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POPULATION DYNAMICS OF THE ARANEID FAUNA FROM DISTRICT GUJRANWALA, PAKISTAN

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ABSTRACT

The density of spiders throughout the growth period of rice and sugarcane was investigated using two types of sampling methods (pitfall traps and hand picking) every week from March to October, 2010. A total of 178 araneid fauna belonged to seven families, 10 genera and 22 species were recorded. The Lycosidae (111) was the most common family whereas specimens holding Oxyopidae (2) family found least common among all the families. The Lycosidae was represented by nine species where as Oxyopidae by one. Maximum specimens were gathered in the month of June (37) when relative humidity (%) and rain fall were 61.4±3.25 and 40±6.01mm respectively followed by April (34) and May (33). Ecological parameters i.e. species richness (R), Shannon diversity index (H), Pielous's Evenness Index (E) and Simpson Diversity Index (D) were 28.14, 2.67, 0.92 and 0.93 at Locality-I and 29.43, 2.69, 0.91, and 0.93 at Locality-II, respectively. Proportional Index of Community Similarity (PS) for both Localities was 64.05%.

Key words: Population, spiders, pitfall traps, distribution, Pakistan.

INTRODUCTION

Spiders play a key role in integrated pest management (I.P.M.) in agro-ecosystems. There is a dire need to explore the spider fauna of Pakistan for their employment in I.P.M. The climate of Punjab is very diverse and suitable for the wide varieties of crops. But unfortunately phytophagous insects cause serious damage to agricultural crops, vegetables, and fruit trees, ornamental and wild plants. In the recent year, the use of the insecticides in the agro-ecosystems of Pakistan has increased by several folds. Unintelligent use of insecticides adversely affected the non-targeted organism that not only cause deadly harms to human health but also deplete biodiversity essential for ecological stability. Spiders are abundant, diversely populated and mostly comprised amongst the largest portions of invertebrate fauna in any environment (Coddington and Levi, 1991; Wolff, 1990). They are widely distributed on every continent except Antarctica, and have adapted to all known ecological environments except air and open sea (Foelix, 1996). Ecological parameters and taxonomic importance of different species of spiders from fruit gardens, cotton fields, citrus and guava fruit gardens were investigated by many researchers (Nentwig, 1986; Ghafoor, 2002; Platnick, 2004; Alvi, 2007; Maqsood, 2011). They have been reported to occur in peak numbers of more than 1,000 individuals per m^2 (Ellenberg *et al*., 1986) and have attained 7^{th} number in the biodiversity (Nyffeler and Benz, 1980). Approximately, 120,000 species of spiders occur worldwide and only one fourth of the total fauna has been classified and named (Roberts, 1985). The various Localities occupied are soil, houses, forests, meadows, woodlands, croplands, and the petals of flowers and even they may have adopted amphibious life (Gertsch, 1979).

Spiders can, effectively, be used for pest control in different economically important crops viz., wheat, rice, maize and cotton (Mansour *et al*., 1980; Manoley *et al.,* 2003). The ecological and faunistic studies which have been performed on forests, fields and grasslands showed that spiders are more common predators of the harmful insects (Nyffeller, 1982; Nentwig, 1986; Nyffeler and Benz, 1980; Riechert and Lockely, 1984). An integrated management program needs to be encouraged in order to conserve biodiversity and minimize dependence on pesticides in crop fields (Morrison, 1986; Biswas and Biswas, 1996). Ecological diversity plays very important role in natural check (Huffaker, 1975). So, biological control through spiders is one of the best strategies to reduce the use of chemical pesticides as well as the populations of the insect pests. The present study aims to contribute to our growing knowledge on the distribution and ecology of spider communities across two Localities. Collection of the araneid fauna from both localities at District Gujranwala will provide us the useful information about their population dynamics, species richness and their diversification for further studies.

MATERIALS AND METHODS

Study area: An experiment was conduced during March, through October, 2010 at Gujranwala (32°9′N 74°11′E), Punjab, Pakistan. Two rice and sugarcane plots (each 400 m^2) at two distinct localities (I- Tehsil Gujranwala and II-

Tehsil Kamoki) were selected for the study of Population dynamics of Araneid Fauna. Both localities selected for studies varied according to their environmental factors viz. temperature, light, vegetation, (%) relative humidity and elevation from sea levels. Collected species varied due to their morphological characteristics, metabolic processes and genetically. Neither plot was treated with any type of insecticides or herbicides throughout the experimental period. Meteorological data of rain fall, temperature and humidity was gathered from Meteorological Department, Gujranwala during the whole research period.

Collection of spiders: The density of spiders throughout the growth period of the rice and sugarcane crops was investigated using two types of sampling methods (pitfall traps and hand picking) every week from March to the October, 2010. Twenty pitfall traps were set and operated each month for five consecutive days i.e. for twenty four hours in each plot of rice and sugarcane fields simultaneously. The traps were 14 cm long glass jars with 7 cm wide circular moths. Each of the traps, when operational, contained a 150 ml of 70% ethyl alcohol and a small quantity of kerosene oil. The former served as a preservative and the latter helped in minimizing evaporation of alcohol as well as preventing the spiders from escaping from the traps. The traps were so sunk in the ground at each of the selected points that the rim of the jar was at the level with the soil surface. The traps were checked each morning and evening to ensure that all of them were operational. All the traps were replaced with fresh ones after two days, that is, after 48 hours. After the completion of another 72 hours all the traps were taken out. The traps with their contents were brought to the laboratory where the contents were strained using a fine-mesh strainer. From the strained materials were placed under a binocular microscope and specimens of spiders were picked out carefully. The specimens were washed in water and dehydrated in alcohol before being stored for various periods of time in 95% ethanol containing a little quantity of glycerine. Specimens were brought to araneid laboratory, GCU, Faisalabad for identification by using the keys of Dyal (1935); Tikader and Malhotra (1980); Tikader and Biswas (1981); Barrion and Litsinger (1995) and other related literatures. For the estimation of Ecological parameters i.e. species richness (R), Shannon diversity index (H), Pielous's Evenness Index (E), Simpson Diversity Index (D) and Proportional Index of Community Similarity (PS) were calculated for both localities.

RESULTS

A total of 178 araneid fauna belonged to seven families, 10 genera and 22 species were recorded. Of total collected fauna two most dominant were *Pardosa birmanica* (23), *Lycosa madani* (21) while *Pardosa oakleyi* (17), *Lycosa kempi* (13) *Plexipus bengalensis* (13) and *Hippasa holmerae* (13) were less captured species. Most of them belonged to family Lycosidae in which genus *Lycosa* contained 38 while 47 and 19 specimens belonged to genus *Pardosa* and *Hippasa* respectively (Table 1). Genus *Lycosa* contained *Lycosa madani* (21) *Lycosa kempi* (13) *Lycosa tista* (4) and *Lycosa mackenziei* (7); Genus *Pardosa, Pardosa birmanica* (23), *Pardosa oakleyi* (17) *Pardosa leucopalpis.* (7); Genus *Hippasa* had *Hippasa holmerae* (13) *Hippasa madraspatna* (6). Family Salticidae comprised of genus *Marpissa* and *Plexipus* with 10 and 22 specimens respectively. Genus *Marpissa* contained *Marpissa carinata* (8), *Marpissa tenebrosa* (6), *Marpissa mirabilis* (4) while Genus *Plexipus, Plexipus bengalensis* (13)*, Plexipus pakulli* (9). (Table 1). Family Thomicidae represented genus *Thomisus* with three species i.e. *Thomisus bulani* (7), *Thomisus elongates* (5) and *Thomisus pugilis* (5) whereas family araneidae consisted of genus *Cyclosa* with one species i.e. *Neoscona bengalensis* (3). Family Clubionidae contained only 3 specimens i.e. *Clubiona sp.* Family Gnaphosidae contained genus *Gnaphosa* including *Gnaphosa harpax* (1) and *Gnaphosa eucalyptus* (1). Two Specimens of *Oxyopes ratnae* belonged to family Oxyopidae. Family Lycosidae found at peak position with three genera i.e. *Lycosa*, *Pardosa* and *Hippasa* with nine species including 111 specimens. With 23 specimens *Pardosa birmanica* abundantly found at Locality-I while *Lycosa madani* (21) and *Pardosa oakleyi* (17) were less found genus (Table 1).

Members of Family Clubionidae and Family Gnaphosidae did not found at Locality-I. A general look on the results showed that the family Lycosidae was the most abundant among the all seven families during the whole trapping session. The order of abundance of the families were Lycosidae > Saltcidae > Thomicidae > Araneidae > Gnaphosidae > Clubionidae > Oxyopidae. Ecological parameters viz. species richness (R), Shannon diversity index (H), Pielous's Evenness Index (E) and Simpson Diversity Index (D) were 18, 28.14, 2.67, 0.92 and 0.93 at Locality-I whereas 19, 29.43, 2.69, 0.91, and 0.93 at Locality-II respectively. Proportional Index of Community Similarity (PS) for both localities was 64.05%.

DISCUSSION

Family Lycosidae not only showed the overall dominance at two Localities but also present in huge percentage in each month during pitfall trapping sessions (Table-1). Members belonged to Lycosidae were the most populated araneid fauna gathered from the whole period of study from both under study localities. It was 19.10%

in April, 18.5% in May and 20.7% in June and with little bit difference in percentage in remaining months. Family Lycosidae was 65.7% of the total spiders. On the contrary Alvi, (2007) collected lycosids (334) 32% of the total araneid fauna. The Ferguson (1989) reported that population of ground dwelling spiders peaked in the June and were dominated by Lycosidae.The similar studies but in different habitats in temperate zone. Duffey, (1962) demonstrated that the Lycosids accounted for 43% of the cursorial species and 55 percent of the cursorial spiders. Maqsood (2011) collected about 182 comprised of 5 genera and 16 species. Krebs (1978) stated that when establishment of territories begins inter and intra-species competition act and reduce the number of spiders with the normal phenological progression. It may be possible that this phenomenon acted during the study and specimens of *Lycosa* derived out genera and become dominant or may effect seasonal changes (Ali and Regan, 1986). Aranidae family comprised of *N. bengalensis* including only three specimens from both localities. On the contrary Ghafoor (2002) collected (54) a great number of specimen belonged to this family during studying the biological impacts of cursorial spiders of cotton fields at Pakistan. Alvi (2007) gathered about 112 (39%) members included in this family during his taxonomical and ecological studies of spiders from some fruit gardens of district Jhang, Pakistan. Similarly Maqsood (2011) collected a very large number of spiders from guava gardens. The abundance (%) for families Lycosidae (65.52%) was maximum followed by the Salticidae (22.11%) and Thomicidae (9.04%) whereas Araneidae (3.11%), Clubionidae (3.41%); Gnaphosidae (2.55%) and Oxyopidae (2.34%) showed, almost, same abundance (%) (Table 2).

Clubionidae family comprised of very few specimens (3) gathered from both localities. The captured specimens of the family Gnaphosidae were only two. Ghafoor (2002) collected eighty (74%) specimens of this family from cotton fields while Alvi (2007) and Maqsood (2011) in their ecological study collected very high number of spiders (62%) from fruit gardens and guava gardens (55%). Maximum specimens were collected from March to June. Saltisidae family included two genus including forty specimens following the lycosidae. Members of specimens collected during resent research period similar to the specimens collected by Ghafoor (2002) from cotton fields and Maqsood (2011) who collected about 26% of total captured arranged fauna from citrus and guava gardens but were very less than gathered by Alvi (2007) from fruit gardens (53%). Most of the spiders were gathered in between March and July. Thomisidae family comprised of seventeen specimens belonged to three species. Alvi (2007) captured fifty member of this family from district Shorkoot from some fruit gardens which belonged about 29.20 % of the total collected spider fauna. Similarly Maqsood (2011) gathered a great number (254) of specimens belonged to this family. Yan (1991) in his survey recorded 112 species belonging to 66 genera and 18 families and concluded that the number of pest species and spider diversity varied between Locality-I and Locality-II. Spiders belonged to genus Thomisus were captured from the month of April to June (Table 3).

The month of June with its climatic conditions i.e. average rainfall, temperature and relative humidity found to be more suitable for spider population to increase. Highest proportion of spiders (20.7%) was trapped during same month. Results clearly demonstrated that increase in temperature and relative humidity favored spider population to increase through March (15) to June (37). But on the other hand increase in rainfall suppressed spider population in the months of July (24) and August (18) while temperature (37.75C^{o}) and relative humidity (79.5% R.H.) were quite high. July was recorded the month of highest temperature and average rainfall but with decline in the number of spiders. Ecological factors observed in both the sites kept on boosting spider population till June with high temperature and relative humidity then slowly decrease through July to October because of decrease in temperature and increased rainfall.

A number of measures were employed in analyzing the data from the study. Total number of specimen per samples at Locality-II (R=29.43) was greater than at Locality-I (R=28.14). Similarly Shannon diversity at Locality-I (H=2.69) was greater than at Locality-II (H=2.67). Relative abundance of any species which showed the richness at any Locality was greater at Locality-I (E=0.92) as compared to Locality-II (E=0.91). The parameter which was used to quantify the bio-diversity of any Locality was similar (D=0.93) at both localities under experimentation (Table 2). Maximum specimens were collected (37) in the month of June when mean rain fall (40 mm). The averaged rain fall in the month of June helped them freely moving in search of food and shelters. The seasonal changes in the abundance of the spiders depend on their inherent life cycle schedules and effect of temperature, relative humidity and rainfall (Mumma, 1993). In the present study high abundance of spider was recorded in the months of May and June due to high temperature and relative humidity with well suited light period and air and not much rainfall. The high rainfall during the trapping session did not affect spider's abundance significantly due to high temperature and relative humidity suitable for their reproduction. As the study was carried out in the hotter months of the year; the abundance, species richness and diversity was significantly high during the study period. During these months due to high temperature, relative humidity, ample light and abundant food made the period favorable for the spider population. High rain fall in the month of July (190 mm) significantly decreased their population might be due to the less availability of food

Table 1. **Data of families, genus and species of Araneid fauna captured during (March to October, 2010).**

Family	*Genus*	*Species*	*Months*								
			Mar	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Total**
Araneidae	Neoscona	*N. bengalensis*	-	-	-	-	2	1	-	-	3
Clubionidae	Clubiona	*C. sp.*	1	1	-	1	-	-	-	-	3
Gnaphosidae	Gnaphosa	*G. harpax*	-	-	-	-	1	-	-	-	1
		G. eucalyptus	-	-	-	-	-	-	-	1	1
Lycosidae	Lycosa	*L. madani*	2	4	4	4	4	2	-	1	21
		L. kempi	1	3	-	3	-	2	3	1	13
		L. tista	-	1	2	1	-	-	-	-	4
		L. mackenziei	1	2	1	1	1	1	-	-	7
	Pardosa	*P. birmanica*	3	5	4	5	-	4	2	1	23
		P. oakleyi	-	2	6	4	4	3	2	-	17
		P. leucopalpis	-	1	1	2	1	-	1	1	7
	Hippasa	*H. holmerae*	-	1	6	1	2	2	1	-	13
		H. madraspatna	-	1	1	2	1	-	1	-	6
Oxyopidae	Oxyopes	*O. ratnae*	-	1	-	-	1	-	-	-	2
Saltisidae	Marpissa	*M. carinata*	1	3	1	3	-	-	-	-	8
		M. tenebrosa	1	1	1	1	1	1	-	-	6
		M. mirabilis	-	-	1	1	-	1	1	-	4
	Plexipus	*P. bengalensis*	2	2	2	1	2	1	1	2	13
		P. pakulli	1	1	-	4	2	1	-	-	9
Thomisidae	Thomisus	*T. bulani*	1	2	1	2	1	-	-	-	7
		T. elongatus	1	2	1	-	1	-	-	-	5
		T. pugilis	-	1	2	1	-	1	-	-	5
		Grand total	15	34	33	37	24	18	11	6	178

Table 2. Data for Species Richness (R), Shannon Diversity Index (H), Pielous's Evenness Index (E) and Simpson Diversity Index (D) for spiders collected from both localities, March to October, 2010.

Parameters	*Locality-I (Gujranwala)*	*Locality–II (Kamoki)*
Margalef index (Species Richness), R=S-1/ln (n)	28.14	29.43
Shannon Diversity Index, H=EX ln (S)H	2.67	2.69
Pielou's Evenness Index, E=H / ln (S)	0.92	0.91
Simpson Diversity Index, D=1-$\sum^{s}_{i=}$ 1ni(ni-1) /N (N-1)	0.93	0.93
Proportional index of community similarity (PS)	64.05%	

Table 3. Data for temperature (mean ± SE), Relative humidity (%), rain fall (%) and spiders caught during through March to October 2010 at Gujranwala

Month	*Temperature (°C)*		*Mean R.H. (%)*	*Average Rainfall (mm)*	*Total No. of specimens*
	Mean	**Ranges**			
March	21.95±0.98	14.7-29.2	58±2.14	28±0.58	15
April	28.65±1.54	19.4-37.9	43±1.25	19±0.36	34
May	31.8±2.85	24.0-39.6	52.9±0.21	24±1.25	33
June	35.1±1.41	27.4-42.8	61.4±3.25	40±6.01	37
July	37.75±2.11	28.0-43.5	79.5±4.10	190±1.01	24
August	33.3±3.11	27.3-39.3	85.2±0.21	172±4.25	18
September	29.75±0.58	24.7-34.8	81.8±0.54	62±1.98	11
October	24.85±0.44	19.5-30.2	62.4±1.54	25±1.54	6

and hide. In future more studies can be planned to observe the araneid fauna with respect to biotic and a biotic factors. Their combinations with other populations will depict the influences of araneid fauna populated in

various crops. Their predatory efficacy can be studied as compared to other predatory fauna used for the biological control in various agro-ecosystems.

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