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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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TURFGRASS & LANDSCAPE RESEARCH FIELD DAY

September 15, 2022

UC RIVERSIDE

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 2022 UCR Turfgrass and Landscape Research Field Day. This marks the 15th consecutive year of this event under my watch. Time flies when you're having fun! We missed seeing everyone in person in 2020 and some of you in 2021 due to the pandemic. 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. Especially in light of the severity of the current drought, we are excited to show you our new hybrid bermudagrasses that are nearing release. In particular, UCR 17-8 bermudagrass is capable of maintaining green color and quality under irrigation as low as 30% of reference evapotranspiration (ETo). That's easily 50-70% less water required compared to tall fescue! Even more than that, we have identified products on display at Field Day that can help turf look good with comparable reductions in water use. For the 11th 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 light blue shirts with our Turfgrass Science logo, 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. 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 14, 2023**.

Sincerely,

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

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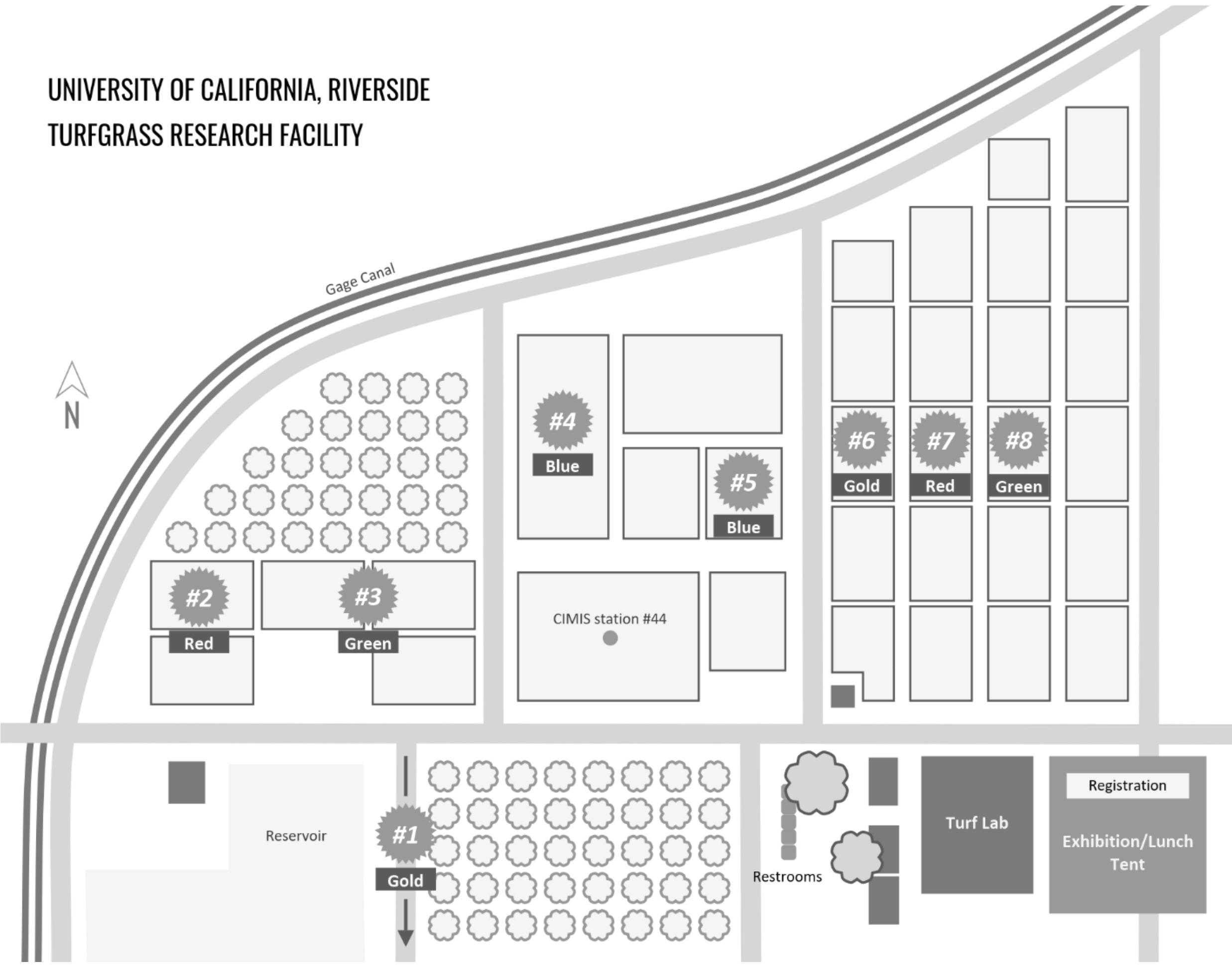

2022 Turfgrass and Landscape Research Field Day Agenda

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 *Gold tent*	**Improvement of Bermudagrass, Kikuyugrass, and Zoysiagrass for Winter Color Retention and Drought Tolerance** Adam Lukaszewski, Marta Pudzianowska, and Christian Bowman
Stop #2 *Blue tent*	**Management of Localized Dry Spots on Putting Greens** Pawel Orlinski
Stop #3 *Green tent*	**Evaluation of Fungicides for Control of Anthracnose Disease on *Poa* Greens** **Effects of Biostimulants on *Poa Greens*** Jim Baird
Stop #4 *White tent*	**Evaluation of Products for Water Conservation on Bermudagrass Turf Using a Linear Gradient Irrigation System** 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 *Gold Tent*	**Evaluation of Products for Salinity Management and Rapid Blight Disease on *Poa* Greens** Jim Baird
Stop #6 *Blue Tent*	**Warm-Season Turfgrass Breeding – Evaluation of Bermudagrass, Zoysiagrass, Seashore Paspalum, and St. Augustinegrass Lines Under Salinity Stress** **Everything You Wanted to Know About UCR17-8 and UCRTP6-3 Bermudagrasses** Marta Pudzianowska, Adam Lukaszewski, and Christian Bowman
Stop #7 *Green Tent*	**Postemergence Control of Yellow and Purple Nutsedge and Green *Kyllinga* in Bermudagrass Turf** Pawel Orlinski
Stop #8 *White Tent*	**Evaluation of Products for Water Conservation on Bermudagrass Turf** Valentina Bindi and Taylor Oliver
12:50-2:00 PM	**Barbeque Lunch and Trade Show**
2:00 PM	**Adjourn**

Stop #1: Improvement of Bermudagrass, Kikuyugrass and Other Warm-season Turfgrass Species for Winter Color Retention and, Drought Tolerance

Marta Pudzianowska, Christian Bowman, Luiz H. Monticelli, Adam J. Lukaszewski, and Jim Baird

Department of Botany & Plant Sciences
University of California, Riverside

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 2021:

- Initiated registration of UCR 17-8 and UCR TP6- 3.
- Established test plots of UCR 17-8 and UCR TP6-3 at several golf courses and a sports field in Southern and Northern California.
- Established two replicated test plots of bermudagrass hybrids selected for fairways/sports fields and greens and replicated test plots of kikuyugrass selected for fairways/sports fields.
- Established new bermudagrass and kikuyugrass nurseries.
- Continued testing of bermudagrass hybrids in trials established in previous years in Riverside, Coachella Valley, Northern California and Nevada.
- 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.

New UCR bermudagrasses – UCR 17-8 and UCR TP6-3:

Eight years of testing of UCR 17-8 and UCR TP6-3 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. Testing under reduced irrigation revealed the ability of UCR 17-8 to retain good quality and green cover with reduced water inputs. UCR 17-8 was included as a local check in United States Golf Association/National Turfgrass Evaluation Program (USGA/NTEP) Warm-Season Water Use Trial (2018-2020) and in NTEP Bermudagrass Water Use trial (started in 2019). In the USGA/NTEP trial UCR 17-8 was the best performer under 45% ET_o, and one of two best performers under 30% ET_o. Similarly, in the Bermudagrass NTEP trial UCR 17-8 was one of the best performing entries both in quality and green cover retention under 35% ET_o.

In October 2021 sod of UCR 17-8 and UCR TP6-3 was harvested and planted at several locations in Southern and Northern California: The Farms GC, Rancho Santa Fe; Wilshire CC, Los Angeles; California State University, Titan Sports Complex, Fullerton; Cinnabar Hills Golf Club, San Jose; and Yocha Dehe Golf Club, Brooks. In April 2022 large, replicated test plots of UCR 17-8, UCR TP6-3, 'Santa Ana' and 'TifTuf' were established at UCR to investigate performance of the two newest releases in the UCR breeding program under various management practices such as fertilization and irrigation levels, traffic tolerance etc. UCR 17-8 and UCR TP6-3 are expected to be commercially available in limited quantities in 2024.

Evaluation of bermudagrass and kikuyugrass under drought:

2022 is the last year of evaluation of bermudagrass and kikuyugrass entries and hybrids under drought. The bermudagrass dry-down study was established in 2019 consisting of 71 UCR hybrids and 5 commercial cultivars ('Bandera', 'Celebration', 'Santa Ana', 'TifTuf', 'Tifway II'). Entries are maintained under fairway mowing height (0.5 in) and subjected to two consecutive dry-down periods (60 days) followed by recovery periods (14 days) to evaluate individual responses to prolonged drought stress. Results from the first dry-down cycle this year are similar to the previous years, showing multiple UCR accessions that are outperforming current commercial cultivars based on their average green (living tissue) coverage determined through digital image analysis. Five entries, UCRC180217, UCRC180557, UCRC180040, UCRC180146, and UCRC180229, have consistently remained among the top 10 performers since the first dry-down year (2020), with two of the five, UCRC180217 and UCRC180557, remaining among the top 5 performers each year. To evaluate responses to drought stress in kikuyugrass, a dry-down study was established in 2019 similar to that of bermudagrass, consisting of 38 different accessions with three replicates each, and using 'Whittet' and 'AZ-1' selections as commercial checks. Entries were subjected to a single dry-down period followed by a recovery period in order to evaluate individual responses to drought stress. Results from this year were similar to those of last year, where a few UCR hybrids and selections outperformed the commercial checks in their area of green coverage.

Evaluation of bermudagrass hybrids for roughs and residential areas use:

Bermudagrass hybrids for this study were selected from nurseries planted in 2018 and 2019. Twenty-two bermudagrass hybrids were selected and planted at UCR in three replicates in 2021.

UCR 17-8 and UCR TP6-3, as well as six cultivars (‘Bandera’, ‘Bullseye’ ‘Celebration’, ‘Midiron’ ‘Santa Ana’, ‘Tifway II’) were added as checks. Plots are mowed once a week (2 inches). Establishment rate (% ground cover), turfgrass quality (1-9; 9=best), genetic color (1-9; 9=darkest) and seedhead production (1-9; 9=lowest) were evaluated. The fastest establishment occurred with UCR 17-8 and UCR TP6-3, while UCRC190311, UCRC180035 and ‘Midiron’ were the slowest entries to establish (Table 1). UCRC18015 showed high turfgrass quality and dark genetic color, with relatively low seedhead production. High turfgrass quality was also demonstrated by ‘Bandera’ and ‘UCRC190307’. ‘Bullseye’ produced the fewest seedheads, however turfgrass quality of this cultivar was relatively low.

<u>Other continued studies:</u>

<u>Bermudagrass:</u>

- Evaluation of bermudagrass hybrids in the nursery established in 2020.
- An evaluation study of 12 UCR hybrids and 3 commercial cultivars (‘Bandera’, ‘Midiron’ and ‘Tifway II’) suitable for roughs/lawns at the West Coast Turf sod farm in Coachella Valley, CA initiated in 2019.
- A study at the Shadow Creek Golf Course, Las Vegas, NV initiated in July 2020. It includes 21 UCR hybrids selected for superior quality and winter color retention and four commercial cultivars (‘Latitude 36’, ‘Santa Ana’, ’Tahoma 31’ and ‘TifTuf’).
- Shade trial including 35 UCR hybrids from 2018-2019 nurseries, with UCR 17-8, UCR TP6-3 and five commercial checks (‘Celebration’, ‘Latitude 36’, ‘Santa Ana’, ‘Tifway’ and ‘TifTuf’).

<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 University of California, Riverside.
- 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 (**Stop #6)**.
- Finished collaborative study with TAMUS evaluating their zoysiagrass lines in Northern California, at Meadow Club, Fairfax, CA and Napa Golf Course, Napa, CA. This project was funded by United States Golf Association.

New studies:

- Established new bermudagrass nursery with 259 hybrids.
- Established replicated test plots of 57 bermudagrass hybrids (selected from 2018 and 2019 nurseries) and seven checks (‘Latitude 36’, ‘Santa Ana’, ‘Tahoma 31’, ‘TifTuf’, ‘Tifway’, UCR 17-8 and UCR TP6-3) for fairways/sports fields.
- Established replicated test plots of six bermudagrass hybrids (selected from 2018 and 2019 nurseries) and five checks (‘Tifdwarf’, ‘TifEagle’, ‘Miniverde’, UCR 17-8 and UCR TP6-3) for greens.
- Established new kikuyugrass nursery with 406 hybrids.
- Established 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 1. Establishment (% cover on 10/15/2021), turfgrass quality (1-9; 9=best), genetic color (1-9; 9=darkest green) and seedhead production (1-9; 9=lowest), of 22 UCR hybrids selected for roughs/lawns, UCR 17-8, UCR TP6-3 and 6 bermudagrass cultivars at UCR, Riverside,2022.

Entry	Establishment		Turfgrass Quality		Genetic Color		Seedhead Production	
Bandera	58.4	abcd	6.3	ab	8.0	abcd	7.3	abc
Bullseye	49.2	abcd	4.3	bc	8.3	abc	9.0	a
Celebration	53.4	abcd	5.7	abc	8.7	ab	7.0	abc
Midiron	35.1	bcd	5.0	abc	6.7	abcd	6.7	abcd
Santa Ana	50.6	abcd	4.7	abc	7.3	abcd	6.7	abcd
Tifway II	44.9	abcd	4.7	abc	6.0	cd	7.0	abc
UCR 17-8	73.7	a	6.0	abc	7.3	abcd	6.3	abcd
UCR TP6-3	71.1	ab	6.0	abc	7.0	abcd	7.3	abc
UCRC180007	47.1	abcd	4.7	abc	6.0	cd	6.3	abcd
UCRC180015	51.3	abcd	6.7	a	9.0	a	7.3	abc
UCRC180035	32.4	cd	4.0	c	6.0	cd	7.0	abc
UCRC180052	39.6	abcd	5.0	abc	7.0	abcd	8.0	abc
UCRC180109	58.7	abcd	5.7	abc	7.7	abcd	7.7	abc
UCRC180139	47.3	abcd	5.3	abc	8.0	abcd	7.3	abc
UCRC180217	56.6	abcd	5.7	abc	8.0	abcd	7.3	abc
UCRC180231	62.7	abcd	5.3	abc	6.7	abcd	7.3	abc
UCRC180594	70.1	abc	5.3	abc	6.3	bcd	5.3	cd
UCRC180600	52.9	abcd	5.0	abc	8.0	abcd	6.0	bcd
UCRC180661	65.5	abcd	5.7	abc	7.3	abcd	7.7	abc
UCRC190108	62.4	abcd	5.3	abc	8.7	ab	7.0	abc
UCRC190199	48.5	abcd	5.3	abc	8.0	abcd	6.7	abcd
UCRC190225	42.5	abcd	4.7	abc	7.0	abcd	8.7	ab
UCRC190307	50.6	abcd	6.3	ab	7.3	abcd	7.7	abc
UCRC190311	31.9	d	6.0	abc	8.7	ab	7.3	abc
UCRC190326	61.7	abcd	5.3	abc	7.0	abcd	7.7	abc
UCRC190336	58.1	abcd	6.0	abc	7.7	abcd	6.7	abcd
UCRC190420	59.4	abcd	6.0	abc	6.3	bcd	8.3	ab
UCRC190480	49.9	abcd	4.7	abc	5.7	d	4.0	d
UCRC190545	44.2	abcd	5.0	abc	5.7	d	8.0	abc
UCRC190766	61.7	abcd	5.7	abc	7.7	abcd	8.0	abc

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

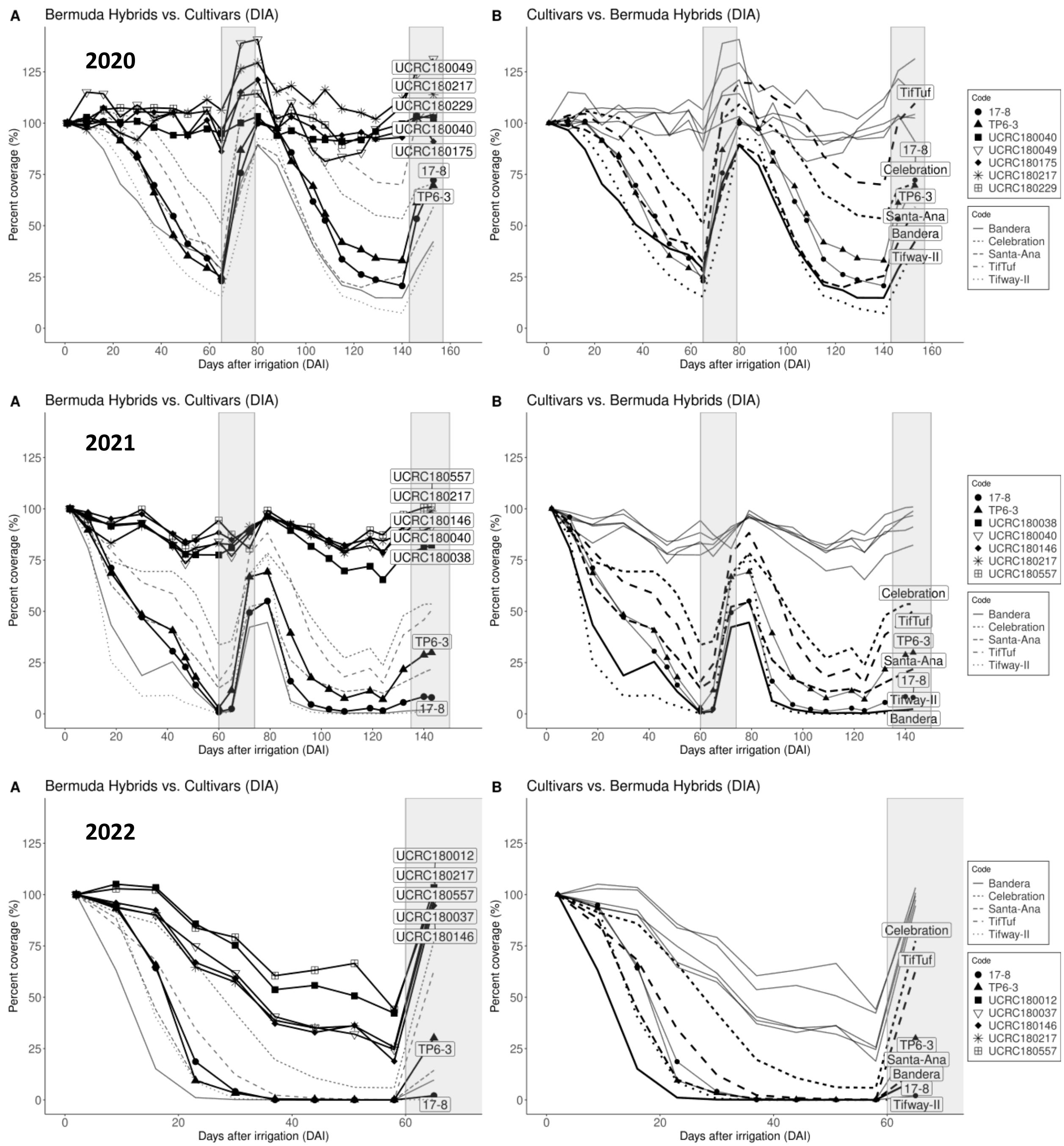

Figure 1. Performance of bermudagrass genotypes in response to prolonged drought stress. Evaluation of the average percent coverage (0 – 100%) for selected bermudagrass accessions based on digital image analysis (DIA). Evaluations were normalized to their respective values on the first day of the dry-down period. The grey regions represent recovery periods (irrigation at 150% ET_0 for 14 days) following the first (2020, 2021, 2022) and second (2020, 2021) dry-down period. Comparisons are shown between UCR hybrids (solid lines) and commercial cultivars (dashed lines), A – UCR hybrids accentuated, B – cultivars accentuated. UCR, Riverside, 2020-2022.

Stop #2: Management of Localized Dry Spot (LDS) on Putting Greens

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

Introduction:

Localized dry spot (LDS) occurs when soil becomes repellent to receive and retain water. In general, LDS occurs most commonly on sandy soils, thatchy turf, and under deficit irrigation. At UCR, we can best create this phenomenon when relying solely upon hand watering of sand-based creeping bentgrass putting greens. Soil surfactants have been used successfully to prevent the onset of localized dry spot (LDS) on golf course putting greens and other areas. The objective of this study was to evaluate the performance of several products applied preventatively for management of LDS.

Materials and Methods:

The study was conducted on a mature sand-based creeping bentgrass 'Pure Distinction' putting green with a history of LDS. The green was mowed 5 days/wk at 0.125 inches and received bi-weekly sand topdressing. Target fertilization on the green was 1-2 lbs N/1,000 ft^2/yr. Treatments were applied preventatively starting on July 29, 2022 (Table 1 and Fig. 1). Treatments were applied on 3-ft by 3-ft plots with 1.5-ft borders using a CO_2-powered backpack sprayer equipped with a single TeeJet AI9505E air induction nozzle followed immediately by hand watering (ca. 0.15 inches). Spray volume was 1 gal/1,000 ft^2 for all treatments except Skeepon (4 gal/1,000 ft^2). Treatments were replicated 6 times. To help induce LDS, irrigation was reduced to 80% ET_o based on water loss during the previous week using hand watering only. From August 8 to 26, the study area was irrigated 3 times/wk and then daily thereafter but still based on 80% ET_o. Data collection consisted of bi-weekly turfgrass quality (1-9; 9=best); digital image analysis to measure green turf cover (%) and dark green color index (DGCI) (0-0.666); and Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker handheld crop sensor. In addition, soil volumetric water content (VWC; %) was collected at 1.5- and 3-inch depths using a Field Scout 350. Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05). Replicate plots that were subjected to scalping from mowing were excluded from the analysis.

Results:

Ratings taken from the start of the study until August 30 revealed no significant differences among treatments (data not shown). On August 30 (last rating taken before publication of this report), the only significant treatment differences were found for DGCI. Vitalife, a biostimulant, produced the darkest green color turf among most soil surfactant products. Despite higher-than-expected VMC under deficit irrigation, LDS symptoms were present on the study area on August 30 and are expected to proliferate and reveal treatment differences by Field Day and beyond. The study will continue in the fall until appreciable rainfall occurs.

Acknowledgments:

We appreciate the financial support of Ac-Planta, Aqua-Aid, Aquatrols, Exacto, Harrell's, Mitchell Products, Necternal, and Simplot Partners.

Table 1. Treatments and data collected on August 30, 2022 in the localized dry spot study, Riverside, CA. Visual Quality (VC; 1-9, 9 = best); Normalized Difference Vegetation Index (NDVI; 0-1, 1 = greenest, healthiest); Volumetric Moisture Content (VMC; %) of soil at 1.5- and 3-inch depths; Dark Green Color Index (DGCI; 0-0.666, 0.666 = darkest green color).

Trt No	Treatment	Company	Rate (oz/1,000 ft^2)	Interval	VQ	NDVI	VWC 3"	VWC 1.5"	DGCI
1	Control	--	--	--	5.00	0.78	36.10	28.60	0.408 ab
2	EXP DI 2010	--	5	AE	4.60	0.76	41.10	31.40	0.402 ab
3	EXP 355	--	5	AE	4.80	0.77	44.00	32.50	0.392 abc
4	EXP 4050	--	5	AE	4.80	0.76	38.80	29.80	0.371 bc
5	Excalibur	Aqua-Aid	3	AE	5.80	0.78	53.40	33.90	0.397 abc
6	AAS Experimental	--	5	AE	4.60	0.78	44.30	26.40	0.391 abc
7	EXP210HAR2	--	6	AE	4.80	0.77	27.90	29.00	0.388 abc
8	EXP210H3	--	6	AE	5.80	0.78	37.50	31.80	0.401 abc
9	Rely III	Simplot	6	AE	6.00	0.77	42.10	31.10	0.387 abc
10	ReWet	Simplot	8	AE	5.30	0.78	38.70	32.40	0.392 abc
11	EXT 1528	--	4	AE	5.40	0.78	32.50	29.10	0.399 abc
12	EXT 752	--	4	AE	6.00	0.79	41.40	33.40	0.390 abc
13	EXT 1420	--	8	AE	5.80	0.78	42.10	33.70	0.388 abc
14	EXT 1358	--	8	AE	5.00	0.75	35.80	28.30	0.374 bc
15	EXT 1402 EXT 1000	-- --	8 4	AE AE	6.00	0.78	50.20	35.10	0.375 bc
16	EXT 1513	--	8	AE	5.20	0.76	42.00	33.70	0.358 c
17	Revolution	Aquatrols	6	AE	5.60	0.77	53.90	29.50	0.386 abc
18	Zipline	Aquatrols	6	AE	5.80	0.77	57.90	36.10	0.392 abc
19	TriCure AD	Mitchell Products	3	AE	5.70	0.77	37.00	31.90	0.384 abc
20	Hydro-90	Harrell's	5	AE	6.30	0.79	43.10	32.30	0.402 abc
21	Skeepon	Ac-Planta	25	ACEG	5.20	0.76	41.30	32.00	0.396 abc
22	Skeepon	Ac-Planta	12.5	ACEG	4.80	0.76	39.50	30.10	0.400 abc
23	Vitalife	Necternal	30	AE	5.00	0.77	40.00	30.50	0.422 a
24	Time Bandit	Necternal	30	AE	4.80	0.76	34.60	29.70	0.399 abc
				p-value	0.16	0.80	0.58	0.38	0.00

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

Application Intervals: A=07/29/2022; C=08/12/2022; E=08/26/2022; G=09/09/2022

NW

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

Figure 1. Plot plan for the 2022 localized dry spot study. Riverside, CA

Stop #3a: Evaluation of Fungicides for Control of Anthracnose Disease on Annual Bluegrass Putting Greens

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Objectives:

This study was conducted to evaluate 28 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 28, 2022 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; Fig. 1) were applied every 7, 14, or 21 days beginning on June 28 (before disease symptoms were present) and ending on September 16. 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.

Plots were evaluated every two weeks visually for turf quality (1-9; 9=best), Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker handheld crop sensor, 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). Disease symptoms and signs (acervuli of *Colletotrichum cereale*) were first noted in early August. Disease outbreak was uneven, which likely contributed to lack of statistically significant differences among treatments except for visual quality on August 4 (Table 1). The most effective treatments thus far include: trt 23 (Maxtima, Encartis, Affirm); trt 22 (Briskway); trt 24 (Navicon, Lexicon, Signature Xtra, Secure, Primo Maxx); trt 21 (Ascernity, Daconil Action, Briskway, Primo Maxx); trt 11 (Velista); trt 19 (Daconil Action, Appear II, Primo Maxx; and trt 7 (Maxtima). Ratings will continue until October 7.

Acknowledgments:

Thanks to the CTLF, BASF, Bayer, Earth Microbial, FMC, 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. 2022. Riverside, CA.

Trt	Product	Company	Rate (oz/1,000 ft^2)	Interval	Quality 8/4/22	Quality 9/7/22	Cover 8/25/22	Cover 9/7/21
1	Control	--	--	--	5.0 ab	4.6	19	34
2	UCR001	--	0.1309	ACEGIK	5.4 ab	4.8	19	30
3	UCR001	--	0.1309	ADGJ	5.6 ab	5.6	13	20
4	UCR001	--	0.1963	ACEGIK	6.2 ab	5.6	18	24
5	UCR001	--	0.1963	ADGJ	5.4 ab	6.2	9	14
6	UCR001	--	0.1963	EGIK	4.8 b	6	14	17
7	Maxtima	BASF	0.4	ACEGIK	6.2 ab	6.6	4	10
8	Maxtima	BASF	0.4	ADGJ	6.2 ab	6	11	16
9	Kalida	FMC	0.33	ACEGIK	5.8 ab	5.8	10	17
10	Kalida	FMC	0.4	ACEGIK	5.6 ab	5	16	28
11	Velista	Syngenta	0.7	ACEGIK	5.8 ab	6.6	9	8
12	Navicon	BASF	0.85	ACEGIK	6.0 ab	6	10	14
13	Maxtima	BASF	0.6	ACEGIK	5.8 ab	5.6	10	17
14	Maxtima	BASF	0.6	ACEGIK	5.4 ab	6.2	7	12
14	BAS47402	BASF	0.5	ACEGIK				
15	Xzemplar	BASF	0.26	ACEGIK	5.2 ab	5.8	14	24
16	Xzemplar	BASF	0.26	ACEGIK	5.0 ab	5.6	14	20
16	BAS47402	BASF	0.5	ACEGIK				
17	Maxtima	BASF	0.6	ACEGIK	5.2 ab	5.8	11	17
17	BAS91634	BASF	2.0	ACEGIK				
18	Xzemplar	BASF	0.26	ACEGIK	5.4 ab	6.0	12	17
18	BAS91634	BASF	2.0	ACEGIK				
19	Daconil Action	Syngenta	3.5	ACEGIK	5.6 ab	6.4	10	15
19	Appear II	Syngenta	6.0	ACEGIK				
19	Primo Maxx	Syngenta	0.1	ACEGIK				
20	Ascernity	Syngenta	1.0	ACEGIK	5.6 ab	5.8	12	22
20	Appear II	Syngenta	6.0	ACEGIK				
20	Primo Maxx	Syngenta	0.1	ACEGIK				
21	Ascernity	Syngenta	1.0	AG	6.8 a	6.4	8	16
21	Primo Maxx	Syngenta	0.1	AG				
21	Daconil Action	Syngenta	3.5	CI				
21	Primo Maxx	Syngenta	0.1	CI				
21	Briskway	Syngenta	0.9	EK				
21	Primo Maxx	Syngenta	0.1	EK				
22	Briskway	Syngenta	0.9	ACEGIK	6.0 ab	6.8	7	9
23	Maxtima	BASF	0.4	AEI	5.8 ab	7.0	8	11
23	Encartis	BASF	4.0	CGK				
23	Affirm	NuFarm	1.0	EI				
24	Navicon	BASF	0.7	AEI	6.6 ab	6.6	2	8
24	Lexicon	BASF	0.47	CGK				
24	Signature Xtra	Bayer	5.3	CGK				
24	Secure	Syngenta	0.5	EK				
24	Primo Maxx	Syngenta	0.1	ACEGIK				
25	En-Stim A	Earth Microbial	--	ABCDEFGHIJK	5.4 ab	5.4	16	22
26	En-Stim B	Earth Microbial	--	ABCDEFGHIJK	5.8 ab	5.0	18	26
27	En-Stim C	Earth Microbial	--	ABCDEFGHIJK	4.8 b	4.4	28	32
28	Primo Maxx	Syngenta	0.1	ACEGIK	5.8 ab	4.8	20	35
				p-value	0.014	0.214	0.156	0.226

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

Application Intervals: A=6/28/22; B=7/5/22; C=7/14/22; D=7/26/22; E=8/4/22; F=8/9/22; G=8/22/22; H=8/25/22; I=9/2/22; J=9/10/22; K=9/16/22

NW

	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft
6 ft	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
6 ft	28	8	2	24	1	15	18	13	14	5	22	26	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**
6 ft	25	10	3	7	17	16	6	11	4	12	9	23	19	27	20	21	**5**	**21**	**23**	**11**
6 ft	**26**	**3**	**1**	**2**	**8**	**7**	**14**	**15**	**28**	**18**	**13**	**25**	**19**	**22**	**6**	**20**	**27**	**10**	**4**	**9**
6 ft	**24**	**12**	**17**	**16**	28	2	4	12	26	19	13	11	14	17	5	9	25	7	21	23
6 ft	**6**	**7**	**4**	**11**	**2**	**23**	**19**	**25**	3	8	16	1	27	10	20	24	15	6	18	22
6 ft	**15**	**14**	**20**	**10**	**24**	**21**	**17**	**13**	**28**	**5**	**9**	**12**	**3**	**22**	**16**	**8**	**18**	**1**	**26**	**27**

Figure 1. Plot plan for the 2022 anthracnose fungicide trial. Riverside, CA.

Stop #3b: Effects of Biostimulants on Annual Bluegrass Putting Greens

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Introduction:

The European Biostimulants Industry Council defines biostimulants as "substances and/or microorganisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to benefit nutrient uptake, nutrient use efficiency, tolerance to abiotic stress, and/or crop quality, independently of its nutrient content." There are several different types of biostimulants including humic and fulvic acids, seaweed extracts, liquid manure composting, and beneficial microorganisms (bacteria and fungi). In the turfgrass industry, there are a plethora of biostimulant products, many often containing several different active ingredients not to mention plant macro- and/or micronutrients. Furthermore, recommended programs often include several different products as tank-mix partners, which makes it difficult to determine which product or active ingredient is responsible for plant responses. The objective of this study was to examine a subset of products applied not only as tank mixtures of recommended products, but also as individual products applied on an annual bluegrass green. Because some products contain nutrients whereas others do not, the study was conducted on an area that received regular applications of liquid fertilizer and was repeated on an adjacent area with no fertilizer.

Materials and Methods:

The study was initiated on June 30, 2022, 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. Fertilizer was applied to half of the study area at a rate of 0.125 lbs N/1000 ft^2/2 wks beginning the first week of July 2022 using liquid formulations of 13.5-0-46 alternated with Fusn 26-0-0. The fertilized area received a total of 0.75 lbs N/1000 ft^2 during the study period in comparison to no fertilizer on the other half of the study area. Both fertilized and unfertilized turf received bi-weekly applications of fungicides including Briskway, Daconil WeatherStik, Secure, Heritage TL, Segway, and Subdue to combat/prevent historical diseases such as anthracnose, summer patch, *Pythium*, and brown ring patch. In addition, Primo Maxx was also applied at a rate of 0.1 oz/1000 ft^2/2 wks on the entire study area. 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 stress and incite disease outbreak.

Treatments (Table 1; Fig. 1) were applied every 7, 14, or 28 days beginning on June 30 (before disease symptoms or stress were present) and ending on September 16. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8003VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Skeepon treatments were applied using a spray volume of 4 gallons/1000 ft^2. Experimental design was randomized with either 3 or 5 replications due to space limitations. Plot size was 4×6 ft.

Data collection consisted of bi-weekly turfgrass quality (1-9; 9=best); digital image analysis to measure green turf cover (%) and dark green color index (DGCI) (0-0.666); and Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker handheld crop sensor. 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:

The study area had a history of anthracnose disease and was the site of previous fungicide trials. Thus, not surprisingly, anthracnose outbreak occurred on the green despite preventative and curative fungicide applications. In addition, parts of the green were subject to severe drought stress from poor irrigation distribution uniformity. Scattered mower scalping also occurred, which may or may not have been related to treatment effects and N applied to half of the study area. In general, only a few significant differences were found among treatments for measurements recorded, namely green cover and DGCI calculated from digital image analysis. Preliminary statistical analysis revealed that only the effect of fertilizer was significant, but not treatment or their interaction. Thus, data are presented separately by fertility level (Table 1). Although many factors could be responsible including non-uniformity of turf conditions and low number of replications for some treatments, there appeared to be interesting trends among treatments regarding their responses with or without added fertilizer (nitrogen). Tank-mixtures containing biostimulants and products containing nutrients (e.g., Gary's Green Ultra) appeared to produce darker, healthier turf with no added blanket fertilizer but sometimes resulted in greater turf scalping on the side where blanket fertilizer was applied. Interestingly, several treatments containing no additional nutrients appeared to provide better turf quality in plots without added fertilizer than in plots treated with blanket fertilizer applications. Ratings will continue until October 7.

Acknowledgments:

Thanks to the CTLF, Ac-Planta, Brandt, Earth Microbial, Necternal, Ocean Organics, and Wilbur Ellis for supporting this research and/or for providing products.

Table 1. Effects of biostimulant treatments on turf quality (1-9, 9 = best) and dark green color index (DGCI; 0-0.666) of annual bluegrass turf with added fertilizer and no fertilizer. 2022. Riverside, CA.

Trt	Product	Company	Rate (oz/1,000 ft2)	Interval (weeks)	DGCI 8/10/22	DGCI 8/10/22	Quality 9/7/22	Quality 9/7/22
					No Fert.	Fert.	No Fert.	Fert.
1	Control	-	-	-	0.356 bcd	0.365 b	6	5.6
2	Nutrio Biosoak	Wilbur-Ellis	15 oz/M	ACEGIK	0.341 bcd	0.361 b	5.7	5
3	Puric Salute	Wilbur-Ellis	1,5 oz/M	ACEGIK	0.365 abcd	0.356 b	5.7	5.3
4	Fourtiplex	Wilbur-Ellis	3 oz/M	ACEGIK	0.347 bcd	0.375 ab	6.3	5.7
5	Nutrio Biosoak + Puric Salute + Fourtiplex	Wilbur-Ellis	15 oz/M + 1,5 oz/M + 3 oz/M	ACEGIK	0.375 abcd	0.382 ab	6.6	5.8
6	OO-XPN	Ocean Organics	6 oz/M	ABCDEFGHIJ	0.402 ab	0.402 ab	6	6.3
7	OO-SR	Ocean Organics	6 oz/M	ABCDEFGHIJ	0.353 bcd	0.383 ab	6.3	6.7
8	OO-XPN + OO-SR	Ocean Organics	6 oz/M + 6 oz/M	ABCDEFGHIJ	0.391 abc	0.407 ab	5.8	6.8
9	Seablend 12-4-5	Ocean Organics	4 lbs/M	AEIM	0.375 abcd	0.389 ab	6.3	5.7
10	OO-XPN + OO-SR + Seablend 12-4-5	Ocean Organics	6 oz/M + 6 oz/M + 4 oz/M	AEIM	0.365 abcd	0.386 ab	6.6	5.4
11	Gary's Green Ultra	Brandt	9 oz/M	ACEGIK	0.408 a	0.424 a	6.2	5.2
	MegAlex		3 oz/M	ACEGIK				
	Turftopia		3 oz/M	ACEGIK				
	Gary's Green Ultra		9 oz/M	BDFHJ				
	Seaweed Max		3 oz/M	BDFHJ				
	Turftopia		3 oz/M	BDFHJ				
12	Turftopia	Brandt	3 oz/M	ACEGIK	0.337 cd	0.367 ab	5.3	5.3
13	Seaweed Max	Brandt	3 oz/M	ACEGIK	0.335 d	0.349 b	6.7	5.3
14	En-Stim A	Earth Microbial	-	ABCDEFGHIJ	0.379 abcd	0.365 b	6	6.3
15	En-Stim B	Earth Microbial	-	ABCDEFGHIJ	0.348 bcd	0.364 b	6.3	5.7
16	En-Stim C	Earth Microbial	-	ABCDEFGHIJ	0.359 abcd	0.366 ab	6.7	5.7
17	Skeepon	Ac-Planta	25 oz/M	ACEGIK	0.375 abcd	0.372 ab	7	5.7
18	Skeepon	Ac-Planta	12,5 oz/M	ACEGIK	0.349 bcd	0.388 ab	6.7	6.7
19	Vitalife	Necternal	30 oz/M	AEIM	0.362 abcd	0.387 ab	5.7	6
20	Time Bandit	Necternal	30 oz/M	AEIM	0.364 abcd	0.374 ab	5.7	5.7
p-value					**0.000**	**0.007**	**0.709**	**0.279**

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

Application Intervals: A=6/30/22; B=7/5/22; C=7/14/22; D=7/27/22; E=8/4/22; F=8/9/22; G=8/19/22; H=8/25/22; I=9/1/22; J=9/10/22; K=9/16/22

NW

	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft
6 ft	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
6 ft	**11**	**7**	**11**	**12**	**16**	**2**	**18**	**3**	**8**	**11**
6 ft	**10**	**13**	**5**	**20**	**1**	**15**	**8**	**13**	**20**	**12**
6 ft	**9**	**10**	**4**	**19**	**14**	**10**	**17**	**2**	**1**	**13**
6 ft	**8**	**16**	**5**	**1**	**12**	**6**	**5**	**8**	**9**	**14**
6 ft	**19**	**6**	**11**	**3**	**15**	**10**	**7**	**11**	**4**	**15**
6 ft	**14**	**5**	**18**	**17**	**1**	**20**	**19**	**18**	**17**	**16**

NE

4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**7**	**11**	**12**	**16**	**2**	**18**	**3**	**8**	**11**
10	**13**	**5**	**20**	**1**	**15**	**8**	**13**	**20**	**12**
9	**10**	**4**	**19**	**14**	**10**	**17**	**2**	**1**	**13**
8	**16**	**5**	**1**	**12**	**6**	**5**	**8**	**9**	**14**
19	**6**	**11**	**3**	**15**	**10**	**7**	**11**	**4**	**15**
14	**5**	**18**	**17**	**1**	**20**	**19**	**18**	**17**	**16**

Figure 1. Plot plan for the 2022 biostimulant trial. Riverside, CA. Plots on the west side received no added fertilizer during the study period. Plots on the east side were sprayed with 0.125 lbs N/1000 ft^2/2 wks (0.75 lbs N/1000 ft^2 total) during the study period.

Stop #4: Evaluation of products for water conservation on bermudagrass turf using a linear gradient irrigation system

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Objectives:

As drought persists throughout the western U.S., golf courses and other turf facilities have been asked to reduce irrigation. After several years of investigating multiple strategies and products to conserve water, our research has demonstrated or corroborated that the use of sufficient N fertility, plant growth regulators (PGRs), soil surfactants, and their combinations, can improve turfgrass quality with less water. Primo Maxx (trinexapac-ethyl) has consistently shown superior quality among other PGRs available in the market. Soil surfactants have demonstrated increased soil moisture uniformity, and therefore turfgrass quality under drought or deficit irrigation. Other products, such as fungicides, fertilizers, and mineral oils have been experimentally used in other scenarios and proved to increase turfgrass quality under abiotic stress conditions. In this study, we evaluated 11 different products or combinations to establish the best option for water conservation using a linear gradient irrigation system (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 2022 prior to the start of the study. When the experiment is in progress, only the center irrigation line provides water to experimental plots. The placement of the center-line sprinklers is 1/3 of normal spacing to allow for a simulated gradient of irrigation, from well-watered near the center to close to zero irrigation at the distant end of the plots. Treatments were applied on 4-ft x 48-ft plots, with each treatment replicated 4 times (two on each side of the field). Treatments were applied on 14- or 28-d intervals, except for the start of the study when all treatments were applied initially on July 10 and repeated six days later. List of treatments, rates, and application timings is provided in Table 1, and plot plan is presented in Figure 1. Each plot was sub-divided into 10 zones of 4-ft length, representing 10 crop coefficients of reference evapotranspiration (ET_o), 75%-69-67-54-42-36-33-28-23-17%, based on catch can tests. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8002VS nozzles. Spray volume was 1 gal/1,000 ft^2 for all treatments except Skeepon (4 gal/1,000 ft^2). Treatments were replicated 4 times. 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 on August 2, the far ends of plots received 0.2 inches of water following treatment applications every 2 wks only. Otherwise, centerline sprinklers were used to apply 75% ET_o divided into 4 irrigation days/wk. Data collection consisted of bi-weekly turfgrass quality (1-9; 9=best); digital image analysis to measure green turf cover (%) and dark green color index (DGCI) (0-0.666); and Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker handheld crop sensor. 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:

By the time of printing this report, no significant trt x subplot interactions were discovered for variables of interest (Table 1). However, analysis of whole-plot means revealed that the combination of Daconil Action, Appear II, Revolution, and Primo Maxx has thus far produced the highest quality, NDVI, VWC, Green Cover, and DGCI among treatments. The study will continue through October and until the first significant and persistent rainfall of the fall season.

Table 1. Treatments applied in the linear gradient irrigation study, Riverside, CA. 2022.

Trt. No	Product	Company	Rate (oz/1,000 ft^2)	Interval (weeks)	Visual Quality											NDVI	VWC	% Green Cover	DGCI
					75%	69%	67%	54%	42%	36%	33%	28%	23%	17%	Mean (A)	Mean (A)	Mean (A)	Mean (A)	Mean (A)
1	Control	-	-	-	7.3	7.3	7	6.8	6.3	6.3	6.3	6	5.5	5.3	6.4 cde	0.55 cde	15.6	60 d	0.361 def
2	Excalibur	Aqua-Aid	3 oz/M	ABFJN	7	7	6.8	6.8	6.8	6.8	6.5	6.3	5.8	5	6.5 bcde	0.58 bc	16.7	63 d	0.355 ef
3	Revolution	Aquatrols	6 oz/M	ABFJN	7	7	7	7	7	6.8	6.3	6	5.8	5.3	6.5 bcd	0.58 bc	16.7	63 d	0.358 ef
4	Civitas	Intelligro	8.5 oz/M	ABDFHJLN	7.5	7.3	7	7	7	7	6.8	6	6.3	6.3	6.8 ab	0.57 bcde	14.8	76 b	0.387 b
5	Turf Screen	Turf Max	1.25 oz/M	ABDFHJLN	7.3	7.3	7	7	6.8	6.8	6.5	6.3	6.3	5.5	6.7 bcd	0.56 bcde	13.8	72 bc	0.38 bc
6	Windjammer (OO-WJ)	Ocean Organics	5 oz/M	ABFJN	7.3	7	7	6.8	6.8	7	6.8	6.5	6	5.5	6.7 bcd	0.59 b	16.6	63 d	0.353 f
7	Vitalife	Necternal	30 oz/M	ABFJN	7.3	7.3	7	7	6.8	7	6.5	6.3	6	5.3	6.6 bcd	0.57 bcde	15.5	67 cd	0.373 cd
8	Skeepon	Ac-Planta	25 oz/M	ABDFHJLN	7	7	6.8	6.8	6.8	6.5	6.3	6	5.5	4.8	6.3 de	0.54 e	15.8	62 d	0.366 de
9	Nanocarbon	Vulpes Corp.	32 oz/M	ABDFHJLN	7	7	7	6.8	6.5	6.5	6.5	6.3	6	5.5	6.5 bcd	0.54 de	15.4	65 cd	0.371 cd
10	Daconil Action + Appear II	Syngenta	3.5 oz/M + 6.0 oz/M	ABDFHJLN	7.8	7.5	7	7	7	7	6.8	6.3	6	5.5	6.8 abc	0.57 bcd	14.7	85 a	0.386 b
11	Primo Maxx	Syngenta	0.25 oz/M	ABDFHJLN	5.8	6	6.5	6.5	6.3	6.5	6.3	6	5.8	5.3	6.1 e	0.57 bcd	15.4	67 cd	0.382 bc
12	Revolution + Daconil Action + Appear II + Primo Maxx	Aquatrols, Syngenta	6 oz/M + 3.5 oz/M + 6.0 oz/M + 0.25 oz/M	ABFJN	8	8	7.8	7.8	7.3	7	7	6.8	6.3	6	7.2 a	0.62 a	17.3	92 a	0.416 a

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

Application timing: A=7/10/2022; B=7/16/2022; C=8/03/2022; D=8/16/2022; F=8/30/2022; H=8/30/2022; J=9/13/2022; L=9/27/2022; N=11/10/2022

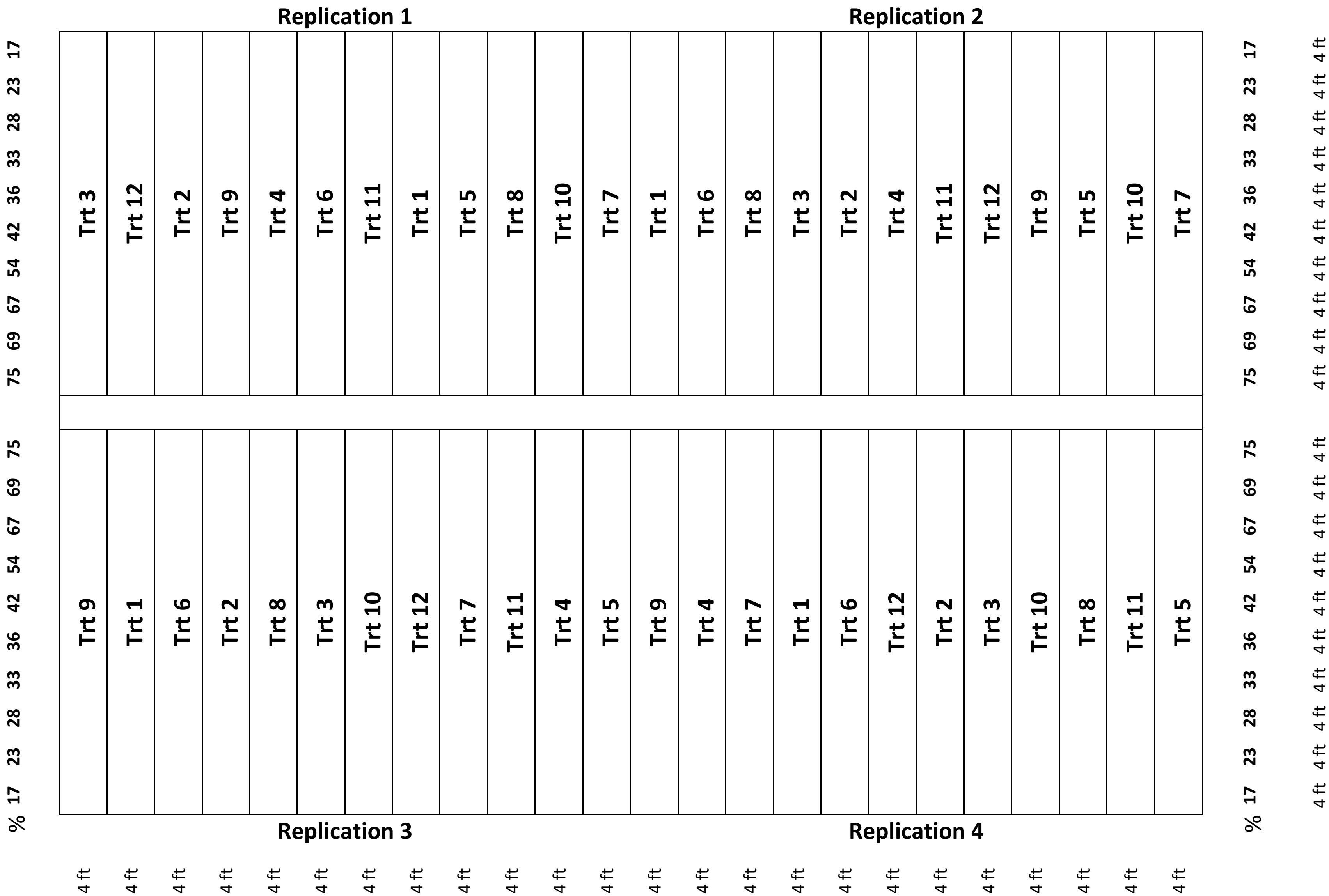

Figure 1. Plot plan for the 2022 linear gradient irrigation system.

Stop #5: Evaluation of Products for Management of Salinity and Rapid Blight Disease on *Poa* 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. Leaching and modification of soil physicochemical properties can help alleviate salinity stress. Overall, numerous products are purported to aid in salinity management, many of which have not been tested under non-biased, replicated experiments on turf.

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 *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 salinity, fungicide, biostimulant, and fertility 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 and 2020 studies were seeded again in spring 2021. In addition, the green became contaminated with bentgrass and various warm-season turfgrasses, which had to be physically removed, replaced with sand, and seeded with annual bluegrass. The combination of hot weather, turf re-establishment, and weed encroachment left the green with sparse areas of annual bluegrass prior to initiation of the study. These areas were excluded from the current study to the best of our abilities. Turf was mowed at 0.125 inches 5 times/wk, lightly topdressed with sand biweekly, and received Primo Maxx at 0.125 oz/M biweekly. 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 2022 using 13.5-0-46 alternated with Fusn 26-0-0. Overall, the green received a total of 0.75 lbs N/1000 ft^2 from liquid and 1.5 lbs N/1000 ft^2 from granular during the study period and before publication of this report. To control diseases other than rapid blight, fungicides including Briskway, Heritage TL, Subdue Maxx, and Segway were applied alone or in various combinations every 2 wks throughout the study period.

A total of 17 treatments including an untreated control were evaluated in this study. The list of products and timing of application is presented in Table 1. The plot plan can be found in Fig. 1. Treatments were applied every 7, 14, or 21 days beginning on July 2, 2022. 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 18, 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 turfgrass quality (1-9; 9=best); digital image analysis to measure green turf cover (%) and dark green color index (DGCI) (0-0.666); and Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker handheld crop sensor. In addition, soil volumetric water content (VWC; %) and electrical conductivity (EC) was collected at a 3-inch depth using a POGO. Data were analyzed using Analysis of Variance with Tukey's honest significant difference (HSD) test (P=0.05).

<u>Results:</u>

Soil EC was ca. 0.25 dS/m for all plots prior to the start of the experiment (data not shown) and rose to at least 1.0 dS/m by September 7 (Table 1). An unforeseen outbreak of summer patch disease occurred early in the study, which adversely affected all treatments except Navicon (data not shown). Despite increased stress from drought and salinity, no significant differences were observed for the measurements thus far in the experiment except for DGCI. Overall, the Brandt (trt 4) and Ocean Organics (trt 7) programs stood out the most in terms of turf quality and color likely due to added nutrients from some of the products. Identification of the causal agent of rapid blight disease is pending

Acknowledgments

Thanks to the CTLF, Ac-Planta, BASF, Brandt, Earth Mircrobial, Exacto, Harrell’s, Necternal, Ocean Organics, Syngenta, and Wilbur-Ellis for supporting this research and/or for providing products.

Table 1. Effects of salinity treatments on turf quality (1-9, 9 = best), electrical conductivity, and dark green color index (DGCI; 0-0.666) of annual bluegrass turf. 2022. Riverside, CA.

Trt	Product	Company	Rate (oz/1,000 ft^2)	Interval (weeks)	VQ 8/24/2022	VQ 9/7/2022	EC 9/7/2022	DGCI 9/7/2022
1	Control	-	-	-	5	5.6	1.343	0.366 abc
2	EM		6 oz/M	AEIM	5.6	5.8	1.473	0.337 c
3	EM		12 oz/M	AEIM	5	5	1.061	0.335 c
4	Gary's Green Ultra		9 oz/M	ACEGIK				
4	MegAlex		3 oz/M	ACEGIK				
4	Seaweed Max	Brandt	3 oz/M	ACEGIK	6.2	6.2	1.357	0.400 a
4	Gary's Green Ultra		9 oz/M	BDFHJ				
4	MegAlex		3 oz/M	BDFHJ				
4	Seaweed Max		3 oz/M	BDFHJ				
5	Puric Salute	Wilbur-Ellis	3 oz/M	ACEGIK				
5	Photo-C3	Wilbur-Ellis	3 oz/M	ACEGIK	5	4.8	1.519	0.336 c
5	Link Ca++	Wilbur-Ellis	15 oz/M	ACEGIK				
6	Daconil Action	Syngenta	3.5 oz/M	ACEGIK	5.8	5	1.059	0.355 abc
6	Appear II	Syngenta	6 oz/M	ACEGIK				
7	OO-XPN		6 oz/M	ABCDEFGHIJ				
7	OO-SR		6 oz/M	ABCDEFGHIJ				
7	OO-DS		0.375 oz/M	ABCDEFGHIJ				
7	OO-WJ	Ocean Organics	5 oz/M	AEIM	6.8	6	1.588	0.385 abc
7	Seablend 12-4-5		4 lbs/M	AEIM				
8	EXT 1402		8 oz/M	AEIM	5.2	5.6	1.456	0.345 bc
9	EXT 1538		8 oz/M	AEIM	5.4	5.6	1.342	0.357 abc
10	EnStim A		-	ABCDEFGHIJ	5.4	5.2	1.337	0.339 c
11	EnStim B	Earth Microbial	-	ABCDEFGHIJ	5.4	5.8	1.353	0.342 c
12	EnStim C		-	ABCDEFGHIJ	5.4	5.2	1.412	0.350 abc
13	Skeepon	Ac-Planta	25 oz/M	ACEGIK				
14	RediRain		10 oz/M	ACEGIK				
14	Scycle	Necternal	10 oz/M	ACEGIK	5	5	1.314	0.333 c
14	Vitalife		20 oz/M	ACEGIK				
15	Navicon	BASF	0.85 oz/M	ACEGIK				
16	Velista		0.5 oz/M	ACEGIK	5.8	5.4	1.168	0.347 abc
16	Appear II	Syngenta	6 oz/M	ACEGIK	5.4	5	1.227	0.398 ab
17	Appear II		6 oz/M	ACEGIK	5.4	5	1.368	0.370 abc
p-value					0.753	0.967	0.640	0.000

N

		8 ft	8 ft	8 ft	8 ft	8 ft	8 ft
		I	II	III	IV	V	VI
4 ft	1		1	3	8	15	
4 ft	2	13	10		4	6	16
4 ft	3	6	16		9	10	3
4 ft	4	9		2	14	17	14
4 ft	5		15	12	7	4	11
4 ft	6		5	11	5	12	
4 ft	7		17		2	7	
4 ft	8		8	5		1	13
4 ft	9	14	11	9	4	16	
4 ft	10	6	3	17	7	2	
4 ft	11	12		13	15	1	
4 ft	12	10		9		8	
4 ft	13		15				
4 ft	14		16				10
4 ft	15		5				16
4 ft	16	1	11	14	8		2
4 ft	17	17	4	13	1	7	4
4 ft	18	3	6	8		15	17
4 ft	19	10	12	11	13	14	6
4 ft	20	7	2	12	9	3	5

Figure 1. Plot plan for the 2022 salinity trial. Riverside, CA.

Stop #6: Evaluation of Bermudagrass, Zoysiagrass, Seashore Paspalum, and St. Augustinegrass Lines Under Salinity Stress

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Objectives:

Evaluation of warm-season turfgrasses under salinity stress is a part of the project “Improving drought tolerance and sustainability of turfgrasses used in southern landscapes through the integration of breeding, genetics, physiology, economics, and outreach” within Specialty Crop Research Initiative (SCRI) funded by the Unites States Department of Agriculture. The objective of this study is to evaluate advanced lines of bermudagrass, seashore paspalum, St. Augustinegrass and zoysiagrass, and identify lines able to tolerate irrigation water of marginal quality.

Materials and Methods:

The study includes 35 lines and four cultivars of bermudagrass, 43 lines and three cultivars of zoysiagrass, 13 lines and two cultivars of seashore paspalum and 26 lines and three cultivars of St. Augustinegrass, developed 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 University of California, Riverside (UCR). The study was planted at UCR, Riverside, CA in June and July 2020. Bermudagrass, zoysiagrass and seashore paspalum were mowed at 2 inches, St. Augustinegrass at 3 inches, once a week. Irrigation with saline water of electroconductivity EC=4.4 dSm^{-1} was applied between July 6th and October 15th in 2021. In 2022 saline water irrigation was started again on July 6th. This salinity level is considered high but realistic. No additional stress was applied.

Results:

Variation in response to salinity stress expressed as changes in turfgrass quality (1-9; 9=best) and leaf firing (1-9; 1=no firing) was observed among and within species. Under salinity stress seashore paspalum entries showed higher turfgrass quality and lower leaf firing than the other species, while St. Augustinegrass had the lowest quality and the highest leaf firing. High variability in quality was observed among zoysiagrass and bermudagrass entries, which suggests that improvement of these two species through breeding efforts is possible. UGZ401, TifZ20301, DALZ1801, DALZ1713, TifZ20309 and ‘Diamond’ zoysiagrasses had high quality and low leaf firing. Among bermudagrasses OSU2034, OSU2035 and ‘TifTuf’ had high quality. Variation in leaf firing in bermudagrass was lower than in zoysiagrass entries. OSU2021, ‘Santa Ana’, ‘TifTuf’ had low leaf firing and good quality. DALSA1909 and DALSA1910, and DALSA1914 were St. Augustinegrass entries with the highest quality and low leaf firing. The variation in leaf firing and turfgrass quality among seashore paspalum entries was low, however most entries of this species showed low firing and high quality. Among them UGP198 and ‘Platinum’ were the best performers.

Acknowledgments:

Thanks to the Unites States Department of Agriculture - National Institute of Food and Agriculture (USDA NIFA) for their support of this research.

Table 2. Turfgrass quality (1-9; 9=best) and leaf firing (1-9; 1=no firing) of zoysiagrass and bermudagrass under irrigation with saline water (EC=4.4 dSm^{-1}) Riverside, CA, 2021-2022.

Zoysiagrass					**Bermudagrass**				
Code	Turf Quality		Leaf Firing		Code	Turf Quality		Leaf Firing	
DALZ1608	6.0	a-e	2.9	a-e	FB1628	5.0	c-g	2.9	a-d
DALZ1713	6.6	a-d	2.3	ab	FB1630	4.9	e-g	3.4	b-e
DALZ1714	6.0	a-e	2.9	a-e	FB2002	5.3	b-g	2.8	a-d
DALZ1715	5.5	b-h	3.7	a-h	OSU2018	5.4	b-g	3.0	a-d
DALZ1801	6.6	a-c	2.2	ab	OSU2022	5.5	b-f	2.8	a-d
DALZ1816	5.5	b-h	3.1	a-g	OSU2034	6.8	a	2.5	a-d
DALZ1901	4.9	e-j	4.4	e-j	OSU2035	6.4	ab	2.1	a-c
DALZ1902	5.1	e-i	3.5	a-h	OSU2037	4.2	g	4.7	e
DALZ1903	6.1	a-e	2.7	a-e	OSU2039	4.7	fg	3.2	a-e
DALZ1904	5.2	e-h	3.3	a-h	OSU2043	5.3	b-g	2.8	a-d
DALZ1905	5.8	a-f	2.9	a-e	OSU2066	5.2	b-g	2.6	a-d
DALZ1906	5.1	e-i	3.6	a-h	OSU2073	5.6	a-f	2.6	a-d
DALZ1907	5.8	a-f	2.6	a-d	OSU2074	5.4	b-g	3.2	b-e
FZ1642	4.3	h-k	4.7	f-j	OSU2075	5.0	c-g	3.6	c-e
FZ1664	5.3	d-h	3.5	a-h	OSU2081	6.0	a-e	2.1	a-c
FZ1680	4.7	f-k	4.4	e-j	OSU2082	5.7	a-f	2.4	a-d
FZ1681	5.4	c-h	3.4	a-h	OSU2088	5.5	b-f	2.7	a-d
FZ1682	5.7	b-g	3.3	a-h	OSU2094	4.9	d-g	3.7	de
FZ1683	5.9	a-f	3.1	a-g	OSU2101	5.0	d-g	3.3	b-e
NCXZ11174	3.6	k	6.0	j	OSU2102	6.2	a-c	1.7	a
NCXZ11199	4.9	e-j	3.9	b-i	TifB20201	5.7	a-f	2.5	a-d
NCXZ11232	4.3	h-k	4.8	g-j	TifB20202	5.3	b-g	2.5	a-d
NCXZ14069	5.8	a-f	3.2	a-g	TifB20203	6.1	a-d	2.4	a-d
NCXZ14070	3.6	jk	5.5	ij	TifB20204	5.8	a-f	2.5	a-d
NCZG09004	5.3	c-h	3.6	a-h	TifB20205	6.0	a-e	2.4	a-d
NCZG09038	5.4	c-h	3.5	a-h	TifB20206	5.9	a-f	2.5	a-d
NCZG09045	4.9	e-k	3.8	a-h	TifB20207	5.2	b-g	2.7	a-d
TifZ20301	6.8	ab	2.1	a	TifB20208	5.5	b-f	3.0	a-d
TifZ20302	5.0	e-i	4.0	c-i	UCRBH17-8	5.9	a-e	2.3	a-d
TifZ20303	6.1	a-e	2.7	a-d	UCRBH4-5	5.4	b-f	2.3	a-d
TifZ20304	5.3	d-h	3.7	a-h	UCRC180127	5.6	a-f	2.4	a-d
TifZ20305	5.5	b-h	2.9	a-e	UCRC180164	5.0	c-g	2.9	a-d
TifZ20306	6.0	a-f	2.9	a-e	UCRC190084	5.1	c-g	2.6	a-d
TifZ20307	5.6	b-h	3.4	a-h	UCRC190280	5.3	b-g	2.7	a-d
TifZ20308	4.9	e-j	3.9	b-i	UCRTP6-3	5.4	b-g	2.4	a-d
TifZ20309	6.6	a-c	2.4	a-c	SantaAna	6.0	a-e	2.0	ab
TifZ20310	5.1	e-i	4.2	d-i	Tahoma31	5.0	c-g	3.1	a-d
TifZ20311	4.4	g-k	4.7	f-j	TifTuf	6.3	ab	2.0	ab
TifZ20312	5.2	e-h	3.8	b-h	Tifway	5.7	a-f	2.9	a-d
UFZ03	5.8	a-f	3.0	a-f					
UGZ401	7.0	a	2.1	a					
UGZ402	3.9	i-k	5.0	h-j					
DeAnza	6.1	a-e	2.5	a-c					
Diamond	6.6	a-d	2.4	a-c					
El Toro	5.7	a-f	3.3	a-h					

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

Table 3. Turfgrass quality (1-9; 9=best) and leaf firing (1-9; 1=no firing) of St. Augustinegrass and seashore paspalum under irrigation with saline water (EC=4.4 dSm^{-1}) Riverside, CA, 2021-2022.

St. Augustinegrass					**Seashore paspalum**			
Code	Turf Quality		Leaf Firing		Code	Turf Quality		Leaf Firing
DALSA1908	5.4	a-d	3.3	ab	UGP113	6.5	ab	1.4
DALSA1909	5.7	ab	3.2	ab	UGP145	6.6	ab	1.3
DALSA1910	5.8	a	3.0	a	UGP198	7.0	a	1.2
DALSA1911	4.9	a-e	4.1	a-c	UGP310	6.8	ab	1.3
DALSA1912	4.4	b-f	4.5	a-e	UGP337	6.8	ab	1.6
DALSA1913	5.5	a-d	3.5	ab	UGP338	5.8	bc	1.3
DALSA1914	5.6	a-c	3.0	a	UGP339	6.0	a-c	1.5
FSA1606	4.6	a-f	4.4	a-d	UGP340	5.2	c	1.6
FSA1615	4.8	a-f	4.4	a-d	UGP341	5.9	a-c	1.7
FSA1617	4.5	b-f	4.1	a-c	UGP347	6.3	a-c	1.6
FSA1619	4.6	a-f	4.4	a-e	UGP357	6.1	a-c	1.5
FSA1627	4.7	a-f	4.1	a-c	UGP358	5.9	a-c	1.8
FSA1809	3.9	e-g	4.8	a-e	UGP73	6.9	ab	1.4
FSA1810	4.8	a-e	4.1	a-c	Platinum	7.0	a	1.3
FSA1836	4.7	a-f	4.7	a-e	SeaStar	6.2	a-c	1.5
NCXS11026	4.7	a-f	4.0	a-c				
NCXS11027	4.8	a-e	4.2	a-d				
NCXS11513	4.5	b-f	4.8	a-e				
NCXS12155	3.1	gh	5.5	c-e				
NCXS12338	4.3	d-g	4.8	a-e				
NCXS12341	4.3	d-g	4.3	a-d				
NCXS12344	4.4	c-g	4.7	a-e				
NCXS12354	4.3	d-g	4.7	a-e				
NCXS14132	2.3	h	6.1	de				
NCXS14271	5.0	a-e	4.0	a-c				
NCXS14450	3.5	f-h	5.0	b-e				
Floratam	5.0	a-e	3.9	a-c				
Palmetto	4.9	a-e	4.3	a-d				
Raleigh	3.1	gh	6.3	e				

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

Plot Plan for SCRI Warm-Season Turfgrasses Salinity Trial – part 1

Zoysiagrass								Bermudagrass						
DALZ 1715	NCXZ 11174	NCZG 09038	DALZ 1907	DALZ 1713	DALZ 1905	NCXZ140 70	DALZ 1608	OSU 2022	OSU 2101	TifB 20206	OSU 2082	UCRBH 4-5	TifTuf	FB1630
FZ1642	UGZ 402	TifZ 20303	NCXZ 11199	TifZ 20305	NCXZ140 69	DALZ 1902	TifZ 20302	FB2002	Tifway	OSU 2074	TifB 20201	TifB 20204	OSU 2102	UCRC180 164
NCXZ 11232	NCZG 09004	DALZ 1714	UFZ03	TifZ 20307	TifZ 20308	DeAnza	FZ1664	UCRC180 127	OSU 2018	OSU 2043	Tahoma 31	OSU 2035	Santa Ana	OSU 2034
FZ1681	UGZ4 01	DALZ 1906	TifZ 20310	TifZ 20306	DALZ 1816	FZ1682	NCZG 09045	OSU 2081	UCRC190 280	TifB 20205	OSU 2088	TifB 20203	OSU 2094	OSU 2075
TifZ 20303	TifZ 20304	TifZ 20308	UGZ 402	FZ1680	TifZ 20309	TifZ 20301	TifZ 20305	OSU 2066	UCRBH 17-8	OSU 2039	UCRBH 4-5	OSU 2018	OSU 2037	FB1628
DALZ 1903	NCZG 09038	DALZ 1904	NCXZ140 70	DALZ 1801	NCZG 09004	FZ1683	DALZ 1714	Tifway	TifB 20208	OSU 2022		OSU 2101	FB1630	TifB 20202
DALZ 1816	DALZ 1907	DALZ 1715	TifZ 20302	FZ1682	DALZ 1901	NCXZ 11232	TifZ 20307	OSU 2082	OSU 2073	Tahoma 31	OSU 2074	OSU 2043	TifB 20207	UCRC180 164
TifZ 20310	FZ1642	El Toro	NCXZ 11174	NCZG 09045	FZ1681	UGZ 401	DeAnza	UCRC190 084	TifTuf	Santa Ana	FB2002	TifB 20206	OSU 2073	OSU 2035
NCXZ 11199	FZ1664	DALZ 1713	TifZ 20312	TifZ 20301	UFZ03	DALZ 1905	DALZ 1801	OSU 2034	OSU 2094	UCRTP 6-3	OSU 2081	OSU 2102	TifB 20204	UCRC180 127
TifZ 20307	TifZ 20306	DALZ 1902	Diamond	DALZ 1715	TifZ 20308	DeAnza	TifZ 20309	FB1628	Santa Ana	TifB 20203	UCRBH 17-8	OSU 2074	UCRC190 280	OSU 2066
TifZ 20311	NCXZ140 69	TifZ 20309	El Toro	TifZ 20310	DALZ 1608	Diamond	TifZ 20311	OSU 2094	UCRC190 084	OSU 2035	TifB 20205	OSU 2088	TifB 20208	Tifway
FZ1683	DALZ 1901	FZ1680	NCZG 09045	DALZ 1903		DALZ 1714	DALZ 1906	TifB 20202	OSU 2075	TifB 20208	OSU 2037	Tahoma 31	UCRTP 6-3	UCRC190 84
TifZ 20302	FZ1682	NCXZ140 70	DALZ 1816	TifZ 20304	DALZ 1904	TifZ 20312	NCZG 09004	TifB 20207	UCRBH 17-8	OSU 2081	TifTuf	UCRC190 280	OSU 2039	OSU2073
NCZG 09038	UFZ03	FZ1681	UGZ 401	TifZ 20312	NCXZ 11174	TifZ 20303	El Toro	OSU 2043	OSU 2101	UCRC180 164	TifB 20207	OSU 2022	FB1628	TifB 20201
DALZ 1904	DALZ 1801	TifZ 20301	DALZ 1901	FZ1683	TifZ 20305	TifZ 20306	DALZ 1907	TifB 20206	FB1630	TifB 20202	UCRBH 4-5	OSU 2066	FB2002	OSU 2082
UGZ 402	DALZ 1903	TifZ 20304	Diamond	TifZ 20311	DALZ 1713	FZ1680	NCXZ 11199	TifB 20204	OSU 2039	OSU 2018	UCRTP 6-3	OSU 2034	TifB 20203	UCRC180 127
DALZ 1608	DALZ 1906	NCXZ 11232	DALZ 1905	NCXZ140 69	FZ1664	DALZ 1902	FZ1642	OSU 2037	TifB20205	OSU 2088	TifB 20201	OSU 2075	OSU 2102	

Plot Plan for SCRI Warm-Season Turfgrasses Salinity Trial – part 2

Seashore Paspalum | St. Augustinegrass

UGP 73	UGP 347	UGP 145	DALSA 1911	NCXS 11027	NCXS 11513	FSA 1617	NCXS 12338	NCXS 12354
UGP 198	UGP 340	UGP 113	NCXS 12155	DALSA 1914	DALSA 1909	NCXS 14271	DALSA 1908	NCXS 12341
UGP 339	Platinum	UGP 338		NCXS 12354	FSA 1810	DALSA 1913	FSA 1809	DALSA 1910
UGP 341	UGP 310	UGP 347	FSA 1619	DALSA 1911	FSA 1615	Raleigh	NCXS 11513	FSA 1627
UGP 337	UGP 73	UGP 340	NCXS 11026	FSA 1617	NCXS 12338	NCXS 14450	FSA 1836	Raleigh
UGP 357	UGP 358	Sea Star	DALSA 1908	FSA 1809	NCXS 14132	NCXS 11027	Palmetto	DALSA 1912
UGP 145	UGP 339	UGP 341	FSA 1606	NCXS 12344	FSA 1836	Floratam	NCXS 12155	DALSA 1909
Platinum	UGP 357	UGP 310	NCXS 14132	FSA 1627	NCXS 11026	NCXS 12354	DALSA 1914	FSA 1619
Sea Star	UGP 341	UGP 358	NCXS 14450	DALSA 1913	Palmetto	FSA 1606	NCXS 12341	NCXS 14271
UGP 338	UGP 113	UGP 337		DALSA 1912	NCXS 12344	FSA 1810	Raleigh	FSA 1809
UGP 340	UGP 198	UGP 339	FSA 1836	NCXS 11513	DALSA 1910	NCXS 12155	Floratam	NCXS 14132
UGP 347	Sea Star	UGP 357	FSA 1615	FSA 1619	FSA 1606	DALSA 1908	FSA 1627	FSA 1615
UGP 310	UGP 145	UGP 73	NCXS 12338	DALSA 1909	FSA 1617	DALSA 1911	NCXS 11026	NCXS 14450
UGP 358	UGP 337	Platinum	DALSA 1910	Floratam	DALSA 1913	DALSA 1912	NCXS 12344	NCXS 11027
UGP 113	UGP 338	UGP 198	NCXS 14271	DALSA 1914	Palmetto	NCXS 12341	FSA 1810	

Stop #7: Postemergence Control of Yellow and Purple Nutsedge and Green Kyllinga in Bermudagrass Turf

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Introduction:

Sedges are a distinctive group of plants that are neither broadleaves nor grasses. Because of this, many herbicides used to control other major weeds in turfgrass are not effective against them. In general, sedges prefer wet areas and tend to produce highest pressure next to leaking sprinklers or in areas where water accumulates; however, once established, they can survive even prolonged drought. Yellow and purple nutsedge produce underground tubers sometimes referred to as nutlets. These organs help plants survive unfavorable conditions and often even herbicide application. While green kyllinga does not produce underground tubers, it is a prolific seed producer and can easily spread over long distance. All three species can also spread through rhizomes.

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.).

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 infrequently at 1.5 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 complete randomized block with 4 replications. Plot size was 3x3 ft with 1-ft alleys. The study was initiated on August 12, 2022. Treatments for this study are presented in Table 1. Plots were evaluated for visual quality (1-9, 9 = best), weed cover (%), weed injury (%), turfgrass injury (%; 20% = acceptable level), Normalized Difference Vegetation Index (NDVI; 0-1) using a GreenSeeker instrument. 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 and using Analysis of Variance with Tukey's HSD post-hoc test for all other parameters at P = 0.05.

Results:

Most treatments tested had significant influence on sedge control (Table 1 and Figure 1). By September 2 (last rating taken before publication of this report) the best working group of herbicides was the sulfonylureas. So far, best activity was observed for trt 21 (Tribute Total) and 23 (Sedgehammer) with trt 13 (Monument), trt 8 (Celero) and trt 17 (Certainty) following closely behind. Revolver (trt 22) despite not being advertised for sedge control showed good activity on purple nutsedge but had very weak activity on other tested species. GameOn herbicide (trt 2) also showed decent sedge control, which was further enhanced when this product was tank-mixed with Sapphire (trt 3) or Dismiss CA (trt 4). The second of these tank-mixes, however, caused short-lasting turf injury, which was on the verge of unacceptable. While plots started with relatively poor aesthetic (Visual quality ~ 4.5) within three weeks some treatments improved quality to acceptable levels including (from non-experimental products): 8 (Celero), 17 (Certainty), 21 (Tribute total), 22 (Revolver) and 23 (Sedgehammer).

Acknowledgments:

Thanks to BASF, Bayer, Corteva, FMC, Gowan, NuFarm, Prime Source, Syngenta and the California Turfgrass & Landscape Foundation (CTLF) for providing products and supporting this research.

Table 4 Herbicide treatments and data collected in yellow and purple nutsedge and green kyllinga control study until 9/2/2022. Purple nutsedge control (%), Green kyllinga control (%), Yellow nutsedge control (%), Visual Quality (1-9, 9 = best) and Turf injury (%). Riverside, CA. 2022.

Trt No	Treatment	Rate	Timing	Purple nutsedge control 9/2/2022	Green kyllinga control 9/2/2022	Yellow nutsedge control 9/2/2022	Visual Quality 8/18/2022	Visual Quality 8/28/2022	Visual Quality 9/2/2022	Turf Injury 8/18/2022	Turf Injury 8/28/2022	Turf Injury 9/2/2022
1	Control			0 b	0 i	0 e	4.4 abc	4.9 ab	4.5 cd	0 f	1 cd	0 d
2	GameOn Specialty Herbicide	4 pt/A	A	72 ab	58 defg	66 abcde	4.3 abc	5.5 ab	5.8 abc	1 ef	6 c	4 cd
3	GameOn Specialty Herbicide + Sapphire	4 pt/A + 8 oz/A	A	100 a	49 efgh	90 abc	4.3 abc	5.4 ab	5.5 abc	1 ef	3 cd	6 bc
4	GameOn Specialty Herbicide + Dismiss CA	4 pt/A + 4 oz/A	A	100 a	81 abcd	78 abcd	3.6 cd	4.9 ab	5.5 abc	20 ab	6 cd	4 cd
5	Experimental 1		A	77 ab	87 bc	89 abc	4.4 abc	5.9 ab	6.5 ab	1 f	1 cd	0 d
6	Experimental 2		A	78 ab	81 bcde	73 abcde	4.1 abcd	4.7 b	5.4 abc	12 cd	15 b	10 b
7	Experimental 3		A	96 ab	90 abc	100 a	4.2 abcd	5.9 ab	6.4 ab	0 f	1 cd	0 d
8	Celero + NIS	10 oz/A + 0.25% v/v	A	100 a	78 cdef	100 a	4.6 abc	5.6 ab	6.1 ab	0 f	0 d	1 cd
9	Experimental 4		A	69 ab	26 defghi	31 abcde	4.7 ab	5.6 ab	5.3 abc	0 f	0 d	0 d
10	Experimental 5		A	27 ab	26 hi	6 e	4.6 abc	5.4 ab	5.5 abc	0 f	0 d	0 d
11	Experimental 6		A	11 ab	20 efghi	25 e	4.4 abc	5.1 ab	5.2 bc	1 f	0 d	0 d
12	Experimental 7		A	19 ab	17 hi	16 e	4.7 ab	5.6 ab	5.4 abc	0 f	0 d	0 d
13	Monument + NIS	15 g/A + 0.25% v/v	AB	100 a	87 abcde	100 a	4.4 abc	5.6 ab	5.9 ab	0 f	1 cd	1 cd
14	Tenacity + NIS	5 oz/A + 0.25% v/v	AB	61 ab	27 h	34 bcde	4.6 abc	5.6 ab	5.5 abc	1 ef	0 cd	0 d
15	Tenacity + Sencor + NIS	5 oz/A + 4 oz/A + 0.25% v/v	AB	64 ab	27 ghi	8 e	3.2 d	5.3 ab	5.8 abc	22 a	1 cd	0 d
16	Tenacity + Princep + NIS	5 oz/A + 16 oz/A + 0.25% v/v	AB	27 ab	20 hi	32 de	3.9 abcd	5.7 ab	5.9 ab	9 cd	2 cd	0 d
17	Certainty + NIS	1.25 oz/A + 0.25% v/v	A	96 ab	85 bc	100 a	4.6 abc	5.7 ab	6.1 ab	0 f	0 d	0 cd
18	Experimental 8		A	100 a	80 abcdef	96 ab	4.8 a	6.0 a	6.2 ab	0 f	1 cd	0 d
19	Basagran + MSO	32 oz/A + 0.5%v/v	A	18 ab	16 hi	25 abcde	4.6 abc	5.5 ab	5.4 abc	0 f	0 d	0 d
20	Experimental 9		A	88 ab	77 abcdef	97 a	4.4 abc	6.0 a	6.4 ab	0 f	1 cd	0 d
21	Tribute total + NIS	3.2 oz/A + 0.25% v/v	A	100 a	98 ab	100 a	4.4 abc	5.8 ab	6.5 a	0 f	0 cd	0 d
22	Revolver + MSO	17.4 oz/A + 0.5% v/v	A	91 ab	38 gh	27 e	4.5 abc	5.9 ab	6.1 ab	0 f	0 d	0 d
23	Sedgehammer + NIS	1.33 oz/A + 0.25% v/v	A	100 a	100 a	97 ab	4.3 abc	5.6 ab	6.1 ab	0 f	0 cd	0 d
24	DISMISS CA	12 oz/A	A	27 ab	20 hi	47 cde	4.3 abc	5.6 ab	5.4 abc	6 def	0 cd	0 d
25	Pylex + MSO	1 oz/A + 0.5% v/v	A	21 ab	24 fghi	17 de	3.7 bcd	2.4 c	3.6 d	15 bc	74 a	40 a
26	Sencor + NIS	4 oz/A + 0.25% v/v	A	52 ab	28 gh	16 de	4.0 abcd	5.4 ab	5.7 abc	8 de	0 d	0 d
p-value				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Application timing: A - 8/12/2022 B - 9/12/2022

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

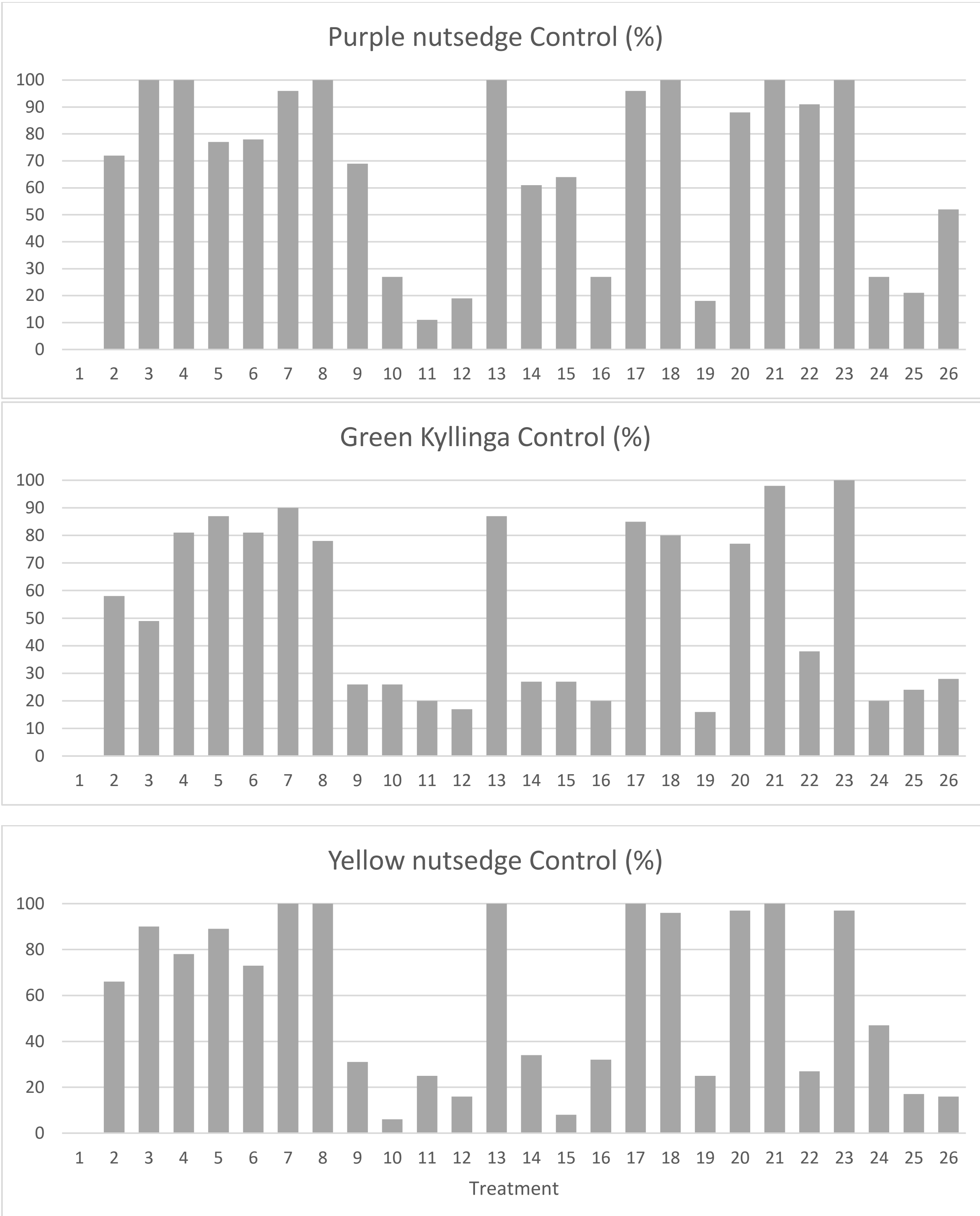

Figure 2. Control (%) of purple nutsedge, green kyllinga and yellow nutsedge by each herbicide treatment on 9/2/2022. Riverside, CA. 2022. All herbicides were applied on 8/12/2022.

Plot Plan for Sedge Control Study

N

Purple nutsedge	16	2	7	11	5	13	21	7	20	10	24	19	18	10	15
	23	12	26	22	1	2	25	22	21	13	12	4	14	9	1
	25	8	5	14	19	16	18	23	22	4	5	24	21	2	11
	1	18	4	10	12	20	15	3	18	26	11	19	5	22	6
	9	21	24	17	11	10	26	7	8	15	16	12	16	26	20
	15	19	3	4	3	9	17	6	17	14	2	8	13	7	23
	13	6	20	8	14	6	24	25	23	1	9	17	25	3	
Green kyllinga	11	7	2	16	7	21	13	5	19	24	10	20	15	10	18
	22	26	12	23	22	25	2	1	12	13	21	1	9	14	4
	14	5	8	25	23	18	16	19	5	4	22	11	2	21	24
	10	4	18	1	15	20	12	11	26	18	3	6	22	5	19
	17	24	21	9	26	10	11	16	15	8	7	20	26	16	12
	3	19	15	17	9	3	4	2	14	17	6	23	7	13	8
	20	6	13	24	6	14	8	9	1	23	25	3	25	17	
Yellow nutsedge	16	2	7	11	5	13	21	7	20	10	24	19	18	10	15
	23	12	26	22	1	2	25	22	21	13	12	4	14	9	1
	25	8	5	14	19	16	18	23	22	4	5	24	21	2	11
	1	18	4	10	12	20	15	3	18	26	11	19	5	22	6
	9	21	24	17	11	10	26	7	8	15	16	12	16	26	20
	15	19	3	4	3	9	17	6	17	14	2	8	13	7	23
	13	6	20	8	14	6	24	25	23	1	9	17	25	3	

Stop #8: Evaluation of Products for Water Conservation on Bermudagrass Turf

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Introduction:

Water scarcity in the Southwest has been a problem for many years, but the current drought is one of if not the worst on record. At present, most water reservoirs located in California are at least half of historical average level and these conditions will likely not get better on their own. In some cases, golf course superintendents are mandated to completely shut off irrigation on fairways and roughs, and further drops in water levels could lead to water shortages for human consumption.

One of the strategies to save water on turf is to ration it by utilizing deficit irrigation. In this case grass is irrigated below its needs, which often leads to reduced quality, but ultimately guarantees better survivability compared to shutting off water completely. Various products can be used to maintain turfgrass quality as well as other traits at or above acceptable levels under reduced irrigation including soil surfactants a.k.a. wetting agents, fertilizer and biostimulants, and plant growth regulators (PGRs). Other products that have been used to help grass survive drought stress include fungicides, mineral oils, pigments and living microorganisms. The objective of this study was to evaluate the performance of several products applied preventatively for management of bermudagrass turf under deficit irrigation.

Materials and Methods:

The study was conducted on mature 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 for all treatments except Skeepon (4 gal/1,000 ft^2). Experimental design was a split-plot design with 24 treatments (Table 1) randomized within ET replacement plots (either 40% or 60% ET) replicated 5 times. Plot size was 3x3 ft with 1-ft alleys. The study was initiated on July 7, 2022. All plots received non-limiting irrigation until August 3, 2022 when deficit irrigation was introduced. 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:

ET replacement had a significant effect on all measured traits except on visual quality, where only treatment effect was statistically significant. Furthermore, the interaction of ET x Treatment was non-significant for all measurements (data not shown). Visual quality was significantly affected only by treatment and, by 9/1/2022 (last rating taken before publication of this report), no significant differences were observed between the two different ET regimes. First significant differences in visual quality between treatments were observed on 8/18/2022. Highest values were observed for trt 2 (Brandt program) and trt 10 (Daconil Action + Appear II). Trt 2 also showed higher NDVI on 9/1/2022 while trt 10 had higher green cover and darker color (Table 2). While the interaction was not significant, all measured traits except visual quality were significantly affected by ET replacement and values were generally higher in 60% ET replacement compared to 40% ET replacement. It is worth noting that after one month of initiating deficit irrigation, treatment numbers 2, 6 (Ocean Organics program), 10, 12 (Appear II) and 20 (Turf Screen) still had acceptable quality under more extreme drought stress of 40% ET replacement (Table 3).

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Thanks to Aqua-Aid, Aquatrols, Brandt, Ac-Planta, Aqua-Aid, Aquatrols, Earth Microbial, Intelligro, Mitchell Products, Necternal, Ocean Organics, Syngenta, Turf Max, Vulpes and the California Turfgrass & Landscape Foundation (CTLF) for providing products and/or supporting this research.

Table 5. Treatments in deficit irrigation study. Riverside, CA. 2022.

Trt No	Treatment	Company	Rate (oz/1,000 ft2)	Water after application (in)	Timing
1	Control				
2	Gary's Green Ultra	Brandt	9	0	ABCDEFGHIJ
	MegAlex	Brandt	3	0	ACEGI
	Turftopia	Brandt	3	0	BDFHJ
3	EXP (TE303+EE2.0)		6	0.12	AEI
	Turftopia	Brandt	6	0	CG
	Seaweed Max	Brandt	3	0	CG
4	EXP (TE303+EE2.0)		10	0.12	A
	EXP (TE303+EE2.0)		6	0.12	EI
5	Civitas	Intelligro	8.5	0	ACEGI
6	OO-WJ	Ocean Organics	5	0.12	AEI
	OO-SR	Ocean Organics	6	0	ABCDEFGHIJ
	OO-XPN (started on 8/16/2022)	Ocean Organics	6	0	ABCDEFGHIJ
7	Revolution	Aquatrols	6	0.12	AEI
8	Zipline	Aquatrols	6	0.12	AEI
9	TriCure AD	Mitchell Products	3	0.12	AEI
10	Daconil Action	Syngenta	3.5	0	ACEGI
	Appear II	Syngenta	6	0	ACEGI
11	Daconil Action	Syngenta	3.5	0	ACEGI
12	Appear II	Syngenta	6	0	ACEGI
13	Excalibur	Aqua-Aid	3	0.12	AEI
14	Nanocarbon	Vulpes	32	0	ACEGI
15	Primo Maxx	Syngenta	0.25	0	ACEGI
16	Skeepon	Ac-Planta	25	0.04	ACEGI
17	Skeepon	Ac-Planta	12.5	0.04	ACEGI
18	Vitalife	Necternal	30	0	AEI
19	Time Bandit	Necternal	30	0.12	AEI
20	Turf Screen	Turf Max	1.25	0	ACEGI
21	Windjammer (OO-WJ)	Ocean Organics	5	0.12	AEI
22	En-Stim A	Earth Microbial		0	ACEGI
23	En-Stim B	Earth Microbial		0	ACEGI
24	En-Stim C	Earth Microbial		0	ACEGI

Application timings: A=7/2/2022 B=7/10/2022 C=7/17/2022 D=7/26/2022 E=8/3/2022 F=8/9/2022 G=8/16/2022 H=8/23/2022 I=8/30/2022 J=9/6/2022

Table 6. Data collected in the deficit irrigation study. Riverside, CA. 2022. Visual Quality (VC; 1-9, 9 = best); Normalized Difference Vegetation Index (NDVI; 0-1, 1 = greenest, healthiest); Volumetric Moisture Content (VMC; %) of soil at 3-inch depth; Green cover (%) and Dark Green Color Index (DGCI; 0-0.666, 0.666 = darkest green color).

Trt No.	Visual Quality				NDVI	VWC	Green Cover	DGCI
	7/18/2022	8/1/2022	8/18/2022	9/1/2022	9/1/2022	9/1/2022	9/1/2022	9/1/2022
1	4.3	4.1	4.8 d	4.4 fg	0.58 cd	16	57 e	0.31 e
2	5.2	4.7	6.7 a	7 ab	0.71 a	16.11	85 abcd	0.39 abcd
3	4.3	4	5.5 abcd	4.9 defg	0.61 bc	18.41	69 cde	0.334 cde
4	4.6	4.1	5.3 bcd	4.9 defg	0.6 bcd	20.92	65 cde	0.322 e
5	6.2	5.8	5.9 abcd	6 abcdef	0.62 bc	19	79 abcde	0.351 bcde
6	4.7	4.9	6.4 ab	6.5 abcde	0.68 ab	21.28	79 abcde	0.353 bcde
7	4.7	4.4	5.6 abcd	5.2 cdefg	0.63 abc	20.21	70 cde	0.33 de
8	4.5	4.4	5 cd	5 cdefg	0.6 bcd	20.32	67 cde	0.33 de
9	5	4.4	5.1 bcd	5 cdefg	0.62 abc	21.78	71 cde	0.335 cde
10	5.6	5.9	4.9 d	7.1 a	0.61 bcd	16.81	98 a	0.455 a
11	4.4	4.3	4.9 d	4.9 defg	0.62 bc	19.7	71 cde	0.34 cde
12	6	6.3	5.5 abcd	6.7 abc	0.6 bcd	20.5	95 ab	0.413 ab
13	4.5	4.5	4.8 d	4.9 defg	0.59 cd	19.39	65 cde	0.324 de
14	4.5	4.3	5.3 bcd	4.8 efg	0.53 d	16.56	58 e	0.323 de
15	4.4	3.7	4.7 d	4.2 g	0.58 cd	20.6	57 e	0.314 e
16	4.7	4.5	4.8 d	5 cdefg	0.59 cd	14.85	61 e	0.318 e
17	4.9	4.5	5.1 bcd	4.7 fg	0.59 bcd	15.76	63 de	0.321 e
18	4.7	4.7	5.3 bcd	5.1 cdefg	0.6 bcd	16.39	66 cde	0.327 de
19	4.7	4.6	5 cd	4.6 fg	0.6 bcd	19.4	67 cde	0.327 de
20	5.2	5.5	6.3 abc	6.6 abcd	0.61 bcd	18.37	88 abc	0.398 abc
21	4.8	4.8	5.2 bcd	5.3 bcdefg	0.63 abc	21.29	72 bcde	0.332 cde
22	4.6	4.3	4.8 d	4.4 fg	0.59 cd	18.2	62 de	0.319 e
23	4.4	4.1	5.2 bcd	4.8 efg	0.6 bcd	14.28	64 de	0.324 de
24	4.7	4.4	5.2 bcd	4.7 fg	0.59 cd	18.61	63 de	0.323 de
p-value	0.325	0.831	0.002	0.001	0	0.225	0.013	0.034

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

Table 7. Data collected on September 1, 2022 in the deficit irrigation study. Riverside, CA. 2022. Visual Quality (VC; 1-9, 9 = best); Normalized Difference Vegetation Index (NDVI; 0-1, 1 = greenest, healthiest); Volumetric Moisture Content (VMC; %) of soil at 3-inch depth; Green cover (%) and Dark Green Color Index (DGCI; 0-0.666, 0.666 = darkest green color).

Trt No.	Visual Quality		NDVI		VWC		Green Cover		DGCI	
	40% ET	60% ET	40% ET	60% ET	40% ET	60% ET	40% ET	60% ET	40% ET	60% ET
1	4	4.8	0.55	0.62	14.9	17.1	48	66	0.29	0.33
2	6.6	7.4	0.67	0.74	10.6	21.6	79	91	0.376	0.404
3	4.8	5	0.6	0.63	16.7	20.1	65	73	0.326	0.342
4	4.8	5	0.57	0.63	18.9	22.9	60	69	0.317	0.326
5	5.8	6.2	0.6	0.63	17.1	20.9	75	83	0.349	0.353
6	6.6	6.4	0.68	0.68	19.8	22.7	79	79	0.354	0.352
7	5.4	5	0.63	0.62	19.5	20.9	71	69	0.335	0.324
8	5	5	0.57	0.62	19	21.6	63	71	0.322	0.337
9	4.6	5.4	0.61	0.64	20.9	22.7	65	77	0.324	0.345
10	7	7.2	0.57	0.65	11.7	22	96	99	0.437	0.474
11	4.8	5	0.6	0.64	18.8	20.6	65	78	0.327	0.354
12	6.6	6.8	0.58	0.62	17.8	23.2	94	96	0.408	0.418
13	5	4.8	0.58	0.6	16.8	22	64	66	0.321	0.327
14	4.6	5	0.47	0.58	10.7	22.4	43	73	0.293	0.353
15	4	4.4	0.56	0.61	18.5	22.7	52	63	0.301	0.327
16	5.4	4.6	0.6	0.58	16.3	13.4	62	60	0.32	0.317
17	4.8	4.6	0.58	0.61	12	19.5	61	66	0.32	0.323
18	5	5.2	0.59	0.62	15.6	17.1	63	69	0.318	0.336
19	4.6	4.6	0.58	0.62	17.1	21.7	65	70	0.325	0.33
20	6.8	6.4	0.59	0.62	16.3	20.5	86	89	0.406	0.389
21	5	5.6	0.62	0.65	20.4	22.2	72	72	0.333	0.331
22	4.2	4.6	0.57	0.61	14.7	21.7	57	67	0.314	0.323
23	4.6	5	0.57	0.63	13.6	15	57	71	0.312	0.337
24	4.4	5	0.55	0.63	12.9	24.3	50	75	0.293	0.353

Plot plan for deficit irrigation study

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

CIMIS data September. 2021 – Aug. 2022

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	5.86 K	0.01	537 K	14.4	88.4 K	61	73.2	81	31	53	53.7	3.4 K	72.2
Oct 2021	4.03	0.44	412 K	10.1 K	77.8	53.1 K	64.2	76	31	51 K	43.2 K	3.6	64.6
Nov 2021	3.31 K	0	343 K	8.7	77.8 K	50.5 K	62.7 K	71 K	25 K	47 K	38.2 K	3.6 K	61
Dec 2021	1.52	3.94 K	216 K	8.8 K	62	42.3	51 K	91	46	70 K	40.2 K	3.2	53
Jan 2022	3.01	0.12	294 K	6 K	68.2	44.7	56	65	23	40 K	29.7 K	4.3 K	51.4
Feb 2022	3.96	0.07	425 K	4.8 K	70.5	43.9 K	57.1 K	57 K	19 K	33 K	23.8 K	5 K	51.8
Mar 2022	5.39 K	0.7	521 K	7.8 K	73.8 K	48.2	60.3 K	73 K	25 K	45 K	36.4 K	4.7 K	56.7
Apr 2022	6.05 K	0.23	595 K	9.8	76.4 K	51.4	63.2 K	80	31	52 K	43 K	4.3	62.5
May 2022	6.54	0.05	624 K	12 K	78.5	54.2 K	64.9	83	37	58 K	48.6 K	4.4	66.5
Jun 2022	7.96 K	0.01	714 K	14 K	89.9	61.3	74.3	77	28	50 K	53.1 K	4.4 K	72.8
Jul 2022	8.15	0	697 K	15.6	91.1	63.6	76	80	29	51	56.3	4.2	72.8
Aug 2022	7.86 K	0	627	15.4	94.3	66.8	79.3	72	27	46	55.8	3.9	73.3
Tots/Avgs	63.64	5.57	500.4	10.6	79.1	53.4	65.2	75.5	29.3	49.7	43.5	4.1	63.2

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 14, 2023

See you then!

UC RIVERSIDE
Turfgrass Science

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