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Effect of Different Materials on some Biological Characteristics of Green Lacewing, *Chrysoperla carnea* (Stephens) under Laboratory Conditions

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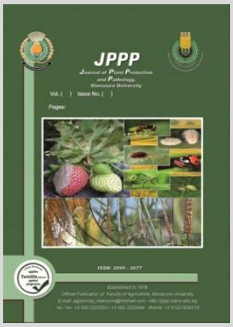

ABSTRACT

Effects of three different materials [mint oil, *Beauvaria bassiana* (Balsam) and lambda cyhalothrin 5 % EC] on the biological aspects of the 2nd larval instar of *Chrysoperla carnea* (Stephens) were evaluated. Experiments were carried out using three concentrations; 0.5, 1 and 2 of field recommended concentration (FRC) under laboratory conditions of 25 ± 2 ºC and 65 ± 5 R.H. The obtained results showed that lambda cyhalothrin was the most effective material against the 2nd larval instar of *C. carnea*, recording the highest percentage of mortality (60, 70 and 70 % at 0.5, 1 and 2 FRC, successively), whereas, mint oil was the lowest effective material recording (30, 50 and 60 %) at 0.5, 1 and 2 FRC, respectively). The means of larval duration detected 8.86, 9.50, 7.00 and 5.55 days, when the larvae of the predator were fed on treated aphid at 0.5 FRC with mint oil, *B. bassiana*, lambda cyhalothrin and control, respectively. The maximum values of fecundity, fertility and hatchability percentages (407 eggs, 89.53 % and 93.85 %, consecutively) were detected with control treatment. On the other hand, lambda cyhalothrin at 2.0 FRC recorded the minimum values of the biological aspects mentioned before showing 6.00 eggs, 33.00 % and 0.00 %, respectively. Finally, all tested materials should be used safely at relatively low rates of application with release of the predator, *C. carnea* for efficient control.

Keywords: *Chrysoperla carnea* , different materials , *Beauvaria bassiana* , mint oil , lambda cyhalothrin , Biological aspects.

INTRODUCTION

Nowadays , there has been considerable interest in development of plant protection programs that depend on using chemical and biological methods of pest control because , the complex of the pest attacking a crop can't be controlled only with biological control. In these so called " Integrated Pest Management" (IPM). Biological control agents such as predators and parasitoids are a key component of IPM and they are often recommended as the first line of defense in an IPM program (Lugoia *et al.* , 2001). These biological agents are often more sensitive to insecticides than the target pests. Therefore , use of selective insecticides is an important strategy for pest control and they should have no adverse effects on these beneficial organismis (Hassan, 1989 and Nasreen *et al.* , 2007).

The green lacewing , *Chrysoperla carnea* (Stephens) (Neuroptera : Chrysopidae) is one of most common and efficient predator of economically important agricultural insect pest worldwide. This predator has a great role in reducing pest populations in field crops and vegetables (Dean and Sterling, 1992). The perfect insecticide must be toxic to target pests , but not to predators and parasitoids (Ishaaya and Cassida , 1981). Nasreen *et al.* (2005) found that chlophyrifos recorded the lowest LC_{50} values when 2nd instar of *C. carnea* was treated with it.

The international Organization of Biological and Integrated Control working group " pesticides and beneficial arthropods" has examined the susceptibility of many predators and parasitoids to high number of pesticides at maximum field rate (Medina *et al.* ,2003b).

Plant essential oils exhibit biological activity against a wide spectrum of different plant pests and may act as fumigants , contact insecticides , repellents and antifeedants , or these oils can affect the growth rate , reproduction and behavior of insect pests (Harwood *et al.* , 1990 ; Isman , 2000 ; Papachristos and Stamopoulous, 2002a , 2004 ; Petrakis *et al.* , 2005 ; Isman *et al.* , 2008 and Kimbaris *et al.* , 2010).

The aromatic plants of mint species (*Mentha viridis*) have adulticidal , larvicidal , growth and reproduction inhibitory effects , Also their repellent activity against many stored product pests and vectors (Rajendran and Sriranjini , 2008 ; Kumar *et al.* , 2010 , 2011 and Michaelakis *et al.* , 2012).

Lambda cyhalothrin is a non – systemic insecticide with contact and stomach action. It gives rapid knockdown and long residual activity. This insecticide used for controlling of a wide spectrum of various insect pests such as aphids, thrips, Lepidopterous larvae, Coleopterous larvae and adults in cereals ornamentals, potatoes, vegetables, cotton as well as other crops. It provides good control of insect borne plant viruses at 2 – 5 g / ha. Also this insecticide used for control of insect pests in public health.

The entomopathogenic fungus, *Beauvaria bassiana* (Balsam) used as a biological agent against various insect pests of agricultural importance especially those with piercing – sucking mouth parts that do not consume biological control agents applied to the surface of host plants

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(Thungrabeab and Togma 2007). This fungus cause an insect disease known as white muscardine in a wide range of insects. It is being used as a biological insecticide to control a number of pests such as termites , thrips , whiteflies , aphid and different beetles. The lethal and sub – lethal effects at the pathogen on predators and parasitoids with regard to fecundity , longevity and survivorship among others were evaluated (Fazal , 2004) and Youssif and Ramadan (2020). So , the successful use of this entomopathogenic fungus for target pest control depends not only on high efficacy against harmful pests , but also potential selectivity and low virulence against non – targeted or beneficial insects (Thungrabeab and Tangma, 2007).

The current study aimed to investigate the impact of different materials (mint oil , *Beauvaria bassiana* and lambda cyhalothrin) on some biological aspects of *C. carnea*.

MATERIALS AND METHODS

The present study was carried out in Plant Protection Department ,Faulty of Agriculture, Zagazig University , Egypt under the laboratory conditions of 25 ± 2º C. and 65 ± 5 % R.H.

Tested Materials

The selected pest control agents and their rates of application were :

1- Mint oil (*Mentha virids* [Linnaeus]) which obtained from Chema Trade Company , Nasr City , Cairo , Egypt.
2- Biover 10 % wp (32 x 10^6 viable spore / mg) [*Beauvaria bassiana* (Balsam)] with a rate of application of 2 gm / L. which obtained from Bioinsecticides Production unit , Plant Protection Institute , ARC , Giza , Egypt.
3- Lambda cyhalothrin (Lambda 5 % EC) which obtained from Kafr El- Zayat Company for Pesticides and Chemicals 61 Al- Hussein Street, Mohandessin – Giza – Egypt.

Three concentrations (0.5 , 1 and 2 field recommended concentration (FRC) for each treatment were used to evaluate the impact of treated aphid with previous materials on some biological aspects of the larval instar of *Chrysoperla carnea* (Stephens).

Stock cultures

Prey culture

Green pepper , *Capsicum annuum* (Linnaeus) , seedlings were sown in plastic pots number 10 , 20 cm diameter and 17 cm height. The pots were kept under standard laboratory conditions at means of 25 ± 2º C. and 65 ± 5% R.H. . Then , the pots were caged and the growing seedlings were artificially infested with the cotton aphid , *Aphis gossypii* Glover nymphs.

Predator culture

Adults of *C. carnea* were collected from green bell pepper fields infested with *A. gossypii*. They were placed in glass chimney cage measured 17 cm height , 7 cm top diameter and 8.5 cm bottom diameter. Each chimney cage was placed on a 9 cm diameter petri dish. Filter paper was placed on the bottom of these petri dishes , and the upper open end of the glass chimney was covered with black muslin cloth tightened with rubber band. The adults were provided with food which consisted of 1 g honey + yeast extracts which was introduced on food card. The laid eggs were collected every day and the newly hatched larvae were reared on *A. gossypii* and individuals until they reached the beginning of the 2nd larval instar to use in the present study.

Experimental Design

Effect of different materials on the 2nd instar larvae of *C. carnea* when fed on sprayed aphid *A. gossypii*.

The experiments were carried out to evaluate the effects of treated aphid with three different pest control agents on some biological aspects of *C. carnea*. Newly molted 2 nd instar larvae of *C. carnea* were used. Three dilutions of each tested agent (0.5 , 1 and 2 FRC) were prepared in distilled water in case of *B. bassiana* and lambda cyhalothrin , but in case of mint oil , the concentrations prepared in aceton. Each larva was confined in petri dish (10 cm diameter and 2 cm height) containing leaflets harbored 40 *A. gossypii* sprayed with the tested concentrations for 24 hours. Afterwards , the larvae transferred to new petri dishes and were provided everyday by fresh leaflets harbored untreated nymphs of the aphid to complete their development. Ten newly molted second larval instar of *C. carnea* were used for each concentration and the control as well. The different biological aspects such as mortality percentage , larval duration , pupal duration , percentage of pupation , pupal weight , adult emergence , longevity of both male and female , fertility, hatchability and incubation period were recorded. Also, the percentage of mortality as a result of fungi infection was calculated. The cadavers were removed from petri dishes then the surface sterilized in 5 % sodium hydrochloride and 75% ethanol solution and rinsed in plenty of sterile water , then left to dry for 48 hr (Dourou – Kpindou *et al.* , 1995). Then , they were kept in humid conditions in desiccators under room condition to clear wether they died with reason of infection by fungus or not as descriebed by Luz and Fargnes (1998).

Statistical Analysis :

The differences among treatment means and their variance were appraised through F test (ANOVA) , calculated according to COSTAT Computer Program (2005).

RESULTS AND DISCUSSION

1- Effect of three different materials on the larvae of *C. carnea* when fed on sprayed aphid , *Aphis gossypii* (Glover)

a- Percentage of mortality

In respect to the impact of different concentrations of three materials (mint oil , *Beauvaria bassiana* and lambda cyhalothrin) on the percentage of mortality for the second larval instar of *C. carnea* , the data obtained in Table (1) and plates (1 and 2) clearly showed that the lowest percentages of mortality were 10.00, 30.00, 40.00 and 60.00 % which recorded with 0 concentration (control), mint oil , *B. bassiana* and lambda cyhalothrin at 0.5 FRC , respectively and increased gradually by increasing concentration being the highest values of 60.00 , 70.00 and 70.00 % at 2.0 FRC for the abovementioned tested materials. Generally, treating with lambda cyhalothrin 5% EC at all tested concentrations of 0.5 , 1 and 2 FRC resulted in the highest percentage mortality. By

comparing the tested materials, it is worthy to mention generally that mint oil was more safe towards the predator's larvae than the other materials. In general , statistical analysis of variance using F. test clearly revealed that these differences reach significancy at 0.01 level of probability.

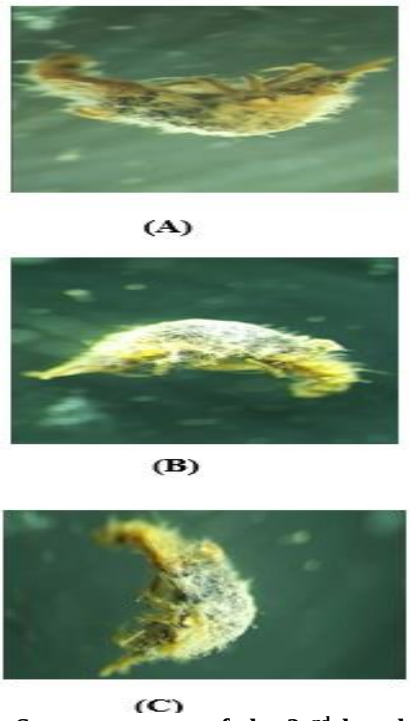

Plate 1. Some symptoms of the 2 nd larval instar of *Chrysoperla carnea* (Stephens) fed on treated aphid with *B. bassiana* under laboratory conditions.

Plate 2. Some symptoms of the 2 nd larval instar of *Chrysoperla carnea* (Stephens) fed on treated aphid with different tested materials except of *B. bassiana* (Biovar) under laboratory conditions.

Many authors such as Amarasekare and Shearer (2013) confirmed the present results and stated that lambda cyhalothrin caused significant larval mortality to both green lacewing species , *C. carnea* and *Chrysoperla johnsoni* (Henry). On the other hand , Maia *et al.*(2016) who found that lambda cyhalothrin was slightly harmful against *C. carnea* larvae. The present results are in accordance with the findings of Youssif and Ramadan (2020) showed that the second larval instar of *C. carnea* was recorded moderate mortality when feeding on aphids sprayed with Biovar (*B. bssiana*) whereas , the total mortality was 36.67 %.

Table 1. Effect of different materials on the biological characteristics of *Chrysoperla carnea* (Stephens) fed on treated aphid under laboratory conditions.

Biological Characteristics / Treatments		Mortality Percentage	Larval duration	Pupal duration (day)	Cocooning (%)	Cocoon weight (mg)
Mint oil	0.5 FRC	30.00	8.86 ± 0.46 bc	8.43 ± 0.48 bc	100.00	6.56±0.45 a
	1 FRC	50.00	9.00 ± 0.71 abc	7.40 ± 0.51 c	100.00	6.48±0.34 ab
	2 FRC	60.00	8.50 ± 0.65 bcd	8.00 ± 0.92 bc	100.00	5.53±0.51 bc
B.bassiana	0.5 FRC	40.00	9.50 ± 0.43 ab	7.50 ± 0.65 c	100.00	6.55±0.34 ab
	1 FRC	50.00	7.40 ± 0.51 cd	8.00 ± 0.58 c	100.00	6.46±0.36 ab
	2 FRC	70.00	8.67 ± 0.33 bcd	8.50 ± 0.50 bc	100.00	5.16±0.17 c
Lambda cyhalothrin	0.5 FRC	60.00	7.00 ± 0.71 d	8.67 ± 0.33 bc	100.00	3.10±0.25 d
	1 FRC	70.00	7.33 ± 0.88 cd	10.00 ± 1.16 ab	100.00	2.70±0.32 d
	2 FRC	70.00	10.67 ± 0.67 a	12.00 ± 1.00 a	66.67	2.25±0.25 d
Control		10.00	5.55 ± 0.29 e	7.13 ± 0.44 c	100.00	7.10±0.28
F. value			8.56 **	4.67**		

Data are expressed as means ± SE. Within the same column, data followed by the same letter are not significantly different (P ≥ 0.05)
FRC: field recommended concentration.

b- Larval duration: Data presented in Table (1) revealed that the highest mean larval duration of *C. carnea* (10.67 ± 0.67 days) was recorded for larvae fed on treated aphid with 2FRC lambda cyhalothrin where as, the lowest one (5.55 ± 0.29 days) was recorded in case of control. In general , statistical analysis of variance using F. test clearly revealed that these differences reach significany at 0.01 level of probability. Similar results were obtained by Morsy (2017) who cleared that the lowest larval duration (7.67 ± 0.56 days) was recorded in the control treatment compared with the other tested materials (*B. bassiana* , Abamectin and Pyriproxyfen). On the other hand , the results found by Youssif and Ramadan (2020) disagree with the present ones and reported that the highest mean larval duration of *C. carnea* (7.00 ± 0.73 days) was detected when larval fed on treated aphid with 1 FRC *B. bassiana*.

c- Pupal duration

The results in Table (1) assured that lambda cyhalothrin caused a significant elongation in the pupal duration over other treatments, showing 12.00 ± 1.00 days at the highest concentration (2FRC) , whereas the shortest mean (7.13 ± 0.44 days) was recorded in the control treatment. Statistical analysis revealed that the differences

between pupal duration means as affected by tested materials were highly significant.

Dissimilar results were obtained by Maia *et al.*(2016) in New York who reported that the length of the pupal period of *C. carnea* was significantly decreased by lambda cyhalothrin treatment. Contrarily , the results found by Youssif and Ramadan (2020) agree with the present ones who found that *B. bassiana* at 1 FRC caused a moderate elongation in the pupal period recrded 7.00 ± 0.73 days. Also , Morsy (2017) reported that the pupal period of *C. carnea* was 7.00 ± 1.00 days when the 2 nd larval instar of the predator fed on treated eggs of *Sitotroga cerealella* with *B. bassiana* at the recommended rate.

d- Percentage of cocooning

According to the results complied in Table (1) and plate (3), it is worthy to mention that the maximum cocooning (100%) was recorded when the larvae of *C. carnea* was fed on treated aphid with each of mint oil and *B. bassiana* at all tested concentrations, lambda cyhalothrin at 0.5 and 1 FRC, as well as control treatment. Meanwhile, the minimum percent of 66.67 % was detected with the highest concentration of lambda cylaothrin (2FRC).

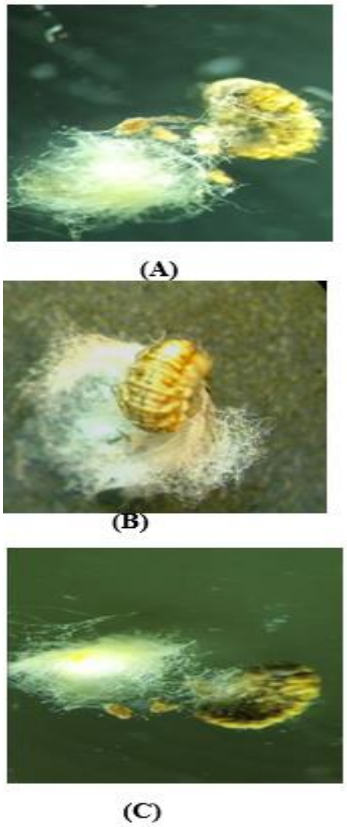

Plate 3. cocooning fialure from the 2 nd larval instar *Chrysoperla carnea* (Stephens) fed on treated aphid with different tested materials under laboratory conditions.

The present results are in close agreement with those obtained by Youssif and Ramadan (2020) who stated that the highest percentage of cocooning (100.00 %) was recorded with *B. bassiana* treatment at all tested concentrations (0.5 , 1 and 2 FRC).

e- Coccon weight

As evidently shown in Table (1) , it is worthy to mention that weight of cocoon differed in the tested materials and recroded the highest mean showing 6.56 ± 0.45 mg , 6.55 ± 0.34 mg , 6.48 ± 0.34 mg and 6.46 ± 0.36 mg in case of mint oil 0.5 FRC , *B. bassiana* .05 FRC and mint oil 1 FRC , respectively . Generally, treating with lambda cyhalothrin at all tested concentrations of 0.5 , 1 and 2 FRC affected negatively the weight of cocoon over the control. Analysis of variance revealed that there were highly significant differences among the means seemed to be highly significant.

f- Adult emergence

Data arranged in Table (2) revealed that the highest mean percentages of adult emergence of *C. carnea* (85.71 and 80.00 %) was detected with mint oil 0.5 and 1 FRC, whereas the lowest percentage (50.00%) was observed when larvae of the predator were fed on treated aphid with lambda cyhalothrin 2.0 FRC. Emergence from normally developed pupae (control) overtaked the other tested materials recording 88.89 %.

These results are in conformity with those obtained by Youssif and Ramadan (2020) who cleared that the lowest percentages of adult emergence (28.57 and 20.00 %) were noticed in case of pyriproxyfen at 1 and 2 FRC , respectively.

Also , they mentioned that control larvae of the predator exceeded other tested pest control agents (*B. bassiana* , neem oil , pyriproxyfen and orange oil) in adult emergence , showing 70.00 %.

g- Male longevity

According to the results complied in Table (2) , it is worthy to mention that the mean of male longevity of *C. carnea* was varied according to different tested materials. The maximum mean of male longevities 15.00, 13.00, 11.50 and 11.00 days were recorded when larvae of *C. carnea* were fed on treated aphid with control, mint oil 2.0 , 0.5 and 1.0 FRC , respectively. The minimum ones 5.00, 5.00, 6.00, 7.00 and 8.00 days were recorded with *B. bassiana* 2.0 FRC , lambda cyhalothrin 1.0 FRC , *B. bassiana* 1.0 FRC , lambda cyhalothrin 1.0 FRC and *B. bassiana* 0.5 FRC. In another words, feeding on treated aphid with lambda cyhalothrin 5% EC resulted in the shortest mean of male adult longevity. The variance between different means of male longevity showed that the differences demonstrated to be highly significant with the three tested materials.The present results are in agreement with the findings obtained by Amarasekare and Shearer (2013) who mentioned that adults treated with lambda cyhalothrin had shorter longevity compared with the adults in the control (43.0 ± 10.1 days). Youssif and Ramadan (2020) cleared that the minimum means of male longevities were 5.00 ± 0.00 and 7.00 ± 0.00 days after feeding on treated aphid with *B. bassiana.*

h- Female longevity

In respect to the the impact of different concentrations of three materials (mint oil , *B. bassiana* and lambda cyhalothrin) on the pre – oviposition period , the data in Table (2) clearly indicated that the abovementioned materials prolonged pre – oviposition period with means ranging between 3.33 ± 0.33 to 13.00 ± 0.00 days over the control (3.00 ± 0.32 days).

Concerning the means of oviposition period as influenced by the tested materials, data in Table (2) clearly indicate that control larvae exceeded the experimented

tested materials, recording 32.60 ± 1.63 days. The highest mean of post – oviposition period (9.00 ± 0.00 and 9.00 ± 0.00 days) were detected with *B. bassiana* and lambda cyhalothrin at 2 FRC, whereas the lowest one (4.50 ± 1.50 days) was recorded with *B. bassiana* 1FRC.

As obviously shown in Table (2), control larvae recorded the highest mean adult female longevity (41.20 ±1.74 days), followed by mint oil at 0.5 FRC recording(31.00 ± 1.58 days). The lowest ones (21.33 ± 1.20 and 21.50 ± 0.50 days) was detected when the larvae of the predator were fed on treated aphid nymphs with *B. bassiana* at 0.5 and 1 FRC , successively.

The present results are in agreement with those obtained by Youssif and Ramadan (2020) who reported that control larvae attained the highest mean of adult female longevity (35.33 ± 0.88 days). On the other hand , these results are not in harmony with the findings of Amarasekare and Shearer (2013) who found that female adults treated with lambda cyhalothrin had shorter longevity (1.0 ± 0.0 day and 1.0 ± 0.00 day) in two green lacewing species , *C. johnsoni* and *C. carnea* , respectively compared with the adults in the control. The differences between means proved to be highly significant.

Table 2. Effect of different materials on biological characteristics of *Chrysoperla carnea* (Stephens) fed on treated aphid under laboratory conditions.

Biological characteristics / Treatments		Adult emergence (%)	Longevity (in days)				
			Male	Female			
				Pre-oviposition	Oviposition	Post - oviposition	Total
Mint oil	0.5 FRC	85.71	11.50 ±0.50 bc	4.50±0.65 ef	20.50± 1.55 b	6.00±0.41cde	31.00±1.58 b
	1 FRC	80.00	11.00±0.00 c	6.00±0.58 d	14.67±2.60 c	7.33±0.33 abc	26.67±1.86 cd
	2 FRC	75.00	13.00±0.00 b	7.50± 0.50 c	11.50±1.50 c	7.00±1.00 bcd	26.00±0.00
B. bassiana	0.5 FRC	66.67	8.00±0.00 d	3.33±0.33 fg	12.67±1.45 c	5.33±0.88 de	21.33±1.20 e
	1 FRC	60.00	6.00±0.00ef	5.50±0.50 de	11.50±1.50 c	4.50±1.50 e	21.50±0.50 e
	2 FRC	66.67	5.00±0.00 f	9.00±0.00 b	7.00±0.00 d	9.00±0.00 a	8.33±0.00 f
Lambda cyhalothrin	0.5 FRC	75.00	7.00±0.00 de	7.50±0.50 c	13.50±1.50 c	8.00±1.00 ab	29.00±0.00 bc
	1 FRC	66.67	5.00±0.00 f	12.00±0.00 a	7.00±0.00 d	5.00±0.00 e	24.00±0.00 de
	2 FRC	50.00	-	13.00±0.00 a	5.00±0.00 d	9.00±0.00 a	27.00±0.00 cd
Control		88.89	15.00±0.58 a	3.00±0.32 g	32.60±1.63 a	5.60±0.51de	41.20±1.74 a
F. value			44.27**	52.15**	38.31**	7.06**	47.32**

Data are expressed as means ± SE. Within the same column, data followed by the same letter are not significantly different (P ≥ 0.05)
FRC: field recommended concentration

i- Fecundity , fertility and percentage of hatchability

According to the results complied in Table (3) , it is worth to mention that the three tested materials before affected negatively fecundity, recording means ranging between 6.00 ± 0.00 to 124.5 ± 8.72 eggs , compared to the control which recorded 407 ± 15.62 eggs. Analysis of data revealed that the differences between all means of fecundity proved to be highly significant at 0.01 level of probability.

Dissimilar results were obtained by Amarasekare and Shearer (2013) who showed that no adult females survived the lambda cyhalothrin treatment preventing the assessment of fecundity.

Table 3. Effect of different materials on the biological characteristics of *Chrysoperla carnea* (Stephens) fed on treated aphid under laboratory conditions.

Biological characteristics / Treatments		Fecundity	Fertility (%)	Hatchability (%)	Incubation period (in days)
Mint oil	0.5 FRC	124.5 ± 8.72 b	78.04 ± 1.02 b	82.67±4.13 b	5.40±0.34 bc
	1 FRC	102.67 ± 9.33 bc	79.06 ± 2.78 b	68.85±3.92 c	5.70±0.45 ab
	2 FRC	47.00 ± 4.00 d	53.58 ± 4.56 d	40.00±0.00 d	5.20±0.40 bc
B.bassiana	0.5 FRC	99.33 ± 10.35 bc	67.17 ± 0.50 bc	65.83±5.63 c	4.00±0.211d
	1 FRC	86.50 ± 3.50 c	57.90 ± 2.34 d	65.00±5.00 c	4.90±0.38 bcd
	2 FRC	8.00 ± 0.00 e	50.00 ± 0.00 c	25.00±0.00 e	7.00±0.00 a
Lambda cyhalothrin	0.5 FRC	55.50 ± 4.50 d	62.75 ± 3.93 ed	58.34±8.33 c	5.75±0.25 ab
	1 FRC	35.00 ± 0.00 de	57.14 ± 0.00 d	40.00±0.00 d	5.40±0.25 bc
	2 FRC	6.00 ± 0.00 e	33.33 ± 0.00 e	0.00±0.00	———
Control		407 ± 15.62 a	89.53 ± 0.95 a	93.85±1.19 a	4.50±0.37 cd
F. value		196.84**	19.33**	28.85**	3.87**

Data are expressed as means ± SE. Within the same column, data followed by the same letter are not significantly different (P ≥ 0.05)
FRC: field recommended concentration

Respecting both of fertility and hatchability percentages , the same trend was detected. The highest means of 89.53 ± 0.95 and 93.85 ± 1.19 % were obtained in case of control , respectively. While , the lowest mean of 33.33 ± 0.00 and 0.00 ± 0.0 % were recorded when larvae of the predator were fed on treated aphid with lambda cyhalothrin 2.0 FRC. Statistical analysis of the results obviously showed that the differences between means of fertility and hatchability were highly significant.

The present results are completely agreement with those obtained by Amarasekare and Shearer (2013) as well as Youssif and Ramadan (2020) who reported that the highest mean of both fertility and hatchability percentages was observed in the control treatment.

k- Incubation period

Data in Table (3) obviously cleared that the differences between incubation period of laid eggs by the adults of *C. carnea* according to the tested materials and

concentrations. The means of this parameter ranged between 4.00 ± 0.211 days for *B. bassiana* at 0.5 FRC and 7.00 ± 0.00 days for the same tested material at 2 FRC. The differences between incubation period means proved to be statistically highly significant.The present results are not in harmony with the findings of some investigators such as Youssif and Ramadan (2020) in Egypt who stated that the maximum mean of incubation period (7.40 ± 1.50 days) was attained by feeding 2 nd larval instars of *C. carnea* on neem oil at 0.5 FRC.

CONCLUSION

In this study, three tested materials (mint oil , *B. bassiana* and lambda cyhalothrin) were used for evaluate the effectiveness against *C. carnea* larvae under laboratory conditions at 25 ± 2 ºC and 65 ± 5 R.H. The obtained results cleared that lambda cyhalothrin 5%EC was the most toxic material comparing with the other materials. The highest percentage of adult emergence (88.89%) was detected with the control , while the lowest one (50.00%) was observed in lambda cyhalothrin at 2FRC. The highest means of fecundity (407 eggs) , fertility (89.53 %) and hatchability (93.85%) were noticed when the 2 nd larval instars of *C. carnea* fed on untreated aphids (control). Meanwhile, lambda cyhalothrin at 2.0 FRC resulted in the lowest means of abovementioned biological aspects showing 6.00 eggs , 33.33 % and 0.00 % , resoectively.

Finally ,the present study can conclude that the tested materials are harmless (relatively safe) to both larvae of *C. carnea* in the laboratory at low concentrations , on the contrary the highest concentrations were injurious , based on this these tested materials might be recommended for apply in IPM programs at low concentrations in addition to releasing the predator *C. carnea* for effective control against insects in green houses and open fields.

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تأثير مواد مختلفة على بعض الخصائص البيولوجية لأسد المن الأخضر *Chrysoperla carnea* (Stephens) تحت الظروف المعملية

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تم تقييم ثلاث مواد مختلفة وهى (زيت النعناع ، البوفاريا باسيانا *Beauvaria bassiana* ومبيد لمبادا سيهالوثرين lambda cyhalothrin ٥ ٪ مركز قابل للاستحلاب وذلك على بعض الصفات البيولوجية ليرقات العمر الثانى لأسد المن الأخضر. تم إجراء التجارب باستخدام ثلاث تركيزات وهى : التركيز الموصى به حقليا ، نصفه وضعفه وذلك تحت الظروف المعملية على درجة حرارة ٢٥ ± ٢ ° م ورطوبة نسبية ٦٥ ± ٥ ٪ . أظهرت النتائج المتحصل عليها أن مبيد لمبادا سيهالوثرين ٥ ٪ كان أكثر المواد المختبرة فاعلية ضد يرقات أسد المن الأخضر ، حيث سُجل هذا المبيد أعلى نسبة مئوية للموت (٦٠,٧٠ ، ٧٠ و ٧٠ ٪ وذلك عند نصف التركيز ، التركيز الموصى به وضعف التركيز، على التوالى) ، بينما زيت النعناع كان أقل المواد المختبرة فاعلية (أقل سمية)مسجلاً (٣٠ ، ٥٠ و ٦٠ ٪ عند نصف التركيز ، التركيز الموصى به وضعف التركيز ، على الترتيب). سُجلت متوسطات فترة الطور اليرقى لحشرة أسد المن الأخضر ٨,٨٦ ، ٩,٥٠ ، ٧,٠ و ٥,٥٥ يوماً وذلك عند تغذية اليرقات على المن المعامل بزيت النعناع ، البوفاريا باسيانا ، لمبادا سيهالوثرين والكنترول ، على التوالى. فيما يتعلق بمتوسطات فترة طور العذراء ، وجد أن هذه المتوسطات كانت ٨,٤٣ ، ٧,٥٠ ، ٨,٦٧ و ٧,١٣ يوم للمواد المختبرة سابقة الذكر والكنترول ، على الترتيب. سُجلت أقصى نسبة مئوية للتشرنق (١٠٠ ٪) مع جميع المواد المختبرة عند التركيزات المختلفة بالاضافة إلى الكنترول فيما عدا لمبادا سيهالوثرين عند ضعف التركيز والذى سُجل أقل نسبة مئوية للتشرنق (٦٦,٦٧ ٪). بخصوص نسبة خروج الحشرات الكاملة ، أوضحت النتائج المتحصل عليها أن أعلى متوسط لنسبة خروج الحشرات الكاملة (٨٥,٧١ ٪) قد سُجل مع زيت النعناع عند نصف التركيز الموصى به وأقل نسبة مئوية (٥٠,٠٠ ٪) لوحظ مع مبيد لمبادا سيهالوثرين عند ضعف التركيز الموصى به. بصفة عامة ، تفوقت يرقات الكنترول على جميع المواد المختبرة مُسجلة ٨٨,٨٩ ٪ نسبة خروج. سُجلت أعلى قيم لعدد البيض الموضوع ، نسبة الخصوبة ونسبة لبفقس (٤٠٧ بيضة ، ٨٩,٥٣ ٪ و ٩٣,٨٥ ٪ ، على التوالى) وذلك فى حالة معاملة الكنترول. على الجانب الأخر فقد أُعطى مبيد لمبادا سيهالوثرين عند ضعف التركيز الموصى به حقلياً أقل متوسطات للقيم البيولوجية سابقة الذكر مُسجلة (٦,٠٠ بيضة ، ٣٣,٣٣ ٪ و صفر ٪ ، على الترتيب). فى النهاية ، يمكن أن نستنتج أن جميع المواد المختبرة يجب أن تستخدم بتركيزات منخفضة بحيث تكون متوافقة مع إطلاق يرقات أسد المن الأخضر وذلك للحصول على مكافحة فعالة.