What Lurks Below

Fight soybean cyst nematode by rotating resistant varieties.

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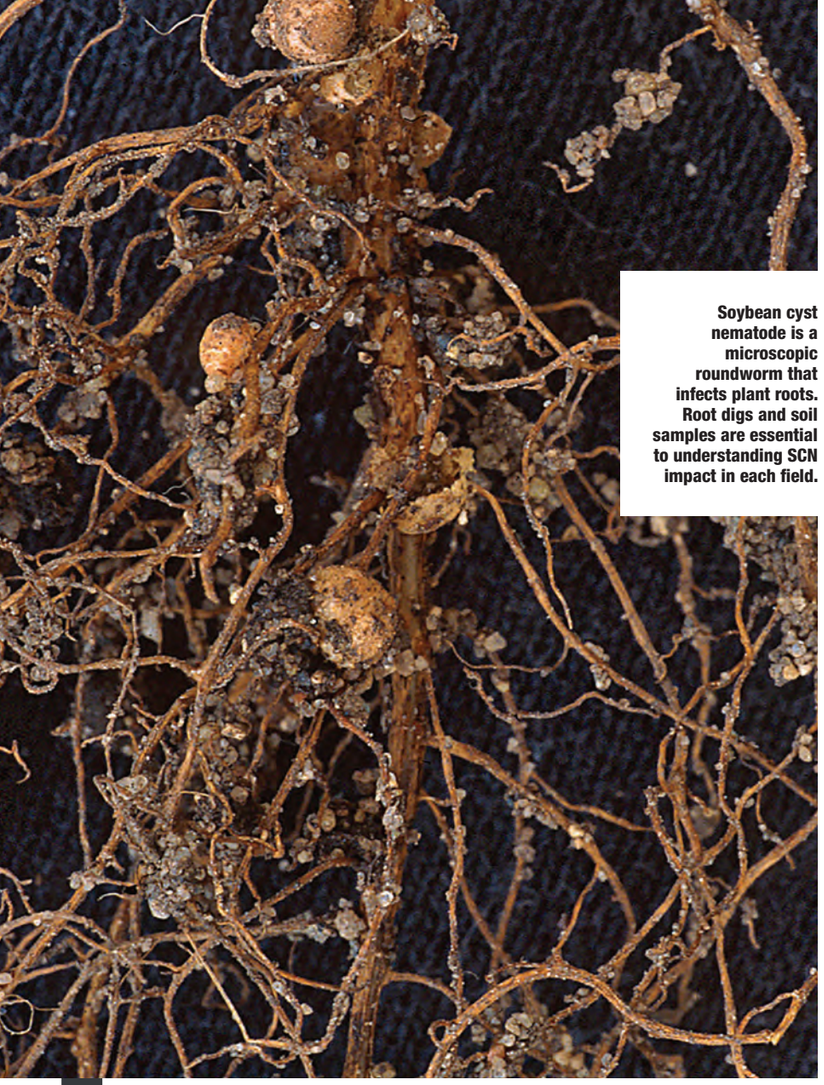
The leading cause of soybean loss in North America, soybean cyst nematode (SCN) has been wreaking havoc on soybean fields for decades. Limited sources of SCN resistance in seed paired with growing pest adaptations mean the problem could soon be harder than ever to manage.

"After more than 20 years of growers using the same source of resistance, nature is finding its way around it, and SCN populations are adapting or more resistant to it," says Troy Bauer, a senior field tech for BASF.

Unmanaged, the microscopic roundworms feed on roots and can cause up to 30% yield loss before aboveground symptoms are visible. Now, researchers and soybean breeders are racing to identify and provide farmers with more management options. ▸

Photography: Courtesy of the SCN Coalition



Soybean cyst nematode is a microscopic roundworm that infects plant roots. Root digs and soil samples are essential to understanding SCN impact in each field.

Reliance on PI 88788

Found in nearly 95% of soybean varieties, plant introduction (PI) 88788 has been soybean farmers' method of keeping SCN at bay for more than 20 years.

"This particular plant introduction has a cluster of genes, referred to as rhg1-b, at a single location in the genome that provides resistance to SCN, meaning that it is easier to breed that resistance trait into commercial varieties," says Melissa Mitchum, a professor in the Department of Plant Pathology at the University of Georgia. "Some of the other modes of action require more than one gene found in different locations in the genome, so the soybean breeder has to make sure both of those genes get carried into the end product to confer resistance."

This relative ease in breeding and limited yield drag have kept PI 88788 at the top of soybean breeders' minds despite other resistance options being available. Early on, Peking-based resistance showed lower yields, making breeders and farmers alike hesitant to adopt it.

Much like herbicide resistance, the reliance on PI 88788 alone is causing problems as SCN adapts.

"As SCN adapts and reproduction increases, yields can decrease," Bauer says.

Rotating resistance sources can extend the life of the management options available today. While some farmers may worry about using a Peking resistance source, losses from today's nematode population can result in far greater yield drags.

"Using resistant varieties, either Peking or PI 88788, you must rotate the sources and rotate your varieties," says Bill Backhaus, an agronomist with BASF. "Many farmers find a soybean variety they like, rotate to corn, and then go back to that variety on the same farm following the rotation. That is a big mistake, and SCN resistance can develop at an even faster rate in that scenario."

Troy Bauer

Research and Development

Over the past few years, researchers at land-grant universities have worked to identify new sources of resistance to SCN. It's a complicated process that requires first identifying the type of SCN most prevalent in today's fields.

"Race-3 or HG type 0 used to be the predominant nematode population out there in the field, but that has changed," Mitchum says. "Most soybeans with resistance to Race 3 or HG type 0 carry the rhg1-a/Rhg4 gene combination from Peking or the rhg1-b from PI 88788. As nematodes have adapted to overcome the PI 88788 type of resistance, those virulent nematodes have become highly prevalent."

Mitchum collaborated with Andrew Scaboo, a soybean breeder at the University of Missouri, to identify the gene combination of rhg1-a and rhg2 from PI 90763.

"That genetic combination confers resistance to SCN HG type 1.2.5.7, or Race 2, which is one of the predominant SCN types out in the field now," Mitchum says. "That is a great trait to plant to combat the increased virulence that we see out there. Breeders are now working to move that into high yielding varieties, and I think that has a lot of promise in rotation."

Understanding the type of SCN prevalent in fields and pairing that with new modes of action could lead to the development of new seeds for farmers.

"Recent work has really opened the door for figuring out which combinations of genes confer resistance to the different HG types of SCN," Mitchum says. "Now the challenge is to move them into commercial varieties and then figure out which rotation strategy is going to be most effective to a farmer's field population. Right now, we're working on not only identifying these other modes of action and getting those gene combinations out there, but also testing these in the field."

While new sources of resistance have been identified, seed varieties that include them cannot be developed overnight.

"Nematode resistance is only one trait a breeder needs to have in the end product," Mitchum says. "Once you start to package traits like insect resistance, herbicide resistance, and nematode resistance, then changing to a different mode of action is difficult for the industry. It takes time to bring that other mode of action to market."

BASF Bt Traits

A new nematode-resistant soybean from BASF is on the horizon. It expresses a novel Bt protein, Cry14Ab-1, that will be part of the GMB151 SCN trait bred into soybean varieties containing native SCN resistance.

"BASF has been developing traits for crops for years to help farmers do the biggest job on Earth, whether directly or indirectly, and in collaboration with many other companies behind the scenes," says Bill Backhaus, an agronomist with BASF. "This is our most recent, and potentially most important, trait to be developed. Our nematode-resistant soybean [NRS] trait will be the first commercially available biotechnology trait developed to control nematodes. The new NRS trait is expected to provide unprecedented protection against nematode pests in soybeans, including SCN."

The trait, in its sixth year of advanced field trials, has shown an average 8% yield benefit over current varieties. BASF is targeting a 2029 commercial release, pending regulatory approval. •

Managing for SCN

Managing SCN population densities is vital to reducing yield loss, as populations can compound over several generations. North Dakota farmer Chandra Langseth has seen little impact from SCN on her farm, thanks to her father-in-law's early SCN management. When the pest was detected just miles away from their operation in the early 2000s, he took an aggressive approach, planting one of the few resistant varieties available at the time.

Bill Backhaus

With high pH soils and iron chlorosis problems, the Langseth farm has specific needs when it comes to soybean varieties. Their first attempt at planting an SCN-resistant variety saw steep yield drags.

"That one SCN-resistant variety just didn't quite cut it," Langseth says. "To my father-in-law's credit, he saw this was something we needed to take care of. That first variety was a Peking, and then PI 88788 started to come into our area and were better suited agronomically, so that yield drag went away."

The Langseths continue to be fairly aggressive with SCN management, as soybeans account for nearly half their acres. That means soil sampling, using available resistant varieties, and introducing seed treatments.

Consistent soil sampling is key to understanding field population densities and knowing where to plant resistant varieties. The life cycle of SCN allows the problem to compound over generations, meaning populations can soar before a farmer recognizes a problem.

"If we don't keep a handle on it, we can get this build effect and all of a sudden we go from OK to yield drag to increased yield drag," Langseth says. "It's not something that we can just rotate out of after one year. It's something that we're stuck with." SF

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Photography: Courtesy of the SCN Coalition and BASF