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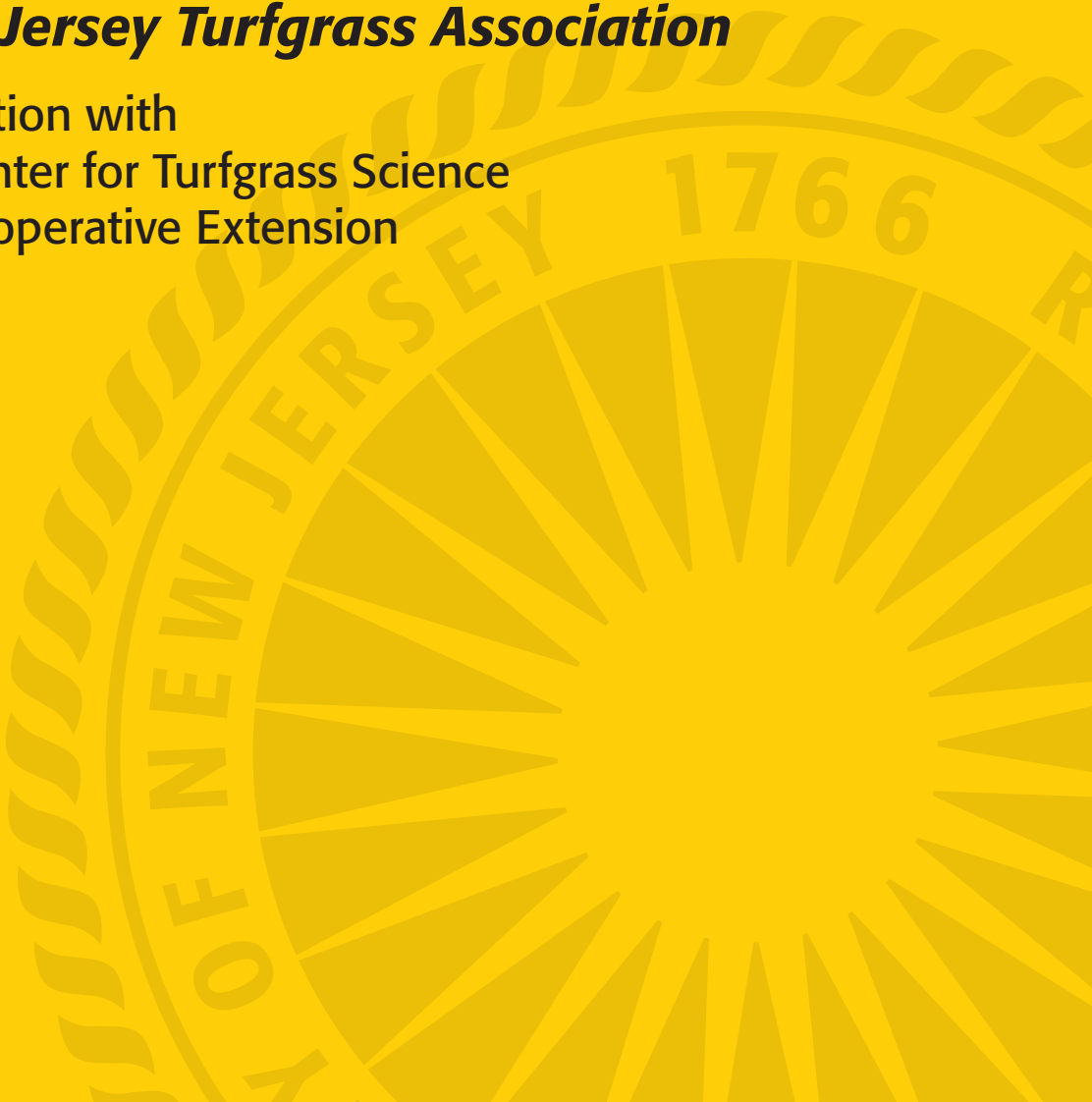

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The Rutgers Turfgrass Proceedings is published yearly by the Rutgers Center for Turfgrass Science, Rutgers Cooperative Extension, and the New Jersey Agricultural Experiment Station, School of Environmental and Biological Sciences, Rutgers, The State University of New Jersey in cooperation with the New Jersey Turfgrass Association. The purpose of this document is to provide a forum for the dissemination of information and the exchange of ideas and knowledge. The proceedings provide turfgrass managers, research scientists, extension specialists, and industry personnel with opportunities to communicate with co-workers. Through this forum, these professionals also reach a more general audience, which includes the public.

This publication includes lecture notes of papers presented at the 2013 GREEN EXPO Turf and Landscape Conference. Publication of these lectures provides a readily available source of information covering a wide range of topics and includes technical and popular presentations of importance to the turfgrass industry.

This proceedings also includes research papers that contain original research findings and reviews of selected subjects in turfgrass science. These papers are presented primarily to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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Dr. Ann Brooks Gould, Editor
Dr. Bruce B. Clarke, Coordinator

CONTROL OF PINK SNOW MOLD ON PERENNIAL RYEGRASS WITH FUNGICIDES AND BIORATIONAL PRODUCTS, 2013-2014

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Fungicides were evaluated for their ability to control pink snow mold (caused by *Microdochium nivale*) on two perennial ryegrass (*Lolium perenne*) tees (#3 and #8) and a fairway (#8) at the Peace Pipe Country Club in Denville, NJ. Turf was established on a sandy loam with a pH of 6.7 in 1995 (both tees) and 2008 (fairway #8), respectively. The tees and fairway were cut five times per week at 0.375 inches and 0.5 inches, respectively, with clippings collected. Fertilizer was applied to all study areas as 46-0-0 (0.50 lb nitrogen (N) per 1000 ft^2) on 27 August 2013 and as 18-3-17 (0.75 lb N per 1000 ft^2) on 23 September 2013. Plots were 3 x 5 ft and were arranged in a randomized complete block with four replications. Turf was irrigated to avoid drought stress.

Fungicides were applied in water equivalent to 1.9 gal per 1000 ft^2 with a CO_2 powered sprayer at 30 psi using 85025 air induction nozzles. Treatments (trt) were applied once on 16 November 2013 when environmental conditions were conducive to pink snow mold development (Tables 1 to 3). Turf was inoculated on 4 December 2013 with oat seed (2.2 g per 3 x 5 ft plot) infested with an isolate of *M .nivale* previously obtained from the Peace Pipe Golf Course and then covered with two layers of an Evergreen EVS Turf Cover (Evergreen, Inc., Mississauga, Ontario) to encourage disease development. Turf covers were removed from all three studies on 1 April 2014 and plots were visually evaluated for percent turf area infested with pink snow mold, turf quality, color, and phytotoxicity. Turf quality was assessed using a 1 to 9 scale, where 9 = best turf quality and 5 = acceptable quality. Color of foliage was visually estimated on a 1 to 5 scale, where 1 = very chlorotic turf, 2 = slight reduction in green color, 3 = normal color of healthy turf, 4 = slight dark green color, and 5 = very dark green color. Phytotoxicity was evaluated using a 1 to 5 scale, where 1 = no foliar discoloration, 2 = slight chlorosis or necrosis, 3 = moderate chlorosis or necrosis, 4 = severe chlorosis or necrosis, and 5 = all turf dead. Data were subjected to analysis of variance and means were separated using the Waller-Duncan *k*-ratio *t*-test (*k* = 100).

Pink snow mold was first observed on 1 April 2014 when turf covers were removed. The average diameter of pink snow mold patches was 4.0 inches. Disease severity of untreated turf was 87, 84 and 91% on fairway #8 (trt 23, Table 1), tee # 8 (trt 20, Table 2), and tee #3 (trt 20, Table 3), respectively, which was considered a very high level of snow mold infestation. Less than 10% turf area infested with pink snow mold represented an acceptable level of disease control. A little over half (63%) of the treatments in the three studies provided acceptable control of pink snow mold during the evaluation period (16 November 2013 to 1 April 2014).

On the fairway trial (Table 1), all Interface 2.27SC + Mirage 2SC treatments (trts 2 to 4 and 12) except Interface 2.27SC @ 3 fl oz + Mirage 2SC @ 1.5 fl oz (trt 1) provided good to excellent disease control, as did Tartan 2.4SC + Interface 2.27SC (trt 5), Interface 2.27SC (trt 7), SP102000028296 SC @ 6.0 fl oz + Mirage 2SC @ 1.5 fl oz (trt 14), SP102000028296 SC @ 8.0 fl oz + Mirage 2SC @ 1.5 fl oz (trt 15), Quali-Pro TM/C 67WDG + QP Ipro 2SC + QP Propiconazole 14.3LC + Foursome 100SL (trt 18), Quali-Pro TM/C 67WDG + QP Ipro 2SC + Tebuconazole 3.6SC + Foursome 100SL (trt 19), QP Enclave 5.3F + Foursome 100SL (trt 21), and Turfcide 400F 4F (trt 22).

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Similarly, on tee #8 (Table 2), Interface 2.27SC alone (trts 3, 7) or applied with Mirage 2SC (trts 1, 2, 12), Tartan 2.4SC (trt 4), Instata 3.6XL (trts 5, 6), SP102000028297 SC alone at rates above 2.862 fl oz (trts 9 to 11) or applied with Mirage 2SC (trts 13 to 15), and Turfcide 400F 4F (trt 18) were very effective at suppressing pink snow mold development. For tee #3, good to excellent disease control was afforded by Turfcide 400F 4F + Foursome 100SL (trts 1 to 3), Interface 2.27SC + Triton 3F (trt 4), Interface 2.27SC + Turfcide 4F + Foursome 100SL (trt 5), Concert II 4.3L + Turfcide 4F + Foursome 100SL (trt 7), Insignia 2.08SC + Turfcide 4F + Foursome 100SL (trt 9), Torque 3.6SC + 26/36 3.8EC (trt 10), Torque 3.6SC + Turfcide 4F + Foursome 100SL (trt 11), Instrata 3.6XL + PAR LC (trt 13), and A13705 1.6SC + PAR LC (trt 17).

Turf quality was acceptable (greater or equal to 5.0) for all entries that provided adequate snow mold control in the three studies, except for Turfcide 400F 4F (trt 22, Table 1) and the high rate of Instata 3.6XL (9.3 fl oz; trt 6, Table 2) which exhibited a moderate degree of phytotoxicity (foliar chlorosis and tip burn [winter injury], respectively). Slight to moderate phytotoxicity (greater or equal to 2.0 on a 1 to 5 scale) was also observed for turf treated with the lower rate of Instata 3.6XL (7.0 fl oz; trt 6, Table 1; trt 18, Table 3), Tartan 2.4SC + Interface 2.27SC (trt 5) and Quali-Pro TM/C 67WDG + QP Ipro 2SC + QP Propiconazole 14.3LC + Foursome 100SL (trt 18, Table 1), Chipco 26GT 2SC + Daconil Ultrex 82.5WDG (trt 17) and Turfcide 400F 4F (trt 18, Table 2), and Concert II 4.3L + Banner Maxx 1.3ME (trt 19, Table 2; trt 6, Table 3). Interface 2.27SC @ 5 fl oz + Mirage 2SC @ 1.5 fl oz (trt 12, Table 1) and tank mixtures containing Mirage 2SC (trts 1, 2, 12, 13, 15, Table 2) had significantly darker green color compared to untreated turf (trt 22, Table 1; trt 20, Table 2) 136 days post-treatment.

Table 1. Control of pink snow mold on a perennial ryegrass fairway #8, Peace Pipe Golf Course, Denville NJ: Rutgers University, 2013-2014.

	Treatment	Rate per 1000 sq. ft.	Percent Disease[1,2] 1 April	Turf Quality[3] 1 April	Color[4] 1 April	Phyto-toxicity[5] 1 April
1	Interface 2.27SC	3.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	14.5 fg	5.7 c-e	5.2 a-c	1.4 e-i
2	Interface 2.27SC	4.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	7.0 hi	5.9 b-d	5.4 ab	1.7 d-f
3	Interface 2.27SC	4.0 fl oz	–			
	+ Mirage 2SC	2.0 fl oz	6.8 hi	5.9 b-d	5.0 b-e	1.5 e-h
4	Interface 2.27SC	5.0 fl oz	–			
	+ Mirage 2SC	2.0 fl oz	0.8 j	6.7 a	5.4 ab	1.9 de
5	Tartan 2.4SC	1.0 fl oz	–			
	+ Interface 2.27SC	3.0 fl oz	0.8 j	5.8 b-d	4.9 b-e	2.1 cd
6	Instrata 3.6XL	7.0 fl oz	15.0 f	4.0 h	4.4 ef	3.1 a
7	Interface 2.27SC	4.0 fl oz	5.0 h-j	6.3 ab	5.2 a-c	1.0 j
8	SP102000028296 SC	4.0 fl oz	19.0 ef	4.7 g	5.0 b-e	1.1 h-j
9	SP102000028296 SC	5.0 fl oz	17.8 ef	5.1 e-g	5.0 b-e	1.0 j
10	SP102000028296 SC	6.0 fl oz	16.5 f	5.0 fg	5.0 b-e	1.0 j
11	SP102000028296 SC	8.0 fl oz	15.3 f	5.4 d-f	5.1 a-d	1.1 h-j
12	Interface 2.27SC	5.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	5.8 h-j	5.9 b-d	5.7 a	1.4 e-i
13	SP102000028296 SC	5.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	23.3 de	4.7 g	5.1 a-d	1.1 h-j
14	SP102000028296 SC	6.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	8.8 gh	5.5 c-f	5.2 a-f	1.2 g-j
15	SP102000028296 SC	8.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	9.0 gh	5.6 c-f	5.2 a-c	1.5 e-h
16	Mirage 2SC	1.5 fl oz	51.8 b	2.8 i	5.0 b-e	1.0 j
17	Chipco 26GT 2SC	4.0 fl oz	–			
	+ Daconil Ultrex 82.5WDG	5.0 oz	28.8 cd	3.6 h	4.6 de	1.7 d-f
18	Quali-Pro TM/C 67WDG	6.0 oz	–			
	+ QP Ipro 2SC	4.0 fl oz	–			
	+ QP Propiconazole 14.3LC	2.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	0.0 j	6.0 b-d	4.0 ef	2.5 bc
19	Quali-Pro TM/C 67WDG	6.0 oz	–			
	+ QP Ipro 2SC	4.0 fl oz	–			
	+ QP Tebuconazole 3.6SC	0.6 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	0.5 j	6.0 b-d	5.4 ab	1.7 d-f
20	QP Ipro 2SC	4.0 fl oz	–			
	+ QP Tebuconazole 3.6SC	1.1 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	34.5 c	3.5 h	5.0 b-e	1.0 j
21	QP Enclave 5.3F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	0.3 j	6.1 a-c	5.5 ab	1.3 f-j
22	Turfcide 400F 4F	12.0 fl oz	1.8 ij	4.7 g	3.8 f	2.8 ab
23	Untreated check	–	87.0 a	1.5 j	5.0 b-e	1.0 j

(Continued)

Table 1. Pink snow mold on a perennial ryegrass fairway (continued).

Treatment	Rate per 1000 sq. ft.	Percent Disease[1,2] 1 April	Turf Quality[3] 1 April	Color[4] 1 April	Phyto-toxicity[5] 1 April
		DAT[6] 136	DAT 136	DAT 136	DAT 136

[1] Percent turf area infested with pink snow mold per plot (3 x 5 ft). Fungicides were applied in 2.0 gal water per 1,000 sq ft at 30 psi applied with an air induction 85025 nozzle on 16 November 2013. Turf was inoculated on 4 December with 2.2 g of oat seed per plot infested with an isolate of *Microdochium nivale* obtained from the Peace Pipe Golf Course. Turf was covered with two layers of a permeable turf cover to enhance disease development.

[2] Values are means of four replicates. Means followed by the same letter are not significantly different according to Waller-Duncan *k*-ratio *t*-test (*k*=100).

[3] Turf quality on a scale of 1 to 9, where 9 = best turf quality and 5 = commercially acceptable quality.

[4] Color of foliage, on a scale of 1 to 10, where 5 = color of untreated turf, less than 5 = increasing foliar necrosis or chlorosis, and more than 5 = increasingly dark green turf.

[5] Phytotoxicity on a scale of 1 to 5, where 1 = no discoloration, 2 = slight foliar chlorosis or necrosis, 3 = moderate chlorosis or necrosis, 4 = severe chlorosis or necrosis, and 5 = all turf dead.

[6] Days after last treatment (DAT) application.

Table 2. Control of pink snow mold on annual bluegrass-perennial ryegrass tee #8, Peace Pipe Golf Course, Denville NJ: Rutgers University, 2013-2014.

	Treatment	Rate per 1000 sq. ft.	Percent Disease[1,2] 1 April	Turf Quality[3] 1 April	Color[4] 1 April	Phyto-toxicity[5] 1 April
1	Interface 2.27SC	4.0 fl oz	–			
	+ Mirage 2SC	2.0 fl oz	1.3 g	6.9 ab	5.7 ab	1.3 cd
2	Interface 2.27SC	5.0 fl oz	–			
	+ Mirage 2SC	2.0 fl oz	1.0 g	6.9 ab	5.5 a-c	1.2 cd
3	Interface 2.27SC	6.0 fl oz	2.5 e-g	6.1 cd	5.0 c-f	1.0 d
4	Tartan 2.4SC	2.0 fl oz	0.8 g	6.4 bc	5.1 c-f	1.1 d
5	Instrata 3.6XL	7.0 fl oz	7.5 e	5.0 ef	4.3 gh	1.9 b
6	Instrata 3.6XL	9.3 fl oz	5.5 ef	4.1 gh	4.1 h	2.8 a
7	Interface 2.27SC	4.0 fl oz	5.3 e-g	5.9 cd	5.1 c-f	1.1 d
8	SP102000028297 SC	2.862 fl oz	23.5 c	4.8 ef	5.0 c-f	1.0 d
9	SP102000028297 SC	3.816 fl oz	7.0 ef	6.4 bc	5.1 b-e	1.2 cd
10	SP102000028297 SC	4.77 fl oz	3.3 e-g	7.2 a	5.3 a-d	1.0 d
11	SP102000028297 SC	5.724 fl oz	4.0 e-g	7.1 ab	5.4 a-d	1.0 d
12	Interface 2.27SC	5.0 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	2.5 e-g	7.4 a	5.5 a-c	1.1 d
13	SP102000028297 SC	3.816 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	4.8 e-g	7.3 a	5.4 a-d	1.0 d
14	SP102000028297 SC	4.77 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	3.3 e-g	6.9 ab	5.8 a	1.0 d
15	SP102000028297 SC	5.724 fl oz	–			
	+ Mirage 2SC	1.5 fl oz	2.3 fg	7.3 a	5.8 a	1.0 d
16	Mirage 2SC	1.5 fl oz	28.8 b	3.7 h	5.0 c-f	1.6 bc
17	Chipco 26GT 2SC	4.0 fl oz	–			
	+ Daconil Ultrex 82.5WDG	5.0 oz	24.0 bc	4.4 f-h	4.7 e-g	2.0 b
18	Turfcide 400F 4F	12.0 fl oz	0.5 g	5.4 de	4.8 d-g	2.1 b
19	Concert II 4.3L	8.5 fl oz	–			
	+ Banner Maxx 1.3ME	1.0 fl oz	14.3 d	4.7 e-g	4.5 f-h	2.0 b
20	Untreated check	–	83.8 a	1.7 i	4.9 d-g	1.0 d
			DAT[6] 136	DAT 136	DAT 136	DAT 136

[1] Percent turf area infested with pink snow mold per plot (3 x 5 ft). Fungicides were applied in 2.0 gal water per 1,000 sq ft at 30 psi applied with an air induction 85025 nozzle on 16 November 2013. Turf was inoculated on 4 December with 2.2 g of oat seed per plot infested with an isolate of *Microdochium nivale* obtained from the Peace Pipe Golf Course. Turf was covered with two layers of a permeable turf cover to enhance disease development.

[2] Values are means of four replicates. Means followed by the same letter are not significantly different according to Waller-Duncan *k*-ratio *t*-test (*k*=100).

[3] Turf quality on a scale of 1 to 9, where 9 = best turf quality and 5 = commercially acceptable quality.

[4] Color of foliage, on a scale of 1 to 10, where 5 = color of untreated turf, less than 5 = increasing foliar necrosis or chlorosis, and more than 5 = increasingly dark green turf.

(Continued)

Table 2. Pink snow mold on annual bluegrass-perennial ryegrass tee # 8 (continued).

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[5] Phytotoxicity on a scale of 1 to 5, where 1 = no discoloration, 2 = slight foliar chlorosis or necrosis, 3 = moderate chlorosis or necrosis, 4 = severe chlorosis or necrosis, and 5 = all turf dead.
[6] Days after last treatment (DAT) application.

Table 3. Control of pink snow mold on annual bluegrass-perennial ryegrass tee #3, Peace Pipe Golf Course, Denville NJ: Rutgers University, 2013-2014.

	Treatment	Rate per 1000 sq. ft.	Percent Disease[1,2] 1 April	Turf Quality[3] 1 April	Color[4] 1 April	Phyto-toxicity[5] 1 April
1	Turfcide 400F 4F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	6.5 g-j	6.2 cd	5.3 a-d	1.0 d
2	Turfcide 400F 4F	12.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	4.5 h-j	6.4 b-d	5.0 c-e	1.0 d
3	Turfcide 4F	16.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	2.0 ij	7.3 ab	5.1 b-e	1.1 d
4	Interface 2.27SC	3.0 fl oz	–			
	+ Triton 3F	0.75 fl oz	5.0 h-j	6.1 d	5.4 a-d	1.3 cd
5	Interface 2.27SC	3.0 fl oz	–			
	+ Turfcide 4F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	0.0 j	7.6 a	5.6 ab	1.0 d
6	Concert II 4.3L	8.5 fl oz	–			
	+ Banner Maxx 1.3ME	1.0 fl oz	18.3 f	4.2 g	4.8 e	2.1 a
7	Concert II 4.3L	8.5 fl oz	–			
	+ Turfcide 4F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	0.0 j	6.4 b-d	5.2 b-e	1.9 ab
8	Insignia 2.08SC	0.7 fl oz	–			
	+ Trinity 1.69L	1.0 fl oz	34.5 de	4.1 g	4.9 de	1.0 d
9	Insignia 2.08SC	0.7 fl oz	–			
	+ Turfcide 4F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	4.8 h-j	7.1 a-c	5.5 a-c	1.0 d
10	Torque 3.6SC	0.9 fl oz	–			
	+ 26/36 3.8EC	4.0 fl oz	0.0 j	6.0 d	4.8 e	1.8 ab
11	Torque 3.6SC	0.9 fl oz	–			
	+ Turfcide 4F	8.0 fl oz	–			
	+ Foursome 100SL	0.5 fl oz	2.0 ij	7.1 a-c	5.6 ab	1.0 d
12	A20744A 50W	0.7 oz	–			
	+ PAR LC	0.36 fl oz	68.5 b	2.6 h	5.6 ab	1.0 d
13	Instrata 3.6XL	7.0 fl oz	–			
	+ PAR LC	0.36 fl oz	8.8 g-i	5.1 ef	5.8 a	1.6 bc
14	Secure 4.17SC	0.5 fl oz	–			
	+ PAR LC	0.36 fl oz	47.3 c	3.6 g	5.2 b-e	1.1 d
15	A13705 1.6SC	2.6 fl oz	–			
	+ Secure 4.17SC	0.5 fl oz	–			
	+ PAR LC	0.36 fl oz	12.5 fg	5.7 de	5.3 b-e	1.1 d
16	A20744A 50W	0.5 oz	–			
	+ Secure 4.17SC	0.5 fl oz	–			
	+ PAR LC	0.36 fl oz	39.8 d	3.8 g	5.3 b-e	1.1 d
17	A13705 1.6SC	2.6 fl oz	–			
	+ PAR LC	0.36 fl oz	9.0 gh	5.9 de	5.6 ab	1.9 a
18	Instrata 3.6XL	7.0 fl oz	12.5 fg	4.2 fg	5.1 b-e	2.0 a
19	Chipco 26GT 2SC	4.0 fl oz	–			
	+ Daconil Ultrex 82.5WDG	5.0 oz	28.8 e	4.4 fg	5.0 c-e	1.0 d

(Continued)

Table 3. Pink snow mold on annual bluegrass-perennial ryegrass tee #3 (continued).

	Treatment	Rate per 1000 sq. ft.	Percent Disease[1,2] 1 April	Turf Quality[3] 1 April	Color[4] 1 April	Phyto-toxicity[5] 1 April
20	Untreated check	–	91.3 a	1.3 i	5.0 c-e	1.0 d
			DAT[6] 136	DAT 136	DAT 136	DAT 136

[1] Percent turf area infested with pink snow mold per plot (3 x 5 ft). Fungicides were applied in 2.0 gal water per 1,000 sq ft at 30 psi applied with an air induction 85025 nozzle on 16 November 2013. Turf was inoculated on 4 December with 2.2 g of oat seed per plot infested with an isolate of *Microdochium nivale* obtained from the Peace Pipe Golf Course. Turf was covered with two layers of a permeable turf cover to enhance disease development.

[2] Values are means of four replicates. Means followed by the same letter are not significantly different according to Waller-Duncan *k*-ratio *t*-test (*k*=100).

[3] Turf quality on a scale of 1 to 9, where 9 = best turf quality and 5 = commercially acceptable quality.

[4] Color of foliage, on a scale of 1 to 10, where 5 = color of untreated turf, less than 5 = increasing foliar necrosis or chlorosis, and more than 5 = increasingly dark green turf.

[5] Phytotoxicity on a scale of 1 to 5, where 1 = no discoloration, 2 = slight foliar chlorosis or necrosis, 3 = moderate chlorosis or necrosis, 4 = severe chlorosis or necrosis, and 5 = all turf dead.

[6] Days after last treatment (DAT) application.