Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 12(2), 2024: http://dx.doi.org/10.7770/safer-V13N1-art383

Biodiversity and Distribution pattern of Hemipteran insect bugs associated with Rice field Ecosystem of Sivaganga, Tamil Nadu, India.

Biodiversidad y patrón de distribución de insectos hemípteros asociados con el ecosistema del campo de arroz de Sivaganga, Tamil Nadu, India.

M. Sangeetha, N. Alaguchamy

PG and Research Department of Zoology, RD Government Arts College (Affiliated to Alagappa University, Karaikudi), Sivagangai – 630561, TN, India.

ABSTRACT

In the present investigation, an attempt has been made to assess the relative abundance of Hemipteran insects associated with the Rice Field Ecosystems in the selected study area of Sivaganga District, Tamil Nadu, India with an aim to identify the composition of Hemipteran insect fauna at species level and determine the diversity/ distribution pattern of Hemipteran insects. A total of 21 taxa belonging to Hemipteran (true bugs) insects were collected from the study area. The mean abundance (number/m^2) per month was ranged between 0 – 25. Shannon's index value was 2.888, 2.853, 2.722, 2.853, 2.795, 2.767 for Jul, Aug, Sep, Oct, Nov, Dec respectively, while the Simpson's index 0.9362, 0.9333, 0.9167, 0.9315, 0.9272, 0.9274 for Jul, Aug, Sep, Oct, Nov, Dec respectively. There was no significant difference in the relative abundance of insects between taxa from the sampling sites.

Keywords: Survey, Diversity, Distribution, Hemipteran insects, Rice field Ecosystem

RESUMEN

En la presente investigación, se ha intentado evaluar la abundancia relativa de insectos hemípteros asociados con los ecosistemas de campos de arroz en el área de estudio seleccionada del distrito de Sivaganga, Tamil Nadu, India, con el objetivo de identificar la composición de la fauna de insectos hemípteros en especies. nivelar y determinar el patrón de diversidad/distribución de los insectos hemípteros. Se recolectó un total de 21 taxones pertenecientes a insectos hemípteros (insectos verdaderos) del área de estudio. La abundancia media (número/m2) por mes osciló entre 0 y 25. El valor del índice de Shannon fue 2,888, 2,853, 2,722, 2,853, 2,795, 2,767 para julio, agosto,

septiembre, octubre, noviembre y diciembre, respectivamente, mientras que el índice de Simpson 0.9362, 0.9333, 0.9167, 0.9315, 0.9272, 0.9274 para julio, agosto, septiembre, octubre, noviembre y diciembre respectivamente. No hubo diferencia significativa en la abundancia relativa de insectos entre los taxones de los sitios de muestreo.

Palabras clave: Encuesta, Diversidad, Distribución, Insectos hemípteros, Ecosistema de arrozales

INTRODUCTION

Rice, wheat, and maize are the world's three leading food crops; together they supply more than 42% of all calories consumed by entire human population. Rice is the staple food of more than half of the world's population. Asia accounts for 90% of global rice consumption. Rice is grown mostly in warm-humid environment under diverse cultural conditions over a wide geographical range (Dale, 1994). Rice field ecosystem offers a biologically diverse and dynamic environment for insect population to flourish shortly after fields are flooded with water (Schoenly *et al.,* 1998; Settle *et al.,* 1996). Arthropods diversity in rice ecosystems has received due research consideration (Way and Heong, 1994; Settle *et al.,* 1996; Bambaradeniya and Amerasinghe, 2003). Kalaisekar and Ramamurthy (2004) studied the population dynamics of three abundant species of coleopterans associated with maize agroecosystems of Delhi. Khan et al. (1989) studied the behavioral and physiological responses of rice leaf folder *Cnaphalocrocis medinalis* to selected wild rice. Arthropods inhabiting tropical agro ecosystems are highly affected by climatic-seasonal dynamics due to marked variation in weather conditions. Genetic diversity of microbes, plants and insects associated with *Oryza sativa* is significantly influenced by local conditions (Nagajothi and Jayakumararaj, 2015; 2020). Krishnaiah and Varma (2011) reviewed changing insect pest scenario in the rice ecosystem – a national perspective. Furthermore, instances of pest outbreaks in rice crop are attributed to prevailing local environmental conditions as reported for *Cnaphalocrocis medinalis* (Khan et al., 1989). Kalaisekar and Ramamurthy (2004) *Altica cyanea, Coccinella septempunctata* kharif season. Anbalagan *et al.,* (2020) reported that infection due to *Micraspis discolor* most dominant during the samba season. Arthropod inventories are good indicators of biodiversity because arthropods respond quickly to environmental changes. Insect-pests have been recognized as major biotic stress responsible for significant reduction in rice yield. Further, it deals with documentation of diversity of Hemipteran insects in pond irrigated rice field ecosystem in Sivaganga District, Tamil Nadu.

MATERIAL AND METHODS

Insect collection: Insect collection was done every week from random sites in and around and nearby villages during cultivation period from july2019 to Dec 2019. Sweeping net, were used to

collect the insects. Some insects were collected by hand-pick method. Net sweeping was done while walking through the fields at random sites. The collected insects were brought to the laboratory and preserved as per standard protocol.

Identification of insects: The collected insects were killed by ethyl acetate vapour, sorted out into different orders and families and mounted in insect boxes. Small and soft bodied insects were preserved in 70% ethanol. Most insects were identified up to genus and species level with the help of experts and by using identification keys provided in different volumes of Fauna of British India and other books (ZSI). Few insects were identified up to family level only. The number of individuals collected under each species, genera, family and orders during the study period (Jul 2019 – Dec 2019) were recorded.

RESULTS AND DISCUSSION

In the present study, the following Hemipteran species associated with rice field ecosystem were documented from selected study area in Sivagangai district viz., *Acanthocephala terminalis*; *Chelinidea vittigera*; *Chinavia hilaris*; *Chrysocoris stollii*; *Circulifer tenellus*; *Corimelaena pulicaria*; *Gerris lacustris*; *Gonocerus acuteangultus*; *Halyomorpha halys*; *Leptocorisa acuta*; *Leptocorisa oratorius*; *Nephotettix malayanus*; *Nephotettix virescens*; *Nilaparvata lugens*; *Oxyrhachis taranda*; *Phytocoris lasiomerus*; *Podisus maculiventris*; *Ranatra linearis*; *Recilia dorsalis*; *Scotinophara coarctata*; *Sogatella furcifera.* The prevalence of true bugs (Hemipteran) species as stem borer, leaf folder and leaf hopper and associated ecosystem were observed during the study period 2019 to 2020 (Table 1). The relative abundance of the Hemipteran insect species is presented in Fig. 1. The individual insect species collected were statistically analysed and the results are presented in Table 2-4.

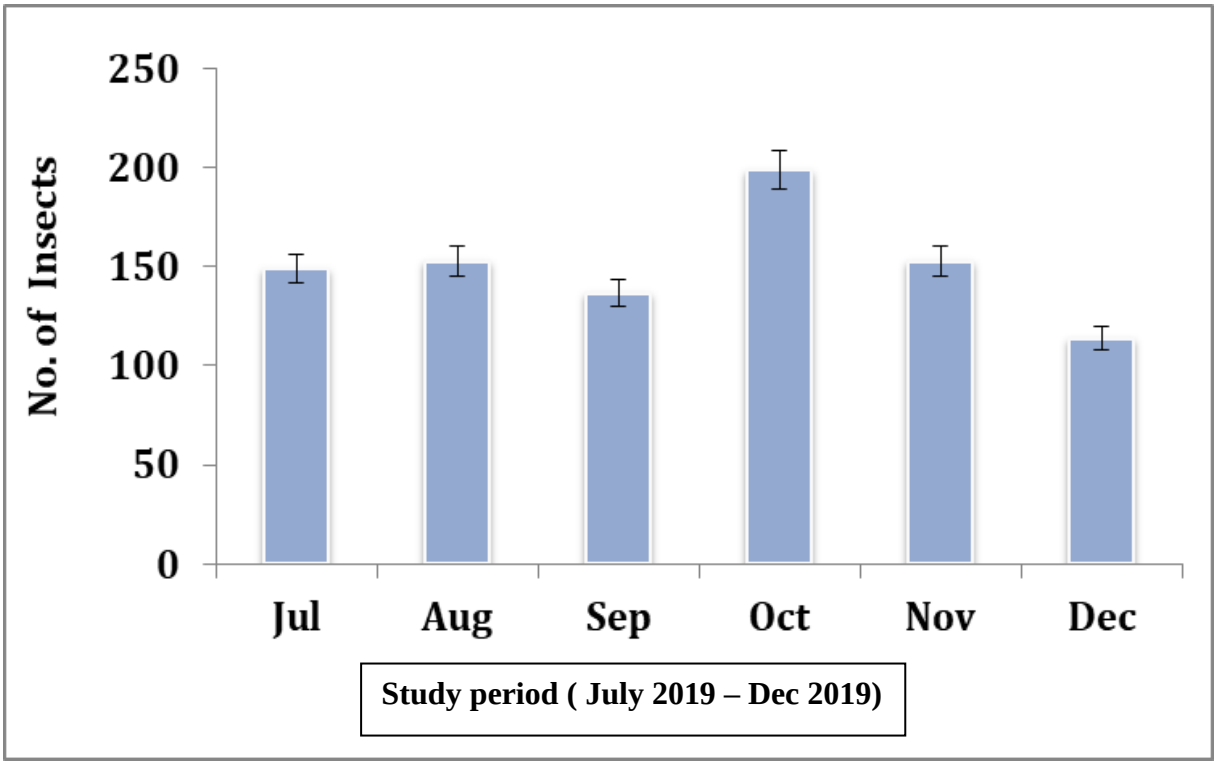

Fig. 1 Prevalence of Hemipteran insect species from Sivagangai, TN, INDIA.

Table 1 List of Hemipteran insect species collected from the rice field ecosystem during the study (Jul –Dec 2019)

Phylum	Class	Order	Family	Genus	Species
Arthropoda	Insecta	Hemiptera	Coreidae	*Acanthocephala*	*Terminalis*
Arthropoda	Insecta	Hemiptera	Coreidae	*Chelinidea*	*Vittigera*
Arthropoda	Insecta	Hemiptera	Pentatomidae	*Chinavia*	*Hilaris*
Arthropoda	Insecta	Hemiptera	Scutelleridae	*Chrysocoris*	*Stollii*
Arthropoda	Insecta	Hemiptera	Cicadellidae	*Circulifer*	*Tenellus*
Arthropoda	Insecta	Hemiptera	Thyreocoridae	*Corimelaena*	*Pulicaria*
Arthropoda	Insecta	Hemiptera	Gerridae	*Gerris*	*Lacustris*
Arthropoda	Insecta	Hemiptera	Coreidae	*Gonocerus*	*Acuteangulatus*
Arthropoda	Insecta	Hemiptera	Pentatomidae	*Halyomorpha*	*Halys*
Arthropoda	Insecta	Hemiptera	Alydidae	*Leptocorisa*	*Acuta*
Arthropoda	Insecta	Hemiptera	Alydidae	*Leptocorisa*	*Oratorius*
Arthropoda	Insecta	Hemiptera	Cicadellidae	*Nephotettix*	*Malayanus*
Arthropoda	Insecta	Hemiptera	Cicadellidae	*Nephotettix*	*Virescens*
Arthropoda	Insecta	Hemiptera	Delphacidae	*Nilaparvata*	*Lugens*
Arthropoda	Insecta	Hemiptera	Membracidae	*Oxyrhachis*	*Taranda*
Arthropoda	Insecta	Hemiptera	Miridae	*Phytocoris*	*Lasiomerus*
Arthropoda	Insecta	Hemiptera	Pentatomidae	*Podisus*	*Maculiventris*
Arthropoda	Insecta	Hemiptera	Nepidae	*Ranatra*	*Linearis*
Arthropoda	Insecta	Hemiptera	Cicadellidae	*Recilia*	*Dorsalis*
Arthropoda	Insecta	Hemiptera	Pentatomidae	*Scotinophara*	*Coarctata*
Arthropoda	Insecta	Hemiptera	Delphacidae	*Sogatella*	*Furcifera*

Table 2 Statistical analysis of Hemipteran insect species collected from the rice field ecosystem during season II (Jul – Dec 2019)

Statistical Parameter	Jul	Lower conf.	Upper conf.	Aug	Lower conf.	Upper conf.	Sep	Lower conf.	Upper conf.
N	21	21	21	21	21	21	21	21	21
Min	3	0	0	2	0	0	1	0	0
Max	18	0	0	19	0	0	25	0	0
Sum	149	110	183	153	110	193	137	83	183
Mean	7.095	5.238	8.714	7.285	5.238	9.190	6.523	3.952	8.714
Std. error	0.925	0.566	1.171	1.030	0.667	1.292	1.262	0.255	1.672
Variance	17.990	6.733	28.833	22.314	9.338	35.080	33.462	1.362	58.676
Stand. dev	4.241	2.594	5.369	4.723	3.055	5.923	5.785	1.167	7.660
Median	6.000	4.000	8.000	7.000	4.000	11.000	5.000	2.000	7.000
25 percentil	3.500	2.000	4.000	3.000	0.500	3.500	2.500	1.000	4.000
75 percentil	9.00	4.500	11.000	10.000	5.500	13.000	8.000	2.500	10.000
Skewness	1.104	0.279	1.987	0.915	0.133	1.805	1.840	0.998	3.631
Kurtosis	0.665	-2.938	2.731	0.311	-2.553	2.0728	4.333	-0.667	9.963
Geom. mean	6.051	4.402	7.287	5.907	4.015	7.372	4.482	2.385	5.957
Coeff. var	59.779	47.527	76.901	64.836	49.909	83.081	88.670	64.101	122.483

Table 3 Statistical analysis of Hemipteran insect species collected from the rice field ecosystem during season II (Oct – Dec 2019)

Statistical Parameter	Oct	Lower conf.	Upper conf.	Nov	Lower conf.	Upper conf.	Dec	Lower conf.	Upper conf.
N	21	21	21	21	21	21	21	21	21
Min	2	0	0	1	0	0	0	0	0
Max	30	0	0	22	0	0	15	0	0
Sum	199	137	251	153	102	199	114	77	147
Mean	9.476	6.524	11.952	7.286	4.857	9.477	5.429	3.667	7
Std. error	1.402	0.148	1.840	1.186	0.680	1.506	0.880	0.548	1.122
Variance	41.262	0.462	71.076	29.514	9.700	47.615	16.257	6.314	26.452
Stand. dev	6.424	0.680	8.431	5.433	3.114	6.900	4.032	2.513	5.143
Median	9.000	7.000	12.000	6.000	2.000	9.000	5.000	3.000	7.000
25 prcntil	5.000	3.000	7.000	3.000	1.000	4.000	2.000	0.000	3.000
75 prcntil	12.000	6.500	14.500	11.000	7.000	15.500	7.500	3.500	9.000
Skewness	1.742	0.933	3.519	1.134	0.328	2.190	0.934	0.264	2.083
Kurtosis	4.222	-0.309	9.664	1.119	-2.235	3.682	0.718	-1.981	2.737
Geom. mean	7.760	5.240	9.674	5.477	3.319	7.052	0.000	-5.583	0.000
Coeff. var	67.786	49.324	94.625	74.567	56.145	96.480	74.274	53.101	98.180

Table 4 Diversity analyses of Hemipteran insect species from Sivagangai, TN, INDIA from July 2019to Dec 2019.

Parameter	Jul	Aug	Sep	Oct	Nov	Dec
Taxa_S	21	21	21	21	21	19
Individuals	149	153	137	199	153	114
Dominance	0.064	0.067	0.083	0.068	0.073	0.073
Simpson_1-D	0.936	0.933	0.917	0.932	0.927	0.927
Shannon_H	2.888	2.853	2.722	2.853	2.795	2.767
Evenness_e^H/S	0.855	0.825	0.724	0.826	0.779	0.837
Brillouin	2.652	2.625	2.486	2.665	2.572	2.506
Menhinick	1.720	1.698	1.794	1.489	1.698	1.780
Margalef	3.997	3.976	4.065	3.778	3.976	3.801
Equitability_J	0.947	0.937	0.894	0.937	0.918	0.940
Fisher_alpha	6.665	6.589	6.919	5.927	6.589	6.511
Berger-Parker	0.121	0.124	0.182	0.151	0.144	0.132
Chao-1	21.000	21.000	24.000	21.000	21.000	19.000

Data depict that the following insects *Halyomorpha halys*; *Leptocorisa acuta*; *Leptocorisa oratorius*; *Nephotettix malayanus*; *Nephotettix virescens*; *Nilaparvata lugens* were dominant in the study area. The occurrence of *Leptocorisa acuta* and *Nilaparvata lugens* was found throughout the year whereas *Ranatra linearis* was absent during the winter months (Fig. 1). These results were almost similar to the findings of Kanagaraj et al. (2019) who reported that three species of rice leaf folders viz., *Cnaphalocrocis medinalis*, *Marasmia patnalis* and *Marasmia ruralis* occurred among which the first was dominant (Gunathilagaraj et al., 1986; BabyRani et al., 2007). *C. medinalis* was abundant during Sep 2019 (72.01%) whereas, *M. patnalis* (37.98%) and *M. ruralis* (22.92%) during Dec 2019 and Dec 2019.

While, it has been previously reported that three stem borers species viz., Yellow stem borer, Pink stem borer and Dark headed stem borer were found in all the regions studies except in the hilly Zone where Yellow stem borer was the only species present (Kanagaraj et al., 2019). Though Yellow stem borer was recorded as the dominant species in most of the regions, the PSB and DHB showed noticeable increase in their proportions. This is agreement with findings of (Anbalagan et al., 2020) who reported that five stem borer species viz., Yellow stem borer *S. incertulas*, Pink stem borer, *S. inferens,* Dark headed stem borer, *C. polychrysus*, Stripped stem borer, *C. suppressalis*, White stem borer *S. innotata* and nine different natural enemies were collected from the rice fields and recorded. Murali Baskaran et al., (2017) reported seasonal and relative abundance of stem-borer and leaf-folder in wetland rice eco-system similar to that of in the present work. Further, Anbalagan et al., (2020) reported that three species of stem borer including *S. incertulas*, *C. suppressalis* and *S. innotata* were found attacking rice among them, *S. incertulas* dominated.

Kanagaraj et al.(2019) reported that three species of rice leaf folders occurred in Madurai district viz., *Cnaphalocrocis medinalis, Marasmia patnalis M. ruralis* among which the first was

dominant. The incidence of all the three species of leaf folder was found throughout the year. This is line with findings of Kanagaraj et al.(2019) who reported three species viz., *C. medinalis, M. patnalis* and *M. ruralis*. The first two species were abundant in all sampling dates. In the present study, four species of rice leafhoppers occurred in the adjoining Madurai district viz., *Nephotettix virescens, N. nigropictus, N. malayanus* and *C. spectra*. Similarly, it has been reported the *N. virescens* and *N. nigropictus* were found throughout the year (Begum et al., 2014). Similar findings were reported by Kanagaraj et al. (2019) who recorded five species of rice leaf hoppers viz., *N. virescens, N. nigropictus, N. malayanus, N. parvus* and *N. cincticeps.*

As conclusion, among the major insect pests in the rice field ecosystem rice stem borers, *Scirpophaga incertulas*, rice leaf folders, *Cnaphalocrocis medinalis* and leafhoppers, *Nephotettix virescens, Nephotettix nigropictus, Nephotettix malayanus* and *Cofana spectra* exhibited dominant occurrence in Sivagangai Dist. To authenticate species level identity DNA barcoding is to be performed so as to plan and implement management strategies.

References

Anbalagan, V., Nithiyanandam, T., and Ponni, C. (2020) Insect diversity and species distribution in rice field of Tharangambadi Taluk, Nagapattinam district, Tamil Nadu, India. International Journal of Entomology Research 5(3): 29-32

Baby Rani W, Amutha R, Muthulakshmi S, Indira K, Mareeswari P. Diversity of rice leaf folders and their natural enemies. Research Journal of Agriculture and Biological Sciences. 2007; 3(5): 394-397.

Bambaradeniya, C. N. B., and Amerasinghe, F. P. (2003). Biodiversity associated with the rice field agro-ecosystem in Asian countries: a brief review. International Water Management Institute (IWMI), Sri Lanka.

Begum MA, Ahmed N, Haq M. Abundance and species composition of rice green leafhopper (Hemiptera: Cicadellidae) in different ecosystems. International Journal of Biosciences. 2014; 4(6): 74-79

Dale, D. (1994). Insect pests of the rice plant–their biology and ecology. Biology and management of rice insects, 438, 442.

Gunathilagaraj K, Mohan R, Gopalan M. Rice Leaf folder Complex in Madurai, TN, India, IRRN. 1986; 11(6):2 4.

Kalaisekar, A., and Ramamurthy, V. V. (2004). Population dynamics of three abundant species of coleopterans associated with maize agroecosystems of Delhi. Indian Journal of Entomology, 66(1), 89.

Kanagaraj L, Chandramani P, Chinniah C, Banumathy S. (2019) Species diversity of major insect pests of rice in Madurai district. Journal of Entomology and Zoology Studies 7(6): 168-170

Khan, Z. R., Rueda, B. P., and Caballero, P. (1989). Behavioral and physiological responses of rice leaf folder *Cnaphalocrocis medinalis* to selected wild rice. Entomologia experimentalis et applicata, 52(1): 7-13.

Krishnaiah K, Varma NRG. Changing insect pest scenario in the rice ecosystem – a national perspective. Indian Journal of Plant Protection. 2011; 30(2): 158-164.

Murali Baskaran RK, Sharma KC, Kumar J. Seasonal and relative abundance of stem-borer and leaf-folder in wetland rice eco-system. Journal of Entomology and Zoology Studies. 2017; 5(2): 879-884

Nagajothi TG, Jayakumararaj R (2015) Genetic diversity of phosphate solubilizing pseudomonads isolated from rice plant (*Oryza sativa* L.) rhizospheric soil, Sivagangai, India

Nagajothi TG, Jayakumararaj R (2020) Genetic diversity, phylogenetic affinities and multifarious functions of Plant Growth-Promoting Rhizobacteria associated with *Oryza sativa* rhizosphere from Vaigai-basin located paddy fields in Madurai district, Tamilnadu, India (In Press)

Schoenly, K. G., Justo Jr, H. D., Barrion, A. T., Harris, M. K., and Bottrell, D. G. (1998). Analysis of invertebrate biodiversity in a Philippine farmer's irrigated rice field. Environmental Entomology, 27(5): 1125-1136.

Settle, W. H., Ariawan, H., Astuti, E. T., Cahyana, W., Hakim, A. L., Hindayana, D., and Lestari, A. S. (1996). Managing tropical rice pests through conservation of generalist natural enemies and alternative prey. Ecology, 77(7): 1975-1988.

Way, M. J., and Heong, K. L. (1994). The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice—a review. Bulletin of Entomological Research, 84(4): 567-587.

Received: 10th December 2022; Accepted: 30th December 2023; First distribution: 23th February 2023