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Bhoyar ES
Section of Agriculture Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Wadaskar RM
Assistant Professor, Section of Agriculture Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Dadhe CG
Section of Agriculture Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Sormare SG
Section of Agriculture Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Bhoyar ES
Section of Agriculture Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Influence of season on biology of predatory reduviid bug, *Rhynocoris marginatus*

Bhoyar ES, Wadaskar RM, Dadhe CG and Sormare SG

Abstract
Studies on biology of reduviid bug, *Rhynocoris marginatus* reared on rice moth, *Corcyra cephalonica* during *Kharif* and *Rabi* season were carried out at Biocontrol laboratory, Entomology section, College of Agriculture, Nagpur (Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola). Experimental results revealed instar wise nymphal durations of 7.1±0.99, 8.3±0.82, 10.1±0.99, 12.9±1.52 and 20±1.16 days for I, II, III, IV and V instar, respectively, whereas, the adult male and female longevity was 81.3±6.33 and 116.9±9.71 days, respectively in *Kharif* season. During the *Rabi* season, nymphal durations were 8.3±1.15, 11.2±1.61, 13.7±1.05, 17.9±1.52 and 22.3±1.33 days for I, II, III, IV and V instar, respectively with male and female longevity of 90.2±6.05 and 119.3±8.50 days, respectively. The incubation period of eggs was lower during the *Kharif* (9.0±0.65 days) than in *Rabi* season (9.4±0.96 days), similarly, fecundity and hatching percentage during *kharif* (279.8±13.38 eggs and 88.38±7.24%, respectively) was more than in *Rabi* season (240.4±12.23 eggs and 77.30±3.77%, respectively). Oviposition period of 56.4±4.47 and 61.6±2.98 days was recorded during *Kharif* and *Rabi* season, respectively. The total developmental period for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* during *Kharif* season was shorter with higher fecundity as compared to *Rabi* season indicating *Kharif* season as an ideal period for rearing under ambient conditions.

Keywords: biology, reduviid bug, *Rhynocoris marginatus*, effect of season

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. The prey records of 182 assassin bugs preying upon 267 insect pests belonging to diverse orders of Insecta (Ambrose and Kumar, 2016) [2] reveal their economic importance. Reduviid bugs are instrumental in managing nearly 20 insect pests.

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, 2010) [1]. Based on laboratory and field studies of pest suppression efficiency, it is known that *R. marginatus* consumes a broad range of prey (Sahayaraj, 2006), specifically pests like *S. litura*, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) and *D. cingulatus* in the field (Sahayaraj, 1999; Sahayaraj and Martin, 2003; Sahayaraj and Ravi, 2007) [10, 12].

The present study was thus framed to study the biology of reduviid bug under ambient conditions along with influence of season on the duration of various life stages.

Material and Method
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 Biocontrol Laboratory, College of Agriculture, Nagpur (Dr. PDKV, Akola). The adult was reared in the laboratory in gogglets (30 x 10 cm) on rice meal moth, *Corcyra cephalonica*. *Rhynocoris marginatus* bugs were reared in ambient conditions during the period of July to December referred as *Kharif* season in the script and October to March referred as *Rabi* season in the script.

The adults were allowed to mate inside the gogglet covered with muslin cloth with corrugated sheet of paper placed inside as an ovipositional substrate. The gogglets were 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 humidity (~85%). The cotton swabs were changed periodically in order to prevent 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) [8]. 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 of similar dimensions (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 colour, size, 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 for estimation of mean values along with standard deviation (Gomez and Gomez, 1994) [4].

Results

Biology of reduviid bug, *R. marginatus*

Eggs: Eggs were laid at the bottom and on the sides of the rearing glass gogglets and also on the muslin cloth cover. *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 they donned a bright red colour.

The Incubation period during *Kharif* season was 7.1±0.99 days with hatching percentage of 88.38±7.24 whereas, during *Rabi* season incubation period of 9.4±0.96 days was evident with hatching percentage of 77.30±3.77. The incubation period in *kharif* season was less as compared to the *Rabi* season, which is desirable trait in biological control.

Nymphs: The study on biology of the Reduviid bug revealed five nymphal instars. Hatching of nymphs from the eggs was affected 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 8 to 10 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 stadial duration of the I, II, III, IV, V instar fed on *Corcyra cephalonica* during *Kharif* season was 7.1±0.99, 8.3±0.82, 10.1±0.99, 12.9±1.52 and 20±1.16 days, respectively whereas, during *Rabi* season, the instar wise stadial duration of 8.3±1.15, 11.2±1.61, 13.7±1.05, 17.9±1.52 and 22.3±1.33 days was recorded for I to V instar, respectively. The total stadial period from egg to adult during *kharif* season was 58.7±2.62 days whereas, it was 73.4±2.31days during the *Rabi* season, the fifth nymphal instar being the longest. The nymphal development during *kharif* season was faster than the *Rabi* season.

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. During *Kharif* season, the time taken for the development of one generation was 147.75±5.11 and 175.55±9.66 days for male and female, respectively. Female longevity was more (116.9±9.71 days), as compared to the males (89.1±5.65 days). During the *Rabi* season, the generation developmental period was 163.6±8.11 and 192.7±6.62 days for male and female reduviid bugs, respectively. The longevity of adult male and female was 90.2±6.05 and 119.3±8.50 days, respectively.

Table 1: Influence of season on various life stages of predatory reduviid bug, *R. marginatus* reared on rice moth, *C. cephalonica*:

Parameters	Mean duration ± SD	
	***Kharif* season**	***Rabi* season**
Incubation period (Days)	9.0±0.65	9.4±0.96
Nymph		
First Instar (Days)	7.1±0.99	8.3±1.15
Second Instar (Days)	8.2±0.79	11.2±1.61
Third Instar (Days)	10.1±0.97	13.7±1.05
Fourth Instar (Days)	12.9±1.45	17.9±1.52
Fifth Instar (Days)	20.3±1.13	22.3±1.33
Total nymphal developmental period (Days)	58.7±2.38	73.4±2.31
Adult longevity		
Male (Days)	89.1±5.65	90.2±6.05
Female (Days)	116.9±9.45	119.3±8.50
Total life cycle		
Male (Days)	147.75±5.11	163.6±8.11
Female (Days)	175.55±9.66	192.7±6.62
Sex ratio (Male: Female)	0.8:1.0	0.75:1.0
Pre-oviposition period (Days)	25.0±2.10	29.1±2.28
Oviposition period (Days)	56.4±4.47	61.6±2.98
Post-oviposition period (Days)	15.4±3.16	22.2±1.58
Fecundity - Total no. of eggs/female	279.8±13.38	240.4±12.23
Egg Hatchability (%)	88.38±7.24	77.30±3.77

*n=20

The females lived longer than that of males. Experimental data revealed a female dominated sex ratio i.e. 0.8:1.0 (male: female) and 0.75:1.0 (male: female) during *Kharif* and *Rabi* season, respectively. The pre-oviposition and post-oviposition period was 25.0±2.10 and 15.4±3.16 days, respectively, whereas, the oviposition period of 56.4±4.47 days was recorded during *Kharif* season. During the rabi season, the pre-oviposition and post-oviposition period were 29.1±2.28 and 22.2±1.58 days, respectively, whereas, the oviposition period of 61.6±2.98 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 279.8±13.38 and 240.4±12.23 eggs during *Kharif* and *Rabi* season, respectively. The egg laying capacity of female gradually decreased with the age. The fecundity during the *Kharif* season was more as compared to *Rabi* season.

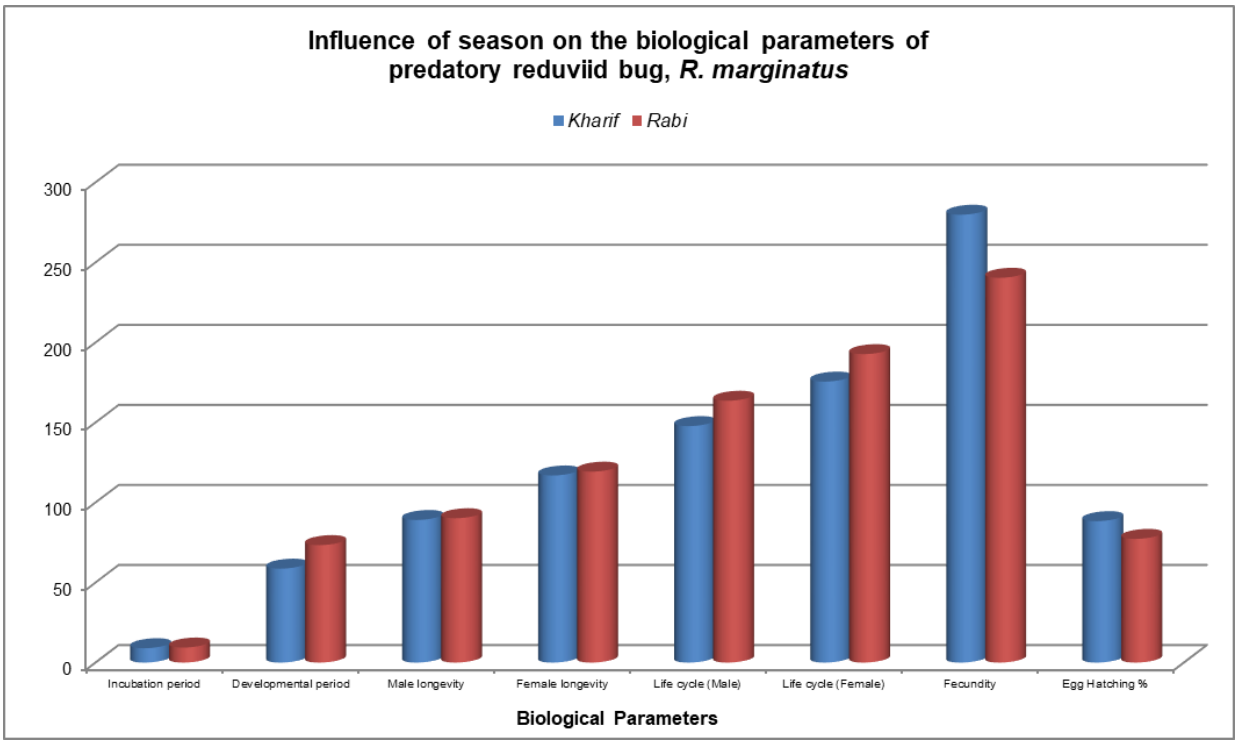

Fig 1: Influence of season on the biological parameters of predatory reduviid bug, *R. marginatus*

Discussion

The study on biology of predatory reduviid bug, *R. marginatus* on rice moth, *C. cephalonica* in the laboratory condition revealed pre-oviposition period of 25.0±2.10 days during *Kharif* season and 29.1±2.98 days during *Rabi* season, which was more than the findings of Sahayaraj and Paulraj (2001) [11] who recorded pre oviposition period of 18.64±0.76 days. Reports of Kumarswamy and Ambrose, 1992 are contrary to the present findings who reported a smaller pre oviposition period of 13 days which may be the effect of conditions under which rearing was done; as the present study was under ambient conditions of the laboratory. The fecundity of reduviid bug under present experimental set up was 279.8±13.38 eggs per female, but, Sahayaraj and Paulraj (2001) [11] and Pravalika (2015) [7] recorded higher fecundity of 405.28±22.15 and 380±11.92 eggs, respectively, which again may be attributed to the rearing under controlled environmental conditions.

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) [3]. The incubation period in present study was 9-10 days which was confirmed by Ambrose and Livingstone (1989) [3] who reported an incubation period of 9-13 days in *R. marginatus*, but, the study of Sahayaraj and Paulraj (2001) [11] reported incubation period of 6.81±0.10 days, lesser than the present findings. On the contrary, Pravalika (2015) [7] recorded an incubation period of 14.4±0.9 days which was higher than the present values. The variation in values can be attributed to difference in temperature and humidity regime during the rearing.

The nymphal development of *R. marginatus* comprised of five nymphal instars (supported by Ambrose and Livingstone, 1989) [3]. During *Kharif* and *Rabi* season when *R. marginatus* was fed with *C. cephalonica*, the developmental period was 58.7±2.38 days and 73.4±2.31 days, respectively. The present result was in conformity with the observations of Ambrose and Livingstone (1989) [3] who reported total nymphal period in the range of 39-85 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. Pravalika (2015) [7] also studied the biology of *R. marginatus* on *C. cephalonica* and observed the developmental period of 70.2±1.58 days which was more than the present study done in *Kharif* season and can be attributed to difference in the rearing conditions.

The total developmental time for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* during *Kharif* season was 147.75±5.11 and 175.55±9.66 days for adult male and female, respectively, whereas, it was 163.6±8.11 and 192.7±6.62 days, respectively during the *Rabi* season indicating the effect of season. It was also noted that the females lived longer than the males which was supported by the work of Kalidas and Sahayaraj, 2012 [5]. The sex ratio observed in present study was female biased (0.8 male:1.0

female during *Kharif* and 0.75 male:1.0 female during the *Rabi* season) and was in corroboration with the reports of Pravalika, 2015 [7]; Ambrose and Livingstone, 1989 [3] and Sahayaraj, 2002 [9]. The total developmental time for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* during *kharif* season was shorter with higher fecundity, whereas, it required more developmental period with lower fecundity during *Rabi* season indicating the *Kharif* as an ideal season for rearing of the reduviid bugs.

Conclusion

The total developmental period for predatory bug, *R. marginatus* reared on rice moth, *C. cephalonica* during *Kharif* season was shorter with higher fecundity as compared to *Rabi* season indicating *Kharif* season as an ideal period for rearing under ambient conditions though the seansons very grearlty influences the lifecycle of reduviid bug.

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