STORED GRAIN PESTS:

In India, post-harvest losses caused by unscientific storage, insects, rodents, microorganisms etc., account for about 10 per cent of total food grains. The major economic loss caused by grain infesting insects is not always the actual material they consume, but also the amount contaminated by them and their excreta which make food unfit for human consumption. About 500 species of insects have been associated with stored grain products. Nearly 100 species of insect pests of stored products cause economic losses.

Storage insect pests are categorized into two types viz.
• Primary storage pests : Internal and External feeders
• Secondary storage pests

Primary storage pests: Insects that damages sound grains are primary storage pests. Some of examples are:

Rice weevil *Sitophilus oryzae,*
Lesser grain borer: *Rhyzopertha dominica* Bostrychidae Coleoptera
Pulse beetle: *Callosobruchus chinensis,*
Red flour beetle: *Tribolium castaneum, Tribolium confusum*
Rice moth: *Corcyra cephalonica*
Khapra beetle: *Trogoderma granarium* Dermestidae Coleoptera

Secondary storage pest: Insects that damage broken or already damaged grains secondary storage pests. Examples:
Saw toothed grain beetle: *Oryzaephillis surinamensis* Silvanidae: Coleoptera
Long headed flour beetle: *Latheticus oryzae* Tenebrionidae Coleoptera
Flat grain beetle: *Cryptolestus minutas,* Cucujidae Coleoptera
Grain lice: *Liposcelis divinitorius* Liposcelidae Psocoptera
Grain mite : *Acarus siro* Acari

A. Primary storage pests:

- **Rice weevil: *Sitophilus oryzae***

Classification:
Phylum: Arthropoda
Class: Insecta
Family : Cruculionidae
Genus: *Sitophilus*
Species: *oryzae*

Diagonostic features:

- Adults are reddish brown having a length of 3 mm with a long, slender, pointed head.
- Full grown larva is 5 mm in length and plumpy, fleshy, legless creature. Its elytra bear four light reddish or yellowish spots.
- The rice weevil breeds from April to October and hibernates in winter as an adult inside cracks and crevices or under wheat bags in the godowns.
- Females lay about 400 eggs on the grain by making a depression and the hole is sealed with agelatinous secretion.
- Eggs hatch in 6-7 days and the young larvae bore directly into grain, where they feed and grow to maturity.
- Pupation occurs inside the grain.
- The pupal stage lasts 6-14 days. On emergence, adult weevil cuts its way out of the grain and lives for about4-5 months.
- There are 3-4 generations are completed in a year.

Damage symptoms

- Both the adults and the grubs cause damage.
- The developing larva lives and feeds inside the grain causing irregular holes.
- The weevils destroy more than what they eat.

➢ Lesser Grain Borer: *Rhyzopertha dominica* (Bostrychidae: Coleoptera)

Classification:

Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Genus: *Rhyzopertha*
Species: *dominica*

Diagnostic features:

- It is the pest of Indian origin and today found throughout the world.
- The adult is a small cylindrical beetle, shining dark brown with a deflexed head.
- The larva is about 3mm long, dirty white, with light-brown head and a constricted elongated body.
- The pest breeds from March to November and in December, it enters hibernation as an adult or as a larva.
- A single female can lay 300-400 eggs in 23-60 days at the rate of 4-23eggs per day.
- Larva cuts a circular hole in the pedicel end of the eggs and comes out of it.

- Larval period 23 - 50 days, pupal period 4 - 6 days and adult live for about 40 - 80 days.
- There are 5-6 generations in a year.

Damage symptoms:

- Both the adults and the grubs cause damage.
- The adults and grubs bore into the grains feed and reduce them to mere shells with many irregular holes.
- The adults are powerful fliers and migrate from one godown to another, causing fresh infestation.

➢ Pulse beetle: *Callosobruchus maculatus* (*chinensis*) (Bruchidae: Coleoptera)

Classification:
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Genus: ***Callosobruchus***
Species: ***maculatus***

Distribution and status
USA, Mauritius, Formosa, Africa, China, the Philippines, Japan, Indonesia, Sri Lanka, Myanmar and India.

Host range
Gram, mung (*Phaseolus aureus*), moth (*Phaseolus aconitifolius*), peas, cow peas, lentil and arhar (*Cajanus cajan*), cotton seed, sorghum and maize.

Diagnostic features :

- Larva is whitish with a light-brown head and 6-7 mm in length.
- The adult beetle measuring 3-4 mm in length, is oval, chocolate or reddish brown and has long serrated antennae.
- The pest breeds actively from March to the end of November.
- It hibernates in winter in the larval stage.
- A single female lays small, oval, scale like 34-113 eggs at the rate of 1-37per day.
- Egg period is 6 -16 days, larval period 10 -38 days. The hibernating larvae take 117-168 days to complete their development.
- The pupal stage lasts 4-28 days.
- The adult escapes by cutting a circular hole in the seed coat and such grains can be spotted easily.
- The average life-span of an adult is 5-20 days.

- The insect passes through 7-8 overlapping generations in a year.

Damage symptoms:

- The adult and grub feed on the grain by making a small hole.
- Infested stored seed can be recognized by the white eggs on the seed surface and the round exit holes with the 'flap' of seed coat.

➢ Red flour beetle: *Tribolium castaneum* (Tenebrionidae: Coleoptera)

Classification:
Phylum: Arthropoda
Class: Insecta
order: **Coleoptera**
Genus: ***Tribolium***
Species: ***castaneum***

Distribution and status: Worldwide

Host range
Wheat-flour, dry fruits, pulses and prepared cereal foods, such as cornflakes.

Diagnostic Features:

- It is a worldwide stored product pest.
- Most abundant insects found in aflour mills.
- The young larva is yellowish white and as it matures, it turns reddish yellow.
- The adults are reddish to black in color
- Adults are very active.
- Males are smaller than females.

Damage symptoms:

- Both the larvae and adults cause damage.
- The greatest damage is during the hot and humid monsoon season.
- The larvae are always found hidden in the food.
- The adults,however, are active creatures, but mostly found concealed in flour.
- Adult construct tunnels as they move through flour and other granular food products.
- In severe infestation, the flour turns greyish and mouldy, and has a pungent, disagreeable odour making it unfit for human consumption.

➢ Rice moth: *Corcyra cephalonica* (Pyralidae: Lepidoptera)

Classification:
Phylum: Arthropoda
Class: Insecta

Order: **Lepidoptera**
Genus: ***Corcyra***
Species: ***cephalonica***

Distribution and status
The rice moth is distributed in Asia, Africa, North America and Europe. In the larval stage, it is an important stored-grain pest in both India and Pakistan.
Host range
It also infests rice, sorghum, maize, gram, groundnut, cotton-seed, milled products, cocoa beans and raisins.

Diagnostic features:

- The rice moth is active from·March to November.
- It passes winter in the larval stage.
- The moth lay eggs singly or in groups of 3-5 each on the grains,bags and on other objects in the godowns.
- A single female lay 62-150 eggs during its lifespan of 24 days. The eggs hatch in 4-7 days and the larvae under silken web-like shelters, preferring the partially damaged grains.
- The larvae are full-fed in 21-41 days, after which they make silken cocoons among the infested grains.
- The pupal stage lasts 9-14 days and the adults live for - one week.
- They complete life-cycle in 33-52 days and the pest completes approximately 6 generations in a year.

Damage symptoms:

- The larvae alone damage the grains of rice and maize by feeding under silken webs.
- When infestation is high, the entire stock of grains may be converted into a webbed mass.
- A characteristic foul odour develops and the grains are rendered unfit for human consumption.

➢ Khapra beetle: *Trogoderma granarium* (Dermestidae: Coleoptera)

Classification:
Phylum: Arthropoda
Class: Insecta
order: **Coleoptera**
Genus: ***Trogoderma***
Species ***granarium***

Distribution and status: Worldwide
Host range:
The Khapra beetle will attack any dried plant or animal matter. It prefers grain and cereal

products, mainly wheat, barley, oats, rye, maize, rice, flour, malt, and noodles. It can also feed on animal products such as dead mice, dried blood, and dried insects

Diagnostic features:

- The insect breeds from April to October and hibernates in the larval stage from November to March in cracks and crevices.
- Female begins to lay white translucent eggs on the grains, singly or sometimes in clusters of 2 -5.
- The eggs are rather cylindrical, rounded at one end and narrow at the other. A female may lay 13 - 35 eggs in 1 - 7 days at the rate of 1 - 26 eggs per day.
- The egg period varies from 3 -10 days. Larval period is 20 - 40 days and pupal period is 4 - 6 days.
- Pupation takes place in the last larval skin among the grains.
- The adults are incapable of flying.
- There are 4-5 generations in a year.
- . The adult is a small dark-brown beetle, 2-3 mm long, with a retractile head and clubbed antennae. The entire body is clothed in fine hairs.

Damage symptoms:

- The greatest damage is done in summer from July to October. The grubs eat the grain near the embryo or at any other weak point and from there proceed inwards.
- They usually confine themselves to the upper 50 cm layer of grains in a heap or to the periphery in a sack of grains. They can reduce the grain to a mere frass.

B. SECONDARY PEST:

- **Long headed flour beetle: *Latheticus oryzae* (Tenebrionidae: Coloeptera)**

Classification:
Phylum: Arthropoda
Class: Insecta
order: **Coleoptera**
Genus: ***Latheticus***
Species ***: oryzae***

Diagnostic Features:

- The beetle is light brown in colour with longated body, measuring 2 -3 mm in length and resembles *Tribolium castaneum*.
- It lays 400 white eggs singly on grain and seams of the bags.
- The incubation period is 7 – 12 days.

- The grub is small, white active which feeds voraciously.
- The larval period is 15-80 days.
- It pupates for 5-10 days.
- Life cycle is completedin 25 days at 35 0 and 70% relative humidity.
- Resembles *Tribolium*. Head is longer in proportion to the body than that of *Tribolium*, paler and brighter than *Tribolium*.

Damage symptoms:

- Both grubs and adult beetles feed on the milled products.
- It occurs as secondary infestation in stored grain.
- It attacks cereal flour, packaged food, rice and rice products.
- Occurs as secondary infestation in stored sorghum, wheat, etc.

- **Grain mite: *Acarus siro* (Acarina)**

Diagnostic Features:

- It is pale straw to dark reddish brown mite.
- It lays about 100 eggs.
- The eggs are hatched into 6 legged larvae which moult into nymphs.
- There are 1-3 instars.
- The life cycle is completed in 9-12 days at 23 0 C and 70 % relative humidity.

Damage symptoms:

It feeds on the surface of the grains. It attacks cereal grains, flour and other eatables.

MANAGEMENT OF STORAGE PESTS:

The effective management of storage pests may be ensured by drying the grains properly before storage, storing new grains in the clean godowns or receptacles and plugging all cracks, crevices and holes in the godowns thoroughly. If infestation of grain has already taken place, then application of chemicals becomes necessary.

- **Surface treatment:**
  Disinfect old gunny bags by dipping them in 0.0125 per cent fenvalerate 20EC or cypermethrin 25EC for 10 minutes and drying them in shade before filling with grains or use new gunny bags. Disinfect empty godowns or receptacles by spraying 0.05 per cent malathion emulsion on the floor, walls and ceiling.
- **Seed treatment:**
  Mixing of malathion 5 per cent at the rate of 250 g per quintal of seed is recommended. The grains may also be treated with/25 ml of malathion 50 EC or 2 ml of fenvalerate 20EC or 1.5 ml of cypermethrin 25EC or 14 ml of deltamethrin 2.8EC per quintal of seed by diluting in 500 ml of water. Against pulse beetle (dhora), cover the pulses stored in bulk with 7 cm layer of sand or sawdust or dung ash.
- **Fumigation:**

Metallic drums or wooden boxes can be used for fumigating small quantities of grain. In India, ethylene dichloride and carbon tetrachloride mixture has been recommended for fumigation of foodgrains in storage at farm level, and hydrogen phosphide in the form of aluminium phosphide or methyl bromide for protection in warehouses, godowns and silos. Mixture of ethylene dichloride and carbon tetrachloride at the rate of 1 litre for 20 quintals of grain or 35 litres per 100 m3 of space with exposure period of 4 days is recommended. Methyl bromide is used at the rate of 3.5 kg per 100 m3 of space with 10-12 hours exposure. The fumigant, hydrogen phosphide (aluminium phosphide), is available in tablet form and can be used at the rate of one tablet (3 g) per metric tonne or 25 tablets per 100 m3 of space with an exposure period of 7 days.

INTEGRATED MANAGEMENT OF STORED PRODUCE PESTS:

Preventive measures:

• Brush the cracks, crevices and corners to remove all debris in the godown.
• Clean and maintain the threshing floor/yard free from insect infection and away from the vicinity of villages.
• Clean the machines like harvester and thresher before their use.
• Made the trucks, trolleys or bullock carts free from infestation.
• Clean the godowns/ storage structures before storing the newly harvested crop to eliminate various bio stages of pest hiding.
• Provide a metal sheet upto a height of 25 cm at the bottom of the wood in doors to arrest the entry of rats.
• Fix up wire meshes to windows, ventilators, gutters, drains etc., to prevent entry of rats, birds and squirrels.
• Remove and destroy dirt, rubbish, sweepings and webbings etc from the stores.
• Close all the rat burrows found in godown with a mixture of broken glass pieces and mud plastered with mud/ cement.
• Plaster the cracks, crevices, holes found on walls, and floors with mud or cement and white wash the stores before storing of grains.
• Provide dunnage leaving gangway or alleyway of 0.75 to 1 m all around to maintain good storage condition.
• Store the food grains in rat and moisture proof storage structures.
• Disinfest the storage structures receptacles by spraying malathion 50 EC @ 3 lit 100 m before their use.