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Pollen diversity in some *Apis florea* honeys from Adilabad District, Andhra Pradesh, India

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ABSTRACT

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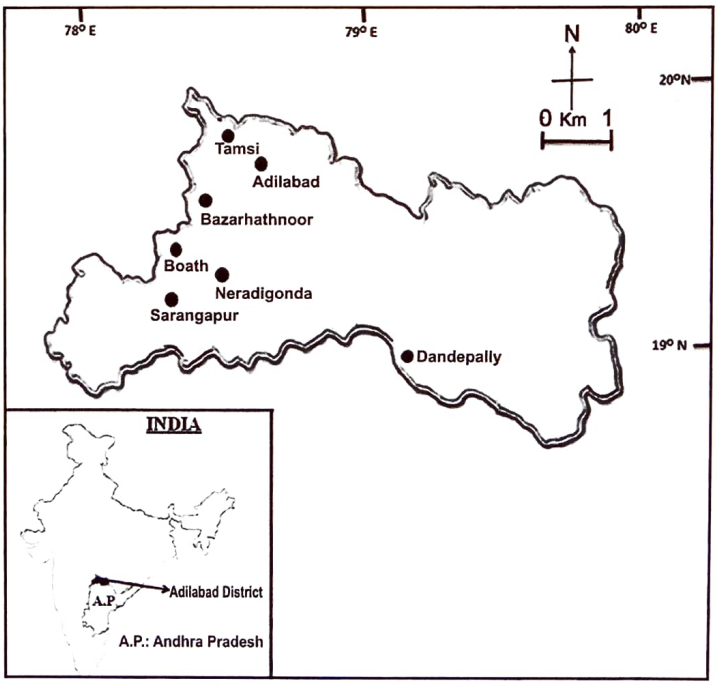
The paper incorporates palynological analysis of twelve honey samples of *Apis florea* collected from agricultural tracts and forest localities of Adilabad District, Andhra Pradesh. Ten of these samples were found to be unifloral and the remaining two were identified as multifloral honeys. Unifloral honeys were represented by *Coriandrum sativum, Ageratum conyzoides, Borassus flabellifer* and *Ocimum basilicum.*

Key-words: Melissopalynology pollen diversity, *Apis florea*, Adilabad, Andhra Pradesh, India.

INTRODUCTION

Pollen analysis of twelve squeezed honey samples of *Apis florea,* collected from various localities in Adilabad District, Andhra Pradesh, was carried out and ten unifloral and two multifloral honeys were recognized. The Adilabad District is situated between 18.40° and 19.56° north latitudes and between 77.46° and 80.01° east longitudes. The district is situated in the northern part of Andhra Pradesh bordered by Yeotmal and Chandrapur districts of Maharashtra on the northern, eastern and western sides and Nizamabad and Karimnagar districts of Andhra Pradesh on the southern side. The honey samples were collected from ten villages, viz. Kumari, Yapalaguda, Kachkanti, Boath, Tamsi, Bazarhathnoor, Dhani, Narsapoor, Ankoli and Wagdhari of seven mandals, viz. Neradigonda, Adilabad, Boath, Tamsi, Bazarhathnoor, Sarangapur and Dandepally of Adilabad District during summer and winter seasons (Text-figure 1, Table 1). These samples were collected from agricultural tracts, viz. Boath, Tamsi, Dhani, Narsapoor and Wagdhari and forest areas, viz. Kumari, Yapalaguda, Kachkanti, Bazarhathnoor and Ankoli of Adilabad District, Andhra Pradesh.



Text-figure 1. Map showing various mandals in Adilabad District, Andhra Pradesh, from where honey samples were collected.

Table 1. Inventory of the honey samples.

S. No.	Sample code	Mandal	Village	Date of collection
1	A-N-K-AF 1	Neradigonda	Kumari	22-11-2010
2	A-A-Y-AF 2	Adilabad	Yapalaguda	17-12-2010
3	A-A-K-AF 3	Adilabad	Kachkanti	14-01-2011
4	A-B-B-AF 4	Boath	Boath	16-02-2011
5	A-T-T-AF 5	Tamsi	Tamsi	13-02-2011
6	A-B-B-AF 6	Bazarhathnoor	Bazarhathnoor	25-02-2011
7	A-S-D-AF 7	Sarangapur	Dhani	20-02-2011
8	A-D-N-AF 8	Dandepally	Narsapoor	04-02-2011
9	A-A-A-AF 9	Adilabad	Ankoli	02-02-2011
10	A-T-T-AF 10	Tamsi	Tamsi	14-03-2011
11	A-N-K-AF 11	Neradigonda	Kumari	28-03-2011
12	A-N-W-AF 12	Neradigonda	Wagdhari	21-03-2011

METHODOLOGY

The methodology recommended by the International Commission of Bee Botany (ICBB, Louveaux et al. 1978) was employed for the recovery and analysis of pollen contents from honey samples. One ml of honey sample was dissolved in 10 ml of distilled water and centrifuged. The resultant sediment was treated with 5 ml of glacial acetic acid and centrifuged. The glacial acetic acid was decanted and the material was subjected to acetolysis technique. Two pollen slides were prepared for each sample and were palynologically scanned and analyzed.

For quantification of pollen types, 300 pollen grains per sample were counted. Based on their frequencies, the pollen types were placed under the following pollen frequency classes as recommended by ICBB, viz. predominant pollen type (>45%), secondary pollen type (16-45%), important minor pollen type (3-15%), minor pollen type (<3%).

OBSERVATION

All the honey samples were palynologically scanned and pollen of forty nine species, belonging to twenty six families, were recorded, viz. *Ageratum conyzoides, Sphaeranthus indicus, Guizotia abyssinica, Xanthium strumarium, Helianthus annuus, Tridax procumbens, Abutilon indicum, Terminalia* sp., *Combretum albidum, Eucalyptus globulus, Psidium guajava, Ricinus communis, Tinospora cordifolia, Grewia asiatica, Justicia procumbens, Bombax ceiba, Madhuca longifolia, Borassus flabellifer, Commelina benghalensis, Cyanotis cristata, Rungia repens, Brassica nigra, Brassica juncea, Evolvulus alsinoides, Impatiens balsamina, Cajanus cajan, Cereus dayamii, Ocimum basilicum, Ocimum sanctum, Sesamum indicum, Careya arborea, Zea mays, Vernonia cinerea, Alangium salvifolium, Alternanthera sessilis, Celosia argentea, Amaranthus spinosus, Sida acuta, Mimosa hamata,*

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Plate 1

1. *Borassus flabellifer.* 2. *Commelina benghalensis.* 3. *Cyanotis cristata.* 4. *Brassica nigra.* 5. *Brassica juncea.* 6. *Evolvulus alsinoides.* 7. *Feronia* sp. 8. *Impatiens balsamina.* 9. *Cereus dayamii.* 10. *Ocimum basilicum.* 11. *Ocimum sanctum.* 12. *Asteracantha* sp. 13. *Sesamum indicum.* 14. *Careya arborea.* 15. *Hygrophila auriculata.* 16. *Rungia repens.* 17. *Ageratum conyzoides.* 18. *Sphaeranthus indicus.* 19. *Guizotia abyssinica.* 20. *Xanthium strumarium.* 21. *Helianthus annuus.* 22. *Tridax procumbens.* 23. *Abutilon indicum.* 24. *Terminalia* sp. 25. *Combretum albidum.* 26. *Cajanus cajan.* 27. *Peltophorum pterocarpum.* 28. *Eucalyptus globulus.* 29. *Psidium guajava.* 30. *Ricinus communis.* 31. *Tinospora cordifolia.* 32. *Grewia asiatica.* 33. *Justicia procumbens.* 34. *Coriandrum sativum.* 35. *Melilotus alba.* 36. *Bombax ceiba.* 37. *Madhuca longifolia.* 38. Poaceae type. 39. *Zea mays.* 40. *Cardiospermum* sp. 41. *Sonchus oleraceus.* 42. *Vernonia cinerea.* 43. *Alangium salvifolium.* 44. *Alternanthera sessilis.* 45. *Celosia argentea.* 46. *Amaranthus spinosus.* 47. *Sida acuta.* 48. *Mimosa hamata.* 49. *Acacia chundra.*

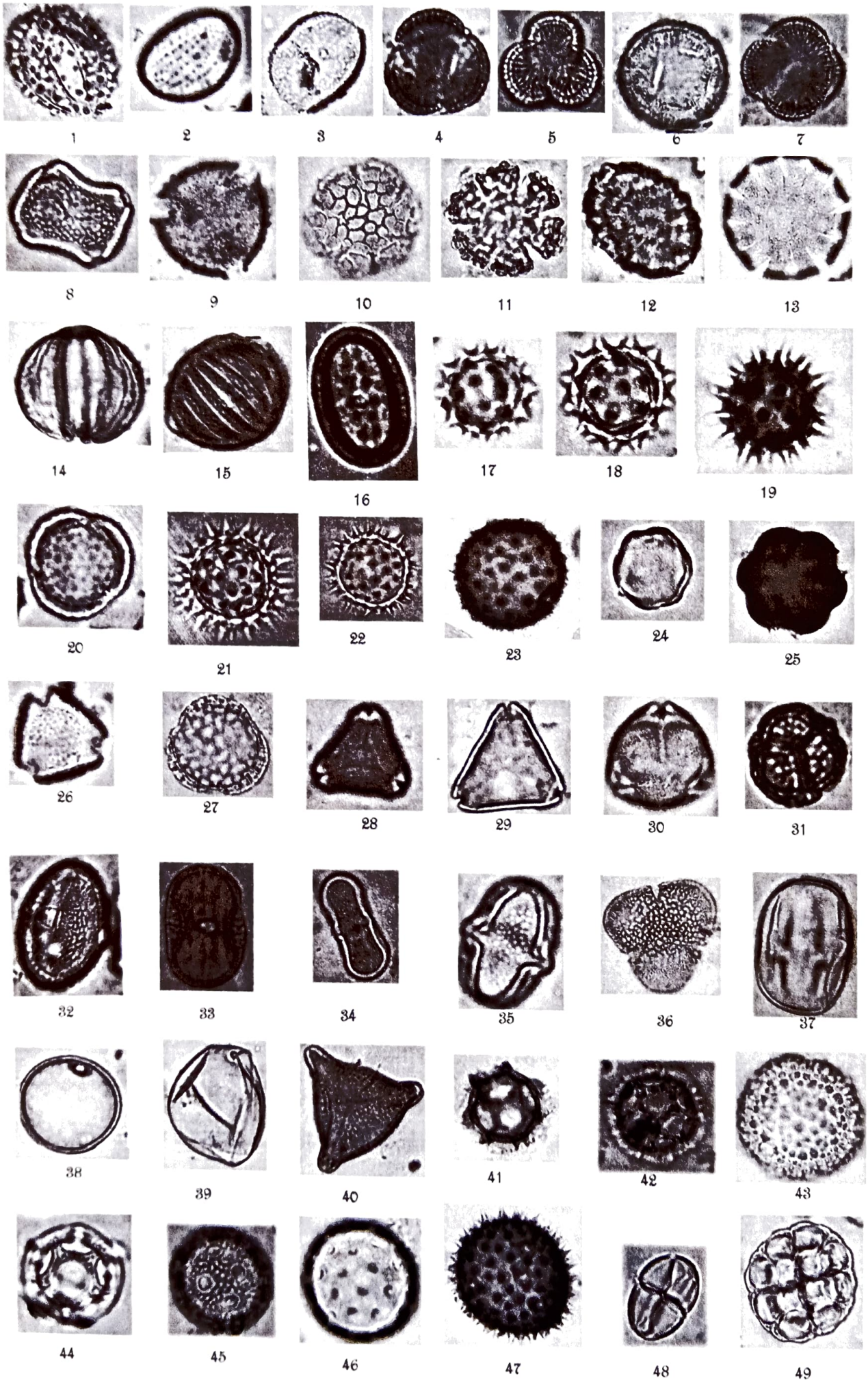
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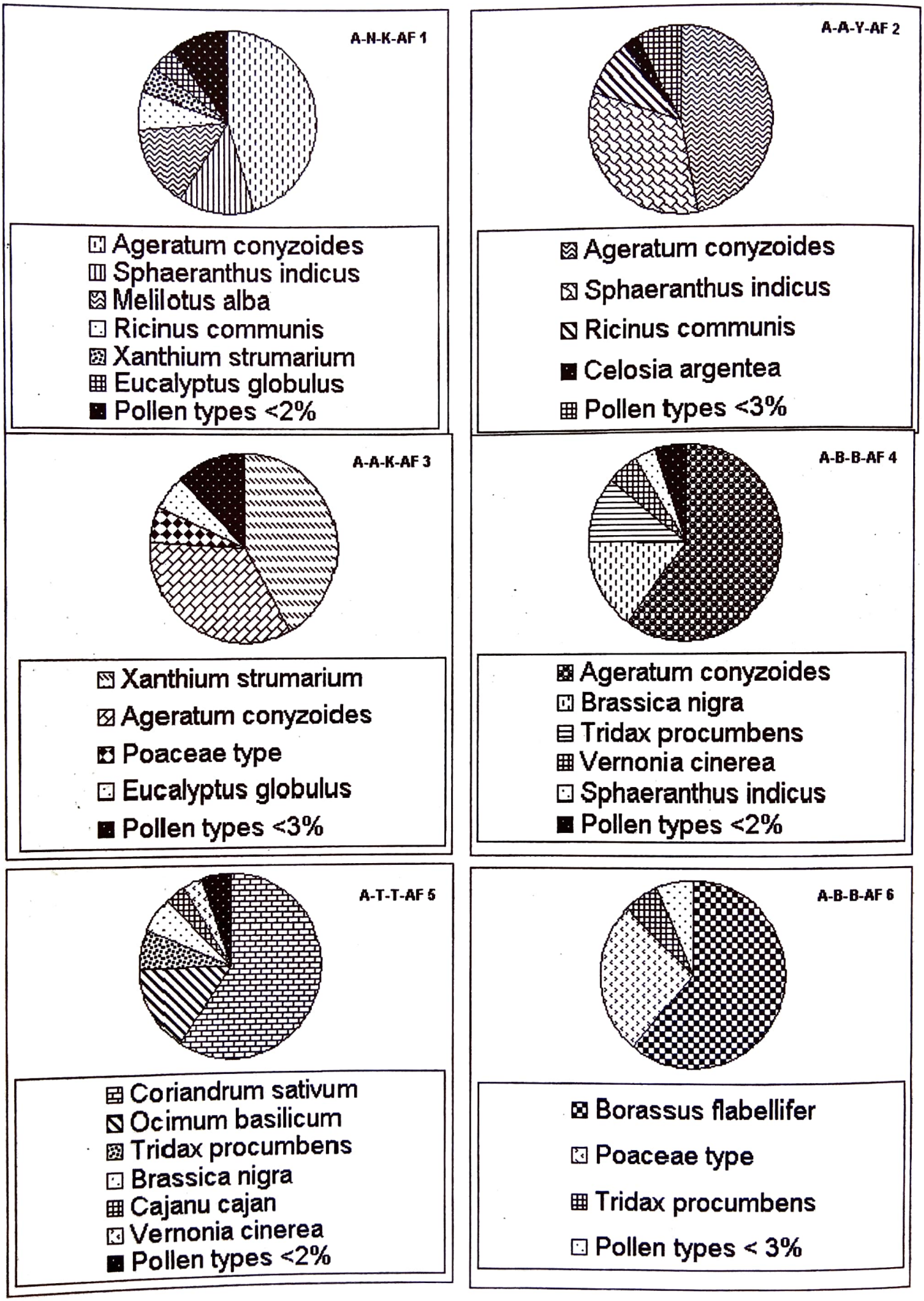
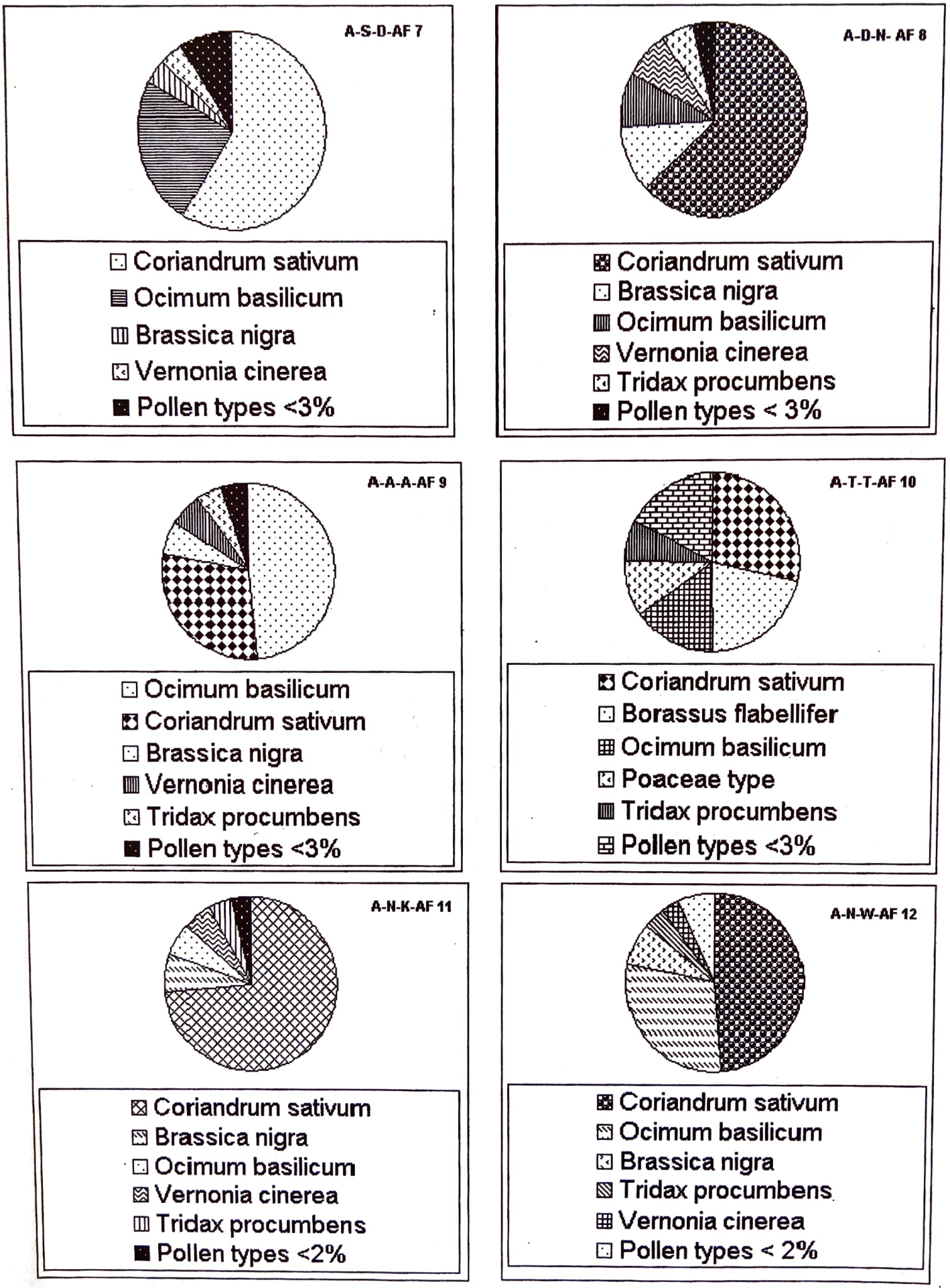
Plate 1



Text-figure 2. Pollen spectra of each honey sample.



Text-figure 2 (continued). Pollen spectra of each honey sample.

Table 2. Pollen types and their families.

Families	Species
Asteraceae	*Ageratum conyzoides, Sphaeranthus indicus, Guizotia abyssinica, Xanthium strumarium, Helianthus annuus, Tridax procumbens, Sonchus oleraceus, Vernonia cinerea*
Combretaceae	*Combretum albidum, Terminalia* sp.
Myrtaceae	*Eucalyptus globulus, Psidium guajava*
Commelinaceae	*Commelina benghalensis, Cyanotis cristata*
Brassicaceae	*Brassica nigra, Brassica juncea*
Lamiaceae	*Ocimum basilicum, Ocimum sanctum*
Amaranthaceae	*Alternanthera sessilis, Celosia argentea, Amaranthus spinosus*
Malvaceae	*Sida acuta, Abutilon indicum*
Fabaceae	*Mimosa hamata, Peltophorum pterocarpum, Acacia chundra, Melilotus alba, Cajanus cajan*
Acanthaceae	*Hygrophila auriculata, Asteracantha* sp., *Rungia repens, Justicia procumbens*
Poaceae	Poaceae type, *Zea mays*
Euphorbiaceae	*Ricinus communis*
Menispermaceae	*Tinospora cordifolia*
Tiliaceae	*Grewia asiatica*
Bombacaceae	*Bombax ceiba*
Sapotaceae	*Madhuca longifolia*
Palmae	*Borassus flabellifer*
Convolvulaceae	*Evolvulus alsinoides*
Balsaminaceae	*Impatiens balsamina*
Cactaceae	*Cereus dayamii*
Pedaliaceae	*Sesamum indicum*
Lecythidaceae	*Careya arborea*
Alangiaceae	*Alangium salvifolium*
Rutaceae	*Feronia* sp.
Sapindaceae	*Cardiospermum* sp.
Apiaceae	*Coriandrum sativum*

Peltophorum pterocarpum, Acacia chundra, Feronia sp., *Hygrophila auriculata, Asteracantha* sp., Poaceae type, *Cardiospermum* sp., *Sonchus oleraceus* and *Melilotus alba* (Plate 1, Table 2).

POLLEN ANALYSIS OF HONEY SAMPLES

The species recorded from honey samples are given below under 4 frequency classes, viz. predominant (P), secondary (S), important minor (I) and minor (M). Percentage of each species is given in parentheses.

A-N-K-AF 1

P: *Ageratum conyzoides* (46.14).

S: Nil.

I: *Sphaeranthus indicus* (14.0), *Melilotus alba* (14.91), *Ricinus communis* (6.37), *Xanthium strumarium* (4.86), *Eucalyptus globulus* (4.36).

M: *Commelina benghalensis* (1.67), *Amaranthus spinosus* (1.17), *Acacia chundra* (1.0), *Grewia asiatica* (1.0), *Cyanotis cristata* (0.83), *Celosia argentea* (0.82), *Guizotia abyssinica* (0.5), *Madhuca longifolia* (0.33), *Borassus flabellifer* (0.33), *Sida acuta* (0.33), *Ocimum basilicum* (0.33), *Tridax procumbens* (0.16), *Alangium salvifolium* (0.16), *Bombax ceiba* (0.16), *Sonchus oleraceus* (0.16), *Vernonia cinerea* (0.16).

A-A-Y-AF 2

P: *Ageratum conyzoides* (48.12).

S: *Sphaeranthus indicus* (34.37).

I: *Ricinus communis* (9.37), *Celosia argentea* (2.69).

M: *Cajanus cajan* (1.66), *Peltophorum pterocarpum* (0.41), *Brassica nigra* (0.41), *Xanthium strumarium* (1.23), *Vernonia cinerea* (0.20), *Rungia repens* (0.20), *Hygrophila auriculata* (0.20), *Guizotia abyssinica* (0.20), *Tridax procumbens* (0.20), *Impatiens balsamina* (0.20), *Ocimum basilicum* (0.20), *Cardiospermum* sp. (0.20).

Table 3. Predominant pollen types in unifloral honey samples

S. No.	Sample Code	Season	Predominant Type
1	A-N-K-AF 1	Winter	*Ageratum conyzoides* (46.14)
2	A-A-Y-AF 2	,,	*Ageratum conyzoides* (48.12)
3	A-B-B-AF 4	,,	*Ageratum conyzoides* (59.95)
4	A-T-T-AF 5	,,	*Coriandrum sativum* (59.64)
5	A-B-B-AF 6	,,	*Borassus flabellifer* (61.11)
6	A-S-D-AF 7	,,	*Coriandrum sativum* (58.72)
7	A-D-N-AF 8	,,	*Coriandrum sativum* (62.68)
8	A-A-A-AF 9	,,	*Ocimum basilicum* (48.68)
9	A-N-K-AF 11	Summer	*Coriandrum sativum* (73.43)
10	A-N-W-AF 12	Summer	*Coriandrum sativum* (48.52)

A-A-K-AF 3

P: Nil.

S: *Xanthium strumarium* (41.98), *Ageratum conyzoides* (33.71).

I: Poaceae type (6.11), *Eucalyptus globulus* (5.95).

M: *Celosia argentea* (2.31), *Cajanus cajan* (2.31), *Guizotia abyssinica* (1.81), *Helianthus annuus* (1.65), *Tridax procumbens* (0.99), *Sphaeranthus indicus* (0.99), *Amaranthus spinosus* (0.49), *Ocimum basilicum* (0.33), *Evolvulus alsinoides* (0.33), *Acacia chundra* (0.16), *Madhuca longifolia* (0.16), *Mimosa hamata* (0.16), *Abutilon indicum* (0.16), *Vernonia cinerea* (0.16), *Sonchus oleraceus* (0.16).

A-B-B-AF 4

P: *Ageratum conyzoides* (59.95).

S: Nil.

I: *Brassica nigra* (15.23), *Tridax procumbens* (10.81), *Vernonia cinerea* (5.4), *Sphaeranthus indicus* (3.68).

M: *Ricinus communis* (1.96), *Rungia repens* (0.49), *Ocimum basilicum* (0.49), *Terminalia* sp. (0.24), *Sonchus oleraceus* (0.24), *Amaranthus spinosus* (0.24), *Cardiospermum* sp. (0.24), *Bombax ceiba* (0.24), *Melilotus alba* (0.24), *Abutilon indicum* (0.24), *Zea mays* (0.24).

A-T-T-AF 5

P: *Coriandrum sativum* (59.64).

S: Nil.

I: *Ocimum basilicum* (14.91), *Tridax procumbens* (7.0), *Brassica nigra* (5.96), *Cajanus cajan* (3.5), *Vernonia cinerea* (3.33).

M: *Evolvulus alsinoides* (1.22), *Tinospora cordifolia* (1.22), *Celosia argentea* (1.22), *Ageratum conyzoides* (0.52), *Peltophorum pterocarpum* (0.35), *Ricinus Communis* (0.35), *Justicia procumbens* (0.35), *Amaranthus spinosus* (0.17), *Sonchus oleraceus* (0.17).

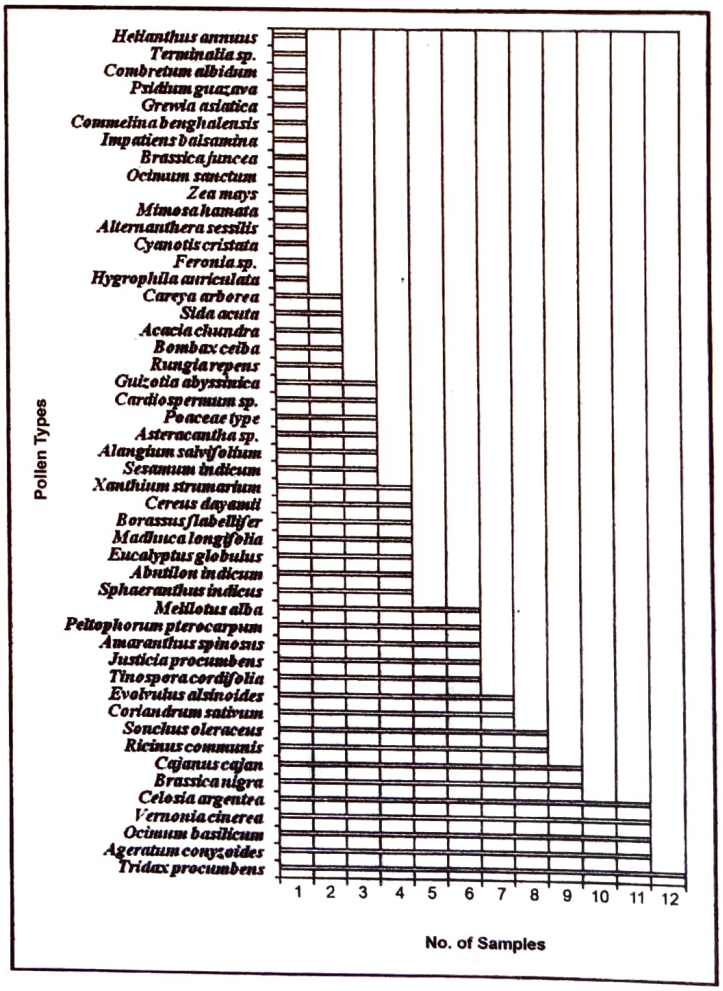
A-B-B-AF 6

P: *Borassus flabellifer* (61.11).

S: *Poaceae type* (26.31).

I: *Tridax procumbens* (6.14).

M: *Sesamum indicum* (2.0), *Careya arborea* (1.16), *Cereus dayamii* (0.58), *Ageratum conyzoides* (0.58), *Melilotus alba* (0.58), *Eucalyptus globulus* (0.29), *Asteracantha* sp. (0.29), *Celosia argentea* (0.29), *Brassica juncea* (0.29), *Alangium salvifolium* (0.29).



Text-figure 3. Overall pollen frequency in honey samples.

A-S-D-AF 7

P: *Coriandrum sativum* (58.72).

S: *Ocimum basilicum* (24.32).

I: *Brassica nigra* (4.17), *Vernonia cinerea* (3.68).

M: *Tridax procumbens* (2.94), *Cajanus cajan* (1.22), *Ageratum conyzoides* (1.22), *Ricinus communis* (0.98), *Tinospora cordifolia* (0.49), *Celosia argentea* (0.49), *Peltophorum pterocarpum* (0.49), *Evolvulus alsinoides* (0.49), *Sonchus oleraceus* (0.49), *Justicia procumbens* (0.24).

A-D-N-AF 8

P: *Coriandrum sativum* (62.68).

S: Nil.

I: *Brassica nigra* (11.0), *Ocimum basilicum* (8.95), *Vernonia cinerea* (7.67), *Tridax procumbens* (5.54).

M: *Xanthium strumarium* (0.85), *Evolvulus alsinoides* (0.63), *Justicia procumbens* (0.21), *Ageratum conyzoides* (0.21), *Melilotus alba* (0.21), *Cajanus cajan* (0.21), *Tinospora cordifolia* (0.21), *Celosia argentea* (0.21), *Asteracantha* sp. (0.21), *Amaranthus spinosus* (0.21), *Sonchus oleraceus* (0.21), *Cereus dayamii* (0.21), *Feronia* sp. (0.21), *Alternanthera sessilis* (0.21).

A-A-A-AF 9

P: *Ocimum basilicum* (48.68).

S: *Coriandrum sativum* (29.38).

I: *Brassica nigra* (6.14), *Vernonia cinerea* (6.14), *Tridax procumbens* (4.6).

M: *Evolvulus alsinoides* (1.75), *Celosia argentea* (0.87), *Cajanus cajan* (0.87), *Justicia procumbens* (0.21), *Ageratum conyzoides* (0.21), *Ricinus communis* (0.21), *Tinospora cordifolia* (0.21), *Abutilon indicum* (0.21), *Peltophorum pterocarpum* (0.21), *Ocimum sanctum (0.21).*

A-T-T-AF 10

P: Nil.

S: *Coriandrum sativum* (28.43), *Borassus flabellifer* (21.28), *Ocimum basilicum* (15.44).

I: Poaceae type (9.98), *Tridax procumbens* (7.72).

M: *Sesamum indicum* (4.14), *Vernonia cinerea* (4.14), *Brassica nigra* (4.14), *Madhuca longifolia* (0.75), *Alangium salvifolium* (0.56), *Careya arborea* (0.56), *Ricinus communis* (0.56), *Psidium guajava* (0.37), *Cajanus cajan* (0.37), *Peltophorum pterocarpum* (0.37), *Celosia argentea* (0.37), *Melilotus alba* (0.18), *Justicia procumbens* (0.18), *Ageratum conyzoides* (0.18), *Tinospora cordifolia* (0.18).

A-N-K-AF 11

P: *Coriandrum sativum* (73.43).

S: Nil.

I: *Brassica nigra* (7.0), *Ocimum basilicum* (6.25), *Vernonia cinerea* (5.2), *Tridax procumbens* (4.42).

M: *Cajanus cajan* (0.78), *Evolvulus alsinoides* (0.78), *Cereus dayamii* (0.26), *Ageratum conyzoides* (0.26), *Madhuca longifolia* (0.26), *Sonchus oleraceus* (0.26), *Justicia procumbens* (0.26), *Tinospora cordifolia* (0.26), *Sida acuta* (0.26), *Celosia argentea* (0.26).

A-N-W-AF 12

P: *Coriandrum sativum* (48.52).

S: *Ocimum basilicum* (29.46).

I: *Brassica nigra* (7.85), *Tridax procumbens* (3.73), *Vernonia cinerea* (3.33).

M: *Cajanus cajan* (1.96), *Evolvulus alsinoides* (1.17), *Ricinus communis* (0.98), *Celosia arborea* (0.58), *Psidium guajava* (0.39), *Abutilon indicum* (0.19), *Peltophorum pterocarpum* (0.19), *Careya arborea* (0.19), *Borassus flabellifer* (0.19), *Combretum albidum* (0.19), *Sesamum indicum* (0.19), *Sonchus oleraceus* (0.19), *Cereus dayamii* (0.19), *Amaranthus spinosus* (0.19), *Melilotus alba* (0.1).

DISCUSSION

Ten of the twelve honey samples were found to be unifloral and two were multifloral. The unifloral samples were represented with predominant pollen types of *Coriandrum sativum* in five samples, viz. 59.64% in A-T-T-AF 5 , 58.72% in A-S-D-AF 7, 62.68% in A-D-N-AF 8, 73.43% in A-N-K-AF 11,

48.52% in W-N-A-AF 12 , *Ageratum conyzoides* in three samples, viz. 46.14% in A-N-K-AF1, 48.12% in A-A-Y-AF 2 , 59.95% in A-B-B-AF 4 , *Borassus flabellifer* in one sample, viz. 61.11% in A-B-B-AF 6, *Ocimum basilicum* in one sample, viz. 48.68% in A-A-A-AF 9 (Table 3).

A total number of forty seven pollen grains, viz. *Tridax procumbens, Ageratum conyzoides, Ocimum basilicum, Vernonia cinerea, Celosia argentea, Brassica nigra, Cajanus cajan, Ricinus communis, Coriandrum sativum, Sonchus oleraceus, Evolvulus alsinoides, Tinospora cordifolia, Justicia procumbens, Amaranthus spinosus, Peltophorum pterocarpum, Melilotus alba, Sphaeranthus indicus, Abutilon indicum, Eucalyptus globulus, Madhuca longifolia, Borassus flabellifer, Cereus dayamii, Xanthium strumarium, Sesamum indicum, Alangium salvifolium, Asteracantha* sp., Poaceae type, *Cardiospermum* sp., *Guizotia abyssinica, Rungia repens, Bombax ceiba, Acacia chundra, Sida acuta, Careya arborea, Hygrophila auriculata, Feronia* sp., *Cyanotis cristata, Alternanthera sessilis, Mimosa hamata, Zea mays, Ocimum sanctum, Brassica juncea, Impatiens balsamina, Commelina benghalensis, Grewia asiatica, Terminalia* sp. and *Helianthus annuus*, were recorded from the honey samples collected during November, December, January and February of 2010-2011 during winter season.

Pollen grains of twenty nine species, viz. *Tridax procumbens, Ageratum conyzoides, Ocimum basilicum, Vernonia cinerea, Celosia argentea, Brassica nigra, Cajanus cajan, Ricinus communis, Coriandrum sativum, Sonchus oleraceus, Evolvulus alsinoides, Tinospora cordifolia, Justicia procumbens, Amaranthus spinosus, Peltophorum pterocarpum, Melilotus alba, Abutilon indicum, Eucalyptus globulus, Madhuca longifolia, Borassus flabellifer, Cereus dayamii, Sesamum indicum, Alangium salvifolium,* Poaceae type, *Cardiospermum* sp., *Sida acuta, Careya arborea, Psidium guajava* and *Combretum albidum*, were recorded during March 2011.

The common palynotaxa recorded in the *Apis florea* honey samples of Ranga Reddy District are *Tridax procumbens, Ageratum conyzoides, Rungia repens, Eucalyptus globulus, Peltophorum* sp., *Ocimum* sp., *Evolvulus alsinoides, Acacia* sp., *Guizotia abyssinica, Cajanus cajan, Asteracantha* sp., *Justicia procumbens, Celosia argentea, Helianthus annuus, Vernonia cinerea, Xanthium strumarium, Terminalia* sp., *Ricinus communis, Sphaeranthus indicus, Amaranthus spinosus, Zea mays, Psidium guazava* and Poaceae type were commonly encountered in *Apis florea* honeys of Ranga Reddy District, Andhra Pradesh (Kalpana et al. 1990, Kalpana & Ramanujam 1990-91, 1991, Ramanujam & Kalpana 1992, Khatija & Ramanujam 1993)

The present study indicates that *Tridax procumbens* is commonly encountered in all the twelve honey samples recorded from both agricultural tracts and forest localities during summer and winter seasons. *Ageratum conyzoides, Ocimum basilicum, Vernonia cinerea* and *Celosia argentea* are commonly recorded from eleven honey samples collected during February and March (*Ageratum conyzoides* in March and *Ocimum basilicum, Vernonia cinerea* and *Celosia argentea* in February samples). *Brassica nigra* and *Cajanus cajan* are not recorded in three samples whereas *Ricinus communis* and *Sonchus oleraceus* are not recorded in four samples (Text-figures 2, 3).

The above account clearly indicates that *Tridax procumbens, Ageratum conyzoides, Ocimum basilicum, Vernonia cinerea Celosia argentea, Brassica nigra, Cajanus cajan, Ricinus communis* and *Sonchus oleraceus* are dominant palynotaxa in *Apis florea* honeys of Adilabad District. The diversity and dominance of pollen content recorded in these squeezed honey samples of *Apis florea* from both agricultural and forest localities clearly express the vegetational diversity of Adilabad District.

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REFERENCES

Fatima K. & Ramanujam C. G. K. 1993. Pollen and chemical characterization of *Apis cerena* and *Apis florea* honeys from Hyderabad urban complex. J. Palynol. 29: 59-67.

Kalpana T. P., Khatija F. & Ramanujam C. G. K. 1990. Pollen analysis of *Apis cerena* and *Apis florea* honeys from Adikmet area, Hyderabad. Proc. Indian Acad. Sci. (Plant Sci.) 100(3): 183-193.

Kalpana T. P. & Ramnujam C. G. K. 1990-91. Pollen analysis of *Prosopis julifera* honeys from Ranga Reddy Dist., A.P., and its relevance to apiculture and social forestry. Current perspectives in palynological research, Silver Jubilee Commemoration Volume of the Journal of Palynology: 345-368.

Kalpana T. P. & Ramanujam C. G. K. 1991. A melissopalynological investigation of honeys from *Apis florea* and *Apis dorsata* hives. Biovigyanam 17(1): 12-23.

Louveaux J., Maurizio A. & Vorwohl G. 1978. Methods of Melissopalynology. Bee World 59: 139-157.

Ramanujam C. G. K. & Kalpana T. P. 1992. *Tamarindus indica* L.: an important forage plant for *Apis florea* F. in South Central India. Apidologie 23: 403-413.