Landscape Coefficients in Mixed Species Landscapes

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Abstract

Landscape irrigation is becoming increasingly important from a resource management point of view. Reference evapotranspiration (ET_o) based irrigation may allow significant water use savings in the landscape. This research will measure landscape crop coefficients (K_L) for landscapes that are comprised of different vegetation types affecting K_L. The K_L will be determined from a ratio of actual evapotranspiration to the ET_o. Irrigation quantity will be based on 70% replacement of ET_o. The K_L value will be measured for the following landscape vegetation mixed-species treatments: 30%/70% turf/woody plant, 70%/30% turf/ woody plant, and 100% woody plant. Soil is being systematically placed into lysimeters containing a drainage system and soil moisture probes. Lysimeters (1585 L) are placed in a randomized complete block design with three blocks. Soil moisture measurements will be made at 0 to 20, 20 to 40, and 40 to 60 cm depths. The K_L will be determined after a rainfall or irrigation for periods of two to five days. Any seasonal effects of the K_L will also be determined. Landscape coefficients are a possible tool in irrigation decision making which could contribute to water savings in urban landscapes.

Statement of Critical Regional Water Problems:

Texas is one of the top water consuming states in the United States. Currently, agricultural irrigation accounts for 60% of the water consumption in Texas. However, that share is expected to decline due to fewer irrigated acres and practice of better water conservation techniques on the farm. Municipal water use is expected to increase from 24% in 2003 to 35% of the total use by the year 2050 primarily due to predicted population growth.

Outdoor irrigation is a highly visible practice which is the target of many conservation efforts. Some estimates of outdoor water use are nearly 50-80% of the total residential use. The majority of this outdoor water use is for landscape (turfgrass and woody plant) irrigation.

Nature, Scope, and Objectives of the Research

Study reference evapotranspiration (ET_o) rates to measured ET rates during establishment of turfgrass and woody plants in a humid environment. To complete this objective, we will compare the ET_o rates to the actual ET rates among replicated treatments: St. Augustinegrass/ woody shrubs (30/70 mix), St. Augustinegrass/ woody shrubs (70/30 mix), and woody shrubs (100%).

Also, evaluate seasonal changes in ET rates for all treatments. All plants will be established under non-limiting conditions.

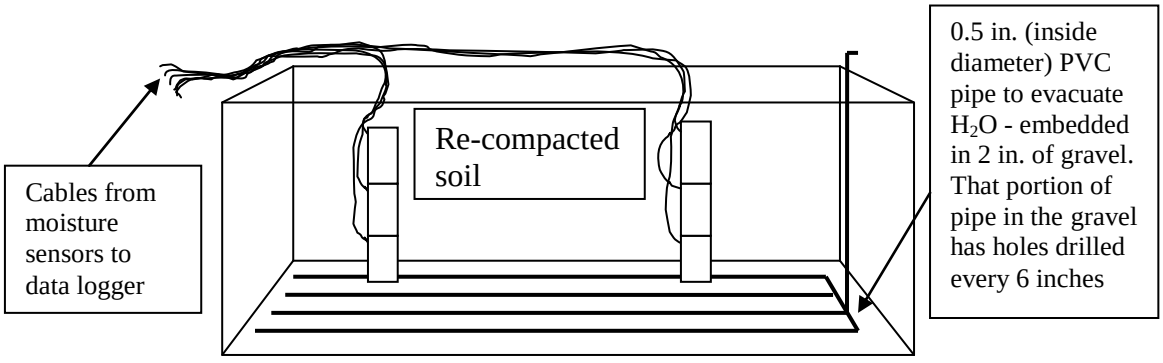
The two underlying hypotheses are:

Hypothesis 1: The relationship between reference ET and actual ET (K_L) will be the same among all treatments and environments for the year of establishment.

Hypothesis 2: The relationship of reference ET to actual ET (K_L) will change during the growing season.

To complete this research, treatments will be arranged in a randomized complete block design with 3 replications. Each treatment per block will be contained in an EPDM plastic lined (2.13m x 1.22m x .68m) lysimeter. The lysimeters are placed in-ground such that the tops are 2.5 cm above surface grade. The space in between the long sides of the lysimeters will be 61 cm. The bottom of each tank will be filled to a 5.1 cm depth with gravel-sized aggregates. This gravel layer will contain a plastic pipe drainage system to allow vacuum drainage during saturated conditions. The remaining volume of each lysimeter will be filled with Falba series topsoil (fine sandy loam), and 2.5 cm of additional soil. At approximately 15 cm beneath the soil surface, a plastic sheet (6 mil, 10 cm wide) is attached to each inner tank surface to prevent preferential water flow along the inside walls. Six soil moisture probes will be placed in 2 locations in each tank (3 probes per location). Probes will monitor volumetric water content at 0-20, 20-40, and 40-60 cm depths through a dielectric constant of the soil.

A data-logger will be used to collect soil water volume data at each depth. Changes in soil water volume will yield actual evapotranspiration data for each treatment. This data will be compared to ET_o data gathered from on-site weather monitoring. Actual ET/ET_o relationship (K_L) will then be compared for differences among treatments.



Treatments will be irrigated semi-automatically with an in-ground system. The amount and frequency of water applied to the plants will be determined by ET_o water loss at a 70% replacement rate minus rainfall. During conditions of soil saturation, excess water will be vacuum evacuated and quantified per treatment. A moisture release curve of the Falba soil series will be performed to characterize volumetric water content between saturation and -1500 KPa.

Results Expected from this Project

It is expected that hourly soil volumetric water content data will be produced by treatment. The onsite weather station will generate daily ET_o data. From these data, landscape coefficients (K_L) can be calculated through out the growing season, where

$$K_L = \frac{\text{actual treatment ET}}{\text{reference ET}}$$

The literature includes several examples of crop coefficients for woody plants as single-species and for turfgrass as a single-species. However, very few examples for mixed-species landscapes exist. There is a lack of science-based information on seasonal irrigation coefficients for mixed-species urban landscapes. It is expected that the K_L will be the same for each model landscape treatment.

One goal is to establish the benefit of ET_o data from weather stations for landscape irrigation in Texas communities. Providing this information will allow more accurate predictions of landscape water needs (weekly and seasonally), and thereby conservation of water. Through public awareness and education, this can be a valuable tool for water consumers and water agencies in Texas.