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# Foraging behaviour of honey bees in niger flowers, *Guizotia abyssinica* Cass. in North Zone of Chhattisgarh

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ABSTRACT

The foraging activity of *Apis cerana indica* was found higher in first week of November 2011 and 2nd week of December 2012 (33.83 bees/5min/$m^2$). Its maximum visitation was found at 1100hrs (66.06 bees/5min/$m^2$). The maximum foraging activity of *Apis dorsata* was observed at 1100hrs (11.75 bees/5min/$m^2$) whereas, the lowest was observed at 1700hrs (0.50 bee/5min/$m^2$).The higher foraging activity of *Apis florea* was noticed at 1300hrs (4.00 bees/5min/$m^2$) and was found least at 0900hrs (0.56 bee/5min/$m^2$).

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## INTRODUCTION

In the agricultural economy of India, oilseeds are important next only to food grains in terms of area, production and value. The diverse agro-ecological conditions in the country are favorable for growing all the nine annual oilseeds, which include seven edible oilseeds, *viz.*, groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower and niger, and two non-edible oilseeds, viz. caster and linseed. Apart from annual oilseeds, a wide range of other minor oil-bearing plants of horticulture and forest origin, including coconut and oil palm are cultivated in the country. In addition, substantial quantity of vegetable oils is also obtained from rice bran and cotton seed and a small quantity of oil from corn and tobacco seed (Hegde, 2012).

Niger, *Guizotia abyssinica* Cass. is an important oilseed crop grown extensively in the hilly areas of Northern Hill Zone of Chhattisgarh. It is a branched annual herbaceous plant, grows upto a height of 1.8 metre. The niger plant complete its life cycle in 3-4.5 months. The yellow flower heads of 2-3 cm develop in the leaf axil, in a cluster of two to five. Each head contains about eight ray florets and 40 to 60 hermaphrodite disk florets. Within the disk floret, the anthers are united to form the corolla tube .The style extends through this tube, and the hairy forked stigma is above.

The crop provides both pollen and nectar to honey bees and large quantities of nectar are collected from this crop wherever extensive cultivation is undertaken. The area of this oilseed crop in Chhattisgarh is 1.08 lakh hectare with the production of 0.27 lakh tonnes and productivity is 260 kg $ha^{-1}$ (Anonymous, 2011).

The crop is totally dependent on external agents for its reproductive development by way of pollination through external agencies particularly by taking the help of insects that to the honey bees, which frequently visit flowers gathering pollens as well as nectar for sustaining their life, which in turn results into florets get cross pollinated.

## MATERIAL AND METHODS

The experiment was conducted at Rajmohini Devi College of Agriculture and Research Station, Ambikapur of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during two consecutive year 2011-12 and 2012-13. It was upland single plot keeping plot size 10x10m$^2$, variety- JNC-9 spacing- 30x10cm. When the niger crop started flowering different honey bee species were recorded starting from 0700 hrs to 1700 hrs at two hours intervals once every week, from randomly selected places from one square meter area within five minutes during early as well as peak flowering period of crop.

## RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

### Foraging behaviour of Indian honey bee (*Apis cerana indica*) :

The foraging behaviour of Indian honey bee (*Apis cerana indica* Fab.) on niger flowers was observed from 0700 to 1700 hrs from starting to full blooming period of the crop. The activity of Indian honey bee was recorded during two consecutive year (2011-12 and 12-13) from 2nd week of Oct. 2011 and 4th week of Nov. 2012 to 1st week of Dec. 2011 and 2nd week of Jan. 2013 at weekly interval at different dates and different hours of the day, *viz*. 0700 hrs, 0900 hrs, 1100 hrs, 1300 hrs, 1500 hrs and 1700 hrrs. The mean number of bees recorded on each date of observations *ie*. Number of bees/ 5min/ m$^2$ is depicted in (Table 1 Fig. 1, Table 2 Fig. 2 and Table 3 Fig. 3).

During 1st week of observation the foraging activity of *Apis cerana indica,* (mean of two year) was started foraging on niger flowers at 0900 hrs (13.00 bees/ 5min/ m$^2$) and gradually reached its peak at 1100 hrs (23.00 bees/5min/m$^2$) thereafter it started decreasing at 1300 hrs (15.00 bees/5min/m$^2$) and at 1500 hrs (8.00 bees/ 5min/m$^2$). The lowest activity was recorded at 1700 hrs (2.00 bees/5min/m$^2$). The activity of bees was not observed early in the morning *i.e.* at 0700 hrs. The mean number of foraging activity of bees was 10.16 bees/ 5min/ m$^2$.

During 2nd week, the maximum foraging activity of bees was recorded at 1100 hrs (50.5 bees/5min/m$^2$). It started declining at 1300 hrs and 1500 hrs accounting 32.00 and 17.5 bees/ 5min/m$^2$, respectively. The activity of bees was not observed in early morning 0700 hrs. Whereas it started its activity at 0900 hrs (19.5 bees / 5min/m$^2$). However, the least activity of bees was recorded at 1700 hrs (5.00 bees/5min/m$^2$). The mean activity of bees was 20.75 bees/5min/m$^2$.

On 3rd week of observation the activity of bees was not seen at 0700 hrs, while it started its activity at 0900 hrs ( 40.5 bees/5min/m$^2$) and reached its peak at 1100 hrs (102.5 bees/5min/m$^2$) with suddenly decreased at 1300 hrs and at 1500 hrs with population of 36.00 bees/ 5min/m$^2$ and 16.00 bees/5min/m$^2$, respectively. The least

**Table 1 : Mean foraging behaviour of *Apis cerana indica* Fab. on niger flowers during the year 2011-12 and 12-13**

| Sr. No. | Date of observations | ( Number of bees visit /5min/m$^2$), Hours of the day(H) | | | | | | Total | Mean |
|---|---|---|---|---|---|---|---|---|---|
| | | 0700 | 0900 | 1100 | 1300 | 1500 | 1700 | | |
| 1. | 12.10.2011 and 23.11.2012 | 0.00 | 13.00 | 23.00 | 15.00 | 8.00 | 2.00 | 61.00 | 10.16 |
| 2. | 19.10.2011 and 30.11.2012 | 0.00 | 19.5 | 50.5 | 32.00 | 17.5 | 5.00 | 124.5 | 20.75 |
| 3. | 26.10.2011 and 07.12.2012 | 0.00 | 40.5 | 102.5 | 36.00 | 16.00 | 1.00 | 196.00 | 32.66 |
| 4. | 02.11.2011 and 14.12.2012 | 0.00 | 42.00 | 107.5 | 38.00 | 13.00 | 2.5 | 203.00 | 33.83 |
| 5. | 09.11.2011 and 21.12.2012 | 0.00 | 49.00 | 100.00 | 38.5 | 13.5 | 0.00 | 201.00 | 33.5 |
| 6. | 16.11.2011 and 28.12.2012 | 0.00 | 27.00 | 82.00 | 25.5 | 6.5 | 0.00 | 141.00 | 23.5 |
| 7. | 23.11.2011 and 05.01.2013 | 0.00 | 21.5 | 43.00 | 20.5 | 3.5 | 0.00 | 88.5 | 14.75 |
| 8. | 30.11.2011 and 12.01.2013 | 0.00 | 10.00 | 20.00 | 5.5 | 3.5 | 0.00 | 39.00 | 6.5 |
| | Total | 0.00 | 222.5 | 528.5 | 211.00 | 81.5 | 10.5 | 1054.00 | 175.66 |
| | Mean | 0.00 | 27.81 | 66.06 | 26.37 | 10.18 | 1.31 | 131.75 | |

activity of bees was noticed at 1700 hrs (1.00 bee /5min/$m^2$) and the mean activity of bees was 32.66 bees/5min/$m^2$.

During the 4th week, the least activity of bees was noticed at 1700 hrs (2.5 bees/5min/$m^2$) and started its foraging activity at 0900 hrs (42.00 bees/5min/$m^2$) with maximum activity at 1100 hrs (107.5 bees/5min/$m^2$) and decreased at 1300 hrs (38.00 bees/5min/$m^2$) and 1500 hrs (13.00 bees/5min/$m^2$). The activity of bees was not seen at early morning *i.e.* at 0700 hrs. During this week the average bees activity was 33.83 bees/5min/$m^2$.

On 5th week, the maximum activity was noticed at 1100 hrs (100.00 bees/5min/$m^2$). It started foraging at 0900 hrs (49.00 bees/5min/$m^2$) and reached its peak at 1100 hrs (100.00 bees/5min/$m^2$) and started decreasing at 1300 hrs (38.5 bees/5min/$m^2$) and at 1500 hrs (13.5 bees/5min/$m^2$). There was no foraging activity observed at 0700 hrs and 1700 hrs.

During 6th week, the foraging activity of bees was started at 0900 hrs (27.00bees/5min/$m^2$) thereafter increased to its peak at 1100 hrs (82.00 bees/5min/$m^2$) and started declining at 1300 hrs and 1500 hrs with 25.5 bees/5min/$m^2$ and 6.5 bees/5min/$m^2$, respectively. There was no foraging activity observed at 0700 hrs and 1700 hrs. The average activity of bees was 23.5 bees/5min/$m^2$.

During 7th week, the maximum foraging activity was observed at 1100 hrs with 43.00 bees/5min/$m^2$ and decreased at 1300 hrs (20.5 bees/5min/$m^2$) whereas at 1500 hrs the population was 3.5 bees/5min/$m^2$. No bee activity was recorded at 0700 hrs and 1700 hrs. The mean bee activity was 14.75 bees /5min/$m^2$.

During last week, the activity of bees was not observed at 0700 hrs and at 1700 hrs While its activity was observed starting at 0900 hrs (10.00 bees/5min/$m^2$) and increased to its peak at 1100 hrs (20.00 bees/5min/$m^2$) and suddenly decreased at 1300 hrs (5.5 bees/5min/$m^2$) and 1500 hrs (3.5 bees/5min/$m^2$). The average activity of bees was 6.5 bees/5min/$m^2$. The present findings are more or less conformity with the earlier workers Chaudhary and Kumar (2000) observed in cardamom *Apis cerana indica* foraging for nectar and pollen peaked from 0700 to 0900 hrs and 0800 to 0900 hrs, respectively. Chaudhary *et al*. (2002) reported foraging activity of *Apis cerana indica* on litchi flowers whereas Kumar *et al.* (2002) reported on sunflower. Chakrabarty and Sharma (2007) observed the maximum activity of bees at 1000 and 1800 hrs (1.24 bees/min/capitulum) with least number at 1400 hrs (0.69 bees/min/capitulum) on sunflower. Gogoi *et al.* (2007) who observed *Apis cerana indica* with maximum number of 9.42 foragers visited flowers of lemon during 1000-1100 hrs. Dhurve (2008) recorded *Apis cerana indica* on niger with its peak activity in the afternoon from 1200 to 1600 hrs. Shaw *et al*. (2008) recorded the Indian bee in 39 flora belonging to 23 families from October to March whereas, the foraging behaviour of Italian bee was recorded in 23 flora belonging to 18 families from January to March. Chandran and Viraktamath (2010) recorded *Apis dorsata*, *Apis cerana* and *Apis florea*

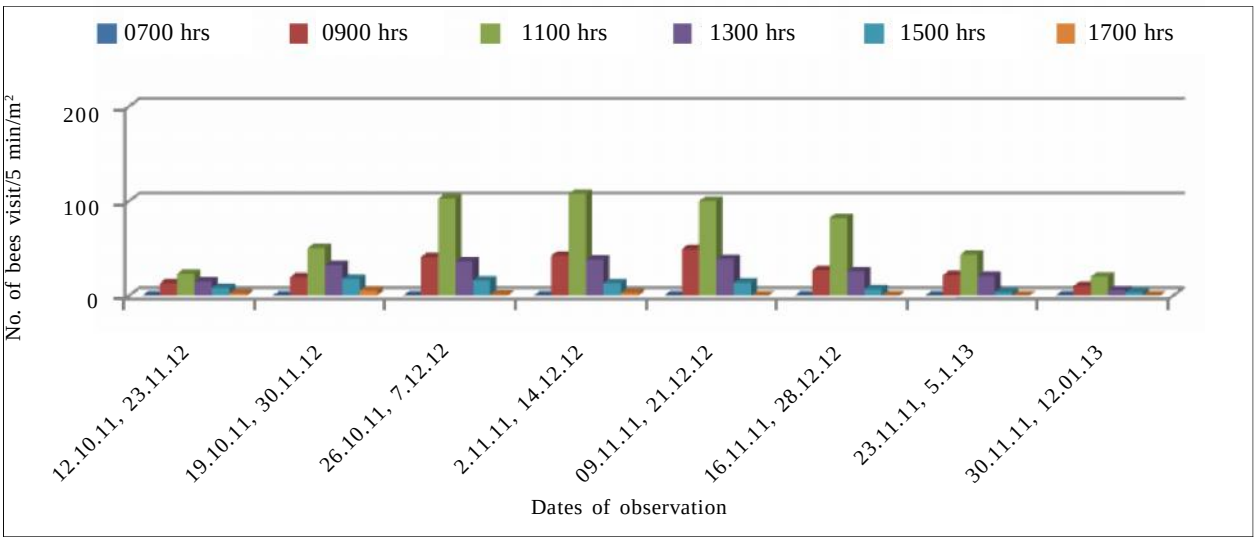


**Fig. 1 : Foraging behaviour of Indian bee, *Apis cerana indica* during 2011-12 and 12-13**

on niger whereas the major flower visitor was *Apis dorsata* visiting with higher number on 11th, 15th and 17th days after flowering and *Apis carana* was more on 11th and 17th days. *Apis florea* visitation was more only on 11th days after flowering. Verma and Pratap (2010) recorded that *Apis carana* started foraging on cauliflower and cabbage at 0700 hrs and 0630 hrs with its peak activity in between 1100 hrs and 1300 hrs for each crop.

**Foraging behaviour of Rock bee (*Apis dorsata*) on niger flowers :**

The foraging behaviour of *Apis dorsata* on niger flowers was observed during both year 2011-12 and 12-13 and is depicted in Table 1 and Fig. 1.

During 1st week, the foraging behaviour of *Apis dorsata* was not observed during both the year from 0700 hrs to 1700 hrs of different hours of the day.

On second week, the foraging activity of *A. dorsata* started at 1100 hrs (5.00 bees /5min/m$^2$), further, it increased and reached the peak at 1300 hrs and it declined at 1500 hrs and 1700 hrs. The bee activity was not seen at morning 0700 hrs and 0900 hrs. The average foraging activity of bees was 2.08 bees/5min/m$^2$ at different hours of the day.

On third week, the least bee activity was observed at 1700 hrs (2.5bees /5min/m$^2$) whereas it started its activity at 0900 hrs (11.00 bees/5min/m$^2$) and reached its maximum activity at 1100 hrs (27.50 bees/ 5min/m$^2$), further, it decreased at 1300 hrs and 1500 hrs with 18.00 bees/5min/m$^2$ and 15.00 bees/5min/m$^2$, respectively. No bee activity was found at 0700 hrs. The average bee

**Table 2 : Mean foraging behaviour of *Apis dorsata* Fab. on niger flowers during the year 2011-12 and 12-13**

| Sr. No. | Date of observations | (Number of bees visit /5min/m$^2$)Hours of the day(H) | | | | | | Total | Mean |
|---|---|---|---|---|---|---|---|---|---|
| | | 0700 | 0900 | 1100 | 1300 | 1500 | 1700 | | |
| 1. | 12.10.2011 and 23.11.2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. | 19.10.2011 and 30.11.2012 | 0.00 | 0.00 | 5.00 | 7.5 | 0.00 | 0.00 | 12.5 | 2.08 |
| 3. | 26.10.2011 and 07.12.2012 | 0.00 | 11.00 | 27.5 | 18.00 | 15.00 | 2.5 | 74.00 | 12.33 |
| 4. | 02.11.2011 and 14.12.2012 | 0.00 | 7.5 | 17.5 | 10.00 | 15.00 | 1.5 | 51.5 | 8.58 |
| 5. | 09.11.2011 and 21.12.2012 | 0.00 | 5.00 | 17.5 | 9.00 | 0.00 | 0.00 | 31.5 | 5.25 |
| 6. | 16.11.2011 and 28.12.2012 | 0.00 | 0.00 | 12.5 | 12.5 | 2.5 | 0.00 | 27.5 | 4.58 |
| 7. | 23.11.2011 and 05.01.2013 | 0.00 | 5.00 | 10.00 | 1.00 | 0.00 | 0.00 | 16.00 | 2.66 |
| 8. | 30.11.2011 and 12.01.2013 | 0.00 | 0.00 | 4.00 | 5.00 | 0.00 | 0.00 | 9.00 | 1.5 |
| | Total | 0.00 | 28.5 | 94.00 | 63.00 | 32.5 | 4.00 | 222.00 | 37.00 |
| | Mean | 0.00 | 3.56 | 11.75 | 7.87 | 4.06 | 0.50 | 27.75 | 4.62 |

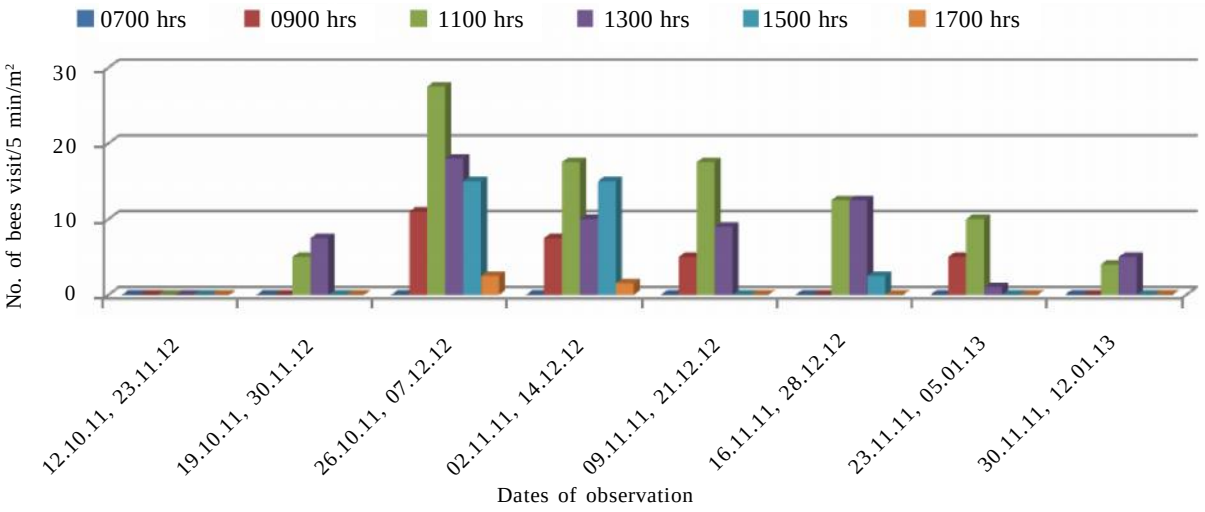


**Fig. 2 : Foraging behaviour of Rock bee, *Apis dorsata* during 2011-12 and 12-13**

activity was 12.33 bees/ 5min/m$^2$.

During 4$^{th}$ week, *A. dorsata* started visiting at 0900 hrs (7.5bees/5min/m$^2$) and reached its peak at 1100 hrs (17.5 bees/5min/m$^2$) thereafter decreased at 1300 hrs (10.00bees /5min/m$^2$). It again increased at 1500 hrs (15.00 bees/5min/m$^2$).The least foraging activity of *A. dorsata* was observed at 1700 hrs (1.5 bees/5min/m$^2$) whereas average activity during 4$^{th}$ week was 8.58 bees/ 5min/m$^2$.

On 5$^{th}$ week, the maximum foraging activity was recorded at 1100 hrs (17.5 bees/5min/m$^2$) which suddenly decreased at 1300 hrs ( 9.00 bees/5min/m$^2$), further, it disappeared at 1500 hrs and 1700 hrs. It was started foraging at 0900 hrs (5.00 bees/5min/m$^2$). There was no bee activity found at morning 0700 hrs. The average bees activity was 5.25 bees/5min/m$^2$.

On 6$^{th}$ week, there was no foraging activity noticed at 0700 hrs and 0900 hrs. It started its activity at 1100 hrs (12.5 bees/5min/m$^2$) and reached its peak at 1300 hrs (12.5bees/5min/m$^2$) and decreased at 1500 hrs (2.5 bees/5min/m$^2$) and further it declined at 1700 hrs. The average activity of *A. dorsata* was 4.58 bees/5min/m$^2$).

**Table 3 : Mean foraging behaviour of *Apis florea* Fab. on niger flowers during the year 2011-12 and 12-13**

| Sr. No. | Date of observations | (Number of bees visits/5min/m$^2$), Hours of the day(H) | | | | | | Total | Mean |
|---|---|---|---|---|---|---|---|---|---|
| | | 0700 | 0900 | 1100 | 1300 | 1500 | 1700 | | |
| 1. | 12.10.2011 and 23.11.2012 | 0.00 | 0.00 | 1.5 | 2.5 | 1.5 | 0.00 | 5.5 | 0.91 |
| 2. | 19.10.2011 and 30.11.2012 | 0.00 | 0.00 | 3.0 | 4.0 | 2.0 | 0.00 | 9.0 | 1.5 |
| 3. | 26.10.2011 and 07.12.2012 | 0.00 | 0.00 | 2.5 | 4.0 | 0.00 | 0.00 | 6.5 | 1.08 |
| 4. | 02.11.2011 and 14.12.2012 | 0.00 | 1.5 | 5.5 | 6.0 | 1.5 | 0.00 | 14.5 | 2.41 |
| 5. | 09.11.2011 and 21.12.2012 | 0.00 | 0.00 | 4.5 | 2.5 | 1.00 | 0.00 | 8.00 | 1.33 |
| 6. | 16.11.2011 and 28.12.2012 | 0.00 | 0.00 | 5.0 | 5.0 | 2.5 | 0.00 | 12.5 | 2.08 |
| 7. | 23.11.2011 and 05.01.2013 | 0.00 | 1.5 | 5.0 | 5.5 | 1.5 | 0.00 | 13.5 | 2.25 |
| 8. | 30.11.2011 and 12.01.2013 | 0.00 | 1.5 | 2.5 | 2.5 | 0.00 | 0.00 | 6.5 | 1.08 |
| | Total | 0.00 | 4.5 | 29.5 | 32.0 | 10.00 | 0.00 | 76.00 | 12.66 |
| | Mean | 0.00 | 0.56 | 3.68 | 4.00 | 1.25 | 0.00 | 9.5 | |

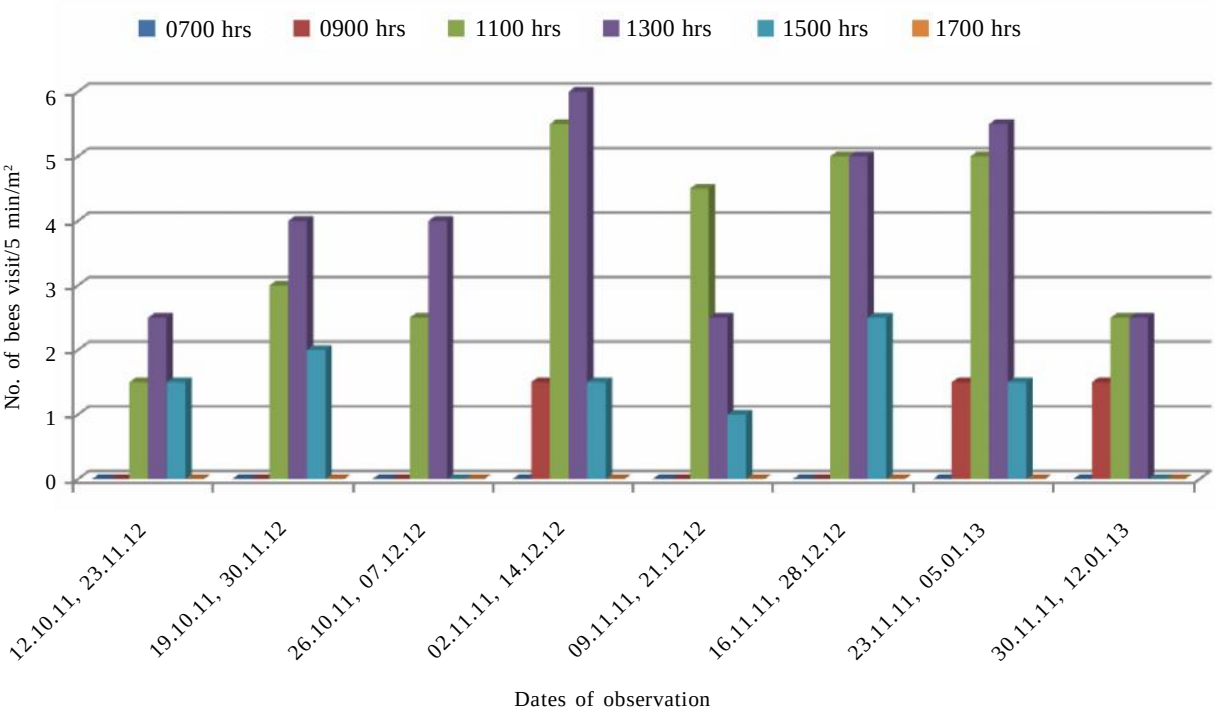


**Fig. 3 : Foraging behaviour of little bee, *Apis florea* during 2011-12 and 12-13**

On 7th week, the maximum foraging activity of *A. dorsata* was recorded at 1100 hrs (10.00 bees/5min/$m^2$) further it decreased at 1300 hrs (1.00 bee/5min/$m^2$) and declined at 1500 hrs and 1700 hrs. The activity was started at 0900 hrs (5.00 bees/5min/$m^2$). While, the bee activity was not recorded at 0700 hrs. The average activity of *A. dorsata* was 2.66 bees/5min/$m^2$.

During 8th week, no foraging activities was observed at 0700 hrs and 0900 hrs. However, it started its activity at 1100 hrs (4.00 bees/5min/$m^2$) and maximum activity was recorded at 1300 hrs (5.00 bees/5min/$m^2$), thereafter it declined at 1500 and 1700 hrs. The mean activity of bees was 1.5 bees/5min/$m^2$). The present results are in close agreement with the earlier workers of Kumar and Singh (2008) reported peak activity of *Apis dorsata* on safflower crop at 1100 hrs and the least at 1500 hrs. Singh (2008) who recorded the maximum foraging frequency of *Apis species* at 1200 hrs, followed by 1000, 1400 and 1600 hrs on parental lines of *Brassica napus*. Dhurve (2008) noticed maximum foraging cativity of *Apis dorsata* in between 1000 to 1600 hrs of the day which ranged from 36.90 to 45.56 bees/$m^2$/5min. It was less at 0800 hrs with 22.73 bees/$m^2$/5min and least at 1800 hrs which recorded 18.96 bees/$m^2$/5min. Selvakumar *et al*. (2001) who also recorded the activity of *Apis dorsata* on cauliflower constituted 28.23 per cent and the pollen gatherers reached to its peak at 1400 hrs while nectar collectors remained constant throughout the day. Chandran and Viraktamath (2010) recorded the activity of *A. dorsata* on niger crop with its higher visitation on 11th , 15th and 17th day after flowering.

**Foraging behaviour of Little bee (*Apis florea*) on niger flowers :**

The mean foraging behaviour of *Apis florea*, is depicted in Table 3 and Fig. 3

During 1st week of observation at the time flowering of crop, the foraging activity of *Apis florea* was started at 1100 hrs (1.5 bees/5min/$m^2$) and its maximum activity was recorded at 1300 hrs (2.5bees/5min/$m^2$). Further, it decreased and declined at 1500 hrs and 1700 hrs with 1.5 bees/5min/$m^2$ and zero population, respectively. The activity of bees was not recorded at 0700 hrs and 0900 hrs. The mean activity of bees was 0.91 bee/5min/$m^2$.

During 2nd week, the bee activity was not observed at 0700 hrs and 0900 hrs. However, bees started its activity at 1100 hrs (3.00 bees/5min/$m^2$), it reached maximum activity at 1300hrs (4.00 bees/5min/$m^2$) and decreased at 1500 hrs (2.00 bees/5min/$m^2$) thereafter, it declined at 1700 hrs. The average activity of bee was 1.5 bees /5min/$m^2$.

During 3rd week, the maximum foraging activity of *A. florea* was recorded at 1300 hrs (4.00 bees/5min/$m^2$), further it declined at 1500 hrs and 1700 hrs. It started its activity at 1100 hrs (2.5 bees/5min/$m^2$). There was not foraging activity noticed at 0700 hrs and 0900 hrs. The average activity of bees was 1.08 bees/5min/$m^2$.

During 4th week, the bees were not observed at 0700 hrs. However, it started its activity at 0900 hrs with 1.5 bees/5min/$m^2$ and reached its peak at 1300 hrs (6.00 bees/5min/$m^2$) and started decreased at 1500 hrs with 1.5 bees/5min/$m^2$) thereafter, it declined at 1700 hrs. The average activity of bee was 2.41 bees/5min/$m^2$.

On 5th week, the foraging activity of *A. florea* was not recorded at 0700 hrs and 0900 hrs, later, reached its maximum activity at 1100 hrs (4.5 bees/5min/$m^2$). It started decreasing at 1300 hrs (2.5 bees/5min/$m^2$) and least activity at 1500 hrs (1.00 bee/5min/$m^2$). Further, it declined at 1700 hrs. The activity of bees was not observed at 0700 hrs and 0900 hrs. The mean activity of bee was 1.33 bees/5min/$m^2$ .

On 6th week, the bees started its activity at 1100 hrs with 5.00 bees/5min/$m^2$ and at 1300 hrs with 5.00 bees/5min/$m^2$ thus two maximum activity periods were recorded. Further, it decreased at 1500 hrs of the day (2.5 bees/5min/$m^2$) and it declined at 1700 hrs. The mean activity of bee was 2.08 bees/5min/$m^2$.

On 7th week, the maximum activity of bees was observed at 1300 hrs (5.5 bees /5min/$m^2$), further it decreased and declined at 1500 hrs (1.5 bees/ 5min/$m^2$) and at 1700 hrs with no population. Its activity was not observed at 0700 hrs but it started its activity at 0900 hrs (1.5 bees/5min/$m^2$) and gradually reached its peak at 1300 hrs (5.5 bees/5min/$m^2$). The average activity of bee was 2.25 bees/5min/$m^2$.

During 8th week, two peak activity was recorded at 1100 hrs and 1300 hrs accounting to 2.5 bees/5min/$m^2$ and 2.5 bees/5min/$m^2$ ,respectively. Further, it decreased at 1500 hrs and 1700 hrs and started its activity at 0900 hrs (1.5 bees /5min/$m^2$) but it was not observed at 0700 hrs. The mean foraging activity of bee was accounting to 1.08 bees/5min/$m^2$. The present results are in close agreements with the earlier workers Abrol (2010) who observed *Apis florea* on onion and it visited 1.33 +0.26

and 6.17+0.58 umbels and flowers/min, during different hours of the day. Chandran and Viraktamath (2010) observed *Apis florea* on three elite genotypes of niger where *Apis florea* visitation was more on 11th days after flowering. Lal (2011) recorded *Apis florea* on different crops. The maximum foraging activity was observed in between 0700 hrs to 0900 hrs time period.

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