Soybean Cyst Nematode
Michigan State University Extension Service
G.W. Bird, Department of Entomology
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8 pages

Cooperative Extension Service ● Michigan State University ● Extension Bulletin E-2200 ● March 1990 ●

AG FACTS

NEMATODE DETECTION SERIES

Soybean Cyst Nematode

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Department of Entomology

The soybean cyst nematode (SCN) is a major limiting factor in U.S. soybean production. Soybean yield losses in individual fields can be as high as 100%. SCN can also be a problem of dry beans and snap beans. The SCN was found in Michigan for the first time in 1987. It is currently known to be in Gratiot, Van Buren and Saginaw Counties. Although the SCN has currently been detected in only three counties, all Michigan soybean, dry bean and snap bean growers should be aware of this potential problem and take action to prevent the SCN from becoming established on their farms.

SCN can be avoided through proper use of crop rotation. **Never grow soybeans two years in a row on the same site.** The same is true for dry beans and snap beans or rotations among these three crops. As with all nematodes, it is much easier to prevent a problem than alleviate it once it has become established.

SCN problems symptoms

Stunted plant growth is the most common symptom of a SCN problem. Initially the stunting and associated yield losses may be slight, but after several soybean crops the stunting and yield losses can become very severe. The stunting is frequently in circular patches or oblong areas following the tillage or soil texture patterns of the field. In some cases young plants will die, leaving barren areas that will be filled with weeds later in the growing season (Fig. 1). Yellowing of foliage is another common symptom; however, this may not always be present. SCN problems sites can also be recognized by a failure of the leaf canopy to close at the proper time of the growing season. Infected plants have poorly developed root systems,

Figure 1. Soybean field infested with the soybean cyst nematode

and the number of functional nitrogen fixing nodules is greatly reduced. Symptoms associated with SCN damage are generally more pronounced when the plants are under stress from conditions such as drought, low soil fertility or soil compaction.

SCN females can be observed on roots of soybeans, dry beans and snap bean plants. They are very small white spheres about the size of the head of a pin and are attached to the roots. In heavily infested sites they can be readily observed about 45 days after planting, and again about 75 days after seeding (Fig. 2). While the nematode can move through the soil only a short distance on its own, rapid spread can occur by the movement of infested soil. Cysts in soil adhering to equipment, soil peds in seed lots, or soil moved by wind and water can spread SCN to previously noninfested fields.

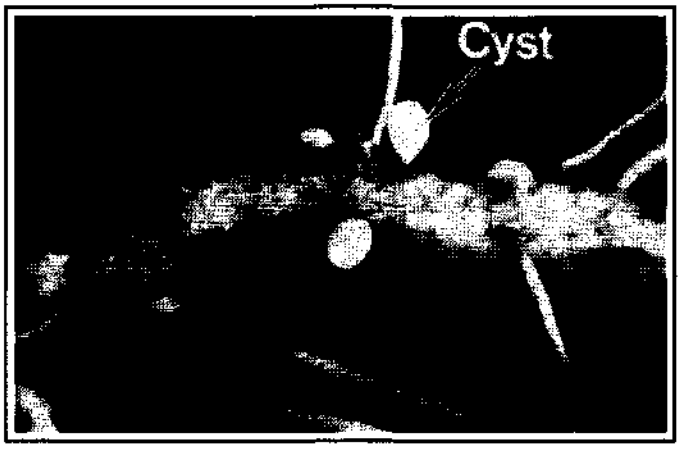

Figure 2. Cyst nematode on soybean root

SCN management

SCN management consists of the following four procedures:

- Determining the extent and severity of the problem.
- Developing an appropriate management strategy.
- Implementing specific management tactics.
- Evaluating the SCN management program.

SCN management is a good example of integrated pest management (IPM). It utilizes all of the major components of IPM including:

- Exclusion/Avoidance,
- Eradication/Containment,
- Control, or
- The decision to take no action.

When the SCN population density in a given location is greater than the action threshold, the currently available control tactics include:

- Crop rotation,
- Resistant soybean varieties,
- Chemical nematicides,
- SCN Sampling.

A laboratory analysis of soil and root or shoot system tissue is usually necessary for diagnosis or long-term avoidance of plant-parasitic nematode problems associated with soybeans. In Michigan, this service is provided by the Michigan State University Diagnostic Service Laboratory, operated under the direction of the Michigan Cooperative Extension Service. There are also a number of private laboratories that provide nematode detection services. A $10 fee is charged by MSU for analysis of each combined soil and root or individual sample. The rate of $9.00 per sample is charged for lots of 20 to 49 samples, and $8.00 per sample for 50 or more samples. Pre-payment is desired. A $5 fee is charged for all billings. Growers, pest management organizations, corporations, and researchers can contract with the MSU Nematode Advisory Service Laboratory for billing on a monthly or quarterly basis.

Samples for nematode analysis should be forwarded to the:

Nematode Advisory Service Laboratory
Department of Entomology
Michigan State University
East Lansing, Michigan 48824

Samples delivered directly to MSU should be taken to Room 35 in the basement of the Natural Science Building. All samples must be submitted with a completed nematode sample information form (Fig. 3). These forms are available at county Cooperative Extension Service offices.

The results from the samples are used to decide how to deal with nematode problems and how to avoid problems.

Diagnosing Problems: When soybean plants exhibit symptoms such as stunting, yellowing, wilting, yield reduction, root galling, root-lesions or plant mortality that cannot be attributed to other causes, appropriate soil, root system, or shoot system, take samples and submit them for nematode analysis.

Avoiding Nematode Problems: Generally, soil from Michigan agricultural sites should be analyzed for nematodes every 3-5 years. The results from these tests are used to make decisions for avoiding nematode problems.

Figure 3. Completed nematode sample form for soybean site.

MICHIGAN COOPERATIVE EXTENSION SERVICE
MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN 48824
AND U.S. DEPARTMENT OF AGRICULTURE COOPERATING

NEMATODE ADVISORY SERVICE SAMPLE SUBMISSION FORM

Name: Mike Jones
Address: RR2 County Road 3
Altuna Zip: 43072
County: Burke Township: Monroe
Section: 16 Sample Date: 20 Aug 89
Sample/Field I.D.: Dad's 80
Soil Type: McBay Sandy Loam

Present Crop/Plant: Soybeans
Variety: M-42
Planting Date: 5 May 88
Future Crop 19 90: Soybeans
Past Crops 19 89: Corn
19 87: Dry beans
Nematicide Use: None
(Name and Treatment Date)

SAMPLE METHOD (check): As described in MSU Ext. Bull. E-800 ☒ Other (describe) ☐

REASON FOR SAMPLE (check): Problem Avoidance/IPM ☐ Problem Diagnosis ☒

TYPE OF ANALYSIS REQUESTED

- ☒ Soil and root analysis for root-feeding nematodes ($10, $9 or $8/sample)[1,2]
- ☐ Foliar nematode analysis ($10, $9, or $8/sample)[1,2]
- ☐ Verticillium dahliae analysis for potato soil ($5/sample).[2]
- ☒ Soybean cyst nematode race determination ($15/field).[2]

DISEASE SYMPTOMS

Above Ground Symptoms	% of Plants in Field with Symptoms
Yellowing	40
Necrosis	
Stunting	40
Wilting	
Other low yields	

Distribution (check): Entire Planting ☐ Localized ☒ Scattered ☒

Below Ground Symptoms (check): Galls ☐ Excessive branching ☐ Rot ☐ Reduced Growth ☒

COMMENTS:

About 20 spots in 80 acre field.

Soybeans last planted in 1987. 1990 will be the 10th crop of soybeans.

Return Results to: Sam Smith, Consultants
Address: RR2
Altuna, MI County: Burke
Zip: 43958

[1]$10/sample for 0-19 samples, $9/sample for 20-49 samples, $8.00/sample for >50 samples.

[2]A billing charge of $5 will be added for all sample lots or quarterly contracts not paid at the time of sample submission.

No. of samples: 1 Amount enclosed $: 0.00

DO NOT WRITE BELOW THIS LINE

Number of samples received: 1
Samples number(s): 43067

Date Received: 25 Aug 89
Amount Received $: 0.00

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When to sample: Generally, soil and root samples can be taken, submitted and reliably processed whenever the soil is not frozen. For the best possible results, however, samples for soybeans should be taken from 45 days after planting until the soil freezes in late fall or winter.

Sampling instrument: Take samples with a soil sampling tube, trowel, or narrow-bladed shovel at a 2 to 12-inch depth. Include as many feeder roots as possible to recover any root-feeding (endoparasitic) nematodes.

Sample size: Each sample should consist of a pint to a quart of soil taken from a larger sample composed of 10 or more subsamples (Fig. 4).

- Small area (less than 0.5 acres), take at least 10 subsamples.
- Medium area (0.5-1.0 acres), take at least 25 subsamples.
- Large area (1-80 acres), take at least 50 subsamples. No one sample should represent more than 80 acres, and each sample should be from an area of a uniform soil type.

The sampling pattern depands on the commodity and field history. Mix subsamples in a clean pail or a plastic bag and submit one pint to a quart for nematode analysis.

The number of subsamples (soil cores or borings) needed depends on the size, history and uniform soil texture of the area being investigated (Figs. 5-7). This is basically a common sense approach to sampling, as illustrated in the following three diagnosis.

Samples from problem areas: Plant-parasitic nematodes feed only on living tissues and are rarely found in dead root samples. Therefore, take samples from the margin of the problem area where the plants are still living.

Sampling container: Either the special nematode sample container provided by Extension or a plastic bag can be used for nematode samples. Place samples in plastic bags as soon as possible. Nematodes will be

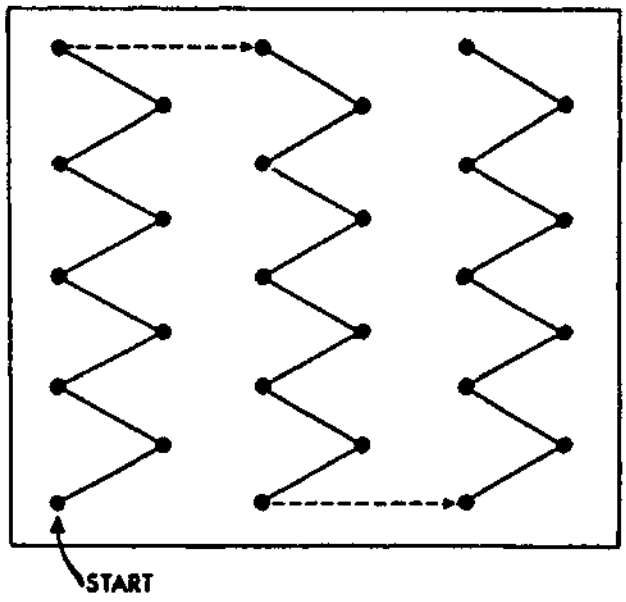

Figure 4. Pattern for fallow fields or areas planted in a cover crop.

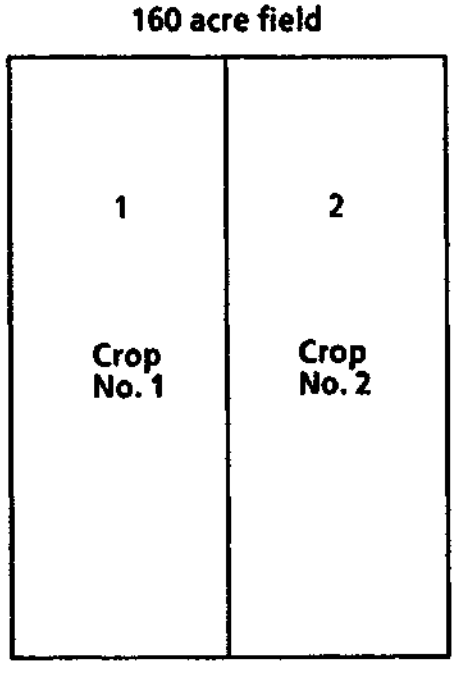

Figure 5. Two samples required for 160 acres.

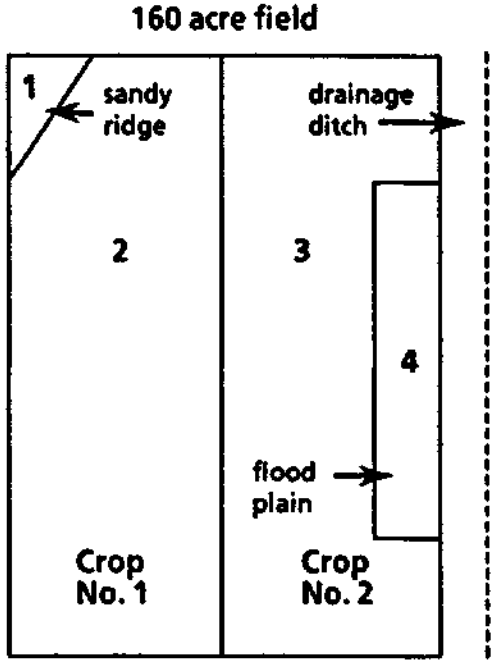

Figure 6. Four samples required for 160 acres.

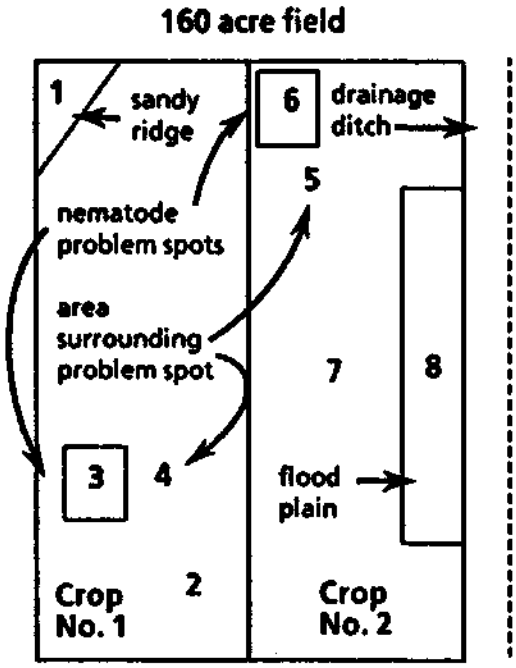

Figure 7. Eight samples required for 160 acres.

killed if the sample is allowed to dry. It is important that nematodes are living when the sample arrives at the laboratory.

Samples storage: Soil and root samples should be regarded as perishable. Handle accordingly, and process as soon as possible. Ideally, they should be stored at 10-15C (50-58F). Do not expose them to direct sunlight or store them in hot areas such as the trunk of your car. Temperatures greater than 40C (100F) will kill nematodes.

How to submit samples

Samples for nematode analysis are usually submitted through the local extension office, accompanied by a completed form (Fig. 3). The information requested on the form is essential for diagnosing nematode problems and proper recommendations for nematode population management.

It generally takes two weeks from the time a sample is taken until the results are returned to the grower. The results may be returned through the local extension agent, a private consultant, or directly. The rapid root and soil assays used for mineral soils, however, are not always satisfactory for analyzing organic soils. In a few cases, a bioassay that requires a 45-day incubation period is used to analyze organic soils. When this procedure is recommended, the grower will be immediately notified of the delay and will receive the results within two months after the sample was received.

Results and recommendations

Sample results and recommendations are usually returned to the grower by the local extension agent. The types and numbers of nematodes will be recorded on the assay form along with an indication of whether or not nematodes are a problem (Fig. 8). If nematodes appear to be a problem, you will be referred to an appropriate extension bulletin for a recommendation. The recommendation should be discussed in detail with the local extension agent or private consultant.

Table 1. Recommended crop rotation sequences for reducing and maintaining soybean cyst nematode populations below damage levels. The system is based on risk levels identified from previous nematode samples.

Year of Rotation	Soybean Cyst Nematode Risk Level [1]			
	0 (None)	1 (Low)	2-3 (Medium)	4-5 (High-Extreme)
1st	Susceptable soybeans	Non-host	Non-host	Non-host
2nd	Non-host	Resistant soybean variety	Non-host	Non-host
3rd	Susceptable soybeans	Non-host	Resistant soybean variety	Non-host
4th	Non-host	Susceptable soybean variety	Non-host	Resistant soybean variety
5th	Susceptable soybeans	Non-host	Susceptable soybean variety	Non-host
6th	Non-host	Resistant soybean variety	Non-host	Non-host
7th	Susceptable soybeans	Non-host	Non-host	Non-host
8th	Non-host	Susceptable soybean variety	Resistant or susceptable variety	Resistant or susceptable variety

[1] Risk level (0-5)based on results of nematode sampling.

Action thresholds

SCN action thresholds are often expressed as either cysts per 100 cm^3 soil or viable units (eggs and second-stage juveniles per 100 cm^3 soil. The MSU Nematode Laboratory uses a risk index system of 0-5 [0=no risk detected, 1=low risk, 2-3=moderate risk, 4=high risk and 5=extreme risk). These are indicated on the sample results form (Fig. 8).

Crop rotation

Using non-hosts of the SCN should be the basis of all soybean cyst nematode managment programs. Crops such as corn, sorghum, small grains, sugarbeets, and potatoes are all non-host crops grown in Michigan soybean producing areas. Dry beans, snap beans and possibly alfalfa are hosts of the SCN. Crop rotation recommendations for four different SCN risk levels are given in Table 1.

Resistant varieties

Several maturity group II and III cultivars have been released which are resistant to some populations of SCN (Table 2). Resistant varieties should not be planted in an infested field for several consecutive years. This practice may cause selection of populations which can overcome the resistance.

SCN races

Several different races of the SCN have been reported. In the selection of an appropriate resistant va-

Figure 8. Nematode sample results form for a soybean cyst nematode problem site.

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AND U.S. DEPARTMENT OF AGRICULTURE COOPERATING

NEMATODE ADVISORY SERVICE REPORT

Name Mike Jones
Sample Number 43072
Date Received 26 Aug 89

Date Processed 27 Aug 89
Nematode Analysis Method ☒C ☒S ☐BA ☐VA ☐SCNRD ☐OA
Sample Condition Good

PLANT PARASITIC NEMATODES, POPULATION AND THRESHOLD

Nematode	Population Soil[1]	Population Root[2]	Risk Index[3]
Root-lesion ☒ Penetrans ☐ _____	5	12	1
False root-lesion			
Root-knot ☐ Northern ☐ _____			
Cyst ☒ Soybean ☐ Oat ☐ Sugarbeet ☐ Clover	72 cysts	312 J2s	5
Pinewood			
Stubby-root		●	
Dagger		●	
Needle		●	
Stunt		●	
Lance	2	1	1
Sheath		●	
Ring	48	●	0
Pin		●	
Spiral		●	
Foliar			
Other			
Other			

[1]Nematodes/100 cm³ soil
[2]Nematodes/1.0 g root
[3]Risk Index
0 = None Detected
1 = Low
2-3 = Moderate
4 = High
5 = Severe

Sample Fee $ 10.00
Billing Fee $ 5.00
Amount Billed $ 15.00

OCCURRENCE OF BENEFICIAL NEMATODES

Saprophagous Nematodes CM
Predaceous Nematodes FW
Endomycorrhizal Fungi CM
Nematode Trapping Fungi NN
NN = none
FW = few
CM = common
AB = abundant
EX = extreme

DIAGNOSIS:
Nematode problem site ☒
Disease complex problem site ☐
Possible problem site ☐
Future problem site ☒
Possible future problem site ☐
No problem detected ☐

GENERAL RECOMMENDATION:
Action advisable ☒
Employ tactic on a trial basis ☐
Refer to MSU Ext. Bulletin No. 1582 pages 46-47 pages _____
No action strategy available ☐
Submit root sample _____
Submit addition soil sample ☒ before next soybean crop.
No action required at this time ☐

SPECIFIC RECOMMENDATIONS/COMMENTS:
- **Soybean cyst nematode problem.**
- **Crop rotation recommended (corn, potatoes, wheat, pickles)**
- **Do not rotate with drybeans**
- **Resample before next soybean crop.**
- **Soybean cyst nematode nematicides in E-1582.**
- **Soybean cyst nematode race determination optional.**

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Table 2. Maturity Group I and III soybean varieties resistant to some populations of soybean cyst nematode (according to Purdue University, E-207)

Variety	Maturity Group
CN 210	II
CN 290	II
Fayette	III
Cartter	III
Asgrow 3307	III

riety for a specific field, it is essential to have identified the SCN race. Race determination is provided as a service of the MSU Nematology Laboratory ($15.00 per sample). Specific fields can have more than one SCN race, and the race composition can change with time.

Nematodes

Cyst nematodes are often difficult to control with nematicides. Generally, nematicides are classified as fumigant or non-fumigant nematicides. Fumigant nematicides provide excellent cyst nematode control, but can only be used on a pre-plant basis and are often too costly for use in Michigan soybean production. Five non-fumigant nematicides are registered for use in soybean production in Michigan. Nematicide recommendations for SCN control in Michigan are provided in the MSU Extension Bulletin E-1582.

Management success evaluation

One way to analyze the sucess of nematode population management is to submit a post-treatment sample for nematode analysis. These samples should be taken four to six weeks after implementing a tactic. It is important that the original forms be completed so the post-treatment results can be compared with those of the original.

Additional information

Extension bulletins on the control of nematodes that damage fruit, vegetable, field and ornamental crops are available at the County Extension offices or by writing the MSU Bulletin Office, P.O. Box 231, East Lansing, Michigan 48824.

Major Revision-3:90-5.5M-TCM-SP, Price 40¢.

File 27.326 (Insects and Nematodes)