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Identification and record of insect pollinators of sunflower (*Helianthus annuus* L.) in new alluvial zone of West Bengal

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Abstract
The field experiments were conducted to record the insect pollinators of sunflower (variety: PAC-36) at Kalyani District Seed Farm (AB) of Bidhan Chandra Krishi Viswavidyalaya in Nadia district of West Bengal during 2016. Different species of insect pollinators visiting sunflower were collected and identified. The result revealed the presence of seven species of insects belonging to six genera in six families under four orders namely Hymenoptera, Diptera, Lepidoptera and Coleoptera on the flower heads of sunflower. These species included *Apis mellifera* L, *Apis dorsata* L, *Megachile* sp., *Musca domestica*, *Sarcophaga* sp., *Danaus chrysippus* and *Cheilomenes sexmaculata*.

Keywords: insect, pollinators, sunflower, *Apis mellifera*, *Apis dorsata*

1. Introduction
Pollination is the act of transferring pollen grains from the anther of a flower to the stigma. One of the ways that plants can produce offspring is by making seeds to produce a new plant. Flowers are the tools that plants use to make their seeds and these can only be produced when pollen is transferred between flowers of the same species. Plant species which reproduce through seed are either self-pollinated or cross pollinated [6]. Of all the agricultural crops about 95% are cross pollinated whereas remaining 5% are self-pollinated in nature. Even in some self-fertile species, the flowers are so constructed that either wind or insects are needed for pollination. So, most flowering plants rely on biotic and / or abiotic external agents for pollination which include wind, water, birds, insects, bats and other animals that visit flowers [11].

In case of sunflower, the morpho-physiological disagreement of stamens and pistils, protandrous nature of the florets and pollen not well adapted to be transported by wind, hinder the process of pollination by anemophily [3]. However, the close association of the tubular florets on head (500- 1000 in number), which are hermaphrodite in nature, and the outer ray florets, which are sterile, make the sunflower inflorescence more conspicuous to various insects that visit the flowers [16]. Moreover, sequence of flower opening allows them to be assisted when visited by pollinated insects [5, 4]. Bees are the most important insects in the sunflower pollination process and unlike other insects that visit *Helianthus annuus*, only for their own food, bees visit a greater number of flowers to fulfill the needs of their colony [13, 14]. In sunflower, the major anthophilous (flower frequenting) taxa among insects are the beetles (Coleoptera), flies (Diptera), wasps, bees and ants (Hymenoptera), thrips (Thysanoptera), and butterflies and moths (Lepidoptera) [10, 12, 2]. The objective of this study was to record different species of insect pollinators visiting sunflower and their relative abundance.

2. Materials and Methods
2.1 Experimental site
The present experiment was conducted during April 2016 at District Seed Farm (AB Block) of Bidhan Chandra Krishi Viswavidyalaya situated at Kalyani in Nadia district of West Bengal (22.99^0 N latitude, 88.43^0 E longitude, with an altitude at 13 m above the mean sea level).

2.2 Experimental layout
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 X 6m size.

Sunflower seeds (variety: PAC-36) were sown on 4th January, 2016 at a spacing of 45 X 30cm and two seeds were placed per pit to obtain uniform crop stand. All recommended cultural practices were done.

2.3 Collection of different species of insect pollinator visiting sunflower

The experimental plot was kept free from chemical spray during flowering period. Observations were made on different pollinators visiting the sunflower field during flowering. All types of pollinators were collected using hand net from sub plot and were subsequently identified.

3. Results and Discussion

Data provided in Table-1 shows that the member of the order Hymenoptera, Diptera, Coleoptera and Lepidoptera visited the capitulum of sunflower during the period of study. Among the different orders, hymenoptera was most important in respect of number of individuals involved in pollination service. Of the two hymenopteran families (Apidae and Megachilidae) found to visit flowers, the formers was most abundant with two species of honey bees namely, *Apis dorsata* and *Apis mellifera*. Megachilidae was represented by a single species of leaf cutter bee, *Megachile* sp. Diptera was represented by two families, Muscidae and Sarcophagidae. The former family was represented by a single species *Musca domestica*, the common housefly, which visited the flower heads more frequently. Sarcophagidae was less frequent with a single species i.e. *Sarcophaga* sp. The monarch butterfly, *Danaus chrysippus* (Danaidae) represented Lepidoptera. The predatory coccinellid species, *Cheilomenes sexmaculata* (Coccinellidae) visited the flower heads and this species was the only representative of the order Coleoptera.

In the present investigation seven species of insects belonging to six genera in six families under four orders were found to visit sunflower, of which *Apis mellifera* was the most abundant followed by *A. dorsata*. In an earlier study, Swaminathan and Bharadwaj [17] recorded *A. dorsata* as the most frequenting bee species on sunflower. However, this study was conducted before large scale introduction and adoption of *A. mellifera* in India. Bhowmik and Bhadra [1] reported 17 species of insect pollinators belonging to 13 families under 5 orders on sunflower. The present results are also very similar to those of Nderitu *et al*., [15] who recorded 14 insect species visiting sunflower floral heads belonging to the order Lepidoptera, Hymenoptera, Diptera and Coleoptera. Jadhav *et al*. [8] observed nine Hymenopterans on sunflower. However, they recorded a total number of 24 insect visitors from four orders. In another study Kasina *et al*. [9] recorded 14 insect species belonging to four main orders i.e. Hymenoptera, Lepidoptera, Diptera and Coleoptera. Ion *et al*. [7] recorded insect visitors of sunflower in Romania mainly belonging to four insect orders: Hymenoptera, Lepidoptera, Diptera and Hemiptera. The recorded differences in number of insect pollinators on sunflower by different authers are mainly due to different locations of their experiment.

Table 1: Lists of insects visiting sunflower flower during 2016

S. No.	Common name	Scientific name	Family	Order
1.	Italian bee	*Apis mellifera*	Apidae	Hymenoptera
2.	Rock bee	*Apis dorsata*	Apidae	Hymenoptera
3.	Leaf cutter bee	*Megachile* sp.	Megachilidae	Hymenoptera
4.	House fly	*Musca domestica*	Muscidae	Diptera
5.	Flesh fly	*Sarcophaga* sp.	Sarcophagidae	Diptera
6.	Monarch butterfly	*Danaus chrysippus*	Danaidae	Lepidoptera
7.	Lady bird beetle	*Cheilomenes sexmaculata*	Coccinellidae	Coleoptera

4. Conclusion and Recommendations

It is clear from present finding that the sunflower capitulum in bloom is highly attractive to multitude of insect species, especially those belonging to Hymenoptera. The results indicate a diversity of pollinator insects, especially bees, which also plays a significant role in seed set of sunflower. Hence, Sunflower growers should encourage visits of pollinators to their crop for obtaining high yield.

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