



# Pest Facts

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## Stored Product Arthropod Pests

Stored products may be infested at every point from their origin to final use. For example, pests may infest food in the field where the product is grown, picked, or harvested, storage bins or granaries where it is held until sale; mills, where it is ground, mixed or packaged; warehouses, where it is held for use or redistribution; food processing plants, where it is added to other products (e.g., candy, pet food, baking mixes); food service establishments, where it is prepared for public consumption; retail food stores, where it is sold; and in pantries and cupboards, where it is held for use. Direct losses due to stored product pests include (1) the actual consumption of food resulting in loss of weight, nutrients, germination, grade, and market value and (2) contamination and damages to structures or containers by rodent or insect activities. Indirect losses include (1) the introduction of mildew, bacteria, fungi, (2) management costs, (3) human aversion, (4) loss of prestige and customer confidence. The following discussion, modified from Walter Ebeling's, "Urban Entomology", provides information regarding the identification and management of commonly encountered stored product arthropods.

### PESTS OF WHOLE GRAINS AND SEEDS

Most stored product pests feed on readily-available starch of broken or ground-up seeds and grains. Few species can chew through the strong seed coat or place eggs inside intact grains. Pests which can include the rice and granary weevil, Angoumois grain moth, the lesser grain borer and several species of seed beetles.

Granary Weevil (*Sitophilus granarius*)

Rice Weevil (*Sitophilus oryzae*)

Lesser Grain Borer (*Rhyzopertha dominica*)

Cadelle (*Tenebroides mauritanicus*)

Angoumois grain moth (*Sitotroga cerealella*)

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### Granary weevil (*Sitophilus granarius*)

This is one of the most important and oldest known pests of stored grain. It is believed to have spread from the eastern Mediterranean area to cooler regions throughout the world. In the United States, the granary weevil is frequently found in northern states rather than in the South. It may cause almost complete destruction of grain in grain elevators, farmer's bins, or ships. This species has become domesticated, losing functional wings. It has primarily become a pest of stored products and depends on man for transportation.

#### Description

The adult is polished chestnut-brown or black, approximately 4 to 9 mm long and is similar in appearance to the closely related rice weevil, but lacks the pale markings on its elytra (wing covers), and its wings are useless. The pits on the thorax are elongate rather than round or irregularly shaped. The small, leg-less larvae of the granary weevil may be distinguished from those of other beetles infesting grain and other stored products by the bottom surface being straight, while the top surface is rounded. The larvae of other beetles are more "worm-like". The larvae of any beetle may be distinguished from those of moths by not having the short, fleshy, leg-like abdominal appendages known as "prolegs", which aid in movement and in clinging to surfaces.



Granary Weevil

#### Life Cycle

The female creates a hole in a grain kernel with the mandibles at the end of her long, slender snout, deposits an egg in the hole, and seals it with a gelatinous material. She may lay more than 200 eggs under favorable conditions. The eggs hatch in a few days, and the larvae feed on the interior of the kernel, hollowing them out. There are 4 larval instars, and the developmental period is from 3 to 5 weeks. Pupation within the kernel requires 5 to 16 days. The entire life cycle may vary from as little as a month to as long as 5 months, depending on temperature. There are commonly 4 generations per year. The granary weevil is long-lived, surviving for 7 to 8 months as an adult. The female lays very few eggs at temperatures below 60 F, but can survive for 2 months or more at 35 F. A temperature of 120 F for 1 hour or 130 F for 1/2 hour is fatal.

### Rice Weevil (*Sitophilus oryzae*)

This insect is primarily a pest in warm countries, and in the United States it is most important in the South. The larva feeds inside a kernel of grain in which both larva and pupa must complete their development. Both larvae and adults eat similar food, but the adult crawl or fly about and feed on various products. They have been reported to occur on beans, nuts, cereal what products and grapes and have been observed sucking the juice from apples and pears, gradually forming cavities in which they conceal themselves. Unlike the granary weevil, the adults have well-developed wings and fly from stored grain to fields of corn, wheat or rice and start infestations that continue in storage. In northern states, infestation begins in new grain when it is stored in farm bins, warehouses or grain elevators.

#### Description

The adult is 2.5 to 3.5 mm long, somewhat smaller than the granary weevil. It is reddish brown with 4 faint reddish or yellowish spots on the elytra, round or irregularly shaped punctures on the pronotum and with the head prolonged into a long, slender snout bearing the mandibles at its tip.



Rice Weevil

#### Life Cycle

The female lives 4 to 5 months, and lays about 300-400 eggs. Like the granary weevil, she bores a small hole in the kernel with her mandibles, lays an egg, and covers the hole with a gelatinous fluid. The small, white, leg-less larva, with a brownish-black head, develops through 4 instars. In warm weather, the combined stages from egg to pupa may take as few as 26 days. After emergence, the adult stays in the kernel for 3-4 days, hardening and maturing, then it bores its way out. This weevil is basically a grain pest, but has been reared from solidified farinaceous products such as macaroni or caked flour. The most favorable temperatures for development are 80 to 86 F. Below 45 F the beetle is dormant. It usually dies after 2 weeks of freezing temperatures, or after an hour at 120 F.

### Lesser Grain Borer (*Rhyzopertha dominica*)

This is one of the smallest grain-infesting beetles, but one of the most important. Originally native to the tropics, it has spread to all parts of the world. 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. Both adults and larvae feed within the interiors of nearly all grains, including rice, with the kernels reduced to shells.

#### Description

The adult is about 3 mm long, polished dark brown or black and has a roughened surface. In common with other bostrichids, which are principally woodborers, the lesser grain borer is almost cylindrical and the head is vertically positioned under the thorax so that it cannot be seen from above. Likewise, this insect, though small, has powerful jaws with which it can bore directly into wood. It can eat its way into wooden and paper boxes and may destroy book bindings.



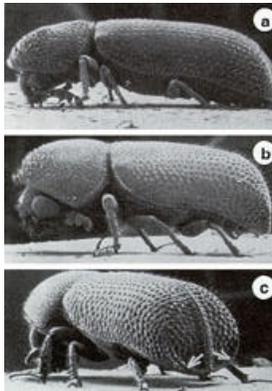
Lesser Grain Borer

#### Life Cycle

The female lays 300-500 eggs, singly or in clusters, in loose grain product. They hatch in a few days. The larvae molt 2 to 4 times. They may feed on the flour produced by the boring of the adults, or may bore directly into kernels that have been slightly damaged. They complete their growth within the grain, transform to white pupae, and the adults cut their way out. The life cycle takes only 1-2 months to complete, depending on temperature.

#### Other Bostrichids (borers)

Another bostrichid beetle that is believed to have acquired its grain-feeding habits relatively recently is the larger grain borer, *Prostephanus truncatus*. It is similar in appearance and habits to the lesser grain borer, but is a little larger (4 mm) and has a smooth polished surface. It is a tropical insect, not yet widely distributed in the United States, but may be occasionally found infesting corn in the southern states. It also has been reported from California, Texas and the District of Columbia.



a. Lesser Grain Borer; b. Larger Grain Borer; c. Larger Grain Borer (truncated posterior)

Cadelle (*Tenebroides mauritanicus*)

The cadelle is believed to be a native of America, as all species of its family Ostomidae are found in the New World. It is one of the best known of the stored-grain pests, because it is also commonly found as a "pantry pest" in the house, where adults and larvae feed on cereals, breakfast foods, potatoes, shelled and unshelled nuts or fruit and prefer to lay eggs under the flaps of cartons. They can gnaw through sacks and paper packages. Unlike the granary and rice weevils, they feed not only on whole grains, but also on flour and a variety of other products and are therefore much more important as pantry pests.

The cadelle may have been originally a predator under loose bark as other species of the family are today. It does attack the larvae of other grain-infesting insects. Another peculiarity of this insect is its habit of burrowing into the woodwork of grain bins or other wooden structures, sometimes causing them to collapse. It may remain there for long periods in large numbers, only to emerge and infest the next grain load. Other grain pests may also hide in its burrows.

Description

The shiny black adult is elongate, oblong and flattened and is one of the largest of the grain infesting beetles, being about 8 mm long. The prothorax, is distinctly separated from the rest of the body by a loose, prominent joint.



Cadelle

#### Life Cycle

Females lay about 1,000 eggs loosely in flour, grain or other food. The fleshy white to grayish larva has a black head and black plate with two horn-like black projections at the tip of the abdomen. The life cycle may be as short as 70 days, but much longer under conditions unfavorable to the insect's development (cool, dry). The females generally live for a year, but have been kept alive for more than 3 years in the laboratory.

#### Angoumois Grain Moth (*Sitotroga cerealella*)

The Angoumois grain moth is second only to the rice and granary weevils in its importance as a pest of stored grain in the United States. It attacks grains maturing in the field as well as in storage. Infested grain in storage has a sickening taste and smell that make it unpalatable. Only whole grain is infested, so other grain products are "safe".

#### Description

Adults are small, buff to grayish or yellowish-brown moths, with a wingspan of 13-17 mm. The size of the adult depends on how much food the larva has consumed. The hindwings narrow down to a point, and are heavily fringed with long hairs.



Angoumois Grain Moth

## Life Cycle

Each female lays about 40 white eggs on or near the grain, and in 4 -8 days these hatch into minute, white larvae that bore into the kernels. The larvae are pale yellowish when mature, with a yellowish-brown head and are about 5 mm long when fully grown. They have poorly developed abdominal prolegs. The larva passes through 3 instars in about 3 weeks, but may hibernate before changing to a reddish-brown pupa in the spring. Pupation takes place in a silken cocoon in the feeding cavity of the kernel. There are 2-4 generations/year.

## PESTS OF BROKEN GRAIN

This group is composed of insects that are general feeders on stored food, attacking not only broken grains, flour and cereals, but such products as dried meat, vegetables, fruit, milk, sugar, candy, tobacco or drugs.

Confused flour beetle (*Tribolium confusum*)

Red flour beetle (*Tribolium castaneum*)

Yellow mealworm (*Tenebrio molitor*)

Dark mealworm (*Tenebrio obscurus*)

Flat grain beetle (*Cryptolestes pusillus*)

Mediterranean flour moth (*Anagasta kuehniella*)

Indian meal moth (*Plodia interpunctella*)

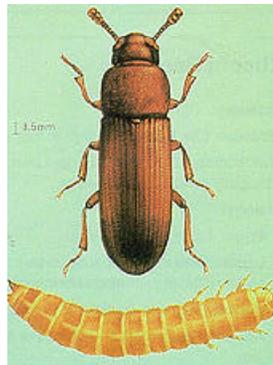
Spider Beetles

### Confused flour beetle (*Tribolium confusum*) / Red flour beetle (*Tribolium castaneum*)

These two beetles, along with the sawtoothed grain beetles and Indian meal moth are considered to be the most important pests of stored foods in grocery stores and in the home. *Tribolium* spp. are believed to have been semi-predators originally, feeding on living and dead materials under bark. *Tribolium confusum* and *T. castaneum* now infest stored grains and grain products, peas, beans, shelled nuts, dried fruits, spices, chocolate, drugs, snuff, cayenne pepper, herbarium and museum specimens, and many other items. They are unable to feed on undamaged grain, but are serious pests in flour mills. In the United States, the confused flour beetle is the more abundant of the 2 species in the northern states, whereas in the south, the red flour beetle is more abundant. They are about equal in numbers in the intermediate regions.

## Description

*Tribolium confusum* and *T. castaneum* are small, reddish-brown beetles about 3.5 mm long. They are similar in size and appearance as well as in life histories and habits. However, they can be distinguished with the aid of a hand lens. The antenna of *T. confusum* is gradually enlarged toward the tip, ending in "club" of 4 segments, whereas that of *T. castaneum* is abruptly club-like, with the club consisting of 3 segments. *T. confusum* has the sides of the thorax almost straight, while those of *T. castaneum* are curved.



Confused Flour Beetle

## Life Cycle

Each female deposits 400 -500 clear-white, sticky eggs on or among food particles, in cracks or through the meshes of sacks containing food, such as cereal products. She lays only 2 -8 per day, but she is long-lived and may survive as long as 2 years. The tiny eggs can be removed from flour by sifting it through sieves. Eggs hatch in 5 to 12 days as small, brownish-white larvae, which go through 5 to 12 instars and reach maturity in as few as 30 days, under optimum conditions, but may require up to 4 months. The full-grown larvae are 4 to 5 mm long, slender, cylindrical, wiry in appearance and white, tinged with yellow. They can be distinguished from larvae of other species that are somewhat similar in appearance by the prominent, 2-pointed termination of the last body segment.

As the larvae mature, they come to the surface of their food to pupate. In heated storehouses and mills, there are 4-5 generation annually.

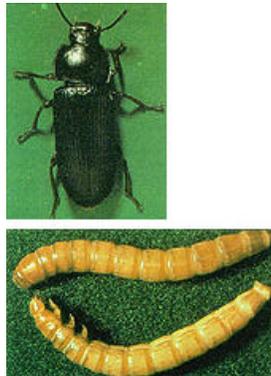
## Yellow Mealworm (*Tenebrio molitor*), Dark Mealworm (*Tenebrio obscurus*)

These 2 species are similar in appearance, habits and life histories. Their common names are based on the colors of the larvae infesting stored products. They are nocturnal and seek moist, dark, undisturbed places. They may be found in accumulations of grain in

neglected corners of mills, under bags of feed in warehouses and feed stores, or in grain bins where some of the grain has become damp. Mealworms are of only moderate importance as pantry pests.

#### Description/Life Cycle

The adult *Tenebrio molitor* is shiny dark brown to black, while *T. obscurus* is pitch black. Both are more than 12 mm long. The female lays an average of 400-500 bean shaped sticky, white eggs to which particles of food adhere. Eggs are laid singly or in clusters in the food material. In about 2 weeks, they hatch into slender, white larvae, which soon acquire the characteristic color of their species; bright yellow for the yellow mealworm and dark brown for the dark mealworm. The larvae have a hard, shiny cuticle that gives them a resemblance to the larvae of elaterid beetles (wireworms). After 14 to 15 molts, the larvae pupate near the surface of their food medium. The adults normally emerge in the spring and early summer, and live for 2-3 months, one full generation/year.



Yellow/Dark Mealworm Beetle

Mealworms and Canthariasis. In cases of gastrointestinal canthariasis (infestation by beetle larvae), mealworms are the ones most often implicated. Eggs or larvae are ingested in cereals and breakfast foods, and in either case live larvae may eventually be passed in the feces.

#### Flat Grain Beetle (*Cryptolestes pusillus*)

This beetle is widely distributed, and is one of the most common pests of stored grain, but it cannot attack sound, uninjured kernels. The larvae also feed on dead insects, and often subsist as scavengers.

#### Description

The small, flattened, reddish brown adult is only about 2 mm long. The male's antennae

are not quite as long as its body, and those of the female are about half as long. The elytra have 5 parallel ridges. The beetles can both jump and fly.



Flat Grain Beetle

#### Life Cycle

The female lays her eggs (oviposits) in crevices in the grain, or in loose, farinaceous material. The larva is slender and pale, with a black head and has a pair of slender, black, spine-like processes at its posterior end. It is particularly fond of the germ of the wheat, and many kernels are left uninjured except for the removal of the germ. The full grown larva forms a cocoon of a gelatinous substance to which food particles adhere. Development from egg to adult may require only 5 weeks under favorable conditions, although the average in summer is about 9 weeks.

#### Mediterranean Flour Moth (*Anagasta kuehniella*)

The Mediterranean flour moth owes its name to the belief by some that this insect, now cosmopolitan in distribution, originated in the Mediterranean region. It first appeared in the United States in California in 1892. The larvae spin silken threads that cause a matting of flour particles that may clog machinery in flour mills. Modern fumigation methods have greatly decreased the importance of this pest in mills, but it is still one of the important pantry pests in the home. The mature larvae crawl around extensively and may be found anywhere in the house/store. This moth infests flour, cereals, bran, biscuits, dog food, nuts, seeds, chocolate, dried fruits and many other stored foods.

#### Description

The adult moth is 7 -12 mm long, and has a wingspan of 24 mm or less. The forewings are pale gray, transversely marked with 2 zigzag black lines. The hindwings are dirty-white. When at rest, the forepart of the body is arched in a characteristic posture.



Mediterranean Flour Moth

#### Life Cycle

The female lays several hundred eggs in flour or other larval food, which hatch in 3-5 days. The larvae stay in silken tubes, and, are full grown in 40 days, being about 15 mm long and whitish pink. They pupate in clean flour or other food material in silken cocoons or may not spin cocoons if they pupate in cracks and crevices. Either way, they leave the mass of infested material at this period. The pupal stage lasts 8-12 days, and the entire life cycle usually takes 9-10 weeks. The rate of development is largely determined by temperature. Under favorable conditions, there may be at least 4-5 generations/year.

#### Indian Meal Moth (*Plodia interpunctella*)

This cosmopolitan insect prefers coarser grades of flour and is therefore the most common pest in whole wheat or graham flour and commeal (Indian meal). It also breeds successfully in shelled or ear corn, matting it over with silken threads. In the home, it infests broken grain and grain products, dried fruits, seeds, crackers, biscuits, nuts, powdered milk, chocolate, candy, red peppers and dog food. By its extensive webbing, it spoils more food than it can consume.

#### Description

The adult moth has a wingspan of about 20 mm. The wings are pale gray, and the outer portion of the forewing is reddish brown, with a coppery luster. The adults are often seen flying about the home/store and are likely to be mistaken for clothes moths, but the wing color is very distinct from the uniform gray of the clothes moth's wings.

#### Life Cycle

Although generations overlap as the season progresses, oviposition usually starts in April



(temperate regions), the female laying 200-400 eggs, singly or in groups, on the larval food over a period of up to 18 days. Egg-laying usually takes place at night. Shortly after hatching, the dirty-white larvae find crevices in the food medium and feed in or near a tunnel-like case of silk with frass incorporated into it. The larva generally retains its dirty-white color, but may be yellow, pink, brown, or greenish, depending on its food. The head and prothoracic shield are brown. The average length is about 13 mm when full grown. The larval period is variable, depending on food and temperature. A heavy webbing usually extends throughout the infested material. The larvae crawl out of the infested food to spin their cocoons and pupate. In heavy infestations, they frequently pupate far away from the original food source. Life cycles have been noted to range from 27 to 300 days. There are generally 4-6 generations/year, but under favorable temperatures there may be 7 or 8.

The hymenopterous parasite *Bracon hebetor* is often seen during Indian meal moth infestations. Outbreaks of the moth are nearly always terminated by this parasite which may increase rapidly to enormous numbers.



*Bracon hebetor*

#### Dermestid Beetles

Dermestid beetles are best known as scavengers and feeders on animal matter, but some species belonging to the genera *Trogoderma*, *Attagenus*, *Anthrenus* and *Dermestes* can vary their diet by feeding at least in part on grain products. They are often found in warehouses, farm granaries, flour mills and food-packaging plants. They may also infest household products after breeding in carpets, hides, bird or insect nests, dead rodents or other sources of infestation within the house/store.

*Trogoderma* is the genus most commonly found in stored food, but not necessarily in the home. Some common species in the United States are *T. variable*, *T. glabrum*, *T. inclusum*, *T. ornatum*, *T. simplex*, *T. sternale* and *T. grassmani*. Their relative abundance is greatly affected by climatic factors. In California, *T. simplex* was found to be the most widely distributed species among 18 climatic zones.

The khapra beetle, *Trogoderma granarium*, is a serious pest of cereals in India and other parts of the world. Effective eradication measures have been taken whenever it has become established in the United States. It is a quarantinable pest.



Khapra Beetle

### Spider Beetles

Spider beetles are found throughout the world. They can remain active in freezing temperatures and therefore be pests in certain climates and circumstances in which other insects cannot. The farther north, the greater the relative importance of spider beetles. In North America, they attain their greatest importance in the northern U.S. and in Canada where they can survive the winter in unheated warehouses and seriously infest cereal products during the spring and summer. Because spider beetles can live as general scavengers, they can survive on rat droppings and miscellaneous debris in buildings such as empty warehouses. The source of infestation is sometimes difficult to locate.

### Biology

Spider beetles are small (1.5-4.4 mm) long, oval or cylindrical and can be easily recognized by their long legs and the constriction of the prothorax near its base. As in the closely related family Anobiidae, the prothorax extends over the head like a cowl. When the insect is viewed from above, the head is not visible, and only the filiform or moniliform antennae can be seen.

The larvae are white, fleshy and scarabaeiform (curved). There are usually 3 instars. They spin some silk, often in the form of a feeding cocoon. A cocoon is also spun in which to pupate, and the adult spends considerable time in it before emerging. The adult life is longer than the developmental period and the female oviposits during most of it. However,

few eggs are laid when larval food is unavailable and readily obtainable drinking water is required to ensure maximum reproduction.

#### Economic Importance

Most species of spider beetles are cosmopolitan and are inclined to be omnivorous, feeding on broken grain or grain products, seeds, dried fruits or meats, wool, hair, feathers, rat and mouse droppings, insect and other animal remains, and plant and animal museum specimens.

Spider beetles may be pests in warehouses, grain mills, museums, and homes and appear to thrive best in old wooden buildings. In such structures, a typical scarring of the wood can sometimes be found where the insects have formed pupal cells. When preparing to pupate, this species also commonly damages containers made of cardboard, sacking or wood. In warehouses, spider beetles are primarily pests of cereal products, particularly those that have long remained in storage. Their principle damage is the lowering of the quality of the stored food products because of the presence of dead insects and the silk and cocoons spun by the larvae. Whole grain is seldom seriously attacked, and any small damage that occurs is easily recognizable.



Spider Beetle

## GENERAL FEEDERS ON STORED FOODS

Sawtoothed grain beetle (*Oryzaephilus surinamensis*)

Merchant grain beetle (*Oryzaephilus mercator*)

Cigarette beetle (*Lasioderma serricorne*)

Drugstore beetle (*Stegobium paniceum*)

Tobacco moth (*Ephestia elutella*)

Almond moth (*Cadra cautella*)

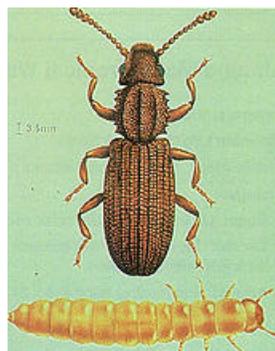
Raisin moth (*Cadra figulilella*)

### Sawtoothed Grain Beetle (*Oryzaephilus surinamensis*)/Merchant Grain Beetle (*O. mercator*)

These beetles often do considerable damage to grains, although their infestation generally follows that of other insects, such as the granary or rice weevils; they cannot attack sound kernels. Their flat form allows it to penetrate into very narrow cracks, crevices, and imperfectly sealed packages. They are almost omnivorous, and attack such foods as cereals, bread, macaroni, dried fruits, nuts, dried meats, sugar and many other products. It is one of the most common stored product pests.

#### Description

The adults are small, slender, flattened, brown about 3 mm long. They can be easily identified by the 6 sawlike "teeth" on each side of the thorax. The posterior femora (leg) of the males possess a tooth, while those of the females are not.



Sawtoothed/Merchant Grain Beetle

## Life Cycle

The female lays 45-290 white, shiny eggs over a period of 2-5 months. They are deposited singly or in clusters in crevices in the food. In warm summer weather (80-85 F), they hatch in 3-5 days, and in cool spring and fall weather (68-73 F), in 8-17 days. The larvae molt 2-4 times. When mature, they are yellowish white and less than 3 mm long. Before pupation, they generally construct crude pupal cells or cocoons from particles of seeds or other foodstuffs, fastening them together with an oral secretion. Whether this cell is made or not, the larva attaches itself by its anal end to some solid object to pupate. The complete life cycle (egg to egg) may range from 27-375 days. The adult life may vary from a few days to more than 3 years. The adults have apparently never been seen in flight, although they sometimes have been captured in flight traps.

## Cigarette Beetle (*Lasioderma serricorne*)

This beetle is considered to be the most destructive pest found in stored tobacco, but it may also has attack a wide range of foods. It can live and fly outdoors in the tropics and subtropics, but can survive only in warm buildings in temperate regions. It is distributed throughout the United States and southern Canada.

## Description

The adult is light brown, small, oval and about 3 mm long. In common with other anobiids, the ptinids and the bostrichids, the head and prothorax are bent downward so as to give the insect a strongly humped appearance. It has occasionally been confused with the drugstore beetle, but has serrate antennae and smooth elytra, whereas in the drugstore beetle the last 3 antennal segments are long and broad, forming a distinct "club" and the elytra are striate. The larvae of the two species are also similar, except that the larva of the cigarette beetle has more and longer hairs, giving it a more fuzzy appearance.



Cigarette Beetle

### Life Cycle

The female lays her oval, whitish eggs in and about the food materials, and they hatch in 6-10 days in warm weather. There are 4 -6 larval instars. The full-grown larvae are about 4mm long, curved, hairy, and pupate in silken cocoons covered with bits of food. The life cycle may require 40-50 days, and there are usually 3-6 generations/year.

### Food and Other Materials Attacked

Based on the records of many investigators, plant materials attacked by the cigarette beetle include: aniseed, areca nuts, atta, bamboo, beans, biscuits, cassava, chickpeas, cigars, cigarettes, cocoa beans, coffee beans, copra, coriander, cottonseed, cottonseed meal, cumin, dates, dried banana, dried cabbage, dried carrot, dried fruits, drugs, flax tow, ginger, grain, herbs, insecticides containing pyrethrum and yeast. It also breeds in animal matter, such as dried insects and dried fish, fishmeal, and meatmeal. This insect also feeds on furniture stuffing and bookbinders' paste and may incidentally damage cloth, upholstery, paper and books

### Drugstore Beetle (*Stegobium paniceum*)

This cosmopolitan species resembles the cigarette beetle, and rivals it as a stored product pest. It feeds on any of the household foods and species as well as wool, hair, leather, and drugs.

### Description

The adult is cylindrical (2-3.5 mm long). The color is uniformly reddish to reddish brown. Very fine hairs are arranged in longitudinal rows on the elytra. The drugstore beetle can be distinguished from the cigarette beetle by the distinctly striate elytra, the 3 enlarged segments at the tips of the antennae, and by the less hairy larva.



Drugstore Beetle

### Life Cycle

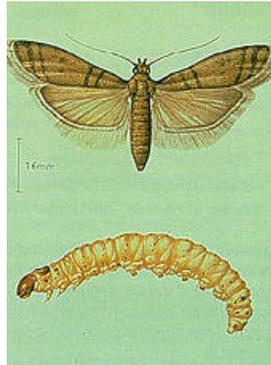
The life cycle resembles that of the cigarette beetle. There may be from 1-4 generations, depending on the temperature. The drugstore beetle possesses symbiotic organisms that resemble yeast and produce vitamins of the "B" group. For this reason, it may subsist on foods of very low quality.

### Tobacco Moth (*Ephestia elutella*)

This cosmopolitan pest of stored tobacco is also a pest of cereals, chocolate, cocoa beans, coffee, cottonseed, dried fruit, flour, nuts, seeds and spices.

### Description

The adult moth has a wingspan of 15-16 mm. The forewings are brownish gray, crossed with 2 oblique, light-colored bands, while the hindwings are uniformly gray. The mature larva is 10-15 mm long, and creamy white tinged with yellow, brown, or pink. The light brown pupa turns nearly black just before the emergence of the adult.



Tobacco Moth

### Almond Moth (*Cadra cautella*)

The larvae of this cosmopolitan insect feed on cereals, cocoa beans, dried fruits, flour, grain, peanuts, seeds and shelled nuts.

## Description

The almond moth resembles the Mediterranean flour moth. It has a wing span of 14-20 mm. The forewings are mottled gray on most individuals, but on some they are strongly



Almond Moth

suffused with fawn-colored scales. The moths fly with a conspicuously rapid wing motion and dart about quickly. The larvae are so similar to those of the raisin moth.

## Raisin Moth (*Cadra figulilella*)

This cosmopolitan moth is one of the most common pests of dried fruits, but it occasionally feeds on cereals and nuts, and also bored holes in oranges. Damage to dried fruits, particularly raisins, is caused by the larvae feeding on the surface of the fruit and by the resulting pellets and webbing. Processed fruits in storage, if less than a year old, may sometimes be infested, if older, this rarely occurs, and then only very lightly.

## Description

The adult moth is about 10 mm long when at rest with its wings folded. The forewings are grayish and the hindwings are satiny white. Both pairs have a prominent, satiny fringe. The full-grown larvae are about 13 mm long, white with 4 rows of purple spots along their backs.

## Life Cycle

The adults, which live only about 2 weeks, stay in shaded and protected places during the day and are active chiefly in the early evening. The female lays about 350 minute, white eggs, scattering them over the surface of the host fruit. They hatch in about 4 days, and the larvae feed on the fruit for about a month, starting with ripening of the earliest kinds. They then enter the soil or some dark retreat to pupate. Breeding may continue from April or May until November in temperate regions.

## STORED PRODUCT PEST MANAGEMENT

### Inspection

In large facilities, become familiar with the entire operation before making an inspection. The pathway a product takes is vitally important for detection and control. Pests occur in machinery, stacked products, waste dumps, delivery spills, etc. In homes and retail businesses, excess clutter, bad lighting, storage areas with blocked access, and rooms located above or below infested materials are special target sites.

-All inspections should be conducted with a strong flashlight. A knife, hand lens, screwdriver and mirror are also helpful.

-Flushing agents may be used, but care must be taken not to contaminate foodstuffs.

-Special attention should be given to all spills. Check for pests, cast skins and tracks in spilled products or dust.

-Inspect the back of shelving, floors under shelves and all dark areas.

-A pheromone trapping program should be implemented. Information may be obtained from your local pest management professional. Also, consult the Armed Forces Pest Management Board, Technical Information Memorandum No. 27, Stored-Product Pest Monitoring Methods.

-Keep detailed inspection records. Written inspection findings/pictures and recommendations for changes must be clear.

### Identification

To manage any pest, proper identification is absolutely necessary. Specimens may be collected from infested products, light and pheromone traps and storage areas. Understanding the differences in biology/behavior among stored product pests is critical in designing an effective program. Keys for the most common stored product arthropods have been included in this fact sheet. However, consult with your local pest management professional to ensure positive identification.

### Habitat Alteration

-Institute a good ongoing cleaning/sanitation program. Removal of pest resources is critical in obtaining satisfactory control. Pesticide use without cleaning will not result in managing stored product pest infestations

-Caulk cracks and crevices and repair holes which may serve as pest harborages and accesses.

-Replace wooden shelving and pallets with those made of non-porous materials. This will reduce resources potentially exploitable by pests.

-Recommend good lighting. This will allow proper inspection. Replace mercury vapor with sodium vapor lights.

-Identify and repair moisture/ventilation problems. Warm/moist conditions will encourage insect growth and development.

-Product storage areas: Keep food off the floor on pallets or shelving located at least 18" from the wall. This provides an inspection and cleaning corridor. Paint with a light color. Dust ledges and window sills, examine for signs of insects. Return or discard damaged/infested stock immediately. Place in isolated (morgue) area away from other products. Practice sound product rotation (first in, first out)

-Climatic manipulation: Cool and dry conditions tend to suppress insect growth and development. If possible, place infestable products (i.e., pet food, pasta, flour, etc.) in cool/dry storage areas/refrigerator/freezer.

-Recommend the reduction of clutter and debris in/outside the facility. Reduce the amount of product stored

-Collect and discard old rodent bait.

-Install air curtains over exterior-access doors.

-Recommend storing materials that are not commonly infested (e.g., animal bedding, paper products, canned goods) away from infestible products.

### Communication

-Provide pest management training to facility employees. Their involvement is critical to identifying problem areas and maintaining a high level of sanitation. Ensure everybody understands the pest management program and provide input.

-Suppliers and distributors are an important link in the food distribution chain and must be considered when planning and executing a pest management program.

Carefully examine incoming merchandise

Document all problems, and offer suggestions for improvement. Consider changing the label of consistently infested products.

Change supplier/distributor if problems are not resolved.

### Chemical Control

Chemical control should only be considered in conjunction with other techniques and performed by a certified applicator.

-Pesticides registered for use in the infested area should be carefully applied to cracks and crevices. Check with your local pest management professional for information.

-Apply spot treatments only in areas where there is an obvious and immediate need to kill migrating insects.

-Limited use of DEFLIs (Devices for the Electrocuting Flying Insects) in problem areas should be considered.

-Investigate pheromone trapping to reduce small populations.

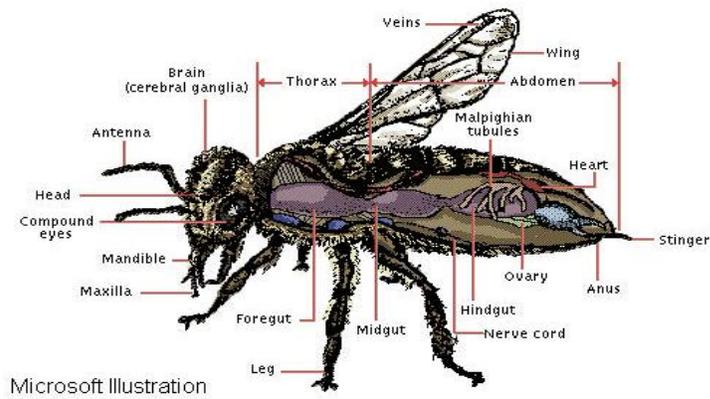
Follow-up

Ongoing monitoring and inspection should be conducted in all facilities. A complete pest management program is recommended for food handling operations. Clear communication is important. Recommendations on cleaning/sanitation should be evaluated continuously.

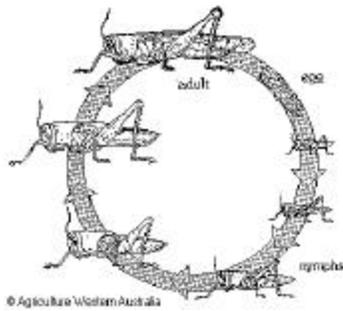
For additional information regarding stored product pest management, contact your local pest management professional or DSCP at 510-337-8122, DSN 686-8122 or email [paa5245@exmail.dscp.dla.mil](mailto:paa5245@exmail.dscp.dla.mil)

Disclaimer: Mention of a product or service is for illustrative purposes only and does not constitute endorsement by the United State government, Department of Defense, Defense Logistics Agency or the Defense Supply Center Philadelphia.

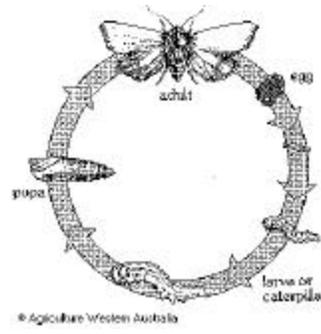
## Common Insect Structures and Developmental Characteristics



## Basic Insect Anatomy

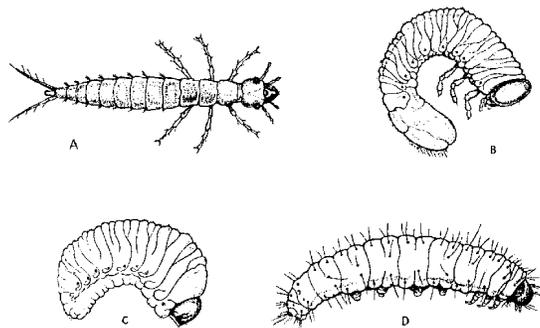


Gradual Metamorphosis (Cockroach)



Complete Metamorphosis (Beetles/Moths)

## Insect Developmental Patterns



Insect Larval Forms: A. Campodeiform (mayfly); B. Scarabaeiform (grubs); C. Legless (Beetles); D. Cruciform (Moths)



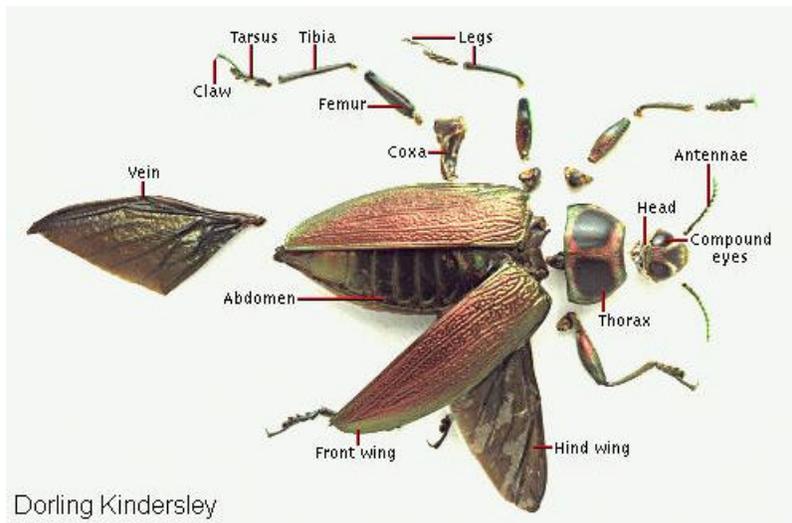
Almond Moth Damage to Peanuts



Cigarette Beetle Damage to Cigar



Indian Meal Moth Damage to Flour



Dorling Kindersley

Basic Insect Anatomy

