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What happens during pathogen infections in crop plants?

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Soybean cyst nematode: Challenges and opportunities for sustained, profitable soybean production

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The soybean cyst nematode (SCN), *Heterodera glycines*, continues to be a widespread and damaging pathogen of soybean. The pest has been found in all soybean-producing states except New York and all Iowa counties except Allamakee (Figure 1). Although the nematode has been present in the Midwest for four decades, the situation with SCN continues to evolve.

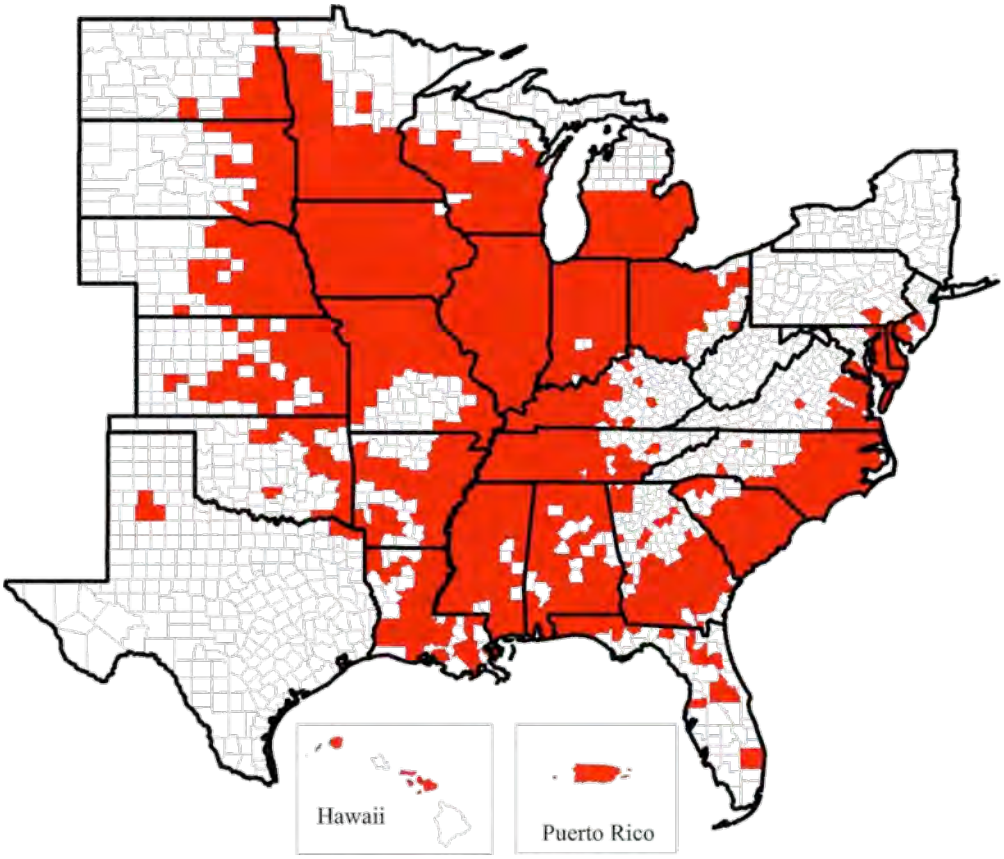

Figure 1. Known distribution of the soybean cyst nematode in the United States as of 2014 (Tylka and Marett 2014). More recent map is not available.

Yield loss and population density increases can occur without symptoms

The reproduction and damage caused by SCN is affected greatly by weather – primarily rainfall. There is greater SCN reproduction and greater damage in dry growing seasons than in wet growing seasons. SCN reproduction and yield loss occur in years with adequate or excess moisture, but obvious symptoms of damage are usually lacking. Unfortunately, the lack of symptoms can lead to undetected increases in SCN population densities to very damaging levels that can cause 30 to 50 percent yield loss, especially during hot, dry growing seasons. Iowa State University (ISU) recommends sampling fields prior to growing every third soybean crop to get a feel for the SCN population densities that are present.

SCN soil sampling guidelines are as follows:

- It is best to use a soil probe, not a spade, to collect soil cores.
- Samples can be collected following a soybean or corn crop.
- Collect 8-inch-deep soil cores.
- The more soil cores collected from the smaller the area, the more accurate the results will be. Collecting 15 to 20 soil cores from every 20 acres often is recommended.
- Collect samples from different management zones in a field, if such zones exist.
- Combine soil cores and mix them well before placing the mixed soil into a soil sample bag.
- Most private soil-testing labs in Iowa can process samples for SCN.
- SCN samples also can be sent to ISU's Plant and Insect Diagnostic Clinic, 327 Bessey Hall, 2200 Osborn Dr, Iowa State University, Ames, IA 50011-4009, 515-294-0581.

Not all SCN-resistant soybean varieties the same

Soybean varieties that are resistant to SCN produce greater yields and allow less reproduction of the nematode than varieties that are susceptible (Tylka et al. 2015). But SCN population densities can buildup inadvertently if the resistant varieties that are grown do not provide full protection against the nematode. Some varieties are described as moderately resistant instead of resistant to SCN. Farmers are advised to grow soybean varieties that have the strongest SCN control. Also, full SCN resistance in soybean requires multiple genes from the breeding line (such as PI 88788) that was used to develop the variety. Not all varieties on the market described as SCN resistant possess all of the available resistance genes, a condition which leads to less than full nematode control.

Iowa State University tests the nematode control and agronomic performance of many SCN-resistant soybean varieties in experiments conducted throughout Iowa each year. The results of the work, funded by the soybean checkoff through the Iowa Soybean Association, are posted online at http://www.isuscntrials.info. A hard copy report of the results of the 2016 experiments will be mailed as a special insert in the January 14, 2017, issue of the Iowa Farmer Today.

SCN population densities are building up on PI 88788 resistance

An inadvertent buildup in SCN numbers also can occur by growing SCN-resistant soybean varieties with the same source of resistance repeatedly in the same field, causing a shift in (or selection for) the SCN population with increased ability to reproduce on the source of resistance. The increased reproduction of SCN populations in Iowa fields is a real problem because almost all SCN-resistant soybean varieties available to Iowa farmers contain resistance genes from the same breeding line, called PI 88788 (see Figure 2).

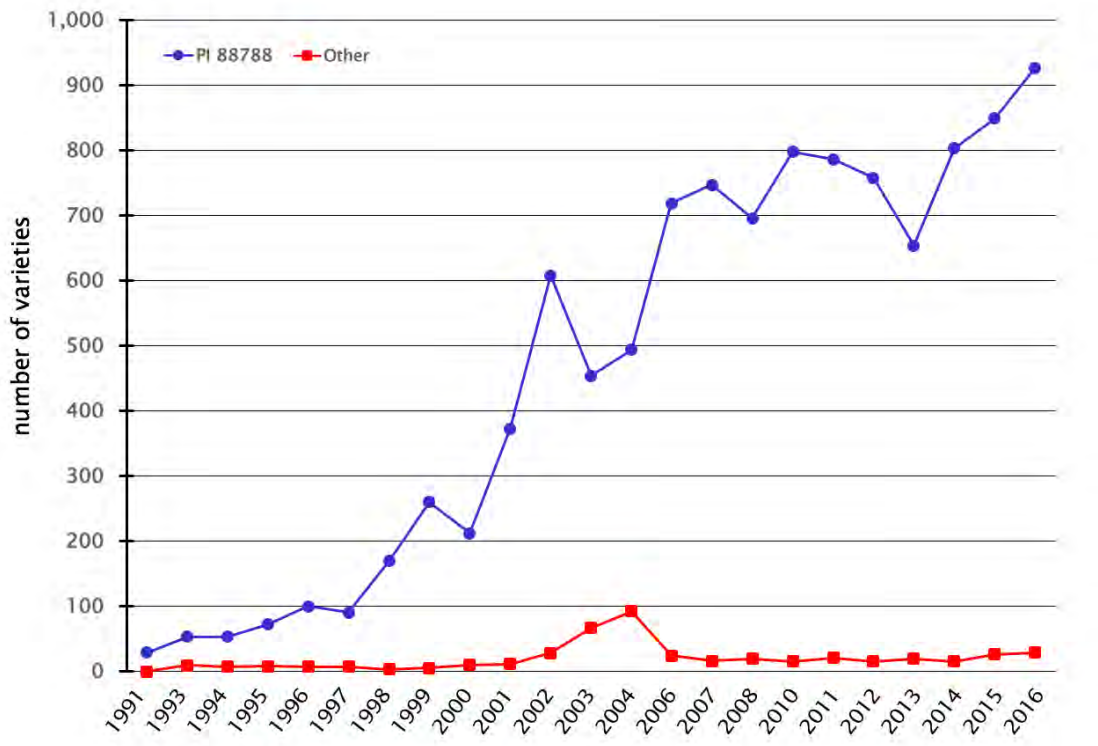

Figure 2. The number of SCN-resistant soybean varieties available to Iowa soybean farmers from 1991 to 2016 containing PI 88788 resistance genes versus all other sources of resistance (Tylka and Mullaney 2016).

If SCN numbers are unexpectedly high and yields of SCN-resistant soybean varieties have started to decline for no apparent reason, it might be worth having an SCN "HG type test" conducted on a sample of the SCN population from the field. This test determines if the SCN population in the field has developed increased reproduction on soybean varieties with the PI 88788 source of resistance as well as other resistance sources. Consult the ISU Plant and Insect Diagnostic Clinic at 515-294-0581 or *pidc@iastate.edu* for instructions on how to collect and submit a sample for HG type testing.

New management options are available

Several nematode-protectant seed treatments are available with activity against SCN. These products are relatively new and represent a significant and unique opportunity to broaden the scope of SCN management programs. Currently there are products from Bayer, Plant Health Care, Inc., and Syngenta. Additional nematode-protectant seed treatment products will become available from Monsanto and Valent in upcoming years. Other such products are likely to be brought to market in the near future as well. These seed treatments are recommended to be used on resistant varieties. So in addition to providing SCN protection on their own, hopefully the seed treatments will slow the rate of decline of effectiveness of resistant varieties as SCN populations continue to develop increased reproduction on PI 88788 resistance.

Conclusions

Given its ability to survive in soil for many years and to reproduce quickly when conditions are favorable, it is almost inevitable that SCN will continue to be a leading cause of soybean yield loss in the future. Many fear that yield losses from SCN will increase in future years as more and more SCN populations develop increased ability to reproduce on PI 88788.

The use of nonhost crops and nematode-protectant seed treatments can help slow development of an SCN crisis. But long-term, sustainable SCN management will require a multi-faceted, integrated pest management approach that includes use of nonhost crops, nematode-protectant seed treatments, conventionally bred soybean varieties with resistance from multiple, different breeding sources, and varieties with transgenic SCN resistance, if they become available.

References

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