

B.Sc. Ag
V Sem

**Pests of Crops and Stored
Grain and their Management**

Credit - 3(2+1)

**As per ICAR
5TH Dean Syllabus**

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ENTO 331 - CROP PESTS AND STORED GRAIN PESTS AND THEIR MANAGEMENT

Lecture No. 1

PEST OF RICE

More than 100 insect species are associated with the rice crop at one stage or the other and 20 of these are pests of major economic significance. Among the sucking pests, BPH, GLH, WBPH, rice earhead bug pose severe threat to rice production.

Major pests				
1.	Thrips	<i>Stenchaetothrips biformis</i>	Thripidae	Thysanoptera
2.	Green leafhopper	<i>Nephotettix virescens</i> , <i>N. nigropictus</i> and <i>N. cincticeps</i>	Cicadellidae	Hemiptera
3.	Brown plant hopper	<i>Nilaparvata lugens</i>	Delphacidae	Hemiptera
4.	White backed plant hopper	<i>Sogatella furcifera</i>	Delphacidae	Hemiptera
5.	Rice earhead bug	<i>Leptocorisa acuta</i>	Alydidae	Hemiptera
6.	Mealy bug	<i>Brevennia rehi</i>	Pseudococcidae	Hemiptera
7.	Rice black bug	<i>Scotinophora lurida</i> and <i>S. coarctata</i>	Podopidae	Hemiptera
Minor pests				
8.	Earhead stink bug/ Shield bug / Red spotted bug	<i>Menida histrio</i>	Pentatomidae	Hemiptera
9.	Rice striped bug	<i>Tetroda histeroides</i>	Pentatomidae	Hemiptera
10.	White rice leafhopper	<i>Cofana spectra</i>	Cicadellidae	Hemiptera
11.	Blue rice leafhopper	<i>Empoasca maculifrons</i>	Cicadellidae	Hemiptera
12.	Zigzag striped leafhopper	<i>Recilia dorsalis</i>	Cicadellidae	Hemiptera

MAJOR PESTS

1. Thrips: *Stenchaetothrips biformis* (Thripidae: Thysanoptera)

Distribution and status: Bangladesh, India, Indonesia, Japan, Malaysia, Sri Lanka, Thailand and Vietnam. Minor but has potential to become major.

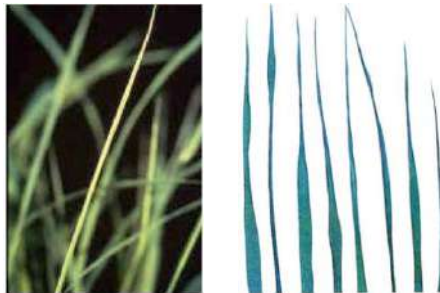
Host range: *Echinochloa* sp.

Damage symptoms

Both nymphs and adults lacerate the tender leaves and suck the plant sap, causing yellow or silvery streaks on the leaves of young seedlings. Terminal rolling and drying of leaves from tip to base is the typical symptom of attack. It causes damage both in nursery and main field.



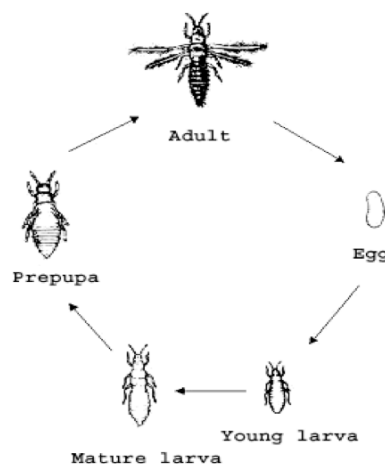
Leaf curling caused by Rice Thrips (IRRI)



ETL: 60 Nos. per 12 wet hand sweeps in nursery

Bionomics

Adults dark brown, female inserts the eggs singly within the leaf tissues in young leaves. Egg period 3-5 days, life cycle completed in 13-19 days.



Management

- Spray endosulfan 35 EC 80 ml or monocrotophos 36 WSC 40 ml/800 m² nursery.
- Spray Endosulfan 35 EC 1.0 L or Monocrotophos 36 WSC 1.0 L or Azadirachtin 0.15% w/w 1.5-2.5 L or Lambda-Cyhalothrin 2.5 EC 500 ml or Lambda-Cyhalothrin 5 EC 250 ml in 500 L water/ha
- Grow resistant cultivars like PTB 12, PTB 20, PT 321, H 4

2. Green leafhopper: *Nephotettix virescens*, *N. nigropictus* and *N. cincticeps* (Cicadellidae: Hemiptera)



Nephotettix virescens



N. nigropictus

Distribution and status: India, South Japan to oriental region, west of south Africa, Phillippines, Formosa, Sri Lanka

Host range: Rice, millets, grasses

Damage symptoms

Both nymphs and adults desap the leaves and cause “hopper burn” due to heavy infestation. Yellowing of leaves from tip downwards is the typical symptom caused by this pest. However, it is more important as a vector for rice tungro virus, rice yellow dwarf and transitory yellowing diseases.



ETL: 60 Nos. / 25 sweeping – Nursery

10 Nos. / hill - Flowering stage

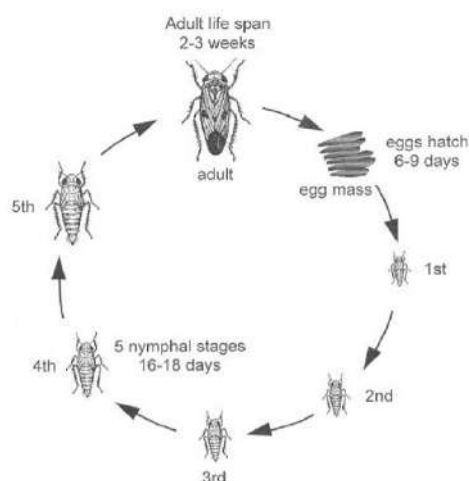
5 Nos. / hill - Vegetative stage

2 Nos. / hill - Tungro endemic area

Bionomics

Adults green with black spot and black patch on wings, gravid female inserts 200-300 eggs in batches of 8-16 in midrib of leaf blade. Egg period 6-7 days, nymphs undergo five instars and become adult in 25 days. Adult longevity 20-30 days. The population normally increases from August onwards, reaches maximum

during September - October and declines from November.



Management

1. Use resistant varieties like IR 20, IR 50, CR 1009, Co 46, PTB 2, PTB 18, IET 7301, IET 7302, IET 7303 and Vani, Vikra marka, Lalit, Nidhi
2. Nursery should not be raised near the lamp posts.
3. Apply neem cake @ 12.5 kg/800 m² nursery as basal dose.
4. Apply carbofuran 3 G @ 3.5 kg or phorate 10 G @ 1.0 kg or quinalphos 25 EC 80 ml or endosulfan 35 EC 80 ml per 800 m² nursery. Maintain the water level at 2.5 cm for 3 days after granular application.
5. Spray any of the following insecticide in 500 L water/ha
 - Acephate 75 SP 666-1000 g
 - Imidacloprid 17.8 SL 100 -125 ml
 - Endosulfan 35 EC 1000 ml
 - Quinalphos 25 EC 1000 ml
 - Buprofezin 25 SC 800 ml
 - Phosphamidon 40 SL 875 ml
 - Ethofenprox 10EC 500-750 ml
 - Thiamethoxam 25 WG 100 g
 - Fipronil 5 SC 1-1.5 kg or 0.3 GR 16.7 - 25.0 kg
 - Lambda-Cyhalothrin 2.5 EC 500 ml or 5 EC 250 ml
 - Fenobucarb (BPMC) 50 EC 500-1500 ml

3. Brown plant hopper: *Nilaparvata lugens* (Delphacidae: Hemiptera)

Distribution and status

Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Maharashtra, Madhya Pradesh, Uttar Pradesh, Haryana and Punjab in India, South East Asia, China, Japan, Korea

Host range: Rice, sugarcane, grasses

Damage symptoms

Nymphs and adults congregate at the base of the plant above the water level and suck the sap from the tillers. The affected plant dries up and gives a scorched appearance called “hopper burn”. Circular patches of drying and lodging of matured plants are typical symptoms caused by this pest. It is the vector of grassy stunt, ragged stunt and wilted stunt diseases.



ETL: 8-10 Nos./hill or 20 Nos./hill when spider is present at 1 No./hill

Bionomics

The brown plant hopper has a brown body and chestnut brown eyes. Adult measures about 4 - 4.5 mm in length capable of flying a long distance drifting with the wind. Adults are of two forms viz., macropterous (long winged) and brachypterous (short winged). The female makes an incision in the leaf sheath and inserts 200-300 small eggs, egg period -6 days; nymphal period - 15 days and adult longevity 18-20 days.



Management

1. Use resistant varieties like Aruna, Karnataka, Karthika, Krishnaveni, Makon, Abhey, Asha, Divya, Py 3, Co 42, Co 46, PTB 21, Jyoti (PTB 29) and PTB 33, Manasarowar, Bhadra, IET 7575, IET 6315, MTU 1249, R 650 - 1820, Shyraksha, Arvindar, kartik, bharatidasan, neela, uday, sonasali, vajram, chaitanya, nagarrjuna and chandana,
2. Avoid close planting and provide 30 cm rogue spacing at every 2.5 m to reduce the pest incidence.
3. Avoid use of excessive nitrogenous fertilizers.
4. Control irrigation by intermittent draining.
5. Set up light traps to monitor and control pest population.

6. Release of natural enemies like wolf spider, *Lycosa pseudoannulata* and green mirid bug *Cyrtorrhinus lividipennis*.
7. Avoid use of insecticides causing resurgence such as synthetic pyrethroids, methyl parathion, fenthion and quinalphos.
8. Drain the water before the use of insecticides and direct the spray towards the base of the plants.
9. Spray neem seed kernel extract 5% (25 kg/ha) (or) neem oil 2% (10 L/ha).
10. Spray imidacloprid 17.8 SL 125 ml or buprofezin 25 SC 325 ml or or acephate 75 SP 625 g or or /ha.

- | | |
|--|--|
| • Acephate 75 SP 665-1000 g | • Fenobucarb (BPMC) 50 EC
500-1500 ml |
| • Methyl demeton 25 EC 1000 ml | • Dichlorvos 76 WSC 350 ml |
| • Chlorpyrifos 25 EC 1250 ml | • Ethofenprox 10 EC 500-750 ml |
| • Benfuracarb 3 GR 3.3 kg | • Clothianidin 50 WDG 20-24 g |
| • Imidacloprid 70 WG 30-35 g
or 30.5 m/m SC 60-75 ml or
17.8 SL 100-125 ml | • Fipronil 5 SC 1.0 -1.5 L or 0.3
GR 16.7 - 25.0 kg |
| • Buprofezin 25 SC 800 ml | |

4. White backed plant hopper: *Sogatella furcifera* (Delphacidae: Hemiptera)

Distribution and status: India, Burma, Sri Lanka, China, Pakistan, Japan, Indonesia, Korea

Host range: Rice, maize, millets, sugarcane, grasses

Damage symptoms

Both nymphs and adults suck the sap and cause stunted growth and “hopper burn” leading to yield loss. “Hopper burn” is caused in irregular patches. Nymph falls on water keeping its legs stretched.

Bionomics

In white nymphs, vertex characteristically gives a narrow face to the hoppers. Forewings hyaline with dark veins and a dark spot in the middle of posterior edge. Pronotum pale yellow and adults possess a diamond like marking on the thorax. The

female lays upto 758 eggs in as many as 112 egg masses with 1-24 eggs in each in leaf sheath and in the mid rib of leaves. The ovipositional site characterized by black streaks. Egg period 6-7 days; nymphal period 12-17 days with five instars. The female longevity about 2 months.



Management

- Same as given for BPH.
- Use resistant varieties like AR 133, IC 25687, Tangner, Amelbero, HKR-10, HKR-126, IET 8116

5. Rice earhead bug: *Leptocorisa acuta* (Alydidae: Hemiptera)

Distribution and status: India and rice growing areas

Host range: Rice, Millets

Damage symptoms

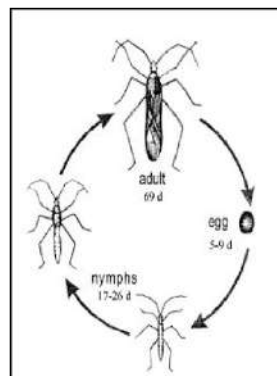
Both nymphs and adults suck the sap from individual grains at milky stage. Affected grains become chaffy with black spots at the site of feeding puncture. Yield loss may be 10- 40%. Obnoxious odour emanates on disturbing the bugs in the field.



Damaged grains caused by rice bug (IRRI)

ETL: 5 bugs/100 panicles or 1 bug/hill - flowering stage; 16 bugs/100 panicles or 3 bug/hill- milky stage.

Bionomics



Brownish green adults are slender with long legs and antennae, lay 200-300 flat, dark, reddish brown eggs in rows of 10-15 on the leaves or panicles. The egg period 5-8 days, green to brown nymphs undergo five instars in 17-27 days. Adults fairly long lived (30-50 days).

Management

1. Remove alternate host, *Echinochloa* from bunds and field.
2. Ensure synchronous planting on community basis in an area.
3. Use neem seed kernel extract 5% or notchi leaf powder extract 5% or *Ipomoea* leaf powder extract 5% or *Prosopis* leaf powder extract 5%
4. Dust quinalphos 1.5 D or carbaryl 10 D or malathion 5 D @ 25 kg/ha or spray malathion 50 EC 500 ml or monocrotophos 36 WSC 500 ml/ha.

6. Mealy bug: *Brevinnia rehi* (Pseudococcidae: Hemiptera)

Distribution and Status

Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, Madhya Pradesh, West Bengal and Kerala in India, Bangladesh, Thailand

Host range: Rice, graminaceous weeds

Damage symptoms

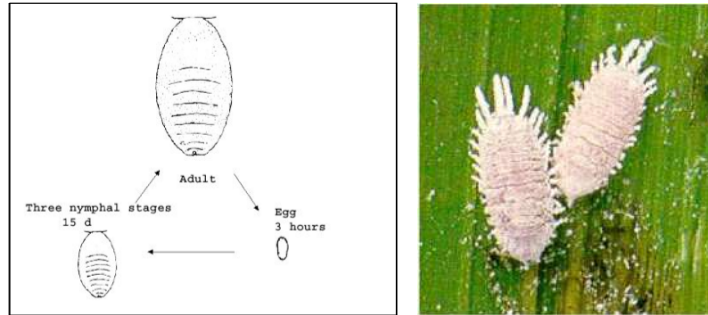
Large number of insects remains in leaf sheath and suck the sap, affecting plants in circular patches. Plants become weak, yellowish and stunted. Presence of white waxy fluff in leaf sheath is a typical symptom of damage.



Field damage caused by mealy bugs (IRRI)

Bionomics

The mealy bug is small reddish white, soft-bodied, wingless insect covered with filamentous materials. It lays 126-139 eggs in the leaf sheath and reproduces parthenogenetically. The egg period 1-2 days; nymphal period 17-34 days, nymphs remain within the leaf sheath and suck the plant sap.



Management

1. Parasitoids such as *Adelencyrtus* sp., *Xanthoencyrtus* sp. and *Dolichoceros* sp. and coccinellid predators can be utilized.
2. Remove the grasses and trim the bunds during the main field preparation before transplanting.
3. Remove and destroy the affected plants.
4. Spray dimethoate 30 EC 500 ml/ha in initial stages of infestation.

7. Rice black bug: *Scotinophora lurida* and *S. coarctata* (Podopidae: Hemiptera)

Distribution and Status: India

Host range: Rice, millets

Damage symptoms

Both nymphs and adults suck plant sap from the culm during tillering to flowering at the base of the plant. It also sucks the sap from leaf sheath, leaf and panicle. The affected plants turn reddish brown or yellow. During tillering stage, it causes drying up of central shoot (dead heart), stunted growth and reduced tillers. During reproductive stage, it affects the panicle development and causes chaffy grains (white ears). In severe cases, plants wilt, dry and turn bug burned, similar to hopper burn damage of brown plant hopper.

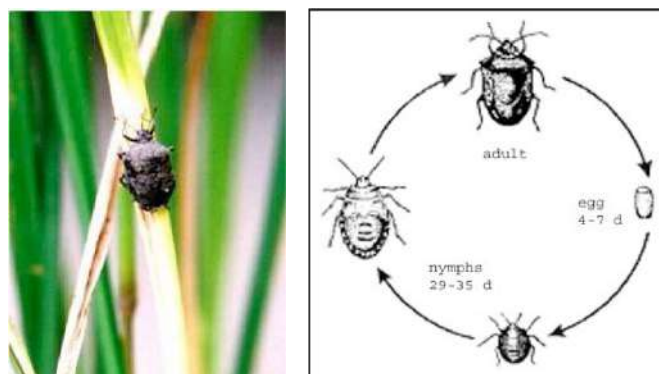


Bug burn (PhilRice)

ETL: 10% damage at tillering stage or 5 bugs / hill

Bionomics

Adults are brownish black with a prominent scutellum and pronotum having a spine on either side. 1 mm long greenish eggs are laid in masses on the stem and leaves that turn pinkish during hatching. Brown nymphs with yellowish green abdomen and 2-3 black scent glands.



Management

1. Keep the field free from weeds and grasses.
2. Drain the excess water from the field.
3. Set up light traps to attract and kill large number of bugs.
4. Conserve the predators *viz.*, spiders, coccinellids and wasps to check the pest.
5. Ducks can be allowed in the field to pick up the bugs
6. Spray NSKE 5% or monocrotophos 36 SL @ 1000 ml/ha or acephate 75 SP @ 625 g per ha for effective pest suppression.

MINOR PESTS

8. Earhead stink bug / Shield bug / Red spotted bug: *Menida histrio* (Pentatomidae: Hemiptera)

Both nymphs and adults suck the ear heads and cause individual grains chaffy.



9. Rice striped bug: *Tetroda histerooides* (Pentatomidae: Hemiptera)

The nymphs and adults suck the sap from the stem and cause stunting and

yellowing of tillers. Adult is brown with a prominent “V” shaped mark on its back. It lays cylindrical eggs in rows on the under surface of the leaves. The egg period 5-7 days, nymphal period 40-50 days, life cycle completed in 49-62 days. The adult longevity is about 2 weeks.

10. White rice leafhopper: *Cofana spectra* (Cicadellidae: Hemiptera)

Nymphs and adults suck the sap causing yellowing of leaves and stunting of tillers. Nymphs are elongate and pale green coloured. Adults are white in colour, 3-4 times larger than green leafhopper. They are the biggest of rice hoppers.

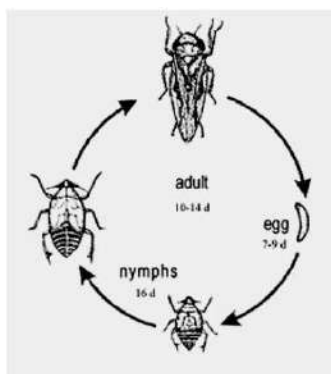


11. Blue rice leafhopper: *Empoasca maculifrons* (Cicadellidae: Hemiptera)

Nymphs and adults suck the sap of the leaves and cause “hopper burn” in the seedlings in the form of whitish waxy lines on the leaf blades in the initial stage of attack and subsequent drying. Small blue leafhoppers with yellowish vertex having a black patch in the middle of pronotum.

12. Zigzag striped leafhopper: *Recilia dorsalis* (Cicadellidae: Hemiptera)

Both nymphs and adults suck plant sap and cause tip drying and orange discoloration of both margins of leaves. Adults have white fore wings with pale brown bands forming the shape of W.



QUESTIONS

1	Terminal rolling and drying of leaves from tip to base in both rice nursery and mainfield.	
	a. Thrips	b. GLH
	c. WBPH	d. BPH
2	_____ acts as a vector for rice tungro virus	
	<i>Nephotettix nigropictus</i>	<i>Nilaparvata lugens</i>
	<i>Cofana spectra</i>	<i>Empoasca maculifrons</i>
3	ETL for GLH in tungro endemic area	
	a. 2 Nos/ hill	b. 5 Nos / hill
	c. 10 Nos / hill	d. 60 Nos / hill
4	Alternate host of <i>Stenchaetothrips biformis</i> is _____	
	a. <i>Phasalum scrobiculatum</i>	b. <i>Cyanodan dactylon</i>
	c. <i>Panicum</i> sp	d. <i>Echinochloa</i> sp.
5	Which of the following is white leaf hopper	
	a. <i>Nephotettix nigropictus</i>	b. <i>Cofana spectra</i>
	c. <i>Empoasca maculifrons</i>	d. <i>Nilaparvata lugens</i>
6	Which of the following is blue rice leaf hopper	
	a. <i>Nephotettix nigropictus</i>	b. <i>Cofana spectra</i>
	c. <i>Empoasca maculifrons</i>	d. <i>Nilaparvata lugens</i>
7	Hopper burn' is the symptom of _____ pest in rice	
	a. <i>Nephotettix nigropictus</i>	c. <i>Sogatella furcifera</i>
	b. <i>Nilaparvata lugens</i>	d. all the above

8	Use of synthetic pyrethroids may cause resurgence of sucking pest in rice Say True or false	
9	Tip drying and orange discoloration of rice leaves is typical symptom of -----	
	a. <i>Nephotettix nigropictus</i>	c. Recilia dorsalis
	b. <i>Empoascanara maculifrons</i>	d. <i>Nilaparvata lugens</i>
10	Which of the following pest causes damage to the grain at milky stage	
	a. Earhead bug	b. Mealy bug
	c. Black bug	d. Stink bug
11	----- act as a vector ragged stunt and wilted stunt.	
	a. <i>Nephotettix nigropictus</i>	b. <i>Empoascanara maculifrons</i>
	c. <i>Nilaparvata lugens</i>	d. <i>Cofana spectra</i>
12	----- ----- act as a vector for transitory yellowing diseases.	
	a. <i>Nephotettix nigropictus</i>	c. <i>Cofana spectra</i>
	c. <i>Empoascanara maculifrons</i>	d. <i>Nilaparvata lugens</i>
13	Zigzag striped leafhopper belongs to _____ family	
	a. Alydidae	c. Pentatomidae
	c. Cicadellidae	d. Delphacidae
14	Rice black bug belongs to _____ family	
	a. Alydidae	b. Pentatomidae
	c. Podopidae	d. Delphacidae
15	ETL for rice earhead bug in milky stage - 16 bugs/100 panicles or 3 bugs/hill.	
16	Green mirid bug which feeds on BPH ----- <i>Cyrtorhinus lividipennis</i>	
17	Alternate wetting and drying is a good management technique for controlling -----	

	a. BLH	c. GLH
	b. WBPH	d. BPH
18	Rice earhead bug belongs to _____ family	
	a. Alydidae	b.Pentatomidae
	c. Podopidae	d.Delphacidae

Lecture No. 2

PESTS OF RICE – BORERS AND FOLIAGE FEEDERS

Yellow stem borer, leaf folder, gall midge, other defoliators are important and cause significant reduction in yield in rice growing areas.

Major pests				
1.	Yellow stem borer	<i>Scirpophaga incertulas</i>	Pyraustidae	Lepidoptera
2.	Gall midge	<i>Orseolia oryzae</i>	Cecidomyiidae	Diptera
3.	Swarming caterpillar	<i>Spodoptera mauritia</i>	Noctuidae	Lepidoptera
4.	Leaf folder	<i>Cnaphalocrocis medinalis</i>	Pyralidae	Lepidoptera
5.	Rice case worm	<i>Nymphula depunctalis</i>	Pyraustidae	Lepidoptera
6.	Rice skipper	<i>Pelopidas mathias</i>	Hesperiidae	Lepidoptera
7.	Spiny beetle / Rice hispa	<i>Dicladispa armigera</i>	Chrysomelidae	Coleoptera
8.	Whorl maggot	<i>Hydrellia sasakii</i>	Ephydriidae	Diptera
9.	Rice horned caterpillar	<i>Melanitis ismene</i>	Satyridae	Lepidoptera
10.	Yellow hairy caterpillar	<i>Psalis pennatula</i>	Lymantriidae	Lepidoptera
Minor pests				
11.	Grasshopper	<i>Hieroglyphus banian</i>	Acrididae	Orthoptera
12.	Short horned grasshopper	<i>Oxya nitidula</i>	Acrididae	Orthoptera
13.	Blue beetle	<i>Halticia cyanea</i>	Chrysomelidae	Coleoptera
14.	Rice root weevil	<i>Echinocnemus oryzae</i>	Curculionidae	Coleoptera
15.	Rice root weevil	<i>Hydronomidus molitor</i>	Curculionidae	Coleoptera
16.	Rice root grub	<i>Arthrodeis</i> sp.,	Tenebrionidae	Coleoptera

MAJOR PESTS

1. Yellow stem borer: *Scirpophaga incertulas* (Pyraustidae: Lepidoptera)

Distribution and Status: Afghanistan, Bangladesh, Burma, Cambodia, China, India, Sri Lanka and Indonesia.

Host range: Rice

Damage symptoms

Larva feeds on the stem and causes drying of the central shoot known as “dead heart” in the young seedlings, and drying of the panicle in grown up plant called “white ear”. Damage ranges from 30-80%.



Whitehead or dead panicles at reproductive stage (IRRI)

ETL

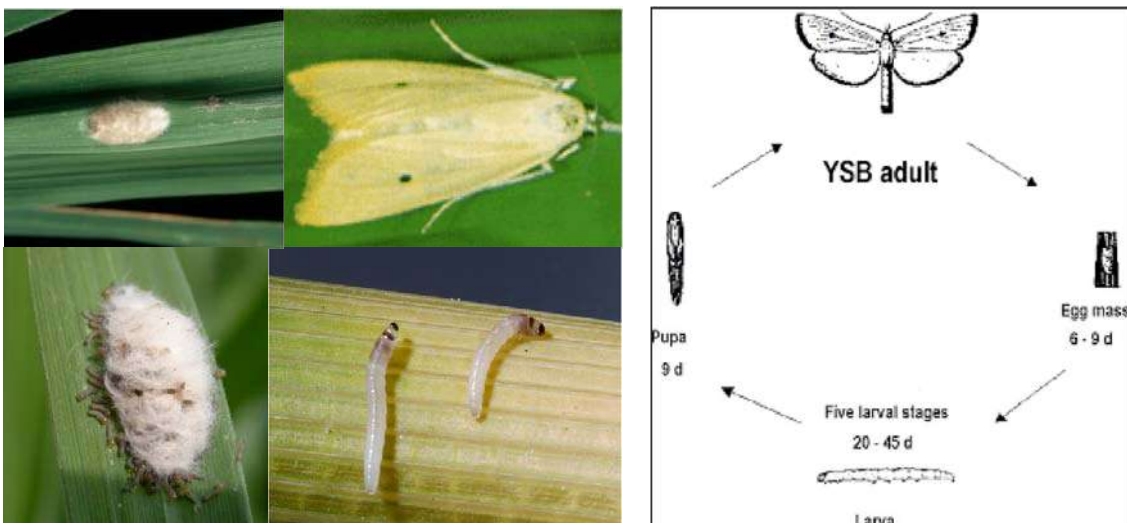
2 egg masses/ m²

10% dead hearts - Vegetative stage

2% white ear - Flowering stage

Bionomics

Female moth has bright yellowish brown fore wings with a black spot and a tuft of yellow anal hairs while male is smaller with pale yellow forewings without black spot. Each female lays 170-200 eggs in a mass of 15-80 on the upper surface of leaf tips covered with buff coloured hairs.



The egg period 6-9 days; larva pale yellow with dark brown head, swims in water

and bores in to the stem near the node. The larva migrates to other tillers also. Larval period 20-45 days, pupation in white silken cocoon. Pupa dark brown in color, pupal period is 6-10 days.

Management

1. Grow resistant varieties viz., Ratna, Jaya, TKM 6, IR 20 and IR 26, Sayasree, Saket, IET 3127, IET 2812, MTU 5849, PTB 12, PTB 20, PT 321, H 4
2. Clip the seedling tips before transplanting to eliminate egg masses and collect & destroy the egg masses in main field.
3. Avoid close planting and continuous water stagnation at early stages.
4. Collect and destroy the dead hearts and white ears.
5. Set up light traps to attract and kill the moths.
6. Install sex pheromone traps to monitor and mass trap.
7. Release the egg parasitoid, *Trichogramma japonicum* twice on 30 and 37 DAT @ 5 cc/ha/release.
8. Apply *Bacillus thuringiensis* var *kurstaki* and neem seed kernel extract in the combination of 2.5 g/L and 1% to reduce the oviposition by the stem borer.
9. Apply carbofuran 3 G @ 25 kg or benfuracarb 3 G 33 kg or chlorantraniliprole 0.4 G 10 kg or fipronil 0.3 G 17-25 kg or cartap hydrochloride 4 G 18.75 kg or spray acephate 75 SP 666-1000 g cartap hydrochloride 50 SP 1 kg or monocrotophos 36 SL 1.0 L or quinalphos 25 EC 1.0 L or azadirachtin 0.15 W/W 1.5-2.5 L or azadirachtin 5 % 400 ml or carbosulfan 25 EC 800-1000 ml or chlorantraniliprole 18.5 SC 150 ml or ethofenprox 10 EC 500-750 ml or fipronil 5 SC 1-1.5 L or fipronil 80 WG 50-62.5 g or flubendiamide 20 WG 125 g or flubendiamide 39.35 M/M SC 50 ml or lambda-cyhalothrin 2.5 EC 500 ml/ 5 EC 250 ml or phosphamidon 40 SL 1.25 L or thiacloprid 21.7 SC 500 ml or thiamethoxam 25 WG 100 g per ha using water @ 500 L/ha
10. Harvest the crop up to the ground level and disturb the stubbles with plough immediately after the harvest

2. Gall midge: *Orseolia oryzae* (Cecidomyiidae: Diptera)

Distribution and Status: India, Burma, Cambodia, Sri Lanka, China, Indonesia, Nigeria, Sudan, Vietnam and Pakistan.

Host range

Rice, wild species of *Oryza* and grasses like *Paspalum scrobiculatum*, *Panicum* spp., Cyanodan *dactylon* and *Eleusine indica*.

Damage symptoms

The maggot feeds at the base of the growing shoot causing formation of a tube like

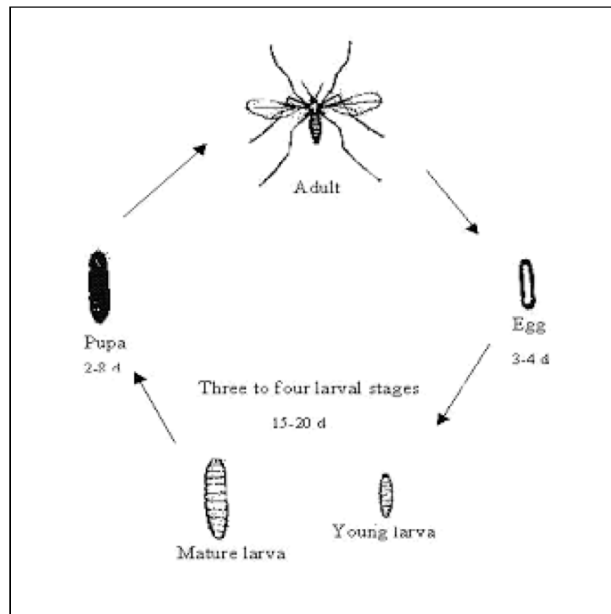
gall similar to “onion needle” or “silver-shoot”. Infested tillers produce no panicles.



Onion shoots affected tillers (IRRI)

ETL: 10% silver shoots.

Bionomics



Orange coloured mosquito like fly is active during night and lays 100-300 reddish, elongate, tubular eggs just near the ligule of the leaf blade. Egg period 3-4 days, maggot pale red during feeding and larval period 8-10 days. Maggot pupates at the base of the gall and moves to tip of the gall and projects outside during emergence. Life cycle lasts for 15-20 days.

Management

1. Encourage early planting of the crop with quick growing varieties to escape infestation.
2. Use resistant varieties like MDU-3, Shakthi, Vikram, Sureka, IR 36, Kkatiya, Dhanaya Lakshmi, Phalguna, Kunti, Shamlei, Asha, Rajendran, Shrakasha, Erra mallelu, Kavya, Orugallu and R 650 -1820
3. Plough immediately after crop harvest.
4. Remove the alternate host.
5. Apply fertilizers in balanced manner.
6. Set up light trap @ 1 / ha as a monitoring device. Infra red light trap attracts gall midge effectively.
7. Release larval parasitoid, *Platygaster oryzae* through parasitized galls @ 1 per 10 m² in the main field at 10 days after transplanting (DAT).
8. The is an effective predator.
9. Conserve predatory spiders like *Tetragnatha*, *Argiope catenulata* and carabid beetle (*Ophionia indica*) in rice ecosystem.
10. Apply carbofuran 3G @ 25 kg or fipronil 0.3 G 16.7 - 25.0 kg or spray endosulfan 35 EC 1.0 L or quinalphos 25 EC 1.0 L or ethofenprox 10 EC 500-750 ml or fipronil 5 SC 1.0 -1.5 kg or lambda-cyhalothrin 2.5 EC 500 ml / 5 EC 250 ml or thiamethoxam 25 WG 100 g in 500 L water/ha

3. Swarming caterpillar: *Spodoptera mauritia* (Noctuidae: Lepidoptera)

Host range

Rice, maize, jowar, wheat, barley and sugarcane

Distribution and status

India, South East Asia, USA, Australia, Africa

Damage symptoms

This is a sporadic pest but causes very serious damage to young crops when it appears in large numbers. The caterpillars feed at night and hide during the day.

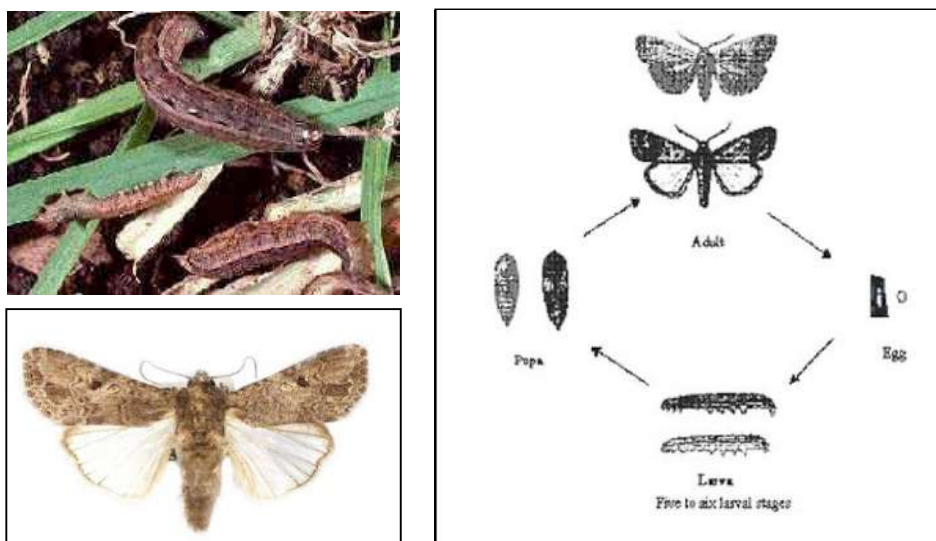


Damaged leaf blades and Panicles cut off from the base (IRRI)

Larvae cut the seedlings in large scale and appears as if grazed by cattle by its nocturnal feeding. Peduncles of ears are bitten through in maturing crop. They feed gregariously and march from field to field. The damage is severe in July - September. It breeds on a variety of grasses. Yield loss ranges from 10-20%.

Bionomics

Adult moth is medium sized stoutly built, dark brown with a conspicuous triangular spot on fore wings. Eggs are laid in masses on leaves and covered with grey hairs. The egg period is 7 days. Caterpillar is cylindrical, dark to pale green with lateral lines along the body. The larval period is 20-25 days. It pupates in an earthen cocoon in soil for 10-15 days.



Management

1. Conserve larval parasitoids viz., *Apanteles ruficus*, *Meteorus* sp., *Charops bicolor*, *C. dominans*, *Drino unisetosa*, *Pseudoperichaeta orientalis*, *Strobliomyia aegyptia*, *Pseudogonia cinerascens*, *Tachinia analis*, *Cuphocera varia*, *Sturmia inconspicua*, *Chelonus* sp., *Euplectrus euplexiae*, *E. spodopterae* and a parasitic nematode (*Hexamermis* sp.)
2. Conserve pupal parasitoids viz., *Netelia* sp., *Actias* sp., *Drino* sp. and *Isomera cinerascens*
3. Protect vertebrate predators of the larvae viz., House Crow *Corvus splendens*, Jungle Crow *C. macrorhynchos*, Cattle Egret *Bubulcus coromandus*, Indian pond heron or Paddy bird *Ardeola grayi*, white breasted water hen *Amaurovius phoenicocurus*, Indian Myna *Acridotheres tristis*.
4. Flood the nursery to expose the hiding larvae to the surface for birds to pick them up.

5. Kerosenate water during irrigation to suffocate and kill the larvae.
6. Allow ducks into the field to feed on the larvae.
7. Drain water from nursery and spray chlorpyrifos 20 EC 80 ml (or) endosulfan 35 EC 80 ml during late evening.

4. Leaf folder (or) leaf roller: *Cnaphalocrocis medinalis* (Pylalidae: Lepidoptera)

Distribution and status

India, Sri Lanka, China, Japan, Madagascar, New Guinea, Pakistan, Bangladesh, South East Asia, Korea.

Host range: Grasses



Damage symptoms

The caterpillar folds the leaves longitudinally and remains inside. It scrapes the green tissues of the leaves and makes them white and dry. During severe infestation the whole field exhibits scorched appearance.

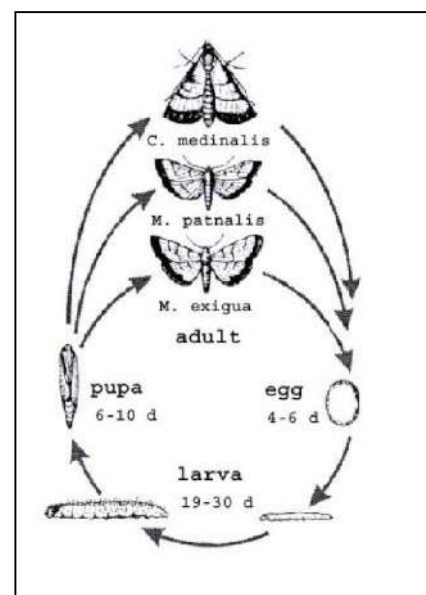
ETL

10% damaged leaves in vegetative stage

5% damaged leaves (flag leaf) in flowering stage

Bionomics

The adult moth is often seen in the field during daytime. The moth is brownish with many dark wavy lines in centre and dark band on margin of wings. The female moth lays eggs in batches of 10-12, which are arranged in linear row in the lower surface of leaves. The eggs are flat, oval in shape and yellowish white in colour. The egg period is 4-7 days. Larva is 15-20 mm long, pale green, transparent, actively moving caterpillar. The larval period is 15-20 days. It pupates inside the leaf fold. The pupa is greenish brown. The pupal period is 6-8 days. Total life cycle: 25-35 days.





Management

1. Use resistant varieties like TNAU LFR 831311, Cauvery, Akashi, TKM-6, IET 7511, IET 9225 and IET 9797, ASD 20, VC Dhan 221, PTB 12, PTB 20, PT 321, H 4
2. Clipping of affected leaves reduces the pest population.
3. Trim the bunds and remove grassy weeds.
4. Avoid use of excessive nitrogenous fertilizer.
5. Set up light traps to attract and kill the moths.
6. Release *Trichogramma chilonis* thrice on 37, 44 and 51 DAT followed by three sprays of monocrotophos 36 SL 1.0 L/ha on 58, 65 and 72 DAT.
7. Apply benfuracarb 3 G 3.3 kg or cartap hydrochloride 4 G 1.875 - 2.5 kg /ha
8. Spray any of the following insecticide in 500 L water/ha

• NSKE 5% 25 kg	• Chlorpyrifos 20 EC 1.25 L
• Acephate 75 SP 666-1000 g	• Ethofenprox 10 EC 500-750 ml
• Azadirachtin 0.15% w/w 1.5 - 2.5 L	• Fipronil 80 WG 50 - 62.5 g
• Azadirachtin 5% 400 ml	• Phosalone 35 EC 1.5 L

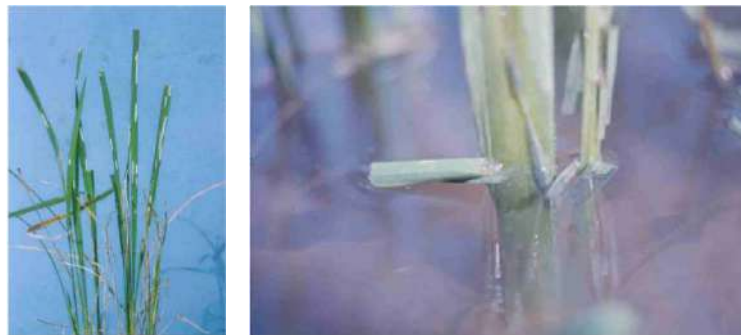
- Cartap hydrochloride 50 SP 1 kg
- Flubendiamide 20 WG 125 - 250 g
or 39.35 M/M SC 50 ml
- Chlorantraniliprole 18.5 SC 150 ml or 0.4 G 10 kg
- Phosphamidon 40 SL 1.25 L
- Lambda-cyhalothrin 2.5 EC 500 ml
or 5 EC 250 ml
- Thiamethoxam 25 WG 100 g

5. Rice case worm: *Nymphula depunctalis* (Pyraustidae: Lepidoptera)

Distribution and Status: India, South East Asia, Australia

Host plant: Rice

Damage symptoms

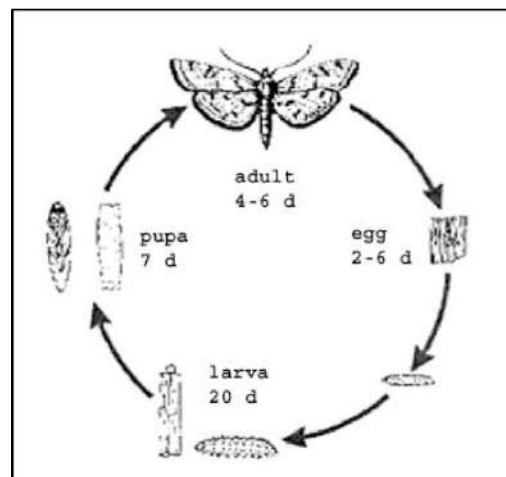


Floating leaf cases (IRRI)

The caterpillars feed on green tissues of the leaves and form tubular cases around them by cutting the apical portion of leaves, which float on water. Several tubes are also seen hanging from the plants. In case of severe infestation plants are unable to grow. They damage leaf tips. The apical portion of cut leaves bear whitish papery areas since the chlorophyll is scrapped.

Bionomics

Adult is a delicate white moth with pale brown wavy markings. Eggs are laid on leaves. Egg period is 2-6 days. Larva is pale translucent green with orange head. Larva constructs a case. Larval period is 14-20 days. Larva has filamentous gills on the sides of the body that helps to lead a semi aquatic life. It pupates in case it self for 4-7 days. The total life cycle occupies 19-37 days.





Management

1. Conserve larval parasitoids viz., *Elasmus* sp., *Apanteles* sp., *Bracon* sp.,
2. Conserve pupal parasitoids viz., *Pediobius* sp., *Apsilops* sp., *Eupteromalus parnarae*
3. Drain water from the field
4. Dislodge the cases by running a rope over the young crop
5. Spray endosulfan 35 EC or monocrotophos 36 SL 1.0 L or phenthoate 50 EC 1.0 L in 500 L water/ha.

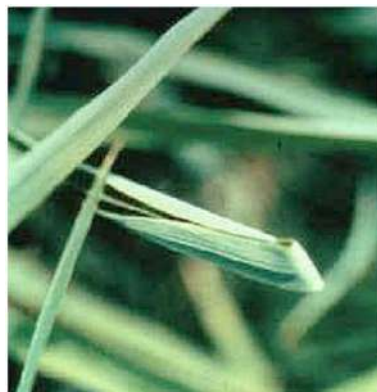
6. Rice skipper: *Pelopidas mathias* (Hesperiidae: Lepidoptera)

Distribution and status: India, South East Asia, China, Africa

Host range: Rice, Sugarcane

Damage symptoms

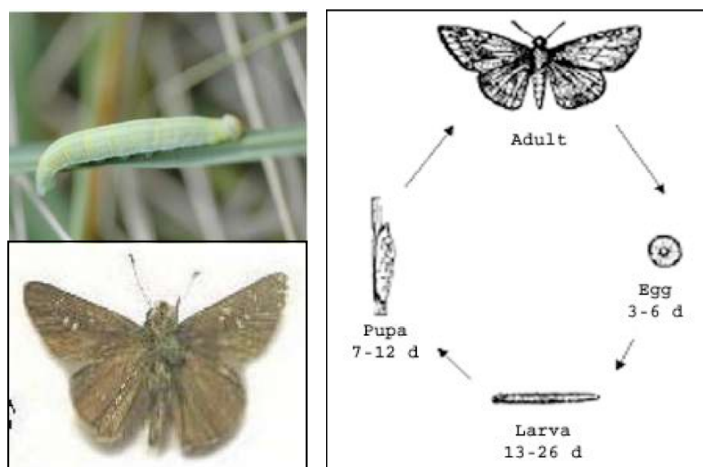
Edges of the leaves are fastened with webbing. Backward rolling of leaves, feeding from margin inwards are symptoms of damage.



Folded Leaves (IRRI)

Bionomics

Adult butterfly has brown coloured wings and curved antennae. Eggs are laid singly on the leaf blades. Larva is pale green with constricted neck.



7. Spiny beetle / Rice hispa: *Dicladispa armigera* (Chrysomelidae: Coleoptera)

Distribution and status

Bangladesh, Burma, Southern China, India, West Malaysia, Nepal, Pakistan, Sumatra, Thailand, West Iran.

Host range: Rice

Damage symptoms

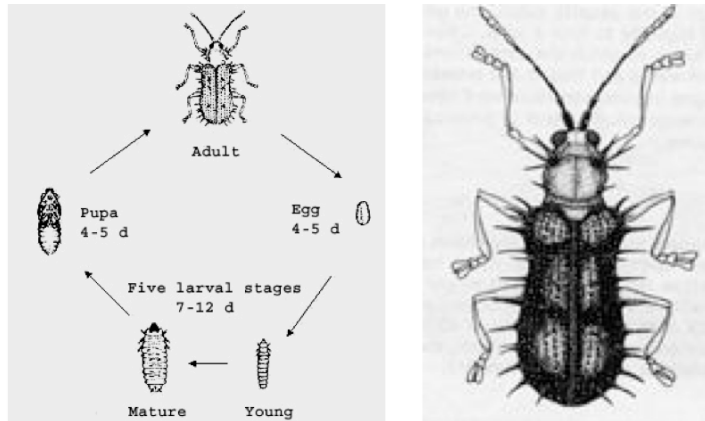
Adults feed on chlorophyll by scraping and cause white parallel streaks (or) white patches along the long axis of leaf. Grubs mine into the leaves and make blister near leaf tips.

Damage on leaf (IRRI)



Bionomics

Adult is blue - black shiny beetle with spines on the thorax and elytra. It lays eggs singly on the leaf tip. Grub is minute, flat and yellow. It mines between the epidermal layers of leaf and pupates in leaf mines. Egg period: 4-5 days; Larval period: 7-12 days; Pupal period: 3-5 days. There are six generations / year.



Management

1. The leaf tips containing blotch mines should be plucked and destroyed.
2. Manual collection and killing of beetles with hand nets may help in reducing the population of the pest.
3. Dust the crop with 10% BHC dust @ 30 kg/ha at least two times at an interval of 40 days.
4. Spray endosulfan 1.0 L or lambda-cyhalothrin 2.5 EC 500 ml / EC 250 ml in 500 L water/ha.

8. Whorl maggot: *Hydrellia sasakii* (Ephydriidae: Diptera)

Distribution and status: Philippines

Host range: Rice, *Cyanodon dactylon* and *Echinochloa crusgalli*

Damage symptoms

Yellowish white longitudinal marginal blotching with hole in a few places on the emerging leaves. Leaves become shriveled. Plant gets stunted and maturity is delayed. Maximum damage is observed on 30 DAT.

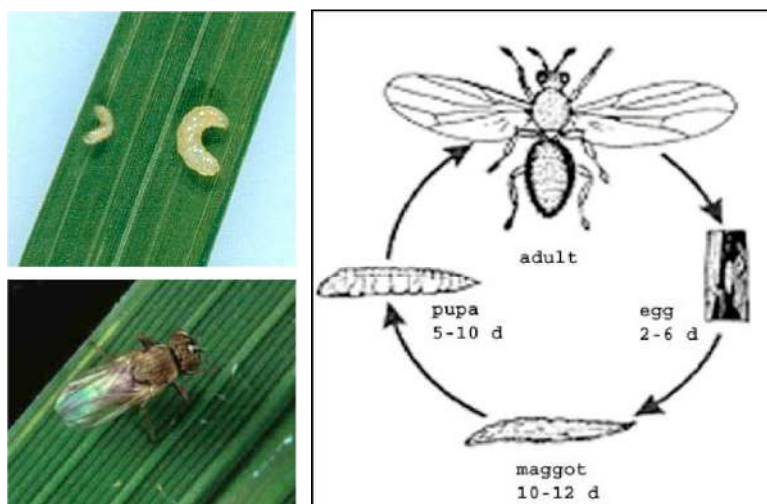


Pinholes and patches (IRRI)

ETL - 25% damaged leaves

Bionomics

The adult is a small dull grey fly. Maggot is 2 mm in length and feeds on the tender tissue inside the whorl. It is yellowish white in colour.



Rice whorl maggot (IRRI)

Management

1. Apply carbofuran 3G 10 kg or cartap hydrochloride 4 G 18.75-25.0 kg or fipronil 0.3 G 16.70 - 25.0 kg shortly after transplanting.
2. Spray endosulfan 35 EC 1.0 L or quinalphos 25 EC 1.0 L or ethofenoprox 10 EC 500-750 ml or fipronil 5 SC 1.0 -1.5 L or in 500 L water/ha.

9. Rice horned caterpillar: *Melanitis ismene* (Satyridae, Lepidoptera)

Distribution and status: Throughout India

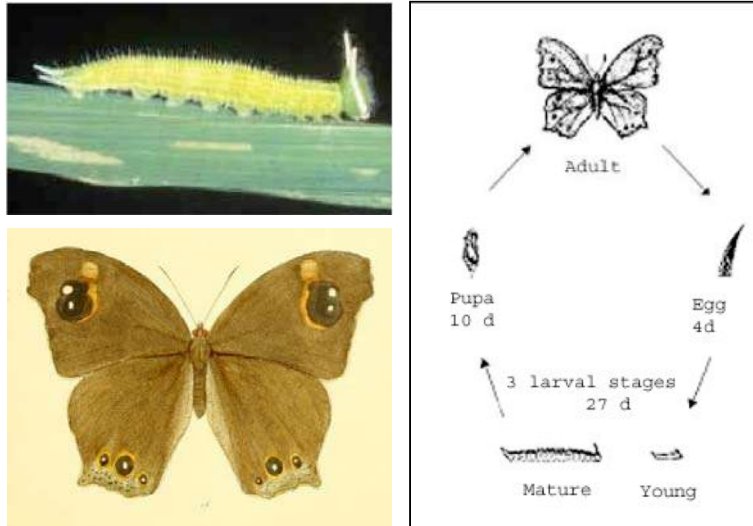
Host range: Rice, Millets

Damage symptoms

The larva of this butterfly feeds on leaf blades of rice. Leaves are defoliated from the margin or tip irregularly.

Bionomics

The butterfly lays round white eggs singly on the leaves. The caterpillar is green, slightly flattened with two red horn processes on the head and two yellow processes in the anal end. It pupates in a greenish chrysalis, which suspends from the leaf. The butterfly is dark brown with large wings having a black and yellow eye like spot one on each of the fore wings.



10. Yellow hairy caterpillar: *Psalis pennatula* (Lymantriidae: Lepidoptera)

Distribution and status: Assam, Andhra Pradesh, Punjab and South India.

Host range: Rice, grasses, wheat

Damage symptoms: Caterpillar causes defoliation

Bionomics

The caterpillar is yellowish brown with red stripes and has an orange head. Tufts of hairs are present all over the body of which two in the anterior and one in the posterior region are prominent. It pupates in a pale white cocoon of silk and frass attached to the leaf and the adult moth is stout with straw coloured forewings. It lays eggs in masses of upto 57 eggs on leaves. The egg period is 10-11 days. The larval period lasts for 25-35 days.

MINOR PESTS

11. Grasshopper: *Hieroglyphus banian* (Acrididae: Orthoptera)

Damage symptoms

The nymphs and adults cause enormous loss to the crop by chewing and cutting various plant portion viz., leaves, flowers and grains. They completely defoliate the plants leaving only the mid ribs and the plant growth is affected.

Bionomics

Adults are green, larger with transverse black lines on pronotum. It lays eggs in soil at a depth of 5 cm.

Nymphal period is from 2.5 - 3.5 months



Management

1. Expose the eggs to be picked up by birds after ploughing and trimming the bunds
2. Egg parasitoids *Cacallus* spp., *Barycomus* spp. and *Seelio* spp., should be encouraged.
3. Dust the crop with 5-10% BHC (or) methyl parathion 2% or lindane 2 D 25-30 kg/ha (or) malathion 5 D 20 kg/ha
4. Spray dichlorvos 76 EC 500 ml/ha (or) malathion 50 EC 2.5 lit/ha.

12. Short horned grasshopper: *Oxya nitidula* (Acrididae: Orthoptera)

Damage symptoms

Nymphs and adults feed on leaves leaving the stalks and midribs. Irregular feeding on seedlings and cutting of stem at panicle stage are the symptoms of damage.

Bionomics

Grasshopper is green, smaller with brown band on sides. Eggs are laid in soil which hatch out in June - July and mature in August - September.

Management

Expose the eggs during summer ploughing so that they are picked up by birds.

13. Blue beetle: *Halticia cyanea* (Chrysomelidae: Coleoptera)

A medium sized steel blue beetle often found in large numbers on rice but is harmless as it breeds on the common weed, *Ammania* sp., found in wetlands.

14. Rice root weevil: *Echinocnemus oryzae* (Curculionidae: Coleoptera)

Damage symptoms

Grubs feed on the roots of rice plants resulting in stunting and non formation of tillers. Presence of dead plants in large patches is a typical symptom.

Bionomics

The adult weevil is shiny black with oblong body covered with greyish scales. The female lays eggs in soil near the roots of grasses. The incubation period is 3-4 days. The grub is creamy white, aquatic and feeds on root hairs. The larval period lasts for 11 months. The grub over-winters in soil at a depth of 25-30 cm, after September. It pupates during May. The pupal period is 10-12 days.



15. Rice root weevil: *Hydronomidus molitor* (Curculionidae: Coleoptera)

Damage symptoms

Yellowing of newly transplanted seedlings and presence of dead plants in large patches.

Bionomics

Adult is shiny black weevils with oblong body covered with greyish scales. Grub is creamy white and aquatic.

16. Rice root grub: *Arthrodeis* sp., (Tenebrionidae: Coleoptera)

Damage symptoms

They feed on roots and cause yellowing and gradual wilting of entire plants.

Bionomics

Black coloured shiny beetle.

Integrated Pest Management in Rice

A. Cultural method

1. Remove / destroy stubbles after harvest and keep the field free from weeds.
2. Trim and plaster the bunds of rice field to expose the eggs of grasshoppers and to eliminate the bug breeding in grasses.
3. Form the bunds narrow and short to reduce the damage by rodents.
4. Use resistant varieties wherever available.
5. Provide effective drainage wherever there is problem of BPH.
6. Clip the tip of seedlings before transplanting to prevent the carry over of egg masses of rice yellow stem borer from nursery to mainfield.
7. Organise synchronized planting wherever possible.
8. Leave 30 cm rogue space at every 2.5 m to reduce damage by BPH and rodents.
9. Avoid use of excessive nitrogenous fertilizers.
10. Use irrigation water judiciously (Alternative wetting and drying reduce BPH and case worm).
11. Remove the egg masses of stem borer in the main field.

B. Mechanical methods

1. Dig out the rat burrows and destroy the rats and young ones at the beginning of the season.
2. Set up light traps to monitor and control pests.
3. Set up-bow traps to kill rodents.

C. Biological methods

1. Release *Trichogramma japonicum* twice on 30 and 37 DAT @ 5 cc/ha/release against stem borer.
2. Release *Trichogramma chilonis* on 37, 44 and 51 DAT (thrice) @ 5 cc/ha/release against leaf folder.
3. Release of *Platygaster oryzae* parasitized galls @ 1 per 10 m² in the mainfield on 10 DAT against gall midge.
4. Set up owl perches to reduce rat damage.

D. Plant products

1. Spray neem seed kernel extract 5% (25 kg/ha), neem oil 3% (15 lit/ha) to control brown planthopper.
2. Spray botanicals viz., NSKE, *Vitex negundo* (Notchi), *Prosopis juliflora* and *Ipomoea carnea* leaf extract 5% to control earhead bug and black bug.

E. Chemical methods

1. In BPH prone area / season avoid use of synthetic pyrethroids, methyl parathion and quinalphos and use recommended chemical at recommended doses.
2. Use insecticides based on ETL.

QUESTIONS

1.	Paddy stem borer belongs to _____ family	
	a. Pyralidae	b. Hesperidae
	c. Cecidomyiidae	d. Pyraustidae
2.	'White ear' in rice is due to _____ attack	
	a. Stem borer	b. Leaf folder
	c. Swarming caterpillar	d. case worm
3.	Gall midge belongs to _____ family	
	a. Pyralidae	b. Hesperidae
	c. Cecidomyiidae	d. Pyraustidae
4.	'Silver shoot' in rice is due to _____ attack	
	a. Stem borer	b. Leaf folder
	c. Gall midge	d. case worm
5.	Flating of tubular cases in rice field is due to _____ pest	
	a. <i>Orseolia oryzae</i>	b. <i>Nymphula depunctalis</i>
	c. <i>Spodoptera mauritia</i>	d. <i>Scirpophaga incertulas</i>
6.	Alternate host of rice skipper (<i>Pelopidas mathias</i>) is _____	
	a. Potato	b. Sugarcane
	c. Maize	d. Wheat
7.	Backward rolling of leaves is the typical symptom of _____	
	a. <i>Orseolia oryzae</i>	b. <i>Scirpophaga incertulas</i>
	c. <i>Pelopidas mathias</i>	d. <i>Nymphula depunctalis</i>
8.	Alternate host of <i>Cnaphalocrocis medinalis</i> (leaf folder) is _____	
	a. pulses	b. grasses
	c. maize	d. wheat

9.	Alternat host of <i>Melanitis ismene</i> is _____	
	a. millets	b. pulses
	c. sugarcane	d. castor
10.	Scorching symptom of the entire rice field is due to _____	
	a. <i>Cnaphalocrocis medinalis</i>	b. <i>Scirpophaga incertulas</i>
	c. <i>Pelopidas mathias</i>	d. <i>Nymphula depunctalis</i>
11.	Alternate host of Yellow hairy caterpillar is _____	
	a. millets	b. pulses
	c. sugarcane	d. wheat
12.	Which of the following pest causes onion needle or silver shoot symptoms in rice	
	a. <i>Nephotettix nigropictus</i>	b. <i>Cofana spectra</i>
	c. <i>Orseolia oryzae</i>	d. <i>Hydrellia philipiana</i>
13.	Irregular feeding of rice foliage is caused by -----	
	a. Army worm	b. Green beetle
	c. Spiny beetle	d. Grass hopper
14.	Presence of dead plants in patches is the symptom of -----	
	a. <i>Altica cyanea</i>	b. <i>Leptisma pygmaea</i>
	c. <i>Echinochermus oryzae</i>	d. <i>Hydronomidus molitar</i>
15.	Cutting of seedling tip before transplanting is a good management technique for controlling	
	a. Stem borer	b. Leaf folder
	c. Mealy bug	d. Grasshopper
16.	Passing of rope over the crop is done to dislodge the following pest	
	a. Leaf folder	b. Caseworm
	c. Mealy bug	d. Grasshopper
17.	Judicious application of fertilizer is done to minimize ----- damage in rice	
	a. Leaf folder	b. GLH

	c. Caseworm	d. BPH
18.	'White ear' in rice is due to _____ attack	
	a. Stem borer	b. Leaf folder
	c. Swarming caterpillar	d. case worm
19	Floating of tubular cases in rice field is due to _____ pest	
	a. <i>Orseolia oryzae</i>	b. <i>Nymphula depunctalis</i>
	c. <i>Spodoptera mauritia</i>	d. <i>Scirpophaga incertulas</i>
20.	Alternate host of rice skipper (<i>Pelopidas mathias</i>) is _____	
	a. Potato	b. Sugarcane
	c. Maize	d. Wheat
21.	Backward rolling of leaves is the typical symptom of _____	
	a. <i>Orseolia oryzae</i>	b. <i>Scirpophaga incertulas</i>
	c. <i>Pelopidas mathias</i>	d. <i>Nymphula depunctalis</i>
22.	Alternate host of <i>Melanitis ismene</i> is _____	
	a. millet	b. pulses
	c. sugarcane	d. castor
23.	Alternate host of Yellow hairy caterpillar is _____	
	a. millets	b. pulses
	c. sugarcane	d. wheat
24.	----- ia a chemical responsible for gall formation in rice Cecidogen	
25.	Gall formation is nothing but modification of ----- Leaf sheath	
26.	Write the scientific name of green horned caterpillar is----- <i>Melanitis leda ismene</i>	
27.	----- egg parasitoid can be released against rice stem borer <i>Trichogramma japonicum</i>	
28.	----- egg parasitoid can be released against rice stem borer <i>Trichogramma chilonis</i>	

29.	Write the scientific name of rice crab <i>Paratelphusa hydrodromus</i>
30.	Write the scientific name of rice mite <i>Oligonychous oryzae</i>
31.	Trimming of bunds is recommended for the control of _____ grasshopper

Lecture No 3

PESTS OF SORGHUM, PEARL MILLET AND FINGER MILLET

I. PESTS OF SORGHUM

More than 150 species of insects have been reported to damage sorghum. However over a dozen species are very serious and constitute a major constraint in sorghum production. Shoot fly, stem borers, shoot and ear head bug and aphids are serious pests that bring reduction in the yield.

Major pests				
1.	Sorghum Shootfly	<i>Atherigona soccata</i>	Muscidae	Diptera
2.	Stem borer	<i>Chilo partellus</i>	Crambidae	Lepidoptera
3.	Pink stem borer	<i>Sesamia inferens</i>	Noctuidae	Lepidoptera
4.	Shoot bug	<i>Peregrinus maidis</i>	Delphacidae	Hemiptera
5.	Earhead bug	<i>Calocoris angustatus</i>	Miridae	Hemiptera
6.	Sorghum midge	<i>Contarinia sorghicola</i>	Cecidomyiidae	Diptera
7.	Plant lice (Aphids)	<i>Rhopalosiphum maidis</i> , <i>Melanaphis sacchari</i>	Aphididae	Hemiptera
Minor Pests				
8.	Earhead web worm	<i>Cryptoblabes gnidiella</i>	Pyraustidae	Lepidoptera
9.	Gram caterpillar	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
10.	Plant bug	<i>Dolycoris indicus</i>	Pentatomidae	Hemiptera
11.	Stink bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera
12.	Mirid bug	<i>Creontiades pallidifer</i>	Miridae	Hemiptera
13.	Slug caterpillar	<i>Thosea apierens</i>	Cochlididae	Lepidoptera
14.	Leaf roller	<i>Marasmia trapezalis</i>	Pyralidae	Lepidoptera
15.	Flea beetle	<i>Cryptocephalus schestedii</i> , <i>Monolepta signata</i>	Chrysomelidae	Coleoptera
16.	Red hairy caterpillar	<i>Amsacta albistriga</i> , <i>A. moorei</i>	Arctiidae	Lepidoptera
17.	Semilooper	<i>Eublemma silicula</i>	Noctuidae	Lepidoptera
18.	Weevils	<i>Mylocerus maculosus</i> <i>M. discolor</i> , <i>M. subfaciatus</i>	Curculionidae	Coleoptera
19.	Wingless grasshopper	<i>Colemania sphenaroides</i>	Acrididae	Orthoptera

MAJOR PESTS

1.Sorghum Shootfly: *Atherigona soccata* (Muscidae: Diptera)

Distribution and status

Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka

Host range: Maize, ragi, bajra, rice, wheat and grasses

Damage symptoms

The maggot on hatching migrates to the upper surface of leaf and enters between the leaf sheath and stem. After reaching the soil level, the maggot bores inside the stem and cuts the growing point resulting in “dead heart” symptom. The infested plant produces side tillers. The attack is more severe during summer than kharif season



Bionomics



Adult, a whitish grey female fly lays white, cigar-shaped eggs on the lower surface of leaf blades mostly during morning hours. The egg is white, cylindrical, distal end somewhat flattened. The incubation period varies from 2-3 days. Maggot is dirty white and apodous. Mature larvae are yellow and about 6 mm long. The larval period is 8-10 days and has four larval instars. It pupates at the base of the stem or in soil for 8-10 days. The life cycle is completed in 17-21 days.

ETL: 10% dead hearts or 1 egg / plant

Management

1. Use resistant varieties like Co-1, CSH 15R, Maldandi and Hagari, M35-1, Swati, SPV 491, IS - 18551, 5566, 5285, 5613, ICSV 700, ICSV 705, Phule Yashoda, CSH 7, CSH 8
2. Sow sorghum immediately at the onset of monsoon rains to minimise shootfly damage.
3. Use higher seed rate (12.5 kg/ha) and remove the shoot fly damaged seedlings at the time of thinning or raise nursery and transplant only healthy seedlings.
4. Pull out and destroy plants showing dead hearts at the time of thinning.
5. Set up hanging type of plastic fishmeal trap @ 12/ha till the crop is 30 days old.
6. Treat 100 kg seeds with chlorpyrifos 20 EC 400 ml or quinalphos 25 EC 400 ml or imidacloprid 48 FS 1.2 L or imidacloprid 70 WS 1.0 kg or thiomethoxam 30 FS 1.0 L
7. Granular application of phorate 10 G or carbofuran 3 G to the furrow at the time of sowing at 2.5 kg a.i./ha.
8. Spray endosulfan 35 EC @18 ml, dimethoate 30 EC @ 12 ml and methyl demeton 25 EC @12 ml for an area of 120 m² nursery.
9. Spray any one of the following insecticides in the mainfield - endosulfan 35 EC 500 ml, dimethoate 30 EC 500 ml (250 L of spray fluid/ha).

2. Stem borer: *Chilo partellus* (Crambidae: Lepidoptera)

Distribution and status

India, Pakistan, SriLanka, Indonesia, Iraq, Japan, Uganda, Taiwan, Sudan, Nepal, Bangladesh and Thailand.

Host range

Maize, sorghum, sugarcane, bajra, rice, *Sorghum halepense*, finger millet, etc.

Damage symptoms

It infests the crop a month after sowing and the damage persists upto

emergence of ear heads. Central shoot withering leading to “**dead heart**” is the typical damage symptom. Bore holes are visible on the stem near the nodes. Young larva crawls and feeds on tender folded leaves causing typical “**shot hole**” symptom. Affected parts of stem may show internally tunneling caterpillars.

Bore holes and tunneling by caterpillars



Shot hole symptom

Broken stem



ETL: 10% dead heart

Bionomics

The adult moth is medium in size and straw coloured. It lays about 300 scale-like flat oval eggs in batches on the under surface of leaf near the midrib. The incubation period is 2-5 days. The larva is yellowish brown with a brown head and the prothoracic shield measures about 25 mm long. The larval period is 28 - 50 days with seven instars. It pupates inside the stem and emerges in 7-10 days through the larvae's entry holes as adult. The total life cycle is completed in 30 to 40 days



Management

1. The stubbles should be ploughed up during winter and burnt to destroy the hibernating larvae.
2. Grow resistant cultivars like E 302, E 303, IS 2205, ICSV 700
3. Dead hearts should be pulled out and used as fodder or buried in manure pits.
4. Sow lab lab or Dolichos as an intercrop in the ratio of 4:1 to minimise the stem borer damage.
5. Set up light trap till midnight to attract and kill the stem borer moths.
6. Bio-control agents viz., *Trichogramma chilonis* (egg parasitoids) *minutum*, *Bracon chinensis* and *Apanteles flavipes*, (larval parasitoids) should be encouraged.
7. Mix any one of the following insecticides with sand to make up the total quantity of 50 kg and apply in the leaf whorls. Phorate - 10 G 8 kg, carbofuran 3 G 17 kg, endosulfan 4D 25 kg or spray endosulfan 35 EC 750 ml (or) carbaryl 50 WP 1 kg (500 L spray fluid/ha).

3. Pink stem borer: *Sesamia inferens* (Noctuidae: Lepidoptera)

Distribution and status

India, Pakistan, Malaysia, Taiwan, Burma, Bangladesh, Sri Lanka, South East Asia, China, Korea, Japan and Indonesia.

Host range: Sorghum, maize, rice, wheat, sugarcane, bajra and ragi, barley, guinea grasses.

Damage symptoms

The pink larva bores into the stem and damages the central shoot resulting in dead heart.



Bionomics

The adult moth is fawn-colored, with dark brown streaks on the fore wings and white hind wings. The female lays about 150 creamy-white and hemispherical eggs that are arranged in two or three rows between the leaf sheath and the stem of the host plant. Egg period 7 days. The fully grown larvae measures about 25 mm and is pale yellow with a purple pink tinge and a reddish-brown head. The larval period 25 days but in cold months it may be extended to 75 days. Pupation occurs in the larval tunnel in the stem and the adult emerges in 12 days. One generation may take 6-7 weeks. The life cycle is completed in 45-75 days. There are 4-6 generations per year.



Management

1. Release egg parasitoids: *Telenomus* sp., *Trichogramma chilonis*; Larval parasitoids: *Apanteles flavipes*, *Bracon hebetor*; Pupal parasitoid: *Tetrastichus ayyari*
2. Spray endosulfan 35 EC @ 1 L/ha or chlorpyrifos 20 EC 1.0 L / ha or apply carbofuran 3 G @ 25 kg/ ha or cartap hydrochloride 4 G @18.75 kg/ha at every 20 days interval after germination of the crop.

4. Shoot bug: *Peregrinus maidis* (Delphacidae, Hemiptera)

Distribution and status: Karnataka, Tamil Nadu Andhra Pradesh and Madhya Pradesh

Host range: Sorghum, maize, rice, millets

Damage symptoms

Adults and nymphs suck sap from plants. The attacked plants become unhealthy stunted and yellow. The leaves wither from top downwards. Panicle formation is inhibited and the plants die if attack is severe. Honeydew secreted by the bug causes growth of sooty mould on leaves. The midribs of the leaves turn red due to egg-laying and may dry up subsequently.



Bionomics

The adult is yellowish brown to dark brown with translucent wings. The brachypterous female is yellowish while macropterous female is yellowish brown and male dark brown. It lays eggs in groups of 1-4 inside the leaf tissue and covered with a white waxy substance. The fecundity of the bug is 97 eggs / female. The egg period lasts for seven days. The nymphal stage undergoes five instars in 16 days. The total life cycle is completed in 18-31 days.



Management

1. Conserve egg parasitoids viz., *Paranagrus optabilis*, *Octetrastichus indicus* and Predators - *Coccinella septumpunctatum*, *Menochilus sexmaculatus*,

Geocoris tricolor

2. Spray dimethoate or methyl demeton 500 ml in 500 L of water

5. Earhead bug: *Calocoris angustatus* (Miridae: Hemiptera)

Distribution and status: South India

Host range: Pearl Millet, maize, tenai, sugarcane and grasses

Damage symptoms

The adults and nymphs damage the earheads by feeding on them. They suck the juice from the grains when they are in the milky stage. The sucked out grains, shrink and turn black in colour and become ill filled (or) chaffy. Older grain shows distinct feeding punctures that reduce grain quality.



Bionomics

Adult male is green in colour and female is green with a brown margin. Blue cigar shaped eggs are laid under the glumes or into the middle of the florets. Each insect lays between 150 and 200 eggs. The egg period is seven days. Nymphs are slender, green in colour. First instar is orange in colour. The nymphal period is 10 - 14 days. The life cycle from egg to adult occupies less than 3 weeks. At least 2 generations of the bug can feed on the same crop when the panicles do not ripen at the same time.



ETL: 10 Nos/ear head

Management

- Dust with carbaryl 10% at 12 kg/ha (or) quinalphos 1.5% 12 kg/ha synchronising during milky stage
- Grow resistant cultivars like IS1760, IS 17645, CSM 388, Chencholam, BBR - 1(ICS V239)

6. Sorghum midge: *Contarinia sorghicola* (Cecidomyiidae: Diptera)

Distribution and status

India, Pakistan, Bangladesh, West Iran, Sri Lanka, Sudan, Java, Africa, South East Asia, South China, South America, West Indies, USA and Italy.

Hosts: Sorghum cultivated and wild species.

Damage symptoms

A maggot feeds on the developing grains and pupates there. White pupal cases protruding out from the grains and chaffy grains with holes are the damage symptoms.



Bionomics



The adult fly is small, fragile with a bright orange abdomen and a pair of transparent wings. It lays eggs singly in developing florets resulting in pollen shedding. A female lays about 30-35 eggs at the rate of 6-10 in each floret. The incubation period is 3-4 days. The maggot has four instars with duration of 8-10 days. Larvae are colorless, but, when fully grown, they are dark orange. Larval period 9 - 11 days. The larval stage undergoes diapause in a cocoon during December - January within a spikelet. Pupates beneath the glume. The pupal period

3 days. When the adult emerges the white pupal skin remains at the tip of the spikelet. A generation is completed in 14-16 days. The insect's rapid developmental cycle permits 9-12 generations.

Management

1. Grow resistant cultivars like DJ 6541, AF 28, ICSV 197, ICSV 745, ICSV 88032
2. Conserve larval parasitoids - *Apanteles* sp., *Eupelones popa*; Larval and pupal parasitoid - *Tetrastichus* spp.; Predators – *Orius albidipennis*; *Tapinoma indicum*
3. Give first application at nearly 90% earhead emergence and repeat after 4 or 5 days. The insecticides recommended are spray endosulfan 35 EC 1.0 L (or) malathion 50 EC 1.0 L (or) carbaryl 50 WP 2 kg/ha or endosulfan 4 D or malathion 5 D or carbaryl 10 D or quinalphos 1.5 D at 25 kg/ha .

7. Plant lice (Aphids): *Rhopalosiphum maidis*, *Melanaphis sacchari* (Aphididae: Hemiptera)

Distribution and status: All sorghum-growing areas of the world.

Host range: Sorghum, maize, ragi

Damage symptoms

Colonies of aphids are seen in central leaf whorl, stems, or in panicles. The young and adults suck the plant juice. This frequently causes yellowish mottling of the leaves and marginal leaf necrosis. The aphid produces an abundance of honeydew on which molds grow. In panicles, honeydew may hinder harvesting. The aphid also transmits maize dwarf mosaic virus.



Bionomics

Rhopalosiphum maidis

The aphid is dark bluish-green and somewhat ovate. It is 2 mm long, with black legs, cornicles, and antennae. Winged and wingless forms occur. Females give birth to living young without mating and a generation requires only a week or so. The adult is yellow coloured with dark green legs.

Melanaphis sacchari

The sugarcane aphid is yellow to buff. Numbers increase rapidly during dry spells or at the end of the rainy season. The female of the wingless form deposits 60-100 nymphs within its reproductive period of 13-20 days. The winged form produces slightly fewer nymphs. The life cycle is completed in 5.5-7.0 days during the dry season.

Rhopalosiphum maidis



Melanaphis sacchari



Management

Spray the base of attacked plants with a contact (or) systemic insecticide like dimethoate 30 EC or methyl demeton 25 EC 500 ml in 500 L of water

MINOR PESTS

8. Ear head web worm: *Cryptoblabes gnidiella* (Pyraustidae: Lepidoptera)

Host: Sorghum, Maize

Damage symptoms

The larvae destroy the grain in the head. They produce webs of silken thread that remain on and inside the head. Heavily infested heads may be covered with webbing.



Bionomics

The adult moth is small with brown fore wings and light brown hind wings. Creamy white, round or conical eggs are laid singly on the spikelets and on grains of the panicle. The egg period is 3-4 days. The larva is light brown with dark head and has dark lateral lines on the body. The larval duration is 9-10 days. It constructs silken cocoon and pupates within the silken webs. Pupal period 7 days. The life cycle is completed in 23-24 days.



9. Gram caterpillar: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Distribution and status: World wide. It is major on cotton, lablab, chillies, tomato, pulses, maize and minor on sorghum.

Host range: Cotton, sorghum, lab lab, soybean, pea, safflower, chillies, tomato, groundnut, tobacco, gram, okra, maize etc.

Damage symptoms

Larvae hide within the ear heads and feeds on the grains. Earheads are partially eaten and appear chalky. Feecal pellets are visible within the ear head.



Bionomics

Adult is brown coloured moth with a 'V' shaped speck on forewings and dull black border on the hind wing. Larva is green with dark broken grey lines and dark pale bands. It shows colour variation of greenish to brown.



Management

Spraying of insecticides as given under cotton

10. Plant bug: *Dolycoris indicus* (Pentatomidae: Hemiptera)

Damage symptoms: Grains become chaffy or spotted black and get shriveled.

Bionomics: Brown coloured bug with a white patch on the scutellum.



11. Stink bug: *Nezara viridula* (Pentatomidae: Hemiptera)

Damage symptoms

Grains become chaffy or spotted black and get shriveled. A stinking smell emanates from the bug.

Bionomics

Adult is green in colour. Nymph is brownish red with multi colour spots.



12. Mirid bug: *Creontiades pallidifer* (Miridae: Hemiptera)

No external symptom will be visible. The earhead should be tapped either on the palm (or) a piece of cardboard. A number of brownish (or) greenish nymphs and adults can be seen. On the developing grains small brownish spots will be visible. In severe infestation, the grains get shriveled without maturing and the earheads appear uneven.

13. Slug caterpillar: *Thosea apierens* (Cochlididae: Lepidoptera)

Damage symptoms

Irregular feeding and defoliation are the symptoms of attack.

Bionomics

It is a brown stout moth with a pair of white bands on forewings. Larva is green with stinging hairs.

14. Leaf roller: *Marasmia trapezalis* (Pyralidae: Lepidoptera)

Damage symptoms

Leaves are folded longitudinally especially near the tips and leaves dry from the tip.



Bionomics

Adult moth possess greyish wings with three dark transverse stripes and a dark wide sub terminal band. Larva is pale greenish yellow with conspicuous setae. Head and thoracic shield are reddish brown in colour.

Management

Hand pick rolled leaves and spray carbaryl 50 WP at 1 kg/ha.

15. Flea beetle: *Cryptocephalus schestedii*, *Monolepta signata* (Chrysomelidae: Coleoptera)

Damage symptoms

It makes small holes on the leaves.

Bionomics

Black beetle with long antennae and four pale yellow spots on elytra.



Management

Spray endosulfan 35 EC 1.0 L in 750 L of water

16. Red hairy caterpillar: *Amsacta albistriga*, *A. moorei* (Arctiidae: Lepidoptera)

Distribution and status

Oriental in distribution including India. It is a serious pest on pulses in Rajasthan and groundnut in southern part of India. *Amsacata albistriga* is predominant in South India while *A. moorie* dominates northern parts of the country.

Host range

Maize, sorghum, green gram, sesame, pearl millet, finger millet, groundnut, sunhemp, castor, cotton.

Damage symptoms

The larvae feed on the leaves gregariously by scrapping the under surface of tender leaflets leaving the upper epidermal layer intact in early stages. Later, they feed voraciously on the leaves and main stem of plants. They march from field to field gregariously. Severely affected field looks as if grazed by cattle.



Bionomics

Adults are medium sized moths. In *A. albistriga*, forewings are white with brownish streaks all over and yellowish streaks along the anterior margin and hindwings are white with black markings. A yellow spot is found on the head. In *A. moorei*, all markings are red in white wings. On receipt of heavy rains, in kharif season, moths emerge out from soil in the evening hours. It lays eggs on the under surface of the leaves. The eggs are cream coloured or bright yellow and laid in groups. A female moth may lay about 600-700 eggs. Egg period is 2-3 days. Tiny greenish caterpillar feeds on the leaves gregariously. A full-grown larva measures about 5 cm in length with reddish brown hairs all over the body arising on warts. The larval period is 40-50 days. The grown up larva pupate in earthen cells at a depth of 10-20 cm. They pupate mostly along the field bunds and in moist shady areas under the trees in the field and undergo pupal diapause till the next year.



ETL - 8 egg masses / 100 meter

Management

- Use light trap
- Dig trenches around the infested field and dust any of the insecticide viz., endosulfan 6% D or methyl parathion 2% D or fenvalarate 2% D.
- Spray endosulfan 35 EC 750 ml/ha quinalphos 25 EC 750 ml/ha (or) dichlorvas 76 WSC 625 ml/ha (or) chlorpyriphos 20 EC 1250 ml/ha in 375 litres of water.

17. Semilooper: *Eublemma silicula* (Noctuidae: Lepidoptera)

Damage symptoms

Extensive webbing of grains and presence of broken grains can be seen on the ear head.

Bionomics

The adult moth is small with reddish buff coloured wings having wavy lines. Eggs are laid on spikelet and grain. The egg period is four days. Larva is pale yellow. Larval period lasts for 12-13 days. It pupates within the gallery for about 12 days.

ETL: Caterpillar 2 nos. / earhead

Management

Spray two to three rounds of phosalone 750mi in 500 L of water at fortnightly interval.

18. Ash weevils: *Myloccerus maculosus* , *M.viridanus*, *M.subfasciatus* & *M. discolor* (Curculionidae: Coleoptera)

Distribution and status: Throughout India

Host range: Bajra, maize, sorghum, pulses, groundnut, cotton, guava

Damage symptoms

Leaf margins are notched resulting in wilting of plants in patches. Plants come off easily when pulled. Roots are eaten away by grubs. Adult feed on leaves.

Bionomics

***M.viridanus*:** Adult weevil with greenish white elytra

***M. maculosus*:** Adult weevil with greenish white elytra having dark lines.

***M. discolor*:** Adult weevil is brown with white spot on elytra. Grub is small, white apodous and found feeding on roots. Weevil appear during summer and lay ovoid, light yellow eggs in the soil. Female lays on an average 360 eggs over a period of 24 days. Eggs hatch in 3-5 days. Grub period 1-2 months, pupate in soil inside earthen cells and pupal period is 7-10 days. Life cycle is completed in 6-8 weeks. There are 3-4 generations in a year. Adults live fairly long for 4-5 months in the winter.

***M. subfasciatus*:** The adult weevil light grayish to white with four black spots on the wing covers. The eggs are light yellow and laid deep in the soil. The grubs are fleshy, yellow-colored. Pupation occurs in earthen cells in the soil. Egg, larval, and pupal periods last for 3 - 11, 3-42, and 5- 7 days respectively.

M. viridanus



M. subfasciatus



M. discolor



Management

1. Pest can be suppressed by disturbing the soil upto a depth of 7.5 cm and destroying the immature stages
2. Spray 2.5 kg carbaryl 50 WP in 500 L of water/ha

19. Wingless grasshopper: *Colemania sphenaroides* (Acrididae: Orthoptera)

Damage symptoms

Nymphs feed on growing plants and adult feeds on florets, ears and defoliate.

Bionomics

The adult grasshopper is wingless, greenish yellow with blue-black antennae with purple band behind the eye and laterally on thorax. It lays eggs in batches in the soil at a depth of 6 cm during October and November. The eggs hatch in the following June and July during monsoon rain.

Integrated Pest Management in Sorghum

A. Cultural methods

1. Complete the sowing of sorghum in a short time to avoid continuous flowering, which favours grain midge and earhead bug multiplication.
2. Sow Sorghum: lablab/cowpea (4:1) as an intercrop to minimize stem borer damage.
3. Take up early sowing of sorghum immediately after the receipt of South West or North East Monsoon to minimize the shoot fly incidence.
4. Use increased seed rate upto 12.5 kg per hectare and remove the shoot fly damaged seedlings at the time of thinning in case of direct sowing or raise nursery and transplant only healthy seedlings.
5. Plough soon after the harvest, remove and destroy the stubbles.

B. Mechanical method

1. Set up light traps till mid night to monitor, attract and kill adults of stemborer, grain midge and earhead caterpillars.
2. Set up sex pheromone trap at 12/ha to attract male moths *Helicoverpa* sp. from flowering to grain hardening.
3. Set up the TNAU low cost fishmeal traps @ 12/ha till the crop is 30 days old.

C. Biological methods

1. Take up two applications of NPV at 10 days interval at 250 LE/ha along with crude sugar 2.5 kg + cotton seed kernel powder 250 g on the ear heads to reduce the larval population of *Helicoverpa* sp.

D. Chemical methods

1. Use seeds pelleted with insecticides.
2. Arpocarb fishmeal formulation is more effective in attracting the shoot fly adults especially the females.

Preparation of Arpocarb fishmeal: Fishmeal powder is to be sprayed first with 2% starch dissolved in hot water as a sticking agent. The insecticide Arpocarb should then be sprayed at 50 ml/kg of fishmeal powder. The resultant mixture is shade dried and can be used at 50 g/trap. The formulated product should be moistened well before placing in the trap. The formulation can be changed once in 10-14 days depending upon the smell.

II. PESTS OF PEARL MILLET

Major pests				
1.	Shoot fly	<i>Atherigona approximata</i>	Muscidae	Diptera
2.	Stem borer	<i>Chilo partellus</i>	Crambidae	Lepidoptera
3.	Pink stemborer	<i>Sesamia inferens</i>	Noctuidae	Lepidoptera
4.	Grain midge	<i>Geromyia penniseti</i>	Cecidomyiidae	Diptera
5.	Stink bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera
Minor pests				
6.	Leaf beetle	<i>Lema downsei</i>	Galerucidae	Coleoptera
7.	Black hairy caterpillar	<i>Estigmene lactinea</i>	Arctiidae	Lepidoptera
8.	Wingless grasshopper	<i>Neorthacris simulans</i>	Acrididae	Orthoptera
9.	Semilooper	<i>Antoba (=Eublemma) silicula</i>	Noctuidae	Lepidoptera

MAJOR PESTS

1. Shoot fly: *Atherigona approximata*, Muscidae: Diptera

Damage symptoms

A serious pest on pearl millet all over India in Tamil Nadu during cold weather season; it attacks the crop both in seedlings and boot leaf stage. It causes dead hearts in young plants and chaffy grains in the mature crop.

Bionomics

Adult is greyish white fly. The egg-stage of the fly lasts 37-48 hours, larval stage 7-9 days and pupal stage 6 days.

Management

As given under Sorghum

2. Stem borer: *Chilo partellus* (Crambidae: Lepidoptera)

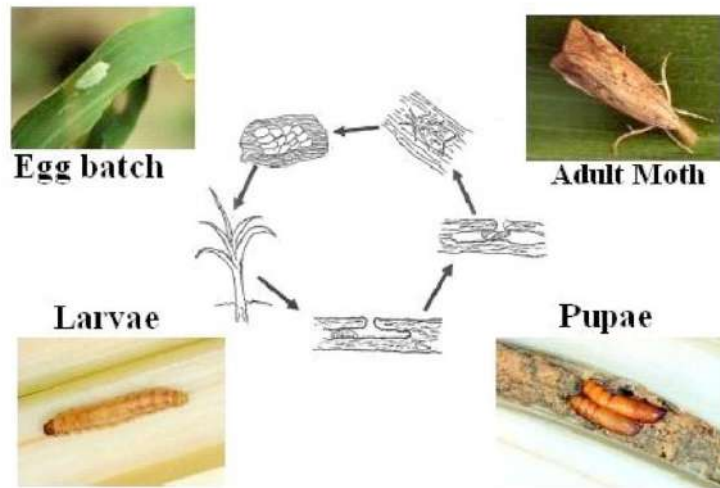
Damage symptoms

It infests the crop a month after sowing and upto emergence of earhead. Central shoot withering leading to “dead heart” is the typical damage symptom. Bore holes visible on the stem near the nodes. Young larva crawls and feeds on tender

folded leaves causing typical “shot hole” symptom. Parts of stem may show internally tunneling caterpillars.

Bionomics

Life cycle of Chilo partellus



Management

As given under sorghum

3. Pink stemborer: *Sesamia inferens* (Noctuidae: Lepidoptera)

Distribution and status

India, Pakistan, Malaysia, Taiwan, Burma, Bangladesh, Sri Lanka, South East Asia, China, Korea, Japan and Indonesia.

Host range: Sorghum, maize, rice, wheat, sugarcane, bajra and ragi, barley, guinea grasses

Damage symptoms

Pink larva enters into the stem causing dead heart symptom.

Bionomics

The adult moth is a straw coloured moth with white wings. The larva is pinkish brown with dark head. The life cycle is completed in 45-75 days. There are 4-6 generations per year.



4. Grain midge: *Geromyia penniseti* (Cecidomyiidae: Diptera)

Damage symptoms

Maggot feeds on developing grains causing grainless glumes with white pupal case attached to the tip of the spikelet.

Bionomics: Adult is a light pink fragile fly.

Management

Dust any one of the insecticides – malathion 5D 25 kg, carbaryl 10 D 25 kg, endosulfan 4 D 10 kg/ha.

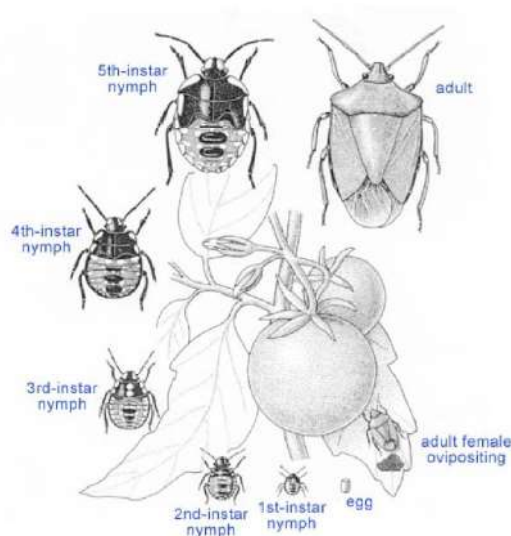
5. Stink bug: *Nezara viridula* (Pentatomidae: Hemiptera)

Damage symptoms

Grains become chaffy or spotted black and get shrivelled. A stinking smell emanates from the bug.

Bionomics

Adult is green in colour. Nymph is brownish red with multi colour spots.



Management of ear head pests

Apply any one of the insecticides at 25 kg/ha - carbaryl 10 D, malathion 5 D, or spray carbaryl 50 WP 750 g (or) endosulfan 35 EC 750 ml/ha at 50% flowering stage.

MINOR PESTS

6. Leaf beetle: *Lema downsei* (Galerucidae: Coleoptera)

Damage symptoms

Grubs and adults scrape the chlorophyll. It results in withering and drying of

leaves leading to burnt up appearance.

Bionomics

Grub is whitish with a small black head and a swollen humped body and has the habit of carrying its fecal matter dorsally. Adult is a straw coloured beetle.

7. Black hairy caterpillar: *Estigmene lactinea* (Arctiidae: Lepidoptera)

Damage symptoms

Larva feeds on leaves voraciously and causes severe defoliation.

Bionomics

Adult is a large white moth with crimson markings on head, body and wings. Larva is thick with black head and hairs.



8. Wingless grasshopper: *Neorthacris simulans* (Acrididae: Orthoptera)

Damage symptoms

Both nymphs and adults feed on leaves and cause defoliation.

Bionomics

Greenish brown in colour with red stripe on the sides without wings.

9. Semilooper: *Antoba* (=Eublemma) *silicula* (Noctuidae: Lepidoptera)

Distribution: India

Hosts: Sorghum, pearl millet, finger millet

Damage symptoms

Extensive webbing of grains and presence of broken grains on the ear head.

Bionomics

The adult moth is small with reddish buff coloured wings having wavy lines. Eggs are laid on spikelet and grain. The egg period is 4 days. Larva is a pale yellow semilooper. Larval period lasts for 12-13 days. It pupates within the gallery for about 12 days.

ETL: caterpillars 2 Nos./ear head

III. PESTS OF FINGER MILLET

Major pests				
1.	Pink stem borer	<i>Sesamia inferens</i>	Noctuidae	Lepidoptera
2.	White borer	<i>Saluria inficita</i>	Phycitidae	Lepidoptera
3.	Root aphid	<i>Tetraneura nigriabdominalisi</i>	Aphididae	Hemiptera
4.	Cut worm	<i>Spodoptera exigua</i>	Noctuidae	Lepidoptera
5.		<i>Holotrichia consanguinea</i>	Melolonthidae	Coleoptera
Minor pests				
6.	Flea beetle	<i>Chaetocnema pusaensis</i>	Alticidae	Coleoptera
7.	Earhead caterpillars	<i>Sitotroga cerealella</i>	Gelechiidae	Lepidoptera

MAJOR PESTS

1. Pink stem borer: *Sesamia inferens* (Noctuidae: Lepidoptera)

Damage symptoms

Pink larva enters into the stem and causes dead heart symptom.

Bionomics

The adult is a straw coloured moth with white wings. The larva is pinkish brown with dark head. The life cycle is completed in 45-75 days. There are 4-6 generations per year.

Management

Spray cartap hydrochloride 4G @ 25kg/ha, fipronil 0.3G 15kg chlorpyrifos 10G 10kg, in whorls .

2. White borer: *Saluria inficita* (Phycitidae: Lepidoptera)

Damage symptoms

A potential pest on finger millet in South India. Larva bores into the stem at the base of the tiller close to the soil level and causes dead heart.

Bionomics

Adult is a small moth with dark brown forewings with a white band along the anterior margin and white hind wings. Larva is creamy white with yellow head.

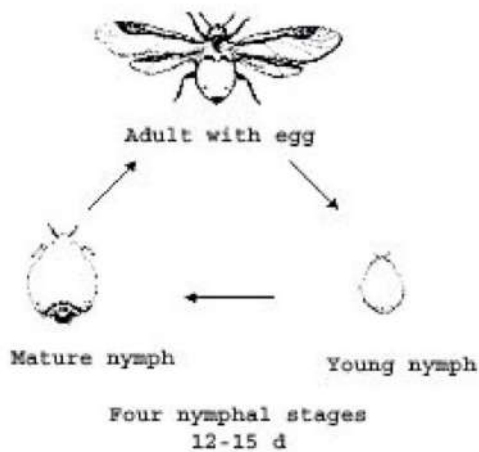
3. Root aphid: *Tetraneura nigriabdominalisi* (Aphididae: Hemiptera)

Damage symptoms

Aphid remains at the base of the plant and suck the sap. The infested plants turn pale yellow and become stunted. Wilting and drying of plants in patches is the typical symptom. Black ants attend them for honeydew and their presence confirm the root aphid attack. It occurs on many grasses too.



Bionomics



The aphids are pinkish and globular. It reproduces viviparously. They have 4 nymphal instars with a total nymphal duration of 7-9 days. Adult lives for 5-11 days and produces 10-35 off springs.

Management

Spraying the base of attacked plants with a contact or systemic insecticides controls the aphid.

4. Cut worm: *Spodoptera exigua* (Noctuidae: Lepidoptera)

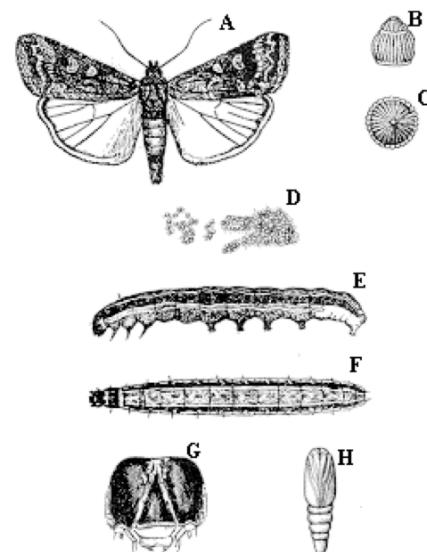


Damage symptoms: Defoliation.

Host range: onion, brinjal, cotton, cowpea, chillies, daincha.

Bionomics

Moth is brown coloured with white hind wings. It lays eggs in groups. Larva is



Beet Armyworm. A, Adult. B-C, Eggs (enlarged). D, Egg mass. E-F, Larvae. G, Larval head. H, Pupa.

nocturnal in habit. It is brownish green with wavy lines on the dorsal surface and yellow stripes laterally. The larval period is 10-16 days. It pupates in earthen cocoons in soil for 7-11 days.

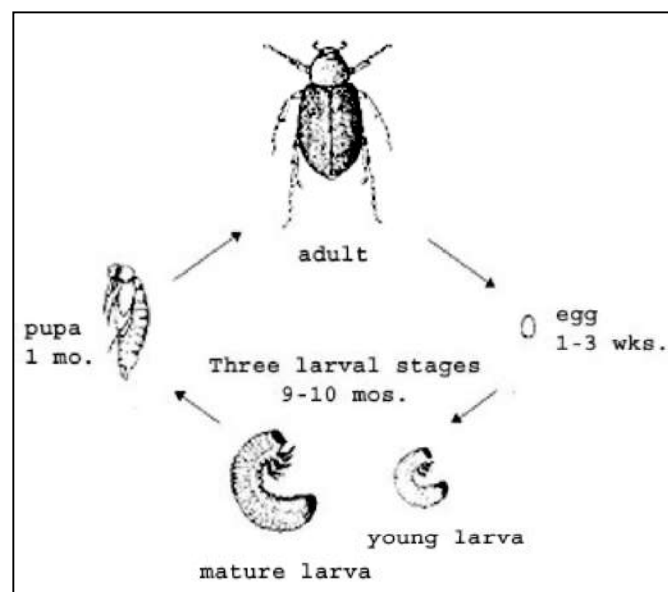
5. *Holotrichia consanguinea* (Melolonthidae: Coleoptera)

Damage symptoms

Grubs feed on roots and results in the death of the grown up plants.

Bionomics

Grub is fleshy, 'C' shaped, whitish yellow in colour found close to the base of the clump. Adult is dark brown.



MINOR PESTS

6. Flea beetle: *Chaetocnema pusaensis* (Alticidae: Coleoptera)

Damage symptoms

Adult beetles cause small holes in the leaves of young plants.

Bionomics

Adult is a dark blue beetle with enlarged hind femur.

7. Earhead caterpillars: *Sitotroga cerealella* (Gelechiidae: Lepidoptera)

It is a major stored product pest. Under field conditions larvae feed on the developing grains.

Management of finger millet pests

1. Spray any one of the following insecticides mixed in 10 lit. of water using a high volume of sprayer if dusting is not done to protect the seedling in the nursery - methyl demeton 25 EC 20 ml and dimethoate 30 EC 20 ml.
2. Spray any of the following insecticides per ha for the control of stemborer, leaf feeder - endosulfan 35 EC 1000 ml and carbaryl 50 WP 1 kg.
3. Spray carbaryl 50 WP 1 kg/ha at milky stage to check ear head bug and ear head caterpillars.
4. Mix dimethoate 30EC 3 ml in one litre of water and drench the rhizosphere of the infested and surrounding plants with solution to check the root aphid.

QUESTIONS - Sorghum, Pearl millet and Finger millet

1.	To minimize sorghum stem borer damage cowpea or lab lab is sown as intercrop in the ratio _____	
	a. 4:1	b. 2:1
	c. 3:2	d. 1:2
2.	Which is the following pest attack is a month old sorghum crop after sowing and upto emergency of ear head	
	a. Shoot fly	b. Stem borer
	c. Pink stem borer	d. White stem borer
3.	The affected sorghum plant producing more side tillers is due to attacking of _____	
	a. Shoot fly	b. Stem borer
	c. Pink stem borer	d. White stem borer
4.	----- diapause occurs in Red hairy caterpillar	
	a. Egg	b. Larval
	c. Pupal	d. Adult
5.	.----- type of diapause is occurred in sorghum grain midge	
	a. Egg	b. Larval
	c. Pupal	d. Adult
6.	.----- acts as an vector for transmitting chlorosis diseases on sorghum	
	a. Shoot bug	b. Earhead bug

	c. Mirid bug	d. Plant bug
7.	_____ transmits freckled yellow disease in sorghum	
	a. Shoot bug	b. Earhead bug
	c. Mirid bug	d. Plant bug
8.	<i>Thosea apierens</i> belongs to the following family	
	a. Muscidae	b. Cochlidae
	c. Crambidae	d. Miridae
9.	----- among the following one is a serious pest of cumbu	
	<i>Atherigona approximata</i>	a. <i>Chilo partellus</i>
	<i>Atherigona orientalis</i>	d. <i>Sesamia inferens</i>
10.	Chaffy shriveled millet grains with black spots is the typical symptom of	
	a. Stink bug	b. Grain midge
	c. Ear head bug	d. Soot bug
11.	_____ is the scientific name of shootfly of pearl millet	
	a. <i>Atherigona approximata</i>	b. <i>Atherigona orientalis</i>
	c. <i>Atherigona soccata</i>	d. <i>Atherigona oryzae</i>
12.	Withering and drying of leaves leading to burnt appearance is the damage symptom	
	a. Leaf beetle	b. Ash weevil
	c. Flea beetle	d. Black hairy caterpillar
13.	Shot holes in millets is caused by -----	
	a. Leaf beetle	b. Stem borer
	c. Pink stem borer	d. Gall midge
14.	.----- is a pest of pearl millet at seedling and boot leaf stage	
	a. Shoot fly	b. Stem borer
	c. Pink stem borer	d. Gall midge
15.	----- is site of pupation for sorghum shootfly	
	a. Stem	b. Soil
	c. Both a & b	d. Leaf

16.	White pupal case protruding out from the chaffy sorghum grains with holes are the damage symptoms of -----	
	a. Grain midge	b. Earhead bug
	c. Mirid bug	d. Shoot bug
17.	Alternate host of sorghum shoot fly is _____	
	a. Maize	b. Ragi
	c. wheat	d. all the above
18.	Alternate host of <i>Chilo partellus</i> is _____	
	a. Blackgram	b. Sesame
	c. Maize	d. all the above
19.	Alternate host of <i>Sesamia inferens</i> is _____	
	a. sugarcane	b. wheat
	c. rice	d. all the above
20.	Alternate host of red hairy caterpillar	
	a. Green gram	b. castor
	c. cotton	d. all the above
21.	Alternate host of <i>Peregrinus maidis</i> is _____	
	a. sugarcane	b. groundnut
	c. rice	d. all the above
22.	Alternate host of <i>Rhopalosiphum maidis</i> is _____	
	a. maize	b. sorghum
	c. ragi	d. all the above
23.	Alternate host of <i>Helicoverpa armigera</i>	
	a. cotton	b. tomato
	c. groundnut	d. all the above
24.	Arpocarb fishmeal is used to attract _____	
	a. gram caterpillar	b. shoot fly
	c. pink stem borer	d. red hairy caterpillar
25.	Arpocarb fishmeal formulation is more effective in attracting the shoot fly female/male	
26.	Grainless glumes with white pupal case is the symptom of _____ in bajra	

	Grain midge
27.	Potential pest of finger millet under South Indian conditions is _____ Pink stem borer
28.	Site of pupation of cut worms in is ----- Earthen cocoon in soil
29.	Presence of ants for honey dew secretion in Finger millet is an the indication of ----- Root aphid
30.	Dead hearts in young plants and chaffy grains in developed grains are the symptoms of _____ in pearl millet. stem borer
31.	Webbing of grains and presence of broken grains are the symptoms of _____ in bajra semilooper, Antoba silicula
32.	Chaffy or spotted black and shrivelled grain is the symptom of _____ in bajra stink bug, Nezara viridula

Lecture No 4

PESTS OF MAIZE AND WHEAT

I. PEST OF MAIZE

More than 130 insects have been recorded causing damage to maize in India. Among these, about half a dozen pests are of economic importance. Shoot fly, borers, shoot bug and aphid, polyphagous pest like cornworm cause considerable yield reduction in maize.

Major pests				
1.	Maize shootfly	<i>Atherigona orientalis</i>	Muscidae	Diptera
2.	Stem borer	<i>Chilo partellus</i>	Crambidae	Lepidoptera
3.	Pink stem borer	<i>Sesamia inferens</i>	Noctuidae	Lepidoptera
4.	Cornworm/ Earworm	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
5.	Web worm	<i>Cryptoblabes gnidiella</i>	Pyraustidae	Lepidoptera
6.	Aphid	<i>Rhopalosiphum maidis</i>	Aphididae	Hemiptera
7.	Shoot bug	<i>Peregrinus maidis</i>	Delphacidae	Hemiptera
Minor Pests				
8.	Climbing cut worm	<i>Mythimna separata</i>	Noctuidae	Lepidoptera
9.	Ash weevil	<i>Mylocerus</i> sp.,	Curculionidae	Coleoptera
10.	Phadka grasshopper	<i>Hieroglyphus nigrorepletus</i>	Acrididae	Orthoptera
11.	Leafhopper	<i>Pyrilla perpusilla</i>	Lophopidae	Hemiptera

Major pests

1. Maize shootfly: *Atherigona orientalis* (Muscidae: Diptera)



Distribution and status

Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka.

Host range: Maize, sorghum, ragi and bajra

Damage symptoms

The maggot feeds on the young growing shoots resulting in “dead hearts”.

Bionomics: Small grey coloured fly.

Management

- Grow resistant cultivars like DMR 5, NCD, VC 80
- Furrow application of phorate granules 10 G 10 kg/ha (or) lindane 6 G 25 kg per ha

2. Stem borer: *Chilo partellus* (Crambidae: Lepidoptera)

Distribution and status

India, Pakistan, Sri Lanka, Indonesia, Iraq, Japan, Uganda, Taiwan, Sudan, Nepal, Bangladesh and Thailand.

Host range: Jowar, bajra, sugarcane and rice

Damage symptoms



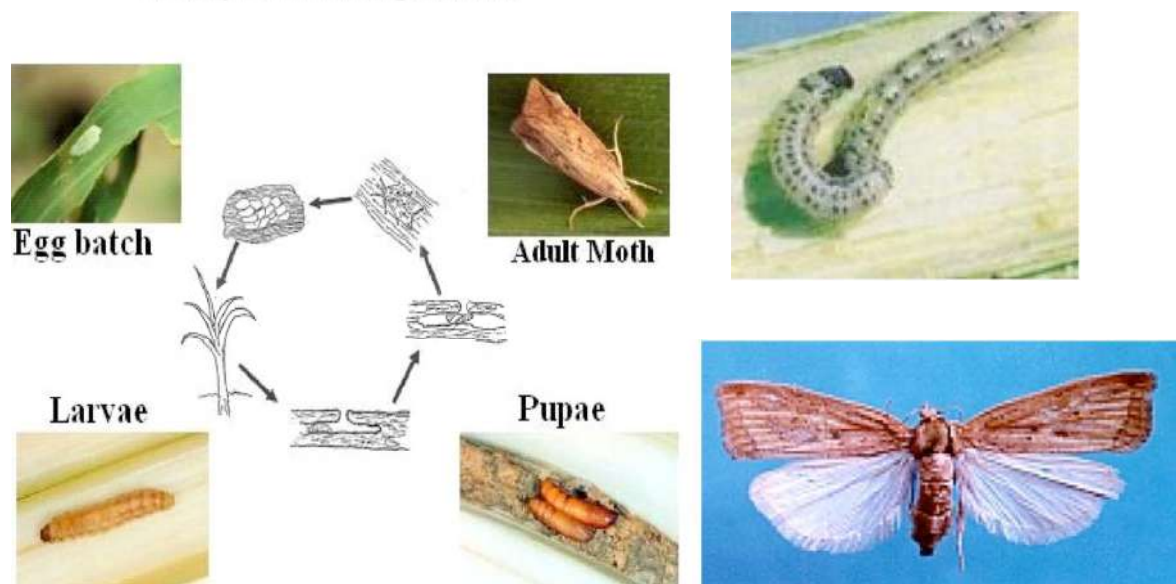
It infests the crop a month after sowing and upto emergence of cobs. Central shoot withering leading to “dead heart” is the typical damage symptom. Bore holes are visible on the stem near the nodes. Young larva crawls and feeds on tender folded leaves causing typical “shot hole” symptom. Affected parts of stem may

show internally tunnelling caterpillars.

Bionomics

The adult moth is medium sized, straw coloured. It lays flat oval eggs in batches on the under surface of leaves near the midribs. The fecundity is about 25 eggs per female.

Life cycle of *Chilo partellus*



The incubation period is 2-5 days. The larva is yellowish brown with a brown head which mines the midrib enter the stem and feeds on the internal tissues. The larval period is 28-50 days with 7 instars. It pupates within the stem for 2-15 days. The adult longevity is 2-12 days.

ETL: 10% dead hearts.

Management

1. Grow resistant cultivars like Him 129, Ganga 4,5,7 and 9, Ganga safed 2, Deccan 101 and 103, Him 123, Ageti, C 1, 3 and 7, Kanchan, Kundan
2. Sow lab lab or cowpea as an intercrop to minimise the stem borer damage (Maize : Lablab 4:1).
3. Set up light trap till midnight to attract and kill the stemborer moths.
4. Mix any one of the following insecticides with sand to make up the total quantity of 50 kg and apply in the leaf whorls - phorate 10 G 8 kg, carbofuran 3 G 17 kg, carbaryl + lindane 4G 20 kg, endosulfan 4 D 10 kg (or) spray endosulfan 35 EC 750 ml (or) carbaryl 50 WP 1 kg (500 L. spray fluid/ha).
5. Collect the stubbles after harvest and burn to destroy diapausing borers.

3. Pink stem borer: *Sesamia inferens* (Noctuidae: Lepidoptera)

Distribution and status

India, Pakistan, Malaysia, Taiwan, Burma, Bangladesh, Sri Lanka, South East Asia, China, Korea, Japan and Indonesia.

Host range

Sorghum, maize, rice, wheat, sugarcane, bajra, ragi and guinea grass.

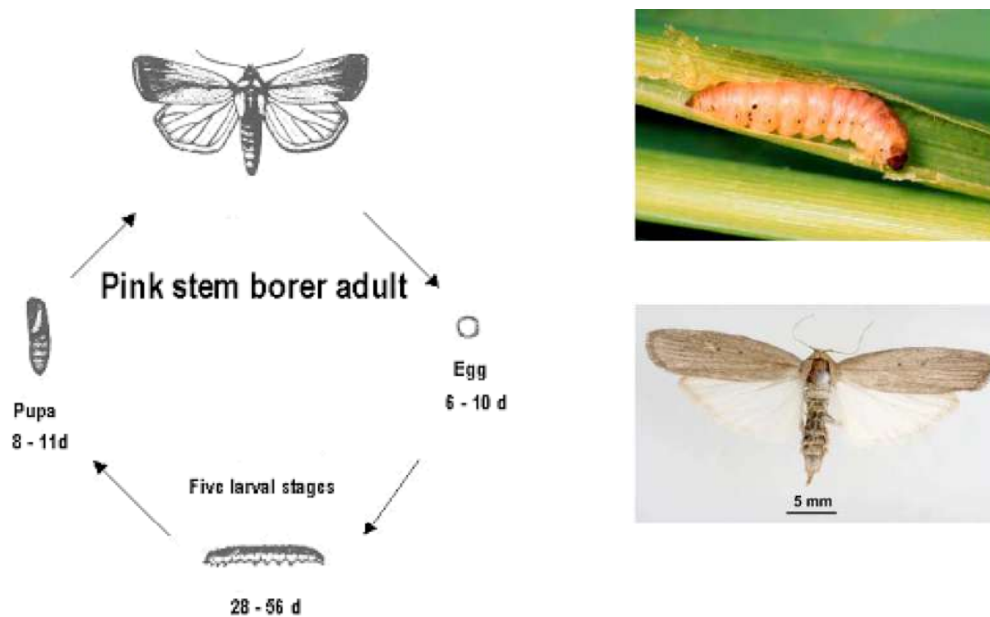
Damage symptoms



Pink larva enters into the stem causing dead heart symptom similar to that of stem borer.

Bionomics

The adult moth is straw-coloured with white wings. The larva is pinkish brown with dark head. The life cycle is completed in 45-75 days. There are 4-6 generations per year.



Management

- Grow resistant cultivars like Deccan 101 and 103
- Spray endosulfan 35 EC 1.0 L/ha. at every 20 days interval after germination of the crop.

4. Corn worm/Earworm: *Helicoverpa armigera*, (Noctuidae: Lepidoptera)

Damage symptoms

Larva feeds on silk and developing grains.

Bionomics

Adult is brown coloured moth with a 'V' shaped speck on fore wings and has a dull black border on the hind wing. Larva is green with dark broken grey lines and dark pale bands; shows color variation from greenish to brown.



Management

Apply at silk drying stage either carbaryl 10 D 25 kg/ha (or) spray carbaryl 50% WP 1.0 kg./ha in 500-600 L of water per ha. Repeat the insecticidal application 15 days later

5. Web worm: *Cryptoblabes gnidiella* (Pyraustidae: Lepidoptera)

Damage symptoms

The larva first feeds on the lemma of the flowers scraping the chlorophyll and later on the milky grains. The caterpillar causes damage by constructing webs on maize cobs and feeding on the flowers and grains.

Bionomics

Eggs are laid singly on spikelets and grain. They hatch in 3-4 days. Larva has duration of 9-10 days. The full-grown larva is 12 mm long and dark brown. It forms silken webs on cobs and remains inside them and pupates within. Adult is 7 mm across wings with dark grey forewings. Life cycle is completed in 23-24 days.



Management

Spray monocrotophos 36 SL (or) endosulfan 35 EC 1 l/ha.

6. Aphid: *Rhopalosiphum maidis* (Aphididae: Hemiptera)

For Distribution, status, host range, damage symptoms, bionomics and management refer sorghum

7. Shoot bug: *Peregrinus maidis* (Delphacidae: Hemiptera)

For Distribution, status, and host range refer sorghum

Damage symptoms

Injury to the plants is caused by the adults and nymphs which suck sap from them. The attacked plants become unhealthy, stunted and yellow. The leaves wither from top downwards. Panicle formation is inhibited and the plants die if attack is severe. Honeydew secreted by the bug causes growth of sooty mould on leaves.



Management

Spray 500 ml dimethoate 30 EC or methyl demeton 25 EC in 500 L of water per ha.

Minor Pests

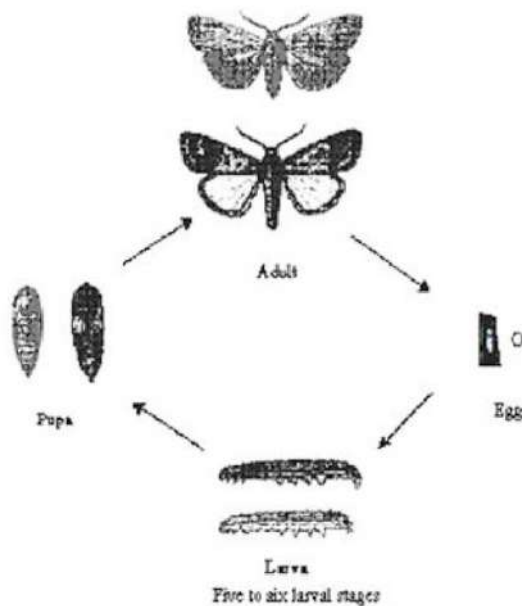
8. Climbing cut worm: *Mythimna separata*, (Noctuidae: Lepidoptera)

Damage symptoms

Irregular feeding of leaves.

Bionomics

Adult is a brown coloured moth with white hind wings. Larva is a light yellowish green caterpillar.



Video in agropedia

For bionomics and management refer wheat

9. Ash weevil: *Myllocerus* sp., (Curculionidae: Coleoptera)

Damage symptoms

The larva feeds on the secondary roots and adults on leaves.

Bionomics

Adult is a grey coloured weevil. A female weevil lays 98-350 eggs and they hatch in 3-12 days. Larvae and pupae are in soil. There are four larval instars of 23-40 days. Pupal period lasts 3-9 days. Life cycle is completed in 29-58 days.



Management

Spray endosulfan 35 EC 0.07%.

10. Phadka grasshopper: *Hieroglyphus nigrorepletus* (Acrididae: Orthoptera)

Damage symptoms

Leaves defoliated from the margin; plants often rendered bare.

Bionomics

Nymphs and adults have green and brown forms, the brown being the most common form. Both have a conspicuous irregular black dorsal pronotal stripe. Adults are mostly brachypterous. Eggs are laid one by one.

Management

Dusting with lindane at 25 kg /ha gives effective control of the pest.

11. Leafhopper: *Pyrilla perpusilla* (Lophopidae: Hemiptera)

Refer sugarcane



II. PESTS OF WHEAT

Wheat is comparatively less susceptible to insect pests in the field. However in recent years about half a dozen pests have become quite serious.

Major pests				
1.	Wheat Aphid	<i>Macrosiphum miscanthi</i>	Aphididae	Hemiptera
2.	Climbing cutworm/armyworm	<i>Mythimna separata</i>	Noctuidae	Lepidoptera
3.	Ghujhia Weevil	<i>Tanymecus indicus</i>	Curculionidae	Coleoptera
4.	Gram Pod Borer	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
5.	Termites	<i>Odontotermes obesus</i> and <i>Microtermes obesi</i>	Termitidae	Isoptera
6.	Molya Nematode/cyst nematode	<i>Heterodera avenae</i>	Heteroderidae	Tylenchida
7.	Wheat-gall Nematode	<i>Anguina tritici</i>	Tylenchidae	Tylenchida
Minor pests				
6.	Aphid	<i>Schizaphis graminum</i> and <i>Rhopalosiphum maidis</i>	Aphididae	Hemiptera
7.	Hopper	<i>Laodelphax striatella</i>	Delphacidae	Hemiptera
		<i>Pyrilla perpusilla</i>	Lophopidae	Hemiptera
8.	Jassids	<i>Amrasca</i> spp	Cicadellidae	Hemiptera
9.	Wheat bug	<i>Eurygaster maura</i>	Pentatomidae	Hemiptera
10.	Wheat thrips	<i>Anaphothrips favicinctus</i>	Thripidae	Thysanoptera
11.	Cut worms	<i>Agrotis</i> spp.	Noctuidae	Lepidoptera
		<i>Marasmia trapezalis</i>	Pyraustidae	Lepidoptera
12.	Pink borer	<i>Sesamia inferens</i>	Noctuidae	Lepidoptera
13.	Shootfly	<i>Atherigona naqvii</i> and <i>A. orzae</i>	Muscidae	Diptera
14.	Whorl maggot	<i>Hydrellia griseola</i>	Ephydridae	Diptera
15.	Flea beetle	<i>Chaetocnema basalis</i>	Chtysomelidae	Coleoptera

Major pests

1. Wheat Aphid: *Macrosiphum miscanthi* (Aphididae: Hemiptera)

Distribution and status: Widely distributed in wheat growing areas.

Host range: Wheat, barley, oats, *Cynodon dactylon*

Damage symptoms

Like other aphids, the nymphs and adults suck the sap from plants, particularly from their ears. They appear on young leaves or ears in large numbers during the cold and cloudy weather. The damage is particularly severe in years of cold and cloudy weather. A heavily manured, well-irrigated and succulent crop will harbour the pest for a longer period and suffer greater damage.

Bionomics

The insects are green, inert, louse like. The nymphs and the females look alike, except that the latter are larger. It breeds at a fast rate during cold weather and reaches the height of its population in February-March when the ears are ripening. The females give birth to young ones) and are capable of reproducing without mating. During the active breeding season, there are no males and the rate of reproduction is very high. When the wheat crop is ripe and the summer is approaching, the winged forms of both males and females are produced and they migrate to other plants like doob grass (*Cynodon dactylon*). It is not known how the pest passes the summer and the monsoon season. In October-November, the aphids again appear on wheat. If available, barley is preferred to wheat. The losses due to aphids have been reported upto 36 per cent.



English grain aphid adult and nymphs on wheat leaf



ETL: 5 aphids/ear head

Management

Spray 375 ml of dimethoate 30 EC or oxydemeton methyl 25 EC or monocrotophos 36SL in 500 L of water per ha. Since the aphids appear first on the borders of the crop, spray only the infected strip to check further spread.

2. Armyworm: *Mythimna separata* (Noctuidae: Lepidoptera)

Distribution and status

Cosmopolitan. Sporadic and has gained prominence as a pest of wheat only recently, particularly after the introduction of Mexican varieties in India

Host range

Wheat, sugarcane maize, jowar, bajra, *baru* grass (*Sorghum halepense*) and other graminaceous crops.

Damage symptoms

The freshly emerged larvae spin threads from which they suspend themselves in the air and then with the help of air currents reach from one plant to another. In the early stages, they feed on tender leaves in the central whorl and later feed on older leaves and skeletonize them totally. The grown-up caterpillars throw out faecal pellets, which are quite prominent.

In the case of a severe attack, whole leaves, including the mid-rib, are consumed and the field looks as if grazed by cattle. The larvae feed voraciously and migrate from one field to another. The pest may also eat away ears, including the awns and immature grains.

Bionomics

Pale brown adults live for 1-9 days and lay eggs singly in rows or in clusters on dry or fresh plants or on the soil. Freshly laid eggs are round, light green, turn pale yellow and finally black. Egg period 4-11 days in summer 19 days in winter. Freshly emerged larvae are very active, dull white and later turn green. In spring, the larval stage is completed in 13-14 days, but in the winter it is prolonged to 88-100 days.

In the pre-pupal stage, the insect spins a cocoon. The pre-pupal stage lasts 1-11 days during January to May. Pupation usually takes place in the soil at a depth of 0.5-5 cm, but it may also occur under dry leaves among the stubble or fresh tillers. Generally, the larvae before pupation seem to select sites near the water-channels. The pupal period is 9-13 days in May and 36-48 days in winter.



Management

The pest can be suppressed by collecting and destroying the caterpillars. (ii) Spray 500 ml of dichlorvos 85 SL or 3 kg of carbaryl 50 WP or 1.0 L of quinalphos 25 EC in 500 L of water per ha.

3. Ghujhia Weevil: *Tanymecus indicus* (Curculionidae: Coleoptera)

Distribution and status: Sporadic pest of considerable importance in wheat growing areas.

Host range: Germinating Rabi crops viz.,Wheat, barley, gram and mustard

Damage symptoms

Only adults feed on leaves and tender shoots of the host plants. They cut the germinating seedlings at the ground level. Often the crop is resown. The damage is particularly serious during October-November when the *rabi* crops are germinating.

Bionomics

Weevils are earthen grey and measure about 6.8 mm in length and 2.4 mm in width. Their fore wings are oblong and hind wings are more or less triangular, but they cannot fly. The pest is active from June to December and undergoes larval or pupal diapause during rest of the year in the soil. Weevils emerging in June mature sexually in October. They mate frequently and lay 6-76 eggs in 5-11 installments in the soil under clods or in crevices in the ground. The egg period is 6-7 weeks. Young grubs enter the soil. Grub period is 10-18 days and pupate in earthen chambers at a depth of 15-60 cm. The pupal stage lasts 7-9 weeks, and the adults emerge next year in June or July. The pest has only one generation in a year.

Management

Dust carbaryl or malathion 5 D @ 25 kg per ha.

4. Gram Pod Borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

The gram pod borer attacks wheat at maturity. It feeds on the grains in the ear heads. The damage is more where wheat follows cotton.



Management

Spray 3 kg of carbaryl 50 WP or 2.0 L of quinalphos 25 EC in 500 L of water/ha.

5. Termites: *Odontotermes obesus* and *Microtermes obesi* (Termitidae: Isoptera)

Termites damage the wheat crop soon after sowing and near maturity. The damaged plants dry up completely and are easily pulled out. The plants damaged at later stages give rise to white ears.

Management

(i) Treat the seed @ 4 ml of chlorpyrifos 20 EC or 7ml of endosulfan 35 EC/kg of seed. (ii) If the attack is noticed in the standing crop, dilute 2.5 L of endosulfan 35 EC in 5 L of water and mix it with 50 kg of soil and broadcast evenly in one hectare, followed by light irrigation.

6. Molya Nematode/cyst nematode: *Heterodera avenae* (Heteroderidae: Tylenchida)

Distribution and status: Widely distributed in Europe and Australia and has recently been recorded in Rajasthan, Haryana and the Punjab.

Host range: Wheat, barley, oats and rye



Damage symptoms

Attacked plants remain stunted and give a shriveled unhealthy appearance. Presence of nematodes stimulates the formation of branched rootlets. The main root remains short or bunched, bearing small galls. In case of severe infestation, the seedlings may fail to come out of the soil. The plants that escape the early damage produce short stalks and ears, yielding a poor harvest.

Bionomics

This nematode passes unfavourable season in the form of cysts, mostly in the soil. A cyst consists of the dead body of a female containing a large number of eggs. When the conditions are favourable, eggs hatch within the cysts and the larvae are set free into the soil in the second stage of growth. The larvae may invade any underground part of a susceptible plant but most of them enter it at or near the root tips. After moving a short distance through the cortex, they assume a position, more or less parallel to the main axis of the root, with the head away from the tip.

The male increases in girth, until the width is equal to about 1/5th of its length and during this period it undergoes the second and third moultings. The body begins to elongate and becomes folded or coiled within the cuticle during the third stage. After assuming the final cylindrical shape, it moults for the fourth time and becomes an adult. The female does not undergo such metamorphosis, but after the second and third moultings it continues to increase in girth until it becomes ovate. It then undergoes the fourth or final moulting and emerges as a full grown adult. After mating, the eggs mature inside the body of the female and it dies, the body being converted into a cyst.

Management

- Follow crop rotation with non host crops mustard, pulses, fenugreek or carrot for one or two years
- Grow cyst nematode resistant wheat Raj MR-1 or barley RD 2035 or RD 2052
- Plough two to three times during summer
- Apply carbofuran @ 45 kg/ha

7. Wheat-gall Nematode: *Anguina tritici* (Tylenchidae: Tylenchida)

Distribution and status: Cosmopolitan. It causes ear-cockle or *mamni* disease. The nematode is also the carrier of the bacterial yellow slime ear-rot (*tundu* disease) caused by *Corynebacterium tritici*

Host range: Rye, spelt and emer. Oats and barley are immune.

Damage symptoms

If the black rounded *mamni* galls are soaked in water overnight, the coat softens and a large number of larvae are set free. Affected plants are more or less stunted and their leaves are wrinkled, rolled or twisted. A variable number of grains in an infested ear may produce galls. The diseased ears are shorter and thicker than the healthy ones and the glumes are spread farther apart

Bionomics

Under natural conditions, the dry galls either fall to the ground from the ripe ears or they are harvested and find their way to the stores along with the healthy produce. The galls though dry remain viable for long periods. Single gall contains 800 to 30,000 larvae which revive and become active when the gall is moistened.

When wheat is sown, the galls become soft on imbibing moisture and the larvae are set free into the soil. From there, they reach the host plants, if available within a distance of one third of a metre. They rise up the plant and find a site for feeding as free parasites on the young leaves and the growing-points. Later on, as the plants approach the earing stage, they penetrate into the primordia of the flower-buds and form the galls instead of normal seed.

In the developing galls, the larvae mature into males and females, as the case may be. A single gall at this stage may contain 40 females and an equal number of males. They mate within the gall and the gravid females lay a large number of eggs. The young larvae on emerging from the eggs develop up to the second stage and then become dormant. They remain in that state in the dry galls till the next sowing season. There is only one generation in a year.

Management

- (i) The wheat gall nematode can be controlled by separating the galls from the wheat seed by floating them on water in a tub. The galls, being lighter, float on the surface and may be skimmed off. The seed should then be dried before sowing.
- (ii) The pest can also be suppressed by sowing clean seed in uninfested soil. Only one year's fallowing is sufficient to eradicate this nematode from the fields.

Minor pests

The other pests of wheat are,

- Aphids: *Schizaphis graminum* and *Rhopalosiphum maidis* (Aphididae: Hemiptera)
- Hopper: *Lodelphax striatella* (Delphacidae: Hemiptera)
Pyrilla perpusilla (Lophopidae: Hemiptera)
- Jassids: *Amrasca* spp. (Cicadellidae: Hemiptera)

- Wheat bug: *Eurygaster maura* (Linnaeus) (Pentatomidae: Hemiptera)
- Wheat thrips: *Anaphothrips favicinctus* (Thripidae: Thysanoptera)
- Cut worms: *Agrotis* spp. (Noctuidae: Lepidoptera.); *Marasmia trapezalis* (Pyraustidae: Lepidoptera)
- Pink borer: *Sesamia inferens* (Noctuidae: Lepidoptera)
- Shootfly: *Atherigona naqvii* and *A. orzae* (Muscidae: Diptera); *Hydrellia griseola* (Ephydridae: Diptera)
- Flea beetle: *Chaetocnema basalis* (Chrysomelidae: Coleoptera).

Questions - Maize and Wheat

1.	Lablab or cowpea is sown as an intercrop to minimise ----- damage. Stem borer	
2.	Maize stem borer undergoes _____ generation per year	
	a. 4-6	b. 2-5
	c. 3-4	d. 3-4
3.	_____are immune to wheat gall nematode - Oats and barley	
4.	Presence of shot holes and dead heart is the damage caused by _____ in maize Stem borer – <i>Chilo partellus</i>	
5.	----- causes damage by constructing webs on maize cobs and feeds on the flowers and grain Web worm	
6.	Dead heart in the later stages in maize is due to	
7.	Ghujia weevil has _____ generation in a year one	
8.	Bunchy roots with galls in wheat is due to the attack by _____ Cyst nematode, <i>Heterodera avenae</i>	
9.	Winged forms of wheat aphid migrate to _____ for breeding. <i>Cynodon dactylon</i>	
10.	Rabi wheat suffers more from the attack of _____ ghujia weevil. <i>Tanymecus inidcus</i>	
11.	_____ stage alone does the damage by cutting wheat seedlings at ground level Adult	

	a. Shoot fly	b. Stem borer
--	--------------	---------------

	c. Pink borer	d. b and c
12.	Alternate host of <i>Sesamia inferens</i> is _____	
	a. Sugarcane	b. Bajra
	c. Rice	d. All the above
13.	Alternate host of <i>Atherigona orientalis</i> is	
	a. Bajra	b. groundnut
	c. redgram	d. all the above
14.	Which one of the following larva feeds on silk and developing maize grains	
	a. Stem borer	Earworm
	c. Web worm	d. Cutworm
15.	Site of pupation for ash weevil is	
	a. Soil	b. On leaf
	c. Within leaf	d. In between leaf

Lecture No 5

PESTS OF PULSES - BLACK GRAM, GREEN GRAM, LABLAB AND COWPEA

One of the major constraints for low yield of pulse crop is the extensive damage caused by insect pests. About 250 insects have been recorded feeding on pulse crops. Of these, about one dozen insects including pod borers, stem borers, leaf miners, foliage caterpillars, cutworms, jassids, aphids and whiteflies are most important. Some polyphagous insects also feed on these crops and cause considerable damage.

Major pests				
1.	Bean aphid	<i>Aphis craccivora</i>	Aphididae	Hemiptera
2.	Thrips	<i>Ayyaria chaetophora</i> , <i>Caliothrips indicus</i> , <i>Megalurothrips distalis</i>	Thripidae	Thysanoptera
3.	Whitefly	<i>Bemisia tabaci</i>	Aleyrodidae	Hemiptera
4.	Green leafhopper	<i>Empoasca kerri</i> , <i>E. binotata</i> , <i>E. flavescens</i>	Cicadellidae	Hemiptera
5.	Pod bug	<i>Riptortus pedestris</i> <i>Clavigralla horrens</i> <i>Clavigralla gibbosa</i> <i>Anoplocnemis phasiana</i>	Coreidae	Hemiptera
6.	Lablab bugs / stink bug	<i>Coptosoma cribraria</i>	Coremelanidae	Hemiptera
7.	Leaf webber	<i>Eucosma critica</i>	Eucosmidae	Lepidoptera
8.	Lab-lab leaf miner	<i>Cyphosticha coerulea</i>	Gracillariidae	Lepidoptera
9.	Termites	<i>Odontotermes obesus</i>	Termitidae	Isoptera
Minor pests				
10.	Redgram scale	<i>Ceroplastodes cajani</i>	Coccidae	Hemiptera
11.	Redgram leaf roller	<i>Caloptilia soyella</i>	Gracillariidae	Lepidoptera
12.	Leaf folder	<i>Anticarsia irrotata</i>	Noctuidae	Lepidoptera
13.	Leaf eating caterpillar	<i>Azazia rubricans</i>	Noctuidae	Lepidoptera
14.	Sphingid caterpillar	<i>Acherontia styx</i>	Sphingidae	Lepidoptera
15.	Leaf cutter bee	<i>Megachile anthracena</i>	Megachilidae	Hymenoptera

Major pests

1. Bean aphid: *Aphis craccivora* (Aphididae: Hemiptera)



Distribution and status

Cosmopolitan, India, Africa, Argentina, China, U.S.A., Europe, Australia

Host range

Groundnut, red gram, peas, beans, safflower, lablab, niger

Damage symptoms

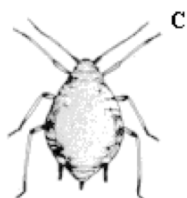
Both nymphs and adults cause the damage by sucking the plant sap. Infested pods become deformed, withered and malformed. Severe infestation may result in complete drying of affected pods. They also act as vector of pea virus.

Bionomics

It is a greenish black coloured aphid. The total life cycle occupies an average of 3-8 days. It reproduces parthenogenetically and viviparously. The female may



produce 8-30 young ones in a life span of 10-12 days. The nymphs transform into adult in 5-8 days after passing through four instars.



Aphids. A-B, Bean aphids. C, Cowpea aphid.

Management

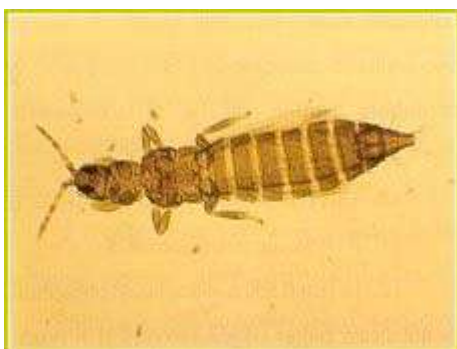
1. Grow resistant cowpea cultivars like P 1473, P 1476, MS 9369, Bendel Lobia 1
2. Use entomopathogenic fungus *Fusarium pallidoroseum* or *Beauveria bassiana* to cause epizootics in aphids in the cowpea field.
3. Spraying of infested crop with 500 methyl demeton 25 EC or dimethoate or 125 ml imidacloprid in 500 L water per ha effectively control aphids. As the strong point of this pest lies in its very quick multiplication, the insecticidal treatment has to be repeated as soon as aphid population is found to have built up again.

2. Thrips: *Ayyaria chaetophora*, *Caliothrips indicus*, *Megalurothrips distalis* (Thripidae: Thysanoptera)

Damage symptoms

The leaves are mottled with characteristic silvering due to the attack of insect especially under dry spell on lab lab, black gram, green gram, cow pea. Later leaves dry and shed. Damaged plants do not develop pods. It also acts as a vector of many diseases.

Bionomics Tiny yellow fringe winged adults.



Caliothrips indicus

Management

Spray Malathion 50 EC 1.0 L or Carbaryl 50 WP 1.0 kg in 700 L water.

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

Distribution and status: Cosmopolitan. It is a vector of yellow mosaic disease..

Host range : Black gram, green gram, red gram, lobia, cotton, tobacco and cassava



Damage symptoms

The damage is caused by both nymphs and adults, which are found in large numbers. They suck plant sap and lower its vitality. Severe infestation results in premature defoliation, development of sooty mould or honey dew and shedding of flowers and pods.

Bionomics

Adult is a minute insect with yellow coloured body with white waxy bloom. Nymph is greenish yellow, oval in outline along with puparia on the under surface of leaves.



Management

- Grow black gram resistant varieties like ML 337, ML 5, MH 85-61, ML 325
- Spray the infested crop with malathion 50 EC 1.0 L or phosalone 50 EC 750 ml or dimethoate 30 EC 750 ml in 700 - 1000 L water per hectare.

4. Green leafhopper: *Empoasca kerri*, *E. binotata*, *E.flavescens* (Cicadellidae: Hemiptera)

Host plants

Greengram, blackgram, cowpea

Damage symptoms

The nymphs and adults feed on tender leaves and other parts of the plant by sucking the plant sap. In cases of severe attack, leaves become brittle and dry. Characteristics hopper burn i.e cupping of leaves appear. The plant may lose its vigour resulting in poor growth.

Bionomics

Elongate, active wedge shaped green insects found on the under surface of leaves. The female inserts its eggs inside the veins of leaves. The incubation period lasts for 4-8 days. There are five nymphal instars occupying 7-10 days.

Management

Spray the infested crop with methyl-o- demeton 750 ml in 700 - 1000 L water per hectare



5. Pod bug: *Riptortus pedestris*, *Clavigralla gibbosa*, *Clavigralla horrens*, *Anoplocnemis phasiana* (Coreidae: Hemiptera)



Riptortus pedestris



Anoplocnemis phasiana

Host range: Redgram and other pulses.

Damage symptoms

The nymphs and adults suck the juice of unripe seeds from the green pods. In case of severe infestation the tender parts get shrivelled and later dries up. The bugs are seen clustered around on the pods.



Bionomics

Riptortus pedestris - The female bug lays an average of 115 eggs singly on pods at their base. The egg period is 3-4 days. The nymphs are brownish black and hemispherical which resembles brown ant. The nymphal stage undergoes 5 instars in 16 days. *Clavigralla gibbosa* - It is bigger than *C. horrens* in size. It lays eggs in groups of 3-15 on pods or leaves. The fecundity is 60-400 eggs per female. The incubation period is 4 days. There are 5 nymphal instars. The nymphal duration varies from 7-31 days. The adult bug lives upto 150 days. *C. horrens* - It is brown, flat, narrow - bodied bug with conspicuous lateral spines on the prothorax and enlarged hind femur.

Management

Spraying the infested crop with endosulfan 35 EC 2.0 L in 700 - 1000 L water per hectare

6. Lablab bugs / stink bug: *Coptosoma cribraria* (Coremelanidae: Hemiptera)

Host range: Bean, lentil etc.

Damage symptoms

Both nymphs and adults cluster on the tender shoots and suck the sap. Heavily infested vines dry and shed away. Moderately infested plants remain weak and stunted in growth.

Bionomics

Oval shaped greenish bugs lay ivory white sculptured eggs in double rows in batches of 35-50 on the tender pods. Incubation period is about 7 days. Total life cycle is completed in about 49 days in South India.



Management

Spray the infested crop with endosulfan 35 EC 2.0 L in 700 L water per hectare.

7. Leaf webber: *Eucosma critica* (Eucosmidae: Lepidoptera)

Distribution and status: Widely distributed in India.

Host range: Red gram and other pulses

Damage symptoms

The damage is caused by the larvae, which bores into the tender shoots of folded leaves and feed from within. Since the terminal leaves get spun together growing tip is damaged. The growth of the main shoot is affected



Bionomics

The small and dark brown moth lays eggs singly or in rows on leaves, petioles (or) stems. The grooves or depressions are preferred for egg laying. Around 80-100 eggs are laid by one female. The incubation period lasts for 3-4 days. Larval period is about 14-21 days and pupal period 4-6 days. Pupation occurs within the folded buds, flowers or pods in a silken cocoon.

Management

Spray the infested crop with endosulfan 35 EC 2.0 L in 700 L water per

hectare.

8. Lab-lab leaf miner: *Cyphosticha coerulea* (Gracillariidae: Lepidoptera)

Distribution and status: Throughout India

Host plants: Blackgram, greengram, cowpea.

Damage symptoms

Tiny larvae bore into the epidermis of the leaf and forms blisters through mining.

Management

Spray the infested crop with endosulfan 35 EC 2.0 L or methyl demeton 750 ml in 700 litre water per ha.

9. Termites: *Odontotermes obesus* (Termitidae: Isoptera)

Host plants – wheat, barley, sugarcane, pea, sorghum, pearl millet, maize, groundnut.

Damage symptoms

Termite damage starts soon after sowing and continues till the growing stage. The leaves of damaged plants droop down which later wither and dry. Such plants are easily uprooted.



Bionomics

7-10 days after aerial flight the female lays the first batch of eggs numbering 100-130. These eggs hatch in 40-42 days. The female termite then swells to become queen and lays upto 30,000 eggs per day. The members of this group are social insects and are composed of workers, soldiers, king and queen.

Management

1. Where the pest is of regular occurrence the soil should be mixed with endosulfan 4D or quinolphos 1.5 D or chlorpyrifos 5 D BHC or 10 D @ 35 kg/ha at the time of sowing.
2. If the incidence of pest is noticed in standing crop dilute 2.5 L of endosulphan 35 EC or chlorpyrifos 20EC in 5 L of water and mix it with 50 kg of soil and broadcast even in 1 ha followed by light irrigation.

Minor pests

10. Redgram scale: *Ceroplastodes cajani* (Coccidae: Hemiptera)

Tender branches are covered with scales attended by ants. Adults are round waxy scales.

11. Redgram leaf roller: *Caloptilia soyella* (Gracillaridae: Lepidoptera)

Leaves rolled up apically become white and dries up. Adult moth is very small. Larva is creamy yellow or green with sparse hairs on the body.

12. Leaf folder: *Anticarsia irrotata* (Noctuidae: Lepidoptera)

Larva folds the leaves together. Adult is yellowish brown moth with oblique black lines on the wings. Larva is green coloured.

13. Leaf eating caterpillar: *Azazia rubricans* (Noctuidae: Lepidoptera)

The larva causes severe defoliation. Larva is slender green with ashy white band between each segment. A few narrow lines along the back and bright yellowish brown stripes along the sides may or may not be present. It has looping movement in spite of the presence of all prolegs. Adult moth resembles a dry leaf.

14. SpHINGID caterpillar: *Acherontia styx* (Sphingidae: Lepidoptera)

The larva feeds on leaves and cause severe defoliation. Adult is large, wings grey with waxy markings. Abdomen crimson coloured with black stripes. Larva is a stout green caterpillar with yellowish oblique stripes with curved anal horn.

15. Leaf cutter bee: *Megachile anthracena* (Megachilidae: Hymenoptera)

Red gram leaves showing semi circular or circular cut out. Adults cut small bits of leaves for making larval chambers. Medium sized brown coloured bees.

Questions - pulses

1.	Leaves mottled with characteristic silvering in pulses is due to the attack of	
	a. Thrips	b. Aphids
	c. Leaf hopper	d. Whitefly
2.	Infested pod becomes malformed and withered due to the attack of _____	
	a. Aphids	b. Thrips
	c. Whitefly	d. Pod bug
3.	Premature defoliation, development of sooty mould, shedding of flowers and pods in pulses is due to _____ Whitefly	
4.	<i>Bemisia tabaci</i> belongs to which order	
	a. Diptera	b. Coleoptera

	c. Hemiptera	d. Trichoptera
5.	----- that sucks juice from unripe pods of pulses - Pod bug	
6.	----- lay ivory white sculptured eggs in two rows of 35-50 batches on the tender pods. Stink bug	
7.	Formation of blisters through mining is the symptom of _____ in pulses Leaf miner	
8.	Termite affected plant will come out easily when pulled –Say true or false?	
9.	The queen termite may lay up to----- eggs per day - 30,000	
10.	Adult moth of which insect resembles a dry leaf. - Leaf eating caterpillar	
11.	_____ cut semicircular bits of redgram leaves for making larval chambers. Leaf cutter bee	
12.	----- is the scientific name of leaf cutter bee. - Megachile anthracena	
13.	_____ is the scientific name of pulse pod bug	
	a. <i>Riptortus pedestris</i>	b. <i>Clavigralla horrens</i>
	c. <i>Anoplocnemis phasiana</i>	d. all the above
14.	Alternate host of <i>Aphis craccivora</i> _____	
	a. safflower	b. groundnut
	c. redgram	d. all the above
15.	Alternate host of <i>Bemisia tabaci</i>	
	a. cotton	b. tobacco
	c. Moong	d. all the above
16.	_____is largest in size among the coreid pod bugs in pulses Anoplecnemis phasiana	
17.	_____ can cause epizootics in aphid population in pulses <i>Fusarium pallidoroseum</i> or <i>Beauveria bassiana</i>	
18.	Formation of blisters by minng into the leaf epidermis in lab-lab is due to _____ Leaf miner, Cyphostica coerulea	

Lecture No 6

PESTS OF PULSES - REDGRAM AND CHICKPEA

Pest of redgram

Pod borers, blue butterfly, mites as vectors cause significant yield reduction in redgram.

Major pests				
1.	Gram pod borer	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
2.	Blue butterfly	<i>Lampides boeticus</i>	Lycaenidae	Lepidoptera
3.	Grass blue butterfly	<i>Euchrysops cnejus</i>	Lycaenidae	Lepidoptera
4.	Plume moth	<i>Exelastis atomosa</i>	Pterophoridae	Lepidoptera
5.	Spotted pod borer	<i>Maruca testulalis</i>	Pyraustidae	Lepidoptera
6.	Spiny pod borer	<i>Etiella zinckenella</i>	Phycitidae	Lepidoptera
7.	Field bean pod borer	<i>Adisura atkinsoni</i>	Noctuidae	Lepidoptera
8.	Pod fly	<i>Melanagromyza obtusa</i>	Agromyzidae	Diptera
9.	Stem fly	<i>Ophiomyia phaseoli</i>	Agromyzidae	Diptera
10.	Eriophyid mite	<i>Aceria cajani</i>	Eriophyidae	Acari
Minor pests				
10.	Blister beetle	<i>Mylabris pustulata</i>	Meloidae	Coleoptera
11.	Pod wasp	<i>Tanaostigmodes cajaninae</i>	Tanaostigmatidae	Hymenoptera
12.	Flower webber	<i>Eublemma hemirrhoda</i>	Noctuidae	Lepidoptera

Major pests

1. Gram pod borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Distribution and status: World wide

Host range

Cotton, sorghum, lablab, pea, chillies, groundnut, tobacco, okra, maize, tomato, soybean, safflower, gram, etc.

Damage symptoms

It is a polyphagous species and is an important pest on pulses. Caterpillar first feeds on foliage; later bores into pods and feeds on seeds.



Larva is seen feeding with the head alone thrust inside the parts and the rest of the body hanging out. Boreholes on pods, absence of seeds on pods and defoliation in early stages are the symptoms of attack.

ETL: One larva per five plants in the pod initiation stage

Bionomics



Adult moth is greenish to brown with a 'V' shaped speck on forewings and dull black border on the hind wing. Eggs are laid on the host plants singly. The egg period is 7 days. Full grown larva is 2" long, greenish with dark brown gray lines and dark and pale bands. It shows colour variation from greenish to brown. The larval duration is 14 days. It pupates in soil for 10 days. One generation is completed in 28 days under favorable conditions.

Management

1. Grow Helicoverpa resistant varieties like,
 - Red gram:** T 21, Bori, BDN 2, ICPL 332, ICPL 84060, ICPL 88039, PPE 45-2, ICP 19640, ICP 7035, MA 2, Pant A1, BSMR 1, JG 315 and JG 74 for central zone and ICCV 7
 - Chickpea:** ICCV&, ICCVIO, Dulia
2. Install bird perches @ 50/ha to pick the larvae
3. Set up light trap to monitor, attract and kill the moths
4. Set up pheromone traps @ 12 nos./ha
5. Inundative release of egg parasite *Trichogramma* spp. and egg larval parasites, *Chelonus blackburnii*
6. Spray nuclear polyhedrosis virus (NPV) @ 500 LE/ha in 0.1% teepol.
7. Apply any one of insecticides at 25 kg/ha - endosulfan 1.5 D, quinalphos 1.5 D, carbaryl 5D or spray any of the following insecticides in 700-1000 L of water per ha.

• Azadirachtin 0.03% 2.5-5.0 L	• Lambda cyhalothrin 5 EC 400-500 ml
• <i>Bacillus thuringiensis</i> serovar <i>kurstaki</i> (3a,3b,3c) 5 WP 1.0-1.25 kg	• Lufenuron 5.4 EC 600 ml

- Benfuracarb 40 EC 2.5 L
- Emamectin benzoate 5 SG 220 g
- Ethion 50 EC 1.0-1.5 L
- Indoxacarb 14.5 SC 333-400 ml or 15.8 SC 335 ml
- Methomyl 40 SP 750-1125 g
- NPV of *H. armigera* 2 AS 250 -500 ml
- Spinosad 45 SC 125-160 ml
- Endosulfan 35 EC 1.25 L

2. Blue butterfly: *Lampides boeticus* (Lycaenidae: Lepidoptera)

Distribution and status: India

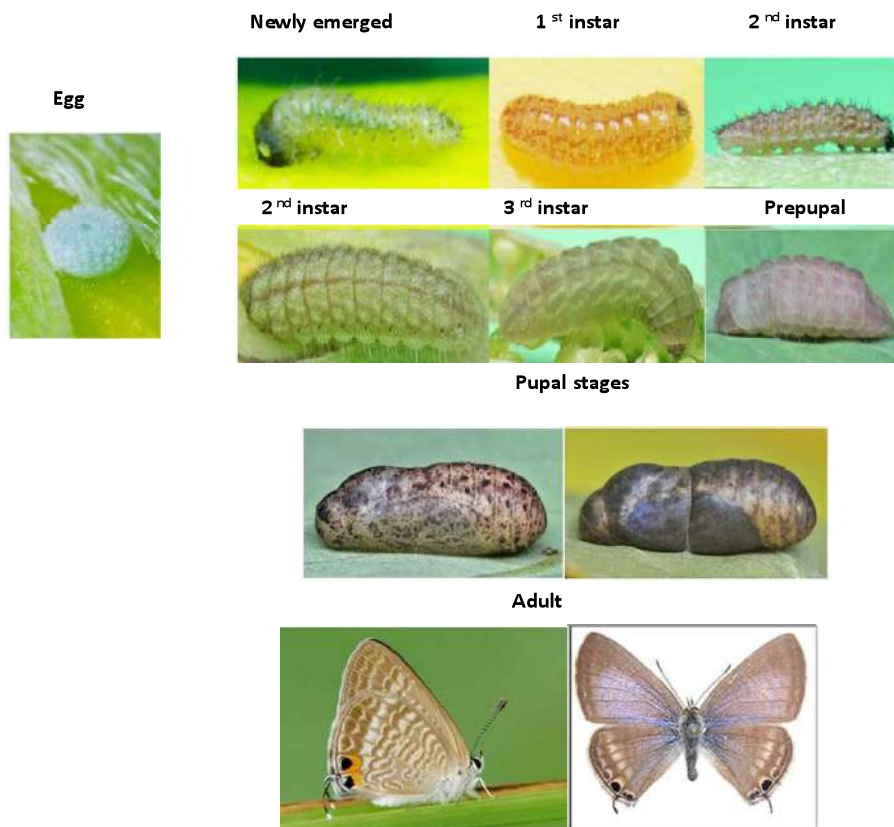
Host range: Cowpea, redgram, blackgram, lablab and niger.

Damage symptoms

The larva feeds inside flower buds; green pods with bore holes and presence of slug like caterpillar.



Bionomics



The adult moth is greyish blue with prominent black spots in the hind wings and a long tail. It lays eggs singly or in group of 2-3 on flower buds, green pods, shoots and leaves. The egg period is 4-7 days. The larva is pale green with a rough skin and measures 1mm in length. The larval period is 9-27 days. It pupates in leaf, twig or pod. The pupal period lasts for 17-19 days.

3. Grass blue butterfly: *Euchrysops cnejus* (Lycaenidae: Lepidoptera)

Distribution and status: Throughout India. Regular pest

Host range: Blackgram, peas, redgram and lablab.

Damage symptoms

Buds, flowers and young pods with boreholes and presence of slug like caterpillar.

Bionomics

The adult butterfly is blue, medium sized with 5 black spots in the hind wings and two black spots in the inner margin. It lays 60-200 eggs singly on stem, pod, and leaf petioles. They hatch in 2-10 days.



The pale green or yellow larva measures about 13 mm in length with a red line and short black hairs on the body. It feeds on flowers; flower stalks and enters the pod. The entry hole on the pod is plugged with excreta. The larval period is 10-21 days with four instars. It pupates in soil or between fallen leaves and debris of the plant for a period of 5-12 days.

Management for Blue butterfly

1. Discourage dense or close planting.
2. Avoid early or late sowing.
3. Dig soil regularly during the period of infestation to kill larvae and pupae.
4. Pick and destroy the larvae, pupae & adults.
5. Release egg parasitoid *Trichogramma* sp.
6. Conserve larval parasitoids *Aploymia* sp., *Hyperencyrtus lycaenephila*, *Listrodromus crassipes*.
7. Chemical control measures are the same as redgram pod borer

4. Plume moth: *Exelastis atomosa* (Pterophoridae: Lepidoptera)

Distribution and status: India, Nepal and New Guinea

Host range: Red gram, lablab, niger and horse gram

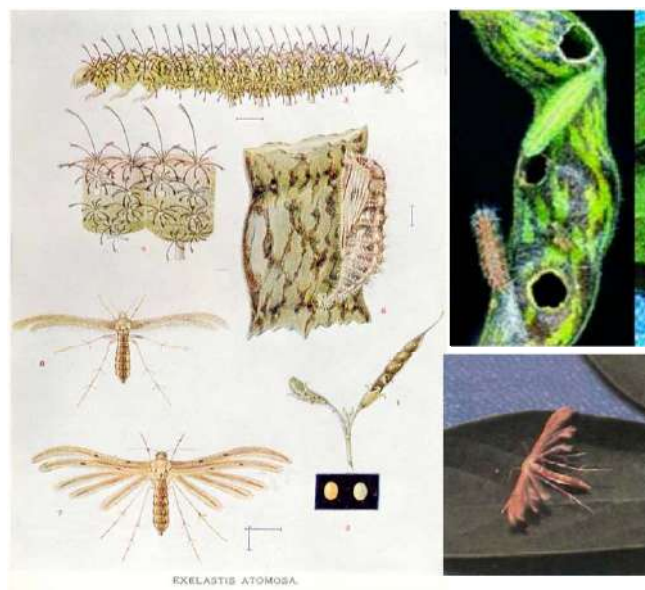
Damage symptoms

The tiny larva bores into unopened buds, flowers and tender parts. 5-20% pods are damaged.



Bionomics

Adult is delicate, brown coloured small moth with plumed wings. Eggs are laid on flower buds and tender pods. Egg period is 4 days. Larva is greenish brown, 10 mm in length densely packed with short hairs and spines. Larval period is 14-30 days. It pupates on the pods itself. Pupal period is 4-8 days.



1. Egg on redgram pod

2. Magnified egg

3. Larva

4. details of larva

5. Pupa

6, 7. Moths

Management

- Conserve Larval parasitoids, *Apanteles paludicolae*, *Diadegma* sp.,
- Chemical control measures are the same as redgram pod borer

5. Spotted pod borer: *Maruca testulalis* (Pyraustidae: Lepidoptera)

Distribution and status

Tropical and sub tropical regions of the world.

Host range

Beans, peas, castor, groundnut, cowpea, rice, sesame, soybean, tobacco, daincha, sugarcane, redgram, lablab, niger, greengram and blackgram.

Damage symptoms



The larva bores the buds, flowers or pods; infested pods and flowers are webbed together. The larva feeds on seeds. The assessment of damage in pigeonpea pods has shown that 5-20% pods may get affected depending upon the locality, month and variety.

Bionomics



Female lays eggs singly on flowers, buds or pods. After hatching larva bores buds or pods and feed on seeds. The full-grown larva is 20 mm in length. It pupates in the dry leaves (or) debris.

Management

- Grow resistant cultivars like ICPL 98001, ICPL 98003, ICPL 98008, ICPL 9804
- Conserve larval parasitoids *Bracon lebetor*
- Chemical control measures are the same as redgram pod borer

6. Spiny pod borer: *Etiella zinckenella* (Phycitidae: Lepidoptera)

Distribution and status

India, Japan, Burma, Australia, Sri Lanka, Indonesia, USA, Mexico, West Indies, South America, Europe, Egypt, India. It is a serious pest of lentils and green peas in North India

Host range

Redgram, horsegram, cowpea and greengram, lentil and green peas.

Damage symptoms

The larva feeds inside green pods and then on pod surface, webbing together 2-4 pods.



Bionomics

Eggs are laid singly (or) in groups preferably at the junction of the calyx and pod or on the pod surface. A female lays 47-178 eggs, which hatch in 5-6 days. The larva bores within the green pods and feeds on seeds. Larval period lasts for 10-13 days. When fully grown the larva drops to ground and forms a cocoon about 2.5 cm or so below ground or under dry leaves. Pupal duration lasts for 9-20 days depending on the climate. The moths pair 24-30 hour after emergence.



Management

1. Conserve natural enemies like *Tetrastichus* sp., *Bracon hebetor*, *Phanerotoma* sp. and *P. hendecasisella*.
2. Chemical control measures are the same as redgram pod borer

7. Field bean pod borer: *Adisura atkinsoni* (Noctuidae: Lepidoptera)

Distribution and status: Cold weather pest found throughout India

Host range: Pigeonpea, lablab and niger

Damage symptoms

The larva bores inside the pod and feeds on the seeds within.



Bionomics

Moths are yellowish brown in colour. Eggs are laid singly on flowers, buds and pods. The eggs are minute in size. The egg, larval and pupal periods lasts 3, 14-15 and 11 days respectively. Full grown larva is 28-35 mm long, brownish green in colour. When full fed, caterpillar pupates in rice store. During February to November, it hibernates in the pupal stage.

Management

- Conserve natural enemies like *Bracon hebetor*.
- Chemical control measures are the same as redgram pod borer

8. Pod fly: *Melanagromyza obtusa* (Agromyzidae: Diptera)

Distribution and status: India, South East Asia, Japan.

Host range: Redgram, Bhendi and Safflower.

Damage symptoms



Maggots cause damage by boring into the soft seeds and feed on grains. The damaged seeds are unfit for consumption as well as for germination. The extent of damage may be even upto 60-70% during severe infestation.

Bionomics

Eggs are laid by them singly or in cluster inside the pod wall by piercing through the ovipositor. The fly lays about 60-80 eggs. Incubation period is 2-4 days. Larval period is about 5-18 days and pupal period varies from 7-10 days. A number of overlapping generations are found in a year.



Management

1. Conserve natural enemies like *Euderus lividus*, *Eurytoma* sp., *Euderus agromyzae*
2. Spray Carbaryl 50 WP 1.5 kg or endosulfan 35 EC 1.25 L or lambda cyhalothrin 5 EC 400 -500 ml or Lufenuron 5.4 EC 2.5 L with 700 L water/ha

9. Stem fly: *Ophiomyia phaseoli* (Agromyzidae: Diptera)

Distribution and status

India, Sri Lanka, Laos, New South Wales Philippines, Burma, East Indies, China, Pakistan, Indonesia, Malaysia, Africa, Fiji, Australia, Thailand, Singapore and Samoa.

Host range

Red gram, bean, cowpea, soybean and lima bean

Damage symptoms

Drooping of the tender leaves and yellowing characterize serious damage of young plants. The sites where maggot and pupae are present become swollen and start ribbing. Older plants show stunting but are not usually killed.



Bionomics



The adult is a small black fly. A female lays 38-79 eggs singly on pods or on flower buds. The egg period lasts about 3 days. The maggot first makes galleries just below the epidermis of the seed feeding deeper into the seeds later. Larval period lasts for 5-6 days. The larva pupates in the larval groove for 8-9 days.

Management

1. Conserve natural enemies like *Euderus lividus*, *Eurytoma* sp., *Euderus agromyzae*
2. Seed pelleting with chlorpyrifos @ 4 ml/kg of seed may reduce stem fly.
3. Spray any one of contact insecticide in the early stages of the attack. Carbaryl 50 WP 1.5 kg or endosulfan 35 EC 1.25 L in 700 L water per ha

10. Red gram sterility mite: *Aceria cajani* (Eriophyidae : Acari)



Distribution

Identified only in India where it is widespread and common. It is the vector of the pigeon pea sterility mosaic disease.

Damage symptoms

Infected plants develop light green or chlorotic leaves which have mosaic patterns. Most infected plants do not bear flowers.

Bionomics

The mites are difficult to see with the naked eye. They are 0.2 mm long, light pink, spindle shaped, and are normally found feeding on the underside of leaflets. Milky white eggs are found on vegetative terminals. Many nymphs are found on young folded leaflets. Plant - to-plant infestation occurs by the wind dispersal of infective mites.

Management.

Use resistant pigeonpea varieties.

Spray dicofol 18.5 EC 1.0 L or wettable sulphur 40 WP 3.0 kg or endosulfan 35 EC 750 ml or dimethoate 30 EC 1.0 L or phosalone 35 EC 1.0 L in 700 L water per ha

Avoid synthetic pyrethroids as they cause resurgence after repeated spray.

Minor pests

II. Flower Feeder

10. Blister beetle: *Mylabris pustulata* (Meloidae: Coleoptera)

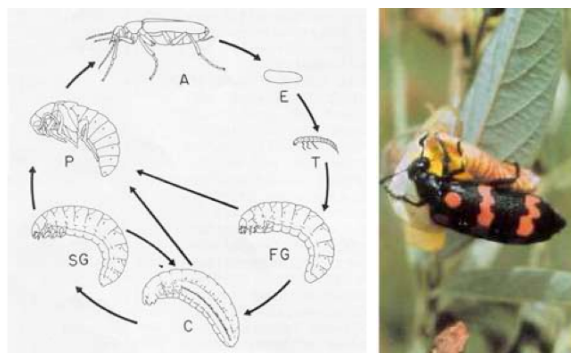
Distribution and status: Throughout India

Damage symptoms

The adult feeds voraciously on buds and flowers. A single beetle can destroy as many as 20-30 flowers/day.

Bionomics

The eggs are laid by female beetle in clusters of 60-80 eggs at 2-3 cm depth in soil. Eggs are light yellowish in colour and cylindrical in shape. Incubation period is about three weeks. Young grubs are white in colour. It pupates inside the soil tunnel.



A- Adult, E – Egg ,T – Triungulin or first instar, FG – first grub phase C- Coarctate phase in instar six/seven, SG- second grub phase, P - pupa

11. Pod wasp: *Tanaostigmodes cajaninae* (Tanaostigmatidae: Hymenoptera)

Distribution and status: Andhra Pradesh, Orissa, Bihar, Maharastra and Karnataka.

Host range: Red gram

Damage symptoms

The larva feeds on young seed of basal locules of pods causing complete abortion of the seed. Larva also feeds on the pod wall after consuming the seed. When the pod is attacked immediately after flower drop, it becomes dry and is shed.

Larva



Adult



Bionomics

Eggs are laid on flowers and very young pods. The white larva is apodous and 2-5 mm long when full-grown. Larval stage lasts for 8-10 days. Pupation is inside pod for 5-7 days.

12. Flower webber: *Eublemma hemirrhoda* (Noctuidae: Lepidoptera)

Larva webs together the flowers and feeds on them. Adult has yellow forewings with purple patches and white hind wings. Larva is green with a black head.

Integrated Pest Management in Pulses

A. Cultural methods

1. Summer deep ploughing is effective in destroying the eggs, larvae and pupae of various pests
2. Pest population of pulses can also be suppressed to some extent by resorting clean cultivation.
3. Early sowing crop escapes the first two broods of stem fly.
4. Increase the seed rate to compensate the damage due to stem fly.
5. Soil raking through weeding may reduce the soil grubs.

6. Apply 50 kg potash/ha to the crop raised with closer spacing (20x10 cm) to reduce the stem fly and pod borer incidence
7. Remove the weeds in and around the field.
8. Collect and destroy egg masses and pupae.
9. Dry the seeds adequately to reduce the moisture level to 8% for the grain purpose.
10. Resistant strains of gram like G-130 & C 214 are less susceptible to *H. armigera*.

B. Mechanical methods

1. Set up light trap to monitor, attract and kill the pod borer moths.
2. Set up pheromone traps @ 12 nos./ha to reduce gram pod borer incidence.

C. Biocontrol methods

1. Release egg parasite *Trichogramma* spp. and egg larval parasite *Chelonus blackburnii* for the control of *H. armigera*.
2. Conserve natural enemies like *Microbracon* sp., *Cotesia* sp, *Bracon hebetor* and *Apanteles* sp. parasitizes the caterpillar pests.
3. Apply NPV @ 500 LE/ha to control *H. armigera*.

D. Chemical methods

1. Soil treatment with chlorpyrifos 5D or quinalphos 1.5 D 2 25 kg/ha against cut-worms and other insects hiding below or on the soil surface.
2. Seed pelleting with chlorpyrifos @ 4 ml/kg of seed may reduce the early pests like stem fly.
3. For sucking pests, spray methyl demeton 25 EC 500 ml (or) dimethoate 30 EC 500 ml/ha (250 l spray fluid / ha)
4. For pod borer, apply any one of the insecticides @ 25 kg/ha endosulfan 4 D, quinolphos 4D and carbaryl 5D.
5. Spray endosulfan 35 EC 1250 ml (or) monocrotophos 36 SL 625 ml/ha or NSKE 5% twice followed by triazophos 0.05% (spray fluid 500 l/ha).
6. For seed purpose: Mix 1 kg of activated kaolin or malathion 5 D for every 100 kg of seeds. Pack in polythene lined gunny bags for storage.
7. Neem seed kernel powder 3% effectively controls the storage pest, bruchid beetle.

Pest of Chickpea

This type is used both as food by human beings and as feed for animals. In general, the kabuli plants and seeds are much more susceptible to insect attack than the desi type.

Questions

- Boreholes on pods, absence of seeds in pods and defoliation are caused by
 - Spiny pod borer
 - Spotted pod borer
 - Field bean pod borer
 - Gram pod borer**
- is a tiny larva that bores into unopened buds, flowers and tender parts of redgram. **Plume moth**
- Infested pods and flowers of redgram webbed together is the symptom of
 - Gram pod borer
 - Spotted pod borer**
 - Field bean pod borer
 - Blue butterfly
- Which entomopathogenic agent is used to control aphids in cowpea field
Fusarium pallidoroseum
- causes damage by boring into the soft seeds and feed on grains
Pod fly
- Drooping of tender leaves and yellowing is caused by
 - Pod fly
 - Stem fly**
 - Blue butterfly
 - Grass blue butterfly
- Which coleopteran pest feeds voraciously on flowers and pods of pulses while the grubs are predators- **Blister beetle**
- is the scientific name of pulse pod wasp - ***Tanaostigmodes cajaninae***
- Red gram sterility mosaic virus is transmitted by ----- ***Aceria cajani***
- Cowpea mosaic virus is transmitted by following pest
 - Aphis craccivora***
 - Aphis gossypii*
 - Myzus persicae*
 - Bemisia tabasi*
- is scientific name of arhar pod fly - ***Melanagromiza obtuse***
- Webbing of infested pods and inflorescence in redgram is due to _____ spotted pod borer ***Maruca testulalis***

13. *Exelastis atomosa* belongs to the family
- a. Agromizidae
 - b. **Pterophoridae**
 - d. Lycaenidae
 - d. None of the above
14. Alternate host of *Lampides boeticus* _____
- a. cotton
 - b. niger
 - d. pulses
 - d. **both b and c**
15. _____ is the scientific name of spotted pod borer
- a. ***Maruca testulalis***
 - b. *Amsacta albistriga*
 - c. *Exelastis atomosa*
 - d. *Lampides boeticus*
16. _____ is the alternate host of *Maruca testulalis*
- a. sugarcane
 - b. tobacco
 - c. rice
 - d. **all the above**
17. _____ is the alternate host of *Adisura atkinsoni*
- a. niger
 - b. lablab
 - c. pigeonpea
 - d. **all the above**
18. _____ is the alternate host of *Melanagromyza obtuse*
- a. redgram
 - b. okra
 - c. safflower
 - d. **all the above**
19. Drooping of tender leaves and yellowing are the damage caused by _____
stem fly , *Ophiomyia phaseoli*
20. Hymneopteran pest on pulses
- a. *Mylabris phalerata*
 - b. ***Tanaostigmodes cajaninae***
 - c. *Adisura atkinsoni*
 - d. *Lampides boeticus*

Lecture No.7

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	<i>Oryctes rhinoceros</i>	Scarabaeidae	Coleoptera
2.	Red palm weevil	<i>Rhynchophorus ferrugineus</i>	Curculionidae	Coleoptera
3.	Black headed caterpillar	<i>Opisina arenosella</i>	Cryptophasidae	Lepidoptera
4.	Coconut Eriophyid mite	<i>Aceria guerreronis</i>	Eriophyidae	Acari
5.	White grub	<i>Leucopholis coneophora</i>	Melolonthidae	Coleoptera
6.	Slug caterpillar	<i>Parasa lepida</i> and <i>Contheyla rotunda</i>	Cochliidiidae	Lepidoptera
Minor pests				
7.	Mealy bug	<i>Pseudococcus longispinus</i>	Pseudococcidae	Hemiptera
8.	Scale insect	<i>Aspidiotus destructor</i>	Diaspididae	Hemiptera
9.	Lacewing bug	<i>Stephanitis typicus</i>	Tingidae	Hemiptera
10.	Termite	<i>Odontotermus obesus</i>	Termitidae	Isoptera
11.	Coconut skippers	<i>Gangara thyraxis</i> and <i>Saustus gremius</i>	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 earthen 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 earthen vessels in different places to attract the adults during night.
- ix. The crown region may be properly cleaned during harvests and the adults may be hooked out using a long wire.
- x. Light traps may be set up to attract the adults during monsoon months and following rains during summer.
- xi. The top-most three axils may be filled with a mixture of sand + Neem Seed Powder (2:1) once in three months (150 g/tree)

- xii. 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.

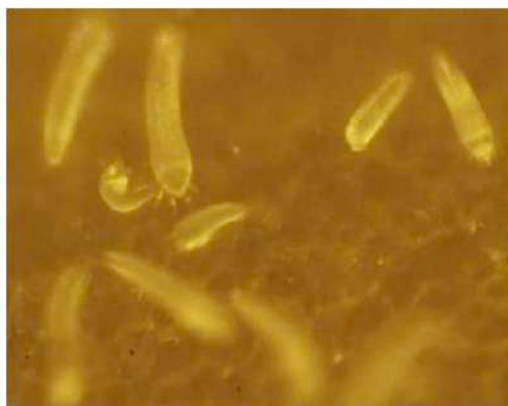
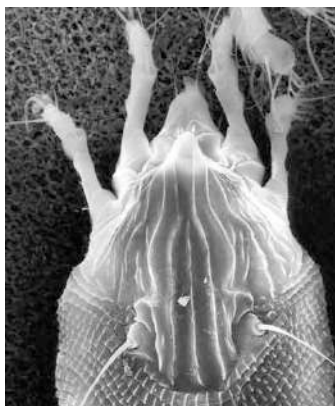
4. Coconut Eriophyid mite: *Aceria guerreronis* (Eriophyidae : Acari)

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 10-12 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 chlorpyrifos @ 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*
(Cochliidiidae: 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.

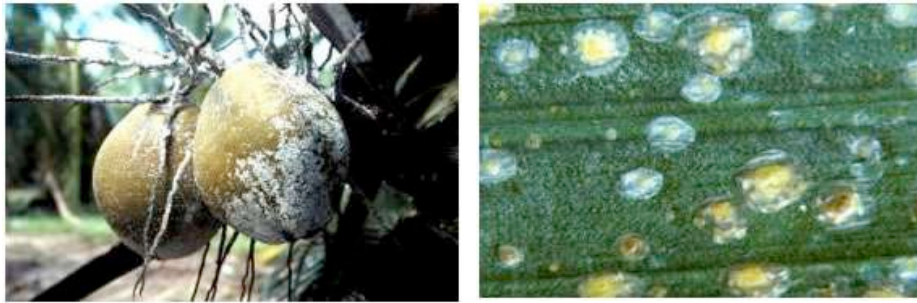
Management

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 thyrasis* and *Saustus gremius* (Hesperiidae: Lepidoptera)



ARECANUT

Major pests				
1.	Spindle bug:	<i>Carvalhoia arecae</i>	Miridae	Hemiptera
2.	Sorghum or white mite	<i>Oligonychus indicus</i>	Tetranychidae	Acari
3.	Palm or red mite	<i>Raoiella indica</i>	Tenuipalpidae	Acari
4.	Root grub	<i>Leucopholis burmeisteri</i>	Melolonthidae	Coleoptera
5.	Inflorescence Caterpillar	<i>Tirathaba mundella</i>	Pyralidae	Lepidoptera
6	Pentatomid bug	<i>Halymorpha marmorea</i>	Pentatomidae	Hemiptera
Minor pests				
7.	Scale insects	<i>Aonidiella orientalis</i>	Diaspididae	Homoptera
8.	Stem weevil	<i>Diocalandra stigmaticollis</i>	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 (cockchafer) 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

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 continuously.

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 colored 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 - ***Opisina 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 rhinoceros 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**)

Lecture No 8

PEST OF OIL SEEDS – GROUNDNUT, SUNFLOWER AND SAFFLOWER

Oilseeds occupy a prominent place among the principal commercial crops grown in India. The important oilseeds cultivated in India are *Brassica sp*, groundnut, sunflower, safflower, castor, sesame and linseed. These crops are damaged by number of pests, of which mustard aphid, mustard sawfly and the painted bug are the most serious. The aphid is the most serious pest on brassica oilseeds throughout India. On groundnut crop, the white grub has recently assumed serious proportions in Rajasthan, Gujarat, Maharashtra, Karnataka and Uttar Pradesh. The leaf miner and the red hairy caterpillar are the serious in central and southern India. The groundnut aphid is a menace throughout the groundnut growing areas. Its incidence during different years varies with rainfall. Intermittent rains have a depressing effect on the aphid population.

I. PEST OF GROUNDNUT

Major pests				
1.	Aphids	<i>Aphis craccivora</i>	Aphididae	Hemiptera
2.	Leaf hopper	<i>Empoasca kerri</i>	Cicadellidae	Hemiptera
3.	Thrips	<i>Scirtothrips dorsalis</i>	Thripidae	Thysanoptera
4.	Red hairy caterpillar	<i>Amsacta albistriga</i>	Arctiidae	Lepidoptera
5.	Leaf miner	<i>Aproaerema modicella</i>	Gelechiidae	Lepidoptera
6.	Tobacco caterpillar	<i>Spodoptera litura</i>	Noctuidae	Lepidoptera
7.	Gram pod borer	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
8.	Pod borer (Ear wig)	<i>Anisolabis stali</i>	Forficulidae	Dermoptera
9.	Pod bug	<i>Elasmolomus sordidus</i>	Lygaeidae	Hemiptera
Minor pests				
10.	Bud borer	<i>Anarsia ephippias</i>	Gelechiidae	Lepidoptera
11.	Stem borer	<i>Sphenoptera perotetti</i>	Buprestidae	Coleoptera
12.	Termites	<i>Odontotermes sp.</i>	Termitidae	Isoptera
13.	White grub	<i>Holotrichia consanguinea</i>	Melalonthidae	Coleoptera

Major pests

I. Sap feeders

1. Aphids - *Aphis craccivora* (Aphididae: Hemiptera)

Distribution and status: India, Africa, Argentina, Chile, U.S.A. Europe and Australia.

Host Plants: Groundnut, beans, safflower, lablab, niger, peas, pulses and some weeds.

Damage symptoms

Both nymphs and adults suck the sap from the leaflets and tender shoots mostly upto two months after germination. It results in wilting of tender shoots during hot weather. Leaves mottled with chlorotic or dark green spots and plant growth becomes stunted. Sometimes honey dew deposited on the leaves and shoots could be seen which attract the ants.



Bionomics

Reddish to dark brown coloured aphids.



Management

1. Spray the infested crop with methyl demeton 25 EC 500 ml or Imidacloprid 17.8 SL 100 -125 ml in 700 L of water per ha. As the strong point of this pest lies in its very quick multiplication the insecticidal treatment has to be repeated as soon as aphid population is found to have built again.
2. Release *Chrysoperla carnea* grubs @ 5000 / ha.

2. Leaf hopper: *Empoasca kerri* (Cicadellidae: Hemiptera)

Damage symptoms

Both adults and nymphs suck sap from young leaves, mostly from the lower surface. The first symptom of attack is a whitening of the veins. Chlorotic (yellow) patches then appear, especially at the tips of leaflets, probably caused by a reaction between the jassids salivary secretion and plant sap. Under severe



infestation, the leaf tips become necrotic in a typical V shape , giving the crop a scorched appearance known as 'hopper burn'



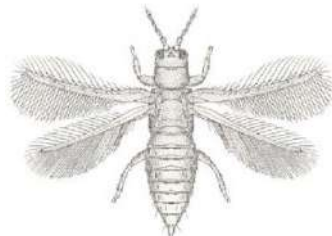
Bionomics

Elongate, active wedge shaped green insects found on the under surface of leaves.

Management

Spraying the infested crop with endosulfan 35 EC 750 ml or imidacloprid 17.8 SL 100 - 125 ml in 700- 1000 L of water per ha.

3. Thrips: *Scirtothrips dorsalis* (Thripidae: Thysanoptera)



Damage symptoms

Nymphs and adults suck sap from the surface of the leaflets. This results in white patches on the upper and necrotic patches on the lower surface of the leaves. It consists of distortions of the young leaf lets and patchy areas of necrotic tissue that puncture and split as the leaflets grow. Injury is normally seen in seedlings.



Bionomics

Nymphs and adults dark coloured with fringed wings. Female thrips lay 40-50 eggs inside the tissues of leaves and shoot. Egg period 5 days, nymphal period 7-10 days and adult period is 25-30 days. There are several overlapping generations.

Management

1. Intercrop lab lab with groundnut 1:4 ratio
2. Spray methyl demeton 25 EC 500 ml or dimethoate 30 EC 500 ml/ ha

II. Leaf feeders

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

Distribution and status

Oriental in distribution including India. It is a serious pest under rainfed conditions on pulses in Rajasthan and groundnut in southern part of India. *Amsacata albistriga* is predominant in South India while *A. moorie* dominates northern parts of the country. Seasonal outbreak largely depends on the climatic conditions and local agricultural practices of the region concerned. It takes place twice a year May-June and August-October. It's outbreak occurs only once in Rajasthan during August- October

Host range

Maize, sorghum, green gram, sesame, pearl millet, finger millet, groundnut, sunhemp, castor, cotton.

Damage symptoms

The larvae feed on the leaves gregariously by scraping the under surface of tender leaflets leaving the upper epidermal layer intact in early stages. Later they feed voraciously on the leaves and main stem of plants. They march from field to field gregariously. Severely affected field looks as though they are grazed by cattle. Sometimes it



results in the total loss of pods. They also feed on sorghum, cotton, finger millet, castor, pulses and cowpea, etc.

Bionomics

Adults are medium sized moths. In *A. albistriga* forewings are white with brownish streaks all over and yellowish streaks along the anterior margin and hind wings white with black markings. A yellow band is found on the head. In *A. moorei* all markings are red in white wings. On receipt of heavy rains, about a month after sowing in *kharif* season, white moths with black markings on the hind wings emerge out from the soil in the evening hours. It lays about 600-700 eggs on the under surface of the leaves. Egg period is 2-3 days. Tiny greenish caterpillar feeds on the leaves gregariously. A full grown larva measures 5 cm in length, reddish brown hairs all over the body arising on warts. The larval period is 40-50 days. With the receipt of showers, the grown up larva pupates in earthen cells at a depth of 10-20 cm. They pupate mostly along the field bunds and in moist shady areas under the

trees in the field and undergo pupal diapause till the next year.



ETL: 8 egg masses/100 meter

Management

1. Organize campaign to collect and destroy the pupae after summer ploughing on receipt of showers.
2. Grow cowpea or red gram as an intercrop to attract adult moths to lay more eggs.
3. Set up 3-4 light traps and bonfires immediately at the onset of rains at 4 weeks after sowing in the rainfed season to attract and kill the moths and to know brood emergence.
4. Collect and destroy egg masses in the groundnut, cowpea and redgram.
5. Collect and destroy gregarious early instar larvae on lace like leaves of inter crops viz., red gram and cowpea.
6. Organize campaign by involving school children (or) general public to collect and destroy the migrating grown up caterpillars from the field.
7. Dig out a trench around the field to avoid the migration of caterpillars, trap larvae and kill them.
8. Use nuclear polyhedrosis virus @ 250 LE/ha.
9. For young caterpillars - apply endosulfan 4D 25 kg/ha (or) carbaryl 10 D 25 kg/ha.
10. Organize mass ground spraying in endemic areas if necessary in the case of outbreak of the pest.
11. For grown up caterpillars - spray endosulfan 750 ml/ha (or) dichlorvos 625 ml/ha (or) chlorpyrifos 1250 ml/ha in 375 litres of water.

5. Leaf miner: *Approaeroma modicella* (Gelechiidae: Lepidoptera)

Distribution and status

India, Pakistan, Sri Lanka, Burma and South Africa.

Host range

Groundnut, soybean and redgram.

Damage symptoms

It prefers rainfed crop and bunch varieties. Young newly hatched green caterpillar mines into the leaflets and feed on green tissues resulting in brownish dried up patches. Later instars caterpillars fold the leaves together and feed on the green tissues by remaining inside. Severely infested crop presents a burnt up appearance. Caterpillars (or) pupae can be seen inside the mines and folded leaflets. It also attacks red gram and soybean.



Bionomics

Adult is dark brown with a white spot on the coastal margin of each forewing. The small hind wings are covered by fringe of minute hair. Adults are found briskly whirling around the plants in field and lay shiny transparent eggs singly on the under surface of leaflets. A female moth lays 150-200 eggs that hatch in 2-3 days. The larvae are pale brown. Fully grown larva measures 6-8 mm. The larval period is 4-17 days. They pupate in white silken cocoons within webbed leaflets and the pupae are reddish brown. The pupal period is 5-7 days. Adult longevity is 5-6 days. Life cycle is completed in 20-25 days. They cause severe damage from September to November to the rainfed crop and during March & April to irrigated crop.



ETL: 1 larva per meter row or five or more active larvae per plant are found up to 30 days after seedling emergence (DAE), 10 larvae per plant at 50 DAE and 15 larvae per plant at 75 DAE or later.

Management

1. Grow resistant cultivars like ICGV 86031, ICGS 156 (M 13), FDRS 10, ICG 57, 156, 541, 7016, 7404, 9883
2. Sow groundnut early and synchronously in rainy and rabi season.
3. Intercrop groundnut with pearl millet @ 4:1 ratio.
4. Set up light traps between 8 and 11 PM at ground level.
5. Mulch the soil with straw within 10 days after germination wherever possible.
6. Avoid water stress in irrigated crop to avoid the pest infestation.
7. Maintain the fields and bunds free from weeds.
8. Apply either endosulfan 4D or carbaryl 10 D at 25 kg/ha when the pest crosses ETL.
9. Spray any one of the following insecticides - endosulfan 35 EC 750 ml/ha, dichlorovos 76 SC 625 ml/ha, quinolphos 25 EC 750 ml/ha, lambda cyhalothrin 5 EC 200-300 ml in 375 L of water,

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

Distribution and status

India, Sri Lanka, Indonesia, Bangladesh, Pacific Islands, China, Pakistan, Korea and Japan.

Host range

Groundnut, citrus, soybean, cotton, tobacco, castor, pulses, millets, safflower, banana, cabbage, tomato, sweet potato, bhendi, chillies, etc.

Damage symptoms

Neonate, green caterpillars feed on the leaves voraciously and present an appearance to the field as if grazed by cattle. Since this pest is nocturnal in habit larvae hide under the plants, cracks and crevices of soil and debris during the day time. Faecal pellets are seen on the leaves and on the ground which is the indicator of the pest incidence.



Bionomics

Adult moth is stout with wavy white markings on the brown forewings and white hind wings with a brown patch along its margin. Eggs are laid in groups and covered with hairs on the leaves. The egg period is 4-5 days. Larva is stout, cylindrical, pale brownish with dark markings. The body may have row of dark spots or transverse and longitudinal grey and yellow bands. When fully grown, measures about 35-40 mm in length. The larval period is 14-21 days. It pupates in earthen cells in soil for 15 days. Life cycle is completed 30-40 days.



ETL: 1-2 egg masses per meter crop row of 7-12 plants or pheromone trap catches exceed 100 moths per night, averaged over a week.

Management

1. Grow castor as a border (or) intercrop in groundnut fields to serve as indicator (or) trap crop.
2. Grow resistant cultivars like ICGV 86031, FDRS 10
3. Monitor the emergence of adult moths by setting up of light traps.
4. Set up pheromone trap (Pherodin SL) to monitor, attract and kill the male moths @

- 12 nos./ha and change the septa once in 3 weeks.
5. Collect egg masses and destroy.
 6. Collect the gregarious larvae and destroy them as soon as the early symptoms of lace-like leaves appear on castor, cowpea and groundnut.
 7. Avoid migration of larvae by digging a trench 30 cm deep and 25 cm wide with perpendicular sides around the infested fields.
 8. Prepare a bait with following for 1 ha. Rice bran 12.5 kg, molasses or brown sugar 2.5 kg, carbaryl 50 WP 1.25 kg (mix the ingredients to obtain a homogenous mixture sprinkle water gradually and bring the bait to a dough consistency. Distribute the above bait on the soil, in and around the field in the evening hours immediately after preparation).
 9. Apply NPV @ 250 LE/ha with crude sugar 2.5 kg/ha which is as effective as that of chlorpyrifos at 200 g a.i./ha at 7 days interval.
 10. Apply any one of the following insecticides per ha to control early instar larvae (1st to 3rd instar). Carbaryl 10 D 25 kg, carbaryl 50 WP 2 kg, quinalphos 25 EC 750 ml, phenthoate 50 EC 1250 ml and dichlorvos 76 SC 750 ml.
 11. Spray any one of the following per ha to control 4th to 6th instar larvae. Chlorpyrifos 2 L, dichlorvos 1 L, phenthoate 2 L or Diflubenzuron 25 WP 400 g or Methomyl 40 SP 750-850 g in 375-500 L of water/ha.

7. Gram pod borer: *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Distribution and status: World wide

Host range

Cotton, sorghum, lablab, soybean, pea, safflower, chillies, groundnut, tobacco, okra, maize, tomato.

Damage symptoms

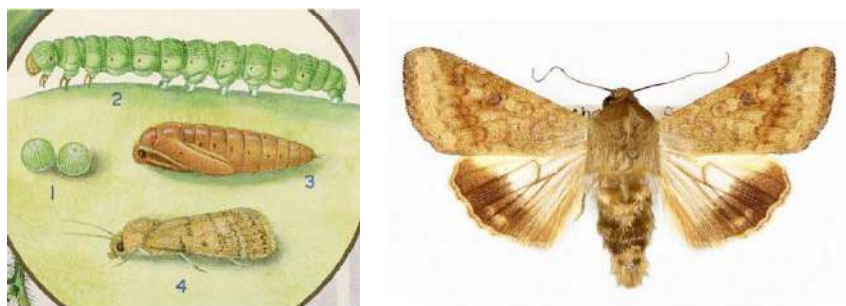


Small or large irregular feeding holes on the leaves. Presence of pale green or rose or brown or chocolate colored caterpillars with dorsal and lateral stripes and hairs on the body. Caterpillars also damage the fruiting bodies by entering into them.

Bionomics

Adult is brown coloured moth with 'V' shaped speck on forewings and dull black border on the hind wing. Eggs are laid singly on host plant. The egg period is 5-7 days. Larva is greenish with dark brown to grey lines. Color varies with kind of host plant. The larval period

is 14-20 days. It pupates in soil and pupal stage lasts for 10 days. Cannibalism is common among larvae.



Management

1. Set up light trap to attract and kill the moths.
2. Set up pheromone traps @ 12 nos./ha to attract male moths.
3. Release of egg parasite *Trichogramma* spp. and egg larval parasite *Chelonus blackburnii*.
4. Apply Nuclear Polyhedrosis Virus (NPV) @ 250 LE/ha.
5. Combined use of NPV of *S. litura* and *H. armigera* on groundnut indicated that single application of NPV of each pest at 250 LE/ha with crude sugar 2.5 kg/ha is highly effective.
6. Spray endosulfan 35 EC 1000 ml or emamectin benzoate 5 SG 220 g or spinosad 45 SC 180-220 ml per ha in 375-500 L of water per ha

III. Pod feeders

8. Pod borer (Ear wig): *Anisolabis stali* (Forficulidae: Dermaptera)

Damage symptoms

Young pods showing bore holes plugged with excreta, sand particles or discoloured pulp. Bored pods are devoid of kernels.

Bionomics



Adult is dark brown to black with forceps like caudal cerci and white leg joints. It lays eggs in clusters of 20-100 in soil and sometimes inside damaged pods and hatch in about a week. The five nymphal instars resemble the adults which can live as long as 250 days. Their unique forked abdominal tip can easily be recognized as letter 'Y'.

Management

1. Apply malathion 5D or endosulfan 4D or carbaryl 10 D at 25 kg/ha prior to sowing in areas where the ear wig is endemic.
2. Repeat the soil application of any one of the above dust formulation on 40th day of sowing and incorporate in the soil during earthing up.

9. Pod bug: *Elasmolomus sordidus* (Lygaeidae: Hemiptera)

Damage symptoms

It is a serious pest at pod maturity stage, pod harvesting stage and harvested produce in the threshing floor. Both nymphs and adults suck the sap from the pod in the field and produce at threshing floor. Freshly harvested pods have shrivelled kernels.

Bionomics

The adult is dark brown, approximately 10 mm long and 2 mm wide. In the field, the females lay their eggs singly in the soil or on groundnut haulms. But in storage eggs are laid loosely among the groundnuts. A female bug may lay upto 105 eggs. The egg period is 4-5 days. The first instar nymphs have a bright red abdomen, later instar become progressively darker. Both nymphs and adults feed on kernels by piercing the pods with their rostrum. The nymphal period is 23-29 days. Since it is nocturnal in habit, it hides under weeds, cracks and crevices in soil and debris during day time.

Management

1. Set up light traps to attract and kill the bugs.
2. Keep the crop refuse in the field along irrigation channel to attract the bugs which can be killed by dusting.
3. Dust the groundnut stored in the gunny bags with malathion 4D.

IV. Borers

10. Bud borer: *Anarsia ephippias* (Gelechiidae: Lepidoptera)

Damage symptoms

The larva bores into the terminal buds and shoots. The tender leaflets emerging from central spindle shows shot-hole symptoms initially. In severe infestation emerging leaflets have only the midribs or several oblong feeding holes. The larva also bores into the apex of the stem. The infestation causes 20-35% shoot damages and yield reduction to the tune of 5%.



Bionomics

The adult moth is buff coloured, active and hovers around plant canopy during sun rise. The larva is chocolate brown to dark brown and 10-15 mm long.



Management

1. Conserve the hymenopteran parasitoids *Bracon sp.*, and *Brachymeria sp.* in the groundnut ecosystem to control the pest.
2. Spray neem oil 3% or Notchi (*Vitex negundo*) leaf extract 5%
3. Spray endosulfan 35 EC 1000 ml or indoxacarb 500 ml or spinosad 45 SC 160-220 ml per ha in 375-500 L of water per ha

11. Stem borer: *Sphenoptera perotetti* (Buprestidae: Coleoptera)

Host range

Groundnut, sesame, gram and other pulses

Damage symptoms

Grubs bore into the stem just below the soil surface and tunnel main roots resulting in wilting of plants in patches. Tunnel contains elongate flat headed grubs.

Bionomics

The dark brown shining beetle lays eggs on the stem of plants that hatch into pale white grub with flat anterior portion. It pupates in the stem itself.

Management

1. Apply malathion 5D (or) endosulfan 4D (or) carbaryl 10D at 25 kg/ha to the hole or furrow prior to the sowing.
2. Repeat the same on 40 DAS during earthing up and gypsum application.

V. Root feeders

12. Termites: *Odontotermes sp.* (Termitidae: Isoptera)

Damage symptoms

It feeds on roots result in wilting of plants in patches. It makes bore holes in pods and damages soft tissue in pod (scarification) leaving thicker portion intact. Termites hover in and around plants.

Bionomics

Cream coloured tiny insects resembling ants with dark coloured head.

13. White grub : *Holotrichia consanguinea* (Melalonthidae: Coleoptera)

Damage symptoms

Growth of plant is retarded. Plants wilt or die. Roots partially or fully eaten off by white and fleshy grubs.



Bionomics



The dark brown adult beetles reenter the soil to hide and lay eggs. Female lays 20 - 80 white, roundish eggs in clusters. Egg period 9 - 11 days. Grubs are white and translucent. Pupates in soil and remain as pupae until the following year. The adult beetles emerge with the first monsoon showers.

Management

1. Plough deep at the time of land preparation to expose grub and kill.
2. Adopt crop rotation with rice in irrigated endemic areas to bring down grub damage.
3. Ensure adequate irrigation to irrigated groundnut in endemic areas since the grub attacks roots under inadequate soil moisture condition.
4. Set up light traps or bonfires to attract and kill the adults on receipt of summer showers.
5. Apply malathion or endosulfan or carbaryl dust @ 25 kg per ha in the soil prior to sowing during last ploughing.
6. Repeat the same on 40 DAS and incorporate in the soil during earthing up.

Pest of Sunflower

Major pests				
1	Leaf hopper	<i>Amrasca biguttula biguttula</i>	Cicadellidae	Hemiptera
2	Capitulum borer	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
3	Tobacco caterpillar	<i>Spodoptera litura</i>	Noctuidae	Lepidoptera
4	Bihar hairy caterpillar	<i>Spilosoma obliqua</i>	Arctiidae	Lepidoptera
5	Semi looper	<i>Trichoplusia ni</i>	Noctuidae	Lepidoptera
6	Cutworms	Agrotis spp.	Noctuidae	Lepidoptera
Minor Pests				
7	Stink bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera
8	Plant bug	<i>Dolycoris indicus</i>	Pentatomidae	Hemiptera
9	Black hairy caterpillar	<i>Estigmene lactinea</i>	Arctiidae	Lepidoptera
10	Ash weevil	<i>Myloccerus</i> sp	Curculionidae	Coleoptera

1. Leaf hopper - *Amrasca biguttula biguttula* (Cicadellidae: Hemiptera)

Damage symptoms

Both nymphs and adults suck the sap from the under surface of leaves. Leaves become crinkled and cup shaped, growth gets stunted, brownish red colour develops on the edges of leaves and the condition is known as "hopper burn". They also attack brinjal, bhendi, cotton and potato.



Bionomics

Adult is a small, slender green insect. Eggs are laid singly in the leaf veins. Egg period is 4-11 days. Nymphs green, wedge shaped. Nymphal period is 7 days. Breeding is noted throughout the year.



Management

- i. Early sowing and close spacing of cotton reduces pest infestation particularly if the rainfall is heavy
- ii. Setup light trap to monitor the broods of leaf hopper and to attract and kill
- iii. Spray monocrotophos 36 WSC @ 1000 ml/ha and NSKE 5% @ 25 kg/ha or 750 ml endosulfan 35 EC in 1000 L of water per hectare.
- iv. Release predators viz., *Chrysopa carnea*

2. Capitulum borer – *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Damage symptoms

Larva feeds on leaves and capitulum.

Bionomics

Adult moth is greenish to brown with a 'V' shaped speck on forewings and dull black border on the hind wings. Eggs are laid on the host plants singly. The egg period is 7 days. Fully grown larva is 2" long, greenish with dark brown grey lines and dark and pale bands. It shows colour variation from greenish to brown. The larval duration is 14 days. It pupates in soil for 10 days.

Management

1. Install bird perches @ 50/ha
2. Set up light trap to monitor, attract and kill the moths.
3. Set up pheromone traps @ 12 Nos./ha.
4. Inundative release of egg parasitoid *Trichogramma* spp. and egg larval parasitoid *Chelonus Blackburnii*.
5. Spray nuclear polyhedrosis virus (NPV) @ 500 LE/ha in 0.1 % teepol.
6. Spray NSKE 5% twice followed by triazophos 0.05%.
7. Apply any one of the insecticides at 25 kg/ha. Endosulfan 4D, quinolphos 4D, carbaryl 5D.
8. Spray endosulfan 35 EC 1.25 l or monocrotophos 1.0 L or chlorpyrifos 1.25 L/ha.

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

Damage symptoms, bionomics, and management are the same as given under groundnut

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

Distribution and status: Sporadic pest widely distributed in the Orient. It is very serious in Bihar, Madhya Pradesh, Uttar Pradesh and Punjab

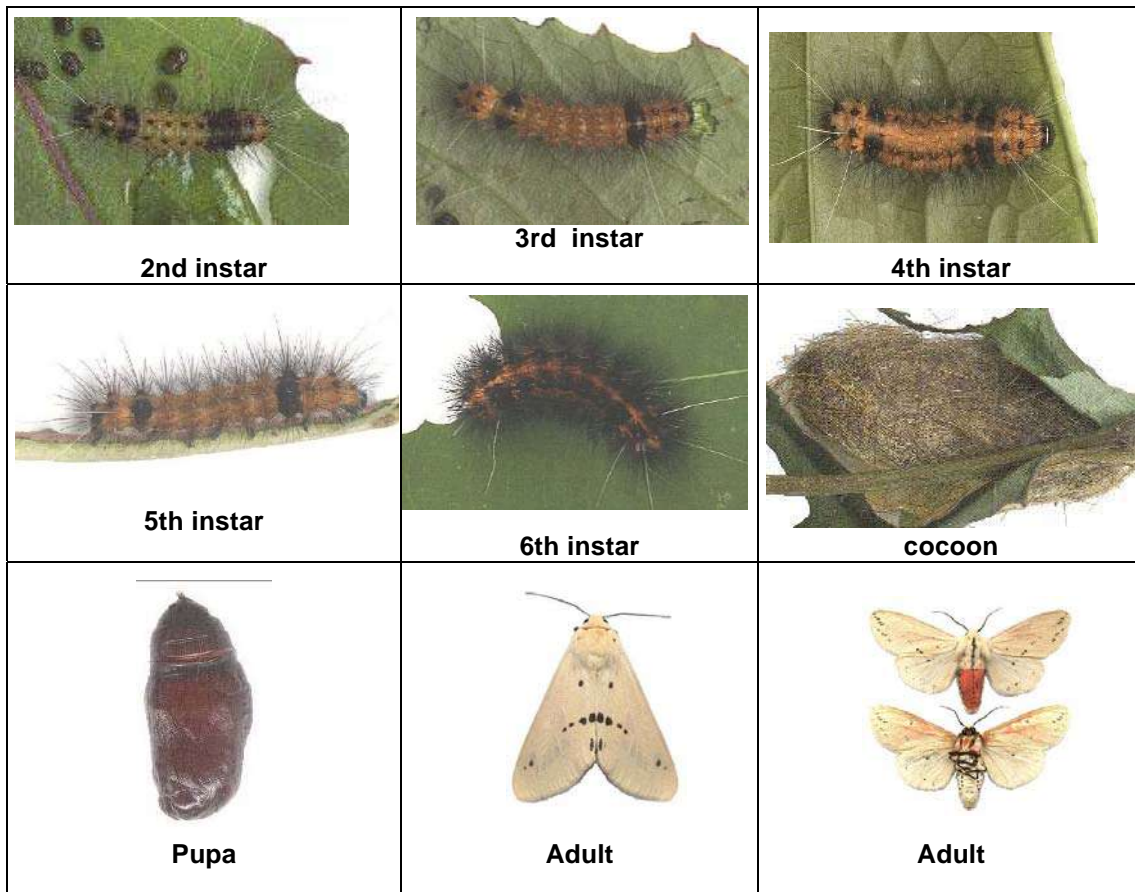
Host range: sesamum, mash (*Phaseolus mungo*), mung (*P. aureus*), linseed, mustard, sunflower and some vegetables.

Damage symptoms: Defoliation



Bionomics

Adults have crimson coloured body with black dots. Wings pinkish with numerous black spots. Larva is orange coloured with broad transverse bands with tuft of yellow hair that are dark at both end.



Pest breeds from March to April and again from July to November. Adult female lays 400-1000 light green, spherical eggs in clusters on the underside of the leaves. Egg period 8-13 days. Larval instars 7 and period 30-56 days. Pupation takes place in plant debris or soil and pupal period 7-15 days. Adult lives for 7 days. Early instars are gregarious and later instars disperse in search of food.

Management

1. Dust young caterpillars with malathion 5 D @ 25 kg/ha
2. When full grown chemical control becomes difficult as in the case of red hairy caterpillar of groundnut.
3. For chemical control measures refer red hairy caterpillar

5. Semi looper - *Trichoplusia ni* (Noctuidae: Lepidoptera)

Damage symptoms

Leaves are with holes and severe damage results in skeletonization and defoliation.

Bionomics

Adult is a stout moth, head and thorax grey in color with basal tufts ferruginous, grey wavy forewings with a slender mark. Larva is slender, attenuated anteriorly and green in colour with light wavy lines and broad lateral strip on either side.

Egg



Larva



Pupal stages



Adult



Management

1. Hand-pick and destroy caterpillars
2. Use light trap to attract and kill adults
3. Spray quinolphos or endosulfan 1.0 L 2 500L of water/ha

6. Cutworms: *Agrotis* spp. (Noctuidae: Lepidoptera)

The cutworms may be serious during March - April in fields where sunflower follows potato. Caterpillars cut the seedlings at the ground level.

Management

1. Sow the crop in ridges to avoid cutworm damage in the germinating seedlings.
2. Where flat sowing is practiced, apply 5 L of chlorpyrifos 20EC per ha before sowing.

The insecticide should be mixed in 25 kg fine soil and broadcasted uniformly in the field after last ploughing but before planking.

Minor pests

7. Stink bug - *Nezara viridula* (Pentatomidae: Hemiptera)

Damage symptoms

Both nymphs and adults suck the sap from the developing seeds in the head. Seeds get shriveled.

Bionomics

Adult is a green coloured bug. Nymph is brownish red with multicolour spots.



8. Plant bug - *Dolycoris indicus* (Pentatomidae: Hemiptera)

Damage symptoms

Both nymphs and adults suck the seeds causing shrivelling of seeds.

Bionomics

Brown coloured bug with a white patch on the scutellum.

Management of sucking pest

Spray methyl demeton 25 EC 500 ml (or) dimethoate 30 EC 500 ml/ha.

9. Black hairy caterpillar – *Estigmene lactinea* (Arctiidae: Lepidoptera)

Damage symptoms

Larva feeds on leaves voraciously and cause severe defoliation.

Bionomics

Adult is large white moth with crimson markings on head, body and wings. Larva is thick with black head and hairs.

Management

Apply any one of the insecticides at 25 kg/ha at 50% flowering. Carbaryl 10D, malathion 5D (or) spray carbaryl 50 WP 750 g (or) endosulfan 35 EC 750 ml/ha.

10. Ash weevil: *Mylocerus* sp., (Curculionidae: Coleoptera)

Damage symptoms: Adult weevil causes marginal notching on leaves while the grub feeds on roots causing wilting of plants.

Bionomics

It is grey colour weevil measuring 3-6 mm long. It lays 360 light yellow coloured eggs

in soil at a depth of about 8 cm. The egg period is 3-5 days. The grub is apodous, cylindrical measuring 8 mm in length. The young grub feeds on roots and completes their development in 1-2 months. It pupates inside the earthen cells. The pupal period is 7 days. The life cycle of pest is completed in 6-8 weeks.

Pest of Safflower

Major pest				
1	Safflower caterpillar	<i>Perigea capensis</i>	Noctuidae	Lepidoptera
2	Safflower bud Fly	<i>Acanthiophilus helianthi</i>	Tephritidae	Diptera
3	Safflower aphid	<i>Uroleucon compositae</i>	Aphididae	Hemiptera
Minor Pests				
4	Leaf hopper	<i>Empoasca punjablensis</i>	Cicadellidae	Hemiptera
5	Green peach aphid	<i>Myzus persicae</i>	Aphididae	Hemiptera
6	Lace wing	<i>Monanthia glubulifera</i>	Tingidae	Hemiptera
7	Stink bug	<i>Dolycoris indicus</i>	Pentatomidae	Hemiptera
8	Safflower caterpillar	<i>Spodoptera exigua</i> <i>Helicoverpa armigera</i> and <i>Eublemma rivula</i>	Noctuidae	Lepidoptera
9	Leafminer	<i>Chromatomyia horticola</i>	Agromyzidae	Diptera
10	Surface weevil	<i>Tanymecus indicus</i>	Curculionidae	Coleoptera

1. Safflower Caterpillar: *Perigea capensis* (Noctuidae: Lepidoptera)

Distribution and status

Serious pest of safflower throughout India

Bionomics

The adult is a dark-brown medium-sized moth with white wavy markings on the forewings. The full grown caterpillar is about 25 mm long, smooth, greenish with purple markings and humped on the anal segment. A female lays about 60 eggs singly or in small clusters on leaves and stems. The eggs hatch in 4-5 days. The larva grows feeding on the leaves and becomes full-grown in 2-3 weeks. It pupates in the soil for 10-15 days.

Damage symptoms

The larvae feed on the leaves and defoliate the plants which lose their vigour and become stunted.

Management

Spray the crop with 2.5 kg of carbaryl 50 WP or 1.25 L of endosulfan 35 EC in 750 L of water/ha.

2. Safflower Bud Fly: *Acanthiophilus helianthi* (Tephritidae: Diptera)

Distribution and status: This pest has been reported from Delhi, Uttar Pradesh, Haryana and Madhya Pradesh in India.

Bionomics

The maggots that feed on flower buds are destructive and when full-grown they are 5 mm long. The adult fly is ash coloured with light brown legs. The adults are active from March to May. The females lay eggs in clusters of 6-24 within the flower buds or the flowers. The eggs hatch in about one day in April and young maggots start feeding on the florets and the thalamus. Within one week they grow to the full and attain a size of 5 x 1.5 mm. They pupate inside the buds. The pupal stage lasts 7 days. The adults emerge out of the bud through the holes made by the maggots before they pupate. Three generations are completed during a crop season.



Damage symptoms



The injury is caused by the maggots which feed upon the floral parts including the thalamus. The infested buds begin to rot and an offensive smelling fluid oozes at the apices giving a soaked appearance to the buds. The pest causes reduction in the yield of safflower seed.

Management

- Remove and destroy the infested buds early
- Conserve larval parasitoids viz., *Ormyrus sp.* (Ormyridae), *Eurytoma sp.* (Eurytomidae) and *Pachyneuron muscarum* (Braconidae) and predator *Chrysopa virgestes* (Chrysopidae)

3. Safflower Aphid: *Uroleucon compositae* (Aphididae: Hemiptera)

Distribution and status

This pest causes considerable damage to safflower in Karnataka, Uttar Pradesh, Madhya Pradesh, Punjab and Haryana.

Bionomics

The aphids are small shining black, soft bodied insects. The nymphs are smaller in size and are reddish brown in colour. The aphid is active from December to April. A female produces 6-56 young ones with an average of 21. It completes its life cycle in 11-16 days. The adult aphid has a life span of 17 days.

Damage symptoms

The aphids suck the sap from leaves, twigs, flowers and capsules. In infested plants, the height, number of leaves and shoots reduce significantly. The plants become weak, remain stunted and sometimes dry up. Seed production is seriously affected. The aphids secrete honeydew which attracts a black sooty mould.

Management

1. Spray 250 ml of dimethoate 30 EC or monocrotophos 36 SL or 625 ml of chlorpyrifos 20 EC in 750 litres of water/ha and repeat the spray after 15 days, if necessary.
2. Conserve parasitoid *Aphidencirtus aphidivorus* and predator *Brumoides suturalis*

Minor Pests of Safflower

- **Leaf hopper:** *Empoasca punjablensis* (Cicadellidae: Hemiptera);
- **Green peach aphid:** *Myzus persicae* (Aphididae: Hemiptera);
- **Lace wing:** *Monanthia glubulifera* (Tingidae: Hemiptera);
- *Dolycoris indicus* (Pentatomidae: Hemiptera);
- **Safflower caterpillar:** *Spodoptera exigua*, *Helicoverpa armigera* and *Eublemma rivula* (Noctuidae: Lepidoptera);
- **Leafminer:** *Chromatomyia horticola* (Agromyzidae: Diptera)
- **Surface weevil:** *Tanymecus indicus* (Curculionidae: Coleoptera)

Question

1. Severely affected groundnut field looking as if grazed by cattle is the typical symptom of ----- **Red hairy caterpillar**
2. Which life stage of red hairy caterpillar undergo diapause ? **Pupa**
3. Groundnut shows burnt appearance when severely infested with ----- **Leaf miner**
4. Intercrop cumbu in groundnut at the ratio of

- a. 1 :4
- c. 2:4

- b. **4:1**
- d. 1:6

5. Fecal pellets seen on groundnut leaves and on the ground is an indicator of _____ pest incidence.

- a. Surul poochi
- c. **Tobacco caterpillar**
- b. Red hairy caterpillar
- d. None of the above

6. _____ is an alternate host of red hairy caterpillar

- a. cotton
- c. cowpea
- b. castor
- d. **all the above**

7. Growing castor as a border (or) intercrop in groundnut fields is to attract -----

Tobacco caterpillar

8. Cannibalism is common in ----- larvae. ***Helicoverpa armigera***

9. Digging out a trench around the field is to prevent _____ attack **Red hairy caterpillar**

10. Scientific name of Black hairy caterpillar is

- a. ***Estigmene lactinae***
- c. *Myllocerous maculatus*
- b. *Spilosoma obliqua*
- d. *Trichoplusia nii*

11. Pod bug sucks the sap from groundnut pod in field as well as storage -Say **True** or false

12. Groundnut leaves with holes resulting in skeletonization and defoliation is due to

- a. **Semilooper**
- c. Tobacco caterpillar
- b. ash weevil
- d. Bihar hairy caterpillar

13. *Sphenoptera perotetti* belongs to _____ family

- a. Gelechiidae
- c. **Buprestidae**
- b. Arctiidae
- d. Noctuidae

14. *Anisolabis stali* belongs to ----- family

- a. **Forficulidae**
- c. Buprestidae
- b. Arctiidae
- d. Noctuidae

15. _____ is an alternate host of groundnut leaf miner
- cotton
 - castor
 - Soybean**
 - all the above
16. _____ is scientific name of groundnut pod bug -***Elasmolomus sordidus***
17. Affected safflower buds with small bore holes; rotten with a foul smelling ooze coming out of the apices, giving the buds a soaked appearance is symptom of _____ **Bud fly (*Acanthiophilous helianth*)**
18. _____ is a pheromone trap is used to monitor, attract and kill male moth of *Helicoverpa armigera* - **Helilure HL**
19. Number of pheromone trap installed in sunflower field to monitor and attract the *Helicoverpa armigera* and *Spodoptera litura* is _____ /ha
- 10Nos
 - 5 Nos
 - 8 Nos
 - 12 Nos**
20. Young groundnut pods showing bore holes with discoloured pulps is the symptom of _____ in groundnut. (**Earwig pod borer**)
21. Characteristic “hopper burn” in sunflower is due to _____ attack. (Leaf hopper)
22. *Spilosoma obliqua* belongs to _____ family
- Noctuidae
 - Arctiidae**
 - Arctiidae
 - Pentatomidae
23. _____ is the scientific name of sunflower capitulum borer
- Dolycoris indicus*
 - Spodoptera litura*
 - Helicoverpa armigera***
 - Spilosoma obliqua*
24. Sunflower leaves with holes leading to skeletonization and defoliation is due to _____ **Semilooper, *Trichoplusia ni***
25. _____ is a serious pest of safflower throughout India (**safflower caterpillar, *Perigea capensis***)

Lecture No 9

PESTS OF GINGELLY, CASTOR, MUSTARD AND LINSEED

Pests of Gingelly

Though a dozen pests attack gingelly, only leaf webber, gall fly and leaf hopper as vector are important and cause economic damage in gingelly.

Major pests				
1.	Leaf webber	<i>Antigastra catalaunalis</i>	Pyralidae	Lepidoptera
2.	Sphinx moth	<i>Acherontia styx</i>	Sphingidae	Lepidoptera
3.	Gall fly	<i>Asphondylia sesami</i>	Cecidomyiidae	Diptera
4.	Leaf hopper	<i>Orosius albicinctus</i>	Cicadallidae	Hemiptera
5.	Pod bug	<i>Elasmolomus sordidus</i>	Lygaeidae	Hemiptera
Minor pests				
6.	Aphid	<i>Aphis gossypii</i>	Aphididae	Hemiptera

I. Leaf feeders

1. Leaf webber: *Antigastra catalaunalis* (Pyralidae: Lepidoptera)

Distribution and status: India, Africa, South Europe, Malta, Burma, Bangladesh, Indonesia, Sri Lanka and U.S.S.R.

Host range: Sesame, *Antirrhinum* and *Duranta*.

Damage symptoms

Larva webs the top leaves together and bore the tender shoots in the vegetative phase. Flowers and young capsules are bored at reproductive stage.



Bionomics



Moth is brown with yellowish brown wings. It lays eggs on tender parts of plants. The egg period is 4-5 days. Fully grown pale green larva with black head and dots all over the body measures 20 mm in length. The larval period is 11-16 days. It pupates in leaf folds in a white silken cocoon for 4-7 days.

ETL: 2 webbed leaves/sq.m. (or) 10% damage.

Management

1. Culture of sesame like EH7, 57, 84, 105, 106 and 156 should be encouraged as these are observed to be completely resistant against *A. catalaunalis*.
2. Dusting the crop with 2% parathion.
3. Spraying with dimethoate 30 EC 500 ml or methyl parathion 50 EC 500 ml or endosulfan 35 EC 1.25 L or carbaryl 50% WP 1 kg in 700 L water per hectare.

2. Sphinx moth: *Acherontia styx* (Sphingidae: Lepidoptera)

Distribution and status: India, Sri Lanka, Burma, Indonesia, Philippines, Malaysia.

Host range: Sesame, Potato, Brinjal and Jasmine

Damage symptoms

The damage is caused by the larvae which feed voraciously on leaves and defoliate the plants. The moth is also harmful as it sucks honey from the honey combs in apiaries.



Bionomics



The adult moth is giant hawk moth, brownish with a characteristic skull marking on the thorax and violet yellow bands on the abdomen. Hind wings yellow with black markings. It lays globular eggs singly on the under surface of leaves. The egg period is 2-5 days. The larva is stout, green with yellowish oblique stripes and curved anal horn. The larval period lasts for 60 days. It pupates in earthen cocoon in soil. The pupal period lasts 14-21 days and 7 months in summer and winter respectively. This insect completes three generations per year.

Management

1. Hand-pick the larvae in the initial stages of attack and destroy by keeping in kerosene oil.
2. Plough the field during winter to expose the hibernating larvae.

II. Borers

3. Gall fly: *Asphondylia sesami* (Cecidomyiidae: Diptera)

Distribution and status: East Africa, India

Host range: Sesame

Damage symptoms

Maggots feed on the ovary and results in the malformation of pods without proper setting of seeds. Flowers and young capsules with gall like swelling is the typical symptom of attack.



Bionomics

Adult is a small mosquito like fly. It lays eggs in the flowers or buds. The egg period is 2-4 days. The maggot is white, found inside the flowers. The larval period is about 2-3 weeks. It pupates inside the malformed capsules. The fly emerges from galls in 7-12 days. The total life cycle is completed in 23-27 days.

Management

1. Dust any one of the insecticides per ha on 25, 35 and 50th day of sowing. Endosulfan 4D 25 kg, phosalone 4D 25 kg, malathion 5D 25 kg.
2. Spray any one of the insecticides on 25, 35 and 50th days of sowing endosulfan 1.0 L, phosalone 1.0 L, quinalphos 1.0 L, dichlorvos 500 ml/ha in 700 L water per hectare
3. Alternate insecticides each time

III. Sap feeders

4. Leaf hopper: *Orosius albicinctus* (Cicadallidae: Hemiptera)

Damage symptoms

Both nymphs and adults suck the sap from leaves and transmit phyllody disease.

Bionomics: Light brown coloured hoppers.

Management

1. Remove sesame phyllody diseased plants from the field.
2. Spray dimethoate 30 EC 500 ml (or) methyl demeton 25 EC 500 ml/ha.

5. Pod bug: *Elasmolomus sordidus* (Lygaeidae: Hemiptera)

Damage symptoms

Both nymphs and adults suck the sap from the young capsules and seeds in field and threshing floor. It results in appearance of black spots on the capsules. The damaged pods shrivel up. It causes reduction in seed weight and oil content.

Bionomics

Adults are dark brown in colour. It lays eggs singly or in batches in the soil. The egg period is 4-5 days. Nymphs are pinkish. It is nocturnal in habit. It hides under the weeds, cracks and crevices in soil and debris during the day time. The nymphal period is 23-39 days.

Management

Control as given in groundnut

Minor pests

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

Damage symptoms

Both nymphs and adults suck the sap from the leaves resulting in curling and crinkling of leaves.

Bionomics

Yellowish to dark insects mostly wingless (apterous) on the under surface of leaves. Quite often attended by ants for the sweet honey dew secretion. Winged forms may be seen under crowded condition.

Pests of Castor

Castor is attacked by more than twenty pests of which capsule borer, hairy caterpillars, other defoliators, leaf hopper and white fly are serious.

Major pests				
1.	Capsule & Shoot borer	<i>Conogethes punctiferalis</i>	Pyraustidae	Lepidoptera
2.	Castor semi looper	<i>Achaea janata</i>	Noctuidae	Lepidoptera
3.	Slug caterpillar	<i>Parasa lepida</i>	Cochilididae	Lepidoptera
4.	Hairy caterpillar	<i>Euproctis fraterna</i>	Lymantriidae	Lepidoptera
5.	Hairy caterpillar	<i>Porthesia scintillans</i>	Lymantriidae	Lepidoptera
6.	Tussock caterpillar	<i>Notolophus posticus</i>	Lymantriidae	Lepidoptera
7.	Hairy caterpillar	<i>Dasychira mendosa</i>	Lymantriidae	Lepidoptera
8.	Castor butterfly / spiny caterpillar	<i>Ergolis merione</i>	Nymphalidae	Lepidoptera
9.	Wooly bear	<i>Pericallia ricini</i>	Arctiidae	Lepidoptera

Minor pests

10.	Leaf hopper	<i>Empoasca flavescens</i>	Cicadellidae	Hemiptera
11.	White fly	<i>Trialeurodes ricini</i>	Aleyrodidae	Hemiptera
12.	Thrips	<i>Retithrips syriacus</i>	Thripidae	Thysanoptera
13.	Castor gallfly	<i>Asphondylia ricini</i>	Cecidomyiidae	Diptera

I. Borers

1. Capsule & Shoot borer: *Conogethes punctiferalis* (Pyraustidae: Lepidoptera)

Distribution and status

India, Australia, Burma, Sri Lanka, China, Indonesia and Malaysia.

Host range

Castor, mango, sorghum ears, guava, peaches, cocoa, pear, avocado, cardamom, ginger, turmeric, mulberry, pomegranate, sunflower, cotton tamarind, hollyhock.

Damage symptoms



The damage is caused by the caterpillar, which bores into the main stem of young plant and ultimately into the capsules. The borer is distributed throughout India where castor is grown.

Bionomics

Adult is medium sized with small black dots on pale yellow wings. It lays eggs on the developing capsules. Egg period is 6 days. Larva measures 24 mm when fully grown. Larva is pale green with pinkish tinge and fine hairs with dark head and prothoracic shield. Larva lives under a cover of silk, frass and excreta. Larval period is 12-16 days. It pupates in the stem or capsule.



Management

Spraying the infested crop with endosulfan 35 EC 2.0 L (or) carbaryl 50 WP 2 kg or methyl parathion 50 EC 2.0 L @ 1000-1200 L water per hectare proved effective in controlling the pest.

II. Leaf feeders

2. Castor semi looper: *Achaea janata* (Noctuidae: Lepidoptera)

Distribution and status: India, Pakistan, Sri Lanka, Thailand, Laos, Malaysia, Philippines.

Host range: Castor, rose, pomegranate, tea, citrus, mango, *Cadiospermum helicacabum*

Damage symptoms

The damage is caused by both the caterpillar and adult moth. The caterpillars feed voraciously on castor leaves. Feeding from the edges inwards, leave behind only the mid rib and the stalk. The damage is maximum in August, September and October. The adult of this species are fruit sucking moths and cause serious damage to citrus crop.



Bionomics



Adult is a pale reddish brown moth with black hind wings having a median white spot on the outer margin. Eggs are laid on the tender leaves. Egg period is 2-5 days. Larva is a semilooper with varying shades of colour with black head and a red spot on the third abdominal segment and red tubercles in the anal region. Larval period is 11-15 days. It pupates in soil for 10-14 days. (*Parallelia algira* looks very similar to *Achaea janata* but the wings have black stripes or triangles)

Management

1. Dusting the infested crop with 2% parathion dust @ 20-25 kg/ha.

2. Spray endosulfan 35 EC 2.0 L or carbaryl 50% WP 2 kg in 1000-1200 L water/ha.
3. Conserve braconid parasitoid *Microplitis ophiusae* since it keeps the pest under check. (Cocoons are often seen on the ventral surface of the posterior side)

3. Slug caterpillar: *Parasa lepida* (Cochilididae: Lepidoptera)

Distribution and status: India, Malaysia, Sri Lanka, South East Asia.

Host range: Castor, pomegranate, citrus, coconut, palm, rose, wood apple, country almond, mango, palmyrah, cocoa, coffee, banana, rice and tea.

Damage symptoms

Larva feeds on leaves voraciously leaving only the midrib and veins resulting in severe defoliation.



Bionomics

Adult moth is green with brown band at the base of each forewing. Eggs are laid in groups and covered with hairs on the leaves. Egg period is 4-5 days. Larva is stout, slug like ventrally flat, greenish body with white lines and four rows of spiny scoli tipped red or black; larval period is 40-45 days. It pupates in plant as cocoons covered with irritating spines and hairs



Management

Spray endosulfan 2.0 L in 1000 L of water per ha

4. Hairy caterpillar: *Euproctis fraterna* (Lymantriidae: Lepidoptera)

Distribution and status: India

Host range: Castor, linseed, groundnut pigeonpea, grapevine, cotton, pomegranate, mango,

coffee, pear and rose

Damage symptoms

Defoliation is the main symptom. The pest is active throughout the year but its activity is reduced in winter.

Bionomics

The adult moth is yellowish with pale transverse lines on fore wings. It lays egg in groups on lower surface of the leaves. The egg period is 4-10 days. The caterpillar possesses red head with white hairs around and a long tuft and a reddish brown body with hairs arising on warts and a long pre- anal tuft. There are six larval instars. The larval periods last for 13-29 days. It pupates in a silken cocoon in leaf folds for 9-25 days. The larva over-winters during winter season.



Management

1. Release larval parasitoids viz., *Helicospilus merdarius*, *H. horsefieldi*, *Apanteles* sp., *Disophrys* sp.
2. Dust the infested crop with parathion 2 D @ 20-25 kg per ha or malathion 5 D 25-30 kg/ha (or) carbaryl 10 D @ 20 kg/ha.

5. Hairy caterpillar: *Porthesia scintillans* (Lymantriidae: Lepidoptera)

Distribution and status, damage symptoms and management as given for *Euproctis fraterna*

Host range: Castor, rose, cotton, redgram, mango, linseed, gogu and sunnhemp

Bionomics

Larva has yellowish brown head, a yellow dorsal stripe with a central red line on the body and tufts of black hairs dorsally on the first three abdominal segments. Adult is yellowish with spots on the edges of forewings. Life cycle is very similar to that of *Euproctis fraterna*.



6. Tussock caterpillar: *Notolophus posticus* (Lymantriidae: Lepidoptera)

Distribution and status, damage symptoms and management as given for *Euproctis fraterna*

Host range: Castor

Bionomics

Male is winged and female being apterous, sluggish cling to the cocoon after emergence. Males are attracted to the females at dusk. Females lay 350 cream coloured subspherical eggs in mass on the cocoon itself.

Egg period 7 days and larval period 16 to 19 days. Larva has brown head with a pair of long pencils of hair pointing forward from prothorax, tuft of yellowish hairs laterally on first two abdominal segment and dorsally on first four abdominal segments and long brown hairs dorsally from 8th abdominal segment. It pupates in transparent silken cocoon inside leaf roll.

7. Hairy caterpillar: *Dasychira mendosa* (Lymantriidae: Lepidoptera)

Distribution and status, damage symptoms and management as given for *Euproctis fraterna*

Bionomics



Adult is yellowish brown moth. Larva is greyish brown with dark prothoracic and preanal tufts of hairs. Prolegs are crimson coloured.

8. Castor butterfly / spiny caterpillar: *Ergolis merione* (Nymphalidae: Lepidoptera)

Damage symptoms

It is a serious though sporadic pest. Insect attacks the crop at an early stage. Insects feed on the leaf tissue and cause defoliation.

Bionomics

Brown butterfly with black wavy lines on the wings. Larva green coloured, spiny (spines branched at the tip) caterpillar with yellow stripe on the dorsal region. Pupates in a brown chrysalis. The adult lays dome shaped, shiny white eggs singly on the underside of the leaves. Single female lays 42 to 50 eggs during her life span. The eggs hatch in about a week. The duration of the pupal stage lasts 5-6 days in September to October and 8 to 9 days in December to January. The life cycle of the pest is completed in 20 to 21 days in August to September and 37 to 42 days in December to January.





Management

1. Collect and destroy promptly the affected leaves, etc., which contain larvae inside.
2. Dust the infested crop with parathion 2 D @ 20-25 kg per ha or malathion 5 D 25 - 30 kg/ha (or) carbaryl 10 D @ 20 kg/ha.

9. Woolly bear: *Pericallia ricini* (Arctiidae: Lepidoptera)

Damage symptoms

The damage is caused by caterpillar. It feeds on leaves resulting in defoliation.

Bionomics



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

Management

1. Collect and destroy the caterpillars

2. Dust the infested crop with parathion 2 D @ 20-25 kg per ha or malathion 5 D 25 - 30 kg/ha (or) carbaryl 10 D @ 20 kg/ha for young caterpillars.
3. Spray endosulfan 35 EC 2.0 L or carbaryl 50% WP 2 kg in 1000-1200 L water/ha.

10. Leaf hopper: *Empoasca flavescens* (Cicadellidae: Hemiptera)

Damage symptoms

Nymphs and adults suck the sap from the under surface of the leaves and cause "hopper burn". Leaves become crinkled and cup shaped.

Bionomics

Adult is green, wedge shaped hopper. It lays eggs within the leaf veins. A female lays 15-37 eggs during an oviposition period of 5-7 days. The egg period is 7-8 days. The nymphal period is 9 days.



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

Damage symptoms

Water soaked spots on the leaves which become yellow and dried. Colonies of whitefly are found on the under surface of leaves.

Bionomics

The adults are pale yellow with white wings covered with waxy powder. It lays eggs in clusters on the under surface of leaves. Nymphal stage undergoes four instars. The life cycle is completed in 19-21 days during July-September.



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

Damage symptoms

Nymphs and adults feed on the upper surface of the leaves. Affected leaves give a shiny appearance. It is also found on cotton and rose.

Bionomics: Pinkish nymph, black adult with fringed wings.

13. Castor gallfly: *Asphondylia ricini* (Cecidomyiidae: Diptera)

Damage symptoms

The damage is caused by maggots. As a result of feeding by them, the buds develop into galls and produce no fruits and seeds. This pest is active from September to March.

Bionomics

Adults are a mosquito like small fly. The female lays eggs singly in the buds. Incubation period is 2-4 days. The young maggot feeds on the floral parts and cause malformation of buds which fail to develop into seeds. Larval period lasts for 14-21 days. The pupal period is 7-12 days. Complete life cycle takes 23-37 days.

Management

Spraying the infested crop with 0.07% endosulfan 35 EC or 0.05% methyl demeton 25 EC @ 1000-1200 L water/ha.

Integrated pest management of castor crop

I. Cultural method

1. Resistant varieties: (a) Variety C3 Pakistan is tolerant. R.C.1098 and R.C.1096 coonoo are resistant to jassid attack. (b) Varieties R.C.1066, R.C.1067, R.C.1092, R.C.1069, R.C.1071 and R.C.1072 are resistant to mite infestation.
2. Summer ploughing: Deep summer ploughing should be followed, so that the larvae of semilooper, hairy caterpillar pupated in the soil will be killed due to scorching sunlight.

II. Mechanical method

1. Set up light trap to attract and kill lepidopteran moths
2. Collect and destroy the egg masses of *Spodoptera litura* and slug caterpillar.
3. Collect and destroy the early instar larvae of *Spodoptera litura*, semilooper and hairy caterpillar.

III. Microbial method

1. Use of bacteria: Spraying of thuricide (*Bacillus thuringiensis*1%) is found to be effective in controlling the larvae of *A. janata* and other lepidopterous larvae.
2. Use of virus: *Nuclear polyhedrosis*, *Cytoplasmic polyhedrosis* and pox-like virus has been found effective against *A. moorei* and *Euproctis* spp.
3. Use of nematodes: *Mermis submigrescens* have been found effective against *A.moorei*.
4. Use of antifeedants: Triphenyl tin compound 45% WP @ 0.06% and other fentin compounds will protect the crop from the attack of *Spodoptera mauritia*, *Spodoptera littoralis*, *Pericallia ricini*, *Spodoptera litura*.
5. Apply NSKE 3% + neem oil 2% for the control of semilooper.
6. Apply dimethoate 500 ml/ha or methyl demeton 25 EC 1500 ml/ha to control sucking pests.
7. Apply endosulfan 4D 25 kg/ha to control semilooper and other pests.
8. Spray any one of the following insecticides/ha thrice from flowering at three weeks interval to control capsule and shoot borer. Malathion 2 L, and carbaryl 50 WP 2 kg in 1000 L of water.

Pests of Brassica

The important cruciferous oilseeds cultivated in India are yellow and brown sarson (*Brassica campestris* var. *sarson*), toria (*B.campestris* var. *toria*), raya (*B. juncea*) and taramira (*Eruca sativa*). These crops are damaged by a number of pests, of which mustard aphid, mustard sawfly and the painted bug are more serious. The aphid is the most serious pest on Brassica oilseeds throughout India.

Major pests				
1.	Mustard Aphid	<i>Lipaphis erysimi</i>	Aphididae	Hemiptera
2.	Painted Bug	<i>Bagrada hilaris</i>	Pentatomidae	Hemiptera
3.	Mustard Sawfly	<i>Athalia lugens</i>	Tenthredinidae	Hymenoptera
4.	Green Peach Aphid	<i>Myzus persicae</i>	Aphididae	Hemiptera
5.	Pea Leaf-miner	<i>Chromatomyia horticola</i>	Agromyzidae	Diptera
6.	Bihar Hairy Caterpillar	<i>Spilosoma obliqua</i>	Arctiidae	Lepidoptera
7.	Cabbage butterfly	<i>Pieris brassicae</i>	Pieridae	Lepidoptera
8.	Diamondback moth	<i>Plutella xylostella</i>	Yponomeutidae	Lepidoptera
Minor pests				
9.	Jassid	<i>Empoasca binotata</i>	Cicadellidae	Hemiptera
10.	Leaf webber	<i>Crociodomia binotalis</i> <i>Hellula undalis</i>	Pyralidae	Lepidoptera
11.	Noctuid caterpillars	<i>Agrotis ipsilon</i> , <i>Mythimna loreyi</i> and <i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
12.	Flea beetles	<i>Phyllotreta cruciferae</i> and <i>Phaedon hrassicae</i>	Coleoptera	Chrysomelidae
13.	Leaf-miner	<i>Chromatomyia horticola</i>	Agromyzidae	Diptera

1. Mustard Aphid: *Lipaphis erysimi* (Aphididae:Hemiptera)

Distribution and status

Distributed worldwide and is a serious pest

Host range

Cruciferous oilseeds like toria, sarson, raya, taramira and Brassica vegetables like cabbage, cauliflower, knol-khol,.

Bionomics

They are louse like, pale-greenish insects



abundant from December to March. During summer, it is believed to migrate to the hills. The pest breeds parthenogenetically and the females give birth to 26-133 nymphs. They grow very fast and are full-fed in 7-10 days. About 45 generations are completed in a year. Cloudy and cold weather (20°C or below) is very favourable for the multiplication of this pest. The winged forms are produced in autumn and spring, and they spread from field to field and, from, locality to locality.

Damage symptoms

Both the nymphs and adults suck cell-sap from leaves, stems, inflorescence or the developing pods. Vitality of plants is greatly reduced. The leaves acquire a curly appearance, the flowers fail to form pods and the developing pods do not produce healthy seeds. The yield of an infested crop is reduced to one-fourth or one-fifth.

Management

1. Sow the crop early wherever possible, preferably up to third week of October.
2. Apply recommended dose of fertilizers.
3. Apply anyone of the following insecticides when the population of the pest reaches 50-60 aphids per 10 cm terminal portion of the central shoot or when an average of 0.5-1.0 cm terminal portion of central shoot is covered by aphids or when plants infested by aphids reach 40-50 per cent

Foliar sprays - 625 -1000 ml of oxydemton methyl 25 EC, dimethoate 30 EC, endosulfan 35 EC, quinalphos 25 EC, malathion 50 EC; 940-1500 ml of chiorpyriphos 20 EC in 600-1000 L of water per ha depending on the stage of the crop.

Granular insecticides - 10 kg of phorate IO G, 33 kg of carbofuran 30 per ha followed by a light irrigation.

4. Conserve parasitoids *Ischiodon scutellaris* (Fabricius), *Diaeretiella rapae* M'Intosh (Braconidae) and *Lipolexis gracilis* Forester (Aphididae), predators viz., *Syrphus serarius* (Wiedmann) (Syrphidae), *Brinckochrysa scelestes* (Banks) (Chrysopidae), *Coccinella septempunctata* Linnaeus, *Menochilus sexmaculatus* (Fabricius) (Coccinellidae) and entomopathogens viz., *Entomophthora coronata* and *Cephalosporium aphidicola*.

2. Painted Bug: *Bagrada hilaris* (Pentatomidae: Hemiptera)

Distribution and status: Widely distributed in Myanmar, Sri Lanka, India, Arabia and East Africa.

Host range: Crucifers, rice, sugarcane, indigo and coffee

Bionomics

The full-grown black nymphs are about 4 mm long and 2.66 mm broad. Sub-ovate, black adult bugs are 3.71 mm long and 3.33 mm broad with a number of orange or brownish spots. It is active from March to December and during this period all the stages can be seen. It passes the winter months of January and



February in the adult stage under heaps of dried oilseed plants lying in the fields. These bugs lay oval, pale-yellow eggs singly or in groups of 3-8 on leaves, stalks, pods and sometimes on the soil. Eggs may be laid during day or night. A female bug may lay 37-102 eggs in its life-span of 3-4 weeks. Egg period is 3-5 days during summer and 20 days during December. There are five nymphal instars with a duration of 22 -34 days. The entire life cycle is completed in 19-54 days and it passes through 9 generations in a year.

Damage symptoms

Both nymphs and adults suck cell sap from the leaves and developing pods, which gradually wilt and dry up. The nymphs and adult bugs also excrete a sort of resinous material which spoils the pods.



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 endosulfan 35 EC or quinalphos 25 EC in 500-600 L of water per ha once in October and again in March-April.
2. Conserve egg parasitoid *Gryon sp.* (Scelionidae) and the adult parasitoid *Alophora sp.* (Tachinidae).

3. 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 days. 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 endosulfan 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)

4. Green Peach Aphid: *Myzus persicae* (Aphididae: Hemiptera)

Distribution and status: Throughout India

Host range: Mustard, peaches, beans, potato, tobacco, turnip, radish, etc

Bionomics

The aphids are minute (2.0-2.5 mm long), delicate, pear-shaped, yellowish-green winged or wingless insects. It remains active from December to March with peak activity during February. The nymph undergoes 4-5 instars taking 4-7 days for apterous and 5-8 days for alate forms. Apterous adults produce 5-92 young ones per female while the alate forms produce 8-49 nymphs. Longevity of adult is 15-27 days for alate and 10-25 days for apterous forms.



Damage symptoms

Both nymphs and adults damage plants by actively sucking their sap. After the appearance of inflorescence, the aphid congregates on terminal buds and feeds there. As a result, there is flower shedding, poor-pod formation and shriveling of grains. The insect also transmits virus diseases. The honeydew attracts sooty mould.

Management

1. Sow the crop in first week of October.
2. Spray 500 ml of dimethoate 30 EC or 625 ml of oxydemeton methyl 25 EC in 750 L of water/ha when aphids start congregating on top flower buds. Only one spray is needed.

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

Distribution and status: Northern India

Host range: Cruciferous plants, antirrhinum, nasturtinum, pea, linseed (*Linum usitatissimum*)

L.) and potato (*Solanum tuberosum* L.).

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. The eggs hatch in 2-3 days and the larvae feed between the lower and upper epidermis by making zig-zag tunnels. Maggot after 5 days pupates within the galleries. The adults emerge in 6 days and lifecycle is completed in 13-14 days. The pest passes through several broods from December to April-May.



Damage symptoms

The large number of tunnels made by the maggots interferes with photosynthesis and proper growth of the plants, making them look unattractive. If the attacked leaves are held against bright light, the minute slender larvae can be seen feeding within the tunnels

Management

Spray 1.0 L of dimethoate 30 EC in 750 L of water per ha and repeat spray at 15 days interval. A waiting period of 20 days should be observed for picking of pods.

6. Bihar Hairy Caterpillar: *Spilosoma obliqua* (Arctiidae: Lepidoptera)

Distribution and status: Sporadic pest widely distributed in the Orient. It is very serious in Bihar, Madhya Pradesh, Uttar Pradesh and Punjab

Host range: Sesamum, mash (*Phaseolus mungo*), mung (*P. aureus*), linseed, mustard, sunflower and some vegetables.

Bionomics

The moth measures about 50 mm across the wing spread. Adults have crimson coloured body with black dots. Wings pinkish with numerous black spots. Larva is orange coloured with broad transverse bands with tuft of yellow hair that are dark at both end. Pest breeds from March to April and again from July to November. Adult female lays 400-1000 light green, spherical eggs in clusters on the underside of the leaves. Egg period 8-13 days. Larval instars 7 and period 30-56 days. Pupation takes place in plant debris or soil and pupal period 7-15 days. Adult lives for 7 days. Early instars are gregarious and later instars disperse in search of food.



Damage symptoms

The caterpillars eat leaves and soft portions of stems and branches. In severe infestation, the plants may be completely denuded of leaves.

Management

1. The young caterpillars can be killed easily by dusting the infested crop with malathion

5 per cent @ 25 kg/ha.

2. When they are full-grown, it is difficult to kill them and very high doses of the pesticides are needed. The chemical control measures are same as in case of red hairy caterpillar.

7. 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

In the Indo-Gangetic plains, this pest appears on cruciferous vegetables from October to April. From May to September, the pest is not found in the plains but breeding takes place in the mountains. 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 endosulfan 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.

7. Diamond backmoth: *Plutella xylostella* (Plutellidae: Lepidoptera)

Refer crucifers

Minor Pests of Brassica Oilseeds

The other insects which appear as minor pests of Brassica crops include the

- Jassid: *Empoasca binotata Pruthi* (Cicadellidae: Hemiptera)
- Leaf webber *Crocidolomia binotalis* Zeller and *Hellula undalis* (Pyalidae: Lepidoptera)
- Noctuid caterpillars: *Agrotis ipsilon*, *Mythimna loreyi* and *Helicoverpa armigera* (Noctuidae: Lepidoptera)
- Flea beetles: *Phyllotreta cruciferae* and *Phaedon brassicae* (Coleoptera : Chrysomelidae)
- Leaf-miner: *Chromatomyia horticola* (Agromyzidae: Diptera)

Pest of linseed

1. Linseed Gall-midge: *Dasineura lini* (Cecidomyiidae: Diptera)

Distribution and status: Serious in Andhra Pradesh, Madhya Pradesh, Bihar, Uttar Pradesh, Delhi and Punjab.

Host range: Linseed

Bionomics

The adult of this gall-midge is a small orange fly. The female lays 29-103 smooth, transparent eggs in the folds of 8-17 flowers or in tender green buds, either singly or in clusters of 3-5. The eggs hatch in 2-5 days. Just after emergence, the larvae are transparent, with a yellow patch on the abdomen. They pass through four instars in 4-10 days and when full-grown become deep pink and measure about 2 mm in length. The full-grown maggots drop to the ground, prepare a cocoon and pupate in the soil. The pupal period lasts 4-9 days. A generation is completed in 10-24 days. There are four overlapping generations during the season.

Damage symptoms

Damage is the result of feeding by maggots on buds and flowers. Consequently no pod-formation takes place.

Management

1. The adult flies can be killed by using light traps. The flies are also attracted in day-time to molasses or gur added to water.
2. As the incidence of this pest is more on the late-sown crop as compared with the nonnal-sown crop, the practice of nonnal-sown crops should be adopted if possible.
3. Dust 5 per cent carbaryl 15-20 kg/ha or spray carbaryl 50 WP 1.125 kg/ha in 600-750 L of water/ha.
4. Conserve larval parasitoids viz., *Systasis dasyneurae* Mani (Miscogasteridae), *Elasmus sp.* (Elasmidae), *Eurytoma sp.* (Eurytomidae), *Torymus sp.* (Torymidae) and *Tetrastichus sp.* (Eulophidae).

2. Beet Armyworm: *Spodoptera exigua* (Noctuidae: Lepidoptera)

The beet armyworm may cause damage by feeding on leaves. Spray the crop with 1.125 kg of carbaryl 50 WP or 1.0 L of malathion 50 EC in 600-750 L of water per ha.

Minor Pests of Linseed

- **Jassid:** *Empoasca kerri* var. *motti* (Cicadellidae: Hemiptera)
- **Whitefly:** *Bemisia tabaci* (Aleyrodidae: Hemiptera)
- **Mirid bug:** *Creontiades pallidifer* (Miridae: Hemiptera)
- **Stink bug:** *Piezodorus hybneri* (Pentatomidae: Hemiptera)
- **Thrips:** *Caliothrips indicus* (Thysanoptera : Thripidae)
- **Bihar Hairy caterpillar:** *Spilosma obliqua* (Arctiidae: Lepidoptera)
- **Leaf caterpillar:** *Grammodes stolidia* (Noctuidae: Lepidoptera)
- **Hairy caterpillar:** *Euproctis scintillans* (Lymantriidae: Lepidoptera)
- ***Spodoptera litura*, *Thysanoplusia orichalcea* and *Helicoverpa armigera*:** (Noctuidae: Lepidoptera).

Question paper on Gingelly, Castor, Mustard and Linseed

1. Flowers and young sesame capsules with gall like swelling is the typical symptom of -----
----- **Gall fly**
2. Lymantriid hairy caterpillars are polyphagous – Say **true** or false
3. Gingelly phyllody is transmitted by
 - a. **Orosius albicinctus**
 - b. *Bemisia tabaci*
 - c. *Aphis craccivora*
 - d. *Cestius physinctus*
4. ----- is the scientific name of Gingelly gallfly - **Asphondylia sesame**
5. Pod bug, *Elasmolomus sordidus* is nocturnal in habit. Say true or false -**True**
6. Name the insect where larvae feed on castor leaves voraciously and adult cause damage to citrus fruits - **Achaea janata**
7. Water soaked spots on the castor leaves become yellow and dried are symptoms of
 - a. **White fly**
 - b. Thrips
 - c. Leaf hopper
 - d. Aphids
8. Which one of the following is a serious but sporadic pest on castor
 - a. **Castor butterfly**
 - b. Castor semilooper
 - c. Castor gallfly
 - d. Woolly bear
9. *Parasa lepida* belongs to family
 - a. Arctiidae
 - b. HesperIIDae
 - c. **Cochilididae**
 - d. Lymantriidae
10. *Pericallia ricini* is the scientific name of wooly bear- Say **True** or false
11. Presence of holes in the leaves of mustard is a symptom of ----- **Plutella xylostella**
12. ----- is a hymenopteran insect without crochets on its pseudolegs - **Sawfly**
13. Saw fly is having ----- pairs of abdominal pseudo legs
 - a. 4
 - b. 2-5

c. 5-8

d. **8 only**

14. A hymenopteran insect having saw like ovipositor on its abdomen - **Sawfly**

15. ETL of sesame leaf webber is _____ **2 webbed leaves/ sq.m**

16. Name some resistant cultivars of gingelly leaf webber - **EH7, 57, 84, 105, 106 and 156**

17. ETL of mustard aphid is _____ **-50-60 aphids per 10 cm**

18. _____ excretes a sort of resinous material that spoils the mustard pods

Painted Bug, *Bagrada hilaris*

19. Braconid parasitoid _____ keeps the population of *Achaea janata* under check

Microplitis ophiusae

20. Larva with branched spines in castor **spiny caterpillar - *Ergolis merione***

21. Which pest lays eggs on the cocoon itself

a. *Euroctis fraterna*

b. *Ergolis merione*

c. *Achaea janata*

d. ***Notolopus posticus***

Lecture No.16 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 play 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	<i>Idioscopus niveosparsus</i> , <i>I. clypealis</i> , <i>Amritodus atkinsoni</i>	Cicadellidae	Hemiptera
2.	Stemborer	<i>Batocera rufomaculata</i>	Cerambycidae	Coleoptera
3.	Fruit fly	<i>Bactrocera dorsalis</i>	Tephritidae	Diptera
4.	Mango nut weevil	<i>Sternochaetus mangiferae</i>	Curculionidae	Coleoptera
5.	Mango mealy bug	<i>Drosicha mangiferae</i>		
6.	Bark eating caterpillar	<i>Indarbela tetraonis</i> , <i>I. quadrinotata</i>	Metarbelidae	Lepidoptera
7.	Flower gall midge	<i>Procystiphora mangiferae</i> , <i>Erosomyia indica</i> , <i>Dasineura amaramanjarae</i>	Cecidomyiidae	Diptera
8.	Mango leaf webber	<i>Orthaga exvinacea</i>	Noctuidae	Lepidoptera
9.	Shoot borer	<i>Clumetia transversa</i>	Noctuidae	Lepidoptera
10.	Leaf caterpillar	<i>Bombotelia jacosatrix</i>	Noctuidae	Lepidoptera
11.	Flower webber	<i>Eublemma versicolor</i>	Noctuidae	Lepidoptera
Minor pests				
12.	Leaf caterpillar	<i>Euthalia garuda</i>	Nymphalidae	Lepidoptera
13.	Leaf miner	<i>Acrocercops syngamma</i>	Gracillariidae	Lepidoptera
14.	Leaf twisting weevil	<i>Apoderus transquebarius</i>	Curculionidae	Coleoptera
15.	Red ant	<i>Oecophylla smaragdina</i>	Formicidae	Hymenoptera
16.	Eriophyid mite	<i>Aceria mangiferae</i>	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>I. niveosparsus</i>	<i>I. clypealis</i>	<i>A. atkinsoni</i>
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 monocrotophos 36 SL 2.5-3.3 L , methyl demeton 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 longevity 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 monocrotophos 36 SL 2.5-3.3L , methyl demeton 25 EC or malathion 50 EC 1.5 -2.0 L or chlorpyrifos 20 EC 3.0 – 4.0 L or methyl parathion 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, which 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 syngamma* (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 wither 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.	Citrus can be covered with perforated 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. <i>Batocera rufomaculata</i>	b. <i>Sternocheatus mangiferae</i>
	c. <i>Bactrocera dorsalis</i>	d. <i>Procystiphora mangifera</i>
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

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

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

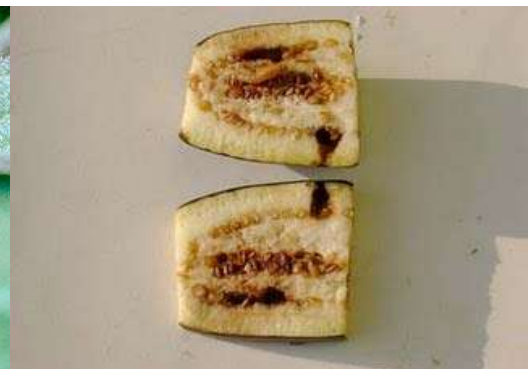
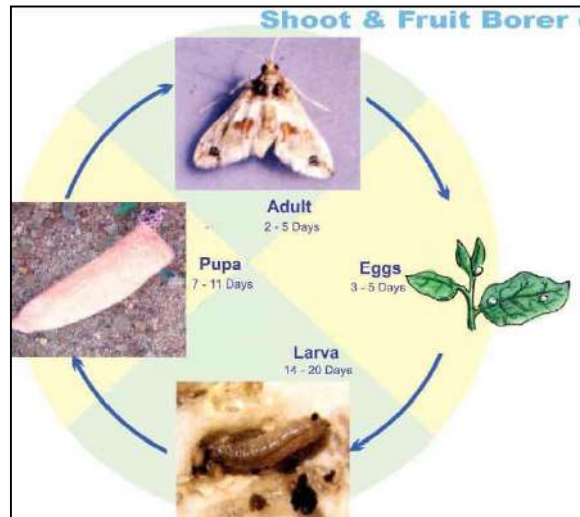
Larva bores into tender shoots and causes withering of terminal shoots / dead hearts - also bores petioles of leaves, flower buds and developing buds, causes withering of leaves, shedding of buds and make fruits unfit for consumption. Attacked fruits are with boreholes plugged with excreta. Fruits become 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, endosulfan 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 endosulfan 35 EC 1.5 L or malathion 50 EC 1.5L or Azadirachtin 0.03% 2.5-5.0 L in 500 - 750 L of water
- Emulsify 1 lit of Neem oil with 60 g of soap dissolved in ½ 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 endosulfan 1.5 L or chlorpyrifos 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, endosulfan 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 earthen 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 endosulfan 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 methyl parathion 750 ml or dimethoate 500 ml or monocrotophos 500 ml or endosulfan 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 *Chrysoperla 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. hystrixellus* (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* (Diaspididae: 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*, *Poeciloceris 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 considerable yield reduction.

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

8.	Cabbage green semilooper	<i>Trichoplusia ni</i>	Noctuidae	Lepidoptera
9.	Aphid	<i>Aphis gossypii</i> , <i>Myzus persicae</i>	Aphididae	Hemiptera
10.	Leaf hopper	<i>Amrasca devastans</i>	Cicadellidae	Homoptera
11.	Stem borer	<i>Euzophera perticella</i> , <i>Pthorimaea operculella</i>	Pyralidae	Lepidoptera
12.	Red spider mite	<i>Tetranychus cinnabarinus</i>	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 <i>H. armigera</i> 0.43% AS 400-600
• Indoxacarb 14.5 SC 400-500 ml	• NPV of <i>H. armigera</i> 2% AS 500
• Lambda cyhalothrin 5 EC 300 ml	• Methomyl 40 SP 750-1125 g
• Novaluron 10 EC 750 ml	• Endosulfan 35 EC 1.0 L
• Carbaryl 50 WP 1 kg	• <i>B. thuringiensis</i> 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

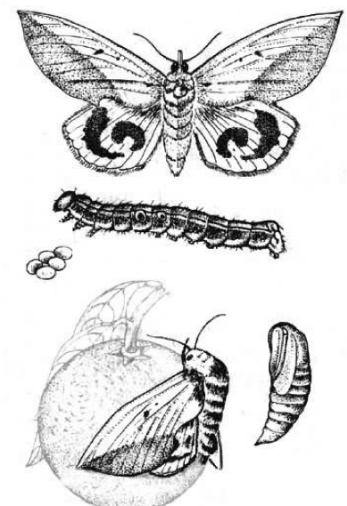
6. Fruit sucking moth: *Othreis fullonica*, *O. materna*, *O. ancilla* (Noctuidae: Lepidoptera)

Damage symptoms

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 velvety 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 <i>Helicoverpa armigera</i> -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. <i>Thrips tabaci</i>	b. <i>Scirtothrips dorsals</i>
	c. <i>Thrips florum</i>	d. <i>Scolothrips indicus</i>
12.	Muranai disease is caused by ----- on chillies- <i>Polyphagodorsonemous latus</i>	
13.	Name the predatory mite feeding on mite	
	a. <i>Aceria cajani</i>	b. <i>Aceria sorghi</i>
	c. <i>Aceria oryzae</i>	d. <i>Amblyseius ovalis</i>
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 <i>Acyrtosiphon pisum</i>	

PESTS OF CHILLIES AND PEAS

PEST OF CHILLIES

More than 20 species have been reported attacking both leaves and fruits of chillies. 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	<i>Scirtothrips dorsalis</i>	Thripidae	Thysanoptera
2..	Muranai mite/ Broad mite/ yellow mite	<i>Polyphagotarsonemus latus</i>	Tarsonemidae	Acarina
3.	Tobacco caterpillar	<i>Spodoptera litura</i>	Noctuidae	Lepidoptera
4.	Fruit borer	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
Minor pests				
5.	Stem borer	<i>Euzophera perticella</i>	Phycitidae	Lepidoptera
6.	Cut worm	<i>Agrotis ipsilon</i>	Noctuidae	Lepidoptera
7.	Green peach aphid	<i>Myzus persicae</i>	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 parthenogenetically. 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 m² area in the nursery
- Dip the roots of seedlings in monocrotophos 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

<ul style="list-style-type: none"> • Imidacloprid 70 WS 500-1000 g or 17.8 SL 125-250 ml • Emamectin benzoate 5 SG 200 • Ethion 50 EC 1.5-2.0 L • Fenpropathrin 30 EC 250-340 ml • Fipronil 5 SC 800-1000 ml 	<ul style="list-style-type: none"> • Imidacloprid 17.8 SL 125-250 ml or 70 WS / 100 kg seed 1.000-1.5L • Lambda cyhalothrin 5 EC 300 ml • Methomyl 40 SP 750-1125 g • Spinosad 45 SC 160 ml • Thiacloprid 21.7 SC 225-300 ml
---	---
- | | |
|---|---|
| <ul style="list-style-type: none"> • Dimethoate 30 EC 500 ml | <ul style="list-style-type: none"> • 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)

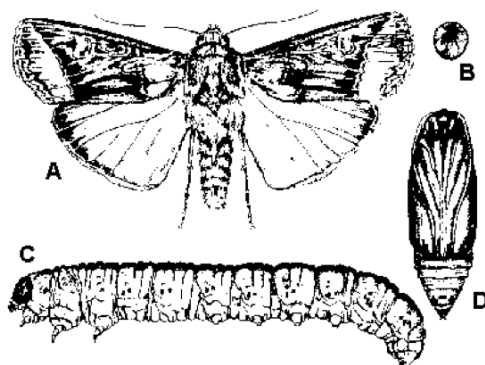
Refer Brinjal

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: Endosulfan 35EC @ 1 L/ha or chlorpyrifos 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	<i>Chromatomyia horticola</i>	Agromyzidae	Diptera
2.	Pea Stem Fly	<i>Ophiomyia phaseoli</i>	Agromyzidae	Diptera
3.	Pea Aphid	<i>Acyrtosiphon pisum</i>	Aphididae	Hemiptera
Minor pests				
4.	American Bollworm	<i>Helicoverpa armigera</i>	Noctuidae	Lepidoptera
5.	Pea Pod Borer	<i>Etiella zinckenella</i>	Pyralidae	Lepidoptera

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

Distribution and status: Wide distribution in Northern India and Indian sub-continent

Host range: Cruciferous plants, antirrhinum, nasturtium, 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 life-cycle 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 15 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: *Acyrtosiphon 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 chlorpyrifos 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 endosulfan 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 <i>Helicoverpa armigera</i> -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. <i>Thrips tabaci</i>	b. <i>Scirtothrips dorsals</i>
	c. <i>Thrips florum</i>	d. <i>Scolothrips indicus</i>
12.	Muranai disease is caused by ----- on chillies-	<i>Polyphagodorsonemous latus</i>
13.	Name the predatory mite feeding on mite	
	a. <i>Aceria cajani</i>	b. <i>Aceria sorghi</i>
	c. <i>Aceria oryzae</i>	d. <i>Amblyseius ovalis</i>
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	<i>Acyrtosiphon pisum</i>

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	<i>Plutella xylostella</i>	Plutellidae	Lepidoptera
Leaf webber	<i>Crociodolomia binotalis</i>	Pyraustidae	Lepidoptera
Cabbage semilooper	<i>Tirchoplusia ni</i>	Noctuidae	Lepidoptera
Cabbage butterfly	<i>Pieris brassicae</i>	Pieridae	Lepidoptera
Cabbage borer	<i>Hellula undalis</i>	Pyraustidae	Lepidoptera
Mustard sawfly	<i>Athalia lugens proxima</i>	Tenthredinidae	Hymenoptera
Cabbage aphid	<i>Brevicoryne brassicae</i>	Aphididae	Hemiptera
Cabbage flea beetle	<i>Phyllotreta cruciferae</i>	Chrysomelidae	Coleoptera
Minor pests			
Painted bug	<i>Bagrada hilaris</i>	Pentatomidae	Hemiptera
Cutworms	<i>Agrotis ipsilon</i>	Noctuidae	Lepidoptera

Major pests

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

Distribution and status: World - wide

Host range: Serious pest 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/10 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

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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 attached 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 a year.



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 *aizawai* (B.t.a.)
- Reduce insects colonising on mustard to prevent defoliation of the entire plant by applying dichlorovos 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: *Tirchoplusia 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

Eggs 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 endosulfan 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 endosulfan 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 later 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 endosulfan 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 endosulfan 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**

Lecture No. 25

PEST OF TUBER VEGETABLES

I. POTATO

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

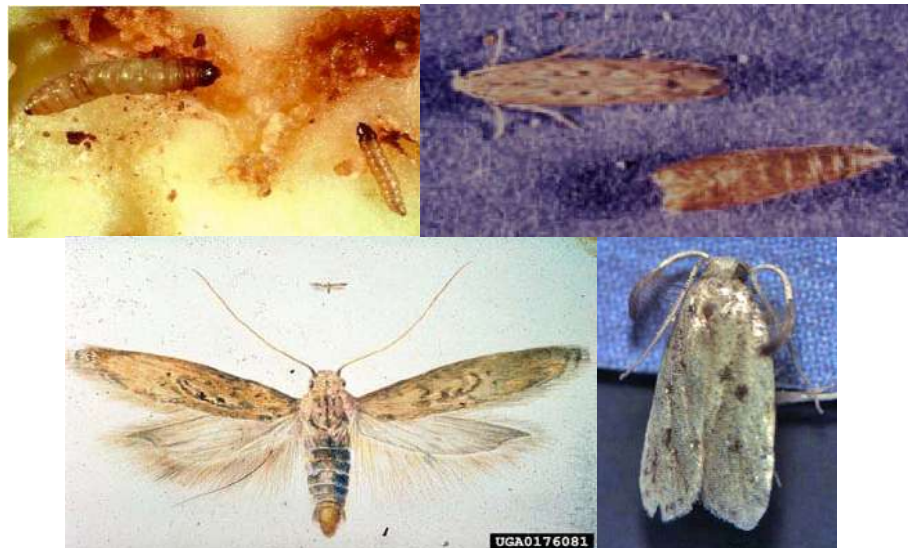
Pest of field and storage. Larva tunnels into foliage stem and tubers which lead to loss of leaf tissue, death of growing points and weakening or breaking of stems. In tubers, irregular shaped galleries are seen with excrements near tuber eyes.



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 pinkish-white 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 10-15 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 21°C. 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 (CS₂) 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 endosulfan 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
<i>Agrotis ipsilon</i>	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
<i>A. segetum</i>	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
<i>Xestia C. nigrum</i>	Brownish larva with series of black markings on lateral area	Reddish brown fore wing with concave sunken pale area. Hind wing is dull brown
<i>Peridroma saucia</i>	Light brown with 4-7 yellowish markings on mid-dorsal 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 chlorpyrifos 20 EC or endosulfan 35 EC 4 ml/ L a day after planting
6. In endemic areas, apply NSKE 5%, endosulfan 35 EC 1 L or chlorpyrifos 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 endosulfan 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, bionomics, 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	<i>Cylas formicarius</i>	Apionidae	Coleoptera
2.	Hairy caterpillar	<i>Cretonotus gangis</i>	Arctiidae	Lepidoptera
3.	Blue pansy	<i>Precis orithya</i>	Nymphalidae	Lepidoptera
4.	Leaf folder	<i>Brachmia convolvuli</i>	Gelechiidae	Lepidoptera
5.	Tortoise beetles	<i>Aspidomorpha miliaris</i> <i>Metriona circumdata</i> <i>Chirida bipunctata</i>	Cassididae	Coleoptera
Minor pests				
6.	Sphinx caterpillar	<i>Agrilus convolvuli</i>	Sphingidae	Lepidoptera
7.	Stem borer	<i>Omphisa anastomosalis</i>	Pyraustidae	Lepidoptera
8.	Spiny beetle	<i>Oncocephala tuberculata</i>	Hispidae	Coleoptera
9.	Brown looper	<i>Hyposidra successaria</i>	Geometridae	Lepidoptera
10.	Sweet potato hopper	<i>Exitianus indicus</i>	Cicadellidae	Hemiptera
11.	Fig bug	<i>Riptortus linearis</i>	Coreidae	Hemiptera
12.	Lygaeid bug	<i>Graptosethus servus</i>	Lygaeidae	Hemiptera
13.	Mealy bugs	<i>Geococcus coffeae</i>	Pseudococcidae	Hemiptera

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

Distribution and status

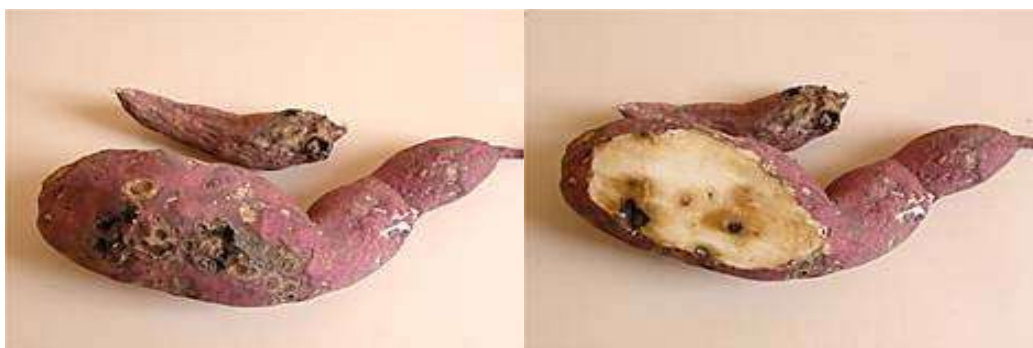
It is a specific pest of sweet potato. Seen in Pantropical, Tropical Africa, India, South East Asia, Australia, Hawaii, South USA, West Indies and South America.

Host range

Ipomoea littoralis, *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 4-5 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 endosulfan 35 EC @ 4 ml /L. Spray endosulfan 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.

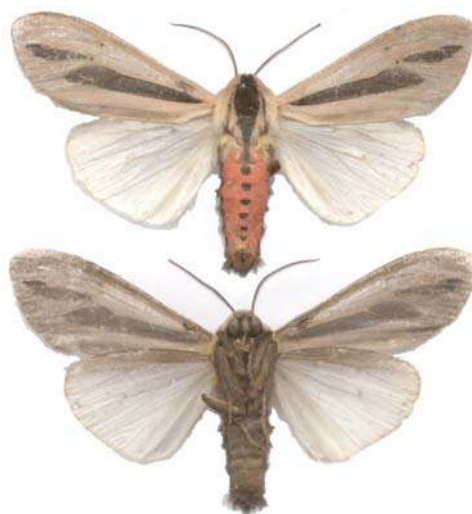
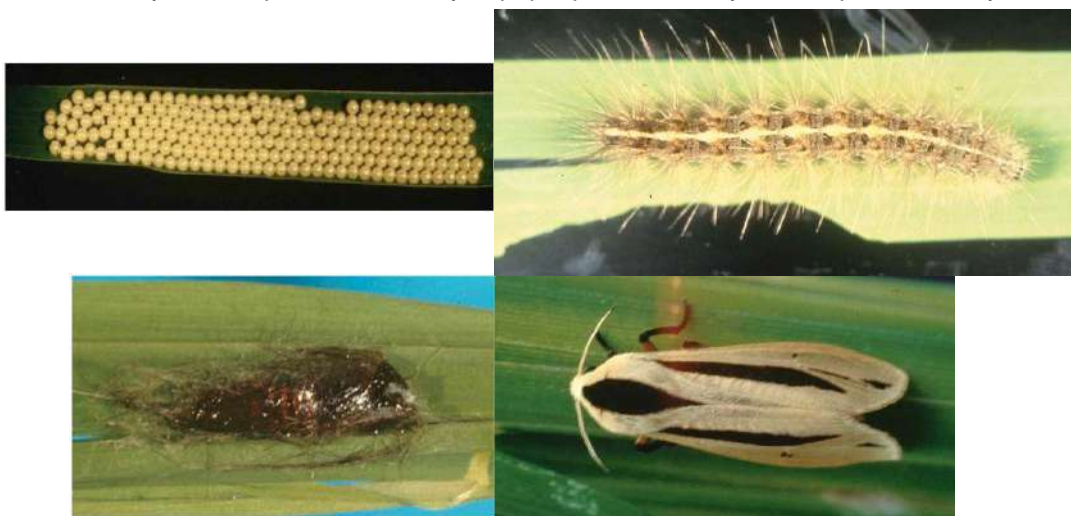
2. Hairy caterpillar: *Creatonotus gangis* (Arctiidae: Lepidoptera)

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 creamy-yellow 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

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 build-up
3. Spray dichlorvas 660 ml or endosulfan 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 endosulfan 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
<i>Aspidomorpha miliaris</i> 	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.
<i>Cassida circumdata</i> 	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 to 5, 10 to 15 and 6 to 8 days respectively. Life cycle is completed in 30 days.
<i>Chirida bipunctata</i> 	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* (Hispididae: 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: *Graptoseethus servus* (Lygaeidae: Hemiptera)

These are greyish-black bugs. Adults and nymphs suck cell sap from tender leaves and devitalize 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	<i>Monolepta signata</i>	Alticidae / Galerucidae	Coleoptera
2.	Hairy caterpillar	<i>Pericallia ricini</i>	Arctiidae	Lepidoptera
3.	Sphinx caterpillar	<i>Theretra gnoma</i>	Sphingidae	Lepidoptera
4.	Sphinx caterpillar	<i>Agrius convolvuli</i>	Sphingidae	Lepidoptera
5.	Aphid	<i>Pentalonia nigronervosa</i>	Aphididae	Hemiptera
		<i>Aphis gossypii</i>	Aphididae	Hemiptera
Minor pests				
6.	Thrips	<i>Heliethrips haemorrhoidalis Caliothrips indicus</i>	Thripidae	Thysanoptera
7.	Grasshopper	<i>Gesonula punctifrons</i>	Acrididae	Orthoptera
8.	Tingid	<i>Stephanitis typicus</i>	Tingidae	Hemiptera
9.	Horned caterpillar	<i>Hippotion oldenlandiae</i>	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 endosulfan 35 EC 1.0 L or carbaryl 50 WP 1.0 Kg in 500 L of water per ha or dust endosulfan 4 D 25 kg per ha .

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

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 endosulfan 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 stripes. 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 endosulfan 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: *Heliethrips haemorrhoidalis* (Thripidae, Thysanoptera)

Silvery white patches and faecal globules 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

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

	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	<i>Aonidomytilus albus</i>	Diaspididae	Hemiptera
Whitefly	<i>Bemisia tabaci</i>	Aleyrodidae	Hemiptera
Spiraling whiteflies	<i>Aleurodicus dispersus</i>	Aleyrodidae	Hemiptera
Mealy bug			
Minor pests			
Thrips	<i>Retithrips syriacus</i>	Thripidae	Thysanoptera
Red spider mites	<i>Tetranychus urticae</i>	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	<i>Hypolixus truncatulus</i>	Curculionidae	Coleoptera
Amaranthus caterpillar or webber	<i>Hymenia recurvalis</i>	Pyraustidae	Lepidoptera
Minor pests			
Leaf webber	<i>Eretmocera impactella</i>	Heliodinidae	Lepidoptera
Leaf webber	<i>Psara basalis</i>	Pyraustidae	Lepidoptera
Tortoise beetle	<i>Aspidomorpha exilis</i>	Cassididae	Coleoptera
Grasshopper	<i>Atractomorpha crenulata</i>	Acrididae	Orthoptera
Leaf twisting weevil	<i>Apoderus tranquebaricus</i>	Curculionidae	Coleoptera
Aphids	<i>Aphis craccivora</i>	Aphididae	Hemiptera
Mealy bugs	<i>Ferrisia virgata</i>	Pseudococcidae	Hemiptera
Thrips	<i>Euryaplothrips crassus</i> , <i>Haplothrips ceylonicus</i>	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. Full-fed 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 endosulfan 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.

Bionomics



Adult is a dark brownish black moth with white wavy markings on wings. Spherical snow-white 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 endosulfan 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, brownish-yellow 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.



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 endosulfan.

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	<i>Gitona distigma</i>	Drosophilidae	Diptera
Bud worm	<i>Noorda moringae</i>	Pyraustidae	Lepidoptera
Leaf caterpillar	<i>Noorda blitealis</i>	Pyraustidae	Lepidoptera
Hairy caterpillars	<i>Eupterote mollifera</i>	Eupterotidae	Lepidoptera
	<i>Pericallia ricini</i>	Arctiidae	Lepidoptera
	<i>Metanastris hyrtaca</i>	Lasiocampidae	Lepidoptera
	<i>Streblote siva</i>	Lasiocampidae	Lepidoptera
Bark borer	<i>Indarbela tetraonis</i>	Metarbelidae	Lepidoptera

Long horn beetles	<i>Batocera rubus</i>	Cerambycidae	Coleoptera
Minor pests			
Aphids	<i>Aphis gossypii</i>	Aphididae	Hemiptera
Scale Insects	<i>Ceroplastodes cajani</i>	Diaspididae	Hemiptera
Bud midge	<i>Stictodiplosis moringae</i>	Cecidomyiidae	Diptera
Leaf eating weevils	<i>Myllocerus</i> 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 endosulfan 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 6-10 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 endosulfan 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 chlorpyrifos 20 EC or quinalphos 25 EC or endosulfan 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



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 endosulfan 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 medium-sized 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: *Myloccerus* 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.



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	<i>Thrips tabaci</i>	Thysanoptera	Thripidae
Onion maggot	<i>Delia antiqua</i>	Anthomyiidae	Diptera
Earwig	<i>Anisolabis stali</i>	Forficulidae	Dermaptera
Potential major pests			
Tobacco caterpillar	<i>Spodoptera litura</i>	Noctuidae	Lepidoptera
Cutworm	<i>Agrotis ipsilon</i>	Noctuidae	Lepidoptera

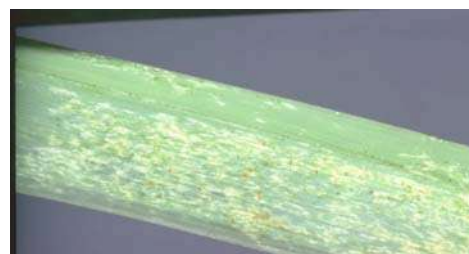
1. Onion thrips: *Thrips tabaci* (Thysanoptera: Thripidae)

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.

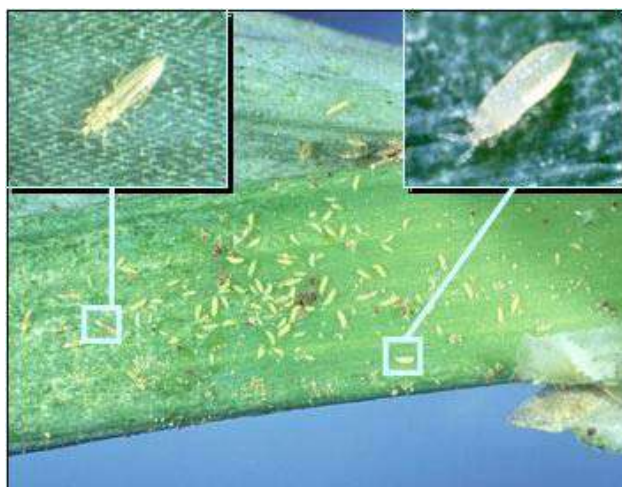
Damage symptoms

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 monocrothos 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 carolovor* 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 IOG 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

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	<i>Conogethes punctiferalis</i>	Pyraustidae	Lepidoptera
2.	Rhizome scale	<i>Aspidiotus hartii</i>	Diaspididae	Hemiptera
3.	Skipper Butterfly	<i>Udaspes folus</i>	Hesperiidae	Lepidoptera
4.	Rhizome maggot	<i>Formosina flavipes</i>	Chloropidae	Diptera
5.	Bihar Hairy Caterpillar	<i>Spilosoma obliqua</i>	Arctiidae	Lepidoptera
6.	Thrips	<i>Panchaetothrips indicus</i>	Thripidae	Thysanoptera
	Minor Pests on turmeric			
7.	Flea beetle	<i>Lema praeusta</i>	Chrysomelidae	Coleoptera
8.	Turmeric scale	<i>Aspidiotus cucumae</i>	Diaspididae	Hemiptera
9.	Banana lacewing bug	<i>Stephanitis typicus</i>	Tingidae	Hemiptera
10.	Leaf thrips	<i>Anaphothrips sudanensis</i> <i>Asprothrips indicus</i> <i>Panchaetothrips indicus</i>	Thripidae	Thysanoptera
	Minor pests on ginger			
	Leaf miner	<i>Acrocercops irradians</i>	Gracillariidae	Lepidoptera
	Weevil	<i>Hedychrous rufofasciatus</i>	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: Throughout India. Very common pest.

Host range: Turmeric, ginger, arrow 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 methyl parathion 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	<i>Bemisia tabaci</i>	Aleyrodidae	Hemiptera
Minor pests			
Aphid	<i>Hyadophis coriandri</i>	Aphididae	Hemiptera
Pentatomid bug	<i>Agonoscelis nubila</i>	Pentatomidae	Hemiptera
Indigo caterpillar	<i>Spodoptera exigua</i>	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	<i>Diaphorina citri</i>	Psyllidae	Hemiptera
Citrus butterfly	<i>Papilio demoleus</i>	Papilionidae	Lepidoptera
Bark borer	<i>Indarbela tetraonis</i>	Metarbelidae	Lepidoptera
Citrus black fly	<i>Aleurocanthus woglumi</i>	Aleyrodidae	Hemiptera
Leaf roller	<i>Tonica zizyphi</i>	Oecophoridae	Lepidoptera

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 dry-up above the point of infestation in ginger and turmeric ----- Shoot borer <i>Conogethes punctiferalis</i>	
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.	<i>Formosina flavipes</i> 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 ----- <i>Aspidiotus hartii</i>	
6.	Turmeric leaves become rolled up, turn pale and gradually dry-up due to----- Thrips <i>Panchaetothrips indicus</i>	
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 <i>Thrips tabaci</i> – Say true or false	
10.	Rolling of turmeric and ginger leaves is caused by _____ Turmeric skipper <i>Udaspes folus</i>	
11.	Discolouration of onion leaves with pale tips and drying form tip downwards is due to onion thrips/onion maggot	
12.	Psyllid <i>Diaphorina citri</i> is common to citrus and curry leaves Say true/ false	
13.	Indigo caterpillar is <i>Spodoptera litura</i> / <i>Spodopera exigua</i>	

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	<i>Longitarsus nigripennis</i>	Alticidae	Coleoptera
Top shoot borer	<i>Cydia hemidoxa</i>	Eucosmidae	Lepidoptera
Berry gall midge	<i>Cecidomyia malabarensis</i>	Cecidomyiidae	Diptera
Marginal gall thrips	<i>Liothrips karnyi</i>	Thysanoptera	Thripidae
Minor pests			
Pepper mussel scale	<i>Lepidosaphes piperis</i>	Diaspididae	Hemiptera
Soft scale	<i>Marsipococcus marsupiale</i>	Coccidae	Hemiptera
Coconut scale	<i>Aspidiotus destructor</i>	Diaspididae	Hemiptera
Whitefly	<i>Aleurocanthus piperis</i>	Aleyrodidae	Hemiptera
Wild silkworm	<i>Cricula trifenestrata</i>	Saturniidae	Lepidoptera

I. Major pests

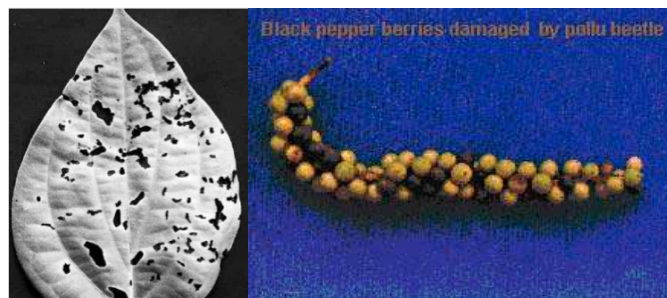
1. Pollu beetle: *Longitarsus nigripennis* (Chrysomelidae: Coleoptera)

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

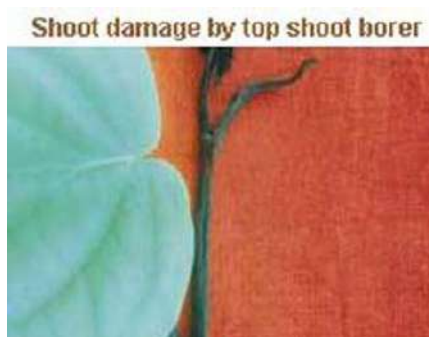
1. Rake the soil and incorporate quinalphos 1.5 D, carbaryl 5 D, endosulfan 4 D @ 25 kg/ha to kill the pupae in the soil
2. Spray dimethoate 30 EC 1.5 L or quinalphos 25 EC 2.0 L in 500 - 1000 L of water per ha.

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 endosulfan 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

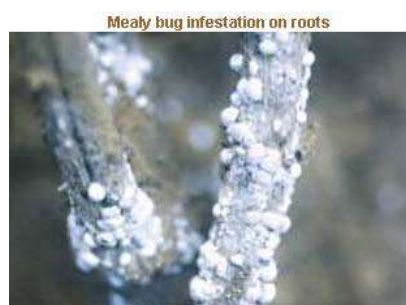
Spray monocrotophos 36 SL 750 ml or dimethaote 30 EC 1.0 L or chlorpyriphos 1.5 L in 500-1000 L water

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)



II. PESTS OF CARDAMOM

About 56 species of insects and mites have been reported to attack cardamom in India.

Major pests				
1.	Cardamom thrips	<i>Sciothrips cardamomi</i>	Thripidae	Thysanoptera
2.	Cardamom whitefly	<i>Dialeurodes cardamomi</i>	Aleyrodidae	Hemiptera
3.	Cardamom aphid	<i>Pentalonia nigronervosa</i> ,	Aphididae	Hemiptera
4.	Shoot, panicle & capsule borer	<i>Dichocrocis punctiferalis</i>	Pyraustidae	Lepidoptera
5.	Rhizome weevil	<i>Prodiocetes haematicus</i>	Curculionidae	Coleoptera
6.	Early capsule borer	<i>Lampides elpis</i> ; <i>Jamides</i> sp	Lycaenidae	Lepidoptera
7.	Hairy caterpillar	<i>Eupterote cardamomi</i>	Bombycidae	Lepidoptera
8.	Galerucid borer	<i>Thamnuroides cardamomi</i>	Galerucidae	Coleoptera
Minor pests				
9.	Shootfly	<i>Formosina flavipes</i>	Chloropidae	Diptera
10.	Brown scale	<i>Saissetia coffeae</i>	Diaspididae	Hemiptera
11.	Root borer	<i>Hilarographa caminodes</i>	Yponomeutidae	Lepidoptera
12.	Skipper butterfly	<i>Plesioneura alysos</i>	Hesperiidae	Lepidoptera
13.	Looper	<i>Eumelia rosalia</i> <i>Ansiodes denticulatus</i> <i>Thalassodes</i> sp	Geometridae	Lepidoptera
14.	Cutworm	<i>Arcilassia plagiata</i>	Noctuidae	Lepidoptera
15.	Lacewing bug	<i>Stephanitis typicus</i>	Tingidae	Hemiptera
16.	Root knot nematode	<i>Meloidogyne</i> spp.		
17.	Red spider mite	<i>Dolyhotetranychus floridanus</i>	Tetranychidae	Acari

Major pests

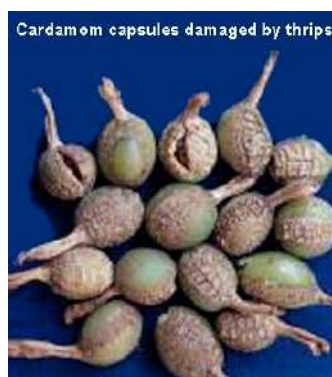
1. Cardamom thrips: *Sciothrips cardamomi* (Thripidae: Thysanoptera)

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
- Remove and destroy alternate hosts like *Panicum longipes*, *Ammomum* sp, *Alocasia* sp, *Colacasia* sp
- Remove dry leaves , leaf sheath and old panicles prior to chemical spraying.
- Spray phenthoate 500 ml or dimethoate or quinalphos 1.0 L or diafenthiuron 50 WP 800 g with 500 - 1000 L water/ha

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 *Colocasia* 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.

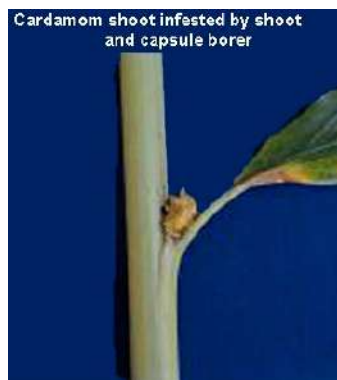
4. Shoot, panicle and capsule borer: *Dichocrocis punctiferalis* (Pyraustidae: Lepidoptera)

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: *Prodiectes haemeticus* (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: *Saissetia coffeae* (Diaspididae: Hemiptera)

Adults and nymphs cause infestation. Infested leaves turn yellow and put forth scorching 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 lays an 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	<i>Aphis gossypii</i>	Aphididae	Hemiptera
Scales	<i>Lepidosaphes cornutus</i>	Coccidae	Hemiptera
White fly	<i>Aleurocanthus nubilans</i> and <i>Dialeurodes pallida</i>	Aleurodidae	Hemiptera
Mealy bug	<i>Geococcus citrinus</i>	Pseudococcidae	Hemiptera
Shoot bug	<i>Pachypeltis politus</i>	Miridae	Hemiptera
Minor pests			
Leaf eating caterpillar	<i>Spodoptera litura</i>	Noctuidae	Lepidoptera
Termite	<i>Odontotermes obesus</i>	Termitidae	Isoptera
Green looper	<i>Synegia sp.</i>	Geometridae	Lepidoptera
Giant African snail	<i>Achatina fulica</i>	Achatinidae	

Two types of cultivation viz., A single betel

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 *Sesbania* leaves
2. Spray chlorpyrifos 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 chlorpyrifos 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 chlorpyrifos 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: *Synechia 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 chlorpyrifos 1.0 L or lambda-cyhalothrin 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 endosulfan 35 EC or phosalone 50 EC or chlorpyrifos 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 endosulfan 35 EC or phosalone 50 EC or chlorpyrifos 20 EC or malathion 50 EC 1000 ml with 500 L water/ha

7. Tea leaf roller: *Caloptilia theivora* (Gracillariidae: Lepidoptera)

Second instar larvae mine the tender leaf and reach the leaf margin. Fourth instar larvae roll 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 endosulfan 35 EC, phosalone 35 EC, chlorpyrifos 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 endosulfan 35 EC or quinalphos 25 EC or chlorpyrifos 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: *Scirtothrips 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., endosulfan 35 EC 500 ml, malathion 50 EC 400-500 ml, chlorpyrifos 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	<i>Xylotrechus quadripes</i>	Cerambycidae	Coleoptera
2.	Red borer	<i>Zeuzera coffeae</i>	Cossidae	Lepidoptera
3.	Shot hole borer	<i>Xylosandrus compactus</i>	Scolytidae	Coleoptera
4.	Berry borer	<i>Hypothenemus hampei</i>	Scolytidae	Coleoptera
5.	Green scale	<i>Coccus viridis</i>	Coccidae	Hemiptera
Minor pest				
6.	Mealy bug	<i>Ferrisia virgata</i> , <i>Planococcus lilacinus</i> , <i>P. citri</i>	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 coffee 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, pellet-like 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: Serious pest of south India

Host range

Anmola, Avocado, Clerodendron, cocoa, Crotalaria, croton, dadap, Dendrobium, mahogany, 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 endosulfan 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 endosulfan 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, Bangladesh, 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 *Verticillium lecanii* fungus @ 6×10^6 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 *Verticillium 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	<i>Rhipiphorothrips cruentatus</i>	Thripidae	Thysanoptera
Red scale	<i>Lindingaspis rossi</i>	Coccidae	Hemiptera
Red spider mite	<i>Tetranychus cinnabarinus</i>	Tetranychidae	Acari
Rose aphid/lice	<i>Macrosiphum rosaeformis</i> , <i>M. rosae</i>	Aphididae	Hemiptera
Minor pests			
Hairy caterpillar	<i>Orgyia (=Notolopus) postica</i> <i>Euproctis fraterna</i>	Lymantriidae	Lepidoptera
Castor semilooper	<i>Achaea janata</i>	Noctuidae	Lepidoptera
Flower chaffer beetle	<i>Oxycetonia versicolor</i>	Cetoniidae	Coleoptera
Leaf folder	<i>Acleris extensana</i>	Tortricidae	Lepidoptera
Leaf cutting bee	<i>Megachile anthracina</i>	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 flower 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 endosulfan 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 from the 8th 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 endosulfan 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 endosulfan 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)



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	<i>Hendecasis duplifascialis</i>	Pyraustidae	Lepidoptera
Gallery worm	<i>Elasmopalpus jasminophagus</i>	Phycitidae	Lepidoptera
Leaf webworm	<i>Nausinoe geometralis</i>	Pyraustidae	Lepidoptera
Jasmine eriophyid mite	<i>Aceria jasmine</i>	Eriophyidae	Acarina
Minor pests			
Jasmine leaf roller	<i>Glyphodes unionalis</i>	Pyraustidae	Lepidoptera
Redspider mite	<i>Tetranychus cinnabarinus</i>	Tetranychidae	Acarina
Jasmine bug	<i>Antestia cruciata</i>	Pentatomidae	Hemiptera
Green plant hopper	<i>Flata ocellata</i>	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 endosulfan 750 ml or chlorpyrifos 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 μ long and 44 μ 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* (Pyrastidae: 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 wetttable 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 <u>Thrips (<i>Rhipiphorothrips cruentatus</i>)</u>			
2.	Circular or semi circular cuttings on rose leaves is caused by <u>Leaf cutter bee</u>			
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 <u>Megachile anthracina</u>			

5.	----- larva attacks buds which are webbed together by silken threads on jasmine Bud worm (<i>Hendicasis duplifascialis</i>)		
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 ----- <i>Aceria jasmini</i>		
9.	Site of pupation for jasmine bud worm is -----		
	Over bud	Soil	Leaf
10.	<i>Elasmopalpus jasminophagous</i> is scientific name of _____		
	Bud worm	Gallery worm	Leaf worn
11.	<i>Antestia cruciata</i> belongs to the family		
	Pyraustidae	Pentatomidae	Phycitidae
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	<i>Oxycarenus laetus</i>	Lygaeidae	Hemiptera
2.	Hollyhock tinged bug	<i>Urentius euonymus</i>	Tingidae	Hemiptera
3.	Sunflower lace wing bug	<i>Cadmilos retarius</i>	Tingidae	Hemiptera
4.	Castor hairy caterpillar	<i>Euproctis lunata</i>	Lymantriidae	Lepidoptera
5.	Ak butterfly	<i>Danais chrysippus</i>	Nymphalidae	Lepidoptera
6.	Lily moth	<i>Polytela gloriosae</i>	Noctuidae	Lepidoptera
7.	Banded blister beetle	<i>Mylabris phalerata</i>	Meloidae	Coleoptera
8.	Gerbera leaf miner	<i>Liriomyza trifolii</i>	Agromyzidae	Diptera
9.	Snails and Slugs	<i>Helix, Achatina fulica</i>	Class Gastropoda	Phylum Mollusca
10.	Root-lesion Nematodes	<i>Pratylenchus spp</i>	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 endosulfan 35 EC 1.0 L in 500 L of water / ha.

3. Sunflower lace wing bug: *Cadmilos retarius* (Tingidae: Hemiptera)

Host range: Sunflower, gaillardia, chrysanthemum, marigold, vernonia, *Argemone 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

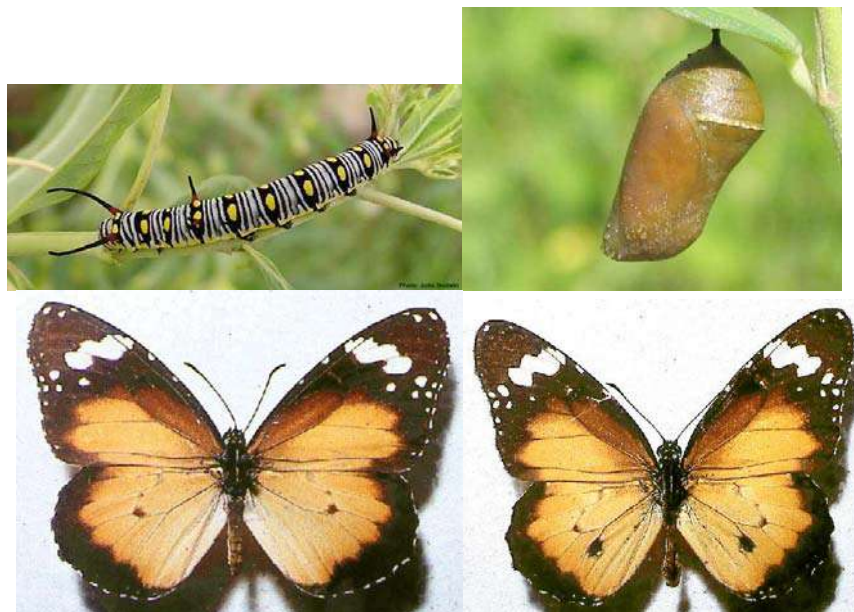
Spray malathion 50 EC 500 ml in 500 L of water/ha.

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 methyl parathion 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 earthen 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 endosulfan 35 EC 1.0 L in 500 L of water/ha.

7. Banded blister beetle: *Mylabris phalerata* (Meloidea: 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 background of the body.



8. Gerbera trifolii leaf

miner: *Liriomyza*
(Agromyzidae)

Diptera)

Devastating pest on gerbera. For more information refer 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: *Laevicantus 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 is 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 metaldehyde 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. zaeae*, 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 10 G @ 10 kg/ha or carbofuran 3G @ 30 kg/ha in soil at the time of planting.

STORED GRAIN PESTS

In India, post-harvest losses caused by unscientific storage, insects, rodents, micro-organisms etc., account for about 10 per cent of total food grains. The major economic loss caused by grain infesting insects is not always the actual material they consume, but also the amount contaminated by them and their excreta which make food unfit for human consumption. About 500 species of insects have been associated with stored grain products. Nearly 100 species of insect pests of stored products cause economic losses

Storage insect pests are categorized into two types viz.

- Primary storage pests : Internal and External feeders
- Secondary storage pests

Primary storage pests: Insects that damages sound grains are primary storage pests

Common name	Pest	Family	Order
Internal Feeders			
Rice weevil	<i>Sitophilus oryzae</i> , <i>S. zeamais</i> , <i>S. granarius</i>	Curculionidae	Coleoptera
Lesser grain borer	<i>Rhyzopertha dominica</i>	Bostrychidae	Coleoptera
Angoumois grain moth	<i>Sitotroga cerealella</i>	Gelechiidae	Lepidoptera
Pulse beetle	<i>Callosobruchus chinensis</i> , <i>C. maculatus</i>	Bruchidae	Coleoptera
Cigarette beetle	<i>Lasioderma sericorne</i>	Anobiidae	Coleoptera
Drug store beetle	<i>Stegobium paniceum</i>	Anobiidae	Coleoptera
Tamarind Beetle	<i>Pachymeres gonagra</i>	Bruchidae	Coleoptera
Sweet Potato weevil	<i>Cylas formicarius</i>	Apionidae	Coleoptera
Potato tuber moth	<i>Phthorimoea operculella</i>	Gelechiidae	Lepidoptera
Arecanut beetle	<i>Araecerus fasciculatus</i>	Anthribidae	Coleoptera
External Feeders			
Red flour beetle	<i>Tribolium castaneum</i> , <i>Tribolium confusum</i>	Tenebrionidae	Coleoptera
Indian meal moth	<i>Plodia interpunctella</i>	Phycitidae	Lepidoptera
Fig moth or almond moth	<i>Ephestia cautella</i>	Phycitidae	Lepidoptera
Rice moth	<i>Corcyra cephalonica</i>	Galleriidae	Lepidoptera
Khapra beetle	<i>Trogoderma granarium</i>	Dermestidae	Coleoptera

Secondary storage pest: Insects that damage broken or already damaged grains secondary storage pests.

Common name	Pest	Family	Order
Saw toothed grain beetle	<i>Oryzaephillis surinamensis</i>	Silvanidae:	Coleoptera

Long headed flour beetle	<i>Latheticus oryzae</i>	Tenebrionidae	Coleoptera
Flat grain beetle	<i>Cryptolestus minutus</i> ,	Cucujidae	Coleoptera
Grain lice	<i>Liposcelis divinatorius</i>	Liposcelidae	Psocoptera
Grain mite	<i>Acarus siro</i>		Acari

Primary storage pests

Internal Feeders

1. Rice weevil: *Sitophilus oryzae* (Curculionidae: Coleoptera)

Distribution and status

World-wide and is found practically throughout India. It is the most destructive pest of stored grain. The rice weevil may be found in the paddy fields as well.

Host range: Rice, sorghum, wheat, barley, maize

Bionomics

Full grown larva is 5 mm in length and plumpy, fleshy, legless creature. Reddish-brown beetle adult is 3 mm in length, with a cylindrical body and a long, slender, curved rostrum. Its elytra bear four light reddish or yellowish spots.



The rice weevil breeds from April to October and hibernates in winter as an adult inside cracks and crevices or under wheat bags in the godowns. During the active season, females lay about 400 eggs on the grain by making a depression and the hole is sealed with a gelatinous secretion. Eggs hatch in 6-7 days and the young larvae bore directly into grain, where they feed and grow to maturity. Then, they pupate inside the grain. The pupal stage lasts 6-14 days. On emergence, adult weevil cuts its way out of the grain and lives for about 4-5 months. At least generations are completed in a year.

Damage symptoms

Both the adults and the grubs cause damage. The developing larva lives and feeds inside the grain causing irregular holes of 1.5 mm diameter on grains of rice, sorghum, wheat, barley, maize before harvest and in storage. The weevils destroy more than what they eat.



2. Lesser grain borer: *Rhyzopertha dominica* (Bostrychidae: Coleoptera)

Distribution and status

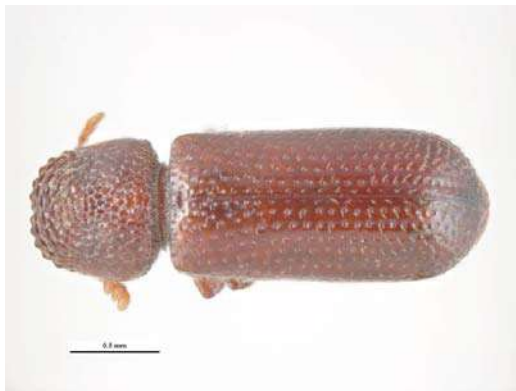
India, Algeria, Greece, United States, New South Wales (Australia), Japan China.

Host range

Wheat, rice, maize, sorghum, barley, lentils, army biscuits, ship biscuits, stored, dried potatoes, corn flour, beans, pumpkin seeds, tamarind seeds and millets.

Bionomics

The larva is about 3mm long, dirty white, with light-brown head and a constricted elongated body. The adult is a small cylindrical beetle measuring about 3 mm in length and less than 1 mm in width. It is shining dark brown with a deflexed head, covered by a crenulated hood-shaped pronotum. No morphological difference separates the two sexes.



The pest breeds from March to November and in December, it enters hibernation as an adult or as a larva. A single female can lay 300-400 eggs in 23-60 days at the rate of 4-23 eggs per day. The eggs are laid singly among the frass or are glued to the grain in batches. When freshly laid, the eggs are glistening white, but later on a pink opaque line appears on them. The incubation period is about 5-9 days.

Larva cuts a circular hole in the pedicel end of the eggs and comes out of it. Larval period 23 - 50 days, pupal period 4 - 6 days and adult live for about 40 - 80 days. There are 5 -6 generations in a year.

Damage symptoms

Both the adults and the grubs cause damage. The adults and grubs bore into the grains feed and reduce them to mere shells with many irregular holes. The adults are powerful fliers and migrate from one godown to another, causing fresh infestation. Adults produce a considerable amount of frass, spoiling more than what they eat.



3. Angoumois grain moth: *Sitotroga cerealella* (Gelechiidae: Lepidoptera)

Distribution and status

Worldwide. In the Indian sub continent, the pest is more abundant in the mountainous areas or where the climate is rather mild.

Host range

Paddy, wheat, maize, sorghum, barley, oats etc.

Bionomics



A full grown larva is about 5 mm long, with a white body and yellow brown head. The adult is a buff, grey yellow, brown or straw coloured moth, measuring about 10-12 mm in wing expanse. The characteristic feature is the presence of the narrow pointed wings fringed with long hair.

Breeding takes place from April to October. The insect overwinters as a hibernating larva and as the season warms up, it pupates in early spring. Females start laying eggs singly or in batches on or near the grain. The eggs are small and white, when freshly laid, turning reddish later on. A single female lays, on an average, 150 eggs, usually within a week after mating. Egg period is 4-8 days. The larval stage may last about 3 weeks. Before pupation, the larva constructs a silken cocoon in a cavity. Pupal period is 9 -12 days and the adult live for about 4 - 10 days. During the active season, the life-cycle is completed in about 50 days. Several generations completed in a year.

Damage symptoms

The damage is at its maximum during the monsoon. Only the larvae cause damage by feeding on the grain kernels before harvest and also in store. The larva bores into grain and feeds on its contents. Exit holes of 1 mm diameter with or without a trap door, are seen on the affected cereal grains. As it grows, it extends the hole which partly gets filled with pellets of excreta. It imparts unhealthy appearance and smell. In a heap of grain, the upper layers are most severely affected.



4. Pulse beetle: *Callosobruchus maculatus (chinensis)* (Bruchidae: Coleoptera)

Distribution and status

USA, Mauritius, Formosa, Africa, China, the Philippines, Japan, Indonesia, Sri Lanka, Myanmar and India.

Host range

Gram, mung (*Phaseolus aureus*), moth (*Phaseolus aconitifolius*), peas, cow peas, lentil and arhar (*Cajanus cajan*), cotton seed, sorghum and maize.

Bionomics

Larva is whitish with a light-brown head. The mature larva is 6-7 mm long. The adult beetle measuring 3-4 mm in length, is oval, chocolate or reddish brown and has long serrated antennae, truncate elytra, not covering the pygidium.



The pest breeds actively from March to the end of November. It hibernates in winter in the larval stage. A single female lays small, oval, scale like 34-113 eggs at the rate of 1-37 per day. Egg period is 6 -16 days, larval period 10 -38 days. The hibernating larvae take 117-168 days to complete their development. The pupal stage lasts 4-28 days. The adult escapes by cutting a circular hole in the seed coat and such grains can be spotted easily. The average life-span of an adult is 5-20 days. The insect passes through 7-8 overlapping generations in a year.

Damage symptoms



The adult and grub feed on the grain by making a small hole. Infested stored seed can be recognized by the white eggs on the seed surface and the round exit holes with the 'flap' of seed coat. Kabuli types are particularly susceptible.

5. Cigarette beetle: *Lasioderma serricorne* (Anobiidae: Coleoptera)

Bionomics



Adult light brown round beetle with its thorax and head bent downwards and this presents a strongly humped appearance to the insect. The elytra have minute hairs on them. Antenna is of uniform thickness. The creamy white oval eggs are laid on the surface of stored material and the incubation period is 9- 14 days. The larval and pupal periods range respectively from 17 – 29 days and 2-8 days. Grub whitish hairy grub.

Damage symptoms

Both grubs and adults bore into tobacco products viz., cigarettes, cheroots and chewing tobacco. Presence of circular pin head sized bore holes on processed tobacco is the typical symptom of attack. It also attacks the grain of wheat, peanut, cocoa, bean, cotton seed etc.

6. Drug store beetle: *Stegobium paniceum* (Anobiidae: Coleoptera)

Bionomics



Adult reddish striated elytra and Antenna is clubbed. It of 10 – 40. Grub is not

brown small beetle has measured 3 mm long. lays the eggs in batches hairy but is pale white,

fleshy with the abdomen terminating in two dark horny points. LP: 10 – 20 and PP: 8 -12 days.

Damage symptoms

Circular pin-head sized bore hole on turmeric, coriander, ginger, dry vegetable and animal matter.

7. Tamarind beetle: *Pachymeres gonagra* (Bruchidae: Coleoptera)



Small grey coloured adult. makes circular holes on fruits of tamarind both in tree and storage.

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

Bionomics



Whitish apodous with brown head. Adult is slender ant like with a long snout and shiny black with reddish brown thorax and legs. Grubs and adults bore into the tubers and make them unfit for consumption. Damage occurs both in field and storage

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

Bionomics

Larva is pale greenish. Adult is small with narrow fringed wings; forewings grey brown with dark spots and hindwings dirty white. Damage occurs both in field and storage. Tubers bored by caterpillars associated with fungal or bacterial infection



10. Arecanut beetle: *Araecerus fasciculatus* (Anthribidae: Coleoptera)

Bionomics

Adult is grey brown.



Damage symptoms

Internal content is eaten leaving outer coat intact. Causes more contamination than the actual damage. Coffee, cocoa, spices, maize, groundnut, brazilnut, dried cassava roots and processed foods.

External Feeders

1. Red flour beetle: *Tribolium castaneum* (Tenebrionidae: Coleoptera)

Distribution and status: Worldwide

Host range

Wheat-flour, dry fruits, pulses and prepared cereal foods, such as cornflakes.

Bionomics



The young larva is yellowish white and measures 1 mm in length. As it matures, it turns reddish yellow, be

The insect breeds from April to October and passes the winter mostly in the t stage. The females lay white eggs. The pupation takes place in the flour. The pupa is yellowish and hairy. The pupal stage lasts 5-9 days. The development period from egg to the adult is 26-30 days in summer

Damage symptoms

Both the larvae and adults cause damage. The greatest damage is during the hot and humid monsoon season. The larvae are always found hidden in the food. The adults, however, are active creatures, but mostly found concealed in flour. Adult construct tunnels as they move through flour and other granular food products. In severe infestation, the flour turns greyish and mouldy, and has a pungent, disagreeable odour making it unfit for human consumption.

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

Distribution and status: The pest is worldwide.

Host range

It infests grains, meals, breakfast foods, soybean, dried fruits, nuts, s, dried roots, herbs, dead insects, etc.

Bionomics

Larva is white, often tinged with green or pink, a light-brown head, On reaching maturity, the larva is 8-3 mm in length. The adult moth is about 13-20 mm in wing expanse with a coppery lustre.



Breeding continues throughout the year. The female moth lays 30-350 minute whitish ovate eggs, singly or in clusters, on or near the appropriate foodstuffs. The egg period is 2 days to 2 weeks depending upon weather. The larvae become full-grown in 30-35 days. They crawl up to the surface of the food material and pupate within a thin silken cocoon. The pupal stage lasts 4-35 days. In summer, the life-cycle is completed in 5 or 6 weeks and there are about 4-6 generations in a year.

Damage symptoms

Only the larva causes damage. Crawling caterpillars completely web over the surface of a heap of grains with silken threads. The adults fly from one bin to another and spread the infestation.

3. Almond Moth / Fig moth: *Ephestia cautella* (Pyralidae:Lepidoptera)

The pest is also known as the dried currant moth.

Distribution and status: Worldwide

Host range

It is a serious pest of dried fruits such as currants, raisons, dried apples, dates, berries, figs, almonds, walnuts, tamarind seeds, etc. It has also been recorded on lac, malted milk, dried mango, pulp, garlic bulbs, various cereal grains and grain products.

Bionomics



The adult moth has greyish wings with transverse stripes on the outer region and the wing expanse is about 12 mm. The female lays whitish eggs indiscriminately in cracks and crevices of the receptacles or on the food stuff. While feeding, the larvae spin tubes in the food material and are full-grown in 40-50 days. The full-grown larva is white with pinkish tinge and measures 1.5 cm. The larvae pupate inside the cocoons and pupal stage lasts about 12 days. The life cycle is completed in about two months and there are 5-6 generations in a year.

Damage symptoms

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

4. Rice moth: *Corcyra cephalonica* (Pyralidae: Lepidoptera)

Distribution and status

The rice moth is distributed in Asia, Africa, North America and Europe. In the larval stage, it is an important stored-grain pest in both India and Pakistan.

Host range

It also infests rice, sorghum, maize, gram, groundnut, cotton-seed, milled products, cocoa beans and raisins.

Bionomics



The rice moth is active from March to November. It passes winter in the larval stage. The moth lays eggs singly or in groups of 3-5



each on the grains, bags and on other objects in the godowns. A single female lays 62-150 eggs during its life-span of 24 days. The eggs hatch in 4-7 days and the larvae under silken web-like shelters,

preferring the partially damaged grains. They are full-fed in 21-41 days, after which they make silken cocoons among the infested grains. The pupal stage lasts 9-14 days and the adults live for - one week. They complete life-cycle in 33-52 days and the pest completes approximately 6 generations in a year.

Damage symptoms

The larvae alone damage the grains of rice and maize by feeding under silken webs. When infestation is high, the entire stock of grains may be converted into a webbed mass. Ultimately, a characteristic foul odour develops and the grains are rendered unfit for human consumption.

5. Khapra beetle: *Trogoderma granarium* (Dermestidae: Coleoptera)

Distribution and status: Worldwide

Host range

The Khapra beetle will attack any dried plant or animal matter. It prefers grain and cereal products, mainly wheat, barley, oats, rye, maize, rice, flour, malt, and noodles. It can also feed on animal products such as dead mice, dried blood, and dried insects

Bionomics

The insect breeds from April to October and hibernates in the larval stage from November to March in cracks and crevices. Female begins to lay white translucent eggs on the grains, singly or sometimes in clusters of 2 -5. The eggs are rather cylindrical, rounded at one end and narrow at the other. A female may lay 13 - 35 eggs in 1 - 7 days at the rate of 1 - 26 eggs per day. The egg period varies from 3 -10 days. Larval period is 20 - 40 days and pupal period is 4 - 6 days. Pupation takes place in the last larval skin among the grains. The adults are incapable of flying. There are 4-5 generations in a year.



Fresh yellowish-white larva grows 4mm long and turns brown. The adult is a small dark-brown beetle, 2-3 mm long, with a retractile head and clubbed antennae. The entire body is clothed in fine hairs.

Damage symptoms

The greatest damage is done in summer from July to October. The grubs eat the grain near the embryo or at any other weak point and from there proceed inwards. They usually confine themselves to the upper 50 cm layer of grains in a heap or to the periphery in a sack of grains.



They can reduce the grain to a mere frass. Since the larvae are positively thigmotactic, they can be collected by merely placing gunny bags on a heap of grain.

Secondary pest

1. Saw toothed grain beetle: *Oryzaephilus surinamensis* (Cucujidae: Coleoptera)

Bionomics

It is slender, dark, narrow, flattened beetle having a row of saw like sharp teeth on each side of the prothorax. The antenna is clubbed and elytra cover abdomen completely. It lays 300 whitish eggs loosely in cracks of storage receptacles of godown. The eggs period is 3 -17 days. The larva is slender, pale cream in colour with to slightly darken patches on each segment. The larval period is 14- 20 days. It pupates in a protective cocoon like covering with sticky secretion. The pupal period is 7-21 days.



Damage symptoms

It feed on grains, dried fruits etc by scarving of grain surface or burrowing holes in them. It attacks rice, wheat, maize, cereal products, oil seeds and dry fruits.



2. Long headed flour beetle: *Latheticus oryzae* (Tenebrionidae: Coleoptera)

Bionomics

Bionomics



The beetle is light brown in colour with longated body, measuring 2 -3 mm in length and resembles *Tribolium castaneum*. It lays 400 white eggs singly on grain and seams of the bags. The incubation period is 7 – 12 days. The grub is small, white active which feeds

voraciously. The larval period is 15-80 days. It pupates for 5-10 days. Life cycle is completed in 25 days at 35 ° and 70% relative humidity.

Resembles *Tribolium*. Head is longer in proportion to the body than that of *Tribolium*, paler and brighter than *Tribolium*.

Damage symptoms

Both grubs and adult beetles feed on the milled products. It occurs as secondary infestation in stored grain. It attacks cereal flour, packaged food, rice and rice products. Occurs as secondary infestation in stored sorghum, wheat, etc.

3. Flat grain beetle: *Cryptolestes minutus* (Cucujidae: Coleoptera)

Bionomics

It is smallest among the stored grain insect pests. It is light to dark reddish brown beetle measuring 1.5 mm to 2.0 mm. It lays white eggs loosely in flour, grain or crevices. The egg period is 5 days. The larva is cigar like yellowish white with two reddish brown spots at anal segment. The larval period is 21 days. It pupates in a gelatinous cocoon. The life cycle is completed in 42 days.

Damage symptoms

Both grubs and adults feed on broken grains or on milled products. In case of heavy infestation it cause heating in grain and flour. It attacks rice, maize, wheat with excessive broken, different flours, ground nut particularly with high moistures and mouldy grains.

4. Grain lice: *Liposcelis divinatorius* (Psocoptera)

Bionomics



It is pale grey or yellowish white coloured, small, pin head sized louse with filiform antenna. It lays about 7-60 eggs. The metamorphosis is incomplete.

Damage symptoms

They are scavengers affecting only germ portion in heavy infestation. It thrive on insect fragments and broken grains. It attacks all starchy material.

5. Grain mite: *Acarus siro* (Acarina)

Bionomics

It is pale straw to dark reddish about 100 eggs. The eggs are hatched into which moult into nymphs. There are 1-3



brown mite. It lays 6 legged larvae instars. The life cycle

is completed in 9-12 days at 23 ° C and 70 % relative humidity.

Damage symptoms

It feeds on the surface of the grains. It attacks cereal grains, flour and other eatables.

Minor Pests of Stored Grains

The other insect species recorded as minor pests on stored grains and products in India are the; the cadelle, *Tenebroides mauritanicus* (Trogossitidae: Coleoptera) and the black fungus beetle, *Alphitobius laevigatus* (Tenebrionidae: Coleoptera)

MANAGEMENT OF STORAGE PESTS

The effective management of storage pests may be ensured by drying the grains properly before storage, storing new grains in the clean godowns or receptacles and plugging all cracks, crevices and holes in the godowns thoroughly. If infestation of grain has already taken place, then application of chemicals becomes necessary.

1. Surface treatment

Disinfect old gunny bags by dipping them in 0.0125 per cent fenvalerate 20EC or cypermethrin 25EC for 10 minutes and drying them in shade before filling with grains or use new gunny bags. Disinfect empty godowns or receptacles by spraying 0.05 per cent malathion emulsion on the floor, walls and ceiling.

2. Seed treatment.

Mixing of malathion 5 per cent at the rate of 250 g per quintal of seed is recommended. The grains may also be treated with/25 ml of malathion 50 EC or 2 ml of fenvalerate 20EC or 1.5 ml of cypermethrin 25EC or 14 ml of deltamethrin 2.8EC per quintal of seed by diluting in 500 ml of water. Against pulse beetle (dhora), cover the pulses stored in bulk with 7 cm layer of sand or sawdust or dung ash.

3. Fumigation

Metallic drums or wooden boxes can be used for fumigating small quantities of grain. In India, ethylene dichloride and carbon tetrachloride mixture has been recommended for fumigation of foodgrains in storage at farm level, and hydrogen phosphide in the form of aluminium phosphide or methyl bromide for protection in warehouses, godowns and silos.

Mixture of ethylene dichloride and carbon tetrachloride at the rate of 1 litre for 20 quintals of grain or 35 litres per 100 m³ of space with exposure period of 4 days is recommended. Methyl bromide is used at the rate of 3.5 kg per 100 m³ of space with 10-12 hours exposure. The fumigant, hydrogen phosphide (aluminium phosphide), is available in tablet form and can be used at the rate of one tablet (3 g) per metric tonne or 25 tablets per 100 m³ of space with an exposure period of 7 days.

Use of improved storage receptacles:

The grains can be best protected by using improved insect-proof receptacles of various types.

(a) Indoor Bins

Domestic metal bins, Gharelu theka, Pucca kothi, Welded wire-mesh bin, Reinforced cement ring bins, Paddy straw-mud structure.

(b) Outdoor Bins

Flat and hopper bottom-metal bins, Composite bins, Partly underground and above ground structures, Seed storage bins, Ferro-cement bins, Pusa bin, Improved godowns, Bulk storage installations and Vacuum process storage.

INTEGRATED MANAGEMENT OF STORED PRODUCE PESTS

The control methods of stored produce pests can be categorized into preventive and curative measures.

Preventive measures

- Brush the cracks, crevices and corners to remove all debris in the godown.
- Clean and maintain the threshing floor/yard free from insect infestation and away from the vicinity of villages.
- Clean the machines like harvester and thresher before their use.
- Made the trucks, trolleys or bullock carts free from infestation.
- Clean the godowns/ storage structures before storing the newly harvested crop to eliminate various bio stages of pest hiding.
- Provide a metal sheet upto a height of 25 cm at the bottom of the wood in doors to arrest the entry of rats.
- Fix up wire meshes to windows, ventilators, gutters, drains etc., to prevent entry of rats, birds and squirrels.
- Remove and destroy dirt, rubbish, sweepings and webbings etc from the stores.
- Close all the rat burrows found in godown with a mixture of broken glass pieces and mud plastered with mud/ cement.
- Plaster the cracks, crevices, holes found on walls, and floors with mud or cement and white wash the stores before storing of grains.
- Provide dunnage leaving gangway or alleyway of 0.75 to 1 m all around to maintain good storage condition.
- Store the food grains in rat and moisture proof storage structures.
- Disinfest the storage structures receptacles by spraying malathion 50 EC @ 3 lit 100 m before their use.

Curative measures

i) Ecological methods

- Manipulate the ecological factors like temperature, moisture content and oxygen through design and construction of storage structures/ godown and storage to create ecological conditions unfavourable for attack by insects.
- Temperature above 42⁰ C and below 15⁰ C retards reproduction and development of insect while prolonged temperature above 45⁰ C and below 10⁰ C may kill the insects.
- Dry the produce to have moisture content below 10% to prevent the buildup of pests.

- Kill the pests bio stages harbored in the storage bags, bins etc., by drying in the sun light.
- Store the grains at around 10 % moisture content to escape from the insects attack.
- Manipulate and reduce oxygen level by 1% to increase the CO₂ level automatically, which will be lethal to all the stages of insects.

ii) Physical methods

- Provide a super heating system by infrared heaters in the floor mills and food processing plants to obtain effective control of pests since mostly the stored produce insects die at 55 –60°C in 10 – 20 minutes.
- Modify the storage atmosphere to generate low oxygen (2.4% and to develop high carbon di oxide (9.0 – 9.5) by adding CO₂ to control the insects.
- **Seed purpose:** Mix 1 kg of activated kaolin (or) lindane 1.3 D (or) malathion 5 D for every 100 kg of seed and store/pack in gunny or polythene lined bags.
- **Grain purpose:** Mix 1 kg activated kaolin for every 100 kg of grain and store. To protect the pulse grains, mix activated kaolin at the above dosage or any one of the edible oils at 1 kg for every 100 kg of grain or mix 1 kg of neem seed kernel for every 100 kg of cereal / pulse and store.
- Do not mix synthetic insecticides with grains meant for consumption.

iii) Cultural methods

- Split and store pulses to escape from the attack by pulse beetle since it prefers to attack whole pulses and not split ones.
- Store the food grains in air tight sealed structures to prevent the infestation by insects.

iv) Mechanical methods

- Sieve and remove all broken grains to eliminate the condition which favour storage pests.
- Stitch all torn out bags before filling the grains.

v) Chemical methods

- Treat the walls, dunnage materials and ceilings of empty godown with malathion 50 EC 10 ml/L (or) DDVP 76 WSC 7 ml/L1 at 3 LI spray solution/10 sq.m.
- Treat the alleyways and gangways with malathion 50 EC 10 ml/L or DDVP 76 WSC 7 ml/ L (1 L of spray fluid/270 m³).
- Spray malathion 50 EC 10 ml/ L with @ 3 L of spray fluid / 100 m² over the bags.
- Do not spray the insecticides directly on food grains.
- Use knock down chemicals like lindane smoke generator or fumigant strips pyrethrum spray to kill the flying insects and insects on surfaces, cracks and crevices.
- Use seed protectants like pyrethrum dust, carbaryl dust to mix with grains meant for seed purposes only.
- Decide the need for shed fumigation based on the intensity of infestation.

- Check the black polythene sheets or rubberized aluminium covers for holes and get them ready for fumigation.
- Use EDB ampoules (available in different sizes 3 ml, 6 ml, 10 ml, 15 ml and 30 ml) at 3 ml/quintal for wheat and pulses and 5 ml/ quintal for rice and paddy (Do not recommend EDB for fumigation of flour oil seeds and moist grains)
- Use EDCT (available in tin containers of 500 ml, 1 liter and 5 litres) at 30 – 40 litres/ 100 cubic meter in large scale storage and 55 ml/quintal in small scale storage.

FUMIGATION

Use fumigants like ethylene dibromide (EDB), ethylene dichloride carbon tetra chloride (EDCT), aluminium phosphide (ALP) to control stored produce pests effectively. Apply aluminum phosphide (available in 0.6 g and 3 gram tablets) @ 3 tablets (3 gram each) per tonne of food grains lot with help of an applicator. Choose the fumigant and work out the requirement based on the following guidelines.

- 3 tablets of aluminum phosphide 3 g each per tonne of grain.
- 21 tablets of aluminium phosphide 3 g each for 28 cubic meters
- Period of fumigation is 5 days

Mix clay or red earth with water and make it into a paste form and keep it ready for plastering all round the fumigation cover or keep ready sand snakes. Place the required number of aluminium phosphide tablets in between the bags in different layer. Cover the bags immediately with fumigation cover. Plaster the edges of cover all round with wet red earth or clay plaster or weigh down with sand snakes to make leaf proof. Keep the bags for a period of 5-7 days under fumigation based on fumigant chosen. Remove the mud plaster after specified fumigation periods and lift cover in the corner to allow the residual gas to escape. Lift the cover after few hours to allow aeration.

STORED GRAIN PESTS

1.	Presence of irregular holes of 1.5 mm diameter on grains of rice, sorghum, wheat, barley, maize in storage is due to attack by _____ Rice weevil: <i>Sitophilus oryzae</i>
2.	Identify the pest- Dark brown beetle with head bent under the thorax; cover covered by a crenulated hood-shaped pronotum and the posterior abdominal end blunt . Lesser grain borer: <i>Rhyzopertha dominica</i>
3.	Identify the pest- Brownish grey colored beetle with truncate elytra, having elevated ivory like spots near the middle of dorsal side. Pulse beetle: <i>Callosobruchus maculatus (chinensis)</i>
4.	Name a storage pest on tobacco Cigarette beetle: <i>Lasioderma serricorn</i>
5.	Adult is slender ant like with a long snout and shiny black with reddish brown thorax and leg. Sweet potato weevil: <i>Cylas formicarius</i>
6.	Name two lepidopterous storage pest - Angoumois grain moth: <i>Sitotroga cerealella</i>, Indian meal moth: <i>Plodia interpunctella</i>

7.	Damage by potato tuber moth (<i>Phthorimoea operculella</i>) occurs both in field and storage- Say true or false
8.	Name a storage pest on arecanut, coffee and cocoa - Arecanut beetle: <i>Araecerus fasciculatus</i>
9.	Gaseous quinones released to the medium produces a readily identifiable acid odour in heavy infestations of _____ Red flour beetle: <i>Tribolium castaneum</i>
10.	Long headed flour beetle: <i>Latheticus oryzae</i> resembles _____ <i>Tribolium castaneum</i>
11.	Name some storage pests belonging to Tenebrionidae - Red flour beetle, Long headed flour beetle
12.	Name the family to which Angoumois grain moth and potato tuber moth belong - Gelechiidae
13.	Name a dermestid storage pest - Khapra beetle
14.	<i>Pachymeres gonagra</i> is a storage pest of _____ Tamarind
15.	Aluminium phosphide is used @ of _____ per ton of food grains. 3 tablets of aluminum phosphide 3 g each
16.	Malathion 50 EC should be sprayed over the gunny bags in 100 m ² at _____ 10 ml/ L with @ 3 L of spray fluid
17.	Pulses for storage should be mixed with ----- kg of edible oil/activated clay for every 100 kg one
18.	Saw toothed grain beetle is a primary / secondary feeder
19.	Name the pests that occur both in the field and storage Rice weevil, pulse beetle, tamarind beetle, Angoumois grain moth, sweet potato weevil and Potato tuber moth
20.	Merely placing the gunny bags on the heap of grains helps in the collection of _____ Khapra beetle <i>Trogoderma granarium</i>
21.	Adults of _____ are powerful fliers and can move across godowns Lesser grain borer <i>Rhizopertha dominica</i>
22.	Angoumois grain moth is an internal/external feeder
23.	Rice moth <i>Corcyra cephalonica</i> is an internal/external feeder
24.	_____ is not recommended for fumigation of flour oil seeds and moist grains EDB
25.	Pulse beetle prefers whole pulse/split pulse