PRACTICAL MANUAL

PESTS OF FIELD CROPS

ENT- 509 3(2+1)

M.Sc. (Ag.) Entomology

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Syllabus ENT 503 3(2+1): Field visits, collection and identification of important pests and their natural enemies; detection and estimation of infestation and losses in different crops; study of life history of important insect pests.

Name of Student .....

Roll No. .....

Session .....

Semester .....

Course Name: .....

Course No. : .....

Credit .....

CERTIFICATE

This is to certify that Shri./Km. .....ID No..... has completed the practical of course.....course No. ..... as per the syllabus of M.Sc. Agriculture ..... semester in the year.....in the respective lab/field of College.

Date

Course Teacher

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Suggested Readings

1. A.S. Atwal and G.S. Dhaliwal: Agricultural Insect pests of South Asia and their Management
2. B.V. David and V.V. Rammurthy: Elements of Economic Entomology
3. Manishekharan and Sudarrajan: Pest Management in Field Crops
4. Pedigo L.P.: Entomology and Pest Management
5. Venu Gopal Rao: Insect Pest Management

Practical No. 1

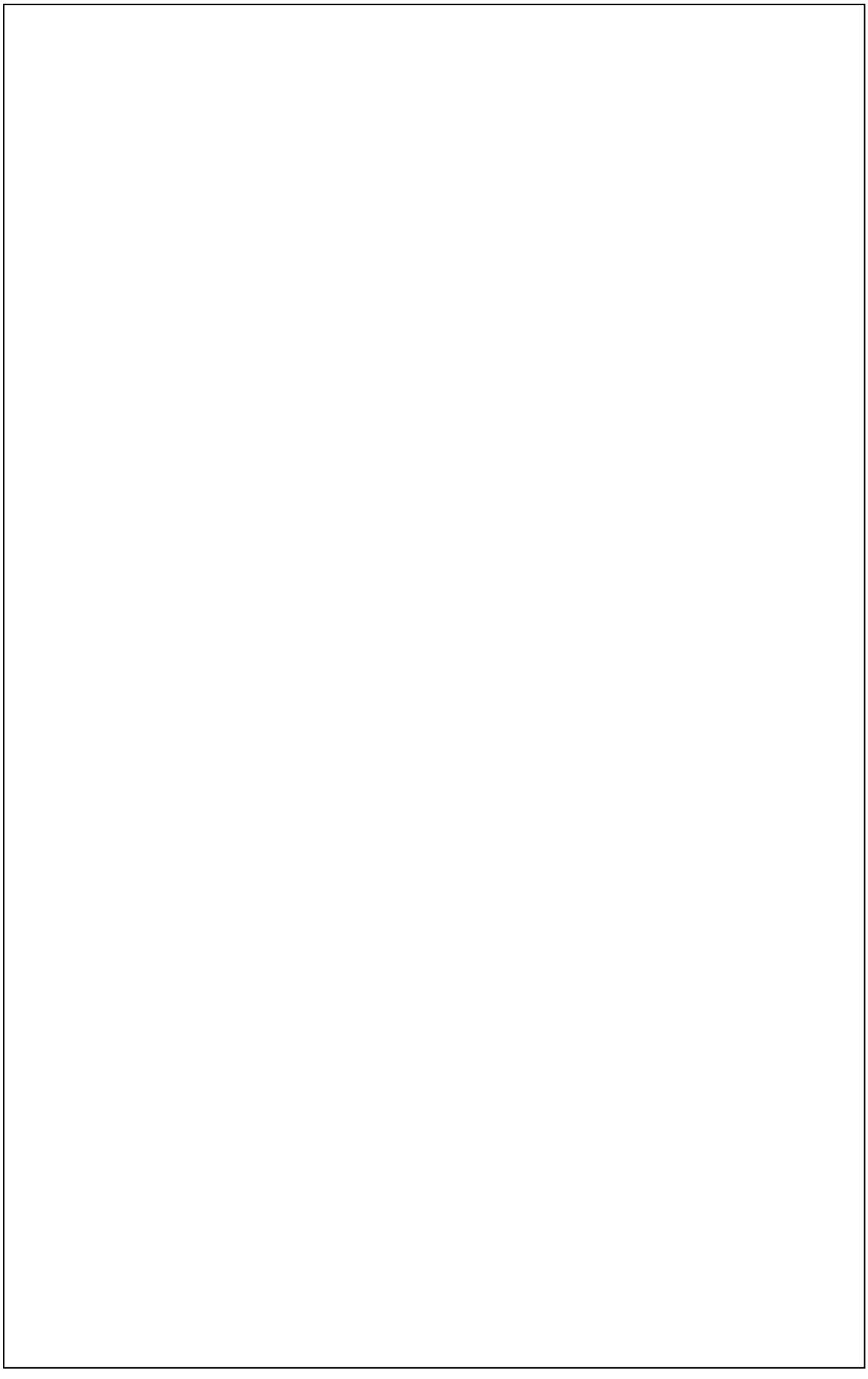
Objective: To identify insect pests attacking rice crops

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

Common name	Scientific name	Family & Order	Damaging symptoms
Rice stem borer	.....	.....	.....
Gall midge	.....	.....	.....
Green leaf hopper	.....	.....	.....
Brown plant hopper	.....	.....	.....
Rice earhead bug	.....	.....	.....
Rice leaf folder	.....	.....	.....
Rice caseworm	.....	.....	.....

Rice grasshopper	....	....	....

Diagram of major insect pests of rice



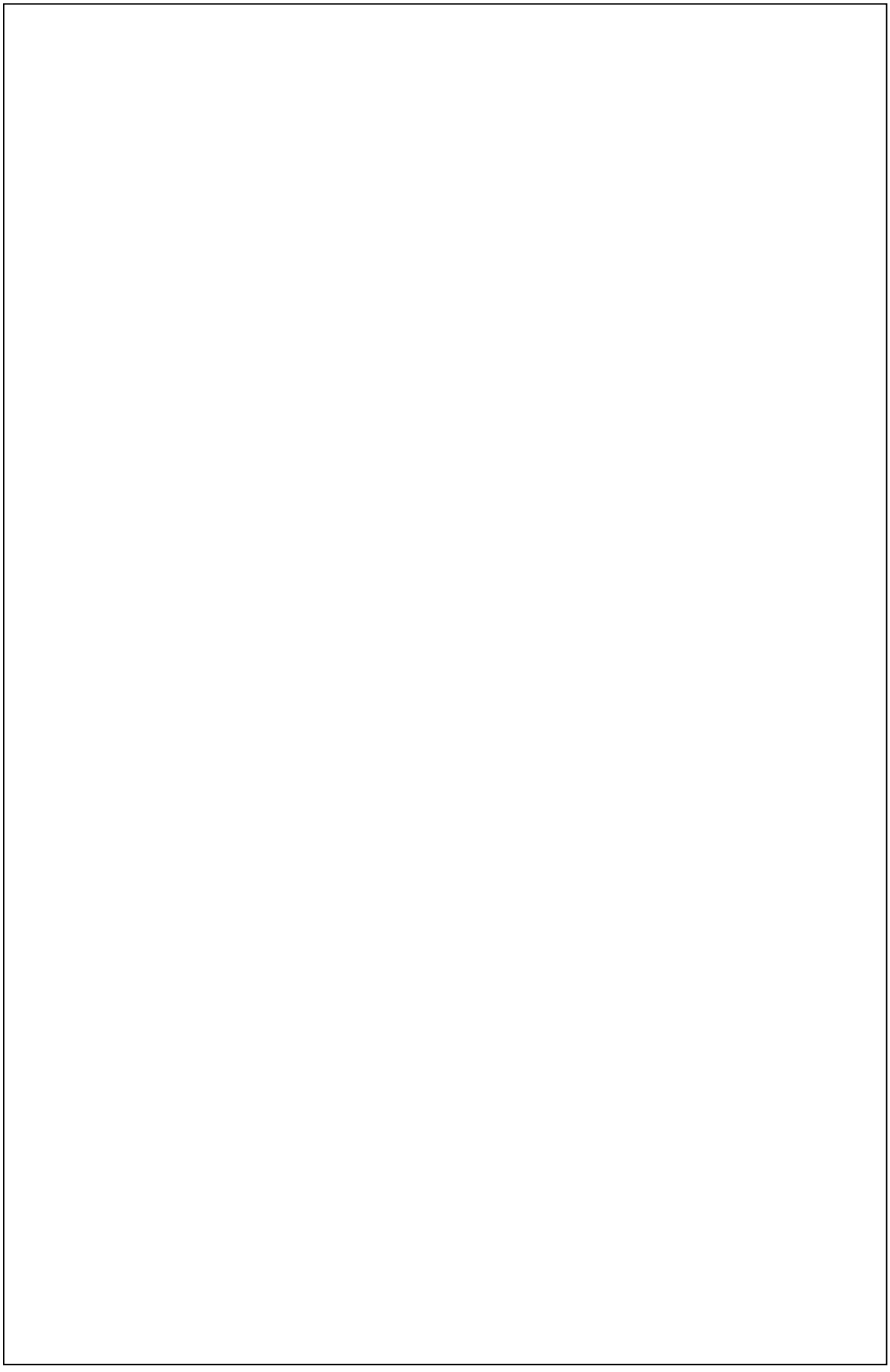
Practical No. 2

Objective: To identify insect pests attacking maize and sorghum crops

Activity: Observe and enlist major pests attacking maize and sorghum crops. Draw a neat diagram of important pests of maize and sorghum crops

Common name	Scientific name	Family & Order	Damaging symptoms
Stem borer	.....	.....	.....
Fall Army worm	.....	.....	.....
Shoot Fly	.....	.....	.....
Shoot Bug	.....	.....	.....
Sorghum Midge	.....	.....	.....

Diagram of major pests of maize and sorghum crops



Practical No. 3

Objective: To identify insect pests attacking wheat and barley crops

Activity: Observe and enlist major pests attacking wheat and barley crops. Draw a neat diagram of important pests of wheat and barley crops

Common name	Scientific name	Family & Order	Damaging symptoms
Wheat Aphid	.....	.....	.....
Climbing cutworm/ armyworm	.....	.....	.....
Ghujhia Weevil	.....	.....	.....
Termite	.....	.....	.....

Diagram of major pests of wheat and barley crops

Practical No. 4

Objective: To identify insect pests attacking Pigeon pea crop

Activity: Observe and enlist major pests attacking Pigeon pea crop. Draw a neat diagram of important pests of Pigeonpea crop

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
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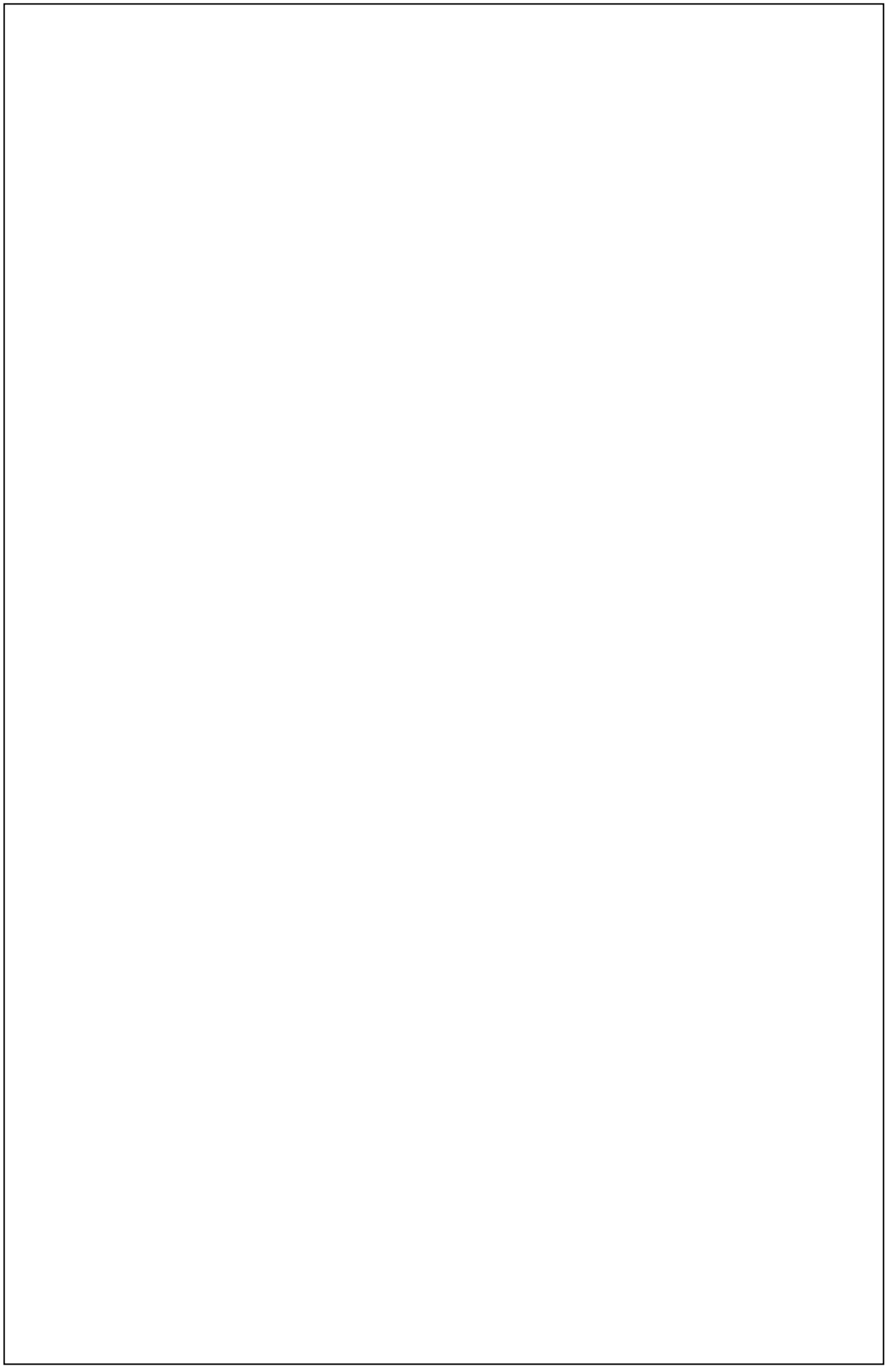
Diagram of major pests of pigeonpea crop



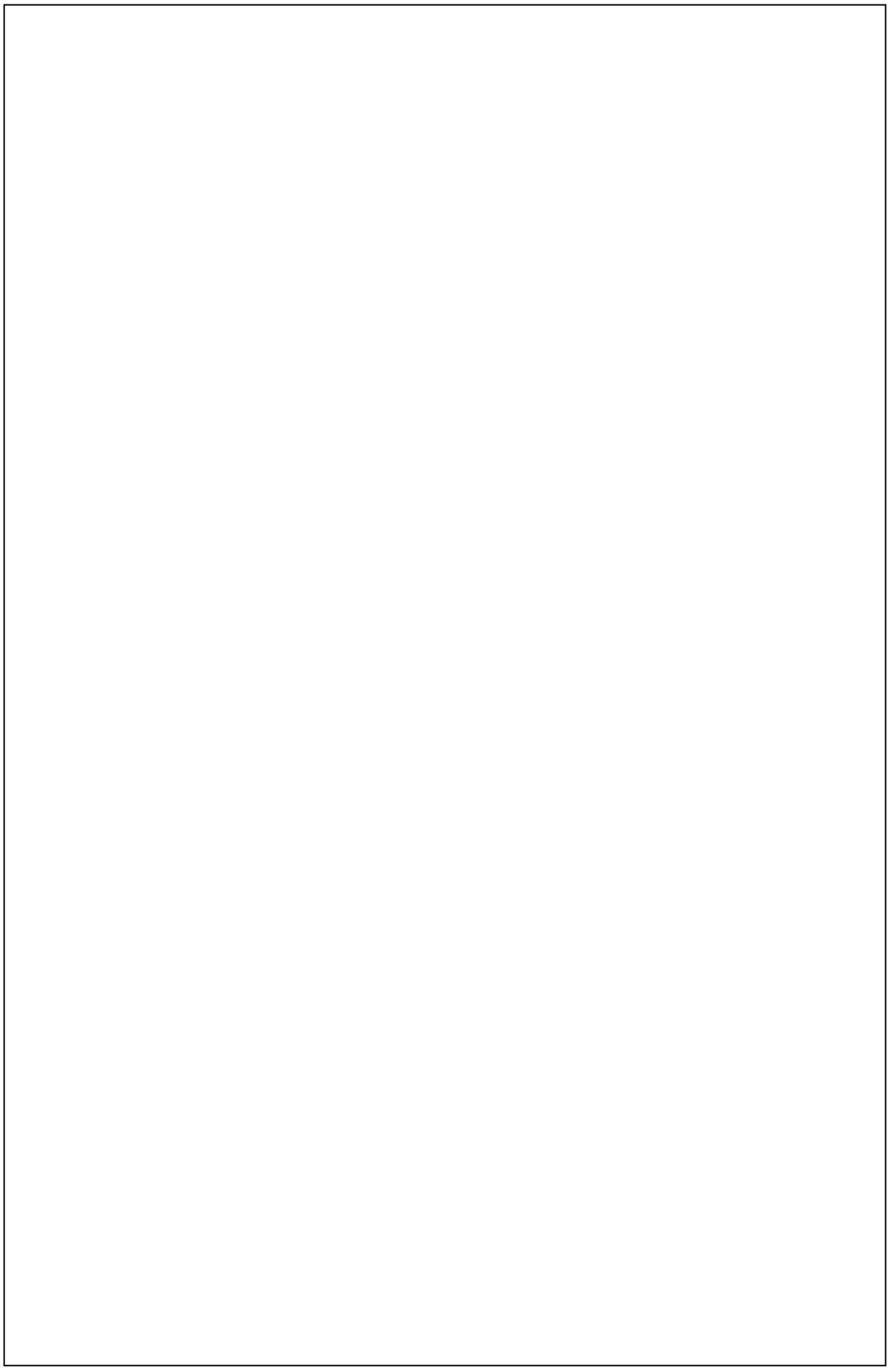
Practical No. 5

Objective: **To identify insect pests attacking chickpea crop**

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

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of chickpea crop



Practical No. 6

Objective: To identify insect pests attacking Mungbean, Urdbean, Cowpea and Pea crop

Activity: Observe and enlist major pests attacking Mungbean, Urdbean, Cowpea and Pea crop. Draw a neat diagram of important pests of Mungbean, Urdbean, Cowpea and Pea crop

Common name	Scientific name	Family & Order	Damaging symptoms
	……	……	……
	……	……	……
			……
	……	……	……
	……	……	……
			……
	……	……	……
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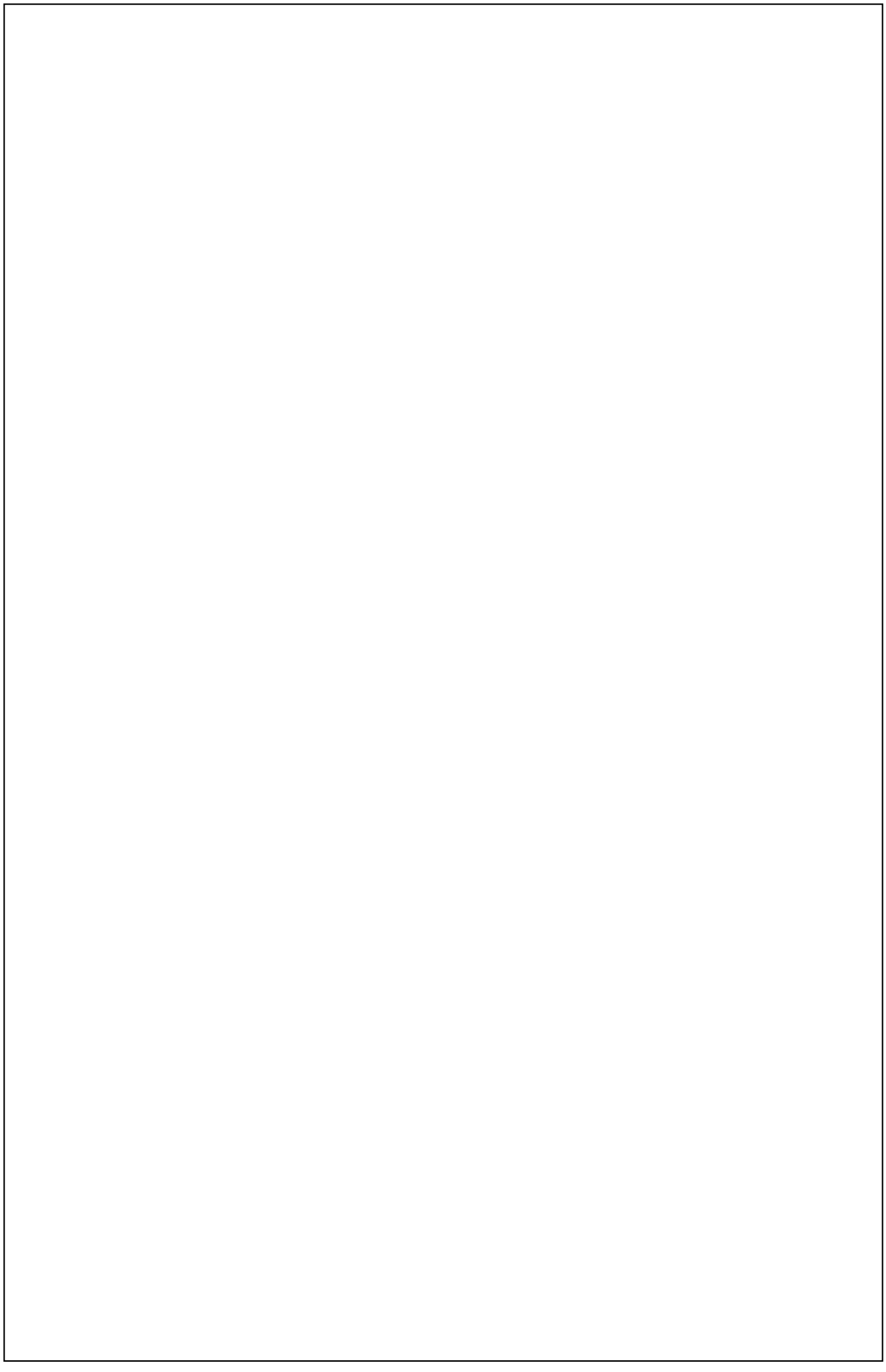
Diagram of major pests of Mungbean, Urdbean, Cowpea and Pea crop



Practical No. 7

Objective: To identify insect pests attacking Groundnut crop

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

Common name	Scientific name	Family & Order	Damaging symptoms
	……	……	……
	……	……	……
	……	……	……
	……	……	……
	……	……	……
	……	……	……
	……	……	……
	……	……	……
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	……	……	……
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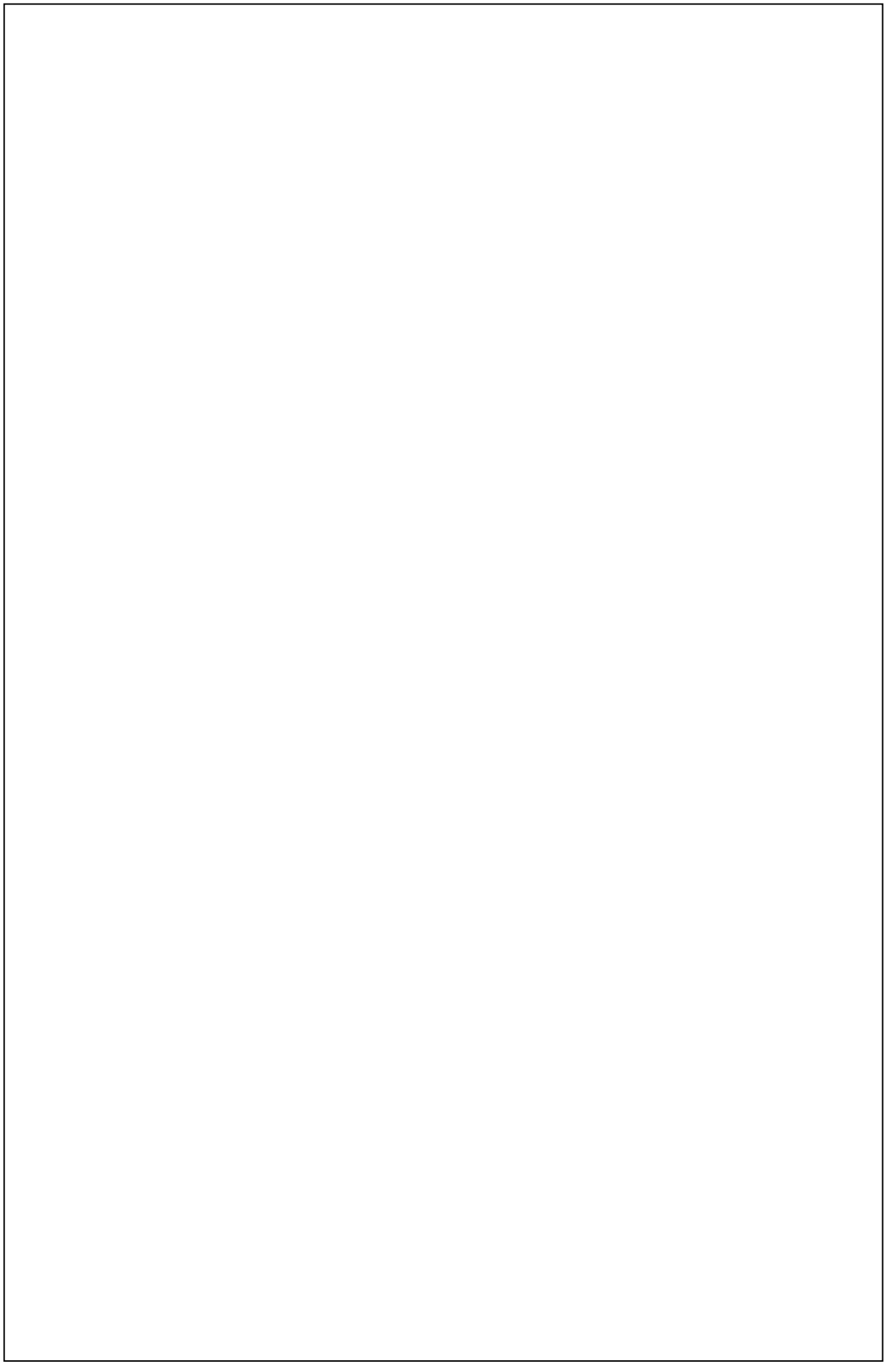
Diagram of major pests of Groundnut crop



Practical No. 8

Objective: To identify insect pests attacking castor crop

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

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of castor crop

Practical No. 9

Objective: To **identify insect pests attacking sunflower crop**

Activity: Observe and enlist major pests attacking sunflower crops. Draw a neat diagram of important pests of sunflower crop.

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of sunflower crop

Practical No. 10

Objective: To identify insect pests attacking Safflower, Mustard and Linseed crops

Activity: Observe and enlist major pests attacking Safflower, Mustard and Linseed crops. Draw a neat diagram of important pests of Safflower, Mustard and Linseed crops

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of Safflower, Mustard and Linseed crops

Draw the life cycle of castor semilooper

Diagram of damaging symptoms of head borer

Practical No. 11

Objective: **To identify insect pests attacking Sesamum and Niger crops**

Activity: Observe and enlist major pests attacking Sesamum and Niger crops. Draw a neat diagram of important pests of Sesamum and Niger crops

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of Sesamum and Niger crops

Practical No. 12

Objective: **To identify insect pests attacking Soybean crop**

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

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major pests of Soybean crop

Practical No. 13

Objective: **To identify sucking pests of cotton**

Activity: Observe and enlist major sucking pests attacking Cotton crop. Draw a neat diagram of important sucking pests of Cotton crop.

Common name	Scientific name	Family & Order	Damaging symptoms
	……	……	……
	……	……	……
			……
	……	……	……
	……	……	……
			……
	……	……	……
	……	……	……
			……
	……	……	……
	……	……	……
			……

Diagram of major sucking pests of Cotton crop

Practical No. 14

Objective: **To identify bollworm pests of cotton**

Activity: Observe and enlist major bollworm pests attacking Cotton crop. Draw a neat diagram of important bollworm pests of Cotton crop.

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major bollworm pests of Cotton crop

Practical No. 15

Objective: **To identify borer pests of sugarcane**

Activity: Observe and enlist major borer pests attacking Sugarcane crop. Draw a neat diagram of important borer pests of Sugarcane crop.

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major borer pests of Sugarcane crop

Practical No. 16

Objective: **To identify sucking pests of Sugarcane**

Activity: Observe and enlist major sucking pests attacking Sugarcane crop. Draw a neat diagram of important sucking pests of Sugarcane crop.

Common name	Scientific name	Family & Order	Damaging symptoms
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……
	…… ……	…… ……	…… …… ……

Diagram of major sucking pests of Sugarcane crop

Practical No. 17

Objective: **Field visit for identifying major insect-pests**

Activity: The students will collect major insect-pest during the field visit and give its description.

Practical No. 18

Objective: **Field visit for identifying major insect-pests**

Activity: The students will collect major insect-pest during the field visit and give its description.

INSECT PESTS OF RICE

S. No.	Common Name	Scientific Name	Family	Order
Stem boring insect				
1	Paddy stem borer	*Scirpophaga incertulas*	Pyralidae	Lepidoptera
Foliage Insect pests				
Sucking insects				
2	Green leaf hopper	*Nephotettix virescens*; *N. nigropictus*	Cicadellidae	Hemiptera
3	Brown plant hopper	*Nilparvata lugens*	Delphacidae	Hemiptera
4	White backed plant hopper	*Sogatella furcifera*	Delphacidae	Hemiptera
Chewing insects				
5	Paddy gall fly	*Orseolia oryzae*	Cecidomyidae	Diptera
6	Paddy blue beetle	*Leptispa pygmaea*	Chrysomelidae	Coleoptera
7	Rice hispa	*Dicladispa armigera*	Chrysomelidae	Coleoptera
8	Swarming caterpillar	*Spodoptera mauritia*	Noctuidae	Lepidoptera
9	Paddy leaf roller	*Cnaphalocrocismedinalis*	Pyralidae	Lepidoptera
10	Rice caseworm	*Nymphula depunctalis*	Pyralidae	Lepidoptera
11	Gundhi bug	*Leptocorisa acuta*	Alydidae	Hemiptera
12	Paddy grass hopper	*Hieroglyphus banian*	Acrididae	Orthoptera

Paddy stem borer (*Scirpophaga incertulas*)

Marks of identification: **Egg** - Laid in a mass and covered with buff coloured hairs. **Larva -** Pale yellow with dark brown head. **Pupa** - White silken cocoon. **Adult –** wingspan of 2.5cm Female moth - bright yellowish brown fore wings with a black spot possess a tuft of yellow hairs Male moth - Smaller with pale yellow forewings without black spot.

Host range: It is a monophagous pest and wild varieties of paddy.

Biology: Fecundity 100-200 long whitish eggs in clusters (80-150 eggs per cluster) near the tip on the upper surface of the leaves covered by brownish hairs. They hatch in about a week and larvae initially feed on the tender leaves and then bore into the stem. Larval period- 4 to 5 weeks. Pupation takes place in the stem. The moths emerge in 8 to 10 days. Life cycle- about two months. There are 3-5 generations in a year. The pest hibernates in larval/ pupal stages in the stubbles.

Nature of damage: The caterpillars initially feed on the tender leaves and then bore into the stem and feed internally thus causing death of central shoot called “dead heart”. When the attack is in seedling stage, seedling is killed, whereas during tillering stage, dead heart formed tiller gets damaged. If they attack the crop in the later stage, the plants bear empty ears, locally known as ‘Palinj’ or white ear head.

Green leaf hopper (*Nephotettix virescens*, N. *nigropictus*)

Marks of identification: The hoppers are wedge-shaped and green in colour measuring 4 to 5 mm in length. The adult is also green in colour with blackish apical margin and a black spot on each forewing. The nymphs are also greenish in colour but are smaller and wingless.

Host range: Paddy and grasses.

Biology: The female inserts the eggs in two rows on either side of mid-rib or leaf sheath. A female lays about 420 eggs in 44 egg masses. The egg period is about 4 to 8 days. The nymphs develop into adults in 15 to 20 days, passing through 4 to 5 nymphal instars. One generation is completed in about 18 to 25 days. There are about six overlapping generations from March to November. The insect overwinters in adult stage.

Nature of damage: Both nymphs and adults of green hopper suck the cell sap from leaves. In case of serious attack, leaves initially become pale yellow, later on turn brown and ultimately wither, without producing ears. However, when the attack during ear head emergence stage, the pest devitalizes the plants and grain filling is adversely affected and proportion of incompletely filled grain is increased. Vector for the diseases viz., Rice tungro virus, rice yellow & transitory yellowing.

Plant hoppers (*Nilparvata lugens, Sogatella furcifera*)

Marks of identification:

Brown plant hopper: Nymphs are initially pale yellowish and turn brownish later. Adults are Brown body and chestnut brown eyes. It has two forms viz., (Macropterous (long winged) and brachypterous (short winged) and measure about 3 to 4

mm in length. It is vector of grassy stunt, ragged stunt and wilted stunt diseases.

White backed plant hoppers: Nymphs are initially dull white and turn yellowish as they grow with black patches on the dorsal margin of tapering abdomen. The newly formed adults are greyish, turning yellowish brown subsequently. Adults measure 3 to 4 mm in length. The dorsal region of pro and mesothorax i.e. back is creamy white longitudinally and lateral sides are blackish. The wings are also yellowish brown. The wings of both the plant hoppers slope over the sides of the body when at rest.

Host range: Graminaceous weeds associated with rice crop and haryali are most preferred parallel hosts.

Biology: Both the plant hoppers have almost similar life style. The female adult deposits the eggs in a single row in batches inside the leaf sheath or on lower side of the leaf midrib by making the incision in the tissues. The eggs are minute, cylindrical creamy white initially and turn somewhat yellowish before hatching. About 100 to 150 eggs are laid by a female. Incubation period lasts for 5 to 6 days during favourable conditions. The nymphs develop into adults in about two weeks and one generation is completed in 18 to 25 days. Brachypterous adults are formed during initial generations when ample food and preferred conditions exist. Macropterous adults are developed when migration becomes necessary.

Nature of damage: Both the plant hoppers have a peculiar habit of attacking the crop from the middle of the field. Both nymphs and adults suck the plant sap from the leaf sheath. Attacked plants turn yellowish with drying of the leaves from the tips. Later plants wither and dry up. Thus circular damage patches are noticed in the field spreading all around if pest is not controlled in time and such circular reddish brown patches are called as "hopper burn".

Paddy gall fly (*Orseolia oryzae*)

Marks of identification: **Egg:** Reddish, elongate, tubular eggs just near the ligule of the leaf blade**. Larva**: Maggot is pale to red colour feeds inside the gall**. Pupa:** pupates at the base of the gall and moves to tip of the gall. **Adult:** Adult is orange coloured mosquito like fly. Adults feed on dewdrops.

Host range: Wild rice, such as *Oryza rufipogon* are common alternate hosts.

Biology: The adults are nocturnal and hide during the day. The females lay small batches of eggs (up to 6) on the undersides of rice leaves. The tiny larvae crawl down the leaf sheath till the leaf axil where they bore their way into the stem. After feeding for about 10 days and forming a pupa pupate inside. Four to seven days later they use spines on the tip of the abdomen to make a hole in the gall near its tip. Here the adult insects emerge. They live for 3-4 days, and there may be as many as 8 generations of midge in the year.

Nature of damage: The larvae of the rice gall midge irritate the tissues of the rice plant which forms a gall commonly known as a silver shoot or onion shoot. This is a pale cylindrical, hollow tube with a green tip replacing the normal culm (stem). The gall is formed from the walls of the leaf sheath growing together, after which the culm stops developing. The stem is stunted and the seed-head does not develop. When the adult insects emerge, the gall withers away and the shoot dies. The plant may respond by producing more tillers, but these usually become infected in their turn.

Paddy leaf roller (*Cnaphalocrocis medinalis)*

Marks of identification: The moth is very active, bright yellow or straw in colour with two distinct wavy lines in the fore wing and one wavy distinct line in the hind wing. It has a wing span of 15mm. Egg - Flat, oval in shape and yellowish white in colour. Larva - Greenish translucent and is 16.5mm long.

Host range: The larvae are considered a pest on rice, maize, wheat and sorghum.

Biology: Eggs are laid singly or in groups arranged in longitudinal rows on the undersurface of the leaves which are scaly white in color. Fecundity is about 56 eggs. Incubation period is 4–8 days. There are 5–6 larval instars, larval period is about 22–23 days. It pupates within the infested leaf fold for a period of 6–7 days. The total life cycle completed in about 5 weeks.

Nature of damage: Before feeding, Leaves fold longitudinally and a larva remains inside. Larvae scrapes the green tissues of the leaves and becomes white and dry. During severe infestation the whole field, exhibits scorched appearance.

Rice caseworm (*Nymphula depunctalis*)

Marks of identification: Adult: Moth is delicate white moth with pale brown wavy markings and is about 5 mm long. Individual egg is light yellow and has a smooth surface, circular, flattened, and measures 0.5 mm in diameter. Mature eggs are darker and develop two purplish dots. Larva - Pale translucent green with orange head. It has filamentous gills on the sides of the body. The larvae are found hanging from the leaf and measures upto 15mm long. The pupa is cream in color and about 5.5 mm long. Mature pupa is silvery white.

Host range: Rice and weeds in rice fields.

Biology: Eggs are laid on leaves and leave sheath in rows and batches. A female lays about 150 eggs which hatch in about

a week. The caterpillars undergo six instars and is characterized by the presence of tubular gills on its body. The gills become branched with the growth in the caterpillar's size. Larger cases are made by the succeeding larval instars. The larval stage pupates inside the last case. Before pupation the case is attached to the leaf sheath above the water level and it's both ends are plugged. The pupal period lasts for about a week, after which it is converted into an adult insect. The pest is active during the monsoon and there may be two or three broods in a season. The life cycle is completed in about 35-40 days.

Nature of damage: The early stages of the crop are damaged by the caterpillars. The leaf blades are eaten away completely leaving the mid rib only. Caterpillars feed on green tissues of the leaves and leave become whitish papery Tubular cases around the tillers by cutting the apical portion of leaves floating of tubular cases on the water. The weeds in rice field serves as alternate hosts.

Paddy gundhi bug (*Leptocorisa acuta*)

The rice gundhi bug is a common and important insect pest of rice. The bugs prefer to attack milk stage grains. The most common species of rice bug are *Leptocorisa oratorius* F. and *Leptocorisa acuta* Thunberg. It is generally distributed throughout India but is more prevalent in Bengal, Bihar, Uttar Pradesh and southern states.

Marks of identification: The bug is about 19 mm in length with long legs and antennae. Its body is slender and green or brown in colour. Eggs are laid on the leaves in groups of 10-20 in straight rows. Eggs are oval shaped and dark reddish brown. The nymph is slender, wingless and brownish green. As it grows up, the green colour deepens. The fully grown nymph is about 14-16 mm long.

Host range: Leptocorisa acuta feeds primarily on graminaceous plants such as rice, wheat, and sugarcane. It is thought that rice in the flowering stage/ attack milk stage grains is preferred. Other important hosts include many well- known weeds. Other reported hosts include mango, guava, jackfruit and beans.

Biology: The adults are crepuscular (active during the early morning and late afternoon). After 8-29 days, adults of both sexes are fully mature. Adults may live up to 69 days. A female lays up to 25-87 eggs over their life time. Eggs are deposited in single or double rows of 10 to 20 on the upper surfaces of the leaves of the host plant. After 6-8 days, the eggs hatch into nymphs. This stage continues for 17-23 days; after that nymph develops into an adult stage. This pest is more common during July to November. During winter their breeding rate is lowered much and the adults manage to tide over the cold on several species of grasses. On paddy it has five broods during the season.

Nature of damage: Both adults and nymphs suck fluid from young shoots, leaves, florets and soft grains using their piercing and sucking mouthparts. As a result, whitish spots appear at the site of feeding. Black or brown spots appear around the holes made by the bugs on which sooty mould may develop. The infested grains easily break during milling. Rice fields severely affected by the bug emit a repugnant smell, hence the name gundhi bug.

Rice Grasshopper (*Hieroglyphus banian*)

Marks of identification: In adult, the body is a shiny greenish yellow colour with three black lines on its upper side. In the early stages, the young are yellowish, with many reddish brown spots. They become greenish as they grow older.

Host range: Rice grasshoppers feed throughout the year on rice, maize, millet, sugarcane and other grasses.

Biology: Breeding season is from October to December. Eggs are laid in soil on the field bunds in the mass of 30 to 40. The hoppers emerge out in the month of June, after the first monsoon rain. They feed on the leaves of paddy or the grasses on the bund. The hoppers take 70 days in case of male and 80 days in case of females to become sexually mature.

Nature of damage: Both young and adult stages feed upon leaves and shoots of paddy. They also cut off the ear heads.

INSECT PESTS OF SORGHUM

S.No.	Common Name	Scientific Name	Family	Order
Seedling and stem boring Insect pests				
1	Jowar shoot fly	*Atherigona soccata*	Muscidae	Diptera
2	Jowar stem borer	*Chilo partellus*	Pyralidae	Lepidoptera
Earhead Insect pests				
3	Jowar earhead midge (midge fly)	*Contarinia sorghicola*	Cecidomyiidae	Diptera
4	Earheadcaterpillar	*Helicoverpa armigera*	Noctuidae	Lepidoptera

Jowar shoot fly *(Atherigona soccata*)

Marks of identification: The adult shoot fly looks like a general house fly, but it is smaller in size (3 mm long). It is dark grey in colour and there are 4 to 5 dark spots on dorsal side of abdomen. The eggs are elongate, flattened and somewhat boat shaped and is provided with two lateral projections. Maggots are apodous, tapering towards head. Fully developed

maggot is pale yellowish colored, measuring 10-12 mm in length.

Host range: Jowar and other millets.

Biology: Each female lays singly about 40 eggs mostly on the lower surface of the leaves or some time on tender stem of young plant. The eggs hatch within 2 to 3 days. The larval period lasts for 10 to 12 days. Pupation takes place inside the stem and it extends for about a week. After which the adult flies emerge and female starts laying eggs on other seedling. A generation is completed in 2 to 3 weeks and there are several generations in a year. The Insect pests carry over winters in larval or pupal stage in the stubbles.

Nature of damage: The shoot fly attacks the sorghum crop in the seedling stage only, starting its attack soon after germination and continuing up to 7th leaf stage. Damaging stage is maggot. The maggot on hatching from egg crawls down within the leaf sheath, till reaches the base of the seedling. Then it bores into the axis of the seedlings and feed on the central shoot. As a result, the central shoot becomes initially pale yellow and finally causing a characteristic dead heart. The earlier plants are almost dead. When the attacked plants are somewhat older, tillers are produced which mature later than main crop. The pest attack is more severe in case of late sown jowar varieties in the *Kharif* season (July- August sowing). Cloudy weather favours the multiplication of this pest and infestation is higher in irrigated fields.

Jowar stem borer (*Chilo partellus*)

Marks of identification: Moths are straw coloured with pale yellowish grey forewings, having minute dots on the apical margin. The hind wings are whitish. Wing expanse is about 25 mm. The caterpillars are dirty white in colour with brown head and many dark spots on the body. Full grown caterpillar measures about 12 to 19 mm in length, having 4 broad and patchy strips.

Host range: Although it is a principal pest of jowar and maize, it has also been recorded on sugarcane and some grasses.

Biology: A female lays about 300 creamy white coloured oval eggs in clusters overlapping each other in batches on under surface of the leaves, near midrib and occasionally on stalk. They hatch in about 6 days. Newly hatched caterpillars feed on tender leaves for a day or two and then bore into the central shoot and cause dead hearts. Larval stage lasts for about 3 to 4 weeks. The pupation takes place inside the stem. However before pupation the larva prepares a hole for the moth to come out. Pupal period lasts for 7 to 10 days. The adult lives for 2 to 4 days. Total life cycle is completed in 6 to 7 weeks. The pest is active from June to November and about 4 generations are completed in a year. The pest hibernates in the larval stage in stubbles or harvested stems.

Nature of damage: The newly hatched larvae crawl over the leaf for about 15-30 minutes and feed on the leaves and then enter the central whorl (Numerous small pin holes are seen in the leaf lamina) and feed there for one or two days. Thereafter, the larvae bore into the stem thereby causing the death of central shoot, commonly known as 'dead heart'. The midrib of leaves is often noticed mined by newly hatched larvae. However, in the later stage of crop the dead hearts are not formed even though larvae continue to bore the stem and tunnel them. The damage into the earlier stage of crop is more spectacular and causes more loss than in the grown-up crop. If the attack is continued during ear head stage the larvae bore into peduncles which may break by wind and affect grain filling.

Earhead midge (Sorghum midge fly) *(Contarinia sorghicola*)

Marks of identification: The adult fly is a slender bodied insect, measuring about 2 mm in length. The abdomen is bright orange in colour. The wings are transparent and when closed the wings extend, just beyond the tip of the abdomen. The maggots are creamy white when newly hatched, but later on turn orange red.

Host range: Jowar, pearl millet and other graminaceous plants like Sudan grass, Johnson grass.

Biology: Adult midges mate soon after emergence and each female lays about 30 to 100 eggs. The eggs are deposited in the flowering spikelets with her long ovipositor. Peak oviposition activity is observed from 8 to 10 a.m. and for about one hour before sunset. The females seldom live for more than a day, while the males live just a few hours. The eggs hatch in about 2 days. The full grown larvae are orange in colour and can be detected by the pale red fluid that exits from a crushed infested glume. Larval development requires 9 to 11 days and pupal period lasts for 3 days. In this way the complete life cycle may require 14 to 16 days and there may be 9 to 12 generations during a season. The midge overwinters in the larval stage in aborted spikelets within a cocoon. Some may remain in this stage of diapause, which is resistant to cold and desiccation, even upto 3 to 4 years.

Nature of damage: The newly hatched maggots feed on the developing ovary, resulting into complete or partial sterility. The injury can be easily noticed as it is stained with red colour.

Earhead caterpillar (*Helicoverpa armigera)*

Marks of identification: Moths stoutly built, light brown, medium sized, forewings with few dark specks near the margin,

hind wings lighter with smoky dark margins caterpillars greenish to brownish with scattered short white hairs and dark brown stripes along the sides of the body, 35 mm in length. Larva remains concealed in the inner branches of the ear and feeds on the grains.

Host range: It is polyphagous feeding on gram, cotton, tomato, peas, tobacco, maize, safflower etc.

Biology: Eggs are laid singly on tender part of the plant. Incubation period is 3-4 days. Larval period 3-4 weeks. Pupation takes place in soil, pupal period is 6-12 days. Carryover pest hibernate in pupal stage in soil. A generation is completed in about 5-7 weeks.

Nature of damage: Caterpillars feed voraciously on the tender parts of the plant and on the developing earheads. The damaged ears could be easily spotted in the field by chalky appearance due to partially eaten grains.

INSECT PESTS OF MAIZE AND PEARL MILLET

INSECT PESTS OF MAIZE

S. No.	Common Name	Scientific Name	Family	Order
1	Shoot fly	*Atherigona soccata*	Muscidae	Diptera
2	Stem borer	*Chilo partellus*	Pyralidae	Lepidoptera
3	Armyworm	*Mythimna separata*	Noctuidae	Lepidoptera
4	Fall armyworm	*Spodoptera frugiperda*	Noctuidae	Lepidoptera
5	Cob earworm	*Helicoverpa armigera*	Noctuidae	Lepidoptera

Armyworm (*Mythimna separate*)

Marks of identification: The forewings are greyish yellow with a dark-grey or reddish- yellow tinge. Round and reniform spots are light or yellowish with indistinct edges, whereas reniform spot with white point at lower margin. External wing margin blackened obliquely from top backward, with dark stroke and with a row of dark points. Hindwings are grey, with dark external margin. Larva has two wide black-brown and one intermediate light dorsal stripe, with black-brown lateral stripe along spiracle line.

Host range: Maize, sorghum, rice etc.

Biology: A female lays eggs on leaves on an average of 996 eggs after a pre-oviposition period of 2-5 days. Oviposition continues for 2-7 days after emergence. Egg incubation is 4-5 days. The larval period is about 20 days. Prepupal and pupal periods last for 1-2 and 8-12 days, respectively. The entire post-embryonic development was completed in 29-39 days.

Nature of damage: Caterpillars feed on leaves. Complete defoliation occurs in severe case. Caterpillars march like an army to neighbouring fields and hence the name army worms.

Fall armyworm (*Spodoptera frugiperda*)

Marks of identification: Forewing of male is shaded with gray and brown, with triangular white patch at the apical region and circular spot at the center of the wing. The forewings of female are uniform grayish brown to a fine mottling of gray and brown. The hind wings are silver-white with a narrow dark boarder in both male and female. Eggs are dorso-ventrally flattened, pale green to yellowish in colour. Full grown caterpillars are brownish black and had three dorsal lines and alight lateral lines. Black tubercles are found dorsally on the body which bears spines. The frons has a white inverted 'Y' line. Pupa is light brown in colour.

Host range: It is most commonly recorded from wild and cultivated grasses; from maize, rice, sorghum and sugarcane. It also damages to vegetable crops, cotton and soybean.

Biology: Female lays eggs in clusters on under or upper surface of leaves, base of the plant and also in whorls. Eggs are covered with scales. Incubation period is 2-3 days. Each larva passes through six instars for a period of 14019 days. Puapation takes place in soil. Pupal period is 9-12 days. Adult survives for 7-12 days. The total life cycle is completed in 32-46 days.

Nature of damage: Larvae cause damage by consuming foliage. Young larvae initially consume leaf tissue from one side, leaving the opposite epidermal layer intact. By the second or third instar, larvae begin to make holes in leaves, and eat from the edge of the leaves inward. Feeding in the whorl of corn often produces a characteristic row of perforations in the leaves. Older larvae cause extensive defoliation, often leaving only the ribs and stalks of corn plants, or a ragged, torn appearance. Larva sometimes burrows into the ear, feeds on kernels.

Corn earworm (*Helicoverpa armigera*)

Marks of identification: Eggs are spherical in shape and creamy white in colour, laid singly. Larva shows colour variation

from greenish to brown. It has dark brown grey lines on the body with lateral white lines. Pupa is rown in colour, occurs in soil, leaf, pod and crop debris. Light pale brownish yellow stout moth. Fore wings of adult is olive green to pale brown with a dark brown circular spot in the centre. Hind wings are pale smoky white with a broad blackish outer margin.

Host range: Polyphagous

Biology: Eggs are laid singly on tender part of the plant. Incubation period is 3-4 days. Larval period is 3-4 weeks. Pupation takes place in soil, pupal period 6-12 days. Carryover pest hibernate in pupal stage in soil. A generation is completed in about 5-7 weeks.

Nature of damage: Larva feeds on silk and developing grains.

INSECT PESTS OF PEARL MILLET

S.No.	Common Name	Scientific Name	Family	Order
1	Shoot fly	*Atherigona soccata*	Muscidae	Diptera
2	Blister beetle	*Zonabris pustulata*	Meloidae	Coleoptera

Blister beetle (*Zonabris pustulata*)

Marks of identification: The adults are large beetles, 25-35 mm long, with a bright conspicuous red or yellow and black patterned coloration. They are rather sluggish in behaviour but are strong fliers. It handled, adults exude an acrid yellow fluid containing cantharidin which cuases blisters on skin.

Host range: Bajara, pulses, okra, cotton etc.

Biology: Eggs are laid in soil in batches (2000). Eggs hatch into active triungulin larvae which feed on egg pods of grasshoppers. The later larval stages are often sluggish with a large body and reduced legs. An abundance of meloid beetles has often been noted following locust invasion.

Nature of damage: Adult beetles feed on flowers.

INSECT PESTS OF WHEAT AND MINORMILLETS

INSECT PESTS OF WHEAT

S. No.	Common Name	Scientific Name	Family	Order
1	Wheat stem borer	*Sesamia inferens*	Noctuidae	Lepidoptera
2	Aphid	*Rhopalosiphum maidis*	Aphididae	Hemiptera
3	Termite	*Odontotermes obesus*	Termitidae	Isoptera

Wheat stem borer (Pink borer) (*Sesamia inferens*)

Marks of identification: Caterpillar is about 25 mm long, flesh coloured (pinkish), smooth with dark spots on the slender body with red head capsule. Moths are small and straw coloured, forewings with marginal dark line and hind wings are pale white. Wing expanse is about 25-30 mm.

Host range: Wheat, maize and sugarcane.

Biology: Creamy white eggs are laid in clusters (upto 100 eggs) inside the leaf sheath. They hatch in 4 to 9 days. Newly hatched larvae disperse to the neighbouring plants and bore into the stem; they become full grown in 3 to 4 weeks. Pupation takes place inside the bored stem. The adults emerge out after 5 to 12 days. The total life cycle is completed in 6 to 7 weeks. Pest hibernates in larval stage in stubbles.

Nature of damage: The young larva after hatching from the egg, bores into the stem, causing death of the central shoot, commonly known as “dead heart”. If the incidence of the pest is noticed in flowering stage, the white ear-heads are formed.

Termites or White ants (*Odontotermes obesus*)

Marks of identification: These are social insects living in a colony. Polymorphic forms are noticed.

Reproductive caste (winged): They live in royal chambers.

Queen: Develops from fertilized eggs. It is much larger in size and has creamy white abdomen which is marked with transvere dark brown stripes. It lives for 5-10 years and lays thousands of eggs. King: Develops from unfertilized eggs. It is much smaller than queen and slightly bigger than workers. It is secondarily wingless insect.

Sterile caste (wingless):

Workers: Develop from fertilized eggs. They are whitish yellow. Head wider than reproductive castes. Mandibles are

stronger, meant for feeding on. They avoid light and need high humidity for their survival.

Soldiers: Develop from unfertilized eggs. They have large head and strongly chitinized sickle shaped mandibles, defend the colony by fighting. Mandibulate type soldiers.

Host range: Termites are polyphagous feeding on crops like wheat, sugarcane, groundnut, cotton, chillies, brinjal, fruit trees etc.

Biology: Soon after, first monsoon showers, the sexual forms leave their colony for nuptial flight during evening. After a short flight mating takes place, they shed their wings and the queen and king settle down in the soil. The female burrows in the soil, lay eggs and establish new colony. The queen gradually grows in size and starts egg laying very rapidly at the rate of one egg per second or 70,000 to 80,000 eggs in 24 hours. It lives for 5 – 10 years. It can live for several years also. There is only one queen in a colony. Incubation period is one week in summer and within 6 months larvae develop to form soldiers or workers. The reproductive castes when produced mature in 1-2 years.

Nature of damage: Worker termites feed on the roots and stem parts of the plants. This results in drying of the plants. Other forms do not cause any direct damage to the crop.

INSECT PESTS OF MINOR MILLETS

S.No.	Common Name	Scientific Name	Family	Order
1	Shoot fly	*Atherigona soccata*	Muscidae	Diptera
2	Wheat / ragi / pink stem borer	*Sesamia inferens*	Noctuidae	Lepidoptera
3	Spotted stem borer	*Chilo partellus*	Pyralidae	Lepidoptera
4	White stem borer	*Saluria inficita*	Noctuidae	Lepidoptera
5	Leaf / Plum/ Ragi aphid	*Hysteroneura setariae*	Aphididae	Hemiptera
6	Ragi root aphid	*Tetraneura nigriabdominalis*	Pemphigidae	Hemiptera

White stem borer (*Saluria inficita*)

Marks of identification: Adult is a medium sized dark brown moth with a pale white band along the costal margin of each forewing. The hind wings are white in colour. The caterpillar is creamy-white in colour.

Host range: Ragi

Biology: The female white stem borer lays the eggs near the tip of the leaf blade. The female lays eggs in batches of about 100 and are covered with silky greyish hairs; they resemble the eggs of the yellow stem borer. The incubation period is about 8 days. The larvae pupate in the stem.

Nature of damage: The caterpillar attacks the base of the tillers close to soil causing deadhearts. Oozing of the excreta from the bored hole is very conspicuous in the infested plants.

Leaf or Shoot aphid (*Hysteroneura setariae*)

Marks of identification: Leaf aphids are also called rusty plum aphid, as the name suggests is a brown, small aphid with dark cornicles.

Host range: Ragi leaf aphid is known to attack all graminaceous plants and other grasses

Nature of damage: Adult and nymphs of aphids suck the sap of the plant from the base of the spicklets, and spread to the entire plant. Resulting in reduced vigour of the plant and stunted growth, generally infestation starts from the border row and spreads. The infestation is alarming when appears on crop of less than a month old. The occurrence is during the months of August and September. When the crop is caught in dry spell, infestation continues throughout the crop growth stage. In severely infested plants even the earheads are fully covered by aphids.

Root aphid: (*Tetraneura nigriabdominalisi*)

Biology: 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.

Nature of damage: 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.

INSECT PESTS OF PIGEONPEA

S. No.	Common Name	Scientific Name	Family	Order
1	Pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
2	Tur plume moth	*Exelastis atomosa*	Pterophoridae	Lepidoptera

3	Tur pod fly	*Melanagromyza obtusa*	Agromyzidae	Diptera
4	Spotted pod borer	*Maruca testulalis*	Pyraustidae	Lepidoptera
5	Leaf webber	*Grapholita critica*	Tortricidae	Lepidoptera
6	Mite	*Aceria cajani*	Eryophyidae	Acarina

Tur pod caterpillar (Tur plume moth) (*Exelastis atomosa*)

Marks of identification: The moths are slender, about 12 mm long and are grey with long narrow wings. The fore wings are divided into two parts and the hind wings are cut into three parts and provided with fringed border. The full grown caterpillars are about 12 mm long greenish brown, covered with short hairs and spines.

Host range: Tur

Biology: A female lays 17-19 minute eggs on the tender shoots, leaves, flowers or podsand they hatch inabout 5 days. On hatching the caterpillars first scrape the surface of pods and gradually cut holes and thrust their heads into the pods and feed on seeds. They become full grown in about 4 weeks and pupate on the surface of the pods. The pupal period lasts for 2 weeks. The total life cycle is completed in about 7 weeks.

Nature of damage: The caterpillar cuts hole in pod, insert the head and feed from outside on developing seed.

Tur pod fly (*Melanagromyza obtusa*)

Marks of identification: Adult flies are black in colour and measure 2.75 mm in length. Full grown larva is creamy white, measuring 3.5 to 4 mm in length.

Host range: Various leguminous crops (Tur, soybean and cowpea).

Biology: The female fly lays about 79 eggs into tender pods. Eggs hatch in 3-8 days. Maggots feed on grains for 10-18 days and pupate in the same pod. The pupal period is 4-9 days. The total life cycle is completed in 3-4 weeks.

Nature of damage: The young maggots after hatching enter soft seeds and feed on them. At first the damage resembles that of leaf miner as their galleries run just under the epidermis of seed. Later they burrow deep down resulting in decaying of the grains which become unfit for either consumption or germination. In advanced cases of damage, the pod shows a twisted appearance

Spotted pod borer (*Maruca testulalis*)

Marks of identification: Full grown caterpillars are on an average 20 mm long, light brown in colour with irregular brownish black dorsal, lateral and ventral spots. The adult moth has brown forewings with three white spots and the hind wings greyish-white with distal brown markings.

Host range: Castor, groundnut, paddy and tobacco.

Biology: Eggs are laid singly on or near flower buds. On hatching the young caterpillars feed on reproductive parts of flowers and move from one flower to another full grown caterpillars are on an average 20 mm long. Pupation takes place inside cocoon on the pods or within the leaf folds.

Nature of damage: The caterpillars feed on tender leaves, flowers, buds and pods. The caterpillars web the flowers together with fine, silken thread, live inside and feed on the floral parts. Lateron they bore into tender pods and feed on developing seeds.

Mite (*Aceria cajani*)

Nature of damage: Mite feeding causes no direct damage to the host, therefore there are no distinctive symptoms attributable to it. However, it is a vector of pigeonpea sterility mosaic virus (PPSMV), which causes mosaic and mottling symptoms on wild and cultivated pigeonpea leaves (*Cajanus cajan*), and inhibits flower production.

INSECT PESTS OF CHICKPEA

Sr. No.	Common Name	Scientific Name	Family	Order
1	Pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
2	Aphid	*Aphis craccivora*	Aphididae	Hemiptera
3	Cutworm	*Agrotis ipsilon*	Noctuidae	Lepidoptera

Gram pod borer (*Helicoverpa armigera*)

Marks of identification: The moths are stout, light yellowish – brown with a wing expanse of about 37mm. The forewings are pale brown with some black dots and the hind wings are lighter in colour with smoky dark margins. The caterpillars are greenish with darker broken grey line along the sides of the body. They are 37 to 50 mm in length, when full grown.

Host range: Besides, gram it infests cotton, tomato, peas, tobacco, safflower, jowar, maize etc.

Biology: The females lay shining greenish whitish yellow eggs, spherical in shape, singly on the tender parts of the plants or flower buds. A single female may lay as many as 700 eggs in 4 days. The eggs hatch in about 6 to 7 days. On hatching, the caterpillars start feeding on tender leaves and shoots and after pod formation begins, they bore into the pod and eat developing grains and become full grown in 14 to 15 days and descend to the ground and pupate in earthen cocoons in the soil near the plants. Their pupal period lasts from one week to a month. The pest is active from November to March. There may be as many as 8 generations in a year on different crops.

Nature of damage: The caterpillars feed on tender foliage and young pods. They make holes in the pods and eat the developing seed by inserting the anterior portion of their body inside the pods. Single larva is capable of damaging many pods. Thus, heavy losses in yields are incurred under heavy infestation level.

Cutworm (*Agrotis ipsilon*)

Marks of identification: Moths are medium sized, stout with greyish brown wavy lines and spots on fore wings. The moths are active at dusk and are attracted by light. Caterpillar is 4-5 cm long, dirty black in colour and have habit of coiling at slightest touch.

Host range: Polyphagous feeding on potato, pulses, barley, oat, tobacco, peas, gram, cotton, tomato, lucerne, chillies, brinjal and other vegetables.

Biology: About 300-350 eggs are laid in clusters laid on ventral leaf surface or moist soil. These eggs hatch in 4-5 days. Larva developes in 3-5 weeks. Pupation takes place in soil in earthen cocoons. Pupal period is 11-18 days. Life cycle is completed in 5-9 weeks. It is cool climate pest active from October.

Nature of damage: The caterpillars hide during the day in cracks and crevices in soil or in debris around the plants and feed on tender leaves during night by cutting seedlings near ground level. The destruction is much more than actual feeding.

INSECT PESTS OF MUNG BEAN, URD BEAN, COWPEA AND PEA

Aphid (*Aphis craccivora*)

Marks of identification: The adults are black and shiny, up to 2 mm long and some are winged. The nymphs are similar to the adults but smaller.

Host range: Polyphagous

Biology: This species can reproduce without mating in Asia creating one generation in a week under optimum conditions. Individual adults can produce about 100 nymphs over a lifespan of up to 30 days. When the population density in the colony reaches a certain limit, winged individuals are found among the wingless forms. They fly away to form new colonies.

Nature of damage: Nymphs and adults suck sap from the tender growing shoots. They secrete a sticky fluid (honeydew) on the plant, which turns black by fungal infection. Although the feeding activity of aphid colonies can retard plant growth particularly at seedling stage, infestation on young seedlings results in twisted shoots under heavy infestation. Seedlings may wilt, particularly under moisture-stressed conditions. However, a more notable issue in chickpea is the transmission of stunt disease, caused by the bean leaf roll virus transmitted by these aphids. Stunt disease limits plant growth, rendering leaflets small, and reddish brown.

White fly (*Bemisia tabaci*)

Host range: It is polyphagous, attacking cotton, chickpea, green and black gram, tobacco and various vegetables including tomato, okra, several wild plants, etc.

Marks of Identification: The adult white fly is approximately 1.0 mm long, a yellow body insect with whitish grey wings and is densely covered with waxy powder. The egg is small stalked and it is about 0.2 mm long, pear shaped and freshly laid egg looks white when laid but later turns brown. The newly hatched nymphs can walk. They are oval in shaped and light yellow in colour which later changes to pale greenish yellow. The nymphs from the 2nd instar to the 4th instar (pupae)are immobile, adhering to leaves or stems. The pupa is black and oval shaped.

Nature of damage: The infestation starts right from the unifoliate stage of the plant and continues till the crop remains green. They transmit yellow mosaic virus. This is a major problem. The nymphs and adults suck the sap from the leaves and stems. Severe infestation results in premature defoliation, development of sooty mould or honey dew and shedding of flowers and pods.

Life Cycle: A single fertilized female lays 40 to 100 yellow eggs on the lower surface of leaves. Hatching occurs after 5-9 days. Nymph develop into 4 instar, fourth instar (pupae) are immobile and pupation take place on the older leaves. The nymphal period is approximately for 7-14 days. The adult emerges in 8-14 days. The life cycle from egg to adult is completed in 13-62 days.

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

Host plants: Greengram, blackgram, cowpea

Nature of damage: 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. The life cycle completed around 7- 21 days

INSECT PESTS OF COWPEA AND PEA

S.No.	Common Name	Scientific Name	Family	Order
1	Aphid	*Aphis craccivora*	Aphididae	Hemiptera
2	Blue butterfly	*Lampides boeticus*	Lycaenidae	Lepidoptera
3	Grass blue butterfly	*Euchrysops cnejus*	Lycaenidae	Lepidotera
4	Pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera

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

Distribution and status: India

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

Nature of damage: 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.

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

Distribution and status: Throughout India. Regular pest

Host range: Blackgram, peas, redgram and lablab.

Nature of damage: It feeds on flowers; flower stalks and enters the pod. Buds, flowers and young pods with boreholes. The entry hole on the pod is plugged with excreta.

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. 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.

INSECT PESTS OF GROUNDNUT

Sr.No.	Common Name	Scientific Name	Family	Order
1	Leaf miner	*Aproaerema modicella*	Gelechidae	Lepidoptera
2	Hairy caterpillar	*Amsacta moori,Spilosoma obliqua*	Arctiidae	Lepidoptera
3	Tobacco leafeating caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
4	Aphid	*Aphis craccivora*	Aphididae	Hemiptera
5	Thrips	*Thrips tabaci*	Thripidae	Thysanoptera
6	White grub	*Holotrichia serrata*	Scarabaeidae	Coleoptera

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

Distribution and status: Oriental in distribution including India. It is a serious pest under rainfed conditions on pulsesin 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.

Nature of damage: 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 migrate 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 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 earthern 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.

Leaf miner: *Aproaeroma modicella* (Gelechiidae: Lepidoptera)

Distribution and status: India, Pakistan, Sri Lanka, Burma and South Africa.

Host range: Groundnut, soybean and redgram.

Nature of damage: 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.

INSECT PESTS OF CASTOR AND SUNFLOWER

INSECT PESTS OF CASTOR

Sr. No.	Common Name	Scientific Name	Family	Order
1	Castor semilooper	*Achaea janata*	Noctuidae	Lepidoptera
2	Capsule & Shootborer	*Conogethes punctiferalis*	Pyraustidae	Lepidoptera
3	Tobacco leafeating caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
4	Slug caterpillar	*Parasa lepida*	Cochilididae	Lepidoptera

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, avacado, cardamom, ginger, turmeric, mulberry, sunflower, cotton, tamarind, hollyhock.

Nature of damage: The damage is caused by the caterpillar, which bores into the main stem of young plant andultimately 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.

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*

Nature of damage: 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 spoton 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).

INSECT PESTS OF SUNFLOWER

Sr. No.	Common Name	Scientific Name	Family	Order
1	Capitulum borer /Gram pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
2	Hairy caterpillar	*Spilosoma obliqua*	Arctiidae	Lepidoptera
3	Jassid	*Empoasca devastens*	Cicadellidae	Hemiptera
4	Thrips	*Thripos tabaci*	Thripidae	Thysanoptera
5	Whitefly	*Bemisia tabaci*	Aleurodidae	Hemiptera
6	Stem borer	*Nupserha bicolor*	Cerambicidae	Coleoptera

INSECT PESTS OF SAFFLOWER, MUSTARD, LINSEED INSECT PESTS OF SAFFLOWER

S. No.	Common Name	Scientific Name	Family	Order
1	Aphid	Ureleucon compositae (=*Dactynotus carthami*)	Aphididae	Hemiptera
2	Capitulum borer; Gram pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
3	Gujhia weevil	*Tanymecus indicus*	Curculionidae	Coleoptera

INSECT PESTS OF MUSTARD

Sr. No.	Common Name	Scientific Name	Family	Order
1	Mustard aphid	*Lypaphis erysimi*	Aphididae	Hemiptera
2	Mustard sawfly	*Athalia proxima(lugens)*	Tenthredinidae	Hymenoptera
3	Painted Bug	*Bagrada hilaris*	Pentatomidae	Hemiptera
4	Leaf webber	*Crocidolomia binotalis*	Pyraustidae	Lepidoptera

INSECT PESTS OF LINSEED

Sr. No.	Common Name	Scientific Name	Family	Order
1	Gall fly	*Dasineura lini*	Cecidomiidae	Diptera

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 toMarch. During summer, it is believed to migrate to the hills. The pest breeds parthen-genetically and the females give birth to26-133 nymphs. They grow very fast and are full-fed in 7-10 days1 about 45 days 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.

Nature of damage: Both the nymphs and adults suck cell-sap from leaves, stems, inflorescence and 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.

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, knol- khol, 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 andundergoes 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.

Nature of damage: 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.

INSECT PESTS OF SESAMUM AND NIGER

Sr. No.	Common Name	Scientific Name	Family	Order
1	Til hawk moth	*Acherontia styx*	Sphingidae	Lepidoptera
2	Gall fly	*Asphondylla sesami*	Cecidomyidae	Diptera
3	Leaf webber	*Antigastracatalaunalis*	Crambidae	Lepidoptera

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

Distribution and status: India, Africa, South Europe, Malta, Burma, Bangladesh, Indonesia, and Sri Lanka

Host range: Sesame, Antirrhinum and Duranta.

Nature of damage: 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.

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

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

Host range: Sesame, Potato, Brinjal and Jasmine

Nature of damage: 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.

INSECT PESTS OF SOYBEAN

Sr. No.	Common Name	Scientific Name	Family	Order
Borers				
1	Stem fly	*Melanagromyza sojae*	Agromyzidae	Diptera
2	Girdle beetle	*Obereopsis brevis*	Cerambycidae	Coleoptera
Leaf feeders				
1	Green semilooper	*Chrysodeixis acuta*	Noctuidae	Lepidotera
2	Brown semilooper	*Mocis undata*	Noctuidae	Lepidotera
3	Tobacco caterpillar	*Spodoptera litura*	Noctuidae	Lepidotera
4	Bihar hairy caterpillar	*Spilosoma oblique*	Eribidae	Lepidotera
5	Gram pod borer	*Helicoverpa armigera*	Noctuidae	Lepidotera
Sucking pest				
1	Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera

Stem fly (*Melanagromyza sojae* Zefint)

Marks of identification: The adult fly is approximately about 2 mm and metallic black in colour. The freshly laid eggs are light yellowish in colour and remains embedded in leaf tissues, mainly located near the base of the leaf. The maggot or larvae is slender and pale whitish in colour. It always remains inside the stem. The pupa is barrel shaped and dark yellowish brown in colour. It also remains inside the stem.

Nature of damage: In early stage of crop growth infested plants show sign of gradual withering of leaf. It causes tunneling in main stem, branches and petioles. In early stage of crop growth only 20-30 percent of the plants are affected but gradually infestation level increase till harvest.

Binomics: The fly remains active throughout the year. The female lays 14-64 singly inside the epidermis of upper or lower side of the leaf, Eggs hatch in 2-3days. The larval period lasts for 7-12 days. Before pupation a full grown maggot makes a small exit hole for escaping of the adult fly. The pupal period lasts for about 5-9 days. Eight-9 generations occurred in a year.

Girdle beetle (*Obereopsis brevis* Swed.)

Marks of Identification: The adult is 7-10 mm long and 2-4 mm width. The female is longer than the male. The adult beetle has a hard shell-like exterior and a pair of long horn like antennae. The elytra is deep brown to black in colour. The thorax and head are dark orange in colour. The eggs is elongate and yellow in colour. The full grown grub is about 19-20 mm long, pale yellow in colour with segmented body and a dark head.

Nature of damage: The female makes two rings or girdles 6-15 mm distance on stem, branches and petioles. As a result the part of the plant above the girdle starts drooping and slowly dries up. The main damage causing stage is the grub (larva). The grub bores the stem of soybean plant. The grub feed inside the stem and completely hollows it, up to the base of the plant. The full grown grub cut the stems from inside causing the pod bearing portions of the plants to fall and 50% of the infested plants are cut off at a mean height of 33 cm, 15% at 18 cm and 22% at 6 cm. In extreme case about 50% or more plants damage was recorded.

Remains active from July to October damaging most severely during August-September. The ovipositing female make two rings.

Binomics or girdles on stem, branches or petioles and makes 3 punctures just above the lower ring before inserting a single egg through the largest whole into pith. The female lays about 10-72 eggs in her life cycle. Eggs hatch in 4-8 days. The larval period lasts for about 32-65 days. In these cases the adults form to start the next generation in the same season. Otherwise the grub requires 248-308 days from October to June- July to develop to the pupa. The diapause of the grub breaks after shower of rains in June/July and the grub develops to pupa from which the adult emerges out in 8-11 days

INSECT PESTS OF COTTON

S.No.	Common Name	Scientific Name	Family	Order
Sucking Insect pests				
1	Aphid	*Aphis gossypii*	Aphididae	Hemiptera
2	Jassid	*Amrasca biguttulabiguttula*	Cicadellidae	Hemiptera
3	Thrips	*Thrips tabaci*	Thripidae	Thysanoptera
4	Whitefly	*Bemisia tabaci*	Aleurodidae	Hemiptera

5	Mealybug	Phenacoccussolenopsis	Pseudococcidae	Hemiptera
Bollworms				
6	Spotted bollworm	*Earias vittella, Eariasinsulana*	Noctuidae	Lepidoptera
7	Americanbollworm	*Helicoverpa armigera*	Noctuidae	Lepidoptera
8	Pink bollworm	*Pectinophoragossypiella*	Gelechidae	Lepidoptera
Chewing Insect pests				
9	Cotton leaf roller	*Sylepta derogata*	Pyralidae	Lepidoptera
10	Cotton greensemilooper	*Anomis flava*	Noctuidae	Lepidoptera
11	Grey weevil	*Myllocerus spp.*	Curculionidae	Coleoptera
Lint strainers				
12	Red cotton bug	*Dysdercus cingulatus*	Pyrrhocoridae	Hemiptera
13	Dusky cotton bug	*Oxycaranushyalinipennis*	Lygaediae	Hemiptera

Aphid (*Aphis gossypii)*

This pest is distributed all over the country. A. gossypii is small, adaptable, easily spread, with a rapid reproductive rate, and the ability to cause serious plant injury in isolated communities.

Marks of identification: Aphids are small soft bodied insects with a pair of cornicles, present on the 6th abdominal segment. Nymphs are light yellowish green, or greenish black or brownish. Adults are mostly wingless, but few winged forms can also be seen with thin transparent wings.

Host range: The cotton aphid has a very wide host range of at least 60 host plants including various field and vegetable crops.

Biology: Females directly produce young ones which mature in about a week, hence population build up is quite fast. Alate and apterous forms multiply parthenogenetically and viviparously and give birth to 8 –22/ day and become adult in 4-7 days. The nymphs moult four times to become adult completing the life cycle in 8- 10 days.

Nature of damage: Nymphs and adults colonize on the undersurface of the young leaves or on shoots. Leaves become curled and plant growth is affected. Besides sucking the sap from plant they secrete honey dew on which sooty mold develops causing interference to photosynthesis.

Cotton jassids (*Amrasca biguttula biguttula*)

It is a cosmopolitan and polyphagous species, distributed widely in all the cotton growing areas of the State.

Marks of identification: The adult is a wedge shaped insect, about 3.5 mm long and pale green in colour. There is a black spot on each of the fore wings and spots on the vertex. The insect is characterized by its habit of walking diagonal in relation to body.

Host range: It is polyphagous species infesting cotton, bhendi, ambadi, potato, brinjal etc.

Biology: Female lays about 30 eggs singly inside the leaf veins, which hatch in 4 to 11 days. Nymphal stage lasts for 7 to 21 days with six nymphal instars. The entire life cycle is completed in 2 to 4 weeks. There are several overlapping generations in a year. The pest is more severe in July to September.

Nature of damage: Both nymphs and adults suck the cell sap mostly from the underside of the leaves. As a result, a characteristic hopper burn symptom is noticed wherein the margins turn yellowish initially and subsequently turn reddish and curl. In cases of heavy infestation, the leaves show brown necrotic patches and the growth of the plants remain stunted which adversely affects the flowering and ultimately yield.

Thrips (*Thrips tabaci*)

It is a cosmopolitan and polyphagous species distributed all over the State.

Marks of identification: The adults are minute delicate insects about 1 mm in length and are light yellow in colour. Their body is narrowed in the middle. Their wings are fringed with hairs, hence called as fringe winged insects. The nymphs and even adults are seen walking fast, when observed under magnifying lens

Host range: Cotton, chilly, cucurbits etc.

Biology: The eggs are laid in the tissues on the lower surface of leaves. A female lays about 30-50 eggs. These eggs hatch in about 2 to 5 days. Nymphs become full grown in about a week, after moulting thrice. The adult lives for 10 to 25 days. There are 3-4 generations in a year.

Nature of damage: The thrips have rasping and sucking type of mouth parts suited for scraping the epidermal tissues of the leaves and sucking the oozing cell sap. As a result of such feeding brown patches are seen of the leaves and also on bolls. Excessive feeding on leaves leads to curling and the growth on the plant is stunted. The pest is active in post monsoon periods.

Whitefly (*Bemisia tabaci*)

This is a minor pest earlier but after 1985 became major pest in many crops.

Marks of identification: Eggs are yellowish white laid singly on the under surface of leaves. Nymph is greenish yellow, oval in outline. Pupa is oval in shape, present on the under surface of the leaves. Adult is minute insect with yellow body covered with a white waxy bloom.

Host range: It is a polyphagous pest which feed on several crops like cotton, tobacco, cassava, cabbage, cauliflower, melon, mustard, brinjal etc.

Biology: The female whitefly lays the eggs singly on the under surface of leaves and mostly on the top and middle crop canopy. A single female lays about 120 eggs. The incubation period varies from 3-30 days. The nymphs after hatching fix themselves to the underside of the leaves and they moult thrice before pupation. The nymphal period varies from 9-19 days. The pupal period is 2-8 days. The total life-cycle ranges from 14 to 107 days depending upon the weather conditions. There are about 12 overlapping generations in a year.

Nature of damage: Nymphs and adults suck the sap from foliage. Chlorotic spots are developed on leaves and yellowing of leaf leading to dropping of matured leaves. Vegetative growth is retarded, boll formation hampered. There is shedding of squares and bolls, bad boll opening in matured bolls and reduces the quality of cotton. They secrete honeydew on which sooty mould develops and interfere in the photosynthesis. Severe infestation after boll bursting makes the lint sticky due to deposition of honeydew. It also transmits the leaf curl virus.

Mealy bug (*Phenacoceus solenopsis*)

Mealy bug considered as an emerging pest of cotton and becoming a new threat for future cotton production.

Marks of identification: Mealy bug has elongated oval body and greenish black colour. There are medium sized filaments around the body and two dark stripes on either side of the middle ridge of the body. They are having waxy coating on the body.

Host range: Cotton, soybean, okra, tomato, brinjal and different weeds.

Biology: Reproduction is sexual and parthenogenetic, female lays eggs without fertilization. In an ovisac which is on the underside of the body, about 200-600 eggs are observed. The young mealy bugs called “crawlers” (nymphs) and emerge from the egg within 3 to 9 days. Nymphal period is about 22-25 days. The pest completes its life cycle within 25-30 days and there are 10-12 generations in a year.

Nature of damage: Both the nymphs and adults suck the cell sap from the leaves, stem and other parts of the plants. The entire plant may be stunted and the shoot tips develop a bushy appearance. The pest also secretes honey dew which encourages the development of black sooty mould, affecting photosynthetic activity. The severe infestation causes late opening of bolls, which ultimately affects the yield and quality of cotton.

Spotted bollworm (*Earias vittella, Earias insulana*)

This is a cosmopolitan pest, having been reported from all the cotton growing areas of the state.

Marks of identification: There are two species of spotted bollworm. The adults of one species have pale white upper wings with a broad greenish band in the middle (E. vitella) The adult of another species have completely green upper wings (E. insulana) Wing expanse is about 25 to 30 mm. The caterpillars of both the species are brownish white and have a dark head and a prothoracic shield. Their main characteristic is that their body surface is irregularly covered with black spots (E. vitella) and spins (E. insulana). A full grown larva measures 19mm in length.

Host range: Besides cotton, the pest infests bhendi, ambadi, hollyhock etc.

Biology: The female lays about 200-400 bluish eggs singly on tender shoots, flower buds, bracts, bolls etc. The egg period is 2 to 10 days. The larval period varies from 9 to 25 days depending on the climate. The full fed larvae pupate in a silken cocoon in the soil, in this stage it remains for 6 to 25 days. The total period of life cycle is about 18 to 46 days. The pest is active practically throughout the year and there are about 7 to 8 generations in a year. Summer bhendi is an important source of ‘carry over’ of the pest from one season to another.

Nature of damage: In the beginning of the cotton season, the caterpillars bore into the growing shoot of the young plants (generally 6 week old) and cause curling of the attacked shoot. When flower buds appear, the larvae are found boring into them which results in the heavy shedding of early formed floral buds. Later they also bore in bolls, which show holes plugged with excreta. The infested bolls are mostly shed. But if they remain on the plant, they open prematurely; consequently lint from such bolls fetches a low price in the market.

American bollworm (*Helicoverpa armigera*)

It is serious pest of cotton in India. It is also popularly known as “gram-pod borer”. It is a cosmopolitan and polyphagous pest

attacking wide range of crops throughout the year.

Marks of identification: The adults are stout, light yellowish brown, with a wing expanse of 37mm. The forewings are pale brown with some black dots and the hind wings are lighter in colour with smoky dark margins. The caterpillars are greenish with dark grey lines along the sides of body. They are 30-35 mm in length, when full grown.

Host range: Besides cotton, it feed on gram, tomato, peas, tur, tobacco, jowar, maize.

Biology: The eggs are laid singly on the tender parts of the plants and they hatch in about 3 to 7 days. A female lays about 300-600 eggs. The caterpillars become full fed in 14 to 15 days and descend to the ground and pupate in earthen cocoons in the soil. The pupal period lasts for one week to a month. There may be as many as 8 generations in a year on different crops.

Nature of damage: This pest causes substantial damage to cotton crop. The newly hatched larvae usually feed on tender leaves and squares of the plant. The larvae make holes in bolls and consume the entire contents inside the bolls. A single larva can destroy 9 to 15 squares and bolls. The excreta of the larvae is noticed on the bracts.

Pink bollworm (*Pectinophora gossypiella*)

Economic importance: It is the most destructive pest of cotton, having reported from almost all the countries in the world. In Maharashtra also it is noticed in all the areas wherever, the cotton crop is grown. The larvae are pinkish in colour and hence the name.

Marks of identification: The moth is small sized, about 5 to 6 mm in length and a wing span of 12.5 mm. Body is dark brown in colour with numerous small spots on the wings. The caterpillar is pinkish in colour when full grown and it measures about 18 to 19 mm in length. The pupa is brownish and measures about 7 mm in length.

Host plants: Besides cotton, this pest also feeds on bhendi, ambadi and hollyhock.

Biology: A single female lays about 100 to 150 eggs on the under surface of leaves, floral buds, bracts and bolls. They hatch within 3 to 25 days, depending upon the climatic conditions. The newly hatched caterpillar is whitish in colour and wanders for some time in search of buds or bolls. On entering the bolls, the entry hole gets sealed and caterpillar leads a concealed life. It becomes full grown in 8 to 21 days. It attains characteristic pink colour in the third instar. They moult thrice. The larva then pupates by spinning a cocoon on bracts or in fallen leaves, flowers, lint under clods or in soil. The pupal stage lasts for 6 to 20 days. This is termed as short cycle generation. While in case of long cycle generation the full grown larvae without undergoing pupation remains in the hibernating stage even upto two years. Carry-over through seed in the form of hibernating larvae is quite negligible in our state, while majority of them hibernate in cocoons amongst the shed bolls, plant debris or in cracks in the soil. As many as 9 generations are completed in a year.

Nature of damage: Unlike the spotted bollworms, the pink bollworm never attacks the shoots but effect floral buds, flowers and bolls only. In the beginning of the season, the caterpillars feed on floral buds, flowers and cause their shedding. Later on they enter the developing boll through the tip portion and entrance hole gets closed up as the boll matures and it becomes extremely difficult to locate the infested bolls unless they drop down to the ground. The larva feeds on the inner contents (particularly seeds) and moves to adjacent locule by making a hole through the septum. As a result of infestation of this pest, ginning percentage, oil and spinning qualities are adversely affected.

INSECT PESTS OF SUGARCANE

Sr. No.	Common Name	Scientific Name	Family	Order
A. Borer Insect pests				
1	Early shootborer	*Chilo infuscatellus*	Pyralidae	Lepidoptera
2	Internode borer	*Chilo saccarifagusindicus*	Crambidae	Lepidoptera
3	Top shoot borer	*Scirpophaga novella*	Pyralidae	Lepidoptera
B. Sucking Insect pests				
4	Whitefly	*Aleurolobus barodensis*	Aleurodidae	Hemiptera
5	Pyrilla (Leafhopper)	*Pyrilla perpusilla*	Fulgoridae(Lophopidae)	Hemiptera
6	White woolyaphid	*Ceratovacuna lanigera,C. graminum*	Pemphigidae	Hemiptera
7	Mealy bug	*Saccharicoccus sacchari*	Pseudococcidae	Hemiptera
8	Scale insect	*Melanaspis glomerata*	Coccidae	Hemiptera
C. Soil Insect pests				
9	Termite	*Odontotermes obesus*	Termitidae	Isoptera
10	White grub(Root grub)	*Holotrichia serrata*	Scarabaeidae	Coleoptera

Early shoot borer (*Chilo infuscatellus*)

Marks of identification: Adult moth is greyish brown or straw coloured with a wing expanse of about 25 mm to 30 mm. Front wings are greyish brown with row of white dots along its apical margin. Hind wings are whitish. Full grown larva is cylindrical in shape with a dark brown head and dirty white body and measures about 20 to 25 mm in length.

Host range: In addition to sugarcane crop this pest infests crops like jowar, maize and grasses.

Biology: A female lays about 300 or more eggs in groups of around 40 eggs on the underside of the leaves and egg masses are covered with crimpson coloured hairs. The egg period is about 6 days. The caterpillar becomes full fed within 4 to 6 weeks and pupates in a larval tunnel in a silken membrane. Pupa is brownish and the pupal period continues for 7 to 10 days. The pest hibernates over winters in larval stage in stubbles and is more active during *Kharif*.

Nature of damage: The attack of this pest is mostly noticed in the early stage of the crop, i.e. up to 3 weeks after germination. The minute caterpillar on hatching initially feeds on the leaves and later on enters into the young shoot and tunnels downwards. In some cases the caterpillars enter the plants from the side of ground level by making holes in the stalk and may bore either or both ways. Thus the central shoot dries up causing deadheart which is characteristic sign of presence of the pest within the plant. The symptoms are damage on the inner surface of a first leaf sheath, biting on the inner surface of stem and offensive smell emitted by deadheart. Such deadhearts can be easily pulled out. If the attack is heavy immediately after planting, replanting becomes necessary for gap filling.

Internode borer (*Chilo saccarifagus indicus*)

Marks of Identification: Adult moths are straw in colour and moderately sized. Fully grown caterpillars are characterised by four strips which are violet in colour. Tubercles are jet black and crochets on the prolegs form complete circle.

Host plants: Sugarcane (Saccharum officinarum); alternate hosts include S. spontaneum, sorghum, Johnson grass (Sorghum halepense), pearl millet, rice, Echinocloa colona, etc.

Biology: Under South Indian conditions the internode borer remains active throughout the year. About 5-6 generations are completed in one year. The moth lay eggs in masses usually on the upper surface of the leaf. The number of eggs in one mass varies from 5-60. The eggs hatch into larvae in about 5-7 days. The larvae enter into stem by burrowing through the internode. The larval period lasts for 25-35 days, after that they are converted into pupa. Before pupation the fully grown larva comes out of the tunnel formed into the stem and take shelter under the tightly fitting leaf sheath on the cane. There it secretes a silken cocoon and undergoes pupation in that. The pupal life lasts for 8-10 days and then adults emerges out. The life span of adults is approximately 3-5 days.

Nature of damage: Neonate larvae feed on the leaf spindle or leaf sheath by scraping the tissues and characteristic white streaks are seen on leaf lamina when it opens. Later, the larvae bore into the tender cane top and most of the borer attack is found in the top five immature internodes. In ratoon crop, formative internodes are badly damaged, resulting in the formation of deadhearts, which do not emit a foul smell when pulled out. The larvae feed on the inner tissues and the frass is pushed out to the exterior.

Sugarcane top shoot borer (*Scirpophaga nivella*)

Marks of identification : Moths are silvery white with a wing expanse of a little more than 25 mm. Females possess orange coloured tuft of hairs at the tip of the abdomen. The matured caterpillars measure 25 to 35 mm in length and yellowish in colour

Host range: Sugarcane, wheat, maize etc.

Biology: Creamy white eggs are laid in clusters on the inner side of the sheath. A female lays about 250- 300 eggs in clusters of 30-60 eggs. They hatch in 4 to 8 days. The larvae have the migratory habit and become full grown in 3 to 4 weeks by tunneling the stems. Pupation takes place inside the tunnel. The adults emerge out from the pupae after 5 to 12 days. The total life cycle is completed in about 6 to 7 weeks.

Nature of damage: Unlike early shoot borer this pest is injurious to sugarcane crop in all the stages of crop growth. The caterpillar on hatching enters first into the midrib of the leaf and later on bore downwards into the shoot from the top causing death of central shoot. As a result side shoots are given out from the upper most internode giving a “bunchy top appearance” Shot holes on leaves, galleries in the midribs, death of central shoot and the bunchy top are the characteristic symptoms of the pest.

Sugarcane leaf hopper or Pyrilla (*Pyrilla perpusilla*)

Marks of identification: The adults are straw coloured hoppers with two pairs of wings, folded like a pointed beak which is quite readily visible. Newly hatched nymphs are milky white in colour with a pair of characteristic anal processes or filaments covered by wax. They are very active and are found in large number on canes.

Host range: Besides sugarcane crop, it also feeds on wheat, barley, maize, pearl millet, jowar.

Biology: Pale greenish yellow eggs are laid in clusters of 20 to 25 mostly on the lower surface of the leaves and also between the detached leaf sheath and the stem. The eggs are covered with white, cottony waxy filaments. Egg laying continues from April to November and on an average a female lays about 400 eggs over a period of about 2 months adult longevity. Incubation period lasts for 7 to 14 days under warm conditions (summer and rainy season) while in winter it continues upto 30 to 40 days. The nymphs become adult hoppers within 50 to 60 days. There are about 5 instars and the life cycle is completed in about 60 days in summer and 120 days in winter. Depending upon the weather conditions 3 to 5 generations are competed in a year.

Nature of damage: Both nymphs and adults suck the cell sap from the lower surface of leaves which as a result lose turgidity, begin to wither and ultimately get dried under severe conditions. Due to feeding, the sucrose percentage of juice and development of cane is adversely affected. Besides sucking the sap, these insects secrete honeydew like substance that spreads on the leaves, on which a black fungus (sooty mould) develops, that adversely affects the photosynthesis and ultimately the yield of canes.

Sugarcane white woolly aphid (*Ceratovacuna lanigera*, C. *graminum*)

Marks of identification: Nymphs are yellowish or greenish yellowish in colour. They moult four times and become adults. Adults are black in colour having two pairs of transparent wings and two cornicles on last abdominal segment.

Host range: Sugarcane, bamboo.

Biology: Each female produces 15 to 35 young ones/day. Maximum 300 nymphs are paid during 20 days of life time. Nymphal period 6-22 days. Adult period 32-57 days. Total life cycle is completed within 30 days.

Nature of damage: Nymphs and adults suck the cell sap from leaves and excrete honeydew like substance on which black sooty mould developed. Yellowish spots develop on leaves, edges dry and complete leaves dried. The growth of the plant remains stunted and yield losses upto 26 per cent. On single leaf 8000 aphids are seen. The damage is more on older sugarcane.

Mealy bug *(Saccharicoccus sacchari)*

Marks of identification: Adults and nymphs of mealy bugs are soft bodied, light coloured, oval creatures and found in large numbers near the nodes, covered over by a mealy white secretion of waxy powder. They are also found in the leaf sheaths. The adults measure about 5 x 2.5 mm size.

Host range: Besides sugarcane the pest is reported to feed on sorghum and grasses.

Nature of damage: Both nymphs and adults remain under the leaf sheaths and continuously suck the cell sap from the cane stalks. As a result the plants are weakened and the sucrose content of the cane juice is reduced. Excretion of honey dew encourages development of black sooty mould, which adversely affects the photosynthesis. Mealy bug also acts as vector of “Mottling” and “Spike” disease of sugarcane.

Scale insect (*Melanaspis glomerata***)**

Marks of identification: Adults are greyish black in colour, oval and slightly convex in shape.

Host range: Sugarcane, Wild grasses.

Nature of damage: Both nymphs and adults suck cell sap from cane stalk. As a result infested canes shriveled. Internodes shortened and sucrose percentage of juice reduced. In severe infestation entire cane covered with the pest, crop dries. Adversely affect market value.