964; Wilkinson et al., 1975; Grafton-Cardwell and Hoy, 1985a). However, my results differed from the previously published reports on the effects of Thiodan, Decis, Ditrifon and Microthiol Special on adult GLW.

Bartlett (1964) reported that Thiodan was very toxic to adult *Ch. carnea* and Tolstova and Burkova (1980 in Jeremina, 1984) pointed out the same is the case for Decis. My tests demonstrated that these pesticides were moderately harmful to the GLW. Although Microthiol Special was found to be of low toxicity and more harmful to adult GLW than Ditrifon (Bartlett, 1964), my results indicate just the reverse, namely Microthial Special was harmless but Ditrifon was very toxic.

These differences may be explained by the use of different screening methods, populations of GLW that originate from areas with different pesticide pressures may show variation in pesticide tolerances (Grafton-Cardwell and Hoy, 1985a).

Table 4. Susceptibility of adult *Ch. carnea* to the chemicals examined

Preparation	Categories of evaluation		
	A	B	C
INSECTICIDES			
Ultracid 40 WP	H	4	4
Ditrifon 50 WP	M	4	4
Ravyon FW	M	4	4
Decisquick EC	M	4	4
Decis 2.5 EC	L	2	3
Thiodan 33 EC	L	2	2-3
Zolone 35 EC	L	1	1
ACARICIDES			
Mitac 20 EC	0	1	0
FUNGICIDES			
Microthiol Special	0	1	0
Orthocid 50 WP	0	1	0
Quinolate V-4-X	0	1	0
Rézoxiklorid 450 FW	0	1	0
Ridomil Plus 50 WP	0	1	0
Ridomil Zineb 72 WP	0	1	0
Rubigan 12 EC	0	1	0
Rubigan Plus	0	1	0
Tilt 250 EC	0	1	0
Topsin Metil 70 WP	0	1	0
Zineb S 80	0	1	0
PLANT GROWTH REGULATORS			
Bercema CCC	0	1	0
Ethrel	0	1	0

A: categories of Bartlett (1964) 0 = no kill, L = LT 50 > 100 hours, M = LT 50 > 24 hours and < 100 hours, H = LT 50 < 24 hours.

B: categories of the IOBC/WPRS-Working Group "Pesticides and Beneficial Organisms" (Franz et al. 1980) 1 = harmless (< 50 % M), 2 = slightly harmful (50–79 % M), 3 = moderately harmful (80–99 % M), 4 = harmful (>99 % M).

C: categories of Bigler (1984) 0 = no effect, 1 = low effect (< 40 % M), 2 = moderate effect (41–70 % M), 3 = high effect (71–90 % M), 4 = extremely high effect (91–100 % M).

In addition, in laboratory cultures of GLW the naturally-occurring resistance of the original sample to some groups of insecticides may decrease with time (Pree et al., 1989) and also their fitness (Jones et al., 1978). Thus laboratory reared test animals might become increasingly susceptible to pesticides. In conclusion, these bioassays on adult *Ch. carnea* provide useful information for the protection of natural populations of this valuable beneficial insect. The chemicals evaluated as harmless in this test might permit the survival of GLW adults in IPM programs but further semi-field or field test of the preparations that were found to be harmful is needed to determine their effects under field conditions because environmental factors may affect the hazard posed by a pesticide to natural enemies (Hassan, 1989).

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