Beneficial fungi examined for battle against destructive beetles

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A foam originally developed by ARS as a way to pump fungal spores into the galleries of Formosan subterranean termites may be useful against ambrosia beetles that attack avocado trees. Credit: Peggy Greb

Avocados aren't just nutritional powerhouses; they're also the chief

ingredient in such party favorites as guacamole dip.

More than 99 percent of the nation's $322 million avocado crop is grown in south Florida and southern California (less than 1 percent is produced in Hawaii), which makes recent infestations of groves there by invasive, wood-boring ambrosia beetles so alarming. A host of counter strategies are in the works, including a biobased foam originally developed by Agricultural Research Service scientists for use against Formosan subterranean termites.

In Miami-Dade County, Florida, avocado growers are contending with Xyleborus glabratus, the redbay ambrosia beetle. In California, particularly Los Angeles County, the fight is against a different ambrosia beetle species—the polyphagous shot hole borer, Euwallacea sp.

Both tunnel into the sapwood of avocado trees, inoculating them with pathogenic fungi in the process. Redbay ambrosia beetles specifically attack members of the Laurel tree family (which includes native tree species and avocado). The shot hole borer, however, has a host range of more than 100 different tree species in 59 different families.

The culprits are fungal pathogens that the beetles carry with them into trees and "farm" as food. Raffaelea lauricola, the fungus spread by redbay ambrosia beetles, causes laurel wilt disease, which is lethal to avocado and other trees. The Fusarium species associated with the borer causes Fusarium dieback, which is lethal to some but not all of the woody plants the insect attacks.

Spraying avocado groves with insecticides to kill the beetles before they infect trees with the fungi may not be an effective disease-management approach, notes Alejandro Rooney, who leads ARS's Crop Bioprotection Research Unit at the National Center for Agricultural Utilization Research in Peoria, Illinois.

Female redbay ambrosia beetle, Xyleborus glabratus (about 2 mm long). Credit: Stephen Ausmus

To fight the harmful fungi, Rooney and colleagues are investigating the potential use of beneficial fungi to target the ambrosia beetles. These include entomopathogenic (insect-infecting) species of Metarhizium, Isaria, and Beauvaria. Early evidence has been promising, notes Rooney, whose team is collaborating with Jorge Peña, Daniel Carrillo, and Jonathan Crane—all with the University of Florida at Homestead—and Akif Eskalen and Richard Stouthamer at the University of California-Riverside.

Using DNA markers, ARS chemist Chris Dunlap devised special tests called "bioassays," which enabled the team to genetically confirm the microbe's ability to infect and kill the beetles—in addition to visual proof in the form of moldy growth on the pests' bodies.

"Our research has shown that three separate strains of the fungi are fatal to the insects, with fungal-induced beetle mortality greater than 95 percent," Dunlap reports.

Repeating this success inside the trunks of avocado trees is the next important step in the team's investigations, and that's where the biobased foam could figure prominently.

Dunlap and ARS colleagues Mark Jackson, Robert Behle, and Maureen Wright originally developed the foam as a way to pump fungal spores deep into the galleries of Formosan subterranean termites, which can nest inside trees. The research team is evaluating the foam's potential against ambrosia beetles in orchard-scale trials with avocado trees.

Polyphagous shot hole borers stimulate a host response in avocado that includes gumming and a white residue around holes the insect has formed. "This gives away their position, and we can spray the foam directly there at the sites of infestation," Dunlap says.

That's not the case with redbay ambrosia beetles, which makes locating them more difficult. For this reason, "We'll probably use a combination of spraying the entomopathogenic fungi on trees and on an avocado mulch, which we know the beetles are attracted to."

Continued field research will be key to determining the effectiveness of this biobased approach to controlling ambrosia beetles. But if successful, it could ultimately help to safeguard an important domestic crop.

"Fungal Foam Tested Against Avocado Threat" was published in the August 2013 issue of *Agricultural Research* magazine.

More information: www.ars.usda.gov/is/AR/archive/aug13/

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