Rutgers New Jersey Agricultural Experiment Station - Cooperative Extension

PLANT & PEST ADVISORY

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INSIDE

Diseases of Turfgrass

Bruce B. Clarke, Ph.D., Specialist in Turfgrass Pathology

General

Dollar spot, copper spot, gray leaf spot and rust are all active at this time. Refer to recent issues of this newsletter for additional information about the identification and management of these diseases.

Stem and Crown Rust

Both diseases are prevalent on susceptible Kentucky bluegrass and perennial ryegrass respectively, at this time. Affected turf prematurely yellows and orange pustules called uredia (reproductive structures) appear on the leaf blades. To control both **stem and crown rust**, maintain adequate fertility and soil moisture, and apply Armada, Banner, Bayleton, chlorothalonil, Compass, Eagle, Headway, Heritage, Insignia, mancozeb, Tartan, Trinity or thiophanate- methyl per manufacturer's recommendations

Take-all patch

This disease, caused by the root and crown infecting fungus, *Gaeumannomyces graminis* var. *avenae,* may redevelop on bentgrass greens and fairways during the next few weeks. Although this disease is most prevalent from April through June, late-summer and fall outbreaks are not uncommon. Infection takes place during cool, wet weather and symptoms are most striking after stress. Infected grass first appears bronze to reddish-brown in color and then fades to a dull brown. Patches are usually circular or ring-shaped and range in size from several inches to two feet or more in diameter. The centers of affected turf are frequently colonized by bluegrass, fine fescues or weeds. Upon close examination, decaying roots and leaf sheaths appear black and dark strands of mycelium often develop parallel to the root axes. The disease is enhanced by poorly drained, light-textured and high pH soils. Although take-all patch is difficult to control, best results have been achieved with the use of acidifying fertilizers during cool weather (e.g., ammonium sulfate) and preventive applications of Banner, Bayleton, Headway, Heritage, Insignia, Trinity or Rubigan in October and November. If the disease has been particularly severe, fungicides should be reapplied twice next spring at 21 to 28-day intervals beginning in early April. Chemicals should be applied in 4 gal water/1000 sq ft or irrigated into the root zone (1/8 to 1/4″ of water) for maximum effectiveness. Whenever practical, overseed infested areas with less susceptible grasses such as fine fescue, Kentucky bluegrass or perennial ryegrass to mask symptom expression. Maintain soil pH at approximately 6.0

See Turf Diseases on page 3

Powdery Mildew

Ann B. Gould, Ph.D., Specialist in Plant Pathology

Powdery mildew is a "summer season" disease that tends to affect outdoor plants after the growing season has begun. Even though the growing season is winding down, powdery mildews are still evident on many susceptible hosts. Powdery mildew is probably the most commonly recognized disease of ornamental plants in the nursery and landscape, affecting more than 7000 plants worldwide. Fortunately, this disease does not affect gymnosperms!

Powdery mildew is caused by more than 300 species of fungi, which include species of *Blumeria, Erysiphe*, *Golovinomyces, Leveillula, Phyllactinia*, and *Podosphaera*. These fungi are **biotrophs**; they obtain all their food only from other living organisms. Powdery mildew fungi obtain nutrients by sending a haustorium (specialized absorbing structure) called a **haustorium** into the cells of the host plant epidermis. Nutrients are translocated from the haustorium to the powdery fungal growth evident on the surface. The relationship between fungus and host plant is pretty sophisticated; the fungus gets the nutrition it needs from the host, but the host is not usually seriously harmed. Most powdery mildew species are host-specific, development of powdery mildew on one species will not necessarily lead to disease on other hosts nearby.

Symptoms

Powdery mildew appears as a white to tan superficial growth on the surface of affected leaves and other aerial tissues. Signs of the fungus can first appear as individual spots that coalesce to cover the entire tissue surface. Asexual spores (or conidia) are produced on this powdery growth and are distributed by air currents to other susceptible plants. Young plants and tissues are often more susceptible to this disease.

Although the fungus does not directly kill the cells it invades, infection does result in a reduction of photosynthesis and an increase in water loss. As a result, the growth rate and aesthetic value of infected plants may be reduced. Leaves may be stunted, curled, or twisted; in highly susceptible plants, new growth, flowers, and buds can be destroyed.

Disease Cycle

Look for powdery mildew disease in the Northeast during the late spring to early fall months. Powdery mats of fungal mycelia develop on susceptible tissues all growing season, and conidia produced by the fungus are carried by the wind to new hosts. Powdery mildew fungi can overwinter in a characteristic fruiting structure (called a **chasmothecium**, formerly referred to as a cleistothecium) that is the result of a sexual reproductive process. Chasmothecia are dark, tiny spheres (about the size of coarse, ground pepper) that can often be seen on infected tissues later in the growing season. During the spring of the following year, these fruiting structures release spores (called ascospores) that start the infection cycle anew. In warmer climates or in greenhouses, the formation of chasmothecia is never observed, and the disease may persist all year as mycelia and conidia. In other cases, the fungus may enter buds and survive the winter there.

Powdery mildew conidia germinate and penetrate host tissues in about 6 hours, and under favorable conditions, the mycelium develops and new spores are produced within 4 to 6 days. Unlike most fungi, the penetration process can occur in the absence of free water, and high humidity does not necessarily promote disease development. Indeed, in many cases, frequent periods of leaf wetness can reduce the severity of this disease. Although the development of powdery mildew is most rapid during periods of warm weather (80°F day/60°F night), damage due to the disease can be actually more severe at cooler temperatures (70°F day/50°F night).

Management

To manage powdery mildew in ornamental plantings, improve air movement around plants through proper spacing and weed control, and increase the amount of sunlight that reaches foliage. Rake old leaves and prune shoots infected the previous growing season to reduce inoculum. Practices that promote succulent growth, including pruning and nitrogen fertilizing, should be avoided on susceptible hosts. Cultivars of crabapple, dogwood, lilac, and crape myrtle resistant to this disease are available and should be planted whenever possible. Rhododendrons that are very susceptible to powdery mildew include Elizabeth, Virginia Richards,

See Powdery Mildew on page 3

Some of the more common hosts of powdery mildews include:

apple and crabapple, azalea and rhododendron, ash, basswood, beech, *Berberis,* birch, blueberry, buckeye, catalpa, Chinese photinia, chrysanthemum, cotoneaster, crape myrtle, dahlia, delphinium, elm, eucalyptus, euonymus, flowering dogwood, gardenia, hawthorn, holly, honeysuckle, horse chestnut, hydrangea snowball, kalanchoe, *Kalmia,* leucothoe, ligustrum, lilac, *Lonicera,* lilac, magnolia, maple, monarda, oak, phlox, *Prunus* (peach, plum, cherry, apricot), pear, peony, poplar, privet, pyracantha, Reiger begonia, roses, serviceberry, spirea, smoke-tree, snapdragon, sycamore, tulip tree, *Vaccinium,* viburnum, walnut, wintercreeper, willow, wisteria, and zinnia.

Powdery Mildew from page 2

Unique, and the Loderi group; many deciduous azaleas are susceptible as well. Plants that are less susceptible include Nova Zembla, Palestrina, and Vulcan.

Since powdery mildew fungi are associated with the surface of leaves, they are easier to manage with fungicides than other foliar diseases. Compounds labeled for powdery mildew control include azoxystrobin, *Bacillus subtilis*, copper (hydroxide, metallic, salts, sulfate), fenarimol (field and landscape only), hydrogen dioxide, Junction, kresoxim-methyl, Manhandle, myclobutanil, neem oil, paraffinic oil, piperalin (enclosed structures only), potassium bicarbonate, propiconazole, Spectro, sulfur (dusting, elemental, flowable, wettable), SysStar, thiophanate-methyl, trifloxystrobin, triadimefon, triflumizole, Twosome, and Zyban. Most of these compounds are applied at the first sign of disease; however, consult the label for timing, rates, and appropriate hosts. ❑

Turf Diseases from page 1

since the disease is enhanced in alkaline soils. Manganese (2 lb Mn/A), applied as a foliar spray in early-April, can help reduce disease severity in soils that are deficient in this micronutrient.

Green Industry Expo

This year's Green Industry Expo will be held at the Trump Taj Mahal Casino/Resort on December 9-11, 2008. This is an excellent opportunity to receive the latest turf management information from nationally renowned speakers. For additional information, please contact Cece Peabody (973) 812-6467 or e-mail execdirector@njturfgrass.org or Marlene Karasik (732) 932-9400 ext. 339 or e-mail mkarasik@aesop.rutgers.edu. ❑

Plant Diagnostic Laboratory Highlights

Richard J. Buckley, Laboratory Coordinator

Turf

Anthracnose takes all the headlines for turfgrass submissions in mid-September. Samples of putting greens diagnosed with anthracnose were submitted from several golf courses in New Jersey, New York, and Pennsylvania. Other than anthracnose, we had two **gray leaf spot** samples from a Middlesex County golf course. We also had a single **summer patch** sample from a Camden county home lawn and a sample of **take all** from a bentgrass putting green on a Maryland golf course.

Landscape

Red oak and pin oak with **bacterial leaf scorch** (BLS) continue to be submitted to the laboratory. The samples this week were from Gloucester, Mercer, and Atlantic counties. We are also getting numerous **BLS** samples from out-of-state foresters. As expected all the red oaks had positives tests for **BLS,** but we also saw positives from red maple, black oak, elm, and sweet gum.

Other diseases and insect pests of note include: **holly pit-making scale** on *Ilex opaca* from Mercer County; **elongate hemlock scale** on Douglas fir from Morris County; and **pine bark beetle** on pines from Mercer County. Two samples of plum, from Cumberland and Somerset counties, were diagnosed with **leaf spot** caused by the fungus *Blumeriella jaapii*. One of the plums also had **black knot**.

Greenhouse and nursery

Rhizoctonia crown and root rot was diagnosed on Peony from a Somerset County grower. **Tip blight**, caused by the fungus *Phomopsis*, was identified on arborvitae from a Cumberland County nursery. **Flat headed borers** were found in samples of hackberry from Sussex County and oak from Gloucester County. Flat headed borers prefer trees under stress and are particularly fond of newly stuck trees. The samples from Gloucester were recently transplanted. ❑

Weather Summary for the Week Ending 8 am Monday 9/15/ 8

	RAINFALL			TEMPERATURE				GDD BASE50		MON
WEATHER STATIONS WEEK	TOTAL	DEP	MX	MN	AVG	DEP	TOT	DEP	%FC	
BELVIDERE BRIDGE	1.41	22.47	-3.96	90	55	71.	7	2727	286	91
CANOE BROOK	.94	25.88	-1.86	93	52	67.	2	2644	196	95
CHARLOTTEBURG	1.53	29.24	1.22	88	51	66.	5	2495	550	93
FLEMINGTON	1.25	23.74	-2.84	93	54	69.	4	2643	132	95
NEWTON	1.89	24.97	-.86	88	53	68.	6	2797	598	93
FREEHOLD *	1.31	18.57	-7.29	92	52	70.	4	2502	-157	93
LONG BRANCH	1.08	20.66	-5.54	85	54	70.	3	2651	49	87
NEW BRUNSWICK	1.30	30.26	4.04	92	55	70.	4	2994	198	94
TOMS RIVER	.72	23.76	-3.01	90	50	70.	3	2901	295	81
TRENTON	1.60	25.59	.75	91	56	71.	4	3117	217	85
CAPE MAY COURT HOUSE	1.42	18.36	-4.83	89	62	73.	3	3075	459	91
DOWNSTOWN	.86	21.43	-2.97	92	52	71.	3	3095	184	88
GLASSBORO	1.15	21.78	-3.79	90	57	72.	4	3123	243	86
HAMMONTON	1.90	20.79	-4.77	91	53	72.	4	3228	339	91
POMONA	.71	23.62	.28	90	55	72.	6	3203	507	79
SEABROOK	1.08	20.20	-3.24	90	59	74.	6	3306	379	85
SOUTH HARRISON	.88	23.02	-2.09	89	56	72	NA	3102	NA	NA

WES KLINE -- GDD BASE 40 PINEY HOLLOW LAST WEEK 240 (Ending 9/8/08) THIS WEEK 221 (Ending 9/15/08)

An Integrated Approach to Nematode Management in Turfgrass

Richard J. Buckley, Director Soil Testing and Plant Diagnostic Services, Albrecht M. Koppenhofer, Ph.D., Specialist in Turfgrass Entomologist, and William T. Crow, Ph.D., Associate Professor of Nematology, University of Florida

Introduction: Nematodes, also called roundworms or eelworms, are the second largest group of animals next to the insects. There are estimates of upwards to 500,000 potential species. Fortunately most nematodes exist free of any parasitic relationship ("free-living"). Free-living nematodes occupy all ecological niches and feed on decaying animal and plant matter, algae, and bacteria. Some of the free-living nematodes are predatory, attacking small soil-borne animals including other nematodes.

Unfortunately there are nematodes that parasitize animals and plants. In dogs, heartworm is a common nematode parasite. On the other hand, several species have even been implicated as disease agents of insect pests. These nematodes have been formulated as biorational pesticides and are used in insect control programs with some success.

Finally, we have the plant parasites. Roughly 3,500 species of nematodes are known to be obligate parasites of plants. Most of these nematodes live in the soil and feed on plant roots, but some can be found in the foliage of herbaceous ornamentals or in the stems of conifers. A total of 13 types of plant parasitic nematodes occur in New Jersey soils. Direct injury from high populations of these nematodes is rarely a problem in grass cut above ½".

Table 1. Plant Parasitic Nematode Genera in New Jersey Turfgrasses.

Cyst	*Heterodera spp.*
Dagger	*Xiphinema spp.*
Lance	*Hoplolaimus spp.*
Lesion	*Pratylenchus spp.*
Pin	*Paratylenchus spp.*
Ring	*Criconemella spp.*
Root knot	*Meloidogyne spp.*
Sheath	*Hemicycliophora spp.*
Spiral	*Helicotylenchus spp.*
Sting	*Belonolaimus spp.*
Stubby root	*Trichodorus spp.*
Stunt	*Tylenchorhynchus spp.*

Morphology: Plant parasitic nematodes range in length from 1/64 to 1/8 inch (40-320 µm), but are very thin and cannot be seen without magnification. Their bodies are translucent, so the internal organs show through the cuticle. They are unsegmented, but might have some segment-like or other ornamentation on the body. In some nematode genera there is sexual

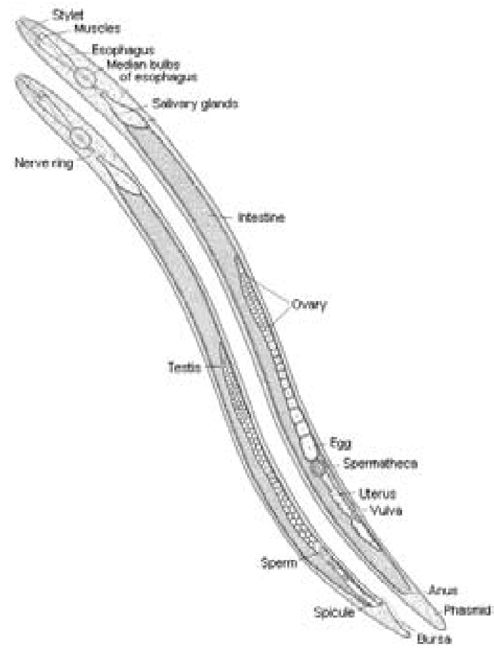

Figure 1. Male and female adults of a typical plant-parasitic nematode.

dimorphism – the male and female have different body shapes.

A plant parasitic nematode is essentially a feeding machine that is much like a straw with a pump. At the front end there is a heavily sclerotized piercing-sucking mouthpart called a 'stylet'. The stylet is strongly muscled and moves in and out of the body to feed. The stylet connects to a pump-like esophageal chamber called the median bulb, which aids the nematode in the withdrawal of plant fluids and serves as the transition to the intestine and excretory chambers.

Life History: Most nematode life cycles have males and females and/or self-fertilizing hermaphrodites, but in some species only females may occur (parthenogenic). The females or hermaphrodites lay eggs (as many as 1000 eggs over a 2- week time span in some species). Each nematode has five growth stages and molts four times, the first of which occurs in the egg, in a gradual transition to the reproductive adult. This process takes roughly 4 to 8 weeks. In many species warmer soil temperatures speed the life cycle.

Conditions that favor nematodes: Nematodes prefer warm soils but will be active anytime the soil temperature is above 40°F. They are semiaquatic and need soil moisture to avoid desiccation and to allow movement. Soils at field capacity are ideal. Nematodes prefer sandy soils with larger pore spaces. We typically assume that USGA recommended sand-based root zone mixes for golf greens are perfect environments for nematode survival. Recent research from Rhode Island reports; however, that greens construction does not appear to influence nematode populations. Their studies suggest that the older the green, the higher the nematode population. The drawback to this research is that most sand-based construction is much newer than

See Nematode Management on page 5

Nematode Management from page 4
the older soil-based greens in the study that had higher nematode populations.

Population dynamics: Plant parasitic nematodes depend on a living host in order to complete their life cycle. They overwinter in all life stages and begin to increase in population as the soil temperatures warm in the spring. By most accounts, nematode populations peak in late-spring to- early-summer, grow slower or crash into the summer, and resume expanding to a second peak in late-summer.

Nematodes are not uniformly distributed in the soil. They are found in diffuse densities of various populations or in "hot spots" that are randomly spaced throughout the turf area. Therefore, different core samples taken from different locations in the same turf area will have different populations. In research conducted at the University of Massachusetts numerous 1 x 4 inch soil cores were taken from a single golf course putting green. Each core yielded populations of stunt nematodes that varied from 50 to- 350 per core. A composite sample of all of the cores yielded an average of 196 stunt nematodes for that green. They also found that the concentration of nematodes varied throughout the soil profile. At the 2 inch depth there were twice as many stunt nematodes than there were at the 4 inch depth. The diffuse nature of nematode populations and random distributions in the soil profile make proper sampling imperative in estimating nematode populations. Single cup cutter sized plugs that are submitted for population estimates often provide misleading results.

Feeding behavior: There are two types of feeding behavior in nematodes. Several genera feed on the outside of the roots (ectoparasites). Some ectoparasites migrate up and down the root and feed in many locations and others remain sedentary and continuously feed in roughly the same spot. Several other genera feed inside the roots (endoparasites). Again, there are migratory species that move up and down the roots between the cells and sedentary species that remain and feed in a single location. Obviously, the endoparasites that migrate cause a great deal of damage to the root system.

Pathology of infected roots: Nematode feeding causes different types of injury to the roots. Most notable is the overall reduction in biomass. Nematodes destroy cells directly by enzymes injected through the stylet. When there are enough feeding sites and enough cells are destroyed, lesions may be present on the root. In some cases, the number of root hairs is reduced and apical growth is affected, so the roots appear stubby or stunted. Some of the endoparasites cause knot-like galls that distort the roots. The feeding sites can also act as infection courts either by mass cell destruction or when the endoparasites force their way into the plant, thus creating an opening for other pathogens to enter.

Symptoms: Plants respond to any root-dysfunction with symptoms related to deficiencies of nutrient or water. Yellowing and thinning of the turf, reduced vigor, and premature wilt have all been attributed to nematode feeding. Turfgrass that is slow to recover from stress, or does not respond to fertilization, might indicate root damage from nematodes.

Since the distribution of nematodes is uneven in the soil and high populations are clustered into "hot spots," the symptoms on the turf population will be seen as non-uniform, poorly performing turf areas that correspond to the nematode "hot spots" in the soil. Nematode damage rarely is uniform or ends abruptly.

Affected plants lack vigor, and so, have a reduced ability to handle periods of environmental stress, or in the case of sports turf, the rigors of turf management. It is not uncommon for these plants to die outright under the stressful conditions, or to be attacked by weak pathogens, like *Colletotrichum cereale*, the cause of anthracnose, or *Curvularia spp.*, the cause of fading out.

Diagnosing nematode damage: Do not depend on aboveground symptoms or root conditions alone to diagnose nematode problems. Analysis of soil samples by a competent laboratory is the best method for determining the types of nematodes present and the potential risks those nematodes pose for the turf. The availability of nematicides is limited. They are expensive and hazardous. Sampling is inexpensive when compared to the cost of unnecessary or poorly chosen nematicide applications.

Soil sampling for nematode analysis is much like sampling for nutrient levels. A 1" (2.5 cm) diameter soil corer is used to systematically sample the affected area. Take at least 25 cores to 4" (10 cm) depth and mix in a bucket. Remove a 1-pint (0.5 Liter) subsample, place it in a plastic bag, and keep it out of direct sunlight and in a cool place until it is shipped to a nematode detection service. If turf damage exists, take the samples from throughout the affected area. If possible, sample a nearby healthy area for comparison. If there is no damage, sample the area in a systematic way.

If the intention is to set baselines and monitor the population over time, choose an area no larger than 500 square feet and return to the same area at a later date for additional samples. To get a clear picture of the nematode dynamics on your site, it may be prudent to sample repeatedly during the season and to repeat the process over several years.

Rutgers nematode resources: FS757 'Proper Sampling of Soil and Plant Tissue for Detection of Plant Parasitic Nematodes' is available from Rutgers Cooperative Extension to assist in the selection of a proper sample. Nematode assay submission forms are available for Rutgers Nematode Detection Service by phone 732-932-9140, fax 732-932-1270, or on the web at www. njaes.rutgers.edu/services.

Damage thresholds: Injury thresholds signify the potential of a nematode population to cause damage. A number of thresholds have been established for most of the common nematodes in turfgrass. Some of the reported thresholds are

See Diagnosing Damage on page 6

Diagnosing Damage from page 5
research based, but others are simply related to a researcher's or practitioner's personal experience. In many cases there is a great divergence in the numbers from source to source. In general, lower population thresholds can be found in reports from the south whereas higher population limits are tolerated in the northeast. Accepted thresholds for bentgrass and tall fescue are listed in table 2.

It is important to note that for most nematode species on many of the major warm- and cool-season turfgrasses there are no known thresholds, therefore, one should use caution when trying to extrapolate from one nematode-turfgrass combination to another. Furthermore, nematodes rarely occur as populations of single species. Most of the time several different species are found associated with the same turf stand. This makes damage thresholds difficult to use in a practical way. Because thresholds only provide a guideline it is important to consider all factors when making a control decision.

Nematode management: Most turfgrasses can withstand some feeding by most kinds of nematodes if given sensible care. Direct injury from high populations of nematodes in New Jersey soils on grass cut above ½ inch is rarely a problem. It is not uncommon to have the highest populations of nematodes on turf in the spring and fall, when the turf is actively growing. Populations of nematodes often increase in root biomass for food.

Management practices that reduce plant stress and promote vigorous root growth will help the grass tolerate the feeding of very high populations of nematodes. Mowing the grass at the proper cutting height for the species, regular aerification to prevent thatch and compaction, proper fertilizer inputs – based on soil test results – and judicious use of irrigation may provide relief by producing a healthier plant overall.

It is also important to monitor and control other diseases. Remember, it is often the cumulative effects of several stress factors, living and non-living, that cause the decline of the turf.

Biorational control: The biorational products, Ditera (dried fermentation solids and solubles of the fungus *Myrothecium verrucaria*), Neo-Trol (ground sesame plants), and Safe-T-Green (linear secondary alchohols reacted with ethylene oxide) are labeled for nematode control in turf. There are many other plant-derived products on the market that make various claims regarding nematode suppression. Some of these products are derived from herbs like pepper, clove, thyme, and wintergreen, or from various trees and shrubs. For most of these products there is no efficacy data provided from legitimate research. In some cases, the products show nematode suppression in the laboratory, but few have maintained that performance in the field. In fact, field trials from Florida, South Carolina and Massachusetts suggest that these biorational products do not consistently suppress populations of plant parasitic nematodes and perform poorly when compared to traditional nematicides and fumigant products.

Biostimulants and soil amendments: You might hear of certain microbial biostimulants, compost products, or other soil amendments that are supposed to affect nematodes in various ways. Most of these claims are unfounded. Researchers at the University of Maryland found that the addition of activated sewage sludge and poultry waste actually increased lance nematode populations on a creeping bentgrass putting green compared with other organic nitrogen sources, which is contrary to reports that organic soil amendments are capable of suppressing plant parasitic nematodes. As with many of the alternate therapies marketed for nematode control, efficacy data from University-based sources is lacking.

Natural enemies: Many microbes, including bacteria, fungi, and actinomycetes, are parasites of nematodes. The bacterium, *Pasturia penetrans*, produces spores that stick to the nematode. Once the spores germinate and penetrate the nematode body, they proliferate and produce more spores that are released when the nematode ultimately dies from the infection. Another microbe, the fungus *Arthrobotrys oligospora*, produces hyphal rings that trap and constrict the nematodes as they pass through and touch them. Although there is promise with *Pasturia*, there are no commercially available forms of these biologicals at the present time.

Entomopathogenic nematodes: The beneficial nematode *Steinernema riobrave* (BioVector) shows some promise as a nematode control at high application rates, but is currently not labeled for use in that manner. Research conducted by Ohio State and Virginia Tech Universities found that the application of these beneficial nematodes reduced the numbers of plant parasitic nematodes on golf course putting greens. At the University of Florida; however, in ten field trials no benefit was recorded using entomopathogenic nematodes to suppress plant-parasitic nematodes.

Chemical control: The decision to use nematicides must be carefully evaluated. The simple presence of plant parasitic nematodes does not warrant chemical applications. Furthermore, when high populations of nematodes occur in the absence of damage to the turf, it is difficult to justify the application. If nematode populations exceed reported damage thresholds, there is appreciable risk to the turf, and all other management issues and stress factors are considered, nematicide applications may be useful in reducing nematode populations and improving turf quality.

Nemacur: In New Jersey, fenamiphos (Nemacur 3EC and 10G) was labeled for use on golf courses and in commercial sod and seed production. In fact, Nemacur has been the most widely-used and consistently effective nematicide used on turfgrasses in the United States for the past 30 years. One of the properties of Nemacur that makes it particularly useful is that it is the only turfgrass nematicide with systemic activity. This means that the material is taken up by the roots of the turf where it can affect endoparasitic nematodes in the roots, as well as affecting ectoparasites in the soil. Fenamiphos is in the class of pesticides termed "organophosphates." These pesticides act on the nervous system of the target pest. Unfortunately, exposure also can affect the nervous system of non-target animals such as fish, birds, and people. Because of the health and environmental risks from organophosphates many of them have been taken off the market in recent years. Nemacur may no longer be purchased legally after 2008. The loss of Nemacur has stimulated great interest in the development of new nematode management options for turf.

Fumigation: Dazomet (Basamid) is a granular product that is gaining popularity for turf managers as a tool for turfgrass renovations. The product, when used at the right temperature and soil moisture levels, releases methyl iso-thiocynate, which is the same active ingredient in older general use fumigant products like Vapam. This material can control many kinds of soil-borne pests including nematodes, fungal disease agents, insects, and weeds. It is labeled for a number

See Fumigation on page 7

Fumigation from page 6

of turf and landscape uses. In turf areas with chronic nematode problems, the renovation of the existing stand, using a product containing dazomet might be prudent. Remember that fumigants have no lasting effect, so nematode populations will begin to recover once the material dissipates. Furthermore, with no competition from other soil microbes that were killed by the fumigant, nematode populations may recover quickly.

Curfew soil fumigant: This is a fumigant nematicide that is labeled for use in the coastal states of the southeast, but not in New Jersey. Curfew (1,3-dichloropropene) is slit-injected into established turf as a liquid that then moves through the soil as a gas. It is a very effective contact nematicide and kills nematodes in soil, but does not have systemic activity. Curfew is custom applied by a few approved applicators and labeling is sought on a state-by state basis. Therefore, the estimated number of sales in a given state must be high enough to justify a registration being pursued. It is unlikely that the economics would justify Curfew being registered beyond the eight states where it is currently labeled.

Problems with nematicide use: No nematicide is equally effective against all nematode species. The endoparasitic species are particularly hard to control. Furthermore, the application of a nematicide product does not guarantee 100% control. There are always survivors, so nematode populations will recover over time.

Finally, there are reports of enhanced microbial degradation of fenamiphos on golf greens after repeated use of the product. Repeated use of any pesticide to the soil over a long period of time will encourage the buildup of bacteria and other microbes that can metabolize (eat) the particular chemical. The net effect is a reduction in the effectiveness of the material. In Florida, there are reports of Nemacur degradation at a rate 20 times faster than normal. Enhanced microbial degradation has been reported for over 200 soil-applied pesticides, so it would not only be prudent to rotate all materials**,** but to keep their use to a minimum.

New chemistries: There is currently a lot of effort going into the discovery and development of new nematicides. New pesticide classes are being developed that look to be effective and yet safer than organophospates to non-target organisms. Molecular biologists and nematologists now know what every gene in certain nematodes does. This has allowed for development of pesticides that target those genes that are only present in parasitic nematodes. Currently field trials with some of these new chemistries are underway with exciting results. One of the good things about turf from a pesticide development standpoint is that it is a non-food crop. That makes it easier to get labeling since residues in food are not a concern. Also, turf is a high-value crop so there is a commercial market. Therefore, many companies are looking to get their initial labeling for new nematicides for golf course turf. Within a few years some effective new turfgrass nematicides should be on the market for your use. The only drawback is that none of these new chemistries currently being evaluated are systemic. This means that they will probably be more consistently effective against ectoparasites than endoparasites.

Table 2. Accepted Damage Thresholds for Plant Parasitic Nematodes on Selected Cool- and Warm-Season Turf

		Damage Threshold (Nematodes/100 cm^3 soil)			
		Cool-season Grasses		Warm-season Grasses	
Nematode	Genera	Bentgrass	Tall Fescue	Bermudagrass	St. Augustine
Awl	*Dolichodorus*	150	50	10	10
Cyst	*Heterodera*	unknown	unknown	unknown	unknown
Dagger	*Xiphenema*	200	150	300	200
Lance	*Hoplolaimus*	150	100	40	40
Lesion	*Pratylenchus*	150	150	150	150
Pin	*Paratylenchus*	unknown	130	unknown	unknown
Ring	*Cricohemella*	1500	150	1000	500
Root Knot	*Meloidogyne*	100	2000	300	80
Sheat	*Hemicycliophora*	200	80	200	80
Spiral	*Helicotylenchus*	600	1000	1000	1000
Sting	*Belonolaimus*	20	12	20	unknown
Stubby Root	*Paratrichodorus*	100	150	100	40
Stunt	*Tylenchorhynchus*	300	100	100	200

Adapted from Couch, 1995. Diseases of Turfgrass, 3rd edition.

Calendar of Events

October 23, 2008, 8:30 a.m. - 4:15 p.m. - South Jersey Nursery Meeting, Managing Agricultural Water Use, Rutgers Cooperative Extension of Cumberland County, Extension Education Center, 291 Morton Avenue, Millville, NJ 08302

Registration Deadline: October 17, 2008 Contact: 856-451-2800

December 3, 2008 - 2008 South Jersey Landscape Conference and Nursery Growers Meeting on at Masso's Crystal Manor in Glassboro, NJ.

Both programs are listed at:
http://gloucester.njaes.rutgers.edu.

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