Gray leaf spot invades new turf

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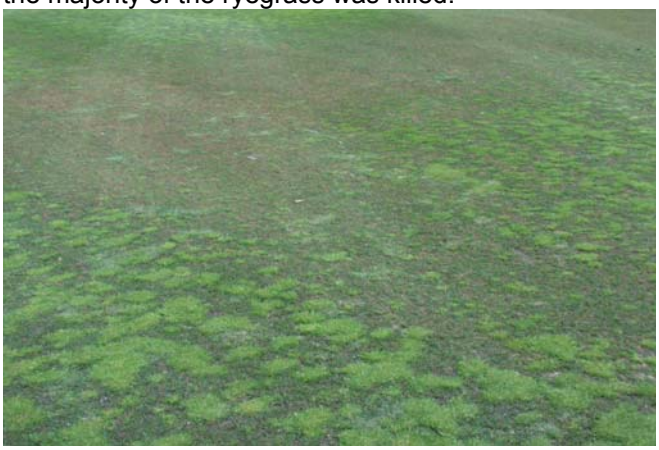
Bottom line: Gray leaf spot caused by the fungus *Pyricularia grisea* has been occurring in epidemic proportions on golf courses since 1995. From its initial epidemic on perennial ryegrass in the central U.S., it has since spread eastward as far as New England, and westward as far as California. Though perennial ryegrass is the most sensitive host, this disease also infects Italian ryegrass, tall fescue and St. Augustinegrass. In 2003, kikuyugrass was added to the list following epidemics in Southern California. Management of the disease is best accomplished preventively through moderation in nitrogen fertilization, use (where possible) of tolerant turf varieties and avoidance of aggressive management practices (aerification, vertical mowing or sand topdressing) during disease threat periods. Application of silicon may also help to prevent disease. Some of the most effective fungicides for GLS include thiophanate-methyl, mixtures of sterol inhibitors with either chlorothalonil or mancozeb, or, in cases where resistance is not a problem, azoxystrobin or trifloxystrobin

Globe trotting gray leaf spot

Gray leaf spot (GLS), caused by the fungus *Pyricularia grisea,* is one of the most serious pathogens of perennial ryegrass. First identified on rye on golf courses in 1985, the fungus did not cause significant trouble until 1995, when a warm and humid summer in the Central U.S. promoted a serious epidemic in Illinois, Kentucky and nearby states. Over the next five years, this disease took to the road, moving rapidly to the east (almost all of the New England states have now been affected) and as far west as Nebraska. By 1997, GLS had reached California, causing infections on St. Augustinegrass lawns (P. Nolan, San Diego County Dept. Agric., pers. commun.). And by 2001, gray leaf spot had begun to cause problems on a few California ryegrass fairways, indicating that the disease can wreak havoc even in areas that are traditionally quite arid. During the summer of 2003, gray leaf spot went to the next level and reached epidemic proportions in California, leaving a trail of damaged perennial ryegrass stretching from the southernmost portions of the state in San Diego, to as far north as Sacramento, over 500 miles away.

Figure 1. In the fairway below, Poa annua (which is naturally resistant to GLS) survived the epidemic, but the majority of the ryegrass was killed.



During the summer of 2003, gray leaf spot also occurred on several California kikuyugrass fairways for the first time. Until then, there had been no records of GLS on golf course kikuyugrass, although there are records of the disease on pastures in Australia and Japan. In the photo above, note the kikuyugrass foliage blighted by gray leaf spot. The brownish/ grayish lesions and twisting and withering of the leaf tips is characteristic of GLS on susceptible grasses.

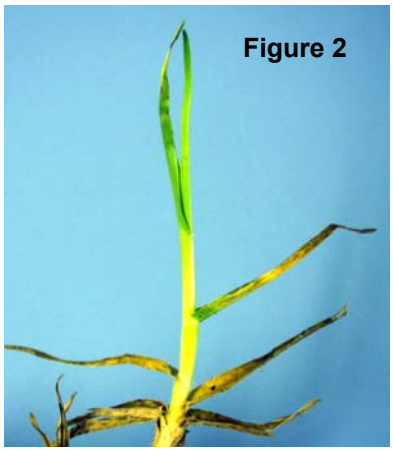


Figure 2

The culprit: *Pyricularia grisea*

Gray leaf spot is caused by the fungus *Pyricularia grisea* (also known as *Magnaporthe grisea*). This disease has long been known to plant pathologists as the cause of the devastating **rice blast**, which is capable of wiping out 50% of the rice yield in the more than 85 countries in which it occurs**.** Described for the first time in a Chinese publication in 1637, rice blast has been known about and studied for years, but the behavior of this same fungus when it invades turfgrass is a relatively new field.

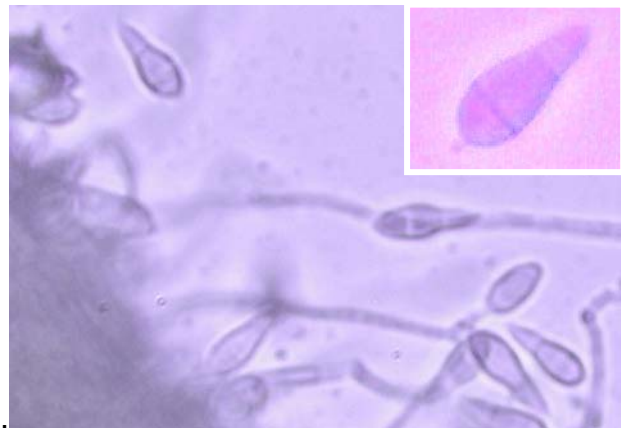
How it kills

Gray leaf spot advances rapidly, killing turf in as little as 7 days after the first symptoms appear. The sequence of events that are thought to lead to turf death are outlined below.

1. Dispersal of fungal conidia (spores): The cycle of disease begins when the conidia pictured below land on the surface of a ryegrass leaf. Though they can't propel themselves through the air, other forces such as wind, rain, dewdrops, sprinkler irrigation, foot

traffic and golf course maintenance equipment move them from plant to plant. The possibility that the infection starts with infected seed has been investigated, but so far there is no evidence that the seed is the source of GLS infections.

Figure 3. Light microscope view of conidia (spores) of *Pyricularia grisea*, the fungus that causes GLS. Note the pear shaped conidia and the small beaks at the tip of each condium. The pink inset micrograph shows a single, highly magnified conidium.



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2. Germination: The conidia secrete a special adhesive material that allows them to attach to the leaf surface. When weather conditions are right (air temperatures > 68F and presence of free water on the leaf surface), the conidia germinate and start to grow as soon as 2 hours after landing on the leaf surface.
3. Penetration of the leaf surface: The fungus begins its growth on the leaf surface through production of a small, short projection known as a **germ tube.** To penetrate the leaf surface, the germ tub swells at its tip and by sheer physical force breaks through the plant cuticle to invade leaf cells.
4. Growth inside the leaf: The fungus now begins its destructive phase in earnest, through rapid growth inside the plant. This fungal growth interferes with photosynthesis (the plant's means of producing the energy and food it needs to survive), causing plant cells to die. It is believed that the fungus produces several toxins as it grows (with wild names like **tenuazonic acid, pyricularin, pyrichalasin**) which are responsible for the damage. Plants show the first signs of injury – small, water-soaked lesions – within a few days after the conidia first contact the plant. The lesions rapidly degenerate into larger and larger gray or brown spots on the leaf surface, some of which are surrounding by a yellowish halo. In the plant's final death throes, the tips of infected leaves darken, wither and twist (Figure 2).
5. Production of new conidia: As the fungus reaches the end of its life cycle inside the leaf, it puts all of its energy into making sure that a future generation of fungal conidia is produced. It does this by producing aerial conidiophores that bear millions of new conidia, making a powdery gray coating on the leaf surface that can be seen with a hand lens.
6. More of the same: The cycle described above repeats itself over and over, producing more and more conidia, as long as weather conditions are permissive (air temperatures above 68F and presence of free water on the leaf surface). By the time August rolls around, there are millions upon billions of conidia present on the golf course, all ready to pounce and create widespread damage.
7. During the winter: Although GLS prefers warmer weather, it infects plants at temperatures as low as 68F. For this reason, it has been known to cause problems as late as November in some areas of the country. But once temperatures finally drop below 68F, then what happens? The GLS fungus spends the cold months in a type of hibernation known as **overwintering,** which allows the fungus to survive without actively growing. It appears to be happiest overwintering in thatch and dead plants. This unfortunately leaves the fungus in an ideal location for re-infection of turf the following spring or summer, as soon as air temperatures warm up sufficiently.

Figure 4. The rough shown below was overseeded with perennial ryegrass, while the adjacent bermudagrass fairways were non-overseeded. Rye in the roughs was severely attacked by GLS while the bermudagrass remained untouched by the disease.

Host range

Susceptibility of key plant species to *P. grisea.*

Highly susceptible	Moderately susceptible	Not susceptible
• Perennial ryegrass • Italian ryegrass • Rice	• Tall fescue • St. August-inegrass • Kikuyugras • Hairy crabgrass • Foxtails • Wheat	• Bermudagrass • Poa annua • Poa trivialis • Kentucky bluegrass

Pyricularia grisea causes damage on over 50 species of grasses. A list of some of the most important of the susceptible and tolerant plant species appears above. It is important to note that even within a given plant species, such as perennial ryegrass, there is significant variation in susceptibility to gray leaf spot. Thus the existence of rye and fescue varieties that are somewhat tolerant to GLS (see below).

Figure 5. Kikuyugrass (left) was severely damaged by GLS, while adjacent bermudagrass (right) was resistant to the disease.

Factors that enhance gray leaf spot

There are three factors that must be in place for gray leaf spot to occur:

1. **the inoculum: gray leaf spot conidia must be present on the golf course**
2. **the host: a susceptible turf variety such as rye, tall fescue, St. Augustinegrass or kikuyugrass**
3. **the right environmental conditions (average air temperatures greater than 68F and presence of free water on the leaf surface)**

These 3 factors are by far the most important in the occurrence of the disease. Unfortunately, you have very little control over them, with the possible exception of swapping to a non-susceptible variety of turf.

There are also several more minor factors in disease incidence and damage. These are, of course, the ones you have more control over (wouldn't you know it?). While attention to these factors will probably not banish the disease from your golf course, attempts to mitigate them can significantly lessen disease damage.

1. **high soil nitrogen levels: application of high rates (more than 1/2 lb N/1000 sq ft) of quick release products such as ammonium, nitrate and urea-based fertilizers, has been associated with increased disease incidence.**
2. **anything that causes stress to turf will increase the likelihood of GLS infection. Common stressors include drought, compaction, shade, high soil salts, poor drainage.**
3. **aggressive cultural practices (aerification, topdressing) serve to move the pathogen around the golf course and also to further stress the turf**
4. **anything that increases humidity: poor air movement, shade, higher mowing heights, poorly draining areas, low spots.**
5. **use of ethofumesate (Prograss) in the springtime, possibly due to thinning of the leaf cuticle by this herbicide. However, applications of Prograss made in the fall do not appear to enhance GLS.**

Management

Fungicide applications are still the most effective means of combating GLS. But before we summarize fungicide efficacy data, a few other preventive practices are worth discussing.

Cultural practices:

- Use of GLS tolerant turf varieties for overseeding. Consult the National Turf Evaluation Program, or NTEP website for GLS tolerance ratings at www.ntep.org/data/pr99/pr99_03-3/pr9903t19.txt
- Substitution of susceptible varieties with resistant varieties such as bentgrass, bluegrass or bermudagrass.
- Moderate nitrogen fertility. During the GLS threat period (air temps greater than 68F), do not exceed more than 1/2 lb N/1000 sq ft in a single application. Total soil nitrogen levels should not exceed 20 ppm.
- Avoid sand topdressing and aerification during the GLS threat period.
- Reduce excessive humidity and moisture via improved drainage and irrigation management.
- Avoid springtime applications of ethofumesate (Prograss) if there is a history of GLS.

Silicon: Long used in rice production for suppression of rice blast (which is also caused by *P. grisea*), the efficacy of silicon for GLS management on golf courses holds some promise. Data from Dr. Larry Datnoff of the University of Florida suggests that pre-plant incorporation of calcium silicate into the soil can reduce (but not cure) GLS on St. Augustinegrass (see Fig. 6).

Researchers are now exploring the efficacy of more practical application methods via foliar applied silicon products for GLS suppression. If your soil is deficient in silicon (less than 40 ppm) and you have a history of GLS, silicon applications may be of some value. We will detail more on the use of silicon for golf course turf in an upcoming *PACE Insights*.

Fungicides:

Results from field research trials conducted over the last several years in Maryland, Pennsylvania, New Jersey, Kansas, Kentucky and Nebraska have identified several effective fungicides for control of gray leaf spot, including:

- Thiophanate-methyl (3336, Fungo, Cavalier, Spectro) alone, or in combination with either

chlorothalonil (Concorde, Daconil, Echo, Manicure) or mancozeb (Dithane, Fore, Protect).

- Azoxystrobin (Heritage) or trifloxystrobin (Compass). While these two strobilurin products are highly effective against GLS, resistance has been documented from some locations in five states (KY, IL, IN, MD, VA). Resistance appears to be correlated with a history of use of either Heritage or Compass at that location.
- A sterol inhibitor fungicide PLUS either chlorothalonil or mancozeb. Labeled sterol inhibitors include propiconazole (Banner Maxx, Propiconazole-Pro) and triadimefon (Bayleton).
- Chlorothalonil or mancozeb sprayed without any other fungicide also provides good control in some cases, but these products were a bit less consistent than any of the products or combinations listed above.

Fungicide use patterns:

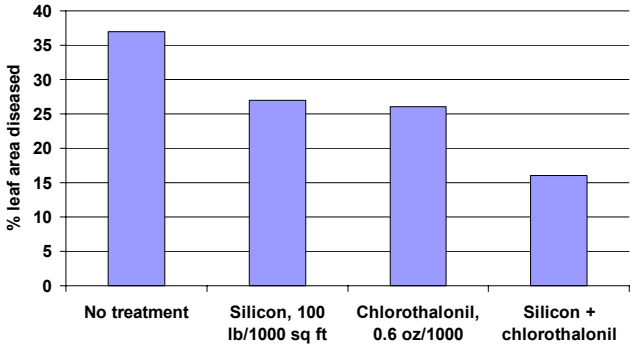
- For best results, products should be applied in 2 gallons/1000 sq ft (87 gallons/acre).
- For best coverage of the foliage, flat fan nozzles should be used.
- Products should not be watered in.
- If disease pressure is heavy, fungicide applications made every two weeks may be necessary for the duration of the disease threat period.

Timing fungicide applications:

This is probably the trickiest part of gray leaf spot management. For courses that have never experienced the disease, fungicide applications should be triggered only after a scouting program has identified early symptoms. Scouting should be initiated once average air temperatures reach 68F and should focus on the most susceptible areas of the course (high mown perennial ryegrass, areas that are shady or have low air movement). Confirmation of the presence of GLS from a diagnostic laboratory is always preferable.

For courses that have a history of the disease, preventive applications are the best way to avoid serious damage. Unfortunately, we don't yet know enough about its biology to predict exactly when GLS will start to show up. This leaves superintendents with several options, some of which are summarized in the table below. Whichever strategy you use, always remember that there is no substitute for your field observations and your records of past history and control of this disease.

Figure 6. Suppression of GLS on St. Augustinegrass.
Dr. Larry Datnoff, University of Florida, 2000



Strategy	Advantages	Disadvantages
Scout fields (when avg. air temps >68F) for early signs of GLS symptoms. Focus scouting efforts on susceptible areas (high mown turf, areas in shade or with low air movement).	If scouting is effective, the most accurate way to time applications	If early symptoms are missed by field scouts, a full fledged epidemic can develop very quickly
Time 1st application by calendar, based on date of 1st symptoms in previous years. Early August in many locations	In an "average" year, calendarized applications will be relatively accurate	If summer weather is unusually cold, hot, wet or dry, GLS may show up much earlier or much later than expected
In the arid southwest, where moisture is the limiting factor for GLS, time 1st application during summertime, but only after a rainfall event or after period of above normal humidity	Avoids unnecessary applications when temps are conducive for disease, but moisture is limiting.	There is a chance that the disease will develop even without high humidity and/or rainfall

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