Investigating New Disease Calls For Detective Work

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If you've got a culprit to catch, call on a private eye, bloodhound or scientist.

Scientist? Of course. Because when you're a scientist, you're also a detective. At least that's how Dr. Tom Evans, University of Delaware plant pathologist, sees it. Evans is investigating the cause of soybean severe stunt disease in Delaware. Also involved in the project are plant pathologist Dr. Bob Carroll, Extension plant pathologist Bob Mulrooney and graduate student Teclemarian Weldekidan.

"It's really a detective story," Evans says. "And the facts point toward a new plant virus as the casual agent, and the dagger nematode as the vector or transmitter."

The disease, although not widespread, is devastating when it hits. The symptoms read like a list of medieval tortures of the plant world. The virus has no respect for youth: the first true leaves, developed when the soybean seedling is only a week old, signal the plant's plight. They are a thickened, misshapen, dark green, in contrast with the brighter, more delicate leaves of healthy plants. As the infected plant struggles to reach maturity, it is further thwarted by shortened internodes (the stem areas between sets of leaves), which result in the characteristically severe stunting. In addition, superficial cankers appear as long brown streaks along the stem. More importantly, the affected plants don't flower much or produce many seeds.

"You end up with very little yield from infected plants," Evans says.

The hunt for the culprit actually began several before Evans joined the university faculty. In the late 1970s, Carroll and Mulrooney noticed the disease near Millsboro while working on another soybean problem.

"We didn't know what the disease was," says Mulrooney. "We thought it might be tobacco ring spot virus or soybean mosaic virus. But we didn't have the virology background to pinpoint the disease. However, we did conduct field trials to identify some resistant soybean varieties."

When Evans arrived on the scene in 1986, the stage was set for a classic case of Extension and research teamwork: Extension personnel bringing a problem observed in the field to researchers, who work toward a solution.

"I was excited when I saw the disease," Evans says. "It looked like a new one."

The Delaware Soybean Board and the Delaware Pest Survey, also interested in the disease, helped fund the project -- actually a hunt for two culprits, the virus and the vector.

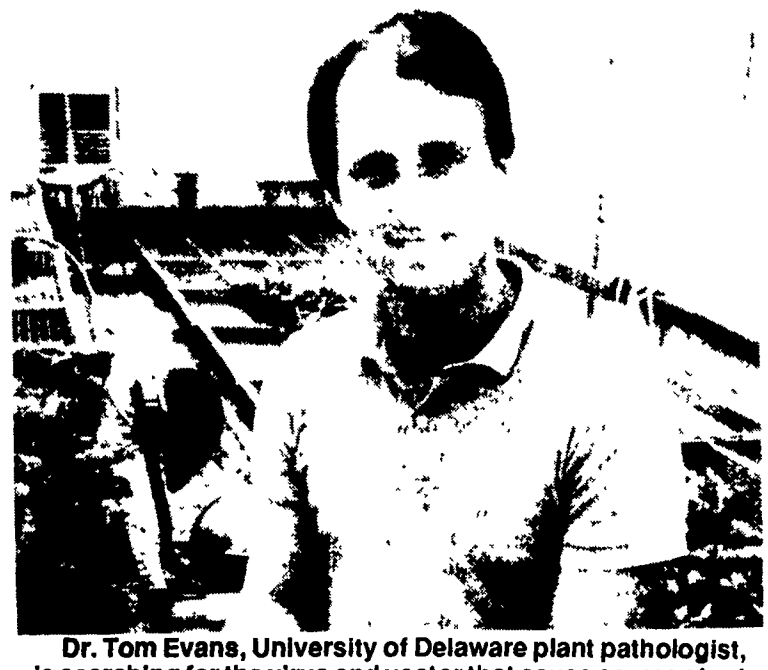
The scientists began by demonstrating that the disease could be transmitted mechanically, the first step in identifying a virus as the casual agent. To do this, sap prepared from infected soybean leaves was rubbed onto plants of susceptible soybean cultivars growing in the greenhouse, producing symptoms identical to those exhibited by infected soybeans in the field. To Evans, this evidence strongly suggests that the disease is not caused by a fungus, bacterium or pesticide residue because sap transmission of a plant pathogen other than a virus is extremely rare.

Step two in the identification process involved the sophisticated technology of electron microscopy. Evans and his co-workers observed infected plants through electromagnetic lenses that magnify up to 100,000 times, searching for spherical or rod-shaped particles that would indicate the presence of the virus.

Evans observed just such spherical particles in infected plants but not in healthy soybeans plants, and he says the probability is good that the particles are causing the disease.

In step three, the scientists gathered and analyzed information that would characterize the virus.

"We noted symptoms, what species or varieties were affected, and the pattern or distribution in the field," Evans says. "Viruses are grouped together according to these characteristics. We were able to match our observations to a particular group.



Dr. Tom Evans, University of Delaware plant pathologist, is searching for the virus and vector that cause severe stunt disease in Delaware soybeans.

"However, this virus acts drastically different from any other virus known to soybeans," Evans notes. "What we're dealing with in soybean stunt disease looks like a nepovirus -- a nematode-transmitted spherical virus. It seems to have the smae chemical makeup and stability, as well as the physical and biological characteristics of the nepovirus group."

Normally, nepoviruses don't severely affect soybeans or annual crops, he explains. They are much more devastating in perennial crops such as orchards where large populations of nematodes (wormlike creatures just barely visible to the naked eye) can build up in the soil over time. However, the scientists have found large numbers of dagger nematodes, the suspected vector, in the soil of most of the fields affected with soybean severe stunt disease.

Based on the evidence, the researchers have developed the following scenario. They suspect that the nematode feeds on the roots of infected soybean plants and acquires the virus. It then overwinters in the soil or on the roots of weeds. When it feeds on new soybean roots in the spring, it infects those plants with the virus. But positively identifying the dagger nematode as the vector of soybean severe stunt disease is diffi-

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