# Taking Aim at Formosan Subterranean Termites

More than 2 years after the April 1998 launch of Operation Full Stop, a national campaign against the Formosan subterranean termite, new technologies and tactics are emerging from the front lines of research to curb the exotic insect's appetite for destruction.

USDA's Agricultural Research Service leads the $5 million-per-year effort and has initiated cooperative agreements with other agencies, organizations, and state universities.

*Coptotermes formosanus,* their opponent, arrived in the United States from the South Pacific over 50 years ago. Now established in 11 states, including California and Hawaii, the pest costs an estimated $1 billion annually in property damage, repairs, and control.

So firmly entrenched is the termite that eradicating it seems unlikely, scientists say. The immediate goal instead is to minimize its destruction with population-management techniques and to wipe out individual colonies within a large geographical area. Other goals include improving detection, precision placement of termiticides, discovering and using biological control agents, and gaining new knowledge of this pest's biology and behavior to use against it.

In an overview of some of the plans to control the termite and to assist pest control operators and property owners, the first stop is ARS' Southern Regional Research Center in New Orleans, Louisiana. In that city, the splinter-sized pest's appetite costs about $300 million annually.

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**Near Keesler Air Force Base in Biloxi, Mississippi, underground bait stations are installed around houses every 15 feet to increase the chance of termite detection. Here, entomologists Guadalupe Rojas (right) and Juan Morales-Ramos place a bait formulation inside a bait station.**

## A Fatal Last Meal

Ironically, this same appetite may prove its undoing. At the center's Formosan Subterranean Termite Research Unit (FSTRU), entomologists M. Guadalupe Rojas and Juan A. Morales-Ramos have created an enticing new termite bait formula called a matrix.

The matrix entices the pest with essential nutrients but ultimately delivers only death. Comparative trials indicate it requires up to 90 percent less material than commercial bait products to kill termite colonies. Some matrices contain slow-acting toxins, and others harbor insect growth regulators, such as diflubenzuron and hexaflumuron, that interfere with the way a termite forms and sheds its outer shell. But the strategy works only if the termites take the bait—and the poison hidden within.

"The trick is making sure the termites quickly find and readily feed on the bait and the impregnated toxins," notes Rojas. She and Morales-Ramos tackled the problem by stimulating the pest's hunger with components of wood, fungi, or other natural food sources.

A commercial product may be on the market soon; ARS has applied for patent protection and is negotiating terms for exclusive licenses to three companies: Ensystex, Procter and Gamble, and Dow AgroSciences.

Ever watchful for environmentally friendly alternatives, Rojas says "We've developed a way to incorporate spores of a natural fungus into the bait matrix." That fungus, a *Metarhizium anisopliae* strain, kills termites by growing inside them, but it is harmless to people, domestic and wild animals, and nonhost insects.

## Chemical Comparisons, Sturdy Termites

Another FSTRU entomologist, Weste L. Osbrink, is measuring the insecticide tolerance levels of termites to chlordane, methoxychlor, several pyrethroids, a carbamate, and fipronil.

Osbrink collected termites from four different colonies and placed them in glass tubes. He then exposed the termites to the insecticides until they died or 8 hours had passed.

"In some instances I found only subtle differences in their responses," Osbrink says. "But one particular colony was 16 times more tolerant than another."

With follow-up studies, Osbrink will investigate possible explanations and ramifications of his findings to current pest-control practices.

## A Grassroots Alternative

Elsewhere, scientists are turning to nature for alternatives to synthetic insecticides. For example, vetiver, a fragrant grass used for erosion control, may kill Formosan termites with nootkatone and other substances exuded by the plant's roots. Louisiana State University (LSU) researchers Gregg Henderson, Roger Laine, Betty Shu, Feng Chen, and Lara Maistrello began investigating the grass' repellency about a year ago at the suggestion of New Orleans vetiver farmer Don Heumann.

"We have since found four more substances in the grass that repel and kill Formosan subterranean termites," says Henderson, whose team is at the LSU Agriculture Center's Experiment Station, in Baton Rouge. "We are now interested in testing the living grass itself as a barrier or repellent." LSU has filed a provisional patent on vetiver's use as a soil treatment or mulch additive, he reports.

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**Bob Melia, president of Real Time Thermal Imaging (left), and Jack Leonard, of the New Orleans Mosquito and Termite Control Board, use thermal imaging (infrared video) to inspect historic Gallier Hall for termite activity. *Inset:* At another location, the technique revealed a termite nest (arrow) inside a wall next to a window frame.**

## Genetic Sleuthing

In New Orleans' Louis Armstrong Park, home to 244 trees and 30 tree species, an ecological study is under way by J. Kenneth Grace, Nan-Yao Su, and Matt Messenger (he's with the New Orleans Mosquito and Termite Control Board, or NOMTCB). Using special marker dyes, DNA analysis, and other tracking techniques, they're monitoring the foraging habits, tree-feeding preferences, and competition of 14 Formosan subterranean termite colonies and a few native ones.

Grace, a University of Hawaii (UH) entomologist, and postdoctoral researcher Claudia Husseneder are obtaining genetic "fingerprints" of Formosan subterranean termite populations in Louisiana, Florida, Texas, and Hawaii. Their approach accomplishes what the naked eye can't: It differentiates individual colonies, specific colony members, and regional termite populations. Genetic fingerprinting will also prove handy in verifying whether a target colony has truly been eliminated by a particular treatment or whether the insects' apparent return is actually another colony that's moved into the abandoned site.

Other UH research includes fingerprinting of a close Formosan cousin from Guam (discovered in Hawaii last fall), termite foraging tactics, new insecticide treatments, baits, wood preservatives, and termite-treatment programs in schools.

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**ARS entomologist Janine Powell (right) and environmental scientist Cathy Hollomon of Mississippi State University change a sticky monitoring card used to capture winged termites called alates.**

## Virtual Termites

When not in New Orleans, entomologist Nan-Yao Su is working at the University of Florida (UF), in Fort Lauderdale, another city troubled by the Formosan subterranean termite. Su's projects there include creating a virtual termite colony using computer-simulation models. With this, Su hopes other scientists will be able to predict geometric patterns that characterize the Formosan's tunneling in soils—and into homes. A key objective is learning more about how reinfestations or recolonization of a treated area can occur.

The same objective applies to a large-area test UF scientists are planning for Florida's Golden Beach. Sandwiched between Florida's intercoastal waterway and the Atlantic Ocean, Golden Beach is a 2-kilometer-wide, 600-meter-long land area with three artificial islands. There, 400 homes will be monitored and treated. "The idea," says Su, "is to create a termite-free zone. That way, we can understand how swarmers come in from across the intercoastal waterway."

## The Vieux Carré: Ground Zero

Swarmers are winged termites called alates that take flight to mate and start new colonies. Back in New Orleans, scientists record how many alates get caught in sticky traps hung from lampposts as one measure of progress in a large-area test begun in 1998.

Led by entomologist Dennis R. Ring of the LSU Agricultural Center Cooperative Extension Service, the study encompasses a 15-block area of the Vieux Carré, also known as the French Quarter, where Formosan subterranean termites have gnawed their way into homes, businesses, trees, and historic buildings.

Entomologist W. David Woodson is lead scientist for ARS on the study. Collaborating scientists are Alan L. Morgan, Xing Ping Hu, and Lixin Mao, LSU; Alan R. Lax, ARS; and Edgar S. Bordes and Ed D. Freytag, NOMTCB.

Public participation is high, Ring reports, with 99 percent of properties undergoing treatment and visual inspection by licensed pest control operators. About 273 properties have one of three commercial bait products, while 47 have one of two liquid termiticides.

Using Geographic Information System and Global Positioning Satellite technologies, Woodson has led development of computerized maps for pinpointing termite hot spots and graphically illustrating population suppression. The goal is to use these technologies to predict termite presence for more precise placement of control measures.

Led by Bordes, NOMTCB researchers are also taking the high-tech road. Using infrared cameras, they're testing a device for remotely detecting areas in the wood that termites have eaten away, based on their heat signatures.

## Taking the Offensive

Well into the study, intended as a blueprint for other communities to coordinate large-scale attacks, scientists are growing more confident of success. Results show that areawide treatment of the 15 blocks is reducing termite numbers and activity.

In July 1999, shortly after the program began, scientists observed nearly equal numbers of feeding termites in the treatment zone and in the surrounding untreated zone. But by June 2000, the number of feeding termites in the treated zone was reduced by half compared to the untreated zone. Also, during the spring 2000 swarming period, twice as many alates were captured outside than inside the treatment zone.

These observations, scientists say, are even more significant because some properties in the outside zone have received treatment by their owners independent of the large-area test.

Ultimately, the true measure of success will be a reduction in property damage through large-area suppression of termite populations. Edgar G. King, Jr., associate area director of ARS locations in the Mid South, says this philosophy differs from that in decades past. Then, the stance was defensive, that is, protecting buildings by surrounding them with toxic soil barriers. Today's strategy is offensive—aimed at reducing termite populations through large-area management. "The Vieux Carré," says King, "is the first test of large-area termite suppression and population elimination. Results thus far support our strategy."

**Testing Expands Into Mississippi**

In Mississippi, a third round of large-area tests is shaping up in Poplarville neighborhoods, at Keesler Air Force base in Biloxi, and at other Gulf Coast locations. Three or four different treatments will be compared, says ARS entomologist Janine E. Powell, project coordinator. Also participating are ARS' Rojas and Morales-Ramos, and David Veal, head of Mississippi State University's Coastal Research and Extension Center.

The team is now monitoring over 30 termite-infested Poplarville homes treated with ARS' new matrix bait system and diflubenzuron. In Biloxi, homes and yards in 12 neighborhoods will receive bait matrix stations containing the *Metarhizium* fungus, diflubenzuron, or both. Powell is also investigating other potential biocontrol agents.

"Mississippi offers another big test area, and yet the environment is substantially different than that of the Vieux Carré," King says. Findings gleaned from such studies will help tailor areawide attacks on the termite—wherever it may be hiding. "It's a dynamic situation," King adds. "We're constantly fine-tuning and improving the technology."—By **Jan Suszkiw,** ARS.

*This research is part of Arthropod Pests of Animals and Humans, an ARS National Program (#104) described on the World Wide Web at http://www.nps.ars.usda.gov/programs/appvs.htm.*

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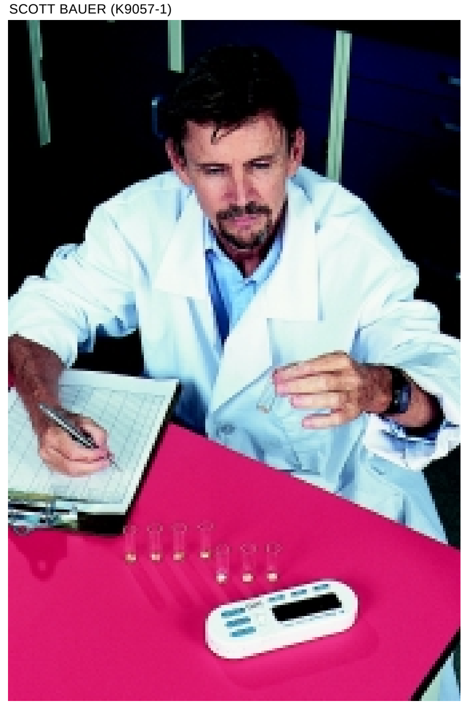

**Weste Osbrink, ARS entomologist, tested various colonies of Formosan subterranean termites *(Coptotermes formosanus)* to gauge their tolerance to several insecticides. He found that one colony was 16 times more tolerant than another.**

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**Soldier termites (darker heads and mandibles) and worker termites in test tubes. The white disks at the bottom of the tubes contain different insecticides.**