

Managing Turfgrass Diseases



PENNSSTATE



College of Agricultural Sciences
Cooperative Extension

Managing Turfgrass Diseases

*Revised by Peter Landschoot,
associate professor of turfgrass science,
from Extension Circular 339,
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by Patricia L. Sanders*

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Introduction

Disease in turfgrasses, as in other plants, develops from an interaction among a susceptible plant, a disease-producing organism (pathogen), and an environment favorable for disease development. Susceptible grasses and pathogens (usually fungi) are present in all lawns. In most cases, the pathogens exist in a dormant or saprophytic (feeding on dead or decaying substances) state and do not attack living plants. Diseases occur when environmental conditions (weather, management, and/or site conditions) become favorable for the build up of pathogen populations and/or cause an increase in the susceptibility of the plant. When this happens, turfgrass loss can occur.

There are a group of turfgrass diseases for nearly every environmental condition that may arise. Some diseases develop during the frigid months of winter under a blanket of snow, whereas others occur only during the hottest and most humid conditions of summer. Some diseases appear more frequently in wet soils and following applications of high rates of fertilizer, while others are triggered by drought and low fertility.

Disease Diagnosis

The first step in turfgrass disease management is identifying the true nature of the problem. Diseases are only one cause of turf loss, and disease control measures will do nothing to alleviate damage from other causes such as insects or drought stress. It is therefore essential to determine whether the problem is disease, and if so, which disease. Disease management strategies that are effective against one disease may have no effect on, or may even worsen, another disease.

The three disease factors (susceptible grass, pathogen, and environment) provide the sources of information for diagnosis. *Symptoms* are the expression of the susceptible grass to the disease and can take on a variety of sizes, shapes, and colors. Two kinds of symptoms should be examined in diseased turfgrass areas: symptoms on individual plants and symptoms on the turf stand. On individual plants, symptoms may appear as small, circular, tan-colored lesions surrounded by brown or purple borders (leaf spotting); as yellow, red, or tan blotches over most or all of the leaf blade (blighting); stunting; wilting; or as a brown or black rot on the crowns and roots. On stands, symptoms may take the form of circular patches, rings, spots, or

as humidity and precipitation just prior to and during disease development can give you an indication of which disease is present. The site characteristics also are important in disease diagnosis. Air movement, drainage, soil conditions, the amount of sun or shade, slope, and nearness of other plantings or buildings all may be important in the development of turf diseases. Poor fertilization and mowing practices may stress the turf and trigger or amplify certain turfgrass diseases, providing additional clues to disease identity.

Disease Control

Successful disease control practices involve manipulation of the environment, the grass, and/or the pathogen, to favor the health of the grass and inhibit the causal fungus. The environment can be altered in many ways, depending on the disease to be managed. For example, some diseases require free water for development. Effective strategies to reduce free water include removing dew and reducing the amount and/or frequency of irrigation. Im-

proved air movement, drainage, thatch reduction, reduced shade, proper regulation of fertilizer applications, and good mowing practices may be appropriate methods for reducing damage from particular diseases and ensuring vigorous turf for recovery from disease damage.

When establishing new turf areas or when renovating disease-damaged turf, it is important to select grasses that are resistant to diseases known to be common in your area or that have damaged your turf in the past. The seeding of disease-resistant grass varieties is an excellent way to minimize turf loss from diseases. For example, certain varieties of Kentucky bluegrass are resistant to leaf spot, a devastating

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irregular areas of dying or dead turf.

In some cases, the pathogen that causes a disease can be observed. Although most turfgrass pathogens are only visible when observed through a microscope, on occasion, pathogens produce structures such as spores, mushrooms, or massive amounts of mycelium (small, thread-like filaments produced by fungi) that can be seen without the aid of a microscope. These fungal structures are the *signs* of the pathogen and are useful, when combined with symptoms, for identifying some diseases.

The environment during the onset of the disease is another source of information used in diseases diagnosis. Factors such as temperature, light intensity, as well

disease on many Kentucky bluegrass turfs. Varietal resistance to other common diseases is available in all cool-season grasses. Another strategy is to seed a grass species that is resistant to a prevalent disease problem. For example, ryegrass may replace bluegrass in an area damaged by summer patch disease, or bluegrass might replace ryegrass in an area where *Pythium* blight is a problem.

In selecting grasses for turf establishment or renovation, it is always preferable to use *mixtures* of different grass species or *blends* of different varieties, rather than seeding a single species or variety. Seeding mixtures and/or blends produces a diverse population of grass plants. Such turf is usually more successful in surviving stress and attack by disease. It doesn't take much imagination to envision what would happen in a planting of one variety of a single species if a disease occurred that was able to cause severe damage on that variety. Diversity in a planting almost always increases odds of survival.

The third method of disease control is reduction of the pathogen population by applying fungicides that will either kill the fungus or keep it from growing. Again, it is important to have identified the disease correctly, so that an appropriate fungicide can be selected. Arbitrary selection and application of fungicides without knowledge of the disease cause can do as much harm as good. Using the wrong fungicide wastes money and may involve the risk of exacerbating the disease, as well as causing other unwanted side effects.

Turfgrass fungicides can be divided into two broad categories:

contact fungicides and systemic fungicides. The contact fungicides generally are applied to the leaf and stem surfaces of turfgrasses and do not move appreciably within the plants. Hence, these materials may be washed or mowed off the leaf and stem surfaces. Consequently, they are only effective for short durations (usually 7 to 14 days) and do not protect new foliage. These fungicides are usually used for the control of foliar diseases and not diseases of the roots and crowns. In general, contact fungicides have a broad spectrum of control and have been used extensively in the turf industry for a number of years.

The systemic fungicides are a newer group of chemicals that are absorbed and translocated within the plant. Thus, they are not as likely to be removed from the plant by rainfall and mowing. (There are several fungicides used on turf called *localized systemics*, meaning that they are translocated to a lesser extent in the plant than the other systemic fungicides.) The systemic fungicides may protect plants for a period of 2 to 4 weeks and will protect new growth. Most systemic fungicides can control both foliar and root/crown diseases. Systemic fungicides tend to have a rather narrow mode of action, thus, they are somewhat prone to a phenomenon called *resistance*.

Resistance in fungi to systemic fungicides occurs because these

fungicides generally poison fungi at only a single location in their growth and development

cycles. In such cases, it is possible that a small portion of the fungus population has the ability to short-circuit or get around the poisoned site and "resist" the poisoning

effects of the fungicide. As these individuals reproduce, a large percentage of their offspring will be resistant to the fungicide as well. If this population grows large enough, the fungicide is no longer effective in controlling the disease and the population is said to be resistant. While resistance does not occur often, it has developed where many fungicide applications have taken place, often with repeated applications of the same or similar fungicides. To reduce the occurrence of resistance, only apply fungicides when absolutely necessary, alternate and mix fungicides with different modes of action, and use broad spectrum contact fungicides in place of systemic fungicides whenever possible.

Turfgrass Diseases

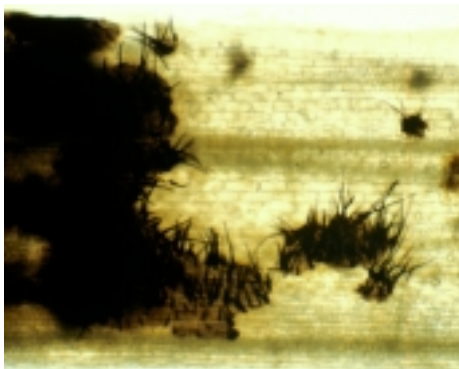
ANTHRACNOSE FOLIAR BLIGHT AND BASAL ROT, *COLLETOTRICHUM GRAMINICOLA*

Anthracnose can occur both as a foliar blight and a rot of the crown, stem base, and roots (basal rot). Anthracnose foliar blight typically occurs during mid-summer and attacks the leaves and stems of most cool-season turfgrass species. Particularly severe cases can develop on annual bluegrass fairways on golf courses. Anthracnose basal rot can occur during spring, summer, and fall and develops in the crowns, stem bases, and roots of annual bluegrass and creeping bentgrass, usually on golf course putting greens.

Symptoms and signs

Anthracnose foliar blight appears as irregular yellow or bronze patches of diseased turf. Symptoms on individual plants first appear as yellow or red lesions on the oldest (outermost) leaves, then progress to a blighting of younger leaves and shoots. Occasionally, fungal fruiting

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ACERVULI OF *COLLETOTRICHUM GRAMINICOLA* ON ANNUAL BLUEGRASS.

structures called *acervuli* can be observed with a good quality hand lens on diseased leaves and stems. Acervuli resemble small, black pin cushions and are the location of spore production.

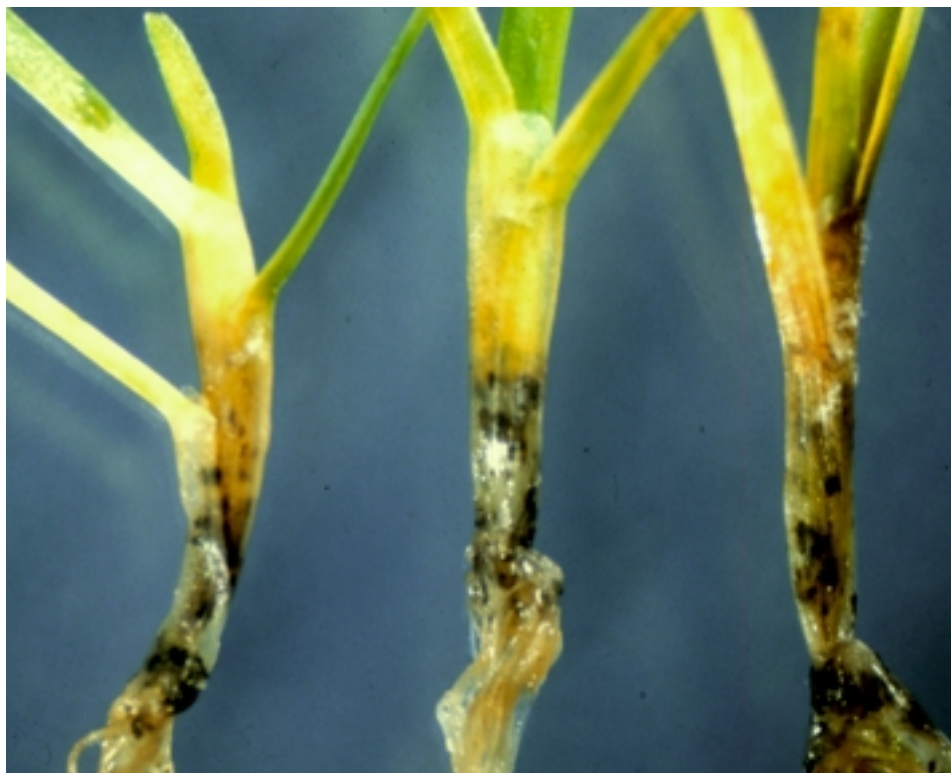
Anthracnose basal rot symptoms vary depending on the grass species affected. On annual bluegrass, symptoms appear as a bright yellowing of the turf in irregular patches. Affected bentgrass turf typically appears as irregular red or bronze patches and rarely appears yellow. On individual plants affected with anthracnose basal rot, a dark brown or black color is present at the base of the plant. As the disease worsens, the darkening (rotting) progresses up the stem and acervuli can be observed with a hand lens on stem and leaf tissue.

Disease cycle

The causal fungus, *Colletotrichum graminicola*, survives the winter as dormant resting structures called sclerotia and as dormant mycelium in infected plant debris. During early spring outbreaks of anthracnose basal rot, the fungus, which may have overwintered in the plant, initiates infection at the base of the plant. Outbreaks of anthracnose foliar blight and/or basal rot can result when spores produced in acervuli are dispersed by splashing water or tracked by mowing equipment from one area to another. These spores then germinate and cause new infections on other



ANTHRACNOSE BASAL ROT SYMPTOMS ON ANNUAL BLUEGRASS PUTTING GREEN.



ROT OF STEM BASES AND CROWNS ON ANNUAL BLUEGRASS AFFECTED BY ANTHRACNOSE BASAL ROT.

plants. Anthracnose is likely to occur when plants are growing slowly (during periods of hot and cold temperatures), during overcast periods, and in high humidity conditions.

Cultural control

Proper fertilization and maintaining good soil physical conditions are the most effective approaches to managing anthracnose. If your turf is underfertilized, increase the rate

and/or frequency of nitrogen fertilizer applications. This will improve resistance to the disease and aid in turf recovery. Add potassium and phosphorus if your soil test report indicates a need. Improved drainage and a regular aeration program will reduce excess soil moisture, alleviate compaction, and improve root growth, creating conditions that are less favorable for anthracnose.

Chemical control

Fungicides are only used to control anthracnose on golf courses. *Preventative* (before the disease occurs) applications of fungicides are generally more effective in controlling anthracnose foliar blight and basal rot than *curative* (after the disease appears) applications. Application timing will vary from one region to another and possibly from year to year at the same location. The best way to time your applications is to keep records for several seasons of the environmental conditions under which the disease occurred on your course, then apply fungicides when conditions are conducive for disease development.

BROWN PATCH, *RHIZOCTONIA SOLANI*

Brown patch is a major summer disease of lawns and golf courses. The most susceptible grass species include perennial ryegrass, tall fescue, and the bentgrasses. Occasionally, brown patch becomes a problem on Kentucky bluegrasses in mid- to late-summer during extended periods of high temperature and humidity.

Symptoms and signs

On high-cut turf, patches may be up to several feet in diameter and circular. In early morning on dew-covered turf, white mycelium of the causal fungus can often be seen on and between grass leaves and stems



SYMPTOMS OF BROWN PATCH ON CREEPING BENTGRASS PUTTING GREEN. NOTE DARK RINGS AROUND PERIPHERY OF PATCH (SMOKE RINGS). (Photo courtesy of Dr. Noel Jackson)



SYMPTOMS OF BROWN PATCH ON TALL FESCUE LEAVES. NOTE IRREGULAR, LIGHT BROWN LESIONS WITH DARK BROWN BORDERS. (Photo courtesy of Dr. Noel Jackson)

in the patch. Sometimes, all the grass within the patch is killed, creating a sunken or "pocket" effect. More often, the turf in these patches is thinned rather than completely killed. Occasionally, no circular

pattern can be seen, and the disease appears as a diffuse blight.

On tall fescue, symptoms of brown patch can be observed on individual leaves and not necessarily in patches. Symptoms on leaves

appear as irregular tan or light brown lesions surrounded by dark brown borders. In severe cases, the entire stand may look discolored and thinned.

A distinguishing feature of brown patch on golf course putting greens is the presence of dark purplish rings around the periphery of the patches. These are called smoke rings and range from 1/4 to 1/2 inch wide. Smoke rings are more pronounced in the early morning hours, usually fading by midday.

Disease cycle

The causal fungus overwinters in the form of resting bodies called sclerotia, either within infected grass tissue or in the soil. The fungus is capable of surviving in soil for years in the absence of a susceptible grass. Disease activity is prevalent when surface moisture and humidity are high, night temperatures are above 68° F and daytime temperatures average 80° F or above. Rainy weather and a saturated atmosphere (100 percent relative humidity) greatly speed disease development. Disease severity is greater on lush, succulent turfgrass maintained with high nitrogen levels than on grass maintained with moderate levels.

Cultural control

Applying nitrogen fertilizers on turf with a known history of brown patch during hot and humid weather may create the need for fungicide applications to control the disease. Removal of dew or guttation water that collects on the grass leaves each morning has proven effective as an aid in reducing brown patch. This removal can be achieved by mowing or by dragging a water hose across the area. Necessary watering should be done in time for the grass to dry before nightfall.



MYCELIUM OF *RHIZOCTONIA SOLANI* ON PERENNIAL RYEGRASS.

Chemical control

Fungicide treatment should only be needed on high-value ryegrass or bentgrass turfs. Fungicide treatment usually is made on a curative basis; the first spray should be applied immediately after the onset of symptoms, especially if prolonged hot, humid weather is expected. In areas where brown patch causes severe thinning on putting greens, preventative fungicide applications may be justified.

DAMPING-OFF DISEASES, *PYTHIUM*, *RHIZOCTONIA*, AND *FUSARIUM* SPP.

Damping-off diseases occur as seed rots and blights of seedlings. This disease seldom occurs on grass planted in early fall or early spring. However, in seedlings from May to August, especially if hot, wet weather persists, seed may decay prior to germination, or new seedlings may become diseased and die.

Symptoms and signs

Seedlings become blighted, then collapse and die, forming circular or irregular patches. Affected plants often appear water soaked and slimy. Sometimes mycelium can be seen on dew-covered grass in early morning. The dead tissue may mat together somewhat like paper-mache and form a crust over the soil surface.



DENSE, WHITE MYCELIUM OF DAMPING-OFF FUNGUS ON SEEDLING TURF.

Disease cycle

Most soils contain fungi that can attack seeds and seedlings. When conditions are favorable for grass seed germination and growth, as in the early fall and spring, these organisms usually are of little significance. Warm, wet weather, however, is more favorable for damping-off fungi and less favorable for seedlings. Under these conditions, fungi can severely damage seed and seedlings.

Damping-off outbreaks are triggered by high temperatures and humidity, water-logged soils, excessive fertilizer, or an excessive seeding rate. In warm weather, higher-than-normal rates of seed may produce a very dense stand of seedlings that will hinder the escape of moisture from the soil surface. Such wet conditions over long periods of time are ideal for invasion by damping-off fungi. High rates of fertilizer can produce a succulent turf that is more susceptible to attack by damping-off fungi. With new seeding techniques, such as hydroseeding and hydromulching, seeding is done all year round, and as a result, damping-off has become a more frequent cause of stand failure. Stand loss to seed decay or seedling blight makes successive attempts to reseed the dead areas more difficult.

Cultural control

Cultural control of damping-off diseases is based on providing

favorable conditions for germination of the grass seeds and growth of the plants while minimizing the conditions that favor the fungi. Often, this can be accomplished by planting in spring or fall when temperatures are cool and grass grows well. For summer seedings, prepare a good seed bed, select a seeding rate sufficiently low so that the stand is not too dense, do not apply excessive amounts of fertilizer, and prevent free water from standing on the soil surface. Avoid using excessive quantities of mulch following seeding.

Chemical control

Three types of chemical control methods may be used with new turf seedings: fungicide seed treatment prior to seeding, fungicide drenches or sprays on the soil after seeding, and/or fungicide sprays on the young seedlings. Each method can be effective, and the choice offers the possibility of chemical protection at various intervals during turf establishment. Selection of fungicide control practices depend on the site, the type of grass seeded, the seeding rate, and the environment at establishment.

DOLLAR SPOT, *SCLEROTINIA HOMOEOCARPA*

With regular watering of home lawns throughout much of the growing season, many turfgrass diseases, once problems only on golf courses and recreational turf areas, now appear commonly. Perhaps the most important of these is dollar spot.

Symptoms and signs

On golf course greens cut at or below 3/16 inch, this disease appears as white or tan spots of dead turf about the size of a silver dollar. Hence the name dollar spot. On home lawns cut at 1 to 3 inches, dead areas may reach 2 to 4 inches



SYMPTOMS OF DOLLAR SPOT DISEASE ON CREEPING BENTGRASS PUTTING GREEN.



SYMPTOMS OF DOLLAR SPOT DISEASE ON KENTUCKY BLUEGRASS LAWN.

in diameter. These spots may run together, producing large areas of dead turf. Affected leaves initially show yellow-green blotches, which progress to a light straw color with a reddish-brown margin. Occasion-

ally, white mycelium can be seen covering affected leaves in early morning on dew-covered grass. Dollar spot symptoms occur anytime from early to late summer. The disease usually reaches peak activity

when air temperatures are in the 80° F range and under high humidity. Symptoms also may appear in the fall. The most severe cases of dollar spot occur on turf receiving closely-spaced summer irrigation. The disease may also occur on nonirrigated turf when humidity is high from prolonged muggy summer weather. Dollar spot is more severe under nitrogen deficiency or when grass grows slowly.

Disease cycle

The causal fungus spreads via mycelium on infected plant parts (mostly clippings). Mycelium may be carried by the wind, water, or on turf equipment and shoes. This fungus does not produce spores. *Sclerotinia homoeocarpa* is thought to survive as thick-walled crusts of mycelium called pseudosclerotia in dormant infected plant tissues.

Cultural control

Late spring nitrogen-fertilizer applications can help to minimize dollar spot severity, since growth will be stimulated during the period (early summer) when dollar spot infection begins. On lawns, fertilizer that releases nitrogen slowly over an extended period is more advantageous than a quick-release product at this time of year. On golf courses, quick-release nitrogen fertilizers can be applied frequently at very light rates instead of using a slow-release fertilizer. Irrigate deeply, infrequently, and early in the morning to minimize moisture accumulation on leaves. Also, remove dew by early morning mowing or by dragging the turf with a water hose.

Chemical control

On irrigated turf with persistent dollar spot problems, fungicides are very effective against most forms of the causal fungus. Fungicides are almost always applied on a curative basis for controlling dollar spot. Both contact and systemic fungicides are effective in controlling this disease. Because resistance to certain



DOLLAR SPOT LESIONS ON KENTUCKY BLUEGRASS LEAVES.



MUSHROOMS PRODUCED BY FAIRY RING FUNGUS.



SYMPTOMS OF FAIRY RING ON HOME LAWN.

systemic fungicides has occurred with *Sclerotinia homoeocarpa*, using contact fungicides in a control program is suggested.

FAIRY RING, VARIOUS BASIDIOMYCETES (MUSHROOM FUNGI)

Symptoms and signs

Fairy rings typically appear as rings of dark green and fast-growing turf. They may also appear as rings of slow-growing or killed turf. The bands of affected turf are from 4 inches to a foot in width, forming

more or less continuous rings ranging from 3 to 200 feet across. In some instances, the center of a stimulated band may contain weakened or dead grass, or bands may have an inner zone of stimulated grass edged with dead or stunted turf on either side.

The first visible evidence of a new fairy ring is usually a cluster of mushrooms or toadstools. They usually appear at the outer edge of rings in late summer or early fall, during periods of high soil moisture.

Disease cycle

Fairy rings are produced by colonies of mushroom fungi that live in soil and thatch. These colonies obtain food from decaying organic matter and grow outward radially, increasing in size year after year. The ring of stimulated grass is thought to be caused by nitrogen substances produced by the breakdown of organic matter by the fungi. The fungi usually do not attack grass, but sometimes they repel water, resulting in death of the turf due to drought. The causal fungi are spread when fungal threads, bits of mushrooms, or spores from the mushrooms are introduced into soil under a turf area.

Cultural control

Try to maintain a sufficient growth rate of the grass. Mow frequently to minimize the differences in grass vigor between the ring and the rest of the lawn. At times, large areas may be killed by fairy rings. When the grass is killed, it may be possible to remove the sod and the top 6 inches of soil and then reseed or resod. However, this practice does not always work. Sometimes nothing, not even weeds, will grow in areas killed by fairy rings.

Chemical control

Attempts to control fairy rings with fungicide drenches or soil fumigation have met with little or no success.

GRAY SNOW MOLD, *TYPHULA INCARNATA*

Snow mold diseases occur during winter and/or late spring under snow cover. Several snow mold diseases affect turfgrasses in the northeastern United States. The two most common are gray snow mold and pink snow mold.

Symptoms and signs

This disease is usually noticed first as the snow melts in the spring. It is commonly found in those turf areas



GRAY SNOW MOLD ON HOME LAWN.



MATTED LEAVES OF GRAY SNOW MOLD-AFFECTED TURF.

of greatest snow accumulation, such as along driveways or over the brink of a hill where snow drifts tend to accumulate. The most notable symptoms are white crusted areas of grass in which blades are dead, bleached, and matted together. These bleached areas range from several inches to several feet across. The chief diagnostic feature of gray snow mold is the presence of hard pinhead-sized fungal bodies called sclerotia. These light to dark brown sclerotia are embedded in the leaves and crowns of the infected grass plants.



SCLEROTIA OF *TYPHULA INCARNATA*, CAUSE OF GRAY SNOW MOLD. (Photo courtesy of Dr. Noel Jackson)

Disease cycle

Sclerotia overwinter in thatch, clippings, and the crown area of the grass plants. They germinate in fall and produce mycelial growth beneath the snow cover and infect plants. Gray snow mold seldom occurs except under snow cover when the soil is not frozen. In most instances, the fungus kills the blades of the plant, but does not kill the crown and roots.

Cultural control

Gray snow mold usually can be managed successfully in home lawns without the use of fungicides.

Keep the turf mowed well into the fall to avoid leaving unclipped grass that tends to fall over and mat when snow falls. Try to avoid creating long-lasting snow banks when removing and piling snow from sidewalks and driveways. When symptoms appear at snow melt in the spring, rake the infected areas and break the crusted, matted leaves to encourage new growth. Kentucky bluegrass and the fine fescues tend to be more resistant to gray snow mold than creeping bentgrass, perennial ryegrass, and tall fescue.

Chemical control

If gray snow mold tends to occur even though the cultural practices are correct, fungicides may be considered. Apply the fungicide prior to the first permanent snow cover in the fall. In many areas, this may be around Thanksgiving. A single application at this time usually will provide a satisfactory measure of control. Applying fungicides after the symptoms appear in the spring is of no value.

LEAF SPOT AND MELTING-OUT (CROWN AND ROOT ROT) DISEASES, *BIPOLARIS*, *DRECHSLERA*, AND *EXSEROHILUM* SPP.

Leaf spot and melting-out diseases are incited by a group of fungi in the genera *Bipolaris*, *Drechslera*, and *Exserohilum*. These fungi used to be referred to as *Helminthosporium* and many individuals still use this name for convenience. Every cool-season grass species probably has a leaf spot/melting-out disease associated with it, but Kentucky bluegrass is particularly susceptible. These organisms, under pasture and native grassland conditions, cause leaf spots of little consequence. However, as cutting height is reduced and the nitrogen level increased, leaf spot diseases may become so severe that complete loss of the turf can occur.



SYMPTOMS OF LEAF SPOT DISEASE ON KENTUCKY BLUEGRASS.

Symptoms

The causal fungi usually first invade the leaves, producing small brown spots. As the disease worsens, the spots on leaf blades expand and produce a dark purplish-red oval border around a tan center. The spots enlarge until the entire width of the leaf blade is blighted. The leaf-spotting or leaf-blighting phase is less damaging to the turfgrass than is the melting-out (crown and root-rot) phase of the diseases. In melting-out, the crowns and roots are damaged, causing severe thinning of the turf.

Disease cycle

This disease cycle outlines the most problematic leaf spot disease, spring leaf spot/melting-out of Kentucky bluegrass. The causal fungus survives the winter in crowns and roots of turfgrass or on turf debris on or in the soil. The fungus becomes active during the cool, wet weather of spring (April to early May). Spores are produced by the causal fungus on leaves and are released

and splashed by rain or irrigation water to newly emerging grass leaves, causing new leaf spots. Successive generations of spores and leaf spots are produced during mid- to late-spring. Spores wash to the crown and root areas, inciting the melting-out phase of the disease usually by late spring or early summer.

Keep in mind that not all leaf spot diseases are spring problems. During summer, leaf spotting fungi can attack nearly every grass species. Certain varieties of Kentucky bluegrass, perennial ryegrass, bentgrasses, tall fescue, and fine fescues are susceptible. It is very difficult to predict when the symptoms will be most severe. In most Kentucky bluegrass turfs, however, mid- to late-spring is the time of greatest activity and damage.

Cultural control

Applying excessive nitrogen in early spring usually will make leaf spot and melting-out diseases more severe. These diseases can also be severe under nitrogen deficiencies.

The lush, dark green, fast growing lawn in early-spring is the kind of condition that encourages the disease in May. Probably the most important factor in controlling spring leaf spot and melting-out diseases is not to apply excessive nitrogen fertilizer (more than 1.5 lb nitrogen/1000 sq ft) in early spring. A nitrogen application in the range of 0.5 to 1.0 lb nitrogen/1000 sq ft in early spring is a reasonable amount of fertilizer to apply for most Kentucky bluegrass lawns. Possibly the best nonchemical method for controlling leaf spot and melting-out diseases is to replant damaged and disease-prone areas with resistant varieties.

Chemical control

Fungicides effectively control leaf spot and melting-out diseases, but correct application and timing are critical. An effective fungicide program requires that the first application be made in early April when the grass begins to green and that applications be repeated during late April and early May, usually at two-week intervals. Fungicides applied at the melting-out stage, when damage is readily apparent, usually produce little improvement. Recovery of the turf at this stage becomes a matter of encouraging regrowth of the thinned turf. If plant loss is severe, overseeding is required. For the summer leaf spot diseases, fungicide applications should begin as soon as the first leaf spots appear.

NECROTIC RING SPOT, *LEPTOSPHAERIA KORRAE*

Necrotic ring spot is one of three patch diseases caused by root pathogens that are problems of cool-season turfs. The other two are summer patch of bluegrasses and fine fescues and take-all patch of creeping bentgrass. Though not all caused by the same fungus, these



SYMPTOMS OF NECROTIC RING SPOT DISEASE ON KENTUCKY BLUEGRASS LAWN.

diseases have similar patch-type symptoms, the causal fungi are related and similar in appearance, and these fungi attack grass roots and crowns in a similar manner.

Symptoms

Symptoms of necrotic ring spot appear as circular, ring-shaped, or serpentine patches of dead or dying turf. Affected areas may be a few inches to a foot or more in diameter. These patches may at times coalesce, or they may stand out as individual dead rings. Leaves and stems of affected turf appear yellow or red, then turn a light tan as the disease progresses. Roots and crowns of diseased plants are rotted and recovery of affected areas is slow. Necrotic ring spot seldom occurs in newly planted turf but can occur on turf that has been recently sodded. It may begin during the fourth or fifth year following seeding and can become progressively more severe.

Disease cycle

Leptosphaeria korrae grows on the surface of grass roots for most of the

growing season without causing visible symptoms. When conditions become favorable for the disease, the fungus attacks and destroys the roots. It is unknown if spores are responsible for transporting the pathogen from one area to another. Environmental conditions that favor necrotic ring spot may vary from one location to another. In some locations, the disease is more severe during the cool periods of spring and fall, whereas in other areas, the disease occurs only in midsummer. Necrotic ring spot is generally more severe on drought-stressed turf, but can damage turf growing in moist soils as well.

Cultural control

To keep necrotic ring spot to a minimum, use cultural practices that reduce turf stress, such as irrigation during periods of drought stress and mowing lawn grasses at two inches or higher. The most effective way to manage necrotic ring spot in a home lawn is to use perennial ryegrass to overseed affected areas. Perennial ryegrass is

highly resistant to this disease. Also, some benefits may result from overseeding Kentucky bluegrass varieties that are resistant to necrotic ring spot.

Chemical control

Most systemic fungicides will provide some control of necrotic ring spot when applied on a preventive basis. However, results are often erratic and the cost of the treatment is usually too high for most home lawn situations.

PINK SNOW MOLD AND FUSARIUM PATCH, *MICRODOCHIUM NIVALE*

Pink snow mold and Fusarium patch are diseases caused by the fungus *Microdochium nivale*. Pink snow mold is the name used to describe the disease associated with snow cover, appearing when snow melts. Fusarium patch is the name of the disease that occurs without snow cover. The causal organism of these diseases, *Microdochium nivale*, was formerly known as *Fusarium nivale*. To avoid confusion, Fusarium was retained as the disease name.

Symptoms and signs

Pink snow mold is a true snow mold since it develops under snow cover. The disease gets its name from the accumulation of pink fungal spores that pile up on the leaves of infected grass plants, producing a pink cast on circular patches of matted grass. Usually only leaves are attacked, but under conditions favorable for disease development the fungus may kill the crowns and roots as well. Thus, pink snow mold can be more severe than gray snow mold. Fusarium patch is similar in appearance to pink snow mold except that the centers of the patches are not usually as matted. Often, a fluffy growth of mycelium can be observed around the periphery of the patch. During periods of cool, wet weather from October to April,



SYMPTOMS OF PINK SNOW MOLD ON ANNUAL BLUEGRASS PUTTING GREEN.

Fusarium patch may appear when temperatures are in the 40° to 50° F range. If pink snow mold develops in the cold, wet weather in early fall, the fungus may continue its activity through the winter and into spring. Damage to the turf is then likely to be quite severe and long-lasting.

Disease cycle

The fungus survives warm dry weather as dormant fungal mycelium or as dormant spores in soil and thatch. Spores germinate in cool, wet conditions, producing hyphae that infect grass leaves.

Cultural control

Pink snow mold usually can be managed successfully in home lawns without fungicides provided the lawn has been established for more than a year. Mow on a regular schedule well into the fall, and avoid high unclipped grass that tends to fall over and mat under snow cover. Try to avoid creating snow banks when removing and piling snow from sidewalks and driveways. Straw mulches and piles



MATTED FOLIAGE OF PINK SNOW MOLD-AFFECTED TURF.

of leaves provide a favorable environment for pink snow mold and should be removed from the lawn before snow fall. In general, creeping bentgrass and perennial ryegrass are most susceptible to this disease, whereas Kentucky bluegrass and the fine fescues are only moderately susceptible.

Fusarium patch is typically only a problem on golf courses and can be managed by maintaining a balanced fertility program and avoiding excessive nitrogen applications in mid-fall.

Chemical control

Fungicide treatment may be needed to control pink snow mold and Fusarium patch in new turfgrass seedings or if a history of unmanageable outbreaks is known. On golf courses, fall or spring fungicide applications may be needed in cold, wet weather.

POWDERY MILDEW, *ERYSIPIHE GRAMINIS*
Symptoms and signs

This fungus first appears as isolated wefts of fine, gray-white, powdery growth on the upper surface of the grass leaf. This growth rapidly becomes more dense and may cover the entire leaf, giving the leaf a gray-white appearance. In severe outbreaks, entire portions of the turf stand may be dull white, rather than green. Individual leaves look as though they are covered with flour or white powder.

Disease cycle

The causal organism overwinters in dead grass and in infected living grass plants. Spores of the fungus spread by wind to leaves of other turfgrass plants. Conditions favorable for the development of powdery mildew include poor air circulation, high atmospheric humidity (but no free water on the leaf surfaces), low light intensity or shade, and cool air temperatures. Kentucky bluegrass, when planted in shaded areas, is particularly susceptible to this disease.

Cultural control

Where occurrence of powdery mildew is frequent, changing landscape plantings to improve air drainage and reduce turf shading will aid in disease reduction. Prune overstory trees to allow sunlight to reach the turfgrass. Turfgrass species differ in their susceptibility to powdery mildew. Kentucky bluegrass, for example, is quite susceptible to this disease, whereas



SIGNS OF POWDERY MILDEW FUNGUS ON KENTUCKY BLUEGRASS.

the fine fescues and tall fescue are quite resistant.

Chemical control

Fungicides, except for highly managed turf areas, are not necessary.

PYTHIUM BLIGHT, *PYTHIUM APHANIDERMATUM*

Pythium blight, also known as grease spot and cottony blight, can be a highly destructive turfgrass disease, especially on bentgrasses and ryegrasses. Severe outbreaks

can completely destroy the turfgrass within a few days if weather conditions favor disease development.

Symptoms and signs

Pythium blight first appears as small, irregularly shaped spots ranging from 1/2 to 4 inches in diameter. Leaves appear water-soaked in appearance at first, then shriveled. Diseased patches fade to a light brown or gray color. Groups of spots frequently join together. At times, the shape of the affected areas may resemble elongated streaks. Both the presence and pattern of these streaks seem to be determined by the flow or presence of surface water. With high humidity in early morning or throughout the day, diseased leaves may be covered with the white, cobwebby, moldlike growth of the causal fungus.

Disease cycle

Pythium fungi may survive for long periods in the soil. In turf with a history of Pythium blight, infected plant debris from the previous season or fungus spores in the soil



SYMPTOMS OF PYTHIUM BLIGHT ON CREEPING BENTGRASS PUTTING GREEN.



DENSE MYCELIUM OF *PYTHIUM APHANIDERMATUM* ON TALL FESCUE LAWN.

are sources of infection. Disease development from the first infection centers occurs by growth of fungal mycelium and movement of spores from plant to plant. Under conditions favorable for disease development, *Pythium* blight can spread very rapidly.

Primarily a warm, wet weather disease, turf blighting and disease development will be most rapid and severe at air temperatures from 85° to 95° F. As the air temperature approaches 95° F, destruction of grass stands can occur in a very short time. *Pythium* blight develops more rapidly when nitrogen levels are high, and more slowly under moderate or low nitrogen fertilizer programs.

Cultural control

In problem areas, satisfactory plant growth maintained through moderate fertilizer applications provides the least risk of *Pythium* blight damage. Kentucky bluegrass, the fine fescues, and tall fescue are less susceptible to *Pythium* blight than perennial ryegrass and bentgrasses. Providing adequate water and air drainage, especially where susceptible grasses are grown, can help control this disease.

Chemical control

In the northeast United States, bentgrasses and ryegrasses may need fungicide protection. Timing of fungicides is important. If continued hot, wet weather is expected, the



SYMPTOMS AND SIGNS OF RED THREAD DISEASE ON PERENNIAL RYEGRASS.

first spray should be applied as soon as symptoms develop. On high value turf, such as golf course putting greens, tees, and possibly fairways, preventative fungicide applications may be justified.

RED THREAD, *LAETISARIA FUCIFORMIS* AND PINK PATCH, *LIMONOMYCES ROSEIPELLIS*

Symptoms and signs

These two diseases present similar symptoms and appear as irregularly shaped patches of blighted grass. From a distance, affected areas have a reddish or pinkish cast. These diseases are usually restricted to the leaves, leaf sheaths, and stems, but in severe cases may kill the entire plant. In the early stages of infection, symptoms appear as small blighted areas on leaves that enlarge rapidly to cover most of the leaf. Affected leaves dry out and fade to a bleached straw color. During moist weather, the leaves may become covered with the pink gelatinous growth of the causal fungi.

Diagnosis of red thread is most certain in the advanced stages of disease development, when bright thread-like coral pink fungus mycelium, 1/16 to 1/4 inch in length, are produced at the tips of the affected leaves. In the case of pink patch, affected leaves are covered with the pink fluffy growth of the causal fungus.



SYMPTOMS AND SIGNS OF PINK PATCH DISEASE ON PERENNIAL RYEGRASS.

Disease cycle

The fungi overwinter as a dried gelatinous mycelium covering on infected dead leaves or in clipping debris from previously infected plants. The fungi spread by transport of mycelium or infected leaves to new areas. The mycelium on living, infected plants are easily broken loose and transported mechanically. Fungi enter leaves through natural openings and cut tips, and spread rapidly through the remainder of the leaf. Red thread and pink patch diseases develop more readily when air temperatures are 65° to 75° F, with prolonged periods of rainy or humid weather. At times, the disease occurs in warmer, drier weather.

Cultural control

Where red thread or pink patch causes turf damage, maintenance of adequate nitrogen levels for turf growth usually will reduce the problem. Turf managers should be aware, however, that at high nitrogen levels other diseases, such as leaf spot and brown patch, may become damaging.

Chemical control

In most turf situations, these diseases are not sufficiently severe to warrant fungicide treatment. Occasionally, however, pure stands of ryegrass or fine fescues may become severely blighted during wet weather. In such cases fungicide treatment will minimize symptoms.

RUST DISEASES, *PUCCINIA* SPP.

There are a number of rust diseases that affect turfgrasses. A few of the more common rusts that occur on cool-season grasses include stem, stripe, crown, and leaf rust. Although there are differences among these diseases with respect to the symptoms and portion of the plant affected, they generally occur under the same environmental conditions.

Symptoms and signs

Early infection appears as a light yellow flecking of the leaves. As these flecks enlarge, they may become somewhat longer than broad and when numerous they are arranged in rows parallel with the veins of the leaves. Soon, the epidermis ruptures and the spots develop into reddish-brown pustules. Severely infected plants have an appearance similar to rusty-iron, hence the name rust. When infected leaves are rubbed between your fingers or walked upon, a red powder collects on fingers or shoes. This powder is composed of millions of tiny spores of the fungus. Rust is normally a late summer or early fall problem and does not occur during other times of the year.

Disease cycle

The cycle of development for rust diseases is quite complex. Of the dozen or so species of rust fungi that affect turfgrasses, all but three go through five distinct spore production stages. Some of these stages, which are necessary for the completion of the entire life cycle, must occur on plants that are unrelated to the grasses. For a specific rust species, completion of the rust life cycle may require grasses and woody shrubs or grasses and herbaceous ornamental plants. In general, rust diseases do not kill turfgrasses, but may weaken them to the point that they become more susceptible to stress-related problems.



SIGNS OF THE CAUSAL FUNGUS OF RUST DISEASE ON KENTUCKY BLUEGRASS. (Photo courtesy of Dr. Noel Jackson)

Cultural control

Adequate nitrogen and irrigation to maintain growth through late summer will minimize rust infections. In most years, the disease will not become severe, although infected turf may become yellowish-orange.

Chemical control

Fungicides are used only as a last resort; one or two sprays applied after the onset of symptoms usually will suffice.

SLIME MOLDS, *MUCILAGO*, *PHYSARUM*, AND *FULIGO* SPP.

Slime molds are different from most other turfgrass pathogens in that they do not directly infect the plant. Instead, this group of organisms feeds on microorganisms and decaying organic debris. During periods of warm, wet weather, slime molds migrate onto the surfaces of turfgrass leaves where they produce massive amounts of their reproductive structures, thus producing a white, blue, or gray patch.

Symptoms and signs

Grass blades and the surface of the soil may be covered with a translucent slimy, creamy-white growth. In a few days, this slimy growth changes to pinhead-sized masses of various colors (usually gray or blue). The affected areas may be



SPORE MASSES OF SLIME MOLD FUNGUS ON KENTUCKY BLUEGRASS LAWN.

from a few inches to many feet, with shapes ranging from rings to streaks or patches.

Disease cycle

Slime molds survive adverse conditions in the spore stage. In cool, humid weather, the spores absorb water. The spore wall cracks open, and a motile spore emerges. The motile spores feed on other microorganisms and decaying organic matter, but do not infect living turfgrasses. Eventually, pairs of spores unite and increase in size. This form of the organism is called a plasmodium, and it is this stage that produces the slimy overgrowth on turfgrasses. Slime mold plasmodia and reproductive structures may shade the grass leaves to the extent that leaves are yellowed, but damage seldom is severe.

Cultural control

Slime molds do not damage turf (apart from shading) and can be removed by sprinkling the leaves with water after the onset of dry weather. Removal of the dry spore masses by mowing, raking, brushing, or sweeping with a pole will aid in returning the grass to normal appearance. Chemical control is not necessary.

SUMMER PATCH, *MAGNAPORTHE POAE*

Summer patch, sometimes called Poa patch, occurs on Kentucky bluegrass and fine fescues on lawns and grounds, and on annual bluegrass on golf course greens and fairways.

Symptoms

Symptoms of summer patch on lawns, grounds or golf course fairways appear identical to necrotic ring spot. Hence, diseased specimens may have to be examined by a qualified diagnostician if positive identification is necessary.

On putting greens, summer patch may begin as small (2 to 3 inch) circular patches that progress to larger (up to 12 inches) patches if conditions favor disease development. More often, large patches will appear suddenly with no indication of previous disease activity. In severe cases, the patches may coalesce and destroy large areas of turf. The patches initially take on a yellow color, then turn tan or a straw-brown color as the plants die. On greens with mixed annual bluegrass/bentgrass populations, the bentgrass usually will colonize the center of patches of affected annual bluegrass, creating a ring-shaped appearance.

Disease cycle

The causal fungus, *Magnaporthe poae*, colonizes grass roots in advance of disease causing activities. When conditions are favorable for disease activity, the fungus will invade the roots. Summer patch commonly occurs in midsummer during extended periods of high temperatures (>82° F) following wet weather or heavy irrigation. The disease does not appear during the cool weather of spring and fall. Summer patch is more frequently observed in areas that receive heavy traffic, poor air circulation, and inadequate drainage.



SYMPTOMS OF SUMMER PATCH DISEASE ON KENTUCKY BLUEGRASS LAWN.



SYMPTOMS OF SUMMER PATCH DISEASE ON ANNUAL BLUEGRASS PUTTING GREEN.

Cultural control

Since summer patch is a root disease, cultural practices that promote good root growth will aid in reducing disease severity. Increased aeration and improved drainage on

compacted and poorly drained soils will alleviate some root inhibition and enable the turf to better resist infection by *Magnaporthe poae*. Because low mowing heights are conducive to shallow rooting,

raising the height of cut may result in less summer patch injury.

Chemical control

On golf courses, summer patch can be controlled with fungicides provided that applications are made on a preventative basis (3 to 4 weeks prior to symptom development) and high rates of systemic fungicides are used. Application of fungicides with large amounts of water (5 to 10 gallons per 1000 sq ft) has provided superior control in some locations. Chemical control of summer patch in lawns is generally considered too expensive.

TAKE-ALL PATCH, *GAEUMANNOMYCES GRAMINIS*

This disease has been called Ophiobolus patch or Gaeumannomyces patch. Only bentgrasses are susceptible, so it is seen most commonly on golf course greens and fairways, where it can cause serious turf losses.

Symptoms and signs

Take-all patch usually appears in the late spring or early summer as reddish-brown or yellow areas of dead grass. Infection centers appear as rings, crescents, or spots in pure bentgrass stands. The center of the patch often is invaded by annual bluegrass or other weeds. In mixed stands of turf, the bentgrass is killed and other grasses in the stand remain. Affected areas may enlarge as much as 6 inches or more in a year and eventually will exceed 3 feet. The symptoms become most conspicuous after turf has been stressed from hot, dry weather, even though moist, cool conditions favor infection and growth of the causal fungus.

Dead or dying roots may be covered with dark brown strands of fungus (runner hyphae), and dark brown to black mats of fungal growth may be present on the stem



SYMPTOMS OF TAKE-ALL PATCH ON CREEPING BENTGRASS FAIRWAY.

bases beneath the leaf sheaths and on the crowns and roots of the killed tillers.

Disease cycle

Take-all patch is most frequently observed on bentgrass planted in recently fumigated soils and/or in recently cleared forested or wetland areas. In these situations, the beneficial microorganisms that compete with or antagonize *Gaeumannomyces* are present in low populations. In most cases, the disease will decline over a period of 4 or 5 years, a phenomenon thought to be associated with the build-up of antagonistic microorganisms. The causal fungus grows on the surface of bentgrass roots and attacks the roots in cool, wet weather, although the symptoms do not appear until warm, sunny weather occurs.

Cultural control

Since disease damage is, time-wise, removed from the symptoms, it is important to implement control measures prior to symptom development. Bentgrass take-all is most

serious in soils with pH above 6.0.

In some cases, liming appears to stimulate the fungus. At present, the only effective control known for bentgrass take-all patch is the use of some form of sulfur or an acidifying fertilizer such as ammonium sulfate or ammonium chloride. Ammonium sulfate should be applied and watered-in two to four times yearly, in spring and fall.

Chemical control

Some of the broad-spectrum systemic fungicides may control this disease if applications are timed to prevent fungal invasion of bentgrass plants in cool, wet environments. However, results obtained from fungicide applications are erratic and rarely give complete control.

YELLOW PATCH, *RHIZOCTONIA CEREALIS*

Yellow patch, which sometimes is referred to as cool temperature brown patch, occurs primarily on bentgrass and annual bluegrass putting greens, but may occasionally be found on Kentucky bluegrass lawns.

Symptoms

On putting greens, this disease becomes visible when snow melts and appears as tan, brown, or yellow rings up to two feet in diameter. The blighted turf usually is located around the periphery of the patch, leaving healthy appearing turf in the center. Damage from yellow patch usually is superficial, but significant turf loss can occur following prolonged snow cover or during prolonged cool and wet weather in early spring. Rings may appear on high cut turf as well, but rarely cause serious damage.

Disease cycle

Rhizoctonia cerealis overwinters as dormant resting structures and begins disease-causing activities during cool, wet weather (fall, spring, or winter) at temperatures of about 40° F. The disease frequently develops under prolonged snow cover, but does not require snow cover to produce symptoms. The fungus primarily attacks the leaf blades of turf, but can infect crowns and roots.

Cultural control

Maintaining adequate levels of soil nutrients will help turf resist severe thinning by this disease. Improved surface and subsurface drainage will aid in reducing surface moisture that provides favorable conditions for disease development. Also, timely removal of winter greens covers will help surface drying and will reduce some disease incidence. Light applications of nitrogen fertilizer in the spring will quicken turf recovery from this disease.



SYMPTOMS OF YELLOW PATCH ON CREEPING BENTGRASS PUTTING GREEN.

Chemical control

Preventative applications of broad spectrum fungicides in late fall and/or winter may help to reduce disease severity in winter or early spring.

NEMATODES

Plant parasitic nematodes are small roundworms, invisible to the unaided eye, that live in the soil and on the roots of plants. They feed on the cell sap of roots by piercing the root with a spearlike mouth part similar to a hypodermic needle. Feeding by nematodes may destroy many of the feeder roots, curtailing the ability of the grass plant to obtain minerals and water from the soil. The feeding wounds produced by nematodes are used by some fungi to gain entry into the interior of the roots, causing root-decay diseases.

The majority of soil nematodes are free-living, do not possess a spearlike mouth part, and do not feed on plant roots. These beneficial

nematodes feed on dead organic matter, fungi, and insects in the soil.

Symptoms

Symptoms of nematode injury are similar to those associated with poor soil fertility. Nematode-infected plants exhibit these symptoms, not because the nutrients are lacking in the soil, but because the roots have been destroyed by nematodes or because the nematodes are taking nutrients needed by the plant as they feed. If soil is of satisfactory structure and texture but poor growth, off-coloring, and thinning of turf occurs and the turf does not respond to fertilization, there is a possibility that nematodes are involved.

Disease cycle

Soil in the root zones of grass plants just beginning to decline is more likely to contain parasitic nematodes than is soil around dead or nearly dead grass plants. Nematodes are easiest to detect in mid- to late summer when their populations are the highest. Accurate diagnosis of a nematode problem requires profes-

sional analysis and identification. Soil and root samples collected for nematode assay should be kept moist and cool until identification is completed. Samples collected from mid-October to May often show lower populations because the nematodes are in the egg stage and cannot be detected by normal sampling techniques.

Cultural control

Vigorous turfgrass is less likely to show damage from nematode injury. However, knowledge of the many factors influencing nematode population levels in northeastern United States is so limited that distinct cultural practice recommendations are not possible.

Chemical control

Nematicides are available as highly toxic fumigants and drenches. Chemical treatment may be undertaken only by professional pesticide applicators and only after professional diagnosis shows nematodes to be the problem.

GENERIC AND TRADE NAMES OF COMMON TURFGRASS FUNGICIDES.

Generic names	Contact (C), localized systemic (LS), or systemic (S)	Common trade names ¹
Azoxystrobin	S	Heritage
Captan	C	Captan
Chloroneb	LS	Terraneb SP, Teremec SP, ProTurf Fungicide V
Chlorothalonil	C	Daconil, Manicure, Thalonil, Echo
Cyproconazole	S	Sentinel
Ethazole (Etridiazole)	C	Koban, Terrazole
Fenarimol	S	Rubigan
Fosetyl-Aluminum	S	Aliette, Prodigy
Flutolanil	S	ProStar
Iprodione	LS	Chipco 26019, ProTurf Fungicide X
Mancozeb	C	Fore, Dithane T/O, Protect T/O, 4 Flowable Mancozeb
Metalaxyl	S	Subdue, Apron (seed treatment only)
Mefenoxam	S	Subdue MAXX
Myclobutanil	S	Eagle
PCNB (Quintozene)	C	Cleary's PCNB, Revere, Penstar, Terraclor, Turfcide, Turfgo Engage
Propamocarb	S	Banol
Propiconazole	S	Banner MAXX
Thiophanate-methyl	S	Cleary's 3336, Fungo 50
Triadimefon	S	Bayleton, ProTurf Fungicide VII, Granular Turf Fungicide
Vinclozolin	LS	Vorlan, Curalan, Touche
Thiram	C	Spotrete-F, Thiram
<i>Combination products</i>		
Fenarimol + Chlorothalonil	S + C	Twosome
Thiophanate-methyl + Chlorothalonil	S + C	ConSyst
Thiophanate-methyl + Mancozeb	S + C	Duosan
Thiophanate-methyl + Iprodione	S + LS	ProTurf Fluid Fungicide
Triadimefon + Metalaxyl	S + S	ProTurf Fluid Fungicide II
Triadimefon + Thiram	S + C	ProTurf Fluid Fungicide III
Metalaxyl + Mancozeb	S + C	Pace

¹Products may be available only through specialized dealers or only in large quantity. Some products can be purchased and applied only by licensed pesticide applicators. This list is presented for information only. No endorsement is intended for products mentioned, or is criticism meant for products not mentioned.

SUMMARY OF DISEASE MANAGEMENT STRATEGIES.

Diseases and pathogens	Environmental management and resistant species/cultivars	Fungicides
Anthracnose (<i>Colletotrichum graminicola</i>)	Provide adequate fertility (especially nitrogen), avoid excess irrigation, improve drainage, aerate to relieve compaction, and improve air circulation. Annual bluegrass and creeping bentgrass particularly susceptible. No resistant cultivars known.	Azoxystrobin Chlorothalonil Cyproconazole Fenarimol Propiconazole Thiophanate methyl Triadimefon
Brown patch (<i>Rhizoctonia solani</i>)	Avoid excess nitrogen and irrigation in summer. Creeping bentgrass, perennial ryegrass, and tall fescue are the most susceptible. Kentucky bluegrass and fine fescues are the most resistant species. <i>Resistant perennial ryegrass cultivars:</i> Prizm, Affinity, APM, Morning Star, Bright Star, Prelude II, Assure, Wind Star, Riviera II, Mulligan, and Seville.	Azoxystrobin Chlorothalonil Cyproconazole Fenarimol Flutolanil Iprodione Mancozeb Myclobutanil Propiconazole Thiophanate methyl Triadimefon Vinclozolin Thiram
Damping-off (species of <i>Fusarium</i> , <i>Pythium</i> , and <i>Rhizoctonia</i>)	Avoid excessive seeding rates and excess nitrogen. Do not seed in summer unless absolutely necessary. Avoid overabundance of mulch. No resistant species/cultivars known.	Captan ¹ Banol Ethazole (Koban) Metalaxyl ¹
Dollar spot (<i>Sclerotinia homoeocarpa</i>)	Avoid nitrogen deficiency, drought stress, and night watering. Remove dew in early morning. Creeping bentgrass, annual bluegrass, and Kentucky bluegrass particularly susceptible. Tall fescue is quite resistant. <i>Resistant creeping bentgrass cultivars:</i> Penn A-1, Penn G-2, L-93, Cato, and Providence. <i>Resistant Kentucky bluegrass cultivars:</i> Preakness, Princeton 104, NuStar, Unique, Banff, A-34, and Eagleton.	Chlorothalonil Cyproconazole Fenarimol Iprodione Mancozeb Myclobutanil Propiconazole Thiophanate methyl Triadimefon Vinclozolin Thiram
Fairy rings (basidiomycete fungi)	Mask symptoms by fertilizing with nitrogen and/or iron. Thoroughly water rings to avoid drought. Core aeration and application of wetting agents may help wetting of affected soils. No resistant species/cultivars available.	Flutolanil
Gray snow mold (<i>Typhula incarnata</i>)	Avoid piling snow in sensitive turfed areas. Remove tree leaves from turf before snow cover. Rake disease damaged areas in spring to break up matted grass. Creeping bentgrass, perennial ryegrass and tall fescue are very susceptible. In problem lawns substitute Kentucky bluegrass or fine fescues for perennial ryegrass or tall fescue.	Azoxystrobin Chloroneb Chlorothalonil Cyproconazole Ethazole Fenarimol Flutolanil Iprodione PCNB Propiconazole Triadimefon Thiram Vinclozolin

¹Also available as seed treatment.

(continued)

SUMMARY OF DISEASE MANAGEMENT STRATEGIES, continued

Diseases and pathogens	Environmental management and resistant species/cultivars	Fungicides
Leaf spot/melting out (<i>Bipolaris</i> , <i>Drechlera</i> , and <i>Exserohilum</i> spp.)	Avoid excessive use of nitrogen in early spring. Avoid using common types of Kentucky bluegrass. <i>Resistant Kentucky bluegrass cultivars:</i> Ascot, Princeton 104, Eclipse, Unique, Alpine, SR 2000, Bartita, Apex, Touchdown, Liberty, and Barblue	Azoxystrobin Chlorothalonil Iprodione Mancozeb Vinclozolin
Necrotic ring spot (<i>Leptosphaeria korrae</i>)	Use cultural practices that reduce turf stress, such as irrigation when turf undergoes drought stress and raising mowing heights to 2 inches or more. Overseed affected areas with perennial ryegrass. Tall fescue is also resistant to necrotic ring spot.	Azoxystrobin Cyproconazole Fenarimol Iprodione Myclobutanil Propiconazole Thiophanate methyl
Pink snow mold/Fusarium patch (<i>Microdochium nivale</i>)	Avoid piling snow in sensitive turfed areas. Continue mowing turf in fall until growth ceases. Do not apply excessive amounts of nitrogen in mid-fall. Creeping bentgrass and perennial ryegrass are more susceptible than Kentucky bluegrass and fine fescues.	Azoxystrobin Cyproconazole Fenarimol Iprodione Mancozeb PCNB Propiconazole Thiophanate methyl Thiram Triadimefon Vinclozolin
Powdery mildew (<i>Erysiphe graminis</i>)	Do not grow Kentucky bluegrass in shaded areas. Prune trees to allow more light to reach turf. Use fine fescues or shade-tolerant ground covers in shaded areas.	Cyproconazole Fenarimol Myclobutanil Propiconazole Triadimefon
Pythium blight (<i>Pythium aphanidermatum</i>)	Avoid excessive nitrogen and irrigation in hot, humid weather. Improve drainage and air circulation in areas where Pythium blight is a problem. Perennial ryegrass and creeping bentgrass are particularly susceptible to Pythium blight. Kentucky bluegrass is less susceptible to this disease.	Azoxystrobin Chloroneb Ethazole Fosetyl-Aluminum Metalaxyl Mefenoxam Propamocarb
Red thread/Pink patch (<i>Laetisaria</i> / <i>Limonomyces fuciformis</i>)/ <i>roseipellis</i>)	Avoid nitrogen deficiencies, especially on perennial ryegrass and fine fescues. Although Kentucky bluegrass and tall fescue are susceptible to these diseases, the resulting damage is usually not as severe as it is in perennial ryegrass and the fine fescues. <i>Resistant perennial ryegrass cultivars:</i> Regal, Legacy, Sherwood, Derby Supreme, Loretta, Gettysburg, Assure, and Pinnacle	Azoxystrobin ² Chlorothalonil Cyproconazole Fenarimol Flutolanil Iprodione Mancozeb Myclobutanil Propiconazole Thiophanate methyl ³ Triadimefon Vinclozolin

² Labeled only for red thread.³ Controls only red thread.

(continued)

SUMMARY OF DISEASE MANAGEMENT STRATEGIES, continued

Diseases and pathogens	Environmental management and resistant species/cultivars	Fungicides
Rust (<i>Puccinia</i> spp.)	Avoid nitrogen deficiencies and moisture stress in late summer/early fall. Applications of nitrogen fertilizer and irrigation at the first sign of infection will help reduce disease severity. Perennial ryegrass and Kentucky bluegrass are very susceptible. The fine fescues and tall fescue are quite resistant to most foliar rust diseases.	Chlorothalonil Cyproconazole Fenarimol Mancozeb Myclobutanil Propiconazole Triadimefon
Slime molds (<i>Mucilago</i> , <i>Physarum</i> , <i>Fuligo</i> spp.)	Remove spores by mowing, brushing, raking, or irrigating the turf.	Fungicides not required.
Summer patch (<i>Magnaporthe poae</i>)	Use cultural practices that promote root growth. Increase aeration and improve drainage on compacted and poorly drained soils. Raise mowing heights of Kentucky bluegrass in summer if mowed below 2 inches in height. Kentucky bluegrass, annual bluegrass, and fine fescues are susceptible. Perennial ryegrass, tall fescue, and creeping bentgrass are resistant.	Azoxytrobin Cyproconazole Fenarimol Myclobutanil Propiconazole Thiophanate methyl Triadimefon
Take-all patch (<i>Gaeumannomyces graminis</i>)	Only a problem on bentgrasses. Use acidifying fertilizers or sulfur to lower thatch and soil pH. Avoid applications of lime where take-all patch is a problem. No resistant cultivars are known.	Azoxytrobin Fenarimol Triadimefon
Yellow patch (<i>Rhizoctonia cerealis</i>)	Improve surface drainage and avoid excessive applications of nitrogen.	Azoxytrobin Chlorothalonil Flutolanil Iprodione Mancozeb PCNB
Nematodes	Use cultural practices that promote root growth. Increase aeration and improve drainage on compacted and poorly drained soils.	Mocap ⁴ (Nematicide) Nemacur ⁴ (Nematicide)

⁴ NOTE: Nematicides are restricted-use pesticides. These are used only to control nematodes and not other diseases.

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