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Impact of Urbanisation, Deforestation and Foraging Pattern of Honey bees

KEYWORDS: *Melissopalynology, Apiculture, Uttar Pradesh, India*

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ABSTRACT *A specific group of plants are foraged by honey bees and the honey produced is known to have related specific characteristics in clinical perspective. A palynological review of plants used by honeybees in wild conditions and a case study from eight sites in the Gangetic Plain (agricultural expanse and urbanisation) of Uttar Pradesh (U.P) forms the basis of this paper. Total 55 pollen taxa were recorded in 8 sites from the southwestern, central and eastern regions of U.P. Indigenous taxa such as Syzyzium cuminii, Feronia lemonica, Aegle marmelos, Murraya koenighii etc. foraged by honey bees have now been recorded as secondary nectar contributors. The dominant primary taxa now foraged by honeybees are Ageratum conyzoides, Prosopis spicigera, P. Juliflora and Eucalyptus globules in the fast changing modern landscape weather rural or urban area.*

Introduction

The presence or absence of pollen in honey enables us to testify the veracity, its geographical provenance and the season of nectar flux (Freitas and Silva, 2006). Further, the relative abundance of different pollen types also helps in getting acquainted with the plant species acting as the prominent plant sources for nectar as well as awakening the local people with regard to the conservation of plant resources. During the last two decades, melissopalynological studies from different parts of India (Jhansi et al. 1994; Ramakrishna and Swathi, 2013; Chauhan and Murthy, 2011; Attri, 2010; Chauhan and Trivedi, 2011) One of the largest states (U.P) of the country has high floral diversity amidst the agricultural expanse and urban areas. The utility of mellissopalynological studies in Apiary industry in clinical perspective has yet not gained due attention. In the present study we endeavour to bring about information of the nature of honey from distinct landscapes of U.P. in order to understand the changing preferences of honeybees induced by alteration in the local flora in modern landscape. The study provides useful information related to allergenic sensitivity of honey to consumers.

Material and method

Eight honey samples (Figure 1) from Jhansi, Girar (southwestern region), Bahraich, Trilokpur (eastern region), Mallawan, Malihabad, Ashakhera and New Hyderabad (central region) in Uttar Pradesh (U.P), were collected for the study of pollen. The study area is humid sub-tropical dominated by southwest monsoon. The average minimum and maximum temperature is 7.6 ºC and 32.5 ºC, respectively and the average annual rainfall is 100-60 cm. Most of the plant species flower between February to April (Figure 3).

Ten gram honey samples were homogenized in deionized water and sieved through 150 mesh. The filtrate was acetolyzed (Erdtman, 1943). The pollen were examined and photographed under Olympus Microscope (BX50). Based on pollen frequency, four classes were recognized (ICBB, 1970; Louveaux et al. 1978). These are 1) Predominant Pollen - PP (>45%); 2) Secondary Pollen - SP (16-45%); 3) Important Minor Pollen - IMP (3-15%) and 4) Minor Pollen - MP (<3%). The diversity of pollen and the class/type of honey from different localities are illustrated in Table 1. The type of honey as monofloral, bifloral and multifloral constituting >45%, (pollen of single species), 22.25% (two species) and <16% (> three species), respectively have been inferred following (Wingenroth, 2001).

The pollen count per slide was about >2000. Only entemophilous pollen was included in the pollen sum and relative percentages were calculated. The anemophilous plants such as *Holoptelea integrifolia*, *Solanum* sp., *Cannabis sativa*, *Amaranthus spinosus, Chenopodium album,* Poaceae and Cyperaceae were excluded from the pollen sum. The statistical dendrogram of pollen data is illustrated in Figure 2. The flowering calendar of the recovered taxa is given in Figure 3. The pollen grains recovered from honey samples are shown in Figure 4.

Results

In the south-western region of U.P the honey analysis from Jhansi shows about 14 trees (79.8%), 7 herbs (15.9%) and 4 shrubs (4.17%). The honey is multifloral type (Table-1). The assemblage of pollen in honey from Girar comprised 4 trees (65.5%) and 7 herbs (34.5%). Since *Syzigium cuminii* contributes about 49.7% of pollen, the honey produced in this area is monofloral. The eastern region is dominated by agricultural land and the plants adapted by honeybees for foraging are restricted to mainly exotic noxious weed i.e., *Ageratum conyzoides* (35.9%) and crop *Brassica campestris* (17.5%) with low percentage of exotic *Eucalyptus globulus* (3.45%). Among the Indigenous plants only *Syzygium cuminii* (25.3%) shows high percentage which is common in arboriculture. In this region, the pollen assemblage in honey from Trilokpur belong to Indigenous taxa usually planted in arboriculture. However, high percentage of *Prosopis* pollen in this area in honey is due to its extensive commercial plantation for land reclamation. Thus, the honeys produced in eastern U.P. are multifloral type. The four sites in the central region of U.P also show multifloral type of honey. The dominant pollen contributor taxa is *Ageratum conyzoides* (20-46%) attributed to large expanse of arable land and wastelands in rural areas such as Ashakhera, Malihabad and Mallawan. High percentage of *Prosopis* species (7- 40%) and other indigenous taxa in urban areas such as New Hyderabad are related to either plantation of exotic trees or few pockets of natural vegetation in the conserved areas in

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the vicinity.

Discussion and Conclusions

In India, about 0.3 million beekeepers produce ~60,000 tons (55% from domesticated and 45% from wild) of honey, earning ~ Rs. 3000 million (Sivaram and Anita, 2000). The diverse flora of India, due to varied climatic conditions in different parts of India, is a boon for honeybees but the present day several constraints in beekeeping along with unforeseen shift in climatic conditions is bringing about changes in the natural vegetation accompanied by the introduction of exotic plants. Among the indigenous plants, the PP and SP contributors are *Feronia lemonia* and *Syzygium cumini* but in the absence of these in rural/urban areas, the honeybees have to depend on a variety of plants in their vicinity. As a result most of the studied honey is multifloral type. Clinically, many people are sensitive to pollen of *Prosopis* spp. which is SP contributor in honey. It is widely available for foraging as it is grown for greening of deserts and reclamation of wastelands. In UAE, about 45% of patients were tested sensitive to proteins present in the pollen of *Prosopis* spp. (Ezeamuzie et al. 2000; Killian et al. 2004). The pollen of *Ageratum conyzoides* is also known to be a common weed allergen and may cause asthma/rhinitis (Pendakur and Ramdas, 2012). The statistical analysis shows the highest frequency of exotic weed *Ageratum conyzoides* indicating its potential in apiculture but could be of less use for those who are allergic to its pollen protein. The exotic trees used for foraging by honeybees are *Prosopis* and *Eucalyptus* species which also have potential allergenic properties. The indigenous taxa foraged are *Syzygium cumini*, *Feronia lemonia*, *Ziziphus* sp., etc. including cultivated crop *Brassica campestris* associated weeds like *Pimpinella tomentosa*, *Xanthium strumarium* etc. Scarcity in number of preferred plant species in an area forces honey bees to forage variety of about 49 other plant species. As a result, most of the honeys produced in U.P are multifloral type dominated by nectar of exotic plant species having allergenic properties.

The melissopalynological records from different parts of India exhibit the pollen of dominant vegetation acclimatized to local climatic conditions. The honey produced in temperate region of Himachal Pradesh is multifloral and monofloral (Attri, 2010). Similarly, the studies from Andhra Pradesh reveal both monofloral and multifloral type (Ramakrishna and Swathi, 2013) with predominance of *Ageratum*, *Prosopis julifera* and *Eucalyptus*. In the peninsular part of India the honeys are monofloral with *Cocos nucifera* (47%) and *Coffea arabica* (64%) pollen in high percentage (Bhargava et al. 2009). Further, there is an utmost need to use melissopalynological studies in order to patent plant specific honey for better commercial use. The study substantially creates awareness among the people about common plant species serving as the nectar source for honey as well as the necessary precautionary measures required for their conservation and propagation in their respective natural habitats.

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Table 1. Type of honeys based on the class of pollen types (ICBB. 1978) from Uttar Pradesh.

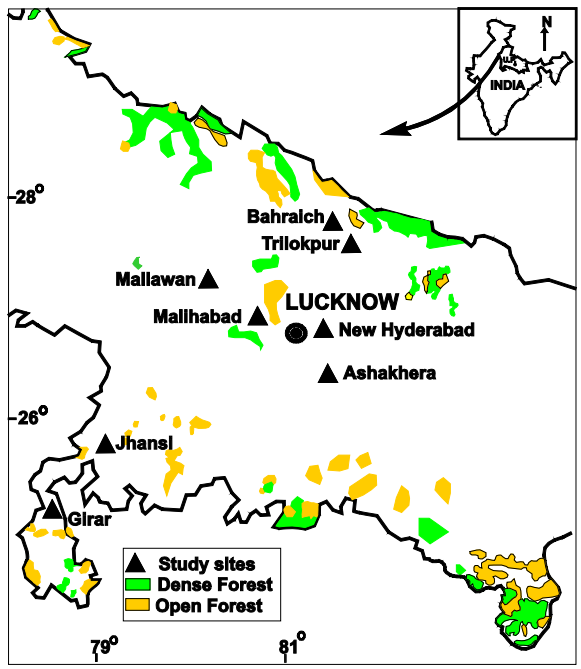

Figure 1

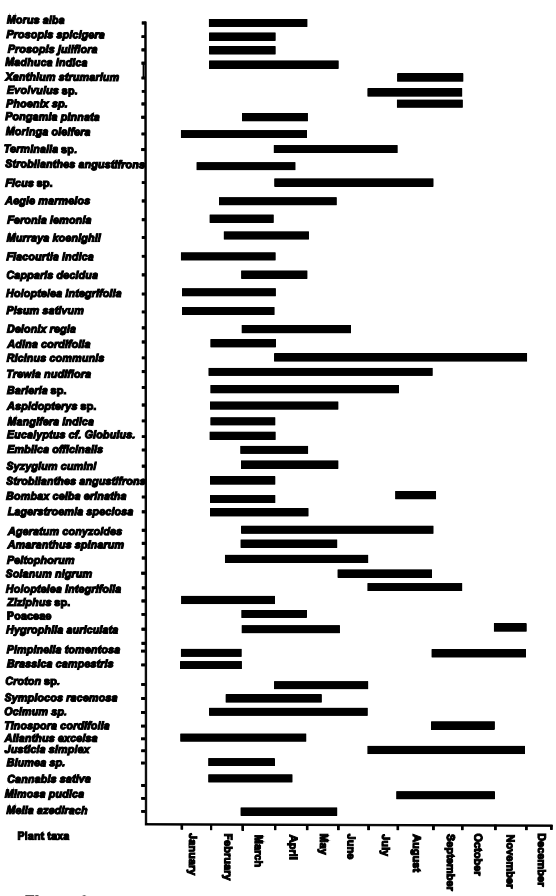

Figure 2

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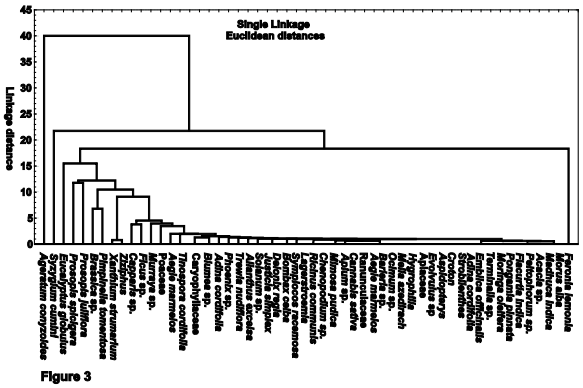
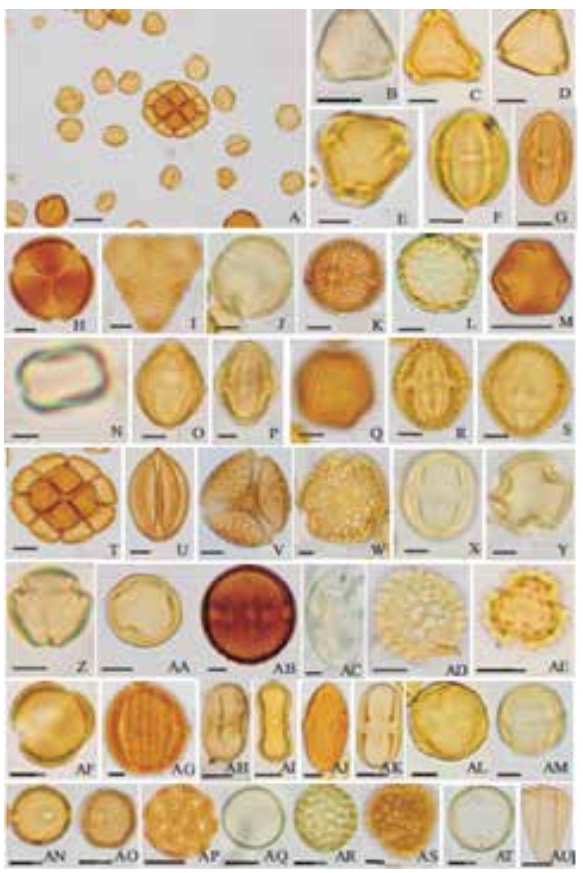


Figure 3



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Localities/ Honey Type	Class of Pollen based on frequency			
	Predominant Pollen (PP) (>45%	Secondary Pollen (SP) (16-45%)	Important minor pollen (3-15%)	Minor pollen types (< 3%)
Jhansi / (Multifloral)		Feronia lemonia	Capparis, Ageratum conyzoides, Ficus, Murraya koenghii	Bombax ceiba, Brassica campestris, Delonix regia, Aegle marmelos Symplocos racemosa , Mangifera indica, Adina cordifolia ,Trewia nudiflora, Syzygium cumini , Strobilanthes angustifrons , Croton, Hygrophila auriculata, Peltophorum, Lagerstroemia, speciosa , Aspidopterys, Barleria, Evuolvulus, Apiaceae, Emblica officinalis, Cucurbitaceae.
Pollen %		33.17	40.61	26.16
Girar / Monofloral	Syzygium cumini	Brassica campestris	Eucalyptus globulus, A.conyzoides	Pimpinella, Tomentosa , Xanthium strumarium , Solanum, Capparis
Pollen %	49.7	23.37	17.3	9.66
Bahraich/ Multifloral		A.conyzoides S. cumini, B. campestris	Pimpinella tomentosa , Eucalyptus globulus	Aegle marmelos , Solanum., Ziziphus, Apium, Ficus, Feronia lemonia , Pisum sativum, Ricinus communis
Pollen %		72.7	20.91	6.39
Trilokpur/ Multifloral		Syzygium cumini, rosopis spicigera , P. Juliflora, M. oleifera	Acacia sp.	Holoptelea integrifolia, Madhuca indica, Ziziphus , Tinospora cordifolia, Cannabis sativa, Eucalyptus globulus , Bombax ceiba Terminalia , Alianthus excelsa
Pollen %		91.27	4.38	5.1
New Hyderabad/ Multifloral		Prosopis spicigera	S. cumini, A. conyzoides, B.ceiba , Ailanthus excelsa , T. cordifolia , Moringa oleifera , Eucalyptus globules, Aegle marmelos	Brassica campestris, Pongamia pinnata, Melia azedarach
Pollen %		16.5	75.46	7.38
Ashakhera/ Bifloral		Ageratum conyzoides, Prosopis spicigera	Prosopis juliflora, Syzygium cumini, Eucalyptus globulus	Tinospora cordifolia , Brassica Campestris, Pimpinella tomentosa, Solanum nigrum,Terminalia, Ricinus communis, Pongamia pinnata , Ailanthus excelsa
Pollen %		52.6	33.1	14.3
Malihabad/ Multifloral		Ageratum conyzoides	Syzygium cumini Eucalyptus globulus	Aegle marmelos, Feronia lemonia, Apium, Ziziphus, Pimpinella tomentosa Solanum sp. Brasssica campestris, Embelica officinalis
Pollen %		46.5	32.8	20.7
Mallawan/ Multifloral		Ageratum conyzoides, Xanthium strumarium, Ziziphus	Syzygium cumini	Phoenix, Pimpinella tomentosa, Peltophorum, Emblica officinalis, Justicia simplex, Mimosa pudica, Eucalyptus globulus , Solanum, Tinospora , cordifolia, Flacurtia indica Acacia nilotica, Blumea, , Brassica campestris
Pollen %		53.3	9.5	37.2

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