

German cockroach (inset), North America's major household roach: For each one trapped, 800 to 2,000 may be hiding.

## Roaches: The Battle Continues

Evicting the most common roaches may get easier

By JANET RALOFF

Few fixtures of urban apartment life elicit such near-universal disgust as the cockroach. The tawny, half-inch-long German cockroach is the major indoor roach in North America, "probably in the world," according to Philip Koehler, a research entomologist with the University of Florida in Gainesville. But new technology has the potential to put these pests on the defensive. An arsenal of new weapons — including several still under development — should improve the success of tactical strikes against this age-old scourge.

The immediate benefit, besides peace of mind, should be better hygiene. Notoriously filthy, cockroaches have been known to carry the *Salmonella* bacteria that cause food poisoning, and have been implicated in spreading diseases like hepatitis. Improved roach control might also bring unexpected relief to many allergy and asthma sufferers.

At its Insects Affecting Man and Animals Laboratory in Gainesville, Fla., the Agricultural Research Service (ARS) has a team of cockroach specialists investigating everything from the insect's nutrition to potential birth control drugs — all in hopes of learning how better to control the proliferation of this consummate urban survivor. The conventional wisdom is that if a female and all her progeny are given enough food and allowed to proliferate, a single fertilized roach can set up a colony of "close to a million offspring within a year," explains Koehler, who conducts much of his research at the ARS lab.

Most humans discourage such proliferation by baiting, trapping, spraying and just plain squashing the fleet-footed pests. Even so, roach populations can become disturbingly large in crowded, low-income areas, according to a two-year survey of German-cockroach populations just completed by Koehler and

Richard Patterson, who studies household insects at the ARS lab. Involving more than 1,000 low-income apartments in the southeastern United States, the study found that 97.5 percent were infested — with a minimum of 160 roaches per dwelling, and an average of 33,600. And those estimates are "conservative," Koehler believes.

The survey also tends to dispel the rubric that roaches prefer to dwell under the kitchen sink. Instead, it found that the best places to trap roaches are, in order, next to the garbage, on kitchen counters, and under the kitchen or dining room table. The insects' use of countertops as a major thoroughfare and for foraging "means that cockroach droppings, roach parts and probably cockroaches themselves are regularly being incorporated into meals," Koehler says. But the pests are not above making a meal of the humans themselves. Where infestations are heavy — the worst cases may involve a quarter million — the roaches will move into bedrooms. "In those cases," Koehler says, "the roaches will climb on people, gnawing off their eyelashes, eyebrows and calluses on their hands and feet."

These bugs can also prove a potent health hazard to those with allergies. Frank Twarog, an allergist at the Harvard Medical School in Boston, says his data suggest that 50 percent of people in the Boston area who have allergies and are exposed to cockroaches will develop an allergic sensitivity to the insects. In a study reported earlier this year, pediatric allergist Elsie Morris at Emory University in Atlanta found that of 48 inner-city children with chronic wheezing, runny eyes and runny nose, 37 proved to be allergic — and more than half of those who proved allergic were sensitive to cockroaches. In fact, 20 of the 21 who tested positive for cockroach sensitivity were asthmatic. "That's serious," she

points out. "Any asthma can be life-threatening." In fact, data by allergy immunologist Bann Kang at Mt. Sinai Hospital Medical Center in Chicago suggest that up to 50 percent of asthmatics with multiple allergies may develop cockroach sensitivities. Her data also show that cockroach allergens tend to elicit far more potent reactions than other substances to which an asthmatic is sensitive.

The new antcockroach ammunition emerging from research labs, scientists say, holds promise against these unsavory invaders of our personal space.

Hydramethylnon, introduced in a cockroach bait for the first time last year, is an insecticide originally marketed to control fire ants. Unlike most chemical roach killers, which are nerve toxins, hydramethylnon affects the cells' ability to convert food into energy, explains Theodore Shapas, group leader for insecticides at American Cyanamid in Clifton, N.J., which has developed the product. Having dined on a "cookie" laced with this pesticide, a cockroach slowly runs out of energy, falls asleep and never wakes. In tests conducted by researchers at the University of Florida in residences having an average of 80,000 roaches, Koehler says, "we were showing in excess of 95 percent control [with hydramethylnon] within a month or two and were able to maintain it for close to two years. We weren't able to achieve that with anything else."

The ARS/University of Florida collaboration in Gainesville also has yielded hydroprene, another newly marketed roach-control agent. Referred to as "birth control for cockroaches," the insect-growth regulator causes exposed juveniles to grow into malformed, sterile adults. While it has proved up to 95 percent effective in controlling cockroaches, it takes about seven months to achieve that control — far longer than with hydramethylnon.

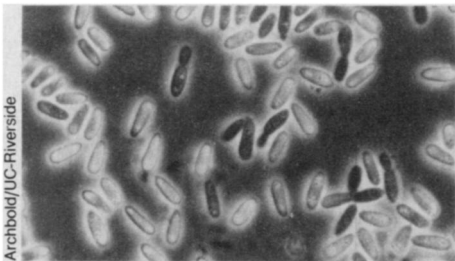
Another family of growth regulators, aimed at juvenile roaches, inhibits the formation of chitin, which forms part of the insect's hard outershell. "We've been able to get complete mortality of eggs from cockroaches that have been treated with these chitin inhibitors," Koehler says, and affected juveniles that survive a molting will "just crawl around and collapse on themselves."

Nutrition studies at the ARS lab have identified other compounds — mostly nontoxic — that appear able to kill cockroaches by inhibiting the conversion of uric acid — a metabolic by-product they are unable to excrete — into nitrogen.

In addition, there are natural biological controls. The latest entry in this category is a pathogen that was discovered inadvertently after it wiped out about 3 million roaches at a German-cockroach

breeding facility at the University of California at Riverside. Puzzled over the costly losses (the roaches had been valued at about \$75,000), entomologists Michael Rust and Edwin Archbold turned some dying roaches over to microbiologist Kathy Atkinson. Her investigations revealed a yeast in the blood of sick roaches that appears somewhat similar to the soil fungus *Metarhizium*.

This yeast does not appear to produce a killing toxin. Instead, it proliferates in a cockroach's blood over a period of weeks. Apparently, Rust says, "the yeast just saps off all of the nutrition and the cockroach starves." As with hydramethylnon, its long latency may prove a benefit. It may provide infected bugs time to go home and share the plague. And infected roaches don't reproduce well, Rust notes. Before long, unable to replace its losses, an infected colony dies off. Rust and Archbold, who hope to harness this yeasty blight, believe it may be most effective as a complement to other controls, weakening the bug so that it succumbs more readily to other chemicals or stresses.



Archbold/UC-Riverside

Blood from dying cockroach harbors 8-micron-long parasitic yeast cells.

Despite the inroads humans have made in controlling roaches, Koehler warns against complacency: "It's my experience that for every technological advance we make, cockroaches come up with some way to overcome it."

Which helps explain "superroach." The ARS/University of Florida researchers brought back roaches from Washington, D.C., when congressmen complained about sharing their cramped quarters with the pests. The insects had evolved a resistance to so many pesticides that they defied control. "When we found they lacked carbamate resistance, we crossed them with a Florida strain that is highly resistant to carbamate [pesticides]," Koehler says. The result, he says, is "a cockroach that is virtually impossible to kill."

At a minimum, the superroach makes a great research tool, since any pesticide that kills it is unlikely to fail—at least initially—in the field. But it may also serve a more important purpose, Koehler jokes: With the Gramm-Rudman-Hollings deficit-reduction bill making federal research money tight, "we figured we could threaten to turn them loose if we didn't get funded. We have a quarter million of them." □

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**Multimind** — Robert Ornstein. This psychologist here presents his view of the mind and its relationship to behavior. "Instead of a single, intellectual entity that can judge many different kinds of events equally, the mind," says the author, "is diverse and complex. It contains a changeable conglomeration of different kinds of 'small minds' — fixed reactions, talents, flexible thinking — and these different entities are temporarily employed . . . and then usually discarded, returned to their place, after use." HM, 1986, 206 p., illus., \$16.95.

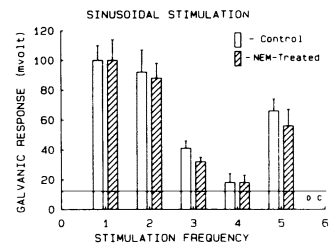
**Pioneering the Space Frontier: The Report of the National Commission on Space** — U.S. National Commission on Space. Proposes a civilian space agenda projected through the next 50 years with three major thrusts: advancing our understanding of our planet, our solar system and the universe; exploring, prospecting and settling the solar system; and stimulating space enterprises for the direct benefit of the people on earth. To accomplish these goals economically, the commission asserts that the nation must make a long-range commitment to advancing technology across a broad spectrum to assure timely availability of critical capabilities, as well as a commitment to creating and operating systems and institutions to provide low-cost access to the space frontier. This volume contains the text of the report with sidebars that explain the scientific terms used. Beautifully illustrated. (See SN: 5/31/86, p.342.) Bantam, 1986, 211 p., color illus., paper, \$14.95.

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