

# Pollen Diversity in *APIS MELLIFERA* and its quantification in the different Eco Habitats in KARNATAKA, INDIA

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**Abstract-** Karnataka is blessed with a variety of bee flora and different types of agro climatic zones. Beekeeping is becoming an important component of present strategies for sustainable agriculture and integrated rural development programme. The indigenous flora available in the different ecological habitat is of great importance to the apiculture industry in terms of honey and crop production. Insect pollinators are more sensitive to floral rewards and forage only on these flowers from which they can maximize the energy gains. India is a vast country, the climatic and floristic conditions therefore vary from tropical and sub-tropical to temperate conditions. The foraging efficiency of honeybees depends on the bee forage, conditions of the colony and foraging range of worker bees. Study on the foraging activity of bees in exploiting the bee forage in a locality depends on the climatic conditions which is highly variable from place to place. Change in the availability of bee flora as a result of weather and pollution probably affects the beekeeping. This paper discusses the pollen diversity in *A.mellifera* and its quantification in different habitats of Karnataka.

**Index Terms-** Indigenous, Pollinator, Forage, Ecological

## I. INTRODUCTION

Karnataka is blessed with a variety of bee flora and different types of agro climatic zones. Beekeeping is becoming an important component of present strategies for sustainable agriculture and integrated rural development programme. The pollination activities of honeybees are important integration function which contributes to the sustainability and diversity of agricultural resource and also contributes to the increased productivity and maintenance of biodiversity (Verma, 2003). Pollen contributes nutrients for the normal development, growth and reproduction in honeybees. Honeybees' forages nectar and pollen in the blooming period make up the honey and bee food store them in their hive. Honeybee also pollinates for plant during the forage help the plants for their propagation. Most of the cultivated crops and commercial plantations provide pollen and nectar, which are food for bees. Those are generally grown on large stretches of land and their contiguity is desirable for successful beekeeping. The crop that needs cross pollination benefit from the foraging activity of honeybees. Honeybees are major pollinating insects representing 91.26 percent of the total number of insects visiting the crops (Lakshmi and Rao, 1998). Though *A. florea*, *Trigona* visited water melons (2%) however *A. cerana* was the major pollinator (87%) in water

melons at Vijayrai, West Godavari district of Andhra Pradesh (Rao and Suryanarayana, 1988).

Choudhary and Kumar (1998) reported *A.florea* as the most abundant visitor on niger (84.50%), followed by *A.cerana* (7.90%) and *A.mellifera*(5.7%) in Pune. Activity of *A.florea* was from 0600 to 1830 hr, where as *A.cerana* and *A. mellifera* activity was from 0600 to 1630 hr and 600 to 1730 hr respectively. Bisht and Pant (1968) reported that *A.cerana* gathered pollen through out the year under Delhi conditions. The higher pollen gathering activity was recorded during January-March where as May and June was the period of lesser activity.

Viraktamath (1990) studied the foraging profile of *A.cerana* in Raichur (Karnataka). He observed major pollen foraging (up to 80%) before noon and nectar foraging through out the day with a major peak during 0600 to 1100 hr and another peak during 1600 to 1800 hr. The first peak was in March with 72 to 81 percent of the returned bees were loaded with pollen and the second peak was in May with 79 to 79 percent probably because of high flowering rate and favourable environmental conditions.

Honeybees were excellent pollinators in tomatoes during winter months producing high quality of fruits resulting in 98 percent fruit set (Sabaraet *al.*, 2002) which is comparable to fruit set by bumblebees. Rao and Suryanarayana (1988) stated that *A.cerana* was the principal pollinating insect and was found to be efficient pollinator than *A.florea* and *Trigona*. Further, *A.cerana* bee population was maximum at 09.00 hr and also during the period the pollen collection was more. Abundance of all insect pollinators irrespective of the species was more at 1200 to 1400 hr on onion crops (Priti, 1998).

## II. MATERIALS AND METHODS

The study area is covered with both plains and densely forested hilly areas consisting of both agriculture and non agricultural flora. The foraging behavior in honeybees *A.mellifera* were studied in different agro climatic regions of Karnataka during 2010-2011

The different apiary sites that were chosen to study were viz. Hesaraghatta village, Arkavathymadhuvana, Jnanabharthi, Shivanahalli, Bhagamandala, Kuntanahalli, Honnavar and Shivakote.

The foraging bees returning without the pollen load and swollen abdomen was captured and micro capillary tubes were used to collect nectar. The abdomen of the nectar foragers were squeezed gently using a cotton swab on the lateral sides of the abdomen. The resultant nectar collected was measured using the method

(Galen and Plow right, 1985) on a visual scale which has been calibrated for direct reading in microlitres ( $\mu$ l).

highest of  $98.19 \pm 1.45$ g in the month of April followed by  $5.69 \pm 3.07$ g in the month of May. Further July and August being the autumn months recorded a least of  $64.53 \pm 3.29$ g and  $68.42 \pm 3.12$ g respectively, thereafter again increased toward the end of the season.

### III. RESULTS AND DISCUSSION

Mean pollen collection in a month by *A.mellifera* during different weeks and the month at apiary site (Table 1) L1 HG showed the

**Table 1: Average pollen collection by *A.mellifera* in different months during 2010-11 (LOCATION – HG)**

| Month | Week  |        |        |       | Mean (g)         |
|-------|-------|--------|--------|-------|------------------|
|       | 1     | 2      | 3      | 4     |                  |
| Jan   | 67.32 | 76.44  | 69.36  | 61.74 | $68.69 \pm 4.70$ |
| Feb   | 76.44 | 72.86  | 78.31  | 72.18 | $75.01 \pm 2.26$ |
| Mar   | 84.13 | 84.18  | 81.72  | 80.48 | $82.37 \pm 1.51$ |
| Apr   | 96.38 | 100.63 | 97.13  | 98.16 | $98.19 \pm 1.45$ |
| May   | 92.14 | 98.63  | 104.12 | 94.32 | $97.67 \pm 3.89$ |
| Jun   | 97.13 | 99.36  | 97.18  | 94.32 | $95.69 \pm 3.07$ |
| Jul   | 70.11 | 64.36  | 62.11  | 60.72 | $64.53 \pm 3.29$ |
| Aug   | 70.29 | 71.13  | 69.63  | 62.38 | $68.42 \pm 3.12$ |
| Sep   | 86.57 | 82.43  | 88.13  | 84.16 | $85.01 \pm 2.05$ |
| Oct   | 94.13 | 92.32  | 91.68  | 90.43 | $91.94 \pm 1.26$ |
| Nov   | 92.32 | 90.43  | 91.16  | 90.28 | $91.11 \pm 0.73$ |
| Dec   | 78.36 | 72.16  | 74.83  | 72.38 | $74.44 \pm 2.23$ |

n = 20 bees

The pollen collected from the apiary site L2 JB (Table 2) showed a mean of  $127.64 \pm 3.45$ g in the month of June which was the highest followed by  $116.52 \pm 2.04$ g in May to a low of

$73.74 \pm 4.59$ g in August followed by  $72.52 \pm 1.29$ g during January and during the rest of the year it was more or less constant ranging from  $80.49 \pm 0.57$ g to  $106.87 \pm 0.95$ g.

**Table 2: Average pollen collection by *A.mellifera* in different months during 2010-11(LOCATION – JB)**

| Month | Week   |        |        |        | Mean (g)          |
|-------|--------|--------|--------|--------|-------------------|
|       | 1      | 2      | 3      | 4      |                   |
| Jan   | 75.38  | 72.16  | 74.11  | 75.32  | $74.52 \pm 1.29$  |
| Feb   | 84.36  | 85.76  | 87.57  | 87.19  | $85.46 \pm 1.89$  |
| Mar   | 93.68  | 94.12  | 98.36  | 97.11  | $95.99 \pm 1.79$  |
| Apr   | 107.44 | 106.57 | 108.23 | 106.74 | $106.87 \pm 0.95$ |
| May   | 114.36 | 118.36 | 114.12 | 116.63 | $116.52 \pm 2.03$ |
| Jun   | 126.32 | 122.13 | 128.61 | 132.71 | $127.64 \pm 3.44$ |
| Jul   | 101.38 | 98.01  | 97.63  | 100.72 | $99.37 \pm 1.46$  |
| Aug   | 80.38  | 78.13  | 70.61  | 70.43  | $73.74 \pm 4.59$  |
| Sep   | 83.11  | 82.366 | 81.63  | 82.57  | $82.79 \pm 0.84$  |
| Oct   | 92.48  | 90.36  | 91.72  | 90.48  | $91.72 \pm 1.21$  |
| Nov   | 95.13  | 94.63  | 90.41  | 91.38  | $92.45 \pm 2.01$  |
| Dec   | 81.16  | 80.14  | 81.06  | 80.48  | $80.49 \pm 0.57$  |

n = 20 bees

Mean pollen collection by *A. mellifera* in different months recorded at apiary site L3 AK (Table 3) showed the highest

pollen collection of  $104.73 \pm 1.99$ g in the month of June and least in the month of January recording  $61.30 \pm 0.63$ g.

**Table 3: Average pollen collection by *A.mellifera* in different months during 2010-11 (LOCATION – AK)**

| Month | Week   |        |        |        | Mean (g)    |
|-------|--------|--------|--------|--------|-------------|
|       | 1      | 2      | 3      | 4      |             |
| Jan   | 62.18  | 60.46  | 61.76  | 60.76  | 61.30±0.63  |
| Feb   | 74.44  | 74.18  | 76.32  | 75.67  | 74.45±1.60  |
| Mar   | 81.67  | 84.63  | 82.68  | 83.14  | 83.55±1.41  |
| Apr   | 94.77  | 94.17  | 96.61  | 97.38  | 95.03±1.82  |
| May   | 98.63  | 94.76  | 92.63  | 95.44  | 95.41±1.92  |
| Jun   | 104.42 | 101.41 | 104.32 | 107.14 | 104.73±1.99 |
| Jul   | 80.66  | 81.13  | 82.63  | 81.72  | 81.86±0.92  |
| Aug   | 71.16  | 70.68  | 72.13  | 74.62  | 72.43±1.47  |
| Sep   | 78.38  | 79.16  | 79.86  | 72.36  | 77.64±2.69  |
| Oct   | 84.19  | 82.64  | 85.32  | 85.64  | 84.43±1.05  |
| Nov   | 89.73  | 87.46  | 86.72  | 84.13  | 86.88±1.80  |
| Dec   | 68.13  | 62.14  | 65.63  | 62.63  | 64.94±2.25  |

n= 20 bees

Highest pollen collection by *A.mellifera* during different months in 2010-11 recorded at the apiary site L4 HN (Table 4 ) was 131.56±2.40g during June which was preceded with May 129.64±2.31g to 115.72±2.14g in the month of May and April

respectively and least pollen were recorded by *A.mellifera* in the month of January 78.38±1.76g. Similarly, in the apiary site L5 BG (Table 5) the highest pollen collectors carrying the highest pollen load was 167.59 ±3.63g during June and the least was recorded in the month of August i.e. 82.69±2.03g.

**Table 4: Average pollen collection by *A.mellifera* in different months during 2010-11 (LOCATION – HN)**

| Month | Week   |        |        |        | Mean (g)    |
|-------|--------|--------|--------|--------|-------------|
|       | 1      | 2      | 3      | 4      |             |
| Jan   | 79.61  | 80.44  | 76.38  | 76.16  | 78.38±1.77  |
| Feb   | 84.32  | 86.16  | 85.71  | 87.36  | 85.23±1.63  |
| Mar   | 94.18  | 86.44  | 98.46  | 82.21  | 85.38±2.11  |
| Apr   | 114.61 | 112.14 | 117.68 | 116.32 | 115.72±2.14 |
| May   | 126.28 | 132.84 | 131.38 | 128.18 | 129.64±2.31 |
| Jun   | 134.13 | 129.44 | 134.38 | 128.43 | 131.56±2.40 |
| Jul   | 118.31 | 112.42 | 110.42 | 113.68 | 113.59±2.60 |
| Aug   | 92.36  | 86.18  | 89.42  | 87.86  | 88.09±2.67  |
| Sep   | 98.36  | 96.83  | 92.13  | 94.56  | 95.05±2.26  |
| Oct   | 120.14 | 126.34 | 121.86 | 118.63 | 121.68±2.58 |
| Nov   | 113.32 | 114.48 | 110.46 | 112.86 | 112.85±1.32 |
| Dec   | 106.32 | 102.13 | 99.38  | 103.68 | 103.13±2.31 |

n = 20 bees

**Table 5: Average pollen collection by *A.mellifera* in different months during 2010-11 (LOCATION – BG)**

| Month | Week   |        |        |        | Mean (g)    |
|-------|--------|--------|--------|--------|-------------|
|       | 1      | 2      | 3      | 4      |             |
| Jan   | 113.61 | 115.36 | 118.68 | 120.36 | 117.27±2.44 |
| Feb   | 118.68 | 120.42 | 126.14 | 122.31 | 120.81±3.28 |
| Mar   | 128.14 | 132.36 | 134.68 | 128.32 | 129.54±3.48 |
| Apr   | 134.63 | 132.81 | 138.44 | 129.18 | 133.85±2.98 |
| May   | 148.32 | 152.63 | 154.82 | 146.81 | 150.44±2.91 |
| Jun   | 160.46 | 169.11 | 168.36 | 170.41 | 167.59±3.63 |
| Jul   | 92.13  | 90.46  | 91.17  | 91.81  | 91.74±0.90  |
| Aug   | 86.13  | 82.43  | 83.40  | 91.36  | 82.69±2.03  |
| Sep   | 94.36  | 98.46  | 92.32  | 94.68  | 95.44±2.20  |

|            |        |        |        |        |             |
|------------|--------|--------|--------|--------|-------------|
| <b>Oct</b> | 107.63 | 112.48 | 114.63 | 116.18 | 112.65±2.89 |
| <b>Nov</b> | 122.34 | 121.46 | 120.13 | 124.36 | 122.13±1.38 |
| <b>Dec</b> | 102.32 | 113.6  | 107.58 | 101.31 | 105.39±4.66 |

n = 20 bees

The mean pollen collection by a forager bee of *A.mellifera* at apiary site L6 KT (Table 6) shows between 92.21±1.63g which

was the least in August and the highest in the month of May with 146.02±2.39g was recorded. In apiary site L7 SK (Table 7) the average pollen collection varied from the lowest of 80.14±1.56 g to the highest of 143.36±3.09g the month of August and September, respectively.

**Table 6: Average pollencollection by A.mellifera in different months during 2010-11 (LOCATION – KT)**

| Month      | Week   |        |        |        | Mean (g)    |
|------------|--------|--------|--------|--------|-------------|
|            | 1      | 2      | 3      | 4      |             |
| <b>Jan</b> | 120.13 | 121.61 | 119.36 | 117.41 | 119.63±1.36 |
| <b>Feb</b> | 123.38 | 121.44 | 117.69 | 124.36 | 122.65±2.96 |
| <b>Mar</b> | 127.63 | 120.19 | 119.31 | 121.48 | 122.28±2.92 |
| <b>Apr</b> | 136.41 | 132.48 | 132.71 | 134.42 | 133.9±1.43  |
| <b>May</b> | 148.61 | 142.38 | 144.36 | 148.38 | 146.02±2.39 |
| <b>Jun</b> | 138.34 | 132.48 | 140.68 | 141.36 | 139±2.39    |
| <b>Jul</b> | 101.32 | 110.31 | 107.63 | 111.38 | 106.66±4.14 |
| <b>Aug</b> | 94.63  | 92.11  | 90.48  | 90.46  | 92.21±1.63  |
| <b>Sep</b> | 112.61 | 114.36 | 111.44 | 114.61 | 112.53±1.86 |
| <b>Oct</b> | 118.46 | 112.12 | 106.36 | 107.39 | 109.79±5.00 |
| <b>Nov</b> | 120.13 | 116.83 | 111.38 | 109.46 | 112.88±4.93 |
| <b>Dec</b> | 114.41 | 106.36 | 109.42 | 112.61 | 110.62±2.76 |

n = 20 bees

**Table 7: Average pollen collection by A.mellifera in different months during 2010-11 (LOCATION – SK)**

| Month      | Week   |        |        |        | Mean (g)    |
|------------|--------|--------|--------|--------|-------------|
|            | 1      | 2      | 3      | 4      |             |
| <b>Jan</b> | 120.41 | 122.38 | 122.78 | 123.46 | 122.73±1.69 |
| <b>Feb</b> | 121.76 | 125.43 | 129.18 | 128.37 | 125.7±2.67  |
| <b>Mar</b> | 126.46 | 126.14 | 130.41 | 129.81 | 129.04±2.39 |
| <b>Apr</b> | 127.73 | 126.63 | 118.61 | 112.32 | 120.34±5.95 |
| <b>May</b> | 132.36 | 139.78 | 141.46 | 139.38 | 138.63±3.21 |
| <b>Jun</b> | 141.32 | 140.18 | 140.26 | 142.36 | 141.79±1.7  |
| <b>Jul</b> | 82.36  | 81.64  | 80.44  | 81.36  | 81.99±1.24  |
| <b>Aug</b> | 80.16  | 79.38  | 77.67  | 81.36  | 80.14±1.56  |
| <b>Sep</b> | 148.63 | 142.44 | 139.63 | 141.46 | 143.36±3.09 |
| <b>Oct</b> | 132.63 | 131.62 | 136.48 | 137.46 | 134.91±2.33 |
| <b>Nov</b> | 122.36 | 128.47 | 129.44 | 128.13 | 126.61±2.67 |
| <b>Dec</b> | 120.34 | 119.63 | 117.57 | 116.36 | 96.87±1.62  |

n = 20 bees

The mean pollen collection at the apiary site L8 SH recorded by the forager *A.mellifera* (Table 8) was 132.71±2.09g as highest in June and least of 71.7±1.43g recorded in the month of July.

After the month of July, from August the amount of pollen collection increases till the end of the year.

**Table 8: Average pollen collection by A.mellifera in different months during 2010-11(LOCATION – SH)**

| Month      | Week   |        |        |        | Mean (g)    |
|------------|--------|--------|--------|--------|-------------|
|            | 1      | 2      | 3      | 4      |             |
| <b>Jan</b> | 130.63 | 132.46 | 130.57 | 136.14 | 132.71±2.09 |

|            |        |        |        |        |             |
|------------|--------|--------|--------|--------|-------------|
| <b>Feb</b> | 138.61 | 136.72 | 132.61 | 138.48 | 134.63±2.55 |
| <b>Mar</b> | 140.43 | 142.18 | 141.17 | 144.58 | 142.94±2.21 |
| <b>Apr</b> | 148.93 | 152.36 | 149.47 | 143.17 | 146.81±4.47 |
| <b>May</b> | 152.71 | 158.63 | 157.42 | 158.13 | 157.45±2.56 |
| <b>Jun</b> | 162.32 | 158.46 | 152.76 | 161.31 | 158.69±3.33 |
| <b>Jul</b> | 72.38  | 70.43  | 71.16  | 70.38  | 71.70±1.43  |
| <b>Aug</b> | 80.16  | 80.91  | 83.63  | 82.10  | 81.39±1.14  |
| <b>Sep</b> | 148.61 | 141.38 | 140.61 | 160.32 | 147.42±7.10 |
| <b>Oct</b> | 131.17 | 136.51 | 132.51 | 130.52 | 131.83±2.68 |
| <b>Nov</b> | 120.14 | 126.14 | 120.14 | 124.58 | 122.97±2.43 |
| <b>Dec</b> | 114.71 | 114.40 | 112.36 | 110.44 | 113.19±1.68 |

*n=20 bees*

Abrol and Bhat (1987) reported that the foraging activity of *A. cerana* was significant with temperature and non significant with relative humidity. Choi (1987) observed that *A. mellifera* in Korea started foraging at 0500 hr and ceased at 2000 hr. There were two foraging peaks, one at about 1100 hrs and the other at about 1600 hr. Flight activity positively correlated with temperature and solar radiation intensity and negatively correlated with humidity.

In another experiment *A. mellifera* started foraging at about 0800 or at 1000 hr and their number was greater between 1200 and 1300 hr and the flight activity stopped around 1800 hr. Flight activity was correlated with the intensity of solar radiation.

Observations on the foragers for pollen nectar sugar concentration and duration of visits presents the information on the foragers carrying pollen loads, nectar volume at different hours of the day. Pollen loads were more during morning hours up to 1100 hr and gradually decreased, and then increased by 1700 to 1730 hr. *A. cerana* carried on an average of 10.01±2.15 g of pollen load compared to 8.27±1.29 g in *A. mellifera*. Reddy (1980) recorded greater amount of honey and pollen stores in February and July. The variations in the results of the present study could be due to different climatic and floral conditions in various places of the state. The high flexibility in pollen gathering activity during different hours of the the day observed in the present study may be related to moisture content in morning, midday and evening. The daily flight showed precise foraging time of bees in a day.

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