WARM-SEASON TURF DISEASES

For best disease control, your fungicides need to be supplemented by proper fertilization and appropriate cultural practices.

by Don Blasingame, Mississippi State University

Slime molds occur during wet weather throughout the spring, summer and fall. They disappear rapidly as soon as it becomes dry. Chemical control is usually not necessary.

Nematodes will cause almost any type of symptom that can be caused by an inadequate root system. Generally, a yellowing or off-color of the foliage is the first symptom.

The Sun Belt is blessed with a wide range of choices when it comes to turfgrass varieties. The dominant turf species used in this region is Bermudagrass. However, five other warm-season grasses are used extensively for turf purposes: St. Augustinegrass, zoysiagrass, centipedegrass, carpetgrass and bahiagrass.

Although most southern turf diseases are caused by fungi, agents such as bacteria, viruses and nematodes can cause serious problems to certain grasses.

Southern turf managers can't depend solely on fungicides for disease control. Good variety selection, proper fertilization and appropriate cultural practices are also very important in disease control. No amount of fungicide will compensate for poor fertility and cultural practices.

Knowing when the most common diseases occur also will aid managers in scheduling fungicide applications (see chart). Also, environmental conditions can induce disease occurrence and severity.

Many of the agents that cause plant disease are normally in the turf (mainly in the thatch area) waiting for the right environmental conditions to develop. In general, the ideal condition for disease development would be high temperature and moisture and heavy thatch.

Fertilizers also affect disease occurrence and severity. For example,

- Low nitrogen levels increase warm-season grasses' susceptibility to dollar spot;
- Low potash increases the severity of many turfgrass diseases, for example, Bermudagrass melting out;
- Low soil pH increases the severity of brown patch;
- Very high nitrogen levels increase the level of most of the fungual diseases of warm-season turf.

Brown patch

Brown patch is the most common turf disease in the Southeast. Although St. Augustinegrass and zoysiagrass are the most susceptible species, even the more tolerant centipedegrass, Bermudagrass and ryegrass are frequently damaged by this fungus.

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FUNGICIDE DIRECTORY

Common Name	Some Trade Names**	Brown Patch	Dollar Spot	Gray Leaf Spot	Melting Out	Pythium Blight	Rusts	Spring Dead Spot
Anilazine	Dyrene, ProTurf fungicide III		●		●		●	
Benomyl	Benlate, Tersan 1991	●	●					●*
Chloroneb	Terraneb SP, ProTurf Fungicide II					●		
Chlorothalonil	Daconil 2787 ProTurf 101V	●	●	●	●		●	
Ethazole	Koban 30, Terrazole					●		
Fenarimol	Rubigan	●	●					●
Iprodione	Chipco 26019 ProTurf, Fungicide VI	●	●		●			
Mancozeb	Fore, Tersan LSR Many Others	●			●		●	
Metalaxyl	Subdue					●		
PCNB (quintozene)	Terraclor Turfcide	●	●		●		●	
Propamocarb	Banol					●		
Propiconazole	Banner	●	●				●	●*
Thiophanate-ethyl	Cleary 3336	●	●		●			
Thiophanate-methyl	Fungo 50, Proturf Systemic Fungicide	●	●					
Thiophanate-methyl + Mancozeb	Duosan	●	●		●		●	
Thiram	Thiram, Tersan 75	●	●					
Triadimefon	Bayleton, ProTurf Fungicide 7	●	●				●	
Vinclozolin	Vorlan		●		●			

* Label approved only in selected states.
** Combination of fungicide + fertilizer are not included.
No endorsement of named products by author is intended, nor is criticism implied for products not mentioned.

Source: Dr. Blasingame

Brown patch is favored by warm, moist weather combined with cool nighttime temperatures. Therefore, in certain areas of the South, brown patch can and does occur any month of the year.

In the South's upper regions, the most favorable conditions for brown patch development occur from late April through mid-October.

Symptoms of brown patch on warm-season grasses are different than the symptoms of the disease on cool-season turf. Even though the grass is usually killed in a circular pattern, many times the smoke ring is not seen on southern turf.

Under certain conditions the fungus may cause a gradual thinning of the turf over a rather large area instead of killing in a circular pattern.

Several factors tend to make the grass more susceptible to brown patch. One is applying too much nitrogen fertilizer. The resulting lush growth is readily attacked. Delay nitrogen applications when disease conditions are favorable.

Another is watering late in the afternoon and allowing the grass to remain wet for a long time. Excessive thatch accumulation also creates a favorable environment for the development of brown patch and many other diseases.

Fungicides are best used on a preventive schedule (see Fungicide Guide). Once symptoms develop, control can be difficult.

Dollar spot is common on Bermudagrass, zoysiagrass and annual and perennial bluegrasses. Symptoms of dollar spot are different on certain warm-season grasses than on cool-season grasses.

On finer textured grasses such as Bermudagrass and zoysiagrass, the disease kills grass in small patches two to three inches in diameter. Under severe conditions, these patches may coalesce so that the turf has a mottled appearance. Blades of grass at the outer edges of the infected area develop tan spots with reddish-brown margins.

On coarser warm-season grasses, turf is killed in larger patches ranging up to a foot in diameter.

Dollar spot is prevalant during mild weather in the spring and fall. Unlike brown patch, dollar spot is retarded by high nitrogen levels. Still, turf managers should consider the impact of high nitrogen on brown patch and other diseases. You should water only in the early morning so the foliage can dry quickly. Fungicides can be used to help bring the disease under control once it gets established.

Leaf spot

A number of fungi cause leaf spots on many southern grasses. Regardless of the causal agent, leaf spots and their control on southern grasses are similar.

Melting out (*Bipolaris spp.*) — Bermudagrass and ryegrass are more severely affected by these infections, although the fungus can survive on centipedegrass and St. Augustinegrass.

Infection can occur over a wide range of temperature, but usually is more severe at 70 to 95° F. Milder temperatures in the spring and fall are more favorable for infection.

Melting out causes small, dark-colored spots or flecks on the leaves and sheaths. Leaf spots are usually more numerous near the collar of the leaf blades.

Severely affected leaves wither and die, and the turf frequently becomes brown and thin.

Symptoms on overseeded ryegrass are altogether different. Although leaf spots may occur, this same melting out can cause severe crown rot. This causes a yellowing and discoloration of the grass and a general thinning of the turf.

Fertilize with adequate levels of nitrogen and potassium if melting out diseases become a problem. With careful management, apply fungicides recommended for melting out blight control.

Gray leaf spots: St. Augustinegrass is the primary host for gray leaf spot.

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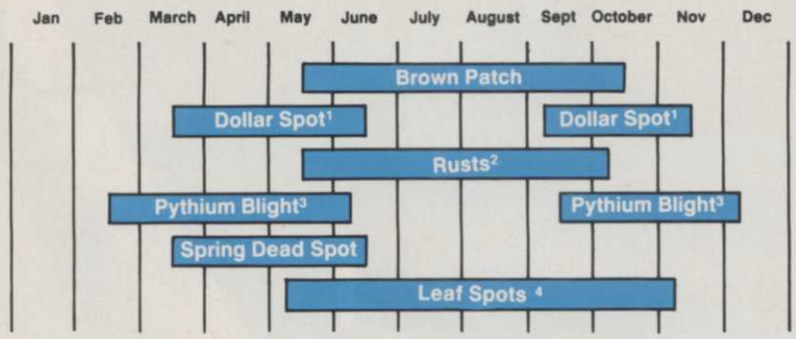
DISEASE CALENDAR

Major Diseases of Warm Season Turf*



* The calendar gives the normal time for turf diseases to occur. However, they may occur at other times depending upon environmental conditions.

1 - Dollar spot affects overseeded turf as well as warm season grasses.

2 - Rust does affect overseeded grasses but is most common on zoysiagrass.

3 - Pythium blight is most damaging on overseeded turf but can cause damage to warm season turf especially during "transition" periods.

4 - Most warm season grasses are affected by certain leaf spots. For example: gray leaf spot of St. Augustine and the helminthosporium complex on bermudagrass.

Source: Dr. Blasingame

The disease occurs throughout the lower South during warm, humid weather.

Spots on the leaf blades are the most visible, but sheath and stem lesions also occur. Leaf spots begin as olive green to brown, water-soaked spots as small as a pinhead. These enlarge rapidly and form a circular to elongated lesion that is brown- to ash-colored with purple margins. The disease occurs during moderate to warm weather accompanied by high relative humidity. Severity of the disease is enhanced by applications of nitrogen fertilizer. It is more a problem in shaded areas where the grass remains wet from dew.

Treatment with a fungicide may become necessary if the disease outbreak is severe and accompanied by prolonged periods of wet favorable weather. The fungicides chlorothalonil and mancozeb have been found to be effective in controlling gray leaf spot.

Rust

Rust of *Puccinia* species infect ryegrass, zoysiagrass, bluegrass, fescue, Bermudagrass and St. Augustinegrass. Zoysiagrass and bluegrass are the most often infected

grasses.

Susceptibility depends on the variety. Fungus infection is favored by minimum and maximum temperatures of 50 to 70°F, respectively. For this reason, the disease does not usually cause severe damage over an extended period. It is likely to be more severe in shaded areas during rainy, humid weather. Affected turf will appear unthrifty and begin to thin.

The disease is characterized by the presence of pustules on the leaf blades. These pustules range from bright orange to cinnamon-brown in color, depending upon the species of fungus present.

Certain varieties of ryegrass are extremely susceptible to rust, and sometimes severe damage can occur. Zoysiagrass, especially Meyer and Emerald, are most severely infected by rust.

Fertilize to stimulate grass growth, mow on a four- to five-day schedule and catch clippings. If necessary, a fungicide may be applied to help reduce the amount of disease present. Triadimefon, chlorothalonil and mancozeb are effective in controlling rust.

Spring dead spot

Spring dead spot is a serious disease of Bermudagrass in certain parts of the upper sunbelt. It is found generally on Bermudagrass or zoysiagrass under high maintenance.

Damage to the turf apparently occurs during the dormant season. When green-up occurs in the spring, areas a few inches to several feet in diameter appear where the sod is completely dead.

Spring dead spot's causal agent has not been identified. The only control procedures recommended are good cultural practices and limiting the use of nitrogen fertilizer, especially late in the growing season.

Research has shown that fungicides can limit the damage. However, at the present time only benomyl and Rubigan are labeled, and these may be of limited use in certain states.

St. Augustinegrass decline

St. Augustinegrass decline (SAD) is caused by a virus. The symptoms are a mosaic-type chlorosis of the leaf blades that resemble nutrient deficiency or mite feeding. Evidently there are several strains of the virus since there is a great range in damage to St. Augustinegrass.

To this point, the disease has only been recorded in Arkansas, Texas, Louisiana and Mississippi. No chemicals are available for the control of SAD.

Several varieties of St. Augustinegrass, however, are resistant to the virus. These can be planted in areas where the disease is a potential problem. Floratam was the first variety released with resistance to SAD. It is also resistant to chinch bugs. It has poor cold tolerance and should be used only in the lower South. Seville is resistant to SAD and is more shade tolerant than common St. Augustinegrass. Raleigh has both SAD resistance and good winter hardiness.

No amount of fungicide will compensate for poor fertility and cultural practices. Knowing when the most common diseases occur will greatly assist landscape managers in scheduling fungicide application.

Downy mildew

Downy mildew of St. Augustinegrass was first described on common St. Augustinegrass in Texas in 1969. Since then the disease has spread and has been identified in Arkansas, Louisiana and Mississippi.

Downy mildew appears as white, raised, linear streaks that develop parallel to the mid-veins of the leaf. Streaks appear in the spring and remain throughout the summer, giving the leaves a yellow appearance with some death toward the tips. Severe disease occurs in grass grown in flood plains or poorly drained areas.

The white-streak symptom is easily confused with the virus disease, SAD. However, the virus symptoms are more yellow in color and more mottled than striped. Downy mildew has been difficult to control with most common turf fungicides. Good drainage is recommended for cultural control.

Fairy rings

Fairy rings generally appear in lawns and other turf areas as circles or arcs of dark green, fast-growing grass during the spring and early summer. A ring of thin dead grass may develop on one or both sides of this circle.

The disease is caused by one of several soil-inhabiting fungi that commonly produce mushrooms. Mushrooms that sometime appear in the ring are the fruiting bodies of these fungi. Stimulation of the grass is due to release of nutrients from the organic breakdown of the thatch by the growing fungus.

No chemicals are labeled for the control of fairy ring. Two general approaches may be considered: removal and suppression. Although relatively impractical, removing infected soil and grass to a depth of 12 inches or more in a band several feet on each side of the infected area and replacement with clean soil is one solution.

Another approach is to suppress the disease. For low-maintenance grass areas, increase the water and fertilization program to stimulate the declining grass inside the ring. Symptoms of fairy ring can be masked by pumping large quantities of water into this area.

Slime molds

Slime molds are a group of organisms that cover above-ground plant parts with a dusty gray-black or dirty yellow mass.

When you look closely at this growth, you see small round balls scattered over the plant. If you rub these between your fingers, a sooty powder emerges. This consists of spores of the fungus.

Slime molds do not feed on living plants. They only use them to assist distributing spores during reproduction. Slime molds occur during wet weather throughout the spring, summer and fall. They disappear rapidly as soon as it becomes dry. Chemical control is usually not necessary.

Nematodes

Although nematology is a fairly new field, it has seen rapid development in the past 10 years. Nematodes, small eel worms, belong to a group of microorganisms which scientists call obligate plant parasites. This term simply means that the organism lives and obtains its food only from living plants. This fact is both good and bad. On the good side, the nematodes very rarely kill the plants that they are feeding on. On the other hand, nematodes feed on the roots of the grass and take the nutrients that would normally be used by the grass. Also, this feeding activity destroys a portion of the root system and makes them much more susceptible to other disease organisms.

In many cases, increased fertilization and water will offset some of the symptoms of a light infestation of nematodes. However, this usually

simply postpones the problem. Eventually a point is reached where no amount of water or fertilizer will substitute for the lack of a root system, and other steps must be taken to remedy the problem.

Normally, favorable conditions for turf development are also favorable for nematode development. This is particularly true in areas where highly maintained turf has a long growing season.

Heavy nematode infestation comes from an inadequate root system. Generally a yellowing or off-color of the foliage is the first symptom. This is followed by a general stunting and thinning out of the grass. Also, the turf frequently will wilt during the hot periods of the day and will respond little to fertilizer or water.

The only positive way to diagnose a nematode problem is to assay the soil around the root system of a plant. Laboratory techniques and assay procedures have been developed over the years to accurately detect not only the number of nematodes present but also the types of nematodes that are causing the problems.

A large number of different nematodes damage turfgrasses. Of course, some are more damaging than others and at different population levels. Usually in a random soil sample from a golf course or home lawn, several different types of plant parasitic nematodes may be present. For example, the single most damaging type of nematode found on Bermudagrass is known as the sting nematode (*Belonolaimus*). This very large nematode causes a great deal of mechanical damage to the root system, making it more susceptible to other types of problems.

The lance nematode (*Hoplolaimus*) is also very potent in its damage of turfgrass. The root-knot nematode (*Meloidogyne*) causes considerable damage to turfgrass. This nematode is probably best known on field crops, vegetables and on ornamentals. It causes galls and swelling of the root system, making it very easy to recognize. The lesion nematode and stubby root nematodes are also found frequently parasitizing grasses.

Ring nematodes have been found in well over 50 percent of the turf samples from the Southeast assayed by our laboratory. Other nematodes that are found in association with the unhealthy turf samples include stunt, dagger, and spiral nematodes. All of these are forms of parasitic nematodes that feed on turfgrass and probably cause some type of damage to the turf. However, they are not as economically damaging as are the first five mentioned.

Nematodes very seldom occur in an area as a single species but rather appear as mixed populations. Mixed populations normally compound the problem since each type contributes its share toward weakening the plant. Some guidelines can be set as to the amount of individual damage by nematode species; however, it is difficult to say how much damage occurs in these populations. This then becomes a matter of judgement.

Spring dead spots' causal agent has not been identified. The only control procedures recommended are good cultural practices and limiting the use of nitrogen fertilizer, especially late in the growing season.

What can be done to combat the high nematode population in turf? Several things can be done. First of all, grass should not be planted in areas where high nematode populations are already present. In other words, if high nematode populations are present in an area where you plan to plant grass, then they must be eradicated prior to seeding or sodding. This can be done by applying a soil fumigant or a nematicide. Also, turfgrass management personnel should insist upon nematode-free planting material.

As with any other type disease, prevention is much better than cure. However, measures can be taken if nematodes are present in established turf: apply a nematicide. A number of nematicides once used in turf are no longer available. All remaining nematicides have been placed on the "restricted pesticide" list and must be applied by a licensed applicator. These materials may be applied in a liquid or granular form, normally either in late spring or early fall.

Be sure to have soil analyzed for nematodes and get professional help *before* using a soil sterilant or nematicide. **LM**

COOL-SEASON TURF DISEASES

Integrating new ideas and new tools with accepted knowledge and fungicides is the key to successful cool-season disease management.

by Dr. Bill Shane, Ph.D., Ohio State University

Cool-season turfgrass managers face a wide variety of diseases that reduce the quality of their grass. Choosing the proper strategies for managing these diseases depends greatly on being able to identify the disease.

Attention has centered recently on the subject of turfgrass patch diseases. Although much has been learned, confusion still remains in the minds of many turf managers when it comes to determining the cause of patches in their own situation.

This article will focus on the pathogens that infect primarily basal stem, crown and root tissues of plants. The diseases discussed here are summer patch, necrotic ring spot, take-all patch and yellow patch diseases of cool-season turfgrass.

Other diseases associated with patch symptoms, (brown patch, Pythium blight, copper spot) are primarily leaf, sheath, and basal stem problems.

A recent challenge to turf managers is determining the proper way to use the relatively new group of fungicides known as the sterol biosynthesis inhibitor compounds (SBI) (triadimefon, fenarimol, propiconizole).

Another new development is the availability of turf disease diagnostic kits. This is a rapid means to determine the cause of turf decline, but it requires some new thinking to use the tool properly.

As more information is gathered about patch diseases, it is becoming clear that not all patch diseases are prevalent in all areas where cool-season turfgrasses are grown. Necrotic ring spot has been common on Kentucky bluegrass in Washington, Colorado, New York, Wisconsin, and Minnesota but less common in Pennsylvania, Maryland and Ohio.

This disease may be prominent for a few years in a region but then become obscure. For example, necrotic ring spot became very scarce in Wisconsin during the summer of 1988, according to Dr. Gayle Worf of the University of Wisconsin.

Summer patch

Summer patch, caused by the fungus *Magnaporthe poae*, is common in Kentucky bluegrass in Rhode Island, Maryland, New Jersey and New York, but apparently less so in other areas of the country. The region of the United States where summer patch is important is somewhat wider for the annual bluegrass form of the disease.

The disease has a fairly distinctive appearance on close-cut annual bluegrass/bentgrass greens. The annual bluegrass is affected whereas the bentgrass is essentially untouched.

Unfortunately, summer patch is difficult to distinguish from necrotic ring spot on Kentucky bluegrass. The most useful characteristic to distinguish the two diseases is that spots of summer patch on Kentucky blue-

Summer patch symptoms on an annual bluegrass/ bentgrass green. Only the annual bluegrass plants are affected.

Rings on Kentucky bluegrass in a lawn due to yellow patch, which is caused by *Rhizoctonia cerealis*. Photos courtesy of Dr. Shane.

TABLE 1. TURF Guide DISEASE

COOL-SEASON TURF DISEASES, TURF DISEASE AND CONTROLS

DISEASE	SEASON AND/OR SUSCEPTIBLE TURFGRASS[2]	CULTURAL	FUNGICIDE/NEMATICIDE ACTIVE INGREDIENT[4]
Algae	All tufgrasses	Reduce shade. Avoid excessive fertilization. Improve soil drainage.	Mancozeb
Anthracnose ***(Colletotrichum graminicola)***	July-August; ANNUAL BLUEGRASS, BENTGRASS, Fine Fescue	Fertilize and water to maintain vigor. Syringing may help to prevent stress.	Benomyl[3], Triadimefon Thiophanate-Methyl[3] Propiconizol, Fenarimol, Chlorothalonil
Brown Patch -	See Rhizoctonia blight		
Dollar Spot ***(Lanzia*** **and Moellerodiscus spp., formerly** ***Sclerotinia homeocarpa)***	Late June-Oct. BENTGRASSES BLUEGRASSES Fescues Ryegrasses	Avoid nitrogen deficiency. Remove dew from greens by mowing, dragging with a hose or pole. Choose more resistant grass varieties.	Chlorothalonil, Cadmium[3], Benomyl[3], Anilizine[3], Fenarimol, Iprodione[3], Propiconizol, Thiophanate- ethyl[3], Thiophanate-methyl[3], Thiram, Triadimefon, Vinclosolin[3]
Fairy Rings (Basiodomycete soil fungi)	April-October All turfgrasses	Remove infested sod and soil, replace with clean soil and reseed or sod. Improve water penetration. Increase N fertilization.	Methyl bromide or Formaldehyde fumigation will eradicate fungus but will also kill turf
Fusarium Blight[5] ***8Fusarium poae, F. vulmorum, F. crookwellense)***	July-August Bluegrasses Bentgrasses Fescues	Reduce heat stress during dry periods by light, frequent watering. Do not cut Kentucky bluegrass ro fescues under 2 inches. Reduce excessive thatch (over ¾ inch).	Triadimefon, Fenarimol Benomyl[3], Iprodione, Thiophanate-methyl[3], Thiophanate-ethyl[3]
Fusarium Patch (Pink Snow Mold) (*Fusarium nivale*)	Nov.-April Bluegrasses Bentgrasses Fescues Ryegrasses	Avoid late fall fertilizing. Rake leaves and cut short. Control drifting snow.	Triadimefon, Benomyl[3], Fenarimol, Iprodione[3], Mancozeb, Mercury chlorides, Pentachloronitrobenzene, Thiram, Thiophanate-methyl[3], Vinclozolin
Grey Snow Mold-	see Typhula blight		
Leafspot/Blight /Melting out (*Drechslera* & *Bipolaris* ssp.)	Leafspot: Spring & fall; Blight & Melting out: June-Aug. KENTUCKY BLUEGRASS BENTGRASSES FINE FESCUE, ryegrasses, tall fescue	Remove clippings. Raise cutting height. Avoid excessive nitrogen. Avoid light, frequent watering.	Cycloheximide, Iprodione, Chlorothalonil, Mameb, Nancozeb, Vinclozolin, Pentachloronitrobenzene
Nematodes	All turfgrasses		Fenamiphos, Ethoprop

grass tend to remain small (3 to 10 inches in diameter) compared to necrotic ring spot (5 inches to 2 feet).

Until recently, identification of summer patch by plant disease clinics has been hampered; the causal fungus displays no consistent distinguishing features when grown on agar in a petri plate.

Formerly, the causal agent was thought to be the fungus *Phialophora graminicola*. This was a major source of confusion to plant pathologists because this fungus was known to be a non-pathogen on cereal crops.

A breakthrough

A major advance in our understanding of summer patch occurred when Peter Landschoot (now at Pennsylvania State University) and Noel Jackson (University of Rhode Island) discovered that there are two mating types, 'A' and 'a', for the causal agent now known as *Magnaporthe poae*. If a suspected *M. poae* strain is paired with the proper mating type, the sexual spore stage (ascospores) is formed and positive identification can be made. Thus, identification of summer patch is now possible, but still takes up to two months.

Yellow patch

Yellow patch, caused by *Rhizoctonia cerealis*, is frequently found on Kentucky bluegrass in Ohio and apparently less frequently in Michigan and Illinois. It is rarely reported in Wisconsin and Minnesota. The bentgrass version of the disease is more often seen in the northern

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Necrotic Ring Spot[5] (*Leptosphaeria korrae*)	Spring & fall KENTUCKY BLUEGRASS, annual bluegrass ryegrasses	Avoid low mowing heights (below 2 inches). Reduce excessive thatch (over ¾ inch). Use Kentucky bluegrass and perennial ryegrass mixtures.	Fenarimol, Propiconizol
Pink Patch[6] (*Limonomyces roseipellis*)	Spring & fall bentgrass, FINE FESCUE, PERENNIAL RYEGRASS	Follow balanced fertilization program.	Cadmium, Mancozeb
Pink Snow Mold -	see Fusarium patch		
Powdery Mildew (*Erysiphe graminis*)	July-Oct. KENTUCKY BLUEGRASS, fine fescue	Reduce shade. Increase air circulation by removing surrounding vegetation.	Triadimefon, Fenarimol, Propiconizol
Pythium Blight (*Pythium aphanidermatum, P. graminicola*)	June-Sept. BENTGRASSES, ANNUAL BLUEGRASS, PERENNIAL RYEGRASS, Kentucky bluegrass	Improve soil drainage. Increase air circulation by removing surroundign vegetation. Avoid mowing wet grass. Avoid excess watering.	Chloroneb, Etridiazole, Propamocarb, Metalaxyl, Fosetyl-Al, Mancozeb
Red Leaf Spot (*Drechslera erythrospila*)	June-Sept. BENTGRASSES	Remove clippings. Fertilize to maintain vigor.	Iprodione, Anilizine
Red Thread (*Laetisaria fuciformis*)	All seasons PERENNIAL RYEGRASS, FINE FESCUE, bentgrass, annaul bluegrass, Kentucky bluegrass	Follow balanced fertilization program.	Vinclozolin, Cadmium, Chlorothalonil, Thiophanate-ethyl, Thiophanate-methyl, Nancozeb, Triadimefon Propiconizole
Rhizoctonia Blight (Brown patch) (*Rhizoctonia solani* = *Thanatephorus cucumeris*)[7]	July-August BENTGRASS, ANNUAL BLUEGRASS, TALL FESCUE, Kentucky bluegrass, fine fescue	Avoid excess nitrogen fertilization. Increase air circulation. by removing surrounding vegetation. Avoid excessive watering.	Anilizine, Chlorthalonil, Mancozeb, Benomyl[3] Maneb, Propiconizole, Pentachloronitrobenzene, Triadimefon, Thiophanate-methyl[3], Thiophanate-ethyl[3], Iprodione
Rust (*Puccinia spp.*)	August-Oct. PERENNIAL RYEGRASS, KENTUCKY BLUEGRASS	Avoid nitrogen deficiency. Use resistant varieties of Kentucky bluegrass and perennial ryegrass.	Mancozeb, Propiconizole, Cycloheximide, Chlorothalonil, Triadimefon, Fenarimol
Slime Molds (*Myxomycete*9	August-Sept. All Turfgrasses	Removing mechanically by mowing or raking.	Zineb, Mancozeb
Snow Mold -	see Fusarium Patch and Typhyula Blight		

United States and Canada.

Two features are useful in distinguishing yellow patch from necrotic ring spot and summer patch. Plants suffering from yellow patch display a white, shredded appearance of the basal stem tissue. In addition, leaf spots somewhat reminiscent of dollar spot are sometimes present on the portion of the leaf blade closest to the leaf sheath.

Yellow patch is generally a less severe disease problem than summer patch and necrotic ring spot but will on occasion cause unsightly patches and scars on Kentucky bluegrass turf.

Take-all patch

Take-all patch, also known as Ophiobolus or Gaeumannomyces patch, is primarily restricted to bentgrass. It is most common to the Pacific Northwest, Northeast and mid-Atlantic regions of the country. It has been reported less frequently in other states such as Wisconsin, Pennsylvania, Michigan and Ohio.

The key for identifying this disease is to watch for it on newly-established greens, especially those greens with high soil pH (> 7). It is also primarily a problem only on bentgrass.

Why these various patch diseases

TABLE 1. TURF Guide DISEASE

TABLE 1
COOL-SEASON TURF DISEASES, TURF DISEASE AND CONTROLS

DISEASE	SEASON AND/OR SUSCEPTIBLE TURFGRASS[2]	CULTURAL	FUNGICIDE/NEMATICIDE ACTIVE INGREDIENT[4]
Strip Smut (*Ustilago striiformis*)	Spring & fall KENTUCKY BLUEGRASS, Bentgrasses	Avoid drought stress. Avoid excess nitrogen.	Propiconizole, Triadimefon, Benomyl, Thiophanate-ethyl *Notes.* Apply extra water for crown penetration. Apply in late fall or early spring
Summer Patch[5] (*Magnaporthe ssp.*, formerly *Phiaophora graminicola*)	June-August ANNUAL BLUEGRASS, KENTUCKY BLUEGRASS	Avoid low mowing height. Reduce excessive thatch. Light, frequent watering during dry periods to reduce heat stress. Use slow-release nitrogen to avoid nutrient depletion. Use Kentucky bluegrass and perennial ryegrass mix.	Fenarimol, Triadimefon; Materials must be applied preventatively.
Take-all Patch (*Ophiobolus patch) (gaeumannomyces graminis* var *avenae*)	Spring & fall BENTGRASS	Avoid topdressing soil with pH greater than 6.0 Avoid use of lime, especially small particle type, where take-all is a problem. Use ammonium chloride, or second best, ammonium sulfate fertilizers.	PMA (not labelled for this disease, but may be effective)
Typhula Blight (Grey Snow Mold) (*Typhula spp.*)	Nov.-April fine fescue, BENTGRASS, ANNUAL BLUEGRASS, Kentucky bluegrass, tall fescue, perennial ryegrass	Avoid heavy fall nitrogen promoting late lush growth. Rake leaves and cut short. Control drifting snow.	Triadimefon, Cadmium, Chloroneb, Anilizine, Pentachloronitrobenzene, Mercury Chlorides, Thiram
Yellow Patch (*Rhizoctonia cerealis*)	Spring & fall Bentgrasses Bluegrasses	Reduce excessive thatch. Avoid excessive watering.	None
Yellow Tuft (Downy mildew) (*Sclerophthora spp.*)	Spring & fall Bentgrass		Metalaxyl

1 Before using any pesticide, read and follow all label instructions.
2 Grass types listed in capital letters have been observed to be especially susceptible to the pathogen.
3 Continued or sole use of these materials may favor build-up or resistant fungal population.
4 Products containing these active ingredients are listed in the following table. Read the product label to see if it is labelled for the disease of concern. Follow all label instructions.
5 Necrotic ring spot ans summer patch are known to cause symptoms once attributed solely to Fusarium blight.
6 Pink patch disease was recently found to be a disease distinct from red thread. Thus, there are few fungicides specifically registered for contorl of this disease at this time.
7 Anothe fungus, *Rhizoctonia zeae*, is also capable of causing brown patch-like symptoms on bluegrass and bentgrass. Benzimidazole type (Tersan 1991, Benomyl, Fungo 50, Clery 3336) are not effective against this pathogen.

Source: Dr. Shane

are prevalent in different regions of the country is still unclear. Most likely reasons are the result of climatic differences and because the causal fungi have not spread to all cool-weather turf growing areas.

Our picture of the diseases in each region of the country is still fragmentary, largely because the diseases are difficult to identify in the field and laboratory.

An exciting development for the turfgrass disease industry has been a new class of fungicides collectively known as the sterol biosynthesis-inhibiting fungicides (SBI) (Table 3). Three are currently labelled for turfgrass diseases, and more are being developed.

Welcome SBI fungicides

Most fungi attacking turf synthesize ergosterol, a sterol used in their cell membranes. The SBI fungicides control many fungi by blocking the synthesis of ergosterol. For this reason, an alternate name, ergosterol biosynthesis inhibitors (EBI), is sometimes used. Fungi, such as those causing Pythium blight and downy mildew that do not manufacture ergosterol, are not controlled by these fungicides.

SBI fungicides are systemic. They have a rather broad spectrum of activity, although not as broad as chlorothalonil or mancozeb (Table 4). Most SBI fungicides do not have good protectant action but rather work best

Table 2.

FUNGICIDE DIRECTORY

TRADE NAMES OF TURFGRASS FUNGICIDES AND NEMATICIDES

Active Ingredient	Some Common Trade Names[1]
FUNGICIDES	
Anilizine	Dyrene, Lescorene, Proturf Fungicide III, Lofts Lawn Fungicide
Anilizine + maneb w/ zinc	Faesy & Besthoff Lawn and Turf Fungicide
Benomyl	Tersan 1991, Rockland Benomyl, Lebanon Fungicide Type B
Cadmium chloride	Caddy
Cadmium chloride + thiram	Dexol Thiram Plus Lawn Fungicide, Lesco Snow Mold Turf Fungicide, Cleary's Granular Turf Fungicide, Cleary's Cad-Trete, Lebanon Fungicide Type T
Cadmium chloride + thiram + zineb	Bonide Lawn Fungicide
Cadmium sebacate + thiram + potassium chromate	Kromad
Cadmium succinate	Cadminate
Chloroneb	Tersan SP, Teremec SP, Proturf Fungicide II
Chlorothalonil	Daconil 2787, Lebanon Fungicide Type D
Cycloheximide	Acti-dione TGF
Cycloheximide + PCNB	Acti-dione RZ
Cycloheximide + thiram	Acti-dione Thiram
Ethazol (etridiazole)	Koban, Terrazole
Fenarimol	Rubigan
Fosetyl-Al	Aliette
Iprodione	Chipco 26019, Proturf Fungicide VI
Mancozeb	Fore, Formec, Dithane M-45, Dithane F-45, Lesco 4, Manzate 200 DF
Maneb	Dithane FZ, Dithane M-22
Maneb + zinc sulfate	Tersan LSR, Dithane M-22 w/Zinc, Lesco 4 F w/Zinc
Mercury chloride	Calo-chlor, Calo-gran
Metalaxyl	Subdue, Proturf Pythium Control
Pentachloronitrobenzene (PCNB, quintozene)	Terraclor, Turfcide, Lawn Disease Preventor, Lesco PCNB
Phenylmercuric acetate	PMAS
Phenylmercuric acetate + thiram	Proturf Broad Spectrum Fungicide, 24-5-3 Fertilizer Plus Fungicide
Propamocarb	Banol
Propiconizol	Banner
Thiabendazole	Tobaz, Mertect 140F
Thiophanate-ethyl	Cleary's 3336 F, Cleary's 3336 WP
Thiophanate-ethyl + thiram	Bromosan WP, Bromosan F
Thiophanate-methyl	Fungo 50, Spot-Kleen, Topsin M, Proturf Systemic Fungicide
Thiophanate-methyl + mancozeb	Duosan
Thiophanate + iprodione	Proturf Fluid Fungicide, Disease Control Plus Fertilizer 23-3-3
Thiram	Tersan 75, Spotrete, Thiramad
Triadimefon	Bayleton, Proturf Fungicide 7, Lebanon Turf Fungicide
Triadimefon + metalaxyl	Proturf Fluid Fungicide II
Triadimefon + thiram	Proturf Fluid Fungicide III
Vinclozolin	Vorlan
Zineb	Zineb
NEMATICIDES	
Ethoprop	Mocap
Fenamiphos	Nemacur

Source: Dr. Shane.

[1]Many products 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.

systemically. SBI fungicides are particularly effective against powdery mildew, rusts and stripe smut.

Jury still out

Information is still incomplete for the activity of these fungicides against the slow-growing root and crown diseases necrotic ring spot, summer patch and yellow patch. Current opinions are that fenarimol and possibly propiconizole provide good action against necrotic ring spot.

Triadimefon is reported to have action against summer patch; effectiveness of fenarimol and propiconizole against this disease is not clear.

With all these patch diseases it is important to apply the fungicides before the symptoms appear. No chemical has been shown to be effective against yellow patch in the field.

Fungicide resistance

Resistance of fungi to fungicides is a constant threat, especially those with systemic action. Resistance of fungi to MBC-releasing fungicides (benomyl, methyl- and ethyl- thiophanate), acylalanine (metalaxyl), and iprodione and vinclozolin fungicides has occurred where the compounds have been used frequently.

Resistance of turf disease fungi to SBI fungicides has not yet been reported. Resistance to SBI has been noted for other systems such as apple scab on apples and powdery mildew on ornamental plants.

It is prudent to assume that resistance to SBI fungicides can and will occur with turfgrass diseases.

Although it appears that a variety of SBI fungicides can be chosen, in actuality all the products being developed for turf have the same mode of action. If a fungus develops resistance to one, it will have resistance to them all.

With most fungicides the appearance of resistance is "all or nothing"—meaning that a fungus with resistance is able to tolerate very high concentrations of the fungicide.

With SBI fungicides, resistance is cumulative; meaning the fungus can still be controlled (for a while) at a higher fungicide dose. As a result, resistance of fungi to SBI fungicides will be more difficult to detect because the fungicides will still control the pathogen, although less satisfactorily.

Basic rules apply

As with any fungicide, it is important to switch or tank mix fungicides with different modes of action to delay or avoid resistance build-up.

Another well-documented effect

TABLE 3.

FUNGICIDE DIRECTORY

Sterol biosynthesis-inhibiting fungicides labelled for or being developed for turfgrass disease control.

ACTIVE INGREDIENT	TRADE NAME	OTHER NAME	COMPANY	CHEMICAL CLASS
LABELLED				
fenarimol	Rubigan	—	Elanco	pyrimidine
triadimefon	Bayleton	—	Mobay	triazole
propiconizole	Banner	Tilt	Ciba Geigy	triazole
EXPERIMENTAL				
penconazole	Spotless	—	Uniroyal	triazole
—	Lynx	HWG 1608	Mobay	imidazole
prochloraz	—	—	Noram	imidazole
flusilazol	Nustar	—	DuPont	triazole

Source: Dr. Shane

TABLE 4.

FUNGICIDE DIRECTORY

Activity of sterol biosynthesis inhibiting fungicides against selected diseases of turfgrass.

ACTIVITY	DISEASES
poor	leafspot (*Drechslera* and *Bipolaris* species)
fair to good	brown patch *(Rhizoctonia solani)* anthracnose *(Colletotrichum graminicola)*
good to excellent	rust (*Puccinia* species) powdery mildew (*Erysiphe* species) stripe smut *(Ustilago striiformis)* dollar spot (*Lanzia* and *Moellerodiscus* species)

Source: Dr. Shane

of SBI fungicides is their growth-regulating effect on the turfgrass plant. High rates of fenarimol can depress *Poa annua* growth. Some SBI fungicides may induce a noticeable greening of other grass species.

There are some indications that high rates of SBI fungicides may in some instances slightly retard the growth of grass types other than *Poa annua*. This is not detrimental except in cases where vigorous growth of turf is desirable; for example, if leaf production is needed to fill out a poor grass stand.

Disease detection kits

A new approach has been developed for the age-old problem of identifying turf diseases. Antibodies—tiny proteins in the immune system of mammals—allow the recognition and neutralization of invading pathogens.

With current technology it is possible to produce antibodies to recognize turf pathogens for diagnostic purposes. With this approach a small sample of leaves suspected of harboring a plant pathogen is ground. The sap is then tested for the proteins or carbohydrates specific to the pathogen.

Agri-Diagnostics and Associates (Cinnaminson, NJ 08077) has developed a kit (Reveal) that positively identifies dollar spot, warm-weather Pythium blight, and brown patch in 10 minutes.

An innovative feature of the Reveal kit is that positive and negative controls are included with each test to insure that it is done correctly.

More kits to come

Antibody-based diagnostic tests for other turf diseases such as necrotic ring spot and summer patch are being developed in other laboratories. These kits allow disease problems to be quickly identified so that proper selection of fungicides can be made.

A knowledgeable turf manager can identify most common turf diseases when the symptoms are typical. However, even the most careful observer can be mislead when disease symptoms and signs are atypical or non-definitive. For example, mycelial growth on tall-cut grass can be due to Pythium blight, brown patch, or Nigrospora blight.

As with traditional methods for diagnosing disease, the quality of the grass sample collected for diagnosis is important for successful use of antibody-based techniques. The pathogen responsible for a patch symptom on a grass stand will usually decline to undetectable levels within a few days of symptom expression.

Note kit selectivity

It is also important to know the selectivity of the tests used. For example, the Agri-Diagnostic test for brown patch used in 1988 was specific for *Rhizoctonia solani* and did not react to most isolates of *Rhizoctonia zeae*, a fungus that also may cause brown patch symptoms.

The antibody kits will react against living and non-living forms of the target fungus. Some turf managers may use the kits to see if a fungicide application was effectively stopping a disease epidemic. However, sufficient time must be given for a fungicide to act and the fungal population to decline through mowing and deterioration before the grass is tested again. Experience has shown that 2 or 3 days are needed to see the results of a fungicide application with the antibody kits.

An attractive aspect of antibody-based diagnostic kits is that the turf manager can in some instances very quickly determine (or at least rule out) one possible cause of a turf problem.

Costs for the diagnostic kits may be an issue, especially for lawn care companies and diagnostic clinics. Current costs for the rapid assay format of the Agri-Diagnostic kits is more than $15 per test. The kits may be economical for golf course settings, in situations where lawsuits may be pending, or for special customer-relation cases. **LM**