

Potential Floral Resources Available in Tropical Moist Deciduous Forest of Chhattisgarh, India

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(Received 24 June, 2022; Accepted 2 August, 2022)

ABSTRACT

The present paper listed about 49 bee plant species, which are well distributed and common in Bastar forest area. The identified bee flora comprises of ornamentals, timber, medicinal, fruits, vegetables and other commercial important plants like spices, pulses, cereals, oil yielding, fibre, fodder etc. Because of economic importance of the bee plants, they are not only protected but also propagated. Some of the common and important bee forage plants are, the species of *Syzygium*, *Cassia*, *Citrus*, *Pongamia*, *Azadirachta*, *Brassica*, *Areca*, *Cocos*, *Guizotia*, *Hilanthus*, *Albezia*, *Lagerstroemia*, *Polyanthus*, *Sapindus*, *Tecoma* etc. The paper reports that the bee-flora is diversified in the region and consists of both wild and cultivated, flowering during different months of the year. The flowering duration for each of the bee plant is provided to know the peak blooming period by the beekeeper. The state has all the four species of honeybees, i.e. *Apis dorsata*, *Apis florea*, *Apis cerana indica* and *Apis mellifera*. However, *Apis mellifera* is very recently introduced in the state. In Chhattisgarh, since pre-historical times beekeeping is practiced with *Apis cerana indica*. During the year 1992 the Thai sac brood disease (TSBV) was very severe in the state and the beekeepers lost most of their colonies. This prompted the state government to introduce *Apis mellifera* with a view to rehabilitate the people who were entirely depending on the beekeeping occupation. In addition to this, Khadi Village Industries Commission (KVIC) of the Ministry of Small Scale Industries, Government of India, and the Department of Industries and Commerce, Government Chhattisgarh have taken up several measures to revive *Apis cerana* beekeeping in the interest of the poor beekeepers and to strengthen beekeeping for crop pollination of large number of economically important crops through honeybees. The present status of beekeeping in the state is discussed.

Key words: Bee flora, Floral resources, Pollen, Flowering plant, Apiculture, Bee forage

Introduction

Honey production and colony development are directly related to floral sources in the immediate area of your apiary. Major nectar flows (sometimes termed honey flows) depend on a few plant species that yield nectar abundantly and are readily available. Besides the two or three main annual sources, there should be a great variety of minor plants yielding both pollen and nectar throughout the sea-

son to support the colonies between the main flows. Large acreages of flowering plants are needed for bees to produce surplus honey. Planting crops just for their nectar and pollen yields is not usually economical. An acre of blooming plants rarely provides surplus honey for more than one or two colonies of bees. The value of land not being used for other purposes can be increased, if it is planted to some nectar-yielding plant such as sweet clover rather than left to grass and weeds. Beekeepers should become

familiar with the major floral sources of their area and when these species bloom. From the standpoint of honey production, the most populous colonies produce the most honey. Thus, the essence of spring management is the development of strong colonies. Efficient management requires proper timing of colony development so that maximum populations will coincide with major nectar flows. The Bastar forest region has a great variety of nectar- and pollen-producing plants, as shown in the table below (Singh, 1982). The widespread distribution of plants such as Teak, Sal, Tamarind, blackberry, several species of clover, and Other forestry and horticultural trees makes it possible to produce a crop of honey in almost any part of the region even within large cities.. This plant produces a large crop of bitter honey with a limited market but good wintering qualities (Abrol, 1997).

We know that India as well as Chhattisgarh are both of the leading mega biodiversity places of the world to have more than 750 species of bee flora (Michener, 1974). It is estimated that majority of the floral resources of India is still unutilized. The existing bee flora in the country can very well support to 150-200 million colonies of bees but presently there are barely one million colonies tapping nectar from 0.5-0.7 per cent of the available bee floras (Hargasim, 1974). Honey bee is a social insect with excellent colony organisation. They have coevolved with angiosperm plants during the course of evolutionary process for mutual benefit, Bees depend solely upon the flowering plants to fulfill their dietary requirements and in turn render pollination of the plants. The proper pollinated plants produce good quality seeds for further perpetuation in the nature. The diet of the honey bees is composed chiefly of carbohydrates which they derive from the nectar. Nectar is a sugar solution in the flower secreted by special glands called nectaries. Nectar consists mainly of carbohydrates which provide energy to bees. Amino acids, terpenes, alkaloids, flavonoids, vitamins and oils are the other fractions presents in the nectar. Many dicotyledonous plants use this nectar to attract pollinating insects. The bees also draw protein and other nutrients from the pollen of the flowers. Pollen is highly proteinaceous material produced within the male reproductive part of the flower called anther. Honey bees require pollen essentially for their brood rearing. The hive bees, especially *Apis mellifera* L. and the sting less bees *Trigona irridipennis* Smith also collect enough

natural resin from plants called propolis which is used for construction of their nest and defense. The plant species which produce nectar, pollen, extra floral nectaries or propolis are visited by bees for one or the other material. These plant species are known as Bee flora or Bee pasturage or Bee forage.

Importance of bee pasturage and their relative utility to honey bees

You might have seen a flying honey bee around the flower. We have already discussed the honey bees depend upon the flowering plants for their dietary requirements. The flowering plants include fruit, vegetable, oilseed, ornamental, herb, shrub, bush, forest or avenue plants. The locations which are rich in nectar and pollen yielding plants for longer duration are ideal for beekeeping. In spite of rich bee flora, every region exhibits a Floral Dearth period of variable durations. During this period very few or hardly any flower providing nectar or pollen are available to the bees. This is a very critical period in beekeeping. During this period, you have to take adequate measures to prevent the decline in bee population and their desertion. The nectar and pollen production potential of plants vary widely due to their taxonomy, geographic distribution, age, season etc. Floral characteristics *viz.* flowering time, length of flowering, flower density, color of petals, amount, location and nutritional status of nectar and pollen influence the acceptability of a plant to the honey bees. Bees can distinguish green, blue, white and violet coloured flowers but insensitive to red flowers (Akranakal, 1987). Bees prefer flowers secreting nectar with higher sugar content. Considering the richness of available nectar and pollen, crop coverage in a locality and acceptability of the species for bee foraging, the plant species of a locality may be categorized into three utility groups as described below:

1. Major utility group Rich source of nectar, pollen or both. Abundant crop coverage (may be seasonal). Frequently foraged by bees.
2. Medium utility group Rich or moderate source of nectar, pollen or both. Area under crop coverage is poor. Moderately foraged by bees.
3. Minor utility group Poor source of nectar or pollen. Less area coverage. Occasionally foraged by bees.

Plenty of information on occurrence of the species of bee flora and their relative utility to bees from different agro-climatic zones of the country is avail-

Table 1. Important Indian Bee Flora.

SI. No.	Plants Species	Common /English/ Hindi Name	Flowering Period**	Dietary Source For Bees
1	<i>Mangifera indica</i>	Mango	Mar-April	NP*
2	<i>Cocos nucifera</i>	Coconut	Jan-Dec.	NP
3	<i>Citrus</i> spp.	Lemon/orange etc.	Mar.-May	NP
4	<i>Terminalia arjuna</i>	Arjun	May-June	NP
5	<i>Helianthus annuus</i>	Sunflower	May-Sept.	NP
6	<i>Plectranthus rugosus</i>	Plectranthus	Aug.-Sept.	N
7	<i>Carica papaya</i>	Papaya	July-Aug.	NP
8	<i>Brassica campestris</i>	Sarson	Jan-March	NP
9	<i>Brassica campestris</i> var toria	Toria	Oct-Nov.	NP
10	<i>Brassica oleracea</i>	Cauliflower	Feb.-March	NP
11	<i>Brassica rapa</i>	Turnip	Feb.-March	NP
12	<i>Raphanus sativa</i>	Raddish	Feb-March	NP
13	<i>Eruca sativa</i>	Taramira	Feb.-March	NP
14	<i>Faberis amara</i>	Candy!uft	Jan.-March	NP
15	<i>Cucumis melo</i>	Muskmelon	April-June	NP
16	<i>Cucumis sativus</i>	Kheera	May-Sep.	NP
17	<i>Citrullus fistulosus</i>	Tinda	April-Oct.	NP
18	<i>Citrullus lanatus</i>	Watermelon	April-June	NP
19	<i>Cucurbita pepo</i>	Chapankadu	April-June	NP
20	<i>Luffa acutangula</i>	Kali tori	May-Oct.	NP
21	<i>Momordica moschata</i>	Pumpkin	April-July	NP
22	<i>Zea mays</i>	Maize	July-Aug.	P
23	<i>Sorghum vulgare</i>	Sorghum	July-Aug.	P
24	<i>Pennisetum typhoides</i>	Bajra	June-July	P
25	<i>Cajanus cajan</i>	Arhar	April-May	NP
26	<i>Cicer arietinum</i>	Bengal gram	Feb.- March	NP
27	<i>Medicago sativa</i>	Lucern	Mar-May	NP
28	<i>Trifolium alexandrium</i> Berseem	Mar-May	NP	
29	<i>Crotalaria juncea</i>	Sun hemp	Sept.-Oct.	N
30	<i>Pisum sativum</i>	Pea	Jan.-Mar.	NP
31	<i>Allium cepa</i>	Onion	May-June	NP
32	<i>Allium sativum</i>	Garlic	May-June	NP
33	<i>Althea officinales</i>	Holly hock	April-July	NP
34	<i>Abelmoschus esculentus</i> Okra	April-Sept.	NP	
35	<i>Morus alba</i>	Mulberry	Feb.- March	P
36	<i>Pongamia glabra</i>	Pugam/Karanj	Mar.- April	N
37	<i>Psidium guajava</i>	Guava	May-June	NP
38	<i>Syzygium cumini</i>	Jamun	May-June	NP
39	<i>Eucalyptus</i> sp.	Nilgiri	Mar-May	NP
40	<i>Callistemon lanceolatus</i> Bottle brush	Mar-April	N	
41	<i>Sesamum indicum</i>	Til	July-Aug.	NP
42	<i>Zizypus</i> spp. '	Ber	June-Nov.	NP
43	<i>Pyrus pashia</i>	Kantha	Mar.-April	NP
44	<i>Rosa</i> spp.	Rose	Jan.-Dec.	NP
45	<i>Cannabis sativa</i>	Bhang	July-Aug.	P
46	<i>Vitis vinifera</i>	Grape	Mar.-April	NP
47	<i>Vitax negundo</i>	Bana	May-Aug.	NP
48	<i>Lantana camara</i>	Lantana	Mar-Sept.	NP
49	<i>Azadirachta indica</i>	Neem	April-May	NP *

N-nectar, P-pollen , Source: Naim and Phadke (1976).

** The flowering period of varies in different seasons and agro-climatic regions

able. A precise annotated list of important bee flora of our country with their flowering period and dietary source for the honey bees is presented in Table 1 (These floras fall under major utility group).

Floral map and floral calendar

Till now you have learnt about the importance of plant species in beekeeping during different seasons. You may recall that flowers are not available during some period of a year. This period is called dearth period. Here come the importance of Floral Map and Floral calendar. In scientific beekeeping, three species of bees viz. Indian hive bee, (*Apis cerana indica*), Italian bees (*Apis mellifera*) and the stingless bees (*Trigona irridipennis*) have been successfully hived, managed and utilized for production of honey, other hive products and managed bee pollination (Naim and Phadke, 1976). Development of floral map and floral calendar of a particular locality /region is a prerequisite for planned stationary and migratory beekeeping with any of the bee species. Preparation of the floral map and floral calendar can be done by adopting the following steps: i) Through seasonal survey of the locality to identify nectar and pollen yielding plants and recording the bee activities. ii) Recording flowering time and duration. ill) Checking whether the flora is source of surplus honey collection or not. It is very simple to identify a nectar and pollen yielding plant species in your locality. Simply observe the movement of bee around the flower. If the bees sit on the flower then it should be marked as nectar containing flower. Nectar collecting bees insert their tongue in the nectaries and identify the suitability of the flora for the source of pollen or nectar. The Photographs of some of the bee flora have been given on Plate 1. Pollen forages can be recognized by the collected pollens in the pollen basket located in the meta thoracic or hind legs. Such bees work on anthers to collect pollen (Akranakal, 1987).

A person intending to start beekeeping must have adequate knowledge about the potentiality of



Fig. 1. Pollen baskets

bee flora of the locality within a radius of 1-3 km (Gromisz, 1993). Floral map and floral calendar related to beekeeping of different states are available. The beekeeper should collect such information and if not available, he/she should prepare the same for his/her locality. *Apis mellifera* bees generally visit flowers within 1-3 km radius (Velthius, 1992). The *A. cerana indica* covers 1-1.5 km. Thus, for a successful beekeeping, abundant bee flora with extended period of flowering should be available within this range around the apiary. Further, density of bee hives in a unit area depends upon richness of available flora. Overcrowding of bee hives will lead to the poor honey yield as well as other complications such as drifting and robbing. Based on the consistent surveys, the desired information is collected. This information can be depicted in various ways implying status of bee pasturage in relation to beekeeping. Scientists of Indira Gandhi Krishi Vishwa Vidyalaya (IGKVV), Raipur (C.G.) after three decades of beekeeping research had prepared beekeeping zones based on the density of bee flora available and number of colonies suitably utilized to explore these floras (Table 1.2). A pictorial illustration of the bee flora developed by IGKVV (Raipur) is presented in Fig. 1.2.

Floral Calendar of a locality guides the beekeeper for efficient bee management to derive maximum benefit from beekeeping. Every region rich in bee flora has a floral dearth period. Similarly, the region

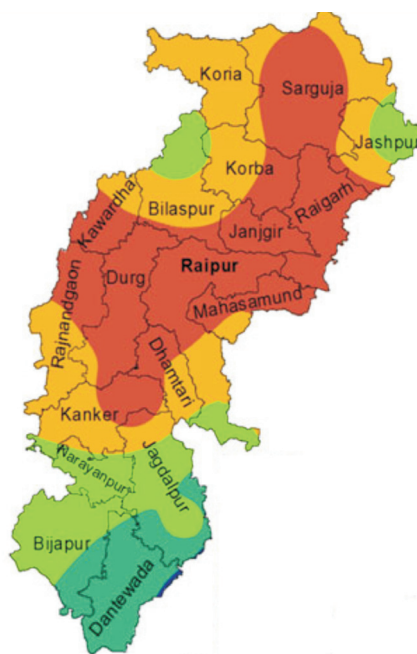


Table 2. Bee Production Zones Developed Based on the Availability Floral Map

SI. No.	Name of the Zone	Area or District	Important Bee Flora
1.	Very High productivity Zone	Dantewada, Bastar	Egyptian clover, Rape seed mustard, Eucalyptus, Pear, Shisham Litchi, Citrus
2.	High productivity Zone	Bijapur, Narayanpur Jagdalpur,	Egyptian clover, Eucalyptus, Pigeon pea Sunflower, Mustard, Shisham and Cotton
3.	Medium productivity Zone	Kanker Dhamtari Rajnandgaon Bilaspur Korba Koria Kawardha	
3.	Low productivity Zone	Durg Janjgir Raipur Mahasamund Raigarh Sarguja	Egyptian clover, Eucalyptus, Indian

Source: Annual report of AICRP on honeybee and pollinators, 2020

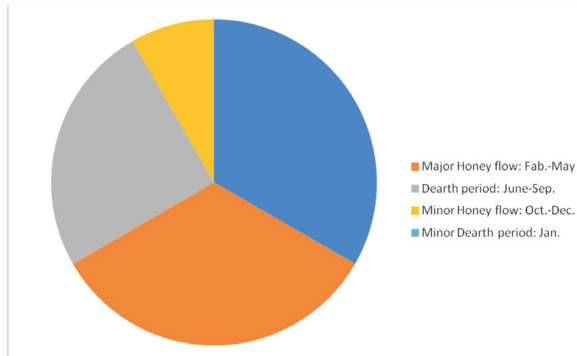
Table 3. Status of Bee Flora and Honey Flow Period of Chhattisgarh

SI. No.	Status of Honey	Flow Period (month)	Bee flora Available
1)	Major Honey flow	Feb.-May	Lemon, Tamarind, Mahua, Mango, Karanja, Jamun, Neem, Sesamum, Niger, Sunflower, Maize, Capsicum
2)	Dearth period	June-Sept.	Papaya, Bitter gourd, Okra, Brinjal, Guava, Moringa, some flowering Weeds
3)	Minor Honey flow	Oct.-Dec.	Brassica, Niger, Sesamum, onion Sunflower, Maize, Capsicum
4)	Minor Dearth period	January	Moringa, Rose Crysanthemum, Brassica, Moringa, Rose

Source: Annual report of AICRP on honeybee and pollinators, 2020

amenable for beekeeping has honey flow period of reasonably longer duration. The calendar months when appreciable number of bee floras produce ample nectar is called as Major honey flow season and when the bee flora yield low quantum of nectar is called Minor honey flow season. Period when nectar availability is very scanty it is referred to as Dearth period. A Minor dearth period is often experienced between minor and major honey flow seasons (Rodinov and Shabanshov, 1986). A typical status of bee flora and honey flow period of

Chhattisgarh is depicted in Table 3 and Fig. 1.3. 10 Calendar months, duration and number of honey flow and dearth period vary from one location to other. Area with short duration of dearth period, one or two major honey flow period of longer duration and remaining period with minor honey flow is the ideal location for beekeeping. Major honey flow coincides in general with the warm summer months of April-May and the dearth period with monsoon months of June-July (Sharma, 1972).



Nectar potential of major bee floras

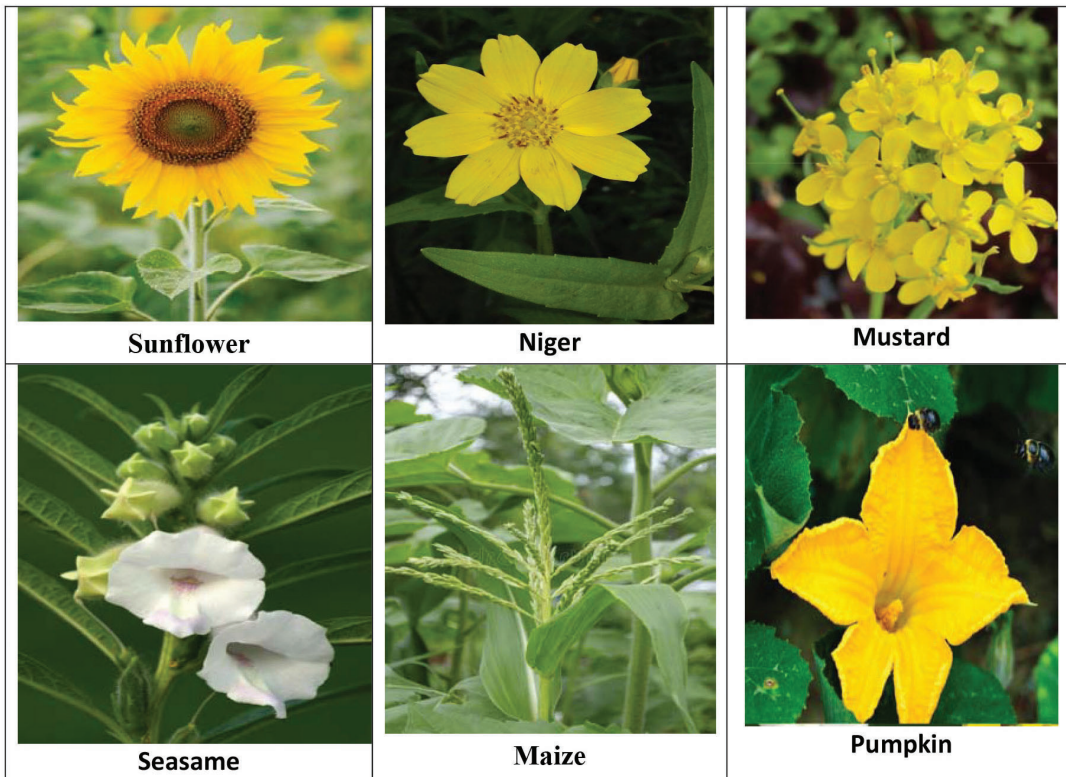
In beekeeping, the availability of nectar and pollen for the consumption of bees is essential. A good number of bee floras have been recognized as high potential source of the nectar or pollen by many scientists and progressive beekeepers through their keen observations and experiences. However, information based on true estimate of potentiality of bee flora in this regard is very scanty. The following few plants have been estimated for their nectar production potential: Eucalyptus: Eucalyptus tree on an average produces 4.0 lakh flowers yielding 15.5 kg of nectar having 54.7% sugar concentration (Sivaram, 1995). Thus, Eucalyptus tree producing

nectar equivalent to 11kg of honey. This tree has been identified as one of the high potential floral sources to honey bees. Pigeon pea (Arhar): Pigeon Pea on an average produces 88 x 10 flowers yielding 106 kg of nectar/ha. The nectar sugar concentration of the crop is estimated to be 38 per cent. Thus, pigeon pea produces nectar equivalent to 50 kg honey/ha (Zamarlicki, 1984).

Brassica spp.: One hectare of *Brassica campestris* var. Toria crop produces 390 million flowers with an average of 0.242 mg nectaral flower. The mean Total Soluble Sugar value of its nectar is 40.4 per cent. Thus, on an average, one hectare Toria crop produces 94.38 kg nectar equivalent to 47.7 kg honey. Honey production potential of *Brassica nepa* us has been estimated to be 11.98 kg (Kevan, 1984).

Development of bee pasturage

Bee pasturage is a prime factor in successful beekeeping. India with great diversity of climate and geographic location, supports varied types of vegetations and cultivated crops. Even then, any locality chosen for beekeeping is not free from floral dearth. Through a systematic programme of afforestation, it is possible to develop continuous bee pasturage by judicious selection of bee friendly plant





species. Bee pasturage development programmes may be undertaken with any non-government or government programmes like Integrated Rural Development Programme (IRDP) or National Rural Employment Guarantee Programme (NREGP). This

will lead to continuous availability of nectar and pollen for successful beekeeping in addition to the aesthetic value, healthy environment and overall economic return to the people of the locality (Suryanarayan, 1986).

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