

FORAGING BEHAVIOUR OF INDIAN HONEY BEE (*Apis cerana indica* FAB.) ON MUSTARD (*Brassica juncea* L.) ECOSYSTEM IN AMBIKAPUR, CHHATTISGARH

Shubham Yadav¹ and G.P. Painkra²

ABSTRACT

A field experiment was conducted during *rabi* season 2019 at Research Cum Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (C.G.) for foraging activity of *Apis cerana indica* on mustard. After the entire study during the different flowering period *viz.*, onset, full bloom and end of bloom it was concluded that low population of Indian honey bee, *Apis cerana indica* was recorded at 7.00-8.00 hrs (1.6 bees/5min/m²). However, its reached its peak at 11.00-12.00 hrs (28.8 bees/5min/m²) followed by at 9.00-10.00 hrs (12.6 bees/5min/m²), 1.00-2.00 hrs (10.6 bees/5min/m²) and 3.00-4.00 hrs (7.2 bees/5min/m²). The present finding also indicate that the maximum population was observed in the full bloom stage in mustard ecosystem at forenoon time period.

(Key words : *Apis cerana indica*, foraging behaviour, mustard ecosystem)

INTRODUCTION

Indian mustard (*Brassica juncea* L.) is the most important oilseed crop commonly known as *rai*. Total six cultivated oilseed species of genus *Brassica* comprises more than 80% of total area occupied by Indian mustard (*Brassica juncea*) alone (Chandrashekhar *et al.*, 2013). Indian mustard is natural amphidiploids having chromosome number (2n=36). It is self pollinated crop but precise amount of (2-15%) pollination occurs due to insect and other factors.

Rapeseed and Mustard are grown under different agro ecological situations such as timely or late sown, rainfed or irrigated, sole and mixed crop with wheat, chickpea, barley, lentil etc.

They are also grown with inter cropping / mixed cropping with wheat crop as well as late sown rice. Mustard seeds are mainly grown in north western parts of India and the major producing states are Rajasthan and Uttar Pradesh. In India it is also cultivated in the states of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh and Chhattisgarh. The cultivation is also being popularized in some non-traditional area such as Andhra Pradesh and Tamil Nadu.

In India, rapeseed and mustard cover an area of 5.96 m ha with the production about 8.32 million tonnes. The productivity of rapeseed and mustard is about 1397 kg ha⁻¹ (Anonymous, 2018). In Chhattisgarh mustard is grown in an area of 47542 ha and with a production of 26999 metric tonn (Solvance and Pathak, 2016) and productivity of 564

kg ha⁻¹ (Anonymous, 2018). Rapeseed and mustard are called by various names in different regions such as *rai*, *sarson*, *raya* or *laha*.

Pollination is a natural solution or service that an organism plays in the ecosystem which is essential in human life. The bees are one of the most important crop pollinators. They increase production up to about 75 per cent of the crop species. The research discovered that habitat fragmentation due to human activities reduces bees diversity causing shifting of bee species in another natural climate which ultimately affecting the pollination activities. The problem can be solved by planting fallow lands and road edges with flowering plants to support wild pollinators throughout the growing season and by reducing pesticide uses especially during crop flower when more bee activities are in the fields. Insect pollinators play an important role in improving the productivity of cross pollinated crops. In present time, mustard is recognized as a better crop for sustaining bee culture occupation.

For a pollinating agent to be effective, its foraging behavior should favour the transportation of anther pollen to flower stigmas on the same plant or different target species plants. Insect mediated pollen transfer in mass flowering *Brassica sp.* has been particularly well studied, as insect pollinator activity can contribute significantly to pollination.

Different bee species of commercial importance are found in India *viz.*, Indian bee (*Apis cerana indica*), Rock bee (*Apis dorsata*), Dwarf bee (*Apis florea*) and European or Italian bee (*Apis mellifera*). *Apis dorsata* are aggressive and cannot be maintained in habitat but they are harvested

1. P.G. Student, IGKV, Dept. of Entomology, Raj Mohini Devi College of Agriculture & Research Station, Ambikapur-497001 (C.G.) India
2. Senior Scientist & PI - All India Coordinated Research Project on Honey Bees & Pollinators, IGKV, Dept. of Entomology, Raj Mohini Devi College of Agriculture & Research Station, Ambikapur-497001 (C.G.) India

from the wild. The honey is also harvested from dwarf bees in the wild as these are nomadic and produce very low yield. *A. cerana indica* and *A. mellifera* introduced from the cool climate temperate zone are more suitable to culturing in artificial honey bee boxes.

MATERIALS AND METHODS

Experimental details

A field experiment was conducted during *rabi* season 2019 at Research Cum Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (C.G.). The GPS location of mustard ecosystem N 23.1417520 and E 83.1804720. Indian honey bee was recorded at 7.00 AM- 8.00 AM, 9.00 AM- 10.00 AM, 11.00 AM-12.00 Noon, 1.00 PM- 2.00 PM, and 3.00 PM - 4.00 PM for five minutes at five days interval in 1 m² area. Observations were recorded from onset of bloom through peak and end of bloom in mustard. The variety of mustard Chhattisgarh Sarson was used. Experimental plot size was 4 m x 3.5 m. Seeds were sown on 20/09/2019.

RESULTS AND DISCUSSION

The results shows in Table 1 and 2 indicates that during the different flowering period *viz.*, onset, full bloom and end of bloom, the minimum population of *Apis cerana indica* was recorded at 7.00-8.00 hrs (1.6 bees/5min/m²). However, its reached its peak at 11.00-12.00 hrs (28.8 bees/5min/m²) followed by at 9.00-10.00 hrs (12.6 bees/5min/m²), 1.00-2.00 hrs (10.6 bees/5min/m²) and 3.00-4.00 hrs (7.2 bees/5min/m²). The present finding also indicate that the maximum population was observed in the full bloom stage in mustard ecosystem.

The results revealed that *Apis cerana indica* showed significant positive correlation with Sunshine hours ($r=0.596$). The regression equation being $y = 1.4787x + 4.2236$ showed that with an increase in sunshine by one hour there was increase in population by 1.4787. Whereas, *Apis*

cerana indica showed significant positive correlation with maximum temperature ($r=0.561$). The regression equation being $y=3.035x+18.721$, it indicates that with an increase in 1°C maximum temperature there was increase in population by 3.0351 (Fig. 1,2 and 3).

Results are in close conformity with the findings of Chaudhary and Kumar (2000), they observed *Apis cerana indica* foraging for nectar and pollen in cardamom and reached peak from 7.00 to 9.00 hrs and 8.00 to 9.00 hrs, respectively. Chakrabarty and Sharma (2007) observed the highest activity of bees at 10.00 and 18.00 hrs (1.24 bees/min/capitulum) with least number at 14.00 hrs (0.69 bees/min/capitulum) on sunflower. Gogoi *et al.* (2007) observed *Apis cerana indica* with maximum number of 9.42 foragers visited flowers of lemon during 10.00-11.00 hrs. Chaudhary *et al.* (2002) reported foraging activity of *Apis cerana indica* on litchi flowers, whereas Kumar *et al.* (2002) reported on sunflower. Dhurve (2008) recorded peak activity of *Apis cerana indica* in the afternoon from 12.00 to 16.00 hrs on niger crop.

The other investigations are also conformity with earlier workers. Paikara *et al.* (2020) worked on corianders flowers and noticed maximum foraging activity of *Apis cerana indica* (6.57 bee/5min/m²), *Apis dorsata* (5.99 bee/5min/m²) and *Apis mellifera* (5.50 bee/5min/m²) between 10.00-12.00 hrs during 4th observation on 29 January and first week of February 2019. Yadav and Painkra (2020) observed the foraging activity of rock bee on mustard crop. Minimum population of rock bee, *Apis dorsata* was recorded at 1.00-2.00 hrs (5.20 bees/5min/m²). Painkra *et al.* (2021) recorded maximum foraging activity of Indian bee (*Apis cerana indica*) at 9.00 AM (14.71 bees/5min/plant) and lowest at 5.00 PM (7.14 bees/5min/plant). Painkra (2021) worked on foraging behavior of stingless bee on radish flower and recorded maximum activity during the first week of March and low population was recorded at 8.00 AM (1.80 bees/5min/m²). The highest population was recorded at 12.00 Noon (15.60 bees/5min/m²) followed by at 2.00 PM (13.20 bees/5min/m²) and decreased at 4.00PM (6.40 bees/5min/m²).

Table 1. Foraging activity of *Apis cerena indica* on mustard during *rabi* season 2019-20

S.No.	Date of observations	Average no. of bees visit /5min/m ² , (hours of the day) (Hrs)								Total	Mean
		7.00-8.00	9.00-10.00	11.00-12.00	1.00-2.00	3.00-4.00					
1	05/11/2019	0.00	0.80	1.00	0.20	0.40				2.40	0.80
2	10/11/2019	0.00	1.00	1.80	0.40	0.60				3.80	1.30
3	15/11/2019	0.00	1.40	2.20	0.60	0.40				4.60	1.50
4	20/11/2019	0.00	1.00	6.00	1.40	1.00				9.40	3.10
5	25/11/2019	0.40	1.80	3.60	0.80	1.20				7.80	2.60
6	30/11/2019	0.40	2.00	3.00	2.60	1.20				9.20	3.10
7	05/12/2019	0.80	2.40	4.00	1.60	1.00				9.80	3.30
8	10/12/2019	0.00	1.00	1.40	0.40	0.80				3.60	1.20
9	15/12/2019	0.00	0.40	1.40	1.00	0.00				2.80	0.90
10	20/12/2019	0.00	0.60	1.80	1.00	0.60				4.00	1.30
11	25/12/2019	0.00	0.20	1.00	0.60	0.00				1.80	0.60
12	30/12/2019	0.00	0.00	1.00	0.00	0.00				1.00	0.30
13	05/01/2020	0.00	0.00	0.20	0.00	0.00				0.20	0.10
14	10/01/2020	0.00	0.00	0.40	0.00	0.00				0.40	0.10
	Total	1.60	12.60	28.80	10.60	7.20				60.80	20.20

Table 2. Correlation of *Apis cerena indica* on mustard with abiotic factors on mustard during *rabi* season 2019-20

S.No.	Date of observations	Temperature (°C)		Relative humidity (%)		Wind speed (km hr ⁻¹)	Sunshine (hours)
		Max.	Min.	RH I	RH II		
		Mean (no. of bees)					
1	05/11/2019	29.50	16.50	89	50	1.50	5.40
2	10/11/2019	25.00	16.30	94	55	2.50	3.40
3	15/11/2019	29.00	10.00	93	29	0.90	9.50
4	20/11/2019	27.80	11.00	93	40	1.10	9.10
5	25/11/2019	26.80	12.30	94	37	1.40	8.50
6	30/11/2019	28.50	12.50	92	44	1.30	8.00
7	05/12/2019	23.50	5.70	95	30	1.20	8.40
8	10/12/2019	24.60	9.30	93	47	0.90	7.80
9	15/12/2019	24.00	14.50	96	87	1.40	5.80
10	20/12/2019	19.50	4.50	97	33	1.10	4.50
11	25/12/2019	26.00	12.70	94	55	1.20	6.40
12	30/12/2019	19.50	4.00	94	39	0.90	9.10
13	05/01/2020	19.20	9.00	98	52	1.30	0.00
14	10/01/2020	20.00	4.50	97	54	1.70	3.10
Mean		-	-	-	-	-	-
Correlation coefficient		0.114	0.000	-0.310	-0.446	-0.106	0.596*

*Significant at 5% level of significance, ** Significant at 1% level of significance

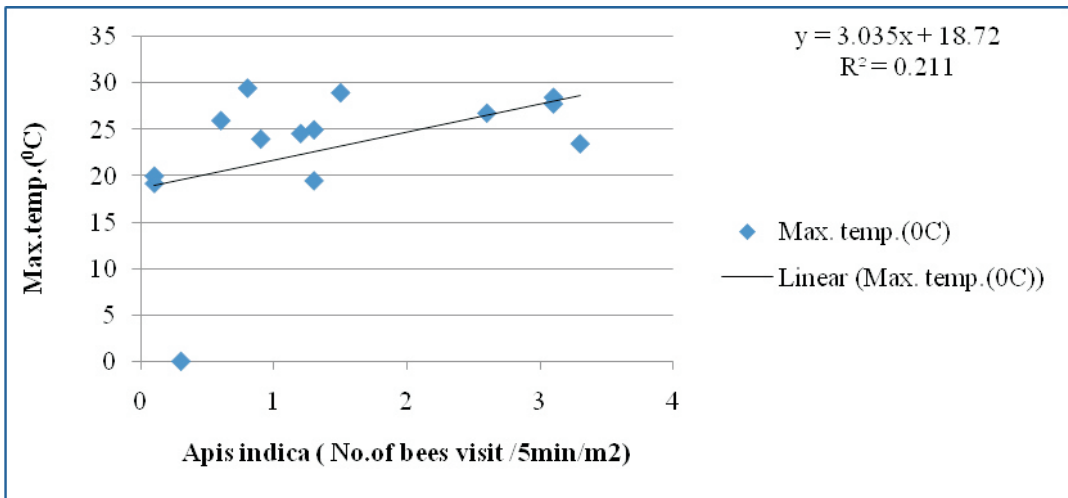


Figure 1. Regression equation between *Apis cerana indica* and max. temperature

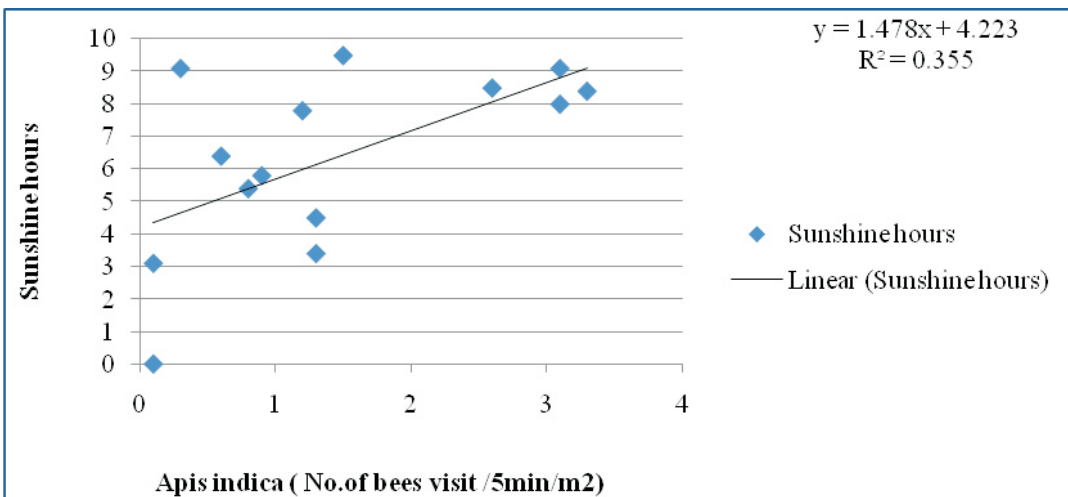


Figure 2. Regression equation between *Apis cerana indica* and sunshine hours

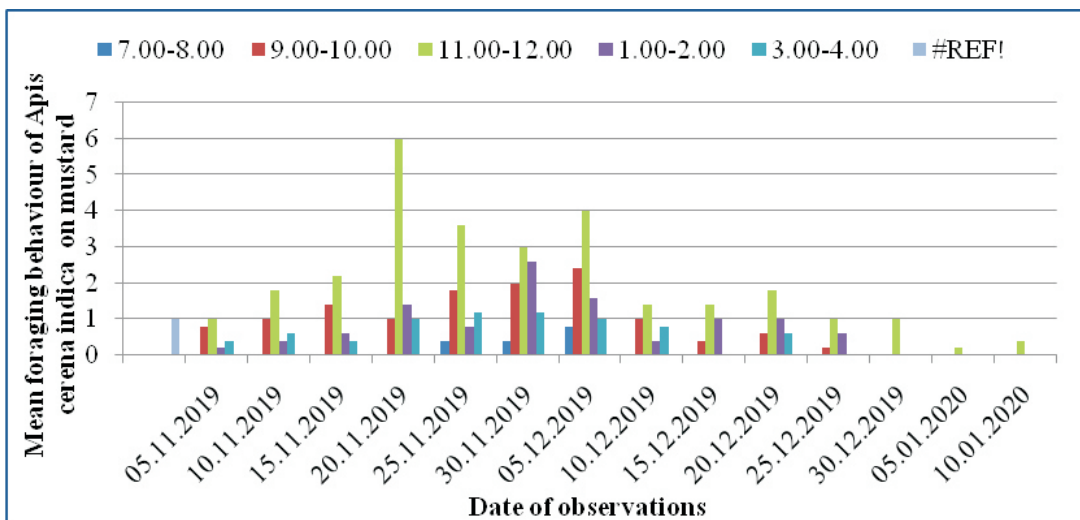


Figure 3. Foraging behaviour of *Apis cerana indica* on mustard during rabi season 2019-20

REFERENCES

- Anonymous, 2018. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Agriculture Statistics at a glance, eands.dacnet.nic.in: 139-141.
- Chandrasekhar, U.S., M. Dadlani, K.Vishwanath, S.K. Chakrabaty and C.T.M. Prasad , 2013. Study of morpho- physiological, phenological and reproductive behavior in protogynous lines of Indian mustard (*Brassica juncea* L.). Euphytica, **193**:277-291.
- Chaudhary, O.P. and R. Kumar, 2000. Studies on honey bee foraging and pollination in cardamom (*Elettaria cardamomum* Maton). J. Spices & Aromatic Crops, **9**(1): 37-42.
- Chakrabarty, S.K. and S.P. Sharma, 2007. Foraging behaviour of honeybees in hybrid seed production of sunflower (*Helianthus annuus*). Indian J. Agril. Sci. **77** (9): 629-631.
- Chaudhary, D.K., B. Singh and P.P. Singh, 2002. Population dynamics of honey bees foraging on litchi flowers. J. Entomological Res. **26**(1):71-75.
- Dhurve, S.S. 2008. Impact of honey bee pollination on seed production of niger.Unpublished M.Sc.(Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India).
- Gogoi, B., A. Rahman, S. Rahman and M.K. Deka, 2007. Foraging behaviour and effect of *Apis cerana* pollination on fruit set and yield of Assam lemon (*Citrus lemon*). Indian J. Agril. Sci. **77**(2):120-22.
- Kumar, M., R. Singh and H.Chand, 2002. Foraging activity of *Apis cerana indica* and *Apis mellifera* visiting sunflower (*Helianthus annus* L.). Shashpa, **9**(1):31-34.
- Paikara, S. P., G.P. Painkra, K.L. Painkra and P.K. Bhagat, 2020. Foraging behavior of different bee species on coriander flowers. JPDS,**12**(9):517-528.
- Painkra,G.P. 2020. Foraging behavior of European honey bee, *Apis mellifera* (Hymenoptera-Apidae) in marigold flowers in Chhattisgarh, India. JPDS, **12**(3):177-180.
- Painkra, G.P., S. K. Jaiswal and V. K. Prajapati, 2021. Foraging behavior of various species of Honey bees on Maize among it's correlation with weather parameters. J. Entomol. Zool. Stud. **9**(1): 613-617.
- Painkra G.P. 2021. Foraging behavior of stingless bee, *Tetragonula iridipennis* Smith 1854 (Hymenoptera: Apidae-Meliponini) on radish flowers . JPDS, **13**(3):127-130.
- Solvance O.P. and H. Pathak , 2016 . An Economic Analysis of Production and Marketing in Rapseed –Mustard crop in Bastar plateau of Chhattisgarh , India. Plant Archives . **16**(1):37-44.
- Yadav, S. and G.P. Painkra, 2020. Foraging behavior of rock bee (*Apis dorsata*) on mustard ecosystem in Ambikapur, Chhattisgarh. JPDS,**12** (10) : 635-639.

Rec. on 15.04.2021 & Acc. on 30.04.2021