J. Biol. Control, 23(4): 381–384, 2009

Impact of intraspecific competition on the predation of *Irantha armipes* (Stål) (Hemiptera: Reduviidae) on cotton bollworm, *Helicoverpa armigera* (Hübner)

S. SAM MANOHAR DAS[1], A. GANESH KUMAR[2] and DUNSTON P. AMBROSE[2]
[1]Department of Zoology, Scott Christian College, Nagercoil 629003, Tamil Nadu, India.
[2]Entomology Research Unit, St. Xavier's College, Palayankottai 627 002, Tamil Nadu, India.
E-mail: eruxavier@gmail.com

ABSTRACT: Intraspecific competition was found to affect the predation of assassin bug, *Irantha armipes* (Stål) on cotton bollworm *Helicoverpa armigera* (Hübner) and quickened predatory acts such as capturing, paralyzing and sucking with reduction in the number of piercing and sucking sites. The impact of competition on predation increased in proportion to the number of competitors confronted.

KEY WORDS: Assassin bug, *Irantha armipes*, intraspecific competition, predation, *Helicoverpa armigera*

INTRODUCTION

Intraspecific competition results when a number of individuals of a same species utilize a common resource for survival, growth and reproduction that is in short supply or due to non-availability or reduction of space in the feeding arena (Andrewartha and Birch, 1958; Miller, 1967). Intraspecific competition leads to a different exploitation strategy especially in predation when compared to the situation of a solitary forager, especially as in the presence of conspecifics, optimal decisions of individuals are likely to depend on the decisions taken by others (Bernstein *et al*., 1991). Intraspecific competition in reduviid predators and in laboratory mass reared ones resulted in cannibalism and affected the predatory efficiency (Taylor and Schmidt, 1996; Ambrose, 1999, 2003). *Irantha armipes* (Stål) is a harpactorine assassin bug predating upon a wide array of insect pests (Das and Ambrose, 2008). The present study was undertaken to understand the impact of intraspecific competition on the predation of *I. armipes* on cotton bollworm *Helicoverpa armigera* (Hübner) to evolve strategies for mass rearing this reduviid and utilize it as a biocontrol agent against *H. armigera*.

MATERIAL AND METHODS

Adults of *I. armipes* were collected from Kodayar Tropical Evergreen Forests (77° 20' 17"E and 8° 28' 9"N) and reared in the laboratory (temperature: 28-34ºC, RH: 65-70% and photoperiod: 12±1h) on cotton bollworm, *H. armigera* in cylindrical plastic containers (200 ml capacity, height 7.2cm and diameter 6.5 cm) in isolation. The life stages of *I. armipes* were recruited from the laboratory culture for the intraspecific competition experiments. The impact of density dependent competition on predatory behaviour was studied in all the five nymphal stages and adults (equal number of males and females) at three levels: (1) two competitors, (2) four competitors and (3) eight competitors in the plastic containers. A control was maintained with a solitary predator for each category. Two-day-old (after eclosion/emergence) and unfed nymphal instars and adult predators were used for the experiments. The predators were first introduced into the experimental containers and after 10 minutes a 10±1 mm long cotton bollworm was introduced. The time taken for the predatory acts such as capturing (the duration between the predator approaching and piercing the prey), paralyzing (the duration between the insertion of rostrum to inject the saliva and the disappearance of visible movements in the prey), sucking (the duration between paralyzing and termination of feeding, indicated by the frequent insertion and withdrawal of rostrum to suck the prey contents) and total predation and the number of piercing and sucking sites were recorded for the predators with 1, 3, and 7 competitors (*i.e*., containers with 2, 4 and 8 predators) and compared with that of predators without competitors (containers with a solitary predator). The percentage increase or decrease in capturing, paralyzing, sucking and total duration and the

Table 1. Impact of intraspecific competition on the predatory behaviour of life stages of *Irantha armipes* on *Helicoverpa armigera* larva (n=6; X±SD)

Life stages of *I. armipes*	No. of predators	Predatory acts (min)				No. of piercing and sucking sites
		Capturing	Paralyzing	Sucking	Total duration	
First nymphal instar	1	3.2±0.36	10.1±0.92	216.4±14.2	229.7±10.2	24.8±1.2
	2	1.4±0.11 (-56.25)	5.9±0.6 (-41.58)	148.6±12.1 (-31.3)	155.9±8.6 (-32.13)	18.4±1.1 (-25.8)
	4	0.57±0.04 (-82.19)	3.8±0.4 (-62.38)	84.6±6.4 (-60.9)	88.97±6.4 (-61.27)	14.8±1.6 (-40.3)
	8	0.42±0.03 (-86.88)	1.52±0.12 (-84.95)	70.6±5.2 (-67.4)	72.54±6.5 (-68.42)	12.4±0.9 (-50.0)
Second nymphal instar	1	2.6±0.18	8.8±0.72	170.8±15.1	182.2±12.4	22.4±1.8
	2	1.8±0.2 (-30.77)	5.2±0.42 (-40.9)	136.4±8.4 (-20.14)	143.4±8.2 (-21.3)	16.6±1.2 (25.89)
	4	0.66±0.07 (-74.6)	3.2±0.18 (-63.64)	74.6±5.2 (-56.32)	78.46±5.6 (-56.97)	12.8±1.4 (-42.86)
	8	0.48±0.03 (-81.54)	1.36±0.08 (-84.55)	62.8±4.8 (-63.23)	64.64±5.2 (-64.52)	10.6±1.1 (-52.68)
Third nymphal instar	1	2.3±0.14	4.9±0.52	152.8±10.1	160.0±6.9	16.8±1.1
	2	0.74±0.05 (-67.83)	3.1±0.28 (-36.73)	87.6±4.2 (-42.67)	91.44±7.2 (42.85)	13.4±1.5 (-20.24)
	4	0.44±0.06 (-80.87)	1.8±0.09 (-63.27)	65.6±5.1 (-57.07)	67.84±4.6 (57.6)	10.8±1.2 (-35.71)
	8	0.26±0.03 (-88.7)	0.76±0.06 (-84.49)	32.8±2.6 (-78.53)	33.82±2.9 (-78.86)	9.2±0.84 (-45.24)
Fourth nymphal instar	1	2.1±0.14	4.2±0.36	142.8±8.6	149.1±10.6	15.1±1.2
	2	0.71±0.08 (-66.19)	2.6±0.27 (-38.1)	76.6±6.2 (46.36)	79.91±5.6 (-45.41)	12.2±0.94 (-19.21)
	4	0.28±0.03 (-86.66)	1.2±0.1 (-71.43)	34.6±2.9 (-75.77)	36.08±2.4 (-75.8)	9.4±0.84 (-37.75)
	8	0.19±0.02 (-90.95)	0.68±0.05 (-83.81)	26.8±1.9 (-81.23)	27.67±2.4 (-81.44)	8.1±0.64 (-46.36)
Fifth nymphal instar	1	1.8±0.11	3.4±0.24	116.4±9.4	121.6±9.4	14.3±1.2
	2	0.68±0.07 (-62.22)	2.1±0.18 (-38.24)	70.4±6.1 (-39.52)	73.18±6.2 (-39.82)	10.8±1.4 (-24.48)
	4	0.24±0.03 (-86.66)	0.92±0.07 (-72.94)	28.4±1.6 (-75.6)	29.56±1.8 (-75.69)	9.8±0.82 (-31.47)
	8	0.16±0.02 (-91.11)	0.59±0.04 (-82.65)	22.4±1.9 (-80.76)	23.15±1.8 (-80.56)	8.4±0.72 (-41.26)
Adult	1	1.4±0.1	2.9±0.03	94.6±7.2	98.9±7.2	12.2±1.4
	2	0.57±0.04 (-59.28)	1.7±0.12 (-41.38)	82.1±5.3 (-13.21)	84.37±8.1 (-14.69)	9.4±0.84 (-22.95)
	4	0.2±0.02 (-85.71)	0.81±0.07 (-72.07)	45.6±3.2 (-51.8)	46.61±3.6 (-52.87)	8.5±0.64 (-30.33)
	8	0.12±0.01 (-91.43)	0.42±0.03 (-85.52)	38.6±2.6 (-59.2)	39.14±2.8 (-6.42)	7.6±0.64 (-37.7)

Values in parentheses indicate percentage of increase or decrease over corresponding control values. All deviations are significant at $P \leq 0.05$

number of piercing and sucking sites were calculated and considered as quickened or decreased predatory activities. Six replicates were maintained in each category. Twenty-four containers with predators at varied densities for each life stage (totally 144) were maintained. Student't' test was applied to understand statistically significant impacts.

RESULTS AND DISCUSSION

Intraspecific competition significantly quickened prey capturing in the life stages of *I. armipes* (Table 1). For instance, 86.88% reduction in capturing time was observed when eight first nymphal instars competed for a larva of *H. armigera*. Similarly quick capturing as a function of intraspecific competition was reported for *Catamiarus brevipennis* (Serville) (Ambrose *et al*., 1985a), *Rhynocoris marginatus* (Fabricius) (Ambrose *et al*., 1985b), *Acanthaspis pedestris* Stål (Ambrose and Amudha, 1987) and *Rhynocoris longifrons* (Stål) (Kumar *et al*., 2009).

As observed for capturing, intraspecific competition also significantly caused quick paralyzing. For instance, when eight adults of *I. armipes* competed for a larva, the paralyzing time decreased to 85.52%. Similar quick paralyzing was observed in *C. brevipennis*, *R. marginatus*, *A. pedestris* and *R. longifrons* (Ambrose *et al*., 1985a, b; Ambrose and Amudha, 1987; Kumar *et al*., 2009) due to intraspecific competition. A similar situation was also reported when more number of predators shared a certain area of predatory arena, thereby reducing the per capita space available for an individual predator (Ambrose, 1999). For instance, when eight *I. armipes* were in a container, each could get 25 ml whereas the solitary predator had 200 ml.

Intraspecific competition also significantly decreased the sucking duration. When four third nymphal instars of *I. armipes* competed for a larva, the sucking duration decreased to 57.07% (Table 1). The reduction in sucking duration was more prominent in nymphal instars than in adults. This could be attributed to the congregational feeding habits of nymphal instars where they are used to share a prey whereas adults are solitary predators. Moreover, the reduction in predation arena reduced the duration of sucking (Ambrose, 1999).

Intraspecific competition significantly reduced the total duration of predation (Table 1). For instance, among competing fifth nymphal instars of *I. armipes*, it decreased from 39.82% when 2 competitors were present to 80.56% when 8 competitors were present. A similar observation was reported for *A. pedestris* and *R. longifrons* (Ambrose and Amudha, 1987: Kumar *et al*., 2009).

The number of piercing and sucking sites also got reduced as a function of intraspecific competition in proportion to the number of competitors (Table 1). This reduction in nymphal instars with competitors could be attributed to the lesser number of sites available for competitors engaged in congregational feeding and to the constant threat perceived from the competitors in adults though they engaged in solitary feeding. It could be a result of reduction in rearing space (Ambrose, 1999).

The observations revealed the intricate interactive prey-predator interaction. The early nymphal instars of *I. armipes* are congregational predators whereas the older nymphal instars and adults are solitary predators. Hence, the impact of intraspecific competition is greater in older life stages when they are mass reared for biological control programmes. Such an understanding on the effects of intraspecific competition on predation is essential to evolve strategies for economical mass rearing of different life stages of a biological control agent as observed in *I. armipes*.

ACKNOWLEDGMENTS

The authors are grateful to the authorities of St. Xavier's College (Autonomous) for facilities. One of us (DPA) acknowledges the financial assistance received from the Ministry of Environment and Forests, Govt. of India (MoEF. No. 23/12/2005-RE dated 16th December 2005).

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(Received: 05.06.2009; Revised: 22.08.2009; Accepted: 11.09.2009)