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Fungicides for Control of Anthracnose and Summer Patch Diseases on Annual Bluegrass Putting Greens 2019 Report

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Fungicides for Control of Anthracnose and Summer Patch Diseases on Annual Bluegrass Putting Greens 2019 Report

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The Bottom Line: Twenty-two commercial and experimental fungicide treatments were tested alone or in combination against an untreated control for their ability to control foliar and basal rot anthracnose (*Colletotrichum cereale*) and summer patch (*Magnaporthe poae*) diseases preventatively on annual bluegrass (*Poa annua*) turf maintained as a golf course putting green. Study was conducted at the Turfgrass Research Facility in Riverside. Treatments were applied every 2 wks, starting from June 2019 for a total of 8 applications. Both anthracnose and summer patch diseases symptoms were observed during the study. However, anthracnose was the primary disease that caused turf damage. In general, UCR Program No. 5 (based on the rotation of Briskway at 0.5 oz/M, Daconil Action at 3.5 oz/M, Signature XTRA Stressgard at 5.3 oz/M, Affirm WDG at 1.0 oz/M, Insignia SC Intrinsic at 0.7 oz/M and Primo Maxx at 0.1 oz/M) was the best performing treatment in the 2019 study, keeping anthracnose disease cover under the 10% threshold and maintaining the highest visual quality of turf under the heaviest pathogen pressure, which occurred on August 27. Next in line were Bayer Programs No. 1 (rotation of Mirage Stressgard at 1.0 oz/M, Daconil Weatherstik at 3.5 oz/M, Signature XTRA Stressgard at 4.0 oz/M, Insignia SC Intrinsic at 0.7 oz/M and Primo Maxx at 0.1 oz/M) and No. 2 (with the addition of Exteris Stressgard at 4.0 oz/M), tank-mixes of Daconil Action (3.5 oz/M) and Primo Maxx (0.1 oz/M) with either Appear II (6.0 oz/M) or Secure Action (0.5 oz/M) and UCR Program No. 3 (rotation of Mirage Stressgard at 1.0 oz/M, Daconil Action at 3.5 oz/M, Signature XTRA Stressgard at 5.3 oz/M, Affirm WDG at 1.0 oz/M, Lexicon Intrinsic at 0.47 oz/M and Primo Maxx at 0.1 oz/M) resulting in anthracnose cover below 15% and turf visual quality at or above minimally acceptable. While several other treatments evaluated in this experiment were statistically comparable to the above-mentioned treatments in terms of disease control, most of them were not able to provide acceptable visual turfgrass quality and therefore, were not considered successful.

Acknowledgments

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Introduction

Anthracnose is a destructive turfgrass disease caused by *Colletotrichum cereale* and it is especially severe on annual bluegrass putting greens. It may develop as a foliar blight, in which the turfgrass leaves are infected, or as a basal rot, which attacks the leaf sheaths, crowns, and stolons of the plant. In the field, symptoms may appear as irregular patches of yellow, bronze, chlorotic, or blighted turfgrass. The pathogen produces black, saucer-shaped pads with black spines protruding from them (acervuli), which can be seen on the infected parts of plants with a magnifying glass or microscope. Management practices such as

Cover photo taken by P. Petelewicz on August 30, 2019. Riverside, CA.

reduced mowing heights, minimal nitrogen fertilization, and suboptimal irrigation are known to exacerbate the severity of anthracnose on turfgrass. On annual bluegrass, turfgrass death usually occurs during prolonged, hot weather conditions when the plants are weakened and under stress.

Summer patch, caused by *Magnaporthe poae*, is a warm-weather disease that appears as crescent-shaped or circular patches with green centers (frog eyes). Turf within these patches is initially off-colored, prone to wilt, growing poorly, or sunken in the turf stand. Over time, the turf continues to decline, turning yellow or straw brown and eventually collapsing to the soil surface. The outer edges of the patch are usually orange or bronze when the disease is actively developing. The subterranean portions of infected plants are seriously rotted and appear brown to black in color. The pathogen forms dark, surface inhabiting mycelia on infected roots and stems. Symptom development for this disease appears to require stressful conditions (high temperatures and light) and possibly subsequent infection by facultative parasites, including *Fusarium* species.

Objectives

This study was conducted to evaluate efficacy of 23 different fungicide treatments to control foliar and basal rot anthracnose (*Colletotrichum cereale*) and summer patch (*Magnaporthe poae*) diseases preventatively on annual bluegrass (*Poa annua*) maintained as a golf course putting green.

Materials and Methods

The study was conducted on mature annual bluegrass (*Poa annua*) 'Peterson's Creeping' turf on a Hanford fine sandy loam amended with sand. Green was established in 2007 from seed and plots were originally inoculated with *Colletotrichum* spores grown in the laboratory. In later years, inoculation was achieved through core aeration and dragging in order to spread the existing inoculum.

Turf was mowed 5 days/wk at 0.125 inches and received 0.125 lbs N/1000 ft^2 in liquid form every 14 days. Fungicide treatments were applied every 14 days beginning on June 6, 2019 (before disease symptoms were present) for a total of 8 applications. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8004VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Experimental design was a complete randomized block with 6 replications. Plot size was 4 ft × 6 ft with 2-ft alleys.

Starting from June 10, plots were evaluated every 2 wks for visual turf quality and visual turf green color intensity (both 1-9; 9=best), injury caused by treatments (phytotoxicity; 0-10; 10=highest), loss of turfgrass stand cover expressed as the percentage of ratio between initial cover and cover at the time of evaluation (0-100%), anthracnose and summer patch disease cover (0-100%), disease symptom severity within the affected area (0-10; 10=highest), disease pressure calculated from the two previously mentioned parameters, and normalized difference vegetation index (NDVI).

Data collected throughout the study were analyzed using analysis of variance for each evaluated trait separately and the means were compared using the Fisher's protected least significant difference (LSD) test at the 0.05 probability level ($P \leq 0.05$).

Results

Although *Colletotrichum cereale* acervuli (Fig. 1) were first noted in the middle of June and anthracnose activity in untreated plots was already observed at a significant level (exceeding the threshold of 10% cover) in the beginning of July, the disease started spreading most rapidly in August (data not shown). The peak of disease activity was on August 27 when disease cover within untreated plots was above 60% and turf

visual quality was 4 (Tables 2 and 3). Although disease cover in untreated plots after this date started to decrease slowly, the severity of symptoms within the area of pathogenic activity increased (data not shown), resulting in progressing turfgrass visual quality deterioration (Tables 2 and 3).

UCR 004 treatment resulted in unacceptable injury to turf (above 3 on 0-10 scale), which peaked on July 29 (average score 4) and persisted until the end of the study (data not shown). Otherwise, the only phytotoxicity resulting from the fungicide treatments was observed in the beginning of the study with its peak on June 17 (2 WAIT - prior to 2nd application). On this date, significant turfgrass injury was observed with both Bayer Programs and UCR Programs No. 1-3 (containing Mirage Stressgard) and UCR Program No. 4 (containing Banner Maxx II). Although the injury with those treatments was statistically significant, none of them crossed the threshold of unacceptable injury level (Table 2) and all of them fully recovered by the next rating event (data not shown).

In the 2019 trial, the best performing treatment in terms of the lowest disease cover (below 10%) on the date of the peak of pathogenic activity (August 27) was UCR Program No. 5 (containing Briskway), while statistically it was no different than: other UCR Programs (with exception of UCR Program No. 1), BASF Program No. 1, both Bayer Programs, Syngenta Program No. 2, tank mixes of Daconil Action and Primo Maxx with either Appear II or Secure Action, as well as UCR 002 (treatment 20 only). Following peak activity, anthracnose pressure steadily decreased toward the final rating date. UCR Programs No. 4 and 5, as well as the tank-mix of Daconil Action with Secure Action and Primo Maxx resulted in the lowest (equal or below 3%) disease cover on September 24, although those treatments were not statistically different from most of the other treatments in the study, with the exception of UCR 002 (treatments 19 and 21 only), UCR 003 and UCR 004 (Table 2). Among listed treatments (on both dates) there were also no significant differences in disease severity within the affected areas, thus no differences in disease pressure ratio (data not shown).

In terms of turfgrass visual quality, no significant differences were found between untreated control and any of the treatments employed in the study on August 27 (peak of the disease), ranging from 4.0 to 6.5 (Table 3). Lack of differences could be also associated with the occurrence of summer patch within the study area, which coverage of ranged from 8% to 20% on August 27 and from 3% to 40% on final data collection date. As in previous years, this pathogen was difficult to distinguish once both diseases became active since their symptoms can be similar in appearance. Therefore, due to high variability among replications, no significant differences were observed among employed treatments in terms of summer patch cover (Table 2). Ultimately, by the end of the study, the highest turfgrass visual quality (above 7) was observed from UCR Programs No. 4 and 5 as well as in tank-mix of Daconil Action, Secure Action and Primo Maxx. However, no statistically significant differences were shown between aforementioned treatments and the majority of remaining treatments employed in the study, with the exception of: BASF Program No. 2, UCR 001 (treatment 17 only), UCR 002 (except for treatment 18), UCR 003 and UCR 004 – all of which were not different from untreated control (Table 3).

Another aspect considered in this study was the impact of the employed fungicides on the intensity of turf green color. Subjective evaluation showed that, on August 27, the treatment that resulted in the darkest overall green color was the standalone tank-mix of Daconil Action with Secure Action and Primo Maxx. Nevertheless, both Bayer Programs and Syngenta Program No. 1, UCR Programs No. 2 through 5 as well as UCR 002 and tank-mix of Daconil Action, Primo Maxx and Appear II were statistically comparable to this treatment. In addition, by the final rate date the highest visual color was observed from UCR Programs No. 4 and 5 (above 8.5), although statistically those treatments were no different from other UCR Programs,

both Bayer and Syngenta Programs, tank-mixes containing Daconil Action, and UCR 004 treatment (Table 3).

Finally, when considering turfgrass cover loss throughout the study, being the result of the impact of the suboptimal conditions working together (with the emphasis on the disease activity), the only significant decrease was observed in untreated control, BASF Program No. 2 and UCR 002 (treatments 19 and 21) and it ranged from 11% to 20% by August 27, although in case of BASF Program No. 2, observed loss of turf was mainly associated with severe scalping which occurred within some plots (Table 3). No further significant differences were shown after August 27 (data not shown).

Tables and Figures

Table 1. Fungicide treatments tested in the preventative foliar and basal rot anthracnose and summer patch disease control study in Riverside, CA. 2019.

No.	Treatment	Active ingredient(s)	Company	Rate (oz/1000 ft^2)	Timing
1	Untreated Control	-	-	-	-
2	*BASF Program No. 1*				
	Navicon Intrinsic	mefentrifuconazole, pyraclostrobin	BASF	0.85	ADG
	Affirm WDG	polyoxin D zinc salt	Nufarm	0.90	BEH
	Signature XTRA Stressgard	aluminium-tris	Bayer	4.00	CF
3	*BASF Program No. 2*				
	Maxtima	mefentrifuconazole	BASF	0.60	ADG
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	BEH
	Affirm WDG	polyoxin D zinc salt	Nufarm	0.90	CF
4	*Bayer Program No. 1*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	ACEG
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	BDFH
	Signature XTRA Stressgard	aluminium-tris	Bayer	4.00	
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
5	*Bayer Program No. 2*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	AG
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	BDFH
	Signature XTRA Stressgard	aluminium-tris	Bayer	4.00	BDFGH
	Exteris Stressgard	fluopyram, trifloxystrobin	Bayer	4.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
6	*Syngenta Program No. 1*				
	Heritage Action	azoxystrobin, acibenzolar-S-methyl	Syngenta	0.40	ACEG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
7	*Syngenta Program No. 2*				
	Velista	penthiopyrad	Syngenta	0.50	ADG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BEH
	Heritage Action	azoxystrobin, acibenzolar-S-methyl	Syngenta	0.40	CF
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H

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8	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	A-H
	Appear II	potassium phosphite	Syngenta	6.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
9	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	A-H
	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
10	*UCR Program No. 1*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	AG
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	BDFH
	Chipco Signature	aluminium-tris	Bayer	4.00	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
11	*UCR Program No. 2*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	AG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
12	*UCR Program No. 3*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	AG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Lexicon Intrinsic	pyraclostrobin, fluxapyroxad	BASF	0.47	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
13	*UCR Program No. 4*				
	Banner Maxx II	propiconazole	Syngenta	2.00	AG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H

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	UCR Program No. 5				
	Briskway	azoxystrobin, difenoconazole	Syngenta	0.50	AG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
14	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
	UCR Program No. 6				
	Maxtima	mefentrifuconazole	BASF	0.80	AG
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
15	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	BDFGH
	Affirm WDG	polyoxin D zinc salt	Nufarm	1.00	CE
	Insignia SC Intrinsic	pyraclostrobin	BASF	0.70	CE
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
16	UCR 001	*classified*	-	-	A-H
17	UCR 001	*classified*	-	-	A-H
18	UCR 002	*classified*	-	-	A-H
19	UCR 002	*classified*	-	-	A-H
20	UCR 002	*classified*	-	-	A-H
21	UCR 002	*classified*	-	-	A-H
22	UCR 003	*classified*	-	-	A-H
23	UCR 004	*classified*	-	-	A-H

Application codes (timing):

A – 06/06/2019
B – 06/19/2019
C – 07/03/2019
D – 07/18/2019
E – 07/31/2019
F – 08/14/2019
G – 08/28/2019
H – 09/14/2019

Table 2. Effect of fungicide treatments on turfgrass injury caused by treatments (phytotoxicity; 0-10; 10=highest), anthracnose disease cover (0-100%) and summer patch disease cover (0-100%) evaluated on annual bluegrass turf. Riverside, CA, 2019.

No.	Treatment	Turfgrass Injury	Anthracnose Cover	Anthracnose Cover	Summer Patch Cover	Summer Patch Cover
		Jun. 17	Aug. 27	Sep. 24	Aug. 27	Sep. 24
1	Untreated Control	0.3 DE*	64.2 A*	43.3 A*	11.7*	36.7*
2	BASF Program No. 1	0.0 E	19.2 C-G	3.3 EF	19.2	19.2
3	BASF Program No. 2	0.0 E	31.7 B-F	13.3 B-F	15.0	22.5
4	Bayer Program No. 1	1.8 C	13.3 FG	4.2 D-F	8.3	8.3
5	Bayer Program No. 2	2.2 BC	14.2 E-G	12.5 B-F	10.8	13.3
6	Syngenta Program No. 1	0.2 DE	33.3 B-F	16.7 B-F	13.3	15.0
7	Syngenta Program No. 2	0.0 E	20.0 B-G	5.8 D-F	12.5	10.0
8	Daconil Action + Appear II **	0.2 DE	12.5 FG	10.8 B-F	8.3	8.3
9	Daconil Action + Secure Action **	0.7 D	12.5 FG	3.0 F	10.0	3.3
10	UCR Program No. 1	1.8 C	33.3 B-F	8.3 C-F	15.8	11.7
11	UCR Program No. 2	2.0 C	15.8 D-G	7.5 C-F	9.2	9.2
12	UCR Program No. 3	2.7 AB	13.3 FG	8.3 C-F	15.0	15.0
13	UCR Program No. 4	2.8 A	23.0 B-G	2.5 F	13.3	5.0
14	UCR Program No. 5	0.5 DE	7.5 G	2.5 F	12.8	7.5
15	UCR Program No. 6	0.2 DE	30.8 B-G	13.7 B-F	19.2	19.2
16	UCR 001	0.0 E	39.2 B-D	10.8 B-F	14.2	39.2
17	UCR 001	0.0 E	43.3 AB	9.2 C-F	15.0	38.0
18	UCR 002	0.0 E	33.0 B-F	8.3 C-F	13.3	23.3
19	UCR 002	0.0 E	33.3 B-F	22.5 BC	17.5	25.0
20	UCR 002	0.0 E	27.5 B-G	11.7 B-F	10.8	24.2
21	UCR 002	0.0 E	37.5 B-E	24.5 B	14.2	26.7
22	UCR 003	0.0 E	33.3 B-F	19.2 B-D	7.5	32.5
23	UCR 004	2.7 AB	42.5 A-C	18.3 B-E	15.0	11.7

*Means followed by the same letter or not followed by any letter in a column are not significantly different (P=0.05).
**Treatments No. 8 and 9 also included Primo Maxx as the tank-mix component.

Figure 1. Close-up on anthracnose (*Colletotrichum cereale*) acervuli occurring on dead annual bluegrass (*Poa annua*) foliage. Photo taken by P. Petelewicz on August 30, 2019. Riverside, CA.

Table 3. Effect of fungicide treatments on turfgrass visual quality (1-9; 9=best),visual turf green color intensity (1-9, 9=best) and turfgrass cover loss (0-100%) evaluated on annual bluegrass turf. Riverside, CA, 2019.

No.	Treatment	Visual Quality	Visual Quality	Visual Color	Visual Color	Turfgrass Cover Loss
		Aug. 27	Sep. 24	Aug. 27	Sep. 24	Aug. 27
1	Untreated Control	4.0*	3.5 E*	5.0 G*	4.0 G*	19.8 A*
2	BASF Program No. 1	5.7	5.5 A-D	6.5 C-F	7.0 B-F	1.7 D
3	BASF Program No. 2	4.3	4.8 C-E	5.8 FG	6.5 C-F	12.5 AB
4	Bayer Program No. 1	6.2	6.5 A-D	7.7 A-D	7.8 A-D	2.6 CD
5	Bayer Program No. 2	6.2	6.7 A-C	7.8 A-C	8.2 AB	5.0 B-D
6	Syngenta Program No. 1	5.2	6.0 A-D	7.0 A-F	7.7 A-E	5.8 B-D
7	Syngenta Program No. 2	5.0	5.7 A-D	6.8 B-F	7.2 A-F	3.2 B-D
8	Daconil Action + Appear II **	6.0	6.0 A-D	7.8 A-C	8.2 AB	4.7 B-D
9	Daconil Action + Secure Action **	6.3	7.2 AB	8.3 A	8.3 AB	1.7 D
10	UCR Program No. 1	4.8	6.5 A-D	6.5 C-F	8.0 A-C	5.5 B-D
11	UCR Program No. 2	6.2	6.5 A-D	7.3 A-E	8.2 AB	2.5 CD
12	UCR Program No. 3	6.0	6.2 A-D	7.2 A-F	8.0 A-C	2.7 CD
13	UCR Program No. 4	5.2	7.3 A	7.0 A-F	8.7 A	5.8 B-D
14	UCR Program No. 5	6.5	7.3 A	8.0 AB	8.7 A	1.0 D
15	UCR Program No. 6	4.5	5.7 A-D	6.5 C-F	7.8 A-D	7.2 B-D
16	UCR 001	5.7	5.7 A-D	6.2 E-G	6.3 D-F	6.3 B-D
17	UCR 001	5.3	5.2 C-E	6.0 E-G	5.8 F	7.5 B-D
18	UCR 002	5.7	5.7 A-D	6.7 B-F	6.8 B-F	2.5 CD
19	UCR 002	4.8	5.3 B-E	6.2 E-G	6.2 EF	11.9 A-C
20	UCR 002	5.2	5.2 C-E	6.3 D-G	5.8 F	7.6 B-D
21	UCR 002	4.0	4.7 DE	5.8 FG	5.7 F	12.6 AB
22	UCR 003	5.5	5.0 C-E	7.0 A-F	5.7 F	6.3 B-D
23	UCR 004	3.8	5.3 B-E	5.0 G	7.5 A-E	6.4 B-D

*Means followed by the same letter or not followed by any letter in a column are not significantly different (P=0.05).
**Treatments No. 8 and 9 also included Primo Maxx as the tank-mix component.

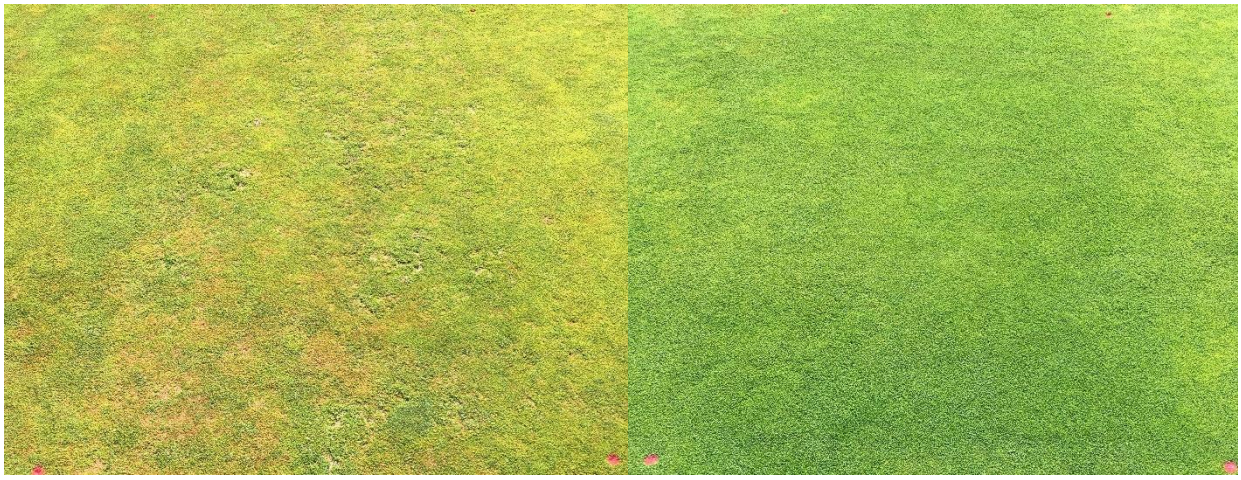

Figure 2. Comparison of untreated plot (left) to plot treated with UCR Program No. 5 (right). Photos taken by P. Petelewicz on August 30, 2019. Riverside, CA.

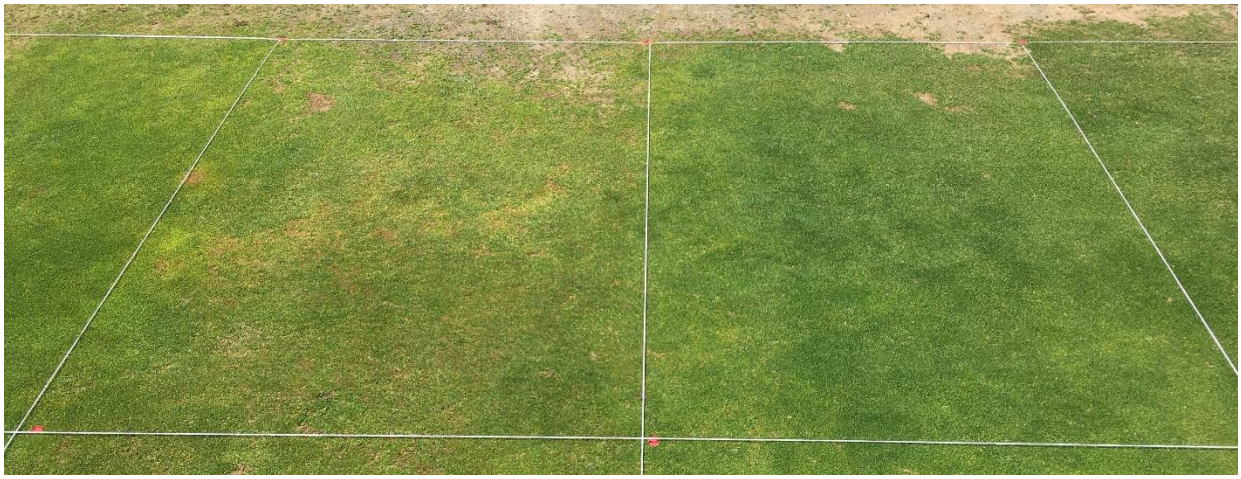

Figure 3. Comparison of untreated plot (left) to plot treated with tank-mix of Daconil Action (3.50 oz/1000 ft^2), Secure Action (0.50 oz/1000 ft^2) and Primo Maxx (0.10 oz/1000 ft^2; right). Photo taken by P. Petelewicz on September 12, 2019. Riverside, CA.

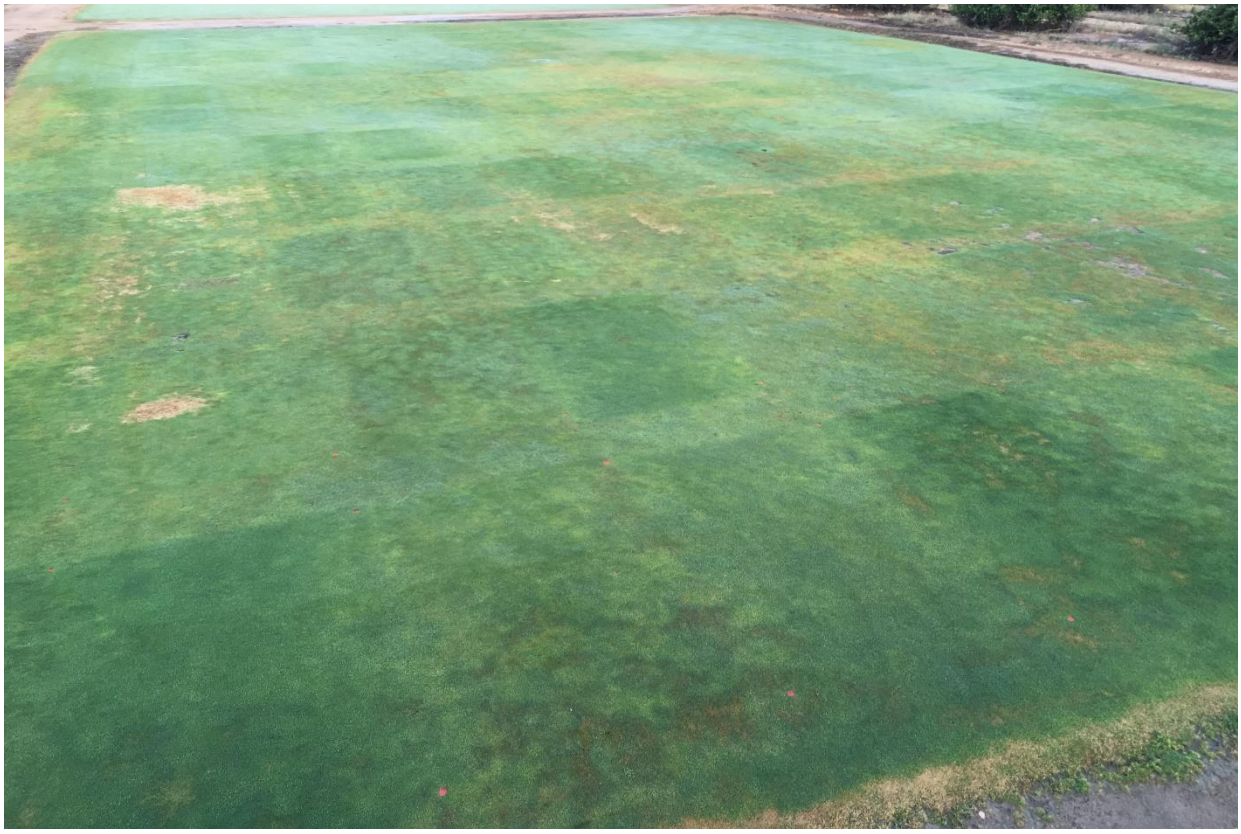

Figure 4. General view of the study. Photo taken by P. Petelewicz on August 30, 2019. Riverside, CA.