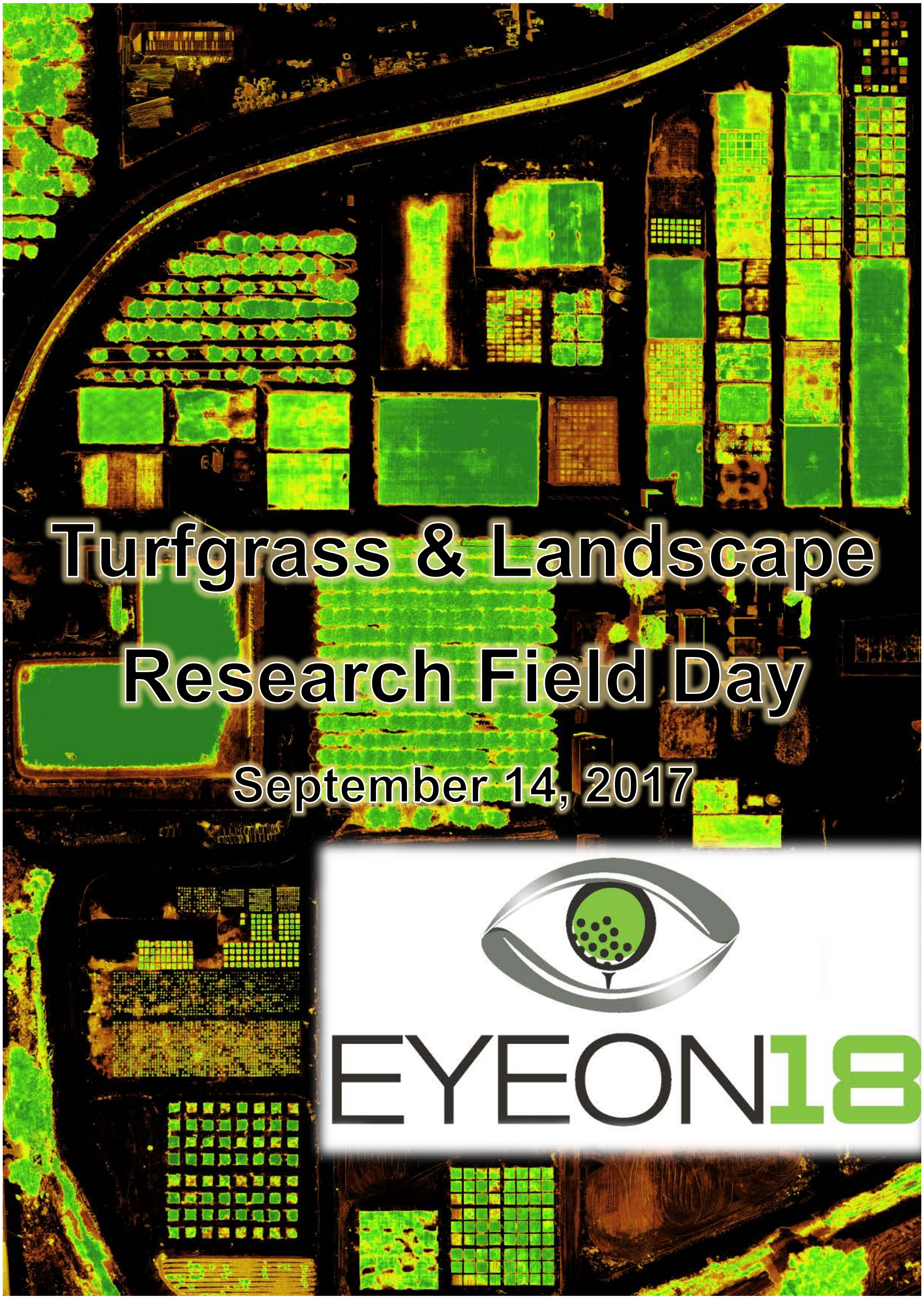


Turfgrass & Landscape Research Field Day

September 14, 2017

EYEON18

University of California Agriculture and Natural Resources

UC RIVERSIDE
UNIVERSITY OF CALIFORNIA
Turfgrass Science

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

UC RIVERSIDE
UNIVERSITY OF CALIFORNIA

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 2017 UCR Turfgrass and Landscape Research Field Day. This marks the 10th consecutive year of this event under my watch. Time flies when you're having fun! 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.

While most of the State was fortunate to get some relief from the drought with rain and snowfall last winter, this summer felt like one of the hottest and certainly most humid in recent memory. Provided no unforeseen rain events between the time of writing this and Field Day, you will witness a lot turf under stress today caused by heat, drought, deficit irrigation, and pathogens, just to name a few. 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 these stresses on turf and landscape plants. For the sixth 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**.

We our happy to report that our turf team is growing to help meet the needs of the largest and most vibrant turfgrass industry in the country, if not the world. Thanks to a generous gift by Mr. John Foster, President and Founder of West Coast Turf, Dr. Marco Schiavon has assumed a new position as Assistant Researcher focusing on turfgrass water and salinity management issues. Furthermore, Dr. Marta Pudzianowska and Dr. Pawel Petelewicz have joined our team as new post-docs in turfgrass breeding and pest management, respectively.

As you enjoy today's tours, please take a moment to thank those folks, mostly wearing fuchsia shirts with our Turfgrass Science logo, who assisted with preparation for this event. Special thanks go to my fellow Field Day planning committee members including Peggy Mauk, Sue Lee, Steve Ries, Sherry Cooper, Lauren McNees, Saundra Wais, and Kellie McFarland. Production of this publication, signs, and online reports would not have been possible without assistance from Mr. Toan Khuong (Associate Specialist). 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 13, 2018.**

Sincerely,

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

2017 Turfgrass and Landscape Research Field Day Sponsors:

(as of September 11, 2017)

Co-Hosts and In-Kind Sponsors

UC Riverside Department of Agricultural Operations

UC Agriculture and Natural Resources

Gold Sponsors

American Sod Farms

Burrtec Waste & Recycling

Delta Bluegrass Company

Grigg Brothers/Brandt

Kurapia Inc.

Simplot Partners

Green Sponsors

Gary and Shelley Crocker – Grasspoint Enterprises USA

Exhibitors:

BASF

Bayer Environmental Science

Burrtec Waste & Recycling

Crop Production Services

Delta Bluegrass Company

Irrometer Company, Inc.

SiteOne

Soil and Water Consulting

Syngenta

Turfgrass Water Conservation Alliance

University of California, Riverside Extension

Westbridge Agricultural Products

West Coast Turf

Thanks for your support throughout the year!

- AA Equipment
- A-G Sod
- Alliance for Low Input Sustainable Turf (A-LIST)
- American Sod Farms
- Anuvia Plant Nutrients
- Aquatrols
- Barenbrug USA
- Baroness
- BASF Specialty Products
- Bayer CropScience
- Bel-Air Country Club
- Best Fertilizer
- Best West Turf
- CAPCA
- California Golf Course Owners Association
- California Golf Course Superintendents Association
- California Sod Producers Association
- California Turfgrass and Landscape Foundation
- Central California Gold Course Superintendents Association
- Clarion
- Coachella Valley Association of Governments
- Coachella Valley Water District
- Cool Planet Energy Systems
- Crop Production Services
- Delta Bluegrass Company
- DLF-Pickseed
- Dow AgroSciences
- Emerald Sod Farm
- Ewing Irrigation
- Eyeon18
- Florasource
- FMC
- Gearmore
- Golf Courses Superintendents association of America (GCSAA)
- Golf Course Superintendents Association of Northern California (GCSANC)
- Golf Course Superintendents Association of Southern California (GCSASC)
- Golf Ventures West
- Gowan Turf & Ornamental
- Grasspoint Enterprises USA
- Grigg Brothers/Brandt
- Gro-Power
- Hi-Lo Desert Golf Course Superintendents Association
- Huma Gro
- Irrometer
- Jacklin Seed by Simplot
- JRX Biotechnology
- Kurapia Inc.
- Lebanon Turf Products
- Links Seed
- Loveland Products
- Martis Camp Club
- Meadow Club
- Metropolitan Water District of Southern California
- Moghu Research Center
- Monsanto
- National Turfgrass Evaluation Program (NTEP)
- Northern California Golf Association
- North Ridge Country Club
- Nufarm Americas
- Ocean Organics
- Pace Turfgrass Research Institute
- Pacific Sod
- Pasatiempo Golf Course
- PBI Gordon
- Pleasanton Golf Center
- Precision Laboratories
- Pure Seed Testing
- P.W. Gillibrand Co.
- Quali-Pro
- San Diego Golf Course Superintendents Association
- Scotts Company
- Seed Research of Oregon
- SePro
- Sierra Nevada Golf Course Superintendents Association
- Sierra Pacific Turf Supply
- Simplot Partners
- SiteOne Landscape Supply
- Soil and Water Consulting
- Solutions 4Earth
- South Coast Air Quality Management District
- Southern California Golf Association
- Southern California Section, Professional Golfers' Association of America
- Southern California Turfgrass Council
- Southern California Turfgrass Foundation
- Southland Sod Farms
- Sports Turf Managers Association-Greater L.A. Basin and Southern California Chapters
- Spyglass Hill GC
- Stover Seed Company
- Syngenta Professional Products
- Target Specialty Products
- Tee 2 Green
- Toro Company
- Turf Star
- Turf Rescue
- Turfgrass Water Conservation Alliance (TWCA)
- United States Golf Association (USGA)
- Water&Soil
- Westbridge Agricultural Products
- West Coast Turf
- Western Municipal Water District
- Wilbur-Ellis
- Yara

CIMIS Data Sep. 2016 – Aug. 2017

Los Angeles Basin-U.C. Riverside - #44

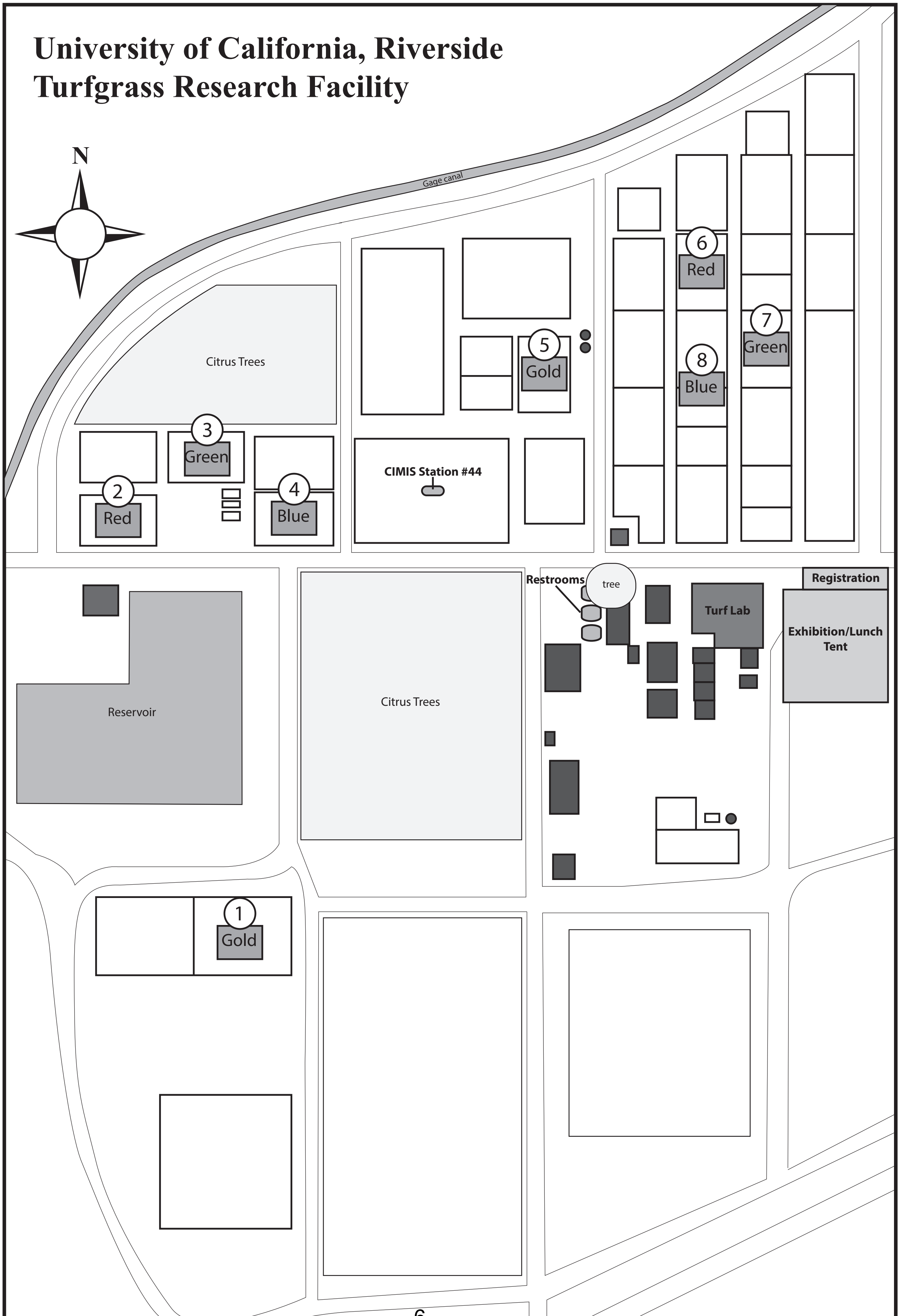
Month Year	Tot ETo (in)	Tot Precip (in)	Avg Sol Rad (Ly/day)	Avg Vap Pres (mBars)	Avg Max Air Tmp (F)	Avg Min Air Tmp (F)	Avg Air Tmp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (F)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Sep 2016	5.30	0	431	12.6 K	87.9 K	60.8	72.9	71	27	47 K	50.1 K	4.0 K	71.5
Oct 2016	3.87 K	0.87 K	329 K	11.2 K	80.7 K	56.6 K	67.7 K	70 L	31 L	51 L	45.9 L	3.5 K	66.4 K
Nov 2016	3.18	1.06	271	7.3	76.2	50.2 K	62.2 K	61	22	40 K	35.1 K	3.7 K	59.7
Dec 2016	1.99	3.65	192	7.8 K	64.2	45.1 K	54.1	73	37	54 K	35.8 K	3.8 K	52.9
Jan 2017	1.81	4.56	201	8.2 K	61.3	44.3	52.4	77	46	62 K	38.2 K	3.6 K	52.4
Feb 2017	2.08	2.14	254	9.8 K	64.9	47.2	55.3	82	46	65 K	43.3 K	3.3	56.3
Mar 2017	5.01	0.15	436	8.6	76.7 K	50.0 K	62.4 K	69	25	45 K	39.7 K	4.0 K	61.2
Apr 2017	6.13	0.04	535 K	9.6 K	77.8	51.1 K	64.6	75	27	47 K	42.6 K	4.7 K	65.1
May 2017	5.95	0.06	534	12.9	78.5	54.4 L	65.6	86	40	62	50.8	4.6 K	68.6
Jun 2017	6.98	0	613	16 K	88.8 K	60.5 K	73.5	88	34	59 K	56.9 K	4.3	74.5
Jul 2017	7.11	0.03	569	18.7 K	93.8 K	65.7 K	78.5	87	33	57 K	61.4 K	4.0 K	78.6 K
Aug 2017	6.4 K	0.39	523	19.8 K	93 K	65.7 K	77.5	93	35	61 L	62.1 L	4.0 K	78.1
Totals/Avgs	55.81	12.95	407	11.9	78.7	54.3	65.6	78	34	54	47	4.0	65.4

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/m^2 = 2.065 Ly/day	25.4 mm = inch	C = 5/9 * (F -32)

m/s = 2.24 mph	kPa = 10 mBars

University of California, Riverside
Turfgrass Research Facility



2017 Turfgrass and Landscape Research Field Day Agenda

7:00 AM	**Exhibitor set-up**
7:30-8:30 AM	**Registration and Trade Show**
8:30 AM	**Welcome and Introductions** Peggy Mauk and Jim Baird
8:40-10:00 AM	**Field Tour Rotation #1** (20 minutes per station)
Stop #1 *Gold Tent*:	**Improvement of Bermudagrass, Kikuyugrass, and Zoysiagrass for Winter Color Retention and Drought Tolerance** Adam Lukaszewski and Marta Pudzianowska
Stop #2 *Red Tent*:	**USGA/NTEP Cool-Season Water Use Trial** Marco Schiavon and Antonio Verzotto
Stop #3 *Green Tent*:	**Evaluation of Fungicides for Control of Anthracnose and Summer Patch Diseases on Annual Bluegrass Putting Greens** Jim Baird
Stop #4 *Blue Tent*:	**Evaluation of Fertilizer Products and Formulations on Bermudagrass Turf; Selective Oxalis Control in Bermudagrass Turf** Pawel Petelewicz
10:00 – 10:30 AM	**Break and Trade Show**
	Biology and Control of Sting and Pacific Gall Nematodes Ole Becker
10:30 – 11:50 AM	**Field Tour Rotation #2** (20 minutes per station)
Stop #5 *Gold Tent*:	**Management of Salinity and Rapid Blight Disease on Annual Bluegrass Putting Greens** Jim Baird
Stop #6 *Red Tent*:	**Best Management Practices for Kurapia Groundcover** Pawel Orlinski
Stop #7 *Green Tent*:	**Remote Sensing and Evapotranspiration (ET) Replacement Strategies for Turf Irrigation; Evaluation of Plant Growth Regulators (PGRs) on Bermudagrass and Seashore Paspalum Turf** Pawel Petelewicz and Jose Espeleta
Stop #8 *Blue Tent*:	**Best Management Practices for Water Conservation on Bermudagrass Turf; How Often Should You Water Your Lawn?** Marco Schiavon and Antonio Verzotto
12:00 – 1:30 PM	**Barbeque Lunch and Trade Show**
1:30 PM	**Adjourn**

Please go on-line and fill out the evaluation form at http://ucanr.edu/turf2017eval.

Trade Show Presentation: Breakthrough in Managing the Pacific Shoot Gall Disease in Annual Bluegrass

Jim Baird[1], Macro Schiavon[1], Manuel Mundo-Ocampo[2], and J.Ole Becker[2]
[1]Department of Botany and Plant Sciences, [2]Department of Nematology
University of California, Riverside, CA 92521

Introduction:

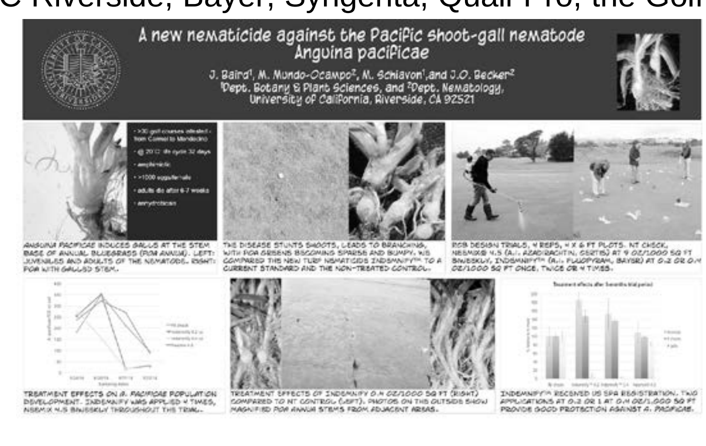
The Pacific shoot-gall nematode, *Anguina pacificae*, parasitizes annual bluegrass (*Poa annua*) on golf putting greens along the northern California coast. They induce cavity-containing galls at the bottom of *Poa* shoots. Mature galls harbor eggs, juveniles, and adults of the nematode. The disease stunts the shoots, resulting in severe stand thinning and poor putting quality. Currently, no effective remedy is available in California.

Research Accomplishments:

During 2014-2017 we tested a couple of new development products with nematicidal activity at several severely *A. pacificae*-infested golf courses. The experimental design was a complete randomized block of 4 x 6 ft plots with 4 replications. The various treatment regimes were compared to the local standard of Neemix 4.5 (a.i. azadirachtin, 9 oz/1000 ft^2, twice a month) and a non-treated control. Fluopyram (0.195 or 0.39 oz/1000 ft^2, once or twice/yr) improved turf appearance within 6-8 weeks as new Poa shoot growth was almost gall-free contrary to Neemix-treated plots and the non-treated control. We hypothesize that fluopyram forms a long-lasting protective barrier on Poa stem bases as it had little effect on soil dwelling nematodes. Fluopyram is registered with the federal EPA as Indemnify® for use in turf. More recently we have discovered that abamectin (Divanem™ from Syngenta) also provides improved turf quality under *Anguina* nematode pressure. Research is ongoing and registration of both nematicides in California is pending.

Acknowledgments:

The project was supported by the UC Agricultural Experiment Station, the College of Natural and Agricultural Sciences at UC Riverside, Bayer, Syngenta, Quali-Pro, the Golf Course Superintendents Association of Northern California, the Northern California Golf Association, and the California Turfgrass & Landscape Foundation. We thank C. Dalhamer at The Pebble Beach Golf Links, J. Mandon at Pasatiempo Golf Club, D. Miller at the Links at Half Moon Bay, F. Villagran, formerly at The Links at Bodega Harbour, and T. Powers at Pajaro Valley Golf Club for their help.



Trade Show Presentation: 25 Years After the Discovery of Sting Nematodes in California: Summary of Research and Extension Efforts

J.Ole Becker and J. Smith Becker
Department of Nematology, University of California, Riverside, CA 92521

Introduction:

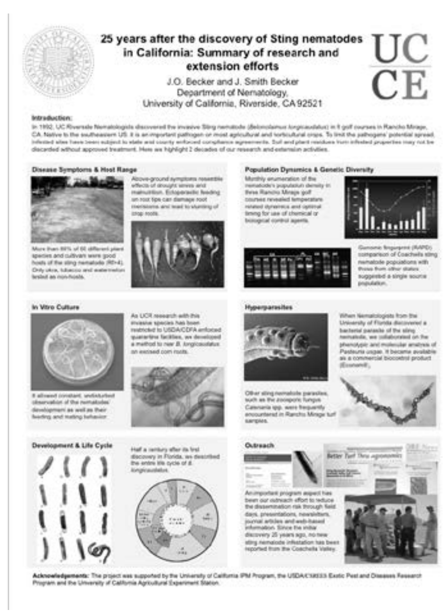
The Sting nematode (*Belonolaimus longicaudatus*) is an important pathogen on most agricultural and horticultural crops. This microscopic roundworm is native to sandy soils in the southeastern US. It feeds with its long mouth stylet near the root tips. This leads to stunting of the roots and to above-ground disease symptoms resembling effects of drought stress and malnutrition. Parasitism perdisposes roots to secondary microbial attack. In 1992, University of California Riverside Nematologists discovered this invasive species in several golf courses centered around Rancho Mirage, CA. To limit the pathogen's potential spread, infested sites have been subject to State and county enforced compliance agreements. Soil and plant residues from infested properties may not be discarded without approved treatment.

Research Accomplishments:

As Sting nematode research at UCR has been restricted to USDA/CDFA enforced quarantine conditions, we developed a culture method to rear *B. longicaudatus* in vitro on excised corn roots. This technique allowed for the first time to observe and describe its complete life cycle. Also, we documented the local population dynamics which pinpointed the most efficacious timing for use of nematicides and biocontrol agents. Genetic comparison of Coachella Sting nematode populations with those from several southeastern states strongly suggested that the Califonia invasion of this nematode originated from a single source population. When University of Florida Nematologists discovered an obligate bacterial parasite of *B. longicaudatus*, our group developed a trixenic culture to study its development and hyperparasitism.

Outreach Activities:

An important program aspect has been our outreach effort to golf course superintendents, pest control advisors, landscape professionals and the general public to educate about the nematode. Familiarity with the biology, ecology, and epidemiology of the sting nematode is considered key to reducing the dissemination risk. Since the original survey a quarter of a century ago, no new Sting nematode infestation has been reported from the Coachella Valley.



Acknowledgements:

The project was supported by UC IPM, USDA/CSREES Exotic Pest & Diseases Research Program, UC Agricultural Experiment Station, and UC Riverside, College of Natural and Agricultural Sciences.

Stop #1: Improvement of Bermudagrass, Kikuyugrass, and Zoysiagrass for Winter Color Retention and Drought Tolerance

Adam J. Lukaszewski, Marta Pudzianowska, and Jim Baird
Department of Botany & Plant Sciences
University of California, Riverside, CA 92521

Project Milestones Since Field Day 2016:

- ✓ New project funded by CTLF, USGA, MWD, and WMWD.
- ✓ Dr. Marta Pudzianowska hired as postdoctoral scholar in turfgrass breeding and genetics.
- ✓ Planted ca. 1,000 bermudagrass and zoysiagrass accessions in replicate plots from University of Florida, Oklahoma State University, Texas A&M, and UCR for evaluation of winter color retention and drought tolerance in Riverside.
- ✓ Continued crossing of UCR bermudagrass accessions, with emphasis on genotypes possessing desirable winter color retention, early spring green-up, and drought tolerance.
- ✓ Conducted a second genetic analysis of existing and new UCR bermudagrass accessions using DArT technology.
- ✓ Established new replicated trials in Riverside, at West Coast Turf in Thermal (Coachella Valley), and at Meadow Club in Fairfax (Northern California) to evaluate 12 of our most promising bermudagrass hybrids or accessions in comparison to Tifway, Santa Ana, TifTuf, and Bandera cultivars.
- ✓ Established a new collection of 105 kikuyugrass genotypes representing greatest genetic diversity from California populations.
- ✓ Selecting for desirable traits among individual kikuyugrass seedlings from wild type seed stocks.
- ✓ Made second attempt to create haploid kikuyugrass plants via androgenesis. Reducing ploidy level often results in reduction of vigor (i.e., aggressiveness) and we hope general improvement in turf quality characteristics.

Background and Justification:

Despite attempts by the turfgrass industry to develop cool-season turfgrasses with improved drought tolerance, repeated testing in Riverside, CA (a Mediterranean climate characterized by hot, dry summers with less than 200 mm of annual rainfall) has demonstrated that even the most drought tolerant cool-season cultivars do not even come close to the warm-season species in terms of drought tolerance and water use efficiency. With water supplies in California uncertain the future of turfgrass and other landscapes is shaky. Use of drought tolerant plant species should be at the forefront of water conservation management plans for golf courses and other landscapes. Warm-season or C4 grasses are better adapted to warmer, drier climates and use at least 20% less water compared to cool-season grasses, yet their use in California and abroad is limited primarily due to the aesthetics of winter dormancy. Thus, we strive to improve winter color retention in and therefore greater acceptance of warm-season turfgrasses for regions where these grasses are adapted. In addition, drought tolerance is not created equal both among and within warm-season species. While buffalograss is considered to be among the most drought tolerant of the warm-season turfgrass species, the primary mechanism for this is drought avoidance by summer dormancy. In California, general observations are that bermudagrass retains the best quality and green color under drought or deficit irrigation, although differences within cultivars are less substantiated. Other warm-season species appear to possess “lesser” drought tolerance, but zoysiagrass and kikuyugrass are best able retain green color longer in response to cooler temperatures.

Thanks to new or continued support from the California Turfgrass and Landscape Foundation (CTLF), United States Golf Association (USGA), Metropolitan Water District (MWD) of Southern California, and Western Municipal Water District (WMWD) we are able to continue this project with full speed ahead. Dr. Marta Pudzianowska (Ph.D., Warsaw University of Life Sciences) joined our team in spring 2017 as a postdoctoral scholar in turfgrass breeding and genetics.

Project Objectives:

1. Develop bermudagrass, kikuyugrass, and zoysiagrass turf-type genotypes with improved winter color retention and drought tolerance for Mediterranean and arid climates.
2. Screen a large collection of bermudagrass and zoysiagrass genotypes from the University of Florida, Oklahoma State University, Texas A&M, and UCR for winter color retention and drought tolerance in Riverside CA.
3. Develop techniques to reduce kikuyugrass ploidy level to diploid by androgenesis to reduce aggressiveness and improve turf quality and playability characteristics.
4. Utilize Diversity Arrays Technology (DArT) markers to aid in breeding efforts and marker-assisted selection.

Bermudagrass:

Bermudagrass is commonly used throughout the southern U.S. and is considered the “go to” warm-season species for many golf courses and athletic fields in California. Its major disadvantage is winter dormancy. Our project focuses on this issue, with the primary goal of shortening winter dormancy (if it can be eliminated at all, it certainly would not be a single step process). For this purpose we established a collection of all six Cynodon species in Riverside, by requesting samples from the USDA and several other sources.

At present the collection approaches 160 accessions; all six species are represented by at least one genotype each. The collection also includes a growing number of samples collected locally, or donated to us by others. These are mostly from abandoned or heavily travelled sites, including a spot in Coachella Valley where no irrigation water was applied for at least three consecutive (and very dry) years. We started intercrossing these species and generated a large number of interspecific hybrids. Some of these were created by controlled one x one cross hybridization (both parents are known) using the detached tiller approach; many others were created by open pollination among the collection accessions. In this case only the female parent is known. The hybrids show variation for every observable characteristic, including the onset of winter dormancy and spring green-up.

Our immediate plans are to attempt to intercross the hybrids with latest dormancy and the earliest green-up, on the assumption that the next generation hybrids may show reduced dormancy period. In the meantime, the best-looking hybrids are being tested in various environments including: the Coachella Valley Agricultural Research Station in Thermal, CA; Arizona Country Club in Scottsdale, AZ; and The Preserve Golf Club in Carmel, CA. Dramatic differences in their behavior are clearly evident. Last year a separate area of these grasses were established at UCR and, once established, irrigation was turned off to evaluate relative drought tolerance. After initial conditioning, two of our new hybrids survived the dry-down in surprisingly good shape. Because of new plantings in the area, the test could not be repeated this year and will be repeated only after a new dry-down area is established, away from any irrigation systems. New sets of hybrids are also being generated, again by open pollination of selected collection accessions. To go back to much more successful cross-pollinations from several years ago we have established a new crossing block on an exposed site with more morning winds.

To establish the parentage of the existing hybrids, the collection and a sample of hybrids were genotyped using the DArT technology. The results were confusing suggesting that some accession designations may be incorrect (some accessions group with species other than those listed); in several cases the accessions appear to be amphiploid, as they share markers of two (or even more, up to four) original known diploid species. This makes tracking the parentage difficult. We have requested new samples from USDA and hope to straighten the matter during upcoming winter.

This year, we chose 12 of our most promising accessions or hybrids for further evaluation in larger, replicated plots (for more realistic cultural care and better evaluation of quality characteristics) across several climatic zones in California. UCR entries included: 10-9, 15-4, 16-6, 17-8, TP1-1, TP1-2, TP3-2, TP5-4, TP6-3, BF1, BF2 and NRCC12. These are being compared with four widely used or new cultivars: Bandera, Santa Ana, TifTuf and Tifway. Experiments were designed as randomized blocks with three replications. Three locations in California were chosen for establishing the trial: University of California, Riverside (Riverside, Inland Southern California); Coachella Valley (Thermal, Low Desert) and Fairfax (Northern California). Plots (5’ x 5’) were established from 2.5-inch plugs on May 22 in Riverside; June 14 in Coachella Valley; and June 22 in Fairfax. During the first year of the test dynamics of establishment are being measured using Digital Image Analysis (DIA) and turf quality is being evaluated after obtaining full cover.

Preliminary results thus far indicate that the bermudagrasses grow fastest in the warmest climates (Table 1), but Riverside was the only location where the accessions reached 100% establishment by the end of August 2017. Tested accessions and hybrids showed different growth dynamics (Table 2). TP 6-3, a UCR hybrid, turned out to be the fastest growing accession in Riverside, reaching 75% cover 51 days after planting (DAP). DIA measurements taken in Coachella Valley also revealed that TP 6-3 is the most rapidly growing entry so far (data not shown). Other faster growing entries were TP 3-2 (75% cover reached at 56 DAP) and NRCC12 (75% cover reached at 57 DAP). TP 6-3 and TP 3-2 were also characterized by high turf quality evaluated in Riverside (UCR), higher than Tifway (Table 3). All tested hybrids and accessions have demonstrated turf quality ratings of 6 (minimally acceptable) or higher and are comparable to commercial cultivars in this study.

Table 1. Differences in average bermudagrass cover (0-100%) among the three test locations in CA. 2017. Based on DIA averaged across 4, 6, and 8 weeks after planting.

Location	Cover (%)
Riverside	37.42 b
Coachella Valley	51.96 c
Fairfax	19.39 a

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

Table 2. Days after planting (DAP) to reach 75% plot cover based on regression analysis in Riverside, CA. Bermudagrass plugs were planted on 22 May 2017.

Accession code	DAP to reach 75% cover
10-9	63
15-4	63
16-6	63
17-8	61
TP1-1	63
TP1-2	59
TP3-2	56
TP5-4	61
TP6-3	51
BF1	64
BF2	63
NRCC12	57
Bandera	61
Santa Ana	52
TifTuf	55
Tifway	58

Table 3. Visual quality (1-9, 9 = best) of bermudagrass Accessions averaged over three rating dates in Riverside, CA. 2017.

Accession code	Visual quality (1-9)
10-9	6.1 e
15-4	6.4 cde
16-6	7.2 abc
17-8	7.0 abcd
TP1-1	6.8 abcde
TP1-2	6.7 abcde
TP3-2	7.4 a
TP5-4	6.8 abcde
TP6-3	7.5 a
BF1	6.8 abcde
BF2	6.6 bcde
NRCC12	6.3 de
Bandera	7.3 ab
Santa Ana	6.7 abcde
TifTuf	6.8 abcde
Tifway	6.4 cde

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

Kikuyugrass:

Kikuyugrass is a warm-season species that originated from the east African Highlands and now inhabits every continent except Antarctica (Mears, 1970). It was first imported into California in the 1920s for soil erosion control on hillsides and riverbanks (Garner, 1925); however, it quickly spread to colonize much of coastal southern and central California. Today, kikuyugrass is officially considered as an invasive weed with sale and transport prohibited in several California counties. Furthermore, it is on the Federal Noxious Weed list, which restricts importation of germplasm into the country and across state boundaries (USDA, 2012). Kikuyugrass spreads aggressively by rhizomes, stolons, and seed (Youngner et al., 1971). Also found in Hawaii and scantly in Arizona, the species is well suited to Mediterranean climates like California because it can photosynthesize across a wide temperature range as evidenced by its superior winter color retention among the warm-season turfgrasses (Wilen and Holt, 1995). These characteristics have allowed kikuyugrass to invade areas including golf courses, athletic fields, and lawns, where it often becomes the dominant managed turfgrass species rather than attempts to selectively remove it (Gross, 2003).

In previous years we have sampled kikuyugrass from throughout California, from our collection at UCR (ca. 20-25 yrs. old), as well as Hawaii and Australia. A total of 20,000 single nucleotide polymorphism (SNP) makers were discovered using the Diversity Arrays Technology sequencing (DArTseq) platform. The hierarchical plot, gap statistics, and the principal coordinate analysis showed that the 336 accessions separated into three main clusters. Seventy-seven percent of the total genetic variation was due to within population variation, while 23% represented among population variation. This means that there is relatively little variation among known sources of the grass. Accessions from Australia and Hawaii showed a much broader degree of genetic diversity than our California samples and would be valuable stock for breeding should such effort become feasible and the exchange of germplasm possible. The level of variation is not impressive, but it does offer hope that progress by selection is possible, even if no germplasm can be imported. This year we established a collection of available genotypes representing the greatest genetic diversity and are conducting dry down events to select for improved drought tolerance. In addition, recently we have located all seed stocks of the grass (from about 20-25 years back) and established ca. 280 individual seedlings. These will be individually assessed, selected for best suitability for turf, and added to our collection. Selected accessions will be intercrossed and new hybrids screened and selected.

Kikuyugrass is tetraploid (presumably autotetraploid). It is very vigorous and aggressive. Autotetraploids in general are larger and more vigorous than their diploid predecessors. We assume that ploidy reduction will automatically reduce vigor and plant size, perhaps creating turf with much finer texture, and less aggressive growth. We have repeated last year's attempt to generate haploids (which here would carry two genomes, as the starting material is tetraploid) via androgenesis. There is no known technology adapted to this species and the species appears to be recalcitrant. This year again we brought in a specialist in androgenesis, some 13,000 anthers were plated but we have no haploids as yet. The consolation is that we now have tested protocols for material collection, application of external stresses to induce the switch from the gametophytic to sporophytic pathway of microspore development, and selected best culture media. We must try this approach in different seasons; perhaps the microspores will be more amenable to manipulation than in summer.

Our assumption in this approach is that reduction of ploidy level to diploid will reduce plant vigor and size. We cannot predict, however, if such diploids will be fertile. In Festulolium where we reduced the ploidy level from tetraploid to diploid (Kopecky et al., 2005), some diploid individuals were in fact fertile and could be intercrossed to generate viable populations. Whether this will work in kikuyugrass is an open question; much depends on the level of differentiation of the genomes in the tetraploid, of which there are no data available.

Zoysiagrass:

Zoysiagrass (Zoysia sp.) is generally considered to have optimal winter color retention among the warm-season turfgrasses. UCR has some tradition in breeding of Zoysiagrass. In the 1980's UCR released cv. 'El Toro', a Z. japonica accession developed by the late Dr. Victor B. Youngner (Gibeault, 2003). El Toro had a much faster establishment rate, better late season color and more rapid spring green-up than other Z. japonica grasses, and less thatch production. This release was followed by two cultivars, 'De Anza' and 'Victoria' which were created by a complex hybridization 'El Toro' x hybrid (Z. matrella x (Z. japonica x Z. tenuifolia). De Anza is known for very good winter color retention. Unfortunately, all but a handful of germplasm from those breeding efforts has disappeared and if the breeding is to be initiated again, a new germplasm collection has to be established. As described below, we have acquired sample accessions from existing germplasm collections and breeding programs to be screened under Southern California conditions for their winter color retention and other critical turf characteristics. If UCR re-enters zoysiagrass breeding, early on progress will be slow, given the long establishment time for zoysiagrass. However, once interesting accessions are identified and hybrids are made (by us or other breeding programs), progress should accelerate rapidly.

Winter Color Retention Germplasm Evaluation:

In an effort to help expedite development of warm-season turfgrasses with improved winter color retention and drought tolerance, bermudagrass germplasm from Oklahoma State University and the University of Florida, zoysiagrass germplasm from Texas A&M University, and germplasm from other breeding programs is now under evaluation in Riverside, CA together with bermudagrass, zoysiagrass, and kikuyugrass germplasm from UCR. Replicate space plantings were established in fall 2016 and starting in fall 2017 accessions will be evaluated for winter color retention, spring green-up, and tolerance to deficit irrigation. Ratings will include visual, digital image analysis, and possibly by remote sensing using the latest drone technologies.

References

Garner, E.S. (1925) Kikuyu Grass. USGA Green Section Record. 5:252-253.

Gibeault V. 2003. Zoysiagrass for California. Calif. Turfgrass Cult. 53:2:1-3.

Gross, P. J. 2003. Looking kindly at kikuyugrass. USGA Greens Section Record. 41:2-8.

Kopecky, D., A.J. Lukaszewski and V. Gibeault. 2005. Reduction of ploidy level by androgenesis in intergeneric Lolium-Festuca hybrids for turf grass breeding. Crop. Sci. 45:274-281.

Mears, P.T. 1970. Kikuyu- (Pennisetum Clandestinum) as a Pasture Grass- A Review. Trop. Grassl. 4:139-152.

United States Department of Agriculture. 2012. Federal Noxious Weed List. https://plants.usda.gov/java/noxious?rptType=Federal (accessed12 March. 2014).

Wilen, C.A., and J.S. Holt. 1996. Physiological mechanisms for the rapid growth of Pennisetum clandestinum in Mediterranean climates. Weed Res. 36:213-225.

Youngner, V.B., W.W. Wright, and E. Zimmerman. 1971. Kikuyugrass-its management and control. Calif. Turfgrass Cult. 21:1-3

Acknowledgments:

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

Stop #2: USGA/NTEP Cool-Season Water Use Trial

Marco Schiavon, Antonio Verzotto, Magdalena Poleska and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside, CA 92521

Objectives:

The National Turfgrass Evaluation Program (NTEP) is designed to develop and coordinate uniform evaluation trials of turfgrass varieties and promising selections in the United States and Canada. Test results can be used by national companies and plant breeders to determine the broad picture of the adaptation of a cultivar. Results can also be used to determine if a cultivar is well adapted to a local area or level of turf maintenance. For more information, please visit ntep.org. The objectives of the 2016 National Cool-Season Water Use and Drought Resistance Test is to identify Kentucky bluegrass, tall fescue and perennial ryegrass cultivars that are best adapted to deficit irrigation and drought conditions.

Materials and Methods:

The study was seeded on 1 November 2016 and established during the winter and spring with non-limiting water. Entry list for the NTEP trial can be found on Table 1. Deficit irrigation, consisting of three irrigation regimes (80%, 60% and 40% ET_o replacements), started on 27 June 2017, and will last until October 25. Plots are mowed at 2.5 inches and fertilized with 0.33 lb N/month. Visual quality (1-9, 9 = best) and percent green cover (digital image analysis) were taken weekly during deficit irrigation and recovery.

Results:

No cultivar was able to withstand two months of 40%ET_o replacement irrigation with the highest % green cover recorded at 28% and 22% for tall fescue and Kentucky bluegrass, respectively (Tables 2 and 3). All of the tall fescue cultivars struggled at 60% ET_o replacements as well, having lost at least half of green cover by the end of August. Kentucky bluegrass performed slightly better than tall fescue at 60% ET_o replacements (Table 3). The best cultivar at 80% ET_o so far is LTP-SYN-A3 for tall fescue with 88% green cover (Table 2), and PST-K13-141 for Kentucky bluegrass with 89% green cover (Table 3).

Table 1. Entry list and plot plan for the 2016 National Cool-Season Water Use and Drought Resistance Test.

Entry Number	Species	Name
1	Kentucky Bluegrass	BAR PP 110358
2	Kentucky Bluegrass	Barrari
3	Kentucky Bluegrass	Everest
4	Kentucky Bluegrass	Blue Note
5	Kentucky Bluegrass	Babe
6	Kentucky Bluegrass	NAI-13-132
7	Kentucky Bluegrass	NAI-13-14
8	Kentucky Bluegrass	Blue Devil
9	Kentucky Bluegrass	Dauntless
10	Kentucky Bluegrass	PST-K13-137
11	Kentucky Bluegrass	PST-K13-143
12	Kentucky Bluegrass	PST-K15-169
13	Kentucky Bluegrass	PST-K11-118
14	Kentucky Bluegrass	PST-K13-141
15	Kentucky Bluegrass	Midnight
16	Perennial Ryegrass	SR 4650
17	Tall Fescue	BarRobusto
18	Tall Fescue	BAR FA 121095
19	Tall Fescue	DLFPS 321/3677
20	Tall Fescue	DLFPS 321/3679
21	Tall Fescue	DLFPS 321/3678
22	Tall Fescue	Nonet
23	Tall Fescue	GO-AOMK
24	Tall Fescue	Supersonic
25	Tall Fescue	Titanium 2LS
26	Tall Fescue	Thor
27	Tall Fescue	Thunderstruck
28	Tall Fescue	RS4
29	Tall Fescue	Kingdom
30	Tall Fescue	MRSL TF15
31	Tall Fescue	Catalyst
32	Tall Fescue	Stetson II
33	Tall Fescue	PST-5SDS
34	Tall Fescue	PST-R511
35	Tall Fescue	LTP-SYN-A3
36	x	x

Plot plan of for the 2016 National Cool-Season Water Use and Drought Resistance Test
North ➔

80% ET_o

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
X	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
5	9	7	1	11	15	13	2	12	3	14	6	10	8	4	X	16	32
17	24	20	29	34	21	18	26	19	22	28	33	35	31	27	30	25	23
6	4	8	12	10	3	15	11	13	7	2	14	1	5	9	16	X	28
25	22	30	23	19	17	24	21	33	31	18	29	20	26	32	35	27	34

40% ET_o

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
X	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
5	9	7	1	11	15	13	2	12	3	14	6	10	8	4	X	16	32
17	24	20	29	34	21	18	26	19	22	28	33	35	31	27	30	25	23
6	4	8	12	10	3	15	11	13	7	2	14	1	5	9	16	X	28
25	22	30	23	19	17	24	21	33	31	18	29	20	26	32	35	27	34

60% ET_o

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
X	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
5	9	7	1	11	15	13	2	12	3	14	6	10	8	4	X	16	32
17	24	20	29	34	21	18	26	19	22	28	33	35	31	27	30	25	23
6	4	8	12	10	3	15	11	13	7	2	14	1	5	9	16	X	28
25	22	30	23	19	17	24	21	33	31	18	29	20	26	32	35	27	34

Table 2. Green cover of tall fescue plots irrigated at 40%, 60% or 80% ET_o replacements on 8/29/2017.

Cultivar	ET_o	Cover (%)	MSGroup
BAR FA 121095	0.4	27	NOPQRSTU
BAR FA 121095	0.6	54	GHIJKL
BAR FA 121095	0.8	59	DEFGHIJ
BarRobusto	0.4	28	NOPQRSTU
BarRobusto	0.6	45	HIJKLMN
BarRobusto	0.8	57	FGHIJK
Catalyst	0.4	22	PQRSTU
Catalyst	0.6	37	KLMNOPQRS
Catalyst	0.8	64	BCDEFGH
DLFPS 321/3677	0.4	21	QRSTU
DLFPS 321/3677	0.6	35	LMNOPQRST
DLFPS 321/3677	0.8	79	ABCD
DLFPS 321/3678	0.4	25	NOPQRSTU
DLFPS 321/3678	0.6	43	IJKLMNOP
DLFPS 321/3678	0.8	79	ABCD
DLFPS 321/3679	0.4	25	NOPQRSTU
DLFPS 321/3679	0.6	40	JKLMNOPQ
DLFPS 321/3679	0.8	73	ABCDEFG
GO-AOMK	0.4	21	QRSTU
GO-AOMK	0.6	28	NOPQRSTU
GO-AOMK	0.8	76	ABCDEF
Kingdom	0.4	20	QRSTU
Kingdom	0.6	49	HIJKLM
Kingdom	0.8	64	BCDEFGH
LTP-SYN-A3	0.4	25	NOPQRSTU
LTP-SYN-A3	0.6	44	HIJKLMNO
LTP-SYN-A3	0.8	88	A
MRSL TF15	0.4	20	QRSTU
MRSL TF15	0.6	50	HIJKLM
MRSL TF15	0.8	75	ABCDEF
Nonet	0.4	17	STU
Nonet	0.6	24	OPQRSTU
Nonet	0.8	72	ABCDEFG
PST-5SDS	0.4	20	QRSTU
PST-5SDS	0.6	32	MNOPQRSTU
PST-5SDS	0.8	82	ABC
PST-R511	0.4	12	U
PST-R511	0.6	44	HIJKLMNO
PST-R511	0.8	78	ABCDE
RS4	0.4	23	OPQRSTU

RS4	0.6	62	CDEFGHI
RS4	0.8	90	A
Stetson II	0.4	19	RSTU
Stetson II	0.6	40	JKLMNOPQR
Stetson II	0.8	61	CDEFGHI
Supersonic	0.4	19	QRSTU
Supersonic	0.6	39	JKLMNOPQR
Supersonic	0.8	80	ABC
Thor	0.4	17	STU
Thor	0.6	44	HIJKLMNO
Thor	0.8	82	ABC
Thunderstruck	0.4	18	STU
Thunderstruck	0.6	44	HIJKLMNO
Thunderstruck	0.8	83	AB
Titanium 2LS	0.4	15	TU
Titanium 2LS	0.6	39	JKLMNOPQR
Titanium 2LS	0.8	58	EFGHIJ

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

Table 3. Green cover of Kentucky bluegrass plots irrigated at 40%, 60% or 80% ET_o replacements on 8/29/2017.

Cultivar	ET_o	Cover (%)	MSGroup
BAR PP 110358	0.4	15	K
BAR PP 110358	0.6	45	GHI
BAR PP 110358	0.8	71	ABCDE
Babe	0.4	14	K
Babe	0.6	38	IJ
Babe	0.8	69	ABCDE
Barrari	0.4	16	K
Barrari	0.6	63	DEFGH
Barrari	0.8	85	ABC
Blue Devil	0.4	15	K
Blue Devil	0.6	56	EFGHI
Blue Devil	0.8	86	ABC
Blue Note	0.4	15	K
Blue Note	0.6	43	HI
Blue Note	0.8	85	ABC
Dauntless	0.4	17	K
Dauntless	0.6	51	EFGHI
Dauntless	0.8	80	ABCD
Everest	0.4	15	K
Everest	0.6	46	FGHI

Everest	0.8	84	ABC
Midnight	0.4	22	JK
Midnight	0.6	65	CDEFG
Midnight	0.8	79	ABCD
NAI-13-132	0.4	13	K
NAI-13-132	0.6	44	HI
NAI-13-132	0.8	68	BCDE
NAI-13-14	0.4	20	JK
NAI-13-14	0.6	55	EFGHI
NAI-13-14	0.8	82	ABCD
PST-K11-118	0.4	20	JK
PST-K11-118	0.6	66	CDEF
PST-K11-118	0.8	88	AB
PST-K13-137	0.4	17	K
PST-K13-137	0.6	50	EFGHI
PST-K13-137	0.8	86	ABC
PST-K13-141	0.4	17	K
PST-K13-141	0.6	57	EFGHI
PST-K13-141	0.8	89	A
PST-K13-143	0.4	16	K
PST-K13-143	0.6	44	HI
PST-K13-143	0.8	85	ABC
PST-K15-169	0.4	18	K
PST-K15-169	0.6	52	EFGHI
PST-K15-169	0.8	79	ABCD

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

Stop #3: Evaluation of Fungicides for Control of Anthracnose and Summer Patch Diseases on Annual Bluegrass Putting Greens

Pawel Petelewicz[1], Marco Schiavon[1], Magdalena Poleska[1],
Pawel Orlinski[1], Jose Espeleta[2], and Jim Baird[1]
[1]Department of Botany and Plant Sciences
[2]Department of Agricultural Operations
University of California, Riverside, CA 92521

Objectives:

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

Materials and Methods:

The study was conducted on mature annual bluegrass (*Poa annua*) turf on a Hanford fine sandy loam amended with sand. Turf was mowed three days/wk at 0.125 inches and received 0.125 lbs N/1000ft^2 every 14 days and monthly sand topdressing.

Fungicide treatments were applied every 14 days beginning on June 9, 2017 (before disease symptoms were present) and ending on September 12 for a total of 8 applications. Treatments were applied using a CO_2-powered backpack sprayer with TeeJet 8004VS nozzles calibrated to deliver 2 gallons/1000 ft^2.

Plots were evaluated for turf quality, injury caused by treatments, and anthracnose and summer patch disease pressure on a weekly basis starting July 18. Volumetric water content, soil temperature, NDVI ratings and digital image analysis (DIA) were taken on biweekly basis starting from June 13.

Experimental design was a randomized block with 4 replications. Plot size was 4 x 6 ft with 2-ft alleys.

Results:

Temperatures and humidity were unusually high and persistent throughout the study this year. Treatments containing Primo Maxx and or most DMI fungicides caused significant turf injury at the onset of applications (Table 2). Primo Maxx injury turned into darker green, higher quality turf between the second and third applications; whereas injury from DMI fungicides tended to persist longer but generally subsided as the study progressed (data not shown).

Historically, anthracnose disease pressure is severe on this research putting green with sporadic occurrence of summer patch disease. This year, summer patch was more prevalent due to extreme weather conditions; however, there were no significant differences among treatments (data not shown). That said, summer patch symptoms appeared slightly more prevalent in the untreated control as well as the following treatments: Affirm; NUP-15014; Rotator; Syngenta Program #5; UCR 001, 002, and 004; and Torque (data not shown).

Significant anthracnose pressure and treatment differences started around August 1 (data not shown). By the end of August, the best treatments in terms of lowest disease cover and highest turf quality included: rotation of Heritage Action + Primo Maxx with Daconil Action + Primo Maxx (Syngenta Program #1); rotation of Briskway + Primo Maxx with Daconil Action + Primo Maxx (Syngenta Program #4); rotation among several fungicides including Mirage, Signature Xtra Stressgard, Insignia and Daconil Ultrex (Bayer Program #2); rotation among several fungicides including Mirage, Signature WDG, Medallion, Insignia and Daconil Ultrex (Bayer Program #5); rotation of Insignia + Daconil Ultrex with Daconil Ultrex; and Headway (Table 2).

Acknowledgments:

Thanks to BASF, Bayer, Syngenta, NuFarm and Clarion for supporting this research.

Table 1. Treatment tested in the anthracnose and summer patch fungicide trial in Riverside, CA. 2017.

No.	Treatments		Application code (timing)	Rate (oz/1000 ft^2)
1	Untreated Control		-	-
2	Bayer Program No. 1	Mirage	A	1.5
		Signature Xtra Stressgard	B	4
		Daconil Ultrex		3.2
		Mirage	C	1
		Insignia		0.7
		Signature Xtra Stressgard	D	4
		Daconil Ultrex		3.2
		Insignia	E	0.7
		Mirage		1
		Signature Xtra Stressgard	F	4
		Daconil Ultrex		3.2
		Signature Xtra Stressgard	G	4
		Mirage		1
		Signature Xtra Stressgard	H	4
		Daconil Ultrex		3.2
3	Bayer Program No. 2	Mirage	A	1.5
		Primo Maxx		0.1
		Signature Xtra Stressgard	B	4
		Daconil Ultrex		3.2
		Primo Maxx		0.1
		Mirage	C	1
		Insignia		0.7
		Signature Xtra Stressgard	D	4
		Daconil Ultrex		3.2
		Insignia	E	0.7
		Mirage		1
		Signature Xtra Stressgard	F	4
		Daconil Ultrex		3.2
		Signature Xtra Stressgard	G	4
		Mirage		1
		Signature Xtra Stressgard	H	4
		Daconil Ultrex		3.2
4	Bayer Program No. 3 *(continued on next page)*	Mirage	A	1.5
		Primo Maxx		0.1
		Signature Xtra Stressgard	B	4
		Daconil Ultrex		3.2
		Primo Maxx		0.1
		Medallion	C	2
		Insignia		0.7

4	Bayer Program No. 3 *(continued from the previous page)*	Signature Xtra Stressgard	D	4
		Daconil Ultrex		3.2
		Insignia	E	0.7
		Medallion		2
		Signature Xtra Stressgard	F	4
		Daconil Ultrex		3.2
		Signature Xtra Stressgard	G	4
		Mirage		1
		Signature Xtra Stressgard	H	4
		Daconil Ultrex		3.2
5	Bayer Program No. 4	Mirage	A	1.5
		Primo Maxx		0.1
		Signature WDG	B	4
		Daconil Ultrex		3.2
		Primo Maxx		0.1
		Mirage	C	1
		Insignia		0.7
		Signature WDG	D	4
		Daconil Ultrex		3.2
		Insignia	E	0.7
		Mirage		1
		Signature WDG	F	4
		Daconil Ultrex		3.2
		Signature WDG	G	4
		Mirage		1
		Signature WDG	H	4
		Daconil Ultrex		3.2
6	Bayer Program No. 5	Mirage	A	1.5
		Primo Maxx		0.1
		Signature WDG	B	4
		Daconil Ultrex		3.2
		Primo Maxx		0.1
		Medallion	C	2
		Insignia		0.7
		Signature WDG	D	4
		Daconil Ultrex		3.2
		Insignia	E	0.7
		Medallion		2
		Signature WDG	F	4
		Daconil Ultrex		3.2
		Signature WDG	G	4
		Mirage		1
		Signature WDG	H	4
		Daconil Ultrex		3.2
7	Affirm		ABCDEFGH	0.88
8	NUP-15014		ABCDEFGH	1.3

9	Rotator		ABCDEFGH	0.5
10	Syngenta Program No. 1	Heritage Action	ACEG	0.4
		Primo Maxx		0.1
		Daconil Action	BDFH	3.5
		Primo Maxx		0.1
11	Syngenta Program No. 2	A22063A	ACEG	0.5
		Heritage Action		0.4
		Primo Maxx		0.1
		Daconil Action	BDFH	3.5
		A22063A		0.5
		Primo Maxx		0.1
12	Syngenta Program No. 3	Velista	ACEG	0.5
		Primo Maxx		0.1
		Daconil Action	BDFH	3.5
		Primo Maxx		0.1
13	Syngenta Program No. 4	Briskway	ACEG	0.7
		Primo Maxx		0.1
		Daconil Action	BDFH	3.5
		Primo Maxx		0.1
14	Syngenta Program No. 5	A14658	ABCDEFGH	6
		Daconil Action		3.5
15	Syngenta Program No. 6	Signature Xtra Stressgard	ABCDEFGH	4
		Daconil Action		3.5
16	Insignia		ACEG	0.7
	Daconil Ultrex			3.2
	Daconil Ultrex		BDFH	3.2
17	UCR 001		ABCDEFGH	--
18	UCR 002		ABCDEFGH	--
19	Torque		ABCDEFGH	1.1
20	UCR 004		ABCDEFGH	--
21	Headway		ABCDEFGH	3
22	UCR 006		CDEFGH	--
23	UCR 007		CDEFGH	--

Application codes / timing:

A – 06/09/2017
B – 06/20/2017
C – 07/04/2017
D – 07/18/2017
E – 08/01/2017
F – 08/15/2017
G – 08/29/2017
H – 09/12/2017

Anthracnose/Summer Patch Fungicide Trial Plot Plan

113 Trt 13	112 Trt 12	111 Trt 11	110 Trt 10	109 Trt 9	108 Trt 8	107 Trt 7	106 Trt 6	105 Trt 5	104 Trt 4	103 Trt 3	102 Trt 2	101 Trt 1
213 Trt 14	212 Trt 15	211 Trt 16	210 Trt 17	209 Trt 18	208 Trt 19	207 Trt 20	206 Trt 21	205 Trt 13	204 Trt 1	203 Trt 8	202 Trt 10	201 Trt 6
313 Trt 14	312 Trt 4	311 Trt 21	310 Trt 7	309 Trt 18	308 Trt 16	307 Trt 11	306 Trt 19	305 Trt 5	304 Trt 12	303 Trt 2	302 Trt 20	301 Trt 3
413 Trt 15	412 Trt 9	411 Trt 17	410 Trt 13	409 Trt 16	408 Trt 8	407 Trt 11	406 Trt 7	405 Trt 20	404 Trt 18	403 Trt 10	402 Trt 14	401 Trt 21
513 Trt 12	512 Trt 19	511 Trt 3	510 Trt 15	509 Trt 6	508 Trt 4	507 Trt 17	506 Trt 5	505 Trt 2	504 Trt 1	503 Trt 9	502 Trt 21	501 Trt 11
613 Trt 7	612 Trt 16	611 Trt 10	610 Trt 1	609 Trt 3	608 Trt 14	607 Trt 18	606 Trt 12	605 Trt 9	604 Trt 6	603 Trt 15	602 Trt 17	601 Trt 8
713 Trt 19	712 Trt 5	711 Trt 13	710 Trt 22						704 Trt 23	703 Trt 20	702 Trt 2	701 Trt 4
813 Trt 23	812 Trt 22	811 Trt 23								803 Trt 22	802 Trt 23	801 Trt 22

→ N

Table 2. Injury [0-100%] caused by fungicides on annual bluegrass turf and effect of treatments on turf quality [1-9, 9 = best] and anthracnose cover [0-100%]. Riverside, CA. 2017.

No.	Treatment	Injury 06/27/2017		Turf quality 08/29/2017		Anthracnose 08/29/2017	
1	Untreated Control	0	G	3.2	DE	56	ABCD
2	Bayer Program No. 1	1	G	5.2	ABCD	29	CDEF
3	Bayer Program No. 2	39	BC	5.8	ABC	15	EF
4	Bayer Program No. 3	25	CDE	5.2	ABCD	24	EF
5	Bayer Program No. 4	55	A	5.5	ABC	24	EF
6	Bayer Program No. 5	45	AB	5.5	ABC	10	EF
7	Affirm	0	G	3.2	DE	60	ABC
8	NUP-15014	16	EF	4.5	ABCD	25	DEF
9	Rotator	0	G	4.0	CDE	24	EF
10	Syngenta Program No. 1	20	DE	6.2	AB	4	F
11	Syngenta Program No. 2	12	EFG	5.8	ABC	16	EF
12	Syngenta Program No. 3	25	CDE	5.0	ABCD	20	EF
13	Syngenta Program No. 4	32	BCD	6.5	A	15	EF
14	Syngenta Program No. 5	0	G	4.0	CDE	31	CDEF
15	Syngenta Program No. 6	0	G	4.0	CDE	21	EF
16	Insignia Daconil Ultrex	0	G	5.8	ABC	16	EF
17	UCR 001	0	G	4.8	ABCD	36	BCDE
18	UCR 002	0	G	4.0	CDE	35	CDEF
19	Torque	11	EFG	4.5	ABCD	18	EF
20	UCR 004	0	G	4.2	BCD	35	CDEF
21	Headway	2	FG	5.5	ABC	6	EF
22	UCR 006	0	G	2.0	E	68	AB
23	UCR 007	0	G	2.0	E	71	A

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

Stop #4a: Evaluation of Fertilizer Products and Formulations on Bermudagrass Turf

Pawel Petelewicz[1], Marco Schiavon[1], Magdalena Poleska[1], Pawel Orlinski[1], Jose Espeleta[2] and Jim Baird[1]
[1]Department of Botany and Plant Sciences,
[2]Department of Agricultural Operations,
University of California, Riverside, CA 92521

Objectives:

This study was conducted to evaluate granular and liquid formulations of products from Anuvia Plant Nutrients alone or in combination with industry standards for longevity and quality on bermudagrass turf maintained as a golf course fairway or athletic field.

Materials and Methods:

The study was conducted on mature 'GN-1' bermudagrass turf mowed 3 days/wk at 0.5 inches. Soil was a Hanford fine sandy loam. Turf received no fertilizer in 2017 before the study began. Fertilizer treatments were initiated on 9 June 2017. Granular treatments were applied twice in 8-wk intervals and liquid formulations were sprayed every 14 days for a total of 8 applications. Liquid treatments were applied using a CO_2-powered backpack sprayer with TeeJet 8004VS nozzles calibrated to deliver 2 gal/1000 ft^2. Experimental design was a randomized block with 4 replications. Plot size was 4 ft x 10 ft with 3-ft alleys. Plots were evaluated for turf quality, NDVI, and DIA every two weeks. Clipping yield was determined every 4 weeks.

Results:

Two weeks after initial application, GreenTRX granular fertilizer and the 50/50 mix of GreenTRX with Signature showed the fastest response in terms of turf quality and NDVI (Table 2). There were no significant differences in turf quality among all treatments during subsequent rating dates with the exception of August 14, when quality of turf treated with 20% Green TRX + 80% GAL-XE ONE 41, LFCO 170304A and UMAXX 46-0-0 decreased significantly in comparison to GreenTRX alone or mixed with Signature. After 4 weeks, NDVI of GreenTRX was significantly lower than in treatments with GAL-XE ONE 41 (both - alone and mixed with Green TRX) and there were no significant differences among the other treatments. No other significant differences were found during other rating dates for turf quality, NDVI, or DIA.

One month after initial application, clipping yield of the GreenTRX treatment was significantly higher compared to Replenish, LFCH 170228A, LFCH 170304A and UMAXX 46-0-0 treatments, but not significantly higher than other treatments containing GreenTRX. Two months later, 20% GreenTRX + 80% GAL-XE ONE 41 treatment provided significantly lower clipping yield than 50% GreenTRX + 50% Signature, but there were no significant differences among the other treatments in comparison to GreenTRX.

Acknowledgments:

Thanks to Anuvia Plant Nutrients, Simplot Partners, Sierra Pacific Turf Supply, and Crop Production Services for supporting this research.

Table 1. Fertilizer treatments applied in study. Riverside, CA. 2017.

Trt	Product	Company	Analysis	Rate (lb N/M)	Total Applications (Frequency)
1	GreenTRX	Anuvia	16-1-2-17S-3Fe	1.5	2 (8 wks)
2	GAL-XE ONE 41 Mini	Simplot	41-0-0	3.0	1
3	20% GreenTRX: 80% GAL-XE ONE 41	Anuvia Simplot	16-1-2-17S-3Fe 41-0-0	3.0	1
4	50% GreenTRX: 50% Signature	Anuvia Loveland	16-1-2-17S-3Fe 40-0-0	1.5	2 (8 wks)
5	Replenish	EarthWorks	10-2-5	1.5	2 (8 wks)
6	LFCH 170228A	Anuvia	8-0-1-7S	0.25	8 (2 wks)
7	LFCO 170304A	Anuvia	8-0-1-7S	0.25	8 (2 wks)
8	UMAXX 46-0-0	Simplot	46-0-0	0.25	8 (2 wks)

Fertilizer granules of both products blended together before application of Treatments 3 and 4.

Plot Plan

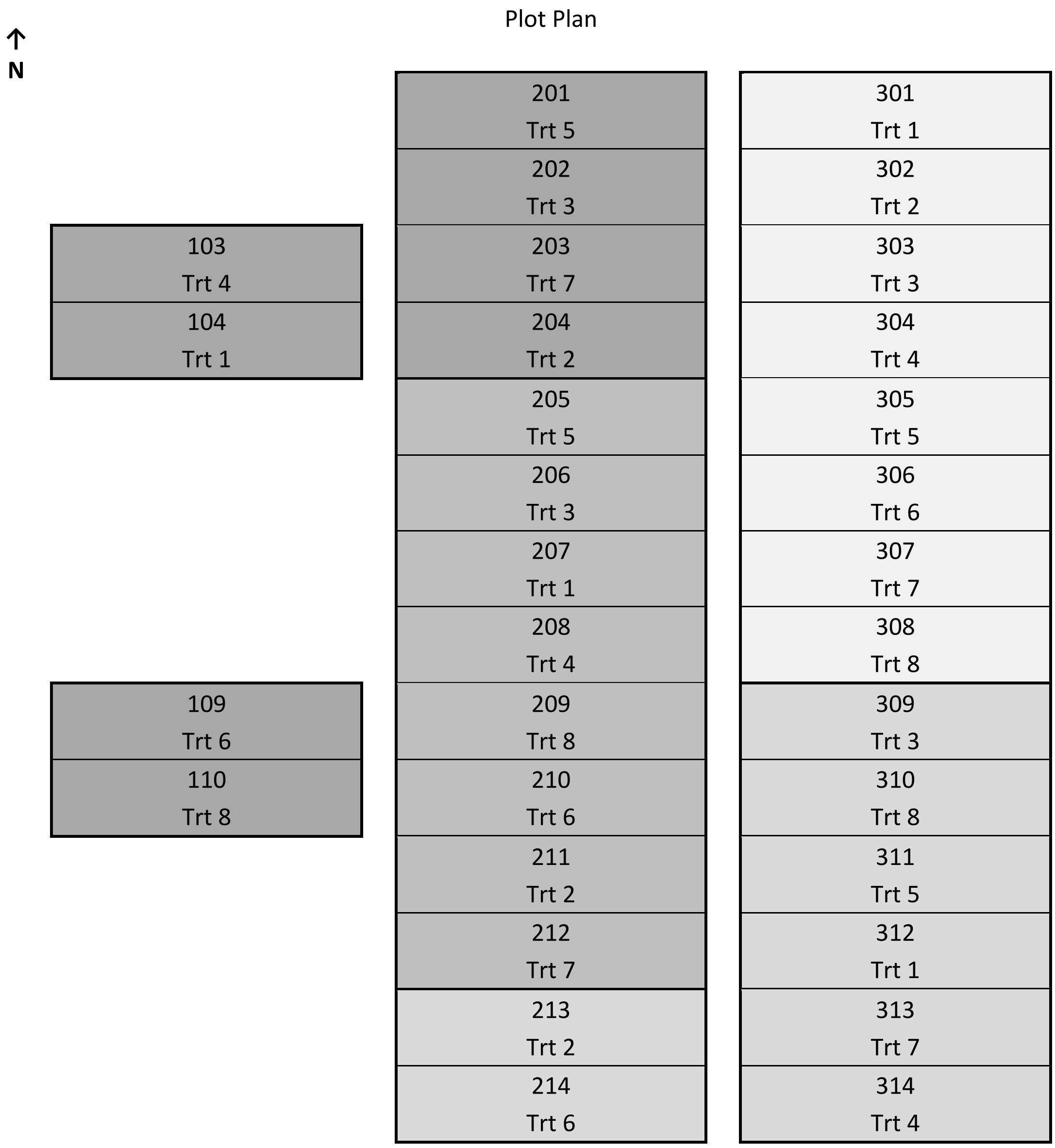


Table 2. Effects of fertilizers on turf quality, clipping yield, and NDVI of bermuda-grass. Riverside, CA. 2017.

No.	Treatment	Turf quality [1-9] 06/19/2017	Turf quality [1-9] 08/14/2017	Clipping yield [g] 07/03/2017	Clipping yield [g] 08/28/2017	NDVI 06/19/2017	NDVI 07/03/2017
1	GreenTRX	6.8 A	7.5 AB	17.4 A	44.5 ABCD	0.77 A	0.69 B
2	GAL-XE ONE 41 Mini	3.8 C	6.5 BC	8.8 AB	31.3 AB	0.72 CD	0.71 A
3	20% GreenTRX: 80% GAL-XE ONE 41	5.5 B	5.8 C	7.8 AB	26.0 D	0.73 C	0.71 A
4	50% GreenTRX: 50% Signature	6.2 AB	7.8 A	7.9 AB	61.4 A	0.77 AB	0.68 BC
5	Replenish	4.2 C	6.8 ABC	5.9 B	56.7 AB	0.74 BC	0.67 C
6	LFCH 170228A	4.0 C	6.5 BC	6.0 B	33.5 BCD	0.69 D	0.68 BC
7	LFCO 170304A	4.2 C	6.2 C	6.8 B	55.9 ABC	0.72 CD	0.68 BC
8	UMAXX 46-0-0	4.0 C	6.2 C	7.3 B	52.9 ABC	0.71 CD	0.68 BC

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

Stop #4b: Postemergence control of *Oxalis* in Bermudagrass Turf

Pawel Petelewicz[1], Marco Schiavon[1], Magdalena Poleska[1], Pawel Orlinski[1],
Jose Espeleta[2] and Jim Baird[1]
[1]Department of Botany and Plant Sciences
[2]Department of Agricultural Operations
University of California, Riverside, CA 92521

Objectives:

This study was conducted to evaluate and determine the potential of various herbicides to control yellow woodsorrel (*Oxalis stricta*) postemergence in bermudagrass turf maintained as a golf course fairway or athletic field.

Materials and Methods:

The study was conducted on mature 'GN-1' bermudagrass turf mowed 3 days/wk at 0.5 inches. Soil was a Hanford fine sandy loam. Turf received no fertilizer in 2017 before the study began. Herbicide treatments were applied on 24 August 2017 using a CO_2-powered bicycle sprayer with TeeJet 8003VS nozzles calibrated to deliver 1 gal/1000 ft^2. Experimental design was a randomized block with 3 replications. Plot size was 7 ft x 10 ft with 4-ft alleys. Plots were evaluated for turf quality, injury to turf and *Oxalis* caused by treatments, and *Oxalis* cover at 4 days, one week, and every two weeks after application.

Results:

Triplet SF, NUP-17033, NUP-16011 and 4speedXT caused a significant decrease in turf quality compared to untreated control 4 days after application and persisted up to one week after spraying (Table 2). Turf recovered from herbicides one week after application except for NUP-16011 and 4speedXT. One week after application, injury to *Oxalis* was greatest from Monument and NUP-16011; however, the extent of *Oxalis* control could not yet be determined for this report.

Acknowledgments:

Thanks to Bayer, NuFarm, and Syngenta for supporting this research.

Table 1. Treatment list for Oxalis herbicide study. Riverside, CA. 2017.

No.	Treatment	Rate	
		oz/A	g/A
1	Untreated Control	-	-
2	Triplet SF	48	-
3	NUP-17033	48	-
4	NUP-16011	28	-
5	4speedXT	48	-
6	Monument	-	15
	NIS	0.25% v/v	
7	Tribute Total	3.2	-
	NIS	0.25% v/v	

Plot Plan:

12 G 1 E Plot Plan

↑**N**

101 Trt 2	201 Trt 2	301 Trt 4
102 Trt 6	202 Trt 4	302 Trt 5
103 Trt 1	203 Trt 3	303 Trt 1
104 Trt 4	204 Trt 5	304 Trt 2
X	205 Trt 7	305 Trt 6
106 Trt 3	206 Trt 1	306 Trt 7
107 Trt 5	207 Trt 3	X
108 Trt 7	208 Trt 6	X

Table 2. Effect of herbicides on turf quality, oxalis cover and injury caused by treatments.

No.	Treatment	Turf quality [1-9] 08/27/2017		Turf quality [1-9] 09/01/2017		Oxalis cover [%] 08/27/2017		Oxalis cover [%] 09/01/2017		Oxalis Injury [%] 09/01/2017		Turf Injury [%] 09/01/2017	
1	Untreated Control	5.3	A	6.3	A	37	A	33	A	0	B	2	BC
2	Triplet SF	4.0	BCD	4.0	CD	23	A	27	A	25	AB	13	B
3	NUP-17033	3.7	CD	4.7	BC	30	A	22	A	25	AB	13	BC
4	NUP-16011	3.0	D	3.0	D	38	A	35	A	33	A	28	A
5	4speedXT	3.0	D	3.0	D	35	A	33	A	30	AB	27	A
6	Monument + NIS	5.0	AB	6.3	A	28	A	32	A	40	A	1	C
7	Tribute Total + NIS	4.3	ABC	5.7	AB	30	A	28	A	28	AB	7	BC

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

Stop #5: Management of Salinity and Rapid Blight Disease on Annual Bluegrass Putting Greens

Marco Schiavon, Pawel Petelewicz, Antonio Verzotto, Magdalena Poleska,
Pawel Orlinski and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside, CA 92521

Objectives:

1) To evaluate the efficacy of products on a *Poa annua* green to reduce stress caused by irrigation with saline water.
2) To evaluate which treatments can effectively control rapid blight disease under saline conditions.

Methods:

A new 5,400-ft^2 research putting green was constructed in 2017. Rootzone was comprised of 8 inches of sand/peat/soil with physical properties conforming to USGA recommendations, but simulating a mature putting green with minimum suggested infiltration rate. *Poa* annua was established in the spring using aeration cores from Mesa Verde Country Club in Orange County. Once established, turf was mowed at 0.110 inches 5 times/week using Baroness walk mower, rolled weekly, topdressed monthly with sand, and received 0.125 lbs N/M and Primo Maxx at 0.125 oz/M every two weeks. Starting on June 23, plots were irrigated with saline water (2.0 dS/m) at 100%ET replacement. The 60' x 90' area was divided into six 30' x 30' areas. Two irrigation methods were replicated 3 times inside the study area:

a) Frequent shallow irrigation: plots are irrigated every day; on Friday plots will be watered with higher volumes in order to simulate a weekly "light flushing".
b) Irrigation on Mon-Wed-Fri.

Salinity is leached when ECe in the last treatment in one replication will reach 2.0 dS/m. Every two weeks, plots were evaluated for turf quality on a scale from 1 = worst to 9 = best, volumetric soil water content (VWC) and soil Electrical Conductivity (EC_e) using POGO, and Naturalized Difference Vegetation Index (NDVI) and Dark Green Color Index (DGCI) using Digital Image Analysis (DIA). Leachate is also collected and analyzed for electrical conductivity (EC_L) on the same day. In addition, disease cover, turf quality, turf cover and turf injury ratings were taken for Rapid Blight treatments on a weekly basis. Also, NDVI, DIA, VWC and EC_e (both using POGO) are taken on this part of trial, but on a biweekly basis.

Treatments were applied by hand or using a calibrated CO_2 boom sprayer (TeeJet 8004VS nozzles; 2 gal/1000 ft^2). Treatments for salinity alleviation trial were watered in with over 1 cm of water immediately following application. Therefore, application of salinity alleviation treatments was rotated every other week with rapid blight treatments starting at the onset of saline irrigation. For treatment lists, see tables on next page.

Results:

During the first month of the study a significant amount of *Poa* was lost due to drought stress from high temperatures and ET rates, and before irrigation volumes were increased to 130%ET replacements. Neither salinity nor rapid blight was responsible for initial loss of *Poa*. Irrigation regime had a greater effect on *Poa* quality and soil salinity, with deep, infrequent irrigation performing better at the beginning of the study, but rapidly losing quality while ECe was increasing, and being surpassed by shallow irrigation without leaching (Figs. 1 and 2). Treatment did not have a significant impact on turf quality improvement thus far although highest quality was achieved by DeSal+StressRx+XPMicro and Nutrimend+Komodo Pro (Table 1).

Given initial turf loss due to drought stress, it was difficult to determine if turf thinning/loss was due to rapid blight disease. However, turf quality and cover results suggest that the disease might be active (Table 3). These data and data collected on September 10 (data not shown) indicate highest turf quality and cover from A19188A, Lexicon, Velista and Secure, and Velista. Lowest quality and cover were observed in the untreated control. Lexicon is known to provide effective control of Rapid Blight. In addition, studies conducted by UCR in Northern California in 2014 and 2015 demonstrated that A19188A, Velista, and Secure were also effective against Rapid Blight disease. Confirmation of the causal agent of Rapid Blight (*Labyrinthula terrestris*) is pending.

Acknowledgments:

Thanks to Aquatrols, Grigg Brothers, Ocean Organics, Solutions 4Earth, BASF, Bayer, NuFarm, Syngenta, Mesa Verde Country Club, P.W. Gillibrand Co., Inc., Golf Course Superintendents Association of Southern California, and the California Turfgrass & Landscape Foundation (CTLF) for supporting this research.

Table 1. Treatments evaluated for alleviation of salinity stress. Riverside, CA. 2017.

No.	Treatment	Company	Rate	Frequency (wks)	Quality (Overall)
1	Untreated Control	--	--	--	5.5
2a	UMAXX	-	0.02 lb/M	2	5.4
2b	Revolution	Aquatrols	6 oz/M	4	
3	Megalex (3-0-0)	Grigg Brothers	7.3 oz/M	2	5.7
4a	Safe Zone (0-0-13)	Grigg Brothers	1 gal/A	4	5.1
4b	Aqua Pam		2 gal/A	4	
5	Nutricor (5-4-4)	Solutions 4Earth	15 fl oz/M	1	5.6
6a	NutriMend (10-3-0)	Solutions 4Earth	16 fl oz/M	1	6.1
6b	Komodo Pro (0-0-16)		8 fl oz/M	1	
7a	NutriMend (10-3-0)	Solutions 4Earth	16 fl oz/M	2	5.6
7b	Komodo Pro (0-0-16)		8 fl oz/M	2	
8a	DeSal	Ocean Organics	0.75 oz/M	2	6.1
8b	StressRx		6 oz/M	2	
8c	XP Micro		6 oz/M	2	
9a	DeSal	Ocean Organics	0.25 oz/M	2	5.7
9b	StressRx	Aquatrols	6 oz/M	2	
9c	XP Micro		6 oz/M	2	
9d	EXP SF1		6 oz/M	2	
10a	UCR001	--	3.5 oz/M	2	5.3
10b	UCR002		6 oz/M	2	
11a	UCR003	--	1.2 oz/M	2	6.0
11b	UCR002		6 oz/M	2	
11a	UCR001	--	0.56 oz/M	2	5.2
11b	UCR002		6 oz/M	2	
11c	UCR003		3.5 oz/M	2	

Treatment 1 in salinity alleviation trial treated with 2-week rotation of treatments 18 and 23 from Rapid Blight trial (below).

Table 2. Fungicide treatments evaluated for Rapid Blight control. Riverside, CA. 2017.

No.	Treatment	Rate (oz/M)	Frequency (wks)
13	Untreated Control	-	-
14	JR1	3	2
	JR2	0.366	2
15	JR1	3	2
	JR2	0.366	2
	Compass	0.2	2
16	JR1	6	2
	JR2	0.732	2
17	JR1	6	2
	JR2	0.732	2
	Compass	0.2	2
18	Lexicon	0.34	2
19	Affirm	0.88	2
20	NUP-15014	1.3	2
21	Rotator	0.5	2
22	Velista	0.7	2
23	Velista	0.5	2
	Secure	0.5	2
24	A19188A	1	2

Plot Plan

N ↑

12 F 4 Application Map

Rep 1, 2

A

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

B

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

Rep 3, 1

C

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

D

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

Rep 2, 3

E

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

F

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

Figure 1. Quality of plots watered either every day (shallow irrigation), or only 3 times per week (deep, infrequent irrigation) with saline water. Riverside, CA. 2017.

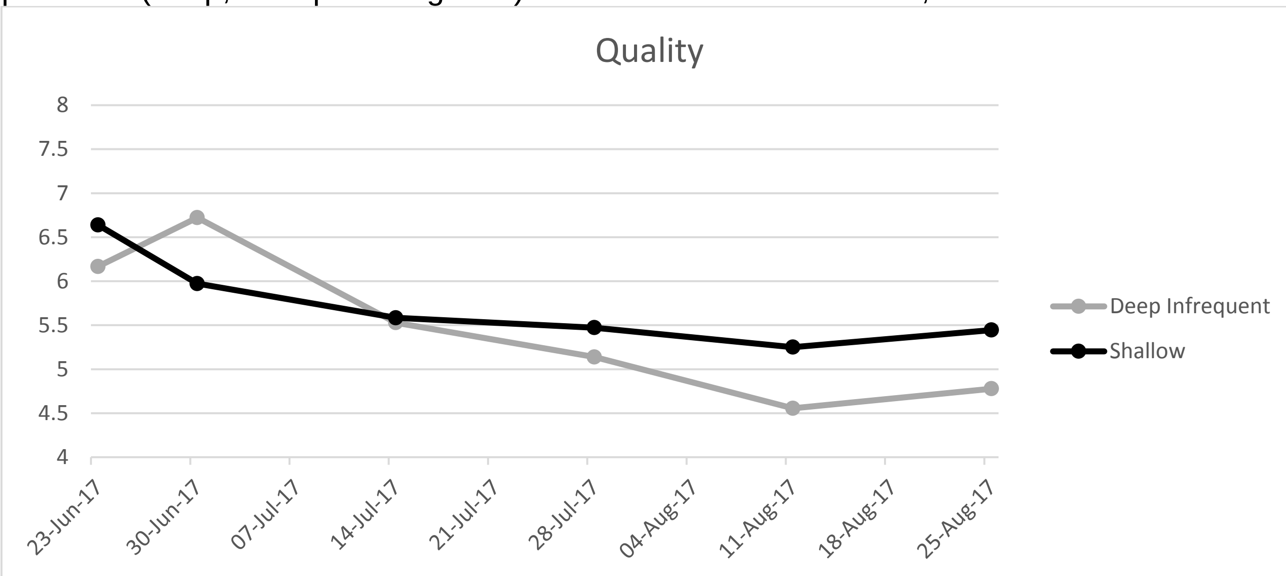


Figure 2. Soil Electrical Conductivity (ECe) of plots watered either every day (shallow irrigation), or only 3 times per week (deep, infrequent irrigation) with saline water. Riverside, CA. 2017.

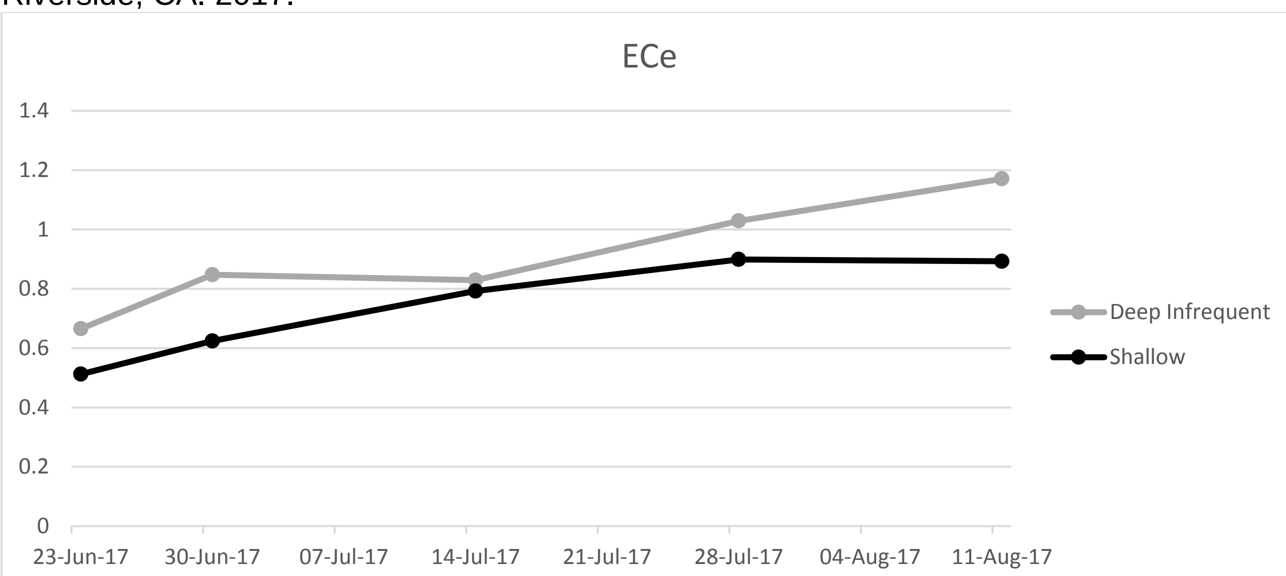


Table 3. Effects of fungicides on turf quality [1-9] and turf cover [%] on a Poa annua putting green irrigated with saline water. Riverside, CA. 2017.

No.	Treatment	Turf quality [1-9] 08/22/2017		Turf cover [%] 08/22/2017	
1	Untreated Control	2.67	B	51.83	ABC
2	JR1 (3 oz/M) JR2 (0.366 oz/M)	3.17	AB	74.17	AB
3	JR1 (3 oz/M) JR2 (0.366 oz/M) Compass (0.2 oz/M)	3.17	AB	61.67	ABC
4	JR1 (6 oz/M) JR2 (0.732 oz/M)	2.83	B	40.83	C
5	JR1 (6 oz/M) JR2 (0.732 oz/M) Compass (0.2 oz/M)	3.17	AB	50.83	BC
6	Lexicon (0.34 oz/M)	4.00	AB	80.83	AB
7	Affirm (0.88 oz/M)	3.00	AB	61.00	ABC
8	NUP-15014 (1.3 oz/M)	2.67	B	57.50	ABC
9	Rotator (0.5 oz/M)	3.50	AB	73.33	AB
10	Velista (0.7 oz/M)	3.67	AB	65.00	ABC
11	Velista (0.5 oz/M) Secure (0.5 oz/M)	3.50	AB	75.83	AB
12	A19188A (1 oz/M)	4.33	A	81.67	A

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

Kurapia Groundcover Frequently Asked Questions

What is Kurapia?

Kurapia [*Phyla (Lippia) nodiflora*) is a low growing, herbaceous, perennial dicot groundcover belonging to the Verbenaceae or Verbena family. Although the species is either native or naturalized to California, Kurapia is a sterile, non-invasive, cultivar from Japan, which is propagated vegetatively by plugs or creeping stems (stolons) only. Kurapia's dense canopy and deep root system provide excellent drought tolerance and soil stabilization even on steep slopes. It is also tolerant of a wide range of soil conditions including salinity, but generally prefers sandy, well-drained soils. Kurapia reaches a maximum height of 3 to 6 inches and produces numerous small, white flowers from spring to late summer. As a result, mowing is not required. However, regular mowing with a rotary or reel mower as low as 2 inches can be used to minimize flowering. Kurapia can tolerate partial shade and light traffic when maintained either non-mowed or mowed similar to a lawn; however, it is not recommended for use under intensive, concentrated traffic. Kurapia is adapted to climate zones of 7b and higher. In regions where average daily temperatures remain above 45 °F, Kurapia will stay evergreen; however, growth will gradually decrease and enter dormancy when average daily temperatures fall to around 38 °F. Kurapia has been known to survive temperatures as low as 13 °F. These temperatures are provided as estimates, as Kurapia greenness, dormancy, and survival will depend upon specific location and environmental factors.

Where can I buy Kurapia?

Kurapia can be purchased as plugs or sod.

Plugs:

Florasource, Ltd.
P.O. Box 758 San Clemente, CA 92674
Tel: 949-498-1131
http://www.kurapiaplugs.com/

EcoTech Services, Inc
2143 S. Myrtle Ave., Monrovia, CA 91016
Tel 626-788-5652
http://www.kurapiadirect.com/

EcoLawn S. B.
2409 Calle Soria
Santa Barbara, CA 93109
Tel: 805-270-2960
http://ecolawnsb.com/
Limited to Santa Barbara County only.

Sod:
West Coast Turf
PO Box 4563
Palm Desert, CA 92261
Tel: 760-340-7300
https://www.westcoastturf.com/Kurapia-Drought-Tolerant-Ground-Cover

Delta Bluegrass Company
PO Box 307, Stockton, CA 95201
Tel: 209-969-4679
http://www.deltabluegrass.com/kurapia-new

Are different cultivars available?
Currently, only one cultivar is commercially available; however, additional cultivars, one that produces pink flowers and another with greater cold tolerance, will be available soon.

How much water does Kurapia need?
Kurapia has similar water requirements as most warm-season turfgrasses (i.e., approx. 50-60% replacement of evapotranspiration (ET). Once established, Kurapia will survive with even less water depending on aesthetic preference, requiring irrigation once a week or longer depending on temperature and ET. In general, Kurapia does not like wet feet. In other words, avoid excessive irrigation. On the other hand, establishment of Kurapia or any drought tolerant plant species is not the time to withhold water. Thus light, frequent irrigation is warranted during the establishment period.

Is Kurapia susceptible to diseases?
In general, California's climate is not conducive to frequent disease activity. However, occasionally the combination of heat and humidity coupled with frequent or heavy irrigation can incite various soil-borne fungal diseases in Kurapia including southern blight and *Pythium*. The best prevention is to avoid over irrigation, especially when Kurapia establishes into a dense canopy. If a fungicide application is needed, a product like Heritage (azoxystrobin) fungicide should provide effective disease control.

How do I control weeds in Kurapia?
In general, weeds are best controlled preventatively using preemergence herbicides like prodiamine, metolachlor, or pronamide at planting or in August-September (winter annuals) and January-February (summer annuals). Sedge (and some broadleaf and grass weeds) can be controlled using halosulfuron, sulfosulfuron, or trifloxysulfuron on mature Kurapia; however, Kurapia disruption of flower production and foliar injury can be expected. Postemergence broadleaf weed control is challenging given that Kurapia is a broadleaf species. Three-way mixes containing 2,4-D, MCPP, and dicamba will cause considerable injury to Kurapia flowers and foliage, but the groundcover will recover in time. Postemergence grass control can be achieved with products containing fluazifop or sethoxydim.

Stop #6: Kurapia Groundcover Tolerance to Homeowner Accessible Herbicides

Pawel Orlinski and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside, CA 92521

Objectives:

Kurapia tolerance to various herbicides has been tested by UCR and the University of Arizona Cooperative Extension. In general, the best and safest weed control in this groundcover is accomplished using preemergence herbicides, specifically metolachlor (e.g., Pennant Magnum), prodiamine (e.g., Barricade), pronamide (e.g., Kerb). This study focused on evaluating products and active ingredients that are accessible to homeowners.

Materials and Methods:

Nine different herbicides were tested on mature Kurapia established in 2015. Soil was a Hanford fine sandy loam. Treatment list is presented in Table 1. Herbicides were applied using a CO_2-powered backpack sprayer with TeeJet 8002VS nozzles calibrated to deliver 1 gal/1000 ft^2. Herbicides were mixed at the 1/2x rate and sprayed 1, 2 (x rate), or 3 (1.5x rate) times representing 3 separate treatments. In the case of Sedge Killer and Sedgehammer+, which are pre-mixtures, treatments were sprayed 1 (x rate), 2 (2x rate), or 3 (3x rate) times. Experimental design was a randomized block with 3 replications. Plot size was 4 ft x 6 ft with 4-ft alleys. Plots were evaluated for flowering (%), green cover (%) and injury (%). Ratings were made at 0, 4, 6, and 8 days after treatment (DAT) before publication of this report.

Results:

Herbicide used was statistically significant in case of all measured traits whereas number of passes over plots was not. Gradual changes of evaluated parameters were observed over time. Almost all of herbicides except for Grass Getter and Fusilade II caused loss of flowers compared to control within 4 DAT. Two of the herbicides lead to browning and loss in green color of plants (Nutsedge Killer and Roundup for Lawns). Both WeedBGone herbicides (Weed Killer and Crabgrass Control) caused yellowing of the plants. Among sedge herbicides only Sedgehammer+ and Monument caused complete loss of flowers with no other effects within 8 DAT. Results are presented in Table 2.

Preliminary results suggest that products containing sulfentrazone are too injurious to Kurapia and thus are not recommended. For grass control, products containing fluazifop or sethoxydim are very safe on Kurapia. For sedge control, it is too early to tell which is safest among Sedgehammer, Certainty, and Monument. An earlier study conducted on newly established Kurapia at UCR found that Sedgehammer was more injurious than

Certainty; however, researchers at the University of Arizona found that both Sedgehammer and Certainty were safe on Kurapia that was likely more established compared to our earlier trial.

Table 1. List of treatments applied in the Kurapia herbicide tolerance study. Riverside, CA. 2017.

Treatment number	Herbicide	Active ingredient(s)	Rate
1	Control	-	-
2	Roundup for Lawns	MCPA + Quinclorac + Dicamba + Sulfentrazone	0.5 x
3			x = 6.4 oz/M
4			1.5 x
5	WeedBGone Weed Killer	Dicamba + 2,4-D + Mecoprop-p	0.5 x
6			x = 4 oz/M
7			1.5 x
8	WeedBGone Crabgrass Control	Quinclorac + Dicamba + 2,4-D	0.5 x
9			x = 6.4 oz/M
10			1.5 x
11	Nutsedge Killer	Sulfentrazone	x = Premix
12			2 x
13			3 x
14	Sedgehammer+	Halosulfuron-methyl	x = 0.5 oz/M
15			2 x
16			3 x
17	Certainty + NIS 0.25% v/v	Sulfosulfuron	0.5 x
18			x = 0.75 oz/A
19			1.5 x
20	Monument + NIS 0.25% v/v	Trifloxysulfuron sodium	0.5 x
21			x = 10 g/A
22			1.5 x
23	Grass Getter + MSO 0.25% v/v	Sethoxydim	0.5 x
24			x = 0.6 oz/M
25			1.5 x
26	Fusilade II + NIS 0.25% v/v	Fluazifop-P-butyl	0.5 x
27			x =24 oz/A
28			1.5 x

NIS – Non-ionic surfactant; MSO – Methylated seed oil

Table 2. Effects of herbicides on flowering, green cover, and injury of Kurapia plants. Riverside, CA. 2017.

Herbicide	Rate	Flowering %						Green cover %						Visual injury %					
		0 DAT		4 DAT		8 DAT		0 DAT		4 DAT		8 DAT		0 DAT		4 DAT		8 DAT	
Control	0	93	ab	95	a	97	a	97	a	98	a	100	a	0	a	0	a	0	a
Roundup for Lawns	0.5x	65		0		0		98		77		80		0		23		14	
	1x	70	ab	0	c	0	c	98	a	72	b	63	b	2	a	28	d	21	cd
	1.5x	56		0		0		100		42		35		0		62		48	
WeedBGone Weed Killer	0.5x	90		0		0		100		98		100		1		2		8	
	1x	85	a	0	c	0	c	100	a	98	a	80	a	0	a	7	ab	20	bc
	1.5x	88		0		0		100		100		82		0		10		26	
WeedBGone Crabgrass Control	0.5x	67		0		0		98		100		92		0		3		13	
	1x	77	a	0	c	0	c	98	a	100	a	93	a	0	a	0	ab	10	ab
	1.5x	100		0		0		100		99		100		0		1		6	
Nutsedge Killer	1x	65		2		0		95		25		17		0		68		74	
	2x	70	ab	1	c	0	c	100	a	4	c	5	c	0	a	64	e	94	e
	3x	78		0		0		100		8		3		0		92		94	
Sedgehammer +	1x	70		41		0		95		96		100		0		2		1	
	2x	67	ab	16	c	0	c	99	a	100	a	100	a	1	a	0	a	0	a
	3x	60		7		0		98		97		96		0		0		0	
Certainty	0.5x	53		19		13		100		100		98		0		0		0	
	1x	88	a	53	bc	4	c	98	a	97	a	98	a	0	a	0	a	0	a
	1.5x	88		40		2		100		98		99		0		2		0	
Monument	0.5x	87		28		0		100		100		100		0		0		0	
	1x	62	ab	19	c	0	c	100	a	100	a	100	a	0	a	0	a	1	a
	1.5x	63		7		0		100		97		100		0		0		1	
Grass Getter	0.5x	68		58		87		98		100		100		0		0		0	
	1x	72	a	77	ab	98	a	98	a	98	a	100	a	0	a	0	a	0	a
	1.5x	95		97		98		100		100		100		0		0		0	
Fusilade II	0.5x	53		60		72		100		100		100		0		0		0	
	1x	90	ab	88	ab	99	a	100	a	100	a	100	a	0	a	0	a	0	a
	1.5x	67		66		72		100		98		97		0		2		1	

Means followed by the same letter for a trait (e.g., flowering %) are not significantly different (P=0.05).

Stop #7a: Remote Sensing and Evapotranspiration (ET) Replacement Strategies for Turf Irrigation

Pawel Petelewicz[1], Marco Schiavon[1], Antonio Verzotto[1], Magdalena Poleska[1], Pawel Orlinski[1], Jose Espeleta[2] and Jim Baird[1]
[1]Department of Botany and Plant Sciences
[2]Department of Agricultural Operations
University of California, Riverside

Background and Justification:

Irrigation scheduling is determining when and how much to irrigate. This is especially important in arid and semi-arid environments where rainfall is scarce and water resources are precious. The old adage of irrigating 10-15 minutes every night is often neither good for water conservation nor desirable for turf health and playability. Instead, most professional turf managers rely on evapotranspiration (ET), soil moisture, and or plant-based information (e.g., reflectance using NDVI) to schedule irrigation. At UCR, much of our turfgrass water conservation research is based on scheduling irrigation to replace a percentage of reference evapotranspiration (ETo) as determined by a California Irrigation Management Information System (CIMIS) weather station located at the UCR Turfgrass Research Facility.

EYEON18 is a technology service company that helps golf course management increase water efficiency and improve playing conditions. Their agriculture drone utilizes multi-spectral capabilities to deliver NDVI and high-resolution visible light images in unison. The dual imagery combined with soil moisture data allow turf managers to quickly evaluate turf growth habits and patterns over large areas. EYEON18 comprises 60+ years of turf management experience paired with a robust fixed-wing platform that can fly up to 800 acres per hour and the average golf course in 20 minutes.

This summer UCR teamed up with EYEON18 to help execute a grant from the Metropolitan Water District to study the water saving capability of their remote sensing system. EYEON18 flew a total of 8 flights over the entire UCR Agricultural Operations research station at the altitude of 300 feet with each mission lasting 19 minutes and covering 409 acres per flight. This study was conducted to help calibrate and compare data collected using EYEON18 technology as well as typical ground level data collected in our turfgrass research program. Three different irrigation strategies were employed to provide a range of irrigation amount (Table 1). The overall objective of this preliminary ongoing research is utilizing these irrigation scheduling technologies to produce the highest turf quality with the least possible consumption of water.

Materials and Methods:

The study was conducted on ‘Tifway II’ bermudagrass established from sod on 27 April 2017. Soil was a Hanford fine sandy loam. Turf received 0.5 lb N/1000 ft^2 every 6 weeks for a target of 5 lbs N/1000 ft^2/yr. Mowing height was 0.5 inches (3 days/wk). Irrigation treatments were initiated on 17 July 2017 and weekly irrigation budgets were divided into 3 events (days) per week by hand watering with a hose/nozzle with a known output (gpm).

Plots were evaluated at ground level for turf quality, volumetric water content (POGO), NDVI (Green Seeker), and using digital image analysis (DIA) every week. Experimental design was a randomized block with 3 replications of irrigation treatments. Individual plots were 20’ x 20’.

EYEON18 flew a total of 8 weekly flights over the entire research station at the altitude of 300 feet with each mission lasting 19 minutes and covering 409 acres per flight. Volumetric water content was recorded within each plot during each flight.

Results:

Table 2 shows the relative amounts of water applied to the turf relative to ETo over the course of an 8-wk period. Irrigating 1.5 inches of water/wk, analogous to frequent irrigation without much regard for irrigation scheduling technology, resulted in ca. 104%ETo replacement on average. In comparison to UCR recommendations of weekly replacement of 75%ETo for bermudagrass turf in Riverside, variable ETo replacement on a weekly basis resulted in ca. 78%ETo averaged over the 8-wk period.

Visual turf quality, volumetric soil moisture, and NDVI determined at ground level by UCR personnel revealed only a few minor differences among the three levels of irrigation (Tables 3-5). Although soil moisture increased and at times turf quality and NDVI were numerically higher in plots receiving the most irrigation, these results demonstrate that 75%ETo was sufficient to maintain turf quality.

With EYEON18 imagery, nuances in plant vigor are distinguishable to the sub-meter level across the entire area of interest (Fig. 1). EYEON18’s goal is to identify patterns from the imagery and assist turf managers with tuning their irrigation systems. Detailed analysis of NDVI results and comparisons to the UCR data is in progress.

Acknowledgments:

Thanks to EyeON18, MWD of Southern California, and CTLF for supporting this research. We appreciate assistance from Sofia Koutzoukis and Holly Andrews who served as UC Pilots in Command during flights.

Table 1. Irrigation treatments employed on bermudagrass turf. 2017. Riverside, CA.

No.	Irrigation Treatments
1	0.65-0.9% Variable ETo replacement (previous wk ETo)
2	75% ETo replacement (previous wk ETo)
3	1.5 inch of water/wk

Table 2. Previous weekly reference evapotranspiration (Eto) and weekly water consumption (inches and gallons) for the three irrigation treatments on bermudagrass turf. 2017. Riverside, CA.

Week	Week starting date	Previous weekly CIMIS ET_0	Variable ETo Replacement	75% ETo Replacement	1.5 inches of water / week	Variable ETo Replacement	75% ETo Replacement	1.5 inches of water / week
			---------- inches ----------			------------ gallons ------------		
1st	7/19/2017	1.7	1.3	1.3	1.5	322	322	374
2nd	7/27/2017	1.6	1.2	1.2	1.5	290	290	374
3rd	8/03/2017	1.1	0.8	0.8	1.5	201	201	374
4th	8/10/2017	1.4	1.0	1.0	1.5	252	252	374
5th	8/17/2017	1.6	1.3	1.2	1.5	323	307	374
6th	8/24/2017	1.4	1.2	1.0	1.5	304	258	374
7th	8/31/2017	1.2	1.1	0.9	1.5	270	224	374
8th	9/06/2017	1.5	1.2	1.2	1.5	286	286	374
Total		**11.5**	**9.1**	**8.6**	**12**	**2248**	**2140**	**2992**

Table 3. Visual turf quality (1-9, 9 = best) in response to three levels of irrigation on bermudagrass turf. 2017. Riverside, CA.

No.	7/19	7/27	8/3	8/10	8/17	8/24	8/31
1	7.0 A	7.3 A	7.7 A	7.0 B	7.0 A	6.3 A	6.7 A
2	7.3 A	7.3 A	7.3 A	7.3 AB	7.3 A	6.7 A	6.3 A
3	7.3 A	7.3 A	7.7 A	8.0 A	7.0 A	6.3 A	6.3 A

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

Table 4. Volumetric soil moisture (0-100%) as determined by a POGO instrument in response to three levels of irrigation on bermudagrass turf. 2017. Riverside, CA.

No.	7/27	8/3	8/10	8/17	8/24	8/31
1	19.9 A	24.5 A	18.3 B	24.0 A	22.4 A	21.1 A
2	21.3 A	24.7 A	21.0 AB	24.7 A	20.8 A	20.9 A
3	19.2 A	27.1 A	22.3 A	27.0 A	24.4 A	23.8 A

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

Table 5. NDVI spectral canopy reflectance (0-1) as determined by a Green Seeker instrument in response to three levels of irrigation on bermudagrass turf. 2017. Riverside, CA.

No.	7/27	8/3	8/10	8/17	8/24	8/31
1	0.75 A	0.74 AB	0.72 B	0.68 A	0.67 A	0.70 B
2	0.75 A	0.73 B	0.73 AB	0.67 A	0.67 A	0.72 AB
3	0.76 A	0.75 A	0.74 A	0.69 A	0.69 A	0.73 A

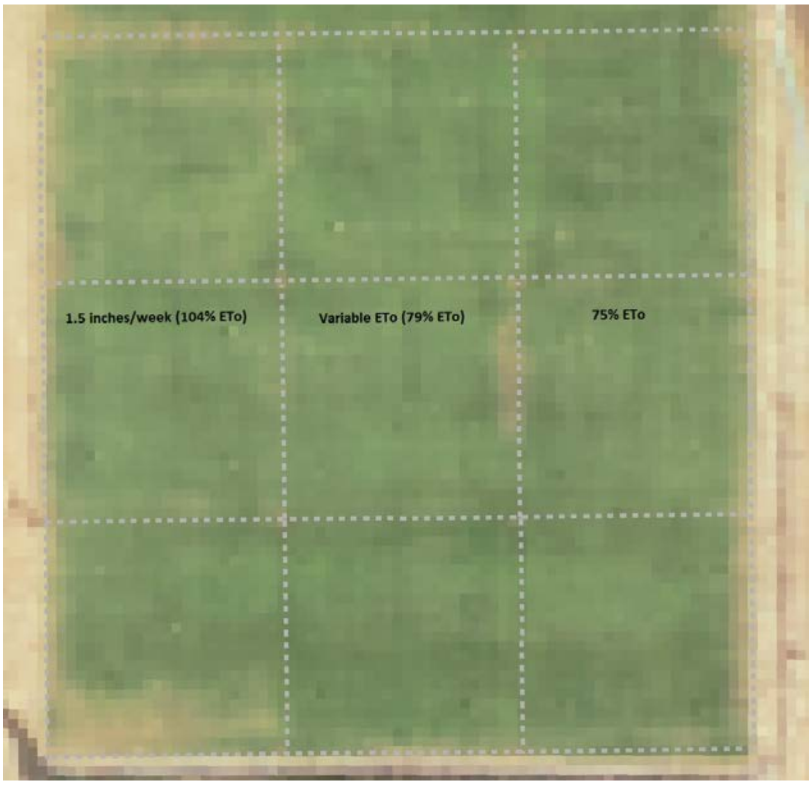
Means followed by the same letter in a column are not significantly different (P=0.05).

<u>Plot plan:</u>

12 E 10 S Plot Plan / Irrigation Map

↑**N**

101 Irrig. No. 1	102 Irrig. No. 2	103 Irrig. No. 3
201 Irrig. No. 3	202 Irrig. No. 1	203 Irrig. No. 2
301 Irrig. No. 2	302 Irrig. No. 3	303 Irrig. No. 1



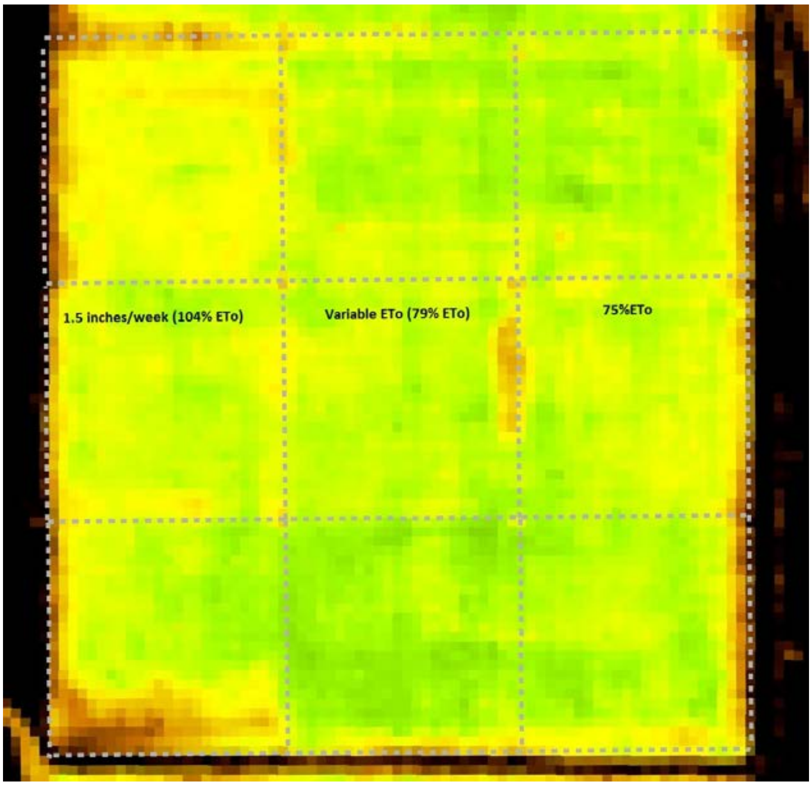


Figure 1. Visible red, green, blue (RGB) high density (HD) image (above) and Normalized Difference Vegetative Index (NDVI) image (below) of the irrigation study area at the UCR Turfgrass Research Facility in Riverside on 6 September 2017 captured by the EYEON18 drone at an altitude of 300 feet with a pixel size of 1.47 cm georeferenced.

Stop #7b: Evaluation of Plant Growth Regulators (PGRs) on Bermudagrass and Seashore Paspalum Turf

Pawel Petelewicz[1], Marco Schiavon[1], Magdalena Poleska[1], Pawel Orlinski[1], Antonio Verzotto[1], Jose Espeleta[2] and Jim Baird[1]
[1]Department of Botany and Plant Sciences
[2]Department of Agricultural Operations
University of California, Riverside

Objectives:

This study is conducted to quantify effects of several plant growth regulators (PGRs) on growth regulation, injury and visual turfgrass quality on bermudagrass and seashore paspalum maintained as a golf course fairway or athletic field. The effects of Primo Maxx and Anuew PGRs on bermudagrass quality under deficit irrigation regime were also evaluated.

Materials and Methods:

The studies were conducted on 'Tifway II' bermudagrass established from sod on 27 April 2017 and on 'Platinum' seashore paspalum established from sod in 2015. Soil was a Hanford fine sandy loam. Turf received 0.5 lb N/1000 ft^2 every 6 weeks for a target of 5 lbs N/1000 ft^2/yr. Mowing height was 0.5 inches (3 days/wk). Irrigation treatments were initiated on 17 July 2017 and weekly irrigation budgets (55% or 80% ET_o) were divided into 3 events (days) per week by hand watering with a hose/nozzle with a known output (gpm).

Plant growth regulators were applied every 3 weeks starting on 21 July 2017. Treatments were applied using a CO_2-powered backpack sprayer with TeeJet 8002VS nozzles calibrated to deliver 1 gal/1000 ft^2. Experimental design was a randomized block with 3 or 4 replications. Plot size was either 4 ft x 6 ft or 4 ft x 8 ft with alleys. Plots were evaluated for turf quality and injury every week on well-watered bermudagrass and seashore paspalum and every 2 weeks on bermudagrass subjected to deficit irrigation. Volumetric water content, NDVI ratings and photos for DIA were taken every two weeks. Clipping yield samples were harvested the day before treatments were applied.

Results:

One-week after initial application of PGRs on bermudagrass grown under optimal irrigation conditions, only Primo Maxx significantly decreased turf quality in comparison to the untreated control (Table 4). However, quality of turf treated with Primo Maxx was highest among all other treatments by September 1. On the same date the only treatment causing turf quality significantly lower compared to the untreated control was Trimmit (22 oz/A). In terms of turf injury, both Primo Maxx and Anuew (16 oz/A) caused slight but significant injury after the initial application, but injury was short-lived. No significant differences in growth reduction among treatments have been observed thus far.

No significant differences in bermudagrass quality have been found thus far with either Primo Maxx or Anuew under deficit irrigation (Table 5). Similar to well-watered bermudagrass, both Primo Maxx and the higher rate of Anuew caused slight but short-lived injury at the onset of the experiment.

On seashore paspalum, only Anuew caused a significant decrease in turf quality in comparison to untreated control one week after initial application. However, on September 1, all PGR treatments showed significantly higher turf quality than the untreated control. Still, no significant differences in quality among PGR treatments have been observed on this species so far (Table 6). Primo Maxx, Anuew (16 oz/A), and Cutless MEC (49.2 oz/A) caused significant turf injury on August 9, but no significant differences were observed for turf injury at the most recent rating. Like bermudagrass, no significant differences in growth reduction among treatments have been observed thus far.

<u>Acknowledgements:</u>

Thanks to SePro, Syngenta, and NuFarm for supporting this research.

Table 1. Treatment list for bermudagrass trial (80% ET_0 replacement). Riverside, CA. 2017.

No.	Treatment	Rate (oz/A)	Timing
1	Untreated Control	-	ABCDE
2	Cutless MEC (12.3 oz/A)	12.3	ABCDE
3	Cutless MEC (18 oz/A)	18	ABCDE
4	Primo Maxx (11 oz/A)	11	ABCDE
5	Anuew (8 oz/A)	8	ABCDE
6	Anuew (16 oz/A)	16	ABCDE
7	Trimmit (16 oz/A)	16	ABCDE
8	Trimmit (22 oz/A)	22	ABCDE

Table 2. Treatment list for bermudagrass trial (55% ET0 replacement). Riverside, CA. 2017.

No.	Treatment	Rate (oz/A)	Timing
1	Untreated Control	-	ABCDE
2	Anuew (8 oz/A)	8	ABCDE
3	Anuew (16 oz/A)	16	ABCDE
4	Primo Maxx (11 oz/A)	11	ABCDE

Table 3. Treatment list for seashore paspalum trial (80% ET_0 replacement). Riverside, CA. 2017.

No.	Treatment	Rate (oz/A)	Timing
1	Untreated Control	-	ABCDE
2	Cutless MEC (12.3 oz/A)	12.3	ABCDE
3	Cutless MEC (18 oz/A)	18	ABCDE
4	Cutless MEC (49.2 oz/A)	49.2	ACE
5	Primo Maxx (11 oz/A)	11	ABCDE
6	Trimmit (16 oz/A)	16	ABCDE
7	Anuew (16 oz/A)	16	ABCDE

Application code / timing:
A – 07/21/2017
B – 08/11/2017
C – 09/01/2017
D – 09/22/2017
E – 10/13/2017

Plot plan:

↑**N**

Bermudagrass (80% ET_0 replacement) Trial Plot Plan

101	Trt 1	201	Trt 2	301	Trt 6	401	Trt 3
102	Trt 2	202	Trt 5	302	Trt 8	402	Trt 6
103	Trt 3	203	Trt 3	303	Trt 4	403	Trt 4
104	Trt 4	204	Trt 1	304	Trt 7	404	Trt 7
105	Trt 5	205	Trt 8	305	Trt 5	405	Trt 2
106	Trt 6	206	Trt 7	306	Trt 1	406	Trt 8

↑**N**

Bermudagrass
(55% ET_0 replacement) Trial
Plot Plan

101 Trt 4	102 Trt 3	103 Trt 2	104 Trt 1
201 Trt 3	202 Trt 1	203 Trt 4	204 Trt 2
301 Trt 2	302 Trt 4	303 Trt 1	304 Trt 3
401 Trt 1	402 Trt 2	403 Trt 3	404 Trt 4

↑N **Seashore Paspalum Trial** Plot Plan

101	Trt 1	301	Trt 4
102	Trt 2	302	Trt 7
103	Trt 3	303	Trt 5
104	Trt 4	304	Trt 1
105	Trt 5	305	Trt 2
106	Trt 6	306	Trt 6
107	Trt 7	307	Trt 3
201	Trt 4	401	Trt 3
202	Trt 5	402	Trt 2
203	Trt 7	403	Trt 7
204	Trt 3	404	Trt 4
205	Trt 1	405	Trt 6
206	Trt 2	406	Trt 1
207	Trt 6	407	Trt 5

Table 4. Effect of PGRs on bermudagrass under optimal irrigation (80% ET0 replacement). Riverside, CA. 2017.

No.	Treatment	Turf quality [1-9] 07/27/2017	Turf quality [1-9] 09/01/2017	Injury [%] 07/27/2017	Injury [%] 08/24/2017	Clipping yield [g] 08/10/2017	Clipping yield [g] 08/31/2017
1	Untreated Control	5.7 AB	6.0 BC	0 C	0 B	26.31 A	8.99 AB
2	Cutless MEC (12.3 oz/A)	6.3 A	5.3 CD	0 C	0 B	27.74 A	17.27 A
3	Cutless MEC (18 oz/A)	5.7 AB	6.7 B	0 C	0 B	24.79 A	10.30 AB
4	Primo Maxx (11 oz/A)	4.0 C	7.7 A	16 A	6.7 A	12.89 A	8.82 AB
5	Anuew (8 oz/A)	5.3 AB	6.3 B	5 BC	6.7 A	10.86 A	5.95 B
6	Anuew (16 oz/A)	5.0 BC	6.0 BCD	11 AB	0 B	25.01 A	9.88 AB
7	Trimmit (16 oz/A)	5.3 AB	6.3 BC	1 C	0 B	18.25 A	7.16 AB
8	Trimmit (22 oz/A)	5.3 AB	5.3 D	1 C	3 B	10.99 A	16.19 AB

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

Table 5. Effect of PGRs on bermudagrass under deficit irrigation (55% ET0 replacement). Riverside, CA. 2017.

No.	Treatment	Turf quality [1-9] 07/27/2017	Turf quality [1-9] 08/24/2017	Injury [%] 07/27/2017	Injury [%] 08/24/2017
1	Untreated Control	6.5 A	5.5 A	0 C	0 B
2	Anuew (8 oz/A)	6.0 A	6.0 A	4 BC	0 B
3	Anuew (16 oz/A)	5.2 A	5.5 A	10 AB	1 AB
4	Primo Maxx (11 oz/A)	5.0 A	6.0 A	13 A	4 A

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

Table 6. Effect of PGRs on seashore paspalum. Riverside, CA. 2017.

No.	Treatment	Turf quality [1-9] 07/27/2017	Turf quality [1-9] 09/01/2017	Injury [%] 08/09/2017	Injury [%] 09/01/2017	Clipping yield 08/10/2017	Clipping yield 08/31/2017
1	Untreated Control	6.2 AB	3.8 B	0 C	2 AB	26.74 A	9.14 ABC
2	Cutless MEC (12.3 oz/A)	6.8 A	6.2 A	0 C	4 A	21.76 A	10.63 AB
3	Cutless MEC (18 oz/A)	6.5 AB	6.0 A	1 C	2 AB	17.52 A	9.68 AB
4	Cutless MEC (49.2 oz/A)	6.2 AB	6.5 A	8 B	1 AB	17.22 A	12.21 A
5	Primo Maxx (11 oz/A)	5.5 BC	6.8 A	14 A	2 AB	17.86 A	2.89 C
6	Trimmit (16 oz/A)	7.0 A	6.2 A	0 C	2 AB	19.31 A	6.47 ABC
7	Anuew (16 oz/A)	5.0 C	6.8 A	16 A	1 B	13.83 A	4.31 BC

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

Stop #8a: Best Management Practices for Water Conservation on Bermudagrass Turf

Marco Schiavon, Antonio Verzotto, Magdalena Poleska, and Jim Baird
Department of Botany and Plant Sciences,
University of California, Riverside, CA 92521

Objectives:

Evaluate management practices including use of plant growth regulators (PGRs), wetting agents, the choice of a correct fertilizer, or combinations thereof can help maintain acceptable turf quality under deficit irrigation.

Methods:

The study was conducted on mature ‘Princess 77’ bermudagrass turf. The 60’ x 90’ field was divided into six 30’ x 30’ plots. Beginning May 18, the plots received either 40% or 70% of previous week ET_0, as determined by an on-site CIMIS station. Treatments were arranged in a split-plot design with 3 different factors randomized within ET_0 replacement plots and 3 replicates. Plant Growth Regulator (Primo Maxx) serves as split plot; wetting agent (Revolution) as split-split-plot; finally, fertilizer products (see Table below) were randomized inside the wetting agent plots (plot size 24 ft^2) and applied monthly beginning May 19, 2017. Each treatment received an equivalent of 1 lb N/M/month. Every two weeks, plots were evaluated for turf quality, volumetric soil water content, Normalized Difference Vegetation Index (NDVI), and Digital Image Analysis (DIA).

Results:

When bermudagrass was watered at 70% ET_0 replacement, plots that were not treated with Primo Maxx or Revolution showed the lowest quality, while greatest quality was achieved by plots that received both Primo Maxx and Revolution (Fig. 1). Fertilizer type did not have an effect at 70% ET_0; however, surrounding turf that received no N showed drastically lower turf quality than any plot that received N fertilization. At 40% ET_0, Revolution had the greatest impact on bermudagrass performance (Fig. 2). In absence of Revolution, ACA 1935 and 5000 showed consistently improved quality, and were followed by SeaBlend + Stress Rx+ XP Micro (Fig. 3), suggesting that biostimulants may have a positive effect on bermudagrass response to deficit irrigation.

Acknowledgments:

Thanks to Aquatrols, Gro-Power, Ocean Organics, Syngenta, Yara, and the California Turfgrass & Landscape Foundation (CTLF) for supporting this research.

Table 1. PGR, wetting agent, and fertilizer study treatment list and plot plan. Riverside. 2016-17.

Plot	Treatment	Company	Rate	Frequency (wks)
Whole Plot	ET_0 replacement	---	40%-70%	Mon-Wed-Fri
Split	Primo Maxx	Syngenta	0.25 oz/M	2
Split-split-plot	Revolution	Aquatrols	6 oz/M	4
Split-split-split-plot	Gro-Power (5-3-1)	Gro-Power	1 lb N/M	4
Split-split-split-plot	SeaBlend (12 4 5) + StressRX + XP Micro	Ocean Organics	1 lb N/M + 6 oz/M + 6 oz/M	4 2 2
Split-split-split-plot	Turf Royale (21-7-14)	Yara	1 lb N/M	4
Split-split-split-plot	Yara Liva (15.5-0-0)	Yara	1 lb N/M	4
Split-split-split-plot	Turf Royale (21-7-14) + ACA 1935	Yara Aquatrols	1 lb N/M + 4 oz/M	4 4
Split-split-split-plot	Turf Royale (21-7-14) + ACA 5000	Yara Aquatrols	1 lb N/M + 4 oz/M	4 2

Plot Plan (North ↑)

Rep 1	70% ET_0	19	20	12	9		13	18	4	3	40% ET_0
		21	22	11	7		15	16	1	2	
		23	24	8	10		17	14	6	5	
		14	18	5	2		9	8	19	21	
		13	17	1	6		11	7	22	24	
		16	15	3	4		10	12	23	20	

Rep 2	70% ET0	5	6	15	16		5	3	13	17	40% ET0
		2	3	17	14		6	2	14	16	
		1	4	18	13		1	4	18	15	
		23	19	10	12		9	11	22	19	
		21	22	8	9		10	12	20	21	
		24	20	7	11		8	7	23	24	

Rep 3	40% ET_0	13	16	2	5		23	19	7	11	70% ET_0
		15	17	1	3		22	21	10	12	
		14	18	6	4		20	24	9	8	
		11	8	20	19		2	3	18	14	
		10	7	24	23		1	6	13	17	
		9	12	22	21		4	5	16	15	

Trt #	Fertilizer	Primo Maxx	Revolution	Trt #	Fertilizer	Primo Maxx	Revolution
1	Gro-Power			13	Gro-Power		x
2	SeaBlend + StressRX + XP Micro			14	SeaBlend + StressRX + XP Micro		x
3	Yara Turf Royale			15	Yara Turf Royale		x
4	Yara Liva			16	Yara Liva		x
5	Yara Turf Royale + ACA 1935			17	Yara Turf Royale + ACA 1935		x
6	Yara Turf Royale + ACA 5000			18	Yara Turf Royale + ACA 5000		x
7	Gro-Power	x		19	Gro-Power	x	x
8	SeaBlend + StressRX + XP Micro	x		20	SeaBlend + StressRX + XP Micro	x	x
9	Yara Turf Royale	x		21	Yara Turf Royale	x	x
10	Yara Liva	x		22	Yara Liva	x	x
11	Yara Turf Royale + ACA 1935	x		23	Yara Turf Royale + ACA 1935	x	x
12	Yara Turf Royale + ACA 5000	x		24	Yara Turf Royale + ACA 5000	x	x

Figure 1. Quality of plots irrigated at 70%ET_0 treated with either Primo Maxx, Revolution, a combination of the two or untreated.

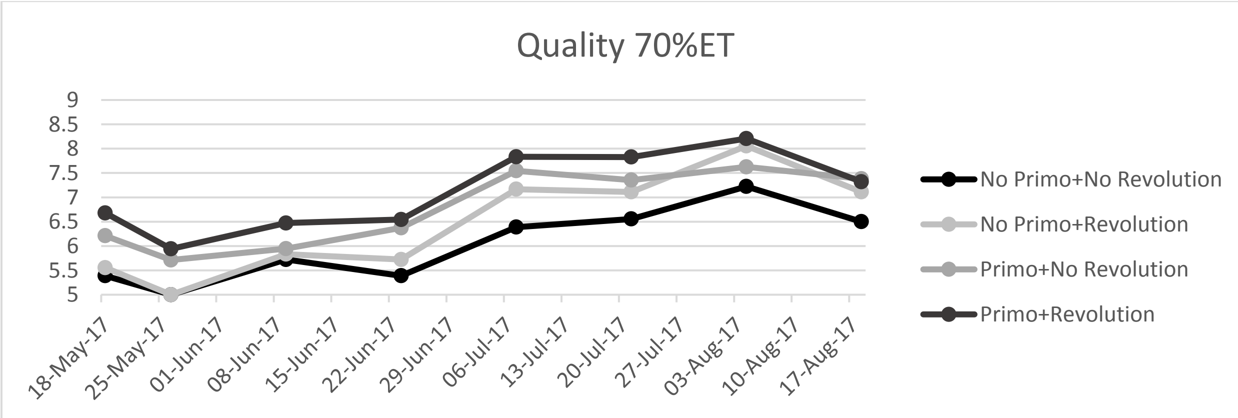


Figure 2. Quality of plots irrigated at 40%ET_0 treated with either Revolution or untreated.

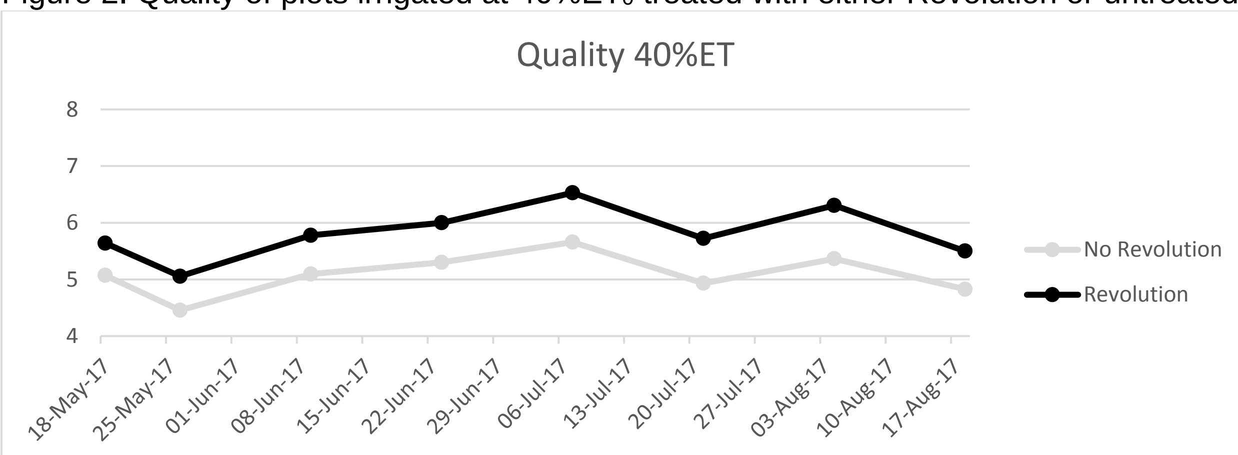
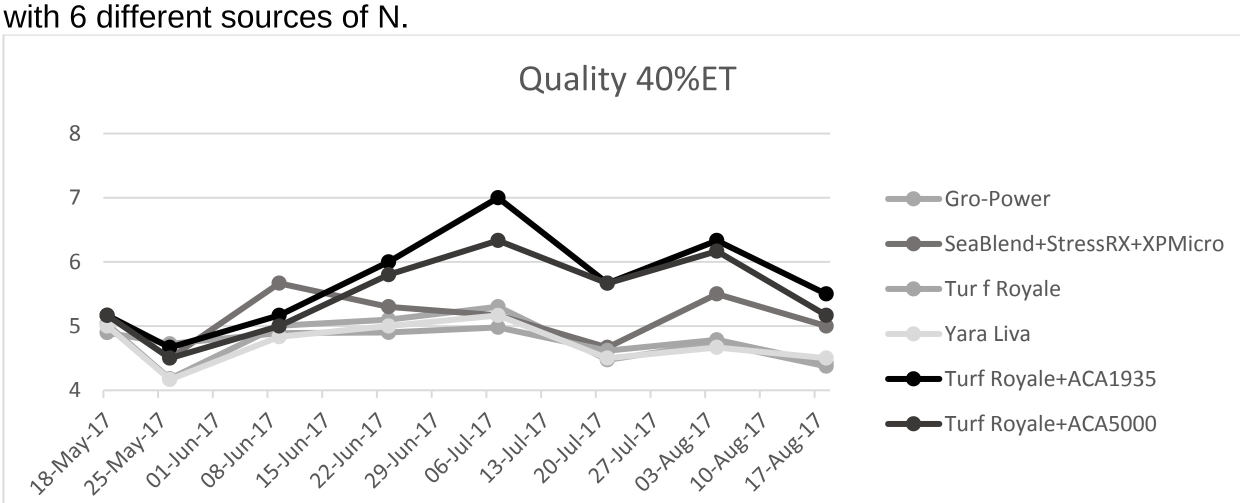


Figure 3. Quality of plots irrigated at 40%ET_0, not treated with Revolution and fertilized with 6 different sources of N.



Stop #8b: How Often Should You Water Your Lawn?

Marco Schiavon, Antonio Verzotto, Magdalena Poleska and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside, CA 92521

Objectives:

Warm-season turfgrasses species are more water use efficient and drought tolerant than cool-season turfgrasses; nevertheless, tall fescue remains the predominant species used on California lawns. Often, restrictions on lawn irrigation are based on number of days to irrigate with little or no regard to irrigation amount. This study investigated the optimal ET replacement requirements for two warm-season (bermudagrass and seashore paspalum) and one cool-season (tall fescue) turfgrasses, and if limitation on days for irrigation could have negative consequences on turf quality.

Materials and Methods:

Three species were sodded at UCR on 24 August 2015: 'Tifway II' bermudagrass, 'West Coaster' tall fescue, and 'Platinum' seashore paspalum. Plots were mowed weekly or biweekly at 2 (warm-season species) or 3 (tall fescue) inches using a rotary mower and receive 2 lb N/M/yr. Clippings are collected. Three irrigation regimes were identified per each species: 1) Extension recommendation different for each species (70%, 85% and 100% ET replacements for bermudagrass, paspalum and tall fescue, respectively) applied 3 times/week; 2) 80% ET replacement 3 times/week across all species; 3) full ET replacement applied only once a week. Irrigation is based on previous week ET_0 as determined by an on-site CIMIS station. Starting on 12 June 2017, plots were evaluated weekly for turf quality, NDVI and digital image analysis.

Results:

Bermudagrass did not show significant differences regardless of the irrigation regime with all the plots showing sufficient quality. Seashore paspalum lost quality when full ET was replaced once a week in comparison to 80% ET replaced 3 times per week (Fig. 1). The only irrigation suitable to achieve sufficient quality for tall fescue was full ET replacement 3 times per week. However, full ET replacement is preferable in tall fescue even when applied once a week in comparison to deficit irrigation applied 3 times per week (Fig. 2). These data suggest that limiting lawn irrigation to as little as once a week neither saves water (often amount of time to irrigate in one day is not provided by the regulator) nor is it optimal for lawn aesthetics.

Acknowledgments:

Thanks to the California Turfgrass & Landscape Foundation (CTLF) for supporting this research.

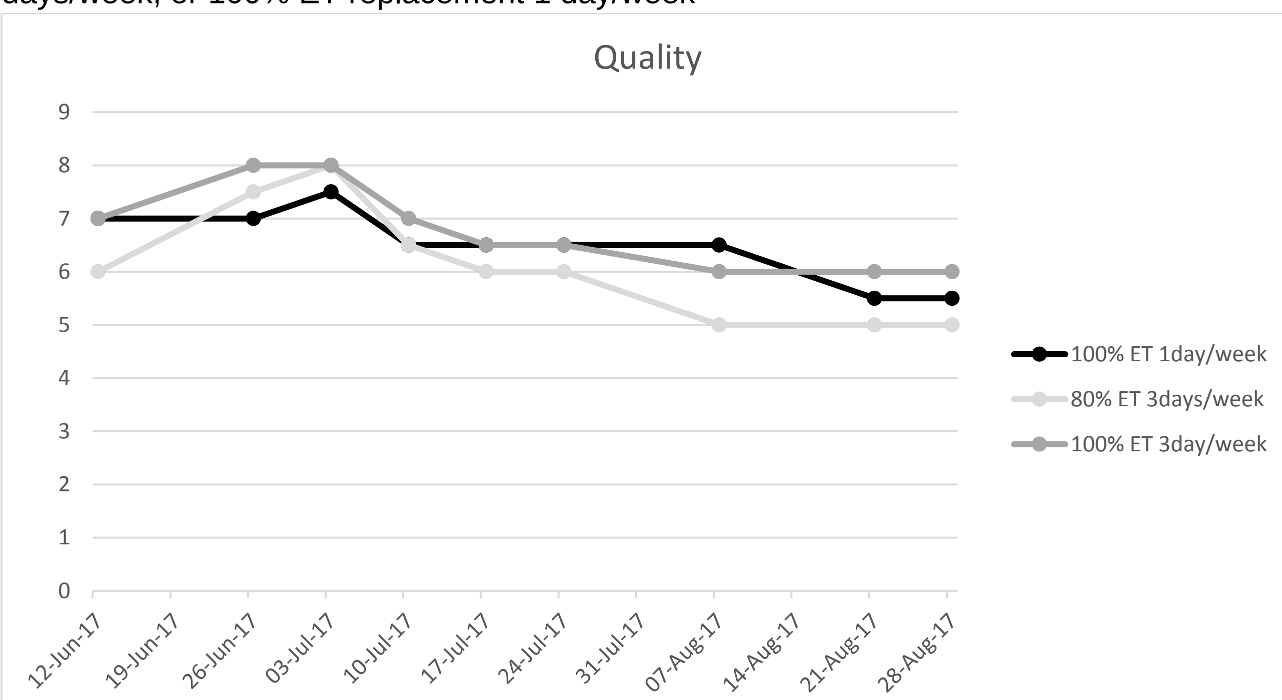
12 E 7 N Irrigation Plan

↑ **N**

Seashore paspalum		Tall Fescue		Bermudagrass	
80% ET_0 replacement; HW 3 d/wk	85% ET_0 replacement; HW 3 d/wk	80% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW 3 d/wk	80% ET_0 replacement; HW 3 d/wk	70% ET_0 replacement; HW 3 d/wk
100% ET_0 replacement; HW only on Mondays	85% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW only on Mondays	100% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW only on Mondays	70% ET_0 replacement; HW 3 d/wk
80% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW only on Mondays	80% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW only on Mondays	80% ET_0 replacement; HW 3 d/wk	100% ET_0 replacement; HW only on Mondays

Figure 1. Quality of seashore paspalum irrigated at either 80% or 85% ET replacements 3 days/week, or 100% ET replacement 1 day/week

Figure 2. Quality of tall fescue irrigated at either 100% or 80% ET replacements 3 days/week, or 100% ET replacement 1 day/week



Save the Date

UCR Turfgrass & Landscape
Research Field Day

Thursday, September 13, 2018

See you then!