Bull. Fac. Agric., Cairo Univ., 57 (2006):549-570.

TOXICITY OF RECOMMENDED PESTICIDES AGAINST SEVERAL VEGETABLE PESTS TO DIFFERENT POPULATIONS OF *Chrysoperla carnea* (STEPHENS) IN THE LABORATORY

(Received: 30.3.2006)

By
H. M. A. Badawy, S. A. El Arnaouty, A. M. El Gantiry* and N. M. Gaber

Department of Economic Entomology ,and Pesticides Faculty of Agriculture, Cairo University, Giza, Egypt
** Plant Protection Research Institute, Agriculture Research Center, Giza*

ABSTRACT

Biological control of aphids must be compatible with chemical control of other insects, plant diseases and mites. The integrated use of natural enemies particularly *Ch. carnea* stages for the management of vegetable aphids with different pesticides against other pests appears possible by the use of selective pesticides or the use of reduced concentrations of other pesticides so that at least one life stage of *Ch. carnea* will be conserved. The data of selectivity indicate that aphox, confidor, bancol and vertimec may be the safest available insecticides for the predator *Ch. carnea* and are good candidates for use against aphids, thrips, leaf miners and red spider mites, respectively. The use of admire, trebon and bio-fly for controlling whiteflies were safer to *Ch. carnea* populations than those of admiral. The insect growth regulator match was moderate toxic to *Ch. carnea* but it is preferable using against cotton leafworms instead of selecron and lannate that caused complete mortality to larvae. The fungicide topas (100) is more suitable to be used against powdery mildew instead of afugan because it had poor side effects on *Ch. carnea* stages. The fungicide ridomil plus used against late blight on vegetable crops was harmless to egg hatching

populations from fields using pesticides intensively (Fayum and Menofia) were more tolerant or resistant to pesticides than those collected from free pesticide fields (Baharia Oasis and Abu-Sembil) and of course the laboratory culture. Although the tested pesticides belong to several chemical groups but the field populations of Fayum and Menofia were tolerant to the most of them except the conventional insecticides; selecron and lannate.

Key words: *Chrysoperla carnea, pesticides, populations, tolerance toxicity,*

1. INTRODUCTION

Vegetable crops growing in the fields and greenhouses are heavily attacked with several insect pests and diseases. The whiteflies, aphids, cotton leaf worms, leaf miners, thrips and red spider mites are very serious pests of tomato, cucumber and green bean in greenhouses. Also, these vegetables are infested with plant diseases such as powdery mildew and early blight. Severe attacks of insect pests and diseases cause considerable loss and reduce the yield.

The intensive use of pesticides causes unexpected side effects such as pest resistance, pest resurgence and outbreak of secondary pests. The needs for specific compounds against economic insects are becoming more and more important. In this respect, recent chemical groups such as insect growth regulators, nereistoxin analogue and neonicotinoid (Wakita *et al.*, 2003) were discovered later, which exhibited different mode of actions. It is essential to reduce limit residues in the environment and harvested crops, and avoid potential problems of pest resurgence and pesticide resistance. Judicious application of chemical products to minimize the risk of adverse effects is integral with the principles of IPM. Therefore, it is necessary to evaluate their toxicity to nontarget insects. An ideal insecticide should be toxic to pests but not to predators and parasites (Ishaaya and Casida, 1981).

The main objective in integrated pest management (IPM) is increasing the role of biological control components under this system. This may be accomplished by maximizing the effects of naturally occurring beneficial species or by augmentative release of specific predators or parasites. In any IPM system the possible side effects of all the crop protection products used should be taken into account. Insecticides as a group are ranked as the most toxic against arthropod natural enemies, while some fungicides and herbicides are rated as harmful.

The common green lacewing *Chrysoperla carnea* (Stephens) (Neuroptera :Chrysopidae) appears to be a good candidate for the use in (IPM) programs, where it is a voracious feeder (Balasubramani and Swamiappan, 1994), has a relatively broad range of acceptable preys (Hydron and WhiteComb, 1979), relative ease of mass production (Morrison, 1985 and El Arnaouty, 1991) and tolerance to some groups of pesticides (Hassan *et al.*, 1985, Bigler and Waldburger 1994, Chen and Liu 2002).

The maintenance of biological components has proven difficult in practice where pesticides must be applied, and the beneficial species are often more sensitive than target species (Croft and Brown 1975). Classical biological control (*i.e.*, the introduction of a predator or parasite for the control of a particular pest spices) and inundation control (*i.e.* repeated mass release of a control agent) programs impose high requirements on the selectivity of chemical control agents to be combined within them.

The ultimate goal of our investigation is to ensure that the timing of pesticide treatment as well as specificity of the recommended products are relatively safer to *Ch. carnea* population and its release strategies as far as possible on tomato, cucumber and green bean in greenhouses. Although *Ch. carnea* is tolerant to many pesticides but it is highly susceptible to field rates of most organophosphorus and carbamate insecticides (Grafton-Cardwell and Hoy 1986). Since these pesticides are commonly used in agriculture today. The present study aimed to select the less toxic pesticides to *Ch. carnea* through the candidate pesticides that are recommended against the same pest target. Moreover, this study was directed to emphasize the impact of pesticide application in different geographical area in Egypt on the tolerance of *Ch. carnea* populations to these pesticides

2. MATERIALS AND METHODS

2.1. Used pesticides

The tested pesticides belong to three categories; insecticides, acaricides and fungicides. They were selected on the basis of their use commercially in the control of different insects and diseases on tomato, cucumber and green bean crops in the greenhouse and open fields (Table 1). The toxicity of certain insecticides which belong to the new chemical groups compared with the conventional insecticides to *Ch. Carnea* was tested. Its toxicity to the release stages of *Ch. carnea* (three day old eggs and the second larval instar) was evaluated. The tested pesticides were used at the recommended rates (R) by the Egyptian Ministry of Agriculture and its dilutions; 1/2, 1/4, 1/8 and 1/16.

Table (1): Tested pesticides.

Type	Trade name	Common name	Chemical group	Rate/ 100L	Pest or disease	Crop
Insecticides	Selecron 72% EC	Profenfos	Organophosphate	187.5 ml	Cotton leaf worm	Tomato
	Lannate 90 % SP	Methomyl	Carbamate	75 ml		Tomato
	Aphox 50% DG	Pirimicarb	Carbamate	50 g	Aphids	Green bean
	Trebon 30% EC	Etofenprox	Pyrethroid	62.5 ml	Whitefly	Tomato
	Confidor20% EC	Imidacloprid	neonicotinoid	50 ml	Thrips	Cotton
	Admire 20 % SC	Imidacloprid	neonicotinoid	125 ml	Whitefly	Tomato
	Admiral 10% EC	Pyriproxyfen	Insect growth regulator	75 ml	Whitefly	Cucumber
	Match 5% EC	Lufenuron		40 ml	Cotton leaf worm	Tomato
	Bancol 50% WP	Bensultap	Nereistoxin analogue	500 g/f	Leaf miners	Tomato
	Bio-fly 30x10"cells/ml	*Beauvaria bassiana*	Bio-pesticide	100 ml	Whitefly	Tomato
Acaricides	Vertimec 1.8% EC	Abamectin	Bio-pesticide	40ml	Red spider mite	Cucumber
Fungicides	Afugan 30%EC	Pyrazophos	Phosphorothiolate	100 ml	Powdery mildew	Cucumber
	Ridomil plus 50% WP	Metalaxyl + Copper oxychlorid	Acylalanine+ Copper oxychlorid	250 g	Late blight	Tomato
	Topas (100) 10% EC	Penconazelc	Triazole	25 ml	Powdery mildew	Tomato

2.2. Rearing of *Chrysoperla carnea*

Adults of *Ch. carnea* were placed in boxes (16 cm x 24 cm x 11 cm), the tops were closed with a black crepe sheet for oviposition. Semi artificial diets droplets on waxed paper and moist cotton wool were used to provide preys and water. The boxes were changed three times every week and the eggs were collected daily. The eggs of *Ch. carnea* were placed in Plexiglas boxes. *Ephestia kuehniella* eggs were used as food source for larval rearing.

Five populations of *Ch. carnea* were used in this test. Two populations of *Ch. carnea* were collected from two locations free from pesticide application in March 2005. About 100 lacewing adults were collected from clover fields in El-Baharia Oasis (Giza Governorate) and another 100 adults were collected from wheat fields in Abu-Sembil (Aswan Governorate). The other two populations of *Ch. carnea* were collected in July 2005 from cotton and pepper fields of Fayum and Menofia (El-khatatba) Governorates, which represent locations of intensive of pesticides. The collected lacewings were reared in laboratory until there were sufficient for testing. The 5th population of *Ch. carnea* that has been reared since ten years in "Chrysopa mass rearing unit" Faculty of Agriculture, Cairo University was used as laboratory susceptible strain to candidate pesticides in the experiments comparing with the other four populations. All laboratory experiments were carried out in controlled rooms at 25 ± 2°C, 65± 5% of relative humidity and 16:8 photoperiod.

2.3. Application of *Ch. carnea* eggs

Eggs laid on black crepe sheets were treated when embryos were three-day old. Each sheet of eggs was cut in two parts; one half was submitted to mist spray with one pesticide formulated in water and the other half was sprayed with water as check treatment. Egg sheets were hung separately until dry. Treated and untreated eggs were removed and placed individually to avoid cannibalism at hatching in small plastic cups of microtitre plates and kept in rearing. Alive and dead larvae of *Ch. Carnea* were recorded after 3 and 6 days of application according to the type of insecticide. Hatching percentage was corrected by Abbott's formula (1925). Testing method was carried out according to Bartlett 1964.

2.4. Application of *Ch. carnea* larvae

This technique was carried out to evaluate the toxicity of tested pesticides to the second larval instar using the method of Grafton-Cardwell and Hoy (1986). Different concentrations of each pesticide were sprayed on the inner surface of small plastic cups (2.5 cm diameter, 2 cm high) and left to dry. After complete dryness of the film, the 2nd instar larvae of *Ch. carnea* were placed individually in these vials for each concentration The control was treated with water only. Eggs of *Ephestia kuehniella* were provided as food for the larvae inside the walls of each plastic cup and more eggs were added daily as needed. Fifteen lacewing larvae were tested for each concentration. The microtitre plates were kept at the same conditions. Mortality counts were recorded after one and three days according to the type of insecticide. The data were corrected by Abbott's formula (1925) and statistically analyzed using proc ANOVA in SAS. Mean replicates were conducted using Dunce Multiple Range Test in SAS (SAS 1988). The formula of Roush and Luttrell (1989) was used to calculate the resistance percentage.

3. RESULTS

3.1. Toxicity of pesticides on culture of *Ch. Carnea* in laboratory

The results of pesticide toxicity to eggs hatching of *Ch. Carnea* are presented in Table (2). All pesticide treatments significantly affected the survival of *Ch. Carnea* hatching. The positive relationship between rate increasing and percentage mortality of egg hatching was found for all tested pesticides. In general, insecticides had the greatest effect on egg hatching except the biopesticides and aphox, whereas fungicides had little impact on egg hatching of *Ch. Carnea* except afugan, which was toxic. It may be attributed to its chemical group phosphorothiolate. The candidate insecticides were arranged according to their toxicity to egg hatching in the following descending order; selecron, lannate, admire, match, admiral, confidor, vertemic, trebon, aphox, Bancol and bio-fly.

Generally, the results confirmed that the new chemical groups; nereistoxin analogue and neonicotinoid in addition to the bio-pesticides were less toxic to egg hatching than the conventional chemical groups; organophosphours and carbamate except aphox. The insecticides; Admire, Match and Admiral showed moderate activity toward egg hatching. Although confidor 20% EC and Admire 20% SC have the same active ingredient (imidacloprid) but admire was more toxic than confidor to egg hatching of *Ch. Carnea.* It may be due to that the rate of application of admire is more than confidor 2.5 times. Also, half dose of recommended rate of application for admire is still more toxic than the recommended dose of confidor and accordingly it was more toxic to egg hatching of *Ch. Carnea.* The fungicides; ridomil plus and topas (100) used against late blight and powdery mildew had low toxicity to egg hatching of *Ch. Carnea.*

In general, the same significant differences in the efficacy of tested pesticides at their recommendation rates were also found in their dilutions. The dilutions of the tested pesticides gave a round figure about the toxicity of pesticide residues on egg hatching of *Ch. Carnea.* It may be useful for choosing the selective insecticides which should be toxic to target pests but not to predators. Although the dilutions of the rates of application reached 1/16 but still some insecticides caused more than 20% mortality to *Ch. Carnea* hatching such as selecron, match, lannate and admiral. Although the insect growth regulator compounds; admiral and match caused moderate toxicity at their recommended dose (46 and 48%) but their dilutions gave a slight decrease in its toxicity to egg hatching comparing with the other tested insecticides.

Table (2): Effect of tested pesticides at different concentrations on egg hatching of *Chrysoperla carnea* (Stephens) in laboratory culture.

Pesticides	% Mortality in egg hatching at different concentrations				
	R	R/2	R/4	R/8	R/16
Selecron 72% EC	90^{a}	58^{a}	58^{a}	42^{a}	38^{a}
Lannate 90 % SP	80^{b}	58^{a}	42^{b}	40^{a}	28^{b}
Aphox 50% DG	26^{f}	20^{ef}	16^{de}	16^{d}	6^{ef}
Trebon 30% EC	28^{ef}	22^{e}	16^{de}	12^{de}	10^{de}
Confidor20% EC	32^{e}	22^{e}	12^{ef}	10^{e}	6^{ef}
Admire 20 % SC	52^{c}	42^{b}	30^{c}	22^{c}	18^{c}
Admiral 10% EC	46^{d}	32^{cd}	32^{c}	28^{b}	22^{c}
Match 5% EC	48^{cd}	36^{c}	34^{c}	32^{b}	30^{b}
Bancol 50% WP	22^{fg}	20^{ef}	14^{ef}	12^{de}	10^{de}
Bio-fly 30x10^{6}cells/ml	20^{g}	18^{ef}	14^{ef}	12^{de}	10^{de}
Vertimec 1.8% EC	32^{e}	22^{e}	20^{d}	16^{d}	12^{d}
Afugan 30%EC	32^{e}	28^{d}	14^{ef}	12^{de}	10^{de}
Ridomil plus 50% WP	20^{g}	16^{fg}	14^{ef}	10^{e}	10^{de}
Topas (100) 10% EC	14^{h}	12^{g}	10^{f}	8^{e}	4^{f}

Means with different letters in the same column are significantly different ($P< 0.05$) using Dunce Multiple Range Test in SAS.

The same tested pesticides that were evaluated against the three-day old eggs of *Ch. carnea* were also tested against the second larval instar. The results of pesticide toxicity to the second larval instar of *Ch. carnea* are set out in Table (3). There is a dose-response relationship between dose increasing and percentage mortality of the second larval instar for all tested pesticides. All pesticide treatments significantly affected the survival of *Ch. carnea* larvae. They can be statistically classified into several groups according to their toxicity to the second larval instar. Selecron and lannate demonstrated the highest significant mortality percentage to *Ch. carnea* larvae at the recommended rate of application and all their dilutions. Afugan at the recommended dose caused a high mortality (70%) to the second larval instar of *Ch. carnea.* The rest of insecticides showed moderate activity toward *Ch. carnea* larvae; their percentage mortality ranged between 30 and 58%. In contrary, the fungicides; ridomil plus and topas (100) were the lowest significant mortality percentage.

Table (3): Effect of the tested pesticides at different concentrations on the second larval instar of *Chrysoperla carnea* (Stephens) in laboratory culture.

Pesticides	% Mortality of second larval instar at different concentrations				
	R	R/2	R/4	R/8	R/16
Selecron 72% EC	100^{a}	100^{a}	100^{a}	96^{a}	90^{a}
Lannate 90 % SP	100^{a}	100^{a}	90^{b}	72^{b}	48^{b}
Aphox 50% DG	32^{f}	22^{ef}	18^{ef}	14^{e}	12^{f}
Trebon 30% EC	30^{f}	24^{e}	16^{f}	10^{ef}	8^{fg}
Confidor20% EC	36^{e}	26^{e}	20^{ef}	12^{e}	8^{fg}
Admire 20 % SC	48^{d}	38^{c}	28^{d}	22^{d}	20^{e}
Admiral 10% EC	40^{e}	32^{d}	22^{e}	12^{e}	8^{fg}
Match 5% EC	58^{c}	38^{c}	28^{d}	26^{d}	24^{d}
Bancol 50% WP	40^{e}	26^{e}	18^{ef}	8^{f}	4^{gh}
Bio-fly 30x10^{6}cells/ml	30^{f}	18^{f}	8^{g}	2^{g}	0^{i}
Vertimec 1.8% EC	30^{f}	18^{f}	16^{f}	14^{e}	8^{fg}
Afugan 30%EC	70^{b}	68^{b}	54^{c}	46^{c}	32^{c}
Ridomil plus 50% WP	18^{g}	10^{g}	8^{g}	6^{f}	4^{gh}
Topas (100) 10% EC	16^{g}	12^{g}	10^{g}	8^{f}	2^{h}

Means with different letters in the same column are significantly different ($P< 0.05$) using Dunce Multiple Range Test in SAS.

Generally, the same significant differences between toxicity of the pesticides to egg hatching were also found with the second larval instar of *Ch. carnea*. The present data confirmed that 3-day old eggs were more tolerant to tested pesticides than the second larval instar of *Ch. carnea*. The tested compound selecron gave complete mortality to *Ch. Carnea* larvae till the quarter of recommended dose and caused 90% mortality at 1/16 of recommended dose. The same trend was also found by lannate, which gave complete mortality by using the recommended dose and its half. Although the insecticide aphox belongs to the same chemical group carbamate but it was less toxic to the second larval instar of *Ch. carnea*. The same significant differences in the toxicity of confidor and admire to egg hatching were also found to *Ch. carnea* larvae.

According to the guidelines of Hassan (1989), the tested pesticides can be categorized harmless (<50% mortality), slightly harmful (50-79% mortality), moderately harmful (80-89% mortality) and harmful (> 90% mortality) in laboratory test. The results showed that the pesticides; admire, admiral, bancol, confidor, aphox, trebon, bio-fly, vertimec, ridomil plus and topas (100) were harmless to *Ch. carnea* larvae and caused mortality less than 50% at their recommended dose. The insecticide match and the fungicide Afugan were classified as slightly harmful, which gave 58 and 70% mortality. The insecticides; selecron and lannate out of the fourteen tested pesticides were classified as harmful and caused complete mortality at their recommended dose to *Ch. carnea* larvae.

3.2. Toxicity of pesticides to field populations of *Chrysoperla carnea*

3.2.1. Free locations of pesticide application

The toxicity data of the tested pesticides at the field, half and quarter rates as ovicidal and larvicidal to *Ch. carnea* populations which were collected from two locations free from pesticides application; El-Baharia Oasis and Abu-Sembal are set out in Tables (4 and 5). The same tested pesticides that were evaluated against the laboratory culture of *Ch. carnea* were also tested against the two field populations. The tested pesticides can be statistically classified into several groups according to their toxicity at the recommended dose to egg hatching and second larval instar of Baharia Oasis population. It was found that the insecticide lannate was more toxic than selecron to the egg hatching in Baharia Oasis and Abu-Sembil populations. In contrary, selecron was more toxic than lannate to laboratory culture.

The same toxicity trend of the tested pesticides to the egg hatching and the second larval instar of Baharia Oasis population was also found in Abu-Sembail population of *Ch. carnea*. The toxicity data to Baharia Oasis and Abu-Sembial populations of *Ch. carnea* confirmed the previously results of the laboratory culture, which indicated that 3-day old eggs were more tolerant to the tested pesticides than the second larval instar. The present results showed that the laboratory culture was more susceptible than field populations of *Ch. carnea* which were collected from Baharia Oasis and Abu-Sembil to the tested pesticides. It was also found that admire was more toxic than confidor to *Ch. carnea* the populations from Baharia Oasis and Abu-Sembil. Also, the insect growth regulators; admiral and match gave moderate toxicity to the egg hatching and the second larval instar of field populations comparing with the toxicity of other tested pesticides. The results presented in Tables (4 and 5) confirmed that the safe pesticides to *Ch. carnea* stages are aphox, trebon, bancol, bio-fly, vertimec, ridomil plus and topas (100). These safe pesticides in addition to match or admiral are protecting the vegetable crops against attacks of most economic insects and plant diseases.

Table (4): Effect of the tested pesticides at different concentrations on eggs hatching and second larval instar of *Chrysoperla. carnea* in the local population (El-Baharia Oasis).

Pesticides	% Mortality in eggs hatching			% Mortality of 2nd instar larvae		
	R	R/2	R/4	R	R/2	R/4
Selecron 72% EC	55^{b}	40^{b}	26^{b}	100^{a}	100^{a}	100^{a}
Lannate 90% SP	70^{a}	46^{a}	40^{a}	100^{a}	98^{a}	88^{b}
Aphox 50% DG	16^{fg}	12^{fg}	8^{e}	20^{h}	16^{f}	12^{fg}
Trebon 30% EC	24^{e}	22^{d}	16^{cd}	26^{fg}	22^{e}	12^{fg}
Confidor 20% SL	26^{e}	12^{fg}	8^{e}	36^{e}	30^{d}	20^{de}
Admire 20% SC	40^{c}	24^{d}	12^{de}	42^{d}	36^{c}	20^{de}
Admiral 10% EC	44^{c}	32^{c}	20^{c}	29^{f}	22^{e}	16^{ef}
Match 5% EC	42^{c}	30^{c}	20^{c}	56^{c}	36^{c}	24^{d}
Bancol 50% WP	18^{fg}	16^{ef}	12^{de}	34^{e}	26^{de}	14^{f}
Bio-fly 30x10^{6} cells/ml	18^{fg}	14^{fg}	10^{e}	26^{fg}	16^{f}	8^{gh}
Vertimec 1.8 % EC	20^{ef}	16^{ef}	16^{cd}	24^{fg}	16^{f}	8^{gh}
Afugan 30% EC	32^{d}	20^{de}	16^{cd}	65^{b}	46^{b}	34^{c}
Ridomil plus 50% WP	14^{g}	12^{fg}	12^{de}	12^{i}	8^{g}	6^{h}
Topas (100) 10% EC	14^{g}	10^{g}	8^{e}	14^{i}	10^{g}	6^{h}

Means with different letters in the same column are significantly different ($P < 0.05$) using Dunce Multiple Range Test in SAS.

3.2.2. Locations of pesticides application

The toxicity data of the tested pesticides at the field, half and quarter rates to the egg and the second larval instar of *Ch. carnea* populations in Fayum and Menofia Governorates are present in Tables (6 and 7). There was a little difference in susceptibility of *Ch. carnea* populations in Fayum and Menofia to the tested pesticides at all tested concentrations. The tested pesticides at the recommended doses can be statistically classified into several groups according to their toxicity to egg hatching and the second larval instar of El-Fayum population. Data showed that there is no statistical differences in the toxicity of confidor, bio-fly, vertimec, admire, bancol, ridomil plus and topas (100) to the egg hatching of Fayum population, which ranged between 10 and 14% mortality. The same trend was obtained in the case of Menofia population. The toxicity of the previously pesticides ranged between 10 and 16% mortality of *Ch. carnea* hatching. While, the same pesticides caused mortality to the second larval instar ranged between 10 and 34%

for Fayum population and 8-36% for El-Menofia population. Based on, slight toxicity to hatching and the second larval instar occurred as using the reduced rates (half and quarter) of field rate. Therefore, these pesticides were safer than the other tested pesticides to the field populations of *Ch. Carnea.*

Table (5): Effect of the tested pesticides at different concentrations on egg hatching and the second larval instar of *Chrysoperla. carnea* in the local population (Abu-Sembil).

Pesticides	% Mortality in egg hatching			% Mortality of 2nd instar larvae		
	R	R/2	R/4	R	R/2	R/4
Selecron 72% EC	60^{b}	38^{a}	22^{b}	100^{a}	100^{a}	100^{a}
Lannate 90% SP	70^{a}	42^{a}	30^{a}	100^{a}	96^{a}	86^{b}
Aphox 50% DG	18^{ef}	12^{ef}	10^{de}	24^{f}	22^{de}	14^{f}
Trebon 30% EC	20^{ef}	18^{d}	16^{c}	24^{f}	18^{ef}	10^{g}
Confidor 20% SL	26^{d}	16^{de}	10^{de}	30^{e}	26^{cd}	18^{de}
Admire 20% SC	40^{c}	32^{b}	20^{b}	44^{c}	28^{c}	22^{cd}
Admiral 10% EC	44^{c}	30^{bc}	22^{b}	39^{d}	28^{c}	18^{de}
Match 5% EC	40^{c}	26^{c}	14^{cd}	52^{b}	36^{b}	24^{c}
Bancol 50% WP	20^{ef}	16^{de}	14^{cd}	26^{f}	18^{ef}	16^{f}
Bio-fly 30x10^{6} cells/ml	20^{ef}	16^{de}	10^{de}	24^{f}	14^{ef}	8^{h}
Vertimec 1.8 % EC	22^{de}	18^{d}	10^{de}	22^{fg}	18^{ef}	10^{g}
Afugan 30% EC	26^{d}	18^{d}	12^{cd}	56^{d}	18^{ef}	12^{g}
Ridomil plus 50% WP	22^{de}	18^{d}	14^{cd}	22^{fg}	16^{ef}	14^{f}
Topas (100) 10% EC	12^{g}	10^{f}	6^{e}	22^{fg}	16^{ef}	10^{g}

Means with different letters in the same column are significantly different (P< 0.05) using Dunce Multiple Range Test in SAS.

The present results confirmed that the collected *Ch. carnea* populations from the fields previously using pesticides intensively were more tolerant or resistant to pesticides than those populations collected from free of previous pesticide application fields or laboratory susceptible strain. Although the tested pestic·des belong to several chemical groups but the field populations of Fayum and Menofia were tolerant to most of them except the conventional insecticides; selecron and lannate that were registered against cotton leafworms in Egypt. Based on, using of match against cotton leafworms on vegetable crops instead of selecron and lannate is safe for *Ch. carnea* populations.

Table (6): Effect of the tested pesticides at different concentrations on egg hatching and the second larval instar of *Chrysoperla carnea* in the local population (Fayum).

Pesticides	% Mortality in egg hatching			% Mortality of 2nd instar larvae		
	R	R/2	R/4	R	R/2	R/4
Selecron 72% EC	44^{b}	30^{b}	16^{b}	100^{a}	98^{a}	96^{a}
Lannate 90% SP	64^{a}	40^{a}	22^{a}	98^{a}	94^{a}	88^{b}
Aphox 50% DG	10^{e}	6^{e}	4^{e}	16^{ef}	12^{e}	10^{de}
Trebon 30% EC	22^{d}	18^{cd}	14^{b}	16^{ef}	12^{e}	6^{ef}
Confidor 20% SL	14^{e}	10^{ef}	8^{c}	28^{d}	20^{d}	10^{de}
Admire 20% SC	12^{e}	10^{ef}	8^{c}	34^{c}	20^{d}	12^{d}
Admiral 10% EC	30^{c}	20^{cd}	16^{b}	28^{d}	20^{d}	14^{d}
Match 5% EC	30^{c}	22^{c}	8^{c}	46^{b}	28^{c}	20^{c}
Bancol 50% WP	12^{e}	10^{ef}	8^{c}	18^{ef}	10^{e}	4^{f}
Bio-fly 30x10⁶ cells/ml	14^{e}	10^{ef}	6^{c}	14^{fg}	10^{e}	4^{f}
Vertimec 1.8 % EC	14^{e}	8^{ef}	6^{c}	20^{e}	12^{e}	6^{ef}
Afugan 30% EC	20^{d}	16^{d}	10^{c}	44^{b}	38^{b}	20^{c}
Ridomil plus 50% WP	12^{e}	8^{ef}	6^{c}	10^{fg}	8^{e}	4^{f}
Topas (100) 10% EC	10^{e}	6^{f}	4^{c}	12^{fg}	8^{e}	4^{f}

Means with different letters in the same column are significantly different ($P < 0.05$) using Dunce Multiple Range Test in SAS.

Table (7): Effect of the tested pesticides at different concentrations on egg hatching and the second larval instar of *Ch. carnea* in the local population (Menofia).

Pesticides	% Mortality in eggs hatching			% Mortality of 2nd instar larvae		
	R	**R/2**	**R/4**	**R**	**R/2**	**R/4**
Selecron 72% EC	46^{b}	32^{b}	20^{b}	100^{a}	100^{a}	98^{a}
Lannate 90% SP	62^{a}	38^{a}	26^{a}	96^{b}	94^{b}	90^{b}
Aphox 50% DG	12^{ef}	10^{f}	6^{d}	10^{g}	8^{g}	6^{e}
Trebon 30% EC	22^{d}	16^{de}	12^{cd}	20^{ef}	16^{ef}	8^{e}
Confidor 20% SL	16^{e}	^{10}f	8^{d}	24^{e}	16^{ef}	8^{e}
Admire 20% SC	14^{ef}	12^{ef}	10^{cd}	36^{d}	22^{d}	14^{d}
Admiral 10% EC	32^{c}	25^{c}	14^{c}	32^{d}	20^{de}	16^{d}
Match 5% EC	32^{c}	20^{d}	10^{cd}	44^{c}	24^{d}	18^{cd}
Bancol 50% WP	14^{ef}	10^{f}	6^{de}	20^{ef}	14^{fg}	8^{e}
Bio-fly 30x10⁶ cells/ml	16^{e}	12^{ef}	6^{de}	16^{f}	12^{fg}	6^{e}
Vertimec 1.8 % EC	14^{ef}	6^{g}	4^{e}	18^{f}	10^{fg}	4^{e}
Afugan 30% EC	20^{de}	18^{d}	10^{cd}	46^{c}	40^{c}	22^{c}
Ridomil plus 50% WP	10^{f}	6^{g}	4^{e}	8^{g}	6^{g}	4^{e}
Topas (100) 10% EC	12^{ef}	8^{fg}	4^{e}	10^{g}	6^{g}	4^{e}

Means with different letters in the same column are significantly different ($P < 0.05$) using Dunce Multiple Range Test in SAS.

The diagnostic concentration technique according to Roush and Luttrell (1989) was used to measure the susceptibility of the field populations to the tested pesticides comparing with the laboratory culture of *Ch. Carnea* as shown in Table (8). The results indicate that the diagnostic technique is accurate to determine the low levels of resistance in such populations of *Ch. Carnea* and to detect the resistance in different stages of field populations.

The highest values of resistance percentage were obtained in the collected populations of *Ch. carnea* from the fields using pesticides intensively (Fayum and Menofia) and the lowest values were in the collected populations from free pesticide fields (Baharia and Abu Sembil). The resistance percentage values of egg hatching in all field populations were higher than those in the second larval instar. Also, the highest values of resistance percentage were obtained with the three-day old eggs when using admire in the field populations of Fayum and Menofia (76.9 and 73.1%), where the lowest values were obtained with the second larval instar when using selecron and lannate in all field populations. Although the insecticides selecron, lannate and aphox have the same mode of action but the second larval instar was resistant to aphox and sensitive to selecron and lannate in all field populations. In contrary, the egg hatching was resistant to the cholinesterase inhibitors (selecron, lannate and aphox) in all field populations of *Ch. Carnea* with contrast with the values of resistance percentage. It can be concluded that the egg hatching is more tolerant than the second larval instar to pesticides and it can be recommended to release the egg stage of *Ch. Carnea* in greenhouses and open fields in controlling aphids.

Data of resistance percentage for egg hatching and the second larval insatr confirmed the previously data of toxicity for tested the pesticide in the different field populations of *Ch. Carnea.* As a conclusion, the results of this study suggest that, it can be monitoring pesticide resistance in different stages of *Ch. Carnea* by using discriminating concentrations. This method can be particularly useful for determining the low resistance ratios.

4. DISCUSSION

Most insecticides are toxic not only to pest insects, but also to the natural enemies of the pests. In an integrated control program, it would be helpful to utilize insecticides of minimal toxicity to the natural enemies of pest species. Such a practice might help alleviate the problem of pest resurgence which is frequently associated with protection. The results obtained with lannate (methomyl) and selecron (profenofos) for *Ch. carnea* agreed with the literature that reports these insecticides are highly toxic to eggs and larvae (Badawy and El Arnaouty, 1999; Dinter and Kratz, 2000 and Nasreen *et al.*, 2003). Guven and Goven (2003) stated that the insecticides profenfos and methomyl showed high toxicity resulting in a mortality rate of 100% in *Ch. carnea* larvae. Varghese and Beevi (2004) found that profenfos was highly toxic to *Ch. carnea* larvae.

Table (8): Resistance percentage of egg hatching and the second larval instar of ***Chrysoperla Carnea*** **in different field populations.**

Pesticides	% Resistance of egg hatching in different populations				% Resistance of the second larval instar in different populations			
	Baharia Oasis	Abu Sembil	Fayum	Menofia	Baharia Oasis	Abu Sembil	Fayum	Menofia
Selecron 72% EC	28.89	33.33	51.11	48.89	0.0	0.0	0.0	0.0
Lannate 90% SP	12.50	12. 50	20.00	22.50	0.0	0. 0	2.00	4.00
Aphox 50% DG	38.46	30.77	61.54	53.85	37 50	25.00	50.00	68.75
Trebon 30% EC	14.29	28.57	21.43	21.43	13.33	20.00	46.67	33.33
Confidor 20% SL	18.75	18.75	56.25	50.00	0.0	16.67	22.22	33.33
Admire 20% SC	23.08	30.08	76.92	73.08	12.50	8.33	29.17	25.00
Admiral 10% EC	4.35	4.35	34.78	30.44	27.50	2.50	30.00	20.00
Match 5% EC	12.50	16.67	37.50	33.33	3.45	10.35	20.69	24.14
Bancol 50% WP	18.18	9.09	45.46	36.36	15.00	35.00	55.00	50.00
Bio-fly $30x10^6$ cells/ml	10.00	0.0	30.00	20.00	13.33	20.00	53.33	46.67
Vertimec 1.8 % EC	37.50	31.25	56.25	56.25	20.00	26.67	33.33	40.00
Afugan 30% EC	0. 0	18.75	37.50	37.50	7.14	20.00	37.14	34.29
Ridomil plus 50% WP	30.0	-10.0	40.00	50.00	33.33	-22.22	44.44	55.56
Topas (100) 10% EC	0.0	14.29	28.57	14.29	12.5	-37.50	25.00	37.50

Plapp and Bull (1978) found that carbaryl was low in toxicity to *Ch. carnea*, while methomyl was highly toxic. They reported that methomyl an oxime carbamate was safer for the predator than carbaryl, an aryl carbamate. In contrary, the results reported here indicated that methomyl, was more toxic than aphox (pirimicarb), aryl carbamte to egg hatching and the second larval instar of *Ch. carnea*. Helgesen and Tauber (1974) reported that pirimicarb was not toxic to *Ch. carnea*. El Arnaouty and Badawy (1998) reported that the carbamate insecticide, primicarb was less toxic to *Ch. carnea*. Jansen (2000) found that the populations of lacewing larvae were unaffected by pirimicarb.

However, it would be regrettable to exclude toxic compounds without looking for their specific uses. Selecron and lannate are recommended to be used in vegetable fields depending on it's highly efficacy to cotton leafworm. The results in this study showed that the insect growth regulator compound, match (lufenuron) gave moderate toxicity to the larvae and low toxicity to egg hatching of *Ch. carnea*. These results supported by Bueno and Freitas (2004) who reported that lufenuron acted as an inhibitor of the ecdysis process for larvae of *Ch. externa*. First and second larvae died upon reaching ecdysis and the third instar larvae died at the start of pupation. Based on, lufenuron was classified as harmful for the three instar stages and showed no ovicidal activity. Accordingly, it can be recommended to use match that was registered in Egypt against cotton leafworms on vegetable crops instead of selecron and lannate depending on being safer for *Ch. carnea* eggs and give a good control to pest insects.

The insecticides; trebon (etofenprox), admire (imidacloprid), admiral (pyriproxyfen) and bio-fly (*Beauvaria bassiana*) were registered against the whitefly insect in Egypt. They can be classified into four groups; pyrethroid, neonicotinoid, insect growth regulator and microbial insecticide, respectively. It is known that these insecticides give excellent control of the whitefly except bio-fly has poor efficacy (Barakat *et al.* 2005). Toxicity results of these compounds to egg hatching and the second larval instar of *Ch. carnea* populations that were collected from Fayum and Menofia were separated between the tested chemical insecticides. It was found that the use of admire and trebon for controlling whiteflies were safer to *Ch. carnea* population than those of admiral. The same finding was obtained by Chen and Liu (2002) who stated that pyriproxyfen significantly reduced the survival rates of egg and larvae of *Ch. rufilabris*.

Earlier studies (Van den Bosch *et al.* 1956, Bartlett 1964, Lingren and Ridgway 1967) suggested that all synthetic organic insecticides widely used in agriculture were highly toxic to both parasitic and predaceous insects. In this respect, the major difference of our finding is that the synthetic pyrethroid and the new chemical group neonicotinoid seem to be an exception to this rule. Our work can be explained from the study of Ishaaya and Casida (1981) who reported that lacewing larvae of *Ch. carnea* have usually active esterases to detoxify pyrethroids. Also, our data support the observation of Varghese and Beevi (2004) who found that the imidacloprid was highly safe to *Ch. carnea.* In the present study, biofly was the least toxic insecticide to *Ch. carnea* populations. This finding was obtained in our previously study (Badawy and El-Arnaouty, 1999). The toxicity of pesticide to predators and insects is based on toxicity of a pesticide active ingredient and on spray frequency. Unfortunately, the vegetable crops are sprayed several times against whitefly through one season in Egypt. Although we have known more about the side effects of whitefly insecticides on *Ch. carnea,* there is much that we do not yet understand about the effect of frequency spray against whiteflies on *Ch. carnea* populations.

The results suggested that bancol (bensultab) which belongs to the relatively new chemical group (nereistoxin analogue) can be used usefully against leaf miners in the vegetable crops, which was quite low in toxicity to the field populations of *Ch. carnea.* The tests with vertimec (abamectin) showed that it did not cause a noxious effect to field populations of *Ch. carnea* that were collected from locations intensively using pesticides; its toxicity was less than 20% for egg hatching and second larval instar. Similar results were obtained by Badawy and El-Arnaouty (1999), Srinivasan and Babu (2000) who reported that abamectin had no adverse influence on the second larval instar. Nasreen *et al.*, (2003) found that abamectin was not toxic to *Ch. carnea.* Abamectin also demonstrated selectivity for other chrysopid species such as *Ch. extema* (Hagen) in earlier studies (Perez, 1983; Ribeiro *et al.* 1988) and also by Bueno and Freitas (2004).

It was found that the tested fungicides; ridomil plus and topas (100) used against late blight and powdery mildew diseases had low toxicity to *Ch. Carnea* stages. In contrary, afugan at the recommended dose caused moderate toxicity to the larvae of field populations (46-65%) and highly toxic to laboratory culture larvae (70%). It may be attributed to its chemical group phosphorothiolate. Generally, it had little impact on egg hatching of *Ch. carnea* populations. However , there is little literature about the side effects of fungicides on the different stages of *Ch. carnea.* Guven and Goven (2003) reported that ridomil revealed low toxicity and caused mortality of 25% to the larvae of *Ch. carnea*. Raudonis *et al*., (2004) found that the fungicides were slightly toxic to *Ch. perla*, and reported that they could be used in integrated pest management.

Biological control of aphids must be compatible with chemical control of other insects, plant diseases and mites. Integrated use of natural enemies particularly *Ch. carnea* stages for the management of vegetable aphids with different pesticides against other pests appears possible by use of selective pesticides or the use of reduced concentrations of other pesticides so that at least one life stage of *Ch. carnea* will be conserved. The data of selectivity indicate that aphox, confidor, bancol and vertimec may be the safest available insecticides for the predator *Ch. carnea* and are good candidates for the use against aphids, thrips, leaf miners and red spider mites, respectively. The integration of the data presented here show that the use of admire, trebon and bio-Fly for controlling whiteflies was safer to *Ch. carnea* population than admiral. The insect growth regulator match was moderate toxic to *Ch. carnea* but it is preferable using it against cotton leaf worms instead of selecron and lannate that caused complete mortality to larvae. The results confirmed that the fungicide topas (100) is more suitable to be used against powdery mildew disease instead of afugan because of its poor side effects on *Ch. carnea* stages. The fungicide redomil plus which is used against the late blight disease on vegetable crops was harmless to egg hatching and second larval instar of *Ch. carnea*. This means that both active ingredients; metalaxyl and copper oxychloride have low toxicity to *Ch. carnea* populations.

The present data confirmed that 3-day old eggs were more tolerant to tested pesticides than the second larval instar of *Ch. carnea*. These results are in agreement with Grafton-Cardwell and Hoy (1985) who stated that the eggs and pupae are the most resistant stages and larvae are more tolerant to pesticides than the adults of *Ch. carnea*.

The common green lacewing, *Ch. carnea* has undergone extensive pesticide screening because it is distributed worldwide and has a wide prey range (New 1975, Bigler 1984 and Bueno and Freitas 2004). The results of some laboratory programs that have screened *Ch. carnea* for its response to various pesticides are different. Effects of pesticides are difficult to categorize because many different methods were used for testing, including LT_{50}, LD_{50} and single field doses. Many different stages were also tested.

This is the first documentation about the variance of pesticides tolerance in different populations of *Ch. carnea* in Egypt. The results of the present study confirmed that the collected *Ch. carnea* populations from the fields using pesticides intensively (Fayum and Menofia) were more tolerant or resistant to the pesticides than those collected from free pesticide fields (Baharia Oasis and Abu-Sembil) and laboratory culture. Although the tested pesticides belong to several chemical groups but the field populations of Fayum and Menofia tolerated most of them except the conventional insecticides; selecron and lannate. Fayum and Menofia populations were more tolerant to the pesticides in general suggests that they are gradually developing resistance to these pesticides due to a higher pesticide pressure in the fields. Similar results were obtained by Grafton-Cardwell and Hoy (1985). It may be more important to have a look at the exposure to all pesticides in each location. Development of resistance to one pesticide may increase the level of tolerance to another (cross-resistance) or decrease tolerance to another (negatively-correlated cross-resistance). It was also found that there are no differences in responses to pesticides between the populations of Fayum and Menofia. Data suggest that *Ch. carnea* response to a particular chemical in one locality may be the same as in another location, it may be due to that the same pesticides using in most Governorates of Egypt. The existence of more tolerant populations gives encouragement that field or laboratory selection for full resistance may one day be successful.

5. REFERENCES

Abbott W.S. (1925). A method of computing effectiveness of an insecticide. J. Econ. Entomol. 18: 265-270.

Badawy H.M.A. and El-Arnaouty S.A. (1999). Direct and indirect effects of some insecticides on *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae). J. of Neuropterology. 2: 67-74.

Balasubramani V. and Swamiappan M. (1994). Development and feeding potential of the green lacewing, *Chrysoperla carnea* Stephens. (Neuroptera: Chrysopidae) on different insect pests of cotton. Anzeiger-fuer-schadling-skunde-pflanzenschutz-ummeitschutz. 8: 165-167.

Bartlett B.R. (1964). Toxicity of some pesticides to eggs, larvae and adults of the green lacewing, *Chrysoperla carnea*. J. Econ. Entomol. 57: 366-369.

Barakat A.A., Badawy H. M.A., El-Mahy S.A. and Ibrahim E. S.(2005). Toxicological studies on new insecticides against piercing sucking insects. Recent Technologies In Agriculture, the 3rd

conference 14-16 Nov. 2005. Faculty of Agriculture-Cairo University (In press).

Bigler F. (1984). Biological control by chrysopids: integration with pesticides. Pp. 233-245. In M. Canard, Y. Semeria, and T. R. New (eds). Biology of Chrysopidae. The Hague, the Netherlands: Dr. W. Junk publishers.

Bigler F. and Waldburger M. (1994). Effect of pesticides on *Chrysoperla carnea* Stephens. (Neuroptera: Chrysopidae) in the laboratory and semi field. J. Appl. Entomol. 17: 55-59.

Bueno A. F. and Freitas S. (2004). Effect of the insecticides abamectin and lufenuron on eggs and larvae of *Chrysoperla externa* under laboratory conditions. Biocontrol 49(3): 277-283.

Chen T.Y. and Liu T.X. (2002). Susceptibility of immature stages of *Chrysoperla rufilabris* (Neuroptera: Chrysopidae) to Pyriproxyfen, a juvenile hormone analogue. J. Appl. Entomol. 126: 125-129.

Croft B. A. and Brown A.W.A. (1975). Responses of arthropod natural enemies to insecticides. Annu. Rev. Entomol. 20: 285-335.

Dinter A. and Kratz T. (2000). Impact of field treatments with the insecticide Lannate (a.i. Methomyl) on foliage and ground dwelling arthropods. Bulletin-OILB/SROP. 23(9): 127-135.

El- Arnaouty S.A. (1991). Studies on the biology and manipulation of *Chrysoperla carnea* Stephens and *Chrysoperla sinica* Tjeder (Neuroptera: Chrysopidae) for controlling the green peach aphid *Myzus persicae* Sulzer (Homoptera: Aphididae) in green houses Ph. D. Thesis, Faculty of Agric. Cairo Unvi. 247P.

El-Arnaouty S.A. and Badawy H.M.A. (1998). Biological effects of some insecticides on immature stages of *Chrysoperla carnea* Stephens *Sensu lato* (Neuroptera: Chrysopidae). Proceeding of the 1st Regional Symposium for Applied Biological Control in Mediterranean Countries. Cairo, Egypt, October 25-29.81-86.

Grafton-Cardwell E.E. and Hoy M.A. (1985). Intraspecific variability in response to pesticides in the common green lacewind *Chrysoperla carnea* Stephens. Hilgardia 53: 1-32.

Grafton-Cardwell E.E. and Hoy M.A. (1986). Genetic improvement of the common green lacewing, *Chrysoperla carnea*: selection for carbaryl resistance. Environ. Entomol. 15: 1130-1136.

Guven B. and Goven M. A. (2003). Side effects of pesticides used in cotton and vineyard areas of Aegean Region on the green lacewing, *Chrysoperla carnea* Stephens. (Neuroptera: Chrysopidae) in the laboratory.Bulletin-OILB/SROP.26(5):21-24.

Hassan S.A. (1989). Testing methodology and the concepts of the IOBC/WPRS Working Group. In: Pesticides and non-target invertebrates. P.C. Jepson Ed. Intercept, Wimborne, Dorset, 1-18.

Hassan S.A., Klinghauf F. and Shanin F. (1985). Role of *Chrysopa carnea* as an aphid predator on sugar beet and the effect of pesticides. Zeitschrift fuer angewandte Entomologie, 100: 163-174.

Helgesen R.G. and Tauber M.J. (1974). Pirimicarb an aphicide non-toxic to three entomophagous arthropods. Environ. Entomol. 3: 99-101.

Hydron S.B. and WhiteComb W.H. (1979). Effects of larval diet on *Chrysopa rufilabris*. Florida Entomol. 62: 293-298.

Ishaaya I. and Casida J.E. (1981). Pyrethroid esterases may contribute to natural Pyrethroid tolerance of larvae of the common green lacewing. Environ. Entomol.10: 681-684.

Jansen J.P. (2000). A three year field study on the short term effects of insecticides used in control cereal aphids on plant dwelling aphid predators in winter wheat. Pest – Management Science 56(6): 533-539.

Lingren P.D. and Ridgway R.L. (1967). Toxicity of five insecticides to several insect predators. J. Econ. Entomol. 60: 1639-1641.

Morrison R.K. (1985). *Chrysopa carnea*, PP. 419-426. in P. Singh and R. F. Moore [eds.], Handbook of insect rearing, vol. i. Elsevier, Amsterdam.

Nasreen A., Mustafa G. and Ashfaq M. (2003). Selectivity of some insecticides to *Chrysoperla carnea* Stephens. (Neuroptera: Chrysopidae) in laboratory. J. of Biological Sci. 6(6): 536-538.

New T.R. (1975). The biology of Chrysopide and Hemerobiidae (Neuroptera) with reference to their use as biological agents: a review. Transactions of the Royal Entomol. Society, 127: 115-140.

Perez C.A. (1983). Efeito de produtos quimicos esterilizantes sobre *Ceratitis capitata* (Wiedemann, 1824) (Diptera : Tephritidae), seus simbiontes e o predator *Chrysoperla externa* (Hagen, 1861) (Neuroptera : Chrysopidae). Dissertacao de Mestrado ESALQ-USP. Piracicaba. 93 pp.

Plapp F.W. and Bull D.L. (1978). Toxicity and selectivity of some insecticides to *Ch. carnea*, a predator of the tabacco budworm. Environ. Entomol. 7: 431-434.

Raudonis L., Surviliene E. and Valiuskaite A. (2004). Toxicity of pesticides to predatory mites and insects in apple tree site under field conditions. Environ. Toxicol. 19 (4): 291-295.

Ribeiro M. J., Matioli J.C. and Carvalho C.F. (1988). Efeito da Avermectina- Bl (MK-936) sobre o desenvolvimento larval de *Chrysoperla externa* (Hagen) (Neuroptera: Chrysopidae). Pesq. Agropec. Bras. 23: 1189-1196.

Roush R.T. and Luttrell R.G. (1989). Expression of resistance to pyrethroid insecticides in adults and larvae of *Tabacco Budworm* (Lepidoptera: Noctuidae): implications for resistance monitoring. J. Econ. Entomol. 82(5): 1305-1310.

SAS Institute (1985). SAS user;s guide: statistics. SAS Institute, Cary, N. C.

Srinivasan G. and Babu P.C.S. (2000). Toxicity of certain insecticides to predatory green lacewing, *Chrysoperla carnea* Stephens. (Neuroptera: Chrysopidae). J. Biological control 14(1): 5-7.

Van den Bosch R., Reynolds H.T. and Dietrick E.J. (1956). Toxicity of widely used insecticides to beneficial insects in California cotton and alfalfa fields. J. Econ. Entomol. 49: 359-363.

Varghese B. and Beevi S.V. (2004). Safety of insecticides to the green lacewing *Chrysoperla carnea* Stephens. Insect. Environ. 10 (1): 45-47.

Wakita T., Kinoshita K., Yamada E., Yasui N., Kawahara N., Naoi A., Nakaya M., Ebihara K., Matsuno H. and Kodaka K. (2003). The discovery of dinotefuran: a novel neonicotinoid. Pest Manag. 59: 1016-1022.

سمية مبيدات الآفات الموصى بها لبعض آفات محاصيل الخضر على عشائر أسد المن المختلفة فى المختبر

هانى محمود عاشور بدوى، سيد أشرف الأرناؤوطى ، عزيزة محمد الجنتيرى*، نيفين محمود جابر*

قسم الحشرات الأقتصادية والمبيدات - كلية الزراعة- جامعة القاهرة- الجيزة- مصر

* معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الجيزة

ملخص

يجب أن تتكامل المكافحة الحيوية للمن مع المكافحة الكيميائية للحشرات الأخرى وأمراض النبات والحلم. واستخدام الأطوار المختلفة لمفترس أسد المن ضد المَن على محاصيل الخضر يمكن أن يتكامل مع استخدام مبيدات الآفات الاختيارية أو استخدام تركيزات منخفضة من مبيدات الآفات، مما يضمن بقاء طور واحد على الأقل من المفترس.

أظهرت النتائج أن المبيدات الحشرية المختبرة وهى أفوكس، كومفيدور، بانكول، فيرتيميك والتي تستخدم في مكافحة المن، التربس، ناخرات الأوراق والعنكبوت الأحمر على التوالي كانت الأكثر أماناً على مفترس أسد المن. كما أن الأدمير، التريبيون، البيوفلاى والتي تستخدم في مكافحة الذباب الأبيض كانت أكثر أماناً للمفترس عن الآدميرال. توصى النتائج باستخدام منظم النمو الحشري ماتش والمستخدم ضد دودة ورق القطن رغم تأثيره المتوسط على المفترس وذلك عوضاً عن مبيدى السليكرون واللآنيت التي تسبب موتاً كاملاً ليرقات المفترس

أوضحت النتائج إمكانية الاستخدام الآمن للمبيد الفطري توباس (١٠٠) على أمراض البياض الدقيقى نظراً لتأثيره الضعيف على أطوار مفترس أسد المن بمقارنته بالمبيد الفطرى أفوجان. في حين أظهر المبيد الفطرى ريدوميل بلاس المستخدم ضد مرض الندوة المتأخرة على محاصيل الخضر تأثيرا أمنا على نسب فقس البيض والعمر اليرقي الثاني من يرقات المفترس. وقد أظهرت العشائر الحقلية من المفترس والتي جمعت من مناطق تستخدم المبيدات (الفيوم- المنوفية) أكثر تحملاً أو مقاومة لمعظم المبيدات (برغم أختلاف المجموعات الكيميائية) عن تلك العشائر المجموعة من مناطق يحظر فيها استخدام المبيدات (الواحات البحرية- أبو سمبل) وكذا عن الحشرات المرباة معملياً.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٥٧) العدد الثالث (يوليو ٢٠٠٦):٥٤٩- ٥٧٠ .