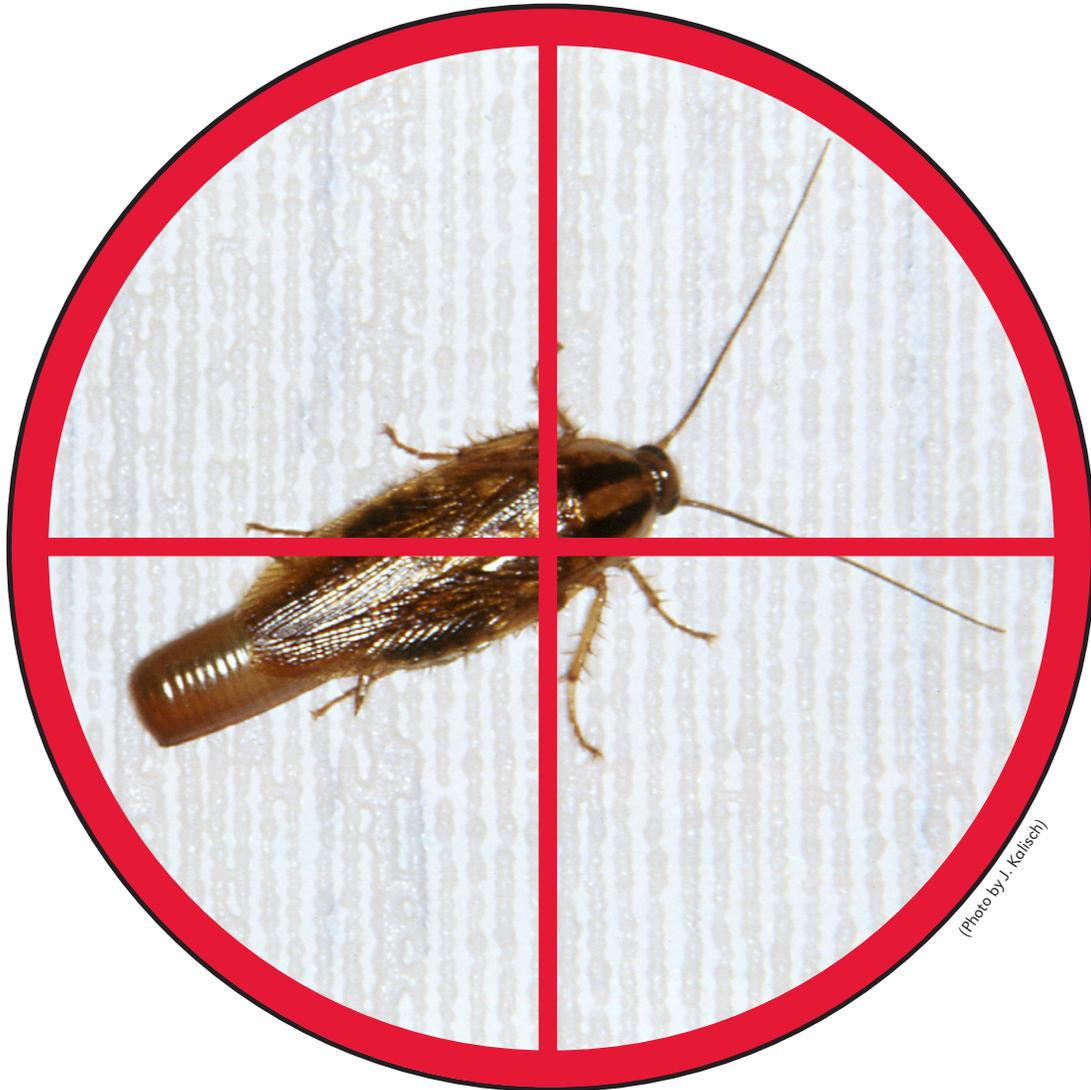


# **COCKROACH CONTROL MANUAL**



*(Photo by J. Kelisch)*

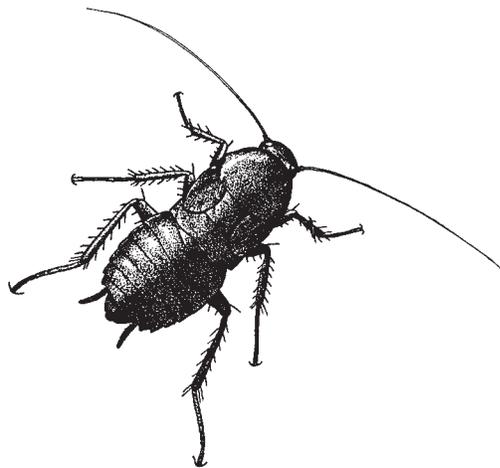
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**Dennis Ferraro, Extension Educator, Douglas & Sarpy Counties**



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# Table of Contents

1	Chapter 1: Introduction
5	Chapter 2: Know Your Enemy
9	Chapter 3: Cockroach Biology
15	Chapter 4: Locate Problem Areas
23	Chapter 5: Primary Control Strategies: Modify Resources
31	Chapter 6: Low-Risk Control Strategies
37	Chapter 7: Insecticide Basics
45	Chapter 8: Insecticides and Your Health
53	Chapter 9: Insecticide Applications
59	Chapter 10: Putting a Management Plan Together



## Preface

It has been more than 10 years since the first edition of the Cockroach Control Manual was completed. While the basic steps for effective and safe cockroach control are still the same, there are more types of control products available than there were 10 years ago. This means you have even more choices in your arsenal to help fight roaches.

The *Cockroach Control Manual* is a practical reference for persons who have had little or no training in insect identification, biology or control methods. We know most people want low toxic methods used inside their homes so we are emphasizing low-risk strategies even more than in the original edition.

We have read enough scientific literature to understand just how easy it would have been to overwhelm you with technical information. Our goal is to translate scientific jargon into everyday English so this manual is easy to read and understand. If you study this manual from cover to cover, you will be able to better understand cockroach biology and behavior and will be able to conduct a successful cockroach control program.

## Author Biographies

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Special thanks to Erin Bauer, Christine Weitzel and Karen Wedding who reviewed parts of this second edition and provided valuable guidance, suggestions and contributions.

### Chapter 1 Introduction

- Fig. 1-1 "Oh oh....Looks like this is gonna be tougher than I thought!" (Jim Kalisch)  
 Fig. 1-2 Child with aspirator (Barb Ogg)

### Chapter 2 Know Your Enemy

- Fig. 2-1 "Contrary to popular opinion, not all cockroaches look the same." (Ami Sheffield)  
 Fig. 2-2 German cockroach live cycle, similar to other cockroach species (Clyde Ogg)  
 Fig. 2-3 Structures of a cockroach body (USDA)  
 Fig. 2-4 Common cockroaches of the Northern U.S. (Jim Kalisch)

### Chapter 3 Cockroach Biology

- Fig. 3-1 "Eeek!...A cockroach in our dinner! Smash it, honey, smash it!" (Jim Kalisch)  
 Fig. 3-2 German cockroach line drawing (Conn. Agr. Exp. Sta.)  
 Fig. 3-3 Reproductive potential of the German cockroach (Clyde Ogg)  
 Fig. 3-4 Brownbanded cockroach male line drawing (Arwin V. Provonsha)  
 Fig. 3-5 Oriental cockroach male and female line drawing (Conn. Agr. Exp. Sta.)  
 Fig. 3-6 Oriental cockroach reproduction cycle (Clyde Ogg)  
 Fig. 3-7 American cockroach line drawing (Conn. Agr. Exp. Sta.)  
 Fig. 3-8 Wood cockroach male (Jim Kalisch)  
 Fig. 3-9 Fecal comparison of German, brownbanded, oriental and American cockroaches (Clyde Ogg)

### Chapter 4 Locate Problem Areas

- Fig. 4-1 "Cockroaches are easily transported from infested dwellings to new places." (Ami Sheffield)  
 Fig. 4-2 German cockroaches and fecal specks on a door frame, under calendar (Barb Ogg)  
 Fig. 4-3 "Come and get it!" (Ami Sheffield)  
 Fig. 4-4 Roach specks in mail holder. (Barb Ogg)  
 Fig. 4-5 Cockroaches in the tight space of a door jam (Vicki Jedlicka)  
 Fig. 4-6 Sticky trap placement (Clyde Ogg)  
 Fig. 4-7 Diagram of trap placements for a hypothetical cockroach infestation (Jim Kalisch)

### Chapter 5 Primary Control Strategies: Modify Resources

- Fig. 5-1 "I admit I seen a few waterbugs, but I got no cockroach problems." (Jim Kalisch)  
 Fig. 5-2 Rhonda the roach, searching for a place to live. (Ami Sheffield)  
 Fig. 5-3 Carrying capacity (Clyde Ogg)  
 Fig. 5-4 Cockroaches live most comfortably in tight places (Jim Kalisch)

- Fig. 5-5 Pulling out a refrigerator drip pan (Vicki Jedlicka)  
 Fig. 5-6 "Yikes" (Soni Cochran)  
 Fig. 5-7 Vacuuming to remove food particles, cockroaches and cockroach specs (Vicki Jedlicka)  
 Fig. 5-8 German cockroach and feces near stacks of papers (Barb Ogg)  
 Fig. 5-9 Caulking cracks and crevices with a caulk gun (Clyde Ogg)  
 Fig. 5-10 Cockroaches in void areas of a drawer (Clyde Ogg)

### Chapter 6 Low Risk Control Strategies

- Fig. 6-1 "Brrrr! It's really cold in here!" (Christine Cepuran)  
 Fig. 6-2 Female German cockroach and nymphs caught in a sticky trap (Chris Arne, J.C. Ehrlich & Co.)  
 Fig. 6-3 Cockroach running from a vacuum cleaner (Ami Sheffield)  
 Fig. 6-4 Dead cockroach (Jim Kalisch)  
 Fig. 6-5 Cockroach with crinkled wings (Clyde Ogg)  
 Fig. 6-6 "This stuff really works" (Ami Sheffield)

### Chapter 7 Insecticides

- Fig. 7-1 Effect of sanitation, habitat modification and control measures on cockroach populations (Chris Arne, J.C. Ehrlich & Co.)  
 Fig. 7-2 Gel bait application and cockroaches feeding on gel bait (Vicki Jedlicka)  
 Fig. 7-3 Application of dust; dust covered German cockroach (Vicki Jedlicka)  
 Fig. 7-4 Ready-to-use sprays (Barb Ogg)  
 Fig. 7-5 *San Diego Union* article about an explosion caused by too many foggers (*San Diego Union Tribune*, Joe Hughes, photo John Gibbons)  
 Fig. 7-6 Dead cockroaches (Jim Kalisch)

### Chapter 8 Insecticide and Your Health

- Fig. 8-1 "Let me assure you, ma'am, that these chemicals are perfectly harmless." (Jim Kalisch)  
 Fig. 8-2 Basic applicator's uniform (Barb Ogg)  
 Fig. 8-3 Goggles will protect eyes (Barb Ogg)  
 Fig. 8-4 Wear a dust mask to avoid inhaling dusts (Barb Ogg)

### Chapter 9 Insecticide Applications

- Fig. 9-1 Gel bait application (Barb Ogg)  
 Fig. 9-2 Bellows duster application (Clyde Ogg)  
 Fig. 9-3 Aerosol crack and crevice application (Barb Ogg)

### Chapter 10 Putting a Management Plan Together

- Fig. 10-1 "Glenn's management plan seems to be missing something" (Jim Kalisch)  
 Fig. 10-2 Home remedies (Ami Sheffield)  
 Fig. 10-3 Ultrasonic devices don't work (Ami Sheffield)

**References to products or companies in the publication are for your convenience and are not an endorsement over similar products or companies.**

**You are responsible for using insecticides according to the current label directions and federal and state laws. Follow label directions exactly to protect the environment and people from insecticide exposure. Failure to do so violates the law.**



Figure 1-1. "Oh oh! ... Looks like this is gonna to be tougher than I thought!"

# Chapter 1

## Introduction

There are over 3,500 cockroach species existing in the world. Thank goodness, only four species live and breed in the northern United States! These four species: the German, brownbanded, oriental (a.k.a., waterbugs), and American cockroaches, are world travelers, living with humans nearly everywhere across the globe.

The presence of cockroaches in the home causes distress to home and apartment dwellers. Part of the distress is because many people dislike any “bugs” in the home. In addition, there is a false belief that cockroaches only live in dirty homes, so there is a negative stigma attached to having them. Many people are embarrassed to admit they share their living quarters with cockroaches.

The simple truth is cockroaches live in dwellings belonging to all ethnic groups and all economic classes of people. Sloppy housekeeping does not automatically mean a person will have an infestation; likewise, immaculate housekeeping does not exempt you from having cockroaches. Because they are usually brought into non-infested residences through human activities, even clean homes can get cockroaches.

However, a clean and tidy home will not sustain as many cockroaches as an identical home which is cluttered and dirty, because there is less food for the cockroaches to eat and fewer hiding places. Other factors like humidity, drippy faucets and other water sources are very important in influencing infestation levels. You will learn how to modify these factors to suppress your cockroach infestation in Chapter 5.

### Cockroaches and Human Health

**Food Poisoning.** Did you know cockroaches have been implicated in cases of *Salmonella* food poisoning? They can also carry *Staphylococcus*, *Streptococcus*, coliform and other bacterial pathogens on their bodies.

The main reason cockroaches harbor and transmit disease pathogens is they will eat just about anything, including discarded food in our kitchen trash can and cat feces in the litter box. After feeding, disease bacteria can remain in the cockroach digestive system for a month or more. Later, human food or utensils can become contaminated with cockroach feces. Cockroaches can mechanically transfer germs by crawling over bacteria-laden substances and later walking over dishes and eating utensils.

**Allergies and Asthma.** Some people are allergic to cockroaches. In infested homes, proteins in crushed cockroach body fragments and feces become a component of house dust. After inhaling dust in a cockroach-infested home, sensitive children and adults develop allergic symptoms similar to those of hay fever: runny nose, itchy eyes and sneezing.

Some people who are allergic to cockroaches may develop asthma, which can be a life-threatening medical condition. Asthma is a chronic lung disorder characterized by obstruction of airways. Symptoms of asthma include coughing, wheezing and difficulty in breathing. The most severe



(B. Ogg)

Figure 1-2. Cockroach allergen, found in cockroach body fragments and feces causes asthma in sensitive individuals

asthmatic attacks can lead to death.

**Cockroach-Induced Asthma.** An estimated 20 million Americans have asthma which has greatly increased in the last few decades. There are ethnic differences in the incidence and mortality associated with asthma. Children who live in inner city, high-density housing, particularly African American and Hispanic children, are more likely to have asthma. Although asthma may have several potential causes, cockroach allergens in the indoor environment are a major asthma trigger. Research has shown 23 to 60 percent of urban dwellers with asthma were allergic to cockroaches.

About 50 percent of asthma cases are caused by allergies. Studies have shown most asthmatics who are allergic to cockroach allergens will have an asthma attack after a single inhalation of allergens. Other potential asthma triggers include dust mites, animal dander, mold and tobacco smoke. People with asthma may react to more than one allergen so identifying and reducing exposure to all allergens are needed to manage asthma effectively.

For people who are sensitive to cockroach allergens, steps to reduce or eliminate cockroach populations will help reduce exposure to allergens and may prevent asthma attacks.

## Can I Control Cockroaches Myself?

You may be asking yourself, “Can I treat my home for cockroaches, or do I need an exterminator?” A pest control service can be useful for part of your cockroach control program, especially if you have a severe infestation and/or do not want to handle insecticides. The safe use of insecticides also requires proper protective clothing and may require some specialized equipment.

The main advantage of doing-it-yourself is the cost savings. Another advantage is you know your home better than a stranger does. For instance, you know where the harborage areas are, and, because you are there more often, you are better able to monitor progress and evaluate control efforts. In addition, insecticide treatments are only one aspect of cockroach control, and pest control firms may not emphasize other important tactics needed for

effective control.

Did you know most insecticides registered for cockroach control are *general use* insecticides? General use insecticides can be used without special training, although it is still important to read and follow label directions. Some manufacturers have labeled their cockroach control insecticides “*for use only by certified applicators*,” which means you cannot use them unless you have taken training and passed a state-licensing examination. Most professional-use products are marketed to pest control professionals so these products will not be found in supermarkets, hardware or discount stores where you might first go to purchase them. But, there are very effective products—some even identical to those sold to the professional—you may be able to find locally.

Whether you wish to do-it-yourself or hire a professional, you need to know what products are most effective and how to use them safely and effectively. You will learn about them in Chapters 6-9 of this manual. But, do not skip over Chapters 2-5. In these chapters, you will learn the tricks-of-the-trade to make your control program a success.

## Multiple Tactics Approach

Because cockroaches are very adaptable, the most effective type of cockroach control includes using several methods at the same time to reduce cockroach populations. Agricultural pest management specialists have used this approach for years. This multiple tactics approach is called *Integrated Pest Management* or IPM.

The basic components of IPM are:

- 1) Identify the pest.
- 2) Understand the biology and behavior of the pest.
- 3) Determine if control is needed.
- 4) Identify all appropriate control measures for the specific situation, including non-chemical and chemical measures.
- 5) Implement safe and effective control tactics.
- 6) Evaluate the control efforts.

When managing cockroaches, this IPM approach includes monitoring suspected infestation areas before treatments to find out the pest species and where the infestation is located.

Later on, you'll want to monitor the same areas to see how successful your control program has been. Preventing entry, using good sanitation practices, sealing cracks and crevices, careful placement of baits, using insect growth regulators with low-toxic insecticides are tactics which will get a cockroach problem under control.

Regardless of whether you decide to do-it-yourself or hire a pest control company to help you with the insecticide treatments, this handbook will present the basic control tactics needed to suppress cockroaches in your dwelling. If all control tactics are used, significant reductions in a cockroach population can be made. Eradication is even possible.

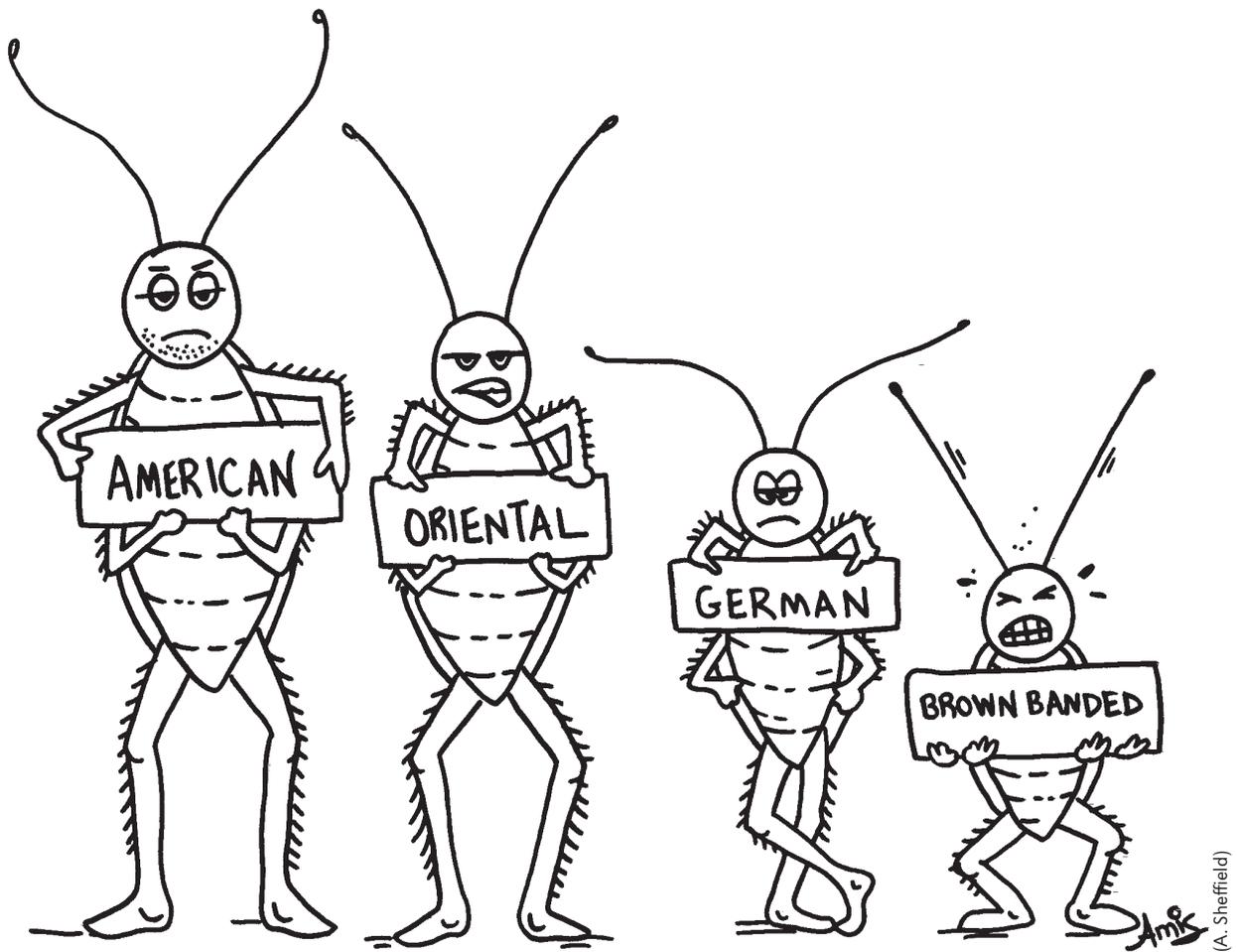


Figure 2-1. Contrary to popular opinion, not all cockroaches look the same.

# Chapter 2

## Know Your Enemy

The first step in insect control is to know what pest you are dealing with. Each domestic cockroach species prefers a different area in a residence, so identification is important for best control. A cockroach infestation has individuals of different sizes, including reproducing adults with wings (usually) and immature individuals without wings. Unlike some insects, butterflies for example, immature and adult cockroaches live in the same habitat and eat the same foods.

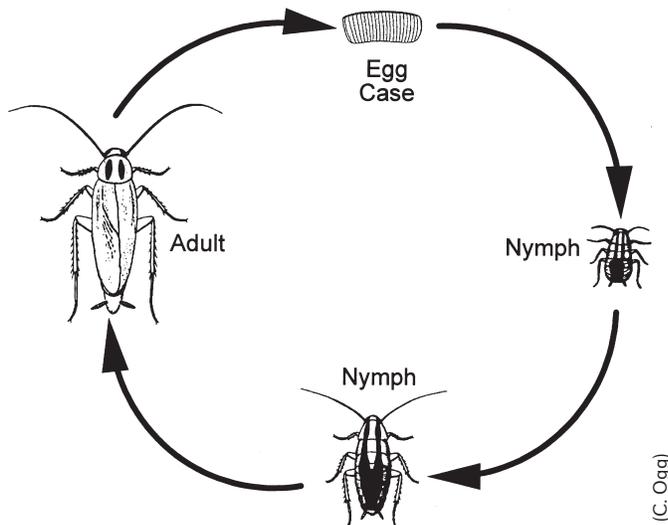


Figure 2-2. German cockroach life cycle, similar to other cockroach species.

Immature cockroaches, called *nymphs*, are smaller than *adults*, and hatch from *egg cases* the adult female deposits. As the nymph grows, it sheds its “skin” or *exoskeleton* so it can get larger. Each nymphal stage is larger than the previous one, and the adult emerges after the last nymphal stage. Figure 2-2 shows the life cycle (egg, nymph and adult) of the German cockroach. Although only two nymphal stages are shown, the German cockroach has at least six. Each cockroach species has a unique number of immature stages (see Chapter 3).

All stages can be identified, but features of adults are larger and more distinctive, so we will concentrate on identifying adults. Identification is

not difficult, but you must recognize features on the cockroach body. Refer to the body parts of a cockroach adult in figure 2-3.

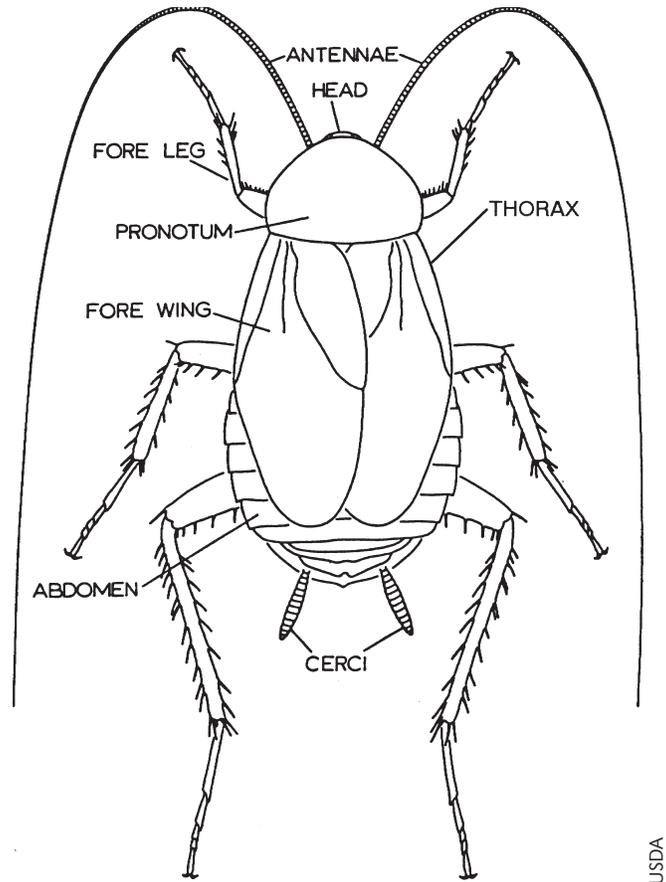


Figure 2-3. Structures of a cockroach body.

**Head.** On the head, cockroaches have chewing mouthparts used to chew or scrape off food too large for them to swallow whole. Cockroaches have a pair of compound eyes, but have poor vision except they can distinguish easily between light and dark. You have probably noticed these pests are nocturnal, (active at night and hidden during the day) because they are repelled by light. Another structure on the head, is a pair of long, well-developed antennae, sensory organs used to detect odors and vibrations in the air. Inside the head is a small brain which coordinates the various body functions.

**Thorax.** On the thorax, all cockroaches have three pairs of legs. Adults of most of the domestic species have two pairs of wings, although one species, the oriental cockroach, has poorly-developed wings in both sexes. Even the winged species are poor flyers, but have excellent running abilities. Many species of cockroaches can defy the law of gravity and crawl across the wall or ceiling.

There is a large plate-like structure on the thorax, just behind the head. This structure, the *pronotum*, has color patterns which distinguish several cockroach species, so it is an important anatomical feature.

**Abdomen.** The abdomen of the cockroach houses the reproductive system. The eggs are enclosed in a tough egg case which protects them from drying out. The female of one species, the German cockroach, carries the egg case around with her until the eggs are nearly ready to hatch. See Table 2-1 for common locations eggs of each species may be found. Cockroaches show no parental care and may be cannibalistic, eating their young if no food is available. They eat injured and

dead cockroaches, too.

On the end of the abdomen, there is a pair of *cerci*, projections which are sensory organs. Cerci function in a similar manner to antennae, sensing vibrations through air or ground. Cerci are directly connected to the legs of the cockroach via abdominal nerve ganglia (a sort of secondary brain), which is an important survival adaptation. Whenever a cockroach “feels” a presence with its cerci, its legs start running, even before the brain receives the signal. Once a cockroach is running, you have to be pretty fast to step on it.

## Identify Your Roaches

Use the following pictures or those on the back cover, to identify your roaches. If you find an odd looking cockroach, take it to an entomologist for identification. Remember, this manual only discusses the most common cockroaches found in the northern states. Southern states have all these cockroaches plus some others.

Table 2-1. Characteristics of common domestic cockroach species

Roach Species	Length	Color and Markings	Eggs <sup>1</sup>	Egg to Adult	Reproductive Characteristics
<b>German</b> ( <i>Blattella germanica</i> )	9/16 in. (14 mm)	Light brown with two dark stripes on the pronotum	37	55-68 days	Female carries egg case until about 24-hours before hatching, then drops it in a secluded place.
<b>Brownbanded</b> ( <i>Supella longipalpa</i> )	9/16 in. (14 mm)	Tan-golden with faint V-shaped lighter bands on wings	16	95-276 days	Egg case glued undersurface of objects, shelves, furniture in crevices.
<b>Oriental</b> ( <i>Blatta orientalis</i> )	1 - 1-1/4 in. (32 mm)	Dark red-brown-black	14	300-800 days	Egg case deposited in debris or food in a sheltered place.
<b>American</b> ( <i>Periplaneta americana</i> )	1-1/2 in. (38 mm)	Reddish brown throughout with a pale band on the edge of the pronotum. A very large roach.	14	285-616 days	Egg case carried up to six days before depositing in a sheltered area.

<sup>1</sup>Average number per egg case. The number actually hatched can be fewer.



(J. Kalisch)

German cockroach



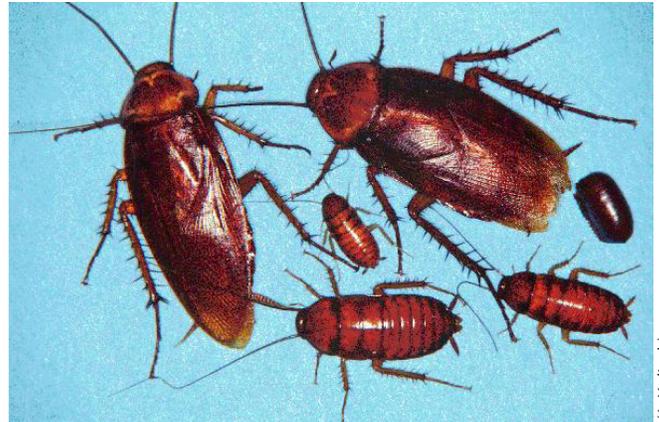
(J. Kalisch)

Brownbanded cockroach



(J. Kalisch)

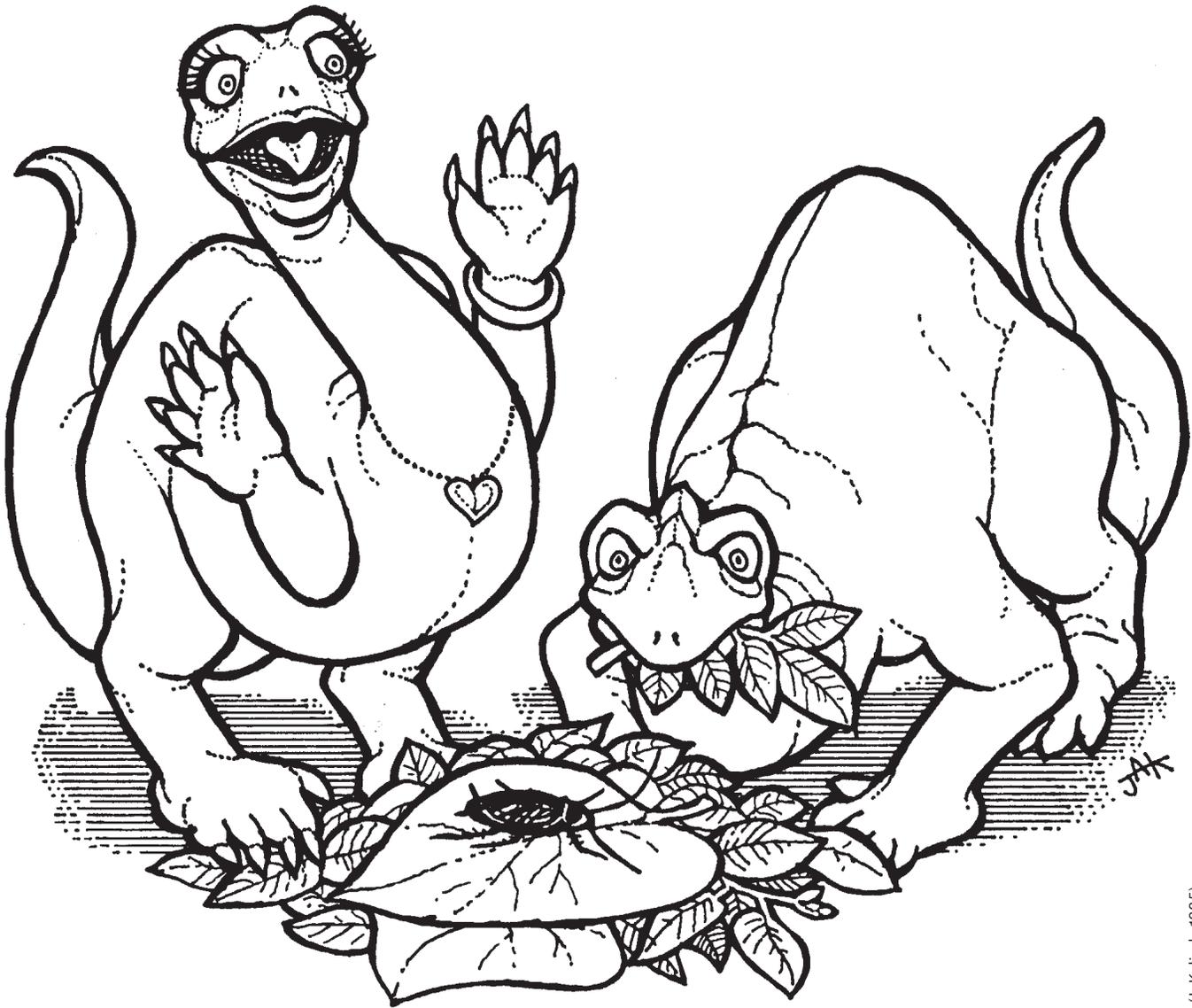
Oriental cockroach



(J. Kalisch)

American cockroach

**Figure 2-4. Common cockroaches of the northern U.S.**



(J. Kalisch 1995)

Figure 3-1. "Eeek!...A cockroach in our dinner! Smash it, honey, smash it!"

## Chapter 3

# Cockroach Biology

Cockroaches are very primitive insects. Their ancestors lived 200-350 million years ago in the Carboniferous Period, even before the dinosaurs. This geological period is sometimes called the “Age of Cockroaches” because they were so abundant. At this time, the climate on the earth was warm and moist, ideal conditions for them to thrive. Although climatic conditions are cooler and less humid now, present-day cockroach species are surprisingly similar to those preserved in fossils from the distant past.

### Living Requirements

In general, cockroaches adapted to living with people need four things to successfully live in a home. They need water, food, shelter and warmth. When we go about our daily activities (cooking, eating, bathing), we provide these requirements, which is why cockroaches survive so well with us. Cockroaches generally will not survive very well in a vacant home. Different cockroaches have slightly different requirements, which will be helpful in knowing where to inspect and later, focus your control efforts.

### Life Cycle, Behavior and Habitat

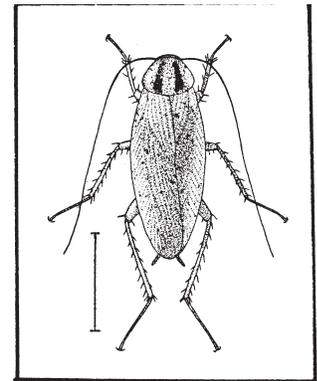
The cockroach is exceedingly hardy. It thrives on only crumbs and can survive a couple weeks without food or water. Cockroaches often live in cracks and crevices so small we can easily overlook them. Because they are such good survivors, it is essential to have a basic understanding of the cockroach life cycle, behavior and habitat before attempting any control tactic. Information about how long cockroaches live, and the number of eggs they produce is called their *life cycle*. Habits or things they do during their entire life cycle can be thought of as *behavior*. The place where cockroaches live and eat is called their *habitat*. The

life cycle, behavior and habitat of each cockroach species will be described in detail.

### German Cockroach (*Blattella germanica*)

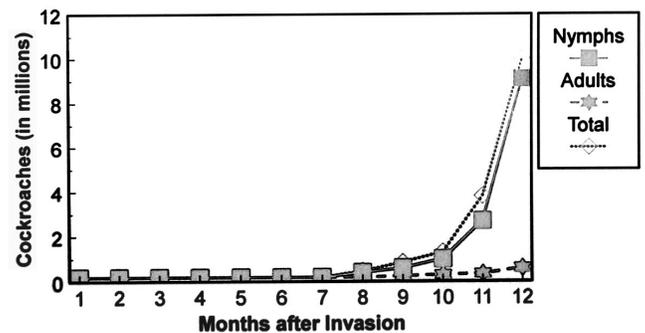
**Life Cycle.** The German cockroach has a tremendous capacity to produce offspring. A female German cockroach produces an egg case (the scientific term is ootheca) containing 30-40 eggs. The female carries this egg case for about three weeks until the day the eggs hatch. She then goes into hiding before dropping her egg case. This behavior reduces possible harm to the female and her eggs. The immature German cockroaches (nymphs) grow fast when conditions are favorable. Nymphs emerging from the egg cases will molt (shed their skins) six or seven times in about 60 days. After the last molt, adult cockroaches emerge fully winged and sexually mature.

The female German cockroach can produce as many as eight egg cases and more than 300 offspring! If half of the nymphs are females, and each of them



(Conn. Agr. Exp. Sta.)

Figure 3-2.



(C. Ogg)

Figure 3-3. Reproductive potential of the German cockroach.

produces 300 nymphs, and if half of those nymphs are females, and they each produce 300 nymphs. . . I think you begin to get the idea! It is theoretically possible for one female German cockroach to produce more than 100,000 cockroaches in one year! (Figure 3-3)

**Behavior and Habitat.** German cockroaches gather, or *aggregate* in warm, humid, dark places near food and water. They like porous surfaces like wood, paper or cardboard better than nonporous surfaces like metal. Cockroaches “mark” these porous surfaces with an aggregation pheromone, found in their feces. A *pheromone* is a chemical produced by one cockroach which affects the behavior of others. This aggregation pheromone attracts other cockroaches, especially the tiniest immature stages, which usually stay in these hidden places until they are larger. These tiny cockroaches don’t need to venture into the outside world for food because they feed on the feces of the adults. Examples of gathering places are cracks and crevices of counter tops, wooden cabinets, in wall and ceiling voids, in and around refrigerators, dishwashers, stoves, washers and dryers and water heaters.

German cockroaches have a high water requirement and are most likely to be found infesting kitchens and bathrooms. If food, water and shelter are available, the cockroach population can multiply rapidly when temperatures are warm. When any one of these resources is limited or is eliminated, populations can’t grow and may even decline.

**Inspections.** Look for German cockroaches (alive or dead), droppings (see Figure 3-10), shed or cast off skins and empty egg cases. Concentrate your efforts on undisturbed areas of high humidity where water is found (kitchens and bathrooms). Use sticky traps to detect infestations and help estimate the size of the cockroach problem (Chapter 4).

## Brownbanded Cockroach (*Supella longipalpa*)

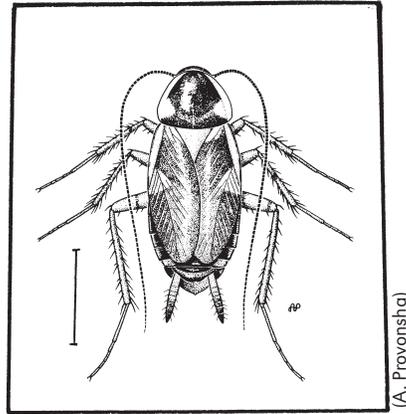


Figure 3-4.

(A. Provansha)

**Life Cycle.** The egg case, containing 13-18 eggs, is glued to inconspicuous places in the habitat, such as on furniture, behind picture frames, walls and ceilings. Egg cases hatch in about 50 days. In her lifetime (approximately six months) the female brownbanded cockroach can deposit as many as 14 egg cases. Nymphs molt six to eight times over a five- to six-month time span, before emerging as sexually mature winged adults. Male brownbanded cockroaches readily fly when disturbed.

A single, female brownbanded cockroach has the potential to produce about 250 offspring. But, because of the long time required for nymphs to grow into sexually mature adults, large populations are not produced as quickly as those of the German cockroach. In addition, because the egg cases are glued to objects in the environment, they are susceptible to drying out, attack by fungi and other mortality factors which all contribute to a low-hatch rate. Brownbanded cockroach infestations are less common than German cockroaches.

**Behavior and Habitat.** Brownbanded cockroaches build up their highest populations in high temperature areas. They do not need as much water as German cockroaches, so they often thrive in drier locations. They are often found in locations at eye-level or above, such as in cabinets, around closet shelves, behind pictures, in warm areas near motors of refrigerators, electric clocks, timers and television sets. Other favorite habitats are around the braces of kitchen chairs and tables, around objects on the wall and in shower stalls. Their egg cases can be found attached to rough surfaces like walls and textured ceilings but can also be found around the kitchen sink, desks, tables and other furniture (Figure 3-5).

**Inspections.** Inspections are similar to those for German cockroaches, but also look for droppings, cast skins, alive or dead individuals and egg cases glued to places in higher and drier areas. Because brownbanded cockroaches take longer to develop and hatch eggs, have such a long development and egg-hatching time, long-term monitoring is especially important.



Figure 3-5. A localized brownbanded infestation was noticed in an office cubicle. The office worker ate lunch at her desk and left food waste in her trash can overnight. She also left partially eaten hard candy in her desk drawer. An inspection of her cubical revealed brownbanded cockroaches infesting her telephone. The warmth from the telephone and food left in the desk encouraged this localized infestation. This photo shows brownbanded egg cases and feces on the underside of the telephone.

## Oriental Cockroach (*Blatta orientalis*)

**Life Cycle.** A female oriental cockroach produces fewer offspring than either the German or the brownbanded females. She can produce up to eight egg cases in a season, but in areas where the winters are cold, like in Nebraska, fewer egg cases (as few as one per year) are produced. The number of offspring may be as low as 16, the number of eggs in a perfectly formed egg case.

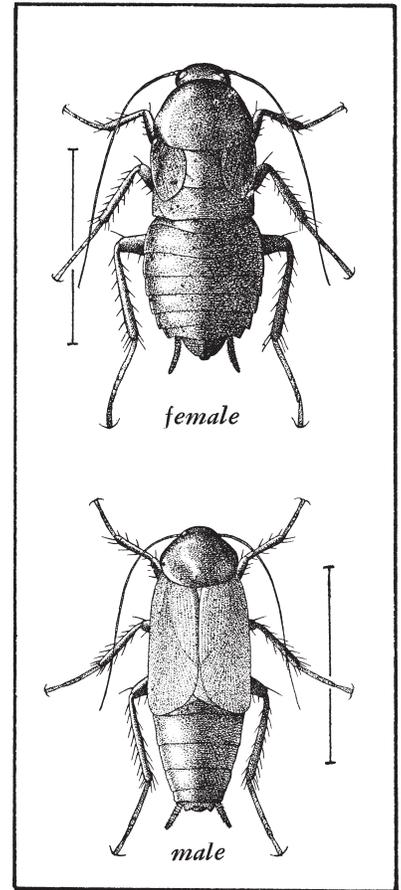


Figure 3-6.

(Conn. Agr. Exp. Sta.)

Within two days after the egg case is produced, it is placed in a sheltered area containing abundant food. In about two months, nymphs emerge and are most active from spring until midsummer. In early spring, only adult oriental cockroaches are found; by late spring nymphs are abundant, and the adults begin to die off. By fall, most individuals are adults (Figure 3-7).

As with the brownbanded species, egg cases are susceptible to drying out, attack by fungus and cannibalism by other cockroaches, if other food is scarce.

**Behavior and Habitat.** Oriental cockroaches are sometimes called “waterbugs” by people who don’t realize they are a type of cockroach. This nickname reflects their affinity for humid, moist locations. Oriental cockroaches differ from the other three species, because it can live outdoors in

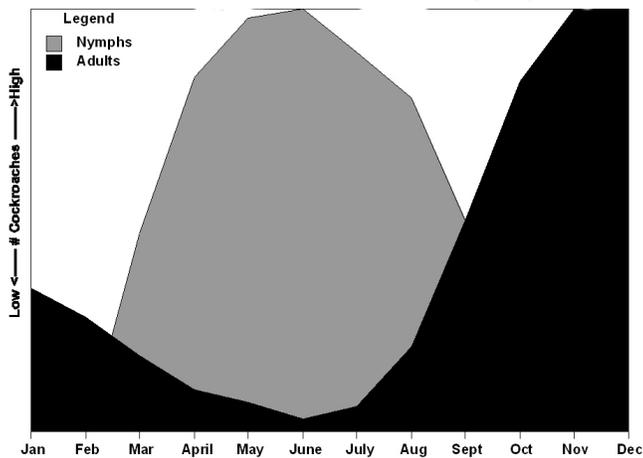


Figure 3-7. Relative number of Oriental cockroach reproduction cycle, showing relative numbers of nymphs and adults during a calendar year.

the northern U.S. Outdoors, oriental cockroaches are found where there is high organic matter, like wood chips or mulch, between soil and the foundation, underneath patio bricks and sidewalks. They sometimes aggregate under garbage cans. During hot, dry periods, they may move indoors to find locations more moist and humid. Indoors, they will be found in basements, especially in cool, damp locations like bathrooms and floor drains. Crawlspace may be infested with oriental cockroaches which may invade homes.

**Inspections.** Infestations will generally be found in areas of high humidity and cool temperatures, generally basements or lower floors. If you repeatedly see oriental cockroaches on upper floors, search for a hidden moisture problem.

In basements, infestations of these insects can sometimes be located by examining spider webs. In homes without basements, crawlspaces may be the source of oriental cockroaches. In kitchens and bathrooms, look around sinks and bathtubs and check plumbing for leaky pipes. Oriental cockroaches produce large fecal smears indicating moister feces (Figure 3-10), live or dead cockroaches and egg cases. Low populations of oriental cockroaches may exist in a home, but home dwellers may only observe these cockroaches for a month or two in the spring when they are most active. Beware! Oriental cockroach numbers observed in the spring may appear low or under control, only to buildup by midsummer.

## American Cockroach (*Periplaneta americana*)

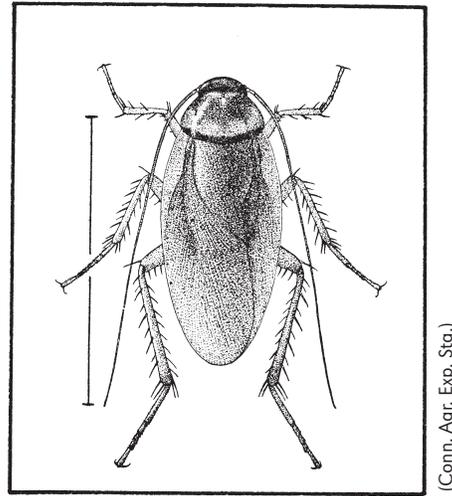


Figure 3-8.

**Life Cycle.** The American cockroach egg case contains 14-16 eggs. Nymphs emerge in about six weeks and undergo 13 molts over the next 18 months, before reaching the sexually mature adult stage. During warm conditions, adult females produce an egg case in about one week and can live more than a year.

American cockroaches seem to have a tremendous potential for producing offspring. But because of cold winters in northern states, American cockroaches develop at a slower rate and produce fewer offspring than in southern states.

**Behavior and Habitat.** American cockroach females glue or place their egg case in locations where offspring are likely to survive. In northern states, American cockroaches are abundant in many cities' sewer systems. They can also be found in commercial establishments like restaurants, grocery stores, bakeries and other places where food is prepared or stored. They are most common in boiler rooms, heated steam tunnels, basements around pipes and around water heaters and wet floor drains. American cockroaches can coexist with German cockroaches.

**Inspections.** American cockroaches are less common in northern states than German and oriental cockroaches. Look for American cockroaches in areas of warmth and high humidity. American cockroach feces may be almost as large as mouse droppings. American cockroaches

are known as “born inebriates,” their desire for fermenting liquids is often very strong. There are many examples of restaurants or bar owners finding American cockroaches in partially empty beer bottles. Bread soaked with beer can be used to attract them. Ongoing inspections, including trapping, are very important because of the long life-span of this cockroach.

## Wood Cockroaches (*Parcoblatta spp.*)

**Behavior and Harborage.** Wood cockroaches live in rotted logs, tree stumps, hollow trees, stopped-up rain gutters and in piles of fire wood. Males and females differ greatly in appearance. Wingless females look similar to oriental cockroaches, but are hardly ever seen. A clear area on the outside of the



(J. Kalisch)

Figure 3-9.

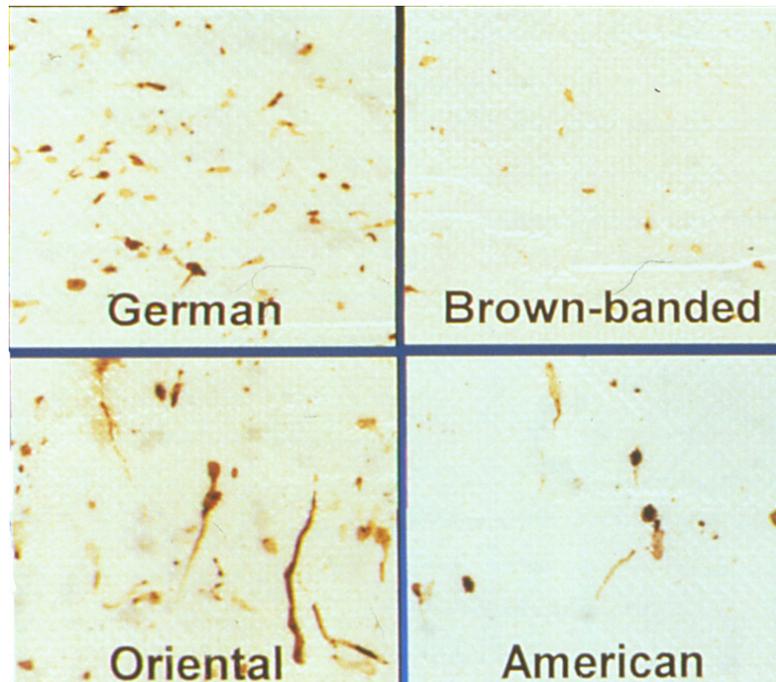
pronotum and margins of the wings differentiate them from domestic cockroaches.

Winged males take flight during late spring in search of females. Males are attracted to light and sometimes accidentally invade homes, where they soon die. Wood cockroaches rarely, if ever breed inside. The best control method is exclusion, by sealing gaps around screens, doors and windows. No chemical control is necessary.

## Comparing Cockroach Feces

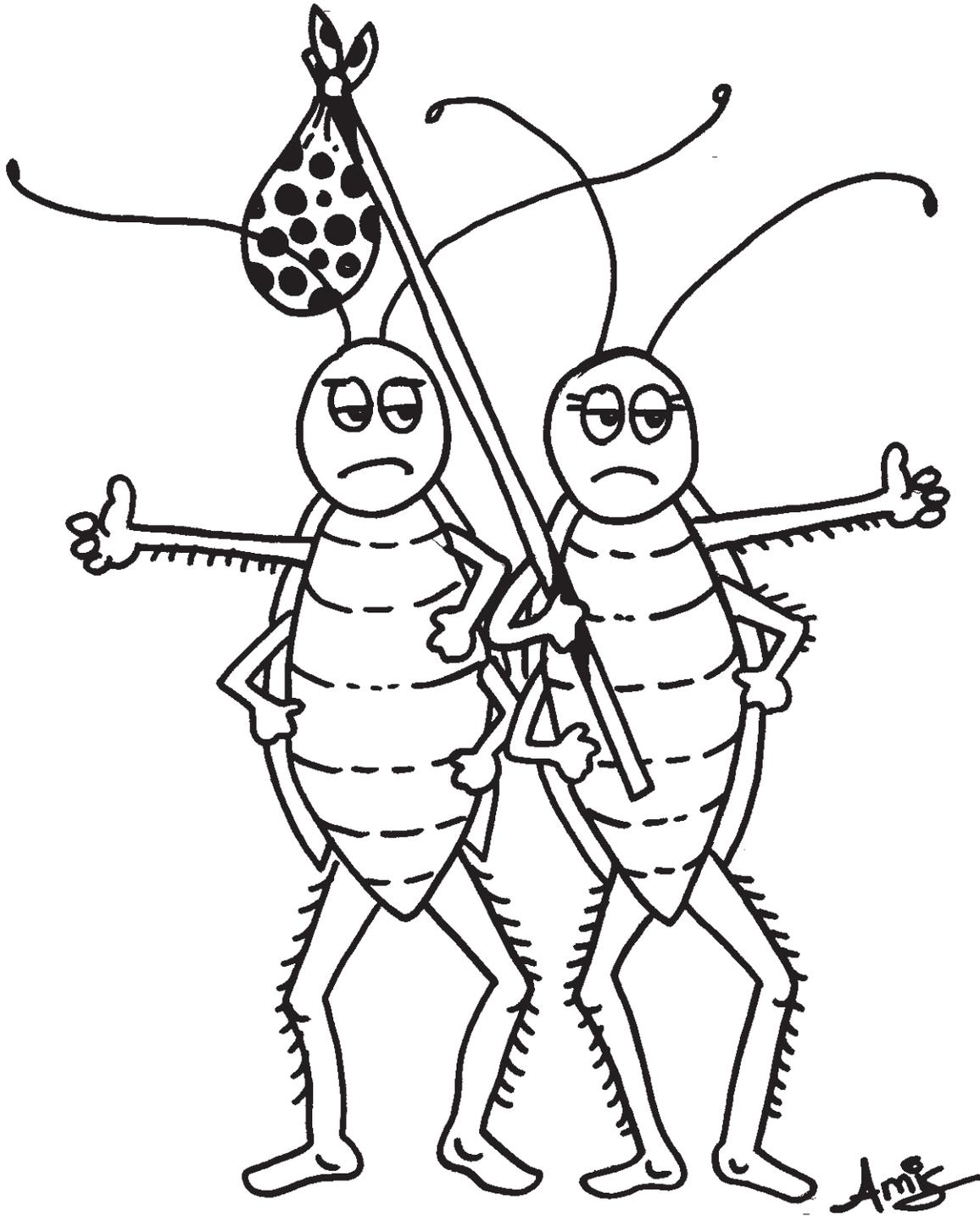
Entomologists sometimes do odd things to teach about their science. We confined healthy cockroaches in petri dishes, with filter paper on the bottom of the dish. The photos below are what their feces looked like after 24 hours.

What conclusions can be made from this comparison? Not surprisingly, small cockroaches have smaller roach feces than large cockroaches. Cockroaches preferring moist places like German and oriental cockroaches have more liquid feces.



(C. Ogg)

Figure 3-10. Fecal specks and smears of the four domestic cockroaches (enlarged).



(A. Sheffield)

Figure 4-1. Cockroaches are easily transported from infested dwellings to new places

## Chapter 4

# Locate Problem Areas

### How Did I Get Them?

Cockroaches are easily transported from infested dwellings to new places. The cockroaches you have may have “come with the house or apartment,” or you may have brought them with you from the last place you lived. Maybe you brought a gravid (pregnant) German or brownbanded cockroach (or an egg case) home in a grocery bag or in a cardboard box. If you work in a cockroach-infested building, you could easily transport them home if you take anything home with you. Oriental cockroaches can often crawl under the door or enter through cracks in the foundation. Repairs on the sewer system may result in displaced American cockroaches coming into buildings.

Cockroaches also move easily from one apartment to another. It is common for apartment tenants to blame their neighbors for their cockroaches, and in some cases, they may be justified. If a cockroach population in one unit gets large, cockroaches will migrate into nearby units for food and new places to live. Other factors can also cause cockroaches to move. Insecticide treatments may trigger movement to nearby apartments. If the neighbor moves out and the unit is empty, cockroaches will move to find water and food.

Because cockroaches are so easily transported, it is hard to **NOT** move them to your next residence if you move. Cockroaches can live in the little spaces of corrugated cardboard, so just moving boxes can transport them with you. One suggestion is to unpack boxes outdoors or in a garage. Or, use plastic tubs instead of boxes to transport your belongings in.

### Where Are They Living?

The first step is to assess the situation. Inspecting and monitoring are important parts of any pest control strategy. By locating the cockroach infestation first, your controls can be more economical, more effective and less time

consuming. The first and most obvious way of detecting live cockroaches is with a visual “night watch”—observing live cockroaches when the lights are turned on unexpectedly. Another method is to examine suspected areas with a flashlight.

In the course of your inspection, you will be looking for live cockroaches, dead cockroaches, cast skins or cockroach parts. Also look for empty or intact egg cases and roach specks or fecal smears (Figure 3-9 and Figure 4-2). The inspection will help you identify the cockroach, where the infestation is located, the size of the infestation and conditions favoring cockroach survival.



(B. Ogg)

Figure 4-2. German cockroaches and fecal specks on the door frame, under a calendar.

### Inspection Equipment

Proper equipment is essential for conducting an inspection. For inspecting your home or apartment, the following three items are recommended:

1. A flashlight to illuminate dark areas where cockroaches like to hide.
2. A mirror with extension arm (such as a dentist’s) to help see hidden areas, like behind sinks, under refrigerators and appliances.
3. Monitoring traps.

## The Inspection

**Visual Examination.** We will use the inspection of a home or apartment for German cockroaches as an example of how to carry out any cockroach inspection. The principles will be similar for brown-banded, oriental and American cockroaches.

It will be helpful to get answers for the following questions. Where did you first see cockroaches? Where do you see them now? Ask others living in the home the same questions.

Consider past or present professional pest control efforts in your home. If the previous pest control tactics included the use of insecticides with a strong repellent effect (this includes most of those currently used today), the cockroach infestation may have moved from its original location. In this case, you should spend some time exploring locations where insecticides were not used, like false ceilings and other areas above your head.

Before beginning a detailed examination of the area, take an overall look at the premises, inside and outside. Build a picture of traffic patterns for people. In particular, where is food brought in? Where is it prepared? Where is it eaten? How are leftovers and other garbage disposed of? Is the trash emptied in a timely manner? Perhaps the cockroaches hitchhiked into the kitchen with food supplies. Consider food storage and related activities, such as recycling bins and cardboard boxes. Could these be encouraging the problem? If introduction with food is confirmed, try to identify where the cockroaches originally came from.

Could cockroaches have been brought into the residence by someone who works in infested buildings? Are there college kids who frequently move between apartments and home? These are easy ways to move cockroaches into residences from infested buildings.

In apartments, the cockroaches may have first entered from outside or from adjoining units. You should check possible entry points such as around water and drain pipes under the sinks, sewer pipes,



Figure 4-3. A single slice of pizza, left on the counter overnight is a feast for cockroaches.

steam supply pipes, conduits for electricity or crevices in walls connecting with other infested areas. Identifying the origin of the cockroaches is valuable from the long-term viewpoint to prevent reinfestation.

***German cockroaches like warm, dark locations near food and water.***

It is helpful to note all those factors favoring German cockroach survival once they have gotten into your home. Since cockroaches need food, look for food sources, such as fresh fruits or vegetables and pet foods. Also, look for food spills or buildup of food material in or under counter tops, stoves and refrigerators. Look in mops and brooms, inside the rims of the floor drain, around the wheels of mobile carts and other similar places. You should also check less obvious food sources, like rodent bait stations, for signs of cockroach activity. Cockroaches aren't killed by rodent baits.

Cockroaches need water as well as food, so check for condensation or leaks providing a water source. Don't forget to consider less obvious sources of water such as planters, pet water dishes and fish tanks.

In addition to food and water, cockroaches need daytime hiding places in which to rest and breed,



(B. Ogg)

Figure 4-4. Cockroach droppings in stacks of mail in letter holder.

and these harborages must be identified during the inspection. Once again, use your knowledge of the target pest to focus your efforts. German cockroaches prefer dark crevices close to moisture. They like bare wooden surfaces, cardboard or paper because these surfaces are easier to climb and because porous surfaces retains their aggregation pheromone. They will also be found in stacks of paper, grocery bags, letters and other paper items (Figure 4-4). Pay particular attention to fixtures made of wood, such as storage shelves, wooden tables and cabinets. Also check behind and under appliances, in the corners of rooms at floor or ceiling level, behind pictures and around the legs or wheels of carts as well as in appliance voids. Don't forget to inspect suspended ceilings.

Sometimes cockroaches become trapped in such things as spider webs, light fittings and partially empty beverage bottles. Look for every clue you can when identifying the problems.

In general, the harder it is to gain access to a potential harborage, the more likely it is to be infested.



(V. Jedlicka)

Figure 4-5. Cockroaches in the tight space of a door jam.

**Trap Placement.** It is now time to use traps to give you a better picture of the size and location of the cockroach infestation. We suggest sticky traps because they are easy to buy and use. Both baited and unbaited sticky traps are available. Baited sticky traps are impregnated with aggregation pheromone and may catch more cockroaches, but



(C. Ogg)

Figure 4-6. Place sticky traps near where you have seen cockroaches or near moisture or food sources.

unbaited ones will work well to locate infestations. Banana extract is another substance attractive to cockroaches. To make your own baited traps, add a few drops of banana extract to the center of the trap.

Make sure to use the same type of traps to make your comparisons valid. Before you position each trap, label the trap so later you will be able to tell where and when it was placed. Place traps near cracks and crevices, moisture or food sources or where you've seen evidence of cockroaches. Dark corners are good locations.

The number of traps you'll need depends upon the extent of the infestation. The more infested locations, the more traps will be needed. Keep in mind you will only catch cockroaches when traps are placed within five to six feet of infested areas, and the closer the trap is to the infested area, the more cockroaches you will catch. When placing traps, consider all possible areas from floor to ceiling. If traps don't catch any cockroaches, move them.

In addition to putting traps in known infestation areas, you must also place enough traps to "cover" the areas of suspected infestation (with German cockroaches this means the kitchen and bathrooms). To accomplish this, first put at least one trap in each of the following locations:

- 1) beside or behind the toilet,
- 2) under the sink in the bathroom,
- 3) beside the shower or bathtub,
- 4) under the kitchen sink,
- 5) behind, under or beside the refrigerator,
- 6) beside, under or behind the stove,
- 7) in the back of each kitchen cabinet,
- 8) beside or under the water heater (if available),
- 9) behind or beside the washing machine,
- 10) behind or beside the automatic dishwasher.

#### Placing Traps in A Hypothetical Kitchen.

This diagram of a kitchen shows suggested places for traps. In this kitchen, we placed more traps than the essential trap placements already discussed. You can never go wrong by using more traps which may give you more information about the infestation to help in your control efforts.

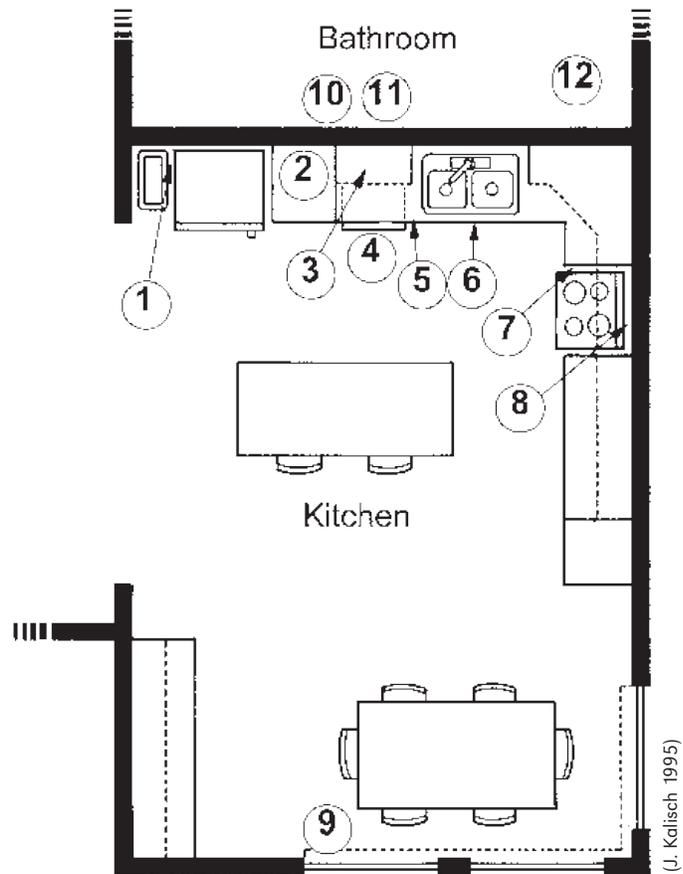


Figure 4-7. Where you should place traps for a hypothetical cockroach infestation.

**Calculating Cockroach Densities.** The length of time you should leave the traps depends on the infestation level. With high infestations, traps may be completely filled overnight. Smaller infestations may require several days to a week or more to catch a significant number of cockroaches. If the sticky trap surface becomes completely covered with roaches, the trap should be removed and replaced because it is no longer effective.

After you get a significant trap catch, record the dates the traps were set out and the collection date on the trap worksheet. Next, check each trap, record the type of cockroaches you have caught and count the total number of cockroaches on each trap. Add counts from each trap to give a grand total. Divide the grand total by the number of traps you used. Divide this number by the number of nights the traps were out. This number is the average number of cockroaches caught per trap per

night. This number can be used to provide a rough estimate of the size of your cockroach population. Refer to Table 1 to determine what your trap count represents. These numbers are relative. For some people, high number of German cockroaches may only be two or three per trap per night. For others, 10-20 cockroaches per trap per night would be considered low.

What can you learn from sticky trap data? First, you should be able to identify the cockroach species.

Second, comparing trap catches will tell you where infestations are located. You can also get an idea of the size of the cockroach population.

**Continue Monitoring.** Even after you have begun control efforts, continue to use sticky traps in the same locations so you can compare populations over time. As before, calculate the number of roaches/trap/night. Doing this will let you evaluate your success.

Table 1. Relative numbers of the four domestic cockroaches placed into low, moderate, high and extremely high categories. These numbers are cockroaches captured per trap each night.

Infestation	German	Brown-banded	Oriental	American
Low	0-5	0-3	0-1	0-1
Moderate	5-20	3-10	1-10	1-10
High	20-100	10-50	10-25	10-25
Very High	100+	50+	25+	25+

## Hypothetical Cockroach Trap Worksheet

**Cockroach Species:** German  
**Date Installed:** September 10  
**Date removed:** September 11  
**Trap Nights:** 1

Trap No.	Location	Total Cockroaches Captures
1	beside refrigerator, against back wall, beside trash can	20
2	pantry shelf, against back wall	21
3	upper cupboard (above dishwasher), against back wall	12
4	front of dishwasher, next to toe-plate	6
5	lower cupboard, against side wall next to dishwasher	9
6	under sink, against back wall, centered under pipes	35
7	against side wall beside stove	6
8	under and behind stove, against back wall	26
9	against wall near heater penetration	4
10	under bathroom sink in vanity, against back wall, centered under pipes	7
11	behind toilet, near water pipe penetration, against wall	2
12	beside shower in bathroom, against wall	0
13	under water heater in basement	0*
14	against wall, near floor drain in basement	0

**Notes:**

\* Trap #13 had a wolf spider in it.

**Grand Total:** 148

**Total #/trap/night:** 10.6

In our hypothetical example, you should note several things. First, the cockroach population is centered in the kitchen, in the areas under the sink, refrigerator/trash can, pantry area and near the stove. There is also a smaller infestation in the bathroom, but no infestation is found in the basement. If the traps in the basement continue to be empty after about a week, they can probably be ignored and need not be replaced.

## Cockroach Trap Worksheet

**Cockroach Species:** \_\_\_\_\_  
**Date Installed:** \_\_\_\_\_  
**Date removed:** \_\_\_\_\_  
**Trap Nights:** \_\_\_\_\_

Trap No.	Location	Total Cockroaches Captures
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

**Notes:**

**Grand Total:** \_\_\_\_\_

**Total #/trap/night:** \_\_\_\_\_



(J. Kalisch)

Figure 5-1. "I admit I seen a few waterbugs, but I got no cockroach problems."

# Chapter 5

## Primary Control Strategies: Modify Resources

### Rhonda, The Roach

Cockroach infestations do not appear out of thin air, even though it may seem that way. German and brownbanded cockroaches are nearly always imported into the structure by human activities. What happens when a cockroach is introduced into a new building? By way of illustrating our discussion, let us look at this situation from a cockroach's viewpoint. We will call our roach *Rhonda*.

*Rhonda, a female German cockroach bearing a fertile egg case, has been living for the past two weeks in the produce section of a supermarket. After a night of foraging, she crawled into a five-pound bag of potatoes. Her bag of potatoes was carefully selected this morning by Mrs. Porter who bought the potatoes to make German potato salad for the Ladies Aid Society pot-luck luncheon on Saturday. After a bumpy ride in the back of the car, Mrs. Porter carried the sack of potatoes into the house and set it on the pantry floor. Rhonda isn't comfortable in the sack of potatoes, so when the activity quiets down, she starts looking for a hiding place. Because Mrs. Porter has a neat pantry area, Rhonda cannot find a very good hiding place. She finally settles behind a box of laundry detergent. Tonight she must search out a more permanent place to live. If she finds a better place, she will mark the newly-found shelter with an aggregation pheromone before she leaves to look for food or water. Marking this place will help her find it again.*

*If Rhonda cannot find a suitable shelter, she will travel from place to place finding temporary places to hide. She will be stressed and have to deposit her egg case in an unsuitable place. Few of her 30+ offspring will survive and an infestation cannot get started. If Rhonda cannot find a food and water source, she will also die after a week or two.*

The lesson in the story is this: every habitat, whether it is a house or apartment kitchen,



Figure 5-2. Rhonda the roach, visibly stressed, is looking for a place to hide.

bathroom, basement or commercial kitchen has a capacity to support a certain number of cockroaches. This is called the *carrying capacity* for the specific cockroach species living there (Figure 5-3). Biological forces always aim to maintain the population at this level, regardless of measures taken to reduce the population, like pesticide applications. After an insecticide application, the remaining

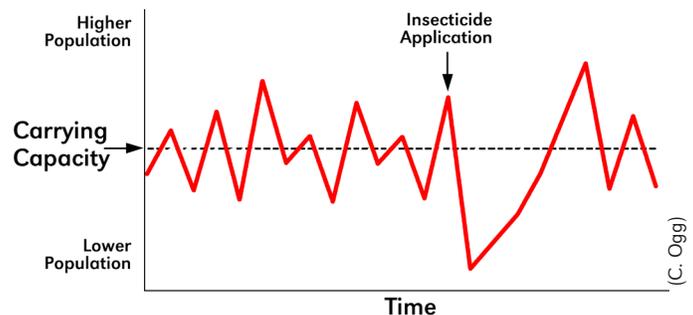


Figure 5-3. The carrying capacity of the environment is based on resources provided by the environment and required by the animal. Every kitchen has the capacity to harbor a cockroach population.

roaches will have less competition for food and hiding places (resources). Their reproductive rate will increase and, in no time, the roach population will rebound.

**The key to effective control is to lower the carrying capacity of the environment by eliminating the resources needed by cockroaches. These needed resources are water, food and shelter.**

Like any animal, cockroaches need these resources to thrive and reproduce. Only small amounts of water and food may be required. The resources in every habitat determine whether or not an infestation can be established and the potential infestation level. Let's discuss each of these required resources individually.

## Essential Resources: Water, Food and Shelter

**Water.** Cockroaches have a waxy coating on their body to prevent moisture loss, but they still need water. One drop of water per day is all a cockroach needs. Any water or moisture will do; they can get water from condensation on pipes, small leaks, moist sponges, soaked wood and moistened food. Different cockroaches have different water requirements. Of those roach species we are discussing, the German and oriental cockroaches need moisture most frequently.

**Food.** Cockroaches eat almost anything: crumbs, hair, fingernail clippings, spots of grease, soiled clothes, pet fur and dead insects (even dead cockroaches). Very small, immature cockroaches stay in hiding places and eat droppings of older cockroaches. If food becomes scarce, cockroaches will cannibalize their own young and eat egg cases. Studies have shown cockroaches eat a balanced diet whenever they can. Food high in protein or is moist, is very attractive to cockroaches. If you are leaving pet food in the dish overnight, you are feeding your cockroaches. And, feeding them well.

**Shelter.** Cockroaches live in cracks and crevices during the day. They prefer wood and paper in their living quarters rather than metal surfaces. Their flat body allows them to squeeze into places where they can touch the surfaces above and below at the same

time (Figure 5-4). Cockroaches can squeeze into cracks 1/16 inch or larger. Cockroaches like warmth produced by electric motors, condensers and ovens and may live inside appliances, especially if there is water nearby.

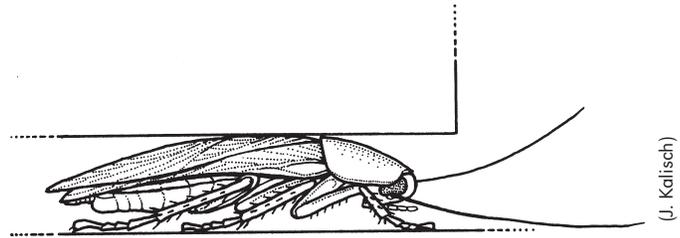


Figure 5-4. Cockroaches live most comfortably in tight places.

## Reduce Water Availability

For German and oriental cockroaches, limiting the availability of water will quickly stress them and make control efforts more effective. It is the first step you should take in your control program.

**Plumbing Problems.** Examine all the sinks in your home. Do your faucets leak? If so, you need to repair them. Inspect the base of the faucet and run the water. Does the base of the faucet leak? Replace the gasket. Then, examine the faucet opening and see if there is a screen present; if not, install one. This screen breaks up the flow of water into a steady stream. But, it also helps to prevent thirsty cockroaches from getting into the faucet to get water.

Make sure there are no leaks in the plumbing underneath the sink especially when the water is off. Repair any leaks, no matter how small. Carefully look for a whitish residue at all connections. This whitish residue is a sign of slow water leakage. Clean the residue, tighten the connection, and check it daily for a week or two to make sure the leak is sealed.

Cold water pipes may sweat from condensation, especially during humid weather in the summer. There is enough moisture on sweating pipes to sustain cockroaches. Pipe insulation will help solve this problem. Make sure you use non-absorbent insulation because if it absorbs water, it may grow mold and attract cockroaches. Be sure to seal the insulation thoroughly. Be careful not to

create hiding places for cockroaches between the insulation materials and the pipes.

All drains should be covered with a fine mesh screen. Cockroaches do not normally enter a structure through a drain but will readily enter drains in search of water. Most kitchen sink strainers will not keep cockroaches from going down the drain. Use a strainer with small round holes, instead of slits. Bathroom sink and tub overflow holes must also be kept clean and washed out occasionally.

**Other Water Sources.** Before storing moist sponges or dish rags overnight, rinse them with an ammonia water solution. This prevents cockroaches from using this source of moisture. You may want to seal sponges in a sandwich bag overnight.

Check plant pot dishes, and make sure there is no standing water in the dishes. Also, place a layer of gravel over the soil in plant pots to cover exposed moist soil.

Petroleum jelly and mineral oil mixed together and applied to the inside rim of the bowl and around the tank of all toilet bowls will prevent cockroaches from using them as a source of water. This mixture should be reapplied weekly.

Always clean and dry dishes, pots and pans immediately after each use. Never leave dishes in the sink with water in them.

Remove pet water dishes overnight and replace each morning.

If your dwelling has excessive humidity, consider purchasing and using a dehumidifier to reduce the humidity. Empty the tank frequently to prevent its use as a water source by cockroaches.

At least once a month, check the drip pan under the refrigerator (Figure 5-5). Clean and dry the pan before replacing it.

## Remove Their Food Supply

**Stored Food.** Cockroaches eat just about anything. All food items must be kept in a sealed container. Once a package of food is opened, make sure it is tightly resealed. If the original package doesn't reseal tightly enough, place the food product in a tightly-sealed container. Cockroaches can easily chew through paper, cardboard or thin plastic containers, so food items packaged in these materials should be transferred to cockroach-proof



(V. Jedlicka)

Figure 5-5. The drip pan of a frost-free refrigerator is attractive to German cockroaches. There is warmth from the compressor and plenty of food and moisture nearby.

containers before being stored in the home. No open food should be left out overnight. Candy, popcorn, fruit and pet foods must be placed in containers for overnight storage. It is hard to completely deprive cockroaches of food, but limiting food makes it easier for other control methods to work effectively.

**Food Waste Management.** While food products are an important source for cockroaches, food waste (garbage) is readily consumed by cockroaches. A garbage disposal is very helpful in reducing waste in the home. However, the garbage disposal must be used daily or whenever waste is



(S. Cochran)

Figure 5-6. If you are leaving pet food out overnight, you are feeding your cockroaches, too.

deposited, and it should be flushed with a cleaning solution after each use.

If a garbage disposal is not available, remove garbage to an outdoor, sealed container before evening. If this is not possible, waste food can be placed in cockroach-proof containers like glass jars with air-tight lids.

Clean all surfaces in food preparation or eating areas, including counters, tables and floors with a cleaning solution after each use. Dishes, bowls, utensils and glasses should be immediately cleaned.

Grease is a special problem and can be hard to clean. Cockroaches feed on the film of grease on oven hoods and walls next to where frying pans have been used.

Clean all spills. Spilled food residue will attract cockroaches. Sponges, cleaning pads and brushes must be thoroughly cleaned after use. Soiled clothing should be placed in an area not readily accessible to cockroaches, such as a sealed plastic bag or a tight fitting hamper (without ventilation holes).

**Initial Cleaning Efforts.** Most of us tend to put off *deep cleaning* jobs (like ovens, behind stoves and refrigerators) until we have a good reason to do them. If you have cockroaches, there should be an incentive to make this extra effort. In fact, there is a good possibility those difficult cleaning areas are contributing to your cockroach infestation. When you clean, you may see cockroaches. Have the vacuum cleaner handy and vac 'em up.



(V. Jeddick)

Figure 5-7 Clean thoroughly to remove food particles, cockroaches and cockroach specs.

Before you begin any control efforts, pull out refrigerators, stoves, freezers and clean behind and beside them. Wash the outside of the appliance. Remove the back of appliances and vacuum dusty areas around motors. (Be sure to unplug appliances when doing this.) Remove items from cupboards, vacuum and clean thoroughly (Figure 5-7). Wash floors. Clean under burners and the stove top. Be sure not to forget the inside and outside the oven and the broiler area, if you have a gas stove. It is important to remove grease. (Cockroaches eat grease with gusto!)

## Cockroaches and Rodents

Cockroaches and mice often coexist in the same dwelling. Both cockroaches and mice are nocturnal and live in dark, hidden locations. Cockroaches eat mouse feces and mice, in turn, may eat cockroaches. Cockroaches eat mouse baits (pellets, blocks) without adverse results. If you are using bait to control mice, you may be feeding cockroaches.

## Eliminate Hiding Places

**Remove Clutter.** Remember, cockroaches prefer to be in tight, small places. These areas are where they feel secure, rest, mate and breed. Most cockroaches only need a 1/16" space, so even small cracks and crevices provide ample harborage. Also, cockroaches prefer porous surfaces like wood, paper, cardboard, insulation, and cloth. Stainless steel, aluminum, plastic laminates, ceramic tiles or baked enamel surfaces are less preferred. If you change the habitat, try to use materials cockroaches dislike. When soft, porous materials are layered (such as corrugated cardboard), it forms a cockroach breeding area. Do not keep stacks of paper bags, sacks, cardboard boxes, rags or pieces of wood in locations where cockroaches may be present. One of the biggest mistakes is the practice of storing paper bags between an appliance and the wall because it establishes a layering effect next to a warm area. This paper bag storage practice is an excellent cockroach breeding site.

Examine all areas, in the kitchen, bathrooms, laundries, basement and storage closets, especially near where cockroaches were found in your traps.



(B. Ogg)

Figure 5-8. A German cockroach and fecal specks near a stack of papers in a heavily infested, very cluttered apartment.

Re-organize and eliminate any clutter. Any portable items providing harborage should be sealed in cockroach-proof containers or heavy plastic bags.

**Seal Them Out!** After you eliminate clutter, search the entire room, and find all cracks, seams and crevices larger than 1/16". Do not overlook cabinets and furniture. These areas need to be sealed so the cockroaches have no places to hide. Commonly neglected areas are behind molding, small holes in cabinet doors, around rubber gaskets, around water pipes, in hollow tube legs of kitchen tables, where cabinets or walls meet each other, or around built-in appliances.

Caulking is an easy, economical way to seal most of these cockroach hiding places. There are three types of caulk:

1. *Latex* caulk is usually cheap, but latex eventually will crack and shrink.
2. *Acrylic* caulks are better than latex, but they still shrink over time. In addition, cockroaches may chew into latex or acrylic caulks.
3. *Silicone* caulks are the best! They are more flexible, waterproof and can't be chewed through.

Before you caulk those crevices, make sure the edges of the space being sealed are clean and dry. Smooth the caulk so it forms a tight seal. Also, use enough caulk to fill the width of the space and about 1/4-inch deep. You will need to use enough caulk so it will last. The disadvantage of silicone caulk is paint will not adhere to the surface like the other

caulks. For spaces greater than 1/2", consider using foam fillers and caulk over the foam. If caulking all the cracks or seams in your home seems to be a major undertaking, use monitoring sticky traps to determine locations where cockroach infestations are established and focus caulking and sealing efforts in those areas.

If cockroaches are infesting the cracks or seams, apply a cleaning solution and desiccation dust (discussed in Chapter 6) to these areas before caulking. Insecticide dusts can be used in void areas, but make sure you read the section about application of dusts before you do this. After you completely seal this area, cockroaches can no longer use it as a hiding place.

Even high-grade silicone seals need to be checked and cleaned regularly. If the edge of the seal begins to flake or peel, clean out the caulk with a knife, and remove the entire section of caulk. Then, clean and smooth the section with abrasive material, like sandpaper, and reapply the caulk.

## Don't Overlook These Places

There are some important areas in a kitchen which are often overlooked as a source of water, food or shelter. Ignoring these "secret" places can counteract the effectiveness of other management tactics.



(C. Ogg)

Figure 5-9. Use caulk to seal cracks and crevices and void areas to eliminate these cockroach hiding places.

**Refrigerators:**

- Door gaskets should be checked and replaced if hard, stiff or cracked. (Yes, roaches can live under refrigerator gaskets.)
- Vacuum the coil and compressor; wash and dry the bottom drip tray.
- Check insulation around motors and clean or replace as needed.

**Dishwashers:**

- Check and repair all leaks.
- Remove bottom panel and clean regularly.
- Check insulation for cleanliness and replace if needed.
- Check door gaskets and seals; replace them if they leak.
- Make sure food residue is removed from inside the dishwasher daily.

**Stoves:**

- Clean the stove regularly and thoroughly. Don't forget to clean under the burners.
- Use heatproof sealants to caulk cracks.
- Check insulation for possible infestations. You may need to replace it. (Cockroaches can live and breed in the insulation if they can gain access inside the walls of the stove).

**Electrical Locations:**

- Examine and caulk around electrical fixtures, outlets and switches. For your safety, turn off the electricity.
- Use a foam sealant if an infestation exists inside the electrical conduit.

**Metal Cabinets:** Even though cockroaches do not prefer metal, they will live in metal cabinets, if they have no other options. Metal cabinets are usually constructed with small openings which allow cockroaches to get inside the doors. Examine cabinets carefully. Seal hinges, latches, seams and holes in the bottom and/or top of the doors.

**Drawers:** Pull out each kitchen drawer and examine the cavity. When the drawer is closed, small void areas are created which provide cockroach harborage (Figure 5-10)

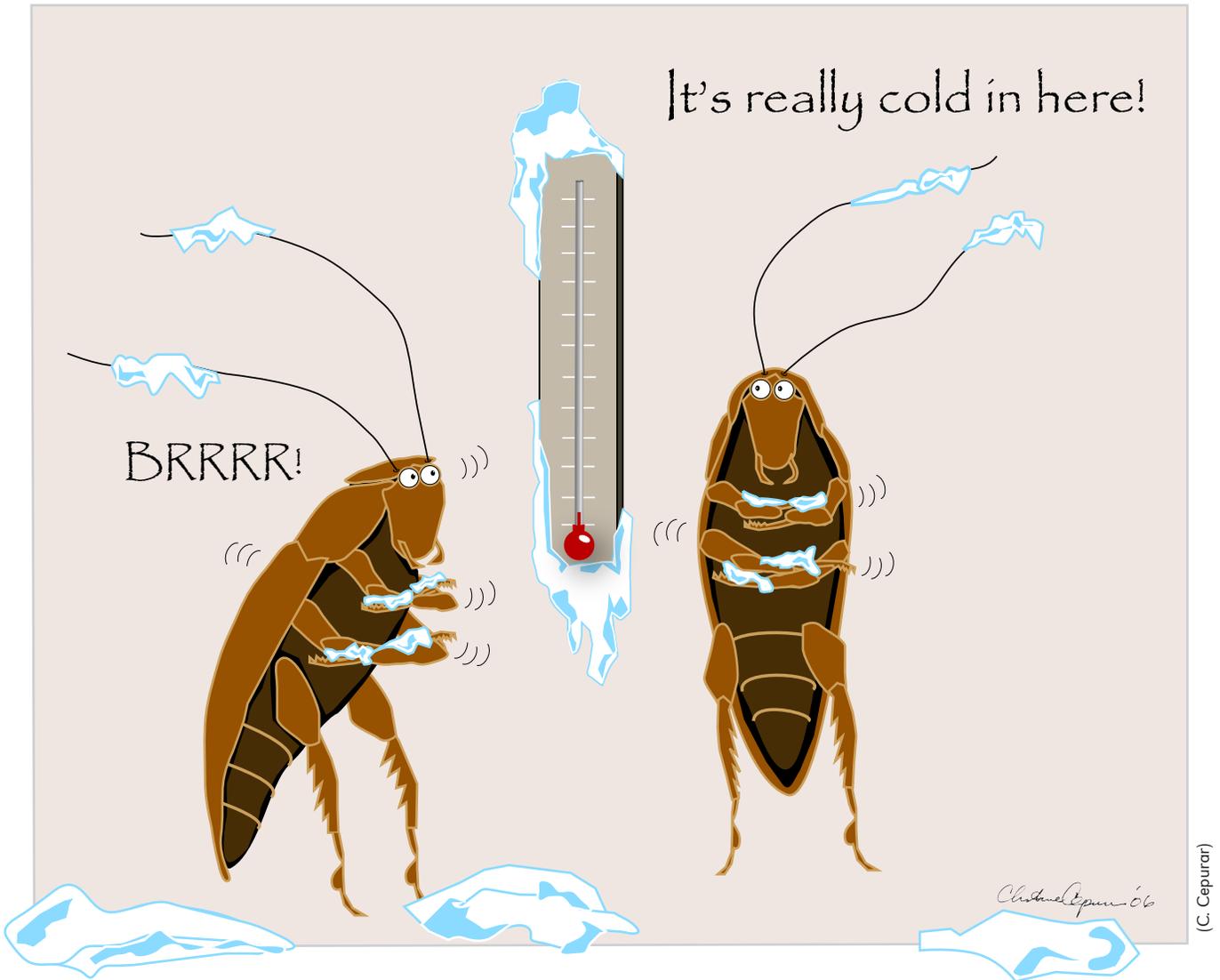
**Small Appliances:** Cockroaches can enter small appliances through small holes and cracks. The most likely infested appliances is the microwave oven, since it may not be cleaned regularly after use and food particles may build up. It should not be necessary to throw appliances away. Instead, take the appliance apart or use a cold treatment, discussed in Chapter 6.



(C. Ogg)

Figure 5-10. A kitchen drawer has been removed to expose a cluster of cockroaches hiding in the void area created when the drawer is closed. Vacuum these cockroaches.





(C. Cepuran)

Figure 6-1. Placing cockroach-infested appliances in the freezer is a non-toxic method of killing the roaches!

## Chapter 6

# Low Risk Control Strategies

Low-risk control tactics pose a reduced hazard to the applicator and/or the home inhabitants and pets, while at the same time are effective in controlling cockroaches. If additional insecticide controls become necessary, see Chapters 7-9.

### You're Trapped! I Gotcha!

**Trapping.** Under certain conditions, traps can be used to control cockroaches. Refer to Chapter 4 for the optimal locations of your traps. Trapping can be successfully used if:

- you have a small cockroach infestation.
- all harborages have been sealed. (If there are fewer hiding places, they are more likely to be trapped.)
- you maintain good sanitation practices.
- you place enough traps close to the infestation centers.
- you use proper trap management.

Baited sticky traps should be placed next to walls, under appliances and in hidden areas. Don't forget to put traps up high, in cabinets, above false ceilings, as well as on the floor. You will need to move traps often and replace traps as needed.

**Cockroach pheromones.** The German cockroach aggregation pheromone, found in fecal pellets, is a combination of chemicals produced by cockroaches that attracts other cockroaches to the area. Pest management professionals have known for years that cockroaches are attracted to ideal harborage areas. Dr. Austin Frishman, a respected cockroach expert, called them "fecal focal points." It is now known the more cockroaches that live in a habitat, the more attractive it becomes to other cockroaches. This is because of the presence of aggregation pheromone.

This pheromone has been synthesized and extracted from cockroaches, and is available for use in the management of cockroaches. When added to sticky traps, the traps catch more cockroaches. When added to products such as boric acid and



Figure 6-2. This sticky trap caught a female German cockroach carrying an egg case. The nymphs later emerged from the egg case.

(Photo courtesy Chris Arne, J.C. Ehrlic & Co.)

diatomaceous earth, more cockroaches are drawn to the insecticides and more cockroaches are killed.

### Heat 'Em or Freeze 'Em

Because they are cold-blooded organisms, insects do not survive very well in extreme cold or hot temperatures. Each insect species has certain temperature and humidity conditions where it thrives. Although there are some differences between species, it should come as no surprise our domestic cockroaches are best adapted to temperatures we maintain in our homes. They do not develop or reproduce when temperatures are too cold (below 45° F) or too hot (above 115° F).

Hot and cold temperatures can be very effective in killing cockroaches, but the adverse temperatures must be maintained for a period of time. Hot and cold treatments are most effective when they "shock" the cockroaches' system. If cold temperatures are gradually lowered, insects have physiological mechanisms that allow them to survive the cold.

But, if you take a jar of cockroaches from room temperature and put it into a sub-zero freezer, the insects will be dead within a half hour. They just cannot adapt that quickly.

Because cockroaches cannot survive temperatures above 115° F to 120° F, it is possible to use heat to eradicate cockroaches from restaurants and food service establishments. After heat-sensitive equipment is removed from the building, the temperature is increased to about 140-150° F for five to six hours. It may not be possible for the homeowner to increase the heat that much inside the home. But if a small, infested appliance has many small crevices and can withstand 150° F heat, a similar procedure can be used. The procedure is simple — place the heat-proof appliance in an oven, and after several hours at 150° F, the roaches will be dead.

Cold can also be used to kill cockroaches, but it takes a prolonged exposure to low temperatures to kill egg cases. Appliances or furniture can be left in a garage when temperatures are below 0° F for several days. If moving, leaving possessions in a truck or van will do the same thing. Infestations in wall voids or indoor cavities can be subjected to extreme cold by using a CO<sub>2</sub> (carbon dioxide) gas canister. This will freeze a localized area.

Infested small appliances can be fumigated with CO<sub>2</sub>. Place the small appliance in a plastic bag or other airtight container and inject carbon dioxide gas. Allow freezing to occur. If a small item can be subjected to freezing, it can be placed in a freezer for several hours (or overnight) to kill the cockroaches.

## Vacuating Cockroaches

Any vacuuming device—a household vacuum, shop-vac or dust buster—can be modified to remove cockroaches. Place a narrow tube on the end of the vacuum hose to extract cockroaches from cracks and crevices. When an infestation is isolated in a small area, you may be able to completely eliminate adults, nymphs and egg cases with the vacuum method. Even if the infestation is large, vacuuming helps in preparation for other control methods. It cleans out old and new egg cases, loose fecal materials and living and dead cockroaches.



Fig 6-3. Vacuuing cockroaches and egg cases is a simple non-toxic control method.

Vacuuing will not kill live cockroaches, so you will need to place the bag in a freezer or seal it in a cockroach-proof container for disposal. Never leave a vacuum that has been used for cockroach control unattended without properly disposing of the bag because cockroaches will quickly escape.

## Bite the Dust!

There are substances, called desiccants, that literally dry out any item or animal that contacts them directly. The body of an insect, like that of other animals, is filled with liquid substances, like blood and digestive secretions. A waxy, protective coating on the outside of their bodies prevents moisture loss. Desiccants kill cockroaches by destroying this waxy layer. The three most effective desiccants for cockroach control are diatomaceous earth, silica aerogel and boric acid.

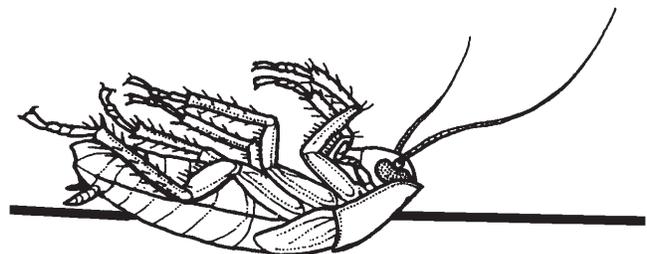


Figure 6-4. Cockroaches exposed to desiccants die from dehydration.

**Diatomaceous Earth.** Diatomaceous earth is mined from the fossilized silica shell remains of diatoms, microscopic sea animals. Diatomaceous earth is virtually non-toxic to humans. However, care should be taken to avoid inhaling diatomaceous earth, as it can cause irritation to eyes and lungs. Because it has an abrasive quality, diatomaceous earth degrades the waxy layer of the cuticle causing the insect to dry out and die.

*Note:* Some grades of diatomaceous earth contain small amounts of crystalline silica which is known to cause silicosis (respiratory disease caused by breathing silica dust) and cancer. The risk of cancer depends upon duration and level of exposure. Pesticide-quality diatomaceous earth and silica aerogel are amorphous (non-crystalline) silica, which *does not cause silicosis or cancer*.

**Silica Aerogel.** Silica aerogel is a non-abrasive, chemically inert substance used as a dehydrating agent because the small particles absorb moisture and oils. Sometimes small bags of silica aerogel are inserted in electrical equipment packages to prevent the accumulation of moisture during shipping or storage. Silica aerogel is also used in the florist trade. Caution should be taken when handling silica aerogel to avoid inhaling the dust.

The silica aerogel particle has a static charge that enables it to stick tightly to the cockroach body. Once on the body, the aerogel absorbs the waxy protective coating, which desiccates and kills the cockroach. Silica aerogel has also been formulated with insecticides. One formulation, Drione®, contains silica aerogel, pyrethrins and piperonyl butoxide, an additive that increases the impact of the pyrethrins.

**Boric Acid.** Boric acid is derived from borax and is usually combined with an anti-caking agent. Cockroaches ingest boric acid when they preen themselves after they have walked through the powder. Cockroaches die because boric acid is a slow-acting stomach poison. Because boric acid also absorbs the cockroach cuticle wax, they may also die from dehydration.

Although boric acid is relatively safe to humans and other mammals, it can be harmful if accidentally ingested and must be kept away from food, children and pets. Care must be taken not to breathe in the dust when you apply it. Like other

desiccants, it should be used in places where it will not move around. Because it has no chemical active ingredient, it remains active indefinitely. Recent studies have shown that humidity and moisture have no effect on the effectiveness of boric acid.

Boric acid is also formulated as an aerosol, a liquid (which dries and leaves a film), and a bait (discussed in Chapter 7).

**Using Desiccants.** Place the desiccant in a duster or a flexible bottle with a small, narrow nozzle (less than 1/4-inch) and apply a very thin coating of the material. Desiccants are more effective when only a dusting is used. Many small puffs of dust are better than one large application.

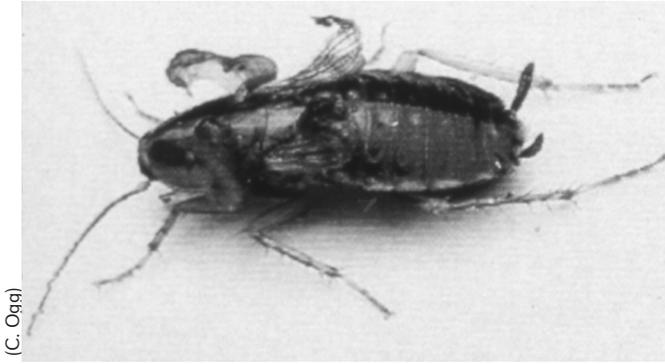
Even in dry locations, the material will eventually absorb moisture from the air. Use small amounts and re-apply often. These dusts can harm motors and electrical equipment, so avoid using them near appliances.

## Insect Growth Regulators (IGR's)

Modern science has brought new weapons into the realm of insect control. Insect Growth Regulators (IGR's) are extraordinary because they alter growth and development of cockroaches, but they are much less toxic to humans and other non-target organisms. Their effects have been observed on growth and development of nymphs, but some effect fertility of adults. The IGRs described have been tested against cockroaches and are very effective and available for use. In general, they are quite safe to use.

Because IGR's don't directly kill cockroaches, they are often mixed with an insecticide, which kills some of the cockroach adults and nymphs. The nymphs not killed by the insecticide will be affected by the IGR and either be unable to reproduce when they become adults or unable to grow properly. Both result in eventual death.

**Hydroprene (Gentrol®).** Hydroprene is an IGR registered for cockroach control in apartments and homes. It is formulated as a concentrated liquid or aerosol designed to be absorbed into the cockroach body. Hydroprene does not kill cockroaches. However, affected cockroaches are darker in color and the wings of affected adults



(C. Oga)

Figure 6-5. Cockroaches exposed to insect growth regulators, like hydroprene and pyriproxyfen, develop crinkled wings.

are crinkled and deformed as shown in figure 6-5. Hydroprene controls cockroaches because it acts like a birth control treatment. Adult cockroaches having deformed wings will be infertile. Hydroprene is nearly non-toxic to humans and vertebrate pets and lasts for 90-120 days before re-treatment is needed. Gentrol® can be purchased as a single treatment, but it can also be purchased pre-mixed with residual insecticides in liquid or crack and crevice aerosol formulations.

#### **Pyriproxyfen (Archer®, Nylar®).**

Pyriproxyfen is an IGR with similar activity as hydroprene. It does not kill cockroaches directly, instead the nymphs exposed to pyriproxyfen develop into infertile adults. Like hydroprene, it is slow acting but extremely non-toxic to people and animals. Pyriproxyfen is available as concentrated liquid, pre-mixed with residual insecticides in liquid or crack and crevice aerosol formulations, and in total-release foggers (see Chapter 7).

**Noviflumuron.** Noviflumuron, like hydroprene, does not directly kill cockroaches, but instead prevents them from shedding their exoskeleton. Because the cockroach cannot grow, it dies. Noviflumuron is similar to two other IGR's, diflubenzuron and hexaflumuron. All three of these compounds have been used successfully to control termite colonies. Recent testing has shown noviflumuron to be effective against German cockroaches and we will likely see products containing this or a similar active ingredient on the market soon.

## Natural Enemies: Predators, Parasites and Pathogens

The use of natural enemies or biological control of domestic cockroaches leaves something to be desired, at least at the present time. There are some vertebrate animals that will feed on cockroaches, including hedgehogs, frogs, turtles, geckos and mice. Cockroaches also have a few invertebrate natural enemies, including mites, helminths (roundworms) and centipedes. We are fairly certain most folks living inside their home would be as unacceptable as a cockroach infestation.

There are some tiny parasitic wasps (genera: *Evania*, *Hyptia*, and *Tetrastichus*) that lay their eggs in egg cases of some cockroaches, including the American, oriental and brownbanded species. Brownbanded cockroaches seem to be most heavily parasitized. When the wasp eggs hatch, the wasp larva eats the embryonic cockroaches and completely destroys them so no cockroaches will hatch. The tiny wasps exit through one end of the egg case. If you see an egg case with a small hole in the end, it has been parasitized.

Scientists have shown that releasing thousands of these tiny wasps in a cockroach-infested dwelling can destroy large numbers of egg cases. At this time, however, this tiny wasp is not a practical method of controlling cockroaches in homes.

**Microbes.** Abamectin (Avert®) is a natural toxin produced by a soil-inhabiting fungus, *Streptomyces avermitilis*. It has been formulated as a bait and a dry flowable dust. Abamectin baits work very slowly, but can be used to reduce small to medium-sized infestations. Abamectin acts as both a stomach poison if ingested, and a contact insecticide when it becomes attached to the cockroach body.

## “Green” Pesticides: It’s Not Easy Being Green!

In the last few decades, there has been a great deal of interest in everything green. Green is used to describe methods, practices and chemicals that are safer for people, animals and the environment.

Green is often used to indicate that “natural” products are to be used when controlling pests such as cockroaches. In response to this green revolution, many new insecticides have been developed. The plant oil extracts and the ingredients oxypurinol and xanthine, mentioned in Chapter 7, are important examples. These, and other similar ingredients, are considered to have minimum risk by the Environmental Protection Agency (EPA). The complete minimum risk list can be found on the EPA Web site at: [www.epa.gov/oppbppd1/biopesticides/regtools/25b\\_list.htm](http://www.epa.gov/oppbppd1/biopesticides/regtools/25b_list.htm).

Many minimum risk and other “green” pesticides can be found in cockroach control products available to the consumer. Most of them show little or no ability to kill cockroaches. Others

have limited effectiveness as a contact spray.

Several plant essential oils (clove oil, mint oil, neem tree seed oil, oil of thyme, phenethyl propionate and oil of rosemary) show some contact toxicity on cockroaches. They are usually marketed as “green,” “environmentally friendly” or “plant based” and are available as dust, aerosol and concentrated formulations.

Another plant oil, limonene, extracted from citrus peels, shows slight contact toxicity to cockroaches. There is no residual effect. Very high vapor concentrations caused mortality in lab test conditions, but no mortality occurred when it was fed to German cockroaches.



Figure 6-6. Hydroprene is an insect growth regulator. Exposed roaches are sterile and cannot reproduce.



## Chapter 7

# Insecticide Basics

We have already learned the importance of reducing water, food, and eliminating harborage (cracks, crevices, clutter) for cockroaches. These primary control strategies should be done *before* doing any insecticide applications. Figure 7-1 shows a graph of how sanitation (food and water) and habitat modification can potentially reduce a cockroach population. It doesn't take a rocket scientist to understand it is easier to deal with a small population than a large one.

Before using chemicals, don't forget about the low risk controls discussed in Chapter 6. A multiple tactics approach will give best control.

Studies have shown poor long term control when insecticide sprays are used as the only method of control compared with a more integrated, multi-tactics approach. Reliance on sprays provides only temporary relief and repeated applications may become necessary to control the rebounding cockroach populations. Scientists call this situation the *insecticide treadmill*.

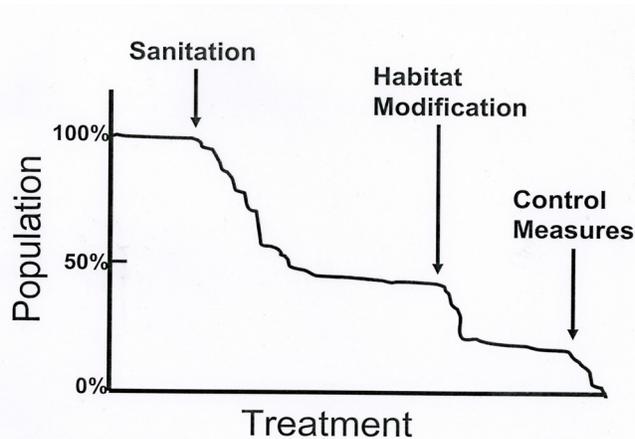


Figure 7-1. Cockroach populations can often be drastically reduced by sanitation (eliminating food and water) and eliminating harborage (cracks, crevices and clutter). Reducing the population makes control easier.

When used in conjunction with primary controls, properly chosen and placed insecticides can be very helpful in controlling cockroach populations. Using insecticides may require special equipment and protective clothing. These details will be discussed in the next three chapters.

## What is a Chemical?

Everything around us, the earth, air, even your body is composed of chemicals. The smallest part of a chemical is called an atom. When atoms exist in a pure state, the substance is called an element. Oxygen, hydrogen, nitrogen, and carbon are some of the most common elements. When two or more elements are combined chemically, they are called compounds. Water, a common compound, has two hydrogen atoms and one oxygen atom (hence,  $H_2O$ ).



Water is an example of a compound.

Animals and plants are composed of chemicals, most of which are very complicated chemical compounds. The chemistry of living things is known as organic chemistry, because they are composed primarily of the organic elements carbon, hydrogen, and oxygen. To some people, the word *organic* means something is *natural*, or grown in the absence of synthetic fertilizers and pesticides. For our purposes, organic refers to a chemical compound containing the organic elements.

Pesticides are chemicals that kill pests. If the pest is a weed, we use a herbicide; if it kills rodents, it is a rodenticide. Fungicides kill fungi, insecticides kill insects, and so on. Most insecticides are organic compounds, synthesized by chemists and manufactured by chemical companies. There are a few insecticides derived from plants, minerals, or non-organic elements with insecticidal properties.

## Formulations

An *active ingredient* is the specific chemical in a pesticide product which “does the dirty work.” An active ingredient is mixed with less toxic *inert ingredients* and are listed on the label. The mixture of active and inert ingredients is called a *pesticide formulation*. Many insecticides, especially those made for in-home applications for homeowners, are Ready-To-Use (RTU) products. Others must be diluted with water to a correct concentration before application. The directions on the label will tell you how to use a pesticide formulation.

There are hundreds of insecticide products labeled for cockroach control inside homes, apartments, and dwellings. In this section, we will describe the formulations used for cockroach control and give advantages and disadvantages of the different formulations.

Some active ingredients are formulated in more than one way. For instance, permethrin, a commonly used pyrethroid insecticide, can be formulated as a dust, in granules, RTU, a wettable powder, an emulsifiable concentrate, an aerosol, and a total-release fogger.

## Baits

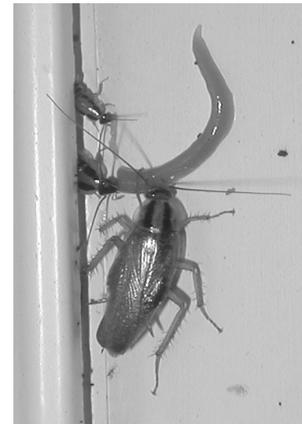
A bait formulation is an edible or attractive substance mixed with an active ingredient. The best active ingredients act slowly which insures enough bait will be eaten by the cockroach to kill it. Baits are marketed over-the-counter at discount stores, hardware stores and even supermarkets and pharmacies. Baits are sold in bait stations and gel formulations in syringe-style applicators. They are easy to use and reasonably safe to humans. They are also marketed to pest management professionals under different product names and active ingredients than may be available to the general public.

Some baits are formulated as granules for both indoor and outdoor use. Baits should be placed near where cockroaches live, in locations where they cannot fall into human food or be reached by children or pets. Bait can be squeezed into cracks and crevices or near locations where cockroaches live (Figure 7-2). Baits are an ideal companion



(V. Jedlicka)

Figure 7-2. (above) Gel bait is applied to areas where cockroach are found, near food, water and harborage. (right) Most German cockroaches find gel baits very palatable, although resistance has occurred in populations where these baits have been used repeatedly.



(V. Jedlicka)

to other types of control and work best when sanitation—limiting water and food sources—is good.

*Advantages:* Most baits are toxic to cockroaches but have low toxicity to mammals. Some baits remain active in cockroach droppings and will kill the immature roaches after they eat their parent’s droppings. Most baits work fairly quickly to reduce cockroach populations. Baits are easily applied and can be removed when control is completed.

*Disadvantages:* Scientists have noticed behavioral resistance, chemical resistance, bait aversion, bait avoidance, and repellency among some cockroach populations. To overcome these factors, it is best to alternate between active ingredients and manufacturers over time. Baits can present a hazard to children and pets. Avoid this problem by carefully placing bait in inaccessible areas and by using tamper-proof stations. Dried up gel bait and empty stations won’t kill cockroaches because they won’t eat it. Baits require attention—check them at least monthly for best results.

There are quite a few active ingredients used in cockroach control baits. Because baits have been so successful in controlling roaches, manufacturers are busily developing new baits and formulations. Some active ingredients include:

**Boric acid:** Boric acid is an inorganic white powder formulated as both a granular and a gel bait. It has very low mammalian toxicity; however, caution must be taken to avoid accidental ingestion. Chapter 6 contains more information about boric acid.

**Hydramethylnon:** Hydramethylnon is a slow-acting stomach poison. It is low in toxicity to mammals and birds. It is available in tamper-proof stations, as a granular bait, and as gel in syringe applicators.

**Fipronil:** Fipronil may be the fastest acting bait on the market and readily transfers to other roaches. Fipronil is effective at very low concentrations. It is available in tamper-proof bait stations, as granular bait, and as a gel in syringe applicators.

**Acetamiprid:** Acetamiprid is readily eaten by cockroaches and transfers from one to another when feces or cockroach corpses are eaten. It is available as a gel formulation in syringe applicators.

**Indoxacarb:** Indoxacarb is considered a reduced risk insecticide by EPA because of its low toxicity to animals. Once eaten by the cockroach, it is converted into a chemical toxic to cockroaches. It readily transfers from one cockroach to the next, increasing its effectiveness. It is available as a gel bait and in a tamper-proof bait station.

**Abamectin:** Abamectin is a toxic extract from a soil microorganism with low toxicity to mammals. It comes in tamper-proof bait stations, a gel bait formulation, or as a flowable dust applied in cracks and crevices. (Chapter 6).

**Imidacloprid:** Imidacloprid is readily soluble in water and has a very low odor. The toxic effects are highly specific against cockroaches and extremely low toward vertebrates. It is available as a gel bait for cockroaches in a syringe applicator.

**Noviflumuron:** Noviflumuron is a low toxic IGR formulated as a bait and has been shown to be effective against German cockroaches. (Chapter 6)

**Oxypurinol and xanthine:** Oxypurinol is a metabolite of a drug used to treat gout in humans and xanthine is a natural substance found in all living things. Combined, these two ingredients work to block the formation and absorption of uric acid. Cockroaches need large amounts of uric acid for metabolism and reproduction. As existing uric acid stores are used up, the cockroach population is gradually controlled within five to nine weeks. These active ingredients are found in a tamper-proof bait station formulation.

**Sulfluramid:** Sulfluramid is another delayed action active ingredient formulated as a cockroach bait. It exhibits low toxicity to mammals, but is slightly toxic to fish and aquatic arthropods. It is available as a tamper-proof bait station.

**Propoxur:** Baygon® 2% Bait. Propoxur is a residual insecticide formulated as a bait. This bait would tend to act more quickly than others, but bait shyness may occur with its use. It is formulated as a granular bait formulation.

## Dusts

Dust formulations contain an active ingredient plus a powdered dry inert substance like talc, clay, nut hulls, or volcanic ash. The inert ingredients allow the dust formulation to store and handle well. In households, dusts should be used only in locations where the inhabitants will not stir the dust, move it around, or inhale it. Appropriate places for dust

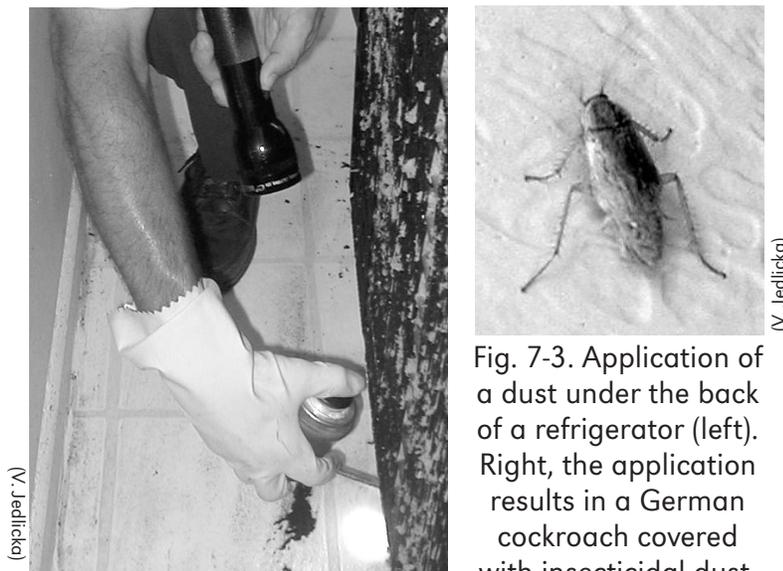


Fig. 7-3. Application of a dust under the back of a refrigerator (left). Right, the application results in a German cockroach covered with insecticidal dust.

applications are wall voids, behind baseboards, in enclosed spaces under kitchen counters, above dropped ceilings, behind appliances (Figure 7-3) and in unused attics. Dusts must be used dry and stored in a dry place.

*Advantages:* Most appropriate of all formulations for application in hard to reach areas such as wall voids. Dusts are easily picked up and transported by cockroaches.

*Disadvantages:* Cockroaches can move dusts before they die. Dusts can be unsightly if applied to visible areas. If applied to excess, it can act as a repellent to cockroaches. If dusts become damp or wet, they may be less effective.

## Ready-To-Use (RTU) Sprays

Ready-to-use liquid spray formulations have already been diluted by the manufacturer and are applied without further dilution. RTU products (Figure 7-4) are often equipped with a pistol grip sprayer, attached to the container with a plastic tube. Nearly all active ingredients currently registered for cockroach control are available in RTU formulations.

*Advantages:* Easy to apply and ready to use



(B. O'g)

Figure 7-4. Ready-to-use sprays are readily available and convenient because no mixing is needed. However, they are not designed for crack and crevice applications.

immediately after purchase. They are safer because you don't need to mix concentrated insecticides.

*Disadvantages:* Application equipment can be awkward to use, and the sprayers sometime don't work properly. Sprayers may leak or dribble, creating a possible hazard. RTU equipment are rarely designed for crack and crevice applications.

## Wettable Powders (WP)

These are dry, finely ground, powdery formulations added to water. They look like dusts, but a wetting agent has been added to the other ingredients to help them mix with water.

*Advantages:* When a wettable powder formulation is sprayed on a porous surface, like wood, the water will penetrate the wood, but the powder stays on the wood surface. This gives the greatest possible residue and residual activity (see How do Insecticides Work? section later in this chapter). They are less likely to stain surfaces.

*Disadvantages:* Constant agitation is needed to prevent settling of the insecticide on the bottom of the spray tank. The dried powder residue is sometimes visible and unsightly. This may limit the use of wettable powder formulations in cockroach control, unless there are areas where the presence of powder on the treated surface is not objectionable.

## Emulsifiable Concentrates (EC)

Water is added to an emulsifiable concentrate, which forms a smooth mixture of the insecticide, solvent, and the water carrier. The inert ingredients are often highly refined oils and other solvents.

ECs are important formulations used for cockroach control, and some can be purchased from discount, drug, grocery, and hardware stores. Professional-use EC formulations can sometimes be purchased from local pest control companies or Internet sites advertising sale of pest control supplies to the public.

*Advantages:* Emulsifiable concentrates formulated for household pests usually have lower concentrations of active ingredients. They are easy to mix and require very little agitation.

*Disadvantages:* EC formulations will be in a concentrated form and need to be mixed in a spray tank with water before use. The petroleum solvents in EC formulations may stain carpets, fabrics, and wallpapers. You need to carefully consider the placement of these insecticides before you use them. EC formulations readily absorb into the skin, thereby exposing the applicator to the insecticide.

## Aerosols

The active ingredient in an aerosol formulation is dissolved in a solvent with pressure from a gas propellant. Common, over-the-counter aerosol formulations have a low percentage of active ingredient. These aerosols are most effective when the liquid contacts the insect directly, and are not very effective when used against cockroaches hiding in cracks and crevices. There are some crack and crevice aerosol formulations, primarily marketed for pest management professionals, containing a higher percentage of the active ingredient. These can be quite effective when used as crack and crevice treatments.

*Advantages:* The main advantage of aerosols is they are easy to use and readily available.

*Disadvantages:* Aerosol container must be held upright during operation, the residual control is very poor, and aerosols are relatively expensive for the amount of insecticide they contain. The solvent vapors are readily airborne and can be harmful to the applicator and household residents.

## Foggers: Total-Release Aerosols

An insecticide fogger is a total-release aerosol which discharges its entire contents in a single application. During fogging, the occupants and pets should leave and remain away for a few hours. Consult the label for the re-entry time and follow

**SignOnSanDiego.com > News > Metro -- 19 bug bomb fogger**

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**19 bug bomb foggers blast a house apart**

SAVE THIS EMAIL THIS PRINT THIS MOST POPULAR

**Pilot light on a wall heater may have ignited them; no one hurt in explosion**

**By Joe Hughes**  
UNION-TRIBUNE STAFF WRITER

**December 18, 2003**

It seemed like a good idea at the time.

A family living in a house infested with cockroaches and rats set off 19 "bug bomb" foggers in their 470-square-foot City Heights home yesterday, causing an explosion that virtually blew the building apart and sent Christmas decorations into the street, police said.

JOHN GIBBINS / Union-Tribune

A family living in a house infested with cockroaches and rats set off 19 "bug bomb" foggers in their 470-square-foot City Heights home Wednesday, causing an explosion that blew the building apart.

(Photo: John Gibbins)

Figure 7-5 shows what can happen if someone uses more foggers than is recommended on the label and neglects to turn off the pilot light. Fortunately no one was hurt in this explosion.

(San Diego Union Tribune, Joe Hughes, reporter).

all precautions before using a fogger. Aerosols and foggers produce very small droplets which settle on furniture, the floors, and countertops. These small droplets are easily inhaled by humans and pets. Fogging is **NOT** the same as fumigation. Fumigation uses deadly insecticidal gases and can only be done by professional, certified applicators.

*Advantages:* Foggers are easy to use and readily available.

*Disadvantages:* Foggers can be dangerous. You *must* extinguish all flames before using. Do not use more foggers than is recommended on the label. Foggers will only kill exposed cockroaches and will not penetrate cracks and crevices where cockroaches are hiding. After using foggers, cockroaches may retreat deep into walls and ceilings to avoid the insecticides. **We do not recommend the use of foggers for cockroach control.**

## Insecticide Classes

The classes of insecticides listed here are grouped based on their chemical structures and the way they kill cockroaches.

**Chlorinated Hydrocarbons—Banned:** A few chlorinated hydrocarbons are DDT, aldrin, endrin, and chlordane. Throughout the 1970's and 80's, the EPA banned most chlorinated hydrocarbons from sale and use in the United States because these insecticides persisted in the environment and increased in the fatty tissues of animals. **None of these insecticides should be used in cockroach control.**

**Organophosphates (OPs)—Old Standards, no longer used:** The OPs were discovered in Germany during World War II research on nerve gas poisons. Some of the more common OPs used in cockroach control until recently were chlorpyrifos (Dursban®), diazinon, and acephate (Orthene®). Changes in environmental laws have resulted in the elimination of most indoor uses of these insecticides. **We do not recommend the use of these insecticides for cockroach control.**

**Carbamates—Early Alternatives, much reduced use:** In 1951, carbamate insecticides were introduced into the world market. There are two carbamates labeled for cockroach control in and around the home: propoxur (Baygon®) and carbaryl (Sevin®). Most indoor uses of these insecticides have been eliminated. **We do not recommend the use of these insecticides for cockroach control.**

**Botanicals—Naturally Occurring:** Botanicals are natural insecticides, made from plant extracts. When processed and concentrated, these botanical insecticides are similar to synthetic insecticides. Some people believe natural-occurring botanicals are safer to use than synthetic insecticides. *This is not necessarily the case.* Nicotine sulfate, a botanical derived from tobacco plants, is more toxic to mammals than many synthetic insecticides.

Oil extracts of the neem tree seeds, the herb thyme, mint, citrus peels (limonene), cloves (eugenol), and phenethyl propionate are sometimes used for cockroach control. Studies have shown these extracted oils have limited toxic activity on cockroaches and are virtually nontoxic to

mammals. They are useful as contact sprays only (kill on contact), with little or no residual activity. These oil extract botanicals were developed in response to public demand for more “natural” and safer products.

Another, older, botanical insecticide used for cockroach control is pyrethrum. Pyrethrum is a mixture of several compounds, including pyrethrins and cinerin. Pyrethrum has low mammalian toxicity but very fast knock-down activity, causing rapid paralysis in the target insects. However, the paralysis may only be temporary unless a synergist (such as piperonyl butoxide or MGK 264) is added. The synergist may have no insecticidal property, but enhances the activity of an insecticide.

To improve on the effectiveness of pyrethrum, chemists have synthesized similar, more stable compounds in the laboratory. These laboratory-created insecticides are known as the synthetic pyrethroids or simply *pyrethroids*.

**Pyrethroids—New Age Insecticides:** There have been dozens of pyrethroids identified and synthesized. A few include esfenvalerate, permethrin, tetramethrin, deltamethrin, cypermethrin and cyfluthrin. Notice nearly all pyrethroid insecticides end with ‘thrin’. This is because these newly synthesized chemicals were modeled after pyrethrins. Chemists have made these compounds more stable and more persistent than natural pyrethrum. A synergist is usually added to the pyrethroid formulation to further increase its effectiveness. One characteristic of pyrethroids is when a cockroach encounters the insecticide, it becomes more excited and active. Because of this, after an application of a pyrethroid you may see cockroaches during the day when previously you have only seen them at night. This change in behavior means the insect is being affected by the insecticide.

Like the botanical pyrethrum, pyrethroids have fast knock-down activity especially against flying insects and low mammalian toxicity. Pyrethroids are very toxic against fish so precautions must be taken to cover fish tanks and disconnect filters when using , at the very least. Pyrethroids are the active ingredients in most of the in-home aerosols you can buy (Raid®, Black Flag®, etc) and in the RTU

formulated products. They are also formulated as dusts, granules, wettable powders, and emulsifiable concentrates.

Exposure to pyrethroids may trigger asthmatic attacks in persons who have allergies or respiratory problems. This problem may limit their use in sensitive areas.

**Novel Chemistries—Specific, Low-Toxic, Environmentally Friendly Insecticides:** As mentioned in Chapter 6, there has been a movement toward “green” insecticides. The plant oil extracts, discussed earlier, are one example. These new products are often only toxic to a specific group of insects. Green insecticide products are usually less toxic to people, other animals and pets, and are much safer to the environment than nearly all insecticides developed previously.

Because of the specific nature of these products, they are also sometimes the only member of their insecticide class. This fact makes it difficult to organize them as has been done previously. Instead, they will be discussed as individual active ingredients in the upcoming paragraphs.

Several of these active ingredients, including imidacloprid, fipronil, noviflumuron, hexaflumuron, diflubenzuron, indoxacarb, acetamiprid, and hydramethylnon were discussed in the earlier section on baits. At the time of this writing, these active ingredients are only available in bait formulations for indoor control of cockroaches.

Chlorfenapyr affects cockroaches either when they contact it or ingest it. Cockroaches die because they are unable to produce energy for cellular activity. It has low mammalian toxicity and low irritation to people. This is the only non-repellent liquid insecticide registered for indoor spray treatments of cockroaches.

**Inorganics—Borates and Diatoms:** Inorganics are insecticides made from elements, compounds, and minerals which do not contain carbon. Sulfur and arsenicals are inorganic insecticides which were in common use from about 1930 until 1960. They are very toxic and should not be used. Boric acid, silica aerogel, and diatomaceous earth are the inorganics currently in use (Chapter 6).

## How Do Insecticides Work?

Insecticides control pests in specific ways. The effectiveness of the treatment increases when the insecticide is used in a manner consistent with the way it works. This information is found on the label.

**Residual insecticides** (persistent) remain active in amounts sufficient to kill pests for at least a week, several weeks, or even years after application. These residual insecticides act by keeping a toxic insecticide residue on a surface the insect will contact. Conversely, non-residual insecticides (non-persistent) break down rapidly after application. Residual insecticides are useful when insects are a continual problem, such as cockroaches in your home.

**Contact insecticides** control the pest on contact and must be applied directly on the insect. Very little toxic residue remains on a surface after spraying a contact insecticide. Most aerosols and foggers contain contact insecticides.

**Stomach poisons** are insecticides eaten by an insect so the poison enters the stomach and then is absorbed into the body. Many baits are stomach poisons.

**Insect Growth Regulators (IGRs)** are insecticides which alter the growth and development of insects (Chapter 6).

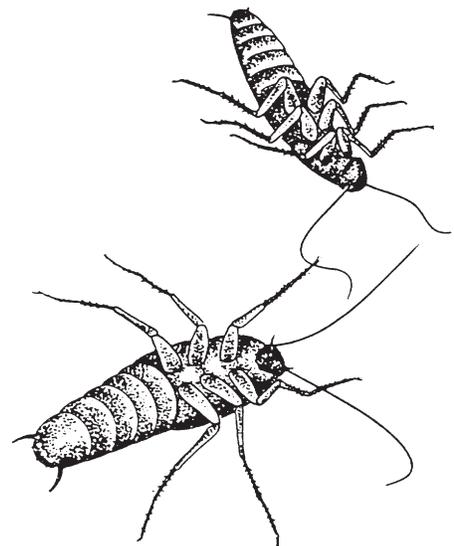


Figure 7-6. Dead cockroaches

(J. Kalisch)



**"LET ME ASSURE YOU, MA'AM, THAT THESE CHEMICALS ARE PERFECTLY HARMLESS!"**

Figure 8-1

(J. Kalisch)

# Chapter 8

## Insecticides and Your Health

### Are Insecticides Dangerous?

Because insecticides are used to *kill* insects, they are toxic to the insect and closely related organisms. Some insecticides kill insects by interfering with nerve transmission; these types of insecticides are potentially toxic to other animals, including humans, because the nervous systems in all animals are similar in structure and function.

The toxicity of each insecticide is different and related to its unique chemical structure. Most insecticides labeled and used inside the home for cockroach control have low to moderate toxicity and care must be taken to avoid exposure to you, your family, and your pets. It is best to strategically place insecticides to reduce exposure to you and your family.

In the last 20 years, manufacturers have developed products which are less toxic to people and pets. When applied correctly, these products more specifically target the pest and reduce risks to people.

The idea of managing risk is expressed by the *Risk Formula*:

$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$

Having an understanding of the toxicity of a product and the potential for personal exposure allows risk to be lowered. No matter how toxic an insecticide is, if the amount of exposure is kept low, risk can be held at an acceptably low level. The toxicity of an insecticide can't be changed, but risk can be managed and you are the manager.

### What is Toxicity?

To do their job, insecticides must control the pest. By their nature, insecticides are toxic and must be handled with care. You can tell the toxicity of a product by reading the signal word (Table 8-1) on the label. Insecticides can enter the human body three ways: 1) through the mouth (*orally*); 2) by absorption through the skin or eyes (*dermally*); and 3) by breathing into the lungs (*inhalation*).

Table 8-1. EPA toxicity categories, corresponding signal words, and relative toxicities for insecticides.

Hazard Indicators				
Signal Word	Danger	Warning	Caution	Caution
Hazard Category	Category I	Category II	Category III	Category IV
Oral LD50	0 - 50 mg/kg	>50 - 500 mg/kg	>500 - 5,000 mg/kg	>5,000 mg/kg
Dermal LD50	0 - 200 mg/kg	>200 - 2,000 mg/kg	>2,000 - 20,000 mg/kg	>20,000 mg/kg
Inhalation LC50	0 - 0.2 mg/liter	>0.2 - 2 mg/liter	>2 - 20 mg/liter	>20 mg/liter
Eye irritation	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin irritation	Corrosive	Severe irritation at 72-hrs	Moderate irritation at 72-hrs	Mild or slight irritation at 72-hrs

**Danger** appears on the labels of all highly toxic products (oral, dermal or by inhalation), or those which are eye or skin irritants. There are only a few products approved for cockroach control with this signal word on their label. Ingesting as little as a taste to about 3½ grams (about ¾ teaspoonful) of one of these insecticides could kill a 150 pound adult. Much less would be needed to kill a child.

**Warning** is the signal word required on the labels of all products moderately toxic, or cause moderate eye and/or severe skin irritation. Lethal dose to kill the same 150 pound adult is 3½ to 35 grams (about ¾ teaspoonful to 2½ tablespoons) of one of these insecticides.

**Caution** signal word is required on the labels of products considered slightly toxic to relatively nontoxic, or cause slight to no eye irritation and/or moderate to mild skin irritation. An average 150 pound adult could be killed by ingesting 35 to more than 350 grams (2½ tablespoons to more than a pint) of one of these insecticides.

Some *Category IV* insecticides are not required to have a signal word on their labels. All labels must bear the statement, *Keep out of reach of children*.

## Relative Insecticide Toxicities

There are other ways for you to compare insecticide toxicities. In the process of getting a label

approved by the EPA, a pesticide manufacturer must determine the mammalian toxicity of the pesticide. Because companies cannot experiment on human beings, they use laboratory rodents to determine the lethal dose (LD) of the pesticide.

An oral LD<sub>50</sub> is the amount of *pure active ingredient* (in milligrams/kilogram of the animal's body weight) resulting in 50% mortality to laboratory rodents when given orally. From the results of many experiments, we can compare the LD<sub>50</sub> of insecticides and other chemicals. Understanding what an LD<sub>50</sub> means can be initially confusing. A *highly toxic* substance has a *low* LD<sub>50</sub> because it takes a small amount of the substance to kill the animal. Conversely a less toxic compound has a higher LD<sub>50</sub>. The LD<sub>50</sub> of each product is one piece of information found on its Material Safety Data Sheet (MSDS). Unfortunately, there is no standardization in the chemical industry. Some MSDS sheets show the LD<sub>50</sub> of the formulated product; others may give the LD<sub>50</sub> of the pure active ingredient.

Tables 8-2 and 8-3 can be used to compare the relative toxicities of some insecticides and other substances commonly found around the home. Please note the low LD<sub>50</sub> of acetone (fingernail polish remover), one of the most dangerous products in the home. Remember, a low LD<sub>50</sub> means high toxicity.

Table 8-2. The LD<sub>50</sub>(mg/kg of body weight) of some substances found around the home. (The Merck Index, 13th edition, 2001.)

Substance	LD <sub>50</sub>	Use
absolute alcohol	10,600	beverage, preservative
acetone	10.7	fingernail polish remover
aspirin	1,000	drug, pain
caffeine	355	constituent in coffee, colas
ethylene glycol	8,540	antifreeze
propylene glycol	24,000-30,000	antifreeze
ibuprofen	626	drug, pain
nicotine	0.3	constituent in tobacco
salt	3,750	food additive
vitamin A	7,910	vitamin
warfarin	323	rodenticide, anticoagulant

Table 8-3. LD<sub>50</sub> of some insecticide active ingredients used in home cockroach control including the corresponding insecticide classes. This table can be used for comparison purposes, but it is important to remember it is the concentration and exposure creating the hazard to the individual (The Pesticide Book, 6th ed. Ware. 2004).

Active ingredient	Oral LD <sub>50</sub>	Class
eugenol (clove oil)	nontoxic	botanical
methoprene	>34,600	insect growth regulator
boric acid	>10,000	inorganic
sumithrin	>10,000	pyrethroid
piperonyl butoxide	>7,500	synergist
hydroprene	>5,100	insect growth regulator
d-limonene (citrus peels)	>5,000	botanical
diatomaceous earth	>5,000	desiccant
hydramethylnon	>5,000	aminohydrazone
tetramethrin	>5,000	pyrethroid
permethrin	>4,000	pyrethroid
sodium borate	2,550	inorganic
resmethrin	2,000	pyrethroid
pyrethrins, pyrethrum	1,500	botanical
acephate	866	organophosphate
allethrin	680	pyrethroid
cyfluthrin	500	pyrethroid
fenvalerate	451	pyrethroid
chlorfenapyr	441	pyrrole
imidicloprid	424	nicotinoid
cypermethrin	250	pyrethroid
deltamethrin	128	pyrethroid
fipronil	97	fiprole
propoxur	95	carbamate
esfenvalerate	75	pyrethroid
lambda-cyhalothrin	56	pyrethroid
abamectin, avermectin b1	10	natural toxin

## Health considerations

**Asthma and Allergies.** Recall from Chapter 1, asthma is a chronic lung disease which has become a serious problem for school-aged children in recent years. These allergies can lead to asthma and cockroach droppings are a common asthma trigger.

Certain insecticides used in homes may also cause or trigger asthma. Research studies indicate exposure to organophosphate insecticides may result in the onset of asthma, leading researchers to list insecticides as one of the preventable causes of asthma in children.

The American Lung Association says asthma attacks have a number of triggers including insecticides. Insecticides known to cause allergies, trigger asthma, and/or respiratory irritation include organophosphates, carbamates, pyrethroids, pyrethrum, and pyrethrins. The active ingredients in most currently available indoor spray, RTU, aerosol and fogger formulations belong to the pyrethroid class of chemicals.

**Special Sensitivity of Children.** The National Academy of Sciences found children are more susceptible to environmental chemicals than adults. This is because children eat more food and drink more liquids on a pound for pound basis than adults. Children also breathe faster and inhale more air than adults. Therefore, considering their relative body weight, children take in more chemicals present in the environment.

At the same time, children's organs are still developing, are more susceptible and less able to detoxify chemicals. For example, a child's lungs do not develop fully until they are 6 - 8 years old. During a child's early years, exposure to environmental chemicals or irritants can have great effects on respiratory development.

Exposure to environmental chemicals during pregnancy can be significant for the child later in life. Researchers have discovered fetuses can become sensitized to chemicals or contaminants while still in the womb. The result is a child born predisposed to developing asthma, allergies, or other health problems.

**Cancer.** The World Health Organization estimates 75-85% of all cancers are related to environmental exposure to pollutants, smoking, and diet. It is understandable many people are concerned about cancer risks of chemicals used inside the home. Tables 3 and 4 do not address cancer risks, but the results of carcinogenicity tests can sometimes be found on MSDS sheets. MSDS sheets are readily available for professional-use pesticides. To obtain MSDS sheets for *over-the-counter* insecticides, you may need to contact the manufacturer's consumer information number, listed on the label. Pesticide information profiles (PIPs) offer similar information as MSDS and are available for many active ingredients: <http://extoxnet.orst.edu/pips/ghindex.html>.

## What if an Insecticide Poisoning Occurs

Get medical advice quickly if unusual or unexplained symptoms appear during the application or later the same day. Insecticide poisoning symptoms are often similar to flu symptoms (headache, fatigue, dizziness, nausea, stomach cramps, and diarrhea). A person who may have been poisoned should not be left alone. Do not let anyone get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late. Take the insecticide container (or the label) to the physician. The key is *rapid* treatment, as time continues to elapse after exposure, the chances for survival decrease. Refer to *Signs and Symptoms of Pesticide Poisoning* (available from University of Nebraska-Lincoln Extension, EC-2505) and *Recognition and Management of Pesticide Poisonings* (available online: <http://npic.orst.edu/rmpp.htm>) for more details about pesticide poisonings.

If the common emergency telephone number is available in your area, immediately call 911 whenever an insecticide poisoning is suspected. Concurrently, the call may be connected to the nearest poison control center. They will be able to provide specific directions on procedures to follow until emergency personnel arrive. If the common

emergency telephone number is *not* available in your area, contact:

1. The Poison Center, 1-800-222-1222
2. The nearest hospital
3. A physician

Always wash exposed skin of the victim with a detergent and plenty of water. Skin irritation can result from continuous exposure if not treated. If clothing has been contaminated, particularly by an insecticide readily absorbed dermally, remove it immediately.

Even though you carefully apply insecticides, accidents can happen. Be prepared. Get a *Hotlines Card* (available from University of Nebraska-Lincoln Extension, EC-2501) and keep it with you at all times. Do not hesitate to contact medical authorities if any symptoms of insecticide poisoning occur. It is better to be safe than sorry.

Most of the insecticides used to control cockroaches are much less toxic than the insecticides used for other applications. When applied properly, they are unlikely to cause any problem for the user. However, use all insecticides safely. Read the insecticide product label completely and comply with all directions given.

Pets are sometimes at risk for insecticide poisonings. If you suspect your pet may have been exposed to an insecticide, contact your veterinarian immediately. For additional information, The American Society for the Prevention of Cruelty to Animals (ASPCA) has an Animal Poison Control Center online: [http://www.asPCA.org/site/PageServer?pagename=pro\\_apcc](http://www.asPCA.org/site/PageServer?pagename=pro_apcc)

## Always Wear the Right Stuff!

Minimizing exposure is the first step toward reducing your risk of insecticide poisoning. The type of personal protective equipment (PPE) needed depends on the toxicity of the insecticide being used and the formulation (i.e., liquid, wettable powder, etc.). Some labels specifically state certain items of clothing, equipment, eye wear, footwear, and gloves must be used. Others carry no statement at all. In general, the more toxic the insecticide, the greater your need to use PPE.

Although most cockroach control insecticides

do not have specific PPE requirements, reasonable precautions should always be taken. Liquid insecticides are often more hazardous to use than dry formulations. Extra protection is warranted while mixing or loading insecticides. In cases where there will be prolonged exposure to the spray or where the application is being made indoors, you should use extra protection.

**Protective Clothing.** When an applicator sprays an insecticide inside the home for cockroaches, where does the spray go? Most will go where the applicator wants it to go, but some insecticide bounces back and gets on the applicator. Studies have shown 80-90 percent of the insecticide which lands on the applicator gets on their hands and forearms. Simply wearing gloves and a long sleeved shirt will drastically reduce dermal exposure during applications.

But, any time you are using insecticides, you should wear at least a long-sleeved shirt and long-legged pants, or coveralls (woven fabric)



Figure 8-2. The basic uniform. When applying pesticides: long sleeved shirt, long pants to protect arms & legs, shoes and socks, and gloves.

(B. Ogg)

which fully cover your arms and legs (Figure 8-2). Select garments made of cotton instead of cotton/polyester blends. Shoes and socks should also be worn. Avoid sandals, thongs, and cloth or canvas shoes to minimize exposure of the feet to liquid insecticides. Leather shoes are suitable while using most insecticides.

#### Protect Your Head, Eyes and Hands.

Protecting your head is advisable, especially if you will be applying insecticides over your head. In general, a wide-brimmed, easily cleaned hat which protects the neck, eyes, mouth, and face is adequate. Avoid hats with cloth or leather sweat bands as these will absorb insecticides. Baseball-style caps have headbands which absorb and retain insecticides.

Insecticides are readily absorbed through the eyes and can cause eye damage. Use goggles or a face shield (Figure 8-3) whenever such a statement is found on the label. Gloves are often needed



Figure 8-3. Insecticides injected into cracks and crevices will sometimes bounce back to the applicator. To prevent this, wear eye protection.

for mixing, loading, and applying insecticides. Unlined, liquid-proof neoprene, butyl, PVC or nitrile gloves which extend well up on the forearm are the best. Avoid lined gloves because the lining can absorb the chemicals and is hard to clean. Latex gloves, commonly used by medical personnel, do not provide adequate protection. Avoid cotton and leather gloves because they can absorb insecticides.

In most cases, wear gloves under the sleeves to keep the insecticide from running down the sleeves and into the glove. When working with hands over your head, roll glove tops into a cuff to keep insecticide from running down the gloves to your forearms.

**Protect Your Lungs.** The lungs and lining of the respiratory system readily absorb insecticide dusts and vapors from the air (Figure



Figure 8-4. Avoid inhaling boric acid by wearing a dust mask.

8-4). Respiratory protection, therefore, is essential whenever the label calls for it. Respiratory protection is recommended during mixing and loading, even if not required by the label. A cartridge respirator is suitable when exposure will be intermittent, such as for cockroach control applications.

Respirators used while applying insecticides should be approved by the National Institute of Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). Be sure to read and follow the manufacturer's instructions for use and care of the respirator. Filters, cartridges, and canisters must be approved for insecticide use (those designated as removing and trapping organic vapors) and must be replaced

at proper intervals. Inspect and test respirators before use to insure a snug fit against the face. Exposed parts of the mask must be cleaned after each use, and the cartridges should be stored in an airtight container.

**Protective Clothing Care.** When working with insecticides, you should wear clean clothing daily. It is best to reserve one set of clothing for insecticide work if possible. Launder and store insecticide contaminated clothing separately. Clothing becoming wet from insecticides should be removed immediately! Fast action will reduce your exposure to the insecticide. Destroy clothing (including shoes and boots) saturated with concentrated insecticides. Waterproof and chemical-resistant hats, gloves, boots and goggles should also be washed daily and hung to dry. Test gloves for leaks by filling them with water and gently squeezing.

## Wash Up!

Good personal hygiene is essential. Soap and water is cheap insurance against insecticide contamination. Wash your hands and face often when working with insecticides. Never smoke, eat, drink, or use the toilet after handling insecticides without first washing your hands! Shower immediately after using insecticides and before changing into clean clothes.

## Insecticide Handling, Storage and Disposal

Insecticides are valuable pest management tools, and like any tool, they must be used carefully and responsibly. Read the label to determine the best way to handle insecticides.

Even when proper procedures are followed, insecticide spills can occur. Knowing what steps to take in the event of an insecticide spill will allow you to respond quickly and properly. Once the spill has been cleaned up, you should read the label for specific decontamination directions. Remember, always wear proper protective clothing when dealing with insecticide spills and to clean up your

equipment and clothing when you are finished.

Store insecticides in a locked and posted cabinet where children cannot get to them. Insecticides should never be stored in a garage, basement, or other unlocked locations in your home. Read the label for correct storage procedures.

Proper rinsing of insecticide containers reduces a potential source of contamination of soil, surface, and ground water. When contamination occurs, plants and animals may be harmed and water supplies affected. Prevention of environmental contamination is always better and less expensive than cleanup.

When an empty liquid insecticide container is disposed of according to label directions, it must be properly rinsed. Triple rinse plastic, non-pressurized metal, and glass containers which have contained liquid or wettable powder formulations. For empty aerosol, bait or dust containers, follow label directions for proper disposal. Refer to *Safe Transport, Storage and Disposal of Pesticides* (available from University of Nebraska-Lincoln Extension, EC-2507) for more details.

## Things to Remember

- ✓ Read and follow all label directions.
- ✓ Store insecticides only in the original, labeled containers.
- ✓ Wear appropriate protective gear as directed by the label.
- ✓ Never reuse an insecticide container for any purpose.



## Chapter 9

# Insecticide Applications

Insecticides are an important tool used for cockroach control, but, to be both effective and safe to inhabitants, these insecticides must be applied properly. This chapter will explain common terminology, types of application equipment and application methods for controlling different cockroach species.

### Definitions

**Broadcast**—Coarse spray of liquid insecticide or application of a dust insecticide over a large area; should be evenly distributed.

**Band/Perimeter**—Coarse spray of liquid insecticide in a wide band or strip; usually several inches (centimeters) wide. Usually around perimeter of a structure.

**Spot**—Application of an insecticide to a small area, usually a gel bait.

**Crack and Crevice Aerosol**—Insecticide application of a specialty aerosol using the application tube provided to place insecticides into voids, cavities, cracks and crevices or other small, tight areas.

**Crack and Crevice**—Placement of the insecticide into cracks, crevices, or seams. Applications must be made so no insecticide residue is found outside the crack, crevice, or seam.

**Dusting**—Thin coat of dust formulation not more than one particle thick.

**Bait Station Placement**—Careful placement of tamper-proof bait stations in areas inaccessible to children and pets and near existing cockroach infestations.



Figure 9-1. Squeeze gel bait into cracks and crevices where cockroaches are hiding.

### Application Equipment

**Bait Stations and Gel Bait Applicators** Insecticide baits are available in sealed, tamper-proof plastic stations or as a gel in a syringe applicator (Figure 9-1). The adhesive tape on the bait stations can be stuck to nearly any surface. When the syringe applicator is used, the gel bait is applied as buttons or small globs (spot application) in areas inaccessible to children

and pets. Determine appropriate locations to place tamper-proof bait stations and/or gel bait based on results from sticky traps used in your cockroach population monitoring efforts.

### Dust Applicators.

To deliver dusts in cracks and crevices you might need to buy a hand-operated duster (Figure 9-2). Look for a local pest control company which sells pest control supplies to the public or on the Internet. The most common types are bulb- and bellows-type dusters. Many over-the-counter dust products are sold in specially designed containers designed to deliver the dust.

**Crack and Crevice Aerosols.** Some aerosols equipped with a narrow application tube are available through pest control companies which sell pest control supplies, the Internet, and sometimes locally at discount or hardware stores (Figure 9-3). These aerosols have a narrow applicator tube or



Figure 9-2. A hand bellows duster can apply dusts in deep into wall voids where cockroaches live. Dusts often remain active for a long time.

straw which is inserted into cracks and crevices during application. Some of these crack and crevice aerosols consist of pure, highly concentrated insecticides dissolved in an inert carrier gas. When the insecticide is injected into a narrow crevice, the inert gases quickly evaporate, leaving only insecticide on the treated surface. These insecticide residues last longer than standard liquid insecticide residues because pure insecticide is more stable than insecticide mixed with water or emulsifiers.

Crack and crevice aerosols have been formulated with many different active ingredients because these aerosols are so safe and effective when used properly. Active ingredients include hydroprene, boric acid, silica aerogel, pyrethrum and many synthetic pyrethroids.

**Ready-to-Use Sprayers.** (RTU) Ready-to-use home pest control liquid formulations provide another way to apply residual insecticide sprays. These products are sold with the applicator nozzle included. They generally have a “pistol-grip” hand-pump attached to the insecticide container and a siphon tube extending to the bottom of the container. These hand pump sprayers can make most of the same liquid spray applications as the compressed-air sprayers, although they usually do not come with a crack and crevice application tube.

**Aerosol Sprayers and Foggers.** Surface and space insecticide applications can be made with aerosol sprayers and aerosol foggers. These aerosol products don’t need any other application equipment. **We do not recommend the use of total-release foggers for cockroach control.**

**Compressed-Air Sprayers.** The basic mechanical unit used by pest control technicians to apply residual sprays for insect control is the compressed air sprayer. One example is the B & G® stainless steel sprayer which has an adjustable nozzle that is capable of delivering different spray



Fig. 9-3. An aerosol with a straw tip delivers insecticide in cracks and crevices where cockroaches live.

patterns. This sprayer can be adapted for crack and crevice treatment. Compressed air sprayers are easy to use, efficient, and readily available.

## Application Methods

How insecticides are applied is extremely important. Many people apply insecticides ineffectively because they either choose the wrong product, wrong formulation or wrong application method.

For example, many people use over-the-counter ant and roach aerosols and expect them to provide long-term control. These products are *contact* insecticides with little residual control. Contact insecticides kill on contact, which means you have to spray the insecticide on the insect for it to work.

Another example is when sprays are applied to baseboards rather than to cracks and crevices where cockroaches live. Because most cockroaches don’t live behind baseboards, this application will not be very effective. Instead, use a crack and crevice aerosol or a sprayer fitted with a crack and crevice applicator tool to treat areas where cockroaches are hiding.

Which insecticide formulation you choose is also very important. Many materials commonly used in home construction can adversely react with certain insecticide formulations, resulting in ineffective control. For example, emulsifiable concentrate (EC) formulations will usually penetrate into porous materials, making the insecticide unavailable to control cockroaches. Wettable powder (WP) formulations on the same porous materials will remain active on the surface of the material after the water has dried. Another example, if you decide to make an application with an EC formulation, you risk damaging some plastic materials. But, a gel bait application (which may be even more effective) will eliminate the chance of

Table 5. Formulations and application techniques for effective treatment of cockroach harborages.

Situation	Formulation	Application
Wooden floors	None	Not recommended
Wooden baseboards <sup>a</sup>	C & C <sup>b</sup> (aerosol, liquid WP or RTU)	Crack and crevice (aerosol, liquid WP, or RTU)
Vinyl baseboards <sup>a</sup>	C & C (aerosol, liquid WP or RTU)	Crack and crevice (aerosol, liquid WP, or RTU)
Carpets <sup>a</sup>	None	Not recommended
Electrical outlets, motors, compressors	Gel bait, dust, C & C aerosol <sup>c</sup>	Spot bait placements, dusting, crack and crevice aerosol treatment using plastic applicator
Painted drywall	None	Not recommended
Above false ceilings	Dust, tamper-proof bait stations	Dusting, bait station placements
Around or on pipes	C & C (aerosol or RTU), gel bait, dust	Crack and crevice (aerosol or RTU), spot bait placements, dusting
Wall voids	Dust, C & C aerosol	Dusting, crack and crevice aerosol application
Insulation, fiberglass	Dust	Dusting
Food storage <sup>d</sup> locations	C & C (aerosol, liquid EC, or RTU), gel bait or tamper-proof bait stations	Crack and crevice (aerosol, liquid EC, or RTU), spot bait placements and/or bait station placements
Appliances <sup>d</sup>	Dust, C & C aerosol, gel bait or tamper-proof bait stations	Dusting under and around, crack & crevice aerosol, or spot bait placements and/or bait station placements
Cabinets <sup>d</sup>	C & C (aerosol, liquid EC or RTU), gel bait or tamper-proof bait stations	Crack and crevice (aerosol, liquid EC or RTU), spot bait placements and/or bait station placements
Hot locations	C & C (aerosol, liquid EC, or RTU), gel bait or tamper-proof bait stations	Crack and crevice (aerosol, liquid EC or RTU), spot bait placements and/or bait station placements
Wet locations	Gel bait or tamper-proof bait stations	Spot bait placements and/or bait station placements
Greasy locations	C & C (aerosol, liquid WP or RTU), gel bait and/or tamper-proof bait stations	Crack and crevice (aerosol, liquid WP, or RTU), spot bait placements and/or bait station placements
Outdoors	Aerosol, liquid EC, or RTU	Band/perimeter and/or broadcast

<sup>a</sup> EC formulations can react with chemicals in wood stains, carpet dyes, and vinyl, resulting in reduced insecticide activity and damage to the surface.

<sup>b</sup> Crack and crevice

<sup>c</sup> Because these crack and crevice products contain no water or oil emulsifiers they are ideal for treating electric motors and switch boxes. The motor housings of refrigerators and freezers are an important and overlooked place where German cockroaches find an ideal habitat.

<sup>d</sup> Before application, remove all food and utensils and protect them from exposure to the insecticide.

damage. Table 5 gives the most effective insecticide formulations and application methods at locations where cockroaches live.

## Species Specific Management

Because cockroach species have preferred habitats, you will need to target specific areas within your home for most effective control. The following will help guide your control efforts.

### German Cockroaches

- Concentrate in kitchen, bathrooms, and any other room where food and/or water is readily available.
- Look for possible cockroach habitats near electrical heat sources, like refrigerator compressors and fan motors.
- Apply crack and crevice treatments and/or gel baits to all cracks, crevices, and seams where cockroach activity is observed. Preferred habitats are in cracks between, under, and behind cabinets and where counter tops touch walls and sinks.
- Examine baseboards, ceiling trim boards, and wall paneling. Apply crack and crevice treatments of liquid, aerosol, or RTU insecticides or gel bait if signs of cockroaches are found.
- Examine wall decorations, like clocks and pictures, for the presence or evidence of cockroaches. Use freezing treatments, gel baits, or crack and crevice aerosols.
- Small appliances, such as toasters and blenders, should be checked for signs of cockroaches. Gel baits, crack and crevice aerosols, or freezing are best treatments. Avoid insecticide contact with food contact surfaces.
- Examine large appliances for signs of cockroaches. Pay particular attention to areas under magnetic seals on refrigerator and freezer doors. If they are found, carefully apply crack and crevice liquid, aerosol, or RTU insecticides and/or gel baits to the infested areas. Never apply insecticides so food, dishes, or utensils can become contaminated.
- Wall, ceiling, or floor voids in kitchens and bathrooms are also favored habitats. Dusts,

crack and crevice liquid, aerosol, RTU, or gel bait applications can be used in these locations. The most likely entrance into wall void areas is through openings around pipes under the sinks. Treat and seal these openings.

- Hollow locations such as table and chair legs are important harborage because they are easily overlooked. Treat these areas similarly as for crack and crevice locations, or carefully apply small amounts of dust. Baits are also especially effective in these locations.

### Brownbanded Cockroaches

- Because brownbanded cockroaches have a lower water requirement than the other cockroach species, they can be found in all rooms of the house, apartment, or building. In addition to all the locations mentioned for German cockroaches, additional locations may need to be treated.
- Check trim and framing around windows, doors, and closets. If a treatment is required, use a crack and crevice liquid or aerosol application, or gel bait.
- Examine pictures, tapestries, and other wall decorations carefully. These locations are especially common for brownbanded infestations. If infestations are found, use freezing treatments, gel or tamper-proof baits, or crack and crevice aerosols.
- Check television, stereo, radio, clocks, and other electric motors with warm microclimate areas. Use special caution when attempting treatment because of the possibility of electrical shock. Use freezing treatments where possible, and dust applied very lightly for others. Some of the crack and crevice aerosols may be labeled for use in electrical appliances as well.
- Textured ceilings are a common place for the female brownbanded cockroaches to attach egg cases. Physically remove egg cases, paint the ceiling to discourage cockroaches from returning, and apply a gel bait as a spot treatment if necessary.
- Furniture with drawers in the bedroom and living room is attractive to the brownbanded cockroach. If infestations or signs are found, treat the interior of furniture using a crack and crevice liquid, aerosol, or RTU insecticide or apply insecticidal

baits.

- Other furniture, such as chairs and couches, can also be infested. If found, apply a crack and crevice liquid, aerosol, or RTU treatment to the underside of infested furniture.
- Hollow locations such as curtain and drapery rods, table legs, and pole lights are important harborage for brownbanded cockroaches as well. Treat these areas similarly as for crack and crevice locations, or carefully apply small amounts of dust. Baits are also especially effective in these locations.

### **Oriental Cockroaches**

Oriental cockroaches require cool temperatures, high moisture, and readily available drinking water. They can occur in many of the locations mentioned earlier for German cockroaches, but concentrate in basements, bathrooms, laundry rooms, and under the kitchen sink. Follow the same treatment recommendations as for German cockroaches plus add those listed here.

Outdoors:

- Make a band/perimeter treatment with a liquid, aerosol, or RTU insecticide to all external entry areas (especially thresholds), to the entire perimeter of basement foundation, and to other slab construction areas (garage, porches, sidewalks, and stairways).
- Reduce vegetation near the foundation of the house.
- Make a crack and crevice and/or spot treatment with a liquid, aerosol, or RTU insecticide to all exterior utilities entering the structure (telephone, cable TV, natural gas, water). Seal utility entrances.
- Reapply treatments to all exterior areas mentioned as needed during warmer months.

Inside:

- Investigate crawlspaces and basement areas containing exposed soil. If cockroaches or signs are found, make crack and crevice liquid, aerosol, or RTU applications to headers, undersides of floor joists, around vents and windows, and sill plate areas. You may also want to apply gel baits or tamper-proof bait stations.
- Make spot treatments with either gel bait or

tamper-proof bait stations underneath sinks and tubs, behind water and gas meters, around floor drains, underneath water heaters, and around humidifiers.

### **American Cockroaches**

- Although American cockroaches are less common than the other species, they can occasionally become a problem in Nebraska dwellings. They are found in all locations where German cockroaches are found, and in some areas where oriental cockroaches are found. If signs of American cockroaches are found, follow the specific treatment recommendations given for German and oriental cockroaches.
- Some habitats are especially attractive to American cockroaches and should be specifically investigated. These areas are very warm, moist locations, such as boiler rooms, steam tunnels, heated floor drains, around hot water supply pipes, and heating ducts.
- In general, liquid, aerosol, and RTU formulations will degrade quickly under hot, moist conditions. Dust and bait applications, if made properly, will be less affected by heat and moisture and will last longer than liquid formulations.

**Before using any insecticide, always read and follow all instructions given on the label. This information is not only informative and useful, but it is the law! Any use not consistent with the label is considered a violation of the law and carries with it strict penalties.**



Figure 10-1. Glenn's management plan seems to be missing something.

## Chapter 10

# Putting a Management Plan Together

At this point, you may be somewhat confused about all these different formulations and chemical classes. How do you decide what to use and where?

First, you should make every effort to reduce water, food, and shelter available to the cockroaches. These efforts will make other control tactics more effective.

Next, you will need to determine which of the previous formulations or compounds will work for you. The control program you select should be based on factors unique to your own personal situation. For instance, if a less toxic approach is important to you, then only consider those tactics that are less hazardous to you, your family, and pets. If the less toxic approach is not as important, and you feel able to mix and apply pesticides, your control program may include wettable powder and emulsifiable concentrate formulations.

Your management plan should consider activities of other people and pets in the environment. For example, if you want to treat a duplex that is vacant, you may choose a different strategy than if you are treating an occupied duplex. If you are treating your own home, you may also want to time the treatment so you can be gone for a period of time afterwards.

### Less Toxic Control Tactics

1. Continually reduce the availability of water, food, and harborage. This is true when using less toxic controls and is true when other control options are used. Any control will be more effective when cockroach resources are eliminated or reduced. Refer to Chapter 5.

2. Reduce humidity with dehumidifiers, if high humidity is a problem. But, to prevent the cockroaches from using the dehumidifier water, empty frequently.

3. Consider using heat or freezing treatments for infested small appliances (Chapter 6).

4. Use baited sticky traps or traps containing cockroach pheromone in infested areas. You may need to get these from a pest control company

that will sell pest control supplies, or search on the Internet to find them.

5. Use insect growth regulators containing hydroprene.

6. Use baits. Gel formulations containing hydramethylnon, fipronil, imidacloprid, boric acid, indoxacarb, and abamectin will work for all cockroach species. Use tamper-proof bait stations if you prefer. (Remember, the baits will work better when sanitation is good.)

7. Use desiccants (silica aerogel and diatomaceous earth) or boric acid dust in dry areas, such as under appliances or in wall voids. Dust formulations can be used in wall voids and other places where people and pets cannot disturb them. Once in place, the chance of exposure is small and hazard is reduced.

8. Use of crack and crevice treatments with aerosols are also relatively safe and easy to use. These aerosols can be purchased from pest control companies that sell pest control supplies, on the Internet, and sometimes locally at hardware or grocery stores.

9. If you have the equipment, use a liquid insecticide in cracks and crevices where cockroaches live. This will reduce exposure to people and pets.

10. Consider a ready-to-use (RTU) home pest control liquid formulation. Try a product that comes with a spray nozzle attachment which is safer than concentrated liquid formulations because you do not need to mix chemicals into a sprayer. The total-release foggers (*not recommended!*) or aerosols not designed for crack and crevice application are contact insecticides and have little long term activity. This means you will have to apply them much more frequently than residual liquid insecticides. When using any insecticides, be sure to read and follow all label directions for use.

11. Continue to monitor your progress with sticky traps.

**Note:** It is possible for cockroach populations to become resistant to insecticides. If control is poor, you may want to periodically change the class of insecticide you are using, this is called *rotation*.

## Rental Management

If you are an apartment manager or rental owner, your approach may be a little different than that of using less toxic controls. You may be more concerned about the effectiveness of specific chemicals than their toxicity. At the same time, you should be concerned about the safety of your tenants and safety to the insecticide applicator.

Between tenants, you will have an opportunity to do a thorough cleaning and treatment of the dwelling. Dripping faucets and leaky plumbing will need to be fixed. Clean under appliances. Cracks greater than 1/16" (1.6 millimeter) will need to be caulked. You may want to dust wall voids with desiccants or boric acid dusts. You may also want to do a full-scale crack and crevice treatment while the apartment or house is vacant.

After new tenants move in, encourage the tenants to be as clean as possible and continue to limit the availability of water and food to cockroaches. You may wish to give them a photocopy of our sanitation suggestions in Chapter 5.

If the cockroach infestation re-occurs, share with your tenants a list of the less toxic control methods on the previous page. They might be willing to use some of these tactics, such as desiccants and boric acid, if they know how. They may also be willing to use baits as an additional control measure.

Communication to the tenant about pesticide use is the responsibility of the rental manager. Labels and MSDS information about any insecticide used in a cockroach treatment should be given to tenants.

If you are using an insecticide treatment, let the tenants know what to expect after treatment. If you use a pyrethroid, tell the tenants that they might see more cockroach activity for a few days. This means that the insecticide is working.

## Insecticide Tips: What to Use?

There are problems with trying to recommend specific insecticides. One problem is that an insecticide that kills cockroaches effectively in toxicity tests in the laboratory may not be as effective in

field tests. Under most conditions, *most* tank-mixed insecticides will reduce cockroach populations. But, regardless of the product, sometimes an insecticide fails to control cockroaches in an apartment, home, or duplex. The reasons for the failure of a specific product are not always known. The bottom line is that if you use a product and it does not control the cockroach population like you expected, *try something else*. It could be that you have a resistant population of cockroaches. Or, maybe the level of sanitation needs improvement or additional caulking of cracks and crevices should be done. The important thing is that you don't give up. If you take all the steps suggested in this manual, you can significantly reduce any cockroach population.

## Working with a Pest Control Company

After all you've learned about controlling cockroaches, maybe you've decided you would rather let somebody else handle the insecticides. What do you look for when you want to find a reputable pest control company? Here are some suggestions to consider:

1. Regardless of how bad the infestation is, take your time in hiring a pest control company. Spend a week or two gathering information.
2. Arrange to have four or five professional pest management companies inspect your home and estimate the cost of the treatment. Request that all bids be put in writing.
3. Ask each company to describe in detail the precise procedures that they will use to treat the infestation. By now, you know the basics of cockroach biology and treatment. Let them know that you know something about cockroach control by asking lots of questions to find out what they know.

**Some questions you might ask the pest control professional:**

- What kind of cockroaches are these?
- Where is the infestation located?
- Will you monitor the infestation with sticky traps?
- What insecticides will be used and why are you going to use it?

- Will the insecticide provide long-term residual control?
- What methods will be used to insure my family's safety?
- What non-toxic or less-toxic types of controls will be used?
- Will IGRs and low-toxic baits be used as part of the treatment?
- How often do you recommend treatment, and how will you know if it is needed?
- Will IPM principles be followed?

Request label and MSDS information for each insecticide that they propose to use. There are no special or secret insecticides available to only select pest control companies. All companies can use any of the insecticides currently registered for use in Nebraska.

4. Be sure to discuss any health concerns that you might have. Some concerns might be family members with allergies, a pregnancy, or pets. How will the pest control company deal with these sensitive problems?

5. How long has the pest control company been in business? This is not definitive, but companies that have been in business for many years often have built a credible reputation with their clients. Request to be furnished with a list of recent references on cockroach control in your area. Be sure to call the references and ask them to comment on the service that they received.

6. Before you hire a company, be sure to check with the Better Business Bureau.

## What Doesn't Work: The Fallacy of Home Remedies

So far, all the chemical and non-chemical control tactics that have been discussed have some adverse action against cockroaches when used properly. There are home remedies and other gizmos that some people believe will work against cockroaches. These approaches may even have a scientific basis, but for various reasons, are not effective against cockroaches.

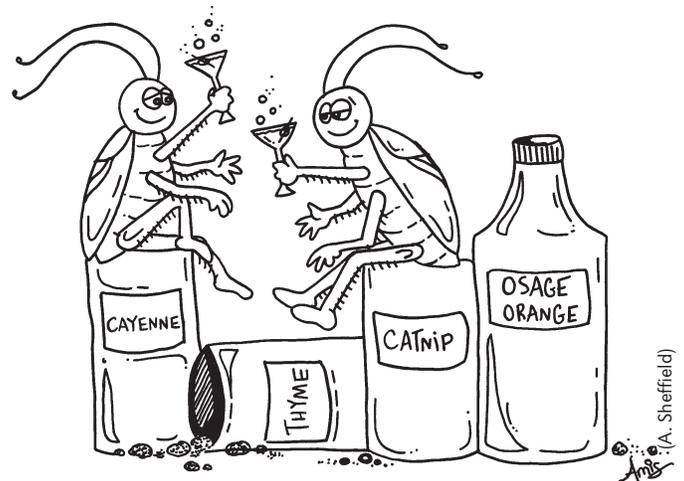


Figure 10-2. Using home remedies for cockroaches wastes valuable time that could be used to reduce the population with products that really work.

## Home Remedies

Home remedies are common household substances that are used for another purpose. It has been shown that some aromatic herbs and spices have repellent properties against insects, especially when the repellent compound is very concentrated. Unfortunately, using repellents against cockroaches is not a very effective strategy. Instead of controlling the infestation, the best you can expect is to move cockroaches to different locations within the same household. Repellents only repel; they may not have any insecticidal properties.

**Osage Orange, Citrus, Cucumber, and Onions.** Insecticidal and repellent chemicals have been extracted from Osage orange, citrus peels, cucumber peels, and onions, but none of these extracted chemicals have been shown to effectively control cockroaches. If the concentrated chemicals are not effective, it follows that the Osage orange, citrus, cucumber peels, and onions themselves will also be ineffective.

**Spices and Herbs.** Certain spices and herbs are said to repel/control insects. Cinnamon, catnip, and thyme are some examples; others include bay leaves, cloves, fennel, garlic, lavender, peppermint, rosemary, spearmint, and tansy. These herbs all contain chemicals that if extracted and concentrated enough, will repel/control some insects, including

cockroaches. But none have been shown to produce practical results under real life situations such as in homes, businesses, and institutions. You may see recipes for garlic pesticide solutions that contain garlic, onions, and hot pepper. These solutions are more repellent to the person making them than they are to cockroaches.

**Salt, Red Pepper, Chalk, Talcum Powder, and Bone Meal.** Some people claim that other household items, like salt, red pepper, chalk, talcum powder, and bone meal, have repellent or insecticidal properties. Unfortunately, these materials will not kill or change the behavior of cockroaches. In fact, the cockroaches may actually eat the red pepper powder.

**Soapy Water.** Soapy water solutions can be used to control certain insects on plants. Liquid dish washing soap mixed with water will kill cockroaches when sprayed directly on the insect. But, as with other contact sprays, dish soap offers no long term control.

**Bacillus Thuringiensis (B.t.).** *Bacillus thuringiensis* is a bacteria that produces a lethal toxin that will control some mosquitoes, black flies, beetles, grasshoppers, crickets, and moth and butterfly larvae. At the present time, no strains of B.t. have been identified that are effective against cockroaches.

**Bran, Baking Soda, and Baking Powder.** An old wives' tale says that if you feed bran to insects, the bran will swell up inside the insect and it will die. There are similar claims made about baking soda and baking powder, common leavening agents used in baking. Bran, baking powder, and baking soda will not cause cockroaches to die

## Devices, Gadgets, and Gizmos

**Ultrasonic Devices.** There are some so-called "ultrasonic devices" that claim to repel insects, rodents, birds, and other vermin. There is no scientific evidence to suggest that cockroaches (or any other insects) respond in any way to ultrasonic sound waves.

In the early 1980's, researchers at the University of Nebraska–Lincoln studied the effect of ultrasonic sound waves on cockroach behavior. Results were reported in *Pest Control* magazine (June, 1982, page

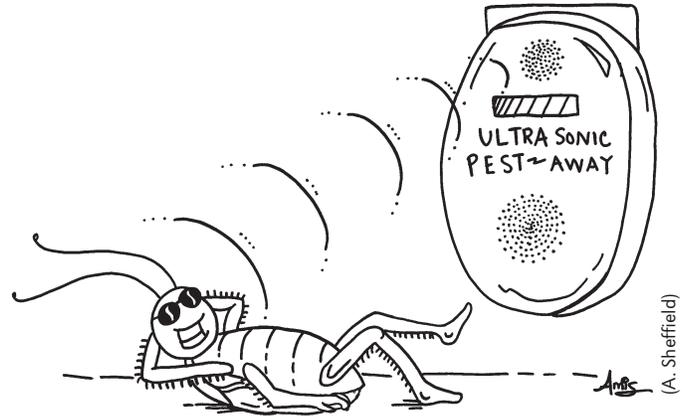


Figure 10-3. Cockroaches survive, even thrive when ultrasonic devices are placed in infested dwellings. Cockroaches and other insects don't have the ability to detect ultrasonic sound waves.

24). In this report, the authors stated, "...it appears that sonic and ultrasonic sound is ineffective to control or repel German cockroaches". Another issue of *Pest Control* (February 1984, page 26) reports on a panel discussion that occurred at the Entomological Society of America meetings. The author says, "the bottom line on ultrasonics is this: none of the researchers who spoke...felt that ultrasonic devices control insects". One panel member summarized the entire issue, "Let's get those devices that don't work off the market..."

One researcher recently said, "These devices are marketed as sonic, ultrasonic, subsonic, and ionic. But they are all simply moronic!"

**Electric Cat.** A device that originated in Brazil is the *Vibromax*, the Electric Cat. This gadget was designed to mount directly to reinforcement bars within concrete floors and walls. The manufacturers claimed that the vibrations produced by the device would imitate those of a mild earthquake. This device was also tested at the University of Nebraska–Lincoln. Results showed that the vibrations produced by the *Vibromax* had no effect on cockroach behavior and would not repel them.

**Bug Zappers.** The last device that should be mentioned is the bug zapper. It is designed to kill flying insects that are attracted to the color of light produced by the device. But the bug zapper does not control cockroaches because they are not attracted to this color of light.

## More Outrageous Claims

**Copper, Aluminum Foil, and Hair.** *Copper foil* is said to produce an electric current that insects don't like and thus repels them. Copper foil has no effect on insects whatsoever. Some people believe that insects will not cross *aluminum foil* because they see their reflection and become confused. It is not possible for cockroaches to see their reflection in foil, let alone become confused. Aluminum foil will not control or repel cockroaches. Finally, it has been said that human or horse hair stretched out in a line will prevent insects from crossing it. It is said that if insects cross the hair, they will die of dehydration. This is the most outrageous claim of all. Human or horse hair will not dehydrate cockroaches!

## Future Controls?

Researchers all over the world continue to look for more effective, safer, and cheaper methods to control cockroaches. These new agents will be inherently less toxic, designed to kill only specific target insects, and the methods used to apply them will be more precise. Many ideas are now being investigated. Probably the most basic change will not be the technology used to control cockroaches, but the attitude about *how* the control work will be done.

Impact on the environment will be considered even more in the future. Many existing formulations will be eliminated and some will be redesigned. A good example are the solvent systems in some aerosols. Products containing ozone-depleting solvents are being phased out now, forcing manufacturers to find more environmentally friendly alternatives. The new formulations will also contain active ingredients safer for the environment

and less toxic to the applicator.

Because they have been so successful, cockroach baits will continue as a major area of development. Over the last few years, the list of active ingredients has grown from only one or two to more than ten. This increase in the number of products was forced by the cockroaches themselves. In some areas where baits have been used repeatedly, some cockroaches wouldn't eat the bait. Some don't like the gel bait formulation; others didn't like the ingredients. But, bait manufacturer and university researchers have found new active ingredients and bait formulations to solve these problems. New problems will almost certainly arise in the future, requiring new solutions. The result will be many more formulations and active ingredients.

Many new cockroach control tactics, along with refinements of the ones already mentioned, will certainly appear over the next decade or so. Some of them will prove to be effective and others will not. Some may work very well, but will be too dangerous or expensive. From time to time you will see or hear about a new product. Remember, ask questions, *be skeptical*, and use common sense when making decisions. If it seems to be too good to be true, it probably isn't.





# Cockroach Pests of the Northern United States

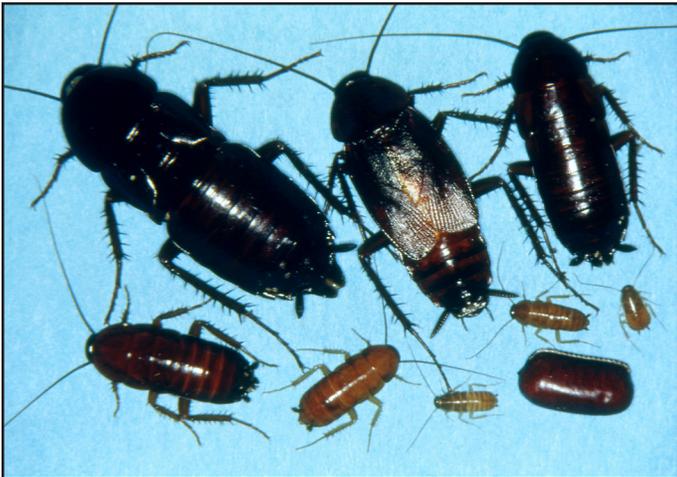


**German Cockroach**  
(enlarged)



**Brown-banded Cockroach**  
(enlarged)

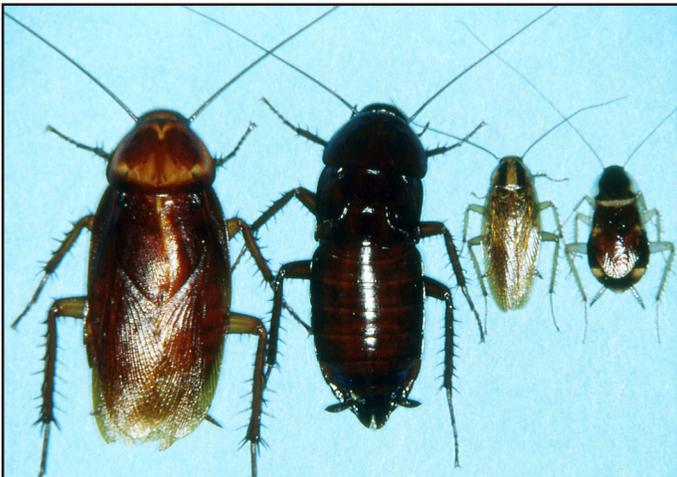
(Photos by Jim Kalisch, UNL Entomology)



**Oriental Cockroach**  
(slightly enlarged)



**American Cockroach**  
(actual size)



**Comparison of Cockroach Adults**  
(enlarged)



**Comparison of Egg Cases**  
(enlarged)