



Chemical control of brown ring patch

Results from three trial locations show that some fungicides on the market provide control of brown ring patch disease.



Brown ring patch is an emergent problem on annual bluegrass (*Poa annua*) and roughstalk bluegrass (*Poa trivialis*) greens in the U.S. (1,2,4). Although the disease is caused by a *Rhizoctonia* pathogen (*Waitea circinata* var. *circinata*), little information is available about the effectiveness of fungicides for controlling it. Brown ring patch tends to occur in spring and summer over a broad range of temperatures (maximum daytime temperatures of 65 F-95 F [18 C-35 C]), initially causing small yellow rings that can expand and turn brown and sunken. Recent work has shown that brown ring patch is closely related to *Rhizoctonia* species that cause leaf and sheath spot or high-temperature brown patch (*R. oryzae* and *R. zeae*), but it is distinct from other *Rhizoctonia* diseases. Brown ring patch is likely to have been present for a long time in the U.S., but because of its symptoms it may have been diagnosed previously as other diseases. For example, in the West, the pathogen had been detected from putting greens in 1986, but was often mistaken for yellow patch (*R. cerealis*). In the Chicago area, Randy Kane, Ph.D., the Chicago District Golf Course Association's plant pathologist, observed the disease and thought it was a variant of leaf and sheath spot (*R. zeae*). However, yellow patch is a low-temperature (<65 F [<18 C]) disease, and leaf and sheath spot are high-temperature (>90 F [32 C]) diseases.

Previous studies have shown brown ring patch to be more severe on low-nitrogen fertility greens (3). Early treatment of the disease with effective fungicides appears to be an important aspect to minimizing its impact on annual and roughstalk

bluegrass greens. Some superintendents have reported a wide range of effectiveness for fungicides typically used against *Rhizoctonia* diseases such as brown patch (*R. solani*). Some of the most common complaints include the tendency of the disease to persist after curative applications and the need for multiple applications for complete control.

In order to provide superintendents with timely information on the best fungicide options for the control of this disease, results were gathered from three study sites in Virginia, Illinois and California. Although much still needs to be understood about controlling brown ring patch, we hope the information presented here will shed some light on effective fungicides and application practices that can help superintendents manage this disease.

Experimental design

Research was conducted at three locations in 2008 on native-soil, push-up style putting greens dominated by annual bluegrass: Reston, Va. (S. McDonald, Turfgrass Disease Solutions LLC); North Barrington, Ill. (D. Settle, Chicago District Golf Association); and La Jolla, Calif. (C. Chen and F. Wong, University of California—Riverside; L. Stowell, Pace Turfgrass Research Institute). All fungicide treatments were applied to greens after brown ring patch symptoms had appeared. (See Table 1 for a complete list of the treatments.) At all locations, the presence of *Waitea circinata* var. *circinata* was confirmed by laboratory analyses. Experimental treatments



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Trial products

| Fungicide | Active ingredient | Fungicide group | Manufacturer | Study sites* | | |
|-------------------------|--|-------------------------------------|-----------------|--------------|----|----|
| | | | | CA | IL | VA |
| 3336 Plus 2F | thiophanate-methyl | benzimidazole | Cleary Chemical | | | x |
| Banner Maxx 1.3 MEC | propiconazole | DMI | Syngenta | x | x | x |
| Chipco 26 GT 2SC | iprodione | dicarboximide | Bayer | x | | x |
| Chipco Triton Flo 3.1SC | triticonazole | DMI | Bayer | x | x | |
| Compass 50WG | trifloxystrobin | DMI | Bayer | | | x |
| Concert 4.3SE | chlorothalonil + propiconazole | chloronitrile + DMI | Syngenta | x | | x |
| Daconil Ultrex 82.5WG | chlorothalonil | chloronitrile | Syngenta | x | x | x |
| Disarm 480SC | fluoaxastrobin | QoI | Arysta | x | | x |
| Emerald 70WG | boscalid | carboxin | BASF | x | | |
| Endorse 2.5WP | polyoxin-D | polyoxin | Cleary Chemical | x | | x |
| Headway 1.39EC | azoxystrobin + propiconazole | QoI + DMI | Syngenta | x | | x |
| Heritage 50WG | azoxystrobin | QoI | Syngenta | x | x | |
| Heritage TL 0.8ME | azoxystrobin | QoI | Syngenta | x | | x |
| Insignia 20WG | pyraclostrobin | QoI | BASF | x | x | x |
| Instrata 3.6SE | chlorothalonil + fludioxonil + propiconazole | chloronitrile + phenylpyrrole + DMI | Syngenta | x | | x |
| Medallion 50WP | fludioxonil | phenylpyrrole | Syngenta | x | | x |
| ProStar 70WG | flutolanil | carboxin | Bayer | x | x | x |
| Renown 5.16SC | azoxystrobin + chlorothalonil | QoI + chloronitrile | Syngenta | x | | |
| Tartan 2.4SC | triadimefon + trifloxystrobin | DMI + QoI | Bayer | x | | x |
| Tourney 50WG | metconazole | DMI | Valent | x | | x |
| Trinity 1.69SC | triticonazole | DMI | BASF | x | | x |

*Study sites are: Torrey Pines Golf Course, La Jolla, Calif.; Biltmore Country Club, North Barrington, Ill.; and Reston (Va.) National Golf Course. x, tested in trials performed at location, either as a stand alone or in combination with other fungicides.

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

were made using CO₂-powered backpack sprayers, with Tee-Jet flat-fan nozzles, in an application volume of 2 gallons of water/1,000 square feet (81.5 milliliters/square meter).

Reston, Va.

The trial in Virginia was conducted on the No. 13 green at Reston (Va.) National Golf Course, which received daily play during the study. The site is a native push-up green comprising approximately 65%-70% annual bluegrass mixed with creeping bentgrass; it has a soil pH of 6.2. The green was mowed once a week during early March, and mowing frequency increased to four times weekly beginning the last week of March. Beginning in April, the green was mowed daily at 0.135 inch (0.34 centimeter). The last fungicide application to this green before the experimental treatments began was Emerald (boscalid) at 0.13 ounce/1,000 square feet (41.4 milliliters/hectare) in early December. Proxy (ethephon, 6 fluid ounces/1,000 square feet [1.9 milliliters/square



Symptoms of brown ring patch at Reston (Va.) National GC on a mixed annual bluegrass and creeping bentgrass green. Photo by S. McDonald



meter]) and Primo Maxx (trinexapac-ethyl, 6 fluid ounces/acre [438.5 milliliters/hectare]) were tank-mixed and applied on March 21 and April 11 to control *Poa annua* seedheads.

Disease activity was noted on Dec. 11, 2007. Four fungicide applications were made on Feb. 8, March 19, and April 2 and 27, 2008. For each treatment, three randomized and replicated 2.5-foot ' 6-foot (0.76-meter ' 1.8-meter) plots were used per treatment. Percent plot area blighted was assessed visually on a 0% to 100% scale.

North Barrington, Ill.

Fungicides were evaluated on an established putting green with a history of brown ring patch at Biltmore Country Club. The green consisted of 70% to 90% annual bluegrass mixed with creeping bentgrass and received daily play during the study. This study used a 6-foot ' 50-foot (0.76-meter ' 15-meter) strip where Daconil Ultrex had been applied at 1.8 ounces/1,000 square feet (0.55 gram/square meter) on May 7. Brown ring patch symptoms first occurred on May 20. The turf was mowed six days a week at 0.110 inch (2.8 millimeters) and fertilized with 3 pounds of nitrogen/1,000 square feet (14.6 grams/square meter) during the season. Fungicides were applied once on May 22 to individual 4-foot ' 3-foot (1.2-meter ' 0.9-meter) plots arranged in a randomized complete block design with three replications per treat-

ment. Plots were rated 11 and 18 days after application. Disease symptoms were visually evaluated as percent plot area affected and number of rings per plot.



Widespread symptoms of brown ring patch at Torrey Pines GC on the No. 4 green of the North Course in May 2008. Photo by L. Stowell



Evaluation of fungicide effectiveness at Biltmore CC in North Barrington, Ill. Photo by D. Settle

La Jolla, Calif.

Experiments were conducted on greens No. 3, No. 5 and No. 6 on the North Course at Torrey Pines Golf Course. Greens were approximately 80% annual bluegrass and 20% creeping bentgrass and mowed three times per week at 0.150 inch. No fungicide or fertility applications had been made to the green since early March, when

Control with repeated fungicide applications, Virginia

| Treatment and rate/1,000 square feet | Disease severity (%) | | | | | | | AUDPC† |
|--------------------------------------|----------------------|--------|-------|--------|--------|--------|--------|--------|
| | Mar 5 | Mar 19 | Apr 2 | Apr 11 | Apr 21 | Apr 29 | May 13 | |
| Heritage 0.8ME TL 2.0 fluid ounces | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| Tartan 2.4SC 2.0 fluid ounces | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| Headway 1.39EC 3.0 fluid ounces | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| ProStar 70WG 3.0 ounces | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| Insignia 20WG 0.9 ounce | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| Disarm 480SC 0.36 fluid ounce | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 0.0c |
| Tourney 50WG 0.37 ounce | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.7c | 0.7c |
| Concert 4.3SE 5.4 fluid ounces | 0.0c | 1.7e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 1.7c |
| Endorse 2.5WP 4.0 ounces | 1.7bc | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 1.7c |
| Banner Maxx 1.3ME 2.0 fluid ounces | 0.0c | 0.0e | 0.0c | 0.0b | 0.0d | 0.0c | 1.7c | 1.7c |
| Compass 50WG 0.25 ounce | 0.7c | 2.3de | 0.0c | 0.0b | 0.0d | 0.0c | 0.0c | 3.0c |
| Trinity 1.69SC 2.0 fluid ounces | 0.0c | 1.7e | 0.0c | 0.0b | 0.0d | 0.0c | 2.0c | 3.7c |
| Instrata 3.6SE 6.0 fluid ounces | 0.0c | 3.3cde | 0.0c | 0.0b | 2.0cd | 0.0c | 0.0c | 5.3c |
| Daconil Ultrex 82.5WG 3.2 ounces | 0.0c | 1.7e | 0.0c | 0.0b | 0.0d | 3.0c | 1.3c | 6.0c |
| Medallion 50WP 0.3 ounce | 0.0c | 0.0e | 0.0c | 0.0b | 2.7cd | 4.7c | 0.7c | 8.1c |
| Chipco 26 GT 2SC 4 fluid ounces | 0.0c | 3.3cde | 0.0c | 0.0b | 6.3bcd | 1.7c | 0.0c | 11.3c |
| 3336 Plus 2F 4.0 fluid ounces | 3.0b | 6.3bcd | 4.0bc | 0.0b | 13.7ab | 17.7b | 25.3b | 70.0b |
| Untreated control | 15.3a | 19.0a | 26.3c | 26.0a | 22.0a | 35.0a | 41.7a | 185.3a |

*Fungicides applied on Feb. 8 and 19, March 19, and April 2 and 27, 2008. Plots were rated from 0% to 100% for disease severity. Values are the average of three replicated plots, and means followed by the same letter are statistically equivalent.

†AUDPC (area under the disease progress curve) values based on the sum of disease from March 5 to May 13.

Table 2. Control of brown ring patch with repeated fungicide applications in Reston, Va.



greens were taken out of play because they were being prepared for the 2008 U.S. Open. Brown ring patch was observed in the first, second and last week of April on greens No. 3, No. 5 and No. 6, respectively. A single fungicide application was made to green No. 3 on April 18 and to green No. 5 on April 25, using four 6-foot ' 6-foot (1.8-meter ' 1.8-meter) replicated plots per treatment. On green No. 6, two applications were made, either on a 14- or 21-day interval, to 4-foot ' 6-foot (1.2-meter ' 1.8-meter) plots, using four replicated plots per treatment. Disease severity was visually evaluated on a 0 to 10 scale, where 0 is no disease and 10 is 100% of the plot area is diseased.

Results

Reston, Va.

At the Reston site, almost all fungicide treatments (except Cleary's 3336 Plus, thiophanate-methyl) provided near-complete control of disease when applied four times over the evaluation period. The AUDPC (area under the disease progress curve) data indicate that all fungicide treatments reduced brown ring patch symptoms when compared to the untreated control (Table 2). Of the fungicide-treated plots, the highest AUDPC was in plots treated with Cleary's 3336 Plus followed by Chipco 26 GT 2SC. Therefore, these two fungicides may not provide acceptable control of brown ring patch under heavy pressure. Plots treated with Heritage TL, Tartan, Headway, ProStar, Insignia, Disarm, Tourney and Concert had an AUDPC value of 0.0, indicating that there was no brown ring patch activity in those plots. It was not surprising that Cleary's 3336 Plus (thiophanate-methyl) did not provide much control given the natural tolerance of *W. circinata* var. *circinata* to this fungicide and historical lack of control with it (4).

North Barrington, Ill.

In the Illinois trial, all fungicides provided significant control of the disease when a single curative application was made on May 22 (Table 3). Although the contact fungicide Daconil (chlorothalonil) reduced the disease, it was apparent by the June 9 evaluation date that fungicides that had more systemic properties provided better control than the contact fungicide alone. Turf quality also appeared to be better when a systemic material was used.

La Jolla, Calif.

In the No. 5 green trial in La Jolla, disease in untreated plots increased from a mean rating of

Brown ring patch control, Illinois

| Treatment and rate/ 1,000 square feet | June 3* | | | June 9* | | | AUDPC [¶] |
|---|----------------|------------------|----------------------|----------------|------------------|----------------------|--------------------|
| | % [†] | No. [‡] | Quality [§] | % [†] | No. [‡] | Quality [§] | |
| Untreated control | 38.3a | 8.3a | 4.0e | 31.7a | 12.7a | 4.7e | 63.3a |
| Daconil Ultrex 82.5WG 3.2 ounces | 11.7b | 3.0b | 6.0dc | 18.3b | 7.7b | 5.7d | 23.0b |
| Insignia 20WG 0.9 ounce | 16.7b | 4.3b | 5.7de | 3.0c | 2.3c | 7.3c | 21.7b |
| ProStar 70WG 2.2 ounces + Chipco Triton Flo 0.55 fluid ounce | 5.0b | 2.0b | 7.7abc | 0.0c | 2.3c | 9.0a | 13.3b |
| Banner Maxx 1.3ME 2.0 fluid ounces | 4.3b | 3.7b | 6.3bcd | 2.3c | 0.3c | 7.0c | 9.7b |
| Heritage 50WG 0.4 ounce | 2.3b | 1.3b | 8.0ab | 0.3c | 0.3c | 8.3ab | 9.2b |
| Chipco Triton Flo 3.1SC 0.55 fluid ounce | 2.0b | 1.0b | 7.0a-d | 0.3c | 0.0c | 7.7bc | 4.7b |
| ProStar 70WG 4.4 ounces | 1.3b | 0.7b | 8.7a | 0.0c | 0.0c | 9.0a | 4.3b |
| ProStar 70WG 2.2 ounces | 1.7b | 1.3b | 7.7abc | 0.0c | 0.0c | 8.7a | 4.2b |

*A single fungicide treatment was made May 22. Values are means of three replicates. Means followed by the same letter in a column are not significantly different.

†Disease severity was assessed by visually estimating the percentage of infected area plot.

‡The number of rings per plot.

§Turf quality was scored visually on a scale of 0 to 9, where 9 is best, 0 is worst, and 6 is acceptable turf quality.

¶AUDPC (area under the disease progress curve) summarizes ring percent per plot on three dates; May 22, June 3 and June 9.

Table 3. Control of brown ring patch in North Barrington, Ill., using a single curative fungicide application.

Single-application control of brown ring patch, California

| Treatment and rate/1,000 square feet | Disease severity [*] | | | | | | AUDPC [†] |
|--|-------------------------------|--------|--------|--------|--------|--------|--------------------|
| | Apr 25 | May 2 | May 9 | May 16 | May 23 | May 30 | |
| Untreated control | 6.5 | 7.3a | 5.3a | 3.3abc | 2.3cde | 2.0b-e | 20.0ab |
| Chipco 26GT 2SC 6.0 fluid ounces | 5.3 | 5.5abc | 4.5ab | 4.8a | 4.3ab | 2.0b-e | 21.0a |
| Disarm 480SC 0.27 fluid ounce + Daconil Ultrex 82.5WG 2.6 ounces | 6.3 | 5.8abc | 2.8cd | 3.3abc | 4.3ab | 3.8ab | 19.8abc |
| Disarm 480SC 0.36 fluid ounce | 4.8 | 4.5bcd | 3.3bcd | 3.5abc | 4.3ab | 3.5ab | 19.0abc |
| Concert 4.3 SE 6.0 fluid ounces | 6.8 | 4.3bcd | 2.3de | 3.3abc | 3.5abc | 3.0abc | 16.3a-d |
| Heritage TL 0.8ME 1.0 fluid ounce | 5.0 | 3.8cde | 1.1e-i | 2.3cd | 4.0abc | 4.8a | 15.9a-d |
| Emerald 70WG 0.18 ounce | 6.5 | 5.3abc | 2.5de | 2.3cd | 3.0a-d | 2.3bcd | 15.3a-e |
| Insignia 20WG 0.90 ounce | 5.5 | 4.5bcd | 2.3de | 2.5bcd | 3.0a-d | 2.5bc | 14.8b-e |
| Banner Maxx 1.3 MEC 2.0 fluid ounces | 6.5 | 5.0abc | 1.8d-h | 2.0cde | 2.5b-e | 2.0b-e | 13.3c-e |
| Chipco Triton Flo 3.1SC 0.55 fluid ounce | 6.3 | 6.8ab | 1.9d-g | 1.5def | 1.5def | 0.5def | 12.1d-g |
| Headway 1.39EC 2.0 fluid ounces | 5.5 | 2.3de | 0.6f-i | 1.4def | 3.0a-d | 2.3bcd | 9.5e-h |
| Endorse 2.5WP 4.0 ounces | 4.3 | 1.3e | 0.5ghi | 1.3def | 2.3cde | 2.5bc | 7.8fgh |
| ProStar 70WG 4.4 ounces | 7.0 | 6.3abc | 0.3hi | 0.0f | 0.0f | 0.0f | 6.5gh |
| ProStar 70WG 2.2 ounces | 6.5 | 5.0abc | 0.5ghi | 0.0f | 0.0f | 0.3ef | 5.8h |
| Chipco Triton Flo 3.1SC 0.55 fluid ounce + ProStar 70WG 2.2 ounces | 6.8 | 4.8a-d | 0.3hi | 0.0f | 0.0f | 0.0f | 5.0h |

*Disease severity was measured on a 0 to 10 scale, where 10 means 100% of the plot area is covered by disease symptoms. Means followed by the same letters are statistically equal.

†AUDPC (area under disease progress curve) values are based on the sum of disease ratings from May 2 to May 30, calculated individually for each plot.

Table 4. Control of brown ring patch in La Jolla, Calif., using a single curative fungicide application.



Control with DMI fungicides, California

| Treatment and rate/1,000 square feet | Disease severity* | | | | | | AUDPC† |
|--|-------------------|--------|--------|-------|--------|--------|---------|
| | Apr 18 | Apr 25 | May 2 | May 9 | May 16 | May 23 | |
| Untreated control | 3.8 | 5.3a | 6.0ab | 5.3a | 4.0a | 3.8abc | 28.0a |
| Banner Maxx 1.3MEC 2.0 fluid ounces | 4.3 | 2.5bc | 1.3c | 1.5b | 2.0b | 2.8bc | 14.3b |
| Instrata 3.6SE 6.0 fluid ounces | 3.3 | 2.3bcd | 1.0cd | 0.6bc | 2.0b | 2.8bc | 11.9bc |
| Medallion 50WP 0.33 fluid ounce + Banner Maxx 1.3MEC 1.0 fluid ounce | 4.5 | 1.5cd | 0.0e | 0.4bc | 1.0bc | 3.3abc | 10.6bcd |
| Chipco Triton Flo 3.1SC 1.1 fluid ounces | 5.0 | 3.0bc | 0.5cde | 0.0c | 0.5bc | 0.3d | 9.3cde |
| Headway 1.39EC 2.0 fluid ounces | 4.3 | 0.8d | 0.0e | 0.4bc | 1.5bc | 2.3c | 9.1cde |
| Tourney 50WG 0.4 fluid ounce | 5.5 | 3.0bc | 0.0e | 0.0c | 0.0c | 0.0d | 8.5cde |
| Trinity 1.69SC 2.0 fluid ounces | 4.3 | 3.3b | 0.3de | 0.1c | 0.3 | 0.0d | 8.1cde |
| Insignia 20 WG 0.5 fluid ounce + Trinity 1.69SC 1.0 fluid ounces | 4.0 | 3.3b | 0.0e | 0.0c | 0.3c | 0.0d | 7.5cde |
| Chipco 26 GT 2SC 4.0 fluid ounces + Chipco Triton Flo 3.1SC 0.55 fluid ounce | 4.8 | 2.0bcd | 0.0e | 0.0c | 0.3c | 0.0d | 7.0de |
| ProStar 70WG 2.2 fluid ounces + Chipco Triton Flo 3.1SC 0.55 fluid ounce | 4.3 | 2.0bcd | 0.0e | 0.0c | 0.0c | 0.0d | 6.3de |
| Endorse 2.5WP 4.0 fluid ounces + Banner Maxx 1.3MEC 1.0 fluid ounce | 4.5 | 0.8d | 0.0e | 0.0c | 0.0c | 0.5d | 5.8e |

*Values reflect the mean of four replicated plots per treatment rated on a scale of 0 to 10 for disease severity, where 10 means 100% of the plot area is covered by disease symptoms. Means followed by the same letter are statistically equivalent.
 †AUDPC (area under the disease progress curve) values are based on the sum of disease ratings from April 18 to May 23, calculated individually for each plot.

Table 5. Control of brown ring patch with DMI fungicides and DMI fungicide tank mixes using a single curative application in La Jolla, Calif.

Two curative fungicide applications, California

| Treatment and rate/1,000 square feet | Disease severity* | | | | |
|---|-------------------|--------|--------|--------|--------|
| | May 2 | May 9 | May 16 | May 23 | May 30 |
| Untreated control | 4.0 | 4.3a | 4.5a | 4.3a | 4.0a |
| Renown 5.16SC 2.5 fluid ounces | 4.0 | 2.8bcd | 1.5c | 0.0c | 0.0c |
| Renown 5.16SC 4.5 fluid ounces | 4.8 | 2.0cde | 1.3c | 0.0c | 0.0c |
| Renown 5.16SC 2.5 fluid ounces† | 4.5 | 1.8de | 1.5c | 1.3bc | 0.0c |
| Renown 5.16SC 4.5 fluid ounces† | 4.8 | 1.8de | 1.3c | 1.0bc | 0.0c |
| Heritage 50WG 0.20 ounce + Daconil Ultrex 82.5WG 2.0 ounces | 4.8 | 2.3cde | 1.3c | 0.0c | 0.0c |
| Headway 1.39EC 1.5 fluid ounces | 4.5 | 1.3e | 1.0c | 0.0c | 0.0c |
| Tartan 2.4SC 1.0 fluid ounce | 4.5 | 3.3abc | 3.0b | 2.0b | 1.3b |
| Concert 4.3SE 3.0 fluid ounces | 4.8 | 3.8ab | 2.8b | 2.0b | 0.5c |

*Disease severity was measured on a 0 to 10 scale, where 10 means 100% of the plot area is covered by disease symptoms. Means followed by the same letters are not significantly different.
 †Applied at a 21-day interval; all other treatments were applied at a 14-day interval.

Table 6. Control of brown ring patch in La Jolla, Calif., using two curative fungicide applications.

6.5 to 7.3 from April 25 to May 2, but from May 2 to May 30, disease decreased to a mean rating of 2.0 as the expanding rings coalesced. Similar decreases in disease in other treated plots were observed over the course of the study (Table 4).

Based on AUDPC values measuring the sum of disease over the five-week evaluation period, plots treated with Chipco 26 GT, Disarm, Disarm + Daconil Ultrex, Concert, Emerald and Heritage were statistically equivalent to the untreated control when used at the rates given in Table 4. Headway, Endorse, ProStar (both rates), ProStar + Chipco Triton Flo, Banner Maxx and Chipco Triton appeared to be the most effective.

Some fungicides appeared to provide faster curative control than others. For example, Headway and Endorse provided the most control on May 2, seven days after application. Other treatments, such as ProStar, provided 14% to 32% control at seven days after application for the 2.2- and 4.4-ounce rates, respectively, but 93% and 96% control at 14 days after application. Chipco Triton + Prostar provided 34% control seven days after application and 96% control 14 days after application.

A curative application was made to the No. 3 green on April 18. Disease in the untreated control



plots increased from a rating of 3.8 on April 18 to a maximum of 6.0 on May 2 and decreased to 3.8 by May 23 (Table 5). Based on AUDPC values, Headway, Tourney, Trinity, Insignia + Trinity, Chipco Triton, Chipco 26GT + Chipco Triton Flo, ProStar + Chipco Triton Flo, and Endorse + Banner Maxx all provided the best control at the rates tested over the five-week period. In this trial, Headway, Chipco 26GT + Chipco Triton Flo, ProStar + Chipco Triton Flo, and Endorse + Banner Maxx provided the highest amount of control seven days after application. As described above, some fungicides took 14 days after application to provide nearly complete control of the disease.

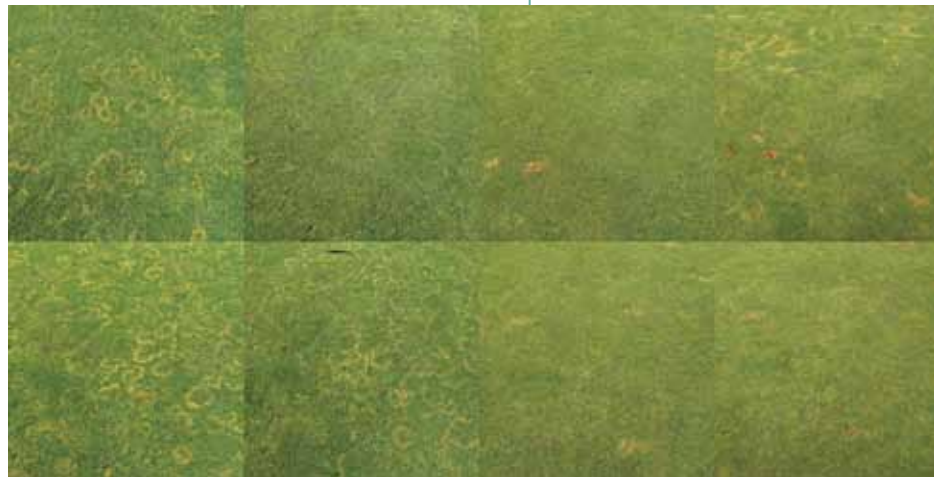
Seven days after the first application on the No. 6 green, all treatments except for Tartan and Concert had significantly less disease than the check treatment (Table 6). By May 16 (14 days after treatment), Renown (all rates), Heritage + Daconil Ultrex, and Headway applications had provided the best control. Although not statistically significant, complete control of the disease was achieved seven days after the second application of these fungicides on May 23 for fungicides on the 14-day interval, and likewise on May 30 for Renown applied on the 21-day interval. Tartan and Concert did provide some disease control in this trial, but they were inferior to Renown, Headway and Heritage + Daconil Ultrex at the rates tested.

Conclusions

The amount of data available for fungicide program effectiveness against brown ring patch is very limited at this time. The results from trials conducted in California, Illinois and Virginia show varying results but provide some general information for selecting products and making management decisions to combat this disease.

Many of the products tested in these trials were effective against brown ring patch to varying degrees under different conditions. It should be noted that benzimidazole fungicides, like thiophanate-methyl (for example, Cleary's 3336), are not effective against brown ring patch. Based on the current information, three observations may help superintendents using fungicides to control this disease.

First, it appears that repeated fungicide applications may be more effective than single applications. When fungicides were applied four times in the Reston trial, all fungicides (except Cleary's 3336 Plus) appeared to provide control of the disease, and no significant differences were seen among treatments. At the La Jolla trial on the No. 6 green, Renown, Headway, or Heritage + Daco-



Differences in fungicide speed and length of control are seen in these photos taken on the North Course at Torrey Pines GC in La Jolla, Calif. Plots were treated with 3 fluid ounces Headway (top row) or 1.1 fluid ounces Chipco Triton (bottom row). Photos were taken (left to right): before application, seven, 14 and 35 days after application. Photo by L. Stowell

nil significantly reduced disease after one application, but the second application 14 or 21 days later resulted in complete control of the disease.

Second, from the trials conducted at La Jolla, some fungicides did appear to give consistently faster control. Although many of the fungicides gave some control seven days after application, Headway and Endorse visually stood out in the trials as having some of the best curative activity. Headway consistently provided some of the best control seven days after application in all three of the experiments conducted at La Jolla. Endorse on the No.3 green and Endorse + Banner Maxx on the No. 5 green also appeared to provide rapid control of the disease after seven days. Unfortunately, when applied alone, both Headway and Endorse appeared to have shorter residual activities than some fungicides, with activity appearing to last no longer than 28 days (see the photo).

Third, some fungicides appeared to take a number of days to provide control of the disease. In the North Barrington trial, less disease was seen at 18 days versus nine days after application. In the La Jolla trials conducted on the No. 3 and No. 5 greens, better control was seen at 14 days versus seven days after application. At both locations, some treatments such as ProStar, ProStar + Chipco Triton, Chipco Triton, Trinity or Tourney, took 14 days or more to provide complete or near complete control of the disease for the 35-day period in which the trial was conducted.

From the collective trial results, it appears many fungicides that typically control other *Rhizoctonia* diseases are also effective against brown ring patch, with some notable exceptions (both good



and bad). As shown previously (4) and in the Reston trial, thiophanate-methyl does not effectively control brown ring patch. Chipco 26GT did not appear to be as strong as other fungicides in the Reston and La Jolla trials. Although not typically considered front-line *Rhizoctonia* fungicides, the DMIs tested in the trials (Banner Maxx, Chipco Triton, Trinity and Tourney), all appeared to be effective alone and in tank mixes with other fungicides. For example, Endorse + Banner Maxx and Headway (a pre-mix of Heritage and Banner Maxx) did appear to be better than Endorse or Heritage used alone. It would be reasonable to say that mixing these DMIs with another fungicide would help in controlling brown ring patch. Bayleton (tridimefon, Bayer Environmental Science), Eagle (myclobutanil, Dow AgroSciences) and Rubigan (fenarimol, Gowan Co.) were not tested in our trials, but should be examined for their effectiveness.

Brown ring patch now appears to be a common disease of annual and roughstalk bluegrass greens in the U.S., but fortunately it appears that there are solid fungicide choices available for its control. Fungicides do vary in their effectiveness and speed in controlling the disease, and two or more applications may provide better control with some of these. Timely and appropriate chemical management combined with other cultural inputs, such as increased fertility (3), could be our best choices for combating brown ring patch, but much still needs to be discovered about this disease.

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The research says

- Fungicides vary in their speed and longevity for brown ring patch control.
- Some DMI fungicides are very effective and should be used as tank-mix partners.
- Fungicide should be applied very soon after the disease appears or preventively at times when the disease has been historically active.