PLANT AND SOIL NEMATODES

DIAGNOSIS OF DISEASE PROBLEMS IN TURFGRASS CAUSED BY PLANT-PARASITIC NEMATODES

A wide range of plant-parasitic nematodes feed on the roots of turfgrass and damage the root system. In some situations, the damage is severe enough to produce symptoms that are be visible aboveground, but this is most likely to occur when the weather is hot and dry, or the grass is stressed for water and nutrients. This fact sheet describes the symptoms nematodes produce on turfgrass, compares the pathogenicity of various nematodes, and explains how to diagnose a potential nematode problem. Details of the management practices which can be used to reduce the damage caused by plant-parasitic nematodes can be found in another fact sheet (PSN 021).

Plant-parasitic nematodes on turfgrass in Australia

Plant-parasitic nematodes have a stylet or mouth-spear that is similar in structure and function to a hypodermic needle. It is used to ingest nutrients from roots. As root tissue is damaged during the feeding process, symptoms such as stunting, swelling and discoloration will appear on roots and root tips.

The stylet of a plant-parasitic nematode (left) and symptoms produced on roots (middle and right)

Couch, hybrid couch, kikuyu, buffalo, bent, fescue, and rye are the most widely grown turf grasses in Australia and more than twenty different plant-parasitic nematodes have been recorded on these grasses. Some of these nematodes are rarely seen on turf and others are not known to cause damage, and so only the most important are considered here. They are listed below by feeding group, common name, and genus.

Sedentary endoparasites: Root-knot (*Meloidogyne*); Cyst (*Heterodera*)
Migratory endoparasites: Lesion (*Pratylenchus*); Lance (*Hoplolaimus*)
Ectoparasites: Sting (*Ibipora*); Needle (*Longidorus*, *Paralongidorus*); Awl (*Dolichodorus*); Dagger (*Xiphinema*); Stubby (*Paratrichodorus*); Sheath (*Hemicycliophora*); Spiral (*Helicotylenchus, Rotylenchus*); Sheathoid (*Hemicriconemoides*), Stunt (*Tylenchorhynchus*) and Ring (*Mesocriconema*, *Ogma*).

Pathogenicity of various plant-parasitic nematodes

Although all the above nematodes feed on the roots of turfgrass, their pathogenicity varies markedly. One way to visualise this is to rate the capacity of each nematode to cause damage on a 1-10 scale, where 10 indicates that the nematode causes severe damage at very low population densities and 1 indicates that little damage is observed, even when very high numbers of the nematode are present. Such a rating scheme is given below. It shows that sting nematode is by far the most damaging nematode pest of turfgrasses in Australia, and that most of the other nematodes cause low to moderate levels of damage.

- Sting: 10
- Root-knot, Cyst, Lance, Awl, Needle, Dagger, Stubby: 5
- Lesion, Stunt, Sheath, Ring, Sheathoid: 3
- Spiral: 1

Nematode diagnosis

The only way to determine whether plant-parasitic nematodes are present at levels that may be causing damage is to collect a sample of soil and roots and forward it to a nematology laboratory. Whenever such a sample is being collected, the most important requirement is to ensure that it is representative of the area of interest. Nematodes tend to be aggregated in their distribution, and so at least 15 cores 10-20 mm in diameter should be collected from randomly selected points in the sampling area to a depth of about 10 cm. If the turf is healthy in some areas and unthrifty in others, samples should be collected from both areas. Once collected, samples should be placed in zip lock plastic bags and forwarded by overnight express to the diagnostic laboratory. As nematodes are vulnerable to excessive heat, samples should always be kept out of the sun and should never be left in a closed vehicle.

Damage thresholds for various nematodes

Damage thresholds indicate the nematode population density required to cause damage. If the number of nematodes recovered from a sample is greater than the damage threshold, some damage would be expected. However, it is important to recognise that the damage thresholds used in the turf industry can be quite variable, as is apparent from the thresholds used in two states in the USA (see the table below). Results from field trials are sometimes used to establish threshold levels, while in other cases they are based on the personal experience of a nematologist or consultant. Damage thresholds will also vary with the source providing the information, and factors such as climate and turfgrass species.

Damage thresholds for plant-parasitic nematodes on selected turf grasses in the USA

Common name	Genus	No. nematodes extracted/200 mL soil				
		Cool-season grasses		Warm-season grasses		
		Bent grass	Tall fescue	Bermudagrass		St. Augustine
				New Jersey	Florida	
Awl	*Dolichodorus*	300	100	20	20	20
Cyst	*Heterodera*	-	-	-		-
Dagger	*Xiphinema*	400	300	600		400
Lance	*Hoplolaimus*	300	200	80	80	80
Lesion	*Pratylenchus*	300	300	300		300
Needle	*Paralongidorus*	-	-	-		-
Pin	*Paratylenchus*	-	260	-		-
Reniform	*Rotylenchulus*	-	-	-		-
Ring	*Criconemella*	3000	300	2000	1000	1000
Root-knot	*Meloidogyne*	200	4000	600	160	160
Sheath	*Hemicycliophora*	400	160	400	300	160
Spiral	*Helicotylenchus*	1200	2000	2000	1400	2000
Sting	*Belonolaimus*	40	24	20	20	-
Stubby root	*Paratrichodorus*	200	300	200	300	80
Stunt	*Tylenchorhynchus*	600	200	200		400

Data in the table were obtained from Buckley et al. (2010) and Crow (2014). Nematode numbers are from 200 mL soil, as this is the volume normally processed in Australia. Thresholds for Bermudagrass are those used in two different states. St. Augustine grass is referred to as Buffalo grass in Australia.

Since no research on damage thresholds has been done in Australia, laboratories providing diagnostic services have no option but to use thresholds obtained from overseas literature. However, this is problematic because the dominant species in a particular genus sometimes differs between locations. Also, the sting nematode in Australia is *Ibipora*, and its damage threshold is not necessarily the same as *Belonolaimus*, the sting nematode that is widespread on turf in the south-eastern states of the USA.

Another factor that makes it difficult to determine whether a nematode count is above or below the damage threshold is the efficiency of the extraction process. Nematodes can be extracted from soil in many ways, and some methods are better than others. For example, when a slow-moving nematode such as ring nematode is present, a much higher count will be obtained using a centrifugal flotation method than with a method that relies on motility. Also, laboratories may use the same extraction method in slightly

different ways, and this may affect extraction efficiency. Thus, the extraction method and its efficiency should always be considered when nematode counts are being assessed.

Impact of environmental, management, and other factors on the level of damage caused by nematodes

Damage thresholds are a useful guide to whether nematodes are likely to be causing root damage. However, when used to make management decisions, they cannot be viewed in isolation from the many other factors that influence turf growth. For example, a golf green with high numbers of a damaging nematode may continue to thrive when it is well managed, whereas its nematode-damaged root system may be unable to cope when the turf is under stress. Stresses that may affect the plant's response to the presence of plant-parasitic nematodes include inadequate nutrition, low mowing heights, high summer temperatures and inadequate moisture.

Root pathogens are another stress factor that should be considered when decisions are being made on whether nematodes are causing damage. Some bacteria and fungi utilise the nutrients released when nematodes feed on roots and so they multiply rapidly and cause more severe disease when root systems are being injured by nematodes. Thus, a plant-parasitic nematode may cause damage at lower population densities when secondary pathogens are present.

When nematode counts are being used to make management decisions, it is also important to consider two other issues in the decision-making process. First, several different plant-parasitic nematodes will normally be found in a turfgrass sample, and it is their collective rather than individual effect that should be considered when deciding whether nematodes are causing damage. Second, numbers of a plant-parasitic nematode will vary, depending on the condition of the root system. Once roots have been damaged, the nematode's population density usually declines because healthy roots are no longer available as a food source. Consequently, when samples are collected after aboveground symptoms appear, nematode numbers may have declined to the point where the role nematodes played in causing the problem is no longer apparent.

Conclusion

When deciding whether plant-parasitic nematodes are contributing to a poor growth problem in turfgrass, damage thresholds are no more than a guideline, and must always be used with caution. Many different factors are usually associated with poor growth, and their collective impacts must be considered. It is often the cumulative effects of several stress factors that cause decline in turfgrass.

Literature cited

Buckley RJ, Koppenhofer AM and Tirpak S (2010). An integrated approach to pest management in turfgrass: Nematodes. *Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension Fact Sheet FS1014.*

Crow WT (2014) Nematode management for golf courses in Florida. *University of Florida, IFAS Extension ENY-008*

Further reading

Smiley RW, Dernoeden PH, Clarke BB (2005) *Compendium of turfgrass diseases. 3rd edition. The American Phytopathological Society. 167 pp.*

Dr Billy Crow is based in the Entomology and Nematology Department of the University of Florida and is the only nematologist in the world who specialises on nematodes that damage turfgrasses. Dr Crow has produced many fact sheets and publications and they a certainly worth reading.

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