

# Nematodes that attack corn in iowa

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Every cornfield in Iowa contains nematodes actively feeding on plants. Nematodes that attack corn are microscopic roundworms, approximately 3/10 to 3/64 inch long, that have been present in Iowa soils since before the land was used for agriculture. A farmer cannot see them with the naked eye and must rely on laboratory analysis for the number and kinds of nematodes present.

Some nematode species spend most of their life in the soil, while others live mostly in the roots. Not all is known about what causes or prevents an increase in nematode populations. The presence of nematodes probably depends on the soil type and its properties, other soil microorganisms, cropping history, climatic factors such as temperature and rainfall, tillage practices, and the use of pesticides. Obviously, a large nematode population indicates that conditions in the present season and possibly prior seasons were favorable for nematode growth and reproduction.

During feeding, nematodes may directly harm plants or they may cause wounds through which fungi and bacteria can enter the plant and cause secondary rots. Some nematodes also transmit plant viruses. Regardless of how nematodes cause plant injury, they are an important factor in reducing corn yields.

## How To Recognize Nematodes

It is difficult to generalize about symptoms because they vary with the kind and number of nematodes present and soil environmental factors. Nematodes may be the cause of low yields despite adequate fertilization, good tillage practices, good seed, and favorable weather. Above-ground symptoms of nematodes can occur any time in the growing season and they tend to be nondescript; therefore, injury by nematodes is often blamed on weather, soil conditions, or some other cause.

Nematode damage is often related to the growing conditions of the plant. A corn plant that is stressed by poor fertility or lack of moisture cannot withstand an additional stress of nematode feeding. Plants growing with adequate moisture and fertilizer are more likely to compensate for nematode feeding by producing new roots.

Although damage can occur in any soil type, corn growing in well-drained soils is most susceptible to damage. In Iowa, these areas include most sandy soils and the well drained loess soils. In poorly drained soils, nematode populations usually increase slowly or may even decline, especially during wet years. However, when the nematode population is high, even vigorously growing plants

will eventually show symptoms of unthriftiness.

After emergence, plants are not normally killed by nematodes. Above-ground symptoms are due to nematode injury to the roots. Early season symptoms may include stunting and/or off-color leaves. In sandy soils, symptoms are often most noticeable in the spring as patches of thin stands or stunted plants (see figure 1).



figure 1

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figure 2

Symptoms later in the season include a ragged or uneven appearance of the plants in the field, lodging, general unthriftiness, and reduced yields (see figure 2). On silty, loam, or clay loam soils, damage may not be noticed until about a month before harvest, when ears are small or do not fill out properly. Thus, above-ground symptoms may be similar to damage from other factors such as fertilizer deficiency, weather, insects, or other diseases.

Root symptoms may vary as much as above-ground symptoms. Common evidence of nematode feeding on roots includes pruning, especially of the feeder roots; proliferation of fibrous roots; thickening or swelling of the smaller roots; and slight to severe discoloration (see figure 3). Discoloration often becomes more severe due to secondary bacteria and fungi entering a nematode wound and further rotting the root. Although nematodes are often responsible for reduced yields, care must be exercised to examine all potentially responsible factors.

### How To Sample for Nematodes

Proper diagnosis of a nematode problem must be done by someone trained in nematology. Samples may be sent to: Plant Nematologist, Room 321, Bessey Hall, Iowa State University, Ames, Iowa 50011. It is helpful to include either a "Plant Nematode Submission Form" that may be obtained at a county extension office or as much information about the field as possible. Such information

should include past cropping history, pesticides used, soil type(s), site description, and distribution of symptoms in planting. A fee is charged per sample. Besides Iowa State University, there are private nematode diagnostic laboratories in Illinois, Minnesota, and Nebraska.

Either a soil probe or a spade may be used to take the sample. The best time to take samples is when symptoms are occurring or in mid-to-late summer, when nematode populations are normally highest. Sample the soil from at least 10 plants in the affected area. Be sure to include as much of the fibrous root system as possible from each plant. Make a composite sample of at least three-fourths a quart of soil and roots. Take a similar sample from an unaffected area. This sample will be used as a comparison to the affected area by the diagnosing laboratory.

Place the samples in a moisture-proof bag. Keep the bags in a cool place such as an ice chest, air-conditioned automobile, or refrigerator until they are sent to the laboratory. However, do not freeze them. Do not keep samples in the sun or an automobile trunk. Overheating will kill the nematodes and make the sample worthless. The nematodes must be alive when they reach the laboratory in order to extract them from the roots.

Ship the sample early in the week so it is not delayed in a post office over the weekend. Approximately seven days are required to process a sample.



figure 3

### Types of Nematodes

When a soil sample is submitted to a laboratory, an analysis report form is returned. The following information will help you interpret the results and understand the different nematodes mentioned on the form.

Several kinds of nematodes attack corn. These are divided into two large groups - ectoparasites and endoparasites. Ectoparasites are nematodes that live mostly in the soil but may penetrate a short distance into a root (see figure 4). Endoparasites are nematodes that penetrate completely into a root and spend most of their life there, but they are also found in soil (see figure 5). Some species are not common but can cause damage in individual fields under certain conditions. Other kinds of nematodes are present in small numbers in the soil of almost every field and probably cause little damage.

Twenty-eight species of plant parasitic nematodes are known to be associated with corn in Iowa. However, pathogenicity to corn has been demonstrated by only a few.

Endoparasites cause the most widespread damage to corn in Iowa. The most important of these are called lesion nematodes. There are several other common nematodes that only partly invade the root, causing some damage but also creating entrance wounds for root rotting organisms. Further research probably will include



figure 4

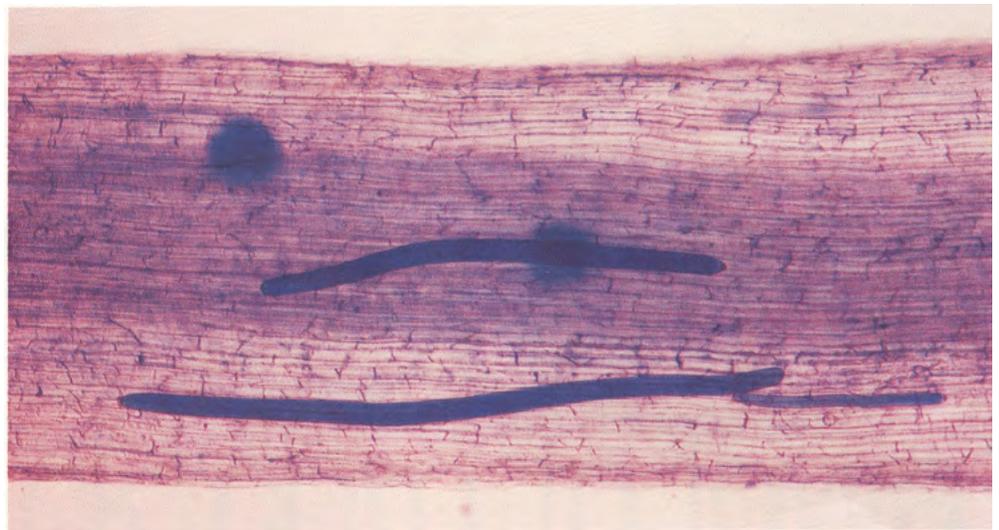


figure 5

new species associated with corn and their relationship to other nematodes or other soil microorganisms.

The complex interactions of biological, physical, and chemical factors existing in a cornfield cause estimates of nematode injury to be inexact. The following are our best judgements of damage based on existing knowledge. These interpretations may be added to and modified as more research is done. Remember, there usually are several species in every field and their effects on the plant may or may not be additive. Because injury will vary with environmental conditions, no single injury threshold figure can be given for all conditions or nematode species.

#### **Ectoparasites**

Numbers of ectoparasite nematodes referred to in the text are those per 100 cubic centimeters of soil, or about one fifth of a pint.

#### **Dagger nematodes (*Xiphinema* spp.).**

The dagger nematode is widespread. It is comparatively large for a plant parasitic nematode and is capable of penetrating deep into the fibrous roots. The largest numbers, between 300 to 500, have always been found in sandy soils. In heavier textured soils, moderate numbers of 100 to 200 have been reached but are usually less than 50. Any number over 300 to 400 is suspected to be causing damage.

#### **Pin nematodes (*Gracilacus* spp.**

*Paratylenchus* spp.). The occurrence of pin nematodes is sporadic throughout the state but they are more common in western Iowa. They are small nematodes that probably are not important by themselves, but they may contribute to losses by other nematodes. More research on these nematodes is needed.

#### **Needle nematodes (*Longidorus* spp.).**

These nematodes are probably the most devastating nematodes to corn in Iowa. However, their occurrence is highly localized, restricted largely to highly sandy soils. Needle nematodes have been found in Benton, Black Hawk, Boone, Des Moines, Lee, Louisa, and Muscatine counties in Iowa.

#### **Sheath nematodes (*Hemicycliophora* spp.).**

This nematode has been found associated with corn only in Muscatine County. Damage is unknown.

#### **Spiral nematodes (*Helicotylenchus* spp.).**

The main species of the spiral nematode, *Helicotylenchus pseudorobustus*, is one of the most common plant parasitic nematodes in Iowa. It is especially common in heavier soils and less so in sandy soils. It is moderately pathogenic to corn in greenhouse tests. Several varieties of corn and soybeans are good hosts. No varieties are highly resistant, but differences in susceptibilities occur.

Some large populations have been found in Buchanan, Black Hawk, Floyd, Plymouth, Louisa, Mahaska, Union, and Guthrie counties. More than 100 nematodes are considered high enough to be harmful and are frequently associated with stunted corn. Fewer than 100 is a low population of nematodes that are probably of minor importance.

#### **Stunt nematodes (*Quinisulcius* spp., *Tylenchorhynchus* spp.).**

These are common throughout the state. Stunt nematodes are generally considered to be mild pathogens but experimental data are lacking for the species that occur in Iowa. Populations up to 100 have been obtained. This number is suspected to be a high enough population to cause injury, but more study is needed.

#### **Ring nematodes (*Criconemoides* spp.**

and related genera). These nematodes are common in sandy soils throughout the state. The most common species of ring nematode is moderately pathogenic in greenhouse tests. The highest population obtained from a cornfield in Iowa has been 660. Populations less than 100 are probably not important but more research is needed.

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### Endoparasites

Numbers of endoparasitic nematodes referred to in the text are per gram of dry root.

**Lance nematodes (*Hoplolaimus galeatus*).** This stout, fairly large nematode occurs in many different soils in all parts of the state. The largest numbers usually are found in corn growing in sandy soils. Populations of about 2,500 have been found in Boone and Des Moines counties. Populations between 300 and 400 cause damage in field tests.

**Lesion nematodes (*Pratylenchus* spp.).** These are probably the most important nematodes attacking corn. Six species feed on corn in Iowa. While only one species, *Pratylenchus hexincisus*, has been proven to be pathogenic to corn, the other species have similar feeding habits and are also probably good pathogens.

Lesion nematodes occur in all fields and sometimes reach enormous numbers of 10,000 to 84,000. Counts of 10,000 and above can be common in all parts of the state in mid-to-late summer. Data from field experiments indicates that a population of 1,000 is the injury threshold under the experimental conditions used in tests. However, the injury threshold number may vary considerably with the soil,

climate, cultivar, and cultural practices. Nematode populations of 1,000-3,000 may be marginal, causing little injury. Economics of any treatment should be investigated,

**Stem nematodes (*Ditylenchus* spp.).** Many species of stem nematodes are found in soil. Many feed on soil fungi and are largely ignored. However, a few species that live inside plants are known as stem-and-bulb nematodes and constitute some of our most serious plant pathogens. A population of 2,000 was obtained from corn roots in Webster County and lesser populations from corn in Sioux County. These occurrences are of interest because a species of stem nematode causes serious damage to corn in Europe.

**Stubby root nematode (*Paratrichodorus* sp.).** This nematode occurs in sandy soils and is a serious pathogen to crops in the southern states. In Iowa, it has been associated with corn in sandy soils in Boone, Lee, and Louisa counties.

### How To Control Nematodes

Nematode control usually involves taking precautions for future crops because nematodes usually are discovered during the growing season and control practices generally are not effective for the present crop. Some

practices that may aid in nematode control are:

1. Fertilize according to soil tests. Plants suffering from nutrient deficiency are more susceptible to injury.
2. Maintain good weed control. Weeds are hosts for many nematodes and may serve as reservoirs for the present or next year's crop.
3. Rotate perennial nematode trouble spots to a crop other than corn. Unfortunately, most nematodes that attack corn also attack soybeans.
4. Use chemical control. The present nematicides cleared for control of nematodes in Iowa on corn are carbofuran, ethoprop, fensulfothion (restricted use registry, spray concentrate), and terbufos. In marginal situations, use test strips to evaluate economics of treatments. Some compounds may be applied either as a band or in the furrow, while others are recommended only for one kind of application.

Read and carefully follow the directions on the label. Consult your local extension office or chemical dealer for the latest rates and methods of application. Check with your local extension office for the latest state recommendations.