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**POLLEN ANALYSIS OF SUMMER HONEYS COLLECTED FROM  
FOREST AREA OF WARORA TAHSIL OF CHANDRAPUR DISTRICT,  
MAHARASHTRA STATE**

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**ABSTRACT**

The paper incorporates a qualitative and quantitative analysis of pollen contents in four squeezed honey samples of *Apis dorsata* hives collected from forest area of Warora tahsil of Chandrapur district. *Terminalia sp.* represents the predominant pollen type in three samples ranged from (49.16% to 65.91%) are designate as Termanalia honey. The other significant pollen types recorded include *Terminalia sp.*, *Blumea sp*, *Sapindence emarginatus*, *Lagiscea mollusc*, *Delonix regia*, *Bombax ceba*, *Albezia lebbeck*, *Pongamia pinnata*, *Carthamus tinctorius*, *Brassica sp.*, *Capsicum annum* and *Astericantha longifolia*. The pollen counts ranged from 7000/g to 967000/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, *Apis dorsata*, Forest area, Warora tahsil**

**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 [1]. 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 (LaxmikantBorkar and Devendra Mate,2017-18, 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 quanlitative and quantitative pollen analysis of five honey sample from forest area of Bramhapuritahtsil 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 [2-16].



Figure 1: Map of Maharashtra Showing Chandrapur District and Warora tahsil

## MATERIALS AND METHODS

Four honey samples viz., CHN-WAR-MAI, CHN-WAR-AMF, CHN-WAR-NEL and CHN-WAR-SOT were collected during the period 31 May 2012 to 24 May 2013 from

Maisa, Amerfulli, Nelgai and Soet respectively. All the samples represent squeezed honey collected from the natural *Apis dorsata* hives (Map) [17].

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) [18-21].

## RESULTS AND DISCUSSION

Of the 4 honey samples collected from Warora tahsil, *Terminalia sp.* ranged from (49% to 65.91%) represent the predominant pollen type in three sample (CHN-WAR-MAI, CHN-WAR-NEL, CHN-WAR-SOT). i.e. unifloral. While one multifloral (CHN-WAR-AMF). The other significant pollen types recorded includes secondary and upto minor pollen *Terminalia sp.*, *Blumea sp.*, *Sapindence emarginatus*, *Lagiscea mollusc*, *Delonix regia*, *Bombax ceiba*, *Albezia lebbeck*, *Pongamia pinnata*, *Carthamus tinctorius*, *Brassica sp.*, *Capsicum annum* and *Astericantha longifolia*

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-WAR-MAI	31-05-2013	Unifloral	967,000/g	0.01	<p><i>P – Terminalia sp.(58.16)</i>  <i>S - Nil</i>  <i>I – Asteracantha longifolia (8.16)</i>  <i>Pisidium guajava(7.33)</i>  <i>Sapindusemar ginatus (7.16)</i>  <i>Capsicum annuum (4.83)</i>  <i>Delonix regia , Pongamia pinnata (each 4.33)</i>  <i>Bombax ceiba (4)</i>  <i>M – Mel(2.66), Ma(2.5), Bl (1.66), Sy, Cu(each 1.33), Car(0.5)</i>  <i>NMP – Typhaan gustata(8.02)</i>  <i>Sorghum vulgare(0.90)</i></p>
CHN-WAR-AMF	02-06-2012	Multifloral	7,000/g	0.02	<p><i>P – Nil</i>  <i>S - Terminalia sp.(28.33)</i>  <i>I – Delonix regia(13.83)</i>  <i>Bombax ceiba (11.5)</i>  <i>Cucurbitaceae type(6.83)</i>  <i>Mangifera indica(5.83)</i>  <i>Capsicum annuum(4.5)</i>  <i>Sapindus emarginatus,</i>  <i>Pongamia pinnata (each 4.46)</i>  <i>Blumea sp.(4.33)</i>  <i>Careyaar borea(4)</i>  <i>M – Ci (2.16), Cart, Az(each 1.66), Ast.l(1.5), Sy, Cel(each 1.33), Ca(1.16), Ru(0.66)</i>  <i>NMP – Nil</i>  <i>APC-7,000/g; HDE/P= 0.02</i></p>
CHN-WAR-NEL	15-04-2013	Unifloral	48,000/g	0.01	<p><i>P – Terminalia sp.(57.91)</i>  <i>S - Nil</i>  <i>I – Asteracantha longifolia(8.33)</i>  <i>Sapindus emarginatus(7)</i>  <i>Mangifera indica(5.66)</i>  <i>Delonix regia(5.5)</i>  <i>M – Mel(2), Ps(2.16), Car(1.33), Cel(1.16),Po(0.5)</i>  <i>NMP – Typhaan gustata(0.82)</i></p>
CHN-WAR-SOT	24-04-2013	Unifloral	898,000/g	0.01	<p><i>P – Terminalia sp.(60.83)</i>  <i>S - Nil</i>  <i>I – Sapindus emarginatus(5)</i>  <i>Asteracantha longifolia(5.33)</i>  <i>Delonix regia(4.33)</i>  <i>Capsicum annuum (7.66)</i>  <i>Pongamia pinnata (3.5)</i>  <i>Pisidium guajava (5.5)</i>  <i>M – Bo(2.5), Mel(2.16), Br(1.33), Bi, Cart, Ca(each 0.66), May, Al (each 0.33)</i>  <i>NMP – Typhaan gustata (0.97)</i></p>

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>Alangium salvifolium</i>	85-92 $\mu\text{m}$ , Amb spheroidal, 72-89 $\times$ 80-94 $\mu\text{m}$ , oblate spheroidal; radially symmetrical	Tetra to heptaporate, pores obscure due to heavy sculpturing, pores circulate to elliptic, 9-12 $\mu\text{m}$ in diam.	Exine 4-6 $\mu\text{m}$ thick, tectate, surface verrucate, verrucae 2-5 $\mu\text{m}$ high, 2-6 $\mu\text{m}$ in diam., surface in between verrucae granular
2	<i>Asteracantha longifolia</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.
3	<i>Azadirachta indica</i>	50-54 $\mu\text{m}$ , Amb squarish, sides convex; 47-54 $\times$ 38-47 $\mu\text{m}$ , subprolate, poles smoothly rounded; Radially symmetrical	Tetracolporate, colpi long, ends tapering, tips acute, oral elongate	Exine 3 $\mu\text{m}$ thick, tectate, surface psilate to locally granular
4	<i>Bidens pilosa</i>	25-29 $\mu\text{m}$ Amb spheroidal; 23-25 $\times$ 27-30 $\mu\text{m}$ , suboblate; Radially symmetrical	Tricolporate, colpi long, ends tapering, tips acute, oral elongate	Exine 1.5 $\mu\text{m}$ thick, tectate, surface echinate, spines 6.8 $\mu\text{m}$ long, base 2 $\mu\text{m}$ broad
5	<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 interapertural region interspersed with psilate
6	<i>Bombax ceiba</i> Linn	51 $\mu\text{m}$ (49.5 $\times$ 52.5) $\mu\text{m}$ , prooblate, 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. Murisimplibaculate, faint LO pattern.
7	<i>Brassica</i> 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, colpi long, ends tapering, tips acute	Exine 2.5 $\mu\text{m}$ thick, subtectate, surface reticulate, heterobrochate, meshes narrow at mesocolpial regions giving a striate look, lumina polygonal.
8	<i>Capparis grandis</i>	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 faintly elongate	Exine 1 $\mu\text{m}$ thick, tectate, surface faintly granular to almost psilate
9	<i>Capsicum annum</i> Linn.	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 elongate	Exine 1.5 $\mu\text{m}$ thick, tectate, surface faintly granular to almost psilate
10	<i>Careya arborea</i> Roxb.	52.1 $\times$ 40.1 $\mu\text{m}$ (48-54 $\times$ 37.5-43.5) $\mu\text{m}$ , subprolate, isopolar, radially symmetrical	Hexacolporate, syncolporate with crassimarginate colpi, 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
11	<i>Carthamus tinctorius</i>	59-65 $\mu\text{m}$ , Amb spheroidal: 58-62 $\times$ 66-73 $\mu\text{m}$ , subprolate, radially symmetrical	Tricolporate, colpi with tapering ends, oral elongate	Exine (spinoid processes included) about 8 $\mu\text{m}$ thick at poles, 10 $\mu\text{m}$ at equator tectate, tectum prominently columellate, columella simple or branched, sharply undulating with supracteal solid, pointed, robust sinule like

				processes
12	<i>Celosia argentea</i>	30-35 µm spheroidal radially symmetrical	Pantoporate, pore No. 15-20, circular. Diam; 4-5 µm, pore membrane flecked with granules, interporal distance 8-11 µm	Exine 2 µm thick, tectate, interporal space coarsely granular
13	Citrus sp.	27-29 µm, Ambsquarish, 26-30 × 25-27 µm, prolate spheroidal radially symmetrical	Tetracolporate, colpi linear, tips acute, oralalongate	Exine 2 µm thick subtectate, surface Reticulate. Heterobrochate, meshes smaller near the apertural regions and larger elsewhere, luminahexa to pentagonal or irregular, psilate, murisimpli to locally duplibaculate
14	Cucurbitaceae type	50-63 µm, subprolate, isopolar, Radially symmetrical	Tricolporate, col. Length 48.7 (48-49.5) µm	Exine thick 4.5 µm, sexine - nexine not discernible, rather coarsely reticulate, mesh 3.4 (3 - 4.5) µm, baculae distinct, clear LO pattern
15	<i>Delonix regia</i>	59.62 µm, Amb more or less spheroidal to subtriangular; 53-56 × 57-60 µm, oblate to suboblate; Radially symmetrical	Tricolporate, colpi long with blunt ends, ora faint, more or less rounded	Exine 5.2 µm thick, subtectate, surface coarsely reticulate. Heterobrochate, meshes smaller near the apertural regions & larger elsewhere, lumina poly to hexagonal with a number of free bacules, muri thick, sinuous, simpli to locally duplibaculate
16	<i>Mangifera indica</i> Linn.	27-31 µm, Ambsubtriangular; 29-32 × 26-28 µm, subprolate; Radially symmetrical	Tricolporatecolpi long, tips acute ora prominently lanlongate	Exine 2.5 µm thick, subtectate, surface striatoreticulae, striations more or less parallel in equatorial view, lumen generally elongated in polar direction, murisimplibaculate
17	<i>Maytenusem arginata</i> Wild.	Oblate, 45-49 µm, Amb, rounded triangular to almost spheroidal, isopolar, Radially symmetrical	Tricolporate, colpi length 9.4 µm, (9-10.5) µm, oralalongate	Exine thick 3 µm, sexine thicker than nexine, reticulate size of mesh 2.4 (1.5-3)µm, distinct LO pattern.
18	<i>Melia azadirachta</i>	47.2 × 36.7 µm., 46.5-48 × 36.37.5 µm., subprolate, isopolar, Radially symmetrical	Tetracolporate, col. Length 36 µm, ora 6.5 µm, lalongate, pantoporate, pores, circular 6.9 µm,	Exine thick 3 µm, sexine- nexine not clear, psilate
19	<i>Pisidium guajava</i> Linn.	24-25 µm, Ambsubtriangular; 13-16 × 26-28 µm, oblate; Radially symmetrical	Tricolporate, syncolpate, parasyncolpate, oralalongate	Exine 1.5 µm thick, tectate surface granular to pailate
20	<i>Pongamia pinnata</i> (Linn) Pierre.	29-31 µm, Ambsubtriangular: 27-31 × 25-28 µm, subprolate; Radially symmetrical	Tricolporate, colpi linear to narrowly elliptic tips acute, oralalongate	Exine 1.5 µm thick, subtectate, surface granular to locally faintly microreticulate
21	<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
22	<i>Sapindus emarginatus vahi.</i>	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, oralOlongate	Exine 2 µm thick on mesocolpia, 1-1.5 µm thick near apertures, surface psilate
23	<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, oralalongate	Exine 1.25 µm thick, tectae, surface granular to smooth
24	Terminalia sp.	19-22 µm, Amb spheroidal; 21-24 × 20-22 µm, subprolate; Radially symmetrical	Tricolporate, colpi alternating with pseudocolpicolpi linear, tips acute pseudocolpi almost equal the size of colpi, ora more of less circular	Exine 1.5 µm thick, tectae, surface psilate to locally finely granular

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 µm, spheroidal; Radially symmetrical	Monoporate, pore circular provided with annulus, pore diam with annulus 4.1 µm without annulus 3.3 µm	Exine 1 µm thick, tectate, surface faintly granular to almost psilate
02	<i>Typha angustata</i> Bory. et Chaub	28-35 µm, ellipsoidal, triangular or spheroidal; Radially symmetrical	Monoporate pore more or less circular 4-5 µm in diam, margin wavy, pore membrane densely granular	Exine 2.5 µm thick, subtectate, surface reticulate in places retipilate, reticulum homobrochate, lumina polygonal to circular, psilate, murisimplibaculate

Fig. 1.1: Palynograph of Maisa

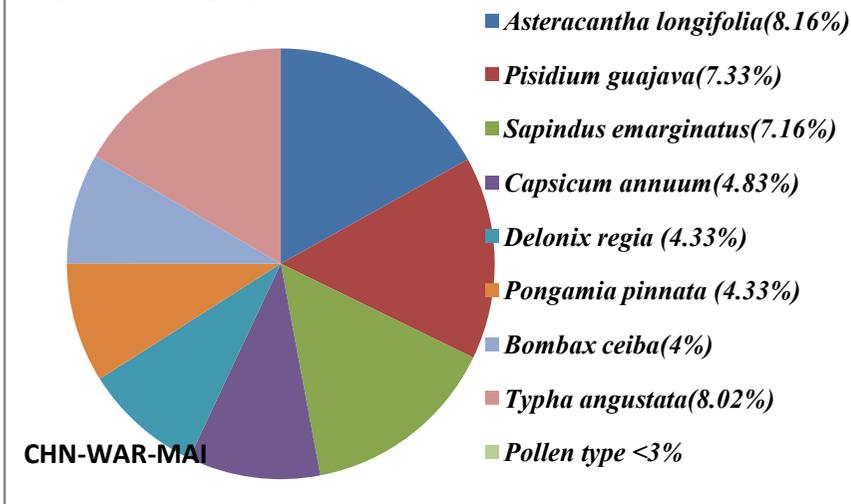
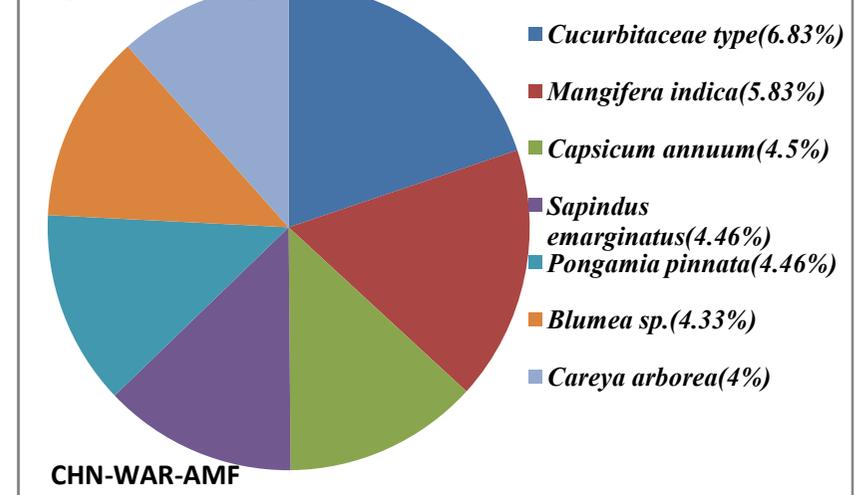


Fig. 1.2 Palynograph of Amarfuli



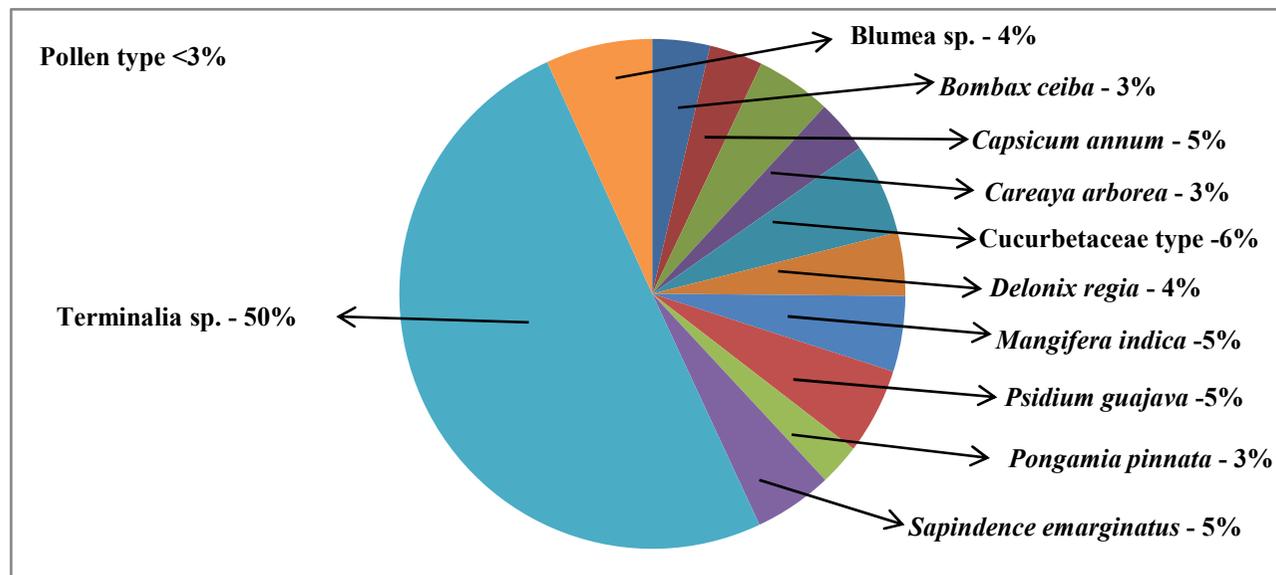
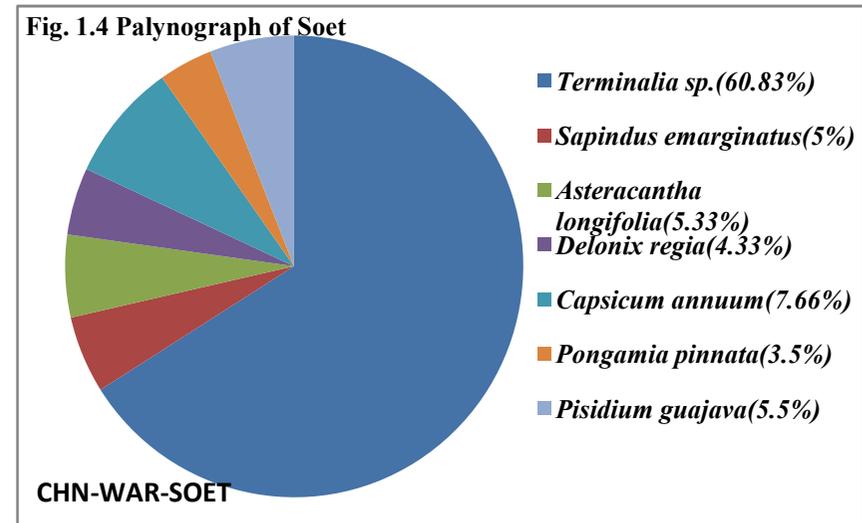
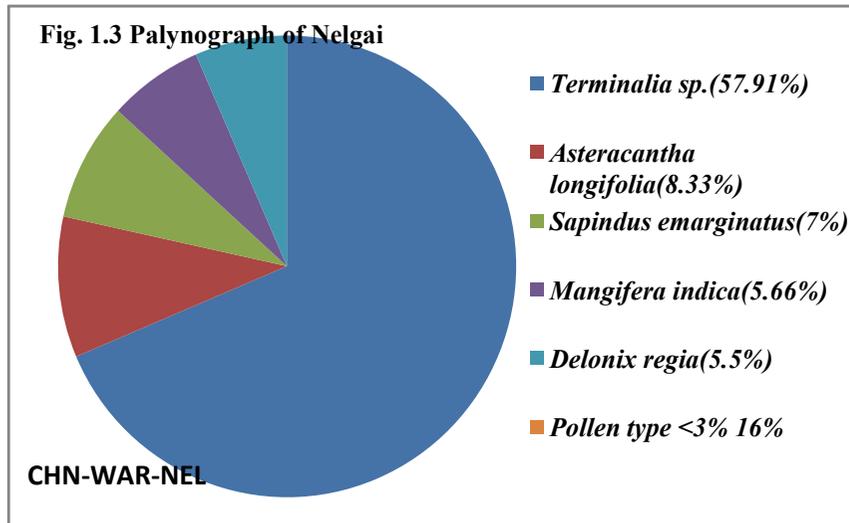
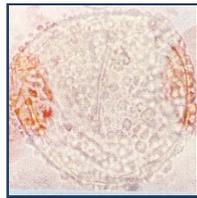


Fig 1.5: Composite palynograph of summer honeys from Chandrapur District

Plate Microscopic photograph of pollen grains found in honey sample



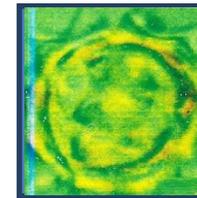
*Alangium salviifolium*



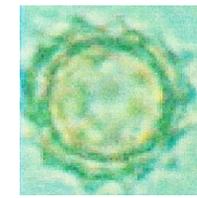
*Astera cantha*



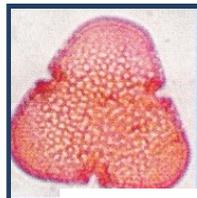
*Azadirachta indica*



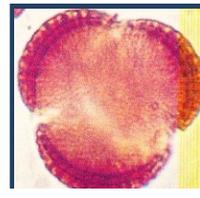
*Bidaen spilosa*



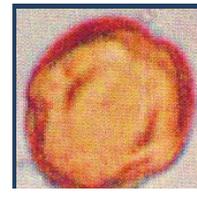
*Blumea sp. longifoli*



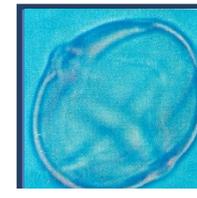
*Bombax ceiba*



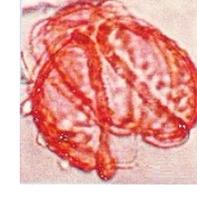
*Brassica sp.*



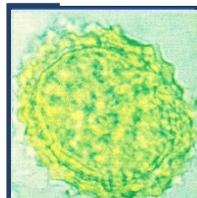
*Capparis grandis*



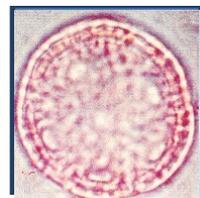
*Capsicum annum*



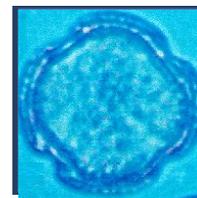
*Careya arborea*



*Carthamus tinctorius*



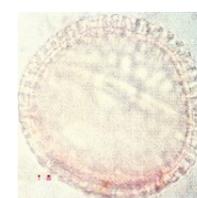
*Celosia argentea*



*Citrus sp.*



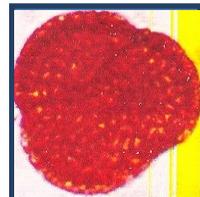
*Cucurbitaceae type*



*Delonix regia*



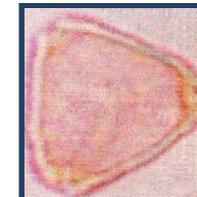
*Mangifera indica*



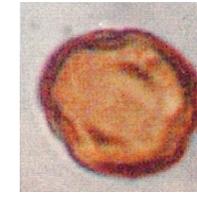
*Maytenusem arginata*



*Melia azadirachta*



*Pisidium guajava*



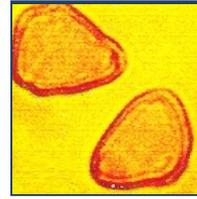
*Pongamia pinnata*



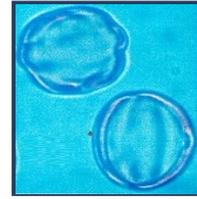
*Rungia repens*



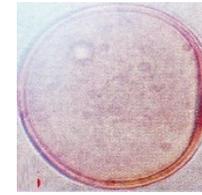
*Sapinduse marginatus*



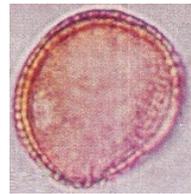
*Syzygium cumini*



*Terminalia sp.*



*Sorghum vulgare*



*Typha angustata*

All together 26 pollen types (24 of melliferous and 2 of non-melliferous taxa) referable to 21 families have been recorded from these samples (Photoplate). The sample (CHN-WAR-AMF) showed the maximum number of pollen type (18) and the sample (CHN-WAR-NEL), the minimum number (11).

In the sample (CHN-WAR-MAI) however the pollen of *Typha angustata* were found to be good number (8.2%). The absolute pollen counts ranged from 7000/g to 967,000/g and the HDE/P ratio ranged from 0.01 to 0.02 and represented by fungal spores (Table 1).

The details of the pollen analysis of the 4 honey samples (melliferous/non-melliferous) are represented in table 1. Similarly individual palynograph (Pollen spectra) of each honey sample and composite palynograph was also given to show the pollen contents of the samples of Warora tahsil (Fig. 1.1-1.5). The distinguishing morphological features of the pollen types encountered in the present study are given below. The bee plants of Warora tahsil are referable to 3 categories:

**1. Crop plants:** *Brassica sp.*, *Capsicum annum*, *Carthamus tinctorius*, and *Sorghum vulgare*.

**2. Arborescent taxa/shrub:** *Azadirachta indica*, *Bombax ceiba*, *Citrus sp.*, *Delonix regia*, *Mangifera indica*, *Melica azadirachta*, *Pongamia pinnata*,

*Sapindence emarginatus*, *Syzygium cumini*, *Terminalia sp.*, *Capparis grandis*, *Mayetusem arginatus*, *Alanzium salviifolium*, *Rungea repens*, *Careaya arborea*

**3. Herbaceous weeds:** *Asteracantha longifolia*, *Celosia argentea*.

Of these three categories the arborersent plants *Terminalia sp.* constitute the chief bee forage plants in this tahsil during summer season. Besides the other arborersent plants *Delonix regia*, *Pongamia pinnata*, *Azadirachta indica* represents most preferred nectar sources for the honeybees. 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 Acanthaceace, Anacardeaceace, Mimoscae, Caesalpinaceace, Celastraceace, Myrtaceace, Samydaceae, Menispermaceace, Liliaceace, 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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