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Biodiversity of insect pests and their predators on okra agroecosystem

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Abstract
A field trial was conducted during the *kharif*, 2016 to investigate the diversity of insect pests and their predators on okra agroecosystem. A total of 17 species of insect pests belonging to different orders and varied families were recorded from the experimental field. The order Hemiptera represented the highest number of 7 species. This was further followed by Lepidoptera (6 species), Coleoptera (3 species) and Orthoptera (1 species). The predator population was also quite diverse in their occurrence with the recorded species belonging to the orders as Coleoptera, Lepidoptera, Hemiptera and Dictyoptera.

Keywords: biodiversity, predators, pests, okra, agroecosystem

Introduction
Okra *Abelmoschus esculentus* L. (Moench) belonging to the family Malvaceae is one of the most commonly grown vegetable crop. It is known as Bhendi in India, Khajiab kheaw in Thailand, Lady's finger in England etc. showing its worldwide preference. Okra is an export-oriented crop and usually accounts for about 60% of the total fresh vegetables export (Pierce, 1987) [12].

In India it is grown in a large area covering about 530.8 thousand hectare area, producing about 6350.3 thousand MT with a productivity about 12 MT/ha (Anonymous, 2013) [3]. The major okra producing states are Andhra Pradesh, Uttar Pradesh, Bihar, Orissa, West Bengal, Karnataka and Assam. Okra is the rich source of vitamins, minerals like Fe, Mn, Zn, Ni. The okra mucilage is suitable for medicinal and industrial applications. The oil content in okra seeds is about 40% and this can be used as an alternative source of edible oil.

Although okra is a rich source of nutrients but in addition to this, it also serves as the house of pest and diseases. Among the several constraining factors in the successful cultivation of okra crop, insect-pests infestation is the prime and the most limiting factor in the successful cultivation of okra.

In India, more than 13 species of insect pests have been reported to infest okra crop (Mandal *et al.*, 2007) [9]. Mani and Singh, 2012 reported 15 arthropod species in okra ecosystem. Leafhopper (Amrasca bigutulla bigutulla), whiteflies (*Bemisia tabaci*), aphids (*Aphis gossypii*), red spider mite (*Tetranychus cinnabarinus*,), red cotton bug (*Dysdercus koenigii*), pumpkin beetle (*Aulacophora foveicollis*), pod borer (*Helicoverpa armigera*) and shoot and fruit borer (*Earias vittella*) and one species of unidentified coleopteran beetle were also reported. Four species of predator *viz.* ladybird beetle (*Coccinella septempunctata, Coccinella sexmaculata* and *Menochilus discolor*) and preying mantid (*Mantis religiosa*) were also reported feeding on aphids.

Arthropods constitute 3/4th of the total animal species and among the arthropods insects occupy the topmost position. These insect vary in colour, shape, size, habitat which make them one of the most rewarding group of animals. India is one of the 12 mega biodiversity country of the world. India's biological diversity is immensely rich and diverse and it is exemplified in its diversified ecosystems (Alfred, *et al.*, 2002) [1].

Although several reports have been published on the pests of okra but the perusal of literature reveals that the consolidated account on 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 okra ecosystem under the climatic conditions of Pantnagar.

Materials and Methods
The present investigation was carried out at the Vegetable Research Centre, GBPUAT, Pantnagar, Udham Singh Nagar (Uttarakhand) during the *kharif* season, 2016. Arka Anamika variety of okra was used in the experiment. All the recommended agronomic practices for this region were followed to raise the crop.

The okra crop 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 (6-8 a.m.) at weekly intervals by using different methods of collection viz., *insitu* and net sweeping (Hassan *et al*., 1995) [6]. *Insitu* count method was employed for recording the insect fauna diversity in the okra field. The insect pests and their predators were recorded on five randomly selected plants from the middle rows excluding the border rows.

Three leaves one each from upper, middle, and lower portion of the plant was counted. The sweep net was used to trap the above ground insect pests and their predators on okra ecosystem. The collected insect fauna was carefully observed. The weekly data obtained from net sweeping was used to prepare the list of the insect fauna prevailing in the okra agroecosystem. All the insects collected from the field were brought to the laboratory where they were killed. These killed insects were than stretched, pinned and preserved in the insect collection box.

Results and Discussion

Based on an immense survey of the okra crop throughout its growing season from August to October, 2016 an inventory of the arthropod fauna was prepared (Table 1). The results from the study revealed the occurrence of several insect pests and predators. 17 species of the insect pests belonging to four orders namely Hemiptera, Lepidoptera, Coleoptera, Orthoptera and thirteen families were recorded. Among the various insect pests of okra recorded in the experimental field in the present study the order Hemiptera represented the highest number of seven species. Among all the hemipteran pests whitefly, jassids and aphids were found as the predominant group of insect pests in the trial field.

Order Lepidoptera consisted of 6 species of insect pests belonging to 2 families, followed by Coleoptera with 3 species in 3 different families and Orthoptera with 1 species belonging to 1 family.

During the course of present study 5 species of predators each belonging to 4 orders i.e. Coleoptera, Diptera, Hemiptera and Dictyoptera was found (Table 2).

Table 1: Diversity of insect pests in okra ecosystem at VRC, Pantnagar, *kharif*, 2016

S. No.	Pest		Family	Order	Pest status
	Common Name	Scientific Name			
1.	Jassids	*Amrasca biguttula biguttula* (Ishida)	Cicadellidae	Hemiptera	Major
2.	Whitefly	*Bemisia tabaci* (Gennadius)	Aleyrodidae	Hemiptera	Major
3.	Aphids	*Aphis gossypii* (Glover)	Aphididae	Hemiptera	Minor
4.	Red Cotton Bug	*Dysdercus cingulatus* (Koenigii)	Pyrrhocoridae	Hemiptera	Minor
5.	Leaf footed bug	*Leptoglossus phyllopus* (*Linnaeus*)	Coreidae	Hemiptera	Minor
6.	Dusky cotton bug	*Oxycarenus hyalipennis* (Cost)	Lygaeidae	Hemiptera	Minor
7.	Jewel bug	*Scutellera spp.* (*Leach*)	Scutelleridae	Hemiptera	Minor
8.	Okra shoot and fruit borer	*Earias insulana* (Fabricius)	Noctudidae	Lepidoptera	Minor
9.	Okra shoot and fruit borer	*Earias vitella* (Fabricius)	Noctudidae	Lepidoptera	Major
10.	Fruit borer	*Helicoverpa armigera* (Hubner)	Noctudidae	Lepidoptera	Minor
11.	Leaf roller	*Sylepta derogata* (Fabricius)	Crambidae	Lepidoptera	Minor
12.	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Noctudidae	Lepidoptera	Minor
13.	Semilooper	*Trichopulsia ni* (Hubner)	Noctudidae	Lepidoptera	Minor
14.	Red pumpkin beetle	*Aulacophora foveicollis* (Lucas)	Chrysomelidae	Coleoptera	Minor
15.	Blister beetle	*Mylabris pustulata* (Thumb)	Meloidae	Coleoptera	Minor
16.	Ash weevil	*Myllocerus subfasciatus* (Latreille)	Curculionidae	Coleoptera	Minor
17.	Short horned grasshoppers	*Hieroglyphus banian* (Fabricius)	Acrididae	Orthoptera	Minor

Table 2: Diversity of Predators in okra ecosystem at VRC, Pantnagar, during *kharif*, 2016

S. No.	Natural enemies		Family	Order	Prey
	Common Name	Scientific Name			
1.	Lady bird beetle	*Coccinella septempunctata* *Menochilus sexmaculata* *Coccinella transversalis*	Coccinellidae	Coleoptera	Soft bodied insects (Aphids, Jassids)
2.	Syrphid fly	*Syrphus spp.*	Syrphidae	Diptera	Aphids
3.	Spiders	Spiders	-	Arachnida	Soft bodied insects (Aphids, Jassids) and Lepidopteran larvae
4.	Predatory stink bug	*Eocanthecona furcellata*	Pentatomidae	Hemiptera	Lepidopteran larvae
5.	Preying mantis	*Mantis religiosa*	Mantidae	Dictyoptera	Aphids

The present results are in accordance to the findings of Mandal *et al*., 2006 [8] who reported 13 species of insect pests in the okra ecosystem. 20 species of insect pests were observed in bhendi ecosystem (Butani and Verma, 1976) [4]. Nayyar *et al.*, 1976 [11] reported 37 insect pest species, further, Rachana *et al*., 2009 [13]; Gangarde, 1974 recorded 19 insect pest species and 4 species of mite in the commercially important okra crop. It was reported that 72 insect pest species were infesting okra (Mallick *et al*., 2016) [7].

Vasconcelos *et al*., 2008 [14] reported 6 species and 4 genera of coccinellids in bhendi ecosystem. Meena *et al*., (2009) [10] reported two predatory species of ladybird beetle like *Coccinella septempunctata* and *Menochilus sexmaculata* on okra crop. Yadav *et al*. 2009 [16] reported some generalists such as *Cheilomenes sexmaculatus* (Fabricius) and *Chrysoperla carnea* (Stephens) feeding on leafhoppers on okra ecosystem. Wagan and Wagan, 2015 recorded spider, lady bird beetle, Ant, and *Crysopa spp*. were associated with the jassids population on okra crop.

4. Conclusion

The overall results of current study revealed the occurrence of several species of insect pests and the predator population in the okra ecosystem. Diversified agroecosystems can support

different types of natural enemies and thereby reduce pest population naturally (Altieri, 1990) [2].

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