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Diversity of Pollinator Bees in Ecological Engineering Organic Field

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ABSTRACT

Study on diversity of bee pollinators was carried at NIPHM, Hyderabad during 2016-17 on sunflower, sun hemp, maize, sweet corn, brinjal, okra, cherry, bottle gourd, ridge gourd and cucurbits. NIPHM maintains ecological engineering (EE) organic field for the purpose of research, training and popularization of the concept of EE. The crops were maintained along with flowering plants like mustard, sunflower, marigold, cosmos etc., to attract beneficial insects. In present study total fourteen bee species from nine genera were identified as pollinators, out of 14 species of bees 5 species were honey bees from family Apidae and Genus Apis and Tetragonula and remaining 9 species were solitary bees. Ecological engineering concept is beneficial to the farmers and environment in many aspects and the most important being conservation of precious bee pollinators.

Key words: *Ecological Engineering, Bee Pollinators, NIPHM, Organic field.*

INTRODUCTION

Pollinators play key role in the survival of integrity of terrestrial ecosystem through their major role in plant reproduction, thereby providing services and goods to the society[8]. Pollination has two important consequences, it maintains biodiversity of flowering plants and maintains ecosystem functioning. Many empirical studies have found positive correlations between pollinator diversity and plant functioning[7].

Pollination by insects and other animals is significant in most terrestrial habitats. Fruit, vegetable or seed production from 87 of the 115 leading global food crops depends upon animal pollination. It involves 67% of species of flowering plants and a relatively high diversity of insect taxa[3]. On the other hand, 35% of crop production worldwide and 70% of major global crop species rely on animal pollination[4]. Lautenbach *et al.*[6], estimated values of bee pollination at €265 billion in global food supply.

Kumar and Naidu[5] estimate about 1200 species of vertebrate pollinators and 80,000 species of insect pollinators are present worldwide. Amongst 80,000 species of insect pollinators, 17,533 species are of bee pollinators worldwide, out of these 633 species from 60 genera belongs to 6 families were reported from India.

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Among the insect pollinators, honey bees are the most important pollinators of angiosperms because of their vegetarian diet, flower visiting habits, floral fidelity, presence of thousands of work force, large number of hairs on body that readily pick up pollen grains and the fact that they exclusively visit many flowers of the same species during a single trip and also their availability throughout the year makes honey bees the most efficient and reliable pollinator[10].

Honeybees pollinate 16% of the total of 0.25 million of flowering plant species in the world and nearly 40000 species of agricultural plants[2]. Worldwide, 90 per cent food supply is contributed by 82 commodities assigned to plant species and bees are pollinators of 63 (*i.e.* 70%) of these plant species and are the most important known pollinators of 39 (48%) of these plant species. One-third of human diet is derived directly or indirectly from bee pollination in developed countries. Of the hundred or so animal-pollinated crops which make up most of the world's food supply, at least 80 % are pollinated by honey bees and wild bees[9]. Over the past two decades many investigators recorded the decline in population of bee species and the colony numbers (colony collapse disorder) due to the environmental problems like climate change, drought, fire, deforestation, pesticides, cell phones and many other reasons. Honey bees are so important to both agriculture and economics so efforts are important to reduce this declination.

MATERIAL AND METHODS

Studies on diversity of bee pollinators were carried out at NIPHM on different crops (sunflower, sun hemp, maize, sweet corn, brinjal, okra, cucurbits, bottle gourd, ridge gourd and cherry). Field data was collected through regular frequent visits to the study sites, during January 2017 – May 2017 between 08.00 – 10.00 am. Whenever bee species was observed on flowers it was caught by sweep insect net. Insect visitors were collected on a sunny day between 08:00 and 10:00 am throughout the entire flowering period on different crops. Field was kept free from any insecticidal spray during the entire study period. Bees collected by aerial netting method were killed with the help of killing bottle. The dead insect was immediately transformed into absolute alcohol. Time and date of collection were documented for each specimen. In the lab, specimens were pinned, mounted and oven–dried for 24 hours at 40 °C. All specimens were kept in insect boxes supplied for pinning and naphthalene balls were kept to enable long storage without pest damage. Specimens of bees were used for identification.

Identification of specimens

Initial identification to the genus level was conducted in the laboratory of Plant health management (PHM) division, NIPHM, Hyderabad. Later the images were shared to Dr. Venkata Rami Reddy P., Principal Scientist, Division of Entomology and Nematology, Pollinator Ecology, Indian Institute of Horticulture Research, Bengaluru, India for confirmation.

RESULTS AND DISCUSSION

In present study total fourteen bee species from nine genera were identified as pollinators, found on different crops at NIPHM. Out of fourteen species of bees five bee species were honeybees from family Apidae and Genus *Apis* and *Tetragonula*, and remaining nine species were solitary bees.

The most rich genus was *Apis*, having four species viz., *Apis florea* (Fabricius, 1787), *Apis cerana indica* (Fabricius, 1793), *Apis mellifera* (Linnaeus, 1758) and *Apis dorsata* (Fabricius, 1793). Genus *Nomada* includes two species *viz.*, *Nomada luteoloides* (Robertson, 1895) and *Nomia* sp. Genus *Xylocopa* includes two species *viz.*, *Xylocopa violacea* (Linnaeus, 1758), *Xylocopa fenestrate* (Fabricius, 1798). Genus *Tetragonula*, *Pseudapis*, *Nomia*, *Halictus*, *Megachile*, *Scolia* and *Amegilla* included one species each *viz.,Tetragonula iridipennis* (Smith, 1854), *Pseudapis oxybeloides* (Smith, 1875), *Nomia* sp., *Halictus* sp., *Megachile* sp., *Scolia* sp., and *Amegilla cingulate* (Fabricius, 1775).

Among all the crops observed, brinjal recorded highest diversity with 14 species of bees (Table 1).

Brinjal (*Solanum melongena*): The movement of bees was extensive in this crop throughout the flowering period when compared to the other crops. The pollinators observed in the brinjal field are honey bees (*Apis dorsata, Apis florea, Apis cerana indica, Apis mellifera, Tetragonula iridipennis*), carpenter bees (*Xylocopa violacea, Xylocopa fenestrata*) and other solitary bee pollinators like *Pseudapis oxybeloides*, *Nomia* sp., *Nomada luteoloides*, *Halictus* sp. (sweat bee), *Megachile* spp. (leaf cutting bees), *Amegilla cingulata* (blue banded bee). Among the insects observed in the brinjal field, carpenter bees (*Xylocopa*) and honey bees (*Apis dorsata*) were found abundant throughout the period.

Okra (*Abelmoschus esculentus* (L.): Single bee pollinator was observed in okra *i.e*., sting less honey bee (*Tetragonula iridipennis*).

Cucurbits: Two species of honey bees, European honey bee (*Apis mellifera*) and stingless bee (*Tetragonula iridipennis*) were found in cucumber (*Cucumis sativus*), ridge gourd (*Luffa acutangula*) and bottle gourd (*Lagenaria siceraria*). Another pollinator found in cucumber is blue banded bee (*Amegilla cingulata*).

Sunflower (*Helianthus annuus*): Three species of honey bees *i.e.*, Indian honey bee, European honey bee and Stingless bee (*Apis mellifera, Apis cerana indica* and *Tetragonula iridipennis*) along with two species of carpenter bees (*Xylocopa violacea, Xylocopa fenestrata*) were found. The present study corroborated with the findings of Amit *et al*. (2010) who noticed more abundance of *Apis* sp. in sunflower ecosystem.

Sweet corn (*Zea mays*): Four species of honey bees i.e., Indian honey bee, European honey bee, Rock bee and Stingless bee (*Apis cerana indica, Apis dorsata, Apis mellifera,* and *Tetragonula iridipennis*) were seen in Sweet corn field. Apart from honey bees no other pollinators were found in the field. **Sun hemp (*Crotalaria juncea*):** Two species of carpenter bees *i.e*., (*Xylocopa violacea, Xylocopa fenestrata*) and two other pollinators *Pseudapis oxybeloides* and *Scolia spp*. were observed.

Cherry: The abundant pollinator in cherry is little bee (*Apis florea*) and sting less bee (*Tetragonula iridipennis*) were seen on Cherry plants.

Table 1: Diversity of bee species from different crops of NIPHM field

S. No.	Crop name	Bee species		Sub-family	Order
1.	Brinjal	1.	Apis florea (Fabricius, 1787)	Apinae	Hymenoptera
		2.	Apis cerana indica (Fabricius, 1793)	Apinae	Hymenoptera
		3.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
		4.	Apis dorsata	Apinae	Hymenoptera
		5.	Tetragonulair idipennis (Smith, 1854)	Apinae	Hymenoptera
		6.	Xylocopa violacea (Linnaeus, 1758),	Xylocopinae	Hymenoptera
		7.	Xylocopa fenestrate (Fabricius, 1798)	Xylocopinae	Hymenoptera
		8.	Pseudapis oxybeloides (Smith, 1875)	Halictinae	Hymenoptera
		9.	Nomia sp.	Halictinae	Hymenoptera
		10.	Nomada luteoloides (Robertson, 1895)	Nomadinae	Hymenoptera
		11.	Nomada sp.	Nomadinae	Hymenoptera
		12.	Halictus sp.	Halictinae	Hymenoptera
		13.	Megachile sp.	Megachilinae	Hymenoptera
		14.	Amegilla cingulate (Fabricius, 1775)	Apinae	Hymenoptera
2.	Okra	1.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera
3	Cucumber	1.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
		2.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera
		3.	Amegilla cingulata (Fabricius, 1775)	Apinae	Hymenoptera
4	Ridge gourd	1.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera
		2.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
5	Bottle gourd	1.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera

		2.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
6	Sun flower	1.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera
		2.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
		3.	Apis cerana indica (Fabricius, 1793)	Apinae	Hymenoptera
		4.	Xylocopa violacea (Linnaeus, 1758),	Xylocopinae	Hymenoptera
		5.	Xylocopa fenestrate (Fabricius, 1798)	Xylocopinae	Hymenoptera
7	Sweet corn	1.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera
		2.	Apis mellifera (Linnaeus, 1758)	Apinae	Hymenoptera
		3.	Apis cerana indica (Fabricius, 1793)	Apinae	Hymenoptera
		4.	Apis dorsata (Fabricius, 1793)	Apinae	Hymenoptera
8	Sun hemp	1.	Xylocopa violacea (Linnaeus, 1758),	Xylocopinae	Hymenoptera
		2.	Xylocopa fenestrate (Fabricius, 1798)	Xylocopinae	Hymenoptera
		3.	Pseudapis oxybeloides (Smith, 1875)	Halictiinae	Hymenoptera
		4.	Scolia spp.	Scoliinae	Hymenoptera
9	Cherry	1.	Apis florea (Fabricius, 1787)	Apinae	Hymenoptera
		2.	Tetragonula iridipennis (Smith, 1854)	Apinae	Hymenoptera

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"If the bee disappeared off the surface of the globe, then man would have only four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man."

- **Albert Einstein** 1965, attributed-to-Eeinstein-no-source.