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A survey of insect pests in cultivated vegetables of Kahikuchi region, Assam, India

Arunima Choudhury[1*], Jayashree Das[2]
[1] Department of Zoology, Handique Girls' College, Guwahati, Assam, India
[2] Assistant Professor, Department of Zoology, Brahmaputra College, Assam Science and Technology University (ASTU), Guwahati, Assam, India

Abstract
India is the hub of agriculture where more than half of its population depends on it for their livelihood. From food crops like wheat, rice, vegetables to cash crops like cotton, jute, etc., India is one of the major players in the agricultural sector worldwide. However, due to the invasion of pests, every year a major portion of crops gets damaged. The survey aimed at identifying the major pests infesting vegetable crops grown in Kahikuchi area, Azara located at the outskirts of Guwahati, Assam. Two approaches were used to catch the pests at different stages of their life cycles, namely, hand capture for wingless or larval insects and hand net for flying ones. Further, a light microscope and taxonomy keys were used to identify them. To gather the insect pests, random sampling technique was applied over the agricultural field region. The study period was from mid-February to end of May in which Rabi crops are being grown. During the survey, it was discovered that 21 host vegetable crops were being infested by more than 20 insect pest species belonging to 21 genera, five insect orders, and 12 insect families.

Keywords: insect pest, management, vegetable crops, Kahikuchi

Introduction
Agriculture plays a vital role in India's economy. About 54.6% of the total workforce is engaged in agriculture and allied sector activities. Similarly, in Assam approximately 63% of its population are involved in agriculture which generates an approximate GDP of 17% for the state. Vegetables contribute significantly to both area and production of horticulture crops, with important crops like brinjal, tomato, okra, cabbage, potato, onion, and cucurbits being grown throughout the country's crop seasons (NHB 2018) [7]. In our daily diet, vegetables are a crucial source of proteins, vitamins, minerals, dietary fibre, micronutrients, phytochemicals, and antioxidants. They also include a variety of possible phytochemicals, such as anti-carcinogenic elements and antioxidants like flavonaoides, glucosinolates, and isothyocyanates, which aid in battling a variety of ailments. Vegetable crop production and productivity grew, but there are still a number of obstacles to their growth, including pests, illnesses, and other abiotic issues. Vegetable crops are one that are frequently attacked by insect pests, which significantly reduce productivity and quality (Sharma *et al*., 2013 and Pati *et al*., 2021) [8]. The primary biotic barrier to the production of vegetables in India is insect infestations and their intensity varies in time and space (Jandial and Kumar, 2007) [3]. Many of them not only cause direct harm but also serve as carriers of many viral infections. An organism that frequently multiplies above a threshold of economic harm and whose presence interferes with people's welfare, convenience, and profits is considered as a 'pest'. The new and invasive pests pose one of the biggest threats to food security. The likelihood of exotic pest introduction has increased along with rising agricultural worldwide trade (Rathee and Dalal, 2018) [10]. Vegetable crop losses of between 30 and 40 percent have been reported. A shift in pest status has been seen in recent years as a result of changes in cropping techniques, climate, and the introduction of extremely input-intensive, high-yielding varieties and hybrids (Rai *et al.*, 2014). The study of different aspects of insect pests is of vital importance so as to employ the correct management techniques and control measures in a sustainable manner. This is crucial for safeguarding India's farmer population, common public and country's economy.

Materials and Method
The study was conducted at Kahikuchi which is a village in the Rani Tehsil of the Kamrup Metro District of Assam. It lies 10 kilometres south of Guwahati, the district headquarters, 3 kilometres from Rani, and 17 kilometres from Dispur, the state capital. It lies on 20°18'N latitude and 91°78'E longitude. The survey was conducted from mid-February to the end of May, 2022. Located in the lower Brahmaputra valley's agro-climatic zone, the place receives an annual average rainfall from 1800–2000mm. The maximum and minimum temperatures, respectively, vary from 19° to 35° C and 8° to 27° C. The soil is primarily alluvial clay loam with a pH range of 4.8 to 5.5. During the survey period, the Rabi crops are present on the fields which are almost ready to be harvested.

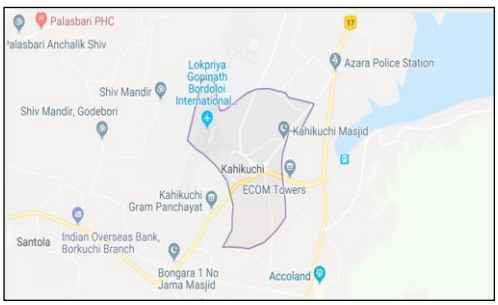

Fig 1: The study area- Kahikuchi, Assam, India (Image source: Google)

Each farm was thoroughly surveyed and plants were selected randomly which were observed to be infested by pests. The insects were visually located on the plants, after which they were captured and taken to the laboratory for identification. Hand nets were used for catching flying insects while a pair of forceps and hand picking method was used for collecting larvae and non-flying insects. The insects were then taken to the laboratory using specimen tubes and rearing jars. Alcohol (70%) was used to preserve the insects for identification. The plants were sampled at various stages of growth, including seedling, vegetative, blooming, fruiting, and at harvest stage too.

For identification of the collected insects as well as larvae, light microscope and taxonomic keys were used. Pests were identified using the key book "Insect Identification" of Scott Schell and Dr. Alex Latchininsky, 2007 and Insect Identification Guide for Southeastern landscape by The University of Georgia.

Result and Discussion

Table 1: Common name, host plant range, nature and extent of damage and status of some insect pests of vegetable crops found in Kahikuchi region, Assam recorded from mid- February to end of May, 2022.

S. No	Scientific name	Common name	Host plants	Nature and extent of damage	Pest status in the area
Order I: Lepidoptera Family 1: Pieridae					
1	*Pieris brassicae*	Cabbage butterfly	*Brassica oleracea capitata, B.oleracea botrytis, Brassica juncea*	Final instar of its larvae often strip growing shoots, sometimes causing damage to entire plant.	Major
2	*Pieris rapae*	Cabbage white butterfly	*Brassica oleracea capitata, B.oleracea botrytis*	Crops are harmed by larvae feeding on leaves, hearts, and curds. Young larvae feed superficially on the outer leaves after hatching. Older larvae chew through narrow veins creating holes in the leaves and harm the outer leaves. The plant's edible part is frequently damaged.	Moderate
3	*Pieris canidia*	Small cabbage butterfly	*Brassica oleracea capitata, B.oleracea botrytis*	Larval stage is highly invasive and they mainly damage the leaves of hosts.	Moderate
Family 2: Noctuidae					
1	*Helicoverpa armigera*	Tomato fruit borer	*Solanum lycopersicum, Pisum sativum,S.tuberosum, Brassica oleracea capitata, B.oleracea botrytis*	Early instars consume the fragile leaves, flower buds, bore into the heads of cauliflower or cabbage, as well as fruits like tomatoes, drilling through to consume the inner content.	Moderate to major
2	*Spodoptera litura*	Taro caterpillar	Allium cepa, *Brassica oleracea capitata, B.oleracea botrytis*	The larvae feed on the leaves of crops. In case on onion, they feed from inside the leaves.	Major
3	*Trichoplusia ni*	Cabbage looper	*Brassica oleracea capitata, B.oleracea botrytis*	The caterpillars devour the leaves of the cabbage plants. Only the midribs and veins of the leaves stay on the plant. The crop is ploughed in when there is a serious infestation.	Minor
4	*Agrotis ipsilon*	Black cutworm	*Brassica oleracea capitata, B.o.gongylodes, B.rapa*	The soil surface is where the growing plants are severed. The larvae consume leaves and during the daytime enter the cabbage heads to feed there.	Major
5	*Thysanoplusia orichalcea*	Slender burnished brass moth	*B.o. capitata, B.o.gongylodes, B.rapa, B.o. botrytis,Pisum sativum, Daucus carota, S.tuberosum*	Pest with a broad diet. Feeds on foliage and, in cases of severe infestation, results in defoliation. Create large holes in the leaves. Additionally, they pierce the crowns of cauliflower and cabbage.	Moderate to major
Family 3: Pyralidae					
1	*Leucinodes orbonalis*	Brinjal borer	*Solanum melongena* and other Solanaceous plants	The fruits are severely harmed by the caterpillars, which create slender tunnels inside them and feed there. External holes are visible.	Moderate
Family 4: Plutellidae					
1	*Plutella xylostella*	Diamond back moth	*B.o.capitata, B.o.botrytis, B.o.gongylodesB.rapa, Raphanus sativus*	Young larvae mine between the upper and lower leaf surfaces and scrape the epidermal leaf tissues for food. All plant parts are consumed by the older larvae, albeit they favour the buds and leaves. They deform the bud shape and make crooked shot holes so that the cabbage head cannot properly develop.	Major

Family 5: Crambidae					
1	*Crocidolomia binotalis*	Cabbage cluster caterpillar	*B.o.capitata, B.o.botrytis*	They initially just consume the undersides of the leaves as food. Later, they consume the remaining leaves as well as the centre shoot.	Minor
Order II: Coleoptera Family 1: Chrysomelidae					
1	*Monolepta signata*	Flea beetle	*B.o.capitata, B.o.botrytis, Capsicum frutescens, R.sativus, B.vulagaris*	Bite marks on the foliage. Severe cases affect the development of the tuber.	Minor
2	*Phyllotreta cruciferae*	Crucifer flea beetle	*B.o.capitata, B.o.gongylodes, B.rapa*	The adults eat leaves, producing distinctive perforations and scraping away leaf tissues. Severe infestations in large populations can even harm young plants.	Major
3	*Psylliodes affinis*	Potato flea beetle	*Solanum tuberosum* and various wild and cultivated Solanaceae.	The final instar larvae feed externally on roots, while the early instar larvae are root-miners and consume leaves and potato stems (Haulms). Adult potato flea beetles consume tiny pits in leaves to create shothole symptom.	Moderate
4	*Raphidopalpa foveicollis*	Red Pumpkin beetle	*Lagenaria siceraria, Cucumis sativus, Cucurbita moschata*	Grubs and adults both inflict damage. The grubs eat the roots, underground stem, and fruits as soon as they hatch. A severe infestation results in crop defoliation, stunted development, and reduced yield.	Major
Family 2: Coccinellidae					
1	*Henosepilachna vigintioctopunctata*	Hadda beetle	*Solanum tuberosum, S.melongena, S. lycopersicum*	Beetles and grubs both eat leaves, reducing plants to their skeletal remains. Infested leaves take on a lace-like appearance, become brown, dry out, and eventually fall off. It causes the plant's growth to slow down and lower yields.	Major
Order III: Hemiptera Family1: Aphididae					
1	*Acyrthosiphon pisum*	Pea aphid	*Pisum sativum* and other plants from Fabaceae family	Direct feeding harm is minimal since it does not develop thick colonies. However, it is a carrier of more than 30 Fabaceae virus infections that can result in significant crop losses.	Moderate
2	*Aphis craccivora*	Groundnut aphid or Cowpea aphid	*Cicer arietinum, Beta vulgaris*, other Brassicaceae and Cucurbitaceae	It causes direct harm to plants by stunting and distorting growth. The resultant honeydew is deposited on the plants where it promotes the formation of sooty moulds, which impede photosynthesis. A number of plant viruses are spread by the aphid.	Major
3	*Brevicoryne brassicae*	Cabbage aphid	*B.o.capitata, B.o.botrytis, B. napus, B. juncea, Raphanus sativus*	Plants become yellow, wilted, and stunted. Due to honeydew secretions, severely infested plants develop a thick layer of tiny, sticky aphids that can eventually cause leaf loss and deterioration. The core of the cabbage head and the underside of the leaves are where cabbage aphids mainly feed.	Major
Family 2: Pseudococcidae					
1	*Paracoccus marginatus*	Papaya Mealy bug	*Phaseolus vulgaris, Solanum lycopersicum, S. tuberosum, S. melongena*	Heavy infestations result in stunted and deformed growth, leaf yellowing, leaf curling, and early fruit loss. Wax secretions and a covering of mealybugs may totally cover fruit.	Moderate
Family 3: Pentatomidae					
1	*Nezara viridula*	Green stink bug	*Brassica rapa, Cucumis sativus, Ipomoea batatus, Solanum lycopersicum, S. melongena*	The insects mostly eat developing shoots and fruiting structures. Tiny, hard, brownish or blackish dots are created when their sucking and piercing mouthparts puncture plant tissues. Additionally, the feeding punctures allow for bacterial and fungal infections.	Minor
Order IV: Diptera Family1: Tephritidae					
1	*Batrocera cucurbitae*	Melon fly	*Solanum lycopersicum, S. melongena*, etc	There may be some necrosis around the puncture mark after oviposition. The fruit then begins to decompose after this.	Moderate
Order V: Thysanoptera Family 1: Thripidae					
1	*Scirtothrips*	Chilli thrips	*Capsicum frutescens,*	The earliest plant tissues are where eggs are	Major

	dorsalis		*Phaseolus vulgaris, S. melongena*	placed, and adult and larval feeding can cause significant cell damage to these developing tissues, resulting in distorted leaves and fruits as well as flower wilting. S. dorsalis produces "leaf curl disease" on chilles. Even though infestation happens all year round, it is most severe in the dry months.	

The survey resulted in finding more than 20 insect pest species belonging to 21 genera, distributed over five insect orders viz., Lepidoptera, Coleoptera, Hemiptera, Diptera and Thysanoptera. The insect species recorded belonged to 12 families which are Pieridae, Noctuidae, Pyralidae, Plutellidae, Crambidae, Chrysomelidae, Coccinellidae, Aphididae, Pseudococcidae, Pentatomidae, Tephritidae and Thripidae. They were found to attack almost 22 host vegetable crops belonging to families.

The several plant families and vegetable crops that were found to be afflicted by insect pests during the field assessment were Alliaceae: *Allium cepa* (onion); Amaranthaceae: *Beta vulgaris* (beet); Apiaceae: *Daucus carota* (carrot); Brassicaceae: *Brassica oleracea capitata* (cabbage), *Brassica oleracea botrytis* (cauliflower), *Brassica oleracea gongylodes* (knol-khol), *Brassica napus* (mustard), *Brassica rapa* (turnip), *Raphanus sativus* (radish), *Brassica juncea* (brown mustard); Convulvulaceae: *Ipomoea batatus* (sweet potato); Cucurbitaceae: *Cucurbita moschata* (pumpkin), *Lagenaria siceraria* (bottle gourd), *Cucumis sativus* (cucumber); Fabaceae: *Cicer arietinum* (chickpea) *Pisum sativum* (pea), *Phaseolus vulgaris* (common bean); Solanaceae: *Capsicum frutescens* (chilli), *Solanum lycopersicum* (tomato), *Solanum melongena* (brinjal/eggplant), *Solanum tuberosum* (potato).

Among different insect pest species spotted and identified, six species were found to be major pest infesting the crops as their comparative abundance were highest among all. They were *Pieris brassicae* (cabbage butterfly), *Spodoptera litura* (taro caterpillar), *Plutella xylostella* (diamond back moth), *Phyllotreta cruciferae* (crucifer flea beetle), *Agrotis ipsilon* (black cutworm), *Raphidopalpa foveicollis* (red pumpkin beetle), *Henosepilachna vigintioctopunctata* (hadda beetle), *Aphis craccivora* (cowpea aphid or groundnut aphid), *Scirtothrips dorsalis* (chilli thrips), *Brevicoryne brassicae* (cabbage aphid).

On contrary, the survey found out the following pests to have lower incidence and hence they were considered as 'minor' in the study area. They were *Trichoplusia ni* (cabbage looper), *Crocidolomia binotali* (cabbage cluster caterpillar) , *Monolepta signata* (flea beetle) and *Nezara viridula* (green stink bug). *Pieris rapae* (Cabbage white butterfly), *Pieris canidia* (Small cabbage butterfly), *Leucinodes orbonalis* (Brinjal borer), *Psylliodes affinis* (Potato flea beetle), *Acyrthosiphon pisum* (Pea aphid), *Paracoccus marginatus* (Papaya Mealy bug) and *Batrocera cucurbitae* (melon fly) were found in moderate numbers. *Helicoverpa armigera* (tomato fruit borer) and *Thysanoplusia orichalcea* (Slender burnished brass moth) were found in between moderate to major numbers. The graphical representation of the approximate percentage of pests have been given in Figure 2.

These findings are in accordance with findings of Firak *et al*. (2013) where they reported that incidence of *Pieris brassicae, Plutella xylostella, Spodoptera litura, Agrotis ipsilon and Brevicoryne brassicae* were highest and *Trichoplusia ni, Crocidolomia binotalis, Monolepta signata* and *Nezara viridula's* status were low in agricultural fields. Keot *et al*. (2002) discovered two insects as major pests: *Phyllotreta cruciferae* and *Pieris canidia*. As minor pests, they identified *Agrotis ipsilon, Monolepta signata, Spodoptera litura* and *Henosepilachna vigintioctopunctata*. In 2018, Bhat had studied the insect pests of vegetable crop in Jammu and Kasmir and found out that *Thysanoplusia orichalcea, Pieris brassicae, Pieris rapae, Plutella xylostella, Agrotis ipsilon and Helicoverpa armigera* were the abundant ones.

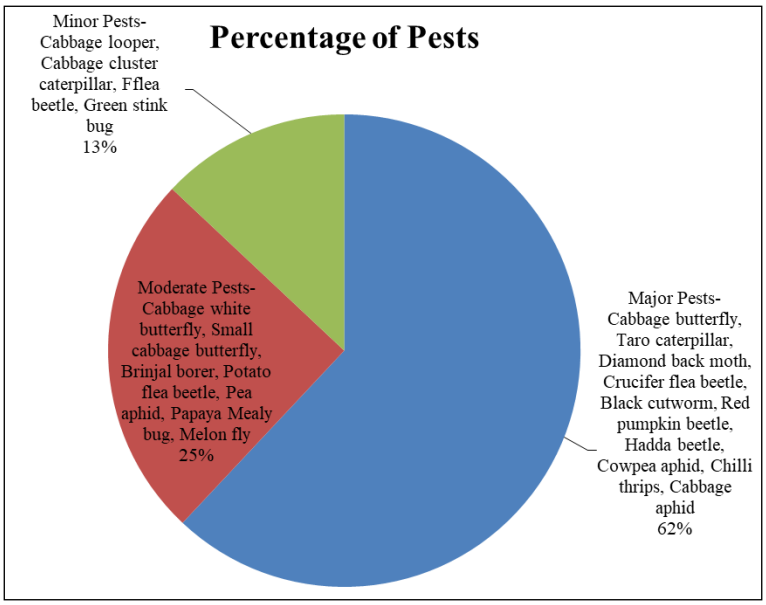

Fig 2: Graphical representation of the percentage of pests found in the study area (approx.)

Pests and Damage Caused by Them

Fig 3: Larval stage of Brinjal borer

Fig 4: Adult stage of Hadda Beetle

Fig 5: Damage by Tomato fruit borer

Fig 6: Adult stage of Red Pumpkin Beetle

Fig 7: Damage caused Mealy bug

Fig 8: Deformed Cucumber due to Fruit fly infestation

Conclusion

The present study highlighted the diversity of the different existing insect fauna of the vegetable crop fields which will be helpful for the application of control methods to keep the insect pests below the economic threshold level under an integrated pest management programme. The biodiversity of the insect pest complex of vegetables was not previously reported from this area. The survey results will help the cultivators of the area to decide the pest control methods and agents in appropriate quantity. This will ensure higher yield and low crop losses due to insect infestation.

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