# Pythium Root Diseases and Summer Decline Phenomena

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*Microscopic view of root rot.*

There has been a lot of research activity and educational offerings the last few years concerning root diseases of golf turf, especially on putting greens. Loss of vigor due to such things as "root rots," "root dysfunction," and "summer decline" increasingly has been blamed on the activity of various *Pythium* species in the root zone of creeping bentgrass and, in some cases, of *Poa annua*. In this article, we will review what we know about *Pythium* as a root colonizing fungus and discuss some possible tie-ins with other ill-defined losses of turf, such as the summer bentgrass decline observed in the southeastern U.S. and our own high temperature, mid-summer decline of *Poa annua*.

The genus *Pythium* contains close to 100 species, many of which can be found living in soils or organic matter, in plant roots, stolons, rhizomes and thatch. *Pythium* fungi are aquatic in nature and are much more abundant in wet or irrigated soils. They require free water or high relative humidity in order for resting stages to break dormancy, mycelia to grow and colonize substrates, and more spores to be produced. Fungal hyphae of *Pythium* grows very quickly and can, therefore, colonize newly available substrates before other microbes can compete. Many species are also tolerant of low oxygen concentrations in wet soils, thus giving them a further competitive advantage.

Many *Pythium* species produce enzymes that cause plant cells to become "leaky" and collapse, and these faster growing fungi have first crack at the nutrients that leak out. You can see why a *Pythium* blight epidemic can move so fast if temperature and moisture conditions remain favorable. Also, *Pythium* species are often the cause of seedling rot and damping off because of their rapid growth, enzymes, and the vulnerability of these tissues.

*Pythium* species are ubiquitous in turf soils and can often be isolated from roots, regardless of the health of the root system or level of stress on the plant. Turf roots are constantly going through cycles of formation, growth, senescence, and death. The ability of *Pythium* to rapidly colonize senescent root hairs and corticle cells, coupled with their ability to form thick-walled resting spores (oospores), insures that *Pythium* species will be a part of the naturally-occuring root flora. When tested under controlled conditions, most of these *Pythium* root isolates are found to be saprophytes or weak parasites (sometimes called "minor root pathogens"). However, these minor pathogens can still weaken and predispose turf to death by other stresses.

Several *Pythium* species are known to be important pathogens of putting green turf. Interestingly, the species that are the most important foliar pathogens are also important root and crown rot pathogens. *Pythium aphanidermatum* and *P. graminicola* are the key foliar blight and root rot species in our region and can cause either type of disease at cool or warm temperatures. *Pythium* (foliar) blight is not exclusively a high temperature disease, and *Pythium* root rot is not exclusively a cool temperature problem.

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### *Pythium* root and crown rot

Root and crown rots caused by *Pythium* spp. are oftentimes very distinctive from other root and crown diseases and can be diagnosed readily by an experienced pathologist. Individual plant symptoms include yellow to light brown discoloration of roots, stolons and tissues in the crown region. This light brown rot is very different than the dark brown to black root and crown rot caused by ectotrophic patch disease fungi such as *Magnaporthe* (summer patch) and *Gaeumannomyces* (take-all patch).

Field symptoms on putting green turf are not always as distinctive. Frequently, there are light green to yellow circular patches of turf that may first appear around the edge of a green or follow swales and drainage patterns where water moves. However, in some cases, there is a more general thinning over a large expanse of a green with no distinct patches or streaks.

In the Chicago area, we have found distinctive *Pythium* root and crown rot only a few times (four to five); and, in most cases, it was on newly constructed bentgrass greens or tees with high sand content rootzones. *Pythium* root rot on *Poa annua* appears to be rare in the Chicago area, although it has been found more frequently in New York and other northeastern states.

Control of *Pythium* root rots with fungicides is difficult at best, which is typical of most root diseases. Once a positive diagnosis is made, a drench application of one of the labeled *Pythium* fungicides is recommended, and repeat applications may be required. Aliette, Banol and Koban have been the most consistent performers in the Northeast.

### *Pythium* root dysfunction

Another rarely-occurring problem that has been observed on new bent greens is *Pythium* root dysfunction (described by C.F. Hodges, Iowa State University). This differs from "typical" *Pythium* root rot in several important ways. First, this problem has been found only on immature bentgrass greens constructed with sand rootzone mixes that are less than 2 years old. Once the plants mature and the soil/root environment stabilizes, this problem gradually disappears. Also, *Pythium* root dysfunction usually occurs during renovation on an existing golf course and has been observed less often on new golf courses.

Second, there are no distinctive root or crown rot symptoms (browning or discoloration), only a noticeable loss of root depth and mass. Foliar symptoms are also

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nondescript; there are no yellow patches or streaks following drainage paths. Instead, there is a general thinning and decline in the health of a green, especially as environmental and management stresses increase during the first full season of grow-in (green open for play).

Third, the *Pythium* species involved (*P. arrhenomenes* and *P. aristosporum*) are different from most other *Pythium* root rots, and these species are not found to be strong pathogens in controlled studies. The youngest parts of the root (tips and root hairs) are infected by these species, which apparently interferes with nutrient uptake and plant vigor. The weakness and shallow depth of the root system predisposes the plants to severe stress.

Diagnosis of this disease is extremely difficult since no distinct symptoms occur and other stress factors have to be considered. It is often difficult to tell whether the presence of other minor root parasites or severe environmental stresses are the key to this type of disease. It is also interesting to note that no fungicide program has been found to control *Pythium* root dysfunction.

## Summer bentgrass decline and *Poa* decline

In the semi-tropical southeastern U.S., growing bentgrass greens through the heat of the summer is a difficult proposition. Prolonged heat and humidity are frequently combined with many other stress factors, including root rot fungi, which results in shallow and weak root systems and plants on the brink of extinction. A disease syndrome has been described by L.T. Lucas (North Carolina State, Raleigh) called "summer bentgrass decline." Generally, the term "syndrome" is assigned to a problem when the actual cause has not been determined or is thought to be the result of several factors interacting.

Recent research at North Carolina State has focused on root and foliar parasitic fungi, primarily *Pythium* and *Rhizoctonia* species. Stress factors that also have been implicated include high soluble salts from fertilizers (e.g., $K_2SO_4$), algae and black layer, rootzone mix problems, and restricted wind movement that causes high surface tempertures (dead air greens). Plant symptoms of summer bentgrass decline are similar to those described for *Pythium* root dysfunction, although the problem is not limited to immature greens.

Unlike *Pythium* root dysfunction, summer decline has been controlled or prevented with fungicides. Most notable is the combination of Aliette (4 oz) plus Fore (8 oz) applied biweekly as a tank mix. Aliette is a systemic fungicide that controls a broad range of *Pythium* species, while Fore is a fairly broad spectrum contact that inhibits *Rhizoctonia*.

On the surface, it would appear that both *Pythium* and *Rhizoctonia* are important to the development of summer bentgrass decline in the Southeast. However, there remains a question as to the role of *Pythium* root infection in this disease complex. First, the Pythum species frequently isolated from affected turf are weak pathogens or nonpathogens of bentgrass roots in greenhouse studies. Second, recent research in the Carolinas has shown that substitution of phosphoric acid for Aliette in a tank mix with Fore provides good control of summer bentgrass decline. Aliette (phosetyl aluminum) contains approximately 26 percent elemental phosphorus, or roughly the equivalent of a 0-52-0 fertilizer. Fore (mancozeb) contains the micronutrients manganese and zinc. Further studies are underway at North Carolina State to try to sort out the fertilizer versus the fungicide effects of the Aliette/Fore control strategy.

In the upper Midwest, mature bentgrass does not undergo a summer decline (even in 1995). However, *Poa annua* surely does! Is there any connection between *Pythium* root rots, *Rhizoctonia* infections, and Poa decline? Probably not. After ten plus years of looking for root pathogens associated with *Poa annua* summer death, we have

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**the Bull Sheet**
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not found consistent activity of *Pythium* or *Rhizoctonia*. More often, we find ectotrophic patch disease fungi such as *Magnaporthe, Gaeumannomyces,* and *Phialophora* spp. which could be a major predisposing factor for *Poa annua* summer decline. Also, several fungicide trials involving *Poa annua* summer survival have been conducted, and Aliette/Fore and other *Pythium* related treatments did not save the *Poa*. Experiences of several superintendents in the Midwest during 1995 support these research findings.

Interestingly enough, there are a couple of fungicides which appear to stop *Poa* decline, even in 1995. Heritage (azoxystrobin, ICIA5504) is a derivative of a naturally-occuring fungicide that is very active against patch diseases, *Rhizoctonia* and other basidiomycetes, plus *Pythium* blight. Lynx (tebuconazole, HWG 1608) is an experimental DMI that has good activity on root diseases and appears to reduce *Poa* decline in field tests. It looks like Aliette/Fore is not the answer for *Poa* decline, but there may yet be an answer; STAY TUNED... ■