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

Symptoms are highly variable. Symptom development depends on several factors, especially population densities of the nematode, the presence of other pathogens, soil nutrient status, field history of resistant soybean varieties, and rainfall. Severe symptoms include circular to oval patches of dying, stunted, yellowed plants. Affected areas may increase in size each year, usually in the direction of tillage. Moderate symptoms include patches of stunted plants, and lower than desired yields. Often, yield is reduced when there are no visible symptoms. Soybean cyst nematode injury can also easily be confused with other crop production problems such as nutrients deficiencies, injury from herbicides, soil compaction, or other diseases.

SCN females can be found clinging to the sides of the 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 becomes brown, hard, and more difficult to see. Roots must be gently dug from the soil, the soil gently shaken or washed off, and the roots examined closely for the presence of 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, soybean cyst nematode 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. In Ohio, under favorable conditions 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 though 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 of 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.

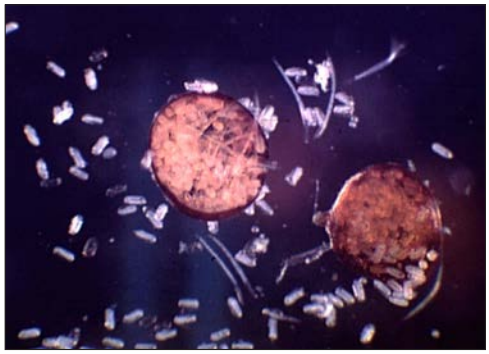
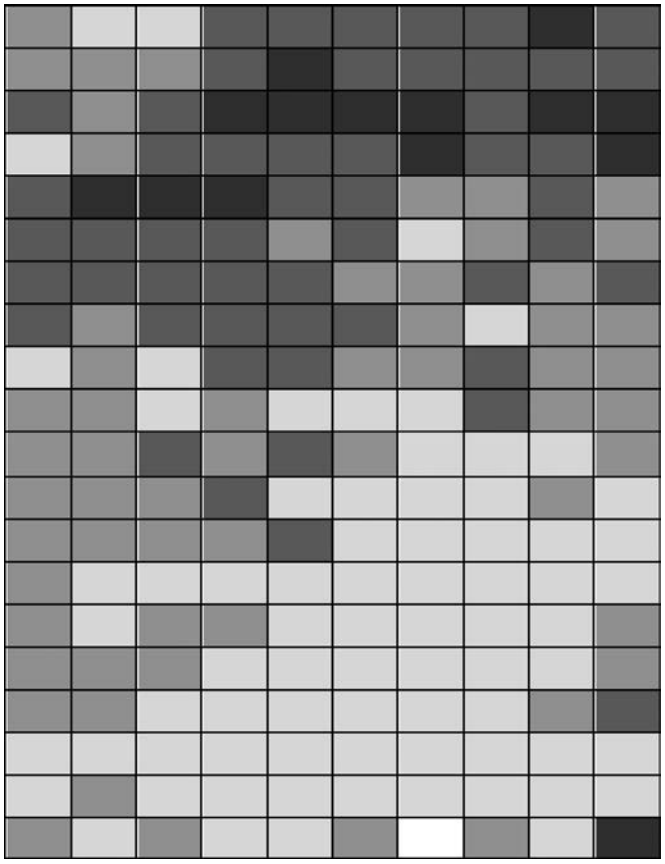


Table 1. SCN field map*



***Eggs per 100 cc soil**

0-40	41-200	201-2000	2001-5000

Management

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

The best time to sample fields for soybean cyst nematode 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).

The number of soybean cyst nematode 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).
- Follow a zigzag pattern; collect 10 to 20 soil cores per 10 to 20 acres.
- Collect cores from areas of similar soil types 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.
- Store sample in a cool, dark place until shipped to a SCN analysis lab.

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

OSU C. Wayne Ellett Plant and Pest Diagnostic Clinic 8995 E. Main St. Bldg. 23 Reynoldsburg, OH 43068 614-292-5006 http://ppdc.osu.edu	Geophyta Inc 2685 CR 254 Vickery, OH 43464 419-547-8538 419-547-8538 fax nathan@geophyta.com
Brookside Laboratory Inc 308 S Main St New Knoxville, OH 45871 419-753-2448 419-753-2949 fax www.blinc.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

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, and rotate. Rotating host crops with non-host crops (corn,

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. 16 to 18 bu/A losses have been recorded in Ohio on susceptible varieties when grown at these populations.
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			

small grains, and alfalfa) is the most effective method of controlling SCN. Under average Ohio conditions, SCN populations may 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 to reduce SCN populations significantly. 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 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 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 sizable SCN populations that can reproduce on the soybeans developed with 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 dates 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 anything that can move soil, such as field machinery, migratory birds, floodwater, or wind. In the past, planting seeds that had not been thoroughly cleaned was probably an important means of moving SCN from field to field.

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. Plant seeds that have been thoroughly cleaned to remove soil particles. 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 used primarily 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 the table below. HG Type applies to 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 1,4 will only reproduce on Peking and PI437654 (Table 4).

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

Links to other useful sources of information 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