Research Article

Feeding and Circadian Behaviour of Spiders (Aranae: Arachnida) in the Sugarcane Fields of Matiari and Hyderabad Districts, Sindh

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Abstract | Feeding and circadian behavior of spiders occurring in two agricultural districts of Sindh, Pakistan were investigated over a four-year period from 2015-2018. Sample size was 2808 specimens which were arranged into 25 species, 15 genera and ten spider families. After analyzing the data from growing to harvesting of sugarcane, two spider guilds were identified on the basis of feeding and circadian behavior. Assemblage of spiders in the sugarcane filed studied under the umbrella of guild study clearly indicate that spiders are voracious predators and excellent biological control agents. Circadian rhythm is necessary for the adaptation in the environment. In present research diurnal behavior was more frequently found as compared with nocturnal.

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1. Introduction

Pakistan is an agricultural country having appropriate average climatic conditions which favor growth of Arthropods. Among Arthropods, insect's fauna multiplies rapidly and causes widespread spoil to our cash crops, which have negative impact on economy. Farmers use pesticides to get rid of targeted pests, in results many non targeted fauna and flora including human endure by dangerous consequences. For the sake of healthy environment farmer need to learn other alternative of pesticides which is Bio control. Control of life by life is eco friendly and one of the safest methods of pest control. Spiders are the natural predators of pests, spiders belong to Aranae a diversified group of carnivorous Arthropods and they are familiar due to their abundance and web formation (Rodrigues *et al.*, 2009; Riechert, 1984). Spiders lack wings and antennae, have two body region; cephalothorax and abdomen; second is soft and unsegmented while first is harder having eight legs (Sharma, 2014). They prey on insects and other small fauna, provide vital service in controlling pests; without them it would reach at threshold level in ecosystem (Platnick, 2018). Mostly spiders are terrestrial, a few aquatic found often in

warmer parts of the world; researchers described 47,566 species while more waiting for description (Ursani *et al.*, 2013; Riechert and Gillespie, 1986). The knowledge about spider fauna is versatile importance due to their diversity, abundance, hunting strategies, guild structure, habitat selection, integrated pest management, bio control and academic point of views. Guild with reference to Ecology a group of closely related species which exploits, compete same kinds of the resources in similar ways as a result of their shared ancestory. Especially for spiders (abundant arthropods) feeding for a common resource mostly insects and other arthropods which has led to numerous attempts to classify them into guilds. Their study is very important because spiders can play a predatory role and could be helpful in reducing pest damage to crops.

2. Materials and Methods

2.1 Collection of spiders

Visits were divided into three periods, on the basis of age of sugarcane crop and five sites of each from Matiari and Hyderabad were chosen. 2808 specimens of spiders were collected in to two phases May-November 2015-2016 and May–November, 2017-2018 (Table 1). The adult spiders were identified using available literatures (Ursani and Soomro, 2010; Platnick, 2006; Siliwal *et al.*, 2005). Some of the immature stages could not be identified and ignored.

Table 1: Year wise collection from District Hyderabad and Matiari.

Year (of Surveyed)	No. of specimen (Hyderabad)	%	No. of specimen (Matiari)	%
2015-2016	729	51.30	706	50.90
2017-2018	692	48.69	681	49.09
Total	1421		1387	

(i) Pitfall method: Most of the collection of the spiders was done by this method, it is proved more suitable during the months of early sowing when the height of the sugarcane plant is not very tall (Figure 1).

(ii) Ground hand collecting: This method of sampling is used to collect the spiders, which are found to be visible in the ground, litter, in broken logs, found in the sugarcane fields (Figure 2).

(iii) Aerial hand collecting: This method was used to collect web-building and free-living spiders on the foliage and stems of sugarcane crop (Figure 3).

(v) Litter sampling: Litter sampling involved sorting of spiders from the litter collection tray. The litter which found on the edges of sugarcane crop (Figure 4).

Figure 1: Managing pit fall method of collection.

Figure 2: Hand picking of spiders during collection.

Figure 3: Observation of spiders from sugarcane shoots.

2.2 Feeding habit

Observations on the feeding habits were determined on live spiders in open fields, during early morning and late evening. After locating the species and quietly watching their feeding for about 2 to 4 hours where data were documented.

Table 2: Showing family wise feeding/foraging for food and making Guilds in sugarcane.

Families	Common name	Feeding Guilds of spiders in sugarcane
Lycosidae	Wolf spiders	Voracious hunters and ground runners
Sparassidae	Huntsman spiders	Foliage runners, feed upon insects present in the foliage
Pholcidae	Cellar spiders	Sheet web builders, prey trap in web
Salticidae	Jumping spider	Stalkers mostly found on the tillers of sugarcane crop
Thomisidae	Crab spiders	Ambushers use camouflage tactics to capture prey
Araneidae	Web builders	Weave orb-webs, not only for trap insects sometimes small birds frogs also trapped in the webs.
Clubionidae	Sac Spiders	Found in foliage, foliage runners and are aggressive hunters.
Gnaphosidae	Ground runners	Sister family of Lycosidae. Feed on insects and arthropods
Oxyopidae	Lynx spider	Stalkers, The majority species make slight use of webs, instead spending their lives as hunting and foraging spiders on sugarcane
Tetragnathidae	Stretch spiders	They mostly found on the shoots of the sugarcane crop above the gound and web was small and built between two shoots of sugarcane. The members of this family entirely feed on flies adult mosquitos and moths and butterflies

Figure 4: Collection of spiders from sugarcane litter.

2.3 Guild spiders

Guild study was carried out while doing live observations in the open field and some experimental observations were documented at green house at sugarcane fields along with morphological and anatomical characteristics of spiders.

3. Result and Discussion

In present study feeding behavior as well as circadian rhythm was observed, two guilds were identified on the basis of these two behaviors in the sugarcane fields of the Hyderabad and Matiari districts (Table 4). 14 genera and 25 species and ten families of the spiders were identified namely Lycosidae, Sparassidae, Salticidae, Tetragnathidae, Araneidae, Clubionidae, Gnaphosidae, Thomisidae, Oxyopidae and Pholcidae (Table 3).

Table 3: Sowing Circadian Rhythm in various spider families found in the sugarcane crop.

Families	Circadian Rhythm
Lycosidae	Diurnal, Nocturnal
Sparassidae	Diurnal
Pholcidae	Diurnal
Salticidae	Diurnal
Thomisidae	Diurnal
Araneidae	Diurnal
Clubionidae	Nocturnal
Gnaphosidae	Diurnal
Oxyopidae	Nocturnal
Tetragnathidae	Diurnal

It was observed during the study that the assemblage of the spiders have significant impact on the pest populations, understanding of guild formation and diversity help in the future study of arthropods fauna found in the ecosystem of sugarcane fields (Table 2). This study was carried out for the first time in these two districts (Matiari and Hyderabad) of Sindh. And its findings will have a positive impact on the role of the spiders as farmer friendly and as predators in integrated pest management IPM. Research demonstrate that a variety of spider's species consume analogous resources (food, shelter, mating etc) in a diverse ways and structures in an assemblage (Guilds) in an ecosystem (Uetz, 1977; Post and Riechert, 1977). In the same way it was also found that not only diverse spider species are linked by means of special guilds in sugarcane crops even their work of art were also deviated. The presence of meticulous spider fauna in sugarcane crops is showing its effect on the especial

Table 4: Showing family wise Spider Guild classification observed in sugarcane fields in Matiari and Hyderabad.

Spider family studies	Uetz, 1977 (2 Guilds)	Post and Riechert, 1977 (8 Guilds)	Hyderabad and Matiari districts survey 2015- 2016 (2 Guilds)
Lycosidae	Wandering spiders	Diurnal running spiders	wandering spider guild
Sparassidae	Web-builders	Crab spiders	---
Pholcidae	Wandering spiders	Web-builders	Web-builders
Salticidae	---	Jumping spiders	wandering spider guild
Thomisidae	---	Crab spiders	---
Araneidae	Web-builders	Orb weavers	Web-builders
Clubionidae	Wandering spiders	Nocturnal running	wandering spider guild
Gnaphosidae	---	spiders	---
Oxyopidae	---	---	---
		Diurnal running spiders	

features of the environment because surroundings arrangement sustains a variety of the spider species.

Activities of spiders were synchronized with the night –day rhythms. Light, humidity, temperature are the major environmental factors effecting the circadian behavior, authors agreed as previously reported research by (Platen, 2013), In present study Lycosidae is the most abundant family making 35.11% of total collected specimen with 03 genera and 09 species. In Lycosids show diurnal as well as nocturnal behavior, while in remaining nine families, seven showed diurnal and while two showed nocturnal behaviors. During study it was observed that spiders are more active during dawn and dusk supported by (Cloudsley-Thomson, 1957; Casas *et al.*, 2008; Ward and Lubin, 1992; Lubin *et al.*, 2001).

Conclusions and Recommendations

It is concluded that spider fauna is polyphagous and contribute a lot in control of pest population. During the study it was observed that not only various spider species are linked by means of special guilds in sugarcane crops even their behavior was differ. The presence of spider fauna in sugarcane crop has direct linked with the environment because clearly shown through the difference in the collection year wise (table.1), although the difference was little. The guilds structure not only found in adults but also witnessed between immature spiders. Three dominant families were Lycosidae, Sparassidae and Saltcidae. This research work is initial step towards gathering of information on ecological status of spiders in various habitats because through this study authors were able to observe and documented the guilds on the basis of feeding and circadian behavior. Now a door is opened for future researchers to work on relationship of spiders and various cash crops for IPM.

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Novelty Statement

This study on the circadian behavior of spiders and guild structure observed in the sugarcane fields of two densely sugarcane growing areas and the work is expected to be of wider appreciation by researchers in the field of agriculture especially for the biological control and pest managements.

Author's Contribution

Samina Malik collected the data and made the observations, Naheed M. Soomro and T. J. Ursani designed the experiments. Naeem Tarique Narejo helped in statistical analysis, Jawaid A. Khokhar and Asif Soomro helped in paper writing.

Conflict of interest

The authors have declared no conflict of interest.

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