Version 1.0

Stored Food Pests FAQ

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This FAQ covers several major groups of Stored Product Pests; Insect pests, being beetles, weevils, and moths; Rodents; and Fungi.

The Importance of Stored Food Pests

The Key to Controlling Pests, Proper Identification

Consumer Stored Product Pests

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My primary resource used for writing this FAQ was General Pest Field Representative Exam Study Guide by Munro & Paulsen, Copyright 1995 - Pest Control Operators of California Inc.

Pesticide Disclaimer: The mention of any pesticides should not be construed to be a recommendation or endorsement of such products. Use only Registered Pesticide Products and Read and follow all Label Directions. The Label is the Law. Although there are some good homemade pesticides, most I have seen recommend unsafe use of such products or are such products, which are ineffective.

THE IMPORTANCE OF STORED FOOD PESTS?

Between harvest and reaching your dinner table better than 20% of food harvested in the US is destroyed by pests. In third world countries this number is often as high as 80% or greater. The sad fact is that much of the food we send to third world countries in the form of charities is simply eaten by insects and rodents on the docks of foreign shores.

Pests in your stored food can be at a minimum a frustrating inconvenience, in a worse case they may cause illness and or destroy your entire food storage cache.

Commercial Post Harvest Bulk Grain Stored Product Pest Control during transport, storage, and processing consists of the following:

a) Monitoring for pests
b) Control using fumigants (methyl bromide, phosphine and others)
c) Control using insect growth regulators and other pesticides
d) Adding diatomaceous earth to grain
e) Pheromone Traps
f) Modified Environments
g) Parasitic wasps

The United States Department of Agriculture (USDA) is responsible for inspecting for insect infestations as well as other contaminants. Random samples are tested for insect and rodent parts, and feces, as well as fungal infestations. The number of these fragments determines

whether the product may be sold to consumers, or must be sold as feed stock or if it must be destroyed rather than to be consumed by either man or animal.

THE KEY TO CONTROLLING PESTS; PROPER IDENTIFICATION

To control any pest, one needs to first make a proper identification of the pest, and secondly know the pest's biology so a proper management strategy may be planned. Pesticides should only be used as part of a larger all inclusive Integrated Pest Management Plan. So how can you really identify these pests based on your descriptions? Van Waters & Rogers has the largest collection of insect (and other pests) specimen slides in the world. Go to their specimen slide search engine page

http://www.vwr-pro.com/vslides.html

and type in the name of the pest from this FAQ you wish to see. The images on the web have large transparent VW&R written across them (which is absent on their real "slides" which may be purchased) but their web images are still excellent!

CONSUMER STORED PRODUCT PESTS

I. INSECTS:

The insect pests of our stored food products consist of many different species, but are primarily either of the order Coleoptera (beetles and weevils) and Lepidoptera (moths). In this section we will review some of the more common species of both orders.

The different species are divided into three groups according to their feeding habits. There are internal feeders, external feeders, and scavengers.

I.A. INTERNAL FEEDERS

The internal feeders are so called because the female deposits a single egg inside a whole kernel of grain. The egg hatching, the larvae feeding, and the pupation all occur within that grain kernel. These insects are primarily a problem in fields or in grain storage and processing facilities.

I.A.1. RICE WEEVIL & GRANARY WEEVIL

1. Adult is reddish-brown in color; about 1/8" long.

2. Rice weevil has four light colored spots on the wing covers and the wing cover is dotted with small round punctures.

3. The rice weevil is one of the most destructive insect pests of

stored grain in the United States.

4. Weevils can be identified by the presence of the characteristic "snout" that is used for boring into the grain kernels.

5. Granary weevil back covers have elongated oval punctures and no colorations; it has no wings.

6. Granary weevil cannot fly so infestation is restricted to stored whole grains; rice weevil is a good flier so also infests fields.

7. Under ideal conditions, development from egg to adult takes as little as four weeks.

8. The adult female lives four to eight months during which time it lays up to 400 eggs.

9. Both can survive the winter by hibernating.

10. The adults are sometimes found in flour or macaroni, but their eggs cannot hatch in these materials.

I.A.2. BEAN WEEVIL

1. This insect, actually a beetle, is called a weevil because its feeding and egg laying habits are like the weevil

2. The adults and larvae feed on beans

I.A.3. ANGOUMOIS GRAIN MOTH

1. This pest is frequently encountered in homes, as well as warehouses and stores; it often is found in seed art or decorative dried "Indian corn".

2. The adult is very small like a clothes moth, yellowish white in color with pale colored wings.

3. The hind wing has a finger-like projection on the leading edge.

I.A.4. LESSER GRAIN BORER

The LESSER GRAIN BORER is an internal feeder of the bostrichid family. This family is more well known for its wood-boring members. The lessor grain borer also bores into wood and books as well as whole grains.

I.B. EXTERNAL FEEDERS

The external feeders are so called because the egg is laid outside the whole grain, and the larvae bores its way in and feeds and develops then inside the grain or product. These insects are often found in homes.

I.B.1. DRUGSTORE BEETLE

1. This beetle feeds on almost every dried plant product there is; it is often found in dried dog food, and spices such as red pepper.

2. The adult is light brown in color, about 1/10" long.

3. It can be distinguished from the cigarette beetle that it resembles by the longitudinal lines on the wing covers (elytron).

4. There will be one to four generations per year depending on temperatures; under ideal conditions development takes about 40 days.

I.B.2. CIGARETTE BEETLE

1. Most common pest of stored tobacco; also infest most other dried plant products.

2. Similar in appearance to the drugstore beetle except body is smooth.

3. More prolific breeder than the drugstore beetle, and is a good flier.

I.B.3. CADELLE

1. The largest of the food pests; is also known as the bread beetle or bolting cloth beetle.

2. The adult is shiny black in color, about 1/3" long, and the pronotum is strongly separated from the wing attachments giving a "tractor and trailer" appearance.

I.B.4. TROGODERMA

1. T. Granarium, the Khapra beetle, is the most destructive of the food infesting insects; many efforts are made to prevent this insect from again becoming established in this country.

2. Some other trogoderma are quite well established already;

the Cabinet beetle (T. ornatum),
the larger Cabinet beetle (T. Inclusum),
and the Warehouse beetle (T. Variable).

The warehouse beetle adult is brown to black and about .12 inch in length. The Larvae is about 0.25 inches and has sharp pointed hairs which can cause severe gastric disturbances when ingested in food.

3. If Khapra beetle is suspected, obtain verified identification immediately and notify agricultural authorities

I.B.5 INDIAN MEAL MOTH

1. Most common pest of dried fruit.

2. Adult is distinctive in appearance and behavior, about a 3/4" wingspread, outer half of forewings are reddish- brown in color, flies at night in an irregular zigzag pattern.

3. The larvae is about 1/2" long, dirty white color with a pinkish or greenish tint; the mature larvae is often found searching for a suitable place to pupate, they are often mistaken for clothes moths.

I.C. SCAVENGERS

The scavengers are so called because they are unable to penetrate or feed on undamaged grain kernels. They lay their eggs and the larvae feed on dust and particles of food products, or on the kernels damaged by the internal or external feeders.

I.C.1 RED FLOUR BEETLE & CONFUSED FLOUR BEETLE

1. Very similar in habits and appearance.

2. Red flour beetle is a strong flier, the last three antenna segments form a distinct club.

3. Confused flour beetle, often called the BRAN BUG does not fly, the antenna segments gradually enlarge to a slender club end.

4. Both are reddish-brown in color, about 1/8" long.

5. Female lays up to 400 eggs in her lifetime of up to three years.

I.C.2 SAW-TOOTH GRAIN BEETLE

1. The smallest of the stored food pests, it is able to easily penetrate almost any package or jar after the original seal has been broken.

2. Adult is about 1/10" long, flattened body; brownish color.

3. Gets its name from the six saw-tooth projections on each side of the thorax; merchant grain beetle very similar in habits and appearance.

4. Are found in almost any stored dry food material, large population develops rapidly in normal household conditions.

5. Female lays about 300 eggs in her life of up to three years.

I.C.3 MEDITERRANEAN FLOUR MOTH

1. Common in household products such as nuts and chocolate as well as spices, dried fruits, and flour.

2. Adult has about 1" wingspan, wings are pale gray with black wavy bars running across them.

3. When at rest, has a characteristic pose with the head elevated and the tip of the abdomen protruding between the wings.

4. Silken threads or mats in infested material indicate this moth.

I.D. CONTROL/PREVENTION RECOMMENDATIONS

I.D.1. PREVENTION:

Purchase your grains and storage foods from a reputable dealer. Even so you will sometimes run into these stored insect pests. Nitrogen packed grains in sealed buckets should be safe from infestation. If you purchase bulk grains or dried fruits in other type packaging, it is sometimes advisable to take steps to kill any stored product insects that may be in the packaging. The first method of making sure you have not brought any stored grain pest into your home is by freezing the grain. Freezing the grain at 0 degrees Fahrenheit for 4-7 days will kill most stored insect pests. Another alternative is to fumigate the food stuffs with carbon dioxide. Sustained exposure to levels of CO_2 as low as 3% can kill insects in active growth and feeding stages. The other alternative is to heat the grains. Spread the grains out on a tray and heat in the oven for 20 minutes at 150 degrees F (66 degrees C), or for two to three hours at 120 - 130 degrees F (49-54 degrees C). By heating the grains you also dry them out, which is important if there is any question about your grain being too damp. Your grains should be placed into sealable containers as soon as possible after purchase regardless as to whether you take these other preventative steps or not.

Diatomaceous earth (DE) will kill larvae and adults, but not eggs or pupae. Both DE and inert gas, if properly used, will prevent outbreaks.

Some suppliers sell pheromone traps, for monitoring many of the moth species that infest stored grain.

I.E. SIGNS OF INFESTATION

THE INFESTED PRODUCTS MUST BE REMOVED AND DESTROYED; when inspecting for infestation look for:

(a) live or dead insects
(b) webbing or silk threads
(c) insect droppings in the bottom of a container
(d) small holes in boxes or bags, sealed or not
(e) flying moths
(f) emergence holes in whole grains, or quantities of grain dust

If you have found insect infestations, the following steps should be taken:

1). After removal of the infested materials, all food particles and residues must be thoroughly cleaned.

2). If you so chose, a registered pesticide for this use, and apply to cracks and crevices, and under shelving and behind paneling. (Often these are the areas where the larvae will go to hide to pupate.)

3). It is normally advised not to eat food that has been contaminated with food storage insects. Insects and other pests can introduce microbes into the food, and there may be an association between pest insects and the development of fungal toxins known as mycotoxins. This having been said, I have often eaten foods that have had relatively minor infestations of sawtooth grain beetles. The infested grain products were used in cooking, and no one was the wiser. However if the grain has been infested by any of the beetles in the Trogoderma family, you definitely should NOT eat the grain; have the grain destroyed. The larvae of all of the Trogoderma beetles and especially the Warehouse beetle have sharp pointed hairs, which can cause severe gastric disturbances when ingested in food. Grains which have any mold, or rodent urine or feces need to also be definitely destroyed and not eaten.

4). For large quantities of infested food material such as railroad cars, ships, grain silos, pallets of bagged products, you may want to investigate the hiring of a professional to fumigate the infested product with methyl bromide or aluminum phosphide. (Neither of these products are available to the consumer and should only be handled by the

appropriately trained and licensed individuals.)

II. RODENTS:

II.A. Comensal Rodents

Comensal (Lives with man) Rodents are those rodents that have become dependent on man for survival, as different from wild or feral rodents. Over the centuries, these rats and mice have adapted to living in or near our dwellings and farms, and eating our stored food and garbage. They have caused more deaths and misery and economic damage than any other group of vertebrates.

The three common species of commensal rodents were first introduced into this country from Europe; during the Gold Rush period they were brought into California in large numbers and have thrived in this climate. Our cities, our suburban areas, and our farms have become heavily populated. Their lives are designed around survival. They breed year round. Their sight is poor, but their highly developed sense of hearing, touch, smell, and taste more than compensate. They are very athletic and acrobatic with excellent balance, swimming, climbing, and burrowing abilities. They are very secretive, usually only seen at night unless a heavy population is competing for limited food or nesting space. Rats will range one hundred feet or more from the nest for food and water. Mice control only a small territory, and are often introduced in crates and boxes. A large population may exist for some time before anyone is aware of their presence.

An infestation is usually detected by noticing one or more signs; gnawed door corners or holes in walls, rub marks or swing marks from their greasy bodies rubbing along a surface, spilled food, or their fecal droppings. Sometimes their constant gnawing, necessary to keep their teeth ground down, causes structural fires.

In addition to the physical damage caused by their eating and gnawing, and the contamination from their feces and urine, the plague they have sometimes carried is probably the best known and most feared, but salmonellosis (food poisoning), murine typhus, and Weil's disease are also a hazard. While there have been reports of rats biting people at night, they will usually only attack when surprised or cornered, then they will bite and scratch fiercely. An infestation of commensal rodents should never be ignored or taken lightly.

II.A.1. PHYSICAL CHARACTERISTICS

II.A.1.a. NORWAY RAT

1. Largest of the commensal rodents.

2. Head and body 7 1/2" to 10" long, tail is shorter than head and body.

3. Weighs from 12 to 20 ounces.

4. The coarse fur is grayish brown on the back and grayish white on the belly; also called Brown rat, or sewer rat depending on the region.

5. Prefers to burrow so is built for digging; stocky body, small close-set ears and eyes, and blunted muzzle.

6. Fecal droppings are 1/2" long, smooth with blunted ends.

7. Live about 12 months.

8. Female has two to four litters of eight or nine per litter.

9. Prefers meats, fish, and grains for food, about one ounce per day.

10. Needs more water than the roof rat, or about one ounce daily.

11. Burrows often found along side of streams and ditches in coastal and valley areas.

II.A.1.b. ROOF RAT

1. Smaller and lighter than Norway rat.

2. Head and body 6" to 8 1/2" long, tail is longer than head and body.

3. Weighs from 8 to 10 ounces.

4. The color varies with the subspecies; the black rat is sooty black on the back and gray below; the Alexandrine is gray-brown on the back and yellow-white underneath.

5. Usually nests in the open or in trees and hedges so is adapted for open living; large wide-spaced ears and eyes, the long tail for balance, and a sharply pointed muzzle.

6. Fecal droppings are 1/4" long, smooth with pointed ends.

7. Live about 12 months.

8. Female has two to four litters of five to seven per litter.

9. Prefers fruits and vegetables as well as grains, about one ounce of food and about one-half ounce of water.

10. Likes to live high up in places; attics, etc., but will live

wherever they have to; found in the foothills up to 3,500'.

II.A.1.c. HOUSE MOUSE

1. Resembles a miniature roof rat.

2. Head and body about 2 1/2" to 3 1/2" long, tail is 3" to 4" long.

3. Weighs less than one ounce.

4. Dusky brownish gray color, slightly lighter underneath.

5. Nests anywhere; may spend complete life in a box or a closet as long as food and water is available; male is very territorial in habits.

6. Fecal droppings are 1/8" long; smooth with pointed ends.

7. Live about 6-9 months.

8. Female has six litters of five or six per litter.

9. Prefers to feed on seeds and grains, needs little water; will nibble when feeding and may feed 15 to 20 times per day.

10. May live outside in summer and move inside for winter.

II.A.2. CONTROL OF COMMENSAL RODENTS

One can consider rodent control from the standpoint of prevention through environmental management and population suppression. Prevention is best, and environmental management is required as part of a suppression operation.

There are biological factors, behavioral factors, and environmental factors to be considered in designing a rodent control program. They must be all weighed and allowed for or the control program will not be successful.

II.A.2.a. BIOLOGICAL FACTORS

1. Rodents begin reproducing at a very young age, have large litters, and breed year around. A 90% population reduction may be replaced in as little as 9 months

2. The territorial movement of rats and mice tend to be quite limited and their movement is usually only at night.

(a) If live rodents are seen during the daytime it indicates that a

heavy population is present

(b) Rats normally range no more than 150 feet from the nest; a male mouse will control an area of 10-20 feet from the nest

(c) Rats will migrate on their own; mice are often carried in boxes or crates into new locations

3. Rats rarely live more than one year; mice average 6- 9 months.

II.A.2.b. BEHAVIORAL FACTORS

1. Rats and mice have poor sight, but their other survival senses are extremely well developed

(a) TASTE sensitive to fresh food; they remember foods that made them sick in the past

(b) SMELL sensitive to certain poisons and freshness, smell of man does not frighten them

(c) HEARING very keen, can identify strange sounds and locate them and they will adapt to any constant noise (including ultrasonics)

(d) TOUCH centered in the whiskers and guard hairs causes them to tend to follow vertical surfaces when they travel

(e) PHYSICAL abilities of climbing, burrowing, and swimming enable them to enter and survive most environments

2. New object avoidance is a term that describes the tendency of rats to be very cautious and wary of new objects introduced into their surroundings (such as bait boxes or traps) and or changes in the surroundings.

(a) Major sanitation programs should be done after the initial suppression is performed.

3. Mice are very curious and will immediately investigate new objects.

(a) Rearranging furniture or storage will encourage the mouse to go out to inspect and remap the new arrangements.

(b) They are often caught in newly set traps.

II.A.2.c. ENVIRONMENTAL FACTORS

1. Poor sanitation usually means abundant food, water, and harborage is

available so a population may become easily established; good sanitation involves;

(a) Garbage and waste in closed containers with no spillage.

(b) Stored foods in rodent proof containers.

(c) Storage 6" off the floor and 18" clear of all walls.

(d) No structural defects or closed areas such as double floors, dead spaces under cabinets, blocked corners, abandoned rooms or buildings.

(e) No outdoor harborage such as rubbish or debris piles, tall or thick weeds, stacks of lumber, pallets, or boxes

(f) No free water such as leaky faucets, standing water as in puddles, toilet bowls or sinks

2. Excluding the rodents from the structure is the most effective and provides the longest term control; rodent- proof the building by correcting:

(a) Openings under or around doors that are more than 1/2" for rats and 1/4" for mice.

(b) Unshielded wooden doors or door frames (use metal kick plates and in some cases metal door frames to keep rats from gnawing through.)

(c) Unscreened sewer drains.

(d) Vines, shrubs, or trees touching or overhanging the structure.

(e) Dirt floors or openings through floor to subarea.

(f) Holes in walls or gaps around pipes or utility entrances.

(g) Practices that permit rodents to be carried in with merchandise or materials.

II.A.3. POPULATION SUPPRESSION THROUGH CHEMICAL POISONING AND TRAPPING

Suppressive measures are considered as supplementary to and not a substitute for basic environmental sanitation.

II.A.3.a. TRAPPING is the preferred method of control when:

(a) The use of chemical rodenticides is to be completely avoided.

(b) The animals may die in an inaccessible area and cause an odor problem; anti-coagulant rodenticides do not cause the animal to go outdoors to die.

(c) The last few survivors of a population refuse to take baits.

The classic snap trap or glue boards are effective for rats; mice can also be caught by snap traps and glue boards, as well as the Ketch-All repeating trap or the Tin Cat device

Mice are easily caught in traps; rats are more wary of new objects so the technique of baiting an unset trap for several feedings is effective in maximizing results.

(a) The best bait is that food that the rodents are eating now, providing it can be affixed to the trap and can be kept fresh.

(b) Baits for rats and mice include rolled oats, peanut butter, gum drops, raisin bread, and bacon.

(c) Cheese is not effective bait material.

(d) If food is not being taken, cotton balls or other nesting materials, or shiny beads may be attractive, especially to mice.

Set the trap against a wall or other vertical surface where the rodents are traveling; use non-toxic tracking powder (talc or flour) to determine the traffic patterns. Like baiting with food, place the trap with the trigger side against the wall and leave for several days before setting the trap.

II.A.3.b. CHEMICAL POISONING

This is the most common method of suppression and for obvious reasons, I recommend using baits ONLY as a last resort. (There are many situations where baits can be safely used, but due to the complexity and potential hazard of baits, I do not recommend lay people use them, but will cover the subject for academic reference.)

(a) Poison baits are hazardous to humans and non-target animals.

(b) Only place poisons in areas or containers that are not accessible to children and non-target animals.

(c) Bait containers must be properly and visibly marked - this is a required safety step.

Many of the same considerations as in trapping apply.

(a) Best bait is familiar food, or other solids or liquids

i. Cereal grains, fish, meat, fruits or vegetables
ii. If water is limited, use water as the bait with a little sugar added for acceptance

Pre-baiting with the unpoisoned bait material will help overcome shyness.

Toxic tracking powder can also be used if food baits are not well taken.

(a) Toxic tracking powders are as hazardous as food poisons so must be handled and applied with the same considerations for safety.

II.A.4. DEALING WITH INFESTED FOOD & CONTAMINATED AREAS:

All foodstuffs, which have show evidence that rodents have either eaten or defecated or urinated upon, should be destroyed.

The U.S. Center for Disease Control (CDC) recommends that to protect yourself from communicable diseases spread by rodents and their urine & feces you should do as follows:

Wear protective clothing, including coveralls, gloves, goggles and a respirator. (Only a hepa filter respirator will filter out viruses) Wear protective clothing when collecting dead rodents. Rodents collected (either already dead, or trapped) should be sprayed with disinfectant (see below for recommendations), it's carcass placed inside two plastic trash bags and disposed of in the garbage. Snap traps should be liberally sprayed with disinfectant if they are to be reused.

It is recommended that you use Lysol, or other disinfectants containing diphenols as your disinfectant. Hospital disinfectants are effective if they contain benzalkonium cloride. Follow the label for the dilution rates of the disinfectant you chose to use. You may also use a mixture of one half cups chlorine bleach with one gallon of water.

Do not sweep up or vacuum areas containing rodent feces or urine. Clean up rodent waste using the disinfectants described above. Mop or sponge the suspected area with the solution. Place your waste inside two plastic garbage bags and throw away in an exterior garbage can.

Attics and subareas should be left alone using the method described above . Take extreme care not to contaminate the living areas of a home or structure with rodent feces and waste that may be found in and attic or sub area.

II.B. Other Rodents

II.B.1 Deer Mice

Deer Mice are of some importance due to the Hantavirus. A full FAQ on Hantavirus can be found in the yet to be released Health Pests FAQ. Deer Mice (Peromyscus spp) are found throughout the nation.. Deer mice are active all year, and are usually found in fields, shrubbery, and wooded areas. Though not normally found in structures they sometimes nest in empty structures, and have been known to get into stored foods. The first outbreak of Hantavirus in the US came about because of pine nuts, which were contaminated with Deer Mice urine. Deer mice are about the same size as house mice but are easily distinguished. Deer mice have a bi-colored tail and body. The upper portion of the tail and body is dark colored usually brown or in the case of juveniles, gray,), and the underside of the body and tail is white. The deer mice in California have also been known to have fleas carrying the bubonic plague. Though Deer mice appear to be the primary vector for the Hantavirus , the virus has been identified in the pinon mouse and chipmunks.

Follow all the safety precautions described above in this FAQ for cleaning up and disposing of feces of rodents.

III. FUNGI & MITES

Both fungi and mites are pests, which appear only in moist grain. Usually proper storage of grains will prevent these problems. With any of the fungi or mites, you should never try to eat the food, and it should be disposed of. Fungi cause mycotoxins in many stored foods. Rather than to list these out, it is better said that any foods (with the exception of cheese) should be thrown out if you suspect fungi infestation. Mite infestations are sign enough that you have a serious moisture problem and most likely have fungi. (There are one or two mites used in grain mills to attack other stored product pests, but these mites should not be present in any of your food storage.)

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DISCLAIMER: Safe and effective pest prevention and elimination, food storage and food preservation requires attention to detail and proper equipment and ingredients. Use all chemical products according to the manufacturer's directions. The label IS the law. The author makes no warranties and assumes no responsibility for errors or omissions in the text, or damages resulting from the use or misuse of

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