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, *Heterodera glycines*, was first identified in Ohio on soybean in 1987 and has now been found in 68 counties in Ohio. Soybean cyst nematode (SCN) 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, tillage practices, soil texture, fertility, pH, and environmental conditions during the growing season. Once SCN has become established in a field, it rarely is eradicated. SCN is the leading cause of soybean yield loss in North America and now occurs in all major soybean production areas worldwide.

Symptoms

SCN 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 severe with circular to oval patches of dying, stunted, 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 females can be found clinging to the sides of soybean roots throughout the summer months. The female body swells with eggs and initially appears as a small, white pearl or "lemon" on the root. 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 or washed off, and the roots examined closely to see the bright white to yellow females. Nodules—where symbiotic nitrogen fixation occurs—are also on the roots of soybean plants but are irregular in shape and much larger, usually greater than 1 mm in diameter.

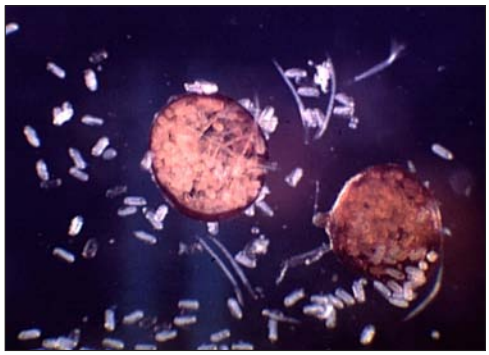
SCN Life Cycle

In the early life stages, SCN is a microscopic (1/64 inch long) roundworm that feeds on soybean roots. There are three major life stages of cyst nematodes: egg, juvenile, and adult. Under favorable conditions in Ohio, the life cycle

can be completed in 24 to 30 days. It is possible 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 lack of food. Water movement throughout the field may also aid in moving SCN juveniles. 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 establishes as its feeding site.

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 developing eggs and young nematode larvae for many years. A cyst usually contains about 250 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 eggs begin to hatch in a few days and may continue to hatch for the next several months to a year. Those eggs remaining in the dead cyst female are protected from the elements and may hatch years later while those on the outside will be killed during the winter. 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.

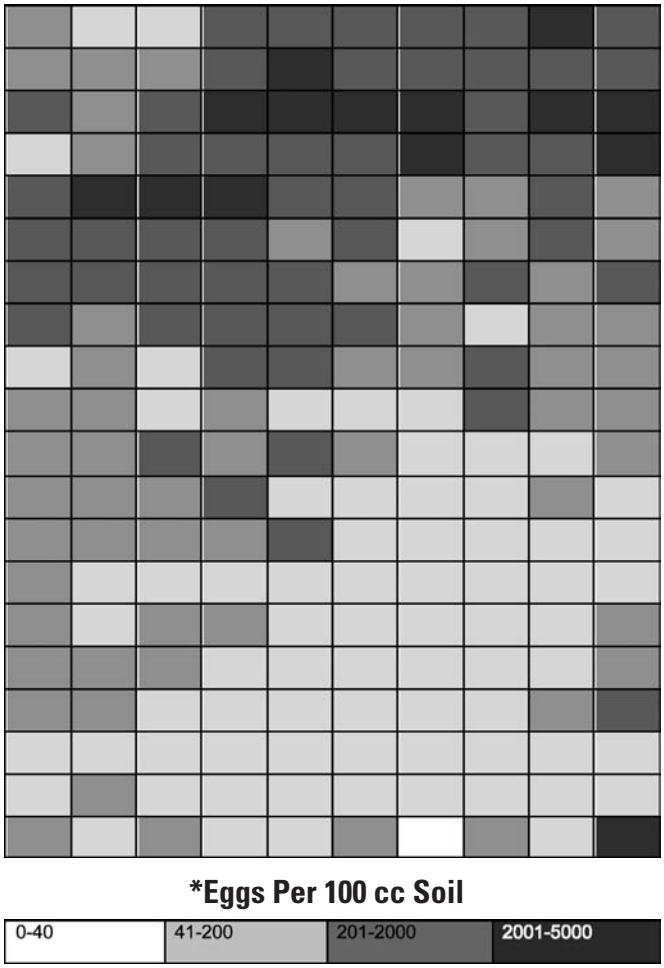


Management

Step 1. Identify the fields that have cysts, and monitor the populations.

The best time to sample fields for SCN is in the fall after soybeans are harvested. SCN populations can increase as much as 10 to 30 fold per growing season, so early sampling may give lower numbers. SCN is not distributed evenly throughout a field (Table 1).

Table 1. SCN Field Map*



The number of SCN cysts or eggs found in the soil sample will determine the best management plan for the field (Table 2). 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 zigzag pattern, collect 10 to 20 soil cores per 10 to 20 acres.
- Collect cores from areas of similar soil type and crop history.
- Dump the 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 it with a permanent marker.
- Store the sample in a cool, dark place until shipping it to an SCN analysis lab.

Table 2. Best SCN 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. When grown at these populations, 16 to 18 bu/A losses have been recorded in Ohio on susceptible varieties.
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			

The following is a listing of labs that process SCN soil samples:

OSU C. Wayne Ellett Plant and Pest Diagnostic Clinic ($15/sample)
8995 E Main St, Bldg 23
Reynoldsburg, OH 43068
614-292-5006
http://ppdc.osu.edu

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

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

Spectrum Analytic Inc
1087 Jamison Rd NW
Washington Court House, OH 43160
800-321-1562
740-335-1562
740-335-1104 fax
www.spectrumanalytic.com

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Step 2. Rotate crops.

Once SCN has been identified, the best disease management strategy is to keep the numbers low. The best way to keep numbers low is to rotate, rotate, rotate. Rotating host crops with non-host crops (corn, small grains, and alfalfa) is the most effective method of controlling SCN (Table 3). Under Ohio conditions, populations typically decline by 50 percent per year under non-host crops. In fields where SCN populations are high, it may take three years or more of non-host crops between soybean crops. It should be noted that nematode populations 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. These are common winter weeds of no-tillage fields. They emerge from September through early November, and they can increase the SCN population by another generation before winter. Therefore, winter annual weeds should be controlled as soon after crop harvest as possible.

Table 3. Other Hosts of SCN

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 resistant soybean varieties 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 mean that the soybeans are immune to SCN. Resistance to SCN is characterized as less than 10 percent reproduction on the resistant variety compared to a susceptible variety. Resistant varieties should not be planted in fields with high numbers of nematodes, and varieties having the same source of resistance should not be planted repeatedly in the same field. Doing so may select for types of SCN that can reproduce on resistant varieties. Moreover, large numbers of SCN juveniles will puncture and damage the roots of resistant varieties even though they cannot reproduce on them, leaving them susceptible to other soil-borne pathogens. There are currently three major sources of resistance that have been incorporated into commercial varieties: PI88788, Hartwig (PI437654), and Peking. Ohio now has some fields with sizeable SCN populations that can reproduce on the soybeans developed with the PI88788 source of resistance.

The female index (FI) is the best way to check for the true level of resistance in individual varieties. The FI is determined in greenhouse assays, where the average number of female cysts on a resistant cultivar is divided by the average number of female cysts on a susceptible cultivar and multiplied by 100. If the FI is less than 10, the cultivar is considered resistant. For most areas, the susceptible cultivar Lee 74 is included in the assay for comparison. The FI is currently only evaluated in a few locations. There is variability among SCN populations, and more research is in progress to assess the best means to implement this across states.

Step 4. Use best management practices.

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

Sudden death syndrome and brown stem rot 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. To remove soil articles, plant seeds that have been thoroughly cleaned. SCN can also be introduced into a field by animals, flooding, or wind-blown dust.

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 4. HG Type applies to the nematode, not the soybean. For example, HG Type 0 will not attack any source of resistance, and HG Type 2 will only reproduce on PI8788. HG Type 2 and 4 will only produce on PI88788 and PI437654.

Table 4. 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

Other Useful Sources on Managing SCN

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