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Species Diversity and Density of Acridids in Paddy Ecosystem in Southern Rajasthan

Abhishek Pareek

Assistant Profesor,
Deptt. of Entomology,
Rajasthan College of Agriculture,
MPUAT, Udaipur,
Rajasthan

Lekha

Assistant Professor,
Deptt. of Entomology,
Rajasthan College of Agriculture,
MPUAT, Udaipur,
Rajasthan

P. S. Rathore

Agriculture Officer,
Deptt. of Entomology,
Rajasthan College of Agriculture,
MPUAT, Udaipur,
Rajasthan

Abstract

Surveys were conducted in paddy ecosystem in different districts of Southern Rajasthan during 2008-09 and 2009-10 to study the density and diversity of acridid species. Results revealed that species diversity was maximum in Udaipur during both the years of study with the Shanon Weiner Diversity Index being 2.141 and 2.106, respectively. The acridid mean and relative density values varied considerably in the paddy ecosystem and population of *Oxya* spp. was most abundant with a range from 24.48 to 29.92 per cent during both the years. However, relative density of *Heiroglyphus banian* Fabricius was also relatively higher over rest of the acridid species with 16.93 to 19.60 per cent during 2008-09 and 2009-10, respectively.

Keywords: Paddy, Ecosystem, Acrididae, Species Diversity, Relative Density, Population Abundance

Indrotuction

Orthopteran insects are a major taxonomic group in natural and disturbed ecosystems of temperate and subtropical regions. These insects are abundant and colonize natural (particularly grasslands) and anthropogenic landscapes (meadows, agricultural fields, lawns, buildings, etc.). Among them, many acridid species cause significant damage to tree seedlings (Joshi *et al.*, 1999) and agricultural crops (Paulraj *et al.*, 2009). They are also important components of the food chain for many birds and mammals (Capinera *et al.*, 1997; Mayya *et al.*, 2005), and hence resource management practices that alter grasshopper population dynamics will affect several trophic levels in the food chain (Capinera *et al.*, 1997). Most grasshoppers are oligophagous and exhibit definite host preferences (Mulkern, 1967), according to which grasshoppers are classified as grass-feeders (graminivorous), forb-feeders (forbivorous) or a mix of the two (ambivorous or mixed feeders) (Isely, 1944). Host plant shifting may occur in grasshoppers when their main host is absent, and may indicate the removal of a particular plant species due to environmental degradation or urbanization. In recent years, farmers have 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 of grasshoppers in relation to their habitats and host plants. Previous studies conducted by Shrinivasan & Muralirangan (1992), Muralirangan *et al.* (1992), Sanjayan *et al.* (1995), Joshi *et al.* (1999), Kandibane *et al.* (2004) and Mayya *et al.* (2005) have added information on grasshopper fauna of different regions of India. In the present study, an effort was made to know the density and diversity of acridid fauna in paddy ecosystem from Southern Rajasthan.

Materials and Methods

The following mathematical/ statistical analyses were made towards estimating the species density and diversity indices.

Mean Density

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

Where,

X_i = Number of grasshopper in i^{th} months

n = Total number of observations

Relative Density (%) =

$$\frac{\text{Number of individuals of one species}}{\text{Number of individuals of all species}} \times 100$$

Diversity Indices

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

Where,

S = Total number of species

P = is the proportional abundance of the i^{th} species

ln = Natural logarithm of n (Log to the base e)

Results and Discussion

Acridid faunal surveys of paddy ecosystem conducted in the four districts viz., Banswara, Dungarpur, Pratapgarh and Udaipur of Southern Rajasthan during 2008-09 and 2009-10 resulted in the collection of a total of 10 acridid species belonging to six sub-families (Acridinae, Catantopinae, Hemiacridinae, Oedopodinae, Oxyinae, and Spathosterninae) and identified as *Acrida* spp., *Oxya* spp., *Catantops pinguis* Stål, *Hieroglyphus banian* Fabricius, *Hieroglyphus nigrorepletus* Bolivar, *Phlaeoba infumata* Brunner, *Spathosternum prasiniferum* Walker, *Trilophidia annulata* Stål, *Truxalis* spp. and *Aiolopus thalassinus* Fabricius. In early studies, Chitra et al. (2000) reported 23 acridid species from rice field of Coimbatore, while Kndibane et al. (2004) collected 15 acridid species from irrigated rice ecosystem in Madurai. Similarly, Akhtar et al. (2012) recorded 22 species of grasshoppers belonging to acrididae family. Regarding abundance of acridid species, Irshad et al. (1977) reported *H. nigrorepletus*, *H. banian* and *H. oryzivorus* most abundant and serious pests of paddy, whereas, Januja (1957) observed *A. thalassinus* in Pakistan and Khan et al. (1963) recorded *Acrida exaltata* Walker from Rajasthan as a pest of paddy. Haldar et al. (1995) also found paddy as the most preferred food by *A. exaltata* hence, may be considered as a pest of rice. Suhail et al. (1999) reported *S. prasiniferum*, *H. nigrorepletus*, and *H. banian* from rice field of Pakistan.

The acridids population in paddy (Tables 1 & 2) clearly showed that *Oxya* spp. dominated the crop ecosystem with 10.53 to 13.50 and 9.67 to 12.33 mean density and 24.48 to 29.92 per cent and 25.44 to 27.78 per cent relative density during 2008-09 and 2009-10, respectively. The members of subfamily Oxyinae have been reported as a pest of rice crop in Pakistan and worldwide (Sultana and Wagan, 2009; Sultana and Wagan, 2007), which is indicative of the fact that paddy is the preferred host; hence, its being reasonably abundant in paddy ecosystem as observed. The findings of Kandibane et al. (2004) are also comparable with our results, who recorded two acridid species viz., *Oxya nitidula* (Walker) and *Oxya fuscovittata* (Marschall) as the most dominant acridid taxa in rice ecosystem. Subsequently, among the districts surveyed, the mean density of *Oxya* spp. was maximum at Banswara during 2008-09 and at Udaipur during 2009-10. However, its relative density was noted to be maximum at Dungarpur during both the years. Results further revealed that the population of *H. banian* was also relatively higher over rest of the acridid species and its density ranged from 16.93 to 19.60 per cent and 16.97 to 18.86 per cent during 2008-09 and 2009-10, respectively. Earlier, Das

et al. (2002) confirmed *H. banian* as a major pest of paddy as it was found highly acceptable food in terms of preference. Jadho & Khurad (2011) also recorded one species of grasshoppers i.e., *H. banian* as insect pest of rice ecosystem from Maharashtra. However, Singh and Sinha (1978) and Garg and Tandon (1983) observed *H. banian*, *H. nigrorepletus* and *Oxya fuscovittata* (Marshall) as dominant acridid pests in paddy. Similarly, Lanjar et al. (2002) recorded four species of grasshoppers viz., *Hieroglyphus banian* (F.), *Oxya nitidula* (Walker), *Chrotogonus trachypterus trachypterus* (Blanchard) and *Aiolopus tumulus* (F.) infesting rice.

A perusal of Tables 1 and 2 indicates that paddy crop ecosystem was highly diverse with respect to acridid population. During both the years (2008-09 and 2009-10), the acridid species diversity was more than 2.0 as given by Shannon Weiner Diversity Index. Earlier, Pfadt (1984) also reported the Shanon-Wiener index value of about 2.0 and indicated high grasshopper diversity in a habitat of mixed grass prairie. Further, the diversity index showed Udaipur district maximum diverse with 2.141 and 2.106 values among all the four districts surveyed during both the years.

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Table 1: Species Density and Diversity of Acridids in Paddy Ecosystem During 2008-09

S.No.	Grasshopper Species	Banswara		Dungarpur		Pratapgarh		Udaipur	
		Mean	Relative Density(%)	Mean	Relative Density(%)	Mean	Relative Density	Mean	Relative Density(%)
1.	<i>Acrida</i> spp.	4.17	8.31	3.83	9.06	4.00	9.64	4.50	9.44
2.	<i>Oxya</i> spp.	13.50	26.91	12.67	29.92	10.33	24.90	11.67	24.48
3.	<i>Catantops pinguis</i>	2.33	4.65	1.17	2.76	2.50	6.02	3.17	6.64
4.	<i>Hieroglyphus banian</i>	9.83	19.60	7.17	16.93	7.50	18.07	8.17	17.13
5.	<i>Hieroglyphus nigrorepletus</i>	1.83	3.65	1.00	2.36	1.67	4.02	2.17	4.55
6.	<i>Phlaeoba infumata</i>	2.83	5.65	3.17	7.48	2.50	6.02	3.00	6.29
7.	<i>Spathosternum prasiniferum</i>	5.33	10.63	4.33	10.24	4.00	9.64	4.67	9.79
8.	<i>Trilophidia annulata</i>	4.83	9.63	4.50	10.63	4.67	11.24	5.50	11.54
9.	<i>Truxalis</i> spp.	3.67	7.31	3.33	7.87	3.00	7.23	2.83	5.94
10.	<i>Aiolopus thalassinus</i>	1.83	3.65	1.17	2.76	1.33	3.21	2.00	4.20
Total		50.15		42.34		41.50		47.68	
Shanon index		2.081		2.031		2.120		2.141	

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Table 2: Species Density and Diversity of Acridids in Paddy Ecosystem During 2009-10

S. No.	Grasshopper Species	Banswara		Dungarpur		Pratapgarh		Udaipur	
		Mean	Relative Density(%)	Mean	Relative Density(%)	Mean	Relative Density(%)	Mean	Relative Density(%)
1.	<i>Acrida</i> spp.	4.67	10.18	4.33	11.11	3.50	9.21	3.83	8.49
2.	<i>Oxya</i> spp.	12.17	26.55	10.83	27.78	9.67	25.44	12.33	27.31
3.	<i>Catantops pinguis</i>	1.83	4.00	1.67	4.27	1.50	3.95	2.67	5.90
4.	<i>Hieroglyphus banian</i>	8.17	17.82	6.67	17.09	7.17	18.86	7.67	16.97
5.	<i>Hieroglyphus nigrorepletus</i>	1.33	2.91	1.33	3.42	1.33	3.51	2.33	5.17
6.	<i>Phlaeoba infumata</i>	3.50	7.64	2.33	5.98	2.00	5.26	2.17	4.80
7.	<i>Spathosternum prasiniferum</i>	4.50	9.82	3.67	9.40	4.50	11.84	4.17	9.23
8.	<i>Trilophidia annulata</i>	4.33	9.45	4.00	10.26	4.33	11.40	5.17	11.44
9.	<i>Truxalis</i> spp.	3.00	6.55	2.50	6.41	2.67	7.02	3.17	7.01
10.	<i>Aiolopus thalassinus</i>	2.33	5.09	1.67	4.27	1.33	3.51	1.67	3.69
Total		45.83		39.00		38.00		45.18	
Shanon index		2.096		2.087		2.086		2.106	