

Irrigation Requirements for Salinity Management on Perennial Ryegrass



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Objectives:

1. Evaluate the interaction of drought and salinity on perennial ryegrass turf maintained as golf course rough.
2. Determine the leaching requirements for salinity management as influenced by several factors including irrigation water quality, soil physical properties, turfgrass species, cultural practices and rapid blight disease incidence.
3. Evaluate new and existing technologies and practices for determining soil water and salinity, and ultimately irrigation requirements for salinity management, turf health, and optimal playing conditions.
4. Assess the population size and activity of plant growth promoting rhizobacteria (PGPR) in the turf rhizosphere in response to imposed drought and salinity stress.

Use of reclaimed, low quality water for turfgrass irrigation is an increasingly common and necessary practice in arid regions of the southwestern U.S. Besides leaching, amendments may help alleviate soil salinity and related effects on turfgrass health. A research area at UC Riverside was sodded with hybrid bermudagrass cultivar 'Tifway II' in August 2012 on a Hanford fine sandy loam. The turf is mowed three times per week at 0.625 inches. Standard bermudagrass cultural practices are maintained throughout the study, including 4 lbs N/M/yr. Beginning November 2012, turf was irrigated at 75% ET_o exclusively with water mixed with a high but not unrealistic concentration of salts (EC = 4.4 ds/m) according the same ion composition of as the Colorado River (Table 1). Eighteen chemical and three microbial treatments started on 4 April 2013 (Table 2).

Treatments are replicated six times and applied by hand or using a calibrated CO₂ boom sprayer followed immediately by irrigation. Every 2 weeks, plots are evaluated for turf quality on a scale from 1 = worst to 9 = best), leaf firing, and volumetric soil water content



Figure 1. Bermudagrass salinity alleviation research area showing suction lysimeters on turf surface prior to insertion below the turf surface. Two 5,000-gal tanks are used to store and deliver saline irrigation water. Riverside, CA.

(VWC). In addition, Digital Image Analysis (DIA) and leachate from suction lysimeters buried 4 inches below the soil surface are collected at the same time (Fig. 1).

Analysis of leachate collected from the plots revealed that salinity is increasing in the rootzone (Fig. 2). From

April to August 2013, results for salinity alleviation were inconsistent. Only three products (ACA 2994, Crossover and Cal Plus applied at 0.75 oz/M) decreased salinity in leachate water on three data collection dates out of 11 (Fig. 2). ACA 2994 also increased bermudagrass quality during June. However, starting from July, plots treated with ACA 2994 were more prone to scalping in comparison to any other treatment. This characteristic caused a significant reduction in turf quality on plots treated with ACA 2994 (Fig. 3). No other treatments differed from the untreated control for turf quality. Likewise, VWC and DIA revealed no significant differences among treatments (data not shown).

In August 2013, soil from selected treatments was bulk sampled across replicates and submitted to a soil testing laboratory for salinity analysis (Table 3). Prior to irrigation with saline water, soil was higher in salinity because it was fallow and without irrigation or natural precipitation for several months prior. Irrigation with saline water resulted in increased soil pH, sodium (Na) concentration, and sodium absorption ratio (SAR). All three treatments selected for analysis appeared to reduce soil Na in comparison to the control. Treatment applications and ratings will continue into late fall until the beginning of the rainfall season. Also prior to rainfall, soil samples will be collected separately by replication for each of the 22 treatments to better assess salinity alleviation. The study will be repeated in 2014.

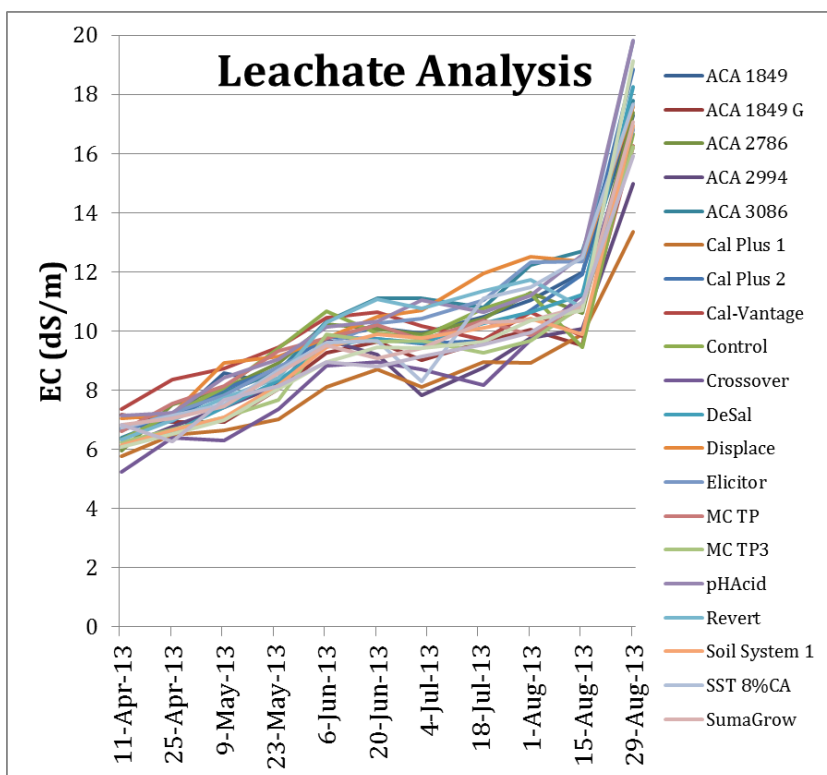


Figure 2. Salinity (measured as electrical conductivity or EC) of leachate water extracted from suction lysimeters in the salinity alleviation study.

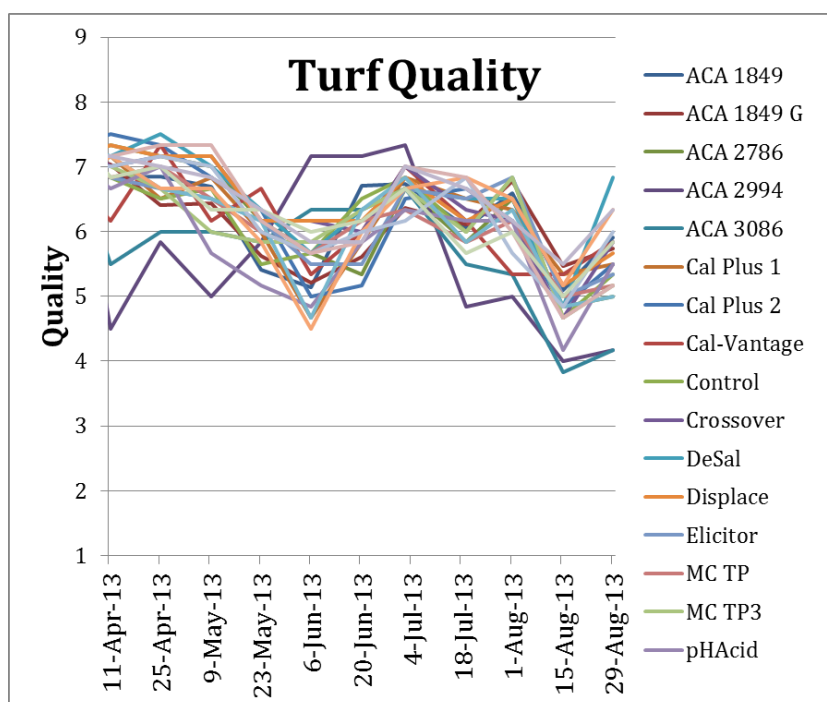


Figure 3. Bermudagrass quality (1 to 9 scale, 9 = best) in the salinity alleviation study.

Table 1. Chemical properties of irrigation water used in salinity alleviation study compared to potable irrigation water used elsewhere at the UCR turfgrass facility.

Chemical Property	Saline Irrigation Water	Potable Irrigation Water
pH	7.57	7.82
Hardness	938.23	215.18
Bicarbonate	209.84	214.72
Carbonate	0.01	0.01
EC (dS/m)	4.43	0.61
Na (ppm)	523.9	53.36
Cl (ppm)	996.27	31.13
Boron (ppm)	0.11	0.08
SAR (meq/L)	18.3	3.24
Nitrate N (ppm)	5.11	5.18
Phosphate (ppm)	0.4	0.01
Potassium (ppm)	129.76	4.16
Magnesium (ppm)	151.99	12.24
Calcium (ppm)	126.03	66
Sulfate (ppm)	707.62	78.1
Manganese (ppm)	0.01	0.01
Iron (ppm)	0.11	0.05

Summary Points

- Use of highly saline (4.4 dS/m) water for irrigation of bermudagrass turf for one year resulted in increased salinity of leachate water and soil, particularly Na. Although turf did not lose density, it did appear to be under physiological drought stress and N-deficient throughout most of the growing season despite non-limiting irrigation water and nutrition.
- Only three products (ACA 2994, Crossover and Cal Plus applied at 0.75 oz/M) decreased salinity in leachate water on three data collection dates out of 11. ACA 2994 was the only treatment to improve turf quality during 2013, although the effect was temporary during June, preceded by turf injury and followed by scalping.
- The microbial treatments (SumaGrow, Soil System 1, UCR001) have not improved turf quality or reduced salinity in leachate water thus far in the experiment.
- Select treatments including ACA 2994, Crossover, and Cal-Vantage/Kick/Terreplex/TriCure AD appeared to reduce soil salinity, especially Na, according to bulk soil analyses.

Table 3. Soil test results for salinity alleviation study area before and after application of saline irrigation and treatments.

Date	Treatment Comments	pH	OM%	Bulk Density	EC (dS/m)	SAR	Olsen P ppm	K ppm	Ca ppm	Mg ppm	Na ppm	Cation Exchange Capacity	Soluble Salts (dS/m)
Nov. 2012	Before Saline Irrigation Treatment	6.6	0.01	0.14	6.5	0.81		261	1904	202	79	12.2	2.45
Apr. 2013	Before Product Treatment Applications	7.7	1.1	1.46	2.13	4.79	29.6	159	1653	351	283	12.8	0.64
Aug. 2013	Control	7.8	0.8	1.58	7.33	8.67	19.1	215	1534	425	487	13.9	0.85
Aug. 2013	Treatment 3	7.7	1	1.43	5.69	7.99	20.8	189	1346	375	450	12.3	0.79
Aug. 2013	Treatment 7	7.5	1.1	1.55	3.23	6.74	20	230	1313	382	413	12.1	0.71
Aug. 2013	Treatment 10	7.7	1.2	1.48	4.24	6.98	21.7	253	1428	384	386	12.7	0.72

Table 2. Treatments applied in the salinity alleviation study.

No.	Treatment	Company	Rate	Frequency (wks)
1	Untreated Control	--	--	--
2	ACA 3086	Aquatrols	8 oz/M	2
3	ACA 2994	Aquatrols	8 oz/M	2
4	ACA 1849	Aquatrols	3 oz/M	2
5	ACA 1849	Aquatrols	3 oz/M	2
5	Gypsum		5 lbs/M	2
6	ACA 2786	Aquatrols	4.5 oz/M	2
7	Cal-Vantage	EarthWorks	5 oz/M	Earthworks products rotated monthly with Mitchell Products
7	Kick	Earthworks	10 oz/M	
7	Terreplex	Mitchell Products	1.5 oz/M	
7	riCure AD	Mitchell Products	4 oz/M	
8	MC TP	Mitchell Products	2 oz/M	2
9	MC TP3	Mitchell Products	2 oz/M	2
10	Crossover	Numerator Tech.	5 lb/M	4
11	Revert	Numerator Tech.	6 oz/M	4
12	SST 8%CA	Numerator Tech.	8 oz/M	2
13	pHAcid Sprayable	Numerator Tech.	1.5 oz/M	2
14	Cal Plus	Westbridge Agric.	0.75 oz/M	2
15	Cal Plus	Westbridge Agric.	1.5 oz/M	2
16	DeSal	Ocean Organics	0.75 oz/M	2
16	EXP 2	Ocean Organics	6 oz/M	2
16	EXP 5-0-1	Ocean Organics	6 oz/M	2
17	Displace	Grigg Brothers	12 oz/M	2
17	Carboplex	Grigg Brothers	6 oz/M	2
18	Elicitor	Grigg Brothers	2 oz/M	2
18	Kelpex	Grigg Brothers	2 oz/M	2
19	SumaGrow	Agribiotic Products	5 oz/M	Initial
19	SumaGrow	Agribiotic Products	3 oz/M	2
20	Soil System 1	LH Organics	50 g/18 gal	2 (every other month)
21	UCR001	UCR	inoculation	Once
22	Turfcare NPN	Gantec	oz/M	2 (Apr-May)
	Turfcare NPN	Gantec	oz/M	4 (Jun-Dec)
	Turfcare 6-1-2	Gantec	2.3 lb/M	Apr/May/Jul/Sep