

FIELD CROPS NEMATODES

Plant-parasitic nematodes are microscopic roundworms that must have living host tissue to feed upon in order to grow and reproduce. Every cultivated plant species has at least one nematode reported to parasitize it. In turn, most agricultural sites are infested with at least one species of plant-parasitic nematode.

About 95% of plant-parasitic nematodes live in the soil and feed in or on roots. Some invade leaf and stem tissue. Plant-parasitic nematodes feed by inserting a needlelike structure, a stylet, into plant cells. This feeding interferes with a plant's ability to function properly. In the case of root-feeding nematodes, infected plants often wilt and appear to suffer from a lack of water or nutrients because their roots are damaged and don't function properly. These symptoms are often mistaken as damage caused by other factors. High nematode population densities can result in plant stunting, yellowing, poor plant health and yield loss. In the presence of other organisms, plant death can occur because nematode feeding sites often act as points of entry for invasion by other plant pathogens such as bacteria and fungi. Some nematodes even carry plant viruses.

Plant-parasitic nematodes typically complete their life cycles in 30-60 days. However, some adults may survive for a year or two. The life cycle of a plant-feeding nematode generally consists of an egg, four juvenile stages and an adult. Female nematodes produce eggs that hatch into young nematodes called juveniles. The juveniles often resemble small adults. First and second-stage juveniles are usually found within eggs. In the case of most plant-parasitic nematodes, the second-stage juvenile (designated J₂) hatches from the egg. A typical nematode molts four times before becoming an adult (similar to insects, nematodes must shed their skin to grow). If females and males are both present, they mate and produce eggs. Females can produce from as many as a few to 500 or more eggs depending on the species.

Because plant-parasitic nematodes are microscopic, samples must be collected and submitted to a Diagnostic Lab for analyses. To avoid or remedy nematode problems, this should be done on a regular basis. To best assess population densities of nematodes, plant tissues and soil should be collected. For more information on the collection and handling of nematode samples consult MSU Extension Bulletin E-2199, "Detecting and Avoiding Nematode Problems."

Additional information on nematodes can be found by obtaining other MSU Extension Bulletins or consulting the Diagnostic Services website, www.pestid.msu.edu. For specific questions, contact Diagnostic Services at MSU.

ALFALFA NEMATODES

Lesion nematodes (*Pratylenchus sp.*)

Status: Very common (found in >75% of samples)

Parasitic habit: Found within plant roots and in soil. Migrate throughout roots while feeding.

Symptoms: Reductions in root volumes and weights. Stunting and reduced yields. Poor cold hardiness.

Management: Use of lesion nematode-resistant alfalfa varieties.

Threshold: Unknown for MI, but population densities > 500 per sample warrant action.

Sampling information: Can be detected year round.

Northern root-knot nematodes (*Meloidogyne hapla*)

Status: Common (found in 25-75% of samples)

Parasitic habit: Found within root tissue and in soil. Remain sedentary in roots while feeding.

Symptoms: Galls on roots. Small tap roots with excessive lateral branching. Slow seedling growth. Reduced yields.

Management: Use of root-knot nematode-resistant alfalfa varieties. Rotation of one to three years with monocots.

Threshold: Unknown for MI, not believed to be a serious problem in areas with temperate climates.

Sampling information: Difficult to diagnose in the soil from Nov. through March.

Stem nematodes (*Ditylenchus dipsaci*)

Status: Rare (found in <5% of samples)

Parasitic habit: Found within buds and leaves. They migrate throughout tissues as they feed.

Symptoms: Patches of poor growth, stunted plants. Internodes are often very short. Leaves may curl and turn white. Stem blackening may occur during periods of moderate temperatures and high humidity.

Reduced yields

Management: Use of stem nematode-resistant varieties. Rotation of 2-4 years with non- or poor hosts such as bean or corn. Small grains are hosts for some populations of stem nematodes but not for others. Good weed control is critical.

Threshold: Unknown for MI. A very serious pathogen of alfalfa.

Sampling information: Very difficult to detect in soil. Leaf and stem tissue must be collected during the growing season.

DRY BEAN NEMATODES

Lesion nematodes (*Pratylenchus sp.*)

Status: Common (found in 25-75% of samples)

Parasitic habit: Found within plant roots and in soil. Migrate throughout roots when feeding.

Symptoms: Reductions in root volumes and weights. Stunting and reduced yields.

Management: Use of a non-fumigant nematicide.

Threshold: 250 per root and soil sample.

Sampling information: Can be detected year round.

Northern root-knot nematodes (*Meloidogyne hapla*)

Status: Infrequent (found in <25% of samples)

Parasitic habit: Found within root tissue and in soil. Remain sedentary within roots while feeding.

Symptoms: Galls on roots. Reduced yields.

Management: Use of a non-fumigant nematicide. Rotation of one to three years with monocots.

Threshold: Unknown for MI. Not considered as destructive as lesion nematode on dry beans.

Sampling information: Difficult to diagnose in the soil from Nov. through March.

Soybean cyst nematodes (*Heterodera glycines*)

Status: Infrequent (found in <25% of samples)

Parasitic habit: Found within roots and in soil. Remain sedentary within roots while feeding.

Symptoms: Patches of yellow, stunted plants. Reduced yields (4-6 cwt/A yield losses on navy beans have been documented in MI). Reduced root nodulation.

Management: Use of a non-fumigant nematicide. However, cyst nematodes are difficult to control with non-fumigant nematicides. Rotation to non-host crops (corn, potato, small grains and sugarbeet).

Threshold: Unknown for MI but population densities > 1000 eggs per 100 cm³ soil warrant action.

Colored beans are extremely good hosts for this nematode.

Sampling information: Can be detected year round. Females are visible to the naked eye on roots from July-Sept.

NEMATOCIDES

NAME

RATE/ACRE

APPLICATION

Temik 15G (RUP)

7.0-14.0 lbs.

Banded

FIELD CORN NEMATODES

Corn needle nematodes (*Longidorus breviannulatus*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Ectoparasite. Not found in roots, remains in soil as it feeds.

Symptoms: Root tip swelling. Patches of stunted plants often observed very early in the growing season. Severely reduced yields (50 bu/A yield losses have been documented).

Management: Rotation to non-host crops (alfalfa, potato, soybean and sugarbeet).

Threshold: 5 per 100 cm³ soil.

Sampling information: These nematodes are extremely difficult to detect in July and August. Sampling should be done in the spring or fall. They are generally confined to sandy fields (>75% sand) where corn has been produced continuously.

Dagger nematodes (*Xiphinema americanum*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Ectoparasite. Not found in roots, remains in soil as it feeds.

Symptoms: Root tip swelling. Stunting. Reduced yields.

Management: Use of a non-fumigant insecticide/nematicide. Rotation to non- or poor hosts (many annual dicots).

Threshold: Unknown for MI but this nematode is not considered very destructive on corn. Damage has been observed at population densities of 250 or more dagger nematodes.

Sampling information: This nematode also can be difficult to detect during the summer.

Lance nematodes (*Hoplolaimus galeatus*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Found within plant roots and soil. Migrate through roots while feeding.

Symptoms: Reduced root volumes and weights. Stunting and reduced yields.

Management: Use of a non-fumigant insecticide/nematicide. Rotation to non- or poor hosts (alfalfa, potato, sugarbeet).

Threshold: 100 per root and soil sample.

Sampling information: Can be detected year round.

Lesion nematodes (*Pratylenchus sp.*)

Status: Very common (found in >75% of samples).

Parasitic habit: Found within plant roots and soil. Migrate throughout roots while feeding.

Symptoms: Reductions in root volumes and weights. Stunting and reduced yields although yield losses are not usually significant.

Management: Use of a non-fumigant insecticide/nematicide.

Threshold: 250 per root and soil sample. It is not usually recommended soil insecticides be utilized solely for nematode control. However, if corn rootworm is an issue, insecticide use (carbamates or organophosphates) will provide some nematode control.

Sampling information: Can be detected year round.

Stunt nematodes (*Tylenchorrhynchus sp.*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Ectoparasite. Not found in roots, remains in soil as it feeds.

Symptoms: Stunting and reduced yields.

Management: Use of a non-fumigant insecticide/nematicide. Rotation to non- or poor hosts (alfalfa, potato, soybean, sugarbeet).

Threshold: Estimated at 500 per 100 cm³ soil.

Sampling information: Can be detected year round.

Coorn continued:

SEED TREATMENT: Avicta Complete Corn (abamectin) is available for nematode control in Michigan. Abamectin has been utilized as an effective seed treatment for control of nematodes on cotton but has not been evaluated at MSU on corn.

NEMATICIDES/INSECTICIDES

NAME	OZ/1000 FT ²	APPLICATION
Counter 15G (RUP)	6.0	In-furrow
Counter 15G (RUP)	8.0	Banded
Mocap 15G (RUP)	8.0	Banded

PASTURE NEMATODES

Lesion nematodes (*Pratylenchus sp.*)

Status: Very common (found in >75% of samples).

Parasitic habit: Found within plant roots and soil. Migrate throughout roots when feeding.

Symptoms: Reductions in root volumes and weights. Stunting.

Management: Use of lesion nematode-resistant or tolerant varieties.

Threshold: Unknown for MI. Very little information is available regarding the impact of these nematodes on grasses used in pastures. However, pastures are vulnerable at establishment especially if nematode population densities are very high.

Sampling information: Can be detected year round.

SMALL GRAINS

Cereal cyst nematodes (*Heterodera avenae*)

Status: Rare (found in <5% of samples).

Parasitic habit: Found within plant roots and soil. Remain sedentary within roots while feeding.

Symptoms: In wheat, additional roots are produced at invasion sites resulting in bushy root systems. Oat roots are shortened and thickened. Patches of stunted plants with fewer tillers. Reduced yields.

Management: Rotation for 2-4 years to non-host crops (dicots).

Threshold: Unknown for MI. Although this nematode is the most serious pathogen of wheat in some parts of the world, it is extremely limited in its distribution in MI.

Sampling information: Can be detected year round.

Lesion nematodes (*Pratylenchus sp.*)

Status: Very common (found in >75% of samples).

Parasitic habit: Found within plant roots and soil. Migrate throughout roots while feeding.

Symptoms: Reduced root volumes and weights. Stunting, yellowing and reduced yields.

Management: Use of tolerant varieties. Use of nematicides on crops where economics are justified.

Threshold: Unknown for MI. However, small grains are excellent hosts for many species of lesion nematodes. Population densities of >500 per root and soil sample should cause injury.

Sampling information: Can be detected year round.

SOYBEAN NEMATODES

Lance nematodes (*Hoplolaimus galeatus*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Found within plant roots and soil. Migrate through roots while feeding.

Symptoms: Reduced root volumes and weights. Stunting and reduced yields.

Management: Use of a non-fumigant nematicide. Rotation to non- or poor hosts (alfalfa, potato, sugarbeet).

Threshold: Unknown for MI. Reported to be 4-100 per 100 cm³ soil for *H. columbus*. Estimated at 125 per root and soil sample for *H. galeatus* in MI.

Sampling information: Can be detected year round.

Lesion nematodes (*Pratylenchus sp.*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Found within plant roots and soil. Migrate through roots while feeding.

Symptoms: Reduced root volumes and weights. Stunting and reduced yields.

Management: Use of a non-fumigant nematicide.

Threshold: Unknown for MI. Reported to be 22-100 per 100 cm³ soil in the Southern U.S. Estimated at 300 per root and soil sample in MI. May predispose SCN-resistant varieties to injury by SCN.

Sampling information: Can be detected year round.

Northern root-knot nematodes (*Meloidogyne hapla*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Found within plant roots and soil. Remain sedentary in roots while feeding.

Symptoms: Galls on roots although they are often very small. Patches of stunted, yellow plants. Reduced yields.

Management: Use of a non-fumigant nematicide. Rotation of one to three years with monocots.

Threshold: Unknown for MI. Estimated at 500 per root and soil sample.

Sampling information: Difficult to diagnose in the soil from Nov. through March.

Soybean cyst nematodes (*Heterodera glycines*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Found within plant roots and soil. Remain sedentary in roots while feeding.

Symptoms: Reduced root volumes and weights. Reduced root nodulation. Patches of stunted (often severe), yellow plants. Young plants may die. Reduced yields (80% or higher yield losses have been documented but losses are often 10-50%).

Management: Use of soybean cyst nematode resistant-soybean varieties. Use of an at-plant nematicide. However, SCN is difficult to control with non-fumigant nematicides. Rotation for 1-3 years with non- or poor host crops (alfalfa, corn, potato, red clover, small grains, sugarbeet).

Threshold: 100 eggs per 100 cm³ soil with an SCN-susceptible soybean variety. Soys grown on coarse-textured soils are more susceptible. SCN-resistant varieties should not be grown if SCN population densities exceed 10,000 eggs per 100 cm³ soil in any soils as significant yield losses (10-25%) may occur especially on sands.

Sampling information: Can be detected year round. Females are visible to the naked eye on roots from July-Sept.

NEMATOCIDES

NAME	RATE/ACRE	APPLICATION
Temik 15G (RUP)	10.0-20.0 lbs.	Banded

SUGARBEET NEMATODES

Lesion nematodes (*Pratylenchus sp.*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Found within plant roots and soil. Migrate throughout roots while feeding.

Symptoms: Reductions in root volumes and weights. Stunting and reduced yields.

Management: Use of a non-fumigant nematicide.

Threshold: Unknown for MI. These nematodes probably do not cause significant yield losses of sugarbeets in MI grown in fine-textured soils. If beets are grown in sand, population densities of >500 per root and soil sample are a concern.

Sampling information: Can be detected year round.

Northern root-knot nematodes (*Meloidogyne hapla*)

Status: Infrequent (found in <25% of samples).

Parasitic habit: Found within root tissue and soil. Remain sedentary within roots while feeding.

Symptoms: Galls on roots. Patches of yellow, stunted plants that may wilt in dry conditions. Reduced yields.

Management: Use of a non-fumigant nematicide. Rotation of one to three years with monocots.

Threshold: Unknown for MI. Population densities of >250 per root and soil sample are estimated to cause yield loss especially if beets are grown in sand. In a trial conducted in the Pacific Northwest, the northern root-knot nematode reduced the fresh root weight of sugarbeet 65%.

Sampling information: Difficult to diagnose in the soil from Nov. through March.

Pin nematodes (*Paratylenchus sp.*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Ectoparasite. Not found in roots, remains in the soil as it feeds.

Symptoms: Stunted plants and reduced yields.

Management: Use of a non-fumigant nematicide. Rotation to non- or poor host crops (alfalfa, dry beans, potato, soybean).

Threshold: Unknown for MI. Not believed to be a serious pathogen but poor growth of sugarbeets has been associated with high pin nematode population densities (>1,000 per 100 cm³ soil).

Sampling information: Can be detected year round.

Sugarbeet cyst nematodes (*Heterodera schachtii*)

Status: Common (found in 25-75% of samples).

Parasitic habit: Found within roots and soil. Remain sedentary within roots while feeding.

Symptoms: Forked or stubby taproots. Roots often have a bearded appearance due to stimulation of lateral roots. Patches of stunted plants that often wilt. Reduced yields.

Management: Use of a fumigant or non-fumigant nematicide. Use of resistant varieties. Rotation for 3-5 years to non-host crops (alfalfa, corn, potato, small grains, soybean). Use of trap crop (oil seed radish). Proper disposal of tare soil.

Threshold: 100 eggs per 100 cm³ soil. In areas where sugarbeet cyst nematodes exist, initial population densities of 1000 eggs and J_{2s} may reduce yields 1-65% depending upon soil texture and location.

Sampling information: Can be detected year round. Females are visible to the naked eye during the growing season usually beginning in June or July.

NEMATICIDES/INSECTICIDES

NAME	RATE/ACRE	APPLICATION
Telone II (RUP)	18.0 gal	Broadcast
Telone C-17 (RUP)	21.6 gal.	Broadcast
Telone C-35 (RUP)	26.0 gal.	Broadcast
Temik 15G (RUP)	27.0-33.0 lbs.	Banded
Counter 15G (RUP)	13.1 lbs.	Knifed-in

FUMIGANT NEMATOCIDES/INSECTICIDES

Trade Name	Common Name	Class	Application	PHI (days)	Remarks
Telone II (RUP)	1,3-dichloro-propene	OC1	Broadcast or in-row	120	Inject 12 inches deep in well-prepared soil. Soil temp. should be 50-80°F. Apply in the fall or at least two weeks before planting in the spring. REI=5 days.
Telone C-17 (RUP)	1,3-dichloro-propene + chloropicrin	OC1	Broadcast or in-row	120	See remarks for Telone II.
Telone C-35 (RUP)	1,3-dichloro-propene + chloropicrin	OC1	Broadcast or in-row	120	See remarks for Telone II.

NON-FUMIGANT NEMATOCIDES/INSECTICIDES

Trade Name	Common Name	Class	Application	PHI (days)	Remarks
Counter 15G (RUP)	terbufos	OP	Banded, in-furrow or knifed-in		If banded on corn, apply in a 7-inch band over the row in front or behind the press wheel, incorporate lightly. In furrow, place granules in the furrow behind the planter shoe. If knifed-in, drill granules 2 inches to the side of the seed and 2-4 inches below the seed. REI=2 days
Mocap 15G (RUP)	ethoprop	OP	Banded	90	Apply in a 6-7 inch band on the row over a closed seed furrow at planting. Mix the granules with the top ½ inch of soil with drag chains, spring-tooth incorporators, or similar equipment. REI=2 days
Temik 15G (RUP)	aldicarb	Carb	Banded	90	Apply granules in a band (band width depends on crop, read label) and work into the soil to a depth of 2-4 inches. Plant in treated zone. On sugarbeets, an at-plant plus post-emergence application can be made. REI=2 days