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Diversity And Abundance Of Hemipteran Fauna Associated With Rice Crop In Hanumangarh District, Rajasthan

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Abstract:

The present investigation was conducted to study the diversity and abundance of hemipteran insect fauna associated with rice crop in Hanumangarh district, Rajasthan. Regular field surveys were carried out from June to November 2022 during the rice-growing season. Insects were collected at fortnightly intervals using sweep nets, hand collection, visual observations and light traps. The collected specimens were preserved and identified with the help of standard taxonomic keys and available literature.

A total of 821 hemipteran individuals, representing 10 species and four families, were recorded from the rice agroecosystem. The recorded families were Delphacidae, Cicadellidae, Alydidae and Pentatomidae. The species included *Nilaparvata lugens*, *Sogatella furcifera*, *Nephotettix virescens*, *Nephotettix nigropictus*, *Recilia dorsalis*, *Cofana spectra*, *Cofana unimaculata*, *Leptocorisa acuta*, *Nezara viridula* and *Scotinophara coarctata*.

The hemipteran population increased from June and attained its maximum abundance in September, followed by a decline during October and November. Cicadellidae was the most abundant and species-rich family, while *Nilaparvata lugens* was the most abundant individual species. The findings provide baseline information on the species composition, abundance and seasonal occurrence of hemipteran insects associated with rice crop in the study area.

Keywords: Hemiptera, rice crop, insect diversity, abundance, planthoppers, leafhoppers, rice bugs

Introduction:

Hanumangarh district is characterised by irrigated agriculture under semi-arid climatic conditions. The rice fields of the region provide suitable habitats for several hemipteran species; however, systematic information regarding their diversity and abundance remains limited. Therefore, the present study was

undertaken to document the hemipteran insect fauna associated with rice crop in hanumangarh district, rajasthan.

The objectives of the study were to identify the hemipteran species associated with rice crop, determine their family-wise and species-wise abundance and provide baseline information regarding their occurrence in the rice agroecosystem of the study area.

Rice (*Oryza sativa*) is one of the most important cereal crops and provides food to a major proportion of the world's population. Rice fields create a favourable habitat for a wide range of insect species because of the continuous availability of plant sap, tender foliage, humid conditions and standing water. Among the various insect groups associated with rice, Hemiptera is particularly important because it includes several sap-feeding pests such as planthoppers, leafhoppers, rice bugs and stink bugs.

Hemipteran insects possess piercing and sucking mouthparts and obtain food by extracting sap from different plant parts. Planthoppers and leafhoppers commonly feed on leaves, leaf sheaths and basal portions of rice plants, whereas rice bugs and stink bugs are often associated with panicles and developing grains. Heavy infestation by these insects may cause yellowing, reduced plant vigour, hopper burn, incomplete grain development and loss of crop productivity. Some leafhoppers and planthoppers may also act as vectors of rice diseases.

The major hemipteran groups associated with rice include members of Delphacidae, Cicadellidae, Alydidae and Pentatomidae. Delphacids such as *Nilaparvata lugens* and *Sogatella furcifera* generally occur near the basal portions of rice plants. Cicadellids such as *Nephotettix virescens, Nephotettix nigropictus, Recilia dorsalis, Cofana spectra and Cofana unimaculata* species are commonly found on leaves and stems. *Leptocorisa acuta* feeds on developing grains, whereas *Nezara viridula* and *Scotinophara coarctata* suck sap from different plant parts.

The abundance and distribution of hemipteran insects are influenced by crop growth stage, temperature, relative humidity, rainfall, irrigation and agricultural practices. Their populations may vary considerably from the vegetative stage to crop maturity because the availability and quality of feeding sites change during crop development.

Materials and Methods:

Study Area:

The present investigation was carried out in selected rice fields located at Dabli Khurd in Hanumangarh district, Rajasthan, India. The study area falls under the Irrigated North-Western Plain agroclimatic zone and is characterised by semi-arid climatic conditions. Rice cultivation in the region is mainly supported by canal and supplementary irrigation. Five rice fields, each approximately one hectare in area, were selected for the survey and collection of hemipteran insect fauna.

Study Period:

Field observations and insect sampling were conducted during the rice-growing season from June to November 2022. The study covered the major developmental stages of the crop, including seedling establishment, vegetative growth, tillering, flowering, grain formation and crop maturity.

Sampling of Hemipteran Insects:

Sampling was carried out at fortnightly intervals in all selected rice fields. Daytime observations and collections were conducted for approximately two to three hours during each sampling visit. Different sampling techniques were used to collect hemipteran insects occurring on leaves, stems, basal plant portions, panicles and surrounding vegetation.

Sweep-net sampling was used to collect planthoppers, leafhoppers, rice bugs and other insects present on the upper portions of rice plants. Visible insects were also collected manually through hand picking and direct visual observation. Plant bases and lower leaf sheaths were carefully examined for the presence of planthoppers and other sap-feeding insects. A light trap fitted with a 260-watt light source was operated overnight at fortnightly intervals to collect nocturnal and light-attracted hemipteran insects.

Photographs of the selected rice fields and different crop-growth stages were taken during the field survey to document the study habitat and sampling conditions.

Preservation and Identification:

The collected specimens were transferred into labelled containers. Small and soft-bodied insects were preserved in 70% ethyl alcohol, whereas comparatively large and hard-bodied specimens were preserved by dry pinning. Each specimen was labelled with the date of collection, sampling site, crop stage and method of collection.

The preserved specimens were examined under suitable magnification and identified using standard taxonomic keys, available literature and diagnostic morphological characters. The collected hemipteran insects were identified up to family, genus and species level using standard taxonomic descriptions, illustrations and dichotomous keys given by Distant (1902, 1904), Daglish (1952), Borrer & Delong (1975).

Data Compilation and Analysis:

The number of individuals belonging to each species was recorded during every sampling visit. Species-wise abundance was calculated by adding the total number of individuals recorded throughout the study period. Relative abundance was calculated as the number of individuals of a species divided by the total number of hemipteran individuals recorded and multiplied by 100.

Results and Discussion:

The present investigation recorded a total of 821 hemipteran individuals belonging to 10 species and four families from the rice agroecosystem of Dabli Khurd, Hanumangarh, Rajasthan, during June to November 2022. The recorded families were Delphacidae, Cicadellidae, Alydidae and Pentatomidae. The hemipteran population showed a gradual increase from June to September, followed by a decline during October and November.

Among the recorded families, Cicadellidae was the most abundant and species-rich family, comprising five species and 403 individuals, representing 49.09% of the total hemipteran population. It was followed by Delphacidae with 207 individuals (25.21%), Pentatomidae with 137 individuals (16.69%) and Alydidae with 74 individuals (9.01%).

Table 1. Species-wise abundance (number/trap*) and realtive abundance of hemipteran insects associated with rice crop

Family	Species	Total individuals	Relative abundance in %	Status
Delphacidae	*Nilaparvata lugens*	106	12.91	Dominant
Delphacidae	*Sogatella furcifera*	101	12.30	Dominant
Cicadellidae	*Nephotettix virescens*	103	12.54	Dominant
Cicadellidae	*Nephotettix nigropictus*	92	11.20	Frequent
Cicadellidae	*Recilia dorsalis*	78	9.50	Frequent
Cicadellidae	*Cofana spectra*	68	8.28	Frequent
Cicadellidae	*Cofana unimaculata*	62	7.55	Frequent
Alydidae	*Leptocorisa acuta*	74	9.01	Frequent
Pentatomidae	*Nezara viridula*	62	7.55	Frequent
Pentatomidae	*Scotinophara coarctata*	75	9.13	Frequent
Total		**821**		

* Average of all time crops field and are expressed in number per cubic meter of field.

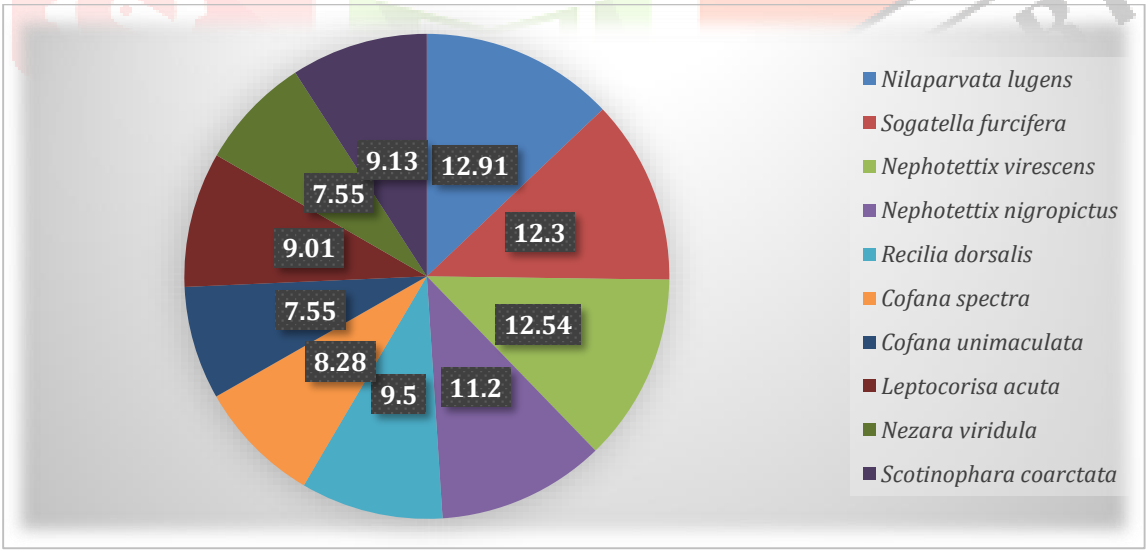

Figure 1: Species wise relative abundance of hemipteran insects associated with rice crop.

Table 2. Month-wise abundance of hemipteran insects

Month	Number of hemipterans
June 2022	15
July 2022	71
August 2022	164
September 2022	257
October 2022	228
November 2022	86
Total	**821**

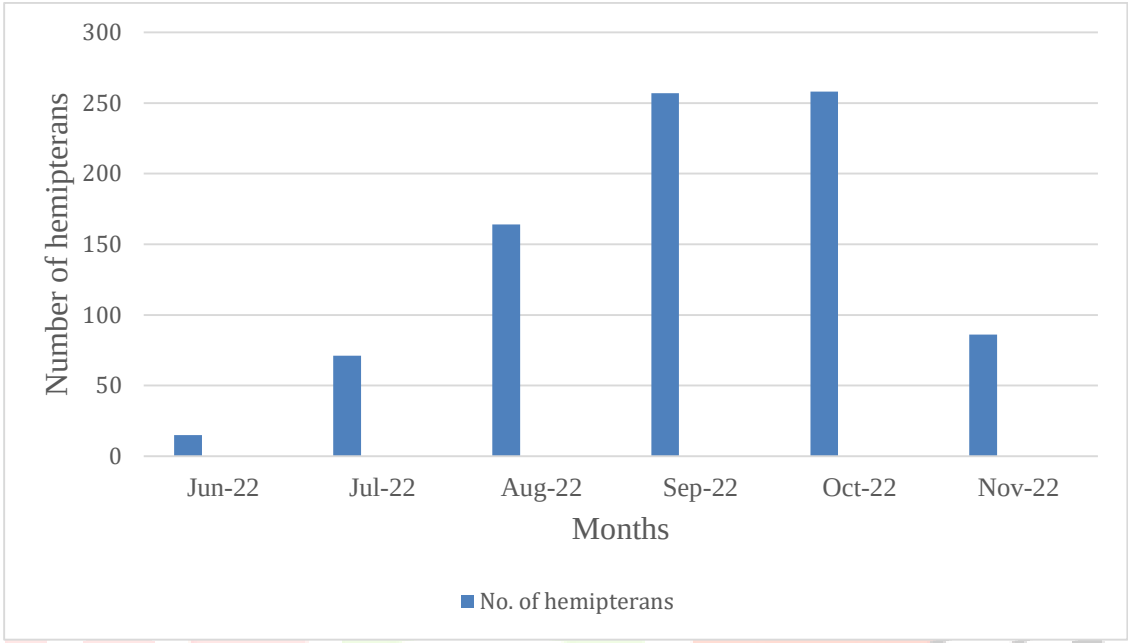

Figure 2: Month wise abundance of hemipteran insects during the rice crop season.

Three species, namely *Nilaparvata lugens, Nephotettix virescens* and *Sogatella furcifera*, were categorised as dominant because their total abundance exceeded 100 individuals. *Nilaparvata lugens* was the most abundant species, with 106 individuals, followed by *Nephotettix virescens* with 103 individuals and *Sogatella furcifera* with 101 individuals. The remaining seven species were categorised as frequent.

The family Delphacidae was represented by *Nilaparvata lugens* and *Sogatella furcifera*. Their populations increased from June onward and reached their maximum abundance in September. Both species declined during October and November. These planthoppers were mainly associated with the basal portions and lower leaf sheaths of rice plants, where nymphs and adults fed by sucking plant sap.

Cicadellidae was represented by five species: *Nephotettix virescens, N. nigropictus, Recilia dorsalis, Cofana spectra and C. unimaculata.* This family showed the highest abundance during the study. Among the cicadellids, *N. virescens* was the most abundant species with 103 individuals. Leafhoppers were commonly observed on leaves and stems, where they fed on plant sap.

The family Alydidae was represented by *Leptocorisa acuta*, with a total of 74 individuals. The species was absent in June and appeared in low numbers during July. Its population increased gradually and reached a maximum during October, indicating its stronger association with the reproductive and grain-development stages of rice. Both nymphs and adults feed on developing grains and may affect grain filling and quality.

Pentatomidae comprised *Nezara viridula* and *Scotinophara coarctata*, with 62 and 75 individuals, respectively. *Scotinophara coarctata* was slightly more abundant than *N. viridula*. These bugs were mainly associated with basal plant portions, stems and developing panicles.

Month-wise abundance showed that only 15 individuals were recorded in June. The population increased to 71 individuals in July, 164 in August and reached its maximum of 257 individuals in September. It subsequently declined to 228 individuals in October and 86 individuals in November. September therefore represented the period of maximum overall hemipteran abundance.

The increase in abundance up to September coincided with the active vegetative and reproductive growth of the rice crop, when suitable feeding sites and tender plant tissues were available. The later decline may have been associated with crop maturity, reduction in tender plant parts and changing field conditions. However, the present study primarily documents abundance patterns and does not establish direct causal relationships.

Overall, the results demonstrated that Cicadellidae was the dominant family in terms of both species richness and abundance, while *Nilaparvata lugens* was the most abundant individual species. The occurrence of dominant planthoppers and leafhoppers, along with rice bugs and stink bugs, indicates that Hemiptera forms an important component of the insect fauna associated with rice crop in Hanumangarh district.

The present study recorded 821 hemipteran individuals belonging to 10 species and four families from the rice agroecosystem of Dabli Khurd, Hanumangarh district, Rajasthan. The occurrence of planthoppers, leafhoppers, rice bugs and stink bugs indicate that Hemiptera forms an important component of the insect community associated with rice crop. Earlier workers have also recognised hemipteran insects as major sap-feeding pests of rice. Pathak and Khan (1994) and Heinrichs *et al.* (2017) described planthoppers, leafhoppers and rice bugs as economically important groups because they feed on vegetative as well as reproductive parts of the crop.

Among the recorded families, Cicadellidae was the most abundant and species-rich family, contributing 403 individuals and five species. *Nephotettix virescens* was the dominant cicadellid species, while *N. nigropictus, Recilia dorsalis, Cofana spectra* and *C. unimaculata* were frequently recorded. Raju *et al.* (1997) reported that the population of *N. virescens* in rice was strongly influenced by ecological conditions and observed its peak occurrence during September and October. This observation is broadly comparable with the present findings, in which the total hemipteran population reached its maximum during September.

Delphacidae was represented by *Nilaparvata lugens* and *Sogatella furcifera*, with 207 individuals. Both species were categorised as dominant in the present investigation. Dhaka *et al.* (2020) also recognised *N. lugens* and *S. furcifera* as important planthopper pests of rice. Their occurrence in relatively high numbers in the present study confirms the suitability of irrigated rice fields for planthopper establishment and multiplication.

The dominance of *Nilaparvata lugens* is important because the species feeds mainly on the basal portions and lower leaf sheaths of rice plants. Continuous sap removal by nymphs and adults may weaken plants and, under severe infestation, produce hopper-burn symptoms. Heong *et al.* (2015) emphasised that rice planthopper abundance is affected by crop management, host-plant condition and ecological interactions within the rice ecosystem. The authors also highlighted the need to understand planthopper ecology rather than relying only on chemical suppression.

The family Alydidae was represented by *Leptocorisa acuta*. Its population increased during the later crop stages and attained its highest abundance in October. This pattern reflects the association of rice earhead bugs with panicle emergence and developing grains. Pathak and Khan (1994) reported that rice bugs generally become more important during the milky and grain-filling stages, when both adults and nymphs suck the contents of developing grains.

Pentatomidae was represented by *Nezara viridula* and *Scotinophara coarctata.* The combined abundance of these species was highest during October. The increase of pentatomid bugs during the reproductive phase may be related to the availability of suitable feeding sites on stems, basal plant portions and developing panicles. The occurrence of *S. coarctata* also indicates that rice black bug forms an important component of the hemipteran pest complex in the study area.

Month-wise analysis showed that hemipteran abundance increased from 15 individuals in June to 71 in July, 164 in August and reached a maximum of 257 individuals in September. The population subsequently declined to 228 individuals in October and 86 individuals in November. Varsha *et al.* (2022) also reported distinct seasonal fluctuations in rice-insect populations and demonstrated that the occurrence of major rice pests varies with crop stage and prevailing meteorological conditions.

The higher population observed during August, September and October coincided with the period of active vegetative growth, panicle development and grain formation. During these stages, the rice crop offered abundant sap, tender tissues and sheltered feeding sites. However, the decline during November may be associated with crop maturity and reduction in suitable feeding material. Similar seasonal variation in rice pest populations has been widely reported, although the magnitude and timing of population peaks may differ among regions because of variations in climate, rice variety, sowing time and field-management practices.

The present findings also support the importance of regular monitoring of hemipteran pests. Seni (2019) and Jaglan *et al.* (2024) evaluated different control measures against major rice insects and brown planthopper, respectively, indicating that accurate knowledge of pest abundance is necessary before adopting management interventions. At the same time, Gurr *et al.* (2011) emphasised the role of parasitoids and ecological engineering in the biological regulation of Asian rice planthoppers. Therefore, pest-management decisions should consider both pest abundance and the conservation of natural enemies.

Overall, the present study showed that Cicadellidae and Delphacidae were the major hemipteran families associated with rice crop in Hanumangarh district. The dominance of *Nilaparvata lugens*, *Nephotettix virescens* and *Sogatella furcifera*, together with the seasonal increase in total abundance up to September, demonstrates the need for crop-stage-based monitoring. The findings are broadly consistent with previous studies reporting the ecological and economic importance of rice planthoppers, leafhoppers and grain-feeding bugs.

Conclusion:

The present study documented the diversity and abundance of hemipteran insects associated with rice crop in Dabli Khurd, Hanumangarh district, Rajasthan. A total of 821 individuals belonging to 10 species and four families were recorded during the rice-growing season from June to November 2022. Cicadellidae was the most abundant and species-rich family, followed by Delphacidae, Pentatomidae and Alydidae.

Among the recorded species, *Nilaparvata lugens*, *Nephotettix virescens* and *Sogatella furcifera* were dominant, whereas the remaining species were categorised as frequent. The overall hemipteran population increased gradually from June and reached its maximum in September, followed by a decline during October and November.

The findings indicate that planthoppers, leafhoppers, rice bugs and stink bugs form an important component of the rice agroecosystem in the study area. The study provides useful baseline information on the species composition, family-wise abundance and seasonal occurrence of hemipteran insects associated with rice crop in Hanumangarh district. Regular monitoring of these insects during different crop-growth stages may help in the timely detection of economically important species and support sustainable pest-management practices.

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