Parasitic Nematodes in Corn

Nematodes are microscopic, thread-like worms, which can be found in virtually any field where corn is grown. While some species of nematodes can be beneficial, plant-parasitic nematodes are those which feed only on plants, and may reduce yield potential by limiting the plant's ability to take in water and nutrients.[1] Nematodes can also create openings for other pathogens to enter the plant and cause disease. The presence of nematodes in a corn field can vary from no obvious symptoms, to severe injury and tremendous yield loss.[2]

Figure 1. Severe nematode injury in corn field. Photo credit: T. Jackson-Ziems, University of Nebraska.

Life Cycle and Environment

The presence of nematodes may vary based on soil type, environmental conditions, and the presence or absence of growing plants. Corn nematodes may flare up in continuous corn cropping systems, but populations can still be maintained when a field is planted to a non-host crop, such as soybeans or alfalfa. Many species thrive in sandy soils, though corn nematodes can be found almost anywhere, including heavier soils.

Under favorable conditions, most parasitic nematodes of corn can complete their lifecycle (egg, four juvenile stages, egg-producing adult) in about one month, and may complete four or more lifecycles in one growing season.[1] Mature females of some species, such as root-knot nematode, can produce hundreds of eggs, leading to rapid growth of population densities.

Corn 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.[1] Endoparasitic nematodes live within the root structure, while ectoparasitic nematodes, such as spiral and needle nematodes, live in the soil outside of the root.

Symptoms

Symptoms of corn nematode feeding are typically found in irregular patches, and not across a whole field (Figure 1). There are often no above ground symptoms unless populations are extremely high, symptoms may also intensify under stressful growing conditions. Below-ground symptoms vary by nematode species. For example, root-knot nematode infection typically causes galls (irregular swelling of the roots), while stubby-root nematodes cause stunted, blunt, and swollen roots. Foliar symptoms may be hard to identify, as they are not unique to nematode feeding, and can be easily confused with nutrient deficiencies, herbicide, or insect damage.[1] The only way to accurately diagnose the presence of parasitic nematodes in corn is through soil and root sampling.

Table 1. Common symptoms of corn nematode damage

Above-ground symptoms	Below-ground symptoms
Thin stands	Swollen roots
Uneven plant height	Lack of fine roots
Stunted plants	Root branching
Uneven tasseling	Necrotic lesions (black or dark brown dead spots)
Leaf yellowing	
Small ears and kernels	

Nematode Species

There are many different nematode species that interact with corn. They vary in size, feeding habit, damage potential, and location (Table 2). Some nematodes can only be found in very sandy soils, while others can be found in a wide range of soil types. Listed below are nematodes that are economically important in corn production.

Lesion *(Pratylenchus spp.)* Lesion nematodes are small migratory endoparasites, and are probably the most important corn nematode in the Midwest. They can be found across a wide range of soil types. Damage from lesion nematodes can range from small water-soaked areas, to severe necrosis of the roots.[4] The damage threshold for lesion nematodes is 1,000 nematodes per gram of root, and populations can reach numbers of 10,000 to 84,000 nematodes. Threshold numbers may vary based on environmental conditions.[5]

Needle (*Longidorus spp.)* Needle nematodes are among the most devastating type of nematodes in corn. They are ectoparasitic, and their presence is highly restricted to sandy soils. These nematodes damage corn roots by feeding on root tips, stunting the lateral roots and essentially destroying the fibrous root system. Damage thresholds for needle nematodes are as low as 1 nematode/100 cc soil; 25 nematodes/100 cc soil can cause severe damage.[4]

Lance *(Hoplolaimus spp.)* Lance nematodes are mostly found in sandy soils, but can be found in many soil types. They are extremely common, and have a wide range of hosts; therefore, crop rotation is ineffective in controlling lance nematodes.[4]

Dagger *(Xiphinema spp.)* Dagger nematodes are ectoparasitic and can cause stunting and chlorosis of corn plants. They are found in sandy and silty loam soils, and are known for their long lifecycle. They reproduce once per year, and can live up to 5 years in favorable conditions. Tillage may be effective in controlling the dagger nematode.[4]

Stubby-root *(Paratrichodorus sp.)* This ectoparasitic nematode is a serious pathogen in southern states, and is found in sandy soils.[5] Stubby-root nematodes can be very damaging. Symptoms include stunted, blunt, and swollen roots.

Root-Knot *(Meloidogyne spp.)* Root-knot nematodes are endoparasitic and cause small galls on corn roots. Soybeans are also a host of root-knot nematode; therefore, rotation to soybeans is not a control method.

Sampling for Nematodes

To confirm the presence of nematodes, soil and root samples must be collected and sent to a nematode testing laboratory for analysis. It is important to collect both soil and root samples to determine the presence of endoparasitic and ectoparasitc nematodes.

Sampling should occur during the middle of the growing season, when nematode numbers are greatest, and damage symptoms are apparent.[1,2,3] 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).[3] Roots from 2 to 3 corn plants should also be collected. Root and soil samples should be refrigerated until the time of shipping.

A general field survey may also be conducted to determine the presence and potential risk of nematodes in a field. This is commonly done by taking soil samples post-harvest in fields where no damage symptoms have been observed. Additional information and instruction on nematode sampling can be found from your local Extension service or nematode testing laboratory.

Management

Once corn nematodes are present in a field, management practices should be used to help minimize crop damage and keep population densities low. Because there are many nematode species, identification is essential for determining the appropriate control option. For certain nematode populations, the best management practice is crop rotation.

Corn management practices that reduce crop stress may help the crop overcome nematode attacks. The following agronomic practices may help farmers manage potential nematode infestations.

1. Fertilize- Plants suffering from nutrient deficiency are more susceptible to injury.
2. Weed Control- Weeds are hosts for many nematodes; managing weeds can help keep nematode populations low.
3. Crop Rotation- For certain nematode species, rotating to a non-host crop can keep population densities low.
4. Chemical Control- Nematicides and seed treatments may be an effective control measure against corn 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 corn nematodes.

Table 2. Common corn nematode characteristics and damage thresholds

Nematode (common name)	Feeding habit	Primary location	Damage potential	Damage threshold (nematodes/ 100 cc soil)
Dagger	Ectoparasite	Sandy soils	Moderate	30-40
Lance	Endoparasite	Roots-sandy soils	Moderate	300-400 per gram of root
Needle	Ectoparasite	Very sandy soils	High	1
Ring	Ectoparasite	Soil	Low	100
Root-knot	Endoparasite	Roots and soil	Low	100
Root-lesion	Endoparasite	Roots	Moderate	1,000 per gram of root
Spiral	Ectoparasite	Clay or loamy soils	Low	500-1,000
Sting	Ectoparasite	Very sandy soils	High	1
Stubby-root	Ectoparasite	Sandy soils	Moderate	40
Stunt	Ectoparasite	soil	Low	100

Source: Tylka, G. 2009. Common corn nematode characteristics. Iowa State University. http://crops.extension.iastate.edu, and Jagdale, G., Davis, R., Bertrand, P., Gay, J., et al. 2013. Guide for interpreting nematode assay results. University of Georgia Extension.

sources:
[1]Grabau, Z. and Vann, C. 2017. Management of plant parasitic nematodes in Florida field corn production. ENY-001. University of Florida. http://edis.ifas.ufl.edu. [2]Zeims, T. 2015. Sampling for nematodes of corn. University of Nebraska- Lincoln. http://cropwatch.unl.edu [3]Tylka, G. 2007. Nematodes in corn production: a growing problem? IC-498. Iowa State University Extension. http://www.ipm.iastate.edu [4]Niblack, T. 2003. More details on corn nematodes. University of Illinois. http://bulletin.ipm.illinois.edu [5]Norton, D. and Nyvall, R.2011. Nematodes that attack corn in Iowa. PM1027. Iowa State University.

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

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

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