



Turfgrass Diseases in Georgia: Identification and Control

Alfredo Martinez, Extension Plant Pathologist

Mila Pearce, IPM Homeowner Specialist

Lee Burpee, Plant Pathologist

Department of Plant Pathology -- Griffin

Systematic Approach to Diagnosis of Turfgrass Diseases

1. Identify the host
 - Some diseases are more likely to occur on certain grass species
2. Define the symptoms of the problem
 - Patches, yellowing, chlorosis, leaf spots, etc.
3. Ask questions to narrow down the cause of the symptoms
 - Could it be environmental?
 - Was anything sprayed?
 - When did you first notice the problem?
 - Where did it start?
 - Has it spread since then?
 - What is your watering and fertilization schedule?
4. Examine the specimen
 - Collect a representative sample with a range of symptoms including leaf blades and roots.
 - Use half of sample to perform diagnosis. Store the rest of the sample inside a plastic bag that contains a moist paper towel.
 - Using a hand lens or compound microscope, observe any fungal signs that may be present (mycelia, sclerotia, pycnidia, etc)
 - Prepare a microscope slide mount based on signs and view with compound microscope.
 - Place a small drop of water or stain on the slide.
 - Pull sections from the roots, blade sheath and /or crown, and any leaf spots.
 - Place cover slip over mount and view beginning with smallest magnification and change magnification as the desired signs in question are found.
5. Consult resources
 - Use literature and resources to reach a diagnosis.

(See Figures 1-5, Page 5)

Simplified Turfgrass Disease Identification Key

A. Distinct patches of yellow to brown colored grass are present.

1. Patch is small, circular, sunken, and rarely exceed 3 inches in diameter. Individual leaf blades develop white lesions.
2. Patch is greater than 6 cm in diameter. Individual leaf blades may or may not develop lesions.
 - a) No lesions
 - i) Circular rings of dark green grass 10-20 cm wide. Concentric ring of dead grass may be present. Mushrooms may be present.
 - ii) Irregular chlorotic patches up to 0.5 m across. Lower leaves are chlorotic first and then chlorosis moves to upper leaves. Runners easily pulled from roots. Roots may be short, rotted, and black. Roots may have dark strands of mycelium parallel to the root axis.
 - b) Lesions on leaf buds or leaf blade
 - i) Rings or circular patches of blighted grass. Gray to brown shaped lesions on leaves or leaf sheaths.
 - ii) Rings or circular patches of blighted grass. No lesions on leaves.

B. Distinct patches are absent.

1. Yellow to orange flecks on leaves or stems. Flecks are easily rubbed off.
2. Yellow to orange flecks are absent.
 - a) Leaf lesions are present.
 - i) Lesions first appear small and water-soaked. Old lesions become dark often surrounded by a yellow zone. Lesions have a wide range of size and primarily occur on warm season grasses in Georgia.

- ii) Small, brown leaf and stem lesions enlarge rapidly to oblong spots. Often spots extend across entire leaf. Spots are tan to gray with purple to brown borders. A general chlorosis may appear. Primarily occurs on St. Augustine grass in summer.
 - iii) Leaf lesions are reddish brown with a yellow halo. Leaves turn yellow and finally tan to brown as they die. Primarily occurs on Centipedegrass, Bentgrass, and Zoysiagrass in Georgia.
- b) Leaf lesions are absent.
- i) Large number of pinhead-sized “balls” that are slimy or crusty. Grass does not die or turn yellow. Slime is easily removed.
 - ii) Turf is chlorotic and slow growing. Small to large areas affected. Grass may be mottled and associated with general decline. As temperature increases the affected areas will die. Roots stunted but usually not discolored.

Dollar Spot

Causal Agent:

Sclerotinia homoeocarpa

Susceptible Turfgrass:

All species of warm- and cool-season turfgrass. Georgia has seen cases in Tall fescues, Bentgrass, Bermuda hybrids and Centipede.

Symptoms:

Symptoms of dollar spot includes sunken, circular patches that measure up to several inches on turfgrass. The patches turn from brown to straw color and may eventually coalesce, forming irregularly shaped areas. Infected leaves may display small lesions that turn from yellow-green to straw color with a reddish-brown border. The lesions can extend the full width of the leaf. Multiple lesions may occur on a single leaf blade. Mycelia may be present.

Conditions Favoring Disease:

Dollar spot is favored by temperatures between 60°F to 85°F and continuous high humidity. This disease is particularly favored by warm days, cool nights, and intense dews. When the disease is severe, it also infects turf growing in areas with low levels of nitrogen and in dry soils.

Management Tips:

- Use an adequate level of nitrogen, particularly in the spring and early summer.
- Mow grass at regular intervals.
- Reduce thatch.
- Increase the air circulation.

- Irrigate turf deeply and as infrequently as possible to avoid drought stress. Avoid frequent and shallow irrigation schedules
 - Remove dew from the turf early in the day.
 - Fungicides are available to control the disease.
- Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.

(See Figures 6-12, Page 5)

Fairy Rings

Causal Agent:

Basidiomycetes of more than 40 species can cause fairy rings; causal agents include: *Agaricus campestris*; *Chorophyllum molybdites*; *Collybis spp.*; *Hygrocybe spp.*; *Lepiota sordida*; *Marasmius oreades*; *Psalliota spp.*; *Sclerotinia spp.*; *Tricholoma spp.*; *Lycoperdon cliticocybe*.

Susceptible Turfgrass:

All species of warm- and cool-season turfgrass. Particularly damaging in Centipede and St. Augustinegrass in south and coastal Georgia

Symptoms:

Fairy ring symptoms vary with causal agents. Above-ground mushroom and puff ball basidiocarps may or may not occur. Typically, this disease has outer rings that are either dark-green or brown in color. The shape and size of the rings vary depending on the species. Activity in the turf ceases when the individual rings come in contact with each other. Some causal agents form fruiting bodies, but do not form rings. Conversely, other causal agents will form rings, but not fruiting bodies. Fairy rings are sometimes responsible for causing hydrophobic areas similar to localized dry spots.

Conditions Favoring Disease:

While fairy rings typically occur in the summer, this disease can also occur on cool-season turfgrass in mild winter climates.

Management Tips:

- Avoid using root zone mixes with high levels of undecomposed organic materials.
 - Reduce thatch by vertical cutting.
 - Aerate soil.
 - Irrigate deeply.
 - Use nitrogen fertilizer to mask symptoms on some types of fairy ring.
 - Use soil wetting agents to help penetrate hydrophobic areas.
 - Fungicides are available to control the disease.
- Consult the current *Georgia Pest Management Handbook* -- commercial or homeowners version.

(See Figures 13-15, Page 6)

Take-All Root Rot

Causal Agent:

Gaeumannomyces graminis var. *graminis*.

Susceptible Turfgrass:

St. Augustinegrass, Bermudagrass and Centipedegrass. Bluegrass and Fescues are rarely affected in Georgia.

Symptoms:

Take-all patch causes wilted, circular patches that are brown or bronze-colored and measure up to several feet in diameter. Infected plants have dark-brown roots.

Conditions Favoring Disease:

Take-all root rot typically occurs in wet conditions and in areas with a high soil pH -- most severe at pH 6.5 or above. This disease is more severe on less fertile and sandy soils.

Signs:

Strands of darkly pigmented, ectotrophic, runner hyphae can be seen on roots, stolons, and rhizomes both with the dissecting and compound microscope. Infection hyphae originate from lobed hyphopodia.

Management Tips:

- Use acidifying fertilizers.
- Apply moderate to high levels of phosphorous, potash and minor elements where these nutrients are depleted from the soil.
- Improve the drainage of the turf.
- Reduce thatch.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.

(See Figures 16-20, Page 6)

Brown Patch/Large Patch

Causal Agent:

Rhizoctonia solani

Susceptible Turfgrass:

Brown patch: All species of cool-season turfgrass.

Large Patch: All species of warm-season turfgrass.

These are the most frequently diagnosed diseases on turf samples at University of Georgia Disease Clinics.

Symptoms:

Brown Patch: The symptoms of brown patch can vary depending on the grass cultivar, climatic and atmospheric conditions, and soil management of the turfgrass. This

disease typically causes rings and/or patches of blighted turfgrass that measure 5 inches to more than 10 feet in diameter. It also causes leaf spots and "smoke rings" -- thin, brown borders around the diseased patches that appear most frequently in the early morning. After the leaves die in the blighted area, new leaves can emerge from the surviving crowns. On wide bladed species, leaf lesions develop with tan centers and dark brown to black margins.

Large Patch: Large patch occurs during the spring and fall, when warm-season turfgrasses are entering or exiting their period of winter dormancy. Circular patches of diseased turf are observed, ranging in diameter from less than 3 ft. up to 25 ft. Leaves of recently infected turf, located at the periphery of the patch, may appear orange in color. Some patches may be perennial, recurring in the same location and expanding in diameter year after year. In contrast to brown patch, *R. solani* infection of warm-season grasses occurs on the leaf sheaths, where water-soaked, reddish-brown or black lesions are observed. Foliar dieback from the leaf tip toward the base occurs as a direct result of these leaf sheath infections.

Conditions Favoring Disease:

Brown patch favors high relative humidity as well as temperatures of over 80°F during the day and over 60°F at night. This disease can be quite active at cool temperatures on warm season grasses in the spring and fall. It also occurs in areas that experience more than 10 hours a day of foliar wetness for several consecutive days. Brown patch infestation is more severe when the turf is cut to a height less than the optimum for the turf-grass being grown. Large patch is favored by high relative humidity as well as temperatures of over 80°F during the day and over 55°F at night.

Signs:

Rhizoctonia produces distinct mycelia with three characteristics for diagnostics. *Rhizoctonia* always has septate hyphae that branch at 90 degree angles, constrictions at the base of the branching, and is tan to light brown color.

Management Tips:

- Use low to moderate amounts of nitrogen, moderate amounts of phosphorous and moderate to high amounts of potash.
- Avoid nitrogen applications when the disease is active.
- Increase the height of cut.
- Increase the air circulation.
- Minimize the amount of shade.
- Irrigate turf early in the day.
- Improve the drainage of the turf.
- Reduce thatch.
- Apply lime if soil pH is less than 6.5

- Remove dew from turf early in the day.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowners version.
(See Figures 21-26, Page 6)

Rust

Causal Agent:

Puccinia spp., *Uromyces* spp.

Susceptible Turfgrass:

Bluegrass, Ryegrass, Bentgrass, Zoysiagrass, Bermudagrass and Fescue

Symptoms:

Rust diseases initially cause light-yellow flecks on the leaf blades and sheaths. The flecks enlarge, elongate, and turn yellow in color. The infected areas raise above the epidermis and then rupture, releasing spores that are yellowish-orange to reddish-brown in color. The leaf blade turns yellow starting at the tip and progressing to the base. A severe disease infection can cause the shoot to turn yellowish to reddish-brown in color and slow in growth. As individual plants die, the turf thins.

Conditions Favoring Disease:

Rust diseases typically occur in early spring through mid-summer, depending on the location of the turf. Rusts favor moist, low-light areas. Depending on the species, rusts favor temperatures between 65°F and 85°F. Severe rust infections occur on slow-growing turfgrass particularly those with low nitrogen levels and/or plant water stress.

Signs:

Teliospores of *Uromyces* and *Puccinia* are one- and two-cells respectively. Spores are orange-red in color and circular to ovoid in shape.

Management Tips:

- Apply adequate levels of nitrogen.
- Remove clippings from turf.
- Reduce thatch.
- Reduce shade and improve air circulation.
- Regulate irrigation to minimize the amount of time moisture remains on the leaf surface.
- Water deeply and infrequently.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.
(See Figures 27-31, Page 7)

Leaf Spot/Melting Out

Causal Agent:

Curvularia spp., *Drechslera* spp. and/or *Bipolaris* spp.

Susceptible Turfgrass:

Creeping red fescue, Kentucky bluegrass, Perennial ryegrass, Tall fescue and all varieties of Bentgrass, Bermudagrass and Bluegrass, Zoysiagrass and Centipede.

Symptoms:

Leaf spot symptoms include purplish-brown to black spots with tan centers on the leaf blade and sheath. The lower leaves of the infected plants become shriveled and blighted. Severe leaf spot can lead to melting-out when leaves and tillers are infected, causing severe thinning of the stand. On cool season turfgrass, melting-out typically follows the appearance of leaf spots.

Conditions Favoring Disease:

Disease occurs at temperatures between 40°F and 80°F in areas that experience more than 10 hours a day of foliar wetness for several consecutive days. The disease is favored by high amounts of nitrogen and a low mowing height.

Signs:

Conidiophores are light to darkly pigmented. Conidia vary from curved with three vertical septations to multi-celled, ovoid and cylindrical.

Management Tips:

- Reduce turf stress by using lightweight equipment.
- Increase air circulation to speed turf's drying process.
- Do not apply high rates of water-soluble nitrogen in the spring.
- Minimize the amount of shade.
- Irrigate turf deeply and as infrequently as possible.
- Reduce thatch in the early spring or fall for cool-season turfgrass and in the summer for warm-season turfgrass.
- Avoid using systemically translocated fungicides, plant growth regulators and herbicides.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.
(See Figures 32-37, Page 7)

(Continued on Page 10)

Systematic Approach to Dianosis of Turfgrass Disease



Figures 1-3

Define the symptoms: patches, yellowing, chlorosis, leaf spots, etc.



Figure 4

Collect a representative sample

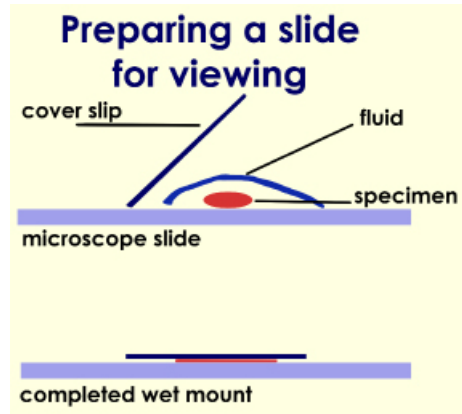


Figure 5

Prepare a microscope slide



Figure 9



Figure 11

Dollar Spot



Figure 6



Figure 7



Figure 8



Figure 10



Figure 12

Fairy Rings



Figure 13



Figure 14



Figure 15

Take-All Root Rot



Figure 16



Figure 17



Figure 18

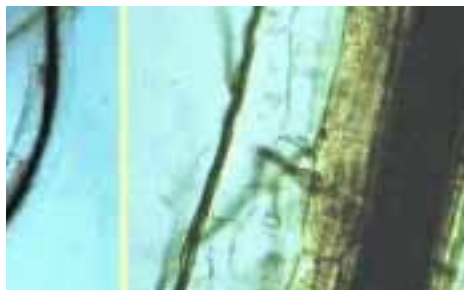


Figure 19

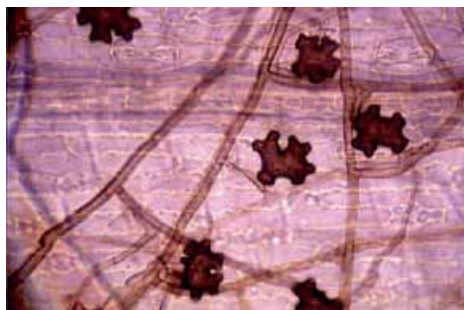


Figure 20

Brown Patch / Large Patch



Figure 21



Figure 22



Figure 23



Figure 24



Figure 25

Rust



Figure 27



Figure 28



Figure 29



Figure 30



Figure 31

Leaf Spot / Melting Out

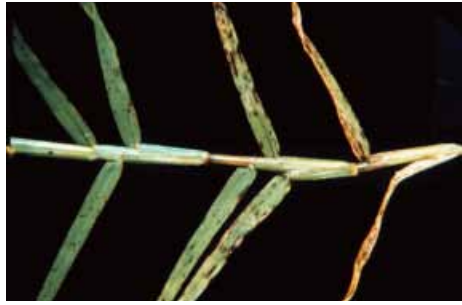


Figure 32



Figure 33



Figure 34



Figure 35. Drechslera



Figure 36. Curvularia



Figure 37. Bipolaris

Gray Leaf Spot



Figure 38

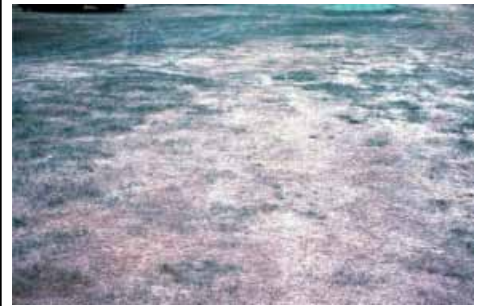


Figure 39



Figure 40



Figure 41



Figure 42

Anthracnose



Figure 43



Figure 44



Figure 45



Figure 46



Figure 47

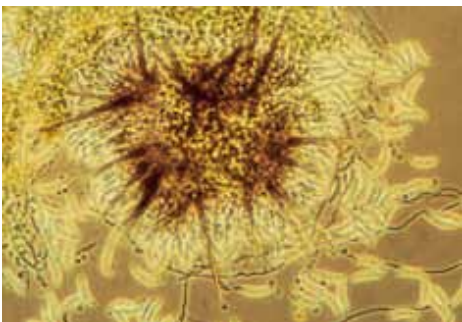


Figure 48

Slime Mold



Figure 49



Figure 50



Figure 51

Pythium Root Rot / Pythium Blight



Figure 52



Figure 53

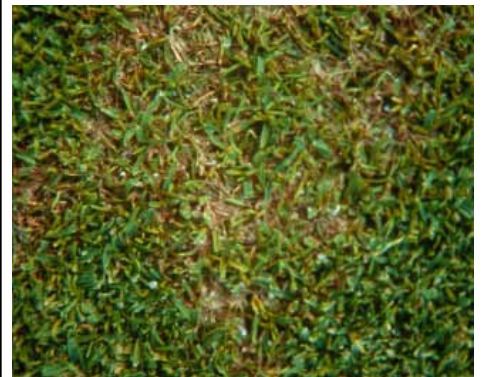


Figure 54



Figure 55



Figure 56

Gray Leaf Spot

Causal Agent:

Pyricularia grisea

Susceptible Turfgrass:

St. Augustinegrass, Perennial ryegrass, Bermudagrass, Centipedegrass, Bentgrass and various species of Fescue

Symptoms:

The symptoms of gray leaf spot vary depending on the grass cultivar. On St. Augustinegrass, gray leaf spot first appears as small, brown spots on the leaves and stems. The spots quickly enlarge to approximately ¼ inch in length and become bluish-gray in color and oval or elongated in shape. The mature lesions are tan to gray in color and have depressed centers with irregular margins that are purple to brown in color. A yellow border on the lesions can also occur. In cool-season turfgrass, the symptoms are similar to those of melting-out.

Conditions Favoring Disease:

Gray leaf spot is favored by daytime temperatures between 80°F to 90°F and night temperatures above 65°F. It is also found in areas with high nitrogen levels and that are stressed by various factors, including drought and soil compaction. This disease is most severe during extended hot, rainy and humid periods.

Signs:

Conidia are produced on the terminal ends of conidiophores which are long and slender. Conidia are ice cream cone-shaped or bowling pin-shaped and usually 2 to 3 celled. Conidia are attached to the conidiophores at the robust end.

Management Tips:

- Avoid medium to high nitrogen levels during mid-summer.
- Irrigate turf deeply and as infrequently as possible to avoid water stress.
- Allow water to remain on leaves for only a short period of time.
- Reduce thatch by vertical cutting.
- When possible, plant turfgrass that is resistant to gray leaf spot.
- Avoid using herbicides or plant growth regulators when the disease is active.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.

(See Figures 38-42, Page 7)

Anthracnose

Causal Agent:

Colletotrichum spp.

Susceptible Turfgrass:

Warm and cool season grasses.

Symptoms:

Anthracnose typically infects turfgrass during warm weather. It causes irregularly shaped patches that are yellow to brown in color. Leaf lesions that are yellow with black centers may also occur. Anthracnose also causes a basal stem and leaf sheath rot during cool, wet weather in the spring and warm, moist weather in the summer. Infected shoots are easily detached. The dead foliage and stems become covered with acervuli -- tiny, spined, black fruiting bodies -- which require magnification to identify.

Conditions Favoring Disease:

Anthracnose is favored by temperatures over 78°F. It occurs in areas that experience more than 10 hours a day of leaf wetness for several consecutive days. Soil compaction and low amounts of nitrogen fertility may enhance the severity of this disease.

Signs:

Long black setae may be seen with the dissecting and compound microscope. Simple conidiophores produce colorless to pink conidia that are single celled, short, and ovoid to cylindrical. Conidia may also be slightly curved.

Management Tips:

- Increase the height of cut.
- Minimize stress by using walk-behind mowers.
- Decrease the amount of foot traffic.
- Maintain adequate nitrogen and a balanced fertility level.
- Irrigate the turfgrass just enough to prevent wilting.
- Do not core aerate while disease symptoms are present.
- Make preventive fungicide applications where the disease is a chronic problem.

(See Figures 43-48, Page 8)

Slime Mold

Causal Agent:

Physarum spp. and *Fuligo* spp.

Susceptible Turfgrass:

Warm season grasses

Symptoms:

Large numbers of pinhead-sized fruiting bodies may suddenly appear on grass blades and stems in circular to irregular patches 1-30 inches in diameter. Affected patches of grass do not normally die or turn yellow and signs of the fungi usually disappear within 1 to 2 weeks. These fungi normally reproduce in the same location each year. The fungi are not parasitic, but they may shade the individual grass leaves to the extent that leaves may be weakened by inefficient photosynthesis.

Conditions Favoring Disease:

Slime molds are favored by cool temperatures and continuous high humidity. An abundance of thatch favors slime molds by providing food directly in the form of organic matter.

Management Tips:

- Remove slime mold by mowing.
- Remove using gardening tool or high pressure stream of water.

(See Figures 49-51, Page 8)

***Pythium* Root Rot/*Pythium* Blight**

Causal Agent:

Pythium spp.

Susceptible Turfgrass:

Pythium Root Rot: Bermudagrass, Centipedegrass, Zoysiagrass and St. Augustinegrass

Pythium Blight: Tall Fescue, Perennial Ryegrass and Bentgrass

Symptoms:

Pythium root rot: *Pythium* root rot is common on highly maintained turf. Although symptoms of *Pythium* root rot are typically nondistinctive, this disease can appear as yellow, irregularly shaped patches. The affected turfgrass is thin, off-color and slow growing, while the root system is stunted with reduced volume and vigor. Foliar mycelium does not occur.

Pythium Blight: Mostly in tall fescue and Bentgrass. *Pythium* blight appears as yellow, irregularly shaped patches. The affected turfgrass is thin, off-color and slow-growing,

while the root system is only slightly stunted, with reduced volume and vigor. Foliar mycelium does occur.

Conditions Favoring Disease:

Some *Pythium* species favor temperatures between 32°F and 50°F while others thrive in temperatures between 70°F and 90°F. *Pythium* root rot occurs in areas with high soil moisture, poor drainage and low light. Disease can be severe in locations with low mowing height and excessive wear. *Pythium* blight does not cause major damage below 70°F.

Signs:

Oospores and sporangia are diagnostic for *Pythium* root rot. Oospores are thick, double-walled, and completely round. They can be seen inside or outside of tissue. *Pythium* sporangia can be easily confused with those of *Phytophthora*, which are lemon-shaped.

Management Tips:

- Increase the height of cut.
- Apply optimum amounts of nitrogen, phosphorous and potash.
- Reduce mowing frequency and use lightweight mowers.
- Avoid over-watering.
- Apply low amounts of nitrogen in the spring when roots are forming.
- Minimize the amount of shade.
- Improve the drainage of root zone.
- Reduce soil compaction through aerification by using lightweight equipment.
- Fungicides are available to control the disease.

Consult the current *Georgia Pest Management Handbook* -- commercial or homeowner version.

(See Figures 52-56, Page 8)

Turfgrass Disease Summary

Disease	Host	Season	Conditions	Symptoms/Signs
Dollar Spot	All warm and cool season grasses	Fall - Spring	Sub-optimal nitrogen levels. Dry roots with humid canopy.	Small straw-colored patches. Irregular white lesions with distinct brown borders on the leaves at the outside edge of the patch. White cottony mycelia in early morning dew.
Fairy Ring	All warm and cool season grasses	Spring, Summer and Fall	Abundant rain. Large quantities of organic matter.	Zone of dead grass inside a ring of dark-green grass or a band of dark-green grass. Ring of mushrooms.
Brown Patch	Cool season grasses	November - May	Temperature below 80°F. Abundant rainfall. Continual wetness for 48 hours.	Infects leaf area closest to the soil. Dark rot at leaf base. Entire leaf will pull out easily. Roots are not affected.
Large Patch	Warm season grasses (especially St. Augustinegrass and Zoysiagrass)	Spring and Fall	Temperatures of over 80°F during the day and over 55°F at night. Abundant rainfall. Continual wetness for 48 hours.	Circular patches of diseased turf. Turf at the periphery of the patch may appear orange. Folia dieback from the leaf tip toward the base.
Take-All Root Rot	All warm season grasses	Summer - early Fall	Abundant moisture.	Root rot. Thinning lawns.
Leaf Spot/Melting Out	All warm and cool season grasses (especially Bermuda)	All year	Mild temperatures. Drought. Wet foliage.	Brown to purple lesion. Turf may appear purple. Lesions on stolons are dark purple to black.
Anthracnose	All warm and cool season grasses (especially Centipede)	Spring	Warm temperatures. High moisture.	Reddish-brown spots surrounded by a yellow halo.
Gray Leaf Spot	St. Augustinegrass, Perennial ryegrass, Bermudagrass, Centipede, Bentgrass and some Fescues	Late Spring - early Fall	Abundant rain. Excessive nitrogen. Compacted soils.	Olive green to brown spots enlarge to form oblong spots that are tan with distinctive dark-brown margins. May appear velvety gray with spore production.
<i>Pythium</i> Root Rot	All warm and cool season grasses	All year	Excessive rain. Poor drainage.	Leaf decline. Thinning. Roots are discolored and easily removed.
<i>Pythium</i> Blight	Cool season grasses, mostly Tall fescue and Bentgrass	Summer	Poor drainage, wet soil.	Leaf decline. Thinning.
Slime molds	All warm season grasses	Fall - Spring	Cool temperatures. High humidity.	Slimy or crusty substance covering grass.

Georgia Turfgrass Disease Calendar (Warm and Cool Season Grasses)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anthracnose												
Fairy Ring												
Take-all Root Rot												
Gray Leaf Spot												
Dollar Spot												
Brown Patch												
Large Patch												
Leaf Spot/Melting Out												
Slime molds												
Pythium Root Rot												
Pythium Blight												

References

- 1) Alberta Agriculture, Food and Rural Development www1.agric.gov.ab.ca/app21/rtw/selcat.jsp
- 2) Cornell University <http://plantclinic.cornell.edu>
- 3) Colorado State University www.ext.colostate.edu
- 4) Kansas State University www.oznet.ksu.edu
- 5) Oklahoma State University <http://pearl.agcomm.okstate.edu>
- 6) Penn State University www.agronomy.psu.edu
- 7) Purdue University www.agry.purdue.edu/turf/tips
- 8) Texas Plant Disease Handbook <http://plantpathology.tamu.edu/Textlab/default.asp>
- 9) University of Georgia www.plant.uga.edu
- 10) University of Wisconsin www.plantpath.wisc.edu
- 11) Compendium of Turfgrass Diseases. 2nd Edition. APS Press. 1996.
- 12) 2003 Pest Management Handbook. University of Georgia



Bulletin 1233

Reviewed May 2012

The University of Georgia and Ft. Valley State University, the U.S. Department of Agriculture and counties of the state cooperating. The Cooperative Extension Service, the University of Georgia College of Agricultural and Environmental Sciences offers educational programs, assistance and materials to all people without regard to race, color, national origin, age, sex or disability.

**An Equal Opportunity Employer/Affirmative Action Organization
Committed to a Diverse Work Force**