A Wireless Sap Flow System for Irrigation Stress Monitoring on Almond Trees at Fresno State University

Author: Mike McClung, Dynamax, Inc.
Presented by:
Michael van Bavel, Dynamax Inc

Dynamax

Objectives:

Schedule Irrigation conserve water and fertigation.

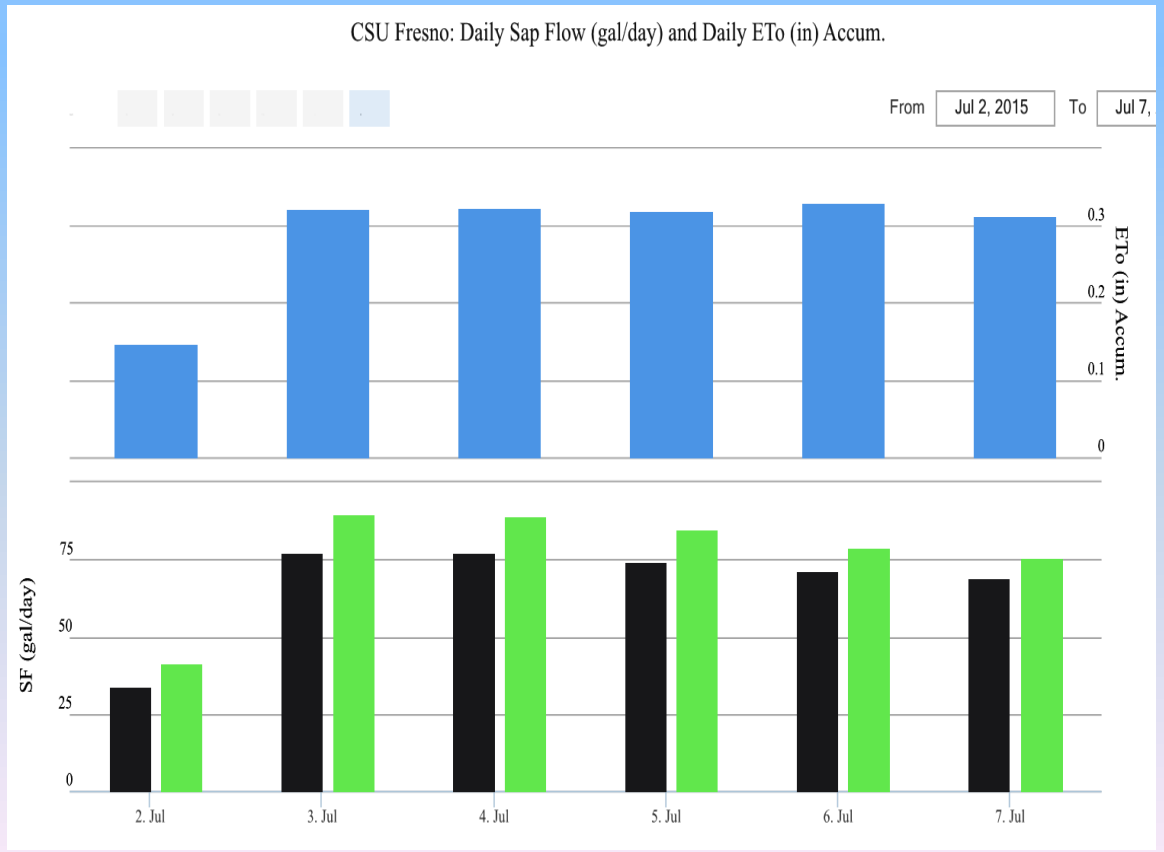
Correlate with Soil Moisture, and ET

Validate with Stem Water Potential

GOALS:

- When and how much to Irrigate?
- Measure stress Ks value?
- What is the Crop Coefficient?

Sap Flow
is the Plant Response to
ALL ENVIRONMENT



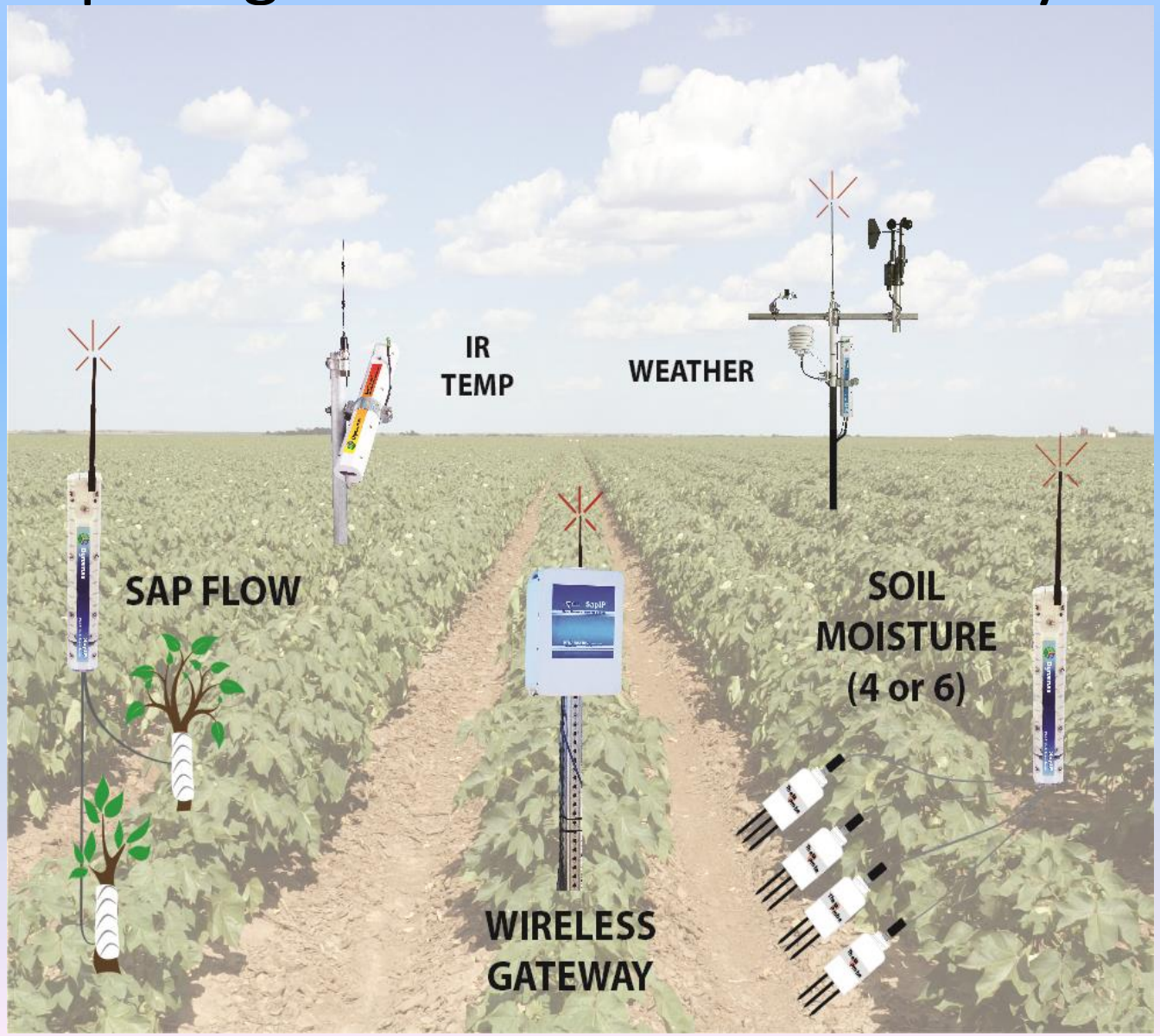
- Weather
- Plant Water
- Soil Status
- Root Health
- Fertility
- Water Balance

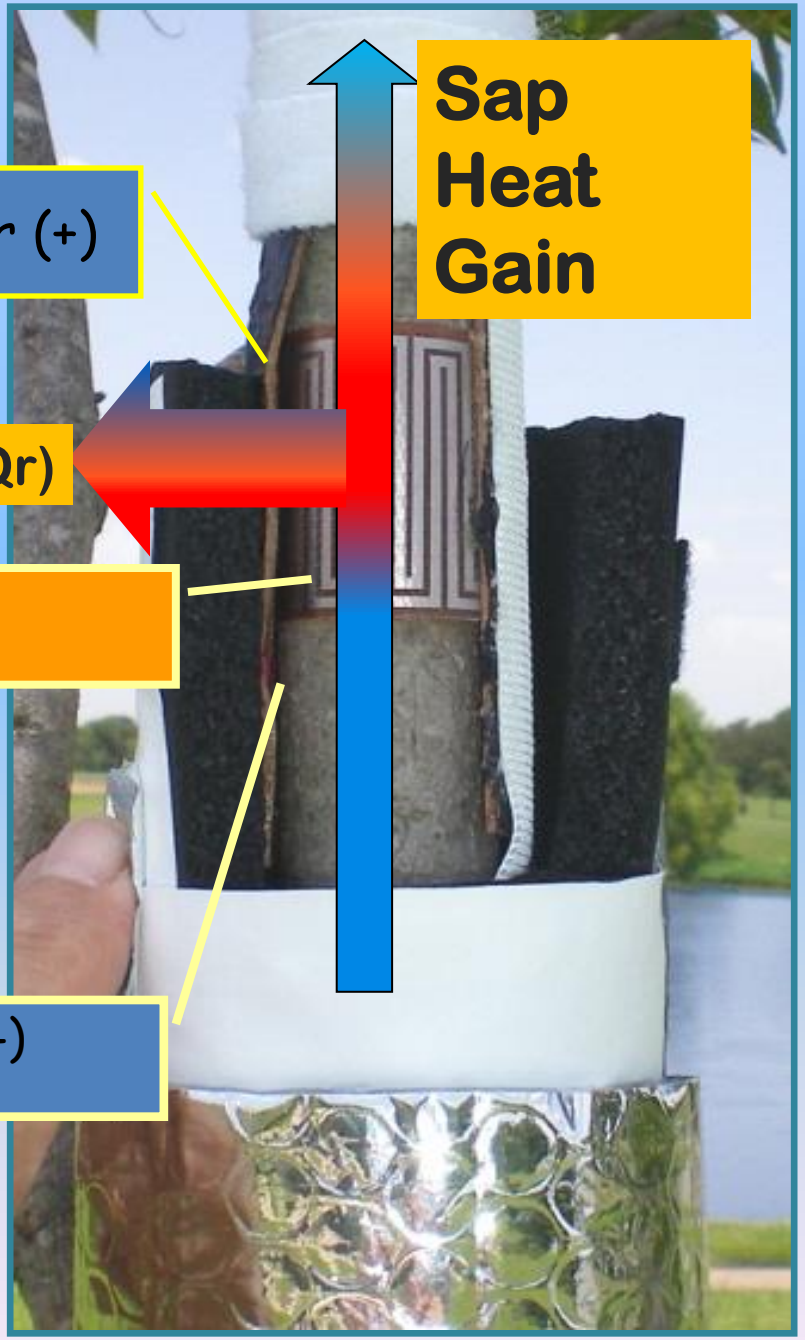
Methods:

Apply ExoSkin Sap Flow Sensors SGEX-25

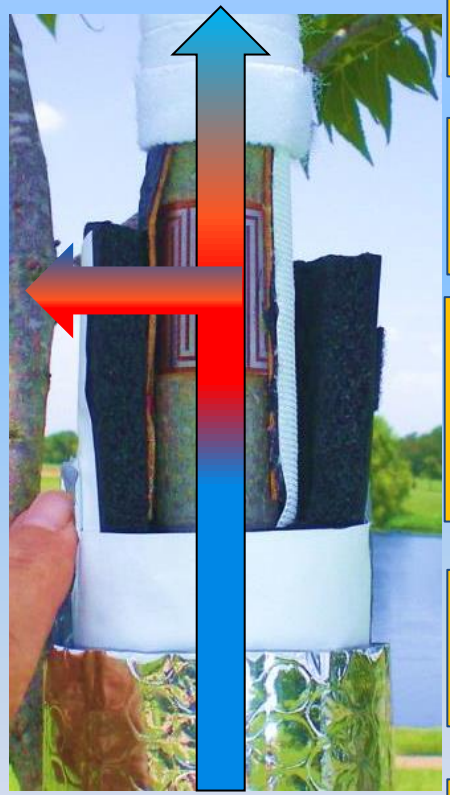
* Energy Balance
* No Calibration
* Easier to install
* Shorter stem requirement
* Lower costs

SapIP Agrisensors.net Wireless Systems




Sap
Heat
Gain
Temp Sensor (+)
(Qr)
Heater Strip
Temp Sensor (-)

✓ Requirements



Shielding and insulation to prevent heat from the sun and irregular temperature swings. Check NTG.

Solar Power required to maintain constant heat. (about 10 W per sensor)

Measure stems, input heater and plant properties into the logger / web site computations.

Real-time computations and communication to grower, and technical support.

Maintenance to observe stem, adjust for growth, check condensate and keep stem healthy.

Sap Flow Application

- Fresno State University Almond Orchards
- Older trees; Nonpariel, Aldrich, & Price varieties
- Drip irrigation systems 14 gal hr (53 l)
- Soil moisture profiles taken SM150 Delta-T
- ET weather data collected CIMIS weather network

Installation and results

- Started June 1, 2015
  - Nonpareil, Price, Aldrich – 2 Zones
- Previous work to validate methods in 2014
- Selection of healthy trees is important
- Representative of the Field (not outliers)
- Measure branches and select representatives
- Index branch dimensions to whole tree (Da Vinci / Huber method)

BASIC Data Collection

- ✓ Sap Flow data
- ✓ ETo for comparison, CIMIS Weather Stations
- ✓ Soil Moisture Data to Validate Irrigation
- ✓ Accumulate daily total water use and check with weekly irrigation schedule
- ✓ Correlated with Pressure Chamber – Stem Water Potential

SapIP Radio Transmitter/Logger

To Internet ACCESS

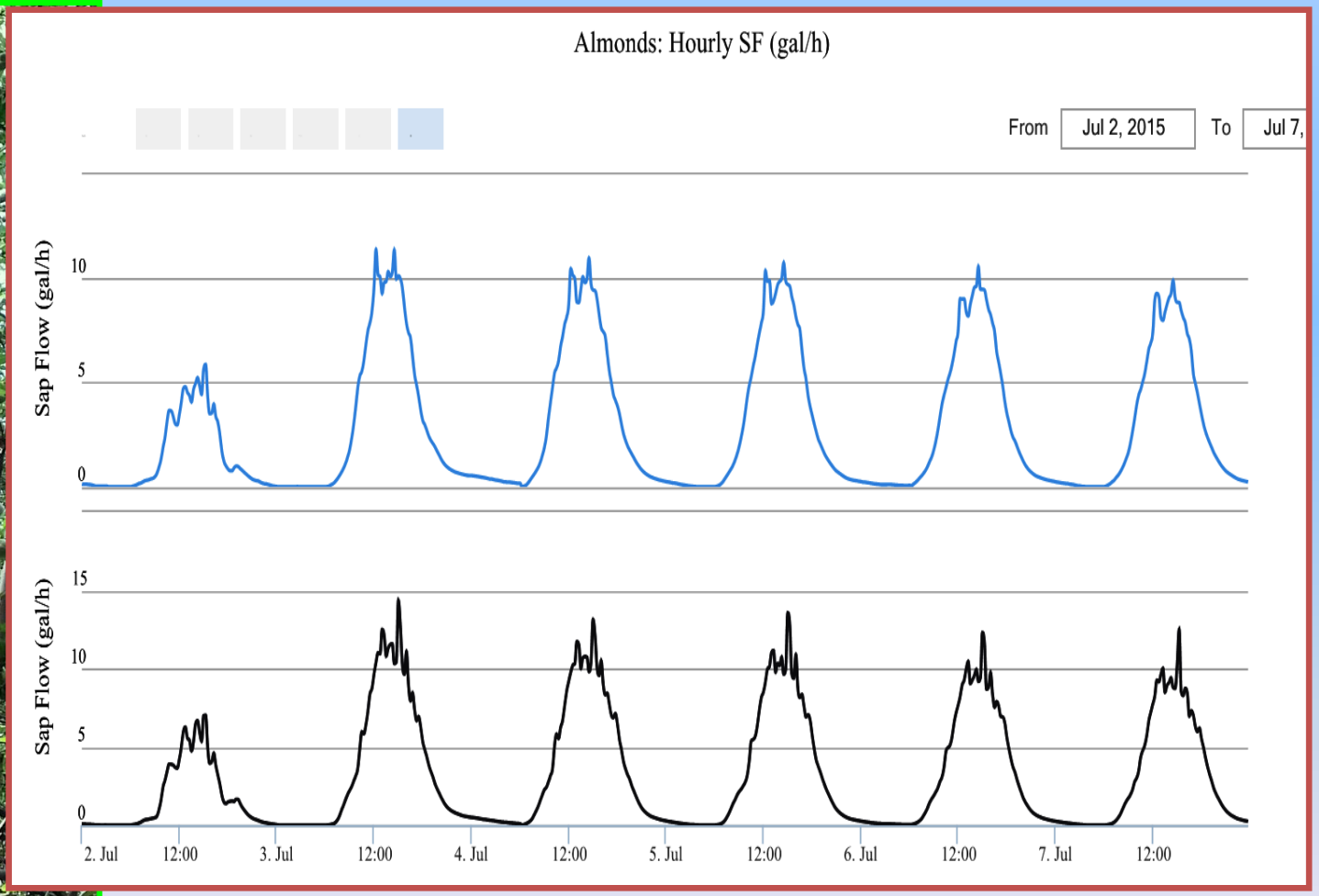
From Remote Fields:

- ✓Water Needs
- ✓Plant Stress
- ✓Soil Moisture
- ✓Weather & ET
- ✓Plant – Soil - Water

Data Retrieved **Agrisensors.NET** Remote Network

SapIP - Network Loggers

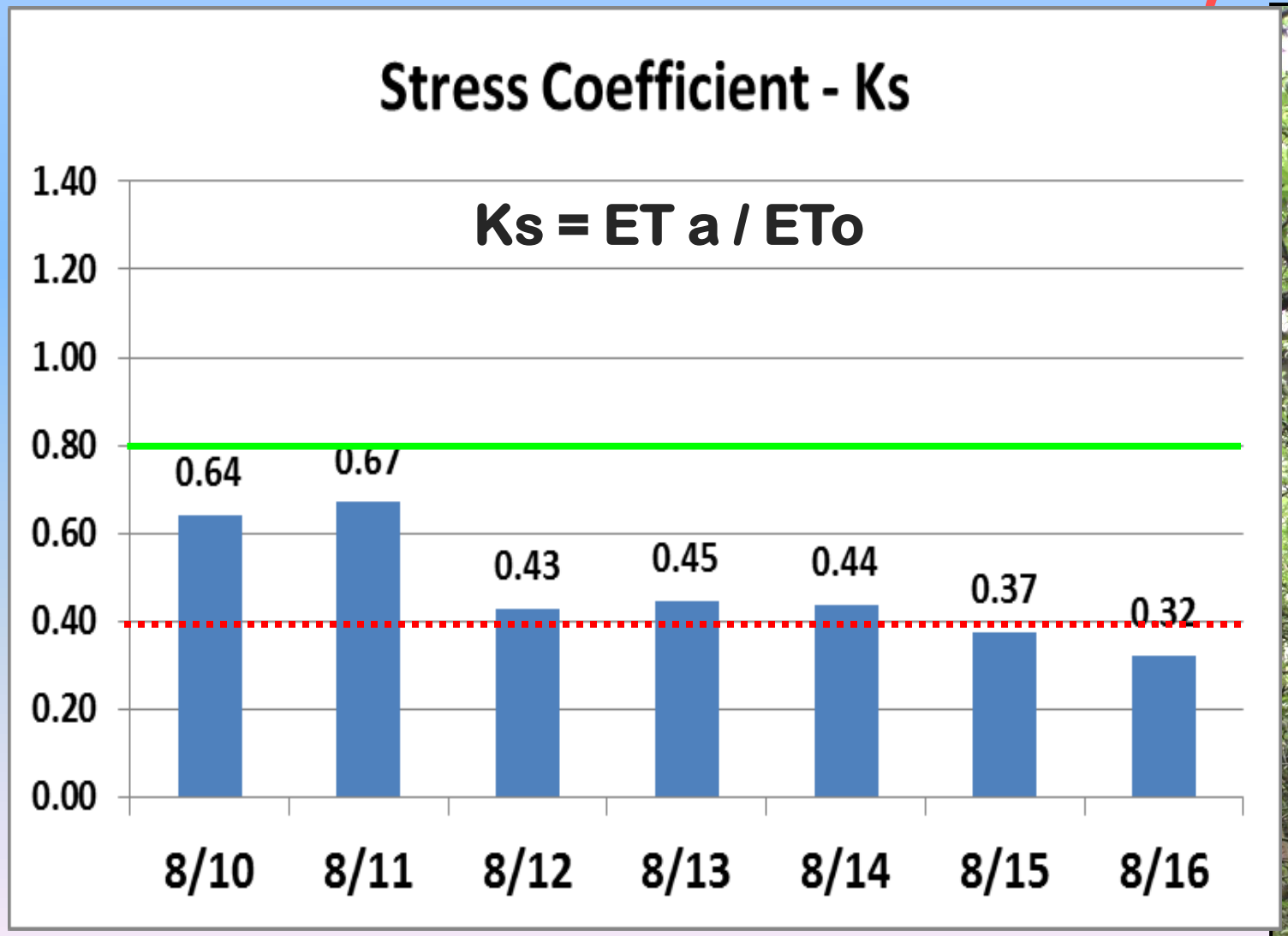
Current Plant Water Usage
WWW Access and Data Storage



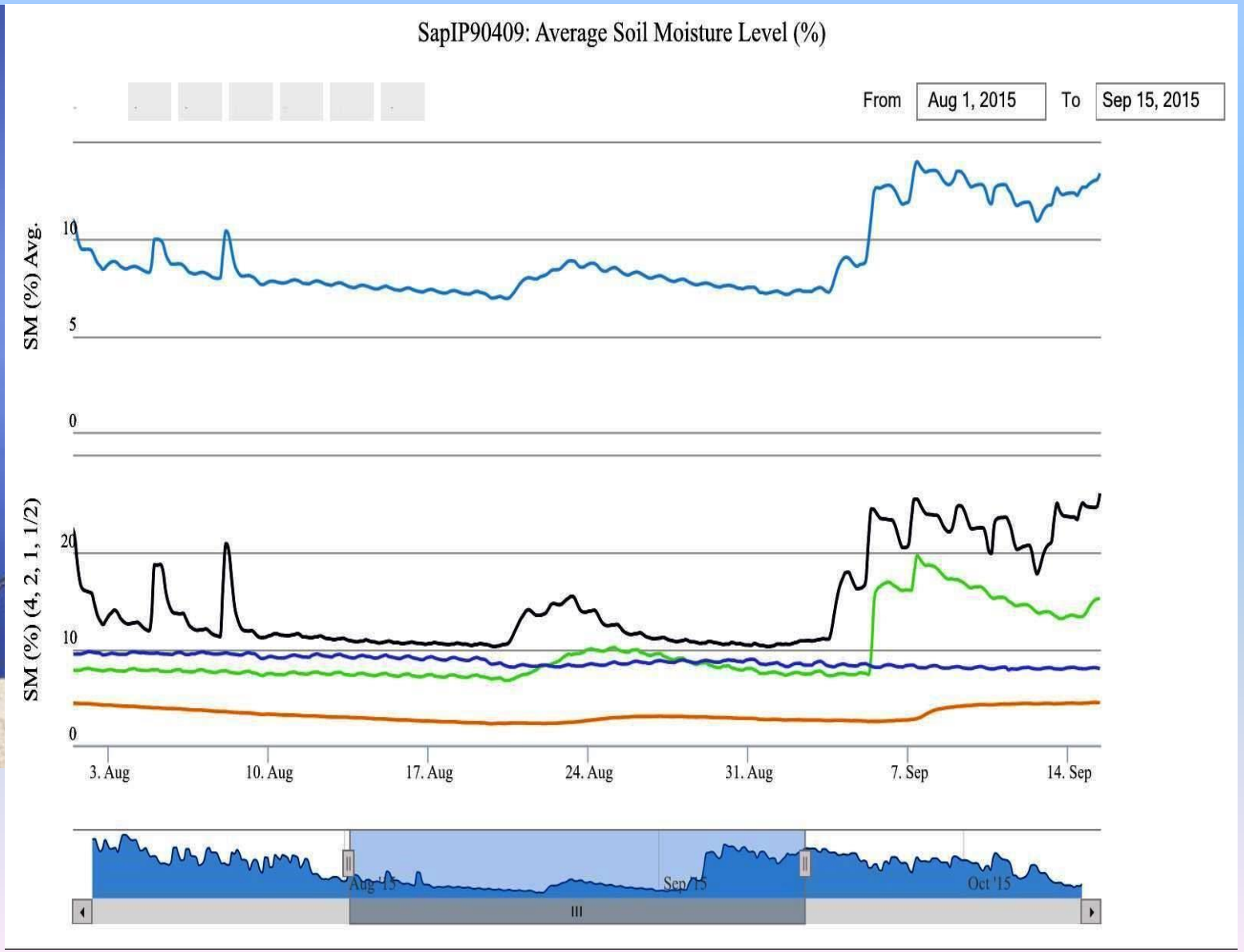
Hour by hour, tree transpiration

Response to weather, irrigation, stress.

Irrigation Stopped - Almonds Severe Stress after 7 Days



• SM150 soil moisture Volumetric

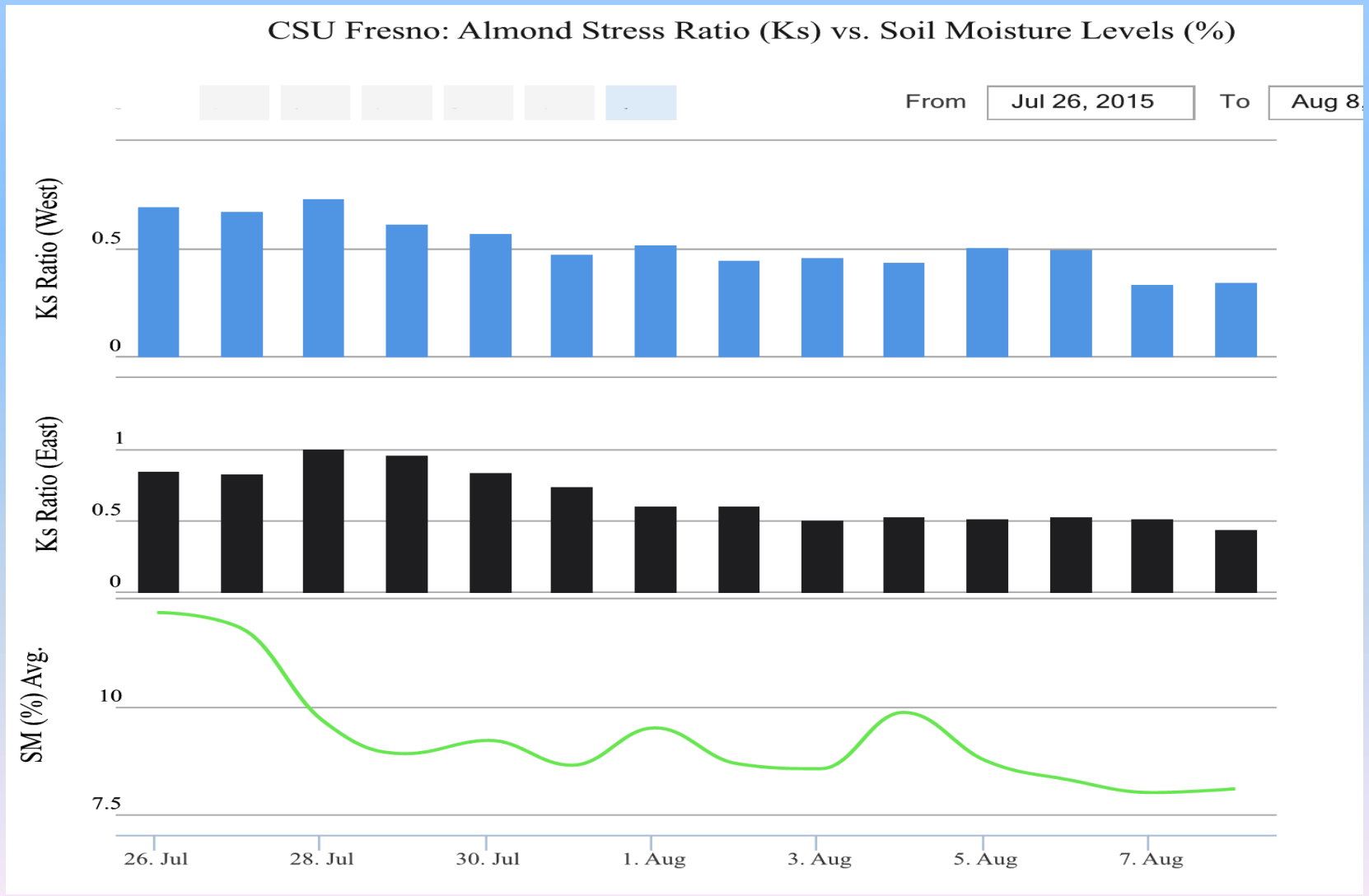


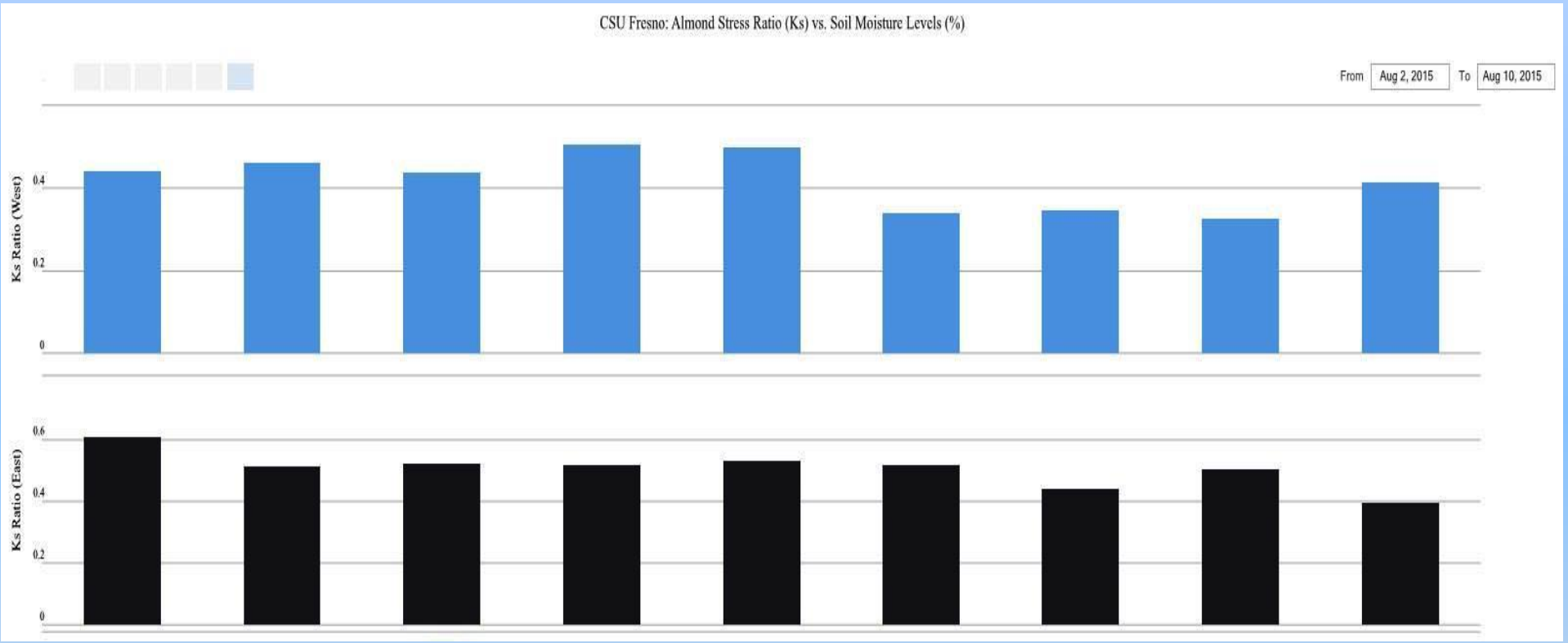
Soil Moisture Sensor Installation

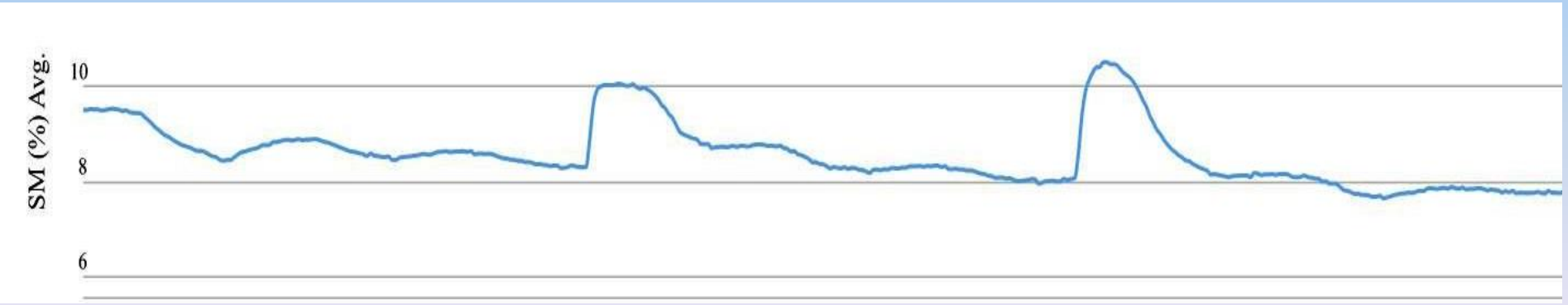
- SM150 Sensors are attached to PVC pipes
- Buried at different depths to get soil moisture profile –
- 6”, 1 ft, 2 ft, 4 ft
- Near emitters in order to see when irrigation starts

Almond Harvest Preparation

Long Irrigation cut off, followed by 3 short cycles.

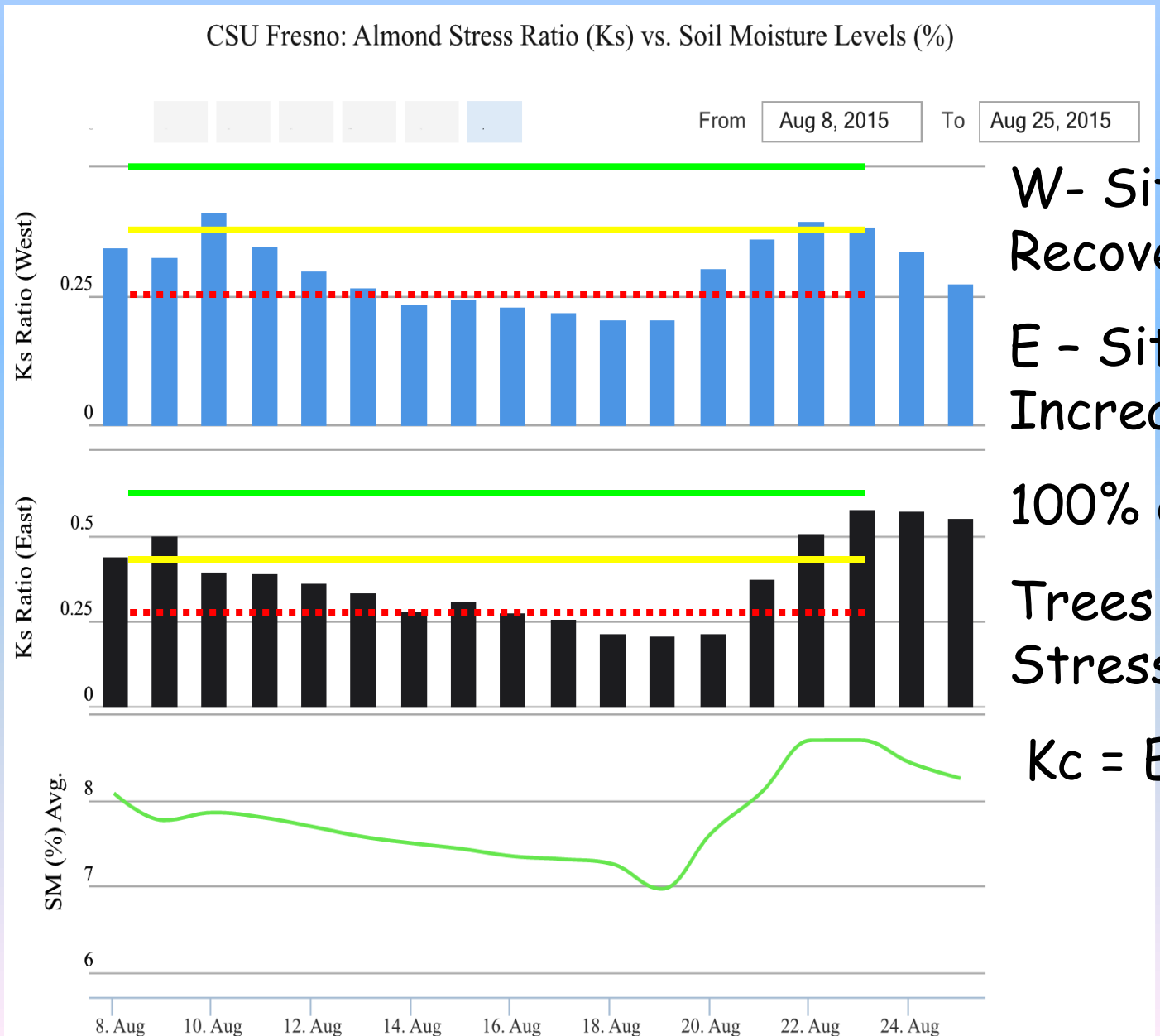






8/2 8/4 8/6 8/8 8/10

Long Irrigation – 380 Gal tree 4 days



W- Site 1 -Limited Recovery

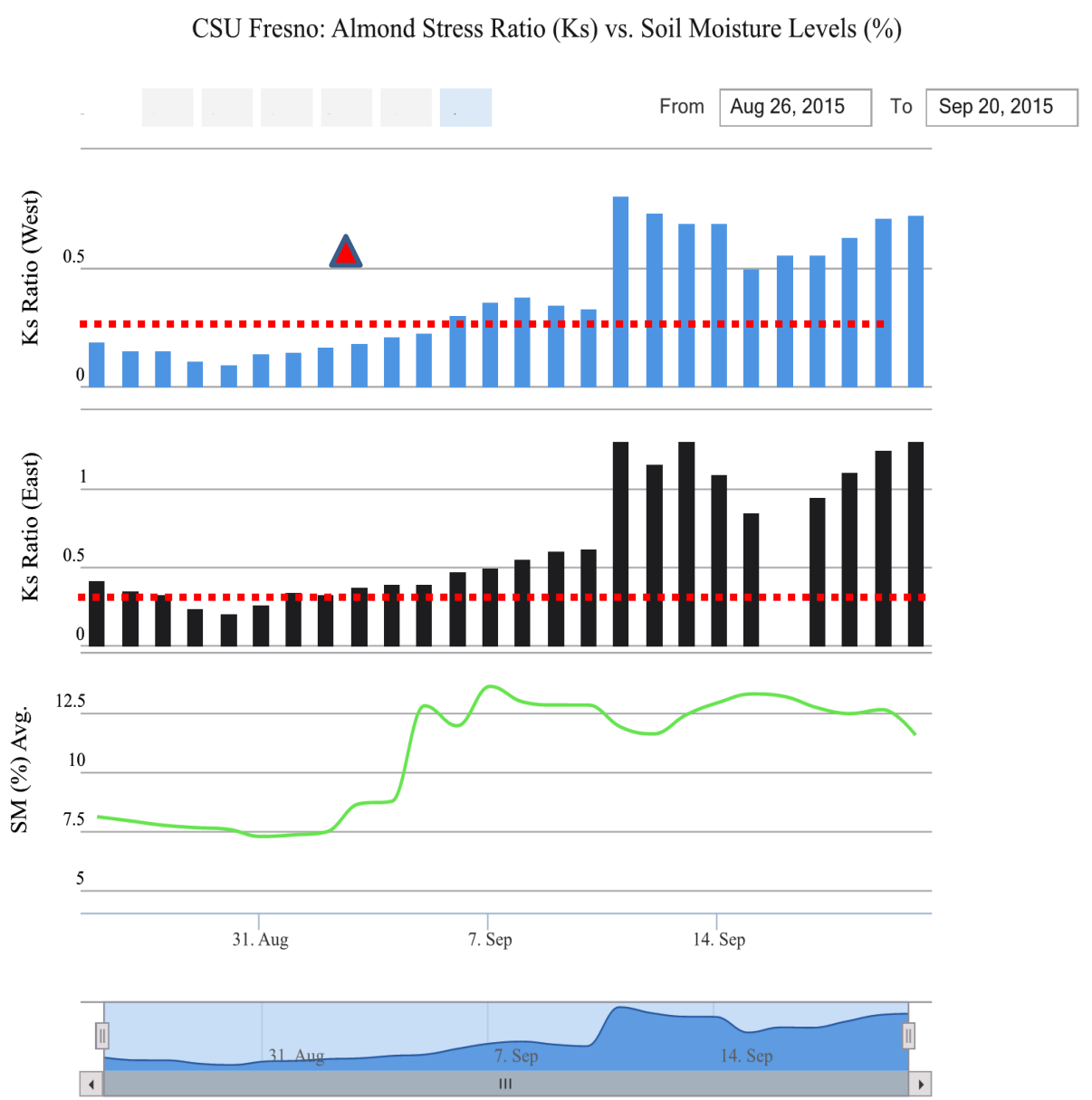
E – Site 2- Sap flow Increases

100% over 3 days

Trees are still Stressed to Ks=.52,

Kc = ETa/ETo

Irrigation started Sept. 3, 5, 7 after harvest

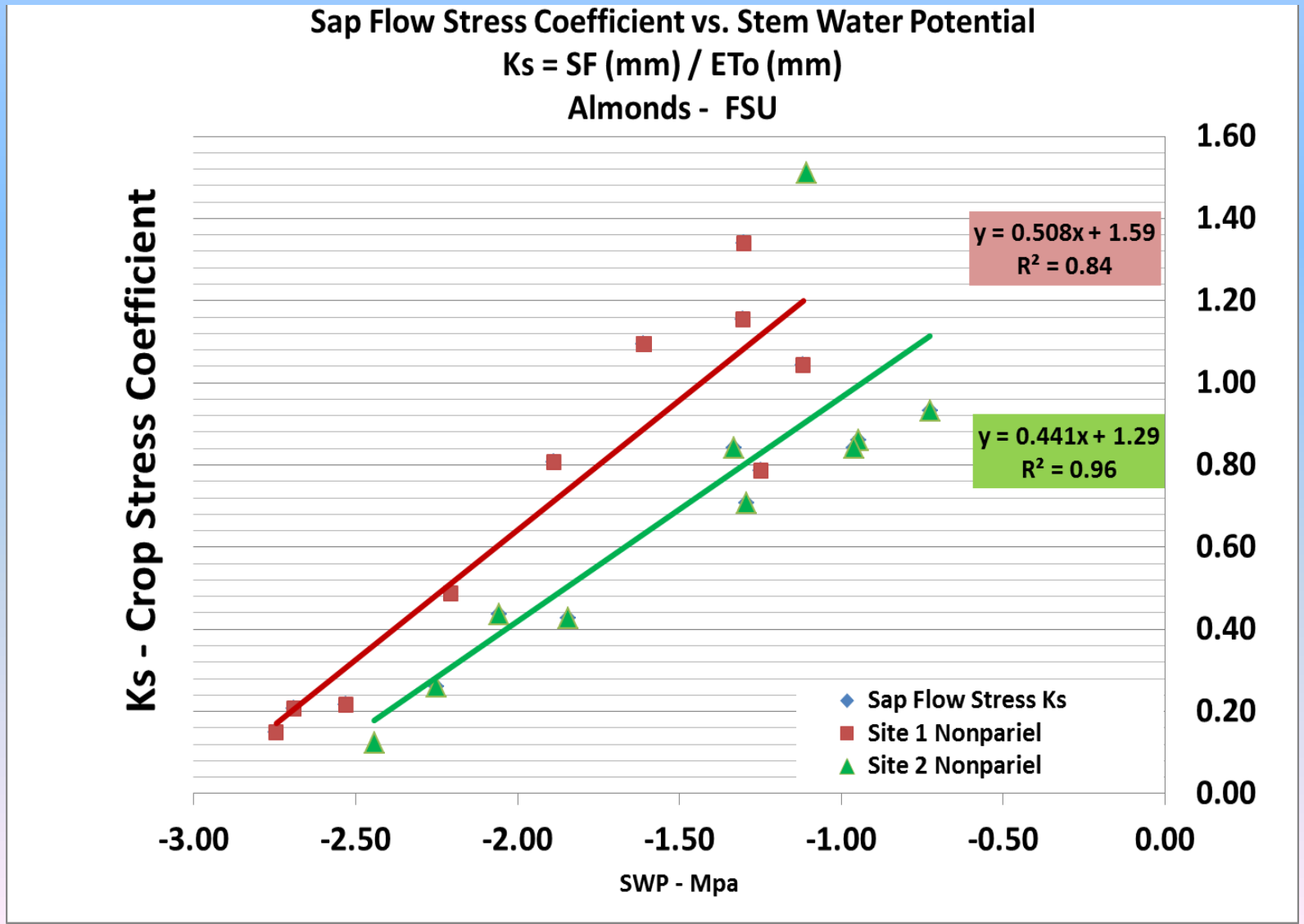


Shells picked up on Sept 2

Recovery –

As Sap flow increases to over 0.5 Ks factor.

Stem Water Potential / Sap Flow Ks is highly correlated.
Characterize the plant – varietal response vs. Soil and irrigation
Clay Loam soil with shallower root development (Red – Site 1)
Sandy soil with deeper root development (Green - Site 2).



Conclusions

The early summer sap flow total agreed with well-watered almond trees grown with the standard irrigation practices. Kc was .80 to 1.0 (data not shown).

- Ks plant stress levels, automated by Agrisensors
- Irrigation cycles - Ks and soil water content:
  - Sap flow comparison to soil water content.
  - Days required for tree recovery after dry-down.
- Developed a tight relations with Stem Water Potential.

New Wireless SapIP System Features

- IR Leaf Temperature Stress Measurement CWSI and iDANS
- Chill Factor, Frost Warnings, Alarms
- Mobile Apps for Phones
- SGDC Sensors with 2 Channel
  - Stem Gauge Dual Channel
  - Double as many sensors per logger

Dynamax

Houston, Texas
Fresno, California

- Invites you to Fresno Office –
- WET Center at Fresno State
- Headquarters for SapIP Services in CA
- On-site install, maintain, and warranty equipment.
- Tel 800 – 896 –7108
- 590-770-0000

www.dynamax.com