

# Bee plants used as nectar sources by *Apis florea* Fabricius in Bankura and Paschim Medinipur districts, West Bengal

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## ABSTRACT

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Ninety four plant species belonging to 40 families were identified through pollen analyses of 57 honey samples of *Apis florea* as well as from field observations in Bankura and Paschim Medinipur districts, West Bengal. Fabaceae had the highest representation in number of plant species (16 taxa), followed by Asteraceae (10 taxa), Cucurbitaceae (6 taxa), Myrtaceae (5 taxa) and Rutaceae (5 taxa). Out of 57 honey samples 22 were identified as unifloral. Among the unifloral honey samples 3 were of *Borassus flabellifer* type, 5 were *Brassica nigratype*, 1 was *Brideliaretusa* type, 1 was *Butea monosperma* type, 6 were *Eucalyptus globulus* type, 1 was *Lannea coromandelica* type and 5 were of *Terminalia arjuna* type. Other secondary pollen types were *Acacia auriculiformis*, *Acacia nilotica*, *Anthocephalus cadamba*, *Citrus lemon*, *Cocos nucifera*, *Coriandrum sativum*, *Peltophorum pterocarpum*, *Phoenix sylvestris*, *Semecarpus anacardium*, *Sesamum indicum*, *Syzygium reticulatum*, *Trianthema portulacastrum*, *Tridax procumbens* and *Ziziphus mauritiana*. The number of foraged plants for the bee species was maximum 25 during February and minimum 8 during October.

**Key-words:** *Apis florea*, secondary pollen, unifloral honey, West Bengal, India.

## INTRODUCTION

Bankura and Paschim Medinipur are the two adjoining districts of south-western part of West Bengal. They are characterized by an overwhelming agro-economic base, low urbanization and industrialization and high flora and fauna diversity. Agriculture is the prime economic activity of these districts. Besides, a considerable part of the districts are covered by dry-deciduous rain forest. The red dwarf honeybee, *Apis florea* Fabricius frequently form hives among the various localities of these districts. The species is wild in nature, not readily managed by man (Hepburn & Radloff 2011,

Wongsiri et al. 1996). In addition to honey production, this bee species also performs as an important pollinator for several wild and cultivated plants of medicinal and economic use grown in those areas. In India including West Bengal, information regarding the foraging behaviour of *A. florea* is quite less. However, some discrete works have been done by Kalpana et al. 1990, Kalpana & Ramanujam 1994, Mahajan et al. 2000, Bhusari et al. 2005, Mukhopadhyay et al. 2007 and Abrol 2010. Therefore, the present work was undertaken with the aim to ascertain the suitability of the flora as nectar sources for sustenance of *A. florea* colonies in this part of the country.

## MATERIAL AND METHODS

Altogether, fifty seven honey samples were collected throughout the year from different localities of Bankura and Paschim Medinipur districts, West Bengal during 2009 to 2013 (Text-Figure 1). Among them 3 (sample no. 13, 23 and 28) were collected from Anchuri, 4 (2, 38, 48 and 51) from Balikhun, 3 (11, 19 and 36) from Bansol, 3 (12, 16 and 24) from Deshra, 5 (1, 9, 15, 17 and 47) from Jenadihi, 4 (3, 10, 27 and 39) from Lachhmanpur, 2 (30 and 35) from Ramsagar, 2 (5 and 26) from Ranipur, 3 (7, 43 and 56) from Sahebdanga and 5 (20, 44, 50, 52 and 54) from Seulibona village of Bankura district; 4 (4, 14, 46 and 53) from Amarda, 3 (8, 31 and 34) from Amlasuli, 4 (25, 29, 41 and 49) from Anandapur, 4 (18, 32, 45 and 54) from Daspur, 3 (33, 37 and 42) from Garhbeta, 2 (6 and 40) from Korui and 3 (21, 22 and 57) were collected from Rangamati of Paschim Medinipur district. Honey samples were collected from wild hives after removing the honeybees fully or partly from the hives by using smoke. Pure honey samples were gathered directly from honey cells with the help of micropipettes.

Qualitative and quantitative analyses of honey samples were done using methods recommended by Maurizio (1951) and International Commission for Bee Botany (Louveaux et al. 1978). Identification was done

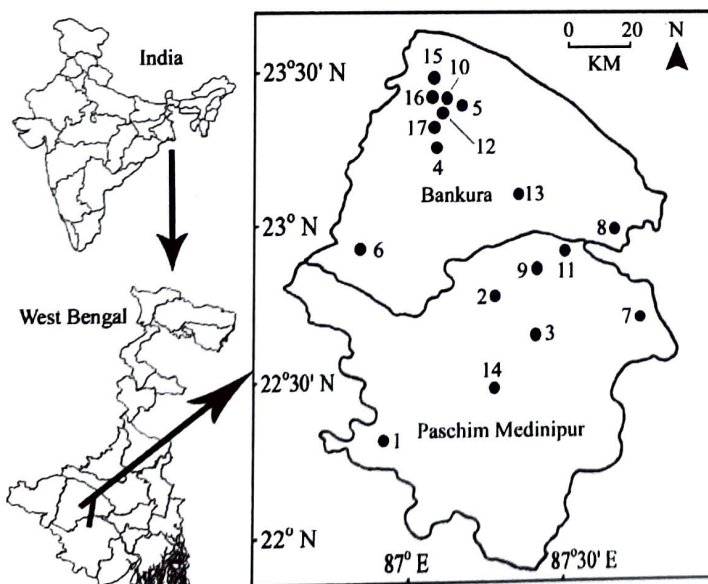
with the help of reference slides prepared from the local flora as well as from published accounts. Photomicrographs of suitable magnifications were made with Leica MPS-60 photoautomat. After identification and count of 200-300 pollen grains for each sample, the pollen types were categorized into one of the following frequency classes (Louveaux et al. 1978): predominant pollen type (>45%), secondary pollen type (16-44%), important minor pollen type (3-15%) and minor pollen type (<3%). For the month-wise calculation of pollen type percentage, an average of the pollen percentage of all honey samples within the month was calculated. To acquire some additional information regarding their nectar sources field surveys in different rural areas in these districts were also carried out.

## RESULTS

During January, 5 honey samples were analyzed. Among them 3 were unifloral to *Brassica nigra* (Table 1 sample no. 01, 13 and 34) and other 2 were multifloral. Secondary pollen types for the multifloral honeys were *Brassica nigra* and *Phoenix sylvestris*. 12 pollen types were identified from these 5 samples (Text Figure 2a). In addition to these, *Syzygium jambos* was also recorded by field observations as a source of nectar for the month.

In February, 5 honey samples were analyzed. Among them 2 were unifloral to *Brassica nigra* (Table 1 sample no. 02 and 03) and other 3 were multifloral types. *Brassica nigra* also represented as secondary pollen type in these multifloral samples. Through melissopalynological analyses, altogether 17 pollen types were identified (Text Figure 2b). Besides, during field observations it was found that 8 plant species viz. *Adhatoda vasica*, *Cucurbita maxima*, *Dolichos lablab*, *Justicia gendarussa*, *Nigella sativa*, *Psidium guajava*, *Ricinus communis* and *Syzygium jambos* also served as nectar sources for the bee species.

In March, 6 honey samples were analyzed. Among them 1 was unifloral to *Butea monosperma* (Table 1 sample no. 05), 1 was unifloral to *Lanea coromandelica* (Table 1 sample no. 36) and other 4 were multifloral types. Through melissopalynological



1. Amarda; 2. Amlasuli; 3. Anandapur; 4. Anchuri; 5. Balikhun; 6. Bansol; 7. Daspur; 8. Deshra; 9. Garhbeta; 10. Jenadihi; 11. Korui; 12. Lachhmanpur; 13. Ramsagar; 14. Rangamati; 15. Ranipur; 16. Sahebdanga; 17. Seulibona

Text figure 1. Collection sites (•) of honey samples.

**Table 1. Quantitative analysis of honey samples of *Apis florea* (Louveaux et al. 1978).**

Sample no.	Pollen types			
	Predominant Pollen (>45%)	Secondary Pollen (16-45%)	Important Minor Pollen (3-15%)	Minor pollen (<3%)
<b>January</b>				
01	<i>Brassica nigra</i> (48.14%)	Nil	<i>Acmella radicans</i> (4.75%), <i>Coriandrum sativum</i> (12.88%), <i>Eucalyptus globulus</i> (12.20%), <i>Moringa oleifera</i> (5.08%) and <i>Phoenix sylvestris</i> (12.54%)	<i>Chrysanthemum indicum</i> (1.02%), <i>Inga dulcis</i> (2.37%) and <i>Ricinus communis</i> (1.02%).
13	<i>Brassica nigra</i> (50.87%)	<i>Phoenix sylvestris</i> (16.72%)	<i>Coriandrum sativum</i> (9.06%), <i>Eucalyptus globulus</i> (9.41%) and <i>Moringa oleifera</i> (6.27%)	<i>Acmella radicans</i> (2.44%), <i>Cocos nucifera</i> (1.39%), <i>Inga dulcis</i> (2.09%) and <i>Tagetes erecta</i> (1.74%).
24	Nil	<i>Brassica nigra</i> (41.40%) and <i>Phoenix sylvestris</i> (26.32%)	<i>Acmella radicans</i> (4.56%), <i>Coriandrum sativum</i> (10.53%), <i>Eucalyptus globulus</i> (9.47%), <i>Moringa oleifera</i> (4.91%)	<i>Tagetes erecta</i> (2.81%).
34	<i>Brassica nigra</i> (53.85%)	Nil	<i>Coriandrum sativum</i> (6.33%), <i>Eucalyptus globulus</i> (14.48%) and <i>Phoenix sylvestris</i> (14.48%)	<i>Cocos nucifera</i> (2.71%), <i>Hygrophila schulli</i> (0.90%) and <i>Tagetes erecta</i> (1.81%).
54	Nil	<i>Brassica nigra</i> (43.45%)	<i>Acmella radicans</i> (4.14%), <i>Coriandrum sativum</i> (12.76%), <i>Eucalyptus globulus</i> (8.97%), <i>Hygrophila schulli</i> (3.10%), <i>Moringa oleifera</i> (8.62%) and <i>Phoenix sylvestris</i> (15.86%)	<i>Chrysanthemum indicum</i> (2.07%) and <i>Tagetes erecta</i> (1.03%).
<b>February</b>				
02	<i>Brassica nigra</i> (63.34%)	Nil	<i>Alangium salvifolium</i> (3.49%), <i>Coriandrum sativum</i> (7.98%), <i>Eucalyptus globulus</i> (5.24%), <i>Melia azedarach</i> (3.24%), <i>Mikania scandens</i> (3.24%), <i>Moringa oleifera</i> (6.73%) and <i>Spondias pinnata</i> (3.74%)	<i>Helianthus annuus</i> (0.75%), <i>Mangifera indica</i> (0.50%) and <i>Phoenix sylvestris</i> (1.75%).
03	<i>Brassica nigra</i> (53.99%)	Nil	<i>Acmella radicans</i> (4.35%), <i>Coriandrum sativum</i> (11.23%), <i>Eucalyptus globulus</i> (8.70%), <i>Foeniculum vulgare</i> (5.43%) and <i>Moringa oleifera</i> (5.80%)	<i>Alangium salvifolium</i> (2.90%), <i>Inga dulcis</i> (2.54%), <i>Mikania scandens</i> (2.17%) and <i>Phoenix sylvestris</i> (2.90%).
04	Nil	<i>Brassica nigra</i> (44.21%)	<i>Acmella radicans</i> (6.01%), <i>Alangium salvifolium</i> (6.87%), <i>Butea monosperma</i> (12.88%), <i>Coriandrum sativum</i> (15.02%), <i>Eucalyptus globulus</i> (6.44%) and <i>Mangifera indica</i> (5.15%)	<i>Helianthus annuus</i> (1.72%) and <i>Mikania scandens</i> (1.72%).
35	Nil	<i>Brassica nigra</i> (38.41%)	<i>Acmella radicans</i> (3.99%), <i>Alangium salvifolium</i> (4.35%), <i>Butea monosperma</i> (5.80%), <i>Coriandrum sativum</i> (13.04%), <i>Eucalyptus globulus</i> (6.52%), <i>Foeniculum vulgare</i> (3.26%), <i>Mikania scandens</i> (7.97%) and <i>Moringa oleifera</i> (12.32%)	<i>Helianthus annuus</i> (2.17%) and <i>Phoenix sylvestris</i> (2.17%).
55	Nil	<i>Brassica nigra</i> (39.51%)	<i>Acmella radicans</i> (3.41%), <i>Alangium salvifolium</i> (4.39%), <i>Allium cepa</i> (3.41%), <i>Coriandrum sativum</i> (13.66%), <i>Eucalyptus globulus</i> (5.37%), <i>Moringa oleifera</i> (10.73%), <i>Spondias pinnata</i> (11.22%) and <i>Phoenix sylvestris</i> (3.90%)	<i>Dalbergia sissoo</i> (1.95%) and <i>Mikania scandens</i> (2.44%).
<b>March</b>				
05	<i>Butea monosperma</i> (48.97%),	Nil	<i>Alangium salvifolium</i> (7.59%), <i>Albizia lebeck</i> (3.45%), <i>Borassus flabellifer</i> (12.09%), <i>Helianthus annuus</i> (3.79%), <i>Lannea coromandelica</i> (14.48%), <i>Spondias pinnata</i> (4.14%) and <i>Syzygium cumini</i> (3.10%)	<i>Flacourtia jangomas</i> (2.41%).
06	Nil	<i>Borassus flabellifer</i> (34.18%) and <i>Lannea coromandelica</i> (24.47%)	<i>Alangium salvifolium</i> (4.22%), <i>Butea monosperma</i> (3.38%), <i>Coriandrum sativum</i> (9.28%), <i>Madhuca indica</i> (3.38%), <i>Spondias pinnata</i> (9.28%) and <i>Syzygium cumini</i> (7.17%)	<i>Citrus maxima</i> (2.95%) and <i>Momordica charantia</i> (1.69%).
07	Nil	<i>Borassus flabellifer</i> (38.68%) and <i>Lannea coromandelica</i> (22.17%)	<i>Alangium salvifolium</i> (8.49%), <i>Albizia lebeck</i> (4.25%), <i>Coriandrum sativum</i> (9.43%), <i>Flacourtia jangomas</i> (3.77%), <i>Madhuca indica</i> (3.77%), <i>Spondias pinnata</i> (5.19%) and <i>Syzygium cumini</i> (4.25%).	Nil

Table 1. continued

25	Nil	<i>Borassus flabellifer</i> (36.23%) and <i>Lannea coromandelica</i> (20.77%)	<i>Alangium salvifolium</i> (3.86%), <i>Albizia lebbek</i> (9.18%), <i>Coriandrum sativum</i> (8.70%), <i>Helianthus annuus</i> (6.28%), <i>Momordica charantia</i> (8.21%) and <i>Spondias pinnata</i> (6.76%).	Nil
36	<i>Lannea coromandelica</i> (47.11%)	<i>Borassus flabellifer</i> (19.11%) and <i>Coriandrum sativum</i> (16.44%)	<i>Alangium salvifolium</i> (5.33%) <i>Flacourtia jangomas</i> (6.67%) and <i>Madhuca indica</i> (3.11%)	<i>Nigella sativa</i> (2.22%).
37	Nil	<i>Borassus flabellifer</i> (43.63%) and <i>Lannea coromandelica</i> (19.61%)	<i>Albizia lebbek</i> (10.29%), <i>Coriandrum sativum</i> (10.29%), <i>Spondias pinnata</i> (3.43%) and <i>Syzygium cumini</i> (7.35%)	<i>Citrullus lanatus</i> (2.94%) and <i>Momordica charantia</i> (2.45%).
<b>April</b>				
14	Nil	<i>Borassus flabellifer</i> (44.83%)	<i>Albizia lebbek</i> (3.45%), <i>Coriandrum sativum</i> (3.94%), <i>Milletia pinnata</i> (6.90%), <i>Peltophorum pterocarpum</i> (8.37%), <i>Sesamum indicum</i> (13.30%), <i>Tamarindus indica</i> (5.91%) and <i>Terminalia arjuna</i> (13.30%).	Nil
15	<i>Terminalia arjuna</i> (48.33%)	<i>Borassus flabellifer</i> (40.56%)	<i>Milletia pinnata</i> (3.06%) and <i>Sesamum indicum</i> (3.33%)	<i>Coriandrum sativum</i> (1.39%), <i>Tamarindus indica</i> (1.11%) and <i>Vernonia cinerea</i> (1.39%)
38	<i>Borassus flabellifer</i> (56.31%)	Nil	<i>Albizia lebbek</i> (11.71%), <i>Coriandrum sativum</i> (11.71%), <i>Syzygium cumini</i> (12.16%) and <i>Taraxacum officinale</i> (3.15%)	<i>Hygrophila schulli</i> (2.70%) and <i>Madhuca indica</i> (2.25%).
39	<i>Borassus flabellifer</i> (52.74%)	Nil	<i>Aegle marmelos</i> (5.47%), <i>Albizia lebbek</i> (9.95%), <i>Coriandrum sativum</i> (6.97%), <i>Leucaena leucocephala</i> (3.48%), <i>Momordica charantia</i> (3.98%), <i>Syzygium cumini</i> (12.44%) and <i>Tamarindus indica</i> (4.98%).	Nil
40	<i>Terminalia arjuna</i> (51.38%)	<i>Borassus flabellifer</i> (19.66%)	<i>Milletia pinnata</i> (7.24%), <i>Peltophorum pterocarpum</i> (5.52%) and <i>Sesamum indicum</i> (12.76%)	<i>Hygrophila schulli</i> (1.38%) and <i>Syzygium cumini</i> (2.07%).
56	<i>Borassus flabellifer</i> (54.70%)	Nil	<i>Helianthus annuus</i> (3.24%), <i>Milletia pinnata</i> (7.69%), <i>Peltophorum pterocarpum</i> (5.98%), <i>Sesamum indicum</i> (13.68%) and <i>Terminalia arjuna</i> (14.10%)	<i>Coriandrum sativum</i> (2.56%) and <i>Momordica charantia</i> (1.28%).
<b>May</b>				
16	<i>Terminalia arjuna</i> (88.79%)	Nil	<i>Borassus flabellifer</i> (4.04%) and <i>Syzygium reticulatum</i> (5.38%)	<i>Sesamum indicum</i> (1.79%).
17	Nil	<i>Peltophorum pterocarpum</i> (19.82%), <i>Syzygium reticulatum</i> (22.12%), <i>Terminalia arjuna</i> (34.10%)	<i>Momordica charantia</i> (6.91%) and <i>Trianthema portulacastrum</i> (14.75%).	<i>Tridax procumbens</i> (2.30%).
26	Nil	<i>Sesamum indicum</i> (20.00%), <i>Terminalia arjuna</i> (31.71%)	<i>Borassus flabellifer</i> (9.76%), <i>Peltophorum pterocarpum</i> (7.32%), <i>Syzygium reticulatum</i> (13.17%), <i>Tamarindus indica</i> (8.78%) and <i>Trianthema portulacastrum</i> (9.27%).	Nil
41	<i>Terminalia arjuna</i> (54.63%)	Nil	<i>Azadirachta indica</i> (3.24%), <i>Borassus flabellifer</i> (10.19%), <i>Sesamum indicum</i> (13.89%), <i>Tamarindus indica</i> (12.96%) and <i>Vangueria spinosa</i> (3.24%)	<i>Corchorus olitorius</i> (2.78%)
42	<i>Terminalia arjuna</i> (61.35%)	Nil	<i>Averrhoa carambola</i> (6.76%), <i>Borassus flabellifer</i> (13.53%), <i>Trianthema portulacastrum</i> (8.21%) and <i>Tridax procumbens</i> (7.25%).	<i>Semecarpus anacardium</i> (2.90%).
57	Nil	<i>Sesamum indicum</i> (19.35%), <i>Syzygium reticulatum</i> (21.20%) and <i>Terminalia arjuna</i> (32.72%)	<i>Momordica charantia</i> (8.76%), <i>Peltophorum pterocarpum</i> (3.23%) and <i>Tamarindus indica</i> (14.75%)	Nil
<b>June</b>				
18	Nil	<i>Citrus lemon</i> (18.72%) and <i>Cocos nucifera</i> (17.73%)	<i>Averrhoa carambola</i> (9.85%), <i>Coccinia grandis</i> (10.34%), <i>Momordica charantia</i> (10.34%), <i>Peltophorum pterocarpum</i> (12.32%), <i>Sesamum indicum</i> (6.90%) and <i>Vitex negundo</i> (13.79%).	Nil

Table 1. continued

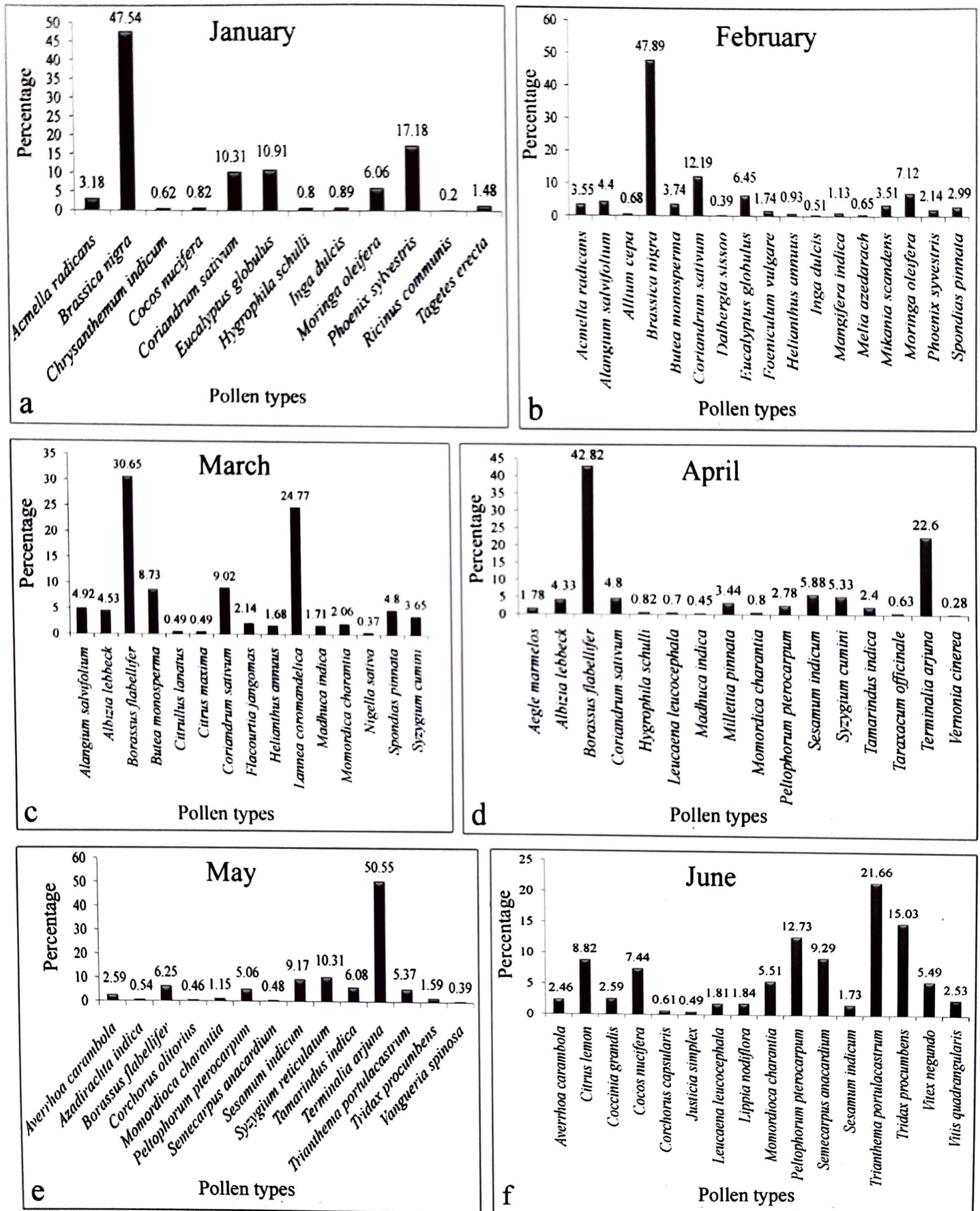
27	Nil	<i>Semecarpus anacardium</i> (18.27%) and <i>Trianthema portulacastrum</i> (34.62%)	<i>Citrus lemon</i> (6.25%), <i>Cocos nucifera</i> (12.02%), <i>Leucaena leucocephala</i> (3.85%), <i>Peltophorum pterocarpum</i> (10.58%), <i>Tridax procumbens</i> (4.33%) and <i>Vitis quadrangularis</i> (10.10%).	Nil
43	Nil	<i>Trianthema portulacastrum</i> (30.88%) and <i>Tridax procumbens</i> (25.49%)	<i>Citrus lemon</i> (10.29%), <i>Lippia nodiflora</i> (7.35%), <i>Momordica charantia</i> (7.35%), <i>Peltophorum pterocarpum</i> (7.84%) and <i>Semecarpus anacardium</i> (6.37%).	<i>Corchorus capsularis</i> (2.45%) and <i>Justicia simplex</i> (1.96%)
44	Nil	<i>Peltophorum pterocarpum</i> (20.19%), <i>Trianthema portulacastrum</i> (21.15%) and <i>Tridax procumbens</i> (30.29%)	<i>Leucaena leucocephala</i> (3.37%), <i>Momordica charantia</i> (4.33%), <i>Semecarpus anacardium</i> (12.50%) and <i>Vitex negundo</i> (8.17%).	Nil
<b>July</b>				
08	Nil	<i>Acacia nilotica</i> (20.47%), <i>Semecarpus anacardium</i> (17.21%) and <i>Trianthema portulacastrum</i> (16.28%)	<i>Anthocephalus cadamba</i> (5.12%), <i>Lippia nodiflora</i> (11.16%), <i>Momordica charantia</i> (5.17%), <i>Peltophorum pterocarpum</i> (6.51%), <i>Tridax procumbens</i> (10.23%) and <i>Vitex negundo</i> (7.91%).	Nil
19	Nil	<i>Semecarpus anacardium</i> (19.90%) and <i>Trianthema portulacastrum</i> (22.82%)	<i>Acacia nilotica</i> (9.71%), <i>Alternanthera paronychioides</i> (7.28%), <i>Anthocephalus cadamba</i> (8.25%), <i>Momordica charantia</i> (9.22%), <i>Peltophorum pterocarpum</i> (6.31%), <i>Tridax procumbens</i> (11.65%) and <i>Vitex negundo</i> (4.85%).	Nil
28	Nil	<i>Acacia nilotica</i> (21.05%)	<i>Cleome viscosa</i> (5.26%), <i>Cucurbita maxima</i> (6.70%), <i>Momordica charantia</i> (5.74%), <i>Murraya paniculata</i> (4.78%), <i>Peltophorum pterocarpum</i> (10.05%), <i>Semecarpus anacardium</i> (15.79%), <i>Trianthema portulacastrum</i> (14.83%) and <i>Tridax procumbens</i> (15.79%).	Nil
45	Nil	<i>Anthocephalus cadamba</i> (16.91%) and <i>Tridax procumbens</i> (29.47%)	<i>Coccinia grandis</i> (7.25%), <i>Cucurbita maxima</i> (3.38%), <i>Lippia nodiflora</i> (9.18%), <i>Murraya paniculata</i> (13.04%) and <i>Peltophorum pterocarpum</i> (15.46%)	<i>Boerhavia diffusa</i> (2.90%) and <i>Psidium guajava</i> (2.42%)
<b>August</b>				
20	Nil	<i>Tridax procumbens</i> (20.95%).	<i>Acacia auriculiformis</i> (10.00%), <i>Acacia nilotica</i> (9.05%), <i>Bridelia retusa</i> (8.10%), <i>Cocos nucifera</i> (10.95%), <i>Leucaena leucocephala</i> (3.33%), <i>Luffa cylindrica</i> (7.62%), <i>Peltophorum pterocarpum</i> (9.52%), <i>Semecarpus anacardium</i> (11.90%) and <i>Ziziphus mauritiana</i> (8.57%).	Nil
29	Nil	<i>Tridax procumbens</i> (30.05%).	<i>Acacia auriculiformis</i> (14.78%), <i>Ageratum conyzoides</i> (3.94%), <i>Coccinia grandis</i> (6.40%), <i>Cocos nucifera</i> (12.81%), <i>Leucaena leucocephala</i> (5.42%), <i>Peltophorum pterocarpum</i> (13.79%) and <i>Ziziphus mauritiana</i> (12.81%).	Nil
46	Nil	<i>Acacia nilotica</i> (26.24%) and <i>Tridax procumbens</i> (23.27%).	<i>Cocos nucifera</i> (12.87%), <i>Cucurbita maxima</i> (3.47%), <i>Luffa cylindrica</i> (6.93%), <i>Peltophorum pterocarpum</i> (15.35%) and <i>Semecarpus anacardium</i> (11.88%).	Nil
47	Nil	<i>Acacia nilotica</i> (18.05%) and <i>Tridax procumbens</i> (23.41%).	<i>Acacia auriculiformis</i> (8.78%), <i>Bridelia retusa</i> (9.76%), <i>Coccinia grandis</i> (5.85%), <i>Cocos nucifera</i> (13.66%), <i>Peltophorum pterocarpum</i> (11.22%) and <i>Semecarpus anacardium</i> (9.27%).	Nil
<b>September</b>				
09	<i>Bridelia retusa</i> (67.80%),	<i>Acacia auriculiformis</i> (17.56%)	<i>Cocos nucifera</i> (8.29%) and <i>Tridax procumbens</i> (3.41%).	<i>Tephrosia purpurea</i> (2.93%)
21	Nil	<i>Acacia auriculiformis</i> (18.98%), <i>Semecarpus anacardium</i> (19.44%) and <i>Ziziphus mauritiana</i> (35.19%).	<i>Cocos nucifera</i> (6.48%), <i>Cucurbita maxima</i> (5.56%), <i>Luffa cylindrica</i> (3.70%) and <i>Tridax procumbens</i> (8.33%).	<i>Antigonon leptopus</i> (2.31%).

Table 1. continued

30	Nil	<i>Acacia auriculiformis</i> (28.37%) and <i>Ziziphus mauritiana</i> (40.87%).	<i>Cocos nucifera</i> (5.29%), <i>Eucalyptus globulus</i> (9.13%), <i>Ocimum sanctum</i> (4.81%) and <i>Tridax procumbens</i> (11.54%).	Nil
48	Nil	<i>Acacia auriculiformis</i> (24.90%), <i>Semecarpus anacardium</i> (21.84%) and <i>Ziziphus mauritiana</i> (35.63%).	<i>Eucalyptus globulus</i> (8.43%) and <i>Tridax procumbens</i> (9.20%).	Nil
<b>October</b>				
22	<i>Eucalyptus globulus</i> (48.13%)	<i>Acacia auriculiformis</i> (23.83%) and <i>Ziziphus sp.</i> (24.30%).	<i>Cocos nucifera</i> (3.74%).	Nil
31	Nil	<i>Acacia auriculiformis</i> (26.13%), <i>Eucalyptus globulus</i> (39.19%) and <i>Ziziphus mauritiana</i> (24.77%).	<i>Cocos nucifera</i> (7.21%).	<i>Antigonon leptopus</i> (2.70%).
49	Nil	<i>Acacia auriculiformis</i> (28.25%), <i>Eucalyptus globulus</i> (37.67%) and <i>Ziziphus mauritiana</i> (27.80%).	<i>Cyanotis axillaris</i> (4.04%).	<i>Luffa cylindrica</i> (2.24%).
50	Nil	<i>Acacia auriculiformis</i> (23.63%), <i>Eucalyptus globulus</i> (44.30%) and <i>Ziziphus mauritiana</i> (32.07%).	Nil	Nil
<b>November</b>				
10	<i>Eucalyptus globulus</i> (54.64%)	Nil	<i>Acacia auriculiformis</i> (13.53%), <i>Brassica nigra</i> (8.22%), <i>Cocos nucifera</i> (11.41%), <i>Eupatorium odoratum</i> (3.18%) and <i>Mikania scandens</i> (6.10%).	<i>Hygrophila schulli</i> (2.12%) and <i>Ricinus communis</i> (0.80%).
23	Nil	<i>Brassica nigra</i> (16.72%) and <i>Eucalyptus globulus</i> (41.11%)	<i>Acacia auriculiformis</i> (12.89%), <i>Cocos nucifera</i> (9.06%), <i>Mikania scandens</i> (12.20%) and <i>Mimosa pudica</i> (4.18%).	<i>Eupatorium odoratum</i> (2.09%) and <i>Hygrophila schulli</i> (1.74%).
32	<i>Eucalyptus globulus</i> (54.74%)	Nil	<i>Acacia auriculiformis</i> (11.92%), <i>Brassica nigra</i> (8.94%), <i>Cocos nucifera</i> (11.38%) and <i>Mikania scandens</i> (5.96%)	<i>Eupatorium odoratum</i> (2.98%), <i>Hygrophila schulli</i> (0.81%), <i>Mimosa pudica</i> (2.44%) and <i>Phyllanthus emblica</i> (0.81%).
51	Nil	<i>Brassica nigra</i> (22.87%) and <i>Eucalyptus globulus</i> (43.50%)	<i>Acacia auriculiformis</i> (15.25%), <i>Eupatorium odoratum</i> (3.14%) and <i>Mikania scandens</i> (15.25%)	Nil
<b>December</b>				
11	<i>Eucalyptus globulus</i> (54.35%)	<i>Brassica nigra</i> (16.30%)	<i>Cassia fistula</i> (5.07%), <i>Coriandrum sativum</i> (6.52%), <i>Mikania scandens</i> (3.99%), <i>Moringa oleifera</i> (4.35%) and <i>Phoenix sylvestris</i> (5.07%).	<i>Acmella radicans</i> (1.81%) and <i>Eupatorium odoratum</i> (2.54%).
12	<i>Eucalyptus globulus</i> (55.60%)	<i>Brassica nigra</i> (20.15%)	<i>Coriandrum sativum</i> (5.22%) and <i>Phoenix sylvestris</i> (7.84%).	<i>Acmella radicans</i> (1.12%), <i>Eupatorium odoratum</i> (2.24%), <i>Inga dulcis</i> (1.87%), <i>Mikania scandens</i> (2.99%) and <i>Moringa oleifera</i> (2.99%).
33	Nil	<i>Brassica nigra</i> (29.44%) and <i>Eucalyptus globulus</i> (44.39%)	<i>Coriandrum sativum</i> (3.27%), <i>Eupatorium odoratum</i> (3.74%), <i>Mikania scandens</i> (7.01%) and <i>Phoenix sylvestris</i> (8.88%).	<i>Acmella radicans</i> (1.87%) and <i>Tagetes erecta</i> (1.40%).
52	<i>Eucalyptus globulus</i> (48.09%)	<i>Brassica nigra</i> (23.28%)	<i>Cocos nucifera</i> (3.05%), <i>Coriandrum sativum</i> (6.11%), <i>Eupatorium odoratum</i> (4.96%), <i>Mikania scandens</i> (4.96%) and <i>Phoenix sylvestris</i> (6.87%).	<i>Acmella radicans</i> (2.67%).
53	Nil	<i>Brassica nigra</i> (30.36%) and <i>Eucalyptus globulus</i> (42.11%)	<i>Coriandrum sativum</i> (3.64%), <i>Mikania scandens</i> (5.26%), <i>Moringa oleifera</i> (3.24%) and <i>Phoenix sylvestris</i> (8.50%).	<i>Chrysanthemum indicum</i> (2.02%), <i>Cocos nucifera</i> (2.43%), <i>Eupatorium odoratum</i> (1.21%) and <i>Tagetes erecta</i> (1.21%).

analyses, 15 pollen types were obtained (Text Figure 2c). Among them secondary pollen types were *Borassus flabellifer*, *Coriandrum sativum* and *Lanea coromandelica*. Besides these 15 taxa, other 9 plant species viz., *Allium cepa*, *Cucurbita maxima*, *Dalbergia sissoo*, *Foeniculum vulgare*, *Inga dulcis*, *Justicia gendarussa*, *Litchi chinensis*, *Murraya*

*koenigii* and *Syzygium jambos* were also identified by field observations. During April, 6 honey samples were analyzed. Among them 3 were unifloral to *Borassus flabellifer* (Table 1 sample nos. 38, 39 and 56), 2 were unifloral to *Terminalia arjuna* (Table 1 sample nos. 15 and 40) and other 1 was multifloral. From pollen analyses 16 pollen types were identified



**Text figure 2a-f.** Month wise (January-June) average percentage of pollen types obtained from honey samples of *Apis florea* in Bankura and Paschim Medinipur districts, West Bengal.

(Text Figure 2d). In addition to 16 pollen taxa, 8 taxa viz. *Averrhoa carambola*, *Azadirachta indica*, *Cassia fistula*, *Citrullus lanatus*, *Cucurbita maxima*, *Foeniculum vulgare*, *Helianthus annuus* and *Psidium guajava* were also recorded through the field observations during this time. During May, 6 honey samples were examined. Among them 3 were unifloral to *Terminalia arjuna* (Table 1 sample nos. 16, 41 and 42) and other 3 were multifloral. Among those multifloral honey samples the secondary pollen types were *Peltophorum pterocarpum*, *Sesamum indicum*, *Syzygium reticulatum*, *Tamarindus indica* and *Terminalia arjuna*. From quantitative analyses of the samples 14 pollen types were obtained (Text Figure 2e). Besides those 14 taxa, other 4 plant species viz. *Citrullus lanatus*, *Lippia nodiflora*, *Luffa cylindrica* and *Murraya paniculata* were also recorded as nectar sources from field observations. In June, after analyses of 4 multifloral honey samples 16 pollen types were obtained (Text Figure 2f). Among them 6 are secondary pollen types viz. *Citrus lemons*, *Cocos nucifera*, *Peltophorum pterocarpum*, *Semecarpus anacardium*, *Trianthema portulacastrum* and *Tridax procumbens*. In addition to those 16 pollen taxa, other plant species viz., *Boerhavia diffusa*, *Calotropis procera*, *Lemnaireocereus* sp., *Mimusops elengi*, *Vangueria spinosa*, *Vigna radiata* and *Vitis trifolia* also served as nectar sources and identified by means of field observations. During July, 4 multifloral honey samples were investigated. Correspondingly 16 pollen types were observed (Text Figure 3a). Among them 5 are of secondary pollen types viz., *Acacia nilotica*, *Anthocephalus cadamba*, *Semecarpus anacardium*, *Trianthema portulacastrum* and *Tridax procumbens*. Rest of the 11 pollen types are represented by important but minor pollen types. In addition to 16 above mentioned taxa, other 8 angiosperm taxa also served as nectar sources and identified through field observations. Those are *Averrhoa carambola*, *Calotropis procera*, *Citrus lemon*, *Cucumis sativus*, *Mimusops elengi*, *Vangueria spinosa*, *Vitis quadrangularis* and *Vitis trifolia*.

During August, 4 honey samples were analyzed and all are multifloral in origin. From these multifloral

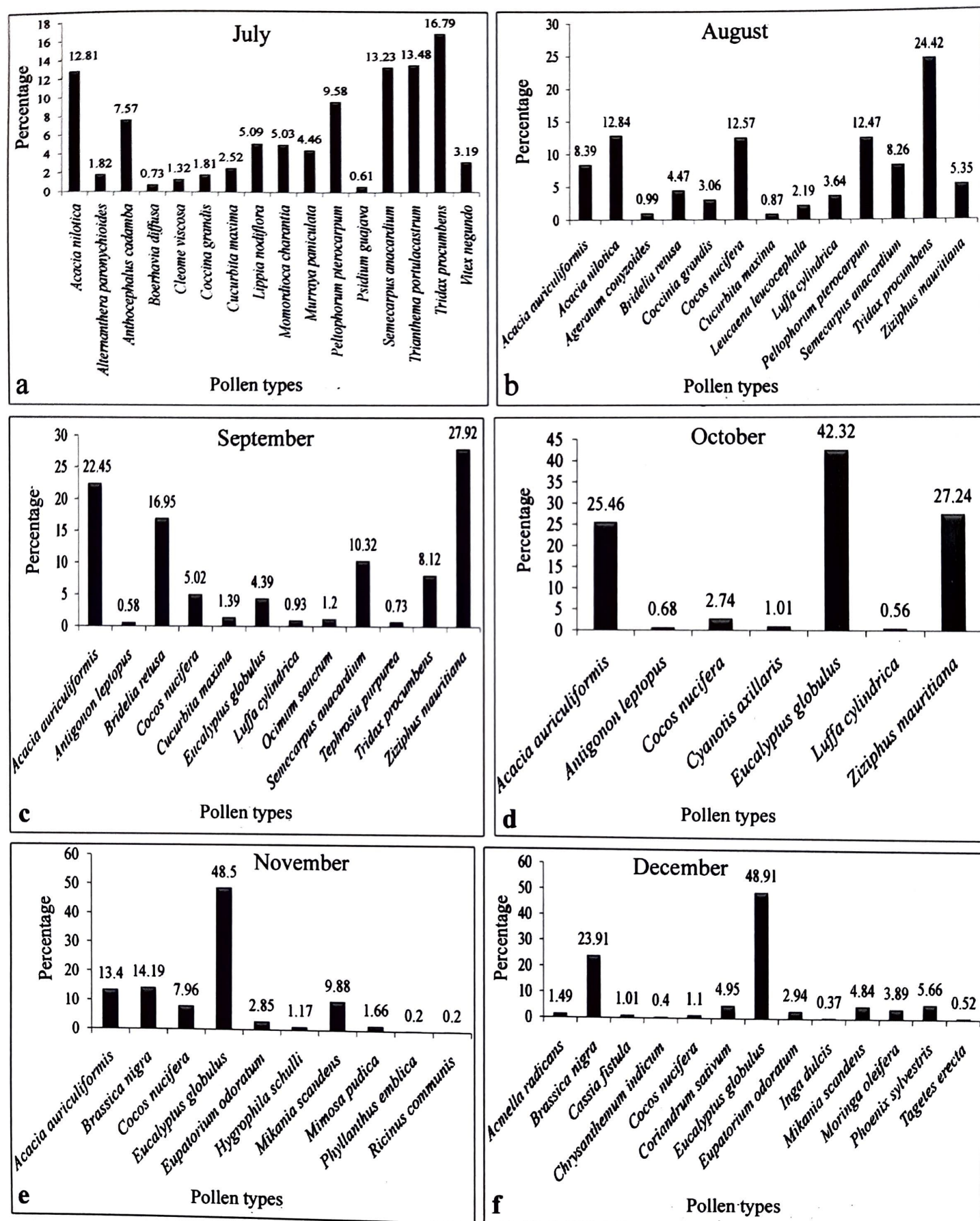
samples 13 pollen types have been recognized (Text Figure 3b). Secondary pollen types were *Acacia nilotica* and *Tridax procumbens*. Besides, other 11 pollen taxa viz., *Alternanthera paronychioides*, *Cucumis sativus*, *Gymnema sylvestre*, *Justicia simplex*, *Lemnaireocereus* sp., *Murraya paniculata*, *Ocimum sanctum*, *Tamarindus indica*, *Tephrosia purpurea*, *Trianthema portulacastrum* and *Vitex negundo* also served as nectar sources and identified through field observations.

In September, 4 honey samples were analyzed. Among them 1 was unifloral to *Bridelia retusa* (Table 1 sample no. 09) and other 3 were multifloral. Secondary pollen types were *Acacia auriculiformis*, *Semecarpus anacardium* and *Ziziphus mauritiana*. From the analysis of these honey samples 12 pollen types were obtained (Text Figure 3c). Field observation data exhibits 4 additional plant species viz., *Cassia tora*, *Justicia simplex*, *Leucaena leucocephala* and *Psidium guajava* those who also supply nectar to *A. florea* colonies.

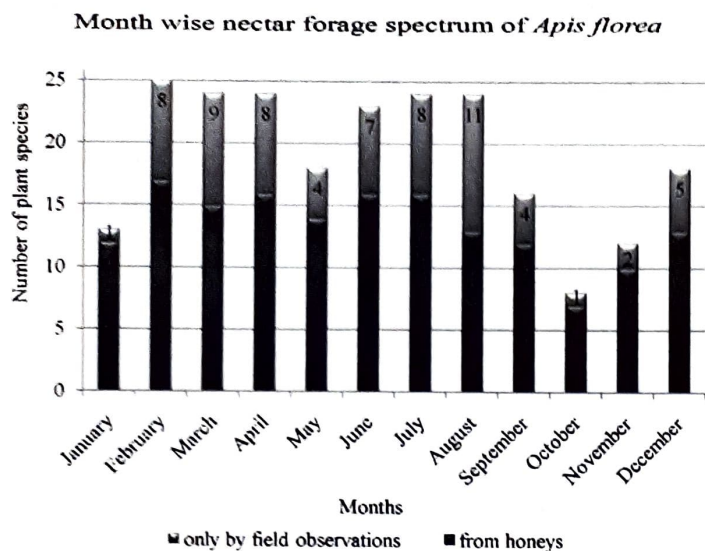
During October, 4 honey samples were examined. Among them 1 was unifloral to *Eucalyptus globulus* (Table 1 sample no. 22) and other 3 were multifloral. Secondary pollen types were *Acacia auriculiformis*, *Eucalyptus globulus* and *Ziziphus mauritiana*. Altogether 7 pollen types were identified (Text Figure 3d). By field observations *Commelina benghalensis* also recorded as nectar source for the bee species. During November, 4 honey samples were evaluated. 2 were unifloral to *Eucalyptus globulus* (Table 1 sample nos. 10 and 32) and other 2 were multifloral. Within the multifloral honey samples the recognized secondary pollen types were *Brassica nigra* and *Eucalyptus globulus*. Analyzing these samples 10 pollen types were identified (Text Figure 3e). Besides these 10 taxa, *Antigonon leptopus* and *Grewia asiatica* also recorded as a source of nectar through field observations.

In December, 5 honey samples were evaluated. Amongst 3 were unifloral to *Eucalyptus globules* (Table 1 sample nos. 11, 12 and 52) and 2 honey samples were multifloral. Secondary pollen types were *Brassica nigra* and *Eucalyptus globulus*. From the





Text figure 3a-f. Month wise (July-December) average percentage of pollen types obtained from honey samples of *Apis florea* in Bankura and Paschim Medinipur districts, West Bengal.



**Text figure 4.** Number of plant species foraged by *Apis florea* as revealed from honey samples and field observations in Bankura and Paschim Medinipur districts, West Bengal.

quantitative analyses of these samples 13 pollen types were identified (Text Figure 3f). In addition to these 13 taxa, other 5 plant species viz., *Grewia asiatica*, *Mimosa pudica*, *Psidium guajava*, *Ricinus communis* and *Sapindus mukorosii* also served as nectar sources and identified by field observations.

## DISCUSSION

Present work reveals that 94 species of angiosperms belonging to 40 families were visited by *A. florea* to accumulate nectar for making honey in Bankura and Paschim Medinipur districts, West Bengal (Table 2). Some of those angiosperm pollen taxa have been depicted in Plate 1. The best represented families were Fabaceae with 16 plant species, Asteraceae with 10 plant species, Cucurbitaceae with 6 plant species, Myrtaceae and Rutaceae each with 5 plant species. Among the 57 honey samples, 22 were unifloral and 35 were of multifloral in origin. Among the unifloral honey samples 3 were of *Borassus flabellifer* type, 5 were *Brassica nigra* type, 1 was *Bridelia retusa* type, 1 was *Butea monosperma* type, 6 were *Eucalyptus*

*globules* type, 1 was *Lannea coromandelica* type and 5 were of *Terminalia arjuna* type. During the month of June to August we did not obtain any unifloral honey, because at that time there is a deficiency of good nectar yielding plants suggesting a dearth period for the bee species. The number of foraged plants is 25 during February, 24 for every month of March, April, July and August, 23 in June, 18 in May and December, 16 during September, 13 in January, 12 during November and only 8 for the month of October (Text Figure 4). *A. florea* forage on both wild as well as cultivated plants like *Allium cepa*, *Brassica nigra*, *Citrullus lanatus*, *Citrus lemon*, *Citrus maxima*, *Coccinia grandis*, *Cocos nucifera*, *Corchorus capsularis*, *Corchorus olitorius*, *Coriandrum sativum*, *Cucumis sativus*, *Cucurbita maxima*, *Dolichos lablab*, *Foeniculum vulgare*, *Helianthus annuus*, *Litchi chinensis*, *Luffa cylindrica*, *Madhuca indica*, *Mangifera indica*, *Momordica charantia*, *Moringa oleifera*, *Nigella sativa*, *Psidium guajava*, *Sesamum indicum*, *Spondia spinnata*, *Syzygium cumini*, *Syzygium jambos*, *Syzygium reticulatum*, *Tamarindus indica* and *Ziziphus mauritiana*. While collecting nectar from the flowers of above mentioned crops, *A. florea* may have helped in their pollination resulting in higher yields and better quality production. Thus, pollination benefits the society by increasing the food security and improving the livelihoods while playing a vital role in conserving the biological diversity in agricultural and natural ecosystems.

## ACKNOWLEDGEMENTS

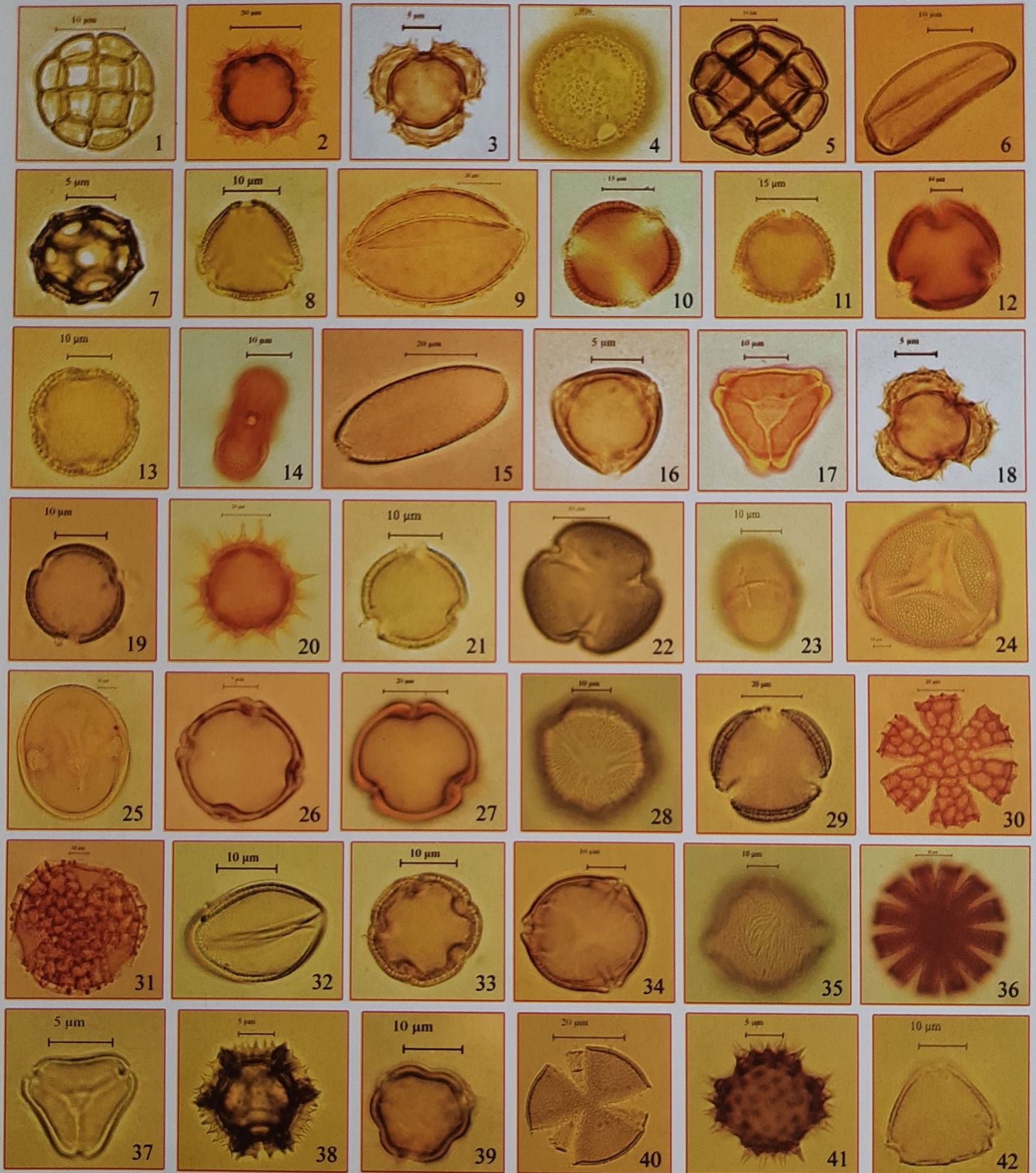
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Table 2. List of plant species foraged by *Apis florea* to collect nectar in Bankura and Paschim Medinipur districts, West Bengal.

Family	Plant species	Habit	Flowering season
Acanthaceae	<i>Adhatoda vasica</i> L.	Shrub	Throughout the year
	<i>Hygrophila schulli</i> (Buch.-Ham.) M. R. & S. M. Almeida	Herb	September-April
	<i>Justicia gendarussa</i> Burm. f.	Shrub	February-March
	<i>Justicia simplex</i> D. Don.	Herb	July-October
Aizoaceae	<i>Trianthema portulacastrum</i> L.	Herb	April-October
Alangiaceae	<i>Alangium salvifolium</i> (L. f.) Wang.	Tree	February-April
Amaranthaceae	<i>Alternanthera paronychioides</i>	Herb	May-December
Amaryllidaceae	<i>Allium cepa</i> L.	Herb	March-April
Anacardiaceae	<i>Lannea coromandelica</i> (Houtt.) Merr.	Tree	February-March
	<i>Mangifera indica</i> L.	Tree	January-March
	<i>Semecarpus anacardium</i> L. f.	Tree	May-June
	<i>Spondias pinnata</i> (L. f.) Kurz	Tree	January-April
Apiaceae	<i>Coriandrum sativum</i> L.	Herb	December-May
	<i>Foeniculum vulgare</i> Mill.	Herb	December-May
Arecaceae	<i>Borassus flabellifer</i> L.	Tree	March-May
	<i>Cocos nucifera</i> L.	Tree	Throughout the year
	<i>Phoenix sylvestris</i> L. Roxb.	Tree	January-May
Asclepiadaceae	<i>Calotropis procera</i> (Aiton) W. T. Aiton	Shrub	June-September
	<i>Gymnema sylvestris</i> R. Br.	Climber	June-September
Asteraceae	<i>Acmella radicans</i> (Jacquin) R. K. Jansen	Herb	December-March
	<i>Ageratum conyzoides</i> L.	Herb	July-December
	<i>Chrysanthemum indicum</i> L.	Herb	December-April
	<i>Eupatorium odoratum</i> L.	Shrub	November-July
	<i>Helianthus annuus</i> L.	Shrub	February-April
	<i>Mikania scandens</i> B. L. Rob.	Climber	November-May
	<i>Tagetes erecta</i> L.	Herb	Throughout the year
	<i>Taraxacum officinale</i> F. H. Wigg	Herb	March-May
	<i>Tridax procumbens</i> L.	Herb	Throughout the year
	<i>Vernonia cinerea</i> Less.	Herb	March-May
Brassicaceae	<i>Brassica nigra</i> L.	Herb	November-March
Cactaceae	<i>Lemaireocereus</i> sp.	Shrub	August
Capparidaceae	<i>Cleome viscosa</i> L.	Herb	June-August
Combretaceae	<i>Terminalia arjuna</i> DC. Wight & Arn.	Tree	April-June
Commelinaceae	<i>Commelina benghalensis</i> L.	Herb	September-November
	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	Herb	September-November
Cucurbitaceae	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Prostrate or Climber	February-May
	<i>Coccinia grandis</i> (L.) Voigt	Prostrate or Climber	May-September
	<i>Cucumis sativus</i> L.	Prostrate or Climber	July-September
	<i>Cucurbita maxima</i> Duchesne	Prostrate or Climber	Throughout the year
	<i>Luffa cylindrica</i> L.	Prostrate or Climber	May-October
	<i>Momordica charantia</i> L.	Prostrate or Climber	February-August
Euphorbiaceae	<i>Phyllanthus emblica</i> L.	Tree	April-August
	<i>Ricinus communis</i> L.	Shrub	July-February

Table 2. continued

Fabaceae	<i>Acacia auriculiformis</i> A. Cunn. ex Benth	Tree	August-November
	<i>Acacia nilotica</i> (L.) Willd. ex Del.	Tree	June-September
	<i>Albizia lebbek</i> (L.) Benth.	Tree	March-May
	<i>Butea monosperma</i> (Lam.) Taub.	Tree	February-April
	<i>Cassia fistula</i> L.	Tree	March-April
	<i>Cassia tora</i> L.	Herb	July-October
	<i>Dalbergia sissoo</i> Roxb.	Tree	April-August
	<i>Dolichos lablab</i> L.	Climber	November-April
	<i>Inga dulcis</i> (Roxb.) Willd	Tree	November-March
	<i>Leucaena leucocephala</i> (Lam.) de Wit	Tree	June-October
	<i>Millettia pinnata</i> (L.) Panigrahi	Tree	March-June
	<i>Mimosa pudica</i> L.	Herb	Throughout the year
	<i>Peltophorum pterocarpum</i> DC. K. Heyne	Tree	March-June
	<i>Tamarindus indica</i> L.	Tree	April-August
	<i>Tephrosia purpurea</i> (L.) Pers.	Herb	July-September
	<i>Vigna radiata</i> (L.) R. Wilczek	Herb	June-August
Lamiaceae	<i>Ocimum sanctum</i> L.	Herb	July-September
	<i>Vitex negundo</i> L.	Shrub	May-August
Meliaceae	<i>Azadirachta indica</i> A. Juss.	Tree	March-May
	<i>Melia azedarach</i> L.	Tree	February-April
Moringaceae	<i>Moringa oleifera</i> Lam.	Tree	November-March
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	Tree	November-April
	<i>Psidium guajava</i> L.	Tree	January-May
	<i>Syzygium cumini</i> L. Skeels	Tree	March-April
	<i>Syzygium jambos</i> L. (Alston)	Tree	January-March
	<i>Syzygium reticulatum</i> (Wight) Walp.	Tree	May-June
Nyctaginaceae	<i>Boerhavia diffusa</i> Linn.	Herb	Throughout the year
Oxalidaceae	<i>Averrhoa carambola</i> L.	Tree	March-September
Pedaliaceae	<i>Sesamum indicum</i> L.	Herb	April-June
Phyllanthaceae	<i>Bridelia retusa</i> (L.) A. Juss.	Tree	August-September
Polygonaceae	<i>Antigonon leptopus</i> Hook. & Arn.	Climber	Throughout the year
Ranunculaceae	<i>Nigella sativa</i> L.	Herb	January-March
Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Tree	August-October
Rubiaceae	<i>Anthocephalus cadamba</i> (Roxb.) Miq.	Tree	July-August
	<i>Vangueria spinosa</i> Roxb.	Shrub	May-July
Rutaceae	<i>Aegle marmelos</i> L. Corr. Serr.	Tree	April-July
	<i>Citrus lemon</i> (L.) Burm. f.	Tree	June-August
	<i>Citrus maxima</i> Burm. Men.	Tree	February-April
	<i>Murraya koenigii</i> (L.) Sprengel	Shrub	February-April
	<i>Murraya paniculata</i> (L.) Jack	Tree	Throughout the year
Salicaceae	<i>Flacourtia jangomas</i> (Lour.) Raeusch.	Tree	February-March
Sapindaceae	<i>Litchi chinensis</i> Sonn.	Tree	February-March
	<i>Sapindus mukorossi</i> Gaertn.	Tree	November-January
Sapotaceae	<i>Madhuca indica</i> J. F. Gmel.	Tree	March-April
	<i>Mimusops elengi</i> L.	Tree	June-August
Tiliaceae	<i>Corchorus capsularis</i> L.	Herb	May-June
	<i>Corchorus olitorius</i> L.	Herb	May-June
	<i>Grewia asiatica</i> L.	Tree	December-January
Verbenaceae	<i>Lippia nodiflora</i> (Linn.) Rich.	Herb	May-July
Vitaceae	<i>Vitis quadrangularis</i> Wall.	Climber	June-July
	<i>Vitis trifolia</i> Linn.	Climber	May-November



### Plate 1

Pollen grains of (1) *Acacia auriculiformis*, (2) *Acmella radicans*, (3) *Ageratum conyzoides*, (4) *Alangium salvifolium*, (5) *Albizia lebbeck*, (6) *Allium cepa*, (7) *Alternanthera paronychoides*, (8) *Anthocephalus cadamba*, (9) *Borassus flabellifer*, (10) *Brassica nigra*, (11) *Bridelia retusa*, (12) *Butea monosperma*, (13) *Citrus lemon*, (14) *Coriandrum sativum*, (15) *Cyanotis axallaris*, (16) *Dalbergia sissoo*, (17) *Eucalyptus globulus*, (18) *Eupatorium odoratum*, (19) *Flacourtia jamgomias*, (20) *Helianthus annuus*, (21) *Lannea coromandelica*, (22) *Leucaena leucocephala*, (23) *Lippia nodiflora*, (24) *Luffa cylindrica*, (25) *Madhuca indica*, (26) *Melia azedarach*, (27) *Moringa oleifera*, (28) *Murraya paniculata*, (29) *Nigella sativa*, (30) *Ocimum sanctum*, (31) *Peltophorum pterocarpum*, (32) *Phoenix sylvestris*, (33) *Phyllanthus emblica*, (34) *Ricinus communis*, (35) *Semecarpus anacardium*, (36) *Sesamum indicum*, (37) *Syzygium reticulatum*, (38) *Taraxacum officinale*, (39) *Terminalia arjuna*, (40) *Trianthema portulacastrum*, (41) *Tridax procumbens*, (42) *Ziziphus mauritiana*.

**REFERENCES**

- Abrol D.P. 2010. Foraging behaviour of *Apis florea* F., an important pollinator of *Allium cepa* L. Journal of Apicultural Research 49(4): 318-325.
- Bhusari N.V., Mate D.M. & Makde K.H. 2005. Pollen of *Apis* honey from Maharashtra. Grana 44: 216-224.
- Hepburn H.R. & Radloff S.E. 2011. Honeybees of Asia. Springer: Berlin.
- Kalpana T.P., Fatima K. & Ramanujam C.G. K. 1990. Pollen analysis of *Apis cerana* and *Apis florea* honeys from Adikmet area, Hyderabad. Proceedings of the Indian Academy of Sciences (Plant Science) 100: 183-193.
- Kalpana T.P. & Ramanujam C.G.K. 1994. *Carum copticum* - A major sources of winter Honeys in Ranga Reddy District, Andhra Pradesh. Proceeding of the Indian National Science Academy 60(6): 583-593.
- Louveaux J., Maurizio A. & Vorwohl G. 1978. Methods of Melissopalynology. Bee World 59: 139-157.
- Mahajan D.M., Salunkhe I.B. & Gunale V.R. 2000. Pollen analysis of *Apis florea* Fabr. Honeys from the South-Western Satpura (Maharashtra). The Indian Forester 126(2): 156-164.
- Maurizio A. 1951. Pollen analysis of honey. Bee World 32: 1-5.
- Mukhopadhyay S.K., Gupta, S., Das A.P. & Bera S. 2007. The beekeeping potential of sub-himalayan West Bengal, India: A palynological assessment of honey. Journal of Apicultural Research 46(3): 165-180.
- Wongsiri S., Lekprayoon C., Thapa R., Thirakupt K., Rinderer T., Sylvester H. & Oldroyd B. 1996. Comparative biology of *Apis andreniformis* and *Apis florea* in Thailand. Bee World 77(4): 25-35.