



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 1031-1033

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Received: 07-01-2018

Accepted: 08-02-2018

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Influence of natural host and artificial diet on the biology of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae)

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Abstract

From last two decades the biological control playing a major role in controlling the insect pests. The genus *Chrysoperla* contains several important species of predatory insects of which the common green lacewing, *Chrysoperla carnea* (Stephens) is a potential predator on many soft bodied insects. The knowledge of biology plays an important role in mass production and its utilization in pest management programme. To insight the information on description and duration of different stages of *C. carnea*, the present study was undertaken in the laboratory Agricultural University, Shimoga during the year 2014. The study revealed that the different host used for analyzing the biology showed a significant difference among themselves. The predator *C. carnea* had completed its incubation period in 3.50 - 4.00 days with 3.80 ± 0.15 days on *Corcyra cephalonica*. 2.20 - 2.50 days with 2.39 ± 0.13 days on Aphid and 2.50 - 3.30 days with 2.90 ± 0.27 days on White fly which showed short period with respect to Aphid host. The predator took varying period of larval stage to complete with 8.90 - 11.50 days, 10.40 - 12.60 and 10.20 - 12.20 days on *Corcyra*, Aphid and White fly, respectively. Predator took 17.80 - 21.50 days and 30.20 - 35.50 days for male and female longevity respectively on *Corcyra*. 19.50 - 25.80, 35.50 - 38.50 days for male and female longevity in Aphid and 17.80 - 21.20, 33.20 - 36.80 days for male and female longevity in White fly. The highest egg laying capacity of 395 - 435 obtained with Aphid host.

Keywords: *Chrysoperla carnea*, biology, Stephens, natural host, artificial diet

Introduction

From last two decades the biological control playing a major role in controlling the insect pests. The predators are scattered in about 167 families of 14 orders of class Insecta. Among the predacious insect orders, Coleoptera, Neuroptera, Hymenoptera, Diptera and Hemiptera contain exclusively (natural enemies) predators (Sattar *et al.*, 2011) ^[9, 10]. In India, 65 species of *Chrysopids* belonging to 21 genera have been recorded from various crop ecosystems. The genus *Chrysoperla* contains several important species of predatory insects of which the common green lacewing, *Chrysoperla carnea* (Stephens) is a potential predator on many soft bodied insects (Chakraborty and Borat, 2010; Sattar and Abro, 2011) ^[2, 9, 10]. They commonly feeds on jassids, whiteflies, thrips, aphids and mites (Singh and Manoj, 2000; Venkatesan *et al.*, 2002) ^[12, 14]. *C. carnea* is now commonly reared in laboratory and used extensively all over the country and has significant potential for commercialization and use against a variety of crop pests in combination with other insect pest management tactics. The knowledge of biology plays an important role in mass production and its utilization in pest management programme (Chakraborty and Borat, 2010) ^[2].

Materials and Method

Initially the rearing started by collecting the grubs from the field. They are reared individually in multi cavity trays to avoid cannibalism and are fed with the natural hosts like *Aphis gossypii* and *Bemisia tabaci* which are collected from the cotton ecosystem or fed with *Corcyra cephalonica* egg in off season until they have become adults.

Adult rearing: Adults of *C. carnea* were collected from field or they can also be collected from rearing from grubs and mixed sex (approximately 1:1) were placed in plastic cage (35cm × 20cm × 20cm), covered with a plastic lid, for maintaining the culture (Mudassar *et al.*, 2013) ^[7]. A sheet of black paper stretched across the top of the cage, acted as an oviposition substrate. Holes were present in the cage for good ventilation.

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These adults were fed on the eggs of *Corcyra cephalonica* or semisolid artificial diet comprising yeast, honey, sugar and water (1:1:1:4). The diet was pasted on plastic strips placed horizontally in adult rearing cage. Wet soaked cotton in Petri dish was placed inside the cage to provide moisture inside the cage (Ashfaq *et al.*, 2004; Chakraborty and Korat, 2010) [2]. Eggs laid on black sheet by females were collected on alternate days with razor. Proper sanitation of cage was ensured (Ashfaq *et al.*, 2004). The adults lay eggs on the brown sheet. From the old troughs or cage, the brown paper sheets along with *Chrysoperla* eggs are removed.

Storage and destalking of eggs: All collected egg sheets are stored at 10 °C in B.O.D. incubator or refrigerator for about 21 days, they serve as stock materials. When the eggs are required for culturing, the egg sheets are kept at room temperature for a day and the eggs during this period turn brown and hatch on 3 days later.

Individual rearing of grubs: In the first step of larval rearing, 120 three day old *Chrysopid* eggs are mixed with 0.75 ml of *Corcyra* eggs (the embryo of *Corcyra* eggs are inactivated by keeping them at 2 feet distance from 15 watt ultraviolet tube light for 45 minutes) in a plastic container (27x18x6 cms). On hatching, the larvae start feeding. On third day the larvae are transferred to 2.5 cm cubical cells of plastic louvers @ one per cell or transferred to multi cavity trays. *Corcyra* eggs are provided in all the cells of each louver by sprinkling through the modified salt shaker. Feeding is provided in two doses. First feeding of 1.5 ml *Corcyra* eggs for 100 larvae and second feeding of 2 ml for 100 larvae with a gap of 3-4 days is done. Total quantity of *Corcyra* eggs required for rearing 100 *Chrysopid* larvae is 4.25 ml

***Corcyra* egg requirement:** The eggs of *Corcyra cephalonica* is given as feeding material for the larvae in the laboratory. Total quantity of *Corcyra* eggs required for rearing of 100 larvae is 4.25 ml. *i.e* 0.0425ml/grub.

Results and Discussion

The eggs are stalked and creamy white to green in colour. The length of the eggs in various species ranged between 0.70 to 2.30 mm and that of the stalk between 2.00 to 26.00 mm. The eggs are laid singly or in clusters of 13 to 16. These observations corroborate with the reports of Patel and Vyas (1985) [8], Gadhia (1988) [4] and Tanwar *et al.* (2005) [13]. Eggs turn pale whitish and then black before hatching. The average incubation period was 2.39 ± 0.13 , 2.90 ± 0.27 and 3.80 ± 0.15 days on *Aphis gossypii*, *Bemisia tabaci* and *Corcyra cephalonica*, respectively. These findings are in accordance with the study reported by Patel and Vyas (1985) [8] and Gadhia (1988) [4]. This indicates that the egg incubation period was less in the tray kept with *A. gossypii* followed by

B. tabaci and *C. cephalonica* egg. Hatching percentage ranged from 73.00 to 89.50 with an average of 81.25. More hatching percentage were observed in Aphid (84.00 – 89.50). These results supported with the reports of Patel and Vyas (1985) [8] and Gadhia (1988) [4] who recorded 93.02 and 93.83 as hatching percentage of eggs in case of *C. scelestes*, respectively.

The larva is white in colour on hatching. Newly hatched young larvae were tiny, elongate shaped whereas the full grown larvae were elongated, spindle shaped, somewhat flattened with large tubercles on the side of swollen abdomen. These observations are in conformity with the report of Jalali *et al.* (2003) [6]. The larva has three instars which are completed in 8.90 - 11.50, 10.40 – 12.60 and 10.20 – 12.20 days on *Corcyra*, Aphid and White fly respectively.

The larva spins a cocoon from which the adult emerges in 9.80 – 9.90, 8.20 – 9.10 and 9.00 – 9.50 days on *Corcyra*, Aphid and White fly respectively which is in agreement with the reports of El-Dakroury *et al.* (1979) [3] and Patel and Vyas (1985) [8]. Adults on emergence mate repeatedly. Generally, pre-oviposition period lasts for 4.00 – 5.00 days with early in the Aphid (3.10 – 4.00). Adult females start laying eggs from fifth day onwards and peak egg-laying period is between 9.00 - 23.00 days after emergence. The male and female longevity is 17.80 - 21.50 and 30.20 - 35.50 days, 19.50 – 25.80 and 35.50 – 38.50 days and 17.80 – 21.20 and 33.20 – 36.80 days on *Corcyra*, Aphid and White fly, respectively. Duration of male and female noticed in present study corroborate with the reports of Gadhia (1988) [4] and Singh and Jalali (1994) [11]. Entire lifespan from egg stage to the death of adult irrespective of their sex ranged from 26 to 47 days with an average of 35.02 ± 0.98 days. These findings are more or less similar to the earlier reports of Gadhia (1988) [4] and Jalali and Singh (1992) [5].

Table 1: The life cycle period

Stage	Actual life cycle period in favorable condition (in days)	
	Range	Mean \pm SD
Incubation period	3.50 - 4.00	3.80 \pm 0.15
Larval period	First instar	2.20 - 3.30
	Second instar	3.20 - 4.00
	Third instar	3.50 - 4.20
Total larval period	8.90 - 11.50	10.2 \pm 0.34
Pupal period	9.80 - 9.90	9.84 \pm 0.05
Adult period	Male	17.80 - 21.50
	Female	30.20 - 35.50
Pre-oviposition period	4.00 - 5.00	4.47 \pm 0.46
Oviposition period	23.50 - 26.20	25.06 \pm 1.04
Post oviposition period	4.00 - 5.00	4.43 \pm 0.39
Number of eggs laid	325.00 - 365.00	343.00 \pm 14.54
Hatching percentage	73.00 - 75.00	73.9 \pm 0.70

At Favourable temperature $28 \pm 1^{\circ}$ C, feeding with *Corcyra cephalonica* eggs.

Table 2: Life cycle reared on natural hosts

Stage	On aphids (days)		On white flies (days)	
	Range	Mean \pm SD	Range	Mean \pm SD
Incubation period	2.20 - 2.50	2.39 \pm 0.13	2.50 - 3.30	2.90 \pm 0.27
Larval period	First instar	2.50 - 3.30	2.50 - 3.30	2.94 \pm 0.33
	Second instar	3.90 - 4.50	3.80 - 4.40	4.04 \pm 0.21
	Third instar	4.00 - 4.80	4.37 \pm 0.29	3.90 - 4.50
Total larval period	10.40 - 12.60	11.50 \pm 0.29	10.20 - 12.20	11.20 \pm 0.25
Pupal period	8.20 - 9.10	8.57 \pm 0.36	9.00 - 9.50	9.20 \pm 0.15
Adult period	Male	19.50 - 25.80	17.80 - 21.20	19.37 \pm 1.26
	Female	35.50 - 38.50	33.20 - 36.80	34.60 \pm 1.26
Pre-oviposition period	3.10 - 4.00	3.59 \pm 0.33	3.90 - 4.20	4.06 \pm 0.11

Oviposition period	25.80 – 28.90	27.03 ± 1.22	24.90 – 28.00	26.09 ± 1.04
Post oviposition period	6.40 – 6.80	6.64 ± 0.16	5.30 – 6.50	5.87 ± 0.46
Number of eggs laid	395.00 – 435.00	413.00 ± 16.68	360.50 – 380.00	369.56 ± 6.59
Hatching percentage	84.00 – 89.50	86.81 ± 2.21	73.00 – 85.00	79.00 ± 4.97

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