J.Biol.Control, **8** (1), 23-26, 1994

Stage and Host Preference and Functional Response of a Reduviid Predator *Acanthaspis pedestris* Stal to Four Cotton Pests

K. SAHAYARAJ and DUNSTON P. AMBROSE
Entomology Research Unit
St. Xavier's College, Palayankottai - 627 002

ABSTRACT

The host and stage preference of *Acanthaspis pedestris* Stal an important reduviid predator of many insect pests in South India were studied using four cotton pests, such as *Earias insulana* Boisdual, *Helicoverpa armigera* (Hubner), *Pectinophora gossypiella* Saunders and *Spodoptera litura* (Fabricius). The functional response was also studied on *P. gossypiella*. The results revealed that medium sized larvae were preferred in case of *E. insulana* (78.87%), *H. armigera* (83.33%) and *S. litura* (66.66%) while in case of *P. gossypiella* (75.0%), only larger larvae were preferred by the predator. The bug preferred *P.gossypiella* (31.28%) to *H. armigera* (29.74%). Functional response showed a linear relationship between the number of prey offered and the number consumed. The females were found to be better predators than the males.

KEY WORDS: *Acanthaspis pedestris*, biocontrol agent, cotton pests, *Earias insulana*, *Helicoverpa armigera*, *Pectinophora gossypiella*, *Spodoptera litura*, host and stage preference, functional response

Acanthaspis pedestris Stal is an important predator of *Earias. insulana,* Boisdual, *Helicoverpa armigera* (Hbn) (Ambrose, 1988; and Ambrose and Sahayaraj, 1991), *Pectinophora gossypiella* Saunders and *Spodoptera litura* F. (Sahayaraj, 1991). Inundative releases of *A. pedestris* have been found effective against pest population (Ambrose, 1988; Sahayaraj, 1991). Considering its biocontrol potential, studies were conducted to generate information on its preference to prey species and stage of prey and its functional response to *P. gossypiella*.

MATERIALS AND METHODS

Nymphs and adults of *A. pedestris* were collected from Sivanthipatti scrub jungle and semiarid zone ecosystems, bordering cotton agroecosystems (77°.47'E and 8°.39'N), Nellai Kattabomman district, Tamil Nadu, India. They were reared under laboratory conditions (temperature 30-32°C; RH 75-85%; photoperiod 11-13 hours) in separate plastic containers (6 x 5 cm) on *H. armigera*. The larvae of *E.insulana*, *H.armigera*, *P. gossypiella* and *S. litura* were reared in the laboratory. To study the stage preference, larvae of above said pest species in 3 different size (small, medium and large) were offered separately to 2 days-old male and female of the predator in a plastic container (7 x 8 cm). The experiment was replicated 13 times. Once the stage preference was known, prey preference studies were conducted by introducing the preferred larval stages of the four prey species in plastic container containing 2 day-old male and female of *A. pedestris* and observations were recorded continuously for 24 hours. The experiment was replicated 13 times.

The functional response was observed at varying densities *viz.*, 1,2,3,4,5 and 6. In each set, a single predator was released. The experiment was run for 24 hours and thereafter the number of prey consumed was counted. The experiment was replicated 10 times. Holling 'disc' equation (Holling, 1959) method was followed to describe the functional response of *A. pedestris* on *P. gossypiella*.

Table 1. Stage preference (in %) of *A. pedestris* on four cotton pests (n = 13, X ± SE)

Name of the pest		Stages of the pest		
		Small	Medium	Big
E. insulana		0	78.87	21.13
	L	0.61 ± 0.23	0.92 ± 0.03	1.33 ± 0.02
	W	13.92 ± 0.71	26.67 ± 2.06	70.40 ± 3.62
H. armigera		23.33	83.33	16.66
	L	1.30 ± 0.05	1.71 ± 0.04	2.47 ± 0.06
	W	99.42 ± 8.99	155.45 ± 6.87	287.72 ± 16.23
P. gossypiella		0	25.00	75.00
	L	0.20 ± 0.01	0.81 ± 0.05	1.10 ± 0.04
	W	8.12 ± 0.35	19.38 ± 2.14	33.56 ± 0.90
S. litura		16.66	66.66	16.66
	L	1.57 ± 0.08	1.82 ± 0.02	2.74 ± 0.13
	W	20.13 ± 1.62	87.68 ± 3.00	165.41 ± 11.68

L - Length; W - width of the prey (in mm)

RESULTS AND DISCUSSION

The results showed that *A. pedestris* preferred medium sized pest *viz., E. insulana H. armigera* and *S. litura* respectively (Table 1). Similar observation was made by Bose (1949) and Weseloh (1988). When *P. gossypiella* was offered to *A. pedestris*, it preferred larger size prey (75.0%) which conforms to the observation of Vanderplank (1958) in *Platymeris rhadamanthus* Gerst, a reduviid predator on *Oryctes monoceros* (Olive). *A. pedestris* did not attempt to prey upon *E. insulana* and *P. gossypiella* which were smaller when compared to their own body size. A similar observation was made by Salt (1967) and Wilson (1976).

The host preference was evaluated continuously for 5 days and the mean preference (in %) is presented in table 2. The preference was significantly higher for *P. gossypiella* followed by *H. armigera* then for *S. litura* and *E. insulana*. The soft cuticle and slow movements of *P. gossypiella* might have enhanced the prey preference by the predator. Moreover, when the predator captured *H. armigera*, it omitted a viscous defensive fluid which compelled the predator invariably to leave off the prey and only after some time the predator could again hold the same prey and suck the body fluid. Strong (1967) and Nault *et al.* (1973) observed that the prey species produced defensive secretion from the cornicle at the time of predatory behaviour. Similar reports were also made by Sahayaraj (1991) in other reduviids *viz., Ectomocoris tibialis* Distant and *Catamiarus brevipennis* Serville on *H. armigera*. Even though *H. armigera* produced defensive secre-

Table 2. Prey preference (in %) of *A. pedestris* on four cotton pests for five days (n = 13)

Day	Name of the pest			
	E. insulana	*H. armigera*	*P. gossypiella*	*S. litura*
1	17.94	33.33	28.20	20.52
2	15.38	25.64	30.77	28.20
3	12.82	23.07	30.77	33.33
4	17.94	33.33	33.33	15.38
5	28.20	33.33	33.33	05.13
Mean	18.45	29.74	31.28	20.51

Table 3. Functional response of *A. pedestris* on large sized *P. gossypiella* at six prey densities (n = 10)

Prey density (x)	Prey attacked (y)	Attack ratio (y/x)	Day's per y (b)	Day's attacked (by)	Days searching Ts=Tt-by	Rate of discovery a=y/x/Ts
			Male			
1	1.0	1.0		0.06	0.93	1.07
2	2.0	1.0		0.13	0.87	1.15
3	3.0	1.0		0.19	0.81	1.23
4	3.2	0.8		0.20	0.80	1.00
5	3.6	0.72		0.23	0.77	0.93
6	3.4	0.56	0.064	0.22	0.72	0.77
			y' = 1.02 (1.0 - 0.17)x			
			Female			
1	1.0	1.0		0.04	0.96	1.04
2	2.0	1.0		0.07	0.93	1.07
3	3.0	1.0		0.11	0.89	1.12
4	3.7	0.9		0.14	0.86	1.07
5	3.9	0.8		0.15	0.85	0.91
6	3.8	0.6	0.038	0.14	0.86	0.73
			y' = 0.99 (1.0 - 0.11)x			

tion, *A. pedestris* preferred it after *P. gossypiella* suggesting the predator's efficiency.

A.pedestris positively responded to the increasing prey density by effectively suppressing them. The functional response of the *A.pedestris* was confined to the type 2 model of Holling (1959) and could be explained by a linear relationship between the number of prey consumed and initial number of prey (Table 3). The number of *A. gossypiella* larvae killed (Y) by the male and female predators increased as the prey density increased and reached its peak at 5 prey density and thereafter the consumption level tended to stabilize (no further increase by "Y" was evident). Similar trend was reported in other assassin bugs (Ables, 1978; Ambrose and Kumaraswami, 1990).

The female predator was found to be more vigorous in suppressing the prey density than male predator which was reflected by the higher K/Tt value (3.9 prey) recorded for the female predator. The female also took lesser time (0.038 days) for handling the prey than the males (0.064 days) (Table 3). The present results are in line with the observation of Bass and Shepard (1974). This is obviously due to the higher nutritional requirement of the females for reproduction.

ACKNOWLEDGEMENTS

The authors are grateful to Rev.Fr.Dr. Francis M. Peter, S.J. Principal, St. Xavier's College, Palayankottai for institutional facilities and encouragements. The authors are grateful to the Department of Environment, Ministry of Environment, Forests and Wild life, for the research scheme (No.14/23/87-MAB/RE) sanctioned to one of us (DPA).

REFERENCES

ABLES, J.R. 1978. Feeding behaviour of an assassin bug *Zelus renardii* Kolenati. *Ann. Entomo. Soc. America*, **71**(4), 476-478.

AMBROSE, D.P. 1988. Biological control of insect pests by augmenting assassin bugs (Insecta : Heteroptera : Reduviidae). *Bicovas*, **2**, 25-40.

AMBROSE, D.P. and KUMARASWAMI, N.S. 1990. Functional response of the reduviid predator *Rhinocoris marginatus* Fab. on the cotton stainer *Dysdercus cingulatus* Fab. *J. Biol. Control*, **4**, 22-24.

AMBROSE, D.P. and SAHAYARAJ, K. 1991. Camouflaging behaviour and the effect of decamouflaging on behaviour and development of *Acanthaspis pedestris* Stal (Insecta : Heteroptera : Reduviidae) in solitary and crowded conditions. *Mitt. Zool. Mus. Berl.*, **67**, 325-337.

BASS, J.A. and SHEPARD, M. 1974. Predation by *Sycanus indagator* Stal in larvae of *Galleria mellonella* and *Spodoptera frugiperda* (Smith). *Ent. Exp. & Appl.*, **17**, 143-148.

BOSE, B.A. 1949. On the biology of *Coranus spiniscutis* Reuter, an assassin bug (Heteroptera : Reduviidae). *Ind. J. Ent.*, **11**, 203-208.

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

NAULT, D.R., EDWARD, L.J. and STYLER, W.E. 1973. Aphid alarm pheromones; Secretion and reception. *Environ. Entomol.*, **2**, 101-105.

SAHAYARAJ, K. 1991. Bioecology, ecophysiology and ethology of chosen predatory hemipterans and their potential in biological control (Insecta, Heteroptera : Reduviidae). *Ph.D. thesis, Madurai Kamaraj University, Madurai.*

SALT, G.W. 1967. Predation in experimental protozoan population. *Eco. Monograph*, **37**, 113-144.

STRONG, F.E. 1967. Observation on cornicle secretions. *Ann.Ent. Soc. America*, **60**, 668-673.

VANDERPLANK, F.L. 1958. The assassin bug *Platymeris rhadamanthus* Gerst. prey on useful beetle of rhinoceros *Oryctes bose* (F.) and *O. monoceros* (Oliv.) *J. Ent. Soc. South Africa*, **21**, 308.

WESELOH, R.M. 1988. Prey preference of *Calosoma sycophanta* L. (Coleoptera : Carabidae) larvae and relationship of prey consumption to predator size. *Can. Ent.*, **120**, 873-880.

WILSON, D.S. 1976. Deducing and energy available in environment and application of optimal foregoing theory. *Biotropica*, **8**, 96- 103.