Indian Journal of Entomology 85(2): 441-444 (2023) DoI. No.: 10.55446/IJE.2021.153

DIVERSITY OF INSECT POLLINATORS ON SESAME

Selvakumari G, B Usha Rani[1]*, K Suresh[2], G Anand[2] and M Shanthi

Department of Agricultural Entomology; [1]ICAR- Krishi Vigyan Kendra, Agricultural College and Research Institute, Madurai 625104, Tamil Nadu, India
[2]Cotton Research Station, TNAU, Srivilliputhur 626135, Tamil Nadu, India
*Email: ushateja@yahoo.com (corresponding author)

ABSTRACT

Field experiment was carried out to explore the pollinator fauna and their abundance and diversity on sesamum. The results revealed 19 pollinators belonging to six families from three orders viz., Hymenoptera, Diptera and Coleoptera. Among these the order Hymenoptera was predominant having 15 species with maximum relative abundance. Foraging behaviour of *Apis* sp. was more (4.19 individuals/ m^2/ 5 min) and non *Apis* sp. was less (1.12 individuals/ m^2/ 5 min). Eventhough Diptera and Coleoptera shared equal number of species, the foraging behaviour and abundance was maximum with Diptera (1.02 individuals/ m^2/ 5 min). The sesamum ecosystem flourished with pollinators during 0800- 1000 and 1000- 1200 hr with higher diversity indices of Shannon's H (2.52) during 1000- 1200 hr and Simpson's D index (0.22) between 1600- 1800 hr. Shannon's E index was higher (0.85) during 1000-1200 and 1600 -1800 hr.

Key words: *Sesamum indicum*, pollinators, insects, abundance, diversity, foraging behaviour, Hymenoptera, Diptera, Coleoptera, diversity indices, dominance, diurnal variations

Sesame *Sesamum indicum* L. is one of the important oilseeds. It is indigenous to Africa due to the preponderance of wild species in that region (Azeez et al*.,* 2017). Among its wild relatives *Sesamum orientale* var. *malabaricum* is restricted to the Indian subcontinent. Bees are excellent pollinators and the flowers attract these to visit them for pollen and nectar. Commercial production of >90% of crops rely on bee pollination. Cross pollination in entomophilous crops based on the coevolution of flowering and activity of insect pollinators serves as the effective source for enhancing the crop yield both qualitatively and quantitatively (Patidar et al*.,* 2017). It is estimated that global annual economic value of insect pollination is €153 billion (Das and Jha, 2018). Being a self-pollinated crop, the tubular floral structure of sesame facilitates cross pollination up to an extent of 65%. The complimentary pollination carried out by honey bees in sesame improves seed germination, vigour of seeds and augments the crop yield. The present study focuses on the relationship of insect pollinators, and investigate their diversity in relation to flowering phenology of sesame and also during different hours of the day.

MATERIALS AND METHODS

The experimental trial was laid out in the farmer's field at Thoppilikuppam (11.56°N, 79.46°E), Cuddalore district, Tamil Nadu during May- July 2021. The experimental plot was laid out in randomized block design in an area of 1.62 ha with plots divided into five subplots of 1 m^2 area as replication plots. The number of insect pollinators from each species visiting the flowers was recorded from 10% flowering stage to flowering cessation period. The insects foraging on the flowers were collected using sweep net, subsequently killed and preserved in ethanol for identification with the help of taxonomist and literature. The foraging behaviour and relative abundance of insect pollinators were observed for 5 min from 0600 - 1800 hr at two hours interval in five plants during alternate flowering days and expressed as mean no. of individuals/ m^2/ 5 min (Das and Jha, 2019). To estimate the rareness and commonness of pollinator species, the diversity indices were computed (Madhuvandhi, 2021).

RESULTS AND DISCUSSION

On observing the foraging activity of floral visitors on sesame a sum of 19 insect pollinators were identified based on their role involved in pollen and nectar collection (Table 1). Among them, 15 species are of Hymenoptera followed by two species each from Diptera and Coleoptera. In Hymenoptera, Apidae is the dominant family with six species and 4 from Halictidae, followed by Megachilidae (3) and Xylocopidae (2). The order Diptera is with two species from family

Table 1. Foraging behaviour of pollinators on sesamum (Thoppilikuppam, Cuddalore)

S. No.	Pollinators/ time of a day	*Mean no. of individuals / m^2/ 5 min						Mean
		0600-0800	0800-1000	1000-1200	1200-1400	1400-1600	1600-1800	
Apis bees		Hymenoptera						
1	*A. c. indica*	8.49± 0.02^{a}	12.21± 0.10^{a}	14.83± 0.07^{a}	10.57± 0.13^{a}	7.50± 0.04^{a}	5.46± 0.07^{a}	9.84
2	*A. dorsata*	5.98± 0.29^{b}	8.21± 0.11^{b}	12.18± 0.08^{b}	7.85± 0.08^{b}	4.49± 0.14^{b}	2.81± 0.06^{b}	6.83
3	*Apis florea*	3.05± 0.06^{c}	5.60± 0.19^{c}	8.39± 0.12^{c}	4.38± 0.12^{c}	2.16± 0.05^{c}	0.87± 0.02^{c}	4.07
4	*Braunsapis* sp.	0.00± 0.00^{f}	1.95± 0.03^{gh}	2.46± 0.08^{g}	1.45± 0.04^{g}	0. 48± 0.02^{h}	0.21± 0.02^{h}	1.09
5	*A. zonata*	1.49± 0.04^{d}	3.06± 0.08^{d}	4.14± 0.12^{de}	2.14± 0.03^{e}	0.03± 0.00^{i}	0.46± 0.14^{g}	1.88
6	*Ceratina* sp.	1.58± 0.14^{d}	2.75± 0.14^{de}	2.25± 0.05^{g}	0.19± 0.06^{k}	0.78± 0.02^{f}	0.52± 0.03^{f}	1.34
Mean		3.43	5.63	7.37	4.43	2.57	1.72	4.19
Non *Apis* bees								
7	*Halictus* sp.	1.35± 0.21^{d}	2.64± 0.06^{e}	4.81± 0.03^{d}	3.28± 0.16^{d}	1.24± 0.23^{e}	0.74± 0.08^{cd}	2.34
8	*Augochlora* sp.	0.80± 0.03^{e}	2.85± 0.02^{d}	3.18± 0.04^{f}	3.44± 0.04^{d}	1.54± 0.05^{d}	0.53± 0.03^{ef}	2.06
9	*Lasioglossum* sp.	0.86± 0.19^{e}	2.31± 0.08^{f}	3.35± 0.07^{f}	1.73± 0.03^{f}	0.42± 0.02^{h}	0.00± 0.00^{i}	1.44
10	*Nomia* sp.	0.86± 0.03^{e}	2.40± 0.04^{f}	4.45± 0.07^{d}	1.38± 0.03^{g}	0.00± 0.00^{i}	0.46± 0.07^{g}	1.59
11	*Xylocopa* sp. 1	0.00± 0.00^{f}	0.51± 0.03^{i}	1.14± 0.07^{j}	1.48± 0.04^{g}	0.00± 0.00^{i}	0.00± 0.00^{i}	0.52
12	*Xylocopa* sp. 2	0.00± 0.00^{f}	1.02± 0.06^{h}	1.42± 0.17^{i}	1.35± 0.32^{h}	0.00± 0.00^{i}	0.00± 0.00^{i}	0.63
13	*Anthidium* sp.	0.00± 0.00^{f}	1.04± 0.08^{h}	2.07± 0.08^{gh}	0.00± 0.00^{l}	0.00± 0.00^{i}	0.00± 0.00^{i}	0.78
14	*Megachile disjuncta*	0.00± 0.00^{f}	0.82± 0.02^{i}	1.33± 0.09^{i}	0.22± 0.03^{k}	0.00± 0.00^{i}	0.00± 0.00^{i}	0.39
15	*Megachile lanata*	0.00± 0.00^{f}	0.52± 0.03^{i}	1.18± 0.05^{j}	0.82± 0.06^{i}	0.00± 0.00^{i}	0.00± 0.00^{i}	0.42
Mean		0.43	1.56	2.54	1.70	0.35	0.19	1.12
Diptera								
16	*Episyrphus* sp.	0.68± 0.04^{e}	2.43± 0.04^{e}	1.79± 0.03^{h}	1.10± 0.0^{h}	0.52± 0.03^{g}	0. 00± 0.00^{i}	1.09
17	*Eristalmus* sp.	1.40± 0.05^{d}	2.04± 0.07^{f}	1.05± 0.08^{k}	0.78± 0.04^{i}	0.52± 0.02^{g}	0.00± 0.00^{i}	0.96
Mean		1.04	2.23	1.42	0.94	0.52	0.00	1.02
Coleoptera								
18	*O. versicolor*	0.00± 0.00^{f}	0.15± 0.02^{j}	0.37± 0.03^{l}	0.72± 0.03^{ij}	0.50± 0.02^{g}	0.64± 0.02^{de}	0.40
19	*Aulocophora foveocolis*	0.00± 0.00^{f}	0.21± 0.02^{j}	0.44± 0.03^{l}	0.56± 0.34^{j}	0.64± 0.02^{g}	0.75± 0.04^{cd}	0.43
Mean		0.00	0.18	0.40	0.64	0.57	0.69	0.41
P Value		0.00	0.00	0.00	0.00	0.00	0.00	
F value		329.67	836.09	901.48	357.86	648.12	424.29	
Species richness (S)		11	19	19	18	13	9	
Shannon's H index		2.00	2.50	2.52	2.45	1.97	1.88	
Shannon's E index		0.83	0.84	0.85	0.84	0.76	0.85	
Simpson's D index		0.18	0.11	0.10	0.12	0.20	0.22	
Simpson Index of biodiversity		0.82	0.89	0.90	0.88	0.80	0.78	
Simpson Reciprocal Index		5.55	9.09	10	8.33	5	4.54	

*Each value mean of five observations with five replications; in a column means followed by same letter(s) not significant with each other (DMRT, $p \leq 0.05$); Mean± Standard Error

Syrphidae. Two coleopterans from family Scarabaeidae and Chrysomelidae were also observed. During the flowering period, Pashte et al. (2013) observed 22 species of insect pollinators, with 17 species from Hymenoptera 3 from Diptera and 2 species of Lepidoptera. Similarly, Ngongolo et al. (2015) at Kichi forest reserve recorded 24 species of floral visitors in three sesame cultivated community farms.

In *Apis* hymenopterans, *A. c. indica* was the dominant forager followed by *A. dorsata* and *A. florea* (Table 2). The activity of *A. c. indica* (14.83 individuals/ m^2/ 5 min) and *A. dorsata* (12.18 individuals/ m^2/ 5 min) was the dominant at 1000-1200 hr while the activity of *A. florea* was maximum during 0800- 1000 hr (8.39 individuals/m^2/ 5 min). The abundance of total *Apis* hymenopterans peaked (7.37 individuals/ m^2/ 5 min) during 1000-1200 hr, whereas their activity was less (1.72 individuals/ m^2/ 5 min) during 1600- 1800 hr. Among the non-*Apis* hymenopterans, *Halictus* sp. was the predominant followed by *Augochlora* sp., *Nomia* sp., *Lasioglossum* sp., *Anthidum* sp., *Xylocopa* sp. 1, *Xylocopa* sp. 2, *M. lanata* and *M. disjuncta.* About Diptera, *Episyrphus* sp. and *Eristalinus* sp. were abundant during 0800- 1000 hr with 2.43 and 2.04 individuals/ m^2/ 5 min, respectively and they wind

Table 2. Relative abundance of pollinators during different flowering periods in sesamum *n=7

S. No.	Pollinators	Abundance of pollinators vs flowering % (No. of individuals/ m^2/ 5 min)*					Abundance (%)
		15 %	50 %	100 %	< 50 %	Mean	
1	*A. c. indica*	6.86	10.74	15.89	5.88	9.84	25.78
2	*A. dorsata*	4.86	7.23	8.67	6.56	6.83	17.89
3	*A. florea*	3.65	4.78	5.14	2.72	4.07	10.66
4	*Ceratina* sp.	0.82	1.04	1,74	0.76	1.09	2.85
5	*A. zonata*	1.19	1.91	2.89	1.53	1.88	4.92
6	*Braunsapis* sp.	0.82	1.57	2.08	0.91	1.3	3.52
7	*Halictus* sp.	1.78	2.62	3.59	1.39	2.35	6.14
8	*Augochlora* sp.	1.61	2.23	3.24	1.18	2.07	5.40
9	*Lasioglossum* sp.	0.63	1.61	2.48	1.05	1.44	3.77
10	*Nomia* sp.	0.74	1.68	2.64	1.32	1.60	4.17
11	*Xylocopa* sp. 1	0.28	0.63	1.06	0.13	0.53	1.37
12	*Xylocopa* sp. 2	0.37	0.72	1.19	0.26	0.64	1.66
13	*Anthidim* sp.	0.48	0.85	1.48	0.34	0.79	2.06
14	*M. lanata*	0.23	0.34	0.94	0.19	0.43	1.11
15	*M. disjuncta*	0.12	0.36	1.0	0.11	0.40	1.04
16	*Eristalinus* sp.	0.78	1.14	1.72	0.75	1.10	2.87
17	*Episyrphus* sp.	0.63	0.94	1.45	0.82	0.96	2.51
18	*O. versicolor*	0.15	0.40	0.94	0.14	0.41	1.06
19	*Aulocophora foveicollis*	0.13	0.51	0.86	0.23	0.43	1.13
Mean		26.13	41.30	59	26.27	38.18	100

up their activity during 1600- 1800 hr. These findings are similar to those of Mahfouz et al. (2012), with maximum and minimum activity of honey bees being at 0900- 1100 and 1500- 1600 hr, respectively; they also observed that abundance of bee activity decreases with diminishing flowers/ plant and with increase in age of the crop.

The studies on foraging behaviour of *A. cerana* on sesame revealed that 0900-1000 hr was the peak period to visit the sesamum flowers (Bhagawati et al., 2016). It was observed that *A. c. indica* revealed maximum abundance (25.78%) followed by *A. dorsata* (17.89%) and *A. florea* (10.66%); and *Ceratina* sp. was the less abundant (2.85%) among *Apis* hymenopterans. In non-*Apis* hymenopterans the maximum share (6.14%) was of *Halictus* sp. with mean population of 2.35 individuals/ m^2/ 5 min. Among Diptera, *Episyrphus* sp. was most abundant (2.87%) with an average of 1.10 individuals/ m^2/ 5 min. With a mean population of 0.43 individuals/ m^2/ 5 min, *A. foveicollis* shared an abundance of 1.13% (Table 2). Similar results were obtained by Pashte and Shylesha (2013) that honey bee species form the dominant pollinators (77.67%) compared to other species of insect pollinators (6.79%).

Species richness (S) was maximum during two consecutive sunshine hours 0800-1000, 1000- 1200 hr with 19 species and minimum (9 species) during 1600-1800 hr. The maximum values of diversity indices Shannon's H (2.52), Simpson's D (0.22) and evenness Index of Shannon's E index (0.85) were observed. Simpson's biodiversity and reciprocal Index were also higher during two consecutive sunshine hours 1000-1400 hr (Table 1).

ACKNOWLEDGEMENTS

Authors thank Dr S Manickavasagam, Professor (Former head) in Agricultural Entomology, Faculty of Agriculture, Annamalai University for identifying the specimens.

REFERENCES

Azeez M A, Olowookere M B, Animasaun D A, Bello B O. 2017. Utility of some floral characters in the assessment of genetic diversity in sesame (*Sesamum indicum* L.). Acta Agriculturae Slovenica 109(1): 61-70.

Bhagawati S, Rahman A, Deka M K. 2016. Diversity of insect foragers with reference to foraging behaviour of Asian honey bee, *Apis cerana* F. on sesamum, *Sesamum indicum* L. Journal of Entomological Research 40 (3): 213-216.

Das R, Jha S. 2018. Record of insect pollinators and their abundance on Indian mustard (*Brassica juncea* L.) in new alluvial zone of West Bengal. International Journal of Pure and Applied Bioscience 6 (5): 848-853.

Das R, Jha S. 2019. Insect pollinators of sesame and the effect of entomophilous pollination on seed production in New Alluvial Zone

of West Bengal. International Journal of Current Microbiology and Applied Sciences 8 (3): 1400-1409.

Madhuvandhi, G. 2021. Pollination efficiency of honey bees in coriander *Coriandrum sativum* L. M Sc (Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Mahfouz H M, Kamel S M, Belal A H, Said M. 2012. Pollinators visiting sesame (*Sesamum indicum* L.) seed crop with reference to foraging activity of some bee species. Cercetari Agronomice in Moldova 45 (2): 49-55.

Ngongolo K, Mtoka S, Rubanza C D. 2015. Floral visitors and pollinators of sesame (*Sesamum indicum* L.) from Kichi forest to the adjacent local communities' farms. Entomology and Applied Science Letters 2 (2): 32-39.

Pashte V V, Shylesha A N. 2013. Pollinator diversity and their abundance on sesamum. Indian Journal of Entomology 75 (3): 260-262.

Patidar B K, Ojha K N, Khan I U. 2017. Role of honeybee (*Apis mellifera*) in enhancing yield of mustard in humid region of Rajasthan, India. International Journal of Current Microbiology Applied Science 6 (7): 1879-1882.

Sowmiya C, Srinivasan M R, Saravanan P A. 2018. Diversity of pollinators in drumstick, *Moringa oleifera* Lam. ecosystem. Madras Agricultural Journal 105 March 1-3, 1.

(Manuscript Received: October, 2021; Revised: November, 2021;
Accepted: November, 2021; Online Published: January, 2022)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e21231