Parasitic Nematodes in Cotton

Nematodes are microscopic, thread-like worms, and can be found in every state where cotton is grown. Parasitic nematodes can cause dramatic yield loss worth millions of dollars, yet go undetected by growers each year. Nematode feeding reduces a plant's ability to take in water and nutrients, and can create an entry-point for fungal and bacterial pathogens. There are four major nematode species that attack cotton: southern root-knot, reniform, lance, and sting nematodes.

Life Cycle

Under favorable conditions, most cotton nematodes can complete their lifecycle (egg, four juvenile stages, egg-producing adult) in one month or less, producing multiple generations per growing season. Mature females of some species, such as root-knot nematode, can produce hundreds of eggs, leading to rapid growth of population densities.

Cotton nematodes spend their entire life in the soil. They are classified by where they live while feeding on the plant, which is important when sampling for nematodes. Endoparasitic nematodes live within the root structure, while ectoparasitic nematodes, such as sting nematodes, live in the soil outside of the root.

Symptoms

Symptoms of cotton nematode feeding are typically found in irregular patches, and not across a whole field (Figure 1). Foliar symptoms include yellowing, wilting, and stunting of plants. These symptoms are not unique to nematode feeding, and can easily be confused with drought stress, nutrient deficiencies, disease, or herbicide damage. Below-ground symptoms vary by nematode species.

Table 1. Damage thresholds for cotton nematodes

Nematode (common name)	Damage threshold (nematodes per 100 cc soil)
Southern root-knot	100
Reniform	250
Columbia lance	80
Sting	1

Jagdale, G., Davis, R., Bertrand, P., Gay, J., et al. 2013. Guide for interpreting nematode assay results. University of Georgia Extension.

Figure 1. In-season symptoms of cotton nematode damage

The presence of nematodes may vary based on environmental conditions, soil type, and the presence or absence of actively growing plants. Sandy and coarse-textured soils are typically where the greatest nematode damage occurs.

Cotton Nematodes

The southern root-knot, reniform, lance, and sting nematodes are all economically important pests in cotton; and their occurrence varies across cotton producing regions. The southern root-knot nematode is found across the entire cotton belt, the reniform nematode is prevalent from North Carolina to Texas, and the lance and sting nematodes are concentrated in the Southeast.[1]

Southern Root-Knot Nematode

The southern root-knot nematode can be found in all cotton production regions in the United States; and are most commonly found in sandy soils. This nematode is responsible for nearly twice as much yield loss across the cotton belt when compared to other cotton nematodes.[2] Root-knot nematodes form galls on roots, and reduce the plant's ability to take in water and nutrients from the soil. Population densities of this species can increase rapidly due to its short life-cycle and large egg production.

Corn, soybean, and sorghum are all hosts of the southern root-knot nematode; therefore, rotating to these crops should be avoided in problem areas. However, rotating to peanuts, which are not a host of this nematode, can drastically reduce population densities.

Reniform nematode

The reniform nematode gets its name because the swollen adult female is kidney, or "reniform" shaped. It is more prevalent in silty soils; and is infrequently found in the same fields with root-knot nematode.[1] Reniform nematodes have a short lifecycle, 18 to 20 days, and can have many generations within one growing season.

The above-ground symptoms of this nematode include stunting, uneven plant heights, premature wilting, and reduced yields.[4] Below-ground symptoms are hard to identify, but may include thin roots, dead tissue, and roots that have a gritty appearance due to the large number of egg masses. Unlike most nematodes, symptoms caused by the reniform nematode are often uniform across a field. None of these symptoms are unique, and a soil sample must be taken to accurately diagnose the presence of the reniform nematode. Crop rotation to corn or rice may be an effective management strategy against the reniform nematode.[4]

Columbia lance nematode

This nematode was first identified near Colombia, South Carolina, and occurs primarily in the coastal plains of Georgia, North Carolina, and South Carolina. Columbia lance nematdoes are relativley large plant-parasitic nematodes and can cause considerable damage. Dark lesions and reduced root growth are common symptoms of lance nematode feeding.[2,5]

Sting nematode

The distribution of sting nematodes is limited to very sandy soils, and they are generally found in southeastern states. Sting nematodes are migratory ectoparasites, and are very damaging to root systems. They feed on root tips, causing the roots to stop elongating. This results in short, stubby root systems with a reduced number of fibrous roots. Dark lesions may also be visible on the root surface.[2,5] Damage thresholds are very low for the sting nematode; it takes only one sting nematode per 100 cc soil to cause economic damage (Table 1).

Nematode Sampling

Soil and root samples should be collected and sent to a nematode testing laboratory to accurately confirm the nematode species present, and the population densities in a specific area. It is generally recommended that samples are taken during late summer or fall; however, guidelines may vary by state.

Soil samples should be taken around the edge of symptomatic areas, at about 12-inches deep, within a few inches of the damaged plants (or intersecting the root zone). The soil should not be overly wet or dry when sampling, and at least 20 soil cores should be collected per sampling area (10 acres or less). A composite sample of roots from up to 5 cotton plants should also be collected. Root and soil samples should be refrigerated until the time of shipping. Additional information and instruction on nematode sampling can be found from your local Extension service or nematode testing laboratory.

Management

Nematodes can not be eliminated from the soil, but it is important to keep populations at low levels to avoid potential yield and quality losses. Identifying nematode species and damage threshold levels are essential for determining the appropriate control methods (Table 1). Nematode damage thresholds may vary by species, soil type, and state. The following cultural practices may help farmers reduce the effects from possible nematode infestations.

Fertilize- Plants suffering from nutrient deficiency are more susceptible to injury.

Weed Control- Weeds are hosts for many nematodes; managing weeds can help keep nematode populations low.

Crop Rotation- For certain nematode species, rotating to a non-host crop can keep population densities low (Table 2).

Nematode-Resistant Varieties- Nematode-resistant (NR) varieties have been bred to combine high yield potential with nematode protection.

Chemical Control- Nematicides and seed treatments may be an effective control measure against cotton nematodes.

Nematode management requires an integrated approach, and is an ongoing process. Sampling and identification of the nematodes present is crucial to creating an effective management strategy against cotton nematodes.

Table 2. Nematode hosts and non-host rotational crops

Nematode (common name)	Cotton	Corn	Sorghum	Peanuts	*Soybean
Southern root-knot	Host	Host	Host	Non-host	Host
Reniform	Host	Non-host	Non-host	Non-host	Host
Columbia lance	Host	Host	Host	Non-host	Host
Sting	Host	Host	Host	Host	Host

*Soybean products are available that are root-knot and reniform nematode resistant.
Source: Mueller, J., Kirkpatrick, T., Overstreet, C., Koenning, S., Kemerait, B., and Nichols, B. 2012. Managing nematodes in cotton-based cropping systems. Cotton Incorporated. http://www.cottoninc.com/.

sources:
[1] Understanding cotton nematodes. National Cotton Council. [2] Koenning, S., Kirkpatrick, T., Starr, J., Wrather, J., Walker, N., and Mueller, J. Plant-Parasitic Nematodes Attacking Cotton in the United States. [3] Overstreet, C. 2016. Nematode problems in cotton. LSU College of Agriculture. [4] Overstreet, C., McGawley, E., and Ferrin, D. 2008. Reniform nematode in Louisiana. Louisiana Plant Pathology Disease Identification and Management Series.. Pub. 3095. [5] Dickerson, O., Blake, J., and Lewis, S. 2000. Nematode Guidelines for South Carolina. EC 703. Clemson Extension.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development, & Agronomy by Monsanto.