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**Rajat Deshwal**

Assistant Professor, Department  
of Entomology, Teerthanker  
Mahaveer University,  
Moradabad, Uttar Pradesh,  
India

**Visvash Vaibhav**

Senior Research Fellow, ICAR-  
National Research Centre for  
Integrated Pest Management,  
New Delhi, India

**Nitin Kumar**

Agronomist, Utkal Tuber India  
Pvt. Ltd. Bangalore, Karnataka,  
India

**Ankit Kumar**

Research Scholar, Department of  
Plant Pathology, Sardar  
Vallabhbhai Patel University of  
Agriculture & Technology,  
Meerut, Uttar Pradesh, India

**Rahul Singh**

Territory Manager, Grasim  
Industries Ltd.- Unit Indogulf  
Fertilisers, Hisar, Haryana,  
India

**Corresponding Author:****Rajat Deshwal**

Assistant Professor, Department  
of Entomology, Teerthanker  
Mahaveer University,  
Moradabad, Uttar Pradesh,  
India

## Stored grain insect pests and their management: An overview

**Rajat Deshwal, Visvash Vaibhav, Nitin Kumar, Ankit Kumar and Rahul Singh**

**Abstract**

About a thousand species of insects have been associated with stored products in different parts of the world. A few pests are considered as pests causing severe damage to the stored grains. This paper gives an overview of damage symptoms and biology of some of the major pests of stored grains viz., *Sitophilus oryzae*, *Rhyzopertha dominaca*, *Trogoderma granarium*, *Tribolium castaneum*, *Lasioderma serricornis*, *Stegobium paniceum*, *Callosobruchus* spp., *Sitotroga cerealella*, *Corcyra cephalonica*, *Oryzaephilus surinamensis*, *Plodia interpunctella*, *Latheticus oryzae*, and *Cadra cautella*. The stored grain insect pests can be categorized on the basis of their feeding behaviour as internal and external feeder or as major and minor pests based on the severity of damage. These systems are developed insect management decisions.

**Keywords:** Stored insect pests, feeders, external, internal, primary, secondary

**Introduction**

In India, post-harvest losses caused by unscientific storage, insects, rodents, microorganisms etc., account for about 10 per cent of total food grains produced. 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. A number of insect pests gain access to the grain storage at various stages of processing of food grains/ seeds viz., during the process of development and maturation of seeds/ grains, processing in threshing yards, during transit or while in storage. Some insect pests initiate damage at the ripening stage of crops and continue during storage. Major sources of infestations are old bags, storage structure, old containers, and cross over infestation [1]. Nearly one thousand species of insects have been associated with stored products in different part of the world. These may destroy the grains and contaminate the rest with undesirable odours and flavours. Majority of insect pests belong to the orders Coleoptera and Lepidoptera [5].

**Classification**

The stored grain insect pests can be categorized as major or minor pests based on the severity of damage. On the basis of their feeding behaviour, these can be grouped as external and internal feeders

**Primary insect pest:** Capable to damage and breed in undamaged solid grains.

Internal feeders: Larvae feed entirely within the kernels or stored material e.g. rice weevil, pulse beetle, granary weevil, Angoumois moth etc.

External feeders: Larvae and adults feed on the grain from outside e.g. rice weevil, pulse beetle, granary weevil, angoumois moth etc.

**Secondary feeders:** These include insects which develop after the infestation of other pests as they feed on cut and broken seeds e.g., saw toothed grain beetle etc.

**Stored Product Pests- An Overview****Rice weevil - *Sitophilus oryzae* (Coleoptera: Curculionidae)**

This is one of the serious pests of paddy, wheat, millet, barley, maize, sorghum and other cereals causing considerable qualitative and quantitative loss during the storage.

Full grown larva is 5 mm in length and plumpy, fleshy, legless creature. Reddish brown adult is 3 mm in length, with a cylindrical body and a long, slender, curved rostrum. Its elytra bear four light reddish or yellowish spots. The rice weevil breeds from April to October and hibernates in winter as an adult inside cracks and crevices or under wheat bags in the godowns. During the active season, females lay about 400 eggs on the grain by making a depression and the hole is sealed with a gelatinous secretion. Eggs hatch in 6-7 days and the young larvae bore directly into grain, where they feed and grow to maturity. Then, they pupate inside the grain. The pupal stage lasts 6-14 days. On emergence, adult weevil cuts its way out of the grain and lives for about 4-5 months. At least generations are completed in a year. Both the adults and the grubs cause damage. The developing larva lives and feeds inside the grain causing irregular holes of 1.5 mm diameter on grains of rice, sorghum, wheat, barley, maize before harvest and in storage. The weevils destroy more than what they eat (Fig-1) [6, 10].



Fig 1: Rice weevil

#### Lesser grain borer - *Rhyzopertha dominaca* (Coleoptera: Bostrychidae)

Originated from India, this insect has now spread throughout the world. Lesser grain borer is regarded as second in importance to rice weevil as destroyer of the stored grains. It is mostly found in warmer regions of the world and damages wheat, barley, maize, paddy, sorghum and other products. The larva is about 3mm long, dirty white, with light-brown head and a constricted elongated body. The adult is a small cylindrical beetle measuring about 3 mm in length and less than 1 mm in width. It is shining dark brown with a deflexed head, covered by a crenulated hood-shaped pronotum. No morphological difference separates the two sexes. The pest breeds from March to November while in December enters hibernation as an adult or as a larva. A single female can lay 300-400 eggs in 23-60 days at the rate of 4-23 eggs per day. The eggs are laid singly among the frass or are glued to the grain in batches. When freshly laid, the eggs are glistening white, but later on a pink opaque line appears on them. The incubation period is about 5-9 days. Larva cuts a circular hole in the pedicel end of the eggs and comes out of it. Larval period is of 23 - 50 days while pupal period is of 4 - 6 days. Adult lives for about 40 - 80 days. There are 5 -6 generations in a year. Both the adults and the grubs cause damage. The adults and grubs bore into the grains feed and reduce them to mere shells with many irregular holes. The adults are powerful fliers and migrate from one godown to another, causing fresh infestation. Adults produce a considerable amount of frass, spoiling more than what they eat (Fig -2) [2, 7, 8, 10].



Fig 2: Lesser grain borer

#### Khapra beetle, *Trogoderma granarium* (Coleoptera: Dermestidae)

Its habit of congregation in cracks and crevices of bricks, masonry and wood storage has given it, the name 'khapra'. It is an external feeder and none of the stage lives in the grain. It is a serious pest of wheat but can also damage jowar, rice, maize, sorghum, oilseeds and pulses. The insect breeds from April to October and hibernates in the larval stage from November to March in cracks and crevices. Female begins to lay white translucent eggs on the grains, singly or sometimes in clusters of 2 -5. The eggs are rather cylindrical, rounded at one end and narrow at the other. A female may lay 13 - 35 eggs in 1 - 7 days at the rate of 1 - 26 eggs per day. The egg period varies from 3 -10 days. Larval period is 20 - 40 days and pupal period is 4 - 6 days. Pupation takes place in the last larval skin among the grains. The adults are incapable of flying. There are 4-5 generations in a year. Fresh yellowish-white larva grows 4mm long and turns brown. The adult is a small dark-brown beetle, 2-3 mm long, with a retractile head and clubbed antennae. The entire body is clothed in fine hairs. The greatest damage is done in summer from July to October. The grubs eat the grain near the embryo or at any other weak point and from there proceed inwards. They usually confine themselves to the upper 50 cm layer of grains in a heap or to the periphery in a sack of grains. They can reduce the grain to a mere frass. Since the larvae are positively thigmotactic, they can be collected by merely placing gunny bags on a heap of grain (Fig- 3) [15, 9].



Fig 3: Khapra beetle

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

Cosmopolitan in distribution, it is the worst pest of flour mills. It feeds on cereals, flour, starchy material, fruit nuts, millets and prepared cereal foods. It usually feed on broken

grains and results in dust formation. Infested flour emits sour and pungent smell, which is due to some secretions of beetles. The young larva is yellowish white and measures 1 mm in length. As it matures, it turns reddish yellow. Pupation takes place in the flour. The pupa is yellowish and hairy. The pupal stage lasts 5-9 days. The development period from egg to the adult is 26-30 days in summer. 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 (Fig. -4) [18, 19].



Fig 4: Red flour beetle

#### Cigarette beetle *Lasioderma serricorne* (Coleoptera: Anobiidae)

It is a cosmopolitan but prefers warm environment. It feeds on a large number of food varying from spices, chocolate, cocoa and tobacco leaves. Adult light brown round beetle with its thorax and head bent downwards and this presents a strongly humped appearance to the insect. The elytra have minute hairs on them. Antenna is of uniform thickness. The creamy white oval eggs are laid on the surface of stored material and the incubation period is 9- 14 days. The larval and pupal periods range respectively from 17 – 29 days and 2-8 days. Grub whitish hairy grub. Both grubs and adults bore into tobacco products viz., cigarettes, cheroots and chewing tobacco. Presence of circular pin head sized bore holes on processed tobacco is the typical symptom of attack. It also attacks the grain of wheat, peanut, cocoa, bean, cotton seed etc. (Fig.- 5) [9, 12, 17].



Fig 5: Cigarette beetle

#### Drug store beetle *Stegobium paniceum* (Coleoptera: Anobiidae)

It is distributed in tropical, subtropical and temperate regions. It is primary pest of turmeric, ginger, pepper, coriander seeds, cumin seeds, etc. Adult reddish brown small beetle has striated elytra and measured 3 mm long. Antenna is clubbed. It lays the eggs in batches of 10 – 40. Grub is not hairy but is pale white, fleshy with the abdomen terminating in two dark horny points. LP: 10 – 20 and PP: 8 -12 days. Circular pin-head sized bore hole on turmeric, coriander, ginger, dry vegetable and animal matter (Fig. -6) [12, 17].



Fig 6: Drug store beetle

#### Pulse beetle *Callosobruchus maculatus* (Coleoptera: Bruchidae)

This is a very important pest of grain legumes both in storage and field. It is distributed throughout India. It attacks peas, chickpea, pigeon pea, black gram, horse gram, cowpea etc. Larva is whitish with a light-brown head. The mature larva is 6-7 mm long. The adult beetle measuring 3-4 mm in length, is oval, chocolate or reddish brown and has long serrated antennae, truncate elytra, not covering the pygidium. The pest breeds actively from March to the end of November. It hibernates in winter in the larval stage. A single female lays small, oval, scale like 34-113 eggs at the rate of 1-37 per day. Egg period is 6 -16 days, larval period 10 -38 days. The hibernating larvae take 117-168 days to complete their development. The pupal stage lasts 4-28 days. The adult escapes by cutting a circular hole in the seed coat and such grains can be spotted easily. The average life-span of an adult is 5-20 days. The insect passes through 7-8 overlapping generations in a year. The adult and grub feed on the grain by making a small hole. Infested stored seed can be recognized by the white eggs on the seed surface and the round exit holes with the 'flap' of seed coat. Kabuli types are particularly susceptible (Fig.-7) [7, 9, 13, 15].



Fig 7: Pulse beetle

### Angoumois grain moth *Sitotroga cerealella* (Lepidoptera: Gelechiidae)

It is named because first in 1736 it was noticed as a pest in Angoumois province of France. It is regarded as one of the most destructive internal feeder in stored grains. The initial infestation takes place when the grain is in or passing through milk stage in the field and usually a small percentage of grain kernels is infested. A full grown larva is about 5 mm long, with a white body and yellow brown head. The adult is a buff, grey yellow, brown or straw coloured moth, measuring about 10-12 mm in wing expanse. The characteristic feature is the presence of the narrow pointed wings fringed with long hair. Breeding takes place from April to October. The insect overwinters as a hibernating larva and as the season warms up, it pupates in early spring. Females start laying eggs singly or in batches on or near the grain. The eggs are small and

white, when freshly laid, turning reddish later on. A single female lays, on an average, 150 eggs, usually within a week after mating. Egg period is 4-8 days. The larval stage may last about 3 weeks. Before pupation, the larva constructs a silken cocoon in a cavity. Pupal period is 9 -12 days and the adult live for about 4 - 10 days. During the active season, the life-cycle is completed in about 50 days. Several generations completed in a year. The damage is at its maximum during the monsoon. Only the larvae cause damage by feeding on the grain kernels before harvest and also in store. The larva bores into grain and feeds on its contents. Exit holes of 1 mm diameter with or without a trap door, are seen on the affected cereal grains. As it grows, it extends the hole which partly gets filled with pellets of excreta. It imparts unhealthy appearance and smell. In a heap of grain, the upper layers are most severely affected (Fig. -8) [4, 11, 15, 17].



Fig 8: Angoumois grain moth

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

It is widely distributed in all rice growing areas of the world and serious pest of stored paddy, rice and other cereals. It flourishes well in humid climates and also attacks wheat, maize, sorghum, barley, millets, soybean and oilseeds. 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. They are full-fed in 21-41 days, after which they make silken cocoons among the infested grains. The pupal stage lasts 9-14 days and the adults live for - one week. They complete life-cycle in 33-52 days and the pest completes approximately 6 generations in a year. The larvae alone damage the grains of rice and maize by feeding under silken webs. When infestation is high, the entire stock of grains may be converted into a webbed mass. Ultimately, a characteristic foul odour develops and the grains are rendered unfit for human consumption (Fig. -9) [11, 15, 17].



Fig 9: Rice moth

### Saw toothed grain beetle *Oryzaephilus surinamensis* (Coleoptera: Silvanidae)

This is generally associated with starchy food and found in warm places. It is dark, narrow, flattened beetle having a row of saw like sharp teeth on each side of the prothorax. The antenna is clubbed and elytra cover abdomen completely. It lays 300 whitish eggs loosely in cracks of storage receptacles of godown. The eggs period is 3 -17 days. The larva is

slender, pale cream in colour with to slightly darken patches on each segment. The larval period is 14- 20 days. It pupates in a protective cocoon like covering with sticky secretion. The pupal period is 7-21 days. It feed on grains, dried fruits etc by scarving of grain surface or burrowing holes in them. It attacks rice, wheat, maize, cereal products, oil seeds and dry fruits (Fig. -10) [1, 3, 16].



Fig 10: Saw toothed grain beetle

**Indian meal moth: *Plodia interpunctella* (Phycitidae: Lepidoptera)**

The pest is worldwide. It infests grains, meals, breakfast foods, soybean, dried fruits, nuts, s, dried roots, herbs, dead insects, etc. Larva is white, often tinged with green or pink, a light-brown head. On reaching maturity, the larva is 8-3 mm in length. The adult moth is about 13-20 mm in wing expanse with a coppery lustre. Breeding continues throughout the year. The female moth lays 30-350 minute whitish ovate eggs, singly or in clusters, on or near the appropriate foodstuffs. The egg period is 2 days to 2 weeks depending upon the weather. The larvae become full-grown in 30-35 days. They crawl up to the surface of the food material and pupate within a thin silken cocoon. The pupal stage lasts 4-35 days. In summer, the life-cycle is completed in 5 or 6 weeks and there are about 4-6 generations in a year. Only the larva causes damage. Crawling caterpillars completely web over the surface of a heap of grains with silken threads. The adults fly from one bin to another and spread the infestation (Fig. – 11) [1, 3, 15].



Fig 11: Indian meal moth

**Long headed flour beetle *Latheticus oryzae* (Coleoptera: Tenebrionidae)**

It was first recorded in 1880 from Kolkata in rice. It infests broken grain and bran. Generally associated with *T. castaneum* and lifecycle and behaviour is almost similar to flour beetle. The beetle is light brown in colour with longated body, measuring 2 -3 mm in length and resembles *Tribolium castaneum*. It lays 400 white eggs singly on grain and seams of the bags. The incubation period is 7 – 12 days. The grub is small, white active which feeds voraciously. The larval period is 15-80 days. It pupates for 5-10 days. Life cycle is completed in 25 days at 35 0 and 70% relative humidity. It resembles *Tribolium*. Head is longer in proportion to the body

than that of *Tribolium*, paler and brighter than *Tribolium*. 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. (Fig. -12) [15, 17].



Fig 12: Long headed flour beetle

**Almond moth *Cadra cautella* (Lepidoptera: Phycitidae)**

Almond moth, also known as fig moth is widely spread in the tropics and subtropics. It is a serious pest of figs, rough rice, dry fruits, wheat, barley, sorghum, soybean, and oilseeds etc. The adult moth has greyish wings with transverse stripes on the outer region and the wing expanse is about 12 mm. The female lays whitish eggs indiscriminately in cracks and crevices of the receptacles or on the food stuff. While feeding, the larvae spin tubes in the food material and are full-grown in 40-50 days. The full-grown larva is white with pinkish tinge and measures 1.5 cm. The larvae pupate inside the cocoons and pupal stage lasts about 12 days. The life cycle is completed in about two months and there are 5-6 generations in a year. The caterpillars make tunnels in the food materials. The number of silken tube is sometimes extremely high and these clog the mill machinery where the infested grains have been sent for milling (Fig. – 13) [12, 14, 15].



Fig 13: Almond moth

**Conclusion**

External feeders are conspicuous by their presence. The internal feeders are very often discernible only after a considerable damage is caused. Understanding the symptoms of damage, lifecycle and biology of major stored product insect pests would help in monitoring and assessment of their damage so as to devise suitable strategies for controlling these pests.

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