The Pharma Innovation Journal 2023; 12(3): 3485-3487

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3485-3487

www.thepharmajournal.com
Received: 22-01-2023
Accepted: 28-02-2023

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Biology of predatory reduviid bug, *Rhynocoris marginatus* (Fab.) on rice meal moth, *Corcyra cephalonica* (Stainton)

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Abstract
Studies on biology of reduviid bug, *Rhynocoris marginatus* reared on rice moth, *Corcyra cephalonica* were carried out at Entomology Laboratory, College of Horticulture, Mojerla. Experimental results revealed instar wise nymphal durations of 6.2±0.60, 7.4±0.49, 9.2±0.80, 12.1±1.20 and 22.3±1.40 days for I, II, III, IV and V instar, respectively, whereas, the adult male and female longevity was 91.20±4.45 and 118.4±6.40 days, respectively. The incubation period of eggs was 10.2±0.75days, fecundity and hatching percentage was 350±10.20 eggs per female and 85.50±5.20 percentage, respectively. Oviposition period was 50.4±4.47. The total developmental period for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* was shorter with higher fecundity due to ideal period for rearing under ambient conditions.

Keywords: Biology, Reduviid bug, *Rhynocoris marginatus*, instars and longevity

Introduction
Reduviid bugs, commonly called as the Assassin bugs or Kissing bugs are members of Reduviidae family, the largest family of predaceous Hemiptera. Reduviids are abundant, occur worldwide and are highly successful as a polyphagous predator. Predatory reduviid bug, *Rhynocoris marginatus* and *R. fuscipes* are important and effective predators of insect pests especially the larval stage. Effectiveness of these predators as biocontrol agents had been demonstrated, and the field releases usually result in quick and effective control of the target (Ambrose *et al*, 2010) [1]. Based on laboratory and field studies of pest suppression efficiency, it is known that *R. marginatus* consumes a broad range of prey (Bhoyar *et al*. 2021) [3]. The impressive prey record of *R. marginatus* prompted the authors to study the feasibility of utilizing this biological control agent by augmenting and subsequently releasing it into the agro-ecosystem. The present study was framed to study the biology of *R. marginatus on* lepidopteran prey *viz*., rice meal moth *Corcyrac ephalonica* (Stainton).

Materials and Methods
Rearing of reduviid bug, *Rhynocoris marginatus*
The culture of predatory reduviid bug, *Rhynocoris marginatus* was procured from the National Institute of Plant Health Management (NIPHM) Hyderabad, Telangana. The culture was reared under ambient conditions in the Entomology Laboratory, College of Horticulture, Mojerla. The adult was reared in the laboratory in glass chamber (60 x 45 x 45 cm) on rice meal moth, *Corcyra cephalonica*. *Rhynocoris marginatus* bugs were reared in ambient conditions during the period from July to December, 2022.
The adults were allowed to mate inside the glass chamber covered with lid having wents, corrugated sheet of paper placed inside as an ovipositional substrate. The glass chamber was examined carefully at regular intervals to record the oviposition. The foam dipped in 10% honey solution was placed in the container as an adult diet to increase the fecundity of reduviid bugs. The eggs laid, were allowed to hatch in petri dishes (10 x 2 cm) with wet cotton swab for maintaining optimum relative humidity. The cotton swabs were changed periodically in order to avoid fungal infection. Mated females were maintained individually in order to record the number of batches of eggs and number of eggs in each batch laid by them. Each batch of eggs was allowed to hatch in an individual container (Rajan *et al*., 2017) [6]. The number of eggs hatched from each batch was recorded to calculate the hatching percentage. Colour of freshly laid eggs and colour at the time of incubation and incubation period was also recorded.

All the newly hatched nymphs were reared individually in another set of petri plates (10 x 2 cm). Small sized larvae of *Corcyra* were provided to I and II instar nymph, while medium and large sized larvae were provided to III, IV and V instar nymphs, respectively. Observations on number of instars, duration of different instars and total developmental period were recorded.

Statistical analysis

The data from all replicates for a parameter was analysed (Table 1) for estimation of mean values along with standard deviation (Gomez and Gomez, 1994) [4].

Table 1: Biology of predatory reduviid bug, *R. marginatus* reared on rice moth, *C. cephalonica*

Parameters	Days (Mean duration ± SD)
Incubation period (Days)	10.2±0.75
Nymph	
First Instar (Days)	6.2±0.60
Second Instar (Days)	7.4±0.49
Third Instar (Days)	9.2±0.80
Fourth Instar (Days)	12.1±1.20
Fifth Instar (Days)	22.3±1.40
Total nymphal developmental period (Days)	57.20±2.49
Adult longevity	
Male (Days)	91.20±4.45
Female (Days)	118.4±6.40
Total life cycle	
Male (Days)	148.4±4.30
Female (Days)	175.60±6.50
Sex ratio (Male: Female)	0.8:1.0
Pre-oviposition period (Days)	23.0±1.90
Oviposition period (Days)	50.4±4.47
Post-oviposition period (Days)	13.1±1.90
Fecundity - Total no. of eggs/female	350±10.20
Egg Hatchability (%)	85.50±5.20

*n=20

Results

Biology of reduviid bug, *R. marginatus*

Eggs: Eggs were laid at the bottom and on the sides of the rearing glass chamber and also on the corrugated paper sheet. *R. marginatus* laid eggs in clusters with eggs glued to each other longitudinally and basally to the substratum. Freshly laid eggs were yellowish in colour. After 5 to 6 days, the fertilized eggs became brownish yellow and a few days before hatching turned to a bright red colour. The Incubation period was 10.2±0.75 days with hatching percentage of 85.50±5.20.

Nymphs: The study on biology of the Reduviid bug revealed five nymphal instars. Hatching of nymphs from the eggs was happened by upward pushing of the operculum by nymph, resulting in the emergence of neonate. The newly hatched nymphs were delicate and fragile. The colour of the nymph was light orange which darkened in 10 to 12 hours after hatching. A change in colour was observed one day after hatching, later on dark orange colour was observed in nymphs with legs black in colour. The posterior end of the abdomen became darker. The overall body was elongated and curved at the anal end and was translucent. It was noticed that the new hatchings preferred small and sluggish prey. The duration of the I, II, III, IV, V instar fed on *Corcyra cephalonica* was 6.2±0.60, 7.4±0.49, 9.2±0.80, 12.1±1.20 and 22.3±1.40 days, respectively The total stadial period from egg to adult was 57.20±2.49 days, the fifth nymphal instar being the longest.

Adults: The adult reduviid bugs were black to brownish in color with a narrow elongated distinct neck. Size of the females was markedly larger as compared to the males. The time taken for the development of one generation was 148.4±4.30 and 175.60±6.50 days for male and female, respectively. Female longevity was more (118.4±6.40 days), as compared to the males (91.20±4.45 days). The females lived longer than males. Experimental data revealed a female dominated sex ratio i.e. 0.8:1.0 (male: female). The pre-oviposition and post-oviposition period was 23.0±1.90 and 13.1±1.90 days, respectively, whereas, the oviposition period of 50.4±4.47 days was recorded. It was observed that the oviposition period was longer than the pre-oviposition period which is a desirable trait from the view point of biological control. The total number of eggs laid by a female bug was 350±10.20. The egg laying capacity of female gradually decreased with the age.

Discussion

The study on biology of predatory reduviid bug, *R. marginatus* on rice moth, *C. cephalonica* in the laboratory condition revealed pre-oviposition period and oviposition period of 23.0±1.90 and 50.4±4.47 days, respectively. which is in line with the findings of (Bhoyar *et al*. 2021) [3] who recorded pre-oviposition period and oviposition period of 25.0±2.10 and 56.4±4.47 days. The fecundity of reduviid bug under present experimental set up was 350±10.20 eggs per female, were in parallel with the findings of Pravalika (2015) [5] recorded higher fecundity of 380±11.92 eggs. The observations on the oviposition by reduviid bug revealed that the eggs were laid in batches and were glued to each other and were pale yellow in colour. These observations were supported by the findings of Ambrose and Livingstone (1989) [2]. The incubation period in present study was 10.2±0.75 days which was confirmed by Ambrose and Livingstone (1989) [2] who reported an incubation period of 9-13 days in *R. marginatus.* The nymphal development of *R. marginatus* comprised of five nymphal instars, was supported by Ambrose and Livingstone, 1989) [2]. When *R. marginatus* was fed with *C. cephalonica*, the developmental period was 57.20±2.49 days. The present result was in conformity with the observations of (Bhoyar *et al*. 2021) [3] who reported total nymphal period in the range of 58.70±2.38 days. They stated that the development and reproduction of reduviid bug was influenced not only by the ecological factors, but also by abiotic factors especially the prey. The total developmental time for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* was 148.4±4.30 and 175.60±6.50 days for adult male and female, respectively. It was also noted that the females lived longer than the males which was supported by the work of Kalidas and Sahayaraj, 2012. The sex ratio observed in present study was female biased (0.8 male:1.0 female) and was in line with the reports of Pravalika, 2015 [5] and Bhoyar *et al.* 2021 [3]. The total developmental period for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* was shorter with higher fecundity due to ideal period for rearing under ambient conditions.

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