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RESEARCH ARTICLE

WINTER POLLEN OF THE ROCK BEE, APIS DORSATA, FROM MUL TAHSIL, CHANDRAPUR DISTRICT, MAHARASHTRA STATE, INDIA

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ABSTRACT

Background- Honey bees gather pollen and nectar from various plants. The nectar and pollen provide glucose and proteins essential for the development of honey bee body tissues. Analyzing the pollen collected reveals how faithfully the bees stick to specific plant species within a given floral community, which is why this study seeks to identify both the primary and secondary pollen sources for the Apis dorsata bee. **Methods:** Pollen loads were recovered directly from the sources in the specified area. The pollen grains of each pollen load were dispersed in 1 ml of glacial acetic acid and later on, subjected to acetolysis. Erdtman (1960) one slide was prepared for each pollen load and microscopically examined. **Results: 70** pollen loads recovered directly from the honeycombs of *Apis dorsata* (Rock Bee) collected from February 2012 from Rajoili and Dongargao, Mul Tahsil of Chandrapur District of Maharashtra State, were analysed. 07 (10%) pollen loads were found to be Uniforal, 10 (14.28 %) bifloral and 53 (75.71%) multifloral. The Unifloral pollen loads contained 37 of *Cajanus cajan*, 11 of *Capsicum annum*, 31 of *Hyptis suaveolens* and 49 *Prosopis juliflora* and 32 of *Tridax procumbens*. The pollen of *Prosopis juliflora* was recovered from 49 (70%) of the total pollen loads studied. **Conclusion**: The study highlights *Prosopis juliflora* do the major pollen source and *Cajanus cajan* (Papillionaceae), *Lathyrus sativus* (Papillionaceae), *Tridax procumbens* (Asteraceae), *Hyptis suaveolens* (Laminaceae), *Prosopis juliflora* (Mimosaceae), *Blumea* sp. (Asteraceae), *Capparis grandis* (Capparidaceae), *Bidens Pilosa* (Asteraceae) as fairly important sources of pollen of the honeybees during the winter period.

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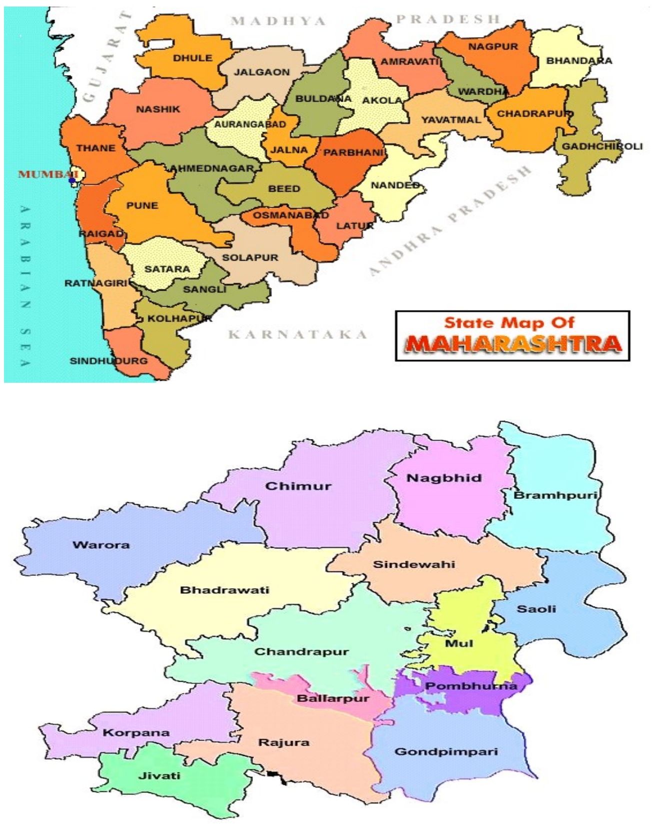
INTRODUCTION

Honey bees visit plants for nectar and pollen. Nectar consists predominantly of sources often associated with a limited quantity of glucose and pollen grains provide the chief source of protein requirement of the bees essential for building their body tissues. (Rahman Khan 1941) particularly during early embryonic growth, bees prefer the nectar of a plant species that has the maximum sugar concentration. (Ramanujam 1991) Similarly, they prefer the pollen type with the maximum nutritive values and palatability. Melittopalynological investigation involving honey samples and pollen loads furnish reliable information on the relative preferences of the honey bees among the floral sources available within their foraging ranges. (Ramanujam 1994) Analysis of pollen load unravels the floral fidelity of fixity of the bees to a particular plant species in any floristic community, by highlighting the numerical status of the pollen type in the individual loads. The quantification of the data would help us to recognize the major and minor sources of pollen in any particular area. (Chaudhari 1978).

Studies involving the analysis of pollen loads are few when compared to those of kinds of honey, in the Indian context. Sharma (1970 A and 1970 b, 1972) and Chaturvedi (1973) studied the pollen loads of *Apis cerena*, the Indian hive bee, from Kangra in Himachal Pradesh and Banthara in the vicinity of Lucknow. Seethalakshmi and Perey (1980) recognized Borassus flabellifer as a good pollen source in Tamilnadu by analysing 900 pollen loads of *Apis cerena* at Vijayarai in West Godawari District of Andra Pradesh and recognized potential of this region for apiculture Kalpana, Khatija and Ramanujam (1990) and Ramanujam and Kalpana (1990) provided information on the pollen sources of *Apis florea*_and *Apis cerena* honey bees in Hydrabad and Ranga Reddy District. Recently Borkar Laxmikant and Mate Devendra (2014) provided information on the pollen source of *Apis dorsata* Honeybees in the Bramhapuri forest area of Chandrapur District of Maharashtra state and Cherian *et al.* (2011) provided information on the pollen sources of *Apis_cerena* honeybees in Nagpur District of Maharashtra. Bee pollen consists of a wide range of secondary plant metabolites, free radicals compounds (polyphenol and flavonoid) and enzymes.

These secondary metabolites include niacin, tocopherol, thiamine, polyphenols, and phytosterols (Denisow B., *et al*. 2016). It is an excellent source of free radicals such as polyphenol and flavonoid compounds (rutin, quercitrin, isoquercitrin, naringenin, kaempferol, and luteolin) (Duan H., *et al*. 2021). The flavonoids present in bee pollen exhibit various activities, including antiviral, antibacterial, antioxidative, anti-ageing, anti-inflammatory, anti-tumour, and analgesic effects, making them key bioactive components and crucial indicators of the pollen's quality (Saisavoey, T et. al 2024). The composition of these substances in bee pollen is significantly influenced by factors such as soil type, weather conditions, and the specific race of bees, which vary according to the plant and geographical origins (Araujo J.S. *et al* 2017, Ksotic A.Z. *et al.* 2017, Mayda N. *et al* 2020). Enzymes like glucose oxidase, phenolic acids and flavonoids, the composition of pollen itself, fatty acids and microbial metabolites in the pollen exert antibacterial effects have been reported in different studies (Campos M *et al* 2008, Erkmen O *et al* 2008, Freire KRL *et al* 2012, Velasquez P *et al* 2017). This study aims to recognize the major and minor sources of pollen to *Apis dorsata* bee in these area during the winter period based on qualitative and quantitative analysis of numerous pollen loads recovered directly from various honeycombs.



Map Showing Mul Tahsil of Sindewahi district from where the pollen loads were collected

MATERIAL AND METHODS

Pollen loads (Comb loads) 70 in number of *Apis dorsata* were obtained from 2 Honeycombs collected from February 2012 from Rajoli and Dongargao are of Mul Tehsil of Chandrapur District of Maharashtra State. (CHN-MUL-RAJ), (CHN-MUL-DON). The pollen grains of each pollen load were dispersed in 1 ml of glacial acetic acid and later on, subjected to acetolysis. Erdtman (1960) one slide was prepared for each pollen load and microscopically examined. All such pollen loads consisting of a single pollen type represent unifloral loads, with two pollen types bifloral and with more than two, multifloral Sharma, (1970 a). Identification of the pollen types was based on the reference palynoslides of the forest flora and the relevant literature. The pollen productivity of the significant taxa was computed using a haemocytometer.

RESULTS

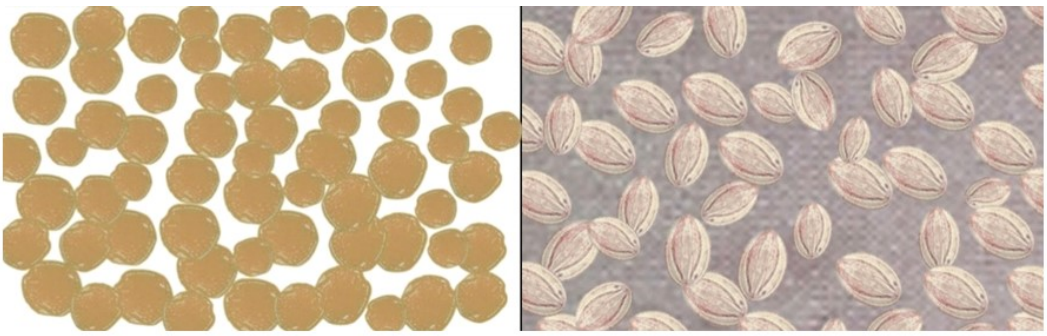
The analysis has brought to light that 07 (10 %) loads were unifloral, 10 (14.28 %) were bifloral and the remaining 53 (75.71%) loads multifloral (Table 2). The pollen grain of 18 taxa referable to 11 families were recorded. These are *Prosopis juliflora* (Mimosaceae), *Cajanus cajan* (Papillionaceae), *Capsicum annum* (Solanaceae), *Lathyrus sativus* (Papillionaceae), *Tridax procumbens* (Asteraceae), *Hyptis suaveolens* (Laminaceae), *Blumea* sp. (Asteraceae), *Capparis grandis* (Capparidaceae) of these *Blumea* sp., *Tridax procumbens, Hyptis suaveolens* are herbaceous weeds which represent the undergrowth, the remaining taxa are either crop plants and arborescent member or shrub of the forest range. The unifloral pollen loads include 07 unifloral loads. 5 contain *Prosopis juliflora*, 2 of *Hyptis suaveolens* (Fig.1) and bifloral 10 (32.12 %) conatain *Prosopis juliflora* and *Cajanus cajan, Lathysrus sativus, Capsicum annum, Hyptis suaveolens, Bidens Pilosa, Tridax procumbens,Capparis grandis, Celosia argentia*, *Blumea* sp in combination. The multifloral loads which are encountered showed the pollen types of *Capsicum annum, Cajanus cajan, Lathysrus sativus, , Lathysrus sativus , Prosopis juliflora, Blumea sp, Capparis grandis, Bidens Pilosa, Psidium guajava, Celosia argentia, Mimosa* sp. And *Coriandrum sativum* (Fig. 2). When the representation (Irrespective of percentage) of the various pollen types in the total number of pollen loads studied was considered & the percentages of pollen types recorded in each bifloral and multifloral load were determined by counting 200 pollen grains at random, (Sharma 1970a) pollen of *Capsicum annum* were noted in as many 96 loads (63.57%) followed by *Cajanus cajan* in 78 loads (51.65%), *Lathysrus sativus* 74 (49%), *Tridax procumbens* 50 (33.11%), *Hyptis suaveolens* 42(27.81%).

DISCUSSION

The analysis showed that the pollen loads obtained from the beehives of *Apis dorsata* in the Rajoli, Dongargao, Mul Tehsil of Chandrapur District of Maharashtra State, originated predominantly from some of the characteristics crop plants Viz. *Capsicum annum, Cajanus cajan, Lathyrus sativus, Coriandrum sativum*. Arborescent and shrubby plants of this area. Viz., *Prosopis juliflora*, *Mimosa* sp., *Capparis grandis, Psidium guajava.* The contribution to herbaceous weeds such as *Celosia argentea, Hyptis suaveolens, Blumea sp., Tridax procumbens* as pollen sources to *Apis dorsata* bees is very meagre. The quantification of the data reveals unequivocally the predominance of the pollen of *Prosopis juliflora* as evidenced by its very high representation of 70% % in the Unifloral loads and pollen of *Cajanus cajan* 52.85% in the totality of the pollen loads material studied. It can therefore be concluded that crop plants *Cajanus cajan, capsicum annum, Lathyrus sativus* constitutes the major source of pollen to the honey bees during the winter period.

Table 1. Pollen morphological characters of the Taxa recorded

S.N.	Pollen Type	Size, Shape & Symmetry	Aperture Pattern	Pollen Wall (sporoderm) structure & sculpture
Apiaceae				
1	***Coriandrum sativum*** Linn.	23-28 µm, Amb seenonly occasionally , rounded triangular; 35-28× 15-16 µm perprolate constricated of the equator, Radially symmetrical	Tricolporate, colpi long, narrow, ora lalongate to circular	Exine 1.5-2 µm thick at poles and 2.5 – 3.5 µm thick at equator, subtectate, surface finely reticulate
Papillionaceae				
2	***Cajanus cajan*** (Linn.) millsp.	35-37 µm Amb rounded triangular ; 32-34× 35-39 µm, oblate spheroidal; radially symmetrical	Tricolporate, colpi long, ends tapering, tips acute, ora circular	Exine 3.1 µm thick, sub tectate, surface reticulate, heterobrochate, meshes smaller near the apertural regions and larger elsewhere, lumina hexa to pentagonal, psilate, muri simplibaculate
3	***Lathyrus sativus*** Linn.	42 × 31.5 µm, prolate to perprolate , Radially symmetrical	Tricolporate, colpi long, ends tapering, ora circular to slightly lalongate	Exine 1.5 µm thick, subtectate, surface reticulate.
4	***Prosopis juliflora*** (Sw.) DC	36-39 µm, Amb rounded triangular; 38-42× 30-35 µm, prolate to subprolate; Radially symmetrical	Tricolllporate, occasionally syncolpate, colpi tapering towards poles, tips acute, ora lalongate	Exine 3.2 µm thick, tectate surface faintly reticulate
Solanaceae				
5	***Capsicum annuum*** Linn.	29-34 µm, Amb spheroidal; 29-35× 26-30 µm, subprolate; radially symmetrical	Tricolporate , colpi constricted at oral region, ends tapering, tips acute, ora prominently lalongate	Exine 1.5 µm thick, tectate, surface faintly granular to almost psilate
Lamiaceae				
6	***Hyptis suaveolens*** (Linn.) Poit.	35-39 µm, Amb spheroidal; 32-35× 36-39 µm, oblate spheroidal ; Radially symmetrical	Hexacolpate, colpi long, tips acute	Exine 2.5 µm thick, subtectate, surface reticulate (at places retipilate), reticulum homobrochate, lumina polygonal to circular with few free pila heads, muri simplibaculate.
Asteraceae				
7	***Tridax procumbens*** Linn.	31-38 µm, Amb rounded triangular to squarish; 30-35x 32-38 µm, oblate spheroidal; Radially symmetrical	Tri to tetra colporate, colpi linear, sharply tapering, ora faint, circular	Exine 5 µm (without spines) thick, tectate, surface echinate, spines 6 µm long, 2.5 µm in diam, at base
8	***Blumea*** sp.	21-24 µm, Amb spheroidal, isopolar, Radially symmetrical	21-24 µm, Amb spheroidal, isopolar, Radially	Exine 3 µm thick, surface echinate, spines 5-6 µm long, 4 spines in the inter apertural region interspinal area psilate
9	***Bidens pilosa*** Linn.	25-29 µm Amb spheroidal; 23-25× 27-30 µm, sub-oblate; Radially symmetrical	Tricolporate, colpi long, ends tapering, tips acute, ora lalongate	Exine 1.5 µm thick,tectate, surface echinate, spines 6.8 µm long, base 2µm broad
Amaranthaceae				
10	***Celosia argentea*** Linn	30-35 µm spheroidal radially symmetrical	Pantoporate, pore No. 15-20, circular. Diam; 4-5 µm, pore membrane flecked with granules, interpolar distance 8-11 µm	Exine 2 µm thick, tectate, interporal space coarsely granular
Capparidaceae				
11	***Capparis grandis*** Linn.	10-12 µm , Amb spheroidal; 14-16 ×9-12 µm prolate to subprolate; Radially symmetrical	Tricolporate, colpi linear to narrowly elliptic, ends tapering, tips acute, ora faint lalongate	Exine 1 µm thick, tectate, surface faintly granular to almost psilate
Myrtaceae				
12	***Psidium guajava*** Linn.	24-25 µm, Amb subtriangular; 13-16× 26-28 µm, oblate; Radially symmetrical	Tricolporate, syncolpate, parasyncolpate, ora lalongate	Exine 1.5 µm thick , tectate surface granular to pailate



Cajanus cajan ***Prosopis juliflora***

Fig. 1. Pollen types in unifloral Pollen Loads

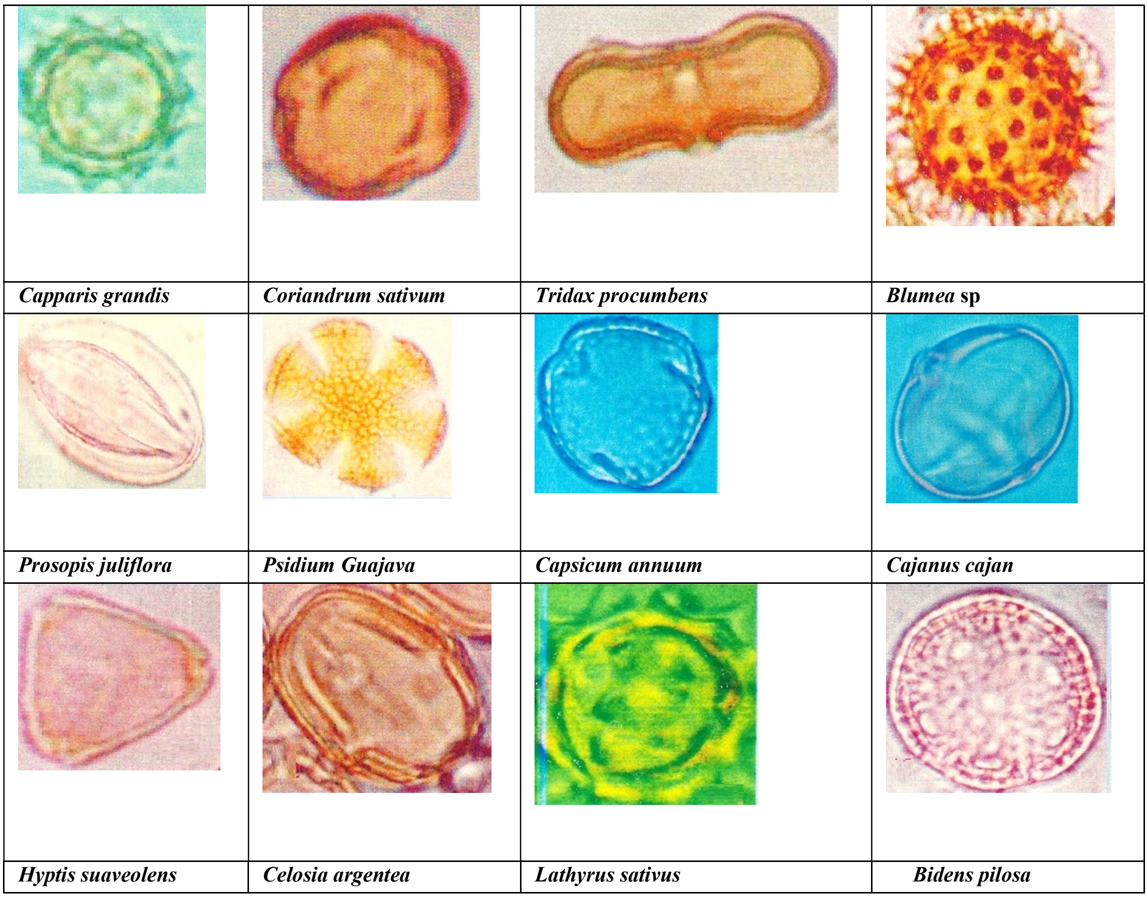


Fig. 2. Light Microscopic photograph of pollen grain in pollen loads

Mul Tahsil							
Comb No	Total Pollen Loads	Unifloral Loads		Bifloral Loads		Multifloral Loads	
		Number	Composition	Number	Composition	Number	Composition
CHN-MUL-RAJ	38	02	2 – Pr	05	2- Pr (23,48), Caj(52,77), 1-Tri(39), Pr(61), 1Leu(56), Pr(44), 1Pr(80), Ca(20)	31	9- Caj(3-39), Caps(3- 60), Lat(13-82) 7-Caps(2-54), Caj(3-51), Lat(7-35), Tri(7-41) 4- Caps(3-60), Ca(9-19), Hy(12-69), Tri(3-25) 1-Caj(4-47), Hy(10-43), Bi(38-36) 1-Caps(7-13), Hy(24-26), Bi(27,28), Cel(35,40) 1-Caj(58), Ps(27), Cel(4), Lat(11)
CHN-MUL-DON	32	05	3 - Pr 2– Hy	05	3-Pr (13,14), hy(86,87) 1-Pr(40,45),mi(55,60), 1Pr(13,15),Caj(85,87)	22	8-Caps(8-13), Hy(7-20), Lat(67-85) 6-Hy(4-20), Caps(6-7), Lat(7-65), Bl(17-51) 4-Lat(4,5), Bi(5,11), Caj(17,32), Bl(52,74) 2-Caj(3-15), Caps(8-10), Lat(8-61), Hy(16-76) 2-Caj(17-51), Lat(7-56), Bl(6-37), Ca(4-20) 1-Mi(5-66), Caps(6-17), Caj(23-78)
Total	70	07 (10%)		10 (14.28%)		53 (75.41%)	

The other fairly significant source of pollen to the honeybees of this area are *Tridax procumbens 50 (33.11%)*, *Hyptis suaveolens* 42 (27.81%), *Capparis grandis* 13 (8.60%), *Bidens pilosa* 12 (7.94%), *Psidium guajava* 8 (5.29%). All these taxa also constitute important pollen sources during the winter season for the honeybees of this area.

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