New Water - Stress Management Technology From

Water is the Problem

- When to Irrigate?
- How Much to Irrigate?
- Water is scarce. Pumping costs up.

- Our Advanced Sensors

-Let the plants Talk to You !

Agenda

- Sap Flow Solutions for Plant Stress Monitoring
- New Technology to Supply Answers to Growers
- With the right data, you will know how much and when to irrigate or can improve current methods

Why is this Different?

How does it Work?

What is Important?

What is Needed?

How do I Benefit from this?

What Is Sap Flow?

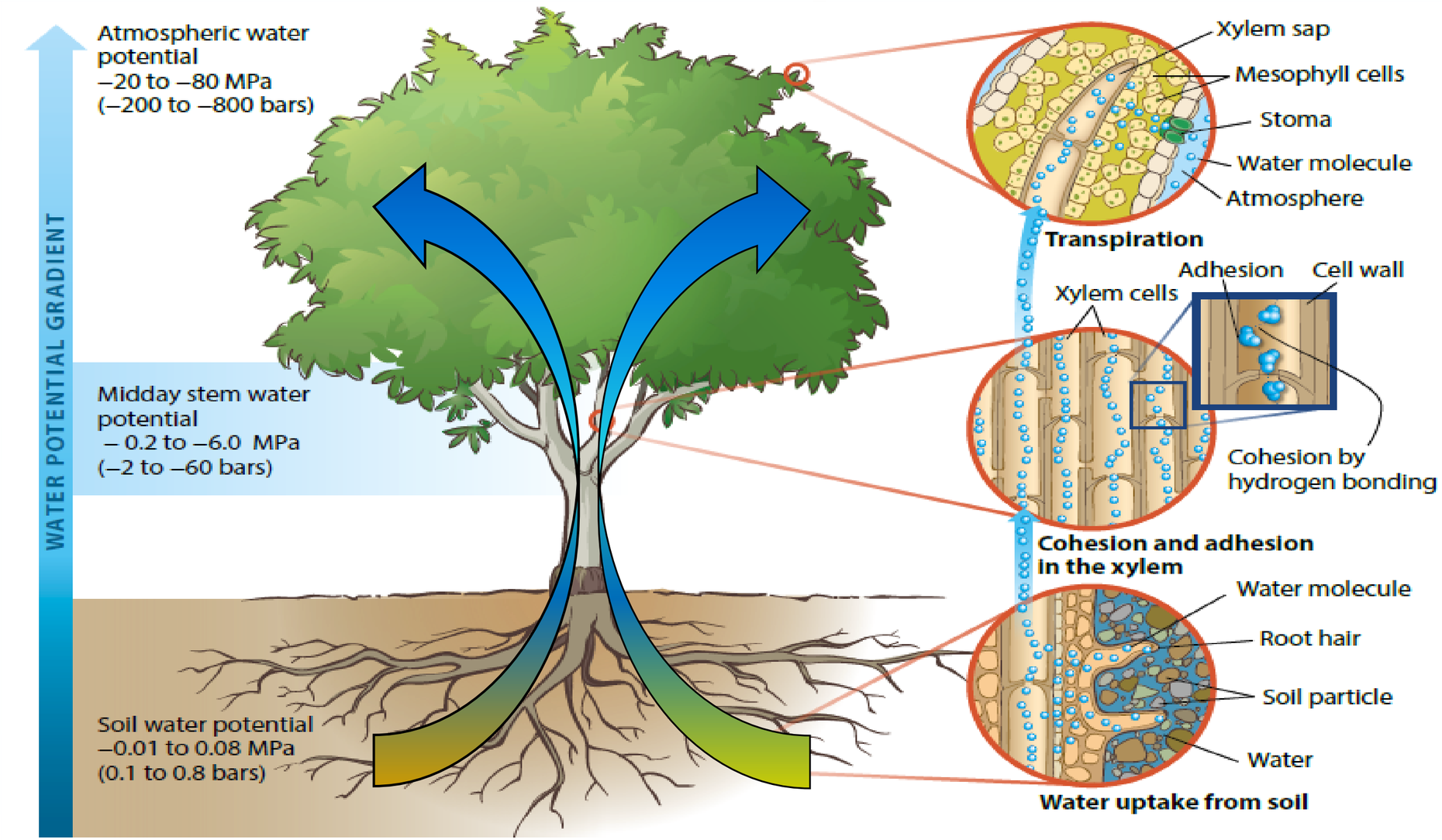
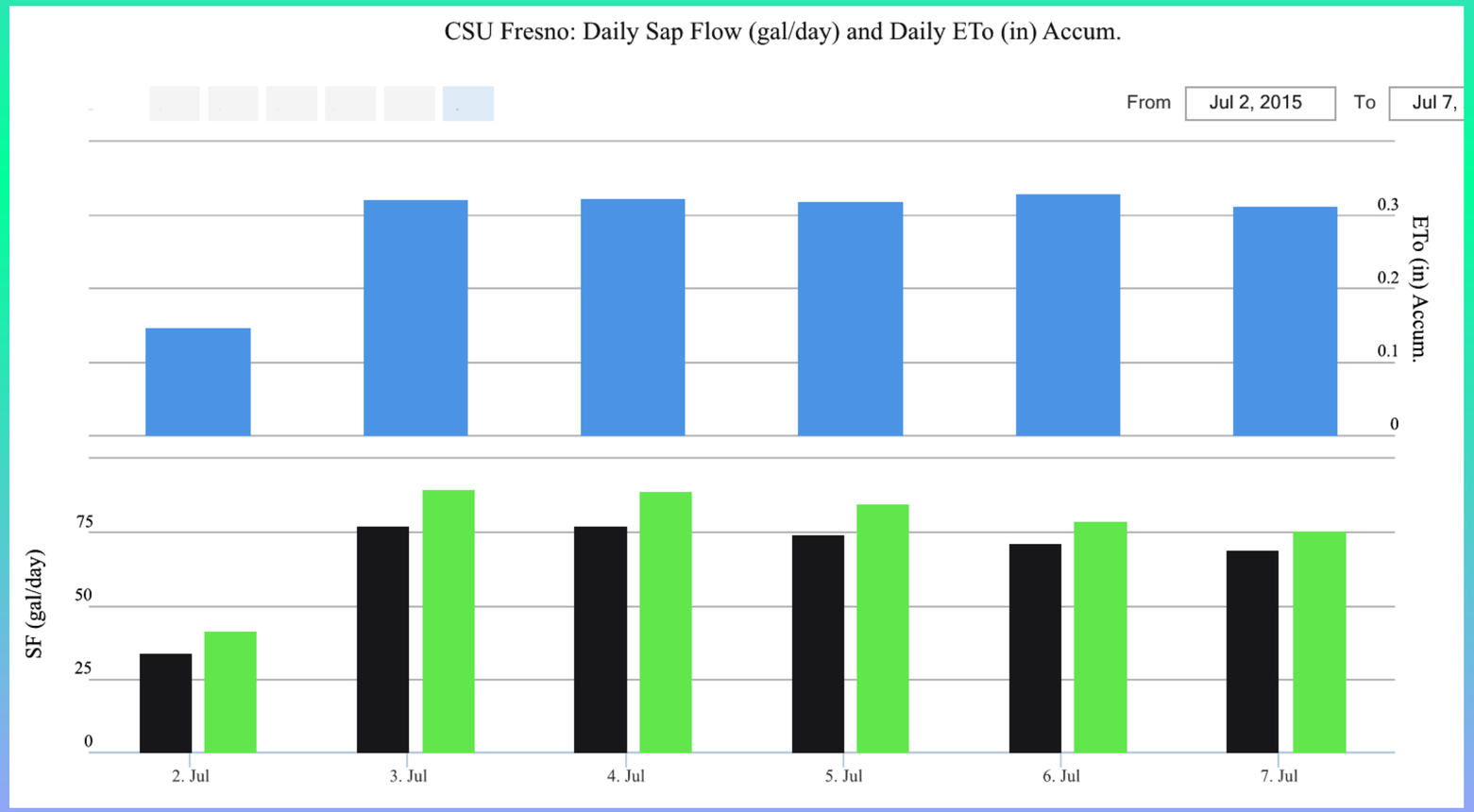


Figure 1. Conceptual illustration of how water moves from the soil through an irrigated tree and into the atmosphere, from both a whole tree and cellular perspective. SWP measures the water-potential gradient that drives this movement of water through the tree. *Source:* Adapted from Pearson 2008.

Sap Flow
is the Plant Response to
ALL ENVIRONMENT

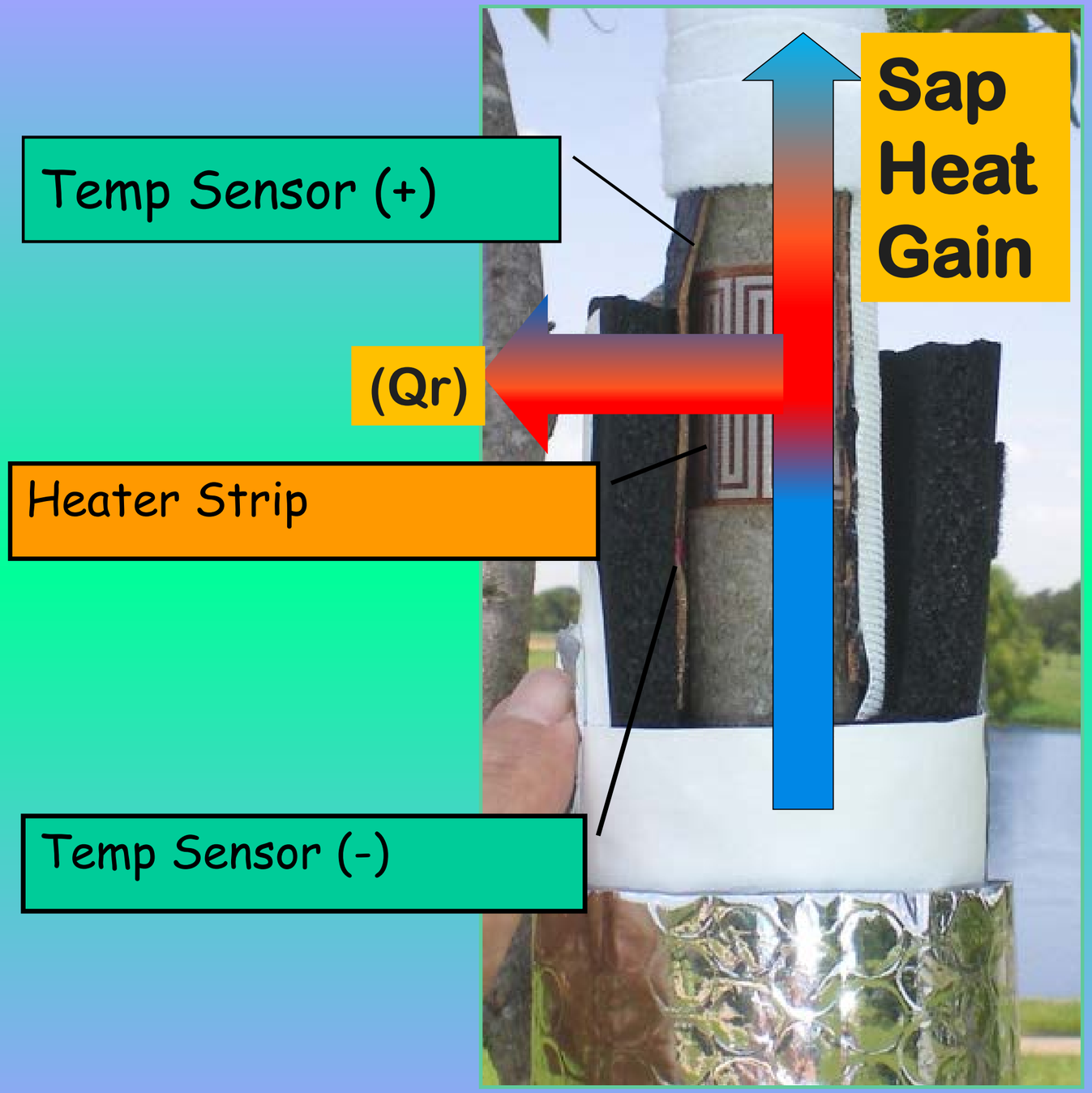


- Weather
- Plant Water
- Soil Status
- Root Health
- Fertility
- Water Balance

Sap Flow Sensor
EXO-Sensor

Plant Transpiration
with no calibration

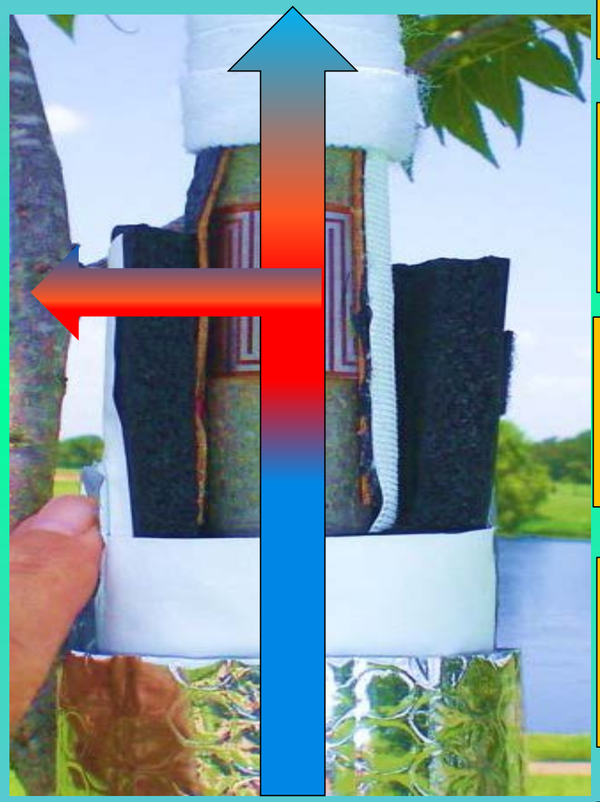
-Energy Balance



Sap Flow Technology

Four Patents & 25 Years Science References

✓ Requirements



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

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 Applications –

- **Commercial Irrigation – Sensors and Systems for:**
- Orchards – Almond, Peach, Citrus, Pistachio, Walnut, many others
- Crops – Corn, Cotton, Soybean, Sunflower, many others
- Viticulture – Wine grapes
- High Value Crops – Kiwi, Peach, Rasp/Blackberry, Plum, Cherry,

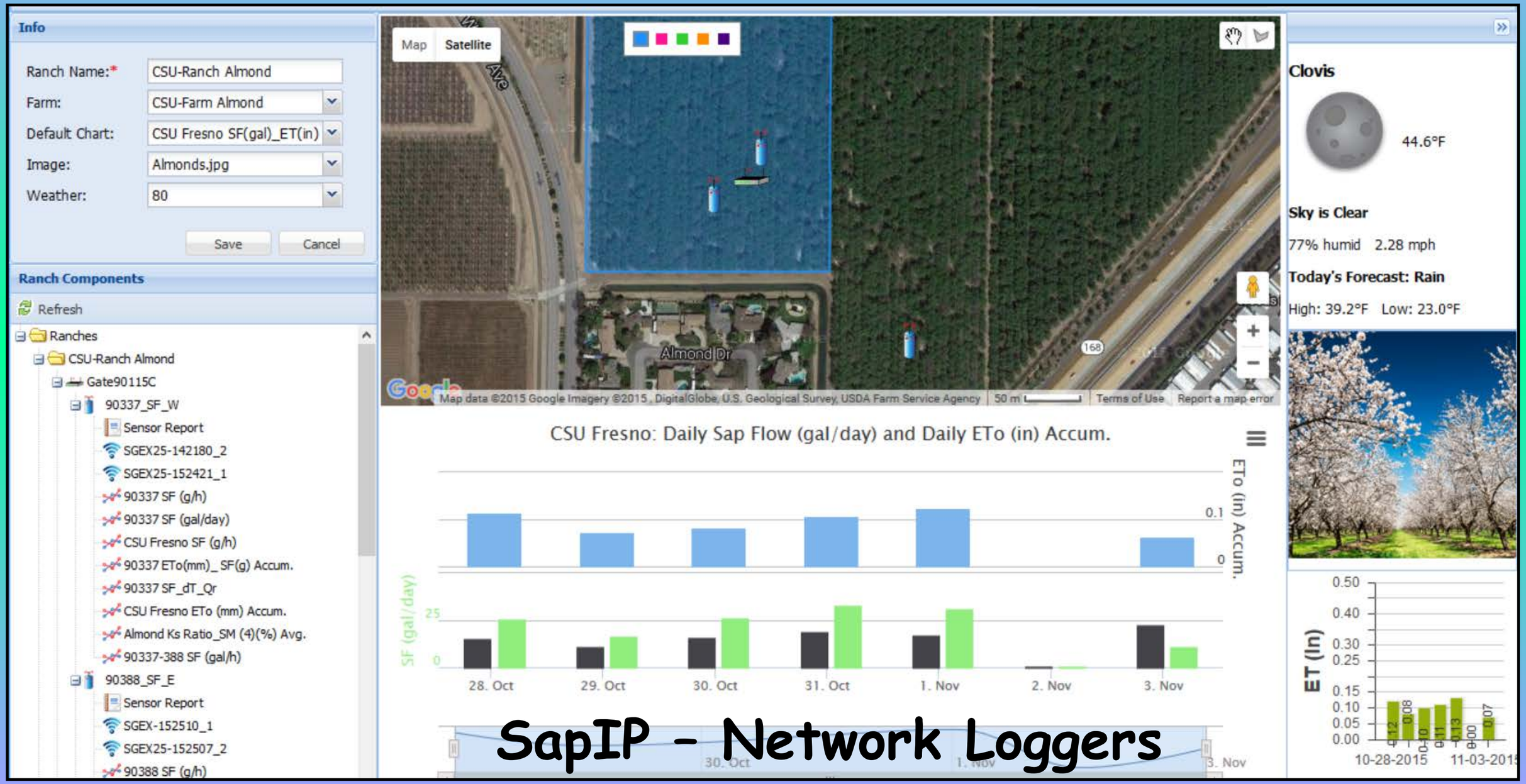
SapIP Radio Transmitter/Logger

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

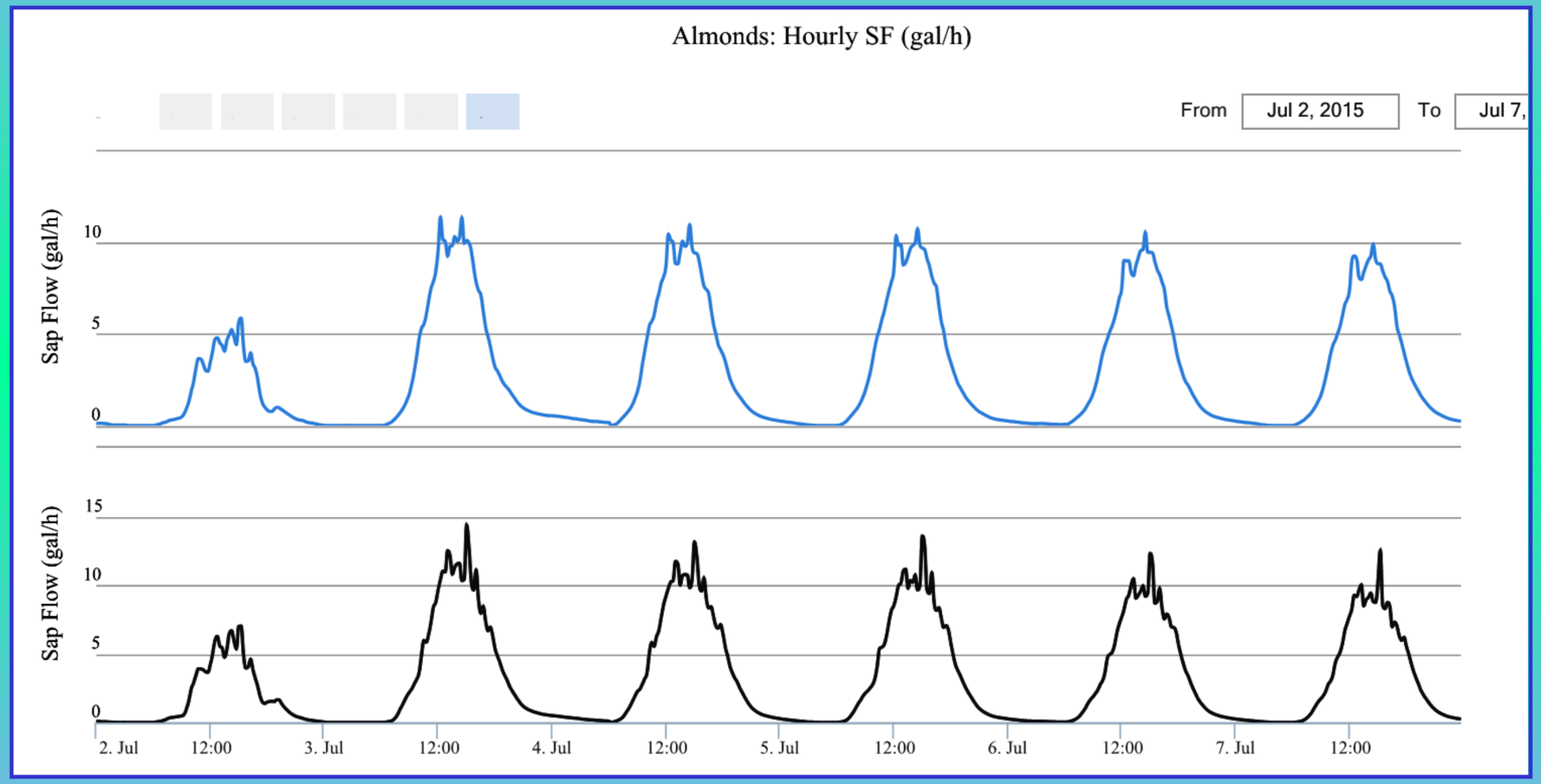
Installation and Results

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

BASIC Data Collection

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

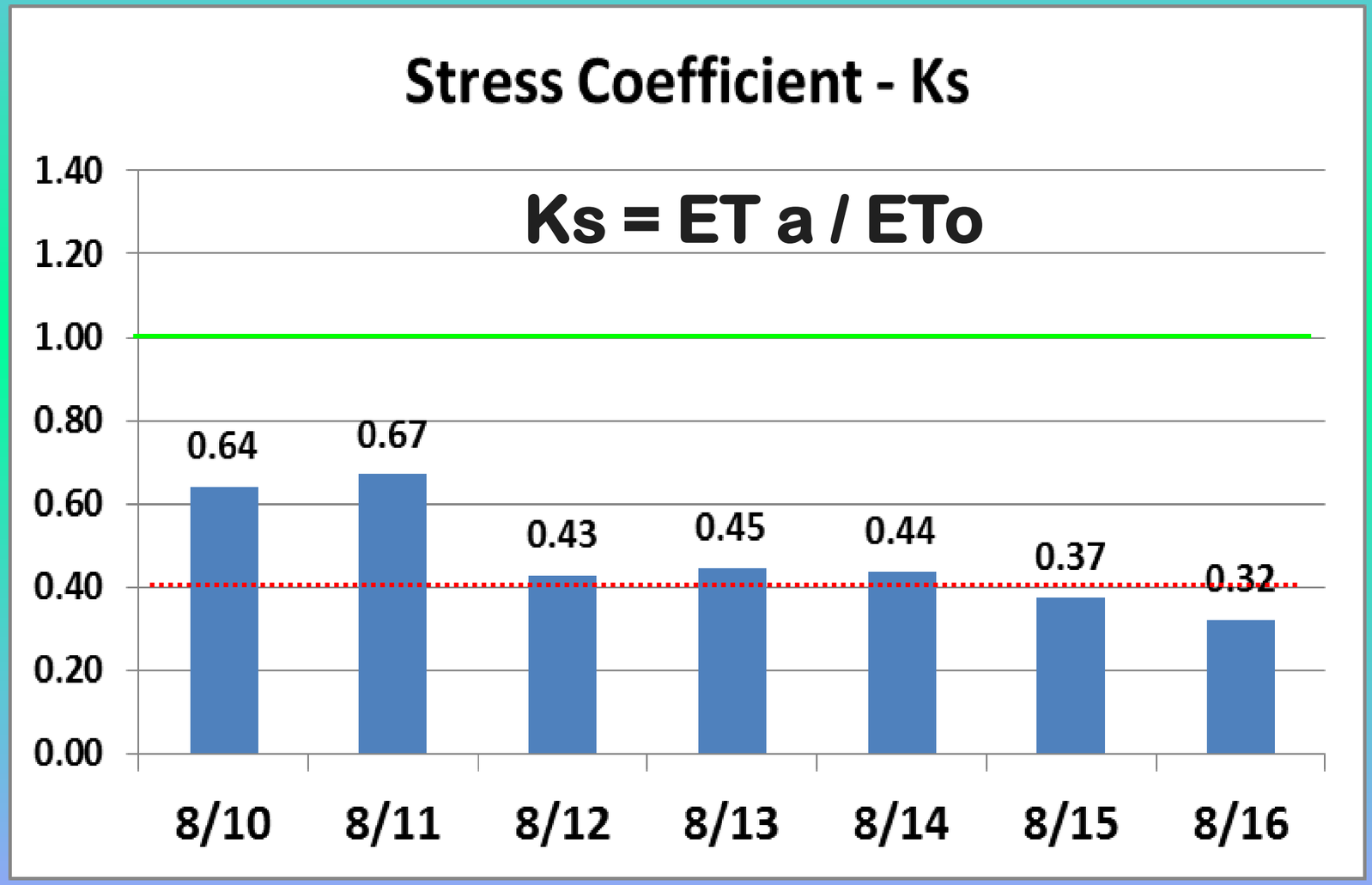
Current Plant Water Usage
WWW Access and Data Storage



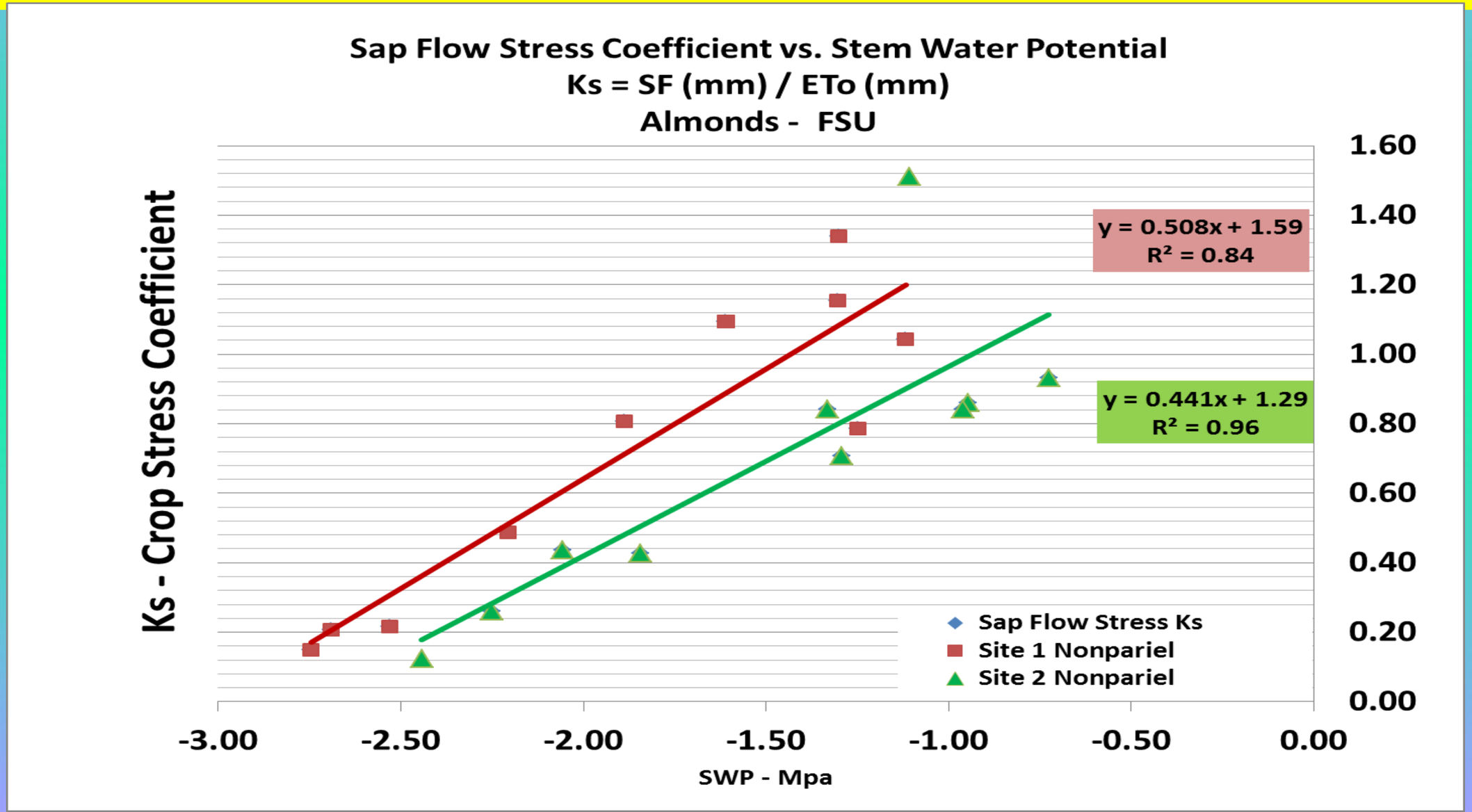
Hour by hour, tree transpiration

Response to weather, irrigation, stress.

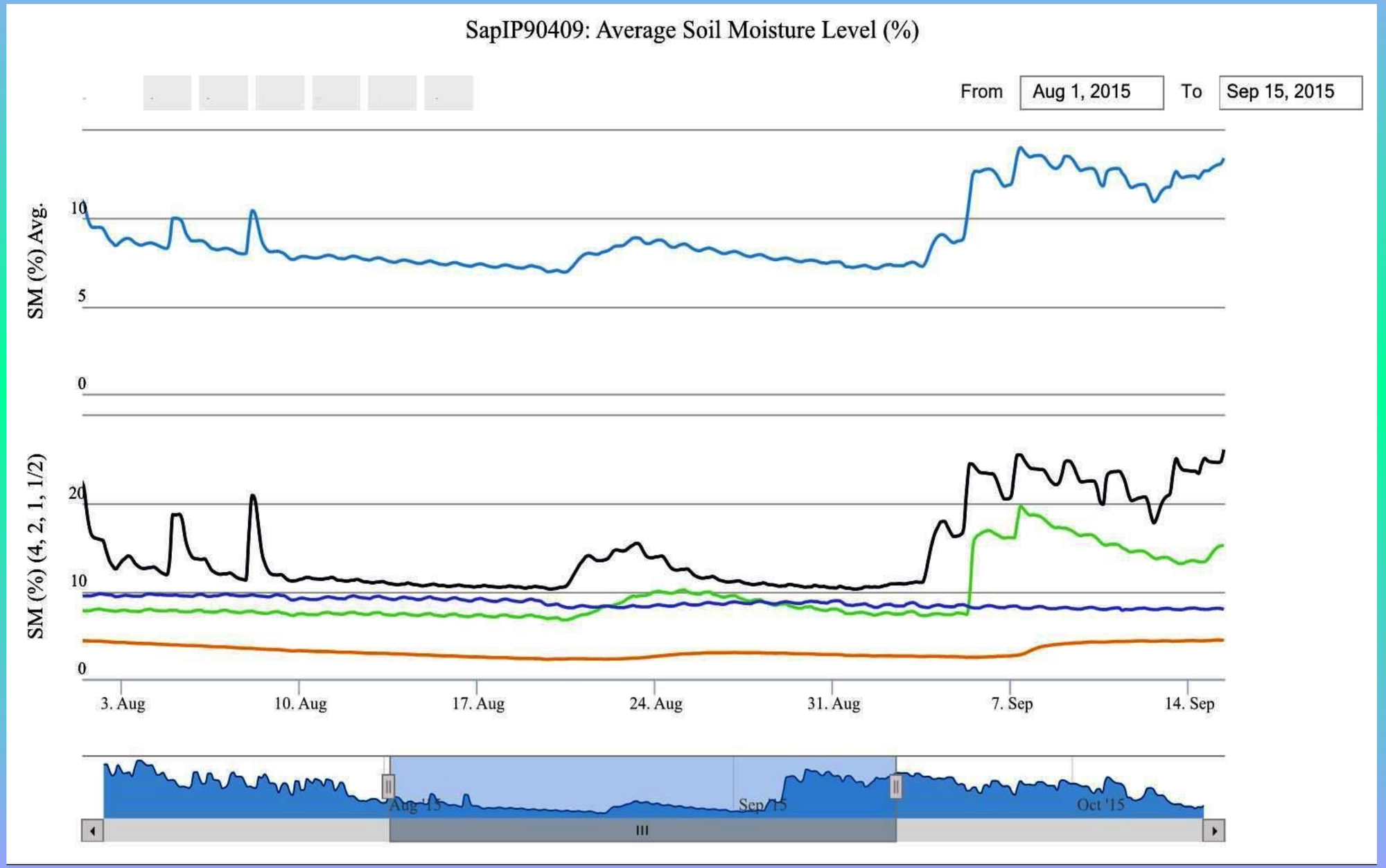
Irrigation Stopped - Almonds Severe Stress after 7 Days



Stem Water Potential / Sap Flow Ks is highly correlated. Characterize the plant – varietal response vs. Soil, or vs. Grower irrigation for deeper water and root development. (2014 data).



SM150 soil moisture-Bury at 6”, 1 ft, 2 ft, & 4 ft



Soil Moisture Sensor Installation

- SM150 Sensors are attached to PVC pipes of different lengths
- Buried at different depths to get soil moisture profile
- Shallow trench used to reach sample site
- Near emitters in order to see when irrigation starts

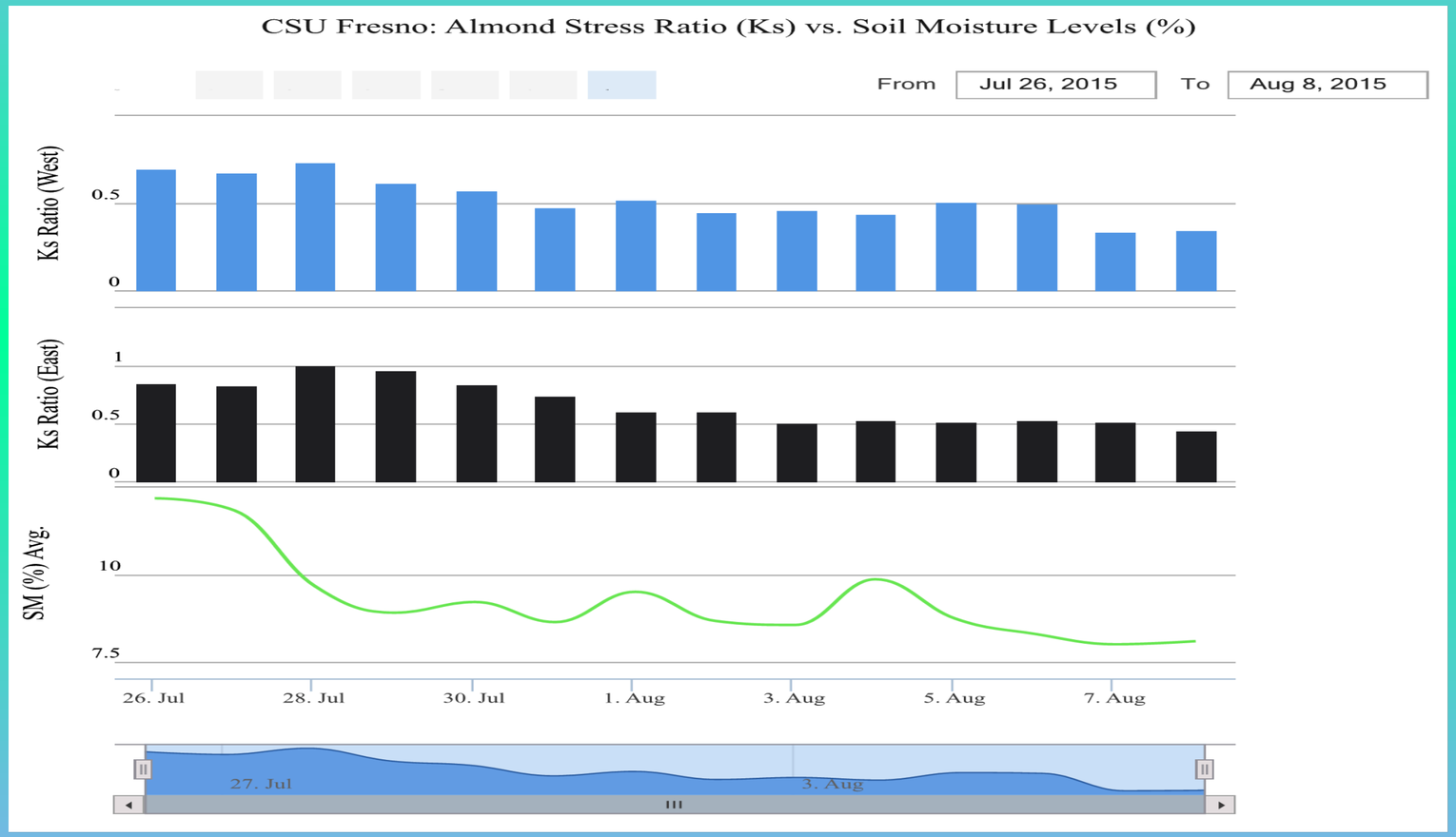
SM150 Installation

- Sensor rods inserted into undisturbed soil
- Buried and left in place
- Inserted at an angle
- No maintenance
- May be left in place for years

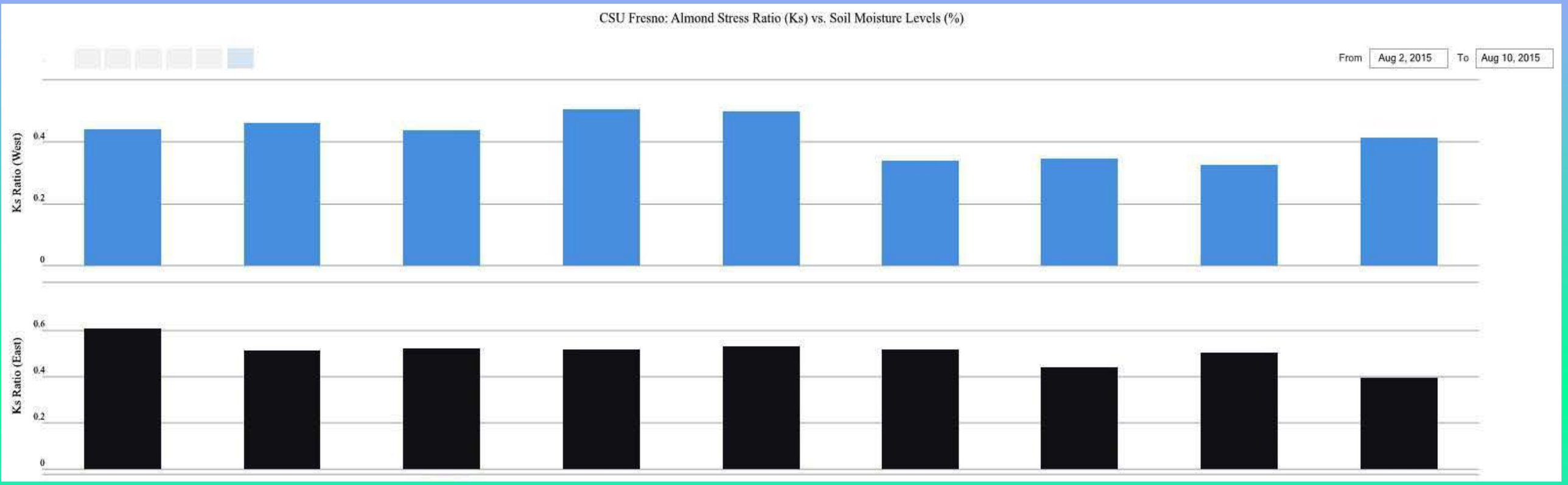
Soil Moisture Sensor Installation

- Sensors and PVC buried
- Cables emerge near SapIP
- Cable entrance sealed
- Final results

Almond Harvest Preparation

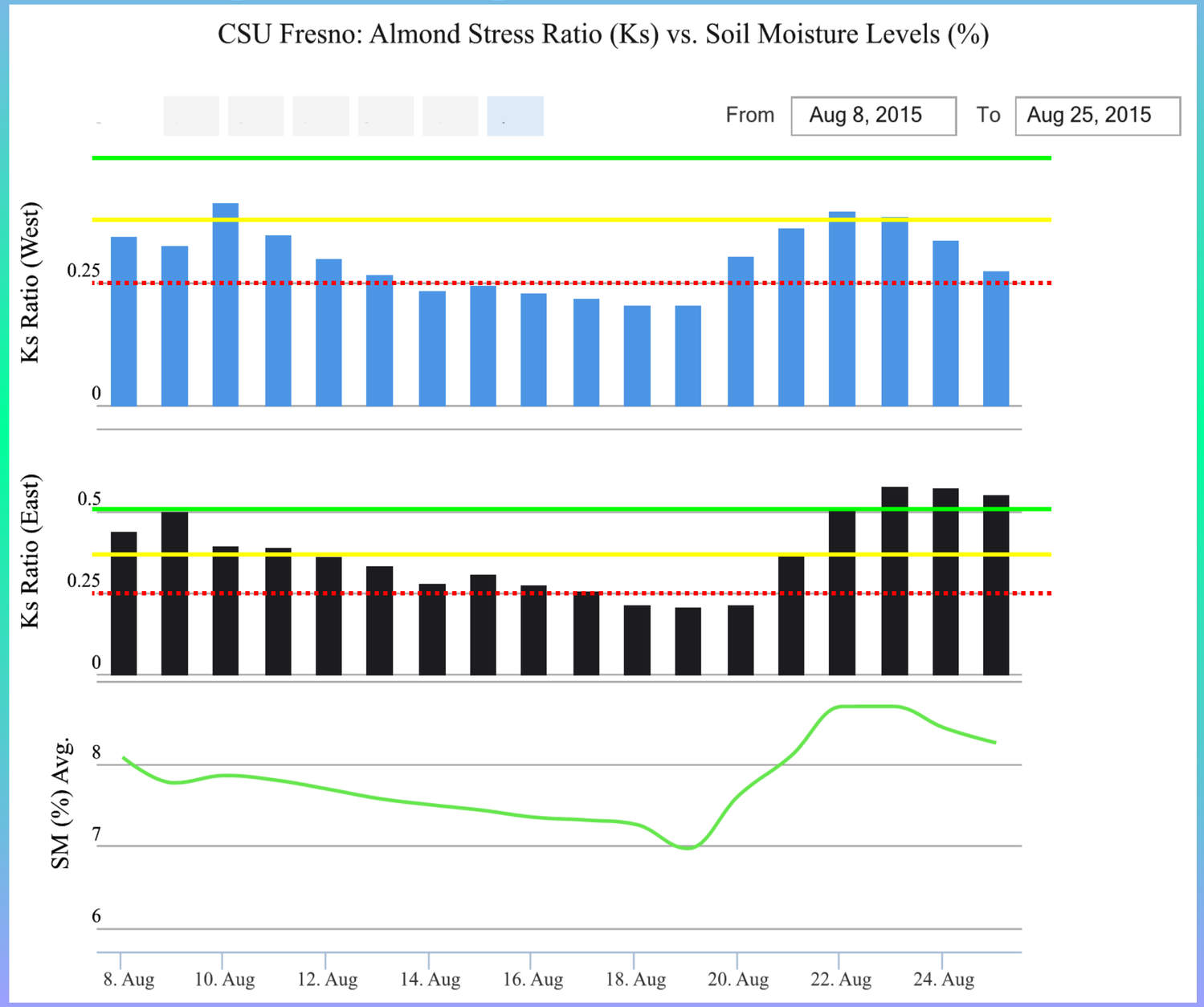


Long Irrigation cut off, followed by 3 short cycles.


CSU Fresno: Almond Stress Ratio (Ks) vs. Soil Moisture Levels (%)
From
Aug 2, 2015
To
Aug 10, 2015
Ks Ratio (West)
0.4
0.2
0
Ks Ratio (East)
0.6
0.4
0.2
0


SM (%) Avg.
10
8
6

Long Irrigation – 380 Gal tree 4 days



W-Limited Recovery

E -Sap flow increases

100% over 3 days

Trees are still Stressed to 52% of Normal Well-Watered Almond

(Kc = Eta/ETo)

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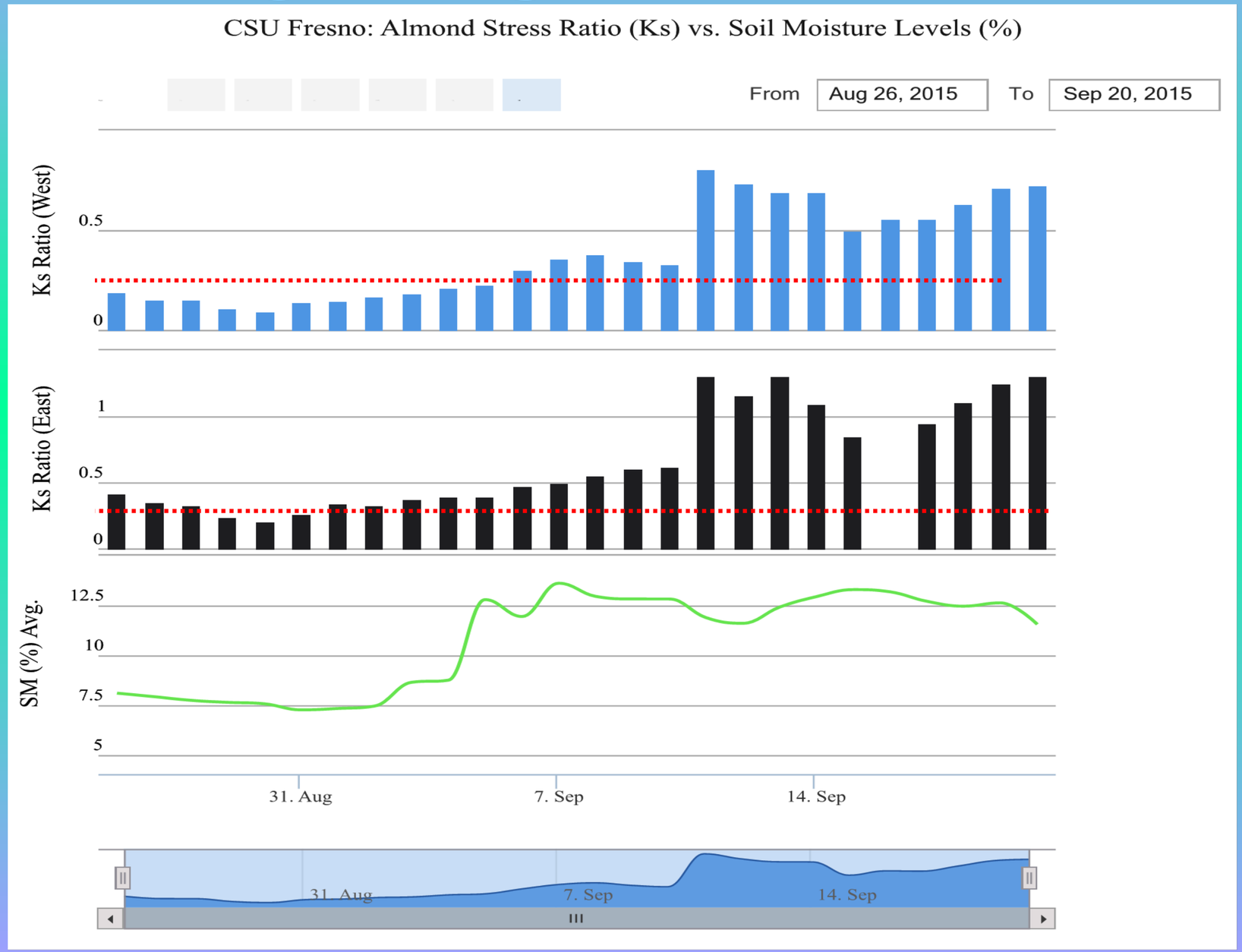

Shells picked up on Sept. 2

Irrigation started Sept. 3, 5, 7 th after harvest

Recovery -As Sap flow increases to over 0.5 Ks factor

Plants Tell You Stress Level by Sap Flow Rate per Hour

Dynamax SapIP monitors plant stress:

- **Plant bio-feedback with Actionable Intelligence**
- **Plant activity – When to Irrigate & How Much**
- **Improve Recovery Time – Avoid Losses**
- **Plant health – When to apply Nutrients**
- **Conserve Water and Energy**
- **Analyzes Stress by Soil and Variety**

New SapIP System Features

- IR Leaf Temperature Stress Measurement
- Chill Factor, Frost Warnings, Alarms
- Mobile Apps for Phones

- **Questions**

How long does it take to install sensors?
Can we sense sap flow in the winter, start of the season?
Can Stress be measured from Nutrients – lack of growth?
Can heat cause stress, and even with high soil moisture?
Why use soil moisture? Will it work as a status tool?
Do we need to measure Pressure Bomb water status?
Do I need an accurate ETo from a local weather station?
How can you use SapIP to conserve water?

Dynamax Fresno, CA

- Serving Central CA, San Joaquin Valley

- WET Center Office
- FSU Almond trial site on campus

- Central CA - Service and support
- On-site install, maintain, and warranty equipment.

- Call us at – 800 – 896 –7108

www.dynamax.com