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Integrated approach for management of lesser grain borer (*Rhizopertha dominica*)

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Insects often cause huge losses to stored grains and grain products, amounting to 5-10 per cent loss in temperate regions and 20-30 per cent in the tropical regions. In India, post harvest losses caused exclusively by insect pests are 12 per cent. In Pakistan, post harvest losses of food grains occur during harvesting, threshing, cleaning, drying, milling, storage, processing, cooking and consumption. According to him the aggregate losses during various post harvest operations in Pakistan are 17.1 per cent in paddy, 15.3 per cent in wheat and 12.6 per cent in maize. These estimates were based on investigation. According to FAO estimate, 10-25 per cent of World's harvest is destroyed annually by insects and rodents.

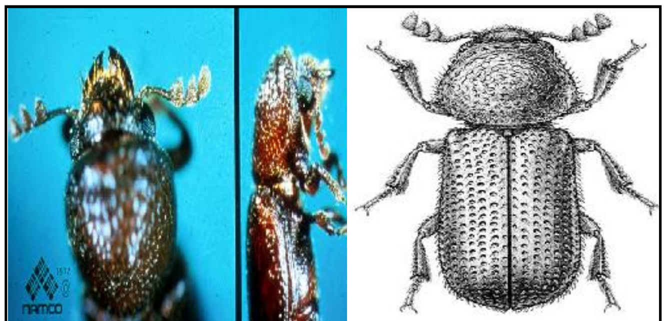
Although it is still relatively rare, the lesser grain borer has become the most commonly encountered primary pest of stored grain in Montana. It is the most economically important primary pest of stored grain in the United States and is a strong flier that can tolerate high temperatures and dry grain (moisture content less than 12%).

The lesser grain borer is recognized as both an internal and external feeder and is a serious pest of both whole kernel stored grain and cereal products.

Losses : Among these insect pests infestation caused by *Rhyzopertha dominica* is 59.8 per cent.

Distribution : This is one of the smallest of the grain-infesting beetles, but one of the most important. Originally native to the tropics, it has spread through commerce to all parts of the world. The Lesser grain borer originated in South America but is now a cosmopolitan pest especially in warm countries and it is most prominent in the United States, southern Canada, Argentina, India and Australia. In the United States, it is particularly widespread in the Gulf states. It is a thermophilic pest which is particularly successful where temperatures are elevated; it is not cold hardy and there is only limited development at temperatures less than 23°C. In Australia and India it is a serious pest of grains. Infestations are encountered in grain stores including ships holds, flour mills and animal feed mills.

Appearance : The lesser grain borer is a cosmopolitan pest of a wide variety of food. It is a small, (1/8" long (3 mm)) reddish-brown to black-brown beetle. The overall shape of the body is slim and cylindrical with prothorax tuberculate, especially anteriorly; elytra with well defined rows of punctures; 5-segmented tarsi. The hood shaped rounded neck shield extends over the head hiding it. Pits on the shield become gradually smaller towards the rear. The last three segments of the antennae form a loose club. Adults can fly. The adults of this species are readily distinguished by the "squared-off" appearance at the front of the body. Viewed from directly above, the cover of the thorax hides the head. However, infestations are infrequent, when compared to the rate of capture for adults in these traps. The antennae have 10 segments with the last 3 enlarged, forming a loosely segmented club. The larvae are white, stout bodied and c-shaped.



Lesser grain borer adult head **Adult**

Habit : The lesser grain borer is characterized as both an internal and external feeder and is a serious pest of both whole kernel stored grain and cereal products. The adults and larvae bore into undamaged kernels of grain, reducing them to hollow husks. They feed on a variety of foods, mainly cereals, but also include flour, macaroni, beans, chick-peas, dried potato, edible bulbs, lentils, herbs and wood in their diet. Preferred grains include wheat, rye, corn, rice and millet but it can infest tobacco, nuts, beans, bird seed, biscuits, cassava, cocoa beans, dried fruit, peanuts, spices, rodenticide baits, and dried meat and fish. Oilseeds and spices are not suitable for larval development. They are also able to survive and develop in the accumulated "flour" produced as the seeds are chewed up.

Life cycle : They are laid singly or in clusters from 2 – 30 and are often attached to the grain. Eggs (up to 500 per female) are laid either on kernels of grain or loose the frass produced by the insect. Oviposition starts approximately 15 days later and can last up to 4 months. Moisture content of the grain can influence oviposition and developmental rates. Females survive for several days after oviposition ceases For example, no eggs are laid on wheat with moisture content below 8 per cent. The egg stage lasts 32 days at 18.1 °C (65°F) to about 5 days at 36°C (97°F). Larval development is more rapid on whole grain than on meal made from the same grain. The young larvae white with brown heads and relatively small legs. Young larvae cannot penetrate undamaged kernels. If inside whole kernels, larvae molt four to five times, where as if in whole meal, they will molt two to seven times (usually three to four). Larval development usually takes 27-31 days at 28°C (82.5°F) and 46 days at 25°C (77°F). Pupation takes place in an enlarged cell where the larval feeding tube ends. The duration of the pupal stage is approximately 5-6 days at 28°C (82.5°F) and 8 days at 25°C (77°F). The total life cycle lasts from 24 – 133 days depending upon temperature. Adults can live for 10 months.

Callow adults remain in the kernel for 3-5 days after ecolosion before beginning to feed and tunnel out of the kernel. They are not strong fliers, often being carried by air currents. Adults have very powerful jaws, powerful enough to bore into wood.

Fig. 1 : Different stages of *Rhyzopertha dominica*

Nature of damage :

–Then eggs are deposited loosely among the kernels of grain and both the adults and the larvae can bore readily into, and out of, intact kernels.

–Adults and larvae have powerful jaws that are used to riddle the grain, creating large, irregular-shaped holes.

–Heavy infestation with lesser grain borers can be identified by a sweetish, musty odor in the storage.

–This odor is a result of the male-produced aggregation pheromone that has been demonstrated to be an effective lure for use in traps.

–This species is very capable of causing insect damaged- kernels (IDK), which are important in quality assessment of samples. Weevils in stored grain also readily cause insect-damaged-kernels (IDK), but the larvae of these species remain within a single kernel.

Management practices :

Preventive methods :

–Drying of seeds under natural sunlight exposes the larvae or eggs on grain and kill them.

–Storing the seed under good ventilation godowns or warehouses to prevent built up of moisture which is favorable to insects for multiplication.

–*Grain status*: Unripe grain should not be stored. Unripe grain is very soft and the husks are loose which makes them very attractive to Lesser grain borer (LGB).

–*Handling grain*: Care should be taken when handling the grain as any cracks or scratches will be taken advantage of by the LGBs.

–*Store temperature*: The lowest temperature that LGBs can survive at is 18° C, so if temperature can be lowered, this will reduce infestation.

–*Store hygiene*: Important methods of prevention for grains that are stored indoors include sound buildings which are kept clean (grain on the floor is swept away) and inspection of the grain before it is stored.

Resistant cultivars : Makundi and Wilkins (1995)

Damage grain by adult *Rhyzopertha dominica*

investigated susceptibility of some sorghum cultivars from Tanzania to *R. dominica.* Susceptibility index (SI)) values ranged from 10.8 to 15.2. With a SI of <12.0, cultivars Vartan 1 and Vartan 16 were considered moderately resistant to the pest. *R. dominica* reared on these cultivars showed non-preference for the ovipositional response. Poor adult emergence in Vartan 1 and Vartan 16 in comparison to Serena, the most susceptible cultivar, suggested a low level of antibiosis.

Mensah and Okonkwo (2000) evaluated the relative susceptibility of 20 local sorghum cultivars to post-harvest infestation by the lesser grain borer, *R. dominica*. Only CV 3, CV 4, CV 5 and CV 6 proved to be resistant to post-harvest attack by the beetles; the remaining cultivars were either intermediate or highly susceptible to beetle attack. Grain hardness, which accounted for about 30.10 per cent of the host resistance, was the most important physical character that influenced the ability of grains to resist beetle attack. High progeny emergence, loss in grain weight and rapid change in moisture content greatly contributed to the loss in seed viability. Length of storage also adversely affected the vulnerability of the test cultivars to beetle attack.

Curative methods:

Biological control :

–Parasitic wasp of grain (*Anisopteromalus calandrae*)

–Warehouse pirate bug (*Xylocoris flavipes*).

Sweet flag rhizome (*Acorus calamus* L.) *powder* : Umoetok and Gerard (2003) reported that, the mortality observed on *R. dominica* indicated that 25 g of *A. calamus* powder resulted in significantly higher percentage mortality (83.22%) than pirimiphos-methyl that gave 56.65.0 per cent and rotenone caused 36.4 per cent mortality.

Neem (*Azadirachta indica*) : Jilani and Su (1983) studied the repellent activity of neem leaf powder to *Sitophilus granaries* (L.) and *R. dominica* on wheat seeds. The results indicated that, the average number of *R. dominica* adult emergence was 3.08, 5.16 and 20.16 with neem leaf powder used at 2.0 and 1.0 per cent and untreated control, respectively.

Patel *et al.* (1993) evaluated the neem seed powder with concentrations 1 per cent, 2 per cent, 3 per cent, 4 per cent, and 5 per cent against *Rhyzopertha dominica* in wheat under laboratory conditions. 5 per cent treatment level showed highest efficiency and reduced the per cent grain damage up to 2.55 per cent, 3.15 per cent and 7.13 per cent as compared to control at 6.57 per cent, 13.6 per cent and 24.71 per cent after 32, 64 and 96 days, respectively.

Eucalyptus leaf powder (*Eucalyptus* sp.) : Shukla *et al.* (2002) reported that, the essential oil of *Eucalyptus pauciflora* Sieber ex Spreng. leaves was found to be the strongest toxicant. The oil at 5.0 per cent concentration killed the test insect pests from 40 to 60 minutes only when used as a contact toxicant. However, as a fumigant, killing time was found to be seven hours against *R. dominica* and *S. oryzae*, five hours against *T. granarium* and six hours against *C. cephalonica* and *Ephestia cautella* (Walker).

Chemical insecticides :

– Use of insecticides like malathion, dichlorvos, chlorpyriphos- methyl and deltamethrin as prophylilactic spray on godowns walls, storage surface.
– Use of fumigants *viz.,* aluminium phosphide sold under trade name celphos (3 tablets /tone of grain) that is popularly used to fumigate the grains. One tablet of 3 gram weight which release one gram of phosphine gas.
– Mixing of grains only with malathion WP.
– Once grains are infested, even controlled atmosphere technique can be used to kill storage pests where the gases *viz.,* carbon dioxide concentration is increased in the closed spaces which close the spiracles of insects and kills the insect through asphyxiation.

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