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EFFECT OF TEMPERATURE ON BIOLOGICAL PARAMETERS OF IMMATURE STAGES OF *CHRYSOPERLA CARNEA* (NEUROPTERA: CHRYSOPIDAE) FEEDING ON RICE MEAL MOTH, *CORCYRA CEPHALONICA* EGGS

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ABSTRACT:- Developmental durations of immature stages of *Chrysoperla carnea*, feeding on *Corcyra cephalonica* eggs at three constant temperatures 24 ±1 °C, 28 ±1 °C and 32 ±1 °C were studied. The results indicated that incubation period was 4.9±0.08, 3.8±0.08 and 3.0±0.06 days at three temperatures, respectively. Developmental duration of first instar were 3.6±0.07, 3.0±0.11, 2.0±0.06 days, second instar were 3.4±0.11, 3.0±0.07, 2.8±0.07 and third instars were, 4.9±0.10, 4.0±0.06, 3.4±0.13 days at three temperatures, respectively. The larval developmental duration were 11.9±0.13, 9.7±0.31, 8.2±0.14 and pupal duration were 9.2±0.10, 8.3±0.10 and 6.8±0.07 days at three temperatures respectively. Biological cycle of immature stages were 26.0±0.13, 21.8 ±0.08 and 18.0±0.56 days, respectively with total survival rate from egg to adult emergence of 82%, 68% and 42% at the respective temperature. The results indicate that developmental cycle of immature stages were significantly different at three different temperatures and with increasing temperature the developmental cycle decrease significantly.

Key Words: Chrysoperla carnea; Immature Stages; Corcyra cephalonica; Eggs; Temperature; Pakistan.

INTRODUCTION

Chrysoperla carnea Stephens also known as aphid lions is by far the most intensively studied species of Chrysopids, because of its abundance and broad habitat range (Tauber et al., 2000).They are voracious predators of a wide variety of soft bodied arthropods including insects i.e., aphids, caterpillar, leafhopper, whiteflies, thrips and insect eggs (Carrillo and Elanov, 2004). *Chrysoperola carnea* has got a considerable attention as a biological control agent because of its ability to control a variety of insect pests having higher searching ability and wide adaptability in field (Morrison, 1985).

C. carnea can easily be mass reared in the laboratory and used against insect pest in the field (Syed et al., 2008). Developmental duration and survival rate of *C.carnea* are influenced by temperature, relative humidity, photoperiod, food quality and quantity (Adane and Gautam, 2002). Temperature is one of the most important environmental factors that influence the developmental rate of a particular insect species (Birch, 1948). Therefore, it is very important to study the relationship between temperature and development for any economically

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important species.

The present work is intended to bring some basic information on the biology of immature stages of C.carnea, when feeding on C.cephalonica eggs at three different temperature levels, which could be usefully employed for mass and quality production of the predator under local environmental conditions.

MATERIALS AND METHOD

Rearing host Insect *Corcyra cephalonica*

The rice meal moth *C. cephalonica* was reared in glass jars (5 kg capacity) on rice grains under laboratory condition of 28±1°C with 65 ±5% relative humidity at Insect Pest Management Programme, National Agricultural Research Centre, Islamabad, during 2010.The jars were covered with muslin cloth at the top. The eggs laid by the female moth outside the muslin cloth through their ovipositor at the top of glass jar were collected and provided as a fresh food for *C. carnea* larvae daily till pupation.

Rearing *Chrysoperla carnea*

Adult *C. carnea* was reared in transparent plastic cages. Upper top portion of the cage were lined with black sheet for oviposition. Adults of *C. carnea* was provided artificial diet adlibitum containing water: yeast: sugar: honey in ratio (6:2:2:1). This diet was sufficient for feeding to 50 adults for five days and the diet was replaced with new diet after each five days.

Two hours fresh eggs of *C. carnea* were collected from black sheet at the top of the cages with razor. Freshly collected eggs of *C. carnea* were counted and kept with in transparent Petri dishes (6cm x 12cm), with a moist filter paper at a density of 10 eggs per Petri dish with 5 replications. A total of 50 eggs were placed in Petri dishes. Each Petri dish was covered with a piece of muslin cloth, held in a position with a rubber band and kept under growth chamber for hatching at three different temperatures 24±1°C (T_1), 28±1°C(T_2) and 32±1°C(T_3) with 65±5% relative humidity and 14:10 D:L photoperiod. Upon hatching the 1^{st} instar larvae were kept separately in transparent vials covered with muslin cloth at the top.

A total of 50 newly emerged first instar larvae were kept in tubes separately. All tubes were placed in a growth chamber at a required temperatue and humidity for further development and survival. The larvae of *C. carnea* were provided 250-300 fresh *C.cephalonica* eggs every morning at the time of observation and the old eggs were replenished with fresh eggs. All larvae remained in the same tubes for different biological observations of immature stages until it emerged as adult.

The following parameters were recorded daily: incubation period, duration of each larval instar, larval, pupal and total developmental duration and survival rate from egg to adult emergence. The data were statistically analyzed and the mean were distinguished using the least significant difference test (LSD).

RESULTS AND DISCUSSION

Developmental duration of immature stages of *Chrysoperla carnea*

The results on the developmental duration of immature stages of *C. carnea* when feeding *C. cephalonica* eggs at three different temperature levels indicated that incubation period of *C.carnea* eggs was 4.9±0.08, 3.8±0.08 and 3.0 ±0.06 days at 24±1°C, 28±1°C and 32±1°C, respectively (Table 1). Josain and Sonia (2003) reported that incubation period was 4 days at 25 °C, while Afzal and Khan (1978) reported that incubation period of *C.carnea* eggs was 4.8 ± 0.4 days under laboratory conditions. The insect passes through three larval instars before transforming into pupa. The average duration of the first, second and third instars were 3.6 ± 0.07, 3.4± 0.11 and 4.9 ± 0.10 days at 24±1°C respectively. Similarly at 28±1°C and 32±1°C the average duration of first, second and third instars were, 2.7 ± 0.11, 3.0 ± 0, 4.0 ± 0.06 and 2.0±0.06, 2.8±0.07, 3.4±0.13 days, respectively (Table 1). The result indicates that with increasing temperature developmental duration for different instars of *C.carnea* were significantly decrease. Previous workers reported different developmental duration for different instars Afzal et al. (1978) reported the average duration of the first, second and third instars were 3.2±0.49, 2.8±0.20 and 6.9±0.49 days respectively, while Mari et al. (2006) reported that developmental duration of first, second and third instars were 2.46±0.05, 4.36±0.10 and 5.91±0.19 days when feeding on aphid.

The mean larval developmental duration were 11.9±0.13, 9.7±0.31 and 8.2±0.14 days, respectively which are significantly different from each other at three temperatures (Table 1). These different values found for *C. carnea* larvae developmental time may be due to differences in the environmental condition under which the experiments were carried out and the capacity of each species to utilize a given type of prey. The larvae completed two moult during the active feeding period and

Table 1. Mean developmental time in days of immature stages of *C.carnea* at three different temperatures

Temperature (±1 °C)	Developmental time of immature stages ± S.E (days)						
	Incubation period	1st Instar duration	2nd Instar duration	3rd Instar duration	Larval duration	Pupal duration	Duration from egg to adult emergence
24	4.9 ±0.08a	3.6 ±0.07a	3.4±0.11a	4.9±0.10a	11.9±0.13a	9.2 ±0.10a	26.0±0.13a
28	3.8±0.08b	3.0±0.11b	3.0±0.07a	4.0±0.06b	9.7±0.31b	8.3±0.10b	21.8±0.08b
32	3.0 ±0.06c	2.0 ±0.06c	2.8 ±0.07b	3.4 ±0.13c	8.2 ±0.14c	6.8 ±0.07c	18.0±0.03c
LSD-value	1.98	1.98	1.98	1.98	1.98	1.99	2.12
F-value	171*	45.5*	17.6*	55.3*	1.47*	153*	65.4*

Means followed by the same letter do not differ significantly at $P \leq 0.05$

passed the last moult with in the coccon. Mean duration of the pupal stage was 9.2±0.10, 8.3±0.10 and 6.8 ±0.07 days at 24±1°C, 28±1°C and 32±1°C, which are significantly different from each other. The average duration and survival rate from egg to adult emergence was 26.0±0.13, 21.8±0.08 and 18.0 ±0.03 days. The survival rate was 82%, 68% and 42% respectively (Table 2). The results of the present studies indicates that temperature have

Table 2. Percentage (%) of *C. carnea* survived from eggs to adult emergence at three constant temperatures when reared on *C. cephalonica* eggs

Temperature (±1 °C)	Number of eggs used	Individuals survived (Nos)	Survival (%)
24	50	41	82
28	50	34	68
32	50	21	42

significant effect on the developmental duration and survival rate of immature stages of *C.carnea*. The result further indicates that out of the three tested temperature T_1 was more suitable temperature for rapid development and high survival rate. The results demonstrate the need for further studies on the effect of temperature for efficient and quality mass production of the predator.

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