Leaching Requirements for Turfgrass Salinity Management and Water Conservation

Alea Miehls and Jim Baird
Department of Botany and Plant Sciences
University of California, Riverside

Donald L. Suarez and Catherine Grieve
U.S. Salinity Laboratory, USDA-ARS, Riverside

Bernd Leinauer
Extension Plant Sciences Department
New Mexico State University

David Crowley
Department of Environmental Sciences
University of California, Riverside

Introduction

The use of reclaimed, low quality water for turf and landscape irrigation is an increasingly common and necessary practice in arid regions of the southwestern U.S. It is estimated that approximately 15% of U.S. golf courses and close to 35% of courses in the southwestern states use recycled water for irrigation (Harivandi, 2011). However, low quality water for turfgrass and landscape irrigation requires that salinity in the root zone must be maintained at levels that do not adversely impact plant quality, growth and playability or use. Therefore, proper irrigation water management through leaching is critical for maintaining low salt levels in the soil.

The main objectives of this research project are to: 1) evaluate the interaction of drought and salinity on perennial ryegrass turf using a line source irrigation experiment in combination with different amounts of irrigation water; 2) determine the leaching requirements for salinity management as influenced by several factors including irrigation water quality, soil physical and biological properties, turfgrass species, and cultural practices; and 3) assess the population size and activity of plant growth promoting bacteria (PGPR) in the turf rhizosphere in response to imposed drought and salinity stress. PGPR have been shown to greatly affect salinity and drought tolerance in plants.

Materials and Methods

In this study, we combined the line source irrigation method of generating a continuous distribution of saline and potable irrigation water with the application of different quantities of water to provide detailed information on the interaction of water application and salinity on plant response. The study area is composed of 12 main plots, each irrigated with saline (EC = ~4.2 dS/m) and potable water (EC = ~0.2 dS/m). In the perpendicular direction, three main plots are irrigated with different amounts of water, ranging from 80 (deficit), 100, 120, or 140% ET_o (evapotranspiration). These irrigation amounts are determined using plant ET_o rates from the previous week provided by the CIMIS station at UC Riverside. Plots irrigated at 120 and 140% ET_o are leaching treatments in which excess water is applied to move salts down below the root zone. To more precisely determine the effects of salinity on turfgrass health and underlying soil, the 12 main plots are subdivided into 9 sub-plots ranging from low to high irrigation salinity (Figure 1).

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 Regimes: 140, 120, 100 and 80% ET_o
(replacement based on CIMIS data from previous week)

Saline/Deficit Irrigation: Initiated on 21 July 2011 at EC = 4.2 dS/m, SAR = 6.83

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 Irrometer suction lysimeters. Soil samples collected prior to salinity treatments and throughout the study are analyzed for EC, SAR, pH and nutrient concentrations. Additional soil samples are collected to assess the change in population size and activity of plant growth promoting bacteria (PGPR) in response to imposed drought and salinity stress.

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Figure 1. Turfgrass salinity research area in Riverside, CA. Alternating irrigation lines are fed by potable (P) or saline (S) water. Two 5,000-gallon tanks are used to store and deliver saline irrigation water. In the perpendicular direction, the area is divided into four irrigation zones, ranging from replacement of 80 to 140% ET_o. Two subsurface drain lines bisect each of the irrigation zones with outlets for collection of leachate. Twelve 30-ft x 30-ft plots represent a continuous distribution of saline and potable water at a given irrigation regime.

Preliminary Results

- ✓ Perennial ryegrass quality was maintained with minimal loss of turf or turf quality during the first six months in 2011 under the study parameters (data not shown).

- ✓ However, after one year of irrigation with high saline water (4.2 dS/m), turfgrass quality has declined substantially across all irrigation regimes, with the lowest quality in plots receiving less overall irrigation at 80 and 100% ET_o (Fig. 1).

- ✓ In addition, using low quality, high saline (4.2 dS/m) water for irrigation has resulted in severe loss of turf regardless of irrigation amount, with 50% cover remaining on turf irrigated at 140% ET_o, 10-20% at 120 and 100% $ET_{o,}$ and no living turf at 80% ET_o (Fig. 2).

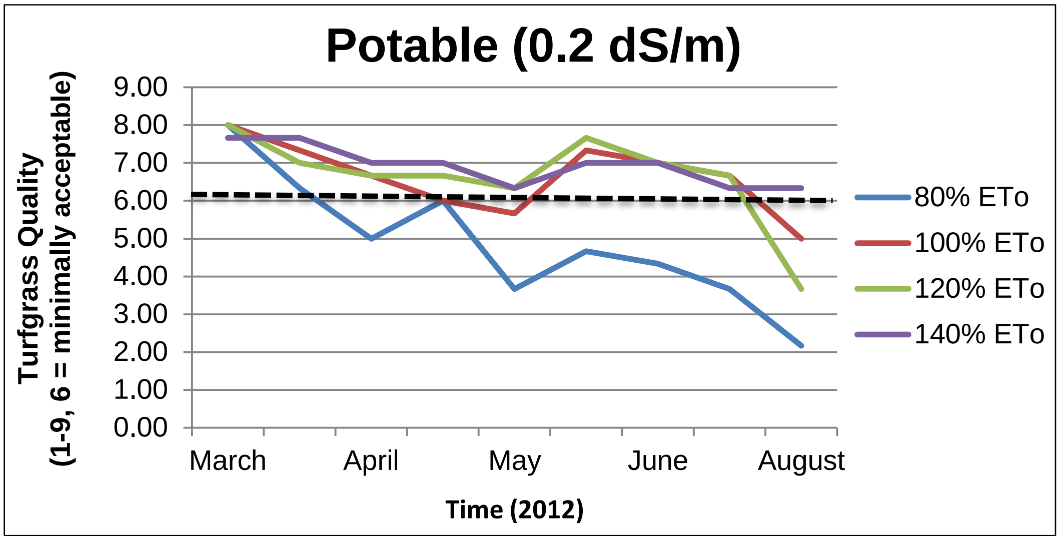
- ✓ Furthermore, as saline and drought conditions worsened, dry clipping yields declined with currently minimal growth across all irrigation regimes (data not shown).

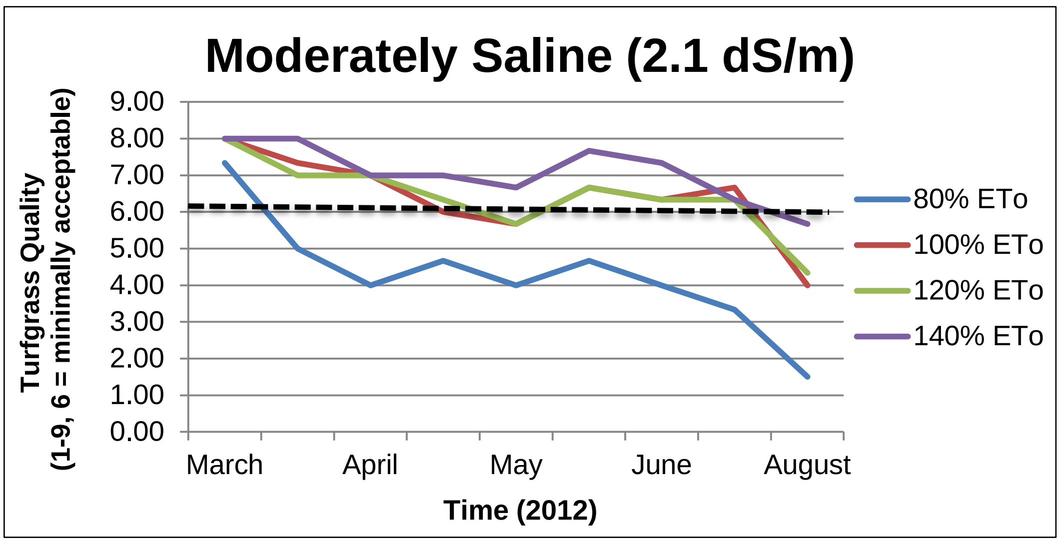
- ✓ Thus far, our research has reinforced that irrigating at 80% ET_o in Riverside, CA is not enough water to maintain perennial ryegrass quality and cover for one year, regardless of water quality (Fig. 1).

- ✓ This study has substantiated the need for maintaining adequate water infiltration, drainage, and distribution uniformity when using low quality water for irrigation to help manage salts in the root zone by leaching, and for maintaining turfgrass that is dry and firm enough for functional use.

- ✓ Extensive soil sampling is underway to correlate soil EC and other important parameters with turf growth and quality.

- ✓ Further turf loss through the upcoming months under these parameters will conclude data collection and results of this research will be published in summer 2013.


Potable (0.2 dS/m)
Turfgrass Quality
(1-9, 6 = minimally acceptable)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
March
April
May
June
August
Time (2012)
80% ETo
100% ETo
120% ETo
140% ETo


Moderately Saline (2.1 dS/m)
Turfgrass Quality
(1-9, 6 = minimally acceptable)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
March
April
May
June
August
Time (2012)
80% ETo
100% ETo
120% ETo
140% ETo

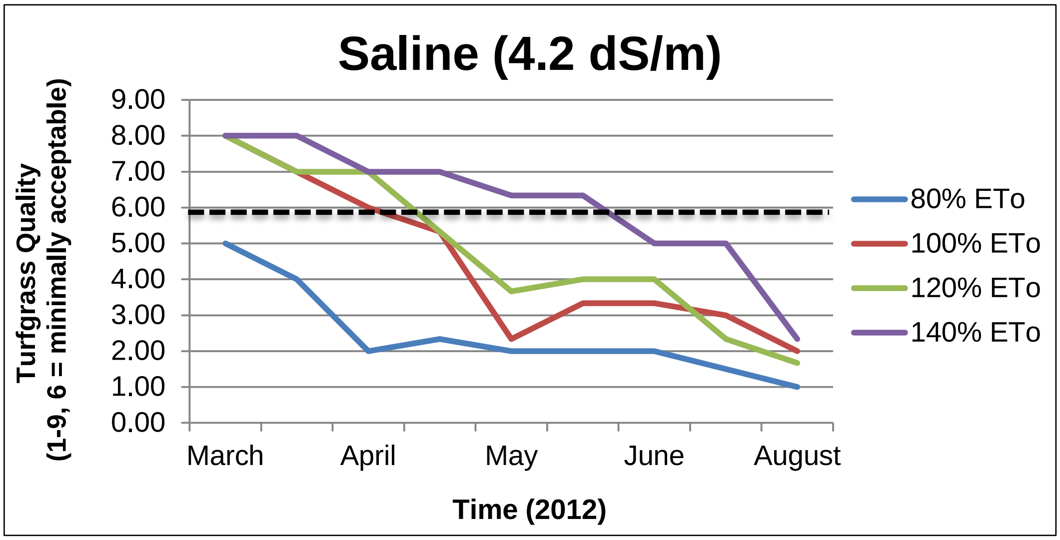
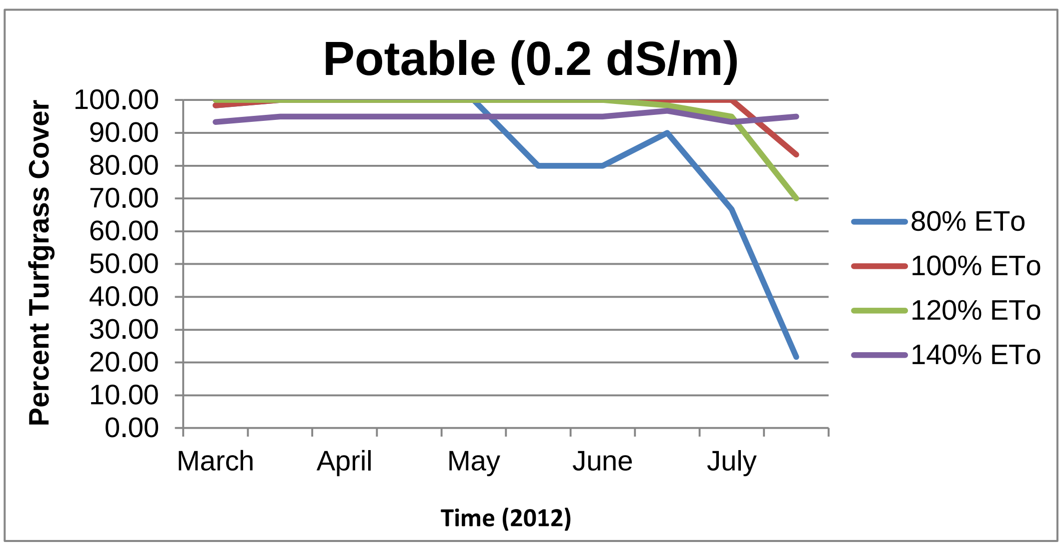
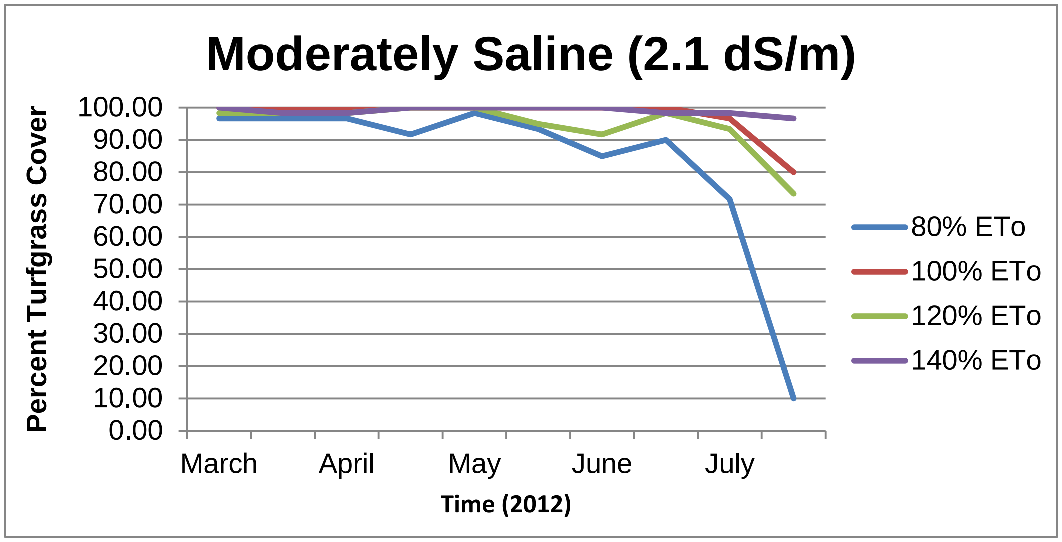


Figure 1. Perennial ryegrass quality in 2012 (1-9, 9 = best, 6 = minimally acceptable) of plots irrigated with potable, moderately saline, and saline water under different irrigation regimes (80, 100, 120, 140% ET_o) following initiation of saline/deficit irrigation on 21 July 2011.





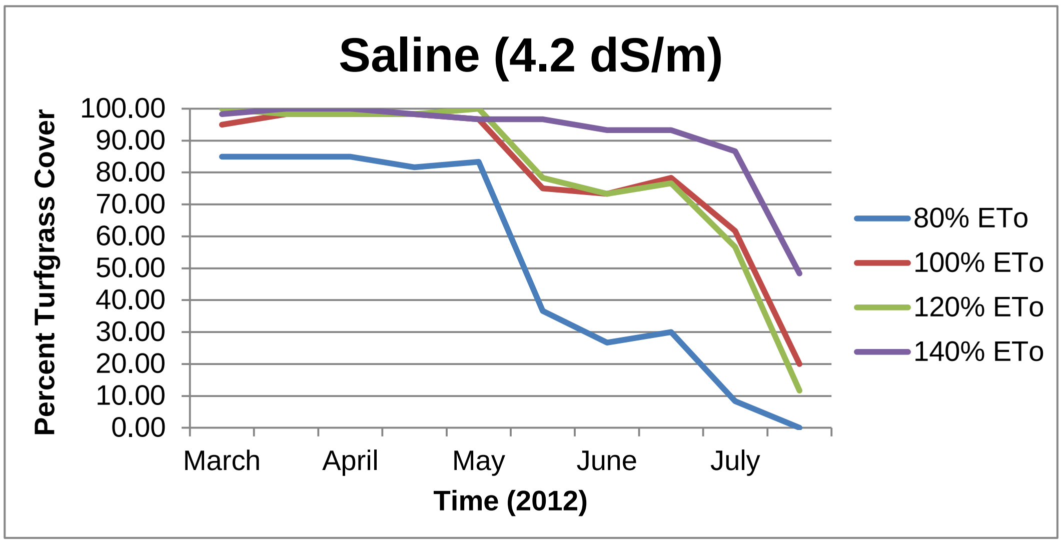


Figure 2. Percent Perennial ryegrass cover on plots in 2012 irrigated with potable, moderately saline and saline water under different irrigation regimes (80, 100, 120, 140% ET_o), following initiation of saline/deficit irrigation on 21 July 2011.

References

Harivandi, Dr. M. Ali. "Purple Gold: A Contemporary View of Recycled Water Irrigation." *USGA Green Section Record* 49.45 (2011): 1-10.