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FEEDING CAPACITY AND HOST PREFERENCE OF *Chrysoperla carnea* (Stephens) (Neuroptera: chrysopidae) ON THREE DIFFERENT INSECT PREY UNDER LABORATORY CONDITIONS.

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ABSTRACT

Laboratory trials of feeding potential of *Chrysoperla carnea* (Steph.) (No choice) were estimated at (25 ± 2 °C, 65± 5% R. H.). Data revealed that the larval stage of *C. carnea* (Steph.) fed on egg masses of *Corcyra cephalonica* (St.) *Pectinophora gossypiella* (Saund.) and *Sitotroga cerealella* (Oliv.) consuming all over its 3 larval instars an average of 493.6±50.32, 654.3±32.54and 673.9±31.52 eggs (total consumed) for the three prey species, respectively, with total larval corresponding periods 8.7 ± 0.94, 9.5 ± 0.97 and 9.6 ± 1.17 days. Statistical analysis of the obtained data obviously cleared that there were significance differences between the mean numbers of consumed *C. cephalonica* eggs and that of *P. gossypiella* and *S. cerealella*; on the other hand there was no significance of *C. carnea* total larval period when feeding upon each of the three preys. In addition, host preference (Free Choice) revealed that *C. cephalonica* was the most preferred host to *C. carnea*. The predator consumed (13.2 ± 6.01, 77.9 ± 31. 14 and 264.1 ± 68.8 eggs of *C. cephalonica* for the 1st, 2nd and 3rd predator larval instars, respectively). *S. cerealella* was the least preferred host, whereas the respective predator larval instars consumed (0.8 ± 1.75, 27.9 ± 24.56 and 63.3 ± 47.2 eggs). Also, numbers of attacked eggs by the predator was recorded. Eggs of Rice moth were the highest attacked with Green Lacewing larvae while eggs of Angoumois grain moth were the least. This result needs more experimental efforts to earn its advantage in certain predacious performance.

Keywords: Green lacewing, *Chrysoperla carnea*, insect preys, host preference, choice, PBW,*Pectinophora gossypiella* , Rice moth, *Corcyra cephalonica*, Angoumois grain moth, *Sitotroga cerealella.*

INTRODUCTION

The green lacewings, *Chrysoperla carnea* (Stephens) ((Chrysopidae: Neuroptera), is a cosmopolitan polyphagous predator, commonly found in a wide range of agricultural systems. Larvae of *C. carnea* are voracious and efficient biological control agents for aphid and various phytophagous arthropods because of its ubiquitous nature, polyphagous habits, and compatibility with selected chemical insecticides and microbial agents (Ridgway and Murphy, 1984; Obrycki *et al*., 1989; Yuksel and Goemen, 1992; Singh and Manoj, 2000 Venkatesan *et al*., 2000, 2002; Zaki and Gesraha, 2001; McEwen *et al.*2001and Uddin *et al*., 2005.)

It is important for the successful development of pest management programs that utilize *C. carnea* as a biocontrol agent to identify alternative high quality prey/food. There are no many studies on the effect of different prey species on the biology, life table parameters, fecundity and adult

longevity of *C. carnea*, despite its importance as a predator of aphid pests. Osman and Selman (1996) reported that Lepidoptera eggs have a high nutritional quality for lacewing. The importance of the nutritional quality of the prey for this predator needs more attention.

The aim of the present study was to evaluate three different prey species (*Corcyra cephalonica, Pectinophora gossypiella and Sitotroga cerealella*) as food for *C. carnea* in terms of survival and development under laboratory conditions to determine the potential of this predator. Consequently, the second objective of this study was to evaluate the prey preference. Such information would be helpful for optimizing the mass rearing of *C. carnea*.

MATERIALS AND METHODS

1-Predator rearing:

Chrysoperla carnea: Adults of Green lacewing was collected from cotton fields and kept in the laboratory conditions (25 ± 2 °C& 65± 5% R. H.) in plastic boxes (22x13x10 cm) covered with black muslin for egg deposition and fed on droplet of semi artificial diet (2 yeast extract: 1 fructose: 1 distilled water) provided once a day on sticky tape with help of fine brush. The laid eggs were collected daily and kept under the same conditions .The neonate was maintained and provided with eggs of Angoumois grain moth, *Sitotroga cerealella*. Many generations on the course of three successive years, C*. carnea* were reared in the laboratory. For the present experiments *C. carnea* adults were obtained from the laboratory colony. The adults were sexed into males & females and 10 pairs of adults were placed in covered plastic boxes for egg laying .Newly hatched larvae were used in the trials.

2-Preys rearing:

a-Sitotroga cerealella: The method of rearing of Angoumois grain moth was a modification of those postulated by Hassan (1995) where soft wheat was provided as a rearing medium.

b-Pectinophora gossypiella: Pink bollworm (PBW) was reared in the laboratory under controlled conditions without exposure to insecticides for several generations on modified artificial diet as described by Abd El-Hafez *et al*. (1982) .

c-*Corcyra cephalonica*: Fresh Rice moth eggs were obtained from "Aswan Organic Agricultural Services Center" kept in ice box to be used before hatching.

3- Feeding capacity of of ***C. carnea* on three different prey species (No choice)**:

Feeding efficiency of *C. carnea* larval instars, 1st, 2nd and 3rd was studied on the eggs of *C. cephalonica*, *P. gossypiella* and *S. cerealella* separately. Experiments were carried out in the laboratory (Plant Protection Research Institute Dokki-Giza). 1st instar larvae of *C. carnea* were given 50 eggs, using glass tubes (2x7 cm.) tightly closed with compressed cotton piece of *C. cephalonica*, *P. gossypiella* and *S. cerealella*. Ten replicates were used / prey species. The same previous technique was used for the 2nd and 3rd instars evaluation, taking in account duplication of egg masses for each

prey to estimate number of consumed eggs for each prey species as well as estimation of number of attacks for each instar and each prey species. The following parameters were recorded daily: number of consumed eggs number of attacks, and duration of predator larval instars.

4- Host preference of of ***C. carnea*** **on three different prey species (Free Choice)**:

For host preference 1st instar larvae of *C. carnea* were given 50 eggs (in the form of 3 patches of *C. cephalonica*, *P. gossypiella* and *S. cerealella* distributed in a petri dish (6 x 12 cm) keeping equal distances from each other and from the larvae which placed in the center of the dish) .Ten replicates were used in the experiment. Numbers of moving the predator *C. carnea* towards each prey species were estimated 6 times during the first 3 hours. The movements were taken as indicator for the number of attacks against the three preys' species, i.e. how many times the predator headed towards the prey). The same previous technique was used for the 2nd and 3rd instars evaluation, taking in account duplication of egg masses for each prey species as mentioned before. Number of consumed eggs and numbers of the predator attacks against each prey species were estimated to both 2nd and 3rd instars. It is important to note that after all the predator larvae trials for feeding there must be remaining of eggs in each egg patch for the three prey species to ensure that the predator larvae are completely satiated. Also, in all case care was taken to prevent predator injury during transferring them to glass tubes or petri dishes.

5. Statistical analysis:

Analysis of variance was done on all estimated data (ANOVA) and Duncan's multiple range tests was used to separate the means (Snedecor & Cochran 1980).

RESULTS AND DISCUSSION

1-Feeding capacity of *C. carnea* (No choice):

Data given in (Table 1) indicated that the 1st, the 2nd and the 3rd instars of *C. carnea* fed on egg masses of *C. cephalonica*, *P. gossypiella* and *S. cerealella* consuming mean numbers of eggs (22.4 ± 2.99, 30. 3 ± 4.34& 32.5 ± 5.49) ; (129.0 ± 20.1, 169.1 ± 14.42& 165.4 ± 28.4) and(316.8 ± 33.14, 440.4 ±30.91& 461.8 ± 44.6) for the three larval instars upon the three preys species, respectively, the total consumption was (493.6±50.32, 654.3±32.54 and 673.9±31.52) for the three prey species with total larval corresponding periods (8.7 ± 0.94, 9.5 ± 0.97 and 9.6 ± 1.17 days) for each prey species. The statistical analysis revealed that there was a significance difference between the mean total number of consumed *C. cephalonica* eggs and that of *P. gossypiella* and *S. cerealella* eggs. Findings of Syed *et al.* (2005) indicated that *C. carnea* consumed more *Bemisia tabaci* (200.5 nymphs) as compared to *Amrasca devastans* (171.8 nymphs).

Table (1): Feeding capacity and duration period of *C. carnea* larvae when fed on three different preys.

instars	Mean numbers of preys consumed eggs*				Larval duration of predator* (Mean ± S.E.)			
	C. cephalonica	*P. gossypiella*	*S. cerealella*	L.S.D	*C. cephalonica*	*P. gossypiella*	*S. cerealella*	L.S.D
1st	22.4 ± 2.99b	30.3 ± 4.34a	32.5±5.49a	2.31	2.5±0.5b	3.4±0.5a	2.6±0.5b	0.48
2nd	129.6± 20.1b	169.1±14.42a	165.4±28.4a	11.5	2.6±0.53a	2.7±0.5a	2.5±0.7a	0.53
3rd	316.8±33.14b	440.4±30.91a	461.8±44.6a	19.5	3.4±0.52a	3.6±0.5a	3.9±0.9a	0.60
total	493.6±50.32b	654.3±32.54a	673.9±31.52a	35.87	8.7±0.94a	9.5±0.97a	9.6±1.17a	0.95

***Means followed by the same letter at the same row in both preys consumed eggs and larval duration of predator are not significantly different at P= 0.05.**

On the other hand, there was no-significance difference of *C. carnea* total larval period when feeding upon each of the three preys (Table 1). The present results concerning larval period disagree with Balasubramani &Swamiappan (1994) who reported that the larval development of *C. carnea* on different hosts in laboratory was rapid on eggs of *C. cephalonica* and longest on neonates of the American bollworm, *Helicoverpa armigera*. Also, Mannan *et al*. (1997) observed that larval duration was long when fed on *Myzus persicae* than *Aphis gossypii*. The disagreement may be due to the differences of the prey species or the laboratory conditions.

2-Host preference of ***C. carnea* (Free Choice)**:

Table (2) & Figure (1) summarize the host preference of the Green lacewing during its larval stages. *C. cephalonica* was the highly preferred host of *C. carnea* with no difference through the1st& 2nd larval instars than PBW eggs. The 1st, 2nd and 3rd predator larval instars consumed 13.2 ± 6.01, 77.9 ± 31.14 and 264.1 ± 68.8 eggs of *C. cephalonica*, respectively; whereas *S. cerealella*

Table (2): Host preference of the Green lacewing ***C. carnea* (Free Choice)**

Larval stage	Mean numbers of preys consumed eggs ± S.D.*			
	C. cephalonica	*P. gossypiella*	*S. cerealella*	L.S.D
1st instar	13.2± 6.01 a	10.8±5.83a	0.8±1.7b	2.61
2nd instar	77.9±31.14a	65.7±35.6a	27.9±24.56b	16.31
3rd instar	264.1± 68.8a	111.2±56b	63.3±47.30c	30.82

***Means followed by the same letter at the same row in preys consumed eggs are not significantly different at P= 0.05.**

was significantly the least preferred host in free choice preference. The respective predator larval instars consumed (0.8 ± 1.75, 27.9 ± 24.56 and 63.3 ± 47.2 eggs of *S. cerealella*). Also, the present results noticed that predatory potential of *C. carnea* was higher in the older instars of all preys than the younger ones. Balakrishnan *et al.* (2005) mentioned that the final instar grub consumed more number of preys compared to earlier instars. Similarly, Shrestha and Enkegaard (2013) investigated the prey preference of *C. carnea*3rd instar. They proved that 3rd instar larvae of *C. carnea* had a significant preference for *N. ribisnigri* at two ratios (10 aphids: 80 thrips, 65

aphids: 25 thrips).Up to the present results we can arrange the prey's in descending order as follows: *C. cephalonica* eggs, followed by *P. gossypiella* and at last *S. cerealella* eggs. This finding was surprising and unexpected as the predator *C. carnea* was reared initially and fed on *S. cerealella* eggs for its facilities and low costs.

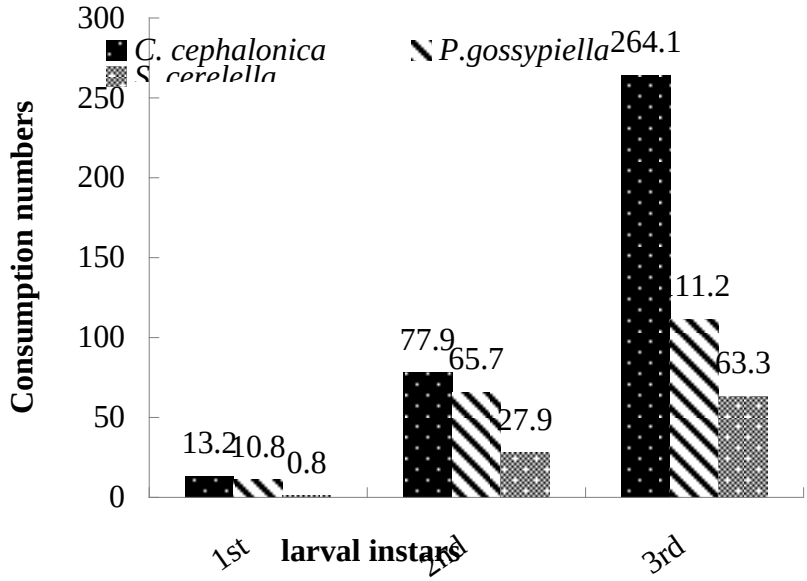

Fig (1): The three larval instars of the predator *C. carnea* upon eggs of three preys, in a free choice trial under laboratory conditions.

3- The predator attacks: Since three prey species, *C. cephalonica*, *P. gossypiella* and *S. cerealella* eggs were provided for *C. carnea* predation, attack numbers was recorded for the predator against each prey species. . Data in (Table3) Clarified that the highest mean number of attack was recorded against *C. cephalonica* eggs (2.3 ±1.21, 3.17 ±1.17 and 3.57 ±1.27) for the three larval instars of C. carnea, respectively, followed by *P. gossypiella* eggs (2.5 ±1.3, 2.0 ± 1.15 and 2.43± 1. 4). In case of *S. cerealella* the least number of attack was recorded (1.5± 0.71, 2.25± 0.5 and 2.2± 0.84) for the three predator larval instars, respectively. Direct observations and comparisons of *C. carnea* during the three instars feeding on *C. Cephalonia*, few numbers of damaged eggs were left after each attack; this number of damaged eggs was not consumed for feeding. The present outcome might support that *C. cephalonica* eggs is more desirable for *C. carnea* larvae than *P. gossypiella* and *S. cerealella* eggs. The personal observations through the present trials concerning number of attacks exhibit that although, *S. cerealella* eggs recorded the least desirable for the predator (the least number of attacks) it recorded the highest number of damaged eggs (not completely eaten). Finally, numbers of damaged eggs (not completely eaten) and number of attacks is not completely understood and need more studies to be clarified.

Table (3): Mean numbers of attacked eggs of the three preys by *C. carnea under* laboratory conditions.

instars	Mean No. of attacked eggs ± S.D.		
	C. cephalonica	***P. gossypiella***	***S. cerealella***
1st	2.3±1.21	2.5±1.3	1.5±0.71
2nd	3.17±1.17	2.0±1.15	2.25±0.5
3rd	3.57±1.27	2.43±1.4	2.2±0.84

***Means followed by the same letter at the same row are not significantly different at P= 0.05**

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الكفاءة الإفتراسية و التفضيل العوائلى للمفترس اسد المن *Chrysoperla carnea* على ثلاث فرائس مختلفة معمليا

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تم تقدير الكفاءة الإفتراسية و التفضيل العوائلى لأسد المن معمليا"على بيض ثلاث فرائس مختلفة وهى فراشة الأرز و دودة اللوز القرنفلية و فراشة الحبوب . وأوضحت النتائج أنه فى حالة تقديم البيض للمفترس بصورة فردية أي كل فريسة على حده كانت فراشة الحبوب فى المرتبة الأولى (673.6±31.52) من حيث عدد البيض الذى تم إفتراسه ، تليها دودة اللوز القرنفلية (654.3±32.54) ثم جاءت فراشةالأرز فى المرتبة الثالثة من حيث عدد البيض الذى تم إفتراسة (493.6±50.32) ، أما فى حالة التغذية الإختيارية أي تقديم الثلاث فرائس معا للمفترس في نفس الوقت فكان بيض فراشة الأرز هى الأكثر تفضيلا" تتبعها دودة اللوز القرنفلية ثم تأتي فراشة الحبوب أخيرا" . وعلى الجانب الآخر تم تقدير الهجمات من قبل المفترس تجاه كل من الفرائس الثلاث خلال 3 ساعات الأولي بمعدل قراءة كل نصف ساعة للأعمار اليرقية الثلاثة ، و أوضحت النتائج ان أكبر عدد من الهجمات تم تسجيله تجاة فراشة الأرز ، تلتها بعد ذلك دودة اللوز القرنفلية ، وكان بيض فراشة الحبوب الأقل تعرضا للهجمات من قبل المفترس. ونخلص من ذلك أن عملية مهاجمة المفترس لبيض الفرائس المختلفة والبيض التالف دون تغذية عليه تحتاج لمزيد من الدراسة لتحديد مدي الإستفادة من الضررالذي يحدثه المفترس لعوائله .