# Plant-parasitic nematodes on corn: Old foes and a possible new nemesis

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## Introduction

Plant-parasitic nematodes are microscopic worms, usually soil borne, that feed on plants. Nematodes that feed on and damage corn have been known to occur in Iowa and other parts of the Midwest since the 1950s. But recent and upcoming changes in Iowa's cropping practices have some anticipating an increase in damage and yield loss to corn from nematodes.

Most corn nematode species maintain their populations when soybeans or alfalfa are grown, but repeated cropping of corn may cause nematode populations to flare up. Also, use of transgenic, insect-resistant corn hybrids for corn rootworm control may reduce the amount of soil-applied insecticide used in the state, and some have speculated that these insecticides may have provided some suppression of plant-parasitic nematode populations in the past. So reduction in use of soil insecticides may lead to increases in corn nematode population densities.

In addition to the many nematode species that have been known to parasitize corn for decades, a new species of cyst nematode feeding on and damaging corn was discovered in 2006 in Tennessee. This nematode could possibly pose a new threat to corn production.

The potential for corn yield loss caused by nematode feeding has largely been ignored in the past 20 years. The recent, increased concern about corn nematodes represents both a renewed interest in some old foes and concern about a possible new nemesis.

## Biology of corn nematodes

There are many species of plant-parasitic nematodes that feed on corn. Most are found anywhere that corn is grown. Nearly all corn nematode species likely are native to the United States and likely fed upon native grasses before corn was cultivated. The common and scientific names of the most frequently found genera of corn nematodes are listed in Table 1. The lesion and needle nematodes are the most common species found damaging corn in Iowa.

**Table 1.** Plant-parasitic nematodes commonly known to feed upon corn in Iowa.

| Common name | Scientific name |
|---|---|
| dagger nematode | *Xiphinema* |
| lance nematode | *Hoplolaimus* |
| lesion nematode | *Pratylenchus* |
| needle nematode | *Longidorus* |
| spiral nematode | *Helicotylenchus* |
| sting nematode | *Belonolaimus* |
| stunt nematode | *Tylenchorhynchus* |

Most corn nematodes feed from the outside of the roots, only inserting their stylet (figure 1) into the roots to feed. These nematodes are called ectoparasites. In contrast, the lance and the lesion nematodes enter the corn root tissue and feed within the roots; they are considered endoparasites. The feeding by the ecto- and endoparasitic nematodes stunts and wounds the corn roots, resulting in a decrease in the overall health and productivity of the corn crop.

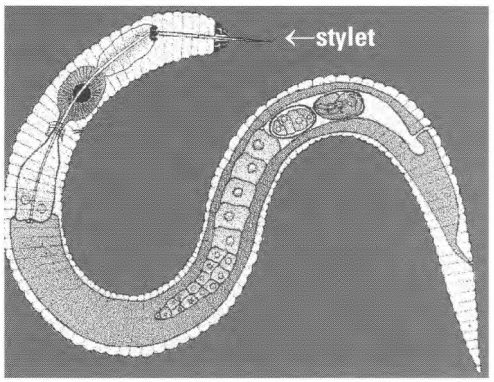


**Figure 1.** Diagram of a typical plant-parasitic nematode. The pointed mouth spear, or stylet, in the anterior end of the worm is characteristic of plant-parasitic nematodes. (from USDA)

In general, it takes four or more weeks for a nematode to complete its life cycle on corn, and for many species, several generations will occur in a growing season on corn. The nematodes that commonly parasitize corn in Iowa generally produce a few dozen eggs per female.

## Symptoms and scouting

There are a variety of above- and below-ground symptoms that corn exhibits when damaged by plant-parasitic nematodes. Common above-ground symptoms include thin stands, uneven plant height, stunted plants, uneven tasseling, leaf yellowing, and small ears and kernels. Swollen roots, lack of fine roots and root branching, and necrotic lesions are common symptoms of nematode feeding on roots. These symptoms are not unique and, thus, cannot be used to definitively diagnose nematode damage.

The only way to accurately determine if plant-parasitic nematodes are damaging corn is to collect a soil and root sample and have it tested. Several points should be considered when collecting a sample for diagnosis of a corn nematode problem.

- Soil and root samples should be collected during the middle of the growing season to determine if the detected nematode populations are present at densities large enough to cause the damage that is being observed.
- Collect numerous (20 or more) soil cores, 8 to 12 inches deep, from the root zone of plants exhibiting a range of symptoms (not just from the most severely affected plants).
- Collect two or three corn root systems from damaged, but not dead, plants.

- If possible, collect a separate soil and root sample from nearby healthy-looking plants. (The number of nematodes recovered from this soil and root sample serves as a good baseline to assess the damage potential of the nematode numbers recovered from the area of the field showing symptoms.)

Once the nematodes are extracted from the soil and roots, identified, and counted, various pieces of information will be considered in determining whether or not the nematodes present in the sample are partially or primarily responsible for the damage observed in the corn crop.

Collecting a good sample and providing pertinent and complete background information about the circumstances in the field are critical steps in making an accurate assessment of the potential for damage. Information about the field history, soil type, and rainfall can be instrumental in making an accurate judgment as to whether the numbers of nematodes recovered from the sample are sufficient to cause damage to corn.

But determining whether corn nematodes are responsible for damaging a corn crop is ultimately based on whether the population densities of the various nematode species recovered from a soil and root sample are high enough to cause the observed damage. Damage thresholds for corn nematodes vary tremendously among different nematode species. For example, only 1 needle nematode per 100 $cm^3$ (a little less than a half-cup) of soil is believed to be capable of damaging corn, but more than 1,000 spiral nematodes per 100 $cm^3$ soil are necessary to be considered damaging to corn. Unfortunately, the damage thresholds that are available for use in interpreting the results of soil samples are based on research done more than 20 years ago.

## Management options

If it is determined that the corn crop is being damaged by plant-parasitic nematodes, two management strategies are available: nonhost crops and soil-applied nematicides. Neither of these management options can be used to offset or stop damage to the current corn crop, but both may be useful in reducing the potential for damage to future corn crops.

If the corn crop is being damaged by needle nematode, certain species of lesion nematode, or a combination of both nematodes, growing the nonhost crops alfalfa and soybean in the field will reduce nematode population densities and, thus, the potential for damage to future corn crops. Even one or two years of growing these nonhost crops may be sufficient to lower the numbers of needle and lesion nematode to below damage thresholds for corn.

There are only a few soil-applied nematicides currently labeled for use in controlling plant-parasitic nematodes on corn. Damaging population densities of plant-parasitic nematodes in corn fields may occur in discrete patches or "hot spots." Consequently, field-wide application of nematicides might not be warranted or economical. Also, research has shown that the benefits of nematicide use in controlling corn nematodes usually does not carry over to future cropping seasons. Thus, nematicide use will be a continual management option.

## New cyst nematodes species on corn

University and USDA nematologists reported in July 2007 that a new cyst nematode species was discovered on corn. Juveniles and cysts (lemon-shaped, dead females filled with eggs) were

discovered in a soil sample taken from a field of stunted corn in northwestern Tennessee (Obion County) in 2006. Results of follow-up greenhouse experiments revealed that the nematode reproduced well on many different corn hybrids, but poorly on other monocots. No dicots were found to be hosts for the nematode.

It is difficult to predict whether this new cyst nematode on corn will move into other states and eventually reach Iowa. Surveys are underway in Tennessee and southern Missouri to check for the presence of this nematode and no other infestations have been found to date. Also, it is unclear how damaging the new cyst nematode would be to corn in the Midwest. Currently, details about the nematode's basic biology – things such as the length of the nematode life cycle, number of generations per season, optimum temperature, survival in frozen soil, and ability to damage corn – are not available.

If the new cyst nematode on corn was found to occur in fields in Iowa and the Midwest, it would seriously disrupt field scouting (soil sampling) and research on the biology and management of the soybean cyst nematode (SCN) because the scouting and research is based on assessing SCN egg population densities in soil. No other cyst nematode species commonly exist in Iowa corn and soybean fields at this time, so eggs recovered from cysts extracted from Iowa soils can be safely assumed to be SCN eggs. But eggs of SCN and other cyst nematodes look similar, so determining SCN population densities would be impossible using current techniques if other cyst nematodes were present in Iowa fields. It would not be possible to distinguish SCN eggs from other cyst nematode eggs.