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Biology of green lace wing, *Chrysoperla* sp., (Neuroptera: Chrysopidae) fed on curry leaf psylla, *Diaphorina citri* (Hemiptera: Liviidae)

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Abstract

The present studies on the biology of green lace wing, *Chrysoperla* sp. (Neuroptera: Chrysopidae) fed on curry leaf psylla, *Diaphorina citri* was conducted in the Bio-control Laboratory, IGKV, Raipur during 2018-19. The results revealed that the average incubation period was (2.94 ± 0.15) days with a mean hatching per cent of 66.71 ± 1.78 . There were three larval instars with an average duration of 4.05 ± 0.10 ; 3.7 ± 0.20 and 4.4 ± 0.28 days respectively. Mean pupal period was of 8.1 ± 0.20 days and the average total development period was estimated to be of 23.19 days. The mean pre-oviposition, oviposition period and fecundity was of 6.1 ± 0.35 days, 6.1 ± 0.35 days and 177.8 ± 2.14 eggs respectively. Mean longevity of male and female was 24.6 ± 0.43 and 29.1 ± 0.53 days respectively and the average sex-ratio of M: F was of 0.75:1 indicating dominance of females in population.

Keywords: *Chrysoperla* sp., biology, feeding potential, *Diaphorina citri*

Introduction

Psyllids are a serious sucking pest of curry leaf. Psyllids extract large quantities of sap from the plants, especially from tender leaves and shoots. This causes curling of the leaves, distortion of shoots and even stops growth and while sucking the sap, nymphs inject a toxin that causes the plant tips to dieback (Costa Lima, 1942) [5] and Catling, 1970) [4]. Increasing population of psyllids with wide range of host plants with poor management system causes huge loss in Agriculture.

Lacewings are important polyphagous predators of the Order Neuroptera and family Chrysopidae. This order consists of a group of insects with rather soft bodies, biting mouthparts and two pairs of very similar membranous wings which are usually held roof-like along the abdomen at rest.

In India, about 65 species of lacewings belonging to 21 genera have been recorded from various agricultural, horticultural and agro-forestry cropping systems, out of these *Chrysoperla* is the most dominant genera, containing several species which are widely used in augmentation programme (Gautam, 1994) [6]. The common green lacewing, *Chrysoperla* spp. also known as 'golden eye' or 'aphid lion' is the most important species, found preying on a broad range of prey including several soft bodied insect pests viz., aphids, scales, thrips, mealybugs, whiteflies, mites and eggs and neonate larvae of several lepidopteran pests and has high tolerance to various groups of pesticides (Ahmed *et al.*, 2012, Tauber *et al.*, 2000) [2], [12]. Their agricultural importance lies in their carnivorous habits. Chrysopid predators are known to feed on more than 80 species of insects and 12 species of mites (Kharizanov and Babrikova, 1978) [7]. A single grub may devour as many as five hundred aphids in its life time and there is no doubt that they play an important part in the natural control of many small homopterous pests (Michaud, 2001, Legaspi *et al.*, 1994) [8], [10]. It has long been considered as a promising candidate for the pest management programs in India due to its wide prey range, geographical distribution, resistance to insecticides, voracious larval feeding capacity and commercial availability (Tauber *et al.*, 2000, Venkatesan *et al.*, 2008), [12], [13] and easy mass multiplication under laboratory conditions (Araujo and Bichao, 1990) [3].

There is a great scope to explore the use of *Chrysoperla* sp. in the management of nymphs and adults of hemipteran insects on field crops as well as horticultural crops. The available literature revealed that none of the earlier workers in Chhattisgarh has made an attempt to study the biology of *Chrysoperla* sp. with the above facts, the present study entitled "Biology of green lace wing, *Chrysoperla* spp., (Neuroptera: Chrysopidae) fed on curry leaf psylla,

Diaphorina citri” was framed and carried out at Biocontrol Laboratory, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2018-19.

Materials and Methods

The experiment was conducted at the Biological Control Laboratory, Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2018-2019. The cultures were maintained at 27 ± 1 °C temperature and $65\pm 5\%$ of relative humidity (RH). Techniques adopted for the maintenance and mass culture of curry leaf psylla, *D. citri* and its predator *Chrysoperla sp.* are given below:

Rearing of curry leaf psylla, *Diaphorina citri* (Hemiptera: Liviidae)

Soft bodied insect curry leaf psylla (nymphs and adults) were collected daily from Instructional Research Farm of College of Agriculture, Indira Gandhi Agricultural University, IGKV, Raipur (Chhattisgarh) and provided as prey food for larvae of *Chrysoperla sp.* tested in different experiments viz: Incubation, hatching percent, larval, pupal periods and adult survival, longevity of male and female, pre-oviposition and oviposition periods, fecundity and sex-ratio were determined on a daily basis.



Fig 1: Curry leaf Psylla, *Diaphorina citri*

Rearing of the predator, *Chrysoperla sp.*

Nucleus culture was maintained in the Biological Control Laboratory, department of Entomology, IGKV, Raipur as per the standard set of procedure given by Gautam (1994) [6]. Adults were transferred to glass jar and fed with honey-water solution (50%) which was applied by dipping cotton balls in it. The glass jar was covered with black and white muslin cloth. Females laid stalked eggs on the inner surface of the cloth. For initial three weeks, the cloth was changed every alternate day and later cloth was changed once in three days. The stalked eggs laid by the females on roof board were destaked after 24 hours by gently brushing with a piece of sponge and kept in plastic or glass jar (15 × 8 cm) covered with black and white muslin cloth (Plate:2).

For larval rearing, cloths containing eggs of predator were transferred to jars for hatching and curry leaf psylla, *D. citri* (nymphs and adults) were provided as larval food 2-3 days after emergence of larvae. Second instar larvae were transferred to plastic jars (15 × 8 cm) @ 15-20 larvae/jar and provided with fresh curry leaf psylla, *D. citri* (nymphs and adults) as food daily in each jar until pupation. Few paper pieces were provided inside the jar for reducing cannibalism and also acting as substrate for pupation. Pupae were collected and kept in separate jars for emergence. After emergence the male and female adults were separated based on their abdominal size. The abdominal size of female was larger as compared to male. The adults emerged from the pupae were collected individually in plastic tubes (5 × 2 cm), (3 × 2) and transferred in the oviposition cage. The

oviposition cages were covered with black and white muslin cloth as *Chrysoperla* prefers to lay eggs on top surface of muslin cloth inside the cage. Wet cotton plug were provided inside the jar to maintain high humidity for better emergence. Culture was maintained at temperature 27 ± 1 °C and $65\pm 5\%$ RH as per the methodology given by Gautam (1994) [6].



Fig 2: Rearing of the adult *Chrysoperla sp.*

Studies on biology of *Chrysoperla sp.*

The studies on biology of *Chrysoperla sp.*, fed on *D. citri* was carried out in a completely randomized design replicated five times maintained at the temperature 27 ± 1 °C and RH at $65\pm 5\%$. To study the biology of *Chrysoperla* ten eggs of *Chrysoperla sp.* were reared on curry leaf psylla, *D. citri* were kept individually in glass vials and open end was plugged with cotton. After hatching, grubs were fed with various hosts insects separately till completion of the larval period. Development period of each instar of *Chrysoperla* were recorded and incubation, hatching percent, larval, pupal periods and adult survival, longevity of male and female, pre-oviposition and oviposition periods, fecundity and sex-ratio were determined on a daily basis.

Results and Discussion

The results regarding the biology and feeding potential of *Chrysoperla sp.* feeding on curry leaf psylla, *D. citri* under controlled conditions revealed that the mean duration of the incubation period was 2.94 ± 0.15 days with 66.71 ± 1.78 per cent hatchability. Previously Qadeer (2012) have reported durations for egg stage and their hatchability to be of 4.0 ± 0.00 days at 26 ± 1 °C which is slightly more than the present studies [11]. The insect passed through three larval instars before transforming into pre-pupa. The average durations of first, second and third instars were 4.05 ± 0.10 , 3.7 ± 0.20 and 4.4 ± 0.28 days. (Table 1), Afzal and Khan (1978) reported that the average duration of first, second and third instars were 3.20 ± 0.09 , 3.4 ± 0.05 and 4.7 ± 0.08 days [1], respectively which varies slightly from the present studies. While Mari *et al.* (2006) [9], reported that developmental duration of first, second and third instars as 2.46 ± 0.05 , 4.36 ± 0.10 and 5.91 ± 0.19 days when *Chrysoperla sp.* fed on aphid which also varies from the present results.

The average pupal period was 8.1 ± 0.20 days and the average total developmental period was 23.19 ± 1.03 days. On an average pre-oviposition period was 6.1 ± 0.35 days; oviposition period was 24.7 ± 0.26 days, Data on fecundity was recorded to be of 177.8 ± 2.14 eggs when reared on *D. citri* (Table 1). The mean sex ratio of *Chrysoperla sp.* (M:F) was 0.75:1 indicating dominance of females in population. The mean longevity of male was 24.6 ± 0.43 days and that of female it was 29.1 ± 0.53 days (Table 1).

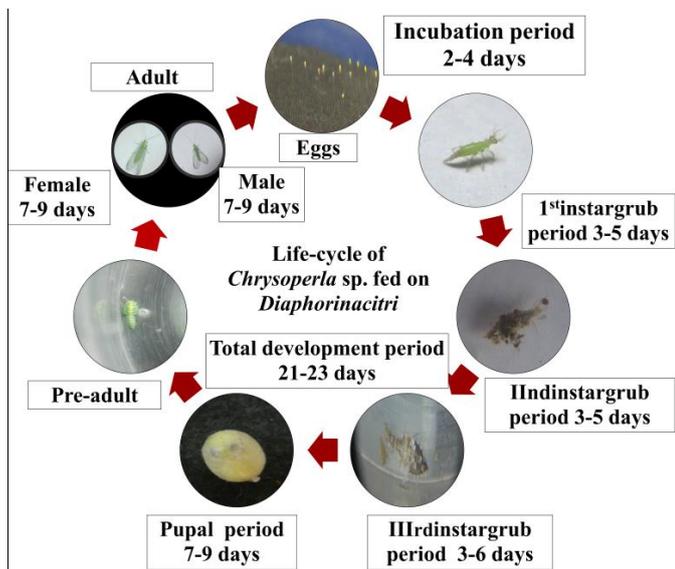


Fig 3: Life-cycle of *Chrysoperla sp.* fed on curry leaf psylla, *D. citri* under laboratory conditions.

Table 1: Life-cycle of *Chrysoperla sp.* fed on curry leaf psylla, *D. citri* under laboratory conditions

Sr. No.	Life stages	Periods (days)	
		Range	Mean ± S.D.
1.	Egg Period or Incubation Period	2-4	2.94±0.15
2.	Hatching percent	64-69	66.71±1.78
3.	Grub periods (days)		
	I Instar	3-5	4.05±0.10
	II Instar	3-5	3.7±0.20
	III Instar	3-6	4.4±0.28
	Total grub period (days)	9-16	12.15±0.58
4.	Pupal Period	7-9	8.1±0.20
5.	Total development period	21-23	23.19±1.03
6.	Pre-oviposition period	23-27	24.7±0.26
7.	Oviposition Period	6-8	6.7±0.26
8.	Fecundity (Number)	17-189	177.8±2.14
9.	Sex ratio	-	0.75:1
10.	Adult Longevity		
	Male	23-27	24.6±0.43
	Female	27-32	29.1±0.53

Conclusion

Thus, the present studies conducted on the biology of green lace wing, *Chrysoperla sp.* (Chrysopidae: Neuroptera) fed on curry leaf psylla, *Diaphorina citri* revealed that that the average incubation period and hatching percent was (2.94±0.15 days), (66.71±1.78 per cent) respectively, while the 1st, 2nd, and 3rd instar larval period had a mean duration of 4.05±0.10; 3.7±0.20 and 4.4±0.28 days respectively. Pupal period was of (8.1±0.20 days) and total developmental period was completed in 23.19 days. The mean pre-oviposition, oviposition period and fecundity was of 6.1±0.35 days, 6.1±0.35 days and 177.8±2.14 eggs respectively. Male longevity was 24.6±0.43 days and female longevity was 29.1±0.53 days in *Chrysoperla sp.* The sex-ratio of *Chrysoperla sp.* (M:F) was found to be of 0.75:1 indicating dominance of females in population.

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