6.0 OBJECTIVES

After going through this unit, you should be able to:

- get acquainted with various insects pests damaging fruits and vegetable crops;
- describe the nature of damage of different insects/pests attacking fruits and vegetable crops and outline measures to manage them under field conditions;
- familiarize with diseases infesting fruits and vegetable crops; and
- identify the symptoms of various diseases of fruits and vegetable crops and the practices which should be adopted to manage these diseases.
6.1 INTRODUCTION

In the previous unit, current status of fruit and vegetable production in India and the
farm production systems, environmental requirements of fruit and vegetable crops in
relation to soil, light, water and temperature and nutrition management for maximizing
production and increasing the efficiency of use of inputs were dealt with. Water
management considerations to meet crop requirements and make the best use of
available water and general practices in fruit and vegetable production were also
covered.

In India, more than 70 per cent of the population is undernourished. The increase in
the consumption of fruits and vegetables will help overcome this problem. A
considerable amount of fruits and vegetables is lost due to attack of insects/pests
and diseases. However, toxic pesticides used to control them not only increase the
cost of production but also pollute the environment and water which has serious
effect on human and animal health. Besides, regular use of the pesticides/insecticides
develops resistance in insects/pests. It is, therefore, very important to know about
the activity/incidence of various insect/pests and diseases of fruits and vegetable
crops so that the same can be managed properly under field conditions at the right
time with the cost-effective strategies which are safe for living beings.

In the next unit, different types of processed products, their FPO specifications,
process of preservation of various types of processed products and importance of
labeling and the storage life of processed products will be dealt with.

6.2 MAJOR INSECT-PESTS AND DISEASES OF
VEGETABLES AND THEIR MANAGEMENT

6.2.1 Cabbage and Cauliflower

Insects

Diamondback moth (*Plutella xylostella*: Plutellidae; Lepidoptera): Yellowish green/
green coloured caterpillars/larvae mine the leaves in the initial stages and later on
bite holes in the leaves. At seedling stage they damage the growing tip. It can be
managed by adopting following practices.

- intercropping and mixed cropping help to reduce this pest;
- remove and destroy the crop debris and stubbles; and
- Diadegma fenestralis and Apanteles (*Cotesia*) *plutellae* are the common
  natural enemies of this pest.

Tobacco caterpillar (*Spodoptera litura, Spodoptera* sp.: Noctuidae; Lepidoptera):
Young caterpillars scrap the leaves while remaining gregarious and later on spread in
the field and eat voraciously on the leaves. It can be managed by adopting following
practices:

- collect and destroy the leaves harbouring egg masses and gregarious stage
  of the pest which are easily seen in the field;
- collect the grown-up larvae and destroy; and
- *Apanteles prodeniae, Canthecona* sp. is the common natural enemy of
  this pest.
Cabbage butterfly (*Pieris brassicae*: Pieridae): Lepidoptera Caterpillars feed gregariously on leaves in the initial stages and later on disperse to other plants and feed on leaves. It can be managed by adopting following practices:

- hand picking and mechanical destruction of larvae during early stage is effective;
- *apanteles glomeratus* is the most important natural enemy of this pest; and
- application of insecticides like Malathion 0.15 per cent, endosulphan 0.07 per cent, *Bacillus thuringiensis* (*B.t.*) formulations @ 1 kg/ha, fenvalerate 0.001 per cent, monocrotophos 0.04 per cent control all the above pests effectively.

Aphids (*Lipaphis erysimi, Brevicoryne brassicae, Lipaphis erysimi, etc.* Aphididae: Hemiptera): Both nymphs and adults of this green coloured soft bodied insect suck sap from leaves and inflorescence and they reproduce parthenogenetically. It can be managed by adopting following practices:

- collect and destroy the newly formed colonies of this pest in the initial stages;
- *Coccinella septempunctata, Chrysoperla carnea, Chilomenus sexmaculatus, Syrphus balteatus* are the common predators of this pest;
- *Diacretiella rapa* is the common parasitoid associated with this pest; and
- application of insecticides like malathian 0.1 per cent, dimethoate 0.03 per cent, oxydemeton methyl 0.025 per cent, imidacloprid 200 SL @ 100 ml/ha prove effective in controlling this pest.

Leaf webber, cabbage borer, etc. are the other insects associated with these crops in India.

### Diseases

**Alternaria Blight** (*Alternaria brassicae, Alternaria brassicicola*): The infection on the leaves starts as minute, brown to blackish lesions, which show concentric rings in the lesion and a zone of yellow halo around the lesions is very prominent.

**Downy Mildew** (*Peronospora parasitica*): Small, creamy to light brown lesions are seen on the lower leaves. The lesions may remain small or enlarge in size.

**Damping off**: As discussed under tomato.

The following integrated measures help manage the above diseases:

- deep summer ploughing;
- crop rotation;
- allow proper aeration;
- seed treatment with Apron SD-35 @ 6g per kg; and
- spray the crop with Dithane M-45 (2g/l) or Ridomil MZ-72 (2.5g/l)

6.2.2 Cucurbits (gourds, pumpkins, melons etc.)

**Insect-pests**

**Fruitfly** (*Bactrocera (=Dacus) cucurbitae*: Tephritidae; Diptera): Female fly lays eggs in the epidermis of fruits; emerging larvae (*Maggots*) feed on the pulp of fruits which result in rottening of the fruits. It can be managed by adopting following practices:
• avoid the ripening of fruits in the field as it attracts flies for egg laying;
• collect the fly attacked fruits and bury them deep in the soil;
• use poison bait (malathian 200 ml + molasses or gur 500g or 20g yeast + 2 l water) or bait spray add 20 l water instead of 2 l.
• *Opius fletcheri, O. compaensus*, etc. are the common parasitoids of this pest.

**Red pumpkin beetle** (*Raphidopalpa (= Aulacophora) fovicolis*: Chrysomelidae: Coleoptera): Shining orange red adult beetles feed on the leaves and the grubs (larvae) of this pest damage the roots underground. It can be managed by adopting following practices:

• deep ploughing helps in exposing/killing the grubs;
• destruction of the crop refuse is very important as it prevents the sheltering of this pest; and
• application of carbaryl 5 per cent dust or carbaryl 0.05 per cent or endosulphan 0.07 per cent or fenvalerate 0.001 per cent is effective is controlling this pest.

Plume moth, aphids, blister beetles, etc. are other insects reported to attack cucurbit crops in India.

**Diseases**

**Downy Mildew** (*Pseudoperonospora cubensis*): Pale green areas appear on upper surface of leaves that later become yellow coloured, angular. On the lower side, purplish downy growth appears in moist weather.

• spray Dithane M-45 @ 0.2 per cent as soon as the disease starts appearing; and
• destroy diseased debris and rouge out the diseased plants to avoid secondary spread.

**Powdery Mildew** (*Erysiphe cichoracearum; Sphaerotheca fuliginea*): Tiny white to dirty grey spots appear on foliage and green stems which become powdery and may cover the entire leaf. Following control measures are recommended:

• diseased crop debris should be burnt; and
• spray the crop with Sulfex 0.2 per cent or Karathane 0.1 per cent or Calixin 0.1 per cent.

**Anthracnose** (*Colletotrichum lindemuthianum*): Small yellowish or water soaked areas which enlarge and turn brown black in colour later on become angular or roughly circular. Following control measures are recommended:

• crop rotation, proper drainage, destruction of wild hosts help in reducing the inoculums;
• seed treatment with Emisan-6 or Bavistin or Benlate @ 2.5 g/kg seed; and
• spray the crop with Dithane M-45 or Blitox-50 @ 0.2 per cent and repeat at 10-15 days interval.

**Mosaic** (Virus): Alternate green and yellow patches on the leaf are seen which are irregular in shape and enlarge rapidly. Following control measures are recommended:
Planning and Management of Horticulture Crops

- destruction of diseased host plants including weeds;
- use of insecticide such as Thiodan (0.1 per cent =) or Metasystox (0.1 per cent) to check the build up of vector population; and
- use of seed from healthy crop.

6.2.3 Brinjal (Egg plant)

Insect-pests

Shoot and fruit borer (*Leucinodes orbonalis*: Pyralidae: Lepidoptera): Initially, this insect attacks the midrib and petioles of the leaves and young tender shoots killing the growing point. Later the larvae (pinkish) bore in the flower buds and fruits and feed on the pulp. Full fed larvae make exit hole in the fruit and pupate on the soil. Following management practices are recommended:

- avoid continuous cropping of the crop in the same field;
- grow relatively less susceptible varieties;
- collect the attacked fruits and bury deep in soil;
- *Trathala* (*Cremastus flavoortalis*, *Microbrackon greeni*, *Phanerotoma* sp. etc., are the common parasitoids of this pest in India; and
- spray endosulphan 0.07 per cent or carbaryl 0.15 per cent or fenvalerate 0.001 per cent or cypermethrin 0.001 per cent or malathion 0.05 – 0.15 per cent at fortnight intervals.

Hadda beetle (*Epilachna dodecastigma*, *E. vigintioctopunctata*: Coccinellidae): Coleptora): Both grubs (Larvae) and adults feed on the leaves by scrapping the chlorophyll leaving the leaves skeletonized which dry away later on. Following management practices are recommended:

- pluck the leaves harbouring different stages of this pest and destroy them;
- remove the weeds harbouring this pest in and around the field; and
- spray malathion 0.1 per cent or carbaryl 0.1 per cent or fenvalerate 0.001 per cent or dichlorvos 0.05 per cent.

Whitefly (*Bemisia tabaci*: Aleurodidae: Hemiptera): Both nymphs and adults suck sap from the ventral sides of the leaves. They exude honey dew on which black mould fungus grows which hinder in normal photosynthesis. It also transmits viral diseases and is more active in dry season. Following management practices are recommended:

- grow less susceptible varieties;
- *Brumus* sp., *Chrysoperla* sp. etc. are the common predators reported praying on the young ones of this pest;
- *Eretmocerus* sp., *Encarsia* sp. etc. are the parasitoids associated with this pest; and
- spray dimethoate 0.03 per cent or oxymeton methyl 0.025 per cent or formothion 0.05 per cent or thiamethoxam 25 WG (100g/ha) or imidacloprid 200 SL (100 ml/ha).
Lacewing bug, aphids, leafhopper (jassid), etc., are other sap sucking pests of this crop.

**Diseases**

**Little Leaf of Brinjal** (*Phytoplasma*): Short leaves appear which seem to be sticking to the stem. Internodes of stem are also shortened and plants look bushy. Following control measures are recommended:

- seed should be taken from healthy plants;
- eradication of weed host, diseased plants and spray of insecticide like Metasystox; and
- @ 0.1 per cent is effective.

**6.2.4 Tomato**

**Insect-pests**

**Fruit borer** (*Helicoverpa armigera*, Noctuidae: Lepidoptera): It is the most serious pest of tomato. Young larvae feed on tender foliage and the advanced stage caterpillars feed on the developing fruits on which circular holes are bored. Very often a part of their body is seen outside the fruit being attacked. Following management practices are recommended:

- intercropping with marigold reduces the incidence of this pest;
- hand picking of the grown up larvae in the early stage of infestation is helpful in checking this pest;
- natural enemies *Campoletis* sp., *Apenteles* (Cotesia) sp., *Microbracon* sp. are the common parasitoids associated with this pest;
- artificial release of egg parasitoid *Trichogramma* sp. is also quite effective;
- nuclear Polyhedrosis virus (NPV) application also reduces the population of this pest substantially; and
- application of endosulphan 0.07 per cent or fenvalerate 0.001 per cent, carbaryl 0.15 per cent etc. are the common insecticides recommended to control this pest.

Whitefly, tobacco caterpillar, fruit sucking moth, hadda beetle etc. are the other insects reported to attack tomato crop in India.

**Diseases**

**Damping Off** (*Pythium aphanidermatum*; *P.debaryanum*; *Phytophthora* spp.; *Fusarrium* spp.; *Rhizoctonia* spp.): The affected seedlings become pale green and brownish and young seedlings are killed before they emerge out of soil. Following control measures are recommended:

- deep summer ploughing helps in minimizing the inoculums;
- burning of trash or sterilization of soil with formaldehyde (1:50 water) drenching;
- seed treatment with Captan followed by drenching with Captan (0.2 per cent); and
- use of cultural practices such as thin planting, light soil, light but frequent irrigation and use of well decomposed manure.
**Early Blight** (*Alternaria solani*): As discussed under Potato.

**Leaf Curl** [*Tobacco Leaf Curl Virus (TLCV)*]: There is downward rolling and curling of the leaves. Older curled leaves become leathery and brittle. Following control measures are recommended:

- use insecticides to prevent the build up of vector population and spray should start soon after planting;
- use healthy seed and seedlings; and
- soil treatment with Carbofuran 1.5 kg / ha.

### 6.2.5 Potato

**Insect-pests**

**Potato tuber moth** (*Phthorimaea operculella*, Gelechiidae : Lepidoptera): Larvae of this insect damage the tubers in the godowns. Infestation of this pest starts in field when its larvae mine leaves, bore in leaf petioles and terminal shoots. Following management practices are recommended:

- remove and destroy the infested tubers;
- only good quality tubers should be stored in cool, dry and well ventilated place (cold storage);
- proper earthing up is most important to prevent the egg laying on tubers through which the pest enters the godowns;
- *Habrobracon gelechiae H. hebetor* are the common parasitoids of this pest insect; and
- spray of malathion 0.05 per cent or carbaryl 0.15 per cent or endosulphan 0.07 per cent prove effective against it in the field.

**Aphids** (*Aulacorthum solani, Myzus persicae*, Aphididae: Homoptera): Green to pale green coloured nymphs and adults of this pest suck sap from leaves and twigs. They are also vectors of leaf curl virus disease. Following management practices are recommended:

- grow comparatively tolerant/less susceptible varieties;
- *Coccinella septumpunctata, Chrysoperla carnea, Chilomenus sexmaculatus, Syrphus balteatus* are the common predators of this pest;
- *Diaeretiella rapa* is the common parasitoid associated with this pest; and
- Oxydemeton methyl 0.025 per cent or dimethoate 0.03 per cent checks this pest effectively.

**Cutworm** (*Agrotis ipsilon*, Noctuidae: Lepidoptera): Caterpillars of this pest hide among clods during day and at night cut the twigs / seedlings and feed on tender parts of plants. In the end of season, the tubers get holes which start decaying. Following management practices are recommended:

- clean cultivation and regular stirring up of the soil reduces this pest's incidence;
- collect the gregarious stage of the larvae and destroy them;
• application of Lindane 20 EC or Chlorpyriphos 20 EC (0.05 per cent or Endosulphan 0.07 per cent on crop and soil followed by raking proves effective); and

• Microplitis sp., Turanogonia sp. Bracon sp., etc. are the important natural enemies associated with this pest.

Leafhoppers, lace wing bug, thrips, hadda beetle, etc. are the other insects which attack potato crop.

Diseases

Late Blight (Phytophthora infestans): Disease starts on leaves as water soaked lesions which later turn as faded green patches from the tip or margin of the leaves on upper surface. The primary infection of the plants is through dormant mycelium surviving in infected tubers. Following control measures are recommended:

• seed/tubers should be taken from healthy crop;

• spray the crop with Dithane M-45 @ 0.2 per cent as prophylactic sprays starting form six weeks after planting till the maturity; and

• use of resistant variety such as Kufri Jeevan, Kufri Alankar, Kufri Anand, Kufri Giriraj, Kufri Chipsona, and Kufri Badshah.

Early Blight (Alternaria solani): Disease appears as small isolated scattered pale brown to dark brown spots on the leaves. Fungus survives in diseased debris. Following control measures are recommended:

• destroy the diseased debris, infected tubers left in the field and follow proper crop rotation; and

• spray the crop with Dithane M-45 (0.2 per cent).

Leaf Roll (Potato Leaf Roll Virus, PLRV): Leaflets of the infected plant roll up along the margins starting from lower leaves which later on become thick and leathery. The virus is transmitted through the aphids (Myzus persicae).

Mosaic (Mild mosaic = Potato Virus): Dwarfing, mottling or mosaic and necrosis appear on plants. Following control measures are recommended:

• use certified seed;

• rogue out diseased plants at the initiation of the disease;

• remove foliage in 3rd or 4th week of December when aphid population starts developing; and

• spray of systemic insecticides like Metasystox or Rogor @ 0.1 per cent for the control of vector.

6.2.6 Chillies

Insect pests

Thrips (Scirtothrips dorsalis, Thripidae: Thysanoptera): Yellow straw coloured nymphs and adults of this pest lacerate the tissue of tender leaves, buds and flowers and imbibe the oozing sap. Activity of thrips is more in dry season. Following management practices are recommended:
Planning and Management of Horticulture Crops

- grow less susceptible or tolerant varieties;
- predacious thrips like, *Scolothrips indicus* and *Frankliothrips* sp. prey on this pest under field conditions; and
- spraying of malathion 0.1 per cent or fenvalerate 0.001 per cent or cypermethrin 0.001 per cent or dimethoate 0.03 per cent or oxydemeton methyl 0.025 per cent or monocrotophos 0.04 per cent are reported to control this pest effectively.

**Termites** (*Odontotermes* sp., *Microtermes* sp. Termitidae: Isoptera): White soft bodied workers of this pest feed on the roots of chili plants. Crop sown in sandy and sandy loams soils are more prone to this pest. Following management practices are recommended:

- avoid the application of raw / un-decomposed FYM;
- collect the crop refuge and burn/bury it in the soil; and
- application of chlorpyriphos 20 EC @ 5 ℓ/ha along with irrigation water or broadcast after mixing in about 20 kg soil followed by irrigation.

**Diseases**

**Leaf Curl** (*Tobacco Leaf Curl Virus, TLCV*): Severe stunting of plants with downward rolling and crinkling of the leaves. Following control measures are recommended:

- rogue out diseased plants; and
- control insect vectors by spraying insecticides.

**Wilt** (*Fusarium oxysporum* f. sp. *capsici*): The plant growth is checked, foliage turns yellow and there is downward curling of leaflets. Dry soils are most favourable for the disease. Following control measures are recommended:

- seed treatment with Thiram or Captan or Bavistin @ 2.5 g/kg seed; and
- follow long term crop rotation and field sanitation to reduce the disease.

**6.2.7 Okra**

**Insect-pests**

**Shoot and fruit borer** (*Earias vittella, E. insulana*: Noctuidae: Lepidoptera): Spindle shaped, black coloured (with white spots) caterpillars (larvae) of this pest bore into the growing shoots killing the growing points of the plant which leads to bushy growth. Later on when flower buds and fruits are formed, the larvae bore into these and feed on the internal contents. The infested fruits are deformed. Following management practices are recommended:

- collect and destroy or bury deep in soil the infested fruits;
- grow resistant varieties;
- *Cotesia* sp., *Microbracon* sp., *Habrobracon* sp., *Elasmus* sp. are the important parasitoids of this pest;
- egg parasitoid, *Trichogramma* sp. is also active in the field against this pest; and
- application of malathion 0.1 per cent or fenvalerate 0.001 per cent or
cypermethrin 0.001 per cent or endosulphan 0.07 per cent or
monocrotophos 0.04 per cent are reported to control this pest effectively.

**Leafhopper** (*Amrasca biguttula biguttula*, Cicadellidae: Hemiptera): Pale green
wedge shaped nymphs and adults of this insect suck sap from the underside of
leaves, near the veins. While feeding they inject toxic saliva in the leaf tissue which
turn yellow and curl. Following management practices are recommended:

- grow yellow vein mosaic virus resistant varieties as this pest is one of the
  vectors of this disease;
- a number of egg parasitoids and predators (*Chrysoperla sp.*, Spiders,
  Ants, etc.) of this pest have been recorded; and
- apply imidacloprid 200 SL or thiamethoxam 25 WG (100 ml / g / ha) or
dimethoate 0.03 per cent or oxydemeton methyl 0.025 per cent.

**Red spider mite** (*Tetranychus cinnabarinus*, Tetranychidae): Minute red coloured
globule shaped adults, larvae and nymphs of this pest suck sap from the ventral
surface of the leaves while remaining under the webbing made by it. Yellowish white
spots appear on the upper surface of the attacked leaves. It is more active during
dry season. Following management practices are recommended:

- *Scymnus sp.*, *Brumus sp.* are common predators of this pest; and
- dust fine sulfur or spray wettable sulfur or Endosulphan 0.07 per cent or
  Methrin (500 ml/ha).

**Diseases**

**Yellow Vein Mosaic** (*Yellow Vein Mosaic Virus, YVMV*): Vein clearing and vein
chlorosis of leaves takes place. Yellowish net work of veins is very prominent. Veins
and vein lets are thickened. Following control measures are recommended:

- grow resistant varieties i.e. ‘Varsha Upshaar, P-7, Parbhani Kranti’, etc.; and
- control the vector of this disease by using insecticides.

### 6.2.8 Pea

**Insect-pests**

**Leaf miner** (*Phytomyza horticola*, Agromyzidae : Hymenoptera): Maggots of
this pest mine the leaves in zig-zag fashion feeding on mesophyll. Shining white
streaks are seen on the leaves. Following management practices are recommended:

- grow resistant varieties;
- collect and destroy infested leaves;
- *Opius sp.*, *Neochrysocharis* sp., etc. are common parasitoids associated
  with this pest; and
- spray imidacloprid 200 SL or thiamethoxam 25 WG (100 ml / g / ha) or
dimethoate 0.06 per cent or oxydemeton methyl 0.05 per cent or
dichlorvos 0.05 per cent.

A number of pod borers and aphids also attack pea crop but are of negligible
significance in India.
Diseases

**Powdery Mildew** (*Erysiphe polygoni*): White floury patches on both sides of the leaves as well as on the tendrils, pods and stems etc. are seen. Following control measures are recommended:

- field sanitation to check infection from diseased debris; and
- spray Karathane 0.1 per cent or Sulfex 0.2 per cent as the disease starts appearing and repeat at 10-15 days interval.

**Rust** (*Uromyces fabae*): Round yellow pustules in clusters appear on leaves which turn brown. Following control measures are recommended:

- diseased crop debris should be destroyed; and
- spray the crop with Dithane M-45 @ 0.2 per cent as the disease starts appearing and repeat at 10-15 days interval.

### 6.2.9 Onion and Garlic

**Insect-pests**

**Thrips** (*Thrips tabaci*, Thripidae: Thysanoptera): Numerous nymphs and adults (slender, fragile, yellowish) are found in between leaf sheath and stem, lacerating the epidermis of the leaf and lapping up the exuding sap. Silvery white blotches appear which turn brown later on. Following management practices are recommended:

- grow resistant / tolerant varieties; and
- spray endosulfan 0.07 per cent or dimethoate 0.03 per cent or monocrotophos 0.04 per cent or fenvalerate 0.001%, etc. to control this pest effectively.

**Onion fly** (*Delia antiqua*, Anthomiidae: Diptera): White maggots of this pest burrow down from leaf sheath in the underground portion of stem and reach the bulb. Following management practices are recommended:

- grow resistant / tolerant varieties;
- apply 4 kg Sevin 4G or Lindane 6 G or Thimet 10 G to the soil followed by light irrigation; and
- spray Endosulfan 0.07 per cent targeting the base of the plants to avoid the egg laying or entry of maggots in the stem.

### Diseases

**Purple Blotch** (*Alternaria porri*): Small water soaked areas develop on the leaf or on the seed stalk which turn brown, enlarge and turn purplish and surrounded by a yellow halo. Following control measures are recommended:

- the field should be well drained and follow crop rotation;
- seed treatment with Thiram or Captan @ 2.5 g/kg seed; and
- spraying should be done with Dithane M-45 @ 0.2 per cent before seed stalks appear and continue at 7-10 days interval.
Check Your Progress 1

Note:  a) Compare your answers with those given at the end of unit.
       b) Use the space below for your answers.

1) List the important insect-pests infesting the fruiting parts of important vegetable crops.

2) List the important diseases of vegetable crops.

3) Which are the important insect-pests of vegetable crops which suck sap from different parts of the plants?

6.3 MAJOR INSECT-PESTS AND DISEASES OF FRUITS AND THEIR MANAGEMENT

6.3.1 Guava

Insect-pests

Fruit flies [Bactrocera (=Dacus) diversus, B. dorsalis, B. cucurbitae, B. zonatus; Tephritidae: Diptera]: These are polyphagous insects and lay eggs in the soft tissue of ripening fruits. Maggots, white in colour, bore into the soft tissue/pulp.

- Pick the fruits before the start of ripening;
- Collect the infested and fallen fruits and bury them deep in the soil or feed them to goats and sheep;
- Deep ploughing around trees exposes the pupae for predators to pick;
- Poison bait with protein hydrolysate, malathion and water (1:1:10);
- Spray the trees with 0.025 per cent oxydemeton methyl or 0.03 per cent dimethoate; and
• spray the trees with bait spray (500 ml malathion + 5 kg Gur (Jaggery) or sugar) in 500 l water.

Bark eating caterpillars (Indarbelia tetraonis, I. quadrinotata, Indarbellidae: Lepidoptera): Black coloured caterpillars of this pest bore into the main stem or branch, mostly at the point of forking. During day time, it remains in the bore hole and at night it feeds on the bark while remaining sheltered in silken galleries made of frass and excreta. Winding silken galleries are seen on the attacked trees. Following management practices are recommended:

• grow comparatively tolerant varieties of guava;
• keep the orchard clean and well attended;
• remove frass of galleries, locate the borer hole and kill the larva mechanically by iron spike;
• during September - October clean the infested portion and apply insecticide solution (10 ml Monocrotophos + 10 l water) around the holes and bark; and
• during February-March remove the galleries, locate the hole and insert a cotton swab soaked in insecticide solution (carbaryl 50 WP 40g or Fenitrothion 10 ml in 10 l water or l l kerosene oil + 100g soap + 9 l water) and close the hole with mud or put 5 ml solution in each hole.

Besides these, castor capsule borer, scales and mealy bugs, thrips etc. are also reported from guava trees.

Diseases

Wilt: Cause of this disease are not fully known. Leaves of the terminal branches turn pale green to yellowish brown. Discolouration of the stem and death of the branches along one side or both the sides may occur. The disease also causes die back symptoms. Following control measures are recommended:

• destruction of infected trees;
• prevent injury during planting and avoid water logging conditions;
• use of L-49 cultivar of guava;
• application of Bavistin @ 15 gm/plant in soil in the month of March, June and September; and
• spray zinc sulphate @ 0.3 per cent in March and September.

6.3.2 Ber

Insect-pests

Fruit flies (Carpomyia visuviana, Tephritidae : Diptera): Female of these fly lay eggs in fruits and the emerging maggots (creamy white) feed on the pulp of the fruits. Following management practices are recommended:

• collect the attacked/fallen fruits and destroy or bury them deep in soil or feed them to animals;
• remove wild ber species plants from the vicinity of the orchard;
• regular deep ploughing and raking of soil around trees;
• pick the fruits as soon as maturity starts;
• use adult fly attractant (Cue lure, methyl eugenol, etc.) for mass trapping;
• apply oxydemeton methyl 25 EC or dimethoate 30 EC (1250 ml/ha) in 500 l water/ha when fruit size is that of a pea; and
• bait spray (malathion 500 ml + 5 kg gur + 500 l water)

Bark eating caterpillar, leaf miner, castor semi looper, hairy caterpillars, etc. are the other insect pests attacking this crop.

Diseases

**Powdery Mildew** (*Oidium erysiphoides f. sp. Ziziphi; Microsphaera alphitoides):** Whitish grey mycelium appears on peanut sized fruits. As the fruit grows, its epidermis becomes corky. Following control measures are recommended:

- spraying of Karathane (0.1 percent) or Sulfex (0.2 per cent) just before flowering, at the peanut size fruit stage, followed by two more sprays at an interval of 15 days.

### 6.3.3 Mango

**Insect-pests**

**Mango hopper**, *Amritodus atkinsoni, Idioscopus clypealis*, Cicadellidae: Hemiptera): Wedge shaped greenish brown coloured, enormous in number, cluster on inflorescence and suck sap. Similar looking adults move to leaves and trunks of trees. Following management practices are recommended:

- do not keep the orchard dense to let the light penetrate;
- keep the orchard clean;
- predators *Mallada boninensis, Chrysoperla sp.* and parasitoids, *Tetrastichus sp.* and fungus *Verticillium lacani* are the natural enemies of this pest; and
- spray Malathion or Carbaryl 0.15 per cent or Endosulphan 0.05 per cent at panicle formation and full bloom stage.

**Mango mealy bug** (*Drosicha mangiferae*, Margarodidae : Hemiptera): Eggs are laid in soil around tree, young ones (nymphs) crawl up the tree trunk and congregate on young shoots and panicles and suck sap. Full fed gravid females, which are crimson coloured, wingless and oval flat, climb down the tree to enter the soil. Following management practices are recommended:

- remove weeds and grasses;
- dig and plough soil around mango trees during summer to kill eggs;
- raking of soil and mixing Methyl parathion 2D @ 250g / tree to kill the emerging nymphs;
- apply heavy irrigation to kill the eggs;
Planning and Management of Horticulture Crops

- prevent nymphs from crawling up the trunk by applying slippery band (alkathene band 15 to 20 cm wide);
- apply methyl Parathion 2D @ 50g on the nymphs or gravid females congregated around these bands; and
- application of Monocrotophos 0.05 per cent or Carbaryl 0.2 per cent on trees helps to kill the already ascended nymphs.

Fruit fly, stem borer, shoot borer, etc. are the other insects associated with this crop.

Diseases

**Malformation or Bunchy Top** (*Fusarium moniliformae* var. *subglutinans*): In young plants, bunching at the apex of the shoot or in the leaf axil takes place. Reduction in the length of panicles is seen. Flower buds are transformed into vegetative buds and give a witches’ broom like appearance. Following control measures are recommended:

- pruning of affected terminals;
- two sprays of 0.2 per cent Captan and 0.1 per cent Malathion at the time of initiation of flowering;
- spray of NAA (300 ppm) in September; and
- de-blossoming of early malformed panicles.

**Black Tip or Necrosis** (Physiological disorder; *SO₂* from brick kilns): Small etiolated area develops at the distal end of the 6-8 weeks old fruits which turn black and cover the whole tip. Following control measures are recommended:

- two sprays of Borax (3-4 kg in 500 l water) at 10-15 day interval; and
- do not establish brick kilns near the mango orchard.

6.3.4 Grapes

**Insect-pests**

**Thrips** (*Rhipiphorothrips cruentatus*, Thripidae : Thysanoptera): Nymphs (reddish) and adults (bright yellowish) rasp the ventral surface of tender leaves and flower stalks and suck the oozing cell sap. Very often fruits are also attacked leading to scratchy patches. Following management practices are recommended:

- grow varieties which bear lax type of bunch; and
- spray Malathion 0.05 per cent or Carbaryl 0.15 per cent and repeat if required after 15 days.

**Grape-vine leaf roller** (*Sylepta lunalis*, Pyralidae: Lepidoptera): Initially, the larvae of this pest feed on epidermis of leaves and later on roll the leaf and feed within. Following management practices are recommended:

- remove the rolled leaves in the initial stages and destroy along with larvae and pupae in side; and
- spray Malathion 0.1 per cent or Endosulphan 0.07 per cent or Carbaryl 0.15 per cent.
Jassids (leafhopper), mealybugs, grapevine beetle, girdler, flea beetle, and wasp are the other insects attacking grapevines.

**Diseases**

**Powdery Mildew** (*Uncinula necator*): The disease appears as small whitish patches on both sides of the young leaves, branches, flower tendrils and fruits. Following control measures are recommended:

- diseased plant parts should be removed and destroyed; and
- spray the vines with Sulfex (0.2 per cent) as disease starts appearing and should be repeated prior to blossoming and at half ripe fruit stage.

**Anthracnose/Bird’s Eye Disease/ Black Spot** (*Gloeosporium ampelophagum*): Circular necrotic spots with grayish-black centers and yellow margins appear on the leaves which dry and fallout leaving shot hole symptoms. Following control measures are recommended:

- proper pruning of vines particularly diseased ones; and
- spray of Bavistin (0.2 per cent) during dormancy and repeat during first week of May, last week of July, second and last week of August.

### 6.3.5 Citrus

**Insect-pests**

**Citrus psylla** (*Diaphorina citri*, Psyllidae: Hemiptera): Nymphs, flattened circular, yellowish orange and adults (brown, 2-3 mm, with their posterior portion of body raised up) suck sap from the terminal shoots and buds and later on spread to leaves. They also exude honeydew on which black mould develops and hinder in photosynthesis. Following management practices are recommended:

- *Tetrastichus* sp., *Diaphorencyrtus* sp. parasitize this pest to an extent of 80 per cent;
- Chrysopids and Coccinellids also suppress population of this pest in the field; and
- spray Dimethoate or Monocrotophos or Oxydemeton methyl or Triazophos or Quinalphos (all 0.05 per cent) or Endosulfan 0.07 per cent.

**Citrus leaf miner** (*Phyllocnistis citrella*, Phyllocnistidae: Lepidoptera): Caterpillars (larvae) feed on the chlorophyll of the leaves making shining, silvery, serpentine mines. The leaves are distorted and plant growth is checked. Following management practices are recommended:

- avoid injury (including pruning) during active growth period of plants;
- avoid frequent irrigation and split dose of nitrogen;
- collect and destroy infested leaves;
- *cirrospilus* sp., *Citrothichus* sp., *Eurytoma* sp. and *Ageniaspis citricola* are the parasitoids actively associated with this pest;
- predators like mantids, spiders, *Mallada boninensis* also reduce its population in the orchard; and
Planning and Management of Horticulture Crops

- spray Dimethoate or Oxydemeton methyl 0.05 per cent or Fenvalerate or Cypermethrin 0.02 per cent at fortnightly intervals when needed.

**Citrus whitefly** (*Dialeurodes citri, Aleurodidae: Hemiptera)*; **Citrus blackfly** (*Aleurocanthus woglumi, Aleurodidae: Hemiptera)*: Nymphs and adults suck sap from leaves and also exude honeydew causing hindrance in photosynthesis. Following management practices are recommended:

- avoid close planting;
- prune and destroy affected twigs;
- avoid excessive irrigation, N application and drought;
- *brumoides suturalis, Verania sp., Aleurothrips sp., Chrysoperla sp.* are the common predators of these pests;
- spray Ethion or Triazophos or Endosulfan or Monocrotophos (all 0.05 per cent); and
- *Encarsia sp. and Eretmocerus sp.* are quite effective natural parasitoids of this pest.

**Citrus butterfly** (*Papilio demoleus, Papilionidae : Lepidoptera)*: Young caterpillars resemble bird droppings (black with white markings) and the grown up caterpillars are yellowish green, smooth and velvety with horn like structure. Caterpillars feed voraciously on citrus leaves. Following management practices are recommended:

- hand picking and destruction of the larvae is helpful;
- *Trichogramma chilonis, Telenomus sp.*, etc. are the common egg parasitoids and *Apanteles flavipes, Brachimeria sp.*, etc. are the important larval parasitoids of this pest; and
- Bt formulations (Dipel, Delfin, etc. @ 1/l/kg/ha or endosulfan 0.07 per cent or malathion or carbaryl both 0.15 per cent) control this pest effectively.

Fruit sucking moth, mealy bug, red scale, fruit flies, thrips etc. are other insects of this fruit crop.

**Diseases**

**Decline or Die-Back** (Physiological disorder): These include die-back of small branches and twigs, yellowing of leaves, and heavy bearing of small fruits. Plant appears wilted, almost completely, and dies within 7-8 years.

**Canker** (*Xanthomonas axanopodis pv. citri*): Lesions appear first as minute water soaked circular spots on leaves, twigs, petioles, branches, thorns and fruits. These spots further enlarge (2-10 mm); turn brown, raised, rough, eruptive and corky. Following control measures are recommended:

- pruning of diseased plant parts before monsoon, followed by spraying with Bordeaux mixture (1 per cent) or Blitox (0.2 per cent) and destruction of diseased debris;
- use of resistant varieties. Lime is more susceptible than orange; and
- spray of Blitox-50 or Fytolan @ 0.2 per cent in the month of July, October, December and February or Streptomycin sulphate (10g) + copper sulphate (10g) in 500ℓ water in October, December and February.
6.3.6 Sapota

Insect-pests

Chikoo moth (*Nephopteryx eugraphalla*, Pyralidae: Lepidoptera): Pinkish larvae of this leaf webber of sapota clump the leaves together and feed on green matter of leaves and often on buds and flower and sometimes on fruits also. Following management practices are recommended:

- remove and destroy the infested leaves/clumped leaves along with larvae;
- spray Malathion 0.05 per cent or Fenvalerate 0.001 per cent or Endosulphan 0.07 per cent to control this pest.

Bud borer, scales and mealy bugs, leafhopper, etc. are the other insect pests of this crop.

Diseases

Pestalotia and other Leaf Spots (*Pestalotiopsis* sp., *Pestalotia* sp.): Small, reddish spots, irregularly scattered on the leaf blade which gradually increase in size and become round. Following control measure is recommended:

- spray Copper oxy-chloride or Zineb 0.3 per cent.

6.3.7 Banana

Insect-pests

Banana weevil (*Cosmopolites sordidus*, Cucurionidae: Coleoptera): Creamy white spindle shaped grubs (larvae) of this pest bore into the stem. Adults feed on pseudostems and suckers during night. Following management practices are recommended:

- use clean pest free planting materia;
- dip the suckers in Monocrotophos (0.05 per cent and then dry for 24 hours before planting);
- keep the orchard clean and well fertilized;
- use banana – corm split trap to collect and destroy the weevils;
- use corm weevil pheromone traps; and
- spray monocrotophos 0.1 per cent.

Flea beetles, hairy caterpillars, bagworms, lacewing bug, aphids, etc. are the other insect pests of this crop.

Diseases

Panama or Wilt (*Fusarium oxysporum* f. sp. *cubense*): Sudden wilting leaves turn yellow, chlorotic, the leaf petiole breaks off and leaf blade hangs down and withers. Following control measures are recommended:

- eradication of infested plants and application of Bavistin @ 2g/l water control this disease; and
- application of lime to the infested pits after chopping off the diseased parts.
Bunchy Top (*Banana Bunchy Top Virus BBTV*): Infected leaves become short, narrow, chlorotic and exhibit mosaic symptoms. The leaves arise in clusters giving a rosette appearance, with dark green patches and the margins roll upward. Following control measures are recommended:

- check the insect vector and do not take diseased suckers to new areas.

### 6.3.8 Litchi

**Insect-pests**

**Leaf curl mite** (*Acervia litchi*, Eriophidae): Nymphs and adults of this pest puncture the ventral surface of leaf tissue and suck the oozing sap. Chocolate brown – velvety growth appears on the affected portion and leaves curl up. Following management practices are recommended:

- collect and burn the mite affected leaves;
- check the pest in initial stages itself;
- dip the layers in 1:1 ratio solution of Dimethoate and moistening agent;
- spray Dimethoate 0.05 per cent or / and 0.012 per cent Dicofol; and
- spray of wettable sulphur @ 100g in 20 l water or Dimethoate 0.05 per cent or Dicofol 0.1 per cent or Methyl demeton 0.05 per cent.

**Fruit borers**: A number of fruit borers attack litchi fruit, the whitish larvae of which bore the fruit and reach the seed. Following management practices are recommended:

- plow the field, collect and destroy fallen fruits;
- *Mesochorus* sp., *Chelonus* sp., *Bracon* sp., etc. are the common natural enemies of these fruit borers; and
- spray Fenvalerate 0.025 per cent or Endosulphan 0.07 per cent or Quinalphos or Monocrotophos (both 0.05 per cent).

Leaf eating caterpillars, aphids, whiteflies, stem/trunk borer, etc. are the other insects which are likely to attack litchi trees.

### Diseases

**Leaf Spots** (*Pestalotia pauciseta*, *Botryodiplodia theobromae* and *Colletotrichum Gloeosporioides*): Initially, small spots, usually on upper surface, appear but later many of them coalesce and form large necrotic areas on the leaf surface. Following control measure is recommended:

- frequent spray of fungicides.

**Fruit Rot of Litchi** (*Aspergillus flavus*, *A. niger*): Convex spots appear on affected leaves on the upper surface and concave on the under surface. Following control measure is recommended:

- one or two pre-harvest sprays of 0.2 per cent Captan or 0.1 per cent Copper oxychloride.

### 6.3.9 Pome Fruits (apple, pear)

**Insect-pests**

**San Jose scale** (*Quadraspidiotus perniciosus*, Diaspididae:Hemiptera): This tiny orange coloured insect secretes dark grey scales over its body for its protection.
They suck sap and plants, especially in nursery, get weak and dry away. The infested plant parts are covered with grey scales. Following management practices are recommended:

- use scale free planting material, especially root stock;
- spray the nursery stock with 3 per cent miscible spray oil and Chlorpyriphos 0.05 per cent;
- *Aphytis* sp., *Encarsia perniciosa* and *Chilochorus* sp. are important natural enemies of this pest;
- mark the infested trees and spray with 2 per cent dormant miscible spray oil at the initiation of the attack; and
- spray chlorpyriphos 0.04 per cent or Fenitrothion 0.05 per cent or Dimethoate 0.03 per cent to control it.

**Wooly apple aphis** (*Eriosoma lanigerum*, Penphygidae:Hemiptera): This aphid feeds (sucks sap) from foliage and roots. Root infestation results in gall or knot formation. While feeding it produces a wooly filament of wax over their bodies. Following management practices are recommended:

- use pest resistant rootstock;
- endoparasite of this aphid, *Aphelinus mali* is well established in India;
- treat the plants in nursery with Carbofuron or Phorate granules @ 0.5g / plant; and
- treat the plants with Chlorpyriphos or Fenitrothion (each 0.05 per cent) or Thiamethoxam 0.025 per cent before planting.

**Diseases**

**Apple Scab** (*Venturia inaequalis*): Light brown or olive green, irregular spots appear on the lower surface of the leaves which become darker, velvety, grayish dark and circular in outline. On fruits, dull, brownish to black spots become corky with deep cracks. Following control measures are recommended:

- fallen leaves should be destroyed by spraying 5 per cent urea (October to November). Pre bud spray of 2 per cent urea in spring on diseased leaves prevents the release of ascospores;
- spray the crop with Dithane M-45 or Bavistin or Dodine or Topsin- M (0.2 per cent), one at green tip stage, one at petal fall stage (April-May), two after petal fall stage at 10-15 days interval; and
- resistant cvs. like Prima, Macfree, Coop-12, Red free and Easygro should be preferred.

**Peach Leaf Curl** (*Taphrina deformans*): New emerging leaves are twisted, thickened, curled downwards and distorted which later on become reddish, thick and fleshy. Following control measures are recommended:

- all fallen diseased leaves, twigs, etc. should be collected and burnt;
- tolerant cvs. are Bed Will’s Early, July Elberta and World’s Earliest; and
• spray the trees in autumn with Bordeaux mixture (6:6:50), or copper oxychloride (0.25 per cent) and before opening of the buds.

6.3.10 Pomegranate

Insect-pests

Fruit borer ([Deudorix (=Virachola) isocrates, Lycaenidae:Lepidoptera]: Also called Anar butterfly, its full grown caterpillars are dark brown with white patches. They bore the fruits and feed on pulp and seeds just below the rind. Following management practices are recommended:

• bagging of fruits just before maturity;
• collect and destroy infested fruits; and
• spray Endosulfan 0.07 per cent just after the initiation of fruit setting.

Bark eating caterpillars, stem boring beetles, shot hole borer, aphids, whiteflies, etc. are the other insects attacking pomegranate trees.

Diseases

Bacterial Blight ([Xanthomonas sp.]: Water soaked lesions appear on leaves, veins and fruits turning into brown irregular patches. Following control measure is recommended.

• spray Streptocycline @ 200 ppm.

Fruit cracking (Physiological Disorder): Fruit rind starts splitting during summer followed by infection of saprophytic fungi. Following control measure is recommended.

• ensure regular irrigation.

Check Your Progress 2

Note: a) Compare your answers with those given at the end of unit.
    b) Use the space below for your answers.

1) List the important insect-pests which suck sap from the different parts of citrus and mango trees.
2) Which are the important diseases of guava, ber, citrus, banana and pomegranate orchards?

3) List the management practices for controlling citrus whitefly and citrus blackfly in citrus.

6.4 LET US SUM UP

- India has diverse climatic conditions and a number of fruits and vegetable crops are grown in different regions. Because of this diversity, various insect-pests and diseases attack these crops at different stages of crop growth. There is hardly any crop which is not attacked or infested by insect-pest or disease causing organisms.
- It is of utmost importance to identify major insect-pests infesting fruits and vegetable crops. It is absolute necessary to ascertain the nature of damage caused by insects-pests so that suitable physical and biological remedial measures are adopted to enhance productivity.
- It is crucial to identify the symptoms of most common disease causing organisms (pathogens) infecting various parts of the plant of different crops in order to initiate timely control measures for checking their spread to other parts of the plant or the adjoining plants.
- In the wake of globalization, fruits and vegetables for exports infested or infected with pests and diseases are not only unacceptable but they are rejected straightway if pesticides residue is found to be beyond a particular limit. Therefore remedial measures need to be initiated at the right time to fulfill the export commitments.

6.5 KEYWORDS

Aphid : This insect commonly called plant lice, is soft bodied, green, yellowish green or black in colour. They suck sap from different parts of the plant and are responsible for the transmission of a number of viral diseases in plants.
Planning and Management of Horticulture Crops

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caterpillar</td>
<td>It is the larval stage of the insects which belongs to the order Lepidoptera (moths and butterflies).</td>
</tr>
<tr>
<td>Diseases</td>
<td>Microorganisms (fungi, bacteria, virus, etc.) when cause infection on any part of the plant, result into the development of a disease which causes economic losses to the farmer.</td>
</tr>
<tr>
<td>Insect-pests</td>
<td>These are those insects which cause damage to the different parts of the plant resulting into economic loss to the farmers.</td>
</tr>
<tr>
<td>Leaf Curl</td>
<td>This condition results when its causal virus is transmitted by the feeding of any insect, or sometimes mechanical transmission also takes place. Leaves start curling, mostly upward, later on drying away.</td>
</tr>
<tr>
<td>Leafhopper</td>
<td>These are small wedge shaped insects, green or yellowish brown in colour. They suck sap from different parts of the plant especially the tender ones or from the leaves.</td>
</tr>
<tr>
<td>Maggot</td>
<td>These are the young ones (larval stage) of different flies and are white to creamy white in colour and feed on the internal content (pulp) of various fruits, making them unfit for human consumption.</td>
</tr>
<tr>
<td>Natural Enemies</td>
<td>These are those organisms which are the enemies of insect-pests or pathogens active in nature and reduce their population.</td>
</tr>
<tr>
<td>Pesticide</td>
<td>It is a broader term used for any material which kill the insect or pathogen (disease causing organisms) e.g. insecticide – to kill insects; fungicide – to kill fungi, etc.</td>
</tr>
<tr>
<td>Wilt</td>
<td>It is a disease which is caused by a number of pathogens in different crops. The plants start withering, leaves droop down and ultimately whole plant dies away.</td>
</tr>
</tbody>
</table>

**6.6 SUGGESTED READING**


Check Your Progress 1

1) Fruit borers of okra, tomato, brinjal; fruit fly of cucurbits; diamondback moth, tobacco caterpillar and pod borer of pea.

2) Damping off, downy and powdery mildews, late and early blights anthracnose, little leaf, leaf curl and leaf roll (virus), wilt, yellow vein mosaic, purple blotch.

3) Leafhopper, whitefly, aphids, thrips, etc.

Check Your Progress 2

1) Mango hopper, mango mealy bug, citrus whitefly, citrus blackfly, citrus psylla, etc.

2) Guava wilt, bacterial blight of pomegranate, powdery mildew of ber, citrus canker, banana wilt, bunchy top of banana, etc.

3) Following management practices are recommended for controlling citrus whitefly and citrus blackfly:
   - Avoid close planting.
   - Prune and destroy affected twigs.
   - Avoid excessive irrigation, N application and drought.
   - *Brumoides suturalis*, *Verania* sp., *Aleurothrips* sp., *Chrysoperla* sp. are the common predators of these pests.
   - Spray Ethion or Triazophos or Endosulfan or Monocrotophos (all 0.05%) 
   - *Encarsia* sp. and *Eretmocerus* sp. are quite effective natural parasitoids of this pest.