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Species richness, density and diversity of acrididae in maize ecosystem in southern Rajasthan

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Abstract

The present study was conducted to study species richness, density and diversity of acrididae in maize ecosystem in different districts (Banswara, Chittorgarh, Dungarpur, Pratapgarh and Udaipur) of Southern Rajasthan during 2008-09 and 2009-10. In total ten acridid species from Banswara, Dungarpur, Pratapgarh and Udaipur; while, eight from Chittorgarh district were observed. With the maximum Shannon Weiner Diversity Index (2.082), acrididae were most diverse in Banswara district during both the years of study. While, Chittorgarh district was least diverse with the index value of 1.838 and 1.869 during 2008-09 and 2009-10, respectively. The mean and relative density values of acridis varied notably in the maize ecosystem and population of *Hieroglyphus nigrorepletus* Bolivar was most abundant with a range from 26.87 to 37.85 per cent during 2008-09 and 26.74 to 35.38 per cent during 2009-10, respectively.

Keywords: Maize, acrididae, species diversity, relative density, population abundance

Introduction

Orthoptera is most diverse and one of the largest orders of grassland insects. The number of known species of orthoptera from around the world is about 20,000 out of which only 1,750 species (nearly 8.75%) are known from India^[1]. In Orthoptera, acridoidea is the largest super family of herbivorous insects, contributing 30-60% of the total biomass of all insect species put together^[2] and forms the first link in the food chain of terrestrial ecosystem. It includes the non-migratory grasshoppers and the gregarious locusts, both are causing considerable damage to agricultural and forest ecosystem. Most grasshoppers are oligophagous and exhibit definite host preferences^[3], according to which grasshoppers are classified as grass-feeders (graminivorous), forb-feeders (forbivorous) or a mix of the two (ambivorous or mixed feeders)^[4]. The distribution pattern of grasshoppers is changing rapidly due to the encroachment of grasslands and forests for agricultural and industrial purposes. It results into host plant shifting when their main host is absent^[5]. Besides, farmers have also altered cropping patterns and agronomical practices due to urbanization, labour problems and a desire for greater profits. The changing scenario in agriculture is affecting primary consumers like grasshoppers and thereby creating impacts for entire food webs, thus it is necessary to study the distribution and diversity of grasshoppers in relation to their habitats and host plants^[6]. Earlier, information on grasshopper fauna of different regions of India has been added^[7-12]. However, there is detailed work on the diversity of orthopteran insects (grasshoppers) in the different crop ecosystems of India wanting till date. Keeping in view this, an attempt was made to investigate the species richness, density and diversity of acrididae in the maize ecosystem in southern Rajasthan.

2. Materials and Methods

Surveys were conducted to assess the relative incidence of the acrididae in maize ecosystem in Banswara, Chittorgarh, Dungarpur, Pratapgarh and Udaipur districts of Southern Rajasthan during two successive *Kharif* seasons (June 2008-November 2008 and June 2009- November 2009). To study the diversity of acrididae, sampling was done by net sweeping; covering a linear distance of 10 m. replicated four times taking different locations. The sampling was done in the forenoon from 8 to 10 a.m. and in the afternoon from 4 to 6 p.m. The collected grasshoppers were killed in a cyanide killing jar and mounted singly with an insect pin. Grasshoppers were pinned through the posterior part of the pronotum slightly to the right side from the mid-line. Each specimen was labeled by giving information about locality, date of

collection and collector’s name. Identification of the acrididae was done with the help of ICAR Network Project on Insect Biosystematics at Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur. Pertinent literature listed under references was consulted and comparisons were made with the identified (from British Museum, London) reference collection in the Department. The most useful key to the genera was that by [13, 14]. Specific determinations were made by referring to recent revised papers on various genera. The species of genera that have not been revised were identified on the basis of descriptions provided by [14]. The following mathematical/ statistical analyses were made towards estimating the species richness and diversity indices.

(i) Mean Density:

$$\sum Xi$$

$$\text{Mean Density} = \frac{\sum Xi}{n} \quad (i= 1, 2, 3, \dots, n)$$

Where,

Xi = Number of grasshopper in ith months
 n = Total number of observations

(ii) Relative Density (%)

$$\text{Relative Density (\%)} = \frac{\text{Number of individuals of one species}}{\text{Number of individuals of all species}} \times 100$$

(iii) Diversity indices

$$\text{Shannon's index (H')} = - \sum_{i=1}^S (Pi \ln Pi)$$

Where,

S = Total number of species
 P = is the proportional abundance of the ith species
 ln = Natural logarithm of n (Log to the base e)

3. Results and Discussion

Acridid faunal surveys of maize ecosystem in Banswara, Chittorgarh, Dungarpur, Pratapgarh and Udaipur districts of

Southern Rajasthan were conducted for two consecutive years. While surveying, a total of 10 acridid species belonging to six sub-families (Acridinae, Catantopinae, Hemiacridinae, Oedopodinae, Oxyinae, and Truxalinae) and identified as *Acrida* spp., *Aiolopus thalassinus* Fabricius, *Catantops pinguis* Stål, *Gastrimargus africanus* Sjost, *Hieroglyphus nigrorepletus* Bolivar, *Oxya* spp., *Phlaeoba infumata* Brunner, *Spathosternum prasiniferum* Walker, *Trilophidia annulata* Stål, and *Truxalis* spp were collected during 2008-09 and 2009-10, respectively. Twelve acridid species belonging to eight sub families from maize field [15]. However, some acridid species were different from the records of the present investigation, which might be due to occurrence and abundance of these species in the particular locality.

The acridid species richness (10) was maximum in Banswara, Dungarpur, Pratapgarh and Udaipur districts. The Chittorgarh district was represented by the least number of species (8) where *Oxya* spp. and *Gastrimargus africanus* Sjost were not recorded during the study period. The relative density of acridid population among the districts surveyed (Tables 1 and 2) indicated that populations of *Hieroglyphus nigrorepletus* Bolivar happened to be the most dominant in maize ecosystem with a range of 26.87 to 37.85 per cent and 26.74 to 35.38 per cent during 2008-09 and 2009-10, respectively. Earlier reports indicate that *H. nigrorepletus* causes considerable damage to rice, maize, millets, sugarcane, wheat and fodder crops [16-26]. However, *Atractomorpha crenulata*, *Gastrimargus sulphureus* (*G. africanus sulphureus*) and *Calliptamus cephalotes* (*C. barbarus barbarus*) recorded as minor pests of maize [27].

The data Tables 1 and 2 further inferred that the acridid species diversity as given by Shannon Weiner Diversity Index was the maximum in Banswara district with 2.082 values among all the five districts surveyed during both the years. Whereas, the Chittorgarh district was least diverse with 1.838 and 1.869 index values during 2008-09 and 2009-10, respectively. Earlier, reported that the Shannon-Wiener index value of about 2.0 indicated high grasshopper diversity in a habitat of mixed grass prairie [28].

Table 1: Relative density and diversity of acrididae in maize ecosystem during 2008-09

S. No.	Grasshopper Species	Banswara		Chittorgarh		Dungarpur		Pratapgarh		Udaipur	
		Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)
1.	<i>Acrida</i> spp.	4.80	7.48	4.40	7.64	4.40	8.21	4.60	8.30	5.20	7.34
2.	<i>Oxya</i> spp.	6.60	10.28	NR	0.00	5.00	9.33	2.60	4.69	5.40	7.63
3.	<i>Catantops pinguis</i>	4.60	7.17	4.60	7.99	4.40	8.21	3.60	6.50	5.40	7.63
4.	<i>Hieroglyphus nigrorepletus</i>	19.80	30.84	21.80	37.85	14.40	26.87	18.20	32.85	23.60	33.33
5.	<i>Phlaeoba infumata</i>	4.40	6.85	4.00	6.94	3.20	5.97	3.60	6.50	4.00	5.65
6.	<i>Spathosternum prasiniferum</i>	7.60	11.84	9.00	15.63	7.60	14.18	7.60	13.72	9.60	13.56
7.	<i>Trilophidia annulata</i>	7.00	10.90	6.20	10.76	6.20	11.57	7.00	12.64	8.60	12.15
8.	<i>Truxalis</i> spp.	3.80	5.92	3.20	5.56	3.40	6.34	3.40	6.14	3.60	5.08
9.	<i>Gastrimargus africanus</i>	1.60	2.49	NR	0.00	2.00	3.73	1.60	2.89	2.40	3.39
10.	<i>Aiolopus thalassinus</i>	4.00	6.23	4.40	7.64	3.00	5.60	3.20	5.78	3.00	4.24
Total		64.20		57.60		53.60		55.40		70.80	
Shanon index		2.082		1.838		2.138		2.043		2.040	

*NR = Not Recorded

Table 2: Relative density and diversity of acrididae in maize ecosystem during 2009-10

S. No.	Grasshopper Species	Banswara		Chittorgarh		Dungarpur		Pratapgarh		Udaipur	
		Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)	Mean	Relative Density (%)
1.	<i>Acrida</i> spp.	4.20	7.32	4.20	8.08	5.40	10.47	4.60	9.20	4.20	6.71
2.	<i>Oxya</i> spp.	5.20	9.06	NR	0.00	4.00	7.75	2.00	4.00	4.60	7.35
3.	<i>Catantops pinguis</i>	5.40	9.41	4.80	9.23	4.20	8.14	3.80	7.60	4.60	7.35
4.	<i>Hieroglyphus nigrorepletus</i>	18.40	32.06	18.40	35.38	13.80	26.74	14.80	29.60	19.20	30.67
5.	<i>Phlaeoba infumata</i>	2.80	4.88	3.20	6.15	3.60	6.98	3.80	7.60	3.80	6.07
6.	<i>Spathosternum prasiniferum</i>	6.60	11.50	7.20	13.85	7.20	13.95	7.60	15.20	8.60	13.74
7.	<i>Trilophidia annulata</i>	5.60	9.76	7.40	14.23	5.80	11.24	6.20	12.40	8.00	12.78
8.	<i>Truxalis</i> spp.	4.00	6.97	3.00	5.77	3.40	6.59	3.00	6.00	3.60	5.75
9.	<i>Gastrimargus africanus</i>	2.00	3.48	NR	0.00	1.00	1.94	1.60	3.20	2.40	3.83
10.	<i>Aiolopus thalassinus</i>	3.20	5.57	3.80	7.31	3.20	6.20	2.60	5.20	3.60	5.75
Total		57.40		52.00		51.60		50.00		62.60	
Shanon index		2.082		1.869		2.125		2.078		2.080	

*NR = Not Recorded

4. Conclusion

The species richness and diversity of acrididae was quite high denotes that the maize ecosystem is dominated by grasses as their primary food source which later move to the main crop. The results which were being presented might be the first comprehensive list of acrididae in the any of the crop ecosystem of southern Rajasthan. It is an obvious fact that acrididae contribute much to the ecological welfare as indicators and their conservation has been recognized as vital for sustainable world in view of their critical role in conservation of ecosystem. However, in some parts of the Rajasthan as well as in some years, few acridid species especially, *H. nigrorepletus* and *Oxya* spp. economically damaged the maize crops. So, this study will definitely give an addition to the existing knowledge of the entomologist of Rajasthan and India as well. Hopefully, there will be a further research study on the acridid biodiversity and taxonomy in this area, in order to get better and comprehensive information on those aspects to be documented for future reference.

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6. References

1. Tandon SK, Hazra AK. Faunal diversity in India: Orthoptera. ENVIS Center, Zoological Survey of India, 1998, 183-188.
2. Mulkern GB. Factors influencing the distribution and abundance of grasshoppers. Term. Rep. Coop. Reg. Proj. 1970; NC52, 9.
3. Mulkern GB. Food selection by grasshoppers. Annual Review of Entomology. 1967; 12:59-78
4. Isely FB. Correlation between mandibular morphology and food specificity in grasshoppers. Annals of Entomological Society of America. 1944; 37:47-67
5. Kumar H, Usmani MK. A checklist of acrididae (Orthoptera: Acridoidea) from Haryana, India. Acta Zoologica Maxicana. 2015; 31(2):234-238.
6. Paulraj MG, Anbalagan V, Ignacimuthu S. Distribution of grasshoppers (Insecta: Orthoptera) among different host plants and habitats in two districts of Tamil Nadu, India. Journal of Threatened Taxa. 2009; 1:230-233.
7. Shrinivasan C, Muralirangan MC. Studies on short-horned grasshoppers (Acridoidea) of Tamil Nadu Part I: Acridinae, Truxalinae, Comphocerinae and Locustinae. *Hexapoda*. 1992; 4:13-26.
8. Muralirangan MC, Shrinivasan C, Suresh P. Studies on short-horned grasshoppers (Acridoidea) of Tamil Nadu. Part II. Hemiacridinae, Oxyinae, Coptacridinae, Tropidopolinae, Caloptinae, Eypreopcnemidinae, Catantopinae and Cyrtacanthacridinae. *Hexapoda*. 1992; 4:149-166.
9. Sanjayan KP, Muralirangan MC, Suresh P, Chand DS, Albert S. Insect diversity in a natural scrub-jungle vegetation of a forest ecosystem in Tamil Nadu, India. *The Entomologist*. 1995; 114:179-194.
10. Joshi PC, Lockwood JA, Vashishth N, Singh A. Grasshopper (Orthoptera: Acridoidea) community dynamics in a moist deciduous forest in India. *Journal of Orthoptera Research*. 1999; 8:17-23.
11. Kandibane M, Raguraman S, Ganapathy N, Gunathilagaraj K. Orthopteran diversity in irrigated rice ecosystem in Madurai, Tamil Nadu. *Zoos' Print Journal*. 2004; 19:1663-1664.
12. Mayya S, Sreepada KS, Hegde MJ. Survey of short-horned grasshoppers (Acrididae) from Dakshina Kannada district, Karnataka. *Zoos' Print Journal*. 2005; 20:1977-1979.
13. Dirsh VM. The African Genera of Acridoidea. Cambridge University Press for anti-locust Research Centre, London. 1965, 579.
14. Kirby WF. Orthoptera (Acrididae), The fauna of British India including Ceylon and Burma. 1914, 276.
15. Thakur SK, Thakur MS. Orthopteran Crop-Pest Relationship in Roper Wetland and its Environ Punjab, India. *International Journal of Plant, Animal and Environmental Sciences*. 2012; 2(1):52-54.
16. Uvarov BP. Rice grasshoppers of the genus *Hieroglyphus* and their nearest allies. *Bulletin of Entomological Research*. 1922; 13:225-41.
17. Uvarov BP. Studies in the Iranian Orthoptera II. Some new or less known Acrididae. *Trudy Zoologicheskii Institut, Leningrad*. 1932; 1:187-233.
18. Uvarov BP. Grasshoppers and Locusts. A Hand Book of

- general acridology. Centre for Overseas Pest Research, London. 1977; III:371-444.
19. Roonwal ML. Notes on the bionomics of *Hieroglyphus nigrorepletus* Bolivar (Orthoptera: Acrididae) at Banaras, United Provinces, India, Bulletin of Entomological Research. 1945; 36:339-341.
 20. Roonwal ML. Ecology and Biology of Grasshopper, *Hieroglyphus nigrorepletus* Bolivar. Distribution and economics, life history, colour form and problem of control. Zeitschrift für Angewandte Zoologie, 1976; 63:307-332.
 21. Ahmad FU. Survey of Grasshoppers in Arid and Semiarid Regions of Pakistan. PI 480. No. PK-ARM-20 1975-80; (FG Pa-212):500.
 22. Bhatia DR, Singh C, Ahluwalia PJS. Incidence of *Hieroglyphus nigrorepletus* Bol. (Orthoptera: Acrididae) in the desert parts of Rajasthan and Kutch district of Gujarat. Indian Journal of Entomology. 1965; 26:464-465.
 23. Charan Singh. Further incidence of *Hieroglyphus nigrorepletus* Bol. (Orthoptera: Acrididae) in the desert parts of Gujarat. Plant Protection Bulletin, 1972; 22:38.
 24. Mason JB. A revision of the genera *Hieroglyphus* Krauss, *Paraheiroglyphus*, Carl and *Hieroglyphodes* Uvarov (Orthoptera: Acridoidea). Bulletin of British Museum of Natural History (Entomology). 1973; 28:507-560.
 25. Sultana R, Wagan MS. Notes on taxonomy, distribution and ecology of *Hieroglyphus nigrorepletus* I. Bolivar, 1912 (Hemiacridinae: Acrididae: Orthoptera), a major paddy pest in Pakistan. Pakistan Journal of Zoology. 2008; 3:171-178
 26. Shishodia MS. Swarming of *Hieroglyphus nigrorepletus* in Western U. P. with a new record of *H. concolor* (Orthoptera: Acrididae). *Bionotes*. 2009; 11:14.
 27. Karimullah MAM, Ahmad S. Insect pests of maize crop in different localities of Kalam. Sarhad Journal of Agriculture. 1992; 8:513- 518.
 28. Pfadt RE. Species richness, density and diversity of grasshoppers (Orthoptera: Acrididae) in a habitat of the mixed grass prairie. *Canadian Entomologist*, 1984; 5:703-709.