RE|SEARCH

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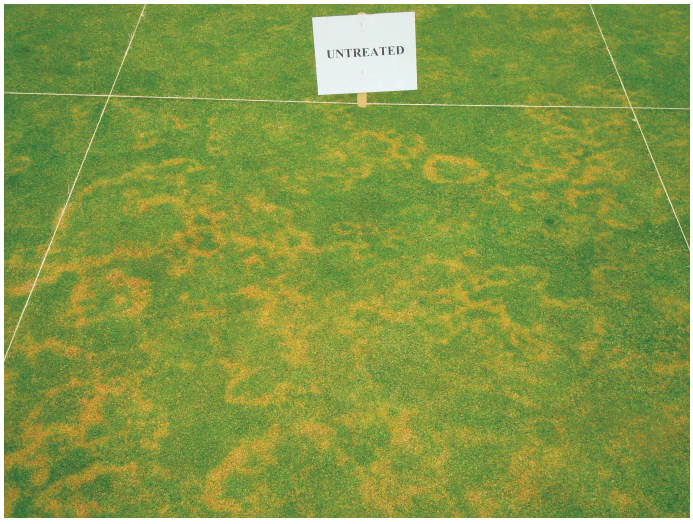
Reducing brown ring patch severity on *Poa annua* greens

Brown ring patch is similar to other *Rhizoctonia* diseases, but does not react the same way to fungicides.

Symptoms of brown ring patch start as small yellow rings with green grass in the center and can ultimately reach a few feet in diameter. The yellow rings can turn an orange or brown color as the disease progresses, and the pathogen may eventually kill affected turf. **Photos by Steve McDonald**



We have conducted joint research studies on the management of brown ring patch since 2010. From a field research perspective, this disease has been challenging to work with because it is difficult to find naturally infected putting greens with uniform disease incidence and severity. The main body of research presented in this paper comes from work conducted in 2010 and 2011 on a putting green in New Jersey that exhibited an unusually uniform distribution of brown ring patch symptoms. Additional data were obtained in 2012 and 2013 from smaller research trials on putting greens in Pennsylvania with less severe disease pressure. Brown ring patch has become an important disease of annual bluegrass (*Poa annua*) putting greens in the Northeastern region of the United States since 2007 (6).

The disease

Brown ring patch is caused by *Waitea circinata* var. *circinata* (sometimes referred to by its asexual stage *Rhizoctonia circinata* var. *circinata*) and is a serious disease of short-mowed annual bluegrass turf throughout much of the cool, humid regions of the United States. In New Jersey and much of the mid-Atlantic and Northeast regions, this disease is often observed from early spring — when annual bluegrass is breaking dormancy — through late spring. However, in cooler regions, it can be a problem during the summer when air temperatures range from 65 F to 95 F (18 C to 35 C). Although the same pathogen can also significantly damage roughstalk bluegrass (*P. trivialis*) and creeping bentgrass (*Agrostis stolonifera*) (4,6), our

Fungicide products

Fungicide	Active ingredient	Fungicide group	Manufacturer	Study years†		
				2010	2011	2013
Affirm 11.3WDG	polyoxin-D	polyoxin	Nufarm/Cleary		C, P	
Banner MAXX 1.3ME	propiconazole	DMI	Syngenta	C	C, P	
Briskway 2.7SC	azoxystrobin + difenoconzaole	QoI + DMI	Syngenta			C
Chipco 26GT 2SC	iprodione	dicarboximide	Bayer	C	C, P	
Chipco Signature 80WDG	Aluminum-tris (fosetyl-AL)	phosphonate	Bayer		C, P	
Chipco Triton Flo 3.1SC	triticonazole	DMI	Bayer	C	C, P	
Cleary 3336 4F	thiophanate-methyl	benzimidazole	Nufarm/Cleary	C	C, P	
Daconil Ultrex 82.5WDG	chlorothalonil	chloronitrile	Syngenta	C	C, P	
Endorse 2.5WP	polyoxin-D	polyoxin	Arysta	C		
Headway 1.39ME	azoxystrobin + propiconazole	QoI + DMI	Syngenta			C
Heritage TL 0.8ME	azoxystrobin	QoI	Syngenta	C	C, P	C
Medallion 50WP	fludioxonil	phenylpyrrole	Syngenta	C	C, P	
Medallion 1SC	fludioxonil	phenylpyrrole	Syngenta			C
Pentathlon 4LF	mancozeb	dithiocarbamate	SePRO		C, P	
ProStar 70WG	flutolanil	SDHI	Bayer	C	C, P	
Secure 4.17SC	fluazinam	pyridinamine	Syngenta		C, P	
Tartan 2.4SC	triadimefon + trifloxystrobin	DMI + QoI	Bayer	C	C, P	
Torque 3.6SC	tebuconazole	DMI	Nufarm/Cleary		C, P	
Torque 3.6SC + Affirm 11.3WDG	tebuconazole + polyoxin-D	DMI+ polyoxin	Nufarm/Cleary		P	
Velista 50WDG	penthiopyrad	SDHI	Syngenta		P	
Velista 50WDG + Banner MAXX 1.3MEC	penthiopyrad + propiconazole	SDHI + DMI	Syngenta		P	
Velista 50WDG + Daconil Ultrex 82.5WDG	penthiopyrad + chlorothalonil	SDHI + chloronitrile	Syngenta		P	
Velista 50WDG + Heritage 50WDG	penthiopyrad + azoxystrobin	SDHI + QoI	Syngenta		P	

†Each fungicide was applied as curative (C) or preventive (P) in each trial year.

Table 1. Fungicides tested (in alphabetical order), their active ingredients and fungicide groups, and research sites.

research with this disease was conducted exclusively on annual bluegrass.

Symptoms of brown ring patch start as small yellow rings (0.25-2 inches [0.635-5 centimeters] wide) with green grass in the center and can ultimately reach a few feet (>0.5 meter) in diameter. The yellow rings can turn an orange or brown color as the disease progresses and, in some cases, the pathogen may eventually kill affected turf. After a severe outbreak, the rings may be sunken, are extremely slow to heal and can adversely affect golf ball roll. In addition, rings of this disease often appear as a series of smaller interconnected crescents, rather than the fairly circular rings typically observed with yellow patch (*Rhizoctonia cereale*), a pattern that can often be used in the field to distinguish between these similar diseases.

Because of the destructive nature of brown ring patch, superintendents usually resort to frequent fungicide applications to manage it. In previous research, brown ring patch efficacy data from California, Virginia and Illinois demonstrated that there was variation in fungicide control depending on the number of applications made and whether treatments were applied on a preventive or curative basis (2). There have also been laboratory studies evaluating fungicide effectiveness, but few field fungicide efficacy trials have been reported in the northeastern United States. Furthermore, since brown ring patch has only recently been recognized as a disease of annual bluegrass turf, limited data are available about the impact of preventive and curative fungicide applications or the impact of post-application irrigation on fungicide performance. Because the pathogen survives in the lower canopy and thatch, fungicide placement may also affect disease control.

Earlier research

Researchers in California investigated the impact of nitrogen fertilizer source and the vegetative suppressant Primo MAXX (trinexapac-ethyl, Syngenta) on the severity of brown ring patch (5). Their research indicated that increasing fertilizer inputs (from 0.5 to 1.0 pound nitrogen/1,000 square feet [2.4 to 4.8 grams/square meter]) reduced the

Curative fungicide trial, 2010

Treatment No./name	Rate/1,000 square feet	% brown ring patch†		
		April 16	April 28	May 7
Curative treatments applied April 8, 2010				
1. ProStar 70WP	2.2 ounces	10.0 a‡	6.9 ab	14.0 bcd
2. Endorse 2.5WP	0.9 ounce	7.2 a	8.0 ab	17.0 a-d
3. Heritage TL 0.8ME	2.0 fluid ounces	7.9 a	2.8 b	1.5 d
4. Banner MAXX 1.3ME	2.0 fluid ounces	11.9 a	24.4 a	32.3 ab
5. Cleary 3336 4FL	4.0 fluid ounces	5.9 a	12.7 ab	10.6 cd
6. Daconil Ultrex 82.5WDG	3.25 ounces	9.3 a	19.1 ab	23.3 abc
7. Chipco 26GT 2SC	4.0 fluid ounces	9.4 a	11.7 ab	13.3 bcd
8. Tartan 2.4SC	2.0 fluid ounces	10.8 a	6.8 ab	13.0 bcd
9. Medallion 50WP	0.5 ounce	7.1 a	9.6 ab	8.6 cd
10. ChipcoTriton Flo 3.1SC	0.75 fluid ounce	7.8 a	6.9 ab	13.6 bcd
11. Not treated	—	18.7 a	26.1 a	35.0 a

†Percent plot area blighted by brown ring patch was rated on a scale of 0%-100%, where 0 = no disease and 100 = entire plot area blighted.
‡Means followed by the same letter are not significantly different from one another. Means were separated using Tukey's HSD test, $P = 0.05$.

Table 2. Impact of curative fungicide applications on brown ring patch disease on a predominantly annual bluegrass putting green at Fiddlers Elbow Country Club, Bedminster, N.J., 2010.

severity of brown ring patch, although this has not typically been the case with other *Rhizoctonia* diseases (3). Moreover, Primo MAXX (5 fluid ounces/acre [0.365 liter/hectare]) applied alone appeared to slightly increase disease severity when compared to the water control, but the combination of Primo MAXX and nitrogen fertilizers had no significant effect on the disease when compared to nitrogen applications alone (5). There have been no reports, however, on the impact of other plant growth regulators (PGRs) — such as Proxy (ethephon, Bayer) or Embark (mefluidide, PBI-Gordon), which are commonly used in spring to suppress annual bluegrass seedheads on greens — on this disease.

Golf course superintendents maintaining predominately annual bluegrass putting greens generally apply either Embark or a tank mixture of Proxy and Primo MAXX before seedhead formation is visible (in the "boot" stage). This stage can be identified by examining the base of the stems of annual bluegrass for swelling or bulging. A change in the stem base indicates that seedheads have begun to form. Seedhead suppressants are most effective when applied just before or at the time of swelling (1). Applying these PGRs several days after swelling has occurred or when seedheads are visible is generally less effective (1). Field observations suggest that outbreaks of brown ring patch may be enhanced by applications of these products; however, there are currently no reports in the literature to support this hypothesis.

Our research

The objectives of our research were to evaluate classes of fungicides commonly used on turf for their ability to control brown ring patch on a preventive or curative basis, to assess the impact of post-application irrigation on fungicide efficacy and to determine the impact of selected PGRs on disease severity. Two fungicides, Velista (penthiopyrad, Syngenta) and Secure (fluazinam, Syngenta), were still experimental materials when they were evaluated in our studies. Velista, which belongs to the carboxamide (succinate dehydrogenase inhibitor; SDHI) class of fungicides, is expected to reach the turfgrass market in 2014; and Secure, a contact fungicide, was brought to market in 2012. Both of these chemistries provide good to excellent control of brown patch (caused by *Rhizoctonia solani*), but their effect on brown ring patch has only recently been evaluated.

2010, 2011 and 2013 fungicide trials

General materials and methods

All of the fungicides, active ingredients, fungicide groups, manufacturers and application timings used in this study are outlined in Table 1. Our two main brown ring patch fungicide trials were conducted on the 11th green of the Meadow Course at Fiddlers Elbow Country Club in Bedminster, N.J. Turf consisted of a mixed annual bluegrass and creeping bentgrass (70:30, respectively) putting green mowed at 0.125 inch (3.2 millimeters) five days per week with a triplex reel mower. Extremely severe and uniform symptoms of brown ring patch had been observed on this green for approximately six years before our study, even though the superintendent had applied fungicides for control. Our treatments were applied in a water carrier volume of 2 gallons/1,000 square feet (81.5 milliliters/square meter) using a CO_2-pressurized boom at 38 psi (262 kpa) with 8008 EVS flat-fan nozzles. Treatment rates and application dates are shown in Tables 2 and 3. Plots were 5 feet × 5 feet (1.5 meters × 1.5 meters) and were replicated four times in a randomized complete block design. A different location of the green was used for each study. Plots were visually rated for percent symptomatic turf on a scale of 0% to 100%, where 0 = no symptoms and 100 = entire plot area blighted. Disease control was considered commercially acceptable if less than 5% of the turf area was blighted.

Methods specific to the 2010 curative fungicide efficacy study

The entire green was treated with the PGR (seedhead suppressant) Embark at 22.5 fluid ounces/acre (1.64 liters/hectare) on April 2 and 3 (total of 45 fluid ounces/acre [3.28 liters/hectare]). All fungicide treatments were applied once to a dry canopy on April 8, 2010.

2010 curative fungicide results

Brown ring patch severity was low (<10%) at the initiation of the study, but the disease was uniformly distributed throughout the trial area. It's important to note that the objective was to evaluate the effect of a single "early-curative" fungicide application on this disease. Most fungicides slowly reduced symptom severity over the study pe-

% brown ring patch, 2011

Treatment No./name	Rate/1,000 square feet	% brown ring patch†		
		April 25	May 2	May 11
Preventive treatments applied March 22, April 11 and April 25, 2011				
1. ProStar 70WP	2.2 ounces	1.00 cd‡	3.9 cd	2.5 cd
2. Affirm 11.3WDG	0.9 ounce	0.00 d	4.5 cd	4.3 cd
3. Heritage TL 0.8ME	2.0 fluid ounces	3.00 cd	3.5 cd	3.3 cd
4. Banner MAXX 1.3ME	2.0 fluid ounces	1.25 cd	14.5 bcd	15.5 cd
5. Cleary 3336 4FL	4.0 fluid ounces	37.3 ab	46.5 a	56.5 a
6. Daconil Ultrex 82.5WDG	3.25 ounces	5.0 bcd	7.3 bcd	7.3cd
7. Chipco 26 GT 2SC	4.0 fluid ounces	22.8a-d	27.3 a-d	28.8 a-d
8. Tartan 2.4SC	2.0 fluid ounces	6.3 bcd	7.0 bcd	7.0 cd
9. Medallion 50WP	0.5 ounce	3.3 cd	4.5 cd	4.5 cd
10. Chipco Triton Flo 3.1SC	0.75 fluid ounce	2.3 cd	3.3 cd	4.0 cd
11. Torque 3.6SC	0.9 fluid ounce	5.0 bcd	5.3 cd	6.0 cd
12. Pentathlon 4LF	10.0 fluid ounces	5.3 bcd	8.3 bcd	9.5 cd
13. Chipco Signature 80WDG	6.0 ounces	14.8 a-d	20.8 a-d	22.5 bcd
14. Velista 50WDG + Daconil Ultrex 82.5WDG	0.5 ounce + 3.25 ounces	9.8 bcd	10.8 bcd	9.5 cd
15. Velista 50WDG + Banner MAXX 1.3ME	0.5 ounce + 1.0 fluid ounce	8.5 bcd	11.8 bcd	12.0 cd
16. Velista 50WDG+ Heritage 50WDG	0.5 ounce + 0.2 ounce	4.0 cd	2.5 d	1.5 d
17. Velista 50WDG	0.5 ounce	5.0 bcd	10.5 bcd	13.0 cd
18. Torque 3.6SC + Affirm 11.3WDG	0.6 fluid ounce + 0.9 ounce	1.3 cd	1.5 d	2.0 d
19. Secure 4.17SC	0.5 fluid ounce	29.0 a-d	32.5 abc	33.8 a-d
Curative treatments applied April 25, 2011				
20. ProStar 70WP	2.2 ounces	25.8 a-d	19.5 a-d	15.9 cd
21. Affirm 11.3WDG	0.9 ounce	22.0 a-d	13.5 bcd	11.5 cd
22. Heritage TL 0.8ME	2.0 fluid ounces	30.5 a-d	8.0 bcd	9.0 cd
23. Banner MAXX 1.3ME	2.0 fluid ounces	18.0 a-d	18.5 a-d	21.3 bcd
24. Cleary 3336 4FL	4.0 fluid ounces	27.5 a-d	36.3 ab	51.5 ab
25. Daconil Ultrex 82.5WDG	3.25 ounces	31.5 a-d	25.0 a-d	23.5 a-d
26. Chipco 26GT 2SC	4.0 fluid ounces	26.5 a-d	25.8 a-d	27.0 a-d
27. Tartan 2.4SC	2.0 fluid ounces	45.3 a	29.8 a-d	26.5 a-d
28. Medallion 50WP	0.5 ounce	17.8 a-d	9.5 bcd	9.3 cd
29. Chipco Triton Flo 3.1SC	0.75 fluid ounce	33.0 abc	17.8 a-d	16.8 cd
30. Torque 3.6SC	0.9 fluid ounce	28.8 a-d	15.5 bcd	18.0 cd
31. Pentathlon 4LF	10.0 fluid ounces	27.8 a-d	27.5 a-d	35.5 abc
32. Chipco Signature 80WDG	6.0 ounces	22.3 a-d	22.5 a-d	25.0 a-d
33. Secure 4.17SC	0.5 fluid ounce	16.8 a-d	19.0 a-d	26.5 a-d
34. Not treated	—	28.8 a-d	46.0 a	52.3 ab

†Percent plot area blighted by brown ring patch was rated on a scale of 0%-100%, where 0 = no disease and 100 = entire plot area blighted.
‡Means followed by the same letter are not significantly different from one another. Means were separated using Tukey's HSD test, $P = 0.05$.

Table 3. Impact of preventive and curative fungicide applications on brown ring patch disease on a predominantly annual bluegrass putting green at Fiddlers Elbow Country Club, Bedminster, N.J., 2011.

Curative fungicide trial, 2013

Treatment No./name†	Rate/1,000 square feet	% brown ring patch (2013)§		
		April 25	May 1	May 15
1. Headway 1.39ME	3.0 fluid ounces	9.5a‡	3.8b	0.0b
2. Briskway 2.7SC	0.5 fluid ounce	9.5a	5.8b	0.0b
3. Briskway 2.7SC	0.725 fluid ounce	10.0a	2.3b	0.0b
4. HeritageTL 0.8ME	2.0 fluid ounces	7.0a	3.3b	0.0b
5. Medallion 1SC	2.0 fluid ounces	10.0a	2.0b	0.0b
6. Not treated		6.8a	20.5a	11.0a

†Treatments were applied on April 25 and May 9, 2013.
‡Means followed by same letter are not significantly different. Means were separated using Tukey's HSD test, $P = 0.05$.
§Percent brown ring patch was rated on a 0-100% scale, where 0 = no disease and 100 = entire plot area blighted.

Table 4. Brown ring patch as affected by curative fungicide applications on a predominantly annual bluegrass putting green in Boyertown, Pa., 2013.

riod, but no treatments provided complete control. On April 16 (8 days after application), there were no significant differences between treated and untreated plots (Table 2). By April 28 (20 days after application), only plots treated with Heritage TL (azoxystrobin, Syngenta) had less brown ring patch than the untreated control. Disease severity peaked (35% turf area affected) on May 7. On that date, all treatments, except Banner MAXX (propiconazole, Syngenta), Endorse (polyoxin-D, Arysta), and Daconil Ultrex (chlorothalonil, Syngenta), exhibited reduced disease severity compared to untreated turf. However, only Heritage TL provided acceptable control (<5% disease severity) by the end of the study.

Methods specific to the 2011 efficacy study

Preventive treatments were initiated on March 22 and were reapplied on April 11 and 25. Curative treatments were applied once (April 25) when there was 18% to 33% brown ring patch present and were therefore considered "late-curative" (rescue) treatments. The entire green was treated with Embark TO for annual bluegrass seedhead suppression in mid-April at the label rate.

2011 preventive fungicide results

Symptoms initially appeared on April 11 as orange-yellow to brown rings, 0.5-2 inches (1.3-5 centimeters) in width, and eventually ranged from 3 inches to 2 feet (7.6-61 centimeters) in diameter. Data representing the impact of preventive and curative fungicide treatments on brown ring patch are presented in Table 3. No fungicide treatments provided complete control of brown ring patch, due to the severity of the disease epidemic.

Brown ring patch severity peaked in this trial on May 11 at 52% turf area affected following a period of cool, humid and overcast weather. Turf receiving preventive fungicide treatments typically had significantly less brown ring patch than the untreated control, but this was not the case for most of the curative treatments. Preventive fungicide treatments that provided acceptable disease control throughout the study included Affirm (polyoxin-D, Cleary/Nufarm); Chipco Triton Flo (triticonazole, Bayer); Heritage TL; Medallion (fludioxonil, Syngenta); and Prostar (flutolanil, Bayer); as well as tank mixtures of Torque (tebuconazole, Cleary/Nufarm) + Affirm; and Velista + Heritage. Preventive treatments that had the highest levels of disease (that is, disease severity equivalent to the untreated control) were: Chipco 26GT (iprodione, Bayer); Chipco Signature (Aluminum-tris, Bayer); Cleary 3336 (thiophanate-methyl, Cleary/Nufarm); and Secure. From this study, it was apparent that, although these fungicides are useful for controlling other turfgrass diseases, they should not be used alone where brown ring patch pressure is high. It should also be noted that some of the fungicides in this study were not labeled for the control of brown ring patch and therefore were not expected to suppress this disease, but we felt it important to assess the disease suppressive activity of as many commonly used turfgrass fungicides as possible in this study.

2011 curative fungicide summary

No curative treatments provided acceptable control of this disease (<5% turf area infected), presumably due to the severity of the epidemic, the late timing of the curative treatments and the fact that only one application was made after symptoms appeared on April 11.

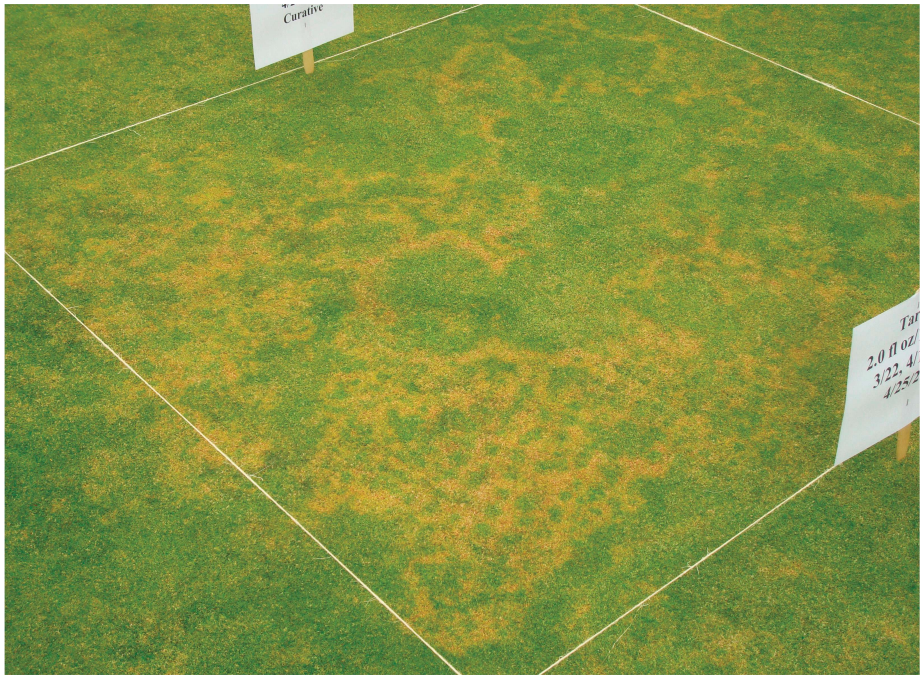
While the level of curative brown ring patch control in this trial was generally fair to poor (8% to 52% turf area blighted), Affirm, Heritage TL, Medallion and Torque had significantly less disease than untreated turf on the majority of the rating dates. It's important to note that disease severity of turf treated with late-curative applications of Banner MAXX, Cleary 3336, Chipco 26GT, Chipco Signature, Daconil Ultrex, Pentathlon (mancozeb, SePRO), Secure or Tartan was equivalent to the untreated control. Therefore, as previously mentioned, such fungicides should not be relied on as standalone treatments, especially when brown ring patch is present.

Methods specific to the 2013 efficacy study

An additional curative field trial was conducted in 2013 on an annual bluegrass research green located in Boyertown, Pa. Treatments were applied on April 25 and May 9 using the methods previously described for our 2010 and 2011 fungicide trials. The site was treated with Primo MAXX at (5 fluid ounces/acre [0.365 liter/hectare]) every 14 days from April 25 throughout the duration of the trial. Turf was mowed at 0.125 inch (3.2 millimeters) five days per week with a Toro Flex 21 hand-reel mower. Disease severity was assessed (pre- and post-treatment) as percent turf area blighted by brown ring patch using the methods previously described for our 2010 and 2011 trials. Disease control was considered commercially acceptable if less than 5% of the turf area was blighted.

The 2013 trial included two pre-mixed fungicides that were not included in our 2011 study — Briskway (azoxystrobin + difenoconazole; Syngenta) and Headway (azoxystrobin + propiconazole; Syngenta) — and were compared to Medallion as well as Heritage TL, which, in our 2010 and 2011 trials, had proven to be effective when applied on a curative basis.

Following the completion of our trials, we saw a greening response in areas that had been severely blighted. This symptom is likely due to a breakdown of organic matter (thatch) and a release of nitrogen and other nutrients resulting in enhanced greening that could be confused with Type II fairy rings.



Annual bluegrass growing in the aerification holes from the previous autumn was seemingly unaffected by brown ring patch. This could be due to several reasons, but less organic matter and improved turf quality are likely two factors.

2013 curative fungicide summary

The treatments were initiated on April 25 when brown ring patch was evenly dispersed throughout the study (7% to 10% disease), and there were no differences among the plots (Table 4). By May 1, all treatments reduced brown ring patch compared to the non-treated control (21% turf area infected). Brown ring patch severity decreased in untreated turf after May 1 with the onset of warmer air temperatures and, by May 15, complete control was observed for all fungicide treatments. Brown ring patch severity was moderate in this trial (7% to 21% in untreated turf). The data indicated that all of the fungicides tested (Briskway, Headway, Medallion SC and Heritage TL) provided acceptable disease when applied twice on a curative basis under moderate disease pressure.

Fungicide suggestions for the management of brown ring patch

To our knowledge, the 2011 trial reported here is the first to evaluate a broad range of

fungicide chemistries commonly available in the turfgrass market for both preventive and curative control of brown ring patch. These data confirm previous research showing that fungicides such as Affirm, Heritage, Medallion and ProStar, which are known to be effective against other *Rhizoctonia* diseases, also provide high levels of brown ring patch control (2). Briskway and Headway are pre-mixed fungicides that contain a DMI (difenoconazole and propiconazole, respectively) combined with azoxystrobin (the active ingredient in Heritage TL). Our data from 2013 indicate that these pre-mixes are as effective as Heritage for the control of this disease when applied curatively under moderate disease pressure.

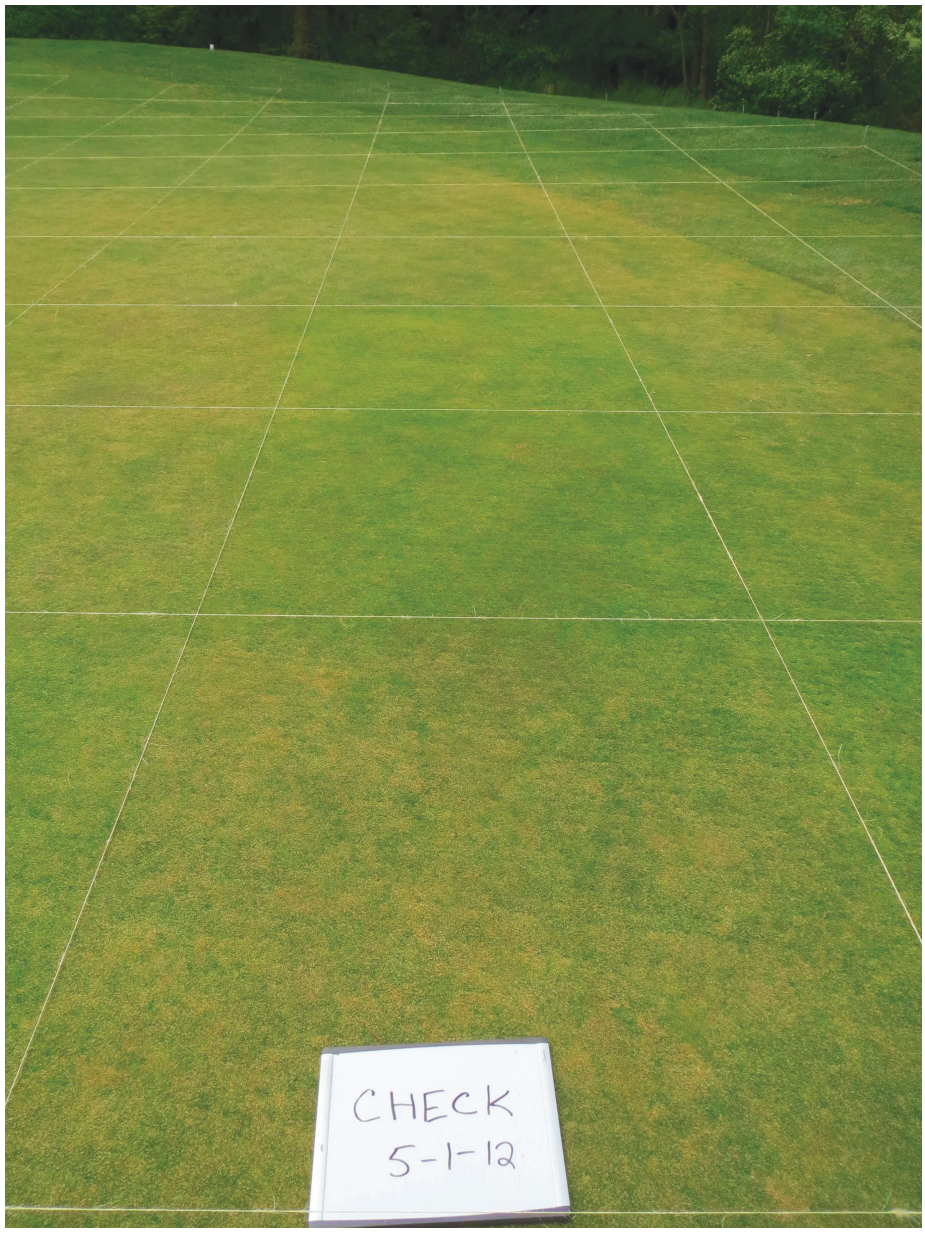
Post-application irrigation and efficacy of curative fungicide treatments, 2011

Two of the most effective fungicides in our 2011 trial, representing two different chemical classes, were selected to evaluate the effect of post-treatment irrigation on curative control of brown ring patch. Heritage TL (2 fluid ounces/1,000 square feet [0.64 milliliter/square meter]) and Chipco Triton Flo (0.75 fluid ounce/1,000 square feet [0.24 milliliter/square meter]) were applied once curatively on April 25. The study was arranged as a split-plot design (each plot had an irrigated and non-irrigated half) with four replications. Water (0.15 inch [3.81 millimeters]) was supplied to the irrigated half of each plot immediately following fungicide application (within 5 minutes) using a watering can.

Post-application irrigation improved brown ring patch control on turf treated with Chipco Triton Flo, but not Heritage TL (data not shown). Although these results are informative and suggest that post-treatment irrigation may improve brown ring patch control for some fungicide chemistries, additional research is needed before definitive statements can be made since only two products were evaluated for one year in this small pilot study.

Additional field observations

Where brown ring patch was severe in our trials, a significant degradation of thatch occurred (visual observations), especially in untreated plots. Following the completion of our trials, we also saw a greening response in areas that had been severely blighted. This has previously been reported (6) and is shown in the photo. This symptom is likely due to a breakdown of organic matter (thatch) and a release of nitrogen and other nutrients resulting in enhanced greening that could be confused with Type II fairy rings (dark green stimulated turf in a circular patch). Fungicide applications targeting these fairy ring-like symptoms would likely have no effect if the patches were caused by brown ring patch. Another interesting field observation was that annual bluegrass growing in the aerification holes from the previous autumn was seemingly unaffected by brown ring patch. This could possibly be due to deeper rooting in the aerification holes resulting in improved plant health or because fertilizer had collected in these areas and enhanced turf vigor. It is apparent from this observation that further research is needed to determine the impact of aerification and rooting on brown ring patch.



All PGR treatments resulted in better turfgrass quality when compared to the untreated control (data not shown). In the plots where seedheads were suppressed, turf remained a dark green color, and ball roll would likely have been more uniform.

Effect of spring applications of PGRs on disease severity, 2012

This small trial was conducted on the same putting green at Fiddlers Elbow Country Club as our 2010 and 2011 fungicide trials, but in

a different quadrant of the green. The PGRs Primo MAXX (5 fluid ounces/acre [0.365 liter/hectare]), Proxy (217.8 fluid ounces/acre [15.9 liters/acre]), Primo (5 fluid ounces/acre) + Proxy (217.8 fluid ounces/acre), and Embark (22 fluid ounces/acre [1.6 liters/hectare]) were evaluated for their effect on brown ring patch and seedheads, in comparison to an untreated control, at early spring application timings and rates typically used on golf courses throughout the Northeast. All treatments were applied on March 20 and April 5, 2012, and turf was maintained as described in our 2011 fungicide efficacy study above. This trial did not receive applications of any other PGR or fungicide treatments in spring 2012.

All PGR treatments resulted in better turfgrass quality when compared to the untreated control (data not shown). This was primarily due to increased seedhead formation on untreated turf resulting in a whitish-brown color that lowered visual quality estimates. Embark, Proxy alone and Primo + Proxy treatments reduced seedheads compared to untreated and Primo-treated turf on the majority of rating dates in this study (data not shown). In the plots where seedheads were suppressed, turf remained a dark green color, and ball roll would likely have been more uniform.

Although all PGRs in this study except Proxy alone exhibited "numerically" more brown ring patch (greater disease severity) than untreated turf, only turf treated with Proxy + Primo had significantly more disease than the untreated control on one rating date (data not shown). These data suggest that PGR treatments that provide a high level of annual bluegrass seedhead and foliar growth suppression during spring may intensify brown ring patch disease on annual bluegrass putting greens. However, since this study was only conducted for one year, additional research is needed before this theory can be confirmed.

Integrated management of brown ring patch

Brown ring patch is a unique turfgrass disease that does not respond to management and environmental conditions in the same way as other diseases caused by *Rhizoctonia*. Historically, many *Rhizoctonia* diseases of cool-season turf have been associated with high levels of fertility and are not known to be affected by PGRs (3). Brown ring patch thrives under a wide range of temperatures that, in some regions, can be present from March through November. Our observation that turf in aerification holes was less affected by this disease confirms some previous reports suggesting that the amount of thatch, organic matter and compaction may play a role in disease severity and control (3).

Superintendents should realize that maintaining greens under conditions of low nitrogen fertility and aggressive PGR use (high rates and/or short application intervals) to enhance playability may lead to enhanced disease pressure and an increased reliance on fungicides to manage brown ring patch on annual bluegrass greens. Therefore, when environmental conditions favor disease development, less aggressive PGR use — as well as adequate irrigation, nitrogen fertility and fungicide applications — should be used to reduce the potential for severe brown ring patch epidemics.

If PGRs are being used to suppress seedheads in early spring and the course has had a history of this disease, it would be prudent to make preventive applications of one of the fungicides found to be effective in this and other studies. Since fungicides are still strongly relied on for brown ring patch management, selection of effective products is important because many of the fungicides commonly used on golf courses are not effective against this disease. Moreover, if brown ring patch becomes active, superintendents should not expect rapid symptom remission because research has shown that it typically takes 14-21 days or more for significant recovery to occur. Repeated fungicide applications on a 14-day interval and increased nitrogen applications will aid in recovery if conditions remain conducive for disease development.

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The RESEARCH SAYS

- Limited data are available on the effect of preventive versus curative fungicide applications, post-treatment irrigation and PGR use on the severity of brown ring patch.
- Preventive fungicides that provided acceptable disease control included Affirm, Chipco Triton Flo, Heritage TL, Medallion and Prostar, as well as tank mixtures of Torque + Affirm and Velista + Heritage.
- Curative fungicide treatments did not always provide acceptable control of brown ring patch.
- Post-application irrigation appeared to improve curative disease control when Chipco Triton Flo (but not Heritage TL) was applied, and turf treated with Proxy + Primo had greater brown ring patch severity than the untreated control; however, additional research is needed to confirm these observations and to more fully understand the impact of post-treatment irrigation and PGRs on this disease.

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