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Distribution and diversity of spiders as natural pest controllers in Sindewahi region, district Chandrapur, Maharashtra

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Abstract
Spiders (Order: *Araneae*) are among the most abundant and ecologically important predators in terrestrial ecosystems. They play a crucial role as natural pest controllers by regulating insect populations in agricultural landscapes. The present study was undertaken to assess the distribution, diversity, and abundance of spider species inhabiting the Sindewahi region of Chandrapur District, Maharashtra. Surveys were conducted between September 2024 to February 2025 across major agricultural and semi-natural habitats. Spiders were collected by hand-picking, sweep-netting, and visual search methods. A total of 73 individuals belonging to 11 species and 6 families were recorded. The families represented were *Salticidae*, *Hersilidae*, *Gnaphosidae*, *Scytodidae*, *Araneidae*, and *Tetragnathidae*. The dominant families in terms of both species richness and abundance were *Araneidae* and *Salticidae*. The highest individual counts were observed for *Nephila pilipes* (14), *Tetragnatha extensa* (10), and *Argiope aemula* (12). The results indicate a moderately high spider diversity, suggesting that spiders form a stable and ecologically significant predator guild in the rice-based agroecosystems of Sindewahi. The study highlights their vital contribution to Integrated Pest Management (IPM) and sustainable agriculture in the region.

Keywords: Spider diversity, agroecosystem, Sindewahi, natural pest controller, Integrated Pest Management (IPM)

Introduction

Spiders (Order: Araneae) are among the most diverse and ecologically significant groups of terrestrial arthropods, comprising over 50,000 described species worldwide (World Spider Catalog, 2023). They occupy a wide range of habitat from forests and grasslands to wetlands and agroecosystems and exhibit remarkable adaptability in their predatory strategies, including web-building, ambushing, and active hunting (Foelix, 2011; Nyffeler & Birkhofer, 2017). As generalist predators, spiders exert substantial top-down control on insect populations, thereby influencing both pest and non-pest species within ecosystems (Marc *et al*., 1999; Riechert & Lockley, 1984). Their predation not only reduces herbivore pressure on crops but also indirectly enhances plant health and productivity, highlighting their functional importance in maintaining ecosystem stability (Cardoso *et al.,* 2011; Nyffeler *et al.,* 2016).

In India, approximately 1,800 spider species distributed across 438 genera and 60 families have been reported, demonstrating considerable taxonomic richness (Keswani *et al.,* 2012). Despite this diversity, studies addressing spider assemblages in agroecosystems of eastern Maharashtra, particularly in rice-growing regions such as Sindewahi, remain limited. Most research in India has historically focused on forested or urban habitats, leaving a knowledge gap regarding spider-mediated pest control in paddy fields and associated vegetation (Sundaram *et al.,* 2016; Reddy & Rao, 2007). Documenting species composition and ecological roles in such landscapes is critical, as spiders are not only bioindicators of environmental health but also provide an eco-friendly alternative to chemical pest management (Nyffeler & Birkhofer, 2017).

The Sindewahi region of Chandrapur District is predominantly agrarian, with rice (Oryza sativa) as the main kharif crop. The structural complexity of paddy fields, including bunds, water channels, vegetation edges, and fallow patches, creates a mosaic of microhabitats that support high spider diversity (Reddy & Rao, 2007; Padhye *et al.,* 2015). Spiders exploit these microhabitats for foraging, shelter, and reproduction, which in turn enhances their efficiency as natural pest suppressors (Marc et al., 1999; Nyffeler *et al.,* 2016). Previous studies have shown that agroecosystems with diverse vegetation and habitat heterogeneity harbor higher spider abundance and species richness, thereby contributing to natural pest regulation and reducing dependence on chemical pesticides (Riechert & Lockley, 1984; Sundaram *et al.,* 2016).

In addition to their ecological roles, spiders also serve as indicators of habitat quality and anthropogenic disturbance. Changes in spider community composition can reflect alterations in environmental conditions, such as pesticide application, habitat fragmentation, or cropping patterns (Cardoso *et al.,* 2011; Nyffeler & Birkhofer, 2017). Hence, understanding the diversity and distribution of spiders in Sindewahi can provide insights into ecosystem functioning and guide the implementation of integrated pest management strategies that are sustainable, cost-effective, and environmentally safe.

Given the paucity of regional data, this study was undertaken with the following objectives: (1) to document the species diversity and habitat distribution of spiders in the Sindewahi region, and (2) to evaluate their potential role as natural pest controllers in rice-dominated agroecosystems. Findings from this study are expected to enhance our understanding of spider ecology in agroecosystems and promote biodiversity-based approaches for sustainable agriculture.

Materials and Methods

Study Area

The study was carried out in the Sindewahi tehsil of Chandrapur District (19.57°N, 79.18°E), located in eastern

Maharashtra. The region experiences a tropical monsoon climate, with an annual rainfall of about 1100 mm. Major habitats include paddy fields, bunds, fallow lands, and surrounding vegetated margins.

Sampling Methods

Spiders were collected from the Sindewahi region between September 2024 to February 2025, covering both the kharif and post-kharif cropping periods. Sampling was conducted during two daily time intervals early morning (7:00–10:00 AM) and late afternoon (4:00–6:00 PM) to account for variations in spider activity patterns. Multiple collection techniques were employed to maximize species capture and ensure representative sampling of the local spider fauna. These included hand-picking of spiders directly from vegetation, soil, and field structures, followed by transfer to specimen tubes containing 70% ethanol for preservation. Sweep-netting was performed across paddy vegetation and along field margins to collect active, free-ranging spiders, while visual searches were conducted on bunds, foliage, and the undersides of leaves to detect web-building and cryptic species.

Specimens were identified using standard taxonomic keys and field guides, including Barrion and Litsinger (1995) [1] and Keswani *et al.* (2012). Identification was primarily based on morphological characteristics such as body coloration, eye arrangement, and web architecture, complemented by observations of behavioral traits where applicable. Care was taken to ensure accurate identification to species level, and all collected specimens were cataloged for further analysis of diversity, abundance, and habitat distribution.

Observations and Results

A total of 73 individuals belonging to 11 species and 6 families were recorded. The list of spider families, species, and their observed abundance is presented in Table 1.

Table 1: Spider Diversity and Abundance in Sindewahi Region

Sr. No.	Family	Species	No. of Individuals
1	*Salticidae*	*Colonus sylvanus*	4
2	*Salticidae*	*Telamonia dimidiata* (♀)	6
3	*Salticidae*	*Telamonia dimidiata* (♂)	8
4	*Salticidae*	*Chrysilla volupe*	4
5	*Hersilidae*	*Hersilia* sp.	2
6	*Gnaphosidae*	*Zelotes indomotensis*	3
7	*Scytodidae*	*Scytodes thoracica*	2
8	*Araneidae*	*Argiope aemula*	12
9	*Tetragnathidae*	*Tetragnatha extensa*	10
10	*Araneidae*	*Nephila pilipes*	14
11	*Araneidae*	*Neoscona adianta*	8
Total			73

Among the collected spiders, the family *Araneidae* exhibited the highest abundance with 34 individuals, followed by *Salticidae*, which accounted for 22 individuals. Families such as *Hersilidae*, *Gnaphosidae*, and *Scytodidae* were represented by comparatively fewer specimens. At the species level, the most abundant spiders were *Nephila pilipes* (14 individuals), *Argiope aemula* (12 individuals), and *Tetragnatha extensa* (10 individuals), whereas the least abundant species included *Scytodes thoracica* and *Hersilia* sp., each recorded with only 2 individuals.

In terms of habitat preferences and spatial distribution, *Araneidae* dominated both in species richness and abundance, particularly thriving in paddy bunds and canopy zones where they constructed large orb webs. *Salticidae* species were commonly observed along vegetation edges and dry bunds, reflecting their preference for elevated and open foraging sites. Members of the *Tetragnathidae* family were restricted to moist crop areas, often building horizontal orb webs in proximity to waterlogged zones, highlighting their affinity for humid microhabitats. Ground-dwelling spiders such as *Gnaphosidae* and *Scytodidae* were primarily encountered under leaf litter and along bund edges, representing a guild adapted to low-lying and concealed habitats. These patterns indicate that both structural and microclimatic factors strongly influence the distribution and abundance of spider families within the Sindewahi paddy agroecosystem.

Table 2: Family-wise Species Richness and Abundance

Family	No. of Species	Total Individuals	Relative Abundance (%)
Araneidae	3	34	46.58
Salticidae	4	22	30.13
Tetragnathidae	1	10	13.70
Gnaphosidae	1	3	4.11
Hersilidae	1	2	2.74
Scytodidae	1	2	2.74
Total	11	73	100

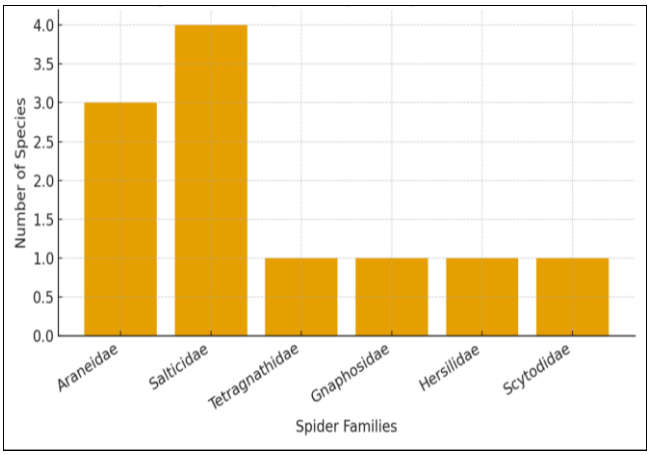

Fig 1: Family-wise Spider Species Richness

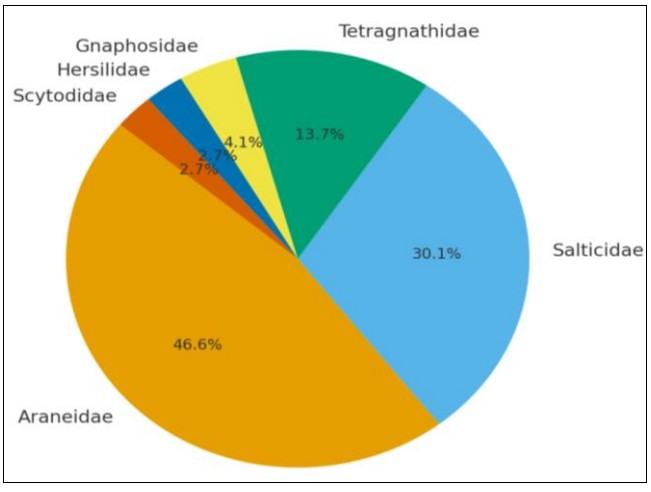

Fig 2: Family-wise Spider Abundance

Eriophora ravilla Night worb wever.

Tetragnatha Montana Female

Araneus ellipticus

Argiope aemula

Neoscona adianta

Cosmophasis microcodes (female)

Nephila pilipes

Lecucauge argyra

Lecucauge venusta

Oxyopes salticus

Telamonia dimidiata

Tetragnatha extensa

Discussion

The present investigation revealed that the Sindewahi agroecosystem supports a diverse spider community (73 species) representing both web-building and cursorial families. The dominance of *Araneidae* and *Salticidae* indicates a balanced trophic structure and functional complementarity between web-dependent and active-hunting predators. Similar guild compositions have been reported in rice and agroecosystems across India and Southeast Asia, emphasizing the ecological universality of these families in pest regulation.

For instance, Barrion and Litsinger (1995) [1] documented 176 spider species from 19 families in Philippine rice fields, where *Tetragnatha* and *Neoscona* were dominant aerial predators. Although the Sindewahi assemblage shows comparatively lower richness, the dominance of *Tetragnatha montana* and *Eriophora ravilla* reflects analogous ecological patterns. In southern India, Sebastian *et al.* (2005) [12] reported 126 spider species from Kerala's rice ecosystems, highlighting a monsoon-associated rise in web-building populations a seasonal pattern mirrored in Sindewahi, where spider abundance peaked between July and September. Similarly, Rajagopal *et al.* (2011) [8] in Tamil Nadu demonstrated that habitat complexity and organic farming significantly enhanced spider richness; the high Evenness Index recorded in Sindewahi likely reflects similar conditions and limited pesticide exposure.

Several other regional studies further corroborate these findings. Sankaran *et al*. (2005) [10] observed an increase in *Salticidae* during rice vegetative stages in Tamil Nadu, corresponding to our early monsoon observations. Tambe *et al.* (2018) [13] recorded 15 species in Maharashtra sugarcane ecosystems dominated by *Araneidae* and Oxyopidae families also prevalent in Sindewahi. Seasonal population shifts similar to our study were described by Satpathy and Mishra (2011) [11] in Odisha rice paddies, attributing fluctuations to prey availability. In northeastern India, Choudhury and Biswas (2010) [2] reported *Leucauge* and *Tetragnatha* as dominant taxa in Assam paddy fields, again consistent with Sindewahi's assemblage. The impact of pesticide use on spider diversity was highlighted by Rajeswari and Jayakumar (2012) [9], who found increased abundance in organically managed Madurai rice fields aligning with Sindewahi's low-input conditions.

Landscape and crop-specific studies from other Indian regions provide additional parallels. Ghosh and Saha (2019) [3] observed seasonal succession in jute–paddy rotations in West Bengal, paralleling the seasonal turnover of dominant guilds seen in Sindewahi. From Tripura, Nanda and Singha (2014) [5] reported the prevalence of *Eriophora*, *Neoscona*, and *Argiope* three genera also abundant in our collections. Patel and Soni (2015) [6] emphasized the generalist predation of spiders in Gujarat cotton fields, demonstrating the adaptability of similar taxa across crop systems. Diurnal activity patterns documented by Joshi et al. (2020) [4] in soybean fields of Madhya Pradesh further validate our daytime sampling design, while Purkait and Saha (2016) [7] highlighted the importance of bund flora and vegetative margins in maintaining spider richness one of the key habitats features in the Sindewahi landscape.

Conclusion

This study presents the first comprehensive record of spider diversity in the Sindewahi region of Chandrapur District, Maharashtra. A total of 73 individuals belonging to 11 species and 6 families were documented, with *Araneidae* and *Salticidae* as dominant families. The prevalence of *Nephila pilipes*, *Argiope aemula*, and *Tetragnatha extensa* reflects a stable predator community typical of rice-based ecosystems. These findings confirm the vital role of habitat heterogeneity and low pesticide use in supporting spider diversity. Spiders serve as effective natural pest regulators, underscoring their significance in Integrated Pest Management (IPM). Conservation of vegetated bunds and non-crop margins is essential to sustain these beneficial predators and promote sustainable agriculture in the region.

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