

***Gaeumannomyces* (Gay-man-o-mycēs)** by Wendy Gelernter, Ph.D. and Larry J. Stowell, Ph.D.

Bottom line: The fungus *Gaeumannomyces graminis* causes several diseases that attack the roots of cool- and warm-season turf, including bermudagrass decline, take-all patch, spring dead spot, and a newly described decline on kikuyugrass and paspalum. These diseases have become more widespread due to stress-induced susceptibility that is caused by recent trends towards lower mowing heights and faster turfgrass conditions. At locations where diseases caused by *Gaeumannomyces* have caused significant damage, it will be necessary to implement stress reduction management practices as well as a systemic fungicide program in order to maintain premiere turf quality.

Familiar to farmers as the very destructive root rot disease known as take-all, *Gaeumannomyces* has long been a problem on wheat, rice, oats and other cereal grass crops grown in temperate climates throughout the world. On golf courses, fungi in this group have become an increasing problem in the last several years, causing at least four different diseases: bermudagrass decline, spring dead spot on bermudagrass, take-all patch on bentgrass and a recently described decline on kikuyugrass and paspalum. In this issue of *PACE Insights*, we will summarize what is known about the causes and management of these diseases, based on the scientific literature and on our own experiences and opinions.

***Gaeumannomyces*: Another ERI fungus**

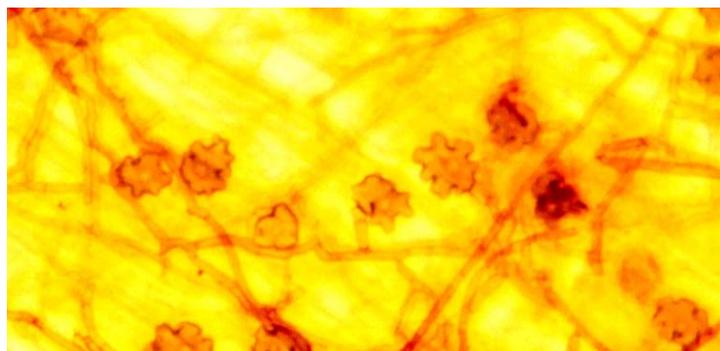
The genus *Gaeumannomyces* is part of a large group of fungi known as **the ectotrophic root infecting fungi** (ERI fungi), a group that includes summer patch and necrotic ring spot, as well as the *Gaeumannomyces* induced diseases. The following features characterize ERI fungi:

- Moderate pathogens that cause gradual decay of roots and stolons
- Plant damage and death usually due to an interaction between stress (see Table 1) and fungal induced root damage
- Plant roots are colonized through the growth of dark colored **runner hyphae** – microscopic, hair-like fungal strands that grow along the surface of roots, stolons and rhizomes.
- Ability to grow on living and dead plant material
- PREVENTION is the best management practice where the disease strikes frequently
- When fungicides are necessary, systemic products are most effective.

Fungi in the genus *Gaeumannomyces* are distinguished by the fact that they prey on the roots of a wide variety of grasses. In all cases – whether the crop is wheat, oats, bermudagrass or bentgrass – damage is caused to the plant when the fungus penetrates and grows inside the root cells. To do this, *Gaeumannomyces* forms a structure known as a hyphopodium (Figure 1), which serves to anchor the fungus to the plant tissue, allowing it to effectively

grow directly into the plant cells.

Figure 1. Micrograph of dark ectotrophic runner hyphae and lobate hyphopodia associated with bermudagrass decline. Approximate magnification 400 X. *Gaeumannomyces* infections on other turf types produce similar dark, runner hyphae, although the shape of the hyphopodia can vary, depending on the species of *Gaeumannomyces* involved.



Fungal vs. root growth: the race for survival

If the growth of *Gaeumannomyces* is not controlled, roots, stolons and rhizomes will eventually die, and the dead tissue will begin to rot, turning brown and black. One of the interesting things about this disease is that despite the below ground destruction that can occur, above-ground symptoms may not appear at all if turf is mowed high (>3/16" for greens and >1/2" for fairways) and conditions for good root growth – fertility, aeration, temperature – are optimized for the turf variety in question. This is because a healthy plant can regenerate new roots faster than these moderate diseases can kill the older roots. But it's a race – a race that the plant can easily lose if root growth slows down due to stress of any kind. And *Gaeumannomyces* has staying power. The fungus can survive and even reproduce by growing saprophytically on thatch and other decaying organic matter, so that it is ready to attack as soon as conditions are right.

And conditions are right when turf stress results in decreased root growth. Under these conditions, the fungus is able to infect the large majority of the roots. Symptoms on the foliage will slowly begin to appear in the form of relatively small (a few inches across),

round to irregular patches of yellowing or bleached looking turf. The lower leaves are the first to become affected, but eventually the upper leaves become chlorotic and die as well. As time goes on, the patches will expand in size, reaching sizes of up to 1½ to 2 feet across (Fig. 2).

Table 1. Turfgrass susceptibility to *Gaeumannomyces* diseases is increased when one or more of these stressors are present:

- Low mowing heights
 - Traffic
 - Extremes in moisture, poor drainage
 - Temperature extremes
 - Reduced solar radiation
 - Poor fertility
 - High pH soils
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Figure 2. Poor turfgrass quality on a hybrid bermuda green infected by *G. graminis*.



Gaeumannomyces infections tend to show up on bermudagrass or bentgrass greens a few years after establishment, suggesting that a build-up in thatch may help promote the disease. Once infections do show up – either on greens or fairways – they tend to recur every year in the same spot. There are currently no turf varieties that are resistant to *Gaeumannomyces* infections.

Why *Gaeumannomyces*? The role of stress

Effective disease management of *Gaeumannomyces* has proven elusive in many cases. This is primarily because *Gaeumannomyces* problems on golf courses result directly from factors which are somewhat beyond our control -- the increased stress that we put on turf these days, in an attempt to constantly increase greens speeds and to improve golfing conditions. As a result, greens and even fairways are mowed much lower than they were ten

years ago. Turf is denser due to the use of growth regulators, which may help promote increased moisture, and therefore the growth of disease-causing fungi. When these factors are combined with the normal, day-to-day stresses that turfgrass faces, the turf can become a sitting duck for invasion by a host of fungal diseases.

Bermudagrass decline

The cause: *Gaeumannomyces graminis* var. *graminis*.

The victim: Bermudagrass greens (“Tifgreen”, alias “328” and “Champion” are particularly susceptible. “Tifdwarf”, which stands up to low mowing better, is not damaged as badly, but can still suffer significantly). This pathogen is also harbored in bermudagrass fairways, but symptoms are only infrequently exhibited.

The timing: Appearance of dead and dying turf is usually first noted between July and September.

Management through stress reduction: Cultural practices that reduce stress will lessen the damage from this pathogen.

1. Pay special attention to the development of symptoms following humid or rainy weather, and during prolonged periods of very warm (average air temperatures above 90°F) weather.
2. Promote root growth, including deep tine aeration, with holes filled with compatible root zone sand at least once each spring.
3. Raise mowing height if possible to 3/16” or higher. Light, frequent topdressing will help keep greens speeds up, and will also help fight algae.
4. When turf shows signs of stress, reduce traffic, and eliminate the clean-up lap during mowing.
5. Balance soil fertility. Where feasible (usually areas with low pH irrigation water and/or heavy rainfall), attempt to gradually reduce soil pH to roughly 5.2 through the use of ammonium based fertilizers. Adequate potassium and manganese may also help the plant fight off the disease.
6. Avoid invasion of algae (through applications of chlorothalonil) into dead spots, as they will inhibit the ability of bermudagrass to re-colonize.
7. On irrigated fairways, evaluate irrigation distribution uniformity and adjust accordingly. Stress caused by too much (or too little) water is a factor in *Gaeumannomyces* infections.

Preventive systemic fungicide applications:

1. If bermudagrass decline is a perennial problem, initiate a preventive fungicide program beginning when average air temperatures exceeds 88° F (or when average soil temperature at a 6 inch depth is 80°F). This temperature trigger – our current best

estimate -- was identified through our observations on bermudagrass greens in the desert southwest.

2. Fungicides must be systemic to be effective. Sterol inhibitor fungicides (Banner Maxx, Bayleton, Eagle and Rubigan) should be used with caution, since research in Florida and California has indicated that phytotoxicity can result, even when air temperatures are relatively cool.
3. Products which are effective against ERI fungi and do not appear to cause phytotoxicity to bermudagrass during hot weather include Heritage, Lynx (currently not registered, but of interest because it is one of the few sterol inhibitors that does not cause turf damage) and benzimidazole products such as Cleary's 3336 or Fungo Flo. These products should be used as described on the label, watered in after application, and should be applied until average air temperatures go below 88° F.

Curative fungicide applications: Once disease strikes, more aggressive steps are needed to help the plants to recover.

1. If decline hits unexpectedly and severely, evaluate the use of Heritage at 0.4 oz/1000 sq ft watered in and applied twice at a 14 day interval. You can drop back to application every 28 days after the second application. This should be continued until air temperatures fall below 88° F.
2. Keep the turfgrass surface moisture adequate for new roots to develop from the crown of the plant. Assume that the deep roots are unable to provide moisture or nutrition.
3. Apply ¼ lb N/1000 sq ft weekly using a complete foliar feed (e.g. Peter's or Nutriculture 20-20-20).
4. Combat algae using chlorothalonil (e.g. Daconil Ultrex 6 oz/1000 sq ft) applied in not more than 2 gal/1000 sq ft and not watered in.

Spring dead spot

The cause: ERI fungi including *Ophiosphaerella* and *Gaeumannomyces graminis* var. *graminis*

The victim: The most destructive disease of bermudagrass fairways wherever winter temperatures are cool enough to induce dormancy.

The timing: Appearance of circular patches of dead turf occurs during the spring when dormant bermudagrass fails to begin to grow again (Figure 3). Damage to turf probably takes place during the previous summer and fall, but because turf is in the process of entering dormancy, the symptoms are not evident until the following spring. It is also likely that

infected crowns are more sensitive to winter temperatures. This disease seems to be worst where average daily temperatures during November are below 55°F.

Figure 3. Spring dead spot, caused by *Gaeumannomyces graminis*, on a bermudagrass fairway.



Management: In addition to the stress management program outlined above for bermudagrass decline, the following additional steps should be taken:

- To improve winter hardiness, ensure adequate soil potassium levels (>110 ppm K)
- If the disease is a perpetual problem, and if cultural practices fail to sufficiently alleviate the symptoms, a preventive fungicide program may be necessary. Based on research results, treatment in the fall, approximately 30-60 days before the onset of dormancy (just prior to overseeding, in many cases), is most effective. Good results have been seen with Heritage, Eagle, Rubigan and Banner Maxx. With the exception of Heritage, some damage to turf should be anticipated following the fungicide application. If Rubigan is used for poa management, this application should also help prevent spring dead spot.

Gaeumannomyces decline of kikuyugrass

The cause: *Gaeumannomyces graminis*. We have encountered this newly described disease on Southern California kikuyugrass fairways and on paspalum.

The victim: Kikuyugrass fairways. Roots are attacked, resulting in moisture and nutrient stress. Scalping is frequently associated with the disease, as the result of root damage (Figure 4).

The timing: Symptoms become obvious in the late summer and fall. As with other *Gaeumannomyces* infections, the fungus is probably most actively growing on roots several weeks earlier.

Management: There is no published research on this disease. However, the same stress reduction procedures discussed above are critical here as well. If the disease does strike despite your best efforts, it appears that Heritage may offer some good curative activity. We were able to observe the impact of this

product (Heritage, at 0.4 oz/1000 sq ft and watered in) when applied after symptoms were observed and the presence of *Gaeumannomyces* was confirmed microscopically (late summer). Following one to two monthly applications at several different golf courses, the quality of the kikuyugrass improved significantly, producing high quality fairway turf. It is probably wise to wait until disease symptoms appear before applying. This is simply because preventive fungicide applications made to fairways are such an expensive proposition, especially if you can't predict with certainty that the disease will show up each year. Please note that although many fungicide labels cover infections caused by *Gaeumannomyces*, kikuyugrass is rarely listed. For this reason, check with your local county commissioner's office prior to application.

Figure 4. Kikuyugrass decline symptoms. Note the disease distribution surrounding the irrigation head in the center of the photograph. Infected plants with damaged roots may be more susceptible to drought.



Take-all patch of bentgrass

The cause: *Gaeumannomyces graminis* var. *avenae*. This fungus colonizes the roots, crowns, stolons and rhizomes.

The victim: Relatively new (3 – 5 years old) bentgrass greens, and to a lesser extent, perennial ryegrass, fescue, annual bluegrass, *Poa trivialis*. The formation of yellow patches of diseased turf with bronzed margins is typical of a take-all infection (Figure 5).

Figure 5. Take-all patch on a bentgrass green.



The timing: Symptoms are usually first seen during late spring/early summer during the first hot days, when turf becomes stressed. However, actual damage to roots usually occurs several weeks earlier

when weather is moist and cool.

Management:

- Stress management, as described above, is still your most important tool. For cool season turf, the heat stress management strategies discussed in the August, 1999 *PACE Insights* are particularly important.
- If the disease is more widespread and is a historic problem, consider preventive systemic fungicide applications. The initiation date for a preventive program is debatable. Some researchers in the northeast feel that applications should begin when air temperatures are still cool -- in the spring -- and again in the late fall. In the southwest, it is more likely that applications made in early summer (initiated when soil temperatures reach 70°F and continued until soil temperatures go below 70°F) will be effective. Sterol inhibitors (Banner Maxx, Rubigan, Eagle, Bayleton) can be used, as long as air temperatures are below 85°F. In addition, benzimidazoles or Heritage should also be effective. This preventive program is essentially the same program that has been successfully used for several years to manage summer patch -- another ERI fungus -- on poa greens.

A reminder on resistance management

If regular fungicide applications become a necessary part of your approach to managing *Gaeumannomyces*, remember to rotate your applications among the three different classes of effective fungicides that are available: 1) strobilurins (Heritage); 2) sterol inhibitors (Banner Maxx, Bayleton, Eagle, Rubigan); 3) benzimidazoles (Cleary's 3336, Fungo Flo).

References

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