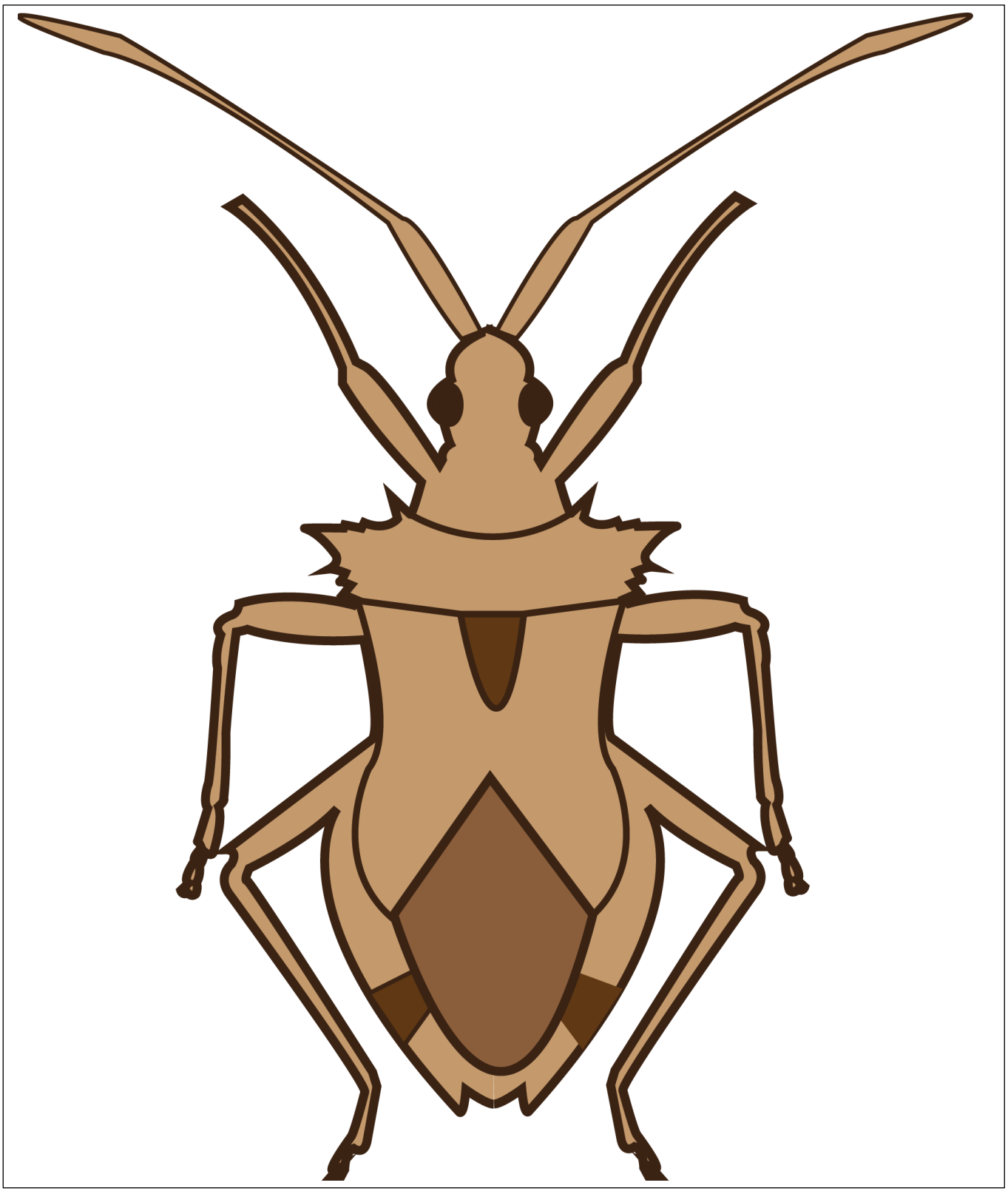
AEN 302 PESTS OF HORTICULTURAL CROPS AND STORED PRODUCES AND THEIR MANAGEMENT (1+1)



Index(Refer syllabus for mid semester)

Students must refer current syllabus from your theory notes .

- Vegetables , fruits and tubers – Mid semester 2022 September
- Plantation crops and flowers lawn and storage – Final semester 2022

PESTS OF MANGO

I. MANGO

There are number of insect pests of this fruit and over 175 species of insect have been reported damaging mango tree but the most abundant and destructive at the flowering stage are the mango hoppers. Also mango mealy bug in North India, stem borer, fruit fly, mango nut weevil and caterpillar pests plat a major role in bringing down the yield. It is almost necessary to control these pests otherwise there is a heavy fruit drop and the trees may remain without fruit.

	Major pests			
1.	Mango hoppers	*Idioscopus niveosparsus, I. clypealis, Amritodus atkinsoni*	Cicadellidae	Hemiptera
2.	Stemborer	*Batocera rufomaculata*	Cerambycidae	Coleoptera
3.	Fruit fly	*Bactrocera dorsalis*	Tephritidae	Diptera
4.	Mango nut weevil	*Sternochaetus mangiferae*	Curculionidae	Coleoptera
5.	Mango mealy bug	*Drosicha mangiferae*		
6.	Bark eating caterpillar	*Indarbela tetraonis, I. quadrinotata*	Metarbelidae	Lepidoptera
7.	Flower gall midge	*Procystiphora mangiferae, Erosomyia indica, Dasineura amaramanjarae*	Cecidomyiidae	Diptera
8.	Mango leaf webber	*Orthaga exvinacea*	Noctuidae	Lepidoptera
9.	Shoot borer	*Clumetia transversa*	Noctuidae	Lepidoptera
10.	Leaf caterpillar	*Bombotelia jacosatrix*	Noctuidae	Lepidoptera
11.	Flower webber	*Eublemma versicolor*	Noctuidae	Lepidoptera
	Minor pests			
12.	Leaf caterpillar	*Euthalia garuda*	Nymphalidae	Lepidoptera
13.	Leaf miner	*Acrocercops syngramma*	Gracillariidae	Lepidoptera
14.	Leaf twisting weevil	*Apoderus transquebarius*	Curculionidae	Coleoptera
15.	Red ant	*Oecophylla smaragdina*	Formicidae	Hymenoptera
16.	Eriophyid mite	*Aceria mangiferae*	Eriophyidae	Acarina

1. Mango hoppers: *Idioscopus niveosparus, I. clypealis, Amritodus atkinsoni* (Cicadellidae : Hemiptera)

Distribution and status

India, Indonesia, Formosa, Philippines, Taiwan, Vietnam, Srilanka, Burma, Pakistan, Bangladesh and Malaysia. Major pest prevalent in the flowering season and devastating in all mango growing areas. **Host range:** Mango

Damage symptoms

Both nymphs and adults suck the sap from tender shoots and inflorescence resulting in withering and shedding of flower buds and also wilting and drying of shoots and leaves.

The flower stalks and leaves in infested trees become sticky due to the deposition of honey-dew secreted by the hoppers that encourages the growth of black sooty mould on foliage and other parts.

The hoppers take shelter in cracks and crevices on the bark during non-flowering season.

Bionomics

Eggs are laid in single into the tissues of the young leaves, shoots, flower stalk and unopened flowers. Incubation period: 4-7 days. Nymphal period: 8-13 days, 5 instars. Life cycle completed in 2-3 weeks.

I. niveosparsus	*I. clypealis*	*A. atkinsoni*
Three spots on scutellum and white band across the wing	Two spots on scutellum and dark spot on the vertex	Two spots on scutellum

IPM

- Avoid close planting, as the incidence very severe in overcrowded orchards
- Orchards must be kept clean by ploughing and removal of weeds
- Pruning of dense canopy to facilitate aeration and sunlight
- Avoid excess use of nitrogenous fertilizers
- Spray dimethoate 30 EC or moncrotophos 36 SL 2.5-3.3 L , methyldemeton 25 EC or malathion 50 EC 1.5 -2.0 L in 1500 – 2000 L of water per ha or acephate 75 SP @ 1 g/L, phosalone 35 EC @1.5 ml/L, or new molecules like buprofezin 25 SC 1-2ml/L of water or imidacloprid 17.8 SL 2-4ml/tree or lambda cyhalothrin 5 EC 0.5-1.0ml/L of water at 10 -15 L of water per tree
- Neem oil 5 ml/lit of water can be mixed with any insecticide for spray
- Spray 3 per cent neem oil or neem seed kernel powder extract 5 per cent

2. Stemborer: *Batocera rufomaculata* (Cerambycidae : Coleoptera)

Distribution and Status: India, Bangladesh

Host range

Mango, rubber, jack-fruit, fig, papaya, apple, eucalyptus and mulberry, morings and silk cotton.

Damage symptoms

The grubs feed by tunneling the bark of branches and main stem. Shedding of leaves and drying of terminal shoots takes place in early stage of attack while damage to main stem causes tree death.

Bionomics

Eggs laid singly on the bark or cracks and crevices on the tree trunk or branches. Incubation period: 1-2 weeks. Grubs yellow, grub period 6 months, and pupal period is 19-36 days. Adults grey with two pink dots and lateral spine on the thorax with a longevity of 6 months.

Management

i. Grow tolerant mango varieties viz., Neelam, Humayudin

ii. Remove and destroy dead and severely affected branches of the tree

iii. Avoid injury at the base of trunk while pruning

iv. Remove alternative hosts like moringa, silk cotton in the near vicinity.

v. During off-season, apply absorbent cotton soaked in 10 ml monocrotophos 36 SL per tree by padding without unnecessarily injuring the trunk.

vi. Use a needle or long wire to pull out the grubs from the bore holes. The bore holes may be filled with DDVP @ 5 ml or monocrotophos 36 WSC 10 to 20 ml or one celphos tablet (3 g aluminum phosphide) or apply carbofuran 3G 5 g per hole and plug with clay + copper oxychloride paste.

vii. Swab Coal tar + Kerosene @ 1:2 or Carbaryl 50 WP 20 g / L (basal portion of the trunk - 3 feet height) after scraping the loose bark to prevent oviposition by adult beetles.

3. Fruit fly: *Bactrocera dorsalis* (Tephritidae: Diptera) Distribution and Status

India, Pakistan, South-East Asia, Malaysia, Indonesia, Formosa, Philippines, Australia, China, Hawaii Islands, China and Taiwan.

Host range

Mango, guava, peach, apricot, cherry, pear, ber, citrus, banana, papaya, avocado, passion fruit, coffee, melons, jack fruit, strawberry.

Damage symptoms

The maggots destroy and convert the pulp into bad smelling, discoloured semi liquid mass unfit for human consumption. Infestation results in fruit drop and liquid oozes out from the fruit upon pressing.

Bionomics

The adult fly is brown or drak brown with hyaline wings and yellow legs. Adult lays up to 200 eggs in a month in clusters of 2-15 just beneath the skin of the ripening fruits. The egg period is 22-23 days. The maggot feeds on pulp and become full grown in about 7 days. It pupates 3-7 inches below the soil.

Management

i. Row interspaces may be ploughed to expose and kill the soil borne puparia.

ii. The infested and fallen fruits should be carefully disposed of.

iii. Apply a bait-spray of malathion 50 EC @ 2 ml/ L with molasses or jaggery (10 g/L) before ripening.

iv. Male annihilation technique: Set up fly trap using methyl eugenol. Prepare methyl eugenol 1 ml/L of water + 1 ml of malathion solution. Take 10 ml of this mixture per trap and keep them at 25 different places in one ha between 6 and 8 am. Collect and destroy the adult flies.

4. Mango nut weevil: *Sternochaetus mangiferae* (Curculionidae: Coleoptera)

Distribution and Status

India, Pakistan, Bangladesh, Srilanka, Burma, Malaysia, South Vietnam, Philippines, East Australia, Africa and Hawaii.

Host range: Mango

Damage symptoms

The grub tunnels in a zig-zag manner through the pulp endocarp, seed coat and finally reaches the cotyledons and destroys them. As the fruit develops the tunnel get closed. The adults that emerge from the pupae also feed on the developing seed and hasten the maturity of infested fruit.

Bionomics

Adult lay eggs singly on the marble sized fruits by scooping out the surface tissue and covering over with transparent secretion. Egg period - 7 days, grub period - 20-30 days yellow creamy grub apodous with five larval instars. Pupation occurs inside the nut along the concave side; pupal period 7 days. Adults stout, 6 mm long, dark brown in colour. Life cycle completed in 40-50 days.

IPM

- Under-sized fruits left on the tree should be picked and destroyed.
- Undertake general cleanliness and destruction of the weevils on the bark during August If the trees are few, bag the fruits with cloth or try paper bags for protection.
- Collect and destroy the fallen fruits and stones
- Spray application of malathion 50 EC 1ml/L; Carbaryl 3-4 kg (4 g/L of water) or Quinalphos 3- 4 L (2 ml/L of water) in 1500-2000 L water per ha in Sept-Oct on the tree first at marble stage of the fruit second at 15 days interval.
- During non flowering season direct spray towards the base of the trunk.
- The infested bark should be washed with kerosene emulsion.
- Spray deltamethrin spray 1.5 - 2.0 L (1 ml/L of water) in 1500-2000 L water per ha after six weeks of fruit set.

5. Mango mealy bug: *Drosicha mangiferae* (Pseudococcidae: Hemiptera)

Distribution and Status

India, Bangladesh, China and South East Asia

Host range

Mango, apple, apricot, ber, cherry, Citrus spp., fig, grape vine, guava, jack, jamun, litchi, mulberry and pomegranate.

Damage symptoms

Damages caused by nymphs and wingless females. They infest the leaves and inflorescence. Nymphs climb up the tree congregate together and suck juice from young shoots, panicles and flower pedicels. The affected parts dry up and yield is reduced substantially.

Bionomics

Oval, shining pink eggs laid in the soil upto 15 cm. Egg hatching starts at the end of December and continues upto month. First instar nymphs climb and ascend the trees immediately. They pass 3 nymphal instars. Adult longetivity for male and female are 7 and 15-35 days respectively. Female lays eggs for 22-47 days during april-may. Adults are oval, flat, body covered with white mealy powder. Males have one pair of black wings and are crimson red.

IPM

- Remove weeds like *Clerodendrum inflortunatum* and grasses by ploughing during June-July.
- Plough orchards during summer to expose the eggs to natural enemies and extreme heat.
- Band the trees with 20 cm wide alkalthene of polythene (400 gauge) in the middle of December (50 cm above the ground level and just below the junction of branching).Tie stem with jute thread and apply a little mud of fruit tree grease on the lower edge of the band.
- Release Australian ladybird beetle, *Cryptolaemus montrouzieri* @ 10/tree
- If necessary spray dimethoate 30 EC or moncrotophos 36 SL 2.5-3.3L , methyldemeton 25 EC or malathion 50 EC 1.5 -2.0 L or chlorpryriphos 20 EC 3.0 – 4.0 L or . 50 EC 1.5 – 2.0 L in 1500 – 2000 L water per ha
- Once the pest reaches the top of the plant, control becomes rather difficult.

6. Bark eating caterpillar: *Indarbela tetraonis, I. quadrinotata* (Metarbelidae: Lepidoptera)

Distribution and status: Throughout India, Burma, Bangladesh and Sri Lanka potential major pest.

Host range: Mango, guava, zizyphus, litchi, orange, pomegranate, bauhinia, loquat, mulberry, moringa, rose, guava and eugenia.

Damage symptoms

Young trees succumb to the attack. Caterpillars bore into the trunk or junction of branches make zig zag galleries Presence of gallery made out of silk and frass is the key symptom. They remain hidden in the tunnel during day time, come out at night and feed on the bark. Under severe infestation, flow of sap is hindered, plant growth arrested and fruit formation is drastically reduced.

Bionomics

Adults emerge in summer and lays 15-25 eggs in clusters under loose bark of the trees. Eggs hatch in 8-10 days. Larvae makes webs and feeds making zig zag galleries on the wood filled with frass and excreta and later bores inside the wood. Larval period is 9 -11 months and then pupates inside the stem. Pupal stage is 3-4 months.

Management

- Kill the caterpillars by inserting an iron spike into the tunnels.
- Injecting ethylene glycol and kerosene oil in the ratio of 1:3 into the tunnel by means of a syringe and then seal the opening of the tunnel with mud.
- Dip a small piece of cotton in any of the fumigants, like chloroform or petrol or kerosene, introduce into the tunnel and seal the opening with clay or mud.

7. Flower gall midge: *Procystiphora mangiferae, Erosomyia indica, Dasineura amaramanjarae* (Cecidomyiidae: Diptera)

Distribution and status: Distributed throughout India

Host range: Mango

a. *Procystiphora mangiferae*

Damage symptoms

The maggot feeds on stalks of stamen, anthers, ovary.

Bionomics

The adult fly is light orange in colour. It lays eggs inside the flower buds. The maggots pupates inside the bud itself. The life cycle is completed in 12- 24 days. **b. *Erosomyia indica***

Damage symptoms

Maggots attack the inflorescence stalk, flower buds and small developing fruits. Inflorescence is stunted and malformed and buds do not open.

Bionomics

Adult fly is yellowish and lays eggs on the inflorescence peduncle or base of the developing fruit. Pupation occurs in soil. **c. *Dasineura amaramanjarae***

Damage symptoms

Maggots feed inside buds and the buds fail to open and drop down.

Bionomics

Maggots hibernate in soil and carry over to the next year and when favourable condition occurs pupate and emerge as adults.

Management

Spray dimethoate 30 EC or methyl demeton 25 EC 3.0 - 4.0 L in 1500-2000 L of water per ha (10-15 L of spray fluid per tree)

8. Flower webber: *Eublemma versicolor* (Noctuidae: Lepidoptera) Distribution and status: widely distributed in India.

Host range Mango

Damage symptoms

Flowers in the inflorescence are webbed together by the larvae, hich remain inside the silk lined gallery and feed. They also bore into the inflorescence stalk.

Bionomics

Female has purplish pink or light orange wings with an apical patch. Adult lays 8 -10 reddish hemispherical eggs on sepals and the incubation period is 3-4 days. Larva is smooth, greenish yellow with light brown head and prothoracic shield.

Management

Spray phosalone 35 EC 3.0 - 4.0 L or carbaryl 50 WP 3.0 kg in 1500-2000 L of water per ha (10-15 L of spray fluid per tree)

9. Mango leaf webber: *Orthaga exvinacea* (Noctuidae: Lepidoptera)

Distribution and status: Common in South India.

Host range: Mango

Damage symptoms

Larvae web up leaves into clusters and feed within. Leaves surface are scraped and they wither and dry up.

Bionomics

Moth is grayish with brownish wings and has wavy lines on fore wings. Adults lays upto 30 50 yellowish green eggs singly near the leaf veins. Egg period is 4 days. Caterpillar pale greenish with brown head and prothoracic shield. Pupation occurs in leaf web. Adult emerges in 11- 14 days.

Management

Remove and destroy the webbed leaves along with larvae and pupae

Spray carbaryl 50 WP at 2.0 L

Conserve predators like carabid beetle *Parena lacticincta*, reduvid *Oecama sp*, parasitoid *Hormiusa* and fungus *Paecilomyces farinosus*.

10. Leaf caterpillar: *Bombotelia jacosatrix* (Noctuidae: Lepidoptera)

Larvae feeds on tender leaves causing defoliation. Larva is smooth with pink spots on the body. Pupation takes place in soil and adult moth is dark brown with lower half of the hind wings white.

11. Leaf caterpillar: *Euthalia garuda* (Nymphalidae : Lepidoptera)

Damage symptoms: The caterpillar feeds on leaves

Bionomics: The adult butterfly is brownish black with white spots on wings. Caterpillar with a light green mid dorsal line has the colour of lead and is not easily detected. It easily camouflages in the mango leaf.

12. Leaf miner: *Acrocercops syngramma* (Gracillariidae : Lepidoptera)

Infests tender leaves and produces blister like patches. Adult moth is silvery grey moth with fringes of hairs on the wing margin. The larva is reddish brown in colour.

13. Leaf twisting weevil: *Apoderus transquebarius* (Curculionidae: Coleoptera)

It is active from May to October. Grub cuts across a leaf from margin to midrib near base. Leaf is then folded longitudinally from tip downwards and a compact thimble-shaped structure is formed. Roll gradually starts drying and ultimately fall down along with pupa. Adults are reddish-brown weevil with head drawn anteriorly into a long snout and posteriorly into neck. Adults come out by making a small hole in dried, rolled mass of leaf. Eggs are oval in shape and yellow in colour. Grubs are apodous and pale-yellow in colour, while pupae are bright yellow.

14. Shoot borer: *Chlumetia transversa* (Noctuidae: Lepidoptera)

Damage symptoms

Neonate caterpillars bore into mid ribs of tender leaves, come out and bore into tender shoots near the growing point tunnelling downwards, throwing excreta through entrance hole. Leaves of affected shoots whither and droop down. **Bionomics**

Adult moths are stout with green forewings. Young caterpillars are yellowish orange with dark brown prothoracic shield. Full grown caterpillars (20-24mm) are dark pink with dirty spots

Management

- Clip off and destroy affected shoots in initial stage of attack.
- In case of severe attack spray carbaryl two times at three weeks interval commencing from initiation of new flush of leaves

14. Red ant: *Oecophylla smaragdina* (Formicidae:Hymenoptera) 15. Eriophyid mite: *Aceria mangiferae* (Eriophyidae :Acari)

Distributed in India, Pakistan and USA and associated with malformation disease of mango. Mite sucks the sap from internal and auxiliary buds resulting in the stoppage of growth and development of close lateral buds, resulting in the buds becoming crowded and malformed and necrosis of tender tissues.

Question paper on Mango and Citrus

1.	----------is a monophagous pest on mango is **Stone weevil, Mango hopper**	
2.	---------- feeds on mango inflorescence during flowering season -**Mango hopper**	
3.	Mango fruit become marble sized due to attack of ---------- **Stone weevil**	
4.	---------- is the scientific name of mango mealy bug -***Drosicha mangifera***	
5.	---------- is the scientific name of mango leaf twisting weevil **- *Apoderus tranquebarious***	
6.	Citurs can be covered with prerforated polythene bag to control the incidence of -------- **Fruit sucking moth**	
7.	Larvae feed their own exuviae after each molting in the case of ---------- **Citrus butterfly**	
8.	Scientific name of citrus leaf mite is---------- ***Eutetranechus orientalis***	
9.	Scientific name of citrus leaf roller is---------- ***Psorostichya zizyphi***	
10.	Male annihilation technique is used to control _____**- Fruit fly**	
11.	The chemical used in male annihilation technique is _____- **Methyl eugenol**	
12.	Breeding weed host of fruit piercing moth- ***Tinospora cordifolia***	
13.	Site of oviposition for mealy bug is----------	
	a. On the leaf	b. On twig
	c. **In soil**	d. On fruit
14.	Severe infestation results in mango fruit drop and liquid oozes out upon pressing	
	a. *Batocera rufomaculata*	b. *Sternocheatus mangiferae*
	c. ***Bactrocera dorsalis***	d. *Procystiphora mangifera*
15.	---------- causes irritation during harvest and is a nuisance in mango orchards	
	a. **Red tree ant**	b. Leaf twisting weevil
	c. Black ant	d. Leaf webber
16.	Citrus butterfly belongs to family	
	a. Nymphalidae	b. **Papilionidae**
	c. Lycaenidae	d. None of the above
17.	Ring like scarred area encircling the citrus stalk and irregular mottled patches on rind is symptom of	
	a. **Thrips**	b. Whitefly
	c. Aphids	d. Scale

18.	Citrus leaf miner belongs to family

	a. Agromycidae	b. **Gracillariidae**
	c. Galuricidae	d. Gelichidae

Citrus :: Index :: Pests of Citrus

There are large number of insect pests of citrus which are widely distributed. Their attack is one of the factors contributing to the problem of citrus decline observed in various parts of India and South Asia. Citrus psyllid, leafminer, blackfly and whitefly are destructive pests which are responsible for reduced quality of fruits and fruit drops. Borers in old orchards are a threat to sustain the productivity.

Major Pests			
Shoot Psyllid	*Diaphorina citri*	Psyllidae	Hemiptera
Citrus Leaf Miner	*Phyllocnistis citrella*	Gracillaridae	Lepidoptera
Citrus Blackfly	*Aleurocanthus* woglumi	Aleyrodidae	Hemiptera
Citrus Whitefly	*Dialeurodes citri*	Aleyrodidae	Hemiptera
Fruit Piercing Moths	*Othreis materna*, *O. fullonica*, *O. ancilla*	Noctuidae	Lepidoptera
Lime/Orange Tree Borer	*Cheledonium cinctum, C. alcamene*	Cerambycidae	Coleoptera
Bark Caterpillar	*Indarbela tetraonis*	Metarbelidae	Lepidoptera
Citrus Butterfly	*Papilio demoleus*, *P. polytes*	Papilionidae	Lepidoptera
Orange Trunk Borer	*Anoplophora versteegi*	Lamiidae	Coleoptera

Shoot psyllid

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1. Shoot psyllid: *Diaphorina citri* (Psyllidae: Hemiptera)

Distribution and Status: America, India, Pakistan, Vietnam, Japan, Sri Lanka, Philippines, Indonesia and China

Host range: Citrus, certain deciduous plants and families of rutaceae.

Damage symptoms

Both nymphs and adults suck cell sap from leaves, which curl up, dry and fall off.

Bionomics

Female lays 200 eggs singly on the underside of soft young leaves, egg period 7-10 days, Nymph pale yellow, with purple eyes and marginally fringed with bristles, nymphal period 25-71 days. Pupa broad oval, pale yellow with an orange yellow band in the middle of body. Adult minute with long wings that extend beyond tip of abdomen, wings and body covered with a white waxy powder.

Management

- Prune the affected trees and dried shoots.
- Conserve natural enemies like parasitois *Tetrastichus radiates* and predators like *Coccinella septumpunctata, C rependa, Chilomenes sexmaculata, Chilocorus nigritus, Brumus suturalis, Chrysoperla carnea.*
- Spray any of the insecticides *viz*., NSKE 5 %, neem oil 10 L, dimethoate 30 EC 3.0 L, of monocrotophos 36 SL 1.5 L, methyl demeton 25 EC 2.5 L, quinalphos 25 EC 1.0 L, imidacloprid 200 SL 250 ml in 1500-2000 L of water per ha during March and again in September.

Citrus leaf miner

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2. Citrus leaf miner: *Phyllocnistis citrella* (Gracillaridae : Lepidoptera)

Distribution and Status

Eastern Asia, North Australia and India.Serious in Tamil Nadu, Madhya Pradesh, Assam, Uttar Pradesh, Punjab and Pakistan.

Host range

Citrus, Pommelo (*Citrus maxima, Citrus grandis)*, willow, cinnamon, *Loranthus* spp.

Damage symptoms

Larva mines into the tender leaves and form zig-zag galleries while feeding on the epidermal cells leaving behind the remaining leaf tissues quite intact. The infested leaves turn pale, get distorted and dry up. The larval damage may lead to secondary infection by fungi and bacteria causing 'citrus canker'.





Bionomics

Female lays 36-76 eggs, 2-3 per leaf. Egg period 2-10 days. Larva pale yellow / pale green with light brown well developed mandibles, larval period 5-30 days. By the time larvae spin cocoons for pupation, leaves get twisted / folded over; pupal period 5-25 days. Adult tiny, silvery white moth with 4.3 mm wing expanse with fringed wings.

Management

- Spray NSKE 5% (50 g/L) or neem cake extract 5% or neem oil 3 % or imidacloprid 17.8 SL 125 ml per ha
- Spray dichlorvos 76 WSC 1.0 L, dimethoate 2 .0 L per ha
- Use 5-15 L of water per tree/1500-2000 L of water per ha

Citrus blackfly

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3. Citrus blackfly: *Aleurocanthus woglumi* (Aleyrodidae: Hemiptera)

Distribution and Status: Sikkim, India, Srilanka, Philippines, Jamaica, Cuba and Bahamas. **Host range**: Citrus, sweet orange, avacado, grape vine, mango, guava, pear, plum.

Damage symptoms

Nymphs and adults suck plant sap, causing curling of leaves and premature fall of flower buds and developing fruits.

Bionomics

Yellowish brown oval eggs, laid spirally, egg period, 7-14 days. Nymphs scale like, shiny black, spiny and bearded by a white fringe of wax, nymphal period 38-60 days. Pupa oval, black with arched dorsum having long black spines and round black teeth. Adults dark orange with smoky wings, forewings having four whitish areas of irregular shape.



Management

- Close planting, water logging or stress conditions are avoided.
- Excessive irrigation and application of nitrogen and pesticidal sprays are avoided
- Spray neem oil 3% or Fish Oil Rosin Soap 30 g/L or quinalphos 25 EC 2.0 L or monocrotophos 36 SL 1.5 L or methyl demeton 25 EC 1 .0 L or ethion 50 EC 2.5 L or triazophos 40 EC 3.0 L or or per ha. Use 5-15 L water/tree or 1500 – 2000 L water per ha during April – May and again during September – October.

Citrus Whitefly

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4. Citrus whitefly: *Dialeurodes citri* (Hemiptera: Aleyrodidae)

Distribution and status :Native of India, America, Guatemala, Bermuda, Chile, Peru, Argentina, Brazil, France, Sri Lanka, China, Taiwan, Vietnam, Japan, Macao, Pakistan and Sikkim.

Host range

Citrus, allamanda, banana shrub, chinaberry, coffee, *Ficus macrophylla*, jasmine, lilac, mock olive, pear, pomegranate, tree of heaven, trumpet vine, umbrella tree, water oak, persimmon, and wild olive.

Damage symptoms

Nymphs and adults suck large quantities of sap. Further injury is caused by sooty mold fungus which grows over fruit and foliage in copious amount of honeydew excreted by the whitefly. Heavily infested trees become weak and produce small crops of insipid fruit.

Bionomics

Tiny mealy white adult female lays about 150 eggs on foliage and hatch in eight to 24 days. Freshly laid eggs smooth yellow turn black with netted ridges. Unfertilized eggs develop into males only. The larvae soon settle to feed and do not move about until the adult stage is reached. The nymph is a flat, elliptical, scale-like, translucent, closely fastened to the underside of a leaf. Nymphal life averages 23 to 30 days. Pupae opaque and eye spots visible. Pupal development requires 13 to 30 days. Adult longevity 10 days. The entire life cycle from egg to adult requires from 41 to 333 days. There are several overlapping broods each year.

Management

- Regularly prune to avoid whitefly problems.
- Conserve predators like Coccinellids *viz*., *Cryptognatha flavescens*., *Verania cardoni*.
- Refer chemicals as given for citrus blackfly**.**

Fruit piercing moths

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5. Fruit piercing moths: *Othreis materna*, *O. fullonica*, *O. ancilla* (Noctuidae: Lepidoptera)

Distribution and Status: Throughout India

Host range: Citrus, mango, grapes and apple

Damage symptoms

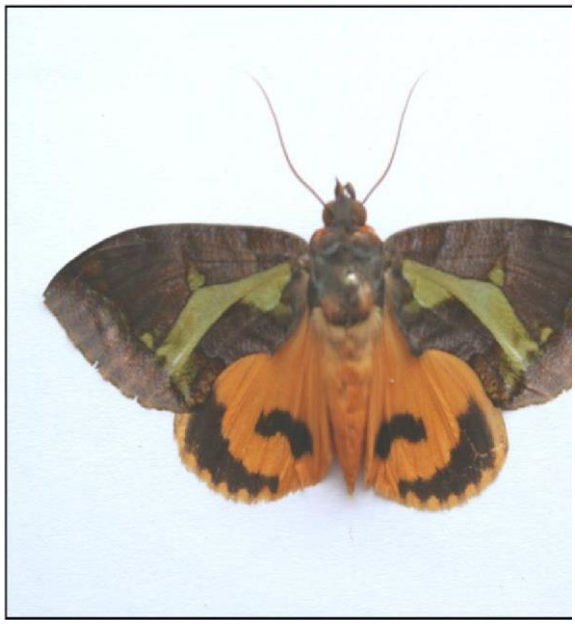
Adult moth pierces the fruits for sucking the juice and makes characteristic pin-hole damage in fruits. Bacterial and fungal infections take place at the site of attack. Whole fruit turns yellow, drops from tree and looks like a premature fruit. In severe cases, all fruits are lost.

Bionomics

Round and translucent eggs laid on wild plants and weeds like *Tinospora cordifolia*, *Cocculus pendulus*, *C. hirsutus* in and around citrus orchard. Egg period two weeks. Larvae are semi-loopers with stout appearance and dorsal hump on the last segment of the body, have distinct eye spots on head and yellow / red lateral spots. Their velvetty dark-brown back ground makes them cryptic. Full-grown larva assumes a characteristic

snake like posture on disturbance, 5 – instars, larval period 4 weeks. Pupates in a pupal case made from leaf pieces and soil particles. Pupa is thick and dark reddish brown with pupal period of two weeks.

O. fullonica	*O. materna*	*O. ancilla*
Adults have tripod black mark in the forewing and curved marking on hind wing.	Adults have three black spots on the fore wings and a circular spot in the hindwing	Adults have white bands in the middle fore wing



Management

- Destroy the weed host, *Tinospora cordifolia, Cocculus pendulus*, *C. hirsutus* in and around citrus orchard
- Apply smoke to repel adult moth
- Operate light traps to attract adults.
- Cover the fruit with perforated poly bags.
- Set up food lures with rotten tomatoes (or) pieces of citrus fruits to collect and kill

- Bait with fermented molasses / jaggery (10 g/ L) + malathion 50 EC 1 ml/L or kill moths with a bait containing gur 1 kg+ vinegar 60 g + lead arsenate 60 g + water 10 L. wide mouthed bottles @ 1 bottle per 10 trees tied to plants when the fruits are in unripe condition.
- Dispose fallen fruits that attracts the moths
- Spray with 2.5 kg of carbaryl 50 WP in 1000 L of water per ha at the time of maturity of fruits.

Lime/orange tree borer

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6. Lime/orange tree borer: *Cheledonium cinctum,* (*Chloridolum*) *C. alcamene* (Cerambycidae; Coleoptera)

Distribution and Status: Major and highly destructive pest in South India.
Host range: Orange

Damage symptoms

The grubs bore into stem and feed on the internal tissues, which results in drying of terminal shoots in early stages, followed by wilting of thicker branches and main stem. Gum exudation and wood powder accumulation on ground below are symptoms of attack.

Bionomics

Adult lays 30-50 eggs are laid on twigs and thorns covered by a resinous fluid secretion. Female lays 30-50 eggs. Egg period 11-72 days, creamy white grub with flat head, grub period 10 months, pupates in a tunnel inside the stem and pupal period three weeks. Dull metallic green to dark violet adults, with a yellow band across the middle of the elytra emerge in April-May and remain within the pupal chamber for a long time. Total life cycle is completed in one year

Management

- Prune infested branches containing grubs
- Plug fresh holes with cotton soaked in monocrotophos solution mixed at 5 ml/ 20 ml of water.
- Undertake stem padding with monocrotophos 2.5 ml+2.5 ml of water.

Pests of Citrus :: **Minor Pests**

Minor Pests			
Leaf Roller	*Psorostichya zizyphi*	Oecophoridae	Lepidoptera
Aphid	*Toxoptera citricidus, T.* aurantii	Aphididae	Hemiptera
Thrips	*Thrips nilgiriensis*	Thripidae	Thysanoptera
Citrus Scale	*Aonidiella aurantii*	Diaspididae	Hemiptera
Citrus Leaf Mite	*Eutetranychus barksi*	Tetranychidae	Acari
Citrus Fruit Rust Mite	*Phyllocoptruta oleivorus*	Eriophyidae	Acari

Leaf roller

10. Leaf roller: ***Psorosticha zizyphi*** **(Oecophoridae: Lepidoptera)**

Distribution and status: India
Host range: Citrus, ber

Eggs laid singly or in groups along the mid rib of leaves. Egg, larval and pupal period lasts for 3-5, 9-11 and 5-10 days respectively. Larva webs together and folds leaves and feed drom within on the epidermis first and on the whole leaves later. Larva pale yellowish green with black head, adult moth small and brown.

Aphid

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11. Aphid: ***Toxoptera citricidus, T. aurantii*** **(Aphididae: Hemiptera)**
Distribution and status: Found in all citrus growing regions.Minor pest **Host range**: Rutaceae and Rosaceae families.

Damage symptoms
Nymphs and adults suck sap from plant parts causing the curling up, deformation, yellowing and crinkling of tender shoots resulting in stunted growth. Blossoms and newly set fruits also affected. Honey dew secreted by the aphids acts as substrate for sooty mould growth.

Bionomics
Adult are wingless and shiny black, nymphs dark reddish brown. Nymphs of brown aphid give out yellow haemolymph and black aphid red haemolymph on squashing.

Management

- Release of coccinellid predator, *Menochilus sexmaculatus* @ 50 per tree.
- Spray 3.0 L dimethoate 30 EC or 1.5 L monocrotophos 36 SL or 2.5 L oxydemeton methyl 25 EC in 1500-2000 L water per ha during March and again in September.

Thrips

12. Thrips: *Thrips nilgiriensis* (Thripidae: Thysanoptera)

Both nymphs and adults lacerate fruits causing ring like scarred area encircling the fruit stalk and irregular mottled patches on rind. Adult with yellowish, fringed wings.

Citrus leaf mite

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14. Citrus leaf mite: ***Eutetranychus orientalis* (Tetranychidae: Acari)**

Distribution and status : Afghanistan, Cyprus, Taiwan, Egypt, India, Iran, Israel, Jordan, Kenya, Lebanon, Mozambique, Pakistan, Sudan, Turkey and Venezuela. Serious pest in lower altitudes.

Host range

Citrus species, Cassia *fistula*, *castor, Cannabis* sp., *Nerium oleander, neem*, *Dalbergia sisso*, Indian coral tree, papaya, almond, peach, pear and curry-leaf .

Bionomics

It passes through egg, larva, protonymph, deutonymph and adult stages. Average fecundity per female is 51.3 eggs and egg period is 5 days. Larval, protonymphal and deutonymphal periods are 1.41, 1.50 and 1.50 days respectively. Total developmental stage from egg to adult 12-13 days. It develops faster on leaves of castor, French bean and lime than on mandarin. Peak population found during March-June and September-October.

Damage symptoms

Mites suck the sap of leaves predominantly from the upper surface of leaves; the affected leaves turn chlorotic and finally drop off resulting in poor plant growth. Infestation starts along the midrib of leaves and later spreads along lateral veins, as a result the region on either side of the midrib and veins turn pale-yellow. In case of severe mite infestation, the upper leaf surface turns pale completely. The webbing produced by the mite trap dust particles, hence the infested leaves are covered with fine dust particles. However, the lower surface remains free of mites and their feeding injury, and appears normal green. In some cases, mite infested fruits also appear chlorotic.

Management

- Prefer relatively resistant Citron (*Citrus medica*), lime variety kagzi lime, *C. sinensis*, *C. aurantifolia* and sweet orange
- Avoid sour lemon variety, sweet lime (*C. limmetioides*), Kharna khattai, grape fruit and *Citrus acida* as they are most susceptible
- Select resistant root stock *Citrus aurantiifolia* followed by *Citrus reshini* and *C. amblycarpa*
- Remove alternate host plants like castor, echandinii, amaltas (C*assia fistula*), *Melia* sp., in orchards.
- Irrigate judiciously, particularly during summer to prevent water stress conditions and resultant flare up
- Conserve coccinellid beetles *viz*., *Scymnus gracilis*, *Stethorus pauperculus* and predatory thrips *viz., Scolothrips,* predatory mites *viz*., *Amblyseius cucumeris*, *A. hibisci*, *Pronematus* sp. and *Agistemus* sp.
- Apply aldicarb 10 G 5 g /nursery plant or Spray any of the insecticides *viz*.,dicofol 18.5 EC, fenpropathrin 10 EC, monocrotophos 36 SL, methyl demeton 25 EC, wettable sulphur 3 g/L, permethrin 25 EC 1.0 L in 1000 L of water /h

Citrus rust mite

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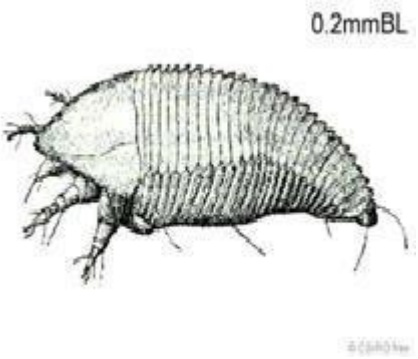
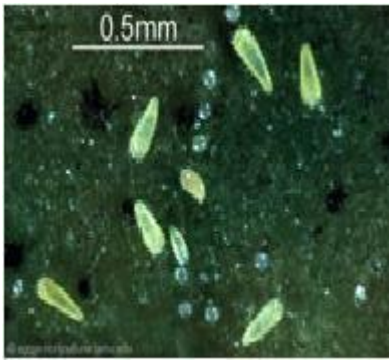
15. Citrus rust mite / Eriophyid mite: *Phyllocoptruta oleivora* (Eriophyidae: Acari)

Host-range and distribution

This species has been reported as a serious pest of citrus in different parts of the world.





Damage symptoms

Fruits are attacked when they are of size of peas, damaged fruits become silvery, reddish brown or purplish black. Affected fruits bear a comparatively thicker skin and have rust spots, which render them unacceptable in the market. Feeding on grapefruit and lemons results in silvered or shark-skin appearance. In summer mites prefer fruits than the leaves. Fruits on the upper branches are more
preferred than those on lower branches. Mites prefer lemon than other citrus species

Bionomics

Citrus rust mite is very small (150 - 165 m), fusiform, dorsally flattened and yellow. A female lays 20 to 30 eggs during a life span of 20 days. The eggs are smooth, spherical, semi-translucent and are laid in groups in indentations on fruits and on ventral surfaces of leaves. Egg period is 3 days and nymphal development is completed in 2-11 days. The life cycle is completed in 7 to 10 days in summer and 14 days in winter

Management

- Irrigate judiciously, particularly during summer to prevent water stress conditions and resultant flare up.
- Spray monocrotophos 36 SL 1.5 L or dicofol 18.5 EC 1.0 L in water 1000 -1500 L /ha

Lecture 18
Pests of Banana and Cashew


Pests of Banana

There are more than 182 insect pests of banana in India. The banana weevil and Pseudostem borer are the most destructive pest in India. Most of the other insect pest feeding on this plant are of minor pests of local importance and are not specific to banana. The aphid *Pentalonia nigronervosa* is however important not as a pest but as vector of very serious disease called Bunchy top of banana.

Major Pests

Major Pests				
1.	Rhizome Weevil	*Cosmopolites sordidus*	Curculionidae	Coleoptera
2.	Pseudostem Borer	*Odoiporus longicollis*	Curculionidae	Coleoptera
3.	Banana Aphid	*Pentalonia nigronervosa*	Aphididae	Hemiptera
4.	Lacewing Bugs	*Stephanitis typicus*	Tingidae	Hemiptera

Major Pests

1. Rhizome weevil: *Cosmopolites sordidus* (Curculionidae: Coleoptera)

Distribution and status: India, South East Asia, Australia, Hawaii Islands, Tropical South Africa and Tropical America. Major pest.

Host range: Banana, cocoa

Damage symptoms

Grubs bore into the rhizome causing death of unopened pipe, withering of outer leaves and finally death of the plant.


Bionomics

Eggs laid in small burrows scooped out by the beetle on the root stock or within leaf sheaths, egg period 5-8 days. Grub is apodous and yellowish with reddish head becomes full-grown in 25 days. Grub pupates within chamber made near the outer surface of the rhizome, pupal period 5-6 days. Adult tunnels within stem, feeding on its internal tissues and lives for one year.


Management

- Use healthy and pest free suckers
- Trap the adult weevils by placing chopped pseudostem in the cropped area
- Uproot and destroy infested rhizomes
- Select infestation - free suckers
- Under take soil incorporation of lindane 1.3 D 20 g/plant or carbaryl 5D 10-20 g/plant or carbofuran 3G 20 g/plant or phorate 10 G 10 g/plant around pseudostem.
- Adopt paring and pralinage of banana suckers before planting.

2. Pseudostem borer: *Odoiporus longicollis* (Curculionidae: Coleoptera)

Distribution and status: It is widely distributed in all banana growing areas. Major pest. **Host range:** Banana

Damage symptoms

Grubs bore holes and tunnels in the pseudostem causing wilting of the plant. They also feed on tissues of leaf sheath from the inner surface and also on decaying tissues.

Bionomics

Eggs thrust within air chamber @ one egg/air chamber in leaf sheath through oviposition slits made by rostrum. Eggs are laid in the psedostem about 1-1.5 m above ground level. Egg period 4-8 days. Grub apodous, grub period 30-65 days with five larval instars. Grubs pupate in tunnel towards the periphery in a cocoon made from pieces of fibrous sheath materials. Pupal period 24-44 days. Adult longevity two years.

Management:

i. Adopt good cultivation practices to improve weevil tolerance ii. Maintain healthy plantation by periodical removal of dry leaves and suckers. iii. Prune the side suckers every month iii. Inject pseudostem with monocrotophos 36 WSC (50 ml + 350 ml water) @ 2 ml at 45 cm height and another at 150 cm height from ground level at monthly intervals from 5th - 8th month. Beyond 8 months (after flowering), this should not be done.

v. Do not dump infested materials into manure pit. vi. Uproot infested trees, chop into pieces and burn.

3. Banana aphid: *Pentalonia nigronervosa* (Aphididae: Hemiptera)

Distribution and status: India, Sri Lanka, Australia

Host range: Banana, cardamom , *Alocasia* sp, *Colocasia* sp, caladium

Damage symptoms

Aphids are seen in colonies on leaf axils and pseudostems. It causes indirect damage by transmitting the notorious virus disease bunchy top.Green streaks initially appear on the secondary viens on the ventral side of the lamina. The affected leaves become brittle, small and petioles get elongated. Crown composed of narrow stunted leaves gives buncy top appearance.


Bionomics

Brown adult has black-veined wings. Aphids live in colonies within leaf-axils or tender leaves and at base of the stem at the ground level. Adults reproduce parthenogenetically 35-50 nymphs during a life span of 27-37 days. Nymphs undergo four instars during 8-12 days nymphal period. Life cycle completed in 12-15 days, about 30-40 overlapping generations completed in a year.


Management

- Spray monocrotophos 36 SL 1.5 - 2.0 L methyl demeton 25 EC or dimethoate 30 EC 3.0-4.0 L in 1500-2000 L water per ha towards the crown and pseudostem base.
- Inject pseudostem with monorotophos 36 SL @1 ml in 4 ml of water per tree at 45 days interval from the 3rd month till flowering.
- Avoid monocrotophos injection after flowering.

4. Lacewing bugs: *Stephanitis typicus* (Tingidae: Hemiptera)

Distribution and status: India, SE Asia, Japan and Korea
Host range: Banana, ginger, turmeric, cardamom and jasmine

Damage symptoms: Both nymphs and adults feed in colonies on undersurface of leaves and cause discolouration.
Bionomics: Adults are small, dull-coloured or white bugs with transparent shiny lace-like reticulate wings, nymphs are black coloured.

Management: Spray methyl demeton 25 EC or dimethoate or monocrotophos 36 SL1.5 - 2.0 L or quinalphos 25 EC 3.0 – 4.0 L in 1500-2000 L of water per ha

Minor Pests

Minor pests				
5.	Thrips	*Helionothrips kadaliphilus*, *Thrips florum*, *Chaetanothrips signipennis*	Thripidae	Thysanoptera
6.	Scale	*Aspidiotus destructor*	Diaspididae	Hemiptera
7.	Leaf Feeder	*Pericallia ricini*	Arctiidae	Lepidoptera
8.	Tobacco Caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
9.	Bagworm	*Kophene cuprea*	Psychidae	Lepidoptera

5. Thrips: *Helionothrips kadaliphilus*, *Thrips florum*, *Chaetanothrips signipennis* (Thripidae: Thysanoptera)

Both nymphs and adults lacerate and suck sap from leaves and fruits, which results in yellowing of leaves and corky scab formation on fruits.

6. Scale: *Aspidiotus destructor* (Diaspididae: Hemiptera)

Refer coconut

7. Leaf feeder: *Pericallia ricini* (Arctiidae: Lepidoptera)

Refer castor. Cause severe defoliation.

8. Tobacco caterpillar: *Spodoptera litura* (Noctuidae: Lepidoptera)

Refer cotton. Cause severe defoliation

9. Bagworm: *Kophene cuprea* (Psychidae: Lepidoptera)

Larva scrapes the chlorophyll and later it riddles with irregular holes on the leaf. Adult moth is brownish in colour. Brown larva covered in conical bag.

Pests of Cashew

The cashew tree is attacked by many pests, but about half a dozen of them cause serious damage when they get favourable conditions. Among all insect pests cashew stem and root borer and tea mosquito bug pose a severe threat to cashew growers.

1. Stem and root borer: *Plocaederus ferrugineus* (Cerambycidae: Coleoptera)

Distribution and status: South India and Maharashtra. Major pest
Host range: Cashew, Moringa, silk cotton and citrus trees
Damage symptoms

Grubs bore into the bark in their early stages and make excessive tunnels in all directions causing wilting of branches and then the tree as a whole. Roots are also affected. Plantation over 15 years are often seen infested.

Bionomics : Ovoid, dirty white eggs laid under loose bark in their early stages and into the wood in their late stages. Egg period 4-6 days. Full grown grub measures 7.5 cm and tunnels its way into the root region, grub period 6-7 months. Pupation occurs in a calcareous chamber and pupal period 60 days. Life cycle completed in one pupal year.

Management

- Undertake periodical cleaning of collar region, removal of grubs, pupae and eggs and inter ploughing wherever possible during monsoon months.
- Uproot and remove dead trees from the plantation • Avoid injury to the trunk or exposed portion of the root.
- Swab the bark of the exposed roots and shoots with carbaryl 50 WP 2 g/L, lindane 20 EC 1 ml/L
- Swab with kerosene - coal tar mixture (1:2) upto one metre height on the trunk and on exposed bark after shaving the infested bark to prevent egg laying.
- Carry out root-feeding with monocrotophos (10 ml) + water (10 ml) in a small polythene bag twice a year on both sides of the trunk.
- Place carbofuran 3 G 5 g or inject 10 ml monocrotopos 36 SL and plug with mud to kill the grubs.
- Follow padding method of insecticide application with monocrtophos 36 SL 10 ml (Remove 5 cm2 bark at 30 cm from the base, place absorbent cotton dipped in 10 ml monocrtophos 36 SL and cover with mud).

2. Tea mosquito bug: *Helopeltis antonii* (Miridae: Hemiptera)

Distribution and status: Karnataka, Goa, Maharashtra and Tamil Nadu
Host range: Tea, neem, moringa and guava

Damage symptoms

Nymphs and adults suck sap on leaves and inflorescence. Leaves are deformed and show angular lesions, particularly along the veins, which may drop off. In flowering stage cause inflorescence blight. Feeding on the stalks of the tender shoots causes elongated green lesions, sometimes accompanied by exudation of gum. Severely damaged shoots die back due to the effect of bug saliva in combination with fungi, which enter the plant tissue through the feeding lesions; the subsequent development of numerous auxiliary buds causes a bunched terminal growth known as 'witches broom'. In case of serious infestations the trees may appear as if scorched by fire. Bug feeding on developing apples and nuts causes brown sunken spots. The growth of trees is seriously retarded and fruit formation of attacking flowering shoots is reduced.

Bionomics


Female inserts 82 eggs into epidermis of tender shoot, axis of inflorescence and nodes. Eggs are elongate and slightly curved with a pair of filaments, egg period 7-8 days. Nymphal period 14-16 days. Life cycle completed in 22-25 days. Adult is a reddish brown bug with black head, red thorax, black and white abdomen, and a knob like process on mid-dorsal thorax.

Management

- Undertake pruning to regulate the shade to facilitate proper penetration of sunlight inside the canopy.
- Spray the following insecticides, thoroughly covering foliage and bark during early morning hours.
- Monocrotophos 36 SL 3.0 L at new flush formation.
- Spray - 35 EC or carbaryl 50 WP 3.0 Kg In 1500-2000 L of water per ha + Urea 3% at flower initiation and again at fruiting time
- iii Do not interplant cashew with crops that are host for Helopeltis bugs, such as cotton, tea, sweet potato, guava and mango

3. Leaf miner: *Acrocercops syngramma* (Gracillariidae: Lepidoptera)

Distribution and status: India and other cashew growing areas.
Host range: Cashewnut

Damage symptoms

Mining of leaves by caterpillars. The thin epidermal peels swells up in the mined areas and appear as whitish blistered patches on the leaf surface. In the older leaves these blisters dry and droop off leaving big holes.

Bionomics

The eggs are laid on very tender leaves. Egg period is 2 - 3 days. The freshly hatched caterpillars are pale white, turning to reddish brown when fully grown. Larval period 14 days. Larva pupates in soil. Pupal period 7 – 9 days. The adult is silvery grey moth.

Management

Spray 2.0 kg carbaryl 50 WP or 1.25 L of malathion 50 EC or 1.5 L of - 35 EC in 1500 - 2000 of water/ha.

4. Shoot and blossom webber: *Macalla moncousalis* (Pyraustidae: Lepidoptera)

Distribution and status: South India and Orissa. Regular pest.
Host range: Cashewnut

Damage symptoms

Larva web together tender leaves and inflorescence and feed on the them. Apples and nuts also covered with webs and their surface tissues are scraped.

Bionomics

Female lays 60 – 90 eggs are laid singly on the underside of the leaves or in groups. Egg period 5 – 6 days. Grown up larva is reddish brown with yellow and pink lines. Larval period 16 -21 days. It pupates in leaf fold as a silken cocoon. Pupal period 8 -14 days. Life cycle is completed in 30 – 40 days.

Management

- Collect and destroy damage plant parts.
- Spray - 35 EC 3 L in 1500 – 2000 L of water per ha.

5. Apple borer/ chikoo moth: *Nephopteryx eugraphella* (Phycitidae: Lepidoptera)

Distribution and status: India. Regular pest of Andhra Pradesh in India. **Host range**: Cashew, sapota, cured tobacco

Damage symptoms

The larva bores into the tender cashew apple and feeds on the internal tissue of false fruit. Attacked apple shrivels and drop.

Bionomics and management: Refer sapota

6. Inflorescence caterpillar: *Hypatima haligramma* (Gelechiidae: Lepidoptera)

Larva of this tiny moth feeds on shoot tips and inflorescence. It pupates inside folded leaves or in small holes made on shoot tip of floral branches. Attacked shoots die and panicle formation suppressed. Larvae also damage tender apples.

7. Thrips: *Rhipiphorothrips cruentatus, Selenothrips rubrocinctus* (Thripidae: Thysanoptera)

Distribution and status: Country wide distribution
Host range: Cashew, guava, grapes, arecanut, pomegranate, Rose

Damage symptoms

Both nymphs and adults suck and scrape underside of the leaves, mainly along the main veins, causing yellowing that conglomerate and progressively turn gray, giving the leaves silver appearance, as a result may fall-down precociously. Heavily infested flowers may not open for fertilization, thus dramatically, lowering crop yields.

Bionomics

The adults are dull dark brown body or black in colour with reddish strip on the first three abdominal segments, 1.3 – 1.8mm long. Lays eggs on lower leaf surface.

Management

Spray dimethoate 30 EC or methyl demeton 25 EC 1.5 L in 1500 -2000 L of water per ha.

8. Bark borer: *Indarbela tetraonis* (Metarbelidae: Lepidoptera)

Distribution and status: Throughout India, Burma, Bangladesh and Sri Lanka potential major pest.

Host range: Mango, guava, zizyphus, litchi, orange, pomegranate, bauhinia, loquat, mulberry, moringa, rose, guava and eugenia.

Damage symptoms : Young trees succumb to the attack. Caterpillars bore into the trunk or junction of branches make zig zag galleries Presence of gallery made out of silk and frass is the key symptom. They remain hidden in the tunnel during day time, come out at night and feed on the bark. Under severe infestation, flow of sap is hindered, plant growth arrested and fruit formation is drastically reduced.

Bionomics : Adults emerge in summer and lays 15-25 eggs in clusters under loose bark of the trees. Eggs hatch in 8-10 days. Larvae makes webs and feeds making zig zag galleries on the wood filled with frass and excreta and later bores inside the wood. Larval period is 9 -11 months and then pupates inside the stem. Pupal stage is 3-4 months.

Management

- Kill the caterpillars by inserting an iron spike into the tunnels.
- Injecting ethylene glycol and kerosene oil in the ratio of 1:3 into the tunnel by means of a syringe and then seal the opening of the tunnel with mud.
- Dip a small piece of cotton in any of the fumigants, like chloroform or petrol or kerosene, introduce into the tunnel and seal the opening with clay or mud

MinorPests :: Slug catterpillar

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9. Slug caterpillar: *Parasa lepida* (Cochlididae : Lepdioptera)

Refer Castor

10. Leaf feeder: ***Cricula trifnestrata*** **(Saturniidae: Lepidoptera)**

Polypahgous pest. Stout, dark brown wild silk caterpillar appears in large numbers sporadically and cause extensive defoliation of trees reducing panicle emergence. Spray acephate 75 SP or carbaryl 50 WP 2.0 kg or - 3.0 L in 1500 -2000 L water per ha.

11. Looper: ***Oenospila flavisucata*** **(Geometridae: Lepiodptera)**

Larvae feed on tender leaves by rolling them. They pupate in rolled leaves.

12. Apple and nut borer: ***Thylocoptila paurosema*** **(Phycitidae: Lepidoptera)**

Caterpillar bores into tender apples and nuts.

Pests of Guava, Pomegranate and Sapota

Pests of Guava

More than 80 species of insects and mites have been recorded in guava trees affecting growth and yield. However in India, the major pests are polyphagous pest like tea mosquito bug, fruit flies, fruit borers, bark eating caterpillars mealy bug and introduced pest namely spiraling white fly.

Major Pests			
Tea Mosquito Bug	*Helopeltis antonii*	Miridae	Hemiptera
Fruitfly	*Bactrocera* (Dacus) *diversus*	Tephritidae	Diptera
Fruit Borer	*Virachola* (*Duodorix*) *isocrates, Rapala varuna*	Lyceanidae	Lepidoptera

Castor Capsule Borer	*Dichocrocis (Conogethes)punctiferalis*	Pyraustidae	Lepidoptera
Mealy Bug	*Ferrisia virgata, Maconellicoccus hirsutus*	Pseudococcidae	Hemiptera
Spiraling Whitefly	*Aleurodicus dispersus*	Aleyrodidae	Hemiptera
Bark Caterpillar	*Indarbela tetraonis*	Metarbelidae	Lepidoptera
Scarlet Mite	*Brevipaplus phoenicus*	Tenuipalpidae	Acari

1. Tea mosquito bug: *Helopeltis antonii* (Miridae: Hemiptera)

Distribution and status: Karnataka, Goa, Maharashtra, Tamil Nadu
Host range: Guava, cashew, tea, moringa, neem and others

Damage symptoms

Adults and nymphs feed on petioles tender shoots and leaf veins causing necrotic lesions, coalesce to form patches. On foliage, brownish-black necrotic patches appear and resin exudes from feeding punctures. Blisters and scales / rusty corky growth /scab formation on fruits, widespread drying of shoots, inflorescence and flowers and shedding of fruits is witnessed.

Bionomics

Female inserts 32 eggs into epidermis of tender shoot, axis of inflorescence and tender fruits, egg period 7-8 days, eggs elongated and slightly curved with a pair of filaments. Nymphal period 14-16 days. Life cycle completed in 22-25 days.

Management

○ Undertake pruning to regulate the shade to facilitate proper penetration of sunlight inside the canopy. ○ Monocrotophos 36 WSC @ 2.5 L in 1500 – 2000 L water per ha at new flush formation. ○ Spray - 35 EC or carbaryl 50 WP @ 2.5 kg in 1500 – 2000 L water per ha + Urea 3% at flower initiation again at fruiting time.

2. Fruit fly: B*actrocera diversus* (Tephritidae: Diptera)

Distribution and status: All guava orchards throughout the country
Host range: Guava, Tomato and other commercial fruits.

Damage symptoms

Maggots bore into fruits and feed on soft pulp. The infested fruits show small cavities with dark greenish punctures and when cut open, the wriggling maggots are seen inside. The infestation causes rotting and dropping of fruits.

Bionomics

Eggs laid on soft skin of fruits and egg period 1-4 days. Maggot pale cream, cylindrical, 5-8 mm in length, larval period 4-5 days. Maggot pupates in soil, pupal period 7 - 13 days. Adult smoky brown with greenish black thorax having yellow marking.

Management

- Collect and destroy the damaged plant parts.
- Summer plough to expose and kill pupae.
- Harvest the fruits when slightly hard and green.
- Spray fenvalerate 20 EC 1 L or - 35 EC or malathion 50 EC 2 L in 1500 – 2000 L of water per ha.
- Rake the soil around the tree and apply lindane dust 1.3 D @ 25 kg per ha.

3. Fruit borer: *Virachola* (*Duodorix*) *isocrates, Rapala varuna* (Lycaenidae: Lepidoptera)

Refer pomegranate

4. Castor capsule borer: *Conogethes punctiferalis* (Pyraustidae: Lepidoptera)

Distribution and status: South India (Major)
Host range: Cardamom, castor, jack, guava

Damage symptoms
Larva bores into the young fruits which dry up and fall prematurely, bore holes plugged with excreta.

Bionomics

Eggs laid on top leaf axils, inflorescence, tender part of plant and fruits, egg period 6-7 days. Larva pale reddish brown with numerous tubercles on body. Larval period 12-16 days. Pupation inside the fruit in a silken cocoon, pupal period 4-11 days. Medium sized bright orange-yellow color has numerous f black dots on wings. Life cycle completed in 25-33 days.

Management

- Collect and destroy the damaged plant parts.
- Use light trap 1/ha to monitor the activity of adults.
- Spray malathion 50 EC at 3 L or - 3 L or dimethoate 30 EC 3 L in 1500 – 2000 L water per ha, two rounds, one at flower formation and next at fruit set.

5. Mealy bug: Ferrisia virgata, Maconellicoccus hirsutus (Pseudococcidae: Hemiptera)
Distribution and status: All over India and other grapevine growing countries.
Host range: Grapevine, Hibiscus, mulberry, guava, custard apple, okra, tamarind and glyricidia.

Damage symptoms

Both nymphs and adults suck sap that results in crinkling and yellowing of leaves and rotting of berries.

Bionomics Female lays 350-500 orange coloured eggs in a loose cottony terminal ovisac; egg period 5-10 days. Crawler nymphs orange coloured, females and males with 3 and 4 nymphal instars respectively. Adult females pinkish and sparsely covered with white wax. One generation per month, but, life cycle extends in winter months. **Management**

- Debark the vines and swab with methyl. @ 1 ml /L to minimize the population
- Spray dichlorvas 1.0 L or chlorpyriphos 1.25 L or buprofezin 25 SC 1.0-1.5 L or methomyl 40 SP 1.25 kg with 500 L water/ha.
- Release Australian lady bird beetle Cryptoleamus montrouzieri @ 2500 – 3750 per ha
- Conserve coccinellid Scymnus craccivora and lepidopteran predator Spalgis epius
- Avoid spraying ., carbaryl, monocrotophos, dimethoate, methyldemeton, quinalphos, diazinon, malathion etc as they are toxic to predators.

6. Spiraling whitefly: *Aleurodicus dispersus* (Aleyrodidae: Hemiptera)

Distribution and status

It is an introduced polyphagous pest of vegetables, fruit trees, ornamentals and shade trees. It is native of the Caribbean Islands and Central America. It is widely distributed in almost all countries due to rapid dispersal and adaptability.

Host range

It is found on 128 plants including guava, cassava, cotton, chillies, tomato, brinjal, bhendi, papaya, crotons and weeds such as *Euphorbia, Corchorus, Eclipta, Vernonia, Vicoa, Acalypha, Alternanthra, Amaranthus, Convolvulus, Abutilon*etc.

Bionomics

Adults are larger than many of the whitefly species and white in colour with waxy coating on the body. Eyes are dark reddish brown. Fore wings are with three characteristic spots. Eggs are laid in a spiraling pattern (concentric circles) on the undersurface of leaves. Egg period lasts for 5-8 days. Nymphal period is 22-30 days. Adult longevity is for 13-21 days. Total life cycle is completed in 40-50 days.

Adults and nymphs congregate heavily on the lower surface of leaf, suck the sap and cause pre-mature leaf drop, chlorosis, yellow speckling, crinkling and curling. Honey dew secretion also leads to the development of sooty mould fungus. The copious white, waxy flocculent material secreted by all the stages of the pest is readily spread by wind and thus cause public nuisance. It is also a suspected vector of mycoplasma disease, lethal yellowing in coconut.

Integrated Pest Management

1. Remove and destroy damaged leaves along with life stages.
2. Remove and destroy weed plants like *Abutilon, Acalypha, Euphorbia,* etc., in the nearby vicinity as these plants are alternate hosts.
3. Use yellow sticky traps at 15/ha to attract and kill the adults
4. Release *Chrysoperla carnea* predators at 10000/ha to kill all life stages
5. Encourage the activity of predators such as *Encarsia* and Coccinellids, *Chilocorus nigrita, Chilomenus sexmaculatus*, etc.
6. Spray Fish oil rosin soap (FORS) 25g/L or NSKE 5% or neem oil 0.03% 1ml/l or phosalone 35 EC 3 L or triazophos 40 EC 3 L or acephate 75 SP 1.5 kg in 1500 -2000 L per ha., two to three times based on the incidence.
7. Avoid using synthetic pyrethroids and extending crop growth.
8. Conserve spiraling whitefly parasitoids, *Encarsia haitiensis* and *E. guadeloupae*.

7. Bark caterpillar: *Indarbela tetraonis* (Metarbelidae: Lepidoptera)

Distribution and status: Throughout India, Burma, Bangladesh and Sri Lanka potential major pest.

Host range: Mango, guava, zizyphus, litchi, orange, pomegranate, bauhinia, loquat, mulberry, moringa, rose, guava and eugenia.

Damage symptoms : Young trees succumb to the attack. Caterpillars bore into the trunk or junction of branches make zig zag galleries Presence of gallery made out of silk and frass is the key symptom. They remain hidden in the tunnel during day time, come out at night and feed on the bark. Under severe infestation, flow of sap is hindered, plant growth arrested and fruit formation is drastically reduced.

Bionomics : Adults emerge in summer and lays 15-25 eggs in clusters under loose bark of the trees. Eggs hatch in 8-10 days. Larvae makes webs and feeds making zig zag galleries on the wood filled with frass

and excreta and later bores inside the wood. Larval period is 9 -11 months and then pupates inside the stem. Pupal stage is 3-4 months.

Management

- Kill the caterpillars by inserting an iron spike into the tunnels. ○ Injecting ethylene glycol and kerosene oil in the ratio of 1:3 into the tunnel by means of a syringe and then seal the opening of the tunnel with mud. ○ Dip a small piece of cotton in any of the fumigants, like chloroform or petrol or kerosene, introduce into the tunnel and seal the opening with clay or mud.

8. Scarlet Mite: *Brevipalpus phoenicus* (Tenuipalpidae: Acari)

Mite lays eggs on stalks of fruits, calyx and leaves. Both nymphs and adults suck the cell sap from fruits which results in browning of nodal regions and appearance of brown patches on calyx and surface of fruits. In severe infestation, these symptoms cover the entire surface of fruits leading to splitting of fruits. Life cycle completed in 22 days.

Management ○ Collect and destroy the damaged plant parts.

- Spray wettable sulphur 3 kg or dicofol 2 L in 1500 – 2000 L of water per ha.

Minor Pests

Minor pests				
9.	Aphids	*Aphis gossypii*	Aphididae	Hemiptera
10	Guava Scale	*Chloropulivinaria psidii*	Coccidae	Hemiptera
11.	Whitefly	*Aleurotuberculatus psidii*	Aleyrodidae	Hemiptera
12.	Thrips	*Selenothrips rubrocinctus*	Thripidae	Hemiptera

9. Aphids: *Aphis gossypii* (Aphididae: Hemiptera)

Refer cotton

12. Thrips: *Selenothrips rubrocinctus* (Thripidae: Thysanoptera)

Both nymphs and adults lacerate the tissues and suck the oozing sap

Pests of Pomegranate

Aphids are important along with fruit borers and fruit flies.

Major Pests				
1.	Anar Butterfly / Fruit Borer	*Duodorix Isocrates / Rapala varuna*	Lycaenidae	Lepidoptera
2.	Castor Semilooper	*Achaea janata*	Noctuidae	Lepidoptera
3.	Fruitfly	*Bactrocera zonata*	Tephritidae	Diptera
4.	Fruit Borer	*Conogethes punctiferalis*	Pyraustidae	Lepidoptera
5.	Aphid	*Aphis punicae*	Aphididae	Hemiptera

1. Anar butterfly / Fruit borer: *Virachola* (*Duodorix*) *isocrates, Rapala varuna* (Lycaenidae: Lepidoptera)

Distribution and status: All over India.
Host range: Aonla, apple, ber, citrus, guava, litchi, loquat, peach, mulberry, pear, sapota, tamarind.

Damage symptoms
Larvae bore inside the developing fruits and feed on pulp and seeds just before the rind exhibiting round bore holes on fruit. Infested fruits are also attacked by bacteria and fungi, which ultimately fall off and give an offensive smell.

Bionomics
Shiny, white, oval shaped eggs laid singly on calyx of flowers and on tender fruits. Egg period 7-10 days, larval period 18-

47 days. Caterpillar, dark brown, having short hairs and white patches all over the body.
Larvae pupates inside fruit but occasionally outside even, attaching themselves to stalk of fruits, pupal period 7-34 days. Male glossy, bluish violet, female brownish violet with an orange patch on forewings. Four generations completed in a year

2. Castor semilooper: *Achaea janata* (Noctuidae: Lepidoptera)

Semilooper feeds on leaves while the adult moth pierces the fruits with its proboscis for feeding, causing injury on the surface of fruits.

For bionomics and management refer castor.

3. Fruitfly: *Bactrocera zonata* (Tephritidae: Diptera)

Refer Mango

4. Fruit borer: *Conogethes punctiferalis* (Pyraustidae: Lepidoptera)

Refer Guava

5.Aphid: *Aphis punicae* (Aphididae: Hemiptera)

Damage symptoms

Both nymphs and adults infest the leaves causing curling, yellowing of leaves and wilting of terminal shoots and premature fruit drop

Bionomics

The aphids are greenish brown in colour. The winged as well as wingless form reproduces parthenogenetically and is viviparous.

Management ○ Prune and burn infested shoots

- ○ Spray dimethoate 30 EC or monocrotophos 36 SL ml or Methyl demeton 25 EC at 750 ml or imidachloprid 200 SL 125 ml per ha in 500 – 1000 L off water per ha ○ Apply carbofuran 3 G at 33 kg per ha
- ○ Release *Chrysoperla carnea* at 15 larvae/ flowering branch four times at 10 days interval starting from flower initiation.

Minor Pests				
6.	Whitefly	*Siphonimus phillyreae*	Aleyrodidae	Hemiptera
7.	Mealybug	*Ferrisia virgata*; *Pseudococcus lilacinus*	Pseudococcidae	Hemiptera
8.	Thrips	*Retithrips syriacus, Rhipiphorothrips cruentatus*	Thripidae	Hemiptera
9.	Slug Caterpillar	*Latoia (Parasa) lepida*	Cochlididae	Lepidoptera
10.	Hairy Caterpillar	*Euproctis fraterna Porthesia scintillans*	Lymantridae	Lepidoptera
11.	Eriophyid Mite	*Aceria granati*	Eriophyidae	Acari
12.	Red Spider Mite	*Tetranychus punicae*	Tetranychidae	Acari
13.	Bagworm	*Clania crameri*	Psychidae	Lepidoptera

6. Whitefly: *Siphonimus phillyreae* (Aleyrodidae: Hemiptera)

It infests lower surface of leaves causing yellowing.

7. Mealybug: *Ferrisia virgata*; *Pseudococcus lilacinus* (Pseudococcidae: Hemiptera)

Nymphs, pale green, winged and wingless adults suck the sap from tender twigs, leaves and buds. It leads to yellowing of leaves, wilting of terminal shoots, blighted appearance of flower buds and dropping of fruits prematurely.
Bionomics and management: Refer coffee.

8. Thrips: *Retithrips syriacus, Rhipiphorothrips cruentatus* (Thripidae: Thysanoptera)

Both nymphs and adults lacerate tender leaves in margins and suck the sap from the exuding lacerated material. Silvery white patches and yellowing and withering of affected leaves.

Bionomics and management: Refer grapes.

9. Slug caterpillar: *Latoia (Parasa) lepida* (Cochlididae: Lepidoptera)

Refer coconut and castor

10. Hairy caterpillar: *Euproctis fraterna,*
***Porthesia scintillans* (Lymantridae: Lepidoptera)**

Refer castor

11. Eriophyid mite: *Aceria granati* (Eriophyidae: Acari)

Both nymphs and adults damage by rolling the edges of leaves and remain inside. Infested leaves become linear and deformed.

12. Red spider mite: *Tetranychus punicae* (Tetranychidae: Acari)

Both nymphs and adults feeds on upper leaf surfaces results in bronzing of leaves.

13. Bagworm: *Clania crameri* (Psychidae: Lepidoptera)

Damage symptoms
The caterpillar scrapes the tissues of the leaves causing circular holes on the leaf surface. It causes severe defoliation.

Bionomics

The female moth is apterous, maggot like and male moth is winged. The eggs are laid within the pupal case. The larva constructs its case and remaining within it feed on the leaves. It becomes full grown in about five weeks.

Pests of Sapota



Major Pests				
1.	Leaf Webber or Chickoo Moth	*Nephopteryx eugraphella*	Pyraustidae	Lepidoptera
2.	Bud Worm	*Anarsia ephippias*	Gelechiidae	Lepidoptera
3.	Fruitfly	*Bactrocera dorsalis, B. zonata*	Tephritidae	Diptera
4.	Stem Borer	*Plocaederus ferrugineus*	Cerambycidae	Coleoptera
5.	Hairy Caterpillar	*Metanastria hyrtaca*	Lasiocampidae	Lepidoptera
6.	Spiraling Whitefly	*Aleurodicus dispersus*	Aleyrodidae	Hemipetera
7.	Mealy Bug	*Ferrisia virgata*	Pseudococcidae	Hemiptera

1. Leaf webber or Chickoo moth: *Nephopteryx eugraphella* (Pyraustidae: Lepidoptera)

Distribution and status: Major pest of sapota, occurs widely in India
Host Range: Sapota and cured tobacco

Damage symptoms

Leaves webbed together in a bunch by larvae, chlorophyll scrapped and leaves reduced to a network of veins; clusters of dried shoots; flower buds and tender fruits bored, become withered and shed.

Bionomics

The female moth lays 374 pale yellow, oval shaped eggs in groups of 2 or 3 on leaves and buds of young shoots, egg period 2-11 days. Larva is 25 cm long, slender and pinkish with a few longitudinal brown lines on dorso-lateral surface, larval period 13 to 60 days. Larvae undergo pupation in the leaf webs, pupal period is 8-9 days. Adult moth is greyish with forewings having brown or black spots and hind wing semi hyaline, 7-9 overlapping generations per year. Maximum activity of pest is seen during June-July. Life cycle completed in 26-92 days.

Management

1. Remove and destroy the infested fruits and dried clusters of leaf webs
2. Spray phasalone 35 EC 3 L or carbaryl 50 WP 3kg in 1500 – 2000 L water per ha

2. Bud worm: *Anarsia ephippias* (Gelechiidae: Lepidoptera)

Distribution and status: Tamil Nadu, Kerala and Karnataka

Damage symptoms

Floral buds and flowers webbed together by larvae and shed.

Bionomics

Female lays 50 -60 eggs in axils of the tender leaves, singly or in batches of 10-20, egg period 3 days. Larva is small, slender, pinkish brown in colour with black head and yellowish brown thoracic shield, larval period 14-16 days. Larvae pupate into the floral webbings, pupal period 7-10 days. Adult moth is grey coloured with black patches on wings. Life cycle completed in 24-29 days.

Management

- Spray - 35 EC or phasalone 35 EC 3 L in 1500 – 2000 L water per ha

3. Fruit fly: *Bactrocera dorsalis, B. zonata* (Tephritidae: Diptera)

Refer mango

4. Stem borer: *Plocaederus ferrugineus* (Cerambycidae: Coleoptera)

Refer cashew

5. Hairy caterpillar: *Metanastria hyrtaca* (Lasiocampidae: Lepidoptera)

Refer Moringa

6. Spiraling whitefly: *Aleurodicus dispersus* (Aleyrodidiae: Hemiptera) Refer guava

7. Mealy bug: *Ferrisia virgata* (Pseudococcidae: Hemiptera)

Refer guava

Pests of Sapota :: Minor Pests

Minor Pests				
8.	Leaf Miner	*Acroercops syngramma*	Gracillaridae	Lepidoptera

9.	Leaf Twisting Weevil	*Apoderus tranquebaricus*	Curculionidae	Coleoptera
10.	Whitefly	*Trialeurodes ricini*	Aleyrodidae	Hemiptera
11.	Guava Scale	*Chloropulvinaria psidii*	Diaspididae	Hemiptera

8. **Leaf miner**: *Acroercops syngramma* (Gracillaridae: Lepidoptera)

   Refer mango
9. **Leaf twisting weevil**: *Apoderus tranquebaricus* (Curculionidae: Coleoptera) Refer mango

10. **White fly:** Trialeurodes *ricini* (Aleyrodidae: Hemiptera)

Lecture 20 Pests of Apple

Since temperate fruits are grown universally, some of the serious cosmopolitan pests namely San Jose scale and Wooly aphis have been introduced accidentally.*Malacosoma indica* in Simla hills, codling moth in Ladakh and stem borer in Uttar Pradesh serious.

Major Pests				
1.	Apple Woolly Aphid	*Eriosoma lanigerum*	Pemphigidae	Hemiptera
2.	San Jose Scale	*Quadraspidiotus perniciosus*	Diaspididae	Hemiptera
3.	Cottony Cushion Scale	*Icerya purchasi*	Margarodidae	Hemiptera
4.	Apple Codling Moth	*Cydia pomonella*	Tortricidae	Lepidoptera
5.	Stem Borer	*Apriona cinerea*	Lamiidae	Coleoptera
6.	Fruitfly	*Bactrocera zonatus*	Tephritidae	Diptera
7.	Tent Caterpillar	*Malacosoma indica*	Lasiocampidae	Lepidoptera

1. Apple woolly aphid: *Eriosoma lanigerum* (Pemphigidae: Hemiptera)

Distribution and status: Hilly tracts in India and world **Host range**: Apple

Damage symptoms

Sap sucking by nymphs and adults results in weakening and death of the smaller plants; galls on the roots and white woolly patches on the trunk. Aphids suck cell sap from the bark of the twigs and from the roots underground. Swelling or knots appear on the roots which hinder the normal plant functions. Aphids crowd together covered with wooly white patches on the trunk.

Bionomics

Reproduction is both sexual and asexual but mostly by parthenogenesis. Aphid is active throughout the year except in cold months of December and January. Wingless forms are present throughout the year whereas winged forms are seen from July to October. Alate form disperses by flight and gives rise to apterous forms by sexual reproduction. In winter, colonies on the tree trunks move to the base of the trunk just below the soil. Female produces 116 young ones, nymphal period 35-42 days with four instars.

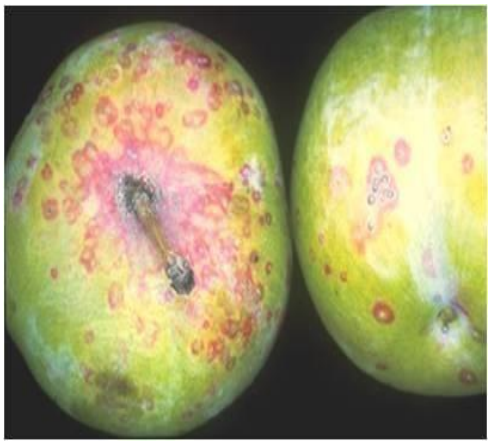
Management

1. Use resistant root stock like Golden delicious, Morton stock 778, 779 or 793.
2. Release eulophid parasitoid *viz*., *Aphelinus mali* during December and June to obtain maximum parasitization.
3. Select healthy plants in the nursery and spray chlorpyriphos 20 EC 0.05% (2.5 ml per L of water) before planting in the main field.
4. During leaf fall, spray diazinon 3.75 L 20 EC in 1500 -2000 L of water / ha against aerial forms.
5. spray methyl demeton 25 EC or malathion 50 EC 2.0 L in 1500-2000 L of water per ha For controlling root forms during winter and summer respectively.
6. Apply the fumigant paradichlorobenzene at 30-110 g/tree in a 15 cm deep trench around the tree about two meters away from the base of the affected tree.

2. San Jose scale: *Quadraspidiotus perniciosus* (Diaspididae: Hemiptera)

Distribution and status: Kashmir, Himachal Pradesh and Tamil Nadu
Host range: Cherry, plum, pear, peach and most other temperate fruit trees

Damage symptoms



Due to sap sucking by nymphs and adults the infested bark becomes reddish pink, purple colouration in fruits.

Bionomics

Overwintering nymphs become active in mid March and the males emerge in April. Females are ovoviviparous and reproduce in mid May producing 200-400 nymphs in a month, nymphal period 20 days. Life cycle completed in 35-40 days. 4-5 generations completed before hibernation which starts in mid October. Insects begin to grow during bloom period. Female scale is round slightly convex with a black pustule and the male is linear.

Management

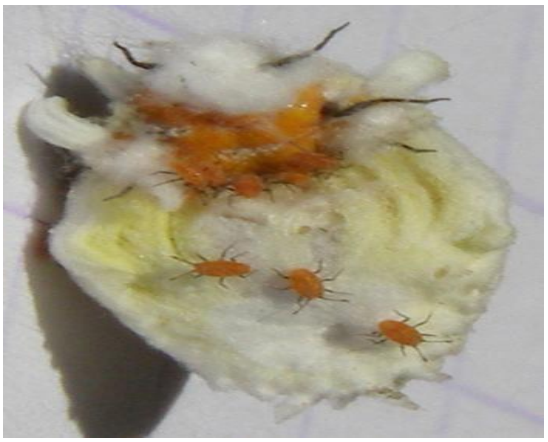
Regularly prune the infested branches and burn them.
Release the parasite *Encarsia perniciosi* to check the over wintering population.
Spray diazion 20 EC 3.75 L or methyl demeton 25 EC 2.0 L in 1500 – 2000 L of water per ha in case of severe scale infestation.
Apply carbofuran 3 G @ 20 - 30 g /plant in nursery.

3. Cottony Cushion Scale: *Icerya purchasi* (Margarodidae: Hemiptera)

Damage symptoms: Sap sucking by nymphs and adults causes yellowing of leaves, Reduced tree vigor. If infestations are heavy, leaf and fruit drop can occur along with twig dieback.

Bionomics: Female with a cottony ovisac. Crawler nymph pinkish with long antenna and group of hairs. The body of the female cottony cushion scale is orange, yellow, or brown. Elongated, fluted, white cottony egg sac is attached to its body. The egg sac contains 600 to 800 red eggs. Females usually occur on twigs. Eggs hatch into crawlers in a few days during warm weather and in 2 months during winter. The crawlers are red with black legs and antennae. They settle along leaf veins and begin to produce the white cottony secretion. Immature scales look reddish for a short period of time. Secondinstar nymphssettle on twigs and leaves, usually along leaf veins. Third-instar scales move to branches and trunks. Adults may be found on branches or on the trunks of trees. The minute, red, winged male is rarely seen. Two to three generations a year. Unlike most other scales,

it retains its legs and its mobility throughout its life. Cottony cushion scale completes its life cycle in 3 months during warm weather conditions.



MANAGEMENT

Conserve natural enemies by controlling ants and dust and by avoiding the use of persistent insecticides.
Keep ants out of trees and shrubs by banding the trunks with sticky substances or by using ant baits
Look for the vedalia beetle and its red eggs and larvae on top of cottony cushion scale scale egg sacs or the beetle's pupal cases. Also, inspect female scales for parasitic fly *Cryptochaetum icerayae s* emergence holes and pupal cases to avoid insecticides.
If natural enemies are absent, spray malathion 50 EC 3.0 L or acephate 75 SP 2.0 kg in 1500 -2000 L of water per ha
Do not apply imidacloprid for cottony cushion scale as it is very toxic to vedalia beetles.

4. Apple Codling Moth: *Cydia pomonella* (Tortricidae: Lepidoptera)

Distribution and status: Kashmir, Himachal Pradesh and Tamil Nadu **Host range**:
Apple

Damage symptoms

It causes two types of fruit damage: stings and deep entries. Stings are entries where larvae bore into the flesh a short distance before dying. Deep entries occur when larvae penetrate the fruit skin, bore to the core, and feed in the seed cavity. Young larvae enters the fruit thorugh calyx penetrates and

attacks the core and flesh. Larvae may enter through the sides, stem end, or calyx end of the fruit. One or more holes plugged with frass on the fruit's surface are a characteristic sign of codling moth infestation. Calyx entries are difficult to detect without cutting the fruit.

Bionomics

Female lays 100 white coloured, oval, flat eggs, singly on developing fruits, leaves and twigs. Egg period 4-12 days, larval period 21-30 days and pupal period 8-14 days. Grown up larvae comes out of the fruit and falls on ground and reach the bark of the tree for shelter in cracks and crevices to construct a silken cocoon and transforms to a yellowish brown pupa.

Management

Kill larvae by mopping up with a pole and some rags dipped in kerosene tied on its end.
Place kerosenized water in an open vessel below the tree so that the larave that fall may also be killed. Spray endosulphan 35 EC 1.75 L or carbaryl 50 WP 2.5 kg in 1500 -2000 L of water/ha.

5. Stem borer: *Apriona cinerea* (Lamiidae: Coleoptera)

Distribution and status: Pakisatn, Afghanistan, Kashmir, Himachal Pradesh and Uttar Pradesh.
Host range: Apple, peach, fig and other fruit trees.

Damage symptoms:

Grub feeding results in branches having small circular hole with mass of excreta. Chewed up wood particles protrude out; bark gnawed and leaves defoliated; shoots with circuitous galleries; trunk hollowed out and the infested trees remain stunted. Adult beetles feed on bark and have an unusual habit of cutting more than they actually consume. Vitality and productivity is greatly impaired.

Bionomics

Female lays eggs inside the cavity, excavated on shoots, egg period 7-9 days. Grubs undergo hibernation during winter and resume feeding in March. Grubs pupate inside the tunnel, pupal period 30-35 days. Life cycle is completed in about 2 years.

Management

Prune and burn all attacked shoots and branches during winter.
Locate live holes and inject with carbon disulphide or cholorform or petrol and seal with mud to kill the adults.

Plug cotton wick soaked with dimethoate 30 EC or methyl demeton 25 EC or dichlorvos 76 EC 10 ml or aluminium phosphide tablet 0.2 g inside the hole and cover with mud.

6. Fruit fly: *Bactrocera zonatus* (Tephritidae: Diptera)

Distribution and status: Widely distributed in Indian sub continent
Host range: Peach, fig, guava, ber, citrus, apple, cucurbits, tomato, brinjal and pear

Damage symptoms: Maggots feed on the fruits causing rotting and dropping of fruits.

Bionomics

Adult fly is small, reddish brown with yellowish cross band on the abdomen. It inserts 137 eggs/female white cylindrical eggs on the fruits in group of 2-9 and cover with resinous secretion. Egg period is 2-4 days and the maggot is dirty white, acephalic, apodous 1cm in length. Maggot period 4-16 days, pupation in soil and pupal period is 7 days.

Management

Hoe the orchard in May – June to expose the pupae present in the soil.
Harvest the ripening fruits and do not let the ripe fruit remain in the tree.
Apply bait spray of yeast hydrolysate (250 g), crude sugar (2.5 kg) and malathion 50 EC (250 ml) in 250 L of water/ha.
Spray 3.125 L fenvalerate 20 EC in 1500 -2000 L of water/ha during severe infestation.

7. Tent caterpillar: *Malacosoma indica* (Lasiocampidae: Lepidoptera)

Distribution and Status: Important pest in north western India and more serious in Shimla Hills. **Host range:** Pear, Apricot and Walnut.

Damage symptoms

Caterpillar feeds gregariously on foliage, leaving behind only the mid rib and other harder veins. The entire plant is defoliated and they feed on soft bark of twigs.

Bionomics

Active from March to May and remaining months are passed as egg stage. Light brown adult lays 300-400 eggs in masses on branches during May- June. Egg hatches the next month and the larva has black head and abodomen. Larval period 40-70 days, pupation on stem and ground in cocoon for 7-21 days during May.

Management

Kill larvae by mopping up with a pole and some rags dipped in kerosene tied on its end.
Destroy all egg bands at the time of pruning in December - January.
Place kerosenized water in an open vessel below the tree so that the larave that fall may also be killed. Spray endosulphan 35 EC 1.75 L or carbaryl 50 WP 2.5 kg in 1500 -2000 L of water/ha.

Minor Pests				
8.	Fruit Piercing Moth	*Calpe aphideroides*	Noctuidae	Lepidoptera
9.	Leaf Miner	*Gracillaria zachrysa*	Gracillariidae	Lepidoptera
10.	Psyllid	*Psylla mali*	Psyllidae	Hemiptera
11.	European Red Mite	*Panonychus ulmi*	Tetranychidae	Acarins

8. Fruit fly: *Bactrocera zonatus* (Tephritidae: Diptera)

Distribution and status: Widely distributed in Indian sub continent
Host range: Peach, fig, guava, ber, citrus, apple, cucurbits, tomato, brinjal and pear

Damage symptoms: Maggots feed on the fruits causing rotting and dropping of fruits.

Bionomics
Adult fly is small, reddish brown with yellowish cross band on the abdomen. It inserts 137 eggs/female white cylindrical eggs on the fruits in group of 2-9 and cover with resinous secretion. Egg period is 2-4 days and the maggot is dirty white, acephalic, apodous 1cm in length. Maggot period 4-16 days, pupation in soil and pupal period is 7 days.

Management
Hoe the orchard in May – June to expose the pupae present in the soil.
Harvest the ripening fruits and do not let the ripe fruit remain in the tree.
Apply bait spray of yeast hydrolysate (250 g), crude sugar (2.5 kg) and malathion 50 EC (250 ml) in 250 L of water/ha.
Spray 3.125 L fenvalerate 20 EC in 1500 -2000 L of water/ha during severe infestation.

9. Leaf miner: *Gracillaria zachrysa* (Gracillariidae: Lepidoptera)

Caterpillars cause mining in leaves, roll young leaves longitudinally into tubular or cone shaped pouch and feed within.

11 European red mite: *Panonychus ulmi* (Tetranychidae: Acarins)
Distribution and status: Though distributed widely in apple growing regions it is occasional pest

Damage

Severe mite infestations can cause bronzing of leaves. Damage is relatively less severe on wide leaf varieties such as Yellow Newton and more severe on narrow leaf varieties such as Red Delicious.

Bionomics

European red mites overwinter as eggs ; eggs hatch in spring when trees bloom. Overwintering eggs in roughened bark at bases of buds and spurs on smaller branches and twigs, or in wounds. Globular, red eggs with a slender stalk (stipe) are laid on leaves. Immature mites bright red, undergo three instars. Adults dark red with six to eight white spots at the base of hairs on the back.

MANAGEMENT

Reduce dusty conditions within the orchard and keep the trees well irrigated. Conserve predatory mites

Lecture no. 21

PESTS OF BRINJAL AND TOMATO

I. PEST OF BRINJAL

Among the various pests brinjal shoot and fruit borer is highly monophagous and destructive which necessitates the grower to go in for 30 - 40 rounds of sprays. Polyphagous insects like hadda beetle, ash weevils, leafhoppers and aphids also cause severe infestation.

Major pests				
1.	Shoot and fruit borer	*Leucinodes orbonalis*	Pyraustidae	Lepidoptera
2.	Hadda / spotted beetle	*Henosepilachna dodecastigma, H. vigintioctopunctata*, *H. demurille*, *H.* implicata	Coccinellidae	Coleoptera
3.	Stemborer	*Euzophera perticella*	Phycitidae	Lepidoptera
4.	Ash weevils	*Myllocerus subfasciatus*, *M. discolor*, *M. viridanus, M. maculosus*	*Curculionidae*	Coleoptera
5.	Brown leafhopper	*Cestius phycitis*	Cicadellidae	Hemiptera
6.	Aphid	*Aphis gossypii*	Aphididae	Hemiptera
Minor pests				
7.	Leafhopper	*Amrasca devastans*	Cicadellidae	Hemiptera
8.	Mealy bug	*Coccidohystrix insolitus* / *Urentius ectinus*/ *U. hystricellus*	Pseudococcidae	Hemiptera
9.	Pod bug	*Anoplecnemis phasiana*	Coreidae	Hemiptera
10.	Cow bug	*Tricentrus bicolor*	Membracidae	Hemiptera
11.	Thrips	*Thrips tabaci*, *Frankliniella schultzei*, *Scirtothrips dorsalis*	Thripidae	Hemiptera
12.	Hard Scales	*Aonidiella aurantii*, *Aspidiotus destructor*,	Diaspidiae	Hemiptera
	Soft scale	*Parasaissetia nigra*	Coccidae	Hemiptera
13.	Spider mite	*Tetranychus cinnabarinus*	Tetranychidae	Acari
14.	Whitefly	*Bemisia tabaci*, *Aleurodicus dispersus*	Aleyrodidae	Hemiptera
15.	Budworm	*Scrobipalpa blapsigona*	Gelechiidae	Lepidoptera

16.	Leaf roller	*Antoba olivacea*	Noctuidae	Lepidoptera
17.	Leaf webber	*Psara bipunctalis*	Pyralidae	Lepidoptera
18.	Sphingid	*Acherontia styx*	Shingidae	Lepidoptera
19.	Leaf Miner	*Scrobipalpa blapsigona*	Gelechiidae	Lepidoptera
20.	Hairy caterpillar	*Selepa celtis* and *docilis*	Noctuidae	Lepidoptera
21.	Grasshoppers	*Atractomorpha crenulata*, *Oxya japonica*, *Poicilocerus pictus*	Acrididae	Orthoptera
22.	Termite	*Trinervitermes biformis, Microtermes* sp	Termitidae	Isoptera

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

Distribution and status

India, Bangladesh, Malaysia, Thailand, Burma, Srilanka, 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

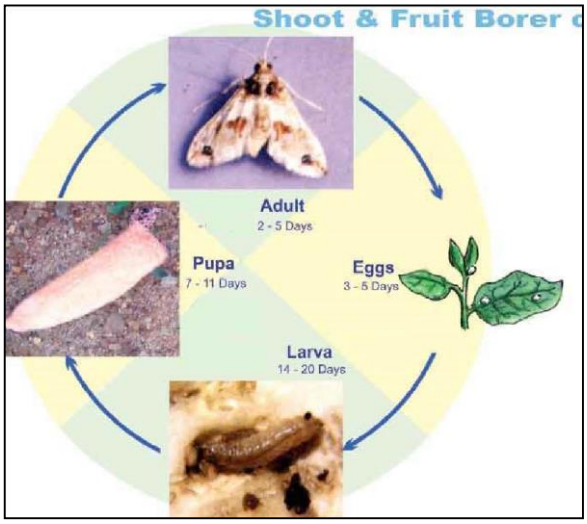
Brinjal, potato, other wild plants belonging to solanaceae, peas.

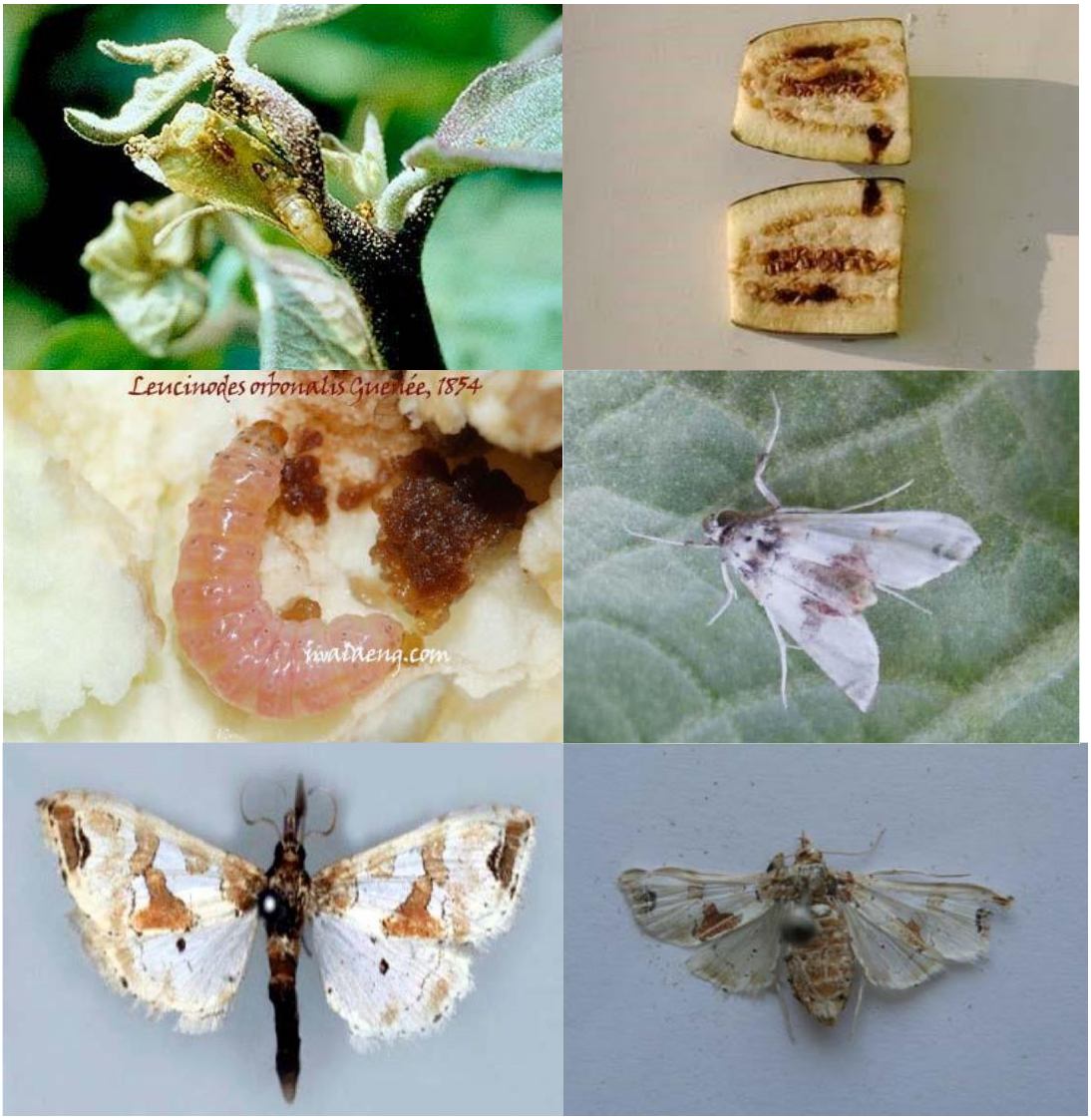
Damage symptoms

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.

Bionomics

Egg period: 3-4 days. About 150-350 creamy white eggs laid singly on leaves, tender shoots, flowers and developing fruits. Larva is stout, pink coloured with sparsely distributed hairs on warts on the body and brownish head. Larval period 15 days - 5 instars. Pupa: 6-8 days in tough greyish cocoon on plant itself, boat shaped cocoon. Medium sized adult with white wings, flashed with triangular brown and red markings on forewing. Total life cycle: 17-50 days.





ETL: 1-5% of fruit damage.

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.
- Spray Bt formulations of *B. thuringiensis* var. *kurstaki* such as Dipel @ 1.5 to 2 ml /L of water.
- Spray any one of the insecticide starting from one month after planting at 15 days interval. Carbaryl 50 WP 2 kg + wettable sulphur 50 WP 2 kg, - 35 EC 1.5 L + Neem oil 1.5 L, Quinalphos 25 EC 1.5 L + Neem oil 1.0 L, NSKE 5%, Azadirachtin 1.0% 1.0-1.5 L or Fenpropathrin 30 EC 250-340 ml or Thiodicarb 75 WP 625-1000 g Flubendiamide 20 WG, 375 g with 500 – 750 L water/ha
- Avoid using synthetic pyrethroids as they cause resurgence of sucking pests.
- Avoid using insecticide at the time of fruit maturation and harvest.
- Uproot and burn old plants before planting new plants since they harbour pest and carry over infestation

Remove infested shoots by hand

Remove and bury infested fruits

Light traps

2. 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.

Damage symptoms

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.

Bionomics

Egg period: 2-4 days: Cigar shaped, laid in clusters on lower leaf surface, yellow; 120-460 eggs/female. Grub: 10-35 days. Yellowish bearing six rows of longitudinal spines. Pupa: 5-6 days. Yellowish with spines on posterior part; anterior portion being devoid of spines. Pupates on the stem or leaves. Adult *E. dodecastigma*: Copper-coloured, 6 spots / elytra *E. demurille*: Dull appearance, light copper coloured and six black spots surrounded by yellowish area on each elytra. *E. vigintioctopunctata*: 14 spots on each elytra, deep red. Total life period: 20-50 days.

7 generations / year.

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 - 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
- Emulsify 1 lit of Neem oil with 60 g of soap dissolved in L. of water, dilute emulsion by adding 20 lit of water, then mix about 400 g of well crushed garlic and spray.
- Mix diflubenzuron invariably with - 1.5 L or chlorpyriphos 1.0 L /ha and spray on the crop which reduces the population by nearly 95% in field.

3. Stemborer: *Euzophera perticella* (Phycitidae: Lepidoptera)

Distribution and status: Indian sub-continent

Host range: Chilli, tomato, brinjal and potato

Damage symptoms

Larva bores into main stem of young and old plants and move downwards. Top shoots of young plants crump and wither. Older plants become stunted. Fruit bearing capacity is adversely affected. There is a distinct thickening of stem at the entry point.

Bionomics

Egg period: 10 days. Creamy and scale-like, laid singly / in batches on young leaves, petioles and branches. Larva: 26-58 days. Fully grown larva is creamy white with few bristle-like hairs, 20 mm. Pupa: Pupates within cocoon inside larval tunnel, 9-16 days. Adult: Greyish brown, forewings with transverse line and white hindwings.
Life cycle is completed in 35-76 days.

Management

Collect and destroy the damaged and dead plants

- Use light traps @ 1/ha to attract and kill the moths.
- Conserve larval parasitoids *Pristomerus testaceus, P. euzopherae*
- Spray any one of the insecticide starting from one month after planting at 15 days interval. Carbaryl 50 WP 2 kg + wettable sulphur 50 WP 2 kg, - 35 EC 1.5 L + Neem oil 1.5 L, Quinalphos 25 EC 1.5 L + Neem oil 1.0 L, NSKE 5%, Azadirachtin 1.0% 1.0-1.5 L or Fenpropathrin 30 EC 250-340 ml or Thiodicarb 75 WP 625-1000 g
- Avoid using synthetic pyrethroids as they cause resurgence of sucking pests.

4. 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.

Bionomics

500 eggs in soil, 6-7 days.Grub: 30-45 days; Pupa: Pupates in soil in earthern cocoons; Adult: 10-12 days. *M. subfasciatus*: Brown; M. *discolor*: Brown and white spots *M. viridanus*: Small light green weevil



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 - 35 EC 1.5 L or malathion 50 EC 1.5 L Carry to pearl millet ?

5. Brown leafhopper: *Cestius phycitis* (Cicadellidae, Hemiptera)

It is a vector of little leaf of brinjal. Nymphs and adults suck cell sap from ventral side of leaf and inject toxins into the plant tissues and cause reduction in size of leaves, shortened petioles, excessive growth of branches general stunting of plants, conversion of floral parts into leafy structures and give the plants a bushy appearance. Fruiting is rare. The adults are small light brown leafhoppers having bright yellow marks on its thorax.

Management

- Rogue out infested plants as soon as they appear in the field and completely destroy them.
- Before transplantation dip the seedlings in 0.2% carbosulfan 25 DS solution to control the insect vectors.
- Spray 3-4 times at 10 days interval with . 750 ml or dimethoate 500 ml or monocrotophos 500 ml or - 1.0 L or imidacloprid 125 ml in 500 -750 L of water /ha

6. Aphid: *Aphis gossypii* (Aphidiae: Hemiptera)

It can be occasionally serious and can be managed by release of first instar grubs of Ch*rysoperla carnea* @ 10,000/ha or by spraying methyl demeton 25 EC or dimethoate 30 EC 500 ml or Fenvalerate 20 EC 375-500 ml or Phosphamidon 40 SL 625-750 ml or Thiometon 25 EC 1000 ml

Minor pests

7. Leafhopper: *Amrasca devastans* (Cicadellidae: Hemiptera)
8. Mealy bug: *Coccidohystrix insolitus* / *Urentius ectinus* / *U. hystricellus* (Pseudococcidae : Hemiptera)
9. Pod bug: *Anoplecnemis phasiana* (Coreidae: Hemiptera)
10. Cow bug: *Tricentrus bicolor* (Membracidae: Hemiptera)
11. Thrips: *Thrips tabaci*, *Frankliniella schultzei*, *Scirtothrips dorsalis* (Thripidae: Thysanoptera)
12. Hard Scales : *Aonidiella aurantii*, *Aspidiotus destructor* (Diaspidiae: Hemiptera)
13. Soft scales: *Parasaissetia nigr* (Coccidae: Hemiptera)
14. Spider mite: *Tetranychus cinnabarinus* (Tetranychidae: Acari)
15. Whitefly : *Bemisia tabaci*, *Aleurodicus disperses* (Aleyrodidae:Hemiptera)
16. Budworm : *Scrobipalpa blapsigona* (Gelechiidae: Lepidoptera)
17. Leaf roller : *Antoba olivacea* (Noctuidae: Lepidoptera)
18. Leaf webber : *Psara bipunctalis* (Pyralidae: Lepidoptera)
19. Sphingid : *Acherontia styx* (Sphingidae: Lepidoptera)
20. Leaf Miner : *Scrobipalpa blapsigona* (Gelechiidae: Lepidoptera)

21. Hairy caterpillar : *Selepa celtis, S. docilis* (Noctuidae:Lepidoptera)

22. Grasshoppers: *Atractomorpha crenulata*, *Oxya japonica*, *Poicilocerus pictus* (Acrididae: Orthoptera)
23. Termite : *Trinervitermes biformis*, *Microtermes* sp. (Termitidae: Isoptera)

PEST OF TOMATO

More than 80 % of the fruit get damaged under severe infestation of fruit borer and fruit sucking moth. Whitefly and thrips act as vector for certain viral diseases, which cause considerale yield reduction.

	Major Pests			
1.	Fruit borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
2.	Serpentine leaf miner	*Liriomyza trifolii*	Agromyzidae	Diptera
3.	Leaf eating caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
4.	Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera
5.	Thrips	*T. tabaci*, *F. schultzi*	Thripidae	Thysanoptera
6.	Fruit sucking moth	*Othreis fullonica*, *O. materna*, *O. ancilla*	Noctuidae	Lepidoptera
	Minor Pests			
7.	Spotted leaf beetle	*Epilachna vigintioctopunctata*	Coccinellidae	Coleoptera
8.	Cabbage green semilooper	*Trichoplusia ni*	Noctuidae	Lepidoptera

9.	Aphid	*Aphis gossypii*, *Myzus persicae*	Aphididae	Hemiptera
10.	Leaf hopper	*Amrasca devastans*	Cicadellidae	Homoptera
11.	Stem borer	*Euzophera perticella*, *Pthorimaea operculella*	Pyralidae	Lepidoptera
12	Red spider mite	*Tetranychus cinnabarinus*	Acaridae	Acarina

1.Fruit borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

For distribution and status, host range, damage symptoms, bionomics refer cotton

Single caterpillar can destroy 2-8 fruits.

Bionomics

Management

- Collect and destroy the infested fruits and grown up larvae.
- Grow less susceptible genotypes Rupali, Roma, Pusa red plum.
- Grow resistant cultivars like BT 1, T 32, T 27, Punjab Kesri, Punjab Chuhashu, Pant Bahar, Azad Pusa Hybrid 4
- Grow simultaneously 40 days old African tall marigold and 25 days old tomato seedling at 1:10 rows to attract *Helicoverpa* adults for egg laying.

- Set up pheromone trap with Helilure at 15/ha and change the lure once in 15 days.
- Release *T. chilonis* 6 times @ 50,000/ha per week coinciding with flowering time based on ETL.
- Release *Chrysoperla carnea* at weekly interval at 50,000 eggs or grubs / ha from 30 days after planting.
- Spray any of the following insecticides with 500 L water/ha

• Azadirachtin 1.0% 1.0-1.5 L	• NPV of *H. armigera* 0.43% AS 400-600
• Indoxacarb 14.5 SC 400-500 ml	• NPV of H. armigera 2% AS 500
• Lambda cyhalothrin 5 EC 300 ml	• Methomyl 40 SP 7501125 g
• Novaluron 10 EC 750 ml	• - 35 EC 1.0 L
• Carbaryl 50 WP 1 kg	• *B. thuringiensis* 1 g/lit
• Quinalphos 1250 ml	

- Do not spray insecticides after maturity of fruits.
- Encourage activity of parasitoid *Eucelatoria bryani*, *Campoletes*, *Chelonus* etc.,

2. Serpentine leaf miner: *Liriomyza trifolii* (Agromyzidae: Diptera) - An introduced pest becoming serious in the recent years.

Damage symptoms

Maggots mines into leaves and cause serpentine mines drying and drooping of leaves.

Bionomics

Egg: 2-4 days. Female thrusts eggs into the epidermal layer of leaves. Larva:

7-10 days. Minute orange yellowish apodous maggots. Pupa: 5-7 days. Pupates within mines. Adult: Pale yellow in colour.

Management

I. Collect and destroy mined leaves

II. Spray NSKE 5%

3. Leaf eating caterpillar: *Spodoptera litura* (Noctuidae: Lepidoptera) For distribution and status, host range, damage symptoms, bionomics and management **Refer cotton**

4. Whitefly: *Bemisia tabaci* (Aleyrodidae: Hemiptera) - It is a vector of Leaf curl virus . Refer cotton

5. Thrips: *T. tabaci*, *F. schultzi* (Thripidae: Thysanoptera)

Damage symptoms

Vector of tomato spotted wilt virus. Lacerate leaf tissues and leaves become spotted and pale (Silvery streaks). Feeds on flowers resulting in pre-mature dropping of

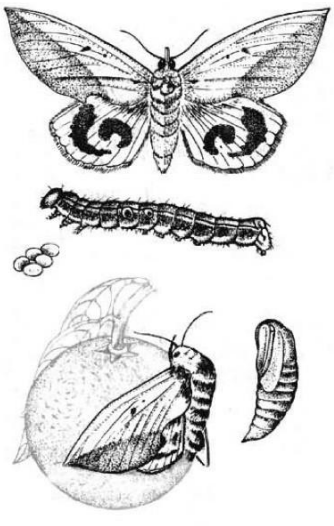

flowers and also cause bud necrosis.

For Bionomics and management refer cotton

6. Fruit sucking moth: *Othreis fullonica*, *O. materna*, *O. ancilla* (Noctuidae: Lepidoptera)

Damage symtpoms

Adults suck the juice of fruits by piercing. Infested fruits will shrink, shrivel, rot and ultimately drop down, causing direct loss to harvestable produce. **Bionomics**



Larva: Semilooper with orange blue and yellow spots on velvetty dark speckled body. Moth: Stout built; with grey and orange coloured wings. *O. materna*: Three black spots on forewings. *O. fullonica*: Tripod black mark on forewings and curved marking on hind wing. Larva feeds on the leaves of the creeper weed *Tinospora cardifolia* and *Cocculus* sp.

Othreis fullonica *O. materna*

Minor pests

- Spotted leaf beetle: *Epilachna vigintioctopunctata* (Coccinellidae: Coleoptera)
- Cabbage green semilooper: *Trichoplusia ni* (Noctuidae: Lepidoptera)
- Aphid : *Aphis gossypii*, *Myzus persicae* (Aphididae: Hemiptera)
- Leaf hopper : *Amrasca devastans* (Cicadellidae: Homoptera)
- Stem borer: *Euzophera perticella*, *Pthorimaea operculella* (Pyralidae: Lepidoptera)
- Red spider mite: *Tetranychus cinnabarinus* (Acaridae: Acarina)

Questions - Brinjal and Tomato

1.	Skeletonization of brinjal leaves is caused by---------- **Hadda beetle**	
2.	Attacked brinjal fruits with boreholes plugged with excreta is indication of presence of ---------- **Shoot and fruit borer**	
3.	Continuous planting of brinjal and ratooning is favourable for multiplication of ---------- **Shoot and fruit borer**	
4.	Little leaf of brinjal is transmitted by ---------- **Leaf hopper**	
5.	Site of pupation for ash weevil is ---------- **Soil**	
6.	Presence of circular holes and larva feeding by thrusting only a part of its body into tomato fruit is symptom of Fruit borer *Helicoverpa armigera* -Say **true** or false	
7.	Give the name of an introduced pest in tomato ---------- **Serpentine leafminer**	
8.	Tomato leaf curl is transmitted by ---------- **Whitefly**	
9.	---- feed on chili flowers resulting in pre-mature dropping of flowers and also cause bud necrosis -**Thrips**	
10.	---------- is the pest where only the adult cause the damage to fruits **Fruit sucking moth**	
11.	Name the predatory thrips feeding on thrips	
	a. *Thrips tabaci*	b. *Scirtothrips dorsals*
	c. *Thrips florum*	d. ***Scolothrips indicus***
12.	Muranai disease is caused by ---------- on chillies- ***Polyphagodorsonemous latus***	
13.	Name the predatory mite feeding on mite	
	a. *Aceria cajani*	b. *Aceria sorghi*
	c. *Aceria oryzae*	d. ***Amblyseius ovalis***
14.	_____are resistant to shoot and fruit borer **Pusa purple round, Arka Kusumakar, Doli – 5**	
15.	Notching of brinjal leaf margins by adults is the damage symptom by _____- **Ash weevil**	
16.	Pea mosaic virus is transmitted by _____ pea aphid ***Acyrthosiphon pisum***	

Lecture no. 22

PESTS OF CHILLIES AND PEAS

PEST OF CHILLIES

More than 20 species have been reported attacking both leaves and fruits of chilles. Severe infestation of thrips and mites cause even death of plants affecting crop stand and finally the yield. The borers reduce the quality of fruits upon severe infestation.

Major pests				
1.	Chillies thrips	*Scirtothrips dorsalis*	Thripidae	Thysanoptera
2..	Muranai mite/ Broad mite/ yellow mite	*Polyphagotarsonemus latus*	Tarsonemidae	Acarina
3.	Tobacco caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
4.	Fruit borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
Minor pests				
5.	Stem borer	*Euzophera perticella*	Phycitidae	Lepidoptera
6.	Cut worm	*Agrotis ipsilon*	Noctuidae	Lepidoptera
7.	Green peach aphid	*Myzus persicae*	Aphididae	Hemiptera

1. 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.

Bionomics

Insect reproduces sexually as well as parthenognetically. Female thrips insert the eggs into the veins and a female lays upto 40-48 eggs. Lifecycle occupies 10-20 days.

Management

- Grow resistant varieties like G5, K2, X 235
- 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 m^2 area in the nursery
- Dip the roots of seedlings in monocrotphos 36 WSC @ 0.05% for 20 min. before transplanting
- Dust carbaryl 5 D 25 kg /ha in the early morning
- Spray any of the following insecticides with water 500 L/ha

• Imidacloprid 70 WS 500-1000 g or 17.8 SL 125-250 ml	• Imidacloprid 17.8 SL 125-250 ml or 70 WS / 100 kg seed 1.0001.5L
• Emamectin benzoate 5 SG 200	• Lambda cyhalothrin 5 EC 300 ml
• Ethion 50 EC 1.5-2.0 L	• Methomyl 40 SP 750-1125 g
• Fenpropathrin 30 EC 250-340 ml	• Spinosad 45 SC 160 ml
• Fipronil 5 SC 800-1000 ml	• Thiacloprid 21.7 SC 225-300 ml
Dimethoate 30 EC 500 ml	Methyl demeton 25 EC 500 ml

- Encourage the activity of predaceous thrips: *Scolothrips indicus* and *Franklinothrips megalops* in the field

2. 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.

Bionomics

The eggs are minute and oval in shape and are laid on the ventral surface of young leaves or on leaf buds. Larva has 3 pairs of legs move sluggishly. The adults measure 0.1 mm in length and bear 4 pairs of the legs. They are yellowish green in colour and translucent in nature. The egg, larval nymphal and adult period occupies 1.5 – 2, 1.5, 1 and 8-10 days, respectively.

Management

➥ Spray any of the following insecticides with 500 -750 L water/ha

• Buprofezin 25 SC 300-600 ml	• Fenpyroximate 5 EC 300-600 ml
• Chlorfenapyr 10 SC 750-1000 ml	• Hexythiazox 5.45 300-500 ml
• Diafenthiuron 50 WP 600 g	• Lambda cyhalothrin 5 EC 300 ml
• Ethion 50 EC 1.5-2.0 L	• Milbemectin 1 EC 325ml
• Fenazaquin 10 EC 1.25 L	• Propargite 57 EC 1.5 L
• Fenpropathrin 30 EC 250-340 ml	• Spiromesifen 22.9 SC 400 g
• Dicofol 18.5 EC @ 2 L	• Phosalone 35 EC 1.5 L
• Wettable sulphur 50 WP @ 4 kg	

➥ Encourage the activity of predatory mite: *Amblyseius ovalis*

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

Refer cotton

4. Fruit borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera) For host range, damage symptoms, bionomics refer cotton

Management

Follow IPM practices as given for cotton

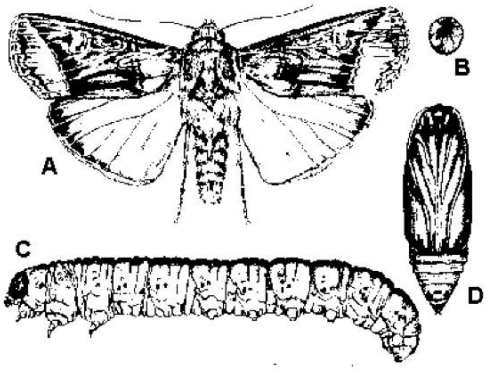
Spray Fipronil 5 SC 800-1000 ml or Indoxacarb 14.5 SC 335-400 ml or Methomyl 40 SP 50-1125 g or Novaluron 10 EC 375 ml or Spinosad 45 SC 160 ml or Thiodicarb 75 WP 625-1000 g

5. Stem borer: *Euzophera perticella* (Phycitidae: Lepidoptera)

Refer Brinjal

6. Cut worm: *Agrotis ipsilon* (Noctuidae: Lepidoptera)


The greasy cut worms come out during night and cut the seedlings at ground level and eat tender leaves. Larva: Black with pale mid dorsal stripes; head pale brown, skin with coarse granules interspersed with small granules. Adult: Forewing pale brown with dark purplish brown along costal and towards base; hind wing white with brown tinge. **ETL**: 2 larvae/ metre row



A- Adult, B- Egg, C- Larva, D- Pupa

Management

- Hand pick and destroy the larvae – morning and evening hours on cracks and crevices in the field
- Plough the soil during summer months to expose larvae and pupae for predation by birds.
- Operate light trap @ 12 traps/ ha
- Place pheromone traps @ 12 traps/ ha to attract male moths
- Poison bait: Rice bran 12.5 Kg +Molasses or Brown sugar 2.5Kg + Carbaryl 50 WP 1.25 Kg – Mix the ingredients well – Keep around the field in the evening hours
- Irrigate in day time to expose larvae for avian predators
- Insecticides: - 35EC @ 1 L/ha or chlorpyriphos 20EC @ 1 L/ha or neem oil @ 3%

7. Green peach aphid: *Myzus persicae* (Aphididae: Hemiptera)

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

Management

- Treat 1.0 kg seeds with Imidacloprid 70WS 10- 15 g
- Spray methyl demeton 25 EC or dimethoate 500 ml or neem based formulations 0.5 -1.0 L or Imidacloprid 70 WS 500-1000 ml or Imidacloprid 17.8 SL 125-250 ml or Fipronil 5 SC 800-1000 ml or Imidacloprid 17.8 SL 125-250 ml

PESTS OF PEAS

Major pests				
1.	Pea Leaf-miner	*Chromatomyia horticola*	Agromyzidae	Diptera
2.	Pea Stem Fly	*Ophiomyiil phaseoli*	Agromyzidae	Diptera
3.	Pea Aphid	*Acyrthosiphon pisum*	Aphididae	Hemiptera
Minor pests				
4.	American Bollworm	*Helicoverpa armigera*	Noctuidae	Lepidoptera
5.	Pea Pod Borer	*Etiella zinckenella*	Pyralidae	Lepidoptera

1. Pea Leaf-miner: *Chromatomyia horticola* (Agromyzidae: Diptera)

Distribution and status: Wide distribution in Northern India and Indian subcontinent

Host range: Cruciferous plants, antirrhinum, nasturtinum, pea, potato and linseed (*Linum usitatissimum* L.)

Damage symptoms

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

Bionomics

The adults are two-winged flies having greyish black mesonotum and yellowish frons. It is active from December to April or May and is believed to pass the rest of the year in soil, in the pupal stage. The adults emerge at the beginning of December and after mating, start laying eggs singly, in leaf tissues. Egg period 2-3 days, larval period 5 days and pupate within the galleries. Pupal period is 6 days and the lifecycle is completed in 13-14 days. The pest passes through several broods from December to April-May.

Management

Spray 1.0 L of dimethoate 30 EC in 750 L of water per ha and repeat spray at I5 day interval. A waiting period of 20 days should be observed for picking of pods.

2. Pea Stem Fly: *Ophiomyia phaseoli* (Agromyzidae: Diptera)

Distribution and status: Widely distributed in India, Sri Lanka, the Philippines, and China Sporadic pest.

Host range: Peas - *Phaseolus mungo* L., *Phaseolus aconitifolius* Jacq., soybean, cowpeas, *Lablab niger* L.

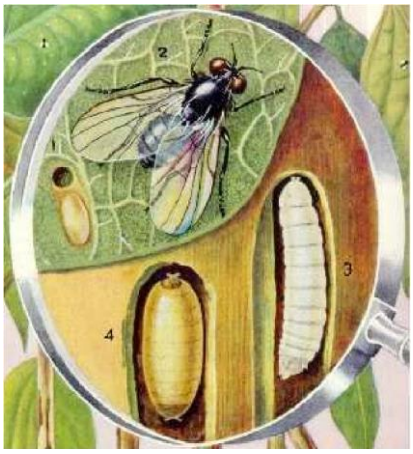
Damage symptoms

The maggots bore into the stem thereby causing withering and ultimate drying of the affected shoots, thus reducing the bearing capacity of the host plants. The adults also cause damage by puncturing the leaves, and the injured parts turn yellow. The damage is more severe on seedlings than on the grown up plants.

Bionomics

The adult flies are metallic black. They are active in summer and mate 2-6 days after emergence. The female lays 14-64· elongate, oval and white eggs into the leaf tissue with the help of its elongated ovipositor. The eggs hatch in 2-4 days They pass through three instars and the larval development is completed in 6-12 days. The larva pupates within its gallery and the pupal period lasts 5-19 days. The female flies live for 8-22 days and the males for 11 days. The pest completes 8-9

generations from July to April and shifts from one host plant to the other in various seasons. It passes winter as larva or as pupa.



Management

(i) Avoid sowing of the crop earlier than mid-October to check the attack of the pest.

(ii) Remove and destroy all the affected branches during the initial stages of attack.

(iii) Sow the crop in the second fortnight of October to escape the damage of the pest.

(iv) Apply 7.5 kg of phorate 10G or 25 kg of carbofuran 3 G per ha in furrows at the time of sowing

(v) On the crop, spray three times 750 ml of oxydemeton methyl 25 EC in 750 L of water per ha. The first application should be just after germination and the other two at an interval of 2 weeks each.

3. Pea Aphid: *Acyrthosiphon pisum* (Aphididae: Hemiptera)

Distribution and status: Cosmopolitan in distribution

Host range: Peas - *Phaseolus mungo* , *Phaseolus aconitifolius* Jacq., soybean, cowpeas, *Lablab niger*

Damage symptoms

Aphids are carriers of pea mosaic. Both nymphs and adults suck the sap from young shoots, ventral surface of tender leaves, inflorescence and even on stems. Curling and distortion of leaves, stunting and malformation shoots occur. Leaves turn pale and dry. Honeydew secretion of aphids leads to sooty mould which hinders the photosynthetic activity of the plants.

Bionomics

Adult aphids are soft bodied, long legged, pear-shaped, green yellow or pink in colour with long conspicuous cornicles Both alate as well as apterous forms are present and these are generally females; males are rare. Winged and wingless males

have been reported from Europe and USA but not from India. Reproduction is parthenogenetic and viviparous. It takes about a week to complete one generation and there are several overlapping generations in a year.

Management

Spray 1.0 L of dimethoate 30 EC in 750 L of water per ha when the attack starts and repeat after 15 days if necessary.

Minor pests

4. American Bollworm: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Refer cotton

Management

Spray 5 L of chlorpyriphos 20EC or 2.0 kg of acephate 75 SP in 750 litres of water per ha.

5. Pea Pod Borer: *Etiella zinckenella* (Pyralidae: Lepidoptera)

The larvae damage the crop by feeding on flowers and pods.

Management

Spray 750 ml of - 35 EC or 2.25 kg of carbaryl 50WP in 750 L of water per ha when the attack starts. Repeat after 15 days if necessary.

Questions Chilles and Peas

1.	Skeletonization of brinjal leaves is caused by---------- **Hadda beetle**	
2.	Attacked brinjal fruits with boreholes plugged with excreta is indication of presence of ---------- **Shoot and fruit borer**	
3.	Continuous planting of brinjal and ratooning is favourable for multiplication of ---------- **Shoot and fruit borer**	
4.	Little leaf of brinjal is transmitted by ---------- **Leaf hopper**	
5.	Site of pupation for ash weevil is ---------- **Soil**	
6.	Presence of circular holes and larva feeding by thrusting only a part of its body into tomato fruit is symptom of Fruit borer *Helicoverpa armigera* -Say **true** or false	
7.	Give the name of an introduced pest in tomato ---------- **Serpentine leafminer**	
8.	Tomato leaf curl is transmitted by ---------- **Whitefly**	
9.	---- feed on chili flowers resulting in pre-mature dropping of flowers and also cause bud necrosis -**Thrips**	
10.	---------- is the pest where only the adult cause the damage to fruits **Fruit sucking moth**	
11.	Name the predatory thrips feeding on thrips	
	a. *Thrips tabaci*	b. *Scirtothrips dorsals*
	c. *Thrips florum*	d. ***Scolothrips indicus***
12.	Muranai disease is caused by ---------- on chillies- ***Polyphagodorsonemous latus***	
13.	Name the predatory mite feeding on mite	
	a. *Aceria cajani*	b. *Aceria sorghi*
	c. *Aceria oryzae*	d. ***Amblyseius ovalis***
14.	_____are resistant to shoot and fruit borer **Pusa purple round, Arka Kusumakar, Doli – 5**	
15.	Notching of brinjal leaf margins by adults is the damage symptom by _____- **Ash weevil**	
16.	Pea mosaic virus is transmitted by _____ pea aphid ***Acyrthosiphon pisum***	

Lecture No 23

PESTS OF OKRA AND CUCURBITS

I. PESTS OF OKRA

The pests that occur on cotton attack okra also as it belongs to Malvaceae family. However, important and difficult ones to control are lepidopteran tissue borers, leafhoppers, leaf eating beetles and mites.

Common Name	Scientific Name	Family	Order
Major pests			
Shoot and fruit borer	*Earias vitella*, *E. insulana*	Noctuidae	Lepidoptera
Fruit borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
Jassids	*Amrasca* bigutula bigutula	Cicadellidae	Hemiptera
Leaf roller	*Sylepta derogata*	Pyraustidae	Lepidoptera
Semiloopers	*Anomis flava*, *Xanthodes graelsii*, *Tarache nitidula*	Noctuidae	Lepidoptera
Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera
Red spider mite	*Tetranychus telarius*	Tetranychidae	Acari
Stem weevil	*Pempherulus affinis*	Curculionidae	Coleoptera
Minor pests			
Shoot weevil	*Alcidodes affaber*	Curculionidae	Coleoptera
Pod fly	*Melanagromysa obtusa*	Agromyzidae	Diptera
Leaf weevil	*Myllocerus* sp.	Curculionidae	Coleoptera
Leaf miner	*Trachys herilla*	Buprestidae	Coleoptera
Grasshoppers	*Poecilocerus pictus*, *Oxya japonica*	Acrididae	Orthoptera
Aphid	*Aphis gossypii*	Aphididae	Hemiptera
Red cotton bug	*Dysdercus koenigii*	Pyrrhocoridae	Hemiptera
Dusky cotton bug	*Oxycarenus hyalinipennis*	Lygaeidae	Hemiptera
Mealy bug	*Ferrisia virgata*	Pseudococcidae	Hemiptera
Soft scale	*Saissetia coffeae*, *Parasaissetia nigra*	Coccidae Diaspididae	Hemiptera
Chafer beetle	*Oxycetonia versicolor*	Cetonidae	Coleoptera
Blister beetle	*Mylabris pustulatus*	Meloidae	Coleoptera

1. Shoot and fruit borer: *Earias vitella*, *E. insulana* (Noctuidae: Lepidoptera)

Distribution and status

Pakistan, India, Sri Lanka, Bangladesh, Myanmar, Indonesia, New Guinea and Fiji.

More abundant in South India than North India.

Host range

Oligophagus, cotton, bhendi, hibiscus, holly hock and other malvaceous vegetables.

Damage symptoms

Larva bores into tender terminal shoots in the vegetative stage and flower buds, flowers and young fruits in the fruit formation stage. The damaged shoots droop, wither and dry up. The infested fruits present a deformed appearance and become unfit for consumption. Bore holes - plugged with excreta.

Bionomics

Egg period: 3-5 days. 385-400 eggs / female. Spherical, light bluish, green, crown shaped, laid singly on shoot tips, buds, flowers and fruits. Larva: 10-17 days. Six instars.: Pupa: 6-10 days. Pupates in an inverted boat shaped cocoon.

	E. vitella	***E. insulana.***
Larva	Brown, with longitudinal white stripes on dorsal side as against for	Cream coloured body with orange dots on prothorax
Adult	Medium sized, head and thorax ochreous white	Adults are smaller than *E. vitella* Head and thorax pea green in colour
	Forewings are pale white with a broad wedge shaped horizontal green patch in the middle.	Forewings uniformly pale yellowish green.

Management

- Grow resistant cultivars like AE 57, PMS 8, Parkins Long green, PKX 9275, Karnual Special
- Collect and destroy infested shoots, buds, flowers and fruits.
- Remove the alternate hosts like *Hibiscus cannabinus*, *H. abelmoschus* and *Abutilon indicum* in the cropped area.
- Release egg parasitoid *T. chilonis* and larval parasitoid *Chelonus blackburnii*.
- Release first instar larvae of *Chrysoperla carnea* @ 1 lakh/ha.
- Set up light traps to monitor the moths and their egg laying @ 12/ha
- Set up pheromone traps @ 5/ha.
- Spray *B.t* formulation such as dipel @ 2 g / lit.
- Spray carbaryl 50% WP 1 kg or - 35 EC or monocrotophos 36 WSC 1.0 L or NSKE 5% or Azadirachtin 5% 400 ml or Fenpropathrin 30 EC 250-340 ml or Pyridalyl 10 EC 500-750 ml with 500 L – 700 L water/ha.

2. Fruit borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Refer cotton

3. Jassids: *Amrasca bigutula bigutula* (Cicadellidae: Hemiptera)

Host range, damage symptoms & bionomics: Refer Cotton **Management**

- Treat 100 kg seeds with Imidacloprid 48 FS 500-900 ml or Imidacloprid 70 WS 500-1000 g or Thiamethoxam 70 WS 285 g
- Spray imidacloprid 70 WG 30-35 g or Imidacloprid 17.8 SL 100 ml or Thiamethoxam 25 WG 100 g or Azadirachtin 5% 400 ml or Lambda cyhalothrin 5 EC 300ml in 500 L water/ha

4. Leaf roller: *Sylepta derogata* (Pyraustidae: Lepidoptera)

Distribution and status: Throughout South East Asia. Minor pest

For host range, damage symptoms and bionomics refer cotton

Management

Collect and destroy rolled leaves and spray carbaryl 50 WP 1.0 kg or phosalone 50 EC 1.0 L in 500 L water/ha

5. Semiloopers: *Anomis flava*, *Xanthodes graelsii*, *Tarache nitidula*

Distribution and status: India, Australia, South East Asia and Pakistan. They are of minor status.

Damage symptoms and bionomics: Refer cotton

6. Whitefly: *Bemisia tabaci* (Aleyrodidae: Hemiptera)

It is a vector that transmits yellow vein clearing mosaic disease

For host range, damage symptoms and bionomics refer cotton

Management

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

7. Red spider mite: *Tetranychus telarius* (Tetranychidae:)

Distribution and status

Africa, Pakistan, Middle East, Sri Lanka, South East Asia, USA and Japan.

Host range

Bhendi, cotton, tomato, brinjal, castor, cucurbits, tea, citrus, grapes, rose, jasmine, marigold.

Damage symptoms

Nymphs and adults feed on ventral leaf surface, under protective cover of fine silken webs. As a result of their feeding numerous yellow spots appear on dorsal side of leaves.

Affected leaves gradually start curling, finally wrinkled and crumpled.

Bionomics

Egg period: 3-5 days. nymphal period: 6-10 days. Adult: Ovate, reddish brown.

Management

Spray wettable sulphur 50 WP 1.0 kg (or) dicofol 1.0 L or abamectin 1.9 EC @ 500 ml which is a new acaricide or fenpropathrin 30 EC 250-340 ml in 500 L water/ha.

8. Stem weevil: *Pempherulus affinis (Curculionidae: Coleoptera)* Damage symptoms

Grubs bore into stem causing gall-like swellings in the stem, near the base.

Bionomics

Egg period: 6-10 days; 50-120 eggs / female. Grub: 35-40, days dark greyish brown with pale cross bands on elytra. Total: Five generations / year.

9. Other pests of minor importance.

Shoot weevil: *Alcidodes affaber* (Curculionidae: Coleoptera)
Pod fly: *Melanagromysa obtusa* (Agromyzidae: Diptera)
Leaf weevil: *Myllocerus* sp. (Curculionidae: Coleoptera)
Leaf miner: *Trachys herilla* (Buprestidae: Coleoptera)
Grasshoppers: *Poecilocerus pictus*, *Oxya japonica* (Acrididae: Orthoptera)
Aphid: *Aphis gossypii* (Aphididae: Hemiptera)
Red cotton bug: *Dysdercus koenigii* (Pyrrhocoridae: Hemiptera)
Dusky cotton bug: *Oxycarenus hyalinipennis* (Lygaeidae: Hemiptera)
Mealy bug: *Ferrisia virgata* (Pseudococcidae: Hemiptera)
Scales: *Saissetia coffeae* (Coccidae: Hemiptera)
Parasaissetia nigra (Diaspididae: Hemiptera)
Chafer beetle: *Oxycetonia versicolor* (Cetonidae: Coleoptera)
Blister beetle: *Mylabris pustulatus* (Meloidae: Coleoptera)

II. PESTS OF CUCURBITS

Cucurbits crops are attacked by several species of insect pests, among which fruit flies and pumpkin beetles are important.

Common Name	Scientific Name	Family	Order
Major pests			
Fruit flies	*Bactrocera cucurbitae*	Tephritidae	Diptera
Pumpkin beetles	*Aulacophora foveicollis, A. cincta, A.intermedia*	Galerucidae	Coleoptera
Leaf eating caterpillar	*Plusia peponis. P.signata, P.orichalcea*	Noctuidae	Lepidoptera
Leaf miner	*Liriomyza trifolii*	Agromyzidae	Diptera
Snake gourd semi looper	*Diaphania indica*	Pyraustidae	Lepidoptera
Minor pests			
Stem gall fly	*Neolasoiptera falcata*	Cecidomyiidae	Diptera
Stem borer /clear winged moth	*Melittia eurytion*	Aegeriidae	Lepidoptera

Stem boring grey beetle	*Apomecyna saltator*	Cerambycidae	Coleoptera
Plume moth	*Sphenarches caffer*	Pterophoridae	Lepidoptera
Stink bug	*Aspongopus janus*	Pentatomidae	Hemiptera
Spotted beetle	*Epilachna vigintioctopunctata*	Coccinellidae	Coleoptera
Flower feeder	*Mylabris pustulata*	Meloidae	Coleoptera

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

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 maggots 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.

Bionomics

Maggots legless and appear as headless, dirty-white wriggling creatures, thicker at one end and tapering to a point at the other. The adult flies are reddish brown with lemonyellow markings on the thorax. Adult flies emerge from pupae in the morning hours and mate at dusk. The female, on an average, lays 58-95 eggs in 14-54 days. Egg period 1-9 days, larval period 3 - 21 days. It pupates deep in the soil. The pupae are barrel-shaped, light brown, pupal period 6-30 days. There are several generations in a year.

B. cucurbitae	***B. ciliatus***	***B. zonata***
Hyaline wings with costal band broad and prominent, anal stripes well developed and hind cross veins thickly margined with brown and grey spots at the apex	Smaller than B. cucurbitae,ferruginous brownbody, prominent dark brown oval spot on either side of 3rd tergite.	Body yellowish with pale yellow band on 3rdtergite and wing expanding10-12mm costal band incomplete and anal band wanting.

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 undersurface of leaves.
- Use attractants like citronella oil, eucalyptus oil, vinegar (acetic acid), dextrose and lactic acid to trap flies.
- Apply the bait spray containing 50 ml of malathion 50 EC + 0.5 kg of gur/sugar in 50 L of water per ha. Repeated at weekly intervals. Keep the bait in earthen lids placed at various corners of the field.
- Spray the bait on the maize plants grown as trap crop
- Use fly trap: Keep 5 g of wet fishmeal in plastic container with six holes (3 mm dia), two cm from the bottom of the bag. Add a drop (0.1 ml) of dichlorvos in cotton plug and keep it inside the bag. Dichlorvos should be added every week and fishmeal renewed once in 20 days (20 traps/acre).
- Use fly traps having methyl eugenol soaked plywood piecies (2" x 2"). Collect and destroy the flies.
- Conserve pupal parasitoids *viz.,Opius fletcheri, O. compensatus* and *O. insisus* (Braconidae), *Spalangia philippinensis* and *Pachycepoideus debrius*. (Pteromalidae), *Dirhinus giffardi* and *D. Izonensis* . (Chalcididae).

Caution:

In cucurbits, DDT, lindane 1.3 D, copper oxychloride, Bordeaux mixture and sulphur dust should not be used as these are highly phytotoxic.

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

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

Serious pest

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 The 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 resown.

Bionomics

Freshly hatched grubs are dirty white; full grown are creamy yellow, 22 mm long. Adult: ***A. foveicollis:*** red, 6.8 mm long. ***A. cincta***: grey with black having glistening yellow-red border and ***A. intermedia***: blue in color.

The creamy, oblong, white grubs with a slightly darker oval shield at the back lead a subterranean life and when full-grown, they measure about 12 mm in length. Adults are oblong , 5-8 mm long, beetles are found concealed in groups. In their life span of 60-85 days, they lay about 300 oval, yellow eggs singly or in batches of 8-9 in moist soil, near the base of the plants. The eggs

hatch in 6-15 days. Grub period 13- 25 days and pupate in thick-walled earthen chambers in the soil, at a depth of about 20-25 cm. The pupal stage lasts 7-17 days The life-cycle is completed in 26-37 days and the pest breeds five times in a year.

Management

i. Early planting of pumpkin during October – November to avoid damage by this pest

ii. Frequent raking of soil beneath the crop to expose and kill the eggs and grubs. iii. Hand collection and destruction of infested leaves and fruits.

iv. Spray malathion 50 EC 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.

3. Leaf eating caterpillar: *Plusia peponis, P. signata and P. orichalcea* (Noctuidae: Lepidoptera)

Distribution and status: Regular and serious pest all over the country.

Damage symptoms

The caterpillar cuts the edges of leaf lamina, folds it over the leaf and feeds from within leaf roll.

Bionomics

Stout adult moth lays spherical sculptured greenish white eggs singly on the tender leaves. Larva is a greenish semi looper with black warts. It is humped on a anal segment. They are active in winter. They pupate in the debris on the ground. Moths are very active at dusk.

Management

Collect and destroy caterpillars.

Encourage activity of *Apanteles plusia* and *A. taragamae*

Spray malathion 50 EC 750 ml, dimethoate 30 EC 500 ml, methyl demeton 25 EC 500 ml in 500-750 L of water per ha

4. Leaf miner: *Liriomyza trifolii* (Agromyzidae: Diptera)

Refer Tomato

Management

Application of NSKE 5% (50g/lit).

Note: HCH (BHC), DDT, copper and sulphur dusts are phytotoxic to gourds.

5. Snake gourd semi looper: *Diaphania indica* (Pyraaustidae: Lepidoptera)

Distribution and status: Widely distributed in India.

Host range: Melon, gourds, cucumber and cucurbits

Damage symptoms

Larvae webs leaves and feed. Ovaries and young developing fruits are also eaten. Affected flowers bears no fruits and infested fruits become unfit for consumption.

Bionomics

Adult has transparent white wings with broad and dark brown marginal patches and orange coloured anal tuft of hairs in the female. Eggs are laid singly or in groups on the lower surface of the leaves. Egg, larval, pupal periods last for 3-6, 9-14 and 5-13 days respectively. Larva elongate bright green with a pair of thin white longitudinal lines on the dorsal side. Pupation take s place in a cocoon in the flowers. Adult lives for 3 -7 days and females lays upto 366 eggs.

Management

1. Collect and early stage caterpillars.
2. Spray Malathion 50 EC or dimethoate 30Ec or methyl demeton 25 EC 500 ml in 500 L of water.
3. DDT, lindane 1.3 D, copper oxychloride, Bordeaux mixture and sulphur dust should not be used as these are highly phytotoxic.
4. Encourage the activity of larval parasitoid of namely Apanteles spp.

6. Stem gall fly: *Neolasioptera falcata* (Cecidomyiidae: Diptera)

Maggot feeds within distal stems of bitter-gourd, ribbed and smooth gourds causing formation of elongated galls in between nodes. Gall formation causes stunting of plants.

Remove and destroy the affected shoots in the early stages of infestation.

7. Stem borer /Clear winged moth: *Melittia eurytion* (Aegeriidae: Lepidoptera) It is a pest of snake gourd and occurs widely in India. Moth is clear winged with fan like tufts of hairs on hind legs. White larvae bore into the stems producing galls. Frass comes out of the gall through a hole made on it. Plants stunted with poor foliage. Pupal period 20-24 days in earthen cocoon in soil.

8. Stem boring grey beetle: *Apomecyna saltator* (Cerambycidae: Coleoptera)

In South India, it attacks *Coccinea* vines, which die as a result. Adult female is a white spotted greyish- brown longicorn beetle and the male is smaller and black. Eggs are laid singly on internodes below the bark.

Grubs bore into the long trailing stems at or near a node and tunnel inside. Adult beetles gnaw the leaf petioles and soft parts of the stem. A female lays 38- 52 eggs, which hatch in 5-7 days. There are six larval instars covered in 31-35 days. Pupal period lasts for seven to nine days. Total life cycle takes 80-98 days. Adult has a longevity period of 37-43 days.

9. Plume moth: *Sphenarches caffer* (Pterophoridae: Lepidoptera)

This is a common pest of bottle-gourd in South India. Adult is a tiny plume moth. Eggs are laid singly on buds and leaves. Both larva and pupa have spines on the body. Larva feeds on the foliage. Collect and destroy larvae and pupae in their early stages. Insecticides as suggested for pumpkin beetles will also manage these pests.

10. Stink bug: *Aspongopus janus* (Pentatomidae: Hemiptera)

It is a large red and black bug found clinging to the leaves and tender shoots in large numbers. Nymphs and adults emit a buggy smell and suck sap from the tender parts and thereby devitalize the plants and retard their growth.

Collect and destroy the leaves and twigs bearing congregating bugs and spray 1.0 in 500 L of water per ha to manage this pest.

11. Spotted leaf beetle: *Epilachna vigintioctopunctata* (Coccinellidae: Coleoptera)

Refer brinjal

12. Flower feeder: *Mylabris pustulata* (Meloidae: Coleoptera)

Beetle feeds on pollens, petals of flowers and flower buds, as a result, fruit setting is affected. Collection and destruction of beetles in the early morning and insecticides as suggested for pumpkin beetles will manage the beetles.

13. Red spider mites: *Tetranychus neocaledonicus (Tetranychidae: Acari)*

This is a common pest of cucurbits. Mite lives beneath thick webs on leaf surface. Parthenogenesis is common. Fertilized female lays 61 to 93 eggs and unfertilized female 39 to 59 eggs. Eggs are laid at random on the webbing on the lower surface of leaves. They hatch in 3 - 27 days for males and females respectively in various seasons. Gravid females are seen during December to March. Under controlled conditions, up to 32 generations are observed/year. Damages are caused by desapping and by covering leaves with thick webs. Remove and destroy infested parts along with colonies and spray dicofol 18 EC 1.0 L in 500 L water/ha

NON INSECT PESTS

Among the non insect groups, mites and nematodes are very important in causing economic losses under vegetable ecosystem. Of the various mites, red spider mite *Tetranychus cinnabarinus* (Boisduval) is serious pest in brinjal, bhendi, cucurbits and crucifers. Nymphs and adults desap the plants resulting in clusters of yellow spots on the dorsal leaf lamina. Currently, dicofol (2ml/ lit) application is found to be effective in managing this pest. Among the nematodes infesting the crops, root knot nematodes, *Meloidogyne* spp cause serious damage to the roots of tomato, brinjal, bhendi, cucurbits, radish, etc.; stunt

nematode, *Tylenchus* spp. in cabbage and cauliflower and cyst nematode, *Globodera* spp. in potato. Management practices against the nematodes include flooding the field, crop rotation with non host crops, planting marigold, *Tagetes erecta*, use of biocontrol agents *Paecilomyces lilacinus*, *Trichoderma harzianum* and insecticide carbofuran (2 kg a.i./ ha).

Questions

1.	Destructive stage of pumpkin beetle is ----------	
	a. Grub	b. Adult
	c. **Both grub and adult**	d. None of the above
2.	Site of pupation for fruit fly is ----------	
	a. Soil	**b.** In between leaf
	c. On fruit	d. Within fruit
3.	Pumpkin beetle belongs to family	
	a. **Galerucidae**	b. Melolonthidae
	c. Curculionidae	d. Meloidae
4.	---------- caterpillar cuts the edges of leaf lamina, folds it over the leaf and feeds from within leaf roll on cucurbit **Leaf caterpillar**	
5.	----------trap used for attract the fruit fly - **Methyl eugenol**	
6.	---------- lure used for controlling of fruit fly on cucurbit -**Cucurbitacine**	
7.	Scientific name of red pumpkin beetle is **---------- Aulacophora foveicollis**	
8.	Larvae make mine on leaves and drying and dropping of leaves is seen due to severe infestation of ---------- **Serpentine leaf miner**	
9.	In cucurbits, DDT, lindane 1.3 D, copper oxychloride, Bordeaux mixture and sulphur dust should not be used as these are highly phytotoxic- Say is **True** or false	
10.	Oozing of brown, resinous fluid from fruits and the fruits become distorted and malformed is due to attack of ---------- on cucurbit- **Fruit fly**	
11.	---------- bore into stem causing gall-like swellings in the stem, near the base. **Stem weevil**	
12.	Yellow vein mosaic virus is transmitted by ---------- ***Bemisia tabaci***	
13.	Yellowing of leaves followed by crinkling and downward curling leading to bronzing leading to typical “hopper burn” symptoms is due to attack of ---------- **Leaf hopper**	
14.	40 days old American tall marigold and 25 days old tomato seedling are grown simultaneously in 1:10 rows to attract ---------- adults for egg laying – ***Helicoverpa armigera***	
15.	Larva of ---------- bores into tender terminal shoots in the vegetative stage and flower buds, flowers and young fruits in the fruit formation stage. **Shoot and fruit borer**	

Lecture No 24

PESTS OF CRUCIFEROUS VEGETABLES

Crucifers are attacked by several pests among which diamondback moth is the most challenging and destructive as it has developed resistance to more than 40 insecticides. Aphids and mustard saw fly are equally destructive under North Indian conditions.

Major pests			
Diamond back moth	*Plutella xylostella*	Plutellidae	Lepidoptera
Leaf webber	*Crocidolomia binotalis*	Pyraustidae	Lepidoptera
Cabbage semilooper	*Tircihoplusia ni*	Noctuidae	Lepidoptera
Cabbage butterfly	*Pieris brassicae*	Pieridae	Lepidoptera
Cabbage borer	*Hellula undalis*	Pyraustidae	Lepidoptera
Mustard sawfly	*Athalia lugens proxima*	Tenthredinidae	Hymenoptera
Cabbage aphid	*Brevicoryne brassicae*	Aphididae	Hemiptera
Cabbage flea beetle	*Phyllotreta cruciferae*	Chrysomelidae	Coleoptera
Minor pests			
Painted bug	*Bagrada hilaris*	Pentatomidae	Hemiptera
Cutworms	Agrotis ipsilon	Noctuidae	Lepidoptera

Major pests

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

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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.


ETL: 20 larvae/l0 plants

Bionomics

Yellowish, pinhead sized eggs are laid singly or in batches of 2-40 on the underside of leaves. A female may lay 18-356 eggs in her life time. Egg period 2 - 9 days. Larva: 8-12 mm

long, pale yellowish green in color, pointed at both the ends with fine erect black hairs scattered over the body. Larval period 8 -16 days. Pupa is a barrel shaped silken cocoon which is open at both the ends and is attaché d to the leaf surface. Pupal period 4-5 days. Adult: Small, greyish brown having pale whitish narrow wings with inner margins yellow. Three pale whitish triangular markings on hind margins of each forewing are prominent. At rest, a dorsal median patch of three diamond shaped yellowish white spots clearly visible by joining both forewings. Hind wings have a fringe of long hairs. Adult moth may live for about 20 days. Total life cycle is completed in 15-18 days. There are several generations in ayear.





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. Alternate Bt. sero types *kurstaki* (B.t.k.)and *aizawal (*B.t.a.)
- 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 any of the following insecticide with 500 1000 L water/ha primordial or head initiation stage. Mix teepol or sandovit 0.5 ml/Lt of water whenever sprays are made
- **Note:** Primordial formation takes place between 17 and 25 days after planting, depending on variety.

• Azadirachtin 0.03% 2.5-5.0 L	• Lufenuron 5.4 EC 600 ml
• Chlorantraniprole 18.5 SC 50 ml	• Indoxacarb 14.5 SC 200-265 ml

	or 15.8 SC ml 265
• Chlorfenapyr 10 SC 750-1000 ml	• Metaflumizone 22 SC 750-1000 ml
• Diafenthiuron 50 WP 600 g	• Novaluron 10 EC 750 ml
• Emamectin benzoate 5 SG 150-200 g	• Pyridalyl 10EC 500-750 ml
• Fipronil 5 SC 800-1000 ml	• Spinosad 2.5 SC 600-700 ml
• Flufenoxuron 10 DC 400	• Thiodicarb 75 WP 1.0-1.3 g
• Quinalphos 25 EC 1000 ml	

2. Leaf webber: *Crocidolomia binotalis* (Pyraustidae : Lepidoptera)

Distribution and status: Regular pest of minor status but occasionally reach serious proportions

Host range: Cabbage, radish, mustard and other cruciferous plants.

Damage symptoms

Young larva feeds gregariously on leaves, later webs together the leaves and feeds. Due to gregarious feeding, rotting of cabbage heads and cauliflower curds are common.

Regular pest of minor status but occasionally turn to serious proportions.

Bionomics

Female moth lays 40-100 eggs on underside of the leaves. Egg period 5-15 days. Larva: with red head, brown longitudinal stripes and rows of tubercles on its pale violet body. Larval period 24-50 days. Pupates in soil, pupa is an earthen cocoon. Pupal period 14-40 days. Adult: Small pale brown with forewing having distinct wavy lines and prominent wavy spots. Hind wings semi-hyaline. Life cycle is completed in 43-82 days. More than one generation may be completed in the season.




Management

1. Spray phosalone 50 EC 1.0 L, fenvalerate 20 EC or cypermethrin 10 EC or deltamethrin 28 EC 250 ml, cartap hydrochloride 50 SP 500 ml, spinosad 45 SC 125 ml/ha or azadirachtin 0.03% 2.5-5.0 L/ha. Do not repeat the insecticides with similar mode of action.
2. The pest is regulated by two larval parasitoids viz., *Microbracon mellus* and *Apanteles crocidolmiae*

3. **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.


Bionomics

E ggs are greenish white, spherical and sculptured and are laid singly on ventral surface of leaves. Adults are stout moths. Head and thorax grey in colour, while abdomen is white with basal tuft of hairs. Pupation takes place in thintransparent cocoons on ventral surface of leaves. Life cycle occupies on month.



Management

1. Hand pick and destroy caterpillars
2. Use light trap to attract and kill adults
3. Spray quinolphos 0.5% or - 0.1 % or malathion 0.1 %

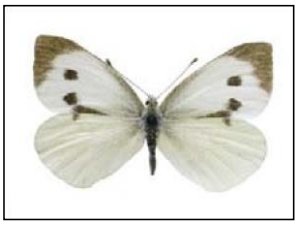
4. **Cabbage butterfly: *Pieris brassicae* (Pieridae: Lepidoptera)**

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

Bionomics






Full-grown pale yellow larva becomes greenish and measures 40-50 mm in length. In adults, the wings are pale white, with a black patch on the apical angle of each fore wing and a black spot on the costal margin of each hind wing. The females have two conspicuous black circular dots on the dorsal side of each fore wing. Males are smaller than the females and have black spots on the underside of each fore wing

The butterflies are very active in the field and lay, on an average, 164 yellowish conical eggs in clusters of 50-90 on the upper or the lower side of a leaf. Egg period is 3-17 days. The caterpillars feed gregariously during the early instars and disperse as they approach maturity. They pass through five stages and are full-fed in 15-40 days. The larvae pupate at some distance from the food plants, often in barns or on trees. The pupal stage lasts 7-28 days. The butterflies live for 3-12 days and the pest breeds four times during October-April.

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

1. When in the gregarious stage, the caterpillars can be easily controlled by picking and destroying the infested leaves.
2. The grown-up caterpillars should be controlled with malathion 5 per cent @ 37.5 kg

per ha or by spraying 1.25 L of - 35 EC or 500 ml of dichlorvos 76 SC in 600-900 L of water per ha.

3. Conserve larval parasitoid *Apanteles glomeratus* (Braconidae) in the natural populations.

5. Cabbage borer: *Hellula undalis* (Pyraustidae: Lepidoptera)

Distribution and status: Worldwide, this is sporadic but occasionally serious

Host range: cabbage, cauliflower, radish, knoll-khol, beet root and the weed *Gynadropis pentaphylla*

Damage symptoms

Larva aborts head formation. Caterpillars first mine the leaves later feed on leaves, shoots sheltered within silken passage and finally bore into the stems. They prevent head initiation causing multiple shoots or heads.


Bionomics




Female moth lays oval shaped eggs singly or in clusters on the undersurface of the leaves or some other parts of the plant. Eggs are pearly white when laid which turns pink next day and latere brown. Egg period 2-3 days. Larva: Pale whitish-brown in colour with 4-5 purplish brown longitudinal stripes. Larval period 7-17 days. Pupa is a cocoon. Pupal period 6 days. Adult: Pale greyish brown. Forewings have grey wavy lines, a pale apical spot and pale edged dark moon shaped (lunule), hind wings pale dusky with slight fuscous suffusion

on apical area. Life cycle is completed in 15-25 days.

Management

Same as for leaf webber

6. Mustard Sawfly: *Athalia lugens* (Tenthredinidae: Hymenoptera)

Distribution and status: Widely distributed in Indonesia, Formosa, Myanmar and the Indian Sub-continent.

Host range: Mustard, toria (*Brassica campestris*), rapeseed, cabbage, cauliflower, knolkhol, turnip, radish, etc

Bionomics


` Dark green larvae have 8 pairs of abdominal prolegs. There are five black stripes on the back, and the body has a wrinkled appearance. A full-grown larva measures 16-18 mm in length. The adults are small orange yellow insects with black markings on the body and have smoky wings with black veins. The mustard sawfly breeds from October to March and undergoes pupal diapause during summer. The adults emerge from these cocoons early in October. They live for 2-8 days and lay 30-35 eggs singly, in slits made with saw like ovipositors along the underside of the leaf margins. Egg period is 4-8 days and the larvae feed exposed in groups of 3-6 on the leaves during morning and evening. They remain hidden during the day time and, when disturbed, fall to the ground and feign death. There are 7 instars with a larval period of 16-35 days. Pupation is in water proof oval cocoons in soil and the pupal period is 11-31 clays. Lifecycle is completed in 31-34 days. It completes 2-3 generations from October to March.

Damage symptoms

The grubs alone are destructive. They bite holes into leaves preferring the young growth and skeletonize the leaves completely. Sometimes, even the epidermis of the shoot is eaten up. Although the seedlings succumb; the older plants, when attacked, do not bear seed.

Management

1. Give first irrigation 3-4 weeks after sowing as it reduces the bug population significantly. (ii) Spray 1.0 L of malathion 50 EC or 625 ml of - 35 EC or quinalphos 25 EC in 500-600 L of water per ha once in October and again in March-
   April.
2. Conserve larval parasitoid *Perilissus cingulator* Morby (Ichneumonidae) and the bacterium, *Serratia marcescens* Bizio (Enterobacteriaceae)

7. Cabbage aphid: *Brevicoryne brassicae* (Aphididae: Hemiptera)

Damage symptoms

Colonies of aphid are found on tender shoots and suck sap from plant tissues. In case of severe infestation plants may completely dry up and die away. On larger plants, feeding damage results in curling and yellowing leaves, stunted plant growth, and deformed heads. White cast skin will be present at the base of the plant. **Management**

1. Set up yellow sticky trap @ 10 / ha.
2. Spray any one of the following:
    - Dimethoate 30 EC 1000 ml/ha
    - Methyl demeton 25 EC 1000 ml/ha
    - Monocrotophos 36 WSC 625 ml/ha
    - Neem oil 2.0 L/ha
    - Azadirachtin 0.03% 2.5-5.0 L/ha

- Aphid skin is covered with waxy filaments and for better adherence on aphid body, add wetting agent in spray fluid.

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

Distribution and status: Europe, USSR, North and South America, Australia, japan and India.

Host range: Mustard, raya, taramira, toria, radish, turnip, cabbage, cauliflower, knoll-khol dahlia, sweet sultan, antirrhinum and sweet peas.

Damage symptoms

Adult beetle feeds on the leaves by making round holes. The stem, flower and even pods may also be attacked. Decaying odour is emitted by the cabbage plants.

Bionomics

The female beetle lays 50-80 creamy white eggs singly in the soil around the host plants. Egg period 5 -10 days. The larva is dirty white in colour and 5mm in length. Larval period 9-15 days. Pupal period 2-4 days. Adult beetle is metallic blue with greenish hue.

Beetle measures 1.8 -2.0 mm. There are 7-8 generations in a year.

Management

Spray 2.5 kg of carbaryl 50 WP or 2 L of - 35 EC in 750 litres of water per ha.

Minor pests

- **Painted bug:** *Bagrada hilaris* (Pentatomidae: Hemiptera)
- **Cutworms:** Agrotis ipsilon (Noctuidae: Lepidoptera)
- **Thrips:** *Thrips tabaci* (Thripidae: Thysanoptera)
- **Aphid:** *Myzus persicae, Liaphis erysimi* (Aphididae: Hemiptera)

Questions

1. First instar larvae of ---------- mine epidermal surface of leaves producing typical white patches on cabbage - **Diamond back moth**
2. What is the ETL for diamond back moth ---------- - **2 larvae / plants**
3. Name the two larval parasitoids of diamond back moth ---------- and ---------- ***Cotesia plutella*** , ***Diadegma semiclausum***
4. Due to gregarious feeding of this pest, rotting of cabbage heads and cauliflower curds are common.

a. Diamond back moth b. **Leaf webber**

c. Head borer d. Aphid

5.Scientific name of cabbage head borer is ---------- ***Hellula undalis***

6. ---------- is the pest of cabbage that prevent head initiation causing multiple shoots or heads. **Head borer**
7. White cast skin of this pest will be present at the base of the plant.

a. Diamond back moth b. Leaf webber

c. Head borer d. **Aphid**

8. Name the wetting agent in the spraying fluid - **Teepol** and **Sandovit**
9. How much wetting agent can be used with water whenever sprays are made -**0.5 ml / lit of water**
10. Wetting agent may be added in spray fluid for better adherence on aphid body because the skin is covered with_____**waxy filament**
11. How many yellow sticky trap can be installed /ac to attract aphid population

a. 3 b. **4**

c. 5 d. 6

12.---------- adult has a fringe of long hairs on hind wing - **Diamond back moth** 13. Mustard crop can be used as trap crop in cabbage field to attract ---------- **Diamond back moth**

14. *Plutella xylostella* belongs to the family

a. **Plutellidae** b. Noctuidae

c. Gelichida d. Gracillaridae

15. How many pheromone trap can be installed / ac to attract the diamond back moth

a. 3 b. 4

c. **5** d. 6

Lecture No. 25

PEST OF TUBER VEGETABLES I. POTATO

	Major pests			
1.	Potato tuber moth	*Phthorimaea operculella*	Gelechiidae	Lepidoptera
2.	Cutworms	*Agrotis ipsilon, A. segetum, Xestia C. nigrum and Peridroma saucia*	Noctuidae	Lepidoptera
3.	White grubs	*Holotrichia excisa, H. repetita, H. notaticollis Anomala communis, A. nathani*	Melolonthidae	Coleoptera Coleoptera
4.	Bihar hairy caterpillar	*Spilosoma obliqua*	Arctiidae	Coleoptera
5.	Hadda Beetles	*Epilachna dodecastigma*, *Henoesepilachna vigintioctopunctata*	Coccinellidae	Coleoptera
6.	Egg plant shoot borer	*Leucinodes orbonalis*	Pyraustidae	Lepidoptera
	Minor pests			
7.	Aphids	*Aphis gossypii, Myzus persicae, Lipaphis erysimi* and *Brevicoryne brassicae*	Aphididae	Hemiptera
8.	Leafhoppers	*Empoasca kerri*	Cicadellidae	Hemiptera
9.	Whiteflies	*Bemisia tabaci*, *Trialeurodes vaporariorum*	Aleyrodidae	Hemiptera
10.	Thrips	*Selenothrips indicus*	Thripidae	Thysanoptera
11.	Green stink bug	*Nezara viridula*	Pentatomidae	Hemiptera
12.	Green leaf Beetle	*Chalaenosoma metallicum*	Chrysomelidae	Coleoptera
13.	Tussock moth	*Dasychira mendosa*	Lymantriidae	Lepidoptera

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

Distribution and status

World wide. 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.

Bionomics

Adults are nocturnal in habit. With the onset of winter, moths fly from godowns to fields and lay eggs singly, near eyes of exposed tubers and on ventral surface of leaves. A single female lays 150 to 250 eggs. Eggs are minute, oval and yellowish in colour. Full-grown caterpillars are pinkishwhite to pale greenish in colour. Pupation takes place in rough silken cocoons. Adults are small moths with silvery body. Fore wing is greyish-brown with minute dark spots and fringes of hairs. Hind wings are dirty white. Egg, larval and pupal periods last for 3 to 4, 7 to 14 days respectively with at least 5 to 7 generations in a year.

ETL: 5% leaf damage

IPM

1. Select healthy tubers and avoid shallow planting of tubers and plant them to a depth of 1015 cm deep
2. Adopt inter-cropping with chillies, onion or pea
3. Earthing-up at 60 days after planting to avoid female moths egg laying on the exposed tubers
4. Install pheromone traps in the field @ 20/ha
5. Remove and destroy infested tubers
6. Release egg-larval parasitoid, *Chelonus blackburni*@ 30, 000 adults/ha twice, 40 and 70 days after planting
7. Store only good and clean tuber in well-ventilated, cool, dry place with temperature not exceeding 21ºC. Cold storage is highly preferable.
8. Keep pheromone traps in godowns also and destroy trapped moths.
9. Fumigate godowns in airtight condition with carbon disulphide (CS_2) or a mixture of carbon disulphide and carbon tetrachloride or with Ecofume.
10. In godowns, cover the upper surface of potato leaves with *Lantana* or *Eupatorium* branches to repel oviposting moths.
11. Spray NSKE 5% or quinalphos 25 EC 1.0 L in 500 L of water per ha to manage foliar damage
12. Treat seed tubers with quinalphos 1.5 D or - 4D dust @ 1 kg/100 kg of tubers

2. 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

Ppolyphagous 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.

ETL: 2 larvae /meter row

Bionomics

Moths appear after dusk, mate and lay eggs on ventral surface of leaves or moist soil. Freshly ploughed fields are preferred for oviposition. A female lays 300 to 450 eggs in 10 to 15 clusters. Eggs are globular in shape, ribbed and whitish in colour. Tiny caterpillars feed gregariously on foliage for a few days and then enter into soil.

Caterpillars are nocturnal in habit and hide during day in cracks and crevices in soil or under debris around plants. At night they come out, cut seedlings near ground level and eat tender parts. Damage is more pronounced in low-lying waterlogged areas. Full-grown caterpillars enter soil and pupate in earthen cocoons. Egg, caterpillar and pupal stages last for 2 to 13, 10 to 30 and 10 to 30 days, respectively. Total life cycle is 30 to 68 days. Two larvae / mt row is considered as ETL.

Cutworm species	**Larval description**	**Adult description**
Agrotis ipsilon	Black with pale mid-dorsal stripes. Head is pale-brown	Fore wing is pale brown with dark purplish brown along costal end. Hind wing is white with brown tinge. Male has bipectinate antenna and female has filiform antenna
A. segetum	Black coloured with brown head. Triangular spots at spiracular region	Fore wing is grey with peg and spot like marking. Hind wing is dull white. Male has bipectinate antenna and female has filiform antenna
Xestia C. nigrum	Brownish larva with series of black markings on lateral area	Reddish brown fore wing with concave sunken pale area. Hind wing is dull brown
Peridroma saucia	Light brown with 4-7 yellowish markings on middorsal line	Reddish brown fore wing with dark brown margin. Male has bipectinate antenna and female has filiform antenna

Agrotis ipsilon ***A. segetum***

Xestia C. nigrum ***Peridroma saucia***

IPM

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

3. White grubs: *Holotrichia excisa, H. repetita, H. notaticollis*, *Anomala communis, A. nathani* (Melolonthidae : Coleoptera)

Host range: Potato, groundnut and sugarcane.

Distribution and status: All over India

Damage symptoms: Grubs feed on roots and tubers; Adults feed on foliage during night; damage more during autumn.

Bionomics

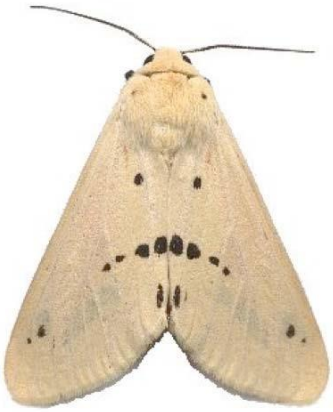
Eggs are laid in the soil near host plants. On hatching, grubs feed on developing roots and tubers of potato as well as other grasses growing around. When full-fed, grubs over winter deep down in the soil. Grubs are C shaped with orange head. Adults emerge as soon as temperature starts rising, but continue to remain in the soil till onset of monsoon. Adults feed on foliage during night and damage is more during autumn. *Holotrichia* adults are brown beetles with pale thorax. *Anomala* adults are smaller than *Holotrichia* and are pale-yellowish. **IPM**

1. Do summer ploughing to expose pupae and adults
2. Dust - 4% or quinalphos 5% D at 25 kg/ha 10 days after first summer rains
3. Install light traps between 7 PM and 9 AM in April-May months
4. Do presowing soil application of entomogenous fungus *Metarhizium anisopliae*1 10 FIB/g during May @ 20 kg/ha and fork the soil
5. Hand pick adult beetles in the morning
6. Hand pick 3rd instar grubs during July-August
7. In endemic areas, apply phorate 10 G at 25 Kg/ha during autumn (August-October)

4. Bihar hairy caterpillar: *Spilosoma obliqua* (Arctiidae: Coleoptera)

It attacks a wide range of cultivated crops including potato. Among vegetables, preferred host of *S. obliqua* is sweet potato.

For distribution and status, host range, bionmics, damage symptoms and management refer sunflower or mustard



5. Eggplant shoot borer: *Leucinodes orbonalis* (Pyraustidae: Lepidoptera)

Refer brinjal

6. Hadda Beetles: *Epilachna dodecastigma*, *Henoesepilachna vigintioctopunctata* (Coccinellidae: Coleoptera)

Refer brinjal

7. Aphids: *Aphis gossypii, Myzus persicae, Lipaphis erysimi* and *Brevicoryne brassicae* (Aphididae: Hemiptera)

Damage symptoms

Colonies of nymphs and adults are seen on ventral surface of leaves and shoots and suck sap there from. Infested leaves become yellowish, wrinkled and cupped, while, tender shoots turn yellowish and die away. They also excrete honeydew on which sooty mould develops covering affected parts with a thin superficial black coating that hinders photosynthetic activity of leaves resulting in stunted growth of plants. In addition, they also act as vectors, for transmitting several viral diseases.

Management

To control aphids, spray dimethoate or oxy-demeton methyl 500 ml or thiamethoxam 25 WG 100 g in 500 L of water per ha or drench thiamethoxam 25 WG 200 g. Repeat the spraying, if necessary, after 10 to 12 days.

8. Leafhoppers: *Empoasca kerri* (Cicadellidae: Hemiptera)

Refer cotton and groundnut

9. Whiteflies: *Bemisia tabaci,* (Aleyrodidae: Hemiptera) Refer

cotton

***Trialeurodes vaporariorum* (Aleyrodidae: Hemiptera)**

Both nymphs and adults desap the plants causing yellowing and wilting of plants. Adult small moth like insect lays pedicellate yellow eggs that turn dark chocolate brown on maturity.

Nymph yellowish white.

Management: As given for *Bemisia tabaci*

10. Thrips: *Selenothrips indicus* (Thripidae: Thysanoptera)

These are tiny, slender, fragile insects. Adults have fringed wings. Both nymphs and adults scrape epidermal tissues of leaves usually near tips and rasp oozing sap. Affected tips get curled

and dry up. Spray 0.2% carbaryl or 0.5% monocrotophos or thiometon to check pest population, if damage is severe.

11. Green stink bug: *Nezara viridula* (Pentatomidae: Hemiptera):

Distribution and status

It is cosmopolitan in distribution and recorded from South Europe and Japan down to Australia and South Africa. It is a minor pest and does not need management exclusively.

Host range

It is a polyphagous pest and also breeds on coffee, citrus, cotton, millets, pulses, potato, rice, indigo, tomato, wheat etc.

Damage symptoms

Nymphs and adults suck cell sap from tender leaves, and shoots, thereby devitalize plants.

Bionomics

Adults are medium-sized bugs and green to reddish-brown in colour. A female lays up to 300 eggs, stuck together in rafts, on dorsal surface of leaves. Eggs are barrel-shaped, whitish in colour, turning pink with age. Freshly hatched nymphs remain clustered around egg-raft and it is only after first moult that nymphs disperse and start active feeding.

12. Green leaf Beetle: *Chalaenosoma metallicum* (Chrysomelidae: Coleoptera)

These green coloured flea beetles feed on potato leaves and cause defoliation in South India.

13. Tussock moth: *Dasychira mendosa* (Lymantriidae: Lepidoptera) Host range

This is a polyphagous pest, attacking a number of fruit trees, potato, castor cauliflower etc.

Damage symptoms: It is a gregarious feeder and causes defoliation of leaves

For bionomics refer castor

II. SWEET POTATO

Major pests				
1.	Sweet potato weevil	*Cylas formicarius*	Apionidae	Coleoptera
2.	Hairy caterpillar	*Creatonotus gangis*	Arctiidae	Lepidoptera
3.	Blue pansy	*Precis orithya*	Nymphalidae	Lepidoptera
4.	Leaf folder	*Brachmia convolvuli*	Gelechiidae	Lepidoptera
5.	Tortoise beetles	*Aspidomorpha miliaris* *Metriona circumdata* *Chirida bipunctata*	Cassididae	Coleoptera
Minor pests				
6.	Sphinx caterpillar	*Agrius convolvuli*	Sphingidae	Lepidoptera
7.	Stem borer	*Omphisa anastomosalis*	Pyraustidae	Lepidoptera
8.	Spiny beetle	*Oncocephala tuberculata*	Hispidae	Coleoptera
9.	Brown looper	*Hyposidra successaria*	Geometridae	Lepidoptera
10.	Sweet potato hopper	*Exitianus indicus*	Cicadellidae	Hemiptera
11.	Fig bug	*Riptortus linearis*	Coreidae	Hemiptera
12.	Lygaeid bug	*Graptosethus servus*	Lygaeidae	Hemiptera
13.	Mealy bugs	*Geococcus coffeae*	Pseudococcidae	Hemiptera

1. Sweet potato weevil: *Cylas formicarius* (Apionidae: Coleoptera)

Distribution and status

It is a specific pest of sweet potato. Seen in Pantropical, Tropical Africa, India, South East Asia, Australia, Hawaii, South USA, West Indies and South America.

Host range

Ipomoea litoralis, I learii, I.purpurea, I.prescaprae, I trifida and I.sepiaria

Damage symptoms

Grubs bore into stems, cause tunneling inside and feed on soft tissues. Grubs and adults bore into tubers both in field and storage godowns. Affected tubers develop dark patches, which later start rotting. Pest is disseminated from field to field through infested vines and is carried over from season to season by breeding in damaged tubers left in the fields after harvest.

Bionomics

Adult weevils are ant-like, slender bodied having elongated snout-like bluish-brown head with non-geniculate antenna, bright red thorax and legs and brownish-red abdomen. Females make small cavities on the tubers or stems and lay eggs singly. Each female lays 100-200 eggs. Grubs are apodus, pale-yellowish white in colour. Pupation takes place in larval burrows. Incubation, grub and pupal stages last for 5 to 10, 16 to 20 and 4 to 8 days respectively. Life cycle is completed in 45 weeks.

IPM

1. Remove previous sweet potato crop residues and alternate host, *Ipomoea* sp. and destroy them. Discourage growing sweet potato in the same field year after year.
2. Use pest free planting materials
3. Mulch with leaves of *Chromolaena doormats, Clerodendron infortunatum* at 3 tonnes/ha at 30 days after planting (DAP)
4. Use cut sweet potato tubers (100 g) as trap during 50-80 DAP at 10 days intervals. Set the traps at 5 m apart at 4 pm and collect and destroy adult weevils at 6 am next day

5. Dip planting materials in monocrotophos 36 WSC 15 ml per L of water.
6. Rake up soil and earth up at 50 days after planting
7. Drench soil with - 35 EC @ 4 ml /L. Spray - 35 EC 1.5 L in 750 L of water per ha any of these, if needed from 30 DAP
8. Harvest immediately after maturity and destroy the crop residues
9. Install yellow sticky trap @12/ha

10. In godowns, treat the bag surface with malathion 5% or carbaryl 5 % dust.

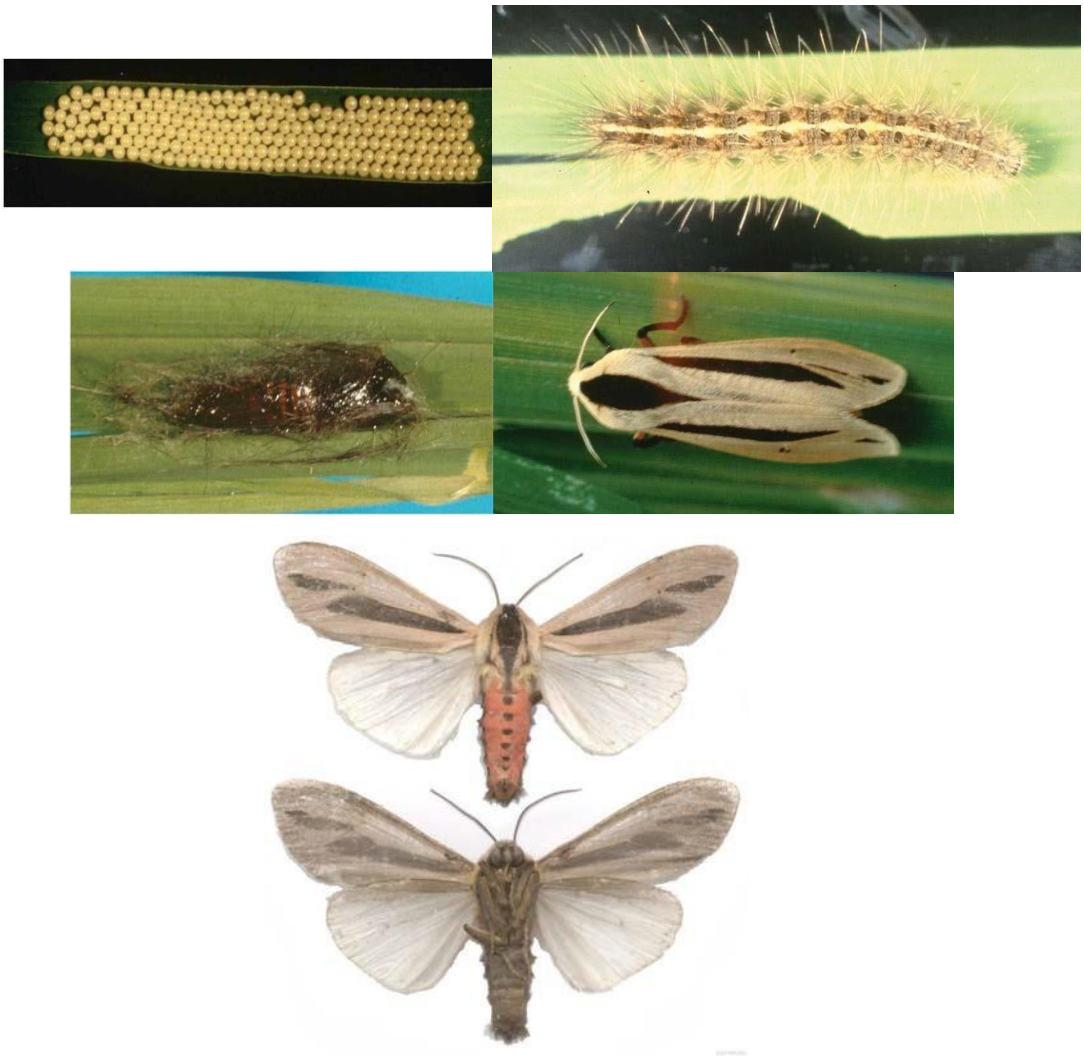
2. Hairy caterpillar: *Creatonotus gangis* (Arctiidae: Lepidoptera)

Distribution and status: Sporadic pest in sweet potato growing region in India

Host range: Polyphagous pest Lucerne, rice, maize, grasses, coffee, groundnut, Johnson grass and also feeds on pastures.

Bionomics

It appears in July and continues till November. Eggs are round in shape and shiny creamyyellow in colour. Caterpillars are cylindrical, slightly tapering posteriorly and dark violet to black in colour. Meso and Meta thorax are light golden-yellow and head black, hairy with characteristic yellow stripe dorsally. Adults have shiny black head. Fore wings are straw coloured with pinkish tinge and a transverse black band at the center. Hind wings are whitish with few black dots at the margin. A female lays 285 to 695 eggs in clusters arranged in rows closely set together. Incubation period is 4-5 days, larval period 22-32 days, pupal period 5-7 days. Adult period 12 days.



Management: as given under Bihar Hairy caterpillar and Red Hairy caterpillar

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3. Blue pansy: *Precis orithya* (Nymphalidae: Lepidoptera)

Host range: Sweet potato, weed striga

Bionomics

Moths are medium-sized with only two pairs of functional legs. More than half of fore wings are velvety black. Hind wings are blue shaped with velvety black towards the base, thus wing pattern resembles the pansy flower. Incubation, larval, pupal periods, adult longevity and life cycle last for 3, 14 to 16, 4 to 8, 3 to 7 and 27 to 29 days respectively.

It is actually a beneficial insect as it feeds on *Striga*, a weed parasite on sugarcane roots.

Damage symptoms: Defoliation

Management

1. After harvesting, give deep ploughing and flood infested fields to kill pupae and to prevent carry-over of pests
2. Collect and destroy egg clusters and leaves bearing caterpillars to prevent population buildup
3. Spray dichlorvas 660 ml or - 35 EC 750 ml to control widespread infestation

4. Leaf folder: *Brachmia convolvuli* (Gelechiidae: Lepidoptera)

Distribution and status: It is regarded as a pest of several *Ipomoea* species.

Host range *Ipomoea triloba* and *I. aquatic,* weed *Mikania cordata* (Asteraceae). **Damage symptoms**

Young larva scrapes the tender surface tissues of leaves remaining in thin webbings. Later on leaves folded longitudinally and green tissues eaten resulting in drying of leaves. Folds are usually single, but sometimes two folds are made, or two leaves are joined together.


Bionomics

Adult is a small slender moth and grayish-brown in colour. It lays eggs in small groups at the base of radiating veins on the underside of leaves. The eggs are oval, yellowish white when newly laid and turn pinkish yellow. Egg period three days. White neonate larva feeds on leaves and becomes full grown in 14 days undergoing five instars.Full-grown larva is slightly flattened and tapering towards both ends. Head is reddish-brown, glossy and flattened; thorax and two abdominal segments are velvety black and other segments are yellowish-white with a velvety black band. It pupates within leaf fold in 7 days.


IPM

- Use of insect-free planting materials.
- Conserve ichneumonid parasite, *Macrocentrus* sp. that attacks young larvae when they have not yet folded the leaf margins.
- If level of infestation warrants the use of chemicals, then contact-systemic insecticides can be applied.
- Collect and destroy folded leaves along with egg clusters,larvae and pupae
- Spray dichlorvos 76 SC 660 ml or - 35 EC 750 ml or carbaryl 50 WP 1.0 kg or phosalone 35 EC 750 ml in 500 L water per ha to control widespread infestation

5. Tortoise beetles: (Cassididae: Coleoptera)

Distribution and status

Throughout Africa, Southern China, Southeast Asia becomes serious occasionally.

Host range

Sweetpotato, *Ipomoea triloba,* coffee, beet, potato and various flowers.

Damage symptoms

Skeletonization of leaves by grubs. Later grubs and adults gnaw holes in leaf lamina. Grubs are green, flat with anal projection always carry debris on its back. Pupation takes place in ventral surface of leaves.

Bionomics These metallic coloured beetles are active during monsoon. Eggs are laid on ventral leaf surface. Grubs are nocturnal in habit

Species	Adult	Grub	Egg	Life cycle
Aspidomo rpha miliaris 	Broad oval shaped, brownish-red in colour with black dots	Flattened with spiny processes covering their body. Dried excreta are seen on the anal process	Laid in 5 to 10 rows	Egg, grub and pupal stages last for 9 to 11, 15 to 20 and 4 to 6 days respectively. Life cycle is completed in 28 to 36 days.
Cassida circumdat 	Broad oval shaped, greenish-yellow in colour with green crescent mark in middle	Pale greenish in colour	Laid singly. Fastened on leaf surface by filaments	Egg, grub and pupal stages last for 3 t0 5, 10 to 15 and 6 to 8 days respectively. Life cycle is completed in 30 days.
Chirida bipunctata 	Small metallic green in colour with six black spots on elytra	Pale greenish in colour	Laid singly	Egg, grub and pupal stages last for 4 to 6, 12 to 14 and 5 to 8 days respectively. Life cycle is completed in 30 days.

Management

Removal of convolvulaceous weeds in the surrounding area may reduce their numbers.

Conserve or encourage larval parasitoids *Tetrastichus* sp, predator *Stalilia* sp., (Mantidae).

Chemical control of this pest is seldom necessary.

Minor pests

6. Sphinx caterpillar: *Agrius convolvuli* (Sphingidae: Lepidoptera)

Distribution and status

It is commonly called as hornworm or giant hawk moth. It is widely distributed from Europe, Africa, Iran, Indian sub-continent, South-East Asia, South-China, Australia and New Zealand. It is of minor importance

Host range

It is a polyphagous pest attacking a number of crops including fruit trees, legumes, vegetables, etc.

Bionomics

It is active during monsoon season. Moths are stout, pale grey in colour having pale grey wings with transverse violet bands on abdomen. Females lay conspicuous seed-like shiny eggs singly on the tender parts of plant.

Eggs are sub-spherical in shape. Full-grown caterpillars are robust, green to dark brown in colour with reddish patches on sides and a curved horn like process at the anal end. Caterpillars feed voraciously on leaves and defoliate the vines. Pupae are reddish-brown in colour and pupation takes place in soil. Incubation, larval and pupal stages last for 5-10, 14-21, 7-11 days respectively. A complete life cycle occupies 4 to 5 weeks.

Management: No specific control measures are required.

7. Stem borer: *Omphisa anastomosalis* (Pyraustidae: Lepidoptera)

Whitish stout caterpillar bores into vines of plant in South India. Pupation takes place within larval tunnels. Moth has straw-coloured wings with wavy markings on them.

7. Spiny beetle: *Oncocephala tuberculata* (Hispidae: Coleoptera)

It occurs commonly in South India. Adult is a small brownish, hispine beetle with blunt projections all over body. It has a life up to 50 days. Eggs are thrust inside leaf tissues. Larva mines the leaf and causes it to wither. When full grown, it constructs a short tunnel in a healthy leaf in which it pupates. Eggs, larval and pupal stages last for 7-10, 17-23,and 8-15 days respectively. Adult also injures the leaves by feeding on them.

8. Brown looper: *Hyposidra successaria* (Geometridae: Lepidoptera)

Larvae feed on leaves. Its egg, larval and pupal periods is 4-5, 18-29 and 8-9 days respectively.

9. Sweet potato hopper: *Exitianus indicus* (Cicadellidae: Hemiptera)

Both nymphs and adults suck sap from leaves and tender shoots, but damage caused is negligible. Adults are active, slender, white leaf hoppers with head, thorax and scutellum greenish in colour.

10. Fig bug: *Riptortus linearis* (Coreidae: Hemiptera):

Nymphs and adults infest and damage tender shoots. Adults are elongated and dark brown bugs.

11. **Lygaeid bug: *Graptosethus servus* (Lygaeidae: Hemiptera)**

These are greyish-black bugs. Adults and nymphs suck cell sap from tender leaves and devitalizing them.

12. **Mealy bugs: *Geococcus coffeae* (Pseudococcidae: Hemiptera)**

Crawlers and adults infest tender roots and tubers. Damage is more severe when slightly infested tubers are stored. Under normal storage conditions, mealy bug multiplies rapidly and stored tubers get thickly covered with mealy growth and become shriveled due to loss of sap. Problem is perpetuated by use of infested tubers as seed. Tubers from infested fields should not be used. Dip the tubers in 0.5% phenthoate solution just before planting.

III. COLACASIA

	Major pests			
1.	Flea beetle	*Monolepta signata*	Alticidae / Galerucidae	Coleoptera
2.	Hairy caterpillar	*Pericallia ricini*	Arctiidae	Lepidioptera
3.	Sphinx caterpillar	*Theretra gnoma*	Sphingidae	Lepidoptera
4.	Sphinx caterpillar	*Agrius convolvuli*	Sphingidae	Lepidoptera
5.	Aphid	*Pentalonia nigronervosa*	Aphididae	Hemiptera
		Aphis gossypii	Aphididae	Hemiptera
	Minor pests			
6.	Thrips	*Heliothrips haemorrhoidalis* *Caliothrips indicus*	Thripidae	Thysanoptera
7.	Grasshopper	*Gesonula punctifrons*	Acrididae	Orthoptera
8.	Tingid	*Stephanitis typicus*	Tingidae	Hemiptera
9.	Horned caterpillar	*Hippotion oldenlandiae*	Sphingidae	Lepidoptera

1. Flea beetle: *Monolepta signata* (Alticidae: Coleoptera) Distribution and status: More severe in South India.

Host range: Polyphagous pest, wide range of host plants like beet root, cabbage, cauliflower, chilli and radish.

Damage symptoms

Bite holes on leaves. In severe cases tuber development affected.

Bionomics:

Adult is 3-4 mm long, reddish brown elytra with two big white spots on each elytron.

Management:

Spray - 35 EC 1.0 L or carbaryl 50 WP 1.0 Kg in 500 L of water per ha or dust - 4 D 25 kg per ha .

2. Hairy caterpillar: *Pericallia ricini* (Arctiidae:Lepidioptera)

Distribution and status: Sporadic pest

Host range: Castor, green manure, moringa

Damage symptoms

The damage is caused by caterpillar. It feeds on leaves resulting in defoliation. Larvae nocturnal and feed voraciously at night.

Bionomics

The larva is robust, greyish black or blackish brown larva with red head and thick tuft of hairs arising from the body. The adult is greyish brown or black colour and black spots on wings. Hind wings are pink or red colour with black spots.

Management

Spray - 35 EC or malathion 50 EC 1.0 L or carbaryl 1.0 kg in 500 L per ha

3. Sphinx caterpillar: *Theretra gnoma* (Sphingidae: Lepidoptera)

Distribution and status: Peninsular India

Damage symptoms

Caterpillars feeds on leaves gregariously and cause defoliation.

Bionomics

Larva 80-85 mm long with green head and yellowish green body speckled with dark green sripes. Adult has greenish brown head and thorax with a white lateral stripe; abdomen brown with a black dorsal patch. Forewings are brown with one discal line parallel to outer margin. Hind wings are black.

Management

Hand picking and destruction of caterpillars in initial stage of attack.

Spray - 35 EC 1.0 L or carbaryl 50 WP 1.0 kg in 500 L water per ha

4. Sphinx caterpillar: *Agrius convolvuli* (Sphingidae: Lepidoptera)

See under Sweet potato

5. *Pentalonia nigronervosa* (Aphididae: Hemiptera)

See under banana

6. Aphis gossypii

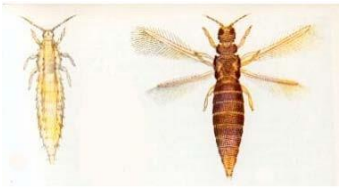
See under cotton

7. Thrips: *Heliothrips haemorrhoidalis* (Thripidae, Thysanoptera)

1.	---------- tunnels into foliage, stem and tubers which lead to loss of leaf tissue, death of growing points and weakening or breaking of stems **Potato tuber moth**
2.	Potato tuber moth is a pest of storage as well as field. Say **True** or false
3.	Fumigation of godowns in airtight condition with carbon disulphide (CS_2) or a mixture of carbon disulphide and carbon tetrachloride or methyl bromide is the control measure for ---------- **Potato tuber moth**
4.	Both grubs and adults of epilachna beetle feed on leaf tissues and skeletonize potato leaves completely. Say **True** or False
5.	---------- and ---------- type of antenna is found in male and female sex of Bihar hairy caterpillar **Pectinate** and **filiform**
6.	What is the scientific name of tussock moth ---------- **Dasychira mendosa**
7.	Barrel shaped eggs is laid by ---------- **Green stink bug**
8.	The scientific name of blue pansy is ---------- **Precis orithya**
9.	Name the brownish red tortoise beetle infesting sweet potato **– *Aspidomorpha miliaris***
10.	Sweet potato weevil has ---------- type of antenna – **Non geniculate**
11.	Which pest feeds on tender foliage and grown up larva cuts the stem at collar region.

	a. Potato tuber moth	b. **Potato cutworm**
	c. Shoot borer	d. Tussock moth
12.	Which is the tiny insect which sucks sap from ventral surface of leaves and devitalize	

Silvery white patches and faecalglobles on leaves.Nymph: Freshly hatched whitish; fully grown greenish brown. Adult: Dark brown.



Minor pests of colocasia

- Thrips: *Caliothrips indicusi* (Thripidae: Thysanoptera)
- Grasshopper: *Gesonula punctifrons* (Acrididae: Orthoptera)
- Tingid: *Stephanitis typicus* (Tingidae: Hemiptera)
- Horned caterpillar: *Hippotion oldenlandiae* (Sphingidae: Lepidoptera)

Question paper on Tubers

	a. Leaf hopper	b. Aphid
	c. **Whitefly**	d. Thrips
13.	Site of pupation for sphinx caterpillar in tubers	
	a. **Soil**	b. Leaf
	c. Inside tubers	d. Within leaf

IV. TAPIOCA

Common Name	Scientific Name	Family	Order
Major pests			
Cassava scale	*Aonidomytilus albus*	Diaspididae	Hemiptera
Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera
Spiraling whiteflies	*Aleurodicus dispersus*	Aleyrodidae	Hemiptera
Mealy bug			
Minor pests			
Thrips	*Retithrips syriacus*	Thripidae	Thysanoptera
Red spider mites	*Tetranychus urticae*	Tetranychidae	Acari

Major pests

1. Cassava scale : *Aonidomytilus albus* (Diaspididae: Hemiptera)

Distribution and status: India, Africa.Major pest in tapioca growing regions

Damage symptoms

Scales infest stems. Leaves of attacked plants become discoloured and dry up. In severe cases desiccation of the stem and death of plants occur. Stunting of the plants results from thousands of the scales feeding on the stems.

Bionomics

This is a hard scale, oval and mussel-like. Male is winged. Eggs are laid inside scale. They hatch in 4 days. Nymphs are active and move on stems spreading to new areas of new stems. They settle close to one another, feed on sap and become full grown in 20

to 25 days. Pest is distributed through movement of crawlers, winged males and infested stems.

Management

1. Select pest-free setts for planting
2. Collect and burn the stems infested with scales
3. Encourage activity of coccinellid predators, *Chilocorus nigritus*
4. Dip setts in methyl demeton 25 EC or dimethoate 30 EC 0.05% or malathion 50 EC 0.1%

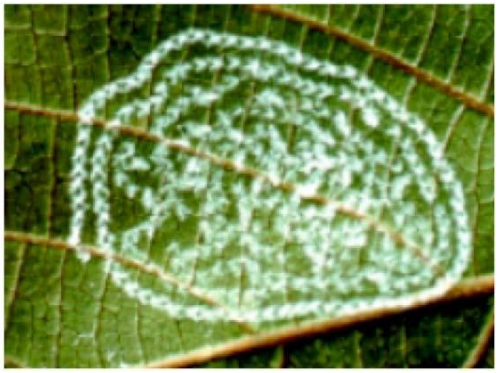
2. Whitefly: *Bemisia tabaci* (Aleyrodidae: Hemiptera)

It transmits cassava mosaic disease in tapioca

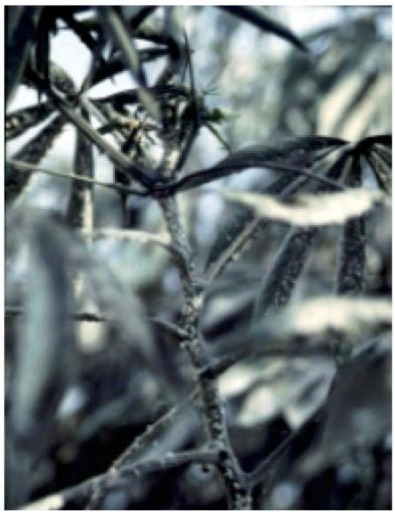
Refer cotton for more information

Cassava mosaic symptom

3. Spiraling whiteflies: *Aleurodicus dispersus* (Aleyrodidae: Hemiptera) Refer Guava



Blackened by spiraling whitefly attack



Minor pests

4. Thrips: *Retithrips syriacus* (Thripidae: Thysanoptera)

Thrips infest both sides of leaves. Infested leaves become discoloured and young plants become stunted. In older plants, leaves dry up and fall.

5. Red spider mites: *Tetranychus urticae* (Tetranychidae: Acari)

They cause damage during rainless summer. Mites infest underside of leaves on either side of the mid-rib. Infested regions turn yellowish. Attacked plants are stunted. Developmental period varies from 9 to 12 days and adult life from 4 to 10 days. A female lays about 4-26 eggs. Mites can be controlled by using acaricides like monocrotophos 750 ml or dicofol 750 ml or wettable sulphur 1.0 kg in 500 L of water per ha

Lecture No. 26

PEST MANAGEMENT IN AMARANTHUS AND MORINGA

I. AMARANTHUS AND OTHER LEAFY VEGETABLES

Major pests			
Amaranthus stem weevil	*Hypolixus truncatulus*	Curculionidae	Coleoptera
Amaranthus caterpillar or webber	*Hymenia recurvalis*	Pyraustidae	Lepidoptera
Minor pests			
Leaf webber	*Eretmocera impactella*	Heliodinidae	Lepidoptera
Leaf webber	*Psara basalis*	Pyraustidae	Lepidoptera
Tortoise beetle	*Aspidomorpha exilis*	Cassididae	Coleoptera
Grasshopper	*Atractomorpha crenulata*	Acrididae	Orthoptera
Leaf twisting weevil	*Apoderus tranquebaricus*	Curculionidae	Coleoptera
Aphids	*Aphis craccivora*	Aphididae	Hemiptera
Mealy bugs	*Ferrisia virgata*	Pseudococcidae	Hemiptera
Thrips	*Euryaplothrips crassus*, *Haplothrips ceylonicus*	Thripidae	Thysanoptera

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

Distribution and status

Specific major pest. Widely distributed in India and neighbouring countries. It attacks both wild and cultivated crops and leafy vegetables with large leaves.

Damage symptoms

Grubs bite into stems, feed on pith region making irregular zigzag tunnels and fill with excreta. Stems split longitudinally. Plants dry completely. Adult feeds on tender leaves, makes circular holes in stems, branches and mid-ribs. Attack causes stunting of plants, twisting and swelling of branches and stem and suppression of shoot and leaf production.

Bionomics

Females lay eggs singly in each hole and cover holes with secretion. A female lays 30-34 smooth, oval and pale yellow eggs, egg period 4 to 10 days. A single stem contains 17-20 grubs in it. Grubs are stout, curved, apodous and white in colour. Grub stage lasts for 12 - 24 days. Fullfed grubs form a greyish-brown hard compact gall like chamber and pupate therein. On emergence, they remain inside the stem for 5 to 6 days, then cut epidermal membrane and emerge out. Adults are ash-grey in colour, with elbowed antennae and brown elytra.


IPM

1. Collect and destroy wild amaranthus hosts in the vicinity of cultivated crop.
2. Collect and destroy affected plant parts along with grubs and adults
3. Spray malathion 50 EC 500 ml or - 35 EC 500 ml or dichlorvos 375 ml in 500 L of water per ha after the harvest of leaves and stems. Plan next harvest 15-20 days later

2. Amaranthus caterpillar or webber: *Hymenia recurvalis* (Pyraustidae: Lepidoptera)

Distribution and status

Destructive pest. Widely distributed in tropical and subtropical regions including Africa, Asia and Australia. In the Indian sub-continent it is found all the year round, but is more active during warmer, rainy and early winter months.

Host range

Amaranthus, beans, melons, spinach, coleus, *Luffa* spp., grasslands and pastures

Damage symptoms

Larvae scrape the epidermal and palisade tissues of leaves; web the leaves with silken threads resulting in drying of webbed leaves.

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Bionomics


Adult is a dark brownish black moth with white wavy markings on wings. Spherical snowwhite eggs laid singly or in batches of 2 to 5, in grooves of leaf veins. Fecundity is 50 to 80 eggs. Caterpillars are greenish in colour with white lines and black crescents on thorax below lateral line. Fully fed, caterpillars drop down and pupate in soil. Incubation, caterpillar and pupal periods last for 3 to 4, 12 to 16 and 8 to 12 days respectively. Life cycle is completed in 3 to 4 weeks.

IPM

1. Collect and destroy affected plant parts along with caterpillars
2. Use light traps @ 1- 2 / ha to attract and kill adults
3. Spray malathion 50 EC 500 ml or - 35 EC 500 ml or dichlorvos 375 ml in 500 L of water per ha after the harvest of leaves and stems. Plan next harvest 15-20 days later.

Minor pests

3. Leaf webber: *Eretmocera impactella* (Heliodinidae: Lepidoptera)

Distribution and status: Sporadic pest. Widely distributed in the Indian sub-continent.

Damage symptoms: Caterpillars web leaves with white silken threads and remain hidden in folds feeding from inside.

Bionomics

Eggs are laid on leaves or on top shoots. Full-grown caterpillars are cylindrical, brownishyellow to brownish-grey in colour with a broad sub median dark stripe and black tubercles bearing several divergent longitudinal hairs. Long brown pupae in white silken cocoons remain attached to leaves. Moths are small, blackish with prominent yellow spots on fore wings. Life cycle is completed in 3 to 4 weeks.

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4. Leaf webber: *Psara basalis* (Pyraustidae: Lepidoptera)

Its habits, symptoms of damage and life history are similar to that of *Hymenia recurvalis*. Full fed caterpillars are greenish in colour. Adults are small with yellowish, white thorax and abdomen with brownish red fore wing and dark brown hind wing.

5. Tortoise beetle: *Aspidomorpha exilis* (Cassididae: Coleoptera)

Eggs are laid singly on ventral surface of leaves. Grubs and adults feed by scrapping outer tissues of leaves. Pupation takes place on leaf surface. Life cycle is completed in 15 to 30 days.

6. Grasshopper: *Atractomorpha crenulata* (Acrididae: Orthoptera)

It is a highly polyphagous pest with a very wide range of host plants both cultivated as well as wild. Nymphs and adults nibble leaf lamina causing irregular holes. In case of severe attack, dust with 4% carbaryl or -.

7. Leaf Twisting Weevil: *Apoderus tranquebaricus* (Curculionidae: Coleoptera)

Refer mango

8. Aphids: *Aphis craccivora* (Aphididae: Hemiptera); Mealy bugs: *Ferrisia virgata* (Pseudococcidae: Hemiptera)

Suck vital sap from leaves.

9. Thrips: *Euryaplothrips crassus*, *Haplothrips ceylonicus* (Thripidae: Thysanoptera)

Infest inflorescence.

II. MORINGA

Major pests			
Pod fly	*Gitona distigma*	Drosophilidae	Diptera
Bud worm	*Noorda moringae*	Pyraustidae	Lepidoptera

Leaf caterpillar	*Noorda blitealis*	Pyraustidae	Lepidoptera
Hairy caterpillars	*Eupterote mollifera*	Eupterotidae	Lepidoptera
	Pericallia ricini	Arctiidae	Lepidoptera
	Metanastria hyrtaca	Lasiocampidae	Lepidoptera
	Streblote siva	Lasiocampidae	Lepidoptera
Bark borer	*Indarbela tetraonis*	Metarbelidae	Lepidoptera

Long horn beetles	*Batocera rubus*	Cerambycidae	Coleoptera
Minor pests			
Aphids	*Aphis gossypii*	Aphididae	Hemiptera
Scale Insects	*Ceroplastodes cajani*	Diaspididae	Hemiptera
Bud midge	*Stictodiplosis moringae*	Cecidomyiidae	Diptera
Leaf eating weevils	*Myllocerus* spp.	Curculionidae	Coleoptera

1. Pod fly: *Gitona distigma* (Drosophilidae: Diptera)

Distribution and status: Serious pest of moringa in South India.

Host range: Moringa

Damage symptoms

Maggots enter into tender fruits by making small-bore holes at the terminal end. This causes oozing out of gummy fluid from fruits, which ultimately results in the drying of fruits from tip upwards. A maximum of 20-28 maggots are found in a fruit. Internal contents of the fruits rot.

Bionomics

Activity is maximum from April to October and declines thereafter. Adult is a small yellowish fly with red eyes. Wings extend beyond body and have a dark spot near the coastal margin. Cigar shaped, sculptured and white coloured eggs are laid on the grooves of tender pod either singly or in groups of 3-4. Egg period 3-4 days, maggot period 18-25 days. Full-grown cream coloured maggots pupate in soil for 5-9 days. **Management**

1. As moringa pod flies are not attracted to methyl eugenol and fish meal, use attractants like citronella oil, eucalyptus oil, vinegar (acetic acid), dextrose or lactic acid to trap flies.
2. Periodically collect and destroy all the fallen and damaged fruits by dumping in a pit and covering with a thick layer of soil to prevent carry-over of the pest.
3. Frequently rake up the soil under the trees or plough the infested field to destroy puparia and apply - 4% at 25 Kg/ha or drench NSKE 5% at 2 L/tree at 50% fruit set.

4. Spray dichlorvos 76 SC 500 ml or malathion 50 EC 750 ml in 500 - 750 ml of water per ha when pods are 20-30 days old and apply Azadirachtin 0.03 % 1.0 L during 50% fruit set and 35 days later.

2. Bud worm: *Noorda moringae* (Pyraustidae: Lepidoptera) **Distribution and status:** Major pest in South India

Host range: Moringa

Damage symptoms

Larvae bore into flower buds and cause shedding of buds up to 75%. Generally, infested buds contain only one caterpillar. Damaged buds seldom blossom; fall down prematurely Activity is more during summer months in South India.

Bionomics

Adult is small in size with dark brown fore wings and white hind wings with dark brown border. It lays oval, creamy white eggs in clusters or singly on flower buds. Caterpillars are dirty brown with a prominent mid-dorsal stripe and black head and prothoracic shield. Full-fed caterpillars come out or pupate in minute brownish cocoons, either in soil or on ground itself, below dried leaves and debris. Egg, larval and pupal periods occupy respectively 3-4, 8-16 and 610 days.

Management

1. Plough around trees to expose and kill pupae
2. Collect and destroy damaged buds along with caterpillars
3. Use light traps to attract and kill adults @ 1-2 /ha
4. Spray carbaryl 50 WP 1.0 kg or malathion or - 1.0 L in 500 - 750 ml of water per ha.

3. Leaf caterpillar: *Noorda blitealis* (Pyraustidae: Lepidoptera)

Distribution and status: It is a sporadically serious pest of drumstick trees especially in South India.

Host range: Moringa

Damage symptoms: Caterpillars feed on leaf lamina, turning them into transparent parchment like structures. Peak period of infestation is during March to April and December to January.

Bionomics

Adults are medium sized moths. Fore wings are uniformly dark in colour with a small white streak near the base. Hind wings are hyaline with broad black marginal band towards anal side. Eggs are laid in batches usually on ventral surface of leaves. Egg, larval and pupal durations last for 3, 7 to 15 and 6 to 9 days respectively. Pupation in soil.

4. Hairy caterpillars

a. Eupterote mollifera (Eupterotidae: Lepidoptera)

Distribution and status: Destructive and specific pest of drumstick in South India.

Damage symptoms

Caterpillars feed gregariously by scrapping bark and gnawing foliage. Severe infestation results in complete defoliation of the tree.

Bionomics

Adults are large-sized moths with light yellowish-brown wings having faint lines. Moths appear with onset of monsoon and lay eggs in clusters on leaves and tender stems. Egg period lasts for 6 days. Full-grown caterpillars are brownish in colour and densely hairy. Hairs are irritating to touch. Larval and pupal periods last for 12 to 14 and 8 to 10 weeks respectively.

Pupation takes place in soil. Only one generation/year.

Management

1. Collect and destroy egg masses and caterpillars
2. Use light traps to attract and kill adults immediately after rains
3. Use burning torch to kill congregating larvae on the trunk
4. Spray chlorpyriphos 20 EC or quinalphos 25 EC or - 35 EC 1.0 L in 500 -750 L of water per ha or fish oil rosin soap 25 g/L on the trunks and foliage, immediately after rain and 15 days later

b. *Pericallia ricini* (Arctiidae: Lepidoptera)

Attacks drumstick, banana, black gram, cotton, cucurbits, castor, cowpea, soybean, tea and yam.

For more information refer castor

c. Metanastria hyrtaca (Lasiocampidae: Lepidoptera)

Distribution and status: Generally called as gristly citrus caterpillar and found all over the Indian sub-continent.

Host range: Polyphagous pest and prefers several Citrus species.

Damage symptoms

Caterpillars are nocturnal in habit and feed gregariously and voraciously. During day, they remain crowded on shady side of tree trunks.

Bionomics

Early instar

Late instar

Adult

Eggs are spherical in shape and pale white in colour. Full-grown caterpillars are cylindrical in shape, greyish-brown in colour, stout and hairy. Stout, greyish-brown moths adults exhibit sexual dimorphism. Male moths have pectinate antennae and chocolate- brown patch in the middle of forewings. Incubation, larval and pupal periods last for 9 to 12, 45 to 100 and 9 to 18 days respectively. Life cycle is completed in 75 to 110 days.

***d. Streblote (Taragama) siva* (Lasiocampidae: Lepidoptera) Distribution and status:** Found all over the Indian sub continent

Host range: Drumstick, rose **(**preferred host)

Bionomics

Full-grown caterpillars are pale ochreous–brown in colour with small black spots and long lateral tufts of ochreous hair. Moth has greyish-white head and thorax and whitish abdomen. Fore wings are beautifully coloured with reddish-brown spot ringed with white. Hind wings are white with slight fuscous on outer margin.

IPM for hairy caterpillars

1. Collect and destroy caterpillars from the plants
2. Use light traps to attract and kill adults
3. Spray carbaryl 1.0 kg or malathion 50 EC or - 35 EC 1.0 L in 500 -750 L of water per ha

5. Bark borer: *Indarbela tetraonis* (Metarbelidae: Lepidoptera)

Refer Mango

6. Long horn beetles: *Batocera rubus* (Cerambycidae: Coleoptera)

Distribution and status

It is widely distributed all over the Indian sub-continent.

Damage symptoms

Grubs make zig-zag burrow beneath the bark, feed on internal tissues, reach sapwood and cause death of affected branch or stem. Adults feed on the bark of young twigs and petioles

Bionomics

Eggs are laid singly in cracks or crevices in the bark of the tree. Grubs are stout, about 100 mm long, yellowish in colour with well-defined segmentation. Pupation takes place within the tunnels. Adults are mediumsized beetles and yellowish–brown with white spots on elytra. Egg, grub and

pupal periods last for 1 to 2, 24 to 28 and 12 to 24 weeks respectively. There is only one generation in a year.

Management

1. Clean affected portion of tree by removing all webbed material, excreta etc.
2. Insert in each hole, cotton–wool soaked in monocrotophos 36 WSC 5 ml or any good fumigant like carbon disulphide, carbon tetrachloride, chloroform or even petrol and seal treated hole with mud.

Minor pests

7. Aphids: *Aphis gossypii* (Aphididae: Hemiptera)

It is a polyphagous pest. Nymphs and adults suck vital sap from twigs. As reproduction is mostly parthenogenic, population build-up is very fast. Spray dimethoate 30 EC 500 ml or malathion 1.0 L in 500 – 750 L of water per ha. All pods should be removed before spraying.

8. Scale Insects: *Ceroplastodes cajani* (Diaspididae: Hemiptera)

Though each insect takes only a few drops of sap during its life time, presence of enormous number of insects sucking the sap continuously at times, weaken trees and ultimately affect size of pods. Spray as given for aphids.

9. Bud midge: *Stictodiplosis moringae* (Cecidomyiidae: Diptera)

It is a minor pest of drumstick. Eggs are laid in clusters on anthers within the flower buds. Maggots feed on internal tissues of buds especially on ovaries. Pest is active during August to January. Infested buds soon fall down and the full-fed maggots come out to pupate in soil. Egg, maggot and pupal periods last for 1 to 2, 6 to 9 and 5 to 8 days, respectively; a single life cycle is completed in 12 to 19 days.

10. Leaf eating weevils: *Myllocerus* spp. (Curculionidae: Coleoptera)

It feeds on a variety of crops. Eggs are laid in soil. Grubs feed on roots of cultivated crops; grasses etc. and pupate in soil. Adults come out of soil and nibble leaves causing minor damage.

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***1. M. subfasciatus* - Elytra grey with black spots**

***2. M. discolor* - Brown elytra with white spots**

***3. M. viridanus* - Full elytra light green**

Questions - Amaranthus and Moringa

1. Irregular zig-zag tunnels in the pith region filled with excreta is due to ----------

Stem weevil - *Hypolixus truncatulus*

2. Site of pupation for amaranthus caterpillar is

a. **Soil** b. Stem

c. Webbed leaf d. On leaf

3. Scientific name of leaf twisting weevil ---------- ***Apoderus tranquebaricus*** 4.

Drying of fruits from tip upwards and oozing of gummy fluid from moringa fruits is due to ---------- **Pod fly - *Gitona distigma***

5. Moringa pod fly is not attracted to methyl eugenol and fish meal say **True** or false

6. ---------- bore into flower buds, cause shedding of buds and feed on tender tissues on moringa. **Bud worm - *Noorda moringae***

7. *Noorda blitealis* pupates in soil say **True** or False

8. Use of burning torch on the trunk of moringa controls ---------- **Hairy caterpillar - *Eupterote mollifera***

9. Male of *Metanastria hyrtaca* has---------- antenna

a. **Pectinate** b. Filiform

c. Setaceous d. Capitate

10. Presence of huge silken webbed masses comprising chewed wooden particles and entry holes covered with excreta is due to ---------- **Bark caterpillar - *Indarbela tetraonis***

11. ---------- feeds on internal tissues of moringa buds especially on ovaries

a. Pod fly b. Bud worm

c. **Bud midge** d. Hairy caterpillar

12. Moringa pod fly belongs to the family

a. Agromizidae b. Tephritidae

c. **Drosophilidae** d. Cecidomyiidae

13. Give the scientific name of some hairy caterpillars of moringa ---------- ***Eupterote mollifera, Pericallia ricini, Metanastria hyrtaca and Streblote (Taragama) siva*** 14. Complete defoliation of moringa tree is due to ---------- **Hairy caterpillar** - ***Eupterote mollifera***

15. Generally, moringa buds infested by bud worm contain ---------- number of caterpillar - **One**

Lecture No 27

PESTS OF ONION, GARLIC,TURMERIC AND GINGER

I. PEST OF ONION

Among the pests attacking onion, onion thrips requires attention as it is the most destructive. Onion maggot under North Indian conditions and earwig under South Indian conditions gain importance occasionally.

Major pests			
Onion thrips	*Thrips tabaci*	Thysanoptera	Thripidae
Onion maggot	*Delia antiqua*	Anthomyiidae	Diptera
Earwig	*Anisolabis stali*	Forficulidae	Dermaptera
Potential major pests			
Tobacco caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
Cutworm	*Agrotis ipsilon*	Noctuidae	Lepidoptera

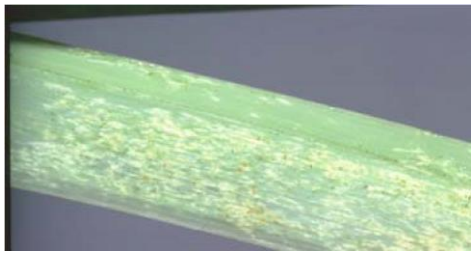
1. Onion thrips: *Thrips tabaci* (Thysanoptera: Thripidae)

Distribution and status: Found world-wide and is found throughout India as a major pest of onion and garlic (*Allium fistulosum*).

Host range: Onion, garlic, cotton (*Gossypium spp.*), cabbage, cauliflower, potato, tobacco, tomato, cucumber (*Cucumis sativus* L.), brinjal, tea, pear, pine apple, chillies, tomato, radish, grapes etc.

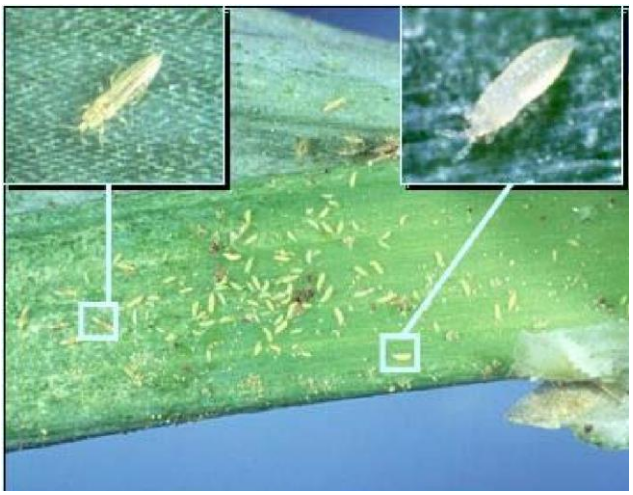
Damage symptoms

Adults as well as by nymphs lacerate the leaf tissue and feed on the plant juice. The insects are just visible to the unaided eye and are seen moving briskly on the flowers and leaves of onion and garlic plants. They usually congregate at the base of a leaf or in the flower. Leaves of attacked plants turn silvery white, curl, wrinkle and gradually dry from tip downwards. The plants do not form bulbs nor do the flowers set seed. Leaf tip discoloration and drying is the main symptom.



Bionomics

The adults are slender, yellowish brown and measure about 1 mm in length. Males wingless; females have long, narrow strap-like wings. Nymphs resemble the adults in shape and colour but are wingless and slightly smaller. This pest is active throughout the year and breeds on onion and garlic from November to May, migrates to cotton and other summer host plants and breeds till September. In October, it is found on cabbage and cauliflower. The adult female 'lives for 2-4 weeks and lays 50-60 kidney-shaped eggs singly in slits made in leaf tissue with its sharp ovipositors. Egg period 4-9 days· Nymphs pass through four stages and are full-fed in 4-6 days, after which they descend to the ground and pupate at a depth of about 25 mm. The pre-pupal and pupal stages last 1-2 and 2-4 days, respectively. Several generations are completed in a year.



Management

- Grow resistant varieties *viz.,* White Persian, Grano, Sweet Spanish and Crystal Wax.
- Use neem coated urea to reduce the infestation of the pest.
- Install sky blue colour sticky traps@ 25/ha

- Spray 625 ml of malathion 50 EC or methy demeton 25 EC or dimethoate 30 EC or moncrotphos 36 SL 500 ml- 750 ml in 500 - 750 L of water per ha as soon as the pest appears. A waiting period of 7 days should be observed, before harvest.
- Conserve predators like *Scymnus nubilis,Orius albidipenis, Chrysopa* sp,and predatory thrips vis., *Aelothrips collartris*

2. Onion Maggot: *Delia antiqua* (Anthomyiidae: Diptera)

Distribution and status: Widely distributed in France, Germany, Canada, USA, Japan, erstwhile USSR and England. This pest also attacks onions in northern India.

Host range: Onion and garlic

Damage symptoms

The maggots bore into the bulbs, causing the plants to become flabby and yellowish. It causes withering in the field and rotting in storage. Damage leads to the invasion of *Bacillus carolovorus* which causes soft rot of onion

Bionomics

The flies are slender, greyish, large-winged. The maggots are small, white and about 8 mm. in length. The female lays elongate, white eggs near the base of the plant, in cracks in the soil. The eggs hatch in 2-7 days. The maggots crawl up, enter the leaf sheath and reach the bulb. They feed there and become full-grown in 2-3 weeks. The maggots then crawl out of the bulb and pupate in the soil. After 2-3 weeks, the adults emerge and start the new generation. In the third generation, the pest often attacks the onions shortly before the harvest. It initiates the process of rotting of the onions in storage.

Management

Grow *Allium fistulosum* as it is more tolerant than *A. cepa* .Apply 10 kg of carbaryl 4G or phorate lOG to the soil followed by light irrigation.

Spray methy demeton 25 EC or dimethaote 30 EC 1.0 L in 500 – 750 L of water per ha.

3. Earwig: *Anisolabis stali* (Forficulidae: Demaptera)

Distribution and status: Throughout India

Host range: Onion, garlic, cabbage, cotton, sorghum and groundnut Carry to groundnut

Damage symptoms: Nymphs bore into the bulb and make cavities which lead to withering of plants.

Bionomics: Adult is brown to black with forceps like caudal cerci and white jointed legs. Adult female lays 21-139 eggs, egg period 14 days. Nymphs white in the early stage turn brown in the later stage, nymphal period 50 -54 days.

Management: Refer Groundnut

4. Tobacco caterpillar: *Spodoptera litura* (Noctuidae:Lepidoptera)

Refer cotton

5. Cutworm: *Agrotis ipsilon* (Noctuidae:Lepidoptera)

Refer potato

II. PEST OF TURMERIC AND GINGER

Major pests				
1.	Shoot borer	*Conogethes punctiferalis*	Pyraustidae	Lepidoptera
2.	Rhizome scale	*Aspidiotus hartii*	Diaspididae	Hemiptera
3.	Skipper Butterfly	*Udaspes folus*	Hesperiidae	Lepidoptera
4.	Rhizome maggot	*Formosina flavipes*	Chloropidae	Diptera
5.	Bihar Hairy Caterpillar	*Spilosoma obliqua*	Arctiidae	Lepidoptera
6.	Thrips	*Panchaetothrips indicus*	Thripidae	Thysanoptera
	Minor Pests on turmeric			
7.	Flea beetle	*Lema praeusta*	Chrysomelidae	Coleoptera
8.	Turmeric scale	*Aspidiotus cucumae*	Diaspididae	Hemiptera
9.	Banana lacewing bug	*Stephanitis typicus*	Tingidae	Hemiptera
10.	Leaf thrips	*Anaphothrips sudanensis* *Asprothrips indicus* *Panchaetothrips indicus*	Thripidae	Thysanoptera
	Minor pests on ginger			
	Leaf miner	*Acrocercops irradians*	Gracillariidae	Lepidoptera
	Weevil	*Hedychrous rufofasciatus*	Curculionidae	Coleoptera

1. Shoot borer: *Conogethes punctiferalis* (Pyraustidae: Lepidoptera)

The caterpillar enters into the aerial stem killing the central shoot which results in the appearance of 'dead heart'. For details on the bionomics and management refer castor.

2. Rhizome scale: *Aspidiotus hartii* (Diaspididae: Hemiptera)

Distribution and status: India, West Africa and West Indies

Host range: Turmeric and ginger

Damage symptoms

Both nymphs and adults infest rhizomes both in field and storage. The infested plants become weak, pale and withered in the field that results in shrivelling of rhizomes and buds.

Bionomics

Scales are minute, circular, light brownish to grey with a thin pale membrane. It reproduces either ovovivparously or parthenogenetically Female lays about 100 oval, yellowish eggs under

the scale. Egg period one day, nymphal period 30 days. Adult is yellow to deep yellow in colour.

Management

i. Apply well rotten sheep manure / poultry manure in two splits @ 10 tons/ha, first before planting and the second at the time of earthing up.

ii. Drench soil with dimethoate 30 EC or phosalone 35 EC @ 2 ml/L of water iii. Soak seed rhizomes, in insecticide solution of either dimethoate 30 EC or phosalone 1.5 ml/L or monocrotophos 36 WSC 1.5 ml/L or dichlorvos 0.5 ml/L for 15 min. for storing.

3. Skipper Butterfly: *Udaspes folus* (Hesperiidae: Lepidoptera)

Distribution and status: Thoughout India. Very common pest.

Host range: Turmeric, ginger, **a**rrow root, cardamom and wild lily.

Damage symptoms:

Larvae webs leaves with silken threads, fold the leaves into a tubular form and feed on them

Bionomics: The adult is a brownish-black butterfly with 8 white spots on forewings and one large patch on hindwing. The full-grown larva is dark-green and measures 36 mm in length. A female lays about 50 eggs on underside of the leaves which hatch in 3-4 days. The larva undergoes 5 instars during 12-21 days and pupates in leaf-fold for 6-7 days. The smooth green colour larva with a black head pupates in December and emerges only in March. Longevity of males and females are 4 and 67 days respectively. The insect is present in abundance during August to October. **Management**

- Hand pick and destroy the caterpillars
- Apply carbaryl 50 WP 1.0 kg or malathion 50 EC 1.0 L in 500 -750 L of water per ha.

4. Rhizome maggot: *Formosina flavipes, Chalcidomyia atricornis* (Chloropidae: Diptera), *Eumerus albifrons* (Syrphidae: Diptera), *Mimegralla coeruleifrons* (Micropezidae: Diptera), *Calobata* sp (Micropezidae: Diptera), *Celyphus* sp (Celyphidae: Diptera)

Distribution and status

Formosina flavipes, Chalcidomyia atricornis - Found on turmeric and ginger in South India

Eumerus albifrons, Mimegralla coeruleifrons - Found on ginger in Karantaka

Celyplius sp – Found on ginger in Kerala and Uttar Pradesh

Host range: Turmeric and ginger

Damage symptoms

Rhizomes and roots are tunneled extensively by the maggots resulting in rotting of rhizomes.

Management:

- Avoid using seed material from the infested fields.
- Spray . 50 EC or dimethoate 500 ml in 500 -750 L water per ha
- Soak seed rhizomes, in insecticide solution of either dimethoate 30 EC or phosalone 1.5 ml/L or monocrotophos 36 WSC 1.5 ml/L or dichlorvos 0.5 ml/L for 15 min. for storing

5. Thrips: *Panchaetothrips indicus* (Thripidae: Thysanoptera)

This is confined to South India. Due to laceration nymphs and adults leaves become rolled up, turn pale and gradually dry-up. Adult is with fringed wings. Spray dimethoate 30 EC 500 – 750 ml in 500 -750 L water per ha to control the thrips.

6. Bihar Hairy Caterpillar: *Spilosoma obliqua* (Arctiidae: Lepidoptera)

This pest damages the turmeric plants extensively in Bihar and Bengal States. For details on the bionomics and management refer sunflower

Minor Pests of Turmeric

Flea Beetle: *Lema praeusta* (Chrysomelidae: Coleoptera)

Both adults and grubs feed on leaf. These are recorded in Orissa and Kerala. *L. praeusta* are observed to feed on leaves of cucurbits and sorghum in fields. Adult lay eggs singly on leaves.

Incubation period is 8-10 days. Grub feeds on leaf tissue for 10-12 days and pupates in the soil. Adults emerge out form pupa, which lasts for 15-25 days. Adults are active during day time and feed on leaves. Longevity of the adults is 43-60 days. **Turmeric scale: *Aspidiotus curcumae* (Hemiptera: Diaspididae)**

Banana lacewing-bug: *Stephanitis typicus* (Tingidae: Hemiptera)

Refer Banana

Leaf thrips: *Anaphothrips sudanensis, Asprothrips indicus* (Thripidae: Thysanoptera)

Minor Pests of Ginger

Leaf miner: *Acrocercops irradians* (Gracillariidae: Lepidoptera)

Weevil: *Hedychrous rufofasciatus* (Curculionidae: Coleoptera)

III. Pest of coriander

Major pest			
Cotton Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera
Minor pests			
Aphid	*Hyadophis coriandri*	Aphididae	Hemiptera
Pentatomid bug	*Agonoscelis nubila*	Pentatomidae	Hemiptera
Indigo caterpillar	*Spodoptera exigua*	Noctuidae	Lepidoptera

The important pest of coriander is only whitefly.

1. Cotton Whitefly: *Bemisia tabaci* (Hemiptera: Aleyrodidae)

The nymphs suck sap of the plants and adversely affect their growth. For bionomics and management.

Refer cotton

Other pests which are found on coriander plants are

2. Aphid: *Hyadophis coriandri* (Hemiptera: Aphididae)

Both nymphs and adults congregate colonise on ventral surface of leaves and suck cell sap. Due to copious production of honey dew, leaves give a glistening appearance in the beginning, but later covered with sooty mould fungus. Nymphs and adults are yellowish green. A single female produces 40 to 50 young ones and they take 8 to 12 days to mature.

Life cycle is completed in 14 to 21 days during summer and 6 weeks in winter.

3. Pentatomid bug: *Agonoscelis nubila* (Hemiptera: Pentatomidae)

Adult and nymphs suck the sap from leaves and stem. Heavily infested plants show stunting. Adults are yellowish. Life cycle is completed in 40 to 60 days. Spray dimethoate or quinalphos 1.5 ml/L

4. Indigo caterpillar: *Spodoptera exigua* (Lepidoptera: Noctuidae)

Refer Jute or linseed

Pest of Curry leaf

Major pest			
Psyllid bug	*Diaphorina citri*	Psyllidae	Hemiptera
Citrus butterfly	*Papilio demoleus*	Papilionidae	Lepdioptera
Bark borer	*Indarbela tetraonis*	Metarbelidae	Lepdioptera
Citrus black fly	*Aleurocanthus woglumi*	Aleyrodidae	Hemiptera
Leaf roller	*Tonica zizyphi*	Oecophoridae	Lepdioptera

Psyllid bug: *Diaphorina citri* (Psyllidae: Hemiptera)

The tender shoot is often severely attacked by the psyllids

Citrus butterfly: *Papilio demoleus* (Papilionidae: Lepidoptera)

The leaves are eaten commonly by the caterpillars.

Leaf roller: *Tonica zizyphi* (Oecophoridae: Lepidoptera)

The larvae sometimes roll the leaflets in large numbers and cause appreciable damage.

Bark borer: *Indarbela tetraonis* (Metarbelidae: Lepidoptera)

Citrus black fly: *Aleurocanthus woglumi* (Aleyrodidae: Hemiptera)

Refer citrus for more information on the distribution, host range, bionomics, damage and management for the above mentioned pests of curry leaf.

Question paper on onion, garlic and turmeric

1.	Pseudostem with bore holes plugged with excreta, dead heart, panicles and spikes dryup above the point of infestation in ginger and turmeric ---------- **Shoot borer *Conogethes punctiferalis***	
2.	Rhizomes and roots tunnelled extensively by the maggots resulting in rotting of rhizome due to	
	a. **Rhizome maggot**	b. Shoot borer
	c. Rhizome scale	d. Thrips
3.	*Formosina flavipes* belongs to the family Chloropidae -Say **True** or False	
4.	Ginger plants become withered in the field and rhizomes rot in storage due to scale - Say **true** or False	
5.	Scientific name of turmeric rhizome scale is ---------- ***Aspidiotus hartii***	
6.	Turmeric leaves become rolled up, turn pale and gradually dry-up due to---------- **Thrips** *Panchaetothips indicus*	
7.	Turmeric rhizome scale belongs to family	
	a. Coccidae	b. Pseudococidae
	c. **Diaspididae**	d. Tingidae
8.	Well rotten sheep manure / poultry manure can be applied for the management of _____**Rhizome scale**	
9.	Garlic is relatively more tolerant than onion to *Thrips tabaci* – Say **true** or false	
10.	Rolling of turmeric and ginger leaves is caused by _____ Turmeric skipper *Udaspes folus*	
11.	Disclouration of onion leaves with pale tips and drying form tip downwards is due to **onion thrips**/onion maggot	
12.	Psyllid *Diaphorina citri* is common to citrus and curry leaves Say **true**/ false	
13.	Indigo caterpillar is *Spodoptera litura*/***Spodopera exigua***	

Lecture No.28

PESTS OF PEPPER, CARDAMOM AND BETELVINE

1. PESTS OF PEPPER

About 20 insect species have been recorded damaging pepper plantation.

Major pests			
Pollu beetle	*Longitarsus nigripennis*	Alticidae	Coleoptera
Top shoot borer	*Cydia hemidoxa*	Eucosmidae	Lepidoptera
Berry gall midge	*Cecidomyia malabarensis*	Cecidomyiidae	Diptera
Marginal gall thrips	*Liothrips karnyi*	Thysanoptera	Thripidae
Minor pests			
Pepper mussel scale	*Lepidosaphes piperis*	Diaspididae	Hemiptera
Soft scale	*Marsipococcus marsupiale*	Coccidae	Hemiptera
Coconut scale	*Aspidiotus destructor*	Diaspididae	Hemiptera
Whitefly	*Aleurocanthus piperis*	Aleyrodidae	Hemiptera
Wild silkworm	*Cricula trifenestrata*	Saturniidae	Lepidoptera

I. Major pests

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

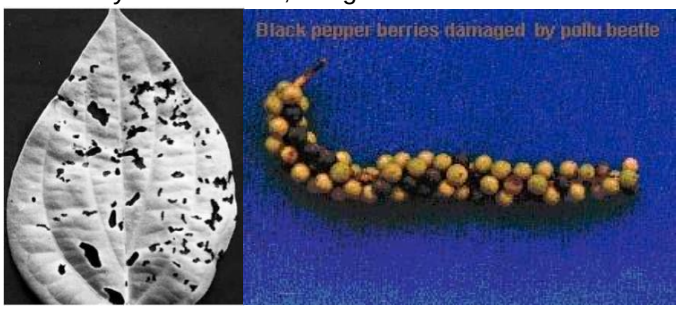
Distribution and status: India (West Coast area)

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.



Bionomics

Adult is a bluish yellow shining flea beetles. Eggs are laid on the berries and lays 1-2 eggs in each hole, egg period 5-8 days, larval period 30-32 days. Pupation occurs in soil in a depth of 5.0 - 7.5 cm. Pupal period 6-7 days. Life cycle completed in 40 - 50 days. Four overlapping generations in a year.

Management

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

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

Distribution and status: India

Damage symptoms

Serious pests of pepper in Kerala. The larva feeds on growing and young leaves causing drying and dying of terminal shoots.

Bionomics

Larva greyish green, 12-14 mm long, larval period 10 -15 days. Pupates inside shoots, pupal period 8 – 10 days. Adult moth is tiny, forewing black with distal half red, hind wing greyish. Life cycle completed in a month.

Management

Spray - 35 EC 1.0 L or quinalphos 25 EC 1.0 L in 500 - 1000 L water/ha

3. Berry gall midge: *Cecidomyia malabarensis* (Cecidomyiidae: Diptera)

Damage symptoms

The maggots infest the berries at the attachment of the berry to the spine, which causes gall like swelling on the tender stalks and shoots. The attacked berries appear larger in size in the beginning but appear shrunken later on.

Bionomics

Management

4. Marginal gall thrips: *Liothrips karnyi* (Thysanoptera: Thripidae)

Distribution and status: India

Host range: Pepper

Damage symptoms

Both nymphs and adults feed on leaves and cause formation of marginal folded galls on them. Presence of white or creamy white nymphs and adults inside the marginal galls is the typical symptom of attack. In severe cases of attack, whole plant becomes stunted and affects formation of spikes.

Bionomics

Eggs are laid in single within the marginal leaf folds or on the leaf surface, egg period 6-8 days. Nymphs whitish and sluggish, nymphal period 9-13 days, pupal period, 2 to 3 days adult longevity is 7-9 days.

Management

Spray monocrotphos 36 SL 750 ml or dimethaote 30 EC 1.0 L or chlorpyriphos 1.5 L in 500-1000 L water

Minor pests

- Pepper mussel scale:*Lepidosaphes piperis* (Diaspididae :Hemiptera)
- Soft scale: *Marsipococcus marsupiale* (Coccidae :Hemiptera)
- Coconut scale: *Aspidiotus destructor* (Diaspididae :Hemiptera)

- Whitefly: *Aleurocanthus piperis* (Aleyrodidae :Hemiptera)

Mealy bug infestation on roots

II. PESTS OF CARDAMOM

About 56 species of insects and mites have been reported to attack cardamom in India.

Major pests				
1.	Cardamom thrips	*Sciothrips cardamomi*	Thripidae	Thysanoptera
2.	Cardamom whitefly	*Dialeurodes cardamomi*	Aleyrodidae	Hemiptera
3.	Cardamom aphid	*Pentalonia nigronervosa,*	Aphididae	Hemiptera
4.	Shoot, panicle & capsule borer	*Dichocrocis punctiferalis*	Pyraustidae	Lepidoptera
5.	Rhizome weevil	*Prodioctes haematicus*	Curculionidae	Coleoptera
6.	Early capsule borer	*Lampides elpis*; *Jamides* sp	Lycaenidae	Lepidoptera
7.	Hairy caterpillar	*Eupterote cardamomi*	Bombycidae	Lepidoptera
8.	Galerucid borer	*Thamnuroides cardamomi*	Galerucidae	Coleoptera
Minor pests				
9.	Shootfly	*Formosina flavipes*	Chloropidae	Diptera
10.	Brown scale	*Saissettia coffeae*	Diaspididae	Hemiptera
11.	Root borer	*Hilarographa caminodes*	Yponomeutidae	Lepidoptera
12.	Skipper butterfly	*Plesioneura alysos*	Hesperiidae	Lepidoptera
13.	Looper	*Eumelia rosalia* *Ansiodes denticulatus* *Thalassodes sp*	Geometridae	Lepidoptera
14.	Cutworm	*Arcilassia plagiata*	Noctuidae	Lepidoptera
15.	Lacewing bug	*Stephanitis typicus*	Tingidae	Hemiptera
16.	Root knot nematode	*Meloidogyne* spp.		
17	Red spider mite	*Dolyhotetranychus floridanus*	Tetranychidae	Acari

Major pests

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

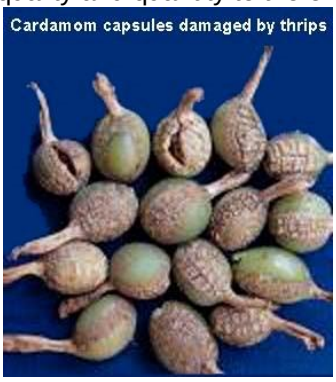
Distribution and status: India and Papua New Guinea. Most destructive pest of cardamom in South India

Host range: Cardamom, tea, grapevine, castor, cotton *Prosopis juliflora*, 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%.



Bionomics

Greyish brown full grown adult female lays 5 - 31 minute, kidney shaped eggs on the leaf sheath, flowers and surface tissues of capsules, egg period 9-12 days. I and II nymphal instars lacerate the surface of the tissues; nymphal period 9-12 days; pupal period 3-5 days. Life cycle is completed in 20 -25 days. High temperature and low humidity favours the growth of the insects.

Management

- Maintain plant density with wider spacing of 2.5x2.5 m
- Regulate the shade in open areas
- Remonve and destoy altenate 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

2. Cardamom whitefly: *Dialeurodes cardamomi* (Aleyrodidae: Hemiptera)

Distribution and status: Serious pests in cardamom growing parts of Kerala in India

Damage symptoms

Nymphs occurs on the under surface of the leaves and suck the sap from the leaves causing yellowing and discolouration. Infested plant becomes stunted and covered with honey dew and sooty mould later.

Bionomics: Adult is small soft bodied moth like insect covered with white waxy bloom. Nymphs are pale greenish to greenish yellow in colour. Life cycle completed within 2-3 weeks

Management

- Collect and destroy damaged leaves with nymphs and puparia
- Use yellow sticky traps @ 12 /ha
- Spray methy demeton 25 EC or dimethoate 30 EC 1.0 L or acephate 75 SP 500 g 500 – 750 L water per ha

3. 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.

Bionomics: refer banana

Management

1. Remove alternate hosts like *Alocasia* and *Colcasia* in the vicinity.
2. Remove partly dried and decayed pseudostems which harbour the colonies of aphids
3. Spray methy demeton 25 EC or dimethoate 30 EC 1.0 L in 500 – 1000 L water per ha.

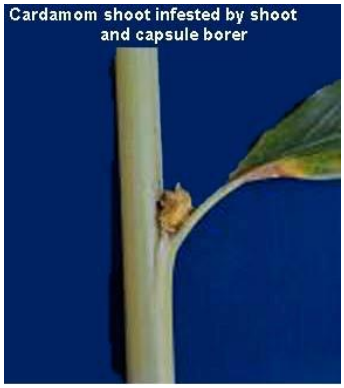
4. Shoot, panicle and capsule borer: *Dichocrocis punctiferalis* (Pyraustidae: Lepidoptera)

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.



Bionomics


Adult moth lays eggs singly/ groups on tender parts of plant. Egg period is 6 to 7 days. Larva is brown in colour and covered with minute hairs arising on warts. Larval period 15-18 days, pupal period 7-10 days. Pupation takes place in loose silken cocoon in larval tunnel.

Adult is pale, yellowish with black spots on wings. Life cycle lasts for 3-35 days.

Management: Refer castor

5. 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

1. Destroy affected plant/seedlings
2. 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

6. Early capsule borer: *Lampides elpis*; *Jamides* sp. (Lycaenidae: Lepidoptera)

Damage symptoms

The larva feeds on the buds, flowers and capsule making a circular bore hole on the developing capsules. The capsules become yellowish brown, dried, empty and shed.

Bionomics

Adult is a blue butterfly with wings having metallic luster on the upper surface and bordered with a white thin line and black shade. It lays eggs on the buds, flowers and inflorescence. Egg period 10 days. The larva is like slug, flat and pink measuring 2 – 3 cm long, larval period 18 – 20 days. Pupal period 15 days. Total life cycle is 45 days.

Management

Spray quinalphos 25 EC 1.5 L or carbaryl 50 WP 1 kg in 500 - 1000 L of water per ha.

7. Hairy caterpillar: *Eupterote cardamomi* (Bombycidae: Lepidoptera)

Distribution and status: South India

Host range: Cardamom

Damage

The caterpillars congregate on the trunks of shade trees and then drop to the cardamom plants. They feed voraciously in leaves of cardamom plants, defoliating within a short time.

Bionomics

The adult are large moth 70 -80 mm, ochrus in colour with post medial lines on the wings. 300 – 800 eggs are laid on the under surface of leaves of shade trees. Egg period 13 – 20 days. Larva is hairy and has a dark – grey body, pale brown head. Larva undergoes 10 instars in 5 months. Pupate in soil at a depth of 2 – 2.5 inch, pupa is cocoon, pupal period 7 – 8 months.

Management

1. Collect and destroy the hairy caterpillars.
2. Set up light traps to attract and kill the moths.
3. Spray phasalone 35 EC 750 ml in 500 - 1000 L of water per ha

8. Galerucid borer: *Thamnuroides cardamomi* (Galerucidae :Coleoptera)

Distribution and status: South India

Host range: Cardamom

Damage symptoms

The adult beetle drill capsules and cause tiny, circular bore holes. The infested capsules drop off of disintegrates with a crater like entry hole permanently. Fine saw like frash thrown out indicates the presence of beetle.

Bionomics

Adult is small dark brown cylindrical beetle with short hairs all over the body. Colourless barrel shaped 6 -12 eggs are laid in clusters in the capsule. The larva is white, soft bodied, wrinkled and slightly curved.

Management

- Regulate shade in thickly shaded areas.
- Spray insecticides like quinalphos 25 EC or phosalone 35 EC 1 L during March, April, May, August and September in 500 - 1000 L per ha.

Minor pests

9. Shootfly: *Formisina flavipes* (Chloropidae: Diptera)

The maggots bore into the central growing shoots of young cardamom causing dead heart symptom.

Adults lay white cigar shaped eggs in between the leaf sheath and pseudostem on the top whorl singly or in rows of 4 - 5. Pupates inside the shoot. Total life cycle is about 50 -92 days.

Management

- Remove the affected shoots at ground level and destroy them.
- Spray dimethoate 30 EC or quinalphos 25 EC 1 L in 500 -1000 L of water per ha.

10. Brown scale: *Saissettia coffeae* (Diaspididae: Hemiptera)

Adults and nymphs cause infestation. Infested leaves turn yellow and put forth scortched appearance. Adult female is red brown to dark brown in colour with smooth shining surface, more or less hemispherical. The eggs hatched inside the body of the female and after some time the crawlers starts emerging from the underside.

11. Lacewing bug: *Stephanitis typicus* (Tingidae: Hemiptera)

Both nymphs and adults suck the sap from the leaves causing yellowing and discolouration of leaves. Adult is small dull coloured bug with transparent shiny lace like reticulate wing. Female laysan average of 30 eggs, singly inserted in leaf tissue. Egg period is 12 days. Nymphal period is 13 days.

12. Cutworm: *Arcilassia plagiata* (Noctuidae: Lepidoptera)

The cut worms feeds on the tender leaves and causes defoliation in the nursery. The caterpillar is dark brown with prominent light yellow and longitudinal marking on the abdominal segments. Pupates in soil for 17 – 18 days.

13. Looper: *Eumelia rosalia*, *Ansiodes denticulatus*, *Thalassodes sp* (Geometridae: Lepidoptera)

14. Root borer: *Hilarographa caminodes* (Yponomeutidae: Lepidoptera) 15. Skipper butterfly: *Plesioneura alysos* (Hesperiidae: Lepidoptera)

16. Root knot nematode: *Meloidogyne spp*.

17. Red spider mite: *Dolyhotetranychus floridanus* (Tetranychidae: Acari)

III. PESTS OF BETELVINE

Major pests			
Aphid	*Aphis gossypii*	Aphididae	Hemiptera
Scales	*Lepidosaphes cornutus*	Coccidae	Hemiptera
White fly	*Aleurocanthus nubilans* and *Dialeurodes pallida*	Aleurodidae	Hemiptera

Mealy bug	*Geococcus citrinus*	Pseudococcidae	Hemiptera
Shoot bug	*Pachypeltis politus*	Miridae	Hemiptera
Minor pests			
Leaf eating caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
Termite	*Odontotermes obesus*	Termitidae	Isoptera
Green looper	*Synegia* sp.	Geometridae	Lepidoptera
Giant African snail	*Achatina fulica*	Achatinidae	

Two types of cultivation viz., A single bete

Major pests

1. Aphid: *Aphis gossypii* (Aphididae: Hemiptera)

Damage symptoms

Both nymph and adults desap the tender shoot and leaves causing yellowing, curling and crinkling in leaves of support plants *viz*.,*Sesbania* spp. Honey dew secreted by the aphids fall on the betelvine leaves and lead to the development of sooty mould which appear as black spots.

Bionomics

Two forms of females are available in an aphid colony. The alate (winged) and apterous (wingless) forms which can reproduce parthenogenetically and viviparously, giving birth to 10 -20 nymphs per day. The nymph becomes adults in another week time. **Management**

1. Clip off excess infested Sesbnia leaves
2. Spray chlorpyriphos 2 ml/L on agathi leaves

2. Scales: *Lepidosaphes cornutus* (Coccidae: Hemiptera)

Damage symptoms

Both nymph and adults infest the leaves, petioles and main veins. The scale infested leaves loose their colour, exhibit warty appearance, crinkle and dry up ultimately. The affected vines present a sticky appearance and wilt in due course.

Management

1. Select scale free seed vines
2. Spray NSKE 5 % @ 50 g / L or chlorpyriphos 20 EC 2ml/L or malathion 50 EC 1ml/L of water

3. **White fly: *Aleurocanthus nubilans* and *Dialeurodes pallida* (Aleurodidae: Hemiptera)**

Damage symptoms

Both nymph and adults suck the sap from the tender leaves causing yellowing, chlorotic spots and shooty mould development on leaves.

Bionomics

Adult is a minute insect covered with white waxy bloom.

Management

4. Mealy bug: *Geococcus citrinus* (Pseudococcidae: Hemiptera)

Damage symptoms

Both nymph and adults found on the root regions and desap the root portions

Management

Spray chlorpyriphos 20 EC 2ml/L or dimethoate 2ml/L. Concentrate the spray towards

the collar region.

5. Shoot bug: *Pachypeltis politus* (Miridae: Hemiptera)

Damage symptoms

Both nymph and adults suck the sap from the tender leaves causing leaf blotches leading to ultimate drying.

Bionomics

The adult is reddish brown bug. It thrusts its eggs singly within the tender plant parts. Egg period 8 - 16 days. Fecundity 72 eggs/female. Nymphal period 12 - 18 days. The incidence of this pest is severe in June to October. **Management:** Spray malathion 50 EC at 2.0 ml/L

Minor pests

6. Leaf eating caterpillar: *Spodoptera litura* (Noctuidae: Lepidoptera)

Damage symptoms

The larva feeds on tender leaves of agathi crop and after complete devastation of agathi, they start feeding in newly planted betelvine causing irregular sides on leaves. It also damages the tip of the veins that results in failure of vein establishment.

Bionomics & Management: Refer cotton

7. Green looper: *Synegia sp.* (Geometridae: Lepidoptera) Damage symptoms

The caterpillar feeds on leaves causing severe defoliation.

Bionomics

The adult is yellow and orange spotted moth. It lays eggs singly on leaves. The larva is dark green and grows to a length of 25 mm. It pupates in leaf fold. Life cycle completed in 25 - 30 days.

8. Giant African snail: *Achatina fulica* (*Achatinidae:* Damage symptoms

The snails are found in betelvine gardens clinging to the lower and protected surface of the leaves of supporting plants. They feed on sprouted buds, leaves, outer layers of the stem of betelvine and supporting trees. Infestation is high during rainy and winter season.

Bionomics

The snails are large, bisexual with shell. Eggs are laid in rainy season in the soil surface or just below in batches of 200, adult fecundity 1000 eggs, egg period 7 days. Young ones take about nine months to mature, adult longevity up to 3 or 4 years. **Management**

1. Heap the gunny bags near the fences of the betel vine gardens to attract, collect and kill the snails
2. Collect and destroy the hiding snails.
3. Metaldehyde pellets 5 % over the field to attract and kill the snails.

10. Betelvine Bug: *Dispunctus politus*

The nymphs and adults damage the leaves by puncturing and sucking the juice causing the leaves to shrivel, fade and dry up.

Question: Pepper, cardamom and betelvine

1. Scientific name of pollu beetle - ***Longitarsus nigripennis***
2. Pepper berries become hollow and crumble when pressed is due to ---------- **Pollu beetle**
3. Pollu beetle pupates in ----------
   a. **Soil** b. Berry
   c. inbetween leaf d. Within berry
4. ---------- causes gall like swelling on the tender pepper stalks and shoots. **Berry gall midge**
5. Presence of white or creamy white nymphs and adults inside the marginal galls of pepper is the typical symptom of attack by
   a. Pollu beetle b. Berry gallmidge
   c. **Marginal gall thrips** d. Topshoot borer
6. Scientific name of pepper mussel scale is ----------
   a. *Aspidiodus destructor* b. *Marsipococcus marsupiae*
   c. ***Lepidosaphes piperis*** d. None of the above
7. *Dichocrocis punctiferalis* larva bores into the central core of the pseudostems resulting in the death of the central spindle causing characteristic “dead heart” in cardamom. Say **True** or False
8. ‘Cardamom itch’ is caused by
   a. **Thrips** b. Whitefly
   c. Aphid d. Scale
9. High temperature and low humidity favours the growth of cardamom thrips. Say **True** or False
10. ---------- is responsible for transmitting Katte or marble mosaic disease in small cardamom
    a. Thrips b. Whitefly
    c. **Aphid** d. Scale
11. Scientific name of cardamom rhizome weevil ---------- ***Prodiactes haematicus*** 12. *Spodoptera litura* after feeding agathi, also damages the tip of the vine and results in failure of vine establishment. Say **True** or False
13. Giant African snail feeds on sprouted buds, leaves, outer layers of the stem of betelvine and supporting trees. Say **True** or False
14. Site of pupation of giant African snail is ---------- **Soil**

Management of mite species

1. Collect and destroy all types of damaged parts along with mites
2. Spray any of the following insecticides with 500 L – 700 L water/ha using hand operated sprayer to ensure proper coverage of spray solution

• Azadirachtin 5% 400 ml	• Flumite 20 SC/ flufenzine 20 SC 400-500 ml
• Dicofol 18.5 SC 1.25 L	• Hexythiazox 5.45 300-500 ml
• Ethion 50 EC 500 ml	• Profenofos 50 EC 800-1000 ml
• Fenazaquin 10 EC 1000 ml	• Propargite 57 EC 750-1250 ml
• Fenpropathrin 30 EC 165-200 ml	• Spiromesifen 22.9 SC 400 ml
• Fenpyroximate 5 EC 300-600 ml	• Wettable sulphur 1.0 kg

3. Spray entomathogen *Paecilomyces fumosoroseus* available a wettable powder against red spider mite (Mycomite)

3. Shot hole borer: *Euwallacea fornicatus* (Scolytidae: Coleoptera)

Damage symptoms

Presence of round shot holes in primary branches. Mortality of buds and dieback symptoms in branches occur. Presence of circular or longitudinal tunnels inside the stem. **Bionomics**

Female beetle is black, small and cylindrical. Male is half the size of female, devoid of wings. Egg period 4 – 6 days, three larval instars lasts for 16 – 18 days, pupae whitish and pupal period 7 – 9 days. Total life cycle lasts for 27 – 33 days.

IPM

- Selectively remove badly affected branches at the time of pruning.
- Apply nitrogen and potassium at 1:2 ratio in the prune year and mid cycle
- Placing of partly dried cut stems of a jungle plant *Montanoa bipinnatifida* @ 400 ha attracts shot hole borer adults
- Perform chemical control in the third and fourth years, if the average percentage of infestation in the new wood is at or above 15 per cent at the end of second year

- Immediately after pruning spray quinalphos or chlorpyriphfos 1.0 L or lambdacyhalothrin 500 ml or lindane 20 EC 2.0 L in 500 L water
- Spray *Beauveria bassiana* available as a wettable powder(Biopower)

4. Sapling borer: *Sahyadrassus malabaricus* (Hepialidae: Lepidoptera)

Damage symptoms

Presence of chewed tissue at the collar region.The tunnel mouth is covered by a thick mat of bark, wood and frass particles held together by silk (particle mat cover); sapling break off at the point of injury.

Bionomics

Adult moths hang vertically by the support of two pairs of legs. Third pair of legs is weak and has scent glands in male. Egg period 7-10 days, larval period 10 months, pupal period 3-5 weeks. **Management**

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

Minor pests

5. Flushworm: (Tortricidae: Lepidoptera) Damage symptoms

Caterpillar ties the margin of tender leaves and forms a case enclosing the bud. Affected leaves become rough, crinkled and leathery. Shoot growth is arrested when buds are damaged.

Bionomics

Adult is a very small blackish brown moth. Eggs are pale yellow and laid singly on the under surface of mature leaves. Incubation period 4-5 days, larva brown, larval period 19-25 days pupal period 8 – 10 days. Pupation takes place on the petioles of outer most leaf.

Management

Spray NSKE 5 % or - 35 EC or phosalone 50 EC or chlorpyriphos 20 EC or malathion 50 EC 1000 ml with 500 L water/ha.

6. Tea tortrix: *Homona coffearia* (Tortricidae: Lepidoptera) Damage symptoms

Caterpillars make leaf nests by webbing the leaves using silken threads and feed from inside. Single caterpillar makes several cases. Young larvae prefer tender leaves while the older larvae prefer matured leaves.

Bionomics

Brown coloured adult moth is bell shaped in outline while at rest. Eggs are laid in masses on the upper surface of mature leaves. Egg period 6 – 8 days, larva green, larval period 20-30 days. Pupation takes place inside the leaf cases. Pupa green initially and turns reddish brown later. Pupal period 9 – 15 days.




Management

Spray - 35 EC or phosalone 50 EC or chlorpyriphos 20 EC or malathion 50 EC 1000 ml with 500 L water/ha

7. Tea leaf roller: *Caloptilia theivora* (Gracillariidae: Lepidoptera)

Second instar larvae mines the tender leaf and reaches leaf margin. Fourth instar larva rolls the leaves from tip downwards.Larva yellowish. Adult is a microlepidopteran with long antenna, golden iridescent patches in forewing and abdomen.

Management

Spray NSKE 5 % or - 35 EC, phosalone 35 EC, chlorpyriphos 20 EC, dimethoate 30 EC, malathion 50 EC, phenthoate 50 EC 1000 ml with water 500 L per ha

8.Scales: *Saissetia coffeae* (Coccidae: Hemiptera)

Damage symptoms

Vegetatively propagated clones are susceptible. Presence of hemispherical brown scale along the midrib and tender stem. Sooty mould found on lower leaves.

Bionomics: Nymphs are white. Adult male is winged. Female is sedentary

Management

Spray any of the following insecticides *viz.,* carbaryl 1 kg or - 35 EC or quinalphos 25 EC or chlorpyriphos 20 EC 1000 ml/ha or ethion 50 EC 500 ml or profenofos 50 EC 800-1000 ml with 500 L water/ha

9. Thrips: *Scirtothips bispinosus* (Thripidae: Thysanoptera)

Damage symptoms

Thrips lacerate leaf tissues and suck oozing sap. Lacerations appear as brownish irregular streaks or silvery patches on the leaf surface. Infested leaves become distorted, crinkled or mottled. Damage is more pronounced in exposed areas during dry weather.

Bionomics

Adults are minute. Wings are characteristically fringed with fine hairs. Thrips insert eggs singly into the leaf tissues. Eggs hatch in 9 days. There are two nymphal instars followed by prepupal and pupal stages. The pupae remain on the leaf, or drop to the ground. Immature stages last for 3 weeks. Under favourable conditions, there could be 12 generations in a year.

Management

- Maintain optimum overhead shade.
- Spray any of the following insecticides *viz.,* - 35 EC 500 ml, malathion 50 EC 400-500 ml, chlorpyriphos 20 EC 500 ml, dimethoate 30 EC 200-300 ml or ethion 50 EC 500 ml or profenofos 50 EC 800-1000 ml with 500 L water/ha.

10. Tea jassid: *Empoasca flavescens* (Cicadellidae: Hemiptera)

Adults and nymphs suck plant sap from tender leaves. Leaves curl downwards, gradually turn brown and dry up. Severity is more in North Eastern India.Wedge shaped nymphs green, adult yellowish green. Eggs are inserted singly into the leaves. Egg period 6 – 13 days, nymphal period 8 – 10 days

11. Aphid: *Toxoptera aurantii* (Aphididae : Hemiptera)

It is a polyphagous species attacking tea and other host plants such as coffee, cacao, citrus etc. Colonies of aphids are seen on tender shoots of tea immediately after pruning. Leaves curl up and shoot growth is stunted. Ants attend aphids for their honeydew. Honey dew fallen on the leaves facilitates the growth of black sooty mould fungus. Adult is dark brown in colour. Both alate and apterous forms exist.

II. PEST OF COFFEE

Both Arabica and robusta coffee are attacked by about one dozen insect pests, only a few of which are serious, some of them being specific to one or the other variety. The coffee stem borer is the pest of Arabica coffee, whereas the shot hole borer prefers robusta coffee. In certain areas the severe attack of white stem borer leads to discontinuation of the crop.

Major pests				
1.	White stem borer	*Xylotrechus quadripes*	Cerambycidae	Coleoptera
2.	Red borer	*Zeuzera coffeae*	Cossidae	Lepidoptera
3.	Shot hole borer	*Xylosandrus compactus*	Scolytidae	Coleoptera
4.	Berry borer	*Hypothenemus hampei*	Scolytidae	Coleoptera
5.	Green scale	*Coccus viridis*	Coccidae	Hemiptera
Minor pest				
6.	Mealy bug	*Ferrisia virgata , Planococcus lilacinus, P. citri*	Pseudococcidae	Hemiptera

Major pests

1. White stem borer: *Xylotrechus quadripes* (Cerambycidae : Coleoptera)

Distribution and status

White stem borer is the most serious pest of *Arabica* coffee in India. It occurs in China, Thailand, Sri Lanka and Vietnam.

Host range

Arabica coffee is the most preferred and principal host plant. Alternate host plants include *Robusta* tree coffee, teak, *Oleadioica* etc. However, borer usually does not breed in these plants.

Damage symptoms

Presence of ridges on the stem; yellowing of leaves. Grubs bores into the branches and cause wilting and occasional drying of plants. Young plants (7 to 8 years old) attacked by the borer may die in a year, while older plants withstand the attack for a few seasons. However, such plants are less productive, yielding more of floats.

Bionomics

Egg period 10 days, grub period 10 months, pupal period 30 days. Grub white or yellowish with anterior end broader and tapering towards tail end. Adult is a black, elongate beetle with grey pubescence on the head, thorax and elytra. Characteristic white markings are seen on the elytra.

Management

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

use any sharp implements. Spray and swab the main stem and thick primaries once in April- May and October - December with Lindane 20 EC 1.25 lit + 200 ml Teepol in 500 L water at the time of peak adult activity (March and September). NSKE 5% also can be applied frequently.

5. Spray *Beauveria bassiana* available as a wettable powder formulation

2. Red borer: *Zeuzera coffeae* (Cossidae: Lepidoptera)

Distribution and status: Widespread in cofee producing areas

Host range: Tea, cinnamon, sandal, cotton, orange, teak and many forest trees.

Damage symptoms

Larva causes damage in Arabica and Robusta coffee by boring into young stem, primary and secondary branches to feed on the wood. In early stages of attack, young plants or branches show signs of wilting. Infested part bears one or two holes through which, pelletlike excrement of the larva hangs out and accumulate at the base of the plant. In advanced cases, the branch or the whole plant dries up.

Bionomics

Eggs are laid in strings on the barks. Egg period is 8 to 12 days. Red larva enters through the junction of leaf stalk and twig, constructs a tunnel that extends even up to the roots. Larval and pupal stage together last for about 12 to 24 months. After moth emergence, pupal skin protrudes outside through exit hole. Adult is a medium sized moth with spotted wings.



Management

1. Cut and burn red borer infested plant or twigs
2. Encourage the activity of braconid parasitoid, *Amyosoma zeuzerae*
3. Use entomopathogen pathogen *Beauveria bassiana* as in the case of white borer management.

3. Shot hole borer: *Xylosandrus compactus* (Scolytidae: Coleoptera)

Distribution and status: Serous pest of south India

Host range

Anmola, Avocado, Clerodendron, cocoa, Crotalaria, croton, dadap, Dendrobium, mahogony, mango, neem etc.

Damage symptoms

Small holes can be seen on the undersurface of young succulent branches between nodes. Withered or dried branches with shot-holes indicate the presence of the pest. Attacked branches dry up. Leaves above the point of attack fall prematurely. Terminal leaves wilt, droop and dry. Withering is faster in young branches and delayed in older twigs. Severe infestation results in the loss of productive branches. Due to the loss of primaries, establishment of young plantations is delayed.

Bionomics

Adult beetle is brown to black with a short, sub cylindrical body. Females are darker and larger, whereas males are dull and small. Body is covered with fine hairs. Female beetle bores into the bark of tertiary branches and lays upto 50 eggs. Egg period 7 days, grub period 20 days and grub feed on ambrosia, a fungal growth developed on the beetle excreta. Grubs pupate near the exit in cocoons. Pupal period 10 days and the lifecycle is completed in 35 - 45 days. There are several generations in a year.

Management

1. As soon as the first symptoms of attack like drooping of leaves is noticed (from September) prune affected twigs 2 to 3 inches beyond the shot-hole and burn as a routine measure at regular intervals.
2. Remove and destroy all the unwanted/infested suckers during summer as the pest prefers to breed during dry weather.
3. Maintain thin shade and good drainage.
4. Spray - 35 EC 1.0 L in 500 L water per ha

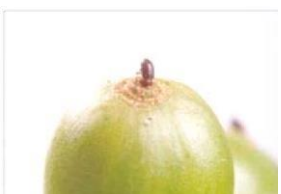
4. Berry borer: *Hypothenemus hampei* (Scolytidae: Coleoptera)

Distribution and status

Cosmopolitan and reported in 58 coffee growing countries. Under Indian conditions, Robusta suffers badly than Arabica as the latter is harvested early, and the pest build up is more when Robusta ripens.

Host range

Females take shelter in the seeds of *Crotalaria*, *Lantana*, *Maesopsis*, tamarind, tea etc, without feeding and breeding.

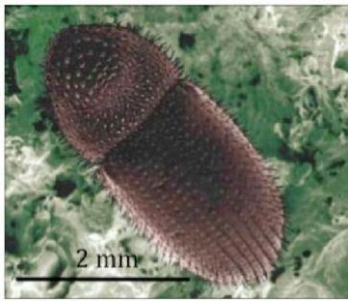


Damage symptoms

Presence of small round hole in the navel region of developed berry is the main symptom. Grubs tunnel in berry, feed on bean and damage endosperm by making small galleries near the main tunnel. As a result, tender berries drop.

Bionomics

Adult berry borer is a small black beetle with a sub cylindrical body covered with thick hairs. Female lays about 30 – 50 eggs in the tunnel. Eggs hatch in about 10 days. Larvae feed on the beans, making small tunnels. Larval and pupal periods last for 20 and 7 days respectively. Development from egg to adult takes 30 days. Sex ratio is 10:1. Mating takes place inside the berries.



Management

1. Maintain thin shade and proper training of the plant.
2. Harvesting should be perfect without any left over beans on plants sole.
3. Harvest of the left over (gleaning) reduces the inoculum to a great extent
4. Dry the berries to the following moisture level

   Parchment - 10%, Arabica cherry - 10.5%, Robusta cherry - 11.0%
5. Spray white muscardine fungus *Beauveria bassiana*
6. Spray - 1.0 L in 500 L water/ha at the time of initial berry formation
7. Seed beans may be transported after thorough disinfestations.

5. Green scale: *Coccus viridis* (Coccidae: Hemiptera)

Distribution and status: India, Sri Lanka, Bangaladesh, Myanmar, Thailand and Malaysia. Widespread serious pest in tropics.

Host range: Citrus, mango, loquat, guava, sapota and a number of weeds.

Damage symptoms

They congregate on the undersurface of leaves close to the midrib and veins, on the green shoots, spikes, berries etc., and suck sap. Severe infestation results in death of the plant. The infested leaves may curl up and tender twigs droop. Honeydew excreted by the scale forms a layer on the leaves and acts as a medium for the growth of the “sooty mould”. Green scale is attended by various species of honeydew seeking ants. Certain ants especially the red ant and the cocktailed ant drive away the natural enemies. Removal of honeydew by ants further enhances survival of nymphs.



Bionomics

Adult scale is flat, oval, light green with an irregular, distinct intestinal loop of blackish spots visible through the dorsum. It is sedentary and leads its whole life usually in one place. Reproduction is by parthenogenesis. Female produces up to 600 progenies. Nymphs develop when the eggs are inside the body, and hatch out at the time or immediately after extrusion. Nymphs are pale yellow. There are three nymphal instars with a total duration of 4 to 6 weeks. Nymphs are disseminated on their own, or through wind. Green scale is a summer pest, proliferating during hot dry weather.

Management

1. Spray white halo fungus *Verticillum lecanii* fungus @ $6x10^6$ spores/ml.
2. Release Australian ladybird beetle *Cryptolaemus montrouzieri* @ 750/ha 3. Spray quinalphos 1.0 L in 500 L water/ha

Minor pests

6. Mealy bug: *Ferrisia virgata, Planococcus lilacinus, P. citri* (Pseudococcidae: Hemiptera)

Host range: Citrus, guava and mango

Damage symptoms

Mealy bugs infest tender branches, nodes, leaves, spikes, berries and roots in large numbers. Both nymphs and adults suck the sap. Young plants succumb to heavy infestation. Leaves become chlorotic, flower buds abort and berries become small if severely infested. A black fungus (sooty mould, *Capnodium* sp.) develops on the honeydew excreted by the bugs. Consequently, the leaves of infested plants become black, affecting photosynthesis.

Bionomics

They are small, soft bodied insects. Adult female is wingless. Oval body is clothed with mealy secretion in the form of small, white threads. Males are rare, small and winged. Reproduction is mainly through parthenogenesis. Female lay 100 to 1000 eggs. Eggs hatch in 3 days. The first instar nymphs crawl and settle in a place for feeding and secrete the mealy covering over the body. Nymphs are disseminated by wind also. There are three nymphal instars. Life cycle is completed in about a month. Mealy bugs multiply rapidly during hot weather with the cessation of monsoon. Nymphs and adults from the root zone migrate to the aerial parts, settle down, feed and reproduce. Intermittent showers and irrigation help in the build up of the pest. Excessive removal of shade in Robusta plantations often leads to flare up of mealy bugs.

Ferrisia vigata

Planococcus lilacinus

P. citri

Management

- Spray 500 ml quinolphos 25 EC or fenitrothion 50EC in 750 L of water /ha

Questions

1. Give the scientific name of the coccid pest of tea- ***Saissetia coffeae***

2. Which sex of the coffee scale is sedentary **- Female**

3. Presence of chewed tissue at the collar region of tea sapling is the damage symptom of _____ **Sapling borer: *Sahyadrassus malabaricus***

4. Adult moths hang vertically by the support of two pairs of legs. Third pair of legs is weak and has scent glands in male. Give the scientific name of the pest - ***Sahyadrassus malabaricus***

5. Presence of round shot holes in primary branches and mortality of buds and dieback symptoms in branches occur due to _____- **Shot hole borer, *Euvallacea fornicates*** 6. Name two mites infesting tea - **Scarlet mite: *Brevipalpus californicus*, Red spider mite: *Oligonychus coffeae*; Purple mite, *Calacarus carinatus;* Pink mite or orange mite: *Acaphylla theae*; Yellow mite: *Polyphagotarsonemus latus***

7. Name the important mirid pest of tea - **Tea mosquito bug, *Helopeltis theivora***

8. Name the aphid infesting tea- ***Toxoptera aurantii***

9. Name a micro lepidopteran insect which infests tea **- Tea leaf roller, *Caloptilia theivora***

10. _____ is the most serious pest of *Arabica* coffee in India.- **White stem borer**

11. *Beauveria bassiana* can be used in the management of _____ in coffee- **Red borer, *Zeuzera coffeae,* White stem borer: *Xylotrechus quadripes***

12. Name the entomopathogen used in the management of coffee green scale- **Fungus *Verticillum lecanii***

13. Robusta suffers badly than Arabica from _____ **Berry borer, *Hypothenemus hampei***

14. Red borer, *Zeuzera coffeae* is a Coleopteran –*Say true or* ***false***

15. The activity of braconid parasitoid, *Amyosoma zeuzerae* is encouraged for the control of _____ - **Red borer, *Zeuzera coffeae***

16. *Assam tea is more susceptible to* _____ Pink mite *Acaphylla theae*

17. An erect knobbed process on the scutellum is characteristic of_____ **tea mosquito bug**.

18. ---------- ties the margin of tender tea leaves and forms a case enclosing the bud **Flush worm**

Lecture No. 24

PESTS OF ROSE AND JASMINE

I. PESTS OF ROSE

Major pests			
Rose thrips	*Rhipiphorothrips cruentatus*	Thripidae	Thysanoptera
Red scale	*Lindingaspis rossi*	Coccidae	Hemiptera
Red spider mite	*Tetranychus cinnabarinus*	Tetranychidae	Acari
Rose aphid/lice	*Macrosiphum rosaeformis, M. rosae*	Aphididae	Hemiptera
Minor pests			
Hairy caterpillar	*Orgyia (=Notolopus) postica Euproctis fraterna*	Lymantriidae	Lepidoptera
Castor semilooper	*Achaea janata*	Noctuidae	Lepidoptera
Flower chaffer beetle	*Oxycetonia versicolor*	Cetoniidae	Coleoptera
Leaf folder	*Acleris extensana*	Tortricidae	Lepidoptera
Leaf cutting bee	*Megachile anthracina*	Megachilidae	Hymenoptera

1. Rose thrips: *Rhipiphorothrips cruentatus* (Thripidae: Thysanoptera)

Distribution and status Cosmopolitan

Host range: Grapes,rose, *Lagestoemia indica, Punica granatum.*

Damage symptoms

Nymph and adult lacerates leaves from the under surface of the leaves and flower buds. As a result white streaks appear on the infested leaves. Leaves show brown patches and get distorted, finally wither and drop down.

Infested flowers do not open, flowers fade and drop down prematurely.

Bionomics

Adults are blackish brown and nymphs are reddish in colour. Eggs are inserted into the tissues. A female lays about 45-55 eggs, nymph, adult period are 2-3 weeks and five days respectively.

Management

Remove and destroy the damaged leaves, twigs and dlower buds along with the pest

Use yellow sticky traps at 15/ha to monitor activity of sap feeder

Spray neem oil 3% or methyl demeton 25 EC 1.0 L in 500-750 L of water per ha or apply carbofuran 3 G 5g/plant

2. Red Scale: *Lindingaspis rossi* (Coccidae : Hemiptera)

Damage symptoms

Reddish brown waxy scales completely cover the stem especially on the lower portion of the old stem and younger shoots. Tiny specks in scurvy like patches on the affected stems appear like spots of pox. The affected plant parts become disfigured, dry wither away. In case of severe infestation, the entire plant dies.

Bionomics

Female scales are wingless, comparatively larger and settle in a suitable feeding site, whereas long winged males move to fertilize the female scale.

Management

Cut and burn affected branches

Rub off scales from twigs with cotton soaked in kerosene or diesel

Spray malathion 50 EC or - 1.0 L in 500 - 750 L of water / ha at the time of pruning and again during March- April or apply carbofuran 3G 5g/plant or spray fish oil rosin soap 25 g /L

3. Red spider mite: *Tetranychus cinnabarinus* (Tetranychidae: Acarina)

Damage symptoms

Nymphs and adults feed on the undersurface of the leaves and are found covered with silken webs. As a result, yellow spots appear on the upper surface, which gradually turn reddish. Affected leaves finally wither away. Growth and flower production are adversely affected.

Bionomics

Both nymphs and adults are red in colour. About 200 whitish, spherical eggs laid on the ventral surface of the leaves and measure about 0.1 mm in diameter. Egg period 4-7 days, larval and pupal periods 3-5 and 8-12 days respectively. Life cycle is completed in 15-20 days and there are 15 generations / year.

Management

Prefer Spinx and temptation varieties as they are moderately susceptible Avoid First Red as it is highly susceptible.

Remove and destroy the damaged leaves along with mites.

Spray Flufenoxuron 10 DC 500 ml or milbemectin 1 EC 450 ml in 500 L of water per ha or bifenazate 50 WP 375 ml kg in 750 L of water per ha or wettable sulphur 40 WP 3.75 kg in 500 -1000 L of water per ha.

4. Rose aphid/lice: *Macrosiphum rosaeformis* (plains); *M. rosae* (hills) (Aphididae: Hemiptera)

Distribution and status: Northern India, Punjab, Delhi, Mysore, Andhra Pradesh and the Nilgiri Hills

Host range: Rose

Damage symptoms

Adults suck saps from the tender leaves, buds and twigs resulting in disfigurement and withering of flowers. They make punctures, producing wounds, which leaves mark as the flowers open. Black fungus develops on the honey dew excreted by the insects.

Bionomics

Small pear shaped soft-bodied aphids, light green to dark blackish green in color. Apterous form has an elongated body, large red eyes, black cornicles and yellowish green tip at the abdomen. Nymphal development completed in 11-14 days in apterous forms and 14-19 days in alate forms. Aphid multiples rapidly in late spring but cannot withstand the summer heat.

Management

Variety Damask is susceptible while Hawaii is comparatively resistant.

Spray malathion 50 EC 500 ml or methyl demeton 25 EC 500 ml in 500 -750 L of water /ha.

Minor pests

5. Hairy caterpillars: *Orgyia (=Notolopus) posticus, Euproctis fraterna* (Lymantriidae: Lepidoptera)

Host range: Castor, rose.

Damage symptoms: Larvae cause defoliation.

Bionomics

***Orgyia postica*:** Hairy caterpillars of brown head, a pair of long pencils of hairs pointing forward from the prothorax and tuft of yellowish hairs dorsally on the first two abdominal segments, yellowish tufts of hairs dorsally on the first four abdominal segments and long brown hairs dorsally form the 8 th abdominal segment. Adult is brown coloured moth with stout abdomen.

Host range: Polyphagous, castor, mango, red gram, linseed, ground nut, grape vine, phalsa, pomegranate and pear.

***Euproctis fraterna*:** Larva is reddish brown with red head surrounded by white hairs arising on warts and a long preanal tuft. Adult yellow moth with pale transverse lines on the forewings.

Management

Hand pick caterpillars and destroy

Spray - 1.0 L in 500 - 1000 L of water per ha

6. Castor semilooper: *Achaea janata* (Noctuidae: Lepidoptera)

Refer castor

For management of defoliators viz., hairy caterpillars and semilooper refer castor

7. Flower chaffer beetle: *Oxycetonia versicolor* (Cetoniidae: Coleoptera)

Buds and flowers with irregular feeding marks. Adult beetles are red coloured with black marking. Fig Hand picking and destroying, spraying - 1.0 L in 500 L of water per ha keeps the pest under check.

8. Leaf folder: *Acleris extensana* (Tortricidae: Lepidoptera)

Larva ties up the tender shoots and feeds by scrapping; bores into buds and flowers.Larva yellowish green with black head and brown prothorax. Adult bell shaped brownish moth.

9. Leaf cutting bee: *Megachile anthracina* (Megachilidae: Hymenoptera)

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Adults attack red gram and rose plants by cutting neat, circular or oval patches on the leaf margins and use cut bits for construction of nest cells. Adult bees are hairy, medium sized dark insects with the base of the abdomen tinged with red brown. They build cells in crevices and cavities in hedges or dead wood. Nest cell is provided with pollen paste and one egg is deposited in each cell.

II. PESTS OF JASMINE

Major pests			
Budworm	*Hendecasis duplifascialis*	Pyraustidae	Lepidoptera
Gallery worm	*Elasmopalpus jasminophagus*	Phycitidae	Lepidoptera
Leaf webworm	*Nausinoe geometralis*	Pyraustidae	Lepidoptera

Jasmine eriophyid mite	*Aceria jasmine*	Eriophyidae	Acarina
Minor pests			
Jasmine leaf roller	*Glyphodes unionalis*	Pyraustidae	Lepidoptera
Redspider mite	*Tetranychus cinnabarinus*	Tetranychidae	Acarina
Jasmine bug	*Antestia cruciata*	Pentatomidae	Hemiptera
Green plant hopper	*Flata ocellata*	Flatidae	Hemiptera

1. Budworm: *Hendecasis duplifascialis* (Pyraustidae: Lepidoptera)

Host range: Jasmine

Damage symptoms

Tiny caterpillar makes holes on the flower bud, feeds on the inner content of the bud It makes a circular hole on the corolla tube emerges and tunnels to move into other buds of the same shoot.. Infested flowers turn violet in colour, and fall off. In case of severe infestation, adjacent flower buds are webbed together by means of silken thread.

Bionomics



Freshly laid eggs of bud worm are round and creamy white in colour which later turn yellow. Eggs are laid singly and glued on the unopened or immature buds, calyx and sometimes on the bud stalk. They hatch in about 3-4 days. The neonate larva is creamy yellow in colour with dark black head and prothoracic shield and passes through five instars.

Pupation mostly takes place inside the soil and sometimes on the leaves, at the junction of petioles and leaf blade. The adult is a small, pale white moth with wavy markings on wings and black patches on the wing margin. The moths have a pair of well developed black palpi and scaly proboscis.

Management

Rake the soil during the off season to expose the pupae and apply carbaryl 10 D around the basin.

Apply carbofuran at 40g/plant basally.

Set up light trap during the peak emergence of adult moths

Collect the damaged pinkish flowers once in a week and destroy to arrest further multiplication.

Spray neem seed kernel extract 5 % or monocrotophos 36 SL 1.0 L or - 750 ml or chlorpyriphos 20 EC at 750 ml or dimethoate 30 EC 500 ml or cypermethrin 25 EC 200 ml in 500 -750 L of water per hectare in the evening hours

Conserve larval parasitoids, *Perilampus sp, Phanerotoma sp and Mesochrous sp*.

2. Gallery worm: *Elasmopalpus jasminophagus* (Phycitidae: Lepidoptera)

Host range: Jasmine

Damage symptoms

Caterpillar web together the terminal leaves, shoots and flower heads and feed on them. Faecal matter is seen attached to the silken web.

Bionomics

Moth is small dark grey which caterpillar is green with a red head and prothorax, and lateral brown streaks on the body. Pupation takes place in the web itself.

Management : Same as given for jasmine bud worm

3. Leaf webworm: *Nausinoe geometralis* (Pyraustidae: Lepidoptera)

Distribution and status: West Africa, India, Pakistan, Sri Lanka, Myanmar, Java, Formosa, china and Australia **Host range:** Jasmine

Damage symptoms

Caterpillars attacks leaves of the plant mostly in the lower bushy and shaded portions. The leaves are webbed in an open and loose manner. The silk threads are seen as a cobweb on the surface of the leaves. Larvae skeletonize the leaves by eating away the parenchyma.

Bionomics

Adult is a medium sized moth, having light brownish wings with white spots. Caterpillar is green with dark warts. Female lays 15-30 greenish yellow eggs on the leaf lamina; egg period 3-4 days. Larva pupate within the web; larval, pupal period are 12-15 days and 6-7 days respectively. Life cycle is completed in 22-24 days.

Management

Spray dimethoate 30 EC 500 ml in 500 – 750 L of water/ha.

4. Jasmine eriophyid mite: *Aceria jasmine* (Eriophyidae: Acarina) **Distribution**

and status: India

Host range: Jasmine, *Jatropha intergrima*

Damage symptoms:

Feeding causes felt-like hairy out growth (Erineum) on the surface of leaves, tender stem and flower buds. Makes web which look like felt and appear to be a white hairy growth on the leaf surface, tender stems and flower buds.

Bionomics: Female is cylindrical and vermiform with two pair of legs and measures about 150-160 long and 44 thick.

Management

Grow resistant variety Parimullai (TNAU).

Spray triazophos 1.5 ml/L in combination with neem oil 5 ml/L twice or thrice or monocrotophos 1.0 L or wettable sulphur 40 WP 3.75 kg or dimethoate 30 EC 625 ml or malathion 50 EC 1.0 L in 500 -750 L of water/ha.

Minor pests Jasmine leaf roller: *Glyphodes unionalis* (Pyraustidae: Lepidoptera)

Caterpillars roll the leaves and feed on them. Adult is a white moth with brown lines along the costal margin of forewings. Caterpillar is green in colour.



Redspider mite: *Tetranychus cinnabarinus* (Tetranychidae: Acarina)

Damage Mites feed on the undersurface of leaves and are found covered with silken webs. As a result of feeding, yellow spots appear on the upper surface of leaves and gradually turn reddish infested leaves wither away.

Bionomics Both nymphs and adults are red in colour. Eggs are laid on ventral surface of leaves and are whitish and spherical. Female lays 200 eggs. Egg period is 4-7 days. Larval and pupal period lasts for 3-5 and 8-12 days respectively. Life cycle is completed in 15- 20 days. There are 15 generations/year. **Management**

Remove and destroy the webbed and damaged leaves along with mites.

Spray dicofol 18.5 EC 1.5 L or wettable sulphur 40 WP 3.75 kg in 500-750 L of water per ha

Jasmine bug: *Antestia cruciata* (Pentatomidae: Hemiptera)

Both nymphs and adults suck the sap from tender shoots and buds and prevent flower formation. Nymph is dark brownish black and round adult bug is dark brown shield shaped bug with orange and white marking on wings.

Green plant hopper: *Flata ocellata* (Flatidae: Hemiptera)

The adult bug is green with minute spot on fore wings. Both nymphs and adults feed on terminal shoots.

Question paper on rose and jasmine

1.	Leaves with yellow patches and black spots of excreta on rose is the typical symptom of **Thrips (*Rhipiphorothrips cruentatus)***			
2.	Circular or semi circular cuttings on rose leaves is caused by **Leaf cutter bee**			
3.	Buds and flowers with irregular feeding marks is due to attack of			
	Leaf cutter bee	**Flower chaffer beetle**	Red spider mite	Rose thrips
4.	What is the scientific name of Leaf cutter bee ***Megachile anthracina***			

5.	---------- larva attacks buds which are webbed together by silken threads on jasmine **Bud worm (*Hendicasis duplifascialis*)**			
6.	Gallery worm caterpillar webs together the terminal leaves, shoots and flower heads and feed on them. Say **True** or False			
7.	_____ causes felt-like hairy out growth (Erineum) on the surface of leaves, tender stem and flower buds of jasmine - **Jasmine eriophyid mite**			
8.	Scientific name of jasmine eriophyid mite is ---------- ***Aceria jasmini***			
9.	Site of pupation for jasmine bud worm is ----------			
	Over bud	**Soil**	Leaf	Within bud
10.	*Elasmopalpus jasminophagous* is scientific name of _____			
	Bud worm	**Gallery worm**	Leaf worn	Leaf roller
11.	*Antestia cruciata* belongs to the family			
	Pyraustidae	**Pentatomidae**	Phycitidae	Miridae
12.	Rose red scale belongs to the family Diaspididae. Say True or **False**			
13.	Mites belong to class ---------- **Arachnida**			
14.	Aphid is also called as lice. Say **True** or False			
15.	Semilooper has prolegs on 5, 6 and 10 abdominal segments. Say **True** or False			

PESTS OF ORNAMENTAL PLANTS

Ornamental plants are attacked by insects, mites, nematodes, millipedes, molluscs, earth worms and rodents. Various species of thrips, aphids, leaf hoppers, scale insects, mealy bugs, leaf miners, caterpillars, cut worms and chaffer beetles attack the common ornamental plants including rose, chrysanthemum, hibiscus, holly hock, sunflower, iris, jasmine etc.,.

Pests of other ornamentals *viz*., chrysanthemum, hibiscus, holly hock, sunflower, iris are detailed below

1.	Dusky cotton bug	*Oxycarenus laetus*	Lygaeidae	Hemiptera
2.	Hollyhock tinged bug	*Urentius euonymus*	Tingidae	Hemiptera
3.	Sunflower lace wing bug	*Cadmilos retiarius*	Tingidae	Hemiptera
4.	Castor hairy caterpillar	*Euproctis lunata*	Lymantriidae	Lepidoptera
5.	Ak butterfly	*Danais chrysippus*	Nymphalidae	Lepidoptera
6.	Lily moth	*Polytela gloriosae*	Noctuidae	Lepidoptera
7.	Banded blister beetle	*Mylabris phalerata*	Meloidae	Coleoptera
8.	Gerbera leaf miner	*Liriomyza trifolii*	Agromyzidae	Diptera
9.	Snails and Slugs	*Helix, Achatina fulica*	Class Gastropoda	Phylum Mollusca
10.	Root-lesion Nematodes	*Pratylenchus spp*	Tylenchidae	Tylenchoidea

1. Dusky cotton bug: *Oxycarenus laetus* (Lygaeidae: Hemiptera)

Host range: *Hibiscus rosasinensis, Dombeya natalensis, Bougainvillea, Jasminum grandiflorum, J. multiflorum, J.humile, Bauhinia*, Plumeria .

Damage symptoms: Flower buds become pale as a result of its feeding and fall down without opening. Adult usually feed on the terminal portions and hide in the clusters of dry leaves and flowers.

Bionomics & Management: Refer cotton

2. 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 - 35 EC 1.0 L in 500 L of water / ha.

3. 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.

4. Castor hairy caterpillar: *Euproctis lunata* (Lymantriidae: Lepidoptera)

Host range: *Lagerstoemia india, Punica granatum, Hibiscus rosasinensis*. Young larvae eat the leaf margins of the host plants. Full grown larvae feed on the entire leaf lamina.

5. Ak butterfly: *Danais chrysippus* (Nymphalidae: Lepidoptera)

Caterpillar population is high during October - November. Larvae feed on leaves and flowers of *Asclepias curassavica* (Blood flower/Mexican butterfly weed) Spray . 50 EC 1 L in 1000 L of water/ ha to control this pest.

Female Male

6. Lily moth: *Polytela gloriosae* (Noctuidae: Lepidoptera)

Distribution and status: Sporadic and specific pest in India and Sri Lanka.

Host range: Lilies

Damage symptoms: Larvae feed on the green matter of leaves which may result in complete defoliation of lily plants.

Bionomics

Adult has red, yellow and black mosaic pattern on fore wings with a row of black and yellow dots on the apical margin. The hind wings are black. Adult lays 13-42 round, yellowish eggs in clusters on the apical portion of the undersurface of the leaves. Larvae emerge in 3-6 days and they feed on leaves for 16-20 days. Larvae have chocolate brown head and possess black, white and red mosaic patterns on the body. They pupate in soil in earthern cocoon and adult emerge in 15 – 20 days. Insect has 2 generations per year and the pupae of second generation hibernate.

Management

Spray malathion 50 EC or - 35 EC 1.0 L in 500 L of water/ha.

7. Banded blister beetle: *Mylabris phalerata* (Meloidae:Coleoptera)

Adult beetles attacks the flowers of *Hibiscus rosasinensis* and *Ruellia indica* and devour them completely. In August, the population becomes high more prominent than flowers. Prominent large beetle has six alternating bright orange, black bands against the general dark back ground of the body.

8. Gerbera leaf miner: *Liriomyza trifolii* (Agromyzidae: Diptera)

Devastating pest of tomato.

9. Snails and Slugs (Class Gastropoda: Phylum Mollusca)

Distribution and status: All over India. Occasionally become major pest and warrant control measures.

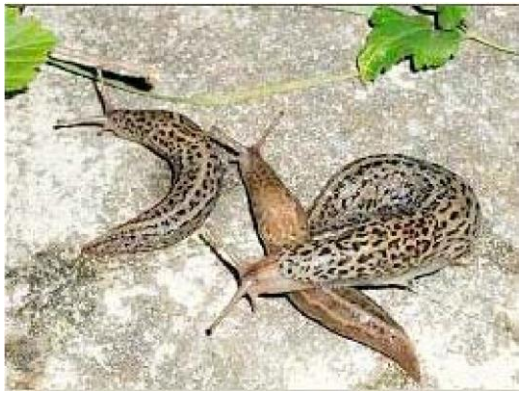
Host range : Vanilla, celery, lettuce, cabbage and a number of ornamental plants.

Common snail : *Helix* spp They are found in Himachal Pradesh, Uttar Pradesh, Andhra Pradesh, Bihar, Maharashtra and Orissa

Giant African snail: *Achatina fulica* - Found in coastal areas of Orissa, West Bengal, Assam, Tamil Nadu and Kerala.

Common garden slug: *Laevicantis alte* - Found in Punjab and Himachal Pradesh, feeds on number of ornamental plants like balsam, portulaca, pot- marigold, verbena, dahlia, cosmos, narcissus and lily.

***Limax* sp** - Found all over India



Damage symptoms

Snails and slugs appear as sporadic pests in those places where damp conditions prevail. They may also appear in large number on roads and runways, creating problems during the taking- off or the landing of the aircraft. When their population in high, they may do serious damage.

Bionomics: Snails and slugs are soft-bodied, asymmetrical, spirally coiled and enclosed in a shell. They have a large flat foot used for creeping and do not have separate sexes The common snail breeds in spring and summer. It makes a hole of 1.24 cm in diameter and 3 cm in depth in damp soil and lays eggs in a loose mass of about 60. The eggs hatch within two weeks and the young snails start feeding upon tender plants. The shell increases in size with age and the snail is full-grown in about two years. Snails are seen at all hours, except during mid day when it is hot and dry. In winter, they stay in colonies and are found among rockeries, loose boards of fences, at the bottom of hedges, in rubbish heaps, etc.

Management

Low population can be collected and destroyed.

Dust 15 per cent metaldehyde dust or spray 20 per cent metaldehyde liquid or sprinkle 5 per cent metaldhyde pellets around infested fields.

10. Root-lesion Nematodes: *Pratylenchus* spp. (Tylenchoidea: Tylenchidae)

Distribution and status: World wide. Of the various ornamental plants, roses are the most affected by parasitic nematodes. These root-lesion nematodes are vagrant parasites of plant roots. Occasionally become serious and warrant control measure.

Damage symptoms

Lesion nematodes feed on the parenchyma of the root and cause lesions, specially when a large number of them feed together. The root injury results in decreased growth of the aboveground portions. The plants bear small or no flowers at all. They inhabit the aboveground portions only in rare cases.

Bionomics

Both adults and larvae move in and out of the roots. The penetration usually occurs in the mature region of the rootlets and not from the root-tips. A female usually lays one egg per day. The egg stage lasts 16-20 days. The development and reproduction are rather slow in *P. pratensis* taking 54 days to complete the life-cycle. In other species, like *P. zeae*, the life cycle is completed in 35-40 days. During periods of

drought, these nematodes lie quiescent, but they resume growth as soon as free moisture is available. The population of the root-lesion nematodes is high in October

Management

Cultivate French marigold or American marigold or sesame in rotation or as an intercrop Mix phorate 1O G @ 10 kg/ha or carbofuran 3G @ 30 kg/ha in soil at the time of planting.

PESTS OF COCONUT AND ARECANUT

COCONUT

The coconut and other palm trees are attacked by specific pests like rhinoceros beetle, red palm weevil, black headed caterpillar and also by a number of polyphagous insects like white grub. Slug caterpillars occasionally major pest status.

Black headed caterpillar is severe in coastal regions.

Major pests				
1.	Rhinoceros beetle	*Oryctes rhinoceros*	Scarabaeidae	Coleoptera
2.	Red palm weevil	*Rhynchophorus ferrugineus*	Curculionidae	Coleoptera
3.	Black headed caterpillar	*Opisina arenosella*	Cryptophasidae	Lepidoptera
4.	Coconut Eriophyid mite	*Aceria guerreronis*	Eriophyidae	Acari
5.	White grub	*Leucopholis coneophora*	Melolonthidae	Coleoptera
6.	Slug caterpillar	*Parasa lepida* and *Contheyla rotunda*	Cochlidiidae	Lepidoptera
Minor pests				
7.	Mealy bug	*Pseudococcus longispinus*	Pseudococcidae	Hemiptera
8.	Scale insect	*Aspidiotus destructor*	Diaspididae	Hemiptera
9.	Lacewing bug	*Stephanitis typicus*	Tingidae	Hemiptera
10.	Termite	*Odontotermus obesus*	Termitidae	Isoptera
11.	Coconut skippers	*Gangara thyrsis and Saustus gremius*	Hesperiidae	Lepidoptera

1. Rhinoceros beetle: *Oryctes rhinoceros*, (Scarabaeidae:

Coleoptera)

Host range

Pineapple, sugarcane, arecanut, sago, oilpalm, palmyra, date palm and wild dates.

Distribution and status

Widely distributed throughout coconut growing areas in India. Regular pest on coconut.

Damage symptoms

Central spindle appears cut or toppled; fully opened fronds show characteristic diamond shaped cuttings. Holes with chewed fibre sticking at the base of central spindle.

Bionomics

Female lays upto 140 oval creamy white eggs in manure pits or decaying vegetable matter at a depth of 5 to 15 cm. Egg period 8-18 days, Stout, sluggish, white grub with pale brown head is found at a depth of 5 to 30 cm. Grubs feed on the decaying matter and grub stage lasts for 99 to 182 days. Grub pupates in earthern cells at a depth of 0.3 to 1 m and emerges as adults in 10-25 days. Adult beetle is stout, black and has a long horn projecting dorsally from the head in male. Horn is short in female.

Management

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

iv. Encourage reduviid predators, *Platymeris laevicollis*

v. Once in three months, drench the manure pits with carbaryl 50 WP 1 g/lit vi. In seedlings, place naphthalene balls @ 3 / tree, in the innermost three leaf axils once in 45 days.

vii. Soak castor cake @ 1 kg/5 lit of water in wide mouthed mud pots and keep them in the garden to attract and kill adults. Replace the slurry once in 30 days.

viii. Fermented toddy may be kept in wide mouthed earthern vessels in different places to attract the adults during night. ix. The crown region may be properly cleaned during harvests and the adults may be hooked out using a long wire.

x. Light traps may be set up to attract the adults during monsoon months and following rains during summer.

xi. The top-most three axils may be filled with a mixture of sand + Neem Seed Powder (2:1) once in three months (150 g/tree)

xii. Fill leaf axil with powdered marotti cake (Hydnocarpus) @ 250 g /palm during May, September and January as a prophylactic measure.

xiii. Incorporate *Clerodendron infortunatum* whole plant in the breeding sites xiv. Use aggregation pheromone traps Rhinolure @ 1/ha. Instal the trap at five feet from the ground level.

2. Red palm weevil: *Rhynchophorus ferrugineus* (Curculionidae: Coleoptera)

Distribution and status

Kerala, Karnataka, Tamil Nadu, Assam and Maharashtras. Enjoys major pest status.

Damage symptoms

Holes on the trunk with brownish ooze; yellowing of inner leaves and gradual wilting of central shoot in the crown. Upto 50 Nos. of grubs can be found feeding on the soft tissues inside the trunk.



Bionomics

Egg: Female lays upto 276 oval, white eggs in scooped out small cavities on palms of upto seven years, and on older trees it deposits in the hands and other cut injuries of trunk. Egg period 2 to 5 days. Grub: Apodous light yellowish grub with a red head becomes full grown in 36-78 days and pupates in a fibrous cocoon inside the trunk itself. Reddish brown adult weevil has six dark spots on thorax. Male has conspicuous long snout with tuft of hairs.

Egg

Grub

Cocoon

Pupa

Adult

Management

i. Remove and disposal of damaged and wilted trees.

ii. Avoid injuries on trunk and any injury should be plastered with clay or cemented with copper oxychloride.

iii. Avoid cutting green fronds.

iv. Root feeding with monocrotophos @ 10 ml + 10 ml water should be done after harvest of nuts. Observe a waiting period of 45 days.

v. Set up attractant traps using mud pots with molasses / toddy 2.5 lit + acetic acid 5 ml + yeast 5 g + split tender coconut stems / petioles @ 30/ac.

vi. Insert 1-2 aluminium phosphide tablets inside the tunnel and plug all the holes with clay + copper oxychloride

vii. Use aggregation pheromone traps @ 1/ha or use ferrolure in combination with food baits consisting of 1kg sugarcane molasses + 5g of yeast + 5ml glacial acetic acid + split petioles of coconut taken in a bucket of 10 L capacity

3. Black headed caterpillar: *Opisina arenosella* (Cryptophasidae: Lepidoptera)

Distribution and status: All over Peninsular India (East and West Coasts)

Damage symptoms: Dried up patches on leaflets of the lower leaves. Galleries of silk and frass on underside of leaflets.

3 to 4 youngest leaves remain green at the centre

Galleries of silk and frass on underside of leaves

Bionomics

Greyish white small moth lays about 180 eggs in groups on leaves. Egg period is 5 days. Greenish brown larva with dark brown head and prothorax, and a reddish mesothorax. Larval period 40 days, pupal period 12 days. It pupates inside the web in a thin silken cocoon.

Management

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

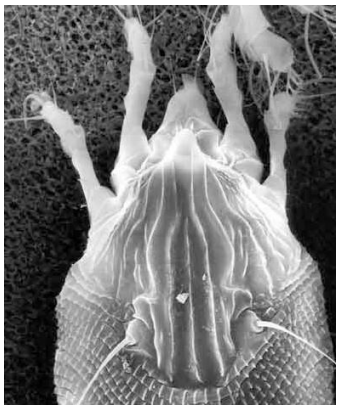
4. Coconut Eriophyid mite: *Aceria guerreronis* (Eriophyidae : Acari)

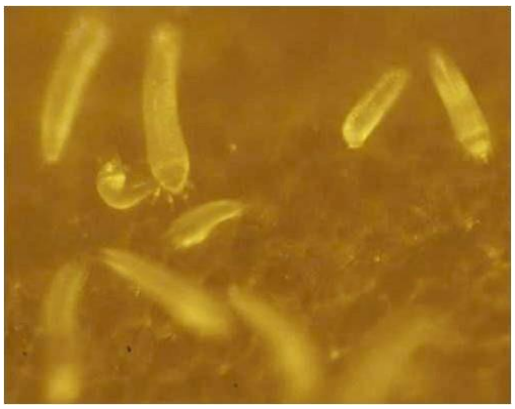
Distribution and status

Tamil Nadu, Karnataka and Andhra pradesh. Recently, observed in Andaman and Lakshadweep Islands. Dispersal of mite also occurs through insects, birds, lizards, squirrels and coconut husk. It attained major pest status after the super cyclone in 1998

Bionomics

- Pale coloured, elongated, worm like mite is very minute in size measuring 200-250 micron length and 36-52 micron in width with two pairs of legs in the anterior end ,head with piercing and sucking mouth parts.
- Life cycle consists of egg, two larval instars and an adult-stage and is completed in 1012 days.





Damage symptoms

The mite infests and develops on the meristematic tissues under the perianth. Initial symptoms exhibit as triangular pale white or yellow patches close to the perianth. Continuous feeding results in necrosis of tissues leading to formation of brown color patches, longitudinal fissures and splits on the outer surface of the husk; oozing of brown gummy exudation; reduced nut size, copra content and malformation of nuts.

Management

i. Nutrients (per tree / year)

Urea 1.3 kg, super 2.0 kg, potash 3.5 kg, neem cake 5 kg, borax 50 g, gypsum 1 kg, MgSO4 500 g, FYM 50 kg **ii. Root feeding**

a. Root feeding with TNAU - Agro Biocide 30 ml/tree
b. Root feeding with carbosulfan 15 ml + 15 ml water / tree at 45 days interval or

fenpyroximate at 10 ml/tree

c. TNAU - Agro biocide - 30 ml/tree - (60 days after Carbosulfan root feeding).

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

iii. Spray - Fenpyroximate 5 EC 1.0 ml/L of water

5. White grub: *Leucopholis coneophora* (Melolonthidae: Coleoptera)

Host range

Sweet potato, tapioca, colocasia and banana raised as intercrop in coconut plantations.

Damage symptom

Leaves turn yellow, immature nuts shed, flowering delayed. White grubs are exposed when base of the tree is dug.

Bionomics

Female lays eggs in the soil at a depth of 7 to 15 cm. Egg period 20 days, grub period 10-11 months, prepupal period 9-12 days. pupal period 25 days. Pupation occurs in soil.

Adult beetle emerges after monsoon showers.

Management

1.Summer ploughing exposes the immature stages

2. Sow the crop early in the kharif season.
3. Treat the seeds with chlorpyriphos @ 12 ml/kg of kernels.
4. Apply phorate 10 G 10 kg or carbofuran 3 G 30 kg per ha in the soil at or before sowing.
5. Spray 500 g carbaryl 50 WP 500 g in 250 L of water per ha on the preferred hosts like ber, guava, banana, in the vicinity

6. **Slug caterpillar: *Parasa lepida, Contheyla rotunda* (Cochlidiidae: Lepidoptera)**

Damage symptoms

Defoliation, leaving only the midrib and veins.

Bionomics

Parasa lepida

Flat shiny eggs are laid on the under surface of leaves in batches of 20-30, egg period 6-7 days. Larva: Larval period is about 42 days and it has greenish body with white lines and four rows of spiny scoli tipped red or black, which cause irritation and pain. It pupates in a compact elliptical chocolate brown shell like cocoon, which is convex above and flat below. Cocoons are covered with irritating spines and hairs; pupal period 21 days. Adult moth has green wings with prominent dark patch at the base of each forewing.

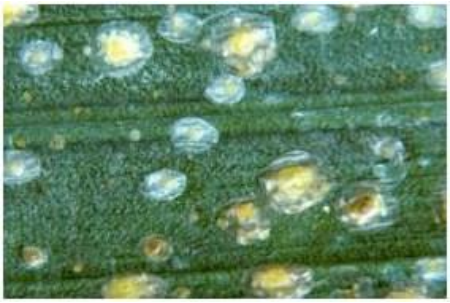
C. rotunda: Larva black or grey dorsally and dorso-laterally. Adult is a small greyish brown moth. Forewings are slight dark in colour with series of black points; hind wings slightly darker.

Management

Spray endosulfan 2.0 L in 1000 L of water per ha

Minor pests

7. **Mealy bug**: *Pseudococcus longispinus* (Pseudococcidae: Hemiptera)
8. **Scale insect**: *Aspidiotus destructor* (Diaspididae: Hemiptera)

9. **Lacewing bug**: *Stephanitis typicus* (Tingidae: Hemiptera)
10. **Termite**: *Odontotermus obesus* (Termitidae: Isoptera)
11. **Coconut skippers,** *Gangara thyrsis and Saustus gremius* **(**Hesperidae: Lepidoptera)





ARECANUT

Major pests				
1.	Spindle bug:	*Carvalhoia arecae*	Miridae	Hemiptera
2.	Sorghum or white mite	*Oligonychus indicus*	Tetranychidae	Acari
3.	Palm or red mite	*Raoiella indica*	Tenuipalpidae	Acari
4.	Root grub	*Leucopholis burmeisteri*	Melolonthidae	Coleoptera
5.	Inflorescence Caterpillar	*Tirathaba mundella*	Pyralidae	Lepidoptera
6	Pentatomid bug	*Halymorpha marmorea*	Pentatomidae	Hemiptera
Minor pests				
7.	Scale insects	*Aonidiella orientalis*	Diaspididae	Homoptera
8.	Stem weevil	*Diocalandra stigmaticollis*	Curculionidae	Coleoptera

1. Spindle bug: *Carvalhoia arecae* (Miridae: Hemiptera)

Distribution and status: Serous pest in Kerala, Karnataka and parts of Tamil Nadu

Damage symptoms

Inhabit the inner most leaf axils, usually below the spindle. Both nymphs and adults suck sap. Infested portions develop necrotic patches leading to drying. Spindle fails to open. Severe infection leads to stunting of the palm.

Bionomics

Adult bugs are brightly coloured red and black Eggs are laid singly between the leaflets of the spindle. The eggs hatch in 9 days. There are five nymphal stages and it is completed in 15-24 days. The light violet brown nymphs have greenish yellow border.

Management

1. Maintain proper drainage in the plantation area.

2. Uproot the heavily infested palm and burn it.
3. Drench the spindle with lindane 1.3 D at 2.5 g/L of water.

4. Place 2 g in perforated poly bags in the innermost leaf axils of palm to kill the immature.

2. Sorghum or white mite: *Oligonychus indicus* (Tetranychidae: Acari)

Adults and nymphs of this spider mite colonise the lower surface of leaves, suck sap, which causes yellowing and drying of leaves. The colony is found below a white web on the leaves. Life cycle is of short duration. The total duration of the immature stages varies from 6.5 to 9.0 days.

Management

Spray dicofol 18.5 EC 2 ml /L or dimethoate 30 EC 1.5 ml /L of water.

3. Palm or red mite: *Raoiella indica* (Tenuipalpidae: Acari)

Host range: Arecanut, coconut, date and ornamentals.

Damage symptoms

Neglected and poorly irrigated gardens and nurseries, particularly those in exposed conditions are prone to severe infestation. Colonies of these mites start declining with the onset of rains in June.

Bionomics

Nymphs and adults are seen in large numbers on the lower surface of leaves, in severe cases of infestation they may be seen on the leaf stalks and on the spindles. The life cycle lasts 13 days. .

Management: As given for sorghum/white mite

4. Root grub: *Leucopholis burmeisteri* (Melolonthidae: Coleoptera)

Distribution and status: Areca tracts of Kerala and Karnataka. Root grubs or `white' grubs occur in low lying and clayey soils where the water table is high. **Host range:** Roots of arecanut, grasses, banana, cocoa, tapioca, yams etc.

Damage symptoms

Grubs feed voraciously on areca roots which results in dropping and drying of leaves. Affected seedlings come off easily. Palms with few years of infestation show a sick appearance, with yellowing of leaves, tapering of stem, and reduction in yield.

The palms topple in case of severe loss of root system

Bionomics

Adult beetles (cockchafers) emerge during May-June after few days of premonsoon showers i.e., after 8-10 days of showers, between 6.30 to 7.30 PM. These beetles lay eggs in soil mostly up to 10 cm depth. Eggs hatch out in about 11

three weeks. The early instar grubs feed on the roots of grasses and other humus. The grub period with three instars is completed in 7 to 8 months. The pupation is in soil in cocoons of mud. This period lasts about one month. The adult beetle is chestnut brown in colour. The second and third instar grubs of these beetles feed on tender and mature roots of the palm, in severe cases of incidence, the bole of the palm is also eaten up.

Management

1. Collect the beetles in the evening after the premonsoon showers and kill them.
2. Apply phorate 10 G 15 g per palm to the soil twice a year. Repeat for 2- 3 years continously.

5. Inflorescence Caterpillar: *Tirathaba mundella* (Pyralidae: Lepidoptera)

Distribution and status: Karnataka and Kerala.

Damage symptoms

The caterpillars feed on the inflorescences especially the tender female flowers and rachillae, web them into a wet mass with silken threads and take shelter in it. Mature caterpillars can damage newly opened inflorescences also. In severe cases of incidence, they bore into the tender buttons and tender nuts as well. Delayed spathe opening, yellowing of spadices, presence of small holes with frass and drying patches on the spathe are the external symptoms of attack.

Bionomics

The adult moth lays eggs in the mechanically damaged portions of the spadices and the emerging caterpillars bore into the inside of the spadices. The egg period lasts five days and the larval period for about 26 days with five instars. Pupal period lasts for 9-11 days.

Management

1. Force open the spadix, remove the damaged inflorescences and burn.

2. Prepare and keep the poison bait to control slugs as they are the predisposing factors.
3. Conserve red ants as they are predatory
4. Spray malathion 2 ml/L of water.

6. Pentatomid bug: *Halymorpha marmorea* (Pentatomidae: Hemiptera)

Distribution and status: Kerala and Karanataka Incidence of this bug is seen from March/April to July/August.

Host range: Arecanut, cowpea, bitter gourd.

Damage symptoms

This bug causes tendernut drop in areca. The later instar nymphs and adult bugs pierce the tender nuts and suck the kernel sap. As a result, the kernel dries up and the tendernuts drop. Characteristic pinprick black marks are seen at the point of feeding sites, which lead internally to the kernel.

Bionomics

Adults are bronze colured with brown spots and measure 1.75 cm long. In the young stage, they are black with white spots on the legs**.**

Management

1. Monitor cow pea and bitter gourd, if any, in the vicinity to remove mechanically and destroy.
2. Conserve eupelmid egg parasitoid *Anastatus bangalorensis*
3. Spray endosulfan 0.05% (1.5 ml /L of water) or fenvalerate to the bunches of the affected palm and the neighboring palms

Minor pests

7. Scale insects: *Aonidiella orientalis* (Diaspididae: Homoptera)

Scale insects colonise the leaves, spathes, leaf sheaths and bunches and suck sap from the tissues. Continuous feeding on nuts results in pre-mature yellowing of nuts and in severe infestation, the kernel may not develop and may turn black and shrivel up. The scale insects are present throughout the year, but are more serious during October to February.

Questions - Coconut

1. Prominent horn is present in which sex of adult rhinoceros beetle ? **Male**

2. .---------- fungus used to control rhinoceros beetle **- *Metarhizium anisopliae***

3. Central spindle appears cut or toppled in coconut is a symptom of ---------- **Rhinoceros beetle**

4. Conspicuous long snout with tuft of hairs in males is seen in - **Red palm weevil**

5. ---------- is an aggregation pheromone used for control of red palm weevil - **Ferrolure**

6. ---------- is the scientific name of coconut black hairy caterpillar -***Opisinia arenosella***

7. Alternate host of *Oryctes rhinoceros* _____

a. pineapple
b. sugarcane
c. arecanut
d. **all the above**

8. Dried up patches on leaflets of the lower leaves of coconut is symptom of

a. **Black headed caterpillar** b. Skipper
c. Rhinoceros beetle d. Red palm weevil

9. Root feeding technique is followed to control following pest
a. Red palm weevil b. Skipper
c. Rhinoceros beetle d. **Black headed caterpillar**

10. Scientific name of slug caterpillar is ---------- ***Parasa lepida***

11. Site of oviposition for white grub is
a. on leaf b. **Soil**
c. inbetween leaf d. on under surface of leaf

12. Brown color patches, longitudinal fissures and splits on outer surface of the coconut husk is due to

a. Red palm weevil b. **Eriophyid mite**
c. Rhinoceros beetle d. Black headed caterpillar

13. Scientific name of eriophyid mite is

a. *Rhynchophorus ferrugineus* b. *Oryctes rhinoceros*
c. *Opisina arenosella* d. ***Aceria guerreronis***

14. *Opisina arenosella* belongs to _____ family

a. Curculionidae **b. Cryptophasidae**
c. Scarabaeidae d. Arctiidae

15. Eriophyid mite attained major pest status in the year -**1998**

16. _____ is a predator of Rhinoceros beetle ***Platymeris laevicollis***

17. Female of rhinoceros beetle lays eggs in _____**(manure pits or decaying vegetable matter)** to a depth of _____ **(5-15 cm)**

18. _____ stage of rhinocesos beetle does the damage to coconut fronds (Adult)

19. Holes on the trunk with brownish ooze is a symptom caused by _____ **(Red palm weevil)**

20. _____ damage is more pronounced in the coastal region (**black headed caterpillar**)