

Size preference and functional response of the reduviid predator *Rhynocoris marginatus* Fabricius (Heteroptera : Reduviidae) to its prey *Spodoptera litura* (Fabricius) (Lepidoptera : Noctuidae)

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ABSTRACT : Laboratory and field cage experiments were carried out to assess the prey and size preference of the reduviid predator *Rhynocoris marginatus* Fabricius. It preferred *Spodoptera litura* (Fabricius) over *Euproctis mollifera* Walker and *Mylabris pustulata* Thunberg. The relationship between preference for different sizes of *S. litura* and the predator, was directly proportional. Functional response of adult female *R. marginatus* to its most preferred prey size of *S. litura* revealed that the predator responded positively to the changing abundance of prey and exhibited Holling's second model of functional response. The possibilities of utilising *R. marginatus* to control *S. litura* in cotton ecosystem is discussed.

KEY WORDS : Cotton ecosystem, *Euproctis mollifera*, functional response, *Mylabris pustulata*, *Rhynocoris marginatus*, size preference, *Spodoptera litura*

Reduviids constitute an important group of predatory insects (Ambrose, 1988). Lack of knowledge on the natural history of reduviids limits their effective utilization as biocontrol agents in IPM programmes. *Rhynocoris marginatus* is an excellent general predator predominantly found in agroecosystems, scrub jungles and semi-arid zones bordering agroecosystems in India.

Although reduviids are polyphagous predators, they exhibit a certain degree of host specificity and preference for a particular size of prey. They attack a greater number of prey at higher prey density than at a lower prey density (McMahan, 1983; Ambrose, 1995). To evolve strategies for mass rearing and release of this predator into the agroecosystem to manage insect pests, it is necessary to evaluate the

biocontrol potential of the predator. Studies were conducted in field cages to generate information on its preference to prey species and prey sizes and the functional response to its most preferred prey to understand the prey-predator interaction.

MATERIALS AND METHODS

The adults and nymphs of *R. marginatus* collected from Sivanthipatti scrub jungles and bordering agroecosystems (77°47' E and 8°30' N), were mass reared in the laboratory (30°C to 32°C temperature, 12-13 h photoperiod, 76-80% relative humidity) in plastic troughs (10 litres) on tobacco caterpillar *Spodoptera litura* (Fabricius) following the method of Claver *et al.* (1996). *Spodoptera litura* larvae were collected from cotton agroecosystem at V. M. Chatram (5 km from Sivanthipatti) and mass reared on cotton and castor leaves. The predators and prey reared in the laboratory were used in the experiments.

Prey preference

To assess the prey preference of *R. marginatus* to *S. litura*, *Euproctis mollifera* Walker (Lepidoptera : Lymantriidae) and *Mylabris pustulata* Thunberg (Coleoptera : Meloidae) a choice test was conducted. Ten newly emerged adult female predators were placed in a rearing mesh cage (38 x 38 x 5 cm). The three different prey species (ten each) were introduced into the cage and placed on the leaves of a potted cotton plant. Prey preference was assessed in terms of the prey consumed by the predator in 24 h.

Size preference

The size preference of *R. marginatus* to the different larval sizes of *S. litura* was evaluated by a choice experiment. Life stages of *R. marginatus* (newly moulted, I, II, III, IV and V nymphal instars and adult males and females) were tested against five different size groups of *S. litura* larvae (0.1 - 0.5, 0.6 - 1.0, 1.1 - 1.5, 1.6 - 2.0 and 2.1 - 2.5 cm long). Life stages of *R. marginatus* were introduced into a mesh cage and the prey larvae (ten of each size) were placed on the leaves of a cotton plant. Size preference of each stage of predators was assessed separately in terms of rate of consumption consecutively for three hours. Six replicates were maintained for each life stage of the predator.

Functional response

Newly emerged adult females of *R. marginatus* starved for 48 h were used in this experiment. The functional response experiments were performed in cotton ecosystem at V. M. Chatram. The branch terminals of flowering plants were covered by small nylon mesh branch cages (10 x 15 cm). The functional response of adult female *R. marginatus* to *S. litura* larvae was assessed at different prey densities viz., 1, 2, 4, 8 and 16 prey/predator, respectively. After every 24 h the number of prey consumed or killed was monitored and the prey number maintained constant by replacing them with fresh prey throughout the experimental period. Six replicates were maintained for each prey density.

Logarithmic regression analysis was used to evaluate the response (Daniel, 1987).

RESULTS AND DISCUSSION

Prey preference

The mean prey preference is presented in Fig. 1. The preference was significantly higher for *S. litura* than for *E. mollifera* and *M. pustulata*. The soft cuticle and slow movement of *S. litura* might have enhanced the preference of the predator.

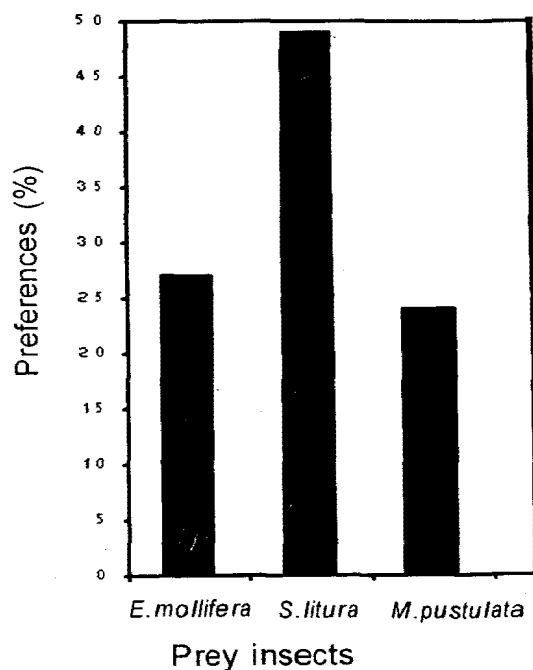


Fig.1. Prey preference of *R. marginatus* to *S. litura*, *E. mollifera* and *M. pustulata*

The pinned *S. litura* caterpillars were found to roll themselves and emit greenish viscous fluid in self defense. However, this behaviour of the caterpillar did not deter the predator as observed in the case of *Acanthaspis pedestris* Stål by Sahayaraj and Ambrose (1994).

Although the hairy caterpillar *E. mollifera* moves slowly, it builds a web around it and this behaviour might have prevented attack by the predator. Reduviid predators, generally, prefer lepidopteran caterpillars (Edwards, 1962; Ables, 1978). Presence of hard exoskeleton and its blister secretion might have deterred the predator from feeding on *M. pustulata*. Hattingh and Samways (1992) reported that the ability of predatory insects to choose between prey types has an important bearing on the outcome of a biocontrol programme suggesting the biocontrol utility of *R. marginatus*.

Size preference

First instar *R. marginatus* preferred less than 1 cm long *S. litura* larvae, reflecting a narrow range of size preference. The second nymphal instar preferred 0.1 to 1.0 cm long *S. litura* larvae followed by 1.1 to 1.5 cm. The third and fourth nymphal instars preferred 0.1 to 2.0 cm long *S. litura* larvae (Fig. 2). The size preference of fifth nymphal instar and adult (both males and females) ranged inbetween 0.6 to 2.5 cm size groups. The fifth instar and adult females preferred 2.0 to 2.5 cm long larvae two to three times more than adult males. This suggests that the fifth instar and the adult predators were more successful in encountering the largest size group of *S. litura* larvae. Size group preferences exhibited by the life stages of *R. marginatus* could be attributed to the dynamics of prey-predator interaction

which is principally governed by the size (Richman *et al.*, 1980; McMahan, 1983; Sahayaraj and Ambrose, 1994).

Functional response

Rhynocoris marginatus responded to the increasing prey density of *S. litura* by

killing more number of prey than at lower prey densities; thus exhibiting type II functional response (Holling, 1959). The number of prey killed (y) by the individual predator increased as the prey density (x) was increased from one prey per predator to 16 preys per predator (Table 1). The positive correlation between the prey

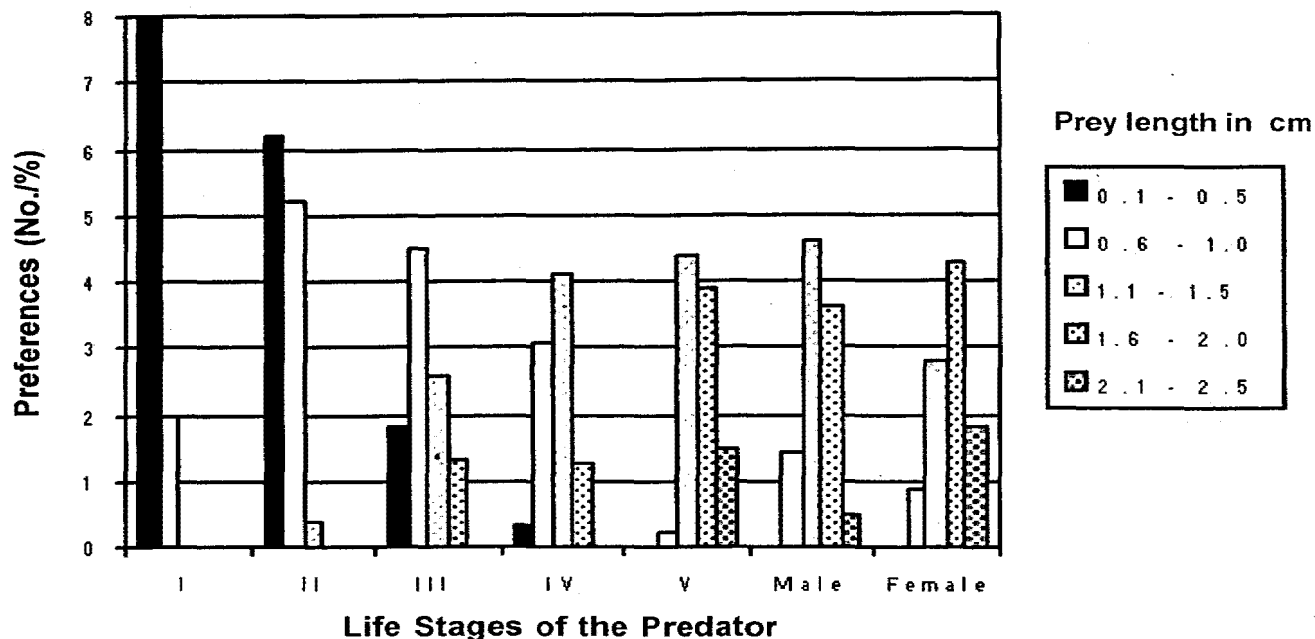


Fig. 2. Preferences of life stages of *R. marginatus* of different size groups of *S. litura* larva

Table 1. Cumulative functional response for adult female of *R. marginatus* to *S. litura*

Prey density (x)	Prey attacked (y)	Max. y (K)	Days per y(b) Tt/k	Days all y's (by)	Days searching (Ts) Tt-by	Attack ratio (y/x)	Rate of discovery y/x ÷ Ts
1	3.83	19.3	0.343	1.31	4.69	3.83	0.82
2	7.33	-	-	2.51	3.49	3.67	1.05
4	9.00	-	-	3.09	2.91	2.25	0.77
8	15.83	-	-	5.43	0.57	1.98	3.47
16	17.50	-	-	6.00	-	1.09	-
							<u>1.53</u>

$$Y = a (Tt-by)x = 1.53 (6-0.34)x$$

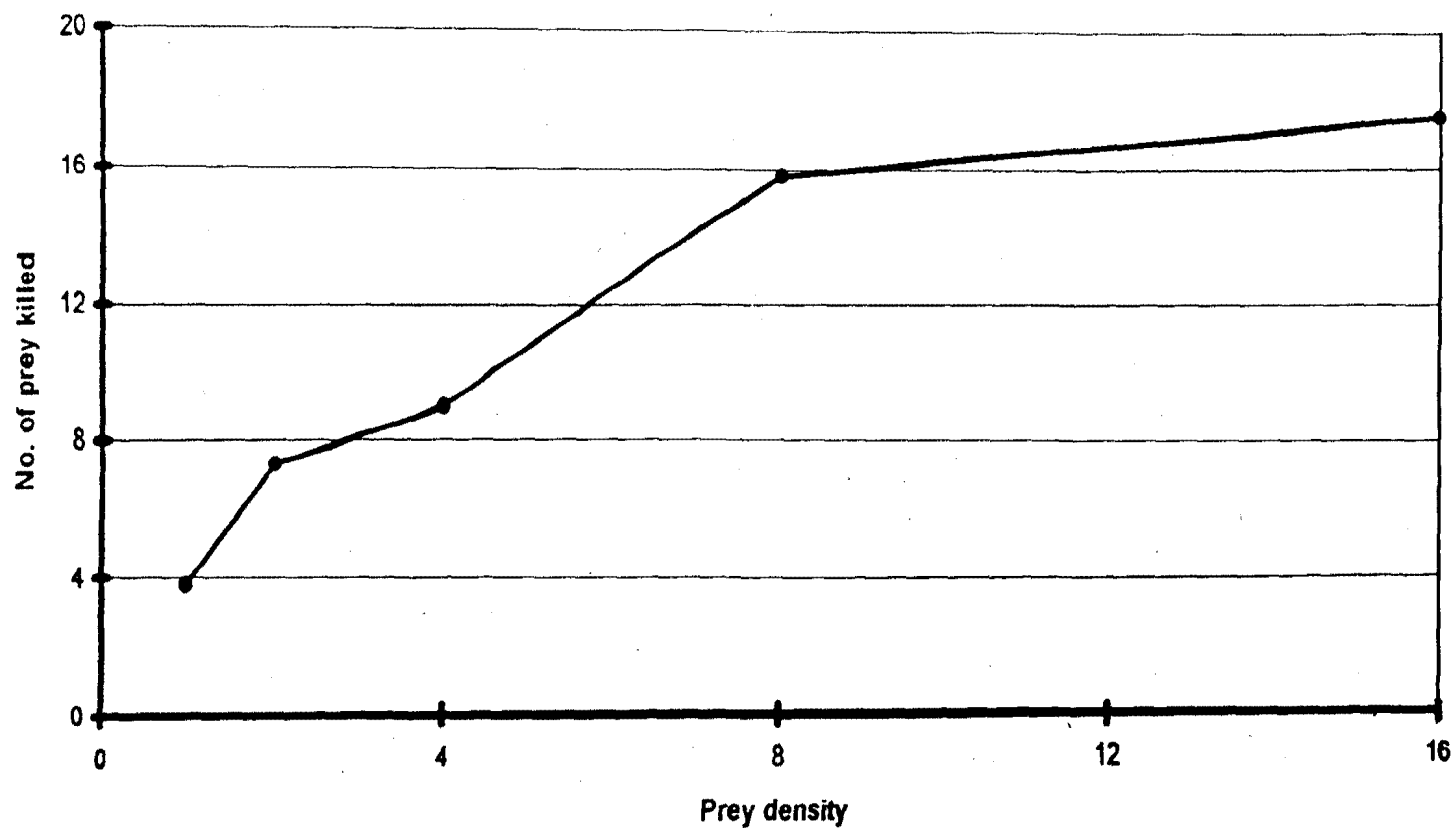


Fig. 3. Functional response of *R. marginatus* to *S. litura*

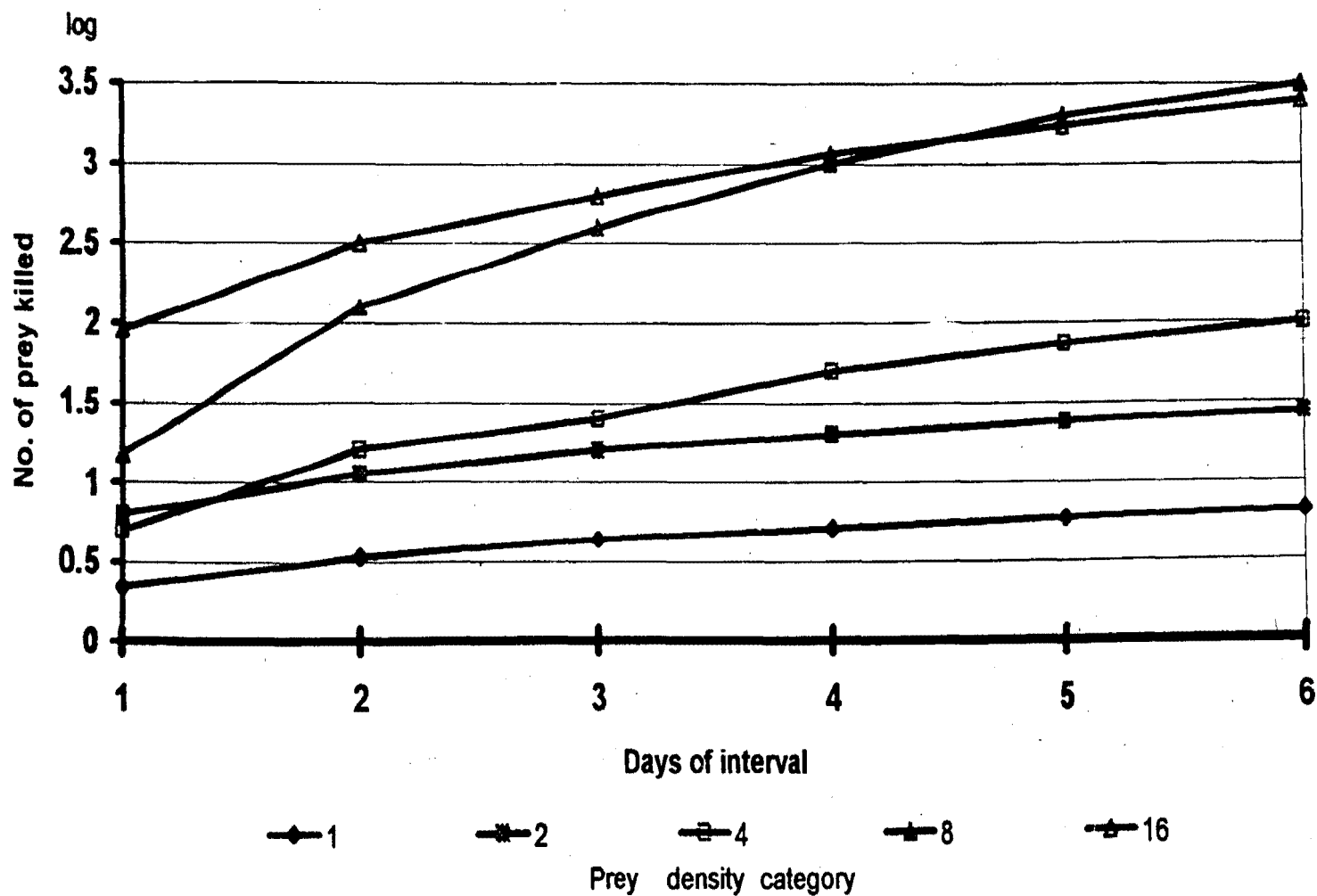


Fig.4. Cumulative number of *S. litura* killed by *R. marginatus* as the age of the latter increased.

density and the prey killed also confirmed this during the first six days of observation ($\log y = 3.53 + 5.17 \log x$; $r = 0.979$). Similar results were also reported for other reduviids (Bass and Shepard, 1974; Awadallah *et al.*, 1984; Ambrose and Kumaraswami, 1990; Sahayaraj and Ambrose, 1994; Ambrose *et al.*, 1996).

The maximum predation was represented by 'K' value and in *R. marginatus* the 'K' value was always restricted to the higher prey density ($K = 9.20$), because time for searching of prey required was less at higher prey density as reported by Morris (1963). The predation rate showed a steep rise from two to eight prey densities (Fig. 3). The highest attack ratio was observed at the density of one prey/predator and the lowest attack ratio was found at the density of 16 preys/predator (Table 1). Hence the attack rate decreased as the prey density increased ($\log y = 3.998 - 1.03 \log x$; $r = 0.972$). The indirectly proportional relationship found between the attack rate and the prey level was similar to the observation of Propp (1982). Hassell *et al.* (1976) stated that the attack rate decreased with increasing prey density in the case of predators having type II functional response.

A negative correlation was obtained between the prey density and the searching time ($\log y = 4.856 - 1.867 \log x$; $r = 0.966$) of the predator at all prey densities. The rate of predation in two, four, eight and sixteen prey density categories increased along with the age of the predator except in one prey category. Fig. 4 shows that

mean number of prey killed by *R. marginatus* increased at various prey densities from 1-6 days interval. The anthocorid *Xylocoris flavipes* (Reuter) and the pentatomid *Podisus maculiventris* (Say) killed more prey as exposure time and density of prey increased (Morris, 1963; LeCato and Arbogast, 1979). The present observations indicate the capability of *R. marginatus* to suppress *S. litura* population in cotton agroecosystem and its potential as a biocontrol agent.

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