

## Relative Abundance and Foraging Behavior of Insect Pollinators of Sunflower (*Helianthus annuus* L.) in West Bengal, India

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**Abstract** Experiment was conducted to evaluate the relative abundance and foraging behavior of insect pollinators of sunflower during 2016. *Apis mellifera* was the most dominant pollinator (47.97%) followed by *Apis dorsata* (46.52%) and these two species comprised 94.49% of total flower visitors. Other insect pollinators show low activity on sunflower. Average number of insect visitors ranged from 5.99 to 7.99/sq m (6.90/sq m). Both species started foraging before 7.00 AM which continued even after 5.00 PM. Peak activity of *A. mellifera* and *A. dorsata* was at 9.00 AM and 11.00 AM respectively. *A. mellifera* visited more number of florets / minute (10.75 florets/min) than *A. dorsata* (6.71 florets/min).

**Keywords** Insect, Pollinators, Relative abundance, Sunflower.

### Introduction

Insect pollinators play a crucial role in improving the productivity of cross pollinated crops. The availability of sufficient number of suitable pollinators during flowering time is essential for achieving optimum pollination. Use of pollinators is considered as one of the reliable, cost effective and eco-friendly methods to increase productivity and quality of crop. Sunflowers produce abundant quantity of nectar and pollen which attract large number of honey bees. Though pollination is performed by other pollinators, honey bees account for a major share among them. Bees visit a greater number of flowers to fulfill the needs of their colony, instead of other insects that visit flowers only for their own food (Muller et al. 2006). Honey bees (*Apis mellifera*), due to higher numbers, vigorous daily activity, as well as their body structure conduct pollen transportation from one sunflower inflorescence to another. This provides an excellent pollination of the tube shaped sunflower florets (Cimu 1960). Other insect pollinators such as flies, butterflies and wasps also visit flowers and conduct pollination, however their activities are not considerable. The flowers visited by honeybees per minute were more in open pollination compared to other insect pollinators. Hence, it is essential to generate information on the status of naturally occurring pollinator diversity, abundance and foraging behavior which has direct impact on the yield and quality of seed production. With this background, the present studies have been undertaken to document relative abundance and

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foraging behavior of insect pollinators of sunflower.

### Materials and Methods

The experiment was conducted at District Seed Farm (A-B) Block) of Bidhan Chandra Krishi Viswavidyalaya situated at Kalyani in Nadia district of West Bengal (22.99° N latitude, 88.43° E longitude, with an altitude at 13 m above the mean sea level) during January to April 2016. The experimental area was designed in three plots measuring 12 × 6 m each. Each of these plots was again divided into four sub plots across the length to get a total of 12 plots of 3 × 6 m size. Sunflower seeds (variety : PAC-36) were sown on 4<sup>th</sup> January, 2016 at a spacing of 45 × 30cm and two seeds were placed per pit to obtain uniform crop stand. All recommended cultural practices were carried out with no spray during flowering period. The number of insect visitors present / sq m area of sunflower field was recorded at around 11.00 AM from which the relative abundance of these species were calculated using the formula :

$$\text{Relative abundance (\%)} = \left( \frac{\text{Population of a particular species visiting flower}}{\text{Total population of all species visiting flower}} \right) \times 100$$

The foraging activity of the two most pre-dominant pollinators i.e. *Apis mellifera* and *Apis dorsata* workers were studied during the blooming period of sunflower. For this purpose, observations were taken on various aspects namely, diurnal activity and number of florets visited per minute of these two species. The number of foraging bees of both the species present per square meter area was recorded at 2 hourly interval starting from 7.00 AM till 5.00 PM. The rate of work of the foragers was studied by recording the number of florets visited per forager per minute.

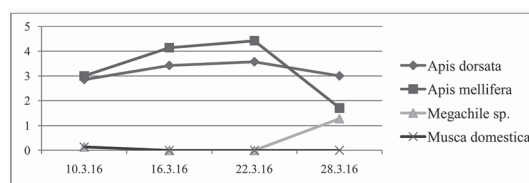


Fig. 1. Graph showing population of different pollinators of sunflower during the course of study 2016.

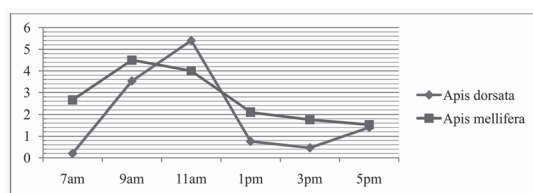
### Results and Discussion

On the basis of insect pollinators recorded per sq m during the entire blooming period (Table 1). *Apis mellifera* was the most predominant species with an average population of 3.31 insects/sq m (1.71–4.42 insects/sq m) representing 47.97% of insects that visited the field. This was followed by *Apis dorsata*, the second most dominant insect visitor with 3.21 insects/sq m (2.85-3.57 insect/sq m) representing 46.52% of insect visitors. Leaf cutter bee, *Megachile sp.* and dipteran fly, *Musca domestica* constituted 5.07% and 0.43 of insect pollinators with an average population of 0.35 (0.00-1.28 insects/sq m) and 0.03 insects/sq m (0.00-0.14 insects/sq m) respectively. *Apis sp.* constituted 94.49% and Hymenoptera contributed 99.56% of the total insect visitors. The monarch butterfly and coccinellid beetle were occasionally seen on the flower heads. The average number of insects/sq m during the blooming period was 6.90. The peak population (7.99 insects/sq m) was observed on 22<sup>nd</sup> March 2016 (Fig 1).

Both the species of honey bees appeared on the field before 7.00 AM as evident from the presence of sufficient number of bees on the crop at 7.00 AM. Honey bee activity continued even after 5.00 PM.

Table 1. Observations for abundance of different pollinators per sq m in sunflower crop.

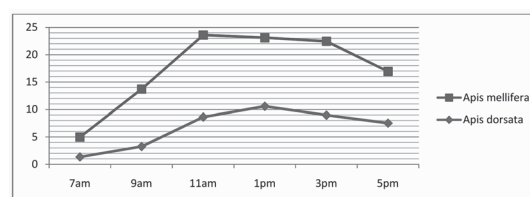
Date	10.3.16	16.3.16	22.3.16	28.3.16	Total	Average	Mean % population
<i>A. dorsata</i>	2.85	3.42	3.57	3.00	12.84	3.21	46.52
<i>A. mellifera</i>	3.00	4.14	4.42	1.71	13.27	3.31	47.97
<i>Megachile sp.</i>	0.14	0.00	0.00	1.28	1.42	0.35	5.07
<i>Musca domestica</i>	0.14	0.00	0.00	0.00	0.14	0.03	0.43
Total	6.13	7.56	7.99	5.99	27.67	6.90	



**Fig. 2.** Diurnal data for population of honey bee sp./sqm.

Only a few *A. dorasta* workers (0.20/sq m) were found to visit sunflower at 7.00 AM. the number of *A. dorasta* workers present per sq m area increased sharply at 9.00 AM (3.53 sq m) which further increased and reached its peak (5.40/sqm) at 11.00 AM. After that, the number decreased sharply (0.76/sqm) at 1.00 PM which further decreased a bit (0.46/sqm) at 3.00 PM. AT 5.00 PM number increased slightly (1.40/sq m) and foraging acyitivity continued beyond that. On the contrary, good numbers of *A. mellifera* workers were present from the early morning. At 7.00 AM, the number of *A. mellifera* workers present per sqm area was 2.66. Then the number increased and reached its peak (4.50/sq m) at 9.00 AM. After that, the number started to decline. At 11.00 AM, 1.00 PM, 3.00 PM and 5.00 PM, the number of *A. mellifera* workers present per sq m area was 4.00 , 2.10, 1.76 and 1.53 respectively. In case of *A. mellifera* also, foraging activity continued beyond that (Table 2, Fig. 2).

The number of florets visited/min by *A. mellifera* was found to be maximum (14.97 florets/min) at 11.00 AM and minimum (3.63 florets/min) at 7.00 AM. In case of *A. dorasta*, it was maximum (10.56 florets/min) at 1.00 PM and minimum (1.35 florets/min) at 7.00 AM. The average number of florets visited per min was more in *A. mellifera* (10.75 florets/min) than *A. dorasta* (6.71 florets/min) (Table 3, Fig.3.).



**Fig. 3.** Diurnal data for no. of florets visited/ min/bee.

In an earlier study, Swaminathan and Bharadwaj (1982) recorded *A. dorsata* as the most frequent bee species on sunflower. However, this study was conducted before large scale introduction and adoption of *A. mellifera* in India. Nderitu et al. (2008) reported *A. mellifera* L. was the most frequent visitor and had the highest pollination efficiency index. Rasheed et al. (2015), Ali et al.(2015), Aytekin and Cagatay (2008) also reported that *A. mellifera* was most dominant pollinator in sunflower. Pollination efficiency of any pollinator does not only depend on the number of pollinators present in the field but also some other factors viz, working duration, rate of work, flower fidelity and constancy. During the present study, two important aspects i.e. working hour and rate of work of two honey bee species were worked out. Activity of *A. mellifera* and *A. dorsata* started before 7.00AM and continued beyond 5.00 PM, though their activity attained peak at 9.00 AM and 11.00 AM, respectively. This is similar to the observations of Kumar et al. (1994) who reported a peak period of *A. mellifera* between 09 : 00 h and 11 : 00 h in India. Kumar and Singh (2005) recorded the maximum activity of the foragers at 11.00 h and the minimum at 15.00 h. Krishna (2014) found that the intensity of *A. mellifera*, *A. indica*, *A. dorsata* and *A. florea* reached at its peak at 10.00—12.00h Kasina et al. (2007) recorded the peak density of *Apis* sp. on sunflower between 10 : 00 AM and 02 : 00 PM. Padamshali (2016) recorded peak activity of *A. mellifera* and *A. dorsata* at 11.00

**Table 2.** Diurnal data for population of honey bee sp./sq m.

Time/ H. bee	7.00AM	9.00AM	11.00AM	1.00PM	3.00PM	5.00PM	Total	Average
<i>A. dorsata</i>	0.20	3.53	5.40	0.76	0.46	1.40	11.75	1.95
<i>A. mellifera</i>	2.66	4.50	4.00	2.10	1.76	1.53	16.55	2.75

**Table 3.** Diurnal data for no. of florets visited / min /bee.

Time / H. bee	7.00 AM	9.00 AM	11.00 AM	1.00 PM	3.00 PM	5.00 PM	Total	Average
<i>A. dorsata</i>	1.35	3.25	8.62	10.56	8.96	7.52	40.26	6.71
<i>A. mellifera</i>	3.63	10.46	14.97	12.54	13.50	9.41	64.51	10.75

AM and 1.00 PM, respectively on onion flowers at Chakdah, which is several kilometers away from the present experimental site. The recorded differences in activity period of honey bees on sunflower by different authors are mainly due to different locations of their experiment. Padamshali (2016) found umbels visited/min was found to be more for *A. dorsata* (1.78 umbels/min) than *A. mellifera* on onion.

#### References

- Ali H, Owayss AA, Khan KA, Alqarni AS (2015) Insect visitors and abundance of four species of *Apis* on sunflower *Helianthus annuus* L. in Pakistan. *Acta Zoologica Bulgarica* 67 (2) : 235—240.
- Aytekin AM, Cagatay N (2008) Observations on the pollination of sunflower (*Helianthus annuus* L. ). *Mellifera* 8 (15) : 2—7.
- Cimu I (1960) Results of bee pollination of sunflowers. *Agric* 33 (1) : 18—20.
- Kasina M, Nderitu J, Nyamasyo G, Oronje ML (2007) Sunflower pollinators in Kenya : Does diversity influence seed yield ? *African Crop Science Conf Proc* 8 : 1149—1153.
- Krishna KV (2014) Studies on pollinator fauna of sunflower (*Helianthus annuus* L.) and their relative abundance. *Annals of Pl Prot Sci* 22 (2) : 303—305.
- Kumar N, Singh R (2005) Relative abundance of *Apis* spp. on rabi season sunflower (*Helianthus annuus* L.). *J Entomol Res* 29 (1) : 65—69.
- Kumar R, Chaudhary OP, Lenin JK (1994) Studies on the foraging behavior of honey bees and their role as pollinators of sunflower (*Helianthus annuus* L.). *Ind Bee J* 56 : 207—210.
- Muller A, Diener S, Schnyder S, Stutz K, Sedivy C, Dorn S (2006) Quantitative pollen requirements of solitary bees : Implications for bee conservation and the evolution of bee flower relationships. *Biol Conserv* 130 : 604—615.
- Nderitu J, Nyamasyo G, Kasina M, Oronje ML (2008) Diversity of sunflower pollinators and their effect on seed yield in Makueni District, Eastern Kenya. *Spanish J Agric Res* 6 (2) : 271—278.
- Padamshali S (2016) Insect pollinator of onion and impact of honeybee pollination on seed productivity. I MSc thesis. Dep of Agric Entomol BCKV, pp 23—24.
- Rasheed MT, Inayatullah M, Shah B, Ahmed N, Khan A, Ali M, Ahmed S, Junaid K, Adnan M, Huma Z (2015) Relative abundance of insect pollinators on two cultivars of sunflower in Islamabad. *J Entomol Zool Studies* 3 (6) : 164—165.
- Swaminathan R, Bharadwaj SC (1982) Bee pollinators and their foraging behavior. *Ind. Bee J* 44 (2) : 32—34.