



Diagnosis and Control of Nematode Problems of Turfgrass

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Plant parasitic nematodes are microscopic worms that usually feed on the roots of plants. In Michigan, they can be severe pests of turfgrasses. Above-ground symptoms of nematode-infected turf include yellowing of leaves, dieback and breakdown of young foliage and a tendency to wilt during periods of high temperature and low moisture. Grass cover generally becomes thin and growth during the summer months is poor. Severely affected areas may become bare and in turn infested by weedy grasses and broadleaf weeds. In addition to causing direct damage to root systems, feeding by some plant parasitic nematodes increases susceptibility of certain turfgrasses to diseases caused by other organisms.

Some nematodes live and feed within the roots of turfgrasses. Others live in the soil and feed on the root surface. Both types migrate through the soil from root to root and can be moved longer distances in sod, irrigation water or in soil on mechanical equipment.

Stunt, stubby-root, root-knot and cyst nematodes are the four most important nematode pests of Michigan turfgrasses. High population densities of the stunt nematode appear to be very commonly associated with Michigan turfgrasses. Spiral, ring and sheath nematodes are also frequently recovered in high numbers from Michigan turfgrasses; however, their overall influence on plant growth and development is unknown.

In Michigan, typical symptoms of Fusarium Blight of Merion Kentucky Bluegrass frequently occur only in the presence of both stunt nematodes and the fungi *Fusarium roseum* and *F. tricinctum*. The stunt nematode increases susceptibility to the fungi and appears to be the predisposing agent for this disease complex.

Detection

Because nematodes are microscopic and the damage they cause is very similar to that resulting from other factors, a laboratory analysis of soil and root tissue is usually necessary for diagnosis of plant-parasitic nematode problems. In Michigan, this service is provided by the Michigan State University Nematode Diagnostic Service Laboratory, which is operated under the direction of the Michigan Cooperative Extension Service. Soil and root samples can be taken, submitted

and reliably processed whenever the soil is not frozen. For the best possible results, however, samples should not be taken until 60 days after the initiation of annual root growth and not after the first frost.

Take turf samples with a soil sampling tube, trowel, or narrow-bladed shovel. The soil should be taken at a 1- to 5-inch depth, and contain as many feeder roots as possible. Each sample should consist of a pint to a quart of soil taken from a larger sample composed of 10 or more subsamples. The number of subsamples (soil cores or borings) needed depends on the size of the area being investigated.

1. *Small area* (less than 5,000 sq. ft.), take at least 10 subsamples.
2. *Medium area* (5,000 sq. ft. to 1 acre), take at least 25 subsamples.
3. *Large area* (1 to 5 acres), take at least 50 subsamples. No one sample should represent more than 5 acres, and each sample should be from an area of a uniform soil type.

Mix the subsamples in a clean pail or a plastic bag and submit one pint to a quart for nematode analysis. Plant parasitic nematodes feed only on living tissues and are rarely found in dead roots. Soil and root samples, therefore, should be taken from the margin of the problem area where the turfgrass is still living.

Use either the special nematode sample container provided by the Extension Service or a plastic bag. Place all samples in plastic bags as soon as possible. Nematodes will be killed if the sample is allowed to dry, and it is important that nematodes are living when the sample arrives at the laboratory.

Soil and root samples are perishable. Handle accordingly, and process as quickly as possible. Ideally, they should be stored at 10-15°C (50-58°F). Samples should not be exposed to direct sunlight or stored in trunks of automobiles. Temperatures greater than 40°C (100°F) will kill nematodes.

Submit all samples through the local extension office, accompanied by a completed form. The information requested on the form is essential for diagnosis of nematode problems and proper recommendations for nematode population management. It generally takes two weeks from the time a sample is taken until the results are returned to the grower by the local extension agent. The rapid root and soil assays used for mineral soils, however, are not always satisfactory for analysis of organic soils. In a few cases, a bioassay that requires

a 45-day incubation period is used for analysis of organic soils. When this is recommended, the grower will be notified immediately of the delay and will receive the results within two months after the sample was taken.

All results and recommendations will be returned to the grower by the local extension agent. The types and numbers of nematodes will be recorded on the assay form, along with an indication of whether or not nematodes are a problem. If nematodes appear to be a problem, a recommendation will be made, which can be discussed in detail with the local extension agent.

The best way to analyze the success of nematode population management is to submit a post-treatment sample for nematode analysis. These samples should be taken four to six weeks after treatment. Special post-treatment assay forms can be obtained from the local extension office. It is important that the forms be completed so the post-treatment results can be compared with those of the original sample.

Sod farm acreage should be sampled for nematodes before seeding. Pre-plant nematode samples are also important when high quality turfs or lawns are desired. In the production of sod, commercial turfs or private

lawns, it is much easier to prevent the occurrence of nematode problems than to rid them once present.

Additional information about diagnosis and control of nematode problems of turfgrass can be obtained by requesting MSU Cooperative Extension Service Bulletin E-800, "Nematode Detection," E-701, "The Hidden Enemy: Nematodes and Their Control," and E-903, "Lawn Pest Control," MSU Bulletin Office, P.O. Box 231, East Lansing, MI 48824.

Sod Farm

Pre-seeding Treatment — If a site is infested with a detrimental plant parasitic nematode, treat with an appropriate soil fumigant or nematicide before seeding. This type of nematode control is generally more satisfactory than treatment at or after seeding. Pre-plant soil fumigants such as DBCP (Nemagon, Fumazone), 1,3-D (D-D, Telone II, or 1,3-D plus chloropicrin (D-D-Pic, Telone C, Ter-o-cide-D) are all suitable for nematode control (Table 1). The amount of chemical required in organic soil is usually approximately twice that needed for mineral soil. Inject soil fumigants to a depth of 6-8 inches, and apply at least

TABLE 1. SOD FARM NEMATODE CONTROL RECOMMENDATIONS

Nematicide	Rate/Acre	Limitations and Directions
<i>BEFORE SEEDING</i>		
DBCP (1,2 dibromo-3-chloropropane) Nemagon Fumazone	3-7 gal.	Apply as preplant at least 14 days before seeding. Aerate soil before seeding. Space chisels 12 in. apart and inject to a 5 to 10 in. soil depth. Apply when soil temperature is between 50 and 80°F. Can be applied as a drench.
1,3-D D-D Telone II	9-25 gal. (Mineral soils) 24-60 gal. (Muck soils)	Apply as preplant broadcast at least 21 days before seeding. Aerate soil before seeding. Space chisels 12 in. apart and inject at a depth of 5 to 10 in. Apply when soil temperature is between 50 and 80°F.
1,3-D plus chloropicrin Telone C Terr-o-cide D-D/Pic	9-25 gal. (Mineral soils) 24-60 gal. (Muck soils)	Same as 1,3-D
<i>ESTABLISHED SOD</i>		
DBCP Fumazone Nemagon	5 gal.	Mix 12-15 oz. of DBCP with 150 to 200 gal. of water and apply as a drench over 1,000 sq. ft. of sod. Water immediately after drench to insure good penetration of chemical. (for professional application only).
Fensulfothion Dasanit 15C	70-130 lb.	Distribute granules evenly over area of sod to be treated. Drench with ½ to 1 inch of water immediately after application. Do not treat newly seeded areas. Do not treat sod that will be cut or handled within 60 days after treatment. (for professional application only)
Phenamophos Nemacur 15C	70-130 lb.	Distribute granules evenly over area of sod to be treated. Drench with ½ to 1 inch of water immediately after application. Do not treat newly seeded areas. Do not apply more than twice a year. Do not treat sod that will be cut or handled within 60 days after treatment. (for professional application only)

21 days before planting. The soil temperature should be between 50 and 80 F. Prior to seeding, work soil to release the fumigant.

Treatment of Established Sod — DBCP (Nemagon, Fumazone) is the only soil fumigant that can be used for nematode control in established sod (Table 1). To insure good penetration of the chemical, apply as a drench.

The granular nematicides Fensulfothion (Dasanit) and Phenamophos (Nemacur) can be used to control nematodes in established sod (Table 1). They must be uniformly distributed over the area to be treated and drenched immediately after application, using ½ to 1 inch of water. Do not harvest the sod for at least 60 days after application. Fensulfothion and Phenamophos are for professional application only.

Commercial Turf

Sites to be used for the establishment of high quality commercial turfs should be sampled for nematodes before seeding or sodding. If sod is to be used, obtain a high quality product grown in nematode-free, nematicide-treated or fumigated soil. This precaution, however, will be of little value unless the soil where the

sod is to be used is nematode-free, nematicide-treated or fumigated.

Pre-plant Treatment — If a site is infested with a detrimental plant parasitic nematode, treat pre-plant with an appropriate soil fumigant or nematicide. This type of control is generally more satisfactory than treatment at or after seeding or sodding.

Pre-plant soil fumigants such as DBCP (Fumazone, Nemagon), 1,3-D (D-D, Telone II), or 1,3-D plus chloropicrin (D-D-Pic, Telone C, Ter-0-cide-D) are all suitable for nematode control in future commercial turf sites (Table 2). Inject to a soil depth of 6-8 inches, and apply at least 21 days before seeding or sodding. The soil temperature should be between 50 and 80 F. Prior to seeding or sodding, work the soil to release the fumigant.

Treatment of Established Commercial Turfs — DBCP (Fumazone, Nemagon) is the only soil fumigant that can be used for nematode control in established commercial turfs (Table 2). To insure good penetration of the chemical, apply as a drench.

The granular nematicides Fensulfothion (Dasanit) and Phenamophos (Nemacur) can be used to control nematodes in many established commercial turfs (Table

TABLE 2. COMMERCIAL TURF SITE NEMATODE CONTROL

Nematicide	Rate/Acre	Limitations and Directions
<i>BEFORE SEEDING OR SODDING</i>		
DBCP		Apply as preplant broadcast at least 14 days before seeding or sodding. Aerate before seeding or sodding. Space chisels 12 in. apart and inject to 5 to 10 in. soil depth when soil temperature is between 50 and 80 F. Can be applied as a drench.
Nemagon Fumazone	3-7 gal.	
1,3-D		Apply as a preplant broadcast at least 21 days before seeding or sodding. Aerate soil before seeding or sodding. Space chisels 12 in. apart and inject to a 5 to 10 in. soil depth when soil temperature is between 50 and 80 F.
D-D Telone II	9-25 gal. (Mineral soils) 24-60 gal. (Muck soils)	
1,3-D plus chloropicrin		Same as 1,3-D
Telone C Terr-o-cide D D-D/Pic	9-25 gal. (Mineral soils) 24-60 gal. (Muck soils)	
<i>ESTABLISHED TURFGRASS</i>		
DBCP	5 gal.	Mix 12-15 oz. of DBCP with 150-200 gal. of water and apply as a drench over 1,000 sq. ft. of turfgrass. Water immediately after drench to insure good protection. (for professional application only)
Fumazone Nemagon		
Fensulfothion Dasanit 15G	70-130 lb.	Distribute granules evenly over area of sod to be treated. Drench with ½ to 1 inch of water immediately after application. Do not treat newly seeded areas. Do not treat sod that will be cut or handled within 60 days after treatment. (for professional application only)
Phenamophos Nemacur 15G	70-130 lb.	

2). They are for professional application only, and may not be suitable for use in certain situations, such as football fields and playgrounds. These materials must be uniformly distributed over the turf and drenched immediately after application, using 1/2 to 1 inch of water.

Home Lawn

Sites to be used for the establishment of very high quality home lawns may be sampled for nematodes before seeding or sodding. If sod is to be used, obtain a high quality product grown in nematode-free, nematicide-treated, or fumigated soil. Again, the soil where the sod is to be used must be nematode-free, nematicide-treated or fumigated.

Pre-plant Treatment — If a site is infested with a detrimental plant parasitic nematode, treat pre-plant

with an appropriate soil fumigant. This type of control is generally more satisfactory than treatment at or after seeding or sodding.

Pre-plant treatment with soil fumigants such as DBCP (Nemagon, Fumazone) or 1,3-D (D-D, Telone II) can be used for nematode control (Table 3). The chemicals should be injected by a professional applicator to a soil depth of 6-8 inches. Apply the chemical when the soil temperature is between 50 and 80 F, and at least 21 days before seeding or sodding. Prior to planting, work the soil to release the fumigant.

Treatment of Established Home Lawns — DBCP (Nemagon, Fumazone) is the only compound recommended for nematode control in established home lawns (Table 1). It must be applied by a professional applicator, and to insure good chemical penetration, it should be used as a drench.

TABLE 3. HOME LAWN NEMATODE CONTROL RECOMMENDATIONS

Soil Fumigant	Rate/Acre	Limitations and Directions
<i>BEFORE SEEDING OR SODDING</i>		
1,3-D		Apply as a preplant broadcast at least 21 days before seeding or sodding. Aerate before seeding or sodding. Space chisels 12 in. apart and inject to a depth of 5 to 10 in. Apply when soil temperature is between 50 and 80°F. (must be applied by a professional applicator)
D-D	9-25 gal.	
Telone II		
DBCP		Apply as a preplant broadcast at least 14 days before seeding or sodding. Aerate soil before seeding or sodding. Space chisels 12 in. apart and inject to a depth of 5 to 10 in. Apply when soil temperature is between 50 and 80°F. (must be applied by a professional applicator)
Fumazone	3-7 gal.	
Nemagon		
<i>ESTABLISHED TURFGRASS</i>		
DBCP		Mix 12-15 oz. of DBCP with 150 to 200 gal. of water and apply as a drench over 1,000 sq. ft. of sod. Water immediately after drench to insure good penetration of chemical. (must be applied by a professional applicator).
Fumazone Nemagon	5 gal.	