Best Management Practices for Turf under Drought or Water Use Restrictions

Aerial photo of research area at UC Riverside taken on 8 September 2015. Bermudagrass in between plots received no chemical treatment, nitrogen or water during the study.

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Best Management Practices for Turf under Drought or Water Use Restrictions

2015 Progress Report

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The Bottom Line: Water conservation strategies including use of PGRs (Primo Maxx), wetting agents (Revolution), and N fertilization (testing 6 different fertilizers applied at a rate of 4 lb/M/year, with urea serving as control applied at 2 lb/M/year) were tested on bermudagrass 'Princess 77' irrigated at either 70% or 40% ET_0, during the summer of 2015, starting July 31. Fertilization regime seemed to have the highest impact on turfgrass quality, with 4 fertilizers (Best Nitra King, Gro-Power, Loveland, and Turf Royale) performing better than the control during every rating date. Our preliminary results so far suggest that proper N management during the summer months could help save 30% water to irrigate bermudagrass. Nevertheless, the late start of the study and natural precipitation may have impacted the results of this study, thus repeating the trial for additional years is warranted .

Introduction:

As water resources inevitably decline due to population growth and resultant irrigation requirements, water use must necessarily be reduced, especially during drought. On turf, drought stress will result in discoloration, and consequent loss of visual quality and turf functionality. The objectives of this study were to evaluate if management practices such as the use of plant growth regulators (PGRs), wetting agents, proper fertilization, or the combined application of the three can help maintain acceptable turf quality under deficit irrigation.

Methods:

The study was conducted on mature bermudagrass 'Princess 77' turf. The turf was mowed three times per week at 0.625 inches during the growing season. Soil was a Hanford fine sandy loam. Environmental data for the site are provided in Table 1. The 60' x 90' field was divided into six 30' x 30' plots. Beginning August 3, and until 31 October 2015 the plots received either 40% or 70% of previous week ET_0 by hand watering, as determined by an on-site CIMIS station. Treatments were arranged in a split-plot design with 3 different factors randomized within ET_0 replacement plots and 3 replicates. Plant growth regulator (Primo Maxx) served as split plot; wetting agent (Revolution) as split-split-plot; finally, fertilizer products (Table 2) were randomized inside the wetting agent plots (plot size 24 ft^2) and applied monthly beginning 31 July 2014. Each treatment received an equivalent of 1 lb N/M/month, for a total of 4 lb

N/M/year except for the Yara Vera (urea) plots, which received ½ lb N/M/month to serve as a control. Prior to application of fertilizer treatments, the entire field received no N in 2015. Granular treatments were applied with shaker jars, while spray treatments were applied using a CO2-powered hand boom sprayer equipped with TeeJet 8004VS nozzles and output of 2 gal/M. All treatments, with the exception of Primo Maxx were irrigated with ca. 1/8 in of water following application. Every two weeks, plots were evaluated for turf quality on a scale from 1 = worst to 9 = best, Naturalized Difference Vegetation Index (NDVI), 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). Visual turf quality and % green cover using DIA were taken to measure the effect of fertilizer products on bermudagrass dormancy in late November and early December.

Data were subjected to analysis of variance (ANOVA). When necessary, multiple comparisons of means were assessed using Fisher's protected least significant difference test at the 0.05 probability level. Each graphical output is presented and discussed only if treatment effect, ET_0 replacement effect, or their interaction was significant during one or more rating dates.

Results:

All ratings collected at the beginning of the study showed that bermudagrass was significantly affected by lack of N fertilization (Figure 1). However, one month after the first pound of N was applied, grass recovered and no differences between ET_0 replacements were found (data not shown). Fertilizer products had an effect on turf visual quality, with 4 products (Best Nitra King, Gro-Power, Loveland, and Turf Royale) performing better than the control (Figure 1), and achieving acceptable quality, despite irrigation regime. These results were corroborated by those of Dark Green Color Index (DGCI) and NDVI, where Best Nitra King, Loveland, and Gro-Power all performed better in comparison to the half rate of urea. In December, when bermudagrass was entering dormancy, all fertilized plots with the exception of WIL-GRO with Infitrate held color better than those fertilized with Vera (Figure 1), with Loveland achieving the numerical highest cover. Revolution also had a positive effect on turf visual quality (Figure 2), but no differences were found for NDVI or DIA. No sign of stress was detected on bermudagrass irrigated at 40% ET_0 a month after the beginning of the study; nevertheless, abundant natural precipitation were recorded at the site of the study in September and October when ET rates were decreasing (Table 1), helping bermudagrass to sustain quality with deficit irrigation. Preliminary results so far suggest that proper N management during the summer months could help save 30% water to irrigate bermudagrass if natural precipitation occurs.

Table 1. Environmental data collected and reported by the California Irrigation Management System (CIMIS) for Station 44 (Riverside) during the salinity alleviation study. Riverside, CA. Weather station located ≈ 100 ft away from study area.

Month Year	Total ETo (in)	Total Precip (in)	Avg Vap Pres (mBars)	Avg Max Air Temp (F)	Avg Min Air Temp (F)	Avg Air Temp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Aug-15	7.65	0	15	92.8	65.4	78	72	26	47	4	75
Sep-15	5.81	1.04	15.7	91.4	65.7	77.2	74	29	50	3.7	73.7
Oct-15	4.21	0.54	13.1	84.8	61.8	72.3	72	29	49	4	69.4

Table 2. PGR, wetting agent, and fertilization study treatment list. 2015.

Plot	**Treatment**	**Company**	**Rate**	**Frequency (wks)**
Whole Plot	ET_0 replacement	---	40%, 70%	Mon-Wed-Fri
Split	Primo Maxx	Syngenta	0.36 oz/M	2
Split-split-plot	Revolution	Aquatrols	6 oz/M	4
Split-split-split-plot	Gro-Power (5-3-1)	Gro-Power	1 lb N/M	4
Split-split-split-plot	WIL-GRO with Infitrate (16-16-16)	Wilbur-Ellis	1 lb N/M	4
Split-split-split-plot	Vera (46-0-0)	Yara	½ lb N/M	4
Split-split-split-plot	Best Nitra King (21-2-4)	Simplot	1 lb N/M	4
Split-split-split-plot	Loveland (5-29-12)	Loveland	1 lb N/M	4
Split-split-split-plot	Turf Royale (21-7-14)	Yara	1 lb N/M	4

PGR Wetting Agent and Fertilization Study Treatment List and Plot Plan

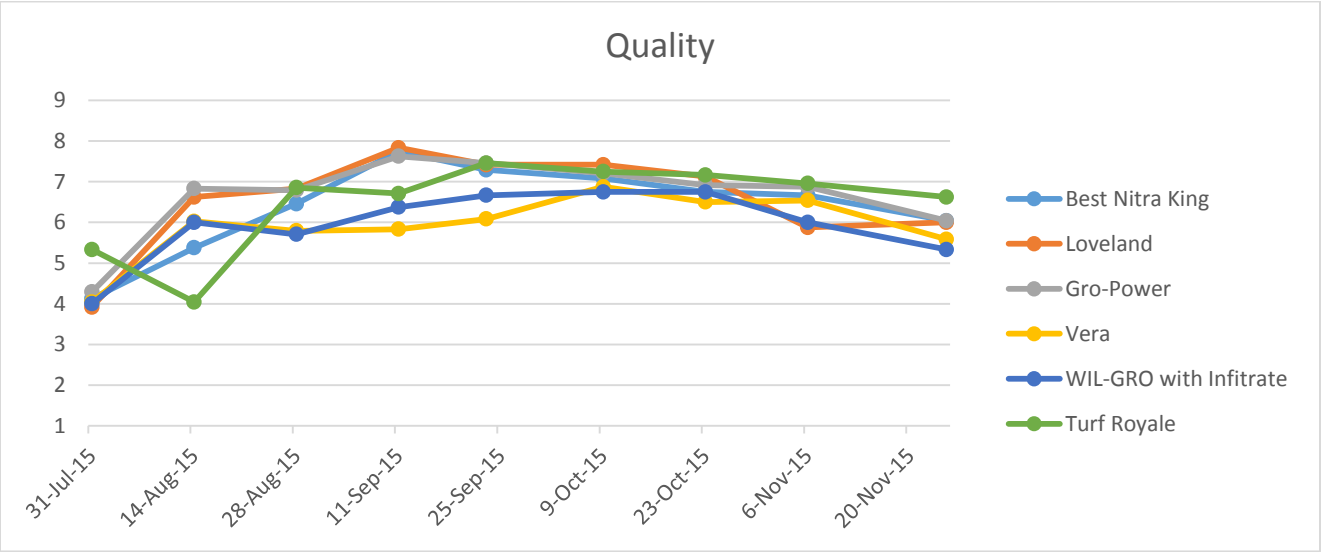
Rep 1	70% ET_0	19	20	12	9		13	18	4	3	40% ET_0
		21	22	11	7		15	16	1	2	
		23	24	8	10		17	14	6	5	
		14	18	5	2		9	8	19	21	
		13	17	1	6		11	7	22	24	
		16	15	3	4		10	12	23	20	

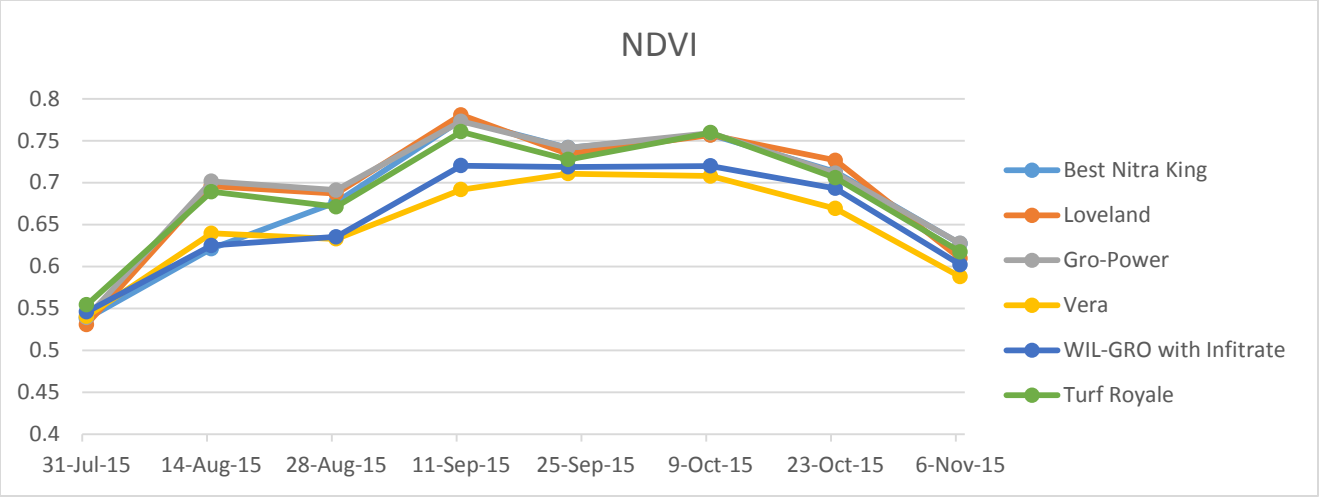
Rep 2	70% ET_0	5	6	15	16		5	3	13	17	40% ET_0
		2	3	17	14		6	2	14	16	
		1	4	18	13		1	4	18	15	
		23	19	10	12		9	11	22	19	
		21	22	8	9		10	12	20	21	
		24	20	7	11		8	7	23	24	

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

Trt #	Fertilizer	Primo Maxx	Revolution
1	Gro-Power		
2	WIL-GRO		
3	Yara Vera		
4	Best Nitra King		
5	Loveland Mini Yara Turf		
6	Royale		
7	Gro-Power	x	
8	WIL-GRO	x	
9	Yara Vera	x	
10	Best Nitra King	x	
11	Loveland Mini Yara Turf	x	
12	Royale	x	
13	Gro-Power		x
14	WIL-GRO		x
15	Yara Vera		x
16	Best Nitra King		x
17	Loveland Mini Yara Turf		x
18	Royale		x
19	Gro-Power	x	x
20	WIL-GRO	x	x
21	Yara Vera	x	x
22	Best Nitra King	x	x
23	Loveland Mini Yara Turf	x	x
24	Royale	x	x

Figure 1. Quality, Naturalized Difference Vegetation Index (NDVI), and % green cover of fertilizer products used during the study. Vera served as control and was applied at 2 lb/N/year instead of 4 lb/N/year.




NDVI
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
31-Jul-15
14-Aug-15
28-Aug-15
11-Sep-15
25-Sep-15
9-Oct-15
23-Oct-15
6-Nov-15
Best Nitra King
Loveland
Gro-Power
Vera
WIL-GRO with Infitrate
Turf Royale

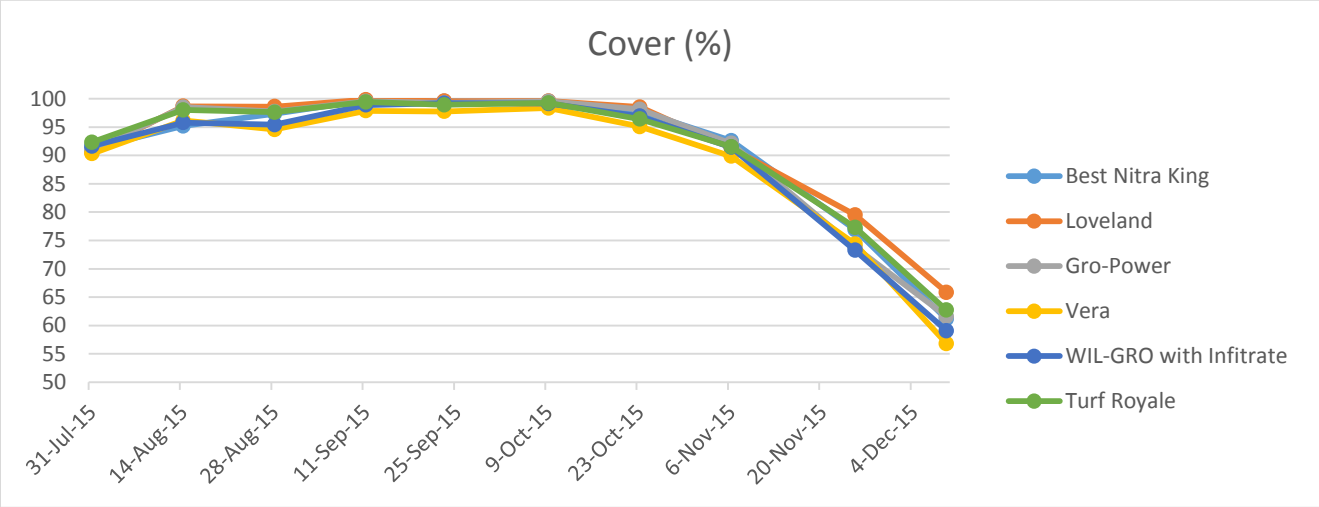
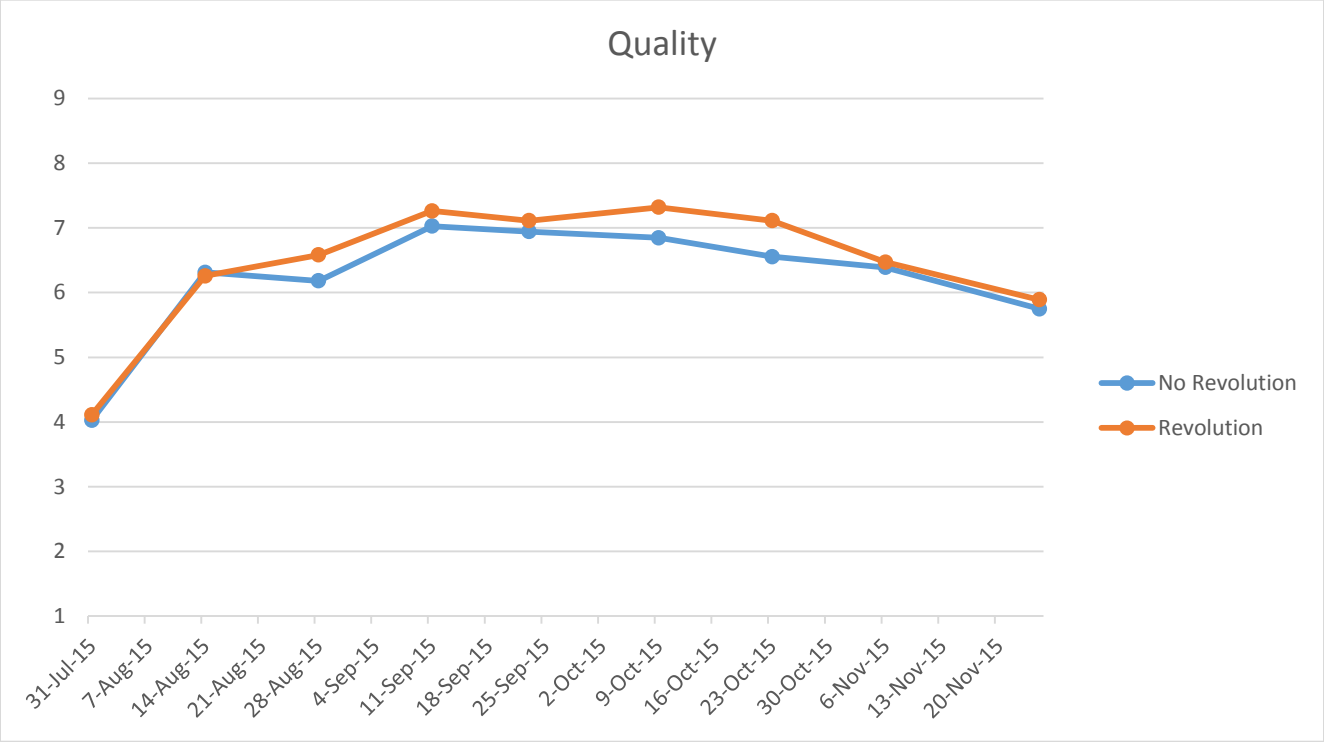

Cover (%)
100
95
90
85
80
75
70
65
60
55
50
31-Jul-15
14-Aug-15
28-Aug-15
11-Sep-15
25-Sep-15
9-Oct-15
23-Oct-15
6-Nov-15
20-Nov-15
4-Dec-15
Best Nitra King
Loveland
Gro-Power
Vera
WIL-GRO with Infitrate
Turf Royale

Figure 2. Quality of plots that received Revolution wetting agent.



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