SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

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CERTIFICATE

This is to certify that the work incorporated in the dissertation entitled

Studies on life cycle of different pests of the cabbage and their control measures

Was satisfactorily carried out by **1) Mr. ONKAR RAMKRUSHNA JADHAV**
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of **T.Y.BSC-ZOOLOGY.** They have completed this project under my supervision and guidance during academic **YEAR 2021-2022**. This project work submitted by them is original and the scientific information obtain from other sources have been duly acknowledged

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(Project Guide)	**(HOD Zoology)**		**(Principal)**

Acknowlegement

It gives us great pleasure to take the opportunity to expose our sincere thanks to our project guide **Miss. Pratibha khapre** mam for their encouragement and guidance, her constructive suggestions and all sorts of help ever since the very inception of the study.

We are thankful to our Principal **Dr. J.D. Sonkhaskar** for providing necessary facilities to carry out project work. We equally thankful to **Dr. Mayura Patil**, Head of the Department of Zoology for providing laboratory facilities and guidance in completing the same project work. We express our thanks to all respected teachers and non-teaching staff of Department of zoology for all the help and kind co-operation during the project. Finally we are thankful to all those who helped me for completing this project.

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INTRODUCTION

This Project is related to the pests on the cabbage and their nature of damage, damage of Host plant and its control measures. This study helps to get knowledge about pests affecting cabbage as a host plant, Each year numerous insect pests damage crops in home gardens and commercial fruit and vegetable fields. Caterpillars, the immature larval stage of butterflies and moths, are the most significant pests of *Brassicacrops* (cabbage).

Pest is an organism that affect vegetable crop. Insects and pests generally attacks on the host plant for their liking, feeding and to complete their life cycle. They damages and uses required parts of the plant and ultimately causes high economic loss to the farmers.

Which simply means that the insects changestheir forms during their life cycle i.e. called metamorphosis. Metamorphosis may be complete or incomplete. Complete metamorphosis consists of four stages-egg, larva, pupa, and adult, which simply means that the insect changes form during its life. While incomplete metamorphosis includes three stages i.e. egg, nymph and adult.

A pest is any living thing, whether animal, plant, or fungus, which humans consider troublesome to themselves, their possessions, or the environment.It is a loose concept, as an organism can be a pest in one setting but beneficial, domesticated, or acceptable in another. Microorganisms, whether bacteria, microscopic fungi, protists, or viruses that cause trouble, on the other hand, are generally thought of as causes of disease (pathogens) rather than as pests. An older usage of the word "pest" is of a deadly epidemic disease, specifically plague. In its broadest sense, a pest is a competitor to humanity.

Agricultural and horticultural crops are attacked by a wide variety of pests, the most important being insects, mites, Nematodes and gastropod molluscs. The damage they do results both from the direct injury they cause to the plants and from the indirect consequences of the fungal, bacterial or viral infections they transmit. Plants have their own defences against these attacks but these may be overwhelmed, especially in habitats where the plants are already stressed, or where the pests have been accidentally introduced and may have no natural enemies.

Ecology:-

The term "plant pest", mainly applied to insect micro predators of plants, has a specific definition in terms of the International plant protection convention and phytosanitary measures worldwide. A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products.

Worldwide, agricultural pest impacts are increased by higher degrees of interconnectedness. This is due to the increased risk that any particular pest problem anywhere in the world (as a system) will propagate across the entire system.

Materials & Methods

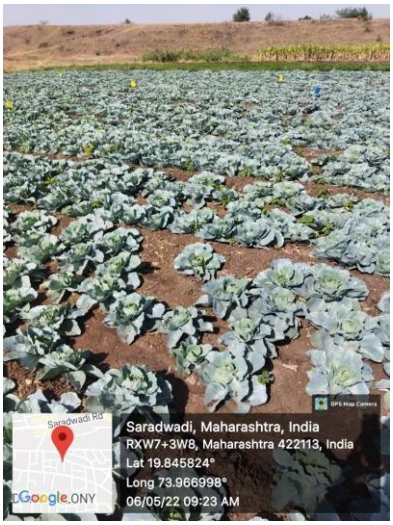


Image of the cabbage crop field

The project was carried out at the village **Saradwadi, Tal. Sinnar, Dist. Nashik, Maharashtra, India,** under the guidance of **Miss. Pratibha Khapre**, Department of Zoology, KSKW Arts, Science and Commerce College, CIDCO, Nashik.

The selected field from Saradwadi village is known to grow different kind of vegetables like cabbage, onion, bringal, cauliflower etc. and has suitable environment for the production of vegetables.

Samples were collected from field of cabbage and thoroughly inspected leaves, stem, bunches and area for identification of different pests and we were taken many photographs of infected parts (leaves) From these site.

The samples were brought to the laboratory for identification of pests. The identification was done by an expert entomologist, Zoology department,K.S.K.W. College, Cidco, Nashik.

Observation & Discussion

The samples of fresh and affected vegetables were collected from field and identified various pests like **diamondback moth, green peach aphid** by morphological method.

Diamondback moth is particularly damage to seedlings and may disrupt head formation in cabbage. The presence of larvae of these pest cause in florets complete rejection of produce, even if the level of plant tissue removal is insignificant.

Diamondback moth (DBM), *Plutella xylostella* is an important pest of cruciferous crops and particularly cabbage.

1. Diamondback Moth (Plutella xylostella)

Information

The diamondback moth (*Plutella xylostella*), sometimes called the cabbage moth, is a moth species of the family *Plutellidae* and genus *Plutella*. The small, greyish-brown moth sometimes has a cream-colored band that forms a diamond along its back.

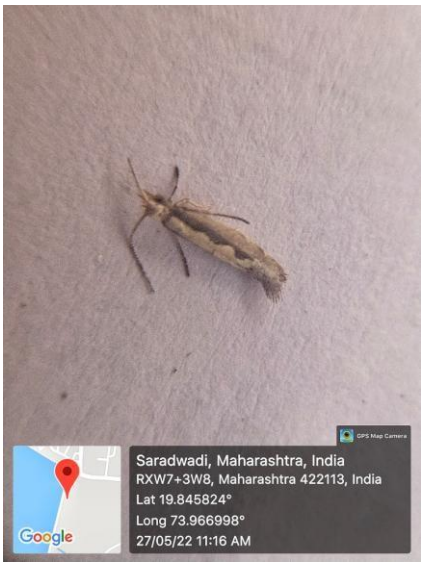


Image of *Plutella xylostella*

Scientific classification

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Plutellidae

Genus: *Plutella*

Species: *xylostella*

Binomial name: ***Plutella xylostella***

Life cycle of Diamondback moth

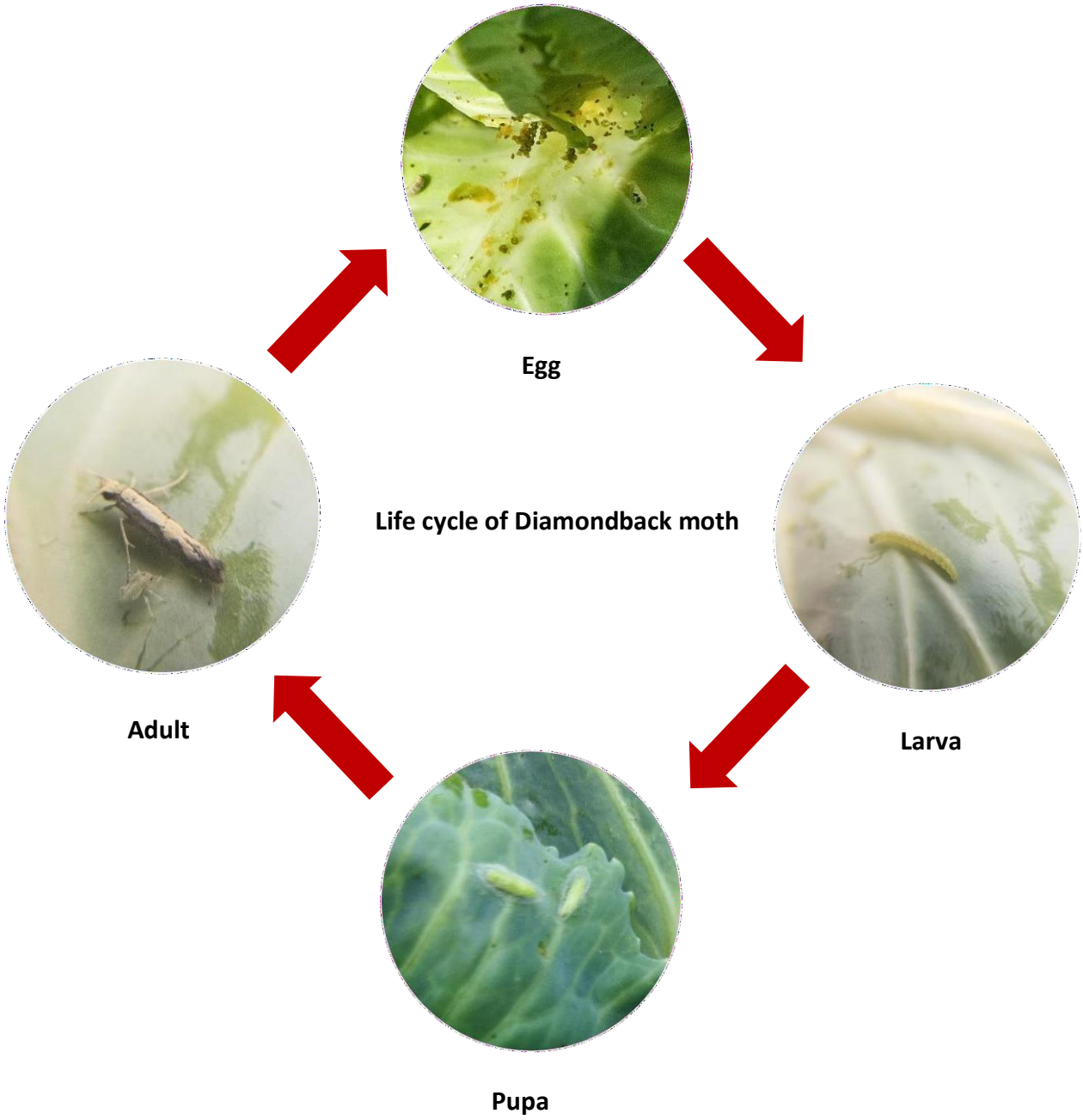


Fig. Life Cycle of Diamondack

Life cycle of Diamondback moth

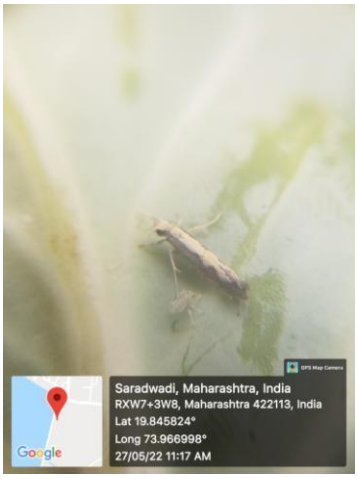
Eggs:- The eggs are oval and flattened, measuring 0.44 mm long and 0.26 mm wide. They are yellow or pale green at first, but darken later. They are laid singly or in groups of two to eight eggs in Life cycle Eggs depressions on the surface of leaves. Females may deposit up to 300 eggs in total, but average production is probably half that amount. The larvae emerge from the eggs in about six to seven days.

Larvae:- The larvae have four instars, each with an average development time of about four days. The larval body form tapers at both ends. The larvae have a few short black hairs and are colorless in the first instar, but pale or emerald green with black heads in later instars. Of the five pairs of prolegs, one protrudes from the posterior end, forming a distinctive "V".

Pupa :-The yellowish pupae are about 8 mm long and are wrapped in a loose silk cocoon. They are usually found on the lower or outer leaves of the food plant, but on cauliflower and broccoli, pupation may occur in the florets. It is possible for a pupa to fall off of its host plant. The pupal stage lasts on average for about eight days, but ranges from five to fifteen days.

Pupa stage of Diamondback Moth

Adult:- The lifespan averages three to four weeks for females, but less for males. These moths are weak fliers, seldom rising more than 2 m above the ground and not flying long distances. They are, however, passive migrants, being easily transferred by wind over long distances. Diamondback moths overwinter as adults among field debris of cruciferous crops, and active adults may be seen during warm periods at any time during the winter in temperate areas.



Adult of Dimondback Moth

Host Plant

Host plant selection is crucial because diamondbacks spend the majority of their life near their host plant. The diamondback moth lays its eggs only on plants in the family Brassicaceae. Nearly all cruciferous vegetable crops are attacked, but some are favoured over others.

These include

- Broccoli
- Cabbage
- Cauliflower

Several wild species in the family also act as hosts, especially early in the season when cultivated crops are unavailable. The egg-laying females have been reported to recognize chemicals in the host plants, glucosinolates and isothiocyanates, that are characteristic of the family Brassicaceae (but also occur in some related families). These chemicals were found to stimulate oviposition, even when applied to a piece of paper. One plant species that contains the egg-laying cues is wintercress, Barbarea vulgaris. Indeed, diamondback moth females lay eggs on this plant species, but the newly hatched larvae die due to the effects of additional natural plant chemicals called saponins.

Host Plant: Cabbage

Nature of Damage

Caterpillars eat many small holes in the leaves of the host plants, often leaving the leaf epidermis (outermost layer of cells) intact, making a 'feeding window'.

Most damage is caused by the caterpillars tunnelling into the heads of plants such as cabbage and brussels sprouts. They also cause contamination of produce by pupating inside broccoli florets and cauliflower curds.

Seedlings of cruciferous forage crops and rapeseed may be destroyed by this pest and severe defoliation or pod grazing may reduce rapeseed yield.

Cabbage Damaged by Diamondback Moth

Cabbage damaged by diamondback moth

Control measures

1. Biological pest control

i) Natural enemies

Natural enemies (local and imported) can help to keep the pest at acceptable levels if they are conserved and their activity encouraged. Habitat management and avoidance of broad-spectrum insecticides early in the season, when the diamondback moth is present in low numbers may preserve natural enemies that can help keep diamondback moth and aphid populations under control later in the season.

Many natural enemies prey on the diamondback moth at different stages of its life cycle. Birds and spiders feed on moths; ants, lacewings, wasps, and parasitic wasps among others attack the caterpillars.

Numerous parasitic wasps attack diamondback moth. The most common are wasps of the genus *Cotesia, Diadegma, Diadromus* and *Oomyzus*. These wasps are also known from Africa and some are reported to effect excellent control of the diamondback moth elsewhere.

2. Biopesticides and physical methods and physical methods

i) Bt (*Bacillus thuringiensis*)

Bacillus thuringiensis var. *aizawai* and Bt var. kurstaki are very effective in controlling infestations of the diamondback moth. Bt var. *kurstaki i*s widely used at a weekly interval and a rate of 0.5/ha. This type of strategy provides effective control of this pest. However, continuous use of Bt can induce development of resistance. Bt kills the diamond back moth and

does not harm beneficial insects. Bt insecticides should be applied when the newly hatch caterpillars appear. Sprays may need to be applied at intervals of 5 to 7 days when populations are high. Because Bt insecticides are UV-degraded treat crops in the late afternoon.

ii) Farmers experience

Farmers in some countries produce their own homemade biopesticides by collecting diseased diamondback moth caterpillars (fat and white or yellowish or with fluffy mould on them), crushing them and mixing them with water in a blender. Large tissue clumps are filtered out and the liquid is sprayed onto the crop (Dobson et al, 2002).

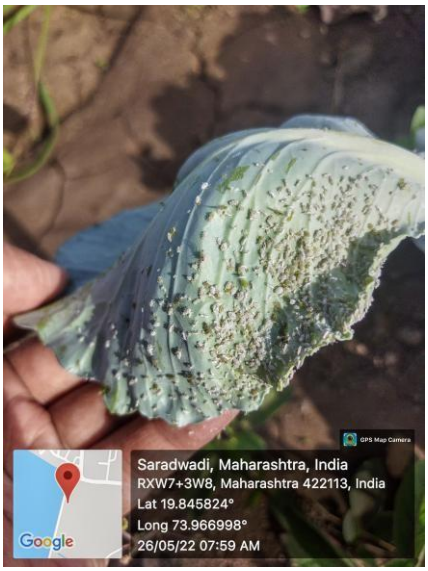
iii)Neem(*Azadirachtaindica*)

Neem-based products give a good control of the diamondback moth and are relatively harmless to natural enemies and non-toxic to warm-blooded animals. Since the action of neem is relatively slow, caterpillars may survive for a few days after application, but their growth and feeding is inhibited and they do not cause further damage to the crop.

2. Cabbage aphid (Brevicoryne brassicae)

Introduction:-

Brevicoryne brassicae, commonly known as the **cabbage aphid** or **cabbage aphis**, is a destructive aphid (plant louse) native to Europe that is now found in many other areas of the world. The aphids feed on many varieties of produce, including cabbage, broccoli (especially), Brussels sprouts, cauliflower and many other members of the genus *Brassica*, but do not feed on plants outside of the family *Brassicaceae*. The insects entirely avoid plants other than those of *Brassicaceae*; even though thousands may be eating broccoli near strawberries, the strawberries will be left untouched.



Binomial name

Brevicoryne brassicae

Scientific classification :-

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Hemiptera

Suborder: Sternorrhyncha

Family: *Aphididae*

Genus: *Brevicoryne*

Species: *B. brassicae*

Geographical distribution:-

The cabbage aphid is native to Europe, but now has a worldwide distribution (Kessing and Mau 1991). Severe damage to various plants in the family *Brassicaceae* has been reported in many areas including Canada, The Netherlands, South Africa, India and China. The cabbage aphid is widely distributed throughout the U.S. and has been found to be more of a pest in the southern states (Carter and Sorensen 2013)

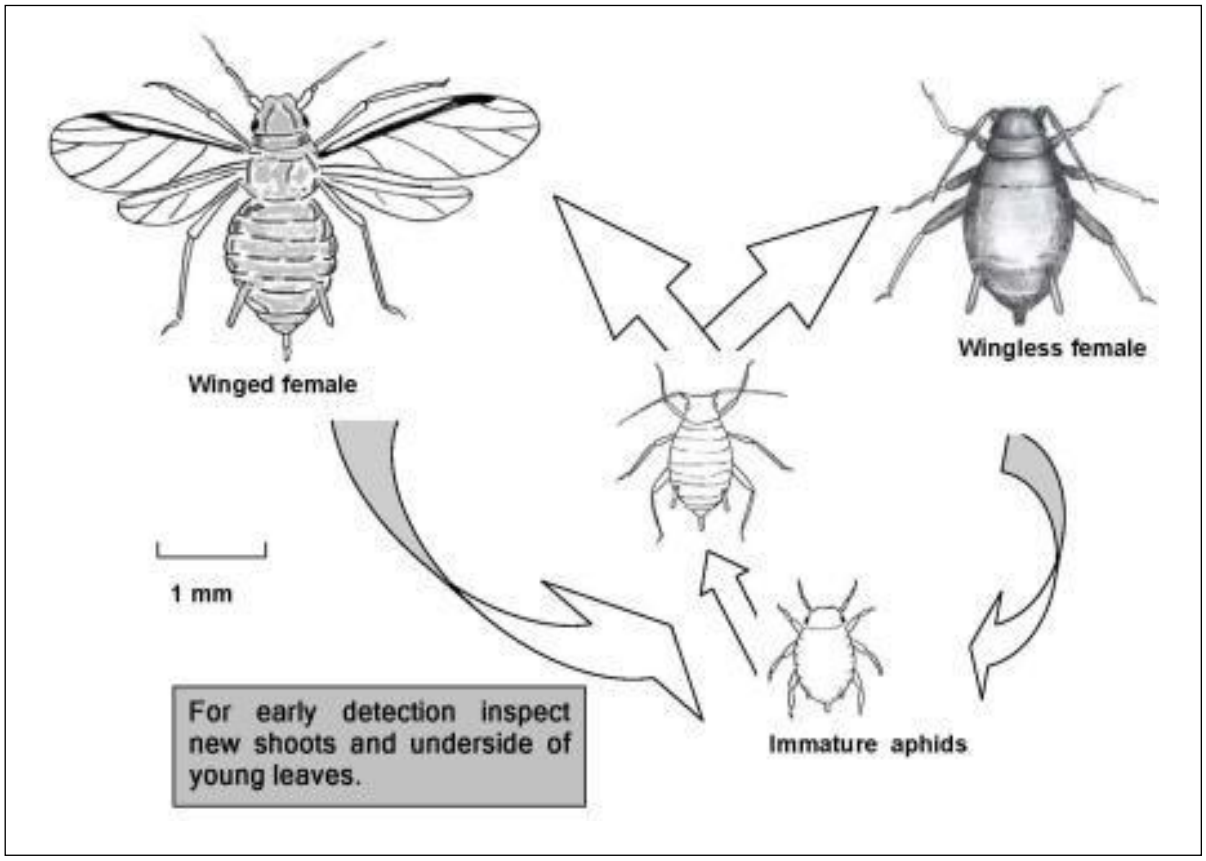
Identification

The cabbage aphid is difficult to distinguish from the turnip aphid (*Lipaphiserysimi* (Kaltenbach)). The cabbage aphid is 2.0 to 2.5 mm long and covered with a greyish waxy covering, but the turnip aphid is 1.6 to 2.2 mm long and has no such covering (Carter and Sorensen 2013).

The cabbage aphid and green peach aphid (*Myzuspersicae* (Sulzer)) can be confused when they are both found feeding on cabbage plants. However, they have distinguishing morphological characteristics. For instance, the cabbage aphid is waxy with short cornicles. On the other hand, the green peach aphid lacks a waxy covering, and has long cornicles (Opfer and McGrath 2013). Moreover, green peach aphids mainly attack cabbage before heading (after transplanting, the cabbage seedling starts producing leaves, and eventually the cabbage plant begins to produce a small, tight head at the center of the group of leaves) begins, but cabbage aphids may attack the crop at any stage (Elwakil and Mossler 2013).

Cabbage aphid, *Brevicorynebrassicae* Linnaeus, winged alate and nymphs on cabbage. Photograph by Onkarjadhav

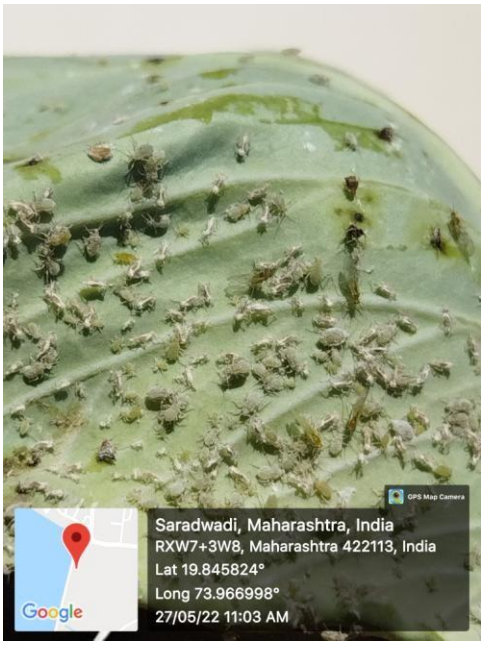
Life cycle of Cabbage aphid



Aphid lifecycle by

Life History

Aphids can reproduce two ways. In warm climates (e.g., in Florida and Hawaii), females give birth to female nymphs without mating. In this case, an aphid colony consists of females only. This occurs during warmer periods in temperate climates as well. In temperate climates, however, the mode of reproduction changes during the autumn as temperatures begin to drop. In response to low temperature or decrease in photoperiod, males are also produced (Blackman and Eastop 1984). Mating takes place and females lay eggs. The egg stage is the overwintering stage of aphids. Generations are overlapping, with up to 15 generations during the crop season (Hines and Hutchison 2013). The total life cycle duration ranges between 16 to 50 days depending on temperature. The life cycle is shorter at higher temperatures (Kessing and Mau 1991).



Photograph of Aphids colony, includes all stages of aphids like. Eggs, Nymphs, Adults

Eggs: In temperate climates, eggs overwinter in plant debris near the soil surface (Hines and Hutchison 2013). Eggs are not laid in warm climates; females produce female nymphs directly (Kessing and Mau 1991).

Nymphs: In instances where eggs are not produced, the female gives birth to nymphs. Nymphs differ from adults (including wingless adults, known as apterae) in having less developed caudae and siphunculi. The nymphal period varies from seven to ten days. Winged forms develop and start migrating to new host plants only when plant quality deteriorates or when a plant becomes overcrowded.

Adults: Aphids are soft-bodied and oval or pear shaped with a posterior pair of tubes called cornicles, which project backward. Aphids have piercing-sucking mouthparts. Adult cabbage aphids can take on two forms: winged and wingless (Herrick and Huntgate 1911). Wingless adults are 1/10 inches long, oval-shaped and appear grayish-green or grayish-white due to their waxy covering (Hines and Hutchison 2013, Natwick 2009, Opfer and McGrath 2013). On the upper abdominal surface, eight dark brown or black spots are located beneath the waxy coating. These spots increase in size toward the posterior end. Winged females are smaller and lack the waxy covering of wingless females (Natwick 2009). The wings are short with prominent veins. The head and thorax are dark brown to black with dark brown antennae. The winged aphids have a yellow abdomen with two dark spots on the dorsal anterior abdominal segments. These two spots merge into a dark band across the last abdominal segment (Kessing and Mau 1991).

Host Plant

The cabbage aphid has a host range restricted to plants in the family Brassicaceae (=Cruciferae), which include both cultivated and wild cruciferous crops (Gabrys et al. 1997).

Major economically important host crops where significant losses have been found include cauliflower (*Brassica oleracea* L. var. *botrytis* L.), brussels sprouts (*Brassica oleracea* L.var. *gemmifera* DC), broccoli (*Brassica oleracea* L.var. *italica* Plenck) cabbage (*Brassica oleracea* L.) Cabbage aphid is an especially big problem in broccoli and cabbage production (Opfer and McGrath 2013).

Nature of Damage

Aphids feed by sucking sap from their host plants. They produce a sugary waste product called honeydew, which is fed on by ants. In turn, the ants provide the aphids with protection from natural enemies. Continued feeding by aphids causes yellowing, wilting and stunting of plants (Opfer and McGrath 2013). Severely infested plants become covered with a mass of small sticky aphids (due to honeydew secretions), which can eventually lead to leaf death and decay (Griffin and Williamson 2012). Cabbage aphids feed on the underside of the leaves and on the center of the cabbage head (Hines and Hutchison 2013).

They prefer feeding on young leaves and flowers and often go deep into the heads of Brussels sprouts and cabbage (Natwick 2009). Colonies of aphids are found on upper and lower leaf surfaces, in leaf folds, along the leafstalk, and near leaf axils.

The cabbage aphid is of agricultural concern because it is a vector of at least 20 viral pathogens that can cause diseases in crucifers and citrus. Both wingless (apterae) and winged (alate) forms are able to transmit viruses, but the wingless aphids demonstrate a higher rate of transmission (Toba 1962). The cabbage aphid's mode of pathogen transmission is non-persistent: the aphid picks up the virus by feeding on infected plants and transfers the pathogen to healthy plants by probing with its mouthparts or feeding (Kessing and Mau 1991).

Photograph of damaged caused by Aphids

Biological pest control

1. Natural Enemies

The most important aphid predators are predatory bugs (e.g. *Anthocoridae, Miridae, Nabidae*), carabid beetles (*Carabidae*), soldier beetles (*Cantharidae*),predatory gall midges(*Cecidomyiidae*), lacewings *(Chrysopidae*), ladybird beetles (*Coccinellida*e) and hoverflies (*Syrphidae*).

In addition, parasitic wasps (parasitoids) are often involved in the control of aphid populations. Parasitised aphids can be easily recognised. They turn brown and hard and remain stuck to the plant surface. They are known as "mummies".

Depending on climatic conditions and crops fungi that cause diseases of insect pests (entomopathogenic fungi) can contribute to a rapid decline of aphid populations. Natural aphid enemies usually appear with a certain delay because they react to the presence of aphids.

It is important to help natural enemies to establish and improve their effectiveness (conservation biocontrol). This can be done through:

- Habitat management. For instance, leaving or growing flowering plants at the boarder of the crops or as companion plants within the crops attracts beneficial insects.
- Avoiding use of pesticides toxic to natural enemies. If pesticides must be used, selective biopesticides that target specific pests should be preferred to broad-spectrum pesticides (that kill a wide range of insects including natural enemies)

2. Biopesticides and physical methods and physical methods

1. Neem

Neem extracts can control early infestations of some aphids, but they are not efficient against all aphid species. For a reliable and satisfactory control neem extracts must be applied at an early stage of aphid attack. Usually repeated spot sprays of affected plants are necessary to achieve control. Neem has a slow mode of action, and usually effects are not visible before 10 days after application. Some neem extracts (e.g. oil extracts) may be phytotoxic. Therefore, test the extract on few plants before going into full scale spraying.

Neem products have in general no or low negative effect on natural enemies. However, products based on neem oil have stronger effects on some natural enemies.

For more information how to prepare Neem water extract

2. Botanicals

Other botanical sprays reported to be effective against aphids include:

3. Chilli pepper

Cut half a kg of hot chilli peppers in small pieces and boil them in 4 litres of water for 20 minutes. Add equal amount of soapy (bar soap) water, Pulverise 100g chillies in a mortar, shake vigorously with 1 litre of water and filter through a cloth. Dilute 1 part of this mixture with 5 parts of soapy water before spraying (G. Stoll, 1988). Chilli also repels ants.

Conclusion

Through the field studies in **Sinnar** of **Nashik** district, we observed that the field area is facing problems with pests on the various vegetable crop including cabbage .We found cabbage is by two types of pests generally. To estimate the damage on the crops caused by these pests needs detailed study.

The interaction of planting dates and Piper emulsion or intercropping treatments can be effectively used to control cabbage pests and improve yields, with the late planting date as viable alternative farm-level adaptation to climate variability. These represent cost-effective and environmentally friendly pest management strategy that can be adopted by farmers to control cabbage pests below economic injury threshold and improve yield.

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- We’re taken some research paper references.