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TABLE 3

Methods of Disease Control for Cool-season Turfgrasses

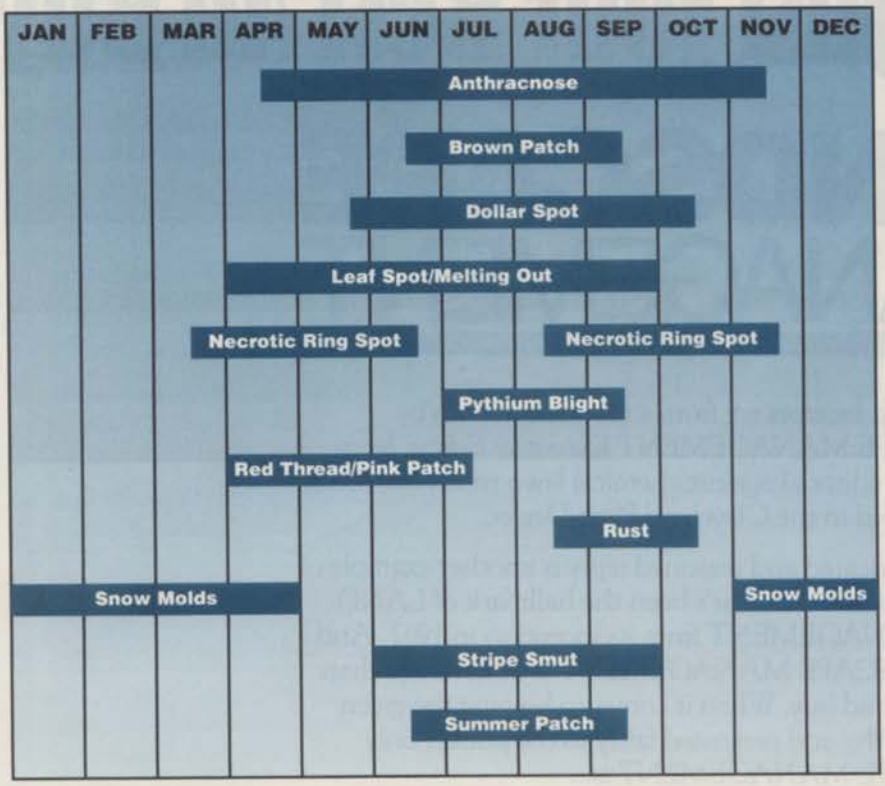
Disease	Cultural control	Chemical control	Resistant species/varieties
Anthracnose	Fertilize to maintain vigor, improve drainage, aeration, and raise mowing height during periods of heat stress.	benomyl, chlorothalonil, mancozeb, propiconazole, triadimefon	Bentgrasses are less susceptible than annual bluegrass on putting greens.
Brown patch	Avoid excess N in summer, increase air circulation, avoid excessive watering, improve drainage.	anilazine, benomyl, chlorothalonil, iprodione, mancozeb, maneb, thiophanates, thiram, vinclozolin	Kentucky bluegrasses are less susceptible to brown patch than other cool-season turfgrasses.
Dollar spot	Avoid N deficiency, maintain good soil moisture, remove guttation and dew from leaf surfaces, avoid night watering.	anilazine, benomyl*, chlorothalonil, fenarimol, iprodione, mancozeb, propiconazole, thiophanates, thiram, vinclozolin	Resistant Kentucky bluegrass varieties include Adelphi, America, Aspen, Challenger, Eclipse, Escort, Nassau, Somerset, & Wabash.**
Fairy ring	Use clean fill during establishment, irrigate, or mask symptoms with N-fertilizer or iron.	None effective, must fumigate with soil sterilant to eradicate the fungus (this will also kill grass).	No resistant species or varieties are available.
Leaf spot/ melting out	Avoid excess N applications in early spring, mow 2" in height, avoid light, frequent irrigation. Do not use benomyl, thiophanates, or triadimefon to control this disease.	anilazine, chlorothalonil, iprodione, maneb, mancozeb, vinclozolin	Resistant Kentucky bluegrasses include: Adelphi, Bristol, Destiny, Eclipse, Enmundi, Glade, Ikone, Leberty, Majestic, Mona, P-104, Rugby, and Somerset.**
Necrotic ring spot	Manage turf for maximum root growth, irrigate to maintain good soil moisture, maintain mowing height at 2" or above.	benomyl, fenarimol, propiconazole	Perennial ryegrasses are resistant.
Powdery mildew	Reduce shade and improve air circulation.	benomyl, fenarimol, propiconazole, triadimefon (fungicides usually not required)	Use grasses adapted to shaded areas such as fine fescues and rough bluegrass. Resistant Kentucky bluegrasses include: A-34, Glade, Touchdown, & Eclipse.**
Pythium blight	Improve drainage, increase air circulation, avoid excess N, reduce irrigation.	chloroneb, etridiazole, metalaxyl*, Fosetyl-Al, propamocarb	Kentucky bluegrass is less likely to be damaged by Pythium blight than other turfgrasses.
Pythium root rot	Increase drainage, aerate	Fosetyl-Al, Subdue as a drench	unknown
Red thread/ pink patch	Maintain adequate fertility of turf (especially N)	alilazine, benomyl***, chlorothalonil, iprodione, propiconazole, thiophanates***, triadimefon, vinclozolin	Resistant perennial ryegrasses include: Allaire, Commander, Delray, Manhatten II, Palmer, Pennant, Prelude, Regal, Regency, SR 4000, SR 4100, and Yorktown II.**
Rust diseases	Avoid N-deficiency and drought-stress (especially in late summer/early fall)	maneb, mancozeb, fenarimol, propiconazole, triadimefon. (fungicides usually not required)	Some resistant Kentucky bluegrasses include: Kenblue, Parade, Rugby, A-34, and Classic**.
Slime molds	Remove spores by spraying water on leaves or brushing turf.	None required.	Not applicable since grasses are not infected.
Snow molds: Gray snow mold	Avoid excess N in fall before grass goes dormant, mow until top growth ceases in fall, prevent accumulation of snow in sensitive areas, rake up mats (patches) in spring to speed recovery.	Fungicides should be applied in late fall before snow cover: chloroneb, fenarimol, iprodione, mercury fungicides,. PCNB, thiophanates, thiram, triadimefon, vinclozolin	Some resistant Kentucky bluegrasses include: Adelphi, Aspen, Enmundi, Plush, and Vantage**.
Pink snow mold	(Same as for gray smow mold)	benomyl, fenarimol, iprodione, mancozeb, mercury fungicides, PCNB, thiophanates, thiram, vinclozolin	Most fine fescues and Kentucky bluegrasses are moderately resistant to this disease.
Stripe smut	Avoid excess N in early spring, avoid drought stress in early summer.	Apply fungicides in early spring or late fall, water-in for good root uptake. Benomyl, fenarimol, propiconazole, thiophanates, triadimefon	Ryegrasses, tall fescues, and the fine fescues are less susceptible to this desease than Kentucky bluegrass.
Summer patch	Avoid low mowing heights, reduce compaction, avoid overwatering in summer, improve drainage.	benomyl, fenarimol, propiconazole, thiophanates, triadimefon	Resistant Kentucky bluegrasses include Adelphi, Enmundi, Sydsport, and Touchdown.
Take-all patch	Use acidifying fertilizers or sulfur to lower pH, avoid P and K deficiency.	Sterol biosynthesis inhibitors may have some benefit if applied prior to root infection.	annual bluegrass

* Resistance has been recorded.
** Based on National Turfgrass Evaluation Program and Penn State data. No endorsement of cultivars is intended for those mentioned, or is criticism meant for cultivars not mentioned.
*** Controls red thread and not pink patch.

Source: Dr. Landschoot

CALENDAR

COMMON DISEASES OF COOL-SEASON TURF



Biologicals:

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Organics an alternative?

Most of the current interest in biological control of turf pathogens is centered around the use of natural organic fertilizers or organic soil amendments. This practice has been successfully employed with other crops and some success has been achieved in controlling turfgrass diseases. Research at Cornell University has shown that some organic amendments suppressed dollar spot and brown patch diseases when applied as a topdressing to a bentgrass putting green.

Similar results have been obtained by researchers from Michigan State University and The University of Rhode Island for the suppression of necrotic ring spot. Although we do not understand the exact mechanisms involved, there is some evidence to suggest that these products stimulate populations of resident antagonists to levels that will suppress some turf diseases. They may also aid in disease control by providing additional nitrogen to the plant. **LM**

—Dr. Landschoot

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Phythium blight is culturally managed by improved drainage, reduced irrigation and a moderate nitrogen diet. Chemical control includes chloroneb, ethazol and metalaxyl.

DISEASE CONTROL IN WARM-SEASON TURF

Integrated disease management first requires the selection of appropriate turfgrass species and cultivars. Proper cultural practices, pesticides, and biological control components follow.

by Monica L. Elliott, Ph.D., University of Florida

Although we can easily divide turfgrasses into cool- and warm-season types, it is people who determine the grass grown in any particular landscape. But people do not necessarily follow the rules. The result is that we find bentgrass grown in Florida and bermudagrass grown in the central U.S.

To confuse the issue even further, we have bermudagrass putting greens over-seeded with ryegrass or bentgrass during the winter months in the southern states. The primary goal is to have attractive turfgrass areas; diseases, however, can quickly blemish this picturesque setting.

Knowing the difference

While turfgrass injuries or disorders may look like diseases, they are not diseases and should not be treated as such.

A disease is primarily an interaction between the plant and a pathogen. It consists of three components: turfgrass host, pathogen and the environment in which the host and pathogen interact. In most turfgrass situations, the environment is the key factor in disease development, since the other two components are virtually always present.

While turfgrasses may be affected by diseases all year long, individual turf diseases are prominent for only a few months each year, based normally on weather patterns/environmental effects. Since it is usually not practical to eliminate the turfgrass host, disease control recommendations are aimed at (1) suppressing the pathogen, and (2) altering the environment so it is less favorable for disease development.

Turfgrass selection

Select turfgrass species and cultivars based on your geographical location

TABLE 1

Diagnostic Features of Common Warm-Season Turfgrass Diseases

Disease	Casual agent(s)	Symptoms/signs	Susceptible grasses
Anthracnose	*Colletotrichum graminicola*	Brown lesion with yellow halo expands to cause yellowing of entire leaf blade. Tiller infection results in stem girdling. Fruiting bodies are dark cushion-like bodies with small black spines and can be seen with hand lens.	bahiagrass, bermudagrass and centipedegrass*
Bermudagrass decline	*Gaeumannomyces* spp. or similiar fungi as yet undetermined.	Begins as small, irregular, yellow patches which expand and thin-out as grass dies. Roots are short, thin and rotted. Usually observed first at edges of putting greens.	bermudagrass*
Brown patch (Rhizoctonia blight); Rhizoctonia leaf and sheath spot	*Rhizoctonia solani, R. zeae, R. oryzae*	Begin as small circular light green patches that turn yellow and then brown or straw-colored. Patches expand to several feet in diameter. Turf at outer margin of patch may appear dark and wilted (smoke ring). Whole leaf facsimiles pull up easily due to basal rot of leaf sheath. Aerial blight common with centipedegrass and St. Augustinegrass. During warm summer months, may also observe distinct light brown foliar lesions.	Bahiagrass, bermudagrass, centipedegrass*, St. Augustinegrass*, and zoysiagrass*
Dollar spot	*Lanzia* spp. and *Moellerodiscus* spp. *(Sclerotinia homoeocarpa)*	Small, bleached patches of dead grass that do not expand but do coalesce with other spots to form large patches. Irregular, light tan lesions with distinct brown borders. White, cottony mycelium may be observed in early morning when dew is present.	bahiagrass*, bermudagrass*, centipedegrass, St. Augustinegrass, zoysiagrass*
Cercospora leaf spot	*Cercospora fusimaculans*	Small, dark brown or purple lesions on leaf blade and sheath that become tan color with age. High disease severity results in leaf death and turf areas that thin-out.	St. Augustinegrass*. Bitter-blue cultivars are less susceptible than yellow-green cultivars.
Fairy ring	*Chlorophyllum, Marasmius, Lepiota* and other basidiomycete fungi	Circular to semi-circular bands of dark green turf with or without mushrooms present in band. Some rings are bands of dead turf. Rings expand each year.	All warm-season turfgrasses.
Gray leaf spot	*Pyricularia grisea*	Lesions begin as small, brown spots that expand into oval areas with tan centers and dark purple or brown margins. Yellow halo may be present. During warm humid weather, lesions covered with gray velvet mat of mycelium. Leaves wither resulting in scorched appearance.	St. Augustinegrass*. Yellow-green cultivars are less susceptible than blue-green/bitter-blue cultivars, St. Augustinegrass treated with the herbicide atrazine is more susceptible.
"Helminthosporium" Leaf Spot/ Melting Out	*Bipolaris, Drechslera* and *Exserohilum* spp. (previously *Helminthosporium* fungi); and *Curvularia* spp.	Leaf spot symptoms vary with specific pathogen and host from small, solid brown to purple lesions to expanded lesions with bleached centers that girdle the leaf blade. Severly infected leaves turn reddish-brown to straw color. "Melting-out" occurs under severe infection as turfareas thin and die. Lesions on stems are dark purple to black. Crown/root rots will also occur.	Bermudagrass*, St. Augustinegrass, zoysiagrass
Pythium Blight	*Pythium* spp.	Small, distinct patches of grass that first appear dark and water-soaked but later turn straw-color. No distinct leaf lesions. Patches spread quickly in "streak" pattern. Cottony mycelium may be observed in early morning when dew present.	All warm-season turfgrasses, primarily Bermudagrass*
Pythium Root Rot	*Pythium* spp.	General turf browning and thinning. Roots appear thin with few root hairs and have a general discoloration. Turf does not repond to N applications.	All warm-season turfgrasses.
Rust	*Puccinia* spp.	Orange to reddish brown pustules on leaves. Severe infections cause yellowing of leaves and thin turf.	Bermudagrass, St. Augustinegrass and Zoysiagrass*
Spring dead spot	*Leptosphaeria korrae, Ophiosphaerella herpotricha* and *Gaeumannomyces graminis* var. *graminis*.	Large, circular patches of bleached, dead grass that appear as dormant turf resumes growth in spring. Root, crown and stolon rot evident.	bermudagrass*
St. Augustinegrass decline	*St. Augustinegrass decline virus (Panicum mosaic virus)*	Initially, observe chlorotic (yellow) mosaic or mottle on leaf blades that gradually becomes more extensive until area appears uniformly yellow and thin. Death may eventually occur.	centipedegrass and St. Augustinegrass* (some cultivars).

*** denotes most susceptible turfgrass species**

Source: Dr. Elliott

and on how the turf will be used and maintained.

Grasses that are not suited for a particular area will be continually stressed, more susceptible to disease, and require increased maintenance costs in terms of labor and pesticides. An area subjected to heavy foot traffic would not be suitable for centipedegrass. Non-irrigated areas would be satisfactory for bahaigrass but not St. Augustinegrass.

Sometimes turfgrass is not even the appropriate plant for a particular landscape. For example, most warm-season turfgrasses do not thrive in heavily shaded areas. Certain cultivars of some turf species are resistant to specific diseases. Selecting disease-resistant cultivars is especially important for controlling viral diseases, in part because there are no chemicals to control these diseases.

The primary viral disease associated with warm-season turfgrasses is caused by the St. Augustinegrass decline virus. It is most frequently observed in centipedegrass and susceptible St. Augustinegrass cultivars. It is normally a mild pathogen of centipedegrass of which there are no resistant cultivars.

However, a number of St. Augustinegrass cultivars are resistant to this virus, including Floratam, the most popular cultivar. Therefore, before you plant a single seed or blade of grass, consult with your local experts to determine the most appropriate turfgrass to plant and then make sure the correct material is installed.

Cutting height matters

Cultural practices should promote an environment that is not conducive for pathogen infection and disease development.

If a disease should affect the turfgrass, these practices should be implemented first or, at the very least, implemented at the same time fungicides are applied.

Mowing is the most common turf maintenance operation. Every time a mower removes leaf tissue, a wound is created through which a pathogen may enter the plant. However, turfgrasses that are cut below their optimum height will be stressed and more susceptible to some diseases.

Always use a sharp mower blade. Turf with active disease areas should be mowed last, as mowers may actually spread the pathogen from one location to another. Likewise, clean the equipment between jobs. A thorough rinse with water is sufficient to remove clippings and debris which may carry plant pathogens.

Not too short on greens

Raise the blade height on golf course putting greens with active disease areas. Over the past few years, the height of cut on greens has been reduced substantially; 3/16 inch or lower is the standard on bermudagrass putting greens. The low height of cut reduces the tissue necessary for photosynthesis, the process by which the plant produces energy.

In addition, diseases eventually reduce the leaf canopy and photosynthesis is reduced even further.

It has often been suggested that leaf clippings should be collected when a leaf disease is active. Clippings disposal is no longer ecologically acceptable and will become illegal in some states in the near future. In general, do not collect leaf clippings unless you have an acceptable method for recycling the material.

A properly constructed compost will kill the pathogen, so you will not infect a turfgrass area by using this composted material in the landscape. In addition, recent studies suggest that using a mulching lawnmower blade with a closed mower deck may help to limit leaf diseases when it is necessary to return clippings to a turf area.

Managing water

Most fungal pathogens require free water or very high humidity to start the infection process. Dew (more importantly, the length of the dew period), which depends on temperature and humidity, is a critical factor. Extending the length of the dew (free water) period by irrigating in the evening before dew forms or in the morning after the dew evaporates extends the dew period. Therefore, irrigate when dew is already present, usually in the pre-dawn hours.

When you do irrigate, apply enough water each time to adequately soak the entire root system. Irrigate to the depth of the roots, but not below them. Shallow irrigations will require you to irrigate more frequently and thus increase the chances for pathogen infection and pathogen movement.

Importance of nitrogen

Many diseases are also influenced by the nutritional status of the grass, especially nitrogen. Both excessively high and low nitrogen fertility contributes to turfgrass diseases. Higher nitrogen applications encourage rhizoctonia diseases, gray leaf spot, helminthosporium leaf spot and pythium blight. Lower nitrogen levels encourage dollar spot, rusts and anthracnose.

Remember: it is easier to add nitrogen to the soil but impossible to remove it. If a foliar disease is active, select a fertilizer blend with a high percentage of the slow-release component and a low percentage of the rapid-release component. This will allow you to "feed" the turf without "feeding" the pathogen.

Note that no single environmental factor influences diease development. One example is centipede decline. Although no specific pathogen has been documented as the causal agent, we do know that excessive fertilization and irrigation contribute to the decline. Dollar spot is another example. Three factors encourage this disease: nitrogen deficiency, dry soils, and high moisture levels surrounding the leaves. Frequent, short irrigation periods in addition to dew periods lead to the dry soils and high leaf humidity. Although fungicides are available for controlling this disease, correcting the three diseases development factors, especially the plant's nitrogen status, will achieve the same goal. Physical and chemical soil properties may not affect disease development directly, but they do affect turfgrass health.

Maintain pH levels

Soil pH is an important growth factor. For example, centipedegrass and

Biological control testing continues

Biological control of turfgrass diseases is a new area of disease management that is still in the experimental research phase for warm-season turfgrasses.

Testing is currently in progress concerning the use of non-pathogenic fungi and bacteria for control of turfgrass diseases. However, the most active area of research involves the use of organic fertilizers for disease suppression. These products are thought to stimulate the development of microorganisms which antagonize turfgrass pathogens. In both cases, further testing is required to substantiate their value in the consistent control of turfgrass diseases and the proper methods for their use. When that is accomplished, biological control will be routinely incorporated into an integrated turfgrass management program.

—*Dr. Elliott*□