



A new *Rhizoctonia* disease of bluegrass putting greens

A new turfgrass disease has been found on annual bluegrass and rough bluegrass.

Editor's note: GCM is publishing the following article to provide the latest information on an emerging disease problem. Although this information is the best available at this time, much more research needs to be done before the disease and its management are fully understood. As additional research on this disease is completed, GCM will publish the results.

Waitea circinata var. *circinata* is a pathogen of cool-season turf that has recently increased in importance in the western, Midwestern and northeastern U.S. It has been found on annual bluegrass (*Poa annua*) and most recently on rough bluegrass (*P. trivialis*). On putting greens, the disease appears as yellow rings ranging from a few inches to a foot in diameter. As the disease progresses, rings can turn light brown to reddish brown, and turf is often slow to recover after damage has occurred.

The new disease has had a few names since being recognized as an emerging disease of bluegrass putting greens. These have included brown ring patch, *Waitea* patch and warm-temperature yellow patch.

Superficially, brown ring patch symptoms are similar to those of yellow patch. Yellow patch symptoms, however, typically occur at daytime air temperatures between 50 F (10 C) and 65 F (18.3 C) and disappear when temperatures increase above 75 F (23.9 C). Field observations suggest that brown ring patch is active at a much broader temperature range (60 F-95 F [15.6 C-35 C]).

The emergence of a 'new' disease

Waitea circinata var. *circinata* first came to our attention in late July 2003 when Melanie Larsen Nowland, then an assistant superintendent at Esmerelda Golf Course in Spokane, Wash., sent samples of yellow patch from annual bluegrass greens to the University of California–Riverside. According to Nowland, it was yellow patch that was occurring under hot weather and, more important, they were having a very hard time controlling it. "The rings just won't go away," she said, adding that multiple applications of Heritage or ProStar were not completely controlling the disease.

In 2004 and 2005, more and more superintendents in California, Oregon and Washington were complaining about widespread yellow patch in both cool and hot weather. The outbreaks were occurring any time from December to July, at maximum air temperatures of 60 F (15.6 C) to 95 F (35 C), and always on annual bluegrass. In many cases, several repeated fungicide applications were needed to suppress disease activity. By 2005, it was clear that something new was emerging.

A *Rhizoctonia*-like fungus was repeatedly isolated from these samples. In some cases, *R. zeae* (sheath and leaf spot or high-temperature brown patch) was found, but in most cases, it was something different. Characterization of the pathogen revealed two surprises. First, it was not yellow patch (*R. cerealis*) at all. Second, it was a *Rhizoctonia* species that no one recognized.



Frank P. Wong, Ph.D.
John E. Kaminski, Ph.D.

Further investigation and DNA fingerprinting of the pathogen revealed that it was *W. circinata* var. *circinata*, a *Rhizoctonia* species that was described as causing “brown ring patch” of bentgrass in Japan (5). This fungus had been described as a minor pathogen of rice in northern California in 1986 (4), and pathologists at the University of California–Davis probably had described it on turf in 1984 (1). However, its importance on turf was not recognized at the time.

In May 2006, superintendents in Ohio and other parts of the Midwest reported outbreaks of yellow rings on annual bluegrass greens. This was soon followed by reports from states in the northeastern U.S., including Connecticut, Massachusetts, New York and Rhode Island.

Although anecdotal reports suggested that symptoms similar to this new disease have been observed in the Northeast for several years, brown ring patch was first confirmed on two golf courses located in the eastern and western portion of Connecticut on May 30, 2006. Daily high temperatures ranged from 80 F (26.7 C) to 88 F (31.1 C) in the days leading up to the initial appearance of symptoms. Around this same period, several superintendents reported the appearance of what was believed to be cool-temperature brown patch on annual bluegrass putting greens. In all of these cases, samples were diagnosed by the University of Connecticut’s Turfgrass Disease Diagnostic Center as brown ring patch. By July 11, *W. circinata* var. *circinata* had been isolated from 11 golf courses in Connecticut, Massachusetts, New York and Rhode Island.

Although disease symptoms appeared throughout regions of New York and New England in a relatively short period of time, brown ring patch was not observed during the heat of the summer. However, disease symptoms reappeared in a few locations in autumn 2006 and became more widespread again in the spring and early summer 2007. Disease symptoms on golf courses in the Northeast have been relatively mild and result in more of an aesthetic decline to the putting surface. In a select number of severe cases, however, the disease caused a significant reduction in stand density as infected turfgrass within the patches collapsed.

To date, the pathogen has been confirmed as causing disease on annual bluegrass in at least 10 states (Figure 1) and recently on rough bluegrass in the California low desert. However, *W. circinata* var. *circinata* has not yet been positively confirmed as a pathogen of creeping bentgrass in the U.S.

Understanding the *Rhizoctonias*

Rhizoctonia fungi are known to cause at least



Typical yellow ring symptoms of *Waitea circinata* var. *circinata* on annual bluegrass. Photo by P. Gradoville, CGCS

four diseases of turfgrass. In the asexual state, they all look the same — nonsporulating mycelia with 90-degree branches. But in the rare, sporulating, sexual form, they can look quite different and thus have a second, sexual name. Plant pathologists call the asexual form the anamorph and the sexual form the teleomorph. The complete list of *Rhizoctonia* diseases and their names is shown in Table 1. At this time, the teleomorphic name *Waitea circinata* var. *circinata* is being used, but at the 2007 American Phytopathological Society meetings, *Rhizoctonia circinata* was proposed as the anamorphic name.

Distribution

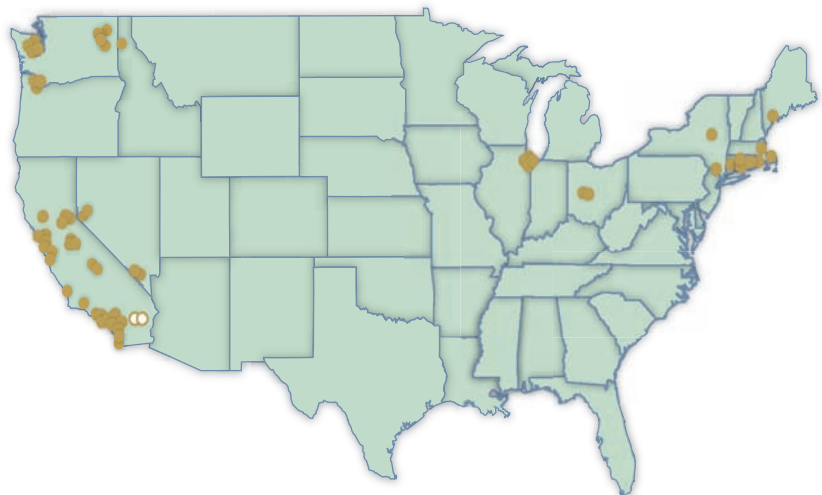
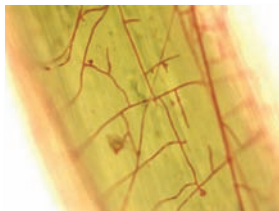


Figure 1. Approximate geographic distribution of *Waitea circinata* var. *circinata* in the U.S. from 2005 to 2007. Diagnoses from annual bluegrass are represented by gold dots and those on rough bluegrass by white dots.



Residual damage on annual bluegrass greens after fungicide treatment. The fungus has been killed, but in this case, recovery is slow. Photo by M. Wolpoff



Typical 90-degree branched mycelia diagnostic for *Rhizoctonia* fungi. This is *Waitea circinata* var. *circinata* infecting a leaf blade of annual bluegrass. The fungus has been stained red in this photo for ease of identification. Photo by F. Wong

Biology and disease cycle

Waitea circinata var. *circinata* is much like other *Rhizoctonia* species, but appears to have specific characteristics that make it difficult to control. The pathogen appears to be able to infect the upper roots, crown, stem and leaves of individual plants. It also appears to degrade thatch, giving rise to sunken rings on greens.

The disease has been diagnosed during periods of maximum air temperatures of about 60 F to 95 F (15.6 C to 35 C), but appears to cause the most damage between 65 F (18.3 C) and 85 F (29.4 C) during periods of high humidity or periods of extended leaf wetness. In controlled laboratory studies, it was capable of growing at temperatures between 50 F (10 C) and 95 F (35 C), with optimal growth occurring between 77 F (25 C) and 86 F (30 C).

Diagnosis and identification

Confirmation of the presence of the patho-



Cross-section of an area affected by *Waitea circinata* var. *circinata*. Note the yellow, degraded thatch caused by colonization by the fungus. Photo by M. Wolpoff

gen can be accomplished by a combination of observed symptoms on greens and laboratory characterization of the fungus. On annual and rough bluegrass greens, symptoms will usually be seen as thin yellow rings that can turn brown or reddish brown as the plants die. A thin green ring inside the initial ring is sometimes present and can remain after the fungus has been killed and the plants recover. Symptoms can easily be confused with those of yellow patch, fairy ring, summer patch or southern blight.

Incubation of symptomatic turf in a moist plastic container or bag will usually result in the production of profuse white mycelia on the foliage, thatch and soil. Under these very moist conditions, infected plants can collapse and take on a water-soaked appearance.



Water-soaked appearance of plants affected by *Waitea circinata* var. *circinata* after overnight incubation in a closed wet container. Note the abundant mycelia produced in the thatch and upper soil. Photo by J. Kaminski

In the laboratory, microscopic examination will show thin 6- to 9-micrometer septate hyphae without clamp connections with the characteristic 90-degree branching typical of the *Rhizoctonia* species. Isolates of the fungus will be white to buff in color with the production of white to orange bulbils (survival structures) that turn dark brown over time. Although bulbils are produced in abun-

Rhizoctonia diseases

Disease	Teleomorph name	Anamorph name	Optimal temp. range ¹	Known or common hosts ²
Yellow patch	<i>Ceratobasidium cereale</i>	<i>Rhizoctonia cerealis</i>	50 F-65 F (10 C-18.3 C)	annual bluegrass, creeping bentgrass, bermudagrass, Kentucky bluegrass, tall fescue, perennial ryegrass, zoysiagrass
Brown patch	<i>Thanatephorus cucumeris</i>	<i>Rhizoctonia solani</i>	70 F-90 F (21.1 C-32.2 C)	all cool- and warm-season species
Sheath and leaf spot	<i>Waitea circinata</i> var. <i>oryzae</i>	<i>Rhizoctonia oryzae</i>	83 F-97 F (28.3 C-36.1 C)	annual bluegrass, creeping bentgrass, bermudagrass, centipedegrass, Kentucky bluegrass, tall fescue, perennial ryegrass, St. Augustine, zoysiagrass
	<i>Waitea circinata</i> var. <i>zeae</i>	<i>Rhizoctonia zeae</i>	83 F-97 F (28.3 C-36.1 C)	
Brown ring patch, <i>Rhizoctonia circinata</i> ³	<i>Waitea circinata</i> var. <i>circinata</i>	none	77 F-86 F (25 C-30 C)	annual bluegrass, creeping bentgrass, rough bluegrass

¹Adapted from Couch 1995 and de la Cerda 2007. ²Proposed name.

Table 1. Complete list of *Rhizoctonia* diseases and their names.



Greening of turf inside yellow rings is sometimes present in affected areas. Photo by E. Ullrich

dance in culture, they are not commonly found in fresh diagnostic samples. Bulbils, however, will develop following 10 to 14 days of incubation in conditions favorable for growth of the pathogen.

Recent research and findings

Recent research at UC Riverside has focused on the identification and characterization of the new pathogen. Analysis of ribosomal DNA sequences confirmed that U.S. isolates were nearly identical to those from Japan and distinct from *Rhizoctonia* species (6).

Because many superintendents have had trouble controlling the disease with fungicides, tests were done using the active ingredients in fungicides typically used for *Rhizoctonia* control: Heritage (azoxystrobin, Syngenta), Banner MAXX (propiconazole, Syngenta), Chipco 26GT (iprodione, Bayer), Cleary's 3336 (thiophanate-methyl, Cleary's) and ProStar (flutolanil, Bayer). In this test, 20 isolates of *W. circinata* var. *circinata* were tested in vitro, using 1/4-potato dextrose agar amended with 100 ppm of the fungicides, and evaluated after 48 hours for mycelial growth. Results indicated almost complete inhibition by all fungicides except for thiophanate-methyl (Figure 2), indicating that like *R. oryzae* and *R. zeae*, the pathogen is naturally resistant to the benzimidazole fungicides.

These results were consistent with a field trial performed at Torrey Pines Golf Course in May

2006, where a single curative application of different fungicides was made to brown ring patch that developed after an application of Banner MAXX (Figure 3).

In greenhouse assays, the efficacy of several fungicides was evaluated for their ability to suppress the disease when applied preventively and curatively on 6-week-old annual bluegrass. In this

Fungicides vs. *Waitea*

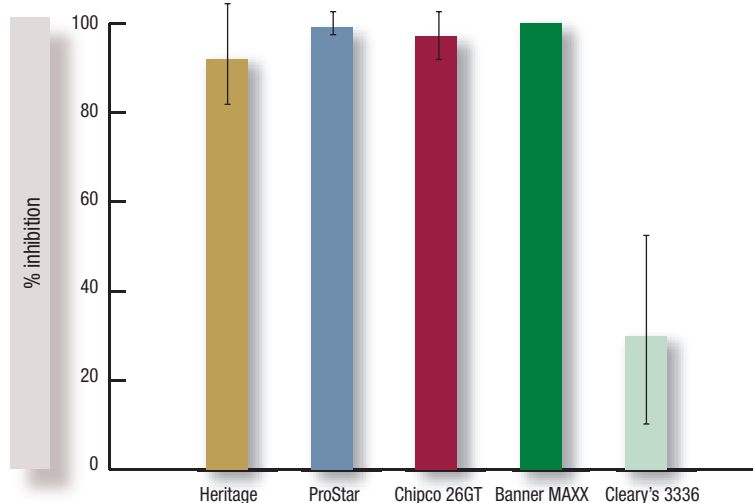


Figure 2. In vitro responses of *Waitea circinata* var. *circinata* isolates to five fungicides. Bars reflect the mean percent inhibition on 1/4-potato-dextrose-agar amended with 100 parts per million of the fungicides, compared to a control plate, for 12 isolates of the pathogen. Error bars reflect the standard deviation. Isolates were measured after 48 hours growth on the media at 82 F (27.8 C).



On a green

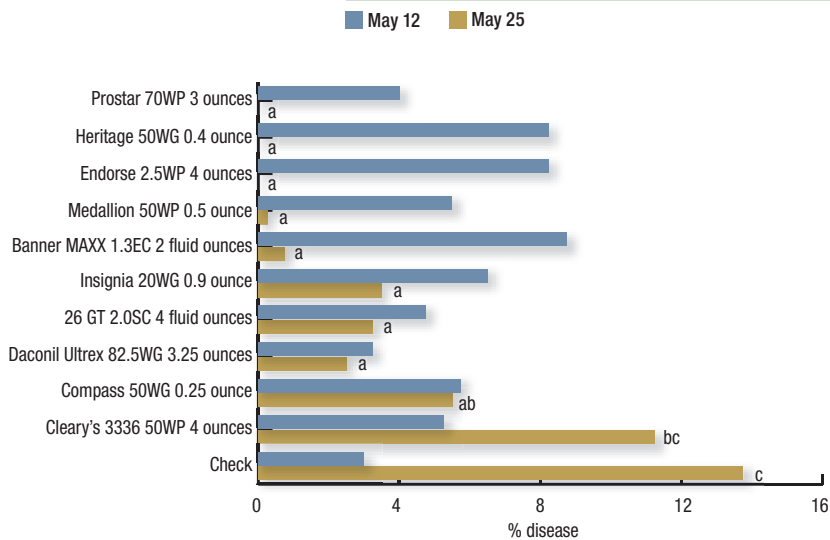


Figure 3. Controlling *Waitea circinata* var. *circinata* on an annual bluegrass putting green at Torrey Pines GC. The whole green was treated with Banner MAXX (2 fluid ounces/1,000 square feet [0.63 milliliter/square meter]) on approximately April 28. Experimental applications were made on May 12 and evaluated May 25, using an application volume of 2 gallons water/1,000 square feet (81.5 milliliters/square meter) with TeeJet 8002VS nozzles using a carbon dioxide-powered sprayer at 35 pounds/square inch (241.32 kilopascals). Each treatment was replicated four times in 6-foot × 6-foot plots on the green. Treatments were not significantly different on the initial evaluation date, May 12; means for the May 25 rating followed by the same letter are equal.

Preventive vs. curative

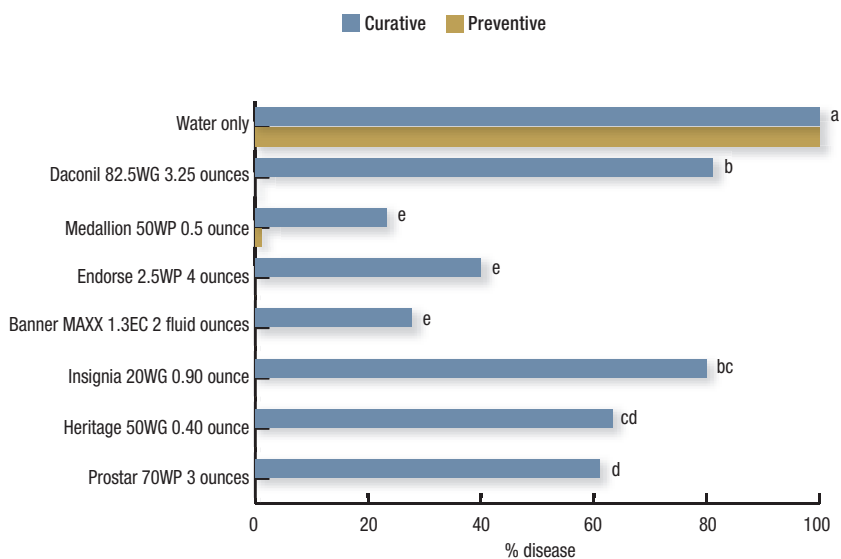


Figure 4. Preventive and curative control of *Waitea circinata* var. *circinata* in greenhouse bioassays. Six-week-old annual bluegrass in 3-inch (7.5-centimeter) pots were treated with fungicides 24 hours before or 48 hours after inoculation and incubated at 82 F (27.8 C) and 80% relative humidity. Plants were rated seven days after inoculation. All preventive treatments were significantly different from the check treatment but not from each other; means for curative rating followed by the same letter are equal.

test, fungicides were applied to plants 24 hours before inoculation (preventive) or 48 hours after inoculation (curative). Plants were incubated at 82 F (27.8 C) with 80% humidity and evaluated seven days after inoculation for disease severity (Figure 4).

Overall management

Using the limited information available, we developed several guidelines for management and control of the disease.

- The pathogen has been observed to be active between 60 F (15.6 C) and 95 F (35 C) and most active between 77 F (25 C) and 86 F (30 C).
- The presence of yellow rings under warm temperature conditions is characteristic of the disease. Samples should be sent to local pathology labs for confirmation of the presence of *W. circinata* var. *circinata* or other diseases such as summer patch, fairy ring or southern blight.
- Many fungicides labeled for control of *Rhizoctonia* — including ProStar, Heritage, Medallion, Endorse, Insignia, Daconil and Banner MAXX — have shown activity against the pathogen, but these appear to be most effective as preventive applications. Fungicides containing only thiophanate-methyl do not effectively control this pathogen.
- Because curative activity of these fungicides appears to be much less than the preventive activity, applications should be made preventively at temperatures of 77 F (25 C) to 86 F (30 C) for courses with a history of the disease, or as soon as symptoms are seen and the presence of the pathogen is confirmed. Two or more curative applications may be needed for adequate control.
- Tank-mixes of fungicides or pre-mixtures such as Headway, Instrata or Concert may be more effective than applications of a single active ingredient.
- Maintain adequate nitrogen fertility to allow for recovery after damage has occurred.
- Since the pathogen acts much like superficial fairy ring, tactics to control fairy ring also should be employed against *W. circinata* var. *circinata*. These include the use of surfactants and adequate spray volume to increase fungicide efficacy as well as thatch and organic matter management (see Fidanza et al., *GCM*, June 2007).

Conclusions

Waitea circinata var. *circinata* is a new *Rhizoctonia* species that causes brown ring patch of annual and rough bluegrass in the U.S. and creeping bentgrass in Japan. It appears to be fairly



Annual bluegrass treated with Banner MAXX, 24 hours before inoculation (left) and 48 hours after inoculation (right) with *Waitea circinata* var. *circinata*. Photo was taken seven days after inoculation and incubation of the plants at 82 F (27.8 C) and 80% humidity. Photo by F. Wong

widespread in the northern and western U.S. on annual bluegrass. Because symptoms are similar to those of other diseases, recognizing and identifying this pathogen is key for its management. Correct fungicide selection and application timing in addition to cultural practices such as thatch management are the major factors in controlling the disease.

Currently, research is being conducted to examine additional cultural practices that affect the development of the disease, in addition to work on the basic biology of the pathogen. We hope that the results from these studies will shed light on how superintendents can best combat this disease.

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Literature cited

1. Adams, G., and R.G. Grogan. 1984. A new disease of turf grass in California caused by a unique *Rhizoctonia*. *Phytopathology* 74:813.

2. Couch, H.B. 1995. Diseases of turfgrass. 3rd ed. Krieger Publishing, Malabar, Fla.
3. de la Cerda, K.A., G.W. Douhan and F.P. Wong. 2007. Discovery and characterization of *Waitea circinata* var. *circinata* affecting annual bluegrass from the western United States. *Plant Disease* 91:791-797.
4. Fidanza, M.A., F.P. Wong, S.B. Martin and S.J. McDonald. 2007. Treating fairy ring with fungicides, new soil surfactant. *Golf Course Management* 75(5):121-125.
5. Gunnell, P.S. 1986. Characterization of the teleomorphs of *Rhizoctonia oryzae-sativae*, *Rhizoctonia oryzae*, and *Rhizoctonia zeae*, and the effect of cultural practices on aggregate sheath spot of rice, caused by *Rhizoctonia oryzae-sativae*. Ph.D. dissertation. University of California, Davis.
6. Toda, T., T. Mushika, T. Hayakawa, A. Tanaka, T. Tani and M. Hyakumachi. 2005. Brown ring patch: A new disease on bentgrass caused by *Waitea circinata* var. *circinata*. *Plant Disease* 89:536-542.



Frank P. Wong (frank.wong@ucr.edu) is an assistant specialist in Cooperative Extension in the department of plant pathology and microbiology at the University of California–Riverside, and John E. Kaminski is an assistant professor in the department of plant sciences at the University of Connecticut, Storrs.

The research says

- *Waitea circinata* var. *circinata* is a new *Rhizoctonia* species that causes brown ring patch of annual and rough bluegrass in the U.S. and creeping bentgrass in Japan.
- It appears to be fairly widespread in the northern and western U.S. on annual bluegrass.
- Because symptoms are similar to those of other diseases, recognizing and identifying this pathogen is key for its management.
- Correct fungicide selection and application timing in addition to cultural practices such as thatch management are the major factors in controlling the disease.