THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Agriculture and Natural Resources

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Soybean Cyst Nematode

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Soybean cyst nematode (SCN) was first identified in Ohio on soybean in 1987 and has now been found in at least 66 counties. This nematode damages soybeans by feeding on plant roots, robbing the plants of nutrients, and providing wound sites for root rotting fungi to enter. The severity of symptoms and yield losses are dependent on several factors including the number of nematodes present in the field at planting, the soybean variety, soil texture, fertility, soil moisture, and tillage practices. Many fields in Ohio show no obvious above-ground symptoms, but do have some yield reductions. Once SCN has become established in a field, it rarely is eradicated. The first step in management of SCN is to determine which fields are infested and how many nematodes are there.

Symptoms

Soybean cyst nematode injury can easily be confused with other crop production problems such as nutrient deficiencies, injury from herbicides, soil compaction, or other diseases. When there are high populations of nematodes present, symptom development can be quite severe with circular to oval patches of stunted and yellowed plants. Affected areas may increase in size each year, usually in the direction of tillage. Under moderate populations, plants may appear stunted in patches or fields may produce less than the desired yields. When populations are low there are no above-ground symptoms.

SCN is a sedentary nematode that feeds in one place. The female body swells and initially appears as a white pearl on the root. These young females can be found clinging to the side of the soybean root throughout the summer. Once the female matures, the outside turns brown and hard and difficult to see. Roots must be gently dug from the soil, the soil gently shaken off, and the roots examined closely to see the bright white to yellow females on the roots.

Figure 1. White females on soybean roots in July *(D. Mills, OSU)*

SCN Life Cycle

The soybean cyst nematode, *Heterodera glycines*, is a microscopic (1/64 inch long) roundworm that feeds on soybean roots. The cyst stage is the body of the dead, female nematode filled with eggs. This cyst is highly resistant to adverse conditions and serves to protect the eggs and young nematode larvae for many years.

There are three major life stages of cyst nematodes: egg, juvenile, and adult. In Ohio, under favorable conditions the life cycle can be completed in 24 to 30 days. It is possible, therefore, to have three to five generations each growing season. The juveniles hatch from eggs and search for soybean roots. However, the juveniles can move only short distances through the soil before entering the root, and if no root is found the nematode dies shortly from

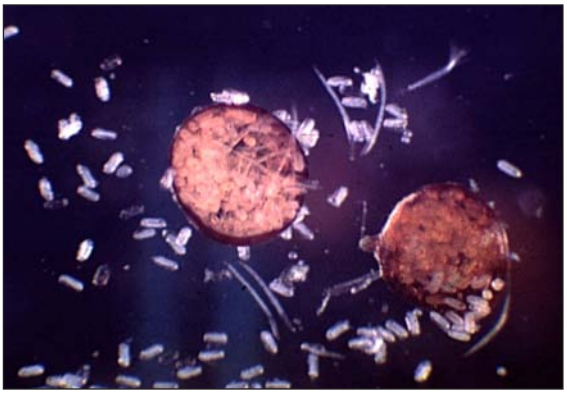

Figure 2. SCN cysts, eggs, and juveniles (*R.M. Riedel, OSU*)

lack of food. After penetrating the root, the nematode feeds on cells in the vascular tissue. It secretes digestive enzymes that stimulate the development of enlarged cells, called syncytia, that the nematode feeds on.

A cyst may contain 150 to 500 eggs depending on how old the cyst is and how healthy the female was when it was feeding on its host. Before the female dies, some eggs are deposited outside the body in a jelly-like mass. These begin to hatch in a few days and may continue to hatch for the next several months to a year. Those remaining in her dead body (the cyst) are protected from the elements and may hatch years later. Generally, 50 percent of the eggs produced by a female hatch each year, thus the population may drop significantly after several years if there are no susceptible host plants present.

Step 1. Identify those fields that have cysts and monitor populations.

The best time to sample fields for soybean cyst nematode is in the fall after the soybeans are harvested. Soybean cyst nematode populations can increase as much as 10 to 30 fold per growing season, so earlier soil sampling may give lower numbers. Soybean cyst nematodes will not be distributed evenly throughout a field. Techniques for sampling soil for SCN by the Soybean Cyst Nematode Coalition are as follows:

- Use a one inch diameter soil probe to collect samples (6 to 8 inches in depth)
- Following a zig zag pattern, collect 10 to 20 soil cores per 10 to 20 acres
- Collect cores from areas of similar soil type and crop history
- Dump cores from each 10 to 20 acre area into a bucket or tub and mix thoroughly
- Place 1 pint (2 cups) of mixed soil in a soil sample bag or plastic zippered bag and label with a permanent marker; and
- Store sample in cool, dark place until shipped to lab doing SCN analysis.

This level of sampling is necessary to obtain relatively accurate counts of the nematode population and to make meaningful recommendations for management. The following is a listing of labs that process SCN soil samples:

C. Wayne Ellett Plant & Pest Diagnostic Clinic
Room 110, Kottman Hall
2021 Coffey Road
The Ohio State University
Columbus, OH 43210
http://ppdc.osu.edu

Brookside Laboratory Inc
308 S Main St
New Knoxville, OH 45871
419-753-2448
419-753-2949 fax
mflock@blinc.com

Geophyta Inc
2685 CR 254
Vickery, OH 43464
419-547-8538
419-547-8538 fax
nathan@geophyta.com

Spectrum Analytic Inc
Washington CH, OH
800-321-1562

The numbers of soybean cyst nematode cysts or eggs found in the soil sample will determine the best management plan for that field. Preplant soybean cyst nematode egg and cyst numbers can give an indication of the potential for yield reduction, but there is no way to predict annual yield loss precisely. Table 1 illustrates several outcomes.

Step 2. Rotate crops.

Once SCN has been identified, the best disease management strategy is to keep the numbers low. And the best way to keep numbers low is to rotate, rotate, rotate. Rotating crops with non-host crops (corn, small grains, and alfalfa) is the most effective method of controlling SCN. Populations typically decline by 50 percent per year under non-host crops under Ohio conditions. In fields where SCN populations are high, it may take three years or

Table 1. Potential population levels of soybean cyst nematode and suggested management strategies for Ohio soybean producers			
Egg count per 100 to 200 cc* of soil	**Cyst count**	**Population level**	**Management strategies**
0–40	0	None detected	Continue to monitor field after two crops of soybeans.
40–200	1	Trace	May begin to measure some yield loss in susceptible varieties at or above 200 eggs/200 cc.
200–2000	1–4	Low	Plant SCN resistant variety or rotate to a non-host crop. At or above 2000 eggs some yield loss may result on SCN resistant lines.
2000–5000	3–20	Moderate	Rotate to a non-host crop next year and return with SCN resistant soybeans the following year.
5000 and over	15–20 and over	High	Rotate to a non-host crop for two to three years then sample the soil to determine nematode populations before planting SCN resistant varieties.
*100 to 200 cc = approximately ½ to 1 cup			

more of non-host crops between soybean crops. It should be noted that the nematode will not be eliminated in these fields. If soybeans are repeatedly planted for several years, SCN will again become yield limiting. SCN populations can increase 10 to 30 fold per year on susceptible soybeans. The nematode can also reproduce on many legume crops and weeds, especially purple deadnettle and henbit. Purple deadnettle and henbit are common winter annual weeds of no-tillage fields. They emerge from September through early November, and they can increase the SCN population by another generation before winter (see table 2). Therefore, winter annual weeds in SCN-infested fields should be controlled as soon after crop harvest as possible.

Table 2. Other hosts of soybean cyst nematode	
Crop plants	***Weed plants***
Aslike clover	*Hemp sesbania*
Bird's-foot trefoil	Common and mouseear chickweed
Green beans, dry beans	Common mullein
Common and hairy vetch	Henbit
Cowpea	Milk and wood vetch
Crimson clover	Pokeweed
Crown vetch	Common purslane
Lespedezas	Spotted geranium
Pea	Wild mustard
White and yellow lupine	Purple deadnettle
Sweet clover	Field pennycress
	Shepherd's-purse

Step 3. Use resistance wisely.

Resistant varieties should be used in crop rotation with non-host crops to prevent the buildup of soybean cyst nematodes in that field. The resistance that is utilized in commercial soybean varieties does not confer immunity. Resistance to SCN is characterized as less than 10 percent reproduction on the resistant compared to a susceptible variety. There can be some increase of soybean cyst nematode numbers through the growing season but not as much as if a susceptible variety was planted in that field. Resistant varieties should not be planted in fields with high numbers of nematodes and the same source of resistance should not be planted repeatedly in the same field. Doing so may select races of SCN that can reproduce on resistant varieties. Moreover, large numbers of SCN juveniles will puncture and damage roots of resistant varieties even though they cannot reproduce in them. There are currently three major sources of resistance that have been incorporated into commercial varieties: PI88788, Hartwig (PI437654), and Peking. Numerous fields in Ohio now have sizeable populations that can reproduce on the soybeans developed with the PI88788 source of resistance.

Step 4. Use best management practices.

- Fertility — Maintain optimum fertility based on soil test. Under high SCN populations, even the most fertile fields will be severely affected; fertilization will not eliminate the problem.
- pH — Research shows that soil pH has an effect on the level of yield loss caused by SCN. Populations

were the highest in areas of the field with the highest soil pH (7.1–8.0 vs 5.8–6.4). Likewise the yield advantage of SCN resistant varieties was greatest in high pH soils and lowest in low pH soils.

- Optimize planting/harvesting for the maturity group for your region.
- Optimize drainage for proper plant growth.

Step 5. Manage other diseases.

Brown stem rot and sudden death syndrome have been shown to interact with SCN. With SCN many of these diseases can have a larger impact than if the plants were infected separately. Choose varieties that are resistant to these and other Ohio soil-borne pathogens.

Step 6. Prevent introduction.

This is the first line of defense. Nematodes can move no more than a few inches a year on their own, so they depend on "hitching rides" on tillage, planting, or harvesting machinery, or in soil peds with seed. Clean machinery thoroughly with steam, hot water, or dry heat before moving from infested fields to noninfested fields and plant only seeds that have been thoroughly cleaned to remove soil particles or obtain seed from non-infested SCN locations. SCN can also be introduced into a field by wind-blown dust, animals, or flooding.

HG Types

Some SCN populations are capable of reproducing on resistant soybean varieties. This information is primarily used by seed companies to help make better breeding decisions for the development of varieties for specific regions.

"HG" stands for the scientific name for SCN, *Heterodera glycines*. An HG Type is a description of an SCN population that is able to develop and reproduce on a resistant soybean line. The number or numbers in the HG Type designation correspond directly to sources of resistance used in available SCN-resistant soybean varieties as seen in table 3. HG Type measures the nematode, not the soybean. For example, HG Type 0 will not attack any source of resistance, HG Type 2 will only reproduce on PI8788, and HG Type 2,4 will only produce on PI88788 and PI437654.

Table 3. Codes for soybean plant introductions (PI) used in the HG Type test

1	PI 548402	Peking
2	PI 88788	
3	PI 90763	
4	PI 437654	Hartwig
5	PI 209332	
6	PI 89772	
7	PI 548316	Cloud

Links to other useful sources of information on managing soybean cyst nematode:

Ohio Field Crop Disease
http://www.oardc.ohio-state.edu/ohiofieldcropdisease/soybeans/scn.htm

Iowa State University
http://www.soybeancyst.info

NSCRP–Plant Health Initiative
http://planthealth.info/scnguide/index.html