COCKROACHES

Integrated Pest Management for Home Gardeners and Landscape Professionals

There are six species of cockroaches in California that can become pests: German cockroach, brownbanded cockroach, oriental cockroach, smokybrown cockroach, American cockroach, and Turkestan cockroach. A seventh species, the field cockroach, is not really a pest. It is usually found outdoors, but sometimes comes indoors when it is hot or dry and is often mistaken for the German cockroach. Of these seven species, the one that has the greatest potential for becoming persistent and troublesome is the German cockroach, which prefers indoor locations. Oriental and American cockroaches occasionally pose problems in moist, humid areas.

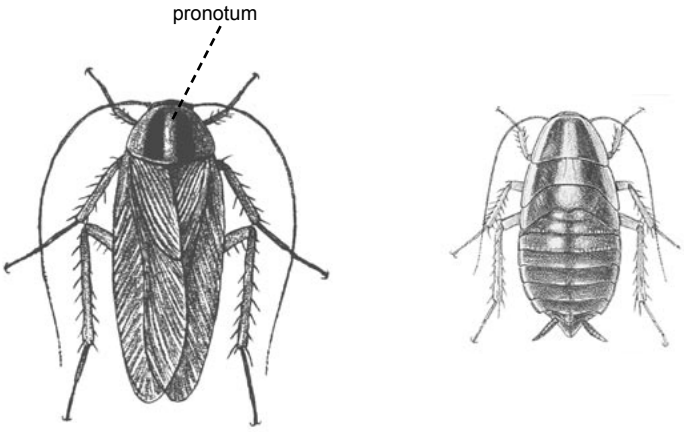


Figure 1. German cockroach adult, actual size ½ inch (left). Immature cockroach, called a nymph (right).

PROBLEMS ASSOCIATED WITH COCKROACHES

Cockroaches may become pests in homes, schools, restaurants, hospitals, warehouses, offices, and virtually in any structure that has food preparation or storage areas. They contaminate food and eating utensils, destroy fabric and paper products, and impart stains and unpleasant odors to surfaces they contact.

People are repulsed when they find cockroaches in their homes and kitchens. Cockroaches (especially the American cockroach, which comes into contact with human excrement in sewers or with pet droppings) may transmit bacteria that cause food poisoning (*Salmonella* spp. and *Shigella* spp.). German cockroaches are believed to be capable of transmitting disease-causing organisms such as *Staphylococcus* spp., *Streptococcus* spp., hepatitis virus, and coliform bacteria. They also have been implicated in the spread of typhoid and dysentery. Indoor infestations of cockroaches are an important source of allergens and risk for asthma among some populations. The levels of cockroaches and allergens are directly related to cockroach density, housing disrepair, and sanitary conditions.

IDENTIFICATION

Cockroaches are medium-sized to large insects in the order Dictyoptera (formerly Orthoptera). They are broad, flattened insects with long antennae and a prominent, shield-shaped section behind the head called a pronotum (Fig. 1). Some people confuse them with beetles, but adult cockroaches have membranous wings and lack the thick, hardened forewings (elytra) of beetles. They are nocturnal and have a tendency to scatter when disturbed. Immature cockroaches (nymphs) look like adults, but are smaller and do not have wings.

Of the six common pest species, German and brownbanded cockroaches (Table 1) inhabit buildings, whereas the oriental, smokybrown, American, and Turkestan cockroaches (Table 2) usually live outdoors or in masonry enclosures away from buildings, only occasionally invading buildings themselves. It is important to correctly identify the species involved in a cockroach infestation so that the most effective control method(s) may be chosen.

German Cockroach

The German cockroach, *Blattella germanica,* is the most common indoor species, especially in multiple-family dwellings. They prefer food preparation areas, kitchens, and bathrooms because they favor warm (70° to 75°F), humid areas that are close to food and water. Severe infestations may spread to other parts of buildings. This species reproduces the fastest of the common pest cockroaches: a single female and her offspring can produce over 30,000 individuals in a year, but many succumb to cannibalism and other population pressures. Egg laying occurs more frequently during warm weather. The female carries around a light tan egg case (about ¼ inch long) until 1 to 2 days before it hatches, when she drops it. Sometimes the egg case hatches while it is still being carried

PEST NOTES Publication 7467

University of California
Agriculture and Natural Resources

May 2007

by the female. Each egg case contains about 30 young, and a female may produce a new egg case every few weeks.

Brownbanded Cockroach

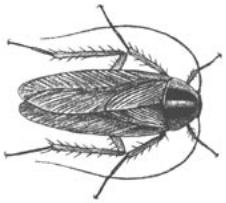
The brownbanded cockroach, *Supella longipalpa*, is not as common as the German cockroach in California and accounts for only about 1% of all indoor infestations. This species seeks out areas that are very warm most of the time, preferring temperatures of about 80°F, about 5° to 10°F warmer than what German cockroaches prefer. Favorite locations include near the warm electrical components of appliances such as radios, televisions, and refrigerators. Brownbanded cockroaches prefer starchy food (e.g., glue on stamps and envelopes), are often found in offices and other places where paper is stored, and are more common in apartments or homes that are not air conditioned. They also infest animal-rearing facilities, kitchens, and hospitals. Adult males sometimes fly when disturbed, but females do not fly. Females glue light brown egg cases, which are about ¼ inch long, to ceilings, beneath furniture, or in closets or other dark places where eggs incubate for several weeks before hatching. Each female and her offspring are capable of producing over 600 cockroaches in one year.

TABLE 1. Identifying Features of Indoor Cockroaches.

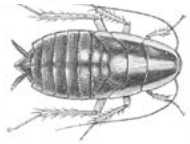
GERMAN

Adult: 0.5 inch; light brown, two dark stripes on pronotum

Preferred location: kitchens, bathrooms, food preparation and storage areas



adult

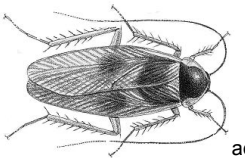


nymph

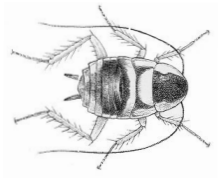
BROWNBANDED

Adult: 0.5 inch; males are golden tan; females are darker brown; both have light-colored bands on abdomen, wings, and sides of pronotum

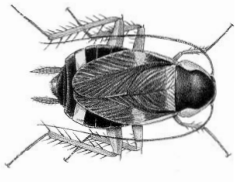
Preferred location: warm areas indoors, behind pictures on walls, in hollow legs of furniture, clutter



adult male



nymph



adult female

Oriental Cockroach

The oriental cockroach, *Blatta orientalis,* is sometimes referred to as a water bug or black beetle. It lives in dark, damp places like indoor and outdoor drains, water control boxes, woodpiles, basements, garages, trash cans, and damp areas under houses. It is most likely to occur in single-family dwellings that are surrounded by vegetation. It is also common in ivy, ground cover, and outside locations where people feed pets. Oriental roaches prefer cooler temperatures than the other species do, and populations of this species often build to large numbers in masonry enclosures such as water meter boxes. At night, oriental cockroaches may migrate into buildings in search of food. They usually remain on the ground floor of buildings and move more slowly than the other species. Oriental cockroaches do not fly and are unable to climb smooth vertical surfaces; consequently they are commonly found trapped in porcelain sinks or tubs. Females deposit dark red-brown egg cases, which are about $^{3}/_{8}$ inch long, in debris or food located in sheltered places. Each female and her offspring can produce nearly 200 cockroaches in one year. Development from a newly emerged nymph to adult can take from 1 to 2 years or more.

Smokybrown Cockroach

The smokybrown cockroach, *Periplaneta fuliginosa*, is usually found in decorative plantings and planter boxes, woodpiles, garages, and water meter boxes; it may occasionally inhabit municipal sewers. They sometimes invade homes, taking refuge in areas such as the attic. Nymphs are dark brown and have white segments at the end of their antennae and across their backs. Smokybrown cockroaches prefer the upper parts of buildings; they also may live under shingles or siding and sometimes get into trees, shrubs, and other vegetation during summer months. Females carry the dark brown to black egg case, which measures about $^{3}/_{8}$ inch long, for about 1 day before dropping it; eggs can quickly hatch in 24 days or take 70 days after being laid, depending on temperature. About 40 to 45 nymphs hatch from a single egg case.

American Cockroach

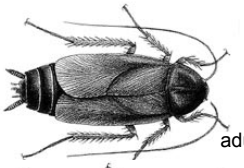
The American cockroach, *Periplaneta americana,* prefers warm and humid

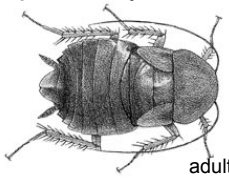
TABLE 2. Identifying Features of Outdoor Cockroaches.

ORIENTAL

Adult: 1.25 inches; almost black; male, wings are shorter than body; female, wings are rudimentary

Preferred location: cool damp, dark places—woodpiles, ivy, ground cover, garages, basements, water meter boxes, and in drains

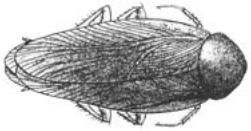

adult male


adult female

SMOKYBROWN

Adult: 1.5 inches; dark brown to mahogany; almost-black pronotum

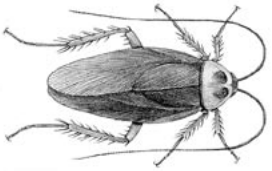
Preferred location: planter boxes, trees, shrubs, vegetation


adult

AMERICAN

Adult: 2 inches; reddish brown; large body, edges of pronotum are light colored

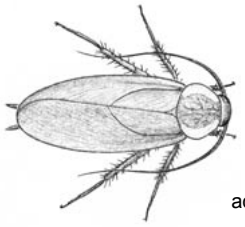
Preferred location: sewers, water meter boxes, storm drains, steam tunnels, animal-rearing facilities

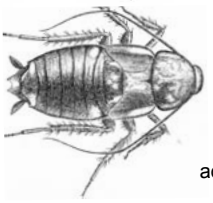

adult

TURKESTAN

Adult: female, 1 inch with cream-colored markings along the edges behind the head and around the short, rounded wings; males slightly smaller with yellowish-tan wings and cream-colored stripes along the edges

Preferred location: water meter boxes, cracks between blocks of poured concrete, compost piles, leaf litter, potted plants

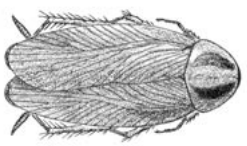

adult male


adult female

FIELD

Adult: 0.5 inch; gray to olive brown; two black stripes on pronotum; one black stripe between the eyes

Preferred location: leaf litter, plant debris


adult

environments, usually with temperatures in excess of 82°F. Under the right conditions, they readily live outdoors and are common pests in zoos and animal-rearing facilities. They are also common in sewers, steam tunnels, and masonry storm drains. Occasionally they forage from sewers and other areas into the ground floor of buildings. Adult females carry the egg cases around for about 6 days and then cement them to a protected surface where they incubate for about 2 months or longer. The egg cases, which are about 3/8 inch long, are brown when laid but turn black in 1 to 2 days. Each egg capsule contains about 12 young; a female and her offspring can produce over 800 cockroaches in one year.

Turkestan Cockroach

The Turkestan cockroach, *Blatta lateralis*, is usually found in water meter boxes, cracks between blocks of poured concrete, compost piles, leaf litter, and potted plants. They may occasionally be found inhabiting sewer systems. Turkestan cockroaches are relatively new to California and are often mistaken for other cockroach species. Females are often confused with the oriental cockroach but can be distinguished by the cream-colored markings along the edges behind the head and around the short, rounded wings. Males are often confused with the American cockroach but are smaller and have yellowish-tan wings with cream-colored stripes along the edges. The nymphs are half black and half dark red. The biology of the Turkestan cockroach is very similar to the oriental cockroach.

Field Cockroach

The field cockroach, *Blattella vaga,* prefers outdoor locations and is usually found in leaf litter and plant debris. Field roaches invade indoor areas when it is hot or dry outdoors and are often mistaken for German cockroaches. Field roaches are more olive in color than German roaches and they have a black stripe between the eyes. Adult females carry the egg cases until they are ready to hatch. Each egg capsule usually contains between 30 and 40 young. Development from a newly

emerged nymph to adult can be completed in about 3 months.

Life Cycle

An adult female cockroach produces an egg capsule, called an ootheca, which it carries around protruding from the tip of the abdomen. The German cockroach carries the ootheca for most of the 30-day incubation period and then drops it about the time the eggs hatch; the adult female field cockroach also carries the ootheca until eggs are ready to hatch. The other five species carry it for only a short time before depositing it in a suitable location where it incubates for weeks or months. Young or immature cockroaches undergo gradual metamorphosis, which means they resemble adults and have similar feeding habits, but they do not have fully developed wings and are not reproductively active. Immediately after molting, cockroaches are white, but their outer covering darkens as it hardens, usually within hours.

Cockroaches are nocturnal. They hide in dark, warm areas, especially narrow spaces where surfaces touch them on both sides. Adult German cockroaches can hide in a crack $^{1}/_{16}$ inch or 1.6 mm wide. Immature cockroaches tend to stay in even smaller cracks where they are well protected. Cockroaches tend to congregate in corners and generally travel along the edges of walls or other surfaces.

MANAGEMENT

Managing cockroaches is not easy. You must first determine where the roaches are located. The more hiding places you locate and manage, the more successful your control program will be. Remember that cockroaches are tropical and most like warm hiding places with access to water. Some locations may be difficult to get to. Reduction of food and water sources and hiding places is essential. If cockroaches have access to food, baits (which are a primary control tool) have limited effect. Sprays alone will not eliminate cockroaches. An IPM approach that integrates several strategies is usually required.

If you know the species of cockroach, you will be better able to determine where the source of infestation is and where to place traps, baits, or insecticides. Note locations of suspected infestations and concentrate control and preventive measures in these areas. The keys to controlling cockroaches are sanitation and exclusion: cockroaches are likely to reinvade as long as a habitat is suitable to them (i.e., food, water, and shelter are available), so the conditions that promoted the infestation must be changed. In addition to sanitation and exclusion, baits can be effective against most species of cockroaches. Pesticide spray products are registered for use on cockroaches and may temporarily suppress populations, but they usually do not provide long-term solutions and are not generally recommended. Commercially available devices that emit ultrasound to repel cockroaches are not effective.

Use the IPM Approach

Change the situation that promotes cockroaches!

- Reduce food and water sources.
- Eliminate hiding places.
- Consider using baits.
- Avoid sprays.
- Use traps to monitor the population.

Monitoring Cockroaches

Traps. Traps offer the best way to monitor cockroach populations. By placing traps in several locations and inspecting them regularly, you can identify the areas of most severe infestation and know where to concentrate control efforts. Traps also can be very helpful in evaluating the effectiveness of control strategies. Available retail cockroach sticky traps work well. These traps are open-ended and are lined inside with a sticky material.

To be effective, traps must be placed where cockroaches are likely to encounter them when foraging. The best places are at the junctions of floors and walls and close to sites where cockroaches are suspected; good potential monitoring sites can be determined by accumulations of fecal matter (e.g., dark spots or smears), cast skins, egg cases, and live or dead cockroaches. Place traps in all corners of the room to give you an idea where roaches are entering. In the kitchen put traps against walls behind the stove and the refrigerator and in cabinets. Number the traps so you can keep records for each trap separately. Check the traps daily for several days until it is apparent where the greatest number of roaches are caught; usually this is within the first 24 hours of placing a trap—after that cockroaches may become wary of the trap. Discard sticky traps by placing them in a sealed plastic bag in the trash. Keep records of roaches trapped in different locations before and after you initiate a management program to evaluate its success.

Other Methods. You can also track a cockroach infestation by using a flashlight to inspect cracks, underneath counters, around water heaters, and in other dark locations. A small mirror on a long handle can be useful in hard-to-see areas. Look for live and dead cockroaches, cast skins, egg capsules, and droppings, all of which aid in identification and are evidence of an infestation.

Sanitation

Cockroaches thrive where food and water are available to them. Even tiny amounts of crumbs or liquids caught between cracks provide a food source. Important sanitation measures include the following:

- Store food in insect-proof containers such as glass jars or resealable plastic containers.
- Keep garbage and trash in containers with tight-fitting lids and use liners. Keep trash cans away from doorways. Remove trash, newspapers, magazines, piles of paper bags, rags, boxes, and other items that provide hiding places and harborage.
- Eliminate plumbing leaks and correct other sources of free moisture. Increase ventilation where condensation is a problem.

- Vacuum cracks and crevices to remove food and debris. Be sure surfaces where food or beverages have been spilled are cleaned up immediately. Vacuuming also removes cockroaches, shed skins, and egg capsules. Removing cockroaches reduces their numbers and slows development. Vacuumed cockroaches and debris should be destroyed. Because bits of cuticle and droppings may cause allergies, it is recommended that the vacuum cleaner have a HEPA (high efficiency particulate absorber) filter or triple filters.

Exclusion and Removal of Hiding Places

During the day cockroaches hide around water heaters, in cupboard cracks, stoves, crawl spaces, outdoor vegetation, and many other dark locations. They invade kitchens and other areas at night. Limiting hiding areas or avenues of access to living areas is an essential part of an effective management strategy. False-bottom cupboards, hollow walls, and similar areas are common cockroach refuges. Prevent access to the inside of buildings through cracks, conduits, under doors, or through other structural flaws. If it is not practical to remedy these problem areas, treat them with boric acid powder insecticides formulated for cockroach control (Table 3).

Limit Access. Take the following measures if observation or trapping shows roaches are migrating into a building from outdoors or other areas of the building:

- Seal cracks and other openings to the outside.
- Use weather stripping on doors and windows.
- Look for other methods of entry, such as from items being brought into the building, especially appliances, furniture, and items that were recently in storage.
- Inspect food deliveries before putting them in kitchens.
- Look for egg cases (oothecae) glued to undersides of furniture, in refrigerator and other appliance motors, boxes, and other items. Remove and destroy any that you find.
- Locate and seal cracks inside the treatment area where cockroaches can hide.
- Trim shrubbery around buildings to increase light and air circulation, especially near vents, and eliminate ivy or other dense ground covers near the house, as these may harbor cockroaches.
- From around the outside of buildings remove trash and stored items such as stacks of lumber or firewood that provide hiding places for cockroaches.
- Consider keeping a layer of gravel about 6 to 12 inches wide around the perimeter of buildings.

Chemical Control

Insecticides are most effective in controlling cockroaches when combined with sanitation and exclusion practices that limit the cockroach's ability to establish or reinvade; *chemical control alone will not solve the problem.* If insecticides are used, they must always be used with extreme care. Indoor chemical control is warranted only if the cockroach population is established, but not for an incidental intruder or two.

Table 3. Dust Products Available in California in 2006.

Active ingredient (a.i.)	Brand name	Availability
Boric acid	Roach Prufe	Homeowners
	Hot Shot Maxattrax Roach Powder	Homeowners

Baits. Bait products are the primary pesticides used to treat cockroach infestations. They can be packaged as pastes, gels, granules, or dusts. Most insecticides used in baits are slow acting. Consequently an effective bait program does not give immediate results, but may take 7 days or longer. Baits can be quite effective for long-term control of cockroaches unless the cockroaches have other food sources available to them.

Baits do not control all cockroaches equally. Female cockroaches with egg cases do very little feeding and avoid open spaces; consequently they are less likely to be immediately affected by a bait.

Bait Stations. The most popular form for home use is prefilled bait stations, which are small plastic units that contain an attractive food base along with an insecticide. Refillable bait stations are available in stores and are refilled with bait granules or gel. The advantage of bait stations is that insecticides can be confined to a small area rather than being dispersed, and they are relatively child resistant. Baits in plastic containers also remain effective for many months.

Gel Bait. For crack and crevice treatments, gel baits can be very effective. Apply gel using a bait gun or syringe in small dabs in cracks and crevices where cockroaches will find it. While they are fresh, bait gels are very effective when placed in locations where they will be found by cockroaches. To remain effective, however, the gels need to be reapplied frequently. Bait gels dehydrate in about 3 days when left in open air. Gels are most effective if applied in indoor areas.

Available commercial baits (see Table 4) may contain abamectin, boric acid, fipronil, hydramethylnon, indoxacarb or imidacloprid mixed with a food base. These vary in effectiveness according to cockroach species.

As with sticky traps, insecticidal baits do not attract cockroaches so place them near hiding spaces or where

TABLE 4. Baits Available in California in 2006.

Active ingredient (a.i.)	Brand name	Form	Availability
abamectin	Avert	gel, powder	Professionals only
boric acid	Niban	granules	Professionals only
	Stapleton's Magnetic Roach Food	paste	Blue Diamond tel. 800 237-5705 available to homeowners
fipronil	Maxforce	bait station, gel	Professionals only
hydramethylnon	Combat	bait station, gel	Homeowners
	Maxforce	bait station, gel	Professionals only
	Siege	gel	Professionals only
indoxacarb	HotShot Maxattrax Ultra Brand Nest Destroyer Roach Bait	pellets	Professionals only
imidacloprid	Pre-Empt Professional Cockroach Gel Bait	gel	Homeowners

roaches are likely to encounter them when foraging. Place bait stations around building perimeters, in valve or water meter boxes, and around planters. Indoors, place baits under appliances, along wall borders, and in cabinets. Baits can also be placed next to fecal specks and droppings of cockroaches, which contain a natural attractant or aggregation pheromone. Look for these fecal specks and droppings under kitchen counters, behind kitchen drawers, and in the back of cabinets.

Dusts. Insecticidal dusts can be an important part of an Integrated Pest Management (IPM) program when applied in enclosed, out of the way locations where cockroaches hide. The most common active ingredient (a.i.) is boric acid powder. Boric acid powder is a contact poison and can be used preventively or when treating existing infestations. Boric acid powder is the least repellent of all the insecticides for cockroach control, and if it remains dry and undisturbed, it provides control for a very long time. Because it has a positive electrostatic charge, the dust clings to the body of a cockroach as it walks through a treated area and the cockroach ingests small amounts when it grooms itself. Because boric acid powder is fairly slow acting, it may take 7 days or more to have a significant effect on a cockroach population. Because of its toxicity to plants, boric acid is not recommended for outdoor use.

Blow dust into cracks and crevices or lightly spread it in areas where visible residues are not a problem and where people will not contact it. Remove kick panels on refrigerators and stoves and apply a light film of dust throughout the entire area underneath these appliances. A thin film of dust is more effective than a thick layer. Holes that are the same size as the tip of a puff-type applicator can be drilled into the top of kick panels beneath cabinets and powder may be applied through the holes to these areas as well as under the sink, in the dead space between the sink and wall, and around utility pipes. Also treat along the back edges and in corners of shelves in cabinets, cupboards, pantries, and closets.

Formulated as an insecticide, boric acid dusts usually contain about 1% of an additive that prevents the powder from caking and improves dusting properties. If it gets wet and then dries and cakes, it loses its electrostatic charge and will not be picked up readily by the cockroach. If this occurs, reapply powder to these areas.

Sprays and Aerosols. Although sprays may provide a quick, temporary knockdown of cockroaches, they do not give long-term control. They are likely just to disperse cockroaches to other areas of the building from which they may return later. Also, cockroaches have become resistant to many insecticides that formerly controlled them. Sprays should not be necessary if an IPM program using sanitation, exclusion, and appropriate baits and dusts is practiced.

Insecticide treatment of breeding sites for oriental and American cockroaches, including inside meter boxes, under uplifted concrete or on sewer lids, or around landscape plantings may be required when populations of these species are high and moving into adjacent buildings. However, an occasional cockroach observed in these sites does not indicate a need for treatment.

Follow-Up

After a cockroach IPM program has been started, evaluate the effectiveness of the methods that are being used with regular monitoring. Use traps or visual inspections to help determine if further treatment is necessary.

If populations persist, reevaluate the situation. Look for other sources of

infestations, make sure that all possible entryways are blocked, be certain that food and water sources are eliminated as much as possible, and continue sealing and eliminating hiding places. It may be necessary to move bait stations to other locations, use more stations, or apply additional dabs of bait if gel baits are being used.

When cockroach populations are under control, continue monitoring with traps on a regular basis to make sure reinfestation is not taking place. Maintain sanitation and exclusion techniques to avoid encouraging a new infestation. If severe reinfestations continue to recur, consider having the infested areas modified or remodeled to reduce the amount of suitable habitat for cockroaches.

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For more information contact the University of California Cooperative Extension in your county. See your telephone directory for addresses and phone numbers.

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Special Thanks to Cheryl Reynolds, UC Statewide IPM Program
TECHNICAL EDITOR: M. L. Flint
COORDINATION & PRODUCTION: P. N. Galin
ILLUSTRATIONS: **Figs. 1-3**: U.S. Departments of Food and Agriculture and Health and Human Services. 1991. Insect and Mite Pests in Food, Vol. II. Washington, D.C.: U.S. Government Printing

Produced by UC Statewide IPM Program, University of California, Davis, CA 95616

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This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Pest Management.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.