Every single drop: Utilizing deficit irrigation to managing warm-season turfgrass lawns.

Jason K. Kruse
University of Florida

Introduction

- Water is the most important environmental factor in establishing plants.
  - Water is the most frequently limiting factor in the landscape.
    - In most regions, irrigation is a constant need.
    - In more humid, high rainfall areas of the country, supplemental irrigation is necessary.

Introduction

- Water availability will set the pace for the rest of the landscape and determines the quality of the landscape.
  - Fertilization is dependent on water.
  - Mowing frequency and number will be determined by mowing.
  - Ornamentals are directly affected by irrigation.

Global Water Demand

- 2X increase every 20 years.
- Past 30 yrs, U.S. population has increased 52%; total water use has increased 300%
- 1960-1998 renewable water resources decreased 50%.
  - Another 50% reduction is expected by 2025.
- In 2001, 33% of all U.S. communities experienced water shortages.
- By 2025, half of all U.S. will experience water shortages and poorer water quality.

Reasons for Various Degrees of Water-Shortage Crises

- Water shortages do not occur only in low-rainfall regions.
- Shortages result from a wide range of reasons, not all are based on an actual shortage of water!
  - Development outpaces infrastructure.
  - Environmental concerns, regulations or legal decisions restrict the amount that can be used.
  - Mechanical and structural shortcomings.
- Water Pollution limits the amount available.

Evapotranspiration

- Evaporation = water loss from the soil surface.
- Transpiration = water loss from the plant.
  - In turf, the soil surface is usually covered by the turf canopy and most of the water loss is due to transpiration.

Estimating Evapotranspiration

- Key information required:
  - Weather-pan evaporation
    - This is a measure of the evaporation from an open, circular pan of water.

Estimating Evapotranspiration

- Key information required:
  - Crop coefficient (KC)
    - In turf, open pan evaporation cannot be used alone.
      - The KC is a decimal number that is usually less than 1.0.
        - » ‘Tifway’ bermudagrass = 0.67
        - » Common bermudagrass = 0.68
        - » ‘Meyer’ zoysiagrass = 0.81
        - » Common centipedegrass = 0.85
        - » ‘Raleigh’ St. Augustinegrass = 0.72

Estimating Evapotranspiration

- In the following example, a pan evaporation rate of 2.25” / week has been measured.
- The KC value for ‘Raleigh’ St. Augustinegrass is listed as 0.72.
- The weekly water requirement of this turf area is:

$$ET_{TURF} = (K_C)\ (\text{Pan Evaporation})$$

$$ET_{TURF} = (0.72)\ (2.25) = 1.62\text{” / week}$$

Factors Affecting Evapotranspiration

- Plant Species
  - Warm-season grasses have lower ET rates than cool-season grasses.
    - Cool-season grasses require about 3X more water to produce a gram of dry matter through photosynthesis.
      - This difference is particularly important during stress periods when stomata close.
        - » Closed stomata decrease water loss but also restrict the entry of CO_2 which limits photosynthesis.

Factors Affecting Evapotranspiration

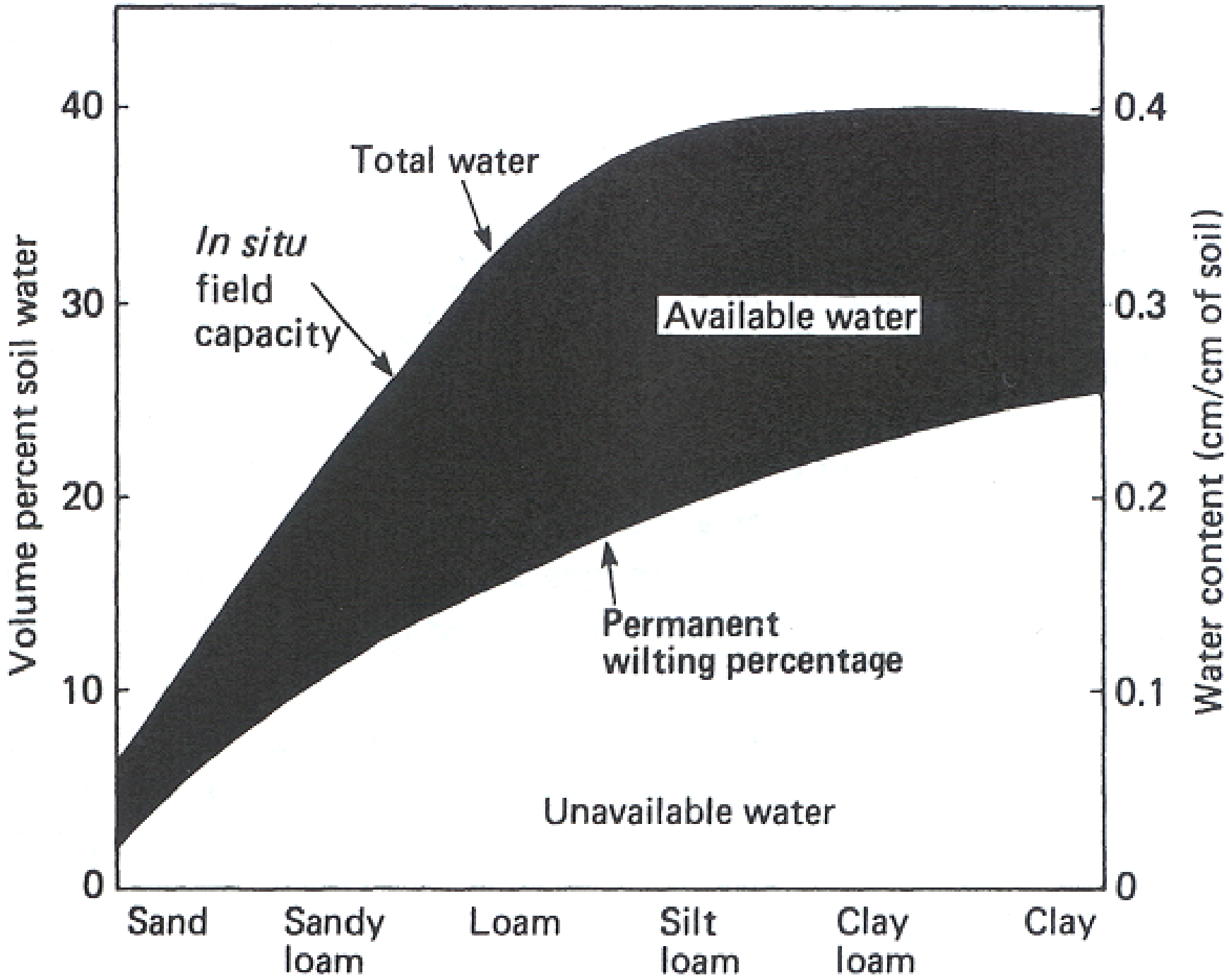
- Humidity
  - Transpirational water loss occurs because of the gradient that exists between the moist cells of the plant and the moisture level in the surrounding environment.
    - The drier the air, the greater the gradient and the more water lost from the plant.

Factors Affecting Evapotranspiration

- Temperature
  - The higher the temperature, the greater the evaporation.
  - The effect of temperature on transpiration is a little more complex.
    - High temperatures can trigger a closing of the stomata, which helps conserve water.

Factors Affecting Evapotranspiration

- Soil Factors
  - Type
    - Coarse-textured, sandy soils have poor water holding capacity and water that is not used by the root system shortly after application can quickly drain to a depth where it cannot be reached.
    - Clays have poor infiltration rates, which causes irrigation water to puddle on the surface and evaporate before it can be used by the plant.
  - Condition
    - Compaction can restrict rooting of plants that would normally develop a deep, extensive root system.

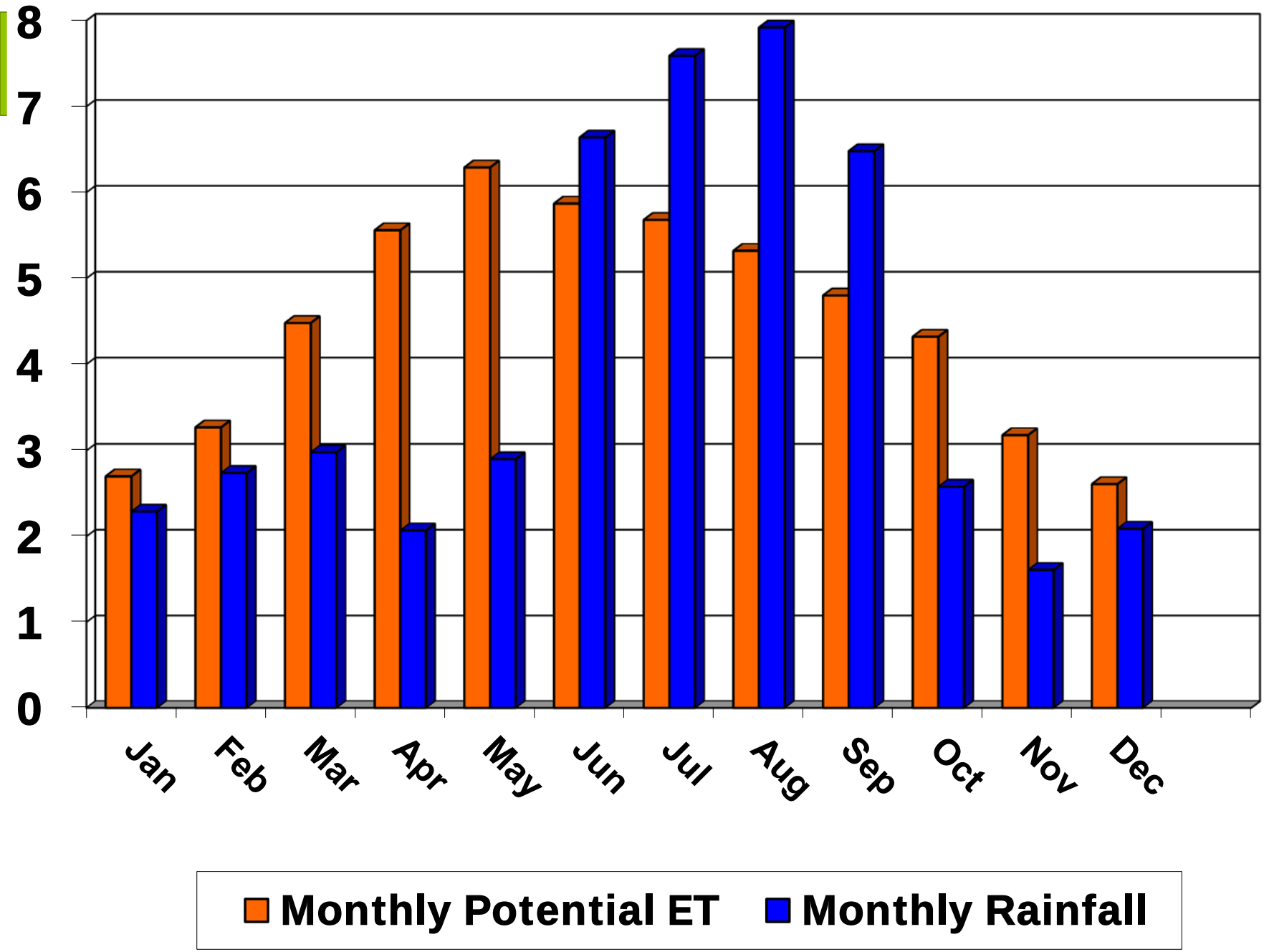

Volume percent soil water
40
30
20
10
0
Water content (cm/cm of soil)
0.4
0.3
0.2
0.1
0
Total water
In situ field capacity
Available water
Permanent wilting percentage
Unavailable water
Sand
Sandy loam
Loam
Silt loam
Clay loam
Clay

Reducing ET Rate

- Early morning irrigation (reduce E)
- Obtain full canopy cover (reduce E)
- Antitranspirants, plant growth regulators (reduce T)
- Deficit irrigation (reduce ET)


'Argentine'
Bahiagrass
100% ET
80% ET
60% ET
40% ET

Water Use in Landscapes


8
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Monthly Potential ET
Monthly Rainfall

Objectives

- Evaluate water use under 10 irrigation strategies.
- Evaluate resulting turf quality (NTEP) under the 10 strategies.
- Collect data to assess soil water and physiological status.

Experimental Design

- RCBD 3 x 3 m plots
- 3 grasses x 4 reps x 10 treatments

Grasses

- ‘Floratam’ St. Augustinegrass (*Stenotaphrum secundatum*)
- ‘Empire’ Zoysiagrass (*Zoysia japonica*)
- ‘Argentine’ bahiagrass (*Paspalum notatum*)

Irrigation Treatments

T1 –2 days/week
T2 –1 day/week, RS
T3 –2 days/week, RS
T4 – ET adjusted
T5 to T7 – Visual wilt cues
T8 – 2 days/week 60% of recommended, RS
T9 – No irrigation
T10 – Re-establishment irrigation

‘Floratam’ St. Augustinegrass

Full recommendation

Visual cues

No irrigation

‘Argentine’ Bahiagrass

Full recommendation

Visual cues

No irrigation

‘Empire’ Zoysiagrass

Full recommendation

Visual cues

No irrigation

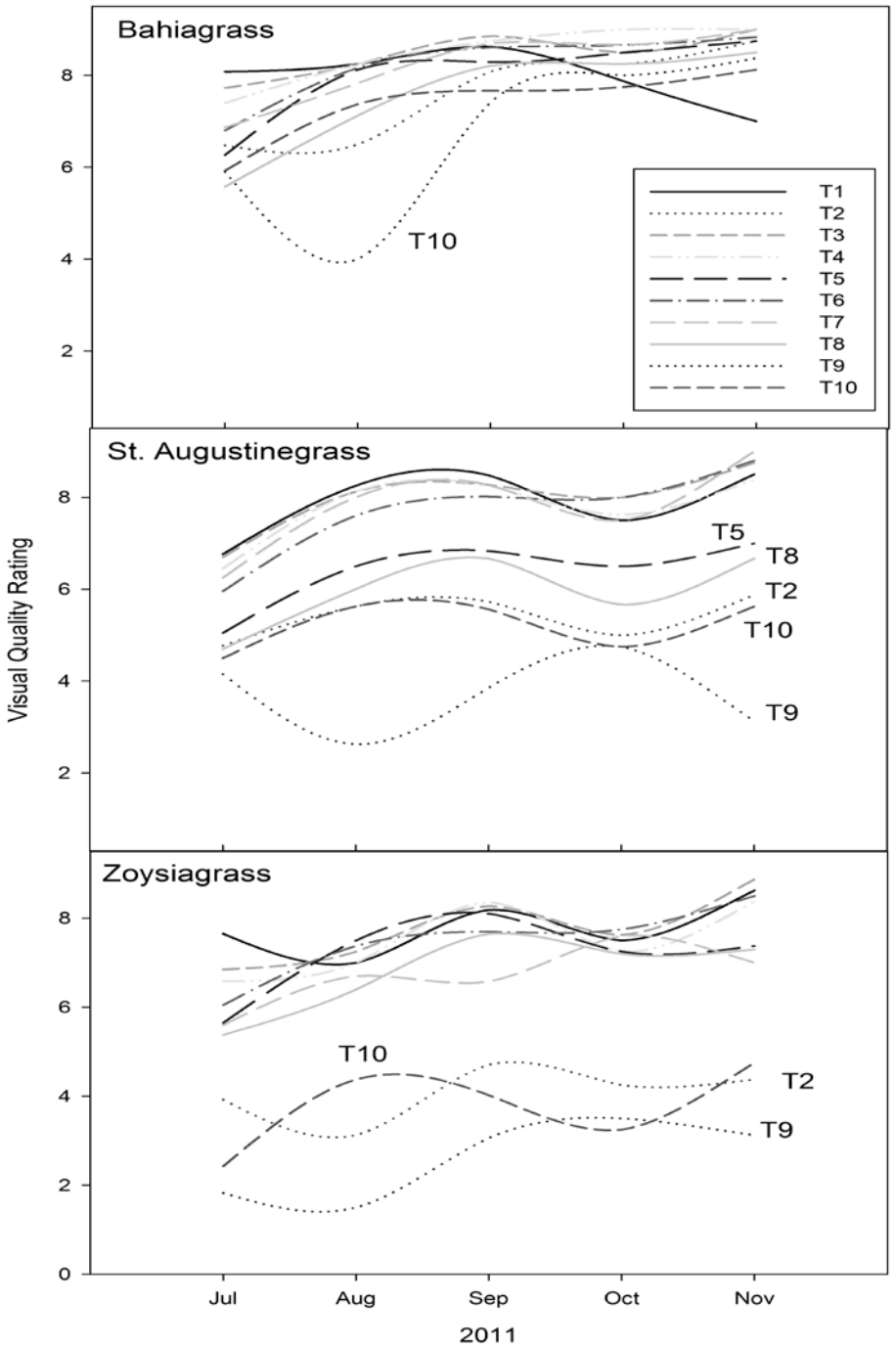
1 Day/wk irrigation w/RS

St. Augustinegrass

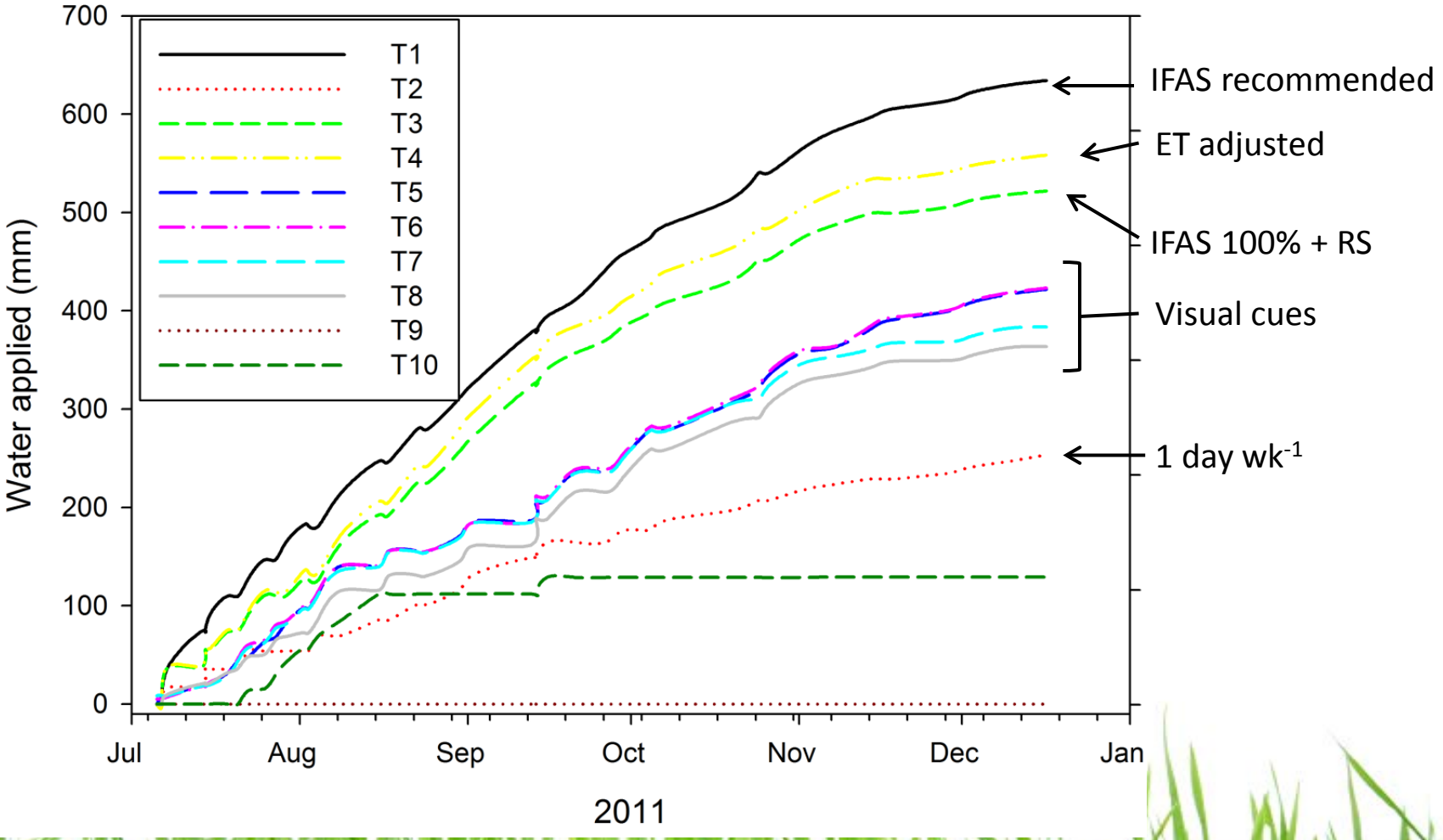
Zoysiagrass

Bahiagrass

Visual Quality



Water applied



Conclusions and recommendations

- Additional water savings possible.
- ET adjustment controller can save water
  - May offer enhanced savings when paired with RS.
- Allowing homeowner manual adjustment can save even more, but does not work in conjunction with DOW restrictions – timing is of critical importance.

Acknowledgements

This work was supported by the Southwest Florida Water Management District and the Florida Agricultural Experiment Station.

Questions?

Jason Kruse, Ph.D.

jkk@ufl.edu