HORTICULTURAL
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Turfgrass Disease Control

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Turfgrass disease is one of the serious and costly reasons for injury and death to grasses used in lawns, golf courses, sport fields, and other areas where grasses are desired. Plant pathogenic fungi are the main cause of lawn diseases. Other organisms, such as nematodes, and several nonparasitic problems are also sources for diseases (Table 1 – Nematodes). **An accurate diagnosis of the problem is essential to any successful control program.** Diagnosis of lawn diseases can be performed at diagnostic clinics, such as the Plant Diagnostic Clinic (http://soilplantlab.missouri.edu/) on the University of Missouri campus – 23 Mumford Hall, Columbia, Missouri 65211.

Disease identification and control involve more than just waiting for diseases to appear, then trying to make a rapid diagnosis and applying a fungicide. Most disease identification guides show only the symptoms of developed diseases. This is helpful, but it is more important to know the conditions that can lead to a disease, and to follow basic cultural practices that can reduce your potential for a disease. Knowing when and under what conditions to anticipate various turfgrass diseases, an individual can prepare for what to do about them, saving time and achieving better results in disease control.

Managing turfgrass diseases

Environmental conditions strongly influence disease occurrence. Although many of the causal agents are always present in turf, diseases do not occur until conditions are favorable for pathogen development. For example, brown patch disease requires wet, humid conditions during warm to hot weather. Being aware of the conditions that increase disease potential is important in taking preventive measures such as applying fungicides before symptoms appear. But before fungicides are considered, there are several turfgrass management practices that need discussion in hopes of reducing the potential for disease. Refer to Table 1 for host species, disease symptoms, conditions favorable for infection and recommended cultural practices and fungicide treatments.

Selecting grass species and cultivars

Some diseases can be avoided by selecting grass species that are not susceptible to certain pathogens. For example, summer patch is a severe problem on Kentucky bluegrass but has little effect on tall fescue. An area historically prone to summer patch disease can be planted to tall fescue to reduce that potential. Likewise, within species of grasses, selected cultivars can offer more disease resistance than others. A cultivar of Kentucky bluegrass may show a higher level of tolerance to rust disease and perhaps be selected as part of a blend or mixture. Even though these grasses are termed "disease resistant," it does not mean that they are 100 percent disease free. Selecting cultivars with higher disease resistance will reduce your potential for turfgrass diseases and becomes the first step in a line of cultural practices to manage turfgrass diseases.

The National Turfgrass Evaluation Program was organized to test species and cultivar performance in several locations of the United States. Most of the data and information generated by this program can be accessed through their Web site at http://ntep.org. You can also contact your local MU Extension center for grasses that have been recommended for Missouri.

Soil fertility

Soil fertility is an important factor in disease development. High nitrogen levels increase the susceptibility of cool-season grasses (Kentucky bluegrass, tall fescue, perennial ryegrass, fine fescue and bentgrass) to leaf spot, Rhizoctonia brown patch and Pythium blight. Low nitrogen levels increase turfgrass susceptibility to dollar spot and red thread. Low potassium levels in the soil reduce turfgrass tolerance to high temperatures and drought stress, which can increase the potential of diseases such as summer patch. Low pH is often associated with diseases such as brown patch as well.

Knowledge of soil fertility as it relates to turfgrass diseases can help guide an individual in deciding how to manage a lawn. A tall fescue lawn can receive two or three fertilizer applications throughout the fall and perhaps receive no additional fertilizer in the spring to reduce the potential for brown patch. Like tall fes-

cue, Kentucky bluegrass can receive fall fertilization but can also receive fertilizer in the spring to help keep dollar spot from infecting the bluegrass.

To minimize the potential for disease, supply enough nitrogen that proper mowing is required on a weekly basis. Sometimes a light application of nitrogen will produce enough active leaf growth that disease symptoms are no longer visible.

Mowing

Turfgrass plants mowed shorter than their optimal height of cut are, in general, more susceptible to diseases. Optimal cutting heights for cool-season grasses range from 2.5 to 4.0 inches, depending on the species. Warm-season grasses can range between 1 and 2 inches.

Seasonal variation in mowing height was once thought to be highly beneficial and is still considered beneficial by some. We know that mowing cool-season grasses a little taller in the summer months can have benefits through summer stress periods (deeper roots, better cooling effect). We also know that cool-season grasses mowed a little taller in the spring and fall compete more successfully against weeds. Therefore, select the tallest, acceptable mowing height for your species of grass and maintain that height during the entire season. This provides benefits throughout the season – competition against weeds as well as reduced summer stress.

Frequency of cut should be determined by the "one-third rule" of mowing. You should make sure that no more than one-third of the leaf growth is removed during a single mowing.

Mowing creates wounds through which fungi can enter the plant and infect it. Leaf cuts made by a sharp mower blade are cleaner and heal faster than the tearing and shredding caused by a dull mower blade. A dull mower blade inflicts more and bigger wounds that increase potential for infection by turfgrass diseases.

Observe leaf tips or grass clippings collected on your mower deck immediately after a mowing to determine the quality of cut. Use this as an indicator of when to sharpen blades.

Watering

Nearly all turfgrass diseases require water for their development. Some disease problems such as Pythium blight, brown patch, and dollar spot are accentuated by extended periods of free moisture. Extended periods of free moisture in turfgrasses can be caused by dew, guttation and frequent irrigation or rainfall. Guttation is the formation of water droplets at the tips of grass leaves. These droplets contain exudates of sugars and proteins and serve as an excellent food source for pathogens. Remove dew and guttation from grass leaves by dragging a hose across the surface of the lawn, using a whipping pole or briefly irrigating only long enough to wash the dew from the surface of the leaves. Following these methods will spread the concentrated dew or guttation over a larger surface area, causing the turf canopy to dry faster.

Improper irrigation alone can create a disease problem. Avoid frequent irrigation that results in extended periods of free moisture. Avoid late evening watering that extends the free moisture period throughout the night. Cool-season grasses can be allowed to have drying periods (near wilting) to disrupt the growth cycle of fungi favored by free moisture.

Irrigation in the early morning not only limits extended periods of dew and guttation but also applies water at a time of the day when temperatures are low (reduced evaporation) and winds are calm (better distribution). A rule of thumb is to avoid puddles and runoff during irrigation, put the water where it is needed, and irrigate only as much as your particular soil type can absorb in one cycle.

Thatch control

Essentially all turfgrass diseases are reduced by good thatch control.

Thatch is a layer of dead and living plant material located between the soil surface and green turf canopy. It is excellent habitat for active and dormant stages of disease-causing organisms. When environmental conditions are optimum, fungi can rapidly grow and infect living turf tissue.

Remove excess thatch when turf is actively growing to promote quicker recovery from power-raking or verticutting. Remove thatch in the spring before application of crabgrass preventer, or in the fall for cool-season grasses and midsummer for warm-season grasses.

Core aerification (removing soil plugs) is a slower process of thatch control but will cause less direct stress on the turf. Breaking up soil plugs and filtering soil into the turf canopy allows soil microbes to breakdown dead organic matter in the thatch layer.

Remove excess thatch when it accumulates to a half inch or more in taller-mowed turf (1.5 to 4 inches) and one-quarter inch in lower-mowed turf (less than 1.5 inches).

Soil aeration and drainage

A good exchange of air between the soil and atmosphere is necessary for vigorous turfgrass growth. Turf areas that stay constantly wet because of poor soil conditions are prime targets for water-favoring, soil-borne diseases such as Pythium blight and brown patch. Surface contouring and subsurface drainage can be costly but permanent solutions to wet soils.

Core aerification and slicing are turf management practices that can be repeated during the season to temporarily increase air exchange and soil drying.

You can also increase light penetration and air movement by selectively pruning your trees and shrubs. This will speed the drying of poorly drained

areas and also reduce the humidity in localized turf areas.

Managing disease with fungicides

Fungicides for managing turfgrass diseases (Table 2) are most effective when combined with cultural practices that reduce plant stress. Most fungicides labeled for use on turfgrass suppress rather than kill the target fungus. Suppression often lasts long enough to allow prevailing environmental conditions to become more favorable for growth and recovery of the turfgrass. Grasses can naturally recover from some diseases when environmental conditions favor growth of the turfgrass. Large patch of zoysia and brown patch in fescue are two examples. Unfortunately, the weakened turf areas may become weedy, and some owners or managers of high-visibility turf areas are unwilling to wait for recovery.

Fungicides work by interfering with critical processes essential to growth and development of fungi. The critical processes are biochemical pathways that may be regulated by one or many genes in the fungus. The point in the biochemical pathway disrupted by the fungicide is known as the action site. Some fungicides interfere with a single action site while others affect multiple action sites. A single action site can be regulated by one gene in the fungus or by multiple genes. Multiple genes in the fungus usually regulate multiple action sites.

The risk of selecting resistant fungal strains is high with repeated use of a fungicide that disrupts a single action site under regulation by a single gene. The risk of selecting resistant fungal strains is low for a fungicide that affects multiple sites under regulation by multiple genes.

Thanks to the work of the Fungicide Resistance Action Committee (FRAC), a turfgrass manager does not need to know the exact biochemical mode of action for a given fungicide. The committee has assigned number or letter codes to commercial fungicides, grouping them according to mode of action. All fungicides with the same FRAC code share a common mode of action and resistance mechanism, even though their chemical structures may be different. Two exceptions in the FRAC classification scheme are the fungicides that have multisite activities and those that have unknown modes of action.

Topical mode of action describes what happens to a fungicide when it contacts a plant. Fungicides have two basic topical modes of action: contact and systemic. Systemic fungicides can be subdivided based on the extent of movement inside the plant. There are three possible fates of systemic fungicides once they have entered a plant: locally systemic, xylem-mobile systemic, or phloem-mobile systemic.

Resistance to fungicides

Repeated use of fungicides with similar modes of action or with a single action site can result in the selection of fungus populations with resistance to the fungicide. Strains of the dollar spot fungus resistant to benzimidazoles, DMI-type fungicides and iprodione have been documented.

Plant pathologists generally agree that certain practices can delay the selection of resistant fungal strains. Here are some examples:

- Do not rely on fungicides alone. Combine fungicide use with cultural practices that reduce disease severity.
- Use contact fungicides alone or in combination with systemics as part of the control program.
- Use fungicides on a preventive, rather than a curative, basis.
- Rotate or mix systemic fungicides with different FRAC codes. Repeated use of the same or a similar fungicide selects resistant members of the population.

Table 1. Common turfgrass diseases in Missouri.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Algae **Host:** All turfgrasses	A green to black scum forms on bare soil or thin turf. The slimy mass dries to form a thin, dark green or black crust. Algae are not parasitic on plants. **Conditions favoring disease:** Low, wet locations. Heavily used areas subject to compaction. High humidity.	Conduct a soil test and apply correct amounts of lime/ fertilizer. Avoid excessive water and watering. Aerify compacted soils to improve drainage. Before reseeding, apply 5 to 10 ounces of lime per 1,000 sq. ft.	Apply 2 to 3 ounces of copper sulfate per 1,000 sq. ft. Some mancozeb and chlorothalonil formulations are labeled for control of algae. They are most effective when used preventively. See Table 2.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Anthracnose *(Colletotrichum graminicola)* **Host:** All turfgrasses, especially annual bluegrasses	Irregular patches of blighted turf, ranging from 2 inches to 10 to 20 feet in diameter. Patches are initially reddish brown, but fade to light tan. Leaf lesions are round to elongated and reddish brown. In later stages, fruiting bodies with black setae can be seen with a hand lens. **Conditions favoring disease:** Temperature 80 to 85 degrees F. Time of year: summer and fall. Prolonged periods of moisture-saturated atmosphere. Low fertility. Excess thatch.	Maintain adequate fertility. Avoid excess thatch.	See Table 2.
Anthracnose basal rot *(Colletotrichum graminicola)* **Host:** Bentgrass, annual bluegrass	Irregular patches of browning turf. Infected bentgrass often takes on an orange cast. On some greens, only bentgrass has been infected, leaving scattered patches of uninfected annual bluegrass. On putting surfaces the symptoms often appear as a patch. Hairlike projections (setae) of fruiting bodies in crowns and on stems are visible with a hand lens. Fruiting bodies may not be evident on leaves. **Conditions favoring disease:** Factors associated with poor root development: saturated conditions, compaction, and summer stress conditions. Symptoms of anthracnose basal rot can occur at any time throughout the year.	When anthracnose basal rot has been identified, suspend management practices, such as topdressing and aerification that injure plants. A light application of nitrogen may promote turf recovery.	Begin a preventive fungicide program in mid-April on greens with a history of anthracnose basal rot. Avoid use of DMI-type fungicides during heat stress periods or when anthracnose basal rot is active. See listings for anthracnose in Table 2.
Brown patch *(Rhizoctonia solani)* **Host:** All turfgrasses	Vary with management practice. With close mowing, the affected areas are circular or irregular — a few inches to several feet. Color is at first purplish green but fades rapidly to light brown as withered leaves dry out. Dark purple “smoke rings” 1/2 to 2 inches in diameter may be observed bordering diseased area. With high mowing, affected areas range from 2 to 50 feet in diameter. Blighted leaves develop in warm, humid weather. **Conditions favoring disease:** Temperature: 80 to 85 degrees F. Time of year: late spring, summer and early fall. Free moisture on leaves, excess thatch, high nitrogen. Observed more frequently on short-cut grasses.	Avoid summer application of nitrogen, especially soluble sources. Avoid frequent irrigation, especially during hot, humid weather. When disease conditions exist, remove dew and guttation with a light irrigation at sunrise.	Avoid the use of DMI-type fungicides during summer heat stress periods. See Table 2.
Dollar spot *(Sclerotinia homoeocarpa)* **Host:** All turfgrasses	Individual leaves develop water-soaked lesions that eventually become straw colored with red-brown margins. Overall symptoms vary with management practice. With close mowing, such as putting greens, spots are circular, straw colored and 2 to 3 inches in diameter. These may eventually coalesce to involve large areas. With higher mowing, affected areas are large (6 to 12 inches in diameter) and irregularly shaped. In early morning, cobwebby mycelium may be seen on affected leaves. **Conditions favoring disease:** Temperature: 60 to 85 degrees F. Times of year: Late spring and early fall or during cool, wet summers. Low nitrogen, excess thatch, high humidity and heavy morning dew.	Avoid nitrogen deficiency and moisture stress. If disease symptoms are present and nitrogen levels are low, then a light nitrogen application (0.25 to 0.5 pounds nitrogen per 1,000 sq. feet) may stimulate recovery.	Repeated use of DMI-type fungicides alone may select for resistant fungal populations. Avoid the use of DMI-type fungicides during summer heat stress periods. See Table 2.

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Fairy rings (Many different basidiomycetes) **Host:** All turfgrasses	Three distinct types of symptoms. Type I: Circular ring of fast-growing green grass with a thin or dead patch of grass inside. Type II: A single ring of stimulated grass. Type III: Circular ring of basidiocarps (mushrooms or puffballs) with no visible effect on the grass. Soil in and around the rings may become hydrophobic (difficult to wet). Symptoms sometimes go away with time. **Conditions favoring disease:** Most severe on light-textured soils. Low fertility, heavy thatch.	Symptoms sometimes can be suppressed by core aerifying, fertilizing and deep watering. On high-visibility lawns and other turf areas, removal of infested soil may be necessary. Remove soil to a depth of 12 inches in an area to include the ring and about 2 feet on either side of the ring. Replace with fresh soil from a non-infested site. Reseed or sod the area.	There are several fungicides labeled for control of fairy ring. Combine fungicide use with aerification and fertilization to maintain optimum fertility. See Table 2.
Gray leaf spot *(Pyricularia grisea)* **Host:** Perennial ryegrass, St. Augustinegrass	Leaf lesions first appear as tiny brown spots that enlarge and become oval or oblong. Mature spots usually have depressed gray centers with brown margins surrounded by a ring of chlorotic tissue. If foliar infection is severe, the leaves may appear burned or scorched. Lesions can be found on leaf sheath, spike, and stems. Leaf blades often have a twisted appearance. **Conditions favoring disease:** Under conditions of high humidity and high temperature (80 to 90 degrees F), the disease may develop rapidly. High nitrogen levels. Symptoms usually occur during mid-summer. New seedlings are most susceptible.	Avoid excessive nitrogen levels or applying nitrogen just before and during the time of year when gray leaf spot is a problem. Irrigation in the middle of the day will allow foliage to dry quickly and thus reduce the potential of the disease. Avoid over-seeding with perennial ryegrass.	Preventative measures are better than curative. Late season infections can be brought under control with first heavy frost. See Table 2.
Helminthosporium diseases **Crown and root rot** *(Bipolaris sorokiniana)* **Leaf spot and melting out** *(Dreschlera poae)* **Net blotch and crown and root rot** *(Dreschlera dictyoides)* **Red leaf spot** *(Dreschlera erythrospila)* **Host:** All turfgrasses are host to one or more of these pathogens.	Thinning of stands in scattered areas. Dead grass appears brown to red in color. Straw-colored lesions with purple or red margins are visible on individual leaf blades. Spots are parallel to blade. Sheaths may be blighted, causing leaves to drop. Crowns and roots may be invaded — discolored tissues. **Conditions favoring disease:** Temperature: wide range. Time of year: early spring and fall. Leaf blighting phase may occur in hot, humid weather. High nitrogen fertility, heavy thatch.	Maintain balanced fertility. Avoid excess nitrogen, especially in the spring.	See Table 2.
Large patch *(Rhizoctonia solani)* **Host:** Zoysia, buffalograss	Large, circular areas of zoysia or buffalograss that fail to green up in the spring. Noticeable thinning; weed invasion. Yellow to orange appearance to zoysia; patch margins with distinct bright yellow-orange leaves. Symptoms disappear during summer but appear again in the fall. **Conditions favoring disease:** Heavy thatch buildup, high nitrogen.	Reducing thatch may help alleviate symptoms. Do not fertilize when the disease is active.	Effective fungicide control can be achieved with preventive application of fungicide in the fall. Most effective when applied before symptoms appear. A second application in the spring may be desirable. See Table 2.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Silvery thread moss *(Bryum argenteum)* **Host:** Turfgrasses on putting surface **Other mosses**	Silvery thread moss is an emerging problem on putting surfaces, even those located in full sun. Mosses may invade and outcompete stressed grass. They are not parasitic on plants. **Conditions favoring disease:** Low fertility, poor drainage, excess shade, soil compaction.	Remove by hand raking. Conduct a soil test and apply correct amounts of lime/ fertilizer. Avoid excessive water and watering. Aerify compacted soils to improve drainage. Before reseeding, apply 5 to 10 ounces of lime per 1,000 sq. ft.	Apply 5 ounces of copper sulfate or ferrous sulfate per 1,000 sq. ft.
Nematodes (many different species) **Host:** All turfgrasses, but especially bentgrass	Patches of turf that have stunted or yellow grass. Patches showing up same places year after year with or without other obvious diseases should be assayed for nematodes. **Conditions favoring disease:** More of a problem in light, sandy soils, such as bentgrass greens. Mild to warm soil temperatures and adequate moisture.		To determine whether plant parasitic nematode populations are high enough to cause damage, soil samples should be assayed by a qualified nematologist. In Missouri, samples can be sent to the Extension Plant Nematology Laboratory. If populations are expected to cause damage, follow recommendations of the lab. Apply Nemacur 10G Turf and Ornamental Nematicide (2.33 pounds/1,000 square feet). FOR USE ONLY ON GOLF COURSES, CEMETERIES AND INDUSTRIAL GROUNDS. Do not treat newly seeded areas. Do not apply more than 200 pounds per acre per year. Do not use on residential lawns or public recreational areas other than golf courses. Follow label instructions. Certified pesticide applicator only.
Microdochium patch (Pink snow patch) *(Microdochium nivale)* **Host:** All turfgrass	Snow cover is not necessary for development of this disease. Irregular to circular patches of bleached, dead grass. Leaf blades tinted pink. **Conditions favoring disease:** Temperature: 32 to 45 degrees F. Time of year: Late fall, winter or early spring. High humidity as found under melting snow, leaves, and mulch or in heavy thatch. High nitrogen levels in late fall.	Avoid excess nitrogen in the fall.	Apply fungicides in November through March in area with a history of the disease. See Table 2.
Powdery mildew *(Blumeria graminis)* **Host:** Bluegrasses, fescues	White to grayish powdery mold on leaves. Severely infected leaves may turn yellow and wither. **Conditions favoring disease:** Temperature: 65 to 70 degrees F is optimum. Time of year: Spring and fall. Damp, cool nights and high humidity, but not free water on leaf surface. Low light intensity (most severe on bluegrass in the shade). Poor air circulation.	Usually, powdery mildew is only a problem in shady locations. Several cultivars of fine fescues are better adapted for shade and are more resistant to powdery mildew than Kentucky bluegrass. Turf-type fall fescue is better adapted for shade than Kentucky bluegrass. Avoid excessive nitrogen. Prune trees to improve light and provide better airflow.	See Table 2.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Pythium blight (Greasy spot) *(Pythium aphanidermatum, P. ultimum)* and others **Host:** All turfgrasses	This disease appears first as an area of water-soaked tissue that turns light brown as the leaf tissue dies. The disease pattern seen in the turf reflects the presence of poor surface drainage. In high humidity, diseased leaves may be covered with white cobweb-like mycelial strands **Conditions favoring disease:** Temperature 85 to 95 degrees F. Time of year: late spring through early fall. Excess thatch. Shade — poor air circulation. Lush dense growth. Excessive water — high rainfall. Calcium deficiency. Compacted soil.	Avoid excess nitrogen and water, especially in hot weather. Provide adequate water and air drainage. Encourage leaf surface drying on a daily basis when conditions are favorable for the disease to occur. Dew or guttation fluids can be removed from turf canopies by a light sprinkling (less than five minutes) shortly after daylight. Removing free moisture in this manner causes quicker canopy drying and reduces the mobility and activity of Pythium. Where dew or guttation is not present, light daily watering may favor development of the disease problem.	See Table 2.
Red thread *(Laetisaria fuciformis)* **Host:** All turfgrasses and **Pink patch** *(Limonomyces roseipellis)* **Host:** Perennial ryegrass, red fescue	Red thread can be distinguished in the advanced stages by the presences of bright red to pink fungus at the tips of the affected leaves. These two diseases present similar symptoms of irregularly shaped patches of affected grass. From a distance, the patch may have a pinkish or reddish cast. On individual leaves, the initial blighted areas can enlarge, causing leaf death. **Conditions favoring disease:** Favored by slow-growing, nitrogen- and calcium-deficient grass. Excessive thatch. Water deficiency.	Correct nitrogen deficiency. Remove and destroy clippings during periods of infection.	See Table 2.
Rust *(Puccinia graminis) (P. coronata) (P. zoysia)* **Host:** All turfgrasses, especially certain varieties of bluegrass, ryegrass, zoysia	Affected grass becomes reddish-brown to yellow-orange color. Individual leaves and sheaths are covered with numerous red pustules. Severely affected leaves may turn yellow, wither and die. Severely rusted lawns are more prone to winterkill. **Conditions favoring disease:** Temperature 85 to 95 degrees F., summer to fall. Low fertility. Moderate soil moisture stress, heavy dew and frequent light rain.	Usually a problem after turf growth has been slowed by moisture stress. Avoid nitrogen and moisture stress. Light nitrogen application at first sign of infection may help.	See Table 2.
Seedling blights and damping off (several fungus species) **Host:** All turfgrasses	Pre-emergence and post-emergence damping off. Seedlings may be stunted and yellowed. Seedlings wilt and collapse. Stand is slow to fill in. **Conditions favoring disease:** Attacks are most severe in warm weather on heavy, poorly drained soils or where seeding rates have been excessive.	Provide good drainage when establishing a new seeding. Fill in low spots to avoid standing water.	Seed treatment or early seedling protection works best. See labels for recommended rates and time of application. A diagnosis of the cause of damping off will help you decide which materials to use. See Table 2.
Slime mold *(Physarum cinereum) (Fuligo* sp.*) (Mucilago spongiosa)* and *(Ste monitis* spp.*)* **Host:** All turfgrasses	Small, white-gray, cream or yellow slimy masses spread irregularly over grass. The masses dry out to form unsightly, powdery structures. Slime molds are primitive fungi that use decaying organic matter as a food base. They are not parasitic on plants. **Conditions favoring disease:** Spring, summer, fall. Humid weather, lush, well-watered grass and excess thatch.	Remove growth by raking, brushing, mowing or hosing.	Fungicides applied to control other diseases should keep slime molds in check. See Table 2.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Smut **Stripe** *(Ustilago striiformis)* **Flag** *(Urocystis agropyri)* **Host:** All turfgrasses, especially certain varieties of bentgrass, bluegrass, ryegrass and fescue	Infected turfgrass plants generally are slow growing and have a yellow or grayish cast. As the disease progresses, long yellow-green streaks develop on the leaves. These become gray or black as epidermal tissue ruptures, releasing black spore masses. Loss of water from the ruptured epidermal tissue results in death. Scattered plants or large patches may be infected. Affected plants are systemically infected and are susceptible to other stresses. **Conditions favoring disease:** Temperature: 50 to 60 degrees F. Time of year: October through November. Excess thatch, frequent watering and susceptible cultivars.	Avoid excess nitrogen and drought. Use uninfested seed or smut-free sod. If plants are infected, allow grass to undergo natural dormancy periods to reduce inoculum. This practice may necessitate renovation and replanting if turf is infected heavily.	See Table 2.
Spring dead spot *(Ophiosphaerella* spp.*)* **Host:** Bermudagrass	Circular patches of bleached, dead grass in spring when dormant bermudagrass resumes growth. Rough, circular, bleached and dead spots appear with regrowth in the spring, varying in size from 2 inches to more than 3 feet in diameter. Sometimes the centers may survive after several years, resulting in doughnuts. The spots often develop into rings and tend to reappear and enlarge in the same area for several years before disappearing.	Remove excess thatch when it reaches 0.5 inch. Aerify to relieve compaction and promote deep root development. Maintain balanced fertility. Promote good soil drainage. Cultivars with a high level of winter hardiness are less affected by spring dead spot.	Fungicide control has not been very effective. See Table 2.
Summer patch *(Magnaporthe poae)* (formerly Fusarium blight complex) **Host:** Kentucky bluegrass, annual bluegrass, fine-leaf fescues	Grayish patches of wilted turf, 2 to 6 inches in diameter, appear first. Large, irregular patches become prominent as wilting leaves turn brown. **Conditions favoring disease:** Occurs more commonly on older established turf. Develops following high temperature and heavy rainfall common in midsummer. Commonly occurs on slopes with southern exposure.	Avoid excess nitrogen, moisture extremes and very close mowing. Irrigate to maintain even growth with little turf wilting. Alternate wetting and drying cycles may increase infection. Plant fescue rather than bluegrass on sites prone to summer patch.	On putting greens where the disease occurs in association with *Poa annua,* manage out the Poa or, when the budget allows, replace it with bentgrass. In well-maintained turf areas of Kentucky bluegrass, consider an early spring preventive application of a DMI-type fungicide. A curative drench of thiophanate methyl in combination with a light application of nitrogen may stimulate recovery. See Table 2.
Take all *(Gaeumannomyces graminis)* **Host:** Bentgrass	First seen as small, depressed, circular patches. Light straw to bronzed color. Increases to several feet in diameter, eventually coalescing to become large and irregular-shaped patches. Centers of patches fill in with resistant grass species creating a frog-eye appearance. Roots have a blackened vascular cylinder. **Conditions favoring disease:** Typically a cool, wet weather disease. Development is favored by high soil pH and/or liming. Especially serious on newly constructed or renovated greens.	High nitrogen fertility and increased acid condition of soil are reported to help control. Use ammonium form of nitrogen fertilizer.	Fungicide controls questionable. See Table 2.
Typhula blight (Gray snow mold) *(T. incarnata* and *T. itoana)* **Host:** All turfgrasses	Not usually serious in Missouri. Gray to straw-colored spots several inches to 2 feet or larger. Affected areas covered with fluffy, bluish-dirty-gray mold. A silvery membranous crust may develop. **Conditions favoring disease:** Temperature: 32 to 45 degrees F. Time of year: winter or early spring. Requires snow cover. High moisture under melting snow. High rate of nitrogen before winter dormancy.	Avoid high nitrogen before winter dormancy.	Most fungicides must be applied in the fall before snow cover. See Table 2.

Disease/ Host	Symptoms/ Conditions favoring disease	Cultural practices	Recommendations
Yellow patch *(Rhizoctonia cerealis)* **Host:** Bentgrass, bluegrass	Light-green to yellow-green, or bronze-colored rings and crescent-shaped patches, ranging from a few inches to about 3 feet in diameter, often with green grass in the center of the circles. Smaller yellow patches usually result from infections that occur under cold, wet conditions. The patches often are sunken as a result of rapid decomposition of the thatch. **Conditions favoring disease:** Temperature: 40 to 60 degrees F optimum. Time of year: spring, fall and winter.	Nitrogen to promote recovery. No resistant varieties.	The disease is difficult to control once symptoms are noted. See Table 2.
Yellow tuft *(Sclerophthora macrospora)* **Host:** Annual bluegrass, Kentucky bluegrass, tall fescue, fine-leaf fescue, perennial ryegrass, roughstalk bluegrass, creeping bentgrass, zoysiagrass	Small yellow spots in the turf, from ¼ to 3 inches in diameter. Infected turf may appear spotted, as though droplets of herbicide had been misapplied to the area. Tufts appear as a dense cluster of yellow shoots, which can be seen arising out of a single axillary bud at the node or terminals of a stem. Infected plants have poorly developed root systems, and die during stress periods. Once the symptoms have developed, formation of the tuft cannot be reversed. **Conditions favoring disease:** Most common during the cool, moist weather of spring or fall.	Avoid standing water. Applications of iron (Fe) will help mask the symptoms. Keep nitrogen levels low or it may be better to make no nitrogen applications at all in June, July and August.	Applications need to begin following the first mowing in the spring and continue until the nighttime temperatures remain above 65 degrees F on a consistent basis. Fungicide applications should begin again in the fall, when the nighttime temperatures drop into the 50s. See Table 2.

For further information

See the following sources, from which some of the information in this publication derives:

Management of Turfgrass Diseases, Second edition, J.M. Vargas, Jr., Lewis Publishers, 1994.

Commonly Used Turfgrass Fungicides and the Diseases They Control, prepared and edited by Dr. Gail Schumann, Turfgrass Pathologist, University of Massachusetts Extension Turf Program.

Compendium of Turfgrass Diseases, Third edition, R.W. Smiley, P.H. Dernoeden and B.B. Clarke, APS Press, 2005.

Greenbook Turf and Ornamental Reference for Plant Protection Products, Vance Communication Corporation, 2005, http://greenbook.net.

Table 2. Basic fungicides labeled for management of turfgrass diseases. *(Compiled by Barb Corwin and Kyle Briscoe)*

				Fungicide classification ➧		
FRAC code[1]	**Group name**	**Chemical group**	**Common name**	**Topical mode of action[2]**	**Selected registrant(s)**	**Selected trade name(s)**
1	Methyl benzimidazole carbamate (MBC)					
		thiophanates	thiophanate methyl	XMS	The Andersons, Cleary	Fungo Flo, Cleary 3336
2	Dicarboximide					
			iprodione	LS	Bayer	Chipco 26 GT
			vinclozolin	LS	BASF	Curalan
3	Demethylation inhibitors (DMI)					
		pyrimidines	fenarimol	XMS	Gowan	Rubigan
		triazoles	myclobutanil	XMS	Dow AgroSciences	Eagle
			propiconazole	XMS	Syngenta	Banner Maxx
			triadimefon	XMS	Bayer	Bayleton
4	Phenylamide					
		acylalalines	metalaxyl(-m)	XMS	Syngenta	Subdue Maxx
7	Carboxamide					
			boscalid	XMS	BASF	Emerald
			flutolanil	XMS	Bayer	Prostar
11	Quinone outside inhibitor (QoI)					
		methoxy-acrylates	azoxystrobin	XMS	Syngenta	Heritage
		methoxy-carbamates	pyraclostrobin	LS	BASF	Insignia
		oximino acetates	trifloxystrobin	LS	Bayer	Compass
12	Phenylpyrrole					
			fludioxonil	C	Syngenta	Medallion
14	Aromatic hydrocarbon					
			chloroneb	C	The Andersons, PBI Gordon	Proturf Fungicide II, Teremec SP
			PCNB (quintozene)	C	Crompton	Turfcide
		1,2,4-thiadiazoles	etridiazole	C	The Andersons	Koban
19	Polyoxin					
		peptidyl pyrimidine nucleoside	polyoxin D	LS	Cleary	Endorse
28	Carbamate					
			propamocarb	LS	Bayer	Banol
33	Phosphonate					
			phophorous acid	PMS	Cleary	Alude
		ethyl phosphonates	fosetyl-Al	PMS	Bayer	Aliette
M	M3					
		dithio-carbamate	mancozeb	C	Dow AgroSciences	Fore
			thiram	C	Cleary	Spotrete
M	M4					
		phthalimides	captan	C	Drexel	Captan
M	M5					
		chloronitriles	chlorothalonil	C	Syngenta	Daconil

Comments: [1] Numbers or letters assigned by the Fungicide Resistance Action Committee (FRAC). Fungicides with the same FRAC code have the same or similar mode of action. For a complete FRAC code list: http://frac.info

[2]Classification from Paul Vincelli, University of Kentucky
C = contact, LS = locally systemic, XMS = xylem-mobile systemic, PMS = phloem-mobile systemic

	Ascomycetes								Basidiomycetes									Imperfects				Oomycetes				Other		
									Rhizoctonia																			
	bentgrass dead spot	dollar spot	gray leaf spot	necrotic ring spot	powdery mildew	spring dead spot	summer patch	take-all patch	brown patch	large patch	yellow patch	fairy ring	gray snow mold	pink patch	red thread	rust	smut	anthracnose	Ascochyta leaf blight	Helminthosporium leaf spots	Microdochium patch	Pythium blight	Pythium root rot	Pythium seedling blight	yellow tuft	algae	seedling blight	slime mold
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● = suppression only

Disclaimer: All product information in this table is presented with the understanding that no endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

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