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Functional response of *Rhynocoris fuscipes* Fabricius (Heteroptera : Reduviidae) to *Riptortus clavatus* Thunberg (Heteroptera : Alydidae)

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ABSTRACT : Functional response of the reduviid predator, *Rhynocoris fuscipes* Fabricius to the bean bug *Riptortus clavatus* Thunberg was studied in pigeonpea branch terminals using field cages. *Rhynocoris fuscipes* positively responded to the changing abundance of prey and exhibited Holling's second model of functional response. The searching capacity of *R. fuscipes* increased with increasing prey density. The considerable number of prey consumed by the predator per day at higher prey density than at lower density reflected the predator's biocontrol potential

KEY WORDS : Functional response, handling time, prey density, *Rhynocoris fuscipes*, *Riptortus clavatus*, searching time

Rhynocoris fuscipes Fabricius is an excellent predator predominantly found in agro-ecosystems, scrub jungles and semi-arid zones bordering agro-ecosystems in India. It was found to be one of the most important predators of insect pests of cotton, maize, black gram and green gram (Singh and Singh, 1987; Ambrose, 1995). *Riptortus clavatus* Thunberg is a serious pest of cotton, cereals and pulses. *Rhynocoris fuscipes* was found voraciously predating upon nymphs of *R. clavatus* on pigeonpea, *Cajanus cajan* L. Millsp. in the field. Hence, an attempt was made to study the functional response of *R. fuscipes* to *R. clavatus* to understand the basic mechanism underlying the prey-predator interaction and to evolve strategies for mass rearing and subsequent release of this predator into the agro-ecosystem to manage *R. clavatus*.

MATERIALS AND METHODS

The nymphs and adults of *R. fuscipes* collected at Sivanthipatti, Nellai Kattabomman District, Tamil Nadu (77° 47' E and 8° 30' N)were reared in the laboratory (30°C - 32°C) in separate plastic containers (7 x 7 x 4 cm) on *Corcyra cephalonica* Stainton larvae. Newly moulted adult females of *R. fuscipes* were used in this experiment. The functional response experiments were conducted in pigeonpea agro-ecosystem at V.M. Chatram village five km north east of Sivanthipatti. The branch terminals of flowering plants were covered with small nylon mesh branch cages (10 x 15 cm) (Pickett *et al*., 1987). Predators starved for 48 h were used in this experiment. The functional response of adult female *R. fuscipes* to fourth instar *R. clavatus* was assessed at six different densities *viz*., 1, 2, 4, 8, 16 and 32 prey/predator, for 4 days. A predator and the prey were introduced into the mesh cage. Thus six different categories of experimental set ups with six different prey levels were maintained, separately. Six replications were maintained for each category. After 24 h the number of prey consumed or killed was recorded and the prey number was maintained constant by replacing them with fresh prey throughout the experimental period.

In the present study 'disc' equation of Holling (1959) was used to describe the functional response of *R. fuscipes* adults at six prey densities. The various parameters in the 'disc' equation are : x = prey density, y = total number of prey killed in a given period of time, y/x = the attack ratio, T_t = total

predator (T_t/k), and a time in days when prey was exposed to the predator, b = time spent for handling each prey by the = 'rate of discovery' per unit of searching time [(y/x)/Ts].

The parameters 'b' and 'a' were directly measured in the present study. The handling time 'b' was estimated as the interval between the time of completion of feeding and the time for the predator to attack again.

The maximum predation was represented by 'k' value and it was restricted to the higher prey density. Another parameter 'a' the 'rate of discovery' was defined as the proportion of the prey attacked successfully by the predator per unit of searching time.

Assuming the predator efficiency is proportional to the prey density and to the time spent by the predator in searching the prey (T_S) the expression of relationship is :

$$y = aT_S x \text{ ------- } (1)$$

But time available for searching is not a constant. It is reduced from the total time (T_t) by the time spent for handling the prey. If we presume that each prey requires a constant amount of time 'b' for consumption, then,

$$T_S = T_t - by \text{ ------- } (2)$$

substituting (2) in (1), Holling's 'disc' equation is

$$y' = a(T_t - by)x$$

The data were subjected to linear regression analysis (Daniel, 1987).

RESULTS AND DISCUSSION

Figure 1 indicates that *R. fuscipes* responded to the increasing prey density of *R. clavatus* by killing more number of prey than they killed at lower prey densities. They exhibited a typical functional response and thus established the applicability of the second model of Holling's 'disc' equation (1959). The number of prey killed (y) by the individual predator increased as the prey density (x) was increased from one prey/predator to 32 prey/predator. The positive correlation obtained between the prey density and the prey killed also confirmed this ($y=2.5011 + 0.3638$; $r=0.9364$) ($p<0.01$). The predicted number of prey killed (y') calculated by using 'disc' equation was more or less similar to the observed number of prey killed at different prey densities (Table 1). The increase in the number of prey killed by the individual predator as a function of increasing prey density confirmed the observation of earlier reports of Awadallah *et al.* (1984), O'Neil (1990), Ambrose and Kumaraswami (1990) and Ambrose *et al.* (1994). The predation rate showed a steep rise from two to eight prey densities. Poole (1974) reported that such response is typical of most invertebrate predators.

The highest attack ratio was observed at the density of one prey/predator and the lowest ratio was found at the density of 32 prey/predator. Hence, the attack ratio decreased as the prey density was increased ($y=1.275 - 0.312$; $r= -0.7562$) ($p<0.01$). The inversely proportional relationship found between the attack rate and the prey level was similar to the observations of Propp (1982), Ambrose and Kumaraswami (1990) and Ambrose *et al.* (1994). It is presumed that the predator required lesser time to search the prey and it spent more time on non-searching activities at higher prey density, which in turn might have caused perceptive decline in the attack rate until the hunger was established. Hassell *et al.* (1976) stated that the attack rate decreased with the increasing prey density with predators having type II functional response.

A negative correlation was obtained between prey density and searching time ($y=3.2147 - 0.1132$; $r= -0.936$) ($p<0.01$) of the predator at all prey densities. The higher searching time (T_S) and the lower handling time (b) recorded confirmed the observation of Bass and Shepard (1974). It was also quite clear that when the interval between successive predations was increased, the searching capability also increased. The predator spent less time for searching the prey at higher prey density as observed by Senrayan (1988). Probability of the predator's contact with the prey at higher prey density would have enhanced the searching ability per unit area. However, Hagen and Bosch (1968) reported that predators were more attracted to prey at higher prey population.

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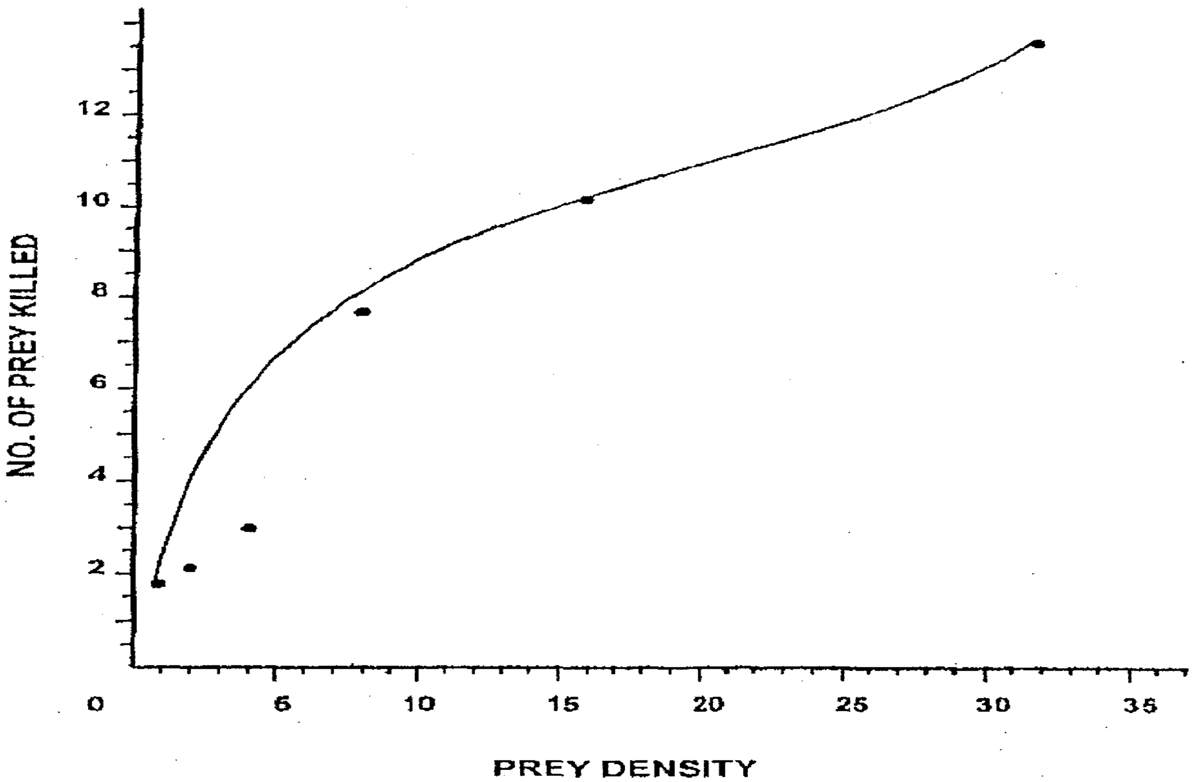

Fig.1. The functional response of *Rhynocoris fuscipes* to *Riptortus clavatus* on pigeonpea terminals

Table 1.Cumulative functional response (y´) of adult female of *Rhynocoris fuscipes* to *Riptortus clavatus*

Prey density (x)	Prey attacked (y)	Attack ratio (y/x)	Rate of discovery (a)	Day all y's (b)	Days Searching (T_s)	Disc equation a(Ts)x=y
1	1.83	1.83	0.53	0.53	3.43	0.53(3.43)1 = 1.82
2	2.14	1.00	0.30	0.62	3.38	0.30(3.38)2 = 2.03
4	3.48	0.87	0.30	1.09	2.92	0.30(2.92)4 = 3.50
8	7.67	0.96	0.60	2.39	1.61	0.60(1.61)8 = 7.73
16	10.17	0.64	0.77	3.17	0.83	0.77(0.83)16 = 10.83
32	12.83	0.40	133.60	4.00	0.003	133.6(0.003)32 = 12.83

REFERENCES

AMBROSE, D. P. 1995. Reduviids as predators : Their role in Biological control. In *Biological control of social forest and plantation crops insects* (T.N. Ananthakrishnan, ed.) Oxford & IBH. New Delhi, pp.153-170.

AMBROSE, D. P. and KUMARASWAMI, N. S. 1990. Functional response of the reduviid predator *Rhynocoris marginatus* Fabr. on the cotton stainer *Dysdercus cingulatus* Fabr. *J. Biol. Control,* 4:163-170.

AMBROSE, D.P., GEORGE, P.J.E. and KALIDOSS, N. 1994. Functional response of the reduviid predator *Acanthaspis siva* Distant (Heteroptera : Reduviidae) to *Camponotus compressus* Fabricius and *Dittoptemis venusta* Walker. *Environ & Ecol.*, **12**:877-879.

AWADALLAH, K. T., TAWFIK, M.F.S. and ABDELLAH, M. M. H. 1984. Suppression effect of the reduviid predator, *Allaeocranum biannulipes* (Montr. et Sign.) on populations of some stored product insect pests. *Z. ang. Ent.*, **97**:249-253.

BASS, J. A. and SHEPARD, M. 1974. Predation by *Sycanus indagator* on larvae of *Galleria mellonella* and *Spodoptera frugiperda. Ent. exp. & appl.*, **17**:143-148.

DANIEL, W. W. 1987. Biostatistics : A foundation analysis in the health sciences. John Wiley & Sons., New York. 733 pp.

HAGEN, K. S. and BOSCH, R. V. 1968. Impact of pathogens, parasites and predators of aphids. *A. Rev. Ent.*, **13**:325-384.

HASSELL, M. P., LAWTON, J. H. and BEDDINGTON, J. R. 1976. The components of arthropod predation I. The prey death rate. *J. Anim. Ecol.*, **45**:135-164.

HOLLING, C. S. 1959. Some characteristics of simple types of predation and parasitism. *Can. Ent.*, **91**:385-398.

O'NEIL, R. L. 1990. Functional response of arthropod predators and its role in the biological control of insect pests in agricultural system. In : *New directions in biological control* (R.R. Basker and P.E. Dunn, eds.) Alan R. Liss Inc., New York pp.83-96.

PICKETT, C. H., WILSON, L. T., GONZALEZ, D. and FLAHERTY, D. L. 1987. Biological control of variegated grape leaf-hopper. *California Agriculture.*, **41**:14-16.

POOLE, P. W. 1974. An introduction on Quantitative Ecology., *McGraw-Hill,* New York, 532 pp.

PROPP, G. E. 1982. Functional response of *Nabis americoferus* to two of its prey *Spodoptera exigua* and *Lygus hesperus. Environ. Ent.*, **11**:670-674.

SENRAYAN, R. 1988. Functional response of *Eocanthecona furcellata* (Wolff.) (Heteroptera : Pentatomidae) in relation to prey density and defence with reference to its prey *Latoia lepida* Cramer (Lepidoptera : Limacodidae). *Proc. Indian Acad. Sci.* (Anim. Sci.)., **97**:339-345.

SINGH, O. P. and SINGH, K. T. 1987. Record of *Rhynocoris fuscipes* Fabricius as a predator of green stink bug, *Nezara viridula* Linn. infesting soybean in India. *J. Biol. Control,* **1**:145-146.