UNIVERSITY OF CALIFORNIA
UC RIVERSIDE

Turfgrass & Landscape Research Field Day

September 13, 2018

University of California Agriculture and Natural Resources

UCR | Turfgrass Science

CA Turfgrass & Landscape Foundation
"Keeping California Green and Growing"

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 2018 UCR Turfgrass and Landscape Research Field Day. This marks the 11th 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.

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

As you enjoy today's tours, please take a moment to thank those folks, mostly wearing green 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 Marco Schiavon, Peggy Mauk, Sue Lee, Steve Ries, Sherry Cooper, Kellie McFarland, and Julia Kalika. 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 12, 2019.**

Sincerely,

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

2018 Turfgrass and Landscape Research Field Day Sponsors:

(as of September 6, 2018)

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Thanks for your support throughout the year!

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- United States Golf Association (USGA)
- West Coast Turf
- Western Municipal Water District
- Wilbur-Ellis
- Yara

CIMIS Data Sep. 2017 – Aug. 2018

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

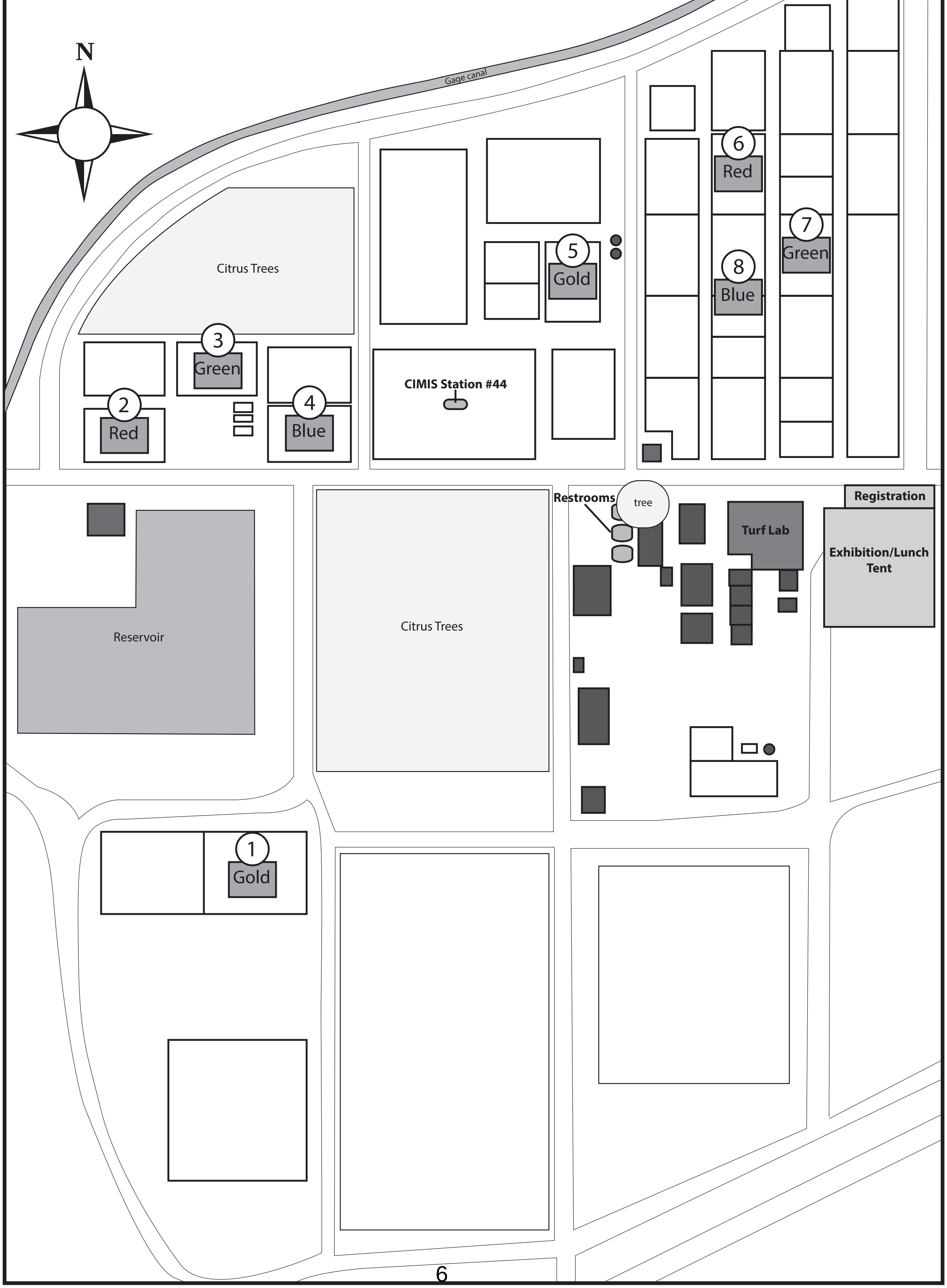
Month Year	Tot ETo (in)	Tot Precip (in)	Avg Sol Rad (Ly/day)	Avg Vap Pres (mBars)	Avg Max Air Tmp (F)	Avg Min Air Tmp (F)	Avg Air Tmp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (F)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Sep 2017	4.92 K	0.06	421	16.6 K	87.1 K	62.2 K	73.4 K	86 K	36 K	60 K	57.0 K	4.1 K	74.3 K
Oct 2017	4.54 K	0.00	354	10.8 K	85.8 K	57.8 K	70.6 K	74 K	24 K	47 L	45.1 L	3.9 K	67.4 K
Nov 2017	2.35 K	0.04	235	11.2 K	76.3 K	52.4 K	63.1 K	83	36	58 K	46.4 K	3.1	62.7 K
Dec 2017	3.09	0.00	234	4.9	73.4 K	45.8	58.4 K	51	16	30 K	24.5 K	4.0 K	52.5 K
Jan 2018	2.41 K	1.65	230	8.8 K	72.6	47.2 K	58.6 K	78	31	52 L	39.1 L	3.2	55.0 K
Feb 2018	3.17	0.30	342	7.0	69.7 K	43.7 K	56.1	76	24	47	34.4	3.7	56.4 K
Mar 2018	3.81	1.64	373	10.4 K	69.2	47.7	57.8	88	39	62 L	42.9 L	3.9 K	60.3 L
Apr 2018	5.69 K	0.00 K	509 K	10.4 K	76.9 K	51.6	63.4 K	82 K	32 K	54 K	44.4 K	4.5 K	65.0 K
May 2018	5.57	0.27	553 K	12.7	75.4	54.7	63.7	85	45	64	50.6	4.3 K	68.6
Jun 2018	7.61	0.00	729 K	14.9	86.3	58.9	71.0	85	34	58	55.1	4.4 K	73.9
Jul 2018	8.04 K	0.04 K	651 K	17.7 K	95.8 L	67.7 K	80.8 K	78 K	31 K	50 K	59.8 K	4.1	78.8
Aug 2018	7.35	0.00	601	17.6 K	92.8	66.3	78.2	81	32	54 K	59.8 K	3.9	77.8
Totals/Avgs	58.55	4.00	436	11.9	80.1	54.7	66.3	79	32	53	47	3.9	66.1

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



2018 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
Stop #3 *Green Tent*:	**Evaluation of Fungicides for Control of Anthracnose Diseases on Annual Bluegrass Putting Greens** Pawel Petelewicz
Stop #4 *Blue Tent*:	**Evaluation of Fertilizer Products and Formulations on Bermudagrass Turf; A New Postemergence Grass Herbicide for Warm-Season Turf** Jim Baird
10:00 – 10:30 AM	**Break and Trade Show**
	Important Plant-Parasitic Nematodes in California Turf grasses Ole Becker and Jennifer 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*:	**Broadleaf Herbicide Safety and Water Use on Kurapia** Pawel Orlinski
Stop #7 *Green Tent*:	**Wetting Agents for Water Conservation on Bermudagrass Turf** Marco Shiavon
Stop #8 *Blue Tent*:	**Evaluation of Fungicides for Control of *Pythium Blight* Disease on Perennial Ryegrass Turf** Pawel Petelewicz
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/turf2018eval.

Trade Show Presentation:

Important Plant-Parasitic Nematodes in California turf grasses

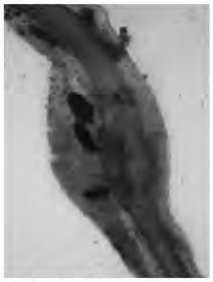
J. Ole Becker and Jennifer Smith Becker
Dept. Nematology
University of California, Riverside, CA 92521

Plant-parasitic nematodes are often severe pathogens in many crops, including turf grasses. In California, only a few species constitute a significant damage threat for golf courses and sports areas. Although many nematode species feed on grassroots, an otherwise healthy lawn can tolerate most ecto- and endoparasitic nematodes. The following illustrates noted exceptions.

Root-knot nematodes (*Meloidogyne* spp.)

Several species of these endoparasitic nematodes can parasitize and reproduce well on turf grasses. In contrast to many other host plants, *Meloidogyne*-induced root galls are very small on grasses. The galls are often invaded by soil microorganisms that accelerate root decomposition.

2nd stage juveniles (J2) invading a root tip



J3 feeding on giant cells surrounded by vascular tissue.

A root with a female root-knot nematode and its eggs

Galled turf grass roots, discolored in response to the invasion of various soilborne microbes.

Sting nematode (*Belonolaimus longicaudatus*)

These invasive ectoparasites are aggressive root feeders on many crops. They require moist, sandy, and warm (> 70˚F) soils. Their long mouth stylet can damage the growing zone in roots. Since their discovery in Coachella Valley golf courses in 1992, regulatory restrictions, as well as research and extension activities by UCR Nematologists, have prevented further spread.

Foliar symptoms caused by root feeding activity of Sting nematodes

Sting nematodes feeding on a root tip

A Sting nematode parasitized by *Catenaria* sp.

Bacterial hyperparasites *Pasteuria usgae* on a Sting nematode.

Pacific shoot gall nematode (*Anguina pacificae*)

These nematodes cause galls at the stem base of annual bluegrass (*Poa annua*). The disease stunts the shoots, leads to branching, with Poa greens becoming sparse and pitted. Cool temperatures with high humidity allow juveniles to reach young shoot tips for infection. These environmental conditions limit the distribution of *A. pacificae* to northern coastal California.

Anguina pacificae with egg

Poa annua shoots with nematode-induced galls.

Juvenile stages of *A. pacificae* exiting a decomposing shoot gall.

A. pacificae-infested *P. annua* green; right, fluopyram treated.

Acknowledgements: The research and extension activities associated with this poster were supported in part by the University of California Agriculture & Natural Resources, UC Riverside's College of Natural and Agricultural Sciences, and UCR's Department of Nematology.

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

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

Project Milestones Since Field Day 2017:

- ✓ Planted ca. 750 bermudagrass hybrids generated by open pollination of selected collection accessions.
- ✓ Continued crossing of UCR bermudagrass accessions, with emphasis on genotypes possessing desirable winter color retention, early spring green-up, and drought tolerance.
- ✓ Evaluating ca. 1,000 bermudagrass and zoysiagrass accessions in replicate plots from University of Florida, Oklahoma State University, Texas A&M, and UCR for winter color retention.
- ✓ Second screening of UCR bermudagrass hybrids, this time for suitability for lawns.
- ✓ Continued evaluation of 12 of our most promising bermudagrass hybrids or accessions in comparison to Tifway, TifTuf, and Bandera cultivars for fairways/athletic fields (0.5 in mowing height) and lawns/rough (2.0 in mowing height).
- ✓ Evaluating UCR kikuyugrass collection accessions for drought tolerance and winter color retention.
- ✓ Started crossing of UCR kikuyugrass accessions selected for desirable quality traits, drought tolerance and winter color retention.
- ✓ Planted ca. 100 selected kikuyugrass seedlings obtained from wild-type seed stocks.

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 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.

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) genetic 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 greenup. After evaluating hybrids and collection accessions for winter color retention and visual quality they are being intercrossed on the assumption that the next generation hybrids may show reduced dormancy period. New sets of hybrids were also generated, 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. In the meantime, the best-looking hybrids were 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 were clearly evident and the best of these hybrids are being used in subsequent tests. Two years ago relative drought tolerance of selected hybrids and collection accessions was tested and two of our hybrids survived it in good shape. Because of new plantings in this area test couldn't be repeated. New dry-down testing area will be established early next year to repeat the test on previously evaluated hybrids and the best of new hybrids obtained this year. To establish the parentage of the existing hybrids, the collection and a sample of hybrids were genotyped using 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. Second genotyping performed last winter, including new samples from USDA, suggests that some accessions may be indeed designated incorrectly, since they grouped closely with USDA samples, but with species other than listed, as in the first genotyping results. Analysis showed also that our best hybrids grouped together with *C. transvaalensis* accessions.

Twelve of our most promising accessions or hybrids chosen in 2017 were further evaluated 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, 2017 in Riverside; June 14, 2017 in Coachella Valley; and June 22, 2017 in Fairfax. During the first year of the test dynamics of establishment were measured and after obtaining full cover, visual turf quality, winter color retention, Normalized Difference Vegetation Index (NDVI) and Dark Green Color Index (DGCI, using Digital Image Analysis) were evaluated. In spring 2018 plots at University of California Riverside and West Coast Turf were divided in half to test suitability both for golf courses and lawns. For this purpose half of the each plot was mowed in 0.5 in 3 times a week and the other half in 2.0 in once a week. The higher mowed part of the plot, beside visual quality, NDVI and DGCI was also evaluated for color, scalping injuries and flowering in the spring.

First year of the study showed that among evaluated hybrids TP 6-3, TP 3-2 and NRCC12 were the fastest growing accessions in Southern California, while 10-9 and 15-4 in Northern California (data not shown). During further evaluation only TP 6-3 showed good visual turf quality and winter color retention, supported by high NDVI and DGCI values in all three areas, placing this hybrid in the highest position of the ranking (Table 1). Over the year of testing also 17-8 and BF1 turned out to be among the best evaluated hybrids, both in Southern and Northern California. BF1 seems to be better adapted to cooler areas. The best of commercial cultivars, TifTuf, showed high ranks in visual quality and NDVI, especially in the desert and in Northern California, however taking into account all analyzed factors, it doesn't outmatch UCR entries. When tested for lawns and mowed at 2.0 in, our entries haven't exceeded the best of commercial cultivars, Tifway 419 (Table 2). However, two of them (17-8 and BF2) seem to be more suitable for lawns than other tested commercial cultivars Bandera and TifTuf.

Table 1. Ranking of twelve bermudagrass hybrids and three commercial cultivars – fairway height (0.5 in mowing height).

Code	Visual Quality (1-9)			Visual Color (1-9)			NDVI (0-1)			DGCI (0-1)			**General ranking**
	UCR	WCT	MC	UCR	WCT	MC	UCR	WCT	MC	UCR	WCT	MC	
10-9	11	8	1	7	7.5	5.5	4	7	10.5	3	7	4	**75.5**
15-4	7	13	6	8	10	7	7	9	13	9	9	8	**106.0**
16-6	8.5	7	6	11	7.5	11.5	11	12	9	11	10	10	**114.5**
17-8	2	3	2	3	6	3	2	4	5	2	6	5	**43.0**
TP1-1	14	11	11	14	15	13.5	14	14	12	14	14	15	**161.5**
TP1-2	12	9	13.5	13	12	11.5	13	13	15	15	12	13	**152.0**
TP3-2	8.5	10	13.5	12	9	8.5	12	10	10.5	12	11	11	**128.0**
TP5-4	15	14	12	15	13	13.5	15	15	14	13	13	12	**164.5**
TP6-3	1	2	6	1	3	4	1	3	3	1	3	3	**31.0**
BF1	3	6	3.5	4	2	2	8	2	4	7	1	1	**43.5**
BF2	4	4	10	2	4	5.5	6	6	6	6	2	6	**61.5**
NRCC12	13	15	15	10	14	10	10	11	7	10	15	14	**144.0**
Bandera	10	12	9	9	11	1	9	8	8	4	8	2	**91.0**
Tifway 419	5	5	8	5	1	15	5	5	2	5	4	7	**67.0**
Tif Tuf	6	1	3.5	6	5	8.5	3	1	1	8	5	9	**57.0**

UCR – University of California Riverside; WCT – West Coast Turf, Thermal; MC – Meadow Club, Fairfax
NDVI – Normalized Difference Vegetation Index; DGCI – Dark Green Color Index
[grey shading] – Hybrids with the highest ranks

Table 2. Ranking of twelve bermudagrass hybrids and three commercial cultivars – lawns (2.0 in mowing height).

Code	Quality (1-9)		Color (1-9)		NDVI (1-9)		DGCI (0-1)		Scalping (1-9)		Flowering (1-9)		**General Ranking**
	UCR	WCT	UCR	WCT	UCR	WCT	UCR	WCT	UCR	WCT	UCR	WCT	
10-9	7	8	14	10	3.5	8	6	5	1.5	9	3	6.5	**81.5**
15-4	11	12	3	12	8	9	8	7	10.5	8	4	1.5	**94.0**
16-6	13	9	10	11	13	11	11	11	8.5	13	12.5	6.5	**129.5**
17-8	3	3	3	3.5	1	2	1	9	4	7	1.5	12	**50.0**
TP1-1	12	12	15	14.5	12	13	14	13	7	11	11	4	**138.5**
TP1-2	9.5	7	8.5	6	14	12	15	10	14.5	14	7	10.5	**128.0**
TP3-2	8	12	11.5	13	11	14	12	14	6	12	12.5	8.5	**134.5**
TP5-4	14	14	8.5	9	15	15	9	12	13	15	7	10.5	**142.0**
TP6-3	2	6	3	6	6	5	4	8	12	10	1.5	8.5	**72.0**
BF1	4	5	3	6	7	6	7	3	8.5	5.5	9	3	**67.0**
BF2	1	4	3	8	2	4	3	2	1.5	5.5	7	5	**46.0**
NRCC12	15	15	13	14.5	9.5	10	13	15	14.5	1	14	15	**149.5**
Bandera	9.5	10	6.5	3.5	9.5	7	5	4	10.5	3.5	5	14	**88.0**
Tifway 419	5.5	2	6.5	1.5	5	3	2	1	4	3.5	10	1.5	**45.5**
TifTuf	5.5	1	11.5	1.5	3.5	1	10	6	4	2	15	13	**74.0**

UCR – University of California Riverside; WCT – West Coast Turf, Thermal; MC – Meadow Club, Fairfax
NDVI - Normalized Difference Vegetation Index; DGCI - Dark Green Color Index
– Hybrids with the highest ranks

<u>Kikuyugrass:</u>

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) markers 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. Last year we established a collection of available genotypes representing the greatest genetic diversity and conducted dry down events to select for improved drought tolerance. Accessions were also evaluated for turf quality and winter color retention. Stolons from genotypes showing the best quality, drought tolerance and color retention were planted in pots and are being used for crossing. Last year, we located seed stocks of the grass (from about 20-25 years back) and established ca. 400 individual seedlings. These were individually assessed, selected for best suitability for turf, and added to our collection. Selected accessions will be intercrossed and new hybrids screened and selected for further evaluation. 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. Two attempts to reduce ploidy via androgenesis have been made. There is no known technology adapted to this species and the species appears to be recalcitrant. We managed to determine the best methods to collect the material and apply external stresses to induce the switch from gametophytic to sporophytic pathway of microspore development, however none of these microspores managed to survive and form a new plant. 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.

<u>Zoysiagrass:</u>

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 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 reenters 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 and zoysiagrass germplasm from Texas A&M University and the University of Florida is now under evaluation in Riverside, CA together with bermudagrass, zoysiagrass, and kikuyugrass germplasm from UCR. Replicate space plantings were established in fall 2016. Starting the winter 2017/2018 accessions are being evaluated for winter color retention and spring green-up, along with turf quality evaluation during the summer season. In addition, tolerance to deficit irrigation will be evaluated. Ratings include visual and NDVI analysis.

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

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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 November 1, 2016 and let establish during the winter and the spring with abundant water. The entry list for the NTEP trial can be found in Table 1. Plots were irrigated using deficit irrigation, consisting of three irrigation regimes (80%, 60% and 40% ET_{os} replacements) for 3 months (from June 27 to October 21) in 2017, and subsequently watered at 100% ET replacement until May 31 2018. Deficit irrigation in 2018 was resumed on June 1 and will last until September 30. Plots are mowed at 2.5 inch 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

As observed in 2017, no cultivar was able to withstand three months of 40% ET_{os} replacement irrigation with the highest % green cover recorded at 28% and 24% for tall fescue and Kentucky bluegrass, respectively (Tables 2 and 3). Cultivars watered at 60% ET_{os} performed slightly better than 2017, with only one cultivar of tall fescue (‘BarRobusto’) and four of Kentucky bluegrass (‘Babe’, ‘BAR PP 110358’, ‘NAI-13-132’, and ‘PST-K15-169’ losing more than 50% ground cover. The best cultivar at 80% ET_{os} was ‘Catalyst’ for tall fescue with 71% ground cover (Table 2), and ‘PST-K13-141’ for Kentucky bluegrass with 77% ground cover (Table 3). No statistical differences were detected in the majority of tall fescue and Kentucky bluegrass cultivars between 40% and 60% ET_{os} replacements.

Table 1. Entry list 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

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

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

ET 60%

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. Cover of tall fescue plots irrigated at either 40%, 60% or 80% ET replacements on 8/29/2018.

Cultivar	ET_{os}	Cover (%)	MSGroup	Cultivar	ET_{os}	Cover (%)	MSGroup
BAR FA 121095	0.4	19	klmn	Nonet	0.4	24	klm
BAR FA 121095	0.6	61	abcdefghi	Nonet	0.6	53	fghij
BAR FA 121095	0.8	67	abcd	Nonet	0.8	66	abcd
BarRobusto	0.4	20	klmn	PST-5SDS	0.4	24	klm
BarRobusto	0.6	49	j	PST-5SDS	0.6	62	abcdefgh
BarRobusto	0.8	61	abcdefghi	PST-5SDS	0.8	69	ab
Catalyst	0.4	19	klmn	PST-R511	0.4	17	klmn
Catalyst	0.6	61	abcdefghi	PST-R511	0.6	57	defghij
Catalyst	0.8	71	a	PST-R511	0.8	65	abcde
DLFPS 321/3677	0.4	16	lmn	RS4	0.4	13	mn
DLFPS 321/3677	0.6	55	efghij	RS4	0.6	65	abcde
DLFPS 321/3677	0.8	64	abcdef	RS4	0.8	67	abcd
DLFPS 321/3678	0.4	24	kl	Stetson II	0.4	19	klmn
DLFPS 321/3678	0.6	57	defghij	Stetson II	0.6	57	cdefghij
DLFPS 321/3678	0.8	64	abcdefg	Stetson II	0.8	68	abc
DLFPS 321/3679	0.4	23	klmn	Supersonic	0.4	28	k
DLFPS 321/3679	0.6	51	ij	Supersonic	0.6	59	bcdefghij
DLFPS 321/3679	0.8	64	abcdef	Supersonic	0.8	62	abcdefghi
GO-AOMK	0.4	25	kl	Thor	0.4	16	lmn
GO-AOMK	0.6	53	hij	Thor	0.6	63	abcdefgh
GO-AOMK	0.8	62	abcdefgh	Thor	0.8	67	abcd
Kingdom	0.4	22	klmn	Thunderstruck	0.4	16	lmn
Kingdom	0.6	63	abcdefgh	Thunderstruck	0.6	53	fghij
Kingdom	0.8	67	abcd	Thunderstruck	0.8	62	abcdefghi
LTP-SYN-A3	0.4	23	klmn	Titanium 2LS	0.4	13	n
LTP-SYN-A3	0.6	58	bcdefghij	Titanium 2LS	0.6	53	hij
LTP-SYN-A3	0.8	67	abcd	Titanium 2LS	0.8	67	abcd
MRSL TF15	0.4	22	klmn				
MRSL TF15	0.6	53	ghij				
MRSL TF15	0.8	59	bcdefghij				

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

Table 3. Cover of Kentucky bluegrass plots irrigated at either 40%, 60% or 80% ET replacements on 8/29/2018.

Cultivar	ET_{os}	Cover (%)	MSGroup
BAR PP 110358	0.4	18	f
BAR PP 110358	0.6	48	cde
BAR PP 110358	0.8	61	abcde
Babe	0.4	14	f
Babe	0.6	48	cde
Babe	0.8	56	bcde
Barrari	0.4	17	f
Barrari	0.6	65	abc
Barrari	0.8	68	ab
Blue Devil	0.4	24	f
Blue Devil	0.6	56	bcde
Blue Devil	0.8	67	ab
Blue Note	0.4	19	f
Blue Note	0.6	58	bcde
Blue Note	0.8	69	ab
Dauntless	0.4	24	f
Dauntless	0.6	57	bcde
Dauntless	0.8	69	ab
Everest	0.4	21	f
Everest	0.6	57	bcde
Everest	0.8	64	abc
Midnight	0.4	22	f
Midnight	0.6	55	bcde
Midnight	0.8	66	ab
NAI-13-132	0.4	17	f
NAI-13-132	0.6	44	e
NAI-13-132	0.8	61	abcde
NAI-13-14	0.4	21	f
NAI-13-14	0.6	64	abc
NAI-13-14	0.8	67	ab
PST-K11-118	0.4	18	f
PST-K11-118	0.6	58	abcde
PST-K11-118	0.8	70	ab
PST-K13-137	0.4	20	f
PST-K13-137	0.6	61	abcd
PST-K13-137	0.8	65	ab
PST-K13-141	0.4	20	f
PST-K13-141	0.6	67	ab
PST-K13-141	0.8	75	a
PST-K13-143	0.4	14	f
PST-K13-143	0.6	61	abcde
PST-K13-143	0.8	67	ab
PST-K15-169	0.4	17	f
PST-K15-169	0.6	46	de
PST-K15-169	0.8	63	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

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Objectives:

This study was conducted to evaluate ability of 33 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 5 days/wk at 0.125 inches and received 0.125 lbs N/1000 ft^2 in liquid form every 14 days. Fungicide treatments were applied every 14 days beginning on June 6, 2018 (before disease symptoms were present) for a total of 8 applications. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8004VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Experimental design was a complete randomized block with 5 replications. Plot size was 4×6 ft with 1-ft alleys.

Starting from June 17, plots were evaluated every two weeks for visual turf quality (1-9; 9=highest), injury caused with treatments (0-10; 10=highest), turf green color intensity (1-9; 9=highest), anthracnose and summer patch disease cover (0-100%), disease symptoms severity within the area of pathogenic activity (0-10; 10=highest) and disease pressure, which calculation of was based on two previously mentioned parameters and introduced to distinguish severely damaged plots from those showing initial symptoms of disease activity within the comparable area of disease cover.

Results:

Some severe scalping occurred at the beginning of the trial on plots located in replications no. 1 and no. 4 due to excessive soil moisture, which was the reason to exclude those replications in statistical analysis performed for the purpose of this report.

Colletotrichum cereale acervuli were first noticed in the beginning of July, but significant anthracnose pressure in untreated control plots started in a first half of August. Before that, starting on July 17 severe disease pressure (even greater than when compared to control) started showing within all UCR 001 to 003 treatments and escalated until the most recent rating date (data not shown). Addition of Daconil Weatherstik and Medallion SC to the UCR experimental materials reduced disease symptoms, but there was no significant difference between those treatments and untreated control in terms of disease cover, disease symptoms severity within cover and disease pressure by August 27, 2018 (Table 2).

By the most recent rating event before publication (August 27), the best treatments in terms of lowest disease cover (0-5%) included: Bayer Program No. 1, 2, 3 and 5, Intelligro Program No. 2, Anthracnose Program No. 2, A22758A, Maxtima and Navicon. Next in line (5-15% of disease cover) were: tank-mix of Daconil Action with Appear II and Primo-Maxx, tank-mix of A19188 with Medallion SC and Anthracnose Program No. 3. Also, Anthracnose Program No. 1, Intelligro Program No. 3 and tank-mix of Nivales T with Echo Dyad ETQ did not differ from control in terms of disease cover but significantly decreased severity of symptoms within the disease activity area on the plots and that directly and positively impacted overall disease pressure (Table 2).

Summer Patch was difficult to distinguish in this year's trial, because once both pathogens started to become active disease symptoms were indistinguishable. Starting on August 27, both diseases were evaluated together but until then treatment efficacy against summer patch mirrored that of anthracnose (data not shown).

Bayer Programs No. 1-3 and No. 4 demonstrated significantly higher quality compared to other plots on August 27, mostly due to improvement in color (together with Maxtima). However it should be mentioned that all Bayer Programs together with A22758A showed some slight initial injury, likely caused by DMI fungicides. No other phytotoxicity was noticed throughout the study with treatments containing Primo Maxx at various rates (Table 2).

Acknowledgments:

Thanks to BASF, Bayer, Intelligro, NuFarm, Syngenta and Wilbur-Ellis for supporting this research and/or for providing products.

Table 1. Treatments tested in the anthracnose and summer patch fungicide trial in Riverside, CA. 2018.

No.	Treatments	Active ingredient(s)	Company	Rate (oz/1000 ft^2)	Timing
1	Untreated Control	-	-	-	-
2	Bayer Program No. 1				
	Mirage Stressgard	tebuconazole	Bayer	1.00	A
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	B
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Mirage Stressgard	tebuconazole	Bayer	1.00	C
	Insignia SC	pyraclostrobin	BASF	0.70	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	D
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	E
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	F
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Mirage Stressgard	tebuconazole	Bayer	1.00	G
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	H
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
3	Bayer Program No. 2 *(continued on next page)*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	A
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	B
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Mirage Stressgard	tebuconazole	Bayer	1.00	C
	Insignia SC	pyraclostrobin	BASF	0.70	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	D
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	E
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	

3	Bayer Program No. 2 *(continued from previous page)*				
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	F
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Mirage Stressgard	tebuconazole	Bayer	1.00	G
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Signature XTRA Stressgard	aluminium-tris	Bayer	5.30	H
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
4	Bayer Program No. 3				
	Mirage Stressgard	tebuconazole	Bayer	1.00	A
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	B
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	C
	Affirm WDG	polyoxin D zinc salt	Cleary / NuFarm	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	D
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	E
	Affirm WDG	polyoxin D zinc salt	Cleary / NuFarm	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	F
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	G
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	H
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
5	Bayer Program No. 4 *(continued on next page)*				
	Mirage Stressgard	tebuconazole	Bayer	1.00	A
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	B
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	C
	Exteris Stressgard	fluopyram, trifloxystrobin	Bayer	4.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	

5	Bayer Program No. 4 *(continued from previous page)*				
	Chipco Signature	aluminium-tris	Bayer	4.00	D
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	E
	Exteris Stressgard	fluopyram, trifloxystrobin	Bayer	4.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	F
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	G
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	H
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
6	Bayer Program No. 5				
	Mirage Stressgard	tebuconazole	Bayer	1.00	A
	Chipco Signature	aluminium-tris	Bayer	4.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	B
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	C
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	D
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Insignia SC	pyraclostrobin	BASF	0.70	E
	Mirage Stressgard	tebuconazole	Bayer	1.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	F
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Mirage Stressgard	tebuconazole	Bayer	1.00	G
	Chipco Signature	aluminium-tris	Bayer	4.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Chipco Signature	aluminium-tris	Bayer	4.00	H
	Daconil Weatherstik	chlorothalonil	Syngenta	3.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
7	UCR 001	*classified*	-	-	A-H
8	UCR 001	*classified*	-	-	A-H
9	UCR 002	*classified*	-	-	A-H
10	UCR 002	*classified*	-	-	A-H
11	UCR 003	*classified*	-	-	A-H
12	UCR 003	*classified*	-	-	A-H

13	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 001	*classified*	-	-	
14	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 001	*classified*	-	-	
15	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 002	*classified*	-	-	
16	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 002	*classified*	-	-	
17	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 003	*classified*	-	-	
18	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
	UCR 003	*classified*	-	-	
19	Daconil Weatherstik	chlorothalonil	Syngenta	3.60	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
20	Intelligro Program No. 1 *(continued on next page)*				
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	A
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Banner Maxx II	propiconazole	Syngenta	1.00	
	Medallion SC	fludioxonil	Syngenta	1.00	B
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	C
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	D
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Heritage	azoxystrobin	Syngenta	0.20	
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	E
	Affirm WDG	polyoxin D zinc salt	Cleary / NuFarm	0.88	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	

20	Intelligro Program No. 1 *(continued from previous page)*				
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	F
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Medallion SC	fludioxonil	Syngenta	1.00	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	G
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	H
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Insignia SC	pyraclostrobin	BASF	0.50	
21	Intelligro Program No. 2				
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	A
	Banner Maxx II	propiconazole	Syngenta	1.00	
	Medallion SC	fludioxonil	Syngenta	1.00	B
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	C
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	D
	Heritage	azoxystrobin	Syngenta	0.20	
	Affirm WDG	polyoxin D zinc salt	Cleary / NuFarm	0.88	E
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	F
	Medallion SC	fludioxonil	Syngenta	1.00	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	G
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	H
	Insignia SC	pyraclostrobin	BASF	0.50	
22	Intelligro Program No. 3 *(continued on next page)*				
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	A
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Banner Maxx II	propiconazole	Syngenta	1.00	

22	Intelligro Program No. 3 *(continued from previous page)*				
	Medallion SC	fludioxonil	Syngenta	1.00	B
	LINK Quality Plus	NPK 5-20-20	Wilbur-Ellis	4.00	
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	C
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	D
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Heritage	azoxystrobin	Syngenta	0.20	
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	E
	Affirm WDG	polyoxin D zinc salt	Cleary / NuFarm	0.88	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	E
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	F
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Medallion SC	fludioxonil	Syngenta	1.00	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	G
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	NuFarm	5.50	H
	Daconil Ultrex	chlorothalonil	Syngenta	3.20	
	Insignia SC	pyraclostrobin	BASF	0.50	
23	Nivales T	fludioxonil	Sipcam Agro	1.00	A-H
	Echo Dyad ETQ	chlorothalonil	Sipcam Agro	4.90	
24	Anthracnose Program No. 1				
	Heritage Action	azoxystrobin, acibenzolar-S-methyl	Syngenta	0.40	ACEG
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
25	Anthracnose Program No. 2				
	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	ACEG
	Appear II	potassium phosphite	Syngenta	6.00	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BDFH
	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	
	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	

26	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	A-H
26	Appear II	potassium phosphite	Syngenta	6.00	A-H
26	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	A-H
27	A22758A	*classified*	-	1.30	A-H
28	A19188	*classified*	-	1.00	A-H
28	Medallion SC	fludioxonil	Syngenta	1.00	A-H
29	Anthracnose Program No. 3				
29	Velista	penthiopyrad	Syngenta	0.50	ADG
29	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	ADG
29	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	BEH
29	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	BEH
29	Heritage Action	azoxystrobin, acibenzolar-S-methyl	Syngenta	0.40	CF
29	Primo Maxx	trinexapac-ethyl	Syngenta	0.10	CF
30	A15457	*classified*	-	0.24	A-H
30	Medallion SC	fludioxonil	Syngenta	1.00	A-H
31	Maxtima	mefentrifuconazole	BASF	0.80	A-H
32	Navicon	mefentrifuconazole, pyraclostrobin	BASF	0.85	A-H
33	Velista	penthiopyrad	Syngenta	0.30	A-H

Application codes (timing):

A – 06/06/2018
B – 06/20/2018
C – 07/06/2018
D – 07/18/2018
E – 08/02/2018
F – 08/15/2018
G – 08/30/2018
H – 09/12/2018

Anthracnose/Summer Patch Fungicide Trial Plot Plan (12 G 4) ↑N

101 Trt 1	102 Trt 2	103 Trt 3	104 Trt 4	105 Trt 5	106 Trt 6	107 Trt 7	108 Trt 8	109 Trt 9	110 Trt 10	111 Trt 11	112 Trt 12	113 Trt 13	114 Trt 14	115 Trt 15	116 Trt 16	117 Trt 17	118 Trt 18	119 Trt 19	120 Trt 20	121 Trt 21
201 Trt 17	202 Trt 5	203 Trt 14	204 Trt 2	205 Trt 7	206 Trt 20	207 Trt 4	208 Trt 15	209 Trt 12	210 Trt 33	211 Trt 32	212 Trt 31	213 Trt 30	214 Trt 29	215 Trt 28	216 Trt 27	217 Trt 26	218 Trt 25	219 Trt 24	220 Trt 23	221 Trt 22
301 Trt 13	302 Trt 22	303 Trt 28	304 Trt 3	305 Trt 23	306 Trt 33	307 Trt 10	308 Trt 8	309 Trt 30	310 Trt 19	311 Trt 27	312 Trt 1	313 Trt 9	314 Trt 21	315 Trt 24	316 Trt 16	317 Trt 31	318 Trt 11	319 Trt 6	320 Trt 29	321 Trt 25
401 Trt 21	402 Trt 7	403 Trt 11	404 Trt 15	405 Trt 6	406 Trt 13	407 Trt 8	408 Trt 16	409 Trt 12	410 Trt 24	411 Trt 31	412 Trt 20	413 Trt 25	414 Trt 29	415 Trt 30	416 Trt 9	417 Trt 3	418 Trt 27	419 Trt 26	420 Trt 32	421 Trt 18
501 Trt 18	502 Trt 23	503 Trt 14	504 Trt 1	505 Trt 32	506 Trt 33	507 Trt 4	508 Trt 28	509 Trt 19	510 Trt 5	511 Trt 10	512 Trt 22	513 Trt 2	514 Trt 26	515 Trt 17	516 Trt 13	517 Trt 20	518 Trt 9	519 Trt 15	520 Trt 29	521 Trt 11
601 Trt 24	602 Trt 25	603 Trt 8	604 Trt 2	605 Trt 30	606 Trt 7	607 Trt 5	608 Trt 21	609 Trt 14	610 Trt 3	611 Trt 33	612 Trt 19	613 Trt 12	614 Trt 6	615 Trt 1	616 Trt 16	617 Trt 27	618 Trt 26	619 Trt 32	620 Trt 10	621 Trt 4
701 Trt 31	702 Trt 22	703 Trt 28	704 Trt 18	705 Trt 17	706 Trt 23	707 Trt 12	708 Trt 9	709 Trt 32	710 Trt 13	711 Trt 16	712 Trt 20	713 Trt 4	714 Trt 24	715 Trt 33	716 Trt 30	717 Trt 6	718 Trt 21	719 Trt 27	720 Trt 5	721 Trt 8
801 Trt 10	802 Trt 11	803 Trt 23	804 Trt 31	805 Trt 3	806 Trt 28	807 Trt 7	808 Trt 2	809 Trt 17	810 Trt 29	811 Trt 1	812 Trt 26	813 Trt 25	814 Trt 22	815 Trt 19				819 Trt 14	820 Trt 15	821 Trt 18

Table 2. Effect of treatments on turfgrass visual quality (1-9; 9=highest), overall disease cover (0-100%), disease symptoms severity within activity cover (0-10; 10=highest), overall disease pressure (0-10; 10=highest), green color intensity (1-9, 9=highest) on August 27 and on turfgrass injury (0-10, 10=highest) on July 3 evaluated on annual bluegrass turf. Riverside, CA, 2018.

No.	Treatment	Visual Quality	Disease cover	Disease severity	Disease pressure	Color	Turfgrass injury
1	Untreated Control	2.7 H-K*	48 A-D*	7.7 A-C*	3.7 A-E*	3.3 K-N*	0.7 B-D*
2	Bayer Program No. 1	8.3 A	2 G	0.3 K	0.0 J	8.3 AB	0.7 B-D
3	Bayer Program No. 2	8.0 AB	0 G	0.0 K	0.0 J	7.7 A-D	0.7 B-D
4	Bayer Program No. 3	7.7 AB	0 G	0.0 K	0.0 J	8.0 A-C	1.0 A-C
5	Bayer Program No. 4	6.3 B-D	15 E-G	2.0 H-K	0.9 H-J	6.7 A-G	1.0 A-C
6	Bayer Program No. 5	8.0 AB	0 G	0.0 K	0.0 J	8.7 A	1.7 A
7	UCR 001	3.0 G-K	38 A-F	8.7 AB	3.4 A-F	3.7 J-N	0.0 D
8	UCR 001	2.3 I-K	62 A	8.3 AB	5.1 AB	3.3 K-N	0.0 D
9	UCR 002	2.0 JK	53 AB	8.3 AB	4.4 A-C	2.7 MN	0.0 D
10	UCR 002	3.0 G-K	52 A-C	8.7 AB	4.4 A-C	3.0 L-N	0.0 D
11	UCR 003	3.0 G-K	45 A-D	8.3 AB	3.8 A-D	3.7 J-N	0.0 D
12	UCR 003	1.7 K	60 A	9.0 A	5.4 A	2.0 N	0.0 D
13	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 001	3.7 F-J	40 A-E	6.0 A-F	2.3 D-H	3.7 J-N	0.0 D
14	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 001	3.0 G-K	38 A-F	5.7 B-G	2.3 D-I	4.0 I-N	0.0 D
15	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 002	4.7 D-G	26 B-G	4.7 C-H	1.5 F-J	5.3 E-K	0.0 D
16	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 002	3.0 G-K	38 A-F	7.3 A-D	3.2 B-G	3.7 J-N	0.0 D
17	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 003	3.7 F-J	46 A-D	4.7 C-H	2.2 D-I	3.7 J-N	0.3 CD
18	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M) + UCR 003	4.7 D-G	28 B-G	6.7 A-E	1.9 D-J	4.7 G-M	0.0 D
19	Daconil Weatherstik (3.6 oz/M) + Medallion SC (1.0 oz/M)	3.0 G-K	46 A-D	6.7 A-E	3.0 C-G	3.7 J-N	0.0 D
20	Intelligro Program No. 1	5.0 D-F	20 D-G	4.7 C-H	0.8 H-J	5.0 F-L	0.0 D
21	Intelligro Program No. 2	6.3 B-D	4 G	4.0 E-I	0.3 IJ	6.3 B-H	0.0 D
22	Intelligro Program No. 3	4.3 E-H	28 B-G	4.3 D-I	1.7 E-J	4.3 H-M	0.0 D
23	Nivales T (1.0 oz/M) + Echo Dyad ETQ (4.9 oz/M)	4.7 D-G	23 C-G	2.7 G-K	0.6 H-J	5.0 F-L	0.0 D
24	Anthracnose Program No. 1	4.3 E-H	27 B-G	2.7 G-K	1.6 F-J	4.7 G-M	1.0 A-C
25	Anthracnose Program No. 2	5.3 C-F	5 G	1.7 H-K	0.1 J	6.0 C-I	0.3 CD
26	Daconil Action (3.5 oz/M) + Appear II (6.0 oz/M) + Primo Maxx (0.1 oz/M)	5.7 C-E	10 FG	2.3 H-K	0.5 H-J	5.7 D-J	1.0 A-C
27	A22758A (1.3 oz/M)	5.7 C-E	2 G	0.7 JK	0.0 J	6.3 B-H	1.3 AB
28	A19188 (1.0 oz/M) + Medallion SC (1.0 oz/M)	5.3 C-F	15 E-G	2.0 H-K	0.5 H-J	5.3 E-K	0.3 CD
29	Anthracnose Program No. 3	7.0 A-C	12 E-G	1.7 H-K	0.6 H-J	7.3 A-E	0.3 CD
30	A15457 (0.24 oz/M) + Medallion SC (1.0 oz/M)	4.0 E-I	48 A-D	3.7 E-J	1.9 D-J	4.3 H-M	0.0 D
31	Maxtima (0.8 oz/M)	6.3 B-D	7 G	0.7 JK	0.1 J	6.7 A-G	0.0 D
32	Navicon (0.85 oz/M)	5.3 C-F	2 G	1.3 I-K	0.1 J	7.0 A-F	0.0 D
33	Velista (0.3 oz/M)	3.7 F-J	38 A-F	3.0 F-K	1.2 G-J	3.3 K-N	0.0 D

*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

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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' hybrid bermudagrass turf on a Hanford fine sandy loam. Turf was mowed 3 days/wk at 0.5 inches and received no fertilizer in 2018 before the study began. Fertilizer treatments were initiated on May 23, 2018. Granular treatments were applied 4 times in 6-wk intervals, twice in 8-wk intervals or once at the beginning of the study and then after 4 weeks, followed by liquid formulations. Liquid treatments were sprayed every 2 wks for a total of 12 applications using a CO_2-powered backpack sprayer with TeeJet 8003VS nozzles calibrated to deliver 2 gallons/1000 ft^2. Experimental design was a randomized block with 4 replications. Plot size was 6×10 ft with 1-ft alleys.

Plots were evaluated biweekly for visual turf quality (1-9; 9=highest) and visual color estimation (1-9; 9=highest) starting from May 23, 2018. NDVI measurements and photos for Digital Image Analysis were also taken at each rating date.

Results:

Statistical analysis showed no significant differences among treatments in terms of visual quality except on July 3, 2018, when plots treated with Replenish demonstrated lower quality in comparison to other treatments, and on August 13, 2018, when plots treated with Polyon 43 Mini alone showed lower quality than plots treated with a combination of this fertilizer and GreenTRX. Overall decrease in turf quality on August 13 was due to verticutting performed in the week preceding this rating event. Fertilizer application on August 15 expedited recovery from verticutting injury that was demonstrated on August 30, 2018, although no significant differences among treatments were found on this date. Also, even though no significant differences were shown among treatments on July 16, 2018, overall visual quality at this date was the highest before the verticutting was performed, as well as in general by the date of this publication.

Statistically significant differences in color among treatments were also found on July 3, when Replenish showed the lowest green color intensity of all treatments. On the other hand, both Polyon treatments showed higher color intensity in comparison to treatments with GreenTRX product. On July 16, rapid green up was demonstrated by treatments applied on July 5 and included GreenTRX alone, Replenish and first application of liquid fertilizer formulations. Similar to visual quality, green color intensity values also decreased after verticutting on the August 13 rating date followed by recovery on August 30. On this date highest color intensity values were demonstrated by all treatments containing GreenTRX and Polyon 43 Mini, significantly higher in comparison to all of the remaining treatments. In addition LF180607CONT showed the lowest green color intensity on this date.

NDVI ratings taken on June 19 reflect the increase of plant vigor since May 23, 2018 as well color ratings taken on the same day (data not shown), showing that Polyon 43 Mini treatment alone and mixed with GreenTRX resulted in significantly higher color than GreenTRX alone or UMAXX 46-0-0. No significant differences in NDVI were shown among treatments after verticutting, which confirms that injury was similar to all plots throughout the study. On August 30, recovery rate was higher from granular treatments containing blends of GreenTRX fertilizer with Signature and/or Polyon 43 Mini in comparison to all liquid formulations.

Acknowledgments:

Thanks to Anuvia Plant Nutrients and Sierra Pacific Turf Supply for supporting this research and for providing products.

Table 1. Fertilizer treatments applied in study. Riverside, CA, 2018.

No.	Treatment	Analysis	Company	Rate (lb N/M)	Total applications (frequency)	Timing*
1	100% GreenTRX	16-1-2-17S-3Fe	Anuvia	1	4 (6 wks)	ADGJ
2	100% Polyon 43 Mini	43-0-0	Harrell's	2	2 (8 wks)	AG
3*	50% GreenTRX** 50% Polyon 43 Mini**	16-1-2-17S-3Fe 43-0-0	Anuvia Harrell's	2	2 (8 wks)	AG
4*	50% GreenTRX** 50% Signature**	16-1-2-17S-3Fe 39-0-0	Anuvia Loveland	2	2 (8 wks)	AG
5	100% Replenish	10-2-5	EarthWorks	1	4 (6 wks)	ADGJ
6	100% GreenTRX 100% LF180607A	16-1-2-17S-3Fe 12-0-12	Anuvia Anuvia	1 0.25	1 (initial only) 12 (2 wks)	A C-N
7	100% GreenTRX 100% LF180607CONT	16-1-2-17S-3Fe 12-0-12	Anuvia Anuvia	1 0.25	1 (initial only) 12 (2 wks)	A C-N
8	100% UMAXX 46-0-0*** 100% UMAXX 46-0-0****	46-0-0 46-0-0	Simplot Simplot	1 0.25	1 (initial only) 12 (2 wks)	A C-N

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

*** Granular formulation of UMAXX used for initial application only

**** Liquid formulation of UMAXX used for following applications

***Timing**

A	5/23/2018
B	-
C	6/22/2018
D	7/5/2018
E	7/17/2018
F	8/1/2018
G	8/15/2018
H	8/29/2018
I	9/12/2018
J	9/25/2018
K	10/9/2018
L	10/23/2018
M	11/6/2018
N	11/20/2018

Fertility Trial Plot Plan

(12 G 1 W) →N

108 Trt 8	107 Trt 7	106 Trt 6	105 Trt 5	104 Trt 4	103 Trt 3	102 Trt 2	101 Trt 1
208 Trt 6	207 Trt 2	206 Trt 5	205 Trt 8	204 Trt 1	203 Trt 7	202 Trt 4	201 Trt 3
308 Trt 7	307 Trt 3	306 Trt 1	305 Trt 4	304 Trt 6	303 Trt 8	302 Trt 2	301 Trt 5
408 Trt 1	407 Trt 5	406 Trt 8	405 Trt 2	404 Trt 7	403 Trt 4	402 Trt 3	401 Trt 6

Table 2. Effect of fertilizers on visual turf quality (1-9; 9=highest) and visual color (1-9; 9=highest) of bermudagrass. Riverside, CA, 2018.

No.	Treatment	Visual Quality			
		07/03	07/16	08/13	08/30
1	100% GreenTRX	5.8 AB*	7.8**	3.3 AB*	7.3**
2	100% Polyon 43 Mini	6.5 A	7.0	2.3 C	7.0
3	50% GreenTRX + 50% Polyon 43 Mini	6.5 A	7.3	3.5 AB	7.5
4	50% GreenTRX + 50% Signature	6.0 AB	7.3	3.0 BC	7.8
5	100% Replenish	4.5 C	7.5	4.0 A	6.5
6	100% GreenTRX + 100% LF180607A	5.8 AB	7.8	2.8 BC	6.0
7	100% GreenTRX + 100% LF180607CONT	5.5 B	7.5	3.0 BC	5.8
8	100% UMAXX 46-0-0 + 100% UMAXX 46-0-0	5.5 B	7.5	3.5 AB	6.3
No.	**Treatment**	**Color**			
		07/03	07/16	08/13	08/30
1	100% GreenTRX	6.0 BC*	8.8 A*	4.0**	8.3 A*
2	100% Polyon 43 Mini	7.0 AB	6.8 C	2.5	8.3 A
3	50% GreenTRX + 50% Polyon 43 Mini	7.5 A	7.5 BC	3.3	8.8 A
4	50% GreenTRX + 50% Signature	6.5 ABC	7.3 BC	3.5	8.5 A
5	100% Replenish	4.3 D	8.0 AB	4.8	7.0 B
6	100% GreenTRX + 100% LF180607A	5.5 C	7.8 B	3.8	6.8 B
7	100% GreenTRX + 100% LF180607CONT	5.8 C	7.8 B	4.0	5.5 C
8	100% UMAXX 46-0-0 + 100% UMAXX 46-0-0	5.5 C	7.8 B	3.5	6.5 B

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

Table 2. Effect of fertilizers on NDVI of bermudagrass. Riverside, CA, 2018.

No.	Treatment	NDVI			
		05/23	06/19	08/13	08/30
1	100% GreenTRX	0.49**	0.68 C*	0.30**	0.71 ABC*
2	100% Polyon 43 Mini	0.48	0.74 A	0.28	0.70 BC
3	50% GreenTRX + 50% Polyon 43 Mini	0.49	0.73 A	0.30	0.74 A
4	50% GreenTRX + 50% Signature	0.49	0.72 AB	0.28	0.74 A
5	100% Replenish	0.49	0.68 C	0.31	0.72 AB
6	100% GreenTRX + 100% LF180607A	0.47	0.69 BC	0.32	0.69 BC
7	100% GreenTRX + 100% LF180607CONT	0.48	0.67 C	0.29	0.68 BC
8	100% UMAXX 46-0-0 + 100% UMAXX 46-0-0	0.45	0.69 BC	0.29	0.68 C

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

Stop #4b: Manuscript (Pinoxaden) – A New Postemergence Grass Herbicide for Warm-Season Turf

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Background and Objectives:

Manuscript (pinoxaden) is a new herbicide from Syngenta that was Federally registered in August 2018. California registration is expected in 2019. Pinoxaden is a Group 1 Herbicide, ACCase inhibitor. Specifically, it represents a new class of ACCase inhibitors called “DENs” (vs. “FOPs” and “DIMs”). The first Manuscript label includes use on bermudagrass, zoysiagrass, and St. Augustinegrass sod for postemergence control of crabgrass, broadleaf signalgrass, bull and thin paspalum, ryegrass, and carpetgrass. Typical rate is 19.6 oz/A broadcast or 9.6 oz/10,000 ft^2 or less for spot treatments. The objectives of this research were to evaluate efficacy of Manuscript applied once or twice as broadcast or spot treatments for postemergence control of smooth crabgrass at early and late tillering stages. Drive XLR8 (quinclorac) herbicide was compared as an industry standard.

Materials and Methods:

The study was conducted from June to September 2018 on mature ‘GN-1’ hybrid bermudagrass turf mowed 3 days/wk at 0.5 inches. Soil was a Hanford fine sandy loam. Turf received no fertilizer in 2018 until August (0.5 lb N/M). Herbicide treatments (Table 1) were applied using a CO_2-powered backpack sprayer with TeeJet 8002VS nozzles calibrated to deliver 1 gal/1000 ft^2 for broadcast applications and TeeJet 8003VS nozzles calibrated to deliver 2 gal/1000 ft^2 for spray-to-wet applications. Experimental design was a randomized block with 5 replications. Plot size was 4 ft x 6 ft with 2-ft alleys. Plots were evaluated for turf injury and smooth crabgrass cover beginning at the time of initial herbicide application.

Results:

Crabgrass control data are presented in Table 2. Although most of the crabgrass was treated at either 2-3 or 5-7 tiller stages, some plants were even more mature at each application timing, thus representing a late or worse case scenario for postemergence control of this species. Two applications of Manuscript were best on younger crabgrass compared to a single application of this herbicide or Drive XLR8. On more mature crabgrass, two applications of Manuscript spray-to-wet were most effective compared to one application or even two broadcast applications. Furthermore, two spray-to-wet applications of Drive XLR8 were ineffective on the older crabgrass populations. Bermudagrass injury from herbicide treatments was negligible throughout the study (data not shown). In summary, Manuscript provided very good selective control of smooth crabgrass in bermudagrass turf. Optimal control would be expected when applications are made to more juvenile crabgrass prior to tillering. However, when later timing is unavoidable, it is best to use higher spray volumes containing Manuscript for more effective control.

Acknowledgments

Thanks to Syngenta for supporting this research.

Table 1. Treatments and application information in the postemergence crabgrass study. 2018. Riverside, CA.

Trt	Product(s)	Rate	Timing	Crabgrass Stage	Application
1	Untreated	--	--	--	--
2	Manuscript	41.8 oz/A	A	2-3 tiller	Broadcast
2	NIS	0.5% v/v	A	2-3 tiller	Broadcast
3	Manuscript	41.8 oz/A	AB	2-3 tiller + 14 DAA	Broadcast
3	NIS	0.5% v/v	AB	2-3 tiller + 14 DAA	Broadcast
4	Drive XLR8	64 oz/A	A	2-3 tiller	Broadcast
4	MSO	0.5% v/v	A	2-3 tiller	Broadcast
5	Manuscript	41.8 oz/A	C	5-7 tiller	Broadcast
5	NIS	0.5% v/v	C	5-7 tiller	Broadcast
6	Manuscript	41.8 oz/A	CE	5-7 tiller + 14 DAC	Broadcast
6	NIS	0.5% v/v	CE	5-7 tiller + 14 DAC	Broadcast
7	Manuscript	9.6 oz/10 gal	D	5-7 tiller	Spray-to-wet
7	NIS	0.5% v/v	D	5-7 tiller	Spray-to-wet
8	Manuscript	9.6 oz/10 gal	DF	5-7 tiller + 14 DAD	Spray-to-wet
8	NIS	0.5% v/v	DF	5-7 tiller + 14 DAD	Spray-to-wet
9	Drive XLR8	7.5 oz/10 gal	DF	5-7 tiller + 14 DAD	Spray-to-wet
9	MSO	0.5% v/v	DF	5-7 tiller + 14 DAD	Spray-to-wet

DA = Days after Timing (A, C, or D).

A = 6/10/18
B = 6/24/18
C = 7/9/18
D = 7/9/18
E = 7/24/18
F = 7/24/18

Table 2. Effects of herbicides on postemergence control (0-100%) of smooth crabgrass. 2018. Riverside, CA.

Trt	Product(s)	Timing	Application	6/24/18	7/24/18	8/28/18
1	Untreated	--	--	0 c	0 e	0 d
2 2	Manuscript NIS	A A	Broadcast Broadcast	67 a	50 b	19 cd
3 3	Manuscript NIS	AB AB	Broadcast Broadcast	66 a	82 a	74 a
4 4	Drive XLR8 MSO	A A	Broadcast Broadcast	22 b	0 e	0 d
5 5	Manuscript NIS	C C	Broadcast Broadcast	0 c	10 de	0 d
6 6	Manuscript NIS	CE CE	Broadcast Broadcast	0 c	25 cd	28 bc
7 7	Manuscript NIS	D D	Spray-to-wet Spray-to-wet	0 c	41 bc	42 b
8 8	Manuscript NIS	DF DF	Spray-to-wet Spray-to-wet	0 c	47 bc	87 a
9 9	Drive XLR8 MSO	DF DF	Spray-to-wet Spray-to-wet	0 c	0 e	0 d

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

A = 6/10/18
B = 6/24/18
C = 7/9/18
D = 7/9/18
E = 7/24/18
F = 7/24/18

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

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Objectives:

1. To evaluate the efficacy of biostimulant/nutrient products on a Poa annua green to reduce stress caused by irrigation with saline water.
2. To evaluate various fungicide treatments for effective Rapid Blight disease (*Labyrinthula terrestris*) on annual bluegrass maintained as a golf course putting green.

Materials and Methods:

A 5400-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 using aeration cores from Mesa Verde Country Club in Orange County. Due to severe loss of turf in 2017 season, plugs after fall aeration were spread throughout the most injured areas in order to renovate damaged areas. Also, *Poa annua* 'Two Putt' seeded at 2 lbs/ 1000ft^2 in the spring of 2018 to improve turf recovery by the beginning of the trial. During the trial, turf was mowed at 0.125 inches 5 times/week using a triplex mower, topdressed monthly with sand, and received 0.125 lbs N/M and Primo Maxx at 0.125 oz/M every two weeks.

Starting on July 2, 2018, plots were irrigated with saline water (2.0 dS/m) at 130% ET_{os} replacement. The 60' × 90' area was divided into six 30' × 30'areas. Single plot size was 4×6 ft with 1-ft or no alleys. Each area was watered by sprinkler system every night, for a total of 0.06 in./night. The remaining ET_{os} is replaced every day by watering with two irrigation methods replicated 3 times inside the study area:

a) Frequent shallow irrigation: plots are hand-watered twice a day (morning+afternoon)

b) Deep irrigation: plots are hand-watered only once in the afternoon.

For salinity alleviation, treatments (Table 1) focused on biostimulants and nutrients, since these types of products helped improve turf quality under saline conditions in previous studies conducted at UCR. 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 (ECe) using POGO, and Naturalized Difference Vegetation Index (NDVI) and Dark Green Color Index (DGCI) using Digital Image

Analysis (DIA). Treatments were applied by hand or using a calibrated CO_2 boom sprayer (TeeJet 8004 VS nozzles; 2 gal/1000 ft^2).

Fungicide treatments were applied every 14 days beginning on July 3, 2018. (before disease symptoms were present) for a total of 8 applications. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8004VS nozzles calibrated to deliver 2 gallons/1000 ft^2.

Every two weeks plots were evaluated for visual turf quality (1-9; 9=highest), volumetric water content (VWC) and soil electrical conductivity (EC_e) using POGO, Naturalized Difference Vegetation Index (NDVI) and Dark Green Color Index (DGCI) using Digital Image Analysis (DIA). In addition, injury caused by treatments (0-10; 10=highest), overall turf cover (0-100%), *Poa annua* cover (0-100%) and injury (0-10; 10=highest) as well as Rapid Blight disease pressure (0-100%) were evaluated on biweekly basis starting from July 2, 2018.

Results:

Increasing mowing height from the previous year caused bentgrass to take over annual bluegrass. Irrigation regime had the greater effect on bentgrass quality and NDVI, with deep, infrequent irrigation performing better than shallow irrigation (Fig. 1). However, differences in irrigation regimes may be the result of uneven distribution of sand in the rootzone. Treatment did not have a significant impact on turf quality.

No significant effect of treatments was shown on any of the parameters evaluated in this trial (visual quality, total turfgrass cover, disease cover, disease severity within cover, annual bluegrass cover and injury, NDVI, cover (DIA), DGCI, VWC, EC_e (POGO); results not shown). This is mostly due to decreased annual bluegrass cover within the trial area, as well as to lack of uniformity in terms of its distribution. Furthermore, acervuli of *Colletotrichum cereale,* causing anthracnose, were found within the study area. All of these factors working together contributed to high variability within treatments, resulting in impeded data analysis.

Although soil salinity increased (Table 4), presence of *Labyrinthula terrestris* has not yet been identified.

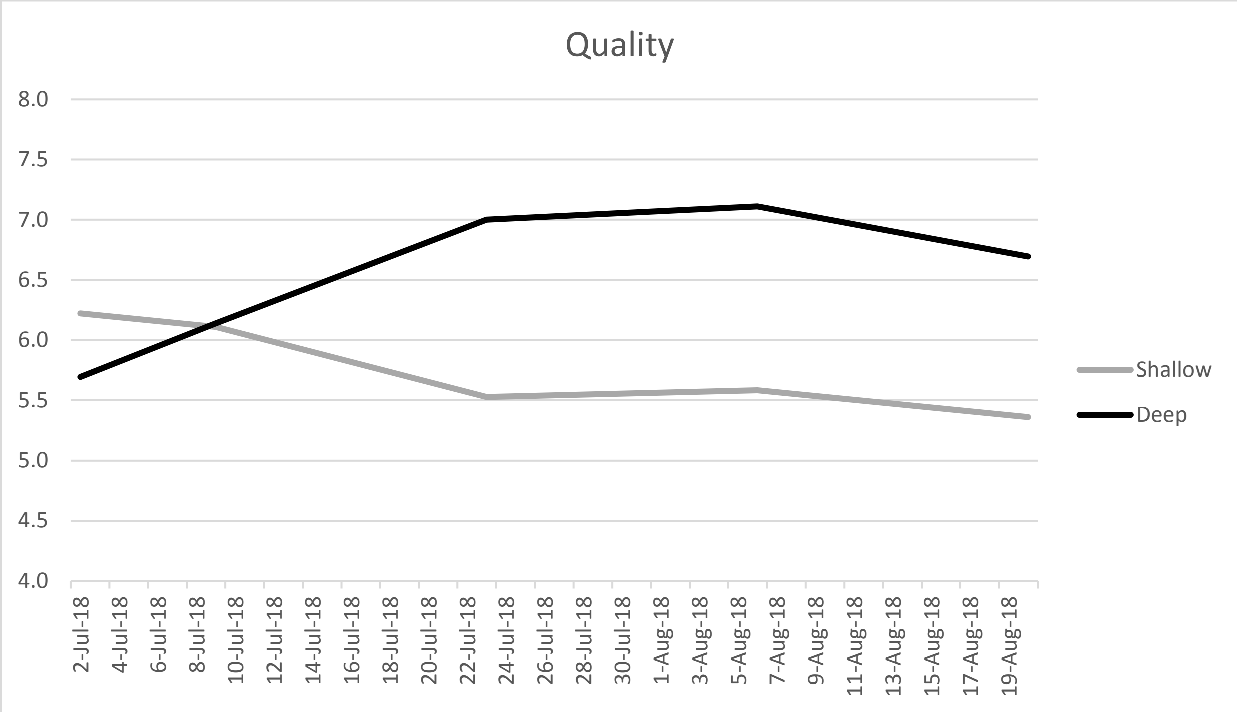
Acknowledgments:

Thanks to the CTLF, Harrell's, OGT, Ocean Organics, Solutions 4Earth, Target, Wilbur-Ellis BASF, Intelligro, NuFarm and Syngenta for supporting this research and/or for providing products.

Table 1. Treatment list for the salinity alleviation trial. 2018. Riverside, CA.

No.	Treatment	Company	Rate	Frequency (wks)
1	Untreated Control	--	--	--
2a	NutriMend (10-3-0)	Solutions 4Earth	16 fl oz/M	1
2b	Komodo Pro (0-0-16)		8 fl oz/M	1
3a	StressRx	Ocean Organics	6 oz/M	2
3b	XP Micro		6 oz/M	2
4a	Aquaplex amino	Wilbur-Ellis	4.5 oz/M	2
4b	Nutrio Unlock P&K		1.5 oz/M	2
4c	Puric humic acid		1.5 oz/M	2
5a	Link Fourtyplex (2-0-3)	Wilbur-Ellis	6 oz/M	2
5b	Nutrio Unlock P&K		1.5 oz/M	2
6a	NutriMend (10-3-0)	Solutions 4Earth	16 fl oz/M	1
6b	Komodo Pro (0-0-16)		8 fl oz/M	1
7	Earthmax	Harrell's	4 oz/M	2
8	SWE	Harrell's	4 oz/M	2
9	Max Amino	Harrell's	1 oz/M	2
10	Soil Surge	Harrell's	1.5	1
11	Algae Green	OGT	8.8 oz/M	2
12a	Element 6	Target	3 oz/M	1
12b	Respo Fuel	Target	3 oz/M	1
12c	Minors Fuel	Target	3 oz/M	1
12d	Root Down 18-0-0	Target	3 oz/M	1

Figure 1. Quality and NDVI of plots hand-watered either every day in the morning and afternoon (shallow), or only in the afternoon (deep). 2018. Riverside, CA.



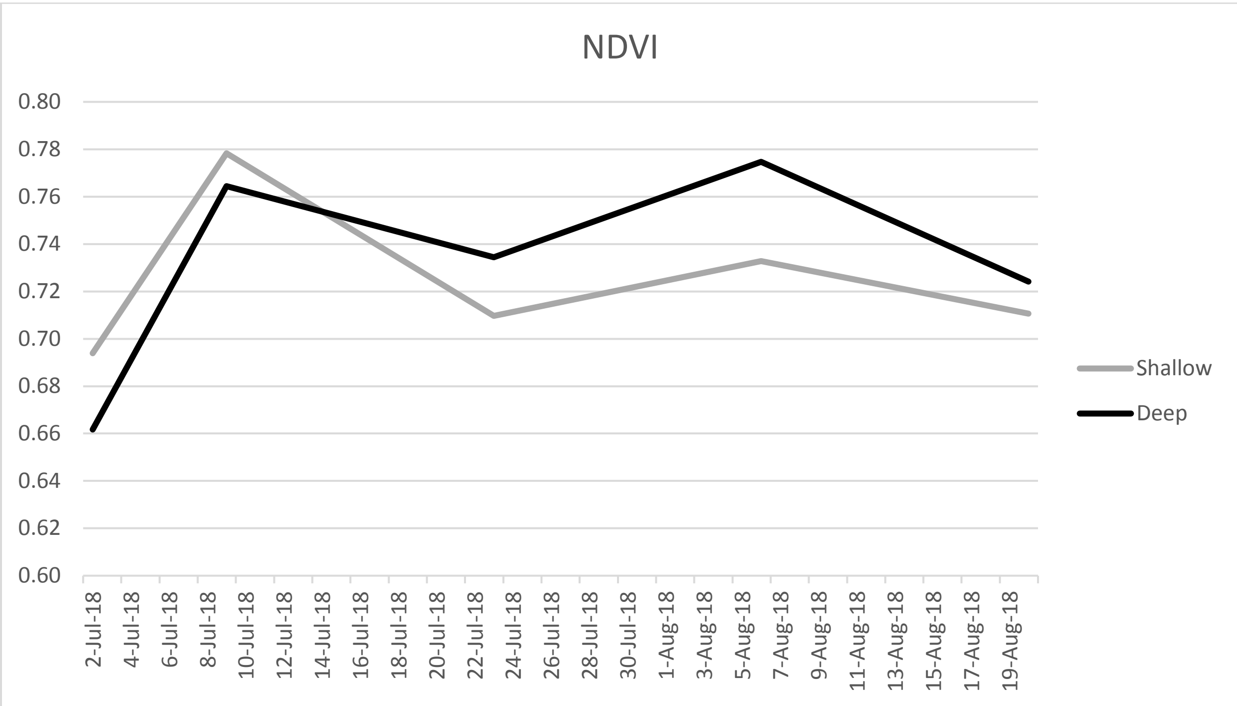


Table 2. Fungicide treatments evaluated for Rapid Blight control. Riverside, CA, 2018.

No.	Treatment	Active ingredient	Company	Rate (oz/M)	Timing*
13	Untreated Control	-	-	-	-
14	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	A-H
	Medallion SC	fludioxonil	Syngenta	1.00	
15	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	A-H
16	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	A-H
	Velista	penthiopyrad	Syngenta	0.50	
17	Secure Action	fluazinam, acibenzolar-S-methyl	Syngenta	0.50	A-H
	Daconil Action	chlorothalonil, acibenzolar-S-methyl	Syngenta	3.50	
18	A18126B	*classified*	-	0.16	A-H
19	Maxtima	mefentrifuconazole	BASF	0.80	A-H
20	Navicon	mefentrifuconazole, pyraclostrobin	BASF	0.85	A-H
21	Velista	penthiopyrad	Syngenta	0.50	A-H
22	Insignia	pyraclostrobin	BASF	0.70	A-H
23	UCR 001	-	-	-	A-H
24**	Intelligro Program				
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	A
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Banner Maxx II	propiconazole	Syngenta	1.00	
	Medallion SC	fludioxonil	Syngenta	1.00	B
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	C
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Velista	penthiopyrad	Syngenta	0.30	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	D
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Insignia	pyraclostrobin	BASF	0.90	
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	E
	Affirm WDG	polyoxin D zinc salt	Nufarm	0.88	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	F
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Medallion SC	fludioxonil	Syngenta	1.00	
	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	G
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Velista	penthiopyrad	Syngenta	0.30	

** Continued on the following page

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24***	Alude	mono- and dibasic sodium, potassium, and ammonium phosphites	Nufarm	5.50	H
	CIVITAS TURF DEFENSE Pre-M1xed	mineral oil	Intelligro	8.50	
	Insignia SC	pyraclostrobin	BASF	0.50	

Table 3. Fungicide treatments used on control for salinity alleviation trial. Riverside, CA, 2018.

No.	Treatment	Active ingredient	Company	Rate (oz/M)	Timing*
SA	Insignia SC	pyraclostrobin	BASF	0.70	ACEG
	Velista	penthiopyrad	Syngenta	0.50	BDFH

***Timing**

A 7/3/2018
B 7/17/2018
C 8/1/2018
D 8/15/2018
E 8/29/2018
F 9/12/2018
G 9/26/2018
H 10/10/2018

Management of Salinity and Rapid Blight Disease Trials Plot Plan

(12 F 4) ↑N

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

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

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

Table 4. Change of ECe within the Rapid Blight trial. Riverside, CA, 2018.

No.	Treatment	EC_e	
		07/02	08/20
13	Untreated Control	0.56	1.75
14	Daconil Action (3.5 oz/M) + Medallion SC (1.0 oz/M)	0.68	1.43
15	Secure Action (0.5 oz/M)	0.70	1.75
16	Secure Action (0.5 oz/M) + Velista (0.5 oz/M)	0.56	1.47
17	Secure Action (0.5 oz/M) + Daconil Action (3.5 oz/M)	0.80	1.53
18	A18126B (0.16 oz/M)	0.67	1.75
19	Maxtima (0.8 oz/M)	0.58	1.50
20	Navicon (0.85 oz/M)	0.51	1.41
21	Velista (0.5 oz/M)	0.70	1.65
22	Insignia (0.7 oz/M)	0.73	1.35
23	UCR 001	0.67	1.41
24	Intelligro Program	0.72	1.63

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

Stop #6: Broadleaf Herbicide Safety and Water Use on Kurapia Groundcover

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Objective:

Out of all herbicides registered in California, the most common active ingredients are 2,4-D (264 products), dicamba (246 products), glyphosate (223 products) and MCPP (194 products) (CDPR, 2018). Glyphosate (a non-selective herbicide) aside, usually broadleaf herbicides are formulated in mixes to control a broader spectrum of weeds and most commonly a 3-way mix of 2,4-D, dicamba and MCPP can be found in different proportions. Since the biggest weed management challenge in Kurapia is selectively controlling broadleaf weeds in a broadleaf ground cover, our goal was to test injury and regeneration rate of Kurapia caused by 2,4-D, dicamba, MCPP and MCPA both alone and in mixes.

Materials and Methods:

Four single ingredient herbicides alone and in 2- or 3-way mixes were tested on mature Kurapia established in 2015. Herbicides used were: Weedar 64 (46.8% 2,4-D), Diablo (49.41% Dicamba), MCPP-p (26% MCPP) and MCPA-4 (48.58% MCPA). Treatments were based according to a 3-factor simplex-centroid design with additional interior points and are presented in Table 1. Soil was a Hanford fine sandy loam. Herbicides were tank mixed and 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 4 replications. Plot size was 4 ft x 6 ft with 2-ft alleys. Plots were evaluated for flowering (1 [no flowers] – 9 [best flowering]), Visual quality (1 [worst] – 9 [best]) and injury (%). Ratings were done on the day of application and 1 week after treatment (WAT) before publication of this report. Kai Umeda, Area Turfgrass Extension Agent at University of Arizona, is repeating this study in Phoenix.

Results:

Applied herbicides had a significant impact on all measured traits. Almost all herbicides caused complete loss of flowers compared to control within 1 WAT with exception of treatment 3 (Dicamba alone) where still few flowers could be observed. From all treatments applied, 2,4-D alone (treatment 2) had the most significant impact on visual quality drop while for all other treatments no significant differences could be observed. The same treatment also caused the greatest injury, although apart from control, only Dicamba and MCPA (alone and in 2-way mix) had significantly less injury than 2,4-D alone. It is still too early to tell which treatment is most injurious or safest to Kurapia since herbicide effect will most likely differentiate more in time. Results are presented in Table 2.

Acknowledgments:

Thanks to Kurapia Inc. for supporting this research and NuFarm for donating herbicides.

References:

CDPR (2018) California Product/Label Database. CDPR. Accessed Sep 1st 2018 https://www.cdpr.ca.gov/docs/label/labelque.htm

Table 1 List of treatments applied in the Kurapia broadleaf herbicide safety study. Riverside, CA. 2018.

	Herbicide (rate)				Active ingredient (rate)				Active ingredient (%)			
Treatment number	**Weedar 64 (oz/A)**	**Diablo (oz/A)**	**MCPP-p (oz/A)**	**MCPA-4 (oz/A)**	**2,4-D (oz/A)**	**Dicamba (oz/A)**	**MCPP (oz/A)**	**MCPA (oz/A)**	**2,4-D**	**Dicamba**	**MCPP**	**MCPA**
1 - Control												
2	43.6				16.9				100%			
3		10.9				4.5				100%		
4			43.6				9.4				100%	
5	21.8	5.4			8.5	2.2			79.1%	20.9%		
6	21.8		21.8		8.5		4.7		64.3%		35.7%	
7		5.4	21.8			2.2	4.7			32.2%	67.8%	
8	14.5	3.6	14.5		5.6	1.5	3.1		55.0%	14.5%	30.5%	
9	29.0	1.8	7.3		11.3	0.7	1.6		83.0%	5.5%	11.5%	
10	7.3	7.3	7.3		2.8	3.0	1.6		38.3%	40.4%	21.3%	
11	7.3	1.8	29.0		2.8	0.7	6.2		28.7%	7.6%	63.7%	
12				43.6				17.3				100%
13	21.8			21.8	8.5			8.6	49.1%			50.9%
14		5.4		21.8		2.2		8.6		20.3%		79.7%
15	14.5	3.6		14.5	5.6	1.5		5.8	43.4%	11.5%		45.1%
16	29.0	1.8		7.3	11.3	0.7		2.9	75.4%	5.0%		19.6%
17	7.3	7.3		7.3	2.8	3.0		2.9	32.3%	34.1%		33.6%
18	7.3	1.8		29.0	2.8	0.7		11.5	18.5%	4.9%		76.7%

Table 2 Effect of herbicides on Flowering, Visual Quality and Injury on Kurapia groundcover. Riverside, CA. 2018.

	Flowering		Visual Quality		Injury (%)	
Treatment	Initial	1 WAT	Initial	1 WAT	Initial	1 WAT
1	7.5 a	6.8 a	7.3 a	7.0 a	0 a	0.00 a
2	5.8 a	1.0 c	6.8 a	5.0 b	0 a	6.50 c
3	7.5 a	2.0 b	7.3 a	6.5 ab	0 a	0.25 ab
4	6.8 a	1.0 c	7.5 a	6.0 ab	0 a	1.50 abc
5	6.0 a	1.0 c	6.5 a	5.5 ab	0 a	3.50 abc
6	7.8 a	1.0 c	7.3 a	5.5 ab	0 a	2.50 abc
7	7.3 a	1.0 c	7.3 a	5.8 ab	0 a	1.00 abc
8	6.8 a	1.0 c	6.8 a	5.8 ab	0 a	2.50 abc
9	6.0 a	1.0 c	7.3 a	5.5 ab	0 a	5.00 abc
10	7.5 a	1.0 c	7.8 a	6.0 ab	0 a	1.00 abc
11	7.8 a	1.0 c	7.8 a	5.8 ab	0 a	2.25 abc
12	6.0 a	1.0 c	7.3 a	6.5 ab	0 a	0.00 a
13	6.0 a	1.0 c	7.0 a	5.5 ab	0 a	5.75 bc
14	8.0 a	1.0 c	7.5 a	6.5 ab	0 a	0.25 ab
15	6.0 a	1.0 c	6.8 a	5.5 ab	0 a	3.75 abc
16	6.5 a	1.0 c	6.8 a	5.8 ab	0 a	2.00 abc
17	6.8 a	1.0 c	7.3 a	5.8 ab	0 a	2.00 abc
18	6.3 a	1.0 c	7.0 a	5.5 ab	0 a	1.75 abc

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

Plot plan → N

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

Stop #7: Wetting Agents for Water Conservation on Bermudagrass Turf

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Justification and Objectives:

Previous research has demonstrated that wetting agents are one of the most important products in a turfgrass water conservation program. Furthermore, Revolution (Aquatrols) and TriCure AD (Mitchell Products) have proven to be among the top products for reducing localized dry spots (LDS) under deficit irrigation. In this study, we aimed to identify "cost effective" products that can help conserve water on large scale areas such as bermudagrass fairways subjected to 45, 55, and 65% ET_{os} irrigation replacement.

Methods:

The study is conducted at the UC Riverside turfgrass research facility in Riverside, CA on mature hybrid bermudagrass 'Tifway II' established in 2017. The 60' x 90' field is divided into 12 20' x 20' plots. From June thru October each year, the plots receive either 45, 55, or, 65% of previous week ET_{os} by hand watering to maximize water distribution uniformity as determined by an on-site CIMIS station. Treatments are arranged in a split-plot design with twelve wetting agent treatments (plot size 24 ft^2) randomized within ET_{os} replacement plots and 4 replicates. Treatments (Table 1) are applied according to company recommendations beginning on May 23 each year. Treatments will be tested against an untreated control and Revolution that will serve as "UCR standard". A 2-wk 'conditioning period' followed first application, with deficit irrigation starting on June 6. The study receives 5 lb N/M/year and is mowed at 0.5 in. Spray treatments are applied using a CO_2-powered hand boom sprayer equipped with TeeJet 8004VS nozzles and output of 2 gal/M. All treatments are irrigated with ca. 0.25 in. of water following application with water coming from the previous week's irrigation budget. Every two weeks, plots are evaluated for turf quality on a scale from 1 = worst to 9 = best, Normalized Difference Vegetation Index (NDVI) using a GreenSeeker instrument, volumetric soil water content (VWC) using time domain reflectometry (TDR), and dark green color index (DGCI) as well as percent cover using Digital Image Analysis (DIA). Leaf samples are collected monthly from May until October to determine proline content in the tissues. Double ring infiltrometer test is also performed monthly from May until October. Visual turf quality and % green cover using DIA will also be taken to measure the effect of wetting agent products on bermudagrass dormancy and green-up in late fall and early spring.

Results

No differences in treatments were found until the end of July, when plots started show differences when irrigated at 55% and 45% ET_{os}. While at 55% ET_{os} Forte+Brilliance and Passage appear to achieve the best quality and NDVI (Table 2 and 3), when irrigation is further reduced to 45% ET_{os}, TriCure AD and Revolution had the greatest impact on bermudagrass performance (Tables 2 and 3). All plots watered at 55% ET_{os} with the exception of control never dropped below an acceptable quality level of 6; however, at 45% ET_{os} Forte + CounterAct Retain and MPX5 dropped below acceptable quality levels in 2 out of 8 rating dates. Sufficient quality was always sustained at 65% ET_{os} even by the control, and no statistical differences were detectable between treatments (data not shown).

Acknowledgments

Thanks to the CTLF for funding this research and Aquatrols, Exacto, Harrell's, Mitchell Products, Numerator Tech, and Precision Laboratories for providing products.

Table 1. Treatment list for the wetting agent trial (2018-2019) at UCR.

Treatment	Rate	Company	Frequency (weeks)
Untreated control	--	--	
Revolution	6 oz/M	Aquatrols	4
ACA001	4 oz/M	Aquatrols	4
TriCure AD	6 oz/M	Mitchell Products	4
MPX-5	3 oz/M	Mitchell Products	4
Forte + CounterAct Retain	0.37 oz/M + 3 oz/M	Simplot	4
Forte + Brilliance	0.37 oz/M + 3 oz/M	Simplot	4
Aquimax Turf Lateral	8 oz/M (initial)/ 4 oz/M (subsequent)	Exacto	4
Passage	6 oz/M	Numerator Tech	4
Vivax	5 oz/M	Precision Laboratories	4
Cascade Plus	8 oz/M (initial)/ 4 oz/M (subsequent)	Precision Laboratories	4
Hydro90+Symphony	3 oz/M + 3 oz/M	Harrell's	4

Table 2. Visual quality of wetting agent treated plots hand-watered at 55% and 45 ET_{os}.

Treatment	55% ET_{os}			45% ET_{os}		
	7/24	8/7	8/21	7/24	8/7	8/21
Untreated control	5.25b	5.75c	5.25d	4.75b	6.25a	4.5b
Revolution	6a	7ab	7ab	6a	6a	6.5a
ACA001	6a	7ab	6.50abc	6a	6.75a	6a
TriCure AD	6a	6.75ab	6.75abc	6a	6.5a	6.75a
MPX-5	5.75a	6.50abc	6.50abc	5.75a	6.25a	5.5ab
Forte + CounterAct Retain	6a	6.50abc	6.50abc	5.75a	6.25a	5.75ab
Forte + Brilliance	6a	6.75ab	7.50a	6a	6.5a	6a
Aquimax Turf Lateral	6a	6.25bc	5.75cd	6a	6.25a	6.5a
Passage	6a	7.25a	7.25a	6a	6.5a	6.25a
Vivax	6a	7.25a	6.75abc	5.75a	6.25a	6.5a
Cascade Plus	5.75a	6.50abc	6.00bcd	6a	6.75a	6.5a
Hydro90+Symphony	6a	7ab	6.75abc	5.75a	6.25a	6.25a

Table 3. NDVI of wetting agent treated plots hand-watered at 55% and 45 ET_{os}.

Treatment	55% ET_{os}			45% ET_{os}		
	7/24	8/7	8/21	7/24	8/7	8/21
Untreated control	0.61b	0.63c	0.56b	0.52d	0.56c	0.51d
Revolution	0.67a	0.76a	0.68a	0.66a	0.70a	0.67a
ACA001	0.67a	0.73ab	0.65a	0.62abc	0.65ab	0.63abc
TriCure AD	0.66a	0.73ab	0.69a	0.63ab	0.70a	0.67a
MPX-5	0.65a	0.74ab	0.68a	0.55cd	0.62abc	0.58bcd
Forte + CounterAct Retain	0.63ab	0.71ab	0.67a	0.56bcd	0.58bc	0.56cd
Forte + Brilliance	0.65a	0.75a	0.70a	0.59abcd	0.67a	0.64abc
Aquimax Turf Lateral	0.64ab	0.69b	0.64a	0.62abc	0.68a	0.66ab
Passage	0.66a	0.75a	0.68a	0.60abc	0.62abc	0.61abc
Vivax	0.64ab	0.72ab	0.68a	0.59abc	0.68a	0.66ab
Cascade Plus	0.64ab	0.71ab	0.67a	0.61abc	0.67a	0.66ab
Hydro90+Symphony	0.64ab	0.71ab	0.67a	0.62abc	0.69a	0.63abc

Stop #8a: Evaluation of Fungicides for Control of *Pythium* Blight Disease on Perennial Ryegrass Turf

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Objectives:

This study was conducted to evaluate ability of sixteen different fungicide treatments to control *Pythium* Foliar Blight disease preventatively on perennial ryegrass (*Lolium perenne*) turf maintained as an overseeded golf course fairway.

Materials and methods:

The study was conducted on mature 'Princess-77' bermudagrass turf overseeded with 'Wicked' perennial ryegrass (*Lolium perenne*) on August 10, 2018 at 1,600 lbs/A. Soil was Hanford fine sandy loam. Five days prior to overseeding, the study area was sprayed with tank-mix of Turflon at 16 oz/A and Reward at 32 oz/A. Furthermore, the day before seeding, turf was verticut and scalped followed by of application Primo Maxx at 0.5 oz/1000 ft^2 to the mat. Turf was mowed 3 days/wk at 0.5 inches starting 14 days after overseeding. Twelve days after trial initiation, silt fence was mounted around the study area to decrease air movement and help incite disease activity. Experimental design was a randomized block with 4 replications. Plot size was 4×6 ft with 2-ft alleys.

Total of 16 fungicide treatments (including untreated control) were applied as described in Table 1 beginning on August 10, 2018. Initial treatment was applied to turf directly before the sowing of the seeds. Treatments were applied using a CO_2-powered backpack sprayer with TeeJet 8004VS nozzles calibrated to deliver 2 gallons/1000 ft^2.

Results:

Unfortunately for this experiment, weather conditions were not conducive for disease development leading up to publication of this report.

Acknowledgments:

Thanks to Bayer, PBI-Gordon, and Syngenta for supporting this research and/or for providing products.

Table 1. Treatments evaluated in Pythium Blight Fungicide trial. Riverside, CA, 2018.

No.	Treatment	Active ingredient	Company	Rate (oz/M)	Total applications (frequency)	Timing*
1	Untreated Control	-	-	-	-	-
2	Heritage Action	azoxystrobin, acibenzolar-S-methyl	Syngenta	0.40	2 (10 days)	AB
3	Subdue Maxx	mefenoxam	Syngenta	1.00	4 (14 days)	ACEF
4	Banol	propamocarb hydrochloride	Bayer	2.00	4 (14 days)	ACEF
5	Banol	propamocarb hydrochloride	Bayer	2.00	4 (14 days)	AE
	Chipco Signature	aluminium-tris	Bayer	4.00		CF
6	Banol	propamocarb hydrochloride	Bayer	2.00	4 (14 days)	AE
	Signature XTRA Stressgard	aluminium-tris	Bayer	4.00		CF
7	Banol	propamocarb hydrochloride	Bayer	2.00	4 (14 days)	AE
	Segway	cyazofamid	PBI-Gordon	0.90		CF
8	Segway	cyazofamid	PBI-Gordon	0.90	4 (14 days)	ACEF
9	Segway	cyazofamid	PBI-Gordon	0.45	1 (14th day only)	C
10	Segway	cyazofamid	PBI-Gordon	0.90	1 (21th day only)	D
11	UCR 001	*classified*	-	-	1 (14th day only)	C
12	UCR 001	*classified*	-	-	1 (21th day only)	D
13	UCR 002	*classified*	-	-	4 (14 days)	ACEF
14	UCR 002	*classified*	-	-	4 (14 days)	ACEF
15	UCR 002	*classified*	-	-	4 (14 days)	ACEF
16	UCR 002	*classified*	-	-	4 (14 days)	ACEF
	UCR 003	*classified*	-	-		

***Timing**

A	8/10/2018	Initial
B	8/20/2018	10 DAIT**
C	8/24/2018	14 DAIT**
D	8/31/2018	21 DAIT**
E	9/7/2018	28 DAIT**
F	9/21/2018	42 DAIT**

**DAIT - days after initial treatment / overseeding

Pythium Blight Fungicide Trial Plot Plan

(12 E 11 N) ↑N

101 Trt 1	102 Trt 2	103 Trt 3	104 Trt 4	105 Trt 5	106 Trt 6	107 Trt 7	108 Trt 8	109 Trt 9	110 Trt 10	111 Trt 11	112 Trt 12	113 Trt 13
201 Trt 7	202 Trt 5	203 Trt 9	204 Trt 12	205 Trt 1	206 Trt 13	207 Trt 6	208 Trt 3	209 Trt 10	210 Trt 2	211 Trt 16	212 Trt 15	213 Trt 14
301 Trt 4	302 Trt 15	303 Trt 8	304 Trt 16	305 Trt 11	306 Trt 14	307 Trt 3	308 Trt 9	309 Trt 1	310 Trt 10	311 Trt 7	312 Trt 5	313 Trt 12
401 Trt 10	402 Trt 5	403 Trt 12	404 Trt 9	405 Trt 14	406 Trt 2	407 Trt 8	408 Trt 16	409 Trt 6	410 Trt 11	411 Trt 15	412 Trt 4	413 Trt 13
501 Trt 8	502 Trt 16	503 Trt 2	504 Trt 15	505 Trt 4	506 Trt 13	507 Trt 6	508 Trt 11	509 Trt 3	510 Trt 14	511 Trt 1	512 Trt 7	

Stop #8b: Evaluation of Plant Growth Regulators (PGRs) on Bermudagrass Turf

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Objectives:

These studies were conducted to quantify effects of two plant growth regulators (PGRs) on growth regulation, injury and visual turfgrass quality on bermudagrass (*Cynodon* spp.) maintained as a golf course fairway or athletic field.

Materials and methods:

The study was conducted on mature 'Princess 77' (Plot 12 E 19 E and Plot 12 E 11 S) bermudagrass turf on a Hanford fine sandy loam. Turf was mowed 3 days/wk at 0.5 inches and received 0.5 lbs N/1000 ft^2 every 6 weeks for a target of 5 lbs N/1000 ft^2/yr.

Plant growth regulator (PGR) treatments were applied every 14 days beginning on July 22, 2018 (12 E 19 E) and August 15, 2018 (12 E 11 S) for a total of 4 applications. Treatments were applied using a CO_2-powered backpack sprayer equipped with TeeJet 8002VS nozzles calibrated to deliver 1 gallon/1000 ft^2. Experimental design was a randomized block with 4 replications. Plot size was 4×10 ft with 2-ft alleys.

Plots were evaluated for visual turf quality (1-9; 9=highest), visual green color intensity (1-9; 9=highest), injury caused by treatments (0-10; 10=highest), NDVI and DIA on biweekly basis starting from July 17, 2018 (12 E 19 E) and August 13, 2018 (12 E 11 S). In addition, clipping yield collection was performed every two weeks, before treatments were applied.

Results:

No significant differences were found among the treatments in terms of visual turf quality, visual green color intensity, NDVI and DGCI or turf cover (DIA) in both trials by September 5, 2018 (Tables 1 and 2). In general, visual turf quality, color and NDVI increased in both studies since the time of initial applications. This was mostly due to improved maintenance practices on those plots.

On the other hand, in the trial conducted on 12 E 19 E plot (Table 3), a significant decrease in clipping yield production was shown with Primo Maxx on August 13, 2018 (4 WAIT).

Acknowledgments:

Thanks to NuFarm and Syngenta for supporting this research and for providing products.

Table 1. Treatments evaluated in Plant Growth Regulators (PGRs) trials. Riverside, CA, 2018.

No.	Treatment	Active ingredient	Company	Rate (oz/A)	Timing*
1	Untreated Control	-	-	-	-
2	Anuew	prohexadione-calcium	NuFarm	12	ABCD
3	Anuew	prohexadione-calcium	NuFarm	24	ABCD
4	Primo Maxx	trinexapac-ethyl	Syngenta	11	ABCD

***Timing (12 E 11 S)**

A	8/15/2018
B	8/29/2018
C	9/12/2018
D	9/26/2018

***Timing (12 E 19 E)**

A	7/22/2018
B	8/1/2018
C	8/15/2018
D	8/29/2018

Plant Growth Regulators (PGRs) Trials Plot Plans

(12 E 11 S) ↑N

101 Trt 1	102 Trt 2	103 Trt 3	104 Trt 4	201 Trt 2	202 Trt 1	203 Trt 4	204 Trt 3

301 Trt 3	302 Trt 4	303 Trt 1	304 Trt 2	401 Trt 4	402 Trt 3	403 Trt 2	404 Trt 1

(12 E 19 E) →N

204 Trt 3	203 Trt 1	202 Trt 2	201 Trt 4	104 Trt 4	103 Trt 3	102 Trt 2	101 Trt 1

S

404 Trt 1	403 Trt 2	402 Trt 4	401 Trt 3	304 Trt 2	302 Trt 4	303 Trt 1	301 Trt 3

Table 2. Effect of plant growth regulators (PGRs) on visual turf quality (1-9; 9=highest), injury caused with treatments (0-10; 10=highest), visual green color intensity (1-9; 9=highest), NDVI and clipping yield (CY; g) of bermudagrass on 12 E 11 S plot. Riverside, CA, 2018.

No.	Treatment	Quality 08/13	Quality 08/27	Color 08/13	Color 08/27	NDVI 08/13	NDVI 08/27
1	Untreated Control	4.3*	6.0*	5.5*	6.5*	0.63*	0.79*
2	Anuew (12 oz/A)	4.8	6.5	6.0	6.3	0.65	0.78
3	Anuew (24 oz/A)	4.5	6.8	5.8	6.5	0.65	0.79
4	Primo Maxx (11 oz/A)	3.8	6.5	5.8	6.3	0.61	0.78

No.	Treatment	CY 08/13	CY 08/27	Injury 08/27
1	Untreated Control	8.6*	7.40*	0.3*
2	Anuew (12 oz/A)	7.1	6.82	0.3
3	Anuew (24 oz/A)	11.4	7.35	0.3
4	Primo Maxx (11 oz/A)	10.6	7.28	0.3

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

Table 3. Effect of plant growth regulators (PGRs) on visual turf quality (1-9; 9=highest), injury caused with treatments (0-10; 10=highest), visual green color intensity (1-9; 9=highest), NDVI and clipping yield (CY; g) of bermudagrass on 12 E 19 E plot. Riverside, CA, 2018.

No.	Treatment	Quality 07/17	Quality 08/27	Color 07/17	Color 08/27	NDVI 07/17	NDVI 08/27
1	Untreated Control	5.0*	6.25*	5.3*	6.5*	0.57*	0.78*
2	Anuew (12 oz/A)	4.8	6.25	5.0	6.5	0.55	0.77
3	Anuew (24 oz/A)	4.5	7.00	4.8	7.5	0.58	0.79
4	Primo Maxx (11 oz/A)	4.8	6.75	4.8	7.0	0.56	0.77

No.	Treatment	CY 07/17	CY 08/13	Injury 07/30	Injury 08/27
1	Untreated Control	2.60	3.09 A**	0.3*	0.0*
2	Anuew (12 oz/A)	1.65	2.18 A	0.5	0.3
3	Anuew (24 oz/A)	2.15	1.84 AB	1.0	0.3
4	Primo Maxx (11 oz/A)	2.11	0.50 B	0.8	0.8

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

Stop #8c: Evaluation of Herbicides and Plant Growth Regulators (PGRs) for Annual Bluegrass Control in Creeping Bentgrass Putting Greens in Southern California

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Objectives:

This study was conducted to evaluate various rates and formulations of several herbicides and plant growth regulators (PGRs) to control annual bluegrass (*Poa annua*) in creeping bentgrass (*Agrostis stolonifera*) maintained as a golf course putting green in Southern California.

Materials and methods:

The study was conducted on a practice green at Bel-Air Country Club in Los Angeles, CA. The green was mature creeping bentgrass (*Agrostis stolonifera*) 'Pure Distinction' on a sand-based rootzone. Target weed was annual bluegrass (*Poa annua*). Total of 16 herbicide and plant growth regulators (PGRs) treatments (including untreated control) were applied as described in Table 1 starting on May 1, 2017. Treatments were applied with CO_2-powered backpack sprayer equipped with TeeJet 8004VS nozzles and calibrated to deliver 2 gallons/1000 ft^2. The green was irrigated with 0.1-0.2 inches of water immediately following each application. Experimental design was a complete randomized block with 4 replications. Plot size was 4×6 ft with 2-ft alleys. Plots were evaluated biweekly for annual bluegrass cover (0-100 %), turfgrass injury (0-100%) caused by treatments, and green color (1-9; 9=darkest) starting from May 1, 2017.

Results:

No statistical differences were found between untreated control and other treatments during first seven rating events in 2017 in terms of *P. annua* cover except for June 12 and July 24 when PoaCure EC at 0.3% v/v applied with Weed Wand applicator caused a significant decrease in target weed cover. Also, weed cover in this treatment persisted in the lowest level among all treatments until April 2, 2018 (data not shown). Beginning August 7, 2017, PoaCure EC at 0.6 and 1.2 oz/M, together with Musketeer at 15 oz/A and Trimmit at 8 oz/A decreased *P. annua* cover when compared to control. However, starting from August 21, 2017 until the most recent rating date, all PoaCure treatments significantly reduced annual bluegrass cover in comparison to untreated control even though no PoaCure applications were made in 2018. In general, PGRs showed very good *P. annua* suppression when compared to control, but starting on January 16, 2018 control with PGRs was not as effective as with PoaCure or HM-0814 treatments at 3 oz/M and 6 oz/M, which started showing significant weed control effects beginning October 30, 2017 (Fig. 1).

No significant turfgrass injury was shown with any rate of PoaCure EC until October 30, following re-application in the fall. It is important to note that re-application of PoaCure in the same calendar year was neither needed nor recommended according to the label. Following repeat applications in the fall, injury symptoms mounted, especially at higher rates, until the point where the damage caused was severe. However, in spring of 2018 plots showed rapid recovery from injury with PoaCure, which lead not only to full turf recovery demonstrated on May 14, 2018 (Fig. 2), but also increased turf quality (data not shown). HM-0814 treatments started showing significant injury on June 24, 2017 at 3 and 6 oz/M, and again on October 16, 2017 and persisting until April 2, 2018. Besides thinning, HM-0814 caused discoloration best described as 'coffee staining' on the foliage. Those symptoms persisted until December 11 and reappeared after spring application in 2018. In the winter, those plots were slightly lime green in color. Injury caused by PGRs was first seen May 30, 2017 and increased with time until November 27, when turf started to recover. With reapplication of PGRs in 2018 injury also reappeared and mounted. The highest level of injury among PGRs so far was caused by Cutless at 24.6 oz/M, with the highest injury peak on November 27, 2017, but even the 1/2x rate caused significant injury. At the same time, there was no PGR treatment causing injury below 25%. PGR treatments also caused turf darkening which was more permanent than discoloration caused by HM-0814 (data not shown).

Best performance in terms of *P. annua* suppression among PGRs was seen with Trimmit at 8 oz/A and Musketeer at 15 oz/A, which was comparable to PoaCure EC at 0.3 oz/M, until January 16, 2018, when Poa infestation started becoming more pronounced than in 2017 season. Both PGR treatments caused injury (Fig. 2), symptoms of which increased over time, as well as significant turf darkening which may be desirable on putting greens (data not shown).

PoaCure didn't show any undesirable effects until fall 2017 re-application when recommended rates were doubled (0.6 oz/M applied 6 times in spring and re-applied 6 times in fall; 1.2 oz/M applied 3 times in spring and re-applied 3 times in fall) totaling 7.2 oz/M. Re-application of PoaCure in such a short time interval was not necessary in this study and is not prescribed on the label. Rather, we wanted to determine the effects of over application on weed control and bentgrass safety (Fig. 2). Considering this fact and persisting annual bluegrass control at the highest level without 2018 reapplication, PoaCure has provided the best overall combination of Poa control and bentgrass safety among all treatments evaluated.

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Table 1. Treatments evaluated for annual bluegrass (Poa annua) control and application timing. Bel-Air CC, Los Angeles, CA, 2017-18.

No.	Treatment	Active ingredient	Company	Rate	Frequency (wks)	Number of applications	Timing*
1	Untreated Control	-	-	-	-	-	-
2	PoaCure EC	methiozolin	Moghu	0.3 oz/M	2	6; 6 (12)	A-F; L-R***
3	PoaCure EC	methiozolin	Moghu	0.6 oz/M	2	6; 6 (12)	A-F; L-R***
4	PoaCure EC	methiozolin	Moghu	1.2 oz/M	2	3; 3 (6)	A-C; L-N***
5	PoaCure EC	methiozolin	Moghu	0.3% v/v	2	6; 6 (12)	A-F; L-R***
6	HM-0814	cumyluron	Helena	1.5 oz/M	4	2; 2 (4)	A, C; L, N
7	HM-0814	cumyluron	Helena	3 oz/M	4	2; 2 (4)	A, C; L, N
8	HM-0814	cumyluron	Helena	6 oz/M	4	2; 2 (4)	A, C; L, N
9	Cutless	flurprimidol	SePRO	6.1 oz/A	2	15	A-O
10	Cutless	flurprimidol	SePRO	15 oz/A	2	15	A-O
11	Cutless	flurprimidol	SePRO	24.6 oz/A	2	15	A-O
12	Legacy	flurprimidol, trinexapac-ethyl	SePRO	10 oz/A	2	15	A-O
13	Musketeer	flurprimidol, paclobutrazol, trinexapac-ethyl	SePRO	15 oz/A	2	15	A-O
14	Trimmit	paclobutrazol	Syngenta	4 oz/A	2	15	A-O
15	Trimmit	paclobutrazol	Syngenta	6 oz/A	2	15	A-O
16	Trimmit	paclobutrazol	Syngenta	8 oz/A	2	15	A-O

**Treatment No. 5 applied using Weed Wand applicator.

***PoaCure treatments (No. 2 to 5) were not applied in 2018 season.

***Timing:**

A	5/1/2017	4/30/2018
B	5/15/2017	5/14/2018
C	5/30/2017	5/29/2018
D	6/12/2017	6/11/2018
E	6/26/2017	6/25/2018
F	7/10/2017	7/9/2018
G	7/24/2017	7/23/2018
H	8/7/2017	8/6/2018
I	8/21/2017	8/20/2018
J	9/5/2017	9/4/2018
K	9/18/2017	9/17/2018
L	10/2/2017	10/1/2018
M	10/16/2017	10/15/2018
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O	11/13/2017	11/12/2018
P	11/27/2017	
R	12/11/2017	

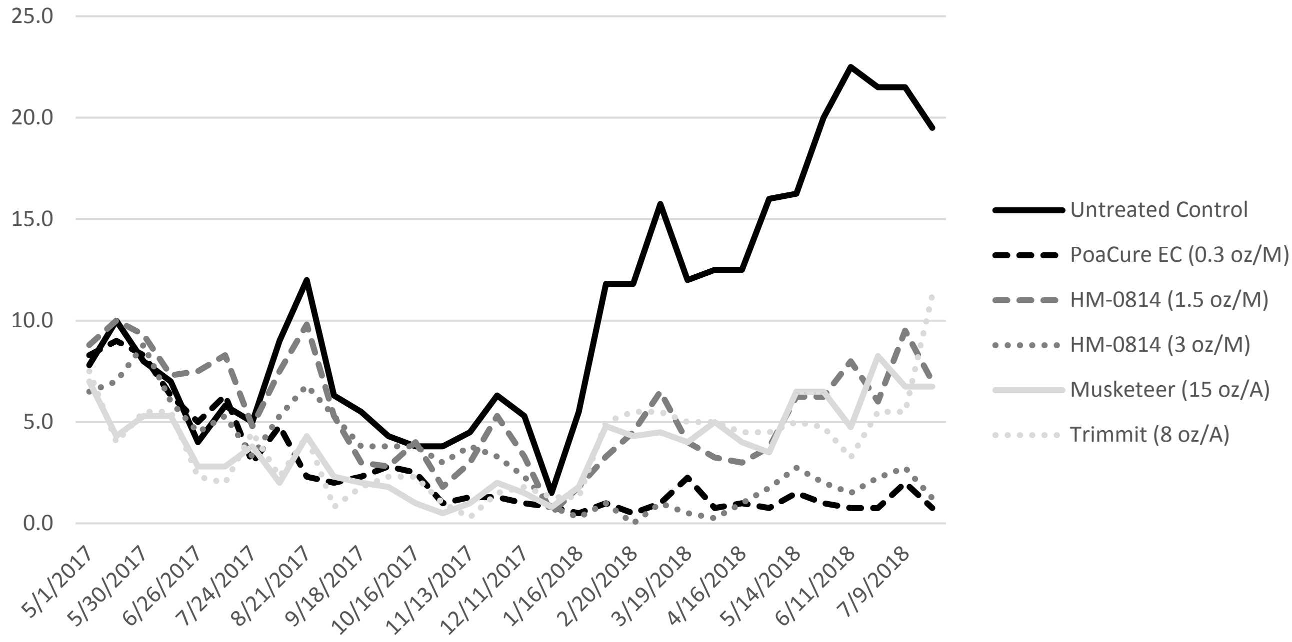

Figure 1. Effect of chosen herbicides and plant growth regulators (PGRs) on annual bluegrass cover (0-100%; y-axis). 2017-18. Bel-Air Country Club, Los Angeles, CA.

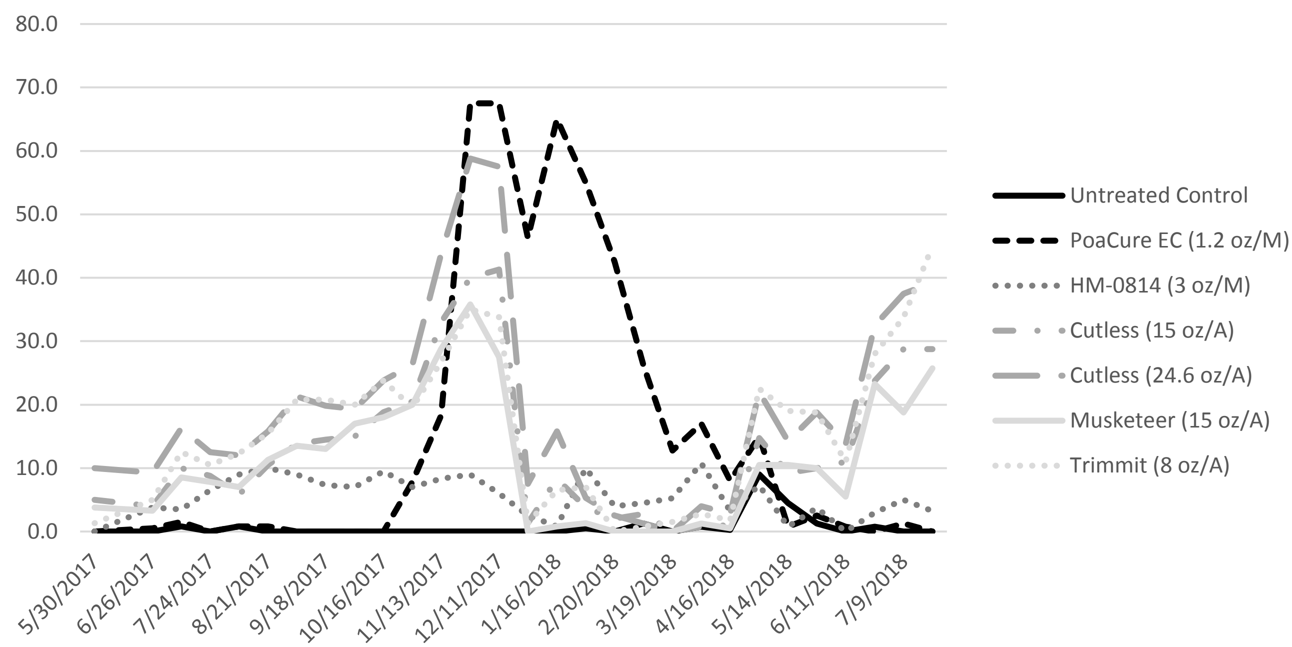

Figure 2. Effect of chosen herbicides and plant growth regulators (PGRs) on creeping bentgrass injury (0-100%; y-axis). 2017-18. Bel-Air Country Club, Los Angeles, CA.

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