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Biodiversity of natural enemies in potato crop ecosystem in mid hills of Meghalaya

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ABSTRACT

Potato is one of the main vegetable crops in Northeastern (NE) Region of India, predominantly in the hilly tracts, where the crop is grown as a rain-fed crop. In NE region, the crop is grown throughout the year occupying about 10% total area in India. North East Hill (NEH) region of India is one of the biodiversity hotspots of mega biodiversity and the climatic conditions are very conducive for the development and reproduction of the natural enemies. Natural enemy specimens (Maximum 10 each) were collected from two experimental fields of potato crop at two different locations *viz*., College of post graduate studies in agricultural sciences (CPGSAS), Umiam and Central Potato Research Station (CPRS), Upper Shillong, Meghalaya during 2019-2020. A total of 14 species of natural enemies belonging to 5 orders and 4 families were recorded from potato ecosystem in mid hills of Meghalaya. Among the 14 species, 13 species were recorded as predators and 1 species as parasitoid, respectively. The order Coleoptera comprised of 65% of the natural enemy diversity, followed by Diptera, Hemiptera and Araneae each with 14%, 7% and 7% diversity, respectively. The predators recorded were *Coccinella septempunctata* (Linnaeus), *Oenopia sexaraeta* (Mulsant) *Micraspis* sp., *Harmonia eucharis* (Mulsant), *Oenopia signatella* (Mulsant), *Oenopia kirbyi* (Mulsant), *Coelophora bissellata* (Mulsant) *Coccinella trasversalis* (Fabricius), *Coelophora* sp. *Episyrphus blateatus* (De Geer), *Sphaerophoria macrogaster* (Thomson), Anthocorid bug Predatory spider, respectively. The parasitoid *Chelonus* sp. an egg larval parasitoid of potato tuber moth belonged to the order Hymenoptera and Braconidae family with 7% distribution among the natural enemies. The comprehensive data generated from this present study would be helpful for developing pest management strategies.

1. Introduction

Vegetables are important source of carbohydrates, minerals, proteins and vitamins. Vegetables account for approximately 59% of total horticulture production. India ranks second in the worldwide production of vegetables, next to china. (Kumar *et al.,* 2017). Among the vegetables, potato is a prominent crop grown worldwide. Potato is scientifically known as *Solanum tuberosum* is originated from South America. It is one of the main vegetable crops in the NE Region of India, predominantly in the hilly tracts, where the crop is grown as a rain-fed crop. In NE Region, the crop is grown throughout the year, occupying about 10% area of total area in the India (Borah, S. 2017). Biotic and abiotic factors are major limiting factors for the production of potato crop. Among biotic factors, insect pests mostly attack the crop from germination to harvest and cause severe yield loss. These insect pests not only damage the crops but also spread diseases as vectors. Besides insect pests, several natural enemies also harbour the potato ecosystem. Natural enemies maintain natural ecological balance by controlling harmful insect pests (Anbalagan *et al*., 2016). The increasing trend in modern and chemical intensive agriculture creates huge threats to biodiversity. Thereby decreases the natural enemy population and enhances buildup of the insect pest population (Straub *et al*., 2008). NE region of India is one of the hotspots of mega biodiversity and the climatic conditions are very conducive for the development and reproduction of the natural enemies. (Thakur *et al*., 2012). Due to the geographical location and difficult terrain, the resources are

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not properly explored and as a result, limited details are available on natural enemies biodiversity in potato ecosystem in mid altitude hills of Meghalaya. The present study was under taken to explore and access the natural enemies biodiversity in potato ecosystem in mid altitude hills of Meghalaya

2. Materials and Methods

i) Location and Site

The experimental sites were located at College of Post Graduate Studies in Agricultural Sciences (CPGSAS), Umiam and Central Potato Research Station (CPRS), Upper Shillong of 25°40L' N latitude, 91°54' E, Meghalaya at longitude in the Northeastern Hill (NEH) Region of India, representing mid altitude of 1010 m above the (msl) with the agro-climatic zone of mixed subtropical hill (Choudhry, 2012). The maximum temperature of this region varies between 20.9 to 27.4°C and minimum temperature varies between 6.70 to 18.10°C with an average annual rainfall of about 2000mm.

ii) Sample collection

Insect specimens were collected from two experimental fields of potato crop from different locations *viz.*, College of post graduate studies in agricultural sciences (CPGSAS), Umiam and Central Potato Research Station (CPRS), Upper Shillong, Meghalaya during 2019-2020. A maximum of ten specimens were collected for each species. Information on host plant, location, collection date and stage collected were recorded for all the individual species.

iii) Species identification

Preliminary identification of the collected species was done based on established taxonomic keys and also by matching morphological characters with identified species in insect Museum of Entomology Section of Crop Protection Division, ICAR Research Complex for NEH Region, Umiam, Meghalaya. The species which could not be identified were sent to ICAR-National Research Centre for Banana (NRCB), Trichy, University of Agricultural Sciences (UAS), Bangalore and Kerala Agricultural University (KAU), Trivandrum for identification by expert taxonomists.

3. Results

The data pertaining to natural enemies associated with potato ecosystem are presented in Table 1. A total of 14 species of natural enemies were recorded to be associated with potato crop in mid hills of Meghalaya during 2019-2020. These natural enemy species belonged to 5 orders and 4 families. Table 1 reveals that among 14 natural enemy species, 13 species were recorded as predators and 1 species as parasitoid, respectively.

Of the 4 orders, the order Coleoptera contained maximum of 9 species belonging, to coccinellidae family and comprised of 65% of the natural enemy diversity (Table1, Fig1). The predators belonging to family Coccinellidae were Lady bird beetles, *Coccinella septempunctata* (Linnaeus), *Oenopia sexaraeta* (Mulsant) *Micraspis* sp., *Harmonia eucharis* (Mulsant), *Oenopia signatella* (Mulsant), *Oenopia kirbyi* (Mulsant), *Coelophora bissellata* (Mulsant) *Coccinella trasversalis* (Fabricius), *Coelophora* sp. (Plate-1). Order Diptera comprised of 2 species *viz.*, *Episyrphus blateatus* (De Geer), *Sphaerophoria macrogaster* (Thomson) having 14% distribution among the natural enemies. Order Hemiptera and Araneae were comprised of only 1 species each, *viz.*, Anthocorid bug and Predatory spider, with 7% distribution each in natural enemy diversity, respectively (Fig-1 and Plate-2).

Table 1. Biodiversity of natural enemies in potato ecosystem in mid hills of Meghalaya

S. No	Common name	Scientific name	Family	Order	Status
1	Ladybird beetle	*Coccinella septempunctata* (L)	Coccinellidae	Coleoptera	Predator
2	Ladybird beetle	*Oenopia sexareata* (Mulsant)	Coccinellidae	Coleoptera	Predator
3	Ladybird beetle	*Micraspis* sp	Coccinellidae	Coleoptera	Predator
4	Ladybird beetle	*Harmonia eucharis* (Mulsant)	Coccinellidae	Coleoptera	Predator
5	Ladybird beetle	*Oenopia signatella* (Mulsant)	Coccinellidae	Coleoptera	Predator
6	Ladybird beetle	*Oenopia kirbyi* (Mulsant)	Coccinellidae	Coleoptera	Predator
7	Ladybird beetle	*Coccinella transversalis* (Fabricius)	Coccinellidae	Coleoptera	Predator
8	Ladybird beetle	*Coelphora bissellata* (Mulsant)	Coccinellidae	Coleoptera	Predator
9	Ladybird beetle	*Coelophora* sp.	Coccinellidae	Coleoptera	Predator
10	Syrphid fly	*Episyrphus balteatus* (DeGeer)	Syrphidae	Diptera	Predator
11	Syrphid fly	Sphaerophoria macrogaster (Thomson)	Syrphidae	Diptera	Predator
12	Anthocoreid bug	Unknown	Anthocoridae	Hemiptera	Predator
13	Predatory spider	Unknown	Unknown	Araneae	Predator
14	*Chelonus* sp.	*Chelonus* sp	Braconidae	Hymenoptera	Parasitoid

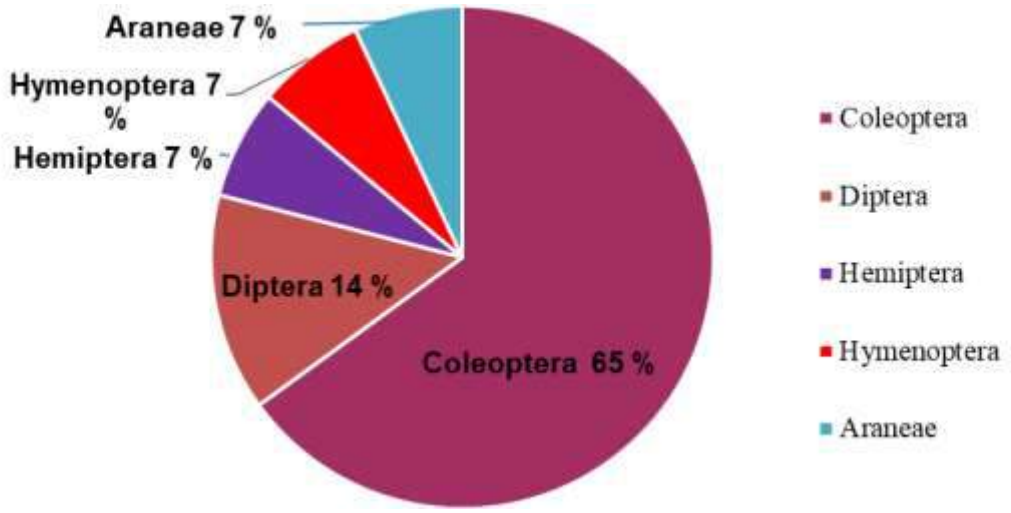

Fig 1. Diversity of natural enemy in potato ecosystem during 2019-2020.

Coccinella septempunctata

Oenopia sexareata

Micraspis sp.

Harmonia eucharis

Oenopia signatella

Oenopia kirbyi

Coccinella transversalis

Coelophora bissellata

Coelophora sp.

Plate-1 Lady bird beetles
Coccinellidae Coleoptera

Episyrphus balteatus

Sphaerophoria Sp.

Anthocoreid bug

Predatory spider

Plate-2 Predatory insects

Chelonus sp.

Plate-3 Egg larval parasitoid of tuber moth

4. Discussion

In the present study, a total of 14 natural enemies (13 predators and 1 parasitoid) were collected, identified and catalogued from potato ecosystem. The predators included nine coccinellids, two syrphid flies, one anthocoreid bug and one predatory spider. The predatory coccinellids viz., *Coccinella septempunctata*, *Oenopia sexaraeta*, *Micraspis* sp., *Harmonia eucharis*, *Oenopia signatella*, *oenopia kirrbyi*, *Coelophora bissellata*, *Coccinella trasversalis*, *Coelophora* sp. were recorded in potato ecosystem. Aiding to this finding, Nakata (1995) studied population of aphids and their natural enemies on potato in Japan. His findings revealed that natural enemies including coccinellids (*Coccinella septempunctata* and *Harmonia axyridis*), anthocoreid bug (*Orius sauteri*) and spiders were found in large numbers from potato crop. In conformity with the present findings, Mukherjee and Suman (2017) studied coccinellid beetle diversity in agro-climatic zones of Bhubaneswar. They reported10 different species of coccinellids. Among these, the highest number found were, *P. dissecta* followed by *Coccinella septempunctata, Coccinella transversalis* in Bhubaneswar. Ghosh and Chakraborty (2012) observed prominent coccinellids *viz.*, *Coccinella septempunctata*, *C. transversalis*, *C. bissellata*, *M. sexmaculata*, *O. sexareata*, *O. kirbyi*, *and C. quadriguttatus*, on brinjal crop.

Similar to the present findings, Saljoqi (2009) also reported *Coccinella septempunctata, Episyrphus balteatus, Chrysoperla carnea* against aphids in potato crop from Pakistan. Among these, *Coccinella septempunctata* was prominent natural enemy to control aphid population effectively.

Krawczyk (2011) reported that syrphid flies are most important predatory insects regulating aphid population. His findings revealed that *Sphaerophoria* sp. and *Episyrphus balteatus.* were the predators of aphids. Among the syrphidae, *Sphaerophoria* sp. was the prominent genus for controlling aphids. In present investigation too, two species of predatory syrphid flies *viz. Episyrphus balteatus* and *Sphaerophoria macrogaster* were recorded in potato ecosystem. Sankari and Thiyagesan (2010) reported that spiders are important predatory insects that reduce the insect pest population in different ecosystems. In present study too, one predatory spider was observed in potato ecosystem.

In present study, an egg- larval parasitoid, *chelonus* sp., of potato tuber moth was recorded from potato ecosystem. In conformity with the present findings, Ballal and Kumar (1991) studied the egg-larval parasitoid *Chelonus blackburni* reaction against various stages and densities of potato tuber moth. Laboratory studies revealed that *P. operculella* is the prominent host. The parasitoid require 0-1, 1-2, 2-3 day old eggs for parasitization.

5. Conclusion

In the present investigation, 14 natural enemies of (Predators and Parasitoid) major insect pests of potato crop were recorded in mid hills of Meghalaya. The comprehensive data generated from this present study would be useful in further understanding of the biodiversity of arthropod fauna associated with potato crop in other regions of the country and this study would be helpful for developing ecofriendly pest management strategies.

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