AVOCADO IRRIGATION SEMINAR

Timing-Scheduling
Influence of Soil and Weather Conditions
Different Irrigation Strategies
Tools Available
Field Experience Discussion

Presented by—
Andres Bascope,
Agricultural Engineer & Avocado Consultant

IRRIGATION SCHEDULING

STEP 1:

Determine Soil Properties: textural classification and Water Holding Capacity

Soil Water Holding Capacity		
Soil Textures	**inches/inch**	
Corse Sand and Gravel	0.02	0.06
Sands	0.04	0.09
Loamy Sands	0.06	0.12
Sandy-Loam	0.11	0.15
Loam and Silt Loams	0.17	0.23
Clay-Loam	0.14	0.21
Clay Loams and Silty-Clay-Loam	0.14	0.21
Silty Caly and Clays	0.13	0.18

Web search: Soil Water Holding Capacity

http://www.ag.ndsu.edu/pubs/ageng/irrigate/eb66w.htm#soil

http://www.noble.org/ag/Soils/SoilWaterRelationships/Index.htm

STEP 2:

Determine Weather Conditions: Crop Evapotranspiration (ETc)

HISTORICAL MONTHLY EVAPOTRANSPIRATION
SANTA PAULA

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Historic Avg Monthly ETo	1.83	2.2	3.42	4.49	5.25	5.67	5.86	5.61	4.49	3.42	2.36	1.83	**46.43**
Kc	**0.65**	**0.65**	**0.7**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.7**	**0.65**	**0.6**	
Daily Avg. ETo	**0.06**	**0.08**	**0.11**	**0.15**	**0.17**	**0.19**	**0.19**	**0.18**	**0.15**	**0.11**	**0.08**	**0.06**	**0.13**
Weekly Avg. ETo	**0.41**	**0.55**	**0.77**	**1.05**	**1.19**	**1.32**	**1.32**	**1.27**	**1.05**	**0.77**	**0.55**	**0.41**	**0.89**
ETo (gal/acre)	49,085	59,009	91,733	120,433	140,818	152,083	157,179	150,474	120,433	91,733	63,301	49,085	**1,245,364**
ETo (AF/acre)	0.15	0.18	0.28	0.37	0.43	0.47	0.48	0.46	0.37	0.28	0.19	0.15	**3.82**
Irrigation (gal/acre)	31,905	38,356	64,213	90,324	105,613	114,062	117,884	112,855	90,324	64,213	41,146	29,451	**900,348**
Irrigation (AF/acre)	0.10	0.12	0.20	0.28	0.32	0.35	0.36	0.35	0.28	0.20	0.13	0.09	**2.76**

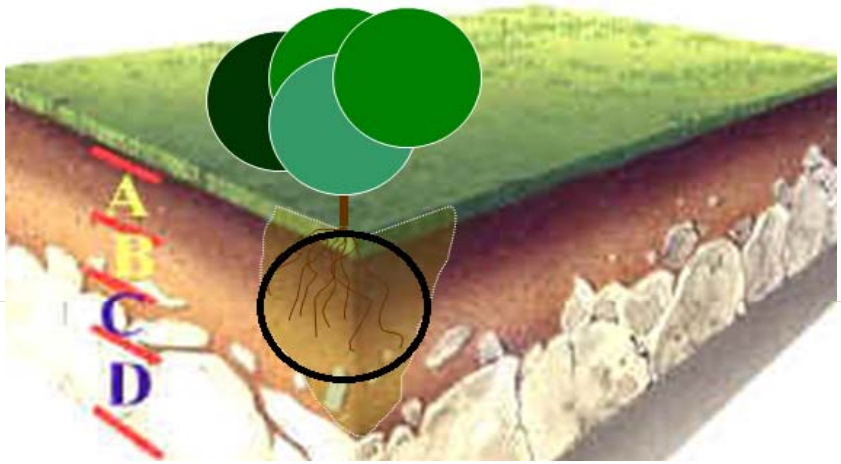
Source: CIMIS. http://wwwcimis.water.ca.gov/cimis/welcome.jsp

STEP 3:

Irrigation Calculator: Combining ETo and Soil Water Holding Capacity (WHC)

Soil Tank Capacity Calculator and Irrigation duration	
Soil Texture Description	Clay-Loam
Soil Tank Capacity ("/inch)	0.2
Root depth (inches)	24
Wet area (%)	0.44
Real Tank Capacity (RTC)	**2.1**
⇩	
RTC	**2.1**
Tank Refilled Point (TRP) (%)	30%
Tank Refilled (inches)	**0.64**
⇩	
Tank Refilled (inches)	0.64
Real Precipitation ("/hr)	**0.13**
Irrigation Time (hrs)	**4.9**

TRP: Maximum: 50%
Spring: 30-40%
Summer: 20-30%



Irrigation Calculator using ETo	
ETo accumulated	**0.4**
daily	**0.12**
Gal/Acre	10729
Kc	0.7
Efficiency	1
Emitters/Acre	109
Emitter (gal/hr)	14.0
Irrigation (gal/acre)	7510
Irrig. in Hrs	**4.9**
Frequency (days)	**3.3**

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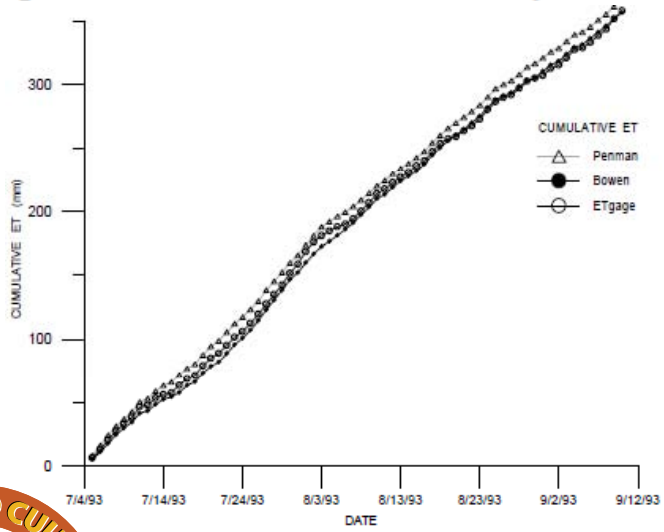
EVAOPTRANSPIRATION (ET gage)

How It Works:

A ceramic evaporator at the top of the instrument responds to sun and weather as plants do. Water is drawn from a reservoir. The water level falls in the sight tube one inch for each inch used by your plants.

Replaceable green canvas covers modify the evaporation rate to simulate ET from field crops or grass.

Rain cannot get into the instrument. The rain gauge, provided with the ETgage, lets you measure rain separately.



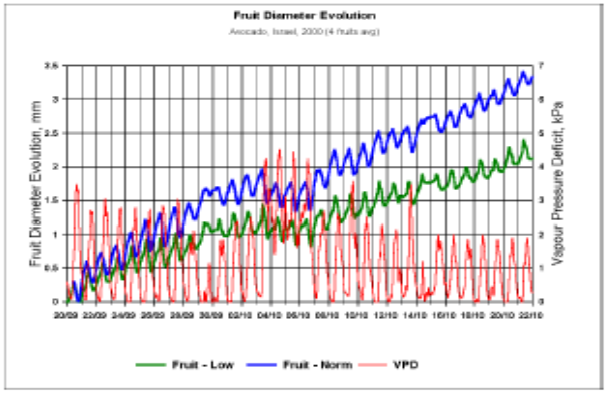
Test Results:

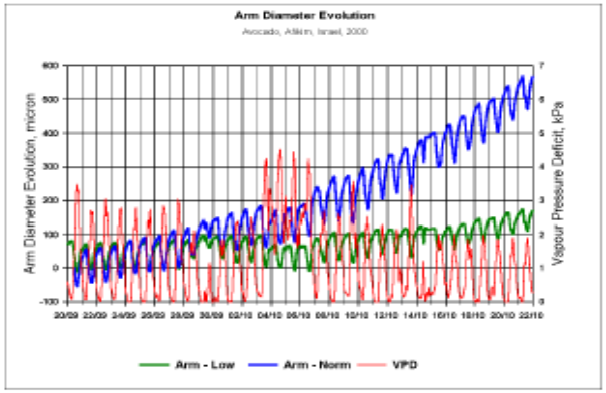
Tests run in various locations since 1988 have shown good agreement with other more expensive ways of measuring ET. The graph at right shows a comparison of the ETgage and two other methods, the Penman equation (using measurements of humidity, temperature, wind, and solar radiation), and a Bowen Ratio Station (a research method that measures the flow of vapor from a crop). The test shows close agreement in a corn crop from July 4 to first freeze at the USDA experiment station in Fort Collins, Colorado. Other data available on request.

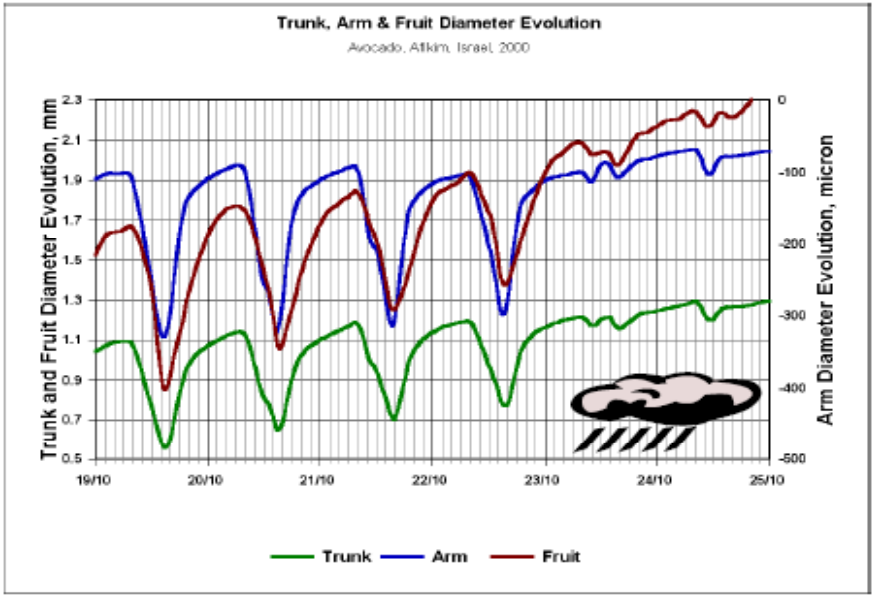
Dendrometers Israel

Example 11. EXAMINING IRRIGATION NORM *(Avocado, Afikim, Israel, 2000)*

As in above-mentioned example, two irrigation regimes were tested for avocado: the norm and 70% of the norm. Lesser-irrigated plants (green curves) had lower fruit growth rate. Behavior of the arm trend was even more differentiated between treatments (see figure to the right).

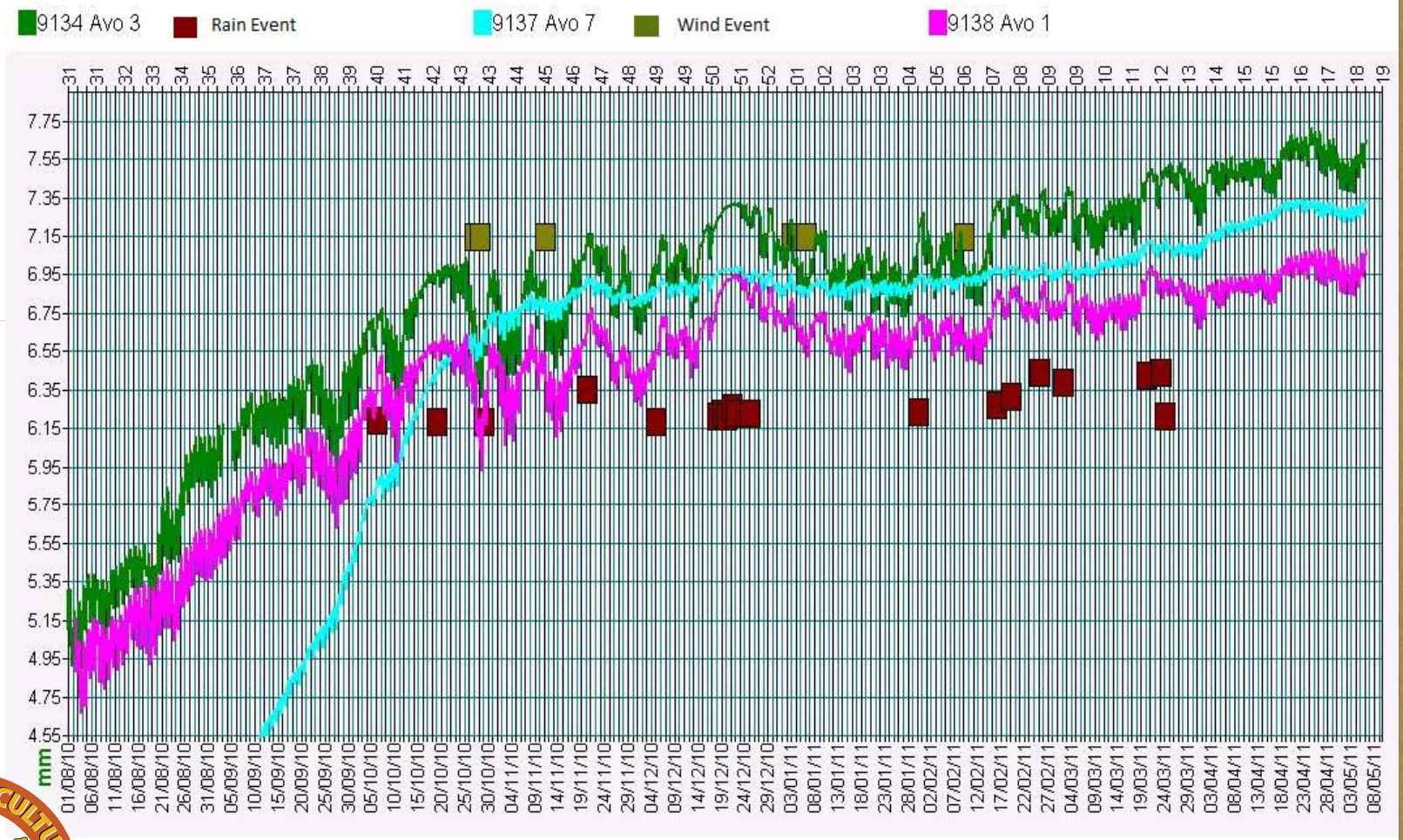






As it is shown in figure at the left, behavior of **trunk**, **arm** and **fruit** of **avocado** were alike in form and trend. Response to rainy conditions, which took place after October 23, was also similar for all objects: daily contraction became much less expressed while the general growth trend turned to more positive value.

Dendrometers ODN Ranch, Somis, Ventura



IRROMETER

Presented by—

Lanny Sowell

IRROMETER COMPANY

- **Established 1951**

- **P.O. Box 2424**
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  Riverside, California
  951.689.1701

- **Tom Penning, President.**

SCHEDULING IRRIGATION

- **WHEN AND HOW MUCH?**
- **Only way to know for sure is to measure it.**

WHY?

- **SAVE MONEY**
- **SAVE WATER**
- **SAVE ENERGY**
- **SAVE LABOR**

MUST KNOW

1. **ROOT ZONE**
2. **IRRIGATION ZONE**
3. **SOIL ZONE**

METHODS

- **Direct Method – soil or plant-based**
- **Indirect Method – ET modeling**
- **Considerations**
- **ACCURACY**
- **COST**
- **ACTUAL VS THEORETICAL**

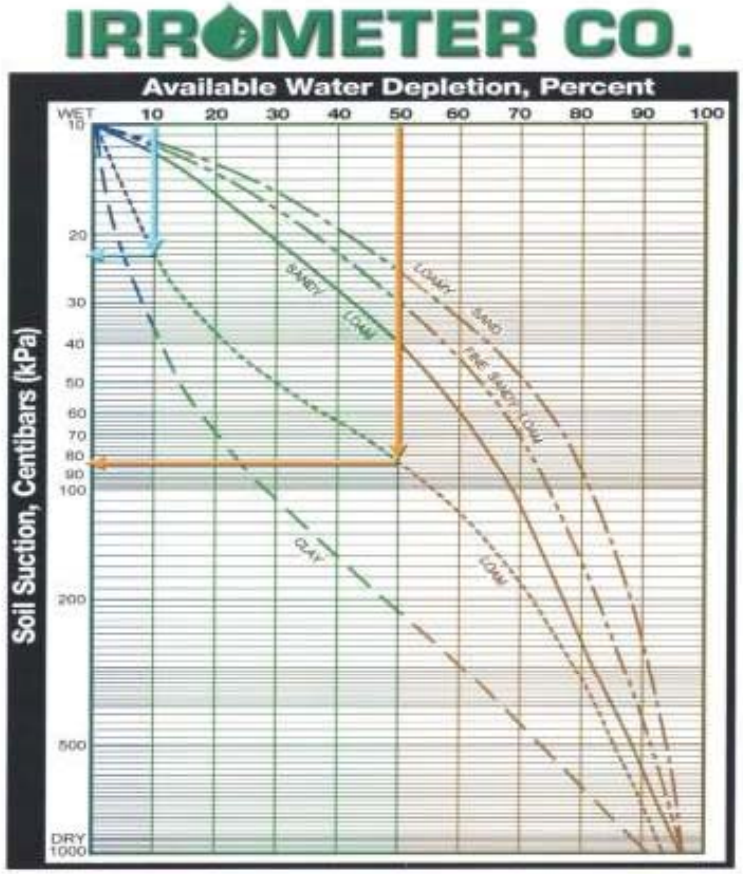
SOIL WATER MEASUREMENT

- **Site Specific**
- **Measure effect of irrigation**
- **Measure effect of rainfall**
- **Measure effect of evaporative loss**
- **Measure effect of crop water use**
- **Can disclose irrigation inefficiencies**

MEASURING SUCTION
VS.
PERCENT MOISTURE

- **Root system reacts to "physical force, not percent"**
- **Soil variability – at site and profile**
- **Ease of data interpretation**

CONVERSION



Graph adapted from: Agronomy No.11 figure 30-2 Irrigation of Agricultural Lands American Society of Agronomy R.M. Hagan, H.R. Haise, T.W. Edminster, editors

EVALUATION OF DATA

- **Rate of change**
- **Effect of soil type**
- **Effect of irrigation method: low frequency vs. high frequency**
- **Crop sensitivity- stage of growth**
- **Leaching**
- **Continuous data**

HOW MANY SENSORS?

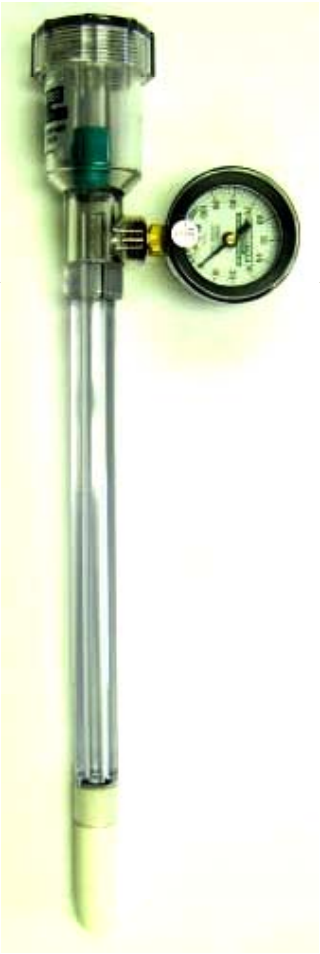
- **One station (group) per irrigation valve.**
- **One station (group) per soil type.**

PLACEMENT OF SENSORS

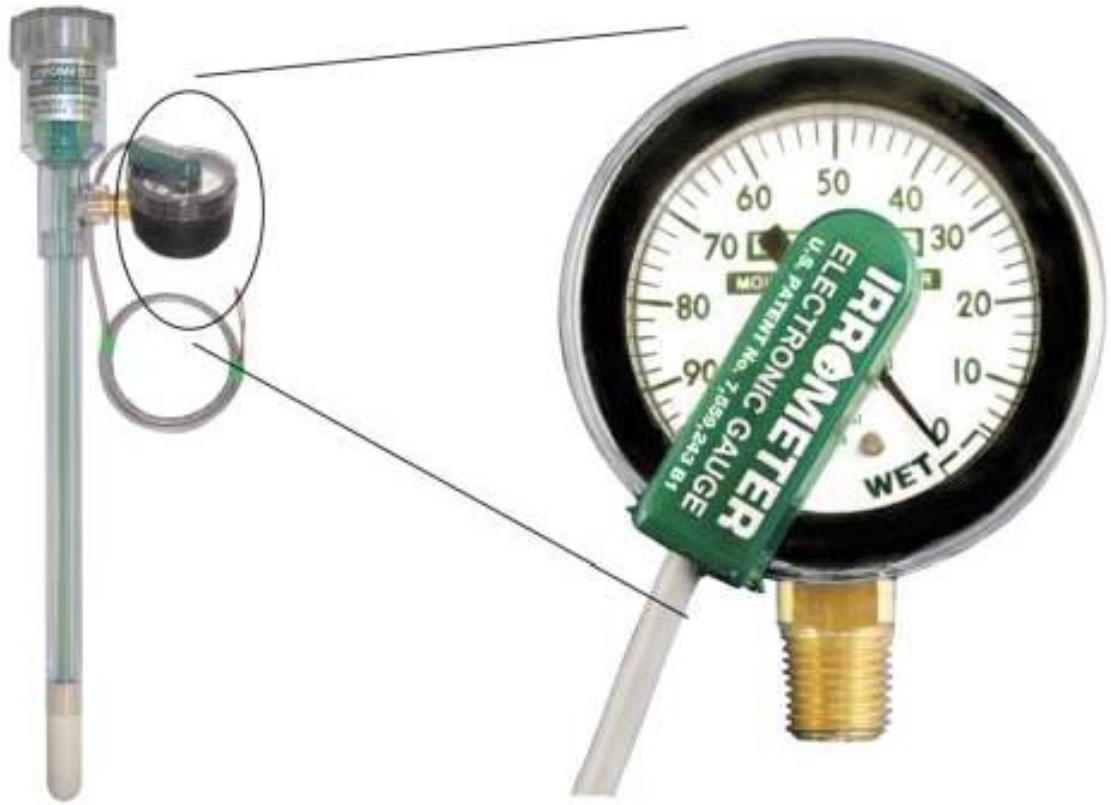
- **Top of root zone**
- **Middle of root zone**
- **Bottom of root zone**
- **In the irrigation zone**
- **Be consistent with placement**

TENSIOMETER

- **Direct method**
- **All soil types**
- **Simple**
- **Reliable**
- **Manual or automatic**
- **MECHANICAL ROOT**



E-GAUGE



WATERMARK

WATERMARK

- **Indirect method**
- **Most soil types**
- **Salinity buffered**
- **Manual or automatic**
- **Stable proven calibration**
- **Low cost**

HANDHELD

DATA LOGGER

WIRELESS

LONG RANGE RADIO

E-NET

SUMMARY

- **SOIL MOISTURE SCHEDULING**
- **PRODUCES BETTER CROPS**
- **PROTECTS WATER RESOURCE**
- **SUSTAINABLE PRACTICE**
- **MAKE MONEY**

REMEMBER. . .

CONTACT

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INNOVATIONS IN SOIL MOISTURE MONITORING

PureSense®
www.PureSense.com

Presented by—
Melissa Naber
888.882.7873

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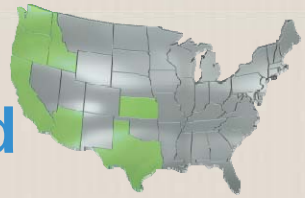
Company Background



- 48 full-time employees
- Serving over 225 customers
- Over 1,300 monitored sites
- 97% renewal rate
  - Now Serving California, Arizona, Oregon, Washington, Idaho Nebraska and Texas

Strong Roots in Agriculture

- Monitoring over 35 different crop types.
- Software developed specifically for agriculture.
- Accommodate a wide range of operation sizes.

Diverse Team

- Development team consists of 9 team members dedicated to keeping the product at the forefront of irrigation management technology.

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Major Crop Types

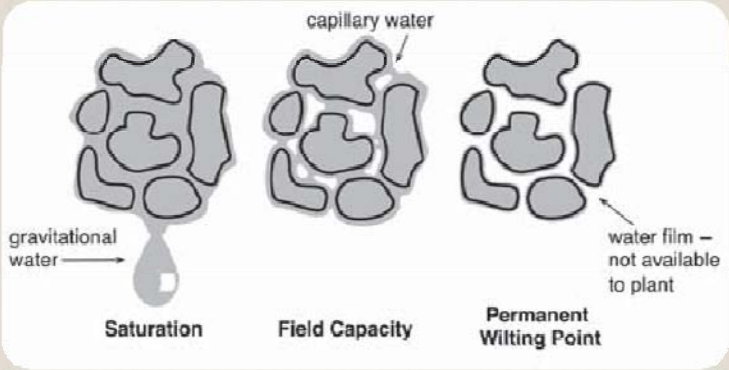
Almonds
Alfalfa
Apples
Avocado
Blueberries
Canola
Carrots
Cherries
Corn
Lemons
Melons
Nursery Crops
Onions
Oranges
Peaches
Pistachios
Pomegranates
Potatoes
Raspberries
Radicchio
Strawberries
Tomatoes
Walnuts
Wine Grapes
Wheat Soybeans

Soil Moisture – What Is It?

Soil Moisture is the water in the pore spaces of a soil PLUS the water held by soil itself.

Soil Moisture Characteristics

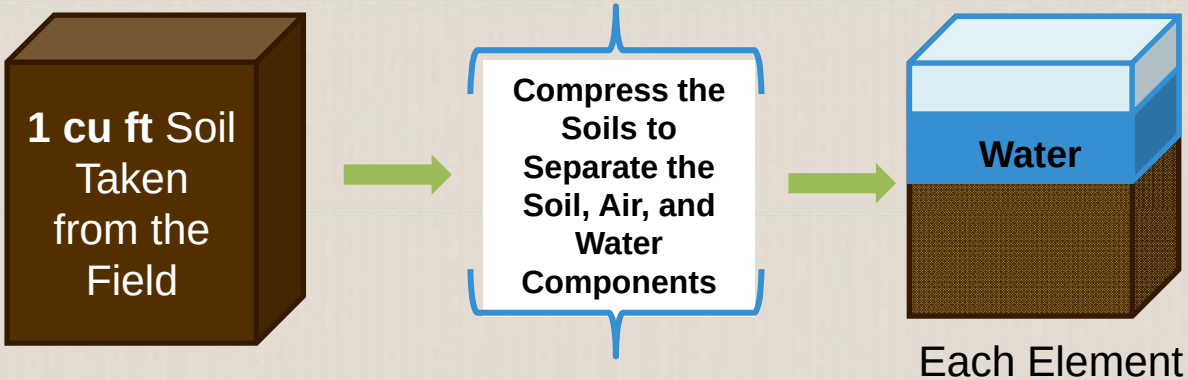
- **Saturation –** All of the pores are filled with water.
- **Field Capacity –** Some water is in the pores, but it no longer drains freely
- **Wilt Point –** Only water held tightly by the soil is present



Water Holding Capacity (WHC) is the total amount of plant-available water when the soil is at field capacity

Measuring Soil Moisture

Capacitance Probes Use Volumetric Soil Moisture

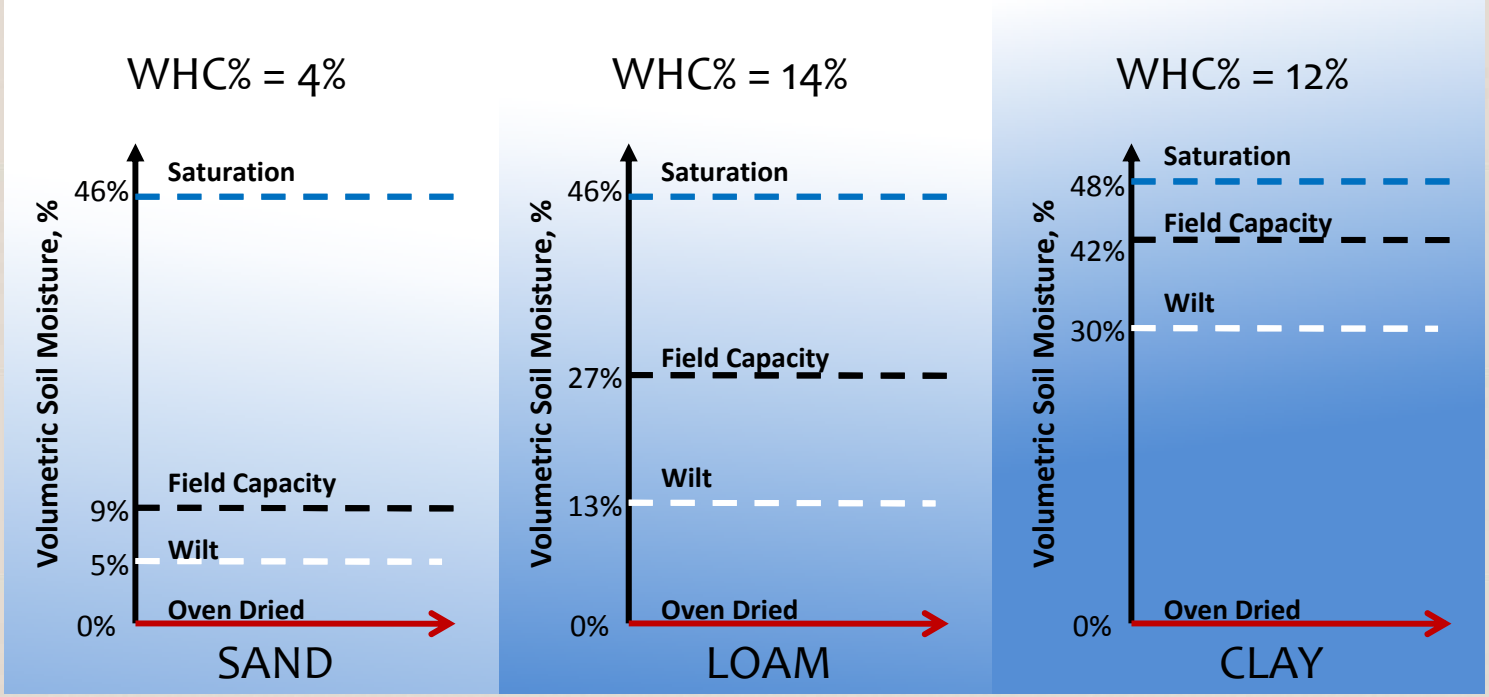


% Air
% Water = VSM
% Soils

Each Element Occupies a Percent of the 1 cu ft Volume

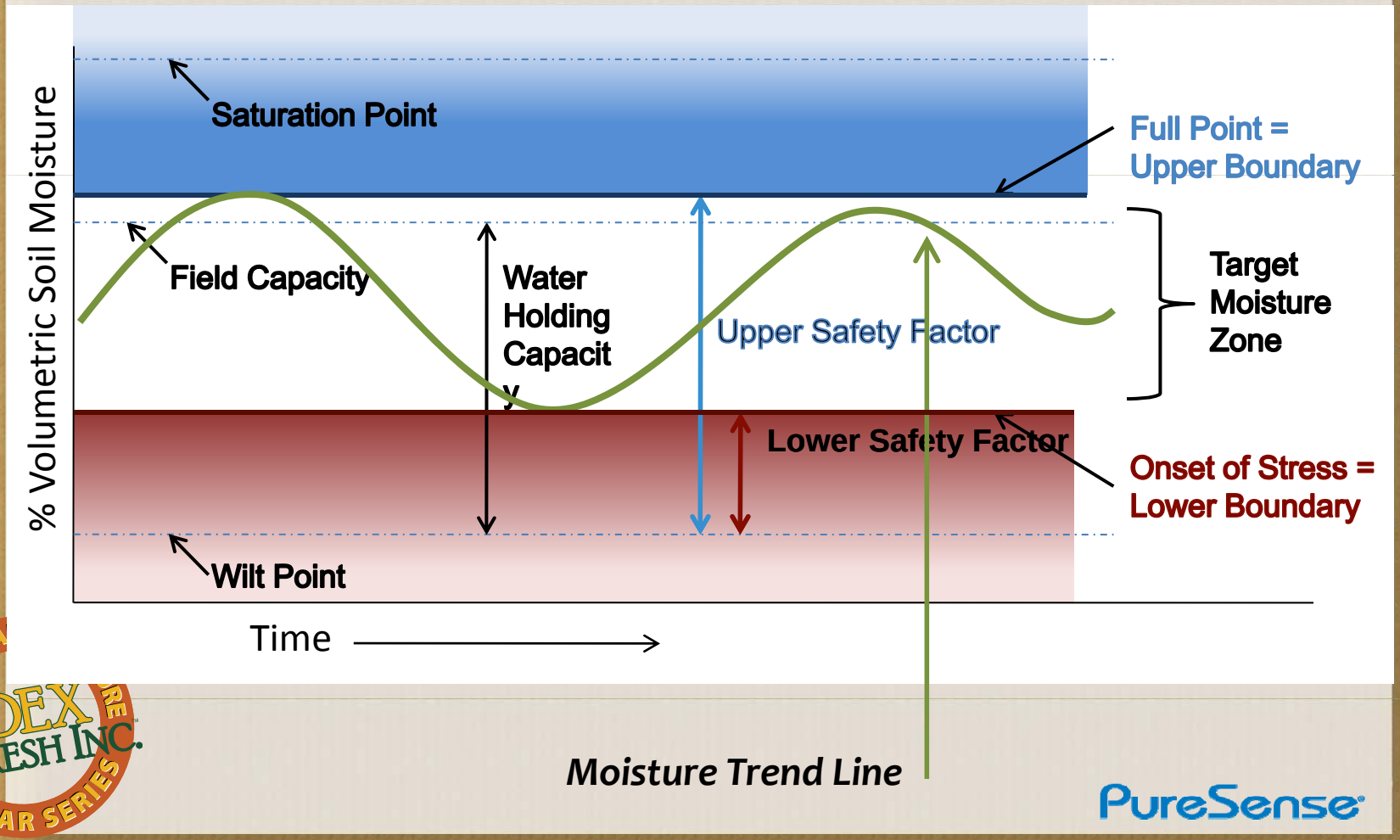
Volumetric Soil Moisture (VSM) is the total water content of soil by volume measured in percent.

Both WHC and VSM Vary Widely with Soil Type

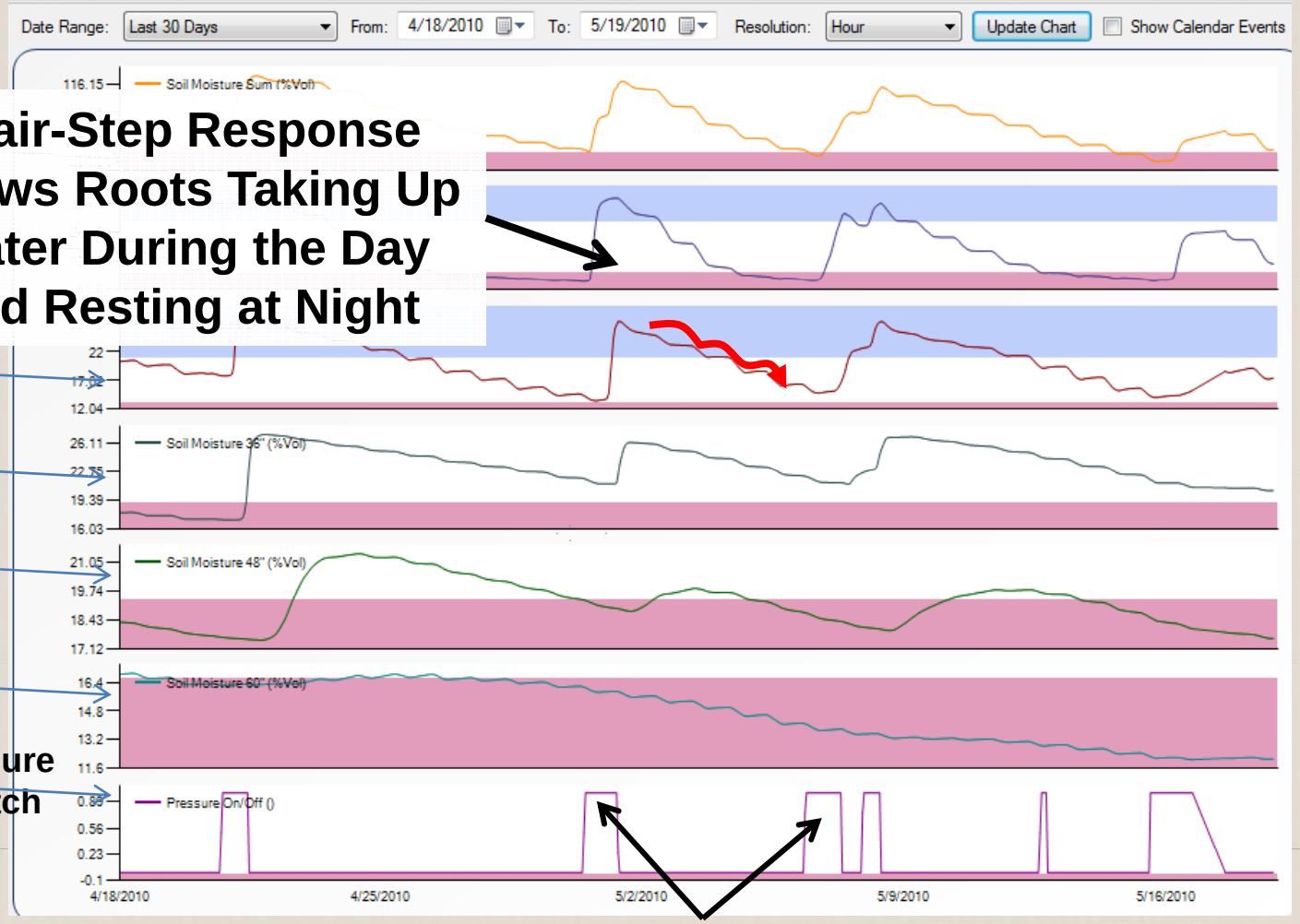


Target Moisture Zone

Making More Accurate Irrigation Decisions



Soil Moisture Response Trends: Root Activity



Stair-Step Response Shows Roots Taking Up Water During the Day and Resting at Night

2 ft

3 ft

4 ft

5 ft

Pressure Switch

Irrigation Events

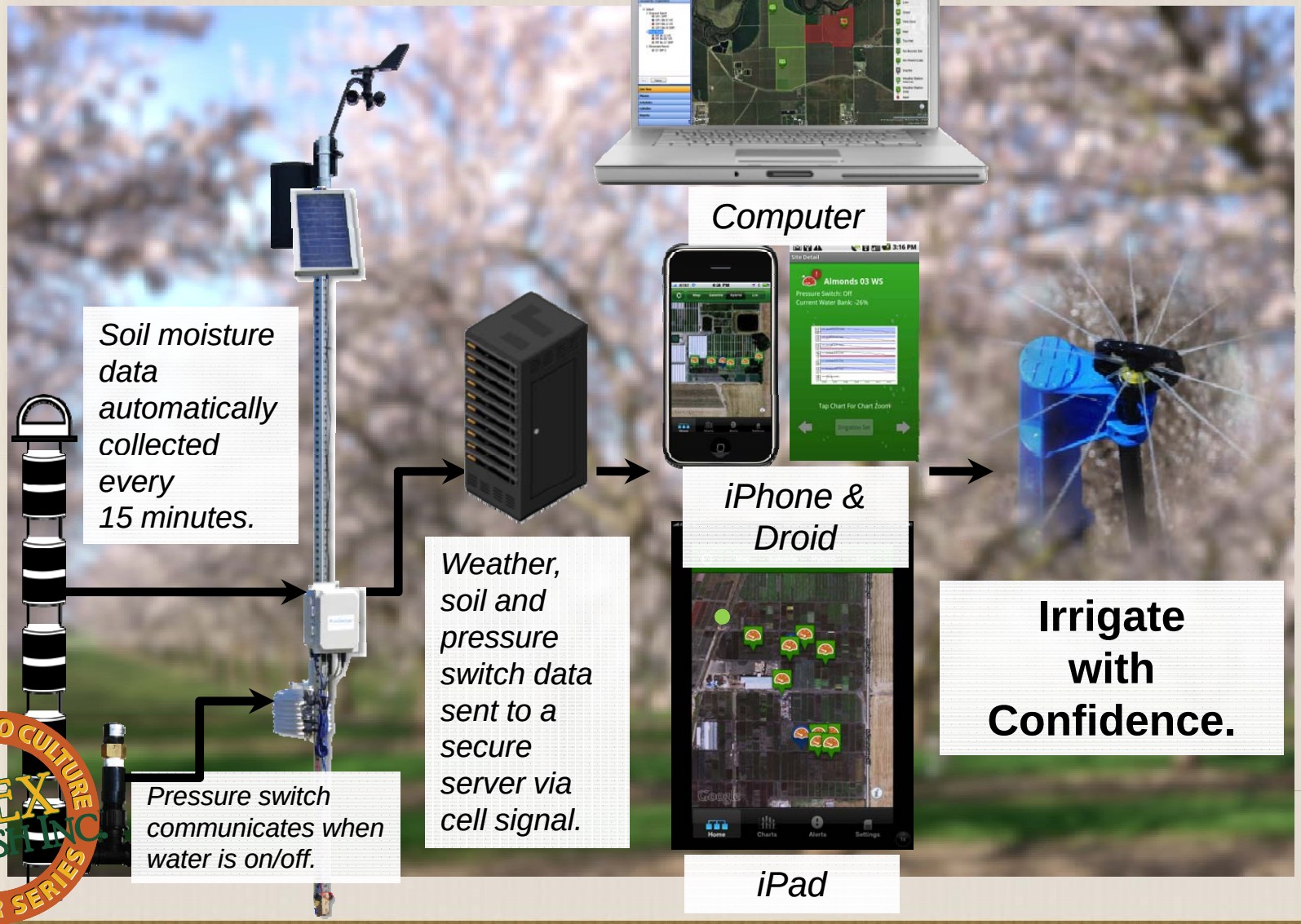
PureSense

How does it all work?

Hardware

- Weather station
- Solar-powered on-board field computer
- Soil probes installed down to 5 ft.
- Pressure switch or rain bucket to capture irrigation event

How It Works



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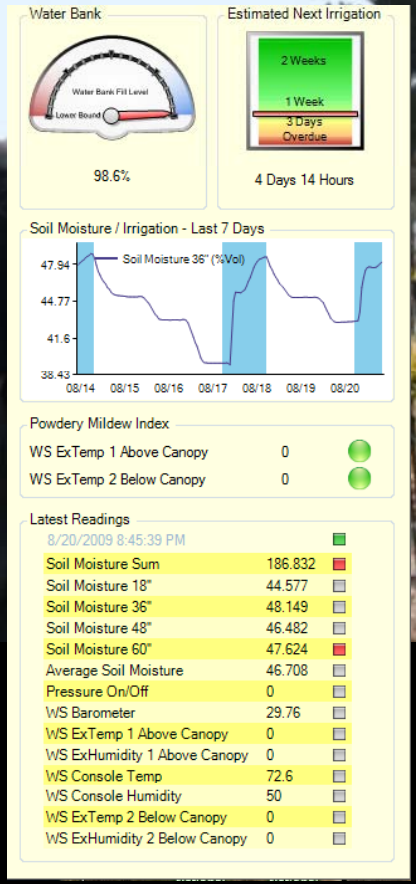
Software



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- Instant readings
- Easy-to-read dashboard
- Training
- Weather reporting-GGD, Heat/Chill hours

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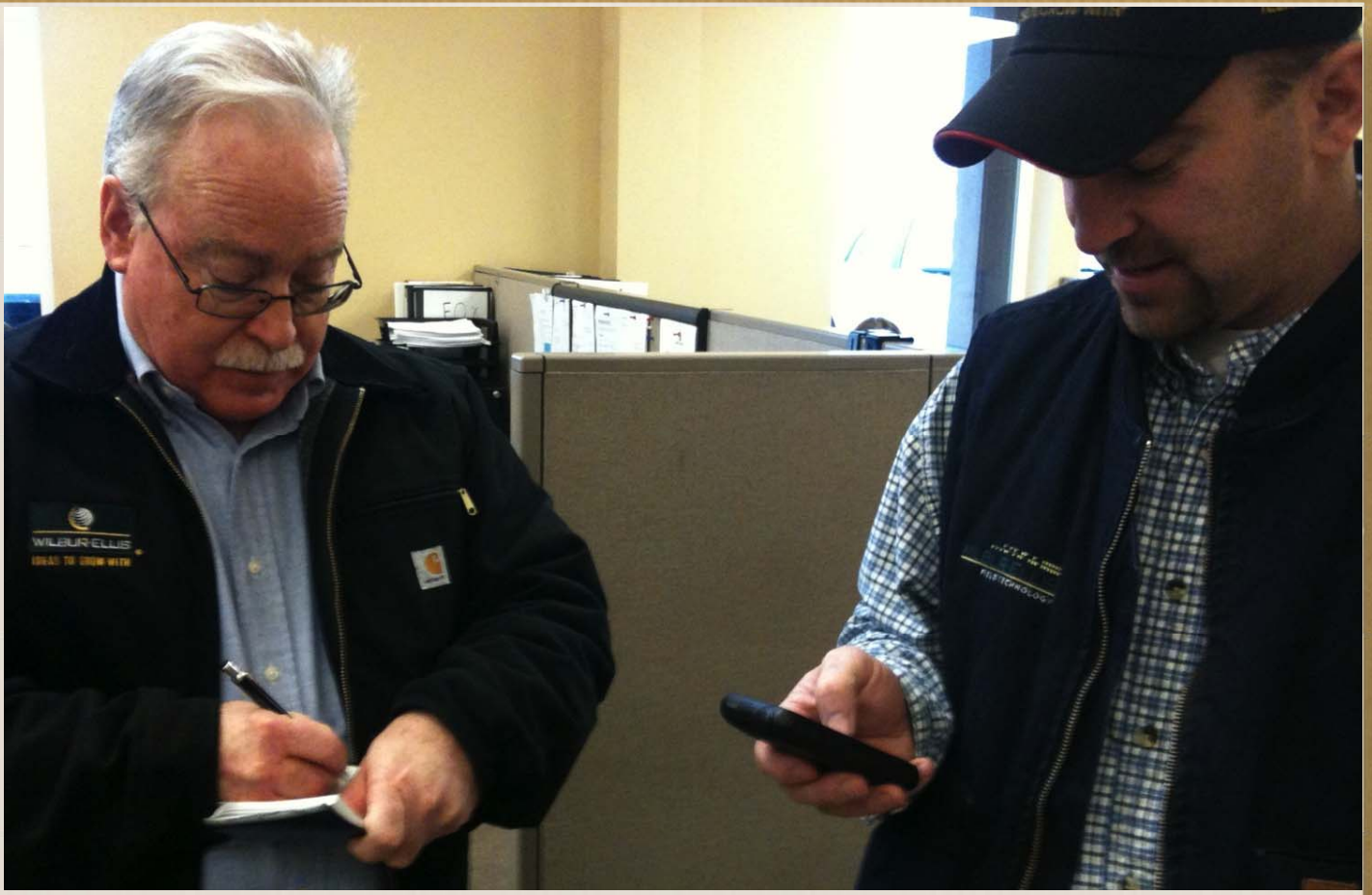

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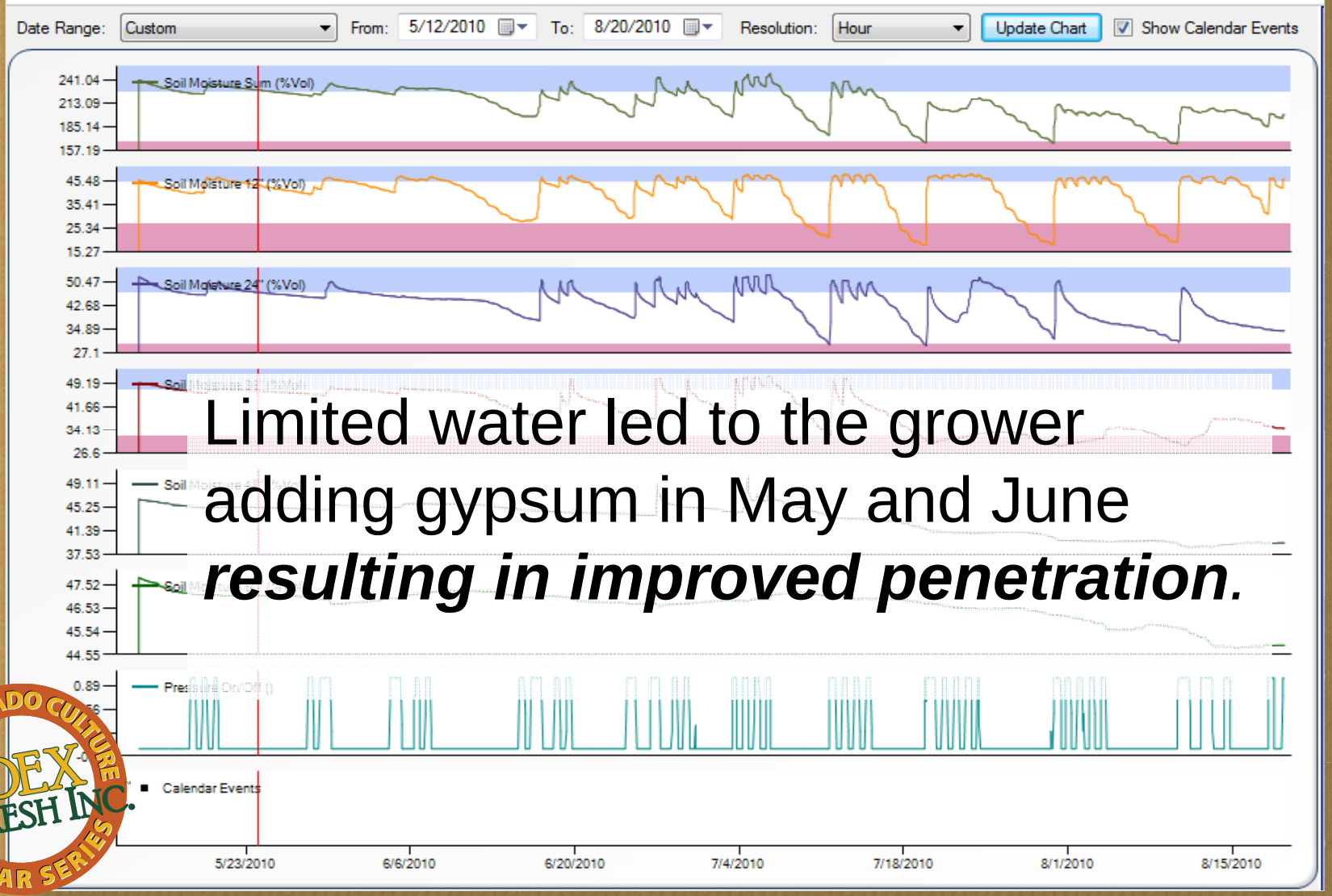
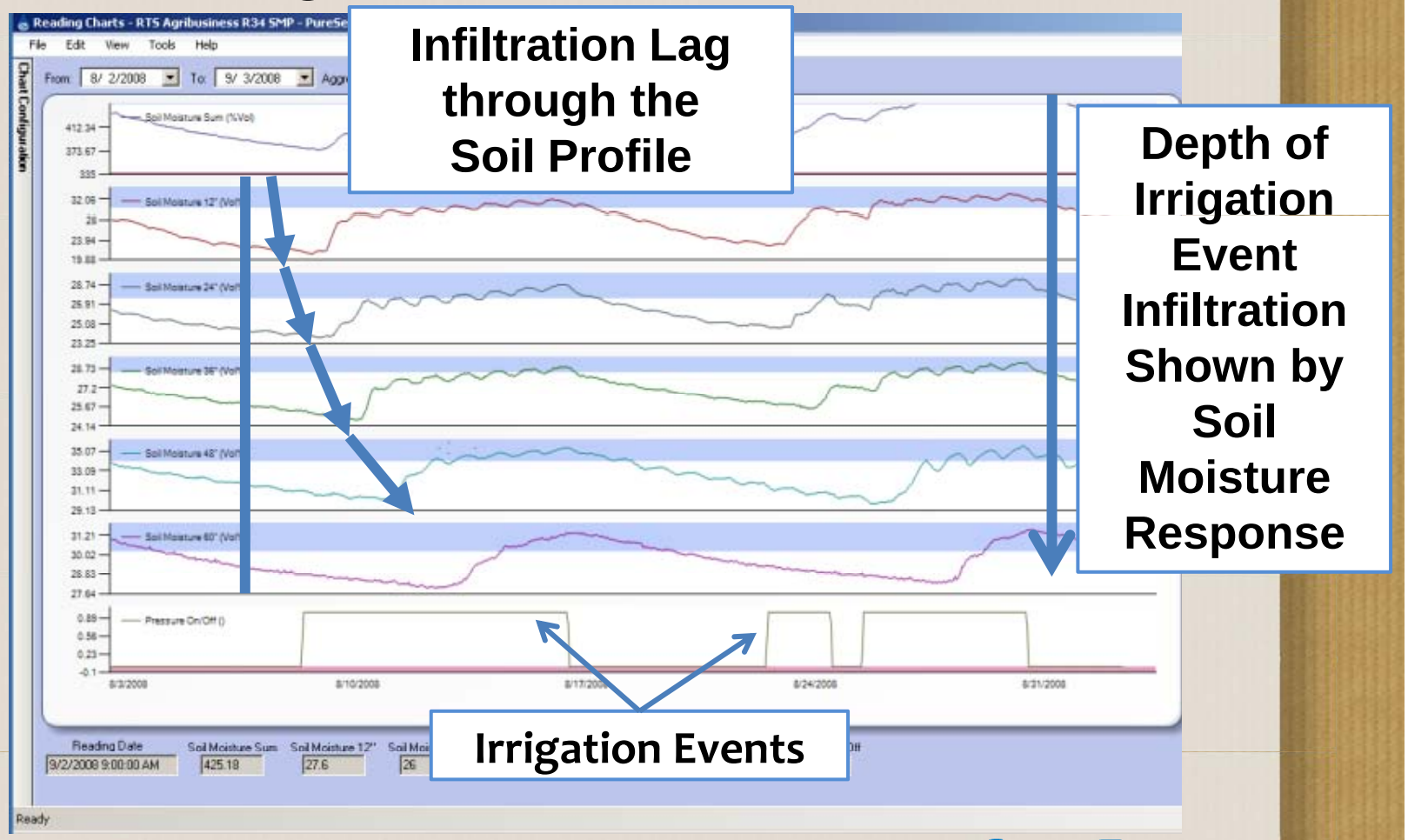
Soil Moisture Response Trends: Root Activity



Limited water led to the grower adding gypsum in May and June ***resulting in improved penetration***.

Soil Moisture Response Trends: Irrigation Infiltration



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