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# A Review on Spider Population Dynamics in Sugarcane Agroecosystem of Belgaum District

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## Abstract

Spiders are important predatory arthropods that contribute significantly to biological pest control in agricultural ecosystems. The present study was conducted to explore the seasonal changes in spider population dynamics in sugarcane agroecosystems of Belgaum district, Karnataka. Field surveys were carried out in selected sugarcane fields across different seasons, and spiders were collected using visual search, sweep netting, and hand collection methods. The collected specimens were preserved and identified to family or genus level using standard taxonomic references. The results revealed the presence of several spider families including Araneidae, Lycosidae, Salticidae, Tetragnathidae, Thomisidae, Oxyopidae, and Clubionidae, indicating considerable diversity within the sugarcane ecosystem. Among these families, Araneidae and Salticidae showed relatively higher abundance compared to other groups. The guild structure analysis indicated the presence of orb-web builders, ground runners, foliage hunters, ambushers, and sac builders, demonstrating functional diversity among spider communities. Seasonal analysis showed that spider populations were highest during the monsoon season and comparatively lower during summer. Additionally, higher abundance of spiders was observed during crop growth stages with dense vegetation. These findings highlight the ecological importance of spiders in sugarcane fields and their potential role in natural pest regulation. The study provides baseline information that may support sustainable pest management practices in sugarcane agroecosystems.

**Keywords: Spider diversity, Sugarcane agroecosystem, Seasonal variation, Biological control, Belgaum district.**

## 1. Introduction

Agricultural ecosystems support a wide variety of organisms that interact with crops and influence productivity, pest populations, and ecological balance. Among these organisms, spiders (Order: Araneae) are important predatory arthropods widely recognized for their role in regulating insect populations. As generalist predators, spiders feed on a broad range of insect pests and contribute significantly to natural biological control in agricultural habitats (Malik, 2022; Shabnam et al., 2021). Their presence in crop fields reduces dependence on chemical pesticides and supports environmentally sustainable farming practices (Deka et al., 2022; Shabnam et al., 2021).

Spiders represent one of the most diverse groups of terrestrial predators and are widely distributed across different ecosystems. They occupy an important ecological position as insectivorous organisms that help maintain ecological stability by feeding on numerous herbivorous insects (Sunderland, 1999; Basumatary and Brahma, 2017). Their polyphagous feeding behavior allows them to prey upon several economically important crop pests. In India, spider diversity is relatively high, with more than 1600 species recorded from various natural and agricultural habitats, indicating their ecological significance in agroecosystems.

In recent years, increasing attention has been given to the role of natural predators in integrated pest management (IPM). Spiders are particularly valuable in this context because they remain active during most of the crop growth period and capture prey across different microhabitats. Different ecological guilds of spiders such as orb-web builders, ground runners, ambushers, and foliage hunters exploit prey at different locations within crop fields, thereby enhancing pest suppression (Shabnam et al., 2021; Anitha et al., 2016).

The population dynamics of spiders in agricultural ecosystems are strongly influenced by environmental conditions and seasonal changes. Factors such as temperature, humidity, rainfall, vegetation structure, and crop phenology can affect spider abundance and distribution.

Studies conducted in various cropping systems have shown that spider populations fluctuate across seasons due to changes in habitat conditions and prey availability (Patra et al., 2023; Singh et al., 2020). Environmental conditions therefore play an important role in shaping spider communities in agricultural landscapes (Rao et al., 2023; Bhuyan et al., 2025).

Sugarcane is one of the most important commercial crops cultivated in tropical and subtropical regions of India. However, sugarcane production is often affected by several insect pests that cause significant economic losses. Spiders form an important component of the natural enemy complex in sugarcane fields because they prey on various insects associated with the crop. Their predatory activity helps maintain pest populations below damaging levels and contributes to ecological stability within the agroecosystem (Malik, 2022).

Despite the ecological importance of spiders, information on their seasonal population dynamics in sugarcane agroecosystems of Belgaum district remains limited. Understanding seasonal patterns of spider diversity and abundance can provide valuable insights into predator–prey interactions and ecological processes in agricultural fields. Therefore, the present study aims to explore the seasonal changes in spider population dynamics in sugarcane agroecosystems of Belgaum district, which may contribute to sustainable pest management and biodiversity conservation in agricultural landscapes.

## 2. Objectives of the Study

- To assess the diversity and abundance of spider populations in sugarcane agroecosystems of Belgaum district.
- To analyse the seasonal variations in spider population dynamics in relation to environmental and crop growth stages in sugarcane fields.

## 3. Methodology

The study was conducted in selected sugarcane fields of Belgaum district, Karnataka, India. Two to three representative sugarcane farms were selected to observe spider diversity and seasonal population dynamics. Field surveys were carried out over one cropping year to record variations across major seasons such as summer, monsoon, and winter. Spider sampling was conducted twice a month using simple collection methods including visual search, sweep net sampling, and hand collection. During visual searches, spiders present on leaves, stems, and surrounding vegetation were carefully observed and recorded. Sweep net sampling was performed by sweeping a standard insect net across the crop canopy along fixed transects. Collected specimens were transferred into labelled containers and preserved in 70% ethanol. The specimens were identified up to family or genus level using standard taxonomic keys. Data were organized in simple tables showing spider abundance across seasons and crop growth stages. Basic descriptive analysis such as total counts and percentage composition was used to interpret seasonal population patterns.

## 4. Discussion & Findings

**I) To assess the diversity and abundance of spider populations in sugarcane agroecosystems of Belgaum district**

**Table 1. Spider Families Recorded in Sugarcane Fields**

| Sl. No | Spider Family | Common Type | Number of Species Observed |
|---|---|---|---|
| 1 | Araneidae | Orb-web spiders | 4 |
| 2 | Lycosidae | Wolf spiders | 3 |
| 3 | Salticidae | Jumping spiders | 5 |
| 4 | Tetragnathidae | Long-jawed spiders | 3 |
| 5 | Thomisidae | Crab spiders | 2 |
| 6 | Oxyopidae | Lynx spiders | 2 |
| 7 | Clubionidae | Sac spiders | 1 |

The results presented in Table 1 indicate the diversity of spider families observed in the sugarcane agroecosystems of Belgaum district. A total of seven spider families comprising approximately twenty species were recorded during the study period. Among these families, Salticidae showed the highest species richness with five species, followed by Araneidae with four species and Lycosidae and Tetragnathidae with three species each. The presence of multiple spider families highlights the ecological diversity within sugarcane fields and suggests that the crop provides suitable microhabitats for different spider groups. Vegetation structure, availability of prey insects, and favorable environmental conditions within the crop canopy likely contribute to the diversity observed. Similar observations have been reported in agricultural ecosystems where spiders exhibit considerable diversity due to their adaptability to various habitats and feeding strategies. The presence of orb weavers, ground runners, and foliage hunters indicates that spiders occupy different ecological niches within the sugarcane ecosystem. Such diversity is beneficial for biological pest control because different spider groups target various insect pests across multiple microhabitats.

**Table 2. Abundance of Spider Families in Sugarcane Fields**

| Spider Family | Number of Individuals | Percentage (%) |
|---|---|---|
| Araneidae | 82 | 24.8 |
| Lycosidae | 65 | 19.7 |
| Salticidae | 71 | 21.5 |
| Tetragnathidae | 43 | 13.0 |
| Thomisidae | 28 | 8.5 |
| Oxyopidae | 26 | 7.9 |
| Clubionidae | 16 | 4.8 |

Table 2 presents the abundance and relative percentage of different spider families recorded during the study. A total of 331 individual spiders were observed, with Araneidae representing the highest proportion (24.8%) followed by Salticidae (21.5%) and Lycosidae (19.7%). The dominance of Araneidae suggests that web-building spiders are well adapted to sugarcane fields where plant structures provide suitable sites for web construction. Salticidae and Lycosidae were also abundant, indicating the presence of active hunting spiders that prey on insects within foliage and soil surfaces. Families such as Thomisidae, Oxyopidae, and Clubionidae were comparatively less abundant but still contributed to the overall predator community. The variation in abundance among spider families may be influenced by habitat characteristics, prey availability, and environmental conditions within the crop ecosystem. The presence of both web-building and hunting spiders enhances pest regulation because these groups capture insects in different ways. Overall, the abundance data demonstrate that sugarcane fields support a considerable population of spiders that may contribute to natural pest suppression.

**II) To analyse seasonal variations in spider population dynamics in sugarcane fields**

**Table 3. Guild Structure of Spiders in Sugarcane Ecosystem**

| Guild Type | Spider Families | Number of Individuals |
|---|---|---|
| **Orb web builders** | Araneidae, Tetragnathidae | 125 |
| **Ground runners** | Lycosidae | 65 |
| **Foliage hunters** | Salticidae, Oxyopidae | 97 |
| **Ambushers** | Thomisidae | 28 |
| **Sac builders** | Clubionidae | 16 |

The guild structure presented in Table 3 illustrates the ecological roles and hunting strategies of spiders present in the sugarcane agroecosystem. Orb-web builders constituted the largest group with 125 individuals, followed by foliage hunters with 97 individuals and ground runners with 65 individuals. Ambushers and sac builders were represented by smaller numbers. The dominance of orb-web builders such as Araneidae and Tetragnathidae suggests that the crop canopy provides suitable structures for web attachment and prey interception. Foliage hunters including Salticidae and Oxyopidae actively search for prey on leaves and stems, while ground runners like Lycosidae capture insects near the soil surface. The presence of multiple hunting guilds indicates functional diversity within the spider community. Such diversity is important for maintaining ecological balance because different guilds exploit prey in different microhabitats and times of activity. This complementary predatory behavior increases the likelihood of controlling a broader range of insect pests in the sugarcane ecosystem. Therefore, the guild composition reflects a stable and functionally diverse predator community.

**Table 4. Seasonal Distribution of Spider Population**

| Season | Number of Individuals Recorded |
|---|---|
| Summer | 78 |
| Monsoon | 146 |
| Winter | 107 |

Table 4 shows the seasonal distribution of spider populations recorded during the study. The highest number of individuals (146) was observed during the monsoon season, followed by winter with 107 individuals, while the lowest population (78 individuals) was recorded in summer. These results indicate that seasonal climatic conditions strongly influence spider abundance in sugarcane fields. Monsoon conditions typically provide higher humidity, moderate temperatures, and increased vegetation growth, which create favourable habitats for spiders and their prey. The increased availability of insects during this period may also contribute to higher spider populations. In contrast, the lower abundance during summer may be associated with high temperatures, reduced humidity, and lower prey availability. Seasonal fluctuations in spider populations are common in agricultural ecosystems and reflect changes in environmental conditions and crop growth stages. Understanding these seasonal trends is important for assessing the ecological role of spiders as biological control agents and for designing sustainable pest management strategies in sugarcane cultivation.

**Table 5. Seasonal Abundance of Major Spider Families**

| Spider Family | Summer | Monsoon | Winter | Total |
|---|---|---|---|---|
| Araneidae | 18 | 41 | 23 | 82 |
| Lycosidae | 14 | 29 | 22 | 65 |
| Salticidae | 17 | 32 | 22 | 71 |
| Tetragnathidae | 9 | 21 | 13 | 43 |
| Others | 20 | 23 | 27 | 70 |

The data presented in Table 5 illustrate the seasonal abundance of major spider families in sugarcane fields. Most spider families showed their highest abundance during the monsoon season. For example, Araneidae recorded 41 individuals during monsoon compared to 18 in summer and 23 in winter. Similar trends were observed for Salticidae and Lycosidae. The higher abundance during the monsoon season can be attributed to favourable environmental conditions such as adequate moisture, moderate temperature, and increased insect activity. These conditions support both spider survival and reproduction. In contrast, the lower counts during summer suggest that extreme temperature and reduced prey availability may limit spider activity. Winter populations were intermediate, indicating that spiders remain active but at

relatively lower levels compared to monsoon. These seasonal differences highlight the influence of climatic factors on spider population dynamics. Such information is valuable for understanding the ecological interactions between spiders and pests and may help in predicting periods when natural pest control by spiders is most effective.

**Table 6. Spider Population in Different Crop Growth Stages**

| Crop Stage | Number of Spiders Recorded |
|---|---|
| Early vegetative stage | 72 |
| Tillering stage | 108 |
| Grand growth stage | 96 |
| Maturity stage | 55 |

Table 6 presents the distribution of spider populations across different sugarcane crop growth stages. The highest number of spiders (108 individuals) was recorded during the tillering stage, followed by the grand growth stage with 96 individuals. Lower numbers were observed during the early vegetative stage and the maturity stage. These findings suggest that spider abundance is closely related to crop growth and habitat complexity. During the tillering and grand growth stages, the sugarcane plants develop dense foliage and complex plant architecture, which provide suitable shelter, web-building sites, and hunting grounds for spiders. These stages also support higher insect populations that serve as prey for spiders. In contrast, the early vegetative stage offers limited vegetation structure, which may restrict spider colonization. Similarly, during the maturity stage, changes in plant structure and management practices may reduce spider habitats. The relationship between crop growth stages and spider abundance highlights the importance of vegetation structure in shaping predator communities within agricultural ecosystems.

## 5. Conclusion

The present study explored the seasonal changes in spider population dynamics within sugarcane agroecosystems of Belgaum district. The findings revealed that sugarcane fields support a diverse community of spiders belonging to several families, indicating that agricultural landscapes can serve as important habitats for predatory arthropods. The presence of different spider families and guilds such as orb-web builders, ground runners, and foliage hunters reflects functional diversity within the ecosystem. This diversity plays an important role in maintaining ecological balance by regulating populations of insect pests.

The study also demonstrated that spider populations vary significantly across different seasons and crop growth stages. Higher abundance was recorded during the monsoon season and during crop stages characterized by dense vegetation. These conditions provide favorable microhabitats and increased prey availability for spiders. Conversely, lower populations during extreme climatic conditions suggest that environmental factors strongly influence spider distribution and activity.

Overall, the study highlights the ecological importance of spiders in sugarcane agroecosystems and emphasizes their potential role as natural biological control agents. The information generated provides baseline data for future ecological research and supports the promotion of environmentally sustainable agricultural practices that conserve beneficial arthropods.

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