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DIVERSITY AND ABUNDANCE OF HOPPERS ON DIFFERENT FIELD CROPS IN NORTH KASHMIR

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ABSTRACT

The present study was conducted on hemipteran hoppers during 2017-2018 at six locations viz. Wadura, Arampora, Dangiwacha, Imberzalwari from District Baramulla and Chogul and Chetkak from Kupwara in Kashmir. The purpose of was to evaluate the preference of the hoppers among various field crops and to the variations in their diversity. Diversity indices such as species diversity index, species evenness index, species richness index and relative abundance were evaluated. Ten species of hoppers were observed on seven field crops, and include *Empoasca decipiens, Amrasca biguttula, Maiestas dorsalis, Macrosteles quadrilineatus, Macrosteles sexnotatus, Laodelphax striatellus, Agallia* spp., *Gurawa minorcephala, Platymetopius fidelis* and *Deltocephalus* spp. There was maximum abundance of *M. dorsalis* on rice, *E. decepiens* on maize, *M. quadrilineatus* on oats and wheat and *A.biguttula* on French bean, sunflower and soyabean.

Key words: Abundance, diversity, hoppers, field crops, damage, vectors, insects, hopper burn, species and Kashmir

Crops are attacked by many hemipteran hoppers viz. leafhoppers, planthoppers, treehoppers and froghoppers. All these belong to suborder Auchenorrhyncha. The leafhoppers under the family Cicadellidae cause considerable damage to crops by direct feeding the plant sap or by indirectly acting as vectors for plant pathogens (Nielson, 1968). These are small wedge shaped insects and distinguished by having one or more rows of small spines extending the length of hind tibia. Cicadellidae (comprising over 22,600 species) is the largest family of insects. Many species feed on herbaceous or woody dicotyledonous plants, while about 1/3rd of the tribes specialize on grass and sedge hosts and are particularly diverse and abundant in grassland ecosystems (Zahniser and Dietrich, 2013). Members of Delphacidae constitute 12,000 species that feed on green plants. They feed on plant sap and damage the plant tissue by ovipositing that lead to wilting of plant commonly known as "hopper burn". Apart from feeding on the plant sap, they also transmit virus during their feeding behaviour which causes disease such as grassy stunt and ragged stunt in rice plant (Reissig et al., 1986) and cause extensive damage to the crop (Dyck and Thomas, 1979). Membracidae family shows expanded hood covering, which often resembles thorn (enlarged and ornate pronotum), commonly known as thorn bugs. Membracids cause injury to the plants by making numerous small slits or crescent like punctures in bark where they lay eggs. So far 235 species of tree hoppers are reported from India (Thirumulai and Prabhakaran, 2014). Family Cercopidae is best known for their nymph stage which produces a cover of frothed up plant sap resembling saliva. Thus study explores the diversity of leafhoppers on agricultural crops in North Kashmir.

MATERIALS AND METHODS

The present study surveyed different field crops such as rice, maize, oats, wheat, french bean, soyabean and sunflower at locations viz., a) Faculty of Agriculture, Wadura, SKUAST-K b) Imberzalwari c) Dangiwacha d) Arampora Sopore e) Chogal Kupwara f) Chetkak Kupwara. Hoppers were collected using a) Sweep net: A canvas sweep net with a fine mesh cloth end over a metal wire was used to sample the hoppers. The net was 38 cms in diameter, 75cms in length and the handle was about 1 m long. b) Light traps: Light traps were installed at all the above mentioned locations in different crops. Hoppers were collected from these areas at fortnightly intervals. c) Sticky traps: Yellow sticky traps were placed in the fields and hoppers removed carefully from the traps so as to prevent injury/damage to them. Samples collected were killed by using ethyl acetate and were removed immediately from killing bottle to prevent discoloration of samples. Samples were dried in oven at 40oC for 10 min, and stored in vials with 70% ethanol. These samples were sent to

IARI New Delhi for identification. Species diversity for each crop and location was worked out by adding up the total number of species found in each community. Different parameters were used to find diversity such as: a) relative abundance: = ni /N x 100 where, ni = Number of Individuals of a single species and N = Total number of individuals of all species b) species diversity index (H): where, H = Shannon- Wiener Biodiversity Index, pi= relative abundance of each species. ln pi = natural log of pi. and S = total number of species. c) Species Richness Index (Ma) = S-1 / 1n N (Pielou, 1975) Where, S= total number of species collected, N = total number of individuals in all the species d) species evenness index: = H / 1n S where, H= Shannon-Wiener biodiversity Index and S = total number of species in the community

RESULTS AND DISCUSSION

The data on diversity and abundance of hoppers on field crops in North Kashmir revealed total of ten species on about seven crops (rice, maize, oats, frenchbean, soyabean, wheat, sunflower). These include *Empoasca decipiens, Amrasca biguttula, Maiestas dorsalis, Macrosteles quadrilineatus, Macrosteles sexnotatus, Laodelphax striatellus, Agallia* spp., *Gurawa minorcephala, Platymetopius fidelis* and *Deltocephalus* spp. (Figs. 1-10). Our results depicted that, *Maiestas dorsalis, Laodelphax striatellus*, *Deltocephalus* spp. infest rice. *E. decepiens*, *M. quadrilineatus, L. striatellus*, *Agallia* spp. were recorded as pest of maize. So far as beans are concerned *E. decepiens, A.biguttula, P. fidelis* and *G. minorcephala* were found to infest this crop. These observations agree with those of Naseri (2009) who reported *E.decepien*s on beans. However, *A. biguttula* was reported as pest on beans by Reddy and Rao (2001). In Kashmir, more species of hoppers infesting beans. The data on relative abundance of hoppers on field crops revealed that *M. dorsalis* (MRA=46.17%) was the most abundant species on rice; and on maize, it was *E. decepiens* (MRA=43.73%); on oats and wheat, it was *M. quadrilineatus*; and in French bean, soybean and sunflower, it was *A. biguttula* (Table 1).

Diversity indices revealed that it was maximum of 1.102 on maize. Among different locations value of species diversity index for rice was maximum of 0.941 at Chogul and lowest 0.864 at Arampora; for maize, it was maximum of 1.321 at Dangiwacha and lowest of 0.682 at Arampora; for oats, maximum at 1.066 was at Arampora and the least of 0.983 at Chetkak; and for French bean, maximum was 1.118 at Imberzalwari and the least of 0.977 at Arampora. Among field crops, average value of species evenness index was found highest 0.959 on maize and lowest 0.684 on rice, whereas the average value of species richness index was found highest 3.782 on french bean and lowest 2.230 on rice. The number of hopper species on all the crops were maximum at Dangiwacha and minimum at Arampora and Imberzalwari. This is due to the fact that Dangiwacha is located at low altitude and has maximum weed flora which promoted hopper development in this area. Imberzalwari is at highest altitude which limited hopper development in this area where as at Arampora, pesticidal application was more as farmers of this region grow vegetables commercially. These sprays may be responsible for least hopper species. The findings on biodiversity indices is explained by the fact that species composition of insect communities is affected by combination of geographical and environmental factors including vegetation, topography, altitude, climate, habitat and human influence (Wasowska, 2004; Lassau et al., 2005). Since North Kashmir experiences temperate climate, which is a bit varrieng in all studied locations and therefore the difference in species richness is relate d to microclimate *e.g.* solar radiation, temperature and humidity. The findings are further supported by Joshi (2008) who observed distinct variation in the diversity of insects occurring between the sites with different degrees of altitude, vegetation and climate.

1 2 3 4 5 6 7 8 9 10

Figs. 1. *Macrosteles sexnotatus*; 2. *Gurawa minorcephala*; 3. *Maiestas dorsalis*; 4. *Agallia* spp.; 5. *Platymetopius fidelis*; 6. *Deltocephalus* spp.; 7. *Laodelphax striatellus*; 8. *Empoasca decepiens*; 9. *Amrasca biguttula*; 10. *Macrosteles quadrilineatus*

Table 1. Diversity indices and relative abundance of hoppers on field crops in North Kashmir

Crop	Locations	S	N	MRA				H	J	Ma
Rice	Wadura	3	24	*Maiestis dorsalis* 58.33	*Laodelphax striatellus* 33.33	*Deltocephalus* spp. 8.33		0.887	0.808	2.685
	Arampora	3	16	56.25	37.50	6.25		0.864	0.787	2.639
	Dangiwacha	3	30	53.33	35.71	6.66		0.882	0.803	2.705
	Chogul	3	28	53.57	35.71	10.71		0.941	0.856	2.699
	Chetkak	3	18	55.55	33.33	11.11		0.936	0.852	2.654
				Empoasca decepiens	*Macrosteles quadrilineatus*	*Laodelphax striatellus*	*Agallia* sp.			
Maize	Wadura	4	85	37.64	11.76	29.41	21.17	1.308	0.943	3.744
	Imberzalwari	2	46	56.52	0	43.47	0	0.684	0.987	1.738
	Arampora	2	42	57.14	0	42.85	0	0.682	0.985	1.732
	Dangiwacha	4	93	36.55	12.90	29.03	21.50	1.321	0.953	3.779
	Chogul	4	89	37.07	12.35	29.21	21.34	1.315	0.948	3.777
	Chetkak	4	80	37.50	11.25	30.00	21.25	1.303	0.940	3.771
				Macrosteles quadrilineatus	*Macrosteles sexnotatus*	*Laodelphax striatellus*				
Oats	Wadura	3	16	50.00	31.25	18.75		1.023	0.932	2.639
	Imberzalwari	3	11	45.45	36.36	18.18		1.036	0.943	2.582
	Arampora	3	9	44.44	33.33	22.22		1.060	0.965	2.544
	Dangiwacha	3	21	47.61	33.33	19.04		1.035	0.942	2.671
	Chogul	3	18	50.00	33.33	16.66		1.011	0.920	2.654
	Chetkak	3	13	53.84	30.76	15.38		0.983	0.895	2.610
				Empoasca decepiens	*bigutulla*	*Gurawa minorcephala*	*Platymetopius fidelis*			
French bean	Wadura	4	107	37.38	48.59	9.34	4.67	1.083	0.781	3.785
	Imberzalwari	4	89	39.32	50.56	6.74	3.37	1.007	0.727	3.777
	Arampora	4	80	41.25	50.00	6.25	2.50	0.977	0.705	3.771
	Dangiwacha	4	118	35.59	45.76	12.71	5.93	1.155	0.833	3.790
	Chogul	4	112	36.28	46.90	10.61	5.30	1.118	0.806	3.788
	Chetkak	4	96	39.58	48.95	8.33	3.125	1.031	0.744	3.780

N = Total no. of individuals of identified species observed/ five sweep nets; MRA: Mean relative abundance; S = Total no. of identified species; H = Species diversity index; J =Species evenness index; Ma= Species richness index

REFERENCES

Dyck V A, Thomas B. 1979. The brown plant hopper problem. In: Brown plant hopper: threat to rice production in Asia. Manila (Philippines): International Rice Research Institute. pp. 3-17.

Joshi P. C, Kumar K, Manoj A. 2008. Assessment of insect diversity along an altitudinal gradient in Pinderi forests of western Himalayas, India. Journal of Asia Pacific Entomology 11: 5-11.

Lassau S A, Hochuli D F, Cassis G, Reid C A M. 2005. Effects of habitat complexity on forest beetle diversity: do functional groups respond consistently? Diversity and Distributions 11: 73-82.

Naseri B, Fathipora Y, Talebi A A. 2009. Population density and spatial distribution pattern of *Empoasca decepiens* (Hemiptera: Cicadellidae) on different bean species. Journal of Agricultural Science and Technology 11: 239-248.

Nielson M W. 1968. The leafhopper vectors of phytopathogenic viruses (Homoptera, Cicadellidae). Taxonomy, biology and virus transmission. United States Department of Agriculture Technical Bulletin No. 1382. 386 pp.

Pielou E C. 1975. Ecological biodiversity. Wiley, New York.

Reddy P P, Rao V R S. 2001. Leafhopper fauna associated with vegetable crops of Andhra Pradesh in India. Entomon 26(2): 121-130.

Reissig W H, Heinrichs E A, Litsinger J A, Moody K, Fiedler L, Mew T W. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 pp.

Shannon C E, Wiener W. 1963. The mathematical theory of communications. University of Illinois Press. Bulletin of Systematic Technology 27: 379-423.

Thirumalai G, Prabakaran S. 2014. A Checklist of Membracidae from India Southern regional centre, Zoological Survey of India, Chennai. pp: 1-11.

Wasowska M. 2004. Impact of humidity and mowing on chrysomelid communities (Coleoptera: Chrysomelidae) in meadows of the Wierzbanowka valley (Pogorze Wielickie hills, Southern Poland). Biologia 59: 601-611.

Zahniser J N, Dietrich C H. 2013. A review of the tribes of Deltocephalinae (Hemiptera: Auchenorrhyncha: Cicadellidae) European Journal of Taxonomy 45: 1-211.

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