Drought and Irrigation Salinity Effects on Perennial Ryegrass

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The use of reclaimed or other saline water sources for turf and landscape irrigation is inevitable in arid regions of the southwestern U.S. However, the use of saline water for turfgrass irrigation requires that salinity in the root zone be maintained at a level that does not adversely impact turf quality. The purpose of this study was to: 1) evaluate the interaction of drought and salinity on perennial ryegrass turf; 2) determine the leaching requirements for salinity management as influenced by several factors including irrigation water quality, soil physical and biological 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 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. This research will help to develop new guidelines and recommendations regarding irrigation of turf with waters of elevated salinity, and perhaps contribute to significant reduction in water use on golf courses and other turf areas where salinity management is a concern.

In this study, we combined the line source method of generating a continuous distribution of saline or potable irrigation water with the application of different quantities of water, representing a range from deficit irrigation to leaching. The study area is composed of 12 main plots, each irrigated with water ranging from electrical conductivity (EC) = 0.6 to 4.6 dS/m. In the perpendicular direction, three of the 12 plots are irrigated at 80, 100, 120, or 140% ET_o. To more precisely determine the effects of salinity on turfgrass health and underlying soil, we subdivided each of the 12 main plots into 9 sub-plots ranging from low to high irrigation salinity.

Location: UCR Turf Facility

Soil: Hanford fine sandy loam

Plot Size: 12 main plots (each 30' x 30'); overall plot area is 10,800ft^2

Species:	Perennial ryegrass 'SR 4550'
Seeding Date:	28 April 2011
Fertility:	0.5 lb N/1000 ft^2/month
Mowing Height:	2.5 inches; twice weekly
Irrigation:	ET_o replacement based on CIMIS data from previous week
Saline/Deficit Irrigation:	Initiated on 21 July 2011 at EC = 4.6 ds/m
Data Collection:	Turfgrass uniformity and quality (1-9, 6 minimally acceptable), percent turfgrass groundcover, canopy temperature, and dry clipping yield are evaluated biweekly. Toro Turf Guard TDR sensors monitor soil moisture, salinity, and temperature continuously at 4" and 8" below the soil surface. Irrometer Watermark sensors monitor soil water potential also at 4" and 8". Leachate is sampled at 10" below the surface using suction lysimeters. Additional soil samples collected prior to salinity treatments and throughout the study to assess the change in population size and activity of PGPR in response to imposed drought and salinity stress.
Acknowledgements:	Special thanks to the Metropolitan Water District of Southern California, USDA-ARS Salinity Laboratory, Toro, Irrometer, Seed Research of Oregon, and Campbell Scientific for funding, equipment, technical support for this project.

Preliminary Results

- ✓ Substantial decreases in dry clipping yield and visual turfgrass quality were found in plots receiving the highest salinity water (near saline irrigation lines) and less overall irrigation (80 and 100% ET_o).
- ✓ Soil salinity concentrations of ≥4 dS/m at 80% Et_o have resulted in a decrease in turfgrass uniformity, color, and overall quality.
- ✓ Without adequate water infiltration and drainage, soil salinity concentrations of ≥5 dS/m appear to cause damage to the turf for all irrigation regimes.
- ✓ It appears that irrigation replacement of $100\% < ET_o < 140\%$ is needed to maintain color and quality of perennial ryegrass during the summer months in an inland Mediterranean climate like Riverside.
- ✓ Thus far, this study has clearly substantiated the need to maintain adequate surface and sub-surface drainage to help manage salts and for maintaining turfgrass that is both dry and firm enough for functional use.

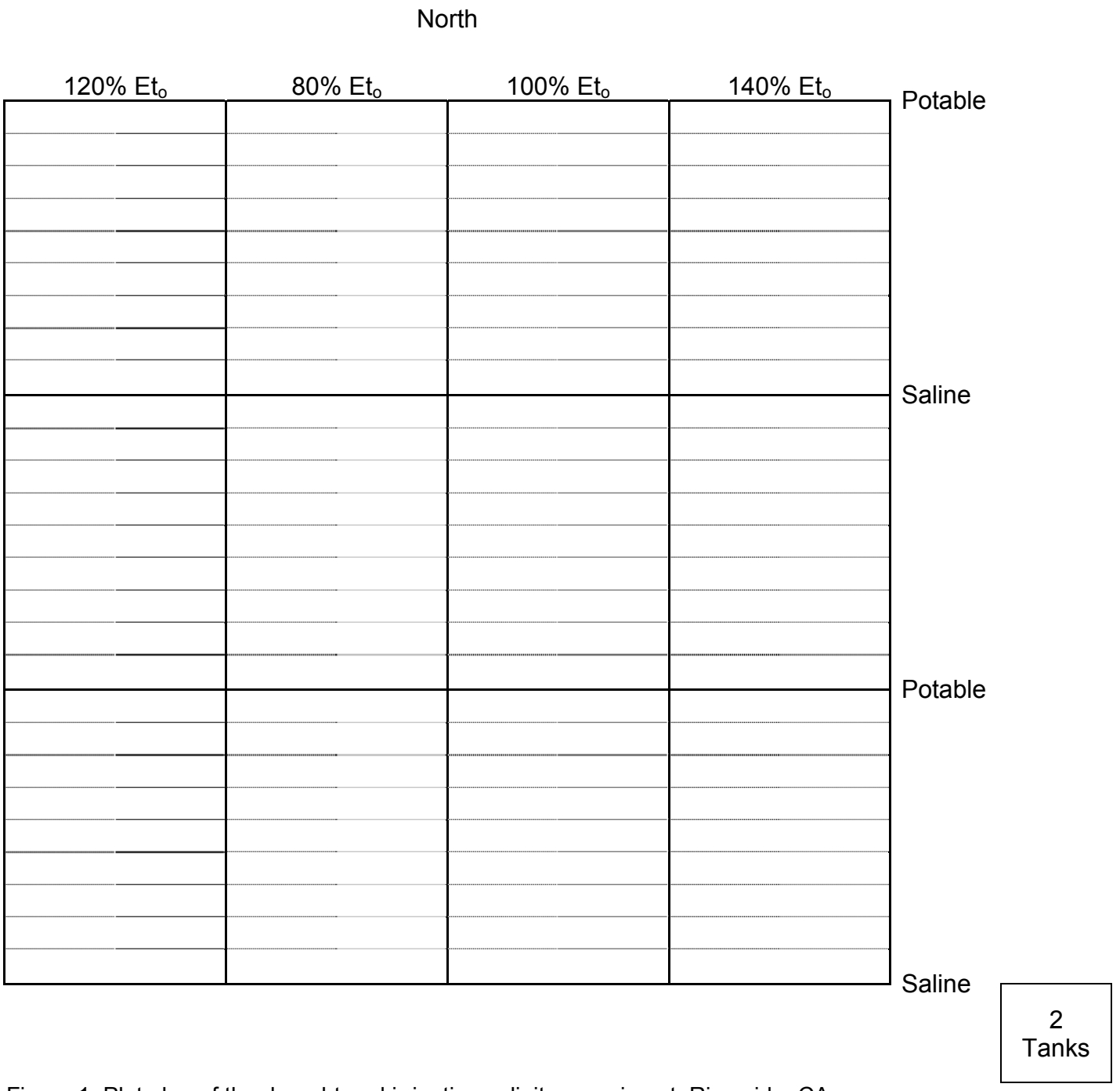
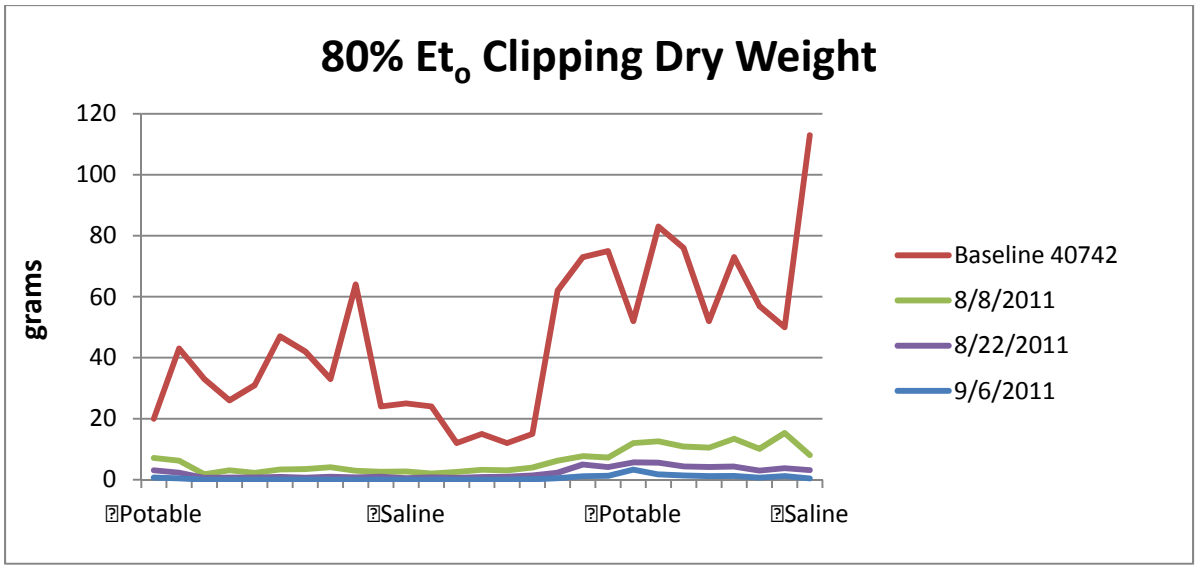
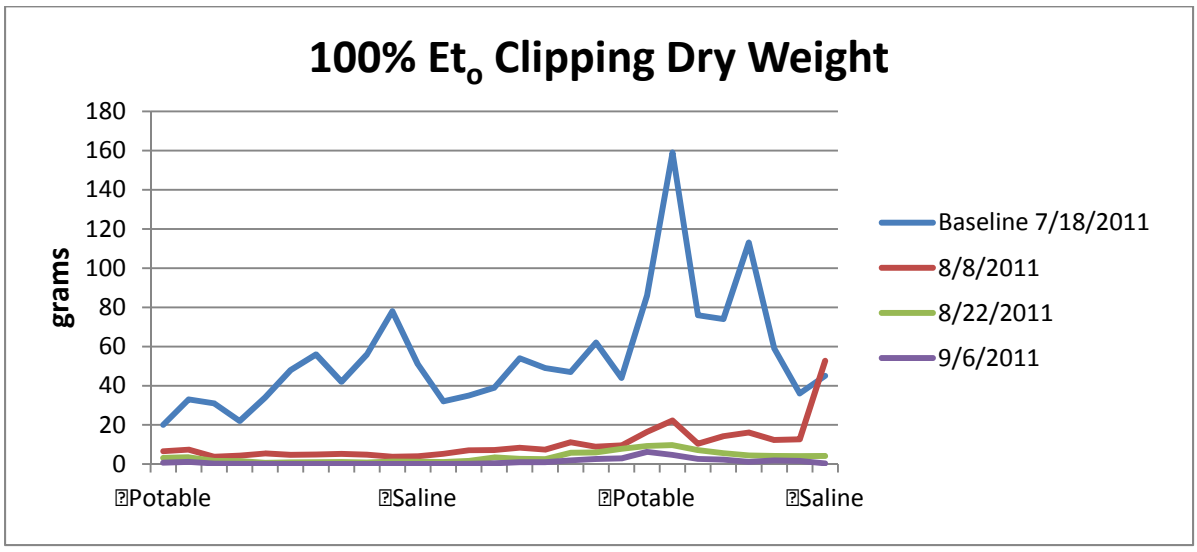
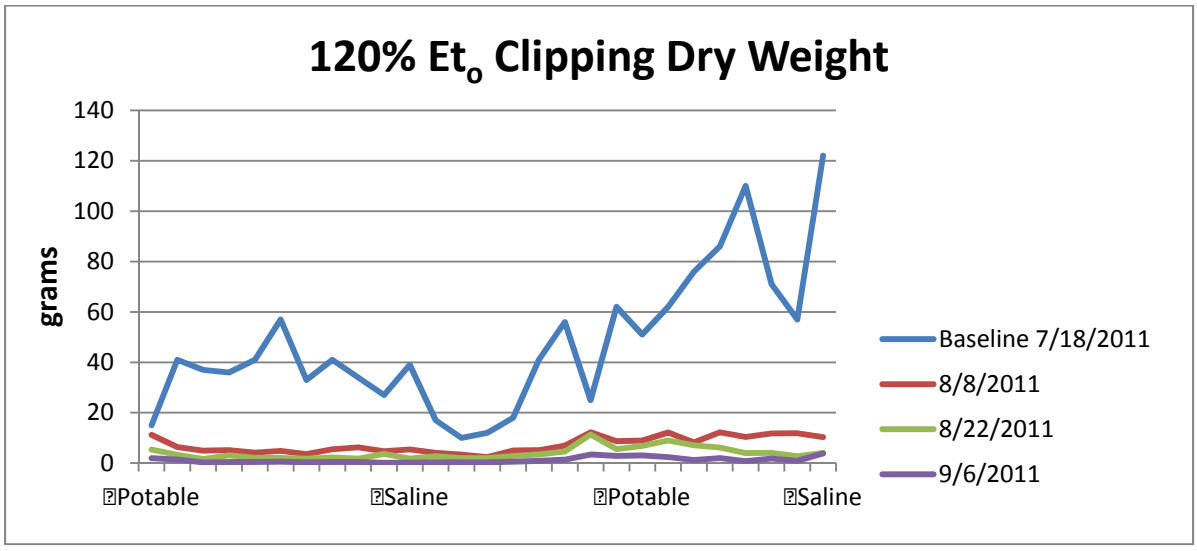


Figure 1. Plot plan of the drought and irrigation salinity experiment. Riverside, CA.


80% Et$_o$ Clipping Dry Weight
grams
120
100
80
60
40
20
0
Potable
Saline
Potable
Saline
Baseline 40742
8/8/2011
8/22/2011
9/6/2011


100% Et$_o$ Clipping Dry Weight
grams
180
160
140
120
100
80
60
40
20
0
Potable
Saline
Potable
Saline
Baseline 7/18/2011
8/8/2011
8/22/2011
9/6/2011


120% Et$_o$ Clipping Dry Weight
grams
140
120
100
80
60
40
20
0
Potable
Saline
Potable
Saline
Baseline 7/18/2011
8/8/2011
8/22/2011
9/6/2011

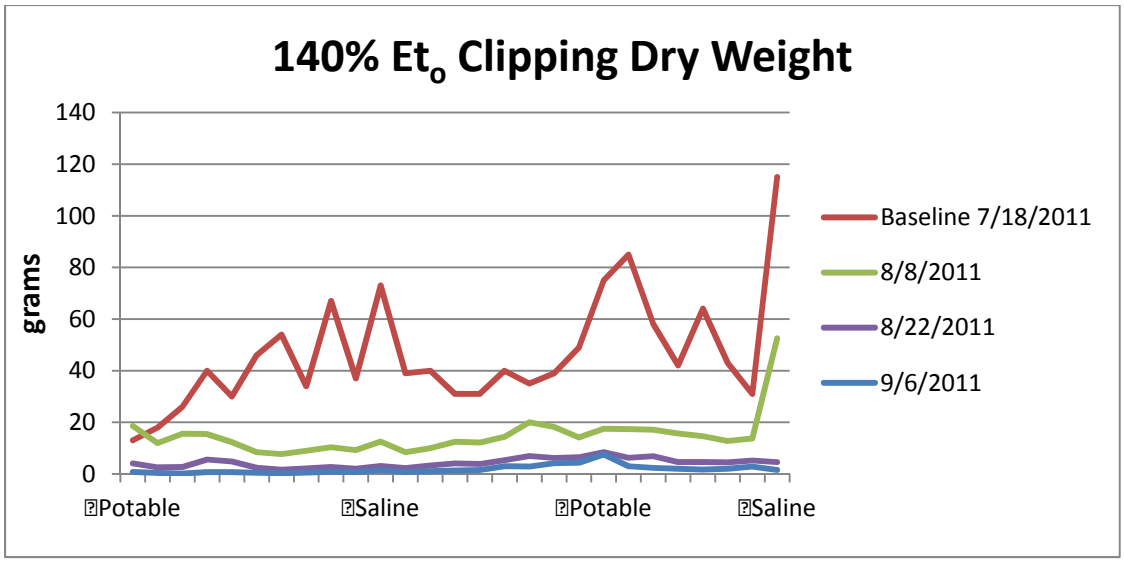
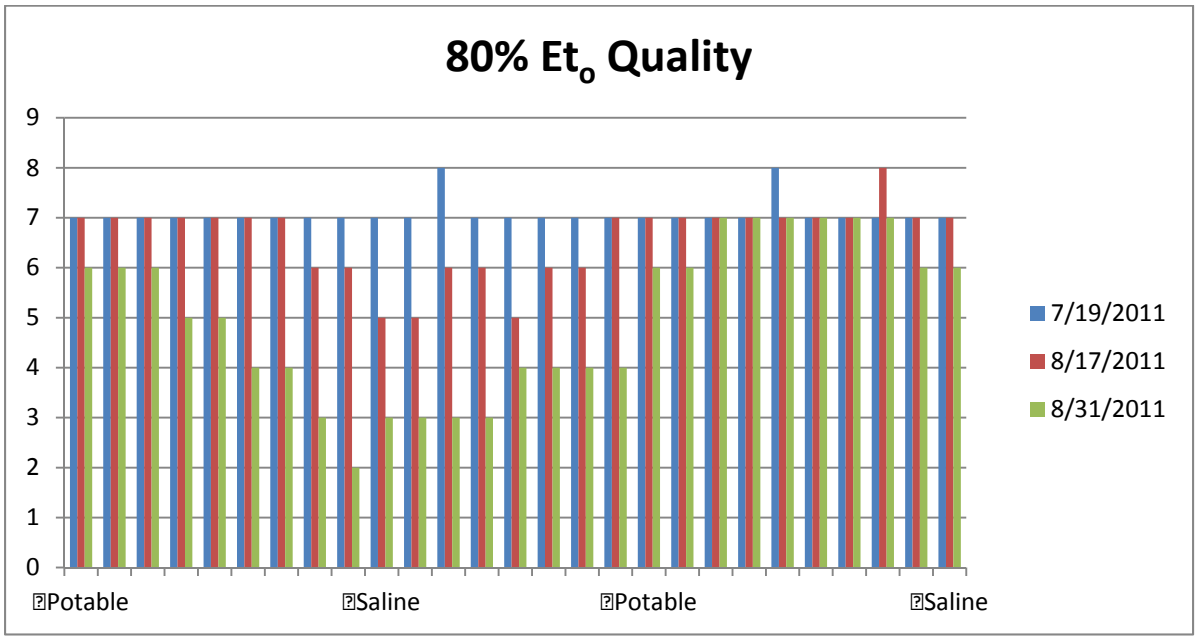
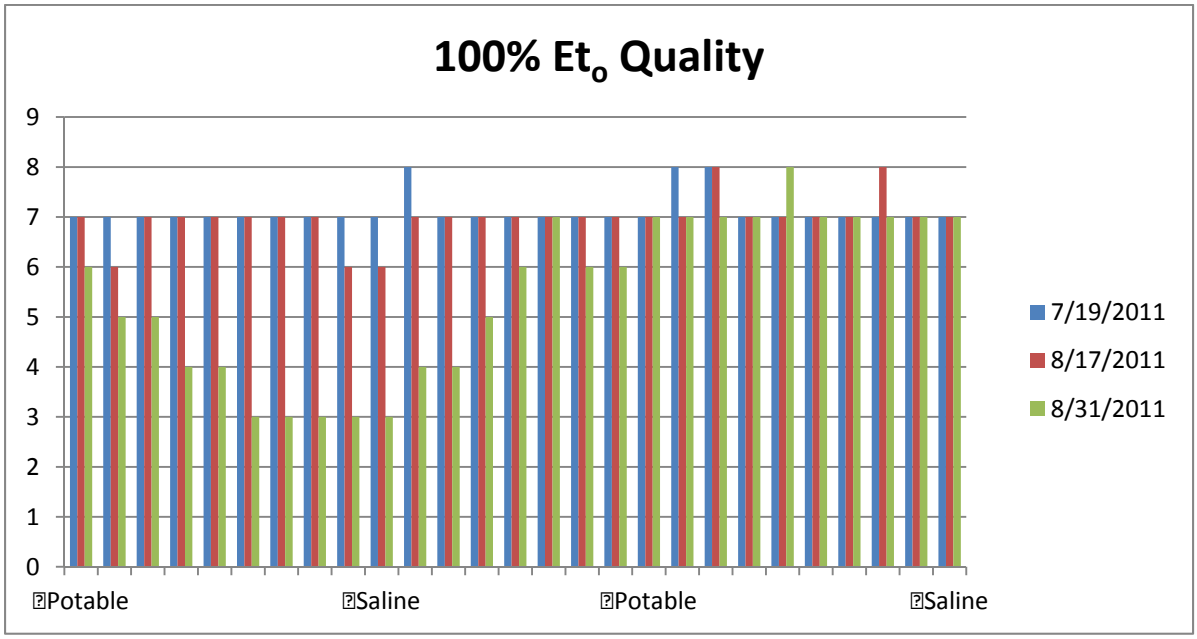
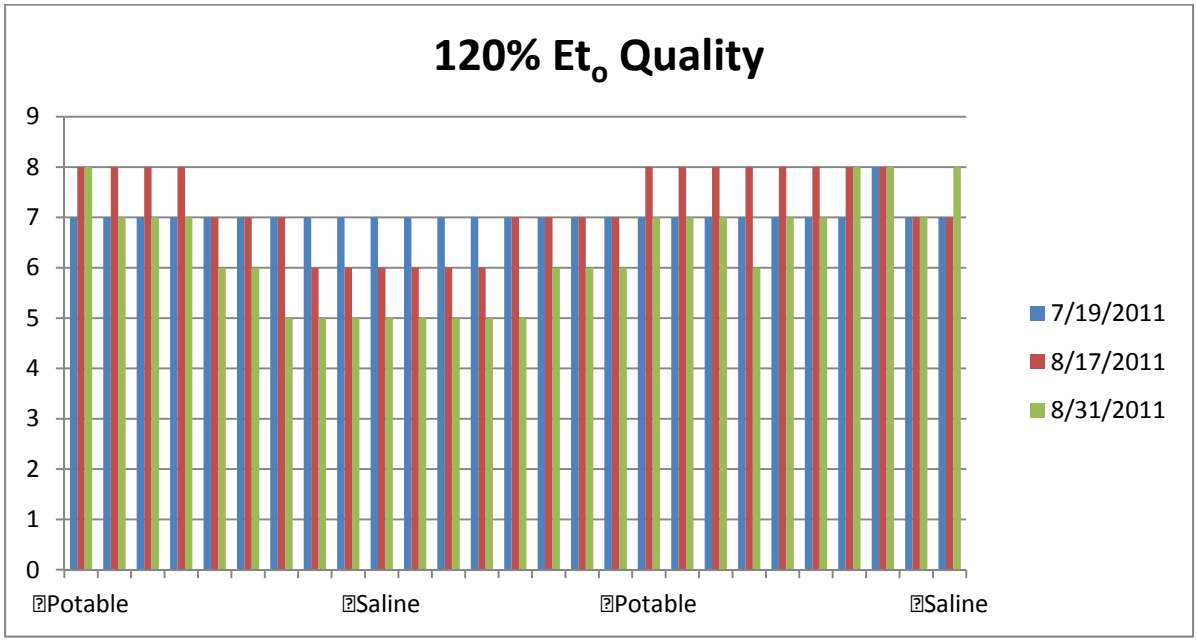


Figure 2. Dry clipping yield of perennial ryegrass prior to and following initiation of saline and deficit irrigation on July 21, 2011. Tick marks on x-axis represent sub-plots in between alternating irrigation lines that deliver potable and saline water.




100% Et$_o$ Quality
9
8
7
6
5
4
3
2
1
0
Potable
Saline
Potable
Saline
7/19/2011
8/17/2011
8/31/2011


120% Et$_o$ Quality
9
8
7
6
5
4
3
2
1
0
Potable
Saline
Potable
Saline
7/19/2011
8/17/2011
8/31/2011

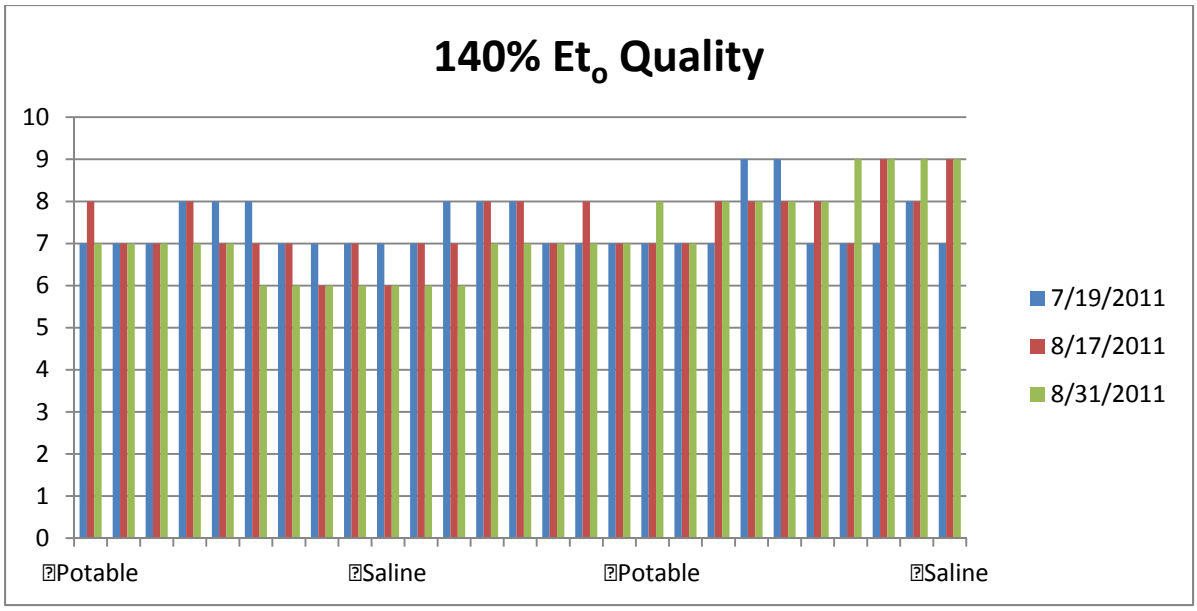


Figure 3. Perennial ryegrass quality (1-9, 9 = best, 6 =minimally acceptable) prior to and following initiation of saline irrigation on July 21, 2011. Tick marks on x-axis represent sub-plots in between alternating irrigation lines that deliver potable and saline water.

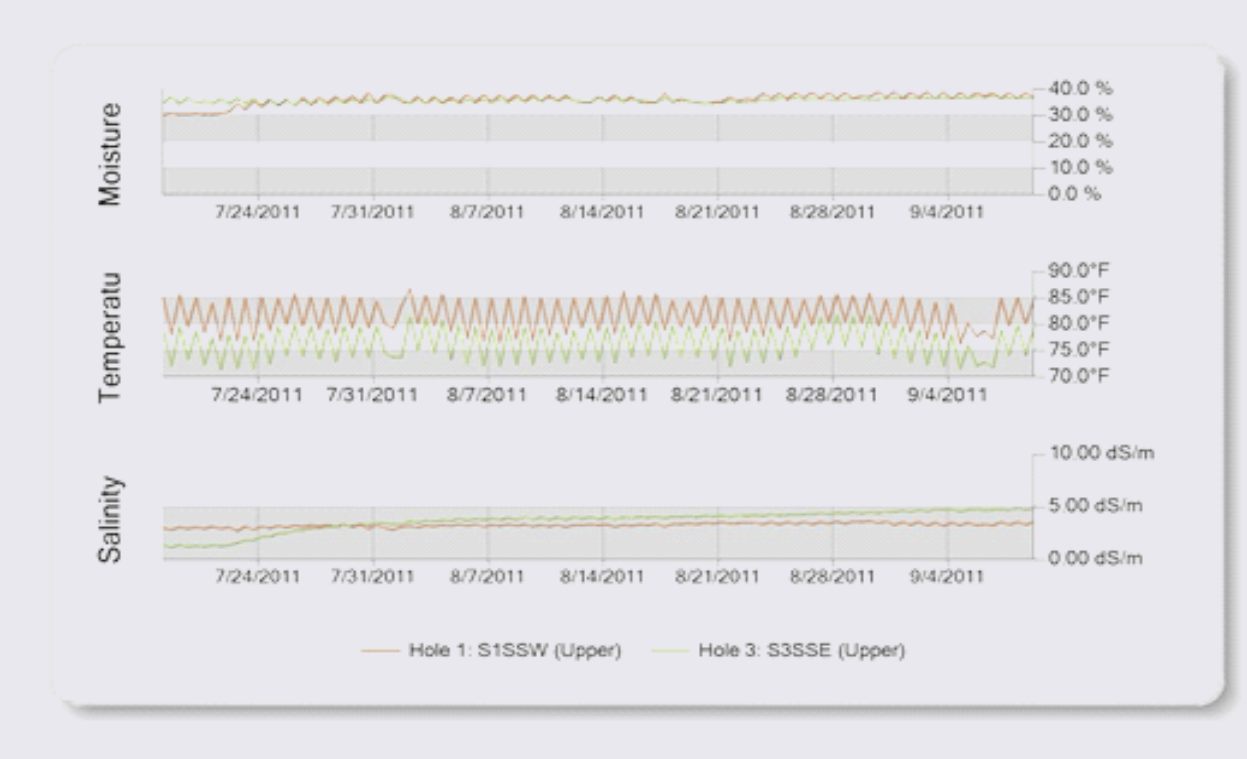


Figure 4. Data collected from Toro Turf Guard wireless sensors at 4 inches below soil surface prior to and following initiation of saline irrigation on July 21, 2011. Hole 1 (red line) = 140% ET_o irrigation treatment. Hole 3 (green line) = 80% ET_o irrigation treatment.