Evaluation of Products for Alleviation of Localized Dry Spots (LDS) and Drought Stress on Turf

At the conclusion of each experiment, the water droplet penetration test was performed on three soil core samples per plot. Water droplets were placed at the thatch-soil interface and 1 cm below. Absorption was measured from 1 (instantaneous; hydrophilic) up to 300 seconds (hydrophobic).

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"Keeping California Green and Growing"

Evaluation of Products for Alleviation of Localized Dry Spots (LDS) and Drought Stress on Turf

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The Bottom Line:

As many as 39 products or product combinations were tested in five separate experiments (3 putting greens; 2 fairways) on three golf courses in northern California and at the University of California, Riverside for their ability to alleviate drought stress and localized dry spots (LDS) on turf. None of the products tested caused turf injury following applications. Localized dry spot, as the name implies, often occurs randomly and non-uniformly in turf thus making it challenging to assess product effects in a replicated experiment and practically impossible in a non-replicated demonstration. As a result, most of the products tested were not significantly different from the untreated control at most locations, and all products tested were no different from the control when irrigation or soil water was not limiting. However, under extreme water stress conditions, Revolution (Aquatrols) performed the best of all products tested in alleviating turf drought symptoms and LDS incidence. TriCure AD (Mitchell Products) was next best and the following products deserved honorable mention (in alphabetical order): A16982A; Affinity (BASF); NT-0949; and Neptune (Numerator Technologies).

Introduction

Maintaining drier, firmer turf is desirable for water conservation and producing optimal playing conditions. However, often there is a fine line between minimal water use and development of persistent localized dry spots (LDS) or even sudden loss of turf. Soil wetting agents or surfactants are commonly used to reduce surface tension of water and increase wetting of the turf profile. Soil fungi can also produce hydrophobic effects (fairy rings) that can be mitigated by fungicides. Overall, there are a plethora of commercial products available that are purported to aid in turf water conservation. The primary objective of this research was to assist California turf managers in identifying commercial and experimental products that can alleviate turf drought stress and/or issues related to LDS.

General Study Conditions

Sprayer

- CO_2-powered backpack hand boom
- Four TeeJet 8004VS flat fan nozzles; 9.5-inch spacing
- Pressure: 30 psi
- Groundspeed: 2.0 mph
- Output: 2 gal/M
- All treatments were watered in following application except for Upplause Plus and MegAlex at UCR

Experimental Design

- Randomized Complete Block
- 3 replications
- 4 ft by 6 or 9 ft plots

Ratings - weekly (UCR) to monthly (northern California)

- Turf Quality (1 to 9 scale, 9 = best)
- Localized Dry Spot (0 to 100%)
- Turf Cover (0 to 100%) – UCR only
- Surface Canopy Temperature (C) – NorCal only
- Soil Volumetric Water Content (%) – FieldScout TDR 300 (Spectrum Tech.)
- Turf Injury (0 to 100%)
- Green Firmness – USGA TruFirm or Clegg Impact Tester
- Water Droplet Penetration – 29 July 2013 (UCR); 12-14 August 2013 (NorCal)

Study Locations

Martis Camp Club

- Truckee, CA
- Scott Bower, Director of Greens & Grounds
- Clint Luedtke, Course Manager
- Jonathan Moulton, Assistant Course Manager
- 10th Green, Putting Park
    - 39°17’31” N, 120°9’49” W
    - Creeping bentgrass
    - USGA Rootzone mix
    - Mowing height – 0.110 inches

- 8th Fairway
    - 39°17’11” N, 120°10’27” W
    - Kentucky bluegrass
    - Native soil amended with topdressing sand
    - Mowing height – 0.450 inches
- Spray Record

Timing	A	B	C
Date	20 May 2013	18 June 2013	16 July 2013
Time	16:30 to 19:00	17:00 to 19:00	9:45 to 11:30
Temperature	70F	57F	66F
Wind	Calm	Breezy	Breezy
Conditions	Clear	Clear	Clear

Callippe Preserve Golf Course

- Pleasanton, CA
- Mike Garvale, Director of Golf Course Operations
- Tom Doyle, Superintendent
- Practice Putting Green
    - 37°37’41” N, 121°51’40” W
    - Creeping bentgrass/annual bluegrass
    - USGA Rootzone mix
    - Mowing height – 0.110 inches
- Spray Record

Timing	A	B	C
Date	21 May 2013	18 June 2013	16 July 2013
Time	8:00 to 9:00	8:00 to 8:45	17:00 to 17:45
Temperature	55F	63F	75F
Wind	Windy	Windy	Breezy
Conditions	Cloudy	Clear	Clear

Preserve Golf Club

- Carmel, CA
- Cory Isom, Superintendent
- Matt Coombs, Assistant Superintendent
- 13th Fairway
    - 36°26’23” N, 121°46’42” W
    - Colonial bentgrass/annual bluegrass/perennial ryegrass
    - Native soil capped with sand
    - Mowing height – 0.350 inches
- Spray Record

Timing	A	B	C
Date	22 May 2013	17 June 2013	17 July 2013
Time	9:30 to 11:30	11:00 to 13:00	8:30 to 10:00
Temperature	65F	63F to 70F	63F to 70F
Wind	Calm to breezy	Calm to breezy	Calm
Conditions	Clear	Clear	Clear

University of California, Riverside

- Riverside, CA
- Research Plot 12G-6
    - 33°57’54” N, 117°20’18” W
    - Creeping bentgrass/annual bluegrass
    - Native soil amended with sand
    - Mowing height – 0.125 inches
- Spray Record

Timing	A (day 0)	B (day 14)	C (day 21)
Date	14 June 2013	28 June 2013	4 July 2013
Time	5:45 to 7:30	5:45 to 6:40	6:45 to 7:00
Temperature	59F	70F	63F
Wind	Calm	Calm	Calm
Conditions	Overcast	Clear	Clear

Timing	D (day 28)	E (day 0)	F (day 14)
Date	12 July 2013	8 August 2013	23 August 2013
Time	6:40 to 7:50	6:00 to 7:30	7:00 to 7:45
Temperature	70F	60F	68F
Wind	Calm	Calm	Calm
Conditions	Partly sunny	Clear	Clear

Timing	G (day 21)	H (day 28)
Date	29 August 2013	6 September 2013
Time	9:00 to 9:15	6:45 to 8:45
Temperature	79F	70F to 81F
Wind	Calm	Calm
Conditions	Clear	Partly Cloudy

Final ratings were taken on 26 and 29 (droplet test) July 2013; area was then aerated, topdressed, fertilized, and seeded with bentgrass. Treatments resumed again on 8 August 2013 and final ratings (excluding droplet test) were taken on 5 September 2013, one week before Field Day.

Results

Callippe Preserve Golf Course Putting Green

- ✓ No significant differences were found among treatments (Table 1) for all measurements taken (turf quality, LDS, canopy temperature, firmness, soil water, and water droplet test) at all rating dates (data not shown). The practice green where the study was located is three-tiered with both steep and flat areas (Fig. 1). Although we attempted to account for this in our experimental design and the golf course staff adequately dried down the green prior to some of the rating dates, replication differences (whether or not a treatment was randomly placed on a slope or a flat area) were too great to identify differences among treatments.

- ✓ None of the treatments caused turf injury following any of the three application dates (data not shown).

Figure 1. Study area on the practice putting green at Callippe Preserve Golf Course, Pleasanton, CA. Photo taken in May 2013 before first application of treatments. Although a green like this would benefit from a product that could help retain soil water on sloped areas, the contours of this green made it difficult to differentiate among the 21 treatments tested.

Table 1. Treatments tested in the localized dry spot (LDS) study on a practice putting green at Callippe Preserve Golf Course, Pleasanton, CA from May to August 2013.

No.	Treatment	Company	Rate (oz/M)	Timing
1	Control	--	--	--
2	A16982A	--	6.3	ABC
3	Affinity	BASF	6.0	ABC
4	APSA-80	Amway	5.0	ABC
5	Aqua Plus	Creative Eco Systems	3.0	ABC
6	Aqueduct	Aquatrols	8.0	ABC
7	Revolution	Aquatrols	6.0	ABC
8	ES TC006A	--	9.0	ABC
9	Displace	Grigg Brothers	12.0	ABC
10	GB-6931	--	6.0	ABC
11	TriCure AD	Mitchell Products	6.0	ABC
12	Neptune	Numerator Technologies	6.0	ABC
13	Revert	Numerator Technologies	6.0	ABC
14	NT-0949	--	6.0	ABC
15	NT-R008	--	6.0	ABC
16	Cascade + Duplex	Precision Labs	5.0	ABC
17	PX13002	--	5.0	ABC
18	PX13011	--	4.0	ABC
19	PX13012	--	5.0	ABC
20	Rely II	Simplot	6.0	ABC
21	Rootzone	WellPlant	15.0	ABC

Martis Camp Club Putting Green

- ✓ Drought stress and presence of LDS were minimal on the putting green study at each of the monthly rating dates (Fig. 2); consequently, only soil volumetric water content was significantly different among treatments in July and August (Table 2). Several products increased water content compared to the control; Neptune and Displace yielded the highest values in July and August, respectively.

- ✓ No significant differences were found among treatments for all other measurements taken (turf quality, LDS, canopy temperature, firmness, and water droplet test) at all rating dates (data not shown).

Figure 2. Study area on the 10th Putting Park green at Martis Camp Club, Truckee, CA. Photo was taken on 12 August 2013, the final rating date for the study. Similar to the USGA TruFirm instrument, the Clegg Impact Tester (shown here) provides a measurement of surface firmness.

Table 2. Effects of treatments on volumetric water content (%) in the upper 3 inches of the root zone in the localized dry spot (LDS) study on the 10th Putting Park green at Martis Camp Club, Truckee, CA.

No.	Treatment	Company	Rate (oz/M)	Timing	7/16/2013	8/12/2013
1	Control	--	--	--	23.1E	15.3DE
2	A16982A	--	6.3	ABC	26.5BCD	19.1ABCDE
3	Affinity	BASF	6.0	ABC	28.9AB	22.2AB
4	APSA-80	Amway	5.0	ABC	26.9BCD	19.6ABCDE
5	Aqua Plus	Creative Eco Systems	3.0	ABC	27.4ABCD	19.6ABCDE
6	Aqueduct	Aquatrols	8.0	ABC	26.9BCD	16.0CDE
7	Cascade + Duplex	Precision Labs	5.0	ABC	27.3ABCD	20.6ABCD
8	Displace	Grigg Brothers	12.0	ABC	27.9ABC	24.2A
9	ES TC006A	--	9.0	ABC	24.4DE	17.3BCDE
10	GB-6931	--	6.0	ABC	27.9ABC	18.6ABCDE
11	Neptune	Numerator Technologies	6.0	ABC	30.3A	21.9ABC
12	NT-0949	--	6.0	ABC	22.6E	13.6E
13	NT-R008	--	6.0	ABC	25.7CDE	19.0ABCDE
14	PX13002	--	5.0	ABC	28.5ABC	23.0AB
15	PX13011	--	4.0	ABC	26.9BCD	19.3ABCDE
16	PX13012	--	5.0	ABC	27.5ABC	17.7BCDE
17	Revert	Numerator Technologies	6.0	ABC	26.5BCD	18.9ABCDE
18	Revolution	Aquatrols	6.0	ABC	26.8BCD	17.7BCDE
19	Rely II	Simplot	6.0	ABC	28.0ABC	19.8ABCD
20	TriCure AD	Mitchell Products	6.0	ABC	28.8ABC	21.0ABCD

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Martis Camp Club Fairway

- ✓ Similar to the putting green study, drought stress and presence of LDS were minimal on the fairway study at each of the monthly rating dates (Fig. 3); consequently, only turf quality was significantly different among treatments at the final rating date in August (Table 3). This was mostly due to the location of some treatments in the dry area (Fig. 3). Most of the products were not significantly different from the control and Briskway fungicide + A16982A produced the numerically highest turf quality (8 out of 9).

- ✓ Volumetric water content was significantly different among treatments at all rating dates including May when treatments were first applied (Table 4). Some treatments (e.g., Briskway fungicide + A16982A) appeared to be favored by having higher soil water in the plots before the study began; whereas other treatments appeared to enhance soil water retention even though antecedent water content was relatively low.

- ✓ No significant differences were found among treatments for all other measurements taken (LDS, canopy temperature, and water droplet test) at all rating dates (data not shown).

Figure 3. Study area on the 8th fairway at Martis Camp Club, Truckee, CA. Photo was taken on 12 August 2013, the final rating date for the study. As is often the case with LDS, note the relatively small dry area (right center) among otherwise non-stressed turf.

Table 3. Effects of treatments on turf quality (1 to 9 scale, 9 = best) in the localized dry spot (LDS) study on the 8th fairway at Martis Camp Club, Truckee, CA.

No.	Treatment	Company	Rate (oz/M)	Timing	8/12/2013
1	Control	--	--	--	6.0ABCD
2	A16982A	--	6.3	ABC	6.7ABCD
3	A16982A	--	12.6	ABC	7.0ABCD
4	Affinity	BASF	6.0	ABC	7.3ABC
5	APSA-80	Amway	5.0	ABC	7.3ABC
6	Aqua Plus	Creative Eco Systems	3.0	ABC	7.7AB
7	Aqueduct	Aquatrols	8.0	ABC	7.0ABCD
8	Bolster	Sustane	3.0	ABC	5.7BCD
9	Briskway	Syngenta	0.72	ABC	7.7AB
10	Briskway A16982A	Syngenta --	0.72 6.3	ABC ABC	8.0A
11	Cascade + Duplex	Precision Labs	5.0	ABC	7.7AB
12	Displace	Grigg Brothers	12.0	ABC	7.3ABC
13	ES TC006A	--	9.0	ABC	6.7ABCD
14	GB-6931	--	6.0	ABC	7.3ABC
15	Heritage TL	Syngenta	2.0	ABC	7.0ABCD
16	Heritage TL A16982A	Syngenta --	2.0 6.3	ABC ABC	7.7AB
17	Lexicon	BASF	0.47	ABC	7.3ABC
18	Lexicon Affinity	BASF BASF	0.47 6.0	ABC ABC	7.0ABCD
19	LT120	Numerator Technologies	8.0	AC	6.0ABCD
20	Microbic with SumaGrow	AgriBiotic Products	3.0	ABC	5.7BCD
21	Moisture Manager	John Deere Landscapes	9.0	A	5.3CD
22	Neptune	Numerator Technologies	6.0	ABC	7.3ABC
23	NT-0949	--	6.0	ABC	7.0ABCD
24	NT-P.0017	--	6.0	ABC	5.0D
25	NT-R008	--	6.0	ABC	7.7AB
26	PX13002	--	5.0	ABC	7.7AB
27	PX13011	--	4.0	ABC	7.0ABCD
28	PX13012	--	5.0	ABC	5.7BCD
29	Revert	Numerator Technologies	6.0	ABC	7.0ABCD
30	Revolution	Aquatrols	6.0	ABC	6.7ABCD
31	Revolution ES TC006A	Aquatrols --	6.0 9.0	A BC	6.7ABCD
32	Rely II	Simplot	6.0	ABC	6.3ABCD
33	TriCure AD	Mitchell Products	6.0	ABC	7.0ABCD
34	UCREXPF1	--	16.0 oz/A	ABC	7.3ABC
35	Xzemplar	BASF	0.26	ABC	6.3ABCD
36	Xzemplar Affinity	BASF BASF	0.26 6.0	ABC ABC	5.3CD

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Table 4. Effects of treatments on volumetric water content (%) in the upper 3 inches of the root zone in the localized dry spot (LDS) study on the 8th fairway at Martis Camp Club, Truckee, CA.

No.	Treatment	Rate (oz/M)	Timing	5/20/2013	6/18/2013	7/16/2013	8/12/2013
1	Control	--	--	24.3ABCDE	25.2E	37.6D	27.3DE
2	A16982A	6.3	ABC	21.9E	30.0BCDE	47.7ABCD	36.6ABCDE
3	A16982A	12.6	ABC	23.8BCDE	42.0AB	58.0A	52.6A
4	Affinity	6.0	ABC	24.7ABCDE	30.2BCDE	45.3ABCD	34.1ABCDE
5	APSA-80	5.0	ABC	23.3BCDE	32.2ABCDE	48.6ABCD	41.7ABCDE
6	Aqua Plus	3.0	ABC	24.5ABCDE	37.0ABCDE	53.0ABC	48.5AB
7	Aqueduct	8.0	ABC	25.3ABCDE	32.4ABCDE	45.2ABCD	37.0ABCDE
8	Bolster	3.0	ABC	22.5CDE	32.9ABCDE	49.4ABCD	35.7ABCDE
9	Briskway	0.72	ABC	21.7E	34.4ABCDE	52.0ABC	47.6AB
10	Briskway A16982A	0.72 6.3	ABC ABC	27.4A	44.1A	56.6A	48.3AB
11	Cascade + Duplex	5.0	ABC	24.9ABCDE	35.3ABCDE	55.4AB	46.0ABC
12	Displace	12.0	ABC	25.0ABCDE	31.2BCDE	40.5CD	35.1ABCDE
13	ES TC006A	9.0	ABC	23.0BCDE	36.0ABCDE	47.1ABCD	39.0ABCDE
14	GB-6931	6.0	ABC	23.5ABCDE	33.5ABCDE	45.7ABCD	39.5ABCDE
15	Heritage TL	2.0	ABC	23.4ABCDE	42.2AB	56.7A	46.8AB
16	Heritage TL A16982A	2.0 6.3	ABC ABC	23.4ABCDE	39.5ABC	56.0A	46.9AB
17	Lexicon	0.47	ABC	26.6AB	35.4ABCDE	47.3ABCD	40.2ABCDE
18	Lexicon Affinity	0.47 6.0	ABC ABC	23.1BCDE	34.1ABCDE	46.3ABCD	47.2AB
19	LT120	8.0	AC	24.3ABCDE	29.0CDE	41.4BCD	32.6ABCDE
20	Microbic with SumaGrow	3.0	ABC	24.6ABCDE	33.0ABCDE	43.0ABCD	39.5ABCDE
21	Moisture Manager	9.0	A	22.0E	34.3ABCDE	46.3ABCD	33.3ABCDE
22	Neptune	6.0	ABC	26.4ABC	39.0ABC	55.6A	50.5A
23	NT-0949	6.0	ABC	25.3ABCDE	36.6ABCDE	50.8ABCD	46.3ABC
24	NT-P.0017	6.0	ABC	24.2ABCDE	25.7DE	37.6D	25.8E
25	NT-R008	6.0	ABC	24.9ABCDE	31.4BCDE	46.5ABCD	44.8ABCD
26	PX13002	5.0	ABC	24.1ABCDE	34.8ABCDE	55.7A	44.6ABCD
27	PX13011	4.0	ABC	21.9E	31.2BCDE	46.2ABCD	40.7ABCDE
28	PX13012	5.0	ABC	23.7ABCDE	27.8CDE	42.9ABCD	34.9ABCDE
29	Revert	6.0	ABC	21.5E	33.0ABCDE	49.6ABCD	43.0ABCDE
30	Revolution	6.0	ABC	26.1ABCD	38.9ABC	48.2ABCD	41.8ABCDE
31	Revolution ES TC006A	6.0 9.0	A BC	22.8BCDE	28.5CDE	39.2CD	31.2BCDE
32	Rely II	6.0	ABC	21.6E	25.6DE	39.4CD	34.6ABCDE
33	TriCure AD	6.0	ABC	24.9ABCDE	39.2ABC	49.2ABCD	44.9ABCD
34	UCREXPF1	16.0 oz/A	ABC	21.8E	27.5CDE	37.7D	28.4CDE
35	Xzemplar	0.26	ABC	24.3ABCDE	34.9ABCDE	47.5ABCD	37.9ABCDE
36	Xzemplar Affinity	0.26 6.0	ABC ABC	23.7ABCDE	33.4ABCDE	44.7ABCD	37.2ABCDE

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Preserve Golf Club Fairway

- ✓ The 13th fairway at Preserve Golf Club provided the most consistent and uniform drought stress and LDS of all study locations presented in this report (Fig. 4). As a result, significant treatment differences were found for turf quality, LDS, soil water, and the water droplet test.

- ✓ Turf quality was significant in July and August (Table 5). Although most treatments were not significantly different from the control in August, Revolution provided the highest and most consistent turf quality followed by TriCure AD.

- ✓ LDS was also significant in July and August (Table 6). Although most treatments were not significantly different from the control, Revolution and TriCure AD resulted in the lowest incidence of LDS (Fig. 5).

- ✓ Soil water content was significant in July and August (Table 7). TriCure AD produced the highest volumetric water content in July and was nearly highest in August next to Affinity.

- ✓ There were no significant differences among treatments for water droplet penetration at the thatch-soil interface (data not shown); however, significant differences were found at 1 cm below (Table 8). Treatments containing Affinity or A16982A resulted in the fastest penetration of water droplets into the soil profile.

- ✓ In summary, Revolution and TriCure AD provided the best overall results in regard to alleviation of drought stress and LDS at Preserve Golf Club.

Figure 4. Fairways like the 13th at Preserve Golf Club, Carmel, CA are prone to LDS and drought stress during summer months when rainfall is scarce and irrigation is minimized, making this an ideal location to test products.

Table 5. Effects of treatments on turf quality (1 to 9 scale, 9 = best) in the localized dry spot (LDS) study on the 13th fairway at Preserve Golf Club, Carmel, CA.

No.	Treatment	Company	Rate (oz/M)	Timing	7/17/2013	8/14/2013
1	Control	--	--	--	5.7BCDE	6.0ABC
2	A16982A	--	6.3	ABC	6.3ABCD	4.2BC
3	A16982A	--	12.6	ABC	6.0ABCD	4.3ABC
4	Affinity	BASF	6.0	ABC	5.3CDE	5.3ABC
5	APSA-80	Amway	5.0	ABC	5.0DE	4.3ABC
6	Aqua Plus	Creative Eco Systems	3.0	ABC	5.3CDE	5.0ABC
7	Aqueduct	Aquatrols	8.0	ABC	5.0DE	4.7ABC
8	Bolster	Sustane	3.0	ABC	4.3E	5.0ABC
9	Briskway	Syngenta	0.72	ABC	5.7BCDE	4.3ABC
10	Briskway A16982A	Syngenta --	0.72 6.3	ABC ABC	5.7BCDE	5.0ABC
11	Cascade + Duplex	Precision Labs	5.0	ABC	6.3ABCD	4.7ABC
12	Displace	Grigg Brothers	12.0	ABC	6.0ABCD	6.0ABC
13	ES TC006A	--	9.0	ABC	5.3CDE	6.6AB
14	GB-6931	--	6.0	ABC	5.7BCDE	5.0ABC
15	Heritage TL	Syngenta	2.0	ABC	5.3CDE	3.7C
16	Heritage TL A16982A	Syngenta --	2.0 6.3	ABC ABC	6.3ABCD	4.3ABC
17	Lexicon	BASF	0.47	ABC	5.0DE	4.7ABC
18	Lexicon Affinity	BASF BASF	0.47 6.0	ABC ABC	6.0ABCD	5.0ABC
19	LT120	Numerator Technologies	8.0	AC	5.0DE	5.0ABC
20	Microbic with SumaGrow	AgriBiotic Products	3.0	ABC	6.7ABC	5.7ABC
21	Moisture Manager	John Deere Landscapes	9.0	A	5.0DE	4.0BC
22	Neptune	Numerator Technologies	6.0	ABC	7.3A	4.7ABC
23	NT-0949	--	6.0	ABC	6.0ABCD	4.3ABC
24	NT-P.0017	--	6.0	ABC	5.7BCDE	6.0ABC
25	NT-R008	--	6.0	ABC	5.3CDE	4.3ABC
26	PX13002	--	5.0	ABC	6.0ABCD	5.3ABC
27	PX13011	--	4.0	ABC	5.7BCDE	4.3ABC
28	PX13012	--	5.0	ABC	6.0ABCD	5.0ABC
29	Revert	Numerator Technologies	6.0	ABC	5.7BCDE	4.7ABC
30	Revolution	Aquatrols	6.0	ABC	7.3A	6.7A
31	Revolution ES TC006A	Aquatrols --	6.0 9.0	A BC	6.0ABCD	4.7ABC
32	Rely II	Simplot	6.0	ABC	6.0ABCD	4.7ABC
33	TriCure AD	Mitchell Products	6.0	ABC	7.0AB	6.0ABC
34	UCREXPF1	--	16.0 oz/A	ABC	5.3CDE	6.3AB
35	Xzemplar	BASF	0.26	ABC	4.3E	4.7ABC
36	Xzemplar Affinity	BASF BASF	0.26 6.0	ABC ABC	5.3CDE	4.3ABC

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Table 6. Effects of treatments on localized dry spot (LDS) incidence (0-100%) in the LDS study on the 13th fairway at Preserve Golf Club, Carmel, CA.

No.	Treatment	Company	Rate (oz/M)	Timing	7/17/2013	8/14/2013
1	Control	--	--	--	15.0ABCD	20.0BC
2	A16982A	--	6.3	ABC	10.0BCD	50.1ABC
3	A16982A	--	12.6	ABC	11.7ABCD	45.0ABC
4	Affinity	BASF	6.0	ABC	16.7ABCD	33.3ABC
5	APSA-80	Amway	5.0	ABC	23.3ABCD	50.0ABC
6	Aqua Plus	Creative Eco Systems	3.0	ABC	20.4ABCD	30.0ABC
7	Aqueduct	Aquatrols	8.0	ABC	25.0ABC	35.0ABC
8	Bolster	Sustane	3.0	ABC	25.0ABC	33.3ABC
9	Briskway	Syngenta	0.72	ABC	11.7ABCD	46.7ABC
10	Briskway A16982A	Syngenta --	0.72 6.3	ABC ABC	13.3ABCD	40.0ABC
11	Cascade + Duplex	Precision Labs	5.0	ABC	11.7ABCD	35.0ABC
12	Displace	Grigg Brothers	12.0	ABC	13.3ABCD	31.7ABC
13	ES TC006A	--	9.0	ABC	16.7ABCD	19.9BC
14	GB-6931	--	6.0	ABC	23.3ABCD	45.0ABC
15	Heritage TL	Syngenta	2.0	ABC	26.7AB	65.0A
16	Heritage TL A16982A	Syngenta --	2.0 6.3	ABC ABC	8.3CD	56.7AB
17	Lexicon	BASF	0.47	ABC	20.0ABCD	51.7ABC
18	Lexicon Affinity	BASF BASF	0.47 6.0	ABC ABC	16.7ABCD	43.3ABC
19	LT120	Numerator Technologies	8.0	AC	20.0ABCD	31.7ABC
20	Microbic with SumaGrow	AgriBiotic Products	3.0	ABC	8.3CD	26.7ABC
21	Moisture Manager	John Deere Landscapes	9.0	A	23.3ABCD	50.0ABC
22	Neptune	Numerator Technologies	6.0	ABC	6.7D	43.3ABC
23	NT-0949	--	6.0	ABC	13.3ABCD	46.7ABC
24	NT-P.0017	--	6.0	ABC	16.7ABCD	20.2BC
25	NT-R008	--	6.0	ABC	20.0ABCD	43.3ABC
26	PX13002	--	5.0	ABC	11.7ABCD	30.0ABC
27	PX13011	--	4.0	ABC	15.0ABCD	46.7ABC
28	PX13012	--	5.0	ABC	11.7ABCD	33.3ABC
29	Revert	Numerator Technologies	6.0	ABC	15.0ABCD	38.3ABC
30	Revolution	Aquatrols	6.0	ABC	6.7D	16.7C
31	Revolution ES TC006A	Aquatrols --	6.0 9.0	A BC	15.0ABCD	36.7ABC
32	Rely II	Simplot	6.0	ABC	13.3ABCD	51.7ABC
33	TriCure AD	Mitchell Products	6.0	ABC	11.7ABCD	18.3BC
34	UCREXPF1	--	16.0 oz/A	ABC	25.0ABC	21.7BC
35	Xzemplar	BASF	0.26	ABC	28.3A	45.0ABC
36	Xzemplar Affinity	BASF BASF	0.26 6.0	ABC ABC	21.7ABCD	51.7ABC

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Table 7. Effects of treatments on volumetric water content (%) in the upper 3 inches of the root zone in the localized dry spot (LDS) study on the 13th fairway at Preserve Golf Club, Carmel, CA.

No.	Treatment	Company	Rate (oz/M)	Timing	7/17/2013	8/14/2013
1	Control	--	--	--	31.1BC	18.2ABC
2	A16982A	--	6.3	ABC	27.7BC	17.5ABC
3	A16982A	--	12.6	ABC	24.3C	15.4ABC
4	Affinity	BASF	6.0	ABC	36.3ABC	25.3A
5	APSA-80	Amway	5.0	ABC	29.6BC	16.6ABC
6	Aqua Plus	Creative Eco Systems	3.0	ABC	35.4ABC	21.2ABC
7	Aqueduct	Aquatrols	8.0	ABC	32.5ABC	20.9ABC
8	Bolster	Sustane	3.0	ABC	29.4BC	21.3ABC
9	Briskway	Syngenta	0.72	ABC	26.1C	10.2C
10	Briskway A16982A	Syngenta --	0.72 6.3	ABC ABC	32.7ABC	16.2ABC
11	Cascade + Duplex	Precision Labs	5.0	ABC	27.3BC	12.9BC
12	Displace	Grigg Brothers	12.0	ABC	32.8ABC	15.7ABC
13	ES TC006A	--	9.0	ABC	35.6ABC	23.1ABC
14	GB-6931	--	6.0	ABC	34.7ABC	17.8ABC
15	Heritage TL	Syngenta	2.0	ABC	27.5BC	15.9ABC
16	Heritage TL A16982A	Syngenta --	2.0 6.3	ABC ABC	27.3BC	11.7BC
17	Lexicon	BASF	0.47	ABC	31.4BC	17.2ABC
18	Lexicon Affinity	BASF BASF	0.47 6.0	ABC ABC	34.7ABC	16.2ABC
19	LT120	Numerator Technologies	8.0	AC	30.4BC	22.0ABC
20	Microbic with SumaGrow	AgriBiotic Products	3.0	ABC	33.5ABC	17.5ABC
21	Moisture Manager	John Deere Landscapes	9.0	A	25.8C	17.7ABC
22	Neptune	Numerator Technologies	6.0	ABC	28.1BC	11.9BC
23	NT-0949	--	6.0	ABC	26.8BC	13.7ABC
24	NT-P.0017	--	6.0	ABC	38.6AB	23.6AB
25	NT-R008	--	6.0	ABC	31.7BC	18.1ABC
26	PX13002	--	5.0	ABC	30.8BC	16.8ABC
27	PX13011	--	4.0	ABC	32.7ABC	16.8ABC
28	PX13012	--	5.0	ABC	33.0ABC	22.9AB
29	Revert	Numerator Technologies	6.0	ABC	30.6BC	16.2ABC
30	Revolution	Aquatrols	6.0	ABC	32.8ABC	21.5ABC
31	Revolution ES TC006A	Aquatrols --	6.0 9.0	A BC	30.5BC	17.2ABC
32	Rely II	Simplot	6.0	ABC	31.0BC	16.2ABC
33	TriCure AD	Mitchell Products	6.0	ABC	44.1A	25.2A
34	UCREXPF1	--	16.0 oz/A	ABC	33.6ABC	21.3ABC
35	Xzemplar	BASF	0.26	ABC	28.8BC	15.8ABC
36	Xzemplar Affinity	BASF BASF	0.26 6.0	ABC ABC	26.5BC	14.8ABC

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Table 8. Effects of treatments on water droplet penetration (seconds) into soil cores 1 cm below the thatch-soil interface in the localized dry spot (LDS) study on the 13th fairway at Preserve Golf Club, Carmel, CA. 14 August 2013.

No.	Treatment	Company	Rate (oz/M)	Timing	Time (seconds)
1	Control	--	--	--	80.2ABCDEF
2	A16982A	--	6.3	ABC	39.1DEF
3	A16982A	--	12.6	ABC	14.3EF
4	Affinity	BASF	6.0	ABC	17.2EF
5	APSA-80	Amway	5.0	ABC	165.8A
6	Aqua Plus	Creative Eco Systems	3.0	ABC	63ABCDEF
7	Aqueduct	Aquatrols	8.0	ABC	66.4ABCDEF
8	Bolster	Sustane	3.0	ABC	77.4ABCDEF
9	Briskway	Syngenta	0.72	ABC	86.1ABCDEF
10	Briskway A16982A	Syngenta --	0.72 6.3	ABC ABC	19.6EF
11	Cascade + Duplex	Precision Labs	5.0	ABC	110.1ABCDEF
12	Displace	Grigg Brothers	12.0	ABC	35.0DEF
13	ES TC006A	--	9.0	ABC	154.4AB
14	GB-6931	--	6.0	ABC	24.9EF
15	Heritage TL	Syngenta	2.0	ABC	115.2ABCDE
16	Heritage TL A16982A	Syngenta --	2.0 6.3	ABC ABC	12.4EF
17	Lexicon	BASF	0.47	ABC	35.3DEF
18	Lexicon Affinity	BASF BASF	0.47 6.0	ABC ABC	48.0BCDEF
19	LT120	Numerator Technologies	8.0	AC	45.6CDEF
20	Microbic with SumaGrow	AgriBiotic Products	3.0	ABC	100.0ABCDEF
21	Moisture Manager	John Deere Landscapes	9.0	A	103.4ABCDEF
22	Neptune	Numerator Technologies	6.0	ABC	138.4ABCD
23	NT-0949	--	6.0	ABC	64.4ABCDEF
24	NT-P.0017	--	6.0	ABC	44.1DEF
25	NT-R008	--	6.0	ABC	72.6ABCDEF
26	PX13002	--	5.0	ABC	113.1ABCDEF
27	PX13011	--	4.0	ABC	151.0ABC
28	PX13012	--	5.0	ABC	20.4EF
29	Revert	Numerator Technologies	6.0	ABC	75.7ABCDEF
30	Revolution	Aquatrols	6.0	ABC	43.2DEF
31	Revolution ES TC006A	Aquatrols --	6.0 9.0	A BC	90.6ABCDEF
32	Rely II	Simplot	6.0	ABC	29.2EF
33	TriCure AD	Mitchell Products	6.0	ABC	36.2DEF
34	UCREXPF1	--	16.0 oz/A	ABC	22.4EF
35	Xzemplar	BASF	0.26	ABC	41.9DEF
36	Xzemplar Affinity	BASF BASF	0.26 6.0	ABC ABC	7.3F

Treatment means followed by the same letter in a column are not significantly different (α = 0.05).

Figure 5. Plot pictures (outlined by golf balls) of Revolution (top left), TriCure AD (top right), and untreated control (bottom) treatments taken on 17 July 2013. Preserve Golf Club, Carmel, CA.

University of California, Riverside Research Putting Green

- ✓ Conducting this study on a research putting green at UCR allowed us to push the turf to the edge of drought stress (and over) and to test product efficacy accordingly. While the site was more variable than desired for testing products on LDS (e.g., most treatments did not differ from the control), the overall occurrence of LDS and long duration of the study allowed us to gain valuable information about the products tested.

- ✓ Shortly after the initial application of treatments in June, the study area was dried too rapidly and severely to allow products enough time to work (Fig. 6). This is further evidence that while many products can be an effective aid to turf under drought stress, they cannot perform miracles in the complete absence of water. Because substantial turf loss occurred during this time, turf cover was evaluated throughout the remainder of the experiment; however, no differences among treatments were found (data not shown).

- ✓ Turf quality was significant on three dates (Table 9). Although rarely different from the control, Revolution provided the highest and most consistent turf quality. NT-0949, Affinity, A16982A, and TriCure AD also provided good quality but not as consistently as Revolution.

- ✓ LDS was also significant at the same dates (Table 10) and the general trend was the same as for turf quality. Some additional products including fungicides also appeared to reduce LDS intermittingly throughout the study. Fairy ring symptoms were not observed during this or any of the other aforementioned studies.

- ✓ Soil water was significant at three dates (Table 11). However, there appeared to be no clear relationship with turf quality and LDS incidence other than for NT-0949, which held the most water during the first part of the experiment.

- ✓ In general, treatments that tended to hold more water also produced a softer turf surface and vice versa (Table 12). And similar to the water droplet penetration test at Preserve Golf Club, better performing products against LDS tended to have shorter droplet retention times (Table 12).

- ✓ In summary, Revolution provided the best overall results in regard to alleviation of drought stress and LDS at UC Riverside. TriCure AD, NT-0949, Affinity, and A16982A also provided good results although not as consistently as Revolution.

Table 9. Effects of treatments on turf quality (1 to 9 scale, 9 = best) in the localized dry spot (LDS) study on a research green at the University of California, Riverside.

No.	Treatment	Company	Rate (oz/M)	Timing (d)	7/11/2013	7/19/2013	9/5/2013
1	Control	--	--	--	6.0bc	6.0abc	5.3abcd
2	A16982A	--	6.3	14	6.7abc	6.0abc	5.0abcd
3	A16982A	--	12.6	14	7.0abc	7.0a	5.7abcd
4	Affinity	BASF	6.0	28	7.0abc	7.0a	6.3abc
5	APSA-80	Amway	2.5	14	6.3abc	6.7ab	5.7abcd
6	Aqua Plus	Creative Eco Systems	3.0	28	6.7abc	5.7abc	6.0abcd
7	Aqueduct	Aquatrols	8.0	14 (28)	7.0abc	5.7abc	6.3abc
8	Revolution	Aquatrols	6.0	14 (28)	7.7a	6.7ab	7.0a
9	ES TC006A	--	9.0	21	5.7c	5.7abc	5.7abcd
10	Displace	Grigg Brothers	12.0	28	6.3abc	6.0abc	6.3abc
11	GB-6931	--	6.0	28	6.7abc	5.7abc	5.7abcd
12	TriCure AD	Mitchell Products	6.0	28	7.3ab	6.3abc	5.7abcd
13	Neptune	Numerator Technologies	6.0	28	5.7c	5.0bc	5.0abcd
14	Revert	Numerator Technologies	6.0	28	5.7c	5.0bc	4.3bcd
15	NT-01533	--	4.0	14	5.7c	5.7abc	5.3abcd
16	NT-0949	--	6.0	28	7.3ab	7.0a	6.7ab
17	NT-R008	--	6.0	28	6.3abc	5.3abc	5.3abcd
18	Cascade + Duplex	Precision Labs	5.0	21	7.0abc	6.3abc	4.3bcd
19	PX13002	--	5.0	21	6.3abc	5.3abc	4.0cd
20	PX13011	--	4.0	21	6.7abc	5.0bc	5.3abcd
21	PX13012	--	5.0	21	6.7abc	6.3abc	4.7abcd
22	Microbic with SumaGrow	AgriBiotic Products	3.0	28	5.7c	5.7abc	5.3abcd
23 23	Revolution ES TC006A	Aquatrols --	6.0 9.0	21 rotation	7.0abc	6.0abc	5.3abcd
24	Heritage TL	Syngenta	1.0	14	7.0abc	6.3abc	5.7abcd
25 25	Heritage TL A16982A	Syngenta --	1.0 6.3	14 14	6.7abc	5.7abc	5.3abcd
26 26	Briskway A16982A	Syngenta --	0.6 6.3	14 14	7.0abc	6.0abc	5.3abcd
27	Lexicon	BASF	0.47	28	7.0abc	6.3abc	6.3abc
28 28	Lexicon Affinity	BASF BASF	0.47 6.0	28 28	6.7abc	5.3abc	6.0abcd
29	Moisture Manager	John Deere Landscapes	9.0	AE	6.3abc	4.7c	4.3bcd
30	MegAlex	ihammer	7.3	14	6.0bc	4.7c	4.7abcd
31	Upplause Plus	ihammer	6.0	14	6.0bc	5.0bc	4.3bcd
32	Control 2	--	--	--	6.7abc	7.0a	6.0abcd
33	Fleet	Simplot	8.0	28	6.3abc	5.7abc	3.7d
34	Fleet	Simplot	16.0	28	7.0abc	6.3abc	6.0abcd
35	Fleet	Simplot	8.0	14	7.0abc	6.0abc	5.3abcd

Treatment means followed by the same letter in a column are not significantly different (α = 0.05). Treatments 7 and 8 were applied at 14-d intervals during the first part of the experiment (June/July) as per another company's protocol and 28-d intervals during the second part (August/September) as per the label. Treatment 29 was applied on June 14 (A) and August 8 (E).

Table 10. Effects of treatments on localized dry spot (LDS) incidence (0-100%) in the LDS study on a research green at the University of California, Riverside.

No.	Treatment	Company	Rate (oz/M)	Timing (d)	7/11/2013	7/19/2013	9/5/2013
1	Control	--	--	--	25abcdefg	28abcdefghi	23abc
2	A16982A	--	6.3	14	14bcdefg	20defghi	25abc
3	A16982A	--	12.6	14	15bcdefg	13hi	20abc
4	Affinity	BASF	6.0	28	3fg	12hi	13bc
5	APSA-80	Amway	2.5	14	18bcdefg	20defghi	22abc
6	Aqua Plus	Creative Eco Systems	3.0	28	22abcdefg	40abcde	18abc
7	Aqueduct	Aquatrols	8.0	14 (28)	5defg	12hi	18abc
8	Revolution	Aquatrols	6.0	14 (28)	3g	6i	13bc
9	ES TC006A	--	9.0	21	29abcde	40abcde	17abc
10	Displace	Grigg Brothers	12.0	28	17bcdefg	38abcdef	15bc
11	GB-6931	--	6.0	28	12bcdefg	20defghi	17abc
12	TriCure AD	Mitchell Products	6.0	28	5efg	18efghi	25abc
13	Neptune	Numerator Technologies	6.0	28	35abc	48a	27abc
14	Revert	Numerator Technologies	6.0	28	30abcd	43abc	42ab
15	NT-01533	--	4.0	14	45a	45ab	23abc
16	NT-0949	--	6.0	28	7defg	18efghi	18abc
17	NT-R008	--	6.0	28	25abcdefg	40abcde	25abc
18	Cascade + Duplex	Precision Labs	5.0	21	5defg	13hi	32abc
19	PX13002	--	5.0	21	20abcdefg	20cdefghi	35abc
20	PX13011	--	4.0	21	17bcdefg	32abcdefgh	17abc
21	PX13012	--	5.0	21	14bcdefg	17fghi	37abc
22	Microbic with SumaGrow	AgriBiotic Products	3.0	28	37ab	37abcdefg	18abc
23 23	Revolution ES TC006A	Aquatrols --	6.0 9.0	21 rotation	18bcdefg	22bcdefghi	25abc
24	Heritage TL	Syngenta	1.0	14	9defg	11hi	22abc
25 25	Heritage TL A16982A	Syngenta --	1.0 6.3	14 14	10defg	25bcdefghi	22abc
26 26	Briskway A16982A	Syngenta --	0.6 6.3	14 14	10cdefg	12hi	15bc
27	Lexicon	BASF	0.47	28	10defg	32abcdefgh	12c
28 28	Lexicon Affinity	BASF BASF	0.47 6.0	28 28	15bcdefg	23bcdefghi	17abc
29	Moisture Manager	John Deere Landscapes	9.0	AE	24abcdefg	42abcd	45a
30	MegAlex	ihammer	7.3	14	20abcdefg	37abcdefg	40abc
31	Upplause Plus	ihammer	6.0	14	28bcde	43abc	35abc
32	Control 2	--	--	--	13bcdefg	15ghi	22abc
33	Fleet	Simplot	8.0	28	18bcdefg	23bcdefghi	42ab
34	Fleet	Simplot	16.0	28	9defg	8i	22abc
35	Fleet	Simplot	8.0	14	27abcdef	23bcdefghi	22abc

Treatment means followed by the same letter in a column are not significantly different (α = 0.05). Treatments 7 and 8 were applied at 14-d intervals during the first part of the experiment (June/July) as per another company's protocol and 28-d intervals during the second part (August/September) as per the label. Treatment 29 was applied on June 14 (A) and August 8 (E).

Table 11. Effects of treatments on volumetric water content (%) in the upper 3 inches of the root zone in the localized dry spot (LDS) study on a research green at the University of California, Riverside.

No.	Treatment	Company	Rate (oz/M)	Timing (d)	6/27/2013	7/19/2013	9/5/2013
1	Control	--	--	--	24ab	21abcd	14abc
2	A16982A	--	6.3	14	22abcd	15bcde	12abcd
3	A16982A	--	12.6	14	21bcdefg	18abcde	11abcd
4	Affinity	BASF	6.0	28	21bcdefg	20abcde	12abcd
5	APSA-80	Amway	2.5	14	18defgh	18abcde	11abcd
6	Aqua Plus	Creative Eco Systems	3.0	28	24abc	19abcde	14abc
7	Aqueduct	Aquatrols	8.0	14 (28)	20bcdefgh	17bcde	13abcd
8	Revolution	Aquatrols	6.0	14 (28)	22abcde	23ab	14abc
9	ES TC006A	--	9.0	21	21bcdefg	15bcde	12abcd
10	Displace	Grigg Brothers	12.0	28	20bcdefgh	15bcde	10cd
11	GB-6931	--	6.0	28	18efgh	16bcde	10bcd
12	TriCure AD	Mitchell Products	6.0	28	18efgh	18abcde	12abcd
13	Neptune	Numerator Technologies	6.0	28	17fgh	20abcde	11abcd
14	Revert	Numerator Technologies	6.0	28	20bcdefgh	16bcde	12abcd
15	NT-01533	--	4.0	14	17fgh	17abcde	13abc
16	NT-0949	--	6.0	28	26a	26a	12abcd
17	NT-R008	--	6.0	28	20cdefgh	19abcde	13abcd
18	Cascade + Duplex	Precision Labs	5.0	21	21bcdefg	14cde	11abcd
19	PX13002	--	5.0	21	20bcdefgh	14cde	11abcd
20	PX13011	--	4.0	21	17gh	13cde	11abcd
21	PX13012	--	5.0	21	19defgh	15bcde	12abcd
22	Microbic with SumaGrow	AgriBiotic Products	3.0	28	19defgh	16bcde	12abcd
23 23	Revolution ES TC006A	Aquatrols --	6.0 9.0	21 rotation	20bcdefgh	16bcde	13abc
24	Heritage TL	Syngenta	1.0	14	21bcdefg	21abc	13abcd
25 25	Heritage TL A16982A	Syngenta --	1.0 6.3	14 14	20cdefgh	15bcde	11abcd
26 26	Briskway A16982A	Syngenta --	0.6 6.3	14 14	18defgh	16bcde	11abcd
27	Lexicon	BASF	0.47	28	19cdefgh	21abcd	13abcd
28 28	Lexicon Affinity	BASF BASF	0.47 6.0	28 28	19defgh	16bcde	11abcd
29	Moisture Manager	John Deere Landscapes	9.0	AE	16h	15bcde	9d
30	MegAlex	ihammer	7.3	14	18defgh	15bcde	11bcd
31	Upplause Plus	ihammer	6.0	14	20bcefgh	13de	10bcd
32	Control 2	--	--	--	19defgh	19abcde	12abcd
33	Fleet	Simplot	8.0	28	20bcdefgh	12e	11abcd
34	Fleet	Simplot	16.0	28	19cdefgh	19abcde	12abcd
35	Fleet	Simplot	8.0	14	22bcdef	15bcde	12abcd

Treatment means followed by the same letter in a column are not significantly different (α = 0.05). Treatments 7 and 8 were applied at 14-d intervals during the first part of the experiment (June/July) as per another company's protocol and 28-d intervals during the second part (August/September) as per the label. Treatment 29 was applied on June 14 (A) and August 8 (E).

Table 12. Effects of treatments on firmness (higher value = firmer surface) and water droplet penetration (seconds) into soil cores 1 cm below the thatch-soil interface in the localized dry spot (LDS) study on a research green at the University of California, Riverside.

No.	Treatment	Company	Rate (oz/M)	Timing (d)	Firmness 7/19/2013	Firmness 9/5/2013	Time (seconds)
1	Control	--	--	--	44bcde	38bcd	72.0cdefgh
2	A16982A	--	6.3	14	52abc	47a	88.3bcdefgh
3	A16982A	--	12.6	14	41cde	43abc	16.4gh
4	Affinity	BASF	6.0	28	41de	43ab	80.2cdefgh
5	APSA-80	Amway	2.5	14	44bcde	39bcd	70.2cdefgh
6	Aqua Plus	Creative Eco Systems	3.0	28	52ab	42abcd	84.0cdefgh
7	Aqueduct	Aquatrols	8.0	14 (28)	39de	42abcd	52.3efgh
8	Revolution	Aquatrols	6.0	14 (28)	37e	40abcd	32.7fgh
9	ES TC006A	--	9.0	21	45abcde	39bcd	165.78abc
10	Displace	Grigg Brothers	12.0	28	42bcde	41abcd	150.11abcd
11	GB-6931	--	6.0	28	40de	38bcd	89.0bcdefgh
12	TriCure AD	Mitchell Products	6.0	28	40de	37bcd	64.6defgh
13	Neptune	Numerator Technologies	6.0	28	40de	40abcd	87.1bcdefgh
14	Revert	Numerator Technologies	6.0	28	37e	43abc	124.1bcdef
15	NT-01533	--	4.0	14	40de	41abcd	946bcdefgh
16	NT-0949	--	6.0	28	36e	37bcd	30.8fgh
17	NT-R008	--	6.0	28	42bcde	36bcd	120.3bcdef
18	Cascade + Duplex	Precision Labs	5.0	21	46abcde	35d	40.2fgh
19	PX13002	--	5.0	21	40de	42abcd	91.7bcdefgh
20	PX13011	--	4.0	21	43bcde	39bcd	145.8abcde
21	PX13012	--	5.0	21	46abcde	39abcd	61.3defgh
22	Microbic with SumaGrow	AgriBiotic Products	3.0	28	44bcde	37bcd	126.2bcdef
23 23	Revolution ES TC006A	Aquatrols --	6.0 9.0	21 rotation	40de	37bcd	99.1bcdefg
24	Heritage TL	Syngenta	1.0	14	38e	37bcd	33.1fgh
25 25	Heritage TL A16982A	Syngenta --	1.0 6.3	14 14	45abcde	41abcd	68.7defgh
26 26	Briskway A16982A	Syngenta --	0.6 6.3	14 14	41cde	38bcd	124.0bcdef
27	Lexicon	BASF	0.47	28	42bcde	40abcd	93.1bcdefgh
28 28	Lexicon Affinity	BASF BASF	0.47 6.0	28 28	43bcde	38bcd	92.0bcdefgh
29	Moisture Manager	John Deere Landscapes	9.0	AE	46abcde	40abcd	226.4a
30	MegAlex	ihammer	7.3	14	47abcde	40abcd	122.2bcdef
31	Upplause Plus	ihammer	6.0	14	56a	41abcd	182.9ab
32	Control 2	--	--	--	38e	39bcd	49.1fgh
33	Fleet	Simplot	8.0	28	50abcd	42abcd	149.4abcd
34	Fleet	Simplot	16.0	28	38e	37bcd	56.0defgh
35	Fleet	Simplot	8.0	14	42bcde	36cd	36.3fgh

Treatment means followed by the same letter in a column are not significantly different (α = 0.05). Treatments 7 and 8 were applied at 14-d intervals during the first part of the experiment (June/July) as per another company's protocol and 28-d intervals during the second part (August/September) as per the label. Treatment 29 was applied on June 14 (A) and August 8 (E).

Figure 6. Photos of the LDS study area at UC Riverside taken on 19 June 2013 (above) and 13 July 2013 (below). Withholding too much water too rapidly after initial application of treatments on 14 June 2013 caused significant turf loss. However, as the below photo shows, some treatments were better than others in responding to severe drought conditions.

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