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Assessment of Honey Plant Resources through Pollen Analysis in Coorg Honeys of Karnataka State

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ABSTRACT

Pollen analysis of honey samples collected from Coorg district of Karnataka state was undertaken to gather information regarding the bee forage plants and to determine the prevailing bee-plant relationship. In the present investigation, 20 honey samples were collected from *Apis cerana* and *Apis dorsata* colonies during January 2010 to April 2011 from bee hives located at 14 locations of Coorg district. A total of 91 pollen types belonging to 42 families were identified. The dominant pollen types were *Coffea sp., Cocos nucifera, Aster sp., Scheffleria sp., Syzygium sp., Terminalia sp., Brassica sp., Croton sp., Oryza sativa*, etc. Among the pollen types observed, 53.84% were tree species and the most preferred. The highest contribution for nectar and pollen source for honeybee in the study area belonged to the Fabaceae and Asteraceae. This paper discusses the honey plant resources, potentialities for commercial beekeeping in Coorg district and also the importance of honeybees in the forest and agriculture ecosystem.

Keywords — Beekeeping, honeybees, honey plants, pollen analysis

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INTRODUCTION

Bees and flowering plants are mutually dependent as bees need flowering plants for food in the form of pollen and nectar, whereas plants need bees for pollination. Honey contains pollen grains which are collected by honeybees while foraging the flowers for pollen and nectar. The microscopic analysis of pollen is the standard method and an effective tool to understand the distribution and abundance of floral nectar sources in any given region. Studying the pollen in honey greatly contributes to the understanding of the geographical and botanical origin of honey, as the bees are known to visit more than 3 km in the search of forage. Knowledge of botanical source of honey is a prerequisite for beekeepers to undertake migratory beekeeping for increasing honey production and pollination. Beekeeping has been practiced in India since time immemorial and referred to as cottage or forest based industry, which provides self- employment to the people living in rural and forest area to generate additional income. Therefore, identification of bee flora helps in sustainable beekeeping practice and increased honey production through migratory beekeeping. The earliest research on the pollen analysis of honey was undertaken by Pfister (1895) by analyzing the pollen content of various Swiss, French, and European honey, and demonstrated the possibility of determining the geographical origin of honey from the pollen within it. Later, Young (1908) studied the pollen content of 100 honey samples from North America and made a note on the pollen grains commonly found in USA honey. Recently, many scientists like Terrab (2003), Barth (2004), Zafar Kaya (2005), Arnon *et al.* (2006), Sodra *et al.* (2007), Floris & Satte (2007), Nilgun (2009), Ernest & Anna (2010), Ige & Modupe (2010) have provided relevant information on pollen and nectar sources of different area. In India, palynological studies were initiated by Deodikar *et al.* (1958) who studied the nectar

yielding plants of Mahabaleshwara hills of Maharashtra. Later, significant work has been carried out from different states of India by Ramanujam & Kalpana (1992); Sivaram (1995); Lakshmi & Suryanarayan (1997); Bhusari (2007); Bera *et al.* (2007); Bhargav *et. al.* (2009); Tidke & Nagarkar (2010); Shilpa & Ratnakar (2011) and More *et al*. (2010). Melissopalynology of *Syzygium* honey has been studied by Suryanarayan (1966).

The present study is aimed at the qualitative and quantitative estimation of pollen in honey samples from Coorg districts of Karnataka to assess the distribution of nectar and pollen sources for honeybees. Coorg is one of the important honey producing districts in the state and the Coorg honey is very famous among the consumers for its special taste.

Fig. 1 — Map of Coorg District in Karnataka State showing 14 sites of collection 20 honey samples.

MATERIALS & METHODS

During the course of present investigation 20 honey samples were collected from 14 different places in Coorg district between January 2010 to April 2011 (Fig. 1). The area falls under Western Ghats and is known for its exceptionally rich diversity of flowering plants. It has a geographical area of 1,584 sq meters and lies between 11^0 56' and 12^0 15' North latitude and 75^0 22' and 76^0 14' East longitude. Coorg has four types of vegetation - Evergreen forest to the west, Moist deciduous and Dry deciduous forest in the central and southern parts, and hill slopes are covered by grasslands. The honey samples were directly collected from the domesticated bee hives of Indian honeybee, *Apis cerana indica* and raw honey either from *Apis cerana indica* or wild bee, *Apis dorsta* from the traditional bee hunters of the study area. The details of honey samples collected from different sites are shown in (Table 1).

Table 1 — Honey samples collected from Coorg district for Pollen analysis

Sl. No.	Honey samples	Place of collection	Method of Extraction	Pollen count	Group
1.	CO-Ku-01	Kushalnagar	Extracted	68300	IV
2.	CO-Sa-02	Sampaje	Extracted	95800	IV
3.	CO-So-03	Somvarpet	Extracted	116000	V
4.	CO-Ku-04	Kutta	Extracted	83000	IV
5.	CO-Vi-05	Virajpet	Squeezed	97500	IV
6.	CO-Po-06	Ponnmpet	Squeezed	102000	V
7.	CO-Si-07	Siddapura	Extracted	116500	V
8.	CO-Ta-08	Talkaveri	Squeezed	100800	V
9.	CO-Mk-09	Makula	Extracted	98000	IV
10.	CO-Na-10	Nagarhole	Squeezed	132000	V
11.	CO-Bg-11	Bagamandala	Squeezed	83000	IV
12.	CO-Sr-12	Srimangala	Extracted	76300	IV
13.	CO-Md-13	Madikere	Extracted	68300	IV
14.	CO-Go-14	Gonikoppa	Extracted	94600	IV
15.	CO- Bg -15	Bagamandala	Extracted	72500	1V
16.	CO- So-16	Somvarpet	Extracted	66300	1V
17.	CO-Ku -17	Kutta	Extracted	84,000	1V
18.	CO- Bg-18	Bagamandala	Squeezed	100000	V
19.	CO- Ta-19	Talakaveri	Extracted	82000	1V
20.	CO-Na-20	Nagarahole	Squeezed	140000	V

For pollen analysis of the honey samples, 10g of honey was dissolved in 10ml of distilled water and centrifuged for 10 min at 2500 rpm. The supernatant solution was decanted and the sediment was treated with acetolysis mixture (Erdtman 1960, Moore *et al*. 1991). Six pollen slides were prepared from each sample and the pollen types were identified with the help of pollen slides prepared from the plants collected from the present study area and also from scientific literature. The quantitative analysis of each honey sample was carried out by using Haemocytometer method (BIS 1994) and categorized into different groups of pollen frequency classes according to the universally followed grading parameters (Louveaux *et al.* 1978) like Group I <2000; Group II 2000 - 10,000; Group III 10,000-50,000; Group1V 50,000- 100,000; Group V > 100,000**,** which indicates extremely poor, poor, rich, very rich and extremely rich amount of pollen in honey (Jose *et al.* 1989). Based on the frequencies of pollen grains in various honey samples, the absolute pollen count and percentage of pollen types were calculated and pollen spectra were prepared. These pollen types were classified based on the recommendations of the International Commission for Bee-Botany (Louveaux 1978, Moore & Webb 1978) i.e., "predominant pollen type" having more than 45% of pollen count; "secondary pollen type" (16-45%); "important minor pollen type" (3-15%) and "minor pollen type" (<3%) (Table 2).

RESULTS & DISCUSSION

Coorg is a very important district of Karnataka in honey production. Two-thirds of the district is covered by forest. Central Coorg has predominantly plantation and agricultural crops. Coffee estates cover 30% of the total area. The abundant rich vegetation makes Coorg one of the hotspots of biodiversity. The investigation of 20 honey samples from the Coorg district of Karnataka revealed that 91 plants belonging to 42 families are useful for honeybees as they provide food in the form of pollen and nectar during different months of the year. The study area has mixed vegetation, so there was less possibility of getting unifloral honey samples from wild and natural colonies of honey bees. The present study confirmed that all the honey samples were found to be multifloral. The family Fabaceae consists of 17 species which is highest; followed by Asteraceae (8 sp.); Anacardiaceae and Myrtaceae (5 sp.); Lamiaceae, Malvaceae, Rubiaceae, Solanaceae and Verbinaceae (3 sp.) each; Acanthaceae, Amaranthaceae, Aracaceae, Bignoniaceae, Euphorbiaceae, Liliaceae, Meliaceae, Poaceae, Rutaceae (2 sp.) each; and the remaining families Annonaceae, Araliaceae, Bombacaceae, Casurinaceae, Combretaceae, Commelinaceae, Convolvulaceae, Brassicaceae, Cyperaceae, Lauriaceae, Lythraceae, Myristicaceae, Moringaceae, Musaceae, Oleaceae, Nymphaeaceae, Pediliaceae, Phyllanthaceae, Polygonaceae, Proteaceae, Rhamnaceae, Santalaceae, Sapindaceae and Zygophyllaceae were represented by single species each (Table 2).

During the study period the secondary dominant pollen type (>50%) were *Coffea sp., Cocos nucifera, Aster sp., Scheffleria sp., Syzygium sp., Terminalia sp., Brassica sp., Croton sp., Oryza sativa*, etc. Other important pollen types (20% - 50%) were *Ageratum conyzoides, Dahlia sp., Eucalyptus sp., Eupatorium odoratum, Dalbergia sissoo, Mimosa pudica, Zea mays* and minor types (10% - 20%) were *Jasminum sp., Cinnamomum sp., Santalum album, Sapindus laurifolia, Tribulus terrestris, Helianthus annuus, Jacaranda sp.,* etc. (Table 2).

The absolute pollen content per gram of honey was in the range of 66,300 to 140,000. Minimum pollen count was found in honey sample CO-So-16 and maximum pollen content was observed in honey sample CO-Na-20. Thirteen honey samples observed in Group IV were considered to be very rich in pollen count and seven samples in Group V were extremely rich in pollen count (Table 1).

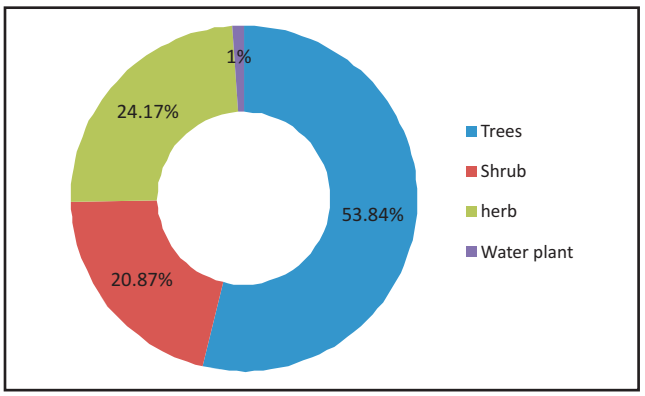

Fig. 2 — Different types of vegetations of beekeeping importance in Coorg district

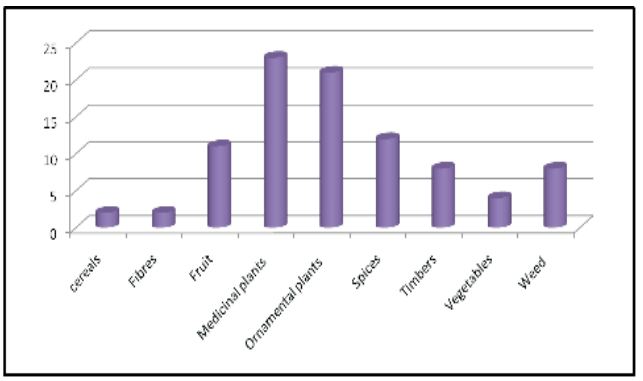

Fig. 3 — Quantification of plants useful for bee forage in Coorg district

Table 2 — Pollen spectrum/Density of the taxa identified in Coorg Honey samples (Bp-Blooming period; Be-Beverage; Ce- Cereals; Ei- Economical importance; Fi- Fiber: Fl- Flower; Fr- Fruit; H-Herb; I- Important minor; M- Minor; Me-Medicinal; N- Nut; Oi- Oil yielding; Or- Ornamental; S- Secondary dominant; S-Shrub; Sp- Spices; T-Tree; Ti- Timber yielding; Ve- Vegetable; Vg- Vegetation type,, W-Water plant ; We-Weed).

Sl.No.	Taxa	Vg	Bp	Ei	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Acanthaceae																							
1	*Adathoda vasica*	S	1-12	Me	-	-	M	-	-	I	-	-	-	-	M	-	-	-	M	-	-	-	-	I
2	*Justicia sps*	H	1-12	We	M	-	-	-	-	-	M	-	-	I	-	-	I	-	-	M	-	-	-	I
	Amaranthaceae																							
3	*Amaranthus spinosus*	S	1-12	Ve	-	I	-	-	-	-	M	-	-	-	-	I	-	I	I	-	-	-	-	I
4	*Gomphrena globosa*	H	1-12	Fl	-	-	M	-	-	-	M	-	-	M	M	-	-	-	-	-	-	-	-	M
	Anacardiaceae																							
5	*Anacardium occidentale*	T	2-5	Fr,N	S	-	-	-	-	M	-	-	-	S	-	-	-	-	-	-	-	-	-	M
6	*Artocarpus heterophyllus*	T	2-5	Fr	-	-	M	-	-	-	-	M	-	-	-	I	-	-	-	-	-	S	-	M
7	*Mangifera indica*	T	2-5	Fr	M	-	-	I	-	-	-	-	-	-	-	M	-	-	I	I	-	-	M	-
8	*Persica americana*	T	8-11	Fr	M	-	-	M	-	-	-	-	M	-	-	-	M	-	I	-	-	-	-	I
9	*Semicarpus anacardium*	T	6-9	Ti	I	-	-	-	-	I	-	-	M	-	-	-	-	I	-	-	-	-	I	M
10	*Annona squomosa*	T	3-6	Fr	-	-	-	M	-	-	-	-	-		M	-	-	-	-	-	-	-	-	I
	Aracacae																							
11	*Areca catechu*	T	6-12	N	-	-	-	M	-	-	-	-	-	-	M	-	-	M	-	-	-	M	-	-
12	*Cocos nucifera*	T	1-12	Fr	M	S	M	-	I	-	-	I	-	M	-	I	M	S	-	-	-	-	I	-
	Araliaceae																							
13	*Schefflera sps.*	T	6-10	Me	-	S	-	M	-	S	-	I	-	I	-	S	M	-	-	-	-	I	-	M
	Asteraceae																							
14	*Ageratum conyzoides*	H	1-12	We	-	S	-	M	-	M	-	I	-	M	-	S	I	-	-	-	M	I	-	I
15	*Astes sps*	H	1-12	Fr	M	-	M	-	S	-	I	-	I	I	-	S	-	-	I	-	-	-	-	I
16	*Bidens biternata*	H	7-12	We	-	M	-	-	-	M	-	-	-	I	-	M	-	-	-	-	I	I	-	I
17	*Dahlia sps*	H	1-12	Fr	-	-	-	I	M	-	-	-	M	-	I	-	-	M	I	-	-	-	I	-
18	*Eupatorium odoratum*	H	1-12	We	-	M	-	M	-	I	-	M	-	I	-	M	-	M	-	-I	-	I	-	I
19	*Helianthus annus*	S	9-12	Oi	-	I	-	-	-	-	-	-	-	-	M	-	I	-	-	-	-	-	I	-
20	*Parthenium sps.*	H	1-12	We	M	-	I	-	I	-	M	-	M	-	-	M	-	-	-	-	M	-	-	I
21	*Tridax procumbens*	H	1-12	We	S	-	-	M	-	-	M	-	-	M	-	-	M	-	-	-	-	I	-	I
	Bignoniaceae																							
22	*Jacaranda sps*	T	1-3	Or	-	-	M	-	-	-	-	-	-	-	-	-	-	M	I	I	-	-	-	M
23	*Tecoma stans*	T	9-12	Or	-	-	-	-	M	-	-	-	I	-	-	I	-	I	-	-	M	-	-	-
	Bombacaceae																							
24	*Bombax malabarica*	T	1-3	Fi	-	-	S	-	-	-	-	-	S	S	-	-	M	-	-	-	-	I	-	M
	Casurinaceae																							
25	*Casuarina equistifolia*	T	1-6	Ti	-	-	-	-	-	-	M	-	-	-	-	-	M	I	-	-	I	-	M	-
	Combretaceae																							
26	*Terminalia sps.*	T	3-6	Ti	S	I	S	-	I	-	M	-	M	-	S	M	S	I	-	-	M	-	-	I
	Commelinaceae																							
27	*Commelina diffusa*	H	8-12	Or	-	-	-	M	-	-	-	M	-	-	-	M	-	-	I	-	I	-	-	-
	Convolvulaceae																							
28	*Ipomea sps*	H	1-12	Or	-	M	-	-	I	-	-	I	-	-	M	-	-	S	-	I	-	-	-	I

	Brassicaceae																						
29	*Brassica sps.*	S	9-12	Oi	-	S	-	-	M	-	M	-	I	M	-	M	-	M	-	I	-	-	M	-
	Cyperaceae																						
30	*Cyperus sps.*	H	3-5	Me	M	-	-	-	M	-	-	S	-	-	-	M	-	-	-	I	-	-	M	-
	Euphorbiaceae																						
31	*Ricinus communis*	S	1-4	Oi	-	-	-	I	-	-	I	-	-	M	-	M	-	-	-	M	-	-	I	-
32	*Croton sp*	H	1-12		-	M	M	-	-	M	-	M	-	-	-	-	I	M	-	-	M	-	-	I
	Fabaceae																						
33	*Acacia sps.*	T	9-12	Me	M	-	M	-	S	M	-	S	M	M	-	M	M	M	-	-	-	I	I	M
34	*Albizia lebbeck*	T	2-5	Ti	-	M	-	S	-	-	M	-	-	-	M	-	-	I	-	-	I	-	-	I
35	*Butea monospermum*	T	1-5	Me	-	-	-	-	I	-	-	M	-	S	-	-	-	-	M	-	-	M	-	I
36	*Caesalpinia decapitate*	T	3-6	Or	M	-	-	-	-	-	M	-	-	-	I	-	-	I	-	-	I	M	M	-
37	*Cassia fistula*	S	9-12	Or	-	-	I	-	-	I	-	-	I	-	-	-	I	-	-	-	I	-	-	M
38	*Dalbergia sissoo*	T	1-7	Ti	S	-	-	-	I	-	-	-	-	I	-	-	M	-	-	-	-	I	-	I
39	*Delonix regia*	T	3-6	Or	-	-	-	-	M	-	-	M	-	-I	-I	M	-	I	-	M	-	-	-	I
40	*Eleocarpus marsupium*	T	7-10	Me	-	-	M	-	-	I	-	-	-	I	-	-	-	-	-	-	-	M	-	-
41	*Erythrina indica*	S	2-5	Or	-	M	-	-	-	M	-	-	I	-	-	M	I	-	-	-	M	-	I	-
42	*Gliricidia sps.*	T	1-4	Me	S	-	-	S	-	-	M	-	-	I	-	-	-	I	-	M	-	-	-	M
43	*Mimosa pudica*	H	1-12	Me	-	M	-	-	M	-	-	-	M	-	-	M	-	M	-	I	-	-	M	M
44	*Peltophorum pterocarpum*	T	1-6	Or	-	-	S	-	I	I	I	-	-	M	-	-	-	M	-	-	I	-	-	M
45	*Pongamia pinnata*	T	2-7	Oi	S	-	-	M	-	-	-	M	-	-	I	I	-	-	-	-	-	I	M	-
46	*Prosopis juliflora*	T	6-10	Me	-	-	-	-	M	-	-	-	M	-	-	M	-	-	I	-	-	-	I	M
47	*Pterocarpus sp.*	T	2-5	Ti	-	M	-	S	-	M	-	I	-	-	M	-	I	-	-	-	-	-	-	I
48	*Samanea saman*	T	3-7	Or	-	M	-	-	I	-	-	-	M	-	-	-	M	-	I	-	-	M	-	I
49	*Tamarindus indica*	T	4-7	Sp	M	-	I	-	I	-	I	-	M	S	-	-	S	I	-	M	-	-	M	-
	Lamiaceae																						
50	*Leucas aspera*	H	1-6	Me	-	M	-	-	-	M	-	-	-	M	-	-	-	-	M	I	-	-	-	I
51	*Ocimum sps.*	H	1-12	Me	M	-	-	M	-	-	-	M	-	-	I	-	I	-	-	M	-	-	M	-
52	*Gmelina arborea*	T	2-4	Me	-	-	M	-	-	-	-	-	-	M	-	-	-	-	M	-	I	-	-	-
53	*Allium cepa*	H	1-4	Ve	-	-	-	-	-	M	-	-	I	-	-	-	-	-	-	M	-	-	-	-
54	*Gloriosa superb*	H	3-6	Fl	-	-	-	M	-	-	-	-	-	M	-	-	-	-	-	-	-	-	I	-
	Lauriaceae																						
55	*Cinnamonum sps*	T	1-6	Sp	-	-	M	-	-	-	-	-	M	-	-	-	-	-	I	-	-	M	-	-
	Lythraceae																						
56	*Lagerstromia lanceolatus*	T	3-6	Ti	-	S	-	-	-	S	-	-	M	-	-	M	-	-						
	Malvaceae																						
57	*Gossypium sps*	T	1-5	Fi	-	M	-	-	-	-	-	-	-	-	-	-	-	-	I	-	I	-	-	-
58	*Hibiscus sps.*	S	1-12	Fl	-	-	M	-	-	M	-	-	-	I	-	-	I	-	-	-	-	-	-	-
59	*Sida acuta*	H	9-12	We	M	-	-	-	-	-	-	M	-	-	-	-	-	M	-	-	-	S	M	I
	Meliaceae																						
60	*Azadirachta indica*	T	2-4	Me	-	-	-	S	-	-	-	M	-	-	M	-	I	-	-	-	-	M	-	I
61	*Cipadessa baccifera*	T	6-9	Me	-	-	M	-	-	-	-	-	M	-	-	-	-	-	I	-	M	-	-	-
	Myrtaceae																						
62	*Callistemmom linearis*	T	2-5	Or	M	-	-	I	-	-	-	M	-	-	-	M	-	-	-	-	-	-	-	-
63	*Eucalyptus sps.*	T	9-12	Me	-	S	-	-	S	-	-	M	-	I	-	M	-	M	-	-	-	S	-	M

64	*Psidium guajava*	T	6-9	Fr	S	-	I	-	I	-	M	-	I	-	S	-	M	-	-	-	-	-	-	-
65	*Syzygium sps*	T	3-6	Sp	S	-	-	M	-	-	I	-	I	-	I	-	-	M	-	-	I	-	I	-
66	*Myristica sps*	T	9-12	Sp	-	-	-	-	-	M	-	-	-	-	-	I	-	-	-	-	-	I	-	-
	Moringaceae																							
67	*Moringa oleifera*	T	1-4	Ve	-	S	-	-	M	-	-	-	-	M	-	-	-	S	M	-	-	-	-	-
	Mussaceae																							
68	*Musa sps*	S	1-12	Fr	-	-	M	-	-	-	-	M	-	-	-	S	-	—	-	I	-	-	-	-
	Oleaceae																							
69	*Jasminum sps*	S	1-12	Fl	-	-	-	-	M	-	-	-	-	M	-	-	M	—	-	-	I	-	I	-
	Nymphaceae																							
70	*Nelumbo nucifera*	W	1-12	Fl	-	M	-	-	-	-	M	-	-	-	M	-	-	-	-	-	-	I	-	-
	Pediliaceae																							
71	*Seasamum orientale*	H	5-9	Oi	-	-	-	M	-	-	-	M	-	-	-	-	-	I	-	-	-	-	-	-
	Phyllanthaceae																							
72	*Embelica officinalis*	T	1-4	Fr	-	M	-	-	-	-	-	-	M	-	-	-	-	M	-	-	I	I	-	I
	Poaceae																							
73	*Oryza sativa*	H	6-10	Ce	M	M	-	-	M	-	S	-	-	M	-	M	-	I	-	-	I	-	-	-
74	*Zea mays*	H	1-12	Ce	-	I	-	-	M	S	-	-	M	-	M	-	I	-	-	-	-	-	-	-
	Polygonaceae																							
75	*Antigonom leptopus*	H	3-6	Me	S	-	M	S	-	I	-	M	-	S	-	I	-	-	-	-	-	M	I	-
	Proteaceae																							
76	*Gravellia robusta*	T	1-3	Ti	-	S	M	-	M	M	-	S	M	I	-	I	M	M	-	-	-	I	-	-
	Rhamnaceae																							
77	*Zizipus jujube*	T	7-10	Fr	-	M	-	-	-	M	-	-	I	-	-	M	-	M	-	-	I	-	-	-
	Rubiaceae																							
78	*Coffea sps*	S	3-4	Be	-	-	-	S	-	M	S	-	S	S	S	-	M	-	I	-	-	I	-	I
79	*Gardenia sps.*	T		Or	-	-	M	-	M	-	-	-	M	-	-	-	I	-	I	-	-	I	M	M
80	*Randia sps*	T	3-6	Me	-	M	-	-	-	-	M	-	-	-	-	-	-	-	M	-	M	-	I	-
	Rutaceae																							
81	*Aegel marmeloes*	T	3-6	Fr	-	-	-	M	-	-	M	-	-	M	-	-	M	-	-	-	M	-	-	-
82	*Citrus sps.*	T	3-6	Fr	M	-	I	-	-	I	-	-	M	-	-	M	-	I	-	-	-	-	-	-
	Santalaceae																							
83	*Santalum album*	T	9-12	Me	-	-	-	-	M	-	-	-	-	M	-	-	-	-	-	-	-	M	-	I
	Sapandaceae																							
84	*Sapindus laurifolius*	T	11-2	Me	-	-	-	-	-	-	M	-	-	-	-	M	-	-	I	-	-	-	-	M
	Solanaceae																							
85	*Capsicum sps.*	S	7-2	Sp	-	-	-	-	M	-	-	-	-	M	-	-	-	-	—	-	I	-	-	-
86	*Datura sps.*	H	1-12	We	-	M	-	-	-	M	-	-	-	-	-	I	-	-	-	-	I	-	-	-
87	*Solanum sps.*	H	1-12	Ve	-	-	-	M	-	-	-	M	-	—	-	-	-	M	-	-	-	-	-	-
	Verbinaceae																							
88	*Clerodendron sps.*	S	2-5	Or	M	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-	-	-	-	-
89	*Homoskiodia sps.*	T	1-12	Or	M	-	-	-	M	-	-	-	-	-	-	-	M	-	-	-	-	-	-	-
90	*Vitex nigundu*	S	9-12	Me	M	-	-	M	-	-	M	-	-	-	-	-	-	M	-	-	I	-	M	
	Zygophyllaceae																							
91	*Tribulus terrestris*	H	1-12	We	-	-	M	-	-	M	-	-	-	M	-	-	M	-	-	-	-	I	-	M

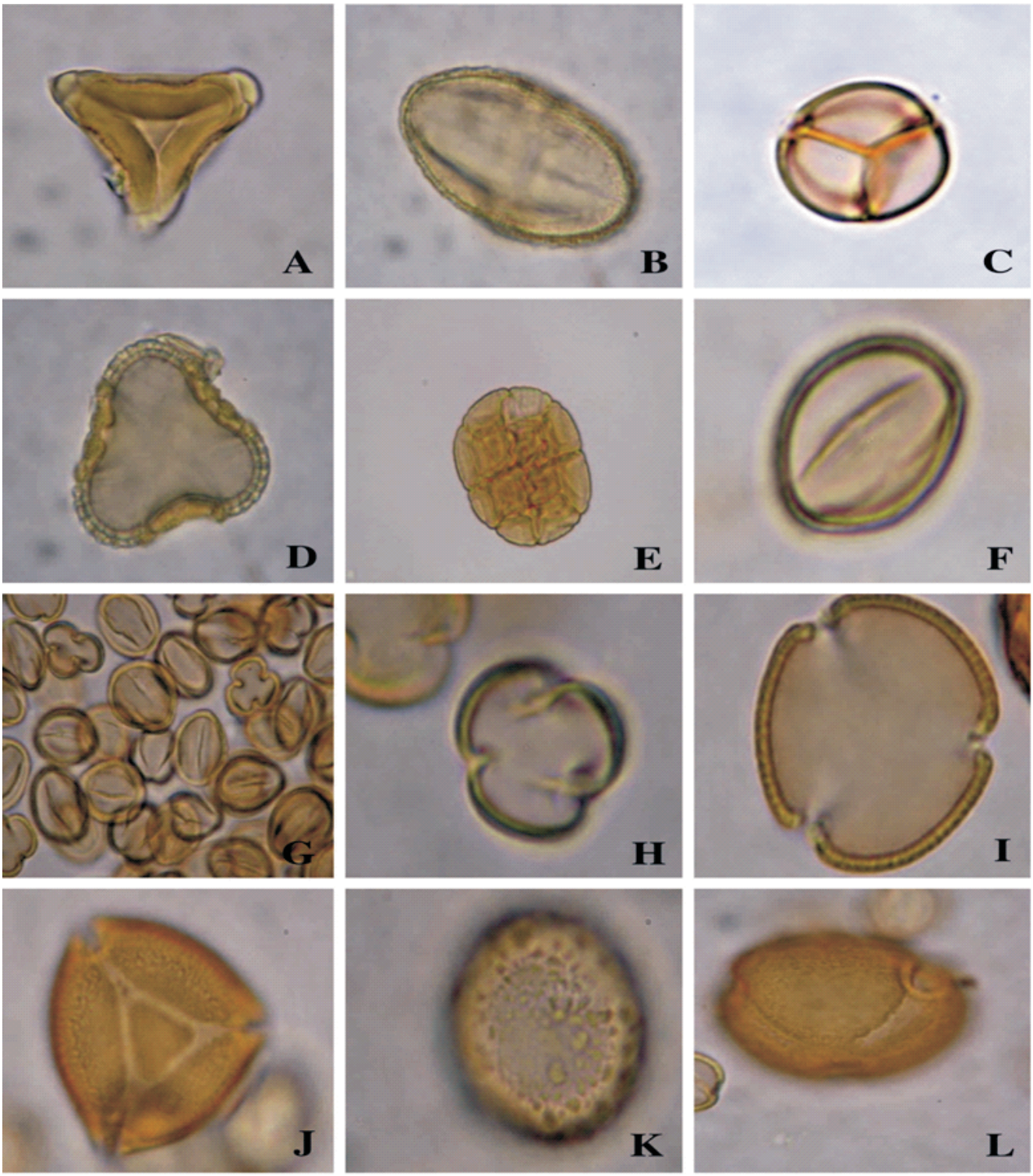

Fig. 4 — Pollen types. *a. Eucalyptus,* b. *Cocos nucifera*, c. *Mimosa pudica,* d. *Caesalpinia sps., e. Acacia sps.* f. *Gliricidia sps,* g. *Eleocarpus& Cocos h. Eleocarpus sps, i. Bombax sps.* j. *Syzygium sps,* k. *Anona sps.* and l. *Brassica sps.*

The result of microscopic analysis of honey samples from the study area suggested that Coorg region has rich and diversified natural flora and cultivated crops. Among the reported taxa, there is a dominance of tree species (53.84%) which includes *Eucalyptus sp., Jacaranda sp., Tecoma stans, Semicarpus anacardium, Terminalia sp., Scheffleria sp., Casuarina equisetifolia, Acacia sp., Albizia lebbeck, Butea monosperma, Dalbergia sissoo, Sapindus laurifolia, Pongamia pinnata, Samanea saman*, *Santalum album, Gossypium sp., Bombax malabaricum* etc. and with sparse distribution of herbs (24.17%) and shrubs (20.87%) as shown in Fig 2. The identified honey plants are categorized according to their economic importance like medicines, spices, timber, vegetables, cereals, fibers, fruits and nuts, weeds and ornamental plants (Fig 3). The most preferred and highest contribution of nectar and pollen source for honey bees in the study area belong to the Fabaceae and Asteraceae (Fig. 4).

From the above observations it is clear that the study area exhibits diversified flora and unlimited potential for bee forage, which constitute a valuable source of pollen and nectar crop for honey bees which in turn are important for the survival of bee colonies and also necessary for organized apiculture industry. Moreover, honeybees being the important pollinators contribute to the increased production and yield of commercial, medicinal, and economically viable plants and thereby contribute towards improving rural and forest economy. The result of our study support the views expressed by Zamarlicki (1984) who reported that knowledge of honey plants is the most important factor in bee management and survival of honey bees. Thus, identification of bee flora including their abundance, distribution and floristic information are essential for good yield of honey (Sivaram 1995).

The study suggests and recommends to agencies like forest and rural development departments that it should make all efforts to include the bee forage plants species, particularly tree species in afforestation and social forestry development programmes in Coorg district. The conservation of honey plants are of utmost importance for the development of both natural and wild bee colonies in the region for sustainable environment and maintaining the natural habitat. The decline in bees adversely affects the pollination of flowering plants which in turn results in substantial decrease in the production of agricultural and horticultural crops and economy of the region (Sharma 1972).

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