

Pests:

In layman terms pest is the organisms that disturbs the human life.

Scientific definition of pest is that those organisms which damage our cultivated plant, our forest, storage, domestic product including other aesthetic qualities are called pest.

In agricultural concepts; the pests are those organisms which harbor in cultivated crops that reduce quantity and quality of crops.

Entomology:

This is the branch of zoological science which deals with insect's morphology, physiology and their life-cycle as well their importance to be studied.

Economic entomology:

This is the branch of entomology which deals with the economic aspects of insects on crop.

Insects:

It is generally defined as the animals of phylum arthropods of class insecta having:

- 1 pair of antenna
- 2 pairs of wings
- 3 pairs of legs
- Segmented body

Classification of insects:**A. On the basis of host association:**

a) Monophagous insects:

These insects depends only one species of plants for whole life-cycle.

Eg., *Bombyx mori* on *Morus alba*

b) Oligophagous insects:

Confined only one family for the whole life-cycle

Eg., Potato tuber moth: depends on the solanaceous crop

Diamond back moth (*Platella xylostella*, Platellidae) feeds on crucifer crops

Cabbage butterfly (*Pieris brassicae*) feeds on crucifer crops

c) Polyphagous insects:

Many agricultural pests fall on polyphagous pests. Those insect-pests visit the diverse plant species to complete the lifecycle.

Eg., *Helicoverpa armigera*, Noctuidae

If on chickpea: chickpea borer

If on tomato: tomato fruit borer

If on maize: maize comb borer

If on cotton: cotton bollworm

Spodoptera litula, Noctuidae (tobacco caterpillar)

Dorylus orientalis, Dorylinae/dae (Red ant)

Agrotis segetum/ A. ipsiton (cut worms)

B. On the basis of Biological characteristics:

- a) r- pest:
Those species which possess high fecundity and strong dispersal
- b) k- pest:
Low fecundity, low dispersal, larger body size
eg., all stem bugs
- c) r-k pest:
Mixer characteristics of r-k pest
eg., all the Dipteron

C. On the basis of Metamorphosis:

- a) Ametabola:
No or simple metamorphosis
There is no difference between adult and im-matures except size and some internal developmental process
Egg- Young- Adult
- b) Paurometabola:

The immature is not well distinct with mature stage
Eg., grasshopper and crickets
Egg-Nymph-Adult
They lay eggs in bunds of fields.
Only 5% agricultural insects fall on this.
- c) Hemimetabola:

Incomplete metamorphosis
The im-matures are aquatic and bear gills for breathing
They differ from adults in appearance
Eg: mayflies, dragonflies etc
Egg- Naid- Adult
- d) Holometabola:

About 90% insects of economic importance fall in it.
The stage is completely differ from one another

Eg., all the Lepidopteron, Coleopteron, Hymenopteron

D. On the basis of plant part damage:

a) Leaf damaging insects:

Well-developed mandibles

The symptoms possess by leaf damage insects are small holes or transparent spots.

Eg., all the adults of white grub at evening period.

b) Stem damaging insects:

They inhibit the stem and make the tunnel inside soft or hard stem.

Basically they fall on two orders:

Lepidopteron: prefer to damage soft tissues

Eg., Rice stem borer (*Scirpophaga incertulas*) Family: Pyralidae

Coleopteron: they prefer hard stem

eg., mango stem borer (*Batocera rufomaculata*), Family: Torambycidae

Orange stem borer (*Stromatium barbatum*), Family: Torambycidae

c) Fruit damaging insects:

Citrus fruit fly

Bactrocera dorsalis, Family: Tephritidae

B. tau, Family: Tephritidae

B. zonatus, Family: Tephritidae

} these species are identified in Nepal

d) Root damaging insects:

Root damaging insects are:

Red ants (*Dorylus orientalis*)

White grub (*Phyllophaga rugosa*)

(*Holotrichia spp.*)

} Scarabacidae

They lay eggs in fresh dung.

So, don't use the fresh dung

Light trap can be done

e) Flower damaging insects:

Thrips: (*Thrips tabaci*); Thribidae



fig: white grub

E. On the basis of Extent on damage:

1. Major pest:

- Economic loss high

- More studied in entomology

- E.g., Brown plant hopper in rice is major pests

(*Nilaparvata lugens*) Family: Delphacidae

Rice earhead bug/ Rice gundhi bug (*Leptocarisa oratorius*), Family: Alydidae

Citrus major pest: *Rhynchocaris humeralis*

Mango major pest: Mango hopper
(*Idioscopus niveosparus*)

Note: *leaf hopper - Cicadellidae*
 Plant hopper - Delphacidae
 Tree hopper - Membracidae

2. Minor pest:
 - Economic loss is low
 - Not studied generally in economic entomology

F. On the basis of population level and ecological principle:

1. Perennials pest:
Green sting bug (हरियो पतेरो)
Not damage significantly though present yearly. This is controlled by natural environment.
2. Occasional/ sporadic pest:
Those pests which are controlled by natural environment but sometimes it may occur huge loss as sometimes.
e.g., Cotton jassids (*Amrasca biguttula biguttula*), Family: Jassidae
3. Key pest:
Those pests which are responsible for damaging even the few population are called key pest.
e.g., *Helicoverpa armigera* is key pest of chick pea
Apple aphid (*Eriosoma lewigeri*), Family: Pemphigidae
Tobacco caterpillar (*Spodoptera litura*), Family: Noctuidae

Termite (धमिरा) and its Managements:

Termite is a social insect which has well defined cast differentiation and work division.

It has king, queen, worker and soldier

King	}	<i>for progeny, after mating their wings falls</i>
Queen		

Worker and soldier are sterile.

A queen can lay up to 10 million of eggs in her life cycle, which is equivalent to 13,000 eggs/day or 1 egg/sec.

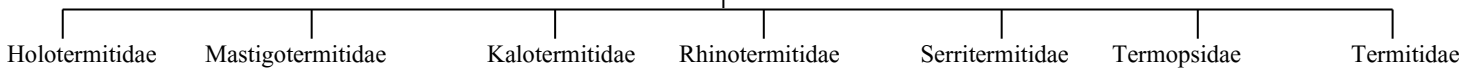
The number of the king and queen in colony is very few.

About 80-90% of the population is of workers which have feeding function for young.

1-2% of the population is occupied by the soldiers that act for defense mechanism in colony.

Termites fall under the order Isoptera

Isoptera



Most of the economic important termites fall on the family Termitidae

Management practices of termites:

It is very difficult to manage because it rest in the deep tunnel. So, preventive measure is useful.

- Colony disruption in large trees like mango
- Strong foundation in building
- Use of eco-friendly materials like neem based pesticides

- Margosom
 - Nemacol
 - Nemarin
- } @ 2-5 ml/lit of water

- Use of water barriers in the leg of furniture
- Pasting the servo engine oil in the beam and dead wood

(In live plant it is not good to use due to phytotoxicity effect)

Locust (सलह) and its Managements:

Order: Orthoptera

Family: Acritidae

No problem in Nepal, but problem is sever in desert areas

There are two types of locust:

- Migratory
It is more serious
Two types:
 - Desert locust (*Schistocera gregaria*) and
 - Migratory locust (*Locusta migratoria*)
- Solitary:
Not so serious

Female locust lays 40-120 eggs at a time inside the sand below 10-15 cm in group

The egg hatches in 2-3 weeks or 2-5 weeks

If temperature increases hatching will be in 2 weeks

Mild cold temperature, the hatching period is lengthened

It has 5-different Nymphal stages

The 1st Nymphal stage can be differentiated by observing the wing development whereas in adult full wing development take place.

It has only one generation per year

Management of Locust:

Here, we generally concern the management of migratory locust.

- Making the small water drain (15 cm wide) towards the movement of locust. It should be 25 cm depth
- Management options should be applied in the morning time because in morning the locust is sluggish and passive. As temperature increases locust activity also increases.
- Collection of the eggs mass and destroy it to reduce further its population increment.
- Flame thrower through helicopter is also used in farmer of India.
- Where radio broadcasting is effective, management practice is very effective (like in China)
- Use of neem based pesticides which is anti-feedant in nature.

Storage Insect Pest and their Managements:

Major storage insects-pest:

Common Name	Scientific Name	Family
Rice weevil	<i>Sitophilus oryzae</i>	Curculionidae
Maize weevil	<i>S. zeamais</i>	”
Granary weevil	<i>S. granarium</i>	”
Rice moth	<i>Corcyra cephalonica</i>	Gelechiidae
Angouimous grain moth	<i>Sitotroga cerealella</i>	”
Khapra beetle	<i>Trogoderma granarium</i>	Dermestidae
Brachids/ pulse beetle	<i>Callosobruchus chinensis</i>	Bruchidae
Cowpea weevil	<i>Callosobruchus maculatus</i>	”
Rust-Red flour beetle	<i>Tribolium castaneum</i>	Tenebrionidae
Confused flour beetle	<i>T. confusum</i>	”
Lesser grain borer	<i>Rhizopertha dominica</i>	Bastrichidae

Angouimous grain moth (अनाज पुतली):

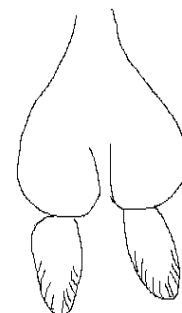
In Nepal, Angouimous grain moth

Female lays eggs in kernel of seed. After 5 days egg hatch into larva and passes 5 different larval stages.

1st instar enters into seed and consumes the starchy part of seed, including embryo.

The pupation takes place in seed itself and sometimes outside of seed in between seed and wall.

The pupal period is 7-9 days, about 5 generation have been reported per year.

**Rice moth (चिल्ला) *Corcyra cephalonica***

- It has dirty brown wings
- Wing is fringed in both pair



- Lay eggs in the outer part of seed (seed coat), in between the seed
- About six generation has been recorded per year
- Larval period is 25-35 days which has 6- different stages
- Larval color is brownish yellow, head is completely yellow
- Pupation takes place inside the cocoon, and pupal period is 7-12 days
- The larva which wrap the seed and hide inside it and seed become useless for human consumption.

Weevil (*Sitophilus*) घुन:

- Having well developed snout or beak
- Female weevil with the help of snout scraps the seed where she lays the single egg. After hatching the grub enter into the seed and consume the starch and sometimes embryo.



Storage insect-pest management:

- Preventive
- Curative
- Preventive measure:
 - Use of the whole grain
 - Storage structure should be clean and
 - Keep the seed in durable storage bin like metal bin or concrete bin
 - Storage bin should be damp proof
 - Storage sac shouldn't attach to the storage wall to prevent damp
 - Moisture level should be maintain 12-14 % and in pulses 8%
 - Store the seed after sun drying
- Curative measure:
 - Use of Aluminum phosphide or Celphos which can be applied in two bases:
 1. Weight basis: 1 tablet per metric ton in air tight condition
 2. Volume basis: 2-4 tablets per m³ in air tight condition and 4-5 tablets in open condition

Phosphine gas: released by celphos and aluminum phosphide this is extremely hazardous to human

Keep such tablets inside the muslin cloth to avoid the contamination with seed

- Mixing the seed with NSKE (Neem Based Kernel Extract) with Bojho powder is very popular in farmer level because it has good result in repelling many insects-pests.

Rodents and their Managements:

2,000 species of rodents are identified in the world

In Nepal, 30 species of rodents are identified

Only 5 different species are economically important that causes huge loss

1. House Rat, *Rattus rattus*
2. House Mouse, *Mus musculus*
3. Brown Rat, *Rattus norvegicus*
4. Lesser Bandicaot Rat, *Bandicata bengalensis*
5. Large Bandicaot rat, *B. indica*

Characteristics of Rat:

1. They are good climber and swimmer
2. They are color blindness but the power of taste, smell and hearing is high
3. They do same action repeatedly at same time

They follow the same path in each day

NARC: Entomology branch: Rodent section is studying about the rodent. A rodent specialist says that:

- 1 rat can consume 16 gm cereal per body weight
 - 208 rat can create 8.5 mt/yr loss
 - 669 rat released on rice field can cause loss equal to 4.06 q/ha
 - 669 rat released on wheat field can cause loss equal to 2.69 q/ha
4. One pair of mature rodent can give offspring of about 2000
 5. They can give birth up to 4-13 offspring at a time

Sign of Rat/Mouse infected area:

- Sign of musky odor
- Can be observe the dragging tail channel
- Four toed footprints of the fore leg and five toed footprints of hind leg can be observed in dusty sand area
- Loose hip can be observe
- A good runway can be observe
- A small hole also can be seen in some place

Some of the economic evidences in the world:

- FAO of UN studies how much loss has occurred by rodents
- FAO reported that pre-harvest loss of the cereal is equal to 20 million metric ton and post-harvest loss is 30 million metric ton annually
- 30% coconut loss is also reported
- 77% of the coconut plantation damage in Colombia is also reported
- 43% of the coca yield reduction in Guinea
- ½ of the national cotton yield in Egypt is reduced due to rodents
- 3/4th of the total barley is damaged in Kenya
- In India, 12.5 million metric ton is loss in cereal
- In Nepal, 19 million dollars in pre-harvest and 6-9 million dollars loss in post-harvest in the cereal by rodents

Management of Rodents:

- Preventive measure
- Curative measure

A. Preventive measure:

- Keeping the harvested product in closed container or durable storage structure like metal bin or concrete bin.
- Plugging the hole around the farm and household
- Sanitation is important, removing of leaves and piling traces
- Avoiding the unnecessary food product around the storage structure
- Cutting the branches which touches roofs or window of house
- Standing jump of the mouse is – 1 meter and running jump is 90 cm so keep the storage product above the 1 meter creating the rat baffles (barrier) in the legs that support the storage bin

B. Curative measure:

- Use of traps:
 - Pot trap, Steel trap, Snap trap, Case trap
- Use of the sticky or greasy substances in the way of the rat
- Use of the chemical poison
- Acute poison : zinc phosphide (Rat kill)
- Chronic poison: Warfarin, Caumarin
- Preparation of bait:
 - They like ghee, egg, flour, pieces of pumpkin, meat, fish, sugar beet, cooked potato, butter etc
 - Prepare in 1:1:18 ration. I.e.,
 - 1: ghee
 - 1: pesticide (poison)
 - 18: ball of flour
 - First 2-3 times without poison and keep poison
- Rearing of cat

Slugs (चिप्ले किरा) and Snail (शंके किरा) Managements:

They are Molluscans, body is soft which is covered by mucous substances. Problem is high in moist area where high density is practiced. They are nocturnal habit. Active up to 12 am (midnight) then after they return to nest. They hide inside the crack, below the soil and leaf.

Snails have a sharp tooth which is called radula; with the help of this stones are easily grinded. The silica contains in the stone which is used for the formation of shell. A snail at a time in a day can lay 20-50 eggs whereas slugs can lay 1000 egg. The egg mass of these both are covered by mucilaginous substances. Hatching takes place within 2-3 weeks.



fig: slug

Nature of damage:

They damage growing tips and succulent leaf, sowing seeds

The problem is high where there is high humidity and rainfall

Management practice of snails and slugs:

Cultural practices:

- Avoiding high density planting and allowing air circulation in plant canopy
- Canal irrigation should be discourage and drip irrigation should be done
- Field sanitation
- They don't like acid, alkali and abrasive material in the way of their. Acid and alkali are responsible for dehydration of their body whereas the abrasive material slows down their movement
- $CuSO_4$, Ferric phosphate which are available in the market with trade name like Slug magic and Metaldehyde which cause dehydration of their body
- Optimum use of salt (NaCl)
- Basically they are attractive in fermented product so keeping the fermented product in the corner of the field attract the snails and slugs then they can be collected and killed.



fig: Snail

Major Insect Pest of Apple/ Peach/ Pear:

(Arranged on the basis of seriousness)

Common Name	Scientific Name	Family	Order
Wooly aphid	<i>Eriosoma lanigerum</i>	Eriosomatidae	Homoptera
San Jose Scale	<i>Quadraspidiotus perniciosus</i>	Diaspididae	
Apple Stem Borer	<i>Zeuzera spp</i>	Cossidae	Lepidoptera
Apple Root Borer	<i>Dorystenes hugeli</i>	Cerambycidae	Coleoptera
Tent Caterpillar	<i>Malacoxoma indica</i>	Lasiocampidae	
Slug Caterpillar	<i>Caina spp</i>	Limacodidae	
Peach leaf curl aphid	<i>Brachycaudes helichrysi</i>	Aphididae	

Wooly aphid:

- Mark of identification:
 - Homopteron
 - Fluid/ sap sucker
 - Body: pink color white, cottony from outside
- Host:

- Apple as primary host
- Pear, Peach, Plum are as secondary host
- Life cycle:
 - Lay the eggs in two season of the year in winter or summer.
 - Sometimes the mature nymph directly gives new nymph.
 - In winter: those nymph which hatches in winter are all males
 - In summer: when the temperature raises the eggs hatch in to the nymph and the mature nymph directly gives new young and those new nymphs are all are the females



In the winter season, the new hatches nymph migrates towards the soil around the trunk of the region. When the temperature raises the nymph proceeds (ascends) towards the aerial part to damage new flush.

- Nature of damage:
 - They are fruit sucker because they have piercing and sucking type mouth part
 - At the time of sucking, they produce honey dew like substances where sooty mold develops which hamper in photosynthesis of plant.
 - In severe infestation, the affected branches shows knots like structure. The nymphs which are around the root region also damage primary and secondary root developing knots. The nutrition and water supplying capacity of root is reduced due to which production is hampered.
- Management practices:
 - In Jumla and Mustang:
 - A kind of the formulation Agro-Servo oil (500 ml) is available in market which can be applied up to 15 plants.(5 ml/lit of water)
 - Use of the eco-friendly systematic pesticides @ 2ml/lit of water
 - Digging or soil cultivation around the tree trunk to damage the nymph
 - Banding with the help of greasy substances above 50cm from ground level
 - The successful release of *Aphelinus mali* (Hymenopteron parasites of woolly aphid). This is success in Nepal

San Jose scale:

- Radish brown and plate like structure
- Male: one pair of wings
- Female: wingless
- The 1st new hatching Nymph called crawlers. After hatching the Nymph, it seeks to find the new flushes. Then after that they show the sedentary habit (female). They are also the sap sucker and suck the fluid from new succulent plant parts, tender fruits. Then after plants shows the yellowing coloration. It develops the honey dew and sooty mold.



- Management practices:
 - Use of systematic nature of pesticide. Agro-Servo Oil (5ml/lit). Highly used in Jumla and Mustang.
 - Cutting the affected branches
 - Use of the quality and healthy sapling
 - Adapting inter and intra quarantine policy to restrict the movement of the affected sapling.

Apple Stem Borer(*Zeuzera spp*):

(Lepidopteron)

- Brown color wing having scale in the body.
- Lay the eggs in the bark in single or sometimes group of 2-3
- Eggs hatches in 7-12 days and enters into the stem by making tunnel
- Easily observe the releasing of the saw dust where it has affected
- The period of the larvae is about 2 years whereas pupal period is 12-14 days



Managements of Apple stem Borer:

- Use of the 1-2 drops of the kerosene in each hole
- Jerking the hole with the help of long stem
- Plugging the hole
- Cutting the affected branches and pasting with Bordeaux mixture

Apple Root Borer(*Dorysthenes hugeli*):

- Coleopteron borer, having long antennae and robust body
- Egg lays around the root region and after hatching the grub enters into the root and damage the xylem of the roots
- The period of the grub is 3-4 years whereas the pupal period is around one month



Managements of Apple Root Borer:

- Flooding and stagnation of the water for 1-2 days
- Tree sanitation, field sanitation

Tent caterpillar(*Malacoxoma indica*):

(So serious nowadays)

- Primary host: Apple, Pear
- Secondary host: Peach, Plum
- Wing having white and black patches with prominent laying of the eggs takes place under side of the leaves in group
- Hatching of the eggs takes place in 7-14 day and 1st stage larvae come together and makes tent like



structure under which they damage the leaf.

- The larval period is 20-25 days whereas pupal period is 17-20 days

Nature of damage:

The larva is damaging stage. Later stage larva are voracious than early stage and damage the leaf. Defoliation of the leaf takes place in heavy infestation.

Management of Tent caterpillar:

- Use of the contact poison
- Collection of the larvae
- Use of Neem Based Bio-pesticide
- Field sanitation
- Removal of alternate host around the orchards

Slug Caterpillar(*Caina spp*) (भुसे किरा):

- The movement of the larva is like slug
- The body is covered by the green, red or black poisonous hair or setae
- Whereas the moth is dirty brown with smooth abdomen
- Laying of the egg takes place in leaf, bark and stem
- 1st stage larva has less hair but high in later stage
- It is also called jelly grub because it has soft body at larva stage
- 25-27 days larval period
- Pupation takes place inside the structure like bird egg
- 20-24 days pupation period
- Only one generation per year



Management of Slug caterpillar:

- Collection of the larva, pupa
- Use of the contact pesticide by mixing 2ml/lit of water
- Field sanitation

Non-Insect Pest:

Common birds:

House sparrow	<i>Passer domesticus</i>	Found around the human settlement. Basically they damage the crop (millet and rice) which are under harvest
Parrot	<i>Psittacula cyanocephala</i>	They damage the maize at the time of harvest
House crow	<i>Corvus splendens</i>	Damage fruits
Jungle crow	<i>Corvus macrohinchus</i>	Damage fruits including cultivated crop around the jungle

Jurelo (Red whiskered bulbul) *Picnonotus jucosus*

Management of these birds:

- Use of crow scarer (scarecrow)
- Hanging the dead birds around the field
- Creating the huge sound
- Tie the tape reel band

Monkey:

Macaca mulatta (बाँदर)

Semnopethus entellus (लँगुरे बाँदर)

- All fruits including maize are damaged by them
- Like to stay in group

Management:

- Coloring the monkey of one of them like tiger
- Creating the loud sound
- Hanging the dead monkey

Jackle (स्याल):

Canis aureus

They like potato and sweet-potato more

Dumsi (Procupine):

Hydrix hodsonii

Active in night, long spiny in body

They prefer vegetables, maize

Management of Dumsi:

Make drain around the periphery of field

The problem is high above 2400 meter high areas

Vectors of Plant and Human Disease:

Agents (living organisms) which carry virus, bacteria, fungus, roundworm, MLO, spiroplasm or any other organisms that causes disease in plants and animals are called vectors.

Plant disease vectors:

Some of the insect spp of order like:

Homoptera

Thysanoptera

Diptera

Hymenoptera

Coleopteran

Homoptera:**Aphids:**

They are the vectors of virus and causes viral disease in plants. About 150 viral diseases have been reported caused by aphids.

Some of the important viral diseases are:

- Cucumber mosaic virus
- Cauliflower mosaic virus
- Beet mosaic virus
- Tobacco mosaic virus
- Turnip mosaic virus
- Wilt
- Potato wilt

Banana aphid (*Pentalonia nigronervosa*) is the vector of Banana bunchy top virus

Citrus aphid/ Brown citrus aphid (*Troxoptera citricidus*) that is the vector of citrus tristiza virus

Leaf hopper:

Family: Cicadellidae

Vector of virus, MLOs, Spiroplasma

Aster yellow

Beet curly top

Blue berry stunt

Rice grassy stunt

Phone beach disease

Pierc's disease

disease in which leaf hopper acts as vector

Plant hopper:

Family: Delphacidae

Order: Homoptera

Vector of MLOs and Virus

20 different diseases have been reported that is caused by its vector action. Among them important diseases are:

- Rice tillering disease
- Cereal mosaic
- Rice Hoja blanca
- Sugarcane Fisi disease

Tree hoppers:

Family: Membracidae

Order: Homoptera

Vectors of Pseudocurly top disease in solanaceous or egg plant

White fly (*Bemisia tabaci*):

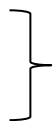
Family: Aleyrodidae

Order: Homoptera

Vector of:

Yellow mosaic virus

Leaf curl virus



In solanaceous or vegetable crops like potato, tomato, chili, etc..

Thrips (*Thrips tabaci*):

Family: Thripidae

Order: Thysanoptera

Vector of Tomato Spotted Wilt Virus (TOPSO)

Mealy Bug (*Maconellicoccus hirsutus*):

Family: Pseudococcidae

Order: Hemiptera

Vector of swollen Shoot virus and Mottle Leaf Virus in Sugar beet



Leaf minor (*Cameraria spp*):

Order: Diptera

Family: Agromyzidae

Vector of Tobacco Mosaic and Soybean Mosaic Virus



Fig. leaf minor

fig: leaf minor damaging tomato leaf

Ant (*Oecophyla smaragdina*)

Family: Formicidae

Order: Hymenoptera

Vector of fungus: in Blue berry plant cause Mummy Berry disease

Bees (*Apis spp*):

Family: Apidae

Order: Hymenoptera

Vector of Bacteria (*Erwinia amylovora*) that cause fire blight

Potato Flea beetle (*Epitrix cucumeris*):

Family: Chrysomelidae

Order: Coleoptera

That causes potato scab

Fruit fly (*Drosophila melanogaster*):

Family: Tephritidae

Order: Diptera

Vector of Bacteria that cause bacterial rot to apple fruit

Vector of Human Disease:

1. Assassin Bug (Kissing Bug): vector of protozoa that causes chagas disease in human
2. Human lice: vector of virus that cause Relapsing fever and Trench fever
3. Black Flies: vector of Round-worm that cause Onchocerciasis
4. Sandflies: vector of virus- cause sand fly fever
: Vector of protozoa- cause Leishmeniasis
5. Horse fly: vector of Bacteria- cause Anthrax
: Vector of Roundworm- cause Loasis
6. House fly, Blow fly, Flesh fly cause viral disease like: Diarrhoea, Dysentery and Cholera
7. Mosquitoes: vector of Roundworm- cause Filariasis
: vector of virus – cause Encephalitis, Dengus ~~by Aedes spp.~~ by *Anophilus spp.*
: Vector of protozoa
8. Rat flea: vector of Bacteria that cause plague

Pests of Banana:

SN	COMMON NAME	SCIENTIFIC NAME	FAMILY
1.	Banana Pseudo-stem weevil	<i>Odoiporus longicollis</i>	Curculionidae
2.	Banana Rhizome weevil	<i>Cosmopolites sordidus</i>	Curculionidae
3.	Banana leaf and Fruit scaring beetle	<i>Nodostoma viridepennis</i>	Chrysomelidae
4.	Banana Skipper	<i>Erionata thrax thrax</i>	Hesperiidae
5.	Banana aphid	<i>Pentalunia nigronervosa</i>	Aphididae

Banana Pseudo-stem Weevil (*Odoiporus longicollis*):

Mark of identification of Banana Pseudo-Stem weevil:

- They have prominent snout, black shiny elytra
- They are red and black in color (adults)
- Larva: devoid of legs which is white in color and head is brown

Life-cycle:

The female pseudo-stem weevil lays the egg inside the pseudo-stem. In general, the female lays single white egg in each chamber of leaf sheath. Hatching of egg takes place in 10 days and the grub start to consume the internal

content of pseudo-stem by making tunnel. Thus, pseudo-stem from the outside seems healthy but internally it is damaged by slight wind. The grub has well developed mandible. Pupation is inside the pseudo-stem. Pupation period is 14 days. Mating of adult takes place morning or evening times.

Management:

- Use resistant variety. Resistant variety are: Robusta, William Hybrid
- Field sanitation
- Removal of hang leaf
- Well aeration
- Use of aluminum phosphide, celphos @ 1tab/pseudo-stem

Banana Rhizome Weevil (*Cosmopolites sordidus*):

In pseudo-stem weevil the abdomen is not completely covered by elytra whereas in banana rhizome weevil the abdomen is completely covered by elytra, it is black and dull

- It lays egg in the cutting pieces of rhizome, inside the soil
- Hatching of eggs takes place in 1-2 weeks
- The body color of larva (grubs) is white whereas head is reddish brown having well developed mandibles
- Pupation takes places in fibrous cocoon and duration of pupa is 1-2 weeks



Nature of damage:

Grub is damaging stage with the help of strong mandibles, the grub makes tunnel inside rhizome, where secondary infection takes place and rhizome start to rot.

Management:

- Field sanitation
- Completely uprooting its stump after harvesting
- Crop rotation
- Umet- granules pesticides which can be applied @1-1/2 spoon per pit while rhizome planting
- Pseudo-stem trapping method: use of circular ring of pseudo-stem to attract its adult from which mass of adult can be trapped

Fruit and leaf scaring beetle:

- Egg lays in soil so grub and pupa is in soil
- Lay egg in canopy of pseudo-stem around the root region
- Hatching of egg takes place in 5-days and passes 4-different larva stages
- Pupation takes place inside the soil by making earthen cocoon
- The pupal period is 1 week
- When the heart emergence takes place in pseudo-stem, the adult comes into the aerial portion of heart and hide inside the heart
- Lifecycle complete in 1-15 month

Nature of damage:

- Grub and adult are damaging stage

- The grub damage the primary root hair
- Where adult scare tender leaf or fruit and reduce the quality
- Adult are active in morning before 9 am
- The activity of beetle is high in morning when temp rises the adult seeks to find the dark places.

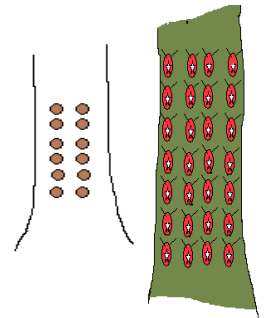
Management:

- Field sanitation
- Digging of the soil around its pseudo-stem to damage the grub
- Flooding
- Use of eco-friendly pesticide early in the morning
- Always use the chemical pesticide in the heart or inside the new leaf
- Removal of flower bud after finger emergence
- Community campaign for the management of pest and pesticide application
- Bagging of the fruits with the help of jute sac, transparent plastic
- Wrapping the bunch of banana

Litchi bug (*Tessara papillosa*):

Mark of identification:

The nymph is red whereas the adult is reddish brown. It lays eggs in row of one –two with like arranged manually. Color of egg is brown. The egg mass consists of 32-35 eggs in a batch. The color of eggs in later stage changes to dark color due to embryonic development of it. Hatching of egg takes place in 7-12 days. It passes 5 nymphal stages. The nymphal period is about 25 days. Adult life period is 5 days.



Management:

Nymph and adults are the damaging stage which sucks the fruits from tender part of the litchi plant i.e., tender fruit, base of the inflorescence, peduncle of leaf. In severe infestation premature fruiting and fruit drop takes place.

Drying of the inflorescence takes place when mass of the nymph simultaneously attack in the base of the inflorescence.

- Collection of all the stages like egg, nymph and adult
- Use of any systematic type of pesticide. Chloropyrivus @ 2ml/lit of water
- Spraying practices should be done with the help of foot sprayer.
- Infestation of bug is high where closer planting is high. So, maintain the crop spacing and do regular pruning in case of crowdy density
- Protection of Hymenopteron parasitoids in the nature because the bug is easily parasitoids by any Hymenopteron species



Mango pest:

SN	COMMON NAME	SCIENTIFIC NAME	FAMILY	ORDER
1.	Mango hopper	<i>Idioscopus niveosparsus</i>	Cicadellidae	Homoptera
2.	Mango fruit fly	<i>Bactrocera dorsalis</i>	Tephritidae	
3.	Mango stem borer	<i>Batocera rufomaculata</i>	Cerambycidae	
4.	Mango shoot gall maker	<i>Apsylla cistellata</i>	Psyllidae	
5.	Mango mealy bug	<i>Drosicha mangiferae</i>	Margamdidae	
6.	Mango leaf gall maker	<i>Procontarinea matteiana</i>	Cecidomydiidae	
7.	Mango stone weevil	<i>Stenochaetus mangiferae</i>	Curculionidae	
8.	Bark eating caterpillar	<i>Inderbela spp</i>	Pyralidae	
9.	Mango slug caterpillar	<i>Latoia lepida</i>	Limacodidae	
10.	Red ant	<i>Oecophyla smaragdina</i>	Formicidae	
11.	Fruit sucking moth	<i>Othreis fullonia</i>	Sphengidae	
12.	Mango leaf weber	<i>Orthaga spp</i>	Pyralidae	

Mango hopper(*Idioscopus niveosparsus*):

Order: Homoptera (Sucking type insects) that left honey dew. Egg-nymph-adult

Family: Cicadellidae

This is greenish brown with black and yellow spots (adult hopper)

It has wedge shaped body structure. Head is wide while tail is tapering. With the help of sickle shape ovipositor, it makes a slit (खाल्लो) in tender leaf where laying of egg takes place. About in 3-7days, egg hatches. The nymphal period is 10-15 days having 4 stages. 1st nymphal stage is yellowish brown color. 2nd stage is brown, 3rd stage is yellowish green and last stage is green. Early stage has partial developed wing while late stage has well developed wings. It has 3 pairs of legs.

Last 2 legs are thick so movement is not in straight line i.e, diagonal movement. Adult female lays egg in single.

Nymph and adult are damaging stage. Life-cycle is too short. 10-12 life-cycle in a year. 1,000 nymph and adult simultaneously attack new flushes and inflorescence in the spring seasons. Apart from sucking the sap, they secrete a honey-dew like substance which falls on the leaves and results in growth of black sooty mould which hinders the photosynthetic activity of the plant. In sever infestation plant become yellow and later stage get wilt.

- Premature of fruit
- Low flowering and fruiting

Management:

- Use of the light trap @ 1 trap/ha
- High density planting should be avoided because problem is high so timely training and pruning is also necessary
- Use of the systematic pesticide in every evening time
- Use of the entomopathogenic fungi: *Metarhizium* that causes 100% mortality in caged condition.
- Banding is practiced to control mango hopper mechanically; 5 cm wide greasy band around trunk of mango tree before hatching of egg in the soil, prevents upward movement of nymphs



Mango mealy bug (*Drosicha mangiferae*):

(mealy means white substance)

Homoptera: egg-nymph-adult

Mark of identification:

Body color is crimson red which is covered by white powdery like substances from the outside so it is called mealy bug.

Life-cycle:

The male has 1-pair of wing, female are wingless. Male dies after 1-2 days of mating whereas female die after laying eggs. Mating takes place in aerial plant parts and female moves towards the soil to lay eggs below 5-15 cm. After **2-3 month of hatching of the egg** (due to in diapause state, waiting favourable condition) takes place and new nymph moves towards aerial part of the plants.

Nymphal period: 2-3 weeks. Damaging stages: nymph and adults

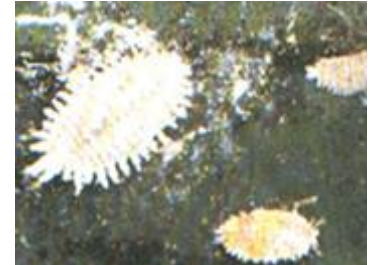
Nature of damage:

Both nymph and adult suck the sap from tender parts of the plant; secrete the honeydew where sooty mold is developed.

Disease resistant of the infected plant is drastically reduced due to vigor-loss.

Management:

- Use of the greasy band about 10-15 cm width in the tree trunk above 15cm of the soil surface to prevent the migration of the female into the soil and hatches new young-ones from the soil to aerial parts of plant
- Use of systematic type of pesticide
- Application of 250 g per tree of Methyl Parathion dust 2% or Aldrin dust 10 % in the soil around the trunk kills the newly hatched nymphs which come in contact with the chemical.
- *Menochilus sexmaculatus*, *Rodolia fumida* and *Sumnius renardi* are important predators in controlling the nymphs.
- The entomogenous fungus *Beauveria bassiana* is found to be an effective bio-agent in controlling the nymphs of the mealy bug.
- Flooding of orchards with water in the month of October kills the eggs.

**Mango fruit fly (*Bactrocera dorsalis*):**

Diptera: egg-maggots- pupa-adult

- It has one pair of true wings. The female has pointed or sharp wedge abdomen whereas male has round or circular shape abdomen.
- The size of the male is smaller than female.
- The body color of the fruit fly is radish brown whereas maggots are white in color.
- The sharp ovipositor of female puncture the



tissue of tender bulb or base of the inflorescence or base of the fruit or growing twigs.

- Hatching of the egg takes place after 1-2 weeks
- The new hatched maggots consume the internal content of the fruit where 2nd infestation takes place and fruit starts to rotten.
- About 3-4 different maggot stages have been reported. The total duration of maggot is 3-4 weeks.
- It takes about 1 month to complete one life-cycle; 4-5 generation is completed in a year.
- Pupation takes place inside the rotten fruit and sometimes even in the fruit that has been dropped in soil.

Maggots and adults:

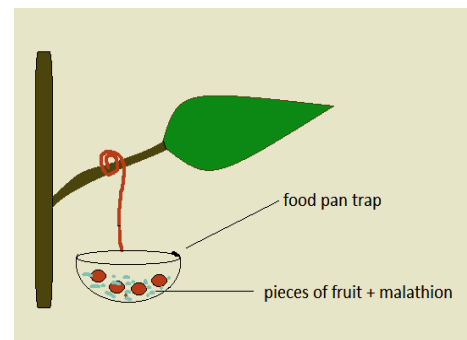
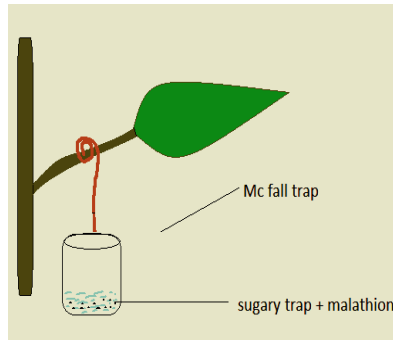
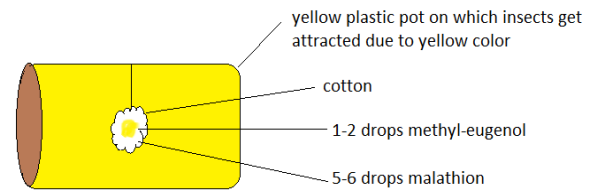
The sharp ovipositor of the female punctures the fruit in tender stage from where rotting starts at the time of fruit development.

After hatching, the maggots consume the internal tissue from where decaying takes place from which fruit gets drop.

Management:

- Collection of the infested fruit and keeping it in the water bucket.
- Complete field sanitation
- Use of methyl-eugenol (it is used to attract only fruit fly of fruit)
- Use of the molasses with malathion in any branch of the tree.

Here, molasses attract insects but malathion on contact kill the pest and fall into the soil due to death. (use malathion @ 2ml/lit of water)



Mango stem borer (*Batocera rufomaculata*):

Robust body, long leg, long antenna, hard elytra

Life-cycle:

- Short
- Lay egg on bark
- After 1-2 weeks of egg laying, hatching takes place
- The new emergence larvae which has strong mandible enters into the stem by making tunnel and damage plant
- The infestation of stem borer can easily be identified by observing the saw dust around the tunnel or hole.



- A typical sound (audible sound) can also be observe at borer infected plant
- About 3-4 month: larval(grub) period
- Pupal period: 1 month
- Pupation takes place inside the stem by making fibrous cocoon.
- The cocoon which is made by wrapping the saw dust of wood.

Management:

- Pouring the kerosene or petroleum oil drop in the hole
- Jerking of the hole, tunnel with the help of long stem
- Plugging the hole
- Cutting infected branches
- The larva which is easily infected by a kind of entomopathogenic fungi which is *Metarrhizium anisopliae*(green muscardin fungi)

Mango stone weevil (*Cryptorhynchus mangiferae*):

The mango stone weevil (*Sternochetus/ Cryptorhynchus mangiferae*) is an important monophagous pest of mango, infesting the seed (stone) within. Female lays eggs of the mango stone weevil on the epicarp of partially developed fruits or under the rind of ripening fruits. Newly emerged grubs bore through the pulp, feed on seed coat and later cause damage to cotyledons. Pupation takes place inside the seed. Discolouration of the pulp adjacent to the affected portion has been observed.

Eggs are minute and white in colour. Adult weevils are 5 to 8 mm long, stout and dark brown in colour.

Eggs (12-36) deposited singly by scooping out the surface of the developing fruit. Grubs hatches in 7 days and after the completion of larval period

pupate inside the nut itself and emerges as adult after 7 days. Life-cycle is completed in 40 to 50 days during June-July. Adults hibernate until the next fruiting season. There is only one generation in a year.

Notes:

Grubs, immediately after hatching, tunnel in a zig-zag manner through the pulp, endocarp and the seed coat and reach the cotyledons. They feed on cotyledons and destroy them. Adults feed on developing seeds.

Control:

- Destroying the affected fruits and exposing the hibernating weevils by digging the soil.
- Spraying the trees with Fenthion (0.01%).



Citrus pest:

SN	COMMON NAME	SCIENTIFIC NAME	FAMILY	ORDER
1.	Citrus stink bug	<i>Rhynchoscoris humeralis</i>	Pentatomidae	Hemiptera
2.	Citrus fruit fly	<i>Bactrocera dorsalis</i>	Tephritidae	
3.	Citrus aphid	<i>Toxoptera citricida</i>	Aphididae	Hemiptera
4.	Citrus psylla	<i>Diaphorina citrii</i>	Psyllidae	
5.	Citrus stem borer	<i>Stromatium barbatum</i>	Cerambycidae	
6.	Citrus leaf miner	<i>Phyllochistis citrella</i>	Phyllochistidae	
7.	Citrus leaf mining beetle	<i>Throscorysa citri</i>	Chrysomelidae	
8.	Citrus scale	<i>Aonidiella aurantii</i>	Diaspididae	
9.	Citrus mealy bug	<i>Planococcus citrii</i>	Pseudococcidae	
10.	Red ant	<i>Oecophylla smaragdina</i>	Formicidae	

Citrus stink bug (*Rhynchoscoris humeralis*):

Major pest of Lamjung and Syangja

Hemiptera: egg-nymph- adult

Mark of identification:

- Pentamid bug, having prominent spines in the thorax
- Brown green or greenish brown in color
- Major host: mandarian, sweet orange and lime

Life-cycle:

- Laying of egg takes place in either ventral or dorsal side of the leaves in cluster.
- Hatching takes place in a week
- Passes **5-nymphal instars**, total duration is 6-8 weeks
- Moulting takes place 4 times
- Egg:- large and circular and brown in initial stage and at the time of hatching the egg change into dark color because of embryonic development

Nature of damage:

- Nymph and adult stage
- Both the stage have piercing and sucking type of mouthpart, which suck the juice from the sap, so juiceless fruit can be found
- Brown ring can be found at the site of infection part

Management:

- Cow urine or buffalo soaked jute scale
- Hanging of carrion in citrus orchard attract the citrus stink bug
- A hymenopteron parasitoids - *Trissolcus priapus*, Scelionidae is the parasitoids of citrus stink bug egg
- Collection of egg masses, nymphal stages
- Removal of alternate host
- Community campaign of pesticide application in large area



Citrus scale *Aonidiella aurantii* (Red scale, California red scale, Armoured scale):

- In world 2 type of scale are found
Hard scale and soft scale, this is hard scale, Soft scales do not have a separate protective covering whereas armoured scales do
- Gives direct nymph
- 150 nymph develops within a period of 3 weeks
- After hatching in nymph for 2-4 hrs, they enters into quiescence, then movement starts and they are called crawlers.
- Crawlers move to seek to suitable host where it completes its lifecycle.
- Female shape: flat and large, reddish brown
- Male are round shape, pale color than female
- Crawlers, nymph and adult are damaging stages. They suck the sap from infected plant.
- In sever infestation the plant become disfigure and distorting, yellowing, wilting and shows dieback symptoms

**Management:**

- Use of Agro-servoil @ 500ml/15 plants or spray with @5ml/ lit water
- Adopting the intra- and inter-quarantine policy while transporting the citrus seedling

Citrus aphid (*Troxoptera citricida*):

Brown citrus aphid: vector of *Tristiza* virus:- major cause of citrus decline in Nepal

Black citrus aphid:

- Wing or wingless aphids are developed
- Mating takes place or gives the nymph parthenogenically, govern by the prevalent climatic situation and host suitability
- 1 mature female give 4400 nymph in 10 days interval
- 47 generation has reported per year
- About 25-35 generation reported in Nepal
- Stress condition: develops wings and go distant places
Gives eggs
- No stress condition: give direct nymph

Management:

- Use Lady bird beetle as natural predators
- Hymenopteron parasites (wasp) feed aphid as their host
- Systematic type of pesticides
- Use of cow urine mixing with water in ratio of 1:7



Fig: nymph of citrus aphid

Citrus stem borer (*Stromatium barbatum*):

Mark of identification:

- Long antenna, robust body, long legs
- Reddish brown body
- Major host: citrus
- Second host: mango, guava
- Lay eggs in bark, eggs hatch in 1-2 weeks
- After hatching enters into the stem by making tunnel
- Larval period 3-4 years
- High infestation can be observed in 1-4 years orchard (main stem)
In old orchard it goes to the branches
- Releasing of saw dust excreta in the hole are the characteristics feature of the stem borer
- 2-3 weeks pupation periods (in stem). Pupation inside fibrous cocoon



Management:

- Use of kerosene drop inside the hole
- Plugging the hole
- Jerking inside the tunnel with the long stick
- Cutting affected branches

Citrus mealy bug:

SCIENTIFIC NAME: *Planococcus citri*

CLASS: Insecta

ORDER: Hemiptera

FAMILY: Pseudococcidae

**DESCRIPTION**

Adults: The female citrus mealybug is wingless and appears to have been rolled in flour (hence the name). It grows to 3 millimeters long and 1.5 millimeters wide. A fringe of small waxy filaments protrude from the periphery. The male is small, but with its wings and tail filaments, it appears to be 4.5 millimeters long.

Eggs: The oblong, yellow eggs are enmeshed in a dense, fluffy, white ovisac.

Crawlers: The tiny crawler is oval and yellow, with red eyes. The antennae are rather distinct.

Nymphs: Female nymphs resemble the larger adult females. Male nymphs are narrower and often occur in a loose cocoon.

BIOLOGY

Host Plants: Citrus mealybugs have been collected from at least 27 host plant families. Many ornamental plants grown in greenhouses are susceptible to attack including begonia, coleus, amaryllis, cyclamen, and dahlia. Citrus mealybug has been collected on canna, narcissus, and tulip outdoors.

Damage: Citrus mealybugs damage hosts by sucking out plant sap, by excreting honeydew in which sooty mold can grow, and by causing distorted growth and premature leaf drop with their toxic saliva. They further disfigure plants by secreting cottony wax. Infested plants usually die unless the pest is controlled.

Life Cycle: The citrus mealybug has been recognized as a pest of citrus and ornamental plants. Because female citrus mealybugs have no wings, they must be transported to the proximity of the next host plant. They can, however, travel short distances by crawling. The immatures can be blown about. Males are small, winged insects. After mating, each female lays up to hundreds of eggs in a dense, fluffy secretion called the egg sac or ovisac. Within a few days, new mealybugs (crawlers) hatch and begin to squirm out of the ovisac. Light infestations are easily overlooked because the mealybugs tend to wedge into crevices on the host plant. As their numbers increase, mealybugs of all sizes can be seen crawling around or feeding on all exposed plant surfaces.

MANAGEMENT STRATEGIES

Control of citrus mealybugs is amazingly difficult. Some commercial flower growers merely discard infested plants rather than trying to rescue them from citrus mealybugs. Horticultural oils may damage amaryllis.

Biological Control: The lady beetle *Cryptolaemus montrouzieri* and parasitic wasps *Leptomastix dactylopii* and *Anagyrus pseudococci* attack citrus mealybugs.

Insect pest of Sugarcane and Jute:

Leaf hopper is the main pest

Leaf feeding insects:

Common name	Scientific name	Family
Army worm	<i>Mythimna separata</i>	Noctuidae
Tobacco caterpillar	<i>Spodoptera litura</i>	Noctuidae

Grasshopper	<i>Hieroglyphus banian</i>	Acrididae
	<i>Atractornorpha crenulata</i>	
Leaf and stem sap feeding insect:		
Common name	Scientific name	Family
Sugarcane leaf hopper	<i>Pyrilla perpusilla</i>	Lophopidae
Sugarcane white fly	<i>Aleurolobus barodensis</i>	Aleyrodidae
Sugarcane mealybugs	<i>Saccharicoccus sacchari</i>	Pseudococcidae
Stem boring insects:		
Common name	Scientific name	Family
Sugarcane early shoot borer	<i>Chilo infuscatellus</i>	Crambidae
Sugarcane top borer	<i>Scripophaga nivella</i>	Pyralidae

Sugarcane leaf hopper:

- Straw color body
- Mouth is pointed / head is pointed while body part is wider like wedge shape
- Anal end of abdomen of nymph has two feather like structure



- Major host:
Sugarcane-sorghum-maize
- Secondary host:
Barley, millet

Life-cycle:

- A female can lay 773 eggs in its life-time.
- The eggs are laid in clusters on the food-plants in the ventral surface of leaf and are covered with whitish fluffy material.
- The egg stage occupies 7–12 days during April–October and 20–41 days during November–March.
- There are five nymphal instars. The nymphal stage occupies 24–65 days during April–September and 78–208 days during October–March.

- 4-5 generation per year

Damaging nature:

Both adults and nymphs do damage. They prefer to feed on those varieties of sugar-cane which have broad, fleshy and succulent leaves and thick, soft stems. Nymph and adult suck the sugary substances from sugarcane and excrete the honeydew substances which develop sooty mold that reduce photosynthesis. This results low sugar level in plant and low yield per unit area.

Infestation is high in high use of nitrogen fertilizer because of succulence. In water-logged and close planting infestation is high.

Management practices:

- (1) Destruction of the adults by hand nets during April;
- (2) destruction of the eggs by crushing during April;
- (3) destruction of the nymphs by a new hopperdozer during November–March;
- (4) dusting with nicotine dust or spraying with nicotine sulphate–fish oil soap mixture.
- (5) mass of the hopper can be attracted in too light trap. So set 1 light trap/ ha
- (6) optimum use of nitrogen fertilizer i.e., 100kg/ha
- (7) maintaining the proportion of population while planting
- (8) use of Staphylinid beetle/ Rove beetle which is the predator of leaf hopper egg.

Sugarcane white fly:

- 1 pair of white wings, abdomen is yellow
- Eye: black (characteristics symptoms)
- Major host:
Sugarcane- maize- sorghum..... In Terai
The problem can be seen in tomato in Hilly region

Life-cycle:

- Egg laying in cluster
- 8-10 days for hatching
- Passes 5 different nymphal stages with in the period of 25-30 days
- Pupal period is 10-11 days
- 9 generation/year

Nature of damage:

Nymph and adult both suck the fluid from growing sugarcane. Secrete honeydew : sooty mold develops: reduced photosynthesis: reduced in sugar content and economic yield.

Sometimes it is the vector of virus that causes mosaic virus disease.

The infestation is high in alkaline soil, waterlogged soil, closed planting and **low nitrogen contain soil.**

Management practices:

- So maintain the proper spacing to facilitate air circulation and use the optimum nitrogen fertilizer i.e., 100 kg/ha.
- Maintaining the proper moisture level in the soil
- Use of systemic nature of pesticide
- Field sanitation

Sugarcane mealy bug:

- The body is covered by white mealy like substances but body color is crimson red or violet color
- Major host:
Sugarcane- maize-jute-cotton
- Secondary host:
All cereals

Life-cycle:

- Male have 1 pair of wing, female are wingless
- Lay egg or directly give to nymph
- 6 stages of the nymph have been recorded
- Total nymphal duration is 3-4 weeks
- Total generation is 4-5/year recorded

Nature of damage:

- Nymph and adult are damaging stages
- Both stage consume sugary substances from sugarcane, that result honeydew secretion: develops sooty mold: reduced photosynthesis.
- Mutualistic relationship can be found with the ant and mealy bug in mealy bug infected field.

Management practices:

- Optimum dose of the nitrogenous fertilizer. 100 kg N/ha.
- The infestation is high in closure spacing, so maintaining the proper spacing.
- Use of any pyrethroid based pesticide. Available in market: roger, stempad, gaidachhap, dhanush, rambad.
@ 1-5 ml/lit with water

Sugarcane early shoot borer:

- Straw color having pointed head
- The larva head is black
- The hind wing which are comparatively white with fore wing
- Major host:
Sugarcane
Maize
Sorghum

Life-cycle:

- Lay the eggs at the ventral surface of leaf adjoining mid-rib in cluster
- Infestation is high in early season
- Larva enter through the base of the plants, consume the internal content of sugarcane. So, it shows the dead heart symptoms.
- Borer infected plant can be easily pulled out
- 5 different larval stage and passes within 3-4 weeks
- Pupal period is 1 week, 4-5 generation per year

- Pupation takes place inside stem
- Ratooning practices should be discourage to minimize infestation
- Uprooting the sugarcane after harvesting
- Field sanitation
- Crop rotation, fallowing the field upto 2yrs and summer ploughing
- Setting the light trap in the sugarcane field also attract moth of it
- Use umet: 2-3 granules/ cane

Top borers:

- Egg laying: adjoining with midrib
- Bunch of hair in last part of abdomen
- Yellow color egg
- The egg mass which is covered by hair like substances to protect from natural eggs
- Hatching: 4-8 days
- 1st stage larva enters into the mid rib and move to the top part of plant making tunnel: end of apical dominance so that secondary branch is developed from the top. Sugarcane yield per ha is reduced.
- Quality of sugarcane is reduced
- 4-5 larval stage
- 4 weeks period of larva
- Pupal period is 1 week
- 3-4 generation/ year

Management practices:

- Field sanitation
- Collection of egg mass
- Cutting the infected leaf, branches
- Setting light trap
- Umet:-2-3 granules/ cane

Jute pest:

Jute hairy caterpillar: *Spilarctia oblique*, Archidae

Jute Apion: *Apion corchori*, Curculionidae

Jute hairy caterpillar:

Egg:1 week

Larva:1-2 weeks, 5 stages

Pupa: 1weeks

4-5 generation/year

Egg laying in lower part of leaf in cluster

Pupation takes place inside the soil

Management practices:

- Use of pyrethroid based pesticide

- Use of neem based pesticide
- Collection of larva

Jute apion (जूटको घुन):

Egg: 1 week

Grub: 2 weeks

Pupal period: 1 week

Prominent snout, black color elytra

Make hole in bark where it lays egg. Fibre length is reduced

Grub is damaging stage

Management practices:

- Use neem based pesticide
- Use the thin bark species
- Use low urine mixture (1:5)

Insect-pests of cucurbits:

Major insect-pests of cucurbits arranged in order of major harm in cucurbits in Nepal:

SN	COMMON NAME	SCIENTIFIC NAME	FAMILY	ORDER
1	Cucurbits fruit fly	<i>Bactrocera cucurbitae (minax)</i>	Tephritidae	Diptera
2	Red pumpkin beetle	<i>Aulacophora foreicollis</i>	Chrysomelidae	
3	Epilachna beetle	<i>Epilachna duodecastigma/ E. vigitictopunctata</i>	Coccinellidae	Coleoptera
4	Cucurbits stink bug	<i>Aspongopus (Coridius) janus</i>	Pentatomidae	
5	Banded blister beetle	<i>Mylabris (Zonabris) phalerata</i>	Meloidae	
6	White fly	<i>Bemisia tabaci</i>	Aleurodidae	
7	Aphid	<i>Aphis gossypii/ Myzus persicae</i>	Aphidae	
8	Stem boring beetle	<i>Apomyccena saltator</i>	cerambycidae	

Cucurbits fruit fly (*Bactrocera cucurbitae*):

Diptera: egg-maggot/larva-pupa-adult

- 1 pair of the wings (forewings)
- Hind wings are modified to halter
- Size of female is larger than male. Abdomen is larger in female than male. Male has rounded abdomen, female has sharp ovipositor
- Maggots are legless
- Major host:
Pumpkin-summer squash-cucumber-spongegurd-snakegurd-ashgurd-bottlegurd
Low infestation in the fruit having hard rind

- With the help of sharp ovipositor, female lays eggs inside the fruit. At the puncturing time, female release gummy substance to plug the hole to protect its progeny
- Color of egg is white and cylindrical shape
- Hatching of egg takes place in 1 week and turns into maggots, consume the internal content at whole period
- 3-4 stages of maggots are recorded
- 2-3 weeks maggots period
- Pupation takes place inside the fruit or sometimes in soil
- Pupation period is 7-10 days
- 4-5 generation/yr



Nature of damage:

- Both adult and maggots are damaging stages
- Adult puncture the fruit from where decaying starts where maggots consume internal content of the fruit and at last it falls. With the advancement of fruit maturity, infestation is reduced due to development of hard rind.

Management practices:

- Collection of the fallen fruit and destroying it
- Field sanitation
- Use of protein bait:
Wheat flour, maize flour or rice flour which is mixed with molasses and mix toxicant called spinosad. It attract large mass of female and male which in turn is killed
- Use of the cuel lure mixing with the malathion. Cuel lure attract the male mass, after contracting with cuellure fruit fly dies. Replaced it 10-15 days interval by cuel lure and malathion
- It should be set at the time of bud emergence
@ 1-2 trap/ropani for monitoring purpose
@5-6 trap/ ropani for management practice
- Use of food based pan trap: use of pieces of ripening pumpkin fruit mixed with malathion. Molasses and slugary substances can be used to increase efficacy.

Pumkin beetle complex:

Red pumkin beetle: *Aulacophora fovicollis*

Blue pumkin beetle : *Aulacophora lewisii*

Green pumkin beetle: *Aulacophora cincta*

Red pumpkin beetle:

- Small and shiny which is reddish brown in color
- Have well developed mandibles
- Major host:
Pumpkin-bottle gurd- cucumber- snake gurd- sponge gurd
- The infestation is high in offseason planting

Life-cycle:

- Egg lay around the plant canopy around root region

- Egg color: yellow
- Within the 1 week egg hatches into the grub and grub starts to consume root hair. The nutrient supplying capacity of root is reduced so plant gets wilt
- Grub period: 2-3 weeks having 5-different stage
- The pupal period is: 7-17 days
- Pupation also takes place within the soil within the earthen cocoon
- 4-5 generation/year

Nature of damage:

- Both the grub and adult are damaging stage
- Grub: root damage
- Adult which have well developed mandible which damage mesophyll tissue of tender leaf

Management practices:

- Soil digging around root region or canopy
- Flooding the field and stagnation
- Collection of the adult
- Use of any antifeedant pesticides like neem based pesticides, Annosom (from *Annona squamosa*) @ 2-3 ml/lit water

Epilachna beetle(spotted beetle):

Epilachna duodecastigma (12 spotted), *E. vigintioctopunctata* (28 spotted beetle)

- Major host:
Bitter gurd-cucumber- and other gurd
- If larva is yellow with yellow hair and body is circle type then it is larva of epilachna beetle, and if larva has red spotted in body and is conical shape it is the larva of ladybird beetle.
- Epilachna looks like the lady bird beetle but its elytra is not shiny as lady bird beetle. It is dull but lady bird beetle is active.

Life-cycle:

- Conical shape egg, lay in lower side of leaf in cluster. Yellow color egg
- Hatches of egg takes place in 3-5 days
- Consume leaf with gregarious feeding (group feeding), the whole leaf turns to transparent. In sever infestation it also damage stem and fruits
- Larva period is: 2-3 weeks
- Pupation also takes place in stem, leaf
- Pupal period: 5-6 days

Management practices:

- Collection of egg masses, larva
- Use of jholmol (antifeedant character)
(tito-piro-tarro)

Cucurbits stink bug:

- Main host:

Sponge gurd-other cucurbitaceous crop

Life-cycle:

- Lay egg in upper part of leaf, lay in cluster
- Brown color egg in early stage which turns into black at the time of hatching
- Hatching period: 1 weeks
- 4-different nymphal stages. The color of the 1st nymphal stage is different than as last
- 1st stage: white
- 2nd stage: }
3rd stage: } greenish grey
- 4th stage: dark brown

Nature of damage:

Nymph and adult are damaging stage

- Both stage suck the fluid from the growing tips, hindrance of apical dominance
 - Use of systematic type of pesticide due to piercing and sucking type mouth part
 - Collection of eggs
- Scenoids is parasites of this stink bug egg

Banded blister beetle:

- Yellow banded strips in the fore-wings
 - Major infestation is in flower of cucurbits
 - It consume the pollen so that pollen sterility ultimately reduced the fruiting capacity of plant
 - Egg lay in soil
- Its larva eat egg of grasshopper, so **larva is the predators and adult is pest.**

Management:

- Collection of the egg
- Use of jholmol (1:6-10 dilution)

Damaging stage:

Adult stage only

Major insect-pest of rice:

- 600 pest are identified in rice
- 10-75% yield loss by rice pests
- High yield loss in Asia upto 35%
 - China: 15%
 - South Africa: 14.4%
 - South America: 3.5%
 - Central and north America: 3.4%
 - Europe: 2%
- Reason behind high loss in yield in Asia:

- . use of high yielding variety (HYV)
- . use of fertilizer
- . intensive farming
- . increasing irrigation area

Classification of Rice Pest:

1. Based on feeding habit:
 - Leaf feeding insect/leaf damaging insects/defoliating insects:
 - Mandibles well developed
 - Leaf biting and chewing, leaf folding, leaf casing

SN	COMMON NAME	SCIENTIFIC NAME	FAMILY	ORDER
1	Rice ear-cutting caterpillar/ army worm (फौजी किरा)	<i>Mythimna separata</i>	Noctuidae	Lepidoptera
2	Rice swarming caterpillar	<i>Spodoptera mauritia</i>	Noctuidae	
3	Rice case worm	<i>Nymphula depunctalis</i>	Pyralidae	Lepidoptera
4	Rice leaf folder	<i>Cnaphalocrocis medinalis</i>	Pyralidae	Lepidoptera
5	Rice white horned caterpillar	<i>Melanitis spp</i>	Satyridae	Lepidoptera
6	Rice skipper	<i>Pelopidas mathias</i>	Hesperidae	Lepidoptera
7	Rice hispa	<i>Dicladispa armigera</i>	Chrysomelidae	Coleoptera
8	Rice grasshopper	<i>Hieroglyphus banian</i>	Acrididae	Orthoptera
9	Rice field cricket	<i>Gryllus bimaculatus</i>	Gryllidae	Orthoptera
10	Rice green horned caterpillar	<i>Melanitis leda ismene</i>	Satyridae	Lepidoptera