PARASITIC NEMATODES IN CORN

- Corn nematodes are microscopic, thread-like worms.
- Nematodes can limit a plant's ability to uptake water and nutrients.
- Depending on the species, parasitic nematodes live and feed outside or inside roots.
- Nematode presence can be obscure, mimic other agronomic factors, or be identifiable.

Nematodes are microscopic, thread-like worms, which can be found in most corn fields and can be beneficial or damaging to a corn plant. Some nematode species are beneficial because as they feed on bacteria or fungi they help mineralize or release plant available nutrients such as ammonium. Additionally, beneficial nematodes help distribute beneficial bacteria, fungi, and other microbes as they travel within the soil and along roots and consume disease-causing organisms.[1] Those causing damage can reduce yield potential by limiting the plant's ability to absorb water and nutrients.[2] Additionally, nematode feeding wounds can provide an entrance point for other potentially destructive pathogens.

Figure 1. Stunted corn caused by sting nematodes.

Picture courtesy of and used with the permission of T. Jackson-Ziems, University of Nebraska.

Nematode presence within a field can be obscure or be quite evident and mimic other stress causing factors such as nutrient deficiencies, insect feeding, chemical or fertilizer injury, and drought (Figure 1). Symptoms usually appear as stunted, yellowish or purplish plants within irregular-shaped patches in the field, and later uneven tasseling and poor ear development may be observed. In many cases above-ground symptoms can go undetected because of favorable growing conditions. Depending on the species, below-ground symptoms may involve root galls, swollen or stunted roots, and a lack of root mass.

Management

Nematode management requires an integrated and ongoing approach that begins with the confirmation and identification of nematode species through soil and root samples sent to a nematode testing laboratory. The collection of root tissue and soil is important to determine the presence of endoparasitic (living within the roots) or ectoparasitic (living outside the roots) nematodes. Sampling for the presence of nematodes should occur during mid-growing season when nematode populations and symptoms are likely to be the greatest.[2,3,4] Sampling techniques include:[4]

- Soil samples should be taken around the edge of symptomatic field areas.
- At least 20 soil cores should be collected per sampling area (10 acres or less).
- Probes should go about 12-inches deep.
- Sampling should occur within a few inches of symptomatic plants to retrieve root tissue (at least two to three plants).
- Soil should not be overly wet or dry.

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- Root and soil samples should be refrigerated until shipped to a nematode analysis laboratory. Contact your local University Extension Office for laboratory locations.

The verification of nematode presence and species helps define management practices. Agronomic practices that help reduce crop stress may help reduce the potential for nematode-caused crop loss. Agronomic practices include:

- Adequate Fertility – Plants suffering from nutrient deficiencies can be more susceptible to nematode injury.
- Weed Control – Weeds are hosts for many nematodes; therefore, managing weeds can help keep nematode populations low.
- Crop Rotation - Depending on nematode species, crop rotation to a non-host crop can help keep specific nematode densities reduced.
- Chemical Control - Nematicides and seed treatments may be an effective control measure.

Nematode Species

There are many nematode species that interact with corn. They vary in size, feeding habit, damage potential, and location. Some are more specific to soil types and others occur throughout a range of soil types. A few of the most important corn nematodes include dagger, lance, lesion, needle, root-knot, sting, and stubby-root. Ring, spiral, and stunt nematodes may be present in many fields but are generally not of economic importance.

Dagger (*Xiphinema* spp.) nematodes are ectoparasitic and can cause stunting and chlorosis. They are found predominately in sandy and silty loam soils, reproduce once per year, and are known for a long lifecycle (up to five years in favorable conditions). They prefer cool, moist soils and migrate deeper into the soil profile as soils become warmer.[11] Dagger nematodes insert a "long" stylet into the root, puncturing cell walls while also injecting enzymes that digest cellular contents. The injected enzymes may vector viruses from other plants the nematodes have fed upon. They can thrive on many agricultural, fruit, and horticultural crops and weeds. Tillage may be an effective control measure because of sensitivity to soil disturbance.[5] Dagger nematodes have the potential to cause moderate damage to corn and have a threshold of 30 to 40 nematodes per 100 cubic centimeters (cc), or about a ½ cup of soil.[13]

Lance (*Hoplolaimus* spp.) nematodes are mostly found in sandy soils but can be found in a range of soil types throughout the United States (Figure 2). They are one of the largest nematode species and have a range of host plants; therefore, crop rotation is likely ineffective for control.[5] These semi-endoparasitic nematodes can cause severe damage to seedling corn and result in mature spindly plants that may have the same height

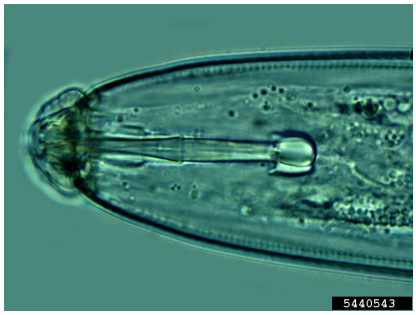

Figure 2. Anterior view of a lance nematode showing the stylet knob and stylet that is inserted into root tissue.

Picture courtesy of and used with the permission of Dr. Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, Bugwood.org.

Figure 3. Root-knot nematode.

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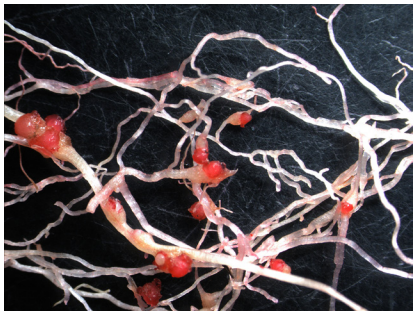

Figure 4. Corn roots showing root-knot galls and egg masses.

Picture courtesy of and used with the permission of Dr. Charles Overstreet, Emeritus, Louisiana State University.

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as noninfected plants.[8] Lance nematodes have a moderate potential for damage to corn plants and have a threshold of 300 to 400 nematodes per gram of soil.[13]

Lesion or **root-lesion** (*Pratylenchus* spp.) nematodes are small endoparasites which are probably the most important corn nematode in the Midwest. They can be found across a range of soil types. Damage can range from small water-soaked root areas or reddish-brown to black lesions on root surfaces and within root tissue to severe necrosis of the roots.[5] The damage threshold is 1,000 lesion nematodes per gram of root and densities can reach 10,000 to 84,000 nematodes per gram.[5,13] Threshold numbers may vary based on environmental conditions.[6]

Needle (*Longidorus* spp.) nematodes are among the most potentially devastating in corn. They are ectoparasitic, highly restricted to sandy soils, feed using a needle-like stylet, and are one of the longest nematodes. They favor cool, moist soil. Their root feeding stunts the lateral roots, causing a bottle-brush appearance, which essentially destroys the fibrous root system. Damage thresholds are as low as one nematode per 100cc of soil, and 25 nematodes per 100cc of soil can cause severe damage.[5] Grass plants are the main hosts for the nematode; therefore, soybean and sugarbeet can be used as rotational non-host crops.

Root-knot (*Meloidogyne* spp.) nematodes are endoparasitic and cause small galls to appear on corn roots in about four to six weeks. Several species may be present in corn fields; however, the southern root-knot nematode is the most common and potentially damaging (Figure 3). The galls can be visible and may help identify and resolve field agronomic issues (Figure 4). The galls may be larger in other host crops compared to those in corn. Roots may also have a stubby appearance. Soybean, cotton, sweet potato, and other vegetable crops are additional hosts. Peanut is not a host of southern root-knot.[9,10] Reduction in corn yield may not be dramatic until an economic threshold of 500 second-stage juveniles per 500cc of soil are measured.[10]

Sting (*Belonolaimus* spp.) nematodes favor soils with a sand content of 80 percent or higher and are common in much of the Southeastern and Midwestern United States in irrigated fields (Figure 5). Other crop hosts include sorghum and soybean, making crop rotation a difficult management tool; however, soybean tends to perform better than corn in the presence of sting nematodes. Wheat, though a host, can compete because of quick early growth; however, sting populations can increase and cause problems for a susceptible double-crop or next-season crop. The ectoparasitic nematode has a damage threshold of just one nematode per 100cc of soil and injures the roots by injecting a toxin into the roots during feeding.[13] Damage appears as a reduced root mass, while individual roots are stubby with dark, shrunken lesions at the tip (Figure 6). Newly emerged corn plants can be severely affected.[7]

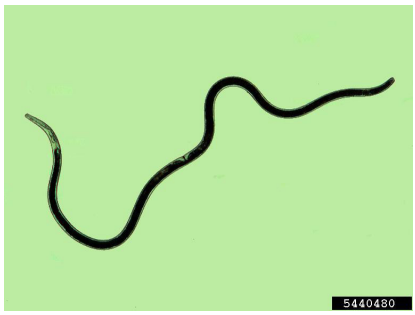

Figure 5. Sting nematode.

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Figure 6. Roots damaged by sting nematode.

Picture courtesy of and used with the permission of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org.

Figure 7. Corn root damaged by stubby-root nematode feeding.

Picture courtesy of and used with the permission of Rome Ethredge, Seminole Crop Consulting, Donalsonville, GA.[12]

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Stubby-root (*Paratrichodorus* spp.) nematodes are ectoparasitic and a serious threat in southern states. They favor sandy soils.[6] Symptoms include stunted, blunt, and swollen roots (Figure 7). Stubby-root nematodes have a moderate potential for damaging corn plants with a threshold of 40 nematodes per 100cc of soil.[13]

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