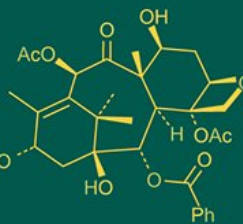
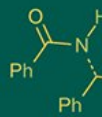


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Insect pollinator diversity and diurnal activity in mustard (*Brassica juncea* L.)

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Abstract

A field study was conducted during the rabi season of 2025-26 at Parbhani, Maharashtra, to document the diversity and diurnal activity of insect pollinators associated with mustard (*Brassica juncea* L.). Regular observations were made throughout the flowering period to identify insect visitors and assess their species composition and activity at different times of the day. A total of 28 insect species representing seven orders, viz., *Hymenoptera*, *Diptera*, *Lepidoptera*, *Coleoptera*, *Hemiptera*, *Orthoptera* and *Thysanoptera*, were recorded from mustard flowers. *Hymenoptera* was the most species-rich order with eight species (28.57%), followed by *Diptera* with seven species (25.00%), while *Lepidoptera* and *Coleoptera* contributed four species each (14.29%). Among the flower-visiting insects, bees constituted an important component of the pollinator assemblage and were observed collecting nectar and pollen from mustard flowers. The diurnal observations revealed marked variation in insect visitation throughout the day. The highest overall activity was recorded at 12:00 h, with a mean visitation of 51.30 insects per 5 min per m², followed by 14:00 h (45.90), whereas the lowest visitation occurred at 16:00 h (27.40). *Hymenoptera* exhibited the highest mean activity (15.60 insects/5 min/m²), followed by *Diptera* (8.60 insects/5 min/m²), with both groups showing maximum activity at 12:00 h. Overall, the study demonstrated that mustard flowers support a diverse insect visitor community, with *Hymenoptera* forming the predominant group and midday representing the period of greatest insect activity.

Keywords: Mustard, *Brassica juncea*, insect pollinators, pollinator diversity, *Hymenoptera*, diurnal activity, flower visitation, Parbhani

Introduction

Pollination is an essential ecosystem service supporting the reproduction of flowering plants and agricultural productivity. More than 87% of flowering plant species are estimated to benefit from animal pollination, while approximately 75% of major food crops benefit from pollination (Ollerton *et al.*, 2011; IPBES, 2016) [16]. Among insect pollinators, bees are particularly important due to their frequent flower visitation, floral fidelity and efficient pollen transfer (Garibaldi *et al.*, 2013) [5]. Increasing concern over pollinator decline highlights the need to understand pollinator communities in agricultural ecosystems. Indian mustard (*Brassica juncea* L.) is an important winter oilseed crop and major source of edible oil in India. Its yellow, nectar- and pollen-rich flowers attract diverse insect visitors. Although mustard is capable of self-pollination, insect visitation can improve pollen transfer, seed set and yield. Nagpal *et al.* (2026) [14] reported 35.50% higher seed yield under open pollination and 19.66% higher yield with *Apis mellifera* compared with pollinator exclusion, demonstrating the contribution of insect pollination to mustard productivity. Mustard flowers support a diverse assemblage of insect visitors, with bees generally representing the major pollinator group. Important visitors include *Apis mellifera*, *A. cerana*, *A. dorsata*, *A. florea* and *Tetragonula iridipennis*, along with insects belonging to *Diptera*, *Lepidoptera* and *Coleoptera*. Recent studies have reported considerable variation in pollinator diversity and abundance in

B. juncea, with *Hymenoptera* frequently being the dominant group (Prajula *et al.*, 2025; Layek *et al.*, 2026) [13, 17]. The diurnal activity of pollinators varies with temperature, light intensity, humidity and floral resource availability, resulting in distinct periods of peak visitation. Determining hourly pollinator activity is therefore important for understanding

the temporal pattern of floral visitation and identifying periods of maximum pollination potential. Pollinator diversity and activity are also influenced by crop phenology, climatic conditions, surrounding vegetation and agricultural practices (Garibaldi *et al.*, 2011; Kennedy *et al.*, 2013)^[5, 10]. Although several studies have documented mustard pollinators in India, information integrating pollinator diversity, relative abundance and diurnal activity remains limited for the Marathwada region of Maharashtra. Therefore, the present study was undertaken to document the diversity of insect pollinators associated with *Brassica juncea* L. and determine their diurnal activity pattern under the agro-ecological conditions of Marathwada, Maharashtra. The study provides information on major pollinator groups, their relative abundance and peak activity periods, contributing to a better understanding of mustard pollination ecology.

2. Materials and Methods: The study was conducted during the rabi season of 2025-26 at the Departmental Farm, Department of Entomology, College of Agriculture, Parbhani, Maharashtra, India. The experimental site is situated between 19°16'-19°30' N latitude and 76°40'-76°50' E longitude, at an elevation of approximately 410-420 m above mean sea level. The region forms part of the Deccan Plateau and experiences a semi-arid tropical climate, receiving approximately 500-900 mm annual rainfall, mainly from the south-west monsoon. The experimental field consisted of medium to deep black cotton soil (Vertisol), characterized by high clay content, good moisture-retention capacity and slightly alkaline reaction. Mustard (*Brassica juncea* L.) cv. TAM 108-1 was used for the investigation. No insecticide or pesticide application was made during the flowering period to permit natural insect visitation.

Insect pollinators visiting mustard flowers were recorded by the direct visual observation method during the flowering period. Observations were made at 08:00, 10:00, 12:00, 14:00 and 16:00 h. At each observation time, all insects visiting flowers within a 1 m² area were counted continuously for five minutes. Observations were recorded at three representative locations within the experimental field. The visiting insects were identified based on their morphological characteristics using standard taxonomic keys and relevant taxonomic literature. Specimens that could not be identified during field observations were collected and subsequently examined in the laboratory for identification. The identified insects were classified according to their respective orders, families and species. The observations were compiled to determine the species composition and taxonomic distribution of insect visitors associated with mustard. The relative representation of major insect groups was determined by pooling the recorded individuals according to their respective taxonomic orders. The relative dominance of individual insect species was calculated as the percentage contribution of individuals of a particular species to the total number of insect individuals recorded using the following formula:

$$\text{Relative dominance (\%)} = \left(\frac{\text{Number of individuals of a particular species}}{\text{Total number of insect individuals recorded}} \right) \times 100$$

The percentage contribution of each insect order to the total insect visitor community was also calculated to determine

the relative representation of major insect groups. The diurnal activity pattern of insect pollinators was assessed from the time-wise observations recorded at different hours of the day. The mean number of insects visiting mustard flowers during the five-minute observation period was calculated for each observation time based on observations from the three sampling locations. The activity of individual insect orders and the total insect visitor community was compared across observation hours to determine the daily pattern of flower visitation and the period of maximum insect activity. The compiled observations were summarized to characterize the insect pollinator species composition, relative representation of major insect groups and diurnal visitation pattern associated with mustard flowers.

3. Results and discussion

3.1 Insect pollinator diversity recorded in mustard during Rabi 2025-26

A total of 28 insect species belonging to seven orders and 13 families were recorded visiting mustard (*Brassica juncea* L.) flowers during the rabi season of 2025-26 (Table 1; Fig. 1). The recorded insect fauna represented a diverse assemblage of flower-visiting insects comprising *Hymenoptera*, *Diptera*, *Lepidoptera*, *Coleoptera*, *Hemiptera*, *Orthoptera* and *Thysanoptera*. Among the recorded orders, *Hymenoptera* exhibited the highest species richness with eight species, followed by *Diptera* with seven species. *Lepidoptera* and *Coleoptera* contributed four species each, while *Hemiptera* comprised three species. *Orthoptera* and *Thysanoptera* were represented by one species each. Thus, *Hymenoptera* and *Diptera* together accounted for more than half of the insect species recorded from mustard flowers, demonstrating their greater representation within the flower-visiting community. The order *Hymenoptera* comprised eight bee species belonging to two families, *Apidae* and *Megachilidae*. Seven species, namely *Apis mellifera*, *A. cerana indica*, *A. dorsata*, *A. florea*, *Tetragonula iridipennis*, *Xylocopa pubescens* and *Amegilla zonata*, belonged to *Apidae*, whereas *Megachile disjuncta* represented *Megachilidae*. These bees were observed actively visiting mustard flowers for pollen and nectar and were therefore considered the principal pollen- and nectar-foraging insects recorded in the present investigation. The occurrence of honeybees, stingless bees and solitary bees indicates that mustard flowers provide floral resources capable of supporting bees with different social and foraging habits. The presence of several *Apis* species is particularly relevant because honeybees generally make frequent visits to mass-flowering crops such as mustard, where abundant and easily accessible floral resources are available. *Diptera* was the second most species-rich order and comprised seven species belonging to five families. The recorded species included *Calliphora vicina* and *Stomoxys calcitrans* under *Calliphoridae*, *Austrosiaxipha connexa* under *Dolichopodidae*, *Sarcophaga* sp. under *Sarcophagidae*, *Epistrophe emarginata* and *Episyrphus balteatus* under *Syrphidae*, and *Lixophaga* sp. under *Anthomyiidae*. Members of *Syrphidae* were recorded as nectar foragers, whereas other *dipterans* were mainly observed as casual visitors. The presence of several *dipteran* species indicates that mustard flowers were also utilized by non-bee insects and that the floral resources of the crop supported a broader visitor community beyond the major bee fauna. *Lepidoptera* represented the third major component in terms of species richness, with four species

belonging to four different families. The recorded species were *Pieris rapae* (Pieridae), *Scopula floslactata* (Geometridae), *Syntomoides imaon* (Erebidae) and *Zizeeria karsandra* (Lycaenidae). All four species were observed mainly as nectar foragers. Their occurrence demonstrates that mustard flowers also provide nectar resources to butterflies and moths during the flowering period. Although these insects may differ from bees in their effectiveness as pollinators, their repeated visits to flowers can contribute to pollen transfer and form an important component of the overall flower-visiting assemblage. *Coleoptera* was represented by four species belonging to three families. The recorded beetles included *Altica* sp. (Chrysomelidae), *Paederus* sp. (Staphylinidae), *Cheilomenes sexmaculata* and *Coccinella transversalis* (Coccinellidae). These insects were primarily categorized as casual visitors rather than regular pollen or nectar foragers. The occurrence of coccinellid beetles on mustard flowers may also be associated with the availability of prey insects and floral resources within the crop canopy. *Hemiptera* contributed three species, namely *Nezara viridula*, *Bagrada hilaris* and *Stictocephala bisonia*, representing *Pentatomidae* and *Membracidae*. These insects were likewise recorded mainly as casual visitors. *Orthoptera* was represented by *Acrida exaltata*, while *Thysanoptera* was represented by *Aeolothrips* sp., both occurring only occasionally on mustard flowers. Based on their observed foraging behaviour, the insect diversity could broadly be categorized into pollen and nectar foragers, nectar foragers and casual visitors. The eight bee species were recorded as pollen and nectar foragers, making *Hymenoptera* the most important group from the standpoint of regular floral resource utilization. Several butterflies, moths and *dipterans* were predominantly nectar foragers, whereas most *Coleopterans*, *Hemipterans*, the recorded *orthopteran* and *thysanopteran* were categorized as casual visitors. This distinction indicates that the insect community recorded on mustard flowers comprised both potential pollinators and insects that used the flowers only occasionally. The present investigation recorded 28 insect species belonging to seven orders and 13 families on mustard flowers, indicating a diverse range of insect visitors during the rabi season. The predominance of *Hymenoptera*, represented by eight species, was mainly due to the presence of diverse bee species, including *Apis mellifera*, *A. cerana indica*, *A. dorsata*, *A. florea*, *Tetragonula iridipennis*, *Xylocopa*

pubescens, *Amegilla zonata* and *Megachile disjuncta*. This finding agreed with Devi *et al.* (2017)^[4], who reported *Hymenoptera* as the major group of insect pollinators associated with mustard. Das and Jha (2018)^[3] also recorded *Hymenoptera* as the most diverse group on Indian mustard, followed by *Diptera* and *Lepidoptera*, which closely corresponded with the order-wise pattern observed in the present study. Similarly, Nishant and Negi (2021)^[15] reported *Hymenoptera* as the most diverse group on mustard, with *Apis mellifera* as an important flower visitor. The occurrence of seven *Dipteran* species as the second most species-rich group in the present investigation was comparable with the findings of Yadav *et al.* (2022), who reported *Hymenoptera* as the most diverse group followed by *Diptera*, *Lepidoptera*, *Hemiptera* and *Coleoptera* on different *Brassica* genotypes. Bijarniya *et al.* (2024)^[1] recorded 36 insect species belonging to eight orders on Indian mustard, with *Hymenoptera* and *Diptera* contributing 12 and nine species, respectively, supporting the greater representation of these two orders observed in the present study. Adlin Prajula *et al.* (2024)^[17] recorded 31 insect species belonging to 16 families and six orders on mustard, further indicating that mustard flowers support a wide range of insect visitors. More recently, Kaundil *et al.* (2025)^[9] recorded 34 insect species belonging to five orders and 12 families on mustard, with *Hymenoptera* and *Diptera* contributing 13 and 10 species, respectively. Their observation of honeybees as regular flower visitors agrees with the prominent representation of bee species in the present investigation. Priyadarshini *et al.* (2025)^[18] recorded 19 insect visitors/pollinators belonging to six orders on *B. juncea*, with *Hymenoptera* contributing the highest number of species, further supporting the dominance of this order in mustard flower visitation. Ramkumar *et al.* (2026)^[19] recorded 24 insect species representing five orders and 14 families on Indian mustard and reported *Hymenoptera* as the dominant order followed by *Diptera*, which closely agrees with the present observation of eight *Hymenopteran* and seven *Dipteran* species. Thus, the consistent predominance of *Hymenoptera* across the present and earlier investigations emphasizes the importance of bees as regular floral visitors of mustard, while the occurrence of *Diptera*, *Lepidoptera* and other insect groups demonstrate the broader value of mustard flowers as a source of floral resources during the flowering period.

Table 1: Insect pollinator diversity recorded in mustard during Rabi 2025-26

S. No.	Common Name	Scientific Name	Family	Order	Forager type
1	European bee	<i>Apis mellifera</i> Linnaeus	Apidae	Hymenoptera	PN
2	Indian bee	<i>Apis cerana indica</i> Fabricius	Apidae	Hymenoptera	PN
3	Rock bee	<i>Apis dorsata</i> Fabricius	Apidae	Hymenoptera	PN
	Little bee	<i>Apis florea</i> Fabricius	Apidae	Hymenoptera	PN
5	Stingless bee	<i>Tetragonula iridipennis</i> Smith	Apidae	Hymenoptera	PN
6	Carpenter bee	<i>Xylocopa pubescens</i> Spinola	Apidae	Hymenoptera	PN
7	Blue banded bee	<i>Amegilla zonata</i> Linnaeus	Apidae	Hymenoptera	PN
8	Leaf-cutter bee	<i>Megachile disjuncta</i> Fabricius	Megachilidae	Hymenoptera	PN
9	Blow fly	<i>Calliphora vicina</i> Robineau-Desvoidy	Calliphoridae	Diptera	CV
10	Nose fly	<i>Stomoxys calcitrans</i> L.	Calliphoridae	Diptera	CV
11	Long legged fly	<i>Austrosclaptus connexus</i>	Dolichopodidae	Diptera	NF
12	Flesh fly	<i>Sarcophaga</i> sp.	Sarcophagidae	Diptera	CV
13	Hover fly	<i>Epistrophe emarginata</i>	Syrphidae	Diptera	NF
14	Marmalade Hoverfly	<i>Episyrphus balteatus</i>	Syrphidae	Diptera	NF
15	Tachinid fly	<i>Lixophaga</i> sp.	Anthomyiidae	Diptera	CV
16	Cabbage white butterfly	<i>Pieris rapae</i> Linnaeus	Pieridae	Lepidoptera	NF
17	Cream wave moth	<i>Scopula floslactata</i>	Geometridae	Lepidoptera	NF
18	Handmaiden moth	<i>Syntomoides imaon</i>	Erebidae	Lepidoptera	NF
19	Dark grass blue butterfly	<i>Zizeeria karsandra</i> Moore	Lycaenidae	Lepidoptera	NF
20	Flea beetle	<i>Altica</i> sp.	Chrysomelidae	Coleoptera	CV

21	Rove beetle	<i>Paederus</i> sp.	<i>Staphylinidae</i>	<i>Coleoptera</i>	CV
22	Six spotted zigzag Ladybird beetle	<i>Cheilomenes sexmaculata</i> Fabricius	<i>Coccinellidae</i>	<i>Coleoptera</i>	CV
23	Ladybird beetle	<i>Coccinella transversalis</i> Fabricius	<i>Coccinellidae</i>	<i>Coleoptera</i>	CV
24	Green stink bug	<i>Nezara viridula</i> Linnaeus	<i>Pentatomidae</i>	<i>Hemiptera</i>	CV
25	Shield bug	<i>Bagrada hiliaris</i> Burmeister	<i>Pentatomidae</i>	<i>Hemiptera</i>	CV
26	Tree hopper	<i>Stictocephala bisonia</i>	<i>Membracidae</i>	<i>Hemiptera</i>	CV
27	Slant-faced grasshopper	<i>Acrida exaltata</i> Walker	<i>Acrididae</i>	<i>Orthoptera</i>	CV
28	Banded thrips	<i>Aeolothrips</i> spp	<i>Aeolothripidae</i>	<i>Thysanoptera</i>	CV

(PN*- Pollen and Nectar forager, NF*- Nectar forager, CV*- Casual visitor)

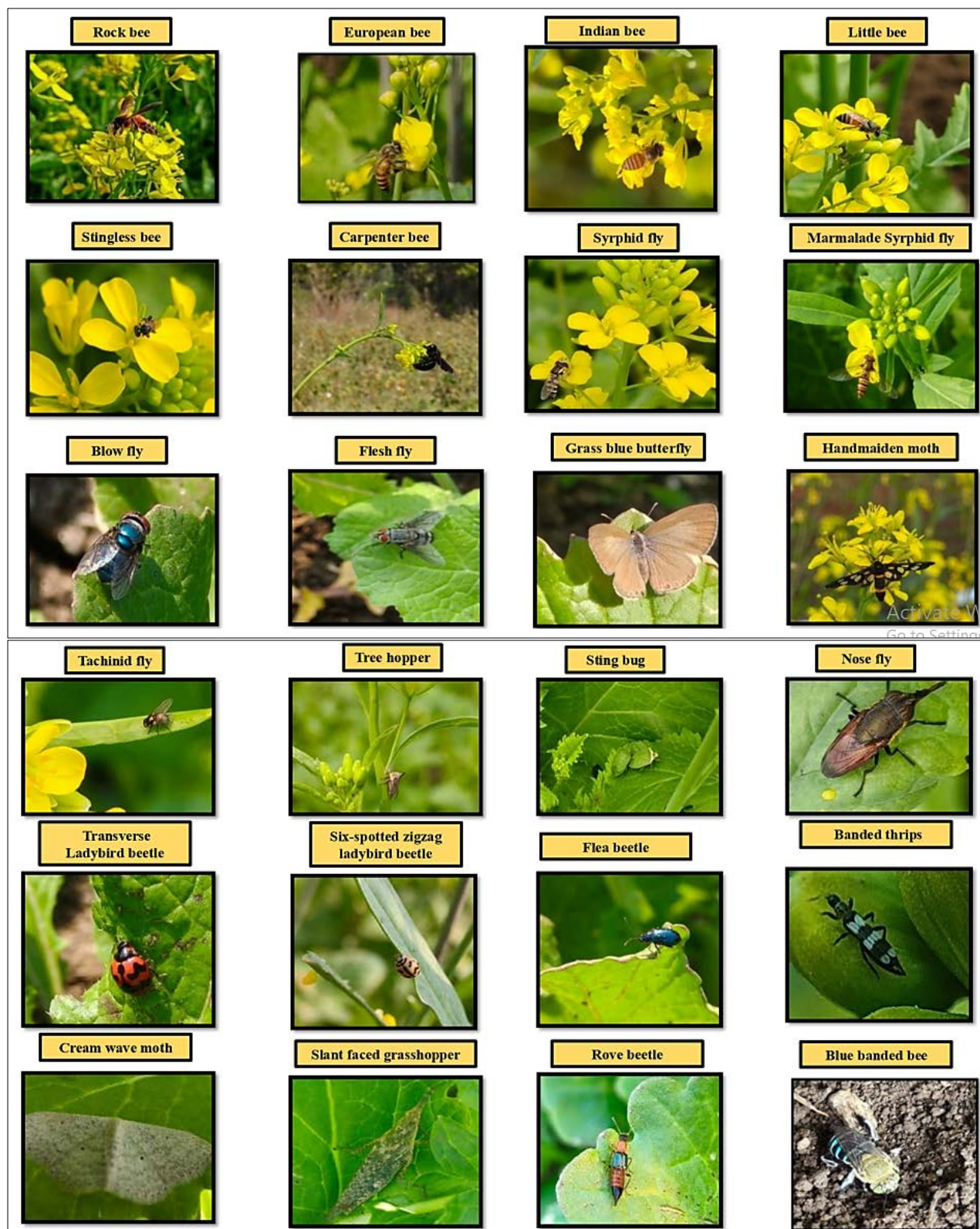


Fig 1: List of insect pollinators observed and collected during Rabi 2025-2026

3.2 Relative dominance of major insect groups associated with mustard during Rabi 2025-26

The relative dominance of major insect groups associated with mustard flowers during rabi 2025-26 is presented in (Table.2; Fig.2). A total of 28 insect species belonging to seven orders were recorded. *Hymenoptera* showed the highest relative dominance with 28.57 per cent, represented by eight species, followed by *Diptera* with seven species contributing 25.00 per cent. *Lepidoptera* and *Coleoptera* were represented by four species each, accounting for 14.29 percent relative dominance each. *Hemiptera* comprised three species with 10.71 percent, followed by *Orthoptera* and *Thysanoptera* with one species each, contributing 3.57 percent each. The combined contribution of *Hymenoptera* and *Diptera* was 53.57 percent, indicating that these two orders constituted more than half of the insect species recorded from mustard flowers. The remaining four orders together contributed 46.43 percent, with *Lepidoptera* and *Coleoptera* showing greater representation than *Hemiptera*, *Orthoptera* and *Thysanoptera*. Thus, the species composition of insect visitors was mainly represented by *Hymenoptera* and *Diptera*, followed by *Lepidoptera* and

Coleoptera, while *Orthoptera* and *Thysanoptera* had comparatively limited representation. The higher relative dominance of *Hymenoptera* (28.57%) in the present study indicates greater representation of bee species on mustard flowers. Kumari *et al.* (2015) ^[12] reported *Hymenoptera* as the major insect group associated with *Brassica juncea*, supporting the present observation. Jyoti *et al.* (2022) ^[8] also recorded *Hymenoptera* as the most diverse group among insect visitors of *Brassica* genotypes. Priyadarshini *et al.* (2025) ^[18] reported *Hymenoptera* as the most abundant group on mustard, followed by *Diptera*, which agrees with the present order-wise pattern. Bijarniya *et al.* (2024) ^[1] observed substantial representation of *Hymenoptera* among insect pollinators of Indian mustard. Jat *et al.* (2026) ^[7] reported *Hymenoptera* as the dominant insect order associated with mustard. Ramkumar *et al.* (2026) ^[19] recorded *Hymenoptera* followed by *Diptera* as the major insect groups visiting Indian mustard. The lower representation of *Lepidoptera*, *Coleoptera*, *Hemiptera*, *Orthoptera* and *Thysanoptera* in the present study may be related to their fewer species recorded on mustard flowers.

Table 2: Relative dominance of major insect pollinator groups associated with mustard during Rabi 2025-26

Sr. No.	Insect Order	No. of Species	Dominance (%)
1	<i>Hymenoptera</i>	8	28.57
2	<i>Diptera</i>	7	25.00
3	<i>Lepidoptera</i>	4	14.29
4	<i>Coleoptera</i>	4	14.29
5	<i>Hemiptera</i>	3	10.71
6	<i>Orthoptera</i>	1	3.57
7	<i>Thysanoptera</i>	1	3.57
Total		28	100.00

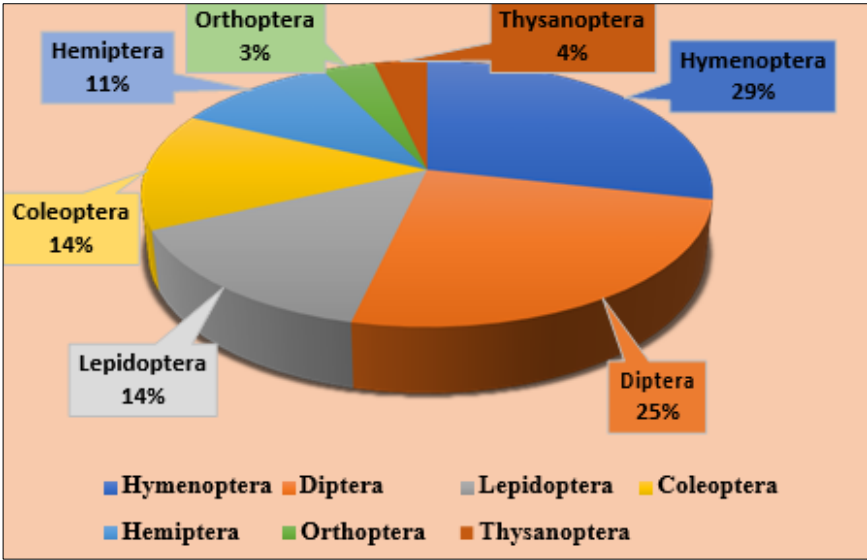


Fig 2: Relative dominance of major insect pollinator groups associated with mustard during Rabi 2025-26

3.3 Diurnal activity pattern of insect pollinators visiting mustard flowers during Rabi 2025-26

The diurnal activity pattern of insect pollinators visiting mustard flowers at different times of the day is presented in (Table.3; Fig.3).The total insect visitation varied considerably with observation time. The highest overall visitation was recorded at 12:00 h (51.30 insects/5 min/m²), followed by 14:00 h (45.90), while the lowest visitation was recorded at 16:00 h (27.40). At 10:00 h, the total visitation was 30.70 insects/5 min/m², with an overall mean of 38.83

insects/5 min/m².Among the different insect orders, *Hymenoptera* recorded the highest mean visitation of 15.60 insects/5 min/m², followed by *Diptera* (8.60), *Lepidoptera* (4.75) and *Coleoptera* (4.45). *Hemiptera*, *Orthoptera* and *Thysanoptera* recorded comparatively lower mean visitations of 3.00, 1.43 and 1.00 insects/5 min/m², respectively. *Hymenoptera* showed maximum activity at 12:00 h (20.60), followed by 14:00 h (18.40), 10:00 h (12.20) and 16:00 h (11.20). *Diptera* also exhibited its highest visitation at 12:00 h (11.40), followed by 14:00 h

(10.20). *Lepidoptera* recorded its maximum visitation at 12:00 h (6.20), followed by 14:00 h (5.60), whereas *Coleoptera* showed corresponding values of 5.80 and 5.20. *Hemiptera* recorded 4.00 insects/5 min/m² at 12:00 h, while *Orthoptera* and *Thysanoptera* recorded 1.90 and 1.40, respectively. Thus, 12:00 h represented the peak activity period for all the recorded insect orders, followed by a gradual reduction in visitation during the afternoon. The results indicate a clear midday peak in insect activity on mustard flowers under the conditions of the present investigation. A distinct diurnal variation was observed in the activity of insect visitors on mustard flowers, with overall visitation increasing from 10:00 h and attaining a maximum at 12:00 h (51.30 insects/5 min/m²), followed by a decline at 14:00 and 16:00 h. Roy *et al.* (2014)^[20] reported a similar pattern in *Brassica juncea*, with insect visitors showing greater activity during the middle hours of the day and peak visitation during 12:00-14:00 h. Their findings indicate that the activity of mustard flower visitors varies considerably with time of day, which corresponds with the progressive increase and subsequent decline in total visitation observed across the observation hours. The order-wise activity in the present data showed *Hymenoptera* (15.60 insects/5 min/m²) as the most active group, followed by *Diptera* (8.60), *Lepidoptera* (4.75) and *Coleoptera*

(4.45). This pattern is comparable with the findings of Chaudhary *et al.* (2026)^[2], who reported *Hymenoptera* as the most species-rich insect order in mustard, followed by *Diptera* and *Lepidoptera*, while *Coleoptera* and *Hemiptera* were comparatively less represented. The greater activity of *Hymenoptera* observed here may therefore reflect their greater association with mustard flowers during the flowering period. Jyoti *et al.* (2022)^[8] also recorded *Hymenoptera* as the predominant pollinator group on different *Brassica* genotypes, followed by *Diptera*, *Lepidoptera*, *Hemiptera* and *Coleoptera*, based on observations conducted at different times of the day, including 10:00, 12:00, 14:00 and 16:00 h. Their observations further demonstrate that several insect groups contribute to the flower-visiting community of *Brassica* and that their occurrence can be assessed through different periods of the day. In the present data, *Hemiptera*, *Orthoptera* and *Thysanoptera* showed comparatively lower mean activity, with values of 3.00, 1.43 and 1.00 insects/5 min/m², respectively. The simultaneous maximum activity of all seven orders at 12:00 h, followed by a reduction during the later afternoon, indicates that the midday period represented the principal activity window of the insect visitor community under the conditions of the study.

Table 3: Diurnal activity pattern of insect pollinators visiting mustard flowers during Rabi 2025

Insect Order	10:00	12:00	14:00	16:00	Mean
<i>Hymenoptera</i>	12.20	20.60	18.40	11.20	15.60
<i>Diptera</i>	6.80	11.40	10.20	6.00	8.60
<i>Lepidoptera</i>	3.80	6.20	5.60	3.40	4.75
<i>Coleoptera</i>	3.60	5.80	5.20	3.20	4.45
<i>Hemiptera</i>	2.40	4.00	3.60	2.00	3.00
<i>Orthoptera</i>	1.10	1.90	1.70	1.00	1.43
<i>Thysanoptera</i>	0.80	1.40	1.20	0.60	1.00
Total	30.70	51.30	45.90	27.40	38.83

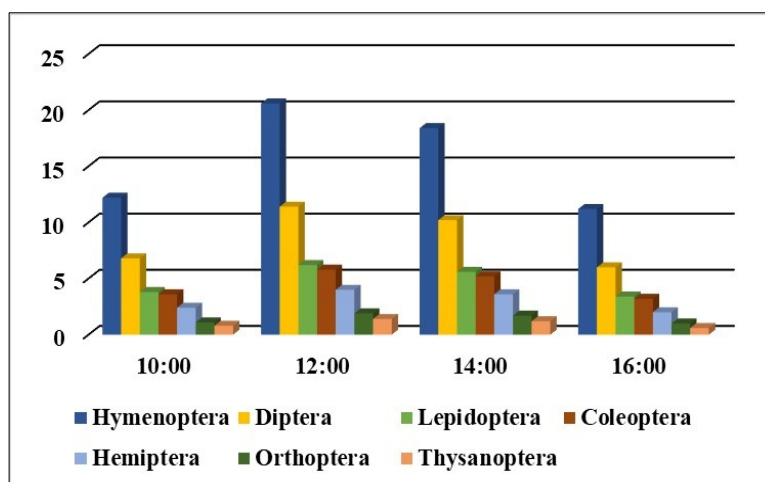


Fig 3: Diurnal activity pattern of insect pollinators visiting mustard flowers during Rabi 2025

4. Conclusion

The study demonstrated that mustard (*Brassica juncea* L.) flowers support a diverse and functionally important insect-visiting community during the rabi season. A total of 28 insect species representing seven orders and 13 families were recorded, with *Hymenoptera* being the most dominant group (28.57%), followed by *Diptera* (25.00%). Bees, particularly *Apis mellifera*, *A. cerana indica*, *A. dorsata*, *A. florea* and *Tetragonula iridipennis*, constituted the major

floral foragers, emphasizing their importance in mustard pollination. Insect visitation exhibited a distinct diurnal pattern, with overall activity reaching a maximum at 12:00 h (51.30 insects/5 min/m²), followed by 14:00 h and a gradual decline during the later afternoon. The predominance of bee visitors and their greater activity during the midday period indicates that mustard provides abundant and accessible floral resources that sustain diverse insect pollinators throughout flowering

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