

Introduction

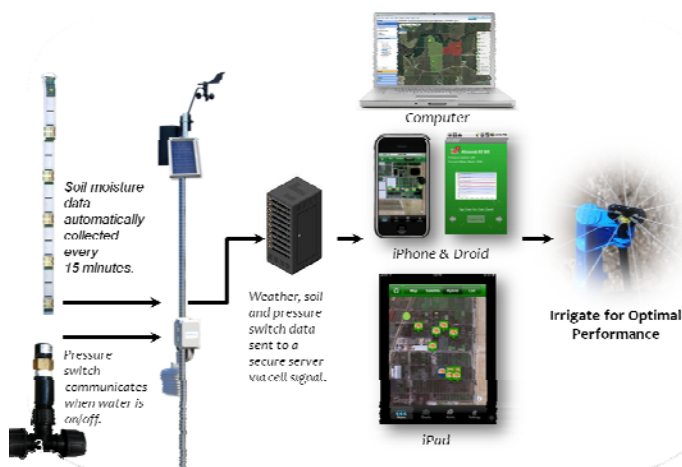
University of California Davis researchers and PureSense joined forces to investigate the effect various cropping systems and approaches have on soil moisture infiltration, retention, and uptake by the crop at the Russell Ranch Sustainable Agriculture Facility.

Selected locations in test plots were monitored by the PureSense mesh field monitoring stations including a base station with full weather system for monitoring local climatic conditions. All of the fields monitored in 2011 produced process tomatoes.

The field research trials had several specific objectives:

- Validate comparability of replicate sensors in detecting soil moisture levels, infiltration and root uptake response, and trends in soil moisture behavior.
- Detect differences in soil moisture profiles based on irrigation methods: drip versus furrow.

PureSense Irrigation Manager: How It Works

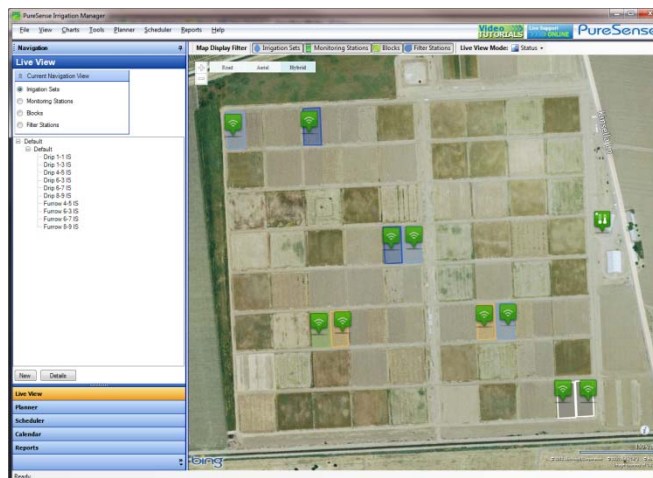
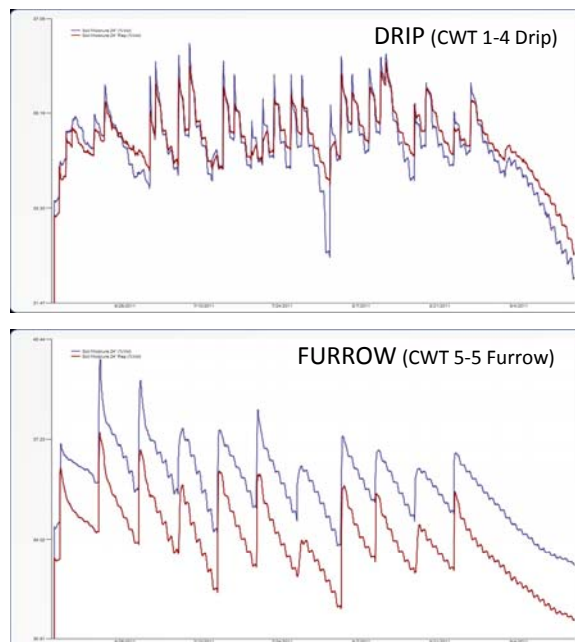


- PureSense Delivers Real-time Field Data Using Wireless Technology. Users access the data and information about their fields using the PureSense Irrigation Manager software application.
- Users can Download the Application onto their Computers, Laptops, or Mobile Devices.
- The Irrigation Manager Software Enables Growers to Check the Soil Moisture Status of their Fields Using the Icons Mapped on their Fields.
- The Color of the Monitored Fields Also Show the Current Moisture Condition.
- Summary Information is Available for Growers by Rolling their Cursor Over the Icons on the Map.
- Standard Charts and Reports are Available to provide Growers with Visible Trends and Documentation About their Irrigation Operation.

Data Quality & Validation

- Data Delivery by the PureSense Irrigation Manager Systems averaged 99% Complete for the 2011 Field Trials
- Soil Moisture Data Proved to be Highly Repeatable – 7.3% Relative Error
- Ec Measures Showed Higher Variability in Measures – 28% Relative Error

Excellent Agreement in Soil Moisture Response at Russell Ranch



Irrigation Event Characterization

- Irrigation Event Tracking is Important for All Growing Operations
- Pressure Measurements were Used to Indicate Irrigation Events and the Duration of Such Events.
- Soil Moisture Data Can Be Used to Confirm Irrigation Events and Provide an Independent Estimate of Irrigation Event Duration.
- Additionally, Soil Moisture Data Can Be Used to Evaluate Infiltration Response of the Soil Profile to Irrigation Events:

$$\square \Delta VSM_{(t_2 - t_1)} * \text{Depth, Inches when } \Delta VSM_{(t_2 - t_1)} > 0$$

Irrigation Efficiency Using Real-time Soil Moisture Data

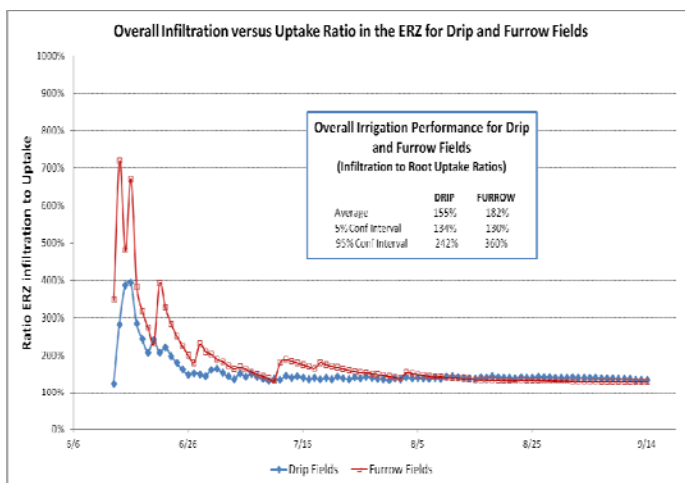
- Tracking Whether the Irrigation Operation Meets Plant Water Demand is One Key Measure of Irrigation Efficiency
- Plant Water Demand was Found Based on Changes in Soil Moisture Over Time

$$\square \Delta VSM_{(t_2 - t_1)} * \text{Depth, Inches when } \Delta VSM_{(t_2 - t_1)} < 0, \text{ during daylight hours, and when drainage flags are not triggered}$$

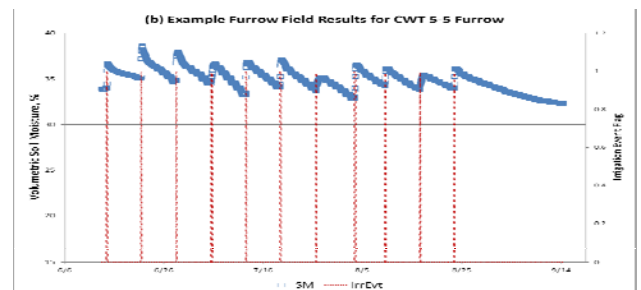
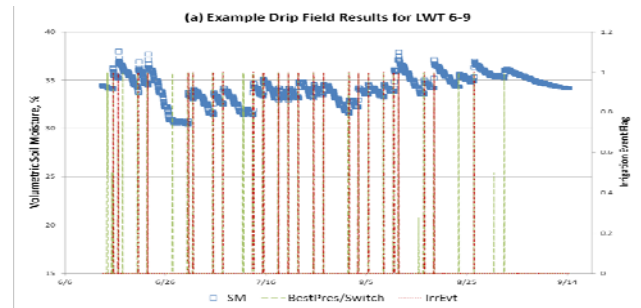
- The Depth of the Effective Root Zone (ERZ) was Defined as that Depth where $\geq 70\%$ of the Crop Water Uptake Occurs
- Comparison of the Infiltrated Water (Inches) to the Crop Water Demand (Inches) within the ERZ Provides a Reasonable Indicator of Irrigation Efficiency

$$\square \text{Efficiency \%} = \text{Infiltration Inches/Crop Uptake Inches (Totals for all measured depths within the ERZ)}$$

Irrigation Efficiency for Drip and Furrow Fields



Soil Moisture Change Used Successfully to Detect Irrigation Events



Helping Growers Schedule Irrigation Using Field & Crop-Specific Kc Values

- Crop Water Demand Using Soil Moisture Changes Can be Used to Help Schedule Irrigation by Determining Crop and Field Specific Kc Factors During Crop Production.
- The Total Crop Water Demand for a defined period of time (e.g., 7-Days) can be Determined Using Changes in Soil Moisture Measures and Compared to the Total Eto for that Same Period of Time.
- Crop Kc Factors Using Real-time Soil Moisture Data Reflects a Grower's Actual Crop Load and Climatic Conditions.

Using Soil Moisture to Estimate Crop Kc Factors for Irrigation Scheduling

