Irrigation By Evapotranspiration-Based Irrigation Controllers in Florida

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Introduction

What is Evapotranspiration (ET)?

It is a combination of evaporation from the soil surface and transpiration from plant surface area. It is considered the plant water requirement.

What is an ET controller?

It is an irrigation controller that applies a depth of water based on an amount determined from weather data and other conditions specific to the landscape.

These conditions could include:

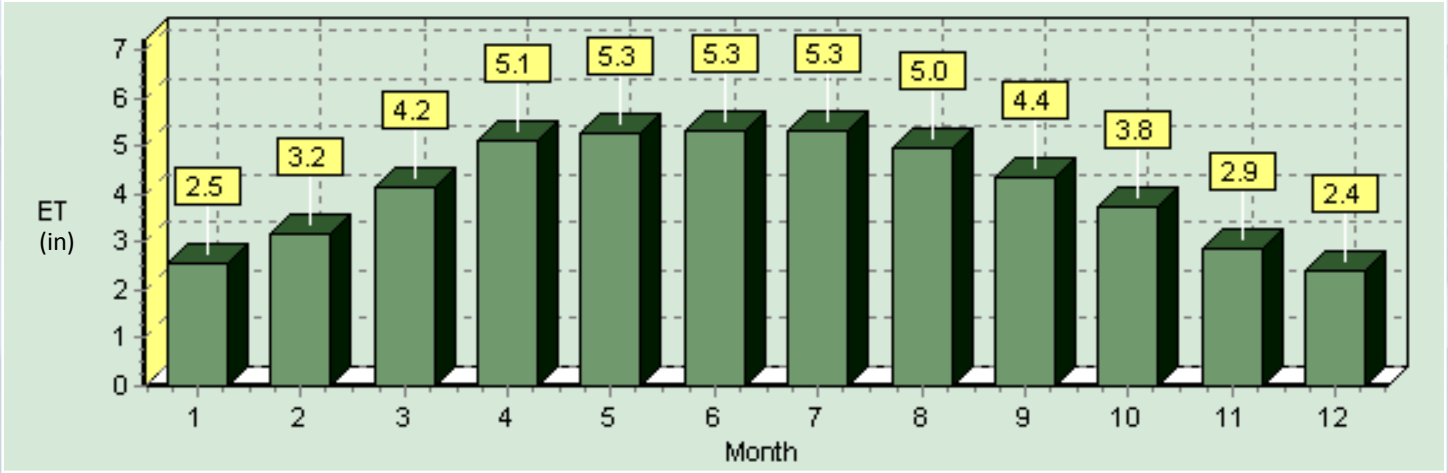
- soil type
- plant type
- sprinkler type
- sun and shade
- *slope*

Introduction

Three types of ET Controllers

- Historically-Based

  ET is derived from historical ET values collected over a large time period



- Stand-Alone

  ET is calculated from on-site weather data by the controller

- Signal-Based

  ET is calculated from a local weather station and sent by signal to the controller

Introduction

Crop Evapotranspiration (ET_c)

$$ET_C = K_C * ET_O$$

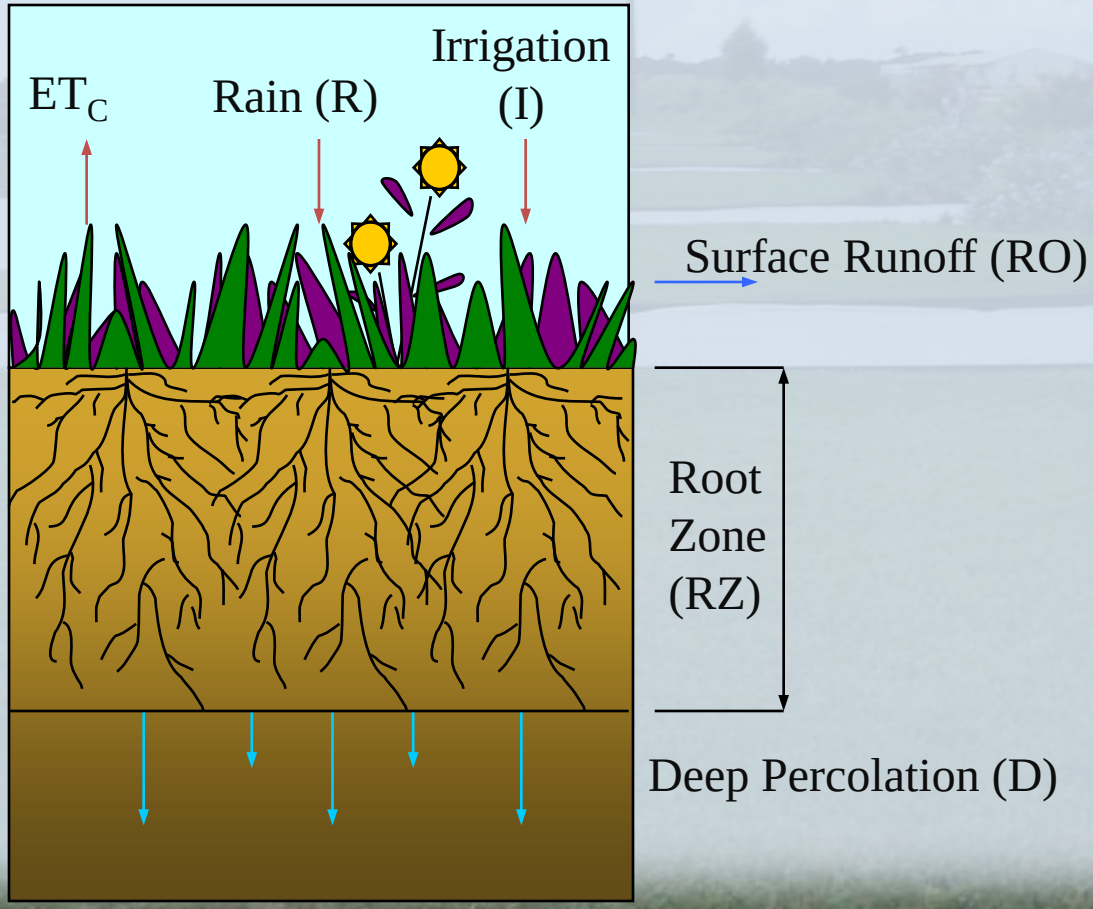
Where K_C values are:

- Updated monthly for seasonal demand changes
- Specific to general crop specified for each zone

Introduction

Irrigation depth is calculated from water needs in the root zone according to a soil water balance.

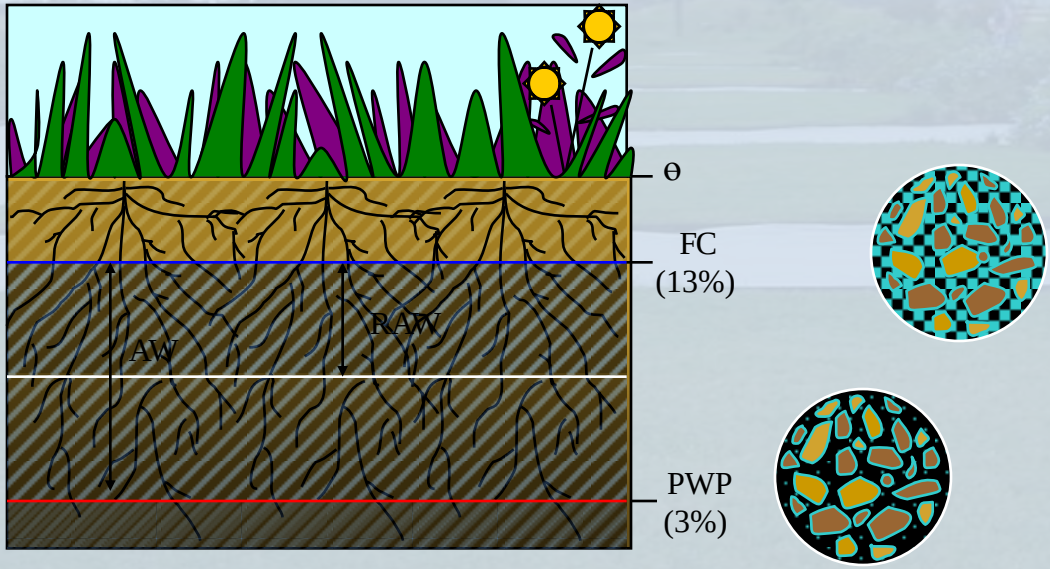
$$\Delta S = R - ET_C + I - D - RO$$



Introduction

Definitions for water storage in the root zone.

$$AW = \frac{(FC - PWP) \times RZ}{100}$$



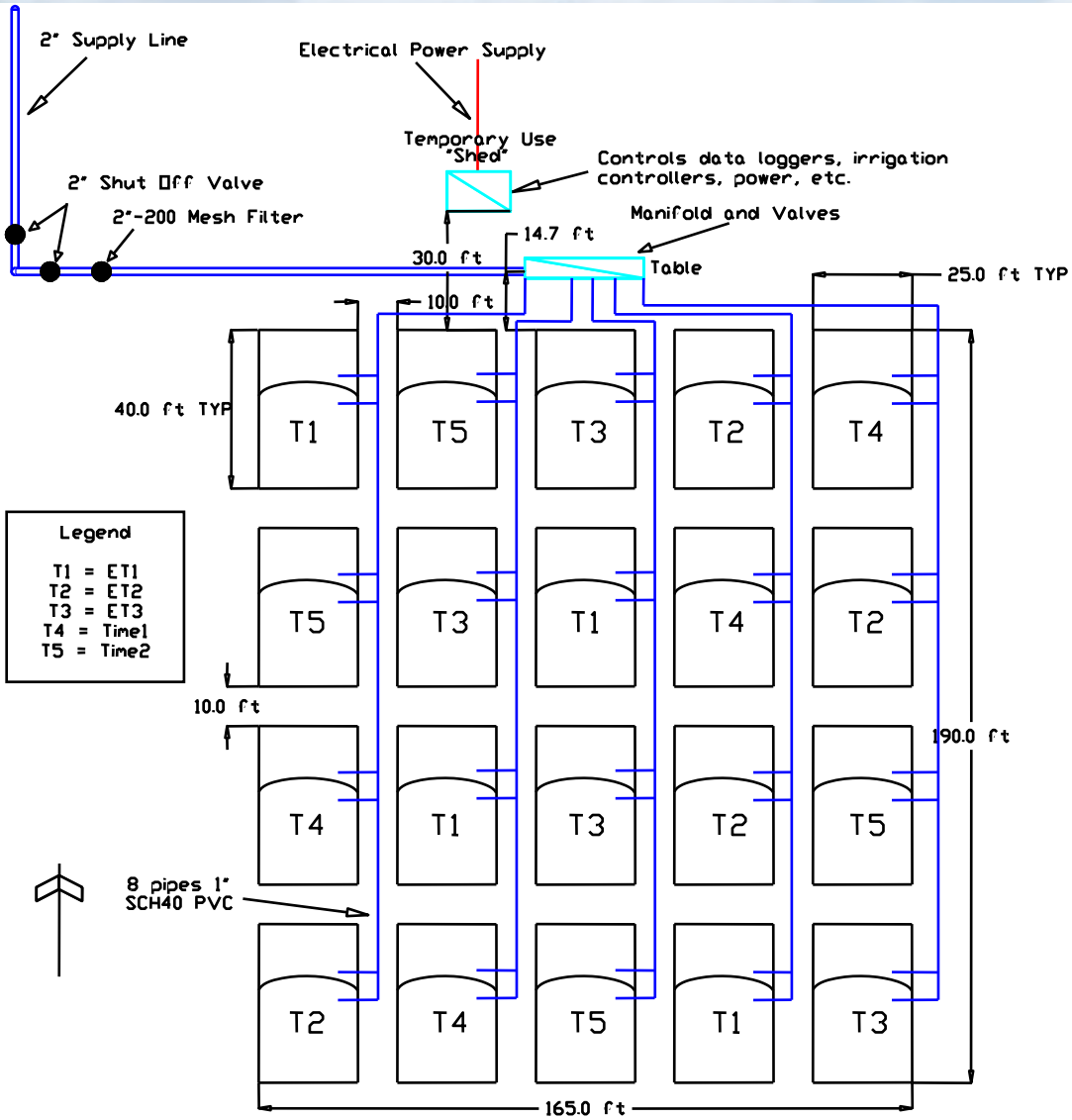
$$RAW = MAD \times AW$$

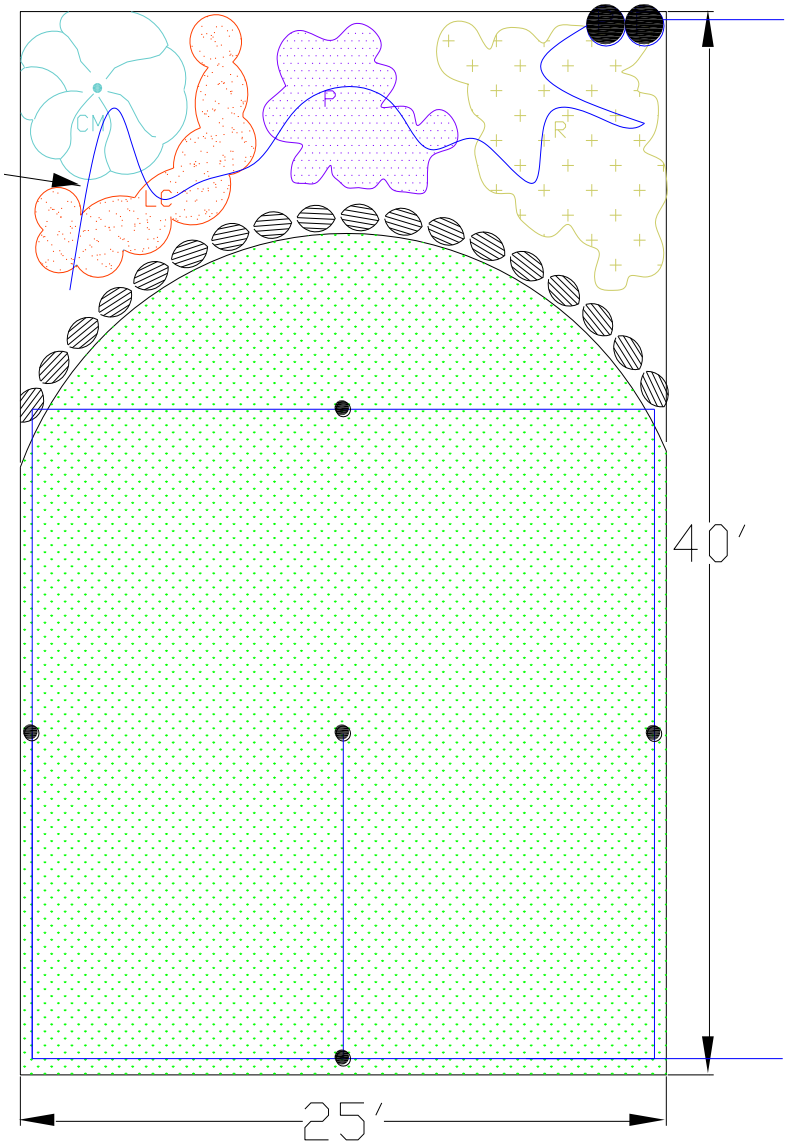
Introduction

The ***objectives*** of the study were to evaluate the ability of three brands of ET-based irrigation controllers to:

- apply irrigation compared to a time clock schedule intended to mimic homeowner irrigation schedules
- maintain acceptable turfgrass quality regardless of water savings results

Materials and Methods





Materials and Methods

Two zones, mixed ornamentals and turfgrass, for twenty plots totals 40 zones.
Each zone has its own irrigation system.

Materials and Methods

Rain Bird 6-in Pop Up Spray Bodies

- 4 - 180° R13-18 Rotary Nozzles
- 1 - 360° R13-18 Rotary Nozzles
- 0.61 in/hr Application Rate

Materials and Methods

Efficiency Factor (2007)

Average low quarter distribution uniformity (DU_{lq}) was calculated as 0.71 from on site catch-can testing. Low half distribution uniformity (DU_{lh}) was calculated as a percentage using the following equation:

$$DU_{lh} = 38.6 + 0.614 * DU_{lq}$$

DU_{lh} was determined to be 0.82. An efficiency factor was calculated from the equation below:

$$E = \frac{100}{DU_{lh}}$$

The efficiency factor is 1.25.

Materials and Methods

ET controller treatments

Toro Intelli-Sense. Signal-based using paging technology. ASCE method used to calculate ET. ET is accurate to 1 km^2 of location using MM5 modeling and broadcasted using paging technology.

Weathermatic SL1600. Stand-alone design using Hargreaves equation for ET. An on-site weather monitor determines temperature and rainfall. Zip code determines solar radiation.

ET Water Smart Controller 100. Signal-based using cellular technology. ASCE method used to calculate ET. Web site used for programming of landscape settings.

Materials and Methods

Toro Intelli-Sense.

Fall through winter 2006 settings:

2 days per week restriction and 95% efficiency

Spring through fall 2007 settings:

7 days per week and 80% efficiency

Weathermatic SL1600.

Fall through winter 2006 settings:

2 days per week restriction and 100% efficiency

Spring through fall 2007 settings:

7 days per week and 80% efficiency

ET Water Smart Controller 100.

Fall through winter 2006 settings:

2 days per week restriction and 95% efficiency

Spring through fall 2007 settings:

7 days per week and 80% efficiency

Materials and Methods

TIME - Time-based schedule with rain sensor.

T4 was determined from UF-IFAS recommendations using the net irrigation requirement for central Florida (Dukes and Haman, 2002) assuming 2 d/wk watering restrictions and:

- **60%** replacement for summer through winter 2006-2007
- **100%** replacement for spring through fall 2007

RTIME - Reduced time-based schedule with rain sensor.

This treatment was 60% of the time-based treatment which corresponds to:

- **36%** replacement for summer through winter 2006-2007
- **60%** replacement for spring through fall 2007

TIME WORS - T4 including events bypassed by the rain sensor

Materials and Methods

Turfgrass quality ratings taken using the National Turfgrass Evaluation Program (NTEP) standards

- Ratings typically based on color and density
- 1-9 scale where 1 represents bare ground or dead turfgrass, 9 represents perfection, and a rating of 5 is minimally acceptable
- Ratings taken seasonally at minimum

1

4

6

8

Results

Savings compared to TIME WORS

Treatment	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2007
Controller A	38%	50%	9%	--	43%
Controller B	39%	60%	15%	41%	59%
Controller C	--	--	30%*	45%	50%
TIME	28%	20%	18%	31%	15%
RTIME	55%	49%	50%	63%	50%

Results

Turfgrass Quality

Treatment	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2007
Controller A	4.8 *a*	5.7 *a*	6.2 *a*	--	6.4 *a*
Controller B	4.9 *a*	5.9 *a*	6.4 *a*	6.1 *a*	7.1 *a*
Controller C	--	--	6.3 *a*	6.1 *a*	7.0 *a*
TIME	4.7 *a*	6.0 *a*	6.2 *a*	6.1 *a*	6.6 *a*
RTIME	4.8 *a*	5.7 *a*	6.1 *a*	5.8 *a*	6.5 *a*

Conclusions

The ET controllers were found to:

- Average 35%-43% in water savings, and
- Apply less irrigation compared to TIME WORS for all seasons.

The results showed that:

- Using a rain sensor will produce 21% average water savings,
- Consistent water savings are more likely by using ET controllers compared to average homeowner practices, and
- There was no relationship between water application and turfgrass quality. *More potential savings?*

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Thank You!

Questions or comments?