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Biodiversity of insect pests and their predators on ecological engineering maize (*Zea mays* L.) Agroecosystem

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Abstract

A field trial was conducted at the National Institute of Plant Health Management during the *Kharif* and *rabi*, 2020 and 2021 to investigate the biodiversity of insect pests and their predators in the maize Agroecosystem. A total of 11 species of insect pests belonging to different orders and varied families were recorded from the experimental field. The order Lepidoptera represented the highest number of 4 species. This was further followed by Hemiptera (3 species), Coleoptera (2 species), Diptera (1 species), and Orthoptera (1 species). The predator population is also quite diverse in their occurrence with the recorded species belonging to the orders Coleoptera, Arachnida, Dictyoptera, Hemiptera, and Hymenoptera.

Keywords: Biodiversity, pests, predators, maize, ecosystem

Introduction

Maize (*Zea mays* L.) has a tropical origin and is traditionally grown in the monsoon season. It is the third most important grain crop grown in diverse geographical and climate conditions around the world and Indian maize is grown in '*Kharif*' (rainy season), '*rabi*' (winter season), and spring seasons where more than 70 percent of the production happen in *Kharif* alone. Worldwide, it is popularly known as the "Queen of cereals" due to its wider adaptability and highest genetic yield potential among cereal crops. It has a wider genetic base and genotypic diversity which makes it to adaptive under different agro-climatic conditions.

Maize is a source of various nutrients such as carbohydrates, proteins, minerals, vitamins, iron, etc., and particularly supplies high energy of 365 Cal/100g. It acts as the source of human food, livestock, and poultry feed. Maize can also be used in milling industries for oil extraction and starch. Maize was originated from central Mexico and is currently one of the most widely distributed crops in the world. In India, it is cultivated over an area of 9.63 million hectares with an annual production of 25.90 million metric tonnes and average productivity of 2.69 metric tonnes per hectare ^[11]. It is cultivated throughout the country in diverse habitats, though Karnataka, Andhra Pradesh, Maharashtra, Bihar, Punjab, Rajasthan, and Haryana are the major producers. In Haryana, it is cultivated over an area of 5000 hectares having an annual production of 17000 tonnes with average productivity of 3.40 metric tonnes per hectare ^[11].

In India Maize is a high economic significant crop. Its production is increasing at a rate three times the annual rate of wheat and two times of annual rate of rice (Fischer *et al.*, 2014) ^[6]. Since the gap between potential and productivity is very wide, there is marvelous scope for the management of crop production and protection practices.

About 250 species of insect and mite pests have been reported damaging this crop out of which only half a dozen are of economic importance which threatens to limit the production of this crop (Mathur, 1991) ^[9]. Major insect pests which cause economic yield losses during different seasons all over the country are maize stem borer, *Chilo partellus* (Swinhoe), pink stem borer, *Sesamia inferens* (Walker), shoot fly *Atherigona soccata* (Rund), armyworm, *Mythimna separata* (Walker), fall armyworm, *Spodoptera frugiperda* (J.E. Smith), maize cob borer, *Helicoverpa armigera*, and maize aphid, *Rhopalosiphum maidis* Fitch (Siddiqui and Marwaha, 1994) ^[10]. Although several reports have been published on the pests of maize the perusal of literature reveals that the consolidated account of the biodiversity of insect fauna is still lacking. Therefore an effort has been made in the present study to provide the current status of the insect fauna diversity prevailing in ecological engineering maize ecosystem under the NIPHM field conditions.

Materials and Methods

The present experiment was conducted at the NIPHM field, Rajendranagar, Hyderabad during *Kharif* and *rabi* seasons, 2020 and 2021. Hybrid maize was cultivated in the ecological engineering, organic field by following all the recommended agronomic practices. The maize crop was grown with various ecological engineering plants belonging to categories of attractant plants, trap plants, and repellent plants in the ecological engineering field of NIPHM.

Regular field visits were done to record the population of different insect pests and predators. The maize was surveyed for the diversity of insect pests and their predators from the seedling emergence of the crop till the final harvesting. The collection of insect fauna was done in the early morning at weekly intervals by using different methods of collection *viz.*, in situ, and net sweeping (Hassan *et al.*, 1995) [7]. The Insitu count method was employed for recording insect fauna diversity in the maize field. The insect pests and their predators were recorded on 10 randomly selected plants from the middle rows excluding border rows.

Counting was done from three leaves of a plant each one from the upper, middle, and lower portion. The sweep net was used to trap the above-ground insect pests and their predators in the maize ecosystem. The collected insect fauna was carefully observed. The weekly data obtained from net sweeping was used to prepare the list of insect fauna prevailing in the maize agroecosystem. The entire insect fauna collected from the

field was brought to the laboratory. Adult stages were identified using keys and immature stages were reared and identified during their adult stage.

Results and Discussion

Based on an immense survey of the maize crop throughout its two growing seasons *Kharif* to *rabi*, 2020 and 2021 an inventory of the arthropod fauna was prepared (Table 1). The results from the study revealed the occurrence of several insect pests and predators. A total of 11 species of insect pests belonging to five orders namely Lepidoptera, Hemiptera, Coleoptera, Diptera, and Orthoptera were recorded. Among the various insect pests of maize recorded in the experimental fields in the present study, the order Lepidoptera represented the highest number of four species. Among all the Lepidopteran pests' tobacco leaf eating caterpillar and fall armyworm were found as the predominant group of insect pests in the trial field.

Order lepidoptera consisted of 4 species of insect pests belonging to 1 family, followed by Hemiptera with 3 species in 3 different families, Coleoptera with 2 species in 2 different families, Diptera with 1 species, and Orthoptera with 1 species.

During the study 6 species of predators belonging to 5 orders *i.e.* Coleoptera, Arachnida, Dictyoptera, Hemiptera, and Hymenoptera were found.

Table 1: Diversity of insect pests in maize ecosystem at NIPHM during *Kharif* and *rabi* 2020-2021

Sr. No.	Pest		Family	Order	Pest status
	Common name	Scientific name			
1	Aphids	<i>Rhopalosiphum maidis</i> (Fitch.)	Aphididae	Hemiptera	Major
2	Leafhopper/Pyrrilla	<i>Pyrrilla perpusilla</i> (Walker)	Lophopidae	Hemiptera	Minor
3	Derbid plant hopper	<i>Proutista moesta</i>	Derbidae	Hemiptera	Minor
4	Flea beetle	<i>Chaetocnema pulicaria</i> (F.E Melsheimer)	Chrysomelidae	Coleoptera	Minor
5	Shoot fly	<i>Atherigona spp.</i> (Rondani)	Muscidae	Diptera	Minor
5	Pink stem borer	<i>Sesamia inferens</i> (Walker)	Noctuidae	Lepidoptera	Minor
6	Tobacco leaf eating caterpillar	<i>Spodoptera litura</i> (Fabricius)	Noctuidae	Lepidoptera	Major
7	Corn borer	<i>Helicoverpa armigera</i> (Hubner)	Noctuidae	Lepidoptera	Minor
8	Fall armyworm	<i>Spodoptera frugiperda</i> (J.E Smith)	Noctuidae	Lepidoptera	Major
9	Chafer beetles	<i>Chiloloba acuta</i> (Wiedemann)	Scarabaeidae	Coleoptera	Minor
10	Short horned grasshopper	<i>Hieroglyphus spp.</i>	Acrididae	Orthoptera	Minor

Table 2: Diversity of predators in maize ecosystem at NIPHM during *Kharif* and *rabi* 2020-2021

Sr. No	Natural enemies		Family	Order	Prey
	Common name	Scientific name			
1	Ladybird beetle	<i>Coccinella transversali</i> , <i>Cheilomenessexmaculata</i> , and <i>Anegleis cardoni</i>	Coccinellidae	Coleoptera	Soft-bodied insects (Aphids)
2	Spiders	Spiders	-	Arachnida	Soft-bodied insects (Aphids) and Lepidopteran larvae
3	Preying mantis	<i>Mantis religiosa</i>	Mantidae	Dictyoptera	Soft-bodied insects (Aphids) and Lepidopteran larvae
4	Predatory stink bug	<i>Eocanthecona furcellata</i>	Pentatomidae	Hemiptera	Lepidopteran larvae
5	Big-eyed bugs	<i>Geocoris spp.</i>	Geocoridae	Hemiptera	Soft-bodied insects (Aphids) and Lepidopteran larvae
6.	Predatory wasp	<i>Vespa cincta</i>	Vespidae	Hymenoptera	Lepidopteran larvae

The present results are in accordance with the findings of Yogesh *et al.*, (2015) [12] whose study revealed that many insect pests were observed at different growth stages of the crop. Pink stem borer (*Sesamia inferens*), green stink bug (*Nezara viridula*), leafhopper (*Cicadulina spp.*), black aphids (*Rhopalosiphum maidis*), and cob borer (*Helicoverpa armigera*) were noticed causing damage at vegetative growth, tasseling and cob stages of the crop. Ahad *et al.*, (2012) [11] and

Kumar *et al.*, (2016) [8] recorded 17 and 11 insect pest species, respectively infesting maize at different stages of growth. Erhan *et al.*, (2013) [5] recorded as many as 9 insect species infesting the crop and Beres (2015) [3] reported seven aphid species from maize, and Deole *et al.*, (2015) [4] recorded 3 lepidopteran species as borers in maize. The variation in insect numbers could be due to varietal differences and different agroclimatic conditions.

Conclusion

The overall results of the current study revealed the occurrence of several species of insect pests and the predator population in the maize. Ecologically diversified Agroecosystem can support different types of natural enemies and thereby reduce pest population naturally Altieri (1990) [2].

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