Water-Use Efficiency and Carbon Sequestration Influenced by Turfgrass Species and Management Practices

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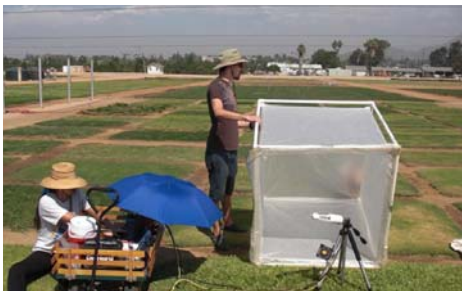
Objectives:

1. Estimate carbon balance of golf course carbon flux and soil carbon pools.
2. Determine associations between water use efficiency and carbon dynamics within turfgrass system.
3. Identify effects of reduced water and nutrient inputs.

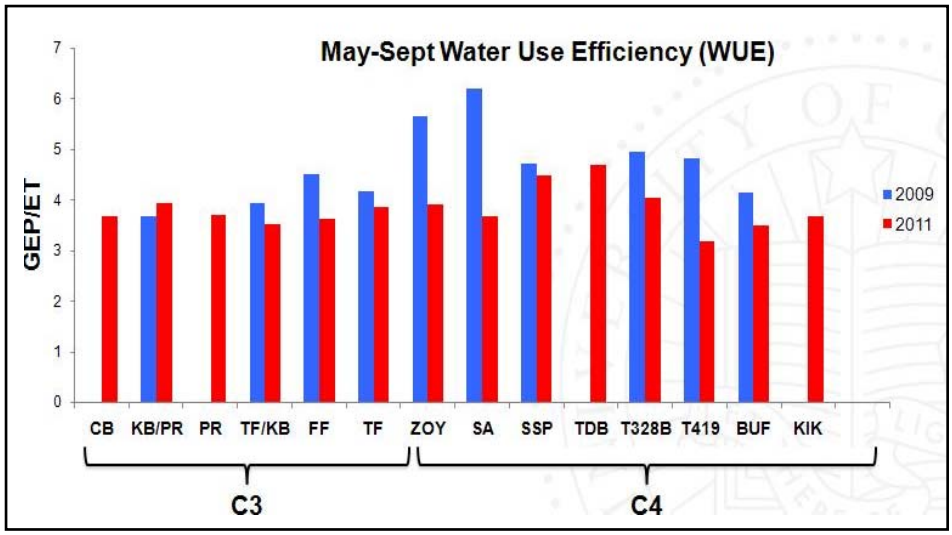
Start Date: 2011
Project Duration: 3 years
Total Funding: $17,734

Our study addresses a need for improved data and understanding of turfgrass carbon dynamics, especially under reduced inputs of water, nutrients, and light. We use this approach to examine annual dynamics of seven cool-season and six warm-season turfgrass species and various cultivars of each in a field experiment, surveys of turf in common land management, regional patterns along a strong coastal to inland gradient, and high resolution sensing and modeling to describe physiological responses to drying and wetting events.

Beginning in 2011 we established a varietal experiment to evaluate turfgrass sensitivity to irrigation deficit. The experimental design was similar to one we used in 2009 to study turfgrass under optimal management conditions. In combination with these direct gas exchange measurements we measured carbon dynamics through a soil inventory approach. To initiate soil inventory we collected cores from the experimental plots and through representative sampling of turfgrass under different conditions throughout the region and at multiple depths. We are preparing the samples for chemical analysis. Our project uses new field monitoring systems to describe turf ecosystem carbon fluxes, water fluxes, and water use efficiencies.



Beginning in the summer of 2011, bi-weekly measurements were initiated on the different species and cultivars under deficit irrigation according to physiology (C_3 vs. C_4).



Differences in species water use efficiency (Gross Ecosystem Production / EvapoTranspiration) between optimal watering (2009) and deficit irrigation over the summer period. Water use efficiency general declined between species and there were large species differences.

Beginning in the summer of 2011 and building upon our preliminary research in 2009-2010, we commenced bi-weekly measurements on the different species and cultivars under deficit irrigation according to physiology (C3 vs. C4). Baseline measurements of gas exchange and soil properties were collected in late spring before the hot and dry summer conditions.

Irrigation ranged from 5-25% below established crop coefficients for cool-season and warm-season turfgrasses (deficit irrigation was based on a percentage of historical crop coefficients). Hand irrigation was used to maintain highest level distribution uniformity. Our measurements were conducted shortly after watering and accurately documents plant condition in response to deficit irrigation.

We found a decrease in water use efficiency associated with deficit irrigation that progressed in intensity throughout the season. Species exhibited significant differences in their sensitivity to deficit irrigation. In a study conducted throughout the day following an irrigation period, we observed a lower water use efficiency in the afternoon than in the morning.

We plan to continue the deficit irrigation measurements throughout the winter. In the following summer we will incorporate nutrient reductions into the experimental design. This work will evaluate how reduced nutrients influence water use efficiency under optimal and deficit irrigation. We also plan to expand regional sampling of turf soils from golf courses through collection across a climate gradient extending from moderate coastal to desert inland.

Summary Points

- Deficit irrigation reduces maximum water use efficiency across all turfgrass species.
- Species varied significantly in sensitivity to deficit irrigation.
- More severe effects of deficit irrigation were observed following extended deficit irrigation.
- Water use efficiency decreased following irrigation events – such measurements may help improve irrigation frequency plans.