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Original Article

Toxicity Evaluation of Certain Pesticides Against Green Lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) under Laboratory Conditions

Aly A. Abd-Ella[1*]; Abd-Elrahman S. Mubarak[2]; Islam R.M. El-Zoghby[2] and Ahmed A. Sallam[3]

[1]Plant Protection Department, Faculty of Agriculture, Assiut University, 71526 Assiut, Egypt
[2]Plant Protection Department, Faculty of Agriculture and Natural Resources, Aswan University
[3]Plant Protection Department, Faculty of Agriculture, Sohag University, Sohag, Egypt

*Corresponding author: aly.abdella@aun.edu.eg
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Abstract

The green lacewing, *Chrysoperla carnea* (Stephens) is considered one of the most effective predators with commercial viability for usage in many agricultural systems against a variety of crop pests. Results showed that after 24 h of exposure the LC_{50} values for chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, lufenoron (72h) and methomyl were 0.201,4.66, 25.86,71.54,258.93 and 388.37 mgL^{-1}, respectively. Chlorpyrifos was the most toxic among the pesticides studied. In consideration of the developmental time of the 2nd instar larvae treated with sublethal concentration (LC_{10}) revealed a significant difference between treats of all tested pesticides compared to untreated control. Plus, no significant difference was observed among lambada-cyhalothrin, abamectin, acetamiprid, and lufenuron treatments considering the larval developmental time. The developmental time of the 3rd instars larvae treated with chlorpyrifos, lufenuron, and acetamiprid were not significant compared to the control treatment. For the pupae's developing time, the differences between treatments and controls were significant. The mean numbers of eggs of *C. cephalonicus* and *Aphis craccivora* Koch consumed by *C. carnea* 2nd and 3rd instar larvae significantly decreased after exposure of sublethal concentration of the selected insecticides compared to the control. In accordance with the results obtained, abamectin, lambada-cyhalothrin and lufenuron might be incorporated into integrated pest management (IPM) programs in combination with *C. carnea* for the control of sucking insect pests. Further, the use of chlorpyrifos, methomyl and acetamiprid in IPM strategies should be taken into consideration when releasing the green lacewing, due to the toxic effects observed under laboratory conditions.

Keywords: *Chrysoperla carnea, insecticides, toxicity, subleatheal effects*

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Introduction

The green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is considered a global predator that can be found both in the wild and on farms (Nadeem *et al*., 2014; Rana *et al*., 2017). Further, it has the capacity to prey on a variety of soft-bodied insects. It has a lot of commercial potentials and might be used against a lot of crop pests in combination with other insect pest management techniques (Jokar and Zarabi, 2012; Sarwar, 2014; Menon *et al*., 2015). The green lacewing adults feed on nectar, pollen, and sugar excretions of insects (such as aphids) and are necessary for population survival in the field (Borah *et al*., 2012; Nadeem *et al*., 2014; Rana *et al*., 2017). Larvae are aggressive foliage-dwelling predators that eat aphids and a variety of other soft-bodied preys (Tauber and Tauber 1983; Tauber *et al*., 2000; Sarwar and Salman, 2016; Rana *et al*., 2017).

On the other side, insecticides generally induce mortality in both pests and their natural enemies because of their physiological similarities (Croft, 1990). In this regard, insecticides that work well with biological control agents are valuable tools in an integrated pest management (IPM) program, thus research on their impact on natural enemies is paramount (Stark *et al*., 2004; El-Zahi, 2012; Amarasekare *et al*., 2013; Ayubi *et al*., 2013). However, acute toxicity and sublethal effects are considered the most common types of toxicological tests on natural enemies (Croft, 1990; Gandhi *et al*., 2005; Medina *et al*., 2006; Desneux *et al*., 2007; Shoeb *et al*., 2017). Importantly, acute toxicity is determined after a brief exposure to a chemical compound (ex, a few hours to a few days), with the death of the organism as the endpoint. In acute toxicology research, the median lethal dosage (LD_{50}) or lethal concentration (LC_{50}) is assessed (Croft, 1990; Stark and Banks, 2003; Rezaei *et al*., 2007; Moustafa, 2016; Shoeb *et al*., 2017). These data are used to evaluate the effects of multiple compounds on a single species or the susceptibility of different species to specific compound (Rumpf *et al*., 1997).

Furthermore, sublethal effects of insecticides are crucial matter in IPM programs because they reduce the ability of the entomophagous to regulate the host or prey (Moustafa, 2016; Shoeb *et al*., 2017). This ability is impacted by changes in aspects that determine the intrinsic rate of rising (rm) and behavior (Croft, 1990; Rezaei *et al*., 2007; Moustafa, 2016; Shoeb *et al*., 2017). Thus, the objectives of this study were to evaluate the lethal and sublethal effects of six insecticides that exemplify different chemical classes on *C. carnea* and food consumption under laboratory conditions.

Materials and Methods

Pesticides

Six active ingredients of commercial formulation pesticides from various chemical classes that are available in Egypt were tested and were obtained from the local market, as shown in Table (1).

Table 1. List of pesticides along with their chemical group, trade names, percentage of active ingredients, formulation types, and recommended field rates.

Active ingredient	Trade Name	% (a.i.)* & Formulation	Chemical group	Recommended field rate (cm^3 or mg a.i./L)
Chlorpyrifos	Pestban	48%EC	Organophosphates	5 cm^3 /L
Lambada-cyhalothin	Dolf-X	5%EC	Pyrethroides	2.5 cm^3 /L
Abamactin	Cam-mek	1.8% EC	Avermectin	0.4 cm^3/L
Acetambrid	Twistrid	40%SP	Neonicotinoides	75 mg /L
Lufenoron (72h)	Lenoflag	5%EC	Benzoylurea	0.8 cm^3 /L
Methomyl	Methocam	90%SP	Carbamates	1500 mg /L

* EC: Emulsifiable Concentrate, SP: Soluble Powder

Insects

The 2nd instar larvae of *C. carnea* were obtained from the mass rearing unit at the Bio Agricultural Services Center, Sahary, Aswan, Egypt. Larvae were fed on nymphs of the cowpea aphid, *Aphis craccivora* Koch (Hemiptera: Aphididae), and the eggs of rice meal moth, *Corcyra cephalonica* Stainton (Lepidoptera: Galleriidae) and its obtained from the same laboratory.

Bioassay tests

Toxicity of some pesticides against *C. carnea*

The toxicity of six pesticides as mentioned in Table 1. to the 2nd instar larvae was estimated, using the Dipping technique. Test solutions (7 concentrations (0.001, 0.01, 0.1, 1.0 , 10, 100 and 1000 mgL^{-1}) for each pesticide) were freshly prepared in tape water. Thirty individuals were divided into three replicates (10 each) were placed in small pieces of gauze and dipped in each concentration for 10 seconds and the control as well. The treated larvae were transferred to glass Petri dishes 9 cm (diameter) containing filter papers placed on the middle of the plate and provided with aphid nymphs as food (20/larva) and the control as well. Larval mortality percentage was recorded after 24h of exposure. Larvae were considered dead by the failure to move when they were touched by a fine camel brush. All treatments were incubated at 26±2 °C temperature and 12:12 h L: D and 65± 5 % RH unto recording of the results. The toxicity of each insecticide was replicated 2 times. The mortality data were corrected by Abbott's formula (Abbott, 1925) if necessary.

Effect of sublethal concentration of certain pesticides on the larval, pre-pupa and pupa duration time

Effect of subleathel concentration (LC_{10}) of chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and lufenoron (72h) on the larval, pre-pupa and pupa duration of 2nd instar larvae of *C. carnea* using dip bioassay which feeding by *A. cracivora* and the eggs of Rice meal moth, *C. cephalonica*, were assessed. The LC_{10} value was calculated from acute toxicity bioassays of pesticides. Ten larvae of the 2nd instar were dipped in every pesticide solution using a small piece of gauze and placed in a 15cm (diameter) Petri dish with a filter paper on its bottom and covered with its cap to prevent insects from escaping.

Effect of sublethal concentration of certain pesticides on consumption rate

Effect of subleathel concentration (LC_{10}) of chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and lufenoron (72h) on the predation efficiency of *C. carnea* larval stage was estimated under laboratory conditions. The predation efficiency of 2nd instar larvae of *C. carnea* using dip bioassay which feeding by A. cracivora and eggs of *C. cephalonicus* were determined. Thirty larvae of *C. carnea* was distributed to every treatment (10 /replicate) and dipped in LC_{10} of all selected pesticides (for 10 seconds) using small pieces of gauze, then they have transferred to 15 cm (diameter) glass Petri dishes which capped with its covers and have filter papers on its bottom. An adequate and counted number of the aphid nymphs were added to the larvae and increased daily until the pupation of the larvae. The consumed number of individuals was recorded daily throughout the larval stage to calculate the predatory potential. Each treatment was replicated three times. The eggs of *C. cephalonica* were stuck to small cards of paper every card containing a known number of eggs and evenly added to the treated larvae. The offered eggs were gradually increased every day until the end of the larval stage. The consumed eggs were counted and recorded daily to estimate the predatory potential.

Data presentation and statistical analyses

The LC_{50}, slope, and $\chi 2$ values were polled and analyzed using probit analysis using SPSS 16 software for Windows, mean mortality percentages corrected by (Abbott, 1925) formula. Toxicity index = [(LC_{50} of the most toxic tested compound/LC_{50} of the tested compound) x 100]. Data were analyzed using one-way ANOVA and presented as mean ± SEM (Standard Error of Mean). Means were separated by Duncan's Multiple Range Test (DMRT) and Tukey's Multiple Comparison Test (TMCT). Figures and statistical analysis were done using Graph Pad Prism 5TM software (San Diego, CA) and SPSS ver. 16, 2015.

Results and Discussion

Toxicity of certain insecticides against the common green lacewing, *C. carnea*

Data in Table (2) demonstrated the LC_{50} values for chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, lufenoron (72h) and methomyl were 0.201, 4.66, 25.86, 71.54, 258.93, and 388.37 mg L^{-1} respectively after 24 h of exposure. Further, the toxicity of pesticide chlorpyrifos was 23 times than Lambada-cyhalothrin 128.7, abamectin 355.9, acetamiprid 1288, Lufenoron, and 1932 times than methomyl based on the level of LC_{50} .The following is a list of the pesticides that were examined for the toxicity to *C. carnea* larvae as followed: chlorpyrifos > Lambada-cyhalothrin > abamectin > acetamiprid > Lufenoron (72h) > methomyl.

Table 2 . Toxicity of certain insecticides against the common green lacewing, *C. carnea* using dip bioassay after 24 h exposure.

Insecticides	LC_{50} (95% FL)	Slope±SE	Toxicity Index	Risk ratio	χ^2
Chlorpyrifos	0.201 (0.03-0.82)a	0.25±0.05	100a	24.87	13.33
Lambada-cyhalothin	4.66 (0.89-1.76)b	0.40 ± 0.02	4.31b	0.54	21.42
Abamactin	25.86 (18.9-31.76)c	0.38±0.03	0.78c	0.02	56.61
Acetambrid	71.54 (47.22-97.72)d	0.35 ± 0.03	0.28c	1.05	29.21
Lufenoron (72h)	258.93 (207.97-294.71)e	0.41 ± 0.04	0.07c	0.003	7.56
Methomyl	388.37 (308.43-436.2)f	0.32 ± 0.03	0.05c	3.86	38.37

Notes: FL: fiducial limits, toxicity index = [($LC_{50}$of the most toxic tested compound/$LC_{50}$of the tested compound)100]. Risk ratio = field recommended rate/LC_{50}. LC_{50} values having different letters are significantly different (95% FL did not overlap).

The aphidophagous predator, *C. carnea* is considered relatively tolerant to insecticides (Medina *et al.* 2008), whereas, the instar larvae are more sensitive than adults (Giolo *et al.* 2009) and can be spoiled by many pesticides (Medina *et al.*, 2004; Hussain *et al.*, 2012), which cause direct mortality and/or modify physicological or behavioral traits (Desneux *et al.*, 2007; Hussain *et al.*, 2012). Moreover, the duration of the harmful activity of insecticides residues must also be taken into account because aged residues are not as harmful as the fresh ones (Medina *et al.*, 2008). Our results are agreement with Hussain *et al.* (2012) which reported that, chlorpyrifos were found to be potent to all instars larvae of *C. carnea* at all treatment intervals.

For evaluation the risk of pesticides to *Aphidius revi* a generalist parasitoid of aphids Desneux *et al.* (2004; 2007) used the risk ratio. In our results the risk ratios may also allow to the risk impact to *C. carnea* among the tested pesticides. The risk ratios using dip bioassay after 24 h exposure 24.87, 0.54, 0.02, 1.05, 0.003 and 3.86 for chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, lufenoron (72h) and methomyl (Table 2). Thus, chlorpyrifos was the most harmful insecticide to the *C. carnea* due to high toxicity and risk followed by methomyl and acetamiprid.

Effects of sublethal concentration of certain pesticides on *C. carnea*

Effect of sublethal concentration of certain pesticides on the larval, pre-pupa and pupa duration time

Results in Table (3) demonstrated that the effect of subleathel concentration (LC_{10}) of certain pesticides on the larval, pre-pupa and pupa duration of 2nd instar larvae of *C. carnea* using dip bioassay which feeding by eggs of *C. cephalonicus*. The LC_{10} of all pesticides tested had a considerable impact on the development time of the 2nd instar larvae (feeding by eggs of *C. cephalonicus* and *Aphis craccivora*) as compared to the control. Whereas, there was no significant difference between lambada-cyhalothrin and abamectin on the larval developmental time,

Table 3. Duration (days ±SEM) of *C. carnea* larvae (L_2) after exposure of sublethal concentration (LC_{10}) of certain insecticides using dip bioassay which feeding by eggs of *C. cephalonicus*

Treatments	Conc. LC_{10} (mgL^{-1})	Duration (days ±SEM) of *C. carnea* from larvae to pupae				
		2nd instar	3rd instar	Pre-pupa	Pupa	Mean
Control	0.00	4 ± 0.67b	6±0.33b	2±0.33b	12±0.33b	24±0.33b
Chlorpyrifos	0.0001	4 ± 0.33b	6±0.33b	2±0.67b	14±0.67a	26±0.67a
Lambda-cyhalothrin	0.003	5 ± 0.33a	7±0.67a	2±0.33b	14±0.33a	28±0.33a
Abamectin	0.011	5 ± 0.67a	8±0.33a	3±0.33a	14±0.67a	30±0.67a
Acetamibrid	0.014	5 ± 0.67a	6±0.67a	2±0.25b	13±0.67a	26±0.67a
Methomyl	0.040	5 ± 0.33a	8±0.33a	3±0.33a	15±0.67a	31±0.33a
Lufenuron	0.196	4 ± 0.33b	6±0.67b	3±0.67a	13±0.33a	26±0.67a

Data are expressed as means ± stander error (SEM). Means followed by the same letter(s) within the same column are insignificantly different (p = 0.05) according to DMRT.

Treatment with LC_{10} (0.003, 0.011, 0.014 and 0.04 mgL^{-1}) of lambada-cyhalothrin, abamectin, acetamiprid, and methomyl significantly increased the developmental period of second instar larvae (5 days), while chlorpyrifos (0.0001 and 0.196 mgL^{-1}) shorted the duration time (4 days) compared the control. In addition, for the 3rd instar larvae, pre-pupae and pupae all treatments significantly increased the developmental time compared the control (Table 3). Three out of the six studied insecticides significantly shortened or increased the duration of the instar larvae, pre-pupae and pupal stage, an effect already published by Vilela *et al.* (2010) in *C. externa* when the instar larvae, pre-pupae and pupal stage came into contact with a different pesticides. The biological meaning of this reduction or increase is not clear, because in some cases, adults of lacewings that emerged behaved normally and did not show alterations in reproduction or sex ratio.

Table 4. Duration (days ±SEM) of *C. carnea* larvae (2nd) after exposure of sub-leathel concentration of certain insecticides using dip bioassay which feeding by *A. craccivora*.

Treatments	Conc. LC_{10} (mgL^{-1})	Duration (days ± SEM) of *C. carnea* from larvae to pupae				
		2nd instar	3rd instar	Pre-pupa	Pupa	Mean
Control	0.00	3.0±0.33b	5.0±0.33b	2.0±0.67 a	10.0±0.67a	20.0±1.33 b
Chlorpyrifos	0.001	4.0±0.67 a	6.0±0.67 a	2.0±0.33 a	11.0±0.33 a	23.0±1.67 a
Lambda-cyhalothrin	0.001	4.0±0.33 a	6.0±0.33 a	2.0±0.67 a	10.0±0.67 a	22.0±0.67 a
Abamectin	0.0001	4.0±0.67 a	6.0±0.67 a	2.0±0.33 a	10.0±0.67 a	22.0±1.33 a
Acetamibrid	0.005	4.5±0.33 a	5.5±0.67 a	2.0±0.33 a	11.0±0.67 a	23.0±0.67 a
Methomyl	0.0001	4.0±0.67 a	6.0±0.67 a	2.0±0.67 a	10.0±0.33 a	22.0±0.67 a
Lufenuron	0.0003	3.0±0.67 b	5.0±0.33 b	2.0±0.33 a	10.0±0.67 a	20.0±0.33 b

Data are expressed as means ± stander error (SEM). Means followed by the same letter(s) within the same column are insignificantly different (p = 0.05) according to DMRT.

Data in Table (4) reveal that, the effect of subleathel concentration (LC_{10}) of certain pesticides on the larval, pre-pupa and pupa duration of 2nd instar larvae of *C. carnea* using dip bioassay which feeding by *A. craccivora*. Results indicated that, chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, and methomyl significantly increased the developmental period of second instar larvae, whereas lufenuron shorted the duration time (4 days) compared the control. In addition, for the 3rd instar larvae, pre-pupae and pupae all treatments significantly increased the developmental time compared the control. The mean developmental time from larvae to pupa significantly increased on the treatment of chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, and methomyl 23, 22, 22, 23 and 22 days respectively, whereas, lufenuron was not effect on the mean duration compared to the control.

Effect of sublethal concentration of certain pesticides on food consumption of *C. carnea* larvae.

As results in Table (5), treatment with chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and Lufenuron on the food consumption of 2nd and 3rd instar larvae of *C. carnea* significantly decreased after LC_{10} treatment compared with that of the control which feeding by *Aphis craccivora*. Methomyl was the most effects on the consumption rate (19.43 and 34.63 individuals/day), followed by, chlorpyrifos (22.87 and 38.83 individuals/day), lambada-cyhalothrin (21.21 and 39.81 individuals/day), abamectin (20.93 and 36.67 individuals/day), acetamiprid (22.98 and 43.49 individuals/day), whereas lufenuron was no significant effect on the consumption rate (23.52 and 41.97 individuals/day) compared the control treatment (25 and 44 individuals/day) for 2nd and 3rd instar larvae, respectively. The mean numbers of *A. cracivora* consumed by *C. carnea* larvae significantly decreased after LC_{10} treatment of all insecticides chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and lufenuron (30.85, 30.51, 28.80, 33.24, 27.03 and 32.75 individuals//larva/ day) compared to the control (34.5 individuals//larva/ day).

Table 5. Mean no. of *Aphis craccivora* consumed by *C. carnea* 2nd and 3rd instar larvae after exposure of sublethal concentration (LC_{10}) of certain insecticides using dip bioassay

Treatments	Conc. LC_{10} (mgL^{-1})	Mean (no. individuals ± SEM) of *A. craccivora* consumed by *C. carnea* /larva/ day			
		2nd instar	3rd instar	Total	Mean
Control	0.00	25.00±1.5a	44.00±2.5a	65.00±4.0a	34.50±2.5a
Chlorpyrifos	0.001	22.87±0.5a	38.83±1.5b	61.70±2.0b	30.85±0.5b
Lambda-cyhalothrin	0.001	21.21±1.0b	39.81±2.0b	61.02±3.0b	30.51±1.0b
Abamectin	0.0001	20.93±1.5b	36.67±1.5b	57.60±3.0b	28.80±0.5b
Acetamibrid	0.005	22.98±0.5a	43.49±1.0a	66.46±1.5a	33.24±0.5a
Methomyl	0.0001	19.43±1.5b	34.63±0.5c	54.06±2.0c	27.03±1.5c
Lufenuron	0.0003	23.52±1.5a	41.97±1.5a	65.49±3.0a	32.75±0.5a

Data are expressed as means ± stander error (SEM). Means followed by the same letter(s) within the same column are insignificantly different (p = 0.05) according to DMRT.

Ability of predation is also adversely affected after pesticides treatment (Santos *et al*., 2015). These results were consistent with this, showing that the predacious potential of larvae of *C. carnea* was significantly reduced when second instar larvae were treated with subleathel concentration of chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and lufenuron. Similar results were previously published regarding the decreased foraging time and feeding capacity of other predators, *Macrolophus pygmaeus* (Hemiptera: Miridae), *Coleomegilla maculata*, *Serangium japonicum* and *Hippodamia* *convergens* (Coleoptera: Coccinellidae) because of neonicotinoid insecticide exposure(Martinou *et al*., 2014; Santos *et al*., 2015; Yao *et al*., 2015).

Data in Table (6) present that the effect of subleatheal concentration of chlorpyrifos, lambada-cyhalothrin, abamectin, acetamiprid, methomyl and lufenuron on the food consumption of 2nd and 3rd instar larvae of *C. carnea* significantly decreased after LC_{10} treatment compared with that of the control which feeding only on the eggs of *C. cephalonicus*. However, methomyl was given the maximum effect on the consumption rate (34.89 and 73.81 eggs/day), followed by abamectin (36.79 and 79.87 eggs/day), lambada-cyhalothrin (40.55 and 85.89 eggs/day), chlorpyrifos (40.74 and 87.32 eggs/day), and acetamiprid (42.51 and 88.42 eggs/day), whereas lufenuron was found no significant effect on the consumption rate (43.40 and 91.29 eggs/day) compared the control treatment (45 and 95 eggs/day) for 2nd and 3rd instar larvae, respectively. The mean number of eggs of *C. cephalonicus* consumed by *C. carnea* larvae significantly decreased after exposure of chlorpyrifos (64.03), lambada-cyhalothrin (63.22), abamectin (58.33), acetamiprid (65.46), methomyl (54.35) and lufenuron (67.35) eggs/day compared to the control (70.00 eggs/day). According to this results, it seems lufenuron, acetamiprid and abamectin may have less harmful effects on feeding consumption of green lacewing larvae than chlorpyrifos, lambada-cyhalothrin and methomyl.

Table 6. Mean no. of eggs of *C. cephalonicus* consumed by *C. carnea* 2nd and 3rd instar larvae after exposure of sublethal concentration of certain insecticides using dip bioassay

Treatments	Conc. LC_{10} (mgL^{-1})	Mean (no. eggs ± SEM) of *C. cephalonicus* consumed by *C. carnea* /larva/ day			
		2nd instar	3rd instar	Total	Mean
Control	0.00	45.00±1.5a	95.00±2.5a	140.00±4.0a	70.00±3.5a
Chlorpyrifos	0.0001	40.74±2.5b	87.32±1.5b	128.10±3.0b	64.03±2.5b
Lambda-cyhalothrin	0.003	40.55±1.5b	85.89±1.5b	126.44±3.0b	63.22±2.5b
Abamectin	0.011	36.79±1.5b	79.87±2.5b	116.66±4.0b	58.33±1.5b
Acetamibrid	0.014	42.51±2.5a	88.42±2.5a	130.93±5.0a	65.46±3.5a
Methomyl	0.040	34.89±0.5c	73.81±1.5c	108.70±2.0c	54.35±2.5c
Lufenuron	0.196	43.40±1.5a	91.29±1.5a	134.69±3.0a	67.35±1.5a

Data are expressed as means ± stander error (SEM). Means followed by the same letter(s) within the same column are insignificantly different (p = 0.05) according to DMRT.

In addition, *C. carnea* is generalist predator that feed on vital small arthropod pests and their eggs, including whitefly, leafhoppers, aphids, lepidopteran pests, and spider mites (Ridgway and Murphy, 1984; Borror *et al.,* 1992; Senior and McEwen, 2001). Larval lacewings fulfill plentiful of the requirements of an effective biological control agent and are voracious active predators with excellent search capacity (Bond, 1980). On the other hand, insecticides used to control insect pests in the crops can affect *C. carnea* larvae and decreased the feeding capacity (Maia *et al*., 2016). Reduced food consumption as a result of insecticidal deterrents in the instars may be contributed to the extended developmental time of the treated larvae (Galavan *et al*., 2005).

Conclusion

To sum up, our data stated that abamectin, lambada-cyhalothrin and lufenuron might be incorporated into IPM programs in combination with *C. carnea* for the control of sucking insect pests. In contrast, the use of chlorpyrifos, methomyl and acetamiprid in IPM strategies should be taken into consideration when releasing the green lacewing, based on the toxic effects observed under laboratory conditions. Analysis of data showed a significant decrease in numbers of eggs of *C. cephalonicus* and *Aphis craccivora* consumed by *C. carnea* 2nd and 3rd instar larvae after treatment by sublethal concentration (LC_{10}) of tested insecticides compared to the control. eventually, despite the acute toxicity of abamectin, lambada-cyhalothrin, and lufenuron on *C. carnea* 2nd instar larvae, these pesticides may be good candidates for use in IPM programs if equivalent results are obtained in field circumstances.

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تقييم سمية بعض مبيدات الآفات على اسد المن الاخضر تحت ظروف المعمل

على أحمد عبدالله[1*], عبد الرحمن سعد مبارك[2]، اسلام راشد مرزوق الزغبى[2]، احمد احمد سلام[3]

[1]قسم وقاية النبات – كلية الزراعة – جامعة اسيوط – 71526 اسيوط – مصر

[2]قسم وقاية النبات – كلية الزراعة والموارد الطبيعية – جامعة اسوان – اسوان – مصر

[3]قسم وقاية النبات – كلية الزراعة – جامعة سوهاج – سوهاج – مصر

الملخص

تعتبر حشرة أسد المن أكثر المفترسات الحشرية انتشارا في العالم ويستخدم بفاعلية علي نطاق تجاري ضد الكثير من الآفات الحشرية للمحاصيل المختلفة، يهدف هذا البحث إلى دراسة التأثيرات المميتة وغير المميتة لبعض مبيدات الآفات على يرقات العمر الثاني من المفترس باستخدام طريقة الغمر تحت الظروف المعملية. تم تقدير قيم التركيز السام النصفي بعد24ساعة من التعرض لمبيدات الكلوروبيرفوس واللامبادا-سيهالوثرين والأبامكتين والأسيتاميبريد واللوفينورون (72ساعة) والميثوميل فكانت0.201و4.66 و25.86و71.54و258.93و388.37ملليجرام لتر$^{-1}$على التوالي. من بين المبيدات الحشرية المختبرة، كان الكلوربيريفوس هو الأكثر سمية. أعطيت يرقات العمر الثاني التركيزات المسببة لموت10% من كل مبيد. بالنظر إلى زمن تطور اليرقات في العمر الثاني، أظهر النتائج وجود فرق معنوي بين معاملات جميع المبيدات التي تم اختبارها(باستثناء الكلوروبيرفوس) والمقارنة. ومع ذلك لم يلاحظ أي اختلاف كبير بين مبيدات اللامبادا-سيهالوثرين والأبامكتين والأسيتامبرد واللوفينورون. كانت الفروق في زمن النمو ليرقات العمر الثالث غير معنوية بين المقارنة ومبيدات الكلوروبيرفوس واللوفينورون والأسيتاميبريد، بينما كانت معاملات اللامبادا-سيهالوثرين والأبامكتين والميثوميل معنوية. بالنسبة لفترة تعذر أسد المن، كانت الاختلافات بين المعاملة بالمبيدات والمقارنة معنوية. كذلك لوحظ ان التأثير تحت المميت لجميع المبيدات ادى الى انخفاض معنوى فى معدل استهلاك يرقات العمر الثالث والرابع عند تغذيتها على بيض حشرة *C. cephalonicus* وحشرة من الفول وأظهرت النتائج فروقا معنوية بين المعاملات بالمقارنة بالكنترول. ووفقًا للنتائج التي تم الحصول عليها، يمكن دمج مبيدات أبامكتين ولامبادا-سيهالوثرين ولوفينورون في برامج المكافحة المتكاملة للآفات بالاشتراك مع المفترس اسد المن لمكافحة الآفات الحشرية الثاقبة الماصة. ومع ذلك فإن استخدام الكلوربيريفوس والميثوميل والأسيتاميبريد في استراتيجيات المكافحة المتكاملة للآفات يجب أن يؤخذ في الاعتبار عند إطلاق اسد المن بسبب التأثيرات السامة التي لوحظت تحت الظروف المعملية.