

Melittopalynology and recognition of major nectar and pollen sources for honey bees in some districts of Andhra Pradesh

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Ramanujam, C.G.K., Kalpana, T.P. & Fatima, K. 1992. Melittopalynology and recognition of major nectar and pollen sources for honey bees in some districts of Andhra Pradesh. In: Venkatachala, B. S., Jain, K. P. & Awasthi, N. (eds) - Proc. 'Birbal Sahni Birth Centenary Palaeobotanical Conference', *Geophytology* **22** : 261 — 271.

The pollen contents of 164 honey samples and 5046 pollen loads from Ranga Reddy, Mahboobnagar and Guntur districts of Andhra Pradesh have been subjected to qualitative and quantitative analysis. In the agricultural tracts of Ranga Reddy District *Carum copticum*, *Prosopis juliflora*, *Phoenix sylvestris*, *Guizotia abyssinica* and *Ageratum conyzoides* during winter and, *Tamarindus indica* and *Ageratum conyzoides* during summer are the chief sources of nectar and pollen for the honey bees. *Sterculia urens*, *Aegle marmelos* and *Adina cordifolia* represent the major bee forage plants of the deciduous forests of Mahboobnagar District during summer. The pollen analysis of honey samples from the agricultural tracts of Guntur District highlighted *Mimosa pudica* and *Sapindus emarginatus* during winter and, *Borassus flabellifer*, *Hygrophila auriculata* and *Phylla nodiflora* during summer, as the reliable sources of nectar. The study brought to light a number of other minor sources of bee forage of local interest.

Key-words—Pollen analysis, honeys and pollen loads, Andhra Pradesh.

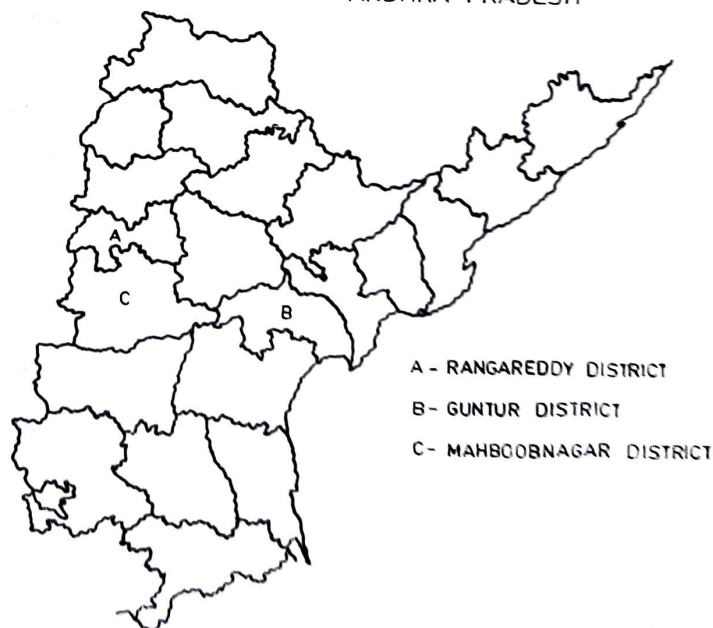
INTRODUCTION

THE forage of honey bees consists of nectar and pollen. Availability of reliable and adequate sources of nectar and pollen is an important pre-requisite for the survival, healthy development and multiplication of honey bees leading to surplus honey production. The bees themselves furnish unequivocal information in this regard, provided we have the wherewithal to understand it. The significance of melittopalynological approach involving qualitative and quantitative analysis of the pollen contents of the honeys and pollen loads, for unravelling the forage sources of bees needs no over emphasis. The pollen complement of honey points towards the nectar source and that of pollen loads, the pollen source. Consequently, recognition of all such areas which have the built in potential to sustain the bee colonies all through the year could be pivotal to bee keeping enterprise designed for commercial honey production.

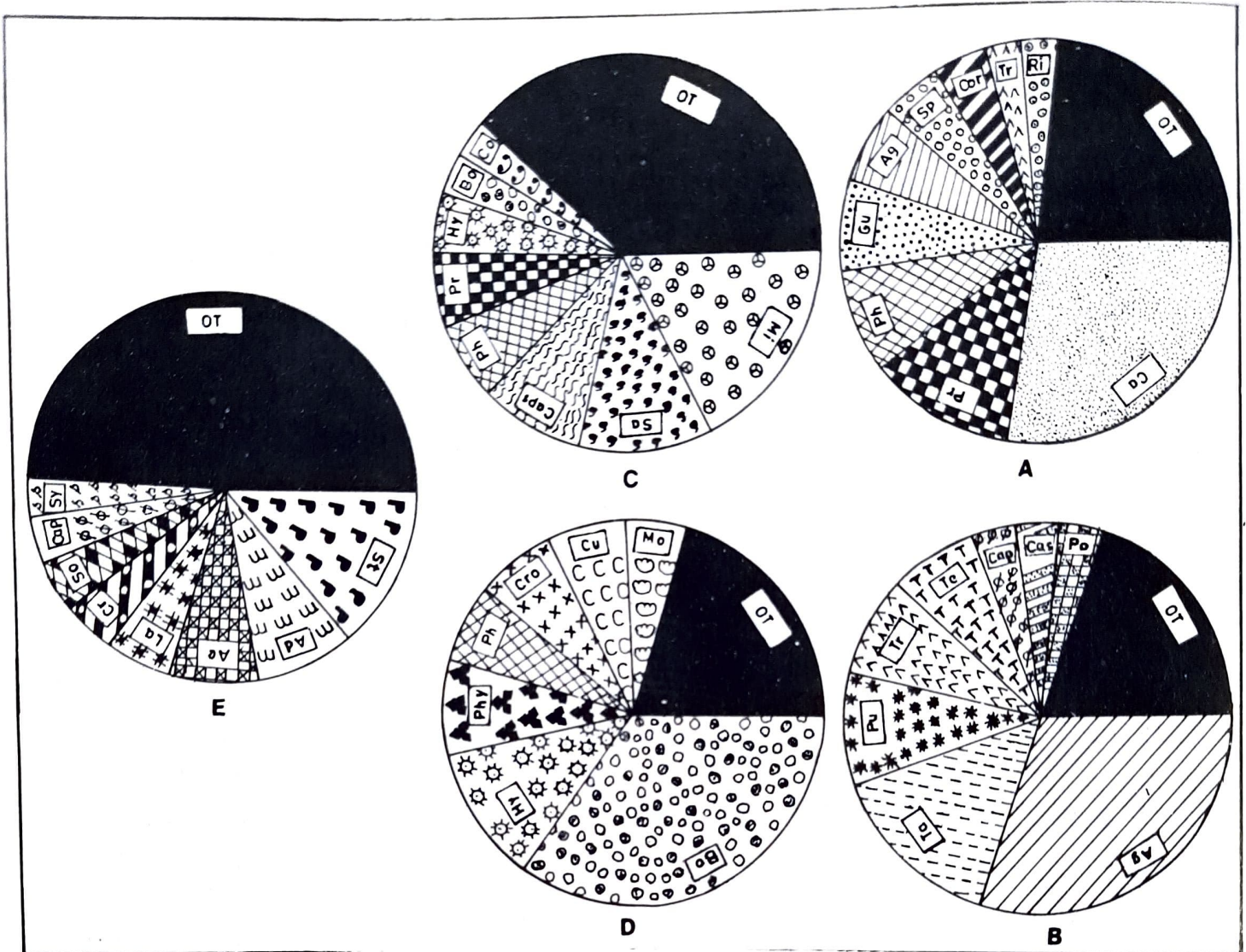
The authors have recently undertaken detailed melittopalynological studies of honeys and pollen loads from different floristic regimes of Andhra Pradesh in order to recognize the seasonal nectar and pollen sources for the

honey bees and assess their suitability for apicultural ventures (Jhansi & Ramanujam, 1986, 1987, 1990:

ANDHRA PRADESH



Map 1. Andhra Pradesh showing the three districts which provided honeys and pollen loads



Text-figure 1. Composite pollen spectra of honeys

A. Ranga Reddy District (Winter). B. Ranga Reddy District (Summer). C. Guntur District (Winter). D. Guntur District (Summer). E. Mahboobnagar District (Summer).

Ad - *Adina cordifolia*, Ae - *Aegle marmelos*, Ag - *Ageratum conyzoides*, Bo - *Borassus flabellifer*, Ca - *Carum copticum*, Cap - *Capparis grandis*, Caps - *Capsicum frutescens*, Cas - *Casearia elliptica*, Co - *Cocos nucifera*, Cor - *Coriandrum sativum*, Cr - *Crataeva magna*, Cro - *Crotalaria juncea*, Cu - *Cucumis* sp., Gu - *Guizotia abyssinica*, Hy - *Hygrophila auriculata*, La - *Lagerstroemia parviflora*, Mi - *Mimosa pudica*, Mo - *Momordica charantia*, Ph - *Phoenix sylvestris*, Phy - *Phyla nodiflora*, Po - *Pongamia pinnata*, Pr - *Prosopis juliflora*, Pu - *Punica granatum*, Ri - *Ricinus communis*, Sa - *Sapindus emarginatus*, So - *Soymida febrifuga*, Sp - *Sphaeranthus indicus*, St - *Sterculia urens*, Sy - *Syzygium cumini*, Ta - *Tamarindus indica*, Te - *Terminalia arjuna*, Tr - *Tridax procumbens*, OT - Pollen types < 3 % and unknown.

Jhansi *et al.*, 1990; Kalpana & Ramanujam, 1989, 1991; Kalpana *et al.*, 1990; Khatija & Ramanujam, 1989; Ramanujam & Kalpana, 1990-91; Ramanujam & Khatija, 1991; Ramanujam *et al.*, 1990).

This contribution is a summation of the over all study highlighting some of the observations arrived at to date with particular reference to Ranga Reddy, Mahboobnagar and Guntur districts.

MATERIAL AND METHODS

164 honey samples (110 from Ranga Reddy, 32 from Mahboobnagar and 22 from Guntur districts) were collected during 1982-91 (Map 1). The samples from the

agricultural tracts of Ranga Reddy and deciduous forests of Mahboobnagar districts represent squeezed honeys of *Apis florea* (Small bee) and *Apis dorsata* (Rock bee) respectively. Enough care was taken to press only the honey storing portion of the combs for obtaining essentially pure honey. The Guntur honeys, however, represent extracted honeys obtained from the apiaries of *Apis cerana* (Indian hive bee). Of the 110 samples collected from Ranga Reddy District, 90 constitute winter honeys (Nov.-Feb.) and 20 summer honeys (April-June). The honeys from Mahboobnagar are essentially summer honeys obtained during March-June while the Guntur honeys were collected both during winter (Sept.-Dec., 13 samples) and summer (March-July, 9 samples) seasons.

Table 1. Pollen analysis of honeys studied

Geographical origin of honeys	Pollen types
Ranga Reddy District	Winter
	P - <i>Carum copticum</i> , <i>Prosopis juliflora</i> , <i>Phoenix sylvestris</i> , <i>Guizotia abyssinica</i> , <i>Coriandrum sativum</i> , <i>Ageratum conyzoides</i> , <i>Mangifera indica</i> , <i>Sphaeranthus indicus</i> , <i>Allium cepa</i> , <i>Syzygium cumini</i> , <i>Helianthus annuus</i> , <i>Evolvulus alsinoides</i> , <i>Eucalyptus globulus</i> , <i>Ailanthus excelsa</i>
	S - <i>C. copticum</i> , <i>G. abyssinica</i> , <i>Tridax procumbens</i> , <i>A. conyzoides</i> , <i>P. juliflora</i> , <i>Rungia repens</i> , <i>Cleome gynandra</i> , <i>Justicia procumbens</i> , <i>M. indica</i> , <i>Capsicum frutescens</i> , <i>S. indicus</i> , <i>E. globulus</i> , <i>P. sylvestris</i> , <i>Cocos nucifera</i>
I - <i>C. copticum</i> , <i>G. abyssinica</i> , <i>T. procumbens</i> , <i>C. sativum</i> , <i>A. conyzoides</i> , <i>Ricinus communis</i> , <i>Cajanus cajan</i> , <i>Brassica nigra</i> , <i>Celosia argentea</i> , <i>P. juliflora</i> , <i>Terminalia</i> sp., <i>C. gynandra</i> , <i>J. procumbens</i> , <i>M. indica</i> , <i>Citrus limon</i> , <i>Sopubia delphinifolia</i> , <i>C. frutescens</i> , <i>Acacia nilotica</i> , <i>Tinospora cordifolia</i> , <i>Buchanania lanzan</i> , <i>S. indicus</i> , <i>A. cepa</i> , <i>A. excelsa</i> , <i>Psidium guajava</i> , <i>Carthamus tinctorius</i> , <i>Melilotus alba</i> , <i>E. alsinoides</i> , <i>Triumfetta rhomboidea</i> , <i>Dodonaea viscosa</i> , <i>Leucas aspera</i> , <i>E. globulus</i> , <i>Lepidagathis cristata</i> , <i>Sapindus emarginatus</i> , <i>Leucaena leucocephala</i> , <i>P. sylvestris</i> , <i>H. annuus</i> , <i>Spinacia oleracea</i> , <i>Cucumis</i> sp., <i>C. nucifera</i> , <i>Clerodendrum</i> sp., <i>Moringa oleifera</i>	
Mahboobnagar District	Summer
	P - <i>A. conyzoides</i> , <i>Tamarindus indica</i> , <i>Punica granatum</i> , <i>Terminalia arjuna</i> , <i>T. procumbens</i> , <i>Casearia elliptica</i> , <i>Capparis grandis</i> , <i>Pongamia pinnata</i>
	S - <i>A. conyzoides</i> , <i>T. indica</i> , <i>T. procumbens</i> , <i>A. excelsa</i> , <i>P. guajava</i> , <i>Borreria hispida</i> , <i>Arachis hypogaea</i> , <i>P. granatum</i>
I - <i>A. conyzoides</i> , <i>T. indica</i> , <i>T. procumbens</i> , <i>C. elliptica</i> , <i>A. nilotica</i> , <i>Grewia tiliaefolia</i> , <i>C. grandis</i> , <i>R. communis</i> , <i>A. cepa</i> , <i>M. indica</i> , <i>H. annuus</i> , <i>S. indicus</i> , <i>B. nigra</i> , <i>P. pinnata</i> , <i>Parkinsonia aculeata</i> , <i>C. frutescens</i> , <i>P. guajava</i> , <i>J. procumbens</i> , <i>Gymnosporia emarginata</i> , <i>S. emarginatus</i> , <i>T. arjuna</i> , <i>A. hypogaea</i> , <i>Oldenlandia umbellata</i> , <i>S. cumini</i> , <i>E. globulus</i> , <i>Annona squamosa</i> , <i>Feronia elephantum</i> , <i>Gardenia latifolia</i> , <i>Caesalpinia bonduc</i>	
Guntur District	Summer
	P - <i>Lagerstroemia parviflora</i> , <i>Crataeva magna</i> , <i>Soymida febrifuga</i> , <i>Aegle marmelos</i> , <i>Spondias pinnata</i> , <i>Prosopis juliflora</i> , <i>Schleichera oleosa</i> , <i>Sterculia urens</i> , <i>Syzygium cumini</i> , <i>Adina cordifolia</i>
	S - <i>Terminalia arjuna</i> , <i>T. alata</i> , <i>Mimosa rubicaulis</i> , <i>Phyllanthus</i> sp., <i>Loranthus longiflorus</i> , <i>Zizyphus xylopyrus</i> , <i>Premna tomentosa</i> , <i>Capparis grandis</i> , <i>Caesalpinia bonduc</i> , <i>C. magna</i> , <i>Grewia</i> sp., <i>G. salvifolia</i> , <i>Lannea coromandelica</i> , <i>S. febrifuga</i> , <i>S. cumini</i> , <i>Phoenix sylvestris</i> , <i>A. cordifolia</i> , <i>Mitragyna parvifolia</i>
I - <i>Terminalia chebula</i> , <i>T. arjuna</i> , <i>T. alata</i> , <i>S. oleosa</i> , <i>Pongamia pinnata</i> , <i>L. coromandelica</i> , <i>Strychnos potatorum</i> , <i>Cassia fistula</i> , <i>Crotalaria</i> sp., <i>Dodonaea viscosa</i> , <i>Eucalyptus globulus</i> , <i>Ageratum conyzoides</i> , <i>Phyllanthus</i> sp., <i>Grewia</i> sp., <i>G. tiliaefolia</i> , <i>G. salvifolia</i> , <i>L. parviflora</i> , <i>Z. xylopyrus</i> , <i>Hyptis suaveolens</i> , <i>Parkinsonia aculeata</i> , <i>Helicteres isora</i> , <i>Rungia repens</i> , <i>M. rubicaulis</i> , <i>Anacardium occidentale</i> , <i>Sphaeranthus indicus</i> , <i>Blepharis maderaspatensis</i> , <i>Cyanotis</i> sp., <i>C. grandis</i> , <i>Randia dumetorum</i> , <i>Casearia elliptica</i> , <i>C. bonduc</i> , <i>Tribulus terrestris</i> , <i>Arachis hypogaea</i> , <i>A. marmelos</i> , <i>Dichrostachys cinerea</i> , <i>P. tomentosa</i> , <i>Gardenia latifolia</i> , <i>Feronia elephantum</i> , <i>S. febrifuga</i> , <i>Delonix regia</i> , <i>Alangium salvifolium</i> , <i>P. juliflora</i> , <i>Bombax malabaricum</i> , <i>Merrimia</i> sp., <i>Flacourtia indica</i> , <i>A. cordifolia</i> , <i>Albizia lebbek</i> , <i>Buchanania lanzan</i> , <i>S. cumini</i> , <i>S. urens</i> , <i>Oldenlandia</i> sp., <i>M. parvifolia</i>	
Guntur District	Winter
	P - <i>Mimosa pudica</i> , <i>Sapindus emarginatus</i> , <i>Capsicum frutescens</i> , <i>Prosopis juliflora</i>
	S - <i>Phoenix sylvestris</i> , <i>Hygrophila auriculata</i> , <i>C. frutescens</i> , <i>Cleome viscosa</i> , <i>Cucumis</i> sp.,
I - <i>Sopubia delphinifolia</i> , <i>Borassus flabellifer</i> , <i>Mangifera indica</i> , <i>Zizyphus jujuba</i> , <i>Coriandrum sativum</i> , <i>Cocos nucifera</i> , <i>Terminalia</i> sp., <i>Brassica nigra</i> , <i>P. sylvestris</i> , <i>C. frutescens</i> , <i>Momordica charantia</i> , <i>P. juliflora</i> , <i>Ricinus communis</i> , <i>S. emarginatus</i> , <i>Cleome gynandra</i> , <i>M. pudica</i> , <i>Tridax procumbens</i> , <i>Sesamum indicum</i> , <i>Tinospora cordifolia</i> , <i>Phyllanthus</i> sp., <i>Dodonaea viscosa</i> , <i>Syzygium cumini</i> , <i>Eucalyptus globulus</i>	
Guntur District	Summer
	P - <i>B. flabellifer</i> , <i>H. auriculata</i>
	S - <i>H. auriculata</i> , <i>B. flabellifer</i> , <i>Phyla nodiflora</i> , <i>P. sylvestris</i> , <i>Cucumis</i> sp., <i>Crotalaria juncea</i> , <i>M. charantia</i>
I - <i>Pongamia pinnata</i> , <i>H. auriculata</i> , <i>Citrus limon</i> , <i>B. nigra</i> , <i>T. procumbens</i> , <i>Sphaeranthus indicus</i> , <i>Delonix regia</i> , <i>Cassia</i> sp., <i>Vitex negundo</i> , <i>Thespesia populnea</i> , <i>P. nodiflora</i> , <i>M. indica</i> , <i>Phaseolus</i> sp., <i>Coccinia indica</i> , <i>C. nucifera</i> , <i>Morinda citrifolia</i> , <i>C. gynandra</i> , <i>C. frutescens</i> , <i>B. flabellifer</i>	

P - Predominant pollen types (>45 %)

S - Secondary pollen types (16-45 %)

I - Important minor pollen types (3-15 %)

Table 2. Pollen types encountered in bifloral and multifloral loads (upto 15% only)

Geographical origin of pollen loads	Bifloral	Multifloral
Ranga Reddy District	Winter <i>Carum copticum</i> (41.46) <i>Guizotia abyssinica</i> (28.46) <i>Phoenix sylvestris</i> (26.83) <i>Sphaeranthus indicus</i> (23.58) <i>Cocos nucifera</i> (21.95) <i>Cajanus cajan</i> (17.89) <i>Coriandrum sativum</i> (15.45)	<i>G. abyssinica</i> (73.24) <i>S. indicus</i> (69.37) <i>Tridax procumbens</i> (67.25) <i>C. copticum</i> (23.59) <i>Ageratum conyzoides</i> (17.25) <i>Cajanus cajan</i>
	Summer <i>A. conyzoides</i> (49.52) <i>Tamarindus indica</i> (33.33) <i>T. procumbens</i> (25.71) <i>Punica granatum</i> (21.9) <i>Dodonaea viscosa</i> (17.14)	<i>A. conyzoides</i> (65.45) <i>T. indica</i> (58.18) <i>Acacia nilotica</i> (50.91) <i>Casearia elliptica</i> (25.45) <i>T. procumbens</i> (23.64) <i>Grewia tiliaefolia</i> (23.64) <i>D. viscosa</i> (16.36) <i>Psidium guajava</i> (14.55)
Mahboobnagar District	Summer <i>Albizia lebbek</i> (22.64) <i>Terminalia chebula</i> (17.62) <i>Aegle marmelos</i> (15.52) <i>Adina cordifolia</i> (15)	<i>A. lebbek</i> (25.37) <i>T. chebula</i> (20.89) <i>Buchanania lanzan</i> (19.4) <i>Tribulus terrestris</i> (16.42) <i>A. cordifolia</i> (15)

5046 pollen loads (1541 from Ranga Reddy and 3505 from Mahboobnagar districts) were collected during 1989-91. The pollen loads were obtained directly from the pollen storing chambers of the honey combs of *Apis florea* (Ranga Reddy District) and *Apis dorsata* (Mahboobnagar District). Of the 1541 pollen loads from Ranga Reddy District, 905 were procured during winter (Nov.-Jan.) and 636 during summer (April-June). All the pollen loads from Mahboobnagar were collected during summer (March-June).

For the technique and methodology adopted in the recovery and study of the pollen contents of the honeys

and pollen loads reference may be made to Kalpana *et al.* (1990). The quantification of the results is in accordance with the procedure recommended by the International Commission for Bee Botany (Louveaux *et al.*, 1978) and the pollen load categorization into unifloral, bifloral and multifloral loads is after Sharma (1970).

OBSERVATIONS

Pollen analysis of honeys—Of the 110 honey samples collected from Ranga Reddy, 94 (77 winter and

Plate 1

(Plates 1.2: unless otherwise mentioned all figs x 750)

- | | |
|-------------------------------------|------------------------------------|
| 1. <i>Mimosa pudica</i> | 19, 20. <i>Soymida febrifuga</i> |
| 2. <i>Capparis grandis</i> | 21, 22. <i>Sterculia urens</i> |
| 3. <i>Justicia procumbens</i> x 500 | 23. <i>Phylla nodiflora</i> x 500 |
| 4. <i>Celosia argentea</i> x 500 | 24. <i>Feronia elephantum</i> |
| 5. <i>Ageratum conyzoides</i> | 25, 26. <i>Aegle marmelos</i> |
| 6, 7. <i>Syzygium cumini</i> | 27. <i>Carum copticum</i> |
| 8. <i>Eucalyptus globulus</i> | 28, 29. <i>Capsicum frutescens</i> |
| 9. <i>Terminalia arjuna</i> | 30. <i>Crataeva magna</i> |
| 10, 11. <i>Sapindus emarginatus</i> | 31, 32. <i>Prosopis juliflora</i> |
| 12, 13. <i>Adina cordifolia</i> | 33. <i>Cocos nucifera</i> |
| 14. <i>Pongamia pinnata</i> | 34, 35. <i>Dodonaea viscosa</i> |
| 15, 16. <i>Punica granatum</i> | 36. <i>Borassus flabellifer</i> |
| 17, 18. <i>Mangifera indica</i> | 37, 38. <i>Grewia tiliaefolia</i> |

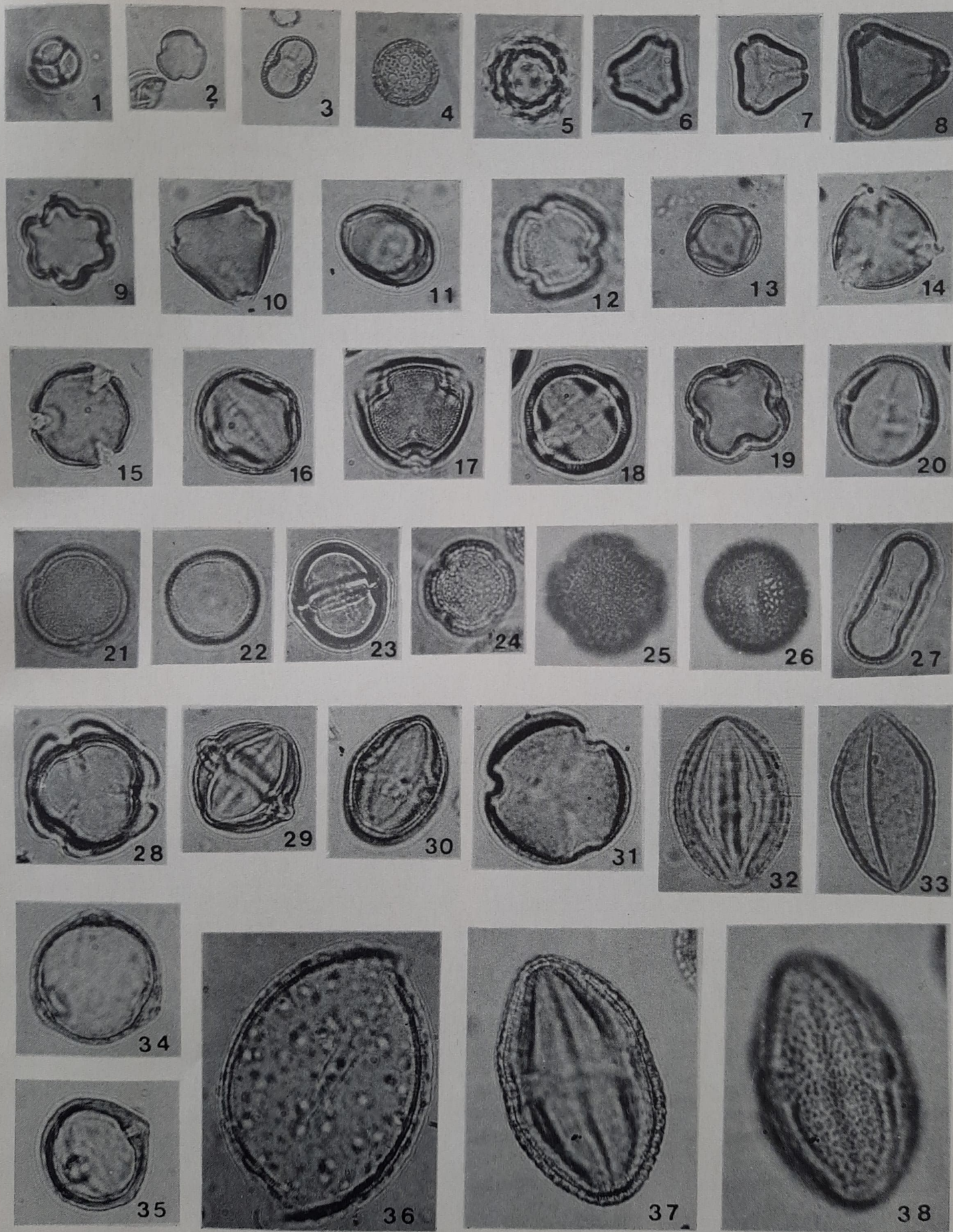


Plate 1

17 summer) were found to be unifloral and 16 (13 winter and 3 summer) multifloral. *Carum copticum* (46.89-67%) in 30 samples, *Prosopis juliflora* (55.66-95.92%) in 12 samples, *Phoenix sylvestris* (46.67-87.67%) in 9 samples, *Guizotia abyssinica* (46.33-67.33%) in 7 samples, *Coriandrum sativum* (53-63.67%), *Ageratum conyzoides* (52.67-84%) in 5 samples each, *Mangifera indica* (54.69-67%) in 2 samples, *Sphaeranthus indicus* (57.33%), *Allium cepa* (52%), *Syzygium cumini* (54.67%), *Helianthus annuus* (82%), *Evolvulus alsinoides* (50.33%), *Eucalyptus globulus* (84.67%) and *Ailanthus excelsa* (49.67%) in one sample each represent the predominant pollen types in the winter honeys. *Ageratum conyzoides* (55.33-86.33%) in 6 samples, *Tamarindus indica* (50.67-88%) in 3 samples, *Punica granatum* (73.33, 74.67%), *Terminalia arjuna* (47.84, 33%) in 2 samples each, *Tridax procumbens* (49.33%), *Casearia elliptica* (51%), *Capparis grandis* (62.67%) and *Pongamia pinnata* (63.67%) in one sample each represent the predominant pollen types in the summer honeys. A total of 94 pollen types were recognized from the winter honeys while the summer honeys showed 78 pollen types.

24 of the 32 Mahboobnagar honeys were found to be unifloral and 8, multifloral. *Sterculia urens* (58-73.33%) formed the predominant pollen type in 7 samples while *Aegle marmelos* (51.33-60.33%), *Adina cordifolia* (46.67-68.67 %) in 4 samples each, *Lagerstroemia parviflora* (50.33, 56.33 %). *Crataeva magna* (54, 58.33 %) in 2 samples each and, *Spondias pinnata* (51.33, %), *Soymida febrifuga* (50.33 %), *Prosopis juliflora* (76.67 %), *Schleichera oleosa* (53 %) and *Syzygium cumini* (51 %) in one sample each represent the other predominant pollen types. Altogether 95 pollen types could be recognized in the honeys from the deciduous forests of Mahboobnagar District.

The 22 samples collected from the agricultural tracts of Guntur District showed 11 (8 winter and 3 summer) unifloral and 11 (5 winter and 6 summer) multifloral honeys. The predominant pollen types recorded from the winter honeys are *Mimosa pudica* (49.6- 53.6%) in 4

samples, *Sapindus emarginatus* (63, 70.2%) in 2 samples, *Capsicum frutescens* (60.27%) and *Prosopis juliflora* (58.2%) in one sample each. In the summer honeys, however, *Borassus flabellifer* (84, 87.12%) in 2 samples, and *Hygrophila auriculata* (49.5%) in one sample constitute the predominant pollen types. 69 pollen types were recorded from the winter honeys while the summer honeys showed 43 pollen types.

Table 1 provides information regarding the predominant (>45%), secondary (16-45%) and Important minor (3-15%) pollen types recorded from the honeys of Ranga Reddy, Mahboobnagar and Guntur districts. Minor pollen types (<3%) encountered in these honeys are not considered in this report. Text-figure 1 (A-E) shows the composite pollen spectra based upon the frequencies of the various pollen types recovered from the honeys of these three districts. *Carum copticum*, *Prosopis juliflora*, *Phoenix sylvestris*, *Guizotia abyssinica*, *Ageratum conyzoides*, *Sphaeranthus indicus*, *Coriandrum sativum*, *Tridax procumbens* during winter and *Ageratum conyzoides*, *Tamarindus indica*, *Punica granatum*, *Tridax procumbens*, *Terminalia arjuna*, *Capparis grandis*, *Casearia elliptica* and *Pongamia pinnata* during summer constitute significant nectar suppliers in the agricultural tracts of the Ranga Reddy District. The noteworthy nectar sources in the agricultural tracts of Guntur District are, viz., *Mimosa pudica*, *Sapindus emarginatus*, *Capsicum frutescens*, *Phoenix sylvestris*, *Prosopis juliflora*, *Hygrophila auriculata*, *Borassus flabellifer*, *Cocos nucifera* during winter, and *Borassus flabellifer*, *Hygrophila auriculata*, *Phyla nodiflora*, *Phoenix sylvestris*, *Crotalaria juncea*, *Cucumis* sp. and *Momordica charantia* during summer. In the deciduous forests of Mahboobnagar District, *Sterculia urens*, *Adina cordifolia*, *Aegle marmelos* followed by *Lagerstroemia parviflora*, *Crataeva magna*, *Soymida febrifuga*, *Capparis grandis* and *Syzygium cumini* are the important summer nectar suppliers. Some of the significant and characteristic pollen types recovered from the honey samples investigated are illustrated here (Pl. 1, figs 1-3S; CPl.2, figs 1-22).

Plate 2

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|------------------------------------|---------------------------------|
| 1. <i>Schleichera oleosa</i> | 11. <i>Buchanania lanzan</i> |
| 2. <i>Sphaeranthus indicus</i> | 12-14. <i>Tamarindus indica</i> |
| 3, 4. <i>Casearia elliptica</i> | 15. <i>Allium cepa</i> |
| 5. <i>Ailanthus excelsa</i> | 16. <i>Helianthus annuus</i> |
| 6. <i>Hygrophila auriculata</i> | 17. <i>Guizotia abyssinica</i> |
| 7. <i>Lagerstroemia parviflora</i> | 18. <i>Caesalpinia bonduc</i> |
| 8. <i>Evolvulus alsinoides</i> | 19. <i>Coriandrum sativum</i> |
| 9. <i>Tridax procumbens</i> | 20, 21. <i>Cucumis</i> sp. |
| 10. <i>Phoenix sylvestris</i> | 22. <i>Momordica charantia</i> |

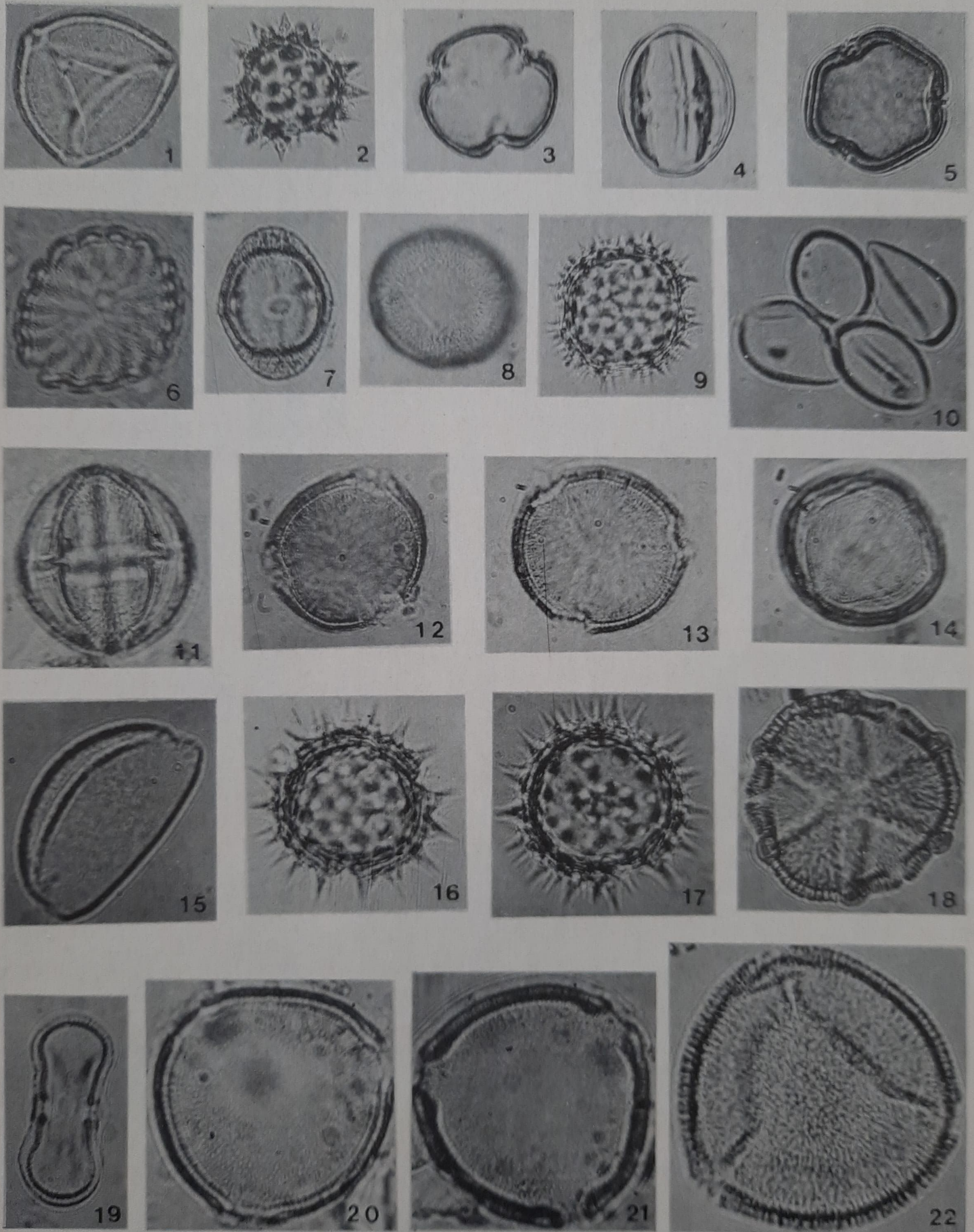
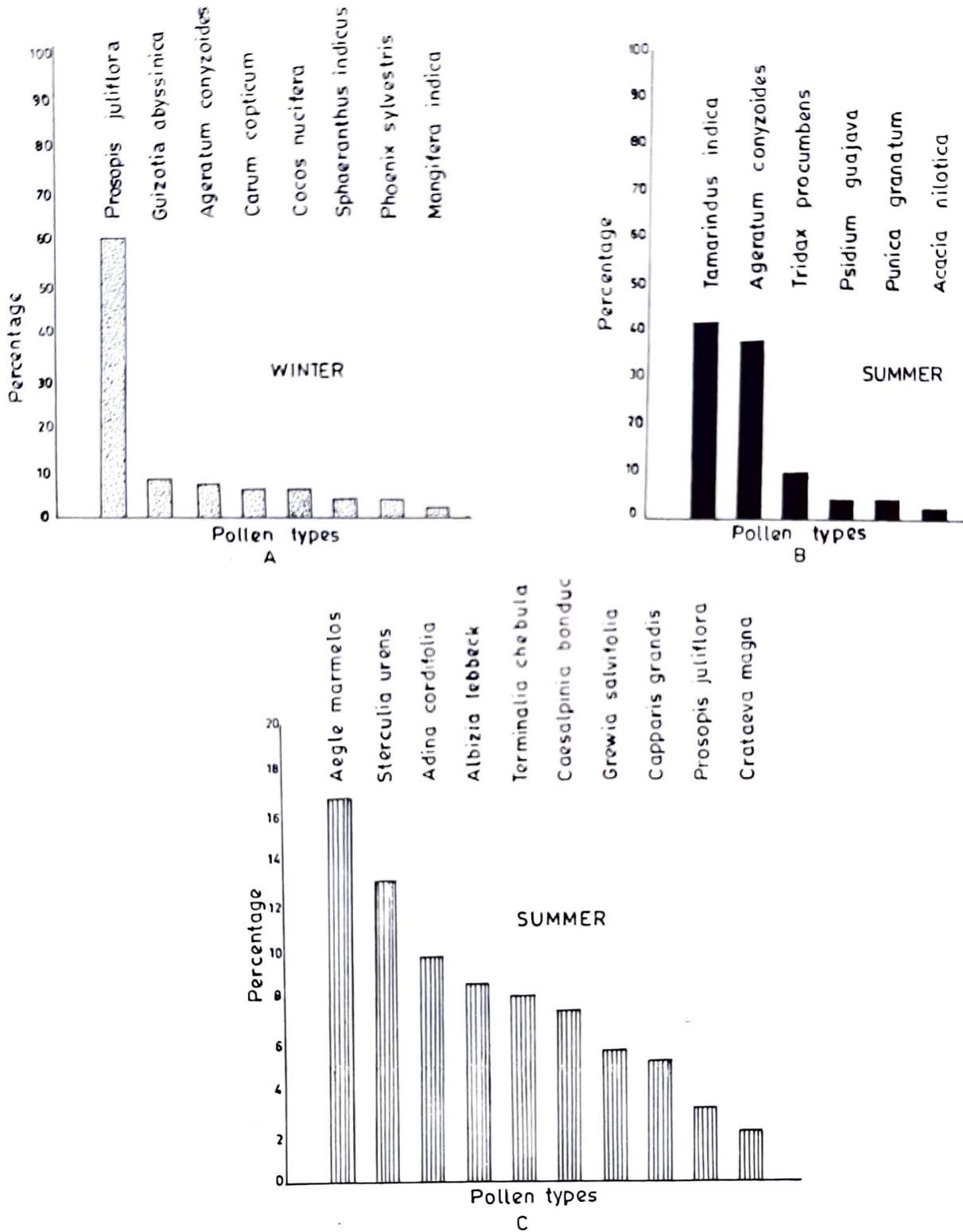


Plate 2



Text-figure 2. Numerical frequency of pollen types from Unifloral loads
 A. B. Ranga Reddy District C. Mahboobnagar District

Plate 3

(All figs x 300)

1. *Carum copticum*
2. *Tamarindus indica*
3. *Lagerstroemia parviflora*
4. *Prosopis juliflora*
5. *Sterculia urens*

6. *Grewia salvifolia*
7. *Aegle marmelos*
8. *Terminalia chebula*
9. *Caesalpinia bonduc*

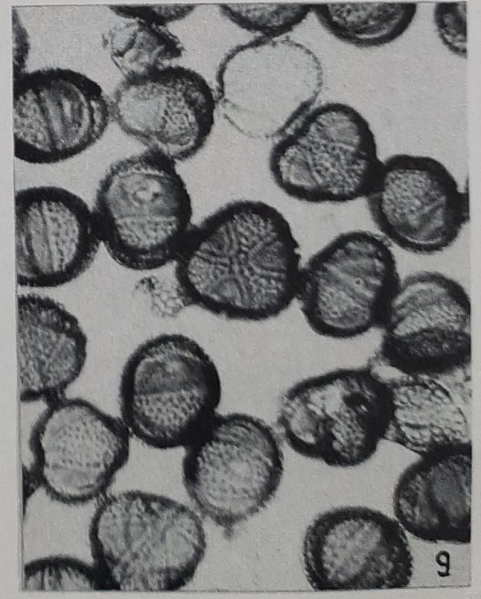
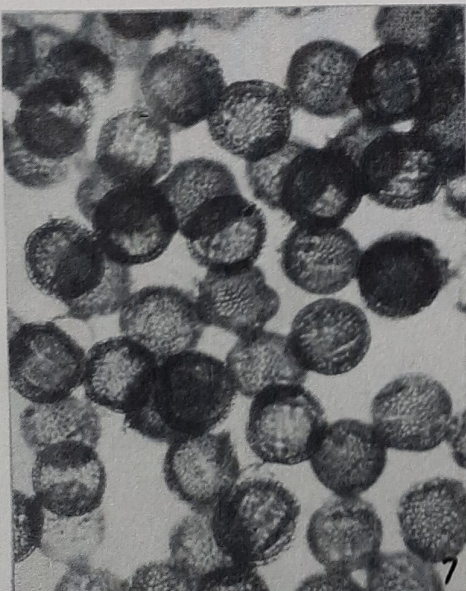
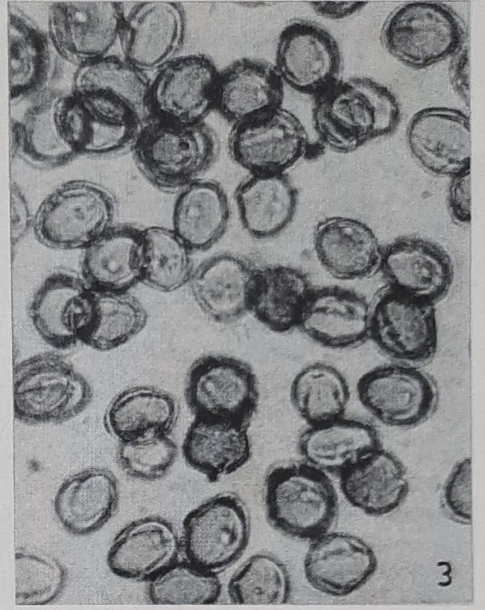
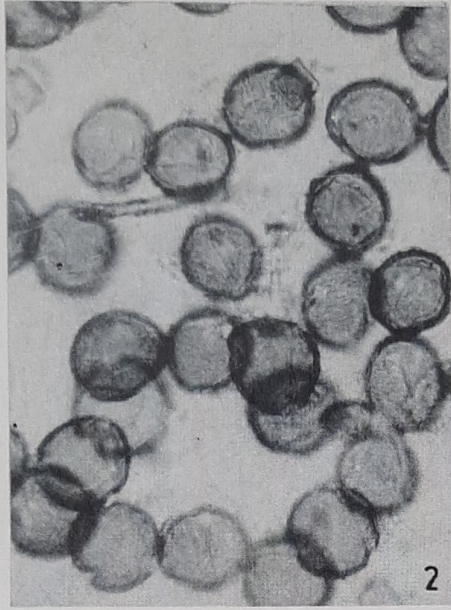


Plate 3

Analysis of pollen loads—The 905 winter pollen loads collected from Ranga Reddy District showed 498 (55.03%) unifloral, 123 (13.59%) bifloral and 284 (31.38%) multifloral loads. 476 (74.84%) of the 636 summer pollen loads were unifloral, 105 (16.51%) bifloral and 55 (8.65%) multifloral. *Prosopis juliflora*, *Guizotia abyssinica*, *Ageratum conyzoides*, *Carum copticum*, *Cocos nucifera*, *Sphaeranthus indicus*, *Phoenix sylvestris* and *Mangifera indica* are the noteworthy (upto 2%) winter sources of pollen as evidenced by the unifloral loads. *Tamarindus indica*, *Ageratum conyzoides*, *Tridax procumbens*, *Psidium guajava*, *Punica granatum* and *Acacia nilotica*, all represented by unifloral pollen loads constitute reliable summer pollen sources. The top 2 pollen types encountered in the bifloral pollen loads are *Carum copticum* and *Guizotia abyssinica* during winter and, *Ageratum conyzoides* and *Tamarindus indica* during summer. In the multifloral loads, however, *Guizotia abyssinica*, *Sphaeranthus indicus* and *Tridax procumbens* in winter and *Ageratum conyzoides*, *Tamarindus indica* and *Acacia nilotica* in summer represent the premier pollen types (Table 2).

2,961 (84.48%) of the 3505 pollen loads collected from Mahboobnagar District were found to be unifloral, 477 (13.6%) bifloral and 67 (1.91%) multifloral. *Aegle marmelos*, *Sterculia urens*, *Adina cordifolia*, *Albizia lebbek*, *Terminalia chebula*, *Caesalpinia bonduc*, *Capparis grandis*, *Grewia salvifolia*, *Prosopis juliflora* and *Crataeva magna* constitute the noteworthy (upto 2%) pollen types recorded from the unifloral loads. Both the bifloral and multifloral loads showed *Albizia lebbek* and *Terminalia chebula* as the top two pollen types. In addition to these, *Buchanania lanzan* was also frequently encountered in the multifloral loads (Table 2).

The numerical status of diverse unifloral pollen loads encountered in Ranga Reddy and Mahboobnagar districts is represented in Text-figure 2 (A-C). Plate 3, figures 1-9 shows pollen types recorded from some of the unifloral pollen loads studied.

DISCUSSION

The three districts, which provided the honey samples and pollen loads for the present study, have characteristic local floras which supply varied nectar and pollen to the honey bees. The quantification of the pollen types in honeys and pollen loads when considered in conjunction with the relative abundance and overall distribution of the various floristic elements has brought to light the key bee forage plants of each district. Accordingly, we consider *Carum copticum*, *Prosopis juliflora*, *Phoenix sylvestris*, *Guizotia abyssinica* and *Ageratum conyzoides* during winter and, *Tamarindus indica* and *Ageratum conyzoides* during summer, the major bee

forage plants in the agricultural tracts of the Ranga Reddy District. We are further of the opinion that winter (November-January) represents the honey flow season in this district. It is pertinent to note that *Carum copticum* and *Guizotia abyssinica* are the important winter crops, and *Prosopis juliflora* utilized extensively in social forestry programmes has now run wild occupying extensive areas.

In the deciduous forests of the Mahboobnagar district, *Sterculia urens*, *Aegle marmelos* and *Adina cordifolia* encountered abundantly furnish copious sources of both nectar and pollen for the honey bees during summer season.

The apiary honeys from the agricultural tracts of Guntur District, however, indicate that *Mimosa pudica* and *Sapindus emarginatus* during winter, and *Borassus flabellifer*, *Hygrophila auriculata* and *Phyla nodiflora* during summer, as the important sources of nectar. This study further brought to light a number of other less important and minor sources of bee forage of local significance in these districts.

Our field studies highlight an appreciable degree of overlapping in the foraging pattern of all the three species of honey bees, viz., *Apis cerana*, *A. dorsata* and *A. florea*, which point towards their fairly common sources of nectar and pollen. There is, however, a consistent tendency in *A. florea* to forage upon greater diversity of weeds in each area, when compared to the other two species. This is amply testified by the overall pollen complement of its honeys.

It is only in parts of the Guntur District that one comes across organized bee keeping on a moderate scale. Apicultural enterprises are particularly non-existing in both Ranga Reddy and Mahboobnagar districts. Our studies indicate that these districts have adequate potential for sustaining bee keeping ventures. As of today, *Apis florea* in the agricultural tracts of Ranga Reddy district and *Apis dorsata* in the deciduous forests of Mahboobnagar District contribute substantially to the local honey production. The information provided in the present study can be utilized profitably in the prospective bee keeping ventures of Ranga Reddy, Mahboobnagar and Guntur districts for enhanced honey production.

ACKNOWLEDGEMENTS

We express our appreciation to Dr. P.R. Reddy, Dept. of Botany, P.G. College of Science, Saifabad for his help in the collection of honey combs from Ranga Reddy District. Sincere thanks are due to Shri K.Venkateswara Rao, bee keeper of Tenali for supplying the apiary honeys from Guntur District. To the officers of the Forest Dept. of Andhra Pradesh we are grateful for their help in procuring honey combs from the deciduous

forests of Mahboobnagar District.

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