

# Irrigation Management Tools and Information under Development in California Avocados



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## Effective irrigation scheduling requires knowledge of:

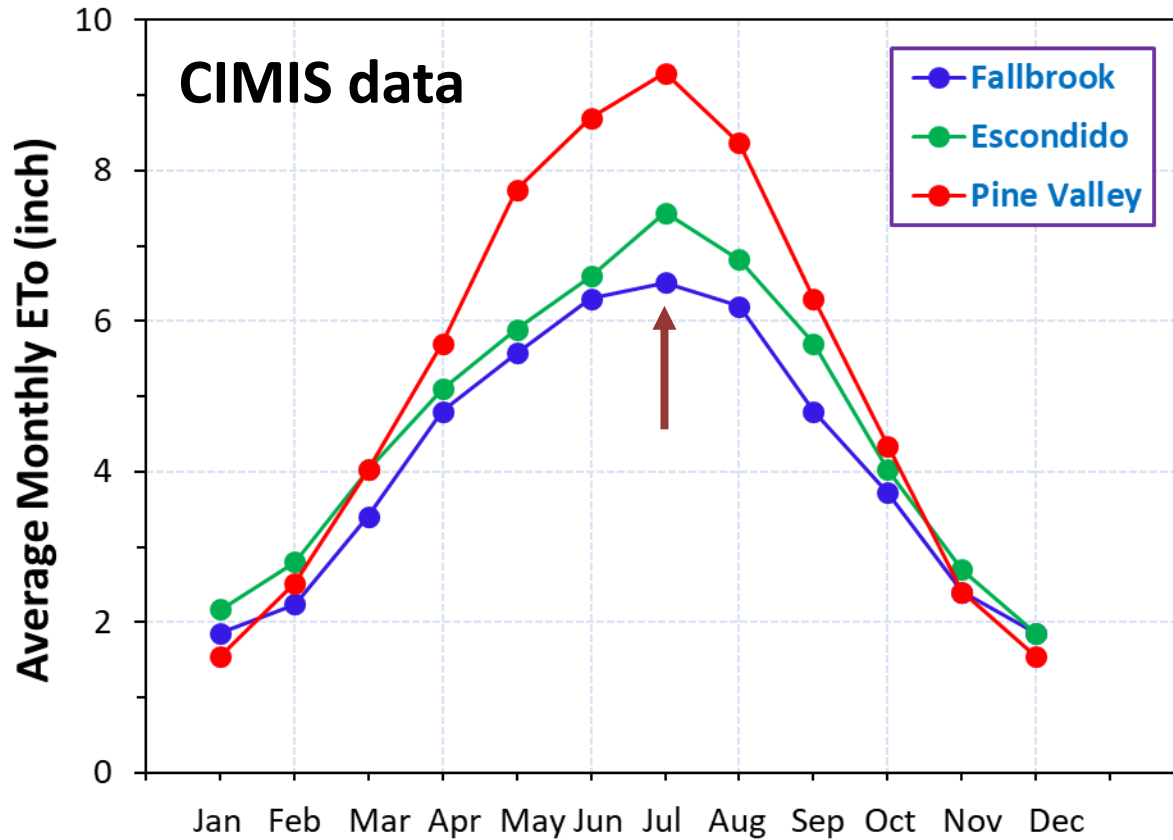
- Soil water-holding capacity
- Crop sensitivity to water stress
- Irrigation and effective rainfall received

Soil type	Avail. Water (in/ft)	Ave. Allow. Depl. (in/ft)	Ave. Allow. Depl. 3 ft. zone (in)
Sandy loam	1.25-1.40	0.66	<b>2.0</b>
Silty clay loam	1.80-2.00	0.95	<b>2.9</b>

- Available soil water content (soil water status)
- Crop water needs or evapotranspiration (ET)



# Different Irrigation water needs in San Diego County



**In July**  
 water needs in Pine Valley could be 40% and 25% more than Escondido and Fallbrook, respectively.

Lemon orchard with tree spacings of 20' × 14'

**In July**

- Fallbrook: 0.21 in/day= 38 gallon/day/tree
- Escondido: 0.24 in/day= 43 gallon/day/tree
- Pine Valley: 0.31 in/day= 54 gallon/day/tree



# Irrigation Scheduling Calculator

English  Español

[Principles of Irrigation](#) Select a Crop:

[Kc Source:](#)   English Units  Metric Units

[Reference Evapotranspiration \(ET<sub>0</sub>\):](#)  in./day or period [Data Source:](#)

[Crop Coefficient \(Kc\):](#)  Get Kc for a month

[Distribution Uniformity \(DU\):](#)  %

[Leaching Requirement \(LR\):](#)  %



Method:  Trees per Acre:   Tree Spacing  by  ft.

Number of Emitters per Tree:

Surface area under tree canopy (ft<sup>2</sup>):  (enter only when surface area covered by canopy is less than 65%)

Emitter Output (Gal/Hour):

Grove Size (acres):

All fields with yellow boxes must be filled out, white fields are optional.

Click on 'Calculate' after any changes are made to recompute totals.

Water per tree per day or period:  gallons

Watering time per tree per day or period:  hours,  minutes

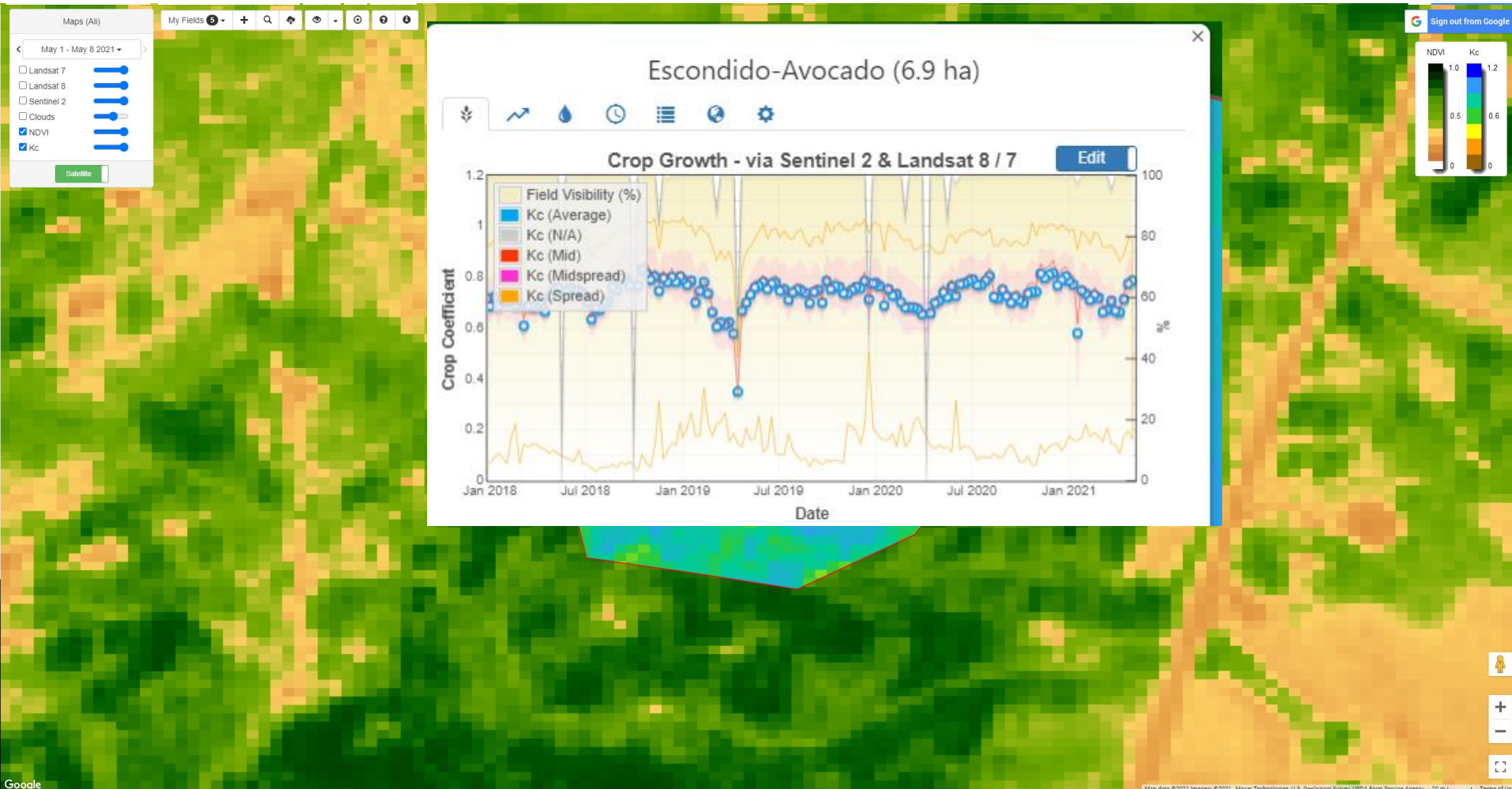
Total Water Requirements for Grove:  gallons

Allocated Water for Grove:  gallons

Shortfall:  gallons


# Using satellite NDVI - IrrisAT


- Landsat & Sentinel 2
- Designed to be used for farmers – very user friendly
- Data Source: <https://irrisat-cloud.appspot.com/#>

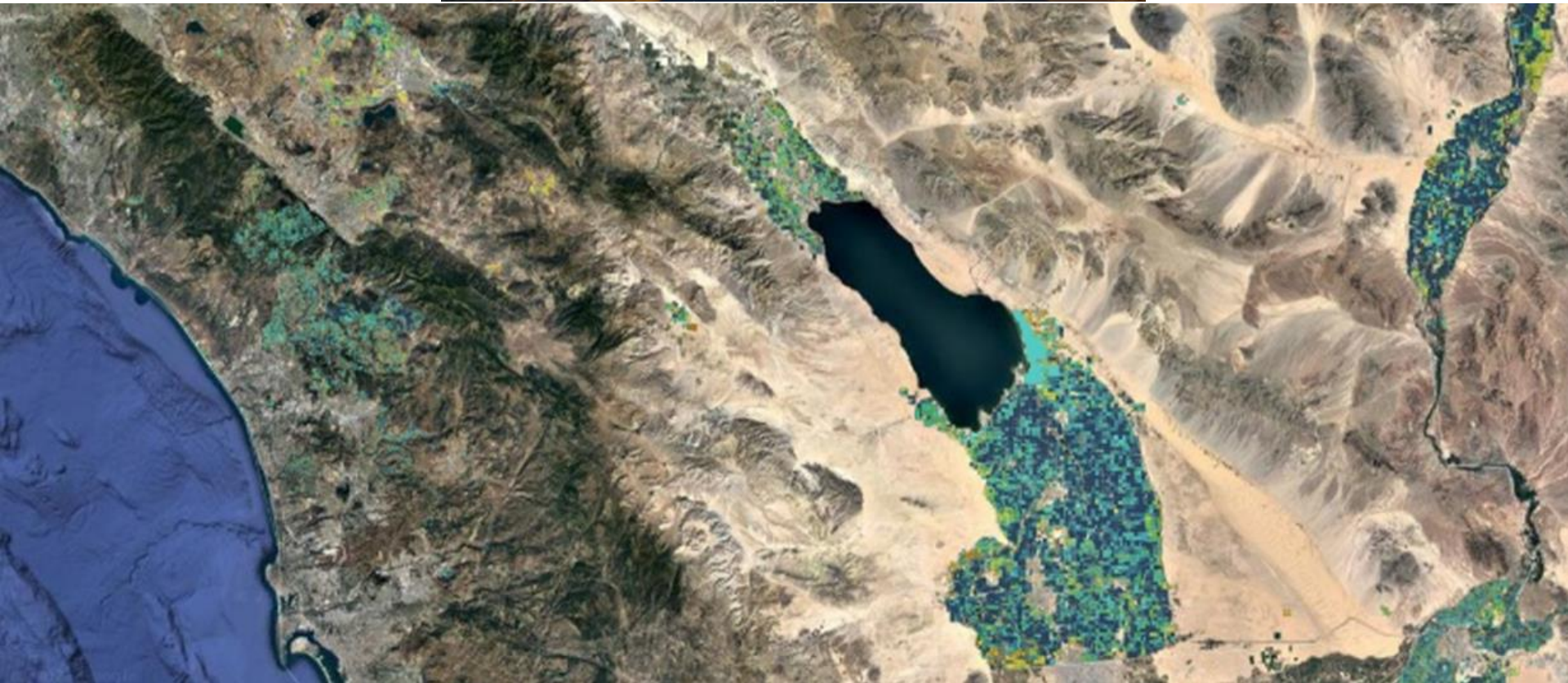


# OPENET

OpenET uses best available science to provide easily accessible satellite-based estimates of evapotranspiration (ET) for improved water management across the western United States. Using the Data Explorer, users can explore ET data at the field scale for millions of individual fields or at the original quarter-acre resolution of the satellite data.

 Explore Data

 View Video





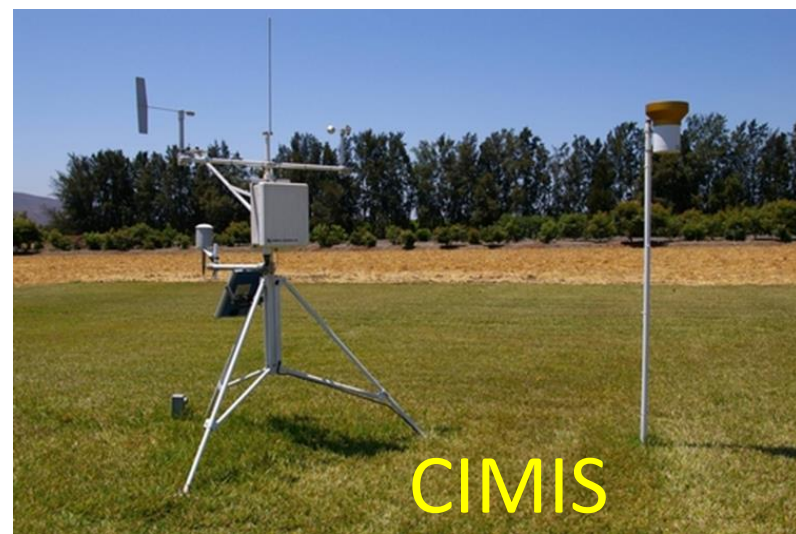
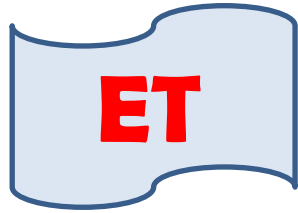
# Inexpensive soil moisture sensors Tensiometer & Watermarks



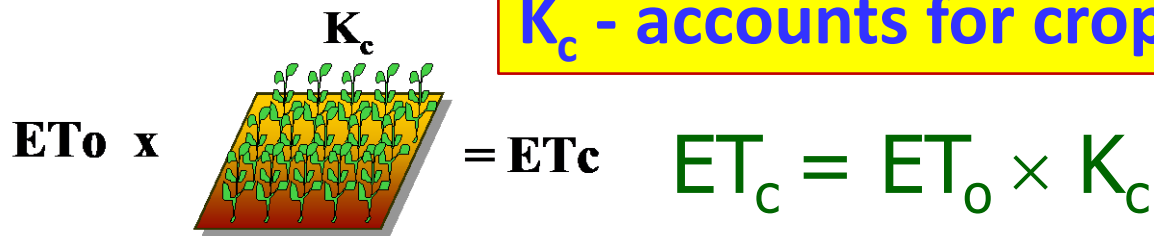
# Telemetry devices (IRROmesh)



# Crop Water Use



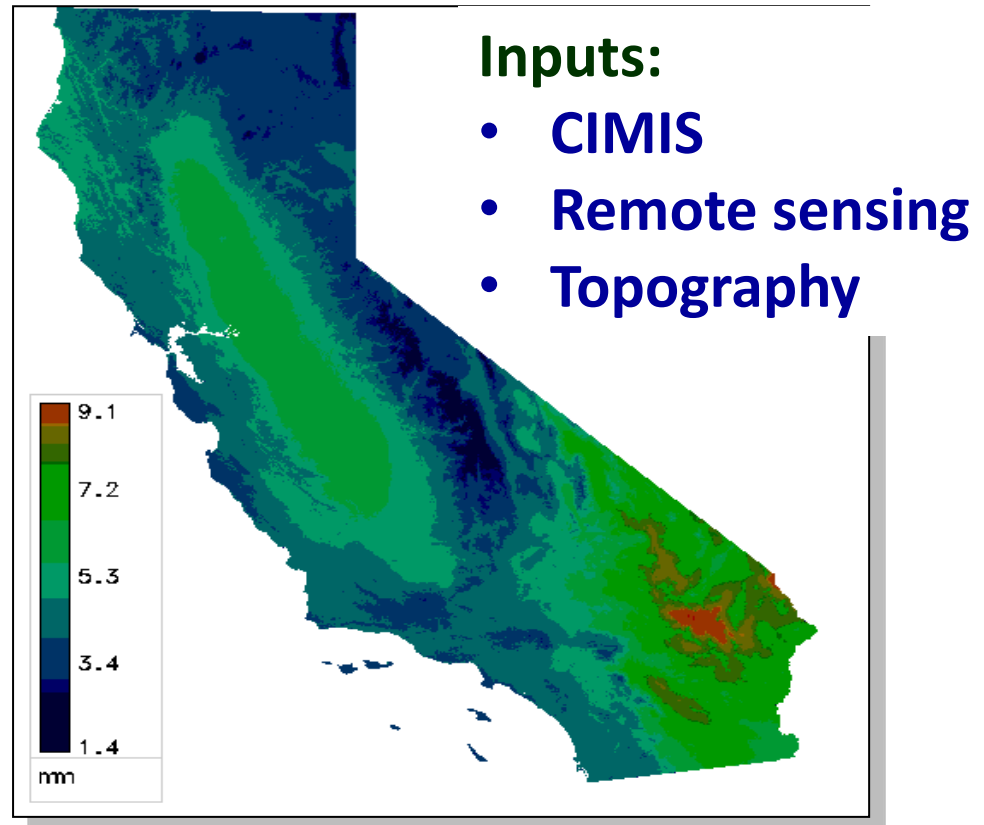
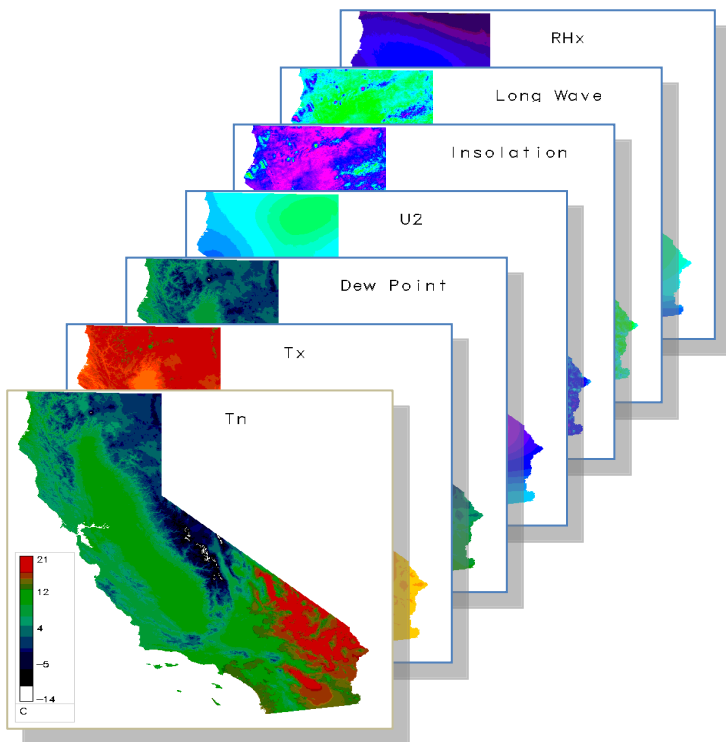
**$K_c$  - accounts for crop**



Months	Kc's
Jan	0.40
Feb	0.50
Mar	0.55
Apr	0.55
May	0.60
Jun	0.65
Jul	0.65
Aug	0.65
Sep	0.60
Oct	0.55
Nov	0.55
Dec	0.50

# ET<sub>o</sub>: Spatial CIMIS

- ❖ Couples remotely sensed data from GOES satellite with point measurements from CIMIS stations to estimate ET<sub>o</sub>.
- ❖ Provides daily maps of ET<sub>o</sub> at 2-km grid.





## Spatial Report by Coordinate

### Spatial Report

This report provides daily ETo and Solar Radiation data at a 2 km resolution. Spatial Report data covers from 2/20/2003 to yesterday's date. Reports are available in several data formats and in English or Metric units. You may specify date ranges and zip codes, map coordinate points, or [data search by address](#). Bing Map tools to center the page on California, recall previously selected points, and clear selected points are also available at the bottom-right.

Create a  in  from  to  using

Run Report

### Address Search

Search to add locations to the coordinate list or double-click the map interface. (ex: 1315 10th St, Sacramento, CA 95814)

### Coordinate List

You must click the "Save Coordinates" button to keep your selection in your coordinate list.

- 92250, CA(32.7904, -115.4262)
- (empty)
- (empty)
- (empty)
- (empty)
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- (empty)





## Graphical Forecasts

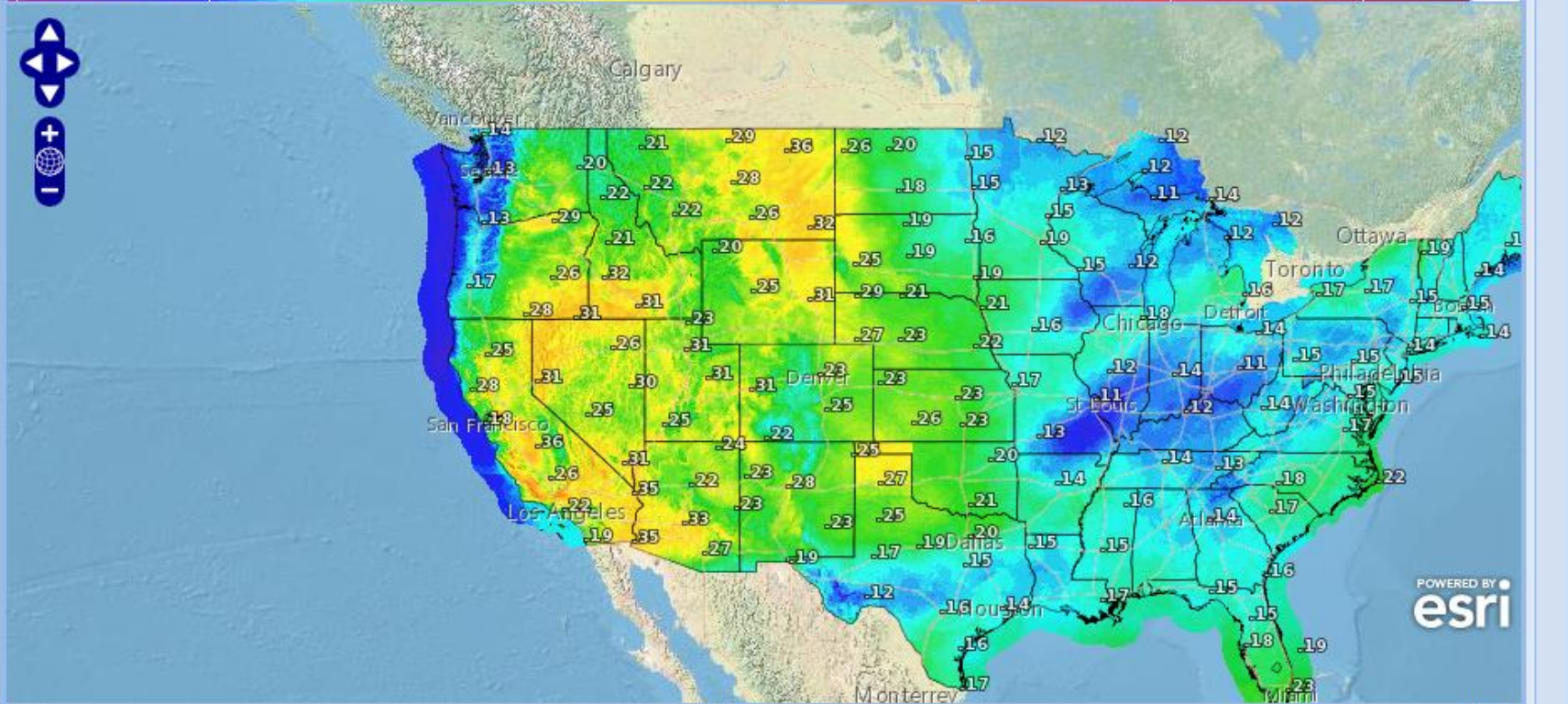
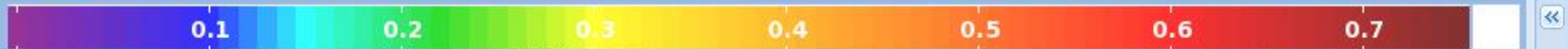
National Weather Service  
National Headquarters

Weather.gov - National Digital Forecast Database Graphical Forecasts

# FRET (Forecast ET<sub>0</sub> for next 7 days)

National Digital Forecast Database Display

ational (CONUS) Daily FRET (in) Ending Sep 3, 5 PM PDT



POWERED BY  
**esri**



Daily FRET (in)  
Through: Sat, Sep 3 2022, 5 PM PDT  
Issued: Sep 03 at 9 AM PDT



# What we need:

More accurate crop coefficient values ( $K_c$ )  
to have a better estimation/forecast of  
crop water needs



Aerial images taken by drone from two avocado sites

## What we do in this project:

- Three-year data collection
- **Working with six mature Avocado sites to represent various climate, canopy features (plant density/tree ages), row orientations, soil types, water sources, and irrigation management practices**

2 sites in Escondido, 2 sites in Temecula, 2 sites in Irvine  
**(450 ft. to 1500 ft. above sea level)**

- **Monitoring towers to measure actual crop water use, soil moisture status, plant water status, NDVI, canopy temperature**
- **Drone evaluations + salinity assessment**
- **Impacts of irrigation regimes**



Avocado grove



Shortwave Radiation  
+  
Longwave Radiation

How much energy is being used to evaporate or transpire water?

Energy used to heat the air or canopy

LE  
Or ET!

$R_n$

H

G

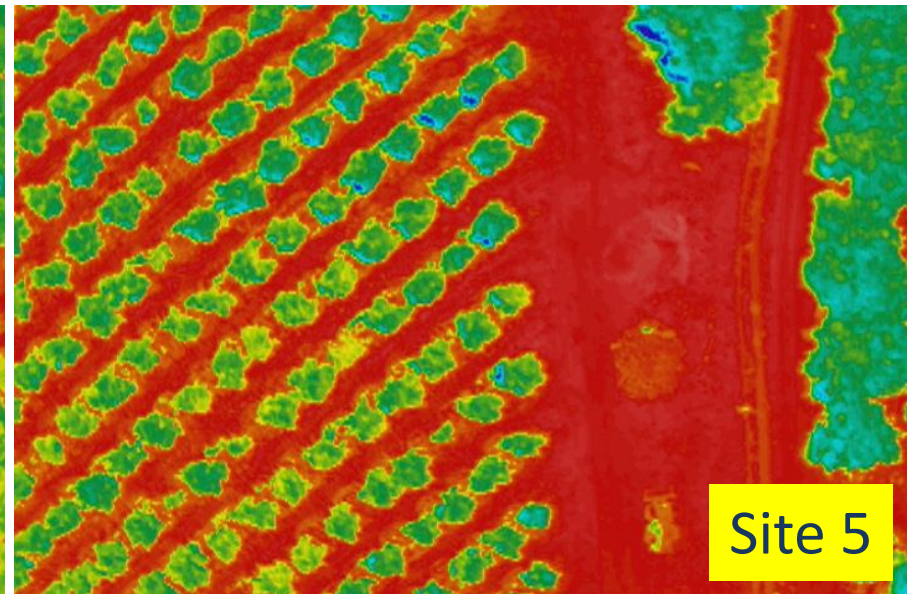
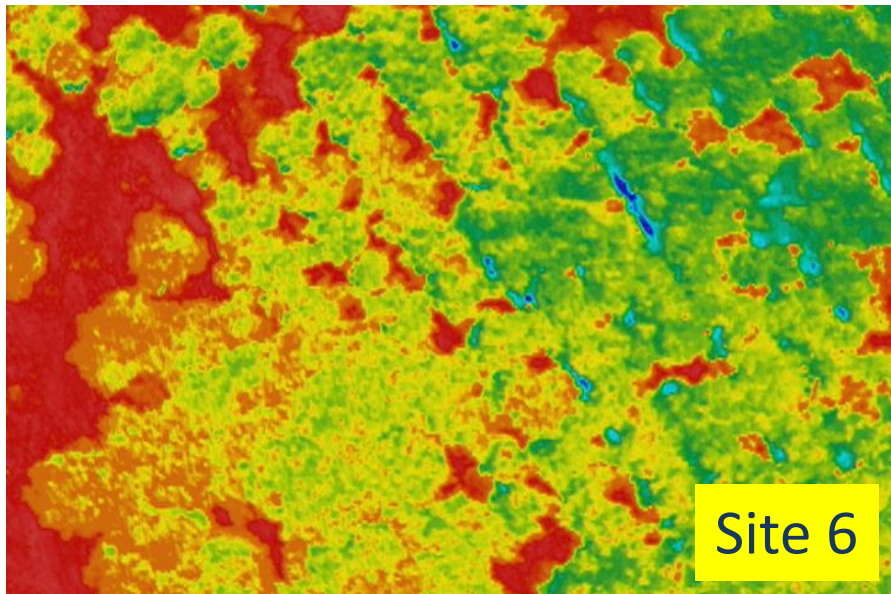
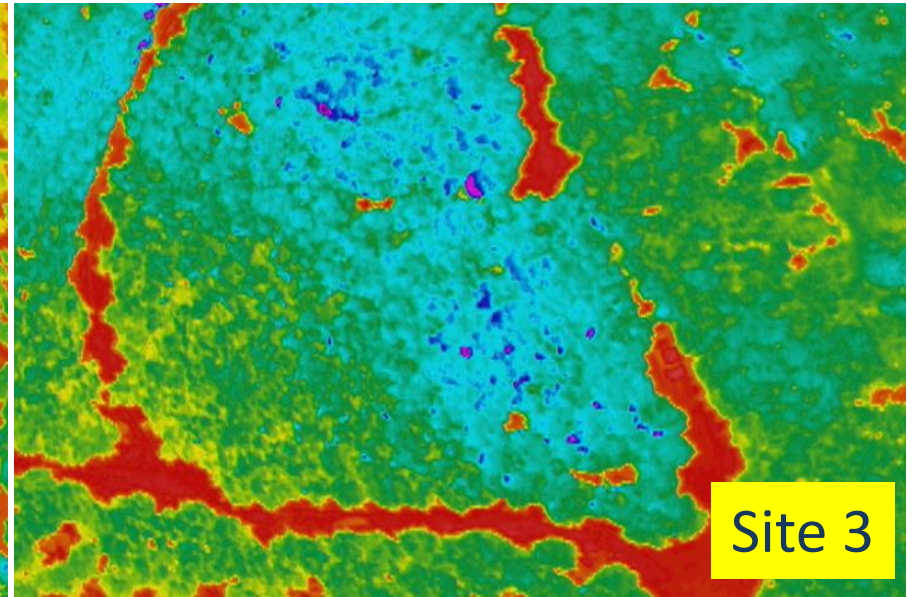
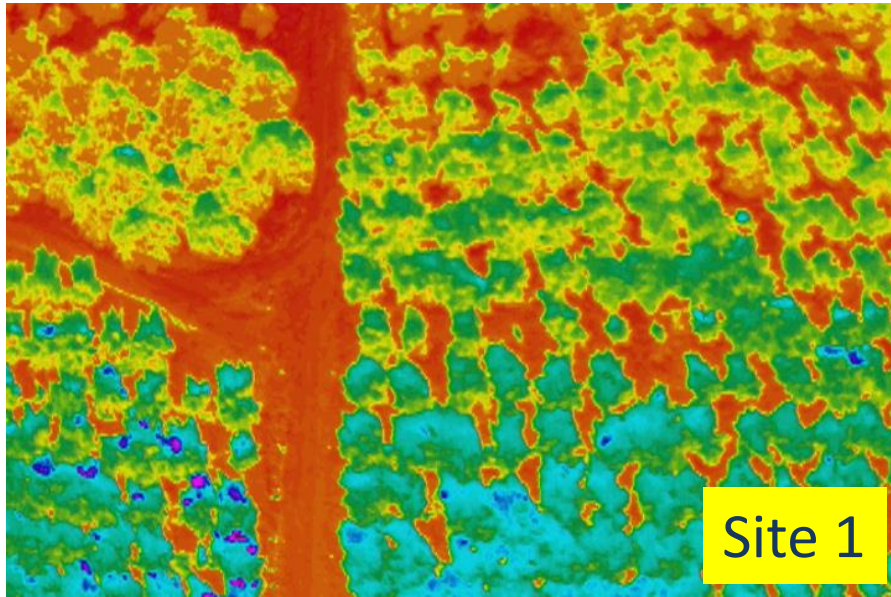
Energy conducted into or out of the ground

$$ET = R_n - (G + H)$$

# Canopy feature of avocado grove makes a difference!



# Thermal images (Week August 8, 2022)



## Canopy temperature measurements (infrared thermometer)

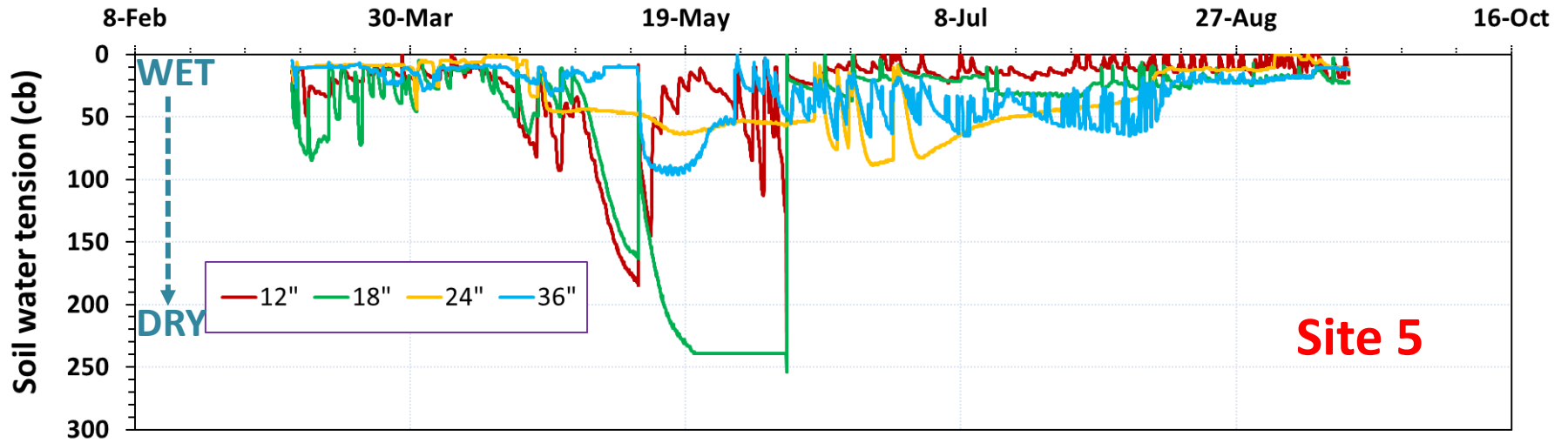




## Insights from an avocado grower:

- We have used Irrrometer sensors as well as the Aquaspy and accumulated a lot of data. After ten years of work, we found soil moisture sensors redundant.
- We have found the Spatial CIMIS input into our Irrigation Decision Support Tool more useful.

# Soil moisture data



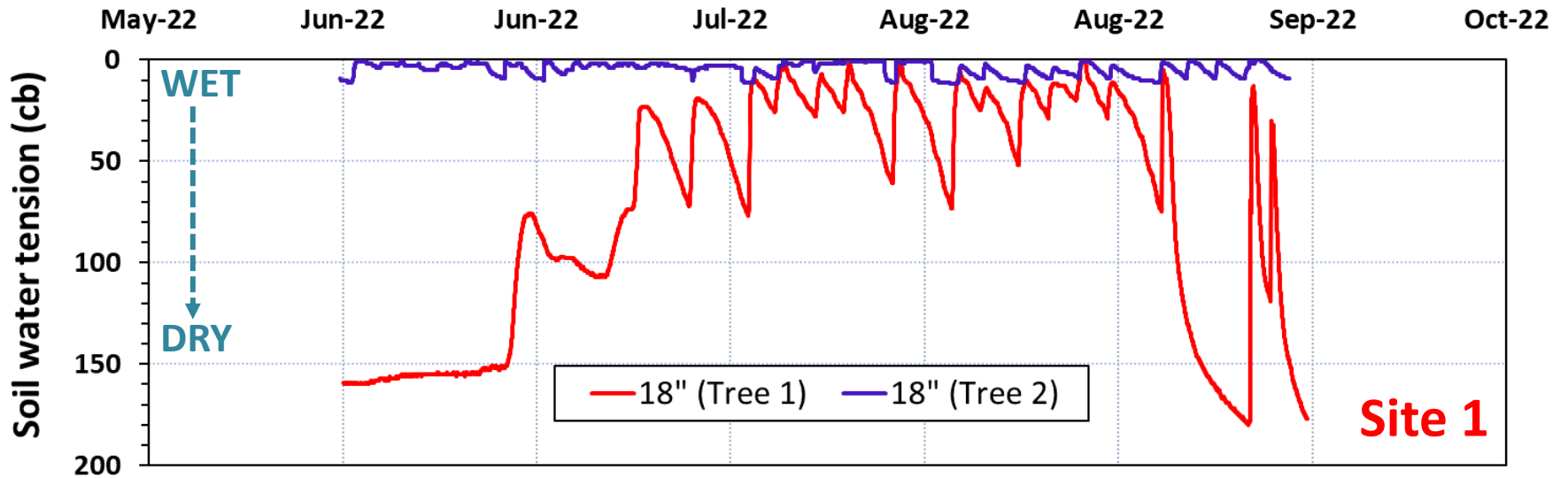
Site 5



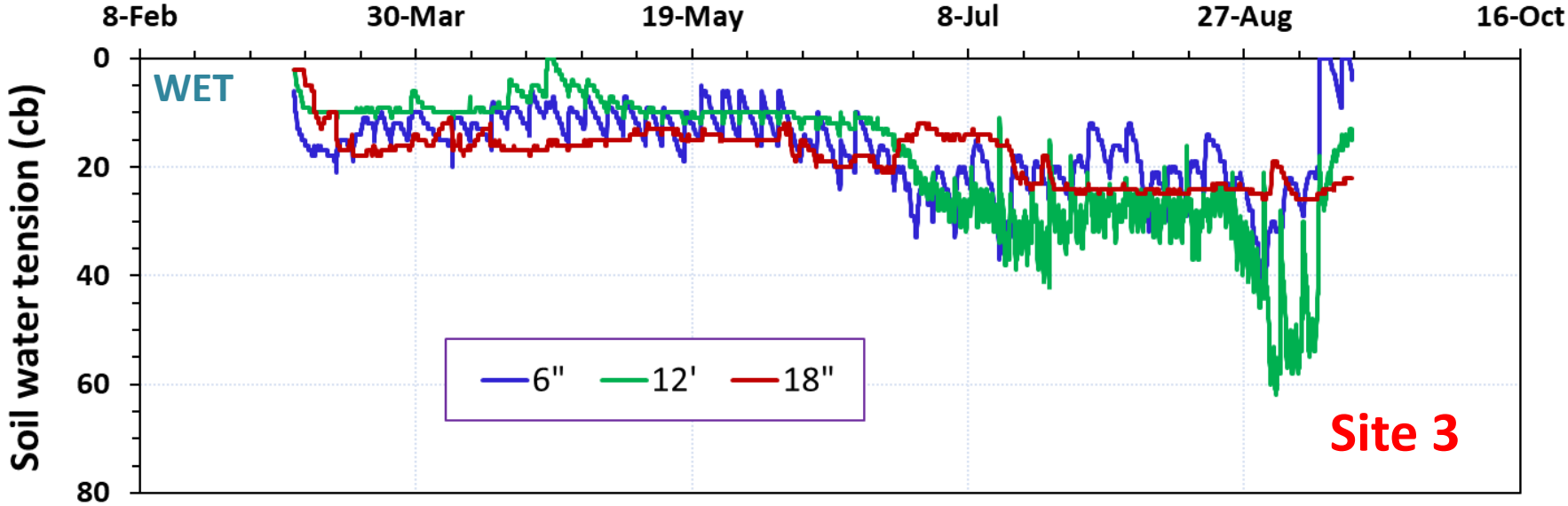
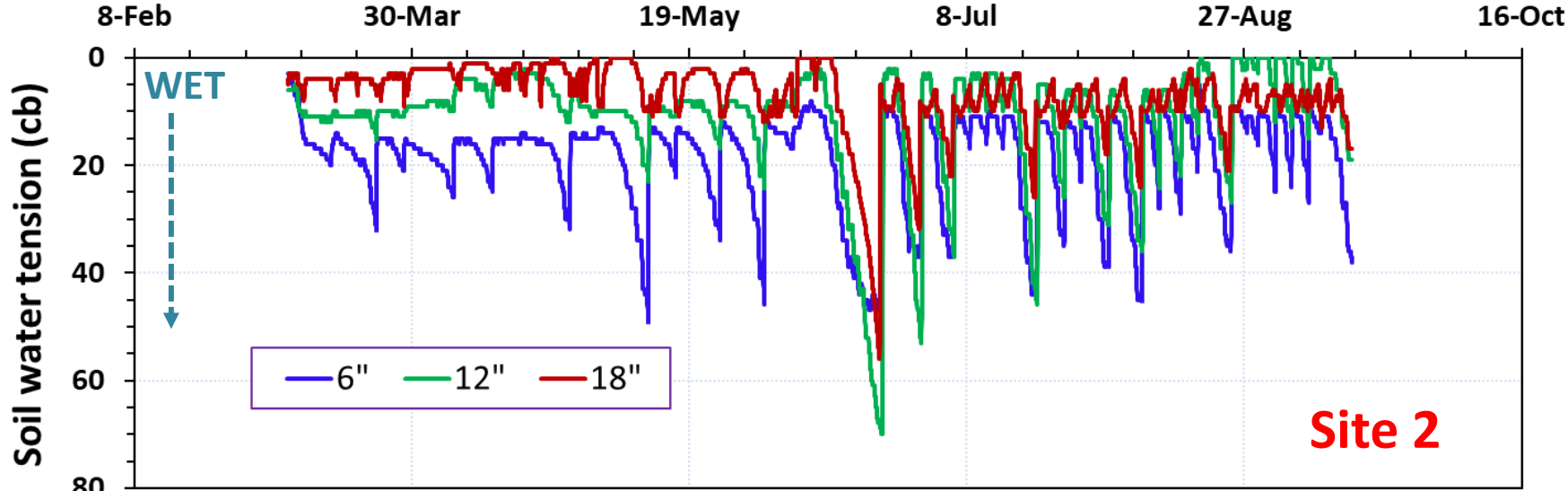
Micro sprinkler



# Soil moisture data



# Soil moisture data

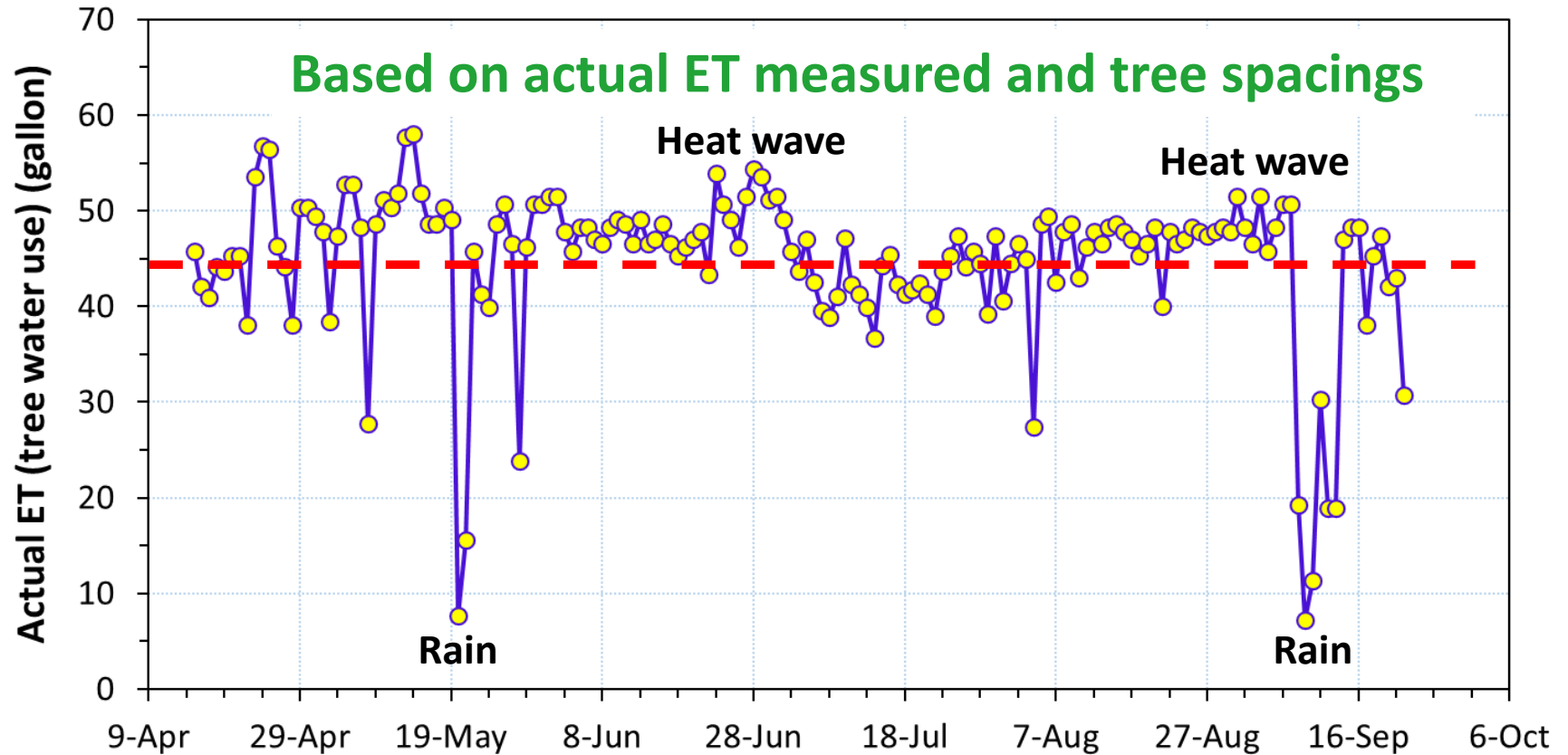


## Crop water use in avocado orchard - Escondido

- ✓ 20 × 20 ft. tree spacings
- ✓ 11-year-old [trees 20 ft. tall]
- ✓ 42% south facing slope
- ✓ 775 ft. above sea level
- ✓ Sandy loam soil (Cieneba coarse )
- ✓ Hass avocado
- ✓ One micro sprinkler per tree  
(flow rate: 25@GPH)

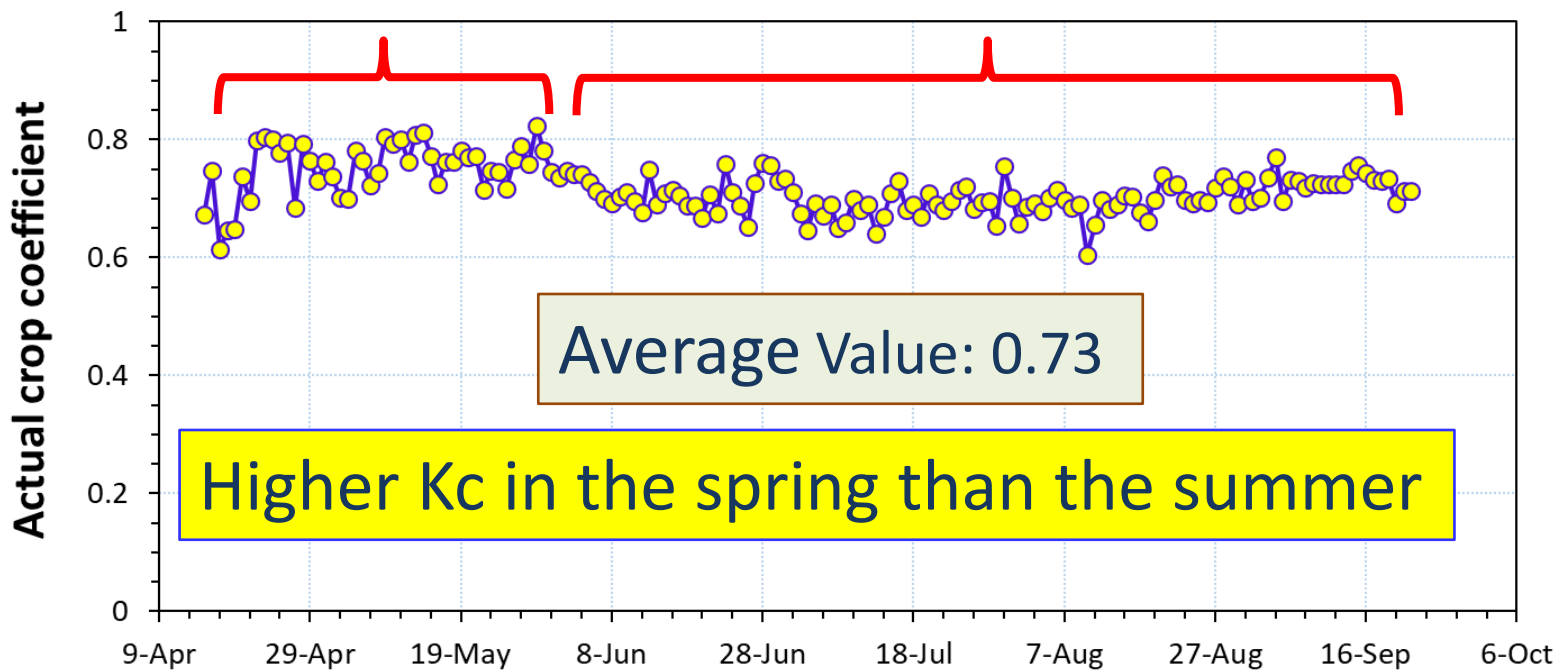


# Crop water use in avocado orchard - Escondido



Average crop water consumption (ET)= 44.8 GPD

# Crop coefficient in avocado orchard - Escondido



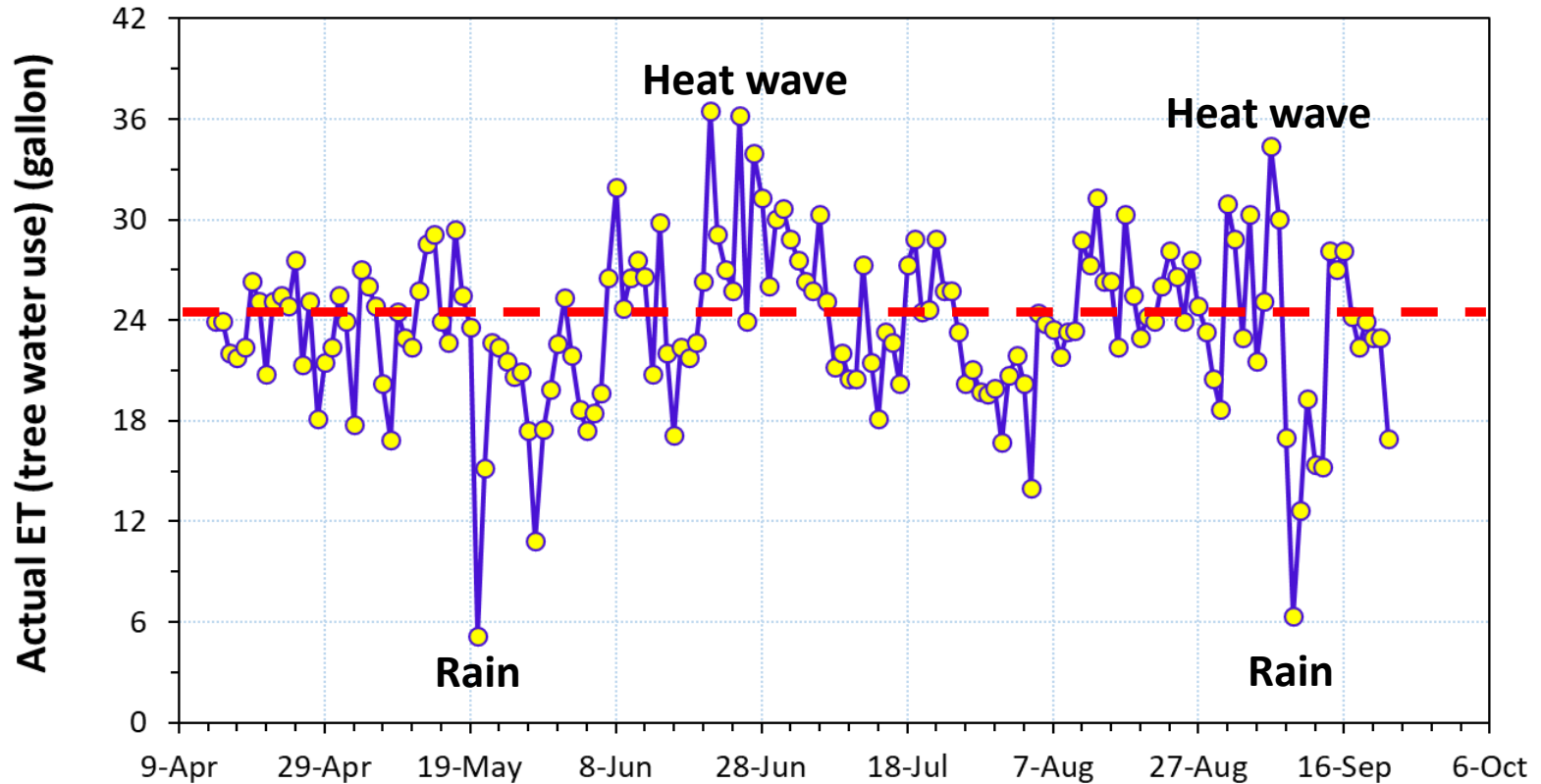
- **New leaves in May** are not fully expanded and not as efficient as the summer.
- **Stomata close** and transpiration slows/stops during hot days.

## Crop water use in avocado orchard - Temecula

- ✓ Tree spacings: 15 × 20 ft.
- ✓ 8-year-old [trees 15 ft. tall]
- ✓ 33% south facing slope
- ✓ 1500 ft. above sea level
- ✓ Loamy soil (Lodo rocky )
- ✓ Hass avocado
- ✓ One micro sprinkler per tree  
(flow rate: 9.5@GPH)



# Crop water use in avocado orchard - Temecula



Average crop water use = 24.3 GPD

Average crop coefficient = 0.64



Thank You (Q & A)

Contact information:

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