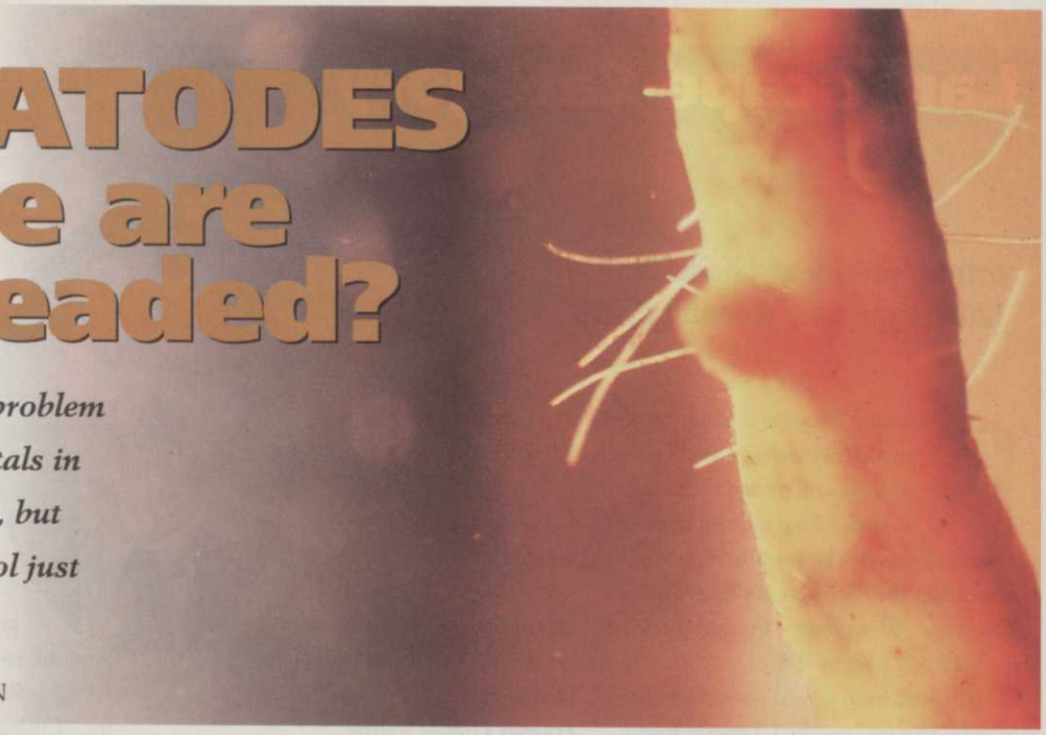
NEMATODES where are we headed?



Nematodes can be a problem for turf and ornamentals in nearly any landscape, but they're tricky to control just about everywhere.

By ROBERT A. DUNN

Lance nematodes protrude from a St. Augustinegrass root after soil was washed from the root.

Nematodes? Who cares? That's a southern problem and nothing to worry about away from the Southeast, right? Wrong! Nematodes become problems more often and are more apt to become severe problems in southern landscapes than in most other regions of the country, but you can be sure that there are some kinds of nematodes in nearly every tablespoonful of landscape soil.

And they occasionally can become serious pests in many parts of the United States. Nematodes visibly damage golf course turf in such states as Massachusetts and Michigan; they occasionally weaken lawns or other fine turf in most northern and middle states; and they can damage many species of ornamentals (with the risk increasing with more warm soil days per year and prolonged culture of the same ornamental species).

Could you recognize damage caused by nematodes if it occurred on a property in your care; would you know when it was serious enough to worry about and what to do about it? There is not enough space here to give a good short-course in nematode diagnostics, but most Land-Grant Universities' Cooperative Extension Services have people and labs that can help you.

Nematodes 101

Plant-parasitic nematodes are, as you may know, microscopic worms (not earthworms — different Phylum) that live in plant roots or the soil around them and feed on the living roots. There are tens of thousands of kinds of nematodes, but only about 10 percent feed on plants. Of these, a few cause almost all of the damage to plants.

In fact, one group, the root-knot nematodes (species in the genus *Meloidogyne* for the technically inclined) have been shown to cause about 75 percent of the economically important nematode damage to plants in the tropical and warm-temperate zones of the world. Root-knot nematodes are those most often detected as causing problems in landscape ornamentals in the central and southern U.S. and may infest interiorscapes anywhere in the country.

The picture in turfgrasses is much more complex — several genera of nematodes can damage grass roots and not all grasses are equally sensitive to each genera. Worse, they do not cause such easily recognized symptoms on grass roots as do the root-knot nematodes on most of their broad-leaved hosts, so their effects are more likely to accumulate for a long time before they are recognized.

Nematodes are stress-causing organisms. They rarely cause a directly lethal disease. Instead, nematodes weaken plants by diverting energy that should go into normal growth or flower production by altering the growth of roots, injuring roots so they lose some of their most necessary tissues or preventing normal root growth.

In many cases, the most practical way to treat a nematode infection is to strengthen the plant that is infected, with special attention to the needs of healthy roots. Fertilization, watering practices and drainage, mowing practices for turfgrasses and improvement of the physical characteristics of the soil may all help plants withstand some nematode infection.

Of course, every pest has circumstances in which it simply overwhelms normal plant health efforts and nematodes are no exception. However, today's landscape manager has few or no highly effective nematicides that can quickly correct a serious

nematode problem on established plant material in the landscape. Why? How did we get into this situation, and what are the prospects for improving it in the next few years?

Wanted: Effective nematode control

The problem stems from a few basic facts about nematode biology and grounds management, coupled with the modern concern about environmental contamination with potent pesticides:

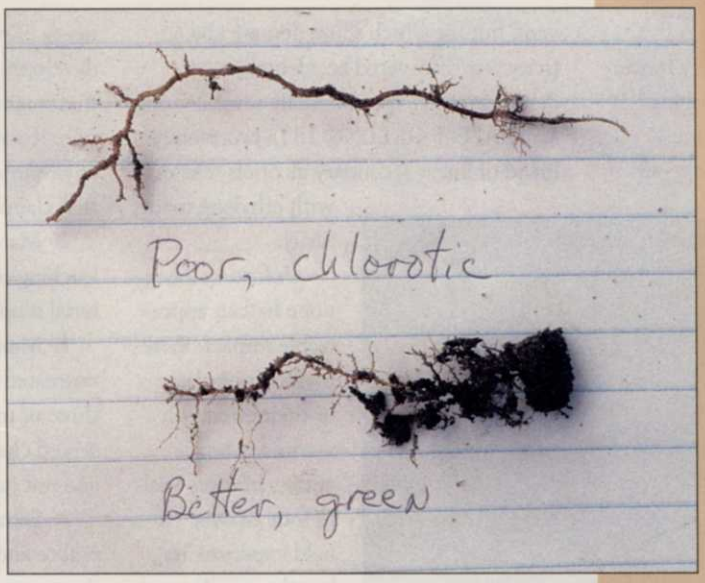
1. Nematodes are *aquatic* animals — if active, they are wet! This means that any control agent, chemical or otherwise, must reach them in water. All chemical nematicides are quite water-soluble.

2. Nematodes are small and their normal movements are not as likely to bring them in contact with a thin zone of treated soil as is often the case with soil-borne insects. We have to get the nematicide to the target organism, because it is very unlikely to contact a thin layer of treated soil by its own movement. Some nematodes live inside roots, so they are even more difficult to reach with chemical treatments. If we apply enough of a pesticide to produce a lethal dose of chemical throughout the volume of soil in which we want to control nematodes, the nematode control rate is almost always the highest on the label for products that are registered for both insect and nematode control.

3. Most of the pesticides marketed for nematode control in the past 25 years have been moderately to highly toxic organophosphate or carbamate compounds, potent cholinesterase inhibitors that are dangerous to fish, birds and all other warm-blooded animals, including man.

4. The soils in which nematodes affect plant roots most are sandy soils with little organic matter or fine mineral particles that could retain soluble compounds or water — the very soils that require the most irrigation to keep plants vigorous. This is a serious "nematicide dilemma" — the soils in which nematicides can be leached most easily through the soil profile and into subsoil and groundwater are those in which we need to apply extra water. This increases the risk of leaching even further — and these are the soils in which plants are most dependent on intact healthy roots. They are most sensitive to the damage caused by nematodes.

Hence, the combination of these four characteristics means that when using nematicides to reduce nematode populations in landscape ornamentals and turfgrasses, we have been applying high rates of toxic and water-soluble pesticides to situations in which necessary cultural practices have most increased environmental risks from their use. These factors, and others, have led to the loss of products formerly used as nematicides for turf and ornamentals.



Nematode affected turfgrass roots (top) show a lack of branching and feeder roots which are necessary to bind particles to the roots, when compared to unaffected turfgrass roots (bottom).

Testing new nematicides

This situation obviously gives rise to high demand for effective nematode control agents that:

Know your nematicide

Many "new" products are being offered to the public as nematicides, ranging from new uses of very well known "traditional" pesticides to products based on materials used as natural nematicides for centuries to new products based on modern technology. Unfortunately, we have few research data by which to evaluate most of these products.

If considering them, keep these facts in mind:

▶ EPA registration of a product as a nematicide is no proof that it works — only that the product is acceptably safe when used as prescribed on the label for the uses claimed. EPA rarely requires proof of efficacy before labeling a product.

▶ The basic rules of biology and chemistry that apply to traditional pesticides (above) apply to any kind of nematicide: They must be water-soluble to reach the target and they are most needed in soils in which the risk of leaching is greatest. That may be less important in terms of environmental contamination with the modern "soft" products, but it still means that they will be lost more quickly from the root-zone where the nematodes live, so they will be where they are needed for a shorter period of time in the soils in which you most need their effects.

▶ A product or treatment that works for the claimed purpose in the cool, heavy soils of the upper Piedmont may be much less effective in the warm, heavily-leached sands of Florida.

▶ are environmentally benign;

▶ have low toxicity to humans and animals, both wild and domestic;

▶ are not phytotoxic so they can be used on a wide range of ornamentals and turf species; and

▶ if at all possible, can also claim to be "natural" — very attractive in today's market.

In 1998, we evaluated many "soft" (i.e., low in toxicity and environmental impact) products for turf nematode control under Florida conditions — exactly the set of circumstances most difficult for persistence of water-soluble compounds. The products tested included three whose "active ingredients" are living microbes: ACTINOVATE PLUS® (*Streptomyces lydicus* WYEC108, an actinomycete; Natural Industries, Inc.); DENY® (0.6 percent *Burkholderia (=Pseudomonas) cepacia*, a bacterium; CCT Corp.); and PROSPERNEMA® (a proprietary formulation of spores of nematode-trapping fungi; Circle One International, Inc.).

Two others were comprised of compounds derived from living organisms: DITERA® (killed culture of a fungus, *Myrothecium verrucaria*; Abbott Laboratories) and an experimental product in early stages of research and development.

Thin bermudagrass turf on a golf course fairway showing typical above-ground response to root stress caused by nematodes.

Two more were botanical materials based on plant products with histories of use as nematicides: NEMAFERT® (mixture of rapeseed meal and neem cake; from Atlantic Australasia) and NEOTROL® (composed 100 percent of ground-up plants of a patented variety of sesame; Parkway Research Corp.).

The last of this year's "soft" candidates was a product originally developed as a solvent, but for which some nematicidal activity was discovered accidentally and demonstrated experimentally several years ago: SAFE-T GREEN® 18 (a proprietary blend of linear secondary alcohols reacted with ethylene oxide; SMI).

Some of the new 'soft' candidate nematicides must be used at very high rates (approximately 1 ton/acre) giving the appearance of a very heavy topdressing on fine turfgrasses.

Unfortunately, none had an appreciable impact on nematode populations or their effects on warm-season turfgrasses in these trials (a total of over 10 field experiments), but the search continues. After all, there is a clear need for better nematode-control agents to protect landscape plantings in many parts of America. With enough incentive, those products will be found.

Strive for root health

What can we do in the meantime? Do everything possible to favor root health and disfavor nematodes — improve soil organic matter content, attend to the nutritional needs of roots, water for maximum root development and minimize other stresses that might inhibit root growth and function. If you decide to try some of the more environmentally friendly new products that claim some effect on nematodes:

▶ Manage soil and water to minimize leaching out of the root-zone once the material is applied correctly.

▶ Make objective comparisons with untreated plants, replicating all treatments three or more times to be sure that observed changes really result from treatment and not just chance.

▶ Sample all plots (including controls) before and after to be able to truly judge the merits of the new treatment.

The stakes may be high: Don't gamble too heavily on a product that is not proven to work in your conditions. A product that does not work in your situation costs money without giving you a return, may disenchant a good client and may lead to development of even more serious situations by delaying more positive action that could have been taken.

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