

Soybean Nematode Control

NON-CHEMICAL CONTROLS

Managing Nematodes

Nematode induced losses in South Carolina soybeans are caused mainly by the root-knot (*Meloidogyne incognita* and *Meloidogyne arenaria*), Columbia lance (*Hoplolaimus columbus*), sting (*Belonolaimus spp.*), and soybean cyst (*Heterodera glycines*) nematodes. Other nematodes, such as lesion (*Pratylenchus spp.*) and reniform (*Rotylenchulus reniformis*) cause losses in some plantings.

Recent nematode surveys (funded by Clemson University IPM) have demonstrated that (out of 500 fields sampled across the Coastal Plain of S.C.) 97% or 485 of the sampled fields had detectable levels of soybean parasite nematodes. Of these 485 fields, 31% or 152 fields had one or more types of soybean damaging nematode at or above the threshold level. The following table gives the numbers and percentages of the fields with each problem nematode:

<u>Nematode</u>	<u>No. fields</u>	<u>% Fields w/ nematodes</u>
Cyst	75	50
Co. Lance	51	34
Root-Knot	11	7
Lesion	9	6
Ring	3	2
Stubby Root	2	1
Sting	1	1

Plants that are stunted or yellowed may have a nematode problem. The best way to determine if nematodes are causing the problem is by submitting a soil sample to the Clemson Agricultural Services Laboratory through your county Extension office. The best time to sample for soybean nematodes is from 3 weeks prior to harvest until 3 weeks after harvest. Your Clemson County Extension Office will have a form outlining how to obtain the best sample

for nematode analysis. Typical soybean nematode soil samples should consist of one sample for each 5-10 acres of soybeans. Use a shovel or soil probe to get soil from the crop row to a depth of 6-10 inches. Each sample should be composed of 10 subsamples mixed together in a bucket, with at least a 1-quart composite sample resulting. This sample should be placed in a plastic bag, sealed and labeled. Include some crop roots in the sample, especially if species determination of root-knot is being requested. This should be kept cool until delivered to your local county Extension office. The cost of each sample sent to the Clemson Agricultural Services Laboratory is \$5 per sample. Laboratory analysis usually does not include race or species determinations. Root-knot species determinations may be made on request for an additional \$15 per sample.

Control recommendations are based on the nematode species and population levels found. Results of the tests are needed for selection of varieties, cropping system, and possible nematicide to use the next year. The five nematode genera that cause soybean yield losses, their symptoms, and controls are described in the following paragraphs.

ROOT-KNOT

Two major root-knot nematode species infect soybeans in South Carolina "southern or common" root-knot nematode (*Meloidogyne incognita*) and race two of the "peanut" root-knot (*Meloidogyne arenaria*).

Symptoms - Affected soybeans are stunted and yellow. They may die later in the growing season. Roots are galled. Don't confuse root-knot galls with nitrogen fixing nodules. Nodules are attached to the roots. Galls are actually root tissue, are usually larger than nodules, and cannot be taken off without destroying the root.

Control - The most cost-effective way to control root-knot nematodes is to use resistant varieties. In-row subsoiling and crop rotation are also helpful. Recommended varieties are listed in Table 1. A recommended nematicide may be used, but the expense should be carefully considered, because economic return may not warrant the expenditure.

Three factors that can influence varietal responses to root-knot nematodes are:

- Extreme environmental conditions - high nematode populations along with a drought on sandy soils can cause erratic varietal response;
- Different races - while not a common occurrence, a root-knot nematode species can have races for which there may be little or no tolerance in varieties;
- A mixed population consisting of a mixture of different species of nematodes may influence varietal responses.

LANCE

The Columbia lance nematode (*Hoplolaimus columbus*) occurs in most soybean growing areas of the state.

Symptoms - Affected plants are stunted and yellow, but usually plants do not die. Damage is often exhibited as uneven (up and down) growth in the row. Roots are usually bunched near the soil surface with poor tap root development and have a hairy or fibrous appearance (with many small rootlets). Nodule development may be poor.

Control - Components of a good control program for lance nematode include: (1) Selecting a variety tolerant to lance (see Table 1) - varieties which have grown well and shown good tolerance are marked with a yes (Y); (2) in-row subsoiling will reduce but not eliminate losses from lance in most Coastal Plain soils; (3) planting early, around mid-May, usually reduces losses; (4) avoid double cropping soybeans in lance nematode fields; (5) crop rotation is ineffective in reducing populations of *H. columbus*; and (6) use of nematicides to reduce losses of *H. columbus* is generally not cost effective, especially if the suggestions above are used.

STING

The sting nematode is sometimes a pest in the more sandy Coastal Plain soils.

Symptoms - Stunted plants with stubby roots and thick, rounded, dark tips. Severely infested areas may have spotty stands as a result of some plants dying.

Control - Select a crop other than soybeans, such as tobacco, watermelon, okra, asparagus, or coastal bermudagrass or use a recommended nematicide along with in-row subsoiling. (Note: Corn and cotton are also hosts for sting nematodes and will not be effective in rotations.)

SOYBEAN CYST

The soybean cyst nematode (*Heterodera glycines*) occurs throughout the Coastal Plain and the lower Piedmont counties. It is easily spread in soil clinging to equipment, and in water runoff, blowing dust, or “mud peds” that may be picked up by the combine when harvesting soybeans. Make sure seeds are free of all foreign matter.

Symptoms - Affected plants are usually stunted and have yellow leaves. Close examination of the roots may show reduced nodulation and tiny white to yellow cysts. **The optimum time to find cysts is to view roots 30-45 days postplant.** These cysts are the females of the cyst nematode. Do not confuse cysts with nodules. Cysts are much smaller and hard to see. Mature cysts (females) slough off the roots, the eggs hatch, and young cyst larvae continue the life cycle, which takes about 30 days to complete. Where soybean cyst nematode (SCN) is suspected in a field, have the soil tested for nematodes. Presently, SCN race 3 predominates in S.C., but race 14 (4) and possibly some other races also are present to a limited extent. Due to changes in taxonomic nomenclature, old race cyst 4 is now referred to as race 14 in South Carolina and the rest of the soybean growing areas. During this transition we will refer to it as race 14 (4). If a race 3-resistant variety shows cyst symptoms, have the soil tested for nematodes. If the results indicate that SCN is the only problem nematode present, chances are good that race 14 (4) or another race is present. Several varieties are available com-

Table 1. 1997 Ratings of South Carolina recommended soybean varieties for nematode tolerance.*

Variety	Mat. Group	Nematode			Cyst Race	
		Lance	<i>M. incognita</i> (So. Root-knot)	<i>M. arenaria</i> (Peanut Root-knot)	3	14 (4)
Buckshot 507(TP)	V	N	N	N	Y	Y
NK's S59-60(TP)	V	N	-	N	Y	Y
Deltapine 3589	V	-	-	-	Y	N
Deltapine 105	V	N	N	N	N	N
HSC 591	V	N	N	N	Y	Y
Hutcheson	V	-	N	N	N	N
Hartz H5350	V	N	N	N	Y	Y
Hartz H5545(TP)	V	N	N	N	Y	N
Hyperformer						
HY 574(TP)	V	N	N	N	N	N
Pioneer 9584	V	N	N	N	Y	N
UAP DG 3576(TP)	V	N	N	N	N	N
Walters	V	-	Y	N	Y	N
Asgrow A6297	VI	N	N	N	Y	Y
Brim	VI	-	N	N	N	N
Bryan	VI	N	Y	Y	Y	N
Deltapine 726	VI	N	Y	N	Y	N
Deltapine 3682	VI	N	Y	N	Y	N
Dillon	VI	Y	N	N	N	N
Doles	VI	-	Y	-	Y	N
HY 677	VI	N	N	N	N	N
NK's S62-66	VI	N	Y	N	Y	Y
Hartz 6686	VI	N	N	N	N	N
Pioneer 9692	VI	-	N	N	Y	N
Pioneer 9641	VI	N	N	N	N	N
Musen	VI	N	Y	N	Y	Y
Braxton	VII	N	Y	Y	N	N
NK's Coker 6847	VII	Y	Y	Y	Y	N
NK's S75-55	VII	N	Y	N	Y	N
Deltapine 3733	VII	-	N	N	Y	N
Hagood	VII	Y	Y	N	Y	N
Hartz H7190(TP)	VII	N	N	N	N	N
Pioneer 9711	VII	N	Y	N	Y	N
Pioneer 9761	VII	N	N	N	Y	N
Stonewall	VII	Y	N	N	Y	N
Thomas	VII	-	Y	N	Y	N
NK's Coker 6738	VIII	N	Y	Y	Y	N
Cook	VIII	-	Y	N	N	N
Hartz H8558	VIII	-	Y	N	N	N
Kirby	VIII	Y	Y	Y	Y	N
Maxcy	VIII	Y	Y	N	Y	N
NK's S83-30	VIII	Y	Y	N	Y	N
Perrin	VIII	N	Y	Y	N	N

Trial Planting Recommendations

*Ratings are a composite of research by Clemson Plant Pathologists and information from seed company re-searchers. General variety performances and growth characteristics in non-nematode fields can be found in various Clemson publications such as Clemson Extension Circulars 477 and 545 and Exp. Station Circular 184.

Nematode Tolerance Ratings:

Y = Yes (Variety recommended for that nematode).

N = No (Variety not recommended for that nematode).

- = Information not available.

mercially with resistance to races 3 and 14 (4) (See Table 1). 'Centennial' (while not currently recommended in South Carolina) has race 1 tolerance according to its original description. Avoid planting a race 14 (4)-resistant variety on your farm until race 14 (4) cyst nematode is identified as the problem. The use of race 14 (4) resistant soybean varieties prior to presence of detectable race 14 (4) cyst nematode population levels, may result in natural selection of races for which there are no resistant soybean varieties.

Control - Divide control into **avoidance** (try to keep from getting it) and **management** (keep it in check if you already have it).

Avoidance: (1) If using seed from SCN-infested fields with soils that tend to "ped" (as in the Mississippi Delta), clean these seed with spiral cleaners to help remove any "mud peds" present; (2) clean all equipment before moving from an infested field, or even a suspected field, to another field; and (3) utilize crop rotation with non-host crops (e.g., corn, cotton, peanuts, sorghum).

Management - If testing confirms SCN on a particular field, use the rotation system with cyst resistant soybean varieties outlined in Table 3. It is the most effective and least expensive control/management. **A nematicide for cyst is not recommended unless harmful levels of other nematodes are present.** If a nematicide is used for cyst, higher labeled rates are required for control. These costs should be considered as well as the current price of soybeans prior to using a nematicide.

Nematologists caution against continuous use of SCN-resistant varieties since there may be a buildup of a new race for which resistance is not available. **For this reason, do not use a resistant variety on an SCN-infested field for more than two consecutive years** (see Table 2).

Double-Cropping - (For Cyst Only) Use of wheat-soybean double-cropping may result in reduced cyst nematode populations, based on information from adjacent states.

RENIFORM

Reniform (*Rotylenchulus reniformis*) nematode is occurring more frequently in South Carolina. Reniform has a wide host range, and cotton is a good host. Soybean varieties with 1,3 cyst resistance may also be tolerant to reniform. 'Centennial' (while not currently recommended in S.C.) is classified as having tolerance to reniform nematode by research and Extension personnel in some southern states. Two-year rotations with non-host crops (small grains, grain sorghum) have resulted in reductions in reniform nematode numbers. Corn is considered to be a poor host, but one on which reniform nematode reproduction can occur. Data on reniform nematode damage, soybean varietal resistance and performance, and non-host crop performance in South Carolina are being investigated at this time.

CHEMICAL CONTROLS

Use Recommended Nematicides.

Table 3 lists the nematicides recommended for South Carolina. They fall into two categories: contact and fumigant. Since they are expensive, establish a need before buying and applying. Take soil samples for nematode analysis in the fall just before or after harvest, regardless of crop, so you can plan for the next crop year. Each sample should represent no more than 5 to 10 acres. County Extension offices have details on nematode sampling.

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Table 2. Recommended rotation systems for control/management of Soybean Cyst Nematode (SCN) in S.C.

Rotation Systems			
Year	1	2	3
1	SCN confirmed	SCN confirmed	SCN confirmed
2	SCN-resistant variety	SCN-resistant variety	Non-host crop*
3	SCN-resistant variety	Non-host crop*	SCN-susceptible variety
4	Non-host crop*	SCN-susceptible variety	SCN-resistant variety
5	SCN-susceptible variety	SCN-resistant variety	SCN-resistant variety
6	Repeat the scheme	Repeat the scheme	Repeat the scheme

*Conduct a soil analysis for nematodes in the fall after harvesting the non-host crop to determine levels of SCN remaining in the field. If SCN is still present, use resistant varieties for 2 years and then a susceptible variety before repeating this scheme. Non-host crops for SCN include: corn, cotton, peanuts, grain sorghum, and tobacco.

Table 3. Recommended nematicides for soybeans in South Carolina.

Nematicide	Rate of Product**
I. Contact	
aldicarb	
R* Temik 15G	11 to 18.7 oz/1,000 ft of row (10 to 15 lb/A): based on 38-inch rows
Lance or sting:	8 to 15 oz/1,000 ft of row (7 to 14 lb/A): based on 36-inch rows:
Application - Temik can be banded over the row during planting to allow mixing into the soil. For best results follow manufacturer's label instructions.	
II. Fumigant	
dichloropropene	29 fl oz/1,000 ft of row, or 3 gal/A for lance, sting only (38-inch rows)
Telone II	29 fl oz/1,000 ft of row, or 4 gal/A for lance, sting only (38-inch rows)
Application - Inject 8 to 10 inches deep in the row and bed up immediately. Allow 7 to 10 days before planting. See manufacturer's label for instructions.	

*Restricted-use pesticides.

**High populations of some nematodes, especially root-knot and cyst (SCN), require the higher labeled rates. Consult your county Extension office of assistance in rate determinations. Nematicides are not generally recommended for cyst management in South Carolina (see previous discussion in cyst section).



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Cooperative Extension Work in Agriculture and Home Economics, Acts of May 8 and June 30, 1914