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BIOLOGICAL CHARACTERISTICS AND PREDATION EFFICACY OF THE GREEN LACEWING, *Chrysoperla carnea* (STEPHENS) (NEUROPTERA: CHRYSOPIDAE) UNDER LABORATORY CONDITIONS

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ABSTRACT

The biological characteristics and predation efficacy of *Chrysoperla carnea* (Stephens) fed on mealy plum aphid, *Hyalopterus pruni* (Geoffroy) colonized on leaves of apricot trees were studied under laboratory conditions of 26.8 – 31.8 °C and 54.5 - 61.1% RH. The obtained data are summarized as follows: The incubation period of the eggs ranged between three and four days, with a mean of 3.38 ± 0.06 days. The 1st, 2nd and 3rd larval instar durations averaged 3.24 ± 0.06, 3.75 ± 0.08 and 6.92 ± 0.14 days, respectively. The total larval duration ranged between 13 and 17 days, with a mean of 13.91 ± 0.17 days. The daily consumed aphids by the 1st, 2nd and 3rd larval instars varied from 6.67 to 11.50, 14.00 to 24.00 and 33.71 to 49.71 individuals, respectively. The total consumption during the larval stage ranged between 340 and 497 individuals per larva, with a mean of 387.91 ± 5.39. The 3rd larval instar is the most efficient as it consumed 70.93% of the total consumed preys during the whole larval stage. The pupal stage lasted a mean of 7.53 ± 0.16 days. The total developmental period of the predator ranged between 22-27 days, with a mean of 24.82 ± 0.21 days. The effect of four artificial diets on the essential biological parameters of adults of the predator were studied. The shortest pre-oviposition period, 4-6 days, with a mean of 5.0 ± 0.45 days was recorded when adults were fed on diet A (3 g sucrose : 2.5 g yeast extract : 2.5 ml honey : 10 ml distilled water : 2.0 g casein). The longest oviposition period, 21 – 29 days, with a mean of 25.40 ± 1.44 days was recorded when mated females were fed on diet C (5 ml hen's egg white : 10 ml milk : 5 ml honey). The highest number of deposited eggs, 237 – 390, with a mean of 303.60 ± 25.30 eggs per female was obtained when females were fed on diet B (5 ml hen's egg yolk : 10 ml milk : 5 ml honey). Data of the post - oviposition period showed that there were no significant differences between the tested diets. The female longevity ranged between 31 – 41 days. The females lived significantly longer when fed on diets containing egg yolk or egg white or mixed egg each with milk and honey. The male longevity ranged between 7 and 14 days. The longest mean longevity of males were recorded when males were fed on diet containing mixed egg, milk and honey.

Key words: *Chrysoperla carnea*, biological characteristics, predation efficacy, mealy plum aphid, artificial diets.

INTRODUCTION

Chrysopidae is one of the main groups used in biological control. Chrysopids are well known green lacewings, such as *Chrysopa* and *Chrysoperla* species. Green lacewings are commonly found in vegetation containing grasses and herbs, and are predacious on aphids, whiteflies, and eggs of various insects, including species of *Helicoverpa*. Several species of green lacewings are reared commercially. Release of lacewings as eggs or larvae can be an effective control strategy for aphids in greenhouses (Scopes, 1969; Hassan, 1975; Hassan and Hagen, 1978) and potentially, for some outdoor crop pests such as *Aphis pomi* De Geer (Hagley,

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1989), *Helicoverpa zea* (Boddie) and *Helicoverpa virescens* Fabricius (Ridgeway and Jones, 1969).

Chrysoperla carnea is a generalist predator of various sucking insect pests and eggs of lepidopteran pests. Several species of aphids, spider mites (especially red mite), thrips, whiteflies, eggs of leafhoppers, moths and leafminers, small caterpillars, beetle larvae and the tobacco budworm are reported as preys of *C. carnea*. Further it has been reported as an important predator of long tail mealybug in green houses (Geetha and Swamiappan, 1998). Larvae of *C. carnea* are voracious and efficient biological control agents for various phytophagous arthropods (McEwen *et al.*, 2001). One larva may devour as many as five hundreds aphids in its life and there is no doubt that they play an important part in the natural control of many small homopterous pests (Michaud, 2001). The efficacy of lacewings will depend not only on the particular predator – prey combination, but also on ecological factors such as the age, structure of the prey population, foliage density, height of the crop, incidence of parasitism and climate (Canard and Duelli, 1984).

So, the present work was conducted to study the biological aspects and predation efficacy of *C. carnea* on *Hyalopterus pruni* aphid and the effect of different artificial diets on the essential biological parameters of predator adults.

MATERIALS AND METHODS

The experiment was conducted under laboratory conditions of 26.8 – 31.8 °C and 54.5 - 61.1% RH at Plant Protection Department, Faculty of Agriculture, Zagazig University, Egypt. The daily maximum and minimum temperature and relative humidity during the experimental period were recoded.

Biological Aspects and Predation Efficacy of *Chrysoperla carnea* (Stephens) on *Hyalopterus pruni* (Geoffroy)

Rearing of *C. carnea*

Adults of *C. carnea* were collected from apricot and peach orchards infested with aphids in newly reclaimed sandy area at El-Khattara district, Sharkia Governorate, Egypt. Adults (females and males) 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 9 cm diameter Petri dish. A piece of filter paper was placed at the bottom of the Petri dishes, and the upper open end of glass chimney was covered with black muslin cloth and was tightened with rubber band. The adult diets were provided inside the glass chimney with the help of small paper strips. Each strip being drilled at three points from honey and maize pollen was offered as adults food to make pits for holding drops of diet. The diets were provided with the interval of 24 hr. Each chimney was provided with a piece of cotton soaked in distilled water placed at the top of glass chimney, over muslin cloth, to maintain moisture. Laid eggs on the walls of chimney and muslin cloth were harvested daily with sharp razor.

Predation efficacy of *C. carnea* and some biological aspects

Sixty newly deposited eggs, within 24 hours, were kept separately in plastic vial (7 x 2 cm) until hatching. After hatching the newly hatched larvae were fed on *H. pruni* (Homoptera: Aphididae) infested leaves of apricot as food. Sufficient number of aphid individuals were offered daily to each *C. carnea* larva. The number of offered preys was increased as the predator larva grew older. Number of consumed aphid individuals was recorded daily until each larva was pupated inside the spherical silky cocoon. Date of cocoons formation was recorded. The cocoons were left until adult emergence. The date of larvae molting, number of each developed larvae, pupae and emerged adults were recorded.

Effect of Different Artificial Diets on the Essential Biological Parameters of *C. carnea* Adults

Four different artificial diets as described by Ulhaq *et al.* (2006) in Table 1 were tested. The different ingredients used in all diets were mixed with a stirrer to make them homogeneous. Fourty newly emerged adults of *C. carnea* from the previous rearing were sexed. Each pair (female and male) was placed in a glass chimney as previously described. These adults were divided into four groups, five replicates each.

Table 1. Different diets used in the experiment

Diets	Ingredients	Weight or Volume
A	Sucrose: yeast extract : honey : distilled water : casein	3g : 2.5 g : 2.5 ml : 10 ml : 2.0 g
B	Hen's egg yolk : milk : honey	5 ml : 10 ml : 5 ml
C	Hen's egg white : milk : honey	5 ml : 10 ml : 5ml
D	Mixed hen's egg : milk : honey	5 ml : 10 ml : 5 ml

Each group was provided by one of the tested diets as food. Three drops of the diet were placed on the card, 2 cm width and 3 cm length. One card of the diet was introduced to a glass chimney containing a pair of adults. Fecundity (number of laid eggs/female), pre-oviposition, oviposition, post-oviposition periods and the adult longevity (males and females) were recorded. The differences among treatment means and their variances were appraised through F test (ANOVA), calculated according to COSTAT Computer Program (2005).

RESULTS AND DISCUSSION

Biological Aspects and Predation Efficacy of *C. carnea* on *Hyalopterus pruni*

Egg stage

Data presented in Table 2 show that the incubation period of the egg stage lasted 3 – 4 days, with a mean of 3.38 ± 0.06 days under laboratory conditions of 26.8 °C and 60.5% RH. The natural mortality during egg stage was 14.29%.

Similar observations were noticed by El-Maghraby *et al.* (2008) in Egypt, who revealed that the incubation period of the *C. carnea* egg stage lasted 3days, with an average of 2.76 ± 0.35 days at means of 26.8°C and 60.5% RH.

Larval stage

Larval durations

Data given in Table 2 show that the 1st, 2nd and 3rd larval instars lasted 3-4, 3-6 and 5-9 days, with means of 3.24 ± 0.06, 3.75 ± 0.08 and 6.92 ± 0.14 days, respectively. The prevailing means of temperature and relative humidity during the larval period were 28.6 °C and 56.3% RH, consecutively. The total larval stage ranged between 13 and 17 days, with a mean of 13.91 ± 0.17 days. The natural mortality in the 1st, 2nd and 3rd larval instars were 8.33, 5.46 and 13.46%, successively. The total mortality during the larval stage was 25.00%.

These results are dissimilar to those of Mannan *et al.* (1997) in India, who revealed that the durations of development of the first, second and third instar larvae of *C. carnea* were 2.60, 2.25, 2.38 and 3.75, 2.78 and 3.35 days when reared on *Aphis gossypii* Glover and *Myzus persicae* (Sűlzer), respectively. Also, El-Maghraby *et al.* (2008) indicated that the 1st, 2nd and 3rd larval instars of *C. carnea* reared on mealy plum aphid infesting leaves of peach trees under room temperature lasted 2 - 5, 3 - 4 and 3 - 4 days, successively.

Predation efficacy

Data obtained in Table 2 show that the daily feeding capacity of the 1st larval instar varied from 6.67 to 11.50 aphids, with a mean of 9.62 ± 0.39 preys. The total consumed aphids by this instar was 19 to 46, with a mean of 31.18 ± 0.96.

The second larval instar preyed on 14.00 to 24.00 aphids daily, with a mean of 19.11 ± 0.77 individuals. This instar consumed a total of 58 to 107preys, with a mean of 81.59 ± 1.99.

The daily consumed aphids by the third larval instar varied from 33.71 to 49.71 individuals, with a mean of 43.20 ± 1.22. The total feeding capacity of this instar ranged between 202 and 384 aphids, with a mean of 275.14 ± 5.89.

Table 2. Duration of different stages and predation efficacy of *Chrysoperla carnea* (Stephens) larvae reared on mealy plum aphid, *Hyalopterus pruni* (Geoffroy) colonized on leaves of apricot trees under laboratory conditions (26.8-29.6 °C and 54.5-61.1% RH)

Biological characteristics	Duration (days)		Number of surviving (Initial)	Mortality (%)	Daily consumed aphids		Total consumed aphids		Consumption (%)	Means of	
Developmental stages	Range	Mean ±S.E			Range	Mean ±S.E	Range	Mean±S.E		Temp. (°C)	RH (%)
Egg stage	3 - 4	3.38 ± 0.06	70	14.29						26.8	60.5
Larval stage 1st instar	3 - 4	3.24 ± 0.06	60	8.33	6.67 - 11.50	9.62 ± 0.39	19-46	31.18 ± 0.96	8.04	27.4	57.8
2nd instar	3 - 6	3.75 ± 0.08	55	5.46	14.00 - 24.00	19.11 ± 0.77	58-107	81.59 ± 1.99	21.03	27.9	54.5
3rd instar	5 - 9	6.92 ± 0.14	52	13.46	33.71 - 49.71	43.20 ±1.22	202-384	275.14 ± 5.89	70.93	29.6	56.9
Total larval stage	13 - 17	13.91 ± 0.17		25.00	24.50 - 34.69	28.38 ± 0.74	340-497	387.91 ± 5.39	100.00	28.6	56.3
Pupal stage	5 - 9	7.53 ± 0.16	45	4.44						29.6	61.1
Total developmental period	22 - 27	24.82 ± 0.21		38.57						28.3	59.3

The daily consumed aphids during the total larval stage ranged between 24.50 and 34.69 preys per larva, with a mean of 28.38 ± 0.74. The total consumption during this stage ranged between 340 to 497 aphids per larva, with a mean of 387.91±5.39.

The 1st, 2nd and 3rd larval instars consumed 8.04, 21.03 and 70.93% of the total consumed preys during the whole larval stage, respectively. These findings indicated that the greatest number of aphids was consumed by the 3rd larval instar.

These results are in agreement with those of Balasubramani and Swamiappan (1994) in India, who mentioned that during the development of *C. carnea* each larva consumed an average of 419.18 *A. gossypii* and the third instar larvae consumed the major portion of the total number consumed (60 – 80 %). Bansod *et al.* (2001) in the same country, found that first larval instar of *C. carnea* fed on 54.05 nymphs of *A. gossypii* and the total larval stage consumed 358.87 nymphs.

Pupal stage

As shown in Table 2 the pupal period ranged between 5 and 9 days, with a mean of 7.53 ± 0.16 days at means of 29.6 °C and 61.1% RH. The natural mortality during the pupal stage was 4.44% as from 45 pupae 43 adults were emerged.

These results are in parallel with those of Mannan *et al.* (1997) who found that the pupal period was 9.43 and 11.40 days when larvae of *C. carnea* were fed on *A. gossypii* and *M. persicae*, respectively. Also, El-Maghraby *et al.* (2008) in Egypt, revealed that the pupal period of the previous predator lasted 6-8 days, with an average of 6.31±0.15 days, when larvae were reared on *H. pruni* at means of 29.5 °C and 66.6% RH.

Total developmental period

Data Tabulated in Table 2 clearly show that the total developmental period ranged between 22-27 days,with a mean of 24.82 ± 0. 21 days, when larvae were fed on *H. pruni* at means of 28.3 °C and 59.3 % RH. The natural mortality during the total developmental period was 38.57%, as from 70 eggs only 43 adults were emerged.

Different results were obtained by several authors according to rearing conditions and prey species as follows: Balasubramani and Swamiappan (1994) found that the total developmental period of *C. carnea* was 20.15 days when the larvae were fed on *A. gossypii* infesting cotton. Atlihan *et al.* (2001) in Turkey, mentioned that the total developmental period of *C. carnea* was 18.81 days, when larvae were fed on *H. pruni* at means of 25 ± 1°C and 65 ± 5% RH. Atlihan *et al.* (2004) studied the developmental time of *C. carnea* on *H. pruni* at 25± 1 °C, 65±5% RH and 16 L : 8 D photoperiod and revealed that the three larval instars were able to complete their development in seven days. El-Maghraby *et al.* (2008) mentioned that the total developmental period of *C. carnea* lasted 17-21 days, with an average of 19.38 ± 0.23 days on *H. pruni* at means of 29.1 °C and 65.3% RH.

Effect of Different Artificial Diets on the Essential Biological Parameters of *C. carnea* Adults

Female

Pre-oviposition period

Data presented in Table 3 show clearly that the pre-oviposition period varied from 4 to 12 days.The shortest period, 4 - 6 days, a mean of 5.0 ± 0.45 days was recorded when adults were fed on diet (A). The longest mean value, 10.6 ± 2.50 days, with a range of 10-12 days was obtained when adults were fed on diet (D). Statistical analysis of the data revealed that the differences between means were highly significant (F= 8.546**).

Mannan *et al.* (1997) found that the pre-oviposition period of *C. carnea* was 6.55 and 9.25 days when its larvae reared on *A. gossypii* and *M. persicae*, respectively. On the other hand, different results were recorded owing to the components of the diet as follows: Ribeiro and Freitas (2000) in Italy, stated that the pre-oviposition period of *C. carnea* can be prolonged directly by the use of suitable adult diet. El-Maghraby *et al.* (2008) showed that the pre-oviposition period of *C. carnea* was 12.0 ± 0.82 days when the mated female was reared on diet consisted of honey + maize pollen.

Table 3. Longevity (in days) and fecundity of adults of *Chrysoperla carnea* (Stephens) fed on different artificial diets under laboratory conditions (29.6 - 31.8 °C and 54.6-61.0% RH)

Biological characteristics	Mean / range of values				F. test	LSD	
	Diet (A)	Diet (B)	Diet (C)	Diet (D)		0.05	0.01
Female:							
Pre-oviposition period	5.0 ± 0.45 b 4-6	7.0 ± 0.67 ab 5-8	7.60 ± 1.21 ab 5-12	10.6 ± 2.50 a 10-12	**	2.17	3.42
Oviposition period	20.60 ± 0.60 b 14-22	23.40 ± 0.60 ab 22-25	25.40 ± 1.44 a 21-29	22.20 ± 3.70 ab 21-24	*	2.74	3.84
Post-oviposition period	4.40 ± 0.51 a 3-6	5.40 ± 0.24 a 5-6	5.40 ±1.03 a 3-8	5.40 ± 0.68 a 4-7	NS	2.28	3.20
Fecundity	178.20 ± 7.51 b 165-207	303.60 ± 25.30 a 237-390	159.80 ±6.63 b 135-170	145.40 ± 5.33 b 128-158	**	47.52	66.62
Female longevity	30.00 ± 0.75 b 31-35	35.80 ± 0.92 a 34-38	38.40 ± 0.75 a 37-41	38.20 ± 0.80 a 36-41	**	2.76	3.87
Male longevity	8.0 ± 0.45 b 7-9	9.20 ± 0.58 ab 7-10	10.20 ± 1.07 ab 8-14	11.60 ± 0.60 a 10-13	**	2.36	3.31

- NS indicates that the differences between treatments are not significant.
- *, ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.
- Means followed by similar letters are not significantly different at 0.05 level of probability.

According to Abd-El-Samad (2011) in Egypt, the pre-oviposition period of *C. carnea* was 3.6 ± 0.5 days when fed on diet consisted of 1g royal jelly + 1 g pollen grains + 5 g honey + 5 ml distilled water.

Oviposition period

As shown from obtained data in Table 3, the longest oviposition period, 21 – 29 days, with a mean of 25.40 ± 1.44 days was recorded when mated females were fed on diet (C). The shortest period of 20.60 ± 0.60 days was obtained when females were fed on diet (A). Statistical analysis showed that there were significant differences between the means of the four tested diets at 0.05 level of probability (F= 5.159*).

Kandil (1996) in Egypt, found that the oviposition period was 20-34 days, with an average of 31.05 days when larvae of *C. carnea* were fed on *A. gossypii*. Abd-El-Samad (2011) mentioned that the oviposition period of *C. carnea* extended from 7 days, when females fed on diet consists of 5 g honey + 5 ml distilled water to reach 9 days, when females reared on diet consists of 1 g pollen grains + 5 g honey + 5 ml distilled water, 12 days on diet consists of 1 g royal jelly + 5 g honey + 5 ml distilled water and 14 days on diet consists of 1 g royal jelly + 1 g pollen grains + 5 g honey + 5 ml distilled water.

Post-oviposition period

As indicated in Table 3, the post-oviposition period varied from three to eight days, with a mean from 4.40 ± 0.51 to 5.40 ± 1.03 days, when the mated females were reared on the tested diets under the laboratory conditions. Statistical analysis indicated that no significant differences were detected between the tested diets.

These results are in full agreement with the findings of El-Maghraby *et al.* (2008) who found that the post-oviposition period of *C. carnea*

Table 3. Longevity (in days) and fecundity of adults of *Chrysoperla carnea* (Stephens) fed on different artificial diets under laboratory conditions (29.6 - 31.8 °C and 54.6-61.0% RH)

Biological characteristics	Mean / range of values				F. test	LSD	
	Diet (A)	Diet (B)	Diet (C)	Diet (D)		0.05	0.01
Female:							
Pre-oviposition period	5.0 ± 0.45 b 4-6	7.0 ± 0.67 ab 5-8	7.60 ± 1.21 ab 5-12	10.6 ± 2.50 a 10-12	**	2.17	3.42
Oviposition period	20.60 ± 0.60 b 14-22	23.40 ± 0.60 ab 22-25	25.40 ± 1.44 a 21-29	22.20 ± 3.70 ab 21-24	*	2.74	3.84
Post-oviposition period	4.40 ± 0.51 a 3-6	5.40 ± 0.24 a 5-6	5.40 ±1.03 a 3-8	5.40 ± 0.68 a 4-7	NS	2.28	3.20
Fecundity	178.20 ± 7.51 b 165-207	303.60 ± 25.30 a 237-390	159.80 ±6.63 b 135-170	145.40 ± 5.33 b 128-158	**	47.52	66.62
Female longevity	30.00 ± 0.75 b 31-35	35.80 ± 0.92 a 34-38	38.40 ± 0.75 a 37-41	38.20 ± 0.80 a 36-41	**	2.76	3.87
Male longevity	8.0 ± 0.45 b 7-9	9.20 ± 0.58 ab 7-10	10.20 ± 1.07 ab 8-14	11.60 ± 0.60 a 10-13	**	2.36	3.31

- NS indicates that the differences between treatments are not significant.
- *, ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.
- Means followed by similar letters are not significantly different at 0.05 level of probability.

According to Abd-El-Samad (2011) in Egypt, the pre-oviposition period of *C. carnea* was 3.6 ± 0.5 days when fed on diet consisted of 1g royal jelly + 1 g pollen grains + 5 g honey + 5 ml distilled water.

Oviposition period

As shown from obtained data in Table 3, the longest oviposition period, 21 – 29 days, with a mean of 25.40 ± 1.44 days was recorded when mated females were fed on diet (C). The shortest period of 20.60 ± 0.60 days was obtained when females were fed on diet (A). Statistical analysis showed that there were significant differences between the means of the four tested diets at 0.05 level of probability (F= 5.159*).

Kandil (1996) in Egypt, found that the oviposition period was 20-34 days, with an average of 31.05 days when larvae of *C. carnea* were fed on *A. gossypii*. Abd-El-Samad (2011) mentioned that the oviposition period of *C. carnea* extended from 7 days, when females fed on diet consists of 5 g honey + 5 ml distilled water to reach 9 days, when females reared on diet consists of 1 g pollen grains + 5 g honey + 5 ml distilled water, 12 days on diet consists of 1 g royal jelly + 5 g honey + 5 ml distilled water and 14 days on diet consists of 1 g royal jelly + 1 g pollen grains + 5 g honey + 5 ml distilled water.

Post-oviposition period

As indicated in Table 3, the post-oviposition period varied from three to eight days, with a mean from 4.40 ± 0.51 to 5.40 ± 1.03 days, when the mated females were reared on the tested diets under the laboratory conditions. Statistical analysis indicated that no significant differences were detected between the tested diets.

These results are in full agreement with the findings of El-Maghraby *et al.* (2008) who found that the post-oviposition period of *C. carnea*

lasted 4-6 days, with an average of 5.25 ± 0.48 days, when the females were fed on honey.

Fecundity

Data presented in Table 3 indicate that the highest number of deposited eggs, 237 – 390, with a mean of 303.60 ± 25.30 eggs / female was recorded when females were fed on diet (B). The lowest values, 128 – 158 eggs, with a mean of 145.40 ± 5.33 eggs were obtained with diet (D). Highly significant differences were found between the diets (F= 22.097**). These results revealed that the diets containing egg yolk, milk and honey in ratios of 5 ml, 10 ml and 5 ml proved to be the best resulting in significantly higher egg laying by the female of *C. carnea* as compared to the other diets under the same laboratory conditions.

The obtained results are in agreement with those of some investigators such as McEwen and Kidd (1995) who recommended that yeast and sugar were necessary for maximum egg production. Honey is also a very important component regarding fecundity. The previous authors, and Kubota and Shiga (1995) reported that a mixture of honey and yeast autolysis is a suitable adult diet for production of fertile eggs. Milevoj (1999) reared adults of *C. carnea* on adult diet consisting milk, eggs, fruits sugars and yeast and found that there is a favourable effect on fecundity. Higher fecundity observed in diet containing egg yolk because egg yolk is rich in protein (amino acids). Ulhaq *et al.* (2006) mentioned that the egg yolk –based diet resulted in a higher fecundity than the other ones, and this may be due to the presence of large amount of essential components like amino and folic acids responsible for egg production.

According to Abd-El-Samad (2011), the highest laid number of eggs per female, 196 ± 11.8, with a maximum hatching eggs of 175 ± 17.0 (89.3%) was obtained when adults were reared on diet containing 1 g royal jelly, 1 g pollen grains , 5 g honey and 5 ml distilled water.

Female longevity

As shown in Table 3, the female longevity ranged between 31-41 days, with means of 30.00 ± 0.75, 35.80 ± 0.92, 38.40 ± 0.75 and 38.20 ± 0.80 days on diets (A), (B), (C) and (D), respectively. There were significant differences between diet (A) and each of (B), (C) and (D) diets. These results indicated that the females lived significantly longer when fed on diets containing egg yolk or egg white or mixed egg each with milk and honey.

The present results are in conformity with those of McEwen and Kidd (1995) who reported that adult life of *C. carnea* is affected directly by the adult diet. They found that the adults receiving only sugar, lived longer than those receiving sugar and yeast. According to Ribeiro and Freitas (2000), adult life can be prolonged directly by the use of suitable diet. Abd-El-Samad (2011) mentioned that the adult female longevity was 24.6 days, when fed on an artificial diet consisted of 1 g royal jelly + 5 g honey + 1 g pollen grains + 5ml distilled water.

The relationship between fecundity and female longevity of *C. carnea* presented in Fig. 1, indicated that there was no obvious relationship between fecundity and female longevity on the tested artificial diets.

Male longevity

Data presented in Table 3 indicate that the male longevity ranged between 7 and 14 days. The longest mean longevity, 11.60 ± 0.60 days, was recorded when males were fed on diet (D) containing mixed egg, milk and honey. Statistical analysis of the data revealed that the differences between the tested diets were highly significant.

According to Duraikkannu *et al.* (2012), the male longevity was 37.6 days on diet consisted of 40 g royal jelly + 30 g protinex + 20 g honey + 10 g glucose in 250 ml water).

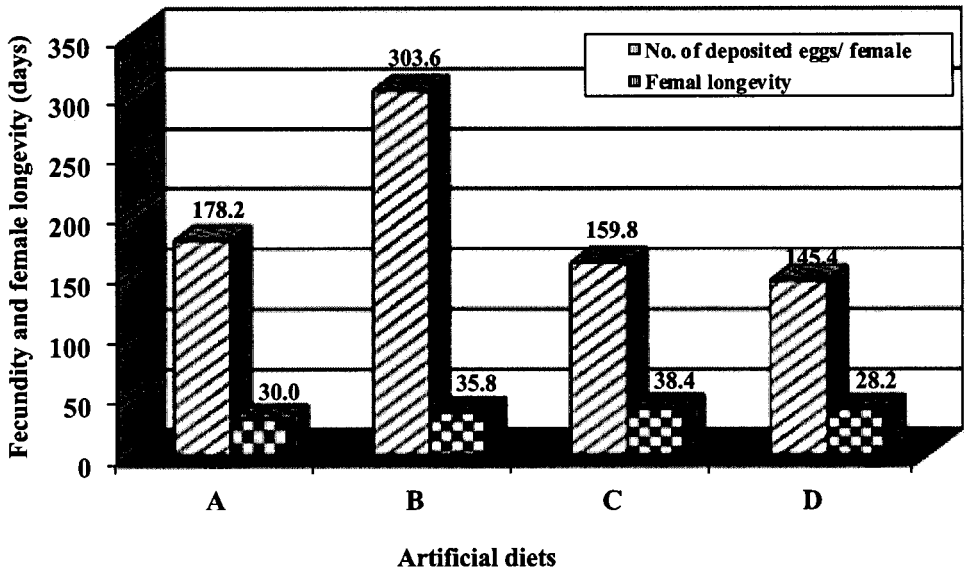

Fig. 1. Relationship between female longevity and fecundity of *Chrysoperla carnea* (Stephens) on different artificial diets

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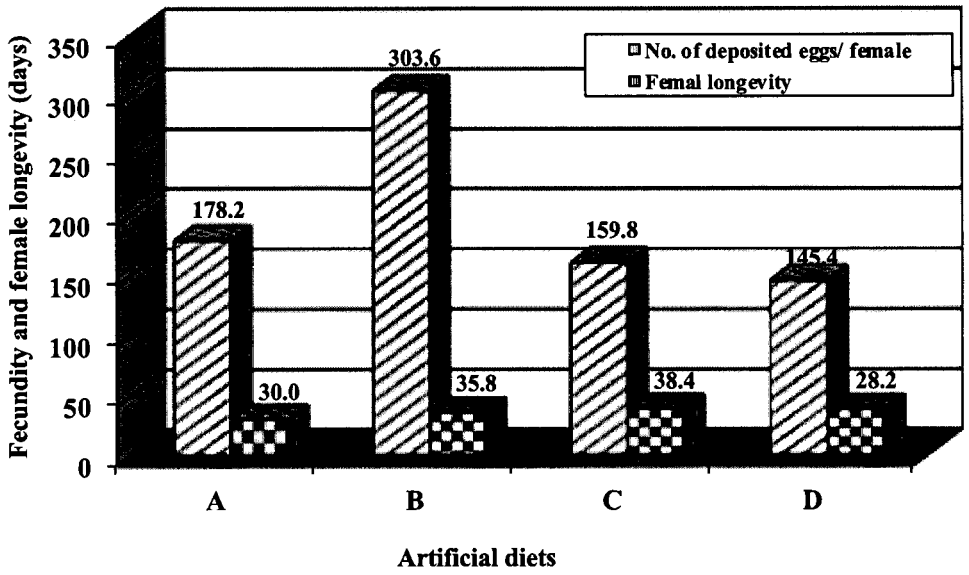

Fig. 1. Relationship between female longevity and fecundity of *Chrysoperla carnea* (Stephens) on different artificial diets

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الخصائص البيولوجية والكفاءة الافتراسية لأسد المن الأخضر *Chrysoperla carnea* (Stephens) (رتبة شبكية الأجنحة: فصيلة أسد المن) تحت الظروف المعملية

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أجريت هذه الدراسة تحت الظروف المعملية (٢٦,٨ – ٣١,٨°م و ٥٤,٥ – ٦١,١% رطوبة نسبية) بهدف التعرف على الخصائص البيولوجية والكفاءة الافتراسية لأسد المن الأخضر عند تغذيته على من البرقوق الدقيقى الموجود فى مستعمرات على أوراق أشجار المشمش، كما تم دراسة تأثير تغذية الحشرات الكاملة على أربع بيئات غذائية صناعية على خصائصها البيولوجية، وقد لخصت النتائج كما يلى: تراوحت فترة حضانة البيض بين ٣ و ٤ أيام وبمتوسط ٣,٣٨ ± ٠,٠٦ يوماً، كان متوسط فترات الأعمار اليرقية الأول، الثانى والثالث هو ٣,٢٤ ± ٠,٠٦ ، ٣,٧٥ ± ٠,٠٨ و ٦,٩٢ ± ٠,١٤ يوماً على التوالى، تراوحت فترة الطور اليرقى بين ١٣ و١٧ يوماً و بمتوسط ١٣,٩١± ٠,١٧ يوماً، وجد أن عدد المن المستهلك بواسطة الأعمار اليرقية الأول، الثانى والثالث إختلف من ٦,٦٧ – ١١,٥٠ ، ١٤,٠٠ – ٢٤,٠٠ و ٣٣,٧١ – ٤٩,٧١ فرداً على التوالى، تراوح عدد المن المستهلك بواسطة يرقة واحدة خلال فترة نموها بين ٣٤٠ و ٤٩٧ فرداً وبمتوسط ٣٨٧,٩١ ± ٥,٣٩ فرداً ، وجد أن العمر اليرقى الثالث هو الأكثر تأثيراً حيث يستهلك ٧٠،٩٣ % من المن المستهلك خلال الطور اليرقى ، كان متوسط فترة طور العذراء ٧,٥٣ ± ٠,١٦ يوماً، تراوحت فترة النمو الكلية للمفترس بين ٢٢و٢٧ يوماً بمتوسط ٢٤,٨٢ ± ٠,٢١ يوماً، وجد أن أقصر فترة لما قبل وضع البيض (٤- ٦ أيام) وبمتوسط ٥,٠ ± ٠,٤٥ يوماً كانت عندما غذيت الحشرات الكاملة على بيئة صناعية مكونة من ٣ جرام سكروز، ٢,٥ جرام مستخلص خميرة ، ٢,٥ ملليجرام عسل نحل ، ١٠ مل ماء مقطر و ٢,٠ جم كازين، سّجلت أطول فترة لوضع البيض (٢١ -٢٩ يوم) وبمتوسط ٢٥,٤٠ ± ١,٤٤ يوماً عندما غّذيت الإناث على بيئة مكونة من ٥ مل بياض بيض دجاج ، ١٠ مل لبن و ٥ مل عسل نحل، وضعت الإناث الملقحة أعلى عدد من البيض (٣٣٧ – ٣٩٠) وبمتوسط ٣٠٣,٦ ± ٢٥,٣٠ بيضة عندما غذيت على بيئة مكونة من ٥ مل صفار بيض دجاج، ١٠ مل لبن و ٥ مل عسل نحل ، ولم تظهر أى فروق معنوية فى فترات ما بعد وضع البيض عندما غذيت الإناث على البيئات المختلفة ، تراوحت فترة حياة الإناث بين ٣١ – ٤١ يوماً، وكانت فترات حياة الإناث أطول معنوياً عندما غذيت على بيئات تحتوى على صفار البيض أو بياض البيض أو خليط البيض مع اللبن والعسل، وتراوحت فترة حياة الذكور بين ٧ و١٤ يوماً ، ولقد كانت فترة حياة الذكور أطول عندما غّذيت على بيئة تحتوي خليط البيض ، اللبن والعسل.

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