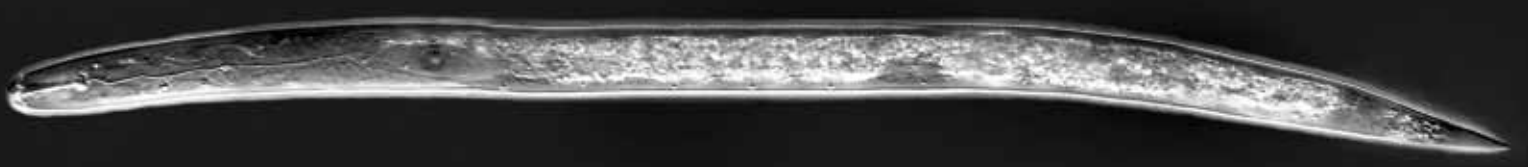


Battling the Nematodes That Threaten Potatoes

LYNN CARTA (D2266-1)

The potato cyst nematode (PCN) is a formidable adversary. It can survive in soils for more than 20 years at depths of up to 40 inches and cause crop losses of up to 70 percent. Two species of PCN exist, and both are evolving threats. The pale cyst nematode, *Globodera pallida,* was discovered in Idaho in 2006, and though its presence in the United States is currently confined to only about 1,000 acres in Idaho, it remains a major threat in Europe. The golden nematode, *G. rostochiensis,* has been a problem in New York State since its discovery there in 1941. While it has been contained to nine New York counties through a coordinated pest management program, it has also been found in key potato-producing regions in Canada.

Potatoes and seed potatoes are exchanged across international boundaries, so a PCN outbreak in Canada or Europe raises concern about the potential threat not only to U.S. potatoes, but also to tomatoes and eggplant. The combined losses to potatoes, tomatoes, and eggplant from PCN could reach an estimated $4.8 billion each year if left unchecked, so keeping PCN from spreading in the United States remains a top priority.

An Essential Safeguard: Testing New Potato Varieties for Nematode Resistance

Xiaohong Wang, a molecular biologist with the Agricultural Research Service's Biological Integrated Pest Management Unit at the Robert W. Holley Center for Agriculture and Health in Ithaca, New York, is battling PCN on several fronts. She has filed a patent application on a molecular diagnostic test that can identify the type of PCN infesting a grower's field from a tiny amount of nematode material. She and her colleagues also test new potato clones and varieties for resistance to golden nematode, and in collaboration with USDA's Animal and Plant Health Inspection Service (APHIS), she helps monitor New York potato fields for particularly damaging races of golden nematode.

DEMOSTHENIS CHRONIS (D2235-1)

Molecular biologist Xiaohong Wang and support specialist David Thurston check golden nematode cysts on the root system of a potato clone developed by the Cornell University potato breeding program.

Differential interference contrast (DIC) light microscope image of an infective juvenile of the pale cyst nematode, *Globodera pallida,* about 0.2 mm long.

Potato cyst nematodes are a quarantine pathogen, and researchers must obtain permission from APHIS before they can work with them. Such restrictions mean that Wang's lab is the only facility in the United States that works with live golden and pale cyst nematodes. There, she and her colleagues use the nematodes to test potato clones developed by partners at Cornell University as part of its potato breeding program. They also conduct small-scale testing of clones from other breeding programs. To test clones, they grow them in a secure greenhouse, inoculate them with the nematodes, and count nematode cysts on the roots of the potato plant.

Wang also identifies specific races of golden nematode from cyst samples collected by APHIS as part of its effort to help monitor New York potato fields and prevent the spread of golden nematode. The identification work is important because there are two races of golden nematode present in the United States, Ro1 and Ro2. While growers can plant potato varieties that resist the common Ro1 race, there are no commercially available varieties that resist Ro2. When the Ro1 race is found in a field and a potato variety resistant to Ro1 is grown there, the nematode effectively cannot reproduce on the potato plants. When the Ro2 race is detected, growers have to switch to a nonhost crop, such as corn or soybeans.

A Diagnostic Tool To Tell Them Apart

Since breeders have yet to develop potatoes that resist pale cyst nematodes, it's

Yellow- and brown-colored golden nematode *(Globodera rostochiensis)* cysts (about 1/3 to 1/2 mm in diameter) on potato roots. XIAOHONG WANG (D814-1)

important to be able to distinguish the pale cyst from the golden nematode. "The pale cyst nematode is genetically more diverse than the golden nematode, and that makes it harder to come up with resistant germplasm in potato breeding programs," Wang says.

Traditional methods used to distinguish between the two PCN species have relied on morphological analyses and PCR (polymerase chain reaction) assays that are time-consuming and require extensive training in nematode morphology and relatively large samples of nematode cysts.

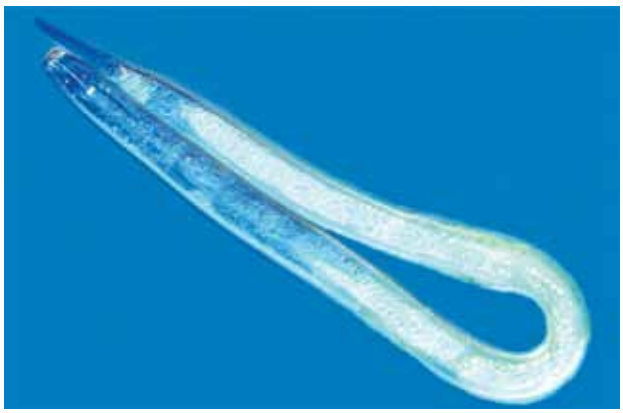
Wang has developed a way to distinguish between the two species of PCN that uses a new genetic marker and is more sensitive and reliable. The system is capable of testing much smaller samples of cyst material, making it a thousand times more sensitive than the current PCR technologies. "If you only have one cyst, you can still use our method to confirm whether you have golden nematode or pale cyst nematode, and our method is relatively easy to perform," Wang says.

Wang and her colleagues developed their system by cloning the parasitism gene that these nematodes use to produce an enzyme, chorismate mutase, that plays an important role in nematode infection. The researchers then sequenced those chorismate mutase genes, compared the sequences, and identified unique regions in each sequence. They then developed a "TaqMan probe" capable of recognizing the unique regions in the nematode's DNA. "It's the first time that a parasitism gene has been used as a diagnostic marker for identifying plant-parasitic nematodes," Wang says.

She has filed a patent application on the technology and described it in a paper recently published in the *European Journal of Plant Pathology*. The system is one of several new technologies developed to distinguish the golden nematode from the pale cyst nematode. But with its high degree of sensitivity and reliability, it should prove to be a valuable tool for nematode regulatory and quarantine programs throughout the United States.—By **Dennis O'Brien,** ARS.

This research supports the USDA priorities of ensuring food safety and promoting international food security and is part of Plant Diseases, an ARS national program (#303) described at www.nps.ars.usda.gov.

Xiaohong Wang is with the USDA-ARS Robert W. Holley Center for Agriculture and Health, Tower Road, Cornell University, Ithaca, NY 14853; (607) 255-3518, xiaohong.wang@ars.usda.gov.



Juvenile golden nematode, about 1/2 mm long.

LYNN CARTA (D2268-1)