4. RESULTS

The present study was initiated with an objective of understanding the preferences of bees for plants as nectar source or pollen source or both in different seasons in North 24 Paraganas. Data were collected under three different heads, namely, i) pollen frequency in honey samples collected from artificial hives of apiary with *Apis mellifera*, ii) the relative presence of pollens of different species in corbicular loads of the bees, and iii) the pollens adhered to the surface of bee body and counting the relative presence of different plant species. Results of the enumerations and analyses of data on pollen diversities in three different kinds of collections for different months in a year have been displayed here in below and in the Tables (4.1 to 4.17) and the Figures (Fig. 4.1 to 4.36). Depending on the availability of different plants in the surroundings and difference in the seasons of flowering of different plants the spectra of species in the collections of pollens by bees were noted to vary widely in different months and still having some species common for consecutive months. Data in record, thus, provides an insight to the plant species preferred by *Apis mellifera* as nectar sources and pollen sources in different seasons and help construct a pollen calendar for *Apis mellifera* in the areas under North 24 Paraganas.

4.1. QUALITATIVE ANALYSIS OF HONEY SAMPLES, POLLEN PELLETS AND SURFACE OF THE BEE BODY SAMPLES

Qualitative analyses of all collected pollen pellets, honey samples as well as surface of the bee body samples of *Apis mellifera* were carried out with the help of reference slides prepared from local area of North 24 paraganas district and adjoining areas of West Bengal. The pollen pellets collected directly from the corbicular loads of bees were used for both qualitative and quantitative estimation. The pollen materials collected from comb cells of hive were used only

to have ideas about the qualitative aspects of forage spectrum, but not for quantitative estimation. Field observation also helped to understand qualitative variations of bee forage.

Pollens of different species with respective characteristic features, visualized under microscope, are as herein below.

***Acacia auriculiformis* L. (Fabaceae) [Fig. 4.1 A & B]**

Pollen grains in polyads, 16-celled, spheroidal (20µm in diameter); amb circular, individual cell sub-globose in periphery and square in centre, exine 2µm in thick, sexine thicker than nexine, surface psilate.

***Acacia nilotica* L. Willd. ex Delite (Fabaceae) [Fig. 4.1 C]**

Pollen grains in polyads, 16-celled, sub-prolate (54µm × 47µm); amb circular, cluster pollen composed of 16 grains in a regular arrangement: 8 grains in the centre, forming assort of cubical block of 4 and 4 in two synchronized planes; surrounded by eight peripheral grains lying along the dividing plane of the two tiers of central group. Individual grains triangular or polygonal in shape; Exine about 2 µm thick, sexine and nexine of equal thickness; surface psilate.

***Ageratum conyzoides* L. (Asteraceae) [Fig. 4.1 D & E]**

Pollen grains radially symmetrical, spheroidal (19.7µm in diameter); amb circular, trizonocolporate, colpi narrowly elliptic, endoaperture lalongate, exine 2.4µm thick, scabrate with sort, blunt spines (2.3µm long).

***Alangium salvifolium* (L. f.) Wang. [Fig. 4.1 F & G]**

Pollen grains radially symmetrical, spheroidal (66µm in diameter); tetrazonoporate, pori circular to oval, exine about 3µm thick, sexine much thicker than nexine, surface verrucate.

***Amaranthus* sp. L. (Amaranthaceae) [Fig. 4.1 H]**

Pollen grains radially symmetrical, spheroidal (15µm in diameter), amb circular, pantoporate, pores 45-50 in number, exine 0.89µm thick, sexine distinctly tegillate, thicker than nexine, surface granulose.

***Anthocephalus cadamba* Miq. (Rubiaceae) [Fig. 4.1 I & J]**

Pollen grains radially symmetrical, sub-prolate (16µm × 13µm); amb sub-triangular, trizonocolporate, obtuse ends, anguloaperture, colpi linear, crassimarginate, extending 3/4th of meridian, ends acute, endoaperture distinct, lolongately oval, exine 1µm thick, sexine tegillate, thicker than nexine, surface reticulate.

***Basella alba* L. (Basellaceae) [Fig. 4.1 K & L]**

pollen grains radially symmetrical, dice shaped (25µm x 25µm), amb square in shape, hexazonocolpate, colpi slit like, exine 3-4µm thick, sexine distinctly tegillate, as thick as nexine except at the angles where sexine is much thicker than nexine, surface reticulate, near the colpi reticulation is very fine.

***Bombax ceiba* L. (Malvaceae) [Fig. 4.2 A & B]**

Pollen grains radially symmetrical, per-oblate (37µm × 76µm; amb triangular, trizonocolpate, planaperturate, exine 3µm thick, sexine slightly thicker than nexine, surface reticulate, heterobrocate and lumina polygonal.

***Borassus flabellifer* L. (Arecaceae) [Fig. 4.2 C & D]**

Pollen grains bilaterally symmetrical, oblate (30µm × 60µm); amb oval-elliptic, anasulcate, sulcus elliptic, tenuimarginate, exine 3µm thick, sexine tegillate, as thick as nexine, surface with sparsely distributed verrucae and gammae, verrucae 3.5µm in diameter.

***Brassica* sp. L. (Brassicaceae) [Fig. 4.2 E & F]**

Pollen grains radially symmetrical, sub-prolate (42µm × 36µm); amb circular, trizonocolpate, colpi elliptic, tenuimarginate, exine 3.5µm thick, sexine distinctly tegillate, thicker than nexine, surface reticulate, lumina polygonal, much wider in mesocolpia than those in apocolpia.

***Carica papaya* L. (Caricaceae) [Fig. 4.2 G & H]**

Pollen grains radially symmetrical, oblate-spheroidal (27µm x 30µm), amb sub-triangular, trizonocolporate, angulo-aperturate, colpi crassimarginate, about 2.5µm wide near equator,

tapering to acute ends, endoaperture lalongately elliptic, exine 2µm thick, sexine tegillate, thicker than nexine, surface reticulate.

***Citrullus lanatus* (Thunb.) Matsum. & Nakai (Cucurbitaceae) [Fig. 4.2 I]**

Pollen grains radially symmetrical, spheroidal (45µm in diameter); amb circular, trizonocolporate, colpi linear, extending almost up to poles, endoaperture circular, exine about 1.5µm thick, sexine distinctly tegillate, slightly thicker than nexine, surface reticulate, heterobrocate.

***Citrus* sp. (L.) Burm. f. (Rutaceae) [Fig. 4.2 J & K]**

Pollen grains radially symmetrical, oblate-spheroidal (25µm × 26µm); amb circular, tetra to pentazonocolporate, colpi narrowly elliptic, extended from pole to pole, endoaperture (2µm × 4µm) lalongate, exine 3µm thick, sexine slightly thicker than nexine, surface reticulate, heterobrocate, lumina polygonal, muri well developed.

***Coccinia grandis* L. J. Voigt (Cucurbitaceae) [Fig. 4.2 L]**

Pollen grains radially symmetrical, prolate (74µm × 51µm); amb circular, trizonocolporate, colpi linear, extending almost up to poles, about 4µm wide near equator, ends acuminate, endoaperture faint, lolongately oval, exine about 3.5µm thick, sexine distinctly tegillate, sexine slightly thicker than nexine, surface reticulate in mesocolpia and rugulo-reticulate in apocolpia, muri well developed, lumina broad 2µm in centre of mesocolpia and quite narrow in apocolpia and adjacent to colpi.

***Cocos nucifera* L. (Arecaceae) [Fig. 4.3 A & B]**

Pollen grains bilaterally symmetrical, oblate (20µm × 35µm); equatorial outline oval-elliptic, anasulcate, sulcus narrowly elliptic, ends pointed, exine about 2µm thick, sexine as thick as nexine, surface reticulate.

***Coriandrum sativum* L. (Apiaceae) [Fig. 4.3 C & D]**

Pollen grains radially symmetrical, per-prolate (25µm × 10µm); constricted at the equator, trizonocolporate, colpi narrowly elliptic, endoaperture lalongate, exine 1.5µm thick, sexine distinctly tegillate, surface finely reticulate.

***Croton bonplandianum* Baill. (Euphorbiaceae) [Fig. 4.3 E & F]**

Pollen grains radially symmetrical, spheroidal (38µm in diameter), outline circular, inaperturate, exine 5µm thick, intectate, surface densely clavate.

***Cucumis sativus* L. (Cucurbitaceae) [Fig. 4.3 G & H]**

Pollen grains radially symmetrical, prolate (45µm × 32µm); amb sub-triangular, trizonoporate, exine about 1µm thick, sexine distinctly tegillate, sexine slightly thicker than nexine, surface microreticulate.

***Cucurbita maxima* Duchesne (Cucurbitaceae) [Fig. 4.3 I, J & K]**

Pollen grains radially symmetrical, spheroidal (50µm in diameter); amb circular, pantoporate, exine about 1.5µm thick, sexine distinctly tegillate, sexine slightly thicker than nexine, surface granulose with sparsely distributed spines (spines 4-5µm long)

***Cyanotis axillaris* D. Don (Commelinaceae) [Fig. 4.3 L]**

Pollen grains bilaterally symmetrical, oblate (26µm × 52µm); equatorial outline elliptic, monosulcate, sulcus narrowly elliptic, ends pointed, exine about 1.5µm thick, surface conate.

***Dalbergia sissoo* Roxb. (Fabaceae) [Fig. 4.4 A & B]**

Radially symmetrical pollen grains, prolate-spheroidal (18µm × 35µm); triangular amb, trizonocolpate, colpi narrowly elliptic, endoaperture lalongate, exine about 0.5µm thick, tegillate sexine as thick as nexine, surface psilate.

***Delonix regia* (Bojer.) Raf. (Fabaceae) [Fig. 4.4 C]**

pollen grains radially symmetrical, spheroidal, diameter 65µm, amb circular, trizonocolporate, colpi narrowly elliptic, ends acute, endoaperture circular, exine 5µm thick, sexine thicker than

nexine, surface reticulate, muri well developed, pila present along the muri, lumina granulate, polygonal, wider at the centre and mesocolpal region and small at the colpal region.

***Duranta erecta* L. (Verbenaceae) [Fig. 4.4 D & E]**

Pollen grains radially symmetrical, oblate-spheroidal (33µm × 35µm); amb sub-triangular, trizonocolporate, endoaperture lolongately oval, exine about 2µm thick, sexine distinctly tegillate, thicker than nexine, surface psilate.

***Eucalyptus globulus* Labill. (Myrtaceae) [Fig. 4.4 F & G]**

Pollen grains radially symmetrical, sub-oblate (19.5µm × 23.5µm); amb triangular or square, sides straight to slightly concave, trizonoparasyncolporate, sometimes tetrazonoparasyncolporate, angulaperturate, colpi linear, 1.5µm thick, sexine as thick as nexine, surface psilate.

***Eupatorium odoratum* L. (Asteraceae) [Fig. 4.4 H & I]**

Pollen grains radially symmetrical, sub-prolate (14.6µm × 12.5µm); amb circular, trizonocolpate, exine 2.7µm thick, scabrate with extremely short, blunt spines (1.4µm long).

***Flacourtia jangomas* (Lour.) Raeusch. (Salicaceae) [Fig. 4.4 J & K]**

Pollen grains radially symmetrical, spheroidal (19µm in diameter); amb circular, trizonocolporate, colpi narrowly elliptic, extending from pole to pole, endoaperture circular, exine 1.5µm thick, sexine thicker than nexine, surface reticulate.

***Foeniculum vulgare* Mill. (Apiaceae) [Fig. 4.4 L]**

Pollen grains radially symmetrical, per-prolate (13µm × 6µm); constricted at the equator, trizonocolporate, colpi narrowly elliptic, endoaperture lalongate, exine 1µm thick, subtectate, surface finely reticulate.

***Holoptelea integrifolia* (Roxb.) Planchon (Ulmaceae) [Fig. 4.5 A]**

Pollen grains radially symmetrical, prolate-spheroidal (23µm × 22µm); amb angular, generally pentagonal, pentaporate, exine 1.2µm thick, sexine distinctly tegillate, surface faintly microreticulate.

***Hygrophila schulli* (Buch.-Ham.) M. R. & S. M. Almeida (Acanthaceae) [Fig. 4.5 B & C]**

Pollen grains radially symmetrical, prolate (36µm × 25µm); amb circular, polyzonoheterocolpate with four colporate apertures, colpi extending almost up to poles, 2-2.5µm wide near equator, gradually tapering to acuminate tips, sides parallel, endoaperture distinct, circular to slightly oval lalongately, exine 2.5µm thick, sexine tagillate, sexine much thicker than nexine, surface reticulate, muri moderately developed, lumina polygonal, 1µm wide.

***Jatropha curcas* L. (Euphorbiaceae) [Fig. 4.5 D & E]**

Pollen grains radially symmetrical, spheroidal (47µm in diameter); inaperturate, exine 4.5µm thick, surface with crotonoid pattern.

***Leucaena leucocephala* (Lam.) de Wit (Fabaceae) [Fig. 4.5 F & G]**

Pollen grains radially symmetrical; prolate- spheroidal (57µm × 50µm); amb sub-triangular; tri to tetrazonocolporate, colpi broad, tapering towards the poles; exine 3.5µm thick, sexine thicker than nexine except at the poles where nexine is distinctly thicker (crassinexinous), surface rugulo-reticulate.

***Lippia nodiflora* (Linn.) Rich. (Verbenaceae) [Fig. 4.5 H & I]**

Pollen grains radially symmetrical, prolate (27µm × 20µm); amb sub-triangular, trizonocolporate, synorate, exine 2.5µm thick, sexine thicker than nexine, surface microreticulate.

***Litchi chinensis* Sonn. (Sapindaceae) [Fig. 4.5 J]**

Pollen grains radially symmetrical, oblate-spheroidal (21µm x 23µm), amb sub-triangular, trizonocolporate, angulo-aperturate, colpi linear, extending almost up to poles, endoaperture

circular to slightly lolongate, exine 3 µm thick, sexine distinctly tegillate, slightly thicker than nexine, surface faintly striato-reticulate

***Luffa cylindrica* L. (Cucurbitaceae) [Fig. 4.5 K & L]**

Pollen grains radially symmetrical, spheroidal (82µm in diameter); amb sub-triangular, trizonocolporate, colpi linear, extending almost up to poles, endoaperture faint, lolongately oval, exine about 4µm thick, sexine distinctly tegillate, sexine slightly thicker than nexine, surface reticulate, heterobrocate, lumina broad in centre of mesocolpia and quite narrowin apocolpia and adjacent to colpi.

***Madhuca indica* J. F. Gmel. (Sapotaceae) [Fig. 4.6 A & B]**

Pollen grains radially symmetrical, prolate-spheroidal (72µm × 64µm); amb circular, tetra to pentazonocolporate, colpi slit like, extending from pole to pole, endoaperture lalongate, exine 3.5µm thick, sexine distinctly tegillate, thicker than nexine, surface rugulate.

***Mangifera indica* L. (Anacardiaceae) [Fig. 4.6 C & D]**

Pollen grains radially symmetrical, spheroidal (30µm in diameter), amb sub-triangular, trizonocolporate, anguloaperturate, colpi narrowly elliptic with acute ends, endoaperture lalongate, exine about 2.5µm thick, sexine distinctly tegillate, sexine as thick as nexine, surface rugulo-reticulate.

***Mikania scandens* B. L. Rob. (Asteraceae) [Fig. 4.6 E]**

Pollen grains radially symmetrical, oblate-spheroidal (20-22µm × 22-24µm); amb circular, trizonocolporate, colpi narrowly elliptic, 16-18µm long and 2-2.5µm wide at the middle, tips acuminate, endoaperture circular, 2.5-3µm in diameter, exine about 2.5µm thick, sexine tegillate, thicker than nexine, surface spinate, spines about 3µm long and more or less 2µm wide at the base.

***Momordica charantia* L. (Cucurbitaceae) [Fig. 4.6 F & G]**

Pollen grains radially symmetrical, prolate-spheroidal (46µm × 42µm); amb ± circular, trizonocolporate, tenuimarginate, exine 2.5µm thick, sexine distinctly tegillate, thicker than nexine, surface rugulo-reticulate, muri moderately developed.

***Monochoria hastata* (Burm. f.) c. Presl ex Kunth (Pontederiaceae) [Fig. 4.6 H, I & J]**

Bilaterally symmetrical pollen grains, oblate (24 - 34µm × 47 - 72µm); elliptic amb, anasulcate, sulcus broad, almost occupying whole length of the grain, tenuimarginate exine about 1.5µm thick, sexine as thick as nexine, surface granulose.

***Moringa oleifera* Lam. (Moringaceae) [Fig. 4.6 K & L]**

Pollen grains radially symmetrical, prolate-spheroidal (42µm × 35µm); amb circular, trizonocolporate, colpi linear, extending 2/3rd of meridian, about 2.5µm wide near equator, ends acute, endoaperture distinct, lolongately elliptic, exine about 2µm thick, sexine slightly thinner than nexine, surface psilate.

***Nigella sativa* L. (Ranunculaceae) [Fig. 4.7 A & B]**

Pollen grains radially symmetrical, sub-oblate (33µm × 39µm); amb circular, trizonocolpate, colpi linear, extending almost up to poles, exine about 5µm thick, sexine distinctly tegillate, much thicker than nexine, surface clavate.

***Phoenix sylvestris* L. Roxb. (Arecaceae) [Fig. 4.7 C & D]**

Pollen grains bilaterally symmetrical, oblate (18µm × 36µm); amb elliptic, anasulcate, sulcus linear, exine 1.5µm thick, sexine tegillate, as thick as or slightly thicker than nexine, surface faintly granulose.

***Poa gangetica* Steud. (Poaceae) [Fig. 4.7 E & F]**

Pollen grains radially symmetrical, spheroidal (54µm in diameter); amb circular, anaporate, pore circular to oval in outline, more or less 3µm in diameter, crassimarginate, exine about 2µm thick, sexine as thick as nexine, surface psilate.

***Polianthes tuberosa* L. (Asparagaceae) [Fig. 4.7 G]**

Pollen grains bilaterally symmetrical, oblate (18µm × 28µm); amb elliptic, monosulcate, sulcus narrowly elliptic, exine about 1.5µm thick, surface conate.

***Punica granatum* L. (Lythraceae) [Fig. 4.7 H & I]**

Pollen grains radially symmetrical, prolate-spheroidal (45µm x 43µm), amb circular, trizonocolporate, colpi narrowly elliptic, endoaperture oval lalongate, exine 2µm thick, sexine distinctly tegillate, thicker than nexine, surface rugulate.

***Raphanus sativus* L. (Brassicaceae) [Fig. 4.7 J & K]**

Pollen grains radially symmetrical, sub-prolate (32µm x 26µm), amb sub-trilobate, trizonocolpate, fossaperturate, colpi narrowly elliptic, tenuimarginate, ± 3.5 µm wide near equator, tapering to acute ends, extending almost up to poles, exine 3µm thick, sexine distinctly tegillate, thicker than nexine, surface reticulate

***Sesamum indicum* L. (Pedaliaceae) [Fig. 4.7 L]**

Pollen grains radially symmetrical, oblate-spheroidal (76µm × 80µm); polyzonocolpate, colpi 54-57µm long and 5-6µm wide at the equator, ends acute, tenuimarginate, exine 2-3µm thick, tegillate, sexine slightly thicker than nexine, surface reticulate, homobrocate, lumina polygonal (1-1.5µm in diameter).

***Spondias pinnata* (L. f.) Kurz (Anacardiaceae) [Fig. 4.8 A]**

Pollen grains radially symmetrical, prolate-spheroidal (32.5µm × 31µm); amb circular, trizonocolporate, colpi narrowly elliptic, endoaperture lalongate, exine 2.5µm thick, sexine as thick as nexine, surface striate.

***Syzygium cumini* L. Skeels (Myrtaceae) [Fig. 4.8 B]**

Pollen grains radially symmetrical, oblate (10µm × 16µm); amb triangular, trizonoparasyncolporate, angulaperturate, colpi narrowly elliptic, 3-4µm long and about 1-2µm wide, ends acute, tenuimarginate, endoaperture lalongate, exine 1.5µm thick, sexine slightly thicker than nexine, surface psilate.

***Tamarindus indica* L. (Fabaceae) [Fig. 4.8 C]**

Pollen grains radially symmetrical, sub-prolate (44µm x 34µm), amb sub-triangular, trizonocolporate, angulo-aperturate, colpi narrowly elliptic, crassimarginate, ± 3.5 µm wide near equator, ends acute, endoaperture ± circular, exine 3.5 to 4 µm thick, sexine distinctly tegillate, almost equal to slightly thinner than nexine, surface striated.

***Terminalia arjuna* DC. Wight & Arn. (Combretaceae) [Fig. 4.8 D & E]**

Pollen grains radially symmetrical, prolate-spheroidal (17µm × 15µm); amb trilobate, trizonocolporate, apertures situated at the top of the lobes, alternating with three thin walled pseudocolpi contiguous at poles and situated in the ditch like indentations between the lobes; colpi slit like, extending almost up to poles, endoaperture distinct, lalongately oval, exine 2µm thick, sexine slightly thinner than nexine, surface psilate.

***Trema orientalis* (L.) Bl. (Cannabaceae) [Fig. 4.8 F]**

Pollen grains radially symmetrical, oblate-sphaeroidal (18µm x 19µm), amb circular, dizonoporate, pore circular, exine 1µm thick, sexine distinctly tegillate, as thick as nexine, surface faintly reticulate.

***Trichosanthes dioica* Roxb. (Cucurbitaceae) [Fig. 4.8 G]**

Pollen grains radially symmetrical, spheroidal (56µm in diameter), amb circular, trizonopororate, provided with an annulus (37µm in diameter), rarely tetrazonopororate, exine 3µm thick, sexine tegillate, thicker than nexine, surface psilate.

***Tridax procumbens* L. (Asteraceae) [Fig. 4.8 H]**

Pollen grains radially symmetrical, oblate-spheroidal (36µm × 38µm); amb circular, tri to tetrazonocolporate, colpi elliptic, tips acute, endoaperture lalongate, exine 3.5µm thick, sexine thicker than nexine, surface echinate with spine length of 5 - 5.5µm.

***Vernonia cinerea* Less. (Asteraceae) [Fig. 4.8 I & J]**

Pollen grains radially symmetrical, spheroidal (18.5µm in diameter), amb circular, trizonocolporate, echinolophate with micropunctate tectum, comprising lacuni surrounded by lophae, tectum surface with spines which are linearly distributed along the ridges of the lophate, diameter of lumina 3µm - 5µm, height of the spine 3µm, exine 2.5µm thick.

***Ziziphus mauritiana* Lam. (Rhamnaceae) [Fig. 4.8 K & L]**

Pollen grains radially symmetrical, sub-oblate (18µm × 21µm); amb sub-triangular, trizonocolporate, colpi narrowly elliptic, endoaperture more or less circular, exine about 1.5µm thick, sexine tegillate, as thick as nexine, surface psilate.

4.2. QUANTITATIVE ANALYSIS OF POLLENS OF DIFFERENT SPECIES IN HONEY SAMPLES OF *Apis mellifera* DURING DIFFERENT MONTHS OF A YEAR

Honey samples, collected for every month in a year, during three consecutive years, were quantitatively measured for estimating the presence of relative amount of pollens of different species in honey during this time. Details of the results obtained for the respective month have been furnished herein below.

Results have been displayed by showing records taken for every month for all the three years separately, as well as considering the collection during a month in all three years together.

Four honey samples were collected in each month by taking one sample in each time of collection for four dates in the month. Each sample itself was a mixture of random collections from multiple cells of hives. Each sample was analayzed and the pollens of different species were recorded.

4.2.1. January

Year 2014

In a decreasing order of frequency of pollens of different species obtained in this month the species were *Brassica* sp. (69.44%), *Coriandrum sativum* (17.55%), *Eucalyptus globulus* (3.06%), *Phoenix sylvestris* (7.38%) and *Ziziphus mauritiana* (2.55%), (Table 4.4, Fig. 4.19).

Year 2015

The species representations in this year for this month were *Brassica* sp. (59.77%), *Coriandrum sativum* (29.21%), *Poa gangetica* (3.14%), *Borassus flabellifer* (3.12%), *Moringa oleifera* (1.58%), *Cucurbita maxima* (1.51%), *Acacia nilotica* (0.89%) and *Phoenix sylvestris* (0.74%). (Table 4.5, Fig. 4.21).

Year 2016

During this year analyses of collected materials showed the occurrence of species as, *Brassica* sp. (52.63%), *Coriandrum sativum* (34.74%), *Phoenix sylvestris* (10.65%), *Acacia nilotica* (1.39%) and *Sesamum indicum* (0.57%). (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of January

While considering the data obtained during the month of January for three consecutive years together, the major representing plant taxa were found as, *Brassica* sp. and *Coriandrum sativum*. Twelve honey samples were collected from artificial hives during this month for three consecutive years. All twelve samples were noted to be unifloral. Amongst them 9 samples were of *Brassica* sp. and rest 3 samples of *Coriandrum sativum*. Quantitative analysis of these 12 honey samples, while considered together, revealed the list of plant species with their respective frequency of presence of pollen grains as *Brassica* sp. (60.61%), *Coriandrum sativum* (27.17%), *Phoenix sylvestris* (6.26%), *Borassus flavellifer* (1.04%), *Eucalyptus globulus* (1.02%), *Poa gangetica* (1.04%), *Ziziphus mauritiana* (0.85%), *Acacia nilotica* (0.76%), *Cucurbita maxima* (0.50%), *Moringa oleifera* (0.52%), and *Sesamum indicum* (0.19%), (Table 4.7, Fig.4.25).

4.2.2. February

Year 2014

The pollens of different species recorded in the honey samples in February of this year were as follows, *Coriandrum sativum* (28.47%), *Brassica* sp. (25%), *Holoptelea integrifolia* (14.27%), *Moringa oleifera* (14.26%), *Cocos nucifera* (12.83%), *Croton bonplandianum* (3.60%), *Trema orientalis* (1.36%) and *Phoenix sylvestris* (0.87%), (Table 4.4, Fig. 4.19).

Year 2015

The species representations in honey samples in this year were *Brassica* sp. (37.70%), *Coriandrum sativum* (29.24%), *Moringa oleifera* (7.81%), *Ziziphus mauritiana* (7.64%), *Basella alba* (5.52%), *Holoptelea integrifolia* (4.86%), *Cucumis sativus* (2.34%), *Phoenix sylvestris* (1.73%), *Eupatorium odoratum* (1.46%), *Madhuca indica* (1%) and *Eucalyptus globulus* (0.66%), (Table 4.5, Fig. 4.21).

Year 2016

During this year analyses of collected materials showed the preponderance of *Brassica* sp. (53.36%) and other species were *Coriandrum sativum* (21.39%), *Phoenix sylvestris* (9.98%), *Poa gangetica* (9.57%), *Cocos nucifera* (3.85%) and *Eucalyptus globulus* (1.31%), (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of February

In consideration of total number of species recorded in this month during three years the major representing plant taxa were found as, *Brassica* and *Coriandrum sativum*. Among total collections 11 honey samples were unifloral, collected on different dates and 1 honey sample was multifloral in origin. These unifloral honeys were of *Brassica* sp., *Cocos nucifera, Coriandrum sativum, Holoptelea integrifolia* and *Phoenix sylvestris.* Among the multifloral honey samples the major representing plant taxa were *Brassica* sp., *Holoptelea integrifolia* and *Phoenix sylvestris*. Quantitative analysis in consideration of all these 12 honey samples, together, revealed the average percentage of pollen grains supplied by different plant species

as follows. The most prevalent being *Brassica* sp. (38.69%), others species follow as *Coriandrum sativum* (26.37%), *Moringa oleifera* (7.35%), *Holoptelea integrifolia* (6.37%), *Cocos nucifera* (5.56%), *Phoenix sylvestris* (4.19%), *Ziziphus mauritiana* (2.54%), *Poa gangetica* (3.19%), *Basela alba* (1.84%), *Croton bonplandianum* (1.20%), *Cucumis sativus* (0.78%), *Eucalyptus globulus* (0.65%), *Eupatorium odoratum* (0.48%), *Madhuca indica* (0.33%) and *Trema orientalis* (0.45%), (Table 4.7, Fig. 4.25).

4.2.3. March

Year 2014

Pollens of different species with respective frequency of occurrence were obtained as *Ziziphus mauritiana* (68.89%), *Nigella sativa* (24.15%), *Brassica* sp. (3.71%), *Alangium salvifolium* (2.46%) and *Moringa oleifera* (0.74%), (Table 4.4, Fig.4.19).

Year 2015

During this year the species in sequence of relative frequency of presence were *Ziziphus mauritiana* (28.86%), *Holoptelea integrifolia* (20.21%), *Nigella sativa* (19.05%), *Moringa oleifera* (14.29%), *Cocos nucifera* (4.02%), *Alangium salvifolium* (2.86%), *Brassica* sp. (2.41%), *Coriandrum sativum* (2.08%), *Mikania scandens* (1.18%) and *Amaranthus* sp. (0.42%), (Table 4.5, Fig. 4.21).

Year 2016

Analyses of collected materials in this year showed the pollens of different species in a sequence of decreasing order as, *Ziziphus mauritiana* (65.68%), *Moringa oleifera* (13.28%), *Holoptelea integrifolia* (6.54%), *Coriandrum sativum* (4.14%), *Nigella sativa* (3.11%), *Borassus flabellifer* (2.31%), *Alangium salvifolium* (2.28%), *Mikania scandens* (1.90%), *Brassica* sp. (0.73%) and *Bombax ceiba* (0.10%), (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of March

In considering the data obtained during the month of March for three consecutive years together the major representing plant taxa were found as, *Nigella sativa* and *Ziziphus mauritiana*. Out of 12 total samples 10 were unifloral for *Ziziphus mauritiana* (7 samples), *Holoptelea integrifolia* and 1 samples for each of *Nigella sativa* and *Moringa oleifera*. Within the multiflioral honey sample the pollens of plant taxa, present in greater number, were *Holoptelea integrifolia, Moringa oleifera* and *Ziziphus mauritiana*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species were *Ziziphus mauritiana* (54.48%), *Nigella sativa* (13.85%), *Moringa oleifera* (12.52%), *Holoptelea integrifolia* (8.91%), *Alangium salvifolium* (2.54%), *Brassica* sp. (2.28%), *Coriandrum sativum* (2.07%), *Cocos nucifera* (1.34%), *Mikania scandens* (1.02%), *Borassus flabellifer* (0.77%), *Amaranthus* sp. (0.14%) and *Bombax ceiba* (0.03%), (Table 4.7, Fig. 4.25).

4.2.4. April

Year 2014

The pollens of different species recorded were as follows. *Ziziphus mauritiana* (30.65%) being the most prevailing one numerically, other two species, almost of similar strength of presence, were *Moringa oleifera* (28.27%) and *Syzygium cumini* (21.91%). Meagre presence was noted for *Nigella sativa* (6.68%), *Leucaena leucocephala* (4.77%), *Alangium salvifolium* (3.05%), *Holoptelia integrifolia* (2.78%) and *Litchi chinensis* (1.88%), (Table 4.4, Fig. 4.19).

Year 2015

The species representations in honey samples in this year were *Mangifera indica* (22.47%), *Duranta erecta* (21.07%), *Sesamum indicum* (18.47%), *Borassus flabellifer* (17.30%), *Momordica charantia* (9.09%), *Coriandrum sativum* (6.27%), *Phoenix sylvestris* (3.85%), *Brassica* sp. (0.63%) and *Holoptelea integrifolia* (0.58%), (Table 4.5, Fig. 4.21).

Year 2016

Pollens of the species occurred in decreasing order of frequency of presence during this time were *Ziziphus mauritiana* (25.10%), *Citrus* sp. (15.88%), *Holoptelea integrifolia* (13.87%), *Borassus flabellifer* (13.20%), *Nigella sativa* (12.80%), *Hygrophila schulli* (9.11%), *Mangifera indica* (3.71%), *Phoenix sylvestris* (3.52%) and *Momordica charantia* (2.75%), (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of April

Among total 12 samples collected during three years in the month of April only 1 honey sample was multifloral with *Momordica charantia, Borassus flabellifer* and *Coriandrum sativum*. Eleven samples were unifloral in nature, of which 3 were of *Ziziphus mauritiana* and 1 samples each of *Borassus flabellifer, Citrus* sp., *Duranta erecta, Holoptelea integrifolia, Mangifera indica, Moringa oleifera, Sesamum indicum* and *Syzygium cumini*. Enumeration of pollen population revealed that the plant species according to their relative presence of pollens in the samples were *Ziziphus mauritiana* (18.58%), *Borassus flabellifer* (10.16%), *Moringa oleifera* (9.42%), *Duranta erecta* (7.02%), *Mangifera indica* (8.72%), *Nigella sativa* (6.49%), *Holoptelea integrifolia* (5.74%), *Citrus* sp. (5.29%), *Sesamum indicum* (6.15%), *Momordica charantia* (3.95%), *Hygrophila schulli* (3.03%), *Phoenix sylvestris* (2.45%), *Leucaena leucocephala* (1.59%), *Alangium salvifolium* (1.01%), *Litchi chinensis* (0.62%) and *Brassica* sp. (0.21%), (Table 4.7, Fig. 4.25).

4.2.5. May

Year 2014

Pollens of the species recorded with respective frequency of occurrence were *Sesamum indicum* (66.27%), *Delonix regia* (13.81%), *Borassus flabellifer* (11.20%), *Trema orientalis* (4.04%), *Amaranthus* sp. (1.98%), *Nigella sativa* (1.56%) and *Momordica charantia* (1.15%), (Table 4.4, Fig. 4.19).

Year 2015

The species representations in this year were *Amaranthus* sp. (46.79%), *Sesamum indicum* (26.39%), *Borassus flabellifer* (19.56%), *Polianthes tuberosa* (4.19%), *Nigella sativa* (2.14%) and *Citrullus lanatus* (0.90%), (Table 4.5, Fig. 4.21).

Year 2016

During this year analyses of collected materials showed the pollens of the species with respective frequency of occurrence as, *Sesamum indicum* (89.87%), *Borassus flabellifer* (9.23%) and *Poa gangetica* (0.88%), (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of May

All 12 samples collected during this month were unifloral, mostly for *Sesamum indicum* (7 samples), *Amaranthus* sp. (3 samples) and 1 samples for each of *Borassus flabellifer* and *Delonix regia.* In consideration of the data obtained during May for three consecutive years together the pollen populations of different species with respective frequencies were *Sesamum indicum* (60.84%), *Amaranthus* sp. (16.26%), *Borassus flabellifer* (13.33%), *Delonix regia* (4.60%), *Polianthes tuberosa* (1.39%), *Trema orientalis* (1.34%), *Nigella sativa* (1.23%), *Momordica charantia* (0.38%), *Poa gangetica* (0.29%) and *Citrullus lanatus* (0.30%), (Table 4.7, Fig. 4.25).

4.2.6. June

Year 2014

Four honey samples, collected during this month in this year, were found as, *Anthocephalus cadamba* (34.07%), *Amaranthus* sp. (31.11%), *Trema orientalis* (30.03%), *Sesamum indicum* (2.91%) and *Jatropha curcas* (1.85%), (Table 4.4, Fig. 4.19).

Year 2015

The species representations in this year for this month were *Amaranthus* sp. (52.38%), *Croton bonplandianum* (16.62%), *Sesamum indicum* (15.39%), *Jatropha curcas* (9.79%), *Trema orientalis* (2.55%), *Cocos nucifera* (1.72%) and *Lippia nodiflora* (1.51%), (Table 4.5, Fig. 4.21).

Year 2016

During this year pollens of only two species recorded in the collections were *Amaranthus* sp. (65.82%) and *Sesamum indicum* (34.18%), (Table 4.6, Fig. 4.23).

Pollens recorded collectively for the month of June

Amongst 12 honey samples, collected during this month of June for three consecutive years, 11honey samples were unifloral of the species *Anthocephalus cadamba* (2 samples), *Amaranthus* sp. (7 samples), *Sesamum indicum* (1 sample) and *Trema orientalis* (1sample). Rest 1 honey sample was multifloral in origin. In multifloral honey sample the major representing plant taxa were *Croton bonplandianum* and *Jatropha curcas*. Enumeration of pollen grains of the species found with their relative presence in 12 samples considered together, in terms of percentage for the species were, *Amaranthus* sp. (49.77%), *Sesamum indicum* (17.50%), *Anthocephalus cadamba* (11.35%), *Trema orientalis* (10.86%), *Croton bonplandianum* (5.54%), *Jatropha curcas* (3.88%), *Cocos nucifera* (0.57%) and *Lippia nodiflora* (0.50%), (Table 4.7, Fig. 4.25).

4.2.7. July

Year 2014

Four honey samples of this month analayzed for this year revealed the species as, *Trema orientalis* (58.90%), *Anthocephalus cadamba* (28.18%), *Amaranthus* sp. (9.29%), *Coriandrum sativum* (1.19%), *Borassus flabellifer* (1.17%), *Cocos nucifera* (0.86%) and *Croton bonplandianum* (0.34%), (Table 4.4, Fig. 4.20).

Year 2015

The species with relative frequency, recorded for this year, were *Anthocephalus cadamba* (54.25%), *Trema orientalis* (42.16%), *Amaranthus* sp. (2.43%), *Alangium salvifolium* (0.96%) and *Sesamum indicum* (0.17%), (Table 4.5, Fig. 4.22).

Year 2016

During this year analyses of collected materials showed the occurrence of species as, *Trema orientalis* (52.07%), *Anthocephalus cadamba* (38.03%), *Amaranthus* sp. (3.65%), *Brassica* sp. (2.01%), *Sesamum indicum* (1.81%), *Poa gangetica* (1.67%) and *Croton bonplandianum* (0.73%), (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of July

Twelve honey samples, collected during the month of July for three consecutive years, showed all honey samples to be unifloral, of which 7 samples for *Trema orientalis* and 5 samples of *Anthocephalus cadamba*. The major representing plant species were – *Anthocephalus cadamba* and *Trema orientalis*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species as *Trema orientalis* (51.04%), *Anthocephalus cadamba* (40.15%), *Amaranthus* sp. (5.12%), *Brassica* sp. (0.67%), *Sesamum indicum* (0.66%), *Poa gangetica* (0.55%), *Borassus flabellifer* (0.39%), *Coriandrum sativum* (0.39%), *Croton bonplandianum* (0.36%), *Alangium salvifolium* (0.32%) and *Cocos nucifera* (0.28%), (Table 4.7, Fig. 4.26).

4.1.8 August

Year 2014

In August of 2014 the pollens of only two species, *Trema orientalis* (52.59%) and *Poa gangetica* (47.54%) were recorded in the collected samples of honey (Table 4.4, Fig. 4.20).

Year 2015

The species representations in this year were *Trema orientalis* (85.23%), *Poa gangetica* (13.40%) and *Cyanotis axillaris* (1.35%), (Table 4.5, Fig. 4.22).

Year 2016

During this year analyses of collected materials showed the presence of the pollens of *Trema orientalis* (35.47%), *Poa gangetica* (28.77%), *Borassus flabellifer* (20%), *Vernonia cinerea* (10.76%) and *Cocos nucifera* (4.99%), (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of August

Considering total collection in the month of August for all three years of survey all twelve samples were unifloral for *Trema orientalis* (9 samples), *Poa gangetica* (2 samples) and *Borassus flabellifer* (1 sample). The major representing taxa within these collections were *Poa gangetica* and *Trema orientalis*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species were *Trema orientalis* (57.77%), *Poa gangetica* (29.90%), *Borassus flabellifer* (6.66%), *Vernonia cinerea* (3.58%), *Cocos nucifera* (1.66%) and *Cyanotis axillaris* (0.45%), (Table 4.7, Fig. 4.26).

4.1.9 September

Year 2014

Four honey samples, collected on four different dates of this month showed the relative representation of three species as *Poa gangetica* (79.06%), *Acacia nilotica* (19.46%) and *Anthocephalus cadamba* (1.47%). (Table 4.4, Fig. 4.20).

Year 2015

The species representations in this year were *Poa gangetica* (63.85%), *Anthocephalus cadamba* (23.67%) and *Acacia nilotica* (12.46%). (Table 4.5, Fig. 4.22).

Year 2016

Study in September of this year showed the presence of *Poa gangetica* (64.63%), *Trema orientalis* (16.03%), *Trichosanthes dioica* (11.87%), *Anthocephalus cadamba* (5.22%) and *Acacia nilotica* (2.15%) in the pollens within honey samples. (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of September

All 12 samples during the month of September for three years, were unifloral mostly for *Poa gangetica* (10 samples) and 1 sample for each of *Anthocephalus cadamba* and *Trema orientalis*. Amongst the pollens species recorded in 12 honey samples *Poa gangetica* was recorded as the most dominating one. Species according to their percentage of abundance in the sample were

obtained as, *Poa gangetica* (69.18%), *Acacia nilotica* (11.36%), *Anthocephalus cadamba* (10.12%), *Trema orientalis* (5.34%) and *Trichosanthes dioica* (3.95%), (Table 4.7, Fig. 4.26).

4.1.10 October

Year 2014

Relative presence of pollens of different species in the samples collected in October of this year was registered as, *Poa gangetica* (49.66%), *Trema orientalis* (31.40%), *Cocos nucifera* (9.31%), *Coriandrum sativum* (5.71%), *Acacia auriculiformis* (2.07%), *Monochoria hastata* (0.96%) and *Sesamum indicum* (0.86%). (Table 4.4, Fig. 4.20).

Year 2015

The species representations in this year for the month of October were *Acacia auriculiformis* (55.42%), *Poa gangetica* (41.73%), *Luffa cylindrica* (1.57%) and *Momordica charantia* (1.13%). (Table 4.5, Fig. 4.22).

Year 2016

In this year the species in decreasing order of their relative presence in the collected honey samples were *Poa gangetica* (60.79%), *Acacia auriculiformis* (16.05%), *Cocos nucifera* (10.76%), *Luffa cylindrica* (3.61%), *Momordica charantia* (3.30%), *Trema orientalis* (2.86%) and *Coccinia grandis* (2.60%), (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of October

Study of the total collections in October for three consecutive years revealed unifloral nature of all honey samples of which majority was of *Poa gangetica* (7 samples), while 3 samples were of *Acacia auriculiformis* and 1 sample each of *Coccnia grandis* and *Trema orientalis*. The relative occurrences of the species were *Poa gangetica* (50.73%), *Acacia auriculiformis* (24.51%), *Trema orientalis* (11.42%), *Cocos nucifera* (6.69%), *Coriandrum sativum* (1.90%), *Coccnia grandis* (0.86%), *Momordica charantia* (1.48%), *Luffa cylindrica* (1.72%), *Monochoria hastata* (0.32%) and *Sesamum indicum* (0.28%), (Table 4.7, Fig. 4.26).

4.1.11 November

Year 2014

The pollens of different species recorded in this year for the month were *Ziziphus mauritiana* (27.97%), *Cyanotis axillaris* (18.09%), *Cocos nucifera* (17.28%), *Poa gangetica* (13.98%), *Brassica* sp. (11.56%), *Trema orientalis* (7.71%), *Amaranthus* sp. (1.81%) and *Phoenix sylvestris* (1.22%), (Table 4.4, Fig. 4.20).

Year 2015

Relative occurrence of pollens in the samples collected during November of this year showed the species as *Brassica* sp. (39.52%), *Cyanotis axillaris* (19.37%), *Poa gangetica* (16.97%), *Amaranthus* sp. (14.66%), *Ziziphus mauritiana* (7.02%) and *Mikania scandens* (2.44%), (Table 4.5, Fig. 4.22).

Year 2016

Representations of different species recorded from the study of pollens obtained in honey samples of the collection during November for this year were *Brassica* sp. (40.29%), *Ziziphus mauritiana* (30.08%), *Poa gangetica* (13.15%), *Acacia auriculiformis* (8.85%), *Cyanotis axillaris* (2.47%) and *Mikania scandens* (0.75%), (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of November

Amongst the total collection of 12 honey samples, by taking the collections of three consecutive years for this month together, 8 were recorded as of unifloral origin and other 4 honey samples of multifloral nature. Unifloral honeys were of 1 sample for each of *Cocos nucifera*, *Cyanotis axillaris* and *Ziziphus mauritiana*, 3 samples of *Brassica* sp. and 2 samples of *Poa gangetica*. Numerically the relative representations of the species were *Brassica* sp. (30.46%), *Ziziphus mauritiana* (21.69%), *Poa gangetica* (14.70%), *Cyanotis axillaris* (13.31%), *Cocos nucifera* (5.76%), *Amaranthus* sp. (5.74%), *Acacia auriculiformis* (2.95%), *Trema orientalis* (2.57%), *Mikania scandens* (2.26%) and *Phoenix sylvestris* (0.40%), (Table 4.7, Fig. 4.26).

4.1.12 December

Year 2014

Pollen frequency in the collections during the month of 2014 showed species representation as *Brassica* sp. (81.91%), *Coriandrum sativum* (8.56%), *Moringa oleifera* (4.78%), *Poa gangetica* (2.44%), *Mikania scandens* (1.24%) and *Cocos nucifera* (1.03%), (Table 4.4, Fig. 4.20).

Year 2015

The species recorded for this year during this month were *Brassica* sp. (79.59%), *Coriandrum sativum* (19.31%) and *Mikania scandens* (1.09%), (Table 4.5, Fig. 4.22).

Year 2016

Species representation during this year for December collection, in decreasing order, were *Brassica* sp. (91.90%), *Mikania scandens* (4.72%), *Coriandrum sativum* (2.69%) and *Moringa oleifera* (0.67%), (Table 4.6, Fig. 4.24).

Pollens recorded collectively for the month of December

All twelve honey samples, collected for December in three years, were unifloral with *Brassica* sp. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species as, *Brassica* sp. (84.47%), *Coriandrum sativum* (10.18%), *Moringa oleifera* (1.79%), *Poa gangetica* (0.81%), *Cocos nucifera* (0.34%) and *Mikania scandens* (2.35%). (Table 4.7, Fig. 4.26).

4.3. QUANTITATIVE ANALYSIS OF POLLENS IN CORBICULAR LOADS OF *Apis mellifera* DURING DIFFERENT MONTHS OF A YEAR

Corbicular loads, the pollens carried in pollen bags on the hind legs of bees, were collected during three consecutive years for every month in a year and enumerated for estimating the relative presence of different species in the loads during different seasons.

In every month during the study for three consecutive years (2014 – 2016) thirtytwo pollen loads were collected by taking 8 bees each time of collection for four dates in a month and resulting in altogether 96 samples in three years. Samples collected in every month for all three years were analyzed separately and also monthwise, by taking into consideration all collections for three years for a month together.

Detail account of the results has been furnished herein below.

4.2.1 January

Year 2014

Pollens of the species obtained in different frequencies in January of this year were *Brassica* sp. (40.62%), *Coriandrum sativum* (15.62%), *Ziziphus mauritiana* (12.50%), *Phoenix sylvestris* (12.50%), *Luffa cylindrica* (6.25%), *Raphanus sativus* (6.25%), *Nigella sativa* (3.12%) and *Cocos nucifera* (3.12%), (Table 4.8, Fig. 4.27).

Year 2015

The species representations in this year were *Brassica* sp. (31.25%), *Phoenix sylvestris* (18.75%), *Coriandrum sativum* (12.50%), *Ziziphus mauritiana* (12.50%), *Nigella sativa* (12.50%), *Luffa cylindrica* (9.37%) and *Cocos nucifera* (3.12%), (Table 4.9, Fig. 4.29).

Year 2016

The decreasing order of the frequency of occurrence of the species found in this year for January were *Brassica* sp. (37.50%), *Coriandrum sativum* (18.75%), *Ziziphus mauritiana* (18.75%), *Cocos nucifera* (9.37%), *Nigella sativa* (6.25%), *Phoenix sylvestris* (3.12%), *Luffa cylindrica* (3.12%) and *Raphanus sativus* (3.12%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of January

Considering the total collection during the month of January for three consecutive years together the major representing plant taxa were found as, *Brassica* sp. and *Coriandrum sativum*. Quantitative analysis revealed the average percentage of pollen grains supplied by

different plant species as *Brassica* sp. (40.62%), *Coriandrum sativum* (15.62%), *Ziziphus mauritiana* (12.50%), *Phoenix sylvestris* (12.50%), *Luffa cylindrica* (6.25%), *Raphanus sativus* (6.25%), *Nigella sativa* (3.12%) and *Cocos nucifera* (3.12%), (Table 4.11, Fig. 4.33).

4.2.2 February

Year 2014

The pollens of different species recorded in the samples collected in February of this year were *Phoenix sylvestris* (21.87%), *Coriandrum sativum* (18.75%), *Brassica* sp. (15.62%), *Holoptelia integrifolia* (15.62%), *Litchi chinensis* (9.37%), *Luffa cylindrica* (6.25%), *Nigella sativa* (6.25%) and *Citrus* sp. (6.25%), (Table 4.8, Fig. 4.27).

Year 2015

The species representations in this year were noted to be *Coriandrum sativum* (25%), *Phoenix sylvestris* (15.62%), *Luffa cylindrica* (15.62%), *Holoptelia integrifolia* (15.62%), *Brassica* sp. (9.37%), *Nigella sativa* (9.37%), *Litchi chinensis* (6.25%) and *Citrus* sp. (3.12%), (Table 4.9, Fig 4.29).

Year 2016

During this year the species with respective frequency of presence were recorded as, *Coriandrum sativum* (25%), *Phoenix sylvestris* (21.87%), *Luffa cylindrica* (9.37%), *Brassica* sp. (9.37%), *Holoptelia integrifolia* (9.37%), *Nigella sativa* (9.37%), *Citrus* sp. (9.37%) and *Litchi chinensis* (6.25%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of February

On the basis of total collection during February for three consecutive years together the major representing plant taxa were found as, *Coriandrum sativum* and *Phoenix sylvestris*. The relative presence of different taxa, in terms of average percentage of pollen grains of different plant species, were *Coriandrum sativum* (22.91%), *Phoenix sylvestris* (19.79%), *Brassica* sp.

(11.45%), *Holoptelia integrifolia* (13.54%), *Litchi chinensis* (7.29%), *Luffa cylindrica* (10.41%), *Nigella sativa* (8.33%) and *Citrus* sp. (6.25%), (Table 4.11, Fig. 4.33).

4.2.3 March

Year 2014

Scrutiny of pollen loads during March of this year identified 15 species as *Citrus* sp. (18.75%), *Hygrophila schulli* (15.62%), *Holoptelia integrifolia* (9.37%), *Moringa oleifera* (6.25%), *Momordica charantia* (6.25%), *Nigella sativa* (6.25%), *Spondias pinnata* (6.25%), *Cocos nucifera* (6.25%), *Mikania scandens* (6.25%), *Alangium salvifolium* (3.12%), *Bombax ceiba* (3.12%), *Cucurbita maxima* (3.12%), *Ageratum conyzoides* (3.12%), *Cucumis sativus* (3.12%) and *Flacourtia jangomas* (3.12%), (Table 4.8, Fig. 4.27).

Year 2015

The species representations in the load samples collected in this year for the month were *Moringa oleifera* (15.62%), *Citrus* sp. (12.50%), *Nigella sativa* (9.37%), *Holoptelia integrifolia* (6.25%), *Mikania scandens* (6.25%), *Cucurbita maxima* (6.25%), *Ageratum conyzoides* (6.25%), *Alangium salvifolium* (6.25%), *Bombax ceiba* (6.25%), *Momordica charantia* (6.25%), *Cocos nucifera* (6.25%), *Borassus flabellifer* (3.12%), *Luffa cylindrica* (3.12%), *Flacourtia jangomas* (3.12%) and *Cucumis sativus* (3.12%), (Table 4.9, Fig. 4.29).

Year 2016

Plant species represented in the load collection of this year were *Citrus* sp. (15.62%), *Hygrophila schulli* (12.50%), *Holoptelia integrifolia* (9.37%), *Coriandrum sativum* (6.25%), *Cucumis sativus* (6.25%), *Mikania scandens* (6.25%), *Luffa cylindrica* (6.25%), *Flacourtia jangomas* (6.25%), *Spondias pinnata* (6.25%), *Cocos nucifera* (6.25%), *Borassus flabellifer* (3.12%), *Cucurbita maxima* (3.12%), *Momordica charantia* (3.12%), *Bombax ceiba* (3.12%), *Nigella sativa* (3.12%) and *Ageratum conyzoides* (3.12%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of March

Taking into account total collection of corbicular loads on this month for three years the species occurring in greater number were noted to be *Citrus* sp., *Hygrophila schulli* and *Holoptelia integrifolia.* Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species e.g. *Citrus* sp.(18.75%), *Hygrophila schulli* (15.62%), *Holoptelia integrifolia* (9.37%), *Moringa oleifera* (6.25%), *Momordica charantia* (6.25%), *Nigella sativa* (6.25%), *Spondias pinnata* (6.25%), *Cocos nucifera* (6.25%), *Mikania scandens* (6.25%), *Alangium salvifolium* (3.12%), *Bombax ceiba* (3.12%), *Cucurbita maxima* (3.12%), *Ageratum conyzoides* (3.12%), *Cucumis sativus* (3.12%) and *Flacourtia jangomas* (3.12%), (Table 4.11, Fig. 4.33).

4.2.4 April

Year 2014

In terms of percentage of occurrence of the pollens in the collection of corbicular loads in April of 2014 the plant species noted were *Borassus flabellifer* (28.12%), *Sesamum indicum* (18.75%), *Cucurbita maxima* (15.62%), *Alangium salvifolium* (12.50%), *Croton bonplandianum* (9.37%), *Moringa oleifera* (9.37%) and *Bombax ceiba* (6.25%), (Table 4.8, Fig. 4.27).

Year 2015

The species representations in this year were *Borassus flabellifer* (40.62%), *Sesamum indicum* (18.75%), *Moringa oleifera* (18.75%), *Bombax ceiba* (9.37%), *Alangium salvifolium* (6.25%) and *Cucurbita maxima* (6.25%), (Table 4.9, Fig. 4.29).

Year 2016

During this year the species with respective frequency of occurrence were *Borassus flabellifer* (31.25%), *Sesamum indicum* (18.75%), *Cucurbita maxima* (12.50%), *Alangium salvifolium* (12.50%), *Bombax ceiba* (12.50%), *Moringa oleifera* (9.37%) and *Croton bonplandianum* (3.12%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of April

Collectively for the month of April during three years pollens of the species found in the corbicular load were *Borassus flabellifer, Sesamum indicum* and *Cucurbita maxima* as the major members. Enumeration of pollen populations revealed that the plant species according to their relative presence of pollens in the samples were *Borassus flabellifer* (28.12%), *Sesamum indicum* (18.75%), *Cucurbita maxima* (15.62%), *Alangium salvifolium* (12.50%), *Croton bonplandianum* (9.37%), *Moringa oleifera* (9.37%) and *Bombax ceiba* (6.25%). (Table 4.11, Fig. 4.33).

4.2.5 May

Year 2014

Species in record during May of this year were Sesamum indicum (34.37%), Borassus flabellifer (21.87%), Alangium salvifolium (12.50%), Cucumis sativus (12.50%), Polianthes tuberosa (9.37%), Trichosanthes dioica (6.25%) and Croton bonplandianum (3.12%), (Table 4.8, Fig. 4.27).

Year 2015

The species representations with respect to pollen counts were Sesamum indicum (28.12%), Borassus flabellifer (18.75%), Alangium salvifolium (12.50%), Trichosanthes dioica (12.50%), Croton bonplandianum (9.37%), Polianthes tuberosa (9.37%) and Cucumis sativus (9.37%), (Table 4.9, Fig. 4.29).

Year 2016

During this year analyses of collected materials showed the prevalence of species as, *Sesamum indicum* (31.25%), *Borassus flabellifer* (25%), *Cucumis sativus* (12.50%), *Alangium salvifolium* (9.37%), *Croton bonplandianum* (9.37%), *Polianthes tuberosa* (6.25%) and *Trichosanthes dioica* (6.25%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of May

Species recorded in pollen load during the month of May for three consecutive years were *Sesamum indicum* (34.37%), *Borassus flabellifer* (21.87%), *Alangium salvifolium* (12.50%), *Cucumis sativus* (12.50%), *Polianthes tuberosa* (9.37%), *Trichosanthes dioica* (6.25%) and *Croton bonplandianum* (3.12%), (Table 4.11, Fig. 4.33).

4.2.6 June

Year 2014

The species recorded in corbicular loads in this year for the month were *Anthocephalus cadamba* (25%), *Cucumis sativus* (18.75%), *Trema orientalis* (18.75%), *Tridax procumbens* (15.62%), *Trichosanthes dioica* (9.37%), *Terminalia arjuna* (6.25%), *Cocos nucifera* (3.12%) and *Croton bonplandianum* (3.12%), (Table 4.8, Fig. 4.27).

Year 2015

The load collections for the month of June in this year showed the species with respective frequency of occurrence as *Amaranthus* sp. (15.62%), *Eucalyptus globulus* (15.62%), *Trema orientalis* (12.50%), *Anthocephalus cadamba* (9.37%), *Cucumis sativus* (9.37%), *Trichosanthes dioica* (9.37%), *Croton bonplandianum* (6.25%), *Terminalia arjuna* (6.25%), *Duranta erecta* (6.25%), *Tridax procumbens* (6.25%) and *Cocos nucifera* (3.12%), (Table 4.9, Fig. 4.29).

Year 2016

Analyses of collected materials during this year showed the preponderance of the species in the following order, – *Anthocephalus cadamba* (15.62%), *Trema orientalis* (12.50%), *Croton bonplandianum* (12.50%), *Amaranthus* sp. (9.37%), *Duranta erecta* (9.37%), *Cucumis sativus* (9.37%), *Trichosanthes dioica* (9.37%), *Eucalyptus globulus* (6.25%), *Terminalia arjuna* (6.25%), *Tridax procumbens* (6.25%) and *Cocos nucifera* (3.12%), (Table 4.10, Fig. 4.31).

Pollens recorded collectively for the month of June

All data on pollen populations, collected in this month for three years, being considered together showed the preponderance of four species among eight total species as *Anthocephals cadamba*, *Cucumis sativus* and *Trema orientalis.* Enumeration of pollen grains of the species found with their relative presence in terms of percentage for the species were, *Anthocephalus cadamba* (25%), *Cucumis sativus* (18.75%), *Trema orientalis* (18.75%), *Tridax procumbens* (15.62%), *Trichosanthes dioica* (9.37%), *Terminalia arjuna* (6.25%), *Cocos nucifera* (3.12%) and *Croton bonplandianum* (3.12%), (Table 4.11, Fig. 4.33).

4.2.7 July

Year 2014

The species recorded in corbicular load in this year for July were *Cocos nucifera* (12.50%), *Cyanotis axillaris* (12.50%), *Amaranthus* sp. (9.37%), *Leucaena leucocephala* (9.37%), *Eucalyptus globulus* (9.37%), *Trichosanthes dioica* (6.25%), *Momordica charantia* (6.25%), *Punica granatum* (6.25%), *Acacia nilotica* (6.25%), *Trema orientalis* (6.25%), *Anthocephalus cadamba* (6.25%), *Terminalia arjuna* (3.12%), *Cucurbita maxima* (3.12%) and *Polianthes tuberosa* (3.12%), (Table 4.8, Fig. 4.28).

Year 2015

The record on the occurrence of species with their relative presence were as *Trema orientalis* (15.62%), *Cocos nucifera* (12.50%), *Cucurbita maxima* (12.50%), *Cyanotis axillaris* (9.37%), *Momordica charantia* (6.25%), *Polianthes tuberosa* (6.25%), *Punica granatum* (6.25%), *Acacia nilotica* (6.25%), *Citrus* sp. (6.25%), *Amaranthus* sp. (3.12%), *Anthocephalus cadamba* (3.12%), *Eucalyptus globulus* (3.12%), *Leucaena leucocephala* (3.12%), *Terminalia arjuna* (3.12%) and *Trichosanthes dioica* (3.12%), (Table 4.9, Fig. 4.30).

Year 2016

Pollens of the species recorded in this year for the month were *Cyanotis axillaris* (18.75%), *Cocos nucifera* (12.50%), *Trema orientalis* (9.37%), *Trichosanthes dioica* (9.37%),

Momordica charantia (9.37%), *Cucurbita maxima* (9.37%), *Eucalyptus globulus* (6.25%), *Acacia nilotica* (6.25%), *Amaranthus* sp. (6.25%), *Polianthes tuberosa* (3.12%), *Citrus* sp. (3.12%), *Punica granatum* (3.12%) and *Leucaena leucocephala* (3.12%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of July

The major representing plant taxa found in 32 samples of corbicular loads in July for three years were – *Cocos nucifera* and *Cyanotis axillaris*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species as follows, *Cocos nucifera* (12.50%), *Cyanotis axillaris* (12.50%), *Amaranthus* sp. (9.37%), *Leucaena leucocephala* (9.37%), *Eucalyptus globulus* (9.37%), *Trichosanthes dioica* (6.25%), *Momordica charantia* (6.25%), *Punica granatum* (6.25%), *Acacia nilotica* (6.25%), *Trema orientalis* (6.25%), *Anthocephalus cadamba* (6.25%), *Terminalia arjuna* (3.12%), *Cucurbita maxima* (3.12%) and *Polianthes tuberosa* (3.12%), (Table 4.11, Fig. 4.33).

4.2.8 August

Year 2014

The species recorded in the pollen load samples, collected for August in this year, were *Trema orientalis* (15.62%), *Poa gangetica* (12.50%), *Cyanotis axillaris* (12.50%), *Cocos nucifera* (12.50%), *Trichosanthes dioica* (9.37%), *Nigella sativa* (6.25%), *Acacia nilotica* (6.25%), *Cucumis sativus* (3.12%), *Foeniculam vulgare* (3.12%), *Anthocephalus cadamba* (3.12%), *Leucaena leucocephala* (3.12%), *Duranta erecta* (3.12%), *Monochoria hastata* (3.12%), *Polianthes tuberosa* (3.12%) and *Cucurbita maxima* (3.12%), (Table 4.8, Fig. 4.28).

Year 2015

The species representations in this year were *Cyanotis axillaris* (15.62%), *Cucumis sativus* (12.50%), *Anthocephalus cadamba* (12.50%), *Amaranthus* sp. (9.37%), *Cocos nucifera* (9.37%), *Cucurbita maxima* (6.25%), *Monochoria hastata* (6.25%), *Polianthes tuberosa*

(6.25%), *Trichosanthes dioica* (6.25%), *Acacia nilotica* (3.12%), *Duranta erecta* (3.12%), *Foeniculum vulgare* (3.12%), *Leucaena leucocephala* (3.12%), *Poa gangetica* (3.12%) and *Trema orientalis* (3.12%), (Table 4.9, Fig. 4.30).

Year 2016

Species in decreasing order of occurrence in the corbicular loads of this year's collection during August, represented through pollen population, were *Cocos nucifera* (12.50%), *Trema orientalis* (12.50%), *Cyanotis axillaris* (9.37%), *Duranta erecta* (9.37%), *Anthocephalus cadamba* (9.37%), *Monochoria hastata* (6.25%), *Polianthes tuberosa* (6.25%), *Leucaena leucocephala* (6.25%), *Amaranthus* sp. (6.25%), *Cucurbita maxima* (6.25%), *Poa gangetica* (6.25%), *Nigella sativa* (3.12%), *Foeniculum vulgare* (3.12%) and *Cucumis sativus* (3.12%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of August

Record of pollen frequency of different species collected in August for three consecutive years of study displayed the major representing taxa as *Trema orientalis*, *Poa gangetica*, *Cyanotis axillaris and Cocos nucifera*. Quantitative analysis revealed the species in sequence of a decreasing order of appearance as *Trema orientalis* (15.62%), *Poa gangetica* (12.50%), *Cyanotis axillaris* (12.50%), *Cocos nucifera* (12.50%), *Trichosanthes dioica* (9.37%), *Nigella sativa* (6.25%), *Acacia nilotica* (6.25%), *Cucumis sativus* (3.12%), *Foeniculum vulgare* (3.12%), *Anthocephalus cadamba* (3.12%), *Leucaena leucocephala* (3.12%), *Duranta erecta* (3.12%), *Monochoria hastata* (3.12%), *Polianthes tuberosa* (3.12%) and *Cucurbita maxima* (3.12%). (Table 4.11, Fig. 4.34).

4.2.9 September

Year 2014

The species of which pollen were recorded in September of this year were *Cocos nucifera* (25%), *Cyanotis axillaris* (21.87%), *Poa gangetica* (15.62%), *Leucaena leucocephala*

(15.62%), *Coccinia grandis* (6.25%), *Trema orientalis* (6.25%), *Acacia auriculiformis* (3.12%), *Foeniculum vulgare* (3.12%) and *Luffa cylindrica* (3.12%). (Table 4.8, Fig. 4.28)

Year 2015

The species representations in this year were *Poa gangetica* (18.75%), *Coccinia grandis* (15.62%), *Cyanotis axillaris* (12.50%), *Cocos nucifera* (12.50%), *Leucaena leucocephala* (9.37%), *Trema orientalis* (9.37%), *Acacia auriculiformis* (9.37%), *Cucumis sativus* (6.25%) and *Jatropha curcas* (6.25%), (Table 4.9, Fig. 4.30)

Year 2016

During this year analyses of collected materials showed the preponderance of species in the collections of corbicular load as, *Poa gangetica* (15.62%), *Cucumis sativus* (15.62%), *Leucaena leucocephala* (12.50%), *Cocos nucifera* (12.50%), *Trema orientalis* (9.37%), *Cyanotia axillaris* (9.37%), *Luffa cylindrica* (9.37%), *Jatropha curcas* (6.25%), *Foeniculum vulgare* (6.25%) and *Acacia auriculiformis* (3.12%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of September

Species recorded altogether for three years during September were *Cocos nucifera*, *Cyanotis axillaris*, *Poa gangetica* and *Leucaena leucocephala* as the most dominating species. Species according to their percentage of representation in the sample were obtained as, *Cocos nucifera* (25%), *Cyanotis axillaris* (21.87%), *Poa gangetica* (15.62%), *Leucaena leucocephala (15.62%), Coccinia grandis* (6.25%), *Trema orientalis* (6.25%), *Acacia auriculiformis* (3.12%), *Foeniculam vulgare* (3.12%) and *Luffa cylindrica* (3.12%), (Table 4.11, Fig. 4.34).

4.2.10 October

Year 2014

Species in decreasing order of appearance in the samples of corbicular load in October of 2014 were found to be *Poa gangetica* (21.87%), *Cyanotis axillaris* (21.87%), *Cocos nucifera* (15.62%), *Acacia auriculiformis* (12.50%), *Jatropha curcas* (6.25%), *Leucaena leucocephala*

(6.25%), *Raphanus sativas* (6.25%), *Coccinia grandis* (3.12%), *Foeniculum vulgare* (3.12%) and *Trema orientalis* (3.12%), (Table 4.8, Fig. 4.28).

Year 2015

The species representations in this year were Poa gangetica (25%), Cocos nucifera (18.75%), Cyanotis axillaris (18.75%), Acacia auriculiformis (9.37%), Raphanus sativus (6.25%), Jatropha curcas (6.25%), Trema orientalis (6.25%), Leucaena leucocephala (6.25%) and Foeniculum vulgare (3.12%), (Table 4.9, Fig. 4.30).

Year 2016

Analyses of collected materials during this year showed the prevalence of species, in decreasing order, as, Cyanotis axillaris (28.12%), Cocos nucifera (18.75%), Poa gangetica (18.75%), Acacia auriculiformis (12.50%), Trema orientalis (6.25%), Leucaena leucocephala (6.25%), Jatropha curcas (3.12%), Foeniculum vulgare (3.12%) and Raphanus sativus (3.12%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of October

Species on record in the corbicular loads during October for three consecutive years were found to be *Poa gangetica* (21.87%), *Cyanotis axillaris* (21.87%), *Cocos nucifera* (15.62%), *Acacia auriculiformis* (12.50%), *Jatropha curcas* 6.25%), *Leucaena leucocephala* (6.25%), *Raphanus sativus* (6.25%), *Coccinia grandis* (3.12%), *Foeniculam vulgare* (3.12%) and *Trema orientalis* (3.12%), (Table 4.11, Fig. 4.34).

4.2.11. November

Year 2014

Pollens on the basis of percentage of occurrence in loads during this month in 2014 were found to be of *Cyanotis axillaris* (25%), *Poa gangetica* (21.87%), *Acacia auriculiformis* (18.75%), *Brassica* sp. (15.62%), *Ziziphus mauritiana* (9.37%), *Jatropha curcas* (6.25%) and *Cocos nucifera* (6.25%), (Table 4.8, Fig. 4.28).

Year 2015

The species representations in this year were *Cocos nucifera* (25%), *Cyanotis axillaris* (18.75%), *Brassica* sp. (18.75%), *Poa gangetica* (18.75%), *Ziziphus mauritiana* (9.37%), *Acacia auriculiformis* (6.25%) and *Jatropha curcas* (6.25%), (Table 4.9, Fig. 4.30).

Year 2016

During this year analyses of collected materials showed the preponderance of species as, *Cyanotis axillaris* (25%), *Poa gangetica* (18.75%), *Acacia auriculiformis* (12.50%), *Cocos nucifera* (15.62%), *Brassica* sp. (12.50%), *Jatropha curcas* (9.37%) and *Ziziphus mauritiana* (6.25%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of November

Pollens of the species obtained in greater number in November, considering collections of three years together for the month, were *Cyanotis axillaris*, *Poa gangetica and Acacia auriculiformis*. Numerically the relative representation of the species were *Cyanotis axillaris* (25%), *Poa gangetica* (21.87%), *Acacia auriculiformis* (18.75%), *Brassica* sp. (15.62%), *Ziziphus mauritiana* (9.37%), *Jatropha curcas* (6.25%) and *Cocos nucifera* (6.25%), (Table **4.11, Fig. 4.34).**

4.2.12. December

Year 2014

In decreasing order of propensity of occurrence of different species in pollen populations the species were *Brassica* sp. (37.50%), *Ziziphus mauritiana* (18.75%), *Phoenix sylvestris* (12.50%), *Raphanus sativus* (9.37%), *Coriandrum sativum* (9.37%), *Acacia auriculiformis* (6.25%) and *Eupatorium odoratum* (6.25%), (Table 4.8, Fig. 4.28).

Year 2015

The species representations in the pollens of corbicular loads for the month of December in this year were *Brassica* sp. (34.37%), *Ziziphus mauritiana* (21.87%), *Eupatorium odoratum*

(12.50%), *Raphanus sativus* (9.37%), *Coriandrum sativum* (9.37%), *Phoenix sylvestris* (6.25%) and *Acacia auriculiformis* (6.25%), (Table 4.9, Fig. 4.30).

Year 2016

During this year analyses of collected materials showed the preponderance of the species *Brassica* sp. (31.25%) and other species followed as *Ziziphus mauritiana* (18.75%), *Phoenix sylvestris* (12.50%), *Acacia auriculiformis* (12.50%), *Coriandrum sativum* (9.37%), *Raphanus sativus* (9.37%) and *Eupatorium odoratum* (6.25%), (Table 4.10, Fig. 4.32).

Pollens recorded collectively for the month of December

Pollens in corbicular loads, in general, for the month of December recorded during three years of study, were *Brassica* sp. (37.50%), *Ziziphus mauritiana* (18.75%), *Phoenix sylvestris* (12.50%), *Coriandrum sativum* (9.37%), *Raphanus sativus* (9.37%), *Acacia auriculiformis* (6.25%) and *Eupatorium odoratum* (6.25%), (Table 4.11, Fig. 4.34).

4.4. QUANTITATIVE ANALYSIS OF POLLENS OF DIFFERENT SPECIES ON THE BODY SURFACE OF *Apis mellifera* DURING DIFFERENT MONTHS OF A YEAR

Pollens, adhered to the body surface of *Apis mellifera* and collected for every month in the year 2017 were quantitatively measured for estimating the presence of relative amount of pollens of different species which the bees might have foraged in different months in a year. Ten bees were taken in a day and thus for ten days in a month. Details of the results obtained for the respective month have been furnished herein below.

4.3.1. January

Among these honeybees, in collection, the major representing plant taxa were *Brassica* sp. and *Coriandrum sativum*. Quantitative analysis of these 100 honey bee species revealed the average percentage of pollen grains supplied by different plant species were *Coriandrum sativum*

(41%), *Brassica* sp. (21%), *Phoenix sylvestris* (17%), *Ziziphus mauritiana* (11%) and *Mangifera indica* (10%), (Table 4.12, Fig. 4.35).

4.3.2. February

Like the month of January hundred honeybees were collected from the hives during February. After analysis the surface of the bee body the major representing plant taxa found were *Coriandrum sativum* and *Mangifera indica*. Quantitative analysis of the pollen grains obtained from the body surface of 100 bees revealed the average percentage of pollen grains supplied by different plant species as *Coriandrum sativum* (25%), *Mangifera indica* (21%), *Brassica* sp. (18%), *Syzygium cumini* (17%), *Phoenix sylvestris* (16%) and *Nigella sativa* (3%), (Table 4.12, Fig. 4.35).

4.3.3. March

Within the pollens from 100 honey bee samples the plant taxa, found in greater number, were *Moringa oleifera* and *Citrs* sp. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species were *Moringa oleifera* (21%), *Citrus* sp. (15%), *Nigella sativa* (14%), *Litchi chinensis* (14%), *Bombax ceiba* (8%), *Alangium salvifolium* (7%), *Hygrophila schulli* (6%), *Cocos nucifera* (6%), *Syzygium cumini* (5%) and *Leucaena leucocephala* (4%), (Table 4.12, Fig. 4.35).

4.3.4. April

Among the pollen population on body surface from the total collection of 100 honey bees the pollens of *Borassus flabellifer* and *Sesamum indicum* were found to be dominating. Enumeration of pollen population revealed that the plant species according to their relative presence of pollens in the samples were *Borassus flabellifer* (15%), *Sesamum indicum* (14%), *Cocos* nucifera (10%), *Nigella sativa* (10%), *Moringa oleifera* (8%), *Alangium salvifolium* (8%), *Leucaena leucocephala* (8%), *Citrullus lanatus* (6%), *Dalbergia sissoo* (6%), *Citrus* sp. (5%), *Cucurbita maxima* (5%) and *Hygrophila schulli* (5%), (Table 4.12, Fig. 4.35).

4.3.5. May

Pollens in record during May showed the major representing plant taxa as *Sesamum indicum* and *Borassus flabellifer*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species as follows, *Sesamum indicum* (28%), *Borassus flabellifer* (23%), *Delonix regia* (9%) *Citrus* sp. (9%), *Citrullus lanatus* (7%), *Dalbergia sissoo* (7%), *Foeniculam vulgare* (7%), *Cucurbita maxima* (6%) and *Jatropha curcas* (4%), (Table 4.12, Fig. 4.35).

4.3.6. June

Out of total pollens collected from the body surface of 100 honeybees in the collection of the month of June the major representing plant taxa were *Amaranthus* sp. and *Anthocephalus cadamba*. Enumeration of pollen grains of the surface of the bee body found with their relative presence in terms of percentage for the species were, *Amaranthus* sp. (21%), *Anthocephalus cadamba* (19%), *Cocos nucifera* (12%), *Borassus flabellifer* (9%), *Dalbergia sissoo* (8%), *Delonix regia* (7%), *Foeniculam vulgare* (7%), *Citrus* sp. (6%), *Tamarindus indica* (6%) and *Jatropha curcas* (5%), (Table 4.12, Fig. 4.35).

4.3.7. July

Pollen record from the collection during the month of July showed the major representing plant taxa to be – *Anthocephalus cadamba* and *Amaranthus* sp. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species were as follows – *Anthocephalus cadamba* (23%), *Amaranthus* sp. (17%), *Cocos nucifera* (15%), *Tamarindus indica* (11%), *Trema orientalis* (11%), *Leucaena leucocephala* (10%), *Delonix regia* (8%) and *Foeniculam vulgare* (5%), (Table 4.12, Fig. 4.36).

4.3.8. August

The major representing taxa of plants during this month were *Poa gangetica* and *Cyanotis axillaris*. Quantitative analysis revealed the average percentage of pollen grains supplied by

different plant species were *Poa gangetica* (32%), *Cyanotis axillaris* (19%), *Cocos nucifera* (11%), *Trema orientalis* (11%), *Amaranthus* sp. (8%), *Leucaena leucocephala* (7%), *Raphanus sativus* (7%) and *Anthocephalus cadamba* (5%), (Table 4.12, Fig. 4.36).

4.3.9. September

Cyanotis axillaris and *Poa gangetica* were recorded as the most dominating species in the collection during this month. Species according to their percentage of representation in the sample were obtained as, *Cyanotis axillaris* (32%), *Poa gangetica* (21%), *Cocos nucifera* (12%), *Trema orientalis* (9%), *Monochoria hastata* (8%), *Raphanus sativus* (7%), *Eucalyptus globulus* (6%) and *Carica papaya* (5%), (Table 4.12, Fig. 4.36).

4.3.10. October

From the survey of pollens during October *Cocos nucifera* and *Trema orientalis* were found as the major representing taxa. The relative abundances of the species were *Cocos nucifera* (16%), *Trema orientalis* (16%), *Acacia auriculiformis* (12%), *Poa gangetica* (12%), *Mikania scandens* (11%), *Monochoria hastata* (11%), *Eucalyptus globules* (8%), *Ziziphus mauritiana* (7%) and *Cyanotis axillaris* (7%), (Table 4.12, Fig. 4.36).

4.3.11. November

The species obtained in greater number in the collection from bee body surface were of *Acacia auriculiformis* and *Ziziphus mauritiana*. Numerically the relative representation of the species were *Acacia auriculiformis* (21%), *Ziziphus mauritiana* (18%), *Cocos nucifera* (15%), *Mikania scandens* (13%), *Trema orientalis* (12%), *Eucalyptus globulus* (11%) and *Brassica* sp. (10%), (Table 4.12, Fig. 4.36).

4.3.12. December

The major represented taxa, appeared through the study of pollens adhered to the bee body surface, collected during December, were *Brassica* sp. and *Coriandrum sativum*. Quantitative analysis revealed the average percentage of pollen grains supplied by different plant species

were as follows, – *Brassica* sp. (49%), *Coriandrum sativum* (18%), *Phoenix sylvestris* (16%), *Ziziphus mauritiana* (11%) and *Mikania scandens* (6%), (Table 4.12, Fig. 4.36).

Categories of different plant species in regard of their contribution to the sustenance of bees, as represented through the relative presence in honey and corbicular load in different months in a year and determined on the basis of the recommendation of Louveaux *et al* (1978), have been displayed in the Table 4.16.

A forage calendar of *Apis mellifera* in the localities of North 24 Paraganas has been constructed and portrayed in the Table 4.17.