
COCKROACHES

Integrated Pest Management in and around the Home

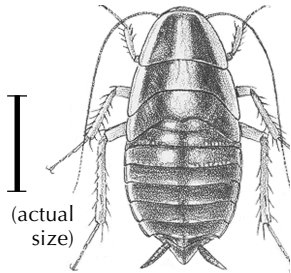


Figure 1. German cockroach nymph

There are five species of cockroaches in California that can become pests: German cockroach, brownbanded cockroach, oriental cockroach, smokybrown cockroach, and American cockroach. Of these, the one that has the greatest potential of becoming persistent and troublesome is the German cockroach, which prefers indoor locations. Oriental and American cockroaches occasionally pose problems in moist, humid areas.

PROBLEMS ASSOCIATED WITH COCKROACHES

Cockroaches may become pests in homes, restaurants, hospitals, warehouses, offices, and virtually 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.

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 *Staphylo-*

coccus spp., *Streptococcus* spp., hepatitis virus, and coliform bacteria. They also have been implicated in the spread of typhoid and dysentery. Some people, especially those with asthma, are sensitive to the allergens produced by these cockroaches. However, a major concern with cockroaches is that people are repulsed when they find cockroaches in their homes and kitchens.

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 pronotum (Fig. 1). Some people confuse them with beetles, but adult cockroaches have membranous wings and lack the thick, hardened forewings or elytra of beetles. They are nocturnal and run rapidly when disturbed. Immature cockroaches (nymphs) look like adults, but are smaller and do not have wings.

Of the five common pest species, German and brownbanded cockroaches inhabit buildings, whereas the oriental, smokybrown, and American cockroaches usually live outdoors, only occasionally invading buildings. It is important to correctly identify the species involved in a cockroach infestation so that the most effective control method(s) for the species involved is chosen (Fig. 2).

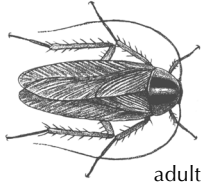
German Cockroach

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

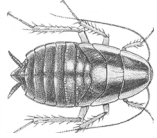
food and water. Severe infestations may spread to other parts of buildings. This species reproduces the fastest of the common pest cockroaches: a single female and her offspring can produce over 30,000 individuals in a year, but many succumb to cannibalism and other population pressures. Egg laying occurs more frequently during warm weather. The female carries around a light tan egg case (about 1/4 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 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 1/4 inch long, to ceilings, beneath furniture, or in closets or other dark places where eggs incubate for several weeks

FIGURE 2. Identifying features of the different species of pest cockroaches**GERMAN**

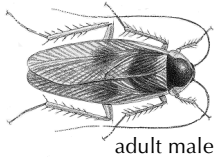
adult



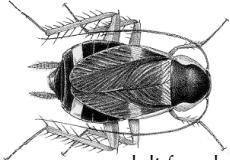
nymph

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

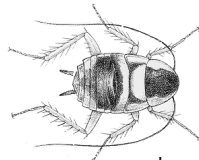
Preferred location: kitchens, bathrooms, food preparation and storage areas

BROWNBANDED

adult male



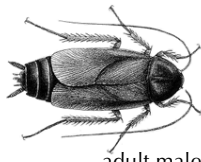
adult female



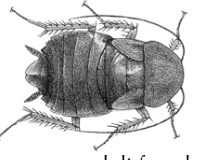
nymph

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

ORIENTAL

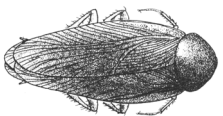
adult male



adult female

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

Preferred location: damp, dark places—woodpiles, garages, basements, and in drains

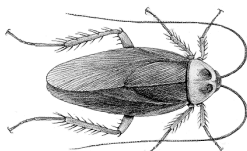
SMOKYBROWN

adult

Adult: 0.5 inch; dark brown to mahogany; almost black pronotum

Nymph: banded pattern on antennae

Preferred location: trees, shrubs, vegetation

AMERICAN

adult

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

Preferred location: sewers, steam tunnels, animal-rearing facilities

before hatching. Each female and her offspring are capable of producing over 600 cockroaches in one year.

Oriental Cockroach

The oriental cockroach, *Blatta orientalis*, is sometimes referred to as a waterbug or waterbeetle. 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. They 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 hatch in as soon as 24 days after being laid or as long as 70 days after laying, 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 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.

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 other four species carry it for only about a day 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 aggregate 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 harborage you locate and treat, the more successful your control program will be. Remember that cockroaches are tropical and like warm hiding places with access to water. Some locations will be difficult to get to. If cockroaches have access to food, baits will have limited effect. Sprays alone will not eliminate cockroaches. An approach that integrates several strategies is 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 infestation and concentrate control measures in these areas. The keys to controlling cockroaches are sanitation and exclusion: cockroaches will continue to invade as long as a habitat is suitable to them (i.e., food, water, and shelter are available), so the conditions that attracted and favored the infestation must be changed. In addition to sanitation and exclusion, baits and sticky traps can be effective against most species of cockroaches. As a last resort, sprays or dusts that are registered for use on cockroaches may temporarily suppress populations, but they do not provide long-term solutions. Commercially available devices that emit sound to repel cockroaches are not effective.

Monitoring Cockroaches

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.

Traps can be purchased or made. Most commercially available cockroach traps are open-ended and contain an attractant substance along with a sticky material that lines the inside. An alternative is to make a cockroach trap from a quart-sized can. The inside top of the can is coated with a petroleum jelly to prevent the roaches from escaping, and a slice of white bread is placed in the can as bait.

To be effective, traps must be placed where cockroaches are likely to encounter them when foraging. The best places are along the edges of floors and walls and close to sites where cockroaches are numerous; these sites can be determined by accumulations of fecal matter (e.g., dark spots or smears), cast skins, egg cases, and live or dead cockroaches. In the kitchen put traps against walls behind the stove and the refrigerator and in cabinets. 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. Trapped cockroaches may be destroyed with hot, soapy water.

You can also monitor a cockroach population at night using a flashlight to inspect cracks, underneath counters, around water heaters, and in other dark locations. Look for live and dead cockroaches, cast skins, egg capsules, and droppings, all of which aid in identification and are evidence of an infestation.

Sticky Traps with Pheromones

Continuous trapping, especially of slow-developing species such as the oriental cockroach, may be helpful. Trapping by itself has not been shown to be effective in controlling German or brownbanded cockroaches because these species have such a high reproductive rate. A recent development in the use of sticky traps, however, has been the addition of an aggregation pheromone attractant. With this development, sticky traps have become more useful as a control tool for German cockroaches. An ad-

ditional benefit of pheromone sticky traps is that the bodies of trapped roaches are removed with the traps. Dead roaches contain proteins that can cause asthma symptoms when they are inhaled by susceptible individuals, so the removal of dead cockroaches may be beneficial in certain situations. Intensive trapping may provide a reduction in German cockroach populations but the number of traps and their placement are critical: follow the manufacturer's recommendations.

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 sealable plastic containers.
- Keep garbage and trash in containers with tight-fitting lids. 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 be allergenic, it is recommended that the vacuum cleaner have HEPA (high efficiency particulate absorber) or triple filters.
- 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.

- Remove trash and stored items such as stacks of lumber or firewood that provide hiding places for cockroaches from around the outside of buildings.

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 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.

Take the following measures if roaches are migrating into a building from outdoors or other areas of the building:

- Seal cracks and other openings to the outside.
- 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.
- Look for oothecae glued to undersides of furniture, in refrigerator and other appliance motors, boxes, and other items. Remove and destroy any that are located.
- Locate and seal cracks inside the treatment area where cockroaches can hide.

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.

Dusts. One effective dust for control of cockroaches is boric acid powder, which is a contact poison. It 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.

Boric acid powder does not decompose and is effective for as long as it is left in place, if it remains dry. 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.

Baits. Baits are formulated as pastes, gels, granules, and dusts. The most popular use of baits in homes is within bait stations, which are small plastic or cardboard units that contain an attractive food base along with an insecticide. Bait gels are placed in small dabs in cracks and crevices where cockroaches will find it. 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 whereas the bait gels dehydrate in about 3 days when left in the open air. But 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.

Most insecticides used in baits are slow acting; cockroaches quickly learn to avoid fast-acting ones. 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.

Commercial baits available (see Table 1) contain abamectin, boric acid, fipronil, hydramethylnon, or sulfluramid mixed with a food base. Sulfluramid is not as effective as the other materials because it is somewhat volatile and there has been some development of resistance to it.

As with sticky traps, baits do not attract cockroaches so place them near hiding spaces or where roaches are likely to encounter them when foraging. When placed next to a sticky trap that contains an attractant pheromone, bait consumption by the roaches is reported to increase. Bait stations can also be placed next to fecal specks and droppings of cockroaches, which contain a natural aggregation pheromone. Look for these fecal specks and droppings under kitchen counters, behind kitchen drawers, and in the back of cabinets.

Insect Growth Regulators. The insect growth regulator (IGR) hydroprene prevents immature cockroaches from becoming sexually mature. It also has the added advantage of stimulating cockroaches to feed. When placed

next to a bait it can increase bait consumption. Under normal circumstances an adult female cockroach carrying an egg case doesn't feed much, but exposure to an IGR will induce her to feed.

Sprays and Aerosols. Applying low-residual insecticides to get a quick knockdown of cockroaches in an infested area can provide immediate relief from a cockroach infestation but generally does not give long-term control. Common home use insecticides include combinations of pyrethrin and piperonyl butoxide or pyrethroids such as cyfluthrin, cypermethrin, and permethrin. The safest application method for home users is the crack-and-crevice spray used in combination with sanitation and exclusion. Avoid the use of insecticide aerosol sprays, bombs, or foggers, as these will just disperse the cockroaches and may actually increase problems.

The faster the knockdown activity of an insecticide, the quicker cockroaches learn to avoid it. Cockroaches are repelled by deposits of residual insecticides such as synergized pyrethrins and emulsifiable concentrate formulations of pyrethroids such as cyfluthrin, cypermethrin, and permethrin. Wettable powder formulations are generally less repellent and more effective on a wide range of surfaces; however, they may be unsightly.

It should be noted that many cockroach populations, especially the German cockroach, have developed resistance (or tolerance) to many insecticides used for their control. Resistance has been documented with allethrin, chlorpyrifos, cyfluthrin, cypermethrin, fenvalerate, and others. Do not expect instant results from an insecticide spray application, but if the cockroaches seem to be unaffected the following day, a different material or strategy may be required.

Under extreme circumstances when professional pest control services are warranted to alleviate a persistent

TABLE 1. Baits Currently Available for Use in Homes

Active ingredient	Brand name	Formulation	Where to get product
abamectin	Avert	gel, powder	pest control company
abamectin plus hydroprene	Raid Max Plus Egg Stoppers	bait station	retail stores
boric acid	Stapleton's Magentic	paste	Blue Diamond Phone: (800) 237-5705
	Niban and others	granules	pest control company
fipronil	Maxforce	bait station	pest control supply store
	Maxforce	gel	pest control supply store
hydramethylnon	Combat	bait station	retail stores
	Combat	granules	retail stores
	Maxforce	gel	pest control supply store
	Siege	gel	pest control company

cockroach infestation, everything should be removed from kitchen drawers, cabinets, cupboards, and closets and stacked in out-of-the-way places and covered to prevent their contamination with the spray. This also allows for thorough coverage of surfaces. Do not replace these items until the spray is dry. Treated surfaces should not be washed or the effectiveness of the treatment will be reduced.

Always combine the use of insecticides with sanitation and exclusion, apply dusts or use bait stations, alternate the types of active ingredients and formulations that are used, or use insecticides, such as boric acid, that do not repel cockroaches or for which cockroaches have not developed resistance.

If you wish to avoid sprays and aerosols completely, a thorough vacuuming with a HEPA or triple filter

vacuum cleaner followed by the use of boric acid dust in cracks and crevices and a baiting program can effectively control severe infestations.

Follow-Up

After a cockroach control program has been started, evaluate the effectiveness of the methods that are being used. 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.

When cockroach populations are under control, continue monitoring with traps on a regular basis to make sure reinfestation is not taking place. Main-

tain 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 or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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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.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse the containers. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

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