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# Biodiversity of Insect Pests in The Agroecosystems of Maize (*Zea Mays* L.) In Telangana State, India

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***Abstract***

*The study was conducted at maize/ corn crop fields in Nalgonda, Warangal, and Ranga Reddy, erstwhile districts of Telangana state, India, during the 2021–22 Kharif and Rabi seasons. Main objective of the study is to investigate Biodiversity of insect pests in the agroecosystems of maize (Zea mays L.) in Telangana state, India. Sweep net and hand-picking methods were used to collect insect pests on maize/ corn fields**.** sixteen insect pest's species were observed, belonging to Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera orders in the class Insecta of the Arthropoda phylum of the Kingdom Animalia. The order Lepidoptera represented the highest number of eight species followed by Hemiptera three species, Coleoptera two species, Orthoptera two species and Diptera one species**.** The family Noctuidae of lepidoptera was the richest with eight species followed by Acrididae of Orthoptera with two species, Chrysomelidae of Coleoptera with one species, Scarabaeidae of Coleoptera with one species, Muscidae of Diptera with one species, Aphididae of Hemiptera with one species, Lophopidae of Hemiptera with one species, and Derbidae of Hemiptera with one species on maize/ corn crop fields. Ecological indices of insect pest's species i.e., Species diversity (Shannon-Wiener Index), Species richness (Margalefs Index) and Species evenness (Pielou Evenness Index) were calculated.*

**Keywords:** *Biodiversity, Insect pests, Agroecosystems, Maize (Zea mays L.), Kharif and Rabi seasons***.**

## 1. Introduction

Maize/ corn, *Zea mays* L., belonging to Family Poaceae; Order Poales is one of the most important cereal crops, playing a key role in economic, political, and social affairs of the world. It is known as the "Queen of Cereals" due to its great production. Maize/ corn is the world's third most widely cultivating crop after wheat and rice. India ranked third in terms of area and maize production. Corn crops around the world are an important source of food production for both humans and animals (Erenstein et al., 2022). 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. Corn is composed of 71.5 per cent starch, 1.9 per cent protein, 4.8 per cent fat and 1.4 per cent ash (Rathore, 2001).

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 tons and average productivity of 2.69 metric tons per hectare. It is cultivated throughout the country in diverse habitats, though Karnataka, Andhra Pradesh, Telangana, Maharashtra, Bihar, Punjab, Rajasthan, and Haryana are the major producers.

Maize, being a C4 plant, has a greater yield potential as compared to other cereals (Scott and Emery, 2016), but attack of insect-pests at various crop growth stages from sowing to maturity poses serious

limitation in full manifestation of yield potential during different seasons. There is report of 250 pests attacking maize (Mathur, 1992) but only a dozen of pests is quite serious and require control measures (Siddiqui and Marwaha, 1994). About 250 species of insect and mite pests have been reported damaging this crop out of which only half a dozen is of economic importance which threatens to limit the production of this crop (Mathur, 1991). In India, nearly 32.1 per cent of the actual produce is lost due to insect pests (Borad and Mittal, 1983). As many as 141 insect pests cause varying degree of damage to maize crop right from sowing till harvest (Reddy and Trivedi, 2008). Major insect pests which cause economic yield losses during different seasons all over the country are *Chilo partellus*, *Sesamia*, *Atherigona soccata*, *Mythimna separata*, *Spodoptera frugiperda*, *Helicoverpa armigera*, and *Rhopalosiphun maidis* (Siddiqui and Marwaha, 1994). The Fall Armyworm, S. frugiperda is a key pest of maize reported for the first time in 2018 in Africa, Nigeria etc, it began to spread widely in India (Deole and Paul, 2018). In India, S. frugiperda is recently reported in Karnataka Tamil Nadu and Telangana infesting maize crop. It is also found in Maharashtra at Solapur district. (Sisodiya et al. 2018). Insects attack maize throughout the cropping cycle and during storage, resulting in as little as 10% to complete loss (Bergvinson et al., 2002).

It is advisable to turn attention to alternatives such as biological solutions (SP-IPM, 2006; Sharma et al., 2013) which have started to be promoted more and more in recent years (Barratt et al., 2018; Armarego-Marriott, 2022). Among these solutions, biological control with natural enemies that feed on pests and have a predatory or parasitic regime is probably the most appropriate (Riddick, 2022).

Main objective of the study is to investigate Biodiversity of insect pests in the agroecosystems of maize (*Zea mays* L.) in Telangana state, India.

## 2. Materials And Methods

The study was conducted at maize/ corn crop fields in Nalgonda, Warangal, and Ranga Reddy, erstwhile districts of Telangana state, India. One crop field was selected from each district. The study was carried out during the 2021–22 Kharif and Rabi seasons. The maize variety '900M Gold' was cultivated in agroecosystems of maize.

The diversity of insect fauna was investigated on maize/corn from seedling emergence to the final harvest. Sample was done every week from maize/ corn crop fields, in the morning hours because most of insects become active when temperature is about 25˚C to 30˚C (Garcia A. et al, 1982). Sweep net and hand-picking methods were used to collect insect fauna on maize/ corn fields (Hassan et al., 1995). For the insect fauna population count, five plots each having an area of 5m x 5m were selected in the maize/corn fields. The insect fauna was observed visually on whole plants. The plant was observed from all angles, from bottom to top, and the leaves were examined on both sides (upper and lower). The insect population was carefully counted. Insect fauna was preserved in 70% ethyl alcohol in glass vials of size 10 cm x 2.5 cm and labeled. Insect fauna was identified with the help of keys by comparing the morphological and taxonomical features (Samiayyan, 2014), and published literature.

Ecological indices of insect species i.e., Species diversity (Shannon-Wiener Index), Species richness (Margalefs Index) and Species evenness (Pielou Evenness Index) were calculated.

Species diversity [Shannon-Wiener index (H)]

$H= -\sum P_i \log P_i$

Where,

H = Shannon-Weiner index,

$\sum$ = Sum,

Pi = ni /N,

ni = Number of individuals of each species in the sample,

N = Total number of individuals of all species in the sample.

Species evenness [Pielou Evenness Index (J)]

$J= H/H_{max}$

Where,

J = Evenness index,

H= Shannon -Weiner index,

$H_{max} = \log S$,

S = number of species.

Species richness [Margalef's Index (D)]

$D = \frac{S-1}{logN}$

Where,

D= Species richness,

S= total number of species,

N= total number of individuals.

## 3. Results and Discussion

A total of 5225 insect pests were collected from maize/corn crop fields in Nalgonda, Ranga Reddy, and Warangal, erstwhile districts of Telangana state, India, using Sweep nets and hand-picking methods during the 2021–2022 Kharif and Rabi seasons. Out of those, sixteen insect species were observed, belonging to Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera orders in the class Insecta of the Arthropoda phylum of the Kingdom Animalia (Table. 1). Among the orders Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera, the order Lepidoptera represented the highest number of eight species followed by Hemiptera three species, Coleoptera two species, Orthoptera two species and Diptera one species (Fig. 1).

**Table. 1. Biodiversity of insect pests on maize/ corn agroecosystems.**

| S. No. | Order | Family | Species | Common Name |
|---|---|---|---|---|
| 1 | Coleoptera | Chrysomelidae | *Chaetocnema pulicaria* (F.E Melsheimer, 1847) | Corn flea beetle |
| 2 | Coleoptera | Scarabaeidae | *Chiloloba acuta* (Wiedemann, 1823) | Flower chafer beetle |
| 3 | Diptera | Muscidae | Atherigona *soccata* (Rondani, 1871) | Sorghum shoot fly |
| 4 | Hemiptera | Aphididae | *Rhopalosiphum maidis* (Fitch, 1856) | Corn leaf aphid/ Corn aphid |
| 5 | Hemiptera | Lophopidae | *Pyrilla perpusilla* (Walker, 1851) | Sorghum planthopper/ Sugarcane planthopper |
| 6 | Hemiptera | Derbidae | *Proutista moesta* (J. O. Westwood, 1851) | Moesta planthopper |
| 7 | Lepidoptera | Noctuidae | *Helicoverpa armigera* (Hübner, 1808) | Corn earworm |
| 8 | Lepidoptera | Noctuidae | *Helicoverpa zea* (Boddie, 1850) | Corn earworm |
| 9 | Lepidoptera | Noctuidae | *Sesamia inferens* (Walker, 1856) | Asiatic pink stem borer |
| 10 | Lepidoptera | Noctuidae | *Sesamia cretica* (Lederer, 1857) | Corn stem borer |
| 11 | Lepidoptera | Noctuidae | *Sesamia nonagrioides* (Lefèbvre, 1827) | Pink stalk borer |
| 12 | Lepidoptera | Noctuidae | *Spodoptera frugiperda* (J. E. Smith, 1797) | Fall armyworm |
| 13 | Lepidoptera | Noctuidae | *Spodoptera litura* (Fabricius, 1775) | Tobacco cutworm/ Cotton leafworm |
| 14 | Lepidoptera | Noctuidae | *Spodoptera ornithogalli* (Guenée, 1852) | Yellow-striped armyworm |
| 15 | Orthoptera | Acrididae | *Hieroglyphus banian* (Fabricius, 1798) | Sorghum grasshopper |
| 16 | Orthoptera | Acrididae | *Hieroglyphus nigrorepletus* (Bolívar, 1912) | Sorghum grasshopper |

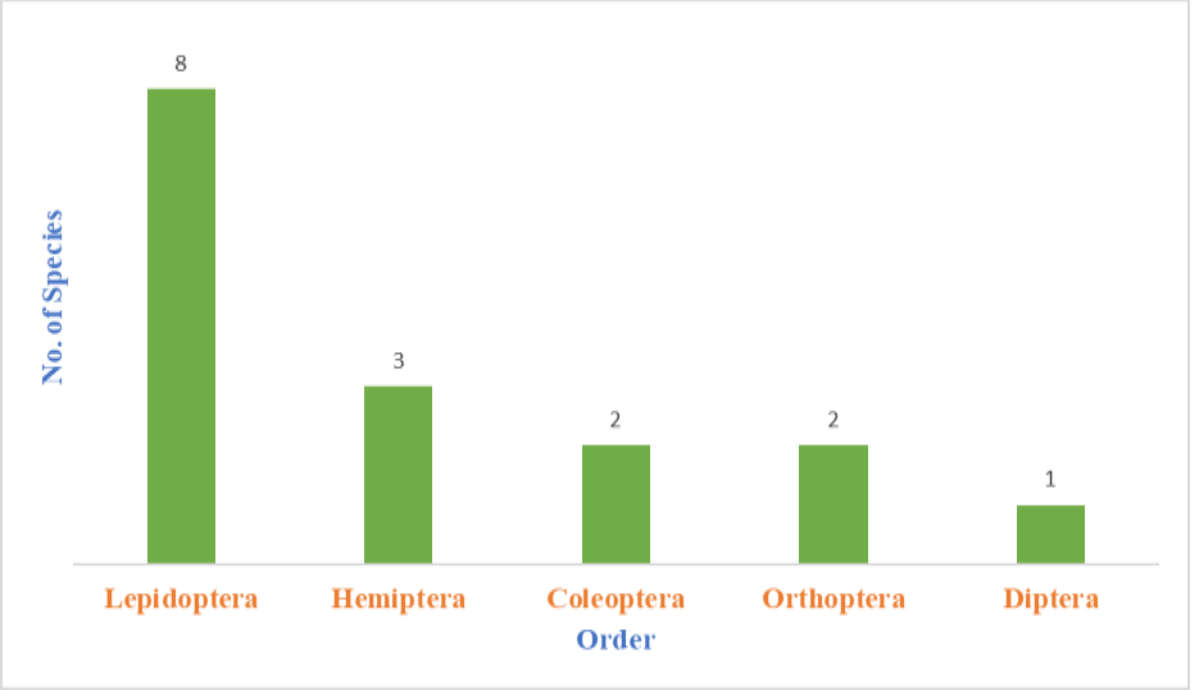


**Fig. 1. Number of Insect pest Species of different orders on maize/ corn agroecosystems.**

The family Noctuidae of lepidoptera was the richest with eight species followed by Acrididae of Orthoptera with two species, Chrysomelidae of Coleoptera with one species, Scarabaeidae of Coleoptera with one species, Muscidae of Diptera with one species, Aphididae of Hemiptera with one species, Lophopidae of Hemiptera with one species, and Derbidae of Hemiptera with one species on maize/ corn crop fields (Fig. 2).

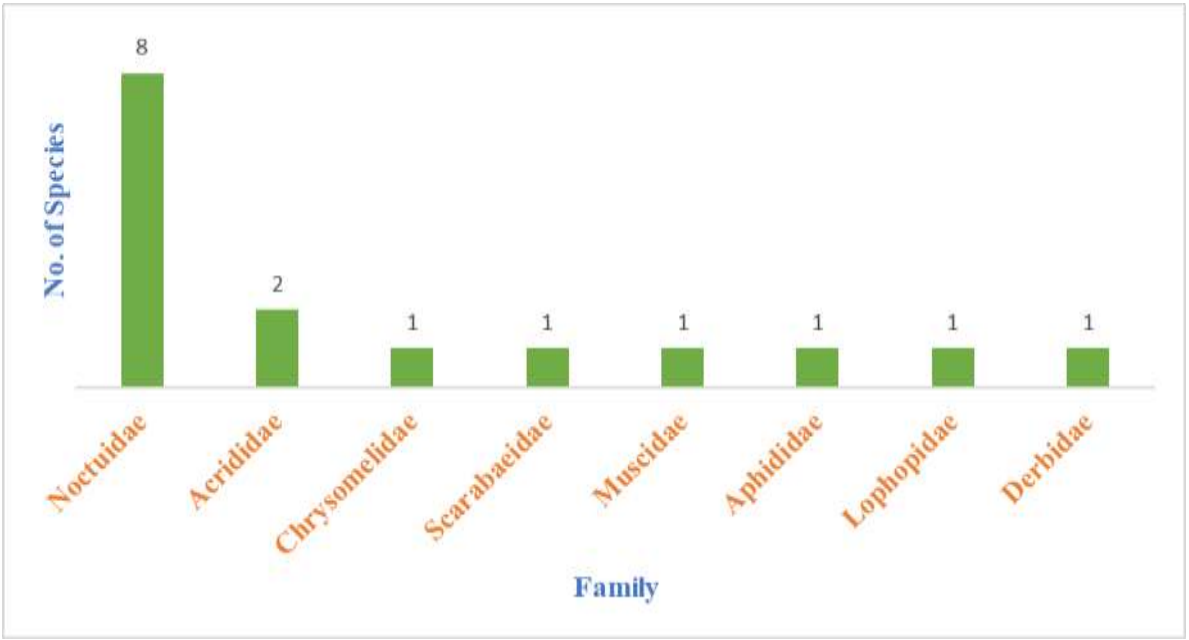


**Fig. 2. Number of Insect pest Species of different families on maize/ corn agroecosystems.**

The species *Chaetocnema pulicaria* (Corn flea beetle) of Chrysomelidae family, and the species *Chiloloba acuta* (Flower chafer beetle) of Scarabaeidae family of Coleoptera Order were observed. The species *Atherigona soccata* (Sorghum shoot fly) of Muscidae family of Diptera Order was observed. The species Rhopalosiphum maidis (Corn leaf aphid/ Corn aphid) of Aphididae family, the species *Pyrilla perpusilla* (Sorghum planthopper/ Sugarcane planthopper) of Lophopidae family, and the species *Proutista moesta* (Moesta planthopper) of Derbidae family of Hemiptera order were observed. The species *Helicoverpa armigera* (Corn earworm), *Helicoverpa zea* (Corn earworm), Sesamia inferens (Asiatic pink stem borer), Sesamia cretica (Corn stem borer), Sesamia nonagrioides (Pink stalk borer), Spodoptera frugiperda (Fall armyworm), Spodoptera litura (Tobacco cutworm/ Cotton leafworm), and Spodoptera ornithogalli (Yellow-striped armyworm) of Noctuidae family of Lepidoptera order were observed. The species *Hieroglyphus banian* (Sorghum grasshopper), and *Hieroglyphus nigrorepletus* (Sorghum grasshopper) of Acrididae family of Orthoptera order were observed (Table. 1).

The calculation included three characteristics, namely species diversity (Shonnon-Wiener Index), Species evenness (Pielou Evenness Index), and Species richness (Margalefs Index) for analysis of community structure of insect pests on maize/ corn agroecosystems (Table. 2). According to ecological indexes, there is significant patronage shown in the species composition of insect pests in the maize/corn agroecosystem.

**Table. 2. Ecological indexes for insect pests on maize/ corn agroecosystems.**

| | H- Values (Diversity) | J- Values (Evenness) | D- Values (Richness) |
|---|---|---|---|
| **Coleoptera** | 1. 582 | 0. 989 | 0. 872 |
| **Diptera** | 1. 215 | 0. 990 | 0.712 |
| **Hemiptera** | 2. 101 | 0. 687 | 2. 113 |
| **Lepidoptera** | 2. 254 | 0. 936 | 1. 655 |
| **Orthoptera** | 1. 463 | 0. 929 | 0. 980 |

The H-values of Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera are below 1.0, which indicates that the habitat structure is not suitable. Maize/ corn agroecosystems are stable for Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera if their H-values exceed 1.0. In the case of Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera, H-values are between 1.463 and 2.254, which indicates that the habitat structure is stable and suitable for these species. Maize/corn agroecosystems have evenness values closer to 1.0, which means that the individuals are equally distributed. Richness values in maize/corn agroecosystems are below 0.5. It indicates that the individuals are low, but closer to 1.0 indicates that they are more (Table. 2).

Our results indicate that sixteen insect species were observed, belonging to the Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera orders in the class Insecta of the Arthropoda phylum of the Kingdom Animalia. Among the orders Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera, the order Lepidoptera represented the highest number of eight species, followed by Hemiptera three species, Coleoptera two species, Orthoptera two species and Diptera one species. Many previous studies of insect pest diversity on maize/ corn crop fields are similar or partially like our study. Edpuganti Sreelatha et al., (2022) investigated the biodiversity of insect pests and their predators in the maize Agroecosystem. They found a total of 11 species of insect pests belonging to different orders and varied families were recorded. The present results are in accordance with the findings of Yogesh et al., (2015) whose study revealed that many insect pests were observed at different growth stages of the crop. Ahad et al., (2012) recorded 17 insect pest species and Kumar et al., (2016) recorded 11 insect pest species infesting maize at different stages of growth. Erhan et al., (2013) observed 9 insect species on the maize crop fields. Beres (2015) reported seven aphid species from maize, and Deole et al., (2015) recorded 3 lepidopteran species as borers in maize.

## 4. Conclusion

As a result of this study, we observed sixteen insect species were observed, belonging to the Coleoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera orders in the class Insecta of the Arthropoda phylum of the Kingdom Animalia during the 2021–22 Kharif and Rabi seasons. diversity of insect pests depends on many factors. It may be concluded that climatic factors determine diversity of insect pests of maize/ corn agroecosystems. The results of present study would be helpful in developing efficient pest management strategies against insect pests of maize/ corn agroecosystems for increased yields, profit, besides safely to the environment.

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