

Diversity and abundance of phytophage hemiptera in an irrigated rice ecosystem of Tamil Nadu, India

M. KANDIBANE

Department of Agricultural Entomology and Plant Nematology, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, KARAIKAL (PUDUCHERRY) INDIA.

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A total of 24 taxa of phytophage hemipterans were recorded in weeded and partially weeded rice ecosystems during *kharif* 2001. Among them, thirteen taxa viz., *Brevènnia rehi* (Lindinger), *Hysteroneura setariae* (Thomas), *Nilaparvata lugens* (Stal), *Nepotettix virescens* (Distant), *Cofana spectra* (Distant), *Recilia dorsalis* (Motsch.), *Sogatella furcifera* (Horvath), *Nezara viridula* (Lin.), *Dolycoris indicus* (Stal.), *Menida histrio* Fab., *Scotinophara lurida* (Burmeister), *Leptocorisa acuta* (Thunberg) and *L. oratorius* (Fabricius) showed greater abundance in weeded rice ecosystem, while rest of the species of phytophage hemipterans exhibited more abundance only in partially weeded plots. The diversity of delphacids had perfect similarity through out the season. During tillering and flowering stages of the crop, cicadellids, pentatomids and red spotted bug exhibited greater diversity (= less similarity). Earhead bugs showed higher diversity during flowering and dough stages. Aphid exhibited perfect similarity in the first and second week, and was absent from the third week to seventh week. A Total of 18 weed species acted as alternate hosts for polyphagous phytophage hemipterans were recorded in partially weeded plot. Of them, *Cyperus iria*, *C. diformis*, *C. rotundus*, *Echinochloa colonum*, *E. crus -galli*, *Ipomea aquatica* and *Marsilea quadrifolia* were dominant.

Key words: Diversity, similarity, relative abundance, weed plants, weeded rice ecosystem, partially weeded rice ecosystem, hemipteran insects.

INTRODUCTION

Several species of leafhoppers and planthoppers are serious pest of rice crop. Many species of Auchenorrhyncha are found commonly in rice fields in south east Asia (Claridge and Wilson, 1981). The more damaging species are the green leafhoppers, *Nephotettix* spp., the zig zag leafhopper, *Recilia dorsalis* (Motschulsky), the brown planthopper, *Nilaparvata lugens* (Stal), the white backed planthopper, *Sogatella furcifera* (Horvath) and the rice delphacid, *Tagosodes* (= *Sogatodes*) *oriziculis* (Muir). Among several *Nephotettix* species, three are important, *N. cincticeps* (Uhler) is distributed in temperate area, *N. virescens* (Distant) and *N. nigropictus* (Stal) are distributed in temperate and tropical asian rice growing area (Pathak and Khan, 1991). Gunathilagaraj and Ganesh Kumar (1997) recorded more than 20 species of planthoppers on rice in worldwide. The most important rice bugs in the sub tropical and tropical rice areas belong to the genus *Leptocorisa*. The lowland rice crops of Asia are dominated by *L. oratorius* (Fab.) (Pathak and Khan, 1991). The rice stink bug, *L. acuta* (Thunb) was found in both dry and wet seasons in India (Gupta and Maheswari, 1971). Two species of pentatomid bugs were

identified by the Zoological Survey of India, Calcutta as *Dolycoris indicus* Stal and *D. baccarum* Linn. In rice ecosystem, *Scotinophara coarctata* (Walker) appeared in South Palawan, Philippines in 1982. The outbreak of the black bug was recorded in 1978 and 1979 in Indonesia and Malaysia, respectively (Dale, 1994). The rusty plum aphid, *Hysteroneuro setaria* (Thomas) feeds on unripened grains of rice (Garg and Sethi, 1979). In Tamil Nadu, the inventory, abundance and diversity of phytophage hemipterans between weeded and partially weeded rice ecosystems had not been studied earlier. Hence, the present investigation to study the check list, abundance and diversity of phytophage hemipterans was taken up in an irrigated rice ecosystem of Tamil Nadu.

MATERIALS AND METHODS

A field trial was conducted in irrigated rice ecosystem at the wetlands of Agricultural College and Research Institute, Madurai, Tamil Nadu during *kharif* 2000. Four ruling rice varieties viz., MDU 5, ADT 36, ADT 39 and ADT 43 were used and each variety was replicated into two treatments namely weeded plot (all the weeds removed) and partially weeded plot (10 weeds allowed / m² with rice plants). The size of the experimental plot

was 8 x 6m. The study area received water from the Vaigai Dam. Monthly minimum and maximum temperatures varied between 28° and 38°C May being the warmest (40° C maximum temperature) and January the coolest (28° C minimum temperature) months during 2000. The average rainfall of Madurai was 893 mm during 2000. The collection of arthropods was done by sweeping with a sweep net at weekly intervals and the collected insects were sorted out into respective taxa based on taxonomic characters. The numbers of taxa in weeded and partially weeded rice ecosystems were recorded in each week. A total of 7-9 samplings were taken during the season. The species of weed plants present in partially weeded rice ecosystem were collected and identified. In the present investigation, Jaccard coefficient index of similarity (Jaccard, 1908) was used to study the similarity of phytophage hemipteran insects between weeded and partially weeded rice ecosystems.

$$\text{Jaccard index (Cj)} = j / (a + b - j)$$

Where,

- j = Number of taxa occurring in both samples A (weeded) and B (partially weeded)
- a = Number of taxa in sample A (weeded) and
- b = Number of taxa in sample B (Partially weeded)

RESULTS AND DISCUSSION

The present study revealed the occurrence of 24 taxa containing 1,1,5,3,1,1,7,1 and 4 species of pseudococcids, aphids, cicadellids, delphacids, meenoplids, membracid, pentatomids, podopids and alydids, respectively in irrigated rice ecosystem (Table 1). The relative abundance of phytophage Hemiptera indicated that *Nephotettix virescens*, *Sogatella furcifera*, *Nilaparvata lugens*, *Hysteroneura satariae*, *Brevenia rehi*, *Menida histrio* and *Leptocorisa acuta* showed more abundance and dominance in weeded plots. Pimm (1984) stated that common species of arthropods had more individuals and exhibited greater dominance than rare species with fewer individuals in a stable ecosystem. The common taxa had ability to survive in low and extreme environmental conditions existing in weeded ecosystem as stated by Shelton and Edwards (1983). In partially weeded plots, the same species of phytophage Hemiptera showed dominance, but exhibited comparatively less abundance. The abundance of common species was less in diversified ecosystem due to the presence of weed plants, which produce unfavourable odour (allelochemicals) that will affect the activity of common species as stated by

Lawton (1983). The rare taxa like *N. nigropictus*, *Hecalus* sp., *C. spectra*, *R. dorsalis*, *Perkinsiella* sp., *Leptocentrus* sp., *Pygomenida varipennis*, *Pseudomanida bengalensis*, *L. oratorius*, *Riptortus pedestris* and *R. linearius* occurred and showed less abundance in partially weeded plots. Risch (1981) stated that rare species preferred diversified ecosystem for their occurrence, because the weed plants present in rice ecosystem acted as alternate hosts and provided favourable climates.

The diversity of phytophage Hemiptera revealed that delphacids showed perfect similarity (1.00) from the first week to fifth week (Table 1). The common species, *N. lugens*, *S. furcifera*, and *Ferkinsiella* sp., were found occurring in both the ecosystems. Hence, these species perfectly fit the Jaccard index as indicated by Magurran (1988). According to the statement of Shelton and Edward (1983), common taxa of arthropods had ability to survive through out the season in existing minimum and maximum environmental conditions. Cicadellids exhibited 0.60, 0.50, 0.40 and 0.60 similarity indices during the third, fourth, fifth and sixth week samplings, respectively. Cicadellids showed less similarity (= more diversity) during tillering and panicle initiation stages of the crop growth. This is supported with the fact that host plant geographical distribution hypothesis predicts wide spread plants have a richer regional pool of insects and consequently usually have richer local communities (Ricklets, 1987; Cornell and Lawton, 1992). And sucking insects mostly preferred growth stages of the crop, which was more susceptible as mentioned by Marques *et al.* (2000). Earhead bug exhibited perfect similarity in the third week and registered 0.60, 0.40, 0.55, 0.80 in fourth, fifth, sixth, and seventh week, respectively. According to the view of Southwood (1961) resource concentration hypothesis predicts that plants that occur higher densities are more likely to be found by herbivores. These conditions favour certain herbivores species that increase in abundance, reducing population of other herbivores (Murdoch *et al.*, 1972; Root, 1973). Pentatomid and red spotted bugs showed higher diversity during flowering and dough stages of the crop. These insects mostly occurred during flowering and dough stages of the crop to suck the sap from developing grains. This finding is in accordance with Marques *et al.* (2000) who stated that in the suitable stage of a crop, some group of insects showed more diversity and abundance. Aphid showed perfect similarity in the first and second week. This insect occurred when the experimental field had high temperature and low humidity as indicated by Dale (1994). In partially weeded plot, there were 18 species of weed plants recorded. Among them,

Table 1. Relative abundance of phytophage hemipterans in irrigated rice ecosystem during kharif 2000

Phytophage fauna	Weeded		Partially weeded	
	Rl.abundance*	Ra.abundance	Rl.abundance*	Ra.abundance
Hemiptera: Pseudococcidae				
<i>Brevennia rehi</i> (Lindinger)	42.00	12	16.00	15
Aphididae				
<i>Hysteroneuro satariae</i> (Thomas)	152.00	6	103.00	5
Cicadellidae				
<i>Nephotettix virescens</i> (Distant)	416.00	1	155.00	1
<i>N. nigropictus</i> (stal)	121.00	7	29.00	11
<i>Hecalus</i> sp.	19.00	15	40.00	9
<i>Cofana spectra</i> (Distant)	50.00	10	30.00	10
<i>Recilia dorsalis</i> (Motsch.)	31.00	13	15.00	16
Delphacidae				
<i>Nilaparvata lugens</i> (Stal)	218.00	4	126.00	3
<i>Sogatella furcifera</i> (Horvath)	270.00	2	129.00	2
<i>Perkinsiella</i> sp	16.00	16	47.00	8
Meenoplidae				
<i>Nisia atrovenosa</i> (Leth.)	91.00	8	124.00	4
Membracidae				
<i>Leptocentrus</i> sp.	11.00	18	18.00	14
Pentatomidae				
<i>Nezara viridula</i> (Lin.)	20.00	14	13.00	17
<i>Dolycoris indicus</i> (Stal)	8.00	20	7.00	19
<i>Menida histrio</i> Fab.	224.00	3	87.00	7
<i>Pygomenida varipennis</i> (Westwood)	19.00	15	25.00	12
<i>Pseudomanida bengalensis</i> (Westwood)	12.00	17	19.00	13
<i>Eusarcoris guttiger</i> (Thunberg)	10.00	19	7.00	19
<i>Tetroda hysteroides</i> Fab.	31.00	13	16.00	15
Podopidae				
<i>Scotinophara lurida</i> (Burmeister)	60.00	9	29.00	11
Alydidae				
<i>Leptocorisa acuta</i> (Thunberg)	158.00	5	94.00	6
<i>L. oratorius</i> (Fab)	45.00	11	9.00	18
<i>Riptortus pedestris</i> (Fab)	12.00	17	18.00	14
<i>R. linearius</i> (Fab.)	8.00	20	13.00	17
Total number of species	24		24	

* Values in the columns are number of individuals collected during the season

Rl. abundance: Relative abundance

Ra. abundance: Rank abundance

Table 2. Taxonomic similarity of phytophage Hemiptera in irrigated rice ecosystem during kharif 2000

Fauna	I week				II week			
	MDU5	ADT 36	ADT39	ADT 43	MDU5	ADT 36	ADT39	ADT 43
Ciccadellids	0.75	0.75	0.80	0.80	0.75	0.75	0.71	0.71
Delphacids	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pentatomids	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
RSB	0.00	0.00	0.00	0.00	0.66	0.60	0.65	0.67
Aphids	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Black bug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Earhead bug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Fauna	III week				IV week			
	MDU5	ADT 36	ADT39	ADT 43	MDU5	ADT 36	ADT39	ADT 43
Ciccadellids	0.60	0.60	0.60	0.60	0.50	0.50	0.50	0.50
Delphacids	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pentatomids	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
RSB	0.75	0.75	0.75	0.75	0.50	0.50	0.60	0.60
Aphids	-	-	-	-	-	-	-	-
Black bug	-	-	-	-	-	-	-	-
Ear head bug	1.00	1.00	1.00	1.00	0.66	0.66	0.60	0.60

Fauna	V week				VI week			
	MDU5	ADT 36	ADT39	ADT 43	MDU5	ADT 36	ADT39	ADT 43
Ciccadellids	0.50	0.40	0.50	0.40	0.60	0.75	0.75	0.75
Delphacids	1.00	1.00	1.00	1.00	-	-	-	-
Pentatomids	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00
RSB	0.50	0.40	0.50	0.40	0.75	0.60	0.75	0.60
Aphids	-	-	-	-	-	-	-	-
Black bug	-	-	-	-	-	-	-	-
Ear head bug	0.40	0.46	0.56	0.40	0.55	0.46	0.52	0.56

Fauna	VII week			
	MDU5	ADT 36	ADT39	ADT 43
Ciccadellids	1.00	1.00	1.00	1.00
Delphacids	-	-	-	-
Pentatomids	1.00	1.00	1.00	1.00
RSB	1.00	1.00	1.00	1.00
Aphids	-	-	-	-
Black bug	-	-	-	-
Ear head bug	0.80	0.80	0.80	0.80

* Values in the columns are indices

RSB – Red spotted bug.

Echinochloa colonum, *Cyperus rotundus*, *C. iria*, *C. diformis*, *Panicum repens* and *Bracharia mutica* were dominant.

From this study it is concluded that the most of phytophage insects dominated and showed greater abundance in weeded plots, because rice crop is a main host. Rare species had fewer individuals and occurred only under favourable stage of the crop growth in partially weeded (=diversified) ecosystem. BPH, GLH, mealy bug, *Nisia atrovonosa* and black bug exhibited their incidence during tillering stage of the crop, while stink bugs, red spotted bugs and earhead bugs occurred during panicle initiation stage of the crop. Mealy bugs and aphids preferred high temperature and dry weather conditions for their occurrence. Most of the polyphagous phytophage and rare species of hemipterans preferred tillering stage of the diversified ecosystem. Since the canopy of weed plants and rice crop during tillering covered the surface area and provided suitable microclimate for their survival and this stage of the crop was also susceptible for hemipteran insects to cause damage

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