Scorpion Toxin Makes Fungus Deadly to Insect Pests

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Fungus injected with deadly scorpion toxin can kill mosquitoes quickly.

University of Maryland entomology professor Raymond St. Leger has discovered how to use scorpion genes to create a hypervirulent fungus that can kill specific insect pests, including mosquitoes that carry malaria and a beetle that destroys coffee crops, but does not contaminate the environment as chemical pesticides do.

In the November issue of the journal *Nature Biotechnology*, St. Leger and Chengshu Wang, a colleague from the Chinese Academy of Sciences, describe how they were able to bioengineer a new version of the fungus Metarhizium anisopliae to inject specific insects with the scorpion toxin *Androctonus australis insect neurotoxin* (AaIT), and kill them within a few days.

"Scorpions have toxins that are superbly adapted to killing insects," says

St. Leger. "A scorpion kills by stabbing its prey, so we were looking for a way to get the toxin into the insect without the scorpion.

"Fungi are really good at that because they are naturally infective. They land on the insect's outer surface, insert little tubes called hyphae, and grow within the insect. You could almost see them as tiny hypodermic needles. If you can get the fungus to insert a toxin into the insect, you can kill the insect very quickly. This is what we did."

Speeding up the Process

The naturally occurring M. anisopliae fungus and other strains like it are already being used to control agricultural pests and mosquitoes, but their effectiveness has been limited in comparison to chemical pesticides. Unlike chemical pesticides, these altered fungi can be used to target specific insects and do not pose a threat to the environment.

In Australia, the fungus is sprayed from airplanes to target locusts and grasshoppers that decimate food crops. In Africa, the spores of the M. anisopliae fungus are put on sheets and hung inside houses to kill mosquitoes. "The problem is it takes quite a few fungal spores to kill the mosquito, and it is slow," says St. Leger. "It reduces the number of mosquito bites that people get, but it doesn't keep people from getting malaria or dengue. We're trying to get a supercharged, hypervirulent fungus that will take out the mosquitoes quickly."

St. Leger also is looking at the possibility of using the enhanced fungus to attack the coffee berry borer, an invasive beetle that causes severe damage to organic coffee crops in Colombia and other parts of Latin America. After oil, coffee is the largest legally traded commodity in the world, so the industry is eager to develop biopesticides that will protect the crop.

Synthetic Gene

To produce the insect-killing fungus, St. Leger created a synthetic scorpion gene which he inserted into the M. anisopliae fungus. "You can't just take out the scorpion gene and put it into the fungus. You have to turn that piece of DNA into something that the M. anisopliae can use properly," he explains.

He also had to create what he calls an "on/off switch" in front of the gene so the fungus will produce the scorpion toxin only when it is in the blood of the insect. "The fungus will never produce it under any other circumstances."

St. Leger tested the infectivity of the transgenic fungus against mosquitoes, caterpillars and the coffee borer beetle. It was nine times more virulent than the wild M. anisopliae in killing mosquitoes, 22 times more virulent to caterpillars, and 30 times more virulent to the coffee borer beetle.

St. Leger believes this supercharged, pathogenic fungus has great potential to become a cost effective biopesticide that can kill using far fewer spores than the wild M. anisopliae fungus. He is currently using a range of genes, including scorpion toxins, to create additional biocontrol agents that are also highly specific to important pest species.

Source: University of Maryland

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