This presentation premiered at WaterSmart Innovations

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Climatologically-based Irrigation Controller Bench Testing in Florida

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Introduction

Why is irrigation research important in Florida?

- Most homes in Florida have automatic irrigation systems
    - Most of these homeowners have no idea how to program their timers
        - When everyone over-irrigates, there's a potential for water shortages
            - Spring 2009 - City of Tampa banned all automatic irrigation

Introduction

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

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.

Introduction

Three types of ET Controllers

- <u>Historically-Based</u>

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

- <u>Stand-Alone</u>

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

- <u>Signal-Based</u>

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

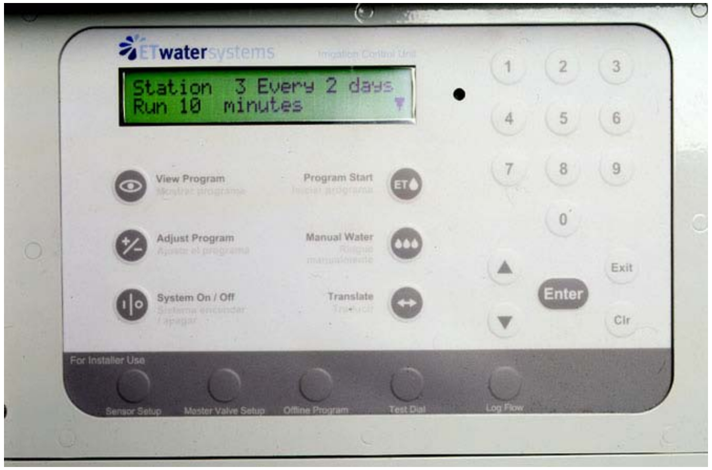
Introduction

Objectives

- Evaluate the ability of three brands of climatologically-based controllers to schedule irrigation for a virtual landscape compared to a simulated soil water balance model, and
- Determine the variability in irrigation scheduling by ET controllers of the same brand.

Treatments

Toro Intelli-sense



ETwater Smart Controller 100

Weathermatic SL1600 and SLW10

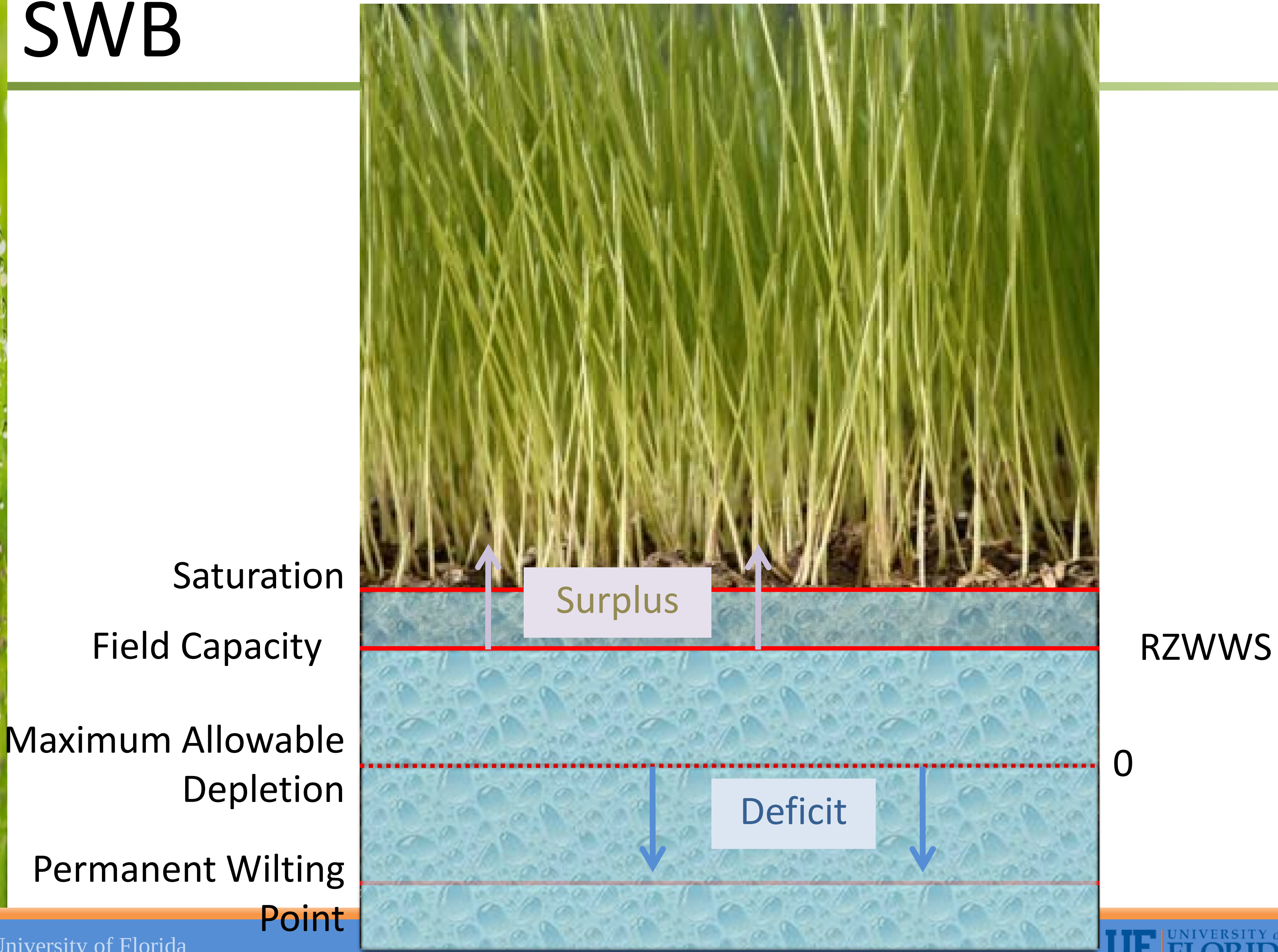
Test Setup

September 9, 2007
through
April 18, 2009

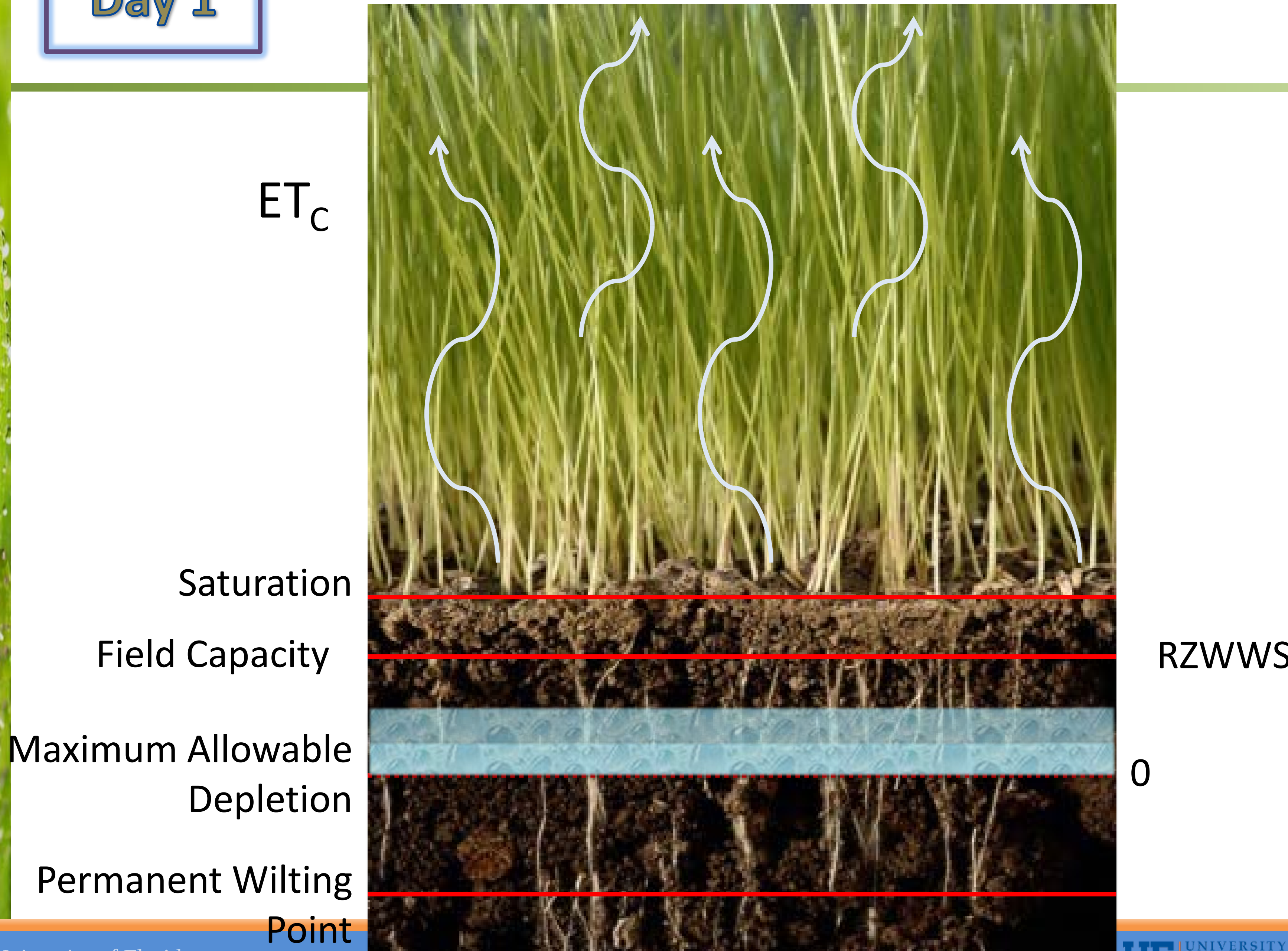
84 weeks

588 days

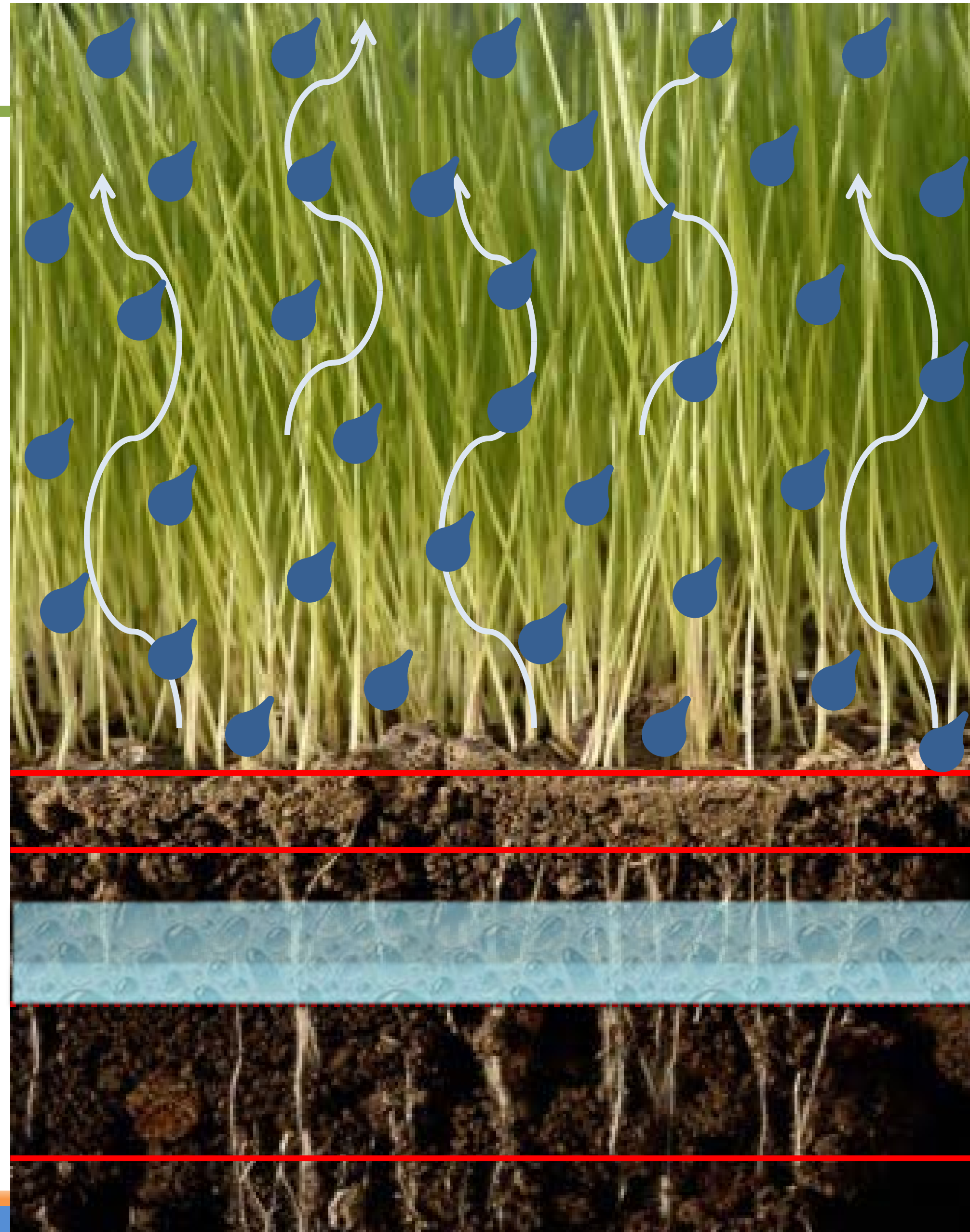
SWB


Saturation
Field Capacity
Maximum Allowable Depletion
Permanent Wilting Point
Surplus
Deficit
RZWWS
0

Day 1


ET_C
Saturation
Field Capacity
Maximum Allowable Depletion
Permanent Wilting Point
RZWWS
0

Day 2



ET_C

Saturation

Field Capacity

Maximum Allowable Depletion

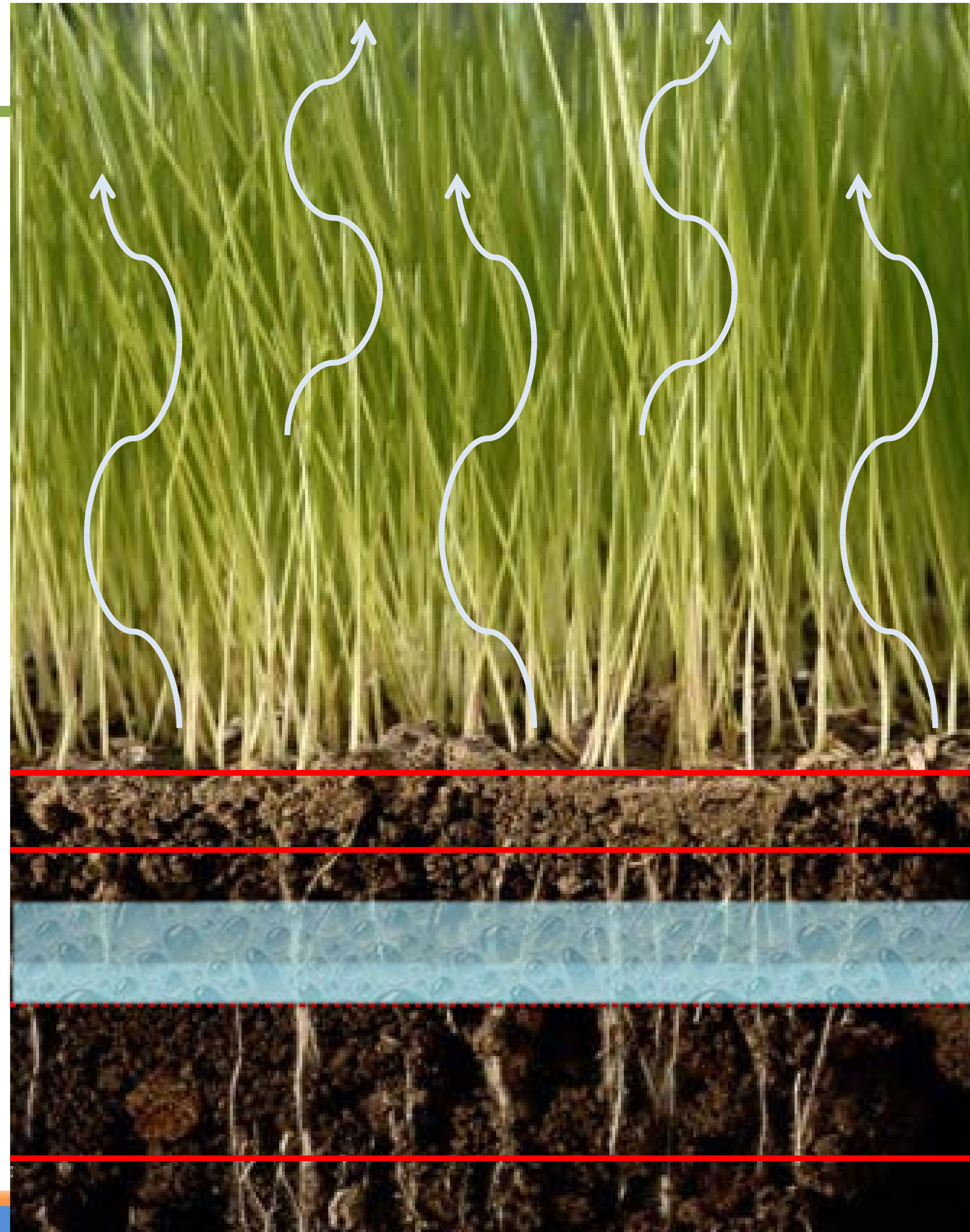
Permanent Wilting Point

RZWWS

0

Day 3

ET_C



Saturation

Field Capacity

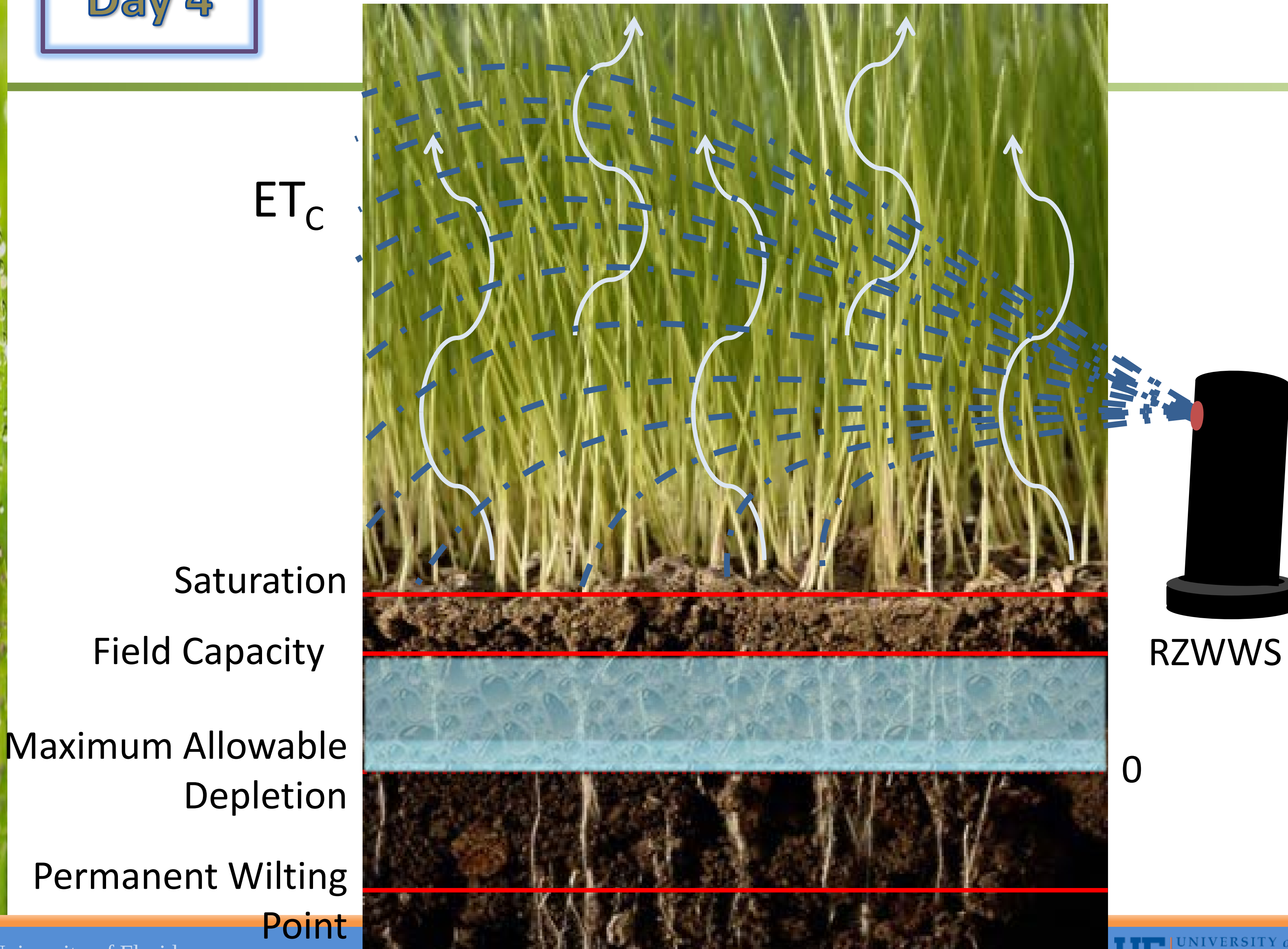
RZWWS

Maximum Allowable Depletion

0

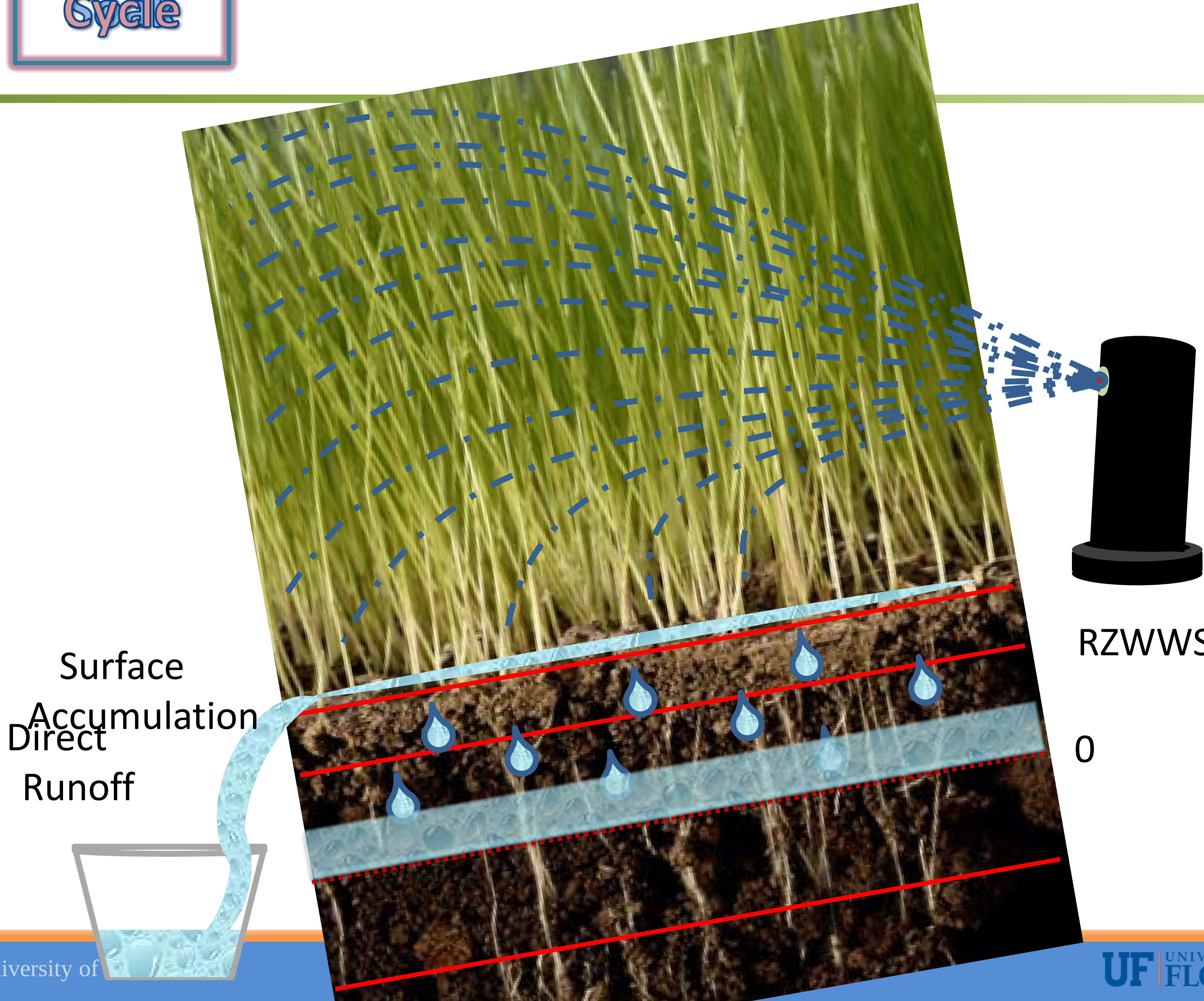
Permanent Wilting Point

Day 4

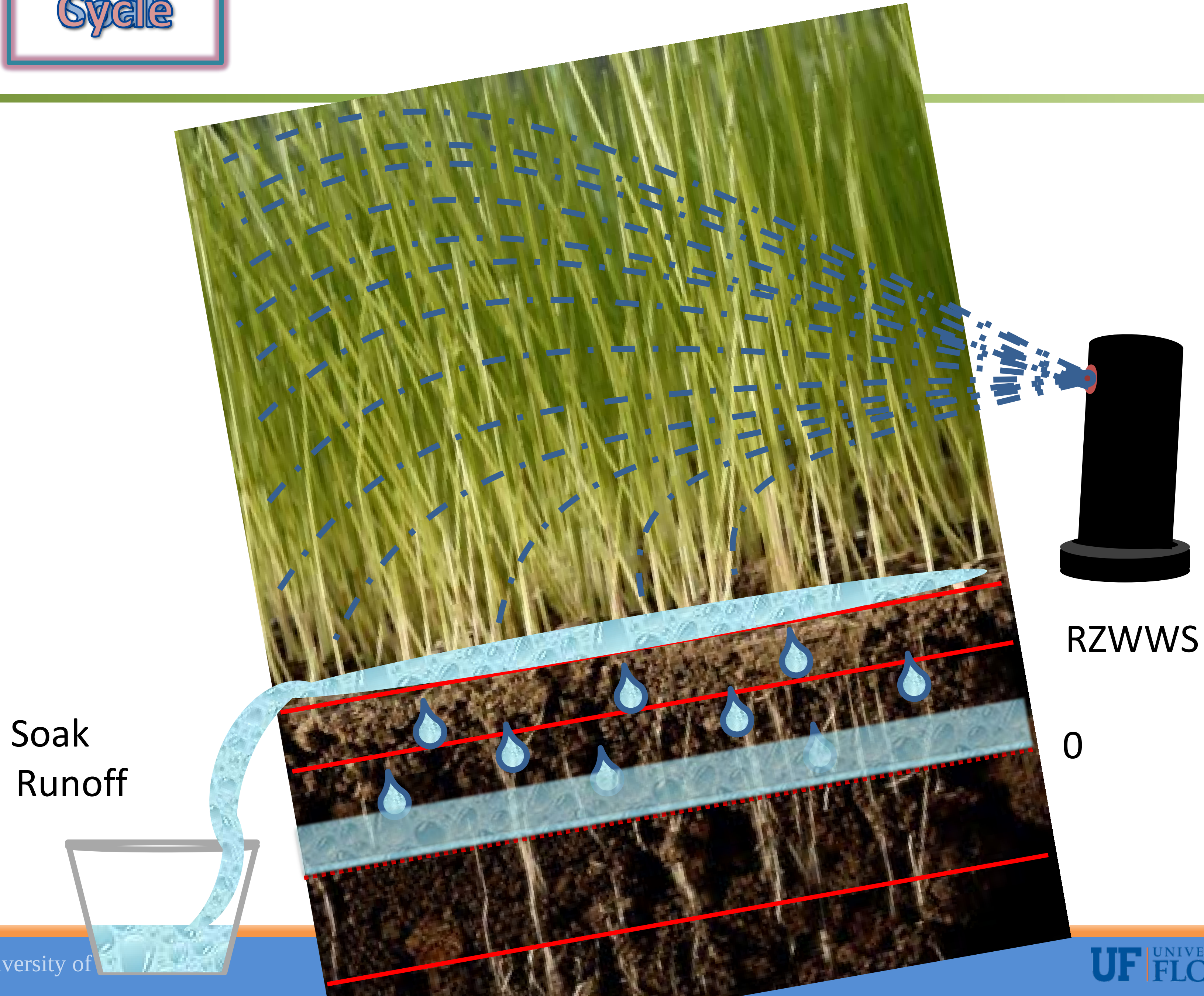


ET_C
Saturation
Field Capacity
Maximum Allowable Depletion
Permanent Wilting Point
RZWWS
0

Cycle



Cycle



Measurement of Performance

- Scheduling Efficiency

$$E = \frac{(I_{NET} - SL)}{I_{NET}} * 100$$

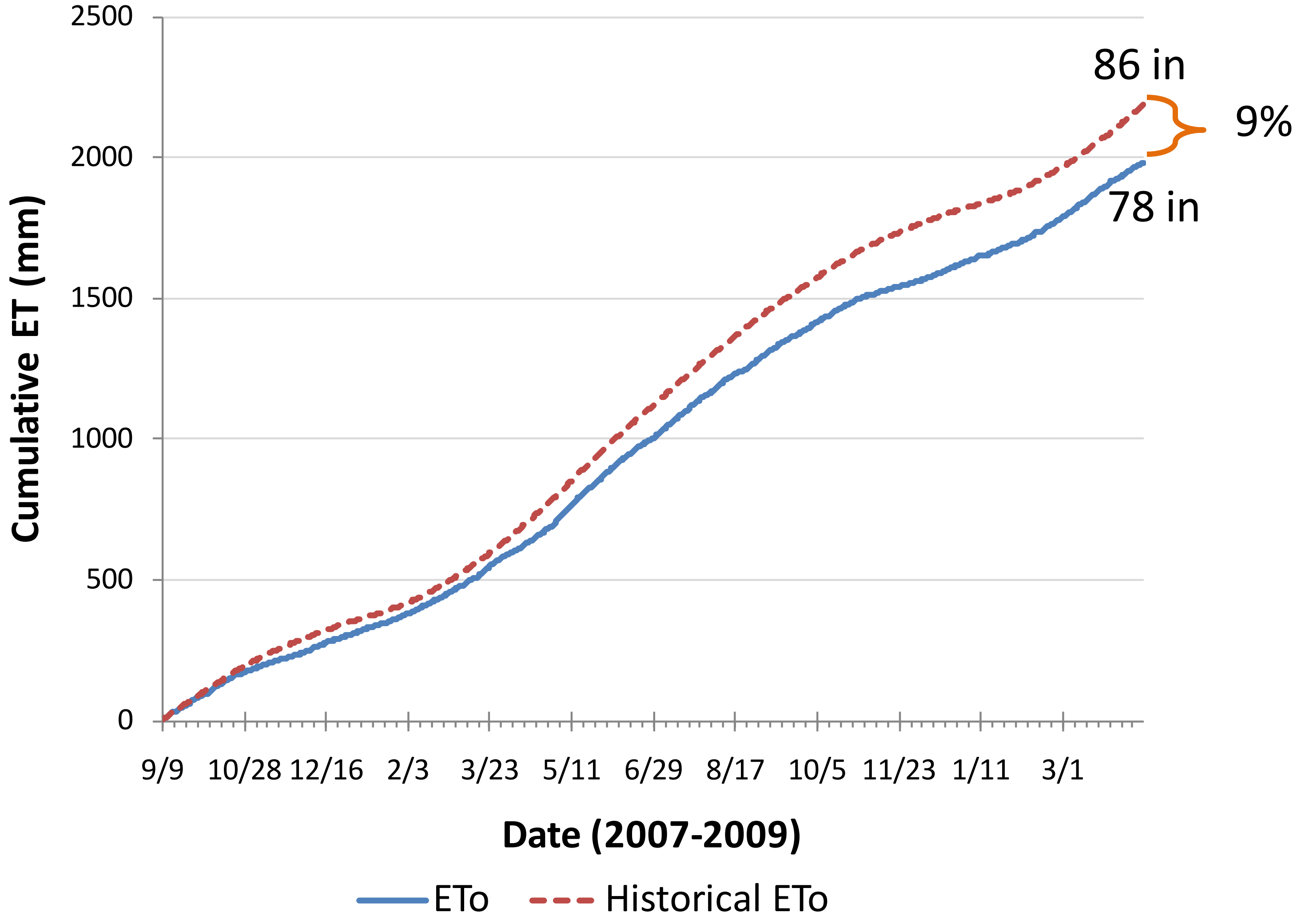
- Irrigation Adequacy

$$A = \frac{(ET_C - D)}{ET_C} * 100$$

Program Settings

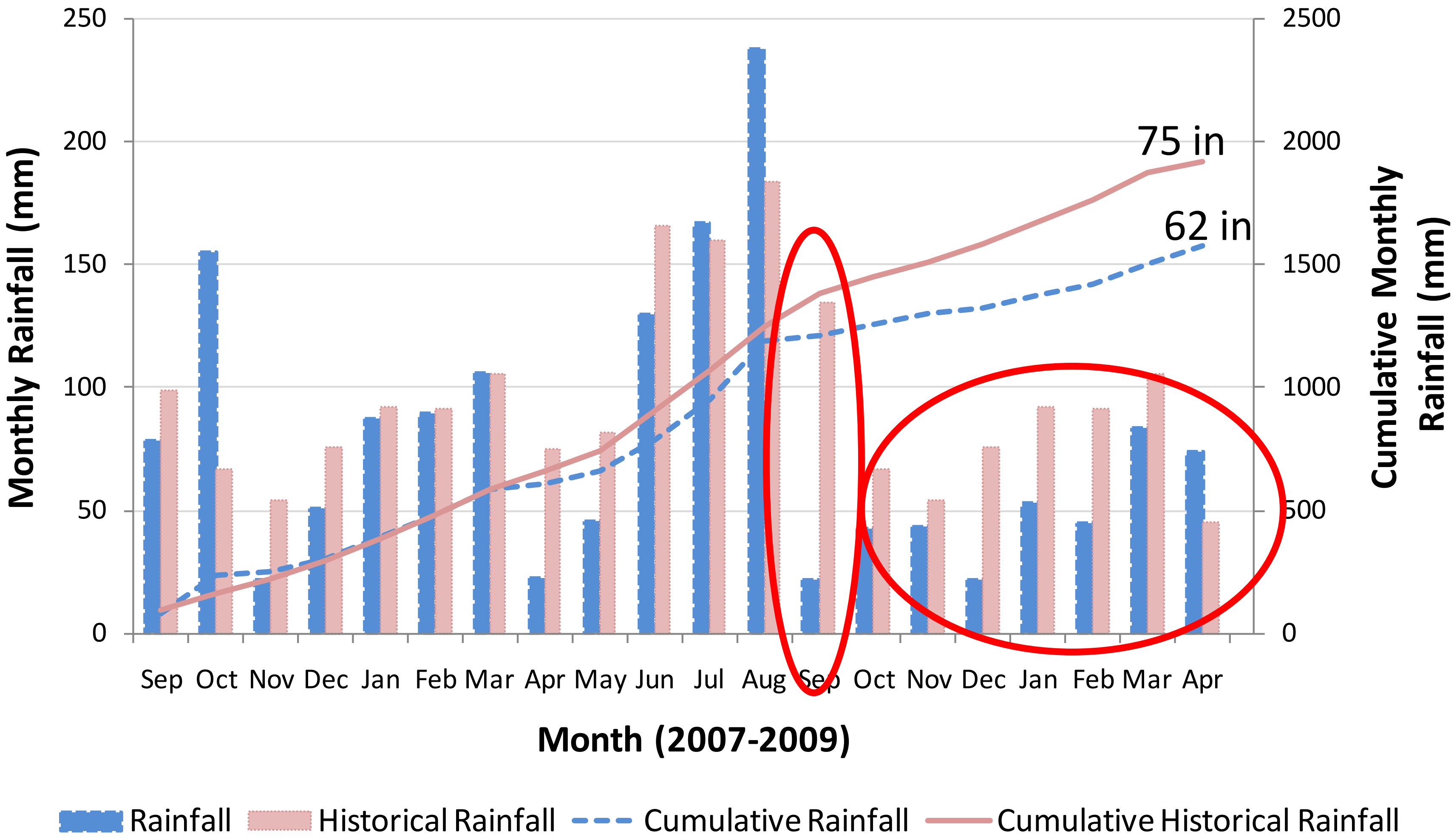
Description	Model	Weathermatic	Toro	ETwater
Soil	Sand	Sand	Sand	Sand
Slope (%)	10	10°	10	10
Exposure	Full Sun	NA	Sunny All Day	Sunny All Day
Readily Available Water (mm)	0.55	NA	NA	NA
Maximum Allowable Depletion (%)	40	NA	50	50
Vegetation	Bermuda	Custom	Warm Season Grass	Warm Season Grass
Root Depth (in)	8.1	NA	6	6
Landscape Coefficient	Varies Monthly	Varies Monthly	Varies Monthly	Unknown
Precipitation Rate (in/hr)	1.60	1.60	1.60	1.60
Application Efficiency (%)	60	NA	60	60
Adjustments (%)	NA	165%	0	0

Weather - ET

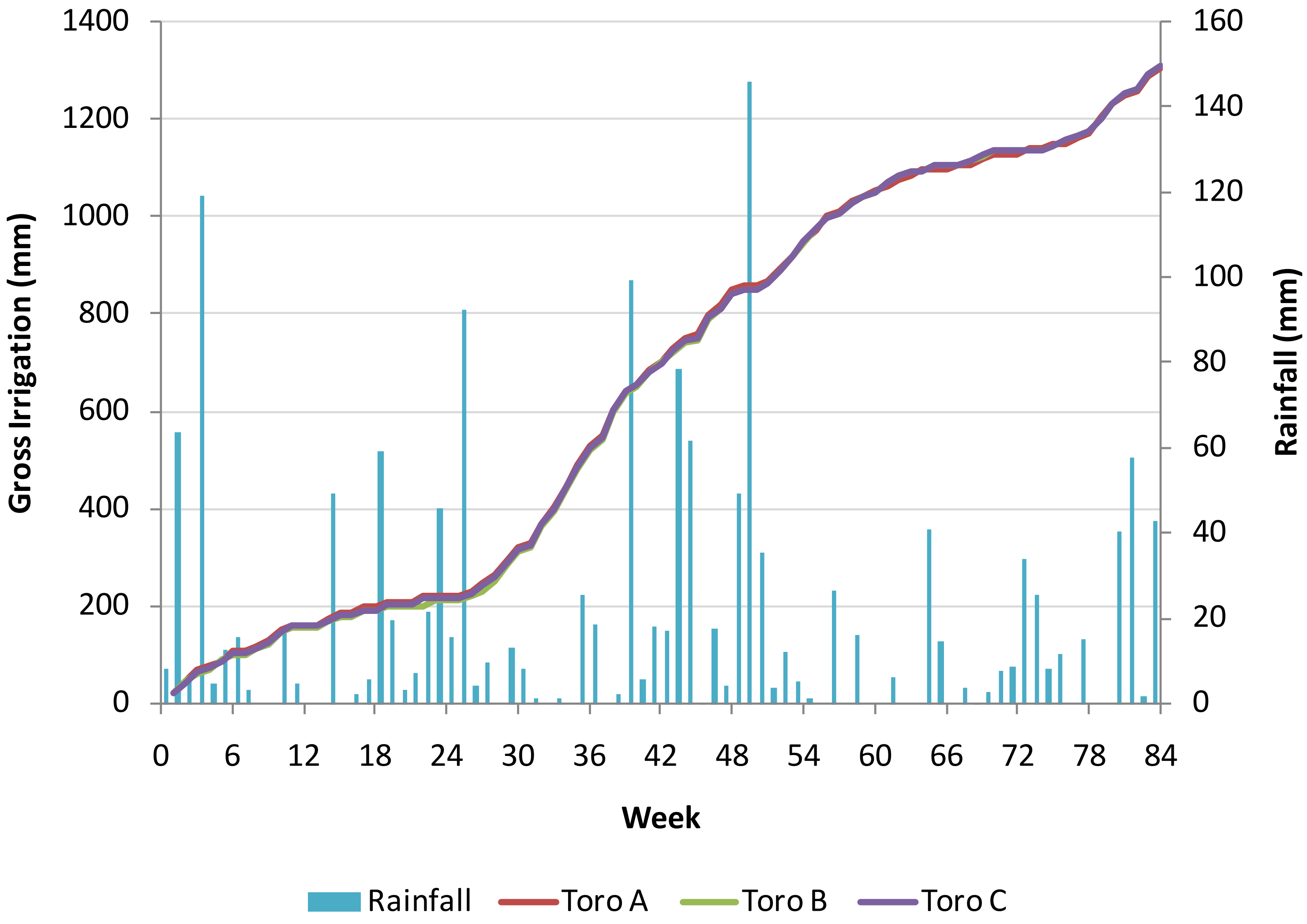


2500
2000
1500
1000
500
0
Cumulative ET (mm)
86 in
9%
78 in
9/9
10/28
12/16
2/3
3/23
5/11
6/29
8/17
10/5
11/23
1/11
3/1
Date (2007-2009)
ETo
Historical ETo

Weather - Rainfall



Toro Replications



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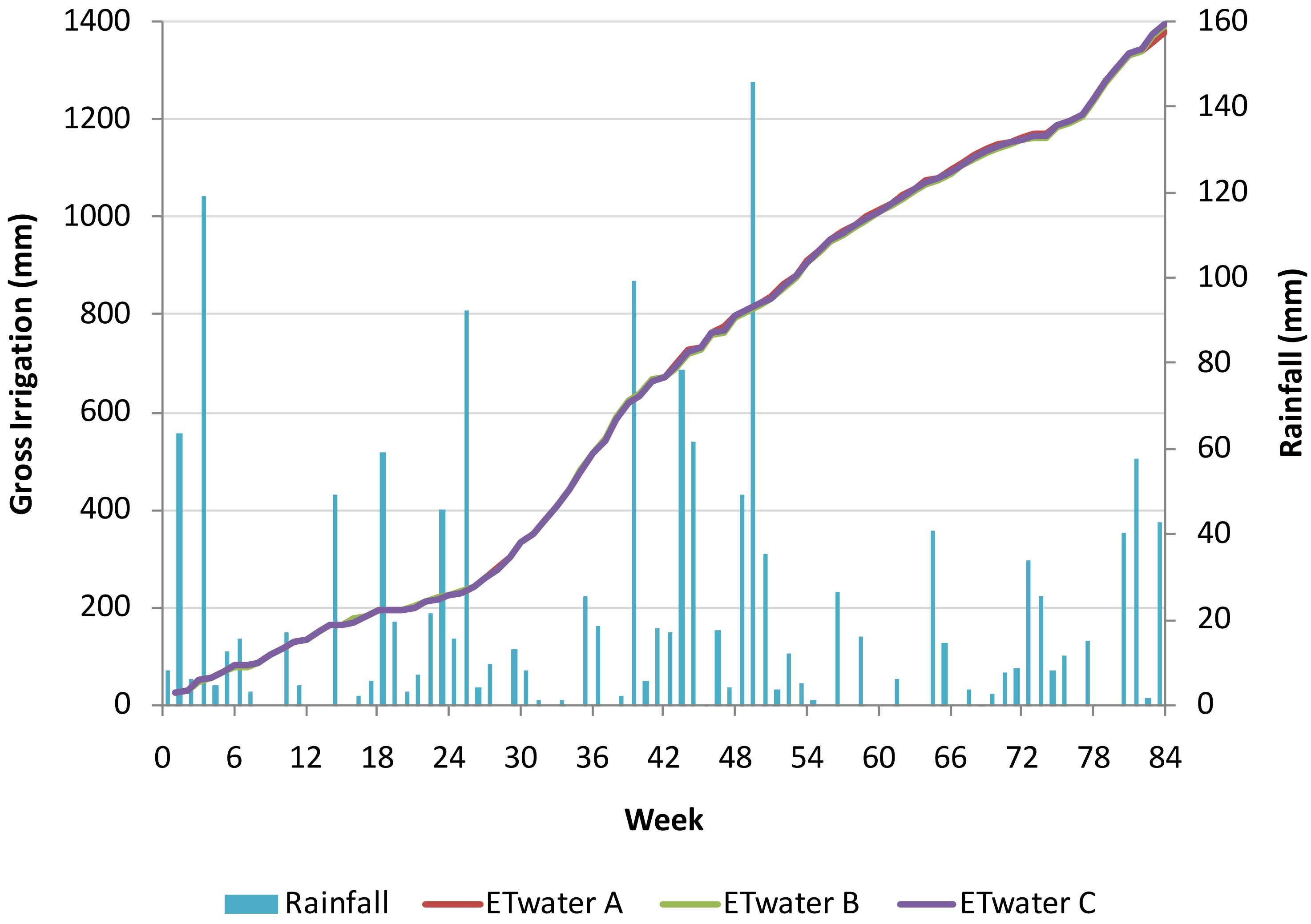
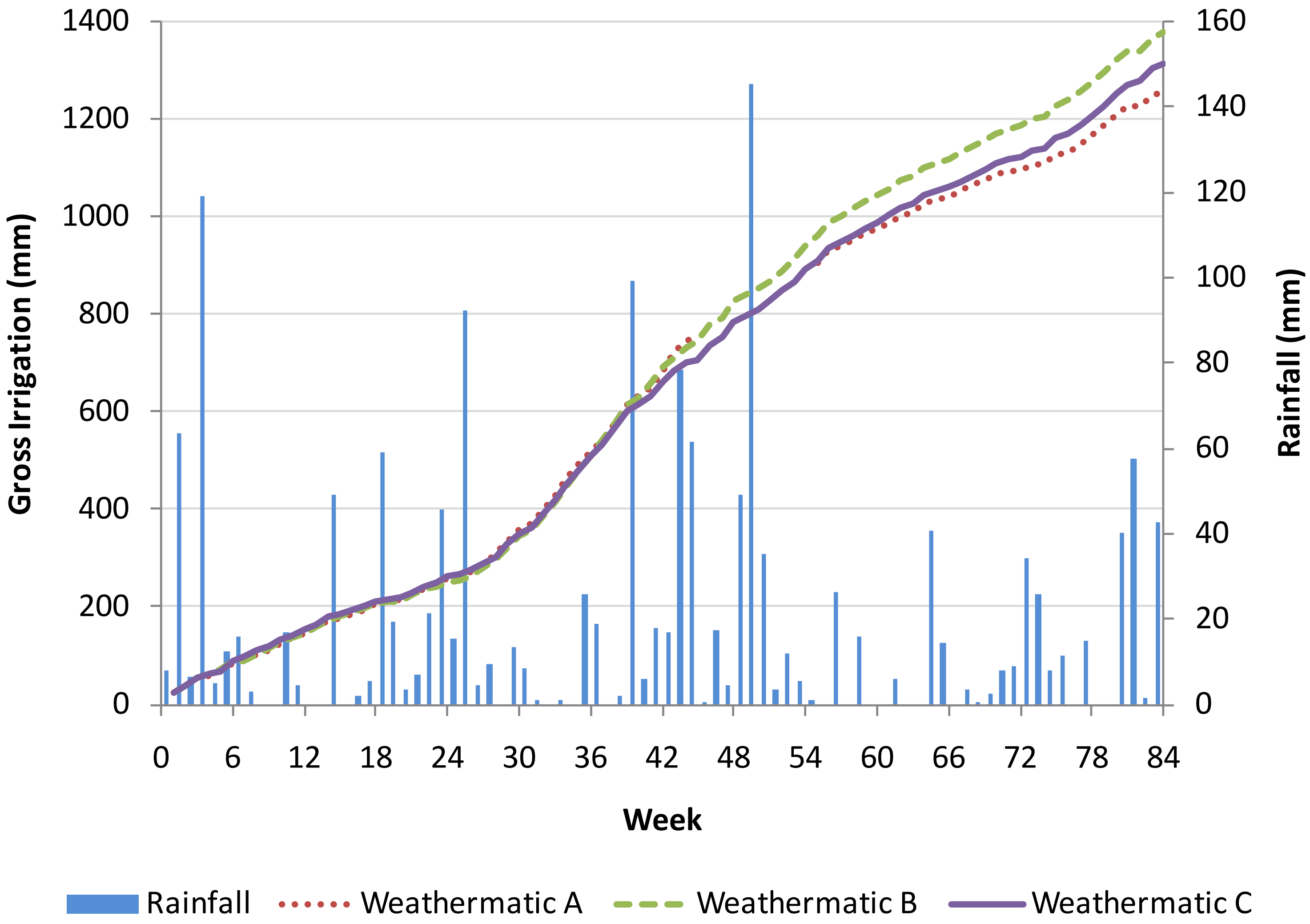
ETwater Replications



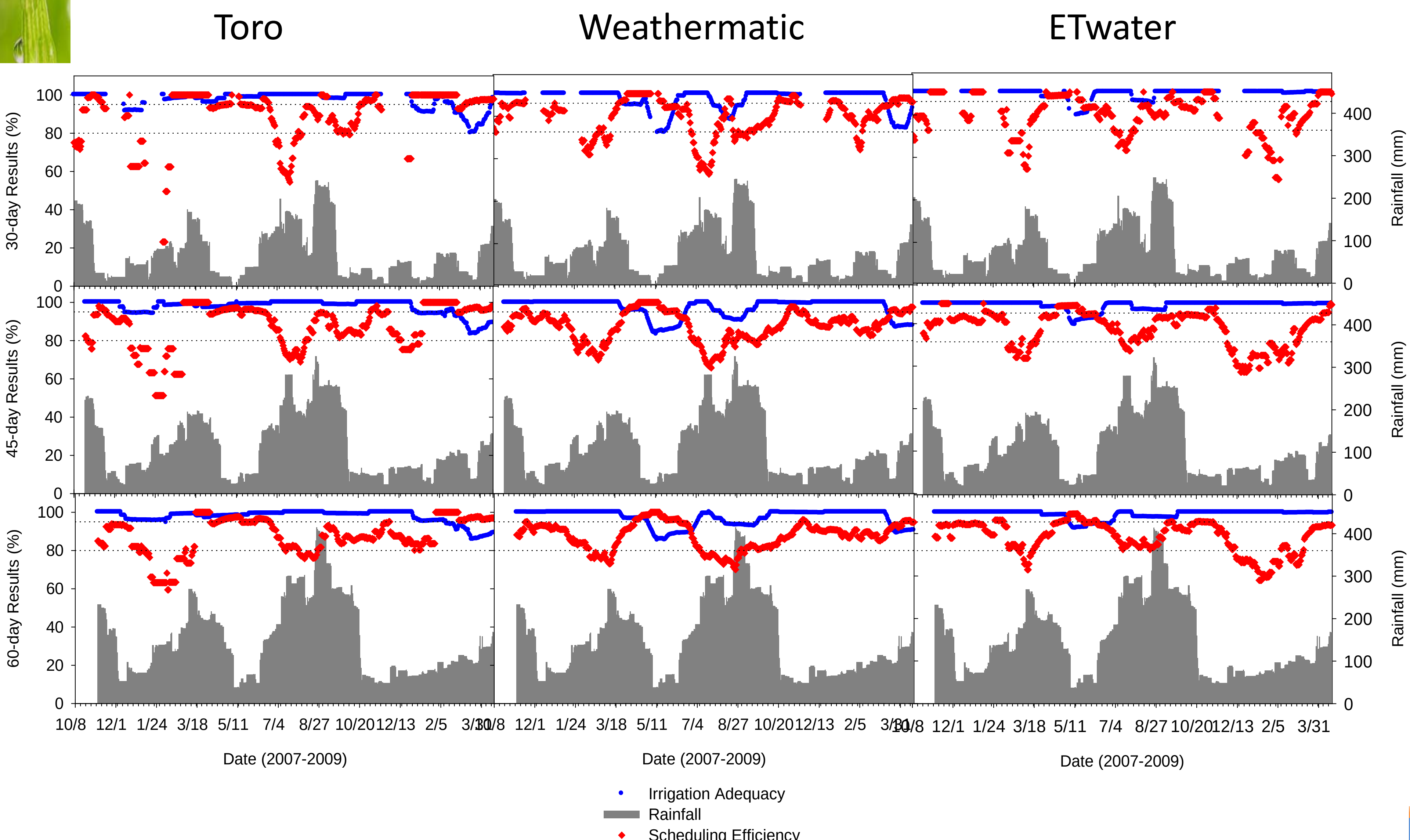
Weathermatic Replications



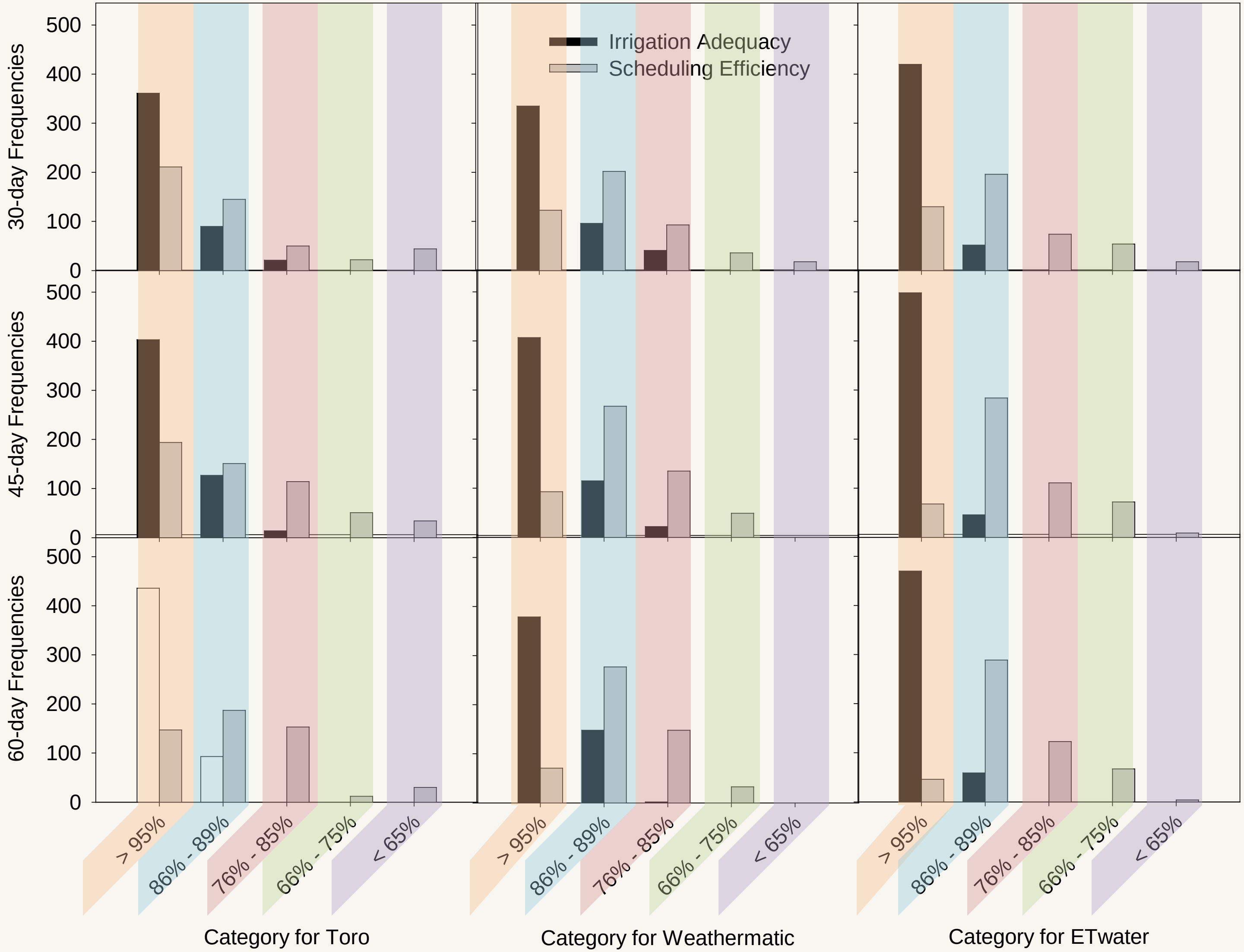
SWB Summary

Parameter	Toro B	Weather-matic B	ETwater B	Model
Total Rainfall (in)	62.1	62.1	62.1	62.1
Effective Rainfall (in)	21.9	19.9	20.6	21.2
Net Irrigation (in)	30.9	32.6	32.9	29.2
Gross Irrigation (in)	51.5	54.3	54.8	48.7
Deficit (in)	1.2	1.6	0.80	0
Surplus (in)	3.3	3.6	3.6	0
Direct Runoff (in)	0.08	0	0	0
Soak Runoff (in)	0	0	0	0
Scheduling Losses (in)	3.4	3.6	3.6	0
Irrigation Adequacy (%)	98	97	98	100
Schedule Efficiency (%)	89	89	89	100
Rainfall Efficiency (%)	44	40	42	43
Overall Efficiency (%)	52	52	53	60

Rolling Results



Frequencies of Results



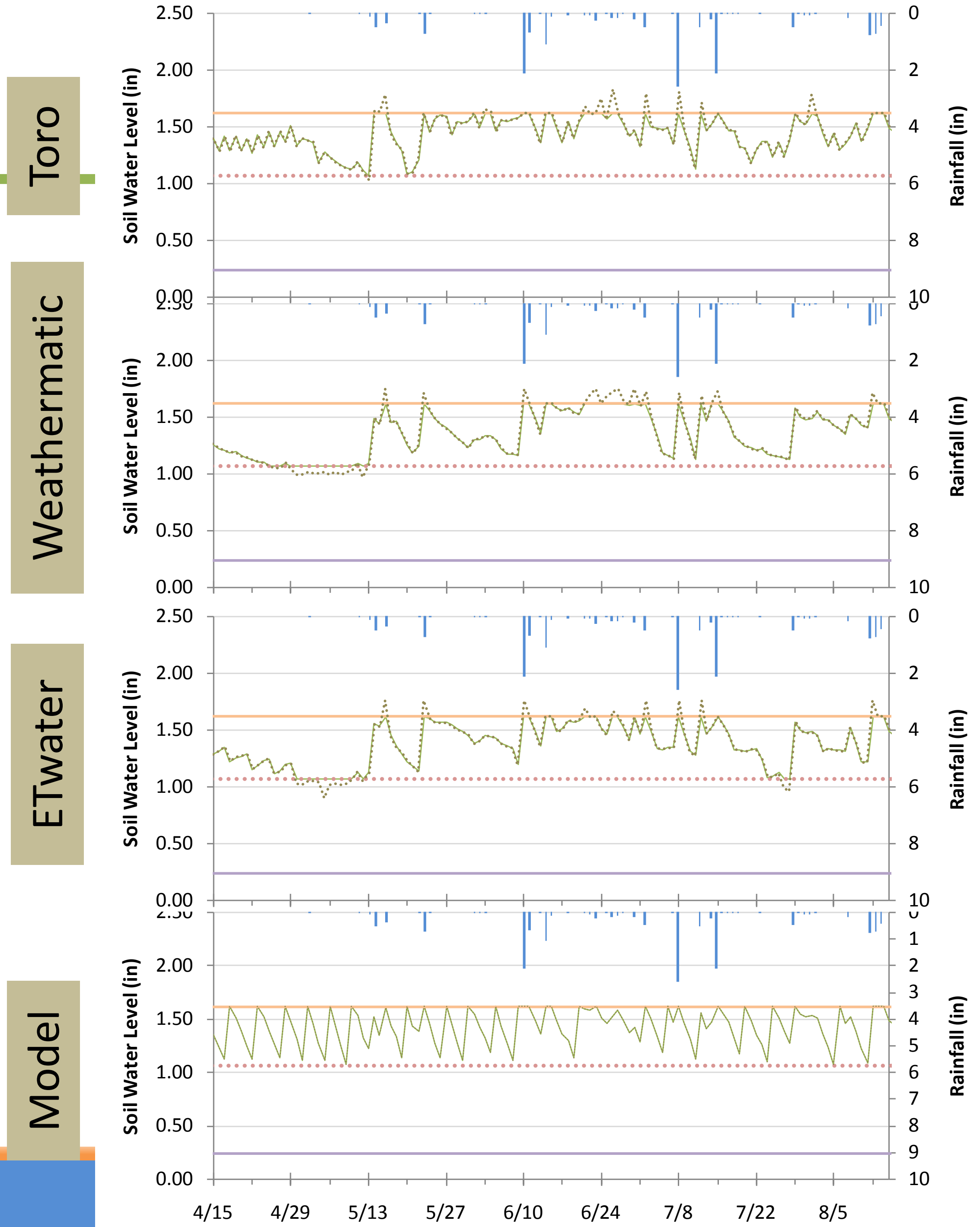
April 15, 2008
to
August 15, 2008

Rainfall, R

SWAT Final Water Level

FC MAD PWP

Actual Final Water Level



Conclusions

- There were no differences in controller replications
- Controller brands performed similarly to each other
- Irrigation adequacy and scheduling efficiency results ranged from high to low depending on time period chosen
  - Rainfall impacted the scheduling efficiency results
- Controllers irrigated many small irrigation events

Conclusions

- 2006-2007 ET controller irrigation study (Davis et al., 2009)
  - Controllers had 43% water savings compared to a UF-IFAS recommended time-based treatment
  - No change in turfgrass quality between treatments

Thank you!

Questions or Comments?