

STUDIES ON FORAGING AND POLLINATING ACTIVITY OF DWARF HONEY BEE (*APIS FLOREA* F.) ON BLOOMS OF *BRASSICA JUNCEA* LINNAEUS IN WEST BENGAL, INDIA

AMIT KUMAR GAYEN¹ & NARAYAN GHORAI

West Bengal State University, Berunanpukuria, Malikapur, Barasat, North 24 Parganas, Kolkata 700126

Corresponding author: zooamit.bnc@gmail.com

Reviewer: Peter Smetacek

ABSTRACT

Dwarf honey bee *Apis florea* F. is an economically important hymenopteran insect that pollinates a large number of flowering crops. A survey was conducted on agricultural land in and around Newtown, North 24 Parganas, W. Bengal, India, during December, 2021 to study the foraging activity of *Apis florea* and their role in pollination of mustard (*Brassica juncea* L.) flowers. Peak foraging activity of dwarf honey bee was mainly observed at 1200 hrs. and minimum foraging activity was noticed at 0800 hrs. & 1700 hrs. The present study also reported that foraging activity of *Apis florea* was maximum on sunny days and least on cloudy days.

KEYWORDS: *Apis florea*, *Brassica juncea*, foraging activity, pollination

INTRODUCTION

Hymenopteran insects, especially honey bees, are very effective in collecting pollen grains (as a protein source) and nectar (as

a carbohydrate source) or both. Red dwarf honey bee *Apis florea* Fabricius, 1787 is a very small wild bee as compared to other *Apis* Linnaeus, 1758 species. Mustard (*Brassica juncea* L.) is an economically important oil producing plant under the family Brassicaceae. *Brassica juncea* is a self incompatible crop which needs insects or other pollinating agents for their pollination. Different species of honey bees have been reported as the most frequent foragers of mustard blooms (Dalio, 2018; Nagpal *et al.*, 2020).

Foraging frequency of bees or the number of flowers visited per unit time depends upon a few factors like length of proboscis (Inouye, 1980), floral structure (Free, 1970), quality and quantity of floral rewards (Rao & Suryanarayana, 1983; Rao, 1991) etc. Foraging behavior of *Apis florea* on onion flowers (*Allium cepa* L.) was studied by Abrol (2010) and he noted that bee foraging behavior is significantly related with various environmental factors. Foraging activity of dwarf bees on blooms of *Ocimum basilicum* was studied by Dalio (2018) and it was observed that this herb is an excellent source of nectar and pollen for

Apis florea. Roy *et al.* (2014) reported that *Apis florea* is an effective pollinator for *Brassica juncea*.

A. florea shows late foraging performance and spent more time (5.9-6.4 sec) on *Brassica juncea* flowers than *A. dorsata* Fabricius, 1793 and *A. mellifera* Linnaeus, 1758 (Tanda, 1984). Sharma *et al.* (2001) and Pandey & Tripathi (2003) observed that workers of *A. florea* stay for a greater time per flower than other bee species. Foraging activities and the foraging patterns of honey bees have changed with different weather condition (Hossam *et al.*, 2012; Shwetha *et al.*, 2021). Foraging behavior of *A. florea* in different environmental conditions was studied by Layek *et al.*, 2015 and revealed that *A. florea* produces both unifloral and multifloral type of honey. The main objective of the present study was to determine the foraging span (time spent per flower) and/or foraging rate (number of flower visited per unit time) of *Apis florea* on mustard flower in different diurnal conditions.

MATERIAL AND METHODS

The field study was conducted during the flowering season of mustard, from December to January, 2021 at an agricultural area of North 24 Parganas, West Bengal. To study the diurnal abundance of *Apis florea*, five random plots were selected of 1 m² area each. Approximately 210-270 plants in each 1 m² area were counted. Observations were taken at every hour from 0700 to 1700 hrs. The number of *Apis florea* individuals present in each quadrat area (1 m²) for a period of 5 minutes at the interval of every

hour from 0700-1700 hrs was noted with the help of measuring tape and stopwatch. The numbers of pollen or volumes of nectar or both bee foragers were noted to study the foraging activity of *Apis florea*. Data were taken on both sunny and cloudy days to analyse the difference in time of commencement, cessation and also highest foraging activity period during different weather conditions.

RESULT AND DISCUSSION

The present observations revealed that the foraging activity of *Apis florea* starts between 0800-0900 hrs and it stop its foraging activity between 1600-1700 hrs on mustard flowers. It has been found that *A. florea* do not show their foraging activity before 7 am and after 5 pm, probably due to low atmospheric temperature, humidity, light intensity and other foraging factors. Maximum abundance was recorded between 1200-1300 hrs probably due to high rewards in terms of pollen and nectar etc.

The data on foraging speed (time spent per flower) of *A. florea* on *B. juncea* flowers was recorded from 0700 to 1700 hrs. The data has been presented in Table 2. In the present observation maximum time spent per flower by *A. florea* (8.26 sec - 8.13 sec) was recorded at 1300-1400 hrs and minimum foraging speed (3.13 sec) was noted at 0800 hrs. The maximum mean foraging speed was 5.77 sec and the minimum mean foraging speed was 4.00 sec. So, foraging speed was significantly low in morning and afternoon hours.

Foraging frequency of *A. florea* on *B. juncea* flowers was also noted under

different weather conditions. The data has been presented in Table 3. During sunny days the pollen foragers of *A. florea* were 1.10-1.74 bees/m²/5 min and nectar foragers were 0.98-1.34 bees/m²/5 min. During cloudy day the pollen foragers of *A. florea* were 0.87-1.34 bees/m²/5 min and nectar foragers were 0.65-1.16 bees/m²/5 min.

Foraging activity of *Apis florea* (bees/m²/5 min) inside and outside the crop field was observed and the data has been presented in Table 4. Foraging activity was greater (2.12 bees/m²/5 min) inside the crop field than along the edge (1.64 bees/m²/5 min) of the field.

Table-1: Abundance of *Apis florea on *Brassica juncea***

*Number of bees per 1 m² per 5 minutes (Average of 25 observations)

Hrs.	Abundance of <i>Apis florea</i>
0700	0.00
0800	0.12 ±0.33
0900	0.32±0.47
1000	0.76±0.43
1100	1.08±0.40
1200	2.12±0.43
1300	2.04±0.45
1400	1.96±0.35
1500	1.24±0.43

1600	0.96±0.45
1700	0.00

Table-2: foraging speed of *Apis florea* on the flowers of *B. juncea* (Average of 15 observations)

Hrs.	Maximum time spent /Flower (sec)	Minimum time spent /Flower (sec)
0700	00	00
0800	5.13	3.13
0900	6.46	3.73
1000	7.13	5.13
1100	7.33	4.86
1200	7.26	5.73
1300	8.26	6.26
1400	8.13	6.53
1500	7.53	4.73
1600	6.33	3.93
1700	00	00
Mean	5.77	4.00

Table-3: Foraging frequency of *Apis florea* under different weather conditions

	Pollen foragers (PF)	Nectar foragers (NF)
Sunny Day	1.10-1.74 bees/m²/5 min	0.98-1.34 bees/m²/5 min
Cloudy Day	0.87-1.34 bees/m²/5 min	0.65-1.16 bees/m²/5 min

Table-4: Foraging activity of *Apis florea* (bees/m²/5 min) inside and outside the crop field (Average of 25 observations)

	Foraging activity inside the crop field	Foraging activity outside the crop field
<i>Apis florea</i> (bees/m²/5 min)	2.12	1.64

Mustard flowers are very attractive and a good source of nectar and pollen for a wide variety of insects belonging to the orders Hymenoptera, Lepidoptera, Coleoptera, Diptera and Hemiptera (Free, 1993; Abrol, 1998; Roy *et al.*, 2014). Roy *et al.* (2014) reported that honeybees are effective pollinators and they collect pollen by their specific pollen baskets

located on hind legs. Layek *et al.* (2015) mentioned that *A. florea* helps our society through their pollination services by enhancing pollination rate in agricultural and natural ecosystems. Tanda (1984) noted that foraging activity of *A. florea* on *B. juncea* flowers started later and they spent more time (5.9-6.4 sec/flower) than *A. mellifera* (3.0-3.2 sec/ flower) and *A. dorsata* (2.2-3.0 sec/ flower). Nagpal *et al.* (2020) observed that *A. florea* spent more time per flower (6.63 sec) than other *Apis* species on the blooms of *B. juncea*. The present findings also revealed that *A. florea* spent most time (8.26 sec) on the blooms of *B. juncea*. Sharma *et al.* (2001) studied *A. florea* on *B. campestris* flowers and observed the same result. On *B. campestris* flowers, *A. florea* spent 3.54 sec/flower followed by *A. dorsata* (2.18 sec/ flower) and *A. mellifera* (1.64 sec/ flower). Pollination efficiency of honey bees is determined by the foraging rate of bees or the number of flowers visited in a short time. Pollination efficiency is directly related to the foraging rate of honey bees. *A. florea* is a very effective pollinator for their very small body size (Free, 1981; Singh, 1982; Gubartalla, 1997) as compared to other *Apis* species and distributed in tropical and subtropical regions of Asia. Dalio (2018) reported that foraging rate of *A. florea* was significantly lower than other bee species on the blooms of *B. napus* L.

According to Abrol (2010), foraging behavior of *A. florea* is positively related with various environmental factors like air temperature, light intensity, solar radiation and nectar-sugar concentration of flower species and negatively related with humidity. The present study also supports

this finding. Abrol (2010) also reported that *A. florea* is an efficient pollinator for its maximum abundance; maximum foraging rate and they are able to perform their work at high temperatures on onion flowers. Shwetha *et al.* (2021) recorded that the foraging activity of *A. cerana* and *A. florea* was significantly higher in sunny weather than on cloudy days. According to Sihag & Abrol (1986) foraging activity of *A. florea* was directly related with air temperature, light intensity, solar radiation and nectar sugar concentration and inversely related with humidity. Foraging activity of *A. florea* on the bloom of *Ocimum basilicum* was observed by Dalio (2018) and he concluded that foraging activity depends on the hours of the day. Priti (1998) studied the foraging rate and forager abundance of insect visitors on onion blooms and observed that the abundance of pollen foragers were more than the nectar foragers.

CONCLUSION

The present study concludes that the hymenopteran bee *A. florea* is a very effective pollinator on mustard blooms. The foraging activity of *A. florea* depends on weather conditions. Nowadays farmers use insecticides frequently, which hamper the foraging rate of hymenopteran bees. So, farmers should ideally follow biological control methods.

ACKNOWLEDGEMENT

Authors are grateful to Dr. Surja Prakash Agarwala, Principal, Vidyanagar College for his continuous encouragement. We are also thankful to our family members and all local farmers.

REFERENCES

- Abrol, D. P. 2006. Factors influencing flight activity of *Apis florea* F., an important pollinator of *Daucus carota* L. *Journal of Apicultural Research* 45(2): 2–6.
- Abrol, D. P. 2010. Foraging behaviour of *Apis florea* F., an important pollinator of *Allium cepa* L. *Journal of Apicultural Research* 49(4): 318-325.
- Dalio, J.S. 2018. Foraging Frequency of *Apis* Species on Bloom of *Brassica napus* L. *The International Journal of Engineering and Science* 7 (2): 28-33.
- Dalio, J.S. 2018. Foraging activity of dwarf honey bee (*Apis florea*) on bloom of *Ocimum basilicum* L. *Journal of research in agriculture and animal science* 5(1): 11-14.
- Free, J.B. 1981. Biology and Behaviour of the Honeybee *Apis florea*, and Possibilities for Beekeeping. *Bee World* 62(2): 46-59.
- Free, J. B. 1970. *Insect pollination of crops*. Academic Press, London. 7(4): 544
- Free, J. B. 1993. *Insect pollination of crops*. Academic Press, London. 684 pp.
- Hossam, F. A., A.A. Ahmad & A.M. Abdelsalam. 2012. Tolerance of two honey bee races to various temperature and relative humidity gradients. *Environmental and Experimental Biology* 10(4): 133–138.
- Inouye, D. W. 1980. The effect of proboscis length and corolla tube lengths

on patterns and rates of flower visitation by bumble bee. *Oecologia* 45(2): 197-201.

Layek, U., R.K. Bhakat & P.Karmakar. 2015. Foraging behaviour of *Apis florea* Fabricius during winter and spring-summer in Bankura and Paschim Medinipur districts, West Bengal. *G.J.B.B.* 4 (3): 255-263.

Nagpal. K., S. Yadav & R. Singh. 2020. Foraging speed of different *Apis* spp. on Indian mustard (*Brassica juncea*) flowers. *Journal of entomology and zoology studies* 8(2): 628-632.

Rao G M. 1991. Studies on the floral biology and pollination requirements of scented methi (*Trigonella corniculata* L.). *Indian Bee Journal* 53(1-4): 39-43.

Rao, G. M., M.C. Suryanarayana. 1983. Potentialities for bee pollination of crops in UP. *Indian Bee Journal* 45: 58-61.

Roy, S., A.K. Gayen, B. Mitra & A. Duttagupta. 2014. Diversity, foraging activities of the insect visitors of Mustard

(*Brassica juncea* Linnaeus) and their role in pollination in West Bengal. *Journal of Zoology Studies* 1(2): 7-12.

Sharma, S. K., J.R. Sing & J.C. Mehla. 2001. Foraging behaviour of *Apis* spp. in semi arid sub tropical climate on flowers of mustard, onion, carrot, berseem and sunflower. *Crop Research* 21(3): 332-334.

Shwetha, B. V., Gavi Gowda & K.S. Jagadish. 2021. Comparative Foraging Behaviour of *A. florea* and *A. cerana* during Different Weather Conditions. *Int. J. Curr. Microbiol. App. Sci.* 10(03): 1690-1696.

Sihag, R. C. & D.P. Abrol. 1986. Correlation and path-coefficient analysis of environmental factors influencing flight activity of *Apis florea* F. *J. Apic. Res.* 25(4): 202-208.

Tanda, A. S. 1984. Foraging behavior of three species of *Apis* on raya in relation to the sugar concentration in its nectar. *Indian Bee Journal* 46:5-6.