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Exploratory Study on Distribution and Ecological Importance of Spiders in Sugarcane Plantations of Belgaum District, Karnataka

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ABSTRACT

Abstract: Spiders are important predatory arthropods that play a significant role in maintaining ecological balance within agricultural ecosystems. The present exploratory study was conducted to investigate the distribution and ecological importance of spiders inhabiting sugarcane plantations in Belgaum District, Karnataka. Field surveys were carried out in selected sugarcane fields using standard sampling techniques such as hand collection, sweep netting, pitfall trapping, and visual searching. Collected specimens were preserved and later identified using available taxonomic keys. The study recorded a diverse assemblage of spider species belonging to several families including Araneidae, Salticidae, Oxyopidae, Lycosidae, Tetragnathidae, Thomisidae, Gnaphosidae, and Clubionidae. The results revealed that both web-building and active hunting spiders were present in the sugarcane agroecosystem. Orb web builders such as Argiope and Neoscona captured flying insects, while hunting spiders such as Plexippus, Oxyopes, and Pardosa preyed on insects inhabiting plant surfaces and ground vegetation. The presence of multiple functional guilds indicates that spiders occupy different ecological niches within the sugarcane ecosystem. Their predatory behavior contributes to the natural suppression of insect populations, thereby supporting biological pest control. The study highlights the ecological importance of conserving spider diversity in agricultural landscapes and provides baseline information for future research on spider communities in sugarcane agroecosystems.

1. Introduction

Spiders (Order: Araneae) are among the most diverse and ecologically important groups of terrestrial arthropods. They are widely distributed in almost all terrestrial ecosystems and play a significant role in maintaining ecological balance through predation on various insect populations (Foelix, 2011; Nyffeler & Birkhofer, 2017) . Because of their predatory nature and wide prey spectrum, spiders are considered dominant biological control agents in many natural and agricultural ecosystems. Their presence contributes to the regulation of pest populations and supports sustainable crop production systems (Nyffeler & Benz, 1987; Sunderland, 1999).

In agroecosystems, spiders are particularly important because they act as natural enemies of numerous insect pests affecting crop plants. Several studies have highlighted that spiders contribute significantly to biological pest control by preying on eggs, larvae, and adult stages of insect pests in crop fields (Riechert & Bishop, 1990; Young & Edwards, 1990; Kajak et al., 1991) . Their predatory activities can reduce pest outbreaks and thereby decrease the dependence on chemical pesticides. As a result, spiders are increasingly recognized as key components of integrated pest management (IPM) programs in agricultural systems (Nyffeler & Benz, 1987; Sunderland, 1999) .

The diversity and distribution of spiders in agroecosystems are influenced by several ecological factors such as vegetation structure, crop type, prey availability, and environmental conditions. Crop plants provide suitable microhabitats for spiders by offering shelter, web attachment sites, and abundant prey populations (Valverde & Lobo, 2007; Warghat et al., 2010). India possesses a rich spider fauna with more than 1,600 recorded species belonging to several families and genera (Keswani et al., 2012) . Many of these species inhabit agricultural landscapes where they contribute to the natural suppression of pest populations. Studies conducted in various Indian crop ecosystems such as rice, cotton, orchards, and vegetable fields have documented diverse spider communities and their significant ecological roles (Sebastian et al., 2005; Tahir, 2009; Umesh et al., 2018) . Despite this diversity, research on spider communities in many crop systems and geographical regions of India remains limited.

In such agroecosystems, natural predators like spiders play a crucial role in regulating pest populations and maintaining ecological balance.

Belgaum District of Karnataka is one of the important agricultural regions where sugarcane cultivation occupies a significant portion of cultivated land. However, studies documenting the diversity and ecological importance of spider

communities in sugarcane agroecosystems of this region are scarce. Since spiders function as efficient natural predators, documenting their distribution and ecological roles can provide valuable insights into their contribution to biological pest control and agroecosystem stability.

Therefore, the present exploratory study aims to investigate the distribution and ecological importance of spiders inhabiting sugarcane plantations in Belgaum District, Karnataka. The study focuses on documenting spider diversity, analyzing their distribution patterns within the crop ecosystem, and evaluating their potential role as natural biological control agents in sugarcane agroecosystems.

2. Methodology

The present study was conducted to investigate the distribution and ecological importance of spiders in sugarcane plantations of Belgaum District, Karnataka. Field surveys were carried out in selected sugarcane cultivation areas within the district to document the diversity and abundance of spider species inhabiting the crop ecosystem. The study sites were selected based on the extent of sugarcane cultivation and accessibility for regular sampling. Sampling was conducted during the active cropping season to ensure adequate representation of spider populations.

Spider specimens were collected using a combination of standard sampling techniques commonly employed in arthropod biodiversity studies. These included hand collection, sweep netting, visual searching, and pitfall trapping. Sweep netting was used to collect spiders present on the foliage and upper parts of the sugarcane plants, while pitfall traps were used to capture ground-dwelling species. Visual searching and hand collection were carried out carefully along plant stems, leaves, and surrounding vegetation to record both web-building and wandering spiders. Sampling was conducted at regular intervals to account for variations in spider presence across the study period.

Collected specimens were preserved in vials containing 70 percent ethanol to maintain their morphological characteristics for identification. The specimens were later examined and identified in the laboratory using standard taxonomic keys and reference literature.

The recorded data were systematically organized to determine species richness, family composition, and relative abundance of spiders within the sugarcane plantations. The diversity and distribution patterns of spiders were analyzed using descriptive statistical methods and biodiversity indices such as the Shannon–Wiener diversity index and Simpson's diversity index. The ecological role of spiders as potential biological control agents was interpreted based on their functional guild classification and predatory behavior observed within the agroecosystem.

3. Discussion & Findings

3.1. Spider Diversity Recorded in Sugarcane Plantations

The field survey conducted in selected sugarcane plantations of Belgaum District revealed a considerable diversity of spiders inhabiting the agroecosystem. A total of 18 spider species belonging to 10 genera and 8 families were recorded during the study period. The observed diversity reflects the suitability of sugarcane plantations as a habitat providing shelter, prey availability, and favorable microclimatic conditions for various spider species.

Among the recorded families, Araneidae and Salticidae were the most dominant, followed by Lycosidae, Oxyopidae, and Tetragnathidae. Web-building spiders such as Neoscona, Argiope, and Tetragnatha were commonly found constructing webs between sugarcane leaves and stems, whereas active hunting spiders such as Plexippus, Oxyopes, and Pardosa were frequently observed moving across plant surfaces and ground vegetation.

Table 1.
Spider species recorded in sugarcane plantations of Belgaum District

Sl. No	Family	Species	Common Habitat in Field
1	Araneidae	Argiope anasuja	Web between sugarcane leaves
2	Araneidae	Argiope pulchella	Plant canopy
3	Araneidae	Neoscona mukerjei	Foliage web builder
4	Araneidae	Neoscona nautica	Plant canopy
5	Salticidae	Plexippus paykulli	Plant stems and leaves
6	Salticidae	Plexippus petersi	Foliage
7	Salticidae	Telamonia dimidiata	Leaf surfaces

8	Oxyopidae	Oxyopes javanus	Active hunter on leaves
9	Oxyopidae	Oxyopes birmanicus	Plant canopy
10	Lycosidae	Pardosa pseudoannulata	Ground vegetation
11	Lycosidae	Hippasa agelenoides	Soil surface
12	Tetragnathidae	Tetragnatha mandibulata	Web between leaves
13	Tetragnathidae	Tetragnatha javana	Plant canopy
14	Thomisidae	Thomisus spectabilis	Flowering weeds
15	Thomisidae	Misumena vatia	Leaf surface
16	Gnaphosidae	Gnaphosa sp.	Soil and litter
17	Clubionidae	Clubiona sp.	Leaf shelter
18	Hersiliidae	Hersilia savignyi	Tree bark near fields

Table 2
Family-wise distribution of spiders

Family	Number of Species	Percentage (%)
Araneidae	4	22.2
Salticidae	3	16.7
Oxyopidae	2	11.1
Lycosidae	2	11.1
Tetragnathidae	2	11.1
Thomisidae	2	11.1
Gnaphosidae	1	5.6
Clubionidae	1	5.6
Hersiliidae	1	5.6

The dominance of Araneidae and Salticidae indicates that sugarcane fields provide suitable conditions for both web-building and hunting spiders. Similar observations have been reported in other agricultural ecosystems where vegetation complexity supports diverse spider guilds.

3.2 Functional Guild Structure

Spiders recorded in the present study were categorized into different functional guilds based on hunting behavior.

Table 3
Functional guild classification

Guild Type	Representative Species	Ecological Role
Orb web builders	Argiope anasuja, Neoscona nautica	Capture flying insects
Jumping spiders	Plexippus paykulli, Telamonia dimidiata	Active predators
Ground runners	Pardosa pseudoannulata, Hippasa agelenoides	Prey on soil insects
Lynx spiders	Oxyopes javanus	Predator of leaf-feeding insects
Crab spiders	Thomisus spectabilis	Ambush predators
Long-jawed spiders	Tetragnatha mandibulata	Capture flying pests

3.3 Ecological Importance in Sugarcane Fields

The presence of multiple spider guilds indicates that spiders occupy different ecological niches within the sugarcane ecosystem. Orb-weaving spiders such as Argiope and Neoscona capture flying insects including moths and flies, which

may act as crop pests. Hunting spiders such as Plexippus and Oxyopes actively prey on leaf-feeding insects and small arthropods found on sugarcane foliage.

Ground-dwelling species such as Pardosa pseudoannulata contribute to controlling soil-dwelling insects and larvae present near the root zone. The coexistence of web-building and wandering spiders enhances the overall predatory efficiency within the field. This diversity of predatory strategies allows spiders to suppress pest populations across different layers of the crop ecosystem.

The findings indicate that sugarcane plantations in Belgaum District support a diverse spider community that contributes to natural pest regulation. By preying on various insect pests, spiders play an important role in maintaining ecological balance and reducing reliance on chemical pesticides. Conservation of spider populations in agricultural landscapes may therefore support sustainable pest management and biodiversity conservation in sugarcane agroecosystems.

Table 4
Predatory role of spiders and their potential prey in sugarcane agroecosystem

Sl. No	Spider Species	Family	Hunting Strategy	Major Prey / Target Pest in Sugarcane Ecosystem
1	Argiope anasuja	Araneidae	Orb web builder	Flying insects, moths, small beetles
2	Argiope pulchella	Araneidae	Orb web builder	Adult moths and dipterans
3	Neoscona mukerjei	Araneidae	Orb web builder	Nocturnal flying insects
4	Neoscona nautica	Araneidae	Orb web builder	Leafhopper adults, moths
5	Plexippus paykulli	Salticidae	Jumping hunter	Aphids, leafhoppers, small caterpillars
6	Plexippus petersi	Salticidae	Active hunter	Small insects on foliage
7	Telamonia dimidiata	Salticidae	Jumping hunter	Plant hoppers, flies
8	Oxyopes javanus	Oxyopidae	Ambush / active hunter	Caterpillars, leaf-feeding insects
9	Oxyopes birmanicus	Oxyopidae	Active hunter	Sugarcane leafhoppers
10	Pardosa pseudoannulata	Lycosidae	Ground runner	Soil insects and larvae
11	Hippasa agelenoides	Lycosidae	Funnel web hunter	Ground insects
12	Tetragnatha mandibulata	Tetragnathidae	Web builder	Mosquitoes, flies, small moths
13	Tetragnatha javana	Tetragnathidae	Web builder	Flying pests
14	Thomisus spectabilis	Thomisidae	Ambush predator	Pollinators and small insects
15	Misumena vatia	Thomisidae	Ambush predator	Small insects visiting flowers

The data presented in Table 4 indicate that the spider species recorded in sugarcane plantations of Belgaum District function as effective natural predators of a wide range of insect pests present in the crop ecosystem. The study shows that different spider families employ varied hunting strategies, enabling them to capture insects occurring in different strata of the sugarcane field such as foliage, plant canopy, and ground surface.

Orb-web building spiders belonging to the family Araneidae (Argiope anasuja, Argiope pulchella, Neoscona mukerjei, and Neoscona nautica) were observed capturing flying insects such as moths, beetles, and dipterans. These insects include several species that act as potential pests in agricultural ecosystems. The presence of orb weavers indicates their role in regulating populations of aerial insects that visit or inhabit sugarcane fields.

Jumping spiders of the family Salticidae, including Plexippus paykulli, Plexippus petersi, and Telamonia dimidiata, were frequently observed actively hunting on leaves and stems. These spiders prey mainly on aphids, leafhoppers, and small caterpillars, which are common herbivorous insects affecting crop plants. Their active predatory behavior contributes to reducing populations of foliage-feeding insects.

Similarly, lynx spiders (Oxyopidae) such as Oxyopes javanus and Oxyopes birmanicus were recorded as active hunters on plant surfaces where they capture leaf-feeding insects. Ground-dwelling spiders like Pardosa pseudoannulata and Hippasa agelenoides (family Lycosidae) were mainly found on soil surfaces and were observed

feeding on soil insects and larvae. These spiders play an important role in controlling insects inhabiting the lower strata of the crop ecosystem.

Overall, the findings demonstrate that the spider community in sugarcane plantations exhibits diverse feeding habits and predatory behaviors. This diversity enables spiders to suppress insect populations across different ecological niches within the field, highlighting their importance as natural biological control agents in sugarcane agroecosystems.

Table 5
Ecological Guild Composition of Spiders in Sugarcane Plantation

Guild Type	Number of Species	Percentage (%)	Ecological Significance
Orb web builders	4	22.2	Control flying insect pests
Jumping spiders	3	16.7	Active predators on plant foliage
Lynx spiders	2	11.1	Capture leaf-feeding insects
Ground runners	2	11.1	Control soil-dwelling pests
Long-jawed spiders	2	11.1	Capture small flying insects
Crab spiders	2	11.1	Ambush predators
Other hunters	3	16.7	General insect predators

3.4. Ecological Guild Composition of Spiders in Sugarcane Plantation

The ecological guild classification presented in Table 5 reveals that spider species recorded during the study belong to several functional groups based on their hunting strategies. The presence of multiple guild types indicates that sugarcane plantations support a structurally diverse spider community capable of exploiting different prey resources within the agroecosystem.

Orb-web builders formed the largest group, accounting for 22.2 percent of the total species recorded. These spiders construct webs between sugarcane leaves and stems and are particularly effective in capturing flying insects such as moths, flies, and other small arthropods. Their dominance suggests that the structural complexity of sugarcane plants provides suitable web attachment sites and favorable microhabitats for web-building species.

Jumping spiders represented 16.7 percent of the recorded species and were commonly observed on foliage and plant stems. These spiders are active hunters with excellent vision and are capable of capturing moving prey such as aphids, leafhoppers, and small insects present on crop plants. Their presence contributes to controlling herbivorous insects that feed on plant tissues. Ground-running spiders and lynx spiders each constituted 11.1 percent of the spider community. Ground-running spiders mainly inhabit the soil surface and control soil-dwelling insects, while lynx spiders actively hunt insects on plant surfaces. Long-jawed spiders and crab spiders were also recorded and contributed to capturing flying insects and ambushing prey respectively.

The presence of multiple functional guilds indicates that spiders occupy different ecological niches within the sugarcane ecosystem. This diversity of predatory strategies enhances the efficiency of natural pest regulation by targeting insects present in different microhabitats of the crop field. Consequently, spider communities play an important ecological role in maintaining biological balance and supporting environmentally sustainable pest management in sugarcane plantations.

Conclusion

The present exploratory study investigated the distribution and ecological importance of spiders inhabiting sugarcane plantations in Belgaum District, Karnataka. The study documented a diverse assemblage of spider species belonging to several families and functional guilds. The results indicate that sugarcane plantations provide favorable habitats that support both web-building and active hunting spiders. The presence of families such as Araneidae, Salticidae, Oxyopidae, Lycosidae, and Tetragnathidae demonstrates the structural and functional diversity of spider communities within the agroecosystem. Orb web-building spiders capture flying insects, while hunting spiders actively prey on leaf-feeding insects and soil-dwelling arthropods. This diversity of predatory strategies enhances the natural regulation of insect populations in the crop field.

The findings highlight the ecological significance of spiders as natural biological control agents in sugarcane ecosystems. By feeding on a wide range of insects, spiders contribute to maintaining ecological balance and reducing

pest populations. Conserving spider diversity in agricultural landscapes can therefore support environmentally sustainable farming practices. The study provides baseline information on spider diversity in sugarcane plantations of Belgaum District and contributes to a better understanding of their ecological role in agroecosystems.

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