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Biology of Big Eyed Bug, *Geocoris erythrocephalus* (Lepeletier & Serville) on Cabbage Aphid, *Brevicoryne brassicae* (L.)

S. Jesu Rajan[1]*, E. Sree Latha[1] and R. Sathish[2]

[1]Centre for Biocontrol Laboratory, National Institute of Plant Health Management (NIPHM), Hyderabad-500 030, Telangana, India
[2]Agricultural Polytechnic, Prof. Jayashankar TS Agricultural University, Hyderabad, India

**Corresponding author*

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A B S T R A C T

Biology of big eyed bug, *Geocoris erythrocephalus* (Lepeletier & Serville) was studied oncabbage aphid, *Brevicoryne brassicae* (L.) at Centre for biocontrol laboratory, National Institute of Plant Health Management (NIPHM), Hyderabad during 2017.Studies showed the incubation period as 8.20 ± 0.42 days. There were total five nymphal instars and average duration of each successive instar was 4.40 ± 0.52, 8.50 ± 0.53, 6.70 ± 0.48, 7.60 ± 0.52 and 5.20 ± 0.42 days, respectively. The average fecundity was 14.00 ± 3.06eggs with an oviposition period of 3.80 ± 0.63days. The adult longevity of male and female bugs was 7.40 ± 0.52 days and 11.50 ± 0.85days, respectively. The average total life cycle was completed in 40.60 ± 2.89 days.

Introduction

Geocoris is a genus of insects in the family Geocoridae commonly known as big eyed bugs. *Geocoris* species are considered to be among the most important predators in cotton, maize, alfalfa, soyabean, straw berry, pea nut and many other crops (Crocker and Whitcomb, 1980).They are commonly known as "big-eyed bugs" due to the characteristic large, prominent, widely separated eyes on both sides of their head. *Geocoris* species are important predators found in nature and agro-ecosystems (Sweet, 2000). They actively hunt their victims, and their big eyes give them a wide field of vision and boost their ability to locate prey. Once have found a meal, they insert their stylet ("needle sharp beak"), inject digestive enzymes, and then suck up the partially digested insides of their prey, leaving behind a hollow cadaver. Both the nymphs and adults feed on aphids, whiteflies, thrips, mites, and the eggs and larvae of caterpillars such as tobacco budworm, bollworm and soybean loopers (Bueno and Van Lenteren, 2012). In addition, they are also predators of plant bugs, especially the younger nymphs. According to Anonymous (2017) in one laboratory study, bigeyed bug nymph consumes an average of 151 tobacco budworm

eggs or 76 first instar larvae during the to complete all five nymphal instars in 21-31 days. Late instar nymphs consumed approximately 10 eggs per day (Anon., 2017). Like many predatory insects in this order, big eyed bugs also feed on nectar and directly on plants, causing little or no damage, but their populations may be affected by systemic insecticides.

Apparently scanty and scattered information is available on the biology of this predator in India. Hence, the present study was carried out under laboratory conditions to determine the life cycle of *G. erythrocephalus.*

Materials and Methods

Studies on the biology of *G. erythrocephalus* were conducted in Centre for biocontrol laboratory, National Institute of Plant Health Management (NIPHM), Hyderabad during 2017-18. Stock culture of the *G. erythrocephalus* was initiated by collecting large number of adults (male and female) from the sweet corn field of NIPHM, Hyderabad. The adults acclimatized under laboratory conditions by rearing for two generations on UV-irradiated *Corcyra cephalonica* Staint on eggs before initiating the experiments.

Biology

The adult *G. erythrocephalus* lays eggs singly on cottonwick or cloth (Richa and Ballal, 2017). Hence, from the lab reared *G. erythrocephalus* culture, one pair of adult was released into each glass beaker (1000 ml) covered with muslin cloth. Ten such sets were maintained. Each container was provided with UV-irradiated *C.cephalonica* eggs and cotton wick for egg laying. After every 24 h, cotton wicks were collected and observed under microscope to record number of eggs laid. Eggs were laid on cloth surface too. The eggs were counted and kept on sterilized blotting paper in small petri dishes to record incubation period. The petri dishes bearing the known numbers of eggs (10 eggs) were kept at laboratory temperature (27 to 30) and relative humidity (60 to 70) for studying different parameters. The emerging predatory nymphs were removed instantaneously with fine brush, kept in plastic boxes provided with cabbage aphids (*Brevicoryne brassicae)* as a food.

Ten freshly hatched nymphs per set were kept individually in plastic boxes provided *B. brassicae*. Observations were recorded on total number of instars, duration of each instar and total nymphal period. When adults were formed, they were collected and observed under microscope to differentiate the sex.The total number of eggs laid (fecundity) by each female during its lifetime, the longevity of male and female adults and their sex ratio were also recorded.

Host rearing

The cabbage leaves infested with aphids kept in plastic boxes were supplied as food for nymphs of *G. erythrocephalus* continuously starting from nymph to adult. The leaf stalks of aphid infested cabbage leaves endowed with water soaked cotton to prevent the drying of leaves.

Statistical analysis

Each experiment was replicated five times and the arithmetic mean and standard error of mean were estimated for all the parameters/observations. Range values were also estimated by pooling up the replication data for each parameter.

Results and Discussion

Females start laying eggs after a duration of 2-3 (av. 2.30 ± 0.48) days. The adult female lays eggs on cotton wick provided inside the

beaker. It indicated that, hairiness is preferable for egg laying by the adult females. A single female lays 10-21 (av.14.00 ± 3.06) eggs in 3-5 (av.3.80 ± 0.63) days of ovipositional period (Table 1).

Egg

The eggs of *G. erythrocephalus* were spindle shape laid singly on cotton fibrils. Eggs were light yellowish initially with two red spots at the blunt end. These two red eyespots help distinguish them from other insect eggs. As the days progress the eggs turns darker and red colour spots became prominent. These observations are in line with the Richa and Ballal (2017) who noticed similar observation on egg of *Geocoris superbus* Montandon. The incubation period ranged from 8 to 9 (av. 8.20 ± 0.42) days (Table 1). This result in corroborate with the Mansfield *et al.*, (2017) observed incubation period of 8.35 days in case of *Geocoris lubra* Kirkaldy.

Nymph

Geocoris nymphs look similar to adults, only smaller and without wings. Nymphal stages have similar behaviour and feeding habits as adults, but tend to feed on smaller prey. Bugs have undergone five nymphalin stars in 30-35(av.32.40 ± 2.47) days. The duration of I, II, III, IV and V instar nymphs were 4-5 (av. 4.40 ± 0.52), 8-9 (av.8.50 ± 0.53), 6-7(av. 6.70 ± 0.48), 7-8(av. 7.60 ± 0.52) and 5-6 (av. 5.20 ± 0.42) days, respectively (Table 1). The present findings are in line with the findings of Ramirez *et al.*, (2011) who noticed nymphs emerge and develop over 3-4 weeks. Young instars are tiny and are easily overlooked. With each successive instar they shed their skin, develop wing pads, and grow larger.

Table.1 Biology of big eyed bug, *G. erythrocephalus* under laboratory conditions

Sl.No.	Stage	Range	Duration (SE.m ± S.D)
1.	Pre- oviposition	2-3	2.30 ± 0.48
2.	Oviposition period	3-5	3.80 ± 0.63
3.	Post oviposition	4-6	5.40 ± 1.17
3.	Fecundity	10-21	14.00 ± 3.06
4.	Incubation period	8-9	8.20 ± 0.42
5.	Nymphal period		
	I Instar	4-5	4.40 ± 0.52
	II Instar	8-9	8.50 ± 0.53
	III Instar	6-7	6.70 ± 0.48
	IV Instar	7-8	7.60 ± 0.52
	V Instar	5-6	5.20 ± 0.42
	Total nymphalperiod	30-35	32.40±2.47
6.	Total life cycle	38-44	40.60 ± 2.89
7.	Sex ratio	1: 0.83-1:1.72	1:1.29
8.	Adult		
	Male	7-8	7.40 ± 0.52
	Female	10-13	11.50 ± 0.85

Adult

Adults are 3-5 mm (3/16 inch or less) long with 2 pairs of fully functional wings (forewings and hindwings). The forewings are hardened at the base and membranous at the tip. At rest the forewings cross over the back, one over the other, creating a triangle pattern behind the pronotum ("shoulders"), pointing toward the rear. Adult bugs exhibits sexual diamorphism. Females are bigger in size than males. Anterior portion of head (in between eyes) looks golden yellow in females whereas in males it looks brown.

After the adult formation females live longer than males. Longevity of female and males were 10-13 (av. 11.50 ± 0.85) and 7-8 (av. 7.40 ± 0.52) days, respectively (Table 1). Male and female ratio was observed to be 1:1.29. *G. erythrocephalus* took 38-44 (av. 40.60 ± 2.89) days for completion of its life cycle. For other *Geocoris* species, total developmental period of 40 days and 35 days were recorded in case of *Geocoris bullatus* (Say) and *Geocorispallens* Stål, respectively when reared on aphids, beans and sunflower seeds (Tamaki and Weeks, 1972) and 47.50 to 50.50 days in case of *G.superbus*reared on*Phenacoccussolenopsis* Tinsley(Richa and Ballal, 2017). Mead (2011) found the averagedevelopment time from egg to adult of bugs was 30 days. This variation in developmental period may be due to change in location.

In conclusion, the present study indicates that, this predator is effective on Cabbage aphid, *Brevicoryne brassicae* (L.) and further studies need to be done to confirm its feeding potential and to exploit this predator for control of aphids which attackvarious crops.

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