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Impact of the pesticides spinosad, azadirachtin and abamactin on *Chrysoperla carnea* (Neuropetra: Chrysopidae)

El-Ashram, D. [1] **and Salma, K.H.R.** [2]
[1]*Organic Agriculture Central Laboratory, Agricultural Research Center, Giza, Egypt.*
[2]*Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.*

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Abstract:

The use of pesticides of natural origin help preserving the predators population in environment. This study using the International Organization of biological control (IOBC) -system and the life table response experiment for spinosad, *Azadirachtin indica* and abamectin on the common green lacewing *Chrysoperla carnea* (Stephens) (Neuropetra: Chrysopidae) under laboratory condition. The results indicated that the height mortality was observed to tearted *C.carnea* larvrae by spinosad at 38.07% and low mortality with abamectin at 13.85%,while total eggs were lower with spinosad than azadirachtin indica and abamectin, no significant different from treated with *A.indica* and abamactin. Abamectin was classified as a harmless but spinosad and *A. indica* were slightly harmful. The result showed significant different among percent of larval survival % between the pesticides and control which was 80.6% , also adult survival% of the control was 86.7%. Life table assays reveled that no significant different among the mean generation time (T) between the treatments and not significant among doubling time (DT), intrinsic rate of increase (rm) and finite rate of increase(λ). The lowest value for net reproductive rate(R0) occurred during spinosad treatment. Abamectin and azidirachtin were non-toxic to *C.carnea* under the tested conditions. Using life table assay was more accurate to find out effects of Spinosad than IOBC method.

Introduction

Chrysoperla carnea (Stephens) (Neuropetra: Chrysopidae) is one of the important natural enemies that has been effectively used to control different pests in the field (Athan *et al*.,2004) and has been fascinating subject for side effects investigation (Vogt *et al*.,1992; Badawy and EL Arnaouty, 1999; Dutton *et al*., 2003 and Medina *et al*.,2003). *C. carnea* has a large number from preys such as eggs , nymphs and adult of insects and spiders which are harm on the plants in open field and green houses, so C.*carnea* considered very important predators. The pesticides harmony with biological control agent is a great go into Integrated pests management (IPM) and understanding about the activity of pesticides toward the pests the non-target insects and the environment in a needful (Stark *et al*., 2004).

The impact of synthetic pesticides on non-target organizes in the natural and the human health risks posed by exposure to these chemicals are issues of growing concern (National

Research Council, 1996 and Cisneros *et al*., 2002). The method used in experiments the side effect of pesticides on natural enemies, suggest by the International Organization of biological control (IOBC) is a classification approach where by initial pesticides hide is done in the laboratory, hemifield and field experiments (Hassan,1998).

This method has designed to evaluate the acute residual toxicity as well as sublethal effect of the pesticides on the reproductive performance (Vogt *et al*.,2000). The death and reduced fecundity, exposure to a toxicant may result in simultaneous manifestation of multiple sublethal effects such as shortened life span, mutation in offspring, changes in fertility rates, developmental rates and sex ratio (Stark *et al*.,2004).

Spinosad is a stomach toxic with contact activity against lepidoptera and Diptera (Xian- Hui *et al*,.2008), it is also a neurotoxin but some field studies show that spinosad is moderately harmful on some parasitoid. Neem oil is a natural pesticide against some insects, but it is deleterious effect on *c. carnea* (Sana *et al*., 2015) compare to abamectin which is safe on some predators.

The objective of this study was to obtain information on the susceptibility *C.carnea* to the pesticides spinosad, azadirachtin and abamectin. Using the International Organization of biological control (IOBC) and life table response experiments (ITREs). Besides giving a report about degree of damage of the pesticides on the fertility, life table parameters, including R0, RM, T, DT and lambda (λ).

Materials and methods

1.*Chrysoperla carnea* rearing:

Adults of *C. carnea* were collected from fields, in Giza, Egypt in Oct. 2020 and were kept in a plastic container 7 cm diameter and 15 cm height, covered with a piece of black gauze. They were fed on an artificial diet consisting of two parts brewer's yeast, one part of honey and a part of sugar mixed to a paste with water. Water was offered using a damp cotton plug put on the cage. Eggs laid by female green lacewing on the walls of chimney and muslin cloth were harvested with sharp razor and one egg per test tube was placed with the help of camel hair brush, after hatching the newly hatched larvea were fed on eggs of *Sitotroga cerellela* with under laboratory conditions (27± 5 C˚ and 70 ± 5% RH.).

2. Pesticides using in this study:

The tested pesticides were used at the recommended field rates (Table 1).

Table (1): Pesticides used in this study .

Active ingredient	Brand name	Recommended field rate
Spinosad	Tracer 24% Sc	0.2 ml/L.
Azadirachtin indica	Neemix 4.5% Ec	1 ml/L.
Abamectin	Vertemic 1.8% Ec	0.4 ml/L.

3. IOBC approach :

The larvae of *C .carnea* were placed on glass plats sprays with pesticides with water as control and left dry. Vogt *et al*. (1998). There were three replicates per treatment each treatment contains twenty larvae under laboratory conditions. During the experiments larvae were fed on *S. cerealella* eggs. Dead larvae were recorded daily, and the mortality was also calculated. The number of pupae that failed to adult was registered as dead larvae. The value of mortality (M) were estimated according to Abbott (1925).The average number of eggs (R)

was measured as fecundity affected by exposure to the pesticides. The total effects of the pesticides E were calculated by formula proposed by Overmeer and Van Zon (1982):
Er=Rt/Rc…………………(1).
Er=Effect on reproduction.
Rt=Reproduction in treatment.
Rc=reproduction in control.
E=100%-(100%-M) X Er…(2).
M=Mortality corrected according to Abbott (1925).
E= Total effect.
Based on total effect was evaluated through the Working Groups Joint pesticides testing programmed in guideline IOBC (Bakker *et al*.,1992):
Class 1 : E < 30% (harmless).
Class 2 : 30 < E < 80% (Slightly harmful).
Class 3 : 80 < E < 99% (Moderately harmful).
Class 4 : E > 99% (Harmful).

4.Life table assay:

Age specific life table parameters were studied on Spinosad, Azadirachtin and Abamectin at 25±1 C, 65±5% RH. Fifty eggs freshly of *C. carnea* from female offspring kept in a plastic bottle and provide with *S. cerealella* after hatching. Life table parameters were determined by taking age class X and the number of individuals surviving to age NX following and calculation of fertility life table parameters by solving the Euler equation (Andrewartha and Birch,1954), the age specific survival rate LX and age specific MX were determined daily.

The net reproductive rate (R0 = $\sum Lxmx$), intrinsic rate of natural increase [rm = InR0(T)-1], finite rate of increase ($\lambda = erm$) ,mean generation time [T = ($\sum xlxmx)/RO$: the sum of development time from the egg stage to half of the life expectation of females after sexual maturation], doubling time (DT = Ln2/rm) and gross reproduction rate (GRR = $\sum mx$) (Sultan *et al*.,2017).

5.Statistical analysis:

Statistical analyses were used Bartlett s test the homogeneity of variances, an assumption of ANOVA.

Results and discussion:

1. Mortality and fecundity:

Results in Table (2) indicated that high mortality were observed when tearted *C.carnea* larvae by Spinosad at 38.07% and low mortality with abamectin at 13.85%,while total eggs were lower with spinosad than *A. indica* and abamectin, while no significant was observed form treated with *A.indica* and abamectin. This results similarly with (Elzen *et al*., 2000) who stated that spinosad at the recommended field rate caused 19-65% mortality in the parasitoid *Catolaccus grandis* (Burks) (Hymenoptera: Pteromalidea). Spinosad also showed high toxicity to some predators such as lady beetle *Stethorus japonicus* Kamiya (Mori and Gotoh ,2001). Our results with neem oil agree with (El-Wakeil *et al*., 2006) whose reported that neem was harmful to adults of *C. carnea.* Our results with those of (Medina *et al*., 2001) whose indicated that neem oil toxic to *C. carnea*.

Table (2): Effect of pesticides on mortality and fecundity of *Chrysoperla carnea*.

Treatments	Con.	Mortality %	Total eggs/Female
Spinosad	0.2ml/l.	38.07a	318c
Azadirachtin indica	1ml/l.	24.30 b	433b
Abamactin	0.4ml/l.	13.85 c	395b
Control	-	10.10 d	613a
LSD 0.05	-	3.10	45.3

2.Classification of the pesticides according to IOBC :

Data in Table (3) showed that Abamectin was total effect less than Spinosad and *A. indica* , so abamectin was classified as a harmless ,but spinosad and *A. indica* were slightly harmful on *C. carnea*. (Sana *et al*.,2015) reported that abamectin benzoate was low residual effect on larvae *C.carnea*. Our results of abamectin are harmony with those (Bueno and Freitas, 2004) who found that *Chrysoperla externa* (Hagen) (Neuroptera: Chrysopidae) egg viability was not affected by abamectin. Our results also agree with (Sana *et al*., 2015) who indicated that Spinosad and neem oil slight residual effect, while indicated (Mostafa *et al.*, 2010) who indicated that spinosad was moderately toxic to *C.carnea* compared with chemical insecticides.

Table (3):Total effect and classification of pesticides for *Chrysoperla carnea* according the IOBC evaluation categories.

Treatments	Con.	Total effect	Classification
Spinosad	0.2 ml/l.	70.66	2
Azadirachtin indica	1 ml/l.	62.08	2
Abamectin	0.4 ml/l.	28.88	1

1= Harmless, 2= Slightly harmful.

3. Life table parameters:

Results in Table (4) revealed that no significant different through the incubation days , but larval durations increased with spinosad treated to 9.6 days, while it for control was 8.0 days while abamactin treated 8.6 days. Amany (2017) reported that larval duration increased from 7.67 days in control to 9.33 days for abamactin compound. Also, significant different in the pupal days of spinosad treated compared all the treatments. Significant different OF 80.6% larval survival on control compared with pesticides. Rezael *et al.* (2007) said that the survival curve of control was significantly different imidacloprid, propargite and pymetrozine pesticides on *C.carnea* . Table (5) indicated that the lowest and highest pre-oviposition period (Days) occurred during treatment with *A. indica* (3.66) and control (7.26), while were lowest oviposition period (Days) was found with spinosad compound. Observed that no significant different during post oviposition period (Days) of all treatments but no. of eggs/female with spinosad treated was significant different compared with the of treatments. Our results are harmony with (Sana *et al.* , 2015) who reported that Abamectin can be included in (IPM) program without any adverse residual effect on bio-control agents used in IPM. This results compatible with (Muhammad *et al.*,2013) who stated that neem oil concentration relatively safe to beneficial insects and suitable for use in integrated pest management of aphids in canola, but our results disagree with Medina *et al*. (2001 and 2003) who found that the residual toxicity of neem oil against adults of *C.carnea*.

Data in the Table (6) showed that no significant different among the mean generation time (T) between the treatments and no significant among doubling time (DT), intrinsic rate of increase (rm) and finite rate of increase (λ). The lowest value for net reproductive rate (R0) occurred during Spinosad treatment . Amany (2017) who that abamectin is used with C. *carnea* in integrated pest management (IPM). The highest value of (Lx)=0.8 was reported with control, while lowest value of (Lx)=0.6 was reported with Spinosad compound. The results are harmony with (Rezaei *et al*., 2006) who reported that the life table assay showed more adverse effects of pymetrozine than the IOBC method.

These results indicated that abamectin and *A.indica* can be used safety on C.*carnea* in integrated pest management (IPM),while spinosad compound need field studies.

Table (4): Effect of the pesticides on developmental parameters to *Chrysoperla carnea* offspring produced by treated larvae of *Chrysoperla carnea* under laboratory condition.

Treatments	Con.	Incubation days	Larval Days	Pupal Days	Larval Survival%	Adult survaival%
Spinosad	0.2ml/l	2.66ab	9.6a	9.3a	60.8%b	61.4%a
Azadirachtin indica	1ml/l	2b	8.6ab	7.6ab	69%b	70.1%a
Abamectin	0.4ml/l	2.66ab	8.6ab	7b	67.6%b	74.1%a
Control	-	2.33ab	8b	8ab	80.6%a	86.7%a
L.S.D 0.05		1.33	1.33	2.24	11.26	42.6

Table (5): Effect of pesticides on reproductive offspring female to *Chrysoperla carnea*

Treatments	Con.	Pre-oviposition period(days)	Oviposition Period(days)	Post-oviposition Period(days)	No. of eggs/female
Spinosad	0.2ml/l	4.66b	10b	7.33a	5.4b
Azadirachtin indica	1ml/l	3.66b	13.66a	5b	6.36a
Abamectin	0.4ml/l	4.0b	14a	5.3b	6.5a
Control	-	7.26a	16.66a	5.3b	7.2a
L.S.D 0.05	-	1.29	4.10	0.76	0.90

Table (6): Life table parameters of *Chrysoperla carnea* treated with pesticides

Treatments	Mean generation time(T)in days	Doubling time(DT) in days	Net reproductive rate(R0)	Intrinsic rate of increase(rm)	Finite rate of increase(λ)	Survivor-Ship(Lx)
Spinosad	39	7.7	45.1	0.09	1.09	0.6
Azadirachtin indica	42	6.93	78.7	0.10	1.10	0.7
Abamectin	41	6.93	77.8	0.10	1.10	0.7
Control	44	6.93	101	0.10	1.10	0.8

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