

[Tech Talk] The Importance of German Cockroach Baiting

Columns - Technically Speaking

April 30, 2012

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We seldom hear of German cockroach infestations as much as we did in the past. Bed bugs have pretty much stolen the pest management headlines! However, commercial kitchens and inner-city apartment dwellings continue to suffer from large German cockroach infestations. In fact, this pest remains the most common cockroach species in homes and institutions in the United States. Its presence leads to serious economic and public health concerns.

German cockroach frass (pepper-like fecal droppings) can soil materials and is unsightly, but this species is implicated in *Salmonella* and *E. coli* food poisonings in affected kitchens as well, and its presence in apartments has been correlated with the development of allergies and asthma in inner-city children; their shed cuticle skins and frass break down into tiny particles which become aerosolized and easily breathed in.

You are important in protecting public health and welfare by successfully ridding your accounts of German cockroach infestations. Baiting is one of the means to accomplish this goal. That doesn't mean that you should ignore other management strategies. Proper baiting and other management strategies are essential for eradicating the foe you are up against. A brief review of its biology and behavior is warranted.



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Reproductive success. Compared with other cockroaches, the German cockroach female has mastered evolutionary reproductive success. On average, a new ootheca (egg case) is produced every month, and contains between 32 and 48 embryos. To illustrate just how prolific she can be, consider this: Assuming that half of the embryos were female in each case each time, and that they would each go on to successfully reproduce 48 embryos at the end of the next month, and so on, for a year, there would be approximately 1,500,000,000,000,000 female cockroaches in one year from just that one original female.

Of course, this assumes perfect conditions of food, temperature, water and harborage, and no control efforts. A 15 followed by 14 zeros is a much larger number than our current \$14.3 trillion federal debt!

Diet. German cockroaches require a diet of carbohydrates, proteins and nutrients. But they prefer greases and carbohydrates. They love messy commercial kitchens, especially along stove lines with fryers and hard-to-reach areas to clean. The grease build-up provides all the food they need. Warmth is an added bonus.

Purdue University research has shown that water is absolutely required in the German cockroach diet, and that males cannot live longer than three days without water. (Females can survive a bit longer.) This tells us that we will find them near water sources – usually in kitchens and bathrooms.

Behavior. Like most insect (and rodent) pests, German cockroaches need to have two sides of their body being touched at all times; this behavioral phenomenon is called *thigmotaxis*. They will be found in areas where this can occur – within cracks, crevices, between corrugations of cardboard boxes, within stacks of paper grocery bags, within refrigerator gaskets or between walls and utility (plumbing and electrical) lines.

They are nocturnal, unless there is a huge infestation; then you will see them during the day, since all the good harborage areas will have been taken and there is no place left to hide.

Adult females tend to remain in the *harborage* (dark, warm, secluded areas) 75 percent of their lives when carrying an ootheca; and they do not stray far from the cracks and crevices once their nymphs hatch. The first instar (stage) nymphs stay close to the mother because they feed only on her frass – an aggregation pheromone in the frass promotes this behavior of



TOP: German cockroach frass can soil materials and is unsightly, but this species is implicated in *Salmonella* and *E. coli* food poisonings in affected kitchens as well. (Photo: Gary Alpert, Harvard University, Bugwood.org) BOTTOM: The German cockroach is more active, produces more eggs and grows faster than other common roaches. Photo: Clemson University - USDA Cooperative Extension Slide Series

huddling close to mom. Older nymphs will feed on the same materials as adults and will leave the harborage to seek food and water. Adult males forage the greatest distances for food and water and, in response to female sex pheromones, to mate.

Knowing these basics of behavior and biology and understanding that most infestations are delivered into an account with goods or on people in the first place tells us where we most need to inspect (and then monitor and bait) in these accounts.

Global focal points. Areas to inspect include kitchens, bars, bathrooms, drains, storage areas (especially housing cardboard), employee lockers, ice machines, trash cans, recycle bins and mop sinks. Within a kitchen, in particular, the most common harborage areas are:

1. Storage with corrugated cardboard (liquor closets, extra ingredient closets, etc.).
2. Sinks and their metal housings, splash guards and plumbing lines into the walls.
(Always check the legs and feet of these metal stands.)
3. Stove lines and the walls behind them.
4. Cove moldings.
5. Wall coverings.
6. Food/trash carts. (Always check the wheel wells of these carts – notorious for transferring hidden cockroaches.)
7. Dishwashers and lines and their metal housings and splash guards.
8. Employee lockers.
9. Drop ceilings.
10. Refrigerator gaskets and motors.
11. Coffee machines and motors.
12. Mixers for baking and their motors.
13. Microwaves and their motors.

When managing these pests, consider what is contributing to the success of the infestation. If we think of food, water and harborage as a three-legged stool, and we remove one of these legs, the population will be stressed, and any efforts we make at control will be more successful. We want that stool to collapse! Work with clients to educate them on removing all sources of food and water which could compete with any baits you place, and point out sources of clutter like cardboard and personal belongings in employee lockers that can serve as harborages.

Monitoring. It's important to place lots of monitors properly. Monitors are inexpensive and provide information 24/7. This fact was brought home to me recently at a restaurant. A savvy technician had placed a monitor in the kitchen prep area near the base of an industrial mixer. It trapped 20 German cockroaches. We opened up the mixer and found a satellite infestation feeding on fermenting dough; they were well hidden within the motor of the mixer.

Monitors are an easy decision-making tool at your disposal. But place them where cockroaches will encounter them; recall the phenomenon of *thigmotaxis* – place monitors where two surfaces meet. Place them along utility conduits, at floor/wall junctions and in corners, where they will naturally encounter foraging cockroaches.

What exactly can a monitor tell you? For example, say you had a female captured on a glueboard monitor. Let's say the ootheca hatched soon afterwards, producing many first instar nymphs. Fortunately, these were also caught. What would a monitor like this tell you? This is the value of a proper monitor placement! You also could see which direction the female was traveling and you know the harborage she was using is nearby; recall that females are in the harborage 75 percent of the time, and do not leave it to feed when carrying an ootheca. Monitors may trap curled wing cockroaches, telling you if any IGR (insect growth regulator) efforts are working.

Baiting. Once your monitors have located the areas of infestation, concentrate your baiting and other management efforts. German cockroaches are small, so they tend to go more toward gel baits, and less so to solid, larger granular baits (reserved for the larger cockroaches.) In addition, the gel is moist and attracts them, and the inert ingredients contain the carbohydrates and proteins their diets need. They then inadvertently consume the active ingredient in feeding on the baits and die.

But, in order for the baits to work, there has to be little food competition, which unfortunately poorly sanitized kitchens provide. You may or may not get cooperation with the client in cleaning the kitchen. Education about cleaning and removing clutter is important. But, regardless of the effort made, use baits. Baits are effective, but they may require persistence, patience, reapplication and repeated reminders to the kitchen staff to do what they can.

It does help to use a plastic putty knife to scrape down old bait placements that have dried out and are no longer palatable to this pest. This happens especially along high-heat stove lines.

New bait placements are critical. Female German cockroaches are in the harborage 75 percent of their lives. So you need to bring the baits to them in the cracks and crevices. *A little dab (pea-sized) will do.* Do not become “bait jockeys” – caulking an area with gel baits; this is unsightly, unnecessary and a waste of good bait. The bait will work in clutter and dirty areas on cockroaches. Bait high and low and in three dimensions. Cockroaches can be in the drop ceiling or below a raised floor. Bring a ladder; pop open the tiles or open access points to inspect, monitor and bait. The cockroaches will tell you where they are. Look for the frass accumulations and place bait there. Get down and get dirty.

A word of caution. First, maintain safety with older metal-tip applicators. Be cautious where you place a metal tip. Also remember that gels have moisture; so use caution when injecting behind an electrical plate; water or metal and electricity do not mix.

If you have been using baits and are having trouble getting control of an infestation, consider the causes as to why. Before thinking resistance is the reason, ask yourself, “Is there too much bait competition? Have baits been placed properly? Is it a bad bait shipment? Have I contaminated the bait?”

Yes, you can contaminate the bait. Nicotine is a natural insecticide and repels insects; if you are a smoker, you may be causing the issue, especially if you don’t wear gloves when baiting or wash your hands after smoking. Of course, vehicle odors from other materials – colognes, soaps, lotions, foods, etc., all can be absorbed by baits and repel cockroaches as well. And, use caution to not contaminate baits by spraying over them with a repellent pyrethroid material.

Perhaps it is resistance. In the early 2000s, glucose aversion to the baits was discovered. Once identified, the bait inert ingredients were remanufactured, and that issue was resolved. There has been some fipronil-based bait resistance documented since 2007. There are currently no resistance issues documented with hydramethylnon-based baits. But over time, all insecticides, when used repeatedly, will eventually drive cockroach populations genetically toward resistance.

How fast can insecticide resistance “evolve”? Scharf et al. [(1998) *Pesticide Biochem. Physiol.* 59:67-79] showed resistance development in one generation of German cockroaches. This was not a study with baits, but illustrates how quickly resistance can occur.

Rotation-based resistance management becomes important to keep our arsenal available to attack our foes. Use insecticides in sequence, or on a generational or seasonal basis. *Refer to the IRAC (Insecticide Resistance Action Committee) website for more tips and information. (<http://www.irc-online.org> (<http://www.irc-online.org>)).*

Documentation. Hold the facility management personnel responsible for their cockroach infestation, especially if you are not getting cooperation or numbers seem to continue to be an issue. Write up the service report to tell them where they need to improve. Record deficiencies, and take clear photos. Get a copy of the report to the decision maker in the account. Then refer to this report on future follow-up visits. Include information on foodborne illness associations with cockroaches and negative impacts on health and business. Remind the account that this is a team effort!

Follow-up. It is likely you will have to reapply materials, especially in heavily washed and sanitized areas. Residuals are constantly being removed with cleaning efforts.

Sunlight also breaks down residuals over time. Baits dry out. Don’t become complacent in your approach – which is especially easy to do with baiting. But, remember that German cockroaches can be delivered into an account with the next shipment of goods or the next employee that walks through the door. Keep employee locker areas well-baited. Schedule a quarterly employee locker day to clean out and bait all areas. Keep

receiving areas well-baited too, and ask the facility to unload goods and get rid of all cardboard before storing items up and off the floor. With such diligence and patience, even the most challenging of German cockroach infestations can be eliminated.

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