

Precautions to be taken during fumigation

- ❖ The Phosphine gas which is released in the process is highly poisonous hence; all precautions should be taken by personnel involved.
- ❖ The fumigation should be carried out by following proper procedures under supervision of trained personnel in appropriately prepared fumigation enclosures.
- ❖ The stock should not be fumigated in rainy days as phosphine is highly inflammable.
- ❖ Entire stack should be covered with Multi-layer Cross laminated (MLCL) fumigation covers 200 GSM and pinholes should be closed properly for successful fumigation.
- ❖ All the corners of plastic cover should be plastered with 6 inch thick layer of mud/ sand snake/ adhesive tapes to prevent leakage of gas.



Stored Grain Insect Pests of Rice and their Management

NRRI Technology Bulletin - 134

© All Rights Reserved, ICAR-NRRI, June, 2019

Editing and layout : GAK Kumar and Sandhyarani Dalal

Photography: Naveenkumar B. Patil



STORED GRAIN INSECT PESTS OF RICE AND THEIR MANAGEMENT

NAVEENKUMAR B. PATIL, BASANA GOWDA G, TOTAN ADAK,
GURU PIRASANNA PANDI G, MAHENDIRAN ANNAMALAI,
PRASANTHI GOLIVE, P C RATH AND MAYABINI JENA



To feed the growing world population of 9.8 billion (by 2050); we need to produce about 70% more food grains. Improving the agricultural production is the major policy to cope-up with the increasing food demand. However, post-harvest loss; a critical issue does not receive the required attention and importance. Globally 1.3 billion tons (worth US\$ 1Trillion) of food produced are wasted annually during post harvest operations which is one third of the total food produced (FAO, 2011). In India the total post-harvest losses at different stages (harvesting, threshing, transportation & storage) have added up to about 36% in rice and 33.5% in wheat (Basavaraja et al., 2007). Post-harvest losses are caused by both biotic (insects, mold, birds, mites, rodents etc.) and abiotic (moisture content, temperature and humidity etc.) factors. Among them the storage loss due to insect pests alone is ranging from 4.0 to 6.0% for cereals (Dhingra, 2016). Reducing the post-harvest losses, especially in developing countries address various problems viz., increasing food availability, reducing pressure on natural resources, eliminating hunger and improving farmers' livelihoods.





Storage insect pests of rice belong to two important orders namely Coleoptera (Beetles) and Lepidoptera (Moths). Beetles are comparatively more destructive, since both grubs and adults attack the stored material, whereas among the moths only the larval stage causes the damage. Apart from quantitative loss, they also deteriorate quality by contaminating the grains with their dead bodies, cast skins, excreta and with their webbings due to which the stored products get bad odour,

colour and taste. Under severe infestation, grains become unfit for consumption. Some of the storage insects are known to infest the grains in the field itself (rice weevil and Angoumois grain moth). Stored grain pests of rice can be classified as PRIMARY and SECONDARY storage pests which are described below.



I) PRIMARY STORAGE PESTS

(Insects that damage sound grains)

a) Internal feeders

1. Rice weevil, *Sitophilus oryzae* (Curculionidae: Coleoptera)



- These are small, reddish brown to chocolate colored weevils having characteristic snout with slightly clubbed elbowed antennae.

Symptoms and Nature of damage

- Presence of irregular holes of 1 to 1.5 mm diameter on rice kernels. Grains are hollowed out; kernels are reduced to mere powder. Adults cut circular holes. Heating takes place during heavy infestation, which is known as 'dry heating'.



2. Lesser grain borer / Hooded grain borer / paddy borer beetle, *Rhyzopertha dominica* (Bostrychidae: Coleoptera)

- Adults are brown to blackish beetles; head deflexed downwards below prothorax to such an extent that it is almost hidden in a dorsal view.
- There is a prominent constriction between prothorax and elytra.



Symptoms and Nature of damage



- Presence of round tunnel (1 mm) in kernels. Presence of frass, shelled grains and foul smell are the characteristic symptoms. Heating is very common under severe infestation. Adults reduce the grain kernels to mere frass. Grubs eat their way into the kernel or feed on the kernel dust or starchy material.

3. Paddy moth or Angoumois grain moth *Sitotroga cerealella* (Gelechiidae: Lepidoptera)

- Moths are dirty yellowish brown with narrow pointed wings completely folded over back at rest in a sloping manner.
- Infests only paddy, but not capable of attacking milled rice or other cereal products.



Symptoms and Nature of damage



- Paddy grains with circular emergence hole with characteristic flap/trap door. Only larvae damage the grains, adults being harmless. Grains are hollowed out. Infestation remains confined to upper 30 cms depth only. Larvae enter the grain through crack or abrasion on grain. It feeds inside and remains in a single grain only.



b) External feeders

1. Rust red flour beetle

Tribolium castaneum
(Tenebrionidae: Coleoptera)

- These beetles are oblong, flat, reddish brown in colour. Three larger segments at the end of the antennae (Clubbed)



Symptoms and Nature of damage

In grains, embryo or germ portion is preferred. They construct tunnels as they move through flour and other granular food products. Presence of grub, adults, moulted skin in the flour and acid odour are important characteristics of infestation. Grubs feed on milled products. In addition they release gaseous quinines to the

medium, which may produce a readily identifiable acid odour under heavy infestations.



2. Rice moth *Corcyra cephalonica* (Pyralidae: Lepidoptera)

- Adult moths are small and medium dark gray with no specific markings to distinguish. It's larvae feed on flour, dried fruits and dry cereals.



Symptoms and Nature of damage

- Larvae cause the damage by webbing together grains and forming lump and feeding inside it. There will be reduction in market quality of grains. Heavy infestation leads to entire stock changing into a webbed mass with foul odour.



II) SECONDARY STORAGE PESTS

(Insects that damage broken or already damaged grains)

1. Saw toothed grain beetle, *Oryzaephilus surinamensis* (Silvanidae: Coleoptera)

- These beetles have narrow, flattened thorax with six teeth like serrations on each side. Antenna is clubbed. Elytra cover abdomen completely.



Symptoms and Nature of damage

- Presence of off odour in grain is common. Adults and grub cause roughening of grain surface and off odour in grain. Grains with higher percentage of broken, dockage and foreign matter sustain heavy infestation.



2. Flat grain beetle *Cryptolestes pusillus* (Laemophloeidae: Coleoptera)

- Adult beetles are reddish brown, flat, oblong and quite shiny, with long slender antennae.



Symptoms and Nature of damage

- Both grubs and adults feed on broken grains or on milled products. In case of heavy infestation it causes dry heating in grain and flour.



MANAGEMENT OF STORED GRAIN PESTS

Stored grain insect infestations rarely begin in the field. Most of infestations develop from small numbers of pests already present in or around farm storage structures. Good hygiene in the grain storage site is important in maintaining grain and seed quality. An effective management program can eliminate or greatly reduce the chance of having serious problems with these insects by following below management measures.

A) PRECAUTIONARY MEASURES

1. The grains should be cleaned and dried well in the sun so as to have moisture content of 13 per cent (for milled rice) and 14 percent (for paddy). If neglected, excess moisture in the grain causes heating and development of insect pests and mould which leads to disagreeable odour, deceleration and even caking.
2. Threshing yard and post harvest machineries (combine harvesters, threshers and dryers) should be cleaned properly to avoid cross infestation and spread of stored grain pests.
3. Storage structure should be well ventilated, hygienic, rodent proof, bird proof and clean.
4. Cracks, holes and crevices in the walls, floors and ceilings of the store house should be sealed properly to prevent the cross infestation.
5. Before stacking the grains, godowns, store rooms and receptacles should be cleaned and made free from insects through disinfestation by dusting malathion 5% or treating the godown floor and walls with DDVP at 1:150 dilution in water to avoid cross infestation of new stock.
6. Hermetic storage bags/super bags should be used for improving the shelf life of stored commodity.
7. The bags or bins can be made damp proof by providing dunnage of bamboo/ wooden stand/ crates of bamboo poles or wooden crates.
8. The bags should be stacked in such way as to allow proper ventilation and sufficient space for periodical inspection.
9. Dusting of malathion 5% dust on the top of the grain surface as a thin film on bags.
10. The incoming new arrivals should not be stored along with old or infested stocks in the godown.
11. Regular Inspections of stock allow early detection of problems and enable corrective action to be taken before damage becomes severe.

B) PROPHYLACTIC TREATMENT : It is undertaken when few insects are found crawling on stored rice bags. It is usually done to prevent cross infestation.

1. Malathion 50% EC diluted with water @ 1:100 and requires about 3 litres of aqueous solution to treat 100m² area for surface treatment on bags containing stock, walls and alleyways. It will be effective for 15-20 days.
2. Deltamethrin 2.5% WP: Dissolve 40 g in 1 litre of water and require about 3 litres of aqueous solution to treat 100m² area for surface treatment on bags containing stock, walls and alleyways. It is effective for 90 days.
3. DDVP 100 EC: Used for air-charging in empty spaces, floor and walls of godown. It is diluted with water @ 1:150 require 3 litres of aqueous solution to treat 100 m² area.

C) CURATIVE TREATMENT : It is undertaken under heavy infestation of stored grain pests by Aluminium phosphide fumigation.

- Fumigation is a process of exposing the grain infested with insects to the fumes of a chemical in an enclosed space at a lethal dose.
- Presently Aluminium Phosphide 56% (F) available in the form of tablets is used as fumigant (each tablet weight is about 3 grams and emanating 1 gram of phosphine during its disintegration. This disintegration into Phosphine, carbon dioxide and ammonia takes place when the tablet comes in contact with atmospheric moisture).
- Phosphine generated is a potent toxic gas and act as respiratory poison for stored grain pests since it can penetrate 10 meters towards all directions.
- Phosphine gas is six times heavier than air, it tends to move downwards.
- Pre-monsoon fumigation: One round of pre-monsoon fumigation of all the available stocks in covered stores is to be ensured for better maintenance of the stock in insect free condition.
- Dosage for stack fumigation under airtight cover is 3 tablets weighing 3 g each per ton of grain and for shed fumigation 21 tablets of 3 g each for 28 cubic meters.
- The tablets should be wrapped in cotton pouches before placing them in the stacks, which helps to discard the remnants after completing the fumigation.

