NATIONAL WATER RESEARCH INSTITUTE

NWRI GRADUATE FELLOW SEMI-ANNUAL PROGRESS REPORT

DATE:	May 1, 2019
Project Title:	Optimizing Recycled Water Application for Turfgrass Irrigation to Conserve Water, Maintain Turf Quality and Sustain Soil Health
Graduate Fellow:	Amninder Singh
Advisor:	Dr. Amir Haghverdi
Institution:	University of California, Riverside

Background and Introduction

In California, about 50 percent of water dedicated to urban water use goes to landscape irrigation (California Water Plan Update 2013). The number can be much higher in summer months when demand is higher. The projected rise in population in Southern California, along with challenges like drought, water shortages, and climate change are the impetus for developing and implementing new approaches for more efficient irrigation practices and promoting the use of recycled water.

The availability of recycled water may play an important role in enhancing urban water use in arid/semi-arid parts of the world, considering the reduced treatment cost compared to other alternatives like seawater desalination and imported surface water. However, recycled water has relatively high salinity compared to potable water. High concentrations of salt in the soil and water could negatively impact the plant growth and soil health (Gonçalves et al. 2007; Qian and Mecham 2005). This problem is particularly important in arid and semi-arid climates of Southern California, where low precipitation is likely not adequate to leach soluble salts from the root zone.

Overview

There is a great potential for optimizing urban landscape water applications using advanced irrigation technologies. Use of smart irrigation controllers, which are automatic irrigation timers with feedback from soil moisture or weather sensors, has achieved significant reductions in irrigation water that is applied in normal to wet weather in Florida and North Carolina (Grabow et al. 2012; Cardenas-Lailhacar and Dukes 2012). However, there is a knowledge gap in their application in semi-arid conditions like in Southern California in order to develop water conservation strategies. Moreover, the relatively high amount of salts in recycled water can modify the dielectric permittivity of the soil and thus alter the readings of the Soil Moisture Sensor (SMS) measuring the soil water content, which needs to be investigated (Cardenas and Dukes 2016).

Hypothesis

The main hypothesis of this study is that smart irrigation technologies can help develop sustainable irrigation practices using recycled water to conserve water while maintaining turf quality and sustaining soil health.

Objectives

The main objectives of this study are to:

- Study salt accumulation in the root zone and its impact on turfgrass quality under different irrigation strategies with recycled water in Orange County, CA.
- Determine the impact of recycled water irrigation on soil permeability.
- Evaluate the performance of smart irrigation controllers for efficient automatic irrigation scheduling when recycled water is used.
- Determine rainfall contribution to salt leaching during rainy seasons.
- Develop recommendations for optimum leaching requirements and irrigation application for turfgrass in Southern California based on the first four objectives.
- Evaluate the efficacy of current 1.0 ETAF1 allocated by DWR2 in 2015 MWELO3 to landscape areas irrigated with recycled water (Haghverdi and Wu 2018).

Progress to Date

Experimental Design

We established 48 research plots at UC ANR SCREC[4] in Irvine, California in the layout shown in fig 1.
The irrigation system was installed in July 2018. Each plot is irrigated by 4 quarter circle pop-up sprinkler heads, all four controlled by a common solenoid valve for independent control of each plot. In early August 2018, an Acclima CS3500 smart irrigation controller was installed and all solenoid valves were wired to the controller. Soil moisture sensors (Acclima TDT sensors) were installed at 12 plots and were connected to the irrigation controller for continuous monitoring of soil water status within the turf effective root zone throughout the experiment.

The plots were covered with bermudagrass sods in August 2018. All plots have been under full irrigation for the establishment of turfgrass and until the start of irrigation experiment in May 2019. Pressure switches and/or flow meters are utilized to precisely record irrigation runtimes and water application on each plot.

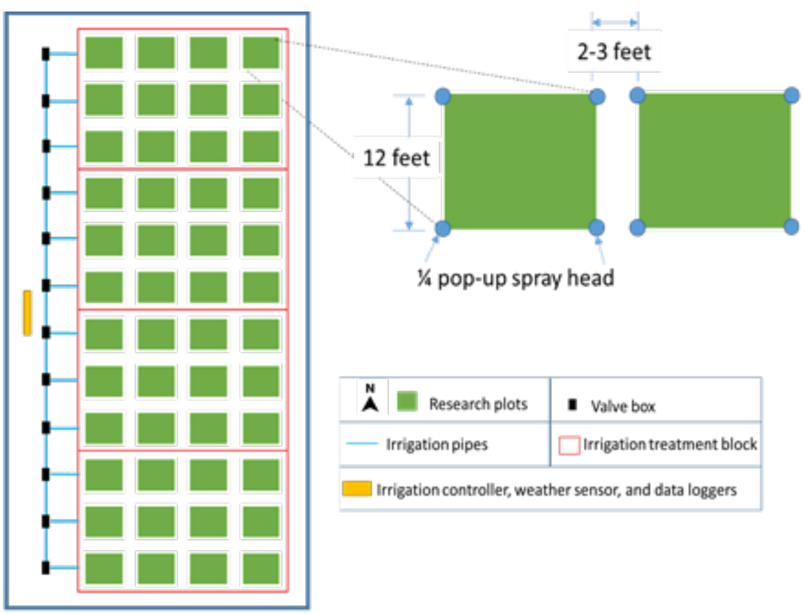

Figure 1. Layout of the experimental plots.

An irrigation uniformity test was performed on the plots following the ANSI/ASABE S626 standard method (Fig 2a and 2b) which resulted in DU_{LH} and CU values of 0.85 and 85%, respectively. Two plots with treatment extremes, i.e. full irrigation and the highest deficit were installed with the setup as shown in Fig. 2c and 2d for continues turf and soil monitoring. SRS sensor and IRT infrared thermometer (Meter Inc.) were installed for continuous NDVI and canopy temperature measurements respectively. TEROS 12 sensors (Meter Inc.) were installed for measurement of soil water and EC dynamics at shallow (5 inch) and deep (10 inches) depths.

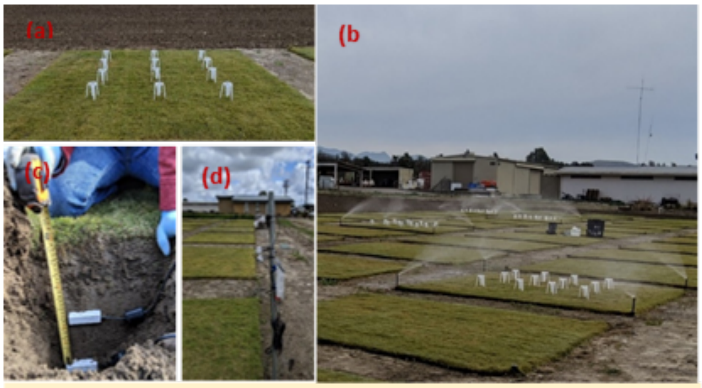

Figure 2. Catch cans used for irrigation uniformity test (a), uniformity test at the plots (b), TEROS 12 sensor during installation (c), and setup for continuous canopy spectral and temperature data measurements. (d).

Data Collection and Analysis

ES-2 sensor (Meter Inc.) was used at a common irrigation inlet for continuous monitoring of recycled water salinity. The data from all the sensors shown in Fig. 3 are collected every 30 minutes.

Figure 3. Daily average of irrigation water EC collected with ES-2 sensor.

The EC of the irrigation water ranged from 0.98 and 1.22 mS/cm with an average of 1.08 mS/cm (fig 3). Fig 4 shows the soil moisture data from Acclima TDT sensors from 12 plots against the precipitation events from January 28 to March 7, which shows a very good response of soil moisture sensors to changes in root zone water content.

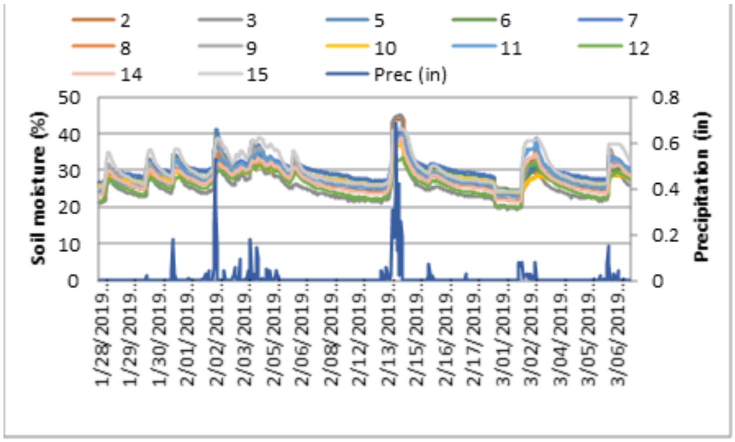

Figure 4. Hourly average soil moisture data from Acclima TDT sensors for 12 plots against precipitation data collected from CIMIS #75.

Conclusions

Turfgrass plots were established and field instrumentation was finished for continuous monitoring of soil moisture content and salinity in the root zone of turfgrass irrigated with recycled water, spectral characteristics of turfgrass, irrigation water salinity, and irrigation runtimes. Irrigation uniformity test was performed on the plots. The suitability of smart irrigation controllers to automatically implement irrigation best management practices will be explored when recycled water is used for irrigation, largely focusing on the summer months (May – September).

Next Steps

Soil samples will be collected to analyze soil hydraulic properties and soil salinity in the lab. Baseline infiltration data using SATURO infiltrometer (METER Group, Inc. USA) will be collected. Irrigation treatments with different soil moisture threshold limits will be imposed and NDVI and canopy temperature data will be collected biweekly using handheld sensors starting the first week of May.

References

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