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Research Article

PRELIMINARY STUDIES ON THE SPIDER FAUNA IN SELECTED AGRO-ECOSYSTEMS OF KOZHINJAMPARA PANCHAYAT, PALAKKAD DISTRICT, KERALA

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ABSTRACT

Spiders are one of the most important arthropod groups in agro-ecosystems. They play an important role in regulating insect pests in agricultural ecosystems. The present study attempts to improve the understanding of resident spider population in the four selected agro-ecosystems viz., Paddy, Banana, Lady's finger and Groundnut in Kozhinjampara Panchayat, Palakkad District, Kerala. Spider population in the four selected agro-ecosystems exhibited different species abundance and composition. A total of 302 individuals belonging to 17 species, 16 genera and 10 families were collected during the study. Among the total spider species, 11 species of 5 families were recorded in the paddy field. In the banana ecosystem, it was 11 species of 8 families, 4 species of 4 families in lady's finger and 3 species of 3 families in the groundnut ecosystem. *Tetragnatha maxillosa* (Tetragnathidae) was most abundant species in the paddy field. In the banana ecosystem, *Plexippus paykulli* and *Chalcotropis pennata* under the family Salticidae was the abundant species. *Pardosa pseudoannulata* (Lycosidae) was the dominant species in both lady's finger and groundnut ecosystem. *Oxyopes birmanicus* (Oxyopidae) was found in four agro-ecosystems. Overall results indicate that the species diversity and richness was greater in banana ecosystem when compared to other three agro-ecosystems. This might be due to the plant architecture and availability of prey species.

INTRODUCTION

Spiders are one of the most important arthropod groups in agro-ecosystems. They colonize almost all habitats and have great ability in resisting adverse ecological conditions. Spiders are extremely important in maintaining pests' densities at low levels, having an important role in pest limitation in agro-ecosystems (Marc *et al.*, 1999). Spiders are ubiquitous in terrestrial ecosystems and abundant in both natural and agricultural habitats (Turnbull, 1973; Nyffeler & Benz, 1987). Spiders are amongst the most dominant and diverse arthropods on vegetation (Moracis-Filho and Romero, 2008) and are thus important components of ecological webs in agro-ecosystems (Thorbek *et al.*, 2004). Environmental characteristics such as host plant architecture as well as prey availability strongly influence the abundance and distribution of spiders on plants (Romero and Vasconcellos-Neto, 2005). Spiders play an important role in regulating insect pests in agricultural ecosystems but in India, studies on the population and abundance of the spider assemblages in agricultural crops are limited. This study analyses the spider fauna in the agro-ecosystems viz., Paddy, Banana, Lady's finger and Groundnut. Kozhinjampara Panchayat is well known for its agriculture. This is the first report of spider fauna from Kozhinjampara Panchayat in Kerala.

MATERIALS AND METHODS

Study Area: Kozhinjampara Panchayat of Palakkad District is well known for its agriculture. This region extends from 10° 44' 0" N and 76° 51' 0" E. Kozhinjampara lies towards eastern region of Palakkad and along the border of Tamilnadu and is 38 Km away from Palakkad town. The flourishing cultivation of groundnut, cotton, vegetables, etc. in this area is all because of the particular kind of black soil, not found anywhere in Kerala state. This is a warm, humid region and the seasonal variation in the temperature ranges from 21°C-39°C.

Study Period: The investigation was carried out for a period of six months. Sampling was conducted in four selected agro-ecosystems: Paddy, Banana, Lady's finger, and Groundnut.

Sampling: Sampling was done by 2 days in a week from quadrates. Spiders were collected by visual search method between 7.30 am - 10.30 am.

Collection of Spiders: During the study, the spiders were collected and preserved for identification. Spiders were collected from the ground stratum and from the terminals of

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plants. Collections were done during morning hours since it was observed that spider activity was the maximum at that time of day and the morning-dew-covered webs were easy to observe.

Collection Methods: Various methods were employed for spider collection, which includes hand picking & using painting brush moistened with alcohol. All the spiders collected by different methods and transferred to bottles containing 70% alcohol as preservatives for identification. Identification was done up to species level by expert taxonomists.

Analysis of Data: The diversity indices like the Shannon-Wiener index (H'), which is sensitive to changes in the abundance of rare species in a community, and the Simpson index (λ), which is sensitive to changes in the most abundant species in a community, Margalef Richness index (R) and Evenness index (E) of spider communities were calculated.

The formula of Shannon-Wiener index is

$H' = -\sum p_i \ln p_i$

Where, p_i = the observed relative abundance of a particular species (Solow, 1993).

The formula of Simpson index is

$\lambda = 1 - \sum n_i (n_i - 1) / [N (N-1)]$

Where, n_i = the number of individuals of species *i*, and $N = \sum n_i$ (Solow, 1993).

The formula of Richness index is

$R = S-1 / \ln (n)$

Where, S= total number of species in a community, and n= total number of individuals observed.

The formula of Evenness index is

$E = \ln (N_1) / \ln (N_0)$

Where, N_1= number of abundant species in the sample, and N_0= number of all species in the sample.

RESULTS

A total of 302 individuals belonging to 17 species, 16 genera and 10 families were collected during the study (Table.1). 11 species of 5 families were collected in the paddy field. In the banana ecosystem, it was 11 species of 8 families, 4 species of 4 families in the lady's finger and 3 species of 3 families in the groundnut field. The spider population in the 4 selected agro-ecosystems exhibited a slightly different species composition. The family level composition also shows differences between the four agro-ecosystems.

Table.1 Taxonomical diversity of spiders collected from four selected agro-ecosystems of Kozhinjampara Panchayat.

Sl. No.	Family	No. of genera	No. of species	No. of individuals
1	Araneidae	2	3	59
2	Clubionidae	1	1	14
3	Hersiliidae	1	1	6
4	Lycosidae	1	1	45
5	Miturgidae	1	1	6
6	Oxyopidae	2	2	48
7	Philodromidae	1	1	6
8	Salticidae	3	3	25
9	Tetragnathidae	3	3	87
10	Thomisidae	1	1	6
	Total	16	17	302

Species Composition: In the Paddy field, a total of 171 individuals belonging to the family Araneidae, Oxyopidae, Salticidae, Tetragnathidae and Thomisidae were collected. Among the five families, Tetragnathidae (50%) was the dominant family. In the Banana ecosystem, a total of 54 individuals of 8 families were collected. Salticidae (32%) was the dominant family among the 8 families. In the Lady's finger ecosystem, a total of 43 individuals of 4 families of spiders were collected. Among the four families, Lycosidae (63%) was the dominant family. In the Groundnut field, a total of 34 individuals belonging to the family Clubionidae, Lycosidae and Oxyopidae were collected. Of these families, Lycosidae (53%) was the dominant family.

Among the total spider species, 11 species in paddy, 11 species in banana, 4 species in lady's finger and 3 species in groundnut ecosystem were recorded (Table.2). Of 11 species of spiders in the paddy field, *Tetragnatha maxillosa* (Tetragnathidae) was the most abundant species followed by *Argiope catenulata* (Araneidae), *Orsinome sp*. (Tetragnathidae), *Argiope pulchella* (Araneidae), *Oxyopes birmanicus* (Oxyopidae), *Tetragnatha mandibulata* (Tetragnathidae), *Runcinia roonwali* (Thomisidae), *Peucetia viridana* (Oxyopidae), *Chalcotropis sp.* (Salticidae), *Guizygiella melanocrania* (Tetragnathidae) and *Neoscona mukerjei* (Araneidae). Of 11 species of spiders in the banana ecosystem, *Plexippus paykulli* and *Chalcotropis pennata* under the family Salticidae was the most abundant species. *Clubiona drassodes* (Clubionidae), *Hersilia savignyi* (Hersiliidae), *Cheiracanthium melanostomum* (Miturgidae), *Oxyopes birmanicus* (Oxyopidae), *Tibellus elongatus* (Philodromidae) were the second dominant species of spiders followed by *Neoscona sp.* (Araneidae), *Tetragnatha maxillosa* (Tetragnathidae), *Argiope pulchella* (Araneidae), and *Hyllus semicupreus* (Salticidae). Among the 4 species of spiders in the lady's finger field, *Pardosa pseudoannulata* (Lycosidae) was the most abundant species followed by *Oxyopes birmanicus* (Oxyopidae), *Chalcotropis pennata* (Salticidae), and *Clubiona drassodes* (Clubionidae). Of 3 species of spiders in the groundnut field, *Pardosa pseudoannulata* (Lycosidae) was the abundant species followed by *Oxyopes birmanicus* (Oxyopidae), and *Clubiona drassodes* (Clubionidae). Out of the 17 species, similar species were observed in the four selected agro-ecosystems. *Tetragnatha maxillosa* (Tetragnathidae) and *Argiope pulchella* (Araneidae) were observed in both paddy and banana ecosystems. *Pardosa pseudoannulata* (Lycosidae) was found in both lady's finger and groundnut ecosystems. *Clubiona drassodes* (Clubionidae) was found in banana, lady's finger and groundnut ecosystem. But *Oxyopes birmanicus* (Oxyopidae) was common in the four selected agro-ecosystems.

Diversity, Evenness and Richness Indices: There were some significant differences in Shannon index, Simpson index, Richness and Evenness index between the four selected agro-ecosystems (Table.2). The highest species diversity was recorded in banana ecosystem (3.55) followed by paddy field (3.23) and the lowest was lady's finger ecosystem (2.30). In the case of Simpson index, the maximum value was 0.90 in banana ecosystem and the minimum was 0.55 in lady's finger field. The species richness of spiders was greater in banana ecosystem (2.51) followed by paddy field (1.94). The evenness value was maximum in lady's finger ecosystem (0.87) followed by groundnut ecosystem (0.82).

Table 2 Parameters of the abundance of spiders in the four selected agro-ecosystems of Kozhinjampara Panchayat.

Type of agro-ecosystems	N	S	H'	λ	R	E
Paddy	171	11	3.23	0.84	1.94	0.74
Banana	054	11	3.55	0.90	2.51	0.52
Lady's finger	043	04	2.30	0.55	0.79	0.87
Groundnut	034	03	2.39	0.62	0.56	0.82

Where, N is the number of individuals, S is the number of species, H' is the Shannon-Wiener index, λ is the Simpson index, R is the richness index and E is the evenness index.

It is clear that the banana ecosystem showed more diverse and richness in the case of abundance of spiders when compared to other three agro-ecosystems. But the species were more evenly distributed in lady's finger ecosystem.

DISCUSSION

Many environmental factors like seasonality, spatial heterogeneity, competition, predation, habitat type, environmental stability and productivity that can affect species diversity (Riechert and Bishop, 1990). In the present study, the overall significant differences found in the diversity, evenness and richness values between the four agro-ecosystems. The results of this study indicate the diversity and species richness was highest in banana ecosystem when compared to other three agro-ecosystems. This might be due to the plant architecture, availability of prey species and also due to the favourable environmental conditions existing in the banana plantations. Ntonifor *et al.* (2012) also suggests that the banana plant architecture and agro-ecosystem offer a diversity of suitable habitats for the spiders. Generally, spiders frequently inhabit plant parts that offer sources of food, shelter and favourable environmental conditions (Arango *et al.*, 2000; Morais-Filho and Romero, 2008). Uetz (1991) suggests that structurally more complex plants can support a more diverse spider community.

The physical structure of the environments has an important influence on the habitat preferences of spider species especially web-building species (Hurd and Fagan, 1992). The results also indicate that similar species are present in four selected agro-ecosystems viz., paddy, banana, lady's finger, and groundnut ecosystem. Out of the 17 species, *Tetragnatha maxillosa* (Tetragnathidae) and *Argiope pulchella* (Araneidae) were observed in both paddy and banana ecosystems. *Pardosa pseudoannulata* (Lycosidae) was found in both lady's finger and groundnut ecosystems. *Clubiona drassodes* (Clubionidae) was found in banana, lady's finger and groundnut ecosystem. But *Oxyopes birmanicus* (Oxyopidae) was common in the four selected agro-ecosystems. The similarity in the distribution of species found in the four selected agro-ecosystems may be attributed to the availability of prey species, vegetation structure and also due to the favourable environmental conditions. Sebastian *et al.* (2005) also suggests that the vegetation structure influence the diversity of resident spider species.

CONCLUSION

From the above results, agro-ecosystems are the main area where spiders were present abundantly because of the presence of different insect fauna. Spiders help to protect agricultural crops without damaging the ecosystems. The study provides information related to the species distribution in a particular habitat with response to environment, disturbance, and availability of food. The increase in the population of spiders suggests that spider population is influenced by the increase in prey population. This study also indicates that the knowledge of the abundance of generalist spiders was a pre-requisite as a tool of biological control and high species diversity and species richness of spider fauna also helpful for the ecological based management in the agro-ecosystems.

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