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TURFGRASS & LANDSCAPE RESEARCH FIELD DAY

September 12, 2024

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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 2024 UCR Turfgrass and Landscape Research Field Day. This marks the 17th 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. With the recent departures of some of my longstanding lab members, we have a young but energetic group that is dedicated to continuing excellence in the UCR turfgrass program. Dr. Christian Bowman completed a Ph.D. in turfgrass breeding & genetics and is the new quarterback (and postdoctoral scholar) of our breeding & genetics program. 'Coachella' hybrid bermudagrass will be golf courses, athletic fields, and lawns in 2025 and 'Presidio' hybrid bermudagrass will follow soon after. Already we are thinking about the next release(s) of bermudagrasses as well as a kikuyugrass cultivar that produces fewer or no male flowers.

For the 13th 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 lilac-colored UCR Turfgrass Science shirts, who assisted with preparation for this event. Special thanks go to my fellow Field Day planning committee members including Dr. Christian Bowman, Sandra Glegola, Peggy Mauk, Sue Lee, Steve Ries, Mariette Malessy, and Maya Maniar. Production of this publication, signs, and online reports would not have been possible without assistance from Christian and Sandra. 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 11, 2025**.

Sincerely,

James H. Baird, Ph.D.
Professor & Cooperative Extension Turfgrass Specialist

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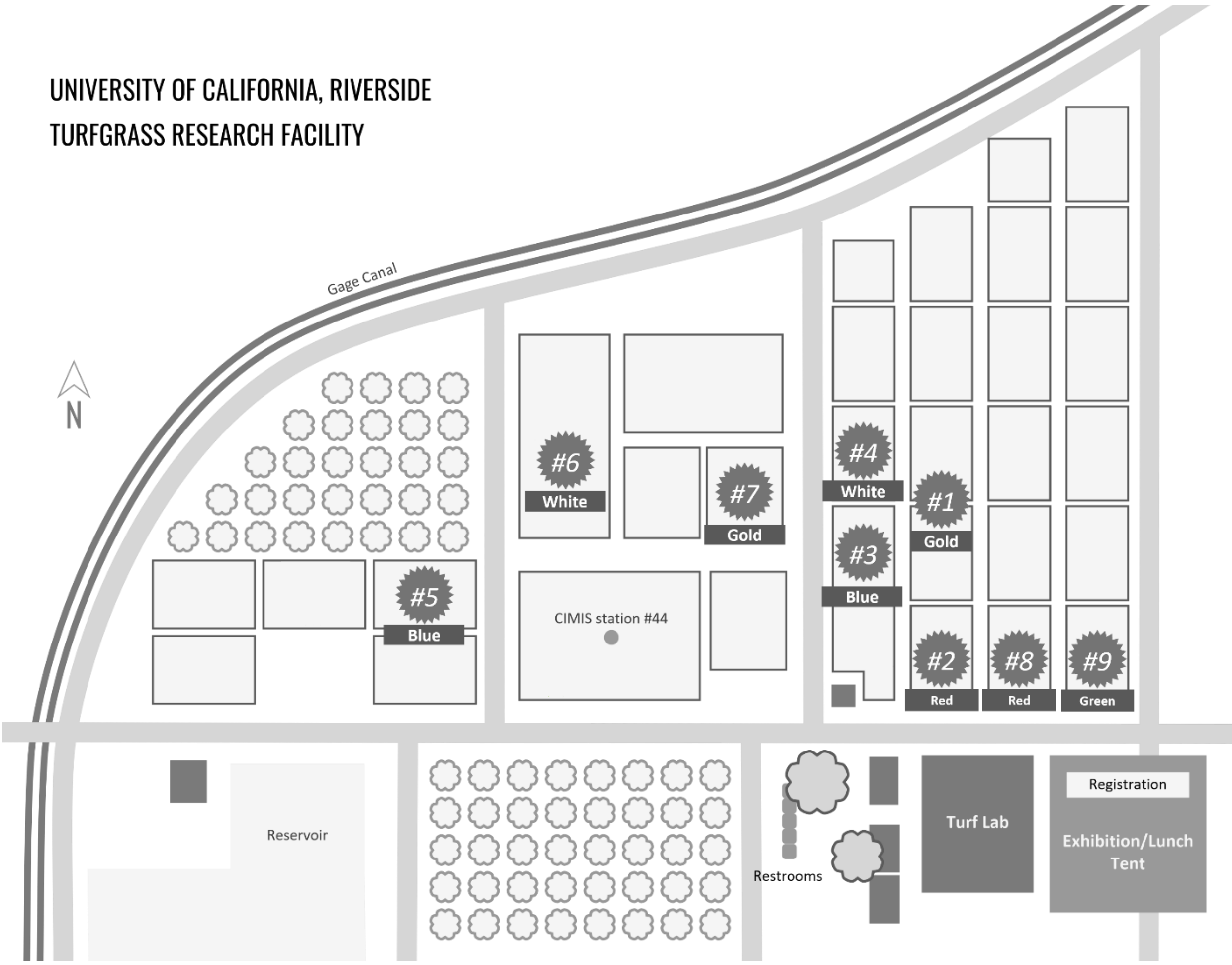

2024 Turfgrass and Landscape Research Field Day Agenda

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*	**Postemergence Control of Yellow and Purple Nutsedge and Green Kyllinga in Bermudagrass Turf; Evaluation of Fungicides for Control of Summer Patch Disease on Kentucky Bluegrass Turf** Michal Sciblak, Martino Benedetti, Sandra Glegola, and Jim Baird
Stop #2 *Red tent*	**Improvement of Bermudagrass and Kikuyugrass for Winter Color Retention and Drought Tolerance** Christian Bowman, Marcel Derendorf, Emma Baswell, Adam Lukaszewski, and Jim Baird
Stop #3 *Blue tent*	**Evaluation of Products for Water Conservation on Bermudagrass Turf** Sandra Glegola, Michal Sciblak, Martino Benedetti, and Jim Baird
Stop #4 *White tent*	**Traffic Tolerance, Divot Recovery, and Other Performance Characteristics of Presidio, Coachella, Santa Ana, and TifTuf Hybrid Bermudagrasses** Jim Baird, Sandra Glegola, and Michal Sciblak
11:00-11:30 AM	**Break and Trade Show**
11:30-12:50 PM	**Field Tour Rotation (20 minutes per Stop)**
Stop #5 *Blue Tent*	**Evaluation of Fungicides for Control of Anthracnose Disease on *Poa* Greens** Sandra Glegola, Michal Sciblak, and Jim Baird
Stop #6 *White Tent*	**Plant Disease-Causing Nematodes in California Turfgrass** J. Ole Becker and Jennifer Smith Becker
Stop #7 *Gold Tent*	**Evaluation of Products for Salinity Management and Control of Rapid Blight Disease on *Poa* Greens; Summer Patch on *Poa* Greens** Michal Sciblak, Martino Benedetti, Sandra Glegola, and Jim Baird
Stop #8 *Red Tent*	**Updating Crop Coefficients for the Major Cool- and Warm-Season Turfgrass Species and Cultivars in California** Christian S. Bowman, Emma Baswell, and Jim Baird
Stop #9 *Green Tent*	**Past, Present, and Future of Golf Course Putting Greens Grasses from Tifton, GA** Brian Schwartz and Jason Peake
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

Michal Sciblak, Martino Benedetti, Sandra Glegola, 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 2.5 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 2-ft alleys. In 2024, the study was initiated on July 31 for treatments 2-8. Then on August 1, the entire research area was lightly irrigated to wash any remaining herbicide from the leaves. Once dry, it was mowed to the height of 2.5 inches. The next day, on August 2, the remaining treatments (9-15) were applied. The process was repeated for the second application on September 11-13. In 2023, the same treatments were applied on same study area (but not the same individual plots) on July 10-12 and repeated on August 21-23. Treatment information for the 2024 study is 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:

Results from 2023 are summarized in Tables 2 and 3. In general, mowing was not a significant factor in this study although sedge or kyllinga control was usually slightly higher when herbicides were applied before mowing vs. after. Celero and Monument provided the best overall control followed closely by Sedgehammer, Certainty, and Monument (Table 2). In terms of specific weed species: Celero and Katana were best on green kyllinga; Sedgehammer, Celero, Certainty, and Monument were best on purple nutsedge; and all herbicides except Dismiss NXT were best on yellow nutsedge (Table 3).

Preliminary results from 2024 (Table 4) show similar trends found in 2023. Treatments will be repeated on September 11 and 13.

Although this research was carried out on 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 has the widest list of tolerant turfgrass species (15), followed by Arkon (13), Sedgehammer (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.

Plot Plan for Sedge Control Study

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

Figure 1. Plot plan for Sedge Control study on Bermudagrass. Riverside, CA. 2024

Table 1. Herbicide treatments applied in postemergence control of yellow and purple nutsedge and green kyllinga in Bermudagrass turf. Riverside, CA. 2024.

Trt No	Treatment	When applied	Active Ingredients	Rate
1	Untreated Control	-	-	-
2	Arkon	Before mowing	pyrimisulfan	3.4 pt/A
3	Dismiss NXT	Before mowing	sulfentrazone + carfentrazone-ethyl	10 fl oz/A
4	SedgeHammer + NIS	Before mowing	halosulfuron-methyl	1.33 oz/A + 0.25 %v/v
5	Celero + NIS	Before mowing	imazosulfuron	10 oz/A + 0.25 %v/v
6	Certainty + NIS	Before mowing	sulfosulfuron	1.25 oz/A + 0.25 %v/v
7	Monument + NIS	Before mowing	trifloxysulfuron-sodium	15 g/A + 0.25 %v/v
8	Katana + NIS	Before mowing	flazasulfuron	3 oz/A + 0.25 %v/v
9	Arkon	After mowing	pyrimisulfan	3.4 pt/A
10	Dismiss NXT	After mowing	sulfentrazone + carfentrazone-ethyl	10 fl oz/A
11	SedgeHammer + NIS	After mowing	halosulfuron-methyl	1.33 oz/A + 0.25 %v/v
12	Celero + NIS	Before mowing	pyrimisulfan	3.4 pt/A
13	Certainty + NIS	Before mowing	sulfentrazone + carfentrazone-ethyl	10 fl oz/A
14	Monument + NIS	Before mowing	halosulfuron-methyl	1.33 oz/A + 0.25 %v/v
15	Katana + NIS	Before mowing	imazosulfuron	10 oz/A + 0.25 %v/v

Application timing: A - 7/31/2024 - 8/02/2024, B - 9/11-13/2024.

Table 2. Data collected in yellow and purple nutsedge and green kyllinga control study in 2023 study. Weed control (%) averaged over all species and dates. Riverside, CA. 2024.

Trt No + Treatment	Before mowing	After mowing	Mean
	Weed Control (0-100%)		
02 Arkon	66.5 a	62.2 a	**64.4 b**
03 Dismiss NXT	44.4 b	41.5 b	**42.9 c**
04 SedgeHammer	72 a	67.4 a	**69.7 ab**
05 Celero	78.8 a	75.1 a	**76.9 a**
06 Certainty	72.3 a	68.3 a	**70.3 ab**
07 Monument	76.4 a	74.1 a	**75.2 a**
08 Katana	73.3 a	71.6 a	**72.4 ab**
Mean	**69.1 a**	**65.7 a**	

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

Table 3. Data collected in yellow and purple nutsedge and green kyllinga control study in 2023 study. Yellow nutsedge control (%), purple nutsedge control, and green kyllinga control. Riverside, CA. 2024.

Trt No + Treatment	Before mowing	After mowing	Mean
Weed Control (0-100%) - Yellow nutsedge			
02 Arkon	76.5 ab	73.7 ab	**75.1 a**
03 Dismiss NXT	51.2 ab	42.6 b	**46.9 b**
04 SedgeHammer	75.2 ab	69.4 ab	**72.3 a**
05 Celero	80.6 a	76.8 ab	**78.7 a**
06 Certainty	79.4 a	74.3 ab	**76.8 a**
07 Monument	78.2 a	75.7 ab	**76.9 a**
08 Katana	78.1 a	69.4 ab	**73.7 a**
Mean	**74.2 a**	**68.9 a**	
Weed Control (0-100%) - Purple nutsedge			
02 Arkon	59.4 a	62.2 a	**60.8 a**
03 Dismiss NXT	22.9 b	44.6 ab	**33.8 b**
04 SedgeHammer	72.2 a	72 a	**72.1 a**
05 Celero	74.5 a	72 a	**73.2 a**
06 Certainty	73.9 a	75.4 a	**74.6 a**
07 Monument	73.1 a	72.2 a	**72.6 a**
08 Katana	60.6 a	67.5 a	**64.1 a**
Mean	**62.4 a**	**66.5 a**	
Weed Control (0-100%) - Green kyllinga			
02 Arkon	63.5 abcd	50.8 de	**57.1 cd**
03 Dismiss NXT	59.2 bcde	37.3 e	**48.2 d**
04 SedgeHammer	68.6 abcd	60.8 abcd	**64.7 bc**
05 Celero	81.2 a	76.3 abc	**78.7 a**
06 Certainty	63.6 abcd	55 cde	**59.3 cd**
07 Monument	77.9 ab	74.3 abc	**76.1 ab**
08 Katana	81.2 a	77.8 ab	**79.5 a**
Mean	**70.7 a**	**61.8 b**	

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

Table 4. Effects of herbicide treatments on yellow and purple nutsedge and green kyllinga control. Treatments were applied before mowing on July 31 and after mowing on August 2. Riverside, CA. 2024.

Trt No	Treatment	Yellow nutsedge				Purple nutsedge				Green kyllinga		
		8/15		*8/30*		*8/15*		*8/30*		*8/15*		*8/30*
		Weed Control (0-100%)										
1	Untreated Control		-				-				-	
2	Arkon	100	a	100	a	68	ab	10	cd	75	ab	63
3	Dismiss NXT	100	a	100	a	24	bc	3	d	50	b	53
4	SedgeHammer + NIS	100	a	80	ab	100	a	80	ab	100	a	94
5	Celero + NIS	100	a	77	ab	100	a	100	a	100	a	100
6	Certainty + NIS	100	a	77	ab	100	a	100	a	100	a	88
7	Monument + NIS	100	a	75	ab	100	a	91	ab	100	a	100
8	Katana + NIS	41	b	56	ab	100	a	67	a-c	100	a	79
9	Arkon	98	a	100	a	83	a	58	a-d	100	a	74
10	Dismiss NXT	97	a	95	a	13	c	7	d	86	ab	85
11	SedgeHammer + NIS	96	a	93	a	91	a	41	b-d	100	a	93
12	Celero + NIS	96	a	92	a	89	a	100	a	95	a	80
13	Certainty + NIS	86	ab	91	a	95	a	93	ab	94	a	99
14	Monument + NIS	72	ab	82	ab	70	a	88	ab	100	a	100
15	Katana + NIS	46	b	34	b	93	a	55	a-d	96	a	100

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

Stop #1b: Evaluation of Fungicides for Control of Summer Patch Disease on Kentucky Bluegrass Turf

Michal Sciblak, Martino Benedetti, Sandra Glegola, and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Objectives:

This study was conducted to evaluate 11 fungicide treatments including an untreated control for preventative control of summer patch (*Magnaporthe poae*) disease on Kentucky bluegrass turf.

Materials and Methods:

The study was initiated on April 11, 2024 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 1-3 days/wk at 2.75 inches and received multiple applications of fertilizer during the study period using ammonium nitrate to help elevate pH and favor shoot growth over root growth. In addition, irrigation was provided deeply and infrequently to provide both waterlogged and drought stress conditions to favor disease activity.

Fungicide treatments were applied every 7 or 14 days beginning on April 11 (before disease symptoms were present) and ending on August 22. 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 except for treatments 10 and 11. Experimental design was a randomized block with 8 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:

Although summer patch disease was present, lack of uniform disease pressure across the study area likely contributed to no significant differences among treatments (Table 2). Nevertheless, Trt 7 (Lexicon Intrinsic) demonstrated the best overall performance numerically in maintaining turf quality while minimizing disease cover. Other promising treatments included Trt 2 (Briskway) and Trt 4 (Syngenta Program).

Acknowledgments:

Thanks to the California Turfgrass & Landscape Foundation (CTLF), BASF, Earth Microbial, Nufarm and Syngenta for supporting this research and/or for providing products.

N

	1	2	3	4	5	6	7
1	8	2	1	7	10	4	3
2	x	11	5	9	x	6	7
3	2	7	3	11	10	8	9
4	4	1	6	9	5	x	2
5	5	9	4	1	3	11	4
6	1	7	10	8	2	6	5
7	11	3	6	7	4	9	1
8	4	8	2	5	8	10	3
9	7	5	9	10	1	3	11
10	1	10	3	11	2	6	8
11	6	2	8	4	7	5	10
12	3	1	7	10	9	11	6
13	9	5	11	6	2	8	4

Figure 1. Plot plan for Summer Patch trial on Kentucky bluegrass. Riverside, CA. 2024.

Table 1. Treatments applied in summer patch fungicide trial on Kentucky bluegrass. Riverside, CA. 2024.

Trt	Product	Active Ingredient	Company	Rate	Frequency
1	Control	-	-	-	-
2	Briskway	Azoxystrobin + Difenoconazole	Syngenta	1 (oz/M)	ACEGIKMOQS
3	Heritage TL	Azoxystrobin	Syngenta	2 (oz/M)	ACEGIKMOQS
4	Posterity XT	Fluopyram + Pydiflumetofen + Propiconazole	Syngenta	3 (oz/M)	A
4	Ascernity	Difenoconazole + Benzovindiflupyr	Syngenta	1 (oz/M)	CO
4	Velista	Penthiopyrad	Syngenta	0.5 (oz/M)	EIQ
4	Heritage TL	Azoxystrobin	Syngenta	2 (oz/M)	GK
4	Briskway	Azoxystrobin + Difenoconazole	Syngenta	1 (oz/M)	MS
5	Maxtima	Mefentrifluconazole	BASF	0.8 (oz/M)	AEIMQ
6	Navicon Intrinsic	Pyraclostrobin + Mefentrifluconazole	BASF	0.85 (oz/M)	AEIMQ
7	Lexicon Intrinsic	Pyraclostrobin + Fluxapyroxad	BASF	0.47 (oz/M)	AEIMQ
8	Xzemplar	Fluxapyroxad	BASF	0.26 (oz/M)	AEIMQ
9	Tourney	Metconazole	Nufarm	0.37 (oz/M)	ACEGIKMOQS
10	En-Turf	-	Earth Microbial	-	ABCEGIKMOQS
11	En-Turf Plus	-	Earth Microbial	-	ABCEGIKMOQS

Application intervals: A = 04/11/2024; B = 04/19/2024; C = 04/25/2024; E = 05/09/2024; G = 05/23/2024; I = 06/06/2024; K = 06/20/2024; M = 07/03/2024; O = 07/25/2024; Q = 08/08/2024; S = 08/22/2024.

Table 2. Effects of fungicide treatments on Kentucky bluegrass turf quality (1-9; 9=best) and summer patch disease cover (0-100%). Riverside, CA. 2024.

Trt No	Turf Quality (1-9; 9 = best)					Disease Cover (0-100%)				
	7/3/24	*7/24/24*	*8/7/24*	*8/21/24*	*9/1/24*	*7/3/24*	*7/24/24*	*8/7/24*	*8/21/24*	*9/1/24*
Trt 1	6.4	5.9	5.8	5	5.1	2.5	1.1	13.8	27.5	31.9
Trt 2	7	6.1	5.8	5.4	6	3.8	0.2	7.5	15.6	21.2
Trt 3	6.6	5.9	5.8	5.2	5.4	0	3.8	13.1	25.6	26.2
Trt 4	6.5	5.9	5.8	5.2	6	0	0.8	15	20	22.5
Trt 5	6.9	6	5.4	5	5.2	0	1	11.9	23.8	28.1
Trt 6	6.5	5.6	5.6	5.2	5.8	7.5	1	8.1	23.1	24.4
Trt 7	6.4	6.1	5.6	5.8	6.4	8.8	3	16.2	16.9	18.1
Trt 8	6.8	6	5.2	5.1	5.4	2.5	0.8	15	21.9	28.1
Trt 9	6	5.5	5.6	5.1	5.1	9	1.6	16.9	23.8	28.8
Trt 10	6.2	5.9	5.5	4.8	5	5	4.1	17.5	28.8	32.5
Trt 11	6.4	5.9	5.1	4.6	4.8	2.5	1.5	15.6	29.4	34.4
p-value	0.576	0.972	0.943	0.414	0.162	0.333	0.426	0.697	0.397	0.652

*Mean values are not significantly different ($p > 0.05$).

Stop #2: Improvement of Bermudagrass and Kikuyugrass for Winter Color Retention and Drought Tolerance

Christian S. Bowman, Marcel Derendorf, Emma Baswell, Adam J. Lukaszewski, and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Background and objectives:

Repeated testing in Riverside, CA has demonstrated that even the most drought resistant 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 and improved genotypes of these two species. 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. Additionally, efforts are being made in kikuyugrass to reduce its invasiveness and enhance its acceptability as a turfgrass through both traditional breeding and lab-based methods.

Project milestones since Field Day 2023:

- Established replicated test plots of advanced bermudagrass hybrids selected for drought and/or shade resistance, as well as for golf courses and athletic fields across Arizona, California, Colorado, Nevada, and New Mexico.
- Established replicated test plots of kikuyugrass selected for reduced/no anther production in California.
- Established new two bermudagrass nurseries.
- Established a new kikuyugrass germplasm collection.
- Continued evaluation of bermudagrass hybrids selected for rough/lawns.
- Continued evaluation of bermudagrass and kikuyugrass hybrids selected for golf courses and athletic fields.
- Continued evaluation of bermudagrass hybrids under shade.
- Continued evaluation of bermudagrass and kikuyugrass nurseries.
- Continued evaluation of 'Coachella' and 'Presidio' hybrid bermudagrasses in comparison to 'Santa Ana' and 'TifTuf' for traffic wear tolerance, divot recovery, and response to cultivation and herbicides.
- Initiated evaluation of experimental bermudagrass lines within the USDA-NIFA Specialty Crop Research Initiative (SCRI) for remote sensing/prediction of performance under drought.

‘Coachella’ and ‘Presidio’ - new UCR hybrid 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 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 resistance under deficit irrigation.

Establishment of advanced bermudagrass hybrids for deficit irrigation trials:

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.

Eight bermudagrass hybrids were selected and planted at seven locations throughout the Southwest in two replicates during the summer of 2024. These hybrids were selected based on their performance when evaluated under drought or shade, as well as under different mowing heights (fairway vs. rough). ‘Coachella’ (UCR TP6-3) and ‘Presidio’ (UCR 17-8), as well as at least two commercial cultivars (‘TifTuf’ and ‘Tahoma 31’ / ‘Santa Ana’), were added as checks. One or two more local checks were included for some of the locations. Plots will be allowed to fully establish before initiating deficit irrigation or dry-down in 2025 and beyond.

Plot establishment varied across locations due to different planting dates and climatic conditions. A preliminary evaluation of turfgrass quality (1-9; 9=best), genetic color (1-9; 9=darkest), seedhead production (1-9; 9=lowest), and establishment (0-100%; 100%=fully established) was performed, though only turfgrass quality and establishment are shown here.

The highest overall quality showed ‘Presidio’ and ‘Coachella’ as the top performers across all locations, with ‘Tahoma 31’ as a close second (Table 1). UCRC180127 had the fastest overall establishment across all locations, followed closely by UCRC190272 and ‘TifTuf’ (Table 2).

Advances in kikuyugrass breeding:

Kikuyugrass exhibits a moderate level of drought resistance and exceptional winter color retention. Though it has some undesirable traits, such as an aggressive growth habit, the UCR turfgrass breeding program is working to improve kikuyugrass through both traditional selection and *in vitro* methods.

Kikuyugrass hybrids with reduced anther production:

Kikuyugrass can be easily distinguished by their unique male flowers (white anther and filament). When the anthers exert in a large stand of turf, it can often give a silvery—almost “snowy”—appearance and requires frequent mowing to remove. Six kikuyugrass hybrids were selected and planted in UCR, Riverside, CA in two replicates during the summer of 2024. These hybrids were selected from among the 2019 and 2022 kikuyugrass nurseries, as well as the germplasm collection established in 2016, for having noticeably reduced anther production. ‘Whittet’ was added as a check, for a total of seven entries. These entries will soon be planted at two additional locations in southern California.

In vitro androgenesis for kikuyugrass with reduced vigor:

Kikuyugrass is an autotetraploid plant that exhibits high vigor and aggressive growth. In the past, there have been attempts to reduce its ploidy level via androgenesis. While this method has been employed in many crops to improve genetic gains, there have been no known attempts (outside of the UCR turfgrass breeding program) to adapt it for kikuyugrass. In theory, generating haploid plants through this method would produce kikuyugrass with reduced vigor and aggression and may also yield leaves with finer texture. This year we have revisited androgenesis in kikuyugrass, though attempts have not yet produced haploids. This project will remain ongoing in the hopes of developing higher quality, less aggressive kikuyugrass turf that requires fewer inputs.

Other continued studies:

Bermudagrass:

- Evaluation of bermudagrass hybrids in the nurseries established in 2020 and 2022.
- Shade trial including 35 UCR hybrids from 2018-2019 nurseries, with ‘Presidio’ (UCR 17-8), ‘Coachella’ (UCR TP6-3), and five commercial checks (‘Latitude 36’, ‘Santa Ana’, ‘TifTuf’, ‘Tifway’).
- Roughs/lawns trial including 22 UCR hybrids from 2018-2019 nurseries, with UCR 17-8, UCR TP6-3 and six commercial checks (‘Bandera’, ‘Bullseye’, ‘Celebration’ (Riley’s Super Sport), ‘Midiron’, ‘Santa Ana’, ‘Tifway II’).
- Fairways/sports fields trial including 57 UCR hybrids from 2018-2019 nurseries, with ‘Presidio’ (UCR 17-8) and five commercial checks (‘Latitude 36’, ‘Santa Ana’, ‘Tahoma 31’, ‘TifTuf’, and ‘Tifway’).

Kikuyugrass:

- Evaluation of kikuyugrass nursery established in 2022.
- 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, Delta Bluegrass Co., Evergreen Turf, Green Valley Turf, Shadow Creek GC, The Club at Las Campanas, and A-G Sod Farms for their support of this research.

Table 1. Turfgrass quality (1-9; 9=best) of 8 UCR hybrids, 'Presidio' (UCR 17-8), 'Coachella' (UCR TP6-3), and other bermudagrass cultivars at Evergreen Turf, Casa Grande, AZ; UCR, Riverside, CA; Delta Bluegrass Co., Stockton, CA; West Coast Turf, Thermal, CA; Green Valley Turf, Littleton, CO; Shadow Creek, Las Vegas, NV; and The Club at Las Campanas, Santa Fe, NM.

Entry	**Casa Grande, AZ** *8/15/2024*	**Riverside, CA** *8/7/2024*	**Stockton, CA** *8/12/2024*	**Thermal, CA** *8/15/2024*	**Littleton, CO** *8/18/2024*	**Las Vegas, NV** *8/27/2024*	**Santa Fe, NM** *8/16/2024*
	Turf Quality (1-9; 9 = best)						
Coachella	8	8	8	8	7	8	7
Presidio	8	8	8	8	7	8	7
TifTuf	8.5	7.5	8	7.5	6.5	8	5.5
Tahoma 31	9	8	8	6.5	7.5	-	6.5
Santa Ana	-	-	-	-	-	7	-
Midiron	6.5	-	-	-	-	-	-
Iron Cutter	-	-	7.5	-	-	-	-
Latitude 36	-	-	7.5	-	-	-	-
UCRC180118	7.5	7	7.5	6	6	7.5	4.5
UCRC180127	8	7.5	7.5	7	7	6.5	5.5
UCRC180146	7	7	7.5	7	6	7	6
UCRC180174	7	7.5	7	7	6	7.5	5.5
UCRC180211	8	6.5	7	6.5	5.5	6.5	4.5
UCRC180217	7.5	7	7	6	5.5	7.5	5.5
UCRC180557	7	6	7	4.5	6	6	5
UCRC190272	7	7	7	6.5	6	6.5	5
Planted:	*5/14/2024*	*6/7/2024*	*5/22/2024*	*6/21/2024*	*6/12/2024*	*5/20/2024*	*5/16/2024*

Table 2. Establishment (0-100%; 100%=fully established) of 8 UCR hybrids, 'Presidio' (UCR 17-8), 'Coachella' (UCR TP6-3), and other bermudagrass cultivars at Evergreen Turf, Casa Grande, AZ; UCR, Riverside, CA; Delta Bluegrass Co., Stockton, CA; West Coast Turf, Thermal, CA; Green Valley Turf, Littleton, CO; Shadow Creek, Las Vegas, NV; and The Club at Las Campanas, Santa Fe, NM.

Entry	**Casa Grande, AZ** *8/15/2024*	**Riverside, CA** *8/7/2024*	**Stockton, CA** *8/12/2024*	**Thermal, CA** *8/15/2024*	**Littleton, CO** *8/18/2024*	**Las Vegas, NV** *8/27/2024*	**Santa Fe, NM** *8/16/2024*
	Establishment (0-100%)						
Coachella	95	50	67.5	62.5	72.5	82.5	37.5
Presidio	92.5	50	75	77.5	65	82.5	55
TifTuf	95	62.5	82.5	80	57.5	87.5	60
Tahoma 31	100	50	82.5	37.5	84	-	62.5
Santa Ana	-	-	-	-	-	87.5	-
Midiron	90	-	-	-	-	-	-
Iron Cutter	-	-	70	-	-	-	-
Latitude 36	-	-	70	-	-	-	-
UCRC180118	92.5	57.5	80	62.5	57.5	80	40
UCRC180127	90	80	75	82.5	67.5	87.5	52.5
UCRC180146	92.5	57.5	82.5	60	77.5	90	45
UCRC180174	82.5	35	65	40	57.5	72.5	35
UCRC180211	97.5	60	50	75	47.5	72.5	37.5
UCRC180217	82.5	50	60	37.5	42.5	80	35
UCRC180557	95	67.5	65	25	55	72.5	32.5
UCRC190272	97.5	60	60	97.5	60	87.5	65
Planted:	*5/14/2024*	*6/7/2024*	*5/22/2024*	*6/21/2024*	*6/12/2024*	*5/20/2024*	*5/16/2024*

	1	2	3	4	5	6	7
1	Presidio	UCRC 180557	UCRC 180127	UCR BH10-9	Coachella	UCR BF2	
2	TifTuf	UCRC 180217	Coachella	UCRC 180146	UCRC 180211	UCRC 180174	
3	UCR BF2	UCR BH10-9	Tahoma 31	UCRC 180127	UCRC 180060	UCRC 180557	
4	UCRC 180174	UCRC 180146	UCRC 180060	TifTuf	UCRC 190272	Tahoma 31	
5	UCRC 180118	UCRC 190272	UCRC 180211	Presidio	UCRC 180217	UCRC 180118	

1	UCRK 220070	UCRK 000025	UCRK 000095	Whittet	UCRK 000090	UCRK 220003	UCRK 190336
2	UCRK 000025	UCRK 000090	Whittet	UCRK 220003	UCRK 000095	UCRK 190336	UCRK 220070

Figure 1. Plot plan for the advanced bermudagrass hybrids under deficit irrigation trial (top) and kikuyugrass hybrids with reduced/no anther production (bottom). Riverside, CA. 2024.

Stop #3: Evaluation of Products for Water Conservation on Bermudagrass Turf

Sandra Glegola, Michal Sciblak, Martino Benedetti, and Jim Baird
Department of Botany & Plant Sciences
University of California, Riverside

Introduction:

Water scarcity is a significant and growing concern in many regions, particularly in areas with dry climates like California. As water resources become increasingly strained, industries that rely heavily on water, such as golf course management, face the challenge of reducing water usage while still maintaining high standards of turfgrass quality. Golf courses, which are often situated in regions with limited water availability, must find innovative ways to sustain healthy and visually appealing turf with less water.

One approach is to employ more drought resistant turfgrass species and cultivars including 'Coachella' and 'Presidio' hybrid bermudagrass from UCR and 'TifTuf' from the University of Georgia. Another approach is to utilize various commercial products to reduce water use and maintain quality on existing turf under deficit irrigation. This approach usually involves preventative application of product(s) followed by intentional reduction of irrigation below what is normally required to sustain optimum turf quality, effectively reducing overall water consumption. To date, several product categories have been identified to aid in turf water conservation including soil surfactants, fertilizer/biostimulants, plant growth regulators (PGRs), and pigments with plant health promotors. However, it should be stated that not all products in a category (e.g., soil surfactants) are created equal when it comes to water conservation or other desired attributes.

Objectives:

This study aimed to evaluate the effectiveness of different products and combinations for managing bermudagrass turf under deficit irrigation conditions. By assessing their performance, this research aims to identify practical solutions that support the health and aesthetics of bermudagrass while simultaneously conserving water—a crucial balance for sustainable golf course management in water-limited environments.

Materials and Methods:

The study was conducted on hybrid bermudagrass (*Cynodon* spp.) 'Santa Ana' turf on a Hanford fine sandy loam. Turf was mowed 3 days/wk at 0.5 inches. The 60 x 90 ft field was divided into 6 (28 x 29 ft) blocks. Treatments were arranged in a split-plot design with 25 treatments (plot size 9 ft^2) randomized within ET_{os} replacement plots and 3 replicates. Treatments (Table 1) were applied according to company recommendations beginning on June 13, 2024. The entire study area was aerated, and then Liquid Natural Clay (trts 24 and 25) was applied by Desert Control using their application equipment. All plots received non-limiting irrigation for ca. one month until July 16, 2025. From July 17th until the end of the study, blocks receive either 45% or 65% of previous day ET_{os} by hand watering to maximize water distribution uniformity as determined by an on-site CIMIS station. Water output from a hose was calibrated weekly to minimize errors from changes in water pressure. All other treatments were applied as granular products or liquids using a CO_2-powered backpack sprayer equipped with a single TeeJet AI9505E nozzle calibrated to deliver 1 gallon/1000 ft^2. 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 green 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:

For the purposes of this preliminary report, only turf quality and green cover data are presented since they were most important in describing treatment differences. The study demonstrated that the effectiveness of different treatments for maintaining bermudagrass turf quality varies significantly under deficit irrigation conditions of 45% and 65% ET_{os}. Treatments generally performed better under 65% ET_{os} compared to 45% ET_{os}, which is expected as higher water availability supports better turf health. However, the degree of difference in visual quality between the two irrigation levels varied across treatments. For example, Civitas Turf Defense combined with Gary's Green Ultra (Trt 5) showed relatively consistent performance across both irrigation levels, suggesting these treatments are robust even under more stringent water-saving scenarios. Combinations of multiple products, such as Civitas Turf Defense with Primo Maxx and Gary's Green Ultra (Trt 6), consistently outperformed many treatments containing individual products, suggesting a synergistic or additive effect that enhances turf resilience under deficit irrigation. Ocean Organics program (Trt 13) performed well at 65% ET_{os} but showed moderate results at 45% ET_{os}, highlighting that some treatments may require a minimum threshold of water availability to be effective. The percent green cover results indicate that certain treatments, particularly those involving Civitas Turf Defense (pigment + mineral oil) alone (Trt 2), or in combination with Primo Maxx (Trt 4) or Gary's Green Ultra (Trt 5 and Trt 6), consistently provided the highest percent cover under both 45% and 65% ET_{os} deficit irrigation conditions.

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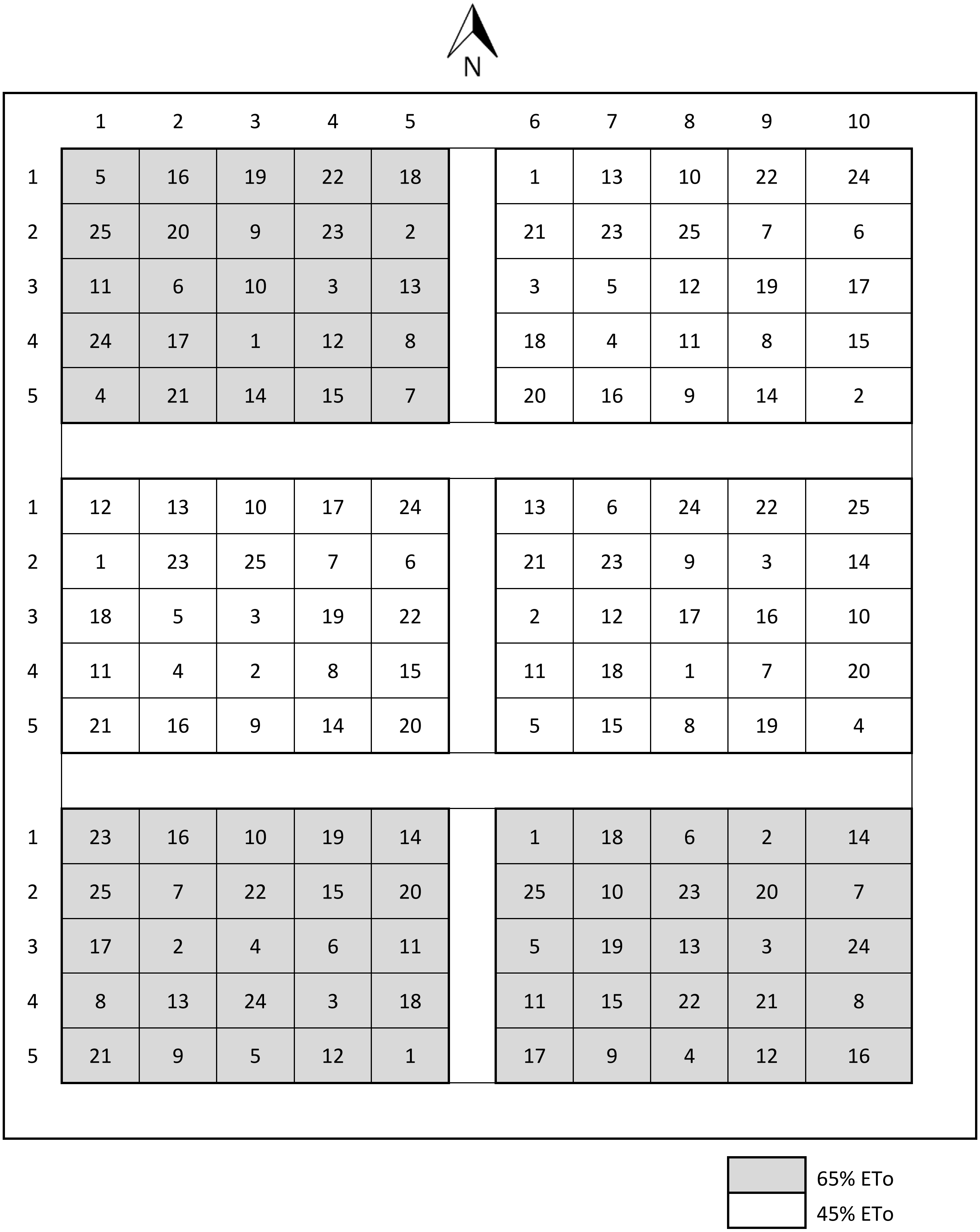


Figure 1. Plot plan for the 2024 deficit irrigation study. Riverside, CA. 2024.

Table 1. Treatments applied in the deficit irrigation study. Riverside, CA. 2024.

Trt No	Treatment	Company	Rate	Rate Units	Timing
1	Untreated Control				
2	Civitas Turf Defense	Intelligro	8.5	fl oz/M	ACEGIKMO
3	Primo Maxx	Syngenta	11	fl oz/A	ACEGIKMO
3	Gary's Green Ultra	Brandt	9	fl oz/M	ACEGIKMO
4	Civitas Turf Defense	Intelligro	8.5	fl oz/M	ACEGIKMO
4	Primo Maxx	Syngenta	11	fl oz/A	ACEGIKMO
5	Civitas Turf Defense	Intelligro	8.5	fl oz/M	ACEGIKMO
5	Gary's Green Ultra	Brandt	9	fl oz/M	ACEGIKMO
6	Civitas Turf Defense	Intelligro	8.5	fl oz/M	ACEGIKMO
6	Primo Maxx	Syngenta	11	fl oz/A	ACEGIKMO
6	Gary's Green Ultra	Brandt	9	fl oz/M	ACEGIKMO
7	A19238 [C]	-	11.3	fl oz/A	ACEGIKMO
7	A21924 [A]	-	1.46	fl oz/A	ACEGIKMO
8	Puric Salute	Wilbur-Ellis	5.88	fl oz/M	AEIM
8	Aquate Pro	Wilbur-Ellis	4	fl oz/M	AEIM
8	Link Fourtiplex	Wilbur-Ellis	2.5	fl oz/M	AEIM
9	21015X	-	5	fl oz/M	AEIM
10	21015Z	-	3	fl oz/M	AEIM
11	RhizoUCR24-1	RhizoSolutions	4	fl oz/M	AEIM
12	RhizoUCR24-2	RhizoSolutions	4	fl oz/M	AEIM
13	OO-WJ	Ocean Organics	6	fl oz/M	A
13	OO-WJ	Ocean Organics	3	fl oz/M	CEGIKMO
13	OO-SRX Foliar	Ocean Organics	6	fl oz/M	ACEGIKMO
13	OO-XPN Foliar	Ocean Organics	6	fl oz/M	ACEGIKMO
13	OO-GG Foliar	Ocean Organics	8	fl oz/M	ACEGIKMO
14	Anuew WDG	Nufarm	0.28	fl oz/M	ACEGIKMO
15	Primo Maxx	Syngenta	11	fl oz/A	ACEGIKMO
16	Revolution	Aquatrols	6	fl oz/M	AEIM
17	DK2	-	16	fl oz/A	AEIM
17	DK2	-	5	fl oz/M	AEIM
18	DK1	-	5	fl oz/M	AEIM
19	A02	-	250	lb/A	AEIM
20	A03	-	512	fl oz/A	ACEGIKMO
21	A03	-	250	lb/A	AEIM
21	A01	-	512	fl oz/A	ABCEGIKMO
22	En-Turf	Earth Microbial	-	-	ABCEGIKMO
23	En-Turf Plus	Earth Microbial	-	-	ABCEGIKMO
24	Liquid Natural Clay	Desert Control	-	-	A
25	Liquid Natural Clay	Desert Control	-	-	A

Application Intervals: A = 6/13/24; B = 6/20/24; C = 6/27/24; E = 07/11/24; G = 07/25/24; I = 08/08/24; K = 08/21/24; M = 09/05/24; O = 09/19/24.

Table 2. Turf quality (1-9; 9 = best) of treatments on bermudagrass under deficit irrigation at 45% and 65% ET_{os}. Riverside, 2024.

Trt	**45% ET_{os}**									**65% ET_{os}**							
	Turf Quality (1-9; 9 = best)																
	6/11	*7/10*		*8/1*		*8/7*		*8/27*		*6/11*	*7/10*		*8/1*	*8/7*		*8/27*	
Trt 1	7	6.3	C-D	6.3	A-C	5.7	AB	4.7	B	7	7	AB	6.7	5.7	AB	5.3	BC
Trt 2	7.3	8.3	A-C	7.3	A-C	6	AB	5.7	AB	7	7.3	AB	7.3	6.7	AB	7	AB
Trt 3	6.7	7	A-D	7.3	A-C	6.7	AB	5.7	AB	7	6.7	AB	7.7	6.7	AB	5.3	BC
Trt 4	7	7.3	A-D	7.3	A-C	5.7	AB	5.7	AB	6.3	6.3	AB	6.7	6.7	AB	7.3	AB
Trt 5	7	9	A	8.7	A	7.7	A	6.7	AB	7	8	A	8.3	7.3	A	7.7	A
Trt 6	7	8.7	AB	8.3	AB	6.7	AB	7.3	A	7	7.3	AB	8.3	7.3	A	7.3	AB
Trt 7	6.7	6.3	CD	7	A-C	6	AB	5.3	AB	7	6	B	5.7	5	B	6.3	A-C
Trt 8	7	7	A-D	6.7	A-C	5.7	AB	5	AB	7	6.7	AB	6	4.7	B	5.7	A-C
Trt 9	7	7.3	A-D	5.7	BC	5	B	6	AB	7	6.3	AB	6.3	6	AB	6.7	A-C
Trt 10	7	7	A-D	6	A-C	5.7	AB	6	AB	6.7	7	AB	6.3	5	B	6.7	A-C
Trt 11	7	7.7	A-D	5.7	BC	4.3	B	5.3	AB	7	6.3	AB	7.3	5.3	AB	6.7	A-C
Trt 12	7	7	A-D	6	A-C	5	B	5.3	AB	7	6.7	AB	6.7	5.7	AB	5.7	A-C
Trt 13	7	8.3	A-C	6.7	A-C	6	AB	5	AB	7	8	A	7.7	7.3	A	7.3	AB
Trt 14	7	6.7	BD	5.7	BC	5	B	4.7	B	7	6	B	6	5	B	6.7	A-C
Trt 15	7	5.7	D	5.7	BC	5	B	5.3	AB	6.7	6	B	6.3	4.7	B	5.7	A-C
Trt 16	7	7	A-D	5.7	BC	4.7	B	5.3	AB	7	6.7	AB	6	5.7	AB	5.7	A-C
Trt 17	7	6.3	CD	6.3	A-C	5	B	6	AB	7	7	AB	6.7	5.3	AB	5.3	BC
Trt 18	7	7.7	A-D	5.7	BC	5	B	4.7	B	7	7	AB	7	6	AB	7	AB
Trt 19	7	7	A-D	5.7	BC	5.3	AB	4.7	B	7	7	AB	6.3	6	AB	6	A-C
Trt 20	7	7.3	A-D	6	A-C	4.7	B	5.3	AB	7	7	AB	6.7	5.3	AB	6	A-C
Trt 21	7	7.7	A-D	6	A-C	5	B	5.3	AB	7	6.7	AB	5.7	5	B	5.7	A-C
Trt 22	6.7	7	A-D	6.3	A-C	5.3	AB	5	AB	6.7	6.7	AB	6.7	6	AB	5.7	A-C
Trt 23	7	7.3	A-D	5.3	C	5.7	AB	4.7	B	7	6.7	AB	6.3	5	B	5.7	A-C
Trt 24	6.7	6.7	B-D	6.3	A-C	5	B	6	AB	6.7	6	B	5.7	4.7	B	5.3	BC
Trt 25	7	7	A-D	6.7	A-C	6	AB	5.7	AB	7	7	AB	6.3	4.7	B	4.7	C
p-value	0.522	0.000		0		0		0.02		0.174	0.01		0.008	0.000		0.000	

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

Table 3. Percent green cover (0-100%) data collected in the deficit irrigation study. Riverside, CA. 2024.

Trt	45% ET_{os} *9/3/2024*		65% ET_{os} *9/3/2024*	
	Percent Green Cover (0-100%)			
Trt 1	54.5	BC	84.2	AB
Trt 2	96.7	A	99.5	A
Trt 3	69.0	A-C	90.3	AB
Trt 4	97.7	A	99.6	A
Trt 5	94.6	AB	99.0	A
Trt 6	98.1	A	99.4	A
Trt 7	57.3	A-C	85.1	AB
Trt 8	47.5	C	74.2	AB
Trt 9	66.8	A-C	98.1	A
Trt 10	75.3	A-C	93.6	AB
Trt 11	48.3	C	93.0	AB
Trt 12	63.5	A-C	80.9	AB
Trt 13	48.0	C	89.0	AB
Trt 14	50.4	C	95.4	AB
Trt 15	54.7	BC	81.8	AB
Trt 16	59.5	A-C	83.2	AB
Trt 17	66.9	A-C	84.8	AB
Trt 18	45.2	C	96.9	A
Trt 19	46.5	C	79.9	AB
Trt 20	58.7	A-C	74.7	AB
Trt 21	63.3	A-C	86.6	AB
Trt 22	66.6	A-C	90.1	AB
Trt 23	40.4	C	83.7	AB
Trt 24	62.5	A-C	82.7	AB
Trt 25	67.2	A-C	66.1	B
p-value	0		0.001	

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

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

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

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 divots among other characteristics. This research aimed to compare these newer cultivars in addition to the longstanding cultivar Santa Ana for their responses to cart traffic, divots, and responses to herbicides.

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 2024, fertilization was targeted at 5 lbs N/M divided into six ½ lb increments. The study area was topdressed with sand monthly during the growing season and irrigation was adjusted between sufficient and deficit levels 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 or actual golf club divots were created followed by replacing the void with sand. Turfgrass performance was evaluated monthly for visual quality (1-9; 9 = best), and color (1-9; 9 = darkest) 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 Fisher's Least Significant Difference (LSD) test at a significance level of P = 0.05.

Results:

During turf establishment from plugs, Presidio and Coachella provided the fastest turf cover (data not shown) and were darkest green in genetic color (Table 2). Percent green cover on non-traffic and traffic areas of turf are shown in Figs. 2 and 3, respectively from October 2023 to September 2024. In general, responses were similar among the four cultivars. In general, Santa Ana and TifTuf possessed better winter color than Presidio and Coachella in this study area (Table 2). However, we have observed similar winter color among these four cultivars in other locations at the UCR Turfgrass Facility and at golf course test sites throughout the State. Under traffic, Presidio and Coachella tended to have more green cover during the late winter and early spring. Presidio showed the most rapid divot recovery in fall and winter (Table 1). In January 2024, the four cultivars were mostly dormant (60-80% green cover; Figs. 4-7). A single application of Roundup Pro Concentrate (glyphosate) at 16 oz/A on January 20 resulted in the greatest and longest-term injury to TifTuf followed by Presidio. Coachella was least affected by Roundup among the four cultivars (Figs. 4-7). Coachella was most adversely affected by a single application of Princep (simazine) herbicide followed by Santa Ana. However, this reduction in green cover determined by digital image analysis was not as apparent to the naked eye as was injury from Roundup. None of the four cultivars were adversely affected by a single application of Kerb (pronamide) herbicide. On August 7, the study area was aggressively verticut for the first time since establishment. Five days later, Presidio, Coachella, and Santa Ana remained significantly injured by the cultivation practice (Table 3). However, complete turf cover was restored by 21 days after verticutting.

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

Figure 1. Plot plan of hybrid bermudagrasses used to evaluate their respective performance characteristics. Riverside, CA. 2024.

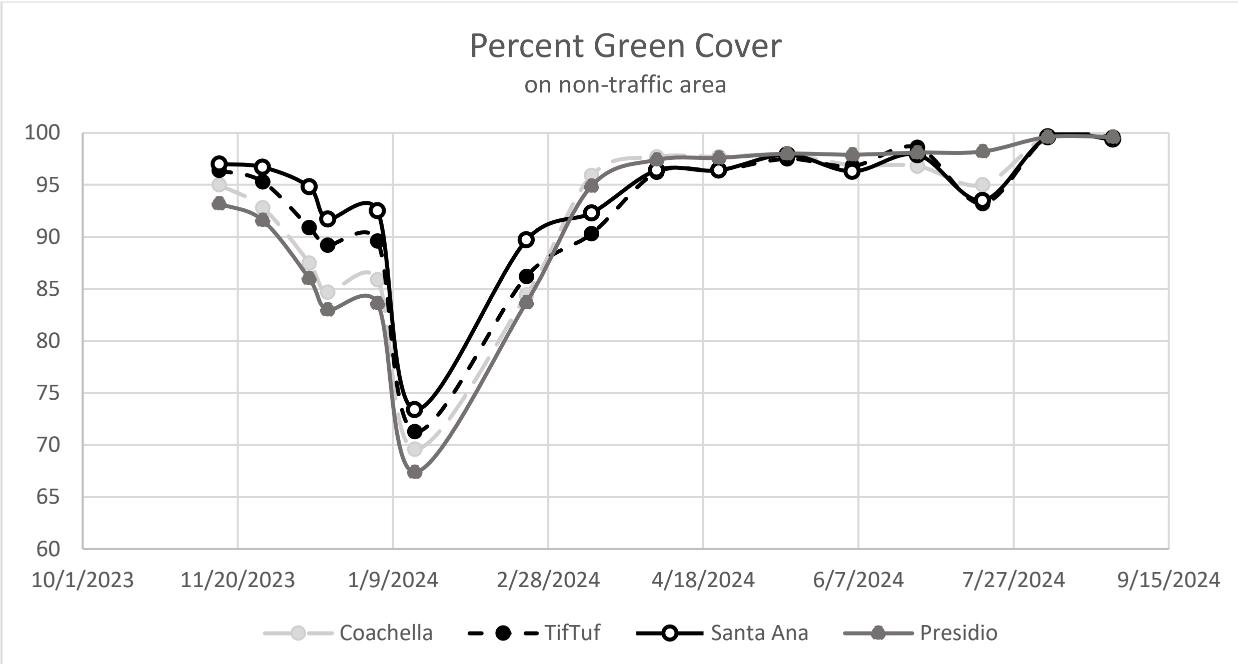


Figure 2. Percent green cover (0-100%) of four hybrid bermudagrass cultivars measured over time on non-trafficked turf. Riverside, CA.

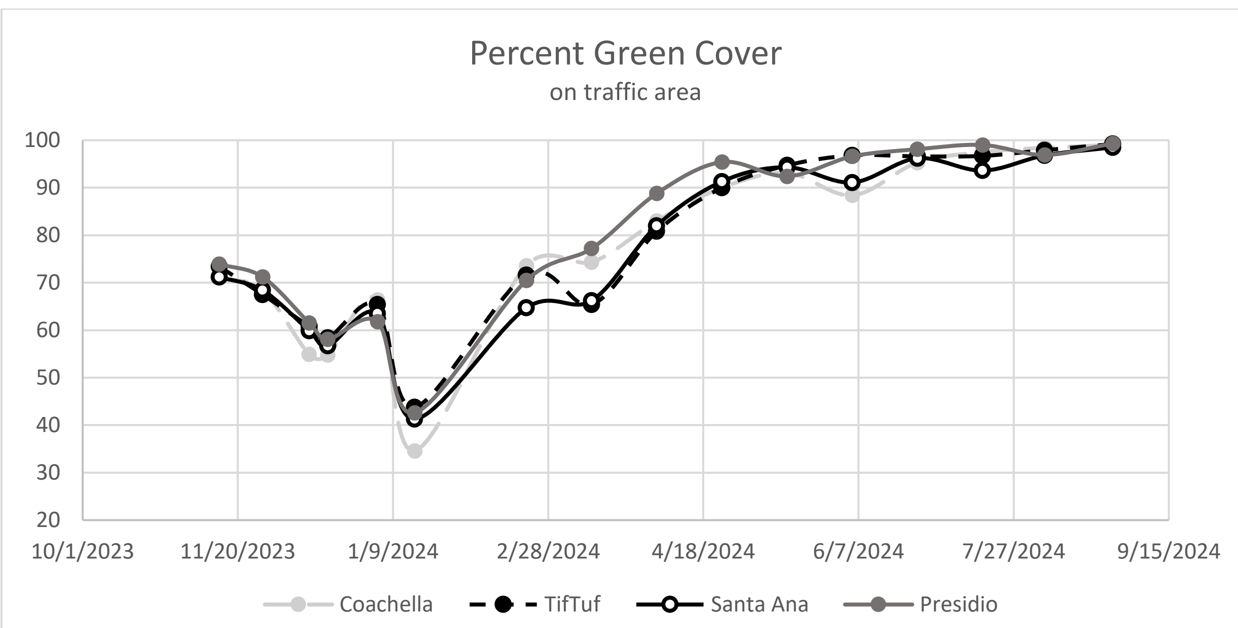


Figure 3. Percent green cover (0-100%) of four hybrid bermudagrass cultivars measured over time on trafficked turf. Riverside, CA.

Table 1. Divot recovery (0-100%) of four hybrid bermudagrass cultivars in fall (9/6/23 – 10/15/23) and winter (1/23/24 – 4/10/24). Riverside, CA.

Percent divot recovery / Fall 2023						
Cultivar	**14 days**		**21 days**		**28 days**	
Coachella	24%	bc	52%	ab	71%	b
TifTuf	33%	b	52%	b	78%	ab
Santa Ana	22%	c	48%	b	77%	b
Presidio	48%	a	65%	a	85%	a
p-value	0.002		0.015		0.05	

Percent divot recovery / Winter 2024						
Cultivar	**14 days**		**28 days**		**56 days**	
Coachella	7%	c	38%		58%	b
TifTuf	7%	bc	39%		61%	ab
Santa Ana	12%	ab	44%		66%	ab
Presidio	17%	a	49%		72%	a
p-value	0.003		0.169		0.056	

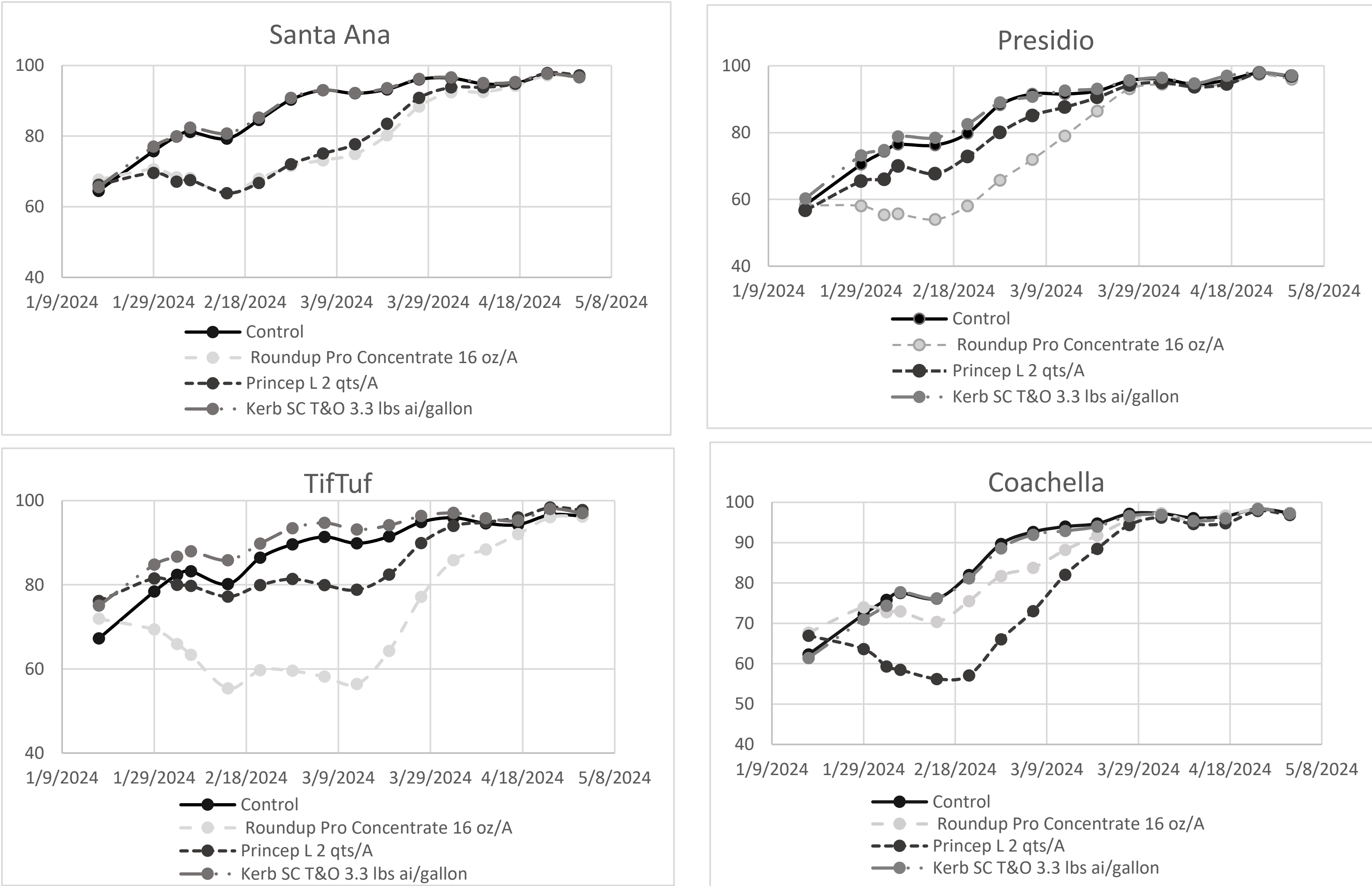
* Means followed by the same letter in a column are not significantly different (P = 0.05).
* Turf images taken by digital camera in JPEG format under consistent lighting. Percent recovery for an individual divot was calculated from the following equation: **%recovery = (%cover(x) - %cover(o)) /(100% - %cover(o)),** where %cover(x) is the percent green cover of the frame interior on the day the image was collected and %cover(o) is the percent green cover of the image on the day of divot injury followed by non-parametric Kruskal Wallis test with Mann-Whitney U-test for pairwise comparisons.

Table 2. Turf quality (1-9; 9=best) and genetic color (1-9; 9=darkest) of four hybrid bermudagrass cultivars. Riverside, CA. 2024.

Turf Quality (1-9; 9 = best)									
Cultivar	*1/17/24*		*2/17/24*	*3/18/24*	*4/21/24*	*5/22/24*	*6/21/24*	*7/22/2024*	*8/24/24*
Coachella	4.3	b	5.3	6.7	6.7	5.7	6.7	7	7.3
TifTuf	6.3	a	6.3	6.7	5.7	6	7.0	7	8
Santa Ana	6.0	a	5.7	5.7	5.7	5.7	6.3	6.7	7.3
Presidio	4.7	b	5.3	6.3	6.7	6	7.7	7.3	7.7
p-value	0.003		0.193	0.193	0.095	0.596	0.201	0.330	0.627

Genetic Color (1-9; 9 = darkest)													
Cultivar	*1/17/24*	*2/17/24*		*3/18/24*		*4/21/24*	*5/22/24*		*6/21/24*		*7/22/24*	*8/24/24*
Coachella	7	6.7	a	8.3	a	7.7	6.3	ab	7.3	a	7.3	7.7
TifTuf	6.3	6.0	b	7.0	b	7.3	6.0	bc	6.0	b	7	8
Santa Ana	6.7	6.0	b	6.7	b	6.7	5.3	c	6.0	b	7	8
Presidio	7	7.0	a	8.0	a	7.7	7.0	a	7.3	a	7.7	7.3
p-value	0.219	0.006		0.003		0.193	0.007		0.045		0.219	0.719

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



Figures 4-7. Percent green cover (0-100%) of bermudagrass cultivars following a single application of herbicides on January 20, 2024. Riverside, CA. 2024.

Table 3. Percent green cover (0-100%) of four hybrid bermudagrass cultivars before and after verticutting on August 7. Riverside, CA. 2024.

Percent Green Cover (0-100%)			
Cultivar	*8/7/2024*	*8/12/2024*	*8/28/2024*
Coachella	99.8	59.1 b	99.7
Presidio	99.6	51.5 b	99.6
Santa Ana	99.6	60.0 b	99.5
TifTuf	99.8	84.5 a	99.5
p-value	0.151	0.032	0.846

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

Stop #5: Evaluation of Fungicides for Control of Anthracnose Disease on *Poa* Greens

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

Objectives:

This study was conducted to evaluate 24 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 6, 2024 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 nutrients throughout the study period except for one application of Gary's Green Ultra at 3 oz/M during the last week of August. 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 beginning on June 6, 2024 (disease symptoms were not visible) and ending on September 5, 2024. Applications were made 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 in between rows.

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 Fisher's protected least significant difference (LSD) test (P=0.05).

Results:

No turf injury from any of the treatments was observed throughout the study (data not shown). However, Treatment 2 (Eagle 20 EW) exhibited PGR-like symptoms that are characteristic of some DMI fungicides, which negatively impacted turf quality (Table 2). Turf quality and disease cover ratings were taken in consideration of drought stress symptoms, which almost always resulted in onset of anthracnose disease as evidenced by acervuli of the fungus observed using a field microscope. In addition, summer patch disease symptoms were noted in the study area although not as prevalent or evenly distributed as anthracnose disease. Treatments 6 (Tuque exoGEM + Primo Maxx), 7 (Syngenta Program), 17 (experimental from PBI-Gordon), 19 (experimental from PBI-Gordon), and 20 (Lexicon Intrinsic + Secure Action + Maxtima + Affirm + Primo Maxx) appeared to exhibit the least summer patch symptoms (data not shown). Overall, the results of this study indicate that Trt 7 (Syngenta Program) was an effective option for managing both visual quality and disease cover in managing foliar and basal rot anthracnose. Trt 7 emerged as the top performer, with disease cover remaining exceptionally low throughout the study period, ranging from 0.4% to 7%. In addition to providing superior disease control, Trt 7 consistently achieved the highest visual quality scores, starting at 8.8 and remaining above 7.0 throughout the study period. In part this was due to the presence of a green pigment (+ phosphite) in Appear II. None of the other treatments contained products with pigment. Similar best treatments to Trt 7 in terms of quality and disease cover were Trts 17 and 19 (experimentals from PBI-Gordon).

Acknowledgments:

Thanks to the California Turfgrass & Landscape Foundation (CTLF), BASF, Corteva, Earth Microbial, PBI-Gordon, Nufarm and Syngenta for supporting this research and/or for providing products.

Table 1. Treatments applied on *Poa* greens for control of anthracnose disease. Riverside, CA. 2024.

No	Treatment	Company	Rate	Units	Timing	No	Treatment	Company	Rate	Units	Timing
1	Untreated Control	UCR	-	-							
2	Eagle 20 EW	Corteva	2.4	oz/M	ACEGIKMO	8	Affirm	Nufarm	0.88	oz/M	ACDEFGHIJKLMNO
3	Floxcor	Corteva	0.36	oz/M	ACEGIKMO	9	NFA0800009	Nufarm	0.196	oz/M	ACEGIKMO
4	Floxcor	Corteva	0.36	oz/M	ACEGIKMO	9	Rotator	Nufarm	0.5	oz/M	ACEGIKMO
4	UCR001	-	0.47	oz/M	ACEGIKMO	9	NFA0800031	Nufarm	1	oz/M	ACEGIKMO
5	Ascernity	Syngenta	1	oz/M	ACEGIKMO	10	NFA0630401	Nufarm	0.75	oz/M	ACEGIKMO
5	Primo Maxx	Syngenta	0.125	oz/M	ACEGIKMO	10	NFA0800031	Nufarm	1	oz/M	ACEGIKMO
6	Tuque exoGEM	Syngenta	1.5	oz/M	ACEGIKMO	11	NFA0800031	Nufarm	1	oz/M	ACEGIKMO
6	Primo Maxx	Syngenta	0.125	oz/M	ACEGIKMO	12	NFA0800031	Nufarm	3	oz/M	ACEGIKMO
7	Daconil Action	Syngenta	3.5	oz/M	A, M	13	NB41030	PBI-Gordon	1.7	oz/M	ACEGIKMO
7	Velista	Syngenta	0.5	oz/M	A, M	14	NB41030	PBI-Gordon	1.7	oz/M	ACEGIKMO
7	Appear II	Syngenta	6	oz/M	A, M	14	NB40896	PBI-Gordon	0.032	oz/M	ACEGIKMO
7	Primo Maxx	Syngenta	0.125	oz/M	A, M	15	NB41030	PBI-Gordon	1.7	oz/M	ACEGIKMO
7	Heritage Action	Syngenta	0.4	oz/M	C	15	NB40896	PBI-Gordon	0.047	oz/M	ACEGIKMO
7	Medallion SC	Syngenta	1	oz/M	C	16	NB41030	PBI-Gordon	1.7	oz/M	ACEGIKMO
7	Primo Maxx	Syngenta	0.125	oz/M	C	16	NB40896	PBI-Gordon	0.063	oz/M	ACEGIKMO
7	Daconil Action	Syngenta	3.5	oz/M	E	17	NB41075	PBI-Gordon	0.5	oz/M	ACEGIKMO
7	Velista	Syngenta	0.5	oz/M	E	17	NB41074	PBI-Gordon	0.19	oz/M	ACEGIKMO
7	Appear II	Syngenta	6	oz/M	E	18	NB41082	PBI-Gordon	0.18	oz/M	ACEGIKMO
7	Primo Maxx	Syngenta	0.125	oz/M	E	18	NB41074	PBI-Gordon	0.19	oz/M	ACEGIKMO
7	Heritage Action	Syngenta	0.4	oz/M	G	19	NB41030	PBI-Gordon	3	oz/M	ACEGIKMO
7	Daconil Action	Syngenta	3.5	oz/M	G	19	NB41074	PBI-Gordon	0.19	oz/M	ACEGIKMO
7	Appear II	Syngenta	6	oz/M	G	20	Lexicon Intrinsic	BASF	0.47	oz/M	AEI
7	Primo Maxx	Syngenta	0.125	oz/M	G	20	Secure Action	Syngenta	0.5	oz/M	E
7	3336 F	Cleary	4	oz/M	I	20	Maxtima	BASF	0.4	oz/M	CGK
7	Secure Action	Syngenta	0.5	oz/M	I	20	Affirm	Nufarm	1	oz/M	CGK
7	Appear II	Syngenta	6	oz/M	I	20	Primo Maxx	Syngenta	0.125	oz/M	ACEGIKMO
7	Primo Maxx	Syngenta	0.125	oz/M	I	21	Pillar SC	BASF	1	oz/M	AEI
7	Ascernity	Syngenta	1	oz/M	K	21	Encartis	BASF	4	oz/M	CGK
7	Daconil Action	Syngenta	3.5	oz/M	K	21	Affirm	Nufarm	1	oz/M	EI
7	Primo Maxx	Syngenta	0.125	oz/M	K	22	Navicon	BASF	0.85	oz/M	ACEGIKMO
7	Briskway	Syngenta	1	oz/M	O	23	En-Turf	Earth Microbial	-	-	ACEGIKMO
7	Secure Action	Syngenta	0.5	oz/M	O	24	En-Turf Plus	Earth Microbial	-	-	ACEGIKMO
7	Primo Maxx	Syngenta	0.125	oz/M	O						

Application Intervals: A = 6/6/24; B/C = 6/12/24; D = 7/19/24; E = 6/26/24; G = 7/10/24; I = 7/24/24; J = 7/31/24; K = 8/8/24; L = 8/15/24; M = 8/22/24; N = 8/29/24; O = 9/5/24.

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

Figure 1. Plot plan for the 2024 anthracnose fungicide trial. Riverside, CA. 2024.

Table 2. Effects of fungicide treatments on turf quality and disease cover on annual bluegrass turf. 2024. Riverside, CA.

Trt No.	Turf Quality (1-9; 9 = best)										Disease Cover (0-100%)									
	7/10/2024		*7/23/2024*		*8/6/2024*		*8/20/2024*		*8/30/2024*		*7/10/2024*		*7/23/2024*		*8/6/2024*		*8/20/2024*		*8/30/2024*	
Trt 1	6.4	f	5.6	gh	4.6	c-f	4.4	f-h	5.0	c-f	10.6	ab	21.0	ab	22.4	a-d	30.0	a-c	26.4	a-e
Trt 2	7.4	c-f	7.0	c-f	5.4	b-d	5.6	b-e	4.8	d-g	1.8	d	2.2	d	10.4	b-f	10.6	e-i	20.0	a-g
Trt 3	7.6	b-e	5.8	f-h	3.8	f	4.2	gh	3.6	g	8.6	a-c	20.0	a-c	30.0	a	33.0	ab	32.0	a-c
Trt 4	7.8	a-e	7.6	a-d	5.2	b-e	5.6	b-e	4.8	d-g	3.2	cd	6.8	d	13.4	b-f	17.0	c-i	24.4	a-f
Trt 5	7.6	b-e	7.6	a-d	5.4	b-d	6.0	bc	5.4	b-e	2.2	d	4.6	d	10.0	b-f	10.4	e-i	14.4	c-g
Trt 6	7.4	c-f	7.4	b-e	6.2	ab	6.4	ab	5.8	b-e	2.2	d	3.6	d	7.0	d-f	5.8	hi	8.6	e-g
Trt 7	8.8	a	8.6	ab	7.4	a	7.2	a	7.4	a	0.4	d	0.8	d	2.0	f	4.4	i	7.0	f-g
Trt 8	7.2	d-f	6.4	d-h	5.6	b-d	5.2	c-g	5.6	b-e	4.8	b-d	10.6	b-d	9.0	b-f	15.4	c-i	21.0	a-g
Trt 9	7.8	a-e	7.4	b-e	5.6	b-d	5.8	b-d	5.6	b-e	4.4	cd	8.0	cd	8.4	c-f	11.4	e-i	17.4	b-g
Trt 10	8.6	ab	8.8	a	5.8	bc	5.8	b-d	6.0	b-d	0.6	d	1.0	d	3.8	f	6.0	hi	10.2	d-g
Trt 11	7.4	c-f	6.2	e-h	4.4	d-f	4.8	d-h	4.6	e-g	14.0	a	24.0	a	23.6	a-c	23.0	a-f	22.0	a-g
Trt 12	6.4	f	5.2	h	4.0	ef	4.0	h	3.8	fg	13.0	a	29.6	a	30.4	a	36.0	a	36.0	a
Trt 13	7.2	d-f	6.8	c-g	5.4	b-d	5.4	b-f	5.4	b-e	2.6	d	5.4	d	7.6	c-f	13.0	e-i	12.0	d-g
Trt 14	8.0	a-d	7.8	a-c	5.8	bc	5.8	b-d	5.6	b-e	1.8	d	2.2	d	6.8	d-f	7.2	g-i	10.0	e-g
Trt 15	6.8	ef	6.0	f-h	4.0	ef	4.0	h	3.8	fg	5.6	b-d	11.2	b-d	25.0	ab	29.0	a-d	35.0	ab
Trt 16	7.0	d-f	6.4	d-h	4.6	c-f	5.0	c-h	4.6	e-g	4.2	cd	9.2	b-d	20.6	a-e	21.6	a-g	28.0	a-d
Trt 17	8.4	a-c	8.0	a-c	6.2	ab	6.0	bc	6.4	ab	1.4	d	2.0	d	5.0	e-f	7.0	g-i	5.0	g
Trt 18	7.4	c-f	7.0	c-f	5.6	b-d	5.8	b-d	5.6	b-e	2.6	d	5.6	d	9.4	b-f	8.2	f-i	10.0	e-g
Trt 19	7.8	a-e	7.8	a-c	6.0	b	6.0	bc	6.2	a-c	2.0	d	3.2	d	3.0	f	7.0	g-i	5.6	g
Trt 20	8.0	a-d	7.8	a-c	5.4	b-d	5.6	b-e	6.0	b-d	2.2	d	4.6	d	11.0	b-f	11.0	e-i	11.4	d-g
Trt 21	7.8	a-e	7.4	b-e	5.0	b-f	5.2	c-g	5.2	b-e	4.0	cd	8.8	b-d	15.0	a-f	22.4	a-g	21.0	a-g
Trt 22	7.2	d-f	6.8	c-g	5.6	b-d	5.4	b-f	5.0	c-f	2.0	d	4.4	d	12.8	b-f	14.0	d-i	12.8	d-g
Trt 23	7.4	c-f	6.2	e-h	5.0	b-f	4.8	d-h	5.0	c-f	13.4	a	27.0	a	16.0	a-f	20.4	b-h	20.0	a-g
Trt 24	7.0	d-f	6.0	f-h	4.4	d-f	4.6	e-h	5.0	c-f	9.0	a-c	21.0	ab	21.0	a-e	25	a-e	21.4	a-g

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

Stop #6: Plant Disease-Causing Nematodes in California Turfgrass

J. Ole Becker and Jennifer Smith Becker
Department of Nematology
University of California, Riverside

Worldwide, many plant-parasitic nematode species occur on golf course turfgrasses. However, only a few species cause severe damage in California. They are generally considered minor problems compared to fungal diseases and are often overlooked and underestimated.

However, root-knot nematodes (*Meloidogyne* spp.; RKN) are California golf courses' most widespread and damaging plant-parasitic nematodes (1). They typically cause symptomatic small root galls, interfering with the grasses' water and nutrient uptake. Aboveground yellowing and stunting indicate nutrient deficiencies. *Meloidogyne naasi* seems to be the most common species, limited to the cooler or coastal areas. In the warmer inland areas of Southern California, *M. graminis* and *M. marylandi* were found almost exclusively (2). RKN infections often lead to secondary fungal diseases.

Two other plant-infecting nematodes cause significant but localized problems in California turf. The sting nematode (*Belonolaimus longicaudatus*) was first detected in 1992 in eight golf courses around Rancho Mirage, Coachella Valley, CA (3). It is a Southeast US native, destructive pathogen. Typically feeding at plant root tips, their long mouth stylet can hit and destroy the growing points, causing short, stunted roots. Their broad host range constitutes a significant potential threat to most crops in the Coachella Valley. Due to State and County regulatory restrictions (4) and UCR Department of Nematology outreach efforts, its known distribution is still limited to the original discovery sites.

The stem-gall nematode, *Anguina pacificae*, is another locally significant plant pathogen. It parasitizes almost exclusively annual bluegrass (*Poa annua*) and requires moisture on the plant surface for infection. These requirements limit the disease to golf courses along a small band of the Pacific coast from Carmel to the Oregon border (4; 5). Inside the grass stem, the nematode induces a cavity that expands. Inside, *A. pacificae* lays eggs, and the next generation develops. The symptomatic stem-gall interferes with water and nutrient transport. The shoots develop stunted and branched; *Poa annua* putting greens become sparse and bumpy.

The organophosphate nematicide Nemacur was the primary turfgrass management tool against plant-parasitic nematodes for three decades until it lost its US registration in 2008. In recent years, Indemnify® (a.i. fluopyram) and Divanem® (a.i. abamectin) received registration with CA Dept. Pesticide Regulation. The products kill nematodes by contact but do not move well in soil. Divanem binds to organic matter and breaks down relatively fast. Indemnify is also registered as a fungicide (SDHI), inhibiting an enzyme complex required for energy production. The compound lasts many months (6). Both products improved turf quality in *A. pacificae*-infested putting greens (7; 8). Another effective SDHI nematicide/fungicide, Trefinti® (a.i. cyclobutrifluram) (9), is expected to receive registration soon in turf and ornamentals. The labels' signal words, indicating the product's acute toxicity, are for Nemacur DANGER, Divanem WARNING, and the SDHI products CAUTION.

A diminished nematicidal activity was recently noted after multiple Indemnify applications in Florida golf turf, likely caused by fluopyram resistance (10). This case demonstrates the risk of overusing one active ingredient or a class of compounds with the same mode of action. Pesticide resistance management by using different modes of action and limiting repeat applications of any single mode of action is long used with insecticides (11) and fungicides (12) but needs to be reemphasized with nematicides for turfgrasses.

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Stop #7a: Evaluation of Products for Salinity Management and Control of Rapid Blight Disease on *Poa* Greens

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

Introduction:

Salinity problems in the southwestern United States are becoming more prevalent due to insufficient rainfall, prolonged drought, and the increasing use of non-potable irrigation water. Golf course superintendents in California managing annual bluegrass putting greens often face salinity challenges from using reclaimed water and salt build-up during dry periods.

Rapid blight, caused by the slime mold *Labyrinthula terrestris*, was first identified as a turfgrass disease in the early 2000s and is now found in at least 11 U.S. states, including California. It rapidly forms water-soaked patches that turn into large dead areas, primarily affecting annual bluegrass (*Poa annua*) greens, and can also impact *Poa trivialis* and perennial ryegrass in overseeded areas, particularly in Arizona. The disease is closely linked to high sodium chloride levels from poor-quality irrigation water or inadequate salt leaching.

Initially, effective control of rapid blight was limited to fungicides like pyraclostrobin (Insignia, Lexicon, Navicon), trifloxystrobin (Compass), and mancozeb (Fore). More recent research has identified additional effective options, including penthiopyrad (Velista), fluazinam (Secure), chlorothalonil + acibenzolar (Daconil Action), and potassium phosphite (Appear II), which help manage the disease and mitigate salinity stress.

Objectives:

This study was conducted to evaluate various fungicide, fertilizer, soil surfactant, and soil chemistry 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 re-established with *Poa annua* var. reptans ‘Two Putt’ seed in the spring 2024. Turf was mowed at 0.125 inches 5 times/wk. 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 Gary’s Green Ultra (BRANDT) was applied at a rate of 3 oz/1000 ft^2 bi-weekly from May until the start of treatment applications. Heritage TL was applied preventatively for summer patch control.

To manage rapid blight on plots where salinity management products were evaluated, Navicon and Velista were applied bi-weekly throughout the study period.

A total of 14 treatments including 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 7, 14 or 21 days beginning on August 8, 2024. 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 4 replications. Plot size was 4×5 ft with 2-ft alleys. Starting from August 15, 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 soil electrical conductivity (EC_e) using a POGO instrument. Data were analyzed using Analysis of Variance with Fisher's honest significant difference (LSD) test (P=0.05).

Results:

An unforeseen outbreak of pink snow mold (*Microdochium*) on the green in May caused severe turf injury and delayed the start of the experiment. Treatments were randomly assigned to the best turf remaining prior to the start of the study, but lower overall turf quality on July 26 was a direct result of the damage caused by pink snow mold. At the time of publishing this report, the third application of products (timing C) had just been applied, making it too early to observe any definitive results. While it is still premature to determine the most effective treatments, preliminary data indicate that Trt 3 (Velista + Primo Maxx) consistently showed the highest turf quality across the evaluation dates (Table 2), with scores ranging from 5.8 to 6.0. On September 2, 2024, the soil electrical conductivity (EC_e) varied between 0.46 and 0.89 dS/m across the treatments. We expect that EC_e will continue to elevate as the study progresses, leading to salinity stress and/or rapid blight disease.

Acknowledgements:

Thanks to the California Turfgrass & Landscape Foundation (CTLF), BASF, Corteva, Earth Microbial, Ocean Organics, Syngenta, and Wilbur-Ellis for supporting this research and/or for providing products.

	1	2	3	4	5	6	7	8	9	10	11
1				6	10	6	9	7	1	8	4
2	13		4	5	8	11	12	10	5	9	3
3		7	5	2	14	12	3	6	11	2	6
4		1	10	13		4			14	3	12
5		9							11	1	
6				12							
7				11	7	2					
8			10	1	14						
9			2	13	4	7		3	9	14	
10			8	13						5	8

Figure 1. Plot plan for the Salinity Alleviation and Rapid Blight Disease trial. Riverside, CA. 2024.

Table 1. Treatments applied in Salinity Alleviation and Rapid Blight Disease trial. Riverside, CA. 2024.

No	Treatment	Company	Rate	Units	Timing	No	Treatment	Company	Rate	Units	Timing
1	Control	-	-	-							
2	Ascernity	Syngenta	1	fl oz/M	ACEGIKMO	4	Ascernity	Syngenta	1	fl oz/M	K
2	Primo Maxx	Syngenta	0.125	fl oz/M	ACEGIKMO	4	Daconil Action	Syngenta	3.5	fl oz/M	K
3	Velista	Syngenta	0.5	oz/M	ACEGIKMO	4	Primo Maxx	Syngenta	0.125	fl oz/M	K
3	Primo Maxx	Syngenta	0.125	fl oz/M	ACEGIKMO	4	Briskway	Syngenta	1	fl oz/M	O
4	Daconil Action	Syngenta	3.5	fl oz/M	A, M	4	Secure Action	Syngenta	0.5	fl oz/M	O
4	Velista	Syngenta	0.5	oz/M	A, M	4	Primo Maxx	Syngenta	0.125	fl oz/M	O
4	Appear II	Syngenta	6	fl oz/M	A, M	5	Insignia	BASF	0.7	fl oz/M	ACEGIKMO
4	Primo Maxx	Syngenta	0.125	fl oz/M	A, M	5	Fore WP	Corteva	8	fl oz/M	ACEGIKMO
4	Heritage Action	Syngenta	0.4	fl oz/M	C	6	DK2	-	16	fl oz/A	AEIM
4	Medallion SC	Syngenta	1	fl oz/M	C	6	DK2	-	16	fl oz/A	AEIM
4	Primo Maxx	Syngenta	0.125	fl oz/M	C	7	DK1	-	64	fl oz/A	AEIM
4	Daconil Action	Syngenta	3.5	fl oz/M	E	8	A02	-	125	lb/A	AEIM
4	Velista	Syngenta	0.5	oz/M	E	9	A01	-	512	fl oz/A	ACEGIKMO
4	Appear II	Syngenta	6	fl oz/M	E	10	A03	-	125	lb/A	AEIM
4	Primo Maxx	Syngenta	0.125	fl oz/M	E	10	A03	-	512	fl oz/A	ACEGIKMO
4	Heritage Action	Syngenta	0.4	fl oz/M	G	11	Nutrio Biosoak	Wilbur-Ellis	14.7	fl oz/M	ACEGIKMO
4	Daconil Action	Syngenta	3.5	fl oz/M	G	11	Puric Salute	Wilbur-Ellis	14.7	fl oz/M	ACEGIKMO
4	Appear II	Syngenta	6	fl oz/M	G	11	WE-2220-1	-	0.73	oz/M	ACEGIKMO
4	Primo Maxx	Syngenta	0.125	fl oz/M	G	12	OO-SRX	Ocean Organics	6	fl oz/M	ACEGIKMO
4	3336 F	Cleary	4	fl oz/M	I	12	OO-XPN	Ocean Organics	6	fl oz/M	ACEGIKMO
4	Secure Action	Syngenta	0.5	fl oz/M	I	12	OO-DS	Ocean Organics	0.375	fl oz/M	ACEGIKMO
4	Appear II	Syngenta	6	fl oz/M	I	13	En-Turf	Earth Microbial	-	-	ABCEGIKMO
4	Primo Maxx	Syngenta	0.125	fl oz/M	I	14	En-Turf Plus	Earth Microbial	-	-	ABCEGIKMO

Application intervals: A = 08/08/2024; B = 08/15/2024; C = 08/22/2024; E = 09/05/2024; G = 09/19/2024; I = 10/03/2024; K = 10/17/2024; M = 10/31/24; O = 11/14/24.

Table 2. Effect of treatments on turf quality (1-9, 9=best) and soil electrical conductivity (EC_e; dS/m), evaluated on 'Two Putt' annual bluegrass turf. Riverside, CA, 2024.

Trt No.	Turf Quality (1-9; 9 = best)				EC (dS/m)
	7/26/24	*8/15/24*	*8/21/24*	*8/30/24*	*9/2/24*
Trt 1	4.8	4.5	4	4.2	0.6
Trt 2	5.2	5	5.2	6	0.76
Trt 3	5.8	6	6	6	0.89
Trt 4	4.2	4	3.8	5	0.62
Trt 5	4.8	4.5	4.5	4.8	0.68
Trt 6	5.2	4.5	4.8	5	0.66
Trt 7	4.2	4	4	4.5	0.46
Trt 8	4.8	4.5	3.5	4.5	0.74
Trt 9	5	4.2	4	4	0.57
Trt 10	5	4.5	4.5	4.8	0.69
Trt 11	5.2	5	5.2	6	0.76
Trt 12	4.5	4.5	4.5	5	0.7
Trt 13	5	4.5	4.5	4.8	0.57
Trt 14	4.8	4.5	4.8	5	0.78
p-value	0.579	0.319	0.143	0.089	0.421

*Mean values are not significantly different ($p > 0.05$).

Stop #7b: Summer Patch on *Poa* Greens

Michal Sciblak, Martino Benedetti, Sandra Glegola, and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Objectives:

This study was conducted to evaluate 11 fungicide treatments including an untreated control for preventative control of summer patch *(Magnaporthe poae*) disease on annual bluegrass greens.

Materials and Methods:

The study was conducted on a 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 re-established with *Poa annua* var. reptans 'Two Putt' seed in the spring 2024. Turf was mowed at 0.125 inches 5 times/wk. 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 Gary's Green Ultra (BRANDT) was applied at a rate of 3 oz/1000 ft^2 bi-weekly since establishment.

Fungicide treatments were applied every 7 or 14 days beginning on April 11 (before disease symptoms were present) and ending on August 22. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet AI9505E nozzles calibrated to deliver 1 gallon/1000 ft^2 and watered in immediately after application except treatment 10 and 11. The experimental design was a randomized block with 7 replications. Plot size was 3x3 ft with 1-ft alleys.

Starting from August 15, 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).

Plots were evaluated every two weeks visually for turf quality (1-9; 9=best) and summer patch disease severity (1-9; 9=worst) 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:

An unforeseen outbreak of pink snow mold (*Microdochium*) on the green in May caused severe turf injury and delayed the start of the experiment. Turf quality ratings taken on June 7 were a direct reflection on the efficacy of these fungicide treatments against pink snow mold (Table 2). Several treatments were effective, but most notably Trt 7 (Lexicon Intrinsic), Trt 4 (Syngenta program), and Trt 2 (Briskway).

Despite lingering effects of pink snow mold damage, summer patch disease symptoms were noted beginning in early July. Overall, Trt 6 (Navicon Intrinsic) and Trt 9 (Tourney) provided the best summer patch control in this study; however, several other treatments also provided lower disease severity and higher turf quality than the untreated control (Table 2).

Acknowledgments:

Thanks to the California Turfgrass & Landscape Foundation (CTLF), BASF, Earth Microbial, Nufarm and Syngenta for supporting this research and/or for providing products.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	**8**	**6**	**10**	**X**	**3**	**9**	**7**	**11**	**5**	**1**	**2**	**10**	**4**
2	**3**	**11**	**2**	**8**	**6**	**1**	**4**	**7**	**9**	**5**	**10**	**3**	**7**
3	**9**	**2**	**7**	**4**	**10**	**5**	**8**	**11**	**1**	**6**	**3**	**8**	**1**
4	**8**	**5**	**9**	**1**	**11**	**2**	**6**	**3**	**7**	**4**	**10**	**5**	**9**
5	**2**	**6**	**3**	**8**	**7**	**1**	**9**	**10**	**4**	**11**	**5**	**2**	**6**
6	**10**	**1**	**7**	**4**	**11**	**8**	**2**	**6**	**3**	**5**	**9**	**11**	**4**

Figure 1. Plot plan for the 2024 Summer Patch study on *Poa* greens. Riverside, CA. 2024.

Table 1. Treatments applied in summer patch fungicide trial on Annual Bluegrass. Riverside, CA. 2024

Trt	Product	Active ingridients	Company	Rate (oz/M)	Frequency
1	Control	-			
2	Briskway	Azoxystrobin + Difenoconazole	Syngenta	1	ACEGIKMOQS
3	Heritage TL	Azoxystrobin	Syngenta	2	ACEGIKMOQS
4	Posterity XT	Fluopyram + Pydiflumetofen + Propiconazole	Syngenta	3	A
4	Ascernity	Difenoconazole + Benzovindiflupyr	Syngenta	1	CO
4	Velista	Penthiopyrad	Syngenta	0.5	EIQ
4	Heritage TL	Azoxystrobin	Syngenta	2	GK
4	Briskway	Azoxystrobin + Difenoconazole	Syngenta	1	MS
5	Maxtima	Mefentrifluconazole	BASF	0.8	AEIMQ
6	Navicon Intrinsic	Pyraclostrobin + Mefentrifluconazole	BASF	0.85	AEIMQ
7	Lexicon Intrinsic	Pyraclostrobin + Fluxapyroxad	BASF	0.47	AEIMQ
8	Xzemplar	Fluxapyroxad	BASF	0.26	AEIMQ
9	Tourney	Metconazole	Nufarm	0.37	ACEGIKMOQS
10	En-Turf	-	Earth Microbial	-	ABCEGIKMOQS
11	En-Turf Plus	-	Earth Microbial	1.27	ABCEGIKMOQS

Application intervals: A = 04/11/2024; B = 04/19/2024; C = 04/25/2024; E = 05/09/2024; G = 05/23/2024; I = 06/06/2024; K = 06/20/2024; M = 07/03/2024; O = 07/25/2024; Q = 08/08/2024; S = 08/22/2024.

Table 2. Effects of fungicide treatments on Annual Bluegrass turf quality (1-9, 9=best) and summer patch disease severity (1-9, 9=worst). Riverside, CA. 2024.

Trt No	**Turf Quality (1-9; 9 = best)**				**Disease Severity (1-9; 9 = worst)**			
	6/7/24	*8/7/24*	*8/21/24*	*8/29/24*	*7/7/24*	*7/24/24*	*8/7/24*	*8/29/24*
Trt 1	4.3 de	4.1 c	2.6 d	2.6 f	3.3 a-c	5.3 a	6.4 a	6.1 a
Trt 2	6.3 a	5.4 a-c	4.0 a-c	4.6 a-c	3.0 b-e	1.9 c-e	3.3 c-e	3.7 bc
Trt 3	5.0 cd	4.6 bc	3.3 b-d	3.4 c-f	2.4 c-f	3.3 bc	3.6 b-d	5.0 ab
Trt 4	6.3 a	5.0 bc	3.7 bc	4.1 b-e	2.1 d-f	1.6 de	2.9 c-e	3.7 bc
Trt 5	5.3 bc	5.6 ab	3.9 bc	4.4 a-d	2.1 d-f	2.3 c-e	3.7 b-d	3.4 bc
Trt 6	5.7 a-c	6.4 a	5.0 a	5.7 a	2.0 ef	0.7 e	1.4 e	1.6 d
Trt 7	6.4 a	5.4 a-c	3.7 bc	4.1 b-e	2.1 d-f	0.7 e	3.3 c-e	4.1 bc
Trt 8	5.9 ab	4.9 bc	3.3 b-d	3.9 b-f	4.1 a	2.9 b-d	3.9 b-d	4.7 ab
Trt 9	5.0 cd	5.9 ab	4.1 ab	5.0 ab	1.6 f	1.0 e	2.1 de	2.9 cd
Trt 10	3.9 e	4.7 bc	3.0 cd	2.7 ef	3.6 ab	4.4 ab	4.9 a-c	6.0 a
Trt 11	4.0 e	4.6 bc	2.6 d	3.0 d-f	3.1 a-d	3.4 bc	5.6 ab	4.9 ab
p-value	0.000	0.034	0.002	0.003	0.000	0.000	0.001	0.000

*Means followed by the same letter or by no letter in a column are not significantly different (P=0.05).

Stop #8: Updating Crop Coefficients for the Major Cool- and Warm-Season Turfgrass Species and Cultivars in California

Christian S. Bowman, Emma Baswell, and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Background and Objectives:

Historically, irrigation water requirements of warm- and cool-season turfgrass species have been broadly advised as 0.6 and 0.8 ET_{os} (reference evapotranspiration for short grass), respectively. However, adoption of deficit irrigation strategies for water conservation and advancements in turfgrass breeding & genetics with respect to drought resistance advocate that turfgrasses use much less water, contrary to popular belief. Recent State legislation, e.g., AB 2947, supports incentivization for conversion of existing turfgrass to more drought resistant turfgrass species and cultivars. However, acceptance of this legislation must also be accompanied by validation of the water requirements among existing and new turfgrass species and cultivars. This study aims to refine the crop coefficients for the major warm- and cool-season turfgrass species and cultivars grown in California, with particular emphasis on hybrid bermudagrass (*Cynodon* spp.) which possesses the greatest drought resistance of all species and use potential throughout most of the State.

Materials and Methods:

A total of 24 entries were selected for this study comprised of six cool-season and seven warm-season species, including nine cultivars or genotypes of hybrid bermudagrass. The broadleaf groundcover Kurapia (*Phylla nodiflora*) and 'Native' bentgrass (*Agrostis pallens*) were also included for comparison. Starting in July 2024, each entry was sodded in 2×2 ft plots with 2-ft alleys in between plots, and 6-ft alleys in between irrigation zones. Most turf was mowed once per week at 2-3 inches with a string trimmer, depending on the species. Mowing was not performed for fine fescue, Kurapia, or *Agrostis pallens*.

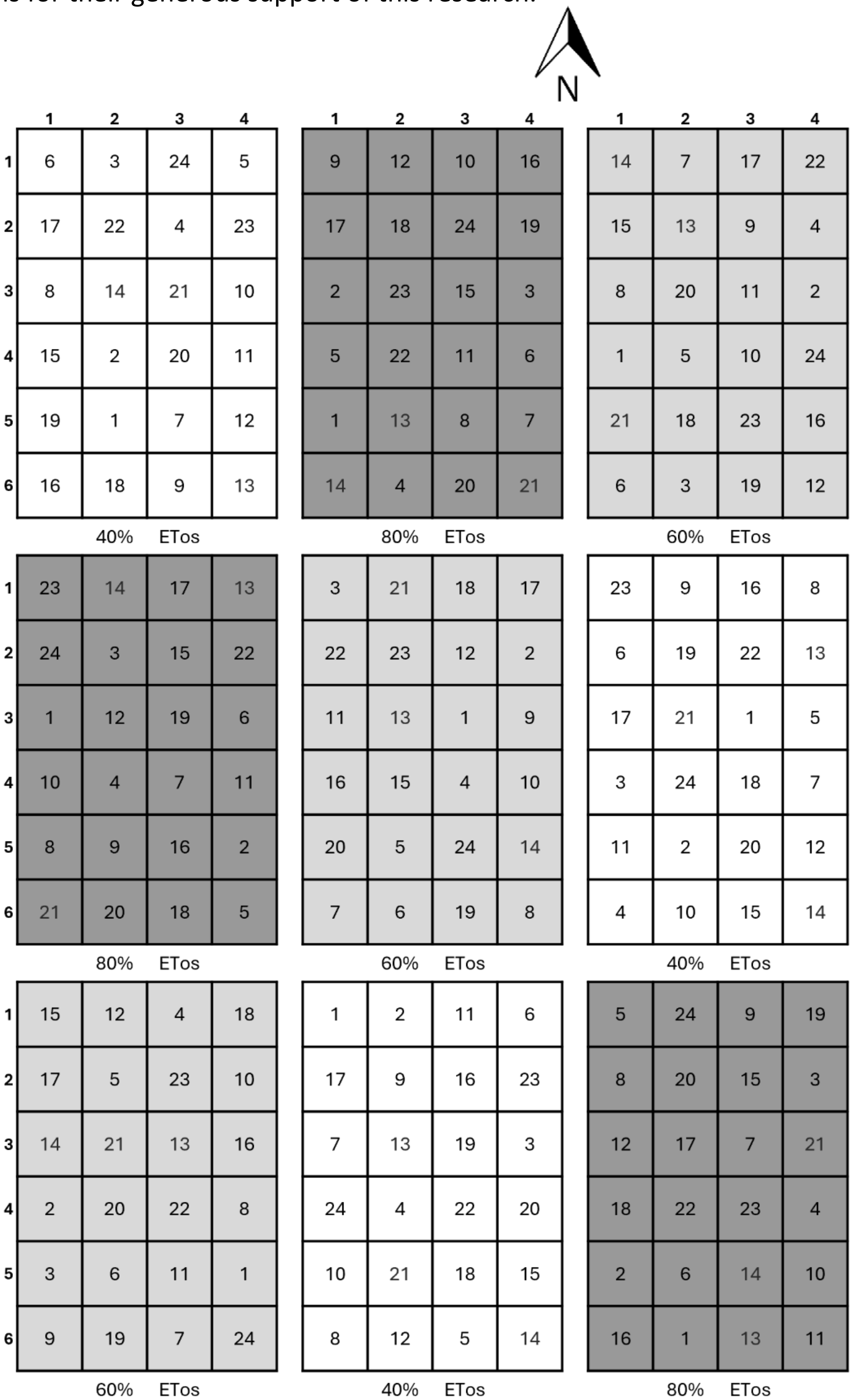
Beginning in January 2025, plant material will be irrigated based on three average annual crop coefficients: 40%, 60%, and 80% of ET_{os} measured by an on-site California Irrigation Management Information System (CIMIS) weather station located approximately 200 ft from the study area. Plots will be hand watered using a calibrated hose with known flow rate from 0-7 days weekly based on the previous week's ET_{os} and considering natural precipitation. Because evapotranspiration is dependent on several factors including temperature, the following irrigation strategies will be employed:

Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Avg ET_{os}
0.2	0.4	0.6	0.4	0.4
0.4	0.6	0.8	0.6	0.6
0.6	0.8	1.0	0.8	0.8

Data collected will include visual and digital image analysis. The study will continue for at least 2 years and afterwards each species and cultivar will be categorized according to Water Use Classification of Landscape Species (WUCOLS) standards and extrapolated by region.

Acknowledgements:

Thanks to the CTLF, USGA, MWD, WMWD, USDA NIFA, West Coast Turf, Delta Bluegrass Co., and A-G Sod Farms for their generous support of this research.



No.	Entry
1	Kentucky bluegrass
2	Tall fescue (Bolero)
3	Fine fescue (Native, mow-free)
4	*Agrostis pallens*
5	Kurapia
6	Perennial ryegrass
7	Creeping bentgrass (Pure Distinction)
8	Bermudagrass (Latitude 36)
9	Bermudagrass (Iron Cutter)
10	Bermudagrass (Tifway)
11	Bermudagrass (Tahoma 31)
12	Bermudagrass (Santa Ana)
13	Bermudagrass (Coachella)
14	Bermudagrass (Presidio)
15	Bermudagrass (UCR BF1)
16	Kikuyugrass (Whittet)
17	Kikuyugrass (UCRK220241)
18	St. Augustinegrass (West Coast Turf)
19	Buffalograss (UC Verde)
20	Zoysiagrass (De Anza)
21	Seashore paspalum (Platinum)
22	St. Augustinegrass (CitraBlue)
23	Tall fescue (West Coast Turf)
24	Bermudagrass (North Bridge)

Figure 1. Plot plan for the multi-species crop coefficient trial including cool- and warm-season turfgrasses as well as turfgrass alternatives. Plots will be irrigated daily at 40%, 60%, or 80% ET_{os} based on the sum of the previous week.

Stop #9: Past, Present, and Future of Golf Course Putting Greens Grasses from Tifton, GA.

Tifgreen – Tifdwarf – TifEagle – Tif3D

Brian Schwartz[1] and Jason Peake[2]
[1]Department of Crop & Soil Sciences
[2]Department of Agricultural Leadership, Education, and Communication
University of Georgia

First a Little History…

Golf courses in the southern United States changed forever when it became possible to plant bermudagrass on the putting greens. The cool-season grasses used for golf greens during the early 1900's were ill-suited for the southern US climate. When these species were planted, golf course superintendents spent a large amount of time and effort to keep them alive from disease and drought during the hot, humid summers. Greenskeepers for southern courses needed better options other than continuing to struggle with cool-season grasses, or reverting back to the use of sand greens. Several golf courses began planting seeded bermudagrass greens, but this came with its own set of problems. Most of the seed came from common-type bermudagrass and struggled to survive under rigorous mowing. These greens were highly inconsistent in appearance, texture, and play. Eventually, they also tended to thin under low mowing and became very weedy over time. However, golf course superintendents began to find patches of small, dense turf that were thriving under intense mowing on the greens. They often selected and increased these grasses for other greens on their golf courses.

Dr. Glenn Burton was approached in 1946 by the USGA Green Section to take the idea of bermudagrass greens and improve on it. With funding provided by the USGA and the generous aid of golf course superintendents who donated plugs of these turf-type bermudagrasses, Dr. Burton eventually bred, developed, and released Tifgreen 328. Tifgreen is an interspecific hybrid between a common bermudagrass selection from North Carolina and an African *Cynodon transvaalensis*. Tifgreen became an immensely popular greens grass in the south because of its ability to withstand so many of the issues faced on the golf course. Compared to older varieties, Tifgreen was uniform, low-growing, and survived well under the intense management found on golf greens during the harsh summers to provide a dense mat that also suppressed weeds.

Tifgreen did come with its own set of unique problems. Soon after its release in 1956, a few dwarf off-types were found at two of the original testing locations, one on the greens of Sea Island Country Club and another at the Country Club in Florence, South Carolina. Samples of these off-types were returned to Dr. Burton and he determined that they were somaclonal variants of Tifgreen, basically new distinct plants created by genetic anomalies that occur during normal cell division. Tifgreen's inherent tendency to produce these somaclonal variations has provided the turf industry with new grasses with beneficial traits that traditional plant breeding has not been able to accomplish. Today, all of the most popular bermudagrass putting greens cultivars used on golf courses, including Tifdwarf, Champion, MiniVerde, and TifEagle originated from Tifgreen.

The unique ability of Tifgreen to produce somaclonal variations can also be its downfall. It has been difficult for the turf industry to maintain genetic purity of these varieties. For this reason alone, the importance of turfgrass certification cannot be overstated. Certified turfgrass is routinely inspected for off-types, including those that are produced by the process of somaclonal variation. The turfgrass certification process identifies problems and helps to insure variety purity for end users.

Where We Found It?

The University of Georgia's Tifton Turfgrass Breeding Program discovered Tif3D during 2012 from the original, 50-year-old Tifgreen putting greens planted at Taylors Creek Golf Course in Fort Stewart, Georgia. Dr. Brian Schwartz (UGA Plant Breeder), Dr. Earl Elsner (retired director of Georgia Seed Development), Patrick O'Brien (now-retired USGA Green Section Southeast Regional director), and Jared Nemitz CGCS (then Golf Course Superintendent at The Ford Field and River Club) collected samples of visually differing and thriving variations. Tif3D was one of the 169 selections brought back to Tifton for further observation because it was dense, dark green, and growing well under shade cast by the nearby treeline. This selection performed better in Tifton-based trials than the other 168 varieties.

Off-site trials of Tif3D, along with the cultivar TifEagle, were planted at fifteen different locations between 2015 and 2019. These experiments were conducted on practice greens and test areas on courses from Virginia to southern Florida. Each off-site planting location was managed and maintained under the established practices of that golf course, including mowing height and schedule, fertilizer and growth regulator programs, fungicide applications, and thatch management practices. Seasonal observations were taken at each trial and included stimpmeter measurements in addition to visual color and uniformity ratings.

Why We like it!

One of the first observations made of Tif3D was that it had an ultra-dwarf growth habit, much like TifEagle rather than the larger plant morphology of Tifgreen. The color of Tif3D resembles that of Tifdwarf, which is darker green than TifEagle, making it aesthetically pleasing. In research conducted since 2015, stimpmeter comparisons have shown Tif3D to have the excellent putting speeds of TifEagle, sometimes even faster with a more true roll. Under the intense management applied by golf courses, Tif3D visually performed as well or better than TifEagle, typically appearing more uniform in look and texture.

Tif3D, like the other ultradwarf bermudagrasses, needs mechanical thatch removal due to the nature of its growth habit. Verticutting, along with hollow- and solid-tine aeration, and sand topdressing are necessary care for ultradwarfs, sometimes leaving weeks of recovery time for the grasses. A truly outstanding quality that Tif3D has demonstrated in many trials is a rapid recovery time after these practices. It has shown the ability to grow back faster from mechanical injury, was well as other stresses like drought and disease injury than other ultradwarf putting greens grasses.

What future information do we want to know?

Currently, studies on establishment and fertilizer usage are being conducted by the UGA Tifton Turf Breeding Program on Tif3D to help superintendents better understand this grass. Trials are presently underway that include sprig rates, cutting-in methods after sprigging, and water usage amount following sprigging. Results will help define the best grow-in practices for Tif3D. These sprigging trials will be followed with studies on fertilization, growth regulator needs, as well as topdressing and verticutting intervals. The information compiled over the next few years will allow us to summarize a general management plan for this new variety. Other possible research to be conducted may include shade and drought trials. It stands to reason that Tif3D may have some shade tolerance due to the environment of the 13th green at Taylors Creek where it was originally found thriving. Further research should also be conducted to confirm what we have observed to-date in our golf course trials.

When will it be available?

Tif3D was officially released from The University of Georgia during 2021. In July of 2021, Georgia Seed Development oversaw the establishment of a one-acre foundation field at Pike Creek Turf in Adel, GA. Establishment of sod production fields began in 2023, with a limited supply being available for sale to consumers in early 2024. Four golf courses completed 18-hole renovations this summer and more have committed for 2025. Both West Coast Turf and Evergreen Turf have licensed Tif3D to complement the other grasses they are growing.

For more information, please visit tif3D.com or contact Dr. Brian Schwartz at tifturf@uga.edu.

CIMIS data September. 2023 – Aug. 2024

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 2023	4.95 K	0.02	476 K	15.8	84.4	62.7	71.7	80	39	60	56.7	3.5 K	74.2
Oct 2023	4.70	0.01	438 K	11.7	85.7 K	57.6	70.5 K	74	26	47 K	46.9 K	3.6 K	67.8
Nov 2023	3.41	0.43 K	322 K	7.1 K	75.1	50.2	61.8	61	22	39 K	33.1 K	4.1 K	58.6
Dec 2023	2.29 K	0.83	257 K	8.5 K	69.3 L	47.1	57.1 K	76 K	35 K	55 L	38.4 L	3.2	54.5 K
Jan 2024	2.30	1.6	283 K	8.5 K	65.3	43.7	53.4	84	37	61 K	39.2 K	3.5	52.8
Feb 2024	2.16	6.39	295 K	10.1 K	62.4	46.1	53.5	91	52	72 K	44.3 K	3.2	54.8
Mar 2024	4.03	1.98 K	445 K	10.1	65.2 K	46.6	55.2	91	46	68	44.6	4.2 K	58
Apr 2024	5.36	0.26 K	570 K	10.7	72.6	48.1	59.3	88	40	62	45.8	4 K	61.1
May 2024	5.76	0.15	603 K	13.5	75.1	53.9	62.4	91	48	70	52.4	4.2	66.8
Jun 2024	6.91 K	0	645	16	86.2	60.1 K	71.6	87	40	62	57.2	4 K	72.8
Jul 2024	8.05 K	0	655	17.7 K	95.1	65.4	79.4	80	31	52 K	59.9 K	3.8 K	75.2
Aug 2024	7.62	0	614	16.4	94.4	63.8	77.9	79	29	51	57.7	3.9	71.9
Tots/Avgs	57.54	11.67	466.9	12.2	77.6	53.8	64.5	81.8	37.1	58.3	48	3.8	64

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

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Golf Course Superintendents, &
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- **Chance to win one of three $100 gift cards!**

Please share this link widely!
https://go.rutgers.edu/turfsurvey

Questions? Contact Yanhong Jin or Cara Cuite at jinyh@sebs.rutgers.edu or cuite@sebs.rutgers.edu

Save the date

UCR Turfgrass and Landscape Research Field Day

Thursday, September 11, 2025

See you then!

Booklet cover: Kimberly-Anne Anacleto
Cover picture and field map: Christian S. Bowman