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The Potential Side Effects of Certain Insecticide Formulations on the Green Lacewing, *Chrysoperla carnea* (Stephens)

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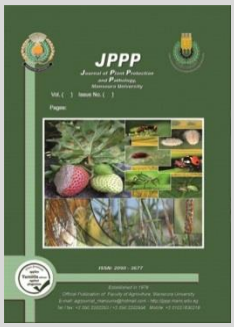

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Treated The second larval instar by residual method indicated that, chlorpyrifos-methyl and methomyl formulations expect Goldben (90.48 % mortality) caused 100 % mortality, while the lowest mortality percent occurred in emamectin benzoate and lufenuron formulations.Except Broact formulation0, there are significant differences between all the tested formulations (ranged from 0.00 to 64.29 % pupation and to 53.57 % adult emergence) and untreated control in pupation (85.71 %) and adult emergence (78.57 %) On the contrary, there are no significant differences between two formulations of each active ingredient except two formulations of emamectin benzoate in pupation percentage only. Treated The second larval instar by feeding method indicated that,chlorpyrifos-methyl formulations is the highly toxic (100 % mortality), when methomyl, emamectin benzoate and lufenuron formulations were low toxic (ranged from 3.70 to 27.27 % mortality) and lufenurononly was high toxic by ingested than leaf residual exposure.. Also, there are highly significant differences between chlorpyrifos-methyl formulations (0.00 % for pupation and adult emergence) with other treatments (ranged from 60.71 to 78.57 % for pupation and from 57.14 to 71.43 % for adult emergence). Treated egg by dipping method showed a significant reduction in hatchability rates for formulations of methomyl and chlorpyrifos-methyl ranged from 65.05% (Goldben) to 76.69% (Reldan), however, there are no significant reductions in hatchability rates for formulations of emamectin benzoate and lufenuron, ranged from 86.08% (Broact) to 95.88% (Match) compared to the control (98.33%), but there are not significant differences between two formulations of each active ingredient.

Keywords: insecticides formulation, *Chrysoperla carnea*, side effects and chlorpyrifos-methyl

INTRODUCTION

Family Chrysopidae includes important predator species with adults feeding on plant pollen and nectar, whereas it larvae prefers sure enough soft-bodied prey such as thrips, whiteflies, aphids, eggs, and larvae of Lepidoptera and Acari (Rimoldi*et al*., 2008). Green lacewing, *Chrysoperla carnea* is a powerful biological control because of an easy way to rear, expanded geographical distribution, high searching ability and high compatibility to different systems (Dhawan, 2000). In spite of all these preciousness *C. carnea* with other beneficial insects have almost exclusion due to frequent use of non-selective insecticides. Harmless all over the world are now blame use of synthetic insecticides. Despite that, these insecticides were effective when pests grow up on economic thresholds level (ETL). But these insecticides have harmful effect on natural enemies. In recent years, the use of lacewings in IPM programs increased because this insect may have an advantage over other introduced or resident natural enemies: a relatively broad tolerance to many insecticides in particular the cocoon and larval stages (Medina *et al*., 2001). Studies of insecticide impact on natural enemies usually address ingestion or topical application of insecticide, exposure of biological enemies to insecticide residues, or field studies assessing changes in natural enemy populations in response to insecticide used (Tillman and Mulrooney, 2000; Martinson *et al*., 2001). Each approach provides different information about pesticide impacts to natural enemies. Studies on pesticide residues and ingestion of toxins provide information on the effect of a compound when applied indirectly on an insect or when it is ingested with food.

Some insecticides (such as organophosphates and carbamates) are generally highly toxic to natural enemies, because their broad spectrum of activity (Croft, 1990).

Other insecticides (such as insect growth regulator and bio-insecticides) that do not appear to kill biological control agents may have also latent effects (Longley and Jepson, 1996).

So, the objectives of the present study were to assess the potential side effects of the tested formulations on *Chrysoperl acarnea* (Stephens)as beneficial bio-element commonly associated with cotton leafworm, *Spodoptera littoralis.*

MATERIALS AND METHODS

1. Insecticide used:

Eight commercial formulations of insecticides belonged to four active ingredients which available in Egypt were used in this study and shown as follows in Table (1):

2. Rearing technique of *Spodoptera. littoralis*:

The laboratory and field strains were reared in the laboratory of Plant Protection Department, Faculty of Agriculture, Cairo, Al-Azhar University, under constant

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conditions as described by El-Defrawi *et al*. (1964). Egg masses were kept in glass jars (500 ml) covered with muslin cloth and provided daily with fresh castor bean leaves (*Ricinus communis*) as a source of food for the larvae. The third larval instar (6-days old) were transferred to glass jars (1 liter) provided with the same food. The prepupae were allowed to pupate in clean jars containing 2 cm high dry sawdust. The resulting pupae were transferred to glass jars containing filter papers and were kept in suitable cages (35×35×35 cm) for mating of the emerged moths. Emerged moths were fed on 10 % sugar solution throw a dipped piece of cotton. The cages were supplied with fresh leaves of tafla, *Nearium oleander* (L) that served as an oviposition site. The newly molted The fourth larval instar of *S. littoralis* were used in treatments in this study.

Table 1. Insecticide used.

Chemical group	Common name	Trade name	Conc.	Formula	Manufacture company	Rate / fed.	Recommended conc. in 200 L water
Avermectin	Emamectin benzoate	Broact Proclaim	5%	SG	AGRES Syngenta	60g	15 ppm
Benzoylurea	Lufenuron	Match Cymax	5%	EC	Syngenta Starchem Industrial Chemicals	160 ml	40 ppm
Carbamate	Methomyl	Lannate Goldben	90%	SP	DuPont USA Starchem Industrial Chemicals	300g	1350 ppm
Organophosphorus	Chlorpyrifos -methyl	Pyrodan Reldan	50 %	EC	Agrochemicals Dow AgroSciences	1000 ml	2500 ppm

3. Green lacewing *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae)

1. Source of *C. carnea*:

The strain of *C. carnea* of this study originally was obtained from Biological control laboratory, Faculty of Agriculture, Cairo University, Egypt. This strain not exposed to any pesticides. *C. carnea* was reared under laboratory conditions (25 ± 2 OC, 65 ±5 % R.H. and photoperiod 14:10 L: D hrs.) for one to two generations before initiation of experiments.

2. Rearing technique of *C. carnea*:

A colony of *C. carnea* was reared in the laboratory of Plant Protection Department, Faculty of Agriculture, Cairo, Al-Azhar University. Adults were kept at 25±2 °C, 65±5% RH, and a photoperiod of 14: 10 (L: D) hrs. in a rearing cage (L: 36cm, W: 25cm, H: 35cm) with ventilation holes on both sides. Cage was covered with the removable lid on the top, lined inside with glossy paper for egg laying. Adult diet i.e. 4g brewer's yeast, 7g honey and 5ml water was offered on the paper cards glued to the back wall of cage(Vogt *et al*., 2000). These cards were changed on alternate day. Eggs were collected daily in Petri dishes and were observed for larval emergence. Then each larva was placed in a separate vial having eggs of *Sitotroga cerealella* as a food and plugged with a cotton bud. After passing through different developmental stages, the larvae turned into cocoons. These cocoons were put in Petri dishes in an adult rearing cage for adult emergence. The adults were reared in a similar manner as mentioned above for further multiplication.

3. Screening of insecticides on different stages of *C. carnea:*

The candidate insecticides were tested against egg and the second larval instar of *C. carnea* under laboratory condition. The recommended concentrations of formulated insecticides were prepared in distilled water. A control treatment of distilled water application was included in each test to assess hatching of *C. carnea* and mortality rates, from the tested stage until the adult phase. The mortality was corrected by Abbott's formula (Abbott, 1925).

1. Leaf residual method:

Leaf dip bioassay was used to treat the second larval instar, as it more closely approximates the field exposure. Fresh cotton (*Gossypium hirsutum*) leaves were collected from60 days old plants of unsprayed field, washed with water. Leaf disks of 7 cm diameter were prepared, and then dipped in the insecticide solutions (recommended concentrations) and distilled water only (untreated control) for 10 seconds and air dried. Ten leaf disks were considered as repeat and each leaf disk had three larvae each. Moistened filter was placed beneath leaf disks to avoid the desiccation of leaves in the Petri plates (7 cm). The mortality percentages were calculated at the end of each exposed and subsequent instars and pupae. Number of pupae not changed into adults within ten days was considered dead. We considered larvae dead if they no longer moved or twitched when being touched 2-3 times with a brush. The larvae survived moved to medium sized plastic box with 24 mg eggs of *Sitotroga cerealella*. After completion of larval development, pupae in the capsules were kept in Petri plates for adult emergence. Rates of pupation and adult emergence were recorded.

2. Feeding potential method:

The tested insecticide solutions (recommended concentrations) were used to evaluate the feeding potential of these insecticide formulations on the second larval instar of *C. carnea*. Three larvae of *C. carnea* were put in Petri plates (7 cm) and exposed to *S.littoralis* eggs dipped in solutions of the insecticide formulations used for 5 seconds. The larvae were allowed to feed on the treated eggs for 24 hrs. Each treatment was divided into 10 replicates. Each replicate included 3 healthy starved larvae. Other 10 replicates were fed on *S. littoralis* eggs treated with distilled water as a control. The percent of mortalities were estimated after 1, 2, 3 and 5 days of treatment.

3. Eggs dipping method:

A batch of 25 (one-day old) eggs of *C. carnea* was dipped into an insecticide solution (at recommended concentration) for 5 seconds, the treated eggs strips were placed on paper tissues for 2 hrs. to absorb extra dilution and air-dry at room temperature, and then transferred to ventilated plastic boxes at the rearing laboratory conditions, based on the methodology described by Medina *et al*. (2001). Control samples were treated with distilled water. The experiment was replicated 4 times. Newly emerged larvae were provided with 12 mg of processed eggs of *Sitotroga cerealella* in each test box. The number of eggs hatched was noted after 48 hrs. of treatment. Eggs were observed for 2 more days to note any delayed hatching.

Mortality percentages were corrected when needed according to Abbott's formula (Abbott, 1925) and pupation and emergence of moths were calculated by following formula:

% Pupation =Number of pupa /Total number of larvae ×100

% Emergence =Number of moths /Total number of larvae ×100

4. Statistical analysis:

Concentration-mortality data (LC) were evaluated using log-probit software program Ldp Line® model "Ehabsoft" (Bakr, 2000).

RESULTS AND DISCUSSION

Toxicity of the tested insecticide formulations at recommended concentration against green lacewings, *Chrysoperla carnea* (Stephens):

1. Toxicity of the tested insecticide formulations on The second larval instar of *C. carnea* by leaf residual method:

Residual contact experiments were conducted because this is the primary way the larvae and adults of both bio control agents are exposed to insecticide contamination. The results in Table (2) indicated the toxicity of emamectin benzoate (Broact and Proclaim), lufenuron (Match and Cymax), methomyl (Lannate and Goldben) and chlorpyrifos-methyl (Pyrodan and Reldan) formulations by leaf residual exposure at recommended concentrations against the second larval instar of *C.carnea*. Chlorpyrifos-methyl formulations are highly toxic (100 % mortality) to the second larval instar followed by methomyl formulations (82.14 and 57.14 % mortality for Goldben and Lannate, respectively), when emamectin benzoate and lufenuron formulations were not toxic (0.0 % mortality) to the second larval instar of *C. carnea* after 24 hrs. of treatment. The mean percentages of mortality were 100 % mortality for two formulations of chlorpyrifos-methyl and methomyl expect Goldben (90.48 % mortality) after 5 days of treatment. The results also showed that the lowest mortality percent occurred in emamectin benzoate and lufenuron formulations ranged from 16.00 % for Match (lufenuron) to 42.86 % for Proclaim (emamectin benzoate) after 5 days of treatment. According to the recommendation of the International Organization for Biological Control, West Palearctic Regional Section (IOBC/WPRS) working group, these pesticides were classified into two classes. The first one is harmful pesticide and this includes chlorpyrifos-methyl and methomyl formulations. The second class is harmless insecticides and this includes emamectin benzoate and lufenuron formulations.

Also, data in Table (2) show that the second larval instar of *C. carnea* are suffering from conventional insecticides chlorpyrifos-methyl and methomyl formulations. While, the larvae slight suffered from emamectin benzoate and lufenuron formulations. Toxicity of lufenuron formulations occurred after three days from treatment (the time of the second larval instar), while with emamectin benzoate formulations it occurred after 48hrs. Toxicity with the chlorpyrifos-methyl and methomyl formulations occurred after 24 hrs. These mean that chlorpyrifos-methyl and methomyl have acute toxicity to the second larval instar of *C. carnea* after treated by leaf residual exposure at recommended concentrations.

The statistical analysis indicated that, except Broact formulation, there are significant differences between all the tested formulations (ranged from 0.00 to 64.29 % pupation and to 53.57 % adult emergence) and untreated control in pupation (85.71 %) and adult emergence (78.57 %) after treated the second larval instar of *C. carnea*. Also, there are highly significant differences between formulations of chlorpyrifos-methyl and methomyl (ranged from 0.00 to 3.57 % in pupation and adult emergence) with emamectin benzoate (46.43 and 75.0 % pupation and 39.29 and 60.71 % adult emergence for Proclaim and Broact, respectively) and lufenuron (53.57 and 64.29 % pupation and 35.71 and 53.57 % adult emergence for Match and Cymax, respectively) after treated the second larval instar of *C. carnea*. On the contrary, there are no significant differences between two formulations of each active ingredient except two formulations of emamectin benzoate in pupation percentage only.

Table 2. Accumulated corrected mortality, pupation and adult emergence of *C. carnea* (Stephens) treated as The second larval instar with leaf residual exposure (24 hrs.) of the tested insecticide formulations at the recommended concentrations under laboratory conditions.

Tested insecticides		Corrected mortalities percentage at candidate intervals (days).					Pupation	Emergency
Common name	Trade name	1	2	3	4	5	(%)	(%)
Emamectin benzoate	Broact	0.00	7.41	24.00	26.09	26.09	75.00	60.71
	Proclaim	0.00	14.29	20.00	30.43	42.86	46.43	39.29
Lufenuron	Match	0.00	10.71	16.00	16.00	16.00	53.57	35.71
	Cymax	0.00	7.41	17.86	17.86	17.86	64.29	53.57
Methomyl	Lannate	57.14	92.86	100.00	100.00	100.00	0.00	0.00
	Goldben	82.14	85.71	88.00	91.30	90.48	3.57	3.57
Chlorpyrifos- methyl	Pyrodan	100.00	100.00	100.00	100.00	100.00	0.00	0.00
	Reldan	100.00	100.00	100.00	100.00	100.00	0.00	0.00
Control							85.71	78.57
L.S.D. at 5%							18.64	26.22
L.S.D. at 1%							25.77	36.25

2. Toxicity of the tested insecticide formulations on the 2nd larval instar of *C. carnea* by feeding potential method:

The second larval instars of C carnea were allowed to feed on the treated eggs of *Spodoptera littoralis* by dipping in solutions of the tested insecticide formulations at recommended concentrations. The Data in Table (3) showed that chlorpyrifos-methyl formulations is highly toxic (100 % mortality), when methomyl, emamectin benzoate and lufenuron formulations were low toxic to the second larval instar of *C. carnea* (ranged from 3.70 to 27.27 % mortality) after 5 days of treatment. According to IOBC/WPRS working group, these insecticides were classified into two classes. The first one is harmful pesticide and this includes chlorpyrifos-methyl formulations. The second class is harmless insecticides and this includes methomyl, emamectin benzoate and lufenuron formulations.

Also The Data in Table (3) show that the larvae of *C. carnea* are suffering from conventional insecticides chlorpyrifos-methyl, while, the larvae slight suffered from methomyl, emamectin benzoate and lufenuron. Toxicity with the chlorpyrifos-methyl occurred only after 24 hrs. These mean that chlorpyrifos-methyl have acute toxicity to the second larval instar by feeding potential.

The statistical analysis in Table (3) revealed that there are highly significant differences between chlorpyrifos-methyl formulations (0.00 % for pupation and adult emergence) with other treatments (ranged from 60.71 to 78.57 % for pupation and from 57.14 to 71.43 % for adult emergence) and the untreated treatment (89.29 % for pupation and 82.14 % for adult emergence) after feeding the second larval instar of C. carnea on eggs of *S. littoralis* treated by the tested insecticide formulations at recommended concentrations, but there are no significant differences between two formulations of each active ingredient.

Table 3. Feeding potential of the tested insecticide formulations at the recommended concentrations the second larval instar of *C. carnea* (Stephens) under laboratory conditions.

Tested insecticides		Corrected mortalities percentage at candidate intervals (days).					Pupation (%)	Emergency (%)
Common name	Trade name	1	2	3	4	5		
Emamectin benzoate	Broact	0.00	0.00	4.35	4.55	4.55	78.57	71.43
	Proclaim	7.41	8.33	26.09	27.27	27.27	67.86	64.29
Lufenuron	Match	3.70	3.70	8.70	18.18	27.27	60.71	46.43
	Cymax	3.70	3.70	3.70	3.70	3.70	75.00	57.14
Methomyl	Lannate	0.00	4.17	17.39	18.18	22.73	67.86	60.71
	Goldben	0.00	0.00	21.74	22.73	27.27	71.43	60.71
Chlorpyrifos- methyl	Pyrodan	85.19	100.00	100.00	100.00	100.00	0.00	0.00
	Reldan	85.19	100.00	100.00	100.00	100.00	0.00	0.00
Control							89.29	82.14
L.S.D. at 5%							17.60	20.50
L.S.D. at 1%							23.97	27.91

The obtained results illustrated in Fig. (1) indicated that all the tested insecticide (except chlorpyrifos-methyl) showed different mortality percentage between methods of exposure (leaf residue and feeding methods) after 5 days of treatment the 2nd instar larvae of *C.carnea*. Methomyl and emamectin benzoate were more toxic when treated *C.carnea* by leaf residual exposure method. On the contrary, lufenuron was high toxic after treated by ingested than leaf residual exposure.

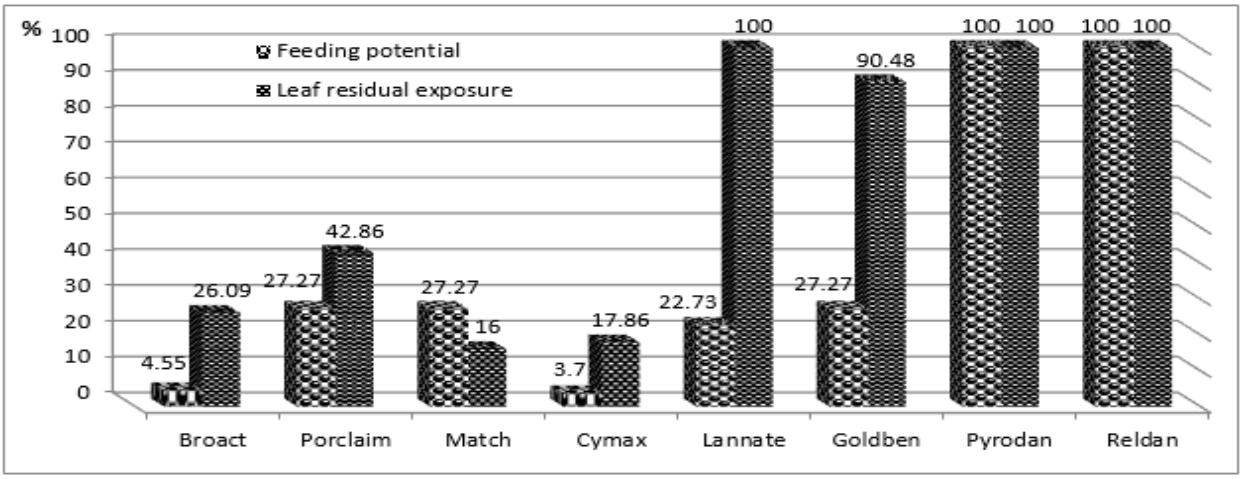

Fig. 1. Comparison between feeding and residual exposure (24 hours) effects of the tested insecticide formulations on mortalities percentage of the second larval instar of *C. carnea* (Stephens) after 5 days of treatment under laboratory conditions.

Analysis of data in Table (4) showed a significant reduction in hatchability rates for formulations of methomyl and chlorpyrifos-methyl against eggs of *C. carnea*, ranged from 65.05% (Goldben) to 76.69% (Reldan), however, there are no significant reductions in hatchability rates for formulations of emamectin benzoate

and lufenuron, ranged from 86.08% (Broact) to 95.88% (Match) compared to the control (98.33%). Also, there are highly significant differences between formulations of chlorpyrifos-methyl and methomyl with emamectin benzoate and lufenuron in hatchability rate of the treated eggs of *C. carnea*, but there are no significant differences between two formulations of each active ingredient.

By sequence the larvae hatched from the treated eggs, The obtained results arranged in Table (4) indicated that the tested insecticide formulations chlorpyrifos-methyl and methomyl caused 100 % mortality of *C. carnea* larvae after 3 days of hatched, followed by Match (lufenuron) and Proclaim (emamectin benzoate) caused 87.97% and 41.95% mortality, respectively after 7 days of hatched, whaleboat (emamectin benzoate) and Cymax (lufenuron) showed the lowest mortality effect (9.70 % and 39.84 % mortality, respectively).

The same trend occurred for the pupation and adult emergence. The statistical analysis shows that there are significant differences between all the tested formulations (except emamectin benzoate formulations in pupation only, not less than 53.20 %) with the untreated control (82.59 % for pupation and 79.88 % for adult emergence) after treated eggs of *C. carnea*. Also, there are highly significant differences between formulations of chlorpyrifos-methyl and methomyl(0.00 % for pupation and adult emergence) with emamectin benzoate (53.20 and 61.99 % pupation and 37.46 and 41.77 % adult emergence for Proclaim and Broact, respectively) and Cymax (39.71 % pupation and 37.34 % adult emergence), but there are not significant differences between two formulations of each active ingredient (Table, 4).

Table 4. Ovicidal effect of the tested insecticide formulations at the recommended concentrations on hatchability, accumulated corrected mortality, pupation and adult emergence of *C. carnea* (Stephens) under laboratory conditions.

Tested insecticides		Hatchability (%)	Corrected mortalities percentage at candidate intervals (days).					Pupation (%)	Emergency (%)
Common name	Trade name		1	2	3	5	7		
Emamectin benzoate	Broact	86.08	4.83	5.44	7.40	8.66	9.70	61.99	41.77
	Proclaim	95.19	23.48	29.90	37.11	40.20	41.95	53.20	37.46
Lufenuron	Match	95.88	37.79	37.51	58.96	78.30	87.97	6.96	3.74
	Cymax	93.14	6.83	12.32	19.38	38.53	39.84	39.71	37.34
Methomyl	Lannate	74.01	97.43	97.99	100.0	100.0	100.0	0.00	0.00
	Goldben	65.05	100.0	100.0	100.0	100.0	100.0	0.00	0.00
Chlorpyrifos-methyl	Pyrodan	69.45	100.0	100.0	100.0	100.0	100.0	0.00	0.00
	Reldan	76.69	100.0	100.0	100.0	100.0	100.0	0.00	0.00
Control		98.33						82.59	79.88
L.S.D. at 5%		15.82						38.32	33.70
L.S.D. at 1%		21.36						45.33	38.94

The obtained results indicated that the two formulations of chlorpyrifos-methyl and methomyl caused 100% mortality to the second larval instar and neonate hatched larvae resulted from eggs treated of *C. carnea*, and there no significant differences between two formulations of chlorpyrifos-methyl and methomyl. Also the insecticide formulations not only affect the exposed life stage but induced lethal effects to the subsequent life stages of *C. carnea*. The high toxicity of chlorpyrifos-methyl for this insect has been observed by Moura*et al*. (2011) and Ferreira *et al*. (2006) that obtained 100% of mortality for the organophosphate chlorpyrifos. The referred authors related mortality rate of 100% on *C. externa* third instar larvae exposed to fenitrothion and methidathion. Organophosphorus insecticides inhibit acetylcholinesterase, which is a class of enzyme that catalyzes the hydrolysis of the neurotransmitter acetylcholine (Fukoto, 1990). This enzyme is common in the class insecta, what explains the broad spectrum and high toxicity of this chemical group for insects. Also, insect predators and parasitoids more susceptible to insecticides than plant feeding insects due to plant feeding insects may have detoxification mechanisms produced by plants (Gill and Garg, 2014).

Methomyl proved toxic to the larvae of *C. carnea* was in favor with the findings of Guven*et al*. (2003). They found that Lannate (methomyl) showed high toxicity resulting in mortality rate of 100 %. Salama, *et al*. (1990) described that Lannate (methomyl) was proved toxic to *C. carnea* larvae in soyabean field conditions. It means that methomyl remained toxic even in field conditions. Also, Plapp and Bull (1978) and Varghese and Beevi (2004) indicated that most organophosphate insecticides and methomyl were highly toxic to *C. carnea*. Also, Badawy and El-Arnaouty (1999) had the same trend and reported that organophosphorous insecticides were more toxic than carbamates.

On the contrary, Gioloet *al*. (2009) studied the effects of different pesticides on larvae of *C. carnea* and found no deleterious effect of organophosphate trichlorfon and phosmet, which were considered harmless (E<30%). These differences in results are probably due to the different concentrations of the active ingredients used, which were higher in the current study and to the better capacity for metabolic detoxification by *C. carnea*, which not helped to diminish its mortality (Castilhos*et al*., 2013).

According to the IOBC/WPRS working group, the two formulations of emamectin benzoate (Broact and Proclaim) and lufenuron (Cymax) were considers harmless insecticides and on the other hand, the Match (lufenuron) was the moderately harmful. The present findings regarding emamectin benzoate are in conformity with those of Sechser and Ayoub (2003) who reported that emamectin benzoate was safer at all stages of *C. carnea*. As with abamectin, surface residues are decomposed rapidly in sunlight, resulting in a relatively

low toxicity to beneficial insects (Jansson and Dybas, 1998).Nohad (2005) in a laboratory experiment observed also that the emamectin benzoate was harmless to *C. carnea* larvae after 48 hrs. even at an exaggerated concentration of 1000 ppm. Moreover Giolo*et al*. (2009) evidenced that abamectin caused cumulative mortality of 22.9% (percentage of dead larvae and pupae) to *C. carnea*, when first-instar larvae were exposed to fresh dry residues of this pesticide until pupation. Castilhos*et al*. (2013) also classified abamectin as harmless to green lacewings. Similar results were obtained by Moura*et al*. (2010) has ranked abamectin as slightly harmful (category 2). Moreover, Holloway and Forrester (1999) found abamectin rapidly absorbed into leaf that delayed its degradation and rendered it safer to the beneficial insect. There was no need of further testing for the safer and were considered compatible with biological control in IPM system. On the opposite, the results of our study contrast with those observed by Vilela*et al*. (2010) that found 64.5% mortality to abamectin for a similar concentration of active ingredient, probably due to the fact that the larvae were directly sprayed.

The present findings regarding lufenuronare in conformity with those of Medina *et al*. (2002), they reported that the chitin synthesis inhibitor (CSI) compounds are relatively harmless to *C. carnea* larvae in the worst-case scenario (laboratory). However, Medina *et al*. (2003) reported that the effect of pesticides on *C. carnea* strongly depends on the concentration used and further studies are needed to take advantage of the potential use of IGRs in the pest control market. Dilbar*et al*. (2012) found that also, lufenuron was intermediately toxic against *C. carnea* larvae.

The present findings are in conformity with Godoy *et al*. (2004). They not recommend lufenuron because this insecticide reduced the survival rate of eggs when sprayed on females. These findings agree to those of Bueno and Freitas (2004) which reported that lufenuron presented no adverse effect on egg survival, but it induced high mortality in neonate larvae from treated eggs of *C. externa*. Similar results were recorded by Vogt (1994) he found that lufenuron showed harmless effects on egg, however, caused high mortality at larval stage of *C. externa*.

The present study may contribute to successful conservation of biological control in crops where common green lacewings are the most common natural enemies. Having focused on short term effects, we are aware of the importance of long term effects of insecticides on natural enemies in the IPM programs, particularly those of chitin synthesis inhibitors. IOBC classification of these insecticides requires evaluation of other developmental stages. Moreover, semi-field and field research will be needed to evaluate the residual toxicity of these insecticides and their potential sub-lethal effects.

REFERENCES

Ayubi1, A.; G. Moravvej; J. Karimi and A. Jooyandeh (2013). Susceptibility of adult green lacewing, Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae) to some prevalent insecticides in laboratory conditions. J. Entomol. Res. 6: 321-332.

Badawy, H.M.A. and S.A. ArnaoutyEL (1999). Direct and indirect effects of some insecticides on Chrysoperla carnea (Stephens) s.l. (Neuroptera: Chrysopidae). J. Neuroptol.2: 67-76.

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

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

Castilhos, R.V.;A.D. Grützmacher; D.E.Nava; M.J. Zotti;P.R.B.Siqueira and D.Spagnol (2013). Selectivity of pesticides used in peach orchards on the larval stage of the predator Chrysoperla externa (Hagen)(Neuroptera: Chrysopidae). Semina: Ciencias Agrarias, Londrina, 34(6 Sup 1), 3585-3596.

Croft, B.A. (1990). Arthropod Biological Control Agents and Pesticides. John Wiley, New York, 723 pp.

Croft, B.A. and A.W.A. Brown(1975). Respose of Arthropode Natural Enemies to Insecticides. Ann. Rev. of Entomol. 20:285-338.

Cross, J. and E. Dickler (1994). Guidelines for integrated production of pomes fruit in Europe. Technical guideline-III. Second edition. IOBC/ WPRS, Montfavet.

Desuky, W.M.;E.F.El-Khayat;M.M.Azab andM.M.Khedr (2012). The influence of some insect growth regulators and bio-insecticides against cotton leafworm and some associated predators under field conditions. J. Agric. Res, 90(1): 55-65.

Dhawan, A.K. (2000). Impact of some new insecticides on natural enemy complex of cotton ecosystem. Pestology; 24(5):8-14.

Dilbar, H.; A. Amjad; T. Ruba; M.H. Muhammad and S. Muhammad (2012): Comparative toxicity of some new chemistry insecticides on Chrysoperlacarnea (Stephens) under laboratory conditions. Journal of AgriculturalResearch, 50 (4): 509.

Duffie, W.D.;M.J. Sullivan and S.G. Turnipseed (1998). Predator mortality in cotton from different insecticide classes. Proc. Beltwide Cotton Conferences.2: 1111-1112.

Elzen, G.W. 1989. Sub-lethal effect of pesticides on beneficial. In Pesticides and Non-target Invertebrates (P. C. Jepsoned.). Intercept Limited, Dorset, England, pp. 129–150.

Fayad, Y.H. and A.A. Ibrahim(1988). Impact of successive insecticidal applications at different interval periods on the number of predators in cotton fields. Bull. Entomol.Soc. Egypt, Economic series. 15: 47-58.

Ferreira, A.J.; G.A.Carvalho; M.Botton and O. Lasmar (1989). Selectivity of insecticides used in apple orchards to two populations of Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae). J. Pest Sci. 14: 259- 268.

Ferreira, A.J.; G.A.Carvalho; M.Botton and O. Lasmar (2006). Seletividade de inseticidas usados na cultura da macieira a duas populações de Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae). Ciência Rural, Santa Maria, v. 36(2) : 378-384.

Fukoto, T.R (1990). Mechanism of action of organophosphorus and carbamate insecticides. Environmental Health Perspectives, North Carolina, 87(1) : 245-254.

Gill, H.K. and H. Garg (2014).Pesticide: Environmental Impacts and Management Strategies. Pesticides-Toxic Effects. Intech. Rijeka, Croatia, 187-230.

Giolo, F.P.; P.Medina; A.D.Grutzmacher and E.Vinuela (2009).Effects of pesticides commonly used in peach orchards in Brazil on predatory lacewing Chrysoperla carnea under laboratory conditions. BioControl, Dordrecht, 54 (5) : 625-635.

Godoy, M.S.; G.A. Carvalho; J.C. Moraes; M.M. Goussain; A.A.Moraes andL.V. Cosme (2004). Seletividade de inseticidas utilizados na cultura dos citros para ovos e larvas de Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae). Neotropical Entomology 33 (3): 639-646.

Guven, B.; M.A. Goven; H. Vogt; U. Heimback and E. Vincula (eds.)(2003). Side effects of pesticides used in cotton and vineyard areas of Aegean Region on green lacewing, Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae), in the laboratory. Proc. IOBC-WPRS working group. Pesticides and beneficial organisms. Bull. OILB-SROP. 26(5): 21-24.

Hussain, D.; A.Ali; R.Tariq; M.Mushtaq-ul-Hassan and M.Saleem (2012). Comparative toxicity of some new chemistry insecticides on Chrysoperla carnea (Stephens) under laboratory conditions. J. Agric. Res, 50(4), 509-515.

Jacobs, R.J.;C.A. Kouskilekas and H.R. Gross(1984). Response of Trichogramma pretiosum (Hymenoptera: Trichogrammatidae) to residues of permethrin and endosulfan. Environ. Entomol. 13, 355–358.

Khan, S.Z.; F.Ullah; S.Khan;M.A.Khan andM.A. Khan (2015). Residual effect of insecticides against different stages of green lacewing, *Chrysoperla carnea* (Neuroptera: Chrysopidae). JEZS, 3(4), 114-119.

Longley, M. and P.C. Jepson(1996). The influence of insecticide residues on primary parasitoid and hyperparasitoid foraging behavior in the laboratory. Ent. Exp. t Appl. 18(3): 259-269.

Mandour, N.S. (2009). Influence of spinosad on immature and adult stages of Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae). BioControl, 54 (1): 93-112.

Martinson, T; L. Williams and G. English-Loeb (2001). Compatibility of chemical disease and insect management practices used in New York vineyards with biological control by Anagrus spp. (Hymenoptera: Mymaridae), parasitoids of Erythroneura leafhoppers. Biol. Control 22: 227–234.

Medina, P.; F.Budia; G.Smagghe andE. Vinuela (2001). Activity of Spinosad, Tebufenozide and Azadirachtin on eggs and pupae of the predator Chrysoperla carnea (Stephens) under laboratory conditions. Biocontrol Sci. Technol. 11: 597–610.

Medina, P.; F.Budia; P.Del Estal and E.Vinuela (2003). Effects of three modern insecticides, pyriproxyfen, spinosad, and tebufenozide on survival and reproduction of Chrysoperla carnea (Stephens) adults. Annals of Appl. Biol.; 142 (1): 55-61.

Medina, P.;G.F. Budia; P.Estal; L.Tirry and E.Vinula (2002). Significance of penetration, excretion, and transovarial uptake to toxicity of three insect growth regulators in predatory lacewing adults. Environ. Entomol., 51(2): 91–100.

Moura, A. P.; , G.A.Carvalho; V.F.Moscardini; O.Lasmar; D.T.Rezende andM.C. Marques (2010). Selectivity of pesticides used in integrated apple production to the lacewing, Chrysoperla externa. J. of Ins. Sci., Madison, v. 10, n. 121, p. 1-20.

Moura, A.P.D.;G.A.Carvalho; L.V.Cosme; E.Alves; M.Botton andP.S. Silva (2011). Toxicological and ultrastructural analysis of the impact of pesticides used in temperate fruit crops on two populations of *Chrysoperla externa* (Neuroptera, Chrysopidae). Revista Brasileira de Entomologia, 55(3), 411-418.

Nasreen, A.; G.Mustafa and M.Ashfaq (2005). Mortality of Chrysoperla carnea (Stephens)(Neuroptera: Chrysopidae) after exposure to some insecticides; laboratory studies. South Pacific Studies, 26(1), 1-6.

Nasreen, A.; M.Ashfaq; G.Mustafa andR.R. Khan (2007). Mortality rates of five commercial insecticides on Chrysoperla carnea (Stephens)(Chrysopidae: Neuroptera). Pak. J. Agri. Sci, 44(2), 266-271.

Ndakidemi, B.; K.Mtei andP.A. Ndakidemi (2016). Impacts of synthetic and botanical pesticides on beneficial insects. Agri. Sci., 7(06), 364.

Nohad, K.A.T. (2005). Integrated pest management oh Helicoverpa Armigera (Hub) (Lepidoptera: Noctuidae: Heliothinae) on cotton by using Bio-control agents and selective insecticides. PhD thesis, 89.

Plapp, F.W. Jr. and D.L Bull (1978). Toxicity and selectivity of some insecticides to Chrysopa carnea, predator of the tobacco bud worm. Environ. Ent., 7, 431-4236.

Rimoldi, F.; M.I.Schneider andA.E. Ronco (2008). Susceptibility of Chrysoperla externa eggs (Neuroptera: Chrysopidae) to conventional and biorational insecticides. Environ. Entomol. 37 (5): 1252–1257.

Sabry, K.H. andA.A. El-Sayed (2011). Biosafety of a biopesticide and some pesticides used on cotton crop against green lacewing, Chrysoperla carnea (Stehens)(Neuroptera: Chrysopidae). J Biopestic, 4, 214-218.

Salama, H.S.; F.N. Zaki; S.A. Salam and A. Shams EL-Din (1990). Comparative Effectiveness of Becillus thuriengensis and Lannate against Spodoptera lituralis. Journal of Islamic Academy of Society. 3(4): 325-329.

Sayed, A.A.A.; E.A. AdelAmer and W.M. Desuky (2015).Side Effect of Some Insect Growth Regulators (IGRs) on the Associated Predators of Cotton Leaf Worm, *Spodoptera littoralis*(boisd.) In Cotton Fields. El- Plant Protection Research Institute, Agriculture Research Center, Dokki, Egypt. Acad. J. Biolog. Sci., 8(3): 79-86.

Sechser, B. and S. Ayoub(2003). Toxicity of thiodicarb, methomyl and emamectin Benzoate against predators of sucking insect pests of cotton. Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz. 110: 184-194.

Silva, R.A.;G.A.Carvalho; C.F.Carvalho andD.I.E.G.O. Bastos Silva (2012). Effects of pesticides on eggs of Chrysoperla externa (Neuroptera: Chrysopidae) and consequences on subsequent development. Revista Colombiana de Entomología, 38(1), 58-63.

Silva, R.A.; G.A.Carvalho; C.F.Carvalho; P.R.Reis; A.M.Pereira andL.V. Cosme (2005).Toxicidade de produtos fitossanitários utilizados na cultura do cafeeiro a larvas de Chrysoperla externa (Hagen) (Neuroptera: Chrysopidae) e efeitos sobre as fases subseqüentes do desenvolvimento do predador. Neotropical Entomology, Londrina, v. 34, n. 6, p. 951-959.

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

Stapel, J.O.; A.M. Cortesero and W.J. Lewis(2000). Disruptive sublethal of insecticides on biological control: Altered foraging ability and life span of a parasitoid after feeding on extra floral nectar of cotton treated with systemic insecticides. Biological Control. 17, 243–249.

Tillman, P.G. and J.E. Mulrooney (2000). Effect of selected insecticides on the natural enemies *Coleomegilla maculata* and *Hippodamia convergens* (Coleoptera: Coccinelidae), *Geocoris punctipes* (Hemiptera: Lygaeidae), and *Bracon mellitor*, *Cardiochiles nigriceps*, and *Cotesia marginiventris* (Hymenoptera: Braconidae) in cotton. J. Econ. Entomol. 93: 1638–1643.

Toda, S. and T. Kashio (1997). Toxic effect of pesticides on the larvae of Chrysoperla carnea (Steph.). Proceedings of the Association for Plant Protection of Kyushu. 43: 101-105.

Ulhoa, J.L.R. (2000). Seletividade de alguns inseticidas utilizados na cultura do algodoeiro a Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae). Dissertação de mestrado, UFLA, Lavras. 57 pp.

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

Vilela, M.; G.A.Carvalho; C.F.Carvalho; M.A.Vilas Boas; M.I.S. Leite (2010).Seletividade de acaricidas utilizados em cafeeiro para larvas de crisopídeos. Revista Ceres, Viçosa, 57(5) : 621- 628, 2010.

Vogt, H. (1994). Effects of pesticides on Chrysoperla carnea Stephens (Neuroptera: Chrysopidae) in the field and comparison with laboratory and semi-field results. Bull. OILB-SROP. 17(10): 71-82.

الأثار المحتملة لبعض تجهيزات المبيدات الحشرية على أسد المن الأخضر

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أوضحت نتائج هذه الدراسة أن أعلى قيم لنسب الموت نتيجة معاملة العمر اليرقي الثاني لأسد المن بطريقة متبقيات المبيدات كانت لكل من تجهيزه مبيدى الكلوروبيروفوس_ميثيل والميثوميل في صورة جولدبن 90,48% و 100% وكان هذه النتيجة متوقعة, بينما كانت أدنى نسبة مئوية للموت لكل من الأمامكتين بنزوات وتجهيزتى مبيد لوفنرون فلم تتعدى 42,86% كذلك أظهرت تجهيزات الأمامكتين بنزوات ما عدا البروأكت فروقا معنوية بينها وبين كل التجهيزات المختبرة فكانت تتراوح من 0,00% إلى 64,29% لمعاملة العذارى ومن 0,00% إلى 53,57% لمعاملة الحشرة الكاملة وذلك مقارنة بالعذارى الغير معاملة بالمبيدات (الكنترول) فكانت 85,71% وكانت للحشرة الكاملة 78,57% ولم يوجد فروق معنوية بين تجهيزتى أي مادة فعالة ما عدا تجهيزتى الأمامكتين بنزوات فى معاملة العذارى فقط. أظهرت النتائج أن معاملة العمر اليرقي الثاني لأسد المن بطريقة التغذية أن تجهيزه الكلوروبيروفوس_ميثيل كانت أعلى سمية100% موت , بينما تجهيزه الميثوميل والأمامكتين بنزوات ولوفنرون كانت أقل سمية تتراوح من 3,70% إلى 27,27% موت ومبيد لوفنرون كان أعلى سمية بطريقة التغذية عنه بطريقة المتبقيات . أيضا وجدت فروق معنوية عالية بين تجهيزات الكلوروبيروفوس_ميثيل عن المعاملات الأخرى فتراوحت من 60,71% إلى 78,57% للعذارى ومن 57,14% إلى 71,43% للحشرة البالغةمقارنة بالمعاملة بدون مبيدات (الكنترول) فتراوحت من 89,29% للعذارى و82,14% للحشرات البالغة ولكن لا يوجد فرق معنوي بين تجهيزتى نفس المادة الفعالة للكلوروبيروفوس_ميثيل. أكدت النتائج أن معاملة البيض لأسد المن بطريقة الغمر أدت إلى تقليل معنوي في نسبة الفقس باستخدام تجهيزات الميثوميل والكلوروبيروفوس_ميثيل فتراوحت من 65,05% للجولدبن إلى 76,69% للرلدان, بينما لم تظهر فروق معنوية في معدل الفقس باستخدام تجهيزات الأمامكتين بنزوات ولوفنرون فتراوحت قيمها من 86,08% باستخدام البروأكت إلى 95,88% باستخدام الماتش مقارنة بالغير معاملة بالمبيدات (الكنترول) فكانت 98,33% لكن لم يكن هناك فرق معنوي بين تجهيزتى المادة الفعالة لمبيدى الميثوميل والكلوروبيروفوس_ ميثيل.التحليل الإحصائي أظهر فروق معنوية بين كل التجهيزات المختبرة عند 0,00% باستثناء تجهيزات الأمامكتين بنزوات في معاملة العذارى فقط ولا تقل عن 53,20% مع الغير معاملة (الكنترول) وكانت 82,59% للعذارى و 79,88% للحشرات البالغة وذلك بعد معاملة البيض لأسد المن.