Fungus Shows Promise for Fire Ant Control

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GAINESVILLE, Fla. – For years, scientists have tried to use environmentally friendly fungi to control fire ant infestations.

But the ants' social behaviors – such as hauling their dead off to what entomologists call "bone yards" in isolated spots away from the nests – have prevented commercial development of this method. The fungus can't spread if infected ants are continually separated from healthy ones. *(Right, fungus-infected ant, photo courtesy researcher Yanhua Fan)*

A new University of Florida study shows, however, that there may be a way to make insect-killing fungi a more potent weapon against fire ants and other pests. Scientists with UF's Institute of Food and Agricultural Sciences modified the fungus so that it produces a peptide that helps regulate the fire ants' nervous system.

The modified fungus was five to eight times as effective in killing fire ants, but had no increased effect on an unrelated insect, the greater wax moth. The researchers were surprised to learn that the modified fungus had another benefit – it disrupted the ants' undertaker-like behavior.

The study was published this month by the online journal PLoS One.

"Potentially, it's important because if you can disrupt this behavior, you may be able to increase the efficacy of the fungus in the nest, because they won't take the dead out and you can spread the infection throughout the nest better. In theory, you could use the same amount of fungus and it would be more effective," said Nemat Keyhani, a UF associate professor of microbiology and cell science and the study's lead author.

Keyhani also led a research team in a similar study of mosquitoes, publishing the findings in this month's issue of Nature Biotechnology.

In that study, the scientists tested *Beauveria bassiana* against mosquitoes, modifying the fungus so that it produced another peptide, called TMOF (trypsin-modulating oostatic factor).

This hormone, discovered by a UF/IFAS entomologist, is produced by mosquitoes. It stops the insects from producing a crucial digestive enzyme called trypsin. Though TMOF is important for the normal digestive process, too much of it causes mosquitoes to starve, unable to take nutrients from food.

Keyhani said the goal of both studies was to show that a host molecule, such as a peptide or hormone that an insect uses for a normal physiological process, can be used against it, disrupting that process and making it more susceptible to microbial infections.

In the mosquito study, combining the fungus with TMOF reduced the survival time of the mosquitoes by 25 percent, reduced females' trypsin activity by 50 percent, and resulted in female mosquitoes laying 40 percent fewer eggs.

"So we've now proven the concept in two different ways – one against mosquitoes and one against fire ants," Keyhani said.

Roberto Pereira, an IFAS research associate scientist in urban entomology and a member of the fire ant research team, said the findings are promising, but more study will be needed to determine commercial viability.

"We would probably want to enhance mortality quite a bit more than we did," he said. "But even a small change in efficacy of the pathogen in causing disease or its ability to spread can cause it to go from a weak pathogen to one that overwhelms the host population."
The ability to show that the modified fungus can target a specific insect population is also important, he said.

Besides Keyhani and Pereira, the fire ant research team included Yanhua Fan of Southwest University in Chongqing, China; Engin Kilic, a postdoctoral student in microbiology and cell science at UF and George Casella, a UF distinguished professor in IFAS statistics.

In addition to Keyhani and Fan, the mosquito research team included former UF entomology professor Dov Borovsky and UF graduate student Chloe Hawkings and UF postdoctoral fellow Almudena Ortiz-Urquiza.