PRACTICAL MANUAL

Insect Pests of Vegetable, Ornamental and Spice Crops

PPH-322 3(2+1)

B.Sc. Horticulture
VI Semester

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Dr. Ankit Upadhyay
Dr. Ranjitha M.R.

Department of Entomology
College of Agriculture
Chandra Shekhar Azad University of Agriculture & Technology,

Kanpur- 208002

Syllabus PPH 322 3(2+1)

Study of symptoms, damage, collection, identification, preservation, assessment of damage/population of important insect-pests affecting vegetable, ornamental and spice crops in field and during storage.

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Practical No. 1

Objective: To study nature, symptoms of damage and management of insect pests of Brinjal, Potato and Tomato

Activity: Observe and enlist major pests attacking Brinjal, Potato and Tomato. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
BRINJAL			
Brinjal fruit and shoot borer			
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Hadda beetle			
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Brinjal stem borer			
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.....			
Brinjal leaf roller			
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.....			
Brinjal lace wing bug			
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.....			
POTATO			
Potato tuber moth			
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Greasy cut worm			
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Green peach aphid			
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Cotton whitefly			
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TOMATO			
Tomato fruit borer			
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Leaf miner			
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Stem borer			
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Tobacco caterpillar			
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Draw the diagram of important pests and nature of damage

Exercise No. 2

Objective: To study nature, symptoms of damage and management of Insect-pests of Radish, Turnip and Carrot

Activity: Observe and enlist major pests attacking Radish, Turnip and Carrot. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
RADISH			
Painted bug			
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.....			
Cabbage borer			
.....			
.....			
TURNIP AND CARROT			
Pea Leaf Minor			
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.....			
Flea beetle			
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Draw the diagram of important pests and nature of damage

Exercise No. 3

Objective: To study nature, symptoms of damage and management of Insect-pests of Cabbage and Cauliflower

Activity: Observe and enlist major pests attacking Cabbage and Cauliflower. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Diamond Back Moth			
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Cabbage borer			
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Cabbage semilooper and Cabbage green semilooper			
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.....			
Cabbage butterfly			
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Tobacco caterpillar			
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Crucifer leaf webber			
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Cabbage flea beetle			
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Draw the diagram of important pests and nature of damage

Exercise No. 4

Objective: To study nature, symptoms of damage and management of Insect-pests of Sweet potato and Walnut

Activity: Observe and enlist major pests attacking Sweet potato and Walnut. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
SWEET POTATO			
Sweet Potato Weevil			
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.....			
Tortoise beetle			
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.....			
Tobacco caterpillar			
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.....			
Bihar hairy caterpillar			
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.....			
WALNUT			
Singhara beetle			
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.....			

Draw the diagram of important pests and nature of damage

Exercise No. 5

Objective: To study nature, symptoms of damage and management of Insect-pests of Onion and Chilli

Activity: Observe and enlist major pests attacking Onion and Chilli. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
ONION			
Onion Thrips			
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Onion Maggot			
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Tobacco caterpillar			
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.....			
Thrips			
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CHILLI			
Chilli Thrips			
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Draw the diagram of important pests and nature of damage

Exercise No. 6

Objective: To study nature, symptoms of damage and management of Insect-pests of Beans and Leafy vegetables

Activity: Observe and enlist major pests attacking Beans and Leafy vegetables.

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
BEANS AND LEAFY VEGETABLES			
Beetles			
.....			
.....			
Leafy Vegetable Caterpillar			
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.....			

Exercise No. 7

Objective: To study nature, symptoms of damage and management of Insect-pests of Cucurbits

Activity: Observe and enlist major pests attacking Cucurbits. Draw a neat diagram of important pests

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Red Pumpkin beetle			
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Melon Fruit Fly			
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Pumpkin Caterpillar			
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.....			
Serpentine Leaf			
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.....			

Draw the diagram of important pests and nature of damage

Exercise No. 8

Objective: To study nature, symptoms of damage and management of Insect-pests of Okra

Activity: Observe and enlist major pests attacking Okra. Draw a neat diagram of important pests and nature of damage

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Spotted bollworms			
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.....			
Red Cotton bug			
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Cotton Jassids			
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.....			
Cotton White Fly			
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Dusky Cotton bug			
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Cotton Leaf Roller			
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Draw the diagram of important pests and nature of damage

Exercise No. 9

Objective: To study nature, symptoms of damage and management of Insect-pests of Rose, Lily and Jasmine

Activity: Observe and enlist major pests attacking rose, lily and jasmine.

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Rose Aphid			
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Lily Moth			
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Jasmine Leaf Webworm			
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Jasmine Gallery Worm			
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Jasmine Budworm			
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Jasmine Thrips			
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Draw the diagram of important pests and nature of damage

Exercise No. 10

Objective: To study nature, symptoms of damage and management of Insect-pests of Chrysanthemum and Sunflower

Activity: Observe and enlist major pests attacking Chrysanthemum and Sunflower. Draw a neat diagram of important pests and nature of damage.

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Chrysanthemum Aphid			
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Chrysanthemum Thrips			
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Chrysanthemum Leaf Folder			
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Chrysanthemum Leaf Minor			
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Chrysanthemum Red Spider Mite			
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.....			
Sunflower Head Borer			
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.....			
Sunflower Bihar Hairy Caterpillar			
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.....			
Sunflower Semilooper			
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Draw the diagram of important pests and nature of damage

Exercise No. 11

Objective: To study nature, symptoms of damage and management of Insect-pests of Cardamom and Large Cardamom

Activity: Observe and enlist major pests attacking Cardamom and Large Cardamom. Draw a neat diagram of important pests and nature of damage.

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Cardamom Aphids			
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Cardamom Thrips			
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Cardamom Weevil			
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Cardamom Hairy Caterpillar			
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Cardamom White Fly			
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Large Cardamom Aphid			
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.....			
Large Cardamom Thrips			
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Draw the diagram of important pests and nature of damage

Exercise No. 12

Objective: To study nature, symptoms of damage and management of Insect-pests of Ginger and Garlic

Activity: Observe and enlist major pests attacking Ginger and Garlic. Draw a neat diagram of important pests

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Ginger Scale			
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Ginger Borer			
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.....			
Ginger Skipper Butterfly			
.....			
.....			
Garlic Thrips			
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Exercise No. 13

Objective: To study nature, symptoms of damage and management of Insect-pests of Coriander and Black Pepper

Activity: Observe and enlist major pests attacking Coriander and Black Pepper. Draw a neat diagram of important pests

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Coriander Aphid			
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.....			
Coriander White Fly			
.....			
.....			
Black Pepper Pollu Beetle			
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.....			
Pepper Shoot Borer			
.....			
.....			

Exercise No. 14

Objective: To study nature, symptoms of damage and management of Insect-pests of Cinnamon and Turmeric

Activity: Observe and enlist major pests attacking Cinnamon and Turmeric. Draw a neat diagram of important pests

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Cinnamon Butterfly			
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Cinnamon Leaf Minor			
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.....			
Turmeric Skipper Butterfly			
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Turmeric Borer			
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Bihar Hairy Caterpillar			
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Exercise No. 15

Objective: To study the insect pests during storage

Activity: Observe and enlist major pests attacking stored vegetables.

Common Name and Scientific name	Order and Family	Nature & symptoms of damage	Management
Potato Tuber Moth			
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.....			
Weevils			
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Exercise No. 17

Objective: Field Visit I

Activity: Observe and enlist major pests attacking Radish, Turnip and Carrot. Draw a neat diagram of important pests and nature of damage.

Observations:……

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Draw the diagram of important pests and nature of damage

Exercise No. 18

Objective: Field Visit II

Activity: Observe and enlist major pests attacking vegetables. Draw a neat diagram of important pests and nature of damage

Observations:……

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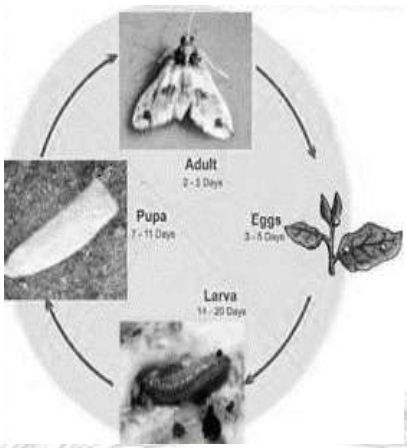
Draw the diagram of important pests and nature of damage

INSECT-PESTS OF VEGETABLES

Common Name	Scientific Name	Order	Family
BRINJAL			
Brinjal shoot and fruit borer	*Leucinodes orbonalis*	Lepidoptera	Pyralidae
Hadda beetle	*Henosepilachna vigintioctopunctata, H. dodecastigma*	Coleoptera	Coccinellidae
Brinjal stem borer	*Euzophera perticella*	Lepidoptera	Pyralidae
Brinjal leaf roller	Eublema olivacea	Lepidoptera	Noctuidae
Brinjal Lace-wing bug	Urentius sentis	Hemiptera	Tingidae
POTATO			
Potato tuber moth	Phthorimaea operculella	Lepidoptera	Gelechiidae
Greasy cutworm	Agrotis ipsilon	Lepidoptera	Noctuidae
Green peach aphid	Myzus persicae	Hemiptera	Aphididae
Cotton whitefly	*Bemisia tabaci*	Hemiptera	Aleyrodidae
TOMATO			
Tomato fruit borer	*Helicoverpa armigera*	Lepidoptera	Noctuidae
Serpentine Leaf miner	*Liriomyza trifolii*	Diptera	Agromyzidae
White fly	*Bemisia tabaci*	Hemiptera	Aleyrodidae
Tobacco caterpillar	*Spodoptera litura*	Lepidoptera	Noctuidae
RADISH, TURNIP AND CARROT			
Painted Bug	*Bagrada hilaris*	Hemiptera	Pentatomidae
Cabbage Borer	*Hellula undalis*	Lepidoptera	Pyralidae
Pea leaf-miner	*Chromatomyia horticola*	Diptera	Agromyzidae
Flea Beetle	*Chaetocnema basalis*	Coleoptera	Alticidae
CABBAGE, CAULIFLOWER, KNOL KHOL, RADISH AND BROCCOLI			
Diamond Back Moth	Plutella xylostella	Lepidoptera	Plutellidae
Cabbage Semilooper/ green Semilooper	*Thysanoplusia orichalcea* and *Trichoplusia ni*	Lepidoptera	Noctuidae
Cabbage butterfly	*Pieris brassicae*	Lepidoptera	Pieridae
Tobacco Caterpillar	*Spodoptera litura*	Lepidoptera	Noctuidae
Cabbage borer	*Hellula undalis*	Lepidoptera	Pyralidae
Crucifer Leaf-webber	*Crocidolomia binotalis*	Lepidoptera	Crambidae
Cabbage flea beetle	*Phyllotreta cruciferae*	Coleoptera	Chrysomelidae
Cabbage aphid,	*Brevicoryne brassicae*	Hemiptera	Aphididae
SWEET POTATO			
Sweet potato weevil	*Cylas formicarius*	Coleoptera	Apionidae
Tortoise beetle	*Aspidimorpha miliaris*	Coleoptera	Cassididae
Tobacco caterpillar	*Spodoptera litura*	Lepidoptera	Noctuidae
Bihar hairy caterpillar	*Spilosoma obliqua*	Lepidoptera	Arctiidae
WALNUT			
Singhara beetle	*Galerucella birmanica*	Coleoptera	Chrysomelidae
ONION			
Onion thrips	*Thrips tabaci*	Thysanoptera	Thripidae
Onion maggots	*Delia antiqua*	Diptera	Anthomyiidae
Thrips	*Caliothrips indicus*	Thysanoptera	Thripidae
Tobacco caterpillar	*Spodoptera litura*	Lepidoptera	Noctuidae
CHILLI			
Chilly thrips	*Scirtothrips dorsalis*	Thysanoptera	Thripidae
CUCURBITS			
Red pumpkin beetle	*Raphidopalpa foveicollis*, *Aulacophora intermedia*, *A. cincta*	Coleoptera	Chrysomelidae
Melon fruit fly	*Bactrocera cucurbitae*, *B. tau, B. dorsalis*	Diptera	Tephritidae
Pumpkin caterpillar	*Diaphania indica*	Lepidoptera	Pyralidae
Serpentine leaf miner	*Liriomyza trifolii*	Diptera	Agromyzidae
OKRA			
Spotted bollworms	*Earias vitella, E. insulana*	Lepidoptera	Noctuidae
Red cotton bug	*Dysdercus koenigii*	Hemiptera	Pyrrhocoridae
Cotton jassid	*Amrasca biguttula*	Hemiptera	Cicadellidae
Cotton whitefly	*Bemisia tabaci*	Hemiptera	Aleyrodidae
Dusky cotton bug	*Oxycarenus hyalinipennis*	Hemiptera	Lygaeidae
Cotton leaf-roller	*Sylepta derogata*	Lepidoptera	Pyralidae
Gram pod borer	*Helicoverpa armigera*	Lepidoptera	Noctuidae
Aphids	*Aphis gossypii*	Hemiptera	Aphididae
Red spider mite	*Tetranychus urticae*	Trombidiformes	Tetranychidae

MAJOR INSECT PESTS OF BRINJAL

Shoot and fruit borer: *Leucinodes orbonalis* (Pyraustidae: Lepidoptera)



Distribution and status- India, Bangladesh, Malaysia, Thailand, Burma, Sri Lanka, Laos, South Africa, Congo. It is a major and regular pest of brinjal causing damage to even 30 -50% of fruits or more.

Host range- Brinjal, potato, other wild plants belonging to Solanaceae, peas.

Damage symptoms-Larva bores into tender shoots and causes withering of terminal shoots / dead hearts also bores petioles of leaves, flower buds and developing buds, causes withering of leaves, shedding of buds and make fruits unfit for consumption. Attacked fruits are with boreholes plugged with excreta. Fruits become out of shape also.

Management

- Avoid continuous cropping of brinjal and ratooning.
- Grow resistance varieties like Annamalai, Pusa purple round, Arka Kusumakar, Doli – 5, Chaklasi Doli, Pusa purple Long, Pusa Purple Round, SM 67, SM 68, Pant Samrat
- Collect and destroy the damaged tender shoots, fallen fruits and fruits with bore holes to prevent population buildup
- Use light traps @ 1/ha to attract and kill the moths.
- Release egg parasitoids *Trichogramma chilonis* @1.0 lakh/ha.

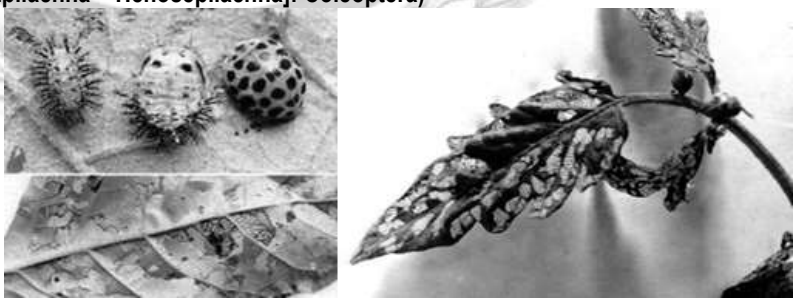
Ash weevils: *Myllocerus subfasciatus*, *M. discolor*, *M. viridanus*, *M. maculosus* (*Curculionidae*: Coleoptera)

Damage symptoms: Notching of leaf margins by adults. Grubs feeds on roots resulting in wilting and death of plants.

Management

- Collect and destroy adult weevil.
- Apply lindane 1.3 D before planting @ 25 kg/ha
- In endemic areas apply carbofuran 3G @ 15 kg/ha, 15 days after planting.
- Spray carbaryl 50 WP 2 kg + wettable sulphur 2 kg or endosulfan 35 EC 1.5 L or malathion 50 EC 1.5 L

Hadda/ spotted beetle: *Henosepilachna dodecastigma* (7-14 spots on each elytra), *H. vigintioctopunctata*; *H. demurille*, *H. implicata* (Coccinellidae [Epilachna = Henosepilachna]: Coleoptera)



Distribution and status: South Canada, USA, Mexico, Guatemala, Africa and South East Asia.

Host range: Brinjal, potato, tomato, cucurbitaceous plants, wild solanaceous plants.

Damaging symptom: Both adult and grubs scrap the lower epidermis of leaves in characteristic manner leaving behind stripes of uneaten areas. The leaves give a stifled appearance. In severe infestation all leaves may be eaten off leaving only the veins intact (Skeletonization) and plants may wither.

Management

- Collect and destroy adult beetles, grubs and pupae.
- Shake plants to dislodge grubs, pupae and adults in a pail of kerosenated water early in the morning or collect them mechanically and destroy.
- Spray carbaryl 50% WP 2 kg + wettable sulphur 2 kg or endosulfan 35 EC 1.5 L or malathion 50 EC 1.5L or Azadirachtin 0.03% 2.5-5.0 L in 500 - 750 L of water

MAJOR INSECT PESTS OF TOMATO

Fruit Borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Distribution and status: Cosmopolitan. Major pest

Host range: Sorghum, lablab, soybean, peas, sunflower, safflower, chillies, groundnut, tobacco, bhendi, maize, tomato.

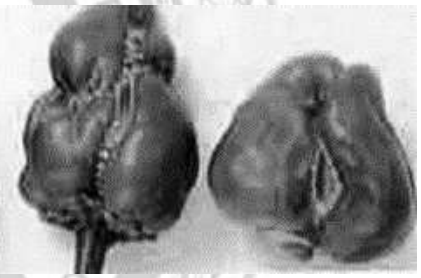
Damage symptoms: The caterpillars feed on leaves, squares, flowers and small bolls. When the squares, flowers and bolls are attacked, they feed the internal content completely by thrusting their head inside leaving the rest of the body outside. The damaged squares and young bolls drop away from the plants. The developed bolls and open bolls are not attacked.

Management:

- Pest monitoring through light traps, pheromone traps and *in situ* assessments by roving and fixed plot surveys has to be intensified at farm, village, block, 00regional and state levels
- Grow Bt cotton viz., Bollgard I containing Cry 1 Ac protein that offers protection against American bollworm and Bollgard II containing Cry 2 Ab in addition to Cry 1 Ac which offers season long protection against Spodoptera and Helicoverpa
- Application of nuclear polyhedrosis virus (NPV) at 3 x 1012 POB /ha in evening hours at 7th and 12th week after sowing.
- Conservation and augmentation of natural predators and parasites for effective control of the pest.
- Inundative release of egg parasite, *Trichogramma* spp., at 6.25 cc/ha at 15 days interval 3 times from 45 DAS, egg-larval parasitoid, *Chelonus blackburnii* and the predator *Chrysoperla* 1,00,000/ha at 6th, 13th and 14th week after sowing.
- Apply endosulfan 35 EC @ 0.2 l/ha. During bolling and maturation stage, apply any one of the following insecticides per ha; phosalone 50 EC 2.5 L quinalphos 25 EC 2.0 L, carbaryl 50 WP 2.5 kg (1000 L of spray fluid/ha),

MAJOR INSECT PESTS OF CHILLI

Chillies thrips: *Scirtothrips dorsalis* (Thripidae: Thysanoptera)



Host range-Tea, grapes, castor, cotton, Prosopis, *Nymphaea pubescens*

Damage symptoms: 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.

Management:

- Inter crop with a green manure crop *Sesbania grandiflora* (agathi) to provide shade which regulate the thrips population
- Do not grow chilli after sorghum – more susceptible to thrips
- Do not follow chilli and onion mixed crop as both the crops are attacked by thrips
- Sprinkle water over the seedlings to check the multiplication of thrips carbofuran 3G @ 200g/ 40 m2 area in the nursery
- Dip the roots of seedlings in monocrotphos 36 WSC @ 0.05% for 20 min. before transplanting

Muranai mite/ Broad mite/ yellow mite: *Polyphagotarsonemus latus* (Tarsonemidae: Acarina)

Damage symptoms-Sudden curling and crinkling of leaves followed by blister patches are initial symptoms of severely attacked plants. Petiole in a few cases becomes elongated and it is referred to "rat tail" symptom. Later they stop growing and die.

Management:

- Spray Buprofezin 25 SC (300-600 ml) insecticides with 500 -750 L water/ha
- Encourage the activity of predatory mite: *Amblyseius ovalis*

MAJOR INSECT PESTS OF CRUCIFERS

Diamond back moth: *Plutella xylostella* (L.) (Plutellidae: Lepidoptera)

Distribution and status: World – wide

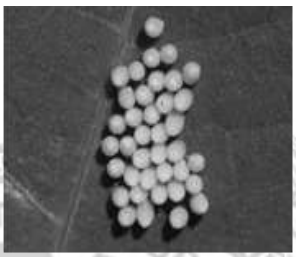
Host range: Serious past of Cabbage and cauliflower, but also feeds on other crucifers and solanaceous plants.

Damage symptoms- First instar larvae mine epidermal surface of leaves producing typical white patches. Larvae, second instar onwards feed externally making holes on the leaves and soil them with excreta. Heavy infestations leave little more than the leaf veins.

Management:

- Grow mustard as trap crop. Raise 2 rows of mustard for every 25 rows of cabbage. Sow first mustard crop 15 days prior to cabbage planting or plant 20 days old mustard seedling at the time of cabbage planting. Plant 35 days old cabbage seedlings.
- Install pheromone trap to monitor DBM adults @ 5 /ha and 25/ha for mass trapping
- Apply *Bacillus thuringiensis* formulation @1 g/L or NSKE 4% spray.
- Reduce insects colonising on mustard to prevent defoliation of the entire plant by applying dichlorovas 350 at 10 or 15 days interval starting from 15 days after sowing.
- Conserve larval parasitoids viz., *Cotesia plutellae* in plains and *Diadegma semiclausum* in hills. Release 40,000 adults / ac, five times @ 8,000 adults/release commencing from 20 days after planting. Also encourage other parasitoids like *Apanteles sicarius*, *Tetrastychus sokolowski* (larval) *Diadrumus collaris* (larval pupal) and *Brachymeria excarinata* (pupal parasitoids)
- Depending upon the pest intensity, spray Fipronil 5 SC 800-1000 ml insecticide with 500 -1000 L water/ha at primordial or head initiation stage. Mix teepol or sandovit 0.5 ml/Lt of water whenever sprays are made

Cabbage butterfly: *Pieris brassicae* (Pieridae: Lepidoptera)




Distribution and status: Throughout India
Host range: cabbage, cauliflower, knol-khol and it may also attack turnip, radish, sarson, toria (*Brassica campestris*) and other cruciferous plants
Damage symptoms-The caterpillars alone feed on leaves, young shoots and green pods. When young, they feed gregariously but the grown-up caterpillars migrate from one field to another. The first instar caterpillars just scrape the leaf surface, whereas the subsequent instars eat up leaves from the margins inwards, leaving intact the main veins. Often, entire plants are eaten up.
Management

- When in the gregarious stage, the caterpillars can be easily controlled by picking and destroying the infested leaves.
- The grown-up caterpillars should be controlled with malathion 5 per cent @ 37.5 kg per ha or by spraying 1.25 L of endosulfan 35 EC or 500 ml of dichlorvos 76 SC in 600-900 L of water per ha.
- Conserve larval parasitoid *Apanteles glomeratus* (Braconidae) in the natural populations.

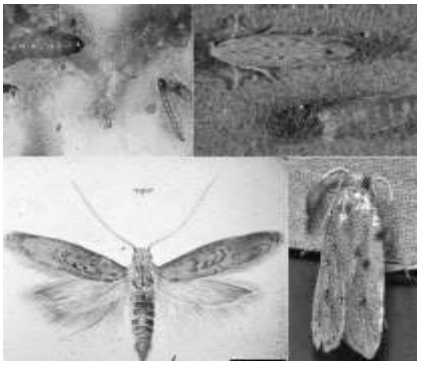
Cabbage semilooper: *Tircihoplusia ni* (Noctuidae: Lepidoptera)



Distribution and status: USA, India and Sri Lanka
Host range: Cabbage, tomato and other cruciferous vegetables.
Damage symptoms- Caterpillars start scrapping and feeding on the leaves initially and later defoliate entire plant leaving midribs and main veins. More damage is evidenced in nurseries than in main field.
Management: Hand pick and destroy caterpillars. Use light trap to attract and kill adults. Spray quinolphos 0.5% or endosulfan 0.1 % or malathion 0.1 %

MAJOR INSECT PESTS OF POTATO

Potato tuber moth: *Phthorimaea operculella* (Gelechiidae: Lepidoptera)



Distribution and status: Worldwide. It is the most destructive pest of potato. It is a cosmopolitan pest, found in warmer countries.
Host range: Tomato, tobacco, brinjal, potato, sugarbeet and solanaceous weeds.
Damage symptoms: Pest of field and storage. Larva tunnels into foliage stem and tubers which lead to loss of leaf tissue, death of growing points and weakening or breaking of stems. In tubers, irregular shaped galleries are seen with excrements near tuber eyes.
Management:

- Select healthy tubers and avoid shallow planting of tubers and plant them to a depth

of 10-15 cm deep.

- Adopt inter-cropping with chillies, onion or pea.
- Earthing-up at 60 days after planting to avoid female moth's egg laying on the exposed tubers.
- Install pheromone traps in the field @ 20/ha
- Remove and destroy infested tubers
- Release egg-larval parasitoid, *Chelonus blackburni* @ 30,000 adults/ ha twice, 40 and 70 days after planting
- Store only good and clean tuber in well-ventilated, cool, dry place with temperature not exceeding 21ºC. Cold storage is highly preferable.
- Keep pheromone traps in godowns also and destroy trapped moths.
- Fumigate godowns in airtight condition with carbon disulphide (CS2) or a mixture of carbon disulphide and carbon tetrachloride or with Ecofume.

Cutworms: *Agrotis ipsilon, A. segetum, Xestia C. nigrum and Peridroma saucia* (Noctuidae: Lepidoptera)

Distribution and status-India, China, northern Europe, Canada, Japan down to South America and New Zealand. They are cool climate pests. In plains, they actively migrate to hilly regions.

Host range-Polyphagous pests. Besides potato, they also feed on barely, beet-root, cole crops, okra, linseed, lucerne, millets, oats, peas, poppy, pulses, tobacco, wheat etc. They can cause economic loss under favourable cold conditions in northern plains.

Damage symptoms-Young larva feeds on tender foliage and grown up larva cuts the stem at collar region.

Management

- Fork soil during summer months to expose larvae and pupae to avian predators
- Install light traps during summer to attract adult moths
- Install pheromone traps @ 5/ha to monitor and attract male moths
- Install sprinkler irrigation system to irrigate in day time to expose larvae for predation by birds
- Drench collar region of plants in evening with chlorpyriphos 20 EC or endosulfan 35 EC 4 ml/ L a day after planting
- In endemic areas, apply NSKE 5%, endosulfan 35 EC 1 L or chlorpyriphos 20 EC 1 L or neem oil 5 L in 500 - 750 L of water per ha . Focus nozzle at the collar region and apply insecticides during evening hours.

MAJOR INSECT PESTS OF OKRA

Whitefly: *Bemisia tabaci* (Aleyrodidae: Hemiptera)

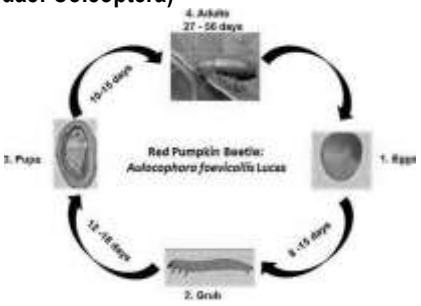
It is a vector that transmits yellow vein clearing mosaic disease

Management

Spray thiamethoxam 25 WG 100 ml or azadirachtin 5% 400 ml or fenpropathrin 30 EC 250-340 ml with 500 L water/ha.

MAJOR INSECT PESTS OF CUCURBITS

Pumpkin beetles: *Aulacophora foveicollis, A. cincta, A. intermedia* (Galerucidae: Coleoptera)



Distribution and status: Widely distributed in Asia, Australia, southern Europe and Africa

Host range: Ash gourd, pumpkin, tinda, ghia tori, cucumber and melon.

Damage symptoms: Both grubs and beetles damage. Grubs remain below the soil surface feeding on roots, underground stems of creepers and on fruits lying in contact with the soil. Adults feed on those parts of the plant which are above the ground. The early sown cucurbits are so severely damaged that they have to be re-sown.

Management

- Early planting of pumpkin during October – November to avoid damage by this pest
- Frequent raking of soil beneath the crop to expose and kill the eggs and grubs.
- Hand collection and destruction of infested leaves and fruits.
- Spray malathion 50 EC 750 ml, dimethoate 30 EC 500 ml, methyl demeton 25 EC 500 ml, 500 g of carbaryl 50WP in 500-750 L of water per ha or apply 7.0 kg of carbofuran. 3G per ha 3-4 cm deep in the soil near the base of the plants just after germination and irrigate.

Cucurbit fruit flies (*Bactrocera cucurbitae*)

Distribution and status: Commonest and most destructive pest throughout India. Also found in Pakistan, Myanmar, Malaysia, China, Formosa, Japan, East Africa, Australia and the Hawaiian Islands Two other allied species common in India are Dacus ciliatis and *Bactrocera dorsalis.*

Host range: Melons, tomato, chillies, guava, citrus, pear, fig, cauliflower, etc.

Damage symptoms: Only the maggot's cause damage by feeding on near-ripe fruits, riddling them and polluting the pulp. Damage by the maggots of this pest causes oozing of brown, resinous fluid from fruits and the fruits become distorted and malformed. The maggots feed on the pulp of fruits and cause premature dropping. The attacked fruits decay because of secondary bacterial infection. After the first shower of the monsoon, the infestation often reaches 100 per cent.

Management:

- Collect infested fruits and dried leaves and dump in deep pits.
- In endemic areas, change the sowing dates as the fly population is low in hot dry conditions and at its peak during rainy season.
- Frequent rake the soil under the vine or plough the infested field after the crop to kill pupae.
- Use ribbed gourd as trap crop and apply carbaryl 1.0 kg or malathion 1.0 L/ha in 500 L water on congregating adult flies on the under surface of leaves.
- Use attractants like citronella oil, eucalyptus oil, vinegar (acetic acid), dextrose and lactic acid to trap flies.

INSECT PESTS OF ORNAMENTAL CROPS

Common Name	Scientific Name	Order	Family
ROSE, LILY, JASMINE, CHRYSANTHEMUM, SUNFLOWER			
Rose Aphid	*Macrosiphum rosaeformis*	Hemiptera	Aphididae
Jasmine leaf webworm	*Nausinoe geometralis*	Lepidoptera	Pyraustidae
Jasmine gallery worm	*Elasmopalpus jasminophagus*	Lepidoptera	Pyralidae
Jasmine bud worm	*Hendecasis duplifascialis*	Lepidoptera	Pyraustidae
Jasmine Thrips	*Thrips orientalis*	Thysanoptera	Thripidae
Lily moth	*Polytela gloriosae*	Lepidoptera	Noctuidae
Banded Blister Beetle	*Mylabris phalerata*	Coleoptera	Meloidae
Milkweed bug	*Lygaeus civilies*	Hemiptera	Lygaeidae
Sunflower Lacewing bug	*Cadmilos retiarius*	Hemiptera	Tingidae
Hollyhock tingid bug	*Urentius euonymus*	Hemiptera	Tingidae
Ak butterfly	*Danaus chrysippus*	Lepidoptera	Nymphalidae
Cotton aphid	*Aphis gossypii*	Hemiptera	Aphididae
Cotton whitefly	*Bemisia tabaci*	Hemiptera	Aleyrodidae
Dusky Cotton bug	*Oxycarenus hyalinipennis*	Hemiptera	Lygaeidae
Red Cotton bug	*Dysdercus koenigii*	Hemiptera	Pyrrhocoridae
Citrus psylla	*Diaphorina citri*	Hemiptera	Aphalaridae
Groundnut aphid	*Aphis craccivora*	Hemiptera	Aphididae
Grapevine thrips	*Rhipiphorothrips cruentatus*	Thysanoptera	Thripidae
Bihar hairy caterpillar	*Spilarctia obliqua*	Lepidoptera	Arctiidae
Castor hairy caterpillar	*Euproctis lunata*	Lepidoptera	Lymantriidae
Pea Leaf miner	*Chromatomyia horticola*	Diptera	Agromyzidae
Cotton grey weevil	*Myllocerus undecimpustulatus*	Coleoptera	Curculionidae
Groundnut white grub	*Holotrichia consanguinea*	Coleoptera	Scarabaeidae

Hollyhock tinged bug: *Urentius euonymus* (Tingidae: Hemiptera)

Host range: Holly hock, *Abutilon indicum, Sida cordifolia*

Damage symptoms: Adults and nymphs suck plant sap from the under surface of leaves. The infested leaves become pale yellow and turn brown. Ultimately they shrivel and dry up.

Bionomics: Bugs have densely reticulate body and wings. Nymphs are spiny in appearance. Adult lays eggs on the upper surface of leaves. Egg period 8-10 days, five nymphal instars completed in 15-27 days. Full development cycle is completed on a single leaf.

Management: Spray dimethoate 30 EC 500 ml or endosulfan 35 EC 1.0 L in 500 L of water / ha.

Sunflower lace wing bug: *Cadmilos retiarius* (Tingidae: Hemiptera)

Host range: Sunflower, gaillardia, chrysanthemum, marigold, vernonia, A*rgemone mexicana*

Damage symptoms: Nymphs and adults suck plant sap and the infested leaves turn yellowish brown and finally dry up.

Bionomics: Small bug, with transparent shiny reticulate wings and black body. Adult

lays eggs mainly on the upper surface of leaves and are inserted slantingly into the plant tissue leaving the opercula exposed which appear like white or brown dots. Eggs hatch in 5-7 days and nymphal period is 2-3 weeks.

Management: Conserve egg parasitoid *Trichogramma* sp., and nymphal, adult parasitic mite *Leptus* sp. Spray malathion 50 EC 500 ml in 500 L of water/ha.

MAJOR INSECT PESTS OF SPICE CROPS

Common Name	Scientific Name	Order	Family
CARDAMOM AND LARGE CARDAMOM			
Banana aphid	*Pentalonia nigronervosa*	Hemiptera	Aphididae
Cardamom thrips	*Sciothrips cardamomi*	Thysanoptera	Thripidae
Cardamom whitefly	*Kanakarajyam cardamom*	Hemiptera	Aleyrodidae
Rhizome weevil	*Prodioctes haematicus*	Coleoptera	Curculionidae
Cardamom hairy caterpillars	*Eupterote cardamomi*	Lepidoptera	Bombycidae
Grapevine thrips thrips	*Rhipiphorothrips cruentatus*	Thysanoptera	Heliothripidae
GINGER AND GARLIC			
Scale	*Aspidiotus hartii*	Hemiptera	Diaspididae
Castor capsule borer	*Dichocrocis punctiferalis*	Lepidoptera	Pyralidae
Skipper butterfly	*Udaspes folus*	Lepidoptera	Hesperidae
CORIANDER			
Cotton aphid	*Hyadaphis coriandri*	Hemiptera	Aphididae
Skipper butterfly	*Udaspes folus*	Lepidoptera	Hesperidae
Castor shoot borer	*Dichocrocis punctiferalis*	Lepidoptera	Pyralidae
Bihar hairy caterpillar	*Spilarctia obliqua*	Lepidoptera	Arctiidae
BLACK PEPPER			
Pollu Beetle	*Longitarsus nigripennis*	Coleoptera	Chrysomelidae
Pepper Shoot borer	*Cydia hemidoxa*	Lepidoptera	Tortricidae
CINNAMON			
Cinnamon Butterfly	*Chilasa clytia*	Lepidoptera	Papilionidae
Cinnamon Leaf miner	*Phyllocnistis chrysophthalma*	Lepidoptera	Phyllocnistidae
TURMERIC			
Skipper butterfly	*Udaspes folus*	Lepidoptera	Hesperidae
Castor shoot borer	*Dichocrocis punctiferalis*	Lepidoptera	Pyralidae
Bihar hairy caterpillar	*Spilarctia obliqua*	Lepidoptera	Arctiidae

Pollu beetle: *Longitarsus nigripennis* (Chrysomelidae: Coleoptera)

Distribution and status: India (West Coast area)

Host range: Pepper (No alternate host reported so far)

Damage symptoms: The grubs bore into the berries of pepper. The infested berries dry up and turn dark in colour. Berries are hollow and crumble when pressed. Such hollow berries are called "POLLU" (Empty). Grub may also eat the spike causing the entire region beyond it to dry up. When contents of one berry is exhausted, the grub move to next and feed continuously.

Management: Rake the soil and incorporate quinalphos 1.5 D, carbaryl 5 D, endosulfan 4 D @ 25 kg/ha to kill the pupae in the soil. Spray dimethoate 30 EC 1.5 L or quinalphos 25 EC 2.0 L in 500 - 1000 L of water per ha.

Cardamom thrips: *Sciothrips cardamomi* (Thripidae: Thysanoptera)

Distribution and status: India and Papua New Guinea. Most destructive pest of cardamom in South India

Host range: Cardamom, tea, grapevine, castor, cotton, ginger and turmeric.

Damage symptoms: Thrips lacerate the surface tissues of capsules and suck the exuding sap. The injured tissues form a corky layer on the capsule surface which appear as scales. Such capsules appear stunted, malformed and shrivelled with gaping slits on the skin. The condition is popularly known as "cardamom itch". Seeds from infected capsules give poor germination. At panicle formation stage, infestation causes stunting of panicles and shedding of flowers. Scrapping of capsules lower their quality and quantity to the extent of even 80-90%.

Management: Maintain plant density with wider spacing of 2.5x2.5 m. Regulate the shade in open areas. Remove and destroy alternate hosts like *Panicum longipes*, *Ammomum* sp, *Alocasia* sp, *Colacasia* sp. Remove dry leaves, leaf sheath and old panicles prior to chemical spraying. Spray phenthoate 500 ml or dimethoate or quinalphos 1.0 L or diafenthiuron 50 WP 800 g with 500 - 1000 L water/ha.

Rhizome weevil: *Prodioctes haematicus* (Curculionidae: Coleoptera)

Distribution and status: India and Sri Lanka
Host range: Cardamom
Damage symptoms-Grubs tunnel and feed on the rhizome causing death of entire clumps of cardamom.
Bionomics- Eggs are laid in cavities made on rhizome. Egg period 8 -10 days. Larvae feed inside the rhizome, larval period 21 days. Pupate in the feeding tunnels, pupal period 21 days. Adult is a brown weevil, 12 mm in length. Adults live for 7 – 8 months. Only one generation in a year.
Management: Destroy affected plant/seedlings. Drench the base of the clump with malathion 1.25 L or carbaryl 50 WP 1.25 kg in 500 1000 L of water/ha

Cardamom aphid: *Pentalonia nigronervosa* f. *caladii* (Aphididae: Hemiptera)
Distribution and status: India, Australia, Sri Lanka. Major pest. It is a vector of "Katte" or marble mosaic disease in small cardamom.
Host range: *Colocasia* sp., *Alocasia* sp. and Banana.
Damage symptoms-Nymphs and adult infest the leaf sheath and the pseudostem. Colonies of aphids are seen inside leaf sheaths of the older pseudostems.
Management: Remove alternate hosts like *Alocasia* and *Colcasia* in the vicinity. Remove partly dried and decayed pseudostems which harbour the colonies of aphids. Spray methy demeton 25 EC or dimethoate 30 EC 1.0 L in 500 – 1000 L water per ha.

Shoot, panicle and capsule borer: *Dichocrocis punctiferalis* (Pyraustidae: Lepidoptera)

Distribution and status: Tamil Nadu, Karnataka and Kerala. Serious pest of nursery in cardamom
Host range: Castor, turmeric, guava, mulberry etc.
Damage symptoms: The larva bores into the central core of the pseudostems resulting in the death of the central spindle causing characteristic "dead heart" symptom. Larva feeds on the immature capsules and feed on seeds rendering them empty. Oozing out of frass materials at the mouth of the bore hole - very conspicuous on stem / pods.