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Research article

STUDY ON HONEYBEE (APIS CERANA) FORAGE PLANTS IN MIZORAM, NORTHEAST INDIA

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ABSTRACT: The pollen morphology of 51 species representing under 28 botanical families have been observed as potential source of pollen and identified from bee honey sample using light microscope. Major pollen yielding plants were found mostly under the family Compositae, Myrtaceae, Malvaceae, Euphorbiaceae, Cucurbitaceae, Leguminosae, Rubiaceae, Lythraceae, Combretaceae and Fabaceae were identified. Although some forage plants are occured throughout the year in the locality but March to June is the major flowering period whereas July to October are minor flow period of pollen while November to February is the least productive period of pollen. Two sites have been studied due to highly difference of environment and geographical area hoping to obtained varieties of species available in the sites. This paper gives the general idea of range of plants species that occur in the area and describe a simplified method for determining the total amount of pollen grains in honey.

Keyword Bee honey, pollen, flower, habitat, Mizoram.

INTRODUCTION

Bee honey originates from either nectar or other sugar containing deposits produced by living plants. It is stored in the honeycombs and used as food source during winter [10]. Pollen is the sole source of protein and lipids in the diet of honeybees, and is crucial for their survival and development. Pollen loads were not same throughout the year, there were great monthly fluctuations in the average weight of the pollen loads carried by the workers [shahera] aswell as the content of pollen in the honey. Characterisation of plant sources for bee honey would be useful across a range of research areas. Pollen are essential tools in analyses of honey. Different type of pollens are used to indicate floral nectar sources utilized by bee to produce honey, relative pollen frequency was often used to verify and label a honey sample as to major and minor nectar sources[7]. Another reason that pollen analyses of honey are required is to identify geographical source of origin [12]. Palynological studies for pollen was carried out to determine the pollen sources for honeybees in Mizoram during 2012-2013. Champhai district lies in the eastern part of Mizoram between 93.21°E longtitude and 23.26°N latitude. The minimum and maximum temperature is 0°C to 20°C during winter and 15°C to 30°C during summer. The average annual rainfall is 1814 mm. Whereas Aizawl is the largest district in the state, but still very remote. Aizawl is located at 3715 feet from the sea level, weather in summer: maximum: 30°C minimum: 20°C and winter: maximum: 21°C minimum: 11°C with rainfall 3,000mm and altitude of 1132 metres/3715 feet. The district occupies an area of 3576.31 km². Aizawl lies just north of Tropic of cancer. The success of beekeeping in the country depends not only on using better strains of bees but also on the abundance and richness of nectar and pollen around an apiary [6].

MATERIALS AND METHODS

Honey sample: In the present study, samples of honey from two districts of Aizawl and Champhai of Mizoram were collected from beekeepers for the study of bee plants from honey. A field survey is done seasonally two times during January to May and October to December in a year of each district from different villages so as to identified all possible pollen available in one complete year. Collected honey were stored in a airtight plastic containers in a refrigerator at 4-6˚C until analysis.

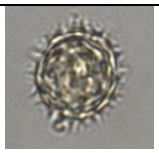
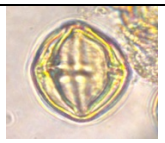
Preparation of Pollen slides: The preserved honey samples was prepared by acetolysis method according to Erdtman (1960) for light microscope which involve the introduction of acetolysis mixture comprising acetic anhydride mixed with concentrated sulphuric acid in the ratio 9:1. The tube was immersed in boiling water bath for 5 min, centrifuged and supernatant decanted. The residues were washed water and decanted, and about few drops of glycerin was added and mounted on slide [11]. Likewise fresh flower of known plant pollen slides was prepared according to same Acetolysis method as reference for identification. [1]. The prepared was studied under light microscope to identified pollen and photograph was taken to study pollen morphology. Bee forage plants were identified with the help of the following [5, 8]

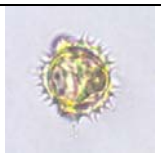
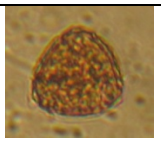
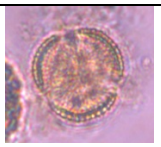
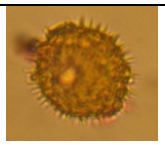
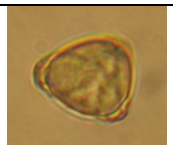
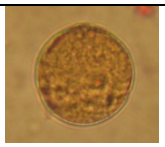
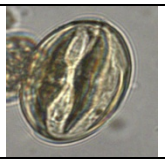
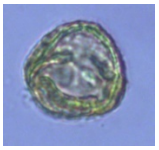
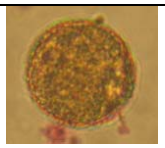
RESULTS AND DISCUSSION

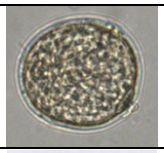
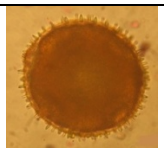
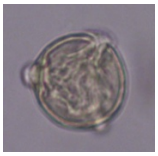
Data collected during the study period 2012-2013 is presented on Table 1. The information collected a total of 50 species belonging to 28 families useful as bee forage to honey bee. Information of flowering period and habitat is given. The bee forage plants includes 40% tree species, 32% shrub, 20% herbs and 8% climbers the most attractive species for honeybees in the present study were trees and shrubs which frequently grow on each of the two site (Figure 1). The pollen morphology varies among different plant species occur in varying in shapes, forms and in symmetry. The families with the largest number of pollen types were: Myrtaceae (5), Compositae, Malvaceae, Euphorbiaceae and Cucurbitaceae (4), Leguminosae (3), Rubiaceae, Lythraceae, Combretaceae and Fabaceae (2) and other 18 families were represented by single pollen type. A surveyed based on pollen analysis of honey samples from *Apis cerana* showed that Myrtaceae family was among the most important families for these bees. The increase number of flowers during March to June enhance the bee to collect more pollen during this period whereas low pollen percentage was found in the month of November to February (Figure 2), which is characterized by low plant flower density [3].

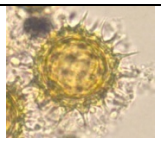
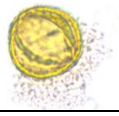
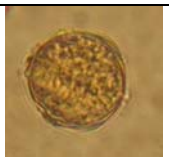
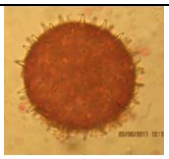
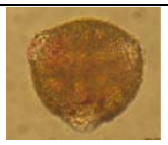
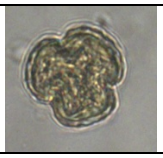
There is a need to understand honeybee plant relationship to study food preferences of honeybees and pollination. A success of beekeeping in different areas depends mainly on the availability of the food source from suitable flowering plants [4].

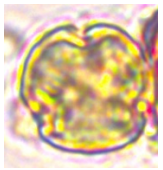
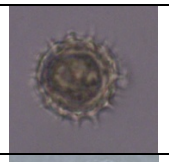
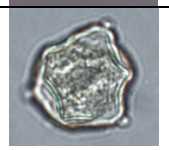
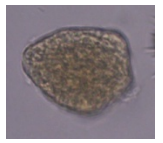
Table 1: Bee forage plants from Aizawl and Champhai with pollen morphology

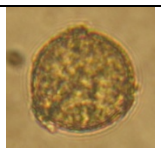
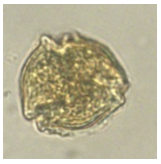
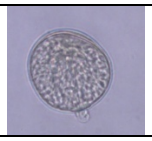
S.No	Scientific Name	Local Name	Family	Habitat	Flowering period	Pollen type	Pollen Morphology
1.	*Ageratum conyzoides* Roxb.	Vaihlenhlo	Compositae	Herb	May-Aug		Spinulous, prolate, echinate, radial symmetry
2.	*Althaea rosea* L.	Anthur	Malvaceae	Shrub	Jan-Dec		Monocolpate, polyporate,
3.	*Anthurium andreanum* Lindedn ex Andre	Anthurium	Malvaceae	Herb	Jan-Dec		Oblate, colpate, prolate, oralolongate, brevicolpi, bilateral symmetry
4.	*Antigonon leptopus*	Parsennote	Polygonaceae	Shrub	Jan-Dec		Striated surface, exine reticulate, oblate shape, bilateral symmetry

5.	*Amaranthus sps.* L.	Zamzo	Amaranthaceae	Shrub	August		Sherical shape with polypantoporate
6.	*Averrhoa carambola* L.	Theiherawt	Oxalidaceae	Tree	June		Trizonocolpate, subprolate reticulate
7.	*Bauhinia variegate* L.	Nauban	Leguminosae	Climber	Feb-May		Tri-periporate prolate-spheroid, reticulate ora-lolongate, bilateral symmetry
8.	*Bidens tripertite* L.	Chabet	Compositae	Herb	June-July		Tricolporate with echinate ornament,
9.	*Bombax malabaricum* L.	Phunchawng	Bombacaceae	Tree	Jan-March		Colporate, prolate, per-oblate, bilateral symmetry
10.	*Callistemon lanceolatus* Sweet.	Bottle Brush	Myrtaceae	Tree	Feb-June		Colporate, prolate, oblate-spheroid, obscure pattern, bilateral symmetry
11.	*Carica papaya* L.	Thingfanghma	Caricaceae	Shrub	July-August		Tricolporate, finely reticulate
12.	*Cassia javanica* Roxb.	Makpazangkang	Fabaceae	Shrub	March-Sept		Isopolar, syncolpate,prolate sheroidal, radial symmetry
13.	*Caesalpinia pulcherrima* L.	Aprilte	Fabaceae	Tree	March-July		Isopolar, sy ncolpate, 3- colporate, colpi broad and granula membrane, radial symmetry
14.	*Citrus limon* (L.) Burm.f.	Limbu	Rutaceae	Tree	March-May		Radiosymmetric and isopolar,
15.	*Cocos nucifera* L.	Coconut	Arecaceae	Tree	Jan-Dec		1-colpate, elongate in shape, monad, reticulate, bilateral symmetry

16.	*Coffee arabica* L.	Coffee	Rubiaceae	Shrub	September		3-colporate, oblate, exine forming a ring, bilateral symmetry
17.	*Coriandrum sativum* L.	Dhania	Apiaceae	Herb	June-Aug		3-Colporate, prolate, perprolate, bilateral symmetry
18.	*Croton jaufra* Roxb.	Valthi	Euphorbiaceae	Tree	Feb-March		Inaperturate, retipilate, radial symmetry, clavateexine
19.	*Cucumis sativas* L.	Fanghma	Cucurbitaceae	Climber	Jan-Dec		3-zoniporate, subprolate, pores circular tenuimarginate
20.	*Cucurbita pepo L.*	Mai	Cucurbitaceae	Climber	May-June		Porate, exine is reticulate, or retipilate, 8-10 radial symmetry
21.	*Cyperus rotundus* L.	Nubengchah	Cyperaceae	Herb	Aug-Feb		Aperture indistinct, pear shaped,3-4 aperturoid areas, bilateral symmetry
22.	*Elaeocarpus lanceifolius* Roxb.	Kharuan	Elaeocarpaceae	Tree	May-June		3-colporate, prolate to prolate spheroid exine obscure, bilateral symmetry
23.	*Euphorbia pulcherrima* Willd.	X'mas par	Euphorbiaceae	Shrub	Dec-Feb		3-colporate, sheroid shape, furrow indistinct, reticulate, bilateral symmetry
24.	*Eucalyptus tereticornis* Smith	Nawalh thing	Myrtaceae	Tree	Jan-March		Colporate, prolate, oblate-sheroid, obscure pattern, parasyncoplate, bilateral symmetry
25.	*Hibiscus rosa sinensis* L.	Midum pangpar	Malvaceae	Shrub	Jan-Dec		Pantaprolate, pores echinate, radial symmetry
26.	*Holmskioldia sanguine* Retz.	Sarawnte	Verbenaceae	Shrub	Sept-Oct		3-colpate, oblate-sheroid shape, spilate surface, furrows are complex with 2 psedocolpi bilateral symmetry

27.	*Ipomea batatas* (L.)Lam.	Kawlbahra	Cucurbitaceae	Herb	Nov-Feb		Pantoporate, pores 70-75, echinate, radial symmetry
28.	*Ixora Coccinea* L.	Mualhawihte	Rubiaceae	Tree	April		Colpate-prolate, oralalongate, radial symmetry
29.	*Jatropha curcus* L.	Kangdamdawi	Euphorbiaceae	Tree	March-April		Inaperturate, reticulate, gemmate exine,crotonoid pattern surface, radial symmetry
30.	*Lagerstromia speciosa* (L.) Pers.	Thlado	Lythraceae	Tree	April-June		Prolate punctitegillate ora circular
31.	*Malvaviscus arboreus* Cav.	Palthing	Malvaceae	Shrub	May-August		Pantoporate, echinate, sheriod, radial symmetry
32.	*Mangifera indica* L.	Theihai	Anacardaceae	Tree	March-April		Colporate, psilateexine, radial symmetry
33.	*Mimosa pudica* L.	Hlonuar	Leguminosae	Herb	April-May		Tetrad. Tetragonal, psilate, radial symmetry
34.	*Momordica charantia* L.	Changkha	Cucurbitaceae	Climber	June-August		3-zonicolporate, prolate, tenuimarginate, columella very faint
35.	*Moringa oleifera* Lam.	Thingbehlawi	Moringaceae	Tree	Jan-May		Ptychotreme, psilateexine, oncus, periporate, radial symmetry
36.	*Psidium guajava* L.	Kawlthei	Myrtaceae	Tree	April-Oct		Triangular spore wall, smooth, prolate, oblate-spheroid, oralalongate, bilateral symmetry

37.	*Punica granatum* L.	Pomegranate	Lythraceae	Shrub	May-June		Colpate, oblate, radial symmetry
38.	*Raphanus sativas* L.	Mula	Brassicaceae	Herb	March-April		Prolate-sheroidal, 3-zonocolpate, granulate exine
39.	*Ricinus communis* L.	Mutih	Euphorbiaceae	Shrub	Jan-March		3-Colporate, prolate-sheroidal, finely reticulate, bilateral symmetry
40.	*Rosa macrophylla* Lindl.	Rose	Rosaceae	Shrub	Jan-Dec		3-colporate, sherical shapeor prolate, sheroid, exine is intectate, surface psilate, bilateral symmetry
41.	*Spilenthes acmella* L.	Ankasa	Compositae	Herb	June-October		Porate,sheroidal shape,radial symmetry
42.	*Solanum melongena* L.	Bawkbawn	Solanaceae	Shrub	June		Prolate, sub- spheroid, punctitegillate, furrow long
43.	*Syzgium cumini* (L.) Skeel	Lenhmui	Myrtaceae	Tree	March-May		Sub triangular spore wall, smooth, psilateexine, colporate, prolate, oblate spheroid, obscure pattern,parasyncoplate, bilateral symmetry
44.	*Syzygium jambos* L. Alston	Rose apple	Myrtaceae	Tree	March-April		Sub triangular spore wall, smooth, psilateexine, colporate, prolate, oblate- spheroid, obscure pattern, parasyncoplate, bilateral symmetry
45.	*Tagetes erecta* L.	Derhken	Compositae	Herb	Jan-Dec		Pantoporate, spinolous exine, radial symmetry

46.	*Tamarindus indica* L.	Tengtere	Leguminosae	Tree	June		3-colporate, syncolpate, colpi long, isopolar,radially symmetry
47.	*Tecoma stans* L.Juss.ex *Terminalia cr*Kunth.	Tawtawrawtpareng	Bignoniaceae	Shrub	Jan-Dec		Tri-zonocolpate, bilateral symmetry
48.	*Terminalia crenulata* Roth.	Tualram	Combretaceae	Tree	Oct-Nov		3-colporate, prolate, sheroid shape, radial symmetry
49.	*Terminalia bellirica* (Gaertn.) Roxb.	Thingvankawk	Combretaceae	Tree	Nov-Feb		3-colporate, prolate, sheroid shape, radial symmetry
50.	*Zea mays* L.	Vaimim	Poaceae	Shrub	July		1-porate, spherical shape, radial symmetry

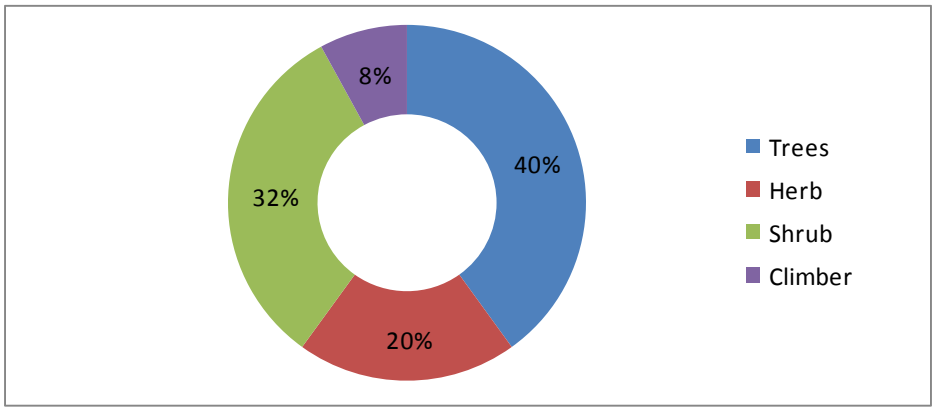


Figure 1: Habitat of foraging plants.

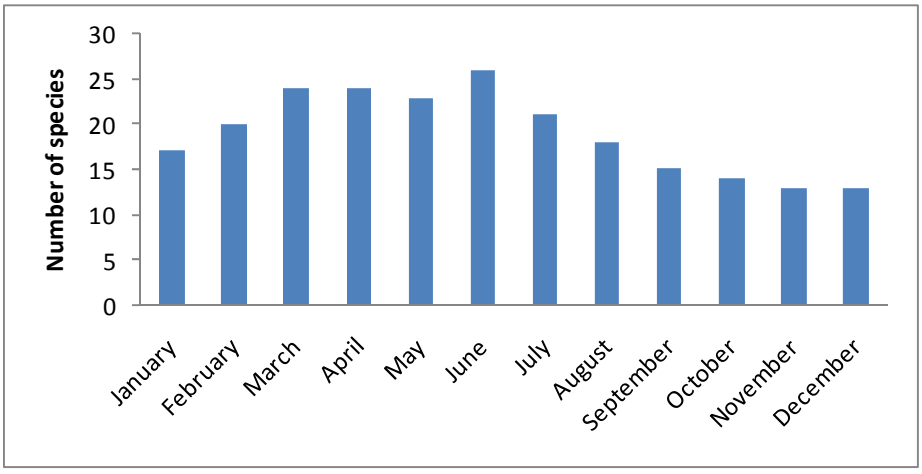


Figure 2: Flowering month of foraging plants.

CONCLUSION

Identification of bee flora helps in providing and improved the efficiency of bee keeping industry and honey production. This study helps beekeepers to formulate bee management for migrating of bee colonies to different floral sources. These studies will be helpful for identifying different floral sources used by honey bees and improved the conservation of economically viable plants. The study of pollen morphology is helpful to identify various species in different families. The present information can help in establishing an apicultural calendar for the region [2]

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