J. Agric. Sci. Mansoura Univ., 32 (8): 6769 - 6776, 2007

BIOLOGICAL ASPECTS OF *Chrysoperla carnea* (STEPH.) (NEUROPTERA: CHRYSOPIDAE) PREDATOR WHEN FEEDING ON *Icerya aegyptiaca* (DOUGLAS) AND *Pectinophora gossypiella* (SAUNDERS) EGGS

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ABSTRACT

Biological aspects of the green lacewing, *Chrysoperla carnea* Steph were studied on the Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas) (Homoptera : Margarodidae) and the pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera : Gelechiidae) eggs in laboratory at the Scale Insects and Mealybug Research Department, and Bollworm Research Department, Plant Protection Institute, ARC during 2006 year. The biological aspects of the larval stages of predatory were affected by temperature and prey egg types. The incubation period was approximately similar when *C. carnea* feeds on *I. aegyptiaca* and *P. gossypiella* eggs, while, the larval period, when feeds on *I. aegyptiaca* eggs are longer than feeds on *P. gossypiella* eggs also, the duration of larval periods was decreased by temperature increasing. It could be concluded that *I. aegyptiaca* was approximately favourable eggs for 1st, 2nd and 3rd larval instars of *C. carnea*. Under two constant temperatures (25±2 and 30±2ºC) and by feeding on *I. aegyptiaca* eggs, the larvae lived for the longest times than when feed on *P. gossypiella* eggs. Longest adult's life span of *C. carnea* was recorded at 25±2°C when feeds on *I. aegyptiaca* eggs. The daily and total number of deposited eggs/female are affected by both temperature and type of food offered to larval stages and to adults. Longevity of female and male are long, where larvae feed on *I. aegyptiaca* eggs than *P. gossypiella* eggs and the adults feeds on artificial diet. The total eggs of *P. gossypiella,* which consumed by larval instars more than the eggs of *I. aegyptiaca* that consumed at 25±2 and 30±2°C. It can be saying that eggs of *I. aegyptiaca* or *P. gossypiella* suitable to complete its lifespan. The potential biological control agent by using *C. carnea* against different species of mealybugs and also against bollworms was considered.

INTRODUCTION

The Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas) Homoptera: Margarodidae is cause several damage by feeding on host tissues and injecting toxins or plant pathogens into host plants. In addition, mealybugs secrete honeydew, which is a, sugary liquid that falls on the leaves, coating them with a shiny and sticky film. Honeydew serves as a medium for the growth of sooty mould fungus which reduces the plant photosynthetic abilities and ruins plants. Mealybug attack can cause premature leaf drop, dieback and may even kill plants. A heavy infestation can cause plants to shed their leaves, become stunted or even die (Anonymous, 1998). For many years this mealybug became a very dangerous pest on fruit trees and ornamental plants in Egypt.

The pink bollworm, *Pectinophora gossypiella* (Saunders), is primarily a mid-and late-season pest of cotton. This species is one of the most destructive pests of cotton, *Gossypium barbadense*, in most of the cotton-producing countries in the world, including Egypt. Full-season (i.e. March-

December) cotton production systems exacerbate the pink bollworm-problem by permitting large diapausing populations, which contribute to the following year's crop infestations, to build up each fall (Bariola *et al*., 1981).

The green lacewing, *Chrysoperla carnea* (Steph.) (Neuroptera: Chrysopidae) is an aphid's predator very common in nature. Only the larval stages can feed on aphids or other species of insects, while the adult usually feeds on nectar, honeydew and other sugar sources. The adult female lay eggs right in the middle of an aphid colony, the larvae are pale brown or grey and start preying after emergence.

Green lacewings are proven broad-spectrum biological control agents, devouring eggs and young larvae of Colorado potato beetles, flea beetles, most caterpillar (worm) pests (armyworms, budworms, bollworms, borers, corn earworms, cabbage loppers, codling moths, etc.), aphids, spider mites, scales, psyllids, mealybugs, whiteflies, thrips, leafhoppers and other pests (Tong-Xian and Tian-Ye 2001; Ali 2003 and Mangoud 2007).

The present work is an attempt to study the biological aspects of *C. carnea* when feed on *I. aegyptiaca* or *P. gossypiella* eggs under two constant temperatures (25±2 and 30±2°C).

MATERIALS AND METHODS

Rearing of *C. carnea*:

C. carnea adults were collected from the field by insect sweep net and brought to the laboratory. The collected adults put in chimney glass (17 cm height, 7 cm top diameter and 8.5 cm bottom diameter). The bottom of each chimney cage was placed on a Petri-dish and its top was covered with black muslin for laying their eggs on it and kept in position by rubber bands (Ali, 2003).

The artificial diet for adults was prepared by adding yeast oxido : factors sugar : water as a ratio 5 : 6 : 10 and put together in a beaker, which mixed with a mixer. The diet should be a viscous pulp, which is easy to spread using a brush or spatula. A piece of cotton with the mixture (artificial diet) was offered to adults. Adults laying their eggs on the muslin cloth on their stalks glued. Eggs were collected daily by scissors and newly black muslin cloth was replaced. The larvae are fed preferable with fresh eggs of *Icerya aegyptiaca* or *P. gossypiella* , which supplied until pupate.

Rearing of *I. aegyptiaca*:

I. aegyptiaca was reared under green house conditions (25±2ºC and 60±5% RH) on small *F. nitida* plants. Ficus plants were grown in pots (30 cm diameter X 25 cm high). Every plant was kept under a glass chimney and its upper opening was covered with white muslin. The potted plants were irrigated and fertilized whenever necessary. An aspirator was used to collect mealybug crawlers from the infested *F. nitida* trees. The crawlers of *I. aegyptiaca* were then carefully transferred to larger ficus plants which were grown in pots and kept in wooden cages (100x135x135 cm) with nylon gauze sides using the method described by Mangoud (2003).

Rearing of *Pectinophora gossypiella*:

The pink bollworm, *P. gossypiella* were reared in Bollworm Division, Plant Protection Research Institute, Agriculture Research Center, Dokki, Giza.

The pink bollworm larvae were collected from infested cotton bolls and reared separately in glass tubes (2 by 7 cm) containing an artificial diet and held in an incubator at 25±2°C, 80±5% R.H. and photoperiod of 14: 10 (L:D) until pupation. Freshly hatched larvae were reared on modified artificial diet (Abd El-Hafez *et al.,* 1982). Pupae were periodically collected and held in separate glass tubles (4X10 cm) covered with muslin until adult's emergence. Emerged adults put in chimney glass after mating the layed eggs. The eggs were deposited on paper discs and subsequently the paper with eggs (one/day old) was cut into sections (2-3 cm each0. were collected to using in this experiment.

Biological studies of *C. carnea*:

Laboratory experiments at 25$\pm$2 or 30$\pm$2°C were carried out to study some biological aspects of *C. carnea*.

Effect of two kinds of eggs at two constant temperatures on certain biological aspects of *C. carnea*:

For studying the preferably feeding of *C. carnea* on *I. aegyptiaca* or *P. gossypiella* eggs at two constant temperatures (in an incubator at 25$\pm$2 and 30$\pm$2°C and 65±5% RH). Each experiment consists of three replicates; each replicate (one Petri-dish) containing five eggs of *C. carnea* were placed in Petri dish of 9 cm in diameter, covered with cotton to prevent cannibalism and group of prey eggs (100 eggs of *I. aegyptiaca* or 100 eggs of *P. gossypiella*) were supplied on a small piece of double scotch tape placed. The number of consumed eggs were estimated daily and replaced with fresh ones till pupation. Suitable moisture was daily maintained by adding few droplets of water as needed. The experiment was carried out in an incubator at 30$\pm$2 and 35$\pm$2°C and 60±5% RH and inspected daily.

Durations of *C. carnea* fed on eggs of the two preys:

Chrysoperla carnea adults, which obtained from the previous treatments at two constant temperatures, just after emergence, each pair of adults, were confined in a glass chimney cage and supplying with the artificial diet as mentioned above. The number of deposited eggs were daily counted and separated until hatching to estimate the percentage of hatchability.

Effect of the two prey (*I. aegyptiaca* or *P. gossypiella* eggs) on some biological aspects of *C. carnea* were selected to study their effects on certain biological aspects of *C. carnea* at two temperatures of 25$\pm$2 and 30$\pm$2°C and 60±5% R.H. The durations of *C. carnea* stages after feeding on the eggs of two prays were estimated to determine incubation period, larval period, pupation period, pre-oviposition, oviposition and post-oviposition periods. Also, all biological aspects were recorded until natural death of adults.

RESULTS AND DISCUSSION

Duration (in days) of developmental stages of *C. carnea* which feeds on *I. aegyptiaca* or *P. gossypiella* eggs are shown in Table (1), the incubation period was averaged 3.53±0.258 and 3.47±0.06 days when

feeding on *I. aegyptiaca* and *P. gossypiella* eggs at 25±2°C, while it decreased to 3.20±0.10 and 3.43±0.058 days at 30±2°C, respectively.

The duration of the 1st larval instar of *C. carnea* feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs are mentioned in Table (1), the 1st larval instar period averaged between 3.37±0.57 and 3.10±0.10 days, when feeding on *I. aegyptiaca* and *P. gossypiella* at 25±2°C, it was decreased to 2.67±0.15 and 2.40±0.10 days at 30±2°C, respectively. The duration of the 2nd larval instar of *C. carnea* this feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs are mentioned in Table (1), the 2nd larval instar period averaged 2.47±0.057 and 2.30±0.10 days when feeding on *I. aegyptiaca* and *P. gossypiella* at 25±2°C, it reached to 2.10±0.10 and 2.07±0.12 days at 30±2°C, respectively. The duration of the 3rd larval instar of *C. carnea* this feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs are mentioned in Table (1), the 3rd larval instar period averaged 3.63±0.057 and 3.33±0.058 days when feeding on *I. aegyptiaca* and *P. gossypiella* at 25±2°C, it was decreased to 2.73±0.058 and 2.67±0.058 days at 30±2°C, respectively.

From the above mentioned, the total larval period of the three larval instars of *C. carnea* this feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs are mentioned in Table (1), the total larval instar period averaged 9.47±0.61 and 8.73±0.54 days when feeding on *I. aegyptiaca* and *P. gossypiella* at 25±2°C, it was decreased to 7.50±0.35 and 7.14±0.30 days at 30±2°C, respectively.

Data in Table (1) revealed that the pupal stage period averaged 7.67±0.115 and 7.27±0.058 days at 25±2°C this feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs, while duration 5.57±0.058 and 5.47±0.057 days at 30±2°C, respectively.

Data in Table (1) revealed that the pre-oviposition period averaged 6.20±0.10 and 5.83±0.15 days at 25±2°C in adult female emerged from larvae feeds on *I. aegyptiaca* eggs or *P. gossypiella* eggs and then the adults feeds on artificial diet, while continued 5.67±0.15 and 5.27±0.57 days at 30±2°C, respectively.

The oviposition period averaged 25.33±1.53 and 23.67±0.57 days at 25±2°C which larvae feed on *I. aegyptiaca* eggs or *P. gossypiella* eggs and then the adults feeds on artificial diet, while durated 18.4±0.25 and 17.33±0.25 days at 30±2°C, respectively, while the post-oviposition period lasted 6.27±0.15 and 5.83±0.06 days at 25±2°C, which larvae feed on *I. aegyptiaca* eggs or *P. gossypiella* eggs and then the adults feeds on artificial diet, while decreased 4.27±0.15 and 3.77±0.16 days at 30±2°C, respectively.

Females deposited 168.33±3.51 and 159.67±1.53 eggs during the oviposition period at 25±2°C, which larvae feed on *I. aegyptiaca* eggs or *P. gossypiella* eggs and then the adults feeds on artificial diet, while deposited 129.33±4.04 and 121.67±3.06 eggs at 30±2°C, respectively.

The adult's lifespan period at 25±2°C was longer than that at 30±2°C in case of the two prey eggs, the adult's lifespan were 38.67±0.58 and 36.33±0.57 days at 25±2°C, which larvae feed on *I. aegyptiaca* eggs or *P. gossypiella* eggs and then the adults feeds on artificial diet, while lasted 28.33±0.57 and 26.33±1.53 days at 30±2°C, respectively.

Table (1): Average duration (in days) of *C. carnea* stages fed on eggs of *I. aegyptiaca* and *P. gossypiella* at two constant temperatures (25±2 and 30±2°C).

Developmental stages	Duration (in days)			
	Mean ± SE at 25±2°C		Mean ± SE at 30±2°C	
	I. aegyptiaca	*P. gossypiella*	*I. aegyptiaca*	*P. gossypiella*
Egg incubation period	3.53±0.058	3.47±0.058	3.20±0.10	3.43±0.058
1st stage	3.37±0.57	3.10±0.10	2.67±0.15	2.40±0.10
2nd stage	2.47±0.052	2.30±0.10	2.10±0.10	2.07±0.12
3rd stage	3.63±0.057	3.33±0.058	2.73±0.058	2.67±0.58
Total larval period	9.47±0.608	8.73±0.54	7.50±0.35	7.14±0.30
Pupal stage	7.67±0.115	7.27±0.058	5.57±0.058	5.47±0.57
Pre-oviposition period	6.2±0.10	5.83±0.15	5.67±0.15	5.27±0.57
Oviposition period	25.33±1.53	23.67±0.57	18.40±0.25	17.33±0.25
Post-oviposition period	6.27±0.15	5.83±0.06	4.27±0.15	3.77±0.16
Total average of eggs/female (fecundity)	168.33±3.51	159.67±1.53	129.33±4.04	121.67±3.06
Adult's lifespan	38.67±0.58	36.33±0.57	28.33±0.57	26.33±1.53

Data in Table (2) mentioned that the female longevity averaged 37.67±1.53 and 36.33±1.57 days, which larvae feed on *I. aegyptiaca* eggs at 25±2°C or *P. gossypiella* eggs and then the adults feeds on artificial diet, while reached 26.67±1.53 and 23.33±1.53 days at 30±2°C this feeds on *P. gossypiella* eggs, respectively.

Also, data in Table (2) indicated that the male longevity lasted 29.63±.58 and 36.33±.73 days, which larvae feed on *I. aegyptiaca* eggs at 25±2°C and then the adult's feeds on artificial diet, while reached 21.33±.56 and 20.55±.53 days at 30±2°C this feeds on *P. gossypiella* eggs, respectively.

The mentioned results are in agreement with those obtained by Tong-Xian and Tian-Ye (2001) they studied the effects of three aphid species (fourth instars only), *Aphis gossypii* Glover; *Myzus persicae*
Sulzer) and *Lipaphis erysimi* (Kaltenbach), on immature development, survival and predation of *C. carnea* under laboratory conditions. They found survival rates of *C. carnea* from first stadium to adult emergence were significantly different among larvae fed different aphid species; also developmental durations of larvae were also significantly different among larvae fed the three aphid species and the developmental duration from first stadium to adult emergence was shortest when larvae were fed *A. gossypii*, followed by *M. persicae*, and then *L. erysimi*. The total number of fourth stadium aphids consumed by larvae differed significantly among individuals fed different aphid species.

Prey eggs consumed by larval stages of *C. carnea* at 25 and 30°C:

Data in Table (3) revealed that the larval stages of *C. carnea* consumed eggs of *I. aegyptiaca* and *P. gossypiella*. The average number of consumed eggs of *I. aegyptiaca* by *C. carnea* 1st, 2nd and 3rd larval instars, at 25±2°C were 31.33±1.53, 161.67±1.53 and 448.33±0.57 eggs, respectively, while, they consumed 36.67±1.53, 175.33±1.53 and 481.67±2.08 eggs at 30±2°C, respectively.

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On the other hand, the average number of consumed eggs of *P. gossypiella* by *C. carnea* 1st, 2nd and 3rd larval instars, at 25±2°C were 28.67±0.58, 156.33±2.08 and 445.33±2.51 eggs, respectively, while, they consumed 31.67±0.57, 171.67±1.15 and 473.00±2.00 eggs at 30±2°C, respectively.

The total eggs of *P. gossypiella* and *I. aegyptiaca* consumed by the three larval instars are approximately similar at 25±2 and 30±2°C.

From the previous results it can be saying *C. carnea* can be using *I. aegyptiaca* or *P. gossypiella* to complete they lifespan and may be considered as potential biological control agent against different species of true mealybugs and also against bollworm.

Heinz (1998) found that *C. carnea* does equally well feeding on green peach and melon aphids. At 24°C, the duration of the various developmental stages are 5.3 days as eggs, 5.8 days as 1st instar larvae, 3.5 days as 2nd instars, 5.2 days as 3rd instars, and 13.4 days as pupae.

Table (3): Number of eggs for each prey consumed by different larval instar of *C. carnea* at 25±2 and 30±2°C.

Stages	No. of consumed *I. aegyptiaca* and *P. gossypiella* eggs/one larva of *C. carnea* (Means±SE)			
	Mean±SE at 25±2°C		Mean±SE at 30±2°C	
	I. aegyptiaca	*P. gossypiella*	*I. aegyptiaca*	*P. gossypiella*
1st instar	31.33±1.53	28.67±0.58	36.67±1.53	31.67±0.57
2nd instar	161.67±1.53	156.33±2.08	175.33±1.53	171.67±1.15
3rd instar	448.33±0.57	445.33±2.51	481.67±2.08	473.00±2.00

Mangoud *et al.* (2007) studied biological aspects of the green lacewing, *C. carnea* Steph on the citrus mealybug, *Planococcus citri* (Risso) and the two spotted-red spider mite, *Tetranychus urticae* (Koch.) eggs under laboratory conditions. Biological aspects of the larval stages of predatory were affected by temperature and prey egg types. It can be saying that eggs of *P. citri* most favourable than *T. urticae* to complete they lifespan.

REFERENCES

Abd El-Hafez, Alia; A. G. Metwally and M. R. A. Saleh (1982): Rearing the pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera : Gelechiidae) on kidney bean diet in Egypt. Res. Bull., Fac. Agric. Zagzig Univ. April, No. 576 , 10 pp.

Ali, K. A. H. (2003): Trails for mass-rearing and release for some predacious insects for controlling of pink and spiny bollworms. Ph.D. Fac. Agric. Moshtohor, Benha Branch, Zagazig Univ.

Anonymous (1998): Two new mealybug threat to the United States.(*http:\\www.hortdigest.com/archives/11*).

Bariola, L.A.; T. J. Henneberry, and D. I. Kittock. (1981): Chemical termination and irrigation cut-off toreduce overwintering populations of pink bollworm. J. Econ. Entomol. 74:106- 109.

Heinz, K.M. (1998): Dispersal and dispersion of aphids and selected natural enemies in spatially subdivided greenhouse environments. Environ. Entomol., 27(4): 1029-1038.

Mangoud, A. A. H. (2003): Personal communication with research worker working on mealybugs during working in the Project 604.

Mangoud, A. A. H., Aziza F. A. El-Safty and Gihan E. Sallam (2007): Biological aspects of *Chrysoperla carnea* when feeding on *Planococcus ficus* and *Tetranychus urticae*. Egypt. J. of Appl. Sci., 22 (2B): 837-845.

Tong-Xian, L. and C. Tian-Ye (2001): Effects of three aphid species (Homoptera: Aphididae) on development, survival and predation of *Chrysoperla carnea* (Neuroptera: Chrysopidae). J. Appl. Entomol. & Zool., 36 (3): 361-366.

الصفات البيولوجية لمفترس أسد المن عند تغذيته علي بيض كلا من البق الدقيقي المصري ودودة اللوز القرنفلية

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تم دراسة الصفات البيولوجية لمفترس أسد المن النوع *Chrysoperla carnea* بمعمل قسم بحوث الحشرات القشرية والبق الدقيقي و معمل قسم بحوث ديدان اللوز في سنة ٢٠٠٦ عند تغذيته علي بيض البق الدقيقي المصري وكذلك بيض دودة اللوز القرنفلية علي درجتي حرارة ٢٥±٢°م ، ٣٠±٢°م. وجد إن الصفات البيولوجية للمفترس تتأثر بتغير درجات الحرارة وكذلك نوع البيض المقدم لليرقات. فوجد أن فترة حضانة البيض كانت متشابهة لحد ما عند التغذية علي بيض البق الدقيقي المصري وكذلك علي بيض دودة اللوز القرنفلية ، بينما فترات حياة الثلاث أعمار يرقية للمفترس كانت أطول عند التغذية علي بيض البق الدقيقي المصري عن بيض دودة اللوز القرنفلية كذلك قلت فترات حياة الأعمار اليرقية للمفترس مع إرتفاع درجة الحرارة. مما سبق يمكن أن نستنتج أن التربية علي بيض البق الدقيقي المصري أو علي بيض دودة اللوز القرنفلية تكون مناسبة لتطور المفترس. كما وجد أن فترة حياة الأعمار الكاملة للمفترس وفترة حياة الفرد الكامل سواء كان ذكر أو أنثي وكمية ووضع البيض اليومي أو الكلي تتأثر بالحرارة وكذلك نوع البيض المقدم لليرقات وكذلك البيئة الصناعية المقدمة للأفراد الكاملة. كذلك وجد أن يرقات المفترس تتغذي علي كمية من بيض البق الدقيقي المصري وكذلك علي بيض دودة اللوز القرنفلية بدرجة متقاربة. من ذلك يمكن القول أن مفترس أسد المن يمكن تربيه يرقاته علي بيض البق الدقيقي المصري وكذلك علي بيض دودة اللوز القرنفلية كما يمكن أن يستخدم كأحد الأعداء الحيوية الهامة في مكافحة أنواع عديدة من البق الدقيقي الحقيقي وكذلك ديدان اللوز.

Table (2): Average duration (in days) of various adult periods of *C. carnea* and number of eggs laid by the adult females when fed on two prey eggs (*I. aegyptiaca* and *P. gossypiella*) at 25±2 and 30±2°C.

Developmental stages	Duration (in days)											
	Mean ± SD at 25±2°C						Mean ± SD at 30±2°C					
	I. aegyptiaca			*P. gossypiella*			*I. aegyptiaca*			*P. gossypiella*		
	Female	Male	Eggs/ female	Female	Male	Eggs/ female	Female	Male	Eggs/ female	Female	Male	Eggs/ female
Pre-oviposition	6.2±0.10	-	-	5.83±0.15	-	-	5.67±0.15	-		5.27±0.57	-	-
Oviposition	25.33±1.53	-	-	23.67±0.57	-	-	18.40±0.25	-		17.33±0.25	-	-
Post-oviposition	6.27±0.15	-	168.33±3.51	5.83±0.06	-	159.67±1.53	4.27±0.15	-	129.33±4.04	3.77±0.16	-	121.67±3.06
Longevity	37.67±1.53	29.63±0.58	-	36.33±1.57	27.26±0.73		26.67±1.534	21.33±0.56		23.33±1.53	20.55±0.53	
Adult's life span	38.67±0.58	32.54±0.54	-	36.33±0.57	31.42±0.58	-	28.33±0.57	22.45±0.73	-	26.33±1.53	21.85±0.73	-