CHAPTER - 5 DISCUSSION

The results of the investigations carried on nesting sites, stingless bee flora, melissoplyynological and palynological studies, and floral calendar of the stingless bee, *T. iridipennis* in Peninsular India during 2009-12 stingless bees, are discussed in this chapter.

5.1 Nesting sites of stingless bee, *T. iridipennis*

The preliminary study on the nesting habits of stingless bees revealed wide range of nesting and feeding behaviours that allow them to share habitats and to occur in high densities. The natural nesting sites of *T. iridipennis* were found on stone walls, plastered walls, window corners, hollow cavities of the tree trunk, termite mounds, electric pipes and in soil. It was evident from the study that *T. iridipennis* prefer rough outer surfaces of walls such as stone walls and roughly plastered walls with crevices for nest building. *T. iridipennis* is adapted to nest in very narrow spaces, as the brood cells are in cluster which can be accommodated well in narrow cavities and are not arranged as horizontal combs like in *Apis* spp. These bees prefer closed structures for nesting and never nest in open conditions. The use of cavities for nesting may help the colonies to regulate nest temperatures and provide protection from predators. Similar nesting sites are also reported by Muthuraman (2006) at Tamil Nadu and Roopa (2002) from Bangalore. Gajanan (2005) reported the nests in hollows of tree trunks, stone walls, mud walls, earthing pipes, switch boards, lamp posts, rafts, corners of walls and termite mounds. Karunaratne and Edirisinghe (2007) recorded a total of 34 nests, 28 built on outside walls that are rough and made of stones, 3 on rough stone walls of a bridge and the other 3 on cemented walls of an office building.
The nesting sites of *T. iridipennis* at Dharwad were wall cavities (12 colonies) and tree cavities (5 colonies) (Danaraddi *et al.*, 2009).

### 5.2 Stingless Bee flora

Peninsular India is rich in melliferous plants. It includes large forest trees, many ornamental trees, fruit trees, weeds and some arable crops which were abundant in farm fallows and was much favoured by bees. The flowering times of the plants were not all the same. *T. iridipennis* utilises a diversity of resources available in the Peninsular India. The present investigation revealed that, of the different groups, trees were dominating other plant groups with 69 trees accounting to 28.16%, followed by 49 ornamental plants (20.00%), 32 Medicinal and aromatic plants (13.06%), 30 Vegetables (12.24%), 27 Fruits and plantation crops (11.02%), 21 Weeds (8.57%), 10 Oil seed crops (4.08%) and Field crops (2.86%).

Among 245 forage plants of *T. iridipennis* recorded, the members of family Asteraceae have topped the list (26 species) followed by Fabaceae (24 species), Euphorbiaceae (13 species), Lamiaceae (11 species), Caesalpinaceae (10 species), Cucurbitaceae (9 species) and Mimosaceae (6 species). The members of these families being highly cross pollinated plants, they seem to have coevolved with bees by providing nectar and pollen and inturn getting pollinated by them. Similar observations were made by Roopa (2002) who recorded 109 plant species to be foraged by *T. iridipennis* of which, 13 plant species were field crops, 2 spices and condiments, 10 vegetable crops, 14 fruit and plantation crops, 12 ornamental plants, 19 medicinal plants, 12 weeds and 27 trees. 71 plant species belonging to 36 families were identified as bee flora in Tripura. 35 species were found to be minor source of pollen and the rest 36 species act as major pollen source (Reema *et al.*, 2007). 140 plant species as bee
Studies on the floral diversity of Stingless bees in Peninsular India

Discussion

forage sources in Dharwad (Bhat et al., 1990), 172 plant species belonging to 53 families were recorded as bee flora in Punjab (Attar et al., 2002).

5.3 Melissopalynological studies of T. iridipennis

Pollen analysis from honey samples of T. iridipennis revealed that during summer (June - September) Acacia auriculiformis, Areca catechu, Calendula officinalis, Callistemon lanceolus, Callistephus chinensis, Ceiba pentandra, Cocos nucifera, Cuphea micrantha, Delonix regia, Helianthus annus, Jatropha curcas, Malvaviscus arboreus, Melampodium paludosum, Musa paradisiaca, Peltophorum ferrugenum, Pterospermum personatum, Punica granatum, Roystonea regia, Sesamum indicum, Syzygium cumini, Tamarindus indica, Terminalia arjuna, Zizyphus jujube and Zizyphus mauritiana were the predominant pollen types. During winter season (October - January) Areca catechu, Bombax malabaricum, Butea monosperma, Cassia auriculata, Ceiba pentandra, Cocos nucifera, Eucalyptus sp., Foeniculum vulgare, Gossypium arborium, Guizotia abyssinica, Helianthus annus, Heva brasilinensis,Ixora coccinia, Lagascea mollis, Laginaria siceraria, Malvaviscus arboreus, Musa paradisiaca, Polyanthus tuberose, Prosopis juliflora and Zizyphus mauritiana were the predominant pollen types. Areca catechu, Azadirachta indica, Butea monosperma, Calliandra haematocephala, Carica papaya, Cassia auriculata, Cocos nucifera, Dalbergia sissoo, Delonix regia, Heva brasilinensis, Ixora coccinia, Jacaranda sp., Mangifera indica, Musa paradisiaca, Peltophorum ferrugenum, Peltophorum pterocarpum, Persea americana, Pongamia pinnata, Psidium guajava, Pterospermum acerifolium, Pterospermum personatum, Punica granatum, Raphanus sativus, Sesamum indicum, Spinacea oleracea, Terminalia arjuna and Zizyphus jujube were the predominant pollen type
during monsoon season (February - May) and served as the nectar sources. This large number of pollen taxa indicates the high plant diversity of the region. Native vegetation in this region, crops and their accompanying weeds, create a current and important resource for honey production in the region. The floral diversity of Peninsular India offers the possibility of diversification in beekeeping production. In this context, pollen analysis studies from honey are particularly relevant for indicating the nectar sources used by bees for honey production in each region and, consequently, for improving the use of bee flora in each locality.

_Prospis julifera_ was the predominant pollen type and _Rotala densiflora, Peltophorium pterocarpum_ and _Cocos nucifera_ was important secondary pollen types in the honey samples collected from a colony of _T. iridipennis_ in Hyderabad, India. _Eucalyptus globosa, Cyanotis_ sp., _Leucaenea leucocephala, Tamarindus indica, Delonix regia, Azadirachta indica, Lawsonia alba, Ageratum conyzoides_ and _Loranthus longiflorus_ constituted minor pollen types Ramanujam _et al._ (1993). Agashe and Rangaswamy (1997) reported _Psidium guajava_ and _Syzygium cumini_ were predominant pollen types in the honey samples of _T. iridipennis_ from Karnataka. Honey samples of _T. iridipennis_ from Himachal Pradesh reported the presence of 11 predominant, 24 secondary, 40 important minor and 23 minor pollen types. Species of _Citrus_ and _Eucalyptus_ were the predominant types (Mattu _et al._, 1997). Agashe and Rangasawamy (2000) identified _Sapindus indica, Milletia ovaliflora, Syzygium caryophyllatum, S. cumini, S. jambolan, Mallotus philippensis, Tabubia arjentia, T. avalenedae, Sclerophyllum pentandrum, Hopea whitiyana, Kidia calicina, Ailanthus malabarica_ and _Ceiba pentandra_ as pollen sources in different honey samples and pollen loads of _T. iridipennis_ collected from Western Ghat area of Karnataka.
5.4 Palynological studies of *T. iridipennis*

Palynological investigations made on pollen loads of *T. iridipennis* collected from 2009 to 2012 from different locations in Peninsular India indicated that *T. iridipennis* was found to collect pollen from 107 plant species. Of these, 29 plant species were recorded from Karnataka, 25 from Kerala, 24 from Andhra Pradesh and 29 from Tamil Nadu. 30 species were major pollen yielders, 34 species were medium pollen yielders, and 36 species were minor pollen yielders. This indicates that, *T. iridipennis* exploited several number of plant species for collection of pollen. The pollen types which were recorded in high levels are abundant in the vicinity of the hives. The palynological composition of pollen loads collected by honeybee colonies reflected the local flora in our investigation. Even though, many taxa were considered as polliniferous, their pollen has no significant attractivity to be stored separately in the hives, and these plants were visited by the bees only as a nectar source.

Pollen analysis offers two advantages. Firstly, pollen analysis revealed the actual use of pollen resources and excluded nectar-only collection and other bee activities that were included in observation of bee visits. Sipes and Tepedino (2005) pointed out that, bees visit a relatively large number of plant species because of their nectar rather than pollen production. Secondly, results of pollen analysis demonstrate that the bee visits were not limited to typical plant species but that they also utilize resources in the surrounding agricultural landscape. Viraktamath et al. (1999) reported *Trigona* sp. exploited 17 species of plant and the pollen sources were strictly different from *Apis* species at Dharwad. Roopa (2002) recorded 41 plant species as pollen source of *T. iridipennis* of which 22 species were major pollen yielders, 7 species were medium pollen yielders and 8 species were minor pollen yielders at Bangalore.
5.5 Floral calendar for *T. iridipennis*

Mapping of key bee flora of different floristic and geographical area helps to determine the suitability of the area to undertake apicultural activities. The information, apart from promoting apicultural industry, will help agricultural production and shall provide both impetus to food security and conservation of biodiversity. In fact, in spite of tremendous scope in apicultural activities owing to its enormous floristic diversity, the beekeeping industry in India has achieved only a fraction of its full potential. This is mainly due to lack of information regarding the role of regional floral resources in context of its apicultural value. In this context it should be kept in mind that pollination management is also important for improving output of the target crop but that these needs must be balanced against the resource value of these plants in other industries such as honey production.

Several workers have developed bee calendars to give beekeepers an idea about the flowering plants that are present in the area and also sustenance of beekeeping in the locality. Suryanarayana *et al.* (1991) provided a floral calendar of plants of significance to beekeeping in Muzaffarpur, Bihar, India. In 2000, Sekhar provided a floral calendar with 116 important plants out of 142 recorded as bee forage for both nectar/or pollen. Krishnaswamy (1981) also prepared a floral calendar of different plant species flowering in Chickmagulur district, Karnataka state. Sankara (2009) prepared a floral calendar of flowering plants of Indian Institute of Science in his field guide. For the present floral calendar will be useful food tool for beekeepers.