Smart Irrigation Practices to Promote Plant Defense Against Diseases

Kati Migliaccio, PhD PE
Associate Professor
Agricultural & Biological Engineering
Tropical REC Homestead
klwhite@ufl.edu @UFTRECwater

UF IFAS UNIVERSITY of FLORIDA

Water stress and plant disease

- Too much water or flooding
  - Anoxic conditions
  - Disease spread (*Phytophthora*)
- Too little water
  - Greater susceptibility to disease
  - Insects view as a ‘good target’

UF IFAS UNIVERSITY of FLORIDA

Role of irrigation

- Add water to plants to prevent water stress
- Right amount, right time, right place
- Too much irrigation can create new problem

UF IFAS UNIVERSITY of FLORIDA

Components of good irrigation

- Equipment has been maintained and is regularly checked for leaks, breaks, problems
- The right system is being used (drip, micro sprinkler, lateral, etc.)
- A smart irrigation schedule is applied

Michael Gutierrez photos

UF IFAS UNIVERSITY of FLORIDA

Smart irrigation schedules

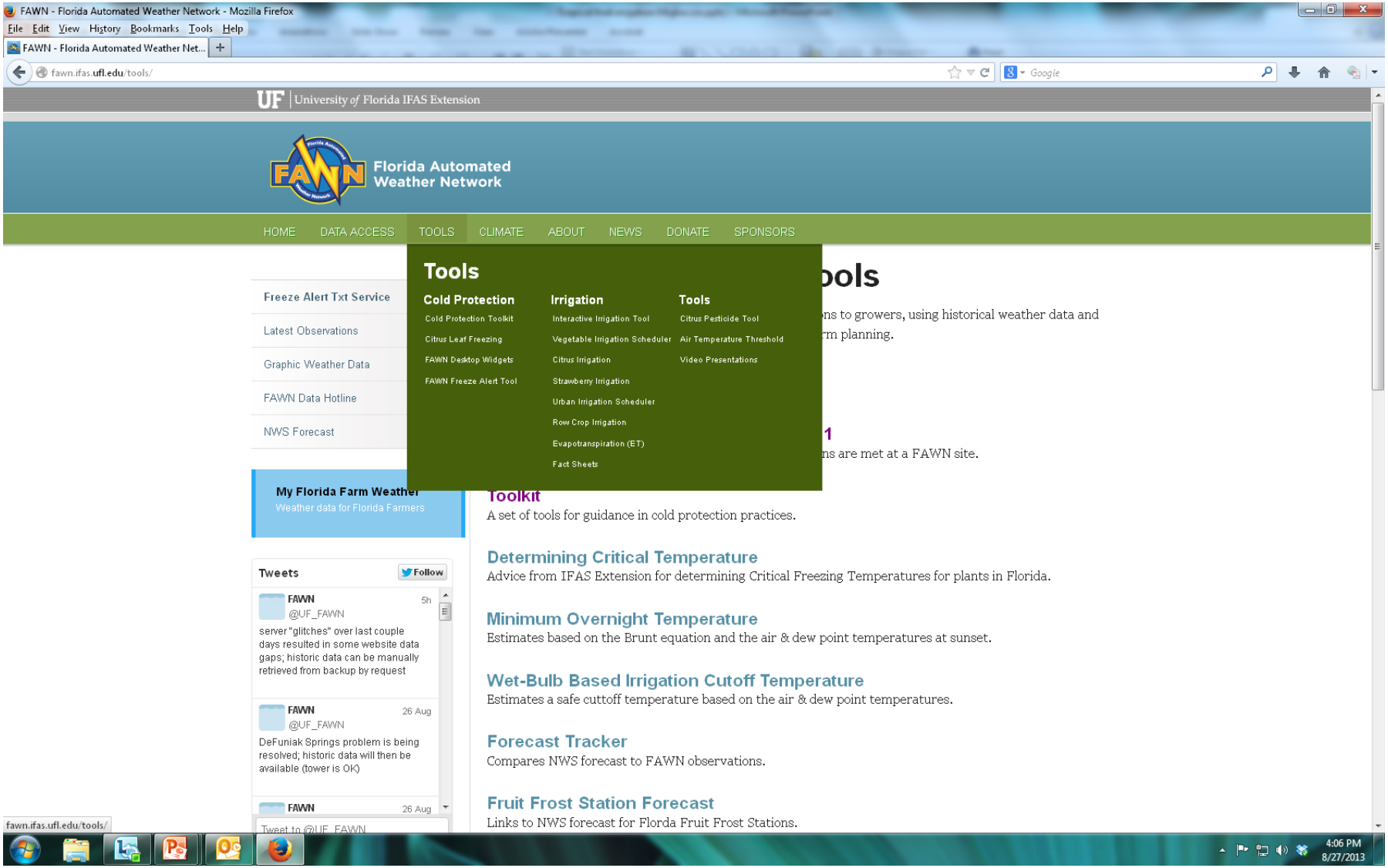
- “Do it myself” scheduling
- Site specific smart hardware scheduling
- Web and app scheduling tools

Michael Gutierrez photo

Do it myself style

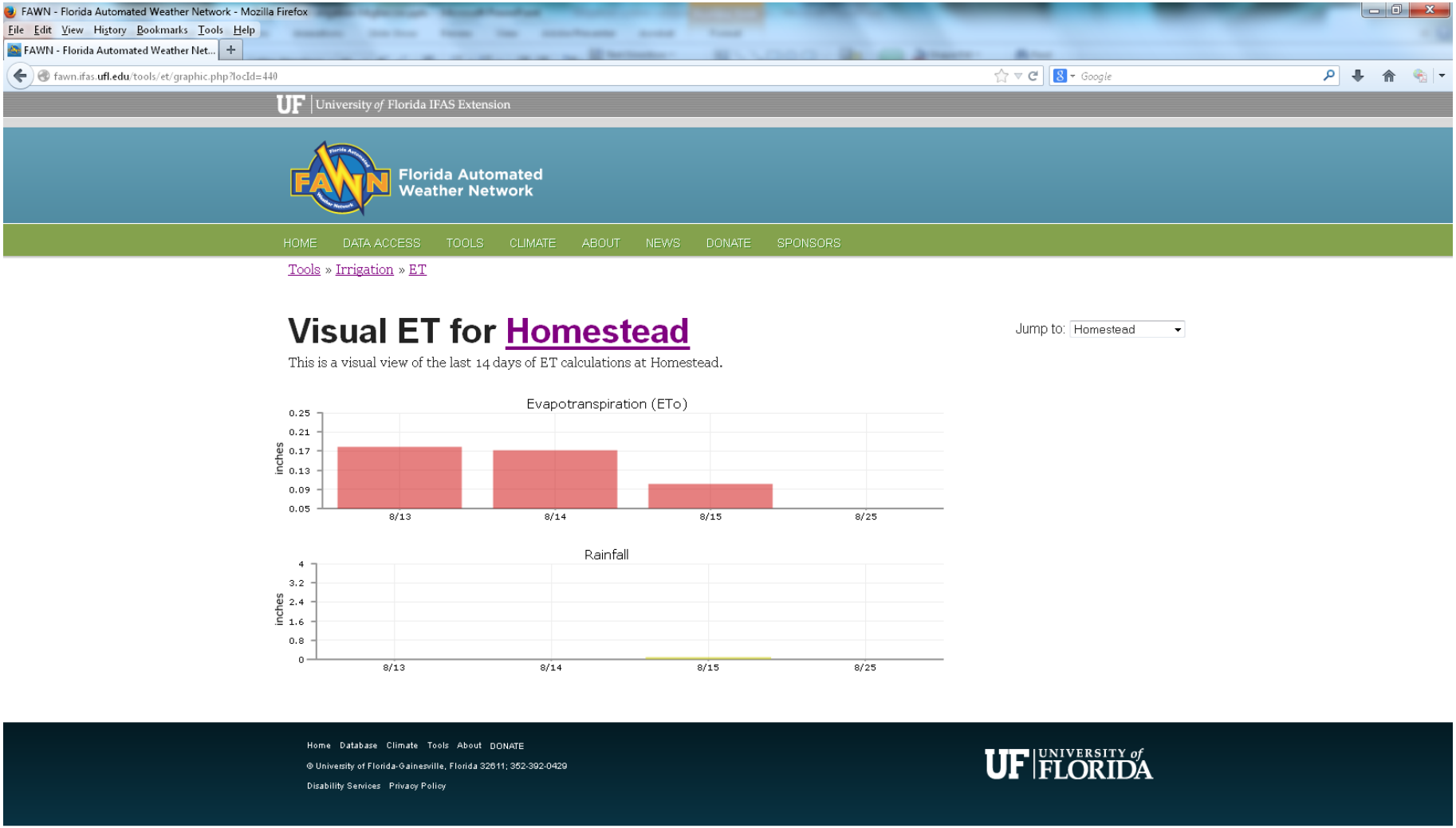
FAWN

- Florida Automated Weather Network
- Free resource with valuable information
- Rainfall and evapotranspiration
- **http://fawn.ifas.ufl.edu/mffw/**



UF IFAS UNIVERSITY of FLORIDA

FAWN: Irrigation using ET



How to use FAWN ET for irrigation?

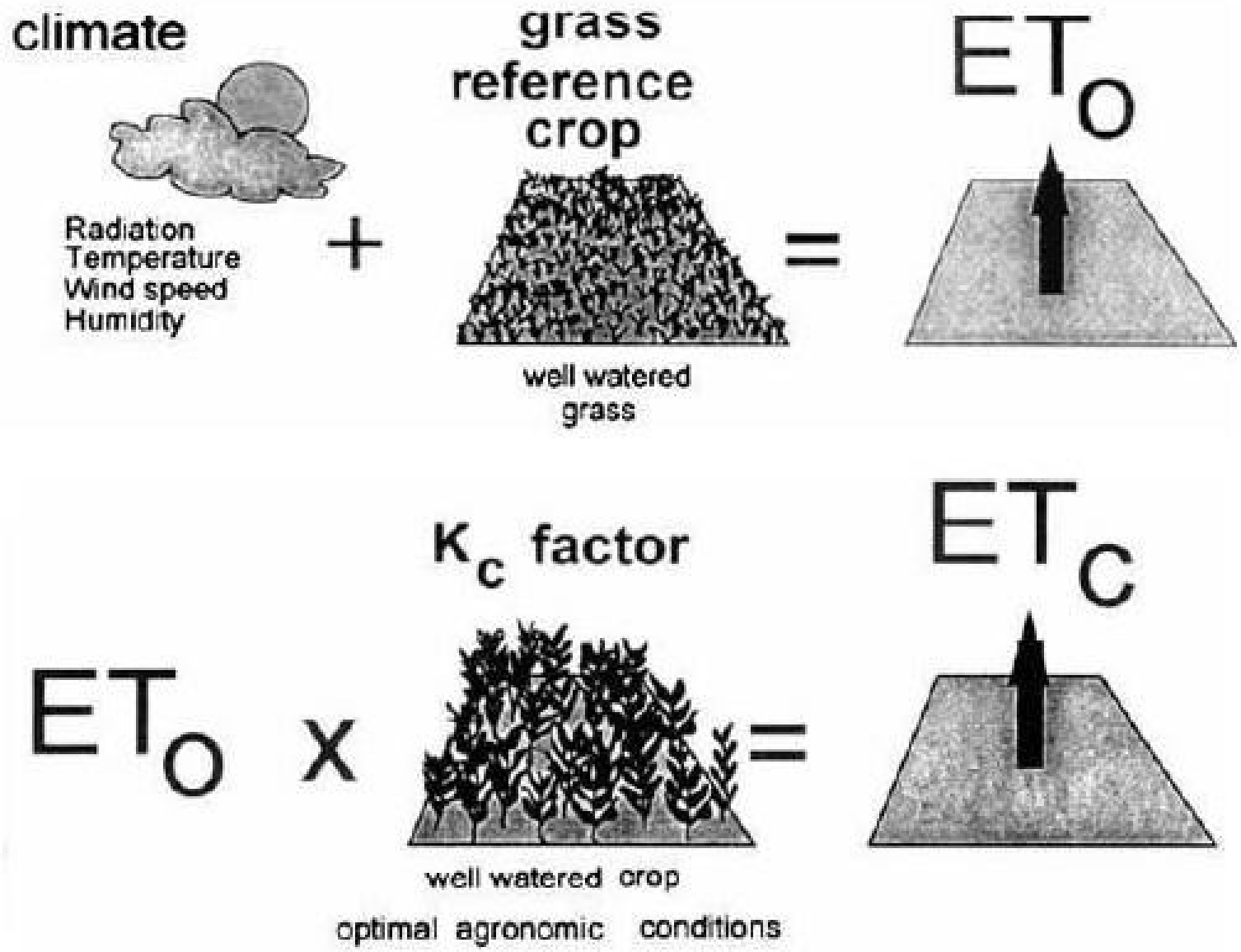
1. Take average of last few days (0.11 inches), multiple by crop coefficient (Kc) (0.9) ETc = 0.1 in/day
2. ETc is the amount of water needed per day, determine how many days you want to irrigate (3 days/wk)
3. Total irrigation for the week (7*0.1 in) divided by the number of irrigation events gives you the amount per event (0.23 in)
4. Determine the deliver rate of your system (0.25 in/hr)
5. Divide amount per event by rate (0.23/0.25*60min); 56 minutes

Smart irrigation systems

ET Controllers

2 methods of determining irrigation:
(1) Soil water balance (2) Relative to historic peak ET

UF IFAS UNIVERSITY of FLORIDA



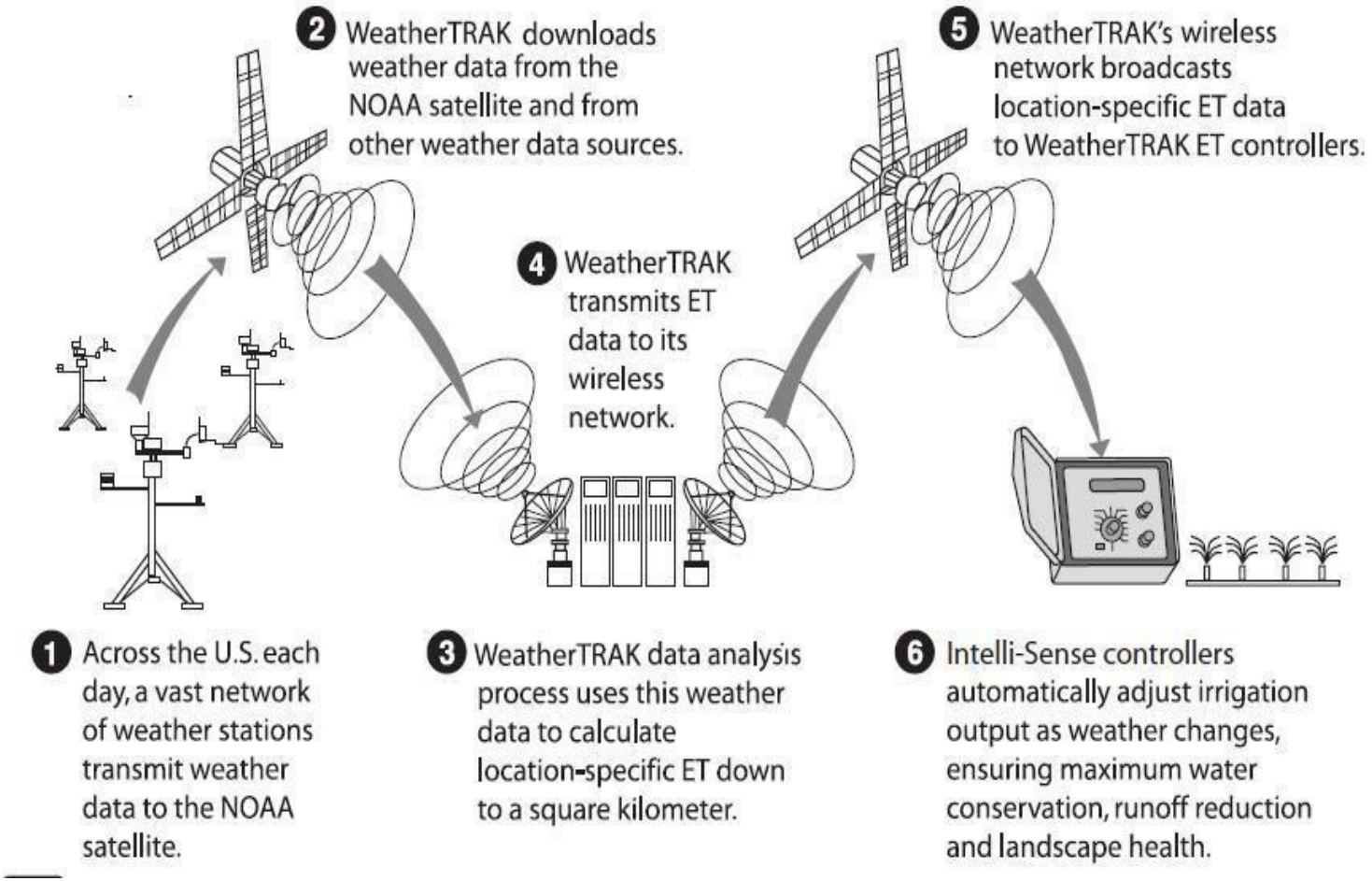
UF IFAS UNIVERSITY of FLORIDA

http://moreprofitperdrop.wordpress.com/

ET based smart irrigation system

- **Signal based**
  - Receive weather data from remote source on daily basis to update irrigation schedule (measurement and control)
  - Annual fee for data, more real-time data used in ET estimation
- **On-site weather based or stand-alone**
  - Uses an on-site sensor to estimate ET and update irrigation schedule (measurement and control)
  - No annual fee for data, less real-time ET data used in ET estimation

ET system schematic



http://www.cisolar.com/catIrrigator2.html

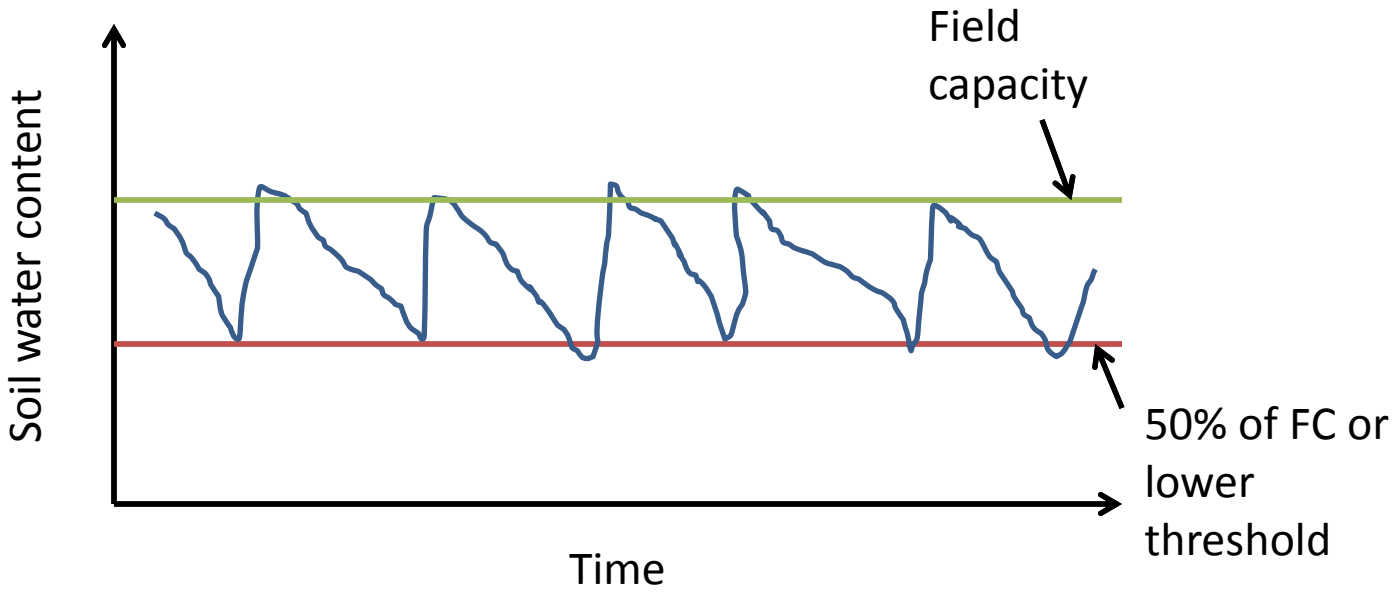
Soil water based smart irrigation system

- Use some type of soil water sensor (SWS) or soil moisture sensor (SMS) to allow or bypass irrigation events (measurement and control)
- Sensor acts as a switch
- Different types exists – but generally use a sensor with TDT technology

UF IFAS UNIVERSITY of FLORIDA

Thresholds

- Set to a ‘lower threshold’ or lower soil water content at which irrigation is needed



Not convinced?

- Try out the virtual tool on FAWN
- Compare different irrigation technologies and see water savings in a virtual environment
- Weblink: http://irrigationtool.appspot.com
- MANY resources on this – most are linked in the tool above or are found on Dr. Duke's website

Web tools / apps

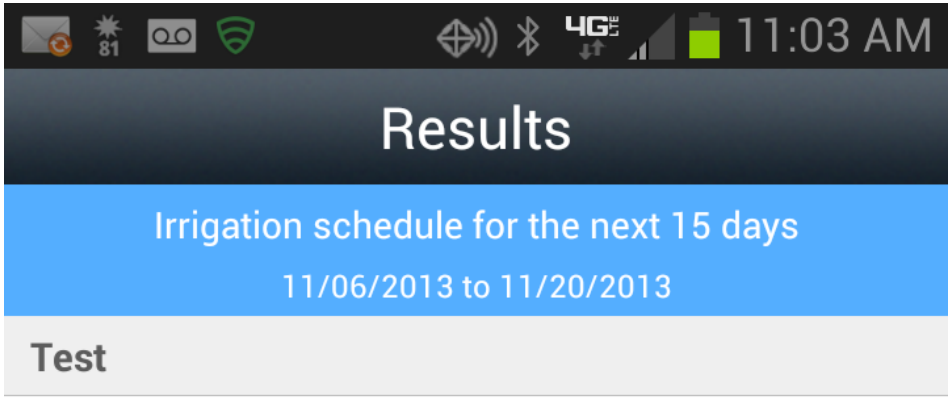
App examples

- Currently develop a suite of irrigation apps
- Citrus, strawberry, and turf have been released
- Coming soon: cotton, avocado, tomato, cabbage, peanut
- Use real-time weather data from FAWN

Citrus app

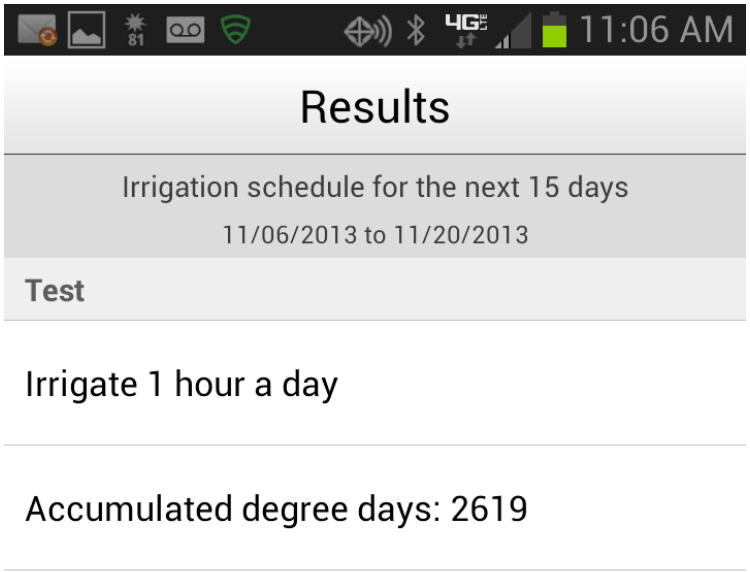
- Irrigation system: micro sprinkler
  - Tree row distances, emitter characteristics, soil type, irrigation depth, trigger depth
- Irrigation delays for rainfall amounts (days)
- Irrigation schedule (minutes) every so many days
- User can select the day of week to receive irrigation notifications

Citrus screenshot



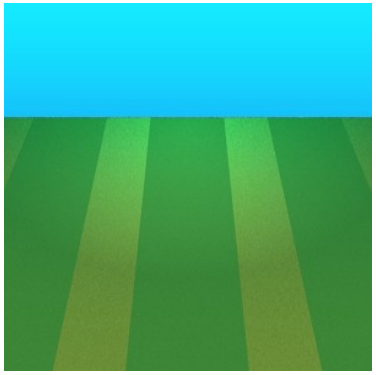
Strawberry app

- Irrigation system: drip
  - Between-row, planting date, harvest date, irrigation rate, efficiency
- Irrigation schedule (minutes/hrs) and degree days accumulated for everyday irrigation

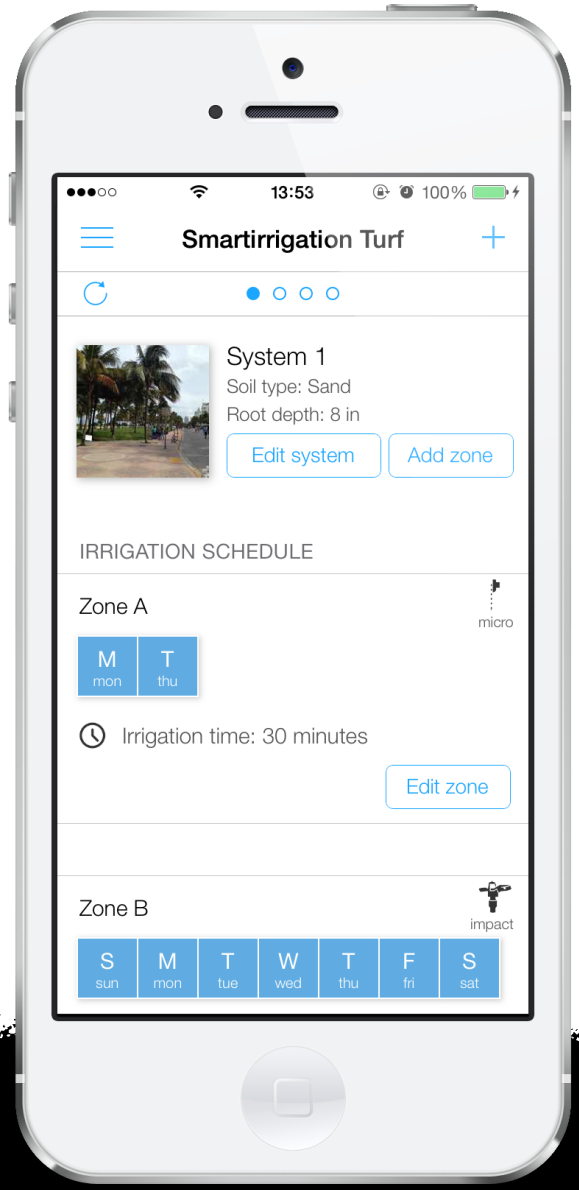


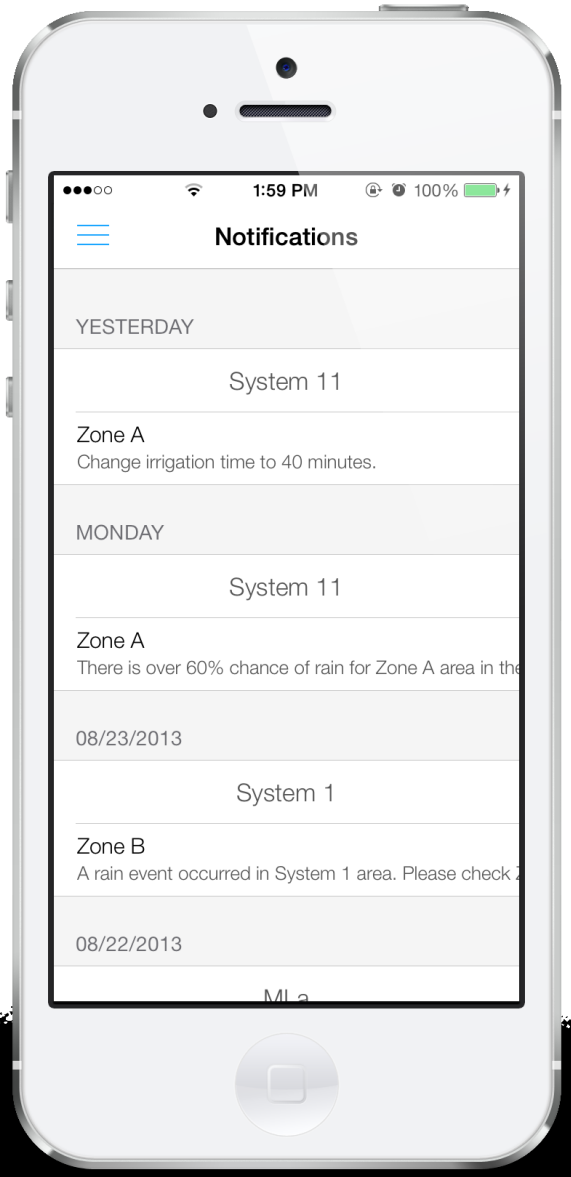
UF IFAS UNIVERSITY of FLORIDA

Urban turf app



- Irrigation system: sprinkler heads
  - Soil type, root depth
  - Micro sprinkler, spray, multi-stream spray, gear driven rotors, impacts
  - Days of week to irrigate
- Irrigation schedule in minutes considering number of irrigation events per week
- Notifications used to adjust irrigation schedules due to rainfall





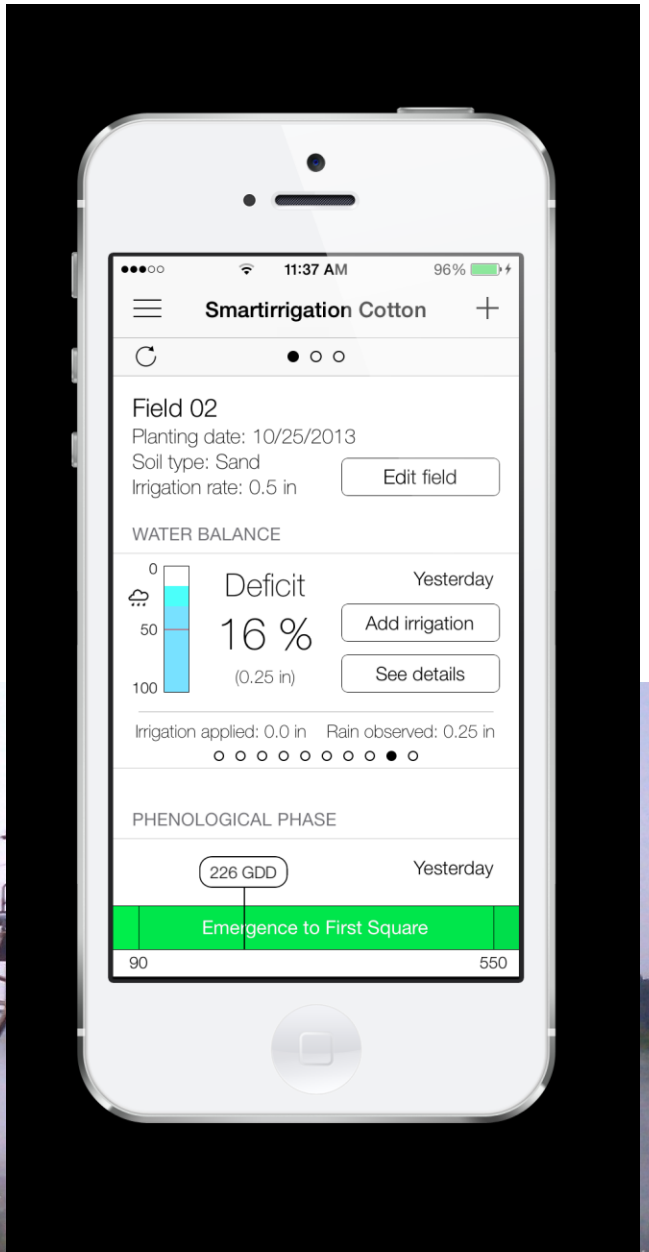
UF IFAS
UNIVERSITY of FLORIDA

Cotton app

- Irrigation application rate
- Plant phenology and crop coefficient (Kc) change with accumulated heat units (GDDs)
  - User can override GDD-driven phenology
- Does not recommend irrigation amounts
  - Advises user of available soil water and stress threshold

Cotton app

- Uses real-time rain data from FAWN and GAEMN
- A daily water balance approach: allow for R to be changed and I to be input



Forecast data

- National Weather Service data: temperature, relative humidity, wind speed, probability of rain
- Current conditions
- Forecast by hour for next 11 hrs
- Forecast by day for next 5 days

Summary

- There are a variety of resources, pick the one (or more) that works best for you
- FAWN – good for the manual irrigation system operator that likes to be in the 'know' and have a say in the decision; works for all crops
- Field tools – good for those that want exact information at their field and/or want automation; works for all crops
- App tool – great for automatic irrigation systems and manual systems, does the math for you; limited on crop

AgroClimate Disease tools