

Evaluation of Forging Profiles and Pollination in Different Species of Honeybees in West Bengal

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ABSTRACT:

The physiology and learning behaviour of bees have been the subject of extensive research. Honey bees pollinate many agricultural food plants, and it is estimated that one-third of the entire human diet is supplied by cultivated plants that rely on the actions of bees for full productivity and quality. This article has been evaluated the forging profiles and pollination in different species of honeybees in West Bengal.

Keywords: Beekeeper, Forging, Honeybees, West Bengal

INTRODUCTION:

The beekeeping sector in India has emerged from a variety of approaches. Bee pollination, honey production, and wax production are examples of these techniques. With careful management and the survival of the bees throughout winter and summer, in both the plains and hills, the use of proper size hives, determined on the basis of the queen's egg laying capacity and utilisation of space for brood rearing and storing of honey, can be ensured. Several researchers have published research on foraging behaviour and pollination [1-3].

West Bengal is one of India's leading states for beekeeping research & development. In comparison to plains with limited floral resources, the state is highly prolific, with extensive forest areas and mountainous regions that give endless sources of bee flora. Because geography, topography, and climate vary greatly from place to place, bee flora is not universally available [4].

The 'Analysis and comparison of foraging profiles and pollination in different species of Honeybees' was carried out in the current study at various locations and apiary sites in West Bengal. The only way to effectively manage and utilize these bees in a given location is to have a

thorough understanding of their behaviour pattern. Because there is a scarcity of data on pollen and nectar loads in honey bees (*A.cerana* and *A.mellifera*), pollen load carrying capacity of honey bees and colony performance, and the time of visitation to various crops, it was proposed to conduct the current research. The objectives of the present study were aimed to fill the lacunae and investigate the following aspects of bee flower relationship primarily to quantify the foraging behaviour of indigenous species of honey bee *A.cerana* and European honeybee *A.mellifera* visiting different plants [5]. Information pertaining to the foraging profiles, pollination efficiency of different honey bee species, are not available hence it has been proposed to carry out the investigation with the following major objectives:

- To determine the foraging population size and its profiles.
- To compare and analyze the pollen and the nectar loads in two different species of honeybees (*A.cerana* and *A.mellifera*) in different agro-climatic zones of West Bengal.
- To determine the pollination requirements of selected economically important agro-horticultural crops.
- To determine the relative pollination efficiency of different honey bee species.

EXPERIMENTAL METHODOLOGY AND ANALYSIS OF DATA:

Geography and Study Area:

West Bengal is on the eastern bottleneck of India, stretching from the Himalayas in the north to the Bay of Bengal in the south. It lies between 85 degree 50 minutes and 89-degree 50 minutes east longitude, and 21 degrees 25 minutes and 27 degrees 13 minutes north latitude. The state has a total area of 88,752 square kilometres (34,267 sq mi). With Bangladesh, which lies on its eastern border, the state forms the ethno-linguistic region of Bengal. To its northeast lies the states of Assam and Sikkim and the country Bhutan, and to its southwest, the state of Odisha. To the west it borders the state of Jharkhand and Bihar, and to the northwest, Nepal. The capital of the state is Kolkata, the third-largest urban agglomeration and the seventh-largest city in India. The study area was covered with both plains and densely forested hilly areas consisting of both agriculture and non-agricultural flora. The foraging behavior in honeybees *A.cerana* and *A.mellifera* were studied in different agro climatic regions of West Bengal. The different apiary

sites that were chosen to study viz. Bagula, Jenadihi, Lokhata, Hingaljung, Satjalia, Krishnapur, Lamahatta, Gurdum.

At each site five colonies of *A.cerana* and *A.mellifera* (having 8 and 10 frames) respectively were selected for the study. Honeybee colonies were selected in a place where there was at least 10 to 15 percent flowering of crop so that, the bees could easily adapt to the crop. At weekly intervals during 2015-21, pollen loads were collected from the foragers, packed and analyzed melissopalynologically as per method described by Suryanarayana et al. (1992) [6]. The foraging trips in honeybees were determined by marking the bees with colored insect paint on the dorsal thoracic region of the bee. The number of trips made by the bee carrying pollen during the day was counted daily, every week and expressed as the number of trips per day in a month. The pollen and nectar were collected at different months of the year.

Identification of Foraging Bees:

The foraging bees had been identified based on the type of bee forage they collect viz. pollen, nectar, propolis and water. The samples were collected based on bees visiting floral and extra floral nectar, while bees were on the plants.

Size of the Foraging Populations:

The foraging activity of *A.cerana* and *A.mellifera* were observed during different hours of the day and throughout the year, during 2015 and 2021 in different seasons. Number of bees foraging for pollen and nectar were recorded described by Zaitoun and Vorwohl, 2003 [7].

Classification of Foraging Bees:

Honeybees collecting pollen were identified as pollen foragers. Further the presence of pollen in the pollen basket of honeybees was noted. Honeybees collecting nectar were conspicuous by the absence of pollen pellets in the pollen basket of the visiting honeybees. Further, the size of the visiting honeybee collecting nectar was comparatively bigger- than honeybee collecting pollen only based on visual observation on the number of incoming bees at the hive entrance. Honeybee collecting both pollen and nectar in the same or different foraging trips were classified as pollen and nectar foragers.

Classification of Pollen Foragers:

The bees which foraged for pollen were seen alighting on any flower and collecting pollen from flowers with the help of its mouth parts and three pair of legs in a swift continuous and simultaneous movement of the body parts. Pollen is molded into a ball like structure and passed into the corbiculae. Returning foragers carrying pollen load were visible and were classified as pollen foragers.

Classification of Nectar Foragers:

The foraging bees were examined for nectar collection. Any foraging bee during her foraging trip thrusting its proboscis either through the corolla or externally from the base of the calyx, so as to reach the nectary of the flowers were classified as nectar foragers.

Sampling of Pollen Foragers:

The foraging bees returning with two loads of pollen were captured randomly at the hive entrance to collect the pollen loads during the study period as per the method.

Determination of Pollen Load:

The pollen foragers were captured with help of sweep net and the pollen loads collected from both the legs with the help of 1mm camel brush transferred into the precalibrated capsules and was electronically weighed independently. Samples of pollen brought by the forager bees into the colonies were collected throughout the day at hourly intervals. The incoming pollen foragers were caught by hand by holding the wings. The loads on the two hind legs were gently removed into a clean paper, the two loads were then packed into two separate packets. Each packet was labelled with data viz. the colony number, bee species, time and date of collection and also the numbers of incoming bees were noted to study the colony performance index.

Sampling of Nectar Foragers:

The foraging bees returning without the pollen load and swollen abdomen was captured and micro capillary tubes were used to collect nectar.

Determination Of Nectar Loads:

The abdomen of the nectar foragers was squeezed gently using a cotton swab on the lateral sides of the abdomen. The resultant nectar collected was measured using the method described by Galen and Plow Right (1985) [8] on a visual scale which has been calibrated for direct reading in microlitres.

Number of Samples:

Sampling was performed twice a week, and then in a month and throughout the year during 2015 and 2021. A total of 756 loads from *A.cerana* and 652 loads from *A.mellifera* were collected during the study period.

Determination of Body Weights and Loads of Foragers:

The foragers were captured for collecting pollen and nectar with the help of a sweep net at the hive entrance. The number of workers captured were 730. After collecting the pollen loads from the foragers the body weight of the bees was also determined.

Determination of Body Weights and Pollen Loads of Foragers

The pollen foragers were captured and the pollen loads were collected and the bees were weighed separately, the body weights were also determined with respect to the amount of pollen (mg).

Determination of Body Weights and Nectar Loads of Foragers

The nectar foragers were captured and the abdomen squeezed to collect the droplets of nectar and the bees were weighed separately, the body weights were determined with respect to the volume of nectar. The data is represented in 1 μ l (1 microlitres).

Relative Percentage of Pollen and Nectar Foragers:

The data collected on pollen and nectar foragers at different hours of the day during the study of foraging behaviour were used to calculate the percentage of pollen and nectar by using the formula:

$$\text{Percent pollen foragers (PF)} = \frac{\text{No. of PF}}{\text{Total No. of incoming bees}} \times \frac{\text{No. of PF}}{\text{Time (60 Sec)}} \times 100$$

$$\text{Percent nectar foragers (NF)} = \frac{\text{No. of NF}}{\text{Total No. of incoming bees}} \times \frac{\text{No. of NF}}{\text{Time (60 Sec)}} \times 100$$

Evaluation of Foragers:

The foragers were evaluated for the pollen and nectar loads during different hours of the day and also throughout the year.

Quantification of Pollen Loads:

Quantification of pollen loads was done by temporarily blocking the hive using a pollen trap and the pollen was collected. This is to study the diversity of pollen and to work out its economics.

Determination of Pollen Trip Frequency:

The foragers carrying pollen to the hive were marked and the number of trips made by the bee carrying pollen from the time of initiation to the cessation of the foraging were counted at the hive entrance in a day, and also at weekly intervals. The time taken by a forager on flower was recorded as the duration of visit and the interval between the starting of foraging and return to the hive was taken as the time taken by a bee per trip [9].

Performance of the Colony During Different Seasons:

To study the colony performance index, five colonies of *A. cerana* were selected for study one each from two different locations. The numbers of workers entering the colony with or without pollen were counted for five minutes at regular intervals, throughout the experimental period between 0600 to 1800 hr in different seasons. The data collected were used to work out the CPI by using the formula given by Punchedhewa et al. (1990) [10].

Study of the Mite Infestation and Their Effect on the Foraging Load:

The presence of phoretic mite, *Neocypholaelaps indica* on the honeybee was studied at two different locations in two to three different colonies for a period of three years. The study is being carried out in those places where the infestation of the mites was severe. The test colonies

were observed twice a month and the number of bees with mite were counted, during the study period.

The number of mites in different workers of selected hives were counted and the mean number of mites/ hives was calculated and presented in the form of results.

Statistical Analysis:

The suitable statistical packages were employed to analyse the data collected during the study period.

Analysis of Data:

The analysis of data was based on the following points to meet the research objectives:

- **Apiary Sites**
- **Size of Foraging Population**
 - Size Pollen Foragers
 - Size of Nectar Foragers
 - Load Carrying Capacity of Pollen Foragers
- **Colony Performance Index of the Foraging Population**
- **Study of Infestation of The Mite on the Foraging Bee and its Effect**

DISCUSSION AND CONCLUSION:

Honeybee foraging behaviour is an action that is the most significant aspect in pollination. Flowers have evolved to generate and offer copious amounts of pollen and nectar in order to attract a large number of bees during the evaluation process. For successful beekeeping, a constant flow of food ingredients is required throughout the year. The amount of nectar and pollen available to foraging bees varies throughout the year, as does the blossoming of different plant species at different times.

Maximum honey output in a given area is also influenced by the vegetation within a honeybee's

flying range from an apiary, favourable weather conditions, and other ecological factors that influence bee fodder production and availability. The considerable difference in honey output by honeybee colonies located in the same apiary and within a narrow range of bee flora is a common phenomenon seen by beekeepers. The genetic make-up of bee colonies varies from one to the next, from one location to the next, and from one hive to the next within the same apiary, which explains the differences in honey yield.

Honeybees are known to change their foraging schedules according to the abundance and availability of food sources. The rate of attractiveness of foraging bees to a particular plant is determined by a number of parameters, including the quality and amount of pollen and nectar, nectar sugar content, flower density, and the number of competing insects. Foraging activity showed a significant seasonal fluctuation. The pollen gathering activity fluctuated more than the nectar gathering activity. During the study period, pollen harvesting activity grew steadily from March to June. In July and August, honey and pollen reserves were lower, while foraging efficiency was lower in January and February. From March through June, pollen collection increased.

Honeybees are gregarious insects that can be found all over the world. In many field crops, honeybees are effective cross pollinators. Bee behaviour is one of the most crucial parts of agriculture. Honeybee foraging behaviour was investigated for five years, from 2015 to December 2021. This research aimed to determine the size of the foraging population by observing bees foraging for pollen or nectar at various times of the day and throughout the year in various agroclimatic eco-zones across West Bengal.

Pollen and nectar gathered by honeybees varied not just within the same location, but also between geographic ecotypes. The foraging activities showed a lot of seasonal fluctuation. Pollen gathering activities fluctuated more than nectar gathering, which rose gradually from March to June. During the months of July and August, the worker bee transported less pollen. The explanation for this was the reduced availability of bee vegetation during the fall and rainy seasons. The nectar gathering activity was also recorded for two years, and nectar availability was practically constant during the study period, with the exception of the rainy season.

For pollen load, comparative studies on the foraging behaviour of *Apis cerana* and *Apis mellifera*

revealed a lower percentage of nectar collectors than pollen collectors during the specified period. The great degree of flexibility in pollen or nectar collection activities seen at various times of the day and during the study period could be attributed to the availability of bee flora, moisture content from morning to evening, and bee efficiency.

Most foragers, however, do not carry the entire loads, as evidenced by the relative size of the foraging population and the weight of the corbicular contents. As a result, foragers who merely collected pollen or nectar followed the partial loading principle. Observations of pollen and nectar loads by foragers at various locations and times of the year. The honeybee's foraging activity in terms of pollen collecting is also reduced by the influence of a Phoretic mite, *N.indica*.

Many parameters, including as trip frequency, pollen collecting frequency, forage time, foraging life length, and foraging load size, change from colony to colony and from place to place within colonies. The magnitude of the forage load varied depending on the time of day.

Understanding bee botany is vital to beekeeping; foraging behaviour is an important component of biology that allows scientists to adapt to the available flora and climatic circumstances. The only way to effectively manage these bees in a given location is to have a thorough understanding of their behaviour pattern.

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