

ASSESSING INSECT POLLINATOR DIVERSITY AND FLORAL PREFERENCES IN AKOT, AKOLA DISTRICT, MAHARASHTRA

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Abstract

*The current study investigates insect visitor diversity and their roles in plant-pollinator interactions in the Akot area, aiming to enhance fertilization and agricultural productivity. Identifying 37 insect species across three orders and nine families, with Lepidoptera and Hymenoptera showing the highest diversity, underscores their vital role as pollinators. Additionally, 18 plant species, attracting a variety of pollinators like butterflies, bees, flies, beetles, hoverflies and bumblebees, contribute to ecosystem biodiversity and support robust pollinator populations. The interplay between plants and insects, exemplified by species like *Crinum asiaticum* and *Rosa indica*, emphasizes the complexity of ecosystem dynamics and underscores the importance of maintaining diverse plant communities for sustaining healthy pollinator populations. Increased awareness among farmers about pollination mechanisms could lead to enhanced crop yields, strengthening the economy.*

Keywords: Bees, Insect, Pollinator, Fertilization, Plant-pollinator interactions

Introduction

Pollination stands as a pivotal biological process vital for the effective transfer of pollen grains from the mature anther to the stigma of flowers, thereby facilitating fertilization crucial for seed and fruit production [1-2]. This intricate process engages a range of both biotic and abiotic agents, each evolving specific strategies over time [3-4]. Abiotic pollination relies on non-living agents like wind, water, and rain, while biotic pollination involves living organisms such as insects, birds, and mammals, including bats, which actively participate as pollinators and benefit from plant nectar [5-7]. Flowers secrete nectar from their stigma, rich in essential nutrients such as carbohydrates, fats, vitamins, proteins, minerals, and other phytochemicals [3], [5].

Insect pollinators, in particular, hold significant importance in upholding ecosystem functions [8], with their absence potentially disrupting pollination processes, underscoring their critical role in flowering plant reproduction and ecological equilibrium [4], [9-10]. Natural ecosystems exhibit diverse environmental gradients and mutualistic relationships among pollinator species, with more pronounced variations in tropical regions compared to temperate zones [11-13]. According to Food and Agriculture Organization (FAO) estimates, over 100 crop species, fulfilling 90% of global food demand, rely on various biotic pollinators, especially insects [14] of the roughly 180,000 flowering plant species, approximately 1,200 are vital crops entirely reliant on pollinators for global agricultural productivity [15-16].

Pollinators serve indispensable roles in agriculture, plant reproduction, ecology, and environmental health, rendering invaluable services to humanity [17]. Delving into plant-pollinator relationships and

implementing conservation efforts proves essential for preserving biodiversity and ensuring food security [4], [18]. The current study aims to explore the diversity of insect visitors and their involvement in plant-pollinator interactions in the Akot area of Maharashtra's Akola district. By comprehending the timing and types of pollinators associated with various plants, the research endeavours to contribute to successful fertilization and enhance agricultural productivity. Heightened awareness among farmers regarding pollination mechanisms has the potential to augment crop yields and bolster the economy [18].

Materials And Methods

Study area: The observation was conducted in Akot Taluka, located within Akola district along the Satpura ranges of Maharashtra, India. Akola district is bordered by the Satpura ranges to the north, with Buldhana district to the west, Washim to the south and Amravati to the east. Fieldwork was carried out extensively in the study area of Akot Taluka September 2025 to November 2025 to observe the plant-pollinator interactions among the various crops and wild varieties.

Sampling procedure: Visual samplings of pollinator visits were conducted weekly in flower strips and agricultural crops within the study area. Sampling occurred between 09:00 and 14:00, considering suitable weather conditions conducive to foraging activities of pollinator visitors. Each week, observations commenced at different locations based on random sampling strategies [19-20].

Data collection: Insect species were meticulously recorded while they visited various flowering herbs, shrubs, and trees, encompassing both cultivated and wild species present in the study

area. Additionally, an exhaustive inventory of plants of economic importance was compiled, and their associated pollinators were identified through a systematic review of literature and available information [21].

Classification of pollinators: Pollinator groups were classified based on their respective insect orders and families prevalent in the study area. This classification facilitated the investigation of pollination mechanisms and the relationship between pollinators and plants, drawing upon established frameworks outlined by [22-23].

Data analysis: Findings from field observations, including plant and insect characteristics, were meticulously documented, and photographic evidence was collected. Identification and authentication of plant species and their visiting insects were conducted using relevant botanical and entomological literature, research papers, reports and botanical floras. The collected data were summarized in tabular formats and elucidated in accompanying textual descriptions, providing insights into the observed plant-pollinator interactions within the study area. These findings contribute to a deeper understanding of pollination dynamics and ecosystem functioning in the Akot Taluka region of Akola district, Maharashtra.

Results and Discussion

(a) Insect flower visitors

A total of 37 species of insects were identified from flowers of studied flowering plants species. The result excludes very small insects that were insignificant of carrying pollens. Identified insects belong to 3 orders, 9 families. The representative orders were Lepidoptera, Hymenoptera. Lepidoptera and Hymenoptera showed highest species diversity then others, respectively (Table 1). Presents a diverse array of insect species, comprising 37 entries distributed across four distinct orders. Among these, Lepidoptera, representing butterflies, emerges as the most prominent order, featuring 14 species spread across five families. Notably, the Hymenoptera order, inclusive of bees, ants, and wasps, accounts for the largest number of species, totalling 17, distributed across six families. Additionally, Diptera, characterized by hoverflies, contributes five species, while one species each is attributed to the Hymenoptera order, outside of bees and wasps (Table 2). This rich assortment showcases the intricate biodiversity within the insect of Akot area, highlighting their varied roles and ecological significance as pollinators and contributors to local ecosystem dynamics.

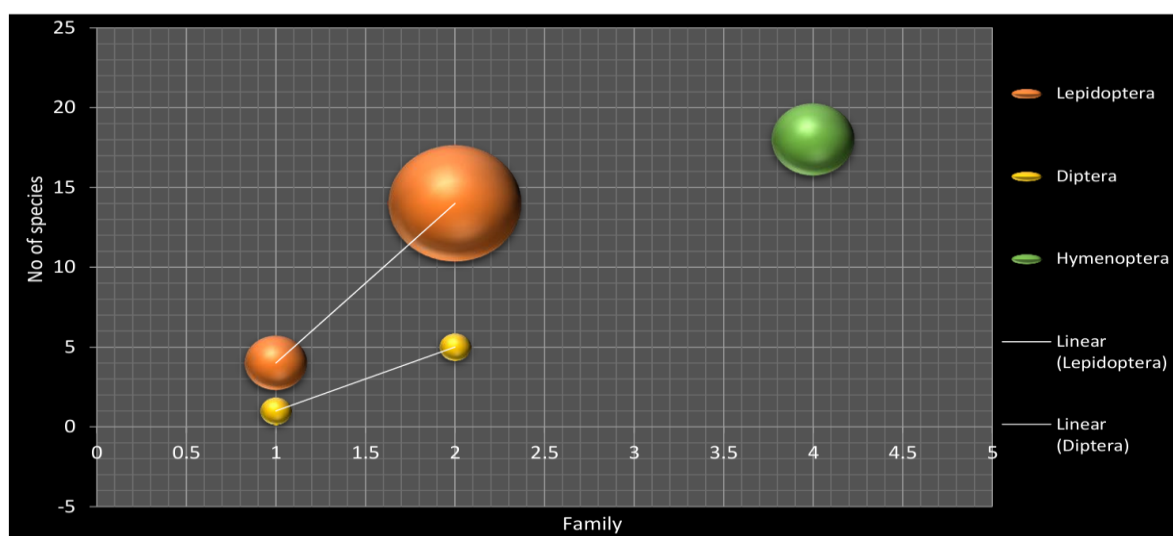
Table 1: Recorded insect visitors on flowers with their classification

S. No.	Name of insect	Order	Family	Insect class
1	<i>Appias lyncida</i>	Lepidoptera	Pieridae	Butterfly
2	<i>Catopsilia pyranthe</i>			
3	<i>Papilio ulysses</i>		Papilionidae	
4	<i>Papilionini spp.</i>			
5	<i>Euploea core</i>		Nymphalidae	
6	<i>Auploea spp.</i>			
7	<i>Tirumala limonis</i>			
8	<i>Hypolimnas spp.</i>			
9	<i>Ithomiini spp.</i>			
10	<i>Charaxes spp.</i>			
11	<i>Deudorix spp.</i>		Lycaenidae	
12	<i>Celastrina spp.</i>			
13	<i>Agriades spp.</i>			
14	<i>Agapetes spp.</i>			
15	<i>Apis dorsata</i>	Hymenoptera	Apidae	Bee
16	<i>Trigona spp.</i>			
17	<i>Anthophora pubescens</i>			
18	<i>Amegilla spp.</i>			
19	<i>Teratohmia spp.</i>			
20	<i>Lipotriches spp.</i>			
21	<i>Ceratina spp.</i>			
22	<i>Nomadinae spp.</i>			
23	<i>Xylocopa pubescens</i>			
24	<i>Apes mellifera</i>			Honey bees
25	<i>Apis florea</i> F.			
26	<i>Bombus haemorrhoidalis</i> Smith			Bumble bee
27	<i>Xylocopa spp.</i>			Carpenter Bee
28	<i>Halictus ligatus</i>		Halictidae	Bee

29	<i>Lasioglossum</i> spp.			
30	<i>Pachycondyla madraspatana</i>		Formicidae	Ant
31	<i>Pachycondyla lepida</i>			
32	<i>Ropalidia</i> spp.		Vespidae	Paper Wasp
33	<i>Palpada</i> spp.	Diptera	Syrphidae	Hoverfly
34	<i>Epistrophe</i> spp.			
35	<i>Milesiini</i> spp.			
36	<i>Myathropa florea</i>			
37	<i>Mallota</i> spp.			

Table 2: Distribution of order among family, species and class of insect

Order	Family	No. of species	Class of insect
Lepidoptera	4	14	1
Hymenoptera	4	18	7
Diptera	1	5	1
Total	9	37	9

**Table 3: Distribution of plants and relations with insect visitor class**

S. No	Plants name	Plant family	Common name	Insect visitor class
1	<i>Crinum asiaticum</i> L.	Amaryllidaceae	Crinum lily	Butterfly, Bee
2	<i>Rosa indica</i>	Rosaceae	Rose	Bee, Butterfly
3	<i>Catheranthus roseuses</i>	Apocynaceae	Graveyard plant	Butterfly, Bee
4	<i>Tagetes lucida</i>	Asteraceae	Marigolds	Bee, Butterfly
5	<i>Hibiscus rosa-sinensis</i>	Malvaceae	China rose	Butterfly, Bee, Flies
6	<i>Ixora coccinea</i>	Rubiaceae	Jungle geranium	Butterfly, Bee
7	<i>Haldina cardifolia</i>	Rubiaceae	Haldu	Honey bees, Flies
8	<i>Clerodendron serratum</i>	Verbenaceae	Bharangi	Bee, Butterfly, Flies
9	<i>Celosia argentea</i>	Amaranthaceae	Red Fox	Flies, beetles
10	<i>Lantana camera</i>	Verbenaceae	Lantana	Butterfly, Bee
11	<i>Combretum indicum</i>	Combretaceae	Rangoon creeper	Bee, beetles
12	<i>Argemone mexicana</i>	Papaveraceae	Mexican poppy	Flies, beetles
13	<i>Calatropis procera</i>	Apocynaceae	Sodom apple	Beetles, Bee, Hoverfly, Bumble bee
14	<i>Strobilanthes integrifolius</i>	Acanthaceae	Ranbhokari	Hoverfly, Bumble bee
15	<i>Urena sinuata</i>	Malvaceae	Vanbhendi	Butterfly, Bumble bee
16	<i>Gloriosa superba</i>	Colchicaceae	Flame lily	Flies, beetles
17	<i>Mangifera indica</i> L.	Anacardiaceae	Mango	Flies, beetles
18	<i>Cuminum cyminum</i> L.	Apiaceae	Cumin	Honey bees, Flies

(b). Major plant visited by insects

The Akola district in Maharashtra exhibits a remarkable array of plants that are frequented by insects for pollination purposes. A total of 18 plant species were selected based on comprehensive observations of insect visitors and pollinators within the study area (Table 2).

1. ***Crinum asiaticum* L. (Amaryllidaceae):** This perennial bulbous plant is characterized by its large, trumpet-shaped flowers that bloom in shades of white, pink, or red. Crinum Lily attracts a variety of pollinators, including butterflies and bees, with its sweet-scented nectar, contributing to ecosystem biodiversity and floral diversity in gardens and landscapes [24].
2. ***Rosa indica* (Rosaceae) Rose:** Renowned for its exquisite beauty and captivating fragrance, the Rose is one of the most iconic and beloved flowering plants worldwide. Its blooms, available in a myriad of colors and forms, attract an array of pollinators, including bees and butterflies, facilitating cross-pollination and ensuring reproductive success [25].
3. ***Catharanthus roseus* (Apocynaceae) Graveyard plant:** This evergreen perennial is prized for its delicate, star-shaped flowers, which bloom in shades of white, pink, or purple. Graveyard Plant serves as a valuable nectar source for butterflies and bees, playing a crucial role in supporting pollinator populations and maintaining ecosystem balance [26].
4. ***Tagetes lucida* (Asteraceae) Marigolds:** These annual or perennial herbaceous plants are renowned for their cheerful, daisy-like flowers that come in shades of yellow, orange, or maroon. Marigolds attract bees and butterflies with their abundant nectar, enhancing garden biodiversity and serving as natural pest repellents due to their strong aroma [27].
5. ***Hibiscus rosa-sinensis* (Malvaceae) - China rose:** This evergreen shrub or small tree is characterized by its large, showy flowers in shades of red, pink, orange, yellow, or white. China Rose attracts a diverse range of pollinators, including butterflies, bees, and flies, with its nectar-rich blooms, contributing to ecosystem health and floral diversity [28].
6. ***Ixora coccinea* (Rubiaceae) - Jungle geranium:** This evergreen shrub is cherished for its dense clusters of small, tubular flowers that bloom in vibrant shades of red, orange, yellow, or pink. Jungle Geranium attracts butterflies and bees with its nectar-rich blooms, serving as a valuable food source for pollinators and enhancing garden beauty [29].
7. ***Haldina cardifolia* (Rubiaceae) Haldu:** This deciduous tree is esteemed for its durable timber and medicinal properties. Haldu's flowers attract honey bees and flies with their sweet nectar, supporting pollinator populations and promoting ecosystem resilience [30].
8. ***Clerodendron serratum* (Verbenaceae) Bharangi:** This perennial shrub is valued in traditional medicine for its therapeutic properties. Bharangi's tubular flowers attract bees, butterflies, and flies, serving as important pollinator resources and contributing to the plant's reproductive success [31].
9. ***Celosia argentea* (Amaranthaceae) Red fox:** This annual or perennial plant is characterized by its striking, flame-shaped inflorescences in shades of red, orange, or yellow. Red fox attracts flies and beetles with its abundant pollen and nectar, facilitating pollination and promoting genetic diversity in the ecosystem [32].
10. ***Lantana camara* (Verbenaceae) - Lantana:** Perennial shrub, native to the American tropics, is prized for its colorful, aromatic flowers that bloom in clusters. Lantana attracts butterflies and bees with its abundant nectar, serving as a valuable food source for pollinators and enhancing garden biodiversity [33].
11. ***Combretum indicum* (Combretaceae) Rangoon creeper:** This vigorous, woody vine is renowned for its fragrant, trumpet-shaped flowers that transition from white to pink to red as they mature. Rangoon creeper attracts bees and beetles, which play essential roles in its pollination and seed dispersal, contributing to its reproductive success and genetic diversity [34].
12. ***Argemone mexicana* (Papaveraceae) - Mexican poppy:** Annual or biennial herbaceous plant is characterized by its prickly stems and bright yellow or white flowers. Mexican poppy attracts flies and beetles with its pollen and nectar, facilitating pollination and contributing to ecosystem functioning [35].



Crinum asiaticum L.



Rosa indica



Catharanthus roseus



Tagetes lucida



Hibiscus rosa-sinensis



Ixora coccinea

Plate 1



Haldina cardifolia



Clerodendron serratum



Celosia argentea



Lantana camara



Combretum indium

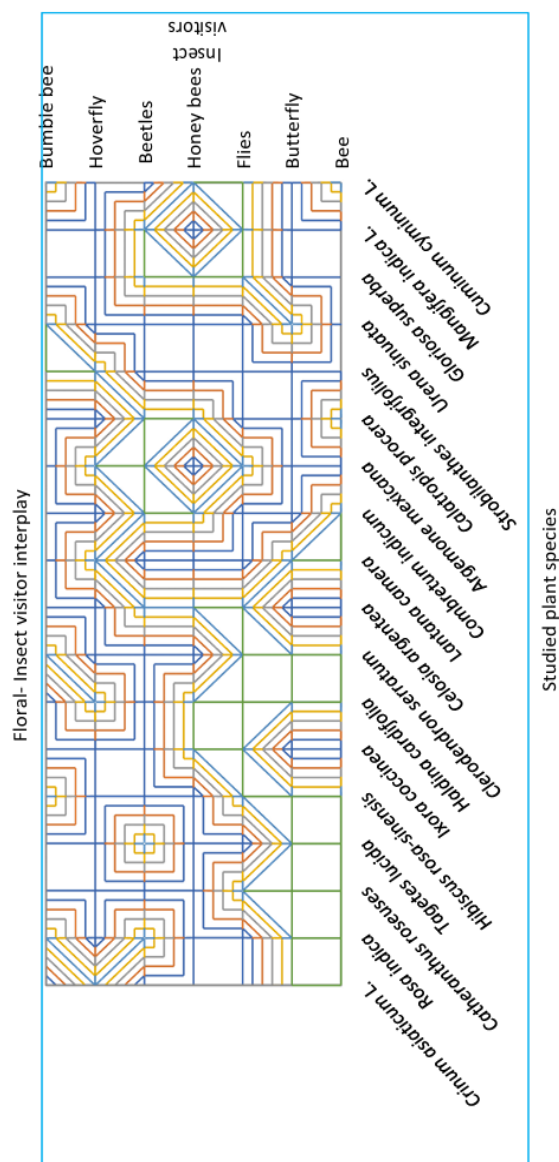


Argemone Mexicana

Plate 2

*Calatropis procera**Strobilanthes integrifolius**Urena sinuata**Gloriosa superba**Mangifera indica**Cuminum cyminum*

Plate 3



Studied plant species

Graph 2 Graphical representation of interrelationships between floral-insect visitors

13. ***Calatropis procera* (Apocynaceae) Sodom apple:** Also known as Milkweed or Rubber Bush, this perennial shrub is valued for its latex and medicinal properties. Sodom Apple attracts beetles and bees with its fragrant flowers, which produce copious amounts of nectar, supporting pollinator populations and enhancing ecosystem biodiversity [36].
14. ***Strobilanthes integrifolius* (Acanthaceae) Ranbhokari:** Perennial herb, native to India, is characterized by its lanceolate leaves and blue-purple flowers that bloom in spikes. Ranbhokari attracts hoverflies and bumblebees with its nectar-rich blooms, facilitating pollination and promoting plant reproduction [37].
15. ***Urena sinuata* (Malvaceae) - Vanbhendi:** (*U. lobata*) Annual herb is prized for its edible leaves and medicinal properties. Vanbhendi attracts butterflies and bumblebees with its

showy flowers, providing them with essential nectar and pollen resources and supporting pollinator populations [38].

16. ***Gloriosa superba* (Colchicaceae) Flame lily:** Striking perennial herb is characterized by its flame-like, red and yellow flowers with reflexed petals. Flame Lily attracts flies and beetles with its nectar, facilitating pollination and ensuring the continuation of its life cycle [39].
17. ***Mangifera indica* L. (Anacardiaceae) - Mango:** Iconic tropical fruit tree is prized for its delicious and nutritious mango fruits. Mango flowers attract flies and beetles with their sweet scent, aiding in pollination and fruit set, ultimately contributing to mango production and biodiversity in orchards [40].
18. ***Cuminum cyminum* L. (Apiaceae) - Cumin:** Aromatic annual herb is renowned for its distinctive flavor and culinary uses. Cumin

flowers attract honey bees and flies with their nectar, supporting pollinator populations and promoting genetic diversity in cumin crops [41].

Conclusion

In terms of insect flower visitors, the research conducted in the Akot area identified a total of 37 insect species across three orders and nine families. Notably, Lepidoptera and Hymenoptera exhibited the highest species diversity, with butterflies and bees being particularly prominent. This diverse assemblage of insect visitors underscores their crucial role as pollinators and contributors to the local ecosystem. Regarding the major plants visited by insects, the study observed 18 plant species serving as important sites for pollination. These plants, spanning various families, attract a diverse array of pollinators, including butterflies, bees, flies, beetles, hoverflies and bumblebees. This interaction between plants and insects plays a pivotal role in fostering ecosystem biodiversity, enhancing floral diversity, and supporting robust pollinator populations. The interrelationship between floral-insect visitors highlights the nuanced dynamics at play within ecosystems. Different plant species attract specific combinations of insect species, with examples like *C. asiaticum* and *R. indica* drawing a varied range of visitors, including bees, butterflies and beetles. This intricate interplay emphasizes the complexity of ecosystem dynamics & underscores the importance of maintaining diverse plant communities to sustain healthy pollinator populations.

References

1. Larue C, Austruy E, Basset G, Petit RJ. 2021. Revisiting pollination mode in chestnut (*Castanea* spp.): An integrated approach. *Botany Letters* 168: 348-372.
2. Sukumaran A, Khanduri VP, Sharma CM 2020. Pollinator-mediated self-pollination and reproductive assurance in an isolated tree of *Magnolia grandiflora* L. *Ecol. Process* 9: 45.
3. Del-Claro K, Torezan-Silingardi HM. 2021. *Plant-animal interactions: Source of biodiversity*. Springer, Cham.
4. Nath R, Singh H, Mukherjee S. 2023. Insect pollinators decline: An emerging concern of Anthropocene epoch. *Journal of Apicultural Research* 62: 23-38.
5. Fattorini R, Glover BJ. 2020. Molecular mechanisms of pollination biology. *Annu. Rev. Plant Biology* 71: 487-515.
6. Kearns CA, Inouye DW. 1997. Pollinators, flowering plants, and conservation biology. *BioScience* 47: 297-307.
7. Kumar P, Singh G, Singh H. 2020. Impact of insect pollinators on quantitative and qualitative improvement in agricultural crops: A review. *Int. Jr. Curr. Microbiology and*
8. Lumentut N, Alouw J, Santosa B. 2022. The role several types of pollinator insects in pollination to improve fruit setting in oil palm (*Elaeis guineensis*) in the Province of Central Sulawesi and North Sulawesi. *IOP Conf Ser: Earth Environ. Sci.* 974: 012083.
9. García-Breijo F, Armiñana JR, Garmendia A. 2020. In vivo pollen tube growth and evidence of self-pollination and prefloral anthesis in cv. Macabeo (*Vitis vinifera* L.). *Agriculture* 10: 647.
10. Khalifa SAM, Elshafiey EH, Shetaia AA. 2021. Overview of bee pollination and its economic value for crop production. *Insects* 12: 688.
11. Adedjoja OA, Kehinde T, Samways MJ. 2018. Insect-flower interaction networks vary among endemic pollinator taxa over an elevation gradient. *PLoS One* 13: e0207453.
12. Carstensen DW, Sabatino M, Trøjelsgaard K, Morellato LPC. 2014. Beta diversity of plant-pollinator networks and the spatial turnover of pairwise interactions. *PLoS One* 9: e112903.
13. Schleuning M, Fründ J, Klein AM. 2012. Specialization of mutualistic interaction networks decreases toward tropical latitudes. *Current Biology* 22: 1925-1931.
14. Millard J, Outhwaite CL, Kinnersley R. 2021. Global effects of land-use intensity on local pollinator biodiversity. *Nat. Commun.* 12: 2902.
15. Hall MA, Jones J, Rocchetti M. 2020. Bee visitation and fruit quality in berries under protected cropping vary along the length of polytunnels. *Journal of Economic Entomology* 113: 1337-1346.
16. in the Anthropocene. *Annu. Rev. Entomology* 65: 457-480.
17. Zattara EE, Aizen MA. 2021. Worldwide occurrence records suggest a global decline in bee species richness. *One Earth* 4: 114-123.
18. Eliash N, Mikheyev A. 2020. Varroa mite evolution: a neglected aspect of worldwide bee collapses? *Current Opinion in Insect Science* 39: 21-26.
19. Azpiazu C, Medina P, Adán Á. 2020. The role of annual flowering plant strips on a melon crop in Central Spain. Influence on Pollinators and Crop. *Insects* 11: 66.
20. Browning A, Smitley D, Studyvin J. 2023. Variation in pollinator visitation among garden cultivars of marigold, portulaca, and bidens. *Journal of Economic Entomology* 116: 872-881.

21. Jaganmohan M, Vailshery L, Nagendra H. 2013. Patterns of insect abundance and distribution in urban domestic gardens in Bangalore, India. *Diversity* 5: 767-778.
22. Chakraborti U, Mitra B, Bhadra K. 2019. Diversity and ecological role of insect flower visitors in the pollination of mangroves from the Indian Sundarbans. *Current Science* 117: 1060.
23. Kevan PG, Baker HG 1983. Insects as flower visitors and pollinators. *Annu. Rev. Entomology* 28: 407-453.
24. Chawla SL, Momin KCh, Pawar RD, et al 2022. Traditional Bulbous Plants. In: Datta SK, Gupta YC (eds) *Floriculture and Ornamental Plants*. Springer Nature Singapore, Singapore, pp 263-305.
25. MacPhail VJ, Kevan PG 2007. Reproductive Success and Insect Visitation in Wild Roses (*Rosa* Spp.) Preliminary Results From 2004. *Acta Horti* 381-388.
26. Miyajima D 2004. Pollination and seed set in vinca [*Catharanthus roseus* (L.) G. Don]. *The Journal of Horticultural Science and Biotechnology* 79:771-775.
27. Singh Y, Gupta A, Kannoja P 2020. *Tagetes erecta* (Marigold) - A review on its phytochemical and medicinal properties. *CMDR* 4.
28. Kaur S 2023. *Hibiscus rosa sinensis* and its phytochemical investigations. *Act. Scie Neuro*. 6: 49-53.
29. Baliga MS, Kurian PJ. 2012. *Ixora coccinea* Linn.: Traditional uses, phytochemistry and pharmacology. *Chin. Jr. Integrated Medicine* 18: 72-79.
30. Warriar KCS. 2019. *Haldina cordifolia* (Roxb.) Ridsdale A promising tree for domestication. *International Journal of Agriculture, Environment and Biotechnology* 12(3): 213-224.
31. Kumar A P, Nishteswar K. 2013. Phytochemical and pharmacological profiles of *Clerodendrum serratum* Linn. (Bharangi): A review. *Int. Jr. Res. Ayurveda Pharm.* 4: 276-278.
32. Nobes SR, Herreid JS, Panter KL, Jabbour R. 2022. Insect visitors of specialty cut flowers in high tunnels. *Journal of Economic Entomology* 115: 909-913.
33. Goulson D, Derwent LC. 2004. Synergistic interactions between an exotic honeybee and an exotic weed: pollination of *Lantana camara* in Australia. *Weed Research* 44: 195-202.
34. Ghissing U, Goswami A, Mitra A. 2023. Temporal accumulation of pigments during colour transformation from white to red in *Combretum indicum* (L.) DeFilipps (syn. *Quisqualis indica* L.) flowers. *Natural Product Research* 37: 529-533.
35. Alam A, Khan AA. 2020. *Argemone mexicana* L.: A weed with versatile medicinal and pharmacological applications. *Annals of Phytomedicine* 9(1): 218-223.
36. Al Sulaibi MAM, Thiemann C, Thiemann T. 2020. Chemical constituents and uses of *Calotropis procera* and *Calotropis gigantea* A review (Part I The Plants As Material And Energy Resources). *Open Chemistry Journal* 7: 1-15.
37. Sarma J, Barbhuiya HA, Dey S, Salunkhe CK. 2021. *Strobilanthes reptans* (Acanthaceae): A new addition to the flora of India. *Rheedea* 31: 58-61.
38. Islam M, Uddin M. 2017. A revision on *Urena lobata* L. *International Journal of Medicine* 5: 126-131.
39. Daniels RJ, Johnson SD, Peter CI. 2020. Flower orientation in *Gloriosa superba* (Colchicaceae) promotes cross-pollination via butterfly wings. *Annals of Botany* 125: 1137-1149.
40. Tharanathan RN, Yashoda HM, Prabha TNO 2006. Mango (*Mangifera indica* L.), The king of fruits-An overview. *Food Reviews International* 22: 95-123.
41. Allaq AA, Sidik NJ, Abdul-Aziz A, Ahmed IA. 2020. Cumin (*Cuminum cyminum* L.): A review of its ethnopharmacology, phytochemistry. *Biomed Res. Ther.* 7: 4016-4021.