

Bees Pollination in Agriculture and Horticulture Crops

Yashvardhan Singh, Anand Harshana*, Huiem Diana Devi and Pramod Kumar Mishra

Department of Entomology, CoA, Indore, RVSKVV, Gwalior (M.P.), India

Corresponding Author

Anand Harshana

Email: anandharshana@gmail.com



OPEN ACCESS

Keywords

Bees, Pollinators, Taxonomic characters, Status, Impact

How to cite this article:

Singh, Y., Harshana, A., Devi, H. D. and Mishra, P. K. 2026. Bees Pollination in Agriculture and Horticulture Crops. *Vigyan Varta* 7 (05):10-15.

ABSTRACT

Bees are essential contributors to pollination processes in agricultural and horticultural ecosystems, directly affecting crop productivity, produce quality, and overall ecosystem health. This article provides a broad review of bee pollination, focusing on bee diversity, basic taxonomy, key identification features, and their distribution across farmland, horticultural fields, forests, and grassland habitats. Both India and other regions of the world support a wide range of bee species, underlining their ecological value and economic relevance. Scientific studies clearly demonstrate that pollination by bees leads to noticeable improvements in yield and quality in important crops such as mustard, sunflower, cotton, tomato, apple, pumpkin, and various vegetable seed crops. Bee pollination should therefore be recognized as a vital ecological input rather than an incidental or cost-free service, as it supports sustainable farming systems, food security, and ecological balance. At the same time, the growing use of chemical pesticides, especially neonicotinoids and pyrethroids, has emerged as a major threat to bee populations, negatively influencing their foraging activity, colony strength, and long-term survival. Protecting both managed and wild bees is essential to ensure stable crop production and the sustainability of agro-ecosystems.

INTRODUCTION

Bees rank among the most effective and economically important pollinators for both agricultural and horticultural crops. Their activity has a direct impact on crop productivity, quality, and the maintenance of biological diversity. A substantial share of global food production depends on zoophily, with bees contributing to nearly one-third of the crops consumed worldwide (Khalifa *et al.*, 2021). Through their pollination services, bees enhance both yield and market quality in a wide range of crops. Adequate bee pollination improved the quality of fruits and vegetables, uniform shape and longer post-harvest life, making them more valuable in commercial markets (Klatt *et al.*, 2014).

Diversity of Bee



Fig A: *Apis florea* on *Celosia argentea* weed



Fig B: *Xylocopa* sp. on *Celosia argentea* weed



Fig C: *Apis dorsata* on safflower

Bees belong to the order Hymenoptera and are under the superfamily *Apoidea*. Based on taxonomic classification, bees are grouped into seven families, namely Colletidae, Andrenidae, Halictidae, Melittidae, Megachilidae, Stenotritidae, and Apidae (Michener, 2000). Globally, more than 20,925 bee species/subspecies have been formally described to date, reflecting the remarkable diversity of this pollinator group (Ascher & Pickering, 2024). India also supports a rich and diverse bee fauna. Current records document approximately 775 species/subspecies distributed across 71 genera and six families. These include Andrenidae with 63 species, Apidae comprising 226 species, Colletidae with 31 species, Halictidae represented by 222 species, Megachilidae with 270 species, and Melittidae consisting of four species (Pannure & Belavadi, 2019; Ascher & Pickering, 2024; Jakhar *et al.*, 2025). The wide variety of bees emphasizes their important ecological role in both natural habitats and agricultural areas. Bees have hairy bodies and special pollen-carrying structures, such as scopa or pollen baskets, that help them efficiently collect and transport pollen. These morphological adaptations make bees highly effective pollinators of wild plants as well as cultivated crops. Broadly, bees can be

categorized into two groups: *Apis* bees and non-*Apis* bees.

Apis bees (honey bees) Species belonging to the genus *Apis*, including *Apis mellifera*, *Apis cerana*, and *Apis dorsata*, are highly social insects and are widely managed for pollination services and honey production. Among these, *Apis mellifera* is the most widely managed pollinator across the world and plays an important role in pollinating crops like apple, almond, sunflower, mustard, and citrus, particularly in large monocropping systems (Klein *et al.*, 2007; Michener, 2000). **Non-*Apis*** bees consist of a wide range of wild and semi-managed species, including bumble bees (*Bombus* spp.), leafcutter bees (*Megachile* spp.), mason bees (*Osmia* spp.), and sweat bees (*Halictus* spp.). Many of these bees can match or even exceed honey bees in pollination efficiency for specific crops. For instance, *Bombus* species are particularly important for crops like tomato and brinjal due to their ability to perform buzz pollination, while *Osmia* species are recognized as highly efficient pollinators in apple and almond orchards (Garibaldi *et al.*, 2013; Michener, 2000).

Taxonomic characters:

a) **Head-** Bees can be categorized into two groups, such as long-tongued bees (Apidae and Megachilidae) and short-tongued bees (families Halictidae, Andrenidae, and Melittidae). In long-tongued bees, the first two segments of the labial palps are elongated and flattened, while the remaining two segments are comparatively smaller. Conversely, in short-tongued bees (Halictidae, Andrenidae, and Melittidae), all four segments of the labial palps are nearly uniform in size. The antennae are geniculate, and the subantennal suture either joins the inner margin of the antennal socket in Apidae or the outer margin in

Megachilidae. The shape of the glossa varies among families: it may be pointed or rounded in Halictidae, bilobed in Colletidae, or elongated in Apidae. Additionally, the facial fovea is broad and depressed in Andrenidae but absent in Halictidae.

- b) **Thorax-** The forewing in Apidae bears three sub marginal cells, whereas in Megachilidae it has two. In Halictidae, the basal vein (first free segment of M) of the forewing is distinctly arched. When present, the scopa is typically located on the hind legs in Apidae, while in Megachilidae it is situated on the ventral side of the metasoma, characterized by dense tufts of hairs.
- c) **Abdomen-** The abdomen is composed of nine segments, with the terminal segment bearing a sting adapted for defense. It lacks distinct differential features, but the size of the abdomen serves as a key factor in distinguishing between worker bees, drones, and queens (Michner, 2007).

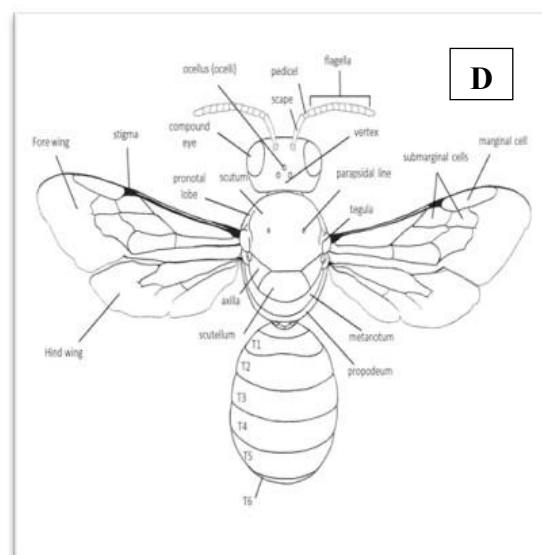


Fig D: Bee anatomy (Source: https://idtools.org/exotic_bee/index.cfm?pageID=3062)

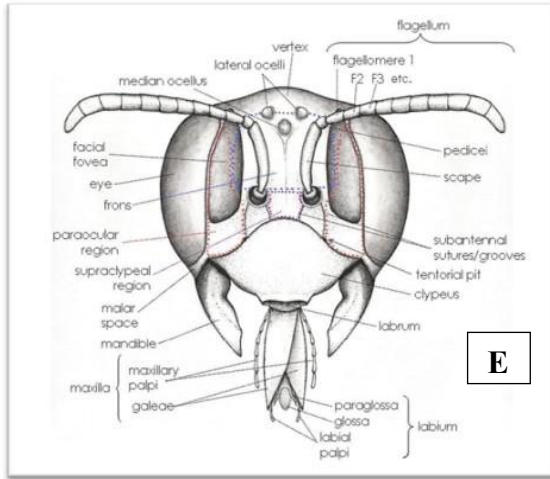


Fig E: Different parts of head
(Source: https://www.co.portage.oh.us/sites/g/files/vyhlif3706/f/uploads/bees_of_ohio_field_guide.pdf);

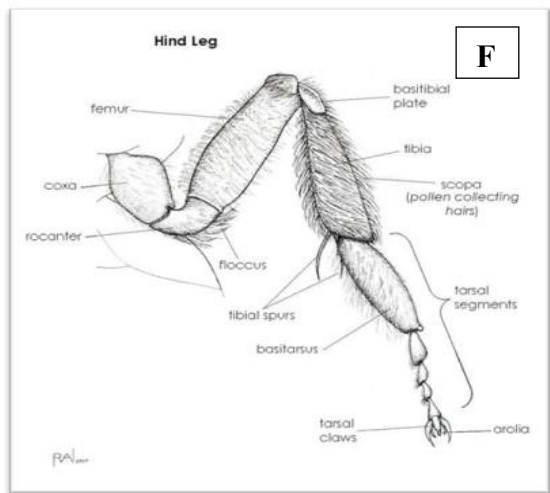


Fig F: Different parts of leg
(Source: https://www.co.portage.oh.us/sites/g/files/vyhlif3706/f/uploads/bees_of_ohio_field_guide.pdf);

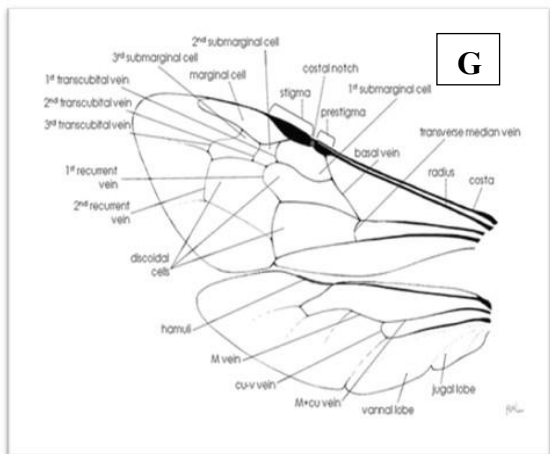


Fig G: Different areas of wings (Source: <https://quizlet.com/32977337/bee-anatomy-flash-cards/>)

Table 1: Status of Bee pollination in important crops

Sr. No	Crop	Crop Type	Reported Yield Increase Due to Bee Pollination	References
1.	Mustard (<i>Brassica juncea</i>)	Agricultural (Oilseed)	43 % increase in seed yield	Ragumoorthi et al., 2020
2.	Sunflower (<i>Helianthus annuus</i>)	Agricultural (Oilseed)	32–48 % higher yield	Ragumoorthi et al., 2020
3.	Cotton (<i>Gossypium spp.</i>)	Agricultural (Cash crop)	17-19 % increase in boll set and yield	Ragumoorthi et al., 2020
4.	Lucerne (<i>Medicago sativa</i>)	Agricultural (Fodder)	112 % increase	Ragumoorthi et al., 2020
5.	Tomato (<i>Solanum lycopersicum</i>)	Horticultural (Vegetable)	20–30 % increase	Greenleaf et al., 2006
6.	Onion (<i>Allium cepa</i>)	Horticultural (Vegetable)	93 % increase	Ragumoorthi et al., 2020
	Cucumber (<i>Cucumis sativus</i>)	Horticultural (Vegetable)	25–40 % increase in yield	Free, 1993
8.	Apple (<i>Malus domestica</i>)	Horticultural (Fruit)	44 % increase	Ragumoorthi et al., 2020
9.	Almond (<i>Prunus dulcis</i>)	Horticultural (Nut)	20–40 % yield increase	Ragumoorthi et al., 2020
10.	Vegetable seed crops (radish, cabbage, carrot)	Horticultural (Seed production)	22–300 % increase in seed yield	Free, 1993

Impact of pesticides on the bee population

Numerous studies have shown a strong link between pesticide use and the decline of wild bee populations over large geographic areas. In particular, the widespread application of neonicotinoids and pyrethroids has been shown to reduce the ability of many bee species to survive and persist within intensively managed agricultural landscapes. Areas with higher pesticide loads consistently support fewer bee species and lower population stability. Long-term exposure to pesticide residues adversely affects bee health and behaviour. Bees subjected to chronic chemical stress often exhibit disrupted foraging activity, reduced pollen-gathering efficiency, and increased mortality among

worker bees. These effects collectively impair brood development and weaken overall colony performance, ultimately reducing reproductive success and population growth. Global trends in bee population decline. Large-scale scientific analyses based on more than 178,000 field observations covering 1,081 wild bee species reveal a clear relationship between pesticide intensity and species decline. Higher exposure to Neonicotinoids and Pyrethroids has been linked with reduced species occurrence probabilities, estimated at 43.3% for Apidae, 28.9% for Andrenidae, 23% for Colletidae and Melittidae, and 19% for Halictidae. In contrast, Megachilidae appear comparatively less affected, showing only a marginal decline of about 0.4%. These findings highlight substantial variation in pesticide sensitivity among bee families. A similar pattern of decline has been observed in India. Estimates indicate that the number of managed bee colonies decreased from around 1.5 million in 2010 to approximately 0.92 million by 2023, representing a reduction of nearly 40% over little more than a decade. This decline corresponds with increased pesticide use in agricultural systems, along with additional pressures from climatic variability and habitat stress (Gill *et al.*, 2012; Guzman *et al.*, 2024; Zhang *et al.*, 2024; Science insights, 2025).

CONCLUSION:

Pollination provided by bees and other insect pollinators functions as a vital ecological input that carries significant economic importance at both global and national levels. The findings discussed in this article highlight that crops reliant on pollinators make major contributions to farm productivity, food availability, nutritional quality, and rural income generation. Improvements in yield, produce quality, and overall market value associated with efficient pollination demonstrate that pollination should be viewed as a form of natural capital rather than an overlooked or

cost-free service. Despite its importance, pollination services are increasingly at risk due to ongoing declines in bee populations caused by habitat degradation, excessive pesticide application, climate-related stresses, and the growing incidence of pests and diseases. Reductions in the diversity and number of pollinators are closely connected with unstable yields, greater production uncertainty, and rising input costs, especially in farming systems that depend heavily on insect pollination. Protecting and restoring bee populations is therefore crucial both for maintaining ecological balance and for ensuring long-term agricultural sustainability and food security.

REFERENCES:

- Ascher, J. S., & Pickering, J. (2024). Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). http://www.discoverlife.org/mp/20q?guide=Apoidea_species. Accessed online on 13.03.2026
- Free, J. B. (1993). *Insect pollination of crops* (2nd ed.). Academic Press.
- Garibaldi, L. A., Steffan-Dewenter, I., Winfree, R., Aizen, M. A., Bommarco, R., Cunningham, S. A., & Klein, A. M. (2013). Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science*, 339(6127), 1608–1611. <https://doi.org/10.1126/science.1230200>
- Gill, R. J., Ramos Rodriguez, O., & Raine, N. E. (2012). Combined pesticide exposure severely affects individual and colony level traits in bees. *Nature*, 491(7422), 105–108. <https://doi.org/10.1038/nature11585>
- Greenleaf, S. S., & Kremen, C. (2006). Wild bees enhance tomato pollination. *Biological Conservation*, 130(4), 481–

492. <https://doi.org/10.1016/j.biocon.2006.01.023>
- Guzman, L. M., Elle, E., Morandin, L. A., Cobb, N. S., Chesshire, P. R., McCabe, L. M., & M'Gonigle, L. K. (2024). Impact of pesticide use on wild bee distributions across the United States. *Nature Sustainability*, **7**(10), 1324–1334.
- Jakhar, S., Meena, M. K., Chaudhary, N., Saroj, & Godara, C. R. (2025). Assessment of bees (Hymenoptera: Apoidea) diversity and distribution in Alwar, Rajasthan, India. *International Journal of Entomology Research*, **10**(2), 66–70.
- Khalifa, S. A., Elshafiey, E. H., Shetaia, A. A., El-Wahed, A. A. A., Algethami, A. F., Musharraf, S. G., & El-Seedi, H. R. (2021). Overview of bee pollination and its economic value for crop production. *Insects*, **12**(8), 688.
- Klatt, B. K., Holzschuh, A., Westphal, C., Clough, Y., Smit, I., Pawelzik, E., & Tscharntke, T. (2014). Bee pollination improves crop quality, shelf life and commercial value. *Proceedings of the Royal Society B: Biological Sciences*, **281**(1775), 20132440.
- Klein, A. M., Vaissière, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society B: Biological Sciences*, **274**(1608), 303–313.
- Michener, C. D. (2000). *The Bees of the World* (2nd ed.). Johns Hopkins University Press.
- Pannure, A. and Belavadi, V.V. (2019). Status and Diversity of Pollinators in India- a case study for Conserving Non-Apis Bees. *ENVIS Newsletter*, ZSI, Kolkata, **25**: 1-4.
- Ragumoorthi, K. N., Srinivasan, M. R., Balasubramani, V., & Natarajan, N. (2020). *Principles of applied entomology* (3rd ed.). A. E. Publications.
- Science Insights. (2025). Bee population decline: The statistics and causes. *Science Insights*. <https://scienceinsights.org/bee-population-decline-the-statistics-and-causes/>
- Zhang, W., Zou, Y., Gu, X., & Sun, S. (2024). Pesticide use is associated with broad-scale declines in wild bee species richness and occupancy. *Nature Sustainability*, **7**(1), 45–54. <https://doi.org/10.1038/s41893-024-01413-8>. Accessed online on 12.03.2026. https://idtools.org/exotic_bee/index.cfm?pageID=3062. Accessed online on 12.03.2026. <https://quizlet.com/32977337/bee-anatomy-flash-cards/>. Accessed online on 12.03.2026. https://www.co.portage.oh.us/sites/g/files/vyhlif3706/f/uploads/bees_of_ohio_field_guide.pdf. Accessed online on 12.03.2026.