# Spinach could be weapon against citrus scourge

CHRISTOPHER SHERMAN - Associated Press - Associated Press

In a lab not far from the Mexican border, the fight against a disease ravaging the worldwide citrus industry has found an unexpected weapon: spinach.

A scientist at Texas A&M's Texas AgriLife Research and Extension Center is moving a pair of bacteria-fighting proteins naturally occurring in spinach into citrus trees to fight a scourge commonly known as citrus greening. The disease hasn't faced this defense before and intensive greenhouse testing so far indicates the genetically enhanced trees are immune to its advances.

Next month, dozens of young sweet orange and grapefruit trees developed by Texas plant pathologist Erik Mirkov will be planted near Lake Okeechobee in South Florida to see how they fare in a commercial citrus grove.

"Some of these growers in Florida, they say 'If you can't have something for us in five years, if you tell me it's going to take eight we're dead,'" Mirkov said.

To hurry along the process, Mirkov and Southern Gardens Citrus, a subsidiary of U.S. Sugar that is funding his research, are pursuing government regulatory approvals while their field testing continues.

Citrus greening was first described in China in the early 1900s as Huanglongbing, which growers and researchers refer to as HLB. The bacterium is carried from an infected tree to healthy ones by the Asian citrus psyllid, a tiny dappled brown insect that showed up in Florida in 1998. The bacterium reproduces and spreads through an infected tree's vascular system making it difficult to take up water and nutrients.

Trees produce smaller fruit that drops to the ground prematurely, and eventually the trees die.

In 2010, a panel convened by the National Academy of Sciences reported that the sort of genetic engineering Mirkov and others are doing "holds the greatest hope" for creating citrus trees resistant to the bacterium. By that time greening was already confirmed in every Florida county with commercial citrus groves.

Mirkov is not alone in his pursuit. He decided early on to only work with genes from foods that are already commonly eaten. But others are pursuing research with honey bee venom, a toxin from a beetle and other compounds. Even Mirkov's backer Southern Gardens Citrus is considering other approaches, including one that would create insect-resistant trees.

Southern Gardens Citrus President Rick Kress said they're looking for trees that are not only HLB resistant, but also produce the fruit they need to be commercially viable.

"The bottom line is the citrus industry needs a solution," Kress said. "That's what's driving all of this."

The disease was confirmed in Florida in 2005 and is present in several other southeastern states and around the world, including major citrus producer Brazil. A study released earlier this year by the University of Florida's Institute of Food and Agricultural Sciences estimated the disease had cost that state's industry $3.63 billion in lost revenues since 2006.

By last year, more than 43 percent of Florida citrus trees had been infected with HLB and the rate is climbing so steeply that Jim Graham, a microbiologist at the University of Florida's Citrus Research and Education Center, expects it to double in the next year or two.

"It won't be long before Florida is 100 percent infected," Graham said. He said HLB has doubled the costs of growing citrus in Florida.

In January, researchers surveying groves in South Texas found infected orange and grapefruit trees in two groves across the street from each other about 10 miles from Mirkov's lab. California, second to Florida in U.S. production, hasn't detected the disease in its citrus groves.

Pete Timmer, professor emeritus at the University of Florida's Citrus Research and Education Center, was called a pessimist when he published an article two years ago on the future of that state's citrus industry. He predicted among other things that genetically enhanced citrus trees resistant to HLB would be widely available in 20 years, but by then there would be few small citrus growers left in the business.

Even with aggressive control of pysllids, Florida has struggled to get a handle on HLB because so many trees are infected, he said. The problem is compounded because young trees planted to replace those already infected are more vulnerable than mature trees.

"Once you get to 100 percent infection you're dead," Timmer said.

Mirkov was drawn to the spinach proteins because as part of the plant's innate immune system they shield it against a broad spectrum of threats. This sort of protein, known as a defensing, is found in plants, insects and mammals, he said.

The trees that will soon begin field testing represent two generations of Mirkov's research, each group carrying one of the two spinach genes. Those two generations of trees already spent 1½ years in a greenhouse packed with psyllids in Florida that exposed them to a concentration of infected insects that far exceeds what they would experience in a commercial grove. Six distinct lines of trees emerged from the third generation with zero infection and about six lines from the second generation passed that test with 10 percent or less infection. Unmodified trees had nearly 100 percent infection rates.

"That pretty much sealed that we had something good," Mirkov said.

The two spinach genes are combined in each tree of a fourth generation that is undergoing psyllid house testing now and should outperform the others, Mirkov said.

That's the generation Mirkov and Southern Gardens Citrus hope to steer through the regulatory process, which could take three to four years and a variety of tests to prove the modified trees are safe for humans and the environment.

"We all want to see our research get used to solve real world problems, I mean that's why you do this stuff," said Mirkov. "I suppose there's some people that do science just for the sake of doing science, but my interest has always been let's find out things in the lab and then use it to solve a problem."

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