Insights

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Rhizoctonia

The unnecessary confusion surrounding *Rhizoctonia*

The fungus *Rhizoctonia* is one of the most common and at the same time one of the most destructive diseases of turfgrass. It can appear in many guises on golf course turf–as a disease of either cool-season turf or warm-season turf, as a hot weather problem or a cool weather problem, and causing symptoms that range from extremely large patches of orange/brown turf over 25 feet in diameter to tiny yellow rings of only a few inches wide (Figures 1, 4, 5).

Figure 1. Differential susceptibility of common bermudagrass (left) vs. hybrid bermudagrass (right) to *Rhizoctonia* infection.

To complicate matters, there are several different strains and species of *Rhizoctonia* that cause problems on golf course turf, but these are almost impossible to distinguish from one another without a specialized microscope, a well-equipped laboratory and several days or weeks to invest in the effort. To further cloud the issue, it appears that symptoms can vary depending not only on the strain of fungus present, but also on turf variety, height of turf cut, soil type, weather and cultural practices.

A large number of common disease names have been generated to describe the different symptoms that *Rhizoctonia* causes (Table 1), but there is little agreement among plant pathologists about which common names match up with which *Rhizoctonia* strains and which symptoms.

In other words, we have a bit of a mess on our hands when we try to talk about *Rhizoctonia* on turf – a mess than can translate into some confusion about how to manage this widespread and destructive disease. We think that most of this confusion is unnecessary and even harmful, and that, with one exception, all *Rhizoctonia* diseases can be successfully managed using the same strategies. In this issue of PACE Insights, we'll present information that we think illustrates why the similarities among *Rhizoctonia* diseases are more important than the differences, and we'll bring you up to date on progress made over the past several years in managing this ubiquitous pathogen.

The common bond

Rhizoctonia diseases share the following characteristics:

- septate hyphae (Figure 3): the thin, thread-like strands of fungal material known as hyphae (hypha = singular) are divided into individual cells by horizontal cross walls called septa (singular = septum)
- hyphal branching at right angles (Figures 2 and 3)
- lack of clamp connections (small bumps at the septa) on mycelium
- production of durable resting structures called sclerotia: *Rhizoctonia* can survive periods of adverse environmental conditions (lack of food, water, fungicide toxicity or harsh temperatures) by producing a dense mass of mycelia that is called a sclerotium.
- absence of spores (many fungal diseases produce spores; *Rhizoctonia* is relatively unique in its lack of spore production)
- active when humidity is high and threat temperatures are greater than 60F average daily air temperature
- well controlled by strobilurins (particularly azoxystrobin and pyraclostrobin) and flutolanil, though many other fungicides are almost as effective (Table 3).

In This Issue:

Bottom Line

Rhizoctonia diseases on golf courses are almost all managed similarly, regardless of the specific strain or species of the pathogen that is involved. The most important things to know about *Rhizoctonia* and its close relative *Waitea*, is that:

- thiophanate metyl may not provide control.
- Whenever threat temperatures exceed 60 F, keep an eye out for *Rhizoctonia* and *Waitea*.
- Maintain adequate moisture and soill nitrogen between 5 and 20 ppm.
- If the more difficult-to-control *Rhizoctonia zeae* is present, optimal fungicide options are narrowed to include azoxystrobin, pyraclostrobin or flutolanil.

Figure 2. Mycelium of *Rhizoctonia*. Note the right-angle branches formed by the individual hyphal strands.

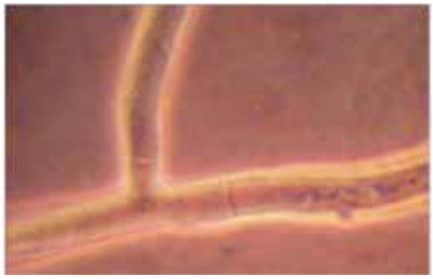

Figure 3. Close-up of an individual *Rhizoctonia* hypha, illustrating right-angle branching and septae (arrows).

Figure 4. *Rhizoctonia* on buffalograss

Table 1. *Rhizoctonia* diseases on golf course turf. *Rhizoctonia* causes many different symptoms, depending on turf type, weather, mowing height and fungal strain. As a result, disease descriptions often overlap with one another, making precise disease identification almost impossible.

Common name(s)	Scientific name	Susceptible turf	Symptoms
• Yellow patch • Cool season brown patch • Winter brown patch	*Rhizoctonia cerealis*	Cool-season, low mown turf, sometimes bermuda and zoysia	Yellow to tan patches or rings 6 inches – 3 feet diameter; usually no smoke rings; occurs fall through spring
• Brown patch • Large patch • Zoysia patch	*Rhizoctonia solani*	• Cool-season (bent, blue, fescue, rye) and warm-season (bermuda, kikuyu, zoysia and paspalum) • Warm-season (bermuda, centipede, St. Augustine, zoysia) • Zoysiagrass	• Brown or tan patches 2 inches to 3 ft diameter, sometimes with smoke ring • Large circular patches 3 – 25 ft diameter, with turf orange or brown • Symptoms in autumn or spring, usually in same place as previous year. Large patches (up to 25 'diameter) or rings characterized by thinning, yellow-orange turf.
Leaf and sheath spot	*Rhizoctonia zeae and R. oryzae*	Tall fescue, bentgrass, centipede, St. Augustine, bermuda	Varying symptoms similar to brown patch; may be difficult to control with thiophanate-methyl

Why it won't go away

This plaintive cry comes from superintendents who have done everything by the book in managing *Rhizoctonia* – scouting, moisture management, nitrogen management, fungicide applications – and still, the disease comes back year after year, frequently in the same location each time. The *Rhizoctonia* just refuses to be eradicated. A look at this fungus' life history will explain why.

First and foremost, *Rhizoctonia* is a soil fungus, and can live happily on decaying organic matter – without the benefit of any living plants nearby – for months and even years. Therefore, even if you were to remove all turf from an area or plant a turf variety that is resistant to *Rhizoctonia* (Table 2), the fungus would still survive quite happily in the soil. But as soon as susceptible turf plants are nearby, watch out! The fungus will attack them as soon as temperature (>60 F) and moisture conditions are right.

Secondly, *Rhizoctonia* has several ways it gets around cold or dry weather, or even lack of nutrients. The mycelium can go into a type of hibernation in the soil, or on pieces of dead plants. Under these conditions, the fungus doesn't actively grow, but it is most definitely still alive, waiting until the right conditions return. The ability of *Rhizoctonia* to grow saprophytically – that is, on dead organic material – is an important weapon in the fungus' arsenal of survival skills. The fungus can also survive for many years in the soil or dead plants in the form of small, irregularly shaped, structures known as sclerotia. The color, size (1 - 3 mm) and shape varies between the different *Rhizoctonia* species, but the function of the sclerotium is the same – survival. The dense mass of mycelium that forms the sclerotium protects the inner hyphal strands from damage from the environment and other stresses (including fungicides).

These two survival mechanisms allow symptoms of brown patch to disappear in dry conditions or cool conditions and then miraculously reappear in the same general area year after year when environmental conditions are conducive.

Once there is sufficient warmth and moisture, *Rhizoctonia* goes into action rapidly. As the fungus starts to grow in the soil and/or thatch, it will actively seek out living plants by sensing chemical stimulants that the poor, unsuspecting plant inadvertently releases as it grows.

Eventually, *Rhizoctonia* will invade turfgrass plants, and the growth of the mycelium will digest and kill plant tissue in the leaves, stolons and crowns. In so doing, the fungus produces more mycelium and more sclerotia – and the amount of fungal inoculum in the soil increases and increases and increases.

Management: cultural practices

Practices that minimize excessive moisture will decrease the chances of *Rhizoctonia* attack. These include improved drainage in low lying areas, use of penetrants to remove moisture, and moderate nitrogen rates (keeping soil levels between 3 – 20 ppm total plant available nitrogen). Dry soil conditions may also stress the grass and stimulate *Rhizoctonia* attack. Avoiding either excessively wet or dry conditions gives the turf plant the upper hand in the battle against *Rhizoctonia*. Excessive nitrogen can give the fungus a boost because this nutrient is frequently limited in the thatch, which forces *Rhizoctonia* to compete with other soil bacteria and fungi for it. When urea, nitrate or ammonium fertilizers are applied, the competition for nitrogen is reduced and *Rhizoctonia* can easily compete with the other organisms under high nitrogen fertility conditions to reach a living plant. For this reason, *Rhizoctonia* infections are sometimes worse following fertilization with nitrogen.

Turf breeders have made good progress in developing perennial ryegrass, fine leaf fescue and bentgrass varieties that do a good job of resisting *Rhizoctonia* infection. While there are no varieties that are completely resistant to this disease, use of the varieties listed in Table 2 should help to decrease the frequency and severity of *Rhizoctonia* damage.

Management: chemical control

It is in the area of chemical control that one important distinction among *Rhizoctonia* diseases appears. As indicated in Table 3, there are several very good fungicide products available for control of *Rhizoctonia* diseases. However, one species of *Rhizoctonia* – *Rhizoctonia zeae*, to be exact – is more difficult to control, and is particularly tolerant to applications of thiophanate-methyl. For this reason, difficult cases of *Rhizoctonia* are typically treated with the strongest and most consistent performers in the arsenal – azoxystrobin, pyraclostrobin and flutolanil (Table 3).

Other than that, chemical control strategies are very similar for all *Rhizoctonia* turf diseases. In order to cover foliage well, applications should be made in no more than 2 gallons/1000 square feet, and should not be watered in. Two to three applications, spaced 14 days apart, are usually necessary. Although some of the most effective fungicides can be used at their high labeled rates on a 28 day schedule (Table 3), best results are almost always achieved when these products are used at lower rates on a 14 day schedule.

Figure 5. *Rhizoctonia* on seashore paspalum. Note masking of disease symptoms by overseeded turf (arrow)

Table 2. Turf varieties with increased tolerance to brown patch. The varieties listed below were among the best of all entries in resisting infection and/or damage from brown patch caused by *Rhizoctonia* in tests conducted 1999 – 2003 by the National Turfgrass Evaluation Program (www.ntep.org). Data below is limited to studies conducted over a three-year period. Similar trials are not yet completed for tall fescue or bluegrass, and NTEP trials for bermudagrass did not include evaluations for *Rhizoctonia*. Therefore the results for these varieties are not presented.

Perennial ryegrass	Fineleaf fescue	Bentgrass fairway	Bentgrass putting green
Pizzazz	Longfellow II	Penn G-6*	Penn G-6*
Gator 3	Ambassador	Penncross*	Bavaria*
Seville II	Minotaur	Brighton	Vesper*
Allsport	Scaldis II	Grand Prix	SR 7200*
Amazing	Bighorn	L-93*	
Secretariat	Berkshire	Imperial	
		Backspin	

What about Waitea?

Brown ring patch (BRP), a new disease of poa greens caused by *Waitea circinata* var. *circinata* shares many features in common with *Rhizoctonia* diseases – particularly yellow patch caused by *Rhizoctonia* cerealis. However, yellow patch is thought to occur only during cool weather (air temperatures 50 - 65F while BRP has been found at a wide range of temperatures, from 50 - 90F. And while yellow patch is fairly easy to control with a wide variety of fungicides, the new disease is not well controlled by fungicides such as thiophanate-methyl (Cleary's 3336), propiconazole (Banner). The most effective products for control of this pathogen include polyoxin-D (Endorse), flutolanil (Prostar), or triticonazole (Trinity). Combinations of Endorse plus Banner Maxx, Trinity plus Insignia, or Heritage plus Banner have also been effective.

Table 3. Activity of fungicide products against *Rhizoctonia* diseases on turfgrass. Based on results from 18 small plot, replicated university field trials conducted around the United States, 2001 – 2003 (for locations, see Table 4). Results obtained from Fungicide and Nematicide Tests, volumes 56, 57 and 58. Systemic fungicides are printed in red, while contact fungicides are printed in green.

Fungicide products with superior activity against brown patch PCNB is an effective product that is not listed below, due to the fact that it was not tested in the 2001- 2003 and that phytoxicity to turf can be a problem with this product.

Active Ingredient	Product(s)	Rate	Frequency
azoxystrobin	Heritage 50 WG	0.4 oz	28 days
pyraclostrobin	Insignia 20WG	0.5 oz	14 days
flutolanil	Prostar 70 WP	1.5 oz	14 days
flutolanil	Prostar 70WP	2.2 oz	28 days
pyraclostrobin	Insignia 20 WG	0.9 oz	28 days

Fungicide products with very good activity against brown patch

Active ingredient	Product(s)	Rate	Frequency
azoxystrobin	Heritage 50WG	0.2 oz	14 days
chlorothalonil	Daconil Ultrex	3.2 oz	14 days
chlorothalonil	Concorde 82.5	3.2 oz	14 days
chlorothalonil + thiophanate-methyl	Spectro 90 WDG	4 oz	14 days
iprodione	Chipco 26GT, Iprodione Pro	4 oz	14 days
iprodione	Top Pro Iprodione	4 oz	14 days
thiophanate-methyl (ineffective on *R. zeae* and *Waitea*)	Cleary's 3336, Top Pro Thiophanate-methyl	4 oz	14 days

Fungicide products with very good activity against brown patch

Active Ingredient	Product(s)	Rate	Frequency
boscalid	Emerald 70 WG	0.13 oz	14 days
chlorothalonil	Echo 720 6F	3.6 oz	14 days
fludioxinil	Medallion 50WP	0.25 – 0.5 oz	14 days
myclobutanil	Eagle 40 WP	0.6 oz	14 days
polyoxin d	Endorse 2.5 WP	4 oz	14 days
propiconazole	Banner Maxx 1.3 MEC	1 – 4 oz	14 – 21 days
thiram	Spotrete 75 WG	4 oz	7 days
triadimefon*	Bayleton 50DF	0.5 – 2 oz	14 days

Figure 4. Background information on 18 trial locations from which *Rhizoctonia* efficacy data was generated. All data is available from the publication Fungicide and Nematicide Tests.

Institute	Researcher	Year	Turf variety
Ohio State University	JW Rimelspach	2003	Creeping bentgrass (0.17")
Pennsylvania State University	W. Uddin	2003	Colonial bentgrass fairway
North Carolina State University	L. Tredway	2003	Creeping bentgrass (A4) green
University of Maryland	P. Dernoeden	2002	Colonial bentgrass fairway
Pennsylvania State University	W. Uddin	2002	Colonial bentgrass fairway
University of Kentucky	P. Vincelli	2002	Creeping bentgrass green
North Carolina State University	L. Tredway	2002	Creeping bentgrass green
Ohio State University	JW Rimelspach	2001	Creeping bentgrass (0.19")
Kansas State University	J. Fry	2002	Creeping bentgrass (0.16")
Ohio State University	JW Rimelspach	2002	Creeping bentgrass (0.19")
University of Kentucky	P. Vincelli	2002	Creeping bentgrass/annual bluegrass green
University of Kentucky	P. Vincelli	2002	Tall fescue rough
Kansas State University	N Tisserat	2001/2002	Zoysiagrass fairways
North Carolina State University	L. Tredway	2002	Creeping bentgrass green (SR1119)
Iowa State University	ML Gleason	2002	Creeping bentgrass greens
University of Maryland	JE Kaminski	2002	Colonial bentgrass fairway height
Pennsylvania State University	W Uddin	2001	Colonial bentgrass fairway height
University of Kentucky	P Vincelli	2001	Creeping bentgrass green

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