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# Assessment of nectariferous and polleniferous plant diversity for honeybees in the foothills of Coimbatore district, Western Ghats, India

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**Abstract**

Honeybees are among the most significant eusocial and ecologically valuable insects, maintaining a unique symbiotic relationship with plants that contributes to ecological balance. This study examines the diversity of bee flora and the seasonal availability of nectar and pollen in the Anuvavi, Marudhamalai, and Palamalai hills, located at the foothills of the Western Ghats in Coimbatore district, Tamil Nadu. Over a year-long survey (April-March 2024), 97 plant species were identified as key nectar and pollen sources for four honeybee species (*Apis dorsata*, *A. cerana indica*, *A. florea*, and *A. mellifera*). These included 20 avenue trees, 17 herbs, 13 fruit-bearing trees, 12 bushes and shrubs, 12 ornamental plants, 8 medicinal plants, 8 agricultural crops, and 7 vegetable plants. A floral calendar was developed based on honeybee foraging behavior, and flowering cycles were compiled into a floral calendar. Peak honey flow occurred during winter (mid-November) and monsoon (mid-July to mid-October), while summer (mid-March to mid-June) marked a dearth period due to heat and floral scarcity. Each of these floral resources has been systematically categorized based on its role as a pollen producer, nectar source, or dual pollen-nectar yielder. This floral chronicle has been meticulously compiled based on systematic field observations and provides a valuable reference for beekeepers, researchers, and conservationists aiming to enhance pollinator health and ensure the continuity of bee-plant interactions in this region.

**Keywords:** Bee flora, dearth period, floral calendar, honeybees, honey flow period

## Introduction

Honeybees (Genus *Apis*) are communal insects hailing from the Apidae family, classified under the order Hymenoptera. Renowned as prolific pollinators, these bees are also economically invaluable (Sharma *et al*. 2004; Tsadila *et al*. 2023) [18, 22]. The flowering season was incredibly significant for every type of plant to complete its life cycle. Improving the excellence and productivity of fruits and seeds in various crops through the pollinating process is another crucial function of beekeeping (Walbot and Evans 2003) [23]. Bee flora serves as the essential source of sugary nectar and pollen for honeybees (Filipiak *et al*. 2022) [8]. As a part of the flora-based apiculture sector, honeybees collect nectar and pollen from approximately 40,000 plant varieties out of the estimated 2,50,000 species worldwide (Thagunna *et al*. 2023) [20]. Pollen and nectar are vital for the development and survival of hymenopteran insects, which thrive in environments that support angiosperms. A stable mutualistic relationship between flowering plants and pollinating bees is consistently observed throughout the flowering season. Even pollination plays a more significant role in improving crop yield than factors such as seed quality, fertilizers, or irrigation (Dar *et al*. 2017; Sawe *et al*. 2020) [7, 17]. Additionally, pollination is a free ecological service provided by bees, essential for the survival of both wild flora and cultivated crops. However, many plant species rely on external agents, such as pollinators, for cross-pollination (Potts *et al*. 2010) [16]. Pollination enhances the productivity and quality of fruits from bee-supportive plants, while also aiding in seed development (Dar *et al*. 2017) [7]. The terminology associated with plant species availability includes: "major honey flow period," which denotes a high nectar yield from numerous plants of a particular species; "minor honey flow period," referring to a modest nectar harvest; and "dearth period," indicating a complete absence of honey flow (Behera *et al*. 2017) [3]. Understanding nectar- and pollen-producing plants is fundamental to effective apiary management, as knowledge of bee flora helps regulate and sustain bee colonies (Dalio *et al*. 2013) [6]. The bee forage calendar serves as an invaluable tool in beekeeping, facilitating the monitoring of seasonal floral patterns, analyzing bee foraging behavior, and assessing the density, distribution, and honey-producing potential of local bee flora. The present study aims to identify existing bee flora resources and develop a floral calendar to map honey flow periods in the Anuvavi, Marudhamalai, and Palamalai hills, located in the foothills of the Western Ghats in Coimbatore district of Tamil Nadu, India.

## Materials and Methods

### Study area

The Anuvavi hill (11°03.5'N and 76°50.9'E; ~690 m. MSL), situated on the Anaikatty Highway, lies 22 km southwest of Coimbatore city. This locale serves as a nexus where an extension of the Western Ghats meets the

Coimbatore plains, a mosaic of cultivated lands interspersed with small- and large-scale brick factories. The vegetation in this region is predominantly dry deciduous (Jamuna *et al*. 2024) [10]. The Marudhamalai hill (11º2.8'N, 76º51.2'E; ~167 – 183 m. MSL) is situated in the southern Western Ghats outcrop near Coimbatore district. The region is characterized by a moist dry deciduous type of forest system. The soil here is primarily red, enriched with organic matter, while the bedrock consists of granite overlaid with a shallow layer of sandy loam. The glacial soils in the area are moderately to well-drained. The maximum and minimum recorded temperatures in this region are 41°C and 16°C, respectively (Paulsamy 2011) [15]. The Palamalai hill (11º10'N, 76º95'E; ~800 m MSL) is located in the foothills of the Western Ghats near Periayanayakkanpalayam in the Coimbatore district of Tamil Nadu, receiving an annual rainfall of approximately 600 – 700 mm, temperatures ranging between 17ºC to 38ºC, and the major forest type is dry to moist deciduous forest (Balakrishnan *et al*. 2023) [2]. Figure 1 illustrates the study area covering Anuvavi, Marudhamalai, and Palamalai Hills.

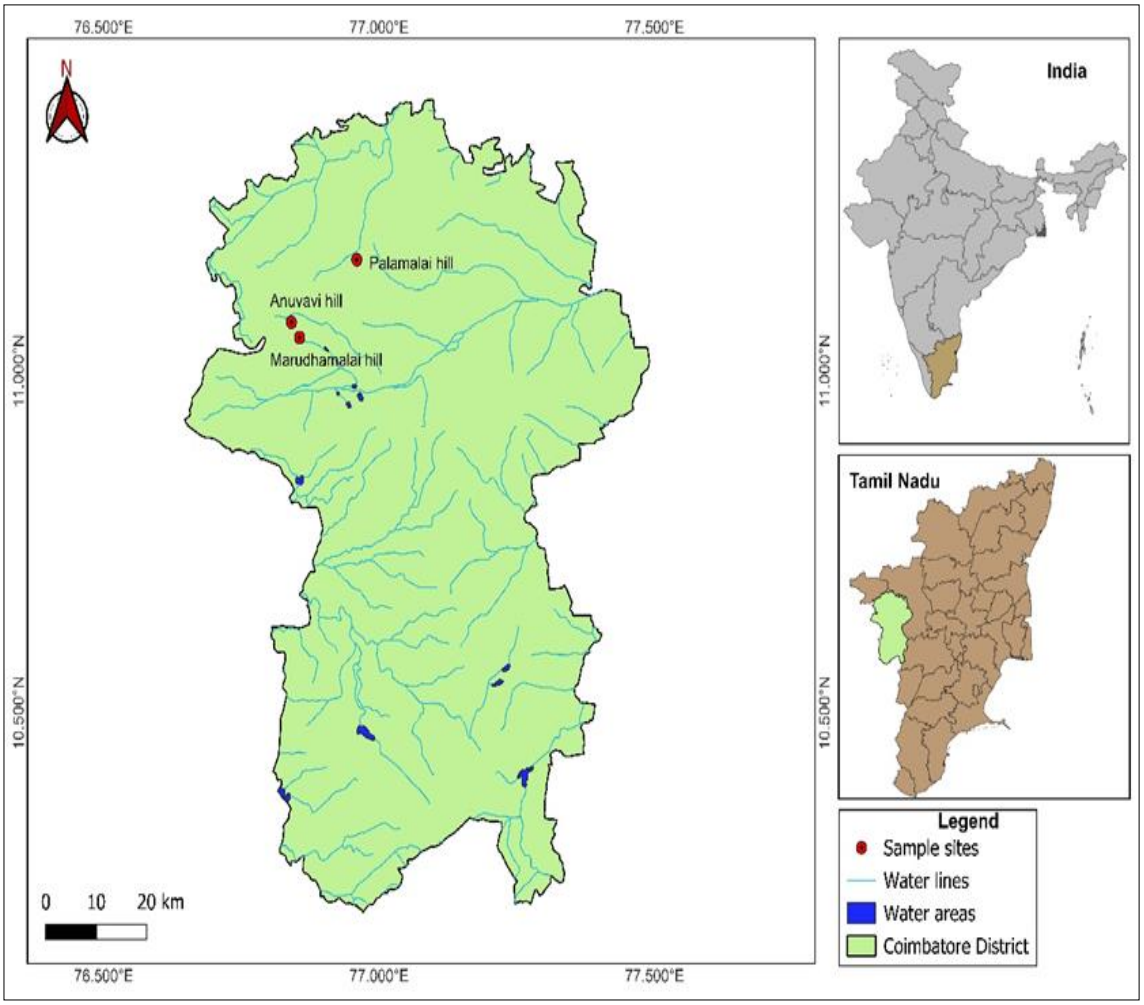


**Fig 1:** Study area map

**Identification of bee flora**

The bee flora study was conducted from April 2023 to March 2024. Honeybees were observed foraging on flowers, with various plant species classified as bee-attractive only after direct visual verification (Bruninga-Socolar *et al*., 2016; Mach and Potter, 2018) [5, 13]. The investigations of nectar and pollen supplies were based on honeybee activities on several flower species (Figure 2). Honey bees with pollen-laden legs were recognized as pollen sources, and honey bees, which extend their proboscis into the blooms, were deemed nectar suppliers (Bista and Shivakoti 2000) [4]. Plants identified as bee-attractive species at a specific site and later observed in subsequent surveys at other locations were only marked for their presence. For plants that could not be classified in the field, samples including flowers, leaves, and stems were collected and preserved in a herbarium. These specimens were then classified with the assistance of a taxonomist and cross-referenced with authoritative sources (MacLeod *et al*. 2020) [14]. A comprehensive chronological record of the flowering intervals of plant species was compiled during the surveys. This data not only facilitated the creation of an annual floral calendar but also enabled the calculation of dearth and honey flow periods.


**Fig 2:** Photographic documentation of some bee-forage plants discovered within the study area - A. *Abutilon indicum*; B. *Plectranthus barbatus*; C. *Solanum lycopersicum*; D. *Cordia sebestena*; E. *Millingtonia hortensis*; F. *Punica granatum*; G. *Plumeria pudica*; H. *Jatropha integerrima*; I. *Hibiscus calyphyllus*; J. *Terminalia catappa*; K. *Celosia argentea*; L. *Ipomea hederifolia*; M. *Tithonia diversifolia*; N. *Hibiscus hirtus*; O. *Thunbergia grandiflora*

## Results and Discussion

A one-year study on nectariferous and polleniferous plants was conducted in the Anuvavi, Marudhamalai, and Palamalai hills, located at the foothills of the Western Ghats in Coimbatore district, Tamil Nadu. The research was carried out in agriculturally cultivated lands. The nectar- and pollen-gathering activities of honey bees were observed across a diverse range of wild and cultivated plant species. The result revealed 97 plant species preferred by four types of honeybees, specifically the giant honeybee (*Apis dorsata*), the Indian honeybee (*Apis cerana indica*), the dwarf honeybee (*Apis florea*), and the Western honeybee (*Apis mellifera*), out of which 12 were bushes and shrubs (Table 1), 17 plants comes under herbs (Table 2), eight medicinal plants (Table 3), eight field crops (Table 4), seven vegetables (Table 5), 13 fruits (Table 6), 20 were avenue trees (Table 7), 12 were ornamental plants (Table 8) respectively. The documented flora was categorized into nectar producers, pollen producers, and those yielding both nectar and pollen (Tables 1-8). Among the 97-plant species identified, 18 were notably rich in nectar, 24 plants were the best source of pollen grains, and 55 plants served both nectar and pollen-yielding. The majority of the honey bees' foraging plants belong to different families, such as Rubiaceae, Apocynaceae, Lamiaceae, Solanaceae, Anacardiaceae, and Fabaceae. The dominant shrubs and bushes come under Rubiaceae and Apocynaceae. The dominant plants and herbs come under the Acanthaceae. The medicinal plants belong to Lamiaceae. Similarly, the dominant field crops of the Poaceae family, vegetable plants

from the Solanaceae family, fruit plants from the Anacardiaceae, the avenue trees of the Fabaceae family, and ornamental plants from Oleaceae are the dominant family were recorded during the study period. The majority of flora consists of avenue trees, followed by herbs, fruit plants, ornamental plants, and medicinal plants. However, avenue trees have a rich source of nectar and pollen. In the absence of agro-horticultural crops, native flowering vegetation emerges as a supplementary food source for honeybees.

**Table 1:** List of Bushes and Shrubs for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Ricinus communis* L. | Castor | Year around | Euphorbiaceae | N+P |
| 2 | *Coffea robusta* L. | Coffee | Year around | Rubiaceae | N+P |
| 3 | *Justicia gendarussa* L. | Karunochi | Mar | Acanthaceae | N |
| 4 | *Camellia sinensis* L. | Tea | Dec | Theaceae | P |
| 5 | *Ixora beddomei* T. Husian&S.R. Paul | Thechi | Year around | Rubiaceae | N+P |
| 6 | *Caesalpinia pulcherima* (L.) Sw. | Peacock flower | Feb-May | Fabaceae | N+P |
| 7 | *Tecoma stans* (L.) Juss. ex Kunth | Yellow bells | Feb-Apr | Bignoniaceae | N |
| 8 | *Biancaea decapetala* (Roth) Alston | Mysore thorn | May-Apr | Caesalpiniaceae | P |
| 9 | *Hibiscus calyphyllus* cav. | Lemon yellow rose | Jan-Apr | Malvaceae | N+P |
| 10 | *Jatropha integerrima* Jacq. | Peregrina | Apr-Jul | Euphorbiaceae | P |
| 11 | *Plumeria pudica* Jacq. | Wild plumeria | Year around | Apocyanceae | N |
| 12 | *Tabernaemontana divaricata* (L.) R. Br ex Roem. & Schult | Crape Jasmine | Jul-Sep | Apocyanceae | N |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 2:** List of Herbs for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Sesamum indicum* L. | Elu | Aug-Oct | Pedaliaceae | N+P |
| 2 | *Celosia argentea* L. | White cockscomb | May-Aug | Amaranthaceae | N |
| 3 | *Canna indica* L. | Mani vazhai | Jul-Nov | Cannaceae | N |
| 4 | *Aystsia gangetica* (L.) T. Anderson | Ganges prime rose | Nov-Apr | Acanthaceae | N+P |
| 5 | *Abutilon indicum* L. | Indian mallow | Jan-Oct | Malvaceae | N+P |
| 6 | *Tithonia diversifolia* (Hemsl.) A. Gray | Giant Mexican Sunflower | Jun-Mar | Compositae | N+P |
| 7 | *Hibiscus hirtus* L. | Lesser mallow | Nov-Jun | Malvaceae | N+P |
| 8 | *Barleria pristonis* L. | Porcupine flower | Oct-Dec | Acanthaceae | N |
| 9 | *Cardiospermum halicacabum L.* | Balloon vine | Sep-Dec | Sapindaceae | P |
| 10 | *Ipomea hederifolia* L. | Scarlet morning glory | Sep-Dec | Convolvulaceae | N |
| 11 | *Plumbago zeylanica* L. | Chithrak | Year around | Plumbaginaceae | N |
| 12 | *Plectranthus barbatus* Andrews | Indian coleus | Aug-Oct | Lamiceae | N+P |
| 13 | *Senna occidentalis* (L.) Link | Coffee senna | Year around | Caesalpiniaceae | N+P |
| 14 | *Chromolaena odorata* (L.) R.M King&H. Rob | Siam Weed | Oct-Dec | Asteraceae | N+P |
| 15 | *Asclepias curassavica* L. | Scarlet milkweed | Year around | Apocyanceae | P |
| 16 | *Solanum seaforthianum* Andrews. | Brazilian nightshade | Jul-Aug | Solanaceae | P |
| 17 | *Thunbergia grandiflora* (Roxb.ex Rottl.) | Blue sky flower | Jun-Oct | Acanthaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 3:** List of Medicinal Plants for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Ocimum sanctum* L. | Thulasi | Year around | Lamiaceae | N+P |
| 2 | *Achyranthes aspera* L. | Shiru kadaladi | Sep-Apr | Amaranthaceae | N |
| 3 | *Leucas aspera* L. | Thumbai | Nov-Feb | Lamiaceae | N |
| 4 | *Tephrosia purpurea* L. | Kattu kozhinji | Oct-Dec | Fabaceae | N+P |
| 5 | *Boerhavia diffusa* L. | Mookuthipoo | Apr-June | Nyctaginaceae | P |
| 6 | *Tridax procumbens* L. | Vettukayapundu | Year around | Asteraceae | P |
| 7 | *Artrabotrys hexapetalus* (L.f) Bhandar | Hari champa | Mar-Aug | Annonaceae | P |
| 8 | *Amylotheca dictophleba* (F. Muell.) Tiegh. | Blue mistletoe | Feb-Apr | Loranthaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 4:** List of Field Crops for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Sorghum vulgare* L. | Cholam | Apr-Jun | Poaceae | P |
| 2 | *Pennisetum typhoides* Trin. | Bajra | Sep-Oct | Poaceae | P |
| 3 | *Eleusine coracana* Gaertn. | Ragi | Jul-Sep | Poaceae | P |
| 4 | *Zea mays* L. | Maize | Apr-Jun | Poaceae | P |
| 5 | *Cicer arietinum* L. | Chickpea | Feb | Fabaceae | N+P |
| 6 | *Gossypium hirsutum* L. | Cotton | Nov-Feb | Malvaceae | N+P |
| 7 | *Saccharum officinarum* L. | Sugar cane | Sep-Nov | Poaceae | N+P |
| 8 | *Musa paradisiaca* L. | Banana | Year around | Musaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 5:** List of Vegetables for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Coriandrum sativum* L | Coriander | June-Aug | Apiaceae | P |
| 2 | *Abelmoschus esculentus* L. | Lady's finger | Year around | Solanaceae | N+P |
| 3 | *Daucus carota* L. | Carrot | June-Aug | Apiaceae | N+P |
| 4 | *Lycopersicon esculentum* Mill. | Tomato | Year around | Solanaceae | P |
| 5 | *Solanum melongena* L | Brinjal | Year around | Solanaceae | P |
| 6 | *Pisum sativum* L. | Pea | Mar-May | Fabaceae | N+P |
| 7 | *Cucumis sativus* L. | Cucumber | Apr-Jun | Cucurbitaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 6:** List of Fruits for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Citrus limon* L. | Citrus | Nov-Feb | Rutacaea | N+P |
| 2 | *Cocos nucifera* L. | Coconut | Year around | Arecaceaea | N+P |
| 3 | *Mutingia calabura* L. | Cherry | Year around | Mutingiaceae | N+P |
| 4 | *Psidium guajava* L. | Guava | May-Jun | Myrtaceae | N+P |
| 5 | *Mangifera indica* L. | Mango | Apr-May & Nov-Dec | Anacardiaceae | N+P |
| 6 | *Punica granatum* L. | Pomegranate | Year around | Lytheraceae | N+P |
| 7 | *Carica papaya* L. | Papaya | Year around | Caricaceae | N+P |
| 8 | *Anacardium occidentale* L. | Cashew | Mar-May | Anacardiaceae | N+P |
| 9 | *Achras zapota* L. | Sapota | Year around | Sapotaceae | N+P |
| 10 | *Passiflora edulis* Sims. | Passion fruit | Year around | Passifloraceae | N+P |
| 11 | *Morus alba* L. | Mulberry | Feb-Apr | Moraceae | N+P |
| 12 | *Phyllanthus emblica* L. | Indian gooseberry | Feb-May | Phyllanthaceae | N+P |
| 13 | *Vitis vinifera* L. | Grape vine | Mar-Apr | Vitaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 7:** Avenue trees for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Delonix regia* (Bojer) Raf. | Gulmohar | Apr-Aug | Fabaceae | N+P |
| 2 | *Saraca indica* L. | Ashoka | Feb-Apr | Fabaceae | P |
| 3 | *Azadirachta indica* A. Juss | Neem | Jan-Mar | Meliaceae | N+P |
| 4 | *Tecona grandis* L. | Teak | Jun-Sep | Verbenaceae | P |
| 5 | *Plumeria rubra* L. f | Indian temple tree | Year around | Apocyanaceae | N+P |
| 6 | *Bauhinia variegata* (L.) Benth | Mountain ebony | Sep-Nov | Fabaceae | N+P |
| 7 | *Terminalia arjuna* (Roxb.) Wight &Arn. | Arjun tree | Apr-Jun | Combretaceae | N+P |
| 8 | *Samanea saman* (Jacq.) Merr. | Raintree | Feb-May | Fabaceae | N+P |
| 9 | *Spathodea campanulata* P. Beauv | Tulip tree | Mar-July | Fabaceae | N+P |
| 10 | *Tamarindus indica* L. | Tamarind | Mar-July | Fabaceae | N |
| 11 | *Millingtonia hortensis* L. f | Indian cork tree | Oct-Dec | Bignoniaceae | N |
| 12 | *Pongamia pinnata* L. Merr | Pongam | Apr-July | Fabaceae | N+P |
| 13 | *Peltophorum pterocarpum* (DC.) K. Heyne | Yellow flame tree | Mar-July | Caesalpinaceae | P |
| 14 | *Melia azedarach* L. | Persian lilac | Mar-Jun | Meliaceae | P |
| 15 | *Michelia champaca* L. | Golden champa | Jun-Sep | Magnoliaceae | N+P |
| 16 | *Cordia sebestena* L. | Scarlet cordia | Year around | Boranginaceae | P |
| 17 | *Sesbania grandiflora* L. | Agati | Nov-Jan | Fabaceae | N+P |
| 18 | *Senna siamea* (Lam.) H.S. Irwin & Barneby | Ironwood tree | Aug-May | Fabaceae | N+P |
| 19 | *Dichrostachys cinerea* Sensu R. Vig | Sickle bush ashy babool | Apr-July | Mimosaceae | N+P |
| 20 | *Terminalia catappa* L. | Indian almond | Feb-May | Combretaceae | N+P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Table 8:** List of Ornamental Plants for Honey Bees

| S. No | Plant Species Name | Common Name | Flowering Period | Family Name | Dietary Source |
|---|---|---|---|---|---|
| 1 | *Jasminum sambac* (L.) Aiton | Jasmine | Mar-Oct | Oleaceae | N |
| 2 | *Rosa indica* L. | Rose | Year around | Rosaceae | N+P |
| 3 | *Chrysanthemum indicum* L. | Indian chrysanthemum | Nov-Dec | Asteraceae | N+P |
| 4 | *Lantana camara* L. | Lantana | Year around | Verbenaceae | N+P |
| 5 | *Callistemon citrinus* Lindl. | Bottlebrush | Year around | Myrtaceae | N |
| 6 | *Nyctanthes arbor-tristis* L. | Night-blooming jasmine | Aug-Dec | Oleaceae | P |
| 7 | *Euphorbia milii* Des Moul. | Crown of thorns | Year around | Euphorbiaceae | N |
| 8 | *Catharanthus roseus* (L.) G. Don | Cape periwinkle | Year around | Apocyanaceae | N |
| 9 | *Helianthus annus* L. | Sunflower | May-Sep | Asteraceae | N+P |
| 10 | *Nerium oleander* L. | Oleander | Year around | Apocyanaceae | P |
| 11 | *Jasminium grandiflorum* L. | Royal jasmine | Aug-Oct | Oleaceae | N |
| 12 | *Bougainvillea spectabilis* Willd. | Paper flower | Year around | Nyctaginaceae | P |

*N-Nectar, P-Pollen, N+P-both Nectar and Pollen

**Honey Flow and Dearth Period**

The study area's honey flow and dearth seasons were identified and compiled in Tables 1-8. The peak foraging activity was recorded during the winter and monsoon seasons. A total of eight herbs, four medicinal plants, four field crops, six fruits, six ornamental plants, seven avenue trees, eight bushes, and shrubs were determined as a major source of food for honeybees during the first honey flow phase from mid-November to mid-February of the winter season. Edible fruits, vegetables, decorative plants, medicinal herbs, climbers, and forests are all viable sources of sustenance for honey bees (Kumar and Bharti 2015; Khalifa *et al*. 2021) [11, 12].

During the monsoon season, the secondary honey production phase occurred from mid-July to mid-October. In this period, two bushes and shrubs, two medicinal plants, eight herbs, four field crops, four fruits, five vegetables, six ornamental plants, and ten avenue trees were documented as food sources for honeybees. The rich diversity of both wild and horticultural plant species has been supported for honey production. To foster thriving honey bee colonies, it is essential to cultivate flowering plants in regions that can serve as prime foraging habitats. Honeybees work on colony development and honey production frequently on these plants. In the second honey flow period, the study area received severe rain, the climate was unsuitable, and it restricted the honey bees' foraging activity.

The summer season was determined to be the honey bee shortage period in the study areas. During this hypercritical dearth period, temperatures soaring to 36°C led to water scarcity and reduced availability of flowering plants. A few bushes and shrub species, one herb species, two medicinal plants, two vegetable plants, three fruit species, and three avenue trees blossomed during the third honey flow period. Nevertheless, the density of honey bees per unit area was relatively low. However, honey bees utilize these resources during a shortage of honey flow. Some researchers have also conducted investigations along these lines and noted similar observations in various parts of India (Singh 2000; Thapa and Pokhrel 2005; Adhikari and Ranabhat 2011) [1, 19, 21]. Different ecological niches within these areas identified multiple sites where abundant floral resources might have been utilized instead of the limited ones. Bees collect substantial amounts of pollen and nectar from commercially valuable plant species throughout the year.

**Bee-floral calendar**

The flowering cycles of each plant species were carefully recorded over time (Tables 1-8). The floral calendar (Figures 3 and 4) has made it much easier to standardize routine management practices for apiary management. Developing a floral calendar for a specific area requires closely monitoring seasonal fluctuations in local plant patterns and the agricultural ecosystem (Franco 2015) [9]. Since many perennial plants are available in these areas, grasping their distribution and bloom schedules is essential for forecasting pollen and nectar availability, which is key to effective apiculture. Comprehending the flowering period is vital for sustainable bee colony management and consistent honey production. The length of each region's flowering season is beneficial for migratory beekeeping. Four distinct types of honey bees were identified in the study area, and these bees serve as highly effective pollinators for a range of agro-horticultural crops in the region.

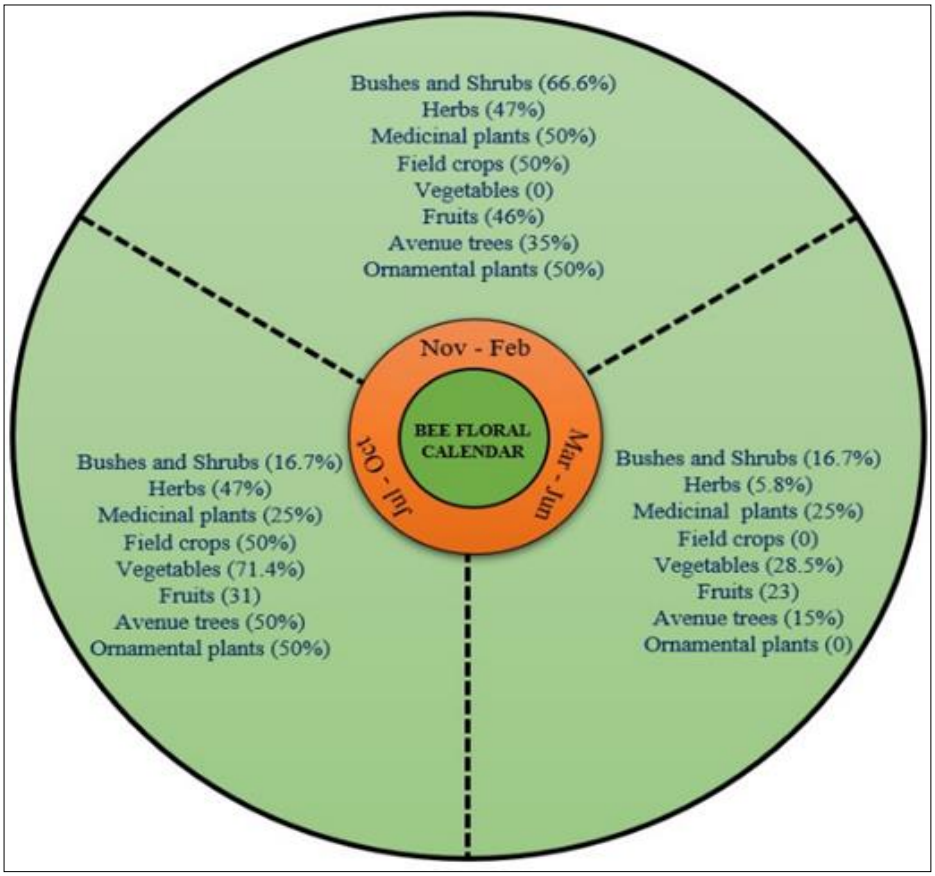


**Fig 3:** Bee floral calendar

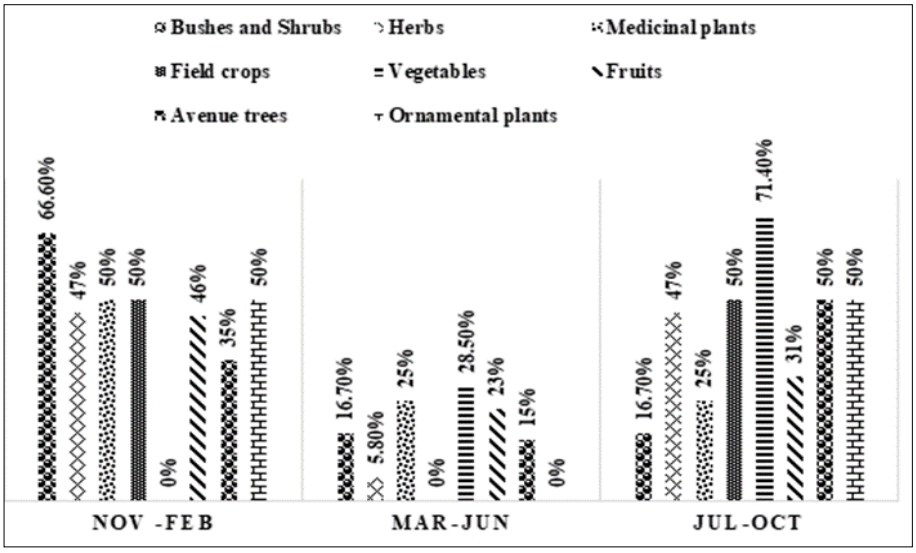


**Fig 4:** Graphical representation of bee floral diversity

## Conclusion

The current study unveiled the presence of 97 plant varieties, including 20 avenue trees, 17 herbs, 13 fruit-bearing trees, 12 ornamental plants, 8 medicinal plants, 8 agricultural crops, 7 vegetables, and 12 bushes and shrubs, which were beneficial to the four species of honeybees. Three honey flow periods were observed from mid-November to mid-February (winter season), mid-July to October (monsoon season), and a dearth period from mid-March to mid-June (summer season). The findings also indicated that the area hosts a larger number of plants yielding both pollen and nectar compared to those providing only pollen or nectar. The research suggests that the local flora is well-suited for starting beekeeping. However, it is essential to prioritize the preservation of existing bee-friendly plants and encourage the proliferation of plant species to guarantee long-term sustainability.

## Acknowledgment

Not applicable

## Conflict of Interest

All authors declare that there is no conflict of interest.

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