Toxicity of some insecticides against the green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) under laboratory conditions

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Abstract: The green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is the most important predators which has significant potential for commercialization and use against many crop pests. The present work aimed to study the toxicity of some insecitides against *C. carnea* larvae under laboratory conditions. The obtained results showed that after 24 h of exposure, the LC_{50} values for abamectin, KZ oil, divor, acetamipride, albolum, super misrona and lambda were 150, 200, 280, 700, 100, 80 and 0.1 mg/L, respectively; while, the corresponding LC_{90} were 284, 431, 586, 1344, 233, 169 and 1 mg/L, respectively. After 48 h, the highest value of LC_{50} (550 mg/L) was recorded when used acetamipride followed by divor (205), KZ oil (150), abamectin (110), albolum (81), super misrona (45) and lambda (0.03); while, the LC_{90} values ranged between 0.18 (in the case of lambda) and 1055 (in the case of acetamipride). With respect to the LC_{50} value after 72 h of exposure, it reached 0.03 mg/L for lambda cyhalothrin, 40 mg/L for super misrona, 70 mg/L for albolum, 90 mg/L for abamectin, 130 mg/L for KZ oil, 180 mg/L for divor and 480 mg/L for acetamipride; while, the LC_{90} values ranged between 0.18 and 714 mg/L. According to the slope values, the present findings referred to low homogeneity of the tested strain of the 2nd instar larvae of *C. carnea*.

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Key Words: Green lacewing, *Chrysoperla carnea,* insecticidal toxicity.

1. Introduction

The green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is the most important species of the genus Chrysoperla. It is a potential predator on many soft bodied insects. It has significant potential for commercialization and use against many crop pests in combination with other insect pest management tactics El Arnaouty and Ferran, (1993) and Chakraborty (2010). *Chrysoperla carnea* is one of the most important predators which have been found to prey upon larvae and pupae of the citrus leafminer, *Phyllocnistis citrella* Stainton in Egypt Eid (1998); Moustafa (1999); Akram (2002) and Moustafa (2004) and Jordan Ateyyat and Mustafa (2000) in addition to Texas and Mixico Legaspi *et al*. (2001). Some previous studies were done to explain the toxicity of insecticides on *C. carnea*. As examples of these insecticides were acetamiprid carbosulfan buprofezin, methamidophos, imidacloprid, thiamethoxam neembaan, lambda, diafenthiuron, thiodicarb cyantraniliprole, chlorantraniliprole, novaluron spinetoram, chlorpyrifos, bifenthrin, lufenuron, emamectin benzoate, flubendiamide, deltamethrin, spinosad and datura leaf extracts Nasreen *et al*. (2005); Preetha *et al*. (2009); Hussain *et al*. (2012); Vivek *et al.* (2012); Amarasekare and Shearer (2013); Shahzad Ali *et al*. (2015) and Ullah *et al*. (2017). In many countries of the world, lambda, abamectin, acetamipride and oils are described as effective insecticides against *P. citrella* Beattie *et al*. (1995); Rae *et al*. (1996); Besheli (2010); Qureshi *et al*. (2011); Damavandian and Moosavi (2014); Ghanim and Elgohary (2015); Mohamed and Satti (2015) and El-Afify, *et al.* (2018). So, the present work aimed to study the toxicity of lambda cyhalothrin, abamectin and acetamipride in addition to some oils (albolium, KZ oil, super misrona and diver) against *C. carnea* larvae under laboratory conditions.

2. Materials and Methods

Rearing of *C. carnea*:

About 2000 eggs of *C. carnea* were obtained from the Laboratory of Rearing and Production of *C. carnea*, Faculty of Agriculture, Cairo University. Then they were reared in the Laboratory of Pesticide Toxicology in the Faculty of Agriculture, Zagazig University, Egypt. The newly hatched larvae of *C. carnea* were fed in castor leaves infested with white fly, *Bemesia tabaci* until they reached to 2nd and 3rd instar larvae. Rearing laboratory conditions were 18°C of temperature, 44% of relative humidity and 11/13 L/D light.

Tested insecticides:

The seven tested insecticides which belong to different groups of chemicals were presented in Table (1).

Bioassay test:

The bioassay tests were performed according to the USEPA procedure (EPA, 1975). Larvae were starved for 24 h before treatment and 48 h during the experiment. Mortality was less than 10% during the acclimatization period. Preliminary screen test was carried out to determine the appropriate concentration. Four replicate per each concentration with ten larvae in each replicate were used. At the beginning of the experiment and every 24 h, the symptoms during holding period (3 days) were recorded. The data of LC_{50} were computed using the EPA probit analysis programs. Leaf-dip bioassay method was used. Fresh navel orange leaves that collected from field and this leaves have been washed by water. Leaf disks of 2 inches in diameter were prepared and then these were dipped in insecticides for 8 to 10 seconds and then air dried. Untreated controls were dipped in tap water only. Ten larvae from the second instar were put on every replicate (three replicates). The percentages of death has been recorded after 24, 48 and 72 h days after application.

Table 1: The concentrations used in acute toxicity of the tested insecticides against aphid lion, *C. carnea* larvae.

Common name	**Trade name**	**Concentrations in** mg/L
Lambda	Catron	1000,100,10,5,1,0.5,0.1,0.01
Acetamipride	Mospilan	1000,100,10,1,0.1
Abamectin	Nasr actine	1000,100,10,1,0.1
K Z oil	K Z oil	1000,100,10,1,0.1
Super Misrona	Super misrona	1000,100,10,1,0.1
Albolum	Albolum	1000,100,10,1,0.1
Divor	Divor	1000,100,10,1,0.1

3. Results

After 24 h of exposure:

Data illustrated in Fig. (1) showed that the LC_{50s} for abamectin, KZ oil, divor, acetamipride, albolum, super misrona and lambda were 150, 200, 280, 700, 100, 80 and 0.1 mg/L, respectively. In this respect the toxicity of the insecticide lambda was 800 times than super misrona, 1000 times than albolum, 7000 times than acetamipride, 2800 times than divor, 2000 times than KZ oil and 1500 times than abamectin at the level of LC_{50}. The corresponding LC_{90} were 284, 431, 586, 1344, 233, 169 and 1 mg/L for abamectin, KZ oil, divor, acetamipride, albolum, super misrona and lambda, respectively (Fig., 2). When compared at the LC_{90}; lambda recorded the values of 169 times than super misrona, 233 times than albolum, 1344 times than acetamipride, 586 times than divor, 431 times than KZ oil and 284 times than abamectin (Fig., 2). The tested insecticides could be showed at the level of toxicity to *C. carnea* larvae as follow: Lambda > super misrona > albolum > abamectin > KZ oil > divor > acetamipride (Figs., 1 and 2).

After 48 h of exposure:

The highest value of LC_{50} (550 mg/L) was recorded when used acetamipride followed by divor (205), KZ oil (150), abamectin (110), albolum (81), super misrona (45) and lambda (0.03), respectively (Fig., 3). After 48 h of exposure (Fig., 4), the LC_{90} values ranged between 0.18 (in the case of lambda) and 1055 (in the case of acetamipride). The other insecticide occupied an intermediate position between the tested insecticides. subsequently Lambda cyhalothrin exhibited the highest toxicity compound, while acetamipride revealed the lowest toxic one (Figs., 3 and 4). After 48 h of exposure, the toxicity of the tested insecticides against larvae of *C. carnea* could be arranged as follows: Lambda – cyhalothrin > super misrona > albolum > abamectin > KZ oil > divor > acetamipride at both levels of toxicity (LC_{50} and LC_{90}).

After 72 h of exposure:

Regarding the toxicity of the tested insecticides after 72 h in Fig. (5), data obtain showed similar trend with 48 h of exposure. The LC_{50} values after 72 h were 0.03 mg/L for lambda cyhalothrin, 40 mg/L for super misrona, 70 mg/L for albolum, 90 mg/L for abamectin, 130 mg/L for KZ oil, 180 mg/L for divor and 480 mg/L for acetamipride. Moreover, resulted LC90s were arranged as in the same order and ranged between 0.18 to 714 mg/L. So, at the LC_{90s} could be in descending order as follows: Lambda cyhalothrin > super misrona > albolum > abamectin > KZ oil > divor > acetamipride (Fig., 6). The toxicity of lambda after 72 h was 1333.33 times than super misrona, 2333.33 times than albolum, 16000 times than acetampiride, 6000 times than divor, 4333.33 times than KZ oil and 3000 times than abamectin (Fig., 6).

Data represented in Table (2) showed that the slope values after 24 h of the exposure ranged between 1.85 and 4.05; while, after 48 h ranged between 1.09

and 3.15. With respect to the slope values after 72 h of the exposure, they ranged between 1.09 and 3.55. These findings referred to low homogeneity of the tested strain of the 2nd instar larvae of *C. carnea*.

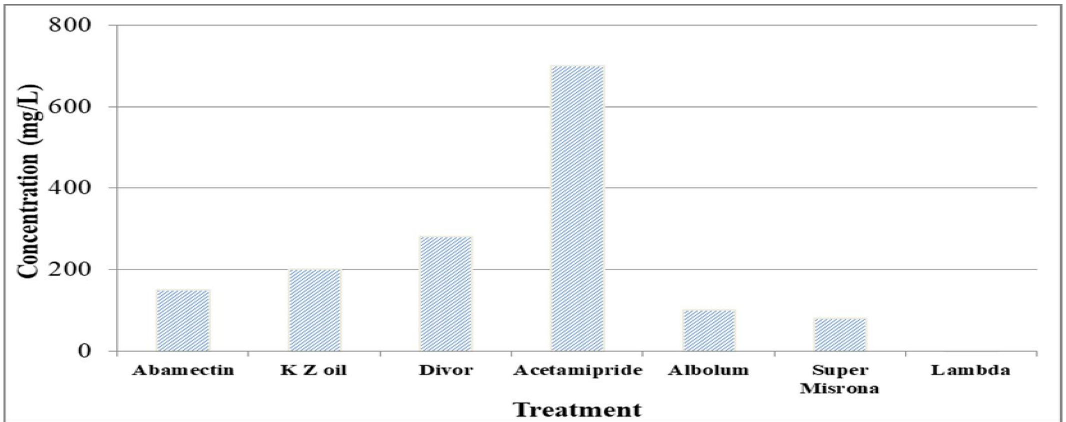

Figure 1: Acute toxicity (LC_{50}) of the tested insecticides against 2nd instar larvae of *C. carnea* after 24 h of exposure.

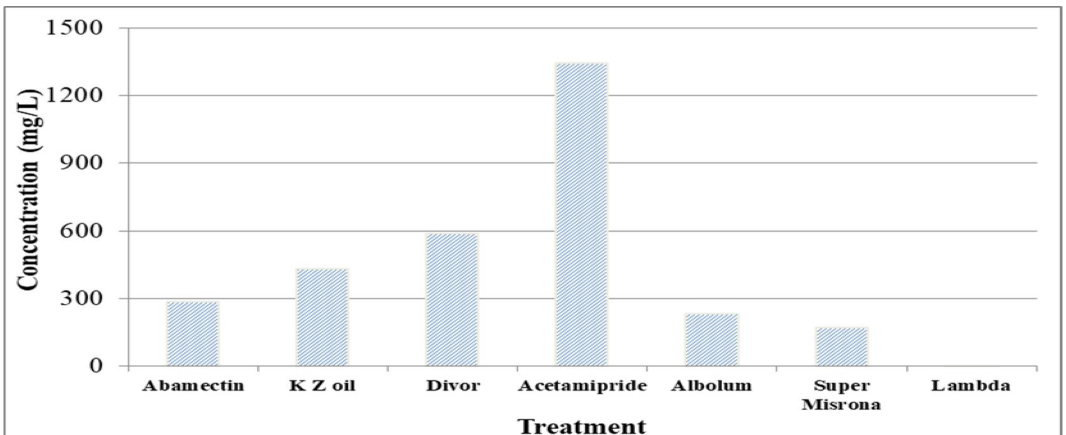

Figure 2: Acute toxicity (LC_{90}) of the tested insecticides against 2nd instar larvae of *C. carnea* after 24 h of exposure.

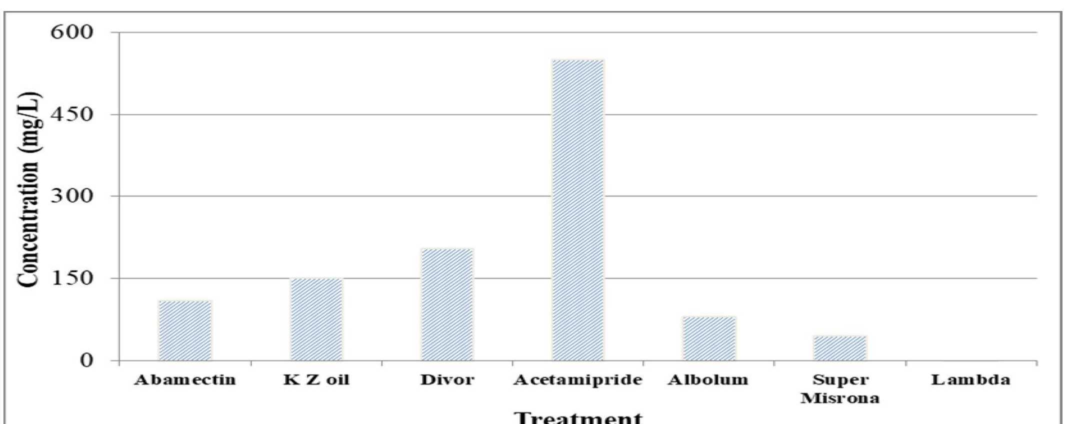

Figure 3: Acute toxicity (LC_{50}) of the tested insecticides against 2nd instar larvae of *C. carnea* after 48 h of exposure.

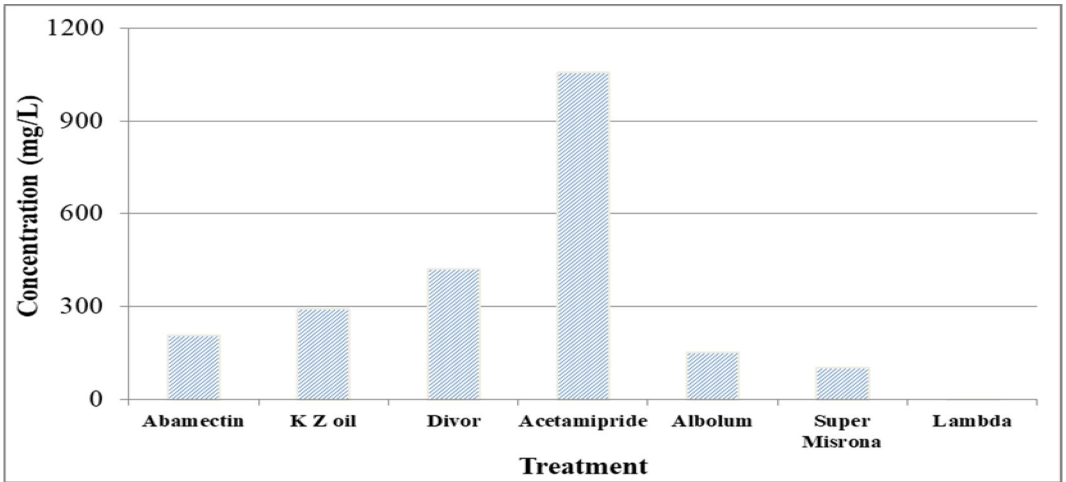

Figure 4: Acute toxicity (LC_{90}) of the tested insecticides against 2^{nd} instar larvae of *C. carnea* after 48 h of exposure.

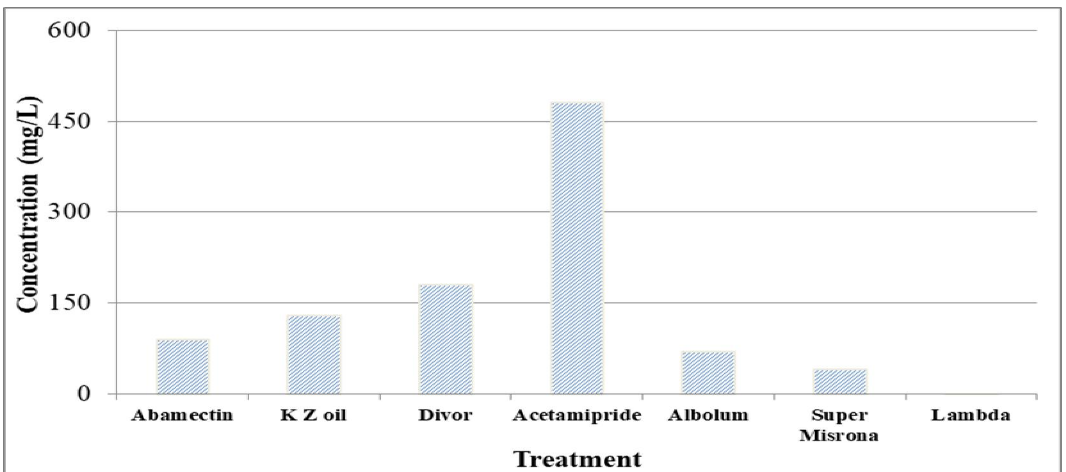

Figure 5: Acute toxicity (LC_{50}) of the tested insecticides against 2^{nd} instar larvae of *C. carnea* after 72 h of exposure.

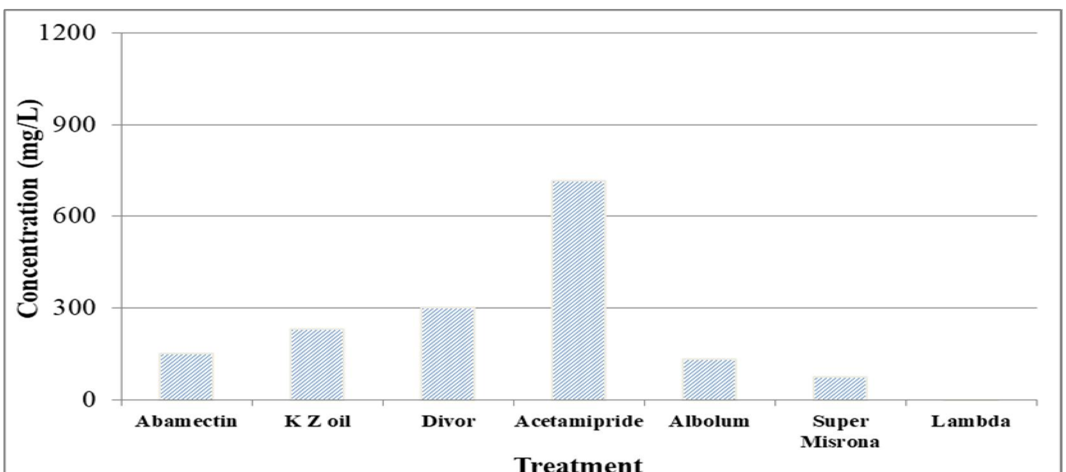

Figure 6: Acute toxicity (LC_{90}) of the tested insecticides against 2^{nd} instar larvae of *C. carnea* after 72 h of exposure.

Table 2: The slope values of the toxicity lines for the tested insecticides against 2nd instar larvae of *C. carnea* after 24, 48 and 72 h of exposure.

Treatment	24 h	48 h	72 h
Abamectin	3.81	2.44	2.44
K Z oil	2.84	1.86	3.15
Divor	3.11	2.33	2.02
Acetamipride	4.05	2.55	1.90
Albolum	2.33	3.15	2.99
Super Misrona	2.86	2.84	3.55
Lambda	1.85	1.09	1.09

4. Discussion

The 2nd larval stage of *C. carnea* was treated by seven chemical insecticides at different concentrations and three interval times (24, 48 and 72 h). Data after 24 h of treatment showed that the toxicity of lambda was the highest while the acetamipride was the lowest effect, as follow: lambda > super misrona > albolum > abamectin > KZ oil > divor > acetamipride. The toxicity values after 48 h of treatment ranged from highest effect 0.03 mg/L of lambda to lowest effect 550 mg/L of acetamipride. While the mortality data after 72 h of exposure time showed nearly the same toxicity values of those of 48 h treatments. The present findings are nearly the same with those of Maroufpoor *et al.* (2010). According to Singh *et al.* (2009), the spinosad toxicity values showed 100% mortality within 24 hours. Other scientists treated *C. carnea* with ten insecticides include four newer insecticides with novel modes of action, using a spray chamber bioassay, they found the spinosad was the lowest toxic from other insecticides tested Elzen *et al.* (1998). Chlorpyrifos was poisonous effects to all instars of *C. carnea* and caused a highest mortality.

The treatment of flubendiamide was comparatively safer and caused less mortality to 1st instar larvae of *C. carnea* at all-time intervals except last 48 hours. The spinosad and chlorantraniliprole were moderately poisonous effects. These were safer for the 2nd and 3rd larval instars of *C. carnea* at all intervals **Hussain *et al.* (2012).** Furthermore, imidachloprid showed lower toxicity of larvae than occurred with adults of C. carnea. Preetha ***et al.* (2009)**. The difference between the present study and others may be attributed to exposure time, concentrations, type of insecticides, application method, geographical strain of *C. carnea* and/or the age of larvae.

According to Afify *et al*. (2018), KZ oil was the most effective treatment in controlling the citrus leafminer, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) infesting navel orange trees under field conditions; while, lambda, super misrona, diver, albolium and abamectin exhibited moderate ranks in controlling this pest. Also the same authors reported that acetamipride was the lowest effective treatment against *P. citrella* in comparison with the previously mentioned tested treatments. It can be noticed that there were some variations in the toxicity of the tested insecticides against *C. carnea* (in the present results) and *P. citrella* (Afify *et al*., 2018). These variations may be attributed to the variations between the enzymatic systems in *C. carnea* and *P. citrella*; where, the effects of the tested pesticides on *P. citrella* (phytophagous insect) is directly in comparison with *C. carnea* (carnivorous insect). So, mode of action of the tested insecticides [*i.e.* lambda (contact and stomach action and has limited plant systemic activity, but exhibits translaminar movement), abamectin (contact and stomach action and has limited plant systemic activity, but exhibits translaminar movement) and KZ oil (ovicidal activity, contact insecticide)] may be differ toxicity from *C. carnea* to *P. citrella*.

Conclusion

To conclude, not all used pesticides to control citrus leafminer *Phyllocnistis citrella*, had certain toxic effects against C. carnea. Mainly, pesticides with translaminar effects could be dependable in IPM to secure predators more than others. They were such as, abamectin and acetamiprid. Besides, mineral oils as KZ oil that would be considered harmless to natural enemies.

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