Biology and Stage Preference of Assassin Bug, *Rhynocoris marginatus* (Fabricius) (Heteroptera: Reduviidae) on Cutworm, *Mythimna separata* (Walker) a Pest of Cereal crops

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ABSTRACT: The Cutworm, *Mythimna separata* (Walker), a serious pest of many cultivated crops was evaluated as prey for the reduviid predator, *Rhynocoris marginatus* Fab. The developmental duration, feeding potential and survival per cent of predator was investigated in the laboratory. Observations clearly indicated that the total developmental period of the predator were 72.9±1.56 days. The number of prey required for its development from egg to adult was 21.2±3.5 third instar larvae. Larval and adult survival was 60% on a diet of only *M. seperata* larvae. The fourth instar larvae were highly preferred (33.9%) followed by fifth (24.9%) and third (22.0%) instars. First and second instar larvae were least preferred. The predator offers great bio-control potential for management of cutworms in multi crop ecosystems.

Key words: Biological control, maize, pearl millet, rice, sorghum,

Introduction

The cut worm *Mythimna separata* (Walker) is a serious pest of cereal crops in Asia and Australia (Sharma *et al.,* 2002) and affects many graminaceous crops like maize, sorghum, pearl-millet, rice and wheat. It has been reported to feed in nature, on 33 plant species and some unspecified weeds belonging to eight plant families (Sharma and Davies, 1983). Defoliation by *M. separata* can reduce up to 46 per cent of maize yield (Hill and Atkins, 1982). In 1983, a serious outbreak of armyworm occurred in maize seedlings in Himachal Pradesh, almost completely destroying the crop (Thakur *et al.,* 1987). The caterpillars are gregarious, polyphagous and a long-distance migratory insects (Jiang *et al.,* 2011). Many bio-control agents have been recorded as mortality factors for this cutworm (Mallapur, 1997; Sharma *et al.,* 2004). *Cotesia ruficrus* was the principle mortality factor, which caused up to 47% parasitism. Very little work has been done on deployment of generalist predators for the management of cutworms.

Reduviidae is the largest family of predaceous terrestrial Heteroptera and many of its members are found to be potential predators of a number of insect pests (Ambrose, 2003). Since they are polyphagous, they are valuable predators in situations where a variety of insect pests occur and for pests that occur across crops. Among reduviid predators, *Rhynocoris marginatus* Fabricius has been reared successfully in the laboratory and deployed against many lepidopteran pests of crops like groundnut (Sahayaraj and Martin, 2003).

Although *R. marginatus* is a general predator, it exhibits a certain degree of host specificity and prefers a particular stage of prey. Hence, knowledge on the prey stage preference of this polyphagous predator is imperative before employing it in biological warfare (James, 1994). Such an understanding will facilitate the augmentation of the predator for biological control programmes. Predators reared on preferred prey stage develop faster with lesser nymphal mortality of *R. marginatus* (Samways and Wilson, 1988), since the preferred stage will provide more energy and the predator could search the prey quickly and handle it easily. The present investigation was therefore undertaken to study the biology and stage preference of *R. marginatus* on *M. separata* in the laboratory.

Materials and Methods

Collection and culture of predator

Adults and nymphs of *R. marginatus* culture was obtained from National Institute of Plant Health and Management, Rajendranagar, Hyderabad, India and reared under laboratory conditions (Temp. 25°C ± 2°C and 75 ± 5% RH) on the larvae of factitious host, *Corcyra cephalonica*.

Collection and maintenance of *Mythimna separata*

The larvae of the cut worm, *M. separata* were collected from fields of ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad. The field collected larvae were reared on baby corn and maintained in the laboratory. Larvae from the second generation onwards were used for the experiment.

Biology and stage preference of *Rhynocoris marginatus*

Adult male and female predators were released in a plastic box (10 cm length 7 cm width and 4 cm height) for mating and the females were then released into individual petri plates for egg laying. The eggs were kept for hatching in individual plastic boxes (10 cm length 7 cm width and 4 cm height) lined with

slightly moist absorbent cotton and filter paper. After hatching, first instar nymphs were kept in the container until they moult and were provided with *M. separata* larvae. After moulting, nymphs were shifted to individual petri dishes and reared up to adult stage. Data was recorded on the size and weight of each instar, morphological characters, nymphal duration, pre-oviposition and oviposition period, fecundity, incubation and adult longevity of both males and females.

To understand the stage preference of *R. marginatus* towards *M. separata*, five different stages of larvae were introduced separately into different sets of plastic containers (16 x 7 cm). A 24 hrs pre-starved adult predator was released into the container with two larvae each of different stages. Five replicates were maintained and observations were made on the stage of the prey that was more preferred by the predator for five days

Results and Discussion

The total nymphal duration of *R. marginatus* reared on *M. separata* was 72.9 ±1.56 days (Table 1). The developmental period of various instars ranged from 14.7 to 20.7 days respectively. The survival percentage ranged from 60-100 percent for various nymphal stages. First instar nymph of *R. marginatus* required 2.0 ± 0.1 larvae per day during its development, where as II, III and IV instar nymphs required 2.4 ± 0.3, 3.5 ± 0.8 and 5.3 ± 1.0 larvae per day, respectively. Maximum predation rate was observed during the fifth instar, which fed on 8.02 ± 1.3 larvae per day during its development period. A total of 21.2 ± 3.5 larvae were required per predator for total development of *R. marginatus*. Present results were in conformation with the observations of Ambrose and Maran (1999). The total developmental period of this predator on S. litura, a most preferred host, was observed to be 46.71±1.58 days (Sahayaraj and Paulraj, 2001). But the survival percentage was quite high when Mythimna was offered as prey, indicating its potential for augmentative bio-control.

Percentage preference of *R. marginatus* to various stages of its prey larvae is presented in the Figure 1. The predator expressed higher preference for the fourth instar (33.9%) larvae though third and fifth instars were also preferred. The offered stage was ranked for preference by individual predators and the rank data was subjected to Kruskal-Wallis non parametric analysis for ascertaining individual prey preference of the predator tested (Figure 2). The overall H-statistic indicated a high level of significance for stage preference opposing the null hypothesis that all stages will be equally preferred (Shapiro-Wilk statistic of normalcy 0.95 at P-value 0.000; Kruskal-Wallis statistic 40.70 at P-value <0.001 assuming a chi-square distribution with 4 df). The means separated by Fisher's LSD showed that preference for third instar and fourth instar was highest. The two tests indicate a preference for third to fifth instar larvae in general.

Consumption of prey in relation to prey size and predator preference towards relatively large size prey due to higher benefit per unit effort (Hassell *et al.,* 1977) might be the reason for *R. marginatus* preference towards third and fourth instar of the prey. Stage preference of reduviids such as *A. pedestris* Stal and *Alloeocranum quadrisignatum* Reuter was apparently determined by their size in relation to their prey size (Ambrose, 2003; Cogni *et al.,* 2002) while observing the influence of prey size on predation success by *Zelus longipes* L. on three lepidopteran larvae observed that though different sized caterpillars were attacked with same frequency, the successful attacks were more frequent in small larvae than medium and large sized ones.

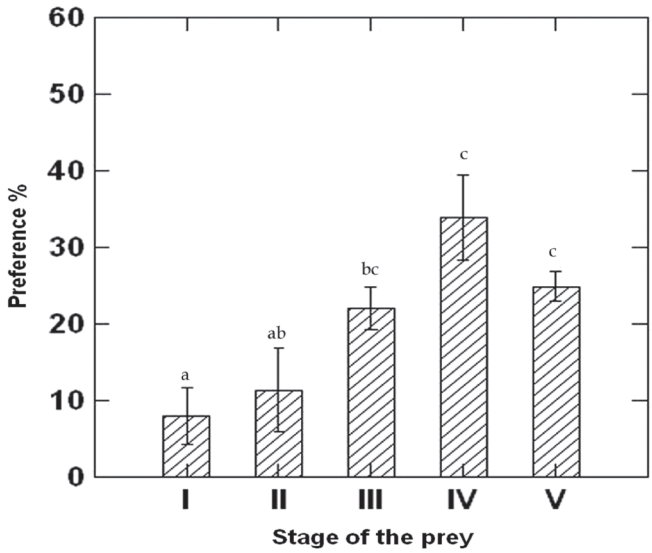

Fig 1. Stage preference of *Rhynocoris marginatus* to different stages of *Mythimna separata*, (n= 15; P=0.01; CD=13.23)

Table 1 : Biology of *Rhynocoris marginatus* on *Mythimna separata*

Stages	Mean duration ± SE (Days)	Mean No. of prey eaten/ predator/day	Survival %	Mortality %
I Instar	14.7±0.28	2.0±0.1	100.00	0.00
II Instar	11.4±0.24	2.4±0.3	80.00	20.00
III Instar	13.8±0.40	3.5±0.8	73.30	7.00
IV Instar	12.3±0.30	5.3±1.0	66.60	6.70
V Instar	20.7±0.33	8.02±1.3	60.00	6.60
Total developmental duration	72.9±1.56			

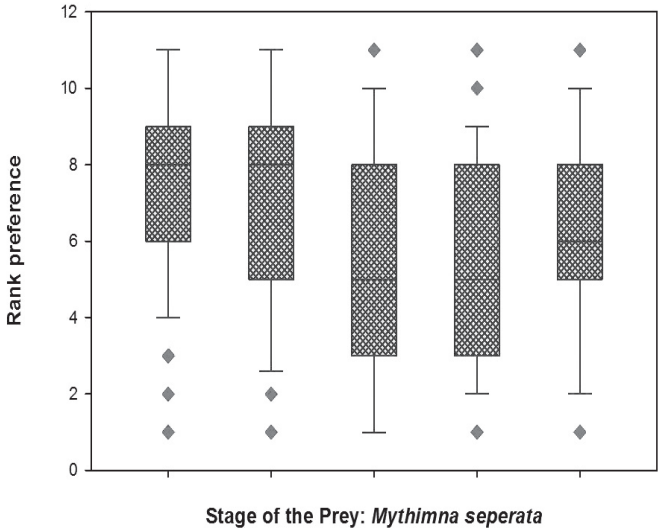

Fig. 2 : Rank preference of *R. marginatus* to different stages of *Mythimna separata*

Conclusion

R. marginatus has significantly reduced the incidence of two other noctuid polyphagous pests, *S. litura* and *Heliothis armigera* (Sahayaraj and Martin, 2003). The ease and success in mass multiplication of *Rhynocoris marginatus* on the factitious host *Corcyra cephalonica* and its successful deployment for biological control of pests in cotton and groundnut indicate that it can also be successfully used for management of cutworms in cereal crops.

Kurskal-Wallis analysis of the average ranking of prey preference of *Rhynocoris marginatus* (n = 25). The box represents the inter quartile range (25th to 75th percentile) of the data, and the line in the centre of the box is the median value of prey preference. The dots are outliers, and the whiskers are the outer range of data. (Shapiro–Wilk statistic of normalcy 0.95 at P-value 0.000; Kruskal–Wallis statistic 40.70 at P-value <0.001 assuming a chi-square distribution with 4 df).

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