Precision Agriculture: Sensors for Irrigation Management

Cotton Inc.
Crop Management Seminar 2010

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University of Tennessee
West Tennessee REC
Water and Fuel Management

Historical Crop Water Use

Actual Crop Water Use

Soil Moisture Measurement

Irrigation System

Soil Water Holding Capacity
Soil Water Sensing Methods

- Resistance
- Tension
- Neutron Scattering
- FDR & TDR
- Dielectric Constant
Many More Sensor Configurations
In a Silt Loam close to Sandy Loam
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnviroSCAN</td>
<td>4.31 in/ft</td>
</tr>
<tr>
<td>TDR</td>
<td>4.17 in/ft</td>
</tr>
<tr>
<td>Trime</td>
<td>3.53 in/ft</td>
</tr>
<tr>
<td>AquaTel</td>
<td>3.08 in/ft</td>
</tr>
<tr>
<td>Troxler RF</td>
<td>3.08 in/ft</td>
</tr>
<tr>
<td>Neutron Probe</td>
<td>2.90 in/ft</td>
</tr>
<tr>
<td>Tensiometer</td>
<td>2.51 in/ft</td>
</tr>
<tr>
<td>WaterMark</td>
<td>2.45 in/ft</td>
</tr>
</tbody>
</table>
Application in Irrigation Scheduling

- As a marker, sensor must be consistent.

- Measure changes in soil water, sensor must have relative accuracy of scale.

- Best communication with others, sensors must be calibrated absolute accuracy.
Soil Water Sensors in Cotton Irrigation Experiment, WTREC, Jackson, TN
Soil Tension with WaterMark Sensors in Deficit Cotton Experiment
2006 Deficit Irrigation of Cotton
Average of 9" & 24" Sensors, Jackson, TN

Tension in cbars

-200 -150 -100 -50 0 50 100 150


GS1 100% 7.9" +162lb
GS1 33% 2.6" +301lb
GS2 100% 4.3" +299lb
GS2 66% 2.8" +253lb
Dryland 1566lb
AquaSpy Capacitance Probe in Deficit Cotton Experiment
Sample of Real Time, AquaSpy Data
2009 Highest Irrigated Plot
Smartfield Canopy Temperature in Deficit Cotton Experiment
Sample of Smartfield Data in 2010

Irrigated and Rainfed in Shallow Soil over Sand

Canopy Temperature

- Ambient Temp
- Plot 608 - 1"/wk at Flower
- Plot 609 - Rainfed
BENEFITS TO CONSIDER

- INCREASE YIELD
- IMPROVE QUALITY
- CONSERVE WATER
- SAVE ENERGY
- DECREASE FERTILIZER
- REDUCE NON-POINT POLLUTION
FACTORS TO CONSIDER

- ACCURACY
- INITIAL COST
- SET-UP REQUIREMENTS
- ROUTINE READINGS
- INTERPRETATION OF READINGS
- COMPATIBLE w/ FARM PRACTICES
- AMORITIZED COST
## Potential Value of Well Managed Deficit Irrigation

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Rainfed</td>
<td>$444,200</td>
<td>$113,400</td>
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<tr>
<td>Irrigation: 2.5” &lt; Optimum</td>
<td>$557,600</td>
<td>$57,600</td>
</tr>
<tr>
<td>Optimum Irrigation</td>
<td>$615,200</td>
<td>$52,600</td>
</tr>
<tr>
<td>Irrigation: 2.5” &gt; Optimum</td>
<td>$562,600</td>
<td>$118,600</td>
</tr>
</tbody>
</table>