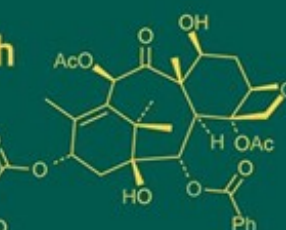


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Diversity and relative abundance of insect pest complex in maize (*Zea Mays* L.) ecosystem

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ABSTRACT

In India maize is the third most important cereal after rice and wheat. Maize crop is attacked by a number of insect pests during different growth stages from sowing to maturity. Diversity study of insect pest complex of maize was carried out at Instructional Cum Research (ICR) farm, Assam Agricultural University, Jorhat during Kharif, 2023 and Rabi, 2023-24. Survey results revealed that a total of 39 arthropod species were found to be associated with maize at different growth stages as recorded from different locations of Assam. Out of 39 species, 17 species were pests and 13 species were natural enemies. In addition, 9 stray pests or casual visitors were also observed. Out of the 17 pests, cut worm *Agrotis ipsilon* Hufnagel, maize stem borer *Chilo partellus* (Swinhoe), fall armyworm *Spodoptera frugiperda* (Smith), armyworm *Mythimna separata* and maize aphid *Rhopalosiphum maidis* (Fitch) were considered as major pests of maize.

Keywords: Diversity, Insect pest complex, Relative abundance, Natural enemies

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops of the world having wider adaptability under varied agro-climatic conditions. Maize is popularly known as “Queen of Cereals” because of its high genetic yield potential. Maize is also known as “Miracle crop” due to its utilization in various purpose like approx 28% of maize used for food purpose, 11% as livestock feed, 48% as poultry feed, 12% in wet milling industry (starch and oil production) and 1% as seed in India (Patel *et al.*, 2024) [1]. India considers maize to be an important crop owing to its high economic importance. Production of maize is increasing at three times faster rate than wheat and at a two times faster rate than rice (Fischer *et al.*, 2014) [2]. Following rice and wheat, maize is becoming India's third most important crop. India produced 28.64 million tonnes of maize grains from an area of 9.72 million hectares having average productivity of 2945 kg per hectare. In different parts of the country maize is grown both as food and fodder crop in different seasons (Kharif, Rabi and Spring). In Assam, maize occupies an area of 28,420 hectares with a production of 87,175 tones and productivity of 3067 kg/ha (Anonymous, 2016) [3]. Currently, Assam is experiencing a growth in the importance of maize. In the past, it was mostly grown for human consumption. However, as the demand for poultry feeds and fodder in the state is rapidly increasing, maize is being used in some small industries. It serves as a source of basic raw material for most of the feed industries.

From the time of sowing until maturity, a number of insect pests attack the maize crop which cause damage to all parts of the plant (roots, stems, leaves, tassels, silk and grains). Approximately 141 different insect and mite pests are known to damage this crop (Reddy *et al.*, 2008) [4]. In which only a few are economically important, limiting the production of this crop. Major biotic constraints of maize are maize stem borer *Chilo partellus* (Swinhoe), pink stem borer *Sesamia inferens* (Walker), shoot fly *Atherigona soccata* Rondani, armyworm *Mythimna separata* (Walker), maize cob borer *Helicoverpa armigera* (Hubner) and maize aphid *Rhopalosiphum maidis* Fitch which cause economic losses in different parts of the country during different seasons (Siddiqui *et al.*, 1994) [5]. Pest complex of a particular crop differs from region to region, depending on the agro-climatic conditions of the region; further, the status of pests of a particular crop has changed with the climate changes. Performing periodic assessment on insect pests and their natural enemies could assist in understanding the relative economic impact of each pest on the crop.

Materials and Method

Diversity study was conducted at the Instructional Cum Research farm of Assam Agricultural University, Jorhat during Kharif, 2023 and Rabi, 2023-24. The field was monitored daily or at weekly intervals for the observation of insect pests on the crop. Collections of insect pests were done mainly by hand picking or using sweep net. The population of different insect pests were assessed by visual observation. The collected insect pests were killed using chloroform and preserved by both dry and wet preservation methods. Larvae of

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lepidopteran pests were preserved in 70% alcohol in glass vials and labelled. Preliminary identification of the collected samples was done based on established taxonomic keys and also by matching the characters with identified species in the Entomology department of Assam Agricultural University, Jorhat. The relative abundance of different insect pests of maize from different districts was worked out using the following formula and expressed in percentage.

Relative abundance of species

$$= \frac{\text{No. of individuals per species}}{\text{Total number of individuals}} \times 100$$

Results

During Kharif, 2023 and Rabi, 2023-24, 17 numbers of insect pests were found to be associated with maize at different growth stages. (Table 1). During seedling stage maize was first infested by cut worm, *Agrotis ipsilon* (Hufnagel) after one week of germination. From early vegetative stage to reproductive stage, the crop was attacked by various lepidopteran pests like maize stem borer *Chilo partellus* (Swinhoe), fall armyworm *Spodoptera frugiperda* Smith, army worm *Mythimna separata* Walker, pink stem borer *Sesamia inferens* Walker, cob worm *Helicoverpa armigera* (Hubner), maize leaf folder *Marasima trapezalis* (Guenee), rice yellow hairy caterpillar *Psalis pennatula* Fabricius and yellow tail tussock moth *Somena scintillans* Walker.

The highest relative abundance among the lepidopteran pests was observed in case of *S. frugiperda* with 22.09 per cent followed by *C. partellus* with 20.05 per cent. This was followed by *M. separata*, *A. ipsilon* and *H. armigera* with 15.09 per cent, 10.52 per cent and 2.08 per cent, respectively, whereas *M. trapezalis*, *P. pennatula*, *S. scintillans* and *S. inferens* showed only 1.35, 1.20, 1.08 and 1.01 per cent relative abundance, respectively. During the study, hemipteran pests like maize aphid *Rhopalosiphum maidis* (Fitch), a new invasive pest rugose spiralling whitefly *Aleurodicus rugioperculatus* (Martin), leaf hopper *Bothrogonia ferruginea* (Fabricius) and green stink bug *Nezara viridula* (Linnaeus) were also noted. The maize aphid had the highest relative abundance, 15.43 per cent, and it was found from the seedling stage to the dough stage of the crop. It was followed by *B. ferruginea*, *N. viridula* and *A. rugioperculatus* with 0.96, 0.86 and 0.82 per cent of relative abundance, respectively. Two orthopteran species *Oxya* sp. and *Trilophidia annulate* (Thunberg) were observed to feed on maize leaves during vegetative stage of the crop with relative abundance 3.25 and 0.75 per cent, respectively. In addition, coleopteran pests viz., flea beetle *Altica* sp. with 0.45 per cent of relative abundance and leaf beetle *Monolepta signata* Olivier with 3.01 per cent relative abundance were also recorded from maize ecosystem.

During the course of study, 5 numbers of pests viz., *Agrotis ipsilon* (Hufnagel), *Chilo partellus* (Swinhoe), *Spodoptera frugiperda* (Smith), *Mythimna separata* (Walker) and *Rhopalosiphum maidis* (Fitch) were categorized as major pests based on high population as well as their presence during the entire crop growth period in the field during both the seasons (Kharif, 2023 and Rabi, 2023-24). Whereas, the insects appeared in the crop with negligible population with minor incidences were considered as minor pests. Minor insect pests comprised of five lepidopteran pests viz., *Helicoverpa armigera* (Hubner), *Sesamia inferens* Walker, *Marasimia trapezalis* (Guenee), *Psalis pennatula* Fabricius and *Somena scintillans* Walker, three species of hemipteran pests viz., *Aleurodicus rugioperculatus* (Martin), *Bothrogonia ferruginea* (Fabricius) and *Nezara viridula* (Linnaeus), two grasshopper species viz., *Oxya* sp. and *Trilophidia annulate* (Thunberg) and two coleopteran pests viz., *Altica* sp., and *Monolepta signata* Olivier.

Many insect pests were observed in maize at different growth stages which were being identified and reported by many scientists from different regions of India as well as the world. Patient et al. (2019) [6] also reported that lepidopterans were the most abundant and the major insect pests of maize and among the lepidopterans, *Spodoptera*

frugiperda was the most represented species. Similar findings were also reported by Khan et al. (2022) [7] who reported that total 8 species of insect pests were associated with the crop throughout the season. Arif et al. (2019) [8] who reported a total of 21 insect species at various phenological stages of maize and among which cut worm, *Agrotis* sp.; maize stem borer, *Chilo partellus* Swinhoe and army worm, *Mythimna separata* Walker emerged as major insect pests of maize. During the investigation, 13 numbers of natural enemies were recorded, out of which 10 species under class Insecta and 3 species were under Arachnida (Table 2). Among the class Insecta, order Coleoptera, family Coccinellidae comprised maximum of 5 species viz., *Coccinella transversalis* (Fabricius), *Harmonia dimidiata* (Fabricius), *Micraspis discolor* (Fabricius), *Cheilomenes sexmaculata* (Fabricius) and *Cryptogon* sp. followed by order Odonata, consisted of 3 species viz., *Ceriagrion* sp. belong to family Coenagrionidae, *Crocothemis servilla* (Drury) and *Neurothemis tullia* (Drury) belong to Libellulidae family. Moreover, 1 dipteran species *Lathryophthalmus* sp. belong to Syrphidae family and 1 orthopteran species *Conocephalus longipennis* (Haan) belong to Tettigonidae family were also recorded as natural enemies of maize pests. Under class Arachnida, order Araneae, family Oxyopidae contains two numbers of spiders viz., *Oxyopes javanus* Thorell and *Oxyopes birmanicus* Thorell, while family Salticidae had only one species viz., *Plexippus* sp (Table 2).

During Kharif, 2023 and Rabi, 2023-24 the relative abundance of natural enemies under order Coleoptera found to be highest with 55.46 and 53.65 per cent followed by order Odonata with 16.50 and 24.07 per cent, respectively. Order Araneae comprised of 16.11 and 14.59 per cent relative abundance in Kharif, 2023 and Rabi, 2023-24, respectively. The relative abundance of order Diptera was recorded as 3.50 per cent in Kharif, while in case of Orthoptera it was recorded as 8.43 and 7.69 per cent during Kharif, 2023 and Rabi, 2023-24, respectively (Table 2).

The coccinellid predators were found in maize ecosystem, they consumed the small soft bodied insects like maize aphids which was one of the major pests of maize. It was also observed that dipteran predator during maggot stage acted as a natural enemy feed upon nymphs and adults of aphid. Additionally, it was noticed that the stem borer's egg mass was being consumed by the meadow grasshopper, *Conocephalus longipennis*. Similar observations on natural enemies of maize were also reported by Kumar et al. (2020) [9]. The result of present study on natural enemies of maize ecosystem was in conformity with the report of Sidar et al. (2017) [10] where they mentioned that rove beetles, ladybird beetles and spiders have been identified as the major natural enemies of maize insect pests.

During the investigation period, 9 species of insects were found to be as casual visitors of maize. Out of these, 4 species of hemiptera viz., *Proutista moesta* (Westwood), *Dysdercus cingulatus* Fabricius, *Cletus* sp., *Leptocoris oratorius* Fabricius, 3 species belong to coleoptera viz., *Aulacophora foveicollis* (Lucas), *Hycleus* sp. and *Oxyctonia versicolor* Fabricius and two species from lepidoptera viz., *Spodoptera mauritia* (Boisduval) and *Syntomoides imaon* (Cramer) were recorded (Table 3).

A study on insect pests of maize from Umiam, Meghalaya, Patra et al. (2013) [11] reported 5 species viz., *Leptocoris acuta* Thun., *Dictyophora pallida* Don., *Poophilus costalis* Walk., *Mylabris pustulata* Thun. and one orthopteran species as casual visitors or stray pests. Whereas, Arif et al. (2019) [8] reported two species viz., Flea beetle, *Altica himensis* and black bean aphid, *Aphis fabae* as casual visitors of maize crop.

Conclusion

The present study documented seventeen pest species associated with maize in Jorhat district of Assam. Among these, five nos. of species were categorized as major pests based on high population as well as their presence during the entire crop growth period in the field during both the seasons. Among the different natural enemies recorded from maize, coccinellid predators were found to be dominant. The bio-

ecology and sequence of occurrence on crop have been depicted in detail which provides a thorough understanding on various pests and natural enemies associated with maize.

Future scope

Considering the economic importance of maize, there is an urgent need to study biology, correlation with weather parameters, population dynamics and the severity of the damage to formulate effective management practices of the major pests of this crop for reducing the crop losses.

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Table 1. Insect-pest of Maize observed During *Kharif*, 2023 and *Rabi*, 2023-24 and their relative abundance

Sl. No.	Order	Common name	Scientific Name	Family	Relative abundance (%)	Crop stage	Status	Kharif,2023	Rabi, 2023-24
1	Lepidoptera	Cut worm	<i>Agrotis ipsilon</i> (Hufnagel)	Noctuidae	10.52	Seedling	Major	✓	✓
2		Maize stem borer	<i>Chilo partellus</i> (Swinhoe)	Pyalidae	20.05	Vegetative-maturity	Major	✓	✓
3		Pink stem borer	<i>Sesamia inferens</i> Walker	Noctuidae	1.01	Vegetative	Minor	✓	✓
4		Fall armyworm	<i>Spodoptera frugiperda</i> (Smith)	Noctuidae	22.09	Vegetative-maturity	Major	✓	✓
5		Army worm	<i>Mythimna separata</i> (Walker)	Noctuidae	15.09	Vegetative	Major	✓	✓
6		Cob worm	<i>Helicoverpa armigera</i> (Hubner)	Noctuidae	2.08	Vegetative-silking	Minor	✓	✓
7		Maize leaf folder	<i>Marasmia trapezalis</i> (Guenee)	Pyalidae	1.35	Vegetative	Minor	✓	✓
8		Rice yellow hairy caterpillar	<i>Psalis pennatula</i> Fabricius	Lymantriidae	1.20	Vegetative-silking	Minor	-	✓
9		Yellow tail tussock moth	<i>Somena scintillans</i> Walker	Lymantriidae	1.08	Vegetative	Minor	✓	-
10	Hemiptera	Maize aphid	<i>Rhopalosiphum maidis</i> (Fitch)	Aphididae	15.43	Seedling-dough	Major	✓	✓
11		Rugose spiralling whitefly	<i>Aleurodicus rugioper-culatus</i> (Martin)	Aleyrodidae	0.82	Vegetative	Minor	-	✓
12		Leaf hopper	<i>Bothrogonia ferruginea</i> (Fabricius)	Cicadellidae	0.96	Vegetative	Minor	✓	-
13		Green stink bug	<i>Nezara viridula</i> (Linnaeus)	Pentatomidae	0.86	Vegetative	Minor	✓	-
14	Orthoptera	Grasshopper	<i>Oxya</i> sp.	Acrididae	3.25	Vegetative	Minor	✓	✓
15		Grasshopper	<i>Trilophidia annulate</i> (Thunberg)	Acrididae	0.75	Vegetative	Minor	✓	✓
16	Coleoptera	Flea beetle	<i>Altica</i> sp.	Chrysomelidae	0.45	Vegetative-silking	Minor	✓	✓
17		Leaf beetle	<i>Monolepta signata</i> Olivier	Chrysomelidae	3.01	Seedling-maturity	Minor	✓	✓

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Table 2. Natural enemies of maize observed during *Kharif*, 2023 and *Rabi*, 2023-24

Sl No.	Order	Common name	Scientific name	Family	Kharif, 2023	Rabi, 2023-24	Host
1	Coleoptera	Transverse ladybird	<i>Coccinella transversalis</i> (Fabricius)	Coccinellidae	✓	✓	Soft bodied insects
2		Ladybird beetle	<i>Harmonia dimidiata</i> (Fabricius)	Coccinellidae	✓	✓	Soft bodied insects
3		Ladybird beetle	<i>Micraspis discolor</i> (Fabricius)	Coccinellidae	✓	✓	Soft bodied insects
4		Ladybird beetle	<i>Cheilomenes sexmaculata</i> (Fabricius)	Coccinellidae	✓	✓	Soft bodied insects
5		Ladybird beetle	<i>Cryptogonus</i> sp.	Coccinellidae	✓	✓	Soft bodied insects
Relative abundance					55.46%	53.65%	
6	Odonata	Damselfly	<i>Ceriagrion</i> sp.	Coenagrionidae	✓	✓	Small insects
7		Scarlet skimmer	<i>Crocothemis servilla</i> (Drury)	Libellulidae	✓	✓	Small insects
8		Pied paddy skimmer	<i>Neurothemis tullia</i> (Drury)	Libellulidae	-	✓	Small insects
Relative abundance					16.50%	24.07%	
9	Diptera	Hover fly	<i>Lathyrrophthalmus</i> sp.	Syrphidae	✓	-	Aphids
Relative abundance					3.50%	0	
10	Orthoptera	Meadow grasshopper	<i>Conocephalus longipennis</i> (Haan)	Tettigonidae	✓	✓	Egg mass of stem borer
Relative abundance					8.43%	7.69%	
11	Araneae	Striped lynx spider	<i>Oxyopes javanus</i> Thorell	Oxyopidae	✓	✓	Small insects
12		Crossed or Burma lynx spider	<i>Oxyopes birmanicus</i> Thorell	Oxyopidae	✓	✓	Small insects
13		Common zebra jumper	<i>Plexippus</i> sp.	Salticidae	✓	-	Small insects
Relative abundance					16.11%	14.59%	

Table 3. Casual visitors observed on maize during *Kharif*, 2023 and *Rabi*, 2023-24

Sl. No.	Order	Common name	Scientific Name	Family
1	Lepidoptera	Rice swarming caterpillar	<i>Spodoptera mauritia</i> (Boisduval)	Noctuidae
2		Handmaiden moth	<i>Syntomoides imaon</i> (Cramer)	Erebidae
3	Hemiptera	Plant hopper	<i>Proutista moesta</i> (Westwood)	Derbidae
4		Red cotton bug	<i>Dysdercus cingulatus</i> Fabricius	Pyrrhocoridae
5		Horned coreid bug	<i>Cletus</i> sp.	Coreidae
6	Coleoptera	Gundhi bug	<i>Leptocoris oratorius</i> Fabricius	Coreidae
7		Red pumpkin beetle	<i>Aulacophora foveicollis</i> (Lucas)	Chrysomelidae
8		Blister beetle	<i>Hycleus</i> sp.	Meloidae
9		Chaffer beetle	<i>Oxycetonia versicolor</i> Fabricius	Scarabaeidae

*Agrotis ipsilon**Chilo partellus* (Swinhoe)

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Spodoptera frugiperda

Mythimna separata (Walker)



Rhopalosiphum maidis (Fitch) *Helicoverpa armigera* (Hubner)

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Sesamia inferens (Walker)

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Marasmia trapezalis (Guenée)

Somena scintillans Walker

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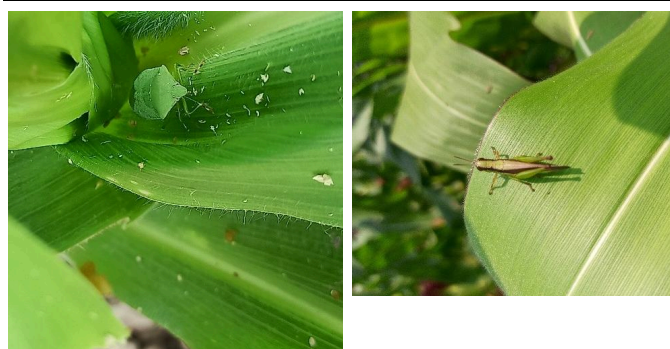
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Psalis pennatula Fabricius

Aleurodicus rugioperculatus
(Martin)

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*Altica* sp.*Monolepta signata* Olivier*Bothrogonia ferruginea*
(Fabricius)*Oxya* sp.*Nezara viridula* (Linnaeus)*Trilophidia annulate*
(Thunberg)**Plate 20.** predatory spiders found in maize ecosystem

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