Rhizoctonia Biology and Management

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Over the past three years, brown patch has caused increasing damage to kikuyugrass and bermudagrass fairways in Southern California, with severe enough symptoms to warrant fungicide applications. With the expected introduction of new and effective products for control of summer patch of poa greens this year, brown patch disease of fairways may replace summer patch as the most serious and costly disease that we deal with here in California. Because applying fungicides to control fairway diseases is uncommon in California, this is an unwelcome turn of events, and one that we would like to reverse, as soon as possible. This PACE Insights will describe the biology and management of *Rhizoctonia* to help you more effectively prevent damage caused by this disease and to control the disease when it appears.

The fungus: The large number of different fungi classified in the genus *Rhizoctonia* contains many plant pathogens that cause widespread destruction to several important crops throughout the world. *Rhizoctonia* was first described more than 130 years ago and its biology and management continues to keep researchers busy (Menzies, 1970). In turfgrasses, there are two major categories, the binucleate and the multinucleate *Rhizoctonia* groups. The binucleate *Rhizoctonia* species represents the cool season yellow patch diseases caused by *Rhizoctonia cerealis*. The multinucleate group includes *R. solani*, *R. zeae*, and *R. oryzae* and they cause the typical brown patch disease symptoms (Sneh et. al. 1991), and are the group that causes brown patch on Southern California, warm-season fairways. Other characters that assist in identifying this pathogen (Figure 1) are septate hyphae, lack of clamp connections (small bumps at the septa) on mycelium, hyphal branching at right angles, production of durable irregular shaped resting structures called sclerotia (Figure 2), and absence of spores (many turfgrass pathogens produce spores). Figures 1 and 2 below illustrate how these characters might appear when viewed with a microscope.

Survival: *Rhizoctonia* can survive periods of adverse environmental conditions (lack of food, water, or harsh temperatures) by producing a dense mass of mycelia that is called a sclerotium. This dense body is also more tolerant of fungicide applications because the fungus is in a resting state. It is the sclerotia that allow symptoms of brown patch to disappear in dry conditions and miraculously reappear in the same general area year after year when environmental conditions are conducive. In addition to survival as sclerotia, *Rhizoctonia* can survive in pieces of colonized plant material and also saprophytically (using organic matter in the thatch and soil). The sclerotia and bits of infected plant tissue can also be moved with cultivation (aeration) equipment from one place to another. There are few pathogens that are as flexible as *Rhizoctonia* spp. in their ability to grow on a variety of substrates and to survive adverse environmental conditions.

Figure 1. Hypha (microscopic strand of living fungus) as it appears when viewed through a compound microscope. Note the right angle branching, septation, multiple nuclei, and lack of clamp connections.

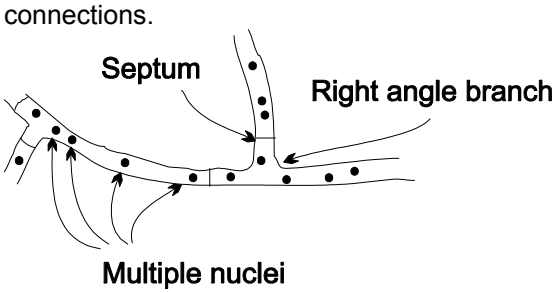
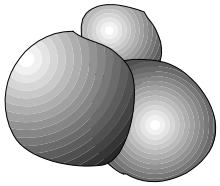


Figure 2. Representation of sclerotia of *Rhizoctonia*. The color, size (1 - 3 mm) and shape varies between the different species but the function of the sclerotium is the same - survival. The dense mass of mycelium protects the inner hyphal strands from damage from the environment including fungicides.

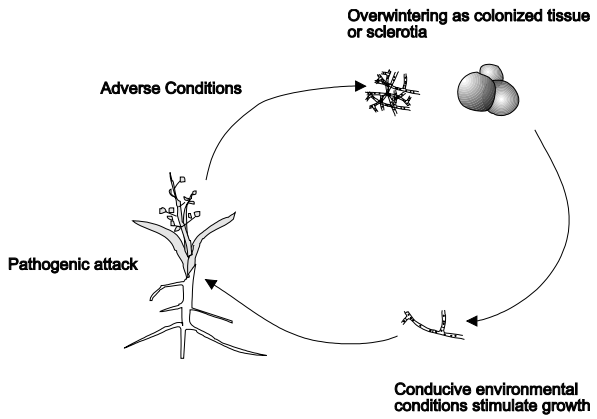


The disease: When *Rhizoctonia* invades turfgrass plants, growth of the mycelium digests and kills plant tissue in the leaves, stolons and crowns. Gross symptoms caused by *Rhizoctonia* infection vary a great deal depending on turf variety, soil type, environmental conditions and strain of the pathogen, causing *Rhizoctonia* symptoms to be frequently confused with symptoms of other diseases. For this reason, you should have the identity of the pathogen confirmed before making any treatment decisions. In general, when *Rhizoctonia* occurs on warm season turf, rings of dead or dying turf appear, and

can increase in size to over 10 feet as the disease progresses. Disease symptoms are most prevalent when weather is cool (autumn and winter) and warm season turfgrass growth has slowed down.

The cycle of *Rhizoctonia* disease (Figure 3) begins when overwintering or resting mycelium in colonized organic matter or sclerotia encounter conducive environmental conditions (high humidity, mild temperatures). Following germination from sclerotia or colonized plant material, the fungus will grow within the thatch layer to eventually encounter a live plant. *Rhizoctonia* is a good saprophyte - it does not require a living host to survive. The thatch layer provides carbon and other nutrients from senescent (older, or dying) foliage. Nitrogen is frequently limited in the thatch and competition between *Rhizoctonia* and native soil fungi and bacteria is intense for this essential element. However, 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. Once attacked by *Rhizoctonia*, the plant will be colonized and killed. When adverse environmental conditions (low humidity, low nutrients) prevail, the fungus will seal itself off in the plant or complete sclerotia development to survive, sometimes for several months, until conditions for growth occur again.

Figure 3. *Rhizoctonia* disease cycle. Conducive environmental conditions (high humidity and mild temperatures) stimulate germination of sclerotia or growth from colonized plant material. Plants are attacked and killed as the disease progresses outwards from a patch or ring. When environmental conditions become dry or nutrients run low, *Rhizoctonia* forms new sclerotia or becomes quiescent in colonized plant tissues awaiting the next period of conducive environmental conditions.



Predicting the Occurrence of Rhizoctonia: In addition to favoring elevated nitrogen conditions, *Rhizoctonia* prefers mild temperatures and high humidities. Can this knowledge be turned into a model that will predict when *Rhizoctonia* is most likely to occur? In a recent study of brown patch on perennial ryegrass, Fidanza et al, 1996 used humidity and temperature data to develop a predictive model for brown patch on perennial ryegrass., which relies on calculation of the Environmental Favorability Index (E) to determine when *Rhizoctonia* is most likely to attack (for calculation of E, see below).

$$E = 0.15 \times RH + 1.4 \times T - 0.033 \times T^2 - 21.5$$

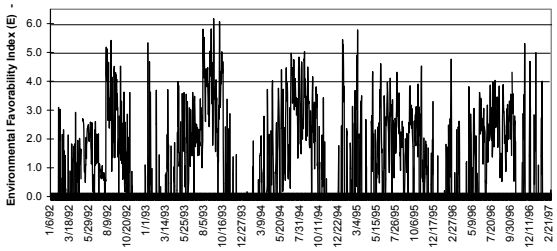
E = environmental favorability index

RH = average relative humidity

T = minimum temperature

According to the model, when the value for E is 6 or higher, brown patch infections should be expected. However, because the model was developed in Maryland for perennial ryegrass, some adjustments may be needed to be useful for warm season grasses in California. Figure 4 illustrates values for the Environmental Favorability Index (E) calculated for 1992 - 1997 for Long Beach CA, where brown patch has become a persistent problem on kikuyugrass and bermudagrass fairways. As Figure 4 illustrates, an E factor of 6 was reached only twice during the past five years in Long Beach.

Figure 4. Environmental favorability Index (E) for brown patch on perennial ryegrass. Data from CIMIS station 102 in Long Beach where fairway brown patch in kikuyugrass and bermudagrass are a growing problem. When the E value reaches 6, brown patch occurs.



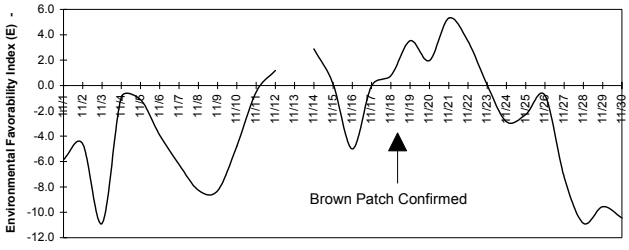
Since brown patch has been a problem in the Long Beach area every year since 1993, the model is clearly too conservative under our conditions. If we adjust the model, and lower the E factor to 5 , however, the number of high brown patch risk days increases (Table 1, Figure 5). Using the E of 5, for example, the model predicted brown patch on November 21, 1996 (Figure 4, Table 1). We

detected brown patch at a Long Beach area golf course on November 19, 1996, suggesting that the model does have some predictive value. Further validation of this model in California will allow us to use it as a tool to trigger scouting, cultural practices, and if necessary, fungicide applications for *Rhizoctonia* management.

Table 1. Days when the Fidanza model E value reaches or exceeds 5.0 in Long Beach, CA. Note that 1993 was predicted to be a very severe year for brown patch and indeed it was. The extended conducive brown patch conditions in 1993 probably resulted in production of heavy brown patch inoculum levels that continue to cause problems today.

Year	No. Days	Brown patch risk dates when E is greater than or equal to 5.0
1992	3	8/3, 8/6, 8/21
1993	9	1/7, 8/2, 8/3, 8/6, 8/28, 9/12, 9/12, 10/4, 10/11
1994	2	6/29, 8/18
1995	3	1/8, 1/10, 3/5
1996	1	11/21
1997		1/2

Figure 5. Environmental favorability index (E) for CIMIS Station 102, Long Beach. The arrow indicates the positive identification of brown patch in significant levels at a Long Beach golf course with kikuyugrass fairways.



Why has brown patch been increasing in recent years? The increases in brown patch at a few Southern California golf courses may result from a high level of residual *Rhizoctonia* inoculum produced during the heavy *Rhizoctonia* year of 1993. This 1993 inoculum appears to be the source of brown patch epidemics that have grown progressively worse each year since then. In addition to high inoculum loads that began in 1993, cultural practices that have improved turf quality and density may increase the likelihood of disease. Based upon research conducted by Giesler, et. al., 1996, increased canopy density will increase brown patch incidence because heavy turf cover results in a modified microclimate that increases humidity at the leaf surface. Use of growth regulators to tighten up the canopy combined with the use of elevated nitrogen fertilization to provide solid and dense turf cover and recovery from traffic damage may therefore result in more conducive conditions for brown patch. While no one should be willing to abandon the quality improvements that these practices produce, superintendents may eventually be able to use *Rhizoctonia* predictive models to better time cultural practices, and thus avoid or decrease the likelihood of *Rhizoctonia* infections.

Solutions: In addition to adjusting the timing of cultural practices, one of the solutions to the current fairway brown patch epidemics will include the reduction of inoculum using properly timed applications of an effective fungicide. In 1997, the Fidanza model will be used to trigger field observations for active brown patch for early warning. Sprays should still be avoided until some disease is observed to ensure that sclerotia and dormant mycelia are germinating because only the actively growing fungus will be most susceptible to the fungicides. When disease has been detected, a new fungicide, Prostar 50 WP (if labeled), should provide very good control (see the research Update on brown patch control included with this issue of PACE Insights) at the maximum labeled rate of 3 oz/1000 sq ft. Due to the high residual activity of this product, a second treatment may not be necessary to control the disease and reduce inoculum for the following year.

References:

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