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Insect pests of stored grain

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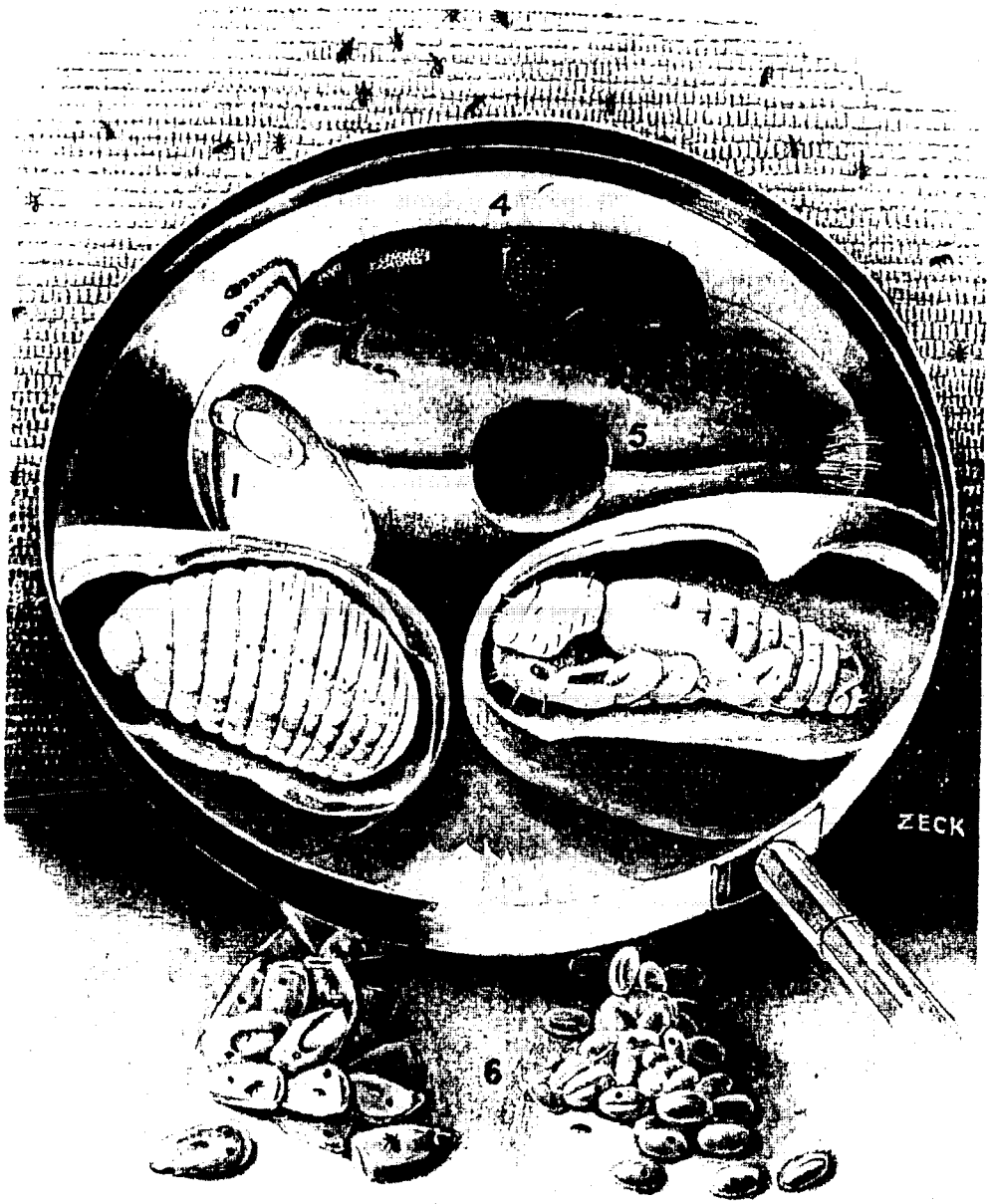

Rice weevil

1. Grain cut to show egg laid within.
2. Fully fed legless larva, or grub, in grain that it has eaten out.
3. Pupa.
4. Adult weevil. Length about 3 mm.
5. Exit hole of adult weevil.
6. Maize and wheat attacked by grain weevils.

Illustration: E. H. Zeck.

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The insects that infest stored grain in Australia all occur in other parts of the world but can cause greater problems here because most grain goes into storage in warm weather. As this favours insect development, pest numbers can build up rapidly.

Stored grain insects infest wheat, oats, barley, rice, maize, sorghum and some oilseeds such as safflower and sunflower. They consume and contaminate grain, produce heat and moisture that may cause grain spoilage, and reduce the germination capacity of seed. The presence of grain pests on farms is particularly undesirable as it represents an early source of infestation of the new season's grain. Grain intended for export must meet very strict requirements of freedom from insect contamination. Keep farm-stored grain in good storages, use suitable insect control treatments and inspect the grain regularly.

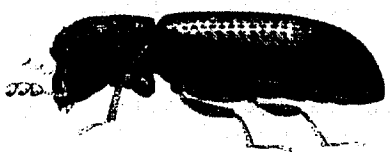
The wide range of climatic conditions in New South Wales suits many different grain insects. Species that are dominant in some areas are less important in others. The main factors limiting the occurrence of various species are temperature and the moisture content of the grain.

Among the insect pests of stored grain, beetles and moths predominate. A few species—lesser grain borer, the grain weevils, rust-red flour beetle, saw-toothed grain beetle and Angoumois grain moth—are the most serious pests of grain in New South Wales. However, many others can be important under special conditions. The insects are accompanied by parasites and predators, including other beetles, wasps, bugs and mites. Mould-feeding beetles, psocids and mites occur in damp grain.

LESSER GRAIN BORER

Lesser grain borer, *Rhyzopertha dominica,* is the major insect pest of stored cereal grains, other than maize, in New South Wales. It probably originated in India and thrives under hot conditions in all parts of the world. It is found in all but the coldest wheat growing areas of Australia. Mass flights have been recorded. Adults and larvae feed on the starchy interior of the grain, producing a lot of floury frass and leaving large, irregularly shaped holes in the empty seed coat.

The adult is a reddish brown cylindrical beetle about 2.5 mm long. The female can lay over 300 eggs. She places the eggs in cracks in damaged grains, in the creases of sound grains or where the seed coat is loose. Sometimes she drops the eggs among the grains. The larva hatches from the egg in about 5 days and usually enters a grain through a damaged part of the seed coat. It feeds inside the kernel and pupates there. The shortest time for development from egg to adult is 24 days in grain of high moisture content



Lesser grain borer. Length about 2.5 mm.

during warm weather. In cool weather development can take 6 months. After emerging the adults feed on grains that have been hollowed out by the larvae and may live for up to 10 months.

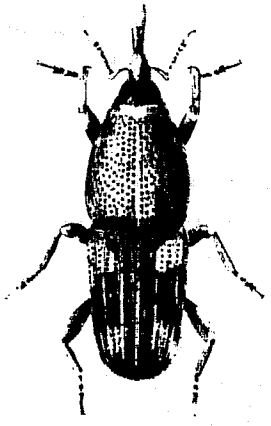
GRAIN WEEVILS

The three species of weevils that attack stored cereal grain in New South Wales—rice weevil, maize weevil and granary weevil—are world-wide pests of major importance. The females lay eggs in sound grains and the immature stages develop completely within the grain kernels, destroying them.

Rice weevil, *Sitophilus oryzae,* infests all types of cereal grains in storage. It can fly and occurs throughout all but the coldest parts of New South Wales. The adult is about 3 mm long and dull brown, with four lighter, reddish spots on the wing covers. The front of the head is elongated into a snout. An adult female produces up to 400 eggs at the rate of 8 to 10 a day, placing each singly in a cavity that she chews into a grain and plugs afterwards. The egg hatches in 3 to 9 days, depending on the temperature. The larva feeds in the grain kernel, making a tunnel that becomes filled with debris and excreta.

The fully fed larva is a pearly white, thick-bodied, legless grub about 3 mm long that pupates in a cell at the end of its tunnel. It changes to the adult weevil, which is soft and light brown at first, then becomes hard and darker. It eats its way out of the grain, leaving a small circular hole in the seed coat. The adults then feed mainly on damaged grains.

Rice weevil. Length about 3 mm.



Rice weevils develop from egg to adult in about 4 weeks in summer or longer in cold weather. Adults that emerge during spring and summer may live 3 to 6 months. There may be six or seven generations a year in New South Wales.

Maize weevil, *Sitophilus zeamais,* usually infests stored maize, but sometimes damages other stored cereal grains. In North Coast areas it attacks maturing maize in the field, especially cobs that have loose or poorly developed husks, or that have already been damaged by other insects, birds, or rodents. The weevil completes its development within the grain after harvest, then continues to infest the stored grain through spring and summer.

Maize weevil resembles rice weevil, but is usually larger (about 4 mm long); its life cycle is similar. It can fly.

Granary weevil, *Sitophilus granarius,* is a cold climate pest prevalent in South Australia and Victoria. In New South Wales it is less common than rice weevil. Granary weevil damages stored grain in southern areas and on the central and northern highlands, sometimes in districts where rice weevil and lesser grain borer are not troublesome. Unable to fly, it has been widely dispersed in New South Wales by man since the mid 1960s.

The adult weevils are about 3.5 mm long and uniformly shiny brown or black, with elongated oval punctures on the thorax. The life cycle is similar to that of rice weevil.

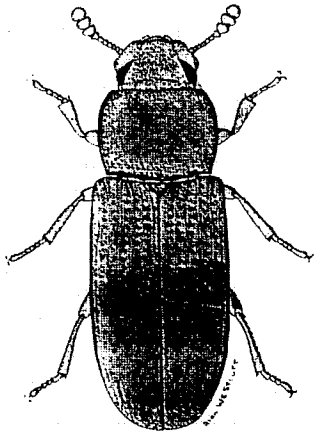
Granary weevil. Length about 3.5 mm.

FLOUR BEETLES

Flour beetles feed, both as larvae and as adults, on grains that are broken by harvesting and grain-handling machinery.

Rust-red flour beetle, *Tribolium castaneum,* is a major pest of all types of stored cereal grain, cereal products, stockfeed meals, stored foodstuffs, and some oilseeds, for example safflower, sunflower and peanuts. It is the commonest of the flour beetles found on farms. As it is a strong flier, it is one of the first insect to infest newly stored grain, appearing first on the surface.

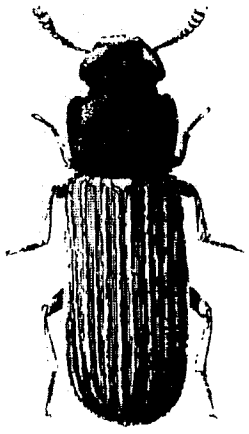
The adult is reddish brown and about 3.5 mm long. It has large eyes and grooved wing cover The antennae end in 3-segmented clubs. It ma live for 2 years. Over several months the fema beetle lays about 400 eggs, dropping them among the grains. The larva, which is white a first, moves about freely among the grains. When fully grown it is about 6 mm long and cream with light brown banding, a light brov head and twin brown points at the rear. It th becomes a pupa that lies loosely in the foodstuff, changing from white to brown before the adult emerges. The time from egg to adult is about 30 days in warm weather.



Rust-red flour beetle. Length about 3.5 mm.

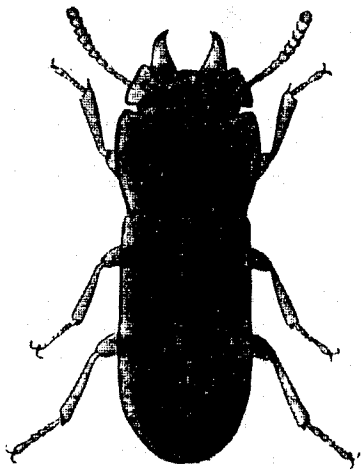
Confused flour beetle, *Tribolium confusum,* is occasionally found on farms in feed preparation sheds, but it is more important as a pest of cereal products in mills and produce stores. It cannot fly. The adult is about 3.5 mm long and dark reddish brown, with small eyes, grooved

Confused flour beetle. Length about 3.5 mm.



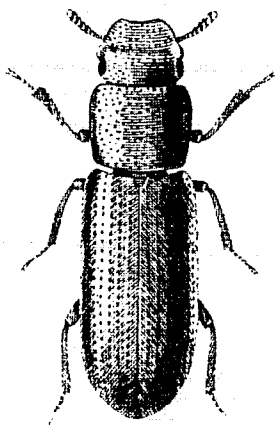
wing covers, and antennae thickening gradually towards the tip. The immature stages and the life cycle are similar to those of rust-red flour beetle.

Broad-horned flour beetle, *Gnathocerus cornutus,* the largest of the flour beetles, is more common in mills than on farms. The adult is light reddish brown and about 4.5 mm long, with smooth wing covers. The male has jaw outgrowths resembling horns. The larva grows to about 8 mm long, and its yellow body is marked by brown bands near the rear end, where there is a single brown point. Development from egg to adult takes about 8 weeks in warm conditions.



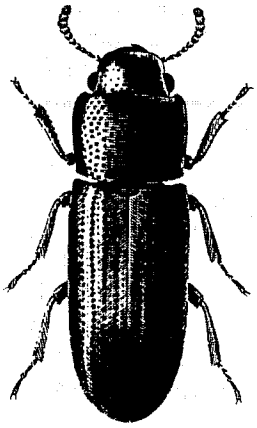
Broad-horned flour beetle, male. Length about 4.5 mm.

Long-headed flour beetle, *Latheticus oryzae,* is light brown and about 3 mm long. It is common in farm-stored grain, although it is only a minor pest.



Long-headed flour beetle. Length about 3 mm.

Small-eyed flour beetle, *Palorus ratzeburgii,* and **depressed flour beetle,** *P. subdepressus,* are other small red-brown flour beetles that often occur in



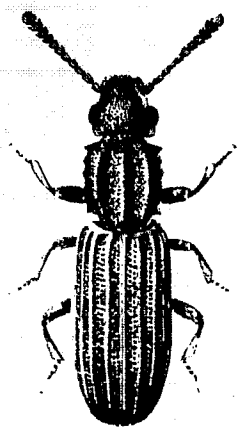
Small-eyed flour beetle. Length 2.5 to 3 mm.

farm-stored grain. They are of minor importance. They are sometimes mistaken for rust-red flour beetle, but do not have the 3-segmented club end on the antenna. Small-eyed flour beetle is 2.5 to 3 mm long and depressed flour beetle is about 2.5 mm long.

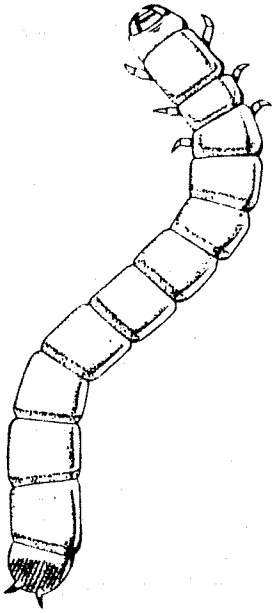
OTHER GRAIN BEETLES

Saw-toothed grain beetle, *Oryzaephilus surinamensis,* which infests a range of foodstuffs, is often found in farm-stored grain. It is a major pest of winter cereals and cereal products and safflower seed. It is commonly present with flour beetles in early infestations. The larvae and adults feed on grain fragments. Because this beetle conceals itself easily in crevices it is difficult to clean out of storages and harvesting machinery. The adult is a slender, dark brown beetle about 3 mm long, with six projections, like saw teeth, on each side of the thorax. It flies readily. The female lays 50 to 300 eggs loosely among the grains. The larva is translucent white, very active and grows to 4 mm long. It pupates in a cocoon made from particles of the food material. Development from egg to adult takes 3 to 4 weeks in warm weather.

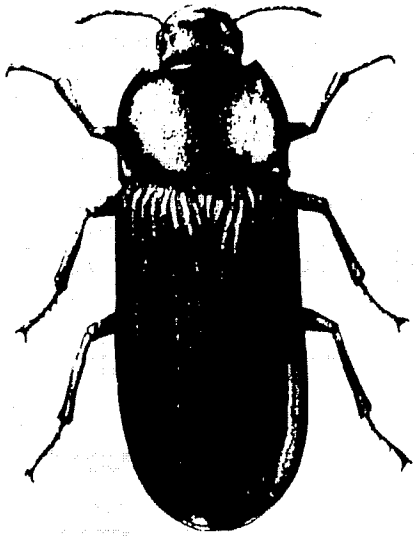
Saw-toothed grain beetle. Length about 3 mm.



Yellow mealworm, *Tenebrio molitor,* and **dark mealworm,** *T. obscurus,* are the larvae of the largest beetles associated with stored products, but are not very important. They are commonly found in farm buildings under discarded grain sacks or in grain remnants in sheds. The larvae grow to about 25 mm long and are yellow (yellow mealworm) or brown (dark mealworm), hard and shiny. After pupating they emerge as dark brown to black beetles about 17 mm long. The yellow mealworm beetle is shiny and the dark mealworm beetle is dull. They have only one full generation a year.

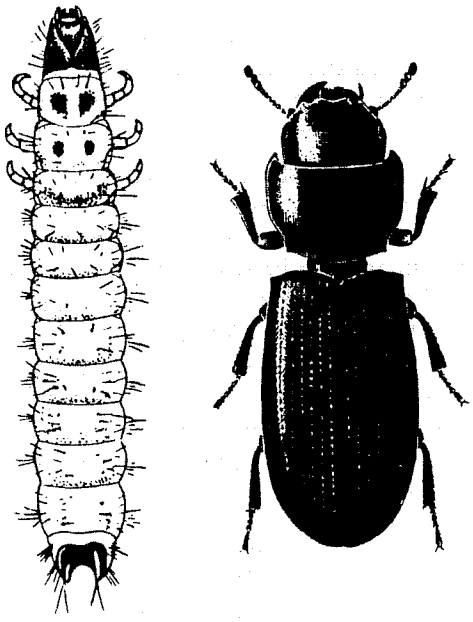


Mealworm larva. Length about 25 mm.



Mealworm adult. Length about 17 mm.

Cadelle, *Tenebroides mauritanicus,* is better known as a mill pest and is uncommon on farms in New South Wales. The larva devours the germ of the grain, leaving the rest of the kernel untouched. It has a black head and a white body



Left: Cadelle larva. Length about 20 mm.

Right: Cadelle adult. Length about 8 mm.

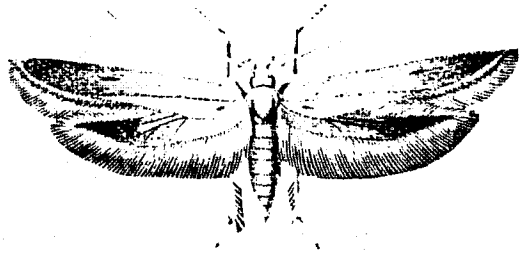
terminating in two black horns and grows to 20 mm long. The adult is a shiny black beetle about 8 mm long. Development from egg to adult can take 2 months but is usually slower. Adult females live a year or more and can lay thousands of eggs.

It is difficult to control cadelle in wooden grain bins, as the larvae can bore into the timber and shelter there.

GRAIN MOTHS

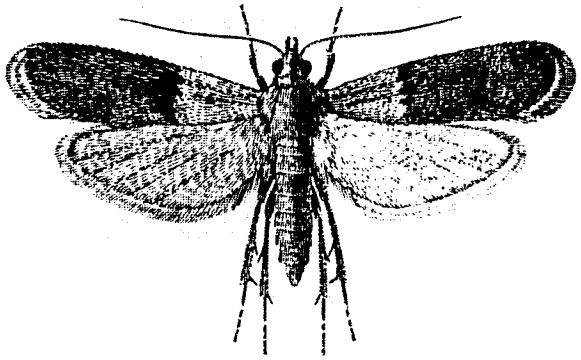
Angoumois grain moth, *Sitotroga cerealella,* infests maize commonly in the field in coastal areas and in long-established inland maize-growing areas. This pest also infests wheat and barley, although field infestation of winter cereals is uncommon. In bulk-stored grain only grain at or near the surface is infested because the moths cannot move about and reproduce amongst the deeper grains. The damage is done by the larval stage, which develops entirely within the grain kernel. This pest does not produce webbing.

Angoumois grain moth. Wingspan about 12 mm.



The moth is slim and buff coloured, with a wingspan of about 12 mm. The tips of the hind wings are shaped like fingerboard signs. Each female lays 150 to 300 eggs, either singly or in batches, on or near grain. The larva bores into a grain and feeds inside. When fully fed, it pupates just beneath the seed coat and changes to the adult. An obvious hole is left in the grain when the adult emerges. The time from egg to adult is as short as 5 weeks during warm weather, and there are several generations per year.

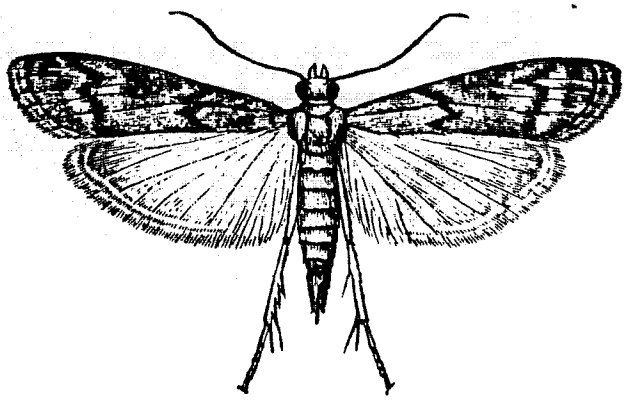
Indian meal moth, *Plodia interpunctella,* infests all types of cereal grains, stored seeds and processed cereals. The larvae spin silken webbing as they move about, feeding. In heavily infested produce in bulk stores this webbing can be dense enough to choke conveyor belts.



Indian meal moth. Wingspan up to 19 mm.

The moth has a wingspan of up to 19 mm. The forewings are reddish bronze on the outer parts and silvery grey at the bases. The female lays 200 to 400 eggs on the foodstuff, placing them singly or in clusters. The young larvae enter crevices in the food and feed in or near tunnel-like cases of silk. They grow to about 13 mm long and are usually cream, but may be greyish white and tinged with pink or green. The head is brown. Unlike the larvae of many other stored product moths they have no dark spots on the body where the hairs arise. They pupate in silken cocoons, usually near the infested foodstuff, but sometimes far away. In grain the larva pupates in a shelter made of several grains webbed together in a lump. Development from egg to adult takes about 4 weeks in summer.

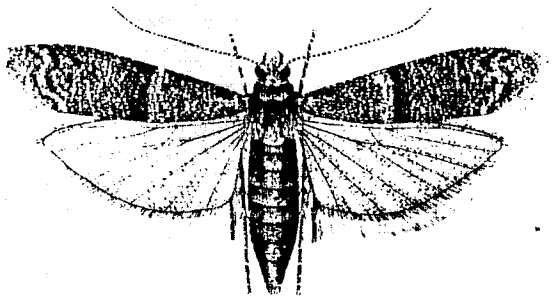
Mediterranean flour moth, *Ephestia kuehniella,* usually occurs in mills, where it infests cereal products, but it has also been found in farm-stored grain. The larvae weave a silken covering whilst feeding, sometimes making a mat that can impede the operation of grain-handling machinery. The adult has mottled grey forewings, with a wingspan of about 25 mm. The eggs are laid on the produce and hatch in a few days. The larvae grow to about 13 mm long and



Mediterranean flour moth. Wingspan about 25 mm.

are whitish or pinkish, with a brown head and a few small black spots on the body. Development from egg to adult takes about 8 weeks in warm weather.

Tropical warehouse moth, *Ephestia cautella,* is common in seed stores, especially on maize, but it also attacks sorghum and other cereals, and safflower and sunflower, particularly when stored in bags. In northern inland areas it infests the grain surface of bulk wheat storages. The larvae spin silken webbing, and this can form an extensive mat on the infested grain. The moth has a wingspan of up to 20 mm and the forewings are grey with darker grey markings. It has a life cycle similar to that of Indian meal moth. The larva grows to about 13 mm long and is creamy or pinkish, with a brown head and rows of small dark spots on the body.



Tropical warehouse moth. Wingspan up to 20 mm.

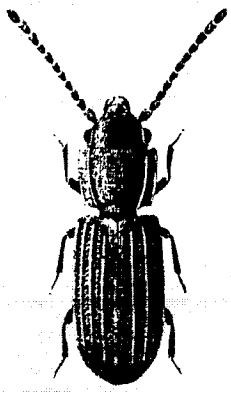
Meal moth, *Pyralis farinalis,* occurs in damp grain, such as wheat in conditioning bins at mills and moist grain remnants on farms. The adult is brown with purple markings, with a wingspan of up to 26 mm. The larva grows to about 25 mm long and is pale yellow. The head and the upper surface of the first body segment are black. The larva spins silken webbing as it feeds and the surface of infested grain can become matted with this webbing.

Meal moth. Wingspan up to 26 mm.

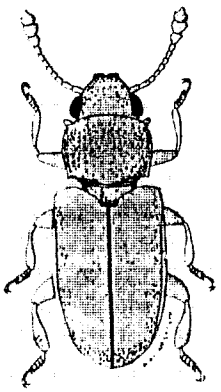
INSECTS IN OVER-MOIST GRAIN

Some insects are commonly found only in mouldy or weather-damaged grain, such as grain stored temporarily in uncovered bins in the field and grain remnants in harvest machinery. They do not damage sound grain but are sometimes regarded seriously as contaminants.

Flat grain beetles, *Cryptolestes* spp., can be numerous in weather-damaged or over-moist grain. They are shiny, rusty brown beetles about 1.8 mm long. One common species has slender antennae almost as long as the rest of its body. These small beetles move very quickly in grain.



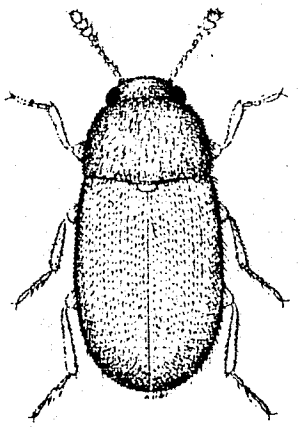
Flat grain beetle. Length about 1.8 mm.



Foreign grain beetle. Length about 2 mm.

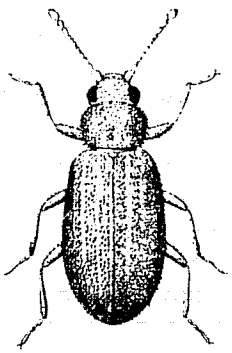
Foreign grain beetle, *Ahasverus advena,* is found in damp grain, where it feeds on moulds. The beetle is reddish brown and about 2 mm long.

Hairy fungus beetle, *Typhaea stercorea,* is a mould-feeding beetle that occurs commonly in wheat held on farms in uncovered bins. It is occasionally numerous enough to cause rejection of weather-damaged grain delivered to bulk storages, although the infestation will not persist if such grain is added to a large bulk of dry grain. The adult is light brown, 2.5 to 3 mm long and covered in fine hairs. The yellow larva also feeds on mould on the damp grain.



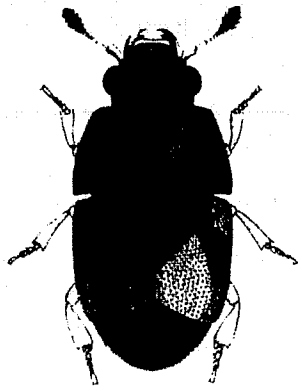
Hairy fungus beetle. Length 2.5 to 3 mm.

Minute mould beetles, *Corticaria* spp., are common in grain remnants in headers. They occur on wheat ears in the field, but, being mould-feeders, will not persist in properly dry grain. These beetles are 1.4 mm long, dark brown and oval-shaped.



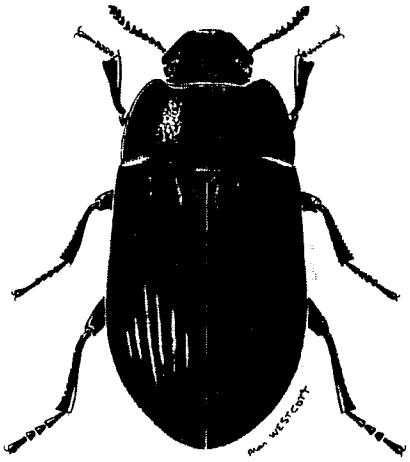
Minute mould beetle. Length 1.4 mm.

Corn-sap beetles, *Carpophilus* spp., infest damp, decaying stored grain. These insects breed in many kinds of decaying fruit and vegetable matter. In maize fields the beetles fly to and infest cobs damaged by other insects or by birds. The adults are about 3 mm long, dark brown or black, usually with dull yellow patches on the wing covers, which are short, so that the end of the abdomen is exposed.



A corn sap beetle. Length about 3 mm.

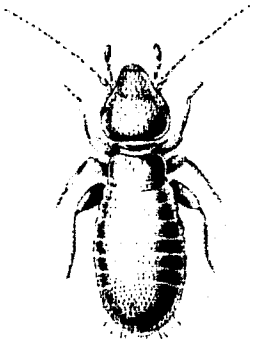
Lesser mealworm, *Alphitobius diaperinus,* is attracted only to spoilt wet grain and other stored products in poor condition. It commonly occurs in deep litter poultry sheds. The larva resembles a mealworm, but grows to less than half its size. The adult is a shiny black beetle about 6 mm long.



Lesser mealworm adult. Length about 6 mm.

Psocids or book-lice, *Liposcelis* spp., are active, soft-bodied insects about 1.5 mm long, sometimes numerous in moist stored grain, especially oats. They commonly occur in old stocks of cereal foods and among musty papers. In cold areas of New South Wales psocids may be the only insects present in stored grain. They feed mainly on mould but can damage grain and could reduce seed viability.

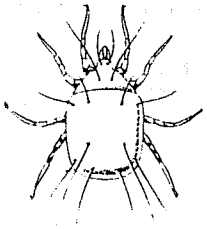
A psocid. Length about 1.5 mm.



MITES IN GRAIN

Mites (Acarina, family Tyroglyphidae) become numerous in grain, cereal products and hay stored in unsuitably moist conditions. They also infest water-damaged oilseeds, including rape (which is not attacked by beetle or moth pests in storage). These mites are microscopic, hairy, white to pink, and look like moving specks of dust. They can build up in numbers to a seething mass. Heavily infested products sweat and develop a disagreeable odour.

Flour mite, *Acarus siro,* is commonly involved in grain infestations.



Flour mite. Length about 0.5 mm.

Other mites parasitise insects and may become numerous in stored products that are heavily infested by insects.

CONTROL SUMMARY

- Make your grain storages weatherproof and suitable for fumigation
- Mix a recommended insecticide with grain that is to be stored on the farm for longer than 6 weeks.
- Check stockfeed grain frequently and fumigate it if it is infested. Grain stored for stockfeed on farms commonly harbours insect pests that spread to grain remnants in harvesting and handling machinery and breed there.
- Clean grain remnants out of all harvesting machinery and stores and dispose of the cleanings, then treat the machinery and stores with recommended insecticides.
- Examine all second-hand sacks, used machinery and stockfeed arriving at your property. Reject or treat (preferably fumigate) deliveries of infested goods to prevent introduction of insects that might initiate new infestations and might be of resistant strains.
- Regular inspections mean early detection— make frequent thorough checks for insects in any stored grain.
- Resistance to insecticides by a number of major pests of grain threatens our grain stores and jeopardises our exports. The best way to

fight resistance is to keep your farm clean and ensure that the grain you deliver is free of insects.

Note: Information in this Agfact was previously published in Entomology Branch Insect Pest Bulletin 52, Insect Pests of Stored Grain (fourth edition, 1980).

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Illustrations:

Rust-red flour beetle, broad-horned flour beetle, foreign grain beetle, lesser mealworm by Alan Westcott.

Tropical warehouse moth after Joan Martin's drawing for Queensland Department of Primary Industries, adapted by Alan Westcott.

Hairy fungus beetle and minute mould beetle from H.E. Hinton 1941, 1945, British Museum (Natural History).

Granary weevil, rice weevil, confused flour beetle, saw-toothed grain beetle, meal snout moth by W. E. Chambers.

Mediterranean flour moth and mealworm adult: U.S.D.A. drawings.

Mealworm larva, cadelle larva, flour mite: from Agriculture Canada publication No. A43-855, *Insect Pests in Cargo Ships,* reproduced by permission of the Minister of Supply and Services Canada.

Other drawings by E. H. Zeck.

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