

Arthropod density in a weed ecosystem maintained around a rice field of Tamil Nadu

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Three field experiments were conducted during *kharif* and *rabi* 2000 and *kharif* 2001 to study the diversity of arthropods on weeds maintained around a rice ecosystem. The study revealed that phytophagous insects of weeds constituted about half of the population of all arthropods. Among the sucking hemipterans, brown planthopper (BPH) was the dominant species of insect, followed by white backed planthopper (WBPH) from the first week to fourth week (tillering stage) in all the three seasons. But, the occurrence of WBPH was absent through out *rabi* 2000. Green leafhoppers and ear head bugs were dominant, followed by red spotted bugs from the fifth week to the last week. Short horned grasshoppers occurred in all the three seasons and expressed the dominance to the extent of 0.79, 1.05 and 1.25 individuals in *kharif* and *rabi* 2000 and *kharif* 2001, respectively. All the lepidopteran insects showed less abundance compared to hemipteran insects during *kharif* 2000 and *kharif* 2001. However, Spodoptera, sphingid and pierid butterfly were absent through out *rabi* 2000. The coleopteran insects *viz.*, blue beetle and pumpkin beetle were recorded. The blue beetle occurred in all the seasons and the pumpkin beetle showed very less abundance and occurred only in the last few weeks. The phytophage dipteran insects showed less abundance in the three seasons. The five groups of natural enemies *viz.*, Orthoptera, Odonata, Hemiptera, Coleoptera and Hymenoptera were recorded. In Odonata, dragonfly was dominant during *kharif* 2000, where as damselfly was dominant during *rabi* 2000 and *kharif* 2001. But, the occurrence of dragonfly was absent during *rabi* 2000. Predatory mirid bugs expressed more abundance in the three seasons. The coleopteran predators *viz.*, ground beetle and coccinellid beetle occurred through out all the three seasons and showed less abundance. Spiders recorded > 0.60 individuals in the three seasons. In the parasitic hymenopterans, ichneumonfly, braconids, and bethylids recorded more abundance in the three seasons. A Total of 18 weed species acted as alternate hosts for polyphagous phytophage insects were recorded in partially weeded plot. Of them, *Cyperus iria*, *C. diformis*, *C. rotundus*, *Echinochloa colonum*, *E. crus – galli*, *Ipomea aquatica* and *Marsilia quadrifolia* were dominant.

Key words : Orthoptera, Hemiptera, Diptera, Lepidoptera, Thysanoptera, Odonata, Coleoptera, Hymenoptera, Density, Weed plants.

INTRODUCTION

Weed plants on rice field bunds and around rice fields' support as boosts for natural enemies by providing pollen and nectar for their survival. They also act as alternate host for several phytophage insects, which are commonly pests of rice. A total of fifty two weed species belonging to 15 families occurring in the rice ecosystem were identified. (Zaheruddeen and Prakasa Rao, 1983). About 40 different species of weed plants have been reported as food or host plants of gundhi bugs. In rice fields gundhi bugs survive in some of weed plants till the rice crop comes to flower when they migrate to rice panicles. The alternate food plants of gundhi bug found in the rice ecosystem were *Paspalum scrobiculatum*, *Panicum annulatum*, *P. repens*, *Echinochloa colonum*, *Setaria glauca*, *E. crus-galli*, *E. miliaceae*, *Cyperus haspan* and *C. iria* (Kalode *et al.*, 1969).

The rice bug, *Leptocorisa oratorius* was detected feeding on graminaceous weeds, and laboratory trails on the insect's survival on *P. repens*, *P. maximum*, *P. punctatum*, *E. crus-galli*, *E. colonum*, *Alloteropsis ciminia*, *Axonopus affinis*, *Chloris barbata*, *Bracharia mutica*, *B. miliiformis*, *Bothriochloa pertusa*, *Elusine indica*, *Dicanthelium clandestinum* weeds gave positive results (Alam, 1989). Of 52 weed species tested along with the cultivated rice *Oryza sativa* Linn. as standard, a graminaceous weed *Leptochloa panicoids* Weight supported larval life and growth of yellow stem borer *Scirpophaga incertulas* (Walker) (Zaheruddeen and Prakasa Rao, 1983).

Rice hispa beetles sometime infested weed hosts like *C. rotundus*, *Panicum ciliaris*, *Digitaria setigera*, *E. colonum*, *E. crus-galli*, *E. indica* and *Leersia hexandra* (Razzaque and Karim, 1989).

Leaf folder (*Cnaphalocrocis medinalis*) was found

on nine host plants of Gramineae family like *Agropyron repens*, *B. Mutica*, *D. ecgyptium*, *Digitaria sanguinalis*, *D. setigera*, *E. colonum*, *E. crus-galli*, *Sorghum munjo* and *S. halopense* (Bharati *et al.*, 1990). In Tamil Nadu the diversity of herbivores and natural enemies in a weed ecosystem maintained around a rice field had not studied earlier. Hence, the present investigation was taken up in a one and half metre weed ecosystem maintained around a rice field of Tamil Nadu.

MATERIALS AND METHODS

The diversity and abundance of arthropods in weedy area maintained around a rice field trial were studied at the wet lands of Agricultural College and Research Institute, Madurai during *kharif* and *rabi* 2000 and *kharif* 2001. Tamil Nadu situated at an altitude of 147m amsl with temperature ranging between 24.4^o and 36.5^oC. The study area received water from the Vagai dam and the annual rainfall was 893 and 954 mm in the respective year, mostly from the north east monsoon between July and November. Each side of the rice field (East, North, West and South), one and half metre weedy area was maintained. The collection of arthropods was done with a sweep net at weekly intervals and about 20 sweeps were made diagonally across each side. The collected insects sorted into respective taxa based on taxonomic characters and the number of individuals in each taxon was recorded. Mean and standard error were worked out to study the abundance of arthropods. Species of weed plants found in weedy areas were collected and identified to know their role against entomophage and phytophage insects.

RESULTS AND DISCUSSION

In the first week sampling, the phytophages of weeds constituted about half of the population of all arthropods sampled. Vegetation of the study site was dominated by BPH and WBPH (1.07, 1.46) in *kharif* 2000 season (Table 1) and the density of BPH was higher (1.55, 1.20) in *rabi* 2000 and *kharif* 2001 seasons (Table 2 and 3). The most dominant herbivore in *rabi* 2000 was GLH, which constituted 1.30 individuals per sweep. Thrips represented 2.65 in *kharif* 2001. Finally, the population of other herbivores was generally low during *kharif* and *rabi* 2000 and *kharif* 2001 seasons. These polyphagous groups might be more dependant on resources provided by weeds than rice. The incidence of thrips was observed under severe dry weather condition but in the subsequent weeks the population was low possibly due to the environmental changes. This is in agreement with Dale (1994) who stated that thrips were normally abundant

during the dry season when there was a little or no rainfall. Therefore, plants that were planted prior to the rains succumbed more to thrips attack.

The most dominant predator in weed ecosystem was the dragonfly, which constituted 1.65 in *kharif* 2000. However, the activity of dragonfly was absent throughout *rabi* 2000. In all the sites, the damselflies were the most abundant predators, which constituted more individuals in both the years. In addition, spiders constituted 0.71, 0.70 and 0.75 during *kharif* and *rabi* 2000 and *kharif* 2001 seasons, respectively.

Among the coleopteran predators, coccinellid beetles registered 0.65, 0.55 and 0.70 in the order of crop seasons in both the years. The densities of hymenopteran parasitoids were relatively low in both the years.

In the second week sampling, phytophagous hemipterans excel in number than the predatory arthropods. Among the sucking insects, WBPH was abundant (1.56, 0.85) in *kharif* 2000 and *kharif* 2001, followed by BPH (1.31, 1.85, 0.80) in all the seasons on weed growth in both the years. The density of GLH decreased to 0, 0.40 and 0.35 in *kharif* and *rabi* 2000 and *kharif* 2001, respectively. Moreover, there was no abundance of GLH through out *kharif* 2000 and *kharif* 2001. Short - horned grasshoppers were prevalent to the extent of 0.79 in *kharif* 2000, 0.60 in *rabi* 2000 and 0.60 in *kharif* 2001. Numbers of lepidopteran, dipteran and hymenopteran insects were low in all the seasons.

Dragonflies were the most dominant predators, present to the level of 1.40 in *kharif* 2000 and 0.50 in *kharif* 2001, followed by damselflies with the abundance of 0.67, 0.75, 0.65 in all the seasons on weed growth in both the years. The reason may be due to the availability of generalist herbivores dominated by the adults of rice leaf folder, stem borer, BPH, WBPH and green leafhopper (GLH) in weed rice ecosystem.

The mirid bug was the next most abundant predator. It constituted 1.08, 0.95 and 1.17 in both the years on weed growth. Cruzdela and Litsinger (1986) documented higher population of mirid bug in rice field adjacent to grassy fallow especially those with *Digitaria* sp. weeds. Also, in the study it is found that mirid bugs were present on weed host, *Cyperus difformis* during *kharif* and *rabi* 2000 seasons. Mirid bugs survived on feeding the eggs of *Nisia atrovenosa* laid on the weed, *C. difformis*. Another possible reason for the density of mirid bugs in weeds might be due to simultaneous abundance of BPH and WBPH on weeds.

The densities of coccinellids recorded were 0.65, 0.75 and 0.65 in all sites in both the years. The number of predatory coccinellids on weed hosts was higher possibly

Table 1 : Arthropod density on weedy area maintained around a rice ecosystem during *kharif* 2000

Fauna	I week*	II week*	III week*	IV week*	V week*	VI week*	VII week*	VIII week*	IX week*
Orthoptera (Chewers)									
Short horned grasshoppers	0.44±0.15	0.79±0.16	0.65±0.14	0.60±0.17	0.54±0.13	0.55±0.11	0.46±0.13	0.50± 0.14	0.57±0.18
Longhorned grasshoppers	0.11±0.05	0.13±0.04	0±0	0.20±13	0±0	0±0	0± 0	0± 0	0± 0
Cricket	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0± 0
Hemiptera (suckers)									
Brown planthopper	1.07±0.16	1.31±0.23	0.95±0.36	1.47±0.15	0.40±0.12	0.42±0.10	0.20 ± 0.06	0±0	0± 0
White backed planthopper	1.46±0.25	1.56±0.35	2.01±0.40	0.93±0.16	0.33±0.11	0±0	0±0	0±0	0± 0
White leafhopper	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0± 0
Green leafhopper	0±0	0±0	0±0	0.16±0.08	0±0	0.96±0.16	0.74±0.18	0.70± 0.14	0± 0
Pentatomid bug	0.14±0.7	0.28±0.08	0.45±0.13	0.17±0.06	0.94±0.16	0±0	0.44±0.14	0.15± 0.07	0.54±0.16
Red spotted bug	0.15±0.11	0±0	0.15±0.11	0.17±0.08	0.26±0.14	0.53±0.13	0.49±0.11	0.43± 0.15	0.37±0.12
Striped bug	0±0	0±0	0±0	0±0	0.45±0.15	0±0	0±0	0±0	0± 0
Earhead bug	0±0	0±0	0±0	0.12±0.10	0.47±0.11	0.66±0.14	0.69±0.14	0.59 ±0.13	0.46±0.12
Lepidoptera									
Stem borer	0±0	0±0	0.13±0.06	0.15±0.07	0.15±0.07	0.23±0.10	0.16±0.06	0±0	0± 0
Leaf folder	0.75±0.5	0±0	0.45±0.16	0.25±0.14	0.08±0.04	0.43±0.12	0.13±0.06	0±0	0± 0
Skipper	0±0	0±0	0.10±0.09	0±0	0±0	0.10±0.04	0±0	0±0	0± 0
Horned caterpillar	0.12±0.08	0.24±0.19	0.15±0.08	0.10±0.06	0.11±0.09	0±0	0±0	0±0	0± 0
Hairy caterpillar	0.15±0.07	0.16±0.06	0.10±0.06	0.16±0.09	0.07±0.03	0±0	0±0	0±0	0± 0
Spodoptera	0±0	0.84±0.14	0.80±0.18	1.02±0.36	0.43±0.10	0.14±0.08	0±0	0±0	0± 0
Sphingid moth	0±0	0.42±0.11	0.17±0.09	0.15±0.08	0.11±0.06	0±0	0±0	0±0	0± 0
Pierid butterfly	0±0	0.38±0.10	0.20±0.08	0.20±0.06	0.15±0.08	0±0	0±0	0±0	0± 0
Coleoptera									
Blue beetle	0±0	0.36±0.15	0.50±0.11	0±0	0.46±0.10	0.36±0.14	0.55±0.11	0±0	0.25±0.13
Pumkin beetle	0±0	0±0	0±0	0±0	0.20±0.08	0±0	0.05±0.04	0±0	0.46±0.10
Diptera									
Whorl maggot	0.22±0.09	0.10±0.06	0.30±0.10	0.12±0.09	0±0	0±0	0±0	0±0	0.24±0.08
Gall midge	0.14±0.10	0.18±0.09	0.20±0.08	0±0	0.10±0.09	0±0	0±0	0±0	0.20±0.07
Other dipterans	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0± 0
Orthoptera									
Long horned grasshopper	0.17±0.09	0.24±0.09	0.35±0.16	0.12±0.09	0.18±0.14	0.15±0.06	0.14±0.07	0±0	0± 0
Odonata									
Dragonfly	1.65±0.19	1.40±0.18	1.10±0.22	0.55±0.18	0.18±0.08	0.29±0.06	0.20±0.13	0.30± 0.12	0± 0
Damselfly	1.0±0.12	0.67±0.12	0.65±0.14	1.06±0.06	0.90±0.12	0.70±0.13	0.89±0.16	0.84±0.14	0.23±0.10
Hemiptera									
Mirid bug	0.75±0.15	1.08±0.09	1.30±0.17	0.76±0.18	0.60±0.16	0.57±0.11	0.44±0.17	0.39 ±0.11	0± 0
Reduviid bug	0±0	0. ±0	0.20±0.11	0.15±0.06	0.07±0.06	0.05±0.04	0±0	0± 0	0.27±0.10
Coleoptera									
Ground beetle	0.30±0.15	0±0	0.20±0.13	0.20±0.13	0±0	0±0	0±0	0±0	0± 0
Coccinellid beetle	0.65±0.14	0.65±0.16	0.65±0.10	0.75±0.09	0.75±0.17	0.69±0.16	0.67±0.14	0.60± 0.13	0.54±0.15
Hymenoptera									
Ant	0.55±0.13	0.44±0.12	0.50±0.19	0.55±0.16	0.37±0.10	0.46±0.13	0.27±0.11	0.40± 0.10	0± 0
Ichneumon wasp	0.59±0.15	0.39±0.13	0.41±0.11	0.35±0.12	0.33±0.11	0.16±0.10	0.26±0.16	0.37± 0.14	0.42±0.10
Braconid wasp	0.19±0.13	0.34±0.14	0.10±0.09	0.25±0.06	0.50±0.15	0.36±0.11	0.18±0.10	0.25± 0.10	0± 0
Chalcid wasp	0±0	0±0	0±0	0.10±0.06	0±0	0±0	0±0	0±0	0± 0
Dryinid wasp	0.30±0.11	0.23±0.14	0.40±0.10	0.20±0.09	0±0	0±0	0±0	0±0	0± 0
Bethylid wasp	0.31±0.14	0.26±0.11	0.50±0.13	0.26±0.11	0.38±0.15	0±0	0.12±0.07	0.68±0.09	0.24±0.15
Spider	0.71±0.13	0.70±0.16	0.65±0.10	0.65±0.14	0.70±0.18	0.38±0	0.48±0.11	0.48±0.10	0.42±0.12

* Values in the columns are mean values of 80 sweeps ± standard error

Table 2 : Arthropod density on weedy area maintained around a rice ecosystem during <i>rabi</i> 2000								
Fauna	I week*	II week*	III week*	IV week*	V week*	VI week*	VII week*	VIII week*
Orthoptera (Chewers)								
Short horned grasshoppers	1.05 ± 0.16	0.60 ± 0.17	0.75 ± 0.09	1.10 ± 0.29	0.65 ± 0.16	0.70 ± 0.17	0.80 ± 0.18	0.80 ± 0.16
Longhorned grasshoppers	0.30 ± 0.11	0.45 ± 0.14	0.10 ± 0.06	0.10 ± 0.09	0.05 ± 0.04	0 ± 0	0.10 ± 0.09	0 ± 0
Cricket	0.40 ± 0.11	0.05 ± 0.04	0.15 ± 0.10	0.10 ± 0.06	0.20 ± 0.19	0 ± 0	0.35 ± 0.16	0 ± 0
Hemiptera (suckers)								
Brown planthopper	1.55 ± 0.13	1.85 ± 0.35	0.70 ± 0.17	0.30 ± 0.14	0.10 ± 0.09	0.80 ± 0.08	0.15 ± 0.04	0 ± 0
White backed planthopper	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
White leafhopper	0.30 ± 0.10	0.35 ± 0.12	0.20 ± 0.13	0.35 ± 0.12	0.05 ± 0.04	0.10 ± 0.06	0.40 ± 0.16	0 ± 0
Green leafhopper	1.30 ± 0.16	0.40 ± 0.11	0.30 ± 0.10	0.90 ± 0.06	0.25 ± 0.09	0.70 ± 0.10	0.90 ± 0.06	0.50 ± 0.16
Pentatomid bug	0.55 ± 0.18	0.50 ± 0.04	0.20 ± 0.13	0 ± 0	0.05 ± 0.04	0.50 ± 0.16	0.85 ± 0.35	0.40 ± 0.16
Red spotted bug	0.45 ± 0.16	0.80 ± 0.08	0.45 ± 0.13	0.25 ± 0.09	0.35 ± 0.12	0.80 ± 0.18	0.85 ± 0.17	0.30 ± 0.14
Striped bug	0 ± 0	0 ± 0	0.20 ± 0.11	0 ± 0	0 ± 0	0.80 ± 0.18	0 ± 0	0 ± 0
Black bug	0 ± 0	0 ± 0	0 ± 0	0.35 ± 0.16	0.35 ± 0.12	0 ± 0	0.20 ± 0.08	0 ± 0
Earhead bug	0 ± 0	0.1 ± 0.06	0.80 ± 0.16	0.75 ± 0.17	0.45 ± 0.14	0.75 ± 0.17	0.45 ± 0.18	0.60 ± 0.13
Lepidoptera								
Stem borer	0.40 ± 0.13	0.45 ± 0.13	0.55 ± 0.18	0.55 ± 0.11	0.20 ± 0.13	0 ± 0	0 ± 0	0 ± 0
Leaf folder	0.80 ± 0.16	0.65 ± 0.14	0.65 ± 0.14	0.30 ± 0.10	0.60 ± 0.16	0 ± 0	0 ± 0	0 ± 0
Skipper	0.25 ± 0.09	0.10 ± 0.06	0.45 ± 0.18	0.10 ± 0.06	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Horned caterpillar	0.35 ± 0.12	0.05 ± 0.04	0.10 ± 0.09	0.30 ± 0.11	0.10 ± 0.09	0 ± 0	0 ± 0	0 ± 0
Hairy caterpillar	0.45 ± 0.13	0 ± 0	0 ± 0	0.10 ± 0.09	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Spodoptera	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Sphingid moth	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Pierid butterfly	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Coleoptera								
Blue beetle	0.30 ± 0.10	0.30 ± 0.10	0.20 ± 0.11	0.50 ± 0.11	0 ± 0	0.15 ± 0.14	0.20 ± 0.13	0.15 ± 0.10
Pumkin beetle	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.30 ± 0.15
Thysanoptera: Thripidae								
Thrips	2.65 ± 0.90	0.3 ± 0.14	0.10 ± 0.06	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Diptera								
Whorl maggot	0.25 ± 0.96	0.20 ± 0.08	0.20 ± 0.08	0.30 ± 0.10	0.30 ± 0.10	0.20 ± 0.08	0.20 ± 0.08	0.30 ± 0.11
Gall midge	0.30 ± 0.15	0.25 ± 0.14	0.35 ± 0.12	0.20 ± 0.08	0.40 ± 0.13	0.15 ± 0.10	0.15 ± 0.07	0.40 ± 0.13
Other dipterans	0 ± 0	0 ± 0	0.30 ± 0.15	0.50 ± 0.16	0 ± 0	0.30 ± 0.10	0.30 ± 0.10	0.40 ± 0.16
Orthoptera								
Long horned grasshopper	0.15 ± 0.10	0.45 ± 0.16	0.20 ± 0.13	0.25 ± 0.14	0.25 ± 0.09	0 ± 0	0.30 ± 0.10	0 ± 0
Odonata								
Dragonfly	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Damselfly	0.60 ± 0.10	0.75 ± 0.17	1.05 ± 0.16	0.65 ± 0.14	0.75 ± 0.12	0.60 ± 0.16	0.75 ± 0.15	0 ± 0
Hemiptera								
Mirid bug	0.95 ± 0.16	0.95 ± 0.19	0.85 ± 0.16	0.75 ± 0.17	0.85 ± 0.17	0.85 ± 0.18	0.65 ± 0.14	0 ± 0
Reduviid bug	0 ± 0	0 ± 0	0.30 ± 0.10	0.05 ± 0.04	0 ± 0	0 ± 0	0 ± 0	0.20 ± 0.13
Coleoptera								
Ground beetle	0.25 ± 0.96	0.35 ± 0.12	0.35 ± 0.16	0.10 ± 0.09	0.25 ± 0.14	0.10 ± 0.06	0.20 ± 0.08	0.05 ± 0.04
Coccinellid beetle	0.55 ± 0.11	0.75 ± 0.18	0.60 ± 0.16	0.85 ± 0.16	0.70 ± 0.14	0.55 ± 0.14	0.06 ± 0.16	0.50 ± 0.19
Rove beetle	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Hymenoptera								
Ant	0 ± 0	0.50 ± 0.13	0.75 ± 0.15	0.75 ± 0.09	0.50 ± 0.19	0.65 ± 0.16	0.55 ± 0.18	0 ± 0
Ichneumon wasp	0.55 ± 0.13	0.60 ± 0.13	1.00 ± 0.15	0.60 ± 0.16	0.60 ± 0.17	0.45 ± 0.16	0.60 ± 0.17	0.50 ± 0.15
Braconid wasp	0.70 ± 0.12	0.65 ± 0.10	0.60 ± 0.13	0.60 ± 0.17	0.25 ± 0.14	0.75 ± 0.15	0.40 ± 0.11	0.95 ± 0.16
Chalcid wasp	0.15 ± 0.07	0 ± 0	0.10 ± 0.09	0.05 ± 0.04	0.15 ± 0.11	0.05 ± 0.04	0.10 ± 0.06	0 ± 0
Dryinid wasp	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Bethylid wasp	0.40 ± 0.10	0.55 ± 0.16	0.65 ± 0.10	0.45 ± 0.14	0.20 ± 0.11	0.80 ± 0.08	0.50 ± 0.11	0 ± 0
Spider	0.70 ± 0.18	0.60 ± 0.13	0.55 ± 0.18	0.45 ± 0.13	0.60 ± 0.13	0.65 ± 0.16	0.55 ± 0.13	0.45 ± 0.14

* Values in the columns are mean values of 80 sweeps ± standard error

Table 3 : Arthropod density on weedy area maintained around a rice ecosystem during *kharif* 2001

Fauna	I week*	II week*	III week*	IV week*	V week*	VI week*	VII week*
Orthoptera (Chewers)							
Short horned grasshoppers	0.60 ± 0.10	0.60 ± 0.18	0.60 ± 0.17	0.60 ± 0.16	0.65 ± 0.11	1.25 ± 0.50	1.00 ± 0.10
Longhorned grasshoppers	0.45 ± 0.18	0 ± 0	0.45 ± 0.18	0 ± 0	0.05 ± 0.04	0 ± 0	0 ± 0
Cricket	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Hemiptera (suckers)							
Brown planthopper	1.20 ± 0.5	0.80 ± 0.18	1.20 ± 0.5	0.80 ± 0.18	0.66 ± 0.12	0.95 ± 0.16	0.55 ± 0.13
White backed planthopper	1.80 ± 0.16	0.85 ± 0.17	1.70 ± 0.15	0.85 ± 0.17	0.55 ± 0.18	0.55 ± 0.11	0 ± 0
White leafhopper	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Green leafhopper	0.60 ± 0.10	1.50 ± 0.13	0.60 ± 0.10	1.20 ± 0.06	1.10 ± 0.15	0.70 ± 0.14	0.90 ± 0.06
Pentatomid bug	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.45 ± 0.11	0.10 ± 0.06	0.30 ± 0.14
Red spotted bug	0.50 ± 0.16	0.35 ± 0.10	0.35 ± 0.12	0.30 ± 0.4	0.20 ± 0.13	0.20 ± 0.13	0.50 ± 0.16
Striped bug	0.35 ± 0.19	0 ± 0	0.20 ± 0.08	0 ± 0	0.20 ± 0.08	0 ± 0	0 ± 0
Black bug	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.40 ± 0.17	0 ± 0
Earhead bug	0.40 ± 0.10	0.60 ± 0.16	0.40 ± 0.16	0.40 ± 0.17	0.40 ± 0.10	0.10 ± 0.06	0.20 ± 0.13
Lepidoptera							
Stem borer	0 ± 0	0.30 ± 0.10	0.20 ± 0.08	0.20 ± 0.08	0 ± 0	0 ± 0	0.30 ± 0.10
Leaf folder	0.50 ± 0.11	0.35 ± 0.16	0.55 ± 0.18	0.35 ± 0.16	0.40 ± 0.17	0.80 ± 0.08	1.75 ± 0.21
Skipper	0.30 ± 0.15	0.30 ± 0.15	0.45 ± 0.11	0.30 ± 0.15	0.10 ± 0.06	0.25 ± 0.09	0 ± 0
Horned caterpillar	0.35 ± 0.10	0.35 ± 0.12	0.25 ± 0.14	0.35 ± 0.12	0 ± 0	0.25 ± 0.14	0.10 ± 0.09
Hairy caterpillar	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Spodoptera	0.90 ± 0.13	0.35 ± 0.16	1.30 ± 0.20	0.35 ± 0.16	0.80 ± 0.18	0.40 ± 0.11	0.75 ± 0.13
Sphingid moth	0.20 ± 0.08	0 ± 0	0.20 ± 0.13	0 ± 0	0 ± 0	0.10 ± 0.06	0 ± 0
Pierid butterfly	0.20 ± 0.11	0 ± 0	0.10 ± 0.06	0 ± 0	0.10 ± 0.06	0 ± 0	0 ± 0
Coleoptera							
Blue beetle	0 ± 0	0.05 ± 0.04	0 ± 0	0.05 ± 0.04	0 ± 0	0 ± 0	0 ± 0
Pumkin beetle	0 ± 0	0 ± 0	0 ± 0	0.20 ± 0.13	0.15 ± 0.10	0 ± 0	0.20 ± 0.08
Diptera							
Whorl maggot	0.30 ± 0.14	0.50 ± 0.11	0.30 ± 0.10	0.50 ± 0.11	0.40 ± 0.10	0.10 ± 0.06	0.30 ± 0.10
Gall midge	0.40 ± 0.10	0.25 ± 0.14	0.35 ± 0.10	0.30 ± 0.10	0.20 ± 0.08	0.30 ± 0.10	0.50 ± 0.19
Other dipterans	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Orthoptera							
Long horned grasshopper	0.20 ± 0.13	0.30 ± 0.15	0.10 ± 0.06	0.30 ± 0.15	0.25 ± 0.14	0.50 ± 0.19	0.30 ± 0.10
Odonata							
Dragonfly	0.50 ± 0.11	0.50 ± 0.04	0.30 ± 0.15	0.10 ± 0.06	0.30 ± 0.10	0.10 ± 0.06	0.30 ± 0.15
Damselfly	0.90 ± 0.9	0.65 ± 0.12	0.90 ± 0.9	0.80 ± 0.16	1.05 ± 0.13	0.60 ± 0.16	0.65 ± 0.12
Hemiptera							
Mirid bug	0.60 ± 0.10	1.17 ± 0.14	0.80 ± 0.10	0.60 ± 0.16	0.45 ± 0.13	1.0 ± 0.14	0.40 ± 0.10
Reduviid bug	0.30 ± 0.14	0.45 ± 0.11	0.20 ± 0.08	0.20 ± 0.08	0.70 ± 0.11	0.10 ± 0.09	0 ± 0
Coleoptera							
Ground beetle	0.10 ± 0.06	0.45 ± 0.11	0.10 ± 0.09	0.50 ± 0.19	0.20 ± 0.13	0.05 ± 0.04	0.10 ± 0.06
Coccinellid beetle	0.70 ± 0.12	0.65 ± 0.12	0.45 ± 0.1	0.50 ± 0.16	0.70 ± 0.18	0.70 ± 0.18	1.10 ± 0.12
Rove beetle	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Hymenoptera							
Ant	0.35 ± 0.1	0.40 ± 0.12	0.40 ± 0.16	0 ± 0	0.20 ± 0.08	0.60 ± 0.17	0.50 ± 0.11
Ichneumon wasp	0 ± 0	0 ± 0	0 ± 0	0.65 ± 0.14	0 ± 0	0 ± 0	0 ± 0
Braconid wasp	0.30 ± 0.10	0.3 ± 0.14	0.40 ± 0.10	0.50 ± 0.11	0.55 ± 0.11	0.50 ± 0.14	0.60 ± 0.13
Chalcid wasp	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dryinid wasp	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Bethylid wasp	0.40 ± 0.1	0.8 ± 0.18	0.40 ± 0.1	0.50 ± 0.11	0.50 ± 0.13	0.55 ± 0.18	0.60 ± 0.10
Spider	0.75 ± 0.16	0.50 ± 0.11	0.60 ± 0.17	0.65 ± 0.10	0.80 ± 0.08	0.70 ± 0.18	0.65 ± 0.14

* Values in the columns are mean values of 80 sweeps ± standard error

due to the availability of alternate resources like pollen, nectar and honeydew. Andow (1988) indicated that the presence of weeds may actually increase predator populations by providing food or other resources.

The abundance of *Spodoptera* and sphingid moths recorded 0.84 and 0.42, respectively, in *kharif* 2000.

In the third week sampling, of the phytophagous lepidopterans, the maximum density of stem borer was recorded (0.55) in *rabi* 2000 and the minimum abundance was registered (0.13, 0.20) in *kharif* 2000 and 2001, respectively. WBPH and BPH were the most abundant herbivores, which contained the densities of 2.01 and 1.70 in *kharif* seasons and 0.95, 0.70 and 1.20 during the three crop seasons. The abundance of short-horned grasshoppers (generally) high, constituted about 0.65, 0.75 and 0.60 in the order of cropping season in both the years. Short-horned grasshoppers were prevalent in weed ecosystem during *kharif* 2000. Capinera and Sechrist (1982) found that grasshoppers had related positively to the presence of more grasses. Numbers of lepidopteran (except stem borer), hymenopteran and dipteran were relatively low in all sites.

The dominant predators were dragonflies (1.10) and damselflies (0.65) in weed ecosystem during *kharif* 2000. The density of coccinellid samples constituted 0.65 in *kharif* 2000, 0.60 in *rabi* 2000 and 0.45 in *kharif* 2001. Spiders were recorded to the extent of 0.65, 0.55 and 0.60 in three seasons, respectively, in both the years. The maximum abundance of ants recorded 0.50, 0.75 and 0.40 in the three seasons.

The maximum density of *Spodoptera* registered was 0.80 in *kharif* 2000. The incidences of WBPH nymphs, *Spodoptera* and sphingid moth larvae on weed hosts were severe in two *kharif* crops from the first week to fourth week. It is opined that the incidence of WBPH in the present study may be treated as a biological indicator to some extent to favour the environmental changes likely to occur. Schoenly *et al.* (1998) who studied that the continuous presence of some herbivores indicated warning of environmental changes. It may also be called as monitor of environmental changes or indicator species of environmental changes or biological indicator. Similarly, the pierid butterflies were recorded 0.20 and 0.10 in *kharif* 2000 and 2001, respectively.

In the fourth week sampling, stem borer and leaf folder were less abundant during *kharif* and *rabi* 2000 and *kharif* 2001. Rice skipper was absent in two *kharif* crops in both the years. The WBPH and BPH were dominant with the maximum abundance of 0.93, 0.85 and 1.47, 0.80, individuals, respectively, in two *kharif* seasons. This is related to the presence of different species of

weed hosts, as BPH survived well on *Leersia hexandra* (Heinrichs, 1979). In the present study, it is found that the above weed species could support the survival of BPH in addition to main crop. GLH were more abundant with the maximum of 0.90 and 1.2 in *rabi* 2000 and *kharif* 2001, respectively, however, it had less population than BPH during *kharif* 2000 in all the sites. GLH on weed hosts was recorded from fourth to seventh week in three seasons. Dale (1994) reviewed that leafhoppers move from one rice crop to another and they feed and breed on grasses found in unprotected ecosystem. Blue forms of GLH were also noticed for the first time in Tamil Nadu during *kharif* 2001. Earlier, Gosh (1980) reviewed the blue forms of *Nephotettix virescens* during February-May, Hyderabad, Andhra Pradesh. The short-horned grasshopper samples had the maximum of 0.60, 1.1 and 0.60 individuals in three seasons.

The most dominant predator in this sampling was mirid bugs, which constituted 0.76, 0.75 and 0.60 individuals in the three seasons. The density of damselflies represented 1.06, 0.65 and 0.80 individuals, followed by coccinellid beetles with the maximum abundance of 0.75, 0.85 and 0.50 individuals in three seasons.

The densities of *Spodoptera*, sphingid and pierid butterfly were relatively low in two *kharif* seasons in both the years and the abundance of these groups of herbivores noticed from second week to sixth week.

In the fifth week sampling, the maximum abundance of GLH was 1.10 individuals in *kharif* 2001.

The density of Damselflies, spiders, coccinellids and mirid bugs recorded with the maximum abundance of 0.90, 0.75, 1.05; 0.70, 0.60, 0.80; 0.75, 0.70, 0.70 and 0.60, 0.85, 0.70 individuals, respectively, in the three seasons. The maximum densities of damselflies registered were 0.90, 0.75 and 1.50 in three seasons.

In the sixth week sampling, green leafhoppers were most abundant with the maximum of 0.96, 0.70 and 0.70 insects in three seasons in 2000 and 2001. The minimum density of WLH showed 0.10 insects in *rabi* 2000. GLH were more abundant than BPH in *kharif* 2000. The abundance of BPH was high with the maximum individuals of 0.80 and 0.95 in *rabi* 2000 and *kharif* 2001, respectively. The density of ear head bugs and short-horned grasshoppers recorded with the maximum abundance of 0.66, 0.75, 0.10 and 0.55, 0.70, 1.25 individuals, respectively, in three seasons.

The dominant group of predators *viz.*, mirid bugs, damselflies, spiders and coccinellids recorded 0.57, 0.80, 1.00; 0.70, 0.60, 0.60; 0.38, 0.65, 0.70 and 0.69, 0.55, 70 insects, respectively. The abundance of lepidopteran, coleopteran (except coccinellid), dipteran and

hymenopteran was low in all the sites.

In the seventh week sampling, the incidence of WBPH was absent in two *kharif* seasons in both the years. GLH were the most abundant with the maximum individuals of 0.74, 0.90, and 0.90 in the three seasons, respectively. The minimum abundance of BPH in *kharif*, and *rabi* 2000 was 0.20 and 0.15 individuals in all sites. The densities of Lepidoptera, Diptera, Coleoptera and Hymenoptera were low in three seasons.

Spiders, damselflies, mirid bugs and coccinellid beetles were the most dominant group of predators, which constituted 0.48, 0.89, 0.44 and 0.67 individuals in *kharif* 2000. Spiders were the most abundant predators in weed ecosystem. It was observed that plant architecture favoured spiders' activities in weed ecosystem with *Cyperus rotundus*, *C. diformis*, *Sphenoclea zeylanica*, *Convolvulus arvensis*, *Echinochloa crus-galli*, *E. colonum*, *Marsilia quadrifolia*, *Spheranthus indicus*, *Chloris barbata* and *Eclipta alba* in the present study.

Most of the lepidopteran groups were absent in VIII, XI, VI, VII and VIII weeks during *kharif* and *rabi* 2000, respectively, since the crop was in a maturity stage. However, these arthropods had few individuals in VI and VII week of *kharif* 2001. Grasshoppers, sucking, dipteran and coleopteran insects showed less number of individuals in the last three week samplings. The cumulative density of grain sucking pentatomids, stink -and red spotted bugs was maximum in weed areas on ninth week during *rabi* 2000. Since the main crop matured earlier, the population of grain sucking Hemiptera diverted to the weed ecosystem (Pathak and Dhaliwal, 1981). 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 *Marsilia quadrifolia* were dominant.

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