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Brown Patch Disease of Turgrasses Caused by Rhizoctonia solani

Philip M. Halisky and Bruce B. Clarke

Rhizoctonia solani is a ubiquitous, soil-borne, thatch-inhabiting fungus that causes unsightly, large, brown patches in turf. When the fungus was first identified as a turf pathogen, it took several years to convince golf superintendents that the disease was not caused by "spiders" and that the web-like threads could be observed in damaged turf actually were fungal mycelium. Today, brown patch disease is recognized as a major foliar disease of turfgrasses. According to a survey conducted by Gould(3), turfgrass pathologists across the United States and Canada ranked Rhizoctonia brown patch as the "number one" turfgrass disease in prevalence and severity on this continent. The host range of *Rhizoctonia solani* includes at least 130 grasses and cereals including all the major turfgrasses (1, 8).

Rhizoctonia brown patch concerns the turfgrass industry for several reasons. There is an obvious loss of aesthetic value as numerous ugly brown patches appear on a green carpet of turf during the middle of the growing season. Although the infected turf is not normally killed by the fungus, it may be severely thinned and weakened before the onset of the fall growing season. Furthermore, no highly resistant source of germplasm has been found in any of the popular turfgrasses to date (5, 9).

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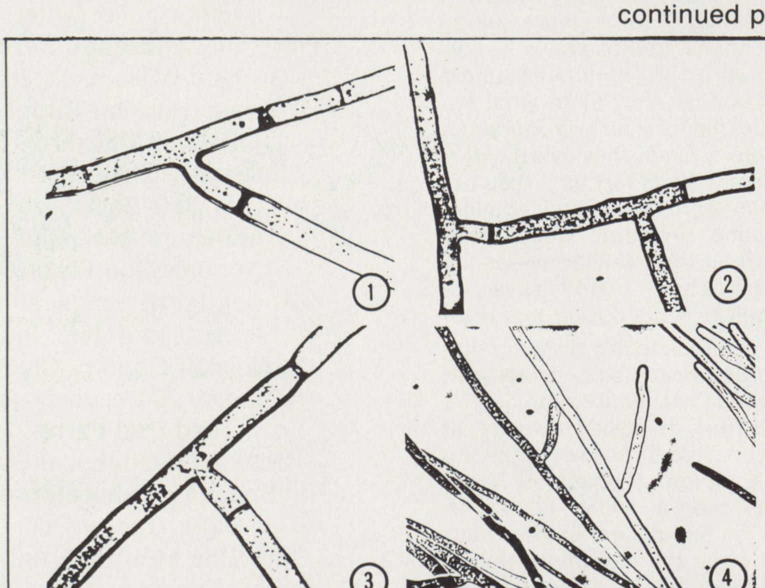

Figure 1. Hyphae of *Rhizoctonia solani* at varied magnification. For identification note: (1) Constriction at the point of union with the main hypha; (2) A septum (cross-wall) in the branch near the constriction; and (3) The mature hyphae branch at right angles to the main hypha.

ABSTRACT

Influence of Soil Compaction on Three Turfgrass Species

R. N. Carrow, Agronomy Journal, Vol. 72, November-December 1980.

The influence of soil compaction on morphological and physiological aspects of three turfgrass species (*Lolium perenne* L. "Pennfine"; *Poa pratensis* L. "Baron", *Festuca arundinacea Schreb*, "Kentucky 31") were subjected to three compaction treatments with a smooth, power roller. Zero, twelve, and twenty-four rollings per week were continued for a period of eight weeks. The site under investigtion was on a Kansas soil of fine, montmorillonitic mesic Aquic Arquidoll.

The visual quality, percentage of turf cover, and total nonstructural carbohydrate (TNC) declined for all species as compaction stress increased. Eight months after compaction ceased, tall fescue and Kentucky bluegrass still exhibited reduced visual quality and percent cover.

Shoot density, verdure, and root growth also were affected by compaction, with the response differing by species. There was increased compaction, reduced verdure, shoot density, and root growth of Kentucky bluegrass; decreased verdure for tall fescue; but perennial ryegrass exhibited no adverse effects except some reduction in root weight at the 12x treatment.

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Comments and Opinions

The 1982 Weather of June, July and August

June, July, and August of 1982 had only nine days of 90°F. temperatures or above compared with thirteen in 1981 and thirty four in 1980. Many agree that the summer of 1982 was less severe than most.

We feel assured by our experiences and reinforced in our opinions by Dr. Cole's article on high temperature effects on *Pythium* in the last issue of *Green World,* that hot summers make trouble. Despite the fact that 1982 was slightly cooler, it was a difficult year for some. Each summer brings cool-season turf near enough to disaster that any slight deviation from required watering, an unusual disease, a miscalculation on which of four or five diseases will occur, or severe mowing (which can arise several ways) cause havoc with fine turf. Of course, hot or hot-wet weather greatly increases the chance of turf loss. Therefore, take time now to review your "summer turf thinking" and be prepared to walk the narrow line again next year.

Response to Bentgrass and Soil Acidity

The April 1982 issue of *Green World* brought a response from Al Radko. Read this for his comments:

"I very much enjoy receiving *Green World* . . . it contains stimulating and interesting material, the latest of which is "Lime's Role in Turfgrass Production." I agree with your expressed role of lime in all but bentgrass culture. My observation through the years convinces me that the overuse of limestone is one of the primary reasons why so much *Poa annua* is prevalent on golf courses today. That, in my opinion, is one of the areas that needs a great deal more research.

I can emphatically state that I have observed a far better long-term bentgrass population in greens, tees and fairways where the pH was between 5.2 and 5.6 than above these readings. I don't mean to say this was the only reason for it, for we all know that it takes an excellent well-rounded program of maintenance and management to produce and keep a high percentage of bentgrass in a stand. I'm not saying apply no lime . . . but I emphatically say apply a lot less if you want to encourage and sustain an excellent bentgrass stand.

I also feel that ammonium sulfate, used wisely and sparingly, is one of the best grass toners that we have at our disposal. Used properly, ammonium sulfate gives tone and color to bentgrass greens like no product does. In the early days, the problem, in my opinion, was caused by the heavy rates and poor timing of ammonium sulfate applications. In those days, everybody was on an ammonium sulfate kick because they liked what the product did for their golf course . . . but unfortunately they overdid it . . . and lost a lot of turf as a result of these malpractices. In my opinion, the same problems would have developed from similar use of any comparable quick-release nitrogen product during that era.

To get back to the pH factor and bentgrass incidence . . . I have also observed excellent almost *Poa annua*-free bentgrass greens at pH's reported to be lower than the 5.2-5.6 range. I observed these greens over a period of several years . . . and observed them later again when the old-timers retired and young men took over and immediately raised the pH to the area of 6.5 . . . and the result was a changeover from 99.9% bentgrass to 99.9 *Poa annua* within five years. I don't say the heavy handed

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Symptoms

Under conditions of close mowing such as those practiced on putting greens, Rhizoctonia brown patch appears as irregularly shaped patches of blighted turfgrass ranging from a few inches up to two feet in diameter. These patches are usually purplish green which rapidly fades to light brown as the withered leaves dry out. Where management practices include high mowing, as on home lawns, parks, or golfcourse fairways, the disease may involve areas ranging from two-to-fifty feet in diameter. These circular patches of light brown, blighted turfgrass are ususally closely appressed to the soil surface, thus creating a sunken or "pocket effect" according to Couch (1).

The chief field diagnostic feature of Rhizoctonia brown patch is evident during periods of warm, humid weather. At these times dark, purplish "smoke rings" measuring one-half to two inches in width may border the diseased areas. These dark colored rings around the circumference of the brown patch contain the actively growing fungus. It is here that the fine, web-like mycelium of this fungus destroys the grass. Usually these "halos" are more prominent during the morning hours and may fade as the day progresses. The remaining turf in the patch appears water-soaked, wilts, and turns light brown in color. Most, but not all of the plants in the patch are killed (1).

Over the years considerable attention has been given to brown patch on bentgrass putting greens; there are several reasons. First, high economic value of the turf is significant. Second is the greater severity of the disease due to the short, frequent mowing and the high levels of soil moisture. Third is the increased susceptibility of bentgrasses, since the disease appears on putting greens in years when no other turf is visibly affected.

In contrast to the prevalence of brown patch on putting greens, coarser grasses such as tall fescue, bluegrasses, and ryegrasses are less severely injured than are bentgrasses. In New Jersey, Zjawin (10) reported that perennial ryegrass (*Lolium perenne*), infected by *Rhizoctonia solani* caused seedling blight in young stands and melting-out symptoms in mature turf. Smoke rings were seldom present. In turfgrass research plots, a web-like pattern and tufts of white mycelium were visible in early morning when the disease was severe. Brown patch development in these plots was favored by high temperature, high humidity, high nitrogen fertility, and moderately poor soil drainage (10).

Disease Cycle

Rhizoctonia solani is considered to be a fungus with "sterile mycelium" (Mycelia Sterilia) and has never been observed to produce asexual spores or conidia. It does, however, produce modified asexual structures called sclerotia, which are globular masses of hardened mycelium. These sclerotia can survive adverse periods with greater success than unprotected mycelium. The fungus exists primarily as a soil-borne saprophyte, but can become pathogenic or aestivate as sclerotia or as mycelium in plant tissues (6). During the winter months the fungus survives as sclerotia. The resumption of growth of the pathogen from the sclerotial stage occurs when air temperatures reach 64° to 68° F. Under these conditions, mycelial growth extends for only a short distance, and the sclerotium serves as a food source for the fungus.

The sclerotia are brown to blackish flattened discs of about 1/32 to 3/32 of an inch in diameter. They may be found embedded in plant tissue or they may be in the soil. The fungus also survives for long periods of time in the soil as a saprophyte, living in dead clippings or in thatch. When there is active infection, clippings which miss the catcher provide a new source of infection for four months or longer. Top dressing applied to greens may also be a source of infection. In addition, *Rhizoctonia* is seed-borne and may be sown with seed unless the seed is chemically treated. Seed-borne inoculum is especially important as seedlings are very susceptible to injury (4, 5, 9).

Rhizoctonia brown patch has been observed to occur most frequently and with greater severity on short-cut turfgrasses. This is primarily due to the more abundant and uniform supply of wound-type infection sites as a result of the frequent mowings. The fungus enters readily through cut ends of leaves. Rowell (7) found that uncut grass inoculated with *Rhizoctonia* remained fairly free of the disease while cut grass was severely damaged. The fungus enters at the tip of the cut blade, through stomata, or by penetrating the leaf directly. Moisture and guttation fluid contribute to rapid spread of the disease, the mycelium bridging from one drop to another. Guttation fluid further provides moisture and nutrients at the cut ends of leaf blades. With continuing moist, warm conditions, the disease results in a brown patch of infected plants several inches to several feet in diameter.

Madison (4) observed that the activity of *Rhizoctonia* also injures roots and causes crown infections in bluegrass turf. He was able to detect early symptoms of root infection before the appearance of brown grass. The reduced root system and attendant water stress provided clues. In the early morning, infested areas of bluegrass appeared without guttation water (dew) while surrounding grass was covered with dew. The lack of dew

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Rhizoctonia continued

Madison (4) attributed to root injury caused by *Rhizoctonia solani*. The infected areas of grass also failed to grow as rapidly after mowing as did healthy grass. Furthermore, infected areas appeared bluish or greyish due to water stress associated with root injury by the fungus.

Weather

Every greenskeeper recognizes a correlation between the appearance of brown patch and the weather. This so-called "brown patch weather" is characterized by extended periods of high temperatures and high-atmospheric humidity. In the Northeast, *Rhizoctonia* is most damaging on putting greens during hot, humid weather. In the spring with warming temperatures, the sclerotia germinate and are likely to first grow as soil saprophytes which reach a high level of activity in two-to-four days at favorable temperatures.

Dickinson (2) gave a detailed description of the response of *Rhizoctonia* on greens to temperature conditions, and offered evidence that the occurence of brown patch was predictable from weather records. When warm temperatures dropped to about 60° F, sclerotia germinated and produced short mycelium threads about half an inch in length. Growth remained static at this temperature, but if a warming trend followed, the mycelium began to grow and become infective at abut 75 - 85° F. A temperature drop to 65° F followed by a rise to 75 - 80° F could result in the appearance of a smoke ring within three hours At this stage the disease could be hindered by poling the greens in order to mechanically break up the fungus mycelium (2).

Strains

The many strains of *Rhizoctonia* may vary as to the plant infected, the severity of the disease caused, and the temperatures at which they are pathogenic. A virulent strain, however, is likely to infect several grass species and cross infection among turfgrass species by a single strain of the fungus is not unusual. Zjawin (9) evaluated the comparative virulence of fourteen collections of *Rhizoctonia solani* in New Jersey and found infection levels ranging from five to ninety-seven percent damping-off in seedlings of perennial ryegrass. Variability in pathogenicity is so extensive in *Rhizoctonia solani* that an entire volume has been compiled on the biology and pathology of this single fungus (6).

The so-called "cold temperature strain" of the brown patch fungus is a misnomer. The fungus is a different species called *Rhizoctonia cerealis* and the disease it causes is newly described as "yellow patch" rather than brown patch. The disease will be described in a following issue of *Green World*.

Control

Control of *Rhizoctonia solani* is never absolute but severity of the disease may be reduced by integrating cultural practices with fungicidal applications. It is advisable to avoid excessively high nitrogen levels by using a balanced fertilization program. Removal of dew arising from atmospheric condensation or guttation water by dragging a water hose or bamboo poles across the greens is recommended.

Brown patch was controlled for decades with mercury-based fungicides that are currently restricted. Quintozene (PCNB) is an effective chemical against *Rhizoctonia*. PCNB is a fungistat which suppresses the growth of *Rhizoctonia* in the soil. At high levels, however, PCNB may cause some yellowing in turfgrass, especially in bentgrass. Today, brown patch is controlled with both contact (protectant) and systemic fungicides. These are listed below. Contact Fungicides: Chipco 26019, Daconil, Dyrene, Terraclor (PCNB).

continued

Rhizoctonia continued

Systemic Fungicides: Bayleton, Cleary 3336, Tersan 1991, Mertect. New products are being continually evaluated and added to this list of fungicides for effective control of brown patch in turf.

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Carol Mann, golfer, on New Orleans Saints Coach Bum Phillips' crew cut: "It reminds me of a good three-wood lie."

Soil Compaction continued

The differences of compaction tolerance among the species were determined by using the growth parameters measued. With aeration porosity at -0.10 bar water content and bulk density as measures of soil compaction, visual quality rating, and percent turf cover gave the best compaction tolerance differentials among species. Species tolerance to compaction, when based on those factors, was perennial ryegrass = Kentucky bluegrass / tall fescue.

Editorial Comment

We have read reports that overseeding of the turf-type ryegrasses in some traffic areas succeeds where other cool-season grasses have failed. It is comforting when research reinforces the opinions formed through observation. This study tells us that ryegrasses have been useful on athletic fields because they tolerate more compaction as well as establish readily from seed.

ABSTRACT

Influence of Water Temperatures on the Measurement of Infiltration Rates for Sandy Sports Turf Root Zones. S. W. Baker. 1982. J. Sports Turf Research Inst. 58:21-27.

Water infiltration rates into columns of fine and coarse sand were determined at temperatures of 5 to 25°C. The rate was 70 percent higher at the warmer temperature. The increase in rate with increasing temperature was greater with coarse than with fine sand. A soil mix that gives 2.5 cm infiltration per hour in summer, with a cooler temperature of 5°C, which is appropriate for Britain's winters, will give only 1.32 cm/hour. Diurnal air temperature changes gave approximately ten percent change in water infiltration rate.

Editorial Comment

While scientists of forty years ago reported water temperature affected infiltration rate, few, if any, considered this effect on water movement into porous turf soils. The author cited a reference showing that the viscosity of distilled water essentially doubles when the temperature drops from 25 to 5°C.

Along with temperature effects, the resistance of the soil material to wetting, and the organic and inorganic impurities of water are expected to influence water infiltration rates greatly. Consider the effect of a slimy microorganism impurity on the percolation rate. With all these and other variable influences on water penetration of a sod, it is not surprising that we find it necessary to adjust turf watering procedures during the season. Also, slower infiltration can be included along with decreased evaporation as reasons for the slow drying of turf soils in our colder months.

REE

Drought and Dust Storms

Periodic dust storms have long been the hallmark of wind erosion of the Great Plains. There is evidence, however, that farmers are measurably more successful than formerly in coping with dry years of given severity. The average annual rainfall in nine Great Plains wheat states was identical, and very low, during 1930-39 and 1950-56 (20.4 and 20.7 inches). Wheat yields per seeded acre, however, differed markedly: 10.6 bushels in the '30s and 15.2 from 1952 to 1956.

Dust storms did not darken the skies of eastern cities between 1950 and 1956. Farmers were learning the art of summer fallow and less cultivation and thereby reducing the exposure of the soil to wind storms.

Agrichemical Age/June 1982

COMMENTARY:

The wheat farmer has learned that the science and art of slowing the wind velocity at the soil surface by leaving crop residue on the surface or tillage creates small ridges or depressions. Occasionally, wind erosion occurs on bare, dry, exposed, sandy New Jersey soils. Turfgrasses, except in the germinating and very young seedling stage, are good protection against wind erosion.

ABSTRACT

Injury to Poa pratensis from Repeat Applications of Elemental Sulphur

S. H. Nelson. University of Saskatchewan, Saskatchewan, Canada. J. Sports Turf Res. Inst. 58:96-99 (1982).

Elemental sulphur (90%) was used repeatedly on *Poa pratensis* L. turf at relatively high rates (440, 660, 880, 1100 and 1320 kg/ha (approximately 400-1200 lbs/acre) to control a moderately alkaline condition in a heavy-clay loam soil. The initial response was the thinning of the turf which first appeared in the third year. The data from soil samples collected at 1-150, 150-300, and 300-600 mm depths, did not explain this thinning, nor the severe injury that occurred the following spring. Two years later, surface samples just below the turf mat revealed a drastic reduction down to a pH of 3.5 as the amount of sulphur increased. The injury incurred by *Poa pratensis* from the repeated use of elemental sulphur at high rates was probably the result of a drastic lowering of pH.

Editorial Comment

You might find it interesting to reread pages 3 and 4 of the April 1982 issue of *Green World* for a review of earlier studies on turf thinning with intense soil acidity.

Radko's Letter continued

use of limestone was the only reason for this demise, but it certainly was one of the principal causes. In my view we still have a lot of research to do to work out this factor for golf courses in all states of varying soils and climate as it relates to those who desire to grow bentgrass to perfection."

Editorial Comment

I agree with most of Al's statements, but he does not mention a major long-term concern. Al, since challenging statements are the only way I hear from you, I have written a few lines for you and the readers.

Comments: The initital response of bentgrass with lowering pH from a slightly acid or alkaline soil pH was recognized in the reports that date back fifty or more years. At this early stage of pH decrease, bentgrass grows with a finer texture, more root fiber develops, and annual bluegrass often decreases. Where does this lead? The 1982 season like other years has shown us bentgrass fairway sites that are stripped of thatch and reseeded. Simply, the golf course superintendent gives up on his attempts to bring thatch under control promptly and efficiently. Certainly, he needs lime and all "tools" for thatch control. Everyone seems to agree that bentgrass failure is a much greater danger as thatch increases. Anyone who is intent on the 5.0 to 5.5 pH for bentgrass should be prepared with a good thatch control program, more watering, and a good fungicide schedule.

During the Advanced Turf Seminar in January 1982, the group was stimulated with Chet Wender's comments on acid soils for bentgrass. Soil samples submitted by Tony Grasso and tested by a commercial firm showed a pH of 6.4 for 18 green and 5.7 for 18 fairway. It seems this fairway and green are not growing with the low pH that will ultimately develop and the conditions that go with a very acid soil.