Occurrence and Distribution of Araneid Fauna Trapped from Cotton Fields of District Faisalabad, Pakistan

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Abstract: Araneid fauna (267) collected from cotton fields comprised of 21 species, 10 genus and 6 families. The contribution of families was Araneidae 6.50%, Clubionidae 2.36%, Gnaphosidae 6.50%, Lycosidae 57.39%, Saltisidae 25.59% and Thomisidae 6.50%. Three genus of *Lysosa*, *Pardosa* and *Hippasa* belog to Lycosidae and two in each Araneidae and Saltisidae families. Temperature (°C) and rainfall increased up to July and relative humidity (%) up to August. Most of above said environmental factors (temperature, relative humidity, rainfall) did not favor the collection of Araneid fauna. The most specimens were collected on June at 34.75°C, 61% relative humidity and average rainfall 42 mm while the least were captured on October. Species richness, Shannon diversity index, Pielou's evenness index and Simpson diversity index evaluated were 55.50, 2.80, 0.92 and 0.93, respectively. It was concluded that spider populations were significantly affected by the environmental factors. Further studies are required to explore the new phenomenon related to the bio-control of various pests through spiders in different agricultural crops.

Key words: Spiders · Predators · Bio-diversity · Humidity · Abundance · Rainfall

INTRODUCTION

Spiders possess the characteristics of predators that can contribute to density-independent limitation of prey, including self-damping, high levels of polyphagy and life cycles that are asynchronous to those of prey species. Hunting spider made up 85.5%-91.7% of the spider fauna in peanut agro ecosystem. Thomicidae, Oxyopidae and Lycosidae were dominant families constituting 74.6% of the total spider fauna of the two years study. Each family in turn was dominated by a single species. Spider's abundance generally increased as the growing season progressed and the plant size and structure increased [1]. Spiders may play an important role in stabilizing or regulating insects populations because they are one of the most numerous insectivores and exhibit a wide variety of lifestyles and foraging strategies [2]. While biological control by spiders has not been clearly demonstrated in natural systems, evidence in agro-ecosystems has been found in several studies and benefits to primary producers have measured. Predation is of great ecological, evolutionary and behavioral interest. The purpose of his study was to determine the role of spiders in suppressing pest populations. His research approaches included laboratory studies of preference, feeding rate and fitness; direct observation of predation events or accumulations of prey carcasses; gut analyses; and field experiments [3].

Spiders can play an important role to regulate insect pests in the agricultural ecosystem. Spiders have a wide range of prey species, can catch significant numbers of prey and use various foraging strategies. Most of the spiders in rice fields seem to evacuate the field after the application of insecticides and move back into the field later. Their predatory capacity can have a synergistic effect in suppressing densities of insect pests when they are used to complement the effect of insecticides [4]. Spiders belong to the most numerous invertebrate predators of arable land in Europe and although they are generalists, a diverse spider fauna contribute to the limitation of various pest species. Assemblages of spider species reduce populations of many insect pests [5], including leafhoppers in rice, aphids in spring barley,

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cotton and scale insects in orchards. Spider assemblages reduce crop damage in rice, soybean and vegetable gardens [6]. Spiders are one of the most natural enemies of insect pest of various crops, including maize [7]. In Central Europe, 30 to 60 species belonging to several families are frequently occurring in agrobiocenoses. Weibull *et al*. [8] suggested that biodiversity in agroecosystems depends on both landscape heterogeneity and farm management, they also studied biodiversity in relation to both landscape variables and farm management. They investigated the species richness of plants, butterflies, carabids, rove beetles and the diversity of spiders in cereal fields, leys (grass and clover crop) and semi-natural pastures at 16 farms in Central East Sweden.

Nyffeler and Sunderland [5] discussed the role of spider fauna of agroecosystems in the northern-temperate zone of Europe include linyphiid spiders and capture the pests (most likely aphids) in their sheet webs. In the US, spider guild structure is more complex and hunters (especially, Lycosidae Oxyopidae, Salticidae, Clubionidae and Thomisidae), that have broader diets (including lepidopteran and heteropteran pests), numerically prevail in many locations. Although in European and U.S. fields spider densities were different from each other but in both localities the spiders feed rather infrequently. They contribute to pest control as part of larger assemblages of natural enemies. They concluded that spiders can be widely applicable to biologically control the pests. In the recent studies it was aimed that to explore the importance of spiders in various agro-ecosystems and their abundance in different agro-climatic conditions. A-biotic factors play a vital role in the diversity of spiders in different agricultural, fruit and vegetable fields. In the recent studies those factors were discussed with the bio-diversity araneid fauna in different agroclimatic environments.

MATERIALS AND METHODS

This study was conducted during mid of March, 2010 to end of October, 2011 in cotton fields from village 120 R/B Kang Kalan at District Faisalabad, Punjab, Pakistan. Eight plots of cotton were selected for the trapping of spiders. The activity density of spiders throughout the growth period of the crop was weekly investigated using 2 types of sampling methods (pitfall traps and hand picking) from March to the October (harvest time). To collect ground spiders in each plot, 20 pitfall traps consisting of wide-mouth glass jars (6 cm in diameter × 12

cm deep) were installed diagonally. Four pitfall traps (on a 5 × 5 m grid pattern) were installed at each corner of the plots and four in the center. These traps were buried into ground with the mouth of jars leveled to the ground surface for seven days. Ethylene glycol (95%; 250 ml) and 2 drops of 1% liquid detergent were added to each trap to break the surface tension. A rain cover (18 × 18 cm) constructed of 0.6 cm plywood and supported by 3 nails (9 cm long) was placed over each trap (the height of rain cover over the mouth of the glass jar was 30 cm). All traps were emptied after seven days. Spiders from each trap were collected and brought to the laboratory. Captured spiders were washed in xylene placed in small jars with 70% ethanol and transported to the arachnology laboratory Government College University, Faisalabad for sorting and identification. Finally spiders were preserved in vials, containing a solution of 70% ethanol and glycerin and prepared for ecological studies. Spiders were identified using Dyal [9] and Tikader and Malhotra [10]. The data obtained was statistically analyzed for the species relative abundance and other diversity indices like Species Richness, Species Richness Margalef Index, Evenness Index, Pielov's Evenness, Shannon Diversity Index, Simpson's Index and Shannon's Index.

RESULTS AND DISCUSSION

During the current studies 493 specimens captured from the cotton fields belonged to six families, 10 genera and 21 species. Family Salticidae comprised of genus *Marpissa* and *Plexipus* with 39 and 48 specimens respectively. The genus *Marpissa* included *M. carinata* (25), *M. tenebrosa* (54) and *Marpissa spp.* (19), respectively. Family Thomicidae represented by the genus *Thomisus* with two species i.e. *T. bulani* and *T. elongates*. Eleven specimens belonged to the family Oxyopidae with single species i.e. *Oxyopes ratnae*. The most dominant species were *Pardosa birmanica*, *Lycosa madani* and *Lycosa kempi* while *Pardosa oakleyi*, *Plexipus bengalensis* and *Hippasa holmerae* were dominant species while the remaining were less frequent. Family Araneidae consisted upon two genera *Cyclosa* and *Neoscona* with two species; *Cyclosa bifida* (43) and *Neoscona bengalensis* (83). Family Clubionidae contained four specimens of the same species i.e. *Clubiona* sp. Family Gnaphosidae represented 19 specimens of two species i.e. *Gnaphosa harpax* (23) and *Gnaphosa eucalyptus* (34). Family Lycosidae remain its peak position with three genera i.e. *Lycosa*, *Pardosa* and *Hippasa* as given in Fig. 1. Tahir *et al*. [11] recorded 1098 Araneid
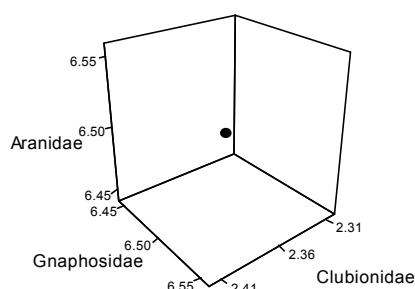
Fig. 1.3: D plot among the contribution of Aranidae, Gnaphosidae and Clubionidae families (%) of total Araneid fauna captured from the cotton plots at district Faisalabad, 2011.
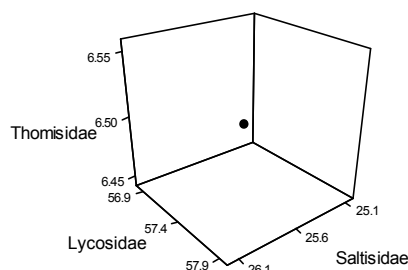

Fig. 2. 3:D plot among the contribution of Thomisidae, lycosidae and sltisidae families (%) of total Araneid fauna captured from the cotton plots at district Faisalabad, 2011.

fauna counting 38 species, 22 genera and nine families. Lycosidae was that the majority abundant family while Gnaphosidae contained the highest spider population. Ghafoor and Mahmood [12] gathered one hundred and seventy eight specimens contained seven families, ten genera and twenty two species captured from the month of March till October, 2010 from the rice and sugarcane fields located at district Gujranwala, Pakistan.

The maximum temperature was recorded 43.2°C on July, which favours the spider population to increase. But high rainfall (192 mm) during the same month hindered spider population to grow. At maximum temperature 42.2°C and 172 mm average rain fall recorded on July represented 28 specimens of Araneid fauna. But most of the specimens were captured on June when temperature, relative humidity and rain fall were 42.5°C, 61 (%) and average rainfall 42 mm, respectively as depicted in Figure 2. In other studies, Alvi [13] captured 32% belonged to Lycosidae of the total collection from fruit gardens of district Jhang, Pakistan. Tahir *et al.* [11] explained that araneid population showed steadily increasing patterns among the populations of immature and adults fauna from January to August. Further, they
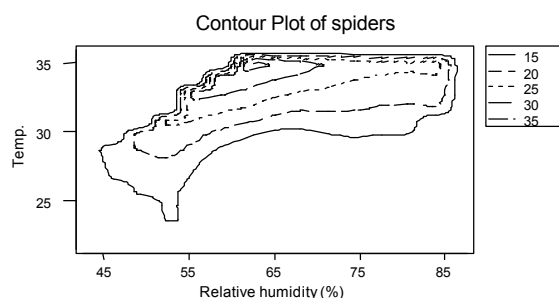

Fig. 3: Contour plot of distribution of spider population with the effect of temperature (°C) and relative humidity (%) from the cotton fields at district Faisalabad.

establish five most abundant species of Lycosidae family including 67.77% of the total trapped fauna. Zabka *et al.* [14] recorded 30 genera and 200 species of Salticidae from New Zealand. The fauna was highly endemic, both on a generic and specific levels. The relationships between Salticidae of New Zealand and Australia, were limited to single representatives of Opisthoncus, Holoplatys, Ocrisiona, Helpis, "Lycidas", "Clynotis" and Hypoblemum. Species richness, Shannon diversity index, evenness and simpson diversity were 55.50, 2.80, 0.92 and 0.93, respectively. The abundance order of the families was Lycosidae > Saltcidae and Araneidae > Gnaphosidae, Clubionidae and Thomisidae. Average rainfall, temperature and relative humidity found to be more suitable for increasing spider population on June. Because highest proportion of spiders i.e. 21.12% was trapped during this same month of June as shown in Fig. 3. Ghafoor and Mahmood [12] demonstrated that temperature and humidity favored the spider population from March (15) to June (37). They captured maximum on June when ranges of temperature, relative humidity and rain falls were 27.4-42.8Co, 61.4-77.54% and 40-69 mm, respectively.

Results clearly demonstrated that increase in temperature and relative humidity favoured spider population to increase through March to June. But on the other hand, increasing rainfall suppressed spider population on July and August while temperature and relative humidity were quite high. July exhibited the highest temperature and average rainfall with decline in number of spiders. Ecological factors observed in all the habitats with little bit variations kept on boosting spider population till June with high temperature and relative humidity then slowly decreased through July to October because of decrease in temperature and increased rainfall as given in Fig. 1. Tahir *et al.* [11] represented that adult

Table 1: Analysis of Variance (ANOVA) for the families of Araneid fauna, temperature (°C), relative humidity (%) and rain fall (mm) trapped from the cotton fields at district Faisalabad

SOV	df	SS	MS	F cal	P value
Families (F)	6	4842.10	873.69	26.25*	0.014
Temperature (T)	1	312.10	312.10	0.26ns	0.1279
Relative humidity (R.H.)	1	488.51	488.51	24.80**	0.0035
FXT	6	804.50	125.91	7.58**	0.001
FXR.H.	6	258.72	22.42	0.33*	0.078
TXR.H.	1	587.20	587.20	1.055*	0.047
FXTXR.H.	6	825.950	140.82	0.584ns	0.213
E	1	19.20	19.20	-	-
Total	28	-	-	-	-

Table 2: Correlation coefficients (Pearson) among the families of Araneid fauna with relative humidities (%), temperature (°C) and rainfall (mm) collected from cotton fields at Faisalabad

Parameters	Families	Temperature (°C)	Relative humidity (%)	Rainfall (mm)
Families	1	-	-	-
Temperature (°C)	0.929**	1	-	-
Relative humidity (%)	0.230^{NS}	0.977*	1	-
Rainfall (mm)	0.431^{NS}	0.539^{NS}	0.581^{NS}	1

*, ** and NS; significance at 5%, 1% and NS non-significance

spiders increased from January to April. They also concluded that adults population decreased on May than again shoot up on June. Species richness improved from January to July while evenness displayed different patterns of araneid population. Ferguson [15] reported the same order of dominance for Lycosidae and Linyphiidae family. He reported that population of ground dwelling spiders peaked on June and were dominated by Lycosidae. Family Lycosidae not only showed the overall dominance in all the four habitats but also present in huge percentage in each month during pitfall trapping sessions. It was 57.28% on April, 65.6% on May and 59.18% on June and with little bit difference in percentage in remaining months. Family Lycosidae was 57.4% in the current research area. Highest proportion Family Lycosidae was recorded from Habitat-2 i.e. 29.17% of total Lycosids. Ghafoor [16] collected maximum number of spiders (74%) belonged to Gnaphosidae from the cotton fields. On the contrary Maqsood [17] gathered (62%) spiders from fruit gardens than guava fields (55%).

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 [18]. Whiteford *et al.* [19] noted that ground dwelling spider was best characterized as a hunting guild and considered primarily of Lycosidae, Thomicidae and Gnaphosidae. All the four habitats showed the slight variations in the species abundance. Yan [20] recorded

112 species belonging to 66 genera and 18 families and concluded that the number of pest species and spider diversity varied between habitats and habitual environmental factors and also effect the community parameter including Shannon index, Evenness index and Simpson's index. The seasonal changes in the abundance of the spiders depend on their inherent life cycle schedules and effect of temperature, relative humidity and rainfall. [21]. 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 favourable for the spider population.

Recent studies have also discussed the possibility that applying diversity indices to invertebrate studies may posses intrinsic shortcomings, since the rate of capture is linked with individual activity. Tahir *et al.* [11] analyzing the activity density of spiders captured from the citrus fields and found three dominant families i.e., Lycosidae (68.85%) followed by Gnaphosidae (10.38%) and Saltisidae (8.38%). From the current studies it was concluded that the environmental factors like temperature, humidity and rainfall etc. effect the araneid populations in crops, fruits and vegetables. In future studies, a collection schedule that included a range of day and night-time as well seasons and even microhabitats, would donate to a more precise picture of araneid community.

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