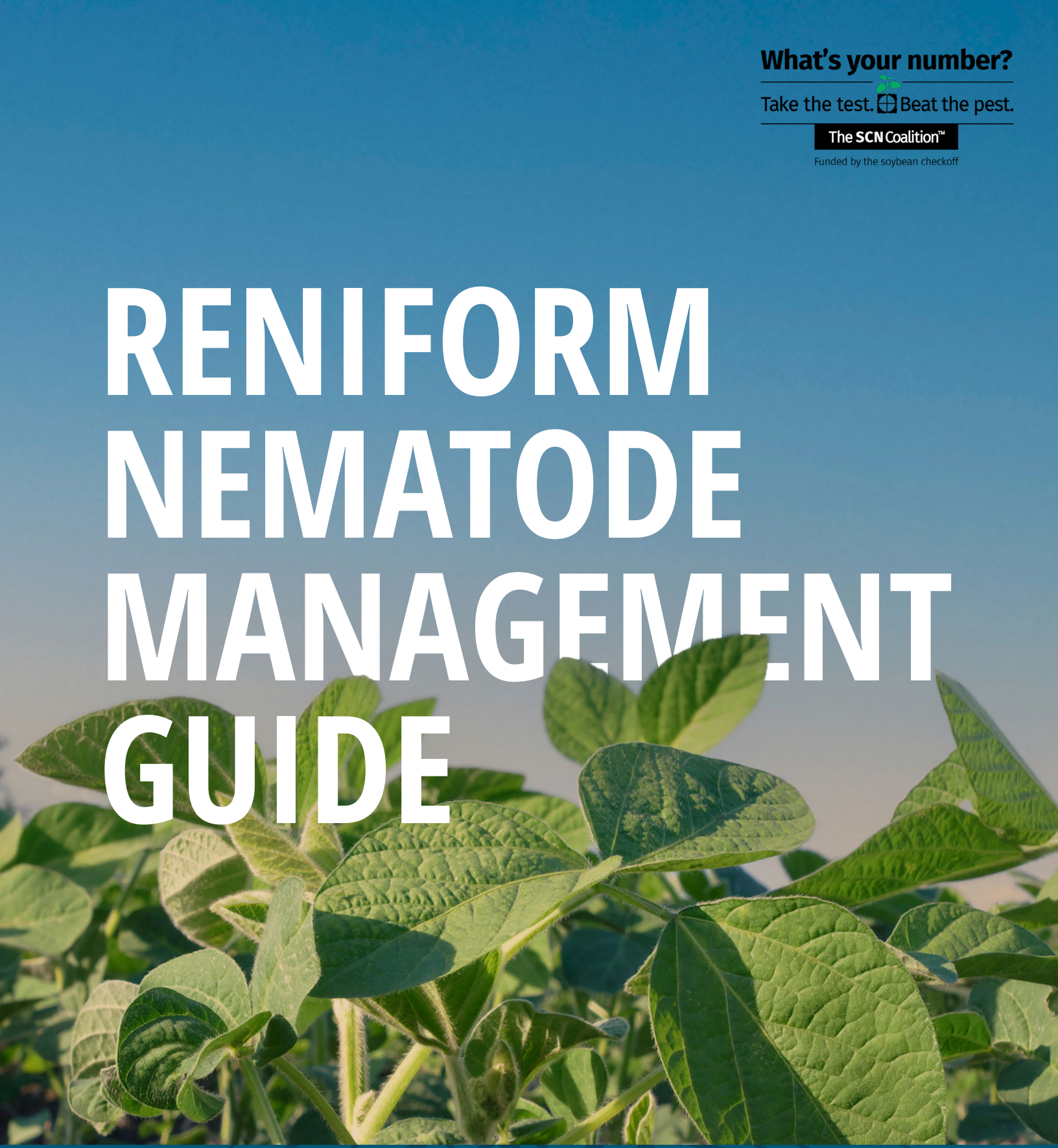
What's your number?

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RENIFORM NEMATODE MANAGEMENT GUIDE



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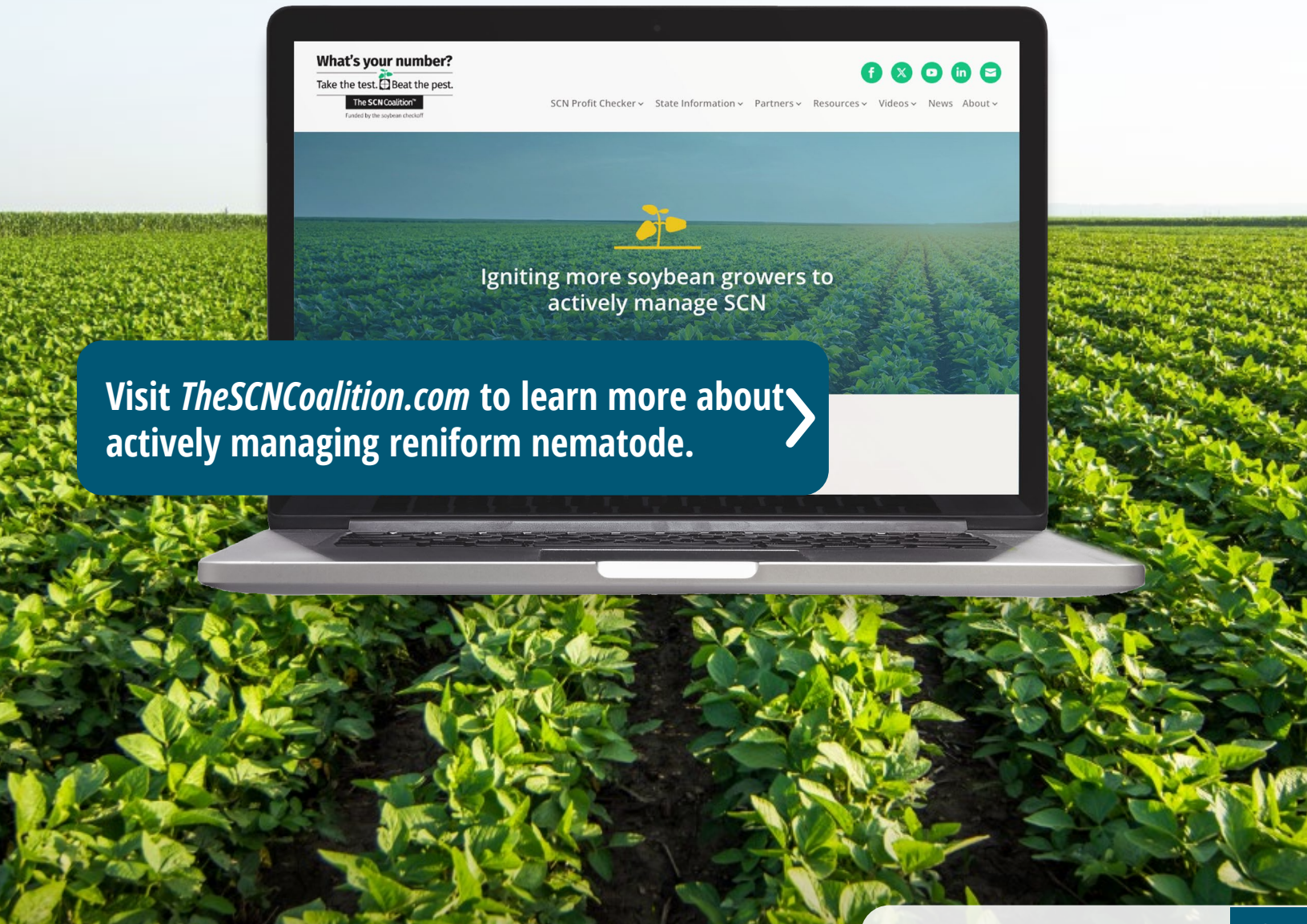


Proven Strategies Farmers Can Implement to Battle Reniform Nematode

Found in many soybean production regions of the southern U.S., the reniform nematode can cause more than a 10% yield loss in individual fields and cost farmers millions in revenue.

The bad news? Once a field is infested with reniform nematode, it's impossible to eliminate it.

The good news? Whether you want quick tips or a scientific deep dive, this guide will help you determine whether you have reniform nematode infestations, tailor a management strategy for your farm and recover potential yield.



Is Reniform *Really* a Problem?

Reniform nematode *(Rotylenchulus reniformis)* is an important pathogen in the southern U.S. for cotton and soybean farmers. Typically associated with subtropical and tropical climates, reniform nematode is distributed as far north as the Missouri Bootheel and southern Virginia, and as far west as the High Plains of Texas (see map). While reniform nematode causes greater yield losses in cotton fields, yield reductions of up to 50% have been documented in soybean greenhouse trials, with 5%-10% reported under field conditions.

How much soybean plants are affected by reniform nematode depends on several factors:

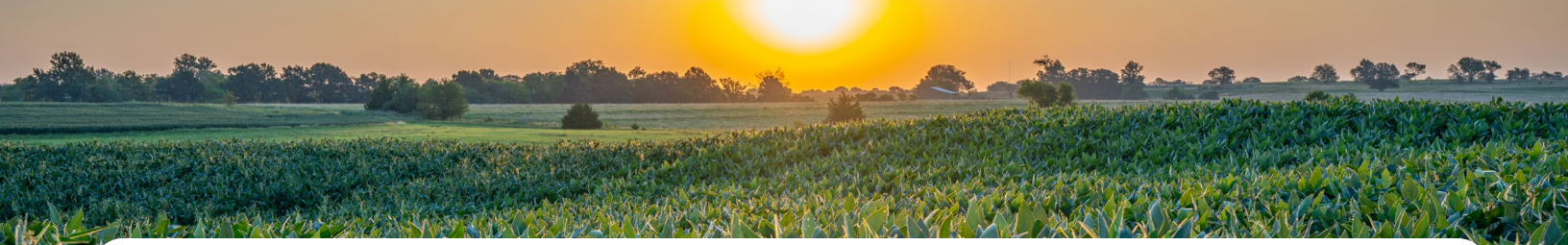
- Nematode population density
- Soybean variety susceptibility
- Soil texture
- Drought-stressed field conditions

Reniform nematode can spread to new fields over time, gradually impacting more areas. High numbers of reniform nematodes, combined with drought or other stressful environmental conditions, can result in significant yield loss.



Adopting an active management plan using the tips from this guide can help you protect your yield and reduce the impact of this pest.





Reniform 101: Biology and Reproduction

The reniform nematode *(Rotylenchulus reniformis)* is a microscopic, nonsegmented roundworm that feeds on roots of many different crops, and soybean is one of them. The name "reniform" means kidney-shaped, reflecting the shape of the mature female's body. Adult females are semi-endoparasitic, meaning that they embed their head and neck into the root to feed, while the rest of the body remains permanently outside the root surface. Males and juvenile stages remain worm-shaped and move freely in the soil.



Infective female reniform nematodes (Bisho Lawaju, Auburn University)



Male reniform nematode (Bisho Lawaju, Auburn University)





Eggs are deposited in a gelatinous matrix surrounding the mature female's body on the root surface. (Bisho Lawaju, Auburn University)

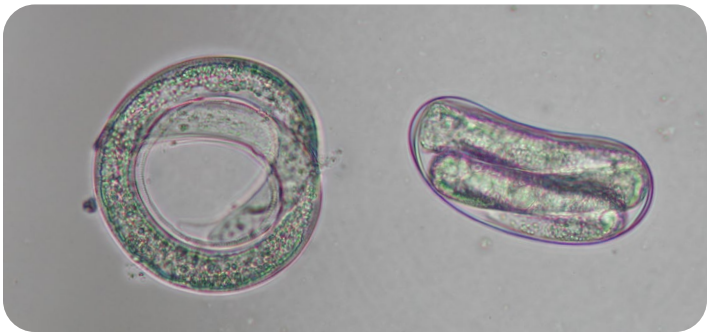
Eggs are deposited in a gelatinous matrix surrounding the female's body on the root surface. The second-stage juveniles (J2) hatch from the eggs, and the nematodes molt three times before becoming adult infective females or noninfective males. At this point, both females and males are worm-shaped, and reniform nematode populations typically consist of roughly equal numbers of males and females. Infective females penetrate the root and establish a permanent feeding site, or syncytium, where they become sedentary and kidney-shaped. Males do not enter the root. Once females become sedentary in a host root, they mate with males and then begin laying eggs. Females can lay from a dozen to a few hundred eggs, depending on soybean susceptibility. Under favorable conditions—temperatures around 80–86 F (27–30 C) and adequate soil moisture—the entire life cycle from egg to egg can be completed in approximately 17–23 days, which can result in several generations developing within a single growing season. Reniform nematodes survive between crops as eggs within egg masses or as vermiform or worm-shaped life stages in the soil. In the absence of a suitable host, these stages can persist for extended periods, including survival in a desiccated (dry) state. They spread within fields as root systems connect across rows and through the movement of soil and water. The nematodes are also disseminated in soil adhering to equipment, boots or plant material.

How to Spot Reniform: Signs and Symptoms

Visible symptoms are usually subtle and vary based on host susceptibility as well as soil and environmental conditions. Often, the first indication of a reniform nematode infestation is low grain yield. Therefore, soil sampling and nematode testing remain the most reliable methods for detecting and managing this nematode species.

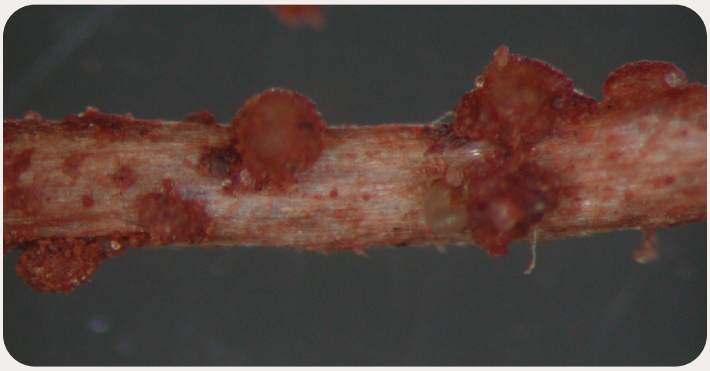
Aboveground symptoms may appear as irregular patches of stunted plants with reduced pod counts. These symptoms are often misdiagnosed as nutrient deficiencies or drought stress.

Unlike soybean cyst nematode (SCN) and root-knot nematode (RKN), the reniform nematode does not produce cysts or galls on roots, so roots often appear normal even when heavily infested. In many cases, small clumps of soil can be seen adhering to the root surface. These “dirty roots” result from soil particles sticking to the gelatinous egg masses produced by female nematodes. Infected plants may also exhibit a smaller root system leading to reduced capacity for water and nutrient uptake and exposure to greater risk from drought, pathogens and pests.



Reniform nematodes (Bisho Lawaju, Auburn University)

Reniform’s Common Yield-Loss Partners



Root looking “dirty” due to reniform nematode infection. (Kathy Lawrence, Auburn University)

In many soybean fields, reniform nematode doesn’t act alone. Reniform nematode impact on soybean yield can be worsened by the presence of other stressors. Other plant-parasitic nematodes may be present, each damaging soybean roots in different ways. Having your soil sample processed by a nematode or plant pathology diagnostic lab is the best way to confirm which nematode species are present. Damage from reniform nematode can also weaken roots, making them vulnerable to soilborne pathogens such as *Fusarium*, *Rhizoctonia* and *Phytophthora,* potentially further reducing yield.



You've Heard About Reniform. What's the Next Step?



Once detected in a field, you can consider reniform nematode a permanent resident. Because reniform nematode population densities can build up rapidly, even low initial levels of greater than 1,000 reniform per 100 cm^3 of soil are a threat to yield in future soybean crops.

Once the crop is planted, there are no proven in-season options to reduce yield loss from nematodes. However, a predictive soil test during or shortly after the growing season can reveal what long-term management strategies you should implement in subsequent seasons. The diagram below illustrates the exponential increase in nematode population numbers with each generation during a single growing season.

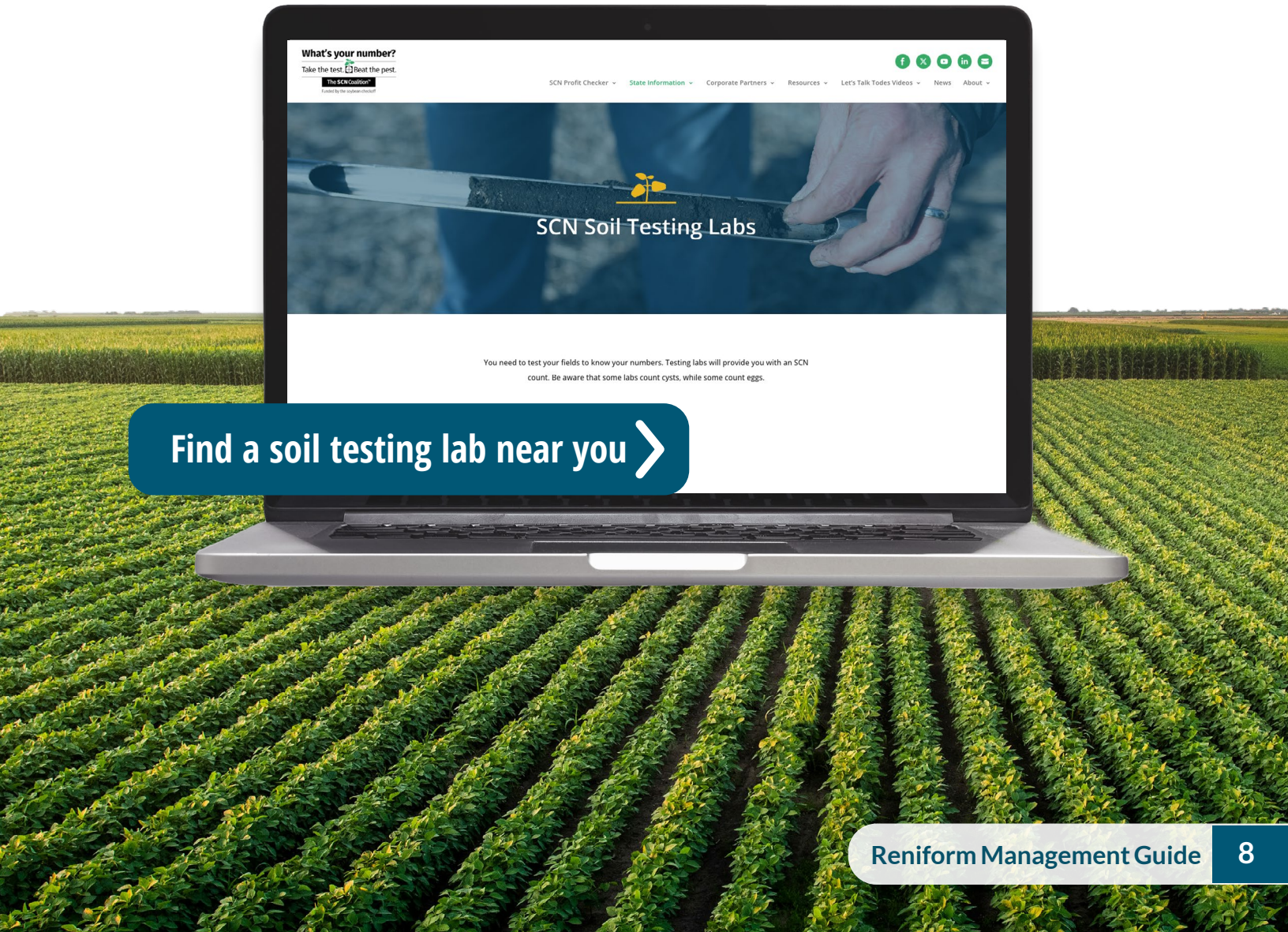


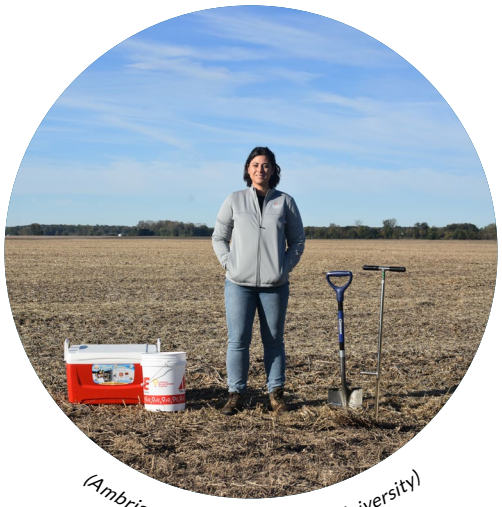
Start With a Soil Test

Soil sampling is the most reliable diagnostic method and is the foundation of any nematode management plan. Soil testing for reniform nematodes is similar to that for SCN and other nematode species. Samples should be collected when the soil is moist, near the maximum plant canopy and from the soil adjacent to the root system.

The reniform nematode shows a preference for silty soils, where moisture retention and soil structure are often favorable for its survival and reproduction. However, this nematode is not limited to silty soils and can occur across a wide range of soil textures, including sandy and clay soils. Its ability to persist under diverse soil conditions contributes to its widespread distribution and makes management challenging.

Nematode population densities are typically highest at peak plant growth, just before harvest, making this an ideal time for predictive soil sampling. Collecting samples when the soil is moist—not dry—provides the best opportunity to detect reniform nematodes. In drier regions, sampling after the last irrigation event is recommended to accurately monitor populations and make informed management decisions for the following season.





(Ambria Small, The Ohio State University)

To help determine what nematode species are present at what population density, both unhealthy—with low yield or other symptoms of reniform nematode infestation—and healthy fields should be sampled. To prevent cross-contamination, sample nonsymptomatic plants first.

Materials for reniform nematode sampling include:

- 1-inch-diameter cylindrical soil probe (or shovel)
- Bucket
- Cooler
- Plastic bags
- Permanent marker

1 Use a cylindrical soil probe at a slight angle to collect soil samples. Samples should be taken in the root zone at the base of the crop if it is present or in the root system of the previously harvested crop.

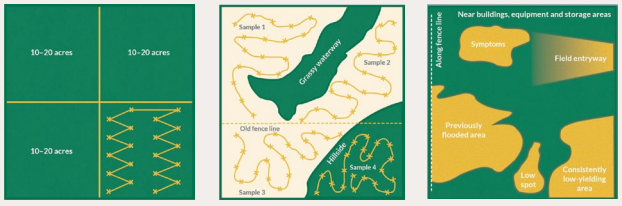
2 Collect soil cores to a depth of at least 6 inches, preferably 8 to 10 inches if soil conditions allow.

If a cylindrical probe is not available, use a shovel. First, clear crop residue from the soil surface, then collect the sample.

When using a shovel, discard the soil from the sides and keep the central portion of the subsample.



3 Collect 10 to 20 soil cores that are 1-inch-diameter in a zigzag or "W" pattern across the entire area to be sampled.



Get a closer look ❯

4 Collect 30 to 40 soil cores (subsamples) from 10-20 acres of similar conditions (soil texture, cropping history, etc.). Place samples in a bucket, breaking the soil cores and mixing them well. If different soil textures occur in the same field, sample them separately. This will represent a composite sample for the area.





5 Place a homogenized composite soil sample (2 cups or 500 ml in volume) in a plastic bag and label it with a permanent marker.

6 Store the sample away from direct sunlight in a cool area or ice chest until it is shipped to the laboratory. High temperatures are the greatest threat to sample integrity.

7 Ship samples within a few days of sampling to obtain the most accurate nematode numbers. Be sure to provide full and accurate field history information as requested by the diagnostic laboratory (e.g., rotation history, crop age, cultivar). For diagnostic laboratories that provide management recommendations, this will assist in providing the most applicable recommendations for your situation.





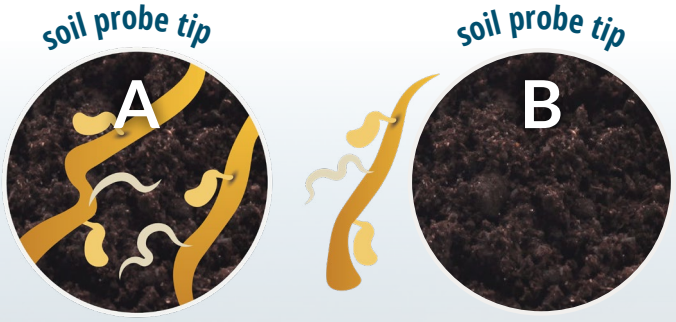
Diagnostic laboratories in some regions may also process root samples for nematodes, and these can be useful for diagnosing reniform nematode and other plant-parasitic nematodes. Root samples should always be submitted in tandem with soil samples, not alone, as certain nematodes will not be detected in roots, and threshold guidelines are typically based on soil counts. Collection and handling for root samples is similar to that described for soil samples, except that 3-10 roots should be submitted per sample depending on the crop stage. Consult with your local diagnostic laboratory to determine if they accept root samples and follow their protocols for root collection and submission.

Interpreting Your Results

Fall damage thresholds for reniform vary among states, and laboratories process their soil samples differently. For this reason, it's best to submit your soil samples to the same nematode diagnostic lab to track seasonal changes in nematode densities and to receive a locally relevant assessment of the risk posed by your numbers.

Why Reniform Soil Test Results are Variable

It all depends on where you put the probe. A 1/2-inch difference can mean the difference between zero and 150 reniform nematodes.





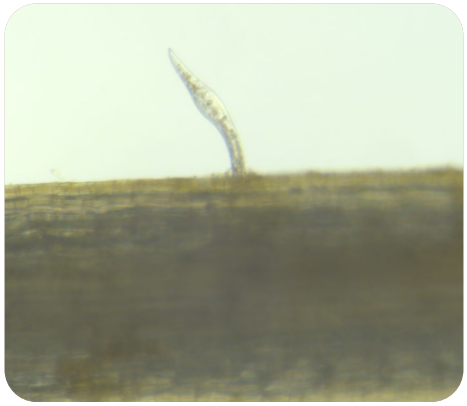


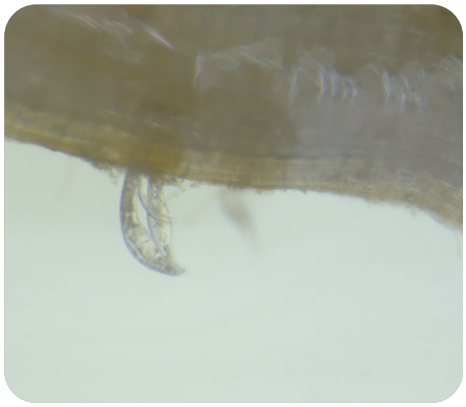
Implement Reniform Nematode Management Solutions

Once reniform nematode is established in a field, it cannot be eradicated, but it can be managed. The goals of active management include:

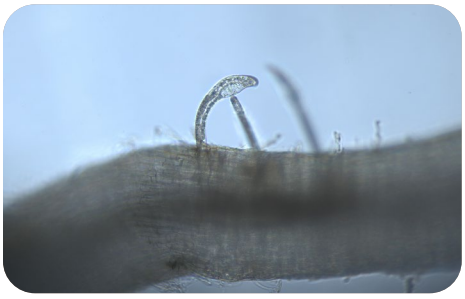
- Improving soybean health and yield
- Keeping nematode numbers low
- Maximizing return on investment of all crop inputs
- Maintaining long-term soybean sustainability in your field

Because the reniform nematode often causes few visible symptoms, the first step in management is knowing if it's present and at what population density. While yearly sampling isn't required, testing every three years, ideally after soybean harvest when the soil is moist, helps assess fields under integrated management. More frequent testing may be needed in fields with high numbers or poor yield performance.





Reniform nematodes infecting soybean root. (Bisho Lawaju, Auburn University)



Reniform nematodes infecting soybean root. (Bisho Lawaju, Auburn University)

An integrated management approach that combines multiple strategies has proven effective in reducing the impact of reniform nematodes on crops. Rotating soybean with nonhost crops such as corn or peanut can help reduce nematode population densities. Seed- and soil-applied (i.e., in-furrow) products are available to protect the developing root system. Resistance in soybean cultivars is a critical tool for nematode management. However, information on reniform resistance in soybean varieties is often lacking but may become available as new varieties are released. Determining which combination of strategies works best for your operation is key to effective nematode management.

Rotate To Nonhost Cash Crops

Soybean and cotton are good hosts for reniform nematode, while corn, grain sorghum and peanut are nonhosts. Rotating to nonhost crops for at least one year can reduce reniform populations by 60%-90%.

Caution: The southern root-knot nematode *(Meloidogyne incognita)* can infect most rotation crops except peanut, so it's important to identify which nematode species are present before planning rotation sequences.

Plant Resistant Cotton Varieties

Some cotton varieties have resistance to the reniform nematode. These varieties can lower reniform populations before planting a subsequent soybean crop, thus limiting yield losses.





Use Resistant or Tolerant Soybean Varieties When Available

Most current soybean varieties either do not have resistance to reniform nematode or have not been evaluated, but some breeding programs are developing resistant varieties.

Note: Resistance to SCN or RKN does not necessarily protect against reniform nematode. Check seed guides for specific information on reniform nematode resistance and consult with your local Extension educator, crop consultant or Extension nematologists and plant pathologists regarding nematode screening programs before selecting a variety.



Consider Nematode-Protectant Seed Treatments or In-Furrow Nematicides

Biological and chemical seed treatments can provide partial early-season protection by reducing nematode infection but do not last season-long. They are best used in fields with low to moderate infestation levels and paired with host plant resistance.

Some conventional or biological nematicides are labeled for in-furrow use in soybean. Efficacy will vary by product and there has been limited testing against reniform nematode in soybean, so consult your local Extension program for field efficacy information. As a general rule, soil-applied nematicides with the same active ingredient as seed-applied have a greater level of root protection and yield response than seed treatments. However, similar to seed treatments, in-furrow products typically provide reniform nematode protection early in the season, not season long.

Manage Soil Health and Fertility

Soybean planted under optimal soil temperature and moisture conditions in well-drained soils with balanced fertility often produces more robust root systems that tolerate nematode feeding. Avoid soil compaction that limits root growth and manage irrigation to prevent prolonged waterlogged soils that can reduce root growth.



Control Weeds and Manage Fallow Periods

Reniform nematodes can survive and reproduce on several weed species that are common in the southern U.S. Weeds can maintain or even increase reniform nematode populations both during the cropping season and fallow periods. Thus, effective weed control throughout and between cropping cycles is critical.

Winter cover crops such as wheat, cereal ryegrass or oats are poor hosts for the reniform nematode. These crops will not kill the nematode, but they do not support significant reproduction. Other winter cover crops, such as clovers and vetch, are hosts for reniform nematodes and can increase nematode populations prior to soybean planting if you experience a warm, moist spring.

Cotton regrowth after harvest is a common occurrence in the southern U.S. These plants can sustain a reniform nematode population; therefore, crop termination by tillage will eliminate potential nematode reproduction during the fall months.

Prevent Spread

Reniform nematodes spread through infested soil, so clean equipment and remove excess soil from tire treads and boots to avoid moving nematodes from infested to noninfested fields.

Integrate and Monitor

No single tactic eliminates reniform nematode. Combine nonhost rotation, resistance, nematicides, sanitation, weed/fallow management and consistent soil testing to track populations and protect yield potential across seasons.

For additional soil testing recommendations, state-specific resources or to learn more about actively managing reniform and other damaging nematodes, visit:

TheSCNCoalition.com

Connect with us on social ***@thescncoalition***



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