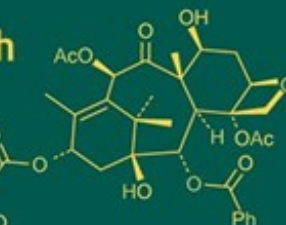


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
Indexing: Embase
IJABR 2026; 10(10): 01-04
www.biochemjournal.com
Received: 22-07-2026
Accepted: 18-09-2026
Published: 01-10-2026

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Diversity and relative abundance of insect visitors and pollinators in sunflower (*Helianthus annuus* L.) ecosystem

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i10a.10246>

ABSTRACT

Studies on the diversity and relative abundance of insect visitors and pollinators on sunflower (*Helianthus annuus* L.) were conducted at the experimental farm of ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad during kharif 2025. Direct visual observations recorded on the sunflower capitulum revealed twelve species of insect visitors belonging to three orders and six families. Order Hymenoptera was represented by seven species from two families, Apidae (six species) and Vespidae (one species), Lepidoptera comprised four species from four families viz., Hesperidae, Nymphalidae, Lycaenidae and Noctuidae, while Diptera was represented by a single species from family Rhiniidae. Of the twelve species, six foraged for both nectar and pollen while the remaining six foraged on nectar alone. Relative abundance data revealed that order Hymenoptera accounted for 91.21 per cent of the total insect visitors, family *Apidae* alone contributing 90.73 per cent, with the stingless bee *Tetragonula iridipennis* Smith, emerging as the single most dominant species (71.45%), followed by *Xylocopa fenestrata* Fab. (5.38%), *Xylocopa confusa* L. (3.65%), *Apis mellifera* Fab. (3.51%) and *Apis florea* Fab. (3.45%). The remaining insect orders together constituted only 8.79 per cent of the total visitors. The predominance of the native stingless bee over *Apis* species on the sunflower capitulum in the present study assumes significance for pollinator conservation and management in oilseed cropping systems.

Keywords: Diversity, Relative abundance, Insect visitors, Pollinators, Sunflower, *Tetragonula iridipennis* Smith

1. Introduction

Sunflower (*Helianthus annuus* L.), belonging to family Asteraceae, is a globally important oilseed crop grown for its high-quality edible oil and as a valuable component of crop diversification. Native to North America, it was first domesticated by indigenous tribes and later introduced into Europe, Asia and other parts of the world, and today ranks as the second most important oilseed crop globally after soybean, owing to its adaptability, short duration and relatively high oil yield. In India, sunflower is cultivated over an area of approximately 3.02 lakh hectares with a production of about 3.97 lakh tonnes and an average productivity of 1,314 kg/ha (DOD, 2023-24), and contributes significantly to the country's edible oil economy. Sunflower is primarily an entomophilous and cross-pollinated crop. Although its hermaphroditic florets permit a degree of self-pollination, optimal seed set, seed filling and oil accumulation largely depend on insect-mediated cross-pollination, a process favoured by the large capitulum bearing numerous disc florets that facilitate frequent insect visits. Among insect pollinators, honey bees (*Apis mellifera* F. and *Apis cerana indica* F.), bumble bees and wild bees such as *Xylocopa*, *Trigona* and *Andrena* are reported to be the most effective and frequent visitors, enhancing pollination efficiency as well as the genetic diversity and resilience of sunflower crops.

Insect-pollinated sunflower has been reported to record higher seed yield and oil content than self- or wind-pollinated crops (Dag *et al.*, 2002; Mallinger and Prasifka, 2017) [1], with open pollination further improving head diameter, seed number per head and 100-seed weight (Chandel *et al.*, 2004) [2]. Similar yield gains attributed to insect pollination have been documented outside India, including a 53 per cent increase in seed yield under open pollination over pollinator-excluded plots in Kenya (Nderitu *et al.*, 2008) [3] and comparable benefits reported from Pakistan, where four *Apis* species were recorded visiting sunflower capitula (Ali *et al.*, 2015) [4]. In India, Jadhav *et al.* (2011) [5] documented the diversity of insect pollinators visiting sunflower capitula at Tirupati, Andhra Pradesh, recording 24 species across four orders, viz., Hymenoptera, Lepidoptera, Diptera and Coleoptera, with *A. dorsata* as the most abundant and effective pollinator followed by *T. iridipennis* and *A. cerana indica*.

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Despite these gains, insect pollinator populations continue to face pressure from habitat loss, pesticide exposure and the intensification of monoculture cropping systems, making it essential to document pollinator diversity under local agro-climatic conditions before pollination benefits can be optimised. The present investigation was undertaken to document the diversity and relative abundance of insect visitors and pollinators on sunflower capitula at Rajendranagar, Hyderabad, during *kharif* 2025.

2. Materials and methods

2.1 Experimental site

The present investigation was carried out at the experimental farm of the ICAR-Indian Institute of Oilseeds Research (IIOR), Rajendranagar, Hyderabad, Telangana, during *kharif* 2025. The site falls under semi-arid tropical conditions with a hot and dry climate suitable for sunflower cultivation, and the soil of the experimental site was red sandy loam, low in available nitrogen, medium in phosphorus and high in potassium. Each plot measured 20 m² and the crop was spaced at 60 cm x 30 cm, with all recommended agronomic practices followed.

2.2 Plant material

Four sunflower genotypes differing in capitulum and floret morphology were evaluated:

1. Pale yellow ray floret sunflower
2. TilhanTec SUNH-1
3. Tubular ray floret HHM
4. White pollen branching

2.3 Assessment of insect diversity and abundance

Insect visitors to the sunflower capitulum were recorded by direct visual observation at the peak blooming stage between 08.00 and 16.00 h. Observations were made at 10-minute intervals per plot, repeated three times daily (morning, noon and afternoon) throughout the flowering period. For every visit, the identity of the insect species together with its family and order, and the type of floral reward exploited (nectar and pollen), were recorded. Representative specimens were collected, preserved and identified using standard taxonomic keys, and identifications were verified by specialists at the Division of Entomology, ICAR-IIOR. The relative abundance (%) of each species was worked out as the proportion of its visits to the total number of insect visits recorded during the entire observation period.

3. Result and discussion

3.1 Diurnal insect visitors on sunflower capitulum

Observations on insect visitors to the sunflower capitulum during *kharif* 2025 revealed the occurrence of twelve species belonging to three orders and six families (Table 1.) Order Hymenoptera was the

most diverse, represented by seven species under two families; family Apidae accounted for six species, viz., *Tetragonula iridipennis* Smith., *Apis mellifera* F., *Apis florea* F., *Xylocopa fenestrata* F., *Xylocopa confusa* L. and *Heterotrigona* sp., while family Vespidae was represented by a single species, *Scolia* sp. Order Lepidoptera comprised four species, one each from four families, namely *Borbo cinnara* Wallace (Hesperiidae), *Hypolimnas misippus* L. (Nymphalidae), *Rapala manae* Hewitson (Lycaenidae) and *Thysanoplusia orichalcea* F. (Noctuidae). Order Diptera was represented by a single species, *Stomorphina xanthogaster* Wiedemann, belonging to family Rhiniidae. With respect to the floral reward exploited, all six species of family Apidae and the dipteran visitor, *S. xanthogaster*, foraged on both nectar and pollen, whereas the wasp, *Scolia* sp., and all four lepidopteran visitors foraged on nectar alone Table 1.

The findings of the present study align with Jadhav *et al.* (2011) [5], who reported 88.85% abundance of the family Apidae on sunflowers at Tirupati. Similar findings were reported by Padhy *et al.* (2024) [6], who recorded Apidae as the most speciose and most abundant family among the pollinators of sunflower in Odisha. The present findings align with Goswami *et al.* (2013) [7] and Basak *et al.* (2018) [8], who reported a similar hymenopteran-dominated pollinator spectrum on sunflower in West Bengal.

Relative abundance of insect visitors on sunflower capitulum

The relative abundance of insect visitors on the sunflower capitulum is presented in Table 2. Among the twelve species recorded, order Hymenoptera accounted for 91.21% of the total insect visitors, comprising family Apidae (90.73%) and family Vespidae (0.48%). Within Apidae, the stingless bee, *T. iridipennis* was the single most dominant species, constituting 71.45 per cent of the total visitors, followed by *X. fenestrata* (5.38%), *X. confusa* (3.65%), *A. mellifera* (3.51%), *A. florea* (3.45%) and *Heterotrigona* sp. (3.29%). The wasp, *Scolia* sp. (family Vespidae) contributed only 0.48% to the total abundance.

The remaining insect orders, Lepidoptera and Diptera, together constituted 8.79% of the total insect visitors. Among these, the dipteran nose fly, *S. xanthogaster*, recorded the highest abundance (4.24%), followed by the skipper, *B. cinnara* (3.38%). The remaining lepidopterans, *H. misippus*, *T. orichalcea* and *R. manae*, each contributed less than one per cent (0.54, 0.54 and 0.48%, respectively) to the total abundance.

The present findings align with Piankra *et al.* (2019) [9], who reported that *T. iridipennis* maintains strong and sustained foraging activity on sunflower throughout the flowering period, reinforcing its standing as an efficient and dependable pollinator of this crop wherever its colonies are locally abundant. Similar findings were reported by Gore *et al.* (2025) [10], who reported low visitation rates for lepidopteran (*P. demoleus*, *D. crysippus* and *R. manae*) and dipteran (*Ischiodon scutellaris*) relative to the dominant hymenopteran foragers on sunflower in Maharashtra, reinforcing that these groups function mainly as occasional nectar foragers rather than as primary pollinators of the crop.

Table 1. Diversity of insect visitors and pollinators recorded on sunflower (*Helianthus annuus* L.) capitulum during *kharif* 2025

Order	Family	Insect species	Forage source
Hymenoptera	Apidae	<i>Tetragonula iridipennis</i> Smith.	NP
		<i>Apis mellifera</i> Fab.	NP
		<i>Apis florea</i> Fab.	NP
		<i>Xylocopa fenestrata</i> Fab.	NP
		<i>Xylocopa confusa</i> L.	NP
		<i>Heterotrigona</i> sp.	NP
	Vespidae	<i>Scolia</i> sp.	N

(continued on next page)

Order	Family	Insect species	Forage source
Lepidoptera	Hesperiidae	<i>Borbo cinnara</i> Wallace	N
	Nymphalidae	<i>Hypolimnas misippus</i> L.	N
	Lycaenidae	<i>Rapala manae</i> Hewitson	N
	Noctuidae	<i>Thysanoplusia orichalcea</i> Fab.	N
Diptera	Rhiniidae	<i>Stomorphina xanthogaster</i> Wiedemann	NP

*NP-nectar & pollen collector, N - only nectar collector

Table 2. Relative abundance of insect visitors on sunflower (*Helianthus annuus* L.) capitulum during kharif 2025

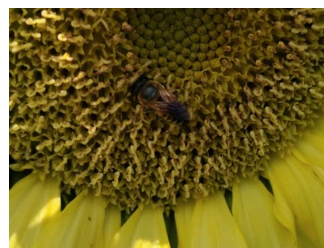
Order	Family	Common Name	Scientific Name	Abundance (%)	Total abundance (%)
Hymenoptera	Apidae	Stingless bee	<i>Tetragonula iridipennis</i> Smith.	71.45	91.21
		Italian bee	<i>Apis mellifera</i> Fab.	3.51	
		Little honey bee	<i>Apis florea</i> Fab.	3.45	
		Carpenter bee	<i>Xylocopa fenestrata</i> Fab.	5.38	
			<i>Xylocopa confuse</i> L.	3.65	
			<i>Heterotrigona</i> sp.	3.29	
		Wasp	<i>Scolia</i> sp.	0.48	
Lepidoptera	Hesperiidae	Skipper	<i>Borbo cinnara</i> Wallace	3.38	8.79
	Nymphalidae	Danaid eggfly	<i>Hypolimnas misippus</i> L.	0.54	
	Lycaenidae	Slate flash	<i>Rapala manae</i> Hewitson	0.48	
	Noctuidae	Slender burnish brass moth	<i>Thysanoplusia orichalcea</i> Fab.	0.54	
Diptera	Rhiniidae	Nose fly	<i>Stomorphina xanthogaster</i> wiedemann	4.24	



Tetragonula iridipennis Smith



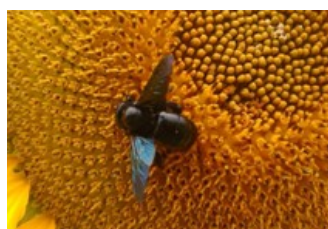
Xylocopa fenestrata F.



Apis mellifera F.



Wasp v



Xylocopa confuse L.



Scolia sp.



Hypolimnas misippus L.



Borbo cinnara Wallace

(continued on next page)

*Thysanoplusia orichalcea* F.*Stomorphina xanthogaster*
Wiedemann

Conclusion

The present study revealed that the sunflower capitulum attracted a total of twelve insect species belonging to three orders and six families with Hymenoptera being the most diverse and abundant group. Unlike most previous reports from India, where *Apis* species dominate the pollinator spectrum of sunflower, the native stingless bee, *T. iridipennis*, emerged as the single most abundant floral visitor in the present study, underscoring its potential as an efficient and locally important pollinator of sunflower. Conservation of stingless bee colonies in the vicinity of sunflower fields, together with further correlation of insect visitation with seed set, seed yield and oil quality, is recommended to harness the full pollination benefits of this crop.

Acknowledgement

I would like to thank Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, for providing support throughout this research. I would like to express my sincere gratitude to ICAR-Indian Institute of Oilseeds Research, officials, and staff for providing necessary research facilities, guidance, support and encouragement throughout my study term.

Competing interests

None

Authors' Contributions

This work was carried out in collaboration among all authors.

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How to cite this article: Swamy K, Boopathi T, Upendhar S, Yadav P. Diversity and relative abundance of insect visitors and pollinators in sunflower (*Helianthus annuus* L.) ecosystem. *International Journal of Advanced Biochemistry Research*. 2026;10(10):01-04. doi: <https://www.doi.org/10.33545/26174693.2026.v10.i10a.10246>