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TURFGRASS & LANDSCAPE RESEARCH FIELD DAY

September 14, 2023

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Turfgrass Science

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

CA TURFGRASS & LANDSCAPE FOUNDATION
"Keeping California Green and Growing"

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College of Natural and Agricultural Sciences
UC Division of Agriculture and Natural Resources
Agricultural Experiment Station and Cooperative Extension

Department of Botany and Plant Sciences-072
Riverside, CA 92521-0124

Welcome to Field Day!

On behalf of the entire UCR Turfgrass and Landscape Team, welcome (back) to the 2023 UCR Turfgrass and Landscape Research Field Day. This marks the 16th consecutive year of this event under my watch. Time flies when you're having fun! Once again, we're happy to have everyone back as we continue to strive to make Field Day one of the pinnacle events of our industry – a place where all come together annually to see old friends, share ideas, and learn about world-class research activities at UCR.

Today, you will see and hear about cutting edge new and longstanding research that addresses turfgrass selection, pest, water, and salinity management issues to help mitigate stresses on turf and landscape plants. This year's event is bittersweet. We are very proud to announce the impending release of the first two cultivars from our turfgrass breeding program since it was resurrected in 2012. 'Coachella' (formerly UCR TP6-3) and 'Presidio' (formerly UCR 17-8) hybrid bermudagrasses mark the first in what will become a progression of new cultivars with improved winter color retention and drought resistance. These new cultivars have been patented and are now in production with commercial availability expected in 2025-26. While this news is very exciting, we are very sad to bid farewell to Dr. Marta Pudzianowska and Pawel Orlinski, who will be continuing their careers at Mississippi State University (MSU). Marta will become the new Assistant Professor of Turfgrass Breeding at MSU. Words cannot describe what both Marta and Pawel have meant to the UCR turfgrass program and me. We will miss them dearly, but at the same time we are excited to watch their careers continue to blossom at MSU. Please take the time to personally thank both Marta and Pawel for their many contributions to the turfgrass industry in California and the Southwest.

For the 12th consecutive year, we welcome several of our industry partners under the Exhibitor's Tent. Please take the time to visit them and learn more about new products and services while enjoying complimentary food and beverages. Last but not least, while this handout serves to give you a brief synopsis of our current research activities for the research tours, you can read or print our full research reports in their entirety from our website, **turfgrass.ucr.edu**.

As you enjoy today's tours, please take a moment to thank those folks, mostly wearing UCR Turfgrass Science shirts of various colors, who assisted with preparation for this event. Special thanks go to my fellow Field Day planning committee members including Marta Pudzianowska, Peggy Mauk, Sue Lee, Steve Ries, Sherry Cooper, and Kate Lyn Sutherland, and Julia Kalika. Production of this publication, signs, and online reports would not have been possible without assistance from Dr. Marta Pudzianowska. Staff and students from UCANR, Agricultural Operations and my lab have worked tirelessly to make this event possible and are deserved of your appreciation. Last but not least, very special thanks to all of our industry partners for their generous donations to our turf and landscape programs throughout the year, and especially for today's delicious food and beverages under the shade of tents!

Enjoy Field Day! And we hope to see you again next year on **Thursday, September 12, 2024**.

Sincerely,

James H. Baird, Ph.D.
Associate Specialist in Cooperative Extension and Turfgrass Science

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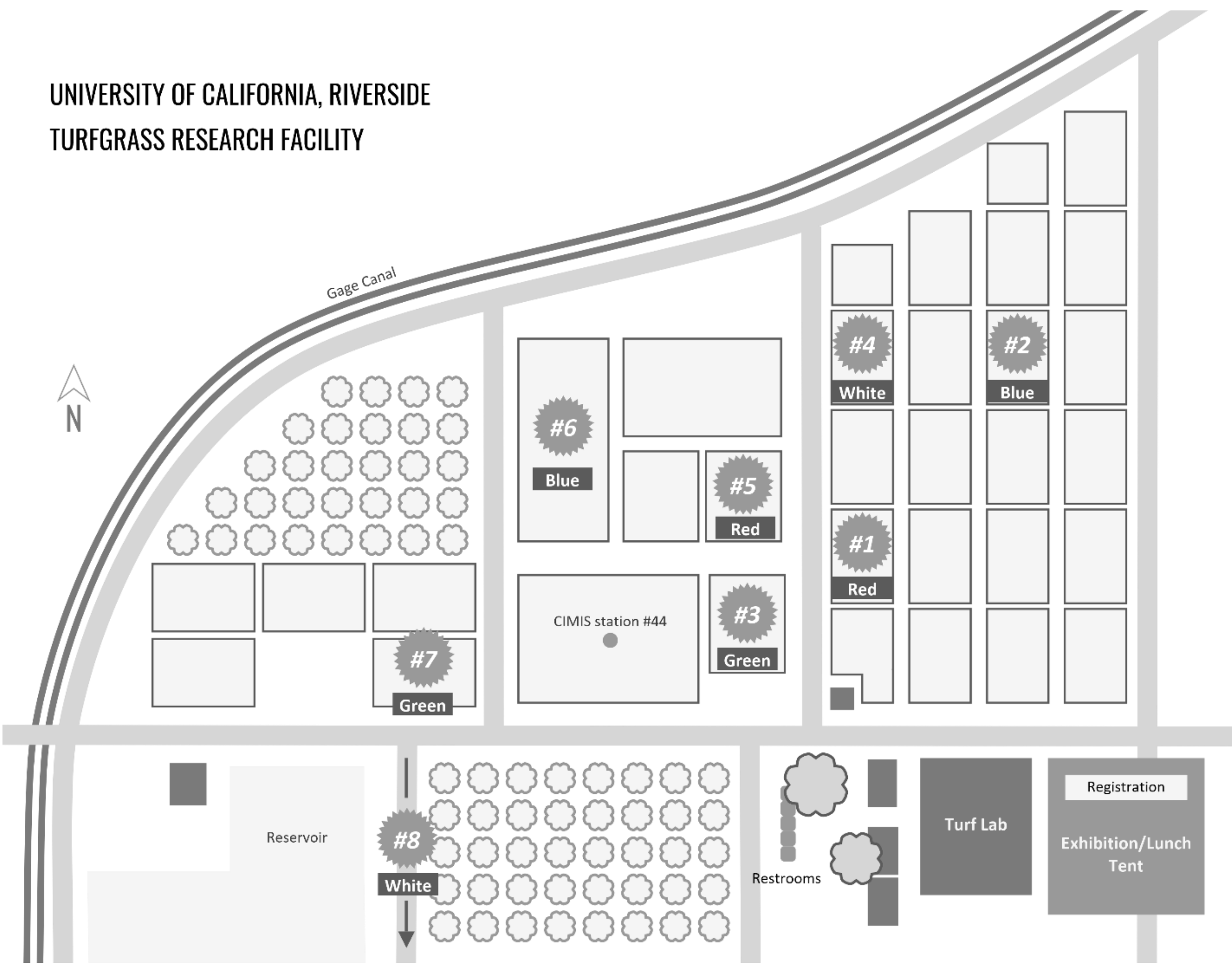
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#6
Blue
#5
Red
#4
White
#2
Blue
#1
Red
CIMIS station #44
#3
Green
#7
Green
Reservoir
#8
White
Restrooms
Turf Lab
Registration
Exhibition/Lunch Tent

2023 Turfgrass and Landscape Research Field Day Agenda

8:00 AM	**Exhibitor Set-Up**
8:30-9:30 AM	**Registration and Trade Show Open**
9:30 AM	**Welcome and Introductions** Peggy Mauk and Jim Baird
9:40-11:00 AM	**Field Tour Rotation (20 minutes per Stop)**
Stop #1 *Red tent*	**Postemergence Control of Yellow and Purple Nutsedge and Green Kyllinga in Bermudagrass Turf; Evaluation of Fungicides for Control of Summer Patch Disease on Bluegrass Turf** Pawel Orlinski
Stop #2 *Blue tent*	**Herbicide Strategies for Conversion from Existing to Improved Bermudagrasses** Jim Baird
Stop #3 *Green tent*	**2023 NTEP Seashore Paspalum Test; Evaluation of Bermudagrass and Kikuyugrass Under Low Light Conditions** Marta Pudzianowska, Adam Lukaszewski, and Christian Bowman
Stop #4 *White tent*	**Traffic Tolerance and Divot Recovery of UCR 17-8, UCR TP6-3, Santa Ana, and TifTuf Bermudagrasses** Sandra Glegola
11:00-11:30 AM	**Break and Trade Show**
11:30-12:50 PM	**Field Tour Rotation (20 minutes per Stop)**
Stop #5 *Red Tent*	**Evaluation of Fungicides for Control of Rapid Blight Disease on *Poa* Greens** Jim Baird
Stop #6 *Blue Tent*	**Chemical Programs for Water Conservation on Bermudagrass Turf Using a Linear Gradient Irrigation System** Sandra Glegola
Stop #7 *Green Tent*	**Evaluation of Fungicides for Control of Anthracnose Disease on *Poa* Greens** Pawel Orlinski
Stop #8 *White Tent*	**Improvement of Bermudagrass, Kikuyugrass, and Zoysiagrass for Winter Color Retention and Drought Tolerance** Adam Lukaszewski, Marta Pudzianowska, and Christian Bowman
12:50-2:00 PM	**Barbeque Lunch and Trade Show**
2:00 PM	**Adjourn**

Stop #1a: Postemergence Control of Yellow and Purple Nutsedge and Green Kyllinga in Bermudagrass Turf

Pawel M. Orlinski and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Introduction:

Sedges represent a unique group of plants that are neither broadleaves nor grasses. As a result, numerous herbicides designed to target dominant weeds in turfgrass prove ineffective against sedges. Typically, sedges thrive in wet conditions, exhibiting the most intense growth near malfunctioning sprinklers or areas that hold water. However, once they are established, they can withstand extended periods of drought. Yellow and purple nutsedge form underground tubers, often called nutlets. These structures enable the plants to endure adverse conditions, frequently even avoiding herbicidal control. Although green kyllinga doesn't develop underground tubers, it can spread extensively by prolific seed production. All three species can also propagate via rhizomes.

Many herbicides instruct users on their labels to avoid mowing for a specific duration before and after use. For herbicides absorbed through the leaves, this amplifies the plant's herbicide absorption, aiding in its efficacy. However, delays in mowing can pose occasional challenges for golf course superintendents or other turf management professionals.

Objectives:

This study was conducted to:

- evaluate and compare the efficacy of various herbicides for yellow nutsedge (*Cyperus esculentus*), purple nutsedge (*Cyperus rotundus*) and green kyllinga (*Kyllinga brevifolia*) control in hybrid bermudagrass (*Cynodon* spp.).
- evaluate efficacy of herbicides when applied to weeds left unmowed for 2-3 weeks compared to application one day after mowing.

Materials and Methods:

The study was conducted on mature hybrid seeded bermudagrass (*Cynodon* spp.) 'Princess 77' turf on a Hanford fine sandy loam. Turf was mowed every 2 weeks at 1 inch. Treatments were applied using a CO_2-powered backpack sprayer equipped with a single TeeJet AI9505E nozzle calibrated to deliver 1 gallon/1000 ft^2. Experimental design was a complete randomized block with 4 replications. Plot size was 3x3 ft with 2-ft alleys. The study was initiated on July 10, 2023 for treatments 2-8. Then on July 11, the entire research area was lightly irrigated to wash any remaining herbicide from the leaves. Once dry, it was mowed to the height of 1 inch. The next day, on July 12, the remaining treatments (9-15) were applied. The process was repeated for the second application on August 21-23. Treatments for this study are presented in Table 1. Plots were evaluated for weed cover (%) biweekly. Weed control (%), for each species separately, was calculated using Henderson-Tilton equation to control effect of non-uniform populations of the weeds. The differences in weed control were assessed using non-parametric Kruskal-Wallis test with Mann-Whitney U-test for pairwise comparisons.

Results:

Most of the herbicides applied in this study yielded significant control; however, the duration of this control varied. By August 21, the date of the last evaluation before publishing this report, the most effective herbicides were Celero (imazosulfuron), Katana (flazasulfuron), and Monument (trifloxysulfuron-sodium). Among them, only Celero demonstrated consistent control of 91-100% across all species. It's crucial to emphasize that the control observed as of August 21 resulted from a single application, as this was the final evaluation before reapplication of products.

For green kyllinga, both Katana and Celero achieved near-perfect control. In the case of purple nutsedge, Celero, Monument, and Certainty (sulfosulfuron; but only pre-mowing) secured 100% control. Meanwhile, for yellow nutsedge, Celero, Certainty, Arkon (pyrimisulfan), and Monument all maintained a comparable control level, ranging from 90-100%.

Statistical analysis didn't identify mowing as a significant factor (data not presented). However, we hypothesize that natural variability between replications could be the reason. It's worth mentioning that, for every herbicide applied on green kyllinga, three herbicide treatments on purple nutsedge, and four herbicide treatments on yellow nutsedge, control levels were numerically higher when the application was made before mowing, compared to those applied post-mowing.

Although this research was carried out on hybrid bermudagrass, it's vital to recognize the differences in the safety of the herbicides used in the study, particularly when weeds are near sensitive turfgrass species. Among the herbicides tested, Dismiss NXT (carfentrazone-ethyl + sulfentrazone) has the widest list of tolerant turfgrass species (15), followed by Arkon (13), Sedgehammer (halosulfuron-methyl; 12), Celero (9), Certainty (8), Katana (5) and Monument (2).

Acknowledgments:

Thanks to Nufarm, PBI-Gordon and Syngenta for providing products and supporting this research.

Table 1. Herbicide treatments and data collected in yellow and purple nutsedge and green kyllinga control study until 8/21/2023. Purple nutsedge control (%), Green kyllinga control (%), Yellow nutsedge control (%). Riverside, CA. 2023.

				Weed control (%)								
Trt No	Treatment	When applied	Rate	Green Kyllinga			Purple Nutsedge			Yellow Nutsedge		
				7/21	8/7	8/21	7/21	8/7	8/21	7/21	8/7	8/21
1	Untreated Control			0 c	0 c	0 f	0 d	0 b	0 b	0 d	0 d	0 b
2	Arkon	Before mowing	3.4 pt/A	92 ab	83 ab	33 ef	100 a	73 ab	60 ab	99 ab	86 bc	92 ab
3	Dismiss NXT	Before mowing	10 fl oz/A	94 ab	73 b	47 cdef	31 cd	33 ab	59 ab	41 bcd	58 c	61 ab
4	SedgeHammer + NIS	Before mowing	1.33 oz/A + 0.25 %v/v	96 ab	91 ab	45 de	100 a	78 ab	93 ab	100 a	84 abc	74 ab
5	Celero + NIS	Before mowing	10 oz/A + 0.25 %v/v	95 ab	100 a	92 ab	100 a	100 a	100 a	100 a	96 abc	93 ab
6	Certainty + NIS	Before mowing	1.25 oz/A + 0.25 %v/v	89 ab	100 a	32 cdef	100 a	100 a	100 a	98 abc	94 abc	100 a
7	Monument + NIS	Before mowing	15 g/A + 0.25 %v/v	92 ab	100 a	84 abcd	98 a	100 a	100 a	79 abc	100 a	93 ab
8	Katana + NIS	Before mowing	3 oz/A + 0.25 %v/v	92 ab	99 a	97 a	100 a	100 a	81 ab	100 a	89 abc	99 ab
9	Arkon	After mowing	3.4 pt/A	91 ab	77 b	24 ef	93 ab	100 a	67 ab	93 abc	94 abc	99 ab
10	Dismiss NXT	After mowing	10 fl oz/A	98 a	51 bc	21 cdef	58 bcd	45 ab	85 ab	40 cd	53 cd	59 ab
11	SedgeHammer + NIS	After mowing	1.33 oz/A + 0.25 %v/v	98 a	78 b	38 cdef	95 ab	94 ab	83 ab	90 abc	84 bc	87 ab
12	Celero + NIS	After mowing	10 oz/A + 0.25 %v/v	77 ab	100 a	91 abc	84 abc	100 a	100 a	99 ab	98 ab	100 a
13	Certainty + NIS	After mowing	1.25 oz/A + 0.25 %v/v	72 ab	99 a	27 bcdef	85 ab	100 a	93 ab	100 a	100 a	96 ab
14	Monument + NIS	After mowing	15 g/A + 0.25 %v/v	85 b	100 a	78 bcd	88 ab	100 a	100 a	88 abc	100 a	88 ab
15	Katana + NIS	After mowing	3 oz/A + 0.25 %v/v	73 ab	100 a	95 a	90 ab	100 a	80 ab	97 abc	82 bc	58 ab

Application timing: A - 7/10-12/2023 B - 8/21-23/2022

Means followed by the same letter in a column are not significantly different (P = 0.05).

Plot Plan for Sedge Control Study

Purple nutsedge	9	5	6	3	14	10	13	7	1	12	10	8
	13	11	10	4	7	5	4	3	14	1	5	4
	12	15	3	1	6	8	12	5	15	2	11	14
	8	4	14	13	9	15	10	11	2	13	7	3
	2	7	1	11	2	12	6	8	9	9	15	6
Green kyllinga	9	5	6	3	14	10	13	7	1	12	10	8
	13	11	10	4	7	5	4	3	14	1	5	4
	12	15	3	1	6	8	12	5	15	2	11	14
	8	4	14	13	9	15	10	11	2	13	7	3
	2	7	1	11	2	12	6	8	9	9	15	6
Yellow nutsedge	9	5	6	3	14	10	13	7	1	12	10	8
	13	11	10	4	7	5	4	3	14	1	5	4
	12	15	3	1	6	8	12	5	15	2	11	14
	8	4	14	13	9	15	10	11	2	13	7	3
	2	7	1	11	2	12	6	8	9	9	15	6

Stop #1b: Summer Patch 2023

Jim Baird, Sandra Glegola, Pawel Orlinski, Taylor Oliver, and Michal Sciblak
Department of Botany and Plant Sciences
University of California, Riverside

Objectives:

This study was conducted to evaluate 18 fungicide treatments to summer patch (*Magnaporthe poae*) disease preventatively on Kentucky bluegrass turf.

Materials and Methods:

The study was initiated on July 1, 2023 on mature Kentucky bluegrass (*Poa pratensis*) turf on a Hanford fine sandy loam. The plot was established in 2022 using a cultivar with confirmed susceptibility to summer patch disease. Turf was mowed 3 days/wk at 1.75 inches and received multiple applications of fertilizer during the study period using ammonium nitrate to elevate pH and favor shoot growth over root growth. In addition, irrigation was provided deeply and infrequently to provide both waterlogged and water stress conditions to favor disease activity.

Fungicide treatments were applied every 14 or 21 days beginning on July 1 (before disease symptoms were present) and ending on September 6 for a total of 4 or 6 applications. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8003VS nozzles calibrated to deliver 2 gallons/1000 ft^2 and watered in immediately after application. Experimental design was a randomized block with 5 replications. Plot size was 4×6 ft with 2-ft alleys.

Plots were evaluated every two weeks visually for turf quality (1-9; 9=best) and summer patch disease severity (0-100% cover) once disease activity was present. Data were analyzed using Analysis of Variance with Fisher's Protected Least Significant Difference (LSD) test (P=0.05).

Results:

No significant differences were observed among treatments until September 3 (Table 1). Although disease distribution was non-uniform across the experimental area, summer patch severity appears to be increasing over time. Of the treatments evaluated, Maxtima fungicide (trt 13) appeared to be the top performing treatment numerically at the time of publication of this report.

Acknowledgments:

Thanks to the CTLF, BASF, Earth Microbial, NuFarm, PBI Gordon, and Syngenta for supporting this research and/or for providing products.

Table 1. Effects of summer patch treatments on turf quality (1-9, 9=best) and disease cover (0-100%). Riverside, CA. 2023.

Trt	Product	Company	Rate (oz/1,000 ft^2)	Frequency	Quality	Cover
					9/3/2023	9/3/2023
1	Control				5.4 ab	17.0 a
2	Briskway	Syngenta	0.7	ACEGIK	5.8 ab	14.4 a
3	Briskway	Syngenta	0.9	ACEGIK	4.6 b	23.0 a
4	Velista	Syngenta	0.5	ACEGIK	5.6 ab	18.0 a
5	Heritage Action	Syngenta	0.4	ACEGIK	5.6 ab	15.0 a
6	Heritage TL	Syngenta	2	A	5.6 ab	17.4 a
6	Velista	Syngenta	0.5	C		
6	Briskway	Syngenta	0.72	E		
6	Velista	Syngenta	0.5	G		
6	Briskway	Syngenta	0.72	I		
6	Heritage TL	Syngenta	2	K		
7	Heritage TL	Syngenta	2	ACEGIK	6.0 ab	12.4 a
8	Tuque exoGEM	Syngenta	2.87	ACEGIK	5.0 ab	23.0 a
9	Tekken	PBI Gordon	3	ADGJ	6.0 ab	13.6 a
10	Xzemplar	BASF	0.26	ACEGIK	5.4 ab	22.0 a
10	MnSO4	-	2 lb/A	ACEGIK		
11	Navicon Intrinsic	BASF	0.85	ACEGIK	5.0 ab	21.0 a
12	Lexicon Intrinsic	BASF	0.47	ACEGIK	5.0 ab	22.0 a
12	MnSO4	-	2 lb/A	ACEGIK		
13	Maxtima	BASF	0.8	ACEGIK	6.6 a	6.2 a
14	Xzemplar	BASF	0.26	ACEGIK	5.8 ab	15.4 a
14	Maxtima	BASF	0.56	ACEGIK		
14	MnSO4	-	2 lb/A	ACEGIK		
15	En-Turf	Earth Microbial	-	ACEGIK	4.4 b	26.0 a
16	En-Turf	Earth Microbial	-	ACEGIK	6.0 ab	12.4 a
16	Heritage TL	Syngenta	1	ACEGIK		
17	Heritage TL	Syngenta	1	ACEGIK	5.6 ab	15.4 a
18	Tourney	NuFarm	0.37	ACEGIK	6.0 ab	9.6 a
				p-value	0.008	0.059

Application Intervals: A = 7/1/23; C = 7/12/23; D = 7/19/23; E = 7/26/23; G = 8/9/23; I = 8/25/23; J = 8/30/23; K = 9/6/23

N

	1	2	3	4	5	6	7	8	9
1	13	6	4	11	8	17	2	16	12
2	18	14	1	7	15	5	9	10	3
3	16	13	6	17	9	3	12	2	10
4	7	4	14	1	11	18	5	15	8
5	13	9	12	2	5	8	17	15	1
6	6	18	7	4	16	10	3	11	14
7	9	12	3	10	6	13	16	18	15
8	8	1	2	5	17	4	7	14	11
9	3	9	6	10	8	14	16	13	15
10	5	12	2	17	11	7	1	4	18

Figure 1. Plot plan for the 2023 summer patch. Riverside, CA.

Stop #2: Herbicide Strategies for Conversion from Existing to Improved Bermudagrasses

Jim Baird, Sandra Glegola, Pawel Orlinski, Marta Pudzianowska,
Taylor Oliver, Julia Gluszkowska and Michal Sciblak
Department of Botany and Plant Sciences
University of California, Riverside

Objectives:

Persistent drought, increasing population, and declining water resources in the western U.S. call for extensive measures to conserve water on turfgrass. One strategy is to use warm-season or C4 grasses that inherently use at least 20% less water than their cool-season or C3 counterparts. However, a challenge with widespread acceptance of warm-season grasses is their winter dormancy in regions with cold temperatures. The UCR turfgrass breeding program is aimed toward developing bermudagrass cultivars with improved winter color retention in the Southwest. Already considered as one the most drought-resistant warm-season turfgrass species in California, to our amazement there exists tremendous variation in bermudagrass genotypes regarding drought resistance. Newer cultivars like 'TifTuf' and soon-to-be released 'Presidio' (UCR 17-8) retained the best green color and quality approaching 30% of reference evapotranspiration in the 2018 National Warm-Season Water Use/Drought Tolerance Test in Riverside, CA (NTEP.org). More recently developed experimental bermudagrass genotypes from UCR can retain color and quality without rainfall or irrigation for more than 50 days during summer months in Riverside, while standard cultivars like 'Tifway II' went completely dormant.

Golf courses in Northern California are switching from cool-season to warm-season turfgrasses on tees, fairways, and rough. In this scenario, conversion is more straightforward since it is usually easier to eradicate cool-season turf with non-selective herbicides like glyphosate and several other herbicides are available to selectively remove cool-season grasses from warm-season turf. The real challenge lies in converting from one warm-season species to another, and especially from bermudagrass to bermudagrass, which would be the most likely scenario in central and southern California as well as most of the Southwest. Several golf courses have already completed conversions including Del Rio CC in Stockton, CA and TPC Summerlin in Las Vegas. At Del Rio, common bermudagrass was sprayed on 14-d intervals with Roundup (glyphosate) + Fusilade (fluazifop) + Turflon Ester (triclopyr) + AMS (ammonium sulfate) followed by the products minus Fusilade followed by Roundup + AMS. Fourteen days after the final application, an asphalt grinder was used to pulverize the dead turf to a depth of 8 inches followed by sprigging with 'Santa Ana' bermudagrass. At TPC Summerlin, common bermudagrass was sprayed on 10-d intervals with Roundup + Fusilade followed by the same cultivation procedure and sodding with 'Bandera' bermudagrass. Time will tell the success of these conversion programs for preventing common bermudagrass reestablishment. Nevertheless, research is warranted to determine the best strategy or strategies for conversion between bermudagrasses, especially in a timely manner, which appears to include a combination of chemicals and cultivation.

In this study, we sought to determine the best herbicide(s) or combinations and number of applications on 3-wk intervals required to eradicate hybrid bermudagrass in anticipation of conversion to an improved hybrid bermudagrass cultivar. We also examined the contribution of continued nitrogen fertilization during the eradication process.

Materials and Methods:

The study was conducted on mature hybrid bermudagrass (*Cynodon* spp.) 'Tifway II' turf on a Hanford fine sandy loam at the UCR Turfgrass Research Facility in Riverside, CA. Turf was mowed 3 x/wk at 0.5 inches. Treatments (Table 1) were first applied on July 20, 2023 and were repeated zero, twice, thrice, or four times on 3-wk intervals using a CO2-powered backpack sprayer equipped with a single TeeJet AI9505E nozzle calibrated to deliver 1 gallon/1000 ft^2. Ammonium sulfate (AMS) was added to each herbicide treatment as an adjuvant to improve glyphosate availability and efficacy. Experimental design was a strip-plot design with 25 treatments randomized and replicated 6 times. Strip plots received 1 lb N/M/2wks (granular 46-0-0) using a 3-ft drop spreader starting one week after initial herbicide application. Turf received non-limiting irrigation throughout the study period. Plot size was 3x3 ft with 1-ft alleys. Plots were evaluated weekly using Digital Image Analysis (DIA) and periodically for visual bermudagrass cover (0-9). Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

Results:

At the time of publishing this report, the third application of herbicides (timing G; trts 14-19) had just taken place, which was too soon for observable results, and the fourth application (timing J; trts 20-25) was scheduled to take place on September 21 (after Field Day). Therefore, for the purpose of discussion of data provided in this report, treatments 14-25 were applied twice just like treatments 8-13 in comparison to the one-time application of treatments 2-7. Although it is too early to identify best treatments, preliminary results point to the obvious conclusion that two applications are better than one for potential bermudagrass eradication, and that tank mix partners with Roundup Pro Concentrate appear to increase efficacy over Roundup alone (Table 2). One notable exception may be treatments containing Segment II herbicide, which appeared to decrease bermudagrass eradication in comparison with other treatments. It is also too early to determine if continued N fertilization helps to increase herbicide efficacy and bermudagrass eradication (Table 3).

Acknowledgments:

Thanks to BASF, Bayer, Corteva Syngenta, Victoria Country Club, the United States Golf Association (USGA) and the California Turfgrass & Landscape Foundation (CTLF) for providing products and/or supporting this research.

Table 1. Herbicide treatments tested for conversion from existing to improved Bermudagrasses.

Trt	Product	Company	Rate		Interval
1	Untreated Control				
2	Roundup Pro Conc.	BAYER	128	fl oz/A	A
2	Ammonium sulfate	-	8.5	lb/100 gal	A
3	Roundup Pro Conc.	BAYER	128	fl oz/A	A
3	Ammonium sulfate	-	8.5	lb/100 gal	A
3	Fusilade II	Syngenta	24	fl oz/A	A
4	Roundup Pro Conc.	BAYER	128	fl oz/A	A
4	Segment II	BASF	40	fl oz/A	A
4	Ammonium sulfate	-	8.5	lb/100 gal	A
5	Roundup Pro Conc.	BAYER	128	fl oz/A	A
5	Turflon Ester Ultra	Corteva	32	fl oz/A	A
5	Ammonium sulfate	-	8.5	lb/100 gal	A
6	Roundup Pro Conc.	BAYER	128	fl oz/A	A
6	Fusilade II	Syngenta	24	fl oz/A	A
6	Turflon Ester Ultra	Corteva	32	fl oz/A	A
6	Ammonium sulfate	-	8.5	lb/100 gal	A
7	Roundup Pro Conc.	BAYER	128	fl oz/A	A
7	Segment II	BASF	40	fl oz/A	A
7	Turflon Ester Ultra	Corteva	32	fl oz/A	A
7	Ammonium sulfate	-	8.5	lb/100 gal	A
8	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
8	Ammonium sulfate	-	8.5	lb/100 gal	AD
9	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
9	Ammonium sulfate	-	8.5	lb/100 gal	AD
9	Fusilade II	Syngenta	24	fl oz/A	AD
10	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
10	Segment II	BASF	40	fl oz/A	AD
10	Ammonium sulfate	-	8.5	lb/100 gal	AD
11	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
11	Turflon Ester Ultra	Corteva	32	fl oz/A	AD
11	Ammonium sulfate	-	8.5	lb/100 gal	AD
12	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
12	Fusilade II	Syngenta	24	fl oz/A	AD
12	Turflon Ester Ultra	Corteva	32	fl oz/A	AD
12	Ammonium sulfate	-	8.5	lb/100 gal	AD
13	Roundup Pro Conc.	BAYER	128	fl oz/A	AD
13	Segment II	BASF	40	fl oz/A	AD
13	Turflon Ester Ultra	Corteva	32	fl oz/A	AD
13	Ammonium sulfate	-	8.5	lb/100 gal	AD
14	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
14	Ammonium sulfate	-	8.5	lb/100 gal	ADG
15	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
15	Ammonium sulfate	-	8.5	lb/100 gal	ADG
15	Fusilade II	Syngenta	24	fl oz/A	ADG
16	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
16	Segment II	BASF	40	fl oz/A	ADG
16	Ammonium sulfate	-	8.5	lb/100 gal	ADG
17	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
17	Turflon Ester Ultra	Corteva	32	fl oz/A	ADG
17	Ammonium sulfate	-	8.5	lb/100 gal	ADG
18	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
18	Fusilade II	Syngenta	24	fl oz/A	ADG
18	Turflon Ester Ultra	Corteva	32	fl oz/A	ADG
18	Ammonium sulfate	-	8.5	lb/100 gal	ADG
19	Roundup Pro Conc.	BAYER	128	fl oz/A	ADG
19	Segment II	BASF	40	fl oz/A	ADG
19	Turflon Ester Ultra	Corteva	32	fl oz/A	ADG
19	Ammonium sulfate	-	8.5	lb/100 gal	ADG
20	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
20	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ
21	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
21	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ
21	Fusilade II	Syngenta	24	fl oz/A	ADGJ
22	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
22	Segment II	BASF	40	fl oz/A	ADGJ
22	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ
23	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
23	Turflon Ester Ultra	Corteva	32	fl oz/A	ADGJ
23	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ
24	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
24	Fusilade II	Syngenta	24	fl oz/A	ADGJ
24	Turflon Ester Ultra	Corteva	32	fl oz/A	ADGJ
24	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ
25	Roundup Pro Conc.	BAYER	128	fl oz/A	ADGJ
25	Segment II	BASF	40	fl oz/A	ADGJ
25	Turflon Ester Ultra	Corteva	32	fl oz/A	ADGJ
25	Ammonium sulfate	-	8.5	lb/100 gal	ADGJ

Application Intervals: A = 7/20/2023; D = 8/10/2023; G = 8/31/2023; J = 9/21/2023

N

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	2	8	13	25	14	9	25	8	21	20	4	10	18	22	17	
2	2	8	13	25	14	9	25	8	21	20	4	10	18	22	17	← Fertilizer
3	5	10	15	6	19	14	18	15	10	6	6	12	23	3	25	← Fertilizer
4	5	10	15	6	19	14	18	15	10	6	6	12	23	3	25	
5	20	18	7	3	21	17	12	22	1	7	1	11	16	14	20	← Fertilizer
6	20	18	7	3	21	17	12	22	1	7	1	11	16	14	20	
7	24	22	12	11	1	16	23	5	13	19	21	15	9	2	7	
8	24	22	12	11	1	16	23	5	13	19	21	15	9	2	7	← Fertilizer
9	16	9	17	4	23	3	11	2	24	4	8	19	13	24	5	← Fertilizer
10	16	9	17	4	23	3	11	2	24	4	8	19	13	24	5	

Figure 1. Plot plan for the 2023 conversion trial. Riverside, CA.

Table 2. Effects of herbicide treatments on visual cover (1-9, 9=best) of Bermudagrasses conversion on 8/2/2023. Riverside, CA. 2023.

Visual Cover																			
Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer	
1	8.9	a	9	a															
2	5	b	4	bc	8	2.1	bc	2.9	bc	14	1.6	c	2.3	bc	20	2.3	bc	2.4	bc
3	3.4	bc	3.7	bc	9	1.9	bc	1.3	c	15	1.7	bc	2.7	bc	21	1.6	bc	2	bc
4	3.5	bc	3.2	bc	10	2.3	bc	2.5	bc	16	2.6	bc	3.3	bc	22	1.8	bc	2.4	bc
5	3.9	bc	4.2	bc	11	1.2	c	2.3	bc	17	1.6	c	1	c	23	1.7	bc	1.4	c
6	3.8	bc	3.6	bc	12	1.2	c	1.9	bc	18	1.4	c	1.5	c	24	1.9	bc	1.8	bc
7	3.3	bc	3.4	bc	13	1.7	bc	1.8	bc	19	2.1	bc	2.3	bc	25	1.4	c	1.6	c

Means followed by the same letter in a column are not significantly different (P=0.05).

Table 3. Effects of herbicide treatments on percent green cover (%) of Bermudagrasses conversion on 7/31/2023. Riverside, CA. 2023.

%Green Cover																			
Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer		Trt	No fertilizer		Fertilizer	
1	72.066	a	66.098	a															
2	0.962	b	0.577	b	8	0.152	b	0.072	b	14	0.033	b	0.081	b	20	0.143	b	0.097	b
3	0.361	b	0.401	b	9	0.028	b	0.034	b	15	0.045	b	0.077	b	21	0.040	b	0.106	b
4	0.448	b	0.147	b	10	0.224	b	0.070	b	16	0.216	b	0.129	b	22	-0.001	b	0.148	b
5	0.482	b	0.869	b	11	0.062	b	0.014	b	17	0.062	b	0.020	b	23	0.071	b	0.014	b
6	0.567	b	0.474	b	12	0.018	b	0.033	b	18	0.016	b	0.015	b	24	0.038	b	0.021	b
7	0.152	b	0.333	b	13	0.032	b	0.065	b	19	0.156	b	0.274	b	25	0.078	b	0.033	b

Means followed by the same letter in a column are not significantly different (P=0.05).

Stop #3: 2023 NTEP Seashore Paspalum Test; Evaluation of Bermudagrass Under Low Light Conditions

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2023 NTEP Seashore Paspalum Test

Objectives:

The National Turfgrass Evaluation Program (NTEP) facilitates evaluation of turfgrass species in various areas of the United States and Canada, providing valuable information for individuals, companies, researchers, and other entities in thirty countries. Seashore paspalum, despite being less utilized than bermudagrass, can provide good playing surface for golf courses and sports fields irrigated with saline water. The objective of this study is to evaluate seashore paspalum lines under fairway mowing height.

Materials and Methods:

The study includes six lines and one cultivar ('Sea Isle I') of seashore paspalum, developed by the University of Georgia (UGA) and MVP Genetics. The study was planted at UC Riverside, CA on 07/27/2023 on a Hanford fine sandy loam in three replicates. Forty-eight plugs per 6 x 6 ft plot were used. Plots are currently establishing, and establishment rate, expressed as percent cover, is being evaluated. After full establishment is reached, they will be mowed at 0.5 inches with a reel mower.

Results:

Most of the entries did not differ significantly in establishment after one month, and showed similar establishment rate to the standard entry, 'Sea Isle I' (Table 1). The highest coverage was reached by UGP 430 (62.7%), while the lowest by UGA 17-330 (34.4%). Both entries were developed at the University of Georgia.

Acknowledgments:

Thanks to the National Turfgrass Evaluation Program (NTEP) for support of this research.

Table 2. Establishment (percent cover) of seashore paspalum entries in 2023 National Turfgrass Evaluation Program; Riverside, CA, 2023.

Code	Source	Establishment			
		8/3/2023		8/29/2023	
MVP-DCC	MVP Genetics	8.4	ab	57.0	ab
UGA 16-111	University of Georgia	9.5	ab	53.7	ab
UGA 16-1253	University of Georgia	4.7	b	54.8	ab
UGA 17-330	University of Georgia	5.9	b	34.4	b
UGP 312	University of Georgia	6.7	ab	50.5	ab
UGP 430	University of Georgia	7.9	ab	62.7	a
Sea Isle I	Standard entry	13.3	a	56.8	ab

Means followed by the same letter in a column are not significantly different (P=0.05).

Plot Plan for 2023 NTEP Seashore Paspalum Test

N

UGA 16-1253	UGA 16-111	MVP-DCC	Sea Isle I	UGP 312	UGA 17-330	UGP 430
MVP-DCC	UGA 16-1253	UGA 17-330	UGA 16-111	UGP 430	UGP 312	Sea Isle I
UGA 17-330	UGP 430	Sea Isle I	UGP 312	MVP-DCC	UGA 16-1253	UGA 16-111

Evaluation of Bermudagrass Under Low Light Conditions

Objectives:

Bermudagrass is the most widely utilized warm-season turfgrass species in California, due to its excellent drought tolerance, high overall quality and good traffic tolerance. One of the disadvantages of this species is poor shade tolerance, which limits its use in tree-dominated landscapes. The objective of this study is to evaluate performance of bermudagrass lines developed at UCR under shade stress.

Materials and Methods:

The study includes 35 UCR experimental bermudagrass lines, two recently patented UCR lines: ‘Coachella’ (UCR TP 6-3) and ‘Presidio’ (UCR 17-8), and four cultivars (‘Latitude 36’, ‘Santa Ana’, ‘TifTuf’, ‘Tifway’). The study was planted in three replicates at UCR, Riverside, CA on 07/23/2021. Plants were established and are maintained under shade cloth (60% shade).

Results:

Significant differences in establishment were observed among UCR lines and cultivars (Table 2). UCRC180211 was the fastest to establish, while ‘Latitude 36’, UCRC180041, and UCRC180133 were the slowest. UCRC180211 had also high overall turfgrass quality and relatively good density, placing it as the top performer so far. Other entries with high overall quality and density were UCRC190640 and UCRC180217.

Acknowledgments:

Thanks to the CTLF, USGA, MWD, and WMWD for support of this research.

Table 2. Establishment (% cover on 4/14/2022), turfgrass quality (1-9; 9=best), and density (1-9; 9=highest), of 35 UCR hybrids selected for roughs/lawns, ‘Presidio’ (UCR 17-8), ‘Coachella’ (UCR TP6-3) and 5 bermudagrass cultivars at UCR, Riverside, 2022-2023.

Code	Establishment		Turfgrass Quality		Density	
UCRC180009	13.3	abcd	2.5	ab	2.3	bc
UCRC180037	10.6	bcd	3.8	ab	3.7	abc
UCRC180038	10.8	bcd	2.3	ab	2.3	bc
UCRC180040	13.2	abcd	2.8	ab	2.7	abc
UCRC180041	5.9	d	1.7	b	1.7	bc
UCRC180049	8.6	bcd	2.2	b	1.3	c
UCRC180127	28.7	abcd	3.3	ab	3.3	abc
UCRC180133	5.2	d	2.3	ab	2.0	bc
UCRC180170	9.6	bcd	3.0	ab	3.0	abc
UCRC180174	18.8	abcd	3.7	ab	3.3	abc
UCRC180176	17.2	abcd	3.2	ab	3.3	abc
UCRC180177	11.4	bcd	3.0	ab	2.7	abc
UCRC180200	12.7	abcd	3.2	ab	2.3	bc
UCRC180211	50.3	a	4.8	a	4.0	ab
UCRC180216	39.0	abcd	3.2	ab	3.7	abc
UCRC180217	29.9	abcd	4.0	ab	5.0	a
UCRC180589	15.1	abcd	2.2	b	2.0	bc
UCRC180609	17.2	abcd	3.2	ab	3.0	abc
UCRC180617	14.9	abcd	4.2	ab	3.0	abc
UCRC190055	36.5	abcd	2.3	ab	3.0	abc
UCRC190073	25.5	abcd	2.3	ab	2.0	bc
UCRC190084	25.8	abcd	3.3	ab	3.0	abc
UCRC190105	43.0	abcd	3.3	ab	3.0	abc
UCRC190127	22.0	abcd	4.0	ab	4.0	ab
UCRC190280	12.4	abcd	3.5	ab	2.7	abc
UCRC190304	21.7	abcd	2.7	ab	3.0	abc
UCRC190499	46.3	ab	4.0	ab	3.7	abc
UCRC190584	31.0	abcd	3.5	ab	3.0	abc
UCRC190640	19.8	abcd	4.8	a	5.0	a
UCRC190687	25.6	abcd	2.8	ab	2.3	bc
UCRC190698	45.0	abc	3.5	ab	3.0	abc
UCRC190741	14.9	abcd	1.7	b	1.7	bc
UCRC190750	14.7	abcd	3.5	ab	4.0	ab
Presidio (UCR 17-8)	21.0	abcd	3.0	ab	2.7	abc
Coachella (UCR TP6-3)	10.8	bcd	3.0	ab	2.3	bc
Latitude 36	4.6	d	3.7	ab	3.3	abc
Santa Ana	17.8	abcd	2.7	ab	2.0	bc
Tahoma 31	7.0	cd	2.2	b	2.0	bc
TifTuf	14.5	abcd	3.8	ab	3.3	abc
Tifway	12.4	abcd	3.8	ab	3.3	abc

Means followed by the same letter in a column are not significantly different (P=0.05).

Plot Plan for 2023 Evaluation of Bermudagrass Under Low Light Conditions

N

UCRC180049	UCRC180211	UCRC180133	UCRC180170	UCRC190127	UCRC180177	UCRC180037	UCRC190584	UCRC190687	UCRC190499
TifTuf	UCRC180009	Tahoma 31	Latitude 36	UCRC180041	UCRC190640	Santa Ana	UCRC190280	UCRC180617	Coachella
UCRC180174	UCRC180127	UCRC180200	UCRC190698	UCRC180176	UCRC190750	UCRC180589	UCRC180040	Presidio	UCRC180217
UCRC190105	Tifway	UCRC180609	UCRC190073	UCRC180038	UCRC190741	UCRC190055	UCRC190304	UCRC180216	UCRC190084
UCRC180617	Presidio	Santa Ana	UCRC190741	UCRC190304	UCRC190687	UCRC180176	UCRC180211	UCRC190280	Latitude 36
UCRC180216	UCRC180177	Coachella	UCRC180049	TifTuf	UCRC180127	UCRC180200	UCRC180037	Tifway	UCRC180041
UCRC180217	UCRC190084	UCRC180040	UCRC190055	Tahoma 31	UCRC180009	UCRC180133	UCRC190127	UCRC180038	UCRC180609
UCRC190584	UCRC180589	UCRC190750	UCRC190640	UCRC180174	UCRC190105	UCRC190698	UCRC190499	UCRC190073	UCRC180170
UCRC190687	UCRC190127	UCRC180038	UCRC180127	UCRC190584	Latitude 36	UCRC180216	UCRC180009	Santa Ana	UCRC180049
UCRC190055	UCRC190304	UCRC190741	UCRC190105	UCRC180211	UCRC190084	UCRC180617	UCRC190640	UCRC180177	Tahoma 31
UCRC190499	UCRC180037	UCRC180041	UCRC190280	Tifway	UCRC180200	Presidio	TifTuf	UCRC180133	UCRC180589
UCRC180609	UCRC180176	UCRC190698	UCRC180170	UCRC190750	UCRC180217	UCRC190073	UCRC180174	UCRC180040	Coachella

‘Coachella’ – known under experimental code UCR TP6-3

‘Presidio’ – known under experimental code UCR 17-8

Stop #4: Traffic Tolerance and Divot Recovery of ‘Presidio’ (UCR 17-8), ‘Coachella’ (UCR TP6-3), ‘Santa Ana’, and ‘TifTuf’ Hybrid Bermudagrasses

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Objectives:

New hybrid bermudagrass (*Cynodon dactylon x. C. transvaalensis*) cultivars including ‘Presidio’ (UCR 17-8), ‘Coachella’ (UCR TP6-3), and ‘TifTuf’ possess improved winter color and drought resistance, yet little is known about their wear tolerance and recovery from divoting. This research aimed to compare these newer cultivars in addition to the longstanding cultivar ‘Santa Ana’ for their responses to cart traffic and divoting.

Materials and Methods:

Four cultivars were established from plugs on 1-ft centers on April 8, 2022. Soil was a Hanford fine sandy loam. Individual plots measured 20 x 22 ft with 3 replications/cultivar. Once established, turf was maintained at 0.5 inches 3x/wk. In 2023, fertilization was targeted at 5 lbs N/M divided into six events. Specifically, 1 lb of N was applied in May and June followed by 0.5 lb of N in July, August, September, and October. The study area was topdressed with sand monthly during the growing season and irrigation was adjusted between 50-60% ETo since these newer cultivars are known to possess improved drought resistance. Traffic treatments were initiated on May 22, 2023. Ten linear passes were made 3 times/wk for a total of 30 passes using an E-Z-GO MPT 48v Work Ready Golf Cart with a weight of 1040 lbs while rapidly turning the wheel back and forth to create added friction and wear. In other areas of the plots, simulated golf club divots were created using a cup cutter to remove a layer of turf like a divot and then replacing the void with sand. Turfgrass performance was evaluated biweekly for Difference Vegetation Index (NDVI; 0-1), dark green color index (DGCI) and green cover using Digital Image Analysis (DIA). Data were collected with the assistance of drone cameras for precise and efficient data collection. Data were analyzed using Analysis of Variance with Tukey’s honest significant difference (HSD) test (P=0.05).

Results:

All four cultivars demonstrated stable NDVI values under both traffic and non-traffic scenarios (Table 1). Turf green cover also remained stable across all cultivars during three measurement dates (Table 2). However, as our study is ongoing, we anticipate further insights into these responses as we continue data collection and analysis over 4 seasons and multiple years, ultimately enhancing our understanding. It's crucial to acknowledge that these results are preliminary and that our study is ongoing. We anticipate that the results may differ as the study progresses. Factors such as seasonality, long-term exposure to traffic, and changing environmental conditions can all play roles in shaping the relationships among traffic, divot recovery, and turf health.

Acknowledgments:

Thanks to the CTLF, USGA, MWD, WMWD, and West Coast Turf for their support of this research.

Bermudagrass Plot Plan

TifTuf	Presidio	Santa Ana
Traffic lane	Traffic lane	Traffic lane
Coachella	Santa Ana	Presidio
Traffic lane	Traffic lane	Traffic lane
Presidio	Coachella	TifTuf
Traffic lane	Traffic lane	Traffic lane
Santa Ana	TifTuf	Coachella
Traffic lane	Traffic lane	Traffic lane

Table 1. Effect of traffic stress on normalized difference vegetation index (NDVI, 0-1) of bermudagrass hybrids. Riverside, CA. 2023.

		NDVI											
No.	**Entry**	5/22/2023		6/19/2023		7/3/2023		7/17/2023		8/2/2023		8/14/2023	
		Non-Traffic	Traffic	Non-Traffic	Traffic	Non-Traffic	Traffic	Non-Traffic	Traffic	Non-Traffic	Traffic	Non-Traffic	Traffic
1	Coachella	0.60	0.57	0.64	0.61	0.63	0.59	0.65	0.64	0.62	0.60	0.60	0.57
2	TifTuf	0.61	0.57	0.63	0.62	0.63	0.59	0.64	0.61	0.63	0.58	0.61	0.58
3	Santa Ana	0.61	0.57	0.63	0.61	0.62	0.60	0.64	0.64	0.61	0.59	0.61	0.57
4	Presidio	0.62	0.56	0.65	0.59	0.62	0.59	0.63	0.64	0.63	0.58	0.62	0.56
	p-value	0.85	0.944	0.884	0.794	0.951	0.895	0.894	0.648	0.906	0.811	0.853	0.902

Means followed by the same letter in a column are not significantly different (P=0.05).

Table 2. Green turf cover (%) and dark green color index (DGCI, 0-0.66) results for four divots made on 7/19/2023 for each repetition, using a 4.25 inch diameter cup cutter. Riverside, CA. 2023.

No.	**Entry**	**Cover**			**DGCI**		
		8/15/2023	8/23/2023	8/30/2023	8/15/2023	8/23/2023	8/30/2023
1	Coachella	80	82	86	0.464	0.461	0.459
2	TifTuf	86	81	79	0.491	0.461	0.459
3	Santa Ana	82	81	86	0.477	0.464	0.475
4	Presidio	86	85	83	0.49	0.464	0.461
p-value		0.582	0.909	0.278	0.190	0.988	0.290

Means followed by the same letter in a column are not significantly different (P=0.05).

Stop #5: Evaluation of Fungicides for Control of Rapid Blight Disease on Annual Bluegrass Greens

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Introduction:

Increasing salinity issues caused by insufficient precipitation, drought, and increasing use of alternative non-potable sources of irrigation water are inevitable for turf and landscape plants in the southwestern United States. Most golf course superintendents in California who manage annual bluegrass putting greens are faced with managing salinity resulting from use of reclaimed irrigation water and/or salt accumulation during extended drought.

Rapid blight, caused by the terrestrial slime mold *Labyrinthula terrestris*, was first discovered as a disease of turfgrass in the early part of this century. Since then, it has been found in at least 11 states in the U.S. including California. As the name implies, rapid blight symptoms appear quickly as water-soaked patches, which soon coalesce into large dead areas. In California, the disease is most severe on annual bluegrass (*Poa annua*) greens, but also can be troublesome on *Poa trivialis* and perennial ryegrass in overseeded turf, particularly in Arizona. Almost always, rapid blight is associated with elevated sodium chloride caused by poor irrigation water and/or extensive periods without rainfall or sufficient leaching of salts. Historically, only a few fungicides have provided effective control of rapid blight, including pyraclostrobin (Insignia, Lexicon, Navicon), trifloxystrobin (Compass), and mancozeb (Fore). More recently, our research identified penthiopyrad (Velista), fluazinam (Secure), chlorothalonil + acibenzolar (Daconil Action), and potassium phosphite (Appear II) as additional products with activity against this disease or salinity related stress.

Objectives:

This study was conducted to evaluate various fungicide and biostimulants treatments for management of salinity and rapid blight (*Labyrinthula terrestris*) disease on annual bluegrass maintained as a golf course putting green.

Materials and Methods:

The study was conducted on a 5,400-ft^2 research putting green that was constructed according to USGA recommendations in 2019. A 12-inch sand and peat rootzone mix was derived to simulate a mature putting green with a minimum allowable infiltration rate. Gravel and drainage were installed below the rootzone layer. The green was established with *Poa annua* var. *reptans* 'Two Putt' seed in the spring 2019 and thin or bare areas of turf following the 2019-2022 studies were seeded again in spring 2023. Turf was mowed at 0.125 inches 5 times/wk and received Primo Maxx at 0.125 oz/M biweekly and Revolution at 6 oz/M monthly. Granular fertilizer (Best Micro Green 15-5-8 + 5% Fe; J.R. Simplot) was applied monthly at 0.5 lb N/M and liquid fertilizer was applied at a rate of 0.125 lbs N/1000 ft^2/2 wks beginning the first week of July 2023 using various sources. To control diseases other than rapid blight (e.g., summer patch and *Pythium*), fungicides including Maxtima, Heritage TL, and Subdue Maxx were applied alone or in various combinations every 2 wks throughout the study period.

A total of 18 treatments including an untreated control were evaluated in this study. The list of products and timing of application are presented in Table 1. The plot plan can be found in Fig. 1. Treatments were applied every 14 or 21 days beginning on July 3, 2023. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8003VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Experimental design was a randomized block with 5 replications. Plot size was 4×6 ft with 2-ft alleys. Starting from July 19, plots were irrigated with saline water (electrical conductivity = EC = 4.4 dS/m) using a combination of the automatic irrigation system and hand watering. Saline water was made by mixing salts in potable water within two 5000-gal storage tanks containing submersible pumps for mixing and agitation. Saline water ion composition was based on Colorado River water (personal communication, D.L. Suarez, USDA-ARS Salinity Laboratory) and contained elevated concentrations of salts including Na^+, Cl^-, and SO_4^{2-} but nominal HCO_3^- and CO_3^{2-}. Saline water used to irrigate plots was classified as very high in salinity. Total salinity of the water was chosen to simulate an extreme, but realistic irrigation salinity for turf in California (personal communication, M. Huck).

Data collection consisted of bi-weekly visual turfgrass quality (1-9; 9=best) and disease cover (0-100%). Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

Results:

There was complete turf cover at the start of the experiment, but with daytime temperatures reaching 100F+ on a regular basis in July and August coupled with the onset of saline irrigation on July 19, turf rapidly declined in areas where turf loss had occurred during previous years. Switching to saline irrigation resulted in much poorer distribution uniformity adue to a faulty pump from the saline tanks. Even though the plot area was supplemented daily with hand watering, turf decline occurred rapidly due to drought stress. Plots that were affected by drought stress (water effect) and not potential rapid blight disease were separated in the statistical analysis from those plots that did not suffer from lack of water (no water effect). At the time of publishing this report, it was not certain if rapid blight disease was present. Although omitting half of the plots jeopardized the power of this experiment in terms of identifying potential treatment differences, it was interesting to note that fungicides previously known or determined by UCR to be effective against rapid blight disease appear to be among the best performers once again in this year's study.

Acknowledgments:

Thanks to the CTLF, Aquatrols, BASF, Brandt, Corteva, Earth Microbial, Exacto, PBI Gordon, and Syngenta for supporting this research and/or for providing products.

Table 1. Effects of salinity treatments on turf quality (1-9, 9=best) and disease cover (0-100%) of annual bluegrass turf on 8/30/2023. Riverside, CA. 2023.

Trt	Product	Company	Rate (oz/1,000 ft^2)	Interval	Quality		Cover	
					Water effect	No water effect	Water effect	No water effect
1	Control				4.8	6.0	35.0	35.0
2	Pillar SC	BASF	1	ACEGIK	5	5.7	35.0	20.0
2	Encartis	BASF	4	ACEGIK				
3	Navicon Intrinsic	BASF	0.7	ACEGIK	5	5.7	50.0	17.7
3	Secure	Syngenta	0.5	ACEGIK				
4	Insignia SC Intrinsic	BASF	0.7	ACEGIK	4.3	7.0	38.3	8.0
4	Fore	Corteva	8	ACEGIK				
5	Lexicon Intrinsic	BASF	0.47	ACEGIK	3.5	6.0	60.0	10.0
5	Secure	Syngenta	0.5	ACEGIK				
6	Tekken	PBI Gordon	3	ADGJ	4	5.3	62.5	30.0
7	Kabuto	PBI Gordon	0.5	ACEGIK	4	5.7	65.0	23.3
8	Kabuto	PBI Gordon	1	ACEGIK	4.5	6.7	50.0	9.0
9	Ascernity	Syngenta	1	ACEGIK	3.7	6.0	58.3	15.0
10	Velista	Syngenta	0.5	ACEGIK	4	6.0	56.7	20.0
11	Tuque exoGEM	Syngenta	1.5	ACEGIK	4	6.0	50.0	21.7
12	Secure Action	Syngenta	0.5	ACEGIK	4	5.5	51.7	27.5
13	Ascernity	Syngenta	1	ACEGIK	4	6.3	45.0	15.0
13	Secure Action	Syngenta	0.5	ACEGIK				
14	Velista	Syngenta	0.5	ACEGIK	4	5.7	57.5	26.7
14	Secure Action	Syngenta	0.5	ACEGIK				
15	Tuque exoGEM	Syngenta	1.5	A	4.7	6.0	41.7	12.5
15	Secure Action	Syngenta	0.5	C				
15	Velista	Syngenta	0.5	E				
15	Secure Action	Syngenta	0.5	G				
15	Ascernity	Syngenta	1	I				
15	Velista	Syngenta	0.5	K				
16	Velista	Syngenta	0.5	ACEGIK	4.5	6.0	52.5	10.0
16	Appear II	Syngenta	6	ACEGIK				
17	Daconil Action	Syngenta	3.5	ACEGIK	3.5	6.0	67.5	18.3
17	Appear II	Syngenta	6	ACEGIK				
18	En-Turf	Earth Microbial		ACEGIK	4.5	5.7	47.5	25.0
18	Navicon Intrinsic	BASF	0.35	ACEGIK				
18	Secure	Syngenta	0.25	ACEGIK				
				p-value	0.77	0.46	0.73	0.17

Means followed by the same letter in a column are not significantly different (P=0.05).

Application Intervals: A = 7/3/23; C = 7/12/23; D = 7/19/23; E = 7/26/23; G = 8/9/23; I = 8/25/23; J = 8/30/23; K = 9/6/23.

N

	1	2	3	4	5	6	7	8	9
1	5	8	11	17	1	16	12	14	3
2	7	10	4	13	2	6	15	18	9
3	3	4	16	12	10	13	18	1	5
4	6	7	9	14	2	17	11	8	15
5	8	12	7	18	3	14	11	15	4
6	6	16	2	13	10	5	9	17	1
7	9	10	11	1	12	13	14	18	4
8	15	16	2	5	8	7	3	6	17
9	17	9	16	11	18	1	5	7	12
10	6	13	4	3	14	2	10	15	8

Figure 1. Plot plan for the 2023 salinity trial. Riverside, CA.

Stop #6a: Chemical Programs for Water Conservation on Bermudagrass Turf Using a Linear Gradient Irrigation System

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Objectives:

Water conservation in the United States has become a critical concern in recent years due to increased awareness of water scarcity and environmental sustainability. Efficient water management on U.S. golf courses and turf facilities has become a top priority. The primary focus of this study was to examine the effectiveness, benefits, and best practices for promoting water conservation using a Linear Gradient Irrigation System (LGIS). We aim to provide valuable insights into achieving water conservation by considering the complex relationship between irrigation and chemical programs for bermudagrass. After years of testing multiple water conservation products, our research has shown that adequate nitrogen (N) fertility, soil surfactants, fungicides, and mineral oils can enhance turfgrass quality while reducing water usage. This has prompted us to explore alternative, cost-effective products to replace existing ones.

In this study, we evaluated eight different program combinations to identify the most efficient approach for water conservation when using LGIS.

Materials and Methods:

The LGIS study area consisted of hybrid bermudagrass 'Tifway 419' mowed at 0.5 inches. The area received 3 lbs N/1000 ft^2 in 0.5- or 1.0-lb increments in 2023 prior to the start of the study. When the experiment was in progress, only the center irrigation line provided water to experimental plots. The placement of the center-line sprinklers is 1/3 of normal spacing to allow for a gradient of irrigation from well-watered near the center to close to zero irrigation at the distant ends of the plots.

For the study, the trial area was divided into 32 plots, 3 feet wide by 48 feet long. Dots were made every 6 feet to serve as reference points in the experiment to collect gradient distribution data using reference evapotranspiration (ETo) factors based on catch can tests. In addition, these points are the designation for the longitude and latitude in the pictures taken with drone cameras. Treatments were applied on 3-ft x 48-ft plots, with each treatment replicated 4 times (two on each side of the field). Furthermore, each plot has its own paired control next to it. List of treatments, rates, and application timings is provided in Table 1, and plot plan is presented in Figure 1. The study was initiated on June 29, 2023. All plots received non-limiting irrigation until July 31, 2023 when we switched to centerline sprinklers that applied 75% ETo divided into 4 irrigation days/wk. For treatments requiring irrigation after application, all sprinklers were used to apply 0.2 inches of water uniformly across the entire plots. Therefore, once centerline irrigation was started, the far ends of plots received 0.2 inches of water following treatment applications every 2 wks only. Turfgrass performance was evaluated biweekly for Difference Vegetation Index (NDVI; 0-1), dark green color index (DGCI) (0-0.666); and green cover using Digital Image Analysis (DIA). Data were collected with the assistance of drone cameras for precise and efficient data collection. In addition, soil volumetric water content (VWC; %) was collected at a 3-inch depth using a Field Scout 350. Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

Results:

Currently, there are no statistically significant differences among the treatment groups in our study. The research is ongoing, and data analysis continues. However, it's worth noting that a significant natural precipitation event (>2 inches of rainfall) disrupted our experiments on August 21. Given the complexity of factors involved in achieving water conservation through LGIS and related chemical programs for bermudagrass, it may take additional time to draw conclusive results. Updates will be provided as our study progresses, providing a more comprehensive understanding of water conservation practices.

Acknowledgments:

Thanks to Aqua-Aid, Intelligro, Ocean Organics, Bayer, Simplot, Syngenta, Harell's, MAX and the California Turfgrass & Landscape Foundation (CTLF) for providing products and/or supporting this research.

Table 1. Treatments applied on the linear gradient irrigation study. Riverside, CA. 2023.

Trt	Product	Company	Rate		Interval
1	Appear II	Syngenta	6	fl oz/1000ft^2	ACEGIKM
2	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
2	Ambient Plus	Simplot	8	fl oz/A	ACEGIKM
3	Signature XTRA Guard	BAYER	4	fl oz/1000ft^2	ACEGIKM
4	Civitas	Intelligro	8.5	fl oz/1000ft^2	ACEGI
5	OO-WJ	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
5	OO-SRX	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
5	OO-XPN	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
5	OO-GG	Ocean Organics	8	fl oz/1000ft^2	ACEGIKM
6	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
6	Ambient Plus	Simplot	8	fl oz/A	ACEGIKM
6	Excalibur	Aqua-Aid	3	fl oz/1000ft^2	AEIM
7	UMAXX	-	2	oz/1000ft^2	ACEGIKM
7	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
7	Ambient Plus	Simplot	8	fl oz/A	ACEGIKM
8	UMAXX	-	2	oz/1000ft^2	ACEGIKM
8	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
8	Ambient Plus	Simplot	8	fl oz/A	ACEGIKM
8	Excalibur	Aqua-Aid	3	fl oz/1000ft^2	AEIM

Application Intervals: A = 6/29/23; C = 7/5/23; D = 07/19/23; E = 07/26/23; G = 08/09/23; I = 08/23/23; J = 08/30/23; K = 09/06/23; M = 09/20/23.

Rep 1																Rep 2															
Control	Trt 1	Control	Trt 2	Control	Trt 3	Control	Trt 5	Control	Trt 7	Control	Trt 8	Control	Trt 6	Control	Trt 4	Control	Trt 5	Control	Trt 3	Control	Trt 6	Control	Trt 2	Control	Trt 8	Control	Trt 1	Control	Trt 4	Control	Trt 7
Control	Trt 6	Control	Trt 8	Control	Trt 5	Control	Trt 7	Control	Trt 4	Control	Trt 1	Control	Trt 3	Control	Trt 2	Control	Trt 8	Control	Trt 3	Control	Trt 5	Control	Trt 4	Control	Trt 6	Control	Trt 7	Control	Trt 1	Control	Trt 2
Rep 4																Rep 3															

Figure 1. Plot plan for 2023 linear gradient irrigation system.

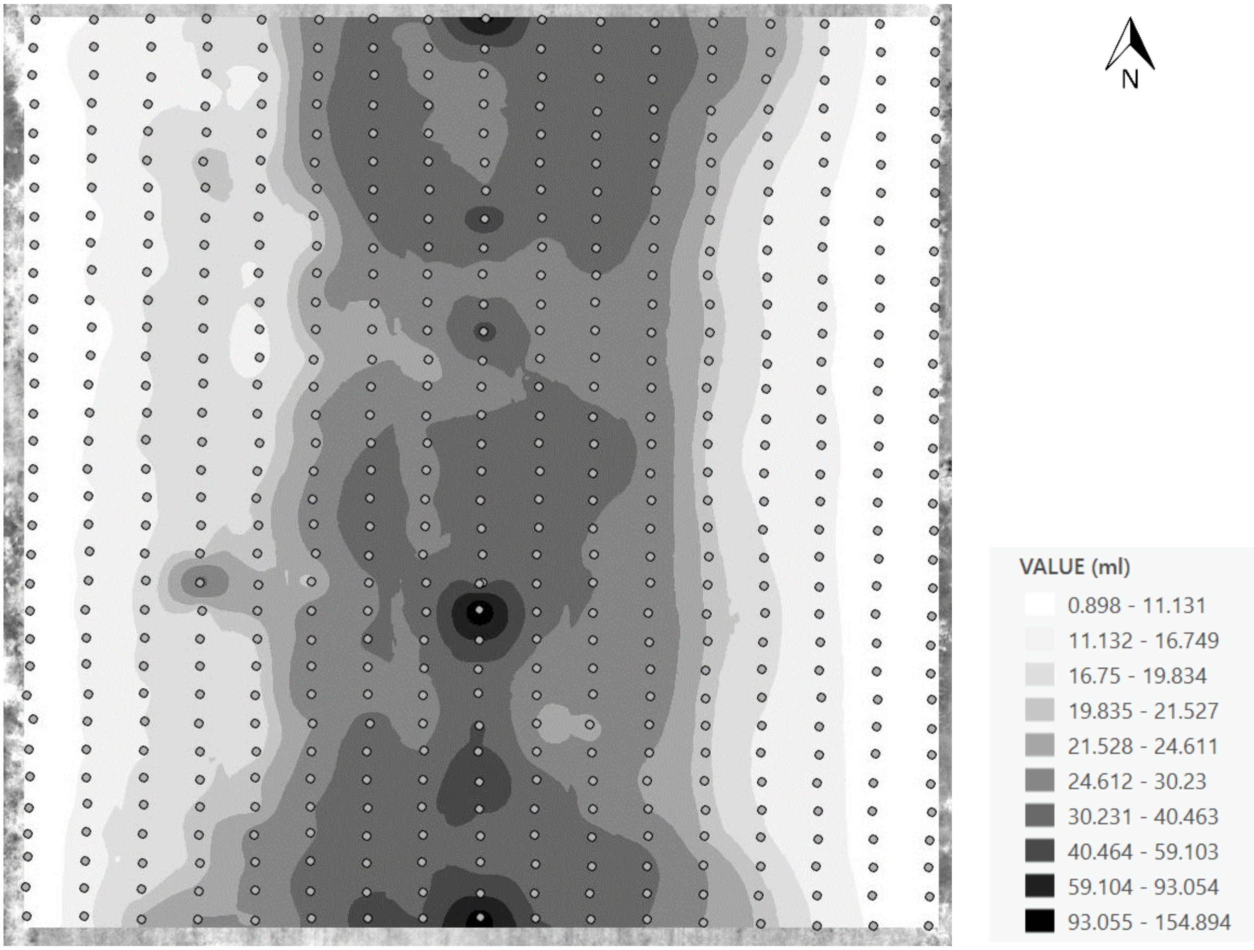

Figure 2. Linear gradient irrigation system (LGIS) gradient distribution based on catch can tests.

Stop #6b: Evaluation of Products for Water Conservation on Bermudagrass Turf

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Introduction:

Water scarcity is a pressing issue in California, a state famous for its dry weather and frequent droughts. In this context, people are paying closer attention to how much water golf courses use for maintenance. With sustainability becoming a top priority in various industries, there's a growing need to find creative ways to reduce water consumption on golf courses while still ensuring that the grass stays healthy and looks good. One promising method to achieve this is deficit irrigation. This method involves intentionally watering turf with less than its ideal requirements. To maintain the quality and essential characteristics of turfgrass during reduced irrigation, there are several products that can be employed. These include soil surfactants (wetting agents), fertilizers, and plant growth regulators (PGRs). Additionally, products like fungicides, mineral oils, pigments, and biostimulants including living microorganisms have shown potential in helping the grass cope with drought stress.
The objective of this study is to evaluate the effectiveness of different products for managing bermudagrass turf under deficit irrigation. By assessing their performance, we aim to identify valuable solutions for maintaining the health and appearance of the grass while conserving water.

Materials and Methods:

The study was conducted on hybrid bermudagrass (*Cynodon* spp.) 'Tifway II' turf on a Hanford fine sandy loam. Turf was mowed 3 days/wk at 0.5 inches. Treatments were applied using a CO_2-powered backpack sprayer equipped with a single TeeJet AI9505E nozzle calibrated to deliver 1 gallon/1000 ft^2. Experimental design was a split-plot design with 25 treatments (Table 1) randomized and replicated 6 times. Plot size was 3x3 ft with 1-ft alleys. The study was initiated on June 29, 2023. All plots received non-limiting irrigation until July 31, 2023 when deficit irrigation was introduced to 50% ETo using hand watering to deliver a known volume of water per unit time. Plots were evaluated biweekly for visual quality (1-9, 9 = best), Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker instrument, soil volumetric water content (VWC; %) at 3-inch depth using a Field Scout 350, and dark green color index (DGCI) as well as percent cover using Digital Image Analysis (DIA). Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

Results:

First significant differences in visual quality among treatments were observed on 7/24/2023. Treatments containing pigment, 16 (Civitas), 17 (Appear II) and 22 (Gary's Green Ultra, Title Phyte + Ambient Plus + Primo Maxx + Excalibur), resulted in higher visual quality compared to the other treatments. Furthermore, those three treatments also maintained high levels of green cover and DGCI (Table 2). Treatment 24 (Anuew) consistently performed the worst across all three dependent variables. However, these are only preliminary results from one month of evaluation. We expect results to be different by the end of the growing season.

Acknowledgments:

Thanks to Aqua-Aid, Aquatrols, Brandt, Earth Microbial, Intelligro, Ocean Organics, Envu, Simplot, Syngenta, Nufarm and the California Turfgrass & Landscape Foundation (CTLF) for providing products and/or supporting this research

Table 1. Treatments applied in the deficit irrigation study. Riverside, CA. 2023

Trt	Product	Company	Rate		Interval
1	Untreated Control				
2	UCR-010	-	2.6	fl oz/1000ft^2	EIMR
3	UCR-011	-	2.6	fl oz/1000ft^2	EIMR
4	UCR-011	-	2.6	fl oz/1000ft^2	CEGIKMOR
5	UCR-012	-	2.6	fl oz/1000ft^2	EIMR
6	UCR-020	-	11.3	fl oz/A	ADGJMP
7	UCR-020	-	11.3	fl oz/A	ADGJMP
7	UCR-021	-	1.57	fl oz/A	ADGJMP
8	UCR-020	-	11.3	fl oz/A	ADGJMP
8	UCR-021	-	2.66	fl oz/A	ADGJMP
9	En-Guard	EARTH MICROBIAL		-	ACEGIKM
9	En-Fix	EARTH MICROBIAL		-	ACEGIKM
10	Revolution	Aquatrols	3	fl oz/1000ft^2	AEIM
11	Primer Select	Aquatrols	3	fl oz/1000ft^2	AEIM
12	Excalibur	Aqua-Aid	3	fl oz/1000ft^2	AEIM
13	Revolution	Aquatrols	6	fl oz/1000ft^2	AEIM
14	Primer Select	Aquatrols	6	fl oz/1000ft^2	AEIM
15	Excalibur	Aqua-Aid	6	fl oz/1000ft^2	AEIM
16	Civitas	Intelligro	8.5	fl oz/1000ft^2	ACEGIKM
17	Appear II	Syngenta	6	fl oz/1000ft^2	ACEGIKM
18	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
19	Ambient Plus	Simplot	8	fl oz/1000ft^2	ACEGIKM
20	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
20	Ambient Plus	Simplot	8	fl oz/1000ft^2	ACEGIKM
21	Signature XTRA Stressgard	Envu	4	fl oz/1000ft^2	ACEGIKM
22	Gary's Green Ultra	BRANDT	9	fl oz/1000ft^2	ACEGIKM
22	Title Phyte	Harrell's MAX	3	fl oz/1000ft^2	ACEGIKM
22	Ambient Plus	Simplot	8	fl oz/A	ACEGIKM
22	Primo Maxx	Syngenta	11	fl oz/A	ADGJMP
22	Excalibur	Aqua-Aid	3	fl oz/1000ft^2	AEIM
23	Primo Maxx	Syngenta	11	fl oz/A	ADGJMP
24	Anuew	Nufarm	18	oz/A	ADGJMP
25	OO-WJ	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
25	OO-SRX	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
25	OO-XPN	Ocean Organics	6	fl oz/1000ft^2	ACEGIKM
25	OO-GG	Ocean Organics	8	fl oz/1000ft^2	ACEGIKM

Application Intervals: A = 6/29/23; C = 7/5/23; D = 07/19/23; E = 07/26/23; G = 08/09/23; I = 08/23/23; J = 08/30/23; K = 09/06/23; M = 09/20/23; O = 10/04/23.

Defficit Irrigation Study
Plot Plan

1	2	3	4	5
10	9	8	7	6
11	12	13	14	15
20	19	18	17	16
21	22	23	24	25

10	23	17	9	2
21	13	6	15	18
14	1	19	11	5
4	16	12	3	25
8	20	7	24	22

22	24	20	25	11
4	8	16	5	23
21	9	10	7	15
12	14	6	1	2
19	3	17	13	18

16	10	9	22	24
1	25	18	4	13
17	5	11	7	23
8	12	6	20	3
14	2	19	15	21

16	25	6	13	15
23	10	19	17	2
22	1	7	12	14
20	8	11	3	21
5	24	4	18	9

15	21	4	18	3
20	1	16	17	25
12	19	14	2	11
6	13	8	9	7
23	10	5	22	24

Table 2. Data collected in the deficit irrigation study. Riverside, CA 2023. Visual Quality (VC; 1-9, 9 = best); Green cover (%), Dark Green Color Index (DGCI; 0-0.666, 0.666 = darkest green color).

Trt No.	Visual Quality				Green Cover			DGCI		
	6/23/2023	7/24/2023	8/9/2023	8/30/2023	7/24/2023	8/9/2023	8/30/2023	7/24/2023	8/9/2023	8/30/2023
1	7.8	7.3 ab	7.0 ab	5.8 ef	90 efg	80 abcdef	67 efgh	0.451 g	0.433 bcdefg	0.431 def
2	7.5	7.3 ab	6.2 b	6.2 cdef	92 bcdefg	75 efg	64 fghi	0.464 defg	0.419 efg	0.422 ef
3	7.2	7.3 ab	6.5 b	6.0 def	90 defg	75 defg	65 fgh	0.455 g	0.419 efg	0.425 ef
4	7.5	7.7 a	6.7 ab	6.0 def	93 bcdefg	77 bcdef	64 fghi	0.462 efg	0.424 cdefg	0.419 ef
5	7.8	7.5 ab	6.5 b	5.7 f	91 cdefg	78 abcdef	67 efgh	0.459 fg	0.432 bcdefg	0.428 def
6	7.8	7.2 ab	7.0 ab	7.0 bcde	91 cdefg	83 abcdef	75 defg	0.468 cdefg	0.456 ab	0.457 cd
7	7.3	7.0 ab	6.5 b	7.2 abcd	90 efg	85 abcde	76 cdef	0.456 g	0.452 abc	0.455 cd
8	7.8	7.0 ab	6.8 ab	8.0 ab	88 g	86 abcd	76 def	0.451 g	0.452 abc	0.454 cd
9	8.3	7.7 a	6.3 b	6.0 def	94 abcdef	77 bcdef	66 fgh	0.469 cdefg	0.422 defg	0.430 def
10	7.8	7.7 a	6.3 b	6.0 def	93 bcdefg	76 cdefg	68 efgh	0.465 defg	0.424 cdefg	0.432 def
11	7.7	7.3 ab	6.5 b	6.3 cdef	92 bcdefg	78 abcdef	67 efgh	0.460 fg	0.421 defg	0.424 ef
12	7.5	7.3 ab	6.8 ab	6.0 def	92 bcdefg	76 cdefg	62 ghi	0.463 efg	0.418 fg	0.413 f
13	7.8	7.5 ab	6.3 b	6.0 def	94 abcde	79 abcdef	63 fghi	0.471 cdefg	0.422 defg	0.421 ef
14	8	7.3 ab	6.8 ab	6.3 cdef	92 bcdefg	77 bcdef	67 efgh	0.466 cdefg	0.423 cdefg	0.428 def
15	7.5	7.7 a	6.7 ab	6.3 cdef	95 abcd	79 abcdef	63 fghi	0.474 bcdefg	0.423 cdefg	0.424 ef
16	8	8.0 a	7.0 ab	8.2 ab	98 a	85 abcde	90 abc	0.489 abc	0.446 abcdef	0.504 ab
17	7.5	7.5 ab	7.0 ab	8.3 a	97 a	86 abc	94 a	0.488 abcd	0.442 abcdef	0.522 a
18	8.2	7.8 a	6.0 b	6.0 def	93 abcdef	73 fg	60 hi	0.465 defg	0.412 g	0.409 f
19	7.7	8.0 a	6.3 b	7.0 bcde	95 abcd	81 abcdef	77 cdef	0.481 abcdef	0.438 abcdefg	0.481 bc
20	7.8	7.5 ab	6.3 b	7.3 abc	96 ab	81 abcdef	80 bcde	0.484 abcde	0.433 bcdefg	0.477 bc
21	8.2	7.8 a	7.0 ab	8.0 ab	98 a	88 ab	93 ab	0.496 ab	0.448 abcde	0.520 a
22	7.3	8.0 a	7.8 a	8.3 a	96 abc	89 a	83 abcd	0.499 a	0.464 a	0.489 b
23	7.7	7.0 ab	6.3 b	7.3 abc	91 defg	82 abcdef	73 defgh	0.465 defg	0.449 abcd	0.443 de
24	7.7	6.3 b	4.3 c	3.7 g	89 fg	66 g	51 i	0.456 g	0.412 g	0.405 f
25	7.8	8.2 a	6.8 ab	7.0 bcde	94 abcdef	82 abcdef	63 fghi	0.462 efg	0.436 abcdefg	0.417 ef
p-value	0.783	0	0	0	0	0	0	0	0	0

Means followed by the same letter in a column are not significantly different (P=0.05).

Stop #7: Evaluation of Fungicides for Control of Anthracnose Disease on Annual Bluegrass Greens

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Objectives:

This study was conducted to evaluate 18 different treatments including an untreated control to manage foliar and basal rot anthracnose (*Colletotrichum cereale*) disease preventatively on an annual bluegrass (*Poa annua*) putting green.

Materials and Methods:

The study was initiated on June 30, 2023 on mature annual bluegrass (*Poa annua*) 'Peterson's Creeping' turf on a Hanford fine sandy loam amended with sand. The green was established in 2007 from seed and the plot area was originally inoculated with the pathogen, which has become ubiquitous since then. Turf was mowed 5 days/wk at 0.125 inches and received no fertilizer during the study period. Initially, irrigation was provided to prevent water stress during the first month of the experiment. Thereafter, irrigation was applied using a combination of the irrigation system and hand watering to promote water stress and incite disease outbreak.

Treatments (Table 1) were applied every 14 or 21 days beginning on June 30 (isolated, minor disease symptoms were present) and ending on September 6. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8003VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Experimental design was a complete randomized block with 5 replications. Plot size was 4×6 ft with 2-ft alleys.

Plots were evaluated every two weeks visually for turf quality (1-9; 9=best), and anthracnose disease cover (0-100%) once disease activity was present. Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

Results:

No turf injury from treatments was observed throughout the study (data not shown). Initially, treatment 15 (Tekken; isofetamid + tebuconazole) exhibited PGR symptoms characteristic of some DMI fungicides. Although disease symptoms gradually increased during the study, no significant differences among treatments were noted until August 30 (Table 1). Tekken applied on 3-wk intervals provided the numerically highest turf quality and lowest anthracnose disease cover on that date. Continued disease progression and treatment separation is expected by Field Day and the end of the study in late September.

Acknowledgments:

Thanks to the CTLF, BASF, Earth Microbial, Envu, PBI Gordon, NuFarm and Syngenta for supporting this research and/or for providing products.

Table 1. Effects of fungicide treatments on turf quality (1-9, 9 = best) and anthracnose disease cover (0-100%) on annual bluegrass turf. 2023. Riverside, CA.

Trt	Product	Company	Rate (oz/1000ft^2)	Frequency	Quality 8/30/2023	Cover 8/30/2023
1	Control				5.4 abc	11.6 abc
2	Navicon Intrinsic	BASF	0.7	AEI	6.2 abc	8.2 abc
2	Signature XTRA	Envu	5.3	CGK		
2	Secure	Syngenta	0.5	EK		
2	Primo Maxx	Syngenta	0.125	ACEGIK		
3	Lexicon Intrinsic	BASF	0.47	AEI	6.4 ab	2.2 c
3	Secure	Syngenta	0.5	E		
3	Maxtima	BASF	0.4	CGK		
3	Affirm	Nufarm	1	CGK		
3	Primo Maxx	Syngenta	0.125	ACEGIK		
4	Pillar SC	BASF	1	AEI	6.6 ab	2.2 c
4	Encartis	BASF	4	CGK		
4	Affirm	Nufarm	1	EI		
5	Tuque exoGEM	Syngenta	1.5	ACEGIK	4.4 c	18.6 ab
5	Appear II	Syngenta	6	ACEGIK		
5	Primo Maxx	Syngenta	0.125	ACEGIK		
6	Tuque exoGEM	Syngenta	1.5	CGK	5.8 abc	8.0 abc
6	Daconil Action	Syngenta	3.5	AEI		
6	Appear II	Syngenta	6	ACEGIK		
6	Primo Maxx	Syngenta	0.125	ACEGIK		
7	Briskway	Syngenta	0.9	ACEGIK	6.2 abc	6.2 abc
7	Primo Maxx	Syngenta	0.125	ACEGIK		
8	UCR001	-	-	ACEGIK	5.8 abc	10.4 abc
9	UCR001	-	-	ACEGIK	6.8 ab	4.2 bc
10	UCR002	-	-	ACEGIK	6.4 ab	4.6 bc
11	UCR002	-	-	ACEGIK	6.4 ab	4.8 bc
12	UCR003	-	-	ACEGIK	6.0 abc	7.8 abc
13	UCR003	-	-	ACEGIK	6.2 abc	5.6 abc
14	UCR004	-	-	ACEGIK	5.8 abc	10.6 abc
15	Tekken	PBI Gordon	3	ADGJ	7.2 a	1.4 c
16	En-Turf	Earth Microbial	-	ACEGIK	5.0 bc	20.0 a
17	En-Turf	Earth Microbial	-	ACEGIK	6.4 ab	4.4 bc
17	Briskway	Syngenta	0.45	ACEGIK		
18	Briskway	Syngenta	0.45	ACEGIK	5.8 abc	11.0 abc
				p-value	0.000	0.000

Means followed by the same letter in a column are not significantly different (P=0.05).

Application Intervals: A = 6/30/23; C = 7/12/23; D = 7/19/23; E = 7/26/23; G = 8/9/23; I = 8/19/23; J = 8/30/23; K = 9/6/23

1	18	4	1	7	11	17	3	12	5
2	15	13	16	14	8	10	6	9	2
3	11	14	7	4	17	5	2	1	8
4	15	18	16	13	6	10	3	12	9
5	14	11	3	10	16	4	7	18	6
6	1	15	17	8	5	2	12	9	13
7	8	15	5	18	11	1	14	4	7
8	10	2	12	3	9	17	6	13	16
9	3	10	9	5	15	7	1	14	18
10	12	16	2	17	8	11	4	6	13
	1	2	3	4	5	6	7	8	9

N

Figure 1. Plot plan for the 2023 anthracnose fungicide trial. Riverside, CA.

Stop #8: Improvement of Bermudagrass, Kikuyugrass and Other Warm-season Turfgrass Species for Winter Color Retention and, Drought Tolerance

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Background and objectives:

Repeated testing in Riverside, CA has demonstrated that even the most drought tolerant cool-season grasses cannot compete with warm-season species in water use efficiency. California has been experiencing drought for several years, affecting water availability and price. Extending the use of warm-season grasses, already better adapted to arid climates, and their further improvement for drought stress resistance, can help tackle this issue. The warm-season turfgrass breeding program at the University of California, Riverside (UCR) was re-established in 2012, by planting a bermudagrass collection and first crosses among collection accessions to develop improved hybrids. In 2016, a collection of kikuyugrass was established and 3 years later the first hybrids were planted. The main goal of the program is to develop new, improved genotypes of these two species. At the same time, extensive testing of bermudagrass, zoysiagrass, seashore paspalum and St. Augustinegrass is also underway, in cooperation with other breeding programs in the United States. In bermudagrass and kikuyugrass, the emphasis is on drought resistance (hence reduced irrigation) and winter color retention. Winter dormancy hampers the replacement of cool-season with warm-season grasses, so selection is also aimed at the reduction of the winter dormancy period. New cultivars with improved winter color retention would likely increase acceptance of warm-season grasses. In addition, with more frequent water shortages, switching to non-potable water resources of lower quality will be necessary. Thus, screening of warm-season grasses for tolerance to saline water becomes an important part of breeding for arid regions.

Project milestones since Field Day 2022:

- ***Registration of UCR TP6-3 as 'Coachella' and UCR 17-8 as 'Presidio'.***
- Initiated evaluation of replicated test plots of bermudagrass hybrids selected for fairways/sports fields and greens and replicated test plots of kikuyugrass selected for fairways/sports fields.
- Continued evaluation of bermudagrass hybrids selected for roughs/lawns.
- Continued evaluation of bermudagrass hybrids under shade.
- Evaluation of bermudagrass and kikuyugrass nurseries.
- Continued evaluation of experimental lines of bermudagrass, zoysiagrass, seashore paspalum and St. Augustinegrass within the USDA-NIFA Specialty Crop Research Initiative (SCRI) for overall performance, and drought and salinity tolerance.

'Coachella' and 'Presidio' - new UCR bermudagrasses coming to the market!

After nine years of testing UCR TP 6-3 and UCR 17-8 were patented and will be released under the cultivar names 'Coachella' and 'Presidio', respectively.

Testing in Riverside and other locations across California showed their high quality both in the summer and in the winter, very good winter color retention, as well as low seedhead production in Northern California and very dark genetic color. In addition, 'Presidio' showed good drought tolerance under deficit irrigation.

The latest study on traffic tolerance and divot recovery of ‘Coachella’ and ‘Presidio’ is presented in **Stop #4** (page 24).

<u>Evaluation of new bermudagrass hybrids for use at golf course fairways, roughs, greens, and for residential areas:</u>

While UCR is working on bringing two new releases to the market, the UCR turfgrass breeding program continues to create and evaluate grasses for the future.

Several test plots including bermudagrass hybrids selected from the nurseries planted in 2018 and 2019 have been established and are under evaluation. Preliminary data from two of them are presented below:

Bermudagrass hybrids for roughs/lawns:

Twenty-two bermudagrass hybrids were selected and planted at UCR in three replicates in 2021. ‘Coachella’ (UCR TP6-3) and ‘Presidio’ (UCR 17-8), as well as six cultivars (‘Bandera’, ‘Bullseye’ ‘Celebration’, ‘Midiron’ ‘Santa Ana’, ‘Tifway II’) were added as checks. Plots are mowed once a week (2 in). Turfgrass quality (1-9; 9=best), spring greenup (1-9;9=fastest), genetic color (1-9; 9=darkest) and seedhead production (1-9; 9=lowest) were evaluated. The highest overall quality showed UCRC190307, UCRC190311, UCRC190420, ‘Presidio’, ‘Coachella’ and UCRC180015 (Table 1). ‘Presidio’, ‘Coachella’, ‘Santa Ana’ had fast spring greenup, followed by UCRC180015 and ‘Celebration’. UCRC180015 had also the darkest genetic color, followed by UCRC190108, UCRC10311 and ‘Celebration’.

Bermudagrass hybrids for fairways/sports fields:

Fifty-seven bermudagrass hybrids were selected and planted at UCR in three replicates in 2022. ‘Presidio’ (UCR 17-8) and five cultivars (‘Latitude 36’, ‘Santa Ana’, ‘Tahoma 31’, ‘TifTuf’, ‘Tifway’) were added as checks. ‘Coachella’ (TP 6-3) was not included in this trial due to contamination during propagation. Plots are maintained under fairway mowing height (5/8 inches). Initial rating of turfgrass quality (1-9; 9=best) were taken in July 2023. The best performing entry so far was ‘Presidio’ (UCR 17-8). Other entries showing good quality were ‘Latitude 36’, ‘Tahoma 31’, UCRC180127 and UCRC180177 (Table 2).

<u>Other continued studies:</u>

<u>*Bermudagrass:*</u>

- Evaluation of bermudagrass hybrids in the nurseries established in 2020 and 2022.
- Shade trial including 35 UCR hybrids from 2018-2019 nurseries, with UCR 17-8, UCR TP6-3 and five commercial checks (‘Latitude 36’, ‘Santa Ana’, ‘Tifway’ and ‘TifTuf’) – **Stop #3** (page 20).

<u>*Other species:*</u>

- Evaluation of experimental lines of bermudagrass (193 lines and cultivars, including 20 UCR entries), zoysiagrass (220), seashore paspalum (94) and St. Augustinegrass (130) at earlier selection stages, for the overall performance and drought tolerance in a Single Space Plant Nursery planted in 2020. The study is a part of the Specialty Crop Research Initiative (SCRI) funded by the Unites States Department of Agriculture – collaborative project among breeding programs at North Carolina State University (NCSU), Oklahoma State University (OSU), Texas A&M AgriLife (TAMUS), the University of Georgia (UGA), the University of Florida (UF) and UCR.
- Evaluation of advanced lines of bermudagrass (39 lines and cultivars), zoysiagrass (45), seashore paspalum (21) and St. Augustinegrass (30) under drought (dry-down study), planted in 2020 – part of the Specialty Crop Research Initiative (SCRI) funded by the Unites States Department of Agriculture.

- Evaluation of advanced lines of bermudagrass (39 lines and cultivars), zoysiagrass (45), seashore paspalum (15) and St. Augustinegrass (29) irrigated with saline water, planted in 2020 – part of the Specialty Crop Research Initiative (SCRI) funded by the Unites States Department of Agriculture.
- Evaluation of new kikuyugrass nursery with 406 hybrids.
- Evaluation of replicated test plots of 40 kikuyugrass hybrids (selected from 2019 nursery) for fairways/sports fields, with 'Whittet' as commercial check.

Acknowledgements:

Thanks to the CTLF, USGA, MWD, WMWD, USDA NIFA, West Coast Turf, A-G Sod Farms, Meadow Club, Napa GC, The Preserve at Santa Lucia, Shadow Creek GC, The Farms GC, Wilshire CC, California State University – Titan Sports Complex, Cinnabar Hills Golf Club and Yocha Dehe Golf Club for their support of this research.

Table 3. Turfgrass quality (1-9; 9=best), spring greenup (1-9; 9=fastest), genetic color (1-9; 9=darkest green) and seedhead production (1-9; 9=lowest) of 22 UCR hybrids selected for roughs/lawns, 'Presidio' (UCR 17-8), 'Coachella' (UCR TP6-3) and 6 other bermudagrass cultivars at UCR, Riverside, 2022-2023.

Entry	Turfgrass Quality		Spring Greenup		Genetic Color		Seedhead production
UCRC180007	5.2	ab	3.0	cde	6.0	cd	5.3
UCRC180015	6.0	a	5.3	abc	9.0	a	7.2
UCRC180035	4.4	b	3.3	cde	6.0	cd	5.8
UCRC180052	5.6	ab	3.0	cde	7.0	abcd	6.5
UCRC180109	5.4	ab	3.0	cde	7.7	abcd	5.8
UCRC180139	5.2	ab	4.7	abcd	8.0	abcd	5.7
UCRC180217	5.3	ab	4.3	abcde	8.0	abcd	6.0
UCRC180231	5.4	ab	3.0	cde	6.7	abcd	5.8
UCRC180594	5.4	ab	4.3	abcde	6.3	bcd	4.5
UCRC180600	5.5	ab	4.7	abcd	8.0	abcd	4.5
UCRC180661	5.3	ab	4.7	abcd	7.3	abcd	5.8
UCRC190108	5.3	ab	3.7	bcde	8.7	ab	6.0
UCRC190199	5.1	ab	3.0	cde	8.0	abcd	5.0
UCRC190225	5.6	ab	2.0	e	7.0	abcd	7.5
UCRC190307	6.2	a	5.0	abcd	7.3	abcd	6.3
UCRC190311	6.2	a	3.0	cde	8.7	ab	7.0
UCRC190326	5.6	ab	2.7	de	7.0	abcd	6.5
UCRC190336	5.3	ab	3.0	cde	7.7	abcd	5.7
UCRC190420	6.1	a	2.7	de	6.3	bcd	6.7
UCRC190480	5.2	ab	4.3	abcde	5.7	d	4.3
UCRC190545	5.2	ab	2.0	e	5.7	d	6.7
UCRC190766	5.6	ab	4.7	abcd	7.7	abcd	6.5
Presidio (UCR 17-8)	6.1	a	6.3	a	7.3	abcd	6.0
Coachella (UCR TP6-3)	6.1	a	6.0	ab	7.0	abcd	6.5
Bandera	5.9	ab	4.3	abcde	8.0	abcd	6.5
Bullseye	4.7	ab	4.0	abcde	8.3	abc	7.5
Celebration	5.6	ab	5.3	abc	8.7	ab	6.3
Midiron	5.0	ab	3.7	bcde	6.7	abcd	5.0
Santa Ana	5.7	ab	6.0	ab	7.3	abcd	5.2
Tifway II	5.2	ab	4.3	abcde	6.0	cd	6.3

Means followed by the same letter in a column are not significantly different (P=0.05).

Table 2. Turfgrass quality (1-9; 9=best) of 57 UCR hybrids selected for fairways, 'Presidio' (UCR 17-8), and 5 other bermudagrass cultivars at UCR, Riverside, 2023.

Entry	**Turfgrass Quality**		**Entry** (cont'd)	**Turfgrass Quality** (cont'd)	
UCRC180009	5.0	bcde	UCRC190084	4.7	cde
UCRC180014	5.3	abcde	UCRC190104	5.7	abcd
UCRC180024	5.0	bcde	UCRC190105	5.7	abcd
UCRC180037	5.7	abcd	UCRC190121	5.3	abcde
UCRC180038	5.7	abcd	UCRC190127	4.7	cde
UCRC180040	5.3	abcde	UCRC190260	5.0	bcde
UCRC180041	5.3	abcde	UCRC190272	5.0	bcde
UCRC180044	5.0	bcde	UCRC190280	5.0	bcde
UCRC180049	5.0	bcde	UCRC190284	5.0	bcde
UCRC180118	5.0	bcde	UCRC190304	5.3	abcde
UCRC180127	6.0	abc	UCRC190325	5.3	abcde
UCRC180128	4.7	cde	UCRC190355	5.7	abcd
UCRC180133	5.3	abcde	UCRC190411	4.7	cde
UCRC180146	5.0	bcde	UCRC190499	5.3	abcde
UCRC180170	5.0	bcde	UCRC190500	5.0	bcde
UCRC180174	5.0	bcde	UCRC190584	5.3	abcde
UCRC180176	4.0	e	UCRC190640	5.0	bcde
UCRC180177	6.0	abc	UCRC190687	4.3	de
UCRC180200	5.0	bcde	UCRC190691	5.0	bcde
UCRC180207	5.0	bcde	UCRC190692	4.7	cde
UCRC180211	5.7	abcd	UCRC190693	5.0	bcde
UCRC180216	5.0	bcde	UCRC190698	5.0	bcde
UCRC180217	4.3	de	UCRC190720	5.0	bcde
UCRC180229	4.0	e	UCRC190741	5.3	abcde
UCRC180492	4.0	e	UCRC190750	4.7	cde
UCRC180551	4.0	e	Presidio (UCR 17-8)	6.7	a
UCRC180581	4.3	de	Latitude 36	6.3	ab
UCRC180589	5.7	abcd	Santa Ana	5.3	abcde
UCRC180609	4.7	cde	Tahoma 31	6.0	abc
UCRC180617	5.7	abcd	TifTuf	5.0	bcde
UCRC190055	5.7	abcd	Tifway	5.7	abcd
UCRC190073	5.0	bcde			

Means followed by the same letter in a column are not significantly different (P=0.05).

CIMIS data September. 2022 – Aug. 2023

Month Year	Total ETo	Total Precip	Avg Sol Rad	Avg Vap Pres	Avg Max Air Temp	Avg Min Air Temp	Avg Air Temp	Avg Max Rel Hum	Avg Min Rel Hum	Avg Rel Hum	Avg Dew Point	Avg Wind Speed	Avg Soil Temp
	(in)	(in)	(Ly/day)	(mBars)	(°F)	(°F)	(°F)	(%)	(%)	(%)	(°F)	(mph)	(°F)
Sep 2021	5.74 K	0.81	501 K	17.4 K	92	66.8 K	77.6 K	80 K	33 K	55 K	59.1 K	3.6 K	75.8
Oct 2021	3.87	0.28	399 K	14.2	80.9	57	67.3	89	37	62	52.4	3.3	69.3
Nov 2021	2.97	1.22 K	335 K	6.7	68.4	44.2	55.9	69	26	45	31.7	4 K	57.6
Dec 2021	1.77	1.79	235	8.5 K	63.6 K	43.5	52.3 K	85	41	64 K	39.2 K	2.9	53.8 K
Jan 2022	2.21	3.09 K	261 K	8.1 K	60.7	42.8	51.3 K	83 K	43 K	63 K	37.1 K	4.4 K	52.8 K
Feb 2022	2.85	2.55	354 K	6.4	63.5	41.3	52 K	73	32	50 K	31.4 K	4.3 K	50.9 K
Mar 2022	3.29	3.91 K	395 K	9.9 K	63.1	44.8	53.1	93	48	71 K	43.3 K	3.6	54.8 K
Apr 2022	5.73	0.07	593 K	11.2	75.9	49.6 K	61.6	87	35	59	46.4	3.8	60.8
May 2022	5.54	0.35 K	565 K	14.4 K	74.9	55.4	63.3	92	50	71 K	53.9 K	4.4	67.4
Jun 2022	5.91	0.07	615 K	14.2	78.2	57.8	66.6	86	45	64	53.8	4.2	69.4
Jul 2022	8.51	0	694 K	15 K	96	66 K	80.3 K	70	24	43 K	55.1 K	3.8	76.9
Aug 2022	7.47	2.11 K	616 K	15.8 K	94.5	65.9 K	78.9	73	28	48 K	56.5 K	3.8 K	76.9
Tots/Avgs	55.86	16.25	463.6	11.8	76	52.9	63.4	81.7	36.8	57.9	46.7	3.8	63.9

M - All Daily Values Missing	K - One or More Daily Values Flagged
J - One or More Daily Values Missing	L - Missing and Flagged Daily Values

W/m2 = 2.065 Ly/day	25.4 mm = inch	C = 5/9 * (F -32)

m/s = 2.24 mph	kPa = 10 mBars

Save the date

UCR Turfgrass and Landscape Research Field Day

Thursday, September 12, 2024

See you then!

UC RIVERSIDE
Turfgrass Science

Booklet cover and field map: Marta Pudzianowska
Cover picture: Marta Pudzianowska