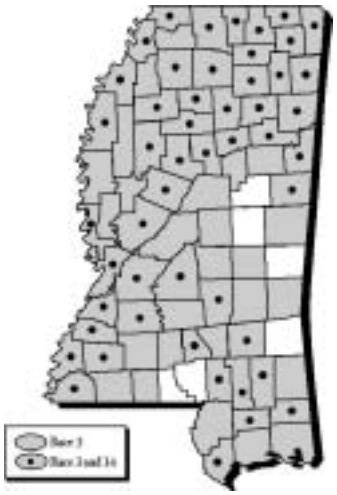
Soybean Cyst Nematode

Mississippi State University Extension Service

Although the soybean cyst nematode (Heterodera glycines) is small in size, it is great in numbers and ability to reduce soybean yields.

Losses caused by the soybean cyst nematode (SCN) in Mississippi have sharply declined since the 1970's. This decline is because of varieties with more types of SCN resistance, use of MSU-ES nematode control programs, and naturally occurring nematode parasites.

SCN was first found in DeSoto County, Mississippi, in 1957. By 1995 SCN had been found in 76 Mississippi counties (see map). Infestations are most prevalent in the northeastern part of the state. Approximately one million acres in Mississippi are infested.



Distribution of the soybean cyst nematode in Mississippi in 1995

SYMPTOMS

You should suspect SCN infestations whenever you see randomly spaced circular areas of stunted and yellow soybeans in the field. Affected plants may wilt, even with adequate soil moisture, and severely infected young plants may die. Heavy infection results in root distortion and smaller than normal root systems. The roots of such plants are generally dark and discolored, and the number of nitrogen fixing nodules is reduced. Careful removal and examination of the root system reveal the white-to-yellow female nematodes and brown cysts clinging to the roots. These are somewhat smaller than the head of a pin and are lemon-shaped.

Since the symptoms of SCN damage to soybean plants are not easy to distinguish from damage resulting from other causes (lightning, herbicides, drought, low fertility, poor nodulation, poor drainage, and soil-inhabiting insects), collect soil samples from the areas of the fields where you suspect cyst nematode infestations, and have the samples analyzed for a sure diagnosis.

Soybean cyst nematode damage

HOST RANGE

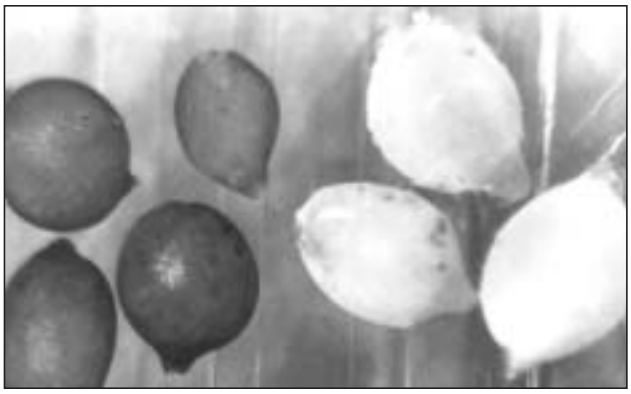
"Hosts" are plants on which the nematode can reproduce. Certain plants other than soybeans can serve as hosts. The host range is limited mostly to legumes and includes annual and common lespedeza, common and hairy vetch, snap beans, and lima beans. Do not use the common and hairy vetches as a winter cover crop in SCN-infested fields.

Some weed hosts of SCN are hemp sesbania (coffee weed), sicklepod, common mullein, low hop clover, and henbit. You should make special effort to control these weeds in SCN-infested fields. Rotation to a nonhost crop in an attempt to reduce an SCN population will not succeed if weed hosts are in the field.

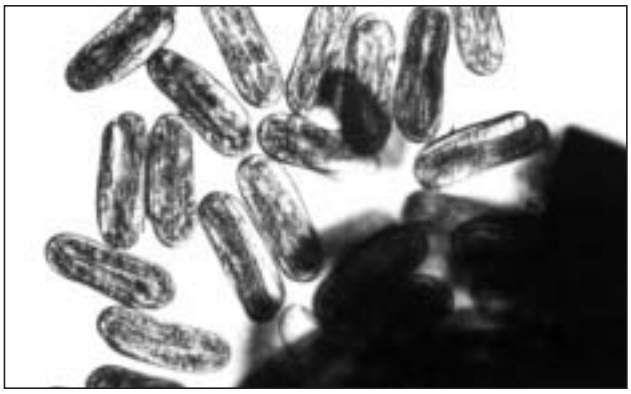
LIFE CYCLE

The ability of the SCN to produce high populations in one growing season on susceptible plants is one factor that makes the nematode so damaging and difficult to control. The nematode completes its life cycle in 25 to 30 days, and each female produces 200 to 500 eggs. Some of the eggs may hatch immediately and begin a new cycle. In Mississippi the nematode may complete as many as three cycles in a growing season. Three forms are involved in the life cycle: egg, juvenile (larva), and adult. The juvenile must find a susceptible host plant and begin to feed before the nematode can reproduce. As the worm-like juvenile feeds, it becomes a white-to-yellow, lemon-shaped female still attached to the root. When the female dies, her body becomes a tough lemon-shaped, brown "cyst," which protects the eggs for several years. The ability to survive pesticides, dryness, and starvation for many years is the second factor that makes this nematode difficult to control.

Life Cycle

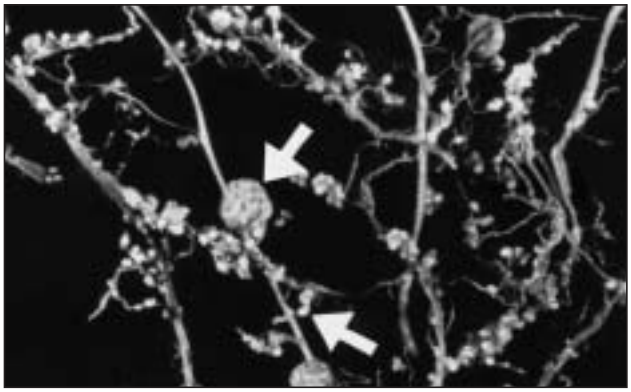


Brown and Yellow cysts



Ruptured cyst and eggs

Juveniles



Soybean roots. Lower arrow points to cysts, upper arrow to nodules.

SPREAD

SCN is a soilborne pest that can move only a few inches each year on its own. However, anything that can move soil can move nematodes. Although we can do little to control movement by wind-blown soil or flooding, we can prevent movement into the fields by soil attached to equipment. Thoroughly clean used equipment bought or rented from cyst-infested areas before taking it to a non-infested field.

RACES

Sixteen types of SCN known as "races" have been officially described. These 16 races differ from each other mainly in their ability to reproduce on certain soybean varieties. In Mississippi we are primarily concerned with three races of the soybean cyst nematode (Race 3, Race 5, and Race 14). Race 3 designates nematode populations that will not reproduce on Race 3-resistant varieties.

Race 14 designates nematode populations that will reproduce on Race 3-resistant varieties. Race 5 designates populations that will reproduce on Race 14-resistant varieties. Races 3 and 14 are the most prevalent races in Mississippi.

A feature of SCN races is their ability to change from one race to another, depending on their feeding needs. For example, when a Race 3 SCN-infested field is planted to a Race 3-resistant variety for several years, the Race 3 population gradually develops the ability to feed on this variety. The variety then is no longer resistant to that population, which is then commonly referred to as Race 14. The reason this process occurs is that usually a few nematodes within a Race 3 population can feed and reproduce on a Race 3-resistant variety. When that variety is planted repeatedly, the offspring of these unusual individuals are free to build up to large populations. This process is a survival mechanism for the nematode. If SCN did not have this ability to change, then all Race 3 populations eventually would be eradicated by resistant varieties.

CONTROL

No method of control eliminates the nematode from the soil. Suggested control methods reduce SCN populations to a level that allows profitable production with little or no damage. Crop rotation, resistant varieties, nematicides, and cultural practices are methods suggested for SCN management.

Cultural Practices: Deep chiseling or subsoiling to break hardpans to allow for maximum root penetration generally increases yields in the presence of nematodes. In low-fertility soils, satisfying soil fertility needs reduces yield losses from nematodes where low to medium populations are present. Providing sufficient water through irrigation will also reduce damage caused by the nematode. However, chiseling, subsoiling, irrigating, and increasing soil fertility will not reduce the nematode population.

As mentioned above, cleaning equipment of soil before moving from infested to noninfested fields prevents spread of the nematode

on equipment. Soil peds in soybeans harvested from infested fields can spread SCN. When purchasing soybeans for seed purposes from other producers, seek seeds that were cleaned with spiral separators to remove soil peds.

Resistance: Using high-yielding varieties with effective cyst resistance is a good example of low cost management of a problem. Contact the diagnostician at the Extension Plant Pathology Laboratory for information on resistance levels of soybean varieties to SCN. Ask your county Extension agent for information on varieties that perform well in your area and are resistant to local disease problems (stem canker, Phytophthora root rot, etc.). Refer to the section on rotations in this publication for instructions for managing SCN with resistance.

Rotation: Rotating soybeans with nonhost crops (corn, cotton, sorghum, peanuts, rice, and sweet potato) is an excellent way to reduce SCN and other pest populations. Fallowing (preventing any vegetation from growing) for a year is equally effective in reducing SCN.

For best results in controlling SCN and other soybean pests, plant a nonhost crop every third year. One year in a nonhost crop can reduce an SCN population by as much as 75 percent. The second year should be planted to a resistant variety. Refer to the rotation plans in this publication for recommended sequences involving nonhost crops.

Many producers are planting soybeans on the same soil year after year because of production problems associated with other crops. Although SCN control is more difficult in monocultured soybeans, it can be managed as long as no variety type (Race 3-resistant, Race 14-resistant, or susceptible) is planted more often than one year out of three. See plan number 2 (Table 2) in the rotation list. One year in a Race 3-resistant variety followed by one year in a Race 14-resistant variety should reduce the population enough that you can safely plant a susceptible variety the third year. However, flooding, weed hosts, and new races can introduce or maintain an SCN population in fields planted in resistant varieties. Therefore, you should send in a representative soil sample for nematode assay at the end of the second season. If the population is low enough, plant a susceptible variety the next year.

The objective of the rotations shown in this publication is to keep a Race 3 population as Race 3. This race is the most easily controlled, because of more control options available. If a Race 3 population changes to Race 14, as can happen when you plant resistant varieties continuously, control options are more limited. Refer to the table for recommendations for Race 14-infested fields. Do not plant Race 3-resistant varieties in those fields until the SCN population is drastically reduced.

The susceptible variety is important to the effectiveness of the rotation program because it helps keep a Race 3 population as Race 3. Experience has shown that you can best avoid race changes with three-year varietal rotations. By planting a susceptible variety the third year (after a Race 3-resistant variety and a Race 14 -resistant variety), you complete the three-year rotation. In this way no variety type is planted more often than one year out of three.

No yield reduction will occur with the susceptible variety if used properly in a rotation program. The "program" includes sampling on schedule. See the instructions in this publication for taking good, reliable soil nematode samples.

Recommended Rotation Plans

Codes used:

S = Susceptible variety

NH = Nonhost crop

R3 = Soybean variety resistant to Race 3

R3+ = Race 3-resistant variety and take representative soil sample for nematode assay at the end of the growing season

R4 = Soybean variety resistant to Race 4

R4+ = Race 14-resistant variety and take representative soil sample for nematode assay at the end of growing season

S + N = Susceptible variety with a nematicide

REPEAT = Repeat plan beginning with year 1

Table 1: For fields containing Race 3 cyst or no cyst

	Year				
Plan	**1st**	**2nd**	**3rd**	**4th**	**5th**
1	NH	R3	R14+	S	Repeat Plan
2	R3	R14+	S	Repeat Plan	
3	NH	R3	R14	Repeat Plan	
4	NH	R3+	S	Repeat Plan	
5	NH	R14+	S	Repeat Plan	

Use rotation plan numbers 2 and 4 with caution if Race 14 is a problem in the vicinity.

Table 2: For Race 14-infested fields

	Year			
Plan	**1st**	**2nd**	**3rd**	**4th**
1	NH	R14+	S	Repeat Plan
2	R14+	*		
3	S+N	R14+	*	

* Depends on outcome of samples.

In fields with populations that reproduce on Race 14 resistant varieties, plant a nonhost crop or use varieties with PI 437654 type of resistance (such as Hartwig). The Hartwig variety is resistant to all races of cyst nematode. Be sure to take a soil sample before planting a susceptible variety.

Nematicides: Aldicarb (Temik) and dichloropropene (Telone II) nematicides are labeled for SCN control. Few acres are treated in Mississippi because of the effectiveness of the rotation program and prohibitive cost of nematicides. All nematicides must be applied at or before planting. For soybeans, no nematicides are cleared for use after planting. Refer to nematicide label for detailed information on its application.

TECHNIQUES FOR COLLECTING SOIL SAMPLES

Populations of soybean cyst nematode vary considerably within a small area of a field. Some areas may not have any nematodes, whereas others may have high populations. For this reason, soil samples must be representative of the field from which they are taken. This becomes extremely important when determining if the population has been lowered enough that you can plant a susceptible variety without a yield reduction while following a rotation program. This is the suggested method for taking soil samples for nematode analysis:

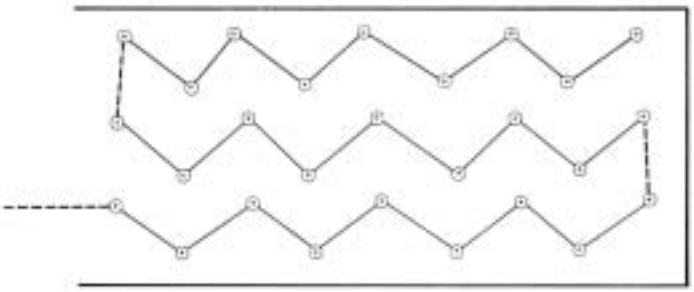
1. Take samples after the growing season, from October to April. Sample during the growing season only from problem areas, for diagnostic purposes.
2. Divide large fields into 25-acre sections and take a sample from each section.
3. Each sample should consist of at least 20 borings taken with a soil probe to a depth of 6 to 8 inches. The recommended pattern is a systematic one, in which the distances between probes are approximately equal (example shown below).
4. Take samples from beneath the previous crop row or root area if possible.
5. If soils differ in appearance, crop growth, or previous treatments, take one sample from each soil type.
6. Mix this soil thoroughly, and put about one pint of this in an "Extension Nematode Soil Sample Bag" (Form 591) or a plastic bag, and seal with a rubber band, twistum, or other similar fastener. Mark your name and the field number on each bag.
7. Keep samples in a cool place until you mail or bring them into the laboratory.
8. Complete the "Extension Nematode Soil Sample Form" (Form 448-A), and place in an envelope in the package containing soil samples (to keep moisture from destroying the form).
9. Mail samples to Extension Plant Pathology Laboratory, Room No. 9, Bost Extension Center, Box 9655, Mississippi State, MS 39762-9655.

You can get the proper forms and soil sample bags from your county Extension office.

Important: Please keep field records, and use the same field designations year after year. This lets you monitor the nematode populations in your fields.

If you furnish the past two years' cropping history with soil samples, we will suggest rotations. If you plant a nonhost crop, we will need to know what the crop was. If you planted soybeans, we need to know what variety you planted. We use this information and the nematode population recovered from your soil samples to determine the race of the cyst nematode you probably have and also help us develop a rotation program for you.

For additional information contact your county Extension agent.



A systematic sampling pattern

MSUcares.com

Revised by **Clarissa J. Balbalian**, Diagnostic Lab Manager, Entomology & Plant Pathology.

Publication 1293
Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. JOE H. MCGILLBERRY, Director (rev.1500-7-03)