

Autonomous Turfgrass and Groundcover Irrigation Management Using Smart Irrigation Controllers in Southern and Central California

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Smart Irrigation Controllers

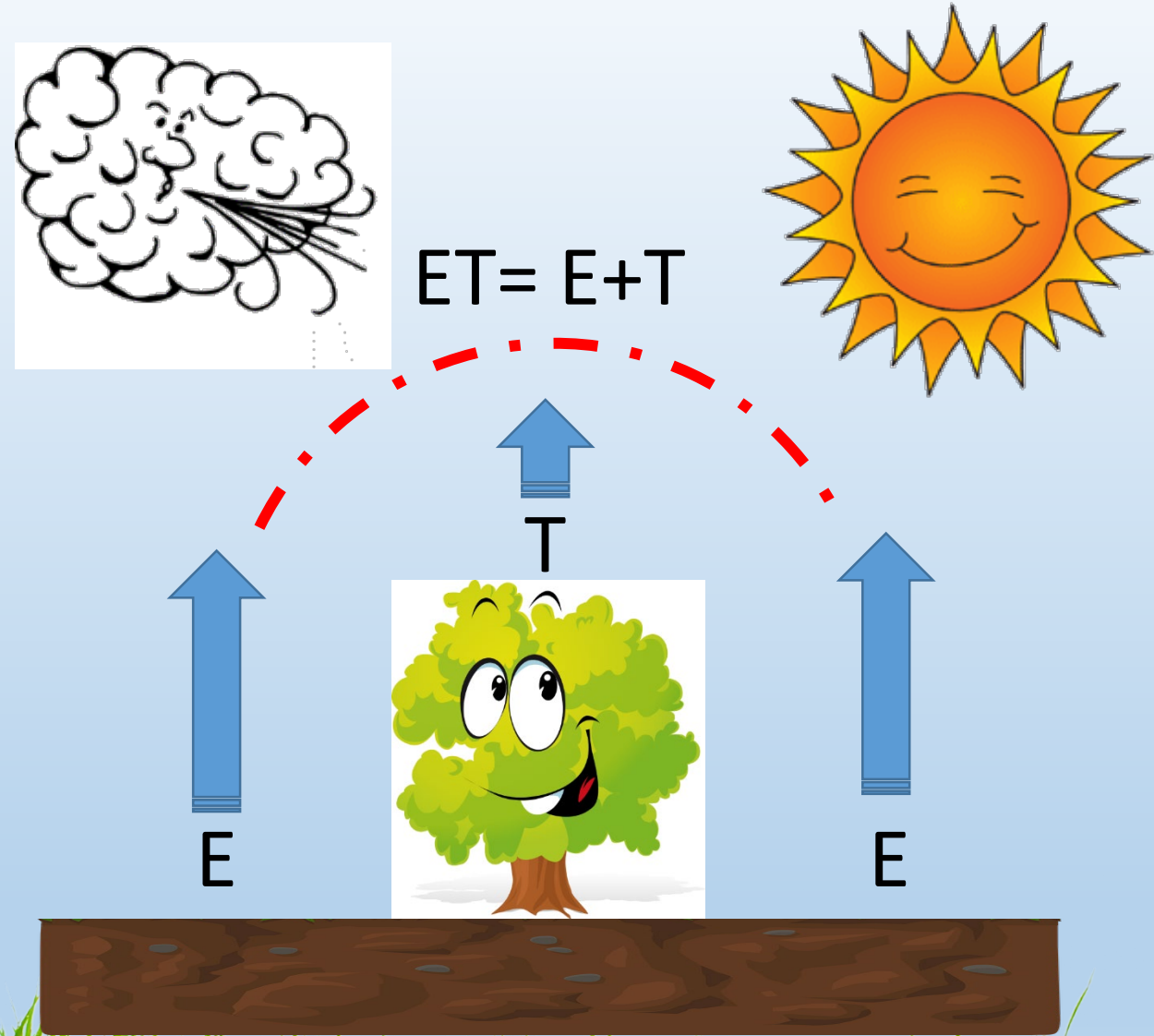
Irrigation association: “*estimate or measure depletion of available plant soil moisture in order to operate an irrigation system*”

Irrigation timer + Sensor

1. Weather based Smart Irrigation Controllers
2. Soil Moisture Sensor based Smart Irrigation Controllers



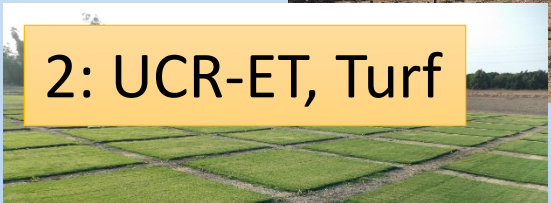
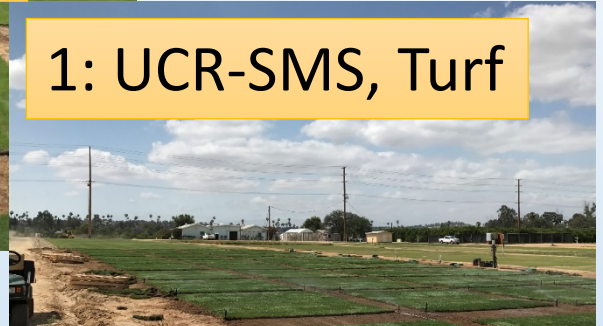
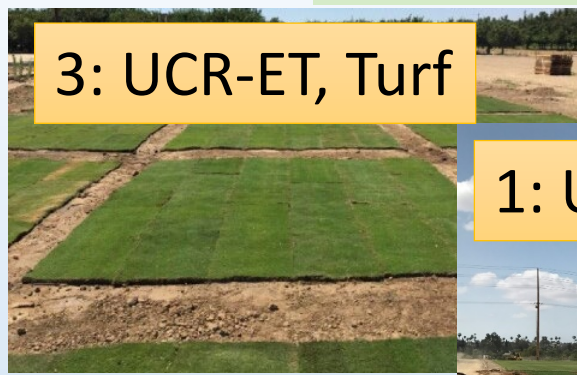
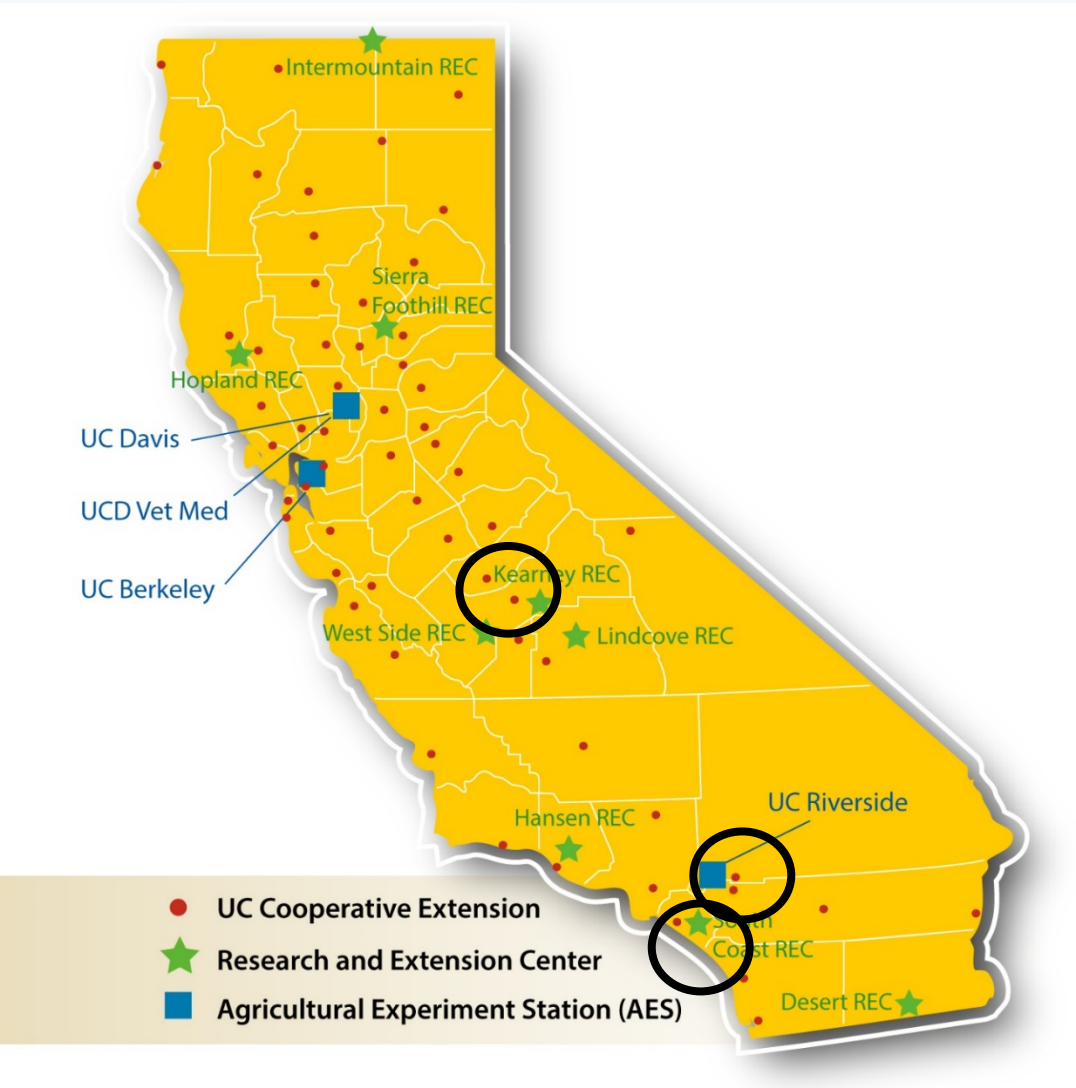
Weather based Smart Controllers



Soil Moisture based Smart Controllers

- ✓ Adjust and apply irrigation based on soil moisture data
- ✓ Eliminate the unnecessary irrigation applications





ET, Turf

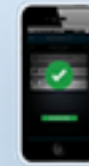
- 72 plots (12 feet * 12 feet)
- 2-3 feet border between plots
- Tall fescue and Bermudagrass
- 6 irrigation levels: 100% ET – 50% ET
- 2 frequencies: 5 days per week, 3 days per week



ET, Turf



SmartLink Aircard with Flow



Log In



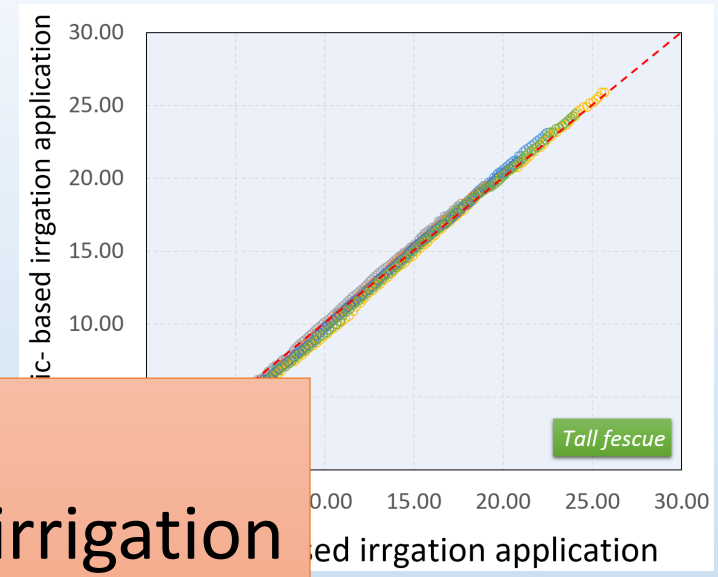
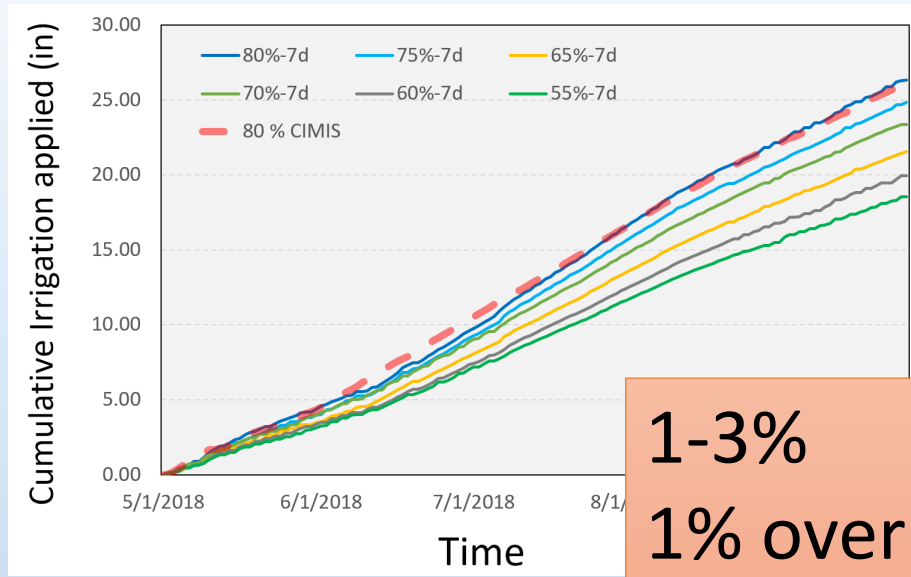
SmartLink™
Wireless Landscape Network

ET, Turf

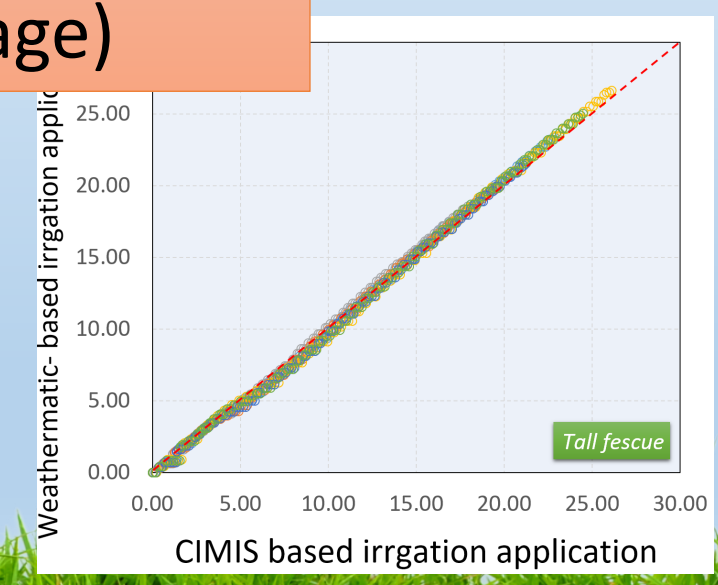
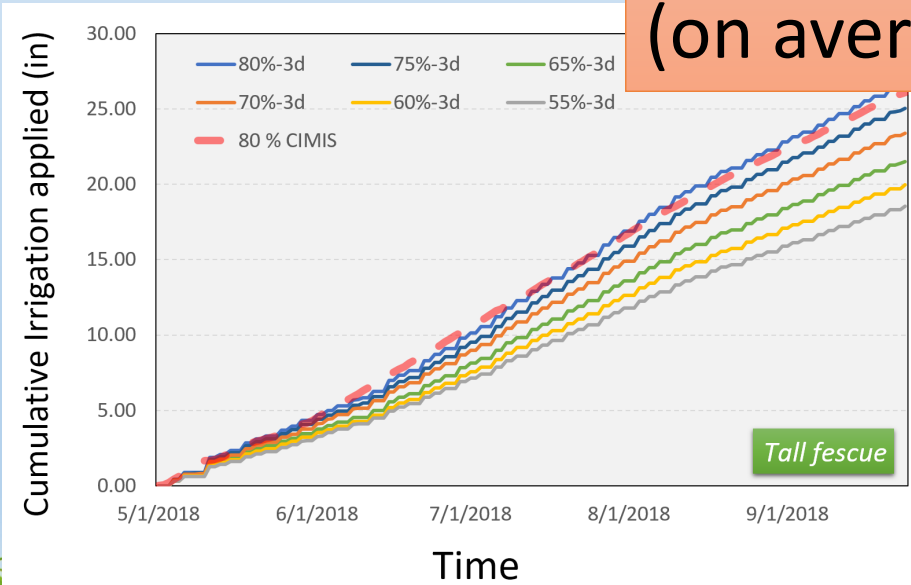
UCR 2018

7 day week⁻¹

3 day week⁻¹



1-3%
1% over irrigation
(on average)

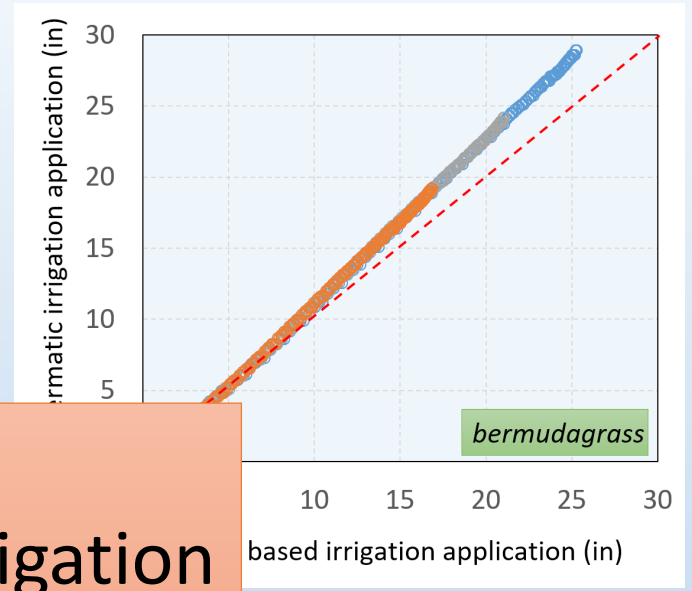
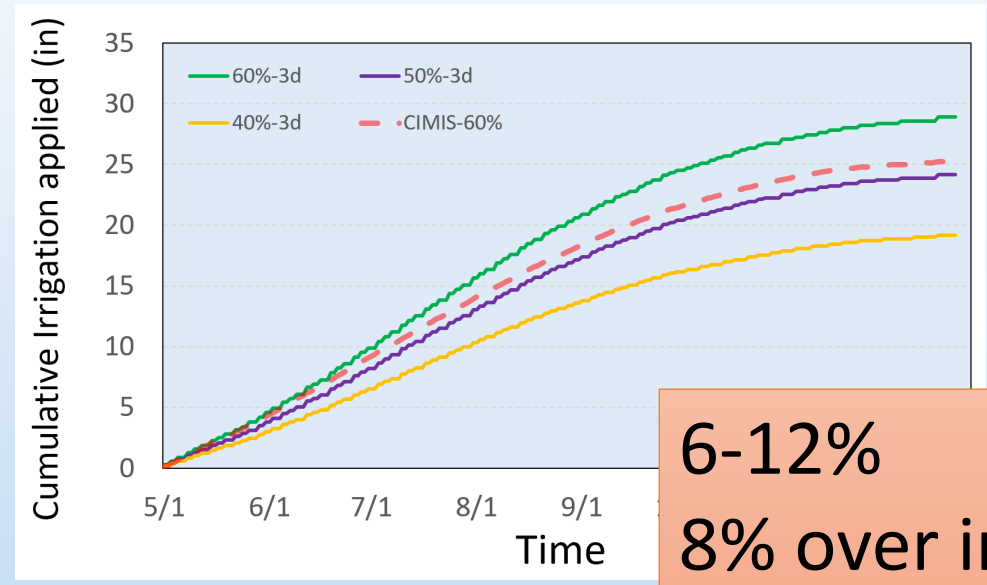


ET, Turf

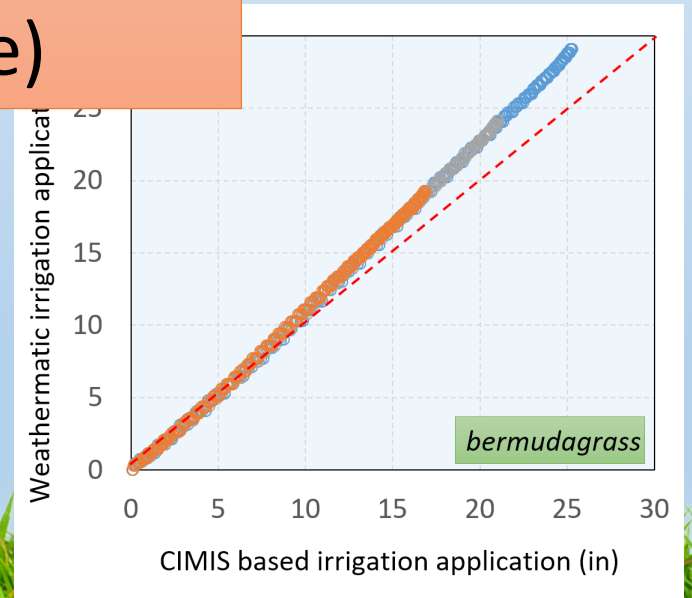
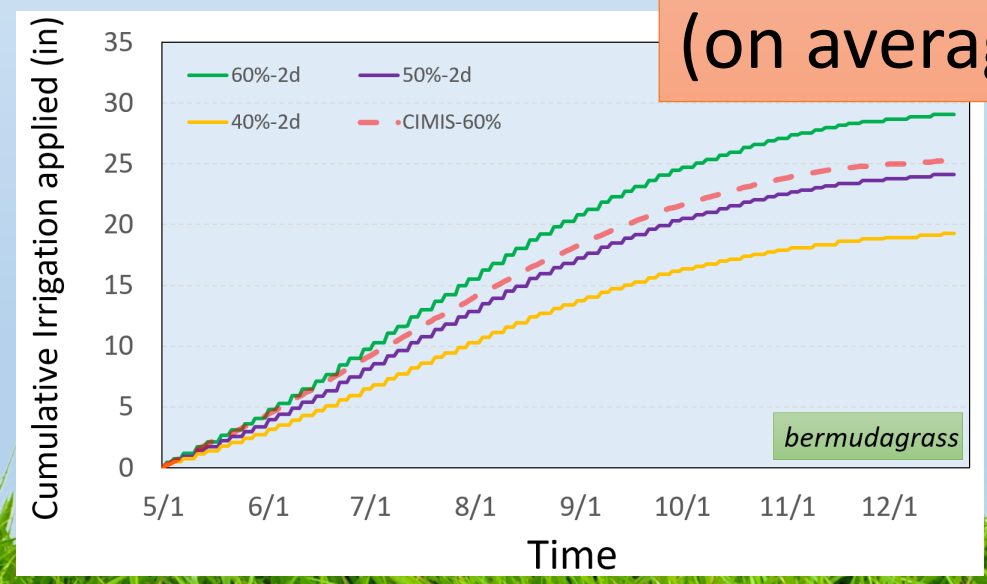
KARE 2018

3 day week⁻¹

2 day week⁻¹

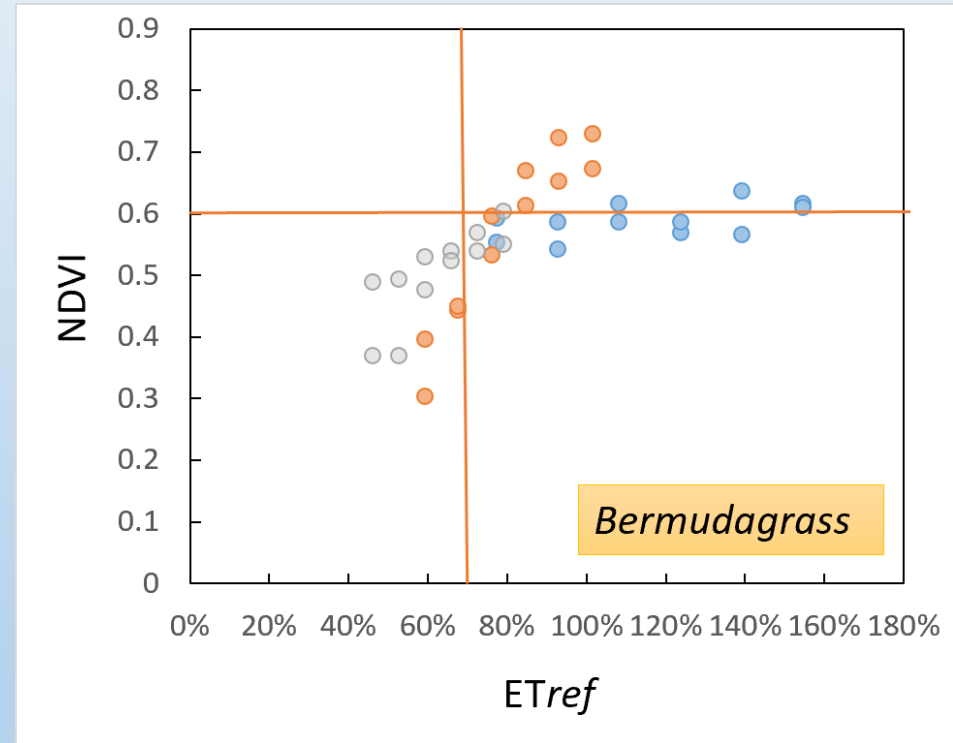
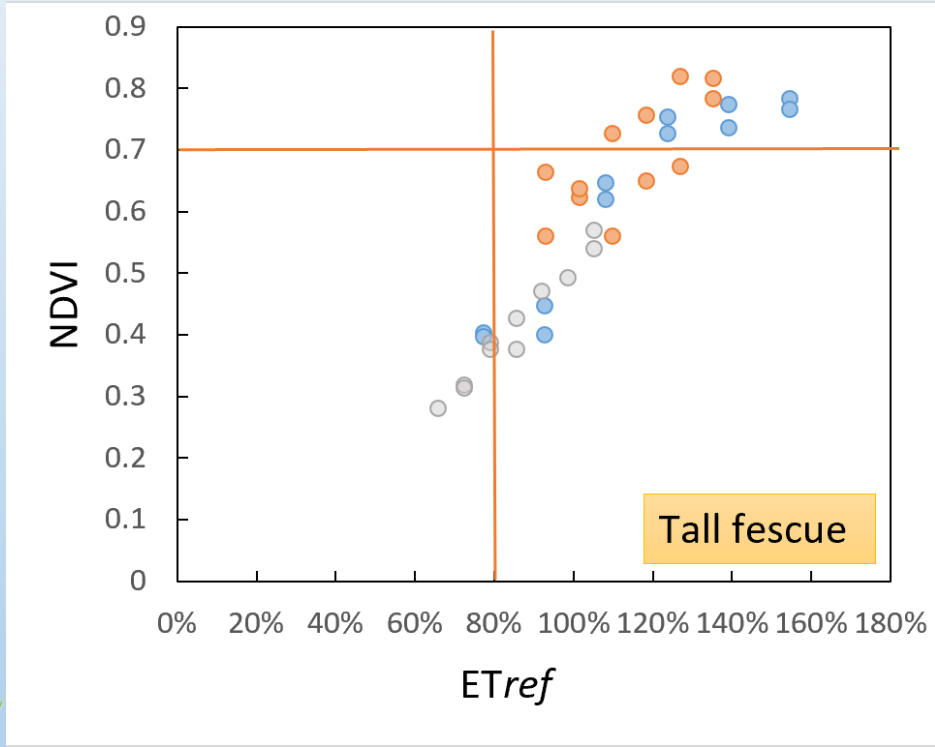


6-12%
8% over irrigation
(on average)



ET, Turf

NDVI (2017, 2018, 2019)



SCREC-SMS, Turf

- 48 plots with Warm season (*bermudagrass*)
- Randomized complete block design
- UC ANR South Coast Research and Extension Center, Irvine
- Recycled water for Irrigation

Treatment	Lower limit	Upper limit	Watering days
1	75%FC	FC	3days/week
2	65%FC	FC	
3	65%FC	FC-10%	
4	55%FC	FC	
5	55%FC	FC-20%	
6	75%FC	FC+10%	
7	75%FC	FC	7days/week
8	65%FC	FC	
9	65%FC	FC-10%	
10	55%FC	FC	
11	55%FC	FC-20%	
12	75%FC	FC+10%	



SCREC-SMS, Turf

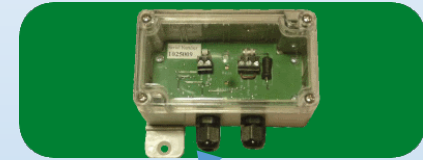
Acclima CS3500 2-Wire Controller
Zone Decoder



Ethernet Adapter



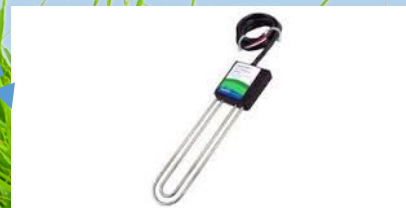
Rain-Freeze Switch

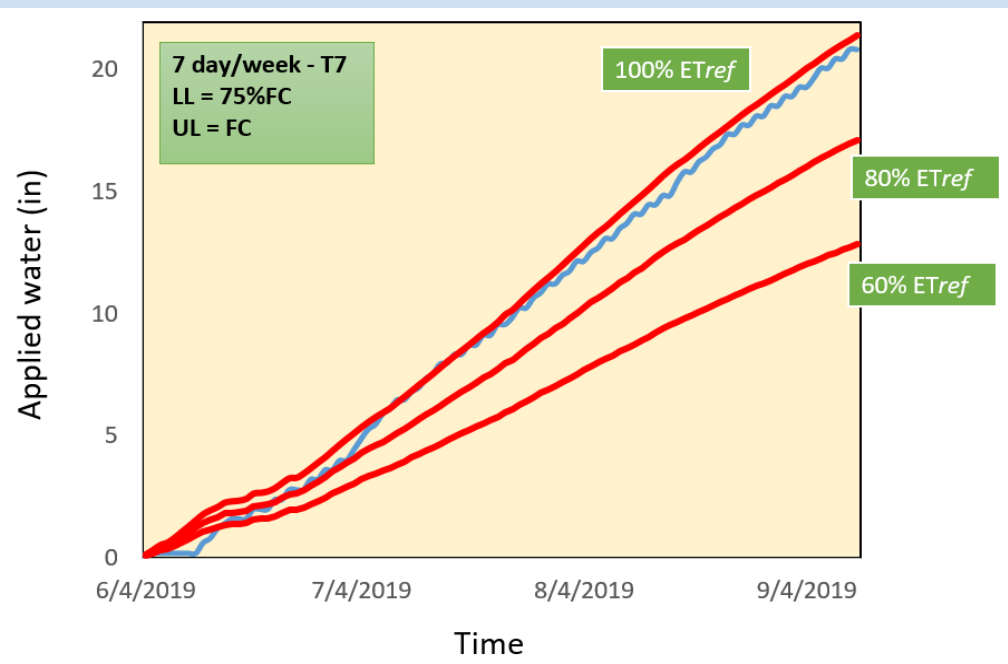
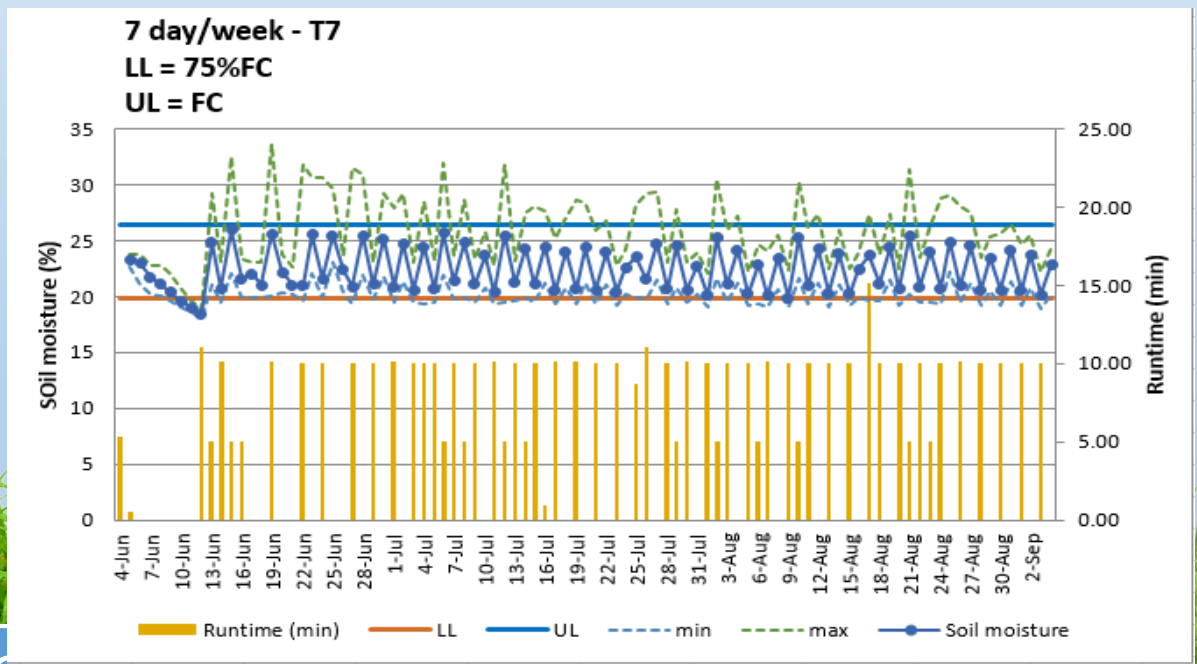
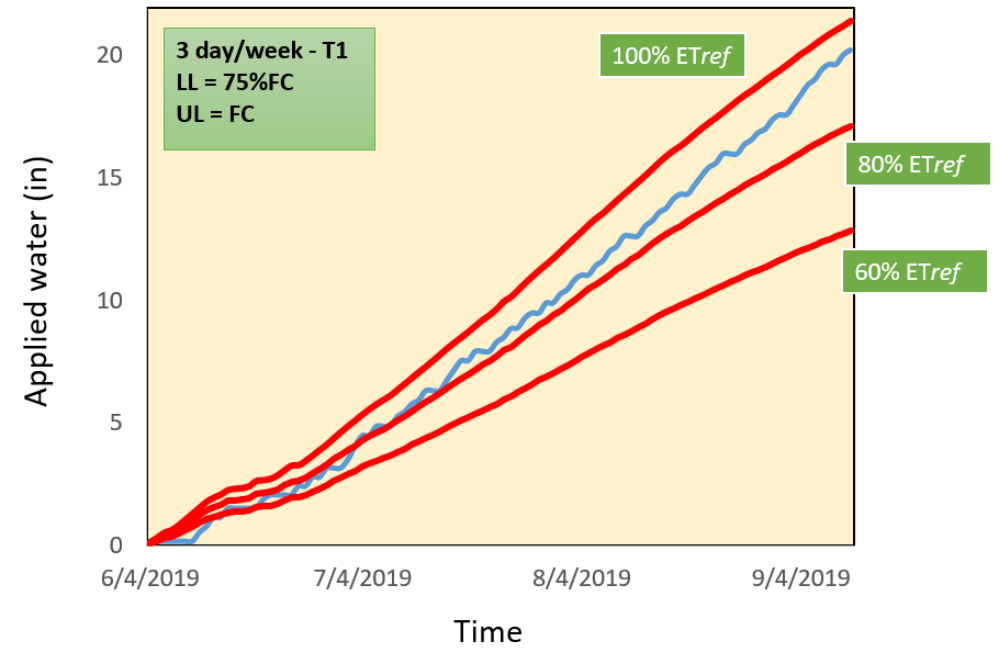
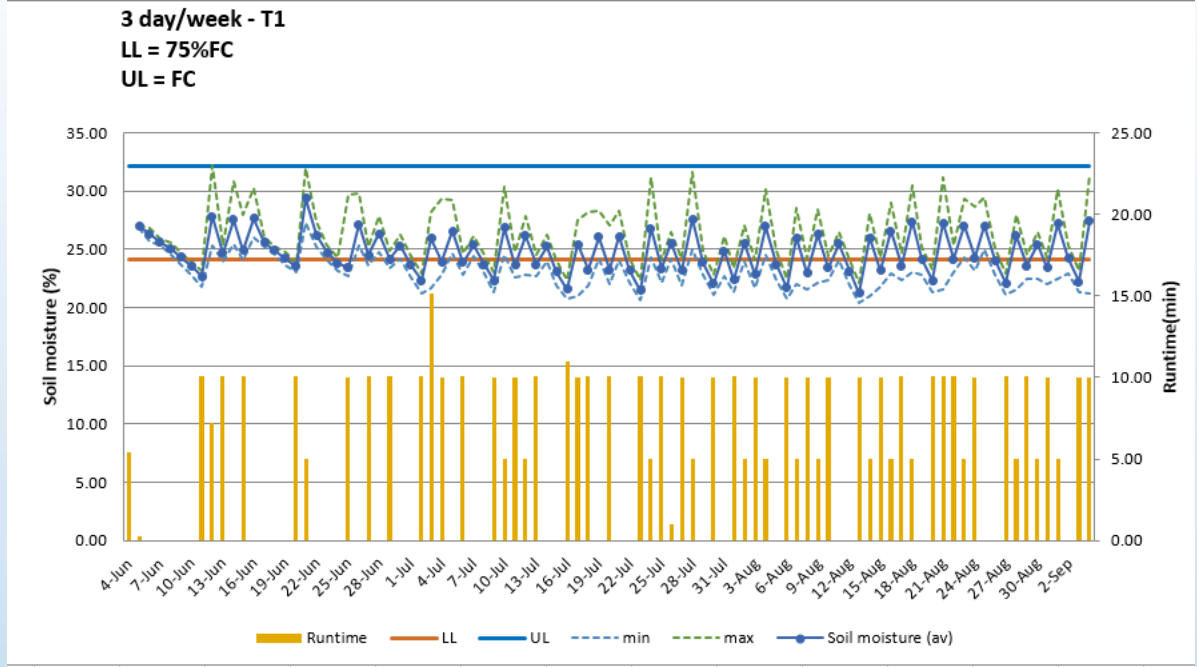


Hydrometer Integrated Flowmeter



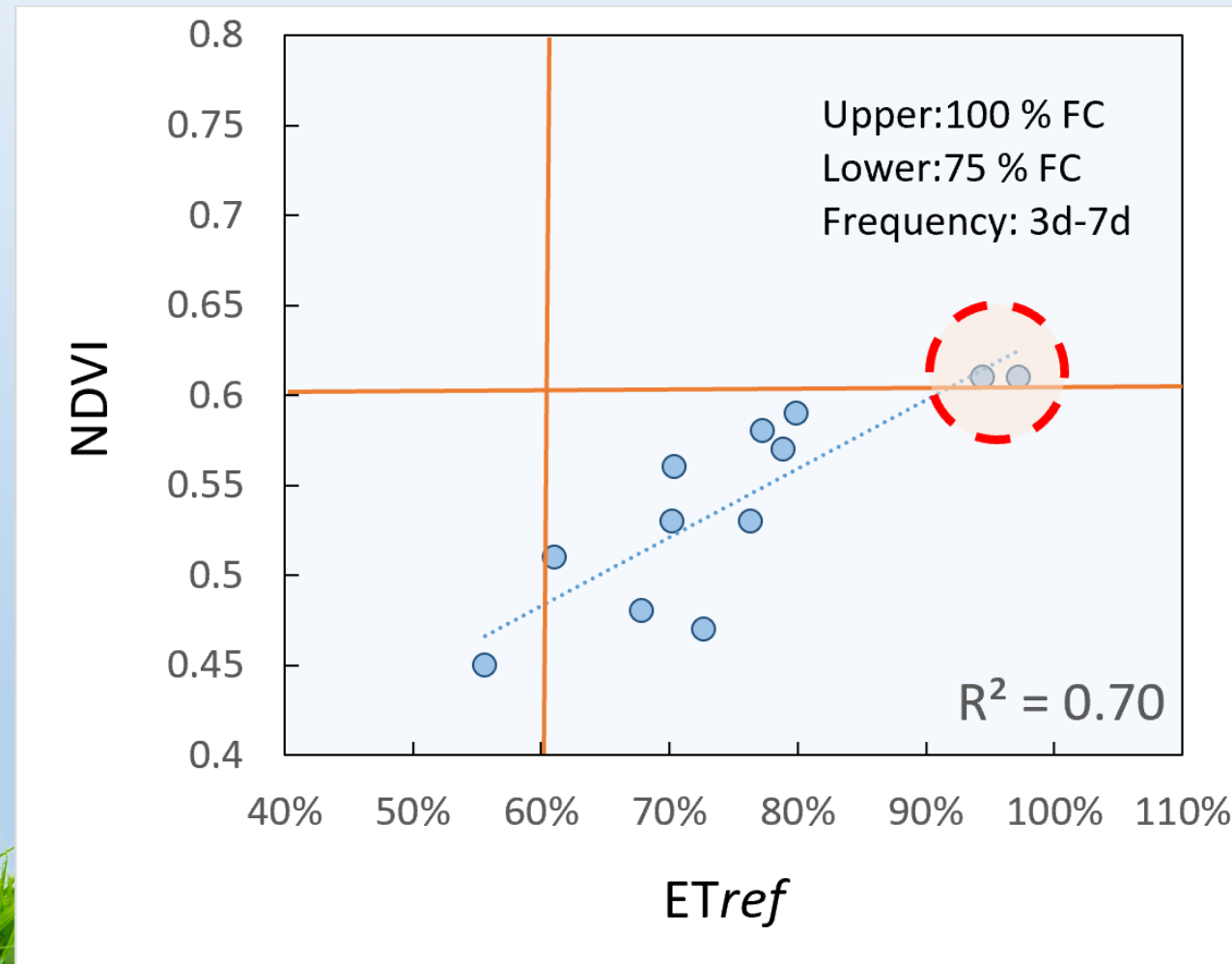
2 Wire TDT sensor





SCREC-SMS, Turf

9/13/2019 (~100 days after initiation of the project)



UCR-SMS, Turf



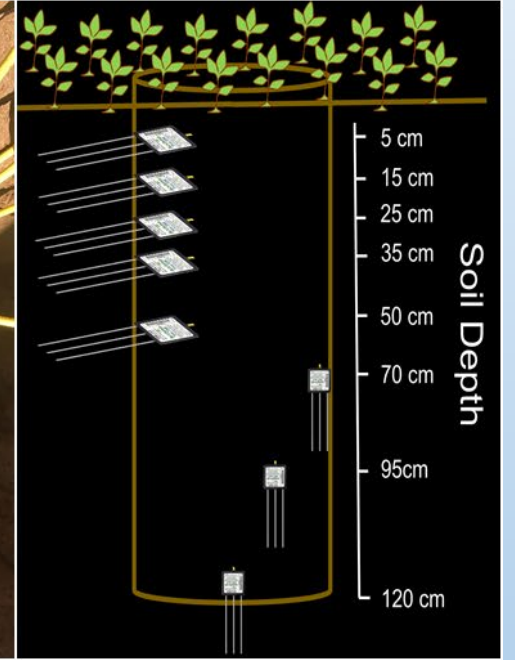
Groundcover irrigation study

- Twelve landscape species
- Four irrigation treatments
- Three replications
- Randomized complete block design



Groundcover irrigation study

- Comprehensive network of time domain reflectometer sensors (TDR; 288 sensors in total)



Groundcover irrigation study

- Handheld tools



a) NDVI

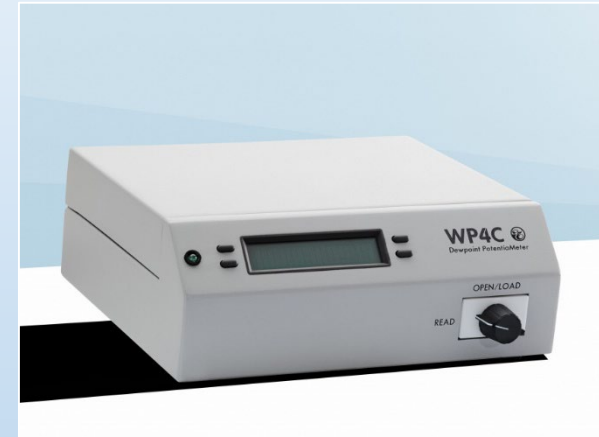
b) Canopy temperature



c) Stomatal conductance



d) Leaf area index



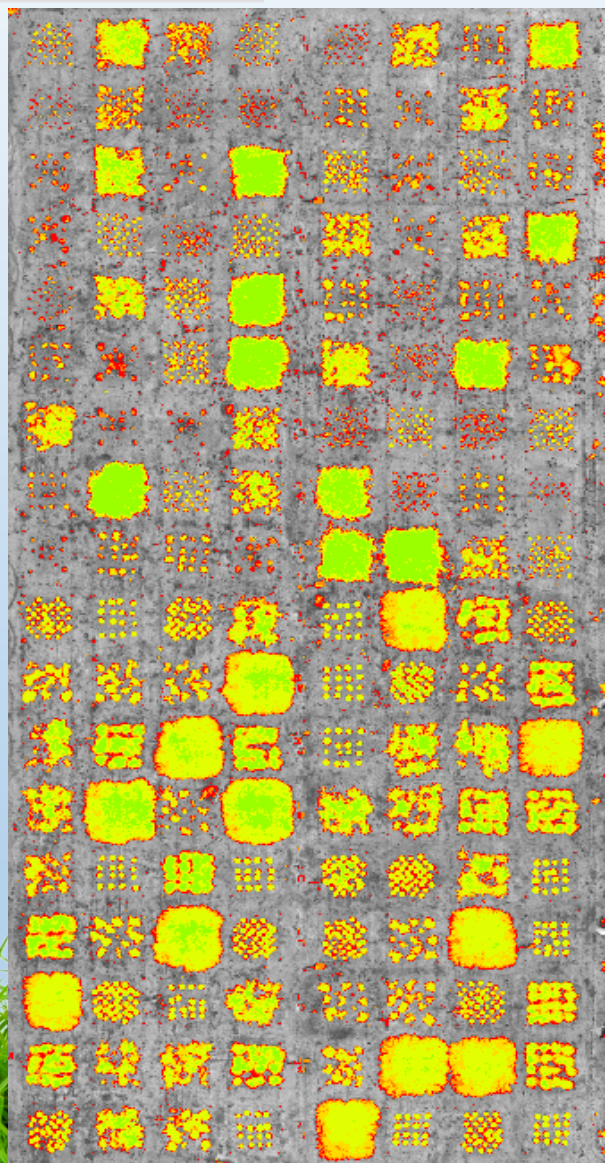
e) Leaf water potential

- Aerial images

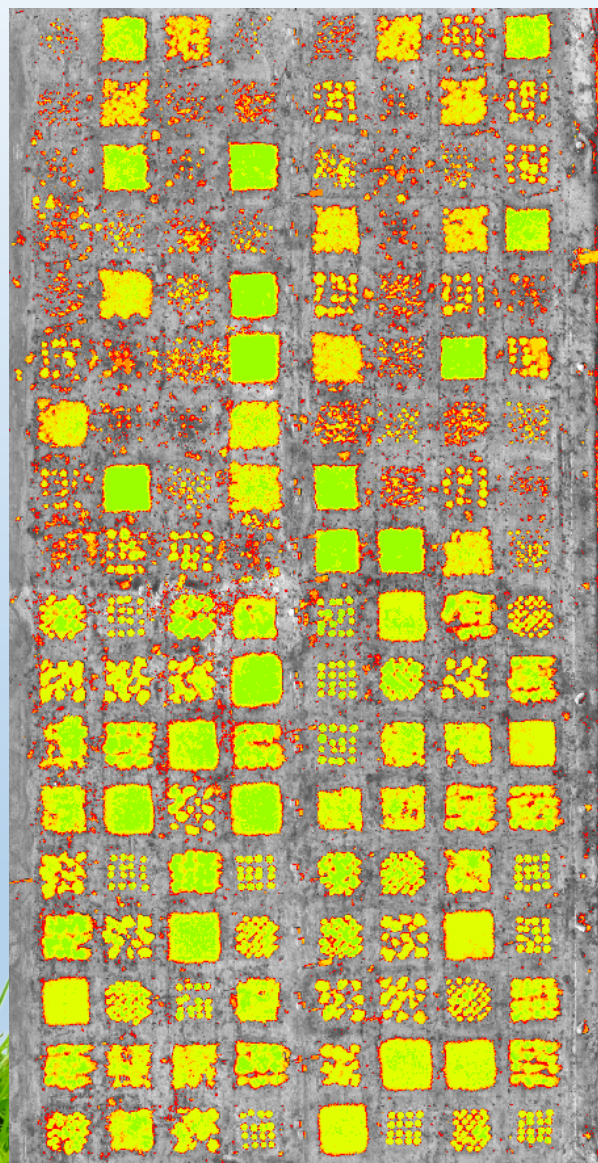


f) Multispectral & thermal remote sensing images

Groundcover irrigation study



07-16-2019



08-21-2019

Legend:
NDVI Values

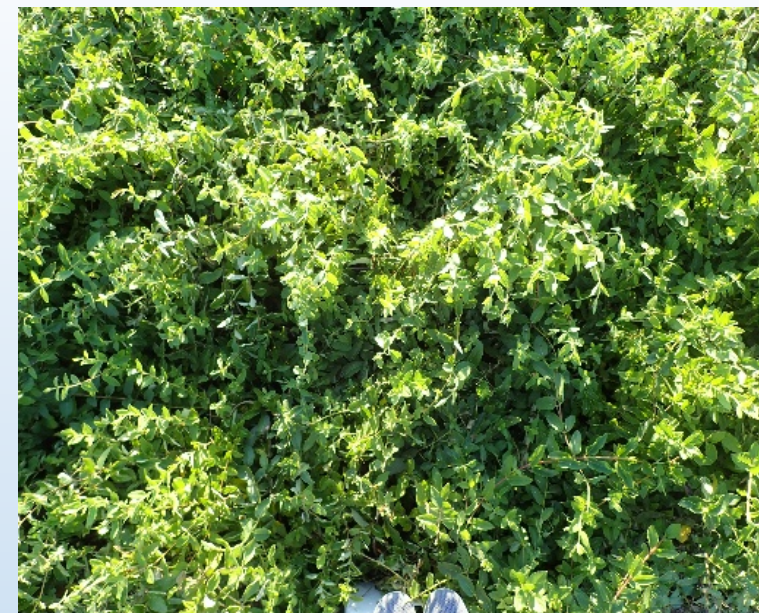
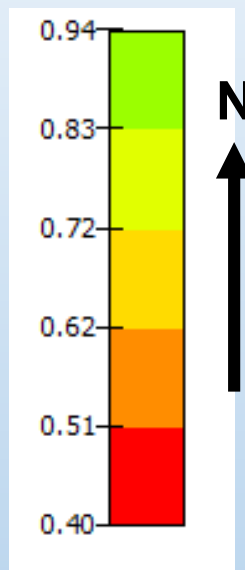


Fig: Lonicera japonica



Fig: Frankenia thymifolia

