

Insect and Mite Pests in the Kitchen and Pantry

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This publication describes the most common insect and mite pests that infest stored food products, and those that invade and carry away fresh or stored foods. Information is also provided on preventive practices and management of these pests.

For most people, finding infested food products in the kitchen and pantry is an occasional occurrence that can be managed. Packaged products and dried foods in storage containers have protein, carbohydrates, and other nutrients that are attractive to insect and mite pests as food and breeding sites. Other related foods such as herbs, spices, and teas may also become infested as well as potpourri and crafts made from seeds, pods, bread dough, dried flowers, and plant stems.

Beetles such as the red flour beetle (Figure 1) and moths such as the Indian meal moth (Figure 13) are the most common and difficult pests to manage in stored food products. Also, occasional infestations by ants, flies, booklice, and mites can be very challenging to exclude.

The first indication of an infestation is usually the presence of small beetles or moths in cupboards or on shelves. They may also rest or crawl on kitchen counters, walls, and floors, or fly around windows or near indoor lights.

Upon closer inspection, these insects may be found within opened packages or containers and in cracks and crevices of cabinets or shelving. Unopened packages stored long-term may also be infested, as adults are able to enter through tiny openings. Adults and larvae with chewing mouthparts also may directly penetrate packaging and plastic wrapping.



Figure 1. Red flour beetles, *Tribolium castaneum*.

Insects are sometimes unintentionally brought into the home within infested food products, or they may fly on their own, gaining access through crevices around windows or doors. They then begin to multiply and spread to other stored foods. As soon as insects or mites are discovered, it is important to identify the pests and eliminate all of their food sources.

The majority of stored-food product pests colonize, feed, and multiply on foods in packaging until their food is exhausted; then they disperse to look for new sources. Other pests are considered invaders, such as cockroaches and ants, which live and multiply elsewhere. They invade kitchens and food storage areas and feed on or carry fresh and dry foods back to their retreats or colonies.



Figure 2. Confused flour beetles in wheat flour.



Figure 4. Sawtoothed grain beetle adult.



Figure 3. Red flour beetle and mature larva.

Stored-Food Product Insects

Flour Beetles (*Tribolium spp.*)

Importance: The confused flour beetle, *Tribolium confusum* (Figure 2), and the red flour beetle, *Tribolium castaneum* (Figure 3), are common pests in home food storage areas, flour mills, and cereal food production facilities. Larvae and adults feed on a number of foods including flour, cereals, cake mixes, beans, peas, dried fruits, nuts, chocolate powder, spices, and tobacco. Flour beetles feed on milled and cracked grains, but they cannot feed on whole seeds or grains. Infested food products develop a pungent, foul odor, and they often become damp and moldy when beetles are overcrowded.

Description: Adults of both species are similar in appearance, being reddish brown, having a smooth-sided thorax, and being just over one-eighth inch long. They are distinguished from each other by the shape of their antennae and eyes. The confused flour beetle (Figure 2) cannot fly and spreads through transport of infested products. Red flour

beetles (Figure 3) spread in the same manner, but they can fly from sources such as grain in fields, stored grain bins, and flour mills.

Life Cycle: Female flour beetles lay eggs on containers, or in the food substance itself, and eggs hatch in five to 12 days. The worm-like larvae are cylindrical, are yellowish-white, and grow to approximately one-quarter inch in length at maturity, in about 30 days after egg hatch. Pupation occurs near the surface of the food, and empty larval and pupal skins usually accumulate as a layer. There may be four to five generations per year, depending on temperature. An adult female may live up to two years and lay more than 400 eggs during her lifespan.

Sawtoothed Grain Beetle (*Oryzaephilus surinamensis*)

Importance: Sawtoothed grain beetles do not feed on whole grain, but on numerous milled cereal products, including bread, cake mixes, rice, chocolate, birdseed, dried fruits, nuts, pasta products, and oil seeds. Their small size and flat body enable them to penetrate narrow cracks in poorly sealed packages. They also hide in crevices of storage areas and may escape treatment.

Description: Sawtoothed grain beetle adults are less than one-eighth inch long, slender, flattened, and uniformly dark brown (Figure 4). They have six saw-like teeth on each side of the thorax behind the head. Although they have wings, they cannot fly and thus spread by infested foods being brought into food storage areas.

Life Cycle: The adult female lays a few hundred white eggs singly into foodstuff. The eggs hatch in three to five days. The larvae are yellowish-white and about one-quarter inch long at maturity. Larvae pupate within the food material and develop to the adult stage. The life cycle from egg to adult may occur in 40 to 60 days. There may be up to six generations each year.



Figure 5. Drugstore beetles and C-shaped larvae.



Figure 7. Warehouse beetle adult and larva.



Figure 6. Cigarette beetle, without lines on wings.



Figure 8. Varied carpet beetle adults and larva.

Drugstore Beetle (Stegobium paniceum) and Cigarette Beetle (Lasioderma serricorne)

Importance: These small, oval beetles feed on a wide variety of dry materials mostly derived from plants, but some also from animals. Products commonly infested include cereals, cookies, crackers, granola, seeds, beans, dried fruits, dried herbs and spices, tobacco, yeast, dry pet foods, animal feed pellets, hay, dried flowers, pharmaceutical products, silk, dried meat, and dried hides. They easily chew through packaging material.

These pests prefer humid and dark locations where host foods are stored. Cigarette beetles are more sensitive to cold temperatures. The first sign of infestation is beetles crawling on shelves, counters or floors, or near lights.

Description: Adult beetles are about one-eighth inch long and oval in shape. The head is bent downward, giving them a humped appearance. Drugstore beetles are brown and have lines (striations) on their wing covers (Figure 5). Cigarette beetles are reddish-brown with no wing striations (Figure 6), and the antennae are long with saw-toothed segments.

Life Cycle: Adult females fly to food sources and deposit single eggs. They live about a month and lay approximately 100 eggs over that time. Larvae of both species are C-shaped



Figure 9. Larder beetle adult and larva.

in form, cream-colored, and slightly hairy. When they reach maturity, they make a cocoon in the food substrate and pupate. There may be 6–8 overlapping generations of these beetles each year.

Dermestid Beetles, Family Dermestidae

Importance: Among the more common dermestid beetle pests of stored foods are the warehouse beetle, *Trogoderma variabile* (Figure 7); varied carpet beetle, *Anthrenus verbasci*

(Figure 8); black carpet beetle, *Attagenus unicolor*; and larder beetle, *Dermestes lardarius* (Figure 9).

Dermestid beetles feed on dry materials of animal origin such as hides, furs, leather, feathers, and taxidermy animal mounts. They also feed on woolen blankets, carpets, and clothing, as well as dead insects. Several species feed on dry foods that contain high protein such as jerky, cheese, yeast, powdered milk, powdered eggs, germs of grains, pollen, pasta, seeds, pet food, and dried fruit. Both adults and larvae are secretive and typically avoid light.

The larder beetle infests animal-based food products such as dried meats and fish, cheese, pet food, rawhide, and chew bones for dogs. Larvae also feed on carcasses of rodents or birds, or on masses of dead insects. Mature larvae later crawl about in search of places to pupate.

Description: Adults of these species are black and oval in form and vary in length from one-eighth to three-eighth inches. The body and wings are usually covered with a characteristic pattern of colored hairs or scales, which helps with identification. An exception is the black carpet beetle, which is completely dark brown or black.

Dermestid beetle larvae are brown, segmented, and worm-like in form. Their bodies appear to be banded and hairy, and some species have wisps of hairs protruding from the tip of the abdomen. Mature larvae are longer than adults. Pupation often occurs in the host food substance, and larval and pupal skins accumulate on top of the food mass. Larvae and their cast skins also can be a health risk in that they have irritating hairs that may cause allergic reactions.

Life Cycle: Dermestid beetle development from egg to adult stage usually takes six weeks, and there can be up to six generations per year.

Granary Weevil (Sitophilus granarius) and Rice Weevil (Sitophilus oryzae)

Importance: These very small, elongated beetles with long snouts generally damage whole grains or seeds, but also have been observed feeding on nuts and beans. They usually do not feed on flour or cereal-based products, unless they have become caked and hardened, and they can infest pasta. Weevil-infested grain or seeds develop numerous holes and become damp and moldy.

Description: Adult granary weevils (Figure 10) are dark brown and just over one-eighth inch long. Their wing covers have distinct striations, but despite having wings, they cannot fly. The thorax on top is covered with dense, oval pits. Rice weevils (Figure 11) are slightly smaller and have four orange spots on their wing covers. The thorax on top is covered with dense, round pits. Rice weevils actively fly and spread more rapidly than granary weevils, and they are more tolerant of hot conditions.



Figure 10. Granary weevil adults.



Figure 11. Rice weevil adult.

Life Cycle: Granary weevils and rice weevils have very similar life histories and habits, completing a life cycle in one month to six weeks. Females can lay 200–300 eggs over a period of several months. They deposit a single egg into each grain kernel after chewing an access hole. Hatching occurs in several days, and the white, legless grub feeds within grain for about two weeks, hollowing the kernel out. Pupation occurs within kernels or seeds, and adults emerge after 10 days. There can be up to six generations per year, depending on temperature and food conditions.

Spider Beetles, Family Ptinidae

Importance: Spider beetles feed on numerous materials such as grain, seeds, cereals, dried fruits, herbs, spices, meats, wool, hair, cork, and even rodent feces and bat guano. They develop most rapidly in cooler, dark, and humid conditions where there is minimal disturbance.

Description: Beetles in this family have a compact, oval body shape and six long legs and antennae, which together resemble the eight legs of a spider (Figure 12). The head projects downward and is not easily visible from above.



Figure 12. Shiny spider beetles.

Common species include the whitemarked spider beetle, *Ptinus fur*; brown spider beetle, *Ptinus clavipes*; and shiny spider beetle, *Gibbium aequinoctiale* (Figure 12). Adults are approximately one-eighth inch long.

Life Cycle: Females lay eggs within the food mass, which hatch in about one to two weeks. Larvae are C-shaped, cream-colored, and approximately one-quarter inch long at maturity. Most spider beetles have two or three generations each year.

Indian Meal Moth (Plodia interpunctella)

Importance: This most productive and globally well-established pest feeds on a wide variety of dry food products. Larvae feed in grain, seeds, birdseed, cereal, meals, granola, cake mixes, trail mixes, candy bars, dried fruits, nuts, chocolate, and baked goods, including cookies. Infested foods have fine silk webbing and fecal pellets present on and near the food surface.

Description: Adult moths are nearly one-half inch long and have distinctive wing markings. The base of the forewing is tan, and the outer two-thirds is reddish-copper bordered by black (Figure 13). The moths easily lose their scales and wings become uniformly tan in color. The larvae may be colored dirty-white or tinted with yellow, pink, tan, or green, depending on the food they consume. The head is pale brown and the body has pale hairs, but no evident spots on the skin (Figure 14).

Life Cycle: Female moths lay single eggs onto the food host material and may in their short life span deposit up to 200–400 eggs. Larvae hatch in three to five days and bore into the food mass, reinforcing their tunnels with silk. They continue to tunnel throughout the food mass as they develop, generally taking three weeks or more to mature.

Mature larvae are about three-quarter inch long and usually evacuate their food host, crawling long distances across



Figure 13. Indian meal moth with coppery wings.



Figure 14. Indian meal moth larva in English walnut.



Figure 15. Mature larvae pupating in corrugated cardboard of a picture frame hanging on the wall.

rooms to find protective places in which to pupate. They may form loose cocoons in crevices, in wall and ceiling corners, and within objects (Figure 15). There they may linger from a few weeks to many months before pupating and thereafter emerging as adults.



Figure 16. Psocids in whole wheat flour.

Under normal conditions in the home, there may be four to six generations of Indian meal moths per year.

Psocids (Liposcelis, Lepinotus spp.)

Importance: Psocids, also called booklice, thrive in humid, damp conditions and feed on microscopic molds and mildew. Flour, cereals, herbs, spices, dry pet foods, paper, and fabrics of plant origin may develop infestations when stored in prolonged humid conditions. Also, psocids may destroy starch-based glues in book bindings or wallpaper in decorated rooms. Book collections in basements often become infested if they remain undisturbed.

Description: Psocids are tiny, flattened insects just over one-sixteenth inch long (Figure 16) ranging in color from nearly translucent tan to brown. Several species infest food products, and adults may be winged or wingless in form.

Life Cycle: Among species that infest stored foods, females reproduce without males (a process called ‘parthenogenesis’). The immature nymphs look like the adults, but are smaller. Females may live more than six months and deposit one egg per day on the food host. Eggs hatch in about a week, and nymphs continue to feed and develop, reaching the adult stage in about a month. Generations overlap, so all life stages are present in any infestation.

Acarid Mites, Family Acaridae

Importance: Acarid mites often originate from landscapes, fields, gardens, and facilities where there may be spoiled vegetable produce and grain, or infested food products. Often these mites feed on molds and fungi, as well as decaying bulbs, plant matter, and mushrooms. Food products that may become infested include cereal, flour, grains, cheese, dried meats, dried fruits, herbs, animal feed, and pet food.



Figure 17. Mold mite adult under a microscope.



Figure 18. Grain mites crawling on table surface.

Kitchen counters and storage shelves in the vicinity of infestations may become covered with a layer of “mite dust” consisting of thousands of live and dead mites. Some people in such conditions may develop skin rashes from contact with the mites, and also allergic reactions by breathing air containing tiny body particles and feces.

Among the mites infesting food products are the grain mite, *Acarus siro*; scaly grain mite, *Suidasia nesbitti*; cheese mite, *Tyrolichus casei* (syn. *Tyrophagus casei*); and mold mite, *Tyrophagus putrescentiae* (Figure 17).

Description: These mites are generally cream-colored, less than one-sixteenth inch long and have a bulb-like soft body that is subject to desiccation in a relative humidity below 60% (Figure 18). Their bodies and legs possess long hairs, and the mites move slowly across open surfaces.

Life Cycle: Reproduction occurs rapidly under ideal conditions. Females may lay 20–30 eggs per day and hundreds over her life span. At room temperature and high relative humidity, a life cycle from egg to adult can be completed in less than two weeks.



Figure 19. Indian meal moth pheromone trap.

Management of Pests of Stored Foods

Preventive Practices

1. Inspect packaged foods for infestation before purchase, and be certain that containers are not damaged and seals are intact. Check the packaging date to be assured that the food is fresh.
2. Examine bulk foods in bins or barrels when weighing them out, and do not purchase them if there is evidence of infestation. Alert the store manager to withdraw the product from sale.
3. Be alert to infested food items and plant materials you may bring in from other sources, such as homes of friends or family, parties, county fairs, farmers' markets, picnics, garage sales, etc.
4. Purchase dried food in package sizes that can be used up in a short time. Do not store food products over a long period of time. Note expiration dates, and use older packages first.
5. Store dried foods in durable containers that seal tightly, such as screw-top glass and plastic jars, heavy-duty storage containers, and re-sealable bags. Transparent containers make regular inspection easy. Cardboard boxes and paper packaging are easily penetrated by pest insects.
6. Store bulk dried foods in a home freezer, and bring out quantities as needed for immediate use.
7. Keep food storage areas clean, and do not allow food particles to accumulate on shelves and container tops, as exposed food attracts insects. Cleanliness is also important in areas where pet foods and birdseed are stored.
8. Monitor for Indian meal moth and other pantry pests with pheromone traps to detect first adults captured (Figure 19).

Curative Management Practices

1. **Inspection:** Use a flashlight or other light source, and carefully examine all food storage areas and food products. Be thorough! Generally, insects are present in foods that are seldom used or in undisturbed storage areas. Be sure to check pet food and birdseed storage areas.
2. **Disposal:** Dispose of all infested food items immediately in an outdoor trash container. Be sure to seal items in a heavy-duty plastic bag or in double bags. For extra measure, place bags in the freezer for three or four days to kill the insects before disposal.
3. **Thorough Cleaning:** Remove all food packages, utensils, dishes, and other related items from kitchen and pantry cabinets. Vacuum all spilled and loose food crumbs and particles in cabinets, on shelves, and in cracks and crevices. Wipe surfaces well with a soapy wash rag.
4. **Freezing Treatment:** To treat valued decorations or crafts made from flour dough, plant products or seeds, kill the insects by placing the items in a freezer for three or four days. Carefully clean items and return to storage areas in well-sealed plastic bags or containers.
5. **Trapping:** Sticky traps with lures are available for intercepting pantry pests entering food storage areas or for controlling those remaining after clean-up. Some are designed for Indian meal moths or flour moths (Figure 19). Others are made for attracting flour beetles, weevils, and carpet beetles. They are dish-like in form and placed on floors or shelves to act as a pitfall trap.
6. **Insecticidal Treatment:** After thoroughly cleaning food storage areas, apply an insecticide if absolutely necessary. Treatment is justified in cases where insects have retreated into cracks and crevices and are resistant to vacuum cleaning, or where adult moths or beetles are numerous, scattered about in food storage areas, and quite active. All items such as food, containers, food preparation equipment, and utensils should be removed from cabinets and shelves and cleaned before applying an insecticide.

Several products for homeowners are available to control stored food insect pests. Most are sold as aerosol can sprays or ready-to-use (RTU) hand-pump bottle sprays. For safety purposes, most are limited to insecticides that do not persist very long, or those which can be applied safely in crevices, along baseboards or beneath cabinetry. Sprays containing pyrethrins penetrate and flush insects out of crevices and quickly debilitate them. The pyrethrin-containing insecticides also break down just hours after application.

For any insecticide product used, be sure to READ, UNDERSTAND, AND FOLLOW ALL INSECTICIDE LABEL DIRECTIONS AND PRECAUTIONS. Do not restock treated shelves, drawers, and cabinets until the insecticide spray has dried thoroughly. Keep all insecticides in their original containers. DO NOT CONTAMINATE FOOD AND WATER. Keep insecticides out of the reach of children and pets.

- If necessary, contact a professional pest control operator to manage an infestation.

Kitchen and Pantry Invaders

Unlike the pests discussed above, some insects invade kitchens and pantries and feed on or carry away food particles. They do not develop and multiply within food, but rather, eat or transport it away to concealed areas or nests nearby. Among these are cockroaches and ants.

Other insects, such as fruit flies, colonize ripe or spoiled fruits and fermenting beverages on countertops. House flies and blow flies enter homes and buildings by being attracted to garbage, pet food in dishes, meats, and spoiling foods that contain protein.

Cockroaches

Importance: Cockroaches are omnivorous scavengers and feed on a wide range of substances such as starchy and sweet foods, meats, cheeses, food scraps, pet food, garbage, dead insects and animals, paper, and wallpaper paste. They transfer bacteria that cause infections including salmonellosis and gastroenteritis. Their saliva, exoskeleton particles, and feces are responsible for triggering allergies and asthma in humans.

Cockroaches are common especially in multi-family housing where they travel easily between units using shared walls and utility channels. They prefer to hide in tight, dark places such as cracks and crevices. Most often they startle residents at night as they quickly scatter when someone turns on a light.

Cockroaches leave accumulations of egg capsules, shed skins, fecal pellets, and fecal smears in voids and crevices, or wherever they hide (Figure 20). Fecal pellets may be evident on items in kitchen drawers and on cabinet shelves. These pests also may invade poorly-sealed storage boxes and damage or contaminate clothing, cardboard, paper products, photographs, and valued memorabilia.

The most common cockroaches that forage in kitchens are the German cockroach, *Blattella germanica* (Figure 21); and the oriental cockroach, *Blatta orientalis* (Figure 22).



Figure 20. Oriental cockroach fecal smears and pellets, and egg capsule.

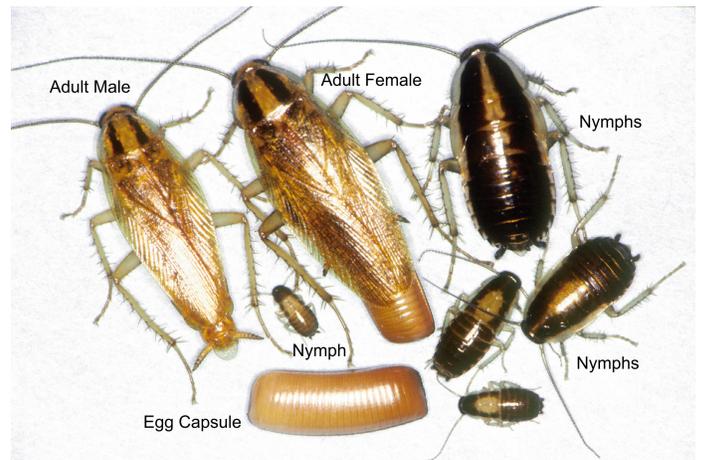


Figure 21. German cockroach with adults, nymphs and egg capsules.

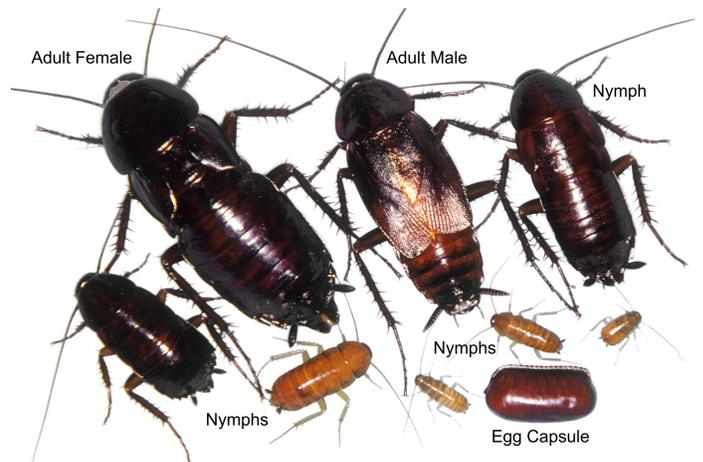


Figure 22. Oriental cockroach with adults, nymphs, and egg capsule.

German cockroaches prefer warm, moist habitats, such as kitchens, bathrooms, and crawlspaces in which to hide and breed. They are successful pests because of their small size, ability to multiply rapidly, wide range of foods, and capacity to hide in small cracks, crevices and holes.

Oriental cockroaches may live outdoors as well as indoors, and they easily survive episodes of cold weather near

freezing. Invasions tend to occur in the spring and autumn during weather transitions. These cockroaches are often called “water bugs” because of their affinity for moisture in kitchens, bathrooms, laundry rooms, crawlspaces, and damp basements.

Description: Cockroaches have flattened, elongated-oval bodies with long thread-like antennae and bristly running legs. Their head is hidden beneath their shield-like pronotum. The tip of the abdomen has a pair of short appendages called cerci. Legs are long and bristly for traction and speed when running.

German cockroach adults are just over one-half inch long, are light brown in color, and have two longitudinal dark bands on the pronotum. They have fully formed wings, but do not fly. Females carry their egg capsules as protection for up to a month and do not release them until the 30–40 nymphs inside are ready to hatch.

Oriental cockroaches are approximately one inch long, shiny, and dark red-brown to black in color. Adult females are wingless, whereas males have nearly full wings, but do not fly. Nymphs are brownish when young, but gradually become darker as they grow larger.

Life Cycle: Cockroaches undergo gradual metamorphosis, and immature forms are smaller, wingless versions of the adults. German cockroaches can complete their life cycle from egg to adult in 100 days, but development varies, based on temperature and nutritional status. A single female can live more than six months and deposit four to five egg capsules in her life span, each containing about 40 eggs. So, three generations per year are common.

In contrast, oriental cockroaches take more than a year to develop from egg to adult. Female adults may live up to six months and deposit up to eight egg capsules, each containing about 16 eggs.

Management: Sanitation is very important for attaining cockroach control and preventing re-infestation. Cleaning the kitchen, regularly disposing of garbage, washing dishes, fixing leaks, and addressing other water issues will reduce food sources and conditions attractive to cockroaches. Organizing living spaces and reducing clutter eliminates harborage in which cockroaches hide. Sealing entry points with caulking or sealant helps to exclude cockroaches from coming inside living spaces. Finally, inspecting incoming products, bags and boxes, and furniture for hitchhiking cockroaches greatly helps to thwart invasion.

To control cockroach populations, using sticky traps and baiting is the preferred and safer method compared to insecticides. Treatment with foggers, sprays, or aerosols generally is ineffective and has the potential not only to contaminate food and counters, but also increases risk of contact with humans and pets.

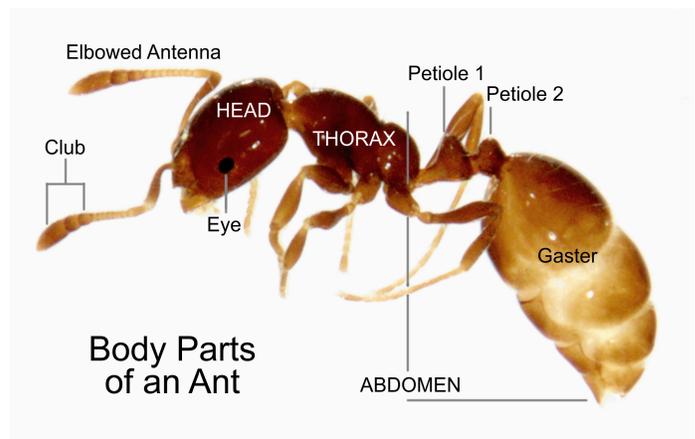


Figure 23. Anatomy of an ant with two petioles.

Baiting involves applying an attractive food-based product that is palatable and which contains a slow-acting toxicant that is compatible with the cockroach’s behavior and biology. In heavy infestations, the volume of bait must be sufficient to provide enough toxicant to kill much of the cockroach population. Baits also must be strategically placed in locations where cockroaches have the greatest chance of encountering them. Sanitation that precedes baiting forces cockroaches to feed on baits.

There are many effective baits on the market with a variety of active ingredients including indoxacarb, fipronil, and dinotefuran. They are relatively inexpensive and widely available. They may be applied as gel drops or in bait stations in areas where cockroaches are active.

Ants, Family Formicidae

Ants are the most common and obvious kitchen invaders, and many enter homes from their nests outdoors in search of food and moisture. Among these are the pavement ant, *Tetramorium caespitum immigrans*, odorous house ant, *Tapinoma sessile*; and thief ant, *Solenopsis molesta*.

Ants have elbowed antennae on their heads and either one or two narrow abdominal segments, called petioles, separating the thorax from the gaster, which is the major part of the abdomen (Figure 23).

Pavement ants nest in immense colonies in the soil around foundations of homes and buildings, and under concrete slabs and large rocks. They may forage indoors for sweets, but prefer fats and proteins, as found in scraps of meats, buttery crumbs, dead insects, and seeds (Figure 24). Workers are just over one-eighth inch long and have dark brown, shiny bodies with two petioles in front of the gaster.

Odorous house ants are black and slightly larger in size than pavement ants and appear to have no petiole at all. They have large colonies and nest in the soil and near moist, warm



Figure 24. Pavement ants feeding on beef gravy.



Figure 26. Thief ant workers.



Figure 25. Odorous house ant workers tending brood.



Figure 27. Odorous house ants feeding on liquid bait.

locations around homes and buildings (Figure 25). Workers are attracted to sweets such as honey, molasses, syrups, and fruit juices spilled on countertops or in opened containers. If a worker is smashed, it emits a rancid coconut odor.

Thief ants often go unnoticed because of their tiny size. Workers are honey-colored to light brown and are about one-sixteenth inch in length. They have tiny eyes, and their abdomens have two petioles (Figure 26). They are called thief ants because they build nests close to other ant colonies and steal eggs, larvae, and food to feed their own colony. They are also called “grease” ants because of their strong preference for oily, greasy foods.

Occasionally, thief ants are mistaken for Pharaoh ants, but they can be differentiated based on their smaller size, two-segmented antennal club, tiny eyes, and affinity for fats and greases.

Thief ants nest outdoors under objects on the ground such as logs and stones, around foundations, and in bare soil. They enter a structure through small cracks and can nest in crevices behind baseboards and under floors, within wall

voids, and in cupboards and other small compartments. Food sources include meats, vegetable oil, peanut butter, potato chips, dairy products, nuts, seeds, and animal fats. Due to their tiny size, they can easily invade packaged food and seemingly sealed containers.

Management: Sanitation is very important for effective ant prevention. Cleaning up spills, wiping food containers, washing dishes, mopping floors, properly storing food (including pet food), and reducing the time food is out on tables and counters are methods used to avoid attracting ants.

Insecticidal treatment for ants involves baiting, where a liquid or solid food bait containing a slow-acting toxicant are applied strategically to eliminate ant colonies (Figure 27). Applying fresh bait over time in small enough doses keeps ants feeding and returning with ingested bait to share with their nest mates and brood. Eventually the colony is eliminated.

There are many effective baits on the market today with a variety of active ingredients including hydramethylnon, fipronil, and boric acid. Baits most attractive to pavement ants and thief ants are those containing grease or oil ingredi-



Figure 28. Common small fruit fly adult.

ents. Sweet syrups are especially attractive to odorous house ants. If baiting proves to be difficult and invasions persist, contact a professional pest control operator.

Small Fruit Fly (Drosophila melanogaster)

Importance: Small fruit flies—also called vinegar or pomace flies—are one of the most common nuisance flies in homes, restaurants, bars, and commercial kitchens. They are found anywhere perishable food is kept. Adults are most abundant in late summer, having developed in gardens and orchards on spoiling fruits, oozes from tree wounds, etc. They fly into structures via doors and window screens. Other life stages may be brought indoors with produce from the grocery store, farmers' market, or home garden.

Ripe, decaying, or fermenting fruits emit odors that attract fruit flies. Common food sources for breeding include ripening bananas, tomatoes, clusters of grapes, squash, melons, fruit juices, open cans of fruits or applesauce, potatoes, onions, and even beer-soaked rags or mops.

Description: Small fruit fly adults can be recognized by their tiny size of just one-eighth inch in length, orange-brown body, red eyes, many-branched antennae, and dark banding on the top of the abdomen (Figure 28). They also tend to hover as they fly over a food source.

Life Cycle: Female flies deposit eggs in masses on the surface of overripe or damaged fruit. Within one day eggs hatch into maggots, which feed on the moist food source and accompanying yeasts. When mature, maggots migrate away from the food host and pupate, and in as little as four days, adults emerge. Under optimal conditions of 85°F or in the summer months, small fruit flies can complete their life cycle from egg to adult in seven to ten days. In southern regions, they may continue to reproduce all year, but in northern latitudes activity may cease over the winter, or the life cycle may be extended in duration.



Figure 29. Small fruit fly trap made from a plastic bottle.

Management: To prevent fruit fly infestations, inspect incoming produce for signs of damage or spoilage. If there is concern that solid fruits will over-ripen or spoil, store them in the refrigerator. Keep track of stored bulbs or tubers that may rot if kept too long. Store only what can be consumed in a reasonable amount of time, and always use older produce first.

Fruit flies can develop even in overlooked bits of fruit or spillage of fruit juices or beverages. Regular sanitation practices such as washing off countertops, sweeping and mopping floors, wiping storage shelves, and cleaning beneath the stove and refrigerator help prevent fruit fly establishment. Be sure to frequently clean trash receptacles, flush the garbage disposal, and rinse empty beverage bottles and cans. Remove garbage daily to outdoor trash bins.

Once food sources are removed, adult flies can be trapped using a homemade fruit fly trap (Figure 29) consisting of a container partially filled with an attractant, and with a funnel attached to the top. The attractant can be apple cider vinegar with a drop of dish soap to break the surface tension to drown the flies.

House Fly (Musca domestica) and Green Bottle Fly (Lucilia sericata)

Importance: House flies and green bottle flies are common pests where food is prepared and readily accessible (Figure 30). They are drawn to kitchens in homes, restaurants, and food-processing facilities by odors of food and garbage. These food sources, if sizeable, may be suitable for breeding, or the flies may simply feed on them for energy and nutrients.

Adult flies feed with sponging mouthparts that are saturated with their saliva to aid with pre-digestion. They feed on moist, decaying organic material and garbage, dead animals, wound dressings, fresh feces and urine, flower nectar, and a wide variety of human foods and beverages. Consequently, they transmit disease pathogens from their bodies and their



Figure 30. House fly (left) and green bottle fly (right).

saliva to exposed human foods, kitchen surfaces, dishes, and utensils. House flies and green bottle flies are known to transmit pathogens that cause cholera, salmonellosis, typhoid fever, dysentery, plague, and a variety of intestinal parasites.

Temperature, light, and humidity affect fly activity. House flies and green bottle flies are active during the day and will frequently rest on floors, walls, ceilings, and windows in buildings.

Description: House flies and green bottle flies are approximately one-quarter inch long and have red eyes and transparent wings. The house fly has four dark stripes on the thorax and a dull, checkered abdomen. The green bottle fly is entirely colored with metallic hues from yellow-green to blue-green.

Life Cycle: Flies undergo complete metamorphosis (egg, larva, pupa, adult), and their larvae are called maggots, which are legless and worm-like (Figure 31).

The female house fly lays clusters of small, elongate, white eggs in moist, warm, organic material, which primarily includes animal feces and wet garbage. The green bottle fly is a blow fly, and it deposits its eggs mainly on freshly killed animals and on compacted garbage containing meat and animal matter.

At room temperature, maggots hatch after a day and burrow into food material. Maggots grow to maturity after a week and migrate to drier locations to pupate. They enclose themselves in a heavy-duty capsule called a puparium. Transformation to the adult stage may take about a week; then, a new adult breaks through one end of the puparium. Adults can live up to three weeks.

The time required to complete the life cycle is dependent on environmental factors such as temperature, humidity, and food resources. Under optimal conditions, house flies and green bottle flies can complete their life cycle from egg to adult in seven to 10 days.



Figure 31. Mature fly maggot and puparia.

Management: The greatest impact on preventing or reducing numbers of flies is to identify and eliminate attractive breeding sources. Do not leave foods or ingredients unattended on counters or tables for very long, and cover foods and return ingredients to storage areas immediately after use.

Other preventive measures include weather stripping windows and doors, replacing screens, and proper trash management.

Sanitation practices are important to implement for garbage, compost piles, and pet waste to prevent germ-carrying flies from entering kitchens. Use well-sealed trash receptacles, and place them a good distance away from the home or building. Regular or frequent disposal of garbage, particularly in summer, also helps to reduce attraction and numbers of flies in the vicinity of the home.

Mechanical control involves trapping or killing flies with sticky traps, fly paper, or a fly swatter. Flies can also be killed with electrocution devices.

Other Occasional Pests

This publication covers only the most common pests that infest foods in storage, that raid and carry away foods in the kitchen or pantry, and that feed on foods and spread germs. There are many other insects that occasionally feed on or infest foods. The key to managing a pest is identification, so that its biology, behavior, and life cycle can be understood. Then, appropriate methods can be applied to eliminate pests. Most of the management practices in this publication can be applied against most pests in the kitchen and pantry.

Other pests that, on rare occasion, infest stored food products, or raw foods and produce are shown in Table 1.

Table 1. Occasional insect pests of stored food products, or raw foods and produce.

Beetles			
			
maize weevil <i>Sitophilus zeamais</i>	cowpea weevil <i>Callosobruchus maculatus</i>	lesser grain borer <i>Rhyzopertha dominica</i>	redlegged ham beetle <i>Necrobia rufipes</i>
			
grain beetles <i>Cryptolestes</i> spp.	hide beetle <i>Dermestes maculatus</i>	yellow mealworm <i>Tenebrio molitor</i>	minute brown scavenger beetles Family Lathridiidae
Moths			
			
Mediterranean flour moth <i>Anagasta kuehniella</i>	raisin moth <i>Cadra figulilella</i>	meal moth <i>Pyralis farinalis</i>	webbing clothes moth <i>Tineola bisselliella</i>
Ants		Flies	
			
little black ant <i>Monomorium minimum</i>	Pharaoh ant <i>Monomorium pharaonis</i>	scuttle fly (aka humpbacked fly) <i>Megaselia scalaris</i>	flesh flies <i>Sarcophaga</i> spp.
Other Insects			
			
American cockroach <i>Periplaneta americana</i>	silverfish and firebrats Order Thysanura	European earwig <i>Forficula auricularia</i>	springtails Order Collembola



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