CHAPTER 9

# Major Pest and Disease Management in Horticultural Crops

## OBJECTIVES

After studying this unit the students will be able to:

- Explain the principle of pest management in horticultural crops.
- Explain the importance of various approaches in managing disease and pest incidence.
- Understand the importance of integrated approach of disease/pest management.

## INTRODUCTION

Before we delve into the management of major pests and diseases of horticultural crops, we should be aware of what a pest is? The term "plant pest" means any living stage of organisms such as non-human animal (rodent), fungi, bacteria, virus, nematode, any infectious agent (phytoplasma) etc. which can directly or indirectly injure, cause damage to, or cause disease in any plant or plant product. Plant diseases and pests have caused severe losses to horticultural production in several ways. There are several pests and diseases, which cause small losses annually throughout the world; however, collectively constitute sizable losses to growers; besides, reducing the aesthetic values of landscape plants and home gardens.

### Management of major diseases and pests

Diseases and pests can damage horticultural crops from the time seeds/saplings are planted until after the crops are harvested, and gardeners/growers who fail to follow good growing practices, which minimize damage from diseases and pests in their gardens/orchard may end up incurring significant losses. The goal of plant disease and pests management is to reduce the economic and aesthetic losses caused by plant diseases and pests.

Many strategies used in disease and pests management can be grouped under two very broad principles of action, prevention and treatment or cure. The first principle (prevention) includes management tactics applied before infection/ infestation (i.e., the plant is protected from disease/pests), the second principle (therapy or curative action) functions with any measure applied after the plant is infected/infested (i.e., the plant is treated for the disease/pest attack). An example of the first principle is enforcement of quarantines to prevent introduction of a disease/pest agent into a region where it does not occur. For instance Ooty (T.N.) has quarantine measures in operation for golden nematode of potato. Similarly, the Ladakh region of J&K had

regulations for quarantine of codling moth of apricot. This implies that potato or apricot from these areas cannot be taken to other areas so as to check the spread of these pests from such areas to other parts of the country.

The second principle is illustrated by heat or chemical treatment of vegetative material such as bulbs, corms, and woody cuttings to eliminate fungi, bacteria, nematodes or viruses, which are established within the plant material. Chemotherapy is the application of chemicals to an infested or diseased plant that stops (i.e., eradicates) the infection/infestation. For example, for elimination of grape fan leaf virus from grapes, chemical compound 'virazole' is employed. Likewise, for elimination of apple mosaic virus from shoot tip, plants are grown at 38 0C for 20 or more days.

There are four general pest management principles viz., exclusion, eradication, protection and resistance.

### Exclusion

This principle is defined as any measure that prevents the introduction of a disease-causing agent (pathogen) or pests into a region, farm, or planting. The basic strategy assumes that most pests can travel only short distances without the aid of some other agent such as humans or other vector, and that natural barriers like oceans, deserts, and mountains create obstacles to their natural spread. In many cases pest are moved with their host plants or even on non-host material such as soil, packing material or shipping containers.

Exclusion may be accomplished by something as simple as cleaning farming equipment to remove contaminated debris and soil that can harbor pathogens/insect-pests such as *Verticillium*, nematodes or other soil-borne organisms and prevent their introduction into non-infested fields.

### Eradication

This principle emphasises at eliminating a pathogen after it is introduced into an area but before it has become well established or widely spread. It can be applied to individual plants, seed lots, fields or regions but generally is not effective over large geographic areas. Two large attempts at pathogen eradication, in the history of pest eradication, in the United States were the golden nematode *(Globodera rostochiensis)* and the citrus canker (caused by *Xanthomonas axonopodis* pv. citri and pv. *aurantifolii*) programs.

Eradication can also be on a more modest scale such as the removal of apple or pear branches infected by the fire blight bacterium (*Erwinia amylovora*) or pruning to remove cankers (caused by *Coneothecium chomatosporus*) on apples. Or, it can be the sorting and removal of diseased

flower bulbs, corms or rhizomes. Hot water treatment of gladiolus corm 50 °C for 30 minutes before planting is followed to eliminate fungi.

Similarly, for export of fruits such as papaya, mango, mangosteen, and litchi to Japan for consumption purposes the fruit is checked for quarantine pests such as fruit fly, as per Plant Quarantine Law of Japan. As per this law, any fruit that has undergone the process of "vapor heat treatment" (VHT) is eligible for import in Japan, as this process sterilises the pests without the use of chemicals in an environmental friendly way. VHT is a non-chemical process of pest management and control, which utilizes heat and humidity to control and fully eliminate pest growth.

Eradication may also be accomplished by destroying weeds, which are reservoirs of various insects, pathogens or their vectors. Elimination of potato cull piles is an effective method of eradicating overwintering inoculum of the late blight pathogen. Similarly, destruction of *Tinospora* weed, an alternative host of fruit sucking moth, is recommended to contain the pest.

Soil fumigation has been a widely used eradication strategy. This technology involves introducing gas-forming chemicals such as carbon disulfide, methyl bromide, or chloropicrin into soil to kill target pathogens. However, undesirable side effects such as killing beneficial organisms, contamination of groundwater, and toxicity of these chemicals may also occur. Volatile fumigants like methyl bromide are incorporated into soil and covered with a plastic film. Likewise, formaldehyde is also mixed in soil to disinfect it from pathogens.

Crop rotation is a frequently used strategy to reduce the quantity of a pathogen, usually soil-borne organisms, in a cropping area.

Burning is another effective means of eradicating pathogens e.g. flaming potato stems prior to harvest may prevent tuber infection by the late blight pathogen. However, burning agricultural fields is controversial because the smoke creates human health and safety and environmental concerns.

**Protection**

This principle depends on establishing a barrier between the pathogen and the host plant or the susceptible part of the host plant. It is usually thought of as a chemical barrier, e.g., a fungicide (chemicals used to kill fungi; cide=kill, which has been derived from Latin *caedere i.e.* to kill), bactericide (chemical for killing bacteria), insecticide (chemical for killing insects) or nematicide (chemical for killing nematodes), but it can also be a physical, spatial, or temporal barrier. For example, bananas are covered with plastic sleeves as soon as the fruit are set) to protect the fruit from various pests including fruit decay fungi. Similarly, bagging of pomegranate fruits with butter paper bag is recommended against *anar* butterfly.

Protection often involves some cultural practice, which modifies the environment, such as tillage to bury pest-infested plant residues, drainage, irrigation, or altering soil pH; besides, rotation to non-susceptible crops, selecting pathogen-free planting stocks, orientation of plantings to improve exposure to sun and air currents, adequate nutrition, proper cultivation to improve root growth and avoid plant injury, and sanitation procedures to eliminate sources of inoculum. It may also involve changing date or depth of seeding, plant spacing, pruning and thinning, or other practices, which allow plants to escape infection/infestation or reduce severity of incidence. Raising planting beds to assure good soil water drainage is an example of cultural management of plant diseases such as root and stem rots. A range of fungicides, bactericides, insecticides etc. are available in the market for the management of pest incidence.

Biological control (also known as bio-control) involves the use of one living organism to control another, and this management technology has received much attention in recent times. The examples of biological control in the management of insect-pests are use of *Trichogramma chilonis* against fruit borer in pomegranate; *Chrysoperla* against aphid, thrips and mites; and baculoviruses against *Helicoverpa* and *Cydia pomonella*. Similarly, biological control of pathogen *Erwinia carotovora* by several plant-growth promoting organisms like *Pseudomonas fluorescence* is a usual practice. Another instance is management of soil borne pathogens e.g. Actinomycetes (*Streptomyces lydicus*) reduced root and seed rot severity in peas and resulted in significantly higher final emergence and significantly lower final disease in spinach challenged by *Pythium* and *Fusarium* (soil-borne fungi).

### Resistance

Use of disease or pest -resistant plants is the ideal method to manage plant diseases and pests problems. Resistant plants are usually derived by standard breeding procedures of selection and/or hybridization. For instance, pomegranate varieties Jyoti and BedanaBosec are resistant to the attack of fruit borer. Recently, resistant plants have been developed through the use of genetic engineering (e.g., resistance to the *Papaya ringspot virus*). Likewise, genes from the bacterium *Bacillus thuringiensis* have been inserted into plants to protect against insect attacks. Plants with these inserted genes are called genetically-modified organisms (GMOs).

### Integrated disease management

Integrated pest management (IPM) is a broad based approach, which integrates a range of practices for economic control of pests. In most cases IPM consists of timely application of a combination of strategies. These may include site selection and preparation, utilizing resistant cultivars, altering planting practices, modifying the environment by drainage, irrigation, pruning, thinning, shading, etc., and applying pesticides, as per requirement. For example, IPM for mango

hopper involves keeping the orchards clean, avoiding overcrowding of trees and water logging to keep the pest at bay and three applications of carbaryl 0.1 % or phosalone 0.05 % at fortnightly interval, or, two sprays of phosphomidon or monocrotophos @ 0.03% at 13 to 18 days interval at flowering and 2 - 3 sprays in June - July. Similarly, IPM of tomato fruit borer (*Helicoverpa armigera*) involves planting marigold as trap crop, sprays of baculovirus, Ha NPV @ 250 LE /ha, mechanical collection and destruction of bored fruit at periodic intervals (3-4 times), chemical spray of Indoxacarb 14.5 SC @ 0.5 ml/l or Thiodicarb 75 WP @ 1g/l. The integrated approach for the management of Panama wilt of banana caused by *Fusarium oxysporum f. sp. Cubense* is controlled by uprooting and burning of affected plants, use of disease-free planting material and resistant/ tolerant cultivar such as 'Gold Finger' and 'Mutiara', crop rotation with paddy followed by banana for 3-5 years once or twice, use of quick lime near the base of the plant and soaking with water and avoiding sunflower or sugarcane in crop rotation, dipping of suckers in Carbendazim (10g/10 litres of water) are recommended. Application of bioagents, such as, *Trichoderma viride* or *Pseudomonas fluorescence* in the soil has also been effective in containing this disease.

## ACTIVITY

1. Visit orchards/vegetable farm/ gardens of your area and find out the major diseases and pests of important horticultural crops.
2. Try to collect information on prevalent management practices being followed in your area in different horticultural crops for the control of pests.
3. Visit a Biocontrol Laboratory of AgriculturalUniversity or Research Institution and see how biocontrol agent, Trichogramma/Trichodermais being multiplied and stored under laboratory conditions.

## CHECK YOUR PROGRESS

1) What do you understand by term 'pest'? Cite some examples of pests in horticultural crops.
2) Enlist some important biological agents.
3) Differentiate between eradication and exclusion for pest management.
4) What does VHT means? How it helps in killing pests of fruits?
5) Discuss the effects of shoot and root pruning on vegetative growth and flowering of a fruit plant.

## SUGGESTED READINGS

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