Timing of Fungicide Applications for Root-Infecting Fungi

By Paul Koch, *Turfgrass Diagnostic Lab, Department of Plant Pathology University of Wisconsin-Madison*

For anyone who attended the 2006 Wisconsin Golf Turf Symposium in Kohler, one overarching theme should have been evident throughout every person's presentation: turfgrass roots are relatively poorly understood. This is evident whether we're talking about root physiology, fertility, or diseases. For varying reasons, much more research has gone into the above ground aspects of turf than the below ground, and nowhere is this more evident than with diseases.

Until as recently as 20 years ago, necrotic ring spot (*Ophiosphaerella korrae*) and summer patch (*Magnaporthe korrae*) were grouped in with other pathogens in a disease known as *Fusarium* blight (Davis and Dernoeden, 1991). We now know that each of those pathogens is in fact its own disease, causing similar symptoms on the same hosts but in different environmental conditions. Take-all patch (*Gaeumannomyces graminis var avenae*) was first reported as a patch disease of turfgrass in 1931 in Holland, and was at the time referred to as Ophiobolus patch because the current classification of the causal agent was *Ophiobolus graminis*. It was re-classified as G. graminis in 1952, but was not commonly referred to as take-all patch until 1981 (Smiley 1993). As you can see, compared to many of the leaf and crown-infecting fungi, the root-infecting fungi have been recognized as pathogens for a relatively brief time.

Due to this relatively brief period of recognition, scientific research into the nature and control of root diseases has been lacking. Very valuable research has been and is currently being conducted with regard to root diseases, but to date our level of understanding lags far behind that of many above-ground diseases. This lack of understanding of root diseases has left turfgrass pathologists poorly equipped to give recommendations to turfgrass managers on how best to control these pathogens. With ever-increasing demands being put on the turf, root mass has continued to decrease and smaller levels of root infection have caused symptoms to the above-ground portion of the plant.

The obvious answer to many of the root disease infections is to alter cultural practices to optimize root health. This would allow the plant to withstand a minor to sometimes moderate infection because there are a greater number of roots to offset those colonized by the pathogen. Those practices include proper mowing height, proper irrigation, excellent surface and subsurface drainage, proper fertility, pH kept below 6.5, and limited thatch development (Couch, 1995). But golfer demands, as well as environmental conditions difficult to alter (e.g. wet soils), sometimes make it impossible to fully manage these diseases with cultural practices alone.

In those cases, it may be beneficial to supplement proper cultural practices with a fungicide program to limit development of the pathogen. But the timing of these applications are critical to success, because once you see symptoms of the root-infecting pathogens it is often too late to implement a fungicide program.

The take-all patch fungus actively attacks creeping bentgrass roots when the root zone is moist and soil temperatures in the top two inches are between 50 and 65°F. Once soil temperatures get above 65°F or

below 50°F, the fungus begins to go into dormancy and does not cause any further infection, but also is not susceptible to fungicide applications. Soil temperatures in the top two inches of the soil profile correspond well with daily air temperatures, meaning that when air temperatures are consistently in the 55-65°F it can be assumed that soil temperatures are close to that range as well.

According to the National Weather Service website, average daily high temperatures on the first of April in Madison are 50°F and on April 30th they are 63°. The average daily high temperature on October 1st then falls back to 66°F, with the average on October 31st being 52°F. Using this data, while assuming an average spring and fall and also leaving a small amount of lag time for the soil temperatures to warm to that of the air temperatures, fungicide applications spaced three to four weeks apart targeting take-all patch could be made in April or early May and again in October (see Table 1). These fungicides should be watered in to locate the fungicide near the point of infection, which usually requires approximately 1/4 inch of water. This by no means guarantees that you will not see any take-all patch infections, since fungicide efficacy against root diseases has many variables that can affect its performance.

Disease	Active Infection Period	Active Soil Infection Temperatures	Symptoms Expressed	Fungicide Application Timing in Spring	Fungicide Application Timing in Fall
Take-all Patch	Spring and Fall	50-65°F	Summer	April/May	Sept/Oct
Necrotic Ring Spot	Spring and Fall	50-65°F	Summer	April/May	Sept/Oct
Summer Patch	Summer	65°F and up	Summer	May	None

Table 1: Summary of active infection periods for root-infecting diseases and fungicide application timing. Timing is based on weather data for Madison, WI.

Figure 1: Weeks of slow to moderate root colonization likely preceded this outbreak of summer patch on Kentucky bluegrass.

Necrotic ring spot is similar in many ways to take-all patch, with the main difference being the host species: take-all patch attacks mainly creeping bentgrass and necrotic ring spot attacks mainly bluegrasses and fescues. But the timing of infection is nearly exactly the same as take-all patch, with active infection happening in the spring and fall of the year and symptoms becoming present in the hotter and drier conditions of summer. For this reason, the same dates listed above for take-all patch can be used as a starting point for necrotic ring spot fungicide applications.

Summer patch, in contrast to necrotic ring spot and take-all patch, does not become active until soil temperatures reach 65°F and is most active on annual and Kentucky bluegrass when soil temperatures reach 82-86°F (Couch, 1995). In cases of severe summer patch outbreaks, there is often a small but steady infection of summer patch throughout the late spring and early summer that leads to a symptom-causing explosion of fungal growth when conditions turn very hot and humid later in the summer (Figure 1). For this reason, it is recommended that areas susceptible to summer patch infection be treated preventatively with two fungicide applications 3-4 weeks apart once soil temperatures reach 60°F. This should provide ample root protection for the majority of the summer, but a third application may be necessary if hot and humid conditions persist into the fall. Using the National Weather Service data from above for Madison, thought should be given to the initial preventative application in southern Wisconsin in early May.

If comparatively little is known about the intricate biology of root-infecting fungi, even less is known about which fungicides show efficacy against them. What works well in one university research trial may not work well in another, and what works for one golf course superintendent has not always worked for his or her neighbor. The reason behind this variation likely lies with varying environmental conditions such as pH, antagonistic microbial populations, and soil composition. The Turfgrass Diagnostic Lab recommends any of the following for controlling root-infecting diseases: azoxystrobin, pyraclostrobin, myclobutanil, propiconazole, and thiophanate-methyl.

All of the fungicides recommended above should be applied at full label rate and watered lightly into the root zone to locate the fungicide near the point of infection. Since all these fungicides are acropetal penetrants (with the exception of pyraclostrobin, which is a localized penetrant), they will be taken in through the roots and transported upwards in the plant and provide at least some protection to the turfgrass leaf tissue.

Applying fungicides will not guarantee you a summer free of root diseases. But proper fungicide application timing, coupled with proper cultural practices, will at least give you a fighting chance.

References:

Couch, H. B. 1995. Diseases of Turfgrasses, 3rd ed. Krieger Publishing Co., Malabar, FL. p. 25-31, 47-51.

Davis, D. B. and P. H. Dernoeden. 1991. Summer patch and Kentucky bluegrass quality as influenced by cultural practices. Agronomy Journal 83: 670-677.

Smiley, RW. 1993. Historical perspective of research on ectotrophic root-infecting pathogens of turfgrass. Pages 1-15 in: Turfgrass Patch Diseases Caused by Ectotrophic Root-Infecting Fungi. B. Clarke and A. B. Gould, eds. APS Press.