

# Annual Cockroach Control Issue] Bait Rotation: Crucial to Control

Features - Annual Cockroach Control Issue

Cockroach baits are PMPs' favorite way to control cockroaches. But if the industry isn't careful, in the future, these products may not work as well as they do today.

- July 21, 2015

- Donna DeFranco

The development of cockroach bait formulations more than 25 years ago revolutionized treatment protocols. No longer tasked with complex preparation and cleanup, PMPs reveled in the ease of use and increased efficacy of cockroach baits. However, overreliance on certain roach bait formulations has resulted in bait resistance and aversion to some popular insecticides, leaving PMPs asking questions about how to achieve and maintain high levels of efficacy. Scientists across the industry are looking to help.

“Cockroach gel baits have been the most effective product for German cockroach control for many years,” says Byron Reid, senior principle scientist at Bayer Environmental Science. “The danger is that we could ruin what has been a very effective tool by not paying attention to the science behind what cockroaches are telling us about baits.”



Reid, along with researchers across the nation, asserts that rotation is a vital component of cockroach treatment and “the only way we can preserve the long-term control of German cockroaches we’ve enjoyed with gel baits for the past 25 years.”

Joe Barile, technical service lead at Bayer Environmental Science, adds, “I was an applicator during that magical transition between liquid insecticide applications and baits. I was involved with Austin Frishman in the early development of these products. I don’t want our industry to go back to methodologies we used back then. Anything we can do to protect and preserve the continued use of bait formulations is paramount.”

## How Cockroaches Evolve to Resist Baits

What physiological mechanisms help cockroaches build resistance to the active ingredients in baits? North Carolina State University Distinguished Professor Coby Schal describes five of them:

- Development of thicker cuticles or mechanisms that prevent a particular insecticide from penetrating the peritrophic membrane, which protects the digestive tract.
- Increased activity of detoxifying enzymes that break down the insecticide before it reaches the target site.
- Increased sequestration, or transportation of the insecticide to a storage site within the body where it is kept clear of the target site.
- Increased excretion to eliminate the pesticide.
- Mutations at the target site that prevent the insecticide from binding (most commonly, these mutations are located on nerves in the sodium channel, where they reduce the activity of pyrethroids).

The mechanisms leading to behavioral resistance aren't as easy to identify, says Schal. "The only well-described mechanism is one we investigated in German cockroach aversion to glucose," he says. "We used a combination of behavioral assays and electrophysiological recordings (similar to EKG), and showed that glucose-averse cockroaches taste glucose as bitter rather than sweet, and therefore refuse to ingest it. The mutations appear to be in the taste hairs (similar to our taste buds), so the behavior results from a change in the sensation of taste rather than in how cockroach brains process this information." —*Donna DeFranco*



Are cockroaches displaying resistance to the bait you apply?

© OXFORD | ISTOCK.COM

What Bayer has done in recent months is to introduce a reduced-risk gel bait featuring a new bait active ingredient (AI), clothianidin. Maxforce Impact is part of the Maxforce Roach Control System developed by Bayer, which incorporates the rotation of gel baits with different active ingredients and bait matrices every 90 to 120 days (the typical German cockroach generational cycle). Bayer based

development of this new product on the science that says resistance and aversion are growing among cockroaches, and the reality that says PMPs need a new plan.

## What Science Says.

Coby Schal, the Blanton J. Whitmire Distinguished Professor at the Department of Entomology at North Carolina State University, describes two major forms of resistance: physiological resistance to the insecticide (the AI) and behavioral deterrence to the bait formulation (usually an aversion to a formulation ingredient other than the insecticide).

“Physiological resistance to the AI is common and very dynamic,” says Schal. “When any insecticide, in any formulation, is used extensively, cockroaches evolve resistance to it. So, we find resistance to AIs such as abamectin, hydramethylnon, fipronil and indoxacarb, which are widely used today. Cockroaches also developed relatively high levels of resistance to previously used insecticides such as sulfluramid and chlorpyrifos.”

Behavioral resistance — sugar aversion, for example — is much less prevalent, says Schal, but increasing in frequency. “In the past three years or so, we sampled about 20 populations and found glucose aversion in only a handful. But we are now finding some fructose aversion and possibly aversions to other sugars. As selection with sugar-containing baits continues, we expect to find more sugar-averse populations,” he explains.

How can PMPs minimize resistance? “The best strategy available is product rotations,” says Michael Scharf, professor and O.W. Rollins/Orkin Chair, Department of Entomology, Purdue University. “It is important to note that no formal research reports exist on this strategy for cockroaches, but in theory it is the most logical option available. Manufacturers are recommending product rotations for some of their products; we believe this is a very positive development for the industry.”

Schal echoes the need for bait rotation and recommends that PMPs alternate bait products based on their toxicological mode of action. “In other words, use a bait that targets target No. 1 in the nervous system for several months and then switch to a bait that targets a different system — mitochondrial respiration, for example — for the next several months, followed by a bait that targets target No. 2 in the nervous system, for several months,” he says.

Schal also suggests that PMPs use a variety of baits concurrently, with the intention of hitting multiple targets at the same time. This method also disrupts the associative learning process: Where cockroaches might have learned that certain aversive tastes are linked to certain smells, they will not be able to discern which smell is coming from which bait when a variety of baits are presented, and so will be more likely to feed.

“With any resistance management strategy, being familiar with the modes of action of bait products is imperative,” Schal adds. “It is also important to understand the behavior of cockroaches in your account. We often start a cockroach control program with a taste test: We place two or three small dabs of bait products side by side near a cockroach aggregation to see which one is most attractive to them. That is the bait we then start with in that account.”

Reid understands the need to appeal to the pest at hand. “Diet matters,” he says. “At different stages of their life cycles, cockroaches prefer to eat different things. Diet also matters based on their environment. If they’re living in a bakery, they’re dying for a steak but you’re just giving them more sugar. You need to be aware of their environmental conditions. It’s not just about what you’re feeding them, but what they’re feeding on in their environment as well.”

It comes back to knowing the pest’s behaviors inside and out — and that comes from having access to the latest research. Michael Rust, distinguished professor of entomology and the graduate division, Department of Entomology, University of California, Riverside, says, “Modern cockroach baits were a panacea for many years. It had become rare to even see a paper at national entomology meetings about German cockroaches. However, insects have that bad habit of evolving and defeating even our best efforts. Research remains a pivotal element of effective pest management.”

Scharf adds that his team at Purdue is testing a variety of resistance monitoring and management strategies, and he hopes to be able to share findings with the industry in the near future. “With the use of sound IPM approaches and widespread adoption of rotational management strategies (including rotation of mixture-based products), we feel that the industry will be able to combat resistance in a sustainable way,” he concludes.

Visit [www.pctonline.com](http://www.pctonline.com) and click on “online extras” to see an infographic that outlines three easy steps for successful cockroach bait rotation.

## **6 Key Cockroach Baiting Tips**

Managing cockroaches with bait formulations has become the norm for pest management professionals. The development of these products has provided the pest control industry with market-pleasing efficacy while creating value for PMPs by changing the culture of structural cockroach management. Few would want to return to the days of night service, clean-out teams and complicated preparation and clean-up requirements.

As research provides more information on gel bait aversion and insecticide resistance in cockroaches, conducting fundamental core practices will keep baits effective and showcase the value PMPs deliver to customers. These core practices include the following:

**Understand Targets:** Invest in learning the fundamentals of biology and behavior of target roach species. German cockroach management differs from American cockroach management because these species live differently.

**Don't Overestimate Bait Attraction:** Bait advertising touts the attractiveness of bait formulations. However, a bait cannot be attractive if it is placed outside of the sensory range of a PMP's targets. It's important for a PMP to remember the biological limits of his/her targets.

**Correctly Place Baits:** Place baits directly into, or as close as possible to, cockroach harborage sites. The goal is to have target roaches find baits before they find competing foods as they forage.

**Find Harborage Sites:** Execute an aggressive inspection and monitoring program, and maintain it continually. Cockroaches typically harbor in microenvironments that are dark, humid and in close proximity to food. Utilize monitor traps to provide information about activity, trends in population growth or decline, and indicators of new introductions/activity. Place sufficient numbers of monitors and maintain or replace them as necessary. Use monitors for positive identification of species.

**Apply Appropriate Amounts of Bait:** Start with label directions as a guide. Determine the area of the zone (e.g., kitchen sinks and attached cabinets) to provide a limit on the total bait allowed to be placed in the area. Apply the minimum amount of bait that corresponds to the size of the population as determined by inspection and trap counts. Be prepared to return in a short period of time (one week or less) for potential re-baiting if the population is high, the treatment site is critical to the overall management strategy or the account is complaining of activity. If old, dried-out bait is present, remove it if possible.

**Use the Right Bait Formulation:** Gel baits are popular because they are easy to apply and effective on German cockroaches. However, some roach species (e.g., brownbanded, smokybrown) prefer drier foods. When conditions warrant, PMPs should remember granular roach baits and bait stations may be smarter investments. Use stations when conditions are damp or dusty, or when long residual activity is necessary. — *Joe Barile, BCE, technical service lead, Bayer Environmental Science*

**About the author:** Donna DeFranco is a frequent contributor to PCT.