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Record of Insect Pollinators and their Abundance on Indian Mustard (*Brassica juncea* L.) in New Alluvial Zone of West Bengal

Rakesh Das* and Shantanu Jha

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, Pin- 741252, West Bengal

*Corresponding Author E-mail: rdas6907@gmail.com

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ABSTRACT

The diversity and abundance of different insect visitors on Indian mustard (Brassica juncea L.) were studied at Instructional Farm Jaguli of Bidhan Chandra Krishi Viswavidyalaya in Nadia district of West Bengal during 2017 - 2018. A total of 13 insect visitors belonging to order Hymenoptera (comprising of 6 species viz., Apis dorsata, Apis mellifera, Apis cerana indica, Apis florea, Ceratina sp. and Halictus sp.), Diptera (comprising of 5 species viz., Episyrphus sp., Eristalinus tabanoides, Musca domestica, Chrysomya sp. and Sarcophaga sp.) and Lepidoptera (comprising of 2 species viz., Amata bicincta and Pieris sp.) were found to visit the mustard blossoms during the period of study. The abundance (percentage of insect fauna/sq.m/2 min.) of Hymenopterans was maximum followed by the Dipterans and Lepidoptera. Among the Hymenopterans, the Honeybees (Apis spp.) were observed maximum, representing 74.52% of the total pollinators. Among the Honeybees, the Italian bee, A. mellifera (35.18%) was dominant sequentially followed by the Indian bee, A. cerana indica (23.11%), Rock bee, A. dorsata (12.00%) and Little bee, A. florea (4.23%). Considerable number of Dipteran flies also visited the crop (21.25%), of which the Syrphids were most common.

Key words: *Indian mustard, Insect, Pollinators, Honeybees, Apis*

INTRODUCTION

Pollination is an essential process for the propagation of sexually reproducing plants. It is the process by which pollens are transferred from the male reproductive part (anther) to the female reproductive organ of a plant (stigma), thereby enabling fertilization to take place[2]. One of the ways that plants can produce offspring is by making seeds to produce a new plant. The reproductive unit is the seed, and pollination is an essential step in the production of seeds in all spermatophytes (seed plants), resulting in the production of offspring that are genetically diverse[4]. Majority of the agricultural crops are cross pollinated in nature. The cross pollinated plants need external agents to get accomplish the task of pollination.

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Both abiotic (*viz*., wind, water etc) and biotic factors act as a vector (pollinator) to transfer the pollen to the female reproductive parts of the flower. More than 75% of the major crops in the world rely on animal pollinators.

Among the various pollinating agents, insects played a major role. They increase the productivity of different crops as proved by different reports from various parts of the world. The global annual economic value of insect pollination is estimated to be € 153 billion[6]. Major insect groups, playing significant role in pollination of different agricultural, horticultural and medicinal herbal crops mainly belong to the orders Hymenoptera, Diptera, Coleoptera, Lepidoptera, Thysanoptera, Hemiptera and Neuroptera[5, 8, 12, 13].

Among rapeseed-mustard group, Indian mustard (*Brassica juncea* L.) is predominantly cultivated in West Bengal and adjoining states. It is grown extensively for its seeds which yield an essential oil and condiment. The inflorescence of *B. juncea*, borne terminally on the main stem and branches, is an elongated corymbose raceme, carrying bright yellow flowers[10, 15]. Indian mustard (*B. juncea*) is a naturally autogamous species, yet in this crop frequent outcrossing occurs which varies from 5 to 30 per cent depending upon the environmental conditions and random variation of pollinating insects[9]. Insect mediated cross pollination may be, only of secondary importance for Indian mustard (*Brassica juncea* L.) which is self-fertile and mainly autogamous[16].

So far, honeybees alone are considered as significant pollinators on *Brassica* crop, however a number of other insects also visit on this crop during flowering period as reported by various workers from different parts of the country[18, 1, 11, 14, 3, 17].

Thus the present study is carried out to record the different insect pollinators visiting mustard flowers and their relative abundance.

MATERIALS AND METHODS

Experimental Location:

The experiment was conducted during November 2017 to March 2018 at Instructional Farm Jaguli of Bidhan Chandra Krishi Viswavidyalaya at Mohanpur in Nadia district of West Bengal. The location of the farm is latitude 23.56° N and longitude 88.32° E. The average elevation above the Mean Sea Level (MSL) of the experimental farm is about 9.75 meters.

Experimental design:

The experimental plot was designed in four large plots measuring 12x6 m each. Then five small plots measuring 1 m^2 (1x1 m) were selected randomly from each of the large plots, representing replications.

Jata rai (local) variety of Indian mustard (*Brassica juncea*) was sown on 15th November, 2017 on each field. The seeds were sown in continuous with row to row spacing of 30 cm. Later excess plants were removed to obtain uniform crop stand. All the normal package of practices was followed for raising a healthy crop.

Diversity of insect pollinators visiting mustard flowers:

Insect visitors of mustard flowers were collected by using hand net. Sweeping was done at two hours' interval from 7.00 am to 5.00 pm, once in a week throughout the blooming period of the crop starting from 10% flowering. Collected insects were killed and were subsequently identified following the literature available elsewhere. Photograph of the different insect visitors on mustard flowers were also taken.

Relative abundance of insect pollinators on mustard flowers:

The number of insect visitors per square meter area of crop had been recorded for two minutes from five randomly selected areas at around 11 am, the time of maximum insect activity. The relative abundance of these insect visitors were calculated by using the following formula:

Relative abundance (%) = (Population of a particular species visiting flowers / Total population of all species visiting flowers) x 100

These observations taken once a week starting from 10 % of the plants came into bloom and continued throughout blooming period of the crop.

RESULTS AND DISCUSSION

Diversity of insect pollinators visiting mustard flowers:

Insect visitors recorded from *B. juncea* along with their systemic position are listed in Table 1 and the photographs are shown in Fig. 1.

Table 1: Insect visitors/pollinators observed on mustard flowers

Sl.No.	Common name	Scientific name	Family	Order
1.	Rock bee	*Apis dorsata*	Apidae	Hymenoptera
2.	European/Italian honey bee	*Apis mellifera*	Apidae	
3.	Indian honey bee	*Apis cerana indica*	Apidae	
4.	Little honey bee	*Apis florea*	Apidae	
5.	Small carpenter bee	*Ceratina* sp.	Apidae	
6.	Sweat bee	*Halictus* sp.	Halictidae	
7.	Amata moth/nine spotted moth	*Amata bicincta*	Arctiidae	Lepidoptera
8.	Pierid butterfly	*Pieris* sp.	Pieridae	
9.	Hover fly	*Episyrphus* sp.	Syrphidae	Diptera
10.	Hover fly	*Eristalinus tabanoides*	Syrphidae	
11.	House fly	*Musca domestica*	Muscidae	
12.	Blow fly	*Chrysomya* sp.	Calliphoridae	
13.	Flesh fly	*Sarcophaga* sp.	Sarcophagidae	

Table 1 showed that a total of 13 insect visitors belonging to order Hymenoptera (6), Diptera (5) and Lepidoptera (2) were found to visit the mustard blossoms during the period of study. Among them Hymenopterans were the pre-dominant floral visitors comprising of six species from two families *viz*., Apidae and Halictidae. The former family was most abundant comprising five species namely *A. dorsata*, *A. mellifera*, *A. cerana indica*, *A. florea* and *Ceratina* sp. than the later one which containing only single species namely *Halictus* sp. They were followed in order of diversity by Dipterans comprising five species belonging to four families namely, Syrphidae, Muscidae, Calliphoridae and Sarcophagidae. The family Syrphidae was represented by two species *viz*., *Episyrphus* sp. and *Eristalinus tabanoides.* However, the rest three families each were represented by single species of insect visitor namely, *Musca domestica* (Muscidae), *Chrysomya* sp. (Calliphoridae) and *Sarcophaga* sp. (Sarcophagidae). Lepidoptera was the least diversified order visiting mustard flowers, comprising two species belonging two families namely, Arctiidae and Pieridae. Arctiidae was represented by *Amata bicincta* and Pieridae was represented by *Pieris* sp. Earlier[19] recorded 29 insect species visiting *B. juncea* blooms, among them, 15 belonged to Hymenoptera, 8 to Diptera and 6 to Lepidoptera, also supports the present findings.

Relative abundance of insect pollinators on mustard flowers:

The relative abundance of insect pollinators was recorded on the mustard flowers once a week during the blooming period of the crop starting from 24th December 2017 to 2nd February 2018 following the methods mentioned earlier. The number of pollinators recorded per sq.m of mustard field is presented in Table 2 and the diagram is shown in Fig. 2.

Table 2: Observations on abundance (percentage of insect fauna/sq.m/2 min) of different insect pollinators on mustard flowers.

Date	24.12.17	30.12.17	05.01.18	12.01.18	20.01.18	27.01.18	02.02.18	Total	Average	Mean % population
A. mellifera	0.14	0.71	1.85	1.57	1.00	0.42	0.14	5.83	0.83	35.18
A. cerana indica	0.85	0.71	0.00	0.14	1.57	0.42	0.14	3.83	0.54	23.11
A. dorsata	0.14	0.00	0.57	1.00	0.14	0.14	0.00	1.99	0.28	12.00
A. florea	0.14	0.28	0.14	0.00	0.14	0.00	0.00	0.70	0.10	4.23
Amata bicincta	0.00	0.28	0.00	0.14	0.14	0.14	0.00	0.70	0.10	4.23
Episyrphus sp.	0.14	0.14	0.00	0.00	0.14	0.42	0.14	0.98	0.14	5.93
Other Dipterans	0.00	0.42	0.28	0.42	0.57	0.85	0.00	2.54	0.36	15.32
Total	1.41	2.54	2.84	3.27	3.70	2.39	0.42	16.57	2.36	

On the basis of insect visitors recorded per square meter during the entire blooming period, *A. mellifera* was the most predominant species with an average population of 0.83 insects/sq.m representing 35.18 % of total insect visitors. This was followed by *A. cerana indica*, the second dominant insect visitor with an average of 0.54 insects/sq.m constituting 23.11 % of insect fauna. The Rock bee, *A. dorsata* and Syrphid, *Episyrphus* sp. occupying 12.00 % and 5.93 % population of insect visitors with an average of 0.28 and 0.14 insects/sq.m respectively. Both *A. florea* and *Amata bicincta* constituted 4.23 % of insect visitors with an average population of 0.10 insects/sq.m. Other dipterans in totality were represented by 15.32 % of insect fauna with an average population of 0.36 insects/sq.m. In the proximity of present findings[7] found a total of 19 insect visitors belonging to order Hymenoptera (15) and Diptera (4) on *B. juncea* and Hymenopterns were most abundant (79.97%) among them followed by Dipterans (16.15%) and others (3.73%). Among various Hymenopterans, the honey bees (*Apis* bees) were observed the maximum followed by non-*Apis* bees.

It was further observed that, the pollinator population increased with flowering and after reaching a peak period gradually declined. It started with 1.41 insects/sq.m on 24th December, 2017, which gradually increased in subsequent weeks to reach its peak on 20th January, 2018 (3.70 insects/sq.m) synchronising peak period of flowering. It again decreased towards cessation of the flowering i.e. 6th week onwards (2.39 insects/sq.m) and minimum abundance was observed on 2nd February, 2018 (0.42 insects/sq.m). The average number of insects/sq.m recorded during the blooming period was 2.36.

CONCLUSION

Present study revealed the importance of pollinator insects to help plant pollination. The investigation showed that mustard flowers were highly attractive to a wide variety of insects. Among all the insect visitors Hymenopterans especially honey bees were the dominant flower visitors. Apart from Hymenopterans, Dipterans and Lepidopterans were also reported to visit mustard flowers during the course of study. Cross pollination by insects, especially honeybees is considered as one of the effective and cheapest method for triggering the crop yield both qualitatively and quantitatively. Hence, enhancement of pollinator insects as a part of crop management should be considered by farmers. This could be achieved by reducing the use of pesticides, creating nesting sites for solitary bees, and providing pollen and nectar rich supplementary for bees.

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Fig. 1: Insect pollinators of mustard

1a. *Apis cerana indica*

1b. *Apis florea*

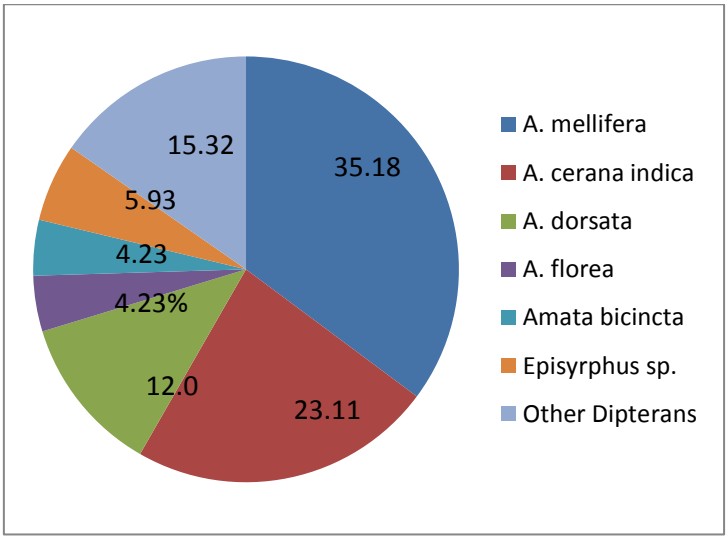
1c. *Apis mellifera*

1d. *Apis dorsata*

1e. *Halictus* sp.

1f. *Amata bicincta*

Fig. 2: Abundance of insect pollinators (percentage of insect fauna/sq.m/2 min)



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