MANAGING NEMATODE PESTS IN MIDSOUTH SOYBEANS

Soybean producers in the Midsouth must contend with nematode pests, several species of which may inhabit a single field. Yield losses caused by soybean cyst nematode (SCN), southern root-knot nematode (RKN), and reniform nematode (RN) were estimated at over 30 million bushels in the Midsouth states in 2014.

All three of the above nematodes feed on soybean roots. Populations can build up rapidly in the soil because females of all three nematode species produce large numbers of eggs in a relatively short period of time.

Damage caused by the nematodes as they feed results in symptoms such as:

- Stunting and yellowing of the foliage
- Stunted and discolored roots
- Roots infected by RKN may have swellings or galls
- Roots infected with SCN or RKN may have fewer nodules, which further limits plant growth and yield by reducing the plant's access to nitrogen.

The change in cropping systems in Mississippi in recent years has led to increased concerns about nematode infestations of soybeans. The effect of these changes are:

- Increased acreage of corn that may be rotated with soybeans has led to heightened concern about soybeans being infested with RKN.
- Growing soybeans on sites once devoted to cotton has led to heightened concern about soybeans being infested with RN.

SAMPLING

Because of these cropping system changes, the need to sample for nematodes has become even more important because of the added risk of infestations from RKN and RN as well as SCN. Consider the below points.

- Properly collected and evaluated soil samples are the best tool for detecting the presence and species of nematodes in the soil.
- To assess potential damage from nematodes in soybean fields, growers must determine which nematode or nematodes are present to make appropriate nematode management decisions.
- Accurate identification of the nematode species and population levels present in a field requires that soil samples be collected and sent to a diagnostic lab for evaluation.
- Properly analyzed samples will indicate where control practices are not needed, and conversely will indicate where control practices are needed to protect yield potential.
- Predictive sampling (sampling to determine if nematode problems are likely to affect a future crop) should be done when population densities are high to decrease the risk of not detecting the presence of a damaging species. Thus, the best time to sample is generally near or just after harvest. Sampling in the fall will allow enough time for analysis so that results can be used as a guide for variety selection or

choosing an alternative crop for the next growing season.

- Proper sampling protocol can be found at MSUcares, Virginia Tech Extension, Univ. of Georgia Dept. of Plant Path.

Mississippi soybean producers may submit soil samples for nematode analysis to the Mississippi State University Extension Plant Pathology Lab. Instructions for sample submission and associated costs are contained in their brochure.

- If test results indicate that the above nematode species are not present in a field, care should be taken to prevent their introduction since nematodes can be moved from field to field by soil that is transported on field equipment.

- If test results indicate the presence of nematodes, the management goal is to keep the nematode population as low as possible since they are very difficult to eliminate. This involves using management practices presented below for each nematode.

- Crop production practices that provide adequate nutrients and water and minimize stress due to insects, weeds, and diseases will enhance soybeans' ability to withstand some nematode feeding damage, but will not prevent yield loss where infestations are severe.

Sampling for nematodes should be considered as important as sampling for soil fertility. This is especially true if there is no history of nematode sampling on either old or new soybean production sites. Once documentation of the absence or presence of nematodes is established for given fields, then management options outlined below can be adopted.

SOYBEAN CYST NEMATODE (SCN)

SCN is the most damaging pest to soybean in the Midsouthern US (Southern Soybean Disease Workers Group). It is found in an increasing number of fields each year. The biggest challenge facing producers with SCN is that this soil-borne pathogen can impact yield with no or few visible aboveground symptoms. Management options and their implications are:

- Determination of the density and race or type of SCN present in individual fields is required to prevent losses and determine management and control practices to apply. Determination of the race or type is especially important because the different SCN resistance sources convey differing levels of resistance against the varied races or types (Rotundo et al., Crop Science).

- Use of SCN-resistant varieties is the best tactic to prevent yield-reducing damage from SCN (Giesler and Wilson, Univ. of Nebraska; Niblack and Tylka, NCSRP; Wrather and Mitchum, Univ. of Missouri; Chen, Agronomy Journal). Ratings of SCN resistance in current varieties is available in the disease ratings section of the most recent Arkansas Soybean Variety Trial results and in the soybean characteristics section of the Tennessee Soybean Variety Trial results.

- Use of SCN-resistant varieties does not compromise yield potential compared to using SCN-susceptible varieties (De Bruin and Pedersen (1), Agronomy Journal; DeBruin and Pedersen (2), Agronomy Journal).

- Soil texture affects movement of SCN in the soil and also may affect its reproduction and development. Basically, major damage to soybean by SCN infestation occurs when the crop is grown on medium- and coarse-textured soils. Apparently, damaging populations of SCN are not sustainable in soils series classified as clay (Heatherly and Young, Crop Science; Young and Heatherly, Journal of Nematology).

- In the Midwest, the yield advantage from using resistant vs. susceptible varieties is more pronounced in high-pH (>7.0) soils (Pedersen et al., Crop Science). The pH of soils has the same meaning regardless of region; however, this relationship has not been confirmed in southern environments. Thus, the possibility of this relationship occurring should at least be considered when growing soybeans on high-pH soils in northeast Mississippi and the Midsouth.

- A variety with resistance to a specific population of a race of SCN should not be planted year after year because SCN adapts to varieties. Continuous planting of such a variety could lead to the development of a different SCN race that damages the crop, making that variety useless for SCN control (Young, Journal of Nematology; Niblack et al., Plant Health Progress).

- Crop rotation is an effective tool for managing SCN. Nonhost crops such as corn, cotton, grain sorghum, and rice successfully reduce SCN populations (Young, Plant Disease Journal).

- It is important to determine the race of SCN in a field and the race-specificity of the resistance gene of a previously planted soybean variety when planning to use a new resistant variety in a crop rotation system for SCN management. The originator of a soybean variety should furnish information about the race-specific resistance of that variety. Varieties with resistance to SCN are available in all MGs.

- Irrigation of soybeans does not affect varietal response to infection by SCN, the capability of SCN to maintain cysts on any variety, or the yield-limiting effect of SCN on susceptible varieties. Irrigation may increase yield of susceptible varieties grown on SCN-infested fields, but often yields will be less than those from irrigated susceptible varieties grown on non-infested fields as well as those from irrigated resistant varieties grown on infested fields. Thus, irrigation of SCN-susceptible varieties grown on infested fields should not be considered since irrigation efficiency (amount of yield increase per unit of applied water) will be low and subsequent yields may be unprofitable (Heatherly et al., Crop Science).

- Resistant varieties are more reliable and cost-effective than nematicides for managing/reducing SCN populations (Wrather and Mitchum, Univ. of Missouri).

- In areas with severe infestations, soybean production without control measures is not economically feasible. Conversely, soybean production can be profitable with proper SCN management.

- Excellent sources for SCN management guidelines are Giesler and Wilson, Univ. of Nebraska, Niblack and Tylka, NCSRP, and Wrather and Mitchum, Univ. of Missouri.

- A PMN webcast titled "Soybean Cyst Nematode Management" by Dr. George W. Bird of Michigan State University provides

great information about SCN topics that include: SCN biology and host-plant relationships; symptoms and problem identification, diagnosis, and confirmation; SCN management practices; SCN type test vs. the currently-used race system; and seed treatments that include both chemical and biological controls.

ROOT-KNOT NEMATODE (RKN)

RKN tends to be associated with sandy soils on sites that have previously been devoted to cotton production in the Midsouth, where the combination of root damage and the reduced water-holding capacity of the soil can result in wilting of infected plants during the heat of the day.

- Management of RKN by crop rotation is complicated by the wide range of hosts for the nematode (see below table). This is especially true for Midsouth producers where the common rotational crops are corn, cotton, and wheat, which all serve as hosts for RKN. Thus rotation of soybeans with these crops is not a management option for this nematode.

- Rotation of soybeans with flood-irrigated rice or grain sorghum will lower RKN numbers dramatically (Kirkpatrick and Thomas, University of Arkansas).

- The use of resistant varieties is the most effective tool for management of RKN; however, the number of current varieties that are resistant to colonization is low (Arkansas Soybean Variety Trial). Using varieties that are only moderately resistant will allow RKN populations to be maintained or increased (Kirkpatrick and Thomas, University of Arkansas).

- Resistance to RKN is more prevalent in MG 6 through MG 8 varieties than in MG 5 and earlier varieties. Wide-spread use of MG 4 and earlier varieties in the Midsouth points to the need for RKN resistance in earlier-maturing varieties.

RENIFORM NEMATODE (RN)

This nematode will infect soybeans, but has not been a major threat to Midsouth soybean production.

- Where RN is a threat to soybeans, use resistant varieties as an effective management tactic, especially since breakdown of resistance has not been reported. RN ratings for current varieties are reported in the disease ratings section of the Arkansas Soybean Variety Trial results.

- A biennial rotation of soybeans with corn, rice, grain sorghum, or wheat, which are poor hosts for RN, is an effective management tactic.

- Rotation of soybeans with cotton, which is an excellent host for RN, should not be done on infested fields (Kirkpatrick and Thomas, University of Arkansas).

NEMATICIDES

Nematicides applied to seed or used in-furrow can reduce early-season root infection by nematodes, but do not provide season-long control and may not be economical. Nematicides can be effective in controlling SCN populations in infested fields, but their use should be based on expected yield and subsequent income, given that lessened yield loss resulting from their use in low-yield environments may not result in yields that are sufficient to be profitable.

Nematicides will not replace the use of resistant varieties and variety/crop rotation as primary nematode control practices.

Nematicide products are available.

Votivo is a biological seed treatment that provides early-season protection against the above three nematode species. Poncho/Vitovo is a combination insecticide/nematicide that is applied to the seed prior to planting. Little is known about the effectiveness of this nematicide in situations with known populations of nematodes. Therefore, at this time there is no supposition that it will replace the accepted practices for nematode control and/or management.

Avicta Complete Beans is a seed treatment product that combines a nematicide (Avicta 500FS) with a fungicide (ApronMaxx) and insecticide (Cruiser 5FS). As with the above product, little is known about the effectiveness of this nematicide in situations with known populations of nematodes. Therefore, there is the same supposition as above regarding its use in lieu of the accepted practices for nematode control and/or management.

Clariva Complete Beans seed treatment is to be used as an on-seed application of separately registered products that has the added nematicide component for control of soybean cyst nematode (SCN). The nematicide component is in addition to the insecticide and fungicide components found in CruiserMaxx Beans with Vibrance. The nematicide component only targets SCN and not other nematode species.

The following four links provide detail about this product from Syngenta, the company that developed and is marketing Clariva.

Syngenta Description
Syngenta Technical Overview
Syngenta video
Syngenta Power Point Presentation

Available information indicates the cost of the nematicide component will increase the seed treatment cost to about $8 to $10 per acre above that for the product without the nematicide.

A Plant Management Network webcast titled "Evaluation of Seed-Applied Nematicide on Soybeans" presents the first year's (2014) results from evaluating the effect of Clariva on SCN across the state of Iowa. These first-year results indicate that Clariva does negatively affect SCN's ability to reproduce, but the long-term effect of this reduction on soybean performance can only be determined with additional years of research.

At this time, little is known about the effectiveness of the above nematicides in situations with known populations of nematodes. Thus, there is no supposition that any of these products will replace the accepted practices for nematode control and/or management. In fact, they should be used in combination with the accepted practices specified in this article.

Management/control options for three economically important nematodes affecting Mississippi soybeans.	
Nematode	**Management/control tactic**
SCN	**Use resistant varieties***. Nematode populations, referred to as "races" or "HG types", vary in their ability to overcome certain sources of resistance. **Crop rotation**. Rotate with nonhost or poor host crops such as corn, cotton, grain sorghum, peanuts, rice, and wheat. Do not rotate with other host crops such as common vetch, lespedeza, and snap bean. **Variety rotation**. A variety with resistance to a specific population of a race or type of SCN should not be planted year after year; i.e., rotate varieties with differing genetic sources for resistance. **Control host weeds**. Common host weeds include but are not limited to common chickweed, common purslane, coffee weed, hemp sesbania, mouse-eared chickweed, mullein, pokeweed, sicklepod, and wild geranium.
RKN	**Use resistant Varieties***. **Crop rotation**. Rotate with nonhost or poor host crops such as peanuts and vetch. Do not rotate with other host crops such as alfalfa, corn, cotton, sweet potato, and wheat. **Control host weeds**. Common host weeds include but are not limited to annual morning glory, barnyardgrass, black nightshade, chickweed, crabgrass, dandelion, horseweed, lambsquarter, Pennsylvania smartweed, pokeweed, purple nutsedge, redroot pigweed, sicklepod, spiny pigweed, spurge, tall ironweed, and yellow nutsedge.
RN	**Use resistant varieties***. **Crop rotation**. Rotate with nonhost or poor host crops such as corn, grain sorghum, peanuts, rice, and wheat. Often, two years of the nonhost crop is needed to effectively reduce RN population. Do not rotate with other host crops such as cotton, cowpea, vetch, snap bean, and sweet potato. **Control host weeds**. Common host weeds include but are not limited to annual sow thistle, beggarweed, black nightshade, cocklebur, coffee weed, crotalaria, hairy vetch, and purslane.
*Information about resistance in current varieties is available from the Arkansas and Tennessee Variety Trial Publications, extension service personnel, crop consultants, seed dealers, and originating seed company.	

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