

Studies on Sources of Bee-forage for Rock Bee (*Apis dorsata* F.) from Garhwal Himalaya, India: A Melissopalynological Approach

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Abstract: Rock bee, *Apis dorsata* F. is the best honey gatherer and important pollinator among the Indian honey bees. While other bees stop their work during night, rock bees are the only bees that work during full moon night to collect nectar and pollen. Seeing the role of rock bees in meeting the honey demand in the country; it was aimed to study the forage of this group of bees on the basis of Melissopalynological analysis. The study was conducted in Garhwal Himalaya, India. Pollen analysis of 21 samples of rock bee honey was made to work out the rock bee flora on the basis of pollen morphology, composition and percentage of pollen present in honey. Methodology suggested by International Commission for Bee Botany (Louveaux *et al.*, 1978) was followed. The pollen analysis revealed the members of family Asteraceae, Brassicaceae, Betulaceae, Myrtaceae, Rosaceae and Rubiaceae as pre-dominant and Acanthaceae, Balsaminaceae, Lamiaceae, Onagraceae, Ericaceae, Polygonaceae and Hippocastanaceae as secondary source of pollen. The species of *Echinops*, *Scurulla*, *Dipsacus*, *Sedum*, *Citrus*, *Juglans*, *Bombax*, *Geranium* and *Plectranthus* have emerged as important minor pollen types. [Nature and Science 2010;8(6):5-15]. (ISSN: 1545-0740).

Key words: Garhwal Himalaya, Bee forage plants, *Apis dorsata*, Melissopalynology.

1. Introduction

Garhwal Himalaya lying between 77° 49' E to 80° 6' E and 29° 36' N to 31° 38' N (Figure 1) has been bestowed with a green cover of forests and vegetation which serves as reserve stock of unconventional fruits, medicinal, ornamental plants and many other forest products. One of them is the nutritious and precious product named honey. The varying agro-climatic conditions of this region widen the scope of availability of honey yielding plants in different regions in different seasons indicating high potential for honey production.

Honey, the liquid gold of nature is a concentrated solution of sugars prepared by the little friends of human beings known as 'bees' from the nectar and pollen of flowers. The great diversity of nectar producing plants yields several types of honeys. Of all the creatures on earth the bees are perhaps the most beloved, as diligent, disciplined and devoted beings.

There are three species of honey bees- *Apis dorsata* Fabr.; *A. florea* Fabr. and *A. cerana-indica* Fabr. present in the area. *Apis dorsata* (Sarang, Bhanwar, Pahari Mahal) has a self migration,

between plains and hills up to an altitude of 1300 m. In undivided state Uttar Pradesh almost 70 % of the honey and 98 % of wax was produced by rock bees (Singh, 1983). This bee has a single combed nest measuring about 1.525m to 2.135m from side to side and 0.61m to 1.22 m from top to bottom. The combs may be suspended from rocks, ceilings of neglected and inhabited houses (Plate-1, Figures 2-5), high hedges, branches of tall forest trees like *Bombax ceiba*, *Toona ciliata*, *Mangifera indica*, *Syzygium cumini*, etc. These bees are very good honey makers and have been observed to begin days work early in the morning and stop it by late hours of evening. The authors have noted these bees collecting nectar and pollen from *Oenothera rosea*, *Nyctanthes arbor-tristis* and *Quisqualis indica* in the late hours of evening up to 9 pm during the months of May and June. They store surplus honey generally in the front portion of the comb which is harvested twice or thrice during the season. A single nest yields 30 to 40 kg. honey per season. The efforts to keep these bees inside hive, box, log or any other mean have not been succeeded till date.

Apis dorsata the dominant honey maker insect is

a dweller of forests. The forests of Garhwal Himalayan region represent rich diversity of vegetation. Broadly these are categorized into sub-montane and montane types on the basis of elevation and due to rich diversity serve as excellent source of nectar and pollen. In alpine zone, although good nectar producing plants are present but due to extreme cold, bees survive less.

Melissopalynology is the method concerned with identification of pollen present in honey (Sawyer, 1975; Maurizio, 1951). A major constraint

for the honey industry in this area has been the lack of information available on the floral sources of nectar and pollen of rock bees. A perusal of literature indicates that some work has been done on *A. dorsata* forage by Jhansi *et al.* (1991), Ramanujam and Khatiza (1992), Ramanujam (1994), Laxmi and Suryanarayan (1997), Sabato (1997) from south India, but from this part of India not any attempt has been made. So the present investigation is aimed to find out the bee-forage sources for *A. dorsata* by field observation and pollen analysis of honey samples.

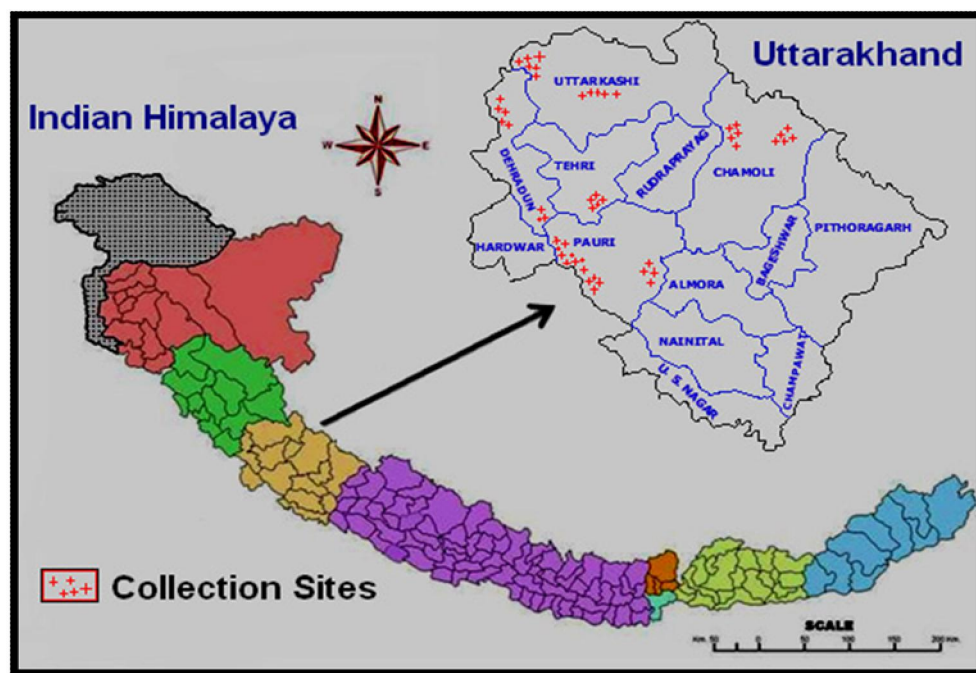


Figure 1. Map showing the Study Area

2. Materials and Methods

Present study deals with field visits to the forests supplemented by laboratory work. Twenty one honey samples from different localities of Garhwal Himalaya were collected. The parameters taken into consideration were the place of collection, season of honey extraction and altitude of locality (Table 1). The plant species occurring in the vicinity of collection sites were collected. Laboratory work consisted of preparation of reference pollen slides of plant specimens following Wodehouse (1935) and

Erdtman (1952). Microscopic pollen analysis of each honey sample was done by using the methods given by the International Commission for Bee-Botany (Louveaux *et al.*, 1978). The plant species enumerated according to their families, have been arranged alphabetically followed by information on local names and flowering period, bee-forage value and other economic uses (Table 2). The value of plant species has been indicated as N for nectar and P for pollen source. The nectar source (N) in the bee flora has been identified on the basis of field observations.



Plate 1.(Figures 2-5) 2. Combs of *Apis dorsata* suspended on ceiling of a building. 3. A single comb. 4. Comb showing the honey chamber. 5. Colony showing worker bees.

Table 1. Study area, honey samples and properties

S. No.	Locality	Elevation (m)	Season	Nature	Colour	Density
1	Dugadda	850	Oct-Nov	Multifloral	Orange red	1.357906
2	Dugadda	850	Mar-Apr	Unifloral	Red-brown	1.42920
3	Ansuya Devi	1800	Mar-Apr	Unifloral	Yellow-brown	1.372988
4	Gopeshwar	1800	Oct-Nov	Multifloral	Dull yellow	1.189264
5	Gopeshwar	1800	May-Jun	Multifloral	Red-brown	1.191384
6	Gopeshwar	1800	Oct-Nov	Multifloral	Blackish brown	1.177841
7	Kirtinagar	500	Apr-May	Multifloral	Dark amber	1.127882
8	Jawargaddi	1300	Oct-Nov	Multifloral	Orange yellow	1.228314
9	Mundoli	2400	Mar-Apr	Multifloral	Dark brown with reddish tinge	1.29785
10	Mordhwaj	300	Mar-Apr	Multifloral	Brick red	1.308158
11	Mordhwaj	300	Oct-Nov	Multifloral	Red brown	1.298158
12	Chamoli	1200	Mar-Apr	Unifloral	Brick red	1.297898
13	Cheela	300	Mar-Apr	Unifloral	Pale yellow	1.301421
14	Cheela	300	Oct-Nov	Multifloral	Reddish-brown	1.312322
15	Nathupur	900	Jan-Feb	Unifloral	Orange red	1.16157
16	Sajahasen	850	Oct-Nov	Multifloral	Pale yellow	1.49257
17	Umrella	1250	May-Jun	Unifloral	Creamish yellow	1.39931
18	Uttarkashi	1250	July	Unifloral	Dark brown	1.27796
19	Raath	1800	Oct-Nov	Unifloral	Red brown	1.277768
20	Panduwala	350	Apr-May	Unifloral	Reddish brown	1.507336
21	Vikasnagar	300	Oct-Nov	Unifloral	Shining red brown	1.457822

3. Results

A total of 194 plant species belonging to 64 families have been identified as dorsata bee forage species (Table 2). Out of the 63 families, 29 were represented by pollen in varying proportions (Figure 6). Some representative pollen types have been given in Plate 2 (Figure 7-12). The findings on the nature, colour and density of honey of the samples collected have been presented in Table 1. Of the 21 samples of *A. dorsata* honey, 9 were unifloral, having a predominant pollen types belonging to the families like Rosaceae (*Eriobotrya japonica*, *Malus bacata*, *Prunus cerasoides*, *P. persica*, *Pyracantha crenulata*, *Pyrus pashia*, *Rosa brunonii*, *R. macrophylla*, *R. sericea*, *Rubus biflorus* and *R. ellipticus*), Asteraceae (*Inula cappa*, *Helianthus annuus*, *Tagetes erectus*, *Tridax procumbens* and *Ageratum conyzoides*), Brassicaceae (*Brassica campestris*, *B. juncea*, *B. rapa*, *B. rugosa* and *Raphanus sativus*), Rubiaceae (*Haldina cardifolia* and *Spermadictyon suaveolens*) and Myrtaceae (*Callistemon citrinus*, *Eucalyptus*

camaldulensis, *E. citriodora*, *E. globulus*, *E. obliqua*, *E. tereticornis*, *Psidium guajava* and *Syzygium cumini*). The remaining 12 samples were multifloral consisting of two or more pollen types, forming the secondary pollen types consisting of the members of Lamiaceae (*Anisomeles indica*, *Leonotis nepetifolia*, *Leucas indica* and *Salvia lanata*), Hippocastanaceae (*Aesculus indica*), Ericaceae (*Rhododendron arboreum* and *Lyonia ovalifolia*), Onagraceae (*Oenothera rosea*), Rutaceae (*Murraya koenigii*), Meliaceae (*Toona hexandra* and *Melia azedarach*), Polygonaceae (*Polygonum plebeium*, *Fagopyrum esculentum* and *Rumex hastatus*), Balsaminaceae (*Impatiens balsamina*), Acanthaceae (*Justicia adhatoda*), anaemophilous and some other members of Asteraceae (*Artemisia nilagrica*, *Bidens pilosa*, *Calendula officinalis*, *Eupatorium adenophorum* and *Sonchus – Launaea* group), and Rosaceae (*Prinsepia utilis*, *Prunus armeniaca*, *P. cerasifera*, *Pyrus communis* and *Spiraea canescens*).

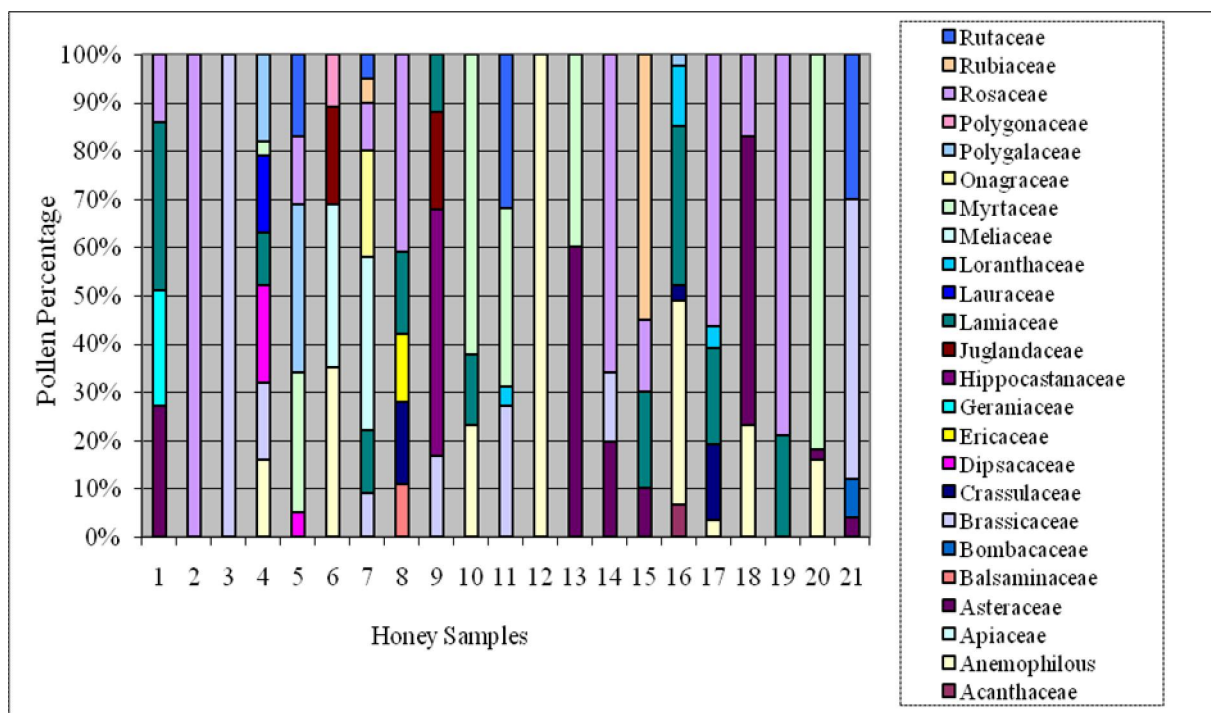


Figure 6. Honey samples showing presence of pollen.

Some anemophilous families such as Amaranthaceae (*Celosia argentea*, *Amaranthus paniculatus* and *Chenopodium album*), Arecaceae

(*Phoenix humilis*), Betulaceae (*Alnus nepalensis*), Cannabinaceae (*Cannabis sativa*), Moraceae (*Artocarpus heterophyllus* and *Morus serrata*),

Poaceae (*Bambusa arundinacea*, *Cymbopogon martinii*, *Eleusine coracana* and *Zea mays*), Ulmaceae (*Holoptelea integrifolia*), Urticaceae (*Urtica dioica*), are considered equally good as entomophilous species by bees.

In spite of these two categories of pollen types some plant species like *Scurulla cordifolia*, *Sedum adenotrichum*, *Juglans regia*, *Bombax ceiba*, *Barleria*

cristata, *Dicliptera rouxburghiana*, *Peristrophe paniculata*, *Dipsacus inermis*, *Dioscorea pentaphylla*, *Pogostemon benghalense*, *Azadirachta indica*, *Haldinia cardifolia*, *Spermadictyon suaveolens*, *Citrus aurantifolia*, *C. sinensis*, *Glycosmis mauritiana*, etc. are indicating their value as important minor to minor bee forage for rock bees.

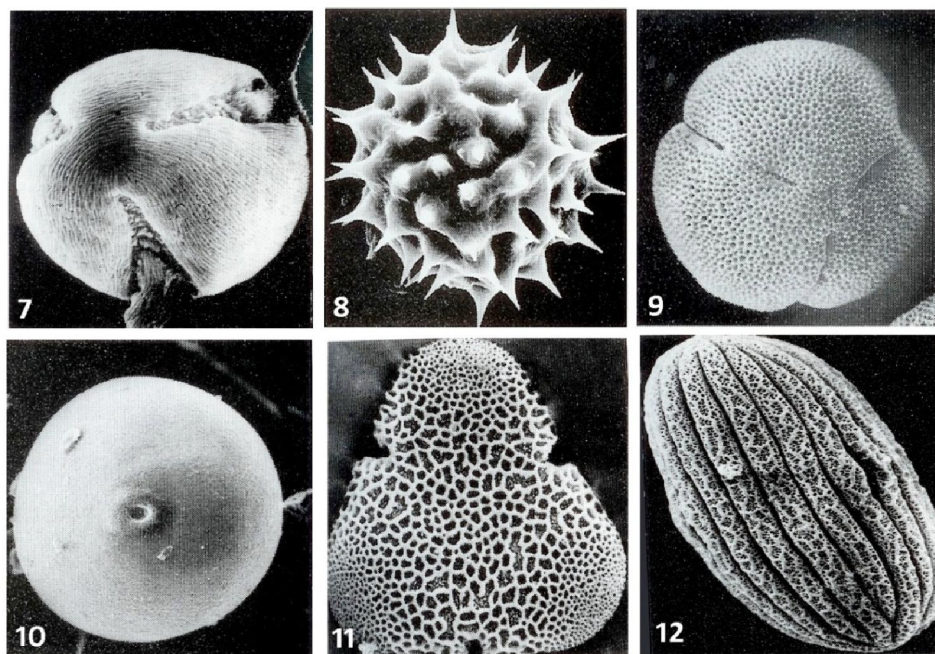


Plate: 2. Microphotographs of pollen grains. (Figures 7-12) 7. *Rubus* sp. 8. *Helianthus annuus*
9. *Rumex hastatus* 10. *Zea mays* 11. *Bombax ceiba* 12. *Plectranthus alatus*

4. Discussion

The forests of Garhwal Himalaya offer huge potential for beekeeping with its vast bee-forage resource (Gaur, 1984). Field studies help in identifying plant species as source of nectar and pollen. The forage sources may be horticultural, agricultural, agro-forestry, wild and weed species found in agricultural fields, waste lands or along road sides. Eighty percent of the honey marketed in India comes from rock bees (Mahendra, 1997). Honey collection from dorsata hives is an income generation activity for small land marginal farmers, landless labours and weaker sections of the society living in the vicinity of the forests. With integrated bee keeping management efforts, there is great potential not only for increasing the production of agricultural and horticultural crops, but also of conserving forest

and grassland ecosystems, thus maintaining biological diversity.

The Rosaceae are rich source of nectar and pollen. The study reveals that out of 21 samples, 10 are indicating the presence of *Rosa* - *Rubus* type pollen in secondary and predominant category. The plant species like *Rosa* spp., *Rubus ellipticus*, *Pyracantha crenulata*, *Prinsepia utilis*, *Prunus cerasoides*, *Pyrus pashia*, *P. malus*, etc. have not received due attention in the area on account of lack of knowledge about their bee forage value.

It is suggested to encourage the cultivation of agricultural and horticultural crops with good bee forage value like *Brassica* spp., *Helianthus annuus*, *Sesamum indicum*, *Zea mays*, *Echinochloa* sp., *Lagenaria* spp., *Momordica* sp., *Cucurbita* spp., *Cucumis* sp., *Punica granatum*, *Litchi chinensis*,

Musa paradisiaca, *Psidium guajava*, *Syzigium cumini*, *Cajanus cajan*, etc. Besides these the naturally growing species like *Aegle marmelos*, *Aesculus indica*, *Melia azedarch*, *Cedrella toona*, *Syzigium cumini*, *Inula* sp., *Plectranthus* sp., *Murraya* sp., *Impatiens* sp., with ornamental trees

such as *Callistemone citrinus*, *Cassia fistula*, *Delonix regia*, *Eucalyptus* spp., *Pongamia pinnata*, *Pterospermum acerifolium* and herb species consisting of Lamiacean, Acanthacean, Crassulacean and Asteracean members should be planted and managed as good bee forage species.

Table 2. Enumeration of plant sources of bee forage for *Apis dorsata* in Garhwal Himalaya, India

S. No.	Family/Name of plant Species	Local Name	Flowering Period	Bee Forage Value ¹	Other Uses ²
Acanthaceae					
1.	<i>Barleria cristata</i> L.	Kala-bansa	Sep - Nov	N3 P3	Md
2.	<i>Dicliptera rouburghiana</i> Nees	Kulartore	Jan - Dec	N1 P3	Fd, Md
3.	<i>Justicia adhatoda</i> L.	Basinga	Dec - Apr	N2 P2	Md
4.	<i>Peristrophe peniculata</i> (Forsk.) Brumitt	Kaknadi	Jul - Sept	N1 P3	Md
Anacardiaceae					
5.	<i>Lannea coromandelica</i> (Houttuyn) Merrill	Kalmina	Mar - Apr	N1	Fw, Ag imp, Md
6.	<i>Mangifera indica</i> L.	Aam	Feb - Apr	N3	Ed, Tm, Md
7.	<i>Semecarpus anacardium</i> L.	Bhilwa	Jun - Sep	N2	Ed, Md,
8.	<i>Rhus parviflora</i> Roxb.	Tungla	Apr - Jun	N2	Ed, Fw, Fd, Md
9.	<i>Spondias pinnata</i> (L.f.) Kurz	Amara	Feb - Apr	N2	Ed, Md
Apiaceae					
10.	<i>Bupleurum falcatum</i> L.	Jangli-jeera	Jul - Sep	N1	Md
11.	<i>Coriandrum sativum</i> L.	Dhania	July - Oct	N1	Md, Ed
Arecaceae					
12.	<i>Phoenix humilis</i> Royle	Khajoor	Mar - Apr	N2	Ed
Asteraceae					
13.	<i>Ageratum conyzoides</i> L.	Gunrya	Jan - Dec	N1 P2	Md
14.	<i>Artemesia nilagrica</i> (Cl.) Pamp.	Kunjaa	Jul - Dec	N3 P2	Md
15.	<i>Bidens pilosa</i> L.	Kumra	Mar - Aug	N2 P2	Md, Fd
16.	<i>Calendula officinalis</i> L.	Calendula	Dec - Feb	N2 P2	Or
17.	<i>Echinops cornigarous</i> DC.	Kandara	Jul - Dec	N2 P2	Ed, Md
18.	<i>Eupatoium adenophorum</i> Sprengel	Bakura	Feb - Aug	N2 P2	Md, Fd
19.	<i>Helianthus annuus</i> L.	Surajmukhi	Sept - Dec	N1 P1	Or, Ed
20.	<i>Inula cappa</i> (Buch.-Ham. ex D.Don) DC.	Atthu	Nov - Jan	N1 P1	Md
21.	<i>Tagetes erecta</i> L.	Genda	Jan - Dec	N1 P1	Md, Or
22.	<i>Tridax procumbens</i> L.	Kumra	Jan - Dec	N1 P1	Md
23.	<i>Sonchus oleracea</i> L.	Dudhia	Mar - Nov	N2 P2	Md
24.	<i>Launaea asplenifolia</i> (Wild.) Hook.	Dudhliya	Mar - Oct	N2 P2	Md
Amaranthaceae					
25.	<i>Celosia argentea</i> L.	Gadrya	Aug - Dec	P2	Ed, Md
26.	<i>Amaranthus paniculatus</i> L.	Chaulai	July - Sept	P2	Ed
27.	<i>Chenopodium album</i> L.	Banthua	Jan - Dec	P2	Ed, Md
Balsaminaceae					
28.	<i>Impatiens balsamina</i> L.	Chunchuni	Aug - Sept	N1 P2	Md, Dy
Betulaceae					
29.	<i>Alnus nepalensis</i> D.Don	Utis	Oct - Nov	P1	Tm, Fw
Bombacaceae					
30.	<i>Bombex ceiba</i> L.	Semal	Jan - Mar	N1 P3	Ed, Fbr, Gum, Md,
Boraginaceae					
31.	<i>Cordia dichotoma</i> Forster f.	Lasora	Mar - Apr	N1	Ag imp, Md, Ed
Brassicaceae					
32.	<i>Brassica campestris</i> L.	Sarson	Nov - Dec	N1 P1	Ed
33.	<i>B. juncea</i> (L.) Czernajew & Cosson	Laya	Nov - Jan	N1 P1	Ed
34.	<i>B. rapa</i> L.	Rada	Oct -Dec	N1 P1	Ed
35.	<i>B. regusa</i> (Roxb.) Bailey	Rai	Jan - Mar	N1 P1	Ed, Md

36. <i>Raphanus sativus</i> L.	Muli	Feb - Apr	N1 P1	Ed
Cactaceae				
37. <i>Opuntia elatior</i> Miller	Nagphani	Jan - Sep	N3	Ed
Caesalpinaceae				
38. <i>Bauhinia purpurea</i> L.	Guiral	Sep - Nov	N2	Ed, Fd, Ag imp
39. <i>B. racemosa</i> Lamk.	Kandli	Mar - Jun	N2	Fd, Md
40. <i>B. valhlii</i> Wight & Arn.	Malu	Apr - Jun	N2	Fd, Fw, Fbr
41. <i>Caesalpinia decapetala</i> (Roth) Alston	Kingari	Feb - Sep	N2	Fd, Md
42. <i>C. fistula</i> L.	Semaru	Feb - Apr	N2	Tm, Fw, Md, Or
43. <i>C. occidentalis</i> L.	Chakunda	May - Nov	N2	Md
44. <i>C. tora</i> L.	Chakunda	Apr - Sep	N2	Md
45. <i>Delonix regia</i> (Bojer ex Hook.) Refin.- Sch.	Gulmohar	Apr - June	N2	Or
46. <i>Tamarindus indica</i> L.	Imli	Jan - Dec	N1	Ed,Md, Fw
Capparaceae				
47. <i>Capparis zeylanica</i> L.	Bauri	Mar - May	N2	Fd, Ed, Md
48. <i>Crataeva adansonii</i> DC.	Varana	Mar - May	N2	Fd, Fw, Md, Ed
Combretaceae				
49. <i>Anogeissus latifolius</i> (Roxb. ex DC.) Wall.	Dhauri	Apr - Jun	N1	Fw, Ag imp, Gum
50. <i>Quisqualis indica</i> L.	Malti	May - Oct	N2	Or
51. <i>Terminalia arjuna</i> Roxb.ex DC.	Arjuna	Mar - May	N1	Ag imp, Md, Md
52. <i>T. bellirica</i> (Gaertn.) Roxb.	Bahera	Mar - June	N1	Tm, Fw, Md
53. <i>T. chebula</i> Retz.	Harari	Apr - Aug	N1	Fd, Ed, Md,
54. <i>T. tomentosa</i> (Roxb.) Wight & Arn.	Asin	June - July	N1	Tm, Md, Fw
Commelinaceae				
55. <i>Commelina benghalensis</i> L.	Kansura	Jul - Nov	N3	Md
Cannabaceae				
56. <i>Cannabis stiva</i> L.	Bhang	July-Nov	P2	Md
Convolvulaceae				
57. <i>Evolvulus arvensis</i> L.	Heyranpatu	Sep - Apr	N2	Md
Cucurbitaceae				
58. <i>Citrullus colocynthis</i> (L.) Shrader	Toru	Jul - Sep	N2	Ed, Md
59. <i>Coccinia grandis</i> (L.)Voigt	Kandaroi	Jan - Jul	N2	Md
60. <i>Cucumis sativus</i> L.	Kakree	July - Aug	N1	Ed, Md
61. <i>Cucurbita maxima</i> Duchesne	Kaddu	July - Aug	N1	Ed
62. <i>Luffa acutangula</i> (L.) Roxb.	Gudari, Torai	Mar - Nov	N1	Ed, Md
63. <i>Momordica charantia</i> L.	Karela	Apr - Sept	N1	Ed, Md
Crassulaceae				
64. <i>Sedum adenotrichum</i> Wallich ex Edgew.	Satyan-Savitri	Mar - Apr	N1 P3	Md
65. <i>Kalanchoe integra</i> (Medik.)Kuntz.	Biskhapara	Sep - Dec	N1 P1	Md
Cuscutaceae				
66. <i>Cuscuta reflexa</i> Roxb.	Akash Bel	Sept - Oct	N2	Md
Dipsacaceae				
67. <i>Dipsacus inermis</i> Wallich in Roxb.	Phulle	Jul -Sept	P3	Ed, Md
Dioscoreaceae				
68. <i>Dioscorea pentaphyla</i> L.	Phal-alu	Aug - Oct	P3	Ed, Md
Ericaceae				
69. <i>Rhododendron arborium</i> Smith	Burans	Mar - May	N1 P2	Ed, Md, Fw
70. <i>Lyonia ovaalifolia</i> (Wallich) Drude	Anyar	Sept - Nov	N1 P2	Md, Fw
Euphorbiaceae				
71. <i>Jatropha curcus</i> L.	Safed arand	Feb - Oct	N2	Md
72. <i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	Ruina	Sep - Nov	N1	Fbr, Fw,Md
73. <i>Phyllanthus emblica</i> L.	Aonla,Aola	Feb - Apr	N1	Ed, Fd, Ag imp
74. <i>Ricinus communis</i> L.	Arand	Feb - Mar	N2	Md
Fabaceae				
75. <i>Butea monosperma</i> (Lamk.) Kuntze	Dhak	Mar - May	N2	Fd, Tm, Md, Dy
76. <i>Cajanus cajan</i> (L.) Millsp.	Tor	Mar - Nov	N2	Ed, Fw, Fbr
77. <i>Cicer arietinum</i> L.	Chana	Feb - Apr	N2	Ed
78. <i>Dalbergia sisoo</i> Roxb.	Sisam	Mar - June	N1	Tm, Fd, Md, Fw
79. <i>Desmodium elegans</i> DC.	Chamlai	Apr - Jun	N2	Fd
80. <i>Erythrina variegata</i> L.	Madaru	Mar - May	N2	Md, Ed
81. <i>Pongamia pinnata</i> (L.) Pierre	Karanjna	Mar - May	N1	Fw, Or

82. <i>Vigna mungo</i> (L.) Hepper	Urd	Sep - Nov	N3	Ed, Fd
83. <i>V. radiata</i> (L.) Wilez	Moong	Aug - Nov	N3	Ed, Fd
Flacourtiaceae				
84. <i>Flacourtia indica</i> (Burm.f.) Merrill	Kandai	Feb - Mar	N1	Ed, Fd, Md
Geraniaceae				
85. <i>Geranium wallichiana</i> D.Don ex Sweet	Ratanjot	Jul - Sept	N1 P2	Md, Dy
Hippocastinaceae				
86. <i>Aesculus indica</i> (Colebr. ex Cambess) Hook. Pangar		Mar - Nov	N1 P2	Md, Fd, Fw
Jugalandaceae				
87. <i>Juglans regia</i> L.	Akhor	Mar - May	P3	Ed, Md, Fw, Dy
Lamiaceae				
88. <i>Anisomeles indica</i> (L.) Kuntze	Goplya	Jul - Aug	N3 P2	Md
89. <i>Leonotis nepetifolia</i> (L.) R.Br.	Lal-guma	Sep - Feb	N2 P2	---
90. <i>Leucas indica</i> (L.) R.Br.	Guma	July - Nov	N2 P2	Md
91. <i>Nepeta graciliflora</i> Benth.	Uprya Ghas	Feb - Apr	N1 P1	
92. <i>Ocimum sanctum</i> L.	Tulsi	Apr - Nov	N2	Md
93. <i>Plectranthus mollis</i> (Aiton) Sprengel	Kala Basinga	Aug - Sept	N1 P1	---
94. <i>Pogostemon banghalense</i> (Burm.f.) Kuntze	Kala Basinga	Jan - Dec	N3 P3	Md
95. <i>Salvia lanata</i> Roxb.	Ghaniya	Mar - June	N2 P2	Md
Lauraceae				
96. <i>Symplocos paniculata</i> (Thunb.) Miq.	Lodh	Mar - May	N1 P1	Fd, Md, Ag imp
Liliaceae				
97. <i>Allium cepa</i> L.	Piaz	Apr - Jun	N2	Ed, Md
98. <i>Asparagus racemosus</i> Willd.	Jhirna	Apr - Nov	N2	Md
99. <i>Smilax aspera</i> L.	Kukurudara	Jun - Nov	N2	Md
Loranthaceae				
100. <i>Scurulla cordifolia</i> (Wallich) G. Don	Lodh	Nov - Apr	N2 P3	---
Lythraceae				
101. <i>Lagerstroemia indica</i> L.	Dhaura	Mar - Oct	N1	Fw
102. <i>Lawsonia inermis</i> L.	Mehandi	Jun - Oct	N3	Md, Dy
103. <i>Woodfordia fruticosa</i> (L.) Kurz	Dhaura	Jan - Apr	N1	Md, Dy
Malvaceae				
104. <i>Abutilon indicum</i> (L.) Sweet	Kanghe	Aug - Apr	N1	Md, Fbr
105. <i>Gossypium herbaceum</i> L.	Kapas	Mar - Oct	N1	Fbr
106. <i>Hibiscus rosa-sinensis</i> L.	Gudhal	Jan - Dec	N1	Or
107. <i>Kydia calycina</i> Roxb.	Phuilau	Jul - Sep	N2	Fbr, Tm, Fd, Md
108. <i>Sida acuta</i> L.	Karenti	Sept - Mar	N2	Md, Fbr
109. <i>S. cordifolia</i> L.	Balu	Mar - Sep	N2	Md
110. <i>Urena lobata</i> L.	Chatkura	Aug - Nov	N2	Fbr
Meliaceae				
111. <i>Azadirachta indica</i> A. H L Juss.	Neem	Mar - Apr	N1P3	Md
112. <i>Melia azedarch</i> L.	Daikan	Mar - Apr	P2	Fd, Tm, Fw
113. <i>Toona hexandra</i> (Wallich ex Roxb.) M. Romer	Pahari-tun	Mar - Apr	N1 P2	Tm, Fd, Fw
Menispermaceae				
114. <i>Tinospora sinensis</i> (Lour.) Merrill	Geloi	Feb - Jul	N3	Md
Mimosaceae				
115. <i>Acacia catechu</i> (L.f.) Willd.	Khair, Katha	Apr - Aug	N1	Fw, Tm, Md
116. <i>A. nilotica</i> (L.) Willd. ex Delile	Babul, Kikar	Mar - Apr	N1	Md, Fd
117. <i>Albizia odoratissima</i> (L.f.) Benth.	Bansa	Mar - Jun	N1	Fd, Ag imp
118. <i>A. lebbek</i> (L.) Benth.	Siris	Feb - Apr	N1	Fw, Tm, Ag imp
119. <i>Mimosa himalayana</i> Gamble	Shia-kanta	Jun - Aug	N1	Md, Fd
Moraceae				
120. <i>Artocarpus heterophyllus</i> Lam.	Kathal	Dec - Mar	N3 P2	Fd, Tm
121. <i>Morus serrata</i> Roxb.	Keemu	Mar - May	N1 P2	Ed, Fd
Moringaceae				
122. <i>Moringa oleifera</i> Lam.	Sahjan	Feb - Apr	N2	Ed, Md
Musaceae				
123. <i>Musa paradisiaca</i> L.	Kela	Mar - May	N1	Ed, Md
Myrtaceae				

124. <i>Callistemon citrinus</i> (Curtis) Skeels	-----	Mar - Oct	N1 P1	Or
125. <i>Eucalyptus camaldulensis</i> Denham	Safeda	Jan - Mar	N1 P1	Tm, Ag imp
126. <i>E. citriodora</i> Hook.	Safeda	Oct - Mar	N1 P1	Tm, Ag imp
127. <i>E. globules</i> Labillardiere	Safeda	Feb - Jun	N1 P1	Tm
128. <i>E. oblique</i> L' Heritier	Safeda	Sep - Nov	N1 P1	Tm
129. <i>E. tereticornis</i> Smith	Safeda	Feb - Oct	N1 P1	Tm
130. <i>Psidium guajava</i> L.	Aamrud	Mar - Apr	P1	Ed
131. <i>Syzygium cumini</i> (L.) Skeels	Jamun	Mar - May	N1 P1	Ed, Tm, Md
Oleaceae				
132. <i>Nyctanthus arbor-tritis</i> L.	Harsingar	Aug - Nov	N2	Md, Dy
133. <i>Olea glandulifera</i> Wallich ex D.Don	Gair	Mar - May	N2	Fd, Ag imp
Onagraceae				
134. <i>Oenothera rosea</i> L' Herit	----	Apr - July	N1 P2	Or
Pedaliaceae				
135. <i>Sesamum orientale</i> L.	Til	Aug - Nov	N2	Ed
Poaceae				
136. <i>Bambusa arundinacea</i> (Retz.) Willd.	Bans	May - Jun	P2	Fd
137. <i>Cymbopogon martinii</i> (Roxb.) Wat.	----	Sep - Nov	P2	Fd
138. <i>Echinochloa crus-galli</i> (L.) P. Beauv.	Jhangora	Aug - Oct	P2	Ed, Fd
139. <i>Eleusine coracana</i> (L.) Gaertner	Mandua	Jul - Sept	P3	Ed, Md, Fd
140. <i>Zea mays</i> L.	Mungri	July - Sept	P2	Ed, Fd
Polygonaceae				
141. <i>Polygonum plebeium</i> R. BR.	Dondya	Jan - Dec	N2 P2	-----
142. <i>Fagopyrum esculentum</i> L. (Moench)	Fafracha	Oct - Nov	N2 P2	Ed, Md
143. <i>Rumex hastatus</i> D.Don	Almor	Feb - Jun	N2 P2	Md, Ed
Proteaceae				
144. <i>Grevillea robusta</i> A. Cunn.	Silver oak	Mar - May	N1	Or
Punicaceae				
145. <i>Punica granatum</i> L.	Darim	Apr - June	N2	Ed, Md
Portulacaceae				
146. <i>Portulea grandiflora</i> Hook.	Luaniya	Jan- Dec	N2	Ed
Rhamnaceae				
147. <i>Ziziphus mauritiana</i> Lam.	Ber	Jun - Sept	N3	Ed
Rosaceae				
148. <i>Eriobotrya japonica</i> (Thunb.) Lindley	Lokat	Mar - May	N1 P1	Ed
149. <i>Malus bacata</i> (L.) Borkhansen	Garh-melo	Mar - May	N1 P1	Ed, Md
150. <i>Prinsipea utilis</i> Royle	Bhainkal	Feb - May	N2 P2	Ed, Md
151. <i>Prunus armeniaca</i> L.	Chugalu	Mar - Apr	N2 P2	Ed, Md
152. <i>P. cerasifera</i> Ehrhart	Alu-bhukara	Feb - Mar	N2 P2	Ed
153. <i>P. cerasoides</i> D.Don	Payyan	Oct - Dec	N1 P1	Md
154. <i>P. persica</i> (L.) Batsch.	Aaru	Mar - Apr	N1 P1	Ed, Md
155. <i>Pyracantha crenulata</i> (D.Don)	Ghingaru	Mar - May	N1 P1	M. Roemer Ed
156. <i>Pyrus communis</i> L.	Naspati	Mar - Apr	N2 P2	Ed
157. <i>P. pashia</i> Buch.-Ham. ex D.Don	Mehal	Feb - Mar	N1 P1	Ed, Fw
158. <i>Rosa brunonii</i> Lindley	Kunja	Mar - May	N1 P1	Md
159. <i>R. macrophylla</i> Lindley	Dand-kunj	Jul - Aug	N1 P1	Ed, Md
160. <i>R. sericea</i> Lindley	Dhurkunja	May - Jul	N1 P1	Ed, Md
161. <i>Rubus biflorus</i> Buch.-Ham. ex Smith	Hisara	Mar - Jun	N1 P1	Ed, Md
162. <i>R. ellipticus</i> Smith in Rees	Hinssar	Mar - Apr	N1 P1	Ed
163. <i>Spiraea canescens</i> D.Don	Jhair-Mairala	May - Jun	N2 P2	Fd
Rubiaceae				
164. <i>Haldina cardifolia</i> (Roxb.) Ridsdale	Haldu	May - Jul	N2 P3	Tm, Fd
165. <i>Spermadictyon suaveolens</i> Roxb.	Padera	Oct - Feb	N2 P3	Fd
Rutaceae				
166. <i>Aegle marmelos</i> (L.) Correa	Bel	Feb - Mar	N2	Ed, Md
167. <i>Citrus aurantifolia</i> (Christ.) Swing	Kagzi-nimbu	Jan - Dec	N1 P3	Ed, Md
168. <i>Citrus jambhiri</i> Lushing.	Jambhiri	Sep - Oct	N2	Ed
169. <i>Citrus reticulata</i> Blanco	Santra	Mar - May	N1	Ed
170. <i>Citrus sinensis</i> (L.) Osbeck.	Malta	Mar - May	N1 P3	Ed
<i>Glycosmis mauritiana</i> (Lamk.) Tanaka	Ban neembu	Feb - Jul	N2 P3	Ed
171. <i>Murraya koenigii</i> (L.) Sprengel	Gandela	Mar - Apr	N1 P2	Ed

Sapindaceae					
172. <i>Sapindus mukorosii</i> Gaertner	Reetha	Mar - Apr	N1	Md	
173. <i>Litchi chinensis</i> Sonnerat	Litchi	Feb - May	N1	Ed	
Sapotaceae					
174. <i>Madhuca longifolia</i> (Koenig) Mac Bride	Mahwa	Mar - Apr	N1	Fd	
Solanaceae					
175. <i>Capsicum annuum</i> L.	Mirch	Mar - Oct	N1	Ed, Md	
176. <i>Datura metel</i> L.	Dhatura	Jul - Oct	N1	Md	
177. <i>Solanum nigrum</i> L.	Makoi	Jan - Dec	N1	Md	
Sterculaceae					
178. <i>Pterospermum acerifolium</i> (L.) Willd.	Champa	Mar - Jun	N2	Or	
179. <i>Sterculia villosa</i> Roxb.	Udala	Feb - Apr	N2	Fbr, Md	
Tiliaceae					
180. <i>Corchorus aestuans</i> L.	Tit patti	May - Sept	N3	Md	
181. <i>Grewia optiva</i> J.R. Drummond ex Burret	Bheemal	Apr - Jun	N2	Md, Fd, Fbr, Ed	
182. <i>Triumfetta rhomboidea</i> Jacquin	Liskura	Aug - Nov	N2	Md	
Ulmaceae					
183. <i>Holoptelea integrefolia</i> (Roxb.) Planchon	Papri	Aug - Sept	N3 P2	Tm, Fw	
Urticaceae					
184. <i>Urtica dioica</i> L.	Kandali	Aug - Dec	P2	Fbr, Md	
Verbenaceae					
185. <i>Callicarpa macrophylla</i> Vahl	Daiya	Jul - Sept	N3	Md	
186. <i>Clerodendrum serratum</i> (L.) Moon.	Banbakri	Apr - Dec	N3	Md	
187. <i>Duranta repens</i> L.	Duranta	Jul - Sept	N2	Or	
188. <i>Lantana camera</i> L.	Kuri-ghas	Jan - Dec	N2	---	
189. <i>Premna barbata</i> Wallich ex Schauer	Gaunta	Mar - May	N1	Ed, Md, Fw	
190. <i>Tectona grandis</i> L.f.	Sagaun	Mar - Apr	N1	Tm, Md	
191. <i>Vitex negundo</i> L.	Siwanli	Mar - Oct	N1	Md	
Vitaceae					
192. <i>Ampelocissus latifolia</i> (Roxb.) Planch.	Bhinura	Jul - Aug	N2	Ed	
Zygophyllaceae					
193. <i>Tribulus terrestris</i> L.	Gokhru	July - Nov	N2	Md	

Abbreviations used:

1. N = Nectar source, P = Pollen source, 1 = Major source, 2 = Medium source, 3 = Minor source.
2. Ag imp = Agricultural implements, Ed = Edible, Fbr = Fibre, Fd = Fodder, Fw = Fuel-wood, Dy = Dye, Md = Medicinal, Or = Ornamental, Tm = Timber.

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