



FLORAL DIVERSITY AND FORAGING BEHAVIOUR OF LITTLE/ DWARF HONEY BEE *APIS FLOREA* F. IN HORTICULTURAL ECOSYSTEM, MADURAI DISTRICT, TAMIL NADU

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ABSTRACT

Among the honey bee species, little/ dwarf bee *Apis florea* F. plays a major role in pollination of various annual and perennial crops and the successful beekeeping depends on the availability of bee foraging plants in any particular area. This study deals with the flora availability of *Apis florea* in the study area and the results revealed that 122 plants belonging to 47 families were identified as bee foraging plants and the major bee floral families are Fabaceae (15 species/ 12.29%) followed by Asteraceae (13 species/ 10.66%), Cucurbitaceae and Euphorbiaceae (7 species/ 5.74% each) and Amaranthaceae (6 species/ 4.92%). These pasturage plants are further grouped into nectar yielders (11), pollen yielders (15) and both nectar and pollen yielders (96).

Key words: *Apis florea*, floral diversity, bee forage, nectar yielder, pollen yielders

Honey bees produce valuable and precious honey, pollen, propolis, royal jelly and wax besides they play a major role in pollination of crops and produce good quality seeds and fruits. Honey bees and foraging plants are said to be coevolved, since plants depend on honey bee for pollination and similarly honey bees depend on plants for nectars and pollens. One third of the crops exclusively depends on insects for pollination and also estimated that one third of food supply relies on insect pollination (Jivan, 2013; Said et al., 2015). The successful beekeeping is not only influenced by strain of honey bee but also depends on the availability of bee foraging plants throughout the year in any particular area (Anita Devi and Mattu, 2017). Among the honey bee species, Little bee *Apis florea* F. is the most important pollinator of various field and horticultural crops in India. With these concepts, the present study was carried out to investigate the floral diversity for little bee, *Apis florea* in Madurai district of Tamil Nadu.

MATERIALS AND METHODS

The study was conducted in the apiary maintained by the Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai (9° 55'25.79" N, 78°05'27.00" E, 331 masl) with an annual rainfall of 840 mm. The area is located under the foot hills of Yanaimalai rock surrounded by major wild and cultivated flora, which continuously supply floral rewards to the honey bees. Dwarf/ little bee hives

were domesticated from trees and shrubs in and around the study area and the hives were maintained in the experimental area. The study was conducted for a period of one year from May 2018 to April 2019.

The flowering plants were continuously monitored at weekly intervals to observe the foraging activity and foraging plants of little bee. The visual observations were made from 06- 18.00 hr for a day and the plants were considered as successful bee foraging plants if 3 bees were found for at least 10 min as described by Bhalchandra et al. (2014). Further, these bee foraging plants were classified into pollen source, nectar source and both pollen and nectar source plants based on the foraging behaviour. If the bees extend their proboscis into the flowers then they were considered as nectar source; if they got loaded with pollen in its corbicula then they were classified as pollen source and if both activities were found simultaneously in the same plant, then they were grouped into both nectar and pollen source plants. The family wise categorization of these foraging crops and identification of major plant families which contributed nectar and pollen source were done. The plant species were identified with the help of published reports, articles, literatures and online sources.

RESULTS AND DISCUSSION

The identified plants of bee forage belonged to a total of 47 families were Acanthaceae, Asteraceae,

Arecaceae, Amaranthaceae, Azioaceae, Apocynaceae, Alliaceae, Apiaceae, Anacardiaceae, Boraginaceae, Brassicaceae, Bignoniaceae, Caricaceae, Cyperaceae, Convolvulaceae, Cucurbitaceae, Caesalpinaceae, Euphorbiaceae, Fabaceae, Lythraceae, Lamiaceae, Malvaceae, Myrtaceae, Musaceae, Moringaceae, Mimosaceae, Moraceae, Oxalidaceae, Piperaceae, Polygonaceae, Pedaliaceae, Punicaceae, Papaveraceae, Poaceae, Rutaceae, Rhamnaceae, Rosaceae, Santalaceae, Sapindaceae, Sapottaceae, Solanaceae, Simaroubaceae, Sterculiaceae, Typhaceae, Vitaceae, Verbenaceae and Zygophyllaceae.

There were a total of 122 floral species belonging to 47 families (floral diversity) was observed in the present study location (Table 1). Out of these 47 families, Fabaceae represented the highest number of foraging plants with 15 species (12.29%) followed by Asteraceae 13 species (10.66%), Cucurbitaceae and Euphorbiaceae each contributed 7 species (5.74%), next in the order were Amaranthaceae 6 species (4.92%), Acanthaceae, Lamiaceae and Poaceae each 5 species (4.10%), Malvaceae and Solanaceae 4 species each (3.28%), Apiaceae, Convolvulaceae, Myrtaceae, Mimosaceae 3 species each (2.46%), Anacardiaceae, Apocynaceae, Brassicaceae, Caesalpinaceae, Rutaceae and Rosaceae each contributed 2 species (1.64%). The following families contributed one species of plant, Arecaceae, Azioaceae, Alliaceae, Boraginaceae, Bignoniaceae, Caricaceae, Cyperaceae, Lythraceae, Musaceae, Moringaceae, Moraceae, Oxalidaceae, Piperaceae, Polygonaceae, Pedaliaceae, Punicaceae, Papaveraceae, Rhamnaceae, Santalaceae, Sapindaceae, Sapottaceae, Simaroubaceae, Sterculiaceae, Typhaceae, Vitaceae, Verbenaceae and Zygophyllaceae.

Similar bee pasturage flora for *Apis cerana indica* and *Trigona irridipennis* had been reported by Singh et al. (2016). They reported 69 foraging plants of *Apis cerana indica* and 64 foraging plants of Stingless bee *Trigona irridipennis* under the foot hills of Nagaland. According to Sambasiva Rao et al. (2015) 165 plant species belonging to 53 families served as foraging plants for *Apis florea* in Andhra Pradesh, among them tree species contributed more followed by shrubs, herbs and creepers.

The major plants that served as bee forager in horticultural ecosystem are presented in Table 2. There were about 45 plants belonging to 26 families were recorded as major bee foraging plants in horticultural ecosystem of the study area. Major foraging plants

Table 1. Floral diversity of bee foraging plants (family wise distribution)

S. No	Family	No. of species	Contribution (%)
1	Fabaceae	15	12.29
2	Asteraceae	13	10.66
3	Cucurbitaceae	7	5.74
4	Euphorbiaceae	7	5.74
5	Amaranthaceae	6	4.10
6	Acanthaceae	5	4.10
7	Lamiaceae	5	4.10
8	Poaceae	5	4.10
9	Malvaceae	4	3.28
10	Solanaceae	4	3.28
11	Apiaceae	3	2.46
12	Convolvulaceae	3	2.46
13	Myrtaceae	3	2.46
14	Mimosaceae	3	2.46
15	Anacardiaceae	2	1.64
16	Apocynaceae	2	1.64
17	Brassicaceae	2	1.64
18	Caesalpinaceae	2	1.64
19	Rutaceae	2	1.64
20	Rosaceae	2	1.64
21	Arecaceae	1	0.82
22	Azioaceae	1	0.82
23	Alliaceae	1	0.82
24	Boraginaceae	1	0.82
25	Bignoniaceae	1	0.82
26	Caricaceae	1	0.82
27	Cyperaceae	1	0.82
28	Lythraceae	1	0.82
29	Musaceae	1	0.82
30	Moringaceae	1	0.82
31	Moraceae	1	0.82
32	Oxalidaceae	1	0.82
33	Piperaceae	1	0.82
34	Polygonaceae	1	0.82
35	Pedaliaceae	1	0.82
36	Punicaceae	1	0.82
37	Papaveraceae	1	0.82
38	Rhamnaceae	1	0.82
39	Santalaceae	1	0.82
40	Sapindaceae	1	0.82
41	Sapottaceae	1	0.82
42	Simaroubaceae	1	0.82
43	Sterculiaceae	1	0.82
44	Typhaceae	1	0.82
45	Vitaceae	1	0.82
46	Verbenaceae	1	0.82
47	Zygophyllaceae	1	0.82

recorded in Southern Karnataka were *Azadirachta*, *Pongamia*, *Syzygium*, *Citrus*, *Cassia*, *Cocos*, *Brassica*, *Albizia*, *Polinathus*, *Areca*, *Lagerstroemia*, *Albezia*, *Guizotia* and *Helianthus*. (Sivaram, 2001). In South

Table 2. Pasturage flora of *Apis florea*- orchards, A C & R I, Madurai

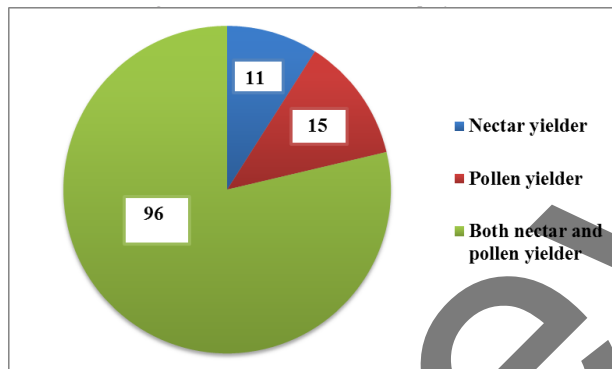
S. No.	Common Name	Scientific Name	Family	Flowering Period	Source Abundance
1.	Mango	<i>Mangifera indica</i>	Anacardiaceae	Dec- March	NP
2.	Cashew nut	<i>Anacardium occidentale</i>	"	Sep- Oct	NP
3.	Coconut	<i>Cocos nucifera</i>	Arecaceae	Jan- Dec	NP
4.	Papaya	<i>Carica papaya</i>	Caricaceae	July- Sept	NP
5.	Guava	<i>Psidium guajava</i>	Myrtaceae	Feb- Apr	NP
6.	Banana	<i>Musa paradisiaca</i>	Musaceae	Jan- Dec	NP
7.	Pomegranate	<i>Punica granatum</i>	Punicaceae	Apr- July	NP
8.	Lemon	<i>Citrus</i> sp.	Rutaceae	Apr- May	NP
9.	Grape	<i>Vitis vinifera</i>	Vitaceae	Sept- Dec	NP
10.	Sapota	<i>Manilkara zapota</i>	Sapottaceae	Oct- Mar	N
11.	Lady's finger	<i>Abelmoschus esculentus</i>	Solanaceae	Jan-Dec	NP
12.	Egg plant	<i>Solanum melongena</i>	"	Jan-Dec	P
13.	Tomato	<i>Lycopersicon esculentum</i>	"	Jan-Dec	P
14.	Chilli	<i>Capsicum annum</i>	"	Jan-Dec	P
15.	Ash gourd	<i>Benincasa hispida</i>	Cucurbitaceae	Jan - Dec	NP
16.	Bitter gourd	<i>Momordica charantia</i>	"	Apr-July	NP
17.	Cucumber	<i>Cucumis sativus</i>	"	Oct - Nov	NP
18.	Pumpkin	<i>Cucurbita maxima</i>	"	Feb-Mar	NP
19.	Drum stick	<i>Moringa oleifera</i>	Moringaceae	Dec- Apr	NP
20.	Cow pea	<i>Vigna unguiculata</i>	Fabaceae	Aug	NP
21.	Red gram	<i>Cajanus cajan</i>	"	Aug-Nov	NP
22.	Lab lab	<i>Lab lab purpureus</i> var. <i>typicus</i>	"	Nov- Apr	NP
23.	Curry leaf	<i>Murraya koenigii</i>	Rutaceae	Mar- Apr	N
24.	French bean	<i>Phaseolus vulgaris</i>	Fabaceae	Jan- Dec	NP
25.	Onion	<i>Allium cepa</i>	Alliaceae	May - July	NP
26.	Coriander	<i>Coriandrum sativum</i>	Apiaceae	Nov - Jan	NP
27.	Pterospermum	<i>Pterospermum</i> <i>personatum</i>	Bignoniaceae	Mar-Apr	NP
28.	Neem tree	<i>Azadirachta indica</i>	Meliaceae	Jan- Dec	NP
29.	Tamarind	<i>Tamarindus indica</i>	Caesalpinaceae	May-June	NP
30.	Eucalyptus	<i>Eucalyptus</i> sp.	Myrtaceae	Nov-Jan	NP
31.	Rain tree	<i>Samanea saman</i>	Mimosaceae	Mar-June	NP
32.	Mulberry	<i>Morus alba</i>	Moraceae	Feb-June	P
33.	Copper pod	<i>Peltophorum ferrugineum</i>	Caesalpinaceae	May-July	N
34.	Physic nut	<i>Jatropha curcas</i>	Euphorbiaceae	July-Oct	NP
35.	Sujjulu	<i>Albizia amara</i>	Mimosaceae	Feb-July	NP
36.	Siris tree	<i>Albizia lebbeck</i>	Mimosaceae	Feb-Apr	NP
37.	Puthranjivi	<i>Putranjiva roxburghii</i>	Euphorbiaceae	Mar-June	NP
38.	Henna	<i>Lawsonia inermis</i>	Lythraceae	Feb-May	NP
39.	Phalsa	<i>Grewia subinaequalis</i>	Malvaceae	Nov-Jan	NP
40.	Gliricidia	<i>Gliricidia sepium</i>	Fabaceae	Feb	NP
41.	Pongamia	<i>Pongamia pinnata</i>	Fabaceae	Mar-May	NP
42.	Mesquite	<i>Prosopis juliflora</i>	Fabaceae	July-Nov	NP
43.	Simaruba	<i>Simaruba glauca</i>	Simaroubaceae	Feb-Mar	NP
44.	Bethalagida	<i>Sterculia foetida</i>	Sterculiaceae	July	NP
45.	Ber	<i>Zizyphus jujuba</i>	Rhamnaceae	May-June	NP

*NP- Nectar and Pollen yielders * N- Nectar yielders *P- Pollen yielders

Tamil nadu also *Pongamia*, *Azadirachta*, *Citrus*, *Albizia* were recorded as the major bee foraging plants.

In the present study grouping of pasturage revealed that, out of 122 floral species, 96 species served as both nectar and pollen source, while 11 species served as only nectar source and 15 served as pollen source (Fig.1). This trend is in accordance with the findings of Hemalatha et al. (2018) who reported that 183 plant species served as both nectar and pollen yielders, 41 plants served as nectar yielders and 29 pollen yielders as bee floral pasturage of *Apis cerana indica*. Alia Sajwani et al. (2014) reported 67 species belonging to 39 families, were found to serve as both nectar and pollen source and 20 floral species were served as nectar feeders and 7 floral species were served as pollen feeders.

Fig. 1. Distribution of bee flora of *Apis florea*



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