

DIVERSITY, ABUNDANCE, AND POLLINATION ROLE OF HYMENOPTERAN INSECTS IN OILSEED CROPS (SUNFLOWER AND NIGER) IN JUNNAR REGION, MAHARASHTRA, INDIA

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Abstract

Hymenopteran insects play a vital role in pollination and ecosystem functioning, particularly in agro-ecosystems dominated by oilseed crops. The present study was conducted in the Junnar region of Maharashtra to investigate the diversity, abundance, and pollination potential of hymenopteran insects associated with sunflower (*Helianthus annuus*) and niger (*Guizotia abyssinica*). A total of 16 study sites were surveyed, and insects were collected using standardized sweep netting methods. During the study, 19 species belonging to 7 families were recorded, comprising 2788 individuals. The family Apidae dominated the assemblage (72.27%), followed by Ichneumonidae (7.39%) and Vespidae (7.35%). Simpson's diversity index ranged from 0.80 to 0.90, indicating high species diversity and evenness across sites. The high visitation frequency of Apidae species confirmed their role as major pollinators of sunflower and niger crops. The study highlights the ecological importance of hymenopteran insects in agro-ecosystems and emphasizes the need for pollinator conservation to ensure sustainable agricultural productivity.

Keywords

Hymenoptera, pollination, sunflower, niger, Sampson diversity index,

Introduction

Hymenopteran insects, including bees, wasps, and ants, represent one of the most ecologically important insect groups due to their multifunctional roles in pollination, parasitism, and biological control (Michener, 2007; Jawale & Belgaonkar 2024). Among these, bees are considered the most efficient pollinators and are responsible for the reproduction of a large proportion of flowering plants, including many economically important crops (Klein et al., 2007; Jawale 2020). Oilseed crops such as sunflower and niger are highly dependent on insect-mediated pollination for improved seed set, yield, and genetic diversity (Panda et al., 1996; Langridge, 1952).

Pollinator diversity in agro-ecosystems is strongly influenced by environmental conditions, floral resource availability, and habitat heterogeneity (Potts et al., 2010). Increasing agricultural intensification, habitat fragmentation, and pesticide use have led to significant declines in pollinator populations worldwide (Winfree et al., 2009). This declines cause a serious threat to agricultural sustainability and ecosystem stability.

India supports a rich diversity of pollinators due to its varied agro-climatic zones, yet region-specific studies remain limited, particularly in semi-arid regions like Junnar in Maharashtra. Understanding local pollinator diversity and their ecological roles is essential for developing sustainable crop management practices. Therefore, the present study aims to assess the diversity,

abundance, and pollination role of hymenopteran insects associated with sunflower and niger crops in the Junnar region.

2. Materials and Methods

The study was conducted in Junnar tehsil of Pune district, Maharashtra, a semi-arid region receiving 50–250 mm annual rainfall and characterized by diverse agricultural practices (Jagdale et al., 2014). Sixteen study sites were selected where sunflower and niger crops were cultivated. Field surveys were conducted through periodic visits, and hymenopteran insects were collected using sweep netting techniques. Specimens were preserved using chloroform in killing bottles and processed following standard entomological procedures including pinning and drying (Borror et al., 2005).

Identification was carried out using standard taxonomic references such as *Hymenoptera of the World* (Goulet & Huber, 1993) and *Fauna of British India* (Morley, 1913). Species abundance was recorded based on the number of individuals observed at each site. Diversity was assessed using Simpson Diversity Index to evaluate species richness and evenness.

3. Results

3.1 Species Diversity and Composition

A total of 2,788 individuals belonging to 19 species and 7 hymenopteran families were recorded. The family Apidae dominated the assemblage (72.27%), followed by Ichneumonidae (7.39%), Vespidae (7.35%), Mutillidae (5.81%), Sphecidae (3.05%), Colletidae (2.15%), and Chrysididae (1.97%). Apidae was represented by six species and showed the highest abundance across all study sites.

Table 1. Composition of Hymenopteran Families in the Study Area

Sr. No.	Family	Percentage (%)
1	Apidae	72.27
2	Ichneumonidae	7.39
3	Vespidae	7.35
4	Mutillidae	5.81
5	Sphecidae	3.05
6	Colletidae	2.15
7	Chrysididae	1.97

3.2 Species Abundance Across Sites

The abundance of hymenopteran insects varied across sites, ranging from 135 to 219 individuals. Sites such as Narayangaon, Hivre, and Anjanawale showed higher abundance, likely due to better floral availability and favorable environmental conditions (Table No.2).

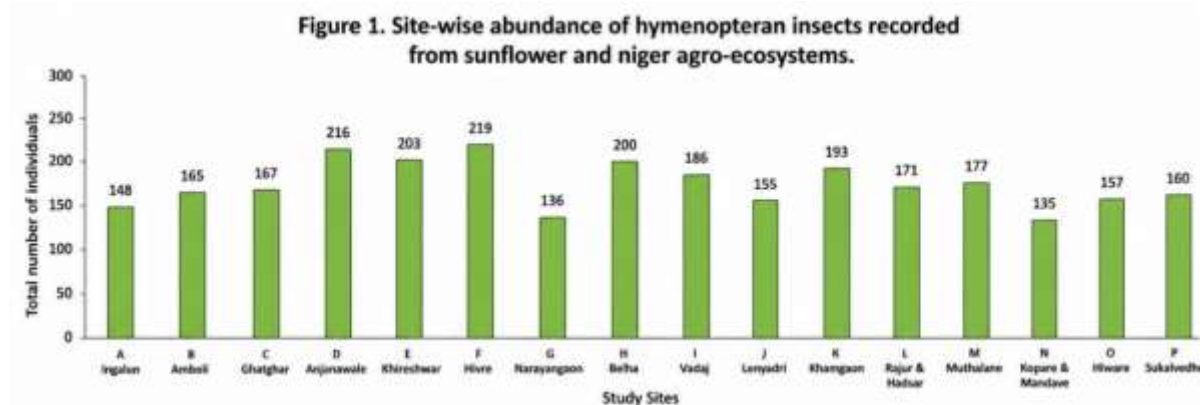
Table 2. Site-wise Abundance and Diversity Index

Site Credentials	Site name	Total Individuals	Simpson Index
A	Ingalun	148	0.80

B	Amboli	165	0.87
C	Ghatghar	167	0.84
D	Anjanawale	216	0.89
E	Khireswar	203	0.89
F	Hivre	219	0.88
G	Narayangaon	136	0.90
H	Belha	200	0.87
I	Vadaj	186	0.85
J	Lenyadri	155	0.88
K	Khamgaon	193	0.85
L	Rajur&Hadsar	171	0.87
M	Muthalane	177	0.87
N	Kopare&Mandave	135	0.89
O	Hiware	157	0.86
P	Sukalvedhe	160	0.83

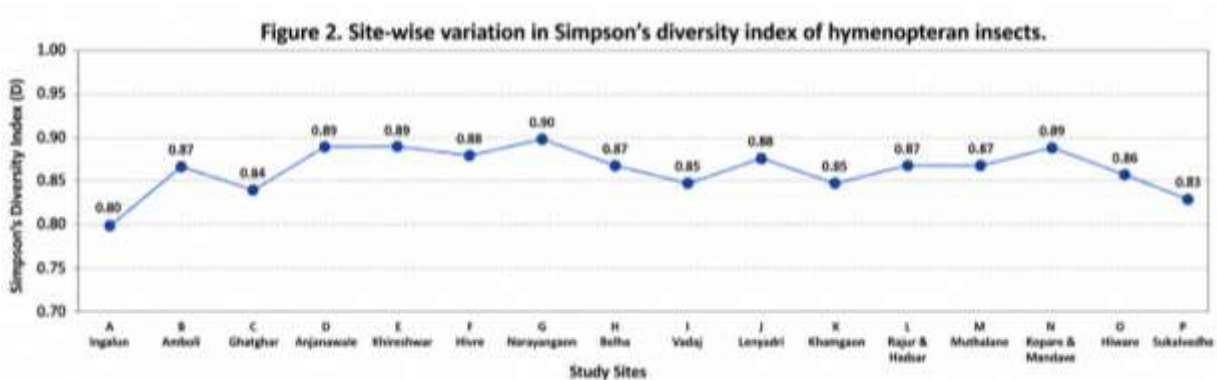
3.3 Pollinator Role in Oilseed Crops

All recorded species were observed visiting sunflower and niger crops. Apidae species exhibited the highest visitation rates, confirming their role as primary pollinators. Other hymenopterans contributed to pollination but at lower frequencies (Fig. No.1). The graph indicates consistently high diversity across sites, with minor variation.



3.4 Diversity Analysis

Simpson's Diversity Index ranged from 0.80 to 0.90, indicating high diversity and relatively uniform distribution of species. The highest diversity was recorded at Narayangaon (0.90), suggesting optimal ecological conditions for pollinator activity. (Fig.No.2.) This figure shows variation in total individuals across study sites, with peaks at sites D, E, and F.



4. Discussion

The dominance of Apidae (Table No. 1) and their widespread abundance (Figure No. 1) clearly indicate their ecological importance as primary pollinators. The high Simpson index values (Table 2; Figure 2) confirm that the agro-ecosystem supports a stable and diverse pollinator community. The dominance of Apidae in the present study confirms their critical role in pollination, consistent with global findings (Klein et al., 2007). Their high abundance is largely due to their efficient foraging behavior, social organization, and adaptability to diverse floral resources (Michener, 2007; Jawale 2020). Similar studies on sunflower pollination have demonstrated that bee activity significantly enhances crop yield and seed quality (Panda et al., 1996).

The high diversity indices observed in this study indicate a stable and resource-rich agro-ecosystem. Floral diversity and habitat heterogeneity likely contributed to sustaining diverse pollinator communities, as reported in other tropical systems (Potts et al., 2010). Variations in abundance across sites reflect differences in local environmental conditions, including crop diversity and microclimatic factors. The presence of additional hymenopteran families such as Ichneumonidae and Vespidae highlights the multifunctional nature of agro-ecosystems. Pollination, predation, and parasitism interact to maintain ecological balance. Such interactions are essential for natural pest regulation and ecosystem stability (Tooker & Hanks, 2000).

5. Conclusion

The agro-ecosystems of the Junnar region support a diverse and abundant community of hymenopteran insects. The dominance of Apidae confirms their role as major pollinators of sunflower and niger crops. High diversity indices indicate a stable ecological system. Conservation of pollinators and adoption of sustainable agricultural practices are essential for maintaining biodiversity and enhancing crop productivity.

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