PRACTICAL MANUAL
ON
INSECT PEST MANAGEMENT
IN VEGETABLES, ORNAMENTALS & SPICES
(ENTOMOLOGY)

A

For B.Sc.
(HORTICULTURE)

COMPILED BY
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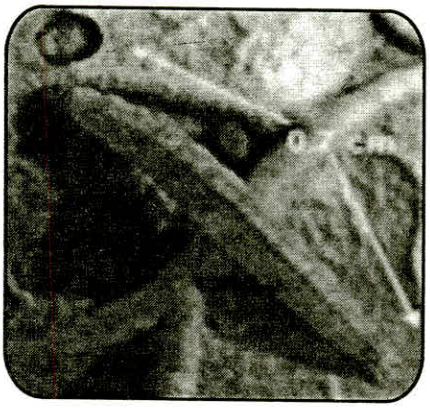
CONTENT

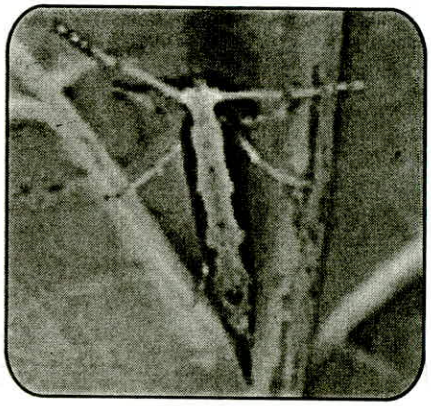
EXERCISE NO - 01
IDENTIFICATION OF INSECT-PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CRUCIFERS

1. Diamondback moth, *Plutella xylostella* (Yponomeutidae : Lepidoptera)

(i) Identification:

- Full grown larvae are 8-12 mm long, green in colour.
- The moths measure about 8-10mm in length and are brown or grey, with conspicuous white spots on the fore wings, which appear like diamond patterns when the wings lie flat over the body.





(ii) Nature of damage: Young caterpillars scrap epidermal leaf tissue, producing typical white transparent patches. Older larvae bite holes on the leaves.

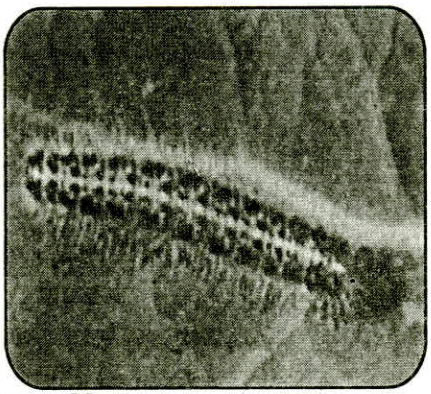
(iii) Control measures:

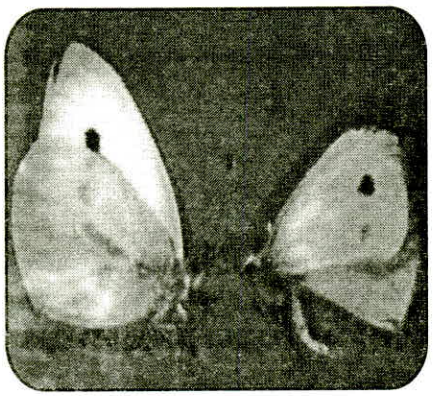
- Remove and destroy all the debris, stubble etc. after the harvest of the crop and plough the fields.
- Tomato, when intercropped with cabbage, inhibits or reduces egg laying by diamond-back moth.
- Indian mustard, which attracts 80-90 % moth for colonisation, can be used as a trap crop.
- Larval stage is parasitized by *Voria ruratis, Itoplectis* sp., *Apanteles sicarius* and *Tetrasticus sokolowskii, Brachymeria excarinata* is associated with pupa. A larval-pupal parasitoid, *Diadrumus collaris* is also found to be associated with this pest.
- NSKE @ 4.0 per cent and Bt formulation (Halt/Dipel) @ 500g/ ha are also effective against the DBM.
- Spray 1 kg of cartap hydrochloride 50SP or 250 ml of Indoxacarb14.5SC or 50 ml of Chlorantraniliprol 18.5SC or 200gm of Emamectin benzoate 5SG in 500 litres of water per ha. Repeat sprays after 10 days, if necessary.

2. Cabbage butter fly, *Pieris brassicae* (Pieridae : Lepidoptera)

(i) Identification:

- **Larvae:** The young larvae are pale yellow, become greenish yellow later on. The head is black and the dorsum is marked with black spots and short hairs.
- **Adults:** The Butterflies are pale white having smoky shade on the dorsal side of the body. The wings are pale white with a black patch on the apical angle of each hind wing.





(ii) Nature of damage:

- Young caterpillars feed gregariously and skeletonise leaves.
- Late instars disperse and move to adjacent plants/ fields and feed on the leaves voraciously.
- Plants are sometimes completely defoliated resulting in heavy yield losses.

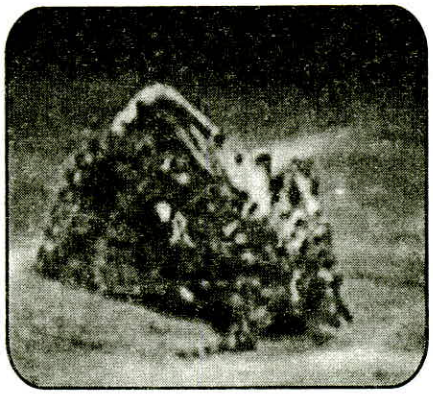
(iii) Control measures:

- Handpicking and mechanical destruction of caterpillars during early stage of attack can reduce infestation.
- NSKE @ 4.0 % and Bt @ 500g/ha are also effective.
- The larvae of this insect are parasitized by *Apanteles glomeratus* in the natural populations.
- Spray one litre of malathion 50EC or 750 ml of novaluron 10EC in 500 litres of water per ha. Repeat sprays after 10 days, if necessary.

3. Cabbage semi-looper, *Thysanoplusia orichalc*ea (Noctuidae : Lepidoptera)

(i) Identification:

- The caterpillars are plump and palish green. On walking, they form characteristic half-loops.
- The adults are light palish brown with a large golden patch on each fore wing. They measure about 42mm across the spread wings.



(ii) Nature of damage:

- Caterpillar defoliates the leaves.

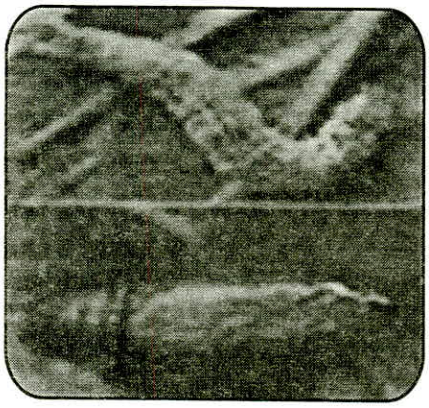
(iii) Control measures:

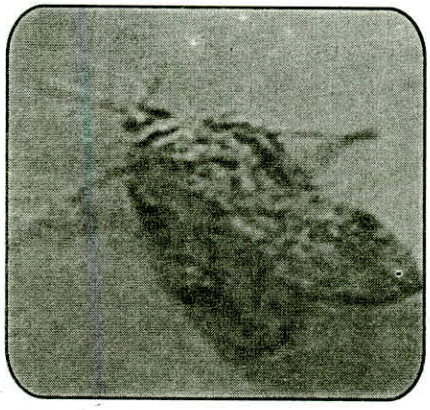
- Spray 1 kg of cartap hydrochloride 50SP or 250ml of Indoxacarb14.5SC or 50 ml of Chlorantraniliprol 18.5SC or 200 gm of Emamectin benzoate 5SG in 500 litres of watter per ha. Repeat sprays after 10 days, if necessary.

4. **Crucifer leaf Webber, *Crocidolomia binotalis* (Pyralidae : Lepidoptera)**

(i) Identification:

- Larvae are about 20mm in length, green in colour with red head and longitudinal red stripes on the body.





(ii) Nature of damage:

- The caterpillars cause considerable damage to the crops by webbing the leaves together and feeding on them. They also feed on flower buds and bore into the pods.

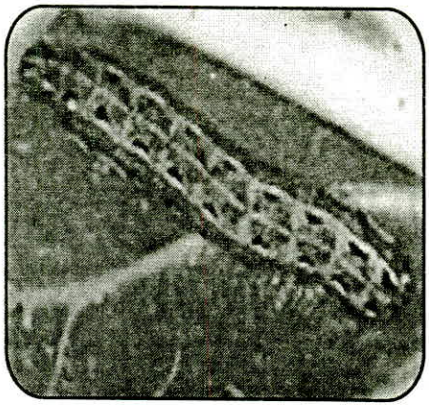
(iii) Control measures:

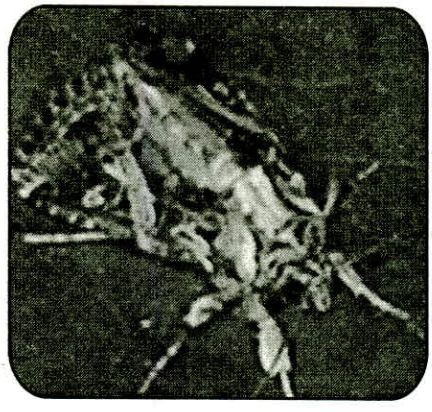
- Remove and destroy the webbed leaves with larvae within.
- Natural enemies like *Apanteles oblique, Apanteles* sp., *Enicospilus xanthocephalus, Palexorista solennis and Eocanthecona furcellata* also take care of the pest in nature.
- Spray 940 ml of malathion 50EC or 500 ml of dichlorvos 76EC in 500 litres of water per ha.

5. **Tobacco caterpillar, *Spodoptera litura* (Noctuidae : Lepidoptera)**

(i) Identification:

- Caterpillars measure 35-40 mm in length at maturity. They are velvety black with yellowish green dorsal strips and lateral white bands.
- The moths are about 22 mm long and measure 40 mm across the spread wings. The fore wings have beautiful golden and greyish brown patterns.





(ii) Nature of damage:

- The caterpillars feed on leaves and fresh growth. They are mostly active at night.

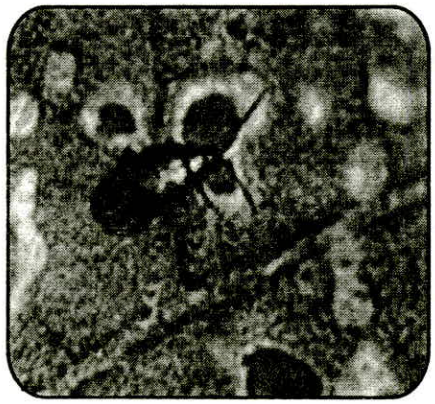
(iii) Control measures:

- Remove the egg masses and clusters of larvae and destroy them.
- Hand picking and destruction of egg masses and early gregarious instars.
- The natural enemies, *Compoletis* sp., *Eriborus* sp., *Rogas* sp., and *Strobliomyia orbata* are associated with larvae of this pest, which should be conserved through judicious use of pesticides.
- Spray 1 kg of cartap hydrochloride 50SP or 250ml of Indoxacarb 14.5SC or 200gm of Emamectin benzoate 5SG in 500 litres of water per ha. Repeat sprays after 10 days, if necessary.

6. Cabbage flea beetle, *Phyllotreta cruciferae* (Chrysomelidae : Coleoptera)

(i) Identification:

- The larva is dirty white in colour with pale white head and measures about 5 mm in length.
- The adult is metallic blue in colour, with a greenish hue.
- The body is elongate narrow in front but broad distally.
- The female beetle measures 2.0 mm in length while the male beetle measures 1.8 mm.



(ii) Nature of damage:

- The adults mostly feed on the leaves by making innumerable round holes in the host plants.
- The stem, the flowers and even pods may also be attacked.
- The old, eaten away leaves dry up, while the young leaves are rendered unfit for consumption.
- A special kind of decaying odour is emitted by the cabbage plants attacked by this pest.

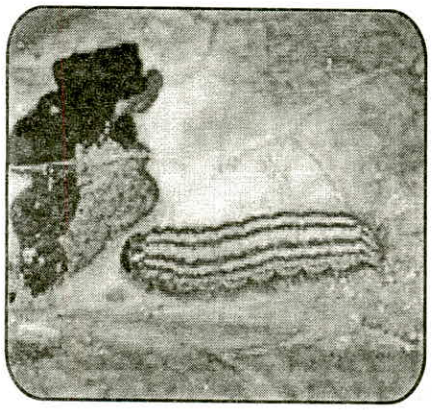
(iii) Control measures:

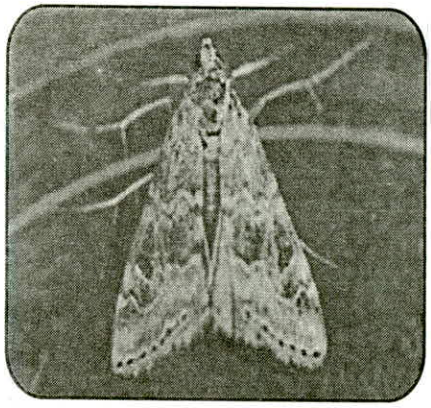
- Deep summer ploughing to kill the over wintering population.
- In endemic areas the off season/ late season crop should be avoided.
- The adults are parasitized by *Microctonus indicus*.
- In early planted crop or seedlings, malathion 5% dust @ 10-15 Kg/ha should be used.
- Spray 2.5 kg of carbaryl 50 WP in 500 litres of water per ha.

7. **Cabbage borer, *Hellula undalis* (Pyralidae : Lepidoptera)**

(i) Identification:

- The caterpillar is 12-25 mm long and creamy yellow with a pinkish tinge and has seven purplish brown longitudinal strips.
- The adult moth is slender, pale yellowish-brown, having grey wavy lines on the fore wings. Its hind wings are pale dusky.





(ii) Nature of damage:

- The caterpillars first mine into the leaves.
- Later on, they feed on the leaf surface, sheltered within the silken passages.
- As they grow bigger they bore into the heads of cauliflower and cabbage.
- When the attack is heavy, the plans are riddled with worms and outwardly the head look deformed.

(iii) Control measures:

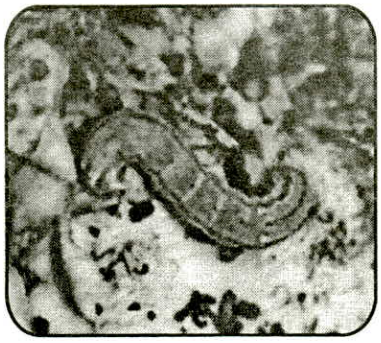
- Collection and mechanical destruction of caterpillars in early stage of attack helps to check the infestation.
- Since the attack is mostly in the nursery and on young plants in the field, spray 1 kg of carbaryl 50WP in 500 litres of water ha.
- Repeat spray at 10 days interval, pick all flowering heads before spraying and observe 7 days waiting period after spray for the next picking.

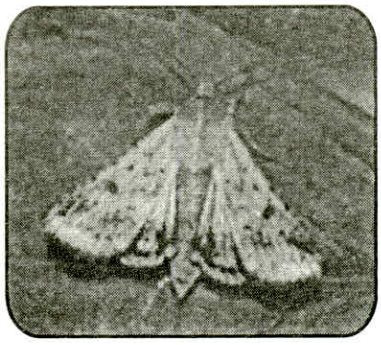
EXERCISE NO - 02
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF TOMATO

1. Tomato fruit borer, *Helicoverpa armigera* (Noctuidae : Lepidoptera)

(i) Identification:

- Newly emerged larvae are yellowish white where as older can be of many colours depending upon the food they consume. Full grown caterpillars are 40-48 mm long with whitish and dark gray longitudinal stripes.
- The moth is stoutly built and yellowish brown. There is a dark speck and a dark area near the outer margin of each fore wing. The fore wings are marked with greyish wavy lines and black spots of varying size on the upper side and a black kidney shaped mark and a round spot on the underside. The hind wigs are whitish and lighter in colour with a broad blackish band along the outer margin. On the tip of the abdomen there is a tuft of hairs in case of females, nevertheless, the tuft of hairs is absent in males.





(ii) Nature of damage:

- The larvae scrape the tomato foliage until early or late second instars stage.
- Thereafter, the larva bores into the fruit making it unfit for marketing.
- The severe cases of infestation, more than 80 percent fruits get damaged.

(iii) Control measures:

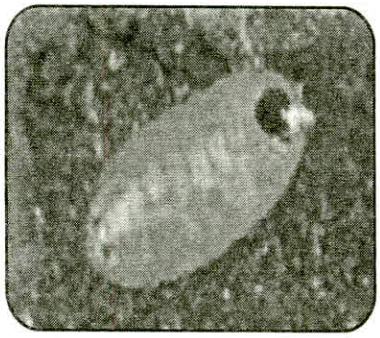
- Use of resistant varieties like Punjab Kesari, Punjab Chhaura, Pant Bahar, Azad, Pusa Hybrid-4 etc.
- Deep summer ploughing to expose the pupae to the sunlight and natural enemies.
- Use of African marigold as a trap crop is useful for control of fruit borer.
- Pheromone traps (5 traps/ ha) of moths for monitoring.
- Monitoring of top three leaves for egg laying.
- *Campoletis chlorideae* is a larval parasite of major importance.
- Spray of HaNPV @ 250 LE/ha at weekly intervals.
- Spray of NSKE @ 4.0 per cent.
- Spray of 750 ml of novaluron 10EC or 1.5 litres of profenophos 50 EC or 1 kg of methomyl 40 SP in 500 litres of water.

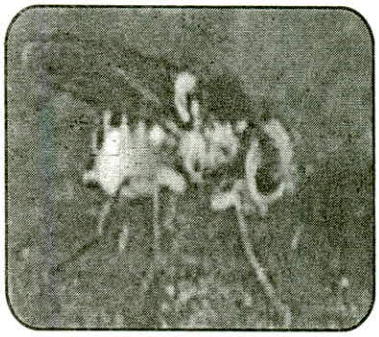
2. Serpentine leaf miner, *Liriomyza trifolii* (Agromyzidae : Diptera)

(i) Identification:

- The larvae are orange yellow, apodous. They move through peristaltic action between the two epidermis. Full-grown maggots are 1.88 x 0.70 mm.

- The adults are minute greyish black flies with plum red eyes and a yellow spot on the scutellum. The females are bigger (2.01x0.61mm) in size than males (1.79x0.52 mm).





(ii) Nature of damage:

- Caterpillars feed inside leaves by making characteristic mines.
- Damaged leaves turn brown and dry while plants get stunted and produce small flowers in case of severe attack.

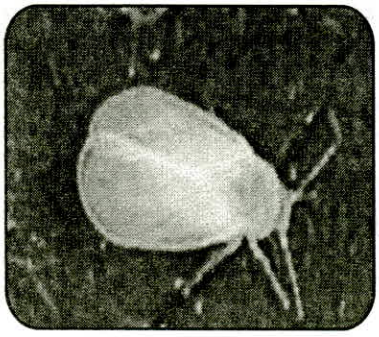
(iii) Control measures:

- Judicious use of nitrogenous fertilizer reduces the build up of the pest in endemic areas.
- Severely infested leaves should be removed and destroyed.
- NSKE @ 4.0 per cent along with sticker is effective.
- Natural enemies especially larval and pupal parasitoids are active during July-August.
- Spray 1 litre of triazophos 40EC or 1 kg of Acephate 75SP in 500 litres of water.

3. Greenhouse whitefly, *Trialeurodes vaporariorum* (Aleyrodidae : Hemiptera)

(i) Identification:

- Newly emerged nymphs are light yellow in colour.
- Greenhouse whiteflies are small insects with white coloured wings.



(ii) Nature of damage:

- The damage is caused by nymphs as well as adults. Suck the cell sap from leaves.
- Leaves turn yellow and dry away.
- Nymphs also excrete honey dew on which sooty moulds develops. Photosynthesis of the plant is reduced.

(iii) Control measures:

- Removal of weed hosts is important to reduce the incidence.
- Protect the nursery by using nylon nets (30 mesh) for 25-30 days.
- To manage sucking pests seed treatment with imidacloprid 70% WS @ 7gm per kg of seed.
- Spray 100 gm of Thiamethoxam 25WG in 500 litres of water.

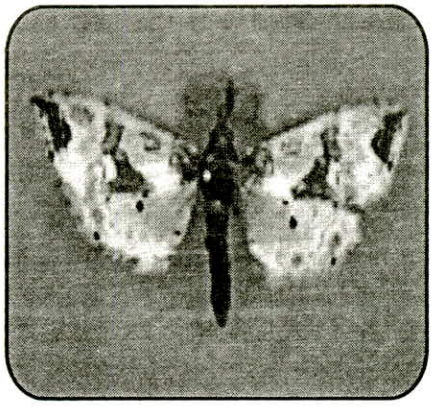
EXERCISE NO - 03
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF BRINJAL

Insect Pests of Brinjal

1. Brinjal shoot and fruit borer, *Leucinodes orbonalis* (Pyraustidae : Lepidoptera)

(i) Identification:

- The caterpillars are creamy white when young, but light pink when full-grown. They measure about 18 23 mm in length.
- The moth is white but has pale brown or black spots on the dorsum of the thorax and abdomen.
- Its wings are white with a pinkish or bluish tinge and are ringed with small hair along the apical and anal margins.
- The fore wings are ornamented with a number of black, pale and light brown spots.
- The moth measures about 20-22 mm across the spread wings.



(ii) Nature of Damage:

- Damages the crop from seedling stage till the harvest.
- In young plants, the caterpillars result in dead hearts.
- Later on they bore into flower buds and fruits.
- Enter from under the calyx, seal the hole with excreta.
- The damaged flower buds are shed without blossoming.
- Fruits show circular exit holes.
- These fruits become unfit for human consumption and lose market value.
- Infestation up to 70 per cent may be recorded.

(iii) Control measures:

- Remove and destroy all the affected shoots and fruits with borers inside.
- Avoid continuous cropping of brinjal crop.
- Do not ratoon the brinjal crop.
- Grow less susceptible varieties like Arka Kesav, Pusa Purple Round, Arka Kasumakar, Pusa Purple

Cluster, Pusa Purple Long, Punjab Barsati, Kalyanpur 2, Punjab Chamkila.

- Collect all attacked shoots and fruits at regular intervals and burry them deep.
- Use sex pheromones @ 100/ ha (10x10m).
- Periodic releases of *Trichogramma chilonis* @ 100000 parasitized eggs/ha.
- The parasitoids associated with larvae of this pest are *Pristomerus testaceus, Cremastus flavoorbitalis, Bracon* sp, *Shirakia schoenobii* and *Iphiaulas* sp. which should be conserved through judicious use of pesticides.
- Spraying of commercial preparations of *Bacillus thuringiensis* var. *Kurstakii* @ 1 kg/ha effectively control this borer.
- Spray 2 litres of quinalphos 25EC or 1.25 litres of triazophos 40EC or 2 kg of carbaryl 50WP or 1 kg of cartap hydrochloride or 500 ml of cypermethrin 10 EC in 500 litres of water per ha.

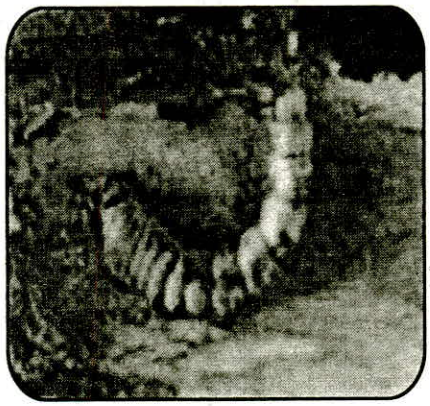
Insecticides of same group should not be used repeatedly in order to avoid development of pesticide resistance and appearance of secondary pests.

A waiting period of 7 days should be observed after the spray.

2. Brinjal stem borer, *Euzophera perticella* (Phycitidae : Lepidoptera)

(i) Identification:

- Full grown caterpillars are 16-18 mm in length and light brown in colour and have a few bristly hairs.
- The moths measure about 32 mm across the spread wings and have pale-yellow abdomens. The head and thorax are greyish, the fore wings are pale straw- yellow and the hind wings are whitish.



(ii) Nature of Damage:

- The caterpillars feed exclusively in the main stem and have never been observed to bore into the fruits. As a result of their attack in the field, stray plants are seen withering and drying up.

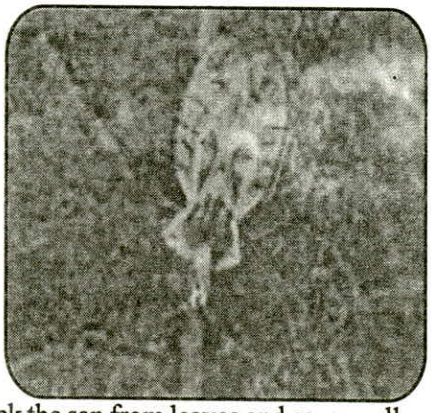
(iii) Control measures:

- When the attack of this borer is serious, the ratooning of brinjal plants should be discontinued.
- The withered plants should be uprooted and burnt.
- *Pristomerus euzophere* and *P. testaceus* have been recorded as important larval parasites of brinjal stem borer which should be conserved through judicious use of pesticides.
- Spray 800 ml of malathion 50EC should be given at 15 day intervals.

3. **Brinjal lace wing bug, *Urentius sentis* (Tingidae : Hemiptera)**

(i) Identification:

- The full-grown nymphs are about 2 mm long and 1.35 mm broad. They are pale ochraceous and are stoutly built, with very prominent spines.
- The adult bugs measure about 3 mm in length and are straw coloured on the dorsal side and black on the ventral side.



(ii) Nature of damage:

- The adults and the nymphs suck the sap from leaves and cause yellowish spots which, together with the black scale-like excreta deposited by them, impart a characteristic mottled appearance to the infested leaves.

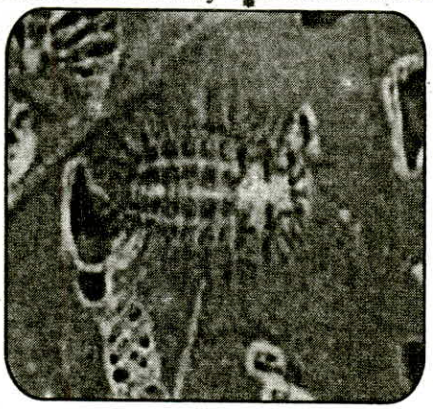
(iii) Control measures:

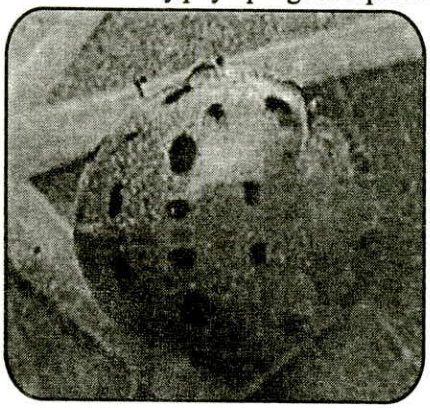
- Apply one litre of dimethoate 30 EC in 500 litres of water per ha.

4. **Hadda beetle, *Epilachna vigintioctopuncatata* (Coccinellidae : Coleoptera)**

(i) Identification:

- Grubs are yellowish, oval bears strong branched spines on body surface and measure 6 mm in length.
- Adult beetles are reddish or brownish hemispherical, 6-8 mm long elytra marked with a series of black spots. The adult resembles lady bird beetle but is considered as the only phytophagous representative of this family.





(ii) Nature of damage:

- Both the adults and grubs cause damage by feeding on the upper surface of leaves.
- They eat up regular areas of the leaf tissue, leaving parallel bands of uneaten tissue in between.
- The leaves, thus, present a lace-like appearance.
- They turn brown, dry up and fall off and completely skeletonise the plants.

(iii) Control measures:

- Collect and destroy the infested leaves along with insects in the initial stages.
- Spray 800 ml of malathion 50 EC or 2.5 kg of carbaryl 50WP in 500 litres of water per ha, at 10 day intervals as soon as the pest appears.

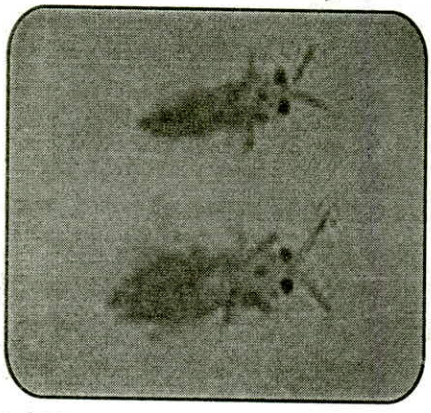
EXERCISE NO - 04
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CHILLI

Insect Pests of Chillies

1. Chilly thrips, *Scirtothrips dorsalis* (Thripidae : Thysanoptera)

(i) Identification:

- The nymphs resemble the adults in shape and colour but are wingless and smaller in size.
- The adults are slender, yellowish brown in colour, having apically pointed wings, and they measure about 1 mm in length.
- The females possess long, narrow wings with the fore margin fringed with long hairs.



(ii) Nature of damage:

- Nymphs and adults lacerate the host tissue and imbibe on the oozing sap.
- Tender leaves and growing shoots are preferred.
- Sometime buds and flowers are also attacked.
- Infested leaves start curling and crumbling.
- Buds become brittle and drop down.
- Incidence is more in dry weather.
- The insect is also responsible for transmitting the virus causing leaf curl disease of chillies.

(iii) Control measures:

- Predatory thrips like *Scolothirps indicus* and *Frankliothrips megalops* have been found feeding up on *Scirtothrips dorsalis* in the nature.
- Spray 1.0 litre of malathion 50EC or 1.0 kg of carbaryl 50WP in 500 litres of water per ha.

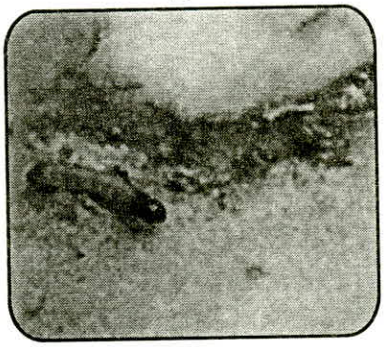
EXERCISE NO - 05
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF POTATO

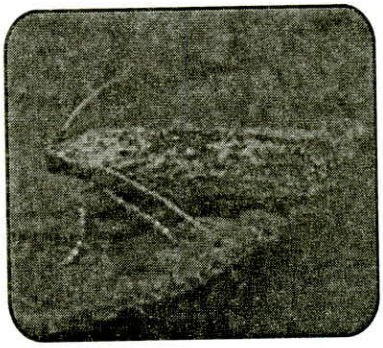
Insect Pests of Potato

1. Potato tuber moth, *Phthorimaea operculella* (Gelechiidae : Lepidoptera)

(i) Identification

- Newly emerged larvae are gray yellowish white with brown head.
- The adult is very small narrow-winged nocturnal moth, about 13 mm across the wings when spread. It is greyish brown with mottling of dark brown.





(i) Nature of damage:

- Larvae which mine the leaves, petiole and terminal shoots causing wilting.
- After tuberization, the larvae enter into the tubers and feed on them. Bore the tubers in stores also.
- Larvae tunnel into the pulp which ultimately becomes unfit for use as seed or for human consumption.
- The infested tubers are further exposed to microbial infection which leads to rotting.

(iii) Control measures:

- All the infested tubers should be removed and destroyed.
- Plant tubers slightly deeper (10 cm) and follow proper earthing up.
- Lift all the tubers from the field at harvest. Destroy self grown potato plants.
- Harvested potatoes should be lifted to cold stores immediately.
- If cold store facilities are not available, only healthy tubers should be stored.
- Cover the stored tubers with 2.5 cm layer of chopped dry leaves of Lantana or Eucalyptus or Eupatorium below and above the potato.
- Potato crop should be harvested immediately after required maturity i.e. by September. Crop left beyond September suffers more.
- Mass trapping of adults with sex pheromones.
- Under field conditions more than 20 traps/ha (some times up to 40 traps/ha) are required.
- Parasitoids like *Chelonus curvimaculatus, Bracon gelechiae, Apanteles* sp, *Melanis* sp and *Diadegma molliplum* are also found to reduce the population of PTM.
- The pest can be checked by spraying 2.0 kg of carbaryl 50WP in 500 litres of water per ha. Repeat spraying 2-3 times at fortnightly intervals and do not dust the edible potatoes.
- In stores dusting the tubers with 5% malathion or 1.5 % quinalphos dust @ 125g dust per 100 Kg of potatoes.

EXERCISE NO - 06
DENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF OKRA

Insect Pests of Okra

1. Cotton leaf hopper, *Amrasca biguttula* (Cicadellidae : Hemiptera)

(i) Identification

- Nymphs are whitish pale green, wingless.
- Adults are about 3 mm long and greenish yellow during the summer, acquiring a reddish tinge in the winter.

(ii) Nature of damage:

- Both nymphs and adults suck cell sap from the leaves.
- Also inject toxic saliva in to plant tissues.
- Affected leaves turn yellowish and curl.
- In case of heavy infestation the leaves turn dark brick red, become brittle and crumble.

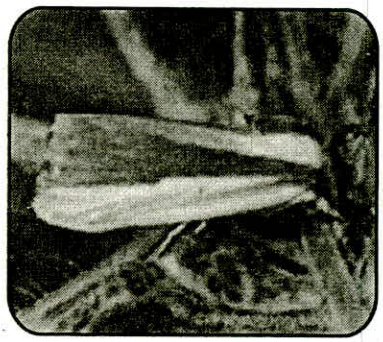
(iii) Control measures:

- Seed treated with imidacloprid 70 WS (3g/Kg) gives protection up to 40-50 days after sowing.
- For seed crop, apply 20 kg of phorate 10G at sowing in furrows or spray twice at fornightly interval starting 15 days after sowing with 625 ml of dimethoate 30EC or 50 g of acetamiprid 20 SP in 500 litres of water per ha.

2. Shoot and fruit borers, *Earias vittella / E. Insulana* (Noctuidae : Lepidoptera)

(i) Identification

- Caterpillars are dull green, 20 mm, having tiny stout bristles and a series of longitudinal black spots on the body.
- The moths are yellow, about 25mm across the wings.



(ii) Nature of damage:

- Larvae cause the damage.
- Larvae bore into growing shoots, flower, flower buds and fruits.
- The shoots infested with borer droop downwards and dry up.
- The infested fruits have a varying number of holes.
- Fruits become distorted and rendered unfit for consumption.

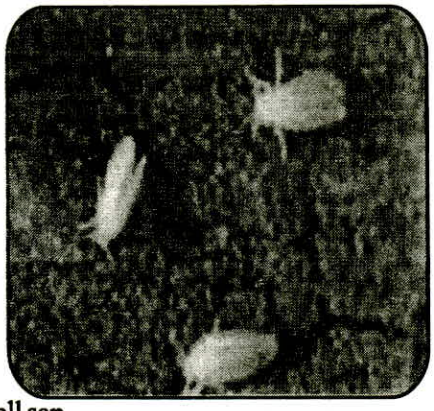
(iii) Control measures:

- Neglected okra fruits left in the field should be collected and destroyed.
- Uproot hollyhock and the ratooned cotton, which are host plants for bollworms.
- Deep ploughing during summer to expose the pupae.
- Avoid over use of nitrogenous fertilizers.
- Spray the crop when 20-30 % shoots show borer damage with 250 ml of fenvalerate 20EC or 400 ml of deltamethrin 2.8EC or 500 ml of cypermethrin 25EC in 500 litres of water per ha.

3. Cotton whitefly, *Bemisia tabaci* (Aleyrodidae : Hemiptera)

(i) Identification:

- Nymphs are oval, scale like and greenish white in colour.
- Adults are minute insects, about 1mm long, covered completely with a white waxy glume.
- Wings are opaque and milky white in colour.



(ii) Nature of damage:

- Nymphs and adults suck the cell sap.
- They also excrete honey dew on which sooty mould grows which interferes with the photosynthesis of the plants.
- Affected plants give a sickly black appearance.
- *B. tabaci* also transmits a number of viruses including vein clearing disease of okra.

(iii) Control measures:

- Clean cultivation.
- Seed treatment with imidacloprid 70 WS @ 2.5 g/ Kg.
- Protect nursery by using nylon nets (200 mesh).
- *Eretmocerus massii* is associated with nymphs and pupae. *Chrysoperla* sp. and *Brumus* sp. prey upon nymphs and adults.
- Spray 750 ml of oxydemeton methyl 25EC or 625 ml of dimethoate 30EC in 500 litres of water per ha.

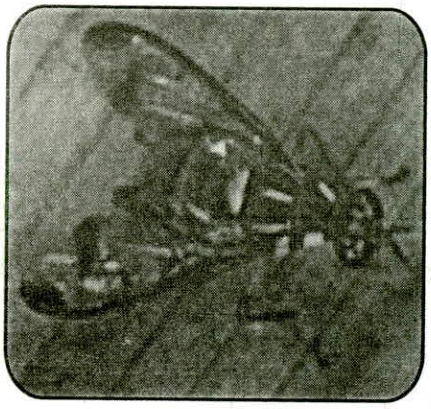
EXERCISE NO - 07
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CUCURBITS

Insect Pests of Cucurbits

1. Fruit flies, *Bactrocera cucurbitae* (Tephritidae : Diptera)

(i) Identification

- The maggots are legless and appear as headless, dirty-white wriggling creatures, thicker at one end and tapering to a point at the other.
- A full-grown maggot is 9-10 mm long and 2 mm broad in the middle.
- The adult flies are reddish brown with lemon-yellow markings on the thorax.



(ii) Nature of damage:

- The larvae feed inside the fruits. Fruits become unfit for consumption and drop prematurely.
- Older fruits show less symptoms, but on split opening, a mass of maggots in pulp is found.
- Infested fruits are also attacked by microbes.

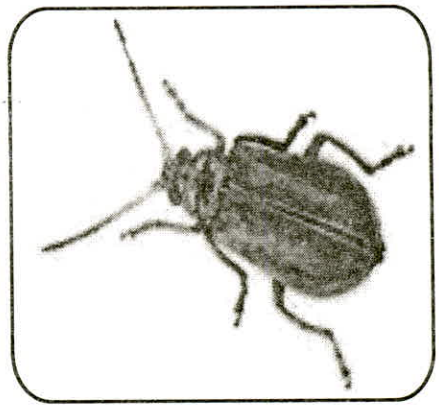
(iii) Control measures:

- Collection and destruction of infested fallen fruits regularly. Frequent raking of the soil under the vine. Ploughing the infested field after the crop is harvested.
- Use of methyl eugenol trap to monitor fruit flies.
- Apply the bait spray containing 50 ml of malathion 50EC + 0.5 kg of sugar/gur in 50 litres of water per ha.

2. Red pumpkin beetle, *Aulacophora foveicollis* (Chrysomelidae : Coleoptera)

(i) Identification:

- Grubs are creamy white, with a slightly darker oval shield at the back.
- Adults are orange coloured, 6-8 mm long with black ventral surface clothed with hairs.



(ii) Nature of damage:

- Both grubs and beetles are damaging. Grubs feed on underground plant parts.
- Beetles damage cotyledons, flowers and tender leaves.
- The early sown cucurbits are so severely damaged that they have to be resown.

(iii) Control measures:

- After the crop is over, plough the field deep to kill the grubs present in the soil. Sow the crop in November to avoid damage by this pest. Apply 17 kg of carbofuran 3G per ha 3-4 cm deep in the soil near the base of the plants just after germination. Spray 875 g of carbaryl 50WP in 500 litres of water per ha.

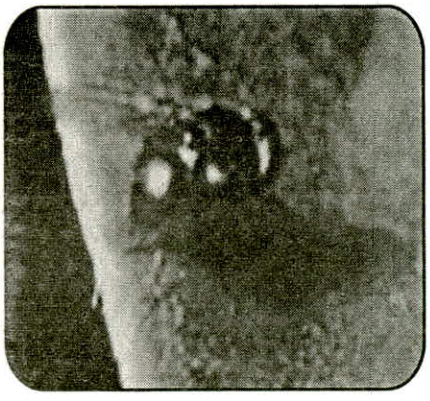
EXERCISE NO - 08
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF BEANS

Insect Pests of Beans

1. Bean fly, *Ophiomyia phaseoli* (Agromyzidae : Diptera)

(i) Identification:

- The maggot is creamy in colour and apodous in form.
- Body length of the male being about 1.9 mm and that of the female 2.2 mm.
- The general colour is shiny black.



(ii) Nature of damage:

- The maggot forms a short linear leaf mine and further on it tunnels underneath the epidermis of the leaf.
- In severe infestation, the stems turn brown, become swollen and break down.
- The attacked plants bear less pods which are mostly empty or else their seeds may be very small.

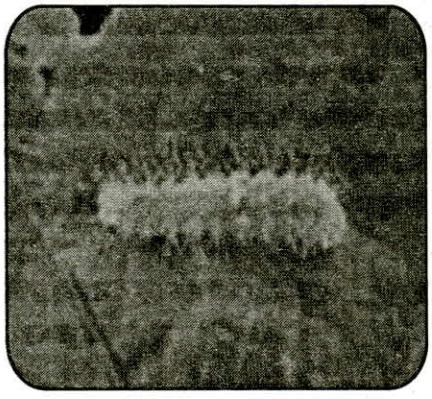
(iii) Control measures:

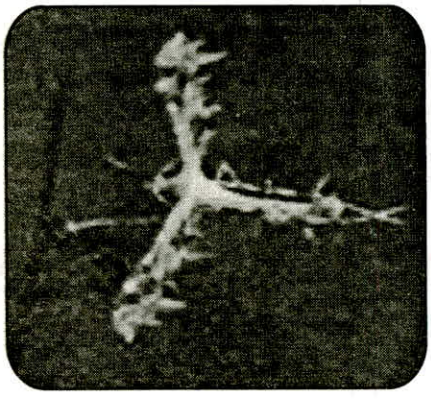
- Apply 750 ml of oxydemeton methyl 25EC in 500 litres of water per ha at 15 day intervals during flowering stage.

2. Plume moth, *Exelastis atomosa* (Pterophoridae : Lepidoptera)

(i) Identification

- The full-grown caterpillar is greenish brown and measures 1.25 cm in length and has short hairs on the body.





(ii) Nature of damage:

- Tiny caterpillar bore into the pods and feed on developing seeds.
- Sometimes the caterpillars emerging from eggs laid on flower buds enter into these buds and feed inside.

(iii) Control measures:

- Spray 1.25 litres of quinalphos 25EC or 500 ml of dichlorvos 76EC in 500 litres of water per ha.

3. Bihar hairy caterpillar, *Spilosoma obliqua* (Arctiidae : Lepidoptera)

(i) Identification

- Larvae are 40-45 mm when full grown and are covered profusely with grey hairs.
- Moths measure about 50 mm across the wings.
- The head, thorax and under side of the body are dull yellow.
- Antennae and eyes are black.

(ii) Nature of damage:

- The caterpillars eat leaves and soft portions of stems and branches.
- In severe, infestation the entire plant can be defoliated.

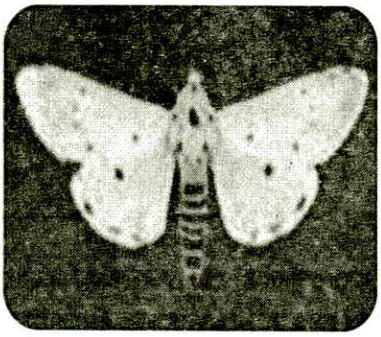
(iii) Control measures:

- Collection and destruction of early gregarious caterpillars.
- Pupae may be collected and destroyed at the time of summer ploughing.
- Spray 1.25 litres of quinalphos 25EC or 500 ml of dichlorvos 76EC in 500 litres of water per ha.

4. Red hairy caterpillar, *Amsacta moorei* (Arctiidae : Lepidoptera)

(i) Identification

- Caterpillars are 25 mm, reddish amber with numerous long hairs.
- Moths are stoutly built and have white wings with black spots.
- The outer margins of the fore wings, the anterior margin for the thorax and the entire abdomen is scarlet red.
- There are black bands and dots on the abdomen.



(ii) Nature of damage

- Young caterpillars prefer the growing points.
- Older ones feed voraciously on all types of vegetation.
- Moving army destroy field after field.
- Under sever infestations there can be complete failure of the kharif crops.

(iii) Control measures:

- The moths are strongly attracted to artificial light. Therefore, use light traps.
- Collect and destroy young gregarious larvae.
- Pupae may be collected and destroyed at the time of summer ploughing.
- In case of serious attack, spray 1.25 litres of quinalphos 25EC or 500 ml of dichlorvos 76EC in 500 litres of water per ha.

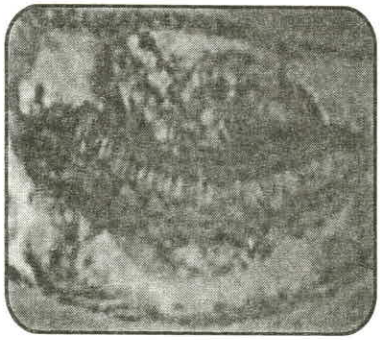
EXERCISE NO - 09
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF PEA

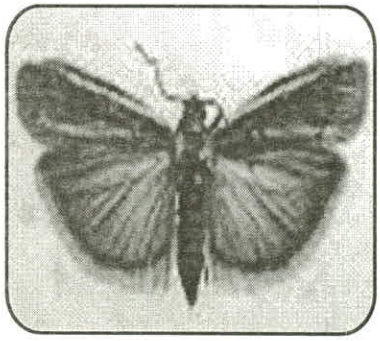
Insect Pests of Peas

1. Pea pod borer, *Etiella zinckenella* (Phycitidae : Lepidoptera)

(i) Identification

- Newly emerged caterpillars are greenish.
- Full grown larvae are rosy with purplish tinge.
- The moths are grey with a wing expanse of about 25 mm.
- The forewings have dark marginal lines and are interspersed with ochreous scales.





(ii) Nature of damage

- The larvae consume floral parts, newly formed pods and seeds inside the developing pods.
- The reduction in yield may be up to 5%.

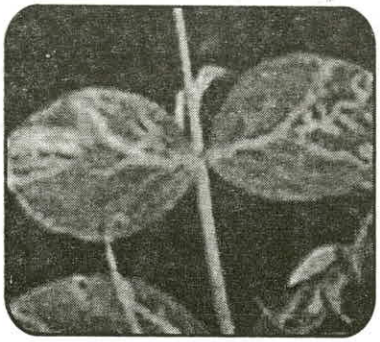
(iii) Control measures:

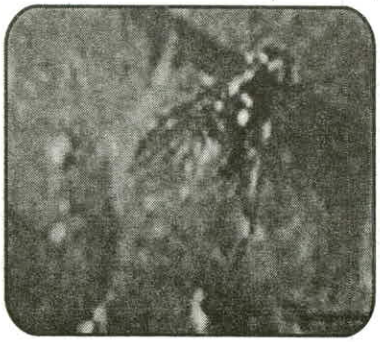
- At flower initiation, spray the crop with 2.25 kg of carbaryl 50WP in 500 litres of water per ha and repeat the treatment after three weeks, if necessary.
- Carbaryl should be used if the husk is to be fed to the cattle.

2. Pea Leaf miner, *Chromatomyia horticola* (Agromyzidae : Diptera)

(i) Identification

- The larva is translucent white and the inverted 'Y' shaped oral hook is clearly visible.
- Initially it is light brown but turns dark towards maturity.
- Adults are two winged flies having greyish black mesonotum and yellowish frons.





(ii) Nature of damage:

- The large number of tunnels made by the larvae interferes with photosynthesis and proper growth of the plants, making them look unattractive.

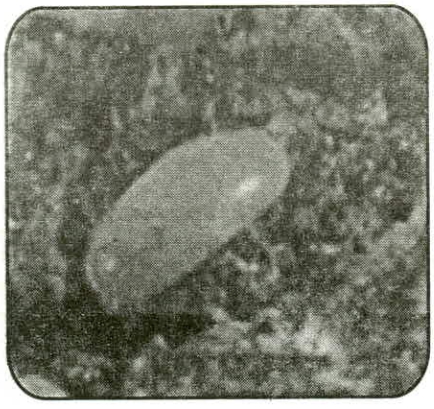
(iii) Control measures:

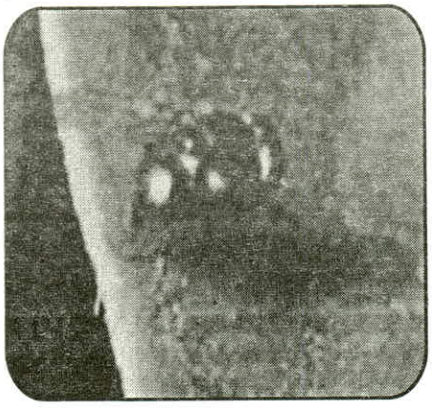
- Large number of larval (*Diglyphus* sp., *Neochrysocharis* sp., *Asecodes* sp., *etc.*) and larval- pupal (*Opius* sp.) parasitoids are active in nature. Avoid insecticides when parasitoids are active.
- Spray one litre of dimethoate 30EC in 500 litres of water per ha and repeat spray at 15 day interval. A waiting period of 20 days should be observed for picking of pods.

3. Pea stem fly or bean fly, *Ophiomyia phaseolii* (Agromyzidae : Diptera)

(i) Identification

- Maggots are initially white, but latter turn yellowish.
- They are small in size (less than 1mm). Adults are metallic black flies.





(ii) Nature of damage:

- The maggots mine through the leaf petioles into stems. Females also puncture the leaves.
- Leaves turn yellow, giving the plants a dry appearance. The stems turn brown, become swollen and break down. Spring crop suffers less than the late summer crop.
- The attacked plants bear fewer pods which are mostly empty or having very small seeds.

(iii) Control measures:

- Remove and destroy all the affected branches during the initial stage of attack.
- Sow the crop in the second fortnight of October to escape the damage of the pest.
- Apply 25 kg of carbofuran 3G per ha in furrows at the time of sowing.
- On the crop, spray three times 750 ml of oxydemeton methyl 25EC in 500 litres of water per ha. The first application should be just after germination and the other two at an interval of 2 weeks each.

4. Pea aphid, *Acyrthosiphum pisum* (Aphididae : Hemptera)

(i) Identification

- Adult aphids are soft bodied, long legged, pear-shaped, green yellow or pink in colour with long conspicuous cornicles.
- Both alates as well as apterous forms are present.

(ii) Nature of damage:

- Both nymphs and adults suck the sap from young shoots, ventral surface of tender leaves, inflorescence and even on stems.
- There is curling of leaves, which become irregularly distorted, while the shoots become stunted and malformed. The leaves turn pale and dry.
- Honeydew secreted by the aphids encourages growth of sooty mould and this superficial black coating on leaves and stems hinders the photosynthetic activity of the plants, which become weak, thus affecting adversely the pod formation. Aphids are carriers of pea mosaic.

(iii) Control measures:

- Spray 1.0 litre of dimethoate 30EC in 500 litres of water per ha when the attack starts and repeat after 15 days if necessary.

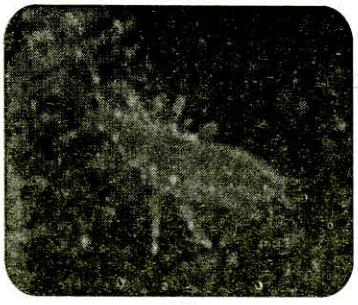
EXERCISE NO - 10
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF ONION & GARLIC

Insect Pests of Onion & Garlic

1. Onion thrips, *Thrips tabaci* (Thripidae : Thysanoptera)

(i) Identification:

- Nymphs and adults are slender, fragile and yellowish in colour.
- Adults have fringed wings heavily with fine hairs.
- Males are 0.8-1.0 mm long while the females are 1.0-1.2 mm long.



(ii) Nature of damage:

- Adults and nymphs lacerate the epidermis of the leaf and lap the exuding sap.
- The affected leaves show silvery white blotches which later become brownish.
- The plants do not form bulbs nor do the flowers set seed.

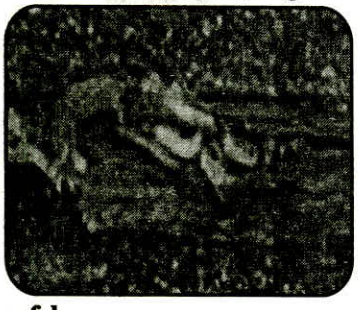
(iii) Control measures:

- Grow resistant verities of onion like White Persia, Grano, Sweet Spanish, Crystal Wax etc.
- Spray 625 ml of malathion 50EC in 500 litres of water per ha as soon as the pest appears.
- A waiting period of 7 days should be observed before harvest.

2. Onion maggot, *Delia antiqua* (Anthomyiidae : Diptera)

(i) Identification:

- The maggots are small, white and about 8 mm in length.
- The flies are slender, greyish, large-winged, rather bristly and about 6 mm in body length.



(ii) Nature of damage:

- The maggots bore into the bulbs causing the plants to become flabby and yellowish.
- They mine through the small bulbs completely, leaving only the outer sheath.
- Larger bulbs are attacked by many maggots at a time.
- Partially attacked bulbs get rottened.

(iii) Control measures:

- Apply 10 kg per ha of phorate 10G to the soil followed by light irrigation.
- Spray 800 ml of malathion 50EC in 500 litres of water per ha 15 day interval is also effective.

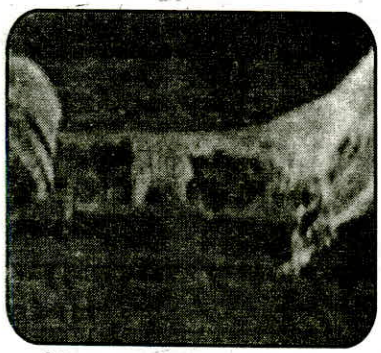
EXERCISE NO - 11
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF LEAFY VEGETABLES

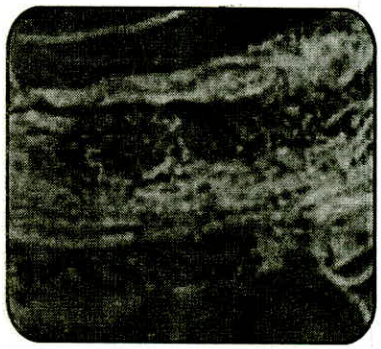
Insect Pests of Leafy vegetables

1. Amaranthus stem weevil, *Hypolixus truncatulus* (Curculionidae : Coleoptera)

(i) Identification:

- Grubs are stout, curved, legless, white and about 13-17 mm long.
- Adult weevils are ash-grey, 10-15 mm long.





(ii) Nature of damage:

- Newly emerged grubs tunnels the stem.
- The affected stems become weak and often split longitudinally due to excessive transpiration and evaporation. The plants desiccate and ultimately dry up completely.
- Adults feed on tender leaves and stems but the loss caused by them is negligible.

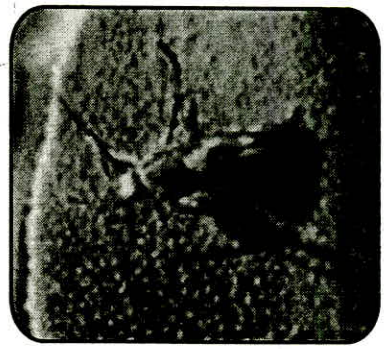
(iii) Control measures:

- Destroy all wild amaranthus plants in the vicinity.
- As soon as infestation is observed, remove and destroy promptly all the affected plants with grubs inside.
- Spray 650 ml of malathion 50EC or dichlorvos 76EC in 500 litres of water is also effective.
- After spraying the crop with insecticides observe a waiting period of 7-10 days.

2. Leaf caterpillar, *Eretmocera impactella* (Heliodinidae : Lepidoptera)

(i) Identification

- Full grown caterpillars are 9-12 mm long, cylindrical, brownish yellow to brownish grey in colour.
- Fore wings are also cupreous with yellow spots, hind wings are pale in colour.
- Wing expanse is 14-18 mm.



(ii) Nature of damage

- Caterpillars web the leaves and feed inside.

(iii) Control measures:

- Spray 500 ml of malathion 50EC in 500 litres of water per ha.

3. Spinach blue beetle, *Altica caerulescens* (Alticidae : Coleoptera)

(i) Identification

- Grubs are 5-10 mm long, dark brown in colour.
- Adults are 5-7 mm long steel blue in colour.

(ii) Nature of damage

- Freshly emerged grubs scrap and feed on chlorophyll containing tissues.
- Later grubs mine inside the leaves and feed on the mesophyll tissue.
- Adults nibble the leaf margins causing very little damage.

(iii) Control measures:

- Spray 1.2 kg of carbaryl 50EC or 500 ml of malathion 50EC in 500 litres of water per ha.
- Observe a waiting period of about 10 days.

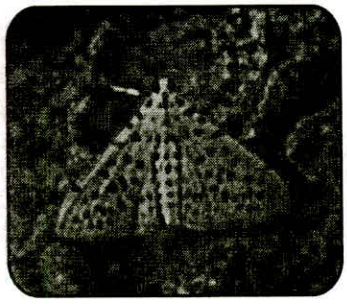
EXERCISE NO - 12
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF TURMERIC & GINGER

Insect pests of Ginger and Turmeric

1. Shoot borer, *Conogethes punctiferalis* (Pyralidae : Lepidoptera)

(i) Identification:

- Full grown larvae are light brown with sparse hairs and measure 16-26 mm in length.
- The adults are medium sized moths with wingspan of 18-21 mm; the wings are orange-yellow with minute black spots.



(ii) Nature of damage:

- The larvae bore into pseudo stems and feed on the central growing shoot resulting in yellowing and drying of infested shoots.
- Affected plants turns yellow and dry up.
- The presence of a bore hole in the pseudostem through which frass is extruded and withered central shoot is a characteristic symptom of infestation.

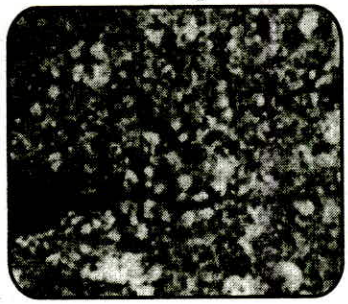
(iii) Control measures:

- This pest can be controlled by cutting and removing the affected shoots and spray the crop with 500 ml of malathion 50EC in 500 litres of water.
- To manage shoot borer, apply carbofuron 3G at 20 kg per ha at the time of planting.

2. Rhizome scale insect, *Aspidiella hartii* (Coccidae : Hemiptera)

(i) Identification:

- This is a small circular hard scale. The adult female is minute, circular and light brown to grey and measure about 1 mm in diameter. Female is ovo-viviparous.



(ii) Nature of damage:

- Scales feed on plant sap in field or on rhizome.
- This pest infests rhizomes of ginger and turmeric both in the field especially in later stages of the crop as well in storage.

(iii) Control measures:

- Dipping the seed rhizome of ginger and turmeric in quinalphos 25 @ 0.1% for 15 minutes after harvest and before planting was also effective in controlling the pest infestation.

EXERCISE NO - 13
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CARDAMOM

Insect pests of Cardamom

1. Banana aphid, *Pentalonia nigronervosa* (Aphididae : Hemiptera)

(i) Identification:

- The Wingless aphid is dark brown, pyriform measuring 1.34 mm in length and with six segmented antennae which are longer than the body.
- Abdomen is dark brown, shining and slightly bulged.
- The winged form is dark brown elongated and pyriform.
- They are larger than the wingless forms by with less body width.

(ii) Nature of damage:

- Both nymphs and adults suck the cell sap from leaf sheath and pseudostem.
- The insect causes little direct damage but is of considerable significance being vector of cardamom mosaic (Kattle disease), Amomum mosaic and Foorky disease of large cardamom.

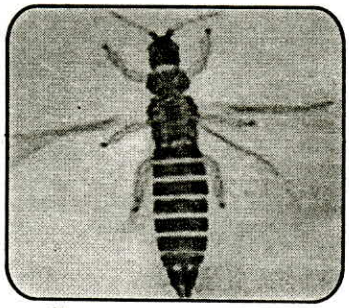
(iii) Control measures:

- Spray 875 ml of dimethoate 30 EC in 500 litres of water per ha at an interval of two weeks.

2. Cardamom thrips, *Sciothrips cardamomi* (Thripidae : Thysanoptera)

(i) Identification:

- The adult is greyish-brown and measures 1.25-1.50 mm in length.



(ii) Nature of damage:

- The thrips cause damage by sucking cell sap.
- It feeds on tender blossoms and the bunch pods of cardamom.
- The attack on the flower stalk results in shedding of flowers.
- The panicle stalks also become stunted and do not bear flowers.

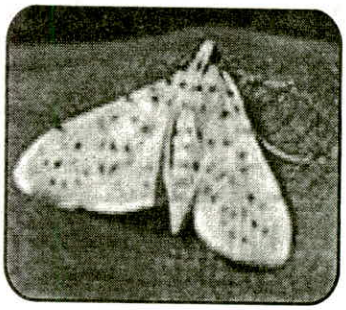
(iii) Control measures:

- Spray 875 ml of dimethoate 30EC or 1.0 litre of quinalphos 25EC in 500 litres of water per ha.
- Application of insecticides can be skipped during June-July.

3. Castor capsule borer, *Dichocrosis punctiferalis* (Pyralidae : Lepidoptera)

(i) Identification:

- The full-grown caterpillar measures 25-30 mm in length, is reddish brown, with black blotches all over the body and a pale stripe on the lateral side.
- The moths are orange yellow, with black markings on both the wings.



(ii) Nature of damage:

- Serious pest of nursery plants and young green pods.
- In nursery plants it bores into the stem and cause death of the central shoot.
- It also eats away the tender seeds of young berries.

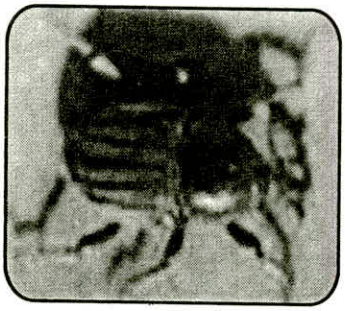
(iii) Control measures:

- Collect and destroy the infested shoots and capsules.
- Spray 1 kg of carbaryl 50WP in 500 litres of water per ha.

4. Rhizome weevil, Prodioctes haematicus (Curculionidae : Coleoptera)

(i) Identification:

- The adult is a brown weevil measuring 12 mm in length.



(ii) Nature of damage:

- The severe tunnelling and feeding by grubs inside the rhizomes results in the death of entire clumps of the cardamom plants.

(iii) Control measures:

- Destroy affected plants/seedlings.
- If the grub population is more in the soil, drench the base of the clamp with 1.25 litres of malathion 50EC or 1.25 kg of carbaryl 50WP in 500 litres of water per ha.

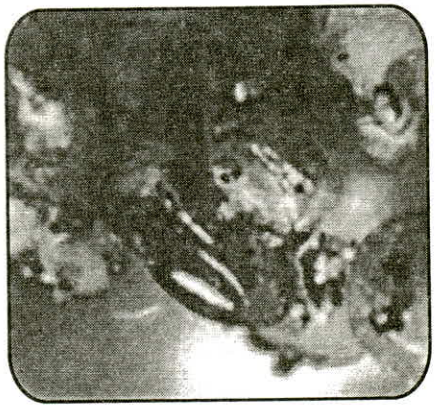
EXERCISE NO - 14
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF BLACK PEPEER

Insect Pests of Black Pepper

1. Polu beetle, *Longitarsus nigripennis* (Chrysomelidae : Coleoptera)

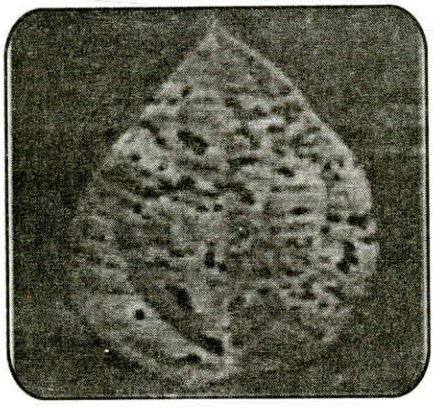
(i) Identification

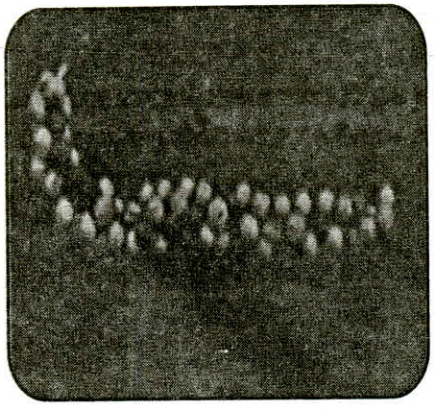
- The full-grown grub is yellowish with a black head and it measures 5 mm in length.
- The adult is a small shining, yellow and blue flea-beetle with stout hind legs.



(ii) Nature of damage:

- The grubs cause damage by boring into the berries and eating the contents completely in about 10 days. The attacked berries appear dark in colour, are hollow inside and crumble when pressed. The grubs may also eat into the spike and cause the entire distal region to dry up. The adults feed voraciously on tender leaves and make holes in them.





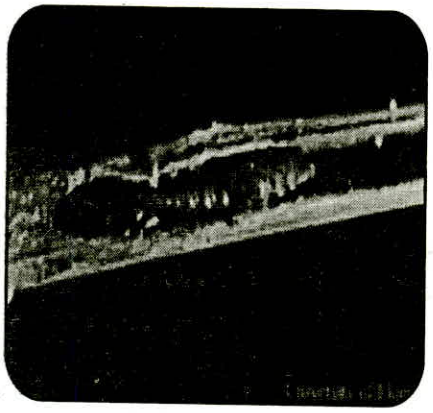
(iii) Control measures:

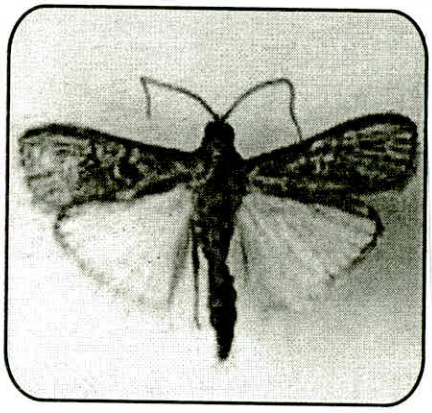
- Tilling the soil at the base of vines at regular intervals can reduce the population considerably.
- Spray 1.5 litres of dimethoate 30EC or 2.0 litres of quinalphos 25EC in 500 litres of water per ha in late July and again in early October.

2. **Top shoot borer, *Cydia (Laspeyresia) hemidoxa* (Eucosmidae : Lepidoptera)**

(i) Identification:

- Full-grown larvae are grayish green and measure 12-14 mm in length.
- The adults are small moths with crimson red and yellow forewings and grey hind wings and with a wing span of 10-15 mm.





(ii) Nature of damage

- The caterpillars damage terminal shoots by boring into them.
- Drying of terminal portions of the vines.

(iii) Control measures:

- Parasitoids like *Apanteles* sp. (Braconidae), have been reported to attack the caterpillars in nature. Spraying vines with one litre of dimethoate 30EC in 500 litres of water per ha.

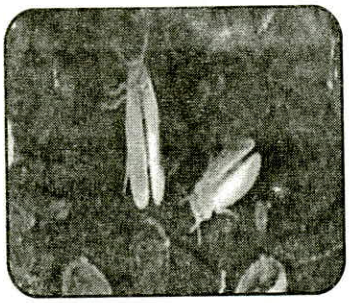
EXERCISE NO - 15
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CORIANDER & CINNAMON

Insect Pests of Coriander

1. Cotton whitefly, *Bemisia tabaci* (Aleyrodidae : Hemiptera)

(i) Identification:

- Nymphs are elliptical.
- Adult is a tiny soft insect measuring 1.0 mm in length, having yellowish white body transparent waxy wings dusted with milky white powder.



(ii) Nature of damage

- Adult and nymph both suck the sap on underside the leaves which results in chlorotic spots and later on the leaves coalesce and become brittle and finally drop down from the plant prematurely.
- The honey-dew secreted by the pest drop on the upper surface of the lower leaves and helps in development of the shooty moulds which interferes with photosynthesis of the leaves.

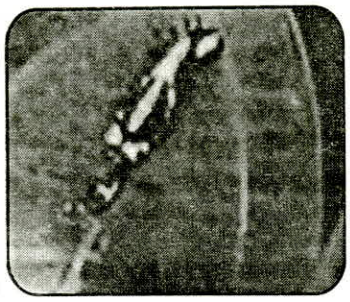
(iii) Control measures:

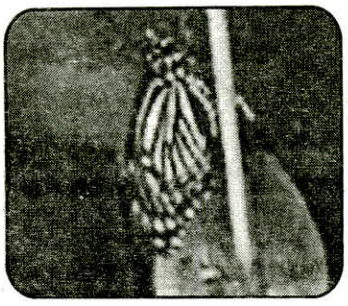
- Judicious use of nitrogen and irrigation as well as proper spacing in plants helps in check of population build up of whiteflies. Use of yellow sticky traps.
- Spray 1 litres of oxy-methyldemeton 25EC or 1 litres of dimethoate 30EC in 500 litres of water per ha. Observe a waiting period of 7 days.

2. Cinnamon butterfly, *Chilasia clytia (Papilionidae* : Lepidoptera)

(i) Identification:

- Freshly hatched larva is jet black is colour with white patches which later under goes various changes in colour pattern.
- The upper side of adult moth is rich velvety brown, while on underside of the body, the colour varies from soft pale brown to rich dark velvety brown.





(ii) Nature of damage

- Early instars feed on the lamina of the freshly emerged leaves.
- Later instars feed voraciously on leaves leaving only the mid ribs.

(iii) Control measures:

- The pest can be kept under check by collecting the butterflies with the help of net and destroying them.
- In case of severe infestation, spray 1.5 litres of quinalphos 25 EC in 500 litres of water per ha.

EXERCISE NO -16
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF ROSE

Insect Pests of Rose

1. Rose aphid, *Macrosiphum rosaeformis* (Aphididae : Hemiptera)

(i) Identification:

- Small (about 2.5mm long) wingless aphids having large red eyes, black cornicles and a yellowish green tip of abdomen.

(ii) Nature of damage:

- The aphids suck the sap from the tender leaves, buds and twigs.
- It is particularly injurious to tender buds, resulting in the disfigurement and withering of flowers. Each aphid makes several punctures, producing wounds, which leave their mark as the flower opens.
- A black fungus also develops on the honey dew giving ugly appearance to the plant.

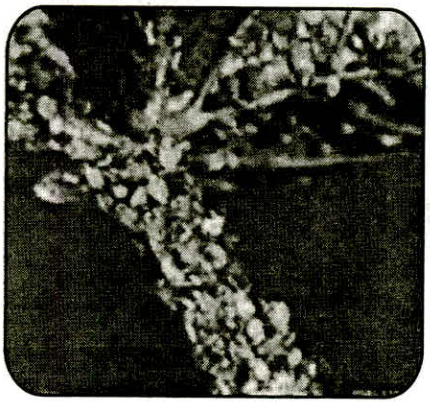
(iii) Control measures:

- Natural enemies like coccinellids, syrphids, chrysopids etc. also take care of these aphids.
- Avoid application of insecticides when these natural enemies are active.
- Spray 500 ml of malathion 50EC or methyl dimethoate 30 EC in 500 litres of water per ha.
- The treatment may be repeated at the reappearance of the pest.

2. Ground nut aphid, *Aphis craccivora* (Aphididae : Hemiptera)

(i) Identification:

Adults are black or brown with variable size.



(ii) Nature of damage:

- Both nymphs and adults suck the cell sap from tender plant parts.
- Downward cupping of leaves and premature drop of flowers.

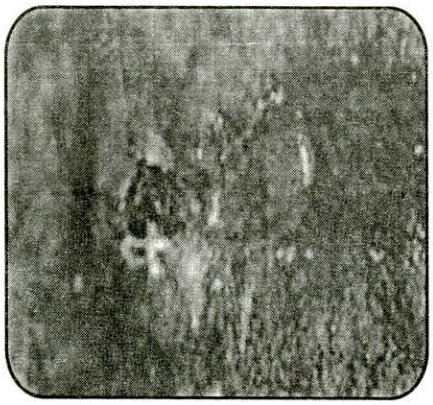
(iii) Control measures:

- Natural enemies like coccinellids, syrphids, chrysopids etc. also take care of these aphids.
- Avoid application of insecticides when these natural enemies are active.
- Spray 500 ml of malathion 50EC or methyl demeton 25 EC in 500 litres of water per ha.
- The treatment may be repeated at the reappearance of the pest.

3. Phytophagous mites, *Tetranychus urticae* (Tetranychidae : Acarina)

(i) Identification:

- Newly emerged larva is dirty white in colour and possesses three pairs of legs.
- A nymph possesses four pairs of legs and is slightly green in colour.
- The male nymph is smaller than the female. Adults are bigger than nymphs.
- Adults are orange coloured mites with two black spots on their body.



(ii) Nature of damage:

- Suck the cell sap from under side of leaves, flower buds and flowers.
- Attacked leaves look dirty, discoloured and dry.
- Webbing of leaves, sepals and petals occur which give untidy look to the plant.
- The infestation is more severe under poly house conditions.
- Damaged plants lose vigour, become stunted and dry in severe cases.

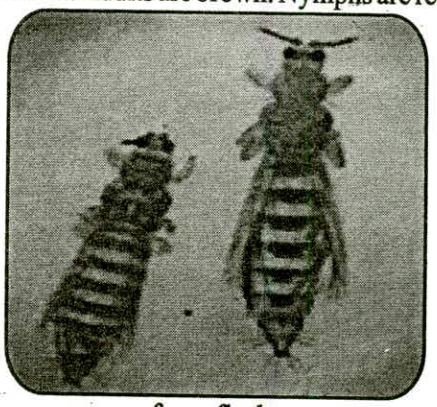
(iii) Control measures:

- Cut and burn the severely infested and dried shoots. Wash plants with force to dislodge webs and reduce mite population. Watering of polyhouse and providing proper ventilation during summer are essential to reduce mite population.
- Spray 500 ml of dimethoate 30 EC or oxydemeton methyl 25 EC in 500 litres of water per ha.

4. **Thrips, *Thrips flavus* (Thripidae: Thysanoptera)**

(i) Identification:

- These are very small, slender insects. Adults are brown. Nymphs are reddish in colour.



(ii) Nature of damage:

- Their attack coincides with the appearance of new flush.
- Both nymphs and adults scrap the surface and suck the oozing cell sap from leaves, tender shoots, apical buds and flowers. Tip of the leaves get mottled and crumbled.
- Brown scars and burnt margins occur on petals of infested flowers.
- Severely attacked flowers remain unopened or half opened and ultimately dries away.

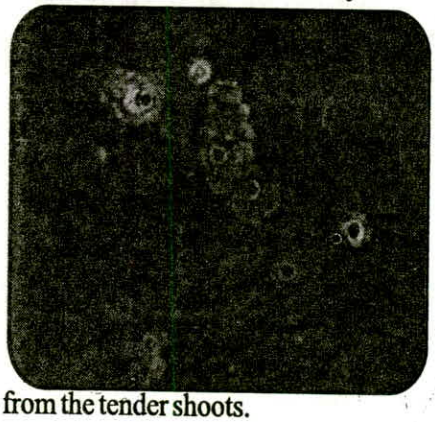
(iii) Control measures:

- Remove grasses from orchard and prune infested leaves. Rake the soil periodically.
- For monitoring of thrips, blue sticky cards should be placed 1-2" above the crop canopy at the rate of 2 per 1000 ft2.
- Spray 500 ml of dimethoate 30 EC or oxydemeton methyl 25 EC in 500 litres of water per ha.

5. **Citrus red scale, *Aonidiella aurantii* (Diaspididae : Hemiptera)**

(i) Identification:

- Female scales are reddish brown with hard waxy scale covering on the body and are without legs and having vestigial antennae.
- Scales are mostly found on the tender shoots.



(ii) Nature of damage:

- Both nymph and adult stages suck the cell sap from the tender shoots.
- The damaged shoots lose vigour, produce small and few flowers, and dry in case of severe attack.

(iii) Control measures:

- Select scale-free planting material.
- Cut and burn heavily infested shoots.
- Apply Pongamia oil (1%) to pruned shoots soon after pruning.
- Apply carbofuran 3G @ 20 kg/ha at 5 cm depth to soil after digging.

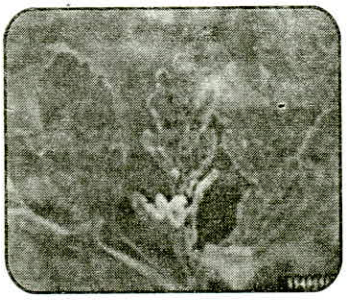
EXERCISE NO - 17
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMGE AND CONTROL MEASURES OF CHRYSANTHEMUM

Insect Pests of Chrysanthemum

1. Chrysanthemum aphid, *Macrosiphoniella sanborni* (Aphididae : Hemiptera)

(i) Identification:

- Nymphs are greenish black where as adults are chocolate brown which feed in groups.
- Adult aphids can be winged or wingless.



(ii) Nature of damage:

- Nymphs and adults by suck the cell sap from growing shoots and apical leaves.
- Feeding results in the loss of vigour, yellowing of leaves, premature leaf fall and stunted growth of plants. Flowers dry up prematurely. Aphids excrete honey dew on which sooty mould develops and interferes with the photosynthesis.

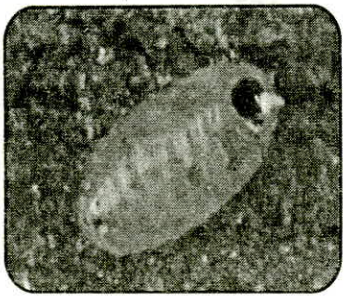
(iii) Control measures:

- Parasitoids like *Aphidius* sp and predators such as coccinellids, syrphids and chrysopids are also active against these aphids in the nature.
- When these natural enemies are active, application of insecticides should be avoided.
- Spray 500 ml of dimethoate 30 EC or oxydemeton methyl 25 EC in 500 litres of water per ha as soon as the attack is noticed. Repeat the spray after 10 days if required.

2. Serpentine leaf miner, *Liriomyza trifolii* (Agromyzidae : Diptera)

(i) Identification

- The larvae are orange yellow without legs. The adults are minute greyish black flies with plum red eyes and a yellow spot on the scutellum. The females are bigger than males.



(ii) Nature of damage:

- Larvae feed on the palisade mesophyll tissue in between the two epidermis of the leaf.
- Affected leaves give transparent papery appearance in the mined area.
- Damaged leaves turn brown and dry while plants get stunted and produce small flowers in case of severe attack. Photosynthesis is reduced.

(iii) Control measures:

- Pluck and burn severely infested older leaves. Parasitoids are more during July-August.
- Spray one litre of dimethoate 30 EC in 500 litres of water per ha.

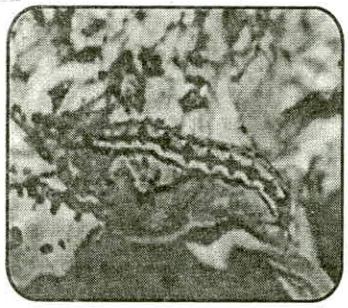
EXERCISE NO - 18
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF CARNATION

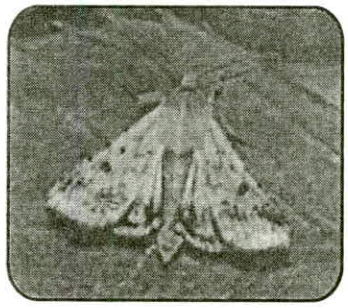
Insect Pests of Carnation

1. Bud borer, *Helicoverpa armigera* (Noctuidae : Lepidoptera):

(i) Identification:

- Caterpillars are greyish to green with broken grey or green lines on lateral sides depending upon the host on which they feed.
- Adult moths are stoutly built and are yellowish brown. Darker area near the outer margins of the forewing.
- The forewings are marked with greyish wavy lines and black spots of varying sizes on the upper side. The hind wings are whitish and lighter in colour with a broad blackish band along the outer margins.





(ii) Nature of damage:

- Damage is caused by the caterpillars. They bore into the developing buds and feed on petals inside them. Infested buds never open and dry as such.
- Partially damaged buds open into deformed flowers.

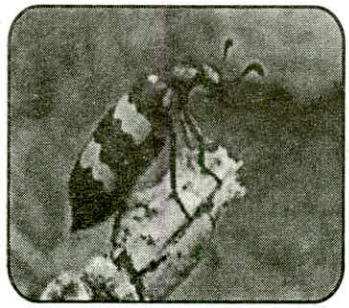
(iii) Control measures:

- Spray 400 ml of deltamethrin 2.8 EC in 500 litres of water per ha.

2. Blister beetles, *Mylabris phalerata* (Meloidae: Coleoptera)

(i) Identification

- Full grown grubs are coarctate and form pseudopupae.
- This prominent large beetle has six alternating, bright orange and black bands, against the general dark background of the body. It is 3 cm in length.



(ii) Nature of damage:

- The adult beetles feed on the floral buds and flowers from July to September.
- Attacked flowers become brownish and unattractive. Larvae are beneficial.
- Grubs feed on the eggs of various grass hoppers and locusts found in the soil.

(iii) Control measures:

- Hand picking and destroying the beetles during morning hours when they are less active is effective.
- Spray 1.25 kg of carbaryl 50 WP in 500 litres of water per ha.

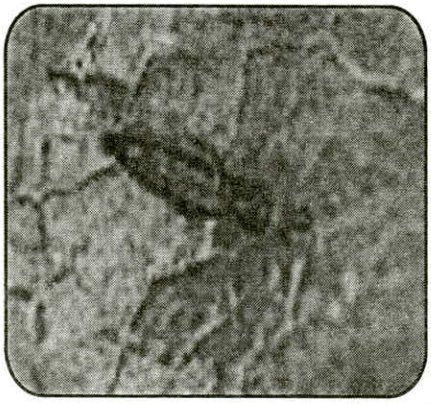
EXERCISE NO - 19
IDENTIFICATION OF INSECT PESTS, THEIR NATURE OF DAMAGE AND CONTROL MEASURES OF GLADIOLUS

Insect Pests of Gladiolus

1. Gladiolus thrips, *Taeniothrips simplex* (Thripidae : Thysanoptera)

(i) Identification

- The nymphs are light yellow.
- Adults are black in colour. Wings have hairs which are arranged like the parts of the feather.



(ii) Nature of damage:

- Both nymphs and adults are rasp the tissue and suck the oozing sap.
- Affected parts develop silvery streaks which later on turn brown
- Attacked leaves get deformed and ultimately dries up.
- If young plants are attacked, there is a reduction in flower production and quality.
- Thrips also attack corms under storage.
- Infested corms become sticky, shrivel and produce weak plants when planted.

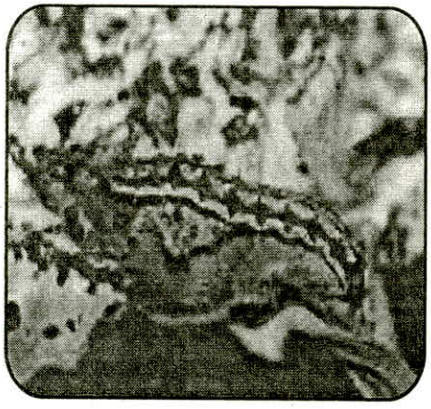
(iii) Control measures:

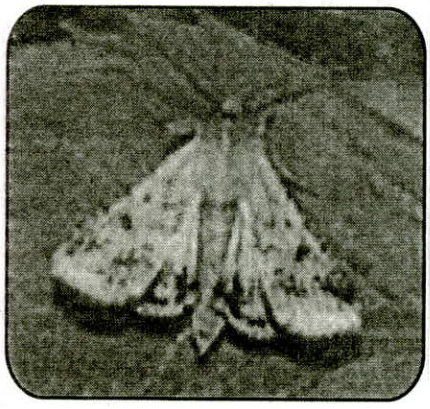
- Field:
- Monitoring with 'Blue' sticky cards.
- Spray 500 ml of oxy- demeton methyl 25EC or 500 ml of dimethoate 30EC in 500 litres of water per ha at 10 day interval.
- Storage:
- Corms infested with thrips should be stored at 20°C for 6 weeks and later should be treated in hot (46°C) for 15 minutes.

2. **Bud borer, *Helicoverpa armigera* (Noctuidae : Lepidoptera)**

(i) Identification

- Caterpillars are greyish to green with broken grey or green lines on lateral sides depending upon the host on which they feed. Adult moths are stoutly built and are yellowish brown. Darker area near the outer margins of the forewing.





(ii) Nature of damage:

- Larvae feed on leaves by eating leaf lamina.
- Caterpillars enter into the developing spikes and feed inside by damaging the flowers.

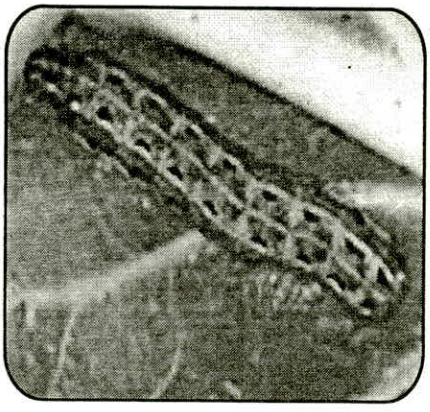
(ii) Control measures:

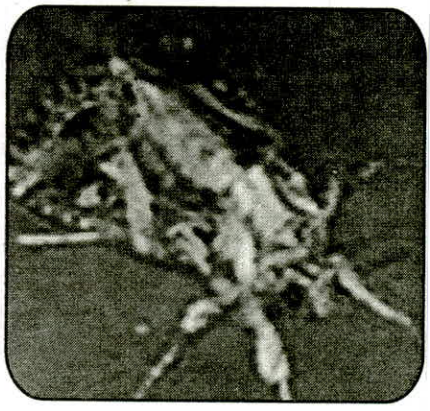
- As soon as the eggs or caterpillars are seen in the field, spray 400 ml of deltamethrin 2.8 EC in 500 litres of water per ha. Spraying should be carried out in the evening hours.

3. **Tobacco caterpillar, *Spodoptera litura* (Noctuidae : Lepidoptera)**

(i) Identification:

- The caterpillars measure 35-40 mm in length at maturity.
- They are velvety black with yellowish-green dorsal stripes and lateral white bands.
- The fore wings have beautiful golden and greyish brown patterns.





(ii) Nature of damage:

- The larvae feed on leaves and fresh growth. Early instars feed gregariously.
- Scrapping the chlorophyll content from the leaves and skeletonising them.
- Later instars scatter and feed voraciously eating the entire leaf.

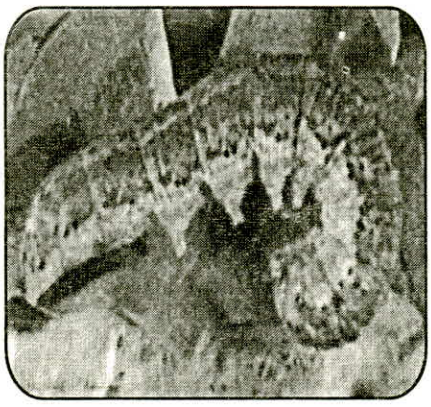
(iii) Control measures:

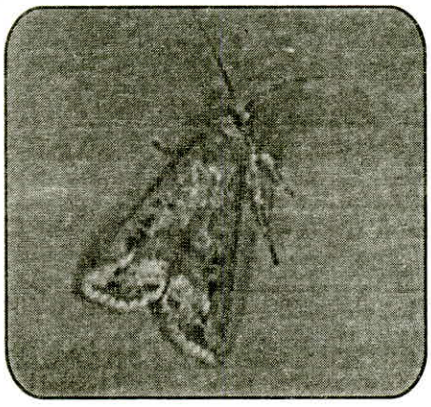
- Collect early gregarious larval instars and destroy them before they got scattered.
- Spray 400 ml of deltamethrin 2.8 EC in 500 litres of water per ha. Repeat the spray as and when required.

4. Cutworms, *Agrotis ipsilon* (Noctuidae : Lepidoptera)

(i) Identification:

- The slightly yellowish caterpillar is 1.5 mm long with a shiny, black head and a black shield on the prothorax. The full-grown larva is about 42-45 mm long and is dark or dark-brown with a plump and greasy body.
- The adult moth measures about 25 mm from the head to the tip of the abdomen and looks dark or blackish with some greyish patches on the back and dark streaks on the fore wings.





(ii) Nature of damage:

- The young larvae feed on the epidermis of the leaves. Attack mainly the newly grown gladiolus plants. Larvae feed during night on emerging shoots.
- Also attack the underground corms thus causing the yellowing of leaves.

(iii) Control measures:

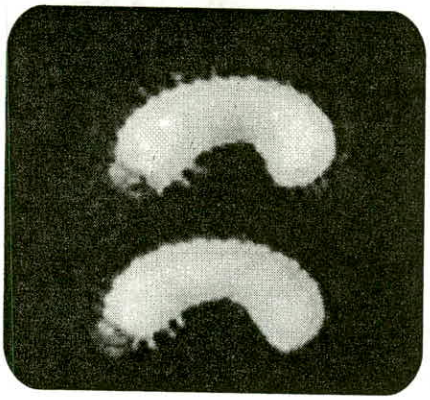
- Light traps help in collecting and killing of adults.
- Drenching of infested area with chlorpyriphos (0.04%) help in controlling the larvae.

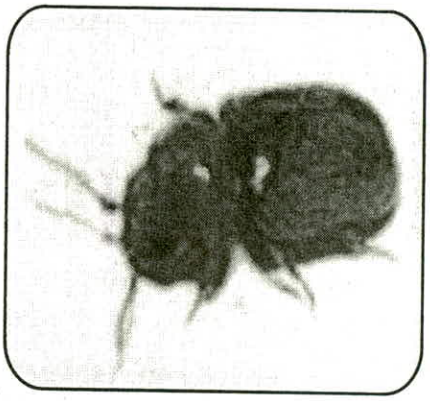
EXERCISE NO - 20
IDENTIFICATION OF INSECT PESTS AND THEIR NATURE OF DAMAGE OF STORED AND PROCESSED VEGETABLES, ORNAMENTALS AND SPICES

1. Cigarette beetle, *Lasioderma serricorne* (Anobiidae: Coleoptera):

(i) Identification:

- Adult beetles are stoutly built, oval in shape, 2.0 to 2.5 mm long, light brown in colour. The elytra are smooth with very short hairs. The antennae are about half the length of body and have segments of which the fourth to tenth are serrate.





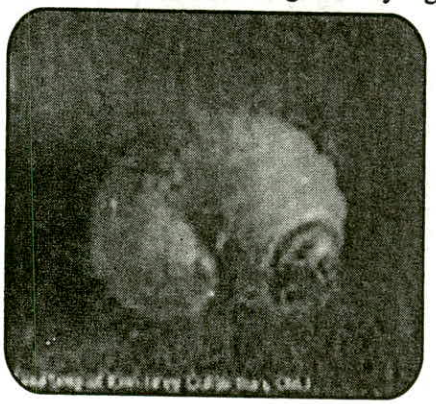
(ii) Nature of damage:

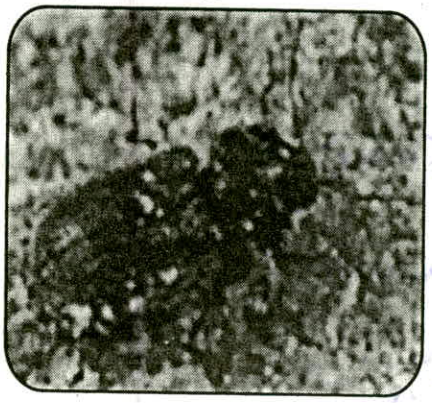
- Grubs damage the commodities by making small cylindrical galleries through them. Adults feed very little if at all. The larvae are very active and move and bore into the commodity.

2. Drugstore beetle, *Stegobium paniceum* (Anobiidae: coleoptera):

(i) Identification:

- It is similar to cigarette beetle in appearance but can be distinguished by its antennae. In *Stegobium* the last three segments form a large loosely segmented club. The elytra have longitudinal striate.





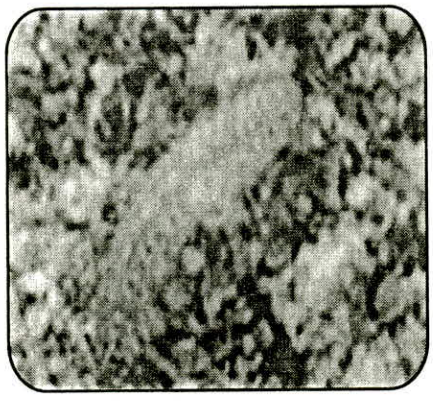
(ii) Nature of damage:

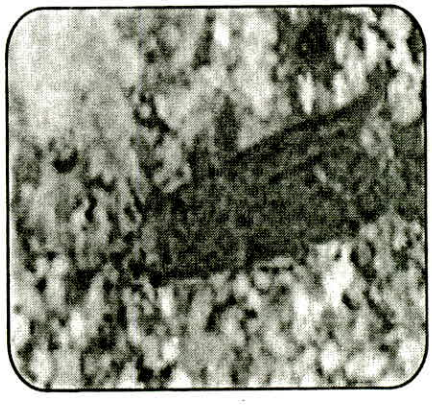
- It is an important pest of processed commodities like chocolate, confectionary, biscuits, dried fruits and vegetables and spices.
- Grubs damage by making small cylindrical galleries through the commodities. larvae are quite active and move around or bore into the commodity.

3. **Almond moth, *Ephestia (Cadra) cautella* (Phycitidae: Lepidoptera):**

(i) Identification:

- Moths are about 13 mm with wing expanse of 20-25 cm. wings are dirty white to grayish in colour with black bands about 4mm from the head.
- It rests with sloped wings over the body almost like the slanting roof of warehouse.
- Being nocturnal, it rests in dark places during day time.





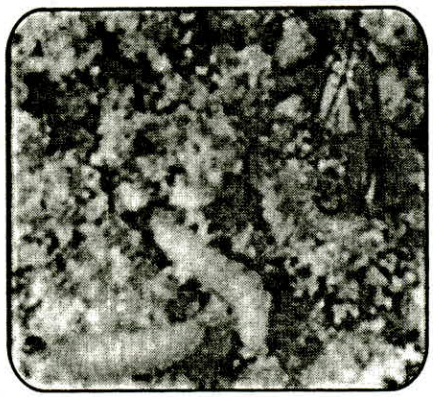
(ii) Nature of damage:

- Damage is caused by the larvae which feed on the germ portion of grains leaving east of the kernel undamaged. They form webs on the top layer of grains, storage bags, etc.

4. **Indian meal moth, *Plodia interpunctella* (Phycitidae: Lepidoptera):**

(i) Identification:

- It is an important pest of dried and stored commodities in the pantry.
- The larva is small whitish, often tinged with green or pink, a light-brown head, a prothoracic shield and an oval plate.
- On reaching maturity, the larva is 8-13 mm in length.
- The adult moth is about 13-20 mm in wing expanse.
- It has a coppery lustre on the outer two-thirds and terminal whitish grey on the inner portions and on the end of the body.
- The palps form a characteristic cone like beak in front of the head.



(ii) Nature of damage:

- The caterpillars make tunnels in the food materials. The number of silken tubes is sometimes extremely high and these clog the mill machinery where the infested grains have been sent for milling.