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Distribution and Abundance of Two Predatory Stink Bugs (Pentatomidae: Hemiptera) Associated with Rice Field

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Abstract: The predatory stinkbugs (PSB) were sampled with sweep nets in rice fields during August to November 2012 at three locations. Two collected PSB species were *Eocanthecons furcellata* (Wolff.) and *Andrallus spinidens* (F.). Although these stink bugs population were found continuously in the rice fields from August to November 2012, they were increased rapidly when crop heading to till the grain-filling stage and then decline suddenly. The population densities of both the PSB were not uniforms in the rice field, the stink bug *E. furcellata* (15.03%) was found less than *A. spinidens* (84.69%)

Key words: *Eocanthecons furcellata* · *Andrallus spinidens* · Deoria District

INTRODUCTION

Members of the subfamily Asopinae is commonly called as predatory stink bugs (PSB) or soldier bugs which are set apart from the other pentatomid subfamilies by their essentially predaceous feeding habits. The predatory stink bug *Andrallus spinidens* (F.) is distributed worldwide [1] and been recognized as a potential biological control agent in rice fields in India, Malaysia and Iran [2- 4]. In the recent years, the predatory stink bug *Eocanthecona furcellata* (Wolff.) has received much attention due to its potential to control outbreaks of Lepidopteran, Coleopteran and Heteropteran insect pests in India [5, 6]. *E. fucellata* is more commonly found in soybean, its prey capture behavior is similar to that of *A. spinidens* [7]. The relative abundance and seasonal occurrence of stink bugs in rice based ecosystem by extensive survey is imperative for utilized the PSB for any biological control program. Works available about the distribution or relative abundance of these two pentatomid predators on Indian agroclimatic zones is not sufficient. Hence, for understanding PSB abundance and the possible biological control role they are playing at rice ecosystem, a survey was undertaken about the distribution and abundance of two sting bugs at three rice cultivating locations in Deoria and calculated their relative density with statistical interpretations, Uttar Pradesh, India.

MATERIALS AND METHODS

Individuals of PSB were collected during a period of three months from August to November 2012 in the areas- viz., Mahuapatan, Bhalwani and Bhujauli colony (in Deoria city) of Deoria district by undertaking frequent field visits at an interval of 10-15 days. Sweep net (30 cm. diameter) and hand picking methods were used to collect the insects in the rice fields and nearby fence and marginal path areas. A total of nine fields, three in each location was observed, each field was near about 15 hectares. These fields were not disturbed throughout the rice growing season to obtain a representative sample of insect population in the area. The observation was started 10-15 days after planting and has continued up to the harvest. The collected insects were placed in plastic bags and transported to laboratory for later counting and preservation. The relative abundance of two species of PSB found in rice fields was determined from the total number of nymphs and adults of each species collected during the 4 months. The diversity of PSB in the three ecosystems were analyzed with traditional Alpha diversity indices viz. Richness index (R1 and R2), Simpson diversity index (1/D), Simpson's evenness index (1-λ') [8] and Shannon's diversity index (H',) were used [9]. Simpson's index is the most meaningful and robust traditional diversity measures available [10]. The Shannon- Weaver index was also determined as it has been widely used by the ecologists [11].

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RESULTS AND DISCUSSION

The two species of PSB collected from the rice fields in Deoria district were *Andrallus spinidens* and *Eocanthecona furcellata*. Amongst the two species of PSB recorded, *A. spinidens* was distributed widely and its density was dominant over the other one (*E. furcellata*). The data collected on population density of PSB in different sites and their abundance month-wise are presented in Figure.1

Andrallus Spinidens: The relative abundance of the species *A. spinidens* was higher in sites 1 and 2 compared to that of site 3 where it was found in low number (Table 1). This hot summer season maximum temperature and minimum humidity record were 40°C and 60%. These results were in line with the earlier observation [12] which stated that the record of *A. spinidens* was more abundant than other bugs in rice ecosystem. The maximum population density recorded was 11.66±2.28, 11.33±1.24 and 7.33±2.05 in sites 1, 2 and 3, respectively, during the month of October. This may be attributed to the favourable environmental condition. For instance, the maximum temperature and high humidity recorded during this month were 30.5°C and 90%, respectively, when rice crop at the grain filling stage (Table 1). This was consistent with the observation of Cherry *et al.* [13] who were further stated that the oldest rice field would lead higher the predatory stink bug population existence. The lowest populations of *A. spinidens* recorded in the Mahuapatan, Bhalwani and Bhujauli sites were 1.00±1.41, 0.66±0.46 and 0.66±0.58 respectively, during the month of November. This winter starting season maximum temperature and low humidity recorded were 25.6°C and 33%. It increased gradually from August to successive month.

Eocanthecona Furcellata: The species *E. furcellata* was the second abundant species followed by *A. spinidens* comprising 20% of all PSB caught by sweep net from all the 3 study sites of the rice fields during 2012 (Figure 1). This species was also observed in greater numbers only during the third visit and distributed more at two locations Mahuapatan (2.66±0.46) and Bhujauli (2.00±0.82) and minimum in number at Bhalwani (1.66±0.46) (Table 1). During the observations, the average minimum temperature and humidity recorded at the locations were 15.8°C and 28% respectively [14]. An early report similarly that *E. furcellata* was not as common as *A. spinidens* but occurs in low numbers in vegetables and soybean.

Table 1: Abundance of two species of Pentatomid Predators at three different locations in Deoria district Rice fields

	Weather parameter							
	Temp.		Humidity			Locations		
Month of observation	Max	Min	Max	Min	Species	Mahuapatan (site1)	Bhalwani (site2)	Bhujauli (site3)
Aug.	40.0	29.0	75	62	*A. spinidens*	2.66±0.46ab*	3.00±1.82b	1.66±0.63ab
					E. furcellata	0.33±0.47a	0.33±0.47a	0.66±0.46b
Sep.	34.5	24.0	88	51	*A. spinidens*	5.00±1.63b	5.33±1.24b	3.66±1.24b
					E. furcellata	1.33±0.47c	0.58±0.46ab	1.33±0.47c
Oct.	30.5	15.8	90	28	*A. spinidens*	11.66±2.28c	11.33±1.24c	7.33±2.05bc
					E. furcellata	2.66±0.46d	1.66±0.46c	2.00±0.82cd
Nov.	25.6	7.2	84	33	*A. spinidens*	1.00±1.41a	0.66±0.46a	0.66±0.58a
					E. furcellata	0.00±0.00	0.00±0.00	0.00±0.00

Mean (± SD) number of total stink bugs (Nymph +Adults) caught in three field sites at a location. Values followed by different letters are statistically significant P=0.01 (DMRT)

Table 2: Ecosystem diversity indices of two species of Pentatomid bugs recorded at Deoria

Ecosystem	Species Richness R1 R2	Evenness Indices E1 E2	Diversity Indices SI SH	Hills Numbers N1 N2
Mahuapatan	0.23—0.23	0.66—0.79	0.71—0.46	1.58—1.41
Bhalwani	0.23—0.23	0.54—0.73	0.77—0.38	1.46—1.29
Deoria City	0.25—0.27	0.78—0.86	0.64—0.54	1.72—1.56

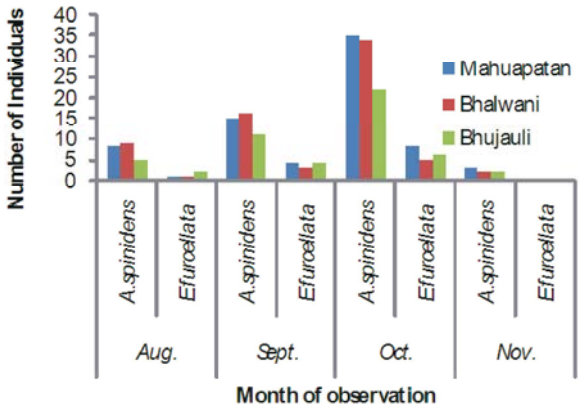

Fig. 1: Bar diagram showing distribution and species richness of PSB collected in three ecosystems

The difference in PSB species density among the rice producing areas found in our study may be due to alternate host plant availability. Asopine pentatomids abundance was mainly due to differences in host range [15] and the presence of alternate hosts could also affect species composition within rice fields [7].

Diversity Indices: Comparative analysis of the PSB provided the following details in the Table 2. The highest Shannon's diversity index (H') was recorded in Bhujauli (0.54) fallowed by Mahuapatan (0.46) and Bhalwani (0.38). As observed for the Shannon's diversity index, the highest Simpson's evenness was found in Bhujauli and lowest evenness in Bhalwani. Richness index was also the highest in Bhujauli (R1= 0.25; R2= 0.27) and the lowest in Bhalwani (R1= 0.23; R2= 0.23) and Mahuapatan (R1= 0.25; R2= 0.27) with no difference between them.

CONCLUSION

The PSB are polyphagous predators of insect larvae, which is distributed in tropical and warm temperate zones worldwide. Seasonal occurrence and relative abundance of these bugs were studied in a population in Deoria, India. The field research showed that PSB density was most abundant from mid-summer to autumn. Reproductive activity of field-collected adults decreased from late summer to autumn, indicating that this bug enters adult diapause in autumn. Only adults were found in early spring and these were not reproductive. Field experiments showed that, irrespective of photoperiod, adult diapauses, their density was induced at lower temperatures, whereas it is avoided at higher temperatures. Ambient temperature falls across the critical range from late summer to autumn. Thus, the bug clearly overwinters in adult diapause induced by low temperatures and this diapause is terminated during the course of winter. Additional research is needed to understand the factors affecting stink bug population development in rice fields. The present investigation clearly shows that two species of pentatomids were active on rice field to manage insect pests in Deoria district though their distribution and relative density varies.

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