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FLORAL SOURCE TO STINGLESS BEES IN AND AROUND THE APIARIES OF MELIPONICULTURISTS AT DIFFERENT DISTRICTS OF KARNATAKA, INDIA

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Abstract: Stingless bee's pollination service is provisioned at various terrestrial ecosystems. Many flowering plant species are rely on stingless bees and in turn stingless bees are rewarded with nectar, pollen, resin, honeydew and nest-building materials with their minimum flight range amidst natural and man-made ecosystems. However, published reports on floral source and floral calendar for stingless bees is poor. Hence, systematic investigation was undertaken at nine districts which represented maidan, malnad, hilly terrain, coastal region, arid zone and agro-ecosystems at the vicinity of Western Ghats by following standard methods. Beekeepers doing Meliponiculture were randomly selected and visited their apiary/meliponary to record the floral source in one square kilometer area during different seasons from 2023 to 2024. Flowering plants for their nectar, pollen and both nectar and pollen source were recorded and photographed by spending 10 minutes per plant/flower after confirming the visit of stingless bees during 0700 to 1800 hours of observation. Total 84 flowering plant species which belong to 45 plant families provided foraging source to stingless bees at different agro-ecosystems of Karnataka. Asteraceae and Rutaceae family members were more predominant (7.1% each) and it was followed by Cucurbitaceae, Lamiaceae and Myrtaceae family members (5.8% each) contributed good foraging source to stingless bees. Mimosaceae, Euphorbiaceae, Fabaceae and Solanaceae family members also contributed considerable amount of foraging source to stingless bees during different seasons. The floral source consists of avenue trees, commercial plants, fruit yielding plants, horticultural plants, medicinal plants, ornamental plants, vegetable crops and weeds which were grouped into climbers, herbs, shrubs and trees have provided foraging source at various agro-ecosystems. Floral calendar revealed the occurrence of pollen (P1, P2 and P3) and nectar (N1, N2 and N3) plants based on their potential source of both pollen and nectar (P1N1, P1N2, P1N3, P2N1, P2N2, P2N3, P3N1, P3N2 and P3N3) plants to stingless bees by blooming during different months around the year i.e., January to December. Thus, stingless bees avail good floral source during different seasons amidst apiary/meliponary at various agro-ecosystems that could help encourage Meliponiculture on large scale basis along with apiculture in Karnataka.

Keywords: Flora, stingless bees, Meliponiculture, Karnataka

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I. INTRODUCTION

Globally, pollination service is provisioned by various animal species at different terrestrial ecosystems (Fontaine *et al*., 2005; Klein *et al*., 2006; Potts *et al*., 2016). Surprisingly, majority of flowering plant species are rely on different species of insects as their primary pollinators (Buchmann and Nabhan, 2012; Ollerton *et al*., 2011). Stingless bees (Hymenoptera: Apidae: Meliponinae) are small to medium sized honeybees (Michener, 2013) known for their well-developed eusocial, colonial life, which are distributed amidst diversified agro-ecosystems in tropical and sub-tropical regions of the world. The stingless bees live in perennial colonies with a single queen, a few hundred to several thousand workers and a few hundred males (Michener, 2007). To have safe and sustained life in their colony, forager-worker stingless bees collect nectar, pollen, resin, mud, cell sap, honeydew, animal's protein, fungal spores for nutrition or nest-building materials (Roubik, 1989; Eltz *et al.,* 2001). Nectar is the principal source of carbohydrates which supply energy (Ramalho *et al.,* 1991; Nicolson, 2011) to bees. Interestingly, stingless bees are generalist foragers (Ramalho *et al.,* 1990; Roubik and Moreno-Patiño, 2009; Vossler *et al.,* 2014) and maintain high floral constancy (Layek and Karmakar, 2018). Thus, all stingless bee species visit flowers for nectar and pollen to feed their offspring (Sakagami *et al.,* 1993) and their nest-mates. While doing so, they perform pollination service to several flowering plant species and hence, stingless bees perform most important pollination service to many native plant species and economically important crops (Slaa *et*

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al., 2006; Rallanawannee and Duangphakdee, 2019). Therefore, stingless bees rearing and management is considered as one of the ways to enhance beekeeping in general, Meliponiculture in particular along with enhanced agriculture crop yield and to produce hive products for human use. In this regard, knowledge of bee flora in general and stingless bee flora in particular is essential for conducting stingless bee keeping activity (Bisui *et al.,* 2019). Many researchers have reported on floral source and their utility by various pollinators during different seasons across the world (Table 1). Ish-Am *et al*. (1999), Giannini *et al*. (2015) have studied stingless bee floral visitation and their role as pollinators to various agricultural crops and natural vegetation. Stingless bees are used to orchards (Wille, 1983; Nogueira, 1997; Giannini *et al.,* 2020) and other variety of crop plants at tropical and sub-tropical regions. Stingless bees actively forage on diverse group of flowering plant species as a result, they would get floral resource throughout the year (Roubik, 1982 and 1992). It could help confer a benefit to stingless bee population by reducing interspecific competition (Antonelli *et al*., 2015; Ramalho *et al*., 1990) with other honeybee species.

Stingless bees forage in order to collect nectar for energy requirement, pollen for protein and other nutritional needs, water for cooling their hives and for metabolic processes, resins and other plant materials for nest building (Vazhacharickal *et al.,* 2020). They have a flight range around 500 to 800 meter radius from their nests used to collect nectar and pollen which makes them suitable for controlled conditions like green houses, poly houses and precision horticultural ecosystems which often lack insect pollinators. These are potentially the most promising pollinator species because of their small size, hence they can visit even the smallest flowers. They can survive under varying temperature conditions i.e., between 18 to 36°C, can build their nest with low cost and locally available materials (Sheetal and Basavarajappa, 2024). Their hives could be placed hanging on the sunshades of houses, open porches or in the farm by using bee hive stands (Dollin and Heard, 1999). However, published reports on floral source and floral calendar for stingless bees is poor. Hence, the present investigation is undertaken to record the floral resources for stingless bees, flowering period and source of nectar or pollen or both pollen and nectar and preparation of floral calendar for stingless bees at different agro-ecosystems amidst various districts of Karnataka, India.

II. MATERIALS AND METHODS

Study Area: Total nine districts were randomly chosen which represented maidan (e.g. Bangalore Urban, Rural and Bellari Districts), malnad (e.g. Chikkamagalore and Shivamoga districts), hilly areas (e.g. Chikkamagalore and Kodagu Districts), coastal region (Dakshina Kannada and Uttar Kannada Districts), arid zone (e.g. Chamarajanagara District) and agro-ecosystems at the vicinity of mountain ranges of Western Ghats (e.g. Kodagu and Chikkamagalore Districts) and semi-arid region (e.g. Mysore) (Kamath, 2001) for the present investigation (Sheetal and Basavarajappa, 2024). Table 2 shows the physiographic details such as latitude, longitude and altitude, environmental factors such as temperature, relative humidity, rainfall and major crops grown at the vicinity of apiary of Meliponiculturists located at different districts of Karnataka.

Methodology: The present study was conducted at different districts of Karnataka namely: Bellari, Bangalore, Chamarajnagar, Chikkamagalore, Dakshina Kannada, Kodagu, Mysore, Shivamoga and Uttara Kannada by visiting beekeepers who are doing Meliponiculture along with Apiculture (Figure 1). In each district (Figure 1), three Meliponiculturists were randomly selected and visited their apiary to record the floral source available to stingless bees during different seasons. The floral source available to stingless bees in and around the apiaries was collected during 2023 to 2024 by following standard methods. One square kilometer area was chosen in and around the apiary for recording the flowering plants for their nectar, pollen and both nectar and pollen source during rainy, winter and summer seasons by following standard methods (Raghunandan and Basavarajappa, 2014; Swathi *et al*., 2021; Nalini and Basavarajappa, 2024). The nectar and pollen yielding plants were recorded, photographed after confirming the visit of stingless bees during 0700 to 1800 hours observation. The study included observation of stingless bee's activities on flowers of different plant species by spending 10 minutes per plant. After ascertained the foraging attempt by the stingless bees, the plant was considered as stingless bee foraging plant as per Waykar and Baviskar (2015). Observed flowering plants were grouped into nectar, pollen and both nectar and pollen plants based on the activities performed by stingless bees. Moreover, stingless bees extend their proboscis into the flowers to collect nectar are considered as nectar plants, stingless bees carrying pollen in their pollen basket were considered as pollen plants and when both the activity was observed on the same plant species, such plant species were categorized as both nectar and pollen plants as per Bista and Shivakoti (2001), Raghunandan and Basavarajappa (2014), Nalini and Basavarajappa (2024). Further, blooming period of flowering plant species was also recorded with the help of published reports and also by consulting plant taxonomists. Collected data was systematically complied and prepared a floral calendar in order to reveal the availability of nectar, pollen, both nectar and pollen sources to stingless bees throughout the year.

Statistical analysis: Collected data was compiled systematically and analyzed statistically by employing various statistical methods as per Saha (2009).

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III. RESULTS

Floral source: Total 84 flowering plant species which belong to 45 plant families were recorded at the vicinity or in and around apiary at various agro-ecosystems of Karnataka (Table 2). Amongst the plant families, Asteraceae and Rutaceae family members were more (6 species each) and contributed 7.1% each floral source to the stingless bees. It was followed by Cucurbitaceae, Lamiaceae and Myrtaceae family members (5 species each) contributed 5.8% each floral source to stingless bees (Table 2). Moreover, Mimosaceae family members (4 species) contributed 4.7% floral source and Euphorbiaceae, Fabaceae and Solanaceae family members (3 species each) have contributed 3.5% each floral source to stingless bees. However, remaining other plant families have contributed 1.1 to 2.3% floral source to stingless bees at various agro-ecosystems of different districts of Karnataka (Table 2). Tables 3 and 4 shows the details about the plant families, plant species and their per cent floral contribution to stingless bees at various agro-ecosystems of different districts of Karnataka.

Vegetation type: Figure 2 shows the floral source available from various type of vegetation at the vicinity of stingless bee colonies at various agro-ecosystems of different districts of Karnataka. The floral source obtained from different vegetation include avenue trees, commercial plants, fruit yielding plants, horticultural plants, medicinal plants, ornamental plants, vegetable crops, weeds and others (Figure 2). Of all, fruit yielding plants, horticultural plants, ornamental plants, medicinal plants and weeds have extended good source of flora to the stingless bees at various agro-ecosystems of different districts of Karnataka (Figure 2).

Plant types: Plants which provide floral sources were grouped into climbers, herbs, shrubs and trees, and others to know about the flow of flora at various agro-ecosystems amidst different tropic levels in Karnataka. Moreover, per cent contribution floral source from climbers, herbs, shrubs, trees and other is depicted in figure 3.

Pollen and nectar plants: Figure 4 shows the pollen plants and nectar plants of stingless bees at different districts of Karnataka. The pollen plants were further grouped into P1, P2 and P3 plants based on their pollen potential and stingless bee's dependence on pollen source as food (Figure 4). Moreover, nectar plants were also grouped into N1, N2 and N3 plants based on their nectar potential and stingless bee's dependence on nectar source as food (Figure 4). Further, total nine types of plants were classified based on their potential pollen and nectar source to stingless bees. They are: P1N1, P1N2, P1N3, P2N1, P2N2, P2N3, P3N1, P3N2 and P3N3 plants which provided both pollen and nectar source to stingless bees by blooming during different months around the year i.e., January to December (Figure 5). Furthermore, floral calendar is prepared to depict the floral source available to stingless bees during different months based on the floral source availed at different districts of Karnataka (Figures 6 and 7).

IV. DISCUSSION

During the present investigation, 84 flowering plant species which belong to 45 plant families have extended floral source to stingless bees at the vicinity of apiary of beekeepers at various agro-ecosystems of Karnataka. Flowering plants belong to different families help protect various insect pollinator species including stingless bees at various natural and man-made ecosystems. In turn, pollinator species including stingless bees pollinate different flowering plant species to propagate and produce their offspring's at different agro-ecosystems amidst terrestrial habitat conditions (Fontaine *et al*., 2005; Klein *et al*., 2006; Potts *et al*., 2006; Ollerton *et al*., 2011; Buchmann and Nabhan, 2012). Amongst the different plant families, Asteraceae and Rutaceae family members were more (7.1%) common at the vicinity of apiaries at different districts of Karnataka. Cucurbitaceae, Lamiaceae and Myrtaceae family members were found 5.8% and it was followed by Mimosaceae family members (4.7%), Euphorbiaceae, Fabaceae and Solanaceae family members (3.5% each) at the vicinity of apiary of beekeepers of different districts of Karnataka. Since, stingless bees are small sized honeybees (Michener, 2013), live in perennial colonies (Michener, 2007) and act as generalist foragers (Roubik and Moreno-Patiño, 2009; Vossler *et al.*, 2014), becomes major sources of pollination to the plants bearing small to medium and medium to large sized flowers (Eltz *et al.*, 2001) amidst various agro-ecosystems with their smaller flight range (e.g. 500 to 800 meter radius) from their colony. Moreover, stingless bees maintain high floral constancy (Layek and Karmakar, 2018) and visit flowers to collect nectar as the principal source of carbohydrates to get energy (Nicolson, 2011), pollen to feed their offspring's (Sakagami *et al.*, 1993) including their nest-mates and other plant materials for nest building (Vazhacharickal *et al.*, 2020). The climbers, herbs, shrubs and trees which are found as avenue trees, commercial plants, fruits yielding plants, horticultural plants, medicinal plants, ornamental plants, vegetable crops and weeds at the vicinity of apiaries at different districts of Karnataka have provided both pollen and nectar to stingless bees. Bangalore Urban, Rural and Bellari Districts experiences maidan conditions, Chikkamagalore, Shivamoga districts experiences malnad conditions, part of Chikkamagalore and Kodagu Districts have hilly areas, Dakshina Kannada and Uttar Kannada Districts have coastal region, Chamarajanagara District has arid zone and majority of the Kodagu and Chikkamagalore

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Districts have mountain ranges at the vicinity of Western Ghats and Mysore district has semi-malnad conditions (Kamath, 2001) which help prevail varied physiographic conditions and environmental factors. All these varied bio-geographical features help grow various type of vegetation along with specific crops majorly at the vicinity of apiaries of beekeepers in Karnataka. Hence, stingless bees visit locally available flowering plant species (Slaa *et al.,* 2006; Rallanawannee and Duangphakdee, 2019) to get nutritional needs and nesting materials (Vazhacharickal *et al.,* 2020), in turn produce hive products thereby encourage Meliponiculture activity (Bisui *et al.,* 2019). Further, based on the pollen potential of the flowering plants, they were grouped into P1, P2 and P3 plants on which stingless bee's depended for the protein source. Similarly, based on the nectar potential of the flowering plants, they were grouped into N1, N2 and N3 plants on which stingless bees depended for nectar as carbohydrate source. Nevertheless, nine types of floral plants were grouped namely: P1N1, P1N2, P1N3, P2N1, P2N2, P2N3, P3N1, P3N2 and P3N3 plants which provided pollen, nectar, both pollen and nectar to stingless bees during different months around the year i.e., January to December at/amidst various apiaries located at different agro-ecosystems of various districts of Karnataka. Similar type of observations were made by various researchers (Ramalho *et al*., 1990; Bista and Shivakoti, 2001; Raghunandan and Basavarajappa, 2014; Antonini *et al.*, 2015; Giannini *et al*., 2015; Waykar and Baviskar, 2015; Potts *et al*., 2016; Giannini *et al*., 2020; Vazhacharickal *et al.*, 2020; Swathi *et al*., 2021; Nalini and Basavarajappa, 2024) during different seasons across the world.

Thus, stingless bees pollinate various agricultural crops (Giannini *et al*., 2015), orchards (Wille, 1983; Nogueira, 1997; Potts *et al*., 2016; Giannini *et al*., 2020), ornamental plant species (Roubik, 1992) and other plants. Due to their generalist foraging nature and perennial habitat, stingless bees require floral resource throughout the year (Roubik, 1992). Furthermore, using all the available floral source at the vicinity/amidst the apiaries of the beekeepers, floral calendar was prepared and that revealed a source of flora available to stingless bees during different months at various agro-ecosystems of different districts of Karnataka. Moreover, stingless bees forage within a flight range around 500 to 800 meter radius from their colony and they can be reared under controlled conditions such as green houses, poly houses, precision horticultural ecosystems, orchards and other agriculture landscapes which often lack many insect pollinators including *Apis* species. It could help confer a benefit to stingless bees by reducing competition from other honeybee species for floral source (Ramalho *et al*., 1990; Antonini *et al*., 2015; Potts *et al*., 2016). As stingless bees are potentially the most promising pollinator species because of their small size, they visit even the smallest flowers. They can survive under varying temperature conditions i.e., between 18 to 36°C, can build their nest with low cost and locally available materials (Sheetal and Basavarajappa, 2004). Their hives could be placed hanging on the sunshades of houses, open porches or in agriculture farms, horticulture gardens and ornamental gardens by using locally made bee hives (Dollin and Heard, 1999) and allow them to forage and pollinate locally available floral resources. Further, by preparing floral calendar based on the blooming period, source of nectar or pollen or both pollen and nectar, it is possible to rear stingless bees around the year at different agro-ecosystems of Karnataka.

V. SUMMARY

- Total 84 flowering plant species which belong to 45 plant families were recorded.
- Amongst the plant families, Asteraceae and Rutaceae family members were more predominant and contributed 7.1% each floral source to the stingless bees.
- Cucurbitaceae, Lamiaceae and Myrtaceae family members contributed 5.8% each floral source to stingless bees.
- Avenue trees, commercial plants, fruit yielding plants, horticultural plants, medicinal plants, ornamental plants, vegetable crops and weeds have provided floral source to stingless bees.
- The climbers, herbs, shrubs and trees were extended floral source to stingless bees amidst various ecosystems.
- Nine types of plants were classified based on their potential pollen and nectar source to stingless bees.
- The P1N1, P1N2, P1N3, P2N1, P2N2, P2N3, P3N1, P3N2 and P3N3 plants which provided both pollen and nectar source to stingless bees around the year.
- Floral calendar indicated the availability of floral source to stingless bees during different months.

VI. CONCLUSION

By looking after the available floral source during different seasons at various agro-ecosystems, using available floral calendar it is possible to rear stingless bees in the name of Meliponiculture year around amidst certain parts of different districts of Karnataka. As stingless bees are living in perennial colonies, they can be used to a greater extent to produce hive products for human advantage and to pollinate flora for the conservation of local biodiversity.

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REFERENCES

[1]. Adhikari, S. Floral phenology and pollination ecology of *Punica granatum* L. in Kathmandu, Nepal. Nepal Journal of Science and Technology. 2010. Vol.11. P. 115-124.

[2]. Adhikari, S. and N.B. Ranabhat. Bee flora in mid hills of Central Nepal.Botanical Oriental Journal of Plant Sciences.2011. Vol.8. P. 45- 56.

[3]. Antonelli, A., Zizka, D., Silvestro, R., Scharn, B., Cascales-Miñana and C.D. Bacon.An engine for global plant diversity: highest evolutionary turnover and migration in the American tropics. Frontline Genetics. 2015. Vol. 6. P. 130.

[4]. Basari, N., Ramli, S. N., Abdul-Mutalid, N. A., Shaipulah, N. F. M. and N.A. Hashim.Flowers morphology and nectar concentration determine the preferred food source of stingless bee, *Heterotrigona itama*. Journal of Asia Pacific Entomology.2021. Vol. No. 2. P. 232 - 236.

[5]. Bhagya, U. and S. Basavarajappa. Floral diversity and seasonal availability to Butterflies (Order: Lepidoptera) at various agro-climatic landscapes of Mysore district, Karnataka, India. International Journal of Entomology Research. 2024. Vol. 9. No.1. P. 102-108.

[6]. Bhatta, V. R. and A.N. Kumar. Survey of bee-friendly flowering plants and bee-plant interaction in an urban green space in Bengaluru, India. Journal of Environmental Biology. 2021. Vol. 42. P. 1330- 1337.

[7]. Bhat, N. S., Manjunath, M. and S. Lingappa. Studies on bee flora of transitional zone of Karnataka. Mysore Journal of Agricultural Sciences. 1990. Vol. 24. No.4. P. 463 - 470.

[8]. Bista, S. and C. P. Shivakoti. Honey bee flora at Kabre, Dolakha District. Nepal Agriculture Research Journal. 2001. Vol. 4. No.5. P.18-25.

[9]. Bisui S., Ujjwal, L. and K. Prakash. Comparing the pollen forage pattern of stingless bee (*Trigona iridipennis* Smith) between rural and semi-urban areas of West Bengal, India. Journal of Asia-Pacific Entomology. 2019. Vol. 22.No.3. P.714-722.

[10]. Buchmann, S. L. and G.P. Nabhan. The forgotten pollinators. Island Press. 2012. P.10.

[11]. Chauhan, A., Singh, H. K. and K.M. Kumaranag. Pollination potential of stingless bee, *Tetragonula iridipennis* Smith in ash gourd. Indian Journal of Entomology. 2019. Vol. 81. No. 4. P. 854-85.

[12]. Danaraddi, C. S. Studies on stingless bee, *Trigona iridipennis* Smith with special reference to foraging behaviour and melissapalynology at Dharwad, Karnataka.Master of Science Thesis. College of Agricultural Science. Dharwad. 2007. P. 1-100.

[13]. Dollin, A. and T.A. Heard. Tips on stingless beekeeping by Australian beekeepers. Native Bees of Australia. 1999. Vol. 7. No.1. P.1 - 17.

[14]. Eltz, T., Brühl, C.A., Kaars, S.V.D. and K.E. Linsenmair. Assessing stingless bee pollen diet by analysis of garbage pellets: a new method. Apidologie. 2001. Vol. 32. P. 341- 353.

[15]. Fontaine, C. I., Dajoz, J., Meriguet and M. Loreau. Functional diversity of plant–pollinator interaction webs enhances the persistence of plant communities PLoS Biology. 2005. Vol. 4. No. 1. P. 1-10.

[16]. Gadhiya, V. C. and J.J. Pastagia. Flowers visited by stingless bees, *Tetragonula laeviceps* Smith. Agres. 2015. Vol. 4. No. 4. P. 323 - 330.

[17]. Giannini, T.C. S., Boff, G., Cordeiro, E. Cartolano, A., Veiga, V., Imperatriz-Fonseca and A. M. Saraiva. Crop pollinators in Brazil: a review of reported interactions. Apidologie. 2015. Vol. 46. No.2. P. 209-223.

[18]. Giannini, T.C., Alves, D.A., Alves, R., Cordeiro, G.D., Campbell, A.J., Awade, M.,Bento, J.M.S., Saraiva, A.M. and V.L. Imperatriz-Fonseca. Unveiling the contribution of bee pollinators to Brazilian crops with implications for bee
management. Apidologie. 2020. P. 1-16.

[19]. Harugade, S. and S. Chaphalkar. Floristic studies with reference to Honey bees of Baramati, Pune District. International Journal of Advanced Research Technology. 2013. Vol. 2. No.8. P. 178-187.

[20]. Heard, T. A. 1999. The role of stingless bees in crop pollination. Annual Review of Entomology. 1999. Vol. 44. No.1. P.183-206.

[22]. Hosamani, V., Kattimani, K. N., Rajeshwari, N. and P.M. Gangadharappa. Diversity of nectariferous and polleniferous bee flora and floral calendar of honey bees in dryland regions of Koppal District. Journal of Pharmacology and Phytochemistry. 2018. Vol. 3. P. 362-366.

[23]. Ish-Am, G. F., Barrientos-Priego, A., Castañeda-Vildozola and S. Gazit.Avocado (*Persea americana* Mill.) pollinators in its region of origin. Review of Chapingo Sericulture and Horticulture. 1990. Vol. 5. P. 137-143.

[24]. Kamath, U.S. Karnataka State Gazetteer, Government of Karnataka, Bangalore Press, Bangalore. 2001. P. 1-100.

DOI: 10.17148/IARJSET.2025.12102

[25]. Klein, A. M., Vaissiere, B.E., Cane, J.H., Steffan, I., Dewenter, S.A., Cunningham, C., Kremen and T. Tscharntke. Importance of pollinators in changing landscapes for world crops. Proceedings of Regional Society of Biological Sciences. 2006. Vol. 274 No.1608. P. 303-313.

[26]. Kumar, M. A., Singh, P. K. and J. Singh. Floral calendar for beekeeping at Bichpuri, Agra, UP. Indian Bee Journal. 2005. Vol. 67. No.3-4. P. 156-160.

[27]. Layek, U. and P. Karmakar.Nesting characteristics, floral resources, and foraging activity of *Trigona iridipennis* Smith in Bankura district of West Bengal, India. Insectes Sociaux. 2018. Vol. 65. P. 117–132.

[28].Layek, U., Bisui, S. and P. Karmakar. Flight range and resource loading-unloading behavior of stingless bee *Tetragonula iridipennis* (Smith). Journal of Apicultural Research. 2021. Vol. 63. No.1. P. 400-411.

[29]. Managanvi, K., Khan, M. S. and P. Srivastava. 2012. Foraging activity of stingless bee (*Trigona laeviceps*). Research Journal of Agricultural Sciences. 2012. Vol. 3. No.1. P. 169-172.

[30]. Michener, C.D. The bees of the world. John Hopkins University Press, Baltimore, USA. 2007. P. 1-15.

[31]. Michener, C. D. The Meliponni. In: Pot Honey. A legacy of stingless bees. Vit, P., Pedro, S.R.M., Roublik, D.W. (Edn). Springer, New York, USA. 2013. P. 1-105.

[32]. Moulya, M. R., Jagadish, K. S., Belavadi, V.v., Eswarappa, G. and A. N. Sringeswara. Diversity of Floral Resources of Stingless Bee, *Tetragonula* nr. *pagdeni* (Hymenoptera: Apidae: Meliponini). Mysore Journal of Agricultural Sciences. 2023. Vol.57. No. 1. P. 152-158.

[33]. Nair, M. Apiculture resource biodiversity and management in Southern Kerala. Ph.D. Thesis. Mahatma Gandhi University, Environmental Resources Research Center, Kerala. 2003. P. 1-100.

[34]. Nalini, B. M. and S. Basavarajappa. Floral source and pollen calendar of pollinating insects amidst agro-ecosystems of Kodagu district, Karnataka, India. Acta Entomology and Zoology. 2024. Vol. 5. No.2. P. 202-212.

[35]. Nagamitsu, T. and T. Inoue. Foraging activity and pollen diets of subterranean stingless bee colonies in response to general flowering in Sarawak, Malaysia. Apidologie. 2002. Vol. 33. P. 303–314.

[36]. Nicolson, S.W. Bee food: the chemistry and nutritional value of nectar, pollen and mixtures of the two. African Zoology. 2011. Vol. 46. P. 197-204.

[37]. Nogueira, N. P. Life and keeping of indigenous stingless bees Nogueirapis.[38]. Ollerton, J., Winfree, R. and S. Tarrant. How many flowering plants are pollinated by animals? Oikos. 1997. Vol. 120. No.3. P. 321-326.

[39]. Pooja, S. and M. S. Khan. Assessment of comparative foraging activity in queen right and queen less colony of stingless bee, *Tetragonula iridipennis* Smith(Hymenoptera: Apidae). International Journal of Advanced Research. 2015. Vol. 3. No. 7. P. 498-502

[40]. Potts,S., Imperatriz-Fonseca, J.V.,Ngo, H.T., Aizen, M.A., Biesmeijer, J.C., Breeze,T.D., Dicks, L.V., Garibaldi, L.A. and R. J.Hill. Settee Safeguarding pollinators and their values to human well-being. Nature. 2016. Vol. 540. No. 7632. P. 220-229.

[41]. Rakshitha, T. N., Prabhu, S.T., Tippannavar, P.S., Hegde, R. V. and G.K. Naidu. Foraging behaviour of stingless bee, *Tetragonula iridipennis* Smith on gherkin. The Pharma Innovation Journal. 2022. Vol. 11. No.11. P. 2372-2375.

[42]. Raghuandan, K. S. and S. Basavarajappa. Floral source and pollen calendar of Asian giant honeybee, *Apis dorsata* Fabricus at southern Karnataka, India. Journal of Ecology and the Natural Environment. 2014. Vol. 6. No.9. P. 321-330.

[43]. Raju, A.J.S. Nesting behavior and foraging ecology of the dammar bee, *Trigona iridipennis* Smith (Apidae: Meliponinae). Deutsche National Bibliotheca, Germany. 2009. P. 1-12.

[44]. Rallanawannee, A. and O. Duangphakdee. Southeast Asian meliponiculture for sustainable livelihood. In: R.E.R. Ranz (Edn.), Modern Beekeeping. 2019. P. 1-7.

[45]. Ramalho, M., Imperatriz-Fonseca, V. L. and A. Kleinert-Giovannini. Ecologia nutricional de abelhas sociais. In: A.R. Panizzi and J.R.P. Parra (Edn.). Ecologia Nutricional de insetos e suas implicações no manejo de pragas. 1991. P. 225-252.

[46]. Ramalho, M., Kleinert-Giovannini, A. and V.L. Imperatriz-Fonseca. Important bee plants for stingless bees (*Melipona* and *Trigona*) and Africanized honeybees (*Apis mellifera*) in Neotropical habitats: A review. Apidologie. 1990. Vol. 21. P. 469-488.

[47]. Roubik, D.W. Seasonality in colony food storage, brood production and adult survivorship: studies of *Melipona* in tropical forest (Hymenoptera: Apidae). Journal of Kans Èntomological Society. 1982. P. 789-800.

[48]. Roubik, D.W. Ecology and natural history of tropical bees. New York: Cambridge University Press, UK. 1989. P. 1-100.

[49]. Roubik, D.W. Ecology and Natural History of Tropical Bees Cambridge University Press, UK. 1992. 1.100.

[50]. Roubik, D. W. Pollination of cultivated plants in the tropics. FAO Agricultural Services Bulletin. 1995. Vol.118. P. 53.

[51]. Roubik, D.W. and J.E. Moreno-Patiño. *Trigona corvina*: An ecological study based on unusual nest structure and pollen analysis. Psyche. 2009. P. 268756.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

DOI: 10.17148/IARJSET.2025.12102

[52]. Rumki, H., Sangma, C.H., Arensungla, P. B. and H. K. Singh. 2022. Stingless bee flora in foothills of Nagaland. The Pharma Innovation Journal. 2022. Vol. 11. No.9. P. 2935-2941.

[53]. Sakagami, S. F., Roubik, D. W. and R. Zucchi. 1993. Ethology of robber stingless bee, *Lstrimelitta limao* (Hymenoptera: Apidae). Sociobiology. 1993. Vol. 21. No.2. P. 237-277.

[54]. Saha, T. K. Biostatistics in theory and practice. Emaky Publications, Delhi. 2009. P. 5-104.

[55]. Sheetal, V. K. and S. Basavarajappa. Spatial distribution of stingless bee,*Trigona iridipennis* Smith in Manasagangotri, Mysore, Karnataka. Hexapoda. 2009. Vol. 6. No.2:136-140.

[56]. Sheetal, V. K. and S. Basavarajappa. Survey on Meliponiculture Practices at different districts of Karnataka, India. International Advanced Research Journal of Science, Engineering and Technology. 2024. Vol. 11. No.11. P. 164-183.

[57]. Shwetha, B. V. Studies on the floral diversity of stingless bees in Peninsular India. Thesis. Department of Zoology. Bangalore University. 2013. P.1-100.

[58]. Singh, A. K., Jaiswal, D. K., Singh, H. K. and R.K. Thakur. Diversity of bees'flora and floral calendar of native honeybees in Nagaland, India. Advanced Life Sciences. 2016. Vol. 5. No.6. P. 2285-2292.

[59]. Sivaram, V. Honeybee flora and beekeeping in Karnataka State, India. In:Proceedings of the 37th International Apicultural Congress. August, 19-24, Durban, South Africa. 2001. P. 1-7.

[60]. Slaa, E. J., Sanchez-Chaves, L.A., Malagodi-Braga, K.S. and F.E. Hofstede. Stingless bees in applied pollination: practice and perspectives. Apidologie. 2006. Vol. 37. P. 293-315.

[61]. Suryanarayana, M. C. Studies on flora of Coorg with emphasis on beekeeping forage plants. Ecological and Botanical Features. 1966. Vol. 28. P. 59-75.

[62]. Suryanarayana, M. C., Mohana Rao, G. and T. Singh. Studies on pollen sources for *Apis cerana* Fabr and *Apis mellifera* L bees at Muzaffarpur, Bihar, India. Apidologie. 1992. Vol. 23. No.1. P. 33-46.

[63]. Swathi, K. A., Sindhushree, D. H. and S. Basavarajappa. Physical and palynological studies in honey samples collected from Uttar Kannada and Shivamogga Districts of Karnataka, India. World Journal of Advance Healthcare Research. 2021. Vol. 5. No.3. P. 503-512.

[64]. Vamshikrishna, N., Vinaykumar, M. M., Venkateshalu, J. B. and P.S. Ajjappalavara. Foraging flora of stingless bees, *Tetragonula* spp., in Bagalkot, Karnataka, India. J. Experimental Zoology. 2021. Vol. 24. No.2. 1449-1453.

[65]. Vazhacharickal, P. J., Jagadish, K. S., Eswarappa, G. and G.B. Anil. An overview of global Meliponiculture with a special focus to Kerala, India. International Journal of Current Research. 2020. Vol. 8. P. 2347 - 3215.

[66]. Velmurugan, P. Studies on nesting behaviour and floral resources of stingless bees *Trigona laeviceps* Smith at Pantnagar. M.Sc. (Ag.) Thesis, G.B.Pant University of Agriculture and Technology, Pantnagar, India. 2011. P. 1-101.

[67]. Venkatachalapathi, A., Subbaiyan, B., Jagathes, K. S., Aravindhan. V. and S. Paulsamy. Study on diversity of social bees foraging medicinal plants in Walayar Valley of Coimbatore District, Western Ghats, India. Academic Journal of Entomology. 2015. Vol. 8. No. 2. P. 84-91.

[68]. Vijayakumar, K. and R. Jeyaraaj. Floral sources for stingless bees in Nellithurai village, Tamilnadu, India. Ambient Science. 2016. Vol. 3. No.2. P. 22 - 25.

[69]. Vossler, F. G., Fagúndez, G. A. and D.G. Blettler. Variability of food stored of *Tetragonisca fiebrigi* (Schwarz) (Hymenoptera: Apidae: Meliponini) from the Argentine Chaco based on pollen analysis. Sociobiology. 2014. Vol. 61. P. 449-460.

[70]. Waykar, B. and R.K. Baviskar. Diversity of bee foraging flora and floral calendar of Paithan taluka of Aurangabad district, Maharashtra, India. International Journal of Entomological Research. 2015. Vol. 4. No.1 P. 66-69.

[71]. Wille, A. Biology of the stingless bees. Annual Review of Entomology. 1983. Vol.28. P. 41- 64.

[72]. Zhang, L., Liu, X., Wang, Y. and Y. Liu. Floral calendar and diversity of honeybee flora in Beijing, China. Acta Entomological Sinica. 2012. Vol. 55. P. 45-55.

Table 1. Published reports available on floral source of stingless bees across the world

Sl. No.	Researched on	Place	Reference
1.	Flora of Coorg with emphasis on bees forage plants	Kodagu, India	Suryanarayanam (1966)
2.	Bee flora of transitional zone	Karnataka, India	Bhat *et al*. (1990)
3.	Pollen sources for *Apis cerana* & *A. mellifera*	Bihar, India	Suryanarayana (1992)
4.	Pollination of cultivated plants	Tropical regions	Roubik (1995)
5.	Stingless bees in crop pollination	Australia	Heard (1999)
6.	Stingless bees for commercial pollination	United Kingdom	Slaa *et al.* (2000)
7.	Honeybee flora and beekeeping	Karnataka, India	Sivaram (2001)

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8.	Foraging activity and pollen diets of stingless bees	Malaysia	Nagamitsu & Inoue (2002)
9.	Apiculture resource	Kerala, India	Nair (2003)
10.	Floral calendar for beekeeping	Delhi, India	Kumar *et al.* (2005)
11.	Stingless bee, *Trigona iridipennis* foraging behavior	Dharwad, India	Danaraddi (2007)
12.	Flora of stingless bee, *T. iridipennis*	Mysore, India	Sheetal and Basavarajapp (2009)
13.	Foraging sources of honey bees and stingless bees	India	Raju *et al.* (2009)
14.	Floral phenology and pollination ecology of *Punica granatum*	Nepal	Adhikari (2010)
15.	Bee flora in mid hills	Nepal	Adhikari (2011)
16.	Floral resource of stingless bee, *T. laeviceps*	Pantnagar, India	Velmurugan (2011)
17.	Foraging activity of stingless bee , *T. laeviceps*	Pantnagar, India	Managanvi *et al.* (2012)
18.	Floral calendar and diversity of honeybee flora	Beijing, China	Zhang *et al.* (2012)
19.	Floral diversity of stingless bees	Bangalore, India	Shwetha (2013)
20.	Floristic studies with reference to Honey bees	Pune	Harugade & Chaphalkar (2013)
21.	Floral source and pollen calendar of *Apis dorsata*	Karnataka, India	Raghuandan & Basavarajappa (2014)
22.	Foraging activity in queen right and queen less colony of stingless bee, *T. iridipennis*	Panthnaagar, India	Pooja & Khan (2015)
23.	Bee foraging and floral calendar	Maharashtra, India	Waykar & Baviskar (2015)
24.	Social bees foraging medicinal plants	Coimbatore, India	Venkatachalapathi *et al.* (2015)
25.	Flowers visited by stingless bees, *T. laeviceps*	-	Gadhiya & Pastagia (2015)
26.	Flora and floral calendar of native honeybees	Nagaland, India	Singh *et al.* (2016)
27.	Floral sources for stingless bees	Tamil Nadu, India	Vijayakumar & Jeyaraaj (2016)
28.	Nectariferous and polleniferous bee flora and floral calendar	Koppal, India	Hosamani *et al.* (2018)
29.	Floral resources and foraging activity of *T. iridipennis*	West Bengal, India	Layek & Karmakar (2018)
30.	Pollen forage pattern of stingless bee *T. iridipennis*	West Bengal, India	Bisui *et al.* (2019)
31.	Pollination potential of stingless bee, *T. iridipennis* in ash gourd	India	Chauhan *et al.* (2019)
32.	Resource loading-unloading behavior of stingless bee, *T. iridipennis*	India	Layek *et al.* (2021)
33.	Bee-friendly flowering plants and bee-plant interaction	Bangalore, India	Bhatta & Kumar (2021)
34.	Palynological studies in honey samples	Karnataka, India	Swathi *et al.* (2021)
35.	Flowers morphology, nectar concentration and preferred food source of stingless bee	Itama, USA	Basari *et al.* (2021)
36.	Flora of stingless bees, *Tetragonula* species	Karnataka, India	Vamshikrishna *et al.* (2021)
37.	Foraging behavior of stingless bee, *T. iridipennis* on Gherkin	Dharwad, India	Rakshitha *et al.* (2022)
38.	Stingless bee flora	Nagaland, India	Rumki *et al.* (2022)
39.	Floral resources of stingless bee, *T. pagdeni*	Bangalore	Moulya *et al.* (2023)
40.	Floral diversity and seasonal availability to butterflies	Mysore, India	Bhagya & Basavarajappa (2024)
41.	Floral source and pollen calendar of pollinating insects	Kodagu, Karnataka	Nalini & Basavarajappa, (2024)

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Table 2. Physiographic details, environmental factors and major crops grown at few districts of Karnataka

Sl. No.	District	Latitude	Longitude	Altitude (in meters)	Tempr. (^{0}C)	RH (%)	Rain fall (mm)	Major Crops Grown
1.	Chamarajanagar	11°55'41"N	76°56'37"E	730.0	28.0 to 29.0	42.0	2.62	Fruits: Banana, Mango, Sapota, Papaya & Pomegranate. Vegetables: Tomato, Beans, Brinjal, Green Chilies & Leafy vegetables. Plantation crops: Coconut, Pulses & Horse gram. Oilseed crops: Groundnut, Sunflower & Sesame.
2.	Kodagu	12°22'14"N to 12°13'17"N	75°48'21"E to 75°48'08"E	1,216	30.0 to 32.0	58.0	2.08	Agricultural crops: Paddy and Pepper Commercial crops: Coffee. Fruits: Orange Pepper as agro-forestry crops. Plantation: Agro-forestry
3.	Bangalore	12°59'16"N to 12°58'56"N	77°35'42"E to 77°35'30"E	913.0	29.0 to 32.0	29.0	2.18	Agricultural crops: Paddy, Rice, Ragi, Corn, Pulses & Peanut Commercial crops: Sugarcane & Mulberry Fruits: Grapes. Oilseed crops: Castor
4.	Mysore	12°17'57"N to 12°06'52"N	76°38'18"E to 76°40'25"E	778.0	29.0 to 31.0	22.0	1.93	Agricultural crops: Paddy, Ragi & Jowar Commercial crops: Tobacco, Cotton, Sugarcane, Ginger & Turmeric Plantation crops: Coconut, Mango, Sapota & Banana Vegetables & other crops: Mysorumallige & Mysoruchigurele. Fruits: Nanjungud Rasabale,
5.	Chikmagaluru	13°19'11"N to 13°14'07"N	75°46'18"E to 75°47'16"E	1,059	32.0 to 35.0	50.0	2.05	Agricultural crops: Paddy, Ragi & Jawar Commercial crops: Coffee, Spices, Black Pepper, Cardamom, Cinnamon, Clove & Nutmeg.
6.	Ballari	15°08'38"N	76°56'16"E	480.0	42.0 to 42.0	14.0	1.13	Commercial crops: Cotton. Agricultural crops: Paddy, Jowar & Cereals Oilseed crops: Sunflower & Ground nut
7.	Uttara Kannada	14°52'14"N	74°40'42"E	524.0	38.0 to 39.0	22.0	1.32	Agricultural crops: Paddy Plantation crops: Orchards of Betel nut, Betel vines, Pepper, Cardamom & Nutmegs. Fruits: Banana
8.	Dakshina Kannada	12°52'36"N to 12°48'56"N	75°14'52"E to 75°11'37"E	121.0	26.0 to 27.0	94.0	3.21	Plantation crops: Coconut, Areca nut, Cashew nut, Rubber, Coco & Black pepper. Fruits: Banana, Sapota, Papaya & Jackfruit. Vegetables: Okra, Gourds, Cowpea, Brinjal & Leafy vegetables.
9.	Shivmoga District	13°55'53"N to 13°55'42"N	75°34'05"E to 75°33'57"E	611.0	23.0 to 27.0	83.0	1.27	Plantation crops: Sandalwood, Rosewood, Teak, Tamarind & other exotic timber yielding trees. Areca nut, Cashew nut & Pepper Fruits: Mango and Jackfruit. Agricultural crops: Paddy, Cotton, Maize, Oil seeds, Chili, Ginger & Ragi.

Note: Source: Kamath (2001); Google Earth.com and Sheetal and Basavarajappa (2024).

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Table 3. Family, common name, scientific name of different flowering plants and their abundance amidst Meliponaries of different districts of Karnataka

Sl. No.	Family	Sl. No.	Common Name	Scientific Name	Flowering plants				
					Status	Foraging Source	Type	Blooming Period	Floral Abundance
1.	Acanthaceae	1.	Spatika	*Barleria cristata*	H	P/N	OP	Sept -Nov	P3N2
		2.	Kanakambara	*Crossandra infundibuliformis*	H	N	OP	Oct-Mar	N1
2.	Anacardiaceae	3.	Mango	*Mangifera indica*	T	P/N	FYP	Dec-Mar	P1N1
		4.	Cashew nut	*Anacardium occidentale*	T	P/N	FYP	Jan-Apr	P1N2
3.	Annonaceae	5.	Ashoka tree	*Polyalthia longifolia*	T	N	OP	Mar-Apr	N1
		6.	Custard apple	*Annona squamosa*	S	P/N	FYP	Mar-July	P1N1
4.	Apiaceae	7.	Fennel	*Foeniculum vulgare*	H	P/N	MP	Apr- May	P3N3
5.	Apocyanaceae	8.	Kanagile	*Nerium oleander*	S	N	OP	Jan- Dec	N2
		9.	Kashi kanigile	*Vinca rosea*	H	N	OP	Jan – Dec	N1
6.	Aracaeae	10.	Red peace lily anthurium	*Spathiphyllum wallisii*	H	N	OP	Feb - Sept	N2
		11.	Coconut	*Cocos nucifera*	T	P/N	EIP	Jan – Dec	P3N2
		12.	Areca palm	*Areca catechu*	T	P/N	EIP	Mar - Apr	P3N3
7.	Asclepidaceae	13.	Yakkada gida	*Calotropis gigantea*	S	P/N	W	Sept – Mar	P1N1
8.	Asteraceae	14.	Shavantige	*Chrysanthemum indicum*	H	P/N	OP	Aug – Oct	P1N3
		15.	Tridax	*Tridax procumbens*	H	P/N	W	Jan – Dec	P2N1
		16.	Dahlia	*Dahlia imperialis*	H	P/N	OP	Aug- Oct	P1N2
		17.	Congress weed	*Parthenium hysterophorus*	H	P	W	Jan-Dec	P1N1
		18.	Niger	*Gui zotia abyssinica*	H	P/N	OYP	Oct-Nov	P3N3
		19.	Sunflower	*Helianthus annuls*	S	P/N	OYP	Jun - Nov	P3N3

Table 3 continued to next page

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Sl. No.	Family	Sl. No.	Common Name	Scientific Name	Flowering plants				
					Status	Foraging Source	Type	Blooming Period	Floral Abundance
9.	Balsaminaceae	20.	Karanakundala	*Impatiens balsamina*	H	P/N	OP	Aug-Oct	P3N3
10.	Brassicaceae	21.	Mustard	*Brassica juncea*	H	P/N	OYP	Jun - Sept	P3N3
11.	Bignoniaceae	22.	Trumpet flower	*Tectoma stans*	S	P/N	OP	Sept-Nov	P3N1
12.	Bromeliaceae	23.	Pineapple	*Ananas cosmus*	S	N	FYP	Jan - Mar	N2
13.	Caesalpinaceae	24.	Gulmohar	*Delonix regia*	T	P/N	OP	Mar-May	P3N2
		25.	Tamrind tree	*Tamarindus indica*	T	N	EIP	Feb-May	P2N1
14.	Caricaceae	26.	Papaya	*Carica papaya*	T	N	FYP	Jul-Sept	P2N3
15.	Compositae	27.	Marigold	*Tegetes errecta*	H	N	OP	Aug-Dec	N2
16.	Convolvulaceae	28.	Sky blue cluster vine	*Jacquemontia pentanthos*	C	P	OP	Sept - Feb	P2
17.	Cucurbitaceae	29.	Seegumbala	*Cucurbita maxima*	C	P/N	VP	Aug-Dec	P2N3
		30.	Sorekayi	*Lagenaria leucantha*	C	P/N	VP	Jan-Dec	P2N3
		31.	Tondekayi	*Coccinia cordifolia*	C	P/N	VP	Jan-Aug	P2N3
		32.	Bitter gourd	*Momordica charantia*	C	P/N	VP	Apr-Jul	P2N2
		33.	Cucumber	*Cucumis sativus*	C	P/N	VP	Oct-Nov	P2N3
18.	Euphorbiaceae	34.	Croton	*Croton bonplandianum*	H	P/N	OP	Jan-Dec	P1N1
		35.	Amla	*Phyllanhus emblica.*	T	N	EIP	Oct-Dec	N3
		36.	Castor	*Ricinus communis*	T	P/N	EIP	Aug-Sept	P1N1
19.	Fabaceae	37.	Honge Mara	*Pongamia pinnata*	T	P/N	EIP	Mar-May	P3N1
		38.	Red powder puff	*Calliandra haematocephala*	S	P	OP	Mar-May	P2N2
		39.	Ratnagandhi	*Caesalpinia pulcherrima*	S	P	OP	Mar - Nov	P1
20	Lamiaceae	40.	Krishna tulsi	*Ocimum sanctum*	H	P/N	OP	Jan-Aug	P3N1
		41.	Rama tulsi	*Ocinum gratissimum*	H	P/N	OP	May-Aug	P3N1
		42.	Thumbe	*Leucas aspera*	H	N	W	June-Sept	N2
		43.	Kama kasthuri	*Ocimum basilium*	H	P/N	OP	Jan - Dec	P3N1
		44.	Maruga	*Origanum majorana*	H	P/N	OP	Aug - Sept	P1N1
21.	Liliaceae	45.	Aloe vera	*Aloe vera*	H	N	OP	Oct-Dec	N3
		46.	Onion	*Allium cepa*	H	P/N	VP	May-Jul	P3N3

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22.	Lauraceae	47.	Avacado	*Persea Americana*	T	P/N	FYP	Feb-Mar	P3N3
23.	Magnoliaceae	48.	Sampige	*Michelia champaka.*	T	P/N	OP	Apr-Sept	P1N1
24.	Malvaceae	49.	Dasawala	*Hibiscus rosa sinensis*	S	P/N	OP	Jan-Dec	P2N3
25.	Meliaceae	50.	Neem	*Azadirachta indica*	T	P/N	EIP	Mar-May	P1N1
26.	Mimosaceae	51.	Touch me not	*Mimosa pudica*	H	P	W	Jan-Dec	P2
		52.	Banni Mara	*Acacia ferruginea*	T	P	EIP	Mar-May	P1
		53.	Gobbali Mara	*Acacia nilotica*	T	P	TYP	May-Jul	P2
		54.	Dodda gulgangi	*Adenanthera pavonia*	T	P/N	OP	Apr-Aug	P1N1
27.	Moringaceae	55.	Drum stick	*Moringa oleifera*	T	P/N	V	Feb-Apr	P2N1
28.	Muntingiaceae	56.	Gasagase plant	*Muntingia calabura*	T	P/N	OYP	Dec-Feb	P1N3
29.	Moraceae	57.	Jack fruit	*Artocarpus heterophyllus*	T	P/N	FYP	Feb-Mar	P1N3
30.	Musaceae	58.	Banana	*Musa paradissiaca*	S	P/N	FYP	Jan-Dec	P1N1
31.	Myrtaceae	59.	Guava	*Psidium guajava*	T	P/N	FYP	Mar-May	P3N3
		60.	Bottle brush	*Callistemon citrinus*	S	P/N	OP	Aug-Nov	P2N2
		61.	Jambu Nerale	*Syzygium cumini*	T	P/N	FYP	Mar-Apr	P2N1
		62.	Rose apple	*Syzygium jambos*	T	P/N	FYP	Mar-Apr	P2N1
		63.	Water apple	*Syzygium aqueum*	T	P/N	FYP	May - Aug	P2N1
32.	Myristicaceae	64.	Jakai/ Nut mug	*Myristica fragrans*	T	P/N	S	Jan - Dec	P2N2
33.	Nymphaeaceae	65.	Water Lilly	*Nymphaea*	H	P	OP	May - Sept	P1
34.	Nyctanthaceae	66.	Parijata	*Nyctanthes arbortristis*	T	N	OP	Aug-Oct	N1
35.	Oleaceae	67.	Jasmine	*Jasminum* sp.	C	N	OP	Oct-Mar	N1
36.	Orchidaceae	68.	Vanilla	*Vanilla planifolia*	C	P/N	EIP	Dec - Feb	P2N2

Table 3 continued to next page

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Table 3 continued from the previous page

Sl. No.	Family	Sl. No.	Common Name	Scientific Name	Flowering plants				
					Status	Foraging Source	Type	Blooming Period	Floral Abundance
37.	Poaceae	69.	Grasses	*Festuca pratensis*	H	P/N	W	May - Jul	P3N3
38.	Piperaceae	70.	Betel leaf	*Piper betel*	C	N	L	Mar - May	N3
		71.	Pepper	*Piprum nigrum*	C	P/N	S	May - June	P2N2
39.	Punicaceae	72.	Pomegranate	*Punica granatum*	S	P/N	FYP	Apr - Jul	P2N1
40.	Rosaceae	73.	Rose	*Rosa centifolia*	S	P/N	OP	Jun -Jul	P1N2
41.	Rubiaceae	74.	Coffee	*Coffea arabica*	S	P/N	BP	Feb - May	P1N3
42.	Rutaceae	75.	Lemon	*Citrus aurantifolia*	S	P/N	FYP	Apr- May	P1N1
		76.	Rue (Nagadali)	*Ruta graveolens*	H	P/N	OP	Jan - Dec	P1N1
		77.	Belada Mara	*Feronia limonia*	T	N	FYP	Feb-May	N3
		78.	Curry leaves	*Muraya koenigii*	S	N	V	Mar - May	N3
		79.	Sweet orange	*Citrus sinensis*	T	P/N	FYP	Feb - Mar	P1N1
		80.	Bush orange	*Citrus trifoliata*	S	P/N	FYP	Feb - Apr	P1N1
43.	Sapotaceae	81.	Sapota	*Manikara achras*	T	P/N	FYP	July - Aug	P3N1
44	Solanaceae	82.	Tomato	*Lycopersicon esculentum*	H	P/N	V	Jan - Dec	P1N3
		83.	Chilli	*Capsicum annum*	H	P/N	V	Jan - Dec	P1N3
		84.	Brinjal	*Solanum melonigena*	H	P/N	V	Jan - Dec	P1N3
45	Verbenaceae	85.	Lantana Gida	*Lantana camara*	S	N	W	Jan - Dec	P1N1

Note: Plant status: C: Climber; H: Herb; S: Shrub; T: Tree. **Foraging source**: P: Pollen; N: Nectar.

Type: W: Weed; L: Leafy; S: Spice; FYP**:** Fruit Yielding Plant; OP: Ornamental Plant; BP: Beverage Plant; V: Vegetables; EIP: Economically Important Plant; OYP: Oil Yielding Plant; TYP: Timber Yielding Plant; MP: Medicinal Plant.

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Table 4. Floral source available to stingless bees at Meliponiculture practicing area at different districts of Karnataka

Sl. No.	Family	No. of Plant species	Floral contribution (%)	Family contribution (%)
1.	Asteraceae & Rutaceae	6 each	7.1 each	14.2
2.	Cucurbitaceae, Lamiaceae & Myrtaceae	5 each	5.8 each	17.4
3.	Mimosaceae	4	4.7	4.7
4.	Euphorbiaceae, Fabaceae & Solanaceae	3 each	3.5 each	10.5
5.	Acanthaceae, Anacardiaceae, Annonaceae, Apocynaceae, Arecaceae, Caesalpinaceae, Liliaceae & Piperaceae	2 each	2.3 each	18.4
6.	Apiaceae, Asclepidaceae, Balsminaceae, Bignoniaceae, Brassicaceae, Bromeliaceae, Caricaceae, Compositae, Convolvulaceae, Lauraceae, Magnoliaceae, Meliaceae, Moraceae, Moringanaceae, Musaceae, Myristicaceae, Nyctanthaceae, Nymphaceae, Oleaceae, Orchidaceae, Poaceae, Punicaceae, Rosaceae, Rubiaceae, Sapotaceae & Verbenaceae	One each	1.1 each	28.6
Total		84	100.0	100.0

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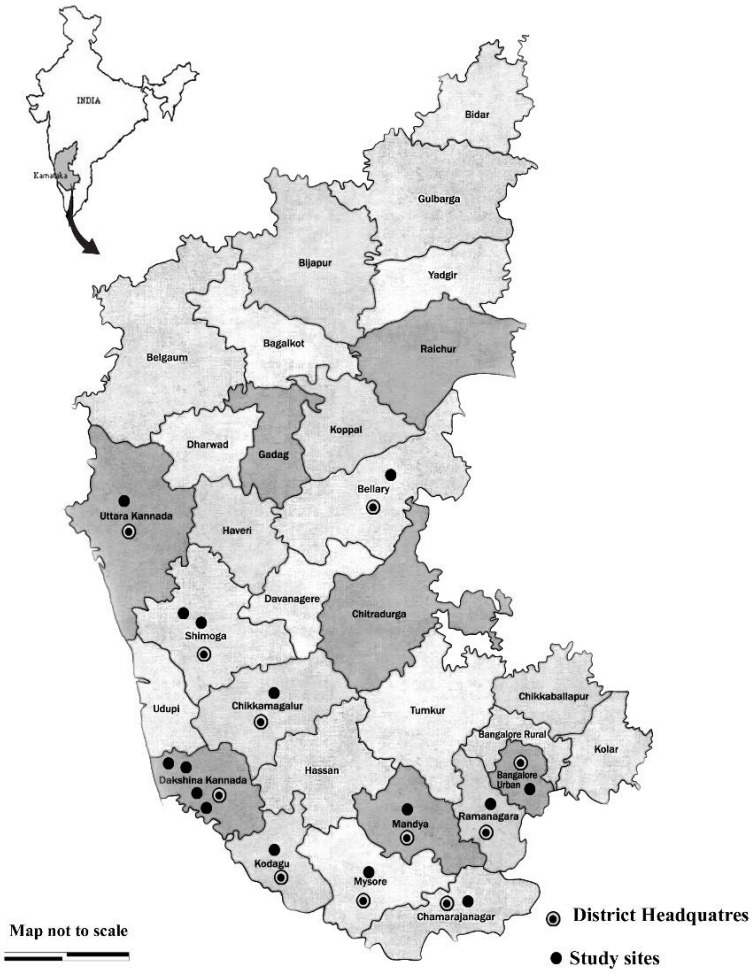

Figure 1. Map showing the study sites in different districts of Karnataka

Source: Sheetal and Basavarajappa (2024)

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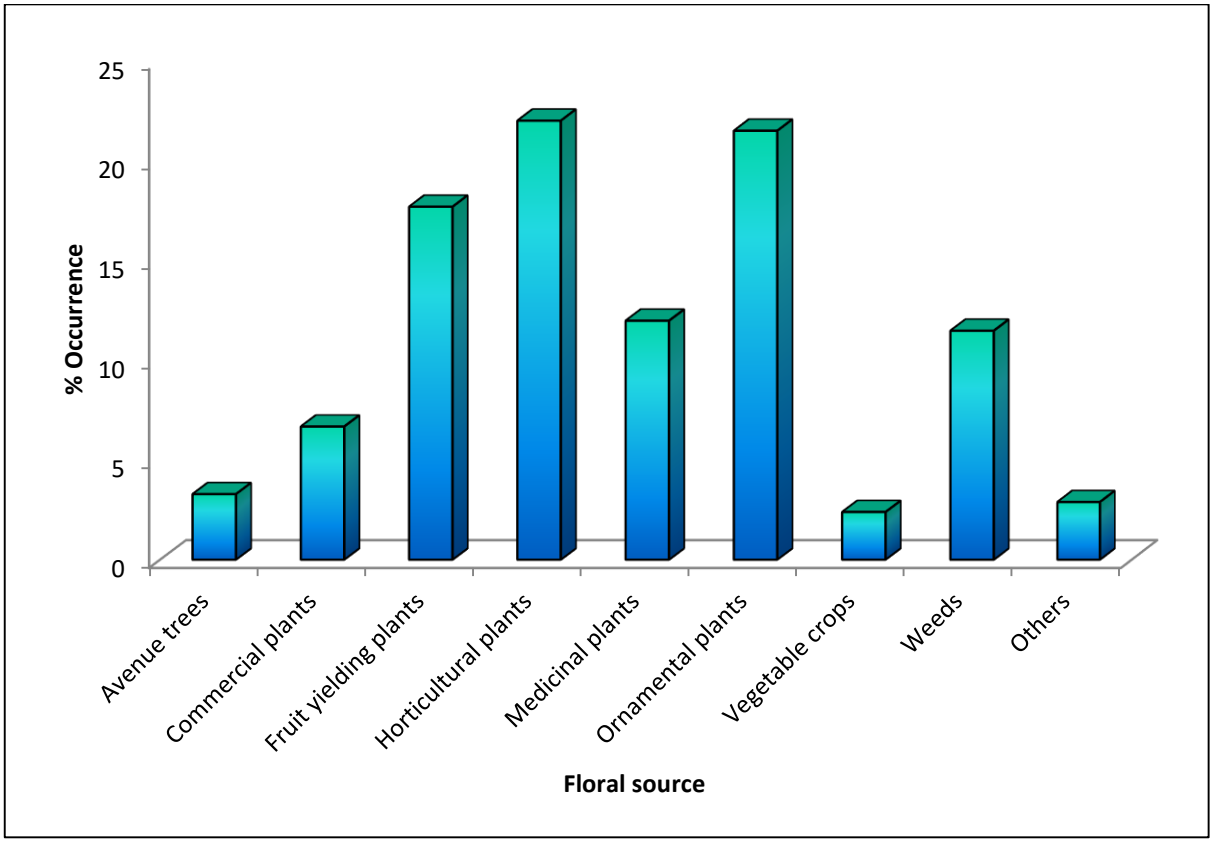

Figure 2. Floral source availability at the vicinity of stingless bee's colonies

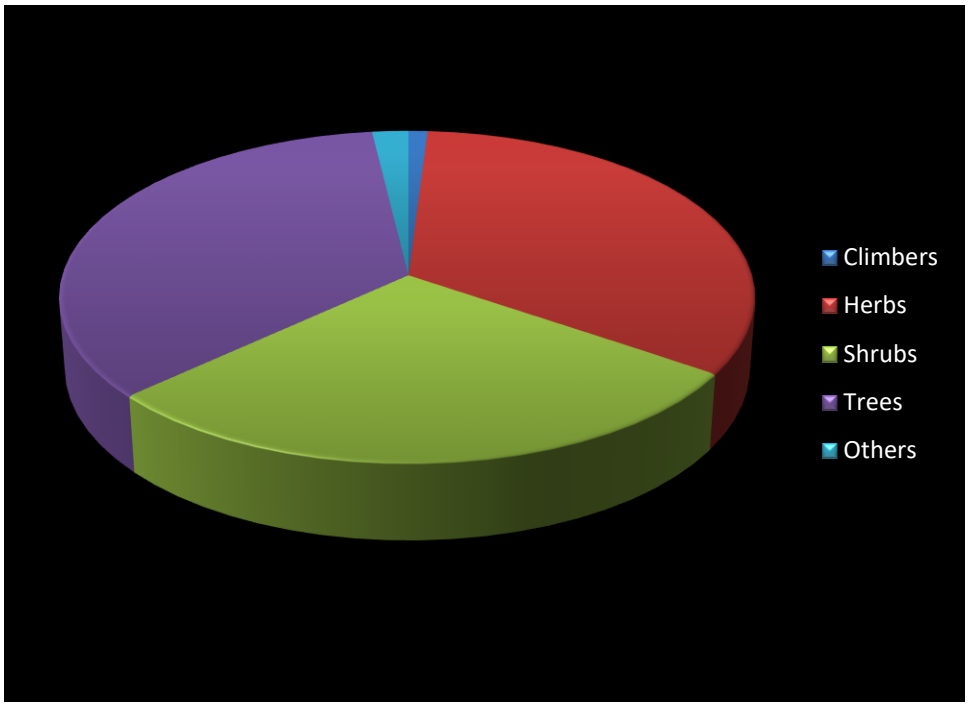

Figure 3. Pie diagram showing the plants provided floral source to the stingless bees

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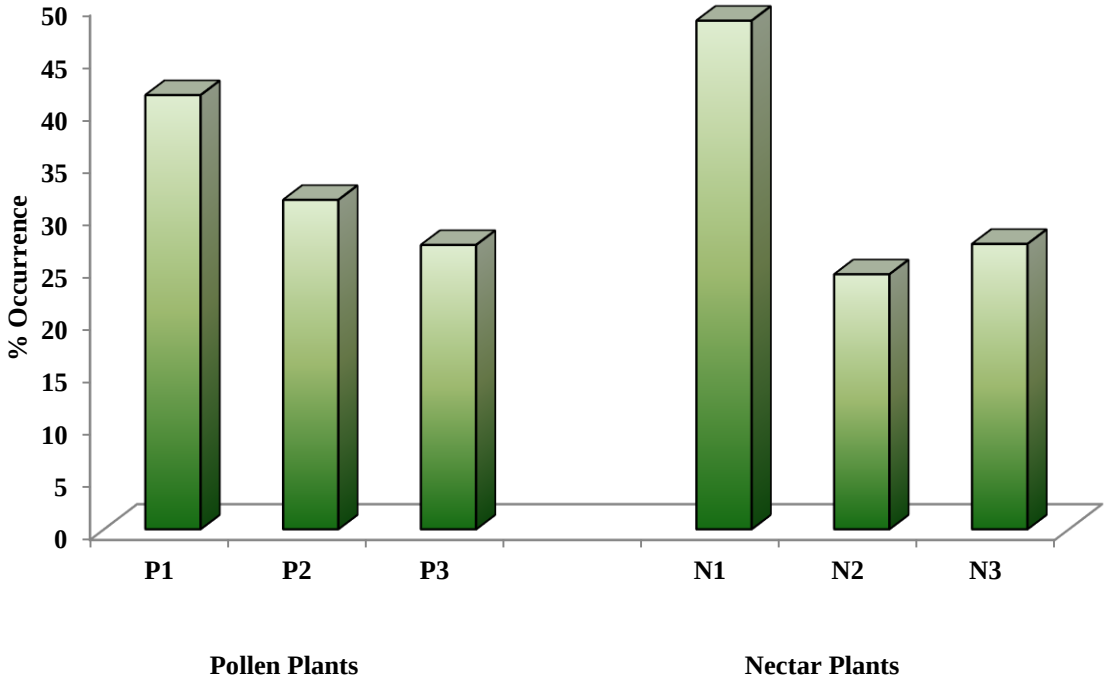

Figure 4. Pollen and Nectar plants available at the vicinity of Meliponary

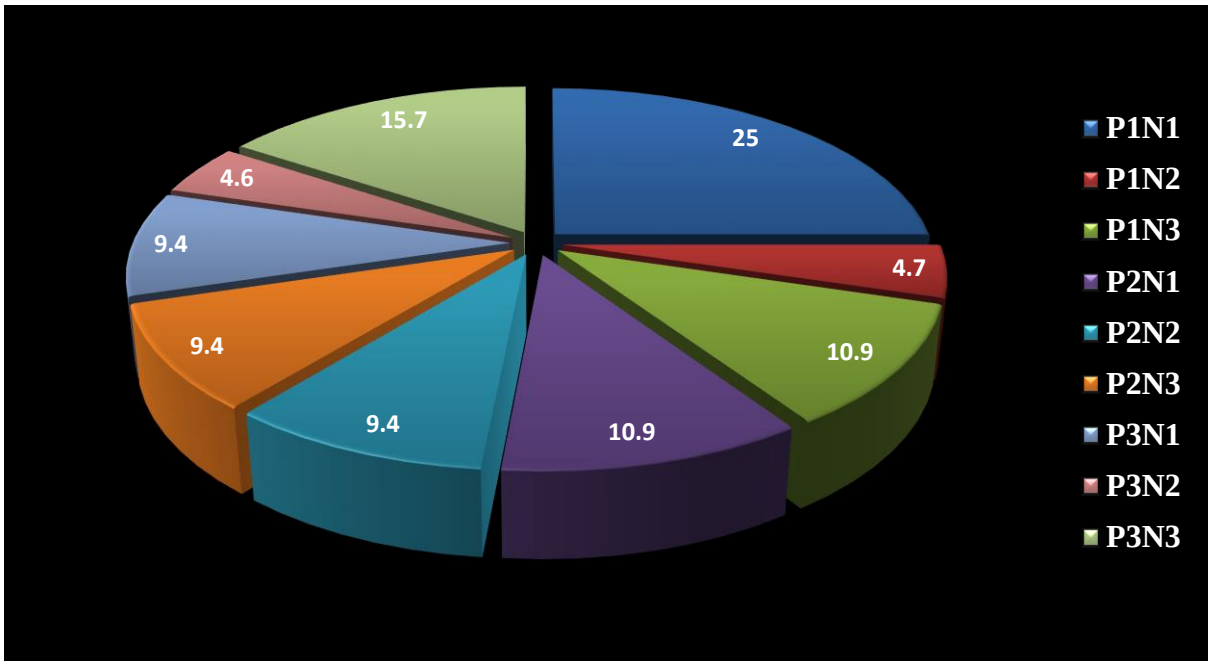

Figure 5. Pie diagram showing the status of pollen and nectar source available to stingless bees at the vicinity of Meliponary

January	February	March	April	May	June	July	August	September	October	November	December	No. spp.
												17

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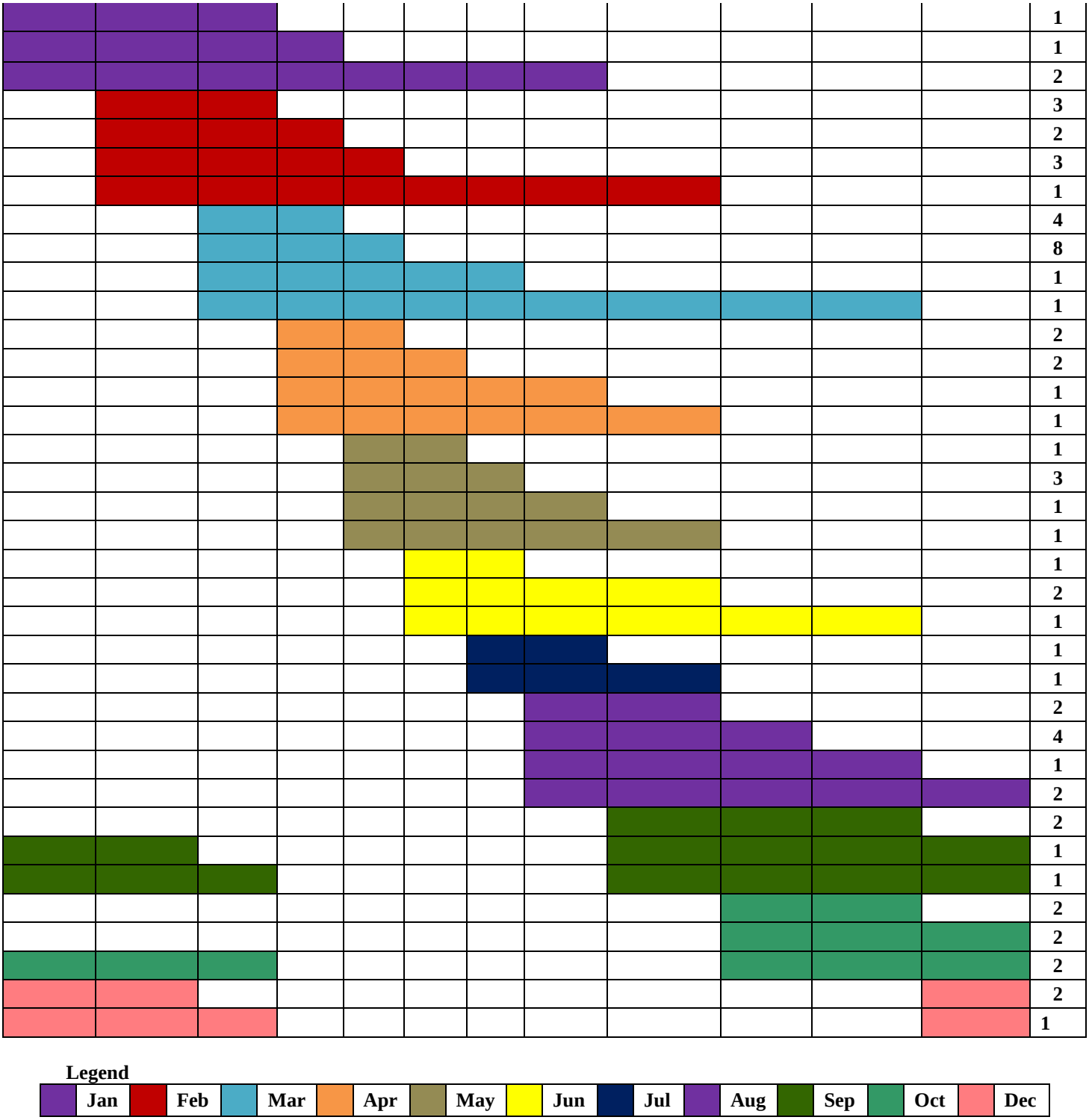

Figure 6. Floral calendar to stingless bees at the vicinity of Meliponary

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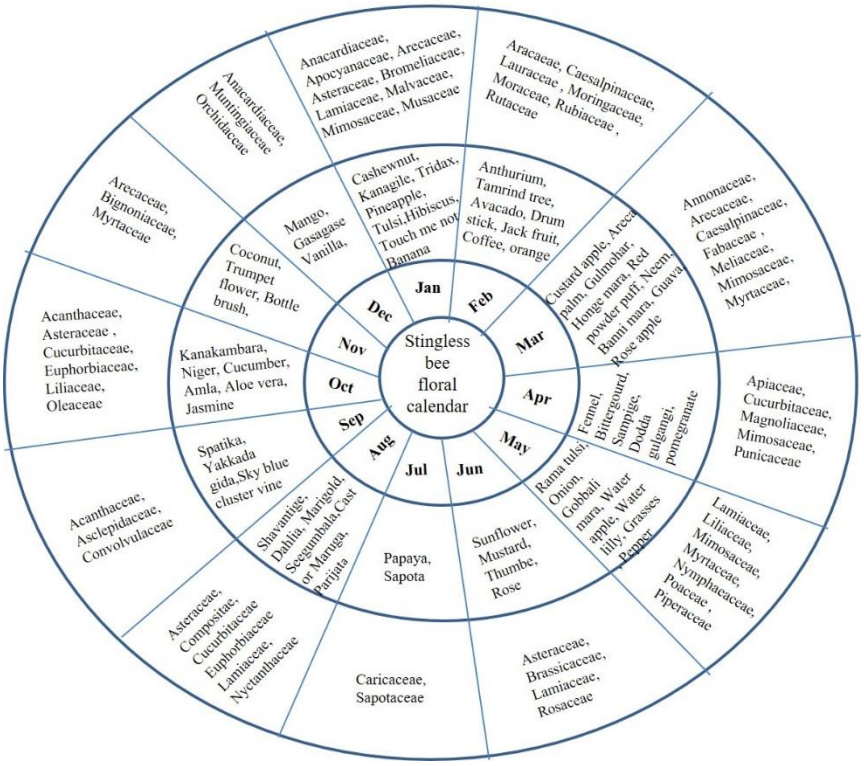

Figure 7. Floral calendar shows the monthly occurrence of different flowering plants which belong to various families to stingless bees at the vicinity of Meliponary