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

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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 coticum, 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 Phyla 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


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>
<thead>
<tr>
<th>Geographical origin of honeys</th>
<th>Pollen types</th>
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<tbody>
<tr>
<td><strong>Ranga Reddy District</strong></td>
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<td>Winter</td>
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<tr>
<td>P</td>
<td><em>Carum copticum</em>, <em>Prosopis juliflora</em>, <em>Phoenix sylvestris</em>, <em>Guizotia abyssinica</em>, <em>Coriandrum sativum</em>, <em>Ageratum conyzoides</em>, <em>Mangifera indica</em>, <em>Allium cepa</em>, <em>Syzygium cumini</em>, <em>Helianthus annuus</em>, <em>Exuvalius alsinoides</em>, <em>Eucalyptus globulus</em>, <em>Alianthus excelsa</em></td>
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<td>S</td>
<td><em>C. copticum</em>, <em>G. abyssinica</em>, <em>Tridax procumbens</em>, <em>A. conyzoides</em>, <em>P. juliflora</em>, <em>Rungia repens</em>, <em>Cleome gynandra</em>, <em>Justicia procumbens</em>, <em>M. indica</em>, <em>Capsicum frutescens</em>, <em>S. indicus</em>, <em>E. globulus</em>, <em>P. sylvestris</em>, <em>Cocos nucifera</em></td>
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<td><strong>Mahboobnagar District</strong></td>
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<td>Summer</td>
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<td>P</td>
<td><em>A. conyzoides</em>, <em>Tamarindus indica</em>, <em>Punica granatum</em>, <em>Terminalia arjuna</em>, <em>T. procumbens</em>, <em>Casearia elliptica</em>, <em>Capparis gradiens</em>, <em>Pongamia pinnata</em></td>
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<td>S</td>
<td><em>A. conyzoides</em>, <em>T. indica</em>, <em>T. procumbens</em>, <em>A. excelsa</em>, <em>P. guajava</em>, <em>Borreria hispida</em>, <em>Arachis hypogaea</em>, <em>P. granatum</em></td>
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<td><strong>Guntur District</strong></td>
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<td>Winter</td>
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<td>P</td>
<td><em>Mimosa pudica</em>, <em>Sapindus emarginatus</em>, <em>Capsicum frutescens</em>, <em>Prosopis juliflora</em></td>
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<td>S</td>
<td><em>Phoenix sylvestris</em>, <em>Hygrophila auriculata</em>, <em>C. frutescens</em>, <em>Cleome viscosa</em>, <em>Cucumis sp.</em></td>
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<td>I</td>
<td><em>Sophusia delphinifolia</em>, <em>Borassus flabellifer</em>, <em>Mangifera indica</em>, <em>Zizyphus jujuba</em>, <em>Coriandrum sativum</em>, <em>Cocos nucifera</em>, <em>Terminalia sp.</em>, <em>Brassica nigra</em>, <em>P. sylvestris</em>, <em>C. frutescens</em>, <em>Mamordica charantia</em>, <em>P. juliflora</em>, <em>Ricinus communis</em>, <em>S. emarginatus</em>, <em>C. nucifera</em>, <em>T. procumbens</em>, <em>Sesamum indicum</em>, <em>Tinospora cordifolia</em>, <em>Phyllanthus sp.</em>, <em>Dodonaea viscosa</em>, <em>Syzygium cumini</em>, <em>Eucalyptus globulus</em></td>
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<td><strong>Summer</strong></td>
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<td>P</td>
<td><em>B. flabellifer</em>, <em>H. auriculata</em></td>
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<td>S</td>
<td><em>H. auriculata</em>, <em>B. flabellifer</em>, <em>Phyla nodiflora</em>, <em>P. sylvestris</em>, <em>Cucumis sp.</em>, <em>Crotalaria juncea</em>, <em>M. charantia</em></td>
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<td>I</td>
<td><em>Pongamia pinnata</em>, <em>H. auriculata</em>, <em>Citrus limon</em>, <em>B. nigra</em>, <em>T. procumbens</em>, <em>Sphaeranthus indicus</em>, <em>Delonix regia</em>, <em>Cassia sp.</em>, <em>Vitex negundo</em>, <em>Theophrastea populnea</em>, <em>P. nodiflora</em>, <em>M. indica</em>, <em>Phaseolus sp.</em>, <em>Coccinia indica</em>, <em>C. nucifera</em>, <em>Murraya citrifolia</em>, <em>C. gynandra</em>, <em>C. frutescens</em>, <em>B. flabellifer</em></td>
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**Table 1. Pollen analysis of honeys studied**
Table 2. Pollen types encountered in bifloral and multifloral loads (upto 15% only)

<table>
<thead>
<tr>
<th>Geographical origin of pollen loads</th>
<th>Bifloral</th>
<th>Multifloral</th>
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<tbody>
<tr>
<td>Ranga Reddy District</td>
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<tr>
<td>Winter</td>
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<tr>
<td>Carum copticum (41.46)</td>
<td>G. abyssinica (73.24)</td>
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<td>Guizotia abyssinica (28.46)</td>
<td>S. indicus (69.37)</td>
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<td>Phoenix sylvestris (26.83)</td>
<td>Tridax procumbens (67.25)</td>
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<td>Sphaeranthus indicus (23.58)</td>
<td>C. coticum (23.59)</td>
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<tr>
<td>Cocos nucifera (21.95)</td>
<td>Ageratum conyzoides (17.25)</td>
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<tr>
<td>Cajanus cajan (17.89)</td>
<td>Cajanus cajan</td>
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<td>Coriandrum sativum (15.45)</td>
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<tr>
<td>Summer</td>
<td>A. conyzoides (49.52)</td>
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<tr>
<td>A. conyzoides (49.52)</td>
<td>T. indica (58.18)</td>
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<tr>
<td>Tamarindus indica (33.33)</td>
<td>Acacia nilotica (50.91)</td>
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<tr>
<td>T. procumbens (25.71)</td>
<td>Casearia elliptica (25.45)</td>
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<tr>
<td>Punica granatum (21.9)</td>
<td>T. procumbens (23.64)</td>
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<td>Dodonaea viscosa (17.14)</td>
<td>Grewia tilaefolia (23.64)</td>
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<td></td>
<td>D. viscosa (16.36)</td>
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<td></td>
<td>Psidium guajava (14.55)</td>
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<tr>
<td>Mahboobnagar District</td>
<td>A. lebbeck (25.37)</td>
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<tr>
<td>Summer</td>
<td>T. chebula (20.89)</td>
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<tr>
<td>Albizia lebbeck (22.64)</td>
<td>Buchanania lanzan (19.4)</td>
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<tr>
<td>Terminalia chebula (17.62)</td>
<td>Tribulus terrestris (16.42)</td>
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<tr>
<td>Aegle marmelos (15.52)</td>
<td>A. cordifolia (15)</td>
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<td>Adina cordifolia (15)</td>
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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 (Louveau 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. Mimosa pudica
2. Capparis grandis
3. Justicia procumbens x 500
4. Celosia argentea x 500
5. Ageratum conyzoides
6. 7. Syzygium cumini
8. Eucalyptus globulus
9. Terminalia arjuna
10. 11. Sapindus emarginatus
12. 13. Adina cordifolia
14. Pongamia planata
15. 16. Punica granatum
17. 18. Mangifera indica
19. 20. Sotyma febrifuga
21. 22. Sterculia urens
23. Phylodendron x 500
24. Feronia elephantum
25. 26. Aegle marmelos
27. Corin coticum
28. 29. Capsicum frutescens
30. Crataeva magna
31. 32. Prosopis juliflora
33. Cocos nucifera
34. 35. Dodonaea viscosa
36. Borassus flabellifer
37. 38. Grewia tilaefolia
17 summer) were found to be unifloral and 16 (13 winter and 3 summer) multifloral. *Carum coticum* (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%), *Helenium 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%), *Carapa 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 %), *Schleicheria 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 these three districts. *Carum coticum*, *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*, *Coriandrum sativum*, *Hygrophila auriculata*, *Momordica charantia* during summer constitute significant nectar suppliers. Some of the significant and characteristic pollen types recovered from the honey samples investigated are illustrated here (Pl.1, figs 1-38; CPI,2, figs 1-22).

Plate 2

1. *Schleicheria oleosa*
2. *Sphaeranthus indicus*
3, 4. *Casearia elliptica*
5. *Alianthus excelsa*
6. *Hygrophila auriculata*
7. *Lagerstroemia parviflora*
8. *Evolvulus alsinoides*
9. *Tridax procumbens*
10. *Phoenix sylvestris*
11. *Buchanania lanzan*
12-14. *Tamarindus indica*
15. *Allium cepa*
16. *Helianthus annuus*
17. *Guizotia abyssinica*
18. *Caesalpinia bonduc*
19. *Coriandrum sativum*
20, 21. *Cucumis sp.*
22. *Momordica charantia*
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 saluwifolia
7. Aegle marmelos
8. Terminalia chebula
9. Caesalpinia bonduc
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 (55.03%) unifloral, 123 (13.59%) bifloral and 284 (31.38%) multifloral loads. 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 the reliable summer pollen loads. The numerical status of diverse unifloral pollen loads encountered in the bifloral and multifloral 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, Capariss grandis, Grewia saluifolia, 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

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forests of Mahboobnagar District.

REFERENCES


