

Insect Pests Of Horticultural Crops And Its Management

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Introduction:

The Horticulture production has become a key driver for economic development in many of the states in the country and it contributes 30.4 per cent to GDP of agriculture. India is globally, second largest producer of fruits and vegetables. Country is the largest producer of mango, banana, coconut, cashew, papaya, pomegranate etc. and also largest producer and exporter of spices. In the foreign trade, export growth of fresh fruits and vegetables in term of value is 14 per cent and of processed fruits and vegetables is 16.27 per cent. Production losses due to pests are around 30 per cent of the total economy of our country. However, study of pest and their management is important in the horticultural crop production.

PESTS OF VEGETABLES

PESTS OF BRINJAL

I Borers

Shoot and fruit borer : General symptoms of damage are withered terminal shoots, bore holes on shoots plugged with excreta,(Fig. 68) shedding of flower buds, drying of leaves due to boring on petioles by larvae. Larva is pink in colour. Adult is medium sized moth with forewings having black and brown patches and dots. Hind wings are opalescent with black dots(Fig. 67).

Stem borer : Stunted growth, withering and wilting of plants. Bore holes on stem and leaf axils are covered with excreta; Infestation caused by larva. Larva is yellowish or light brown with red head. Moth greyish brown, forewings with transverse lines and white hindwings.

Bud worm : Larva causes shriveling and shedding of flower buds. It is pale whitish with pink tinge. Adult moth is small with fringed wings.

II Leaf feeders

Spotted beetle (or) Hadda beetle : Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in colour and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytra.

Leaf roller : Leaves are folded from tip to downwards followed by withering and drying up of leaves. Purple brown larva is ornamented with yellow spots and hairs. Adult is with brown forewings and an olive green triangular patch on outer area.

Ash weevils : Adults cause notching of leaf margins. Grubs feed on roots resulting in wilting of plants. Grub is small and apodous. Adults are greenish white with dark lines on elytra or brownish weevil or brown with white spot on elytra or small and light green in color.

III Sap feeders

Leafhopper : Symptom of damage is yellowing of leaves followed by crinkling and downward curling leading to bronzing and hopper burn. Nymph is light green and translucent. Adult is green in colour.

Aphid : Curling and crinkling of leaves, stunted plants with honeydew secretion and sooty mould are the symptoms of damage. Large number of aphids are seen on tender/apical shoots. Nymph is greenish brown or yellow in colour. Adult is yellowish green to dark green in posterior side.

IV Root feeders

Termites: *Trinervitermes biformis*, *Microtermes* spp : Nymphs and adults gnaw the roots below the ground level, tunnel upwards through the stems and eat inner tissues. The affected plants wither and dry especially in light soils.

PESTS OF TOMATO

I Borer

Fruit Borer : Young larva feeds on tender foliage and from fourth instar onwards infests fruits. They make circular holes and thrust only a part of their body inside fruit and eat inner contents.(Fig. 69) Young larva is yellowish white but gradually becomes green. Full-grown larva is apple green in colour with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

Stem borer : Stunted growth, withering and wilting of plants, stem and leaf axils covered with excreta covering boreholes are symptoms of infestation caused by the larvae. Larva is yellowish or light brown with red head. Moth is with greyish brown forewings having transverse lines and white hindwings.

II Leaf Feeder

Leaf miner : Leaves are often with serpentine mines followed by drying and dropping of leaves due to infestation. Larva is orange yellowish and apodous. Adult is pale yellow fly.

Tobacco caterpillar : Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings with a brown patch along its margin.

Green semilooper : Leaves are with holes and skeletonisation and defoliation represent severe damage. Larva is slender, attenuated anteriorly and green in colour with light wavy lines and a broad lateral stripe on either side. Adult is stout moth. Head and thorax are grey in colour. Abdomen is white with basal tufts ferruginous and grey wavy forewings with a slender Y– mark.

Spotted beetles : Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in colour and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytra.

III Sap Feeders

Green peach aphid : Leaves get curled and crinkled coated with honeydew and sooty mould. Plants remain stunted. Nymphs occur in different

colour forms viz., yellow, green and red. Yellow forms are dominant. Both winged and wingless adults are common.

Fruit sucking moth : Adult sucks the juice by piercing the fruits. Infested fruits will shrink, shrivel, rot and ultimately drop down. Semilooper is with orange blue and yellow spots on its velvety dark speckled body. Stout built moth is with grey and orange coloured wings. Forewing are grey with white patches and a tripod black mark in the center of each(Fig. 70). Hind wings are yellow bearing black patches on the outer margin and curved patch in the middle. The larvae feeds on the leaves of the creeper weed *Tinospora vordifolia*.

PESTS OF BHENDI

I. Borers

Stem weevil : The grub causes gall like swellings on the stem near the base. Grub is white and apodous. Adults feed on leaves, buds and tender terminal shoots. Grub is creamy yellow and apodous. Adult is dark greyish brown with pale cross bands on elytra.

Shoot weevil : Grubs bore into stem and petioles causing gall like swellings. Adults feed on leaves, buds and tender terminal shoots. Grub is creamy yellow and apodous. Adult is dark greyish brown with pale cross bands on elytra.

Shoot and fruit borer: Symptom of attack is withering and drying of tender shoots in the early stage. Larva bores into flowers and flower buds causing withering and dropping of the same. Fruits with bore holes are seen often and sometimes deformed. Larva is stout , spindle shaped, dark

brown in colour and with white patches on the dorsum. *Earias vitella* : small buff colored. Forewings with a wedge shaped green patch in the middle. *E. insulana*: entire forewing is green.

Stem fly : The maggot bores into tender shoots and petiole of leaves resulting in drying of leaves and seedlings. Maggot is yellow in colour. Adult is a small black fly.

Fruit borer : Young larva feeds on tender foliage and from fourth instar onwards attack fruits. They bore circular holes and thrust only a part of their body inside fruit and eat inner contents. Freshly hatched larva is yellowish white but gradually become green. Full-grown larva is apple green in colour with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

III Leaf Feeders

Leaf roller : Young larvae feed on the epidermis, roll the leaves, feed within and eat away the rolled portions. Larva is bright green with dark head and prothoracic shield. Moth is with yellowish fore and hindwings with brown lines and distinct markings.

Semilooper : The caterpillar completely feeds on the leaves (defoliation). *Anomis flava*: Larva is green in colour with 5 white longitudinal lines. Adult is brown and medium sized moth. *Acontia* (= *Xanthodes*) *graellsii*: Larva is green in colour with horse-shoe-shaped black markings on each segment. Moth is yellowish with black markings

all over the wings. *Tarache nitidula*: Larva is green in colour and resembles bird's droppings. Adult is white with grey markings.

Tobacco caterpillar: Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings are having a brown patch along its margin.

PESTS OF CUCURBITS

Fruit flies : The maggots feed on the pulp of the fruits and the symptoms of damage include oozing of resinous fluid from fruits, distorted and malformed fruits (Fig. 71) premature dropping of fruits and unfit for consumption. Maggot is white and apodous. Adult is with hyaline wings or brownish body with brown oval spot on either side of 3rd tergite.

Snake gourd stem weevil : Grub bores into the stem/petiole and causes withering of leaves. Adult is small black weevil and feeds on leaves.

Stem gall fly : Maggot bores inside the distal shoot and induces galls. Adult is slender and dark brown mosquito like fly.

Stem borer : Larva bores into the stem of snake-gourd and produces gall. Adult is dark brown moth with transparent wings.

Leaf miner : Leaves are often with serpentine mines followed by drying and dropping of leaves due to infestation. Larva is orange yellowish and apodous. Adult is pale yellow fly.

Snake gourd semilooper : Larva cuts the edges of leaf lamina, folds it over the leaf and feeds from within the leaf roll. Larva is whitish green and the body is with black warts, off-white longitudinal stripes and a hump on its anal segment. Stout dark brown adult has shiny brown forewings.

Pumpkin caterpillar : The caterpillars lacerate and feed on chlorophyll of foliage; later fold and web the leaves together and feed within. They may also damage ovaries of flowers and boring into young developing fruits. Larva is elongate, bright green with two narrow longitudinal stripes dorsally. Adults are medium sized, wings are white and transparent with broad brown margin. Female has tuft of orange hairs at the anal end.

Pumpkin beetle: Grubs feed on the roots, stem and fruits that spread over the soil. Adults feed on leaf and flower. Grub is creamy yellow. Adult is grey black with black or blue colour with glistening yellow red border.

PESTS OF CRUCIFERS

I Leaf Feeders

Diamond back moth : Young caterpillars cause small yellow mines followed by scrapping of epidermal leaf tissues producing typical whitish patches. Full-grown larvae bite holes in the leaves. Larva is pale yellowish green in color, pointed at both ends with fine erect black hairs scattered over the body. Adult is small, green brown with pale whitish narrow wings. At rest a dorsal median patch of 3 diamonds shaped

yellowish white spots are clearly visible by joining both forewings. Hindwings have a fringe of long fine hairs(Fig. 72).

Cabbage borer : Larvae web the leaves and bore into the stem, stalk or leaf veins. Larva is pale whitish brown with 4-5 purplish brown longitudinal lines. Adult is pale greyish brown with 4-5 purplish brown longitudinal lines. Adult is pale greyish brown moth with forewings having grey wavy lines. Hindwings are pale dusty.

Leaf webber : Young larvae feed gregariously on leaves, later web together the leaves and feed. Larva is with red head, brown longitudinal stripes and rows of tubercles with short hairs on its pale violaceous body. Adult is small with brown forewings having distinct wavy spots. Hindwings are semi-hyaline.

Cabbage semilooper : Damaged leaves are with holes initially and the severe damage is represented by skeletonization. Larva is green color with light wavy lines and broad lateral stripes on either side. Adult is stout moth. Head and thorax are grey in colour and the abdomen is white with basal tufts. Head and thorax are grey in colour and the abdomen is white with basal tufts. Grey wavy forewings are with a slender 'y' mark.

Cabbage butterflies : The caterpillar feeds on leafy vegetation irregularly (defoliation). Sometimes bores into the heads of cabbage. Larva is velvety bluish green in colour with yellow dorsal and lateral stripes are covered with black hair. Adult is with snow white forewings and black apical spots; hind wings are pure white.

Tobacco caterpillar : The caterpillar damages leaves and heads of Cabbage, Cauliflower, Radish and . . Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings with a brown patch along its margin.

Mustard sawfly : Caterpillar like grubs nibble the tender margins of tender leaves and later bite holes on the leaves. Adult is with dark head and thorax, orange coloured abdomen and smoky wings with black veins. Female has a strong saw-like ovipositor.

II SAP FEEDERS

Thrips : Nymphs and adults suck the sap from leaves. Nymph is pale yellow and the adult has fringed wings.

Mustard aphid : Nymphs and adults suck the sap from the under surface of the leaves. Nymph is light yellowish green and adult is darker than nymph.

Cabbage aphid : Nymphs and adults cause crinkling and cupping of distorted primordia. White cast skins are present at the base of the plant. Adult is yellowish green with wavy white filament over the body.

Painted bug : Nymphs and adults desap the leaves, shoots and pods. Adults are small black bugs with red and yellow lines.

PESTS OF MORINGA

Moringa

Bud worm : Larvae bore into flower buds and causes shedding. Larva is dirty brown with mid-dorsal stripe and black head with prothoracic

shield. Adult is small with dark brown forewings and white hindwings with a brown border.

Bud midge : Feeds on internal content of flower bud and causes shedding. Adult is small brownish fly.

Leaf caterpillar : Larva remains in a silken web in the undersurface of leaf and feeds on the leaflets reducing them into papery leaf. Larva is with brown head and without prothoracic shield. Adult is bigger than bud worm.

Moringa hairy caterpillar : Larvae are seen in groups in tree trunks and feed gregariously, scrap the bark and gnaw the foliage resulting in defoliation of tree. Larva is brown and hairy. Adult is large sized, uniformly light yellowish brown in colour with faint lines on wings.

Black hairy caterpillar : Caterpillars feed on leaf lamina initially by scrapping epidermal layers and later by cutting the blades.

Pod fly / fruit fly : Severe infestation results in drying of fruits from tip. Gummy exudate oozes from infested fruits. Adult is small yellowish fly with red eyes.

Bark caterpillar : Zigzag galleries and silken webbed masses comprising of chewed material and excreta of larvae are seen. Larva is stout and dirty brown. Adult is pale brown; forewings with brown spots and streaks.

Stemborer : Grub causes zigzag burrows beneath the bark, which results in death of the branch, or stem. Adult feeds on bark of the young petiole

and twigs. Grub is stout and yellowish. Adult is large sized beetle with yellowish brown elytra.

PESTS OF TUBER CROPS

PESTS OF POTATO

I Leaf Feeders

Common cutworm : Young larvae feed on leaves and the grown up larvae cut the stem at collar region. Larva is black colored with brown head. Adult forewing is grey with spot like markings. Hind wing is dull white.

Black cutworm : Damage as in common cutworm. Larva is black with pale mid dorsal stripes. Adult forewing is pale brown with dark purplish brown and hind wing is with brown tinge.

Spotted beetle : Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in color and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytron.

Bihar hairy caterpillar : Young larvae feed gregariously and skeletonize the leaves. Later instars defoliate completely. Larva is stout with seven orange transverse lines with tuft of yellow hairs, which are dark at both ends. Adult is crimson colored, body with black dots and black antenna. Wings are pinkish with black spots.

II BORERS

Shoot and fruit borer : General symptoms of damage are withered terminal shoots, bore holes on fruits plugged with excreta, shedding of flower buds, drying of leaves due to boring on petioles by larvae. Larvae are pink in color. Adult is medium sized moth with forewing having black and brown patches and dots. Hind wings are opalescent with black dots.

Potato tuber moth : It is a pest of field and storage. Larva tunnels into foliage, stem and tubers, which leads to loss of leaf tissue, death of growing points and weakening or breaking of stems.(Fig. 74) In tubers, irregularly shaped galleries are formed near tuber eyes. Larva is white to yellow or greenish turns red at pupation. Moth is small with silvery body. Forewing is grey-brown with minute dark spots and has a narrow fringe of hairs. Hindwings are dirty white (Fig. 73).

Root grubs : Grubs feed on roots and tubers. Adult feed on foliage during night. Damage is more during autumn. Grub is 'C' shaped with orange head. Adult is brown beetle with pale prothorax.

PESTS OF SWEET POTATO

I Borers Sweet potato weevil : Grubs bore into stem and feed on soft tissues. Grubs and adults bore into tubers both in field and in godowns. Occasionally adults feed on stem and leaves as well. Grub is fattish, apodous and pale yellowish white in colour. Adult is ant like, slender bodied having elongated snout, bluish brown head with non-geniculate antennae, bright red thorax, brownish legs and red abdomen.

Tuber borer : Caterpillars bore inside the tubers and feed the starchy material. The adults are grayish brown; forewings are mottled with fine specks and grayish lines and black spots.

Stem or vine borer : Caterpillar bores into vines (stem) often killing the branch. Larva is stout and whitish in colour. The moth is yellow with dark wavy lines.

II Leaf Feeders

Leaf roller : Tiny larvae scrape the tender surface tissue of leaves and feed in beneath the thin webbings. Larva folds single leaf longitudinally and feed on green tissues

Tortoise beetles : Grubs and adults bite holes on leaves. Grub is flattened yellowish green with spiny processes covering the body. It has a raised anal portion with which it covers its back with excreta and carries the skin on its back. Adult beetle is medium sized with colour variation according to species.

A. miliaris: Broad oval shaped, brownish red in colour with black dots.

C. circumdata: Beetle with green crescent –like mark in the middle

C. bipunctata: Small metallic green with six black spots on elytra.

III Root Feeder

White grub : Grubs feed on roots and tubers and adults feed on leaves. Adult is chestnut colored beetle with glistening pubescence.

PESTS OF TAPIOCA

Cassava scale : Nymphs and adult desap the plant and cause stunting and death. White elongate scales are present on stem.

Whitefly : Nymphs and adults cause chlorotic spots by sucking cell sap from leaves and then yellowing and drying of leaves. Nymph is greenish and oval in outline. Adult is with yellow body covered with white waxy bloom.

Thrips : Nymphs and adults cause silvery patches on leaves. Nymph is reddish in colour. Adult is dark brown or black.

PESTS OF CHILLIES

Chillies

Stem borer : Stunted growth, withering and wilting of plants, stem and leaf axils covered with excreta covering bore holes are the infestation caused by the larvae. Larva is yellowish or light brown with red head. Moth is with greyish brown forewings having transverse lines and white hindwings.

Chilli thrips : Leaves become crinkled, curled upward and shed. Buds become brittle and drop down. Plants get stunted and bronzed. Nymphs and adults are tiny slender, fragile and yellowish straw in colour.

Green peach aphid : Leaves get curled and crinkled coated with honeydew and sooty mould. Plants remain stunted. Adult is mostly yellow in colour.

Tobacco caterpillar : Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings are having a brown patch along its margin.

Cut worm : The greasy cut worms come out during night and curd the seedlings at ground level and eat tender leaves.

Fruit borer : Young larvae feed on tender foliage and from fourth instar onwards attacks fruits. They bore circular holes and thrust only a part of their body inside fruit and eat inner contents. Freshly hatched larva is yellowish white but gradually become green. Full-grown larva is apple green in colour with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

Muranai mite : Sudden curling and crinkling of leaves followed by blister patches are initial symptoms. Plants are severely attacked, stop growing and die. Adult is tiny, oval, glossy or whitish mites.

Eriophyid mite : These mites infest tender shoot cause rusting, leaf size reduction and shedding of flowers.

PESTS OF CARDAMOM, PEPPER AND BETELVINE

PESTS OF CARDAMOM

I Borer

Shoot, panicle and capsule borer : Pseudostem with bore holes plugged with excreta, dead heart, panicles and spikes dry up above the point of infestation and empty capsules are the damages caused by the caterpillar. Larva is pale greenish with pinkish tinge and fine hairs with dark head. Adult is medium sized moth, pale yellowish with small black spots on the wings.

Rhizome weevil : The grubs break the tillers at the base, which results in rotting, falling down and drying of clumps. Grub is glossy white with light brown head. Adult are brown weevil with 3 lines on the pronotum and 3 black spots on each elytron.

PESTS OF PEPPER

I Borers

Pollu beetle : Affected berries are with exit holes, dry up later, turn dark and hollow and crumble when pressed. Irregular feeding holes are seen on leaves. Young grub is with transparent body and grown up is yellow or brownish. Adult is oblong beetle with broad body and shiny black elytra and enlarged hind femur.

Top shoot borer : The infestation results in drying of terminal shoots. Larva is greyish green and 12 –14mm long. Adult is a tiny moth. Forewing is black and distal half is red. Hindwing is greyish.

BETELVINE

Aphid : Nymphs and adults desap the tender shoots and leaves and result in crinkling and curling of leaves and drying.

Whitefly : Nymphs and adults cause chlorotic spots by sucking cell sap from leaves resulting yellowing and drying of leaves. Nymph is greenish and oval in shape. Adult is with yellow body covered with white waxy bloom.

Scale : Infests the leaves, petiole and main vines. Infested leaves lose their colour, exhibit warty appearance., crinkle and dry up ultimately. Vines present a sickly appearance and wilt in due course. Adult is dark brown or light brown scale.

PESTS OF MANGO

I Pests of Inflorescence/Fruit

Mango hoppers : Nymphs and adults cause withering and shedding of flower buds and flowers. Presence of small drops of honeydew on lower leaves followed by development sooty mould. Clicking sound due to movement of jassids amidst leaves is a common phenomenon.

I. niveosparsus - Three spots on scutellum and white band across the wing.

I. clypealis - Two spots on scutellum and dark spots on the vertex

A. atkinsoni - Two spots on scutellum.

Aphid : The infestation results in drying of inflorescence and tender shoots and appearance of sooty mould. Aphids are brown coloured.

Flower webber : Larvae web the inflorescence and tunnel the stalks. Larva is greenish yellow light brown head and prothoracic shield. Adult female moth is with grey wings and male is with purplish pink wings.

Gall midges : *Procystiphora mangiferae* - Causes malformation of flowers and droppings of flower. Maggot and adult are orange coloured. *Dasineura amaramanjarae* - Causes damage to flower buds and dropping of bud. *Erosomyia mangiferae* - Results in stunting and malformation of inflorescence. Maggot is yellowish.

Fruit fly : Semi-ripe fruits are with decayed spots and droppings of fruits. Maggot is yellowish. Adult fly is light brown with transparent wings.

Nut weevil : The infestation results in dropping of fruits at marble stage and tunnelled cotyledons. Ovipositional injuries and eggs are seen on marble sized fruits. Grub is fleshy, yellowish and apodous. Adult is brownish with short snout and papillate scales (Fig. 75).

II Leaf Feeders

Shoot webber : Larvae cause webbing of terminal leaves and defoliation. Larva is pale green with brown head and prothoracic shield. Adult is brownish moth with wavy lines on forewings.

Castor slug : Larva irregularly feeds on the leaves and causes defoliation. Larva is slug like, ventrally flat, greenish body with white lines and four rows of spiny scoli tipped red or black. Adult is green moth with a brown band at the base of forewings.

III Sucking Pests

Whitefly : Nymphs and adults cause yellowing of leaves in patches and the presence of white flies on the ventral side of leaves. Nymphs are greyish white, found in-groups. Adult is dull white in colour.

Scale insect : Nymphs and adults cause yellowing of leaves. They are white elongate hard scale.

Mealy bug : Severe infestation results in drying of leaves and inflorescence. Nymphs and adults are pinkish and undergo diapause in soil during winter.

Eriophyid mite : This worm like mites are found in growing tips, sucking the sap and injecting toxic substances, kill the buds and cause resetting of shoot.

IV Borers

Stem borer : The grub causes drying of terminal shoots in early stage of attack. Wilting of whole tree damage occurs at the main stem. Grub is linear, fleshy and apodous. Adult is greyish beetle with two pink dots and lateral spine on the thorax.

Shoot borer : Larvae bore through the downwards from the growing tip to a depth of 5 or 6 inches. Whole seedling remains stunted with individual twigs showing a peculiar terminal bunchy appearance. Larva is dark pink with conspicuous dark brown prothoracic shield. Adult is greyish moth with dark grey wings having wavy designs.

PESTS OF CITRUS

I Internal Feeders

Orange borer : The grubs cause drying of terminal shoots in the early

stages, followed by wilting of thicker branches and main stem. Grub is creamy white with flat head. Adult is dull metallic green to dark violet or shiny blue beetle with yellow band across the middle of the elytra.

Citrus leaf miner : The infestation by the larva results in leaves with serpentine mines and distortion of the leaf lamina. Larva is minute, reddish or yellowish and apodous. Adult is minute moth with a black spot at the tip of the forewing (Fig. 76).

II Leaf Feeder

Citrus butterfly : The larva causes defoliation of tender leaves. Larva in its early stage resembles bird dropping. Grown up larva is cylindrical, stout and green with brown lateral oblique bands. Adult is dark brown swallow tail butterfly with numerous yellow markings.

III Sap Feeders

Fruit sucking moths : Adult moths pierce the fruit and suck the juice resulting in rotting at the feeding site and dropping fruit. Larva is semilooper with orange blue and yellow spots on its velvety dark speckled body, which feeds on the weed host. Adult is stout-built moth with grey and orange coloured wings. There are 3 black spots on the forewings.

Otheris fullonica - Presence of tripod black marks in the forewing and curved marking in the hindwing. *O. ancilla* - Presence of white band in the middle forewing.

Psyllid : Nymphs and adults infest terminal tender twigs and cause curling and drying of twigs. Transmit citrus greening virus. Nymphs are orange in color; adults are brownish males are shorter than female. Wings are membranous and semitransparent, wings extend beyond the body.

Citrus whitefly : Nymphs and adults suck sap from leaves causing curling over and fall off. Nymph is pale yellow with purple eyes

Black fly : The symptoms of damage are yellowing of leaves in the early stage of attack followed by honeydew deposition on the lower leaves and sooty mould of development. Severe infestation leads to defoliation. Nymph is shiny black scale like and spiny with white markings at the edges.

Scale insects : Suck sap from branches, inject toxic substances. Females are light grey in color; males are smaller than females.

Rust mite : Feeding by adults and nymphs causes silvery, scaly or rusty to black discoloration on the fruits. The affected fruits are smaller and the rind of injured fruits is thicker.

PESTS OF SAPOTA, GUAVA AND POMEGRANATE

PESTS OF SAPOTA

Chickoo moth or leaf webber : Leaves are webbed together in a bunch and the chlorophyll scrapped by the larva. Cluster of dried leaves is hanging from the webbed shoots (Fig. 77). Flower buds and tender fruits are bored, become withered and shed. Larva is pinkish in colour with

three dorso-lateral brown stripes on each side. Adult moth is greyish with hairy brown forewings or black spots and semi hyaline hindwings.

Budworm : Floral buds and flowers are webbed together and shed. Larva is small, slender, pinkish brown in colour with black head and yellowish brown prothoracic shield. Adult is grey coloured moth with black patch on wings.

Fruit fly : Semi-ripe fruit show decayed spots and fruits drop later. Maggot is yellowish. Adult fly is light brown with transparent wings.

Hairy caterpillar : Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth. Male is with pectinate antenna and chocolate brown patch in the middle of forewings. Female is bigger in size than male and has wavy transverse bands on wings.

PESTS OF GUAVA

Fruit borer : Infected fruits are with boreholes plugged with anal segment of the larva. Severe infestation results in fruit rotting and dropping. Larva is dirty dark brown, short and stout built covered with short hairs. Adult is bluish brown butterfly. Female is with 'V' shaped patch on forewing. Fruits are with boreholes. Adult is metallic red coloured butterfly.

Tea mosquito bug : Corky scab formation on fruits is the symptom of damage. The infestations caused by the nymphs and adults caused by the nymphs and adults include inflorescence blight, terminal drying of young shoots and water soaked lesions followed by brownish spots at the

feeding sites (Fig. 78). Nymphs and adults are reddish brown, elongate bugs with black head, red thorax and black and white abdomen.

PESTS OF POMEGRANATE

Fruit borer : Infested fruits are with bore holes plugged with anal segment of the larva. Severe infestation results in fruit rotting and dropping. Larva is dirty dark brown, short and stout built covered with short hairs. Adult is bluish brown butterfly. Female is with 'V' shaped patch on forewing.

Fruit fly : Rotting of fruit is the symptom of infestation. The maggots feed on the pulp of the fruits and the symptoms of damage include of brown resinuous fluid from fruits, distorted and malformed fruits premature dropping of fruits and unfit for consumption. Maggot is white and apodous. Adult is with hyaline wings or brownish with pale yellow band on 3rd tergite.

Shoot and fruit borer : Larvae make holes on fruits. Larva is pale greenish with pinkish tinge and fine hairs with dark head and prothoracic shield. Adult is medium sized and pale yellowish moth with small black spots on the wings.

Mealy bug : Cluster of white mealy bugs on the lower-side of the older plants cause yellowing and drying of leaves. Adults are small, oval, soft bodied and covered with white mealy wax.

PESTS OF BANANA

I Borers

Rhizome weevil : The grub causes death of unopened pipe and withering of outer leaves. Grubs bore into the rhizome and cause death of the plants (Fig. 79). Grub is apodous and yellowish white with red head. Adult is dark coloured weevil.

Pseudostem borer : The grub makes bore holes and tunnels in the pseudostem and causes wilting of the plant. Grub is apodous and creamy white with dark head. Adult is robust reddish brown and black weevil.

II Sap Feeders

Banana aphid : Nymphs and adults are vectors of bunchy top disease. They are seen in colonies on leaf axils and pseudostem. Nymphs and adults are dark

Banana aphid : Nymphs and adults are vectors of bunchy top disease. They are seen in colonies on leaf axils and pseudostem. Nymphs and adults are dark in colour. Winged adults are with black veined wings.

Tingid : The infested leaves are with greyish yellow spots and stunted growth. Presence of white, transparent adults is dull coloured nymphs on the lower surface of leaves. Nymphs and adult are dull coloured bugs with transparent shiny lace-like reticulate wings.

Thrips : Leaf thrips - Cause yellowing of leaves . Adults are with fringed wings. Fruit rust thrips - Cause leaf yellowing and rusty growth over fruit. Adult is yellowish white with shaded wings. Flower thrips - Cause corky scab on fruits and flowers.

PESTS OF CASHEW

I Borers

Cashew tree borer : The grub by internal tunnelling causes wilting of branches and then the tree as a whole (Fig. 80). It also infests trunk and root. Grub is elongated, creamy white brown head. Adult is reddish brown longicorn beetle.

Bark feeder : Zig-zag galleries and silk webbed masses comprising of chewed material and excreta of larvae are seen. Larva is stout and dirty brown. Adult is pale brown with forewings having brown spots and streaks.

Apple borer : Presence of bore holes on the tender cashew (or) apple. Larva is dark pink in colour. Adult is medium sized moth with dark forewings and pale hindwings.

II Inflorescence Feeders

Shoot and blossom borer : The larva causes webbing of tender leaves and inflorescence. Larva is reddish brown with yellow and pink lines. Adult male is dark fuscous. Female is pale and olive green.

Shoot tip and inflorescence caterpillar : The infestation results in webbing of terminal leaves and inflorescence and boring of shoot tip. Larva is yellowish brown. Adult is a dark and tiny moth.

Tea mosquito bug : The infestations by the nymphs and adults include inflorescence blight, terminal drying of young shoots and water soaked lesions followed by brownish spots at the feeding sites.

III Leaf Feeders

Leaf miner : Mining of tender leaves in whitish blotches is the symptom of damage. Larva is reddish brown and minute. Adult is silvery grey moth with fringes of hairs on the wing margins.

Wild silk moth : The larvae feed on leaves, which results in complete defoliation. The infestation is indicated by the presence of golden coloured pupae on the trunk. Larva is stout, dark brown with prominent warts all over the body. Adult is pale yellowish or reddish brown moth with three clear moths on forewings.

Hairy caterpillar : Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth.

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Hairy caterpillar : Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth.

Male is with pectinate antenna and chocolate brown patch in the middle of forewings. Female is bigger in size than male and has wavy transverse bands on wings.

Leaf twisting weevil : The grub rolls leaf terminal, results in drying. Grub is yellowish and apodous. Adult is reddish brown weevil.

Looper : The larva damages the leaf margins. It is a green looper. Adult is green with grey brown markings.

IV Sap Feeders

Aphids : The infestation results in drying of inflorescence and tender shoots and appearance of sooty mould. Aphids are brown coloured.

Red banded thrips : The damage results in crinkling, discolouration and leaf drop. Nymph is greenish yellow with red cross band across first two and last abdominal segments.

Thrips : This species causes silvery white patches on leaves with excreta. Yellowing and withering are due to severe infestation. Nymph is reddish in colour. Adult female is dark brown with yellow legs and antennae. Male is with yellow abdomen.

PESTS OF GRAPEVINE

Stem girdler : The grubs and adults cause wilting of branches and then the entire vine. Adult is medium sized and grey coloured with a white spot in the centre of each elytron.

Chafer beetle : The adults cause complete defoliation of the leaves. Adults are brown coloured beetles.

Ground beetle: The adults cause defoliation of the leaves. Adults are brown coloured beetles.

Flea beetle : The adults bite small holes on tender leaves and the root is damaged by the grubs (Fig. 81). Adult is reddish brown, shiny beetle with six spots on elytra.

Leaf roller : The larva causes rolling of leaves. Larva is pale green with short hairs. Adult is brownish moth with wavy line.

Thrips : Leaf thrips - Cause yellowing of leaves. Adults are with fringed wings. Fruit rust thrips - Cause leaf yellowing and rusty growth over fruit. Adult is yellowish white. Flower thrips - Cause corky scab on fruits and flowers.

Blackfly : Yellowing of leaves is the symptom of damage caused by the nymphs and adults. Nymph is oval in shape, scale like fringes. Adult is minute, delicate insect.

Mealy bugs : Nymphs and adults cause crinkling and yellowing of leaves and rotting of berries.

Berry plume moth : Larvae cause feeding injury on berries. Larva is small, pale green or pink with median red line. Adult is a small moth.

Castor semilooper : Adult causes fruit rotting and dropping. Larva in varying shades of colour. Head is black with black and red spot on the 3rd abdominal segment and red tubercles on the anal region. Adult is pale reddish brown with black hind wing with a median white and 3 large white spots on the outer margin.

PESTS OF COCONUT

Coconut

Rhinoceros beetle : Damage is caused by adult beetles which burrow the leaf sheaths near the crown and cut across the leaf in the folded condition. The damaged leaves show characteristic clippings or holes in the leaflets. The infestation will result in stunting of trees and death of growing point. Adult beetle is stout, black, about 5 cm long and has a long horn projecting dorsally from the head in male, a short horn in female. The grubs feed on decaying vegetable matter and in manure pits at a depth of 5-30 cm.(Fig. 82)

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Red palm weevil : A few small holes with protruding chewed fibrous material and oozing out of a brown liquid from such holes indicate early

infestation. In advanced stage of attack the central shoot shows sign of wilting and on large mass of grubs, pupae and adults are seen inside trunk. The reddish brown weevil has six dark spots on thorax and in the male a conspicuous long snout has a tuft of hairs.

Black headed caterpillar : The larvae live on the undersurface of leaflets within galleries of silk and frass material and feed by scrapping the green matter. The caterpillar is greenish brown with dark brown head and prothorax, and reddish mesothorax.

White grub : The grubs feed on roots and cause stunting and delayed flowering. Adult beetles emerge after monsoon showers.

Termite : Termites damage coconut seedlings.

Scale insect : The undersurface of leaflets is infested by scale insects in large numbers causing yellowing in patches.

Lace wing bug : The nymphs and adults of the lacewing bug feed by sucking the sap from the undersurface of leaflets causing white spots on the upper surface.

Perianth mite : The mite infest and develop on the meristematic tissues under the perianth. Initial symptoms exhibit as triangular pale white or yellow patches close to the perianth. Continuous feeding results in necrosis of tissues leading to formation of brown color patches, longitudinal fissures and splits on the outer surface of the husk; oozing of brown gummy exudation; reduced nut size and copra content and malformation of nuts. The mite is vermiform, elongate body with 2 pairs

of legs in the anterior and of the body ; head with piercing and sucking mouth parts.

PESTS OF COFFEE

I Borers

White borer : Presence of ridges on the stem, yellowing of leaves, wilting of branches and occasional drying of plants are the symptoms caused by the grub. Grub is white or yellowish, anterior and broader and tapering towards tail end. Adult is black, elongate beetle with grey pubescence on the head, thorax and elytra and characteristics white markings on the elytra.(Fig. 83)

Red borer : The larvae cause wilting of branches or plant. Boreholes often are plugged with excreta at the base of the plant. Larva is orange red and smooth, Adult is with dirty white bands and black or steel blue spots on the wings.

Shot hole borer : Adult and grub make small holes on the under surface of young succulent branches between nodes which result in withered and dead branches with shot holes. Grub is milky –white and apodous. Adult is reddish brown to dark brown beetle with a short cylindrical body.

Coffee bean beetle : Infested berries are with small holes, black in colour and shrunken. Grub is milky-white and apodous. Adult is pale grey, elongate oval and slightly flattened tapering anteriorly. Entire body is clothed with hairs.

Berry borer : Infestation by the grubs and adults results in dropping of tender berries. There are many small round holes in the nodal region of developed berry. Damage is often caused to endosperm by making small galleries near the main tunnel. Female adults tunnel into berries. Grub feeds on beans. Grub is white in colour. Adult is black beetle and the males are wingless.

II Leaf Feeder

Leaf miner : The maggots often mine the leaves. Maggot is small and apodous. Adult is very small and brown coloured fly.

PESTS OF TEA

I Leaf Feeders

Looper : Larva causes defoliation of leaves. Larva is grey or dark green in colour. Adult is straw coloured moth. Wings are grey with light brown markings and wavy lines.

Bunch caterpillars : The larvae cause defoliation of leaves. Larva is smooth and hairless and grey in colour with brown patches. Adult is golden brown moth.

Lobster caterpillar : Defoliation of leaves is the symptom of damage by the larva. Larva is brown with white band and elongated legs.

White grub : Grubs feed on roots and rootlets resulting in drying of young plants. Adults are leaf feeders. Grub is fleshy and 'C' shaped. Adult is a brown coloured beetle.

Tea tortrix : Caterpillar makes leaf nest by webbing the leaves. Adult is greenish with black prothorax or brown coloured bell shaped moth. Male is smaller than female. Larva is greenish with black prothorax.

Tea leaf roller : Second instar larva mines the tender and reaches leaf margin. Fourth instar larva rolls the leaves from the tip downwards. Larva is yellowish. Adult is microlepidoptera. Antenna is longer than the body with golden iridescent patches in forewing and abdomen.

Flush worm : Larvae web the tender leaves enclosing the bud; feed on upper epidermis of leaves and apical portion of the bud. Larva is brown colored and 1 cm long; adult is less than 1 cm in size blackish brown in color.

Nettle grubs : The caterpillars are the nuisance to the workers because of their stinging hairs besides scrapping the leaves.

Faggot worm : Larva defoliates order leaves and also feeds on bark. Adult male is reddish brown and winged. The female is wingless and grub like

II Sap Feeders

Red spider mite : Feeding by nymphs and adults causes the leaves to become bronzed dried and crumpled. Nymph and adult are brick red in colour and rounded.

Scarlet mite : The infestation results in brownish leaves. Large number of mites are seen near the petiole and along in the midrib. Nymph and adult are orange and flattened ovate mite.

Purple mite : This species causes brown or coppery brown or smoky discoloration of leaves. Adult mite is dark purple to pink in colour with characteristic white sides running along the back.

Pink mite or orange mite : Continuous desapping causes the leaves turn pale and curl upward. Under severe infestation, leaves become leathery and brown. Damages are often to top 10-15 cm tender leaves. Assam type of tea is susceptible. Nymph and adult are microscopic orange coloured mite and its body is carrot shaped with two pairs of legs.

Yellow mite : The damage is restricted to top two to three leaves and the bud. Leaves become rough and brittle. Corky line or patches appear on the lamina

Internode gets shortened, stunted and deformed. Mites are pale yellow in colour. Male is shorter than female with tapering abdomen and a sucker. Fourth pair of legs is provided with a curved tooth and a pair of whips. They carry female on their back. Female is bigger than male with two pairs of whip.

Thrips : Opened leaves show a parallel brown streaks on either side of midrib. Leaf surface becomes uneven. Nymph is creamy white and adult is with fringed wings and brown abdomen.

Tea mosquito bug : Brownish patches are seen in the tender shoots, buds and stem. Curling of leaves and drying of shoots are caused due to severe attack. Adult is black and red elongated insect with long legs and a dorsal process on the scutellum (Fig. 84).

Scale : There are many hemispherical brown scales seen along the midrib and tender stem followed by sooty mould on lower leaves. Vegetatively propagated clones are susceptible. Nymph is white, adult is winged and female is sedentary.

Tea jassid : The symptoms of damage include yellowing, marginal browning and cupping of leaves. Severity is more in North Eastern India. Nymph and adult are green coloured and wedge shaped.

Tea aphid : Dark brown colonies of aphids infest tender shoots and suck sap causing leaf curl and stunted shoot growth.

III Borers

Shoot hole borer : Grubs and adults make round shot holes in primary branches, which result in the mortality of buds and die-back symptoms in branches. Circular or longitudinal tunnels are seen inside the stem. Adult male is wingless and female is winged.

Red borer : The larvae cause wilting of branches or plant. Bore holes often are plugged with excreta at the base of the plant. Larva is orange red and smooth, Adult is with dirty white bands and black or steel blue spots on the wings.

Hepialid stem borer/Sapling borer : The larvae leave chewed tissue at the collar region. The tunnel mouth is covered by a thick mat of bark, wood and frass particles held together by silk, Sapling break-off at the point of injury. The larva is pale yellow in color, pencil thick, 6-10 cm long and larval duration is around 10 months.

PESTS OF JASMINE

Bud worm : Damaged buds are with boreholes and often webbed with silken threads. Webbing are soiled with excreta. Larva is dark green with black head. Adult is small white moth with black palpi.

Gallery worm : Terminal leaves shoots and flower buds are webbed together by the larvae. Larva is green with red head and thorax and lateral brown streaks on the body. Adult is small and dark grey moth.

Blossom midge : The maggot causes swelling at the base of the buds, stunting and then drying. Adult is with light brownish wings having white spots.

Leaf web worm : Leaves are webbed with loose silken threads and then skeletonised. Larva is green with dark warts. Adult is with light brownish wings having white spots.

Jasmine eriophyid mite : Severe infestation results in felt like hairy outgrowth (white velvety erinium) on the surface of the leaves, tender stem and flower buds.

Flower thrips : Flower petals are lacerated and are with brown streaks. Adult is small and black in colour.

PESTS OF ROSE

Plant lice : Nymphs and adults cause yellowing and drying of tender shoots. Clusters of aphids are seen on tender shoots, buds and flowers. Aphids are small, pear shaped and soft bodied. They are light blackish green in colour.

Thrips : The lacerated leaves are with yellow patches and black spots of excreta. Nymph is red in colour. Adult is dark brown or black in colour.

Scale : Feeding by the nymphs and adults cause drying of plants. Adults are red in colour.

Black fly : Severe infestation results in crinkling of leaves and black oval puparia on the under surface of the leaves. Body is yellow and eyes are red in colour. Nymph is oval and scale like blackish with marginal bristle like fringes.

Eriophyid mite : Infest leaves and flower buds and produce erinium.

Leaf cutter bee : Adult causes circular or semi circular cuttings on the leaves. Adult bee is black in colour.

PESTS OF TREE CROPS

PESTS OF NEEM

Tea mosquito bug : The nymphs and adults suck sap producing terminal srying of young twigs. The bugs are reddish brown, elongate with black head, red throax and black and white abdomen.

Scales : The nymphs and adults of the white convex scales infest the shoots and stem and suck the sap and devitalise the tree.

Anthribid beetles : The dark grayish brown beetles cause damage to the neem seeds in storage.

Thrips : Nymphs and adults infest flowers and leaves and lacerate the chlorophyll and suck the sap resulting shedding of flowers and leaves. The nymphs and adults are yellowish with fringed wings.

PESTS OF TEAK

Teak defoliator : The caterpillars irregularly skeletonises and defoliate older leaves resulting irregular large holes on the leaf lamina; the larva is dark grayish green with faint longitudinal lines. The forewings of adult moth is reddish brown and the hind wings are dark brown with pink edges and center; abdomen with orange segmental bands.

Teak skeletoniser : The caterpillars skeletonises the leaf uniformly. Larva is green with lateral bands. Forewings of the moth is yellow with pink zig zag markings.

Jewel beetle : The metallic blue green adults feed on bark..

PESTS OF SUBABUL

Jumping plant lice : The nymphs and adults infest the terminal tender twigs and suck the plant sap causing drying of terminal shoots; the excess excretion of honey dew favors the growth of sooty mold on the compound leaves in the lower side of the plant. Nymphs are yellowish while the adults are pale greenish yellow in color.

PEST MANAGEMENT

PEST MANAGEMENT IN BRINJAL

Shoot and fruit borer

- i. Collection and destruction of infested plant parts like shoots, buds and fruits.
- ii. Avoid ratooning to minimize shoot and fruit borer infestation.

- iii Spray anyone of the following twice at 30 days after planting at fortnightly interval.
 - a. Quinalphos 25 EC 2 ml/lit + NO 2 ml/lit + Teepol 1 ml/lit.
 - b. Neem Seed Kernel Extract (NSKE) 5% (50 g/lit).
- iv Avoid synthetic pyrethroids.
- .
- v. Growing resistant varieties like Pusa Purple cluster, Arka Kusmak, Doli 5 etc.,

Ash weevil

Apply carbofuran 3G @ 15 kg/ha, 15 days after planting.

Aphid

- i. Release the first instar grubs of *Chrysoperla carnea* @ 10,000/ha.
- ii. Spray methyl demeton 25 EC or dimethoate 30 EC @ 2 ml/lit when situation warrants.

Epilachna beetle

- i. Collect and destroy severely affected leaves along with grubs, pupae and beetles.
- ii. Spray fipronil 2 ml/lit.

Whitefly

- i. Monitor the incidence using yellow sticky trap @ 12/ha.
- ii. Spray Neem oil 3 ml/lit + Teepol 1 ml/lit or NSKE 5% (50g /lit).

PEST MANAGEMENT IN TOMATO

Fruit borers

- i. Plant 40 days old marigold (American Tall) as trap crop with 25 days old tomato seedlings @ 1:16 row ratio.
- ii. Set up pheromone traps @ 12/ha.
- iii. Collect and destroy infested fruits, leaves, egg and gregarious larvae.
- iv. Based on ETL (5% fruit damage) spray quinalphos 2.5 ml/lit (or) *Bacillus thuringiensis* @ 2g/lit.
- v. Release twice, *Trichogramma chilonis* @ 50,000/ha release from flowering onwards at 10 days interval.
- vi. Spray HaNPV (or) SiNPV @ 1.5×10^{12} POSB/ha in the evening hours.
- vii For *Spodoptera litura*, poison baiting with carbaryl 50 WP - 1.25 kg, rice bran 12.5 kg, jaggery 1.25 kg and water 7.5 lit per hectare.
- viii Grow resistant varieties like T27, T32.

Serpentine leaf miner

Spray NSKE 5%.

PEST MANAGEMENT IN BHENDI

Sucking pests (Leaf hopper, aphids and whiteflies)

- i. Grow whitefly tolerant varieties like Arka Anamica, Hisar Unnat, Varsha Uphar or P7 (or) fruit borer resistant varieties like Parkins Long Green, Karnal special.
- ii. Spray dimethoate 30 EC 2 ml/lit, or Neem Seed Kernel Extract 5% (50 g/lit).

Fruit borers

- i. Setting up pheromone traps @ 12/ha.
- ii. Collection and disposal of infested plant parts.
- iii. Release *Trichogramma* egg parasitoid @ 1.0 lakh/ha.
- iv. Release first instar grubs of *Chrysoperla carnea* @ 10,000/ha.
- v. Spray *Bacillus thuringiensis* @ 2 g/lit.
- vi. Based on ETL (5% fruit damage) spraying cartap hydrochloride 5.0 sp 2g/lit or cartap hydrochloride 5.0 wp 1g/lit. combined with NSKE 5%.

Mites

Spraying either wettable Sulphur 50 WP 2 g/lit or dicofol 3 ml/lit.

Nematodes

In endemic areas, apply carbofuran 3G @ 33 kg/ha (or) phorate 10G @ 10 kg/ha with Neem cake @ 400 kg/ha at sowing in furrows along with fertilizers.

PEST MANAGEMENT IN CUCURBITS

Pumpkin beetles and leaf caterpillars

- i. Early planting of pumpkin during October - November
- ii. Frequent raking of soil beneath the crop to expose and kill the eggs and grubs.
- iii. Hand collection and destruction of infested leaves and fruits.
.
- iv. Spray malathion 50 EC 1 ml/lit, dimethoate 30 EC 2 ml/lit,
.
methyl demeton 25 EC or fenthion 100 EC 1 ml/lit.

Fruitfly

- i In endemic areas, sowing time may be adjusted in such a way that
- . fruiting should not coincide with monsoon.
- i Fruit fly resistant pumpkin varieties like Arka Swarramuki may be
- i grown.
- .
- i Ribbed gourd may be grown as a trap crop and carbaryl 50 WP 2
- v g/lit (or) malathion 2 ml/lit, may be sprayed on the congregating
- . adult flies on the under surface of leaves.
- v Attractants like citronella oil, eucalyptus oil, acetic acid (vinegar)
- dextrose and lactic acid may be used to trap adult flies.
- v Poison baiting may be employed with saturated sugar solution 5 ml
- i + malathion 50 EC 5 ml + 100 ml fermented palm juice. This
- mixture may be kept in earthen vessels in many places in the field.
- v Use fishmeal trap to attract and kill the flies. Take 5 g of wet
- i fishmeal in a (20 x 15 cm) polythene bag. Make six holes (3 mm
- dia.) around the periphery of the bag at equidistance at about 2 cm
- from the bottom of the bag. Impregnate an absorbent cotton plug
- with 1 ml of dichlorvos and keep this also inside the poly bag.
- Suspend such fish meal traps at places in the field @ 50/ha.
- Dichlorvos should be replenished every week and fishmeal has to be
- replaced once in 20 days.

Root-knot nematode

In endemic areas, apply carbofuran 3 G @ 33 kg/ha with Neem cake @ 400 kg/ha before sowing.

Leaf miner

Spray Neem Seed Kernel Extract 5%.

Caution

In cucurbits, DDT, Lindane 1.3 D, Copper Oxychloride, Bordeaux mixture and Sulphur dust should not be used as these are highly phytotoxic.

PEST MANAGEMENT IN CRUCIFEROUS VEGETABLES

1. Cutworms

- i. Setting up light traps during summer months to attract the moths.
- ii. Install sprinkler system of irrigation and irrigate during day time to expose the larvae to bird predation.
- iii. Drench the collar region of the plants with chlorpyrifos 2 ml/lit (or) one day after planting (or) apply lindane 1.3 D @ 10 kg/ha in soil before planting.
- iv. Collect and destroy the weed *Gynandropis pentaphylla*.

White grub

- i. Summer ploughing.
- ii. Dusting or quinalphos 5 D @ 25 kg/ha, 10 days after summer rains.
- iii Operate light traps between 7 and 9 PM during April - May to attract adults.
- iv Pre-sowing soil application of entomopathogenous fungus *Metarrhizium anisopliae* @ 20 kg/ha and rake the soil during May.
- v. In endemic areas, apply phorate 10 G @ 25 kg/ha during August - October.

Cabbage aphid

- i. Monitor and attract the aphids using yellow sticky trap @ 12/ha.
- ii. Spray Neem Oil 2% (20 ml/lit) (or) dimethoate 30 EC @ 2 ml/lit along with Teepol @ 0.5 ml/lit.

Diamondback moth

- i. Grow two rows of mustard as trap crop at the end of every 25 rows of cabbage. The first row of mustard should be sown 15 days prior to planting of cabbage or 20 day old mustard seedlings should be planted along with cabbage. The second row of mustard should be sown 25 days after planting of cabbage. The mustard crop should be periodically sprayed with Dithlorvos @ 1 ml/lit once in 10 days to check the migration of Diamondback moth.
- ii. Install pheromone traps to attract and monitor the moths @ 12/ha.

- iii. Based on the ETL (2 larvae/plant), spray cartap hydrochloride 1 g/lit, *Baillus thuringiensis* 2 g/lit or NSKE 5% (50 g/lit) at primordial stage (ca. 17-25 DAP). Spray fluid should be combined with sticking agents like Teepol or Sandovit (0.5 ml/lit).
- iv. Release larval parasitoids @ 20,000/release starting from 20 DAP at fortnightly interval. Five such releases are effective against diamondback moth. In plains release *Cotesia plutellae* (Braconidae: Hymenoptera) and in hills *Diadegma semiclausum* (Ichneumonidae: Hymenoptera).

PEST MANAGEMENT IN MORINGA

Fruit fly

- i. Raking the soil beneath the crop canopy after application of NSKE 5% or Lindane 1.3 D @ 25 kg/ha.
- ii. Collect and destroy the fruits which ooze out or rotten.
- iii. Based on the ETL (15% infested pods), spray dichlorvos 1 ml/lit (or) fenthion 1.5 ml/lit when the pods are 20-30 days old.

Budworm, leaf caterpillar, leaf webber

Spraying dichlorvos 1 ml/lit or dusting carbaryl 10 D @ 25 kg/ha.

Hairy caterpillars

Burning the congregating caterpillars on the bark with flame thrower / burning flame.

PEST MANAGEMENT IN POTATO

Cut worms

- i. Deep ploughing to expose the pupae and larvae to predators.
- ii. Irrigate with sprinklers during day time to expose the larvae to predation.
- iii. Drench the collar region of the plants in evening hours with chlorpyrifos or endosulfan 2 ml/lit one day after planting.

Aphid, Leaf hopper

Spray methyl demeton 25 EC (or) dimethoate 30 EC @ 2 ml/lit (or) acephate 75 SP 1 g/lit.

White grub

- i. Summer ploughing.
- ii. Dust (or) quinalphos 5 D @ 25 kg/ha, 10 days after first summer rains.
- iii Operate light traps between 7.00 - 9.00 PM during April - May.
- iv Soil application of entomopathogenous fungus, *Metarrhizium anisopliae* @ 20 kg/ha and rake the soil during May.
- v. Hand picking adult beetles in the morning hours.
- vi In endemic areas, apply Phorate @ 10 G at 25 kg/ha in soil during August - October.

Potato tuber moth

- i. Deep planting of tubers at 10-15 cm depth.
- ii. Pheromone traps @ 20/ha both in field and godowns.
- iii Earthing up at 60 DAP, to avoid oviposition by moths.
- .
- iv When the foliar damage exceeds the ETL (5%), spray NSKE
. 5% or quinalphos 20 EC 2 ml/lit.
- v. In godowns, the upper surface of potato leaves should be covered with either *Lantana* (or) *Eupatorium* leaves as oviposition deterrents against moths.
- vi Seed tubers may be treated with quinalphos or dust @ 1 kg/ 100
. kg of tubers.

PEST MANAGEMENT IN SWEET POTATO

Sweet potato weevil

- i. Maintaining field sanitation by removing crop residues, debris and alternative hosts.
- ii. Selecting weevil-free planting materials.
- iii. Sweet potato tubers are sliced into pieces of about 100 g and placed 5 m apart in the field from 4.00 PM to attract the weevils. Next day morning, the tubers should be collected with attracted weevils and meticulously disposed.
- iv. Dip the planting material in fenthion 100 EC, fenitrothion 25 EC before planting.
- v. Rake up the soil and earth up 50 DAP.
- vi. Drenching the soil with or fenthion 100 EC @ 2 ml/lit. These insecticides may also be sprayed when necessary.

- vii. Harvesting the tubers immediately after maturity and destroying residues.
- viii. Installing yellow sticky traps @ 12/ha.
- ix. In storage, the tubers may be covered with sand.

Caterpillars, tortoise beetles

- i. Collecting and destroying larvae, damaged leaves and beetles.
- ii. Spraying Fipronil 2 ml/lit.

PEST MANAGEMENT IN TOPIOCA

Scales

- i. Careful selection of setts free from scale insects.
- ii. Stacking the setts in shade in vertical position.
- iii Dipping the setts in dimethoate 0.03% or methyl demeton . 0.025% for 10 minutes before planting.
- iv Encourage the predatory ladybird beetle, *hiloorus nigritus*.
- .

Whitefly

- i. Maintaining field hygiene by removing alternative weed hosts like *Abutilon indicum*.
- ii. Installing yellow sticky traps @ 12/ha.
- iii. Avoid excess irrigation and nitrogen.
- iv. Spray Neem Oil 5 ml/lit (or) Fish Oil Rosin Soap 20 g/lit (or) methyl demeton 25 EC 2 ml/lit (or) Phosalone 35 EC 2 ml/lit. Avoid synthetic pyrethroids.

PEST MANAGEMENT IN TURMERIC

Pre planting treatment : The turmeric rhizomes should be dipped in a mixture of carbendazin 50 WP 1 g/lit + phosalone 35 EC 2 g/lit (or) monocrotophos 36 WSC 1.5 ml/lit.

Rhizomone Scale : Well rotten sheep manure / poultry manure should be applied in two splits @ 10 tons/ha, first before planting and the second at the time of earthing up.

PEST MANAGEMENT IN CHILLIES

Thrips : Spray NSKE 5%, dimethoate 30 EC 2 ml/lit, methyl demeton 25EC 2 ml/lit, formothion 2 ml/lit, quinalphos 1.5 D @ 20 kg/ha thrice at fortnightly intervals.

Aphids : Spray acephate 75 SP 1 g/lit, methyl demeton 25 EC 2 ml/lit or phosalone 35 EC 2 ml/lit.

Yellow Muranai Mite (Broad Mite) : Spray dicofol 18.5 EC 3 ml/lit, ethion 50 EC 4 ml/lit or wettable sulphur 50 WP @ 6 g/lit.

Fruit borers :

- i. Setting up pheromone traps for *Helicoverpa armigera* (or) *Spodoptera litura* @ 12/ha.
- ii. Collection and destruction of grown up caterpillars and damaged fruits.
- iii. Poison baiting with rice bran 5 kg, jaggery 500 g, carbaryl 50 WP 500 g and water 3 lit per acre in the evening hours.
- iv. Spray chlorpyrifos 20 EC 3 ml/lit or quinalphos 25 EC 2.5 ml/lit.

PEST MANAGEMENT IN CARDAMOM

Thrips :

- i. Regulating shade in such a way to have partial shade.
- ii. Spray or phosalone 35 EC @ 1 ml/lit.

Shoot and Fruit borer

- i. Collection and destruction of infested plant parts before spraying.
- ii. Spraying monocrotophos 36 WSC @ 2.5 ml/lit or phosalone 35 EC @ 3 ml/lit.

Hairy caterpillars

Spray phosalone 35 EC @ 1 ml/lit.

Rhizome weevil

Drench lindane 20 EC @ 2 ml/lit.

Mites

Spray dicofol 18 EC @ 2 ml/lit

Aphids (Katte disease vector) : Spraying regularly methyl demeton, 25 EC, dimethoate 30 EC.

Red flour beetle : Storing capsules in alkathene lined jute bags sprayed with malathion 0.1%. Fumigation with methyl bromide.

PEST MANAGEMENT IN PEPPER

Leaf gall thrips

- i. Raking the soil and applying quinalphos 1.5 D @ 20 kg/ha.
- ii. Spray anyone of the following insecticides three rounds at monthly intervals starting from new flush formation.

Dimethoate 30 EC @ 2 ml/lit

Chlorpyrifos 20 EC @ 2 ml/lit

Dhchlorvos 76 WSC @ 1 ml/lit

Pollu beetle

- i. Spray fipronil 2 ml/lit once in July and October

Scales

- i. Removal of severely affected plant parts
- ii. Spray methyl demeton 2 ml/lit or dimethoate 2 ml/lit

PEST MANAGEMENT IN BETELVINE

Scale insect, mealy bugs, aphids :

- i. Selection of infestation free vines for planting.
- ii. Spraying chlorpyrifos 20 EC @ 2 ml/lit, malathion 50 EC @ 1 ml/lit, dimethoate 30 E @ 2 ml/lit NSKE 5% along with teepol 0.5 ml/lit.

Root-knot nematode

- i. Apply Neem Cake @ 1 ton/ha shade-dried *Calotropis* leaves @ 2.5 tons/ha to soil after lowering vines.

Mites

Spray wettable sulphur 50 WP @ 1 g/lit or dicofol 18 EC @ 0.5 ml/lit.

Caution

- Insecticides should be applied only after harvesting leaves
- After sprayings a waiting period of 3 weeks should be strictly observed

PEST MANAGEMENT IN MANGO

Inflorescence hoppers, shoot webber

- i. Spray two rounds of acephate 75 SP @ 1 g/lit, phosalone 35 EC @ 1.5ml/lit, or phosphamidon 85 WSC @ 1 ml/lit. First at the time of panicle emergence and the second a fortnight later.
- ii. Phosphamidon 85 WSC @ 1 ml + Neem Oil 5 ml/lit may be sprayed against both hoppers and shoot webber

Leaf galls and aphids

Spray dimethoate 30 E or methyl demeton @ 2 ml/lit.

Flower webber

Spray phosalone 35 EC @ 2 ml/lit.

Net weevil : Spray fenthion 100 EC @ 1 ml/lit twice. First at the marble stage and the second a fortnight later.

Stem borer

- i. Avoiding injuries at the base of trunk while pruning and removing alternative hosts like moringa in the near vicinity.
- ii. During off-season, padding with 10 ml monocrotophos soaked in absorbent cotton per tree without unnecessarily injuring the trunk.
- iii Using a needle or long wire, the grubs may be hooked out through the bore holes. The bore holes may be filled with carbofuran 3 G @ 5 g/tree and plugged with clay + fytolon paste.

Fruit fly

- i. Interspaces may be ploughed to expose and kill the soil borne puparia.
- ii The infested and fallen fruits should be carefully disposed of.
- .
- ii Apply a bait-spray combining anyone of following insecticides
- i. with molasses or jaggery (10 g/lit) two rounds at weekly interval before ripening
Fenthion 100 EC @ 1 ml/lit (or)
Malathion 50 EC @ 2 ml/lit.

PEST MANAGEMENT IN CITRUS FRUITS

Leaf miner

- i. Spray NSKE 5% (50 g/lit), Neem Cake Extract 5% or Neem Oil 3 ml/lit.
- ii. Spray dichlorvos 76 WSC 1 ml/lit, dimethoate 2 ml/lit or fenthion 1 ml/lit.

Leaf caterpillar

- i. Hand picking and destroying the greenish brown larvae
- ii. Spray endosulfan 2 ml/lit.

White fly, black fly and aphids

- i. Spray quinalphos 2 ml/lit, methyl demeton 1 ml/lit, Neem Oil 3% or Fish Oil Rosin Soap 30 g/lit.

Rust mite

- i. Spray dicofol 18 EC 2.5 ml/lit, or wettable sulphur 50 WP 2 g/lit.

Fruit sucking moths

- i. Destroy the weed host, *Tinospora cordifolia*
- ii. Apply smoke and set up light traps wherever possible
- iii. Set up food lures with rotten tomatoes (or) pieces of citrus fruits
- iv. Cover the fruit with perforated poly bags
- v. Bait with fermented molasses / jaggery + malathion 1 ml/lit

Fruit fly

- i. Interspaces may be ploughed to expose and kill the soil borne puparia
- ii. The infested and fallen fruits should be carefully disposed off.
- iii. Apply a bait-spray combining anyone of following insecticides with molasses or jaggery (10 g/lit) two rounds at weekly interval before ripening
Fenthion 1 ml/lit (or)
Malathion 2 ml/lit

Nematodes

- i. Apply *Pseudomonas fluorescens* formulation @ 20 g/tree at 15 cm depth 50 cm away from the trunk once in four months.

Stem borer

- i. Prune the branches infested
- ii. Plug the fresh boreholes with absorbent cotton soaked in monocrotophos 5 ml/ 20 ml water

PEST MANAGEMENT IN SAPOTA

Leaf webber : Spray phosalone 35 EC 2 ml/lit.

Hairy caterpillars : Spray chlorpyrifos 25 EC or phosalone 35 EC 2 ml/lit.

Bud worm : Spray phosalone 2 ml/lit, phosphamidon 1 ml/lit, or NSKE 5%.

PEST MANAGEMENT IN GUAVA

Tea mosquito bug :

Spray anyone of the following in the early morning hours or late evening hours at 21 day intervals four times minimum. Neem Oil 3%, malathion 1 ml/lit, fenthion 1 ml/lit or endosulfan 2 ml/lit.

Mealy bug :

- i. Release *ryptolaemus montrouzieri* beetles @ 10/tree
- ii. Spray Neem Oil 5 ml + Triazophos 2 ml/lit or Neem Oil 5 ml + Phosalone 2 ml/lit.

Fruit fly

- i. Disposal of infested fruits
- ii. Raking the soil and flooding for 24 h
- iii. Make annihilation technique using methyl eugenol 0.1 ml + dichlorvos -0.04% in cotton wool as in mango.
- iv. Spray malathion or fenitrothion 1 ml/lit
- v. Drench soil with NSKE 5%

PEST MANAGEMENT IN POMEGRANATE

Anar butterfly (or) Fruit borer

- i. Bagging the fruits with polythene covers
- ii. Spray NO 3% or NSKE 5% twice when insect activity is noticed
- iii Release egg parasitoid *Trichogramma chilonis* @ 1 . lakh/acre
- iv Spray dimethoate 1.5 ml/lit based on the ETL of 5 . eggs/plant

PEST MANAGEMENT IN BANANA

Rhizome (or) Corm weevil

- i. Trapping the adult weevils by placing chopped pseudostem in the cropped area
- ii. Selecting infestation - free suckers
- iii. Soil incorporation of lindane 1.3 D 20 g/plant, 10-20 g/plant arbofuran 3G 10 g/plant or phorate 10 G 5 g/plant around pseudostem.

Pseudostem weevil

- i. Disposal of infested trees by chopping and burning
- ii. Maintaining healthy plantation by periodical removal of dry leaves and suckers
- iii. Pseudostem injection with monocrotophos (50 ml + 350 ml water) @ 2ml at 45 cm height and another @ 2 ml at 150 cm height from ground level at monthly intervals from 5th - 8th months. Beyond 8 months (after flowering), this should not be done.

Banana aphid (Vector of Bunchy top disease)

- i. Spray methyl demeton 2 ml/lit, phosphamidon 1 ml/lit, midachlopride 0.5 ml or dimethoate @ 2 ml/lit towards the crown and pseudostem base thrice at 21 day intervals.
- ii. Pseudostem injection of monocrotophos 1 ml in 4 ml of water per tree at 45 day interval from the 3rd month till flowering using "TNAU - Banana Injector".
- iii. Avoid monocrotophos after flowering.

Thrips, Lacewing bug : Spray methyl demeton 2 ml/lit, monocrotophos @ 1 ml/lit or phosphamidon @ 1 ml/lit.

PEST MANAGEMENT IN CASHEW

Stem and Root Borer

- i. Periodical cleaning of collar region, removal of grubs, pupae and eggs and inter ploughing wherever possible during monsoon months.

- ii. Swabbing the bark of the exposed roots and shoots with carbaryl 50 WP 2 g/lit, lindane 20 EC 1 ml/lit or coal tar +
- iii. Kerosene - Coaltar mixture (1:2) upto one metre height on the trunk and on exposed bark after shaving the infested bark.
- iv. Root-feeding with monocrotophos 10 ml + 10 ml water in a small polythene bag twice a year on both sides of the trunk.

Tea mosquito bug

- i. Regulating the shade to facilitate proper penetration of sunlight inside the canopy.
- ii. Spray the following insecticides, thoroughly covering foliage and bark during early morning hours.

Monocrotophos @ 2 ml/lit at new flush formation during November - December.

Malathion / Chlorpyrites 2 m g/lit + Urea 3% at flower initiation during January - February and again at fruiting time during March - April.

Note: Monocrotophos should not be sprayed at flowering time.

PEST MANAGEMENT IN GRAPEVINE

Flea beetle

- i. Loose bark may be removed at the time of pruning.
- ii. Spray phosalone @ 2ml/lit, quinalphos @ 2 ml/lit or immediately after pruning and repeated 2-3 times.

2. Thrips

Spray methyl demeton or dimethoate 2 ml/lit

3. Mealy bug

- i. Release coccinellid beetle *Cryptolaemus montrouzieri* @ 10 / vine
- ii. Apply quinalphos or methyl parathion dust in soil @ 20 kg/ha to kill phoretic ants
- iii. Spray methyl demeton or monocrotophos 2 ml/lit
- iv. Spray dichlorvos @ 1ml / lit + Fish Oil Rosin Soap @ 25 g/lit

4. Stem girdler

Swabbing the trunk with carbaryl 50 WP 2 g/lit

Note: Waiting period for dimethoate and carbaryl is five days.

Fruit bat

Covering with nets and smoking in the evening hours.

PEST MANAGEMENT IN COCONUT

Rhinoceros beetle

- i. Destroy and dispose of all dead trees
- ii. Avoid manure pits in the vicinity of coconut gardens
- iii. Rake and turn up the decaying manure to expose the developing grub, egg and pupae to sun drying and predation. Then apply the fungal culture of *Metarrhizium anisopliae* to manure pits during cooler months of October - December.

- iv. Encourage reduviid predators, *Platymeris laevicollis*
- v. Once in three months, drench the manure pits with Carbaryl 50 WP 1 g/lit
- vi. In seedlings, place naphthalene balls @ 3 / tree, in the innermost three leaf axils once in 45 days.
- vii. Soak castor cake @ 1 kg/5 lit of water in wide mouthed mud pots and keep them in the garden to attract and kill adults. Replace the slurry once in 30 days.
- viii. Fermented toddy may be kept in wide mouthed earthen vessels in different places to attract the adults during night.
- ix. The crown region may be properly cleaned during harvests and the adults may be hooked out using a long wire.
- x. Light traps may be set up to attract the adults during monsoon months and following rains during summer.
- xi. The top-most three axils may be filled with a mixture of Sand + Neem Seed Powder (2:1) once in three months (150 g/tree)
- xii. Use Aggregation pheromone traps.

Red palm weevil

- i. Removal and disposal of damaged and wilted trees.
- ii. Avoiding injuries on trunk. Any injury should be plastered with clay or cement with Fytolon.
- iii. Avoid cutting green fronds.
- iv. Avoiding incidence of Rhinoceros beetle.

- v. Root feeding with monocrotophos @ 10 ml + 10 ml water after harvesting nuts again, only after 45 days nut should be harvested.
- vi. Setting up attractant traps using mud pots with molasses / toddy 2.5 lit + acetic acid 5 ml + yeast 5 g + split tender coconut stems / petioles @ 30/ac.
- vii. Insert 1-2 Aluminium phosphide tablets inside the tunnel and plug all the holes with clay + Fytolon.
- viii. Use aggregation pheromone traps.

Black headed caterpillar

- i. Cutting and burning all the infested leaves and fronds.
- ii. In small plantations, carbaryl 50 WP 2 g/lit may be sprayed.
- iii. In summer months release Bethylids and Braconid and Eulophid parasitoids from January onwards at 1:1:10 per tree.
- iv. Root feeding with monocrotophos @ 10 ml + 10 ml water with a waiting period of 45 days after root feeding.

Shot - hole borer, bark weevil

- i. Swab the stem with Carbaryl 50 WP 2 g/lit.
- ii. Root feeding with monocrotophos 10 ml + 10 ml water

Eriophyid mite - IPM package

- i. **Nutrients (per tree / year)**
Urea 1.3 kg, Super 2.0 kg, Potash 3.5 kg, Neem cake 5 kg,
Borax 50 g, Gypsum 1 kg, MgSO₄ 500 g, FYM 50 kg

ii. Root feeding

- a. Root feeding with TNAU - Agro Biocide 30 ml/tree
- b. Root feeding Carbosulfan 15 ml + 15 ml water / tree (45 days after)
- c. TNAU - Agro biocide - 30 ml/tree - (60 days after Carbosulfan root feeding).

Note: Before root feeding, pluck nuts. After root feeding, next harvest should be done 45 days later.s

Rodents

- i. Fixing inverted cone shaped tin sheets on stem
- ii. Wrapping tin sheets to a length of 1-2 feet on stem 5 m above ground level (or with any thorny plant materials like *Prosopis*)
- iv. Placing Bromodiolone 0.005% @ 10 g/tree at crown region at regular intervals.

PEST MANAGEMENT IN COFFEE

White borer :

- i. Arabica coffee grown under inadequate shade is highly prone to the attack. Provide optimum shade.
- ii. Trace the infested plants prior to the adult flight periods (March and September) by tracing the ridges on the stem. Avoid injuries on stem and roots.
- iii. Uprooted stem / plants should not be heaped inside the plantations.
- iv. Remove the loose scaly bark of main stem and primaries using coir glove or coconut husk to remove cracks and crevices on which eggs are normally deposited. Do not use any sharp implements.

- v. Spray and swab the main stem and thick primaries once in April - May and October - December with Lindane 20 EC 1.25 lit + 200 ml Teepol in 200 lit water at the time of peak adult activity (March and September) NSKE 5% also can be employed in more frequencies.

Shot hole borer

- i. Robusta coffee is more prone to the attack under heavy shade.
- ii. Pruning branches and spray endosulfan @ 2 ml/lit.

Green scales and Mealy bugs

- i. Spray *Verticillium lecanii* fungus @ 6×10^6 spores/ml
- ii. Release *Cryptolaemus montrouzieri* @ 300/ac.
- iii Spray quinalphos 2 ml/lit, fenthion 1 ml/lit or fenitrothion 1 ml/lit

Berry borer

- i. Maintaining thin shade and proper training of the plant.
- ii. Harvesting should be perfect without any left over beans on plants soil.
- iii. The left over harvest (gleaning) reduces the inoculum to a great extent.
- iv. Drying the berries to the following moisture levels.
Parchment 10%; Arabica cherry 10.5%; Robusta cherry 11.0%.
- v. Spray *Beauveria bassiana* fungus (white muscardine fungus).
- vi. Seed beans may be transported after thorough disinfestations.

PEST MANAGEMENT IN TEA

Scales : Spray carbaryl 2 g/lit, endosulfan 2 ml/lit, quinalphos 2 ml/lit or chlorpyrifos 2 ml/lit.

Sahyadrassus borer :

- i. Clean the base of bush
- ii. Kill the hiding larvae by inserting a thick wire into the borer hole.
- iii. Inject quinalphos 2 ml using a syringe or ink filler through the borerhole and plug with moist clay.

Mites : Spray dicofol 2 ml/lit, sulphur 40% 2 g/lit, sulphur 80% 1 g/lit or ethion 50 EC 1ml /lit.

PEST MANAGEMENT IN JASMINE

Budworm / blossom midge : Spray monocrotophos 2 ml/lit or endosulfan 2 ml/lit

Red spider mite and Erineum mites : Sulphur 50 WP 2 g/lit or dicofol 2.5 ml/lit.

PEST MANAGEMENT IN ROSE

Beetles : Hand picking the beetles during dry time and spray endosulfan 2 ml/lit.

Scale :

- i. Severely infested branches should be cut and burnt.
- ii. Spray endosulfan 2 ml/lit, malathion 2 ml/lit FORS 25 g/lit or carbofuran 3 G 5 g/plant at the time of pruning and during March - April.

Mealy bug : Spray monocrotophos 2 ml/lit or methyl parathion 2 ml/lit.

Bud worm : Spray monocrotophos 2 ml/lit.

Thrips, aphids and leaf hoppers : Spray methyl demeton 2 ml/lit (or) NO 3% (or) apply carbofuran 3G 10 g/plant.

PEST MANAGEMENT IN NEEM

Tea mosquito bug and tip borer : Spray carbaryl 50 WP 2 g/lit, endosulfan 2 ml/lit or monocrotophos 1.5 ml/lit.

Seed beetles : Proper hygenic during of seeds and packing.

PEST MANAGEMENT IN TEAK

Skeletonizer and defoliator : Spray on foliage with fenitrothion 1 ml/lit

PEST MANAGEMENT IN SUBABUL

Psyllid

- i. Spray a strong jet of water on new flushes.
- ii. Spray acephate 1 g/lit or triazophos 1 ml/lit and following a waiting period of 7 days before leaf harvest.