Techniques for Scheduling Furrow Irrigation: Introduction of the STAMP Decision Tool

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Introduction

• Irrigated acreage has increased
  • 30% in 2011
  • 49% in 2017

• Of the current acreage, approximately
  • 80% is furrow-irrigated
  • 20% is sprinkler-irrigated

• USGS estimates that irrigation consumption continues to increase despite recent wetter conditions

Key to irrigation → Right time, right place, and right amount
Introduction

- Mid-South put focus on soil moisture sensors
  - Louisiana’s efforts
    - Plot studies repeated on three soil types using two sensor types in 2015/2016
    - Various demonstrations conducted with farmers across the state
Introduction

- What needs to be considered?

<table>
<thead>
<tr>
<th>Soil sensor-based system</th>
<th>Weather-based system</th>
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</thead>
<tbody>
<tr>
<td>Soils information</td>
<td>Soils information</td>
</tr>
<tr>
<td>• Available water holding capacity</td>
<td>• Available water holding capacity</td>
</tr>
<tr>
<td>• Compaction</td>
<td>• Compaction</td>
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<tr>
<td>• Irrigation threshold</td>
<td>• Irrigation threshold</td>
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<tr>
<td>• Sensor selection</td>
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<tr>
<td>Types of readings</td>
<td>Reliable weather data</td>
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<tr>
<td>Processing infrastructure</td>
<td>Processing infrastructure</td>
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<tr>
<td>Communication infrastructure</td>
<td>Plant variety information</td>
</tr>
<tr>
<td>Installation methods/requirements</td>
<td>• Planting date</td>
</tr>
<tr>
<td></td>
<td>• Growth stages</td>
</tr>
<tr>
<td></td>
<td>• Crop coefficients</td>
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</tbody>
</table>

Objective: Develop a basic decision tool to determine when to trigger furrow irrigation events based on plant water requirements for agronomic crops
Materials and Methods

ETc  Rain  Irrigation

Saturation  Field Capacity  Maximum Allowable Depletion
Permanent Wilting Point

Deep Percolation  Surface Runoff
Materials and Methods

- Soil water balance

### Soil Water Balance for Crop Irrigation Management

<table>
<thead>
<tr>
<th>Period</th>
<th>Suggested DAP</th>
<th>Crop Coefficient</th>
<th>Suggested Kc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>0</td>
<td>0.30</td>
<td>0.56</td>
</tr>
<tr>
<td>Development</td>
<td>35</td>
<td>No input</td>
<td>Linear</td>
</tr>
<tr>
<td>Mid</td>
<td>61</td>
<td>No input</td>
<td>Linear</td>
</tr>
<tr>
<td>Late</td>
<td>92</td>
<td>No input</td>
<td>Linear</td>
</tr>
<tr>
<td>Last Irrig. Event</td>
<td>96</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### User Inputs
- Field Size (acres)
- Crop Type
- Soil Type
- Initial Moisture Conditions
- Planting Date: 4/1/16
- Season length (days)
- Field Capacity (in./in.)
- Permanent Wilt Point (in./in.)
- Maximum Allowable Depletion (%)
- Maximum Root Depth (in.)

#### Cell Values

<table>
<thead>
<tr>
<th>Date</th>
<th>Days After Planting</th>
<th>Root Depth (in.)</th>
<th>Field Capacity (FC) (in.)</th>
<th>Permanent Wilt Point (PWP) (in.)</th>
<th>Refill Point</th>
<th>Starting Water Level (SWL1) (in.)</th>
<th>Reference ET (ET0) (in.)</th>
<th>Reference ET with Projections (ET0) (in.)</th>
<th>Kc</th>
<th>Crop ET (ETk)</th>
<th>Total Rainfall (Rt) (in.)</th>
<th>Effective Rainfall (Rf) (in.)</th>
<th>Effective Irrigation (Ir) (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1</td>
<td>0</td>
<td>10</td>
<td>3.0</td>
<td>1.4</td>
<td>2.21</td>
<td>3.03</td>
<td>0.00</td>
<td>0.00</td>
<td>0.30</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Materials and Methods

• Treatment 1 – Irrometer Watermark

• Treatment 2 – Decagon GS1 → 5 sensor depths

• Treatment 3 – Weekly irrigation

• Cotton, sandy clay loam – Bossier City

• Soybean, silt loam – Winnsboro

• Soybean, cracking clay – St. Joseph
Results

- Cotton on sandy clay loam
  - Planted on June 8, 2015
Results

• Comparison of soil moisture sensor estimates and soil water balance
  • 2015 Cotton on sandy clay loam
Results

• Comparison of soil moisture sensor estimates and soil water balance
  
  • 2015 Cotton on sandy clay loam

  Actual Irrigation Events = 5
  Predicted Irrigation Events = 6

  3 day delay
  (7/21 → 7/24)
Results

• Comparison of soil moisture sensor estimates and soil water balance
  • 2016 Cotton on sandy clay loam
Results

• Comparison of soil moisture sensor estimates and soil water balance
  
  • 2016 Cotton on sandy clay loam

Actual Irrigation Events = 2
Predicted Irrigation Events = 2
Results

- Cotton on sandy clay loam
- Planted on May 11, 2016
Results

• 2016 cotton on sandy clay loam
  • Conventional tillage
  • Compaction?
Preliminary Conclusions

• Cannot remove the human component to irrigation!

• A soil water balance is a decent option if sensors are impractical considering cost and management style
  • Better to incorporate field characteristics and infiltration, too
  • A combination of the two would be great!

• Need to verify model in heavier soil types!

• Simple, practical approaches to on-farm water management should be encouraged before technologies
Next Steps...

• Continue testing! Soil water retention curves...

• Write manual and provide full release of tool

• Look at incorporating furrow irrigation models, infiltration, GDD, computerized hole selection, etc.
Questions?

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