



Composition and relative abundance of Indian honeybees (*Apis cerana indica* F.) on Sunflower (*Helianthus annuus* L.) in Gajapati District of Odisha

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ABSTRACT:

Apis cerana indica F., commonly known as the Indian honeybee or Indian hive bee are native to the Indian subcontinent. A detailed research has been conducted on composition, relative abundance and foraging activity of *A. c. indica* at MSSSoA, Gajapati, Centurion University of Technology and Management, Odisha in two cropping seasons. Foraging activities of *Apis cerana indica* was highest at 70 DAS with 4.03 bees/capitulum/5 min in first season where as it was highest at 73 DAS with 5.25 bees/capitulum/5 min. Domestication of *A. c. indica* F. during January to April would be more effective as compared to September to December in the sunflower ecosystem to increase the crop productivity and strengthening beekeeping as their activity was higher during 01:00-02:00 PM at 70 DAS (9.10 bees/capitulum/5 min) in the second season as compared to first season (01:00-02:00 PM, 8.60 bees/capitulum/5 min at 70 DAS)

Keywords: Honeybees, *Apis cerana indica*, foraging activity, sunflower

INTRODUCTION:

Pollinators are transferors such as bees, butterflies, birds, bats, and other insects that play an important role in ecosystems and agriculture by allowing pollen transport from male to female portions of flowers. This is known as pollination, and it has numerous substantial benefits for both the environment and human culture.

Pollinator diversity refers to the large range of species that participate in pollination, which results in fertilization and subsequent seed and fruit production. Indian honeybees (*Apis cerana indica* F.) are a subspecies of the Eastern honeybee (*Apis cerana*) found in the

Indian subcontinent. These bees play a crucial role in pollination, contributing to the ecosystem's biodiversity and supporting agriculture by facilitating the reproduction of various plant species.

The proportional representation or frequency of distinct pollinator species within a given habitat or territory is referred to as relative abundance. It depicts the numerical or population density of various pollinators and their contributions to pollination. Understanding pollinator abundance is critical for analyzing the overall health and operation of pollination networks. Honeybees are regarded as the best pollinators because they not only aid in pollination but also store honey that may be used by humans.

Sunflower, *Helianthus annuus* L., is an important oilseed crop due to its economic, ecological, and ornamental benefits. It is a diploid with the chromosome number $2n=34$ from the Asteraceae (Compositae) family. Sunflowers have brilliant, colourful flowers that produce a lot of nectar and pollen, making them very appealing to pollinators like bees and butterflies. Aside from that, the inflorescence of the sunflower, which is composed of numerous small flowers grouped in a broad disc, provides a generous landing place for pollinators. As a result, an examination of the abundance of the Indian honeybees, *Apis cerana indica* F. associated with the crop sunflower was conducted by observing their population, abundance and foraging activity.

MATERIALS & METHODS:

The current study was conducted over two seasons, the first (September-December, 2021) and second (January-April, 2022) in the Sunflower crop ecosystem at the Experimental Station of Entomology, which is located in the upland area of the Experimental Research Field, M S Swaminathan School of Agriculture, Paralakhemundi (District: Gajapati) Centurion University of Technology and Management, Odisha. The following strategies have been used to keep keen observation on population, abundance, and foraging activities.

Data collected at 05 days interval commencing from 45 DAS in two cropping seasons during 2021-23 on occurrence of various insect pollinators were computed to estimate the composition and abundance of *A. c. indica* in relation to others.

The observations were taken from 10 different locations for 5 minutes by following fixed plot survey in selected experimental sites in every five days during different time period of a day i.e. 07:00 to 08:00 AM, 10:00 to 11:00 AM, 01:00 to 02:00 PM and 04:00 to 05:00 PM in the Sunflower field.

Observations were recorded by counting the number of honeybees foraged on a single capitulum in every 5 minute at 10 different locations in different time duration of a day.

The final composition, abundance and foraging activities were analyzed by following standard statistical methods and represented in the following result and discussion chapter.

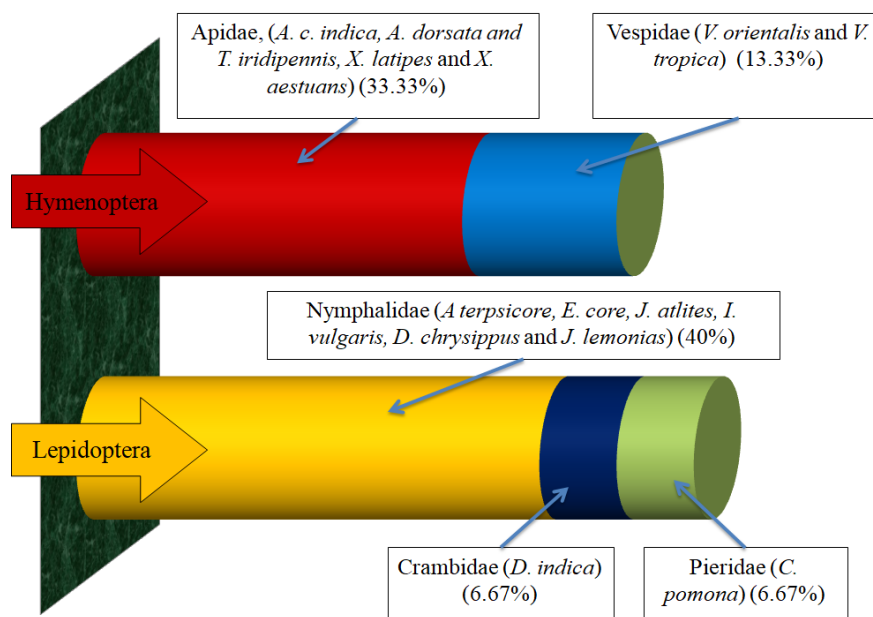
RESULTS & DISCUSSION:

The present study revealed that the activity of *A. c. indica* started at 10 per cent flowering stage coinciding with 45 DAS and the activity continued till the late flowering stage i.e. 84 DAS in the first season, whereas pollinators started arriving at 10 per cent flowering stage coinciding with 48 DAS and the activity continued till the late flowering stage i.e. 88 DAS in the second season. The visits though were very negligible but it continued till the harvest of the crop. A great majority of sunflower plants flowered between 65 DAS to 80 DAS and the diversified activities of pollinators mostly observed during the period were recorded.

Results recorded in first season revealed that the crop sunflower is visited by 14 different pollinators apart from *A. c. indica*. The other foraging pollinators recorded were Rock bees, *Apis dorsata*, Stingless bee *Tetragonula iridipennis*, two species of leaf cutter bees (*Xylocopa latipes* D. and *Xylocopa aestuans* L.), two species of wasps (Oriental hornet, *Vespa orientalis* and *Vespa tropica*), Tawny Coster (*Acraea terpsicore*), Common Crow (*Euploea core*), Grey pansy (*Junonia atlites*), Blue glassy tiger (*Idiopsis vulgaris*), Plain tiger (*Danaus chrysippus*), Lemon pansy (*Junonia lemonias*), Common/Lemon emigrant (*Catopsilia pomona*) and Cucumber moth/Cotton caterpillar (*Diaphania indica*). The percentage contribution of each family from two different orders has been represented in the Plate No. 1.

In the second season sunflower is visited by pollinators belonging to the only order Hymenoptera. The family apidae was the most dominant one. Sunflower crop visited by *A. dorsata*, *A. c. indica*, *T. iridipennis*, *X. latipes*, *X. aestuans*, *V. orientalis* and *A. zonata* observed.

Plate No. 1 Percentage contribution of different families from Order Hymenoptera and Lepidoptera during September-December, 2021



Similarly, Thakur *et al.* (2023) in Jammu and Kashmir, Nayak *et al.* (2021) at Kalahandi district of Odisha, Yasmeen *et al.* in 2021 in Tamil Nadu, Yang *et al.* (2020) at Bayannur of Inner Mongolia autonomous region of China, Bhowmik and Bhadra (2015) in West Bengal, Hussain *et al.* (2015) at Swabi Khyber Pakhtunkhwa region of North Western Pakistan, Rasheed *et al.* (2015) in Islamabad, Krishna *et al.* during (2014) at Parbani of Maharashtra, Goswami *et al.* (2013) at Pantnagar of Uttarakhand, Jadhav *et al.* (2011) at Tirupati, Panda *et al.* (1991) at Bhubaneswar of Odisha, Satyanarayan and Seetharam (1982) at Bangalore of Karnataka have observed *A. c. indica* as an effective foraging pollinator on sunflower.

Similarly, Shankar and Mukhtar in 2022 on sesamum, Padhy *et al.* (2021) on Marigold, Trianto and in 2020 on cowpea, Padhy *et al.* (2020) on sesamum, Umesh *et al.* [93] in 2020 on pumpkin, Padhy *et al.* (2019) on redgram and sesamum, Padhy *et al.* (2018) on redgram, Tharini and in 2016 on bitter gourd have also identified *A. c. indica* foraging on different cropping ecosystem

In the first season, Indian honeybees, *Apis cerana indica* constitute 30.81 per cent of the total foragers and was recorded as the most dominant among the 15 different species visiting sunflower.

Inference drawn from the present investigation revealed that the population of *Apis cerana indica* among different cropping periods was the maximum with 4.03 bees/capitulum/5 min at 70 DAS followed by 65 DAS (2.88 bees/capitulum/5 min) and 60 DAS (2.25 bees/capitulum/5 min), 75 DAS (1.85 bees/capitulum/5 min), 55 DAS (1.50 bees/capitulum/5 min), 80 DAS (1.25 bees/capitulum/5 min), 50 DAS (1.00 bees/capitulum/5 min), 45 DAS (0.58 bees/capitulum/5 min) and was least on 84 DAS with a minimum average foraging of 0.15 bees/capitulum/5 min as given in Table No. 1

The current study revealed that the population of *A. c. indica* was the maximum during 01:00-02:00 PM with a mean population of 3.02 bees/capitulum/5 min followed by 10:00-11:00 AM (2.36 bees/capitulum/5 min), 07:00-08:00 AM (1.28 bees/capitulum/5 min) and was least during 04:00-05:00 PM with a minimum average foraging of 0.22 bees/capitulum/5 min as given in Table No. 1.

The overall maximum abundance of *A. c. indica* was found on 70 DAS during 01:00-02:00 PM with a mean population of 8.60 bees/capitulum/5 min.

Table No.1: Foraging activity of *Apis cerana indica* in different cropping period of sunflower during September to December, 2021 at MSSSoA, Gajapati

Mean Population of <i>Apis cerana indica</i> F. per capitulum area in 5 min					
	07:00-08:00 AM	10:00-11:00 AM	01:00-02:00 PM	04:00-05:00 PM	Mean \pm SD
45 DAS	0.20	1.00	0.90	0.20	0.58 \pm 0.43
50 DAS	0.50	1.70	1.60	0.20	1.00 \pm 0.76
55 DAS	0.60	2.10	2.90	0.40	1.50 \pm 1.20
60 DAS	1.60	3.10	3.90	0.40	2.25 \pm 1.56
65 DAS	2.30	4.10	4.80	0.30	2.88 \pm 2.01
70 DAS	3.10	4.20	8.60	0.20	4.03 \pm 3.49
75 DAS	1.80	2.80	2.70	0.10	1.85 \pm 1.25
80 DAS	1.10	2.00	1.70	0.20	1.25 \pm 0.79
84 DAS	0.30	0.20	0.10	0.00	0.15 \pm 0.13
Mean \pm SD	1.28 \pm 1.00	2.36 \pm 1.34	3.02 \pm 2.55	0.22 \pm 0.13	

In the second season, Indian honeybees, *Apis cerana indica* constitute 33.94 per cent of the total foragers and remained the most dominant among seven different pollinators visiting sunflower.

Inference drawn from the present investigation revealed that the population of *Apis cerana indica* among different cropping periods was the maximum with 5.25 bees/capitulum/5 min at 73 DAS followed by 68 DAS (4.78 bees/capitulum/5 min) and 78 DAS (4.48 bees/capitulum/5 min), 63 DAS (3.35 bees/capitulum/5 min), 58 DAS (2.58 bees/capitulum/5 min), 83 DAS (1.95 bees/capitulum/5 min), 53 DAS (1.53 bees/capitulum/5 min), 48 DAS (0.90 bees/capitulum/5 min) and was least on 88 DAS with a minimum average foraging of 0.20 bees/capitulum/5 min as given in Table No. 2.

The current study revealed that the population of *A. c. indica* was the maximum during 10:00-11:00 AM with a mean population of 4.42 bees/capitulum/5 min followed by 07:00-08:00 AM (3.37 bees/capitulum/5 min), 01:00-02:00 PM (3.12 bees/capitulum/5 min) and was least during 04:00-05:00 PM with a minimum average foraging of 0.20 bees/capitulum/5 min as given in Table No. 2

The overall maximum abundance of *A. c. indica* was found on 70 DAS during 01:00-02:00 PM with a mean population of 9.10 bees/capitulum/5 min.

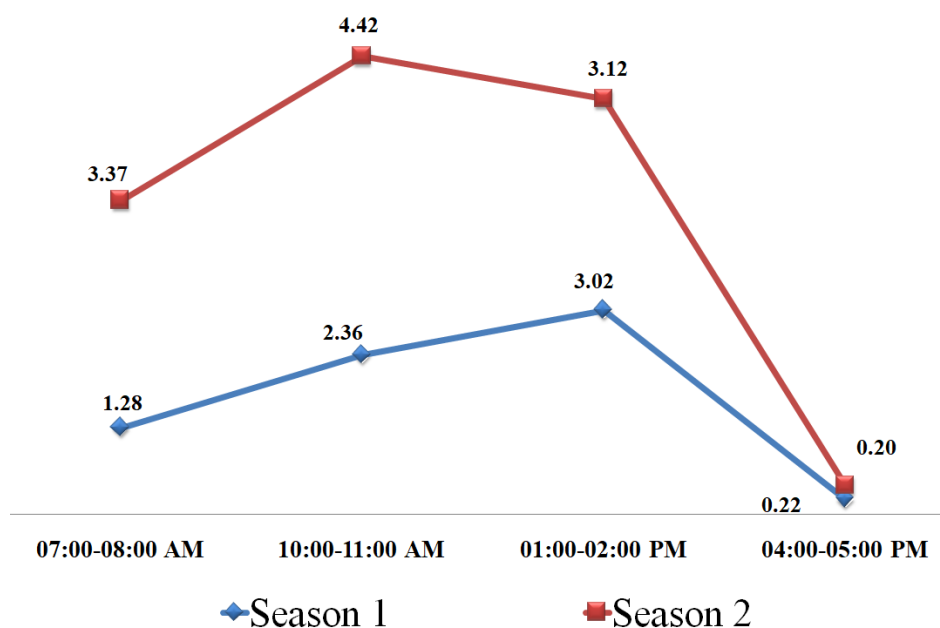
Table No.2: Foraging activity of *Apis cerana indica* in different cropping period of sunflower during January to April, 2022 at MSSSoA, Gajapati

Mean Population of <i>Apis cerana indica</i> F. per capitulum area in 5 min					
	07:00-08:00 AM	10:00-11:00 AM	01:00-02:00 PM	04:00-05:00 PM	Mean \pm SD
48 DAS	0.30	1.30	1.80	0.20	0.90 \pm 0.78
53 DAS	0.70	2.10	3.10	0.20	1.53 \pm 1.32

58 DAS	1.70	3.10	5.10	0.40	2.58 ± 2.01
63 DAS	2.70	4.10	6.10	0.50	3.35 ± 2.36
68 DAS	6.10	8.10	4.70	0.20	4.78 ± 3.35
73 DAS	8.10	9.10	3.70	0.10	5.25 ± 4.16
78 DAS	7.10	8.10	2.70	0.00	4.48 ± 3.80
83 DAS	3.30	3.70	0.70	0.10	1.95 ± 1.81
88 DAS	0.30	0.20	0.20	0.10	0.20 ± 0.08
Mean ± SD	3.37 ± 3.02	4.42 ± 3.25	3.12 ± 2.00	0.20 ± 0.16	

The results from the two season shows that the foraging activity of *A. c. indica* was maximum during 01:00-02:00 PM with a mean population of 3.02 bees/capitulum/5 min in the first season whereas it was maximum during 10:00-11:00 AM with a mean population of 4.42 bees/capitulum/5 min as represented in Plate No. 2.

Plate No. 2. Population trend of *Apis cerana indica* F. during different durations of a day over two season of experiment



Hemanth *et al.* (2020) recorded that *A. c. indica* showed peak activity during 11.00 to 12.00 hrs (5.5 bees/ capitulum/ 5min) when 51- 75% disc florets opened followed by 26-50% opened disc florets during 10.00 to 11.00 hrs (4.06 bees/ capitulum/ 5 min) and less

during 25% opened disc florets from 11.00 to 12.00 (3.63 bees/ capitulum/ 5 min. This follows same trend as that of current study. More or less similar observations were reported by Roopa (2002).

CONCLUSION:

The current research makes it abundantly evident that a wide variety of insect species belonging to the Hymenoptera are extremely attracted to sunflower capitulum among which the major Indian honeybee, *Apis cerana indica* F. was the dominant one. The results concludes that the domestication of *A. c. indica* F. during January to April would be more effective as compared to September to December in the sunflower ecosystem as the foraging activity recorded highest during second season of experiment. These findings can be recommended for both beekeeping and sunflower productivity point of view.

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