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## **Pollen analysis of squeezed summer honeys from Bhadrawati tahsil, Chandrapur district, (Maharashtra state)**

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**Abstract**--The paper incorporates a qualitative and quantitative analysis of pollen contents in five squeezed honey samples of *Apis dorsata* hives collected from forest area of Bhadrawati tahsil of Chandrapur district. *Terminalia* sp. represents the predominant pollen type in three samples ranged from (47.58 to 86.75%) are designate as Termanalia honey. The other significant pollen types recorded include *Terminalia* sp., *Astericanthalongifolia*, *Leucanaealeucocephala*, *Citrus* sp., *Blumea* sp., *Celosia argentea*, *Capsicum annumm*, *Allium cepa*, *Meliaazadirachta*, *Careayaarboarea*, *Delonixregia*, *Pongamiapinnata* and *Mangiferaindica*. The pollen counts ranged from 55000/g to 1265000/g. The data reflects the floral situation of the place were particular honey was produced and the identification of geographical origin based on the presence of a combination of pollen types of that particular area.

**Keywords**--pollen, honey, Apisdorsata, forest area, Bhadrawatitahsil.

## Introduction

Melittopalynology is an applied branch of palynology dealing with the study of pollen grains in honey samples and its application in Apiculture. Plant produces nectar and pollen both of which are avidly sought after by the bees to provide nutrition to the colony. Melittopalynology is concerned with the identification of pollen in honeys. Evaluation of plants for their utility as sources of bee forage provides the information needed to assess the potential for beekeeping in an area. Melittopalynological studies are thus helpful in bee management and in promoting the beekeeping development. Laboratory studies using Melittopalynological methods have been made to evaluate sources of pollen and nectar for honey bees in different parts of the country namely Maharashtra (BorkarLaxmikant et al., 2017,18 and MateDevendra,Bhusariet al., 2005; Phadke, 1962; Kumar and Jagtap, 1988), Andra Pradesh

(Ramanujam and Khatija, 1991, Kalpana and Ramanujam, 1991, Moses,1987, Karnataka (Yoganarasimhan, 1982; Agashe and Ranjaswami, 1997; Sheshagri, 1985; Bhargavaet al., 2009), Lucknow (Suryanarayana, 1976) and Indian honeys (Sen and Banarjee, 1956; Nair, 1964; Seethalakshmi, 1993). Present investigation incorporates a qualitative and quantitative pollen analysis of five honey sample from forest area of Bramhapuritaahsil of Chandrapur District. In order to identify the chief bee foraging plants recognize the uni and multifloral honeys and identify areas suitable for bee-keeping industry in this area. It is further investigated that a study of this nature would also highlight the geographical source of the honey samples.



Fig. 1: Map of Maharashtra Showing Chandrapur District & Bhadravati talahsil

## Materials and Methods

Five honey samples viz., CHN-BHA-MUD, CHN-BHA-KOL, CHN- BHA-KHA, CHN-BHA-BHAN and CHN-BHA-CHA were collected during the period 29 March 2012 to 31 May 2013 from Mudoli, Kolewada, Khawan, Bhandra and Chandankheda respectively. All the samples represent squeezed honey collected from the natural *Apis dorsata* hives (Map).

The squeezing (pressing) of the honey combs was carried out under personal supervision and only honey bearing portion of the comb was used for this purpose. 1 ml of the honey sample was dissolved in 10 ml of distilled water & centrifuged. The sediment obtained was treated with 5 ml glacial acetic acid. The acetic acid was decanted and the material was subjected to acetolysis (Erdtman, 1960) for analysing the pollen content in honeys qualitatively & quantitatively, three pollen slides were prepared for each sample. The recorded pollen types were identified with the help of reference slides collection & relevant literature for quantification of pollen types recorded, a total of 300 pollen grains were counted at random from the three palynoslides prepared for each samples. Based on their frequencies, the pollen types encountered were placed under the pollen frequency classes recommended by the international commission for bee Botany Louveaux *et al.* (1978) viz., predominant pollen type (>45%), secondary pollen type (16-45%), important minor pollen types (3- 15%), and minor pollen types (<3%). Non-melliferous (anemophilous) pollen types were excluded while determine the frequencies of melliferous pollen types (International Commission for Bee Botany Louveaux *et al.* ;1978). The absolute pollen counts of each sample was determined in accordance with the method recommended by Suryanarayana *et al.* (1981). Unacetolysed samples of honey were examined for the study of honeydew elements (fungal spores, hyphal threads and algal filaments).

### Results and Discussion

Of the 5 honey samples collected from Bhadrawatitahsil, *Terminalia sp.* ranged from (47.58% to 86.75%) represent the predominant pollen type in three sample (CHN-BHA-MUD, CHN-BHA-KHA, CHN-BHA-CHA). i.e. unifloral. While (CHN-BHA-KOL, CHN-BHA-BHAN) are multifloral. The other significant pollen types recorded includes secondary and upto minor pollen *Terminalia sp.*, *Asteracanthalongifolia*, *Leucanaealeucocephala*, *Citrus sp.*, *Blumea sp.*, *Celosia argentea*, *Capsicum annum*, *Allium cepa*, *Melia azadirachta*, *Careya arboarea*, *Delonix regia*, *Pongamia pinnata* and *Mangifera indica*.

Table 1 : Pollen frequency class & frequencies(%) in *Apis dorsata* summer Honey

Sample No.	Date of Collection	Type of Honey	Absolute pollen counts (APC) / g	HDE/P	Pollen Type
CHN-BHA-MUD	29-03-2012	Unifloral	264,000/g	0.02	P – <i>Terminalia sp.</i> (48.75) S - Nil I - <i>Sapindus emarginatus</i> (5.5) <i>Asteracanthalongifolia</i> (4.33) <i>Celosia argentea</i> (4.16) <i>Capsicum annum</i> , <i>Blumea sp.</i> (each 3.33) M – <i>Leu</i> , <i>Ma</i> (each 2.83), <i>Mel</i> (2.5), <i>Bo</i> (2.33), <i>Ru</i> (2.16), <i>Ci</i> (2), <i>De</i> , <i>All</i> (each 1.66), <i>Mi</i> (1.33), <i>Cu</i> (1), <i>Az</i> , <i>Car</i> , <i>Alb</i> , <i>Cle</i> (each 0.83), <i>Ps</i> (0.66), <i>Ab</i> (0.5) NMP – Nil

CHN-BHA- KOL	16-04-2012	Multifloral	163,000/g	0.01	P - Nil S - Terminalia sp.(48.75) I - Sapindusemarginatus(8.33) Blumea sp.(8) Capsicum annuum(4.33)
					Bombaxceiba(3) M - Leu(2.5), Ps,Mel, Eu, Car(each 2.33), Ast.l(2.5), Cel, Ci(each 2), All, Br(eah 1.66), De, Par(each 1.33), Gar(1.10), Sy, Cl, Ru(each 1), Po, Bi(each 0.83), Ec(0.5), Alb(0.33), Cu(0.16) NMP - Sorghum vulgare(9.91) Typhaangustata(0.16)
CHN-BHA- KHA	19-04-2012	Unifloral	1265,000/g	0.01	P - Terminalia sp.(47.58) S - Nil I - Sapindusemarginatus(9.66) Asteracanthalongifolia(5.33) Delonixregia, Leucaenaleucocephala(each 4.33) Citrus sp.(4.16) Blumea sp.(3.83) Bombaxceiba(3.16) M - Caps(2.5),Ma, Car(each 1.83),Cel,Pon, Ps(each 1.66), Pr(1.5), Ru, Ca(each 1.16), Az, All(each 0.66), Mi(0.5) NMP - Sorghum vulgare(10.14)
CHN-BHA-BHAN	27-04-2012	Multifloral	243,000/g	0.01	P - Nil S - Terminaliasp.(41.58) I - Blumea sp.(14.16) Capsicum annuum(5.66) Mangiferaindica, Allium cepa(each 4.83) Bombaxceiba(4.66) Pongamiapinnata, Asteracanthalongifolia(each 4.16) Delonixregia, MeliaAzadirachta(each 3.66) Careyaarborea(3) M -Az, Cl(each 0.5) NMP - Typhaangustata(4.14)
CHN-BHA- CHA	31-05-2013	Unifloral	264,000/g	0.02	P - Terminalia sp.(86.75) S - Nil I - Nil M -caps,Cu(each 2), De(1.83), Bo(1),Car, So(each 0.83), Pon, Cel,Ci(each 0.5), Po,Sy,Ru(each 0.33),Bl(0.16)

Table 2: Showing pollen morphology of Melliferous taxa

Sr. No.	Pollen types	Pollen Size, Shape and Symmetry	Aperture pattern	Pollen wall (Sporoderm) Structure and sculpture
1	<i>Abutilon indicum</i>	64-70 $\mu\text{m}$ , Amb spheroidal, isopolar, radially symmetrical	Tricolporate, Colpi length 8.2 (7.5-9) $\mu\text{m}$	Exine thick, 4.5 $\mu\text{m}$ , spinate (echinate) spines height 4.9 (4.6-6) $\mu\text{m}$ , columella of ectine $\pm$ fused, basal cushion sharply defined, cushion thickness 3.4 $\mu\text{m}$ , clear LO Pattern
2	<i>Albizialebeck</i>	16-celled polyad with central eight cells of two superimposed groups of 4 cells each and peripheral 8 cell (4+4+8 condition), spheroidal or biconvex disc, 72-74 $\mu\text{m}$ in diam., each cell of the polyad 17-19m in diam, Amb of individual cell squarish;radially symmetrical	Individual pollen triporate, pores faint	Exine 1.6 $\mu\text{m}$ thick, tectate, surface psilate to faintly granular
3	<i>Allium cepa</i>	14-28 $\times$ 32-48 $\mu\text{m}$ , ellipsoidal, Bilaterally symmetrical	Monosulcate, sulcus tenuimarginate	Exine 1.5 $\mu\text{m}$ thick, subtectate, surface faintly reticulate
4	<i>Asteracanthalongifolia</i> (Linn.) Nees.	56-59 $\mu\text{m}$ , Amb spheroidal or quadrangular; 50-55 $\times$ 52-59 $\mu\text{m}$ , oblate spheroidal; Radially symmetrical	Tetracolporate, colpi long, ends tapering, tips acute, colpi alternating with 4 streak like pseudocolpi, ora more or less circular.	Exine 3.3 $\mu\text{m}$ thick, subtectate, surface reticulate, homobrochate, lumina polygonal and psilate.
5	<i>Azadirachta indica</i>	50-54 $\mu\text{m}$ , Amb squarish, sides convex; 47-54 38-47 $\mu\text{m}$ , subprolate, poles smoothly rounded; Radially symmetrical	Tetracolporate, colpi long, ends tapering, tips acute, oral alongate	Exine 3 $\mu\text{m}$ thick, tectate, surface psilate to locally granular
6	<i>Bidens pilosa</i>	25-29 $\mu\text{m}$ Amb spheroidal; 23-25 $\times$ 27-30 $\mu\text{m}$ , sub-oblate; Radially symmetrical	Tricolporate, colpi long, ends tapering, tips acute, oral alongate	Exine 1.5 $\mu\text{m}$ thick, tectate, surface echinate, spines 6.8 $\mu\text{m}$ long, base 2 $\mu\text{m}$ broad
7	<i>Blumea</i> sp.	21-24 $\mu\text{m}$ , Amb spheroidal, isopolar, Radially symmetrical	Tricolporate, colpi long	Exine 3 $\mu\text{m}$ thick, surface echinate, spines 5-6 $\mu\text{m}$ long, 4 spines in the inter

				apertural region interspinal area psilate
8	Bombaxceiba Linn	51 $\mu\text{m}$ (49.5 $\times$ 52.5) $\mu\text{m}$ , peroblate, isopolar, Radially symmetrical	Tricolporate, col. length 12 (10.5-13.5) $\mu\text{m}$	Exine thick 3 $\mu\text{m}$ , coarsely reticulate, mesh 4.1 $\mu\text{m}$ (3-4.5 $\mu\text{m}$ ) in the major part except at the angles showing medium reticulations 1-8 $\mu\text{m}$ (1.5 -3 $\mu\text{m}$ ), greater number of baculae are found in the lumen. Muri simplibaculate, faint LO pattern.
9	Brassica sp.(Linn) Koch	30-33 $\mu\text{m}$ , Amb rounded triangular to almost spheroidal; 27-31 $\times$ 24-27 $\mu\text{m}$ , prolate spheroidal; radially symmetrical	Tricolporate , colpalends tapering, tips acute	Exine 2.5 $\mu\text{m}$ thick, sub tectate, surface reticulate, heterobrochate, meshes narrow at mesocolpial regions giving a striate look ,lumina polygonal.
10	Capparisgrandis	10-12 $\mu\text{m}$ , Amb spheroidal; 14-16 $\times$ 9-12 $\mu\text{m}$ prolate to subprolate; Radially symmetrical	Tricolporate, colpi linear to narrowly elliptic, ends tapering, tips acute, ora faint lalongate	Exine 1 $\mu\text{m}$ thick, tectate, surface faintly granular to almost psilate
11	Capsicum annumLinn.	29-34 $\mu\text{m}$ , Amb spheroidal; 29-35 $\times$ 26-30 $\mu\text{m}$ , subprolate; radially symmetrical	Tricolporate , colpi constricted at oral region, ends tapering, tips acute, ora prominently lalongate	Exine 1.5 $\mu\text{m}$ thick, tectate, surface faintly granular to almost psilate
12	Careyaarborea Roxb.	52.1 $\times$ 40.1 $\mu\text{m}$ (48-54 $\times$ 37.5 -43.5) $\mu\text{m}$ , subprolate, isopolar, radially symmetrical	Hexacolpate, syncolpate with crassimarginatecolpi, col. Length 43.5 (42-46.5) $\mu\text{m}$	Exine thick , 3 $\mu\text{m}$ , undulating, considerable thick at the poles sexine- nexine not differentiated medium reticulate, more coarse at the poles. Mesh 1.5-3 $\mu\text{m}$ , clear LO pattern
13	Celosia argentea	30-35 $\mu\text{m}$ spheroidal radially symmetrical	Pantoporate, pore No. 15-20, circular.Diam; 4-5 $\mu\text{m}$ , pore membrane flecked with granules, interporal distance8-11 $\mu\text{m}$	Exine 2 $\mu\text{m}$ thick, tectate, interporal space coarsely granular
14	Citrus sp.	27-29 $\mu\text{m}$ , Amb squarish, 26-30 $\times$ 25-27	Tetracolporate, colpi linear, tips acute	Exine 2 $\mu\text{m}$ thick subtectate, surface

		$\mu\text{m}$ , prolate spheroidal radially symmetrical	oralalongate	Reticulate. Heterobrochate, meshes smaller near the apertural regions and larger elsewhere, luminahexa to pentagonal or irregular, psilate, murisimpli to locally duplibaculate
15	Clerodendrum sp.	43-48 $\mu\text{m}$ , Amb spheroidal, 41-44 $\times$ 37- 40 $\mu\text{m}$ , prolate spheroidal ; Radially symmetrical	Tricolporate, colpi fairly long, tips acute, colpal margins broken	Exine 1.5 $\mu\text{m}$ thick (excluding spinules), tectate surface spinulate, spinules 0.6-1 $\mu\text{m}$ long, interspinular space finely granular
16	Cucurbitaceae type	50-63 $\mu\text{m}$ , subprolate, isopolar, Radially symmetrical	Tricolporate, col. Length 48.7 (48-49.5) $\mu\text{m}$	Exine thick 4.5 $\mu\text{m}$ , sexine - nexine not discernible, rather coarsely reticulate, mesh 3.4 (3 - 4.5) $\mu\text{m}$ , baculae distinct, clear LO pattern
17	Delonixregia	59.62 $\mu\text{m}$ , Amb more or less spheroidal to subtriangular; 53-56 $\times$ 57-60 $\mu\text{m}$ , oblateto suboblate;Radially	Tricolporate, colpi long with blunt ends, ora faint, more or less rounded	Exine 5.2 $\mu\text{m}$ thick, subtectate, surface coarsely reticulate. Heterobrochate, meshes smaller near the apertural regions & larger elsewhere , lumina poly to hexagonal with a number of
		symmetrical		free bacules, muri thick, sinuous, simpli to locally duplibaculate
18	Echinopsechinatus	105 $\times$ 86 m ramibaculate, bacula branched, Radially symmetrical	Tricolporate, provided with $\pm$ lalongateora	Exine thick 7 $\mu\text{m}$ , at polar region & 3.5 at equatorial region surface spinulate
19	Eucalyptus globulus	23-27 $\mu\text{m}$ , Amb triangular, sides concave to almost flat; 15-18 $\times$ 25-29 $\mu\text{m}$ , oblate, Radially symmetrical	Tricolporate, syncolpate, parasyncolpate, oralalongate, margins incrasste	Exine 1.5 $\mu\text{m}$ thick, much thickened at angles, tectate, surface psilate
20	Gardenia latifolia	41.4 $\mu\text{m}$ (40.5 $\times$ 142) $\mu\text{m}$ isopolar, radiaaly symmetrical tetrad	Tri-porate pore (4.5 $\mu\text{m}$ ) spheroidal porate united in tetrads	Exine thick, finely reticulate, LO pattern clear
21	Leucanaealeucocephala	52-59 $\mu\text{m}$ , Amb spheroidal : 47-49 $\times$ 51- 58	Tricolporatecolpilong, tips acute, oralalongate	Exine 4 $\mu\text{m}$ thick, subtectate surface

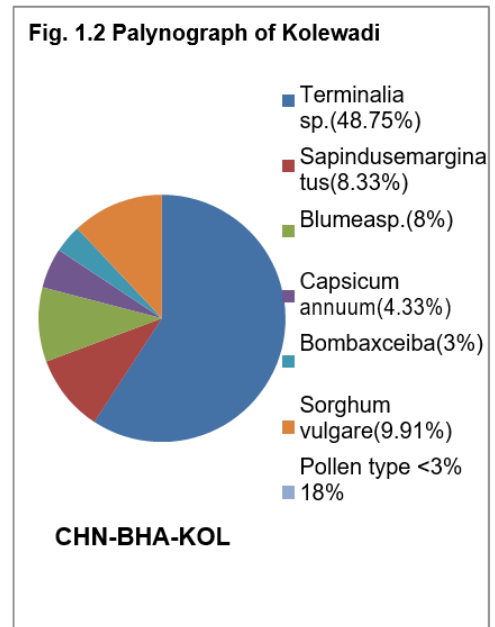
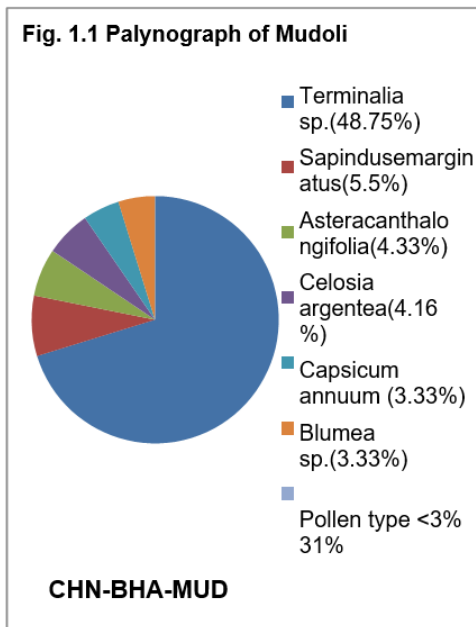
		$\mu\text{m}$ , sub oblate: Radially symmetrical		microreticulate, homobrochate
22	Mangifera indica Linn.	27-31 $\mu\text{m}$ , Amb subtriangular; 29-32 $\times$ 26-28 $\mu\text{m}$ , subprolate; Radially symmetrical	Tricolporate colpi long, tips acute ora prominently lanlongate	Exine 2.5 $\mu\text{m}$ thick, subtectate, surface striatoreticulae, striations more or less parallel in equatorial view, lumen generally elongated in polar direction, murisimplibaculate
23	Melia azadirachta	47.2 $\times$ 36.7 $\mu\text{m}$ ., 46.5-48 $\times$ 36.37.5 $\mu\text{m}$ ., subprolate, isopolar, Radially symmetrical	Tetracolporate, col. Length 36 $\mu\text{m}$ , ora 6.5 $\mu\text{m}$ , lalongate, pantoporate, pores, circular 6.9 $\mu\text{m}$ ,	Exine thick 3 $\mu\text{m}$ , sexine- nexine not clear, psilate
24	Mimosa sp.	Pollen grains in polyads rarely in tetrads, 4-6 celled, 18-20 $\times$ 12-14 $\mu\text{m}$ , elliptic; monad with hemispherical outer and conical inner portions; Radially symmetrical	Apertures faint to indistinct	Exine 0.5 $\mu\text{m}$ thick, tectate, surface psilate
25	Parthenium hysterophorus	16.6 to 19.8 $\mu\text{m}$ , Amb spheroidal, oblate spheroidal, radially symmetrical	Tricolporate colpi long, ends tapering, tips acute, ora lalongate	Exine 3 $\mu\text{m}$ thick, tectate, surface echinate, spines short 2 $\mu\text{m}$ , to 3 $\mu\text{m}$ , long 2 $\mu\text{m}$ , in diam at base.
26	Pisidium guajava Linn.	24-25 $\mu\text{m}$ , Amb subtriangular; 13-16 $\times$ 26-28 $\mu\text{m}$ , oblate; Radially symmetrical	Tricolporate, syncolpate, parasyncolpate, ora lalongate	Exine 1.5 $\mu\text{m}$ thick, tectate surface granular to pailate
27	Pongamia pinnata (Linn) Pierre.	29-31 $\mu\text{m}$ , Amb subtriangular: 27-31 $\times$ 25-28 $\mu\text{m}$ , subprolate; Radially symmetrical	Tricolporate, colpi linear to narrowly elliptic tips acute, ora lalongate	Exine 1.5 $\mu\text{m}$ thick, subtectate, surface granular to locally faintly microreticulate
28	Portulaca oleracea	63 $\mu\text{m}$ , spheroidal; radially symmetrical	Pantacolpate, some of the colpi showing a tendency towards pentagonal arrangement around the polar area of each hemisphere. Colpi faint, 15 $\mu\text{m}$ , long with acute tips	Exine 4 $\mu\text{m}$ thick, tectate, surface densely spinulate, spinules 1-2 $\mu\text{m}$ long.
29	Prosopis juliflora	36-39 $\mu\text{m}$ , Amb rounded triangular; 38-	Tricolporate, occasionally syncolpate,	Exine 3.2 $\mu\text{m}$ thick, tectate surface faintly

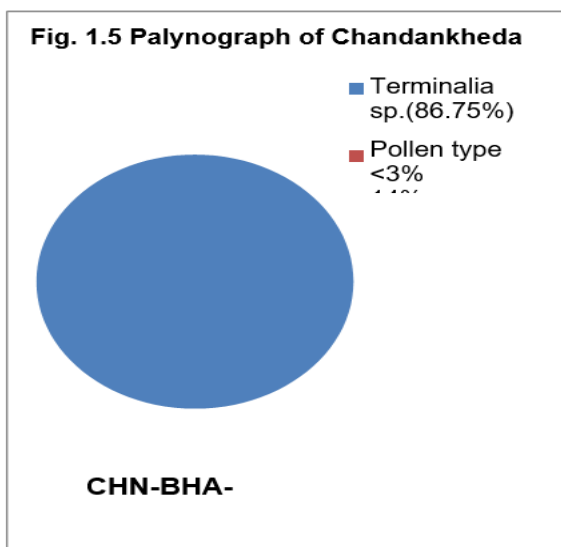
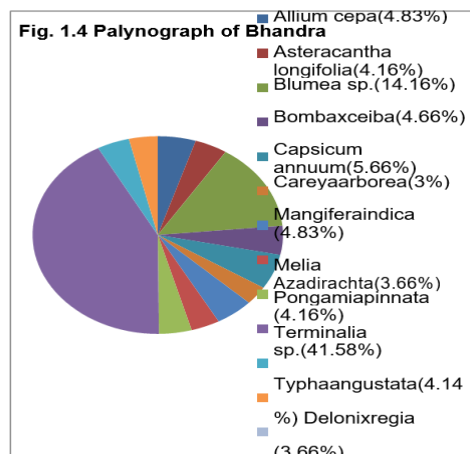
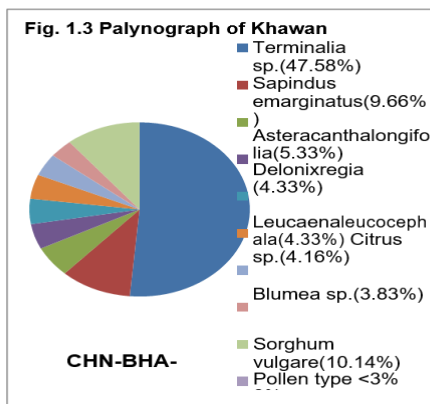
		42× 30-35 μm, prolate to subprolate; Radially symmetrical	colpi tapering towards poles, tips acute, oral alongate	reticulate
30	<i>Rungia repens</i> (Linn.) Nees.	40-44 × 25-26 μm, oblong; Bilaterally symmetrical	Diporate, pores circular, 2.5 μm, in diam, margin of the pores densely beset with small processes	Exine 3 μm thick at poles, 4.6 μm at equator, subtectate, tectum undulating, distinct rounded to irregular areolae (2- 4 μm) linearly aligned in the vicinity of apertures, rest of the wall microreticulate
31	<i>Sapindus emarginatus</i> vahi.	24-26 μm, Amb triangular, sides straight or even slightly concave; 18-20 × 26-29 μm, oblate (occasionally suboblate); Radially symmetrical	Tricolporate, colpi narrowly elliptic long, tips acute, oral alongate	Exine 2 μm thick on mesocolpia, 1-1.5 μm thick near apertures, surface psilate
32	<i>Sonchus oleraceus</i>	39-44 μm, Amb more or less hexagonal with rounded corners, sides straight to slightly convex; 37-47 × 40-45 μm oblate spheroidal, Radially symmetrical	Tricolporate, colpi faint due to heavy sculpture, oral alongate	Exine upto 12 μm thick, tectate, sexine much thicker than nexine at ridges, surface echinolate (echinofenestrates), spines of different sizes, upto 3 μm long, fenestral lumina upto 21, polygonal to irregular, psilate, 6-8 prominent ridges are seen along the equator which join the equatorial lacuna of both the hemispheres
33	<i>Syzygium cumini</i>	16-18 μm, Amb triangular to rarely quadrangular, sides slightly concave; 10.5- 12 × 17-20 μm, oblate; Radially symmetrical	Tricolporate, rarely tetra colporate, syncolpate, parasyncolpate, oral alongate	Exine 1.25 μm thick, tectae, surface granular to smooth
34	<i>Terminalia</i> sp.	19-22 μm, Amb spheroidal; 21-24 × 20-22 μm, subprolate; Radially symmetrical	Tricolporate, colpi alternating with pseudocolpi linear, tips acute pseudocolpi almost equal the size of	Exine 1.5 μm thick, tectae, surface psilate to locally finely granular

colpi, ora more or less circular
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Table 3: Showing pollen morphology of Non-melliferous taxa

Sr. No.	Pollen types	Pollen Size, Shape and Symmetry	Aperture pattern	Pollen wall (Sporoderm) Structure and sculpture
01	<i>Sorghum vulgare</i> Pers.	51-55 $\mu\text{m}$ , spheroidal; Radially symmetrical	Monoporate, pore circular provided with annulus, pore diam with annulus 4.1 $\mu\text{m}$ without annulus 3.3 $\mu\text{m}$	Exine 1 $\mu\text{m}$ thick, tectate, surface faintly granular to almost psilate
02	<i>Typha angustata</i> Bory. et Chaub	28-35 $\mu\text{m}$ , ellipsoidal, triangular or spheroidal; Radially symmetrical	Monoporate pore more or less circular 4-5 $\mu\text{m}$ in diam, margin wavy, pore membrane densely granular	Exine 2.5 $\mu\text{m}$ thick, subtectate, surface reticulate in places retipilate, reticulum homobrochate, lumina polygonal to circular, psilate, murisimplibaculate





**Fig 1.6: Composite palynograph of summer honeys from Bhadrawatitahsil**

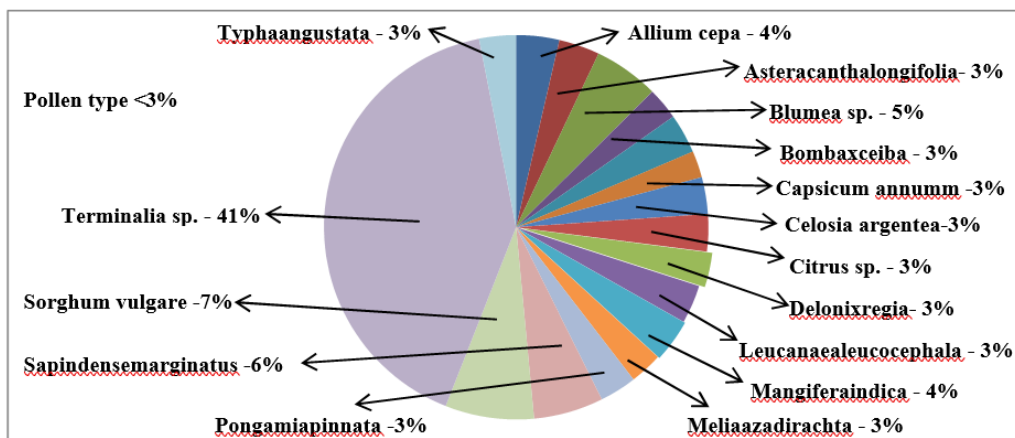
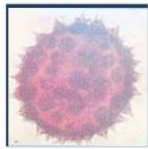
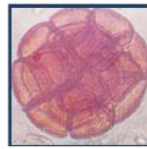


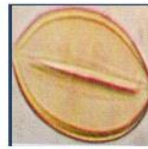
Plate Microscopic photograph of pollen grains found in honey sample



*Abutilon indicum*



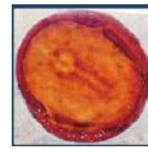
*Albizia lebeck*



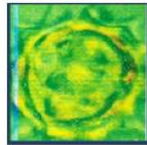
*Allium cepa*



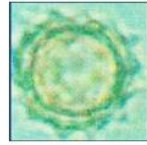
*Asteracanthalongifolia*



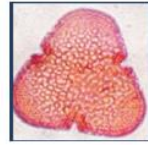
*Azadirachta indica*



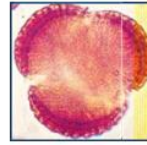
*Bidens pilosa*



*Blumea sp.*



*Bombax ceiba*



*Brassica sp.*



*Capparis grandis*



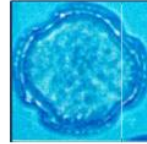
*Capsicum annuum*



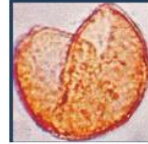
*Careya arborea*



*Celosia argentea*



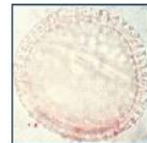
*Citrus sp.*



*Clerodendrum sp.*



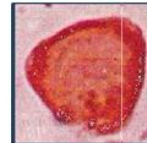
*Cucurbitaceae type*



*Delonix regia*



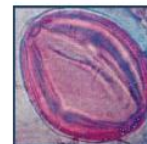
*Echinopsechinatus*



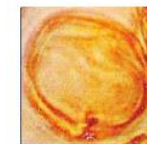
*Eucalyptus globulus*



*Gardenia latifolia*



*Leucaena leucocephala*



*Mangifera indica*



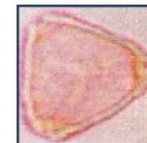
*Melia azadirachta*



*Mimosa sp.*



*Parthenium hysterophorus*



*Psidium guajava*



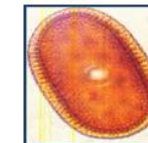
*Pongamia pinnata*



*Portulacaoleracea*



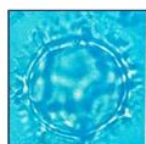
*Prosopis juliflora*



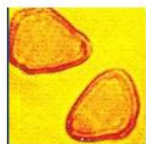
*Rungia repens*



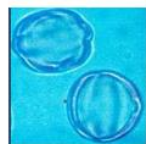
*Sapindus marginatus*



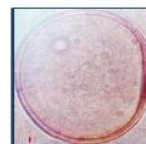
*Sonchus oleraceus*



*zygium cumini*



*Terminalia sp.*



*Sorghum vulgare*



*Typha angustata*

All together 36 pollen types (34 of melliferous and 2 of non-melliferous taxa) referable to 25 families have been recorded from these samples (Photoplate). The sample (CHN-BHA-KOL) showed the maximum number of pollen type (28) and the sample (CHN-BHA-BHAN), the minimum number (14).

In the sample (CHN-BHA-KOL, CHN-BHA-KHA) however the pollen of *Sorghum vulgare* were found to be good number ranged from (9.91 to 10.14%) and sample (CHN-BHA-BHAN) the pollen of *Typha angustata* were found in good number (4.14%). The absolute pollen counts ranged from 55000/g to 1265,000/g and the HDE/P ratio ranged from 0.01 to 0.02 and represented by fungal spores (Table1). The details of the pollen analysis of the 5 honey samples (melliferous/non-melliferous) are represented in table1. Similarly individual palynograph (Pollen spectra) of each honey sample and composite palynograph was also given to show the pollen contents of the samples of Bhadrawatitahsil (Fig. 1.1-1.6). The distinguishing morphological features of the pollen types encountered in the present study are given below. The bee plants of Bhadrawatitahsil are referable to 3 categories:

1. Crop plants: *Allium cepa*, *Brassica sp.*, *Capsicum annum* and *Sorghum vulgare*.
2. Arborescent taxa/shrub: *Azadirachta indica*, *Bombax ceiba*, *Citrus sp.*, *Delonix regia*, *Leucanaealeucocephala*, *Mangifera indica*, *Melica azadirachta*, *Pongamiapinnata*, *Psidium guajava*, *Sapindaceae marginatus*, *Syzygium cumini*, *Terminalia sp.*, *Capparis grandis*, *Mimosa sp.*, *Albizia lebeck*, *Gardenia latifolia*, *Eucalyptus globulus*, *Careya arboarea*.
3. Herbaceous weeds: *Asteracanthalongifolia*, *Celosia argentea*, *Abeutilon indicum*, *Sonchus oleraceus*, *Echilopsechinatus*, *Bidens pilosa*, *Portulaca oleracea*.

Of these three categories the arborescent plants *Terminalia sp.* constitute the chief bee forage plants in this tahsil during summer season. Besides the other arborescent plants *Delonix regia*, *Pongamiapinnata*, *Azadirachta indica* represents most preferred nectar sources for the honey bees. Our observation indicate that *Terminalia sp.* represent abundant nectar and pollen sources to *Apis dorsata*. The region selected for the present study has good potential for sustaining bee keeping ventures because of the diversity of nectar and pollen taxa. Since *Terminalia sp.* are member of combretaceae is major sources of forage for honey bees therefore efforts should be made to increase its cultivation. The other plant encountered in these honey samples are the member of families like Acanthaceae, Anacardeaceae, Mimosaceae, Caesalpinaceae, Celastraceae, Myrtaceae, Samydaceae, Menispermaceae, Liliaceae, Capparidaceae, Amaranthaceae, Cleomaceae, Solanaceae, Papillionaceae and Sapindaceae in this area.

To improve the bee-keeping industry a proper understanding and mutualism between bees and available plant taxa in the region and in a particular season is necessary. The identified taxa were not only the economic crops but also play an important role in the development of bee-keeping in this region. This data reflects the floral situation of the place where particular honey was produced and the identification of geographical origin based on the presence of a combination of pollen types of that particular area.

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