Pythium Root Diseases

by Larry Stowell, Ph.D.

Summary: Based upon the discussion below, *Pythium* may be a contributor to summer turfgrass decline but it is not necessarily the single cause of decline. In order to control this disease, improved cultural practices (eg. reduced salinity, aeration, increased mowing height, and air circulation) and in some cases fungicides will help alleviate the problem. In Southern California, *Pythium* root diseases are controlled by application of a combination of Subdue and Fore (or the package mix product Pace). Alliette and Fore may also work but we have had less experience with this combination. Because the disease symptoms can be confused with necrotic ring spot and brown patch, if applications to control these diseases are unsuccessful, try the Subdue plus Fore combination. Additional research is needed to determine the extent of the role of *Pythium* in turfgrass decline in Southern California and elsewhere.

Some people shudder when they hear the name of the notorious fungus that can transform beautiful smooth golf course greens into ugly spotted and dying patients. Others revel in the study of these plant pathogens. I had the opportunity to spend two days in a hands-on workshop with a group of these pathologists from around the country in August, 1994. The workshop was taught by **Mike Stanghellini**, University of Arizona (my major professor during graduate studies) and **Joe Handcock**, UC Berkeley. The 1994 American Phytopathological Society annual meeting followed the workshop with a Colloquium titled: **Pythium-incited root diseases of turfgrasses**. The colloquium included presentations and discussions between leading *Pythium* experts including: **Joe Vargas**, Michigan State, **Eric Nelson**, Cornell University, **Clinton Hodges**, Iowa State, **Leon Lucas**, North Carolina State, and **Leon Burpee**, Georgia. What did these premiere experts on *Pythium* say...read on to find out.

Stanghellini and **Handcock** are an exciting pair of instructors who made the difficult task of teaching *Pythium* identification a pleasure. The workshop was conducted at New Mexico State University in the laboratory of **Craig Liddel** and **Natile Goldberg**. They provided microscopes and cultures of key *Pythium* species for our use and also utilized a microscope mounted video camera to help the group view the critical parts of the fungus. At this point, you may say BORING! The workshop was not boring but it did not yield much information that will help us manage Pythium in the short haul. However, we may want to develop more accurate identification techniques for *Pythium* in the future.

Having completed a review course in Pythium identification, I felt equipped to thoroughly absorb the valuable information that was going to be presented during the turfgrass colloquium on Pythium root diseases. I never suspected what was going to be uncovered at the colloquium....the experts didn't agree on what is going on below the soil surface. They didn't even provide a strong case for *Pythium* being directly involved.

One of the foundation principles of plant pathology requires that: 1) a pathogen is constantly associated with a disease 2) the pathogen can be isolated in pure culture 3) when this culture is inoculated onto the host, it causes the same disease. Koch developed these postulates after unequivocally demonstrating that a bacterium caused anthrax in 1876. Normally, if you haven't been able to carry out these steps, you have not developed sufficient information to claim that you know the cause of the disease. This is the foundation pathology, not just plant pathology but all fields of pathology, including humans, animals, insects, and plants. The researchers presenting their studies in the colloquium were uniformly unable to prove that *Pythium* causes the root disorders that they were studying. It is not unusual to see controversy at a scientific meeting but in this case there was less controversy than there was lack of understanding of the cause of root disorders. Nobody seemed to have a good answer in spite of huge amounts of detailed research. Some of the highlights are listed below.

The main focus of the research and discussion was on decline in bentgrass with some mention of poa. The Pythium blights that you are all familiar with are well understood and were not part of this colloquium. The root diseases are more difficult to study. Keep in mind, each of the summaries below are addressing what the researchers think are similar diseases.

Eric Nelson, Biology, ecology and pathology of *Pythium* species of turfgrasses

Symptoms: There are two phases, one after snow melt in early June and a second phase in late July through August. The symptoms include chlorosis that does not respond to fertilizers and some patch symptoms. The early June symptoms look like summer patch and poa declines first. Small patches that are pink and orange in appearance are most typical. The symptoms look like many other root pathogens. In July through August, a green can be devastated in two days. This is the most important disease in the Northeast. Roots are devoid of hairs and crowns are discolored. Roots are not drastically discolored. Microscopic observation reveals abundant oospores in root tips and in root hair zone with lobate sporangia in the cortex.

Cause: The most virulent pathogen associated with the disease is *Pythium graminicola*. The most common pathogen is *P. torulosum*, however, many of the *P. torulosum* strains were not virulent. Other *Pythium* species that were associated with the symptoms included *P. aphanidermatum*, *P. aristosporum*, and *P. vanderpoolii*. Attempts to induce disease wwas difficult. Some isolates of these fungi produced disease at high temperatures but not low temperatures and others produced disease at low temperatures but not high temperatures. Temperature is know to influence pathogenicity of fungi but the differences usually fall at species lines rather than within isolates of a species.

Control: There are no varieties of turfgrasses that demonstrate resistance to these fungi. Cultural control includes stress management, water management and increased mowing height. Biological control includes use of organic amendments and microbial agents. However, the biological controls were not described in detail. Chemical control includes use of systemic and contact fungicides that are applied properly and watered in to deliver the fungicides to the root zone area where these fungi are active.

Clifton Hodges, Infection of adventitious roots of *Agrostis palustris* by *Pythium* spp. and subsequent disease development

Symptoms:. Most research is carried out on primary rather than adventitious roots. Hodges focused on the adventitious roots which are the most prevalent roots on older turfgrass stands. Two diseases were described. 1) a dysfunction in newly reconstructed sand greens less than two years old and 2) mature stands 3 years or older. The disease on recently rebuilt greens is expressed as root shortening with cortical tissue loaded with fungal structures. Tips of root hairs develop bulbous ends. The disorder in established greens looks like a non-descript dying of turf in warm weather. Roots are brown and rotted.

Cause: Newly reconstructed stands were primarily attacked by *P. aristosporum* or *P. arrhenomanes*. At least 1/3 of the Pythiums isolated from the mature stands that were 3 or more years old were non-virulent. The primary pathogens were: *P. aristosporum, P. arrhenomanes, P. graminicola, P. rostratum, P. torulosum,* and *P. vanterpoolii*. Some of the fungi stimulated turf growth in cool weather and damaged the turf in warm weather. There was a lot of isolate variation. There was not a good connection between oospores and disease and some of the isolated were not heavy oospore producers. In addition to *Pythium*, the upper inch of infected roots also contained the following pathogens: *Curvularia, Fusarium, Bipolaris, Drechslera,* and *Rhizoctonia*. Other fungi were also associated with the entire length of the roots including: *Microdochium, Acromonium* and *Polymyxa*. **If *Pythium* is the problem, it is part of a root disease complex.**

Control: No chemical controls worked in the field nor in the laboratory to control *P. aristosporum or arrhenomanes*. Other controls were not discussed.

Leon Lucas, Development and management of summer decline of bentgrass

Symptoms: The turf dies and they did not know why. Summer decline occurs in sand and soil greens and appears as a patch type symptom.

Cause: Lucas broadened his discussion beyond the role of Pythium. The overall problem is the lack of roots. Most being only 1/2 inch long. Factors involved include USGA specification greens with heavy thatch and poor air movement. The thatch results in a slow percolation rate at the surface over a high percolation rate sand. The water in the thatch is "perched" and causes a too

wet condition that encourages crown rots and alga growth. The soil then easily becomes anaerobic because oxygen is depleted by roots and microbes in the soil. Once the oxygen is depleted, anaerobic microbes begin to produce phytotoxic hydrogen sulfide. In addition, some microbes can produce substances that make the sand particles hydrophobic causing localized dry spots that are difficult to re-wet.

High salts, sometimes related to over-application of fertilizers, particularly potassium fertilizers, have been related to decline. Lucas recommends keeping the soil EC to below 1200 ppm (about 2 dS/m) and to avoid trying to accumulate potassium during the summer. In addition to physical factors, sterol-inhibitor fungicides and dinitroaniline herbicides should be avoided. Micronutrient deficiencies may also be involved and copper deficiencies produce a non-descript pattern of chlorotic plants. The *Pythium* species that were present in and may also be involved in this decline were: *P. torulosum, P. catenulatum, P. arrhenomanes, P. vanterpoolii, P. oligandrum, P. periilum* and more. *P. arrhenomanes* appeared to be a good pathogen and was considered most important.

Control: The solution is to increase root growth by: 1) spring aeration 2) summer aeration 3) fans where air movement is low 4) open up the green to improve air movement 5) hand syringing, not using the irrigation system to syringe 6) light foliar feeding 1/8 lb N every 10-14 days. Some varieties, for example, Penncross will segregate into clones. Some of the clones are purple in the winter and some are more resistant to cold. Sometimes the clones will appear in patch patterns. Fungicides that worked to reduce the decline included Fore and Alliette. The combination of Alliette plus Fore (4 oz + 8 oz/1000 sq ft) provided the best results but was not significantly better than Alliette plus Daconil 2787 (4 oz + 6 oz/1000 sq ft) or Alliette plus Chipco 26019 (4 oz + 2 oz/1000 sq ft). Always follow label instructions and test combinations on small areas prior to treating large areas. Do not mix flowable formulations of Fore, Daconil 2767 or Chipco 26019 without first contacting your distributor to be sure the products are compatible. The results cited here are results of small plot research trials not large scale applications.

In addition to the colloquium participation, Lucas has recently published a detailed study into the identification of *Pythium* species that attack turfgrasses: **Abad, Z. G., Shew, H.D., and Lucas, L.T. 1994. Characterization and pathogenicity of *Pythium* species isolated from turfgrass with symptoms of root and crown rot in North Carolina. Phytopathology 84:913-921.** In this publication, 33 *Pythium* species were identified to have various levels of virulence on turfgrass. In the end, *P. arrhenomanes* was suggested to be the most important species in North Carolina. Insufficient information is available to determine whether the exact identification to species will influence our management or control recommendations.

Leon Burpee, Observations of bentgrass root infection by *Pythium* spp in Georgia

Symptoms: General thinning of bentgrass turf with no foliar pathogens. Dying from the top down. Chlorosis or necrosis indicating a root problem. Between June and August, sloughing of the cortex or only the steele left.

Cause: Oospores present which suggests *Pythium*. Apleurotic oospores with multiple antheridium were present and characteristic of *P. myriotylum*. When inoculated onto roots, successful cortical infection occurred but cortical sloughing could not be induced. Roots appeared pretty healthy. *P. myriotylum* is a pathogen but virulence appears to be low. Several factors, for example microbes and root senescence, in addition to *P. myriotylum* alone probably interact to cause cortical decay of bentgrass roots.