Soybean Cyst Nematode

MISSISSIPPI STATE UNIVERSITY™ EXTENSION SERVICE

Even though the soybean cyst nematode (SCN) (*Heterodera glycines*) is small in size, it can reach great numbers and has the ability to drastically reduce soybean yield.

Losses caused by SCN in Mississippi have sharply declined since the 1970s. The population decline can be attributed to varieties with more types of SCN resistance, use of MSU Extension Service nematode management programs, and naturally occurring soilborne fungal nematode parasites.

SCN was first detected in Mississippi in DeSoto County in 1957. By 1995, SCN had been positively identified in 76 Mississippi counties (see Figure 1). Generally speaking, infestations have been more prevalent in the northeastern part of the state. As of 1995, approximately 1 million acres of soybean-producing areas in Mississippi were determined to be infested. Since 1995, sporadic fields of infested soybean plants have been observed throughout the state; however, 1995 was the last statewide survey for the nematode.

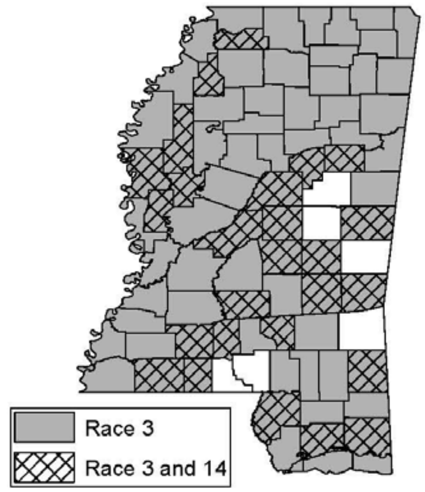

Figure 1. SCN distribution in Mississippi as of 1995.

Symptoms

SCN infestations should be suspected whenever randomly spaced circular areas of stunted and yellow soybean plants are observed in the field. Affected plants may wilt, even with adequate soil moisture, and severely infected young plants may die. Heavy infestation 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 can often reveal the white to yellow female nematodes and brown cysts clinging to the roots. Cysts are somewhat smaller than the head of a pin and are lemon-shaped. In addition, brown cysts can fall off roots, making it difficult to determine the cause of stunted plants.

Since the symptoms of SCN damage are not easy to distinguish from damage resulting from other causes (drought, herbicides, lightning, low fertility, poor drainage, poor nodulation, and soil-inhabiting insects), collect soil samples from the areas of the field(s) where SCN infestations are suspected, and have the samples analyzed for a positive diagnosis.

Figure 2. 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 bean, and lima bean. Do not use the common and hairy vetches as a winter cover crop in SCN-infested fields.

In addition to agronomic crops, SCN can infest some weeds. Weed hosts include common mullein, hemp sesbania (coffee weed), henbit, low hop clover, and sicklepod. Make a 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 present.

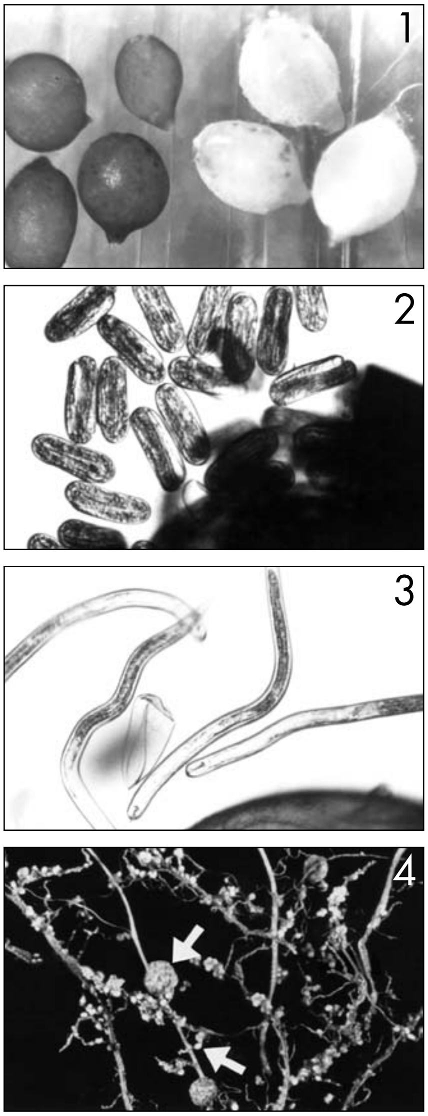

Figure 3. Life cycle of the soybean cyst nematode. 1. Brown and yellow cysts. 2. Ruptured cyst and eggs. 3. Juveniles. 4. Soybean roots. Lower arrow points to cysts, upper arrow to nodules.

Life Cycle

The ability of the SCN to produce high populations in one growing season on susceptible host plants is one factor that makes the nematode so damaging and difficult to manage. 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.

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 windblown soil or flooding, we can prevent movement into fields by soil attached to equipment. Thoroughly clean used equipment bought or rented from cyst-infested areas before taking it to a noninfested field.

Races

Sixteen types of SCN, known as "races," have been officially described, and these differ from each other mainly in their ability to reproduce on certain soybean varieties. In Mississippi, we are primarily concerned with three races of SCN: 3, 5, and 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. Refer to Figure 1 for the particular race(s) present within a specific county.

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 the 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 the ability to change, then all Race 3 populations eventually would be eradicated by resistant varieties.

Management

No method of management eliminates the nematode from the soil. Suggested methods of management 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 and allow for maximum root penetration generally increases yield in the presence of SCN. In low-fertility soils, satisfying soil fertility needs can reduce 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.

Resistance

Using high-yielding varieties with effective cyst resistance is a good example of low-cost management. Contact the diagnostician at the MSU 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.). The next section on rotations gives instructions for managing SCN with resistant varieties.

Rotation

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

For best results in managing 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 suggested sequences involving nonhost crops.

Many producers are planting soybean into the same soil continuously because of production problems associated with other crops. Although SCN management is more difficult in monocultured situations, it can be managed as long as no variety type (Race 3-resistant, Race 14-resistant, or susceptible) is planted more often than 1 year out of 3. (See plan 2 in Table 2.)

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 potentially new races can introduce or maintain an SCN population in fields planted in resistant varieties. Therefore, 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 presented in this publication is to keep a Race 3 population as Race 3. This race is the most easily managed, because of more available options. If a Race 3 population changes to Race 14, as can happen when you plant resistant varieties continuously, management options are more limited. Refer to the table for suggestions for Race 14-infested fields. Do not plant Race 3-resistant varieties in those fields until the SCN population is greatly 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 proven that you can best avoid race changes with 3-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 3-year rotation. In this way, no variety type is planted more often than 1 year out of 3.

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 (page 4) for taking good, reliable soil nematode samples.

Suggested Rotation Plans

S............Susceptible variety
NH.........Nonhost crop
R3..........Soybean variety resistant to Race 3
R3+........Race 3-resistant variety and take representative soil samples for nematode assay at the end of growing season
R4..........Soybean variety resistant to Race 4
R4+........Race 14-resistant variety and take representative soil samples 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 nematodes.

	Year				
Plan	1	2	3	4	5
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	1	2	3	4
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 (e.g., 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

With the loss of aldicarb (Temik), the only labeled nematicide for SCN management is dichloropropene (Telone II) as a preplant nematicide. Few acres are treated in Mississippi because of the effectiveness of the rotation program and prohibitive cost of nematicides. No seed treatment nematicides are available presently; however, they are currently under development.

For soybeans, no nematicides are cleared for use after planting. Refer to the nematicide label for detailed information regarding application methods and restrictions.

Techniques for Collecting Soil Samples

Populations of SCN 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 cores 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 cores 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 soil cores thoroughly, and put about 1 pint in an Extension Nematode Soil Sample Bag (Form 591) or a plastic bag, and seal with a rubber band, twist tie, or other similar fastener. Write 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 it in an envelope in the package with the 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 2 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 soybean, we need to know what variety was planted.

We use this information and the nematode population recovered from soil samples to determine the likely race of the cyst nematode and to develop a rotation program. For additional information, contact your county Extension agent.

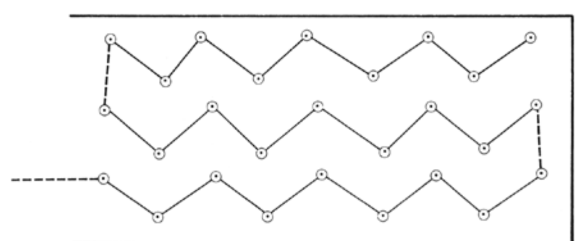

Figure 4. A systematic sampling pattern.

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