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Research Journal of Agricultural Sciences
Volume 14; Issue 05 (Sep-Oct 2023); pp 1518–1521

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

Potential of Bee Foraging and Floral Calendar of Khultabad, Aurangabad District (Maharashtra) India

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Abstract

The research was conducted in Khultabad taluka of Aurangabad district between November 2021 and October 2022. The study consisted of regular visits conducted from 07:00 to 17:00 every month, focusing on the observation of agricultural flowering plants and the bees that visit them. The objective was to determine which plants are beneficial for honeybees. The study identified a total of 39 agricultural plants that serve as bee flora, providing benefits to honeybees. These plants were further categorized based on the type of resources they offer to bees, namely nectar, pollen, or both nectar and pollen. Among the identified plants, 17 were found to yield both nectar and pollen, 11 were nectar-yielding only, and 11 were pollen-yielding only. Based on the findings, it was determined that the months of December to mid-March and August to September are the honey flow periods when a significant amount of nectar and pollen resources are available for honeybees. On the other hand, the period from mid-April to June was found to be critical in terms of food availability for honeybees throughout the year. By considering the food availability and flowering periods of the bee forage plants, the study sites were evaluated for their potential as bee foraging areas.

***Key words*:** Bee foraging, Honey bee, Floral calendar, Agricultural bee flora, Beekeeping

India is one of the world's leading countries in biodiversity, with over 750 species of bee flora. Despite this, the majority of floral resources in India remain underutilized. Pollination is a crucial "free ecological service" that supports crops and wild plants and contributes significantly to global diversity [1]. However, recent environmental factors such as pollution, land fragmentation, increased pests and diseases, genetic diversity issues, and variations in environmental conditions have led to declines in domesticated and wild pollinators [2]. Pollinator decline affects two broad groups of flowering plants: crop plants and wild plants that require external agents for obligate cross-pollination. The existing bee flora in India can support 150-200 million bee colonies, yet there are only one million colonies tapping nectar from 0.5-0.7% of the available bee flora [3]. Bees depend entirely on flowering plants to fulfil their dietary requirements and provide pollination for the plants. These plants are collectively known as bee flora or bee pastures [4]. Honey bees are essential pollinators for several plant species, but their performance depends on the overall health of the colony, which in turn depends on the availability of bee flora in the region. Honey bees require pollen primarily for brood rearing, and bee pasturage is a crucial factor in successful beekeeping [5]. India's diverse climate and geographic location support various types of vegetation and cultivated crops. However, any location chosen for beekeeping is not free from floral dearth. A systematic afforestation program can develop continuous bee pasturage by selecting bee-friendly plant species [6]. Beekeeping programs can be undertaken by non-governmental or governmental organizations such as Integrated Rural Development Programme (IRDP) or National Rural Employment Guarantee Programme (NREGP). This will lead to the continuous availability of nectar and pollen for successful beekeeping, in addition to the aesthetic value, healthy environment, and overall economic benefit for the people of the locality. The floral calendar of a locality can guide beekeepers in efficient bee management to derive maximum benefit from beekeeping.

MATERIALS AND METHODS

The study was conducted in the Khultabad taluka (20.009524N 75.188799E) Aurangabad districts of Maharashtra, India. The study was conducted over a period of one year, from November 2021 to October 2022. Regular visits were made every month, from 07:00 to 17:00, to a selected taluka, with a focus on observing agricultural flowering plants and the bees that visit them. The data was collected through personal visits, with information on bee flora, their flowering time, and contribution percentage collected during the study

Received: 30 Jul 2023; Revised accepted: 03 Oct 2023; Published online: 09 Oct 2023

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Citation: Shinde AM, Saraf SA, Aghade JB. 2023. Potential of bee foraging and floral calendar of Khultabad, Aurangabad district (Maharashtra) India. *Res. Jr. Agril. Sci.* 14(5): 1518-1521.

period. Additionally, the team collected information on the availability of bee flora per month, which was calculated as the number of bee flora species in a month divided by the total number of bee flora, multiplied by 100.

RESULTS AND DISCUSSION

The vegetation characteristics of any given area can provide important insights into its potential for beekeeping. In the case of the study areas at hand, it has been determined that these characteristics are indeed quite favorable for apiary pursuits. As evidenced by survey results, both the cultivated and natural honey flora potential of the region is promising, indicating a high likelihood of success for beekeeping endeavors. It is worth noting that such findings are not only of interest to beekeepers but to anyone with an interest in the region's ecological makeup and potential for agricultural pursuits.

Table 1 Bee flora recorded at Khultabad, Aurangabad district (Maharashtra) India

S. No.	Botanical name	Family	Flowering period	Bee forage value		
				Nectar	Pollen	Nectar + Pollen
1	*Allium cepa L.*	Alliaceae	June-August	-	P	-
2	*Brassica juncea L.*	Brassicaceae	July-August	N	-	-
3	*Cajanus cajan L.*	Fabaceae	July-September	N	-	-
4	*Carthamus tinctorius L.*	Asteraceae	May-July	N	-	-
5	*Cicer arietinum L.*	Fabaceae	December-March	N	-	-
6	*Citrullus lanatus*	Cucurbitaceae	July-August	-	P	-
7	*Citrus aurantifolia*	Rutaceae	October-January, July- September	-	-	NP
8	*Citrus aurantium L.*	Rutaceae	March-November	-	-	NP
9	*Coriandrum sativum L.*	Apiaceae	January-December	-	-	NP
10	*Cucumis melo L.*	Cucurbitaceae	March-May	-	P	-
11	*Cucumis sativus L.*	Cucurbitaceae	August-October	-	P	-
12	*Cucurbita pepo L.*	Cucurbitaceae	August-October	-	-	NP
13	*Cyamopsis denteta*	Leguminosae	June-August	N	-	-
14	*Helianthus annuus L.*	Asteraceae	July-September	-	-	NP
15	*Lagenaria siceraria*	Cucurbitaceae	October-February	-	-	NP
16	*Mangifera indica L.*	Anacardiaceae	January-April	-	-	NP
17	*Moringa oleifera*	Moringaceae	November-February	-	-	NP
18	*Pisum sativum L.*	Fabaceae	August-September	-	-	NP
19	*Punica granatum L.*	Punicaceae	March-June	-	-	NP
20	*Rosa damascene*	Rosaceae	February-April	-	-	NP
21	*Solanum melongena L.*	Solanaceae	January-March, June-July	-	P	-
22	*Triticum aestivum L.*	Poaceae	February-April	N	-	-
23	*Vigna aconitifolia*	Fabaceae	March-May	N	-	-
24	*Vigna mungo*	Fabaceae	August-September	N	-	-
25	*Arachies hypogaea*	Fabaceae	July-October, April-June	-	P	-
26	*Cyamopsis tetragonolobus*	Leguminosae	January-August	N	-	-
27	*Zea mays*	Poaceae	August-September, February-March	-	P	-
28	*Pennisetum glaucum*	Poaceae	August-September	-	P	-
29	*Sorghum vulgare*	Poaceae	March-April, August-September	-	P	-
30	*Vigna radiata*	Fabaceae	August-September	N	P	-
31	*Vigna unguiculata L.*	Fabaceae	July-August	N	-	-
32	*Guizotia abyssinica*	Asteraceae	September-October	-	-	NP
33	*Ambelmoschus esculentus*	Malvaceae	August-November	-	-	NP
34	*Psidium guajava*	Myrtaceae	June-July	-	-	NP
35	*Ziziphus mauritiana*	Rhamnaceae	September-October	-	-	NP
36	*Solanum lycopersicum*	Solanaceae	July-September	-	P	-
37	*Capsicum annuum*	Solanaceae	July-February	-	P	-
38	*Annona squamosa*	Annonaceae	August-October	-	-	NP
39	*Sesamum indicum*	pedaliaceae	August-September	-	-	NP

Note: N- Nectar, P- Pollen, NP- Nectar Pollen

Data in (Table 1) presents the flora, including their botanical names, families, flowering periods, and bee forage value collected by bees. This data was obtained through a survey that identified 41 plant species as major honeybee forage

sources. These include *Citrus aurantifolia, Citrus aurantium, Coriandrum sativum, Cucurbita pepo, Helianthus annuus, Lagenaria siceraria, Mangifera indica, Moringa oleifera, Pisum sativum, Punica granatum, Rosa damascene, Guizotia abyssinica, Gossypium herbaceum, Ambelmoschus esculentus, Psidium guajava, Ziziphus mauritiana, Annona squamosa, Sesamum indicum, Citrus limetta, Allium cepa* L., *Brassica juncea* L., *Cajanus cajan* L., *Carthamus tinctorius* L., *Cicer arietinum* L, *Citrullus lanatus, Cucumis melo* L, *Cyamopsis denteta, Solanum melongena* L., *Triticum aestivum, Vigna aconitifolia, Vigna mungo, Arachies hypogaea, Cyamopsis tetragonolobus, Zea mays, Pennisetum glaucum, Sorghum vulgare, Vigna radiata, Vigna unguiculata, Solanum lycopersicum*.

It's important to note that these plants are visited by the bee (*Apis cerena* indica) for its food, nectar, and pollen. Therefore, they play a crucial role in the bee's diet and ultimately, their survival. The collection of this data provides valuable insight into the plant species that are essential for the survival of the honeybee population. The vegetation that honey bees rely on for survival encompasses a diverse range of plant types, including trees, shrubs, herbs, and creepers. These plants provide not only an ample source of nectar, but also pollen, which is a crucial component of the honey bee's diet. Without access to an adequate variety of flowering plants, honey bees may struggle to maintain their populations and may be more susceptible to disease and other threats. Therefore, it is essential to ensure that habitats are preserved and managed in a way that supports the growth and proliferation of honey bee flora.

The results obtained from this study are in agreement with the findings of Gidey *et al*. [7], who reported that the majority of beekeepers (about 58.4%) cultivate different indigenous bee forage. This indicates that the practice of cultivating different bee forage is common among beekeepers. Furthermore, the findings of this study are consistent with the conclusions drawn by Adhikari and Ranabhat [8], who categorized plants as major, medium, and minor sources of pollen and/or nectar. This classification is important as it helps to understand the availability and distribution of bee flora, which in turn affects the activity of honeybees.

In addition, the findings of this study are also supported by the works of Ara *et al*. [9], Behera *et al*. [10], Ghode and Kumar [11], Jaswal *et al*. [12], Kumar *et al*. [13], Paikara and Painkra [14], Painkra [15], Painkra and Jaiswal [16], Painkra *et al*. [17], Pandey *et al*. [18], Sivaram [19], Yadav *et al*. [20] and Vidya *et al*. [21]. These studies have reported that the activity of honeybees is directly influenced by the availability and quality of bee flora, including the quantity and quality of nectar and pollen present in them. The dependency of honeybees on bee flora is crucial as it determines the success of beekeeping practices and the production of honey.

The area is known for its diverse flora that showcases floral abundance throughout the year. One of the most notable features of this region is the richness of plant species and colorful flowers, which attract honey bees towards them. These bees play a crucial role in pollinating the flowers and ensuring that the area remains a vibrant and thriving ecosystem. Among the diverse flora, horticulture crops are a predominant source of nutritional resources for the local fauna. This includes various fruits and vegetables that are grown in the region and provide a vital food source for the animals that call this area home.

Interestingly, the highest floral abundance in the area was recorded during the month of September, which is a time when many of the flowers are in full bloom. This is closely followed by January and August, which also see a significant increase in floral abundance. On the other hand, the months of October, November, June, and July are recorded with less floral abundance. However, even during these months, the area still boasts a diverse range of flora that continues to support the local ecosystem. Overall, the region's unique and diverse floral abundance plays a crucial role in supporting the local fauna and maintaining a balanced ecosystem.

CONCLUSION

Results of a study conducted in the Khultabad Taluka and Aurangabad districts of Maharashtra have revealed that 39 types of bee flora are useful to honey bees. Bee flora was further classified into pollen and nectar categories based on available secondary data. Bees are crucial components in cropping systems as they pollinate a wide variety of crops. These groups serve as providers of pollen, nectar, and both pollen and nectar. It can be concluded that Khultabad is a rich area for bee flora, indicating the need for scientific beekeeping to improve farmers' livelihood. The study's records of wild bee flora encourage their conservation for sustainable beekeeping in the future. Therefore, it is important to prioritize their preservation and continue to conduct research on the best practices for beekeeping to ensure the longevity of these crucial pollinators in our ecosystem.

Acknowledgment

Express my heartfelt gratitude for the exceptional assistance provided by Department of Zoology, Dr. Rafiq Zakaria Women's College, Aurangabad, and Government College Aurangabad. Your expertise in identifying plant species has been invaluable to the success of my research endeavours at our research centre. I sincerely appreciate the time and effort invested by the botany experts at both institutions. Your contributions have not only expanded my understanding of various plant species but have also enhanced the quality and depth of our research outcomes.

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