extension
ALABAMA A&M & AUBURN UNIVERSITIES

Integrated Management of Southern Root-Knot Nematode on Sweet Potato

► **Southern root-knot nematodes can cause significant economic damage to sweet potato crops. Learn how to recognize their damage, distribution and host range, pest biology, and sampling and management techniques.**

The southern root-knot nematode *(Meloidogyne incognita)* is one of several plant-parasitic nematodes that cause damage to plant roots. Other problematic nematodes for sweet potato production in Alabama include the Javanese root-knot nematode *(Meloidogyne javanica)* and the reniform nematode *(Rotylenchulus reniformis)*. Southern root-knot nematodes cause yield loss in sweet potato production systems by reducing the quality and quantity of marketable potatoes. In 2021, 153,500 acres of sweet potatoes were planted in the United States. This production was worth an estimated $680 million. According to the most recent data, in 2017, Alabama farmers harvested more than 2,000 acres of sweet potatoes.

Symptomology

Root-knot nematode infection mostly manifests itself in below-ground symptoms. Above-ground symptoms include leaf chlorosis, stunting, and plant death (figure 1). Infected plants are also often prone to wilting and may show signs of nutrient deficiencies. This occurs because nematode infection reduces the plants' ability to absorb and transport water and nutrients from the soil. Nematodes travel through the soil slowly, so symptoms are often not uniformly distributed across a production field. Instead, symptoms are usually visible in clusters. However, processes, such as planting and tillage, that move soil from place to place can spread nematodes rapidly across a field. Although nematode infection can cause symptoms in plant foliage, the below-ground symptoms are the most detrimental to yield and quality. These include galling on both the storage and fibrous roots (figure 2). These galls are typically round or ovular-shaped swellings of the root tissue whose size range from barely noticeable to dramatic. The severity of galling depends on several factors, including host plant cultivar, species of *Meloidogyne* nematode present, and nematode population density. In severe cases, southern

Figure 1. Leaf chlorosis and wilting due to southern root-knot nematode infection. (Photo credit: Zane Grabau, University of Florida)

Figure 2. Southern root-knot nematode damage to sweet potato where galling is observable on the fibrous roots.

Internal Root-Knot Nematode Damage

Figure 3. Sweet potatoes after slicing with darkened areas where the root-knot females are embedded.

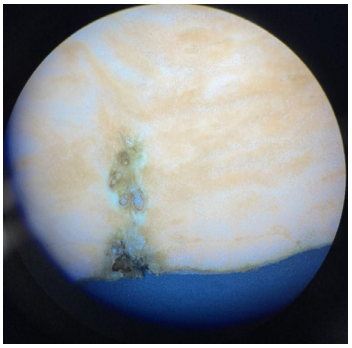

Figure 4. Root-knot nematode females surrounded by necrotic areas in the root tissue at 10X magnification.

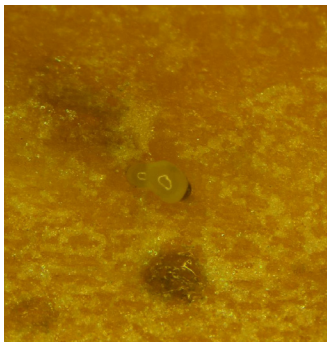

Figure 5. Root-knot nematode female (circled in blue) visible within the root tissue at 20X magnification.

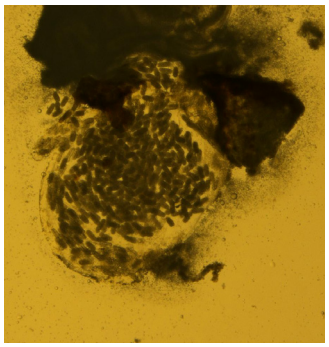

Figure 6. Egg masses emerging from a pierced female at 20X magnification.

root-knot nematode infection can result in malformation or cracking of the storage roots. These nematodes can even enter growing storage roots, causing undesirable, darkened, corky-textured sweet potatoes. Internal sweet potato damage includes darkened areas within the potato where root-knot females produce eggs (figures 3, 4, 5, and 6). On the commonly grown Beauregard variety, these nematodes cause raised areas resembling pimples on the storage roots' surface. Diagnosis of a nematode infection can be made based on a visual inspection of galling on the plant's roots, but the species of nematode can only be determined by using molecular techniques available in a diagnostic laboratory.

Distribution and Host Range

The southern root-knot nematode is widely distributed in tropical and subtropical regions worldwide, including the southeastern United States. These nematodes are most problematic in sandy soils, where the highest populations are generally found. They also have a broad host range, including vegetables, ornamentals, fruit trees, agronomic field crops, cover crops, and weeds. This broad host range makes southern root-knot nematodes problematic to manage with crop rotation.

Pest Biology

The southern root-knot nematode begins its life cycle inside an egg where it completes its first molt. It emerges as a second stage juvenile (J2), which infects the plant root. It enters the root intercellularly and travels to the area of cell elongation. There, the nematode establishes a feeding site by injecting secretions from its esophageal gland into the root cells. These secretions cause the root cells to transform into giant cells that grow rapidly without undergoing cell division. As the nematode feeds on the cytoplasm of these giant cells, it will complete its final molts and become an adult. The cells around the growing female root-knot nematode grow to encompass her expanding body. The female's posterior may protrude from the root, and she will lay eggs in a gelatinous matrix outside her body. Since the majority of the southern root-knot nematode's life cycle occurs inside plant roots, their infection can cause major quality issues for growers of root and tuber crops, like sweet potatoes.

Sampling for Nematodes

Because this pest can cause significant economic damage, all fields to be planted with sweet potatoes should be sampled for southern root-knot nematodes. Experts recommend that fields be sampled in the summer while sweet potatoes are actively growing and after harvest in the fall for a final evaluation. Taking samples each year helps to determine how quickly nematode populations are building, which allows farmers to make informed management decisions.

For accurate results, take samples when the soil is moist but not muddy, ideally following rain. The sampling process involves using a soil sampling probe or shovel to collect soil cores in the field at a depth of 6 to 12 inches. The number of soil samples needed can vary based on the field size, the number of different soil types present, and the sampling budget. However, since nematodes are rarely uniformly distributed across a field, several samples should be taken to determine the extent of the infestation. Additionally, since root-knot nematodes prefer sandy soils, it can be helpful to divide the field based on soil type or in areas where yields were low to determine nematode populations in those areas. After collection, label soil samples, place

them in sealed plastic bags, and keep them cool for transport. To prevent inaccurate results, do not store samples in closed vehicles or expose them to extreme temperatures. If samples cannot be transported immediately, they should be stored in a refrigerator. The Auburn University Plant Diagnostic Laboratory can analyze these samples for a small fee. Growers will receive information about the genera of nematodes in their samples and a population count for each of the genera identified.

Management Options

The threshold for management of root-knot nematodes in sweet potatoes is generally estimated at 10 J2 per 100 cm3 of soil. However, any population level can cause production and quality issues for growers, depending on the warmth and moisture of the growing season. Management typically involves planting resistant varieties, rotating crops, sanitizing, and using nematicides. Planting a resistant variety is a simple way to manage southern root-knot nematode populations, and several resistant sweet potato varieties are available. Table 1 provides more information on the susceptibility of popular sweet potato varieties to southern root-knot nematode. Most of these varieties are widely commercially available but are often lower yielding than older industry standard varieties Beauregard or Orleans. Many growers find success with crop rotation to suppress nematode populations. A southern root-knot resistant variety of soybean, cotton, or grain sorghum should be planted for 2 years after sweet potatoes. Look for information on southern root-knot nematode-resistant varieties in seed catalogs or your seed company's website. Contact your seed supplier for more information.

Good sanitation practices should also be implemented across the operation. For example, wash tractors, harvesters, and other field equipment to remove all soil before being transported from one field to another, especially when moving from a nematode-infested field to an unaffected field. Biological nematicides available to growers include Majestene (heat-killed *Burkholderia rinojenses* and its nonliving spent fermentation media) and MelcoCon LC *(Purpureocilium lilacinum)* (synonym *Paecilomyces lilacinus*) strain 251. Chemical nematicides can also be used to control nematode populations. Nematicides such as Vydate L (oxamyl), Velum (fluopyram), Nimitz (fluensulfone), Movento (spirotetramat), and Mocap EC (ethoprop) are labeled for control of root-knot nematode in Alabama sweet potato crops. Always check the labels for each nematicide application although these chemicals are typically applied before planting and should be either incorporated into the soil through tillage or watered in with irrigation. As always, growers should follow the instructions on the label for best results.

Another type of chemical control, fumigation, can also be used. These products include Telone II (1,3-Dichloropropene), Vapam HL (sodium methyldithiocarbamate), and K-Pam HL (potassium N-methyldithiocarbamate), which are authorized for use in sweet potatoes. These chemicals greatly reduce nematode populations but are acutely toxic to humans and must be applied with specific equipment. For this reason, growers should use caution and follow the label directions when using fumigation for nematode control.

Table 1. Susceptibility of Currently Available Popular Sweet Potato Varieties to Southern Root-Knot Nematode

Variety	Flesh Color	Southern Root-Knot Nematode Resistance
Beauregard	Orange	Susceptible
Orleans	Orange	Susceptible
Bayou Belle	Orange	Intermediate
Covington	Orange	Resistant
Jewel	Orange	Resistant
Bellevue	Orange	Highly Resistant
Bonita	White	Highly Resistant
Burgundy	Orange	Highly Resistant
Evangeline	Orange	Highly Resistant
Murasaki-29	White	Highly Resistant

Adapted from "North Carolina Extension Organic Commodities Production Guide" and "Nematode Management, Louisiana Sweet Potato Production," Louisiana State University AgCenter.

In conclusion, integrated pest management should be used to manage the damage of southern root-knot nematode in sweet potatoes. This can be accomplished by combining resistant varieties, crop rotation, sanitation, and nematicides.

References

- Gazaway, W. Collecting Soil and Root Samples for Nematode Analysis. Alabama Cooperative Extension System, Alabama A&M and Auburn Universities, July 1995.
- Gibson, F. "Statistics by Subject." National Agricultural Statistics Service, USDA, 5 Apr. 2018.
- Grabau, Z. and Noling, J.W. Nematode Management in Sweet Potatoes (Including Boniatos). University of Florida Institute of Food and Agricultural Sciences Extension, University of Florida, 14 Oct. 2021.
- Jennings, K., et. al. Crop Production Management-Sweetpotatoes. North Carolina Organic Commodities Production Guide, North Carolina State Extension, 24 June 2019.
- Kim, Y-H. and Yang, J-W. Recent research on enhanced resistance to parasitic nematodes in sweetpotato. Plant Biotechnology Rep 13, (559–566) 8 Aug. 2019.
- Mitkowski, N.A. and Abawi, G.S. 2003. Root-knot nematodes. The Plant Health Instructor, 2003, revised 2011.
- Ploeg, A., Stoddard, S., Becker, J. O. Control of Meloidogyne incognita in sweetpotato with fluensulfone. Journal of Nematology vol. 51 (2019): 1-8. doi:10.21307/jofnem-2019-018.
- Quesada-Ocampo, Lina. "Sweetpotato Root Knot Nematode." North Carolina State Extension, North Carolina State University, 24 May 2018.
- Smith, T., et.al. "Nematode Management." LSU Ag Center, Louisiana Cooperative Extension Service, 11 February 2017.

Claire Schloemer, Graduate Student; **Scott H. Graham**, *Extension Specialist*, Assistant Professor; and **Kathy Lawrence**, Professor, all in Entomology and Plant Pathology, all with Auburn University

New April 2023, ANR-2993 © 2023 by the Alabama Cooperative Extension System. All rights reserved.

www.aces.edu