Options for Estimating Plant Water Requirements for Irrigation Scheduling in Louisiana

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State Irrigation Specialist
Introduction

• Water use continues to increase across all sectors
• Pattern exists between cultivated cropland and water use for irrigation
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

• Example sensor data from on-farm demonstrations
**Introduction**

- What needs to be considered?

<table>
<thead>
<tr>
<th>Soil sensor-based system</th>
<th>Weather-based system</th>
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<tbody>
<tr>
<td>Soils information</td>
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<tr>
<td>• Available water holding capacity</td>
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<td>• Compaction</td>
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<td>• Irrigation threshold</td>
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<td>• Sensor selection</td>
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<td>Types of readings</td>
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<td>Installation methods/requirements</td>
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<td>• Growth stages</td>
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<td>• Crop coefficients</td>
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Introduction

• Hypothesis: A soil water balance can be used to schedule irrigation in the mid-south

Objective 1: Develop a basic decision tool to determine when to trigger furrow irrigation events based on plant water requirements for agronomic crops

Objective 2: Determine the availability and quality of publically available ETo and rainfall data for use in the decision tool
Objective 1: Soil Water Balance

Crop Evapotranspiration
Effective Rainfall
Effective Irrigation
Surface Runoff
Deep Percolation
**Objective 1: Soil Water Balance**

- Soil water balance

[Excel spreadsheet with red and blue annotations]

**Red: Mandatory information**

**Blue: User inputs**

### Soil Water Balance for Crop Irrigation Management

**Version 1.5 (last Updated 8/30/2016)**

Created by Stacia L. Davis, Ph.D.

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<table>
<thead>
<tr>
<th>Date</th>
<th>Days after Planting</th>
<th>Root Depth</th>
<th>Field Capacity (in.)</th>
<th>Permanent Wilting Point (in.)</th>
<th>Refill Point (in.)</th>
<th>Starting Water Level (SWL) (in.)</th>
<th>Reference ET (in.)</th>
<th>Reference ET with Projections (in.)</th>
<th>Crop ET (in.)</th>
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Objective 1: Measured Soil Moisture

• 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
Objective 1: Measured Soil Moisture

- Measured soil moisture

![Graph showing soil moisture content over time and depth](image-url)
Objective 1: Results

• Comparison of soil moisture sensor estimates and soil water balance
  • 2016 Cotton on sandy clay loam
Objective 1: 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
Objective 1: Results

• Cotton on sandy clay loam
  • Planted on May 11, 2016
Summary

• Hypothesis: A soil water balance can be used to schedule irrigation in the mid-south

Objective 1: Develop a basic decision tool to determine when to trigger furrow irrigation events based on plant water requirements for agronomic crops

Objective 2: Determine the availability and quality of publically available ETo and rainfall data for use in the decision tool
Objective 2: Available Data

- LSU AgCenter Weather Station Network - LAIS
Objective 2: Available Data

- ASCE Standardized ETo Equation
  - Temperature
  - Relative Humidity
  - Solar Radiation
  - Windspeed

\[
ET_{ref} = \frac{0.408\Delta(R_n - G) + \gamma \frac{C_n}{T + 273} (e_s - e_a)u_2}{\Delta + \gamma(1 + C_d u_2)}
\]
Objective 2: Atmometer Study

Red River Research Station
Bossier City, LA

Dean Lee Research Station
Alexandria, LA
Objective 2: Results

- Red River Research Station, Bossier City, LA
  - Cumulative totals
Objective 2: Results

- Red River Research Station, Bossier City, LA
- Daily summary

![Graph showing ETo (in) over dates from 3/19 to 8/13 in 2019, with lines for Atm1 ETo, Atm2 ETo, Atm3 ETo, and WS ETo.]
Objective 2: Results

- Dean Lee Research Station, Alexandria, LA
- Cumulative totals
Objective 2: Results

- Dean Lee Research Station, Alexandria, LA
  - Daily summary
Objective 2: Results

- Rainfall comparison to weather station

<table>
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<tr>
<th>Date (2019)</th>
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<th>Measured Rainfall (in)</th>
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44.1 in - 26% vs 35.1 in
Summary

• The soil water balance may be a good, free option for timing irrigation events. Considerations include:
  • Soil characteristics that affect infiltration and soil water holding capacity
  • Best used on a healthy soil system
  • Availability of good ET and rainfall estimates

• Still determining the quality of economical localized ETo and rainfall estimations
  • May need to adjust crop coefficients to handle higher ETo measured by atmometers
  • Localized rainfall estimations still very important
Summary

• Next steps

  • Estimate ETo and rainfall using NOAA data collected from around the state to determine data availability and quality

  • Estimate ETo using alternative equations for comparison to atmometers

  • Expand atmometer study to include more irrigated regions
Thank you!

Questions?

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