

## Major insect and pest in cucurbitaceous crop and their management: A review

Sharvan Kumar<sup>1</sup>, Anuj Shakya<sup>1</sup>, Vijay Kumar Vimal<sup>2</sup>, Vikash Kumar Yadav<sup>3\*</sup>, Bandana Jaiswal<sup>4</sup>

<sup>1</sup> Assistant Professor, Department of Agriculture, Invertis University, Bareilly, Uttar Pradesh, India

<sup>2</sup> Subject Matter Specialist, Department of Vegetable Science, KVK, Kotwa, Azamgarh, Uttar Pradesh, India

<sup>3</sup> Assistant Professor, Department of Agriculture, Mahayogi Gorakhnath University, Gorakhpur, Uttar Pradesh, India

<sup>4</sup> Assistant Professor, Department of Biotechnology, IIMT University Meerut, Uttar Pradesh, India

### Abstract

Cucurbits, which are members of the *Cucurbitaceae* family, also referred to as the guard family, have been found to be negatively impacted by a variety of biotic limitations, the most significant of which are insect pests. Effective and cost-effective pest management is needed, and this calls for the application of mechanical, chemical, biological, and cultural techniques. Effective pest management requires a combination of these many approaches. Only with a sustained commitment to integrated pest management techniques can pests be controlled (IPM). IPM includes crop rotations, biological control, cultural techniques, the strategic use of resistant varieties, and selective insecticides. Understanding how pests, plants, and the environment interact is essential to integrated pest management (IPM). To preserve crop productivity, IPM must guarantee the least amount of environmental contamination and the best possible use of chemical pesticides. In this sense, it's important to apply environmentally friendly pest management techniques by correctly identifying the pest.

**Keywords:** Insect, pest, cucurbits, management and crop rotation

### Introduction

Cucurbits consist of wide range of vegetables belong to family Cucurbitaceae, commonly known as guard family. *Cucurbitaceae* family has about 110 genera and between 650 to 850 species distributed throughout the world. Cucurbits exclusively include various species viz. Cucumis (Cucumber, Muskmelon), *Cucurbita* (Pumpkin, Gourd, Squash), *Lagenaria* (bottle gourd), Luffa (Sponge gourd) and Momordica (Bitter gourd). The fruits of cucurbits are beneficial for human health which help in purification of blood, improve digestion, boost energy level in the body and remove constipation. Apart from that, member of *Cucurbitaceae* family like *Benincasa hispida* contains volatile oils, flavonoids, glycosides, carotenes,  $\beta$ -sitosterin and uronic acid which are of pharmaceutical importance. The major elements present as phytochemical in cucurbits are most commonly the tetra-tri-terpenoid substance called Cucurbitacins (Rajshree *et al.*, 2016). Cucurbitacins, a terpenoid compound, are the main components found in cucurbits as phytochemicals. A number of biotic and abiotic factors are currently limiting crop productivity and production, which has a negative impact on the crop's yield, both in terms of quality and quantity. One of the biotic

restrictions is that cucurbits face attacks from various insect and non-insect pests at different phases of their growth (Dhillon *et al.*, 2005) <sup>[1]</sup>. Crop attacks can take many different forms, such as leaf defoliation, harm to roots and flowers, a decline in crop stand quality, and eventually a drop in the crop's commercial yield (Singh *et al.*, 2000). In cucurbits, although, the pest complex does not directly attack the commercial part of the plant that is the fruit, they severely damage the crop stand which indirectly reduces the potential yield of the crop. It has been estimated that a single insect pest fauna of fruit fly, *Batocera cucurbitae* can cause a broad range of crop loss in cucurbits which is from 20-39 per cent crop loss in cucumber to about 76-100 per cent crop loss in musk melon (Kumar and Samal, 2020). From this emergency, the study related to the pest complex of cucurbits is worth to be learnt along with their possible managements.

### Different pest complex of Cucurbits

Wide ranges of pest complex have been observed overrunning the cucurbits which can be broadly categorized into two categories viz. Sap suckers and Leaf feeders.

**Table 1:** Major insect and pest of cucurbits

| sS.No. | Common Name                    | Scientific Names                                                                            | Family       | Order       |
|--------|--------------------------------|---------------------------------------------------------------------------------------------|--------------|-------------|
| 1.     | Melon Fruit fly                | <i>Batocera cucurbitae</i> / <i>Batocera ciliates</i>                                       | Tephritidae  | Diptera     |
| 2.     | Aphids                         | <i>Aphis gossypii</i> / <i>Aphis malvae</i> / <i>Myzus persicae</i>                         | Aphididae    | Hemiptera   |
| 3.     | Stink bug                      | <i>Aspongopus janus</i>                                                                     | Pentatomidae |             |
| 4.     | Pumpkin beetle                 | <i>Raphidopalpa foveicollis</i> / <i>Aulacophora cincta</i> / <i>Aulacophora intermedia</i> | Gelerucidae  | Coleoptera  |
| 5.     | Blister beetle (flower feeder) | <i>Mylabris pustulata</i>                                                                   | Meloidae     |             |
| 6.     | Snake guard Semilooper         | <i>Anadevidia peponis</i>                                                                   | Noctuidae    | Lepidoptera |
| 7.     | Pumpkin leaf caterpillar       | <i>Diaphania indica</i>                                                                     | Pyrilidae    |             |
| 8.     | Leaf miner                     | <i>Liriomyza trifolii</i>                                                                   | Agromyzidae  | Diptera     |

### Melon fruit fly (*Bactrocera cucurbitae*)

The melon fruit fly (*Bactrocera cucurbitae*) is a serious pest that can cause significant damage to melon crops. Understanding its life cycle and implementing effective control measures is crucial for managing infestations.

**Life cycle:** The life cycle begins when adult female melon fruit flies lay eggs on the surface of host fruits, especially melons, cucumbers, and other fruits in the *Cucurbitaceae* family (Dhillon *et al.* 2005) [1]. The female uses her ovipositor to insert eggs just beneath the fruit's skin. The number of eggs laid by a female can vary depending on environmental conditions and the availability of suitable host plants. Once the eggs hatch, larvae emerge and burrow into the fruit. These larvae feed on the pulp of the fruit, causing damage and rendering it unmarketable. The larval stage is the most destructive phase of the melon fruit fly's life cycle, as it causes direct damage to the fruit.

After completing their development inside the fruit, the larvae leave the fruit and burrow into the soil to pupate. Pupation occurs within a protective cocoon formed by the larva. The pupal stage is a non-feeding stage during which the insect undergoes metamorphosis, transforming into an adult. Once metamorphosis is complete, adult fruit flies emerge from the pupal case. These adults are ready to mate and reproduce, continuing the life cycle. Adult melon fruit flies feed on nectar and other plant exudates. They also play a crucial role in pollination. The adult stage is the dispersal phase of the fruit fly's life cycle, with adults seeking out suitable host plants for egg-laying.

### Stage of Infestation

The first instar infects the fruits by entering at its soft tissues. The oviposition puncture by female lead to rooting of fruits, thus deteriorating the quality of fruits. The four stages of maggots actively feed inside the fruit and develops quickly passing by three instar.

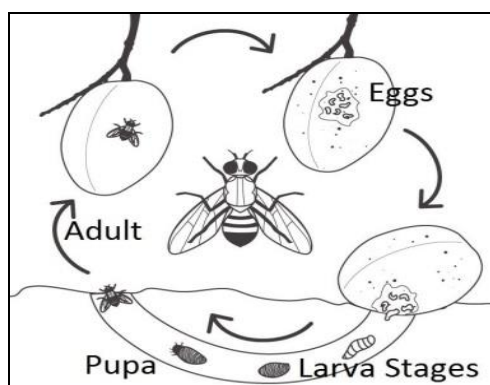


Fig 1: Life cycle of Melon fruit fly

### Damaged symptoms and extent loss

Female fruit flies lay eggs under the fruit's skin using their ovipositors. This results in puncture wounds or scars on the surface of the fruit, which serve as entry points for pathogens, leading to fruit rot and decay. Upon hatching, the fly larvae burrow into the melon fruit, feeding on the pulp and seeds. Their feeding activity causes internal damage, leading to fruit rotting, reduced marketability, and decreased shelf life. The affected fruit often becomes soft, discolored, and emits a foul odor. Severely infested melon fruits may prematurely drop from the plant due to the extensive

damage caused by the larvae. This leads to yield losses and reduces the overall quality and market value of the crop. The wounds created by the oviposition and larval feeding provide entry points for fungal and bacterial pathogens. These secondary infections exacerbate the damage, accelerating fruit decay and further reducing yield and quality. Infestation by melon fruit flies can result in significant economic losses for melon growers and producers. Reduced yields, decreased fruit quality, and increased costs associated with pest management practices contribute to financial losses within the agricultural sector.

### Aphid

#### Life cycle

Aphids typically overwinter as eggs laid on host plants or other structures such as stems or bark. These eggs are often laid in protected areas to survive harsh environmental conditions.

Once conditions become favorable, the eggs hatch into nymphs. Nymphs resemble adult aphids but are smaller and lack wings. They go through several instars (molting stages) during which they grow and develop (Mou *et al.* 2023). After undergoing several molts, nymphs mature into winged or wingless adult aphids, depending on the species and environmental conditions. Adult aphids are typically able to reproduce. Aphids reproduce asexually for much of the year, with females giving birth to live young (nymphs) without the need for fertilization. This process is called parthenogenesis. Under favorable conditions, aphid populations can increase rapidly due to this reproductive strategy.

As populations become dense or environmental conditions become unfavorable, some aphids develop wings, allowing them to disperse to new host plants or areas where conditions may be more favorable. These winged forms are called alates.

### Stage of infestation

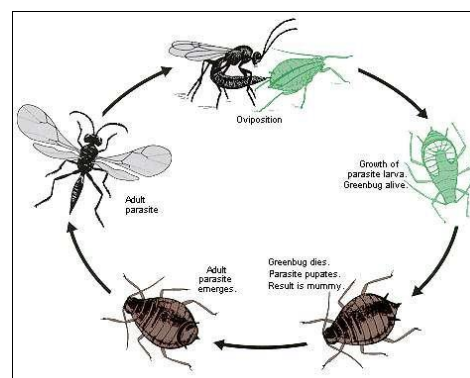


Fig 2: Life cycle of Aphid

### Damaged symptoms and extent loss

Adults and nymphs alike siphon the sap from the succulent plant portions. Nymphs gather under the underside of leaves, tender tips of stems, buds, and blooms. Adults eventually spread to other parts of the plant and infect there similarly. They inject poisons that lead to the deformity of the growth of leaves and flowers. Aphids are unique in that they secrete a large amount of honeydew, which serves as a substrate for the growth of sooty mold (fungi) on plant components. Additionally, honeydew serves as food for the

ants that protect the aphids, interfering with the aphids' ability to be effectively controlled biologically.

The initial sign of an aphid infestation is the downward curling and crinkling of the leaves. Many signs are observed, such as decreased plant vigor and growth, mottling, yellowing, browning, curling or wilting of leaves, which lowers yields, and occasionally plant mortality. The puckering and bending of leaves caused by aphid-infected salivary toxins aids in the plants' defense against pesticides and other natural foes.

### Management

Because of their quick rate of multiplication, they should be monitored frequently—at least twice a week—with particular care paid to the underside of the leaves. A couple of weeks before planting, place the yellow sticky traps to keep an eye on the current aphid population. Applying reflecting mulches, such as aluminum foils, can culturally suppress the aphid population and prevent the spread of viruses to young plants. On late-season melons, spray mulches made of biodegradable synthetic latex and reflective polyethylene have been proven to be beneficial in controlling aphids and diseases caused by viruses carried by aphids.

### Stink bug

#### Life cycle

The life cycle begins when female stink bugs lay eggs. These eggs are typically laid in clusters, often on the underside of leaves or stems of plants. The number of eggs laid can vary depending on species and environmental conditions. Once the eggs hatch, young stink bugs, called nymphs, emerge. Nymphs look like smaller versions of adults but lack fully developed wings and reproductive organs. They go through several nymphal instars, typically five in most species, during which they molt and grow larger. Each instar looks increasingly similar to the adult form. After completing the nymphal stages, stink bugs reach adulthood. At this stage, they have fully developed wings and reproductive capabilities (Yadav *et al.* 2024) [13]. They continue to feed on plants, sucking sap or juices, and reproducing. Adult stink bugs may undergo diapause (a period of dormancy) during colder months in temperate regions, becoming more active again when temperatures rise.

### Stage of infestation

Both nymph and adults are injurious for plant. They suck the sap from leaves and tender parts of the plant. The plants showing yellowing symptoms.

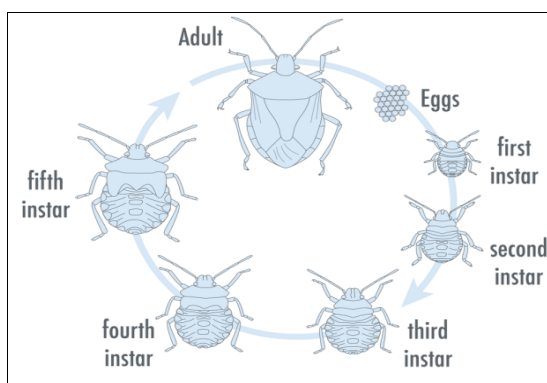


Fig 3: Life cycle of stink bug

### Damaged symptoms and extent loss

Both nymph and adults suck the sap of proximal part of the plant and reduced the growth. The plant showing yellowing symptoms and became extinct.

### Management

Blacklight trap to be found most effective against stink bug it may be helpful to improving the timing of scouting and management for stink bug. Organophosphate and pyrethroids are frequently applied insecticides against stink bug management.

### Pumpkin beetle

**Life cycle:** It is the major insect of cucurbits. This insect showed polyphagous nature, female lays eggs in moist soil where leaves are fallen or at the base of host plant. Its lays eggs in cluster (8-9) hatch into larva form in 6-15 days. Beetle starts laying after 7 days emergence and complete 5 generation earlier October. The grubs are 10-12 mm long possess creamy white body with visible brown head which feeds basal part of the host plant. Adults beetle are deep orange with black colored back. It is oblong about 5-8 mm length and 3.50-3.75 mm width and bears soft hairs on the posterior part of the abdomen.

### Stage of infestation

Both grubs and adults are avid feeder of cucurbits. These actively feed all parts of the plant from root to leaves.

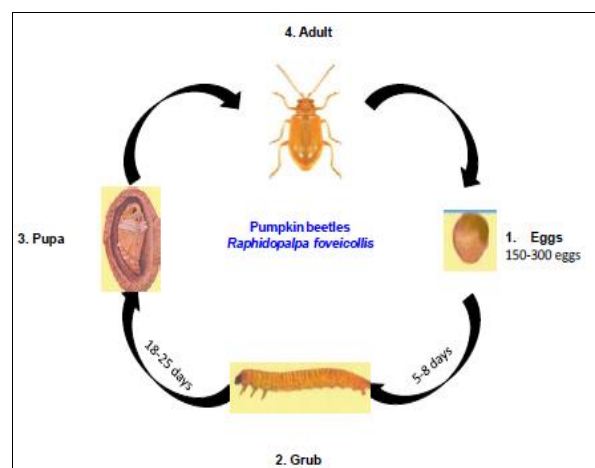


Fig 4: Life cycle of pumpkin beetle

### Damaged symptoms and extent loss

Symptoms of pumpkin beetle damage include skeletonized leaves, wilting, and stunted growth. Extensive infestations can lead to significant yield loss, affecting pumpkin quality and quantity.

### Management

Utilize integrated pest management (IPM) strategies to control pumpkin beetles. Promote parasitic wasps and ladybugs, two examples of natural predators. Flip crops once a year to break the cycles of beetle reproduction. If you want to keep pests away from pumpkin plants, grow trap crops like radishes. To keep beetles out of your garden early in the season, use row coverings. Pick up adult beetles by hand and dispose of the larvae. To repel and destroy beetles, apply neem oil or insecticidal soap, making sure to follow the directions for a safe application. Keep an eye out for

infestation symptoms in plants and act quickly if necessary. You can minimize your influence on the environment and efficiently manage pumpkin beetle populations by combining these strategies.

### Blister beetle (flower feeder)

#### Life cycle

**Blister beetle:** (*Mylabris pustulata*) is a common pest of legume crops but it has observed from numerous families plant like, Solanaceae, malvaceae and cucurbitaceous. Among the cucurbitaceous crop it attack only pumpkin, ridge gourd, bottle gourd and sponge gourd etc. Blister beetles undergo a complete metamorphosis, progressing through four main stages: egg, larva, pupa, and adult. After mating, female blister beetles lay eggs in soil or near host plants. Upon hatching, larvae emerge and begin feeding voraciously on vegetation. Larvae pass through several instars, molting as they grow. Once fully developed, they enter the pupal stage, where they undergo a transformation into adults within a protective cocoon. Finally, adult blister beetles emerge, often in the spring or summer, ready to mate and begin the cycle anew. The entire life cycle typically spans several weeks to months, depending on environmental conditions.

#### Stage of infestation

Adults extensively feed the floral part of cucurbit veins. They prefer the yellow and white color flower of plants.

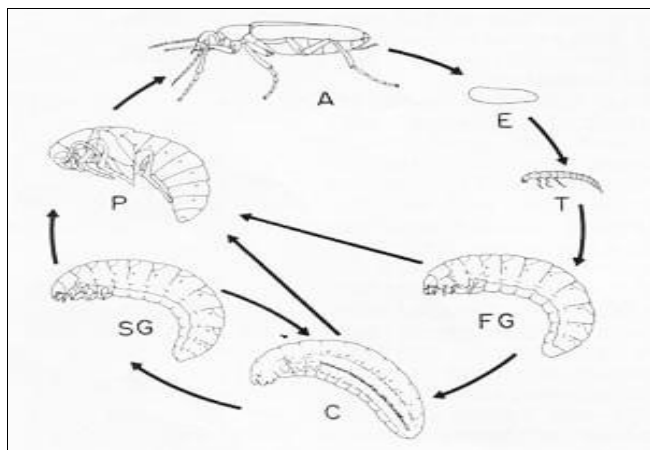


Fig 5: Life cycle of Blister beetle.

### Damaged symptoms and extent loss

Blister beetles, belonging to the Meloidae family, pose a significant threat cucurbits and their vegetation. Upon contact, they release a toxic substance called cantharidin, causing blistering of the skin and mucous membranes in animals, including humans. In plants, they feed voraciously on foliage, resulting in defoliation, stunted growth, and sometimes death. Their impact can be devastating, leading to reduced crop yields and economic losses for farmers. Swift identification and control measures are essential to mitigate the damage inflicted by blister beetles and safeguard agricultural productivity.

### Management

Blister beetles can be controlled by cultural, mechanical, and chemical methods. Cultural methods involve removing beetle-attracting plants from the vicinity, while mechanical methods include physically removing beetles by

handpicking or vacuuming them. Additionally, practices such as crop rotation and timely harvesting can help reduce beetle populations. Chemical control involves using insecticides, but it should be approached cautiously due to potential harm to beneficial insects and environmental concerns. Integrated pest management (IPM) strategies, combining various control methods judiciously, offer a more sustainable approach to managing blister beetle infestations while minimizing adverse impacts on ecosystems.

### Snake gourd Semilooper

#### Life cycle

Snake gourd Semilooper (*Diaphania indica*) begins with eggs laid by adult moths on host plants. Eggs hatch into larvae, which feed voraciously on foliage, buds, and fruits of the snake gourd plant. As larvae grow, they undergo several molts before entering the pupal stage, typically in soil or plant debris. After pupation, adult moths emerge, ready to mate and lay eggs, completing the cycle. This process typically spans several weeks, influenced by environmental factors such as temperature and food availability.

#### Stage of infestation

Caterpillar of the snake gourd Semilooper feed cucurbits and causes huge loss.

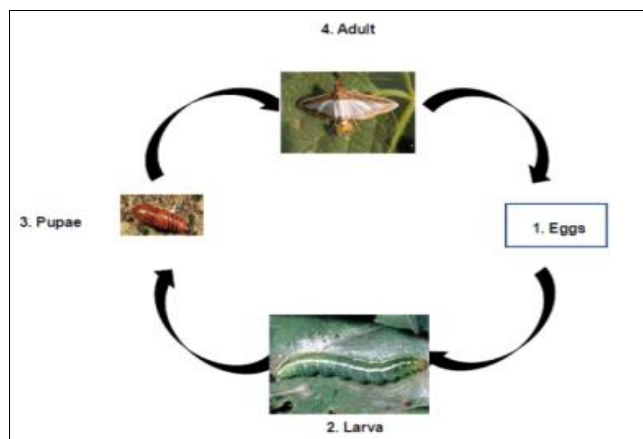


Fig 6: Life cycle of Snake gourd Semilooper.

### Damaged symptoms and extent loss

Snake gourd semilooper (*Chrysodeixis eriosoma*) damage manifests primarily as skeletonization of leaves, leading to reduced photosynthesis and stunted growth. The larvae bore into tender shoots and feed on foliage, resulting in extensive defoliation. Infestation severity varies, but heavy feeding can cause significant yield losses in snake gourd crops. Symptoms include irregular holes in leaves, stripped foliage, and frass accumulation. Severe infestations may lead to plant death or diminished fruit quality. Effective pest management strategies such as biological control with natural enemies, cultural practices like crop rotation, and judicious use of pesticides are crucial for mitigating losses.

### Management

Snake gourd semilooper by employing cultural practices like crop rotation and intercropping with repellent plants. Use biological control agents such as *Bacillus thuringiensis*

and *Trichogramma chilonis*. Employ botanical extracts like neem oil or garlic spray. Monitor and manually remove larvae. Limit pesticide use to minimize environmental impact.

### Pumpkin leaf caterpillar

#### Life cycle

The life cycle of the Pumpkin Leaf Caterpillar begins with the female moth laying eggs on the underside of pumpkin leaves. These eggs hatch into tiny larvae, which then feed voraciously on the pumpkin leaves, growing rapidly through several molts. As they grow, they develop distinct stripes and patterns along their bodies. After reaching maturity, which typically takes around 2-3 weeks, the caterpillars pupate, forming cocoons on nearby surfaces such as leaves or stems. Inside these cocoons, they undergo metamorphosis, transforming into adult moths over a period of 1-2 weeks. Once fully developed, the adult moths emerge from their cocoons, ready to mate and begin the cycle anew. Throughout their life cycle, Pumpkin Leaf Caterpillars play a vital role in the ecosystem as both consumers and potential pollinators, contributing to the balance of their habitat.

#### Stage of infestation

The stage of infestation of pumpkin leaf caterpillars can vary depending on factors like climate and local environment. Typically, signs include chewed leaves, presence of caterpillars, and visible egg clusters. Early detection allows for effective management through methods like manual removal or natural predators, minimizing crop damage.

#### Damaged symptoms and extent loss

The pumpkin leaf caterpillar, often identified as the larva of the squash vine borer or the pumpkin borer moth, inflicts significant damage to pumpkin plants. Plant start wilting, yellowing, and eventual collapse of leaves due to larval feeding on vascular tissues. Extent of loss varies but can be severe, with entire leaves being consumed and plants exhibiting stunted growth or even death. Damage can compromise pumpkin yield and quality, impacting agricultural productivity. Timely detection and management strategies such as biological controls or pesticide application are crucial in mitigating losses caused by this destructive pest.

#### Management

Pumpkin leaf caterpillars involves a multi-faceted approach. Firstly, inspect plants regularly for signs of infestation, like chewed leaves or frass. Handpick caterpillars off plants and destroy them. Encourage natural predators like ladybugs, lacewings, and parasitic wasps. Introduce biological controls such as *Bacillus thuringiensis*, a bacterial insecticide targeting caterpillars. Utilize physical barriers like row covers to prevent adult moths from laying eggs. Crop rotation and intercropping with repellent plants can also deter infestation. Finally, maintain proper plant health through adequate watering and fertilization to enhance plant resilience. Combining these methods can effectively manage pumpkin leaf caterpillars sustainably.

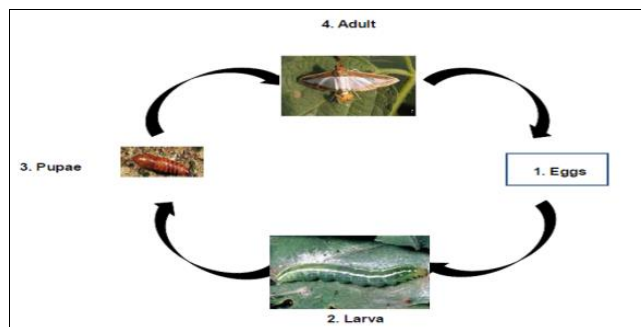


Fig 7: Life cycle of Pumpkin leaf caterpillar

### Leaf Miner

#### Life cycle

Leaf miners are small insect larvae that live inside plant leaves, feeding on the leaf tissue. The life cycle of a leaf miner typically begins when an adult female lays eggs on the surface of a leaf. Once hatched, the larvae tunnel into the leaf, creating characteristic trails or mines as they feed. As they grow, the larvae molt several times before pupating inside the leaf or dropping to the ground. After a period of pupation, adult leaf miners emerge from the leaf or soil, completing the life cycle. This cycle can vary in duration depending on factors such as temperature and host plant species. Leaf miners can cause damage to plants by reducing photosynthetic activity and compromising the structural integrity of leaves.

#### Stage of infestation

Leaf miner usually harmful for crop at maggot stage when they actively feed by making feeding punctures.



Fig 8: Life cycle of Leaf Miner

#### Damaged symptoms and extent loss

Leaf miners, such as certain moth larvae, inflict damage by tunneling within the tissue of leaves, leaving characteristic serpentine patterns. The extent of damage depends on factors like the plant species, miner species, and environmental conditions. Mild infestations may only cause cosmetic damage, leading to aesthetic concerns. However, severe infestations can result in reduced photosynthesis, stunted growth, and decreased yield. If left unchecked, extensive leaf mining can weaken plants, making them susceptible to other stressors and diseases, ultimately compromising their overall health and productivity. Effective management strategies include cultural practices, biological controls, and, in severe cases, chemical interventions.

## Management

Leaf miner infestations can be managed by implementing cultural practices like removing affected leaves, using sticky traps, and applying biological controls such as parasitic

wasps. Chemical control with insecticides may be necessary for severe infestations, but should be used judiciously to minimize harm to beneficial insects and the environment.

**Table 2:** Insect name with their life cycle

| Insects                                                                                     | Stages |         |      |       |
|---------------------------------------------------------------------------------------------|--------|---------|------|-------|
|                                                                                             | Egg    | Maggots | Pupa | Adult |
| <i>Bactocera cucurbitae</i> Or <i>Bactocera ciliates</i>                                    | Y      | Y       | Y    | Y     |
| <i>Aphis gossypii</i> / <i>Aphis malvae</i> / <i>Myzus persicae</i>                         | Y      | N       | Y    | Y     |
| <i>Aspongopus janus</i>                                                                     | Y      | N       | Y    | Y     |
| <i>Raphidopalpa foveicollis</i> / <i>Aulacophora cincta</i> / <i>Aulacophora intermedia</i> | Y      | Y       | Y    | Y     |
| <i>Mylabris pustulata</i>                                                                   | Y      | Y       | Y    | Y     |
| <i>Anadevidia peponis</i>                                                                   | Y      | Y       | Y    | Y     |
| <i>Diaphania indica</i>                                                                     | Y      | Y       | Y    | Y     |
| <i>Liriomyza trifolii</i>                                                                   | Y      | Y       | Y    | Y     |

Source: (Gayawali *et al.* 2023<sup>[2]</sup> and Pessarakli, 2016)<sup>[7]</sup>.

## Conclusion

In conclusion, managing major insect and pest issues in cucurbit crops is crucial for ensuring successful cultivation. Common pests such as aphids, cucumber beetles, and squash bugs can inflict significant damage to crops, leading to yield losses and economic setbacks for farmers. Integrated pest management strategies, including cultural practices, biological control agents, and judicious use of pesticides, offer effective solutions. Regular monitoring, early detection, and timely intervention are key to preventing pest outbreaks and minimizing crop damage. By implementing comprehensive management approaches, farmers can sustainably protect their cucurbit crops and optimize yields while minimizing environmental impact.

## Acknowledgement

The author would like to thank the Dean and Head of the Department of Agriculture, Invertis University, Bareilly, who supported me in the entire work.

## Author's contribution

Author collect the data and prepared the manuscript and all coauthors critically reviewed the manuscript for the final publication.

## Conflicts of Interest

The author's declare's that there are no conflict of interest regarding the publication of this paper.

## References

1. Dhillon MK, Singh R, Naresh JS, Sharma HC. The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. *Journal of Insect Science*,2005;5(1):40.
2. Gayawali P, Bohra K, Rijal S, Karki N, Sahi J. A comprehensive review on integrated pest management of melon fruit fly (*Bactrocera cucurbitae*). *International Journal of Pest Management*,2023;1-9. <https://doi.org/10.1080/09670874.2023.2278052>
3. Kamal MM, Uddin MM, Shajahan M, Rahman MM, Alam MJ, Islam MS. Incidence and host preference of red pumpkin beetle (*Aulacophora foveicollis*) (Lucas) on cucurbitaceous vegetables. *Life Science Journal*,2014;11(7):459-466.
4. Khan MMH, Alam MZ, Rahman MM, Miah MI, Hossain MM. Influence of weather factors on the incidence and distribution of red pumpkin beetle infesting cucurbits. *Bangladesh Journal of Agricultural Research*,2012;37(2):361-367.
5. Mou D-F, Kumdan P, Pingault L, Puri H, Shindhe H, Louis J. Monocot crop-aphid interaction: plant resilience and aphid adaptation. Vol. 57. [doi.org/10.16/j.cois.2023.101038](https://doi.org/10.16/j.cois.2023.101038).
6. Packauskas RJ. The Pentatomidae or Stink bugs, of Kansas with a key to species (Hemiptera: Heteroptera). *The Great Lakes Entomologist*,2012;45:1-10.
7. Pessarakli M. *Handbook of cucurbits: Growth, Cultural Practices and Physiology* (1st ed.). CRC Press. <https://www.taylorfrancis.com>.
8. Rahman AHMM, Anisuzzaman M, Ahmad F, Rafiul Islam AKM, Naderuzzaman ATM. Study of nutritive value and medicinal uses of cultivated cucurbits. *Journal of Applied Science Research*,2008;4(5):555-558.
9. Rai AB, Halder J, Kodandaram MH. Emerging insect pest problems in vegetable crops and their management in India- An Appraisal. *Pest Management in Horticultural Ecosystems*,2014;20(2):113-122.
10. Rajasree RS, Sibi PI, Francis F, William H. Phytochemicals of cucurbitaceous family- A Review. *International Journal of Pharmacognosy and Phytochemical Research*,2016;8(1):113-123.
11. Seshadri VS. Cucurbits. In: Bose TK, Some MG, eds. *Vegetable crops in India*. Naya Prakash, Calcutta,1986:91-164.
12. Sohrab Prashad CS, Hasan W. Study on biology and life cycle of cucurbits fruit fly (*Bactrocera cucurbitae*). *Journal of Pharmacognosy and Phytochemistry*,2018;SPI:223-226.
13. Yadav SPS, Pohkrel S, Poudel A, Devkota S, Katel S, Bhattarai N, Gautam P. Evaluation of different insecticides against *Liriomyza sativae* (Diptera: Agromyzidae) on cucumber plants. *Journal of Agriculture and Food Research*,2024;15:100987.