

Insect pests of Potato ecosystem in mid-hills of Meghalaya

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ABSTRACT

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Potato was one of the main crop in the NE Region of India. The crop is affected by various insect pests in the field as well as in storage. Major limitations for the production of potato crop include both biotic and abiotic factors. Among biotic factors, Insect pests majorly attack the crop from germination to till harvest. The studies were carried out in College of post graduate studies in agricultural sciences (CPGSAS), Umiam and Central Potato Research Station (CPRS), Upper Shillong, Meghalaya during 2019-2020. Insect specimens (Maximum 10 each) were collected from two experimental fields of potato crop CPGSAS, Umiam and CPRS, Upper Shillong. The collected insect pests were categorized into major and minor pests, based on their damage and Economic Threshold Level (ETL). A total of 31 insect pests were recorded, out of these six was regarded as major insect pests *viz.*, *Pthorimaea operculella*, *Thysanoplusia orichalcea*, *Tuta absoluta*, *Macrosiphum euphorbiae*, *Henosepilachna vigintioctopunctata*, *Anomala* sp. The remaining 25 insect species were categorized as minor pests which belonged to 3 orders and 11 families. Among 25 minor insect pests, Lepidoptera, Coleoptera and Hemiptera comprised of 6%, 33% and 42% of the pest diversity with 2, 10 and 13 numbers of insect species respectively. Furthermore, the comprehensive information on the insect pests in this region would be helpful for developing pest management strategies.

1. Introduction

Vegetables are relatively important source of carbohydrates, minerals, proteins and vitamins and can substitute the main cereals of the country. Vegetables accounts for approximately 59% of total horticulture production. India has secured second rank in the worldwide production of vegetables next to China (Kumar *et al.*, 2017). Among the vegetables, potato is a prominent crop grown as worldwide. Potato is scientifically known as *Solanum tuberosum* and it originated from South America, where it was grown as wild plant since 7000 to 9000 years ago. In 17th century, it was introduced by Portuguese, later Britishers introduced to hilly regions of Northern India (Hussain, 2016). It is the world's 4th main food crop next to wheat, rice and maize as its greater yield potential along with prominent nutritive significance. All across the world, people eat

potatoes, and many nations rely on them for food and nutrition security. The potato can be promoted as a nutritious and adaptable part of a balanced diet that also includes other vegetables and entire grains. Potatoes are a crucial source of energy, protein, and micronutrients like iron and zinc when it comes to human nutrition. They also supply essential elements to the diet, such as vitamin C, potassium, and dietary fiber (Bailey *et al.*, 2015).

The significant crop loss caused by the increased pest threat means that despite the many health advantages of potatoes, their output is still limited. The yield losses are further increased by insects' role as viral disease vectors (Shivalingswami *et al.*, 2002). Vegetables are more vulnerable to insect pests and diseases because they lack resistance genes as a result of intensive hybrid production (Dhandapani *et al.*, 2003). Potato is one of the main crops in

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the NE Region of India, predominantly in the hilly tracts, where the crop is grown as a rain-fed crop. In northeastern region, the crop is grown throughout the year occupying about 10% total area in India (Borah S., 2017). Major limitations for the production of potato crop include both biotic and abiotic factors. Among biotic factors, Insect pests majorly attack the crop from germination to till harvest. These insect pests not only damage the crops directly but also act as vectors for diseases. Farmers face variable and multifaceted problems in potato crop, of which insect pests are one of the factors responsible for low production and productivity. India has a huge multiplicity of insect pests, are being that attack on potato crop, because potato crop is being vegetatively propagated from tubers and the tubers are easily transmit some pathogens and insect pests. These pests cause damage potato crop by feeding on leaves, decreasing the photosynthetic area and efficacy by damaging on stems, weakening of stems, therefore preventing nutrient transport and by injuring the potato tubers intended for consumption.

In India, around 60 billion rupees value of potato tubers are lost annually due to insect pests, which nearly accounts for 10-20% of the total production (Chandel *et al.*, 2013). Northeast hill region of India is one of the biodiversity hotspots of mega biodiversity and the climatic situations are very conducive for the development and reproduction of the insect pests (Thakur *et al.*, 2012). The crop is affected by various insect pests in the field as well as in storage. Potato is distressed by as many as 100 arthropod pests. Out of these, 80 pests were reported from India. Among the several insect pests, aphids, jassids, epilachna beetles, potato tuber moth, cutworms white grubs and defoliating caterpillars are severe and accountable for significant economic losses. The significance of aphids and jassids is predominantly owed to the character of spread of the viruses and mycoplasma (Misra and Agarwal, 1988).

2. Materials and Methods

Location and Collection of Insect pests

To study the insect pests in potato ecosystem, the insects were collected from potato crop in different experimental fields of Central Potato Research Station (CPRS, Upper Shillong) and College of Post Graduate Studies in Agricultural Sciences (CPGSAS, Umiam) Meghalaya, at 25°40' N latitude, 91°54' E 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 (Choudhery *et al.*, 2012). Insects were primarily collected by means of hand picking, net sweeping and by using aspirator during June 2019-March 2020.

Identification of the insect specimen

In the insect museum of entomology section of the crop protection division of the ICAR Research Complex for NEH Region in Umiam, Meghalaya, the preliminary identification of the collected species was carried out using established taxonomic keys and by comparing morphological characters with identified species. The species which could not be identified were sent to ICAR-National Research Centre for Banana (NRCB), Trichy, University of Agricultural Sciences (UAS), Bangalore for identification of expert taxonomists.

Preservation of the insect specimen

The insect specimens which were collected from the potato crop, were spread, pinned and kept in insect box provided with labelled information about the species. Photographs were also taken for all the specimens (Figure 1).

3. Results and Discussion

Insect pests associated with potato ecosystem

The data pertaining to the insect pests of potato crop were presented (Table 1 and Figure 3). An overall collection of 31 insect pest species were recorded from potato ecosystem. These insect species belong to 3 orders and 13 families. The collected insect pests were categorized into major and minor pests, based on their damage and Economic Threshold Level (ETL). Out of 31 insect pests 6 insect species were categorized as major pests as they appeared throughout the cropping season causing significant loss of crop in the range of 20-60% and the remaining insect species were classified as minor pests (Table 1).

Aiding to this finding, Misra and Agarwal (1988) reported that potato is distressed by as many as 100 arthropod pests. Out of these, 80 pests were reported from India. Among the several insect pests, aphids, jassids, epilachna beetles, potato tuber moth, cutworms white grubs and defoliating caterpillars are severe and accountable for significant economic losses. Similar to the present findings, Kroschel *et al.* (2020) also reported a total of 49 insect pests. Among 49 insect species, potato tuber moth (*Pthorimaea operculella*) and leaf miner fly (*Liriomyza huidobrensis*) were major pests in many tropical and sub-tropical regions globally. Similar to the present investigation 6 major insect pests recorded on potato crop ecosystem were potato tuber moth (*Pthorimaea operculella*), semilooper (*Thysanoplusia orichalcea*), leaf miner (*Tuta absoluta*), aphid (*Macrosiphum euphorbiae*), hadda beetle (*Henosepilachna vigintioctopunctata*), and white grub (*Anomala* sp.).

In support of this finding, Trivedi and Rajagopal (1992) investigated the distribution, biology, ecology, and management of potato tuber moths. They also noted signs of damage, such as larvae that penetrate leaves and cause foliage

mining and also attacks on tubers that result in irregular galleries deep inside tubers. Similar to present findings, Vashisth (2019) also reported potato tuber moth as a major insect pest on potato and it occurs both in field and storage causing extensible damage to the crop in the field and tubers in the store. In Meghalaya, the potato tuber moth (*Phthorimaea operculella*) caused significant damage, with over 50% of plant infestations and 70% of tuber damage under local storage conditions. (Lal, 1990).

Twinkle and Chattopadhyay (2018) experimentally studied taxonomy of agriculturally important pulisiinae. They reported that *Thysanoplusia orichalcea* is a pulisiinae moth, that attack vegetables, pulses, oilseed crops and grasses. Among the vegetables, potato is one of the important crops attacked by this pest and cause significant losses to the crop. In present study too, *Thysanoplusia orichalcea* was one of the major pests attacking potato crop throughout the season. One of the most dangerous polyphagous pests infesting potatoes in Kashmir is *Thysanoplusia orichalcea* (Fabricius), also known as the green semilooper, slender burnished moth, and golden wing moth (Bhagat, 2018). Since they feed on potato leaves from the vegetative to mature stages, *T. orichalcea* larval stages are significant defoliators. Young larvae make large holes in the leaf lamina, and later instars feed voraciously, leaving just the main veins, drastically reducing the photosynthetic activity. This pest was also damaging other crops from the Compositae, Cruciferae, Leguminosae, Linaceae, Cucurbitaceae, and Chenopodiaceae families (Laute *et al.*, 2015).

Similar to the present investigation Sankarganesh *et al.* (2017) also reported that *Tuta absoluta* attacks on tomato crop in Meghalaya. Kanle Satishchandra *et al.* (2019) studied population growth potential of *T. absoluta* on tomato, potato and brinjal in Bengaluru. Aiding to this finding Kumari (2015) reported *Tuta absoluta* on tomato crop. Larvae in the initial instars were cream colored and in the later stages became green in colour with a dark black head. Larvae had a cream color in their early instars and eventually turned green with a dark black head. They mostly fed on leaves, leaving behind wide tunnels that gave the vegetation a papery appearance.

Notable coleopteran insect pests recorded in the present investigation, were hadda beetle (*Henosepilachna vigintioctopunctata*), white grub (*Anomala* sp.) which were recorded causing huge damage to potato crop. Rajagopal and Trivedi (1989) studied status, bio-ecology and management of *Epilachna vigintioctopunctata* on potato crop. The damage was more from March to September in Kulu valley area of Himachal Pradesh. The larvae feed the leaves of epidermis in a ring like manner. Vinod Kumar *et al.* (2017) reported major white grub species infesting potato crop which were collected

by using light traps, manual collection from trees in Himachal Pradesh. The survey reported nine major species of Scarabaeidae, among these four species were melolonthines viz., *Brahminacoriacea*, *Holotrichia longipennis*, *Holotrichia sikkimensis*, *Holotrichia seticollis* and four species were rutelines viz., *Anomala polita*, *Anomala lineatopennis*, *Anomala dimidiata* and *Anomala propinqua*, in conformity with the present findings that *Anomalasp* were one of the major pests of potato crop in Meghalaya. Gavkare *et al.* (2015) also observed that *Macrosiphum euphorbiae* is one of the important destructive pests causing severe damage to the crops worldwide similar to the present investigation. Like present investigation Munib *et al.* (2016) recorded Semilooper (*Thysanoplusia orichalcea*) and Aphid (*Macrosiphum euphorbiae*) on the potato crop right from sowing up to harvest in Kashmir Valley of Baramulla, Kupwara and Bandipora district.

Among 25 minor insect pests, Lepidoptera comprised of 6% diversity with 2 numbers of insect species viz., leaf eating caterpillar, *Helioverpa armigera* (Hubner) and potato cutworm, *Spodoptera litura* (Fabricius) belonging to family Noctuidae (Table 1, Fig. 2).

Order Hemiptera comprised of 42% of the pest diversity with 13 insect species recorded as minor insect pests (Fig. 2). The minor insect pests recorded were whitefly, *Bemisia tabaci* (Gennadius), hoppers (*Cofana* sp., *Bothrogonia* sp.), leaf hopper (Unknown) plant hopper, *Darthula hardwickii* (Gray), coreid bug, *Cletus punctulatus* (Westwood), coreid bug, *Acanthocoris sordidus* (Thunberg), green stink bug, *Nezara viridula* (Linnaeus), citrus aphid, *Toxoptera citricida* (Kirkaldy), brown aphids (Unknown), cabbage stink bug (*Eurydema* sp.), pentatomid bug (*Bagrada* sp.), Pentatomid bug (Unknown).

Coleoptera comprised of 10 minor insect species consist of 33% of the pest diversity (Fig.2). The order contained ten insect species viz., flea beetle *Arthrotus flavocincta* (Hope), white spotted flea beetle, *Monolepta quadriguttata* (Motschulsky), metallic flea beetle (*Psylliodes* sp.), red pumpkin beetle, *Aulacophora foveicollis* (Lucas), blister beetle (*Epicauta* sp.), grey weevil, *Mylocherus viridis* (Fabricius), blister beetle (*Mylabris* sp.), surface weevil, Chrysomelid beetle, Dung roller, *Omiticellus cinctus* (Fabricius). According to Singh and Singh (1978), one of the main insect pests damaging pigeon pea is the adult blister beetle *M. pustulata*. Additionally, Cowpea is attacked by a variety of insect pests at various phases of crop growth, including the Flower Beetle *M. testulatis*, according to Sardana (1986). This was in conformity with the present findings, where it was recorded as minor pest of potato crop in Meghalaya.

Prasannakumar *et al.* (2012) observed that potato cutworm *Spodoptera litura* (Fabricius) is a pest on potato which causes significant crop losses. Misra and Agarwal (1988) findings revealed that whitefly (*Bemisia tabaci*), green stink bug (*Nezara viridula*), flea beetle (*Psylloides* sp.), blister beetle (*Epicauta hirticomis*), weevil (*Myloccerus subfasciatus*) and leaf eating caterpillars (*Helicoverpa armigera*) were common pests in potato crop. Their findings were in conformity with the present investigation on potato crop.

4. Conclusion

From the present study it can be concluded that a total of 31 insect pests were recorded in potato ecosystem in mid hills of Meghalaya. Among 31 insect pests 6 were major pest status viz., *Pthorimaea operculella* (Zeller), *Thysanoplusia orichalcea* (Fabricius) *Tuta absoluta* (Meyrick) *Macrosiphum euphorbiae* (Thomas) *Henosepilachna vigintioctopunctata* (Fabricius), *Anomala* sp. Out of 25 minor insect pests, 13 insect species belonged to the order Hemiptera in 6 families, 10 insect species belonged to Coleoptera and comprised in 4 families, 2 insect species in the order Lepidoptera belonged to 1 family recorded from potato ecosystem. Furthermore, the comprehensive information on the insect pests in this region would be helpful for developing pest management strategies.

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6. Conflict of interest

The authors disclosed no potential conflicts of interest.

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Table 1. Insect pests in potato crop ecosystem in mid hills of Meghalaya.

| Sl. No. | Common name | Scientific name | Family | Order | Pest status |
|---------|-------------------------|---|----------------|-------------|-------------|
| 1 | Potato tuber moth | <i>Phthorimaea operculella</i> (Zeller) | Gelechiidae | Lepidoptera | Major pest |
| 2 | Potato semilooper | <i>Thysanoplusia orichalcea</i> (Fabricius) | Noctuidae | Lepidoptera | Major pest |
| 3 | South American pinworm | <i>Tuta absoluta</i> (Meyrick) | Gelechiidae | Lepidoptera | Major pest |
| 4 | Potato aphid | <i>Macrosiphum euphorbiae</i> (Thomas) | Aphididae | Hemiptera | Major pest |
| 5 | Hadda beetle | <i>Henosepilachna vigintioctopunctata</i> (Fabricius) | Coccinellidae | Coleoptera | Major pest |
| 6 | White grub | <i>Anomala</i> sp. | Scarabaeidae | Coleoptera | Major pest |
| 7 | Potato cut worm | <i>Spodoptera litura</i> (Fabricius) | Noctuidae | Lepidoptera | Minor pest |
| 8 | Leaf eating caterpillar | <i>Helicoverpa armigera</i> (Hubner) | Noctuidae | Lepidoptera | Minor pest |
| 9 | Blister beetle | <i>Epicauta</i> sp. | Meloidae | Coleoptera | Minor pest |
| 10 | Whitefly | <i>Bemisia tabaci</i> (Gennadius) | Aleyrodidae | Hemiptera | Minor pest |
| 11 | Leaf hopper | <i>Cofana</i> sp. | Cicadellidae | Hemiptera | Minor pest |
| 12 | Leaf hopper | <i>Bothrogonia</i> sp. | Cicadellidae | Hemiptera | Minor pest |
| 13 | Leaf hopper | (Unidentified) | Cicadellidae | Hemiptera | Minor pest |
| 14 | Plant hopper | <i>Darthula hardwickii</i> | Aetalionidae | Hemiptera | Minor pest |
| 15 | Flea beetle | <i>Arthrotus flavocincta</i> (Hope) | Chrysomellidae | Coleoptera | Minor pest |

| | | | | | |
|----|---------------------------|--|----------------|------------|------------|
| 16 | White spotted flea beetle | <i>Monolepta quadriguttata</i> (Motschulsky) | Chrysomellidae | Coleoptera | Minor pest |
| 17 | Coreid bug | <i>Cletus punctulatus</i> (Westwood) | Coreidae | Hemiptera | Minor pest |
| 18 | Red pumpkin beetle | <i>Aulacophora foveicollis</i> (Lucas) | Chrysomellidae | Coleoptera | Minor pest |
| 19 | Grey Weevil | <i>Mylocerus viridis</i> (Fabricius) | Curculionidae | Coleoptera | Minor pest |
| 20 | Coreid Bug | <i>Acanthocoris sordidus</i> (Thunberg) | Coreidae | Hemiptera | Minor pest |
| 21 | Green stink bug | <i>Nezara viridula</i> (Linnaeus) | Pentatomidae | Hemiptera | Minor pest |
| 22 | Pentatomid Bug | <i>Bagrada</i> sp. | Pentatomidae | Hemiptera | Minor pest |
| 23 | Metallic flea beetle | <i>Psylliodes</i> sp. | Chrysomellidae | Coleoptera | Minor pest |
| 24 | Blister beetle | <i>Mylabris</i> sp. | Meloidae | Coleoptera | Minor pest |
| 25 | Cabbage stink bug | <i>Eurydema</i> sp. | Pentatomidae | Hemiptera | Minor pest |
| 26 | Citrus aphid | <i>Toxoptera citricida</i> (Kirkaldy) | Aphididae | Hemiptera | Minor pest |
| 27 | Brown aphid | (Unidentified) | Aphididae | Hemiptera | Minor pest |
| 28 | Pentatomid Bug | (Unidentified) | Pentatomidae | Hemiptera | Minor pest |
| 29 | Surface weevil | (Unidentified) | Curculionidae | Coleoptera | Minor pest |
| 30 | Dung roller | <i>Oniticellus cinctus</i> (Fabricius) | Scarabaeidae | Coleoptera | Minor pest |
| 31 | Chrysomelid beetle | (Unidentified) | Chrysomellidae | Coleoptera | Minor pest |



Figure 1. Experimental field of CPGSAS , Umiam and CPRS , Upper Shillong, Meghalaya

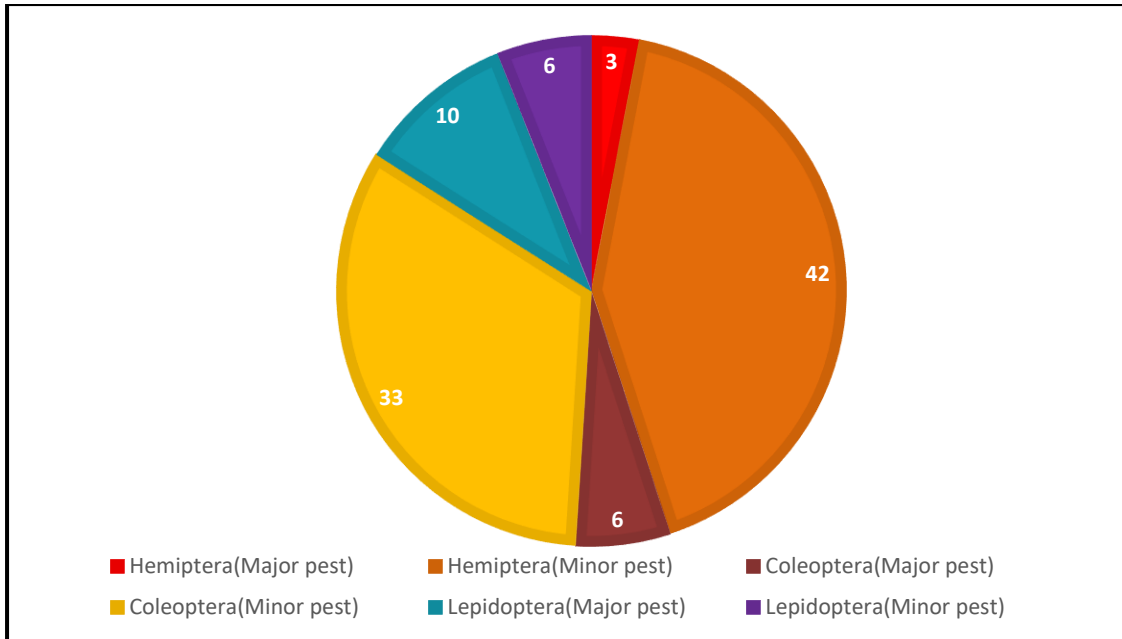


Figure 2. Distribution of insect pests in potato crop



Potato tuber moth



Potato semilooper



South American pinworm



Potato aphid



Hadda beetle



White grub



Potato cut worm



Leaf eating caterpillar



Blister beetle



Whitefly



Leaf hopper



Leaf hopper



Leaf hopper



Plant hopper



Flea beetle



White spotted flea beetle



Coreid bug



Red pumpkin beetle



Grey weevil



Coreid bug



Green stink bug



Pentatomid bug



Metallic flea beetle



Blister beetle



Cabbage stink bug



Citrus aphid



Brown aphid



Pentatomid bug



Surface weevil



Dung roller



Chrysomelid beetle

Figure 3. Insect pests in potato ecosystem in mid hills of Meghalaya.