Site-Specific Management of Cotton Using Remote Sensed Imagery within a Conservation Tillage System

John Fulton¹, Dana Sullivan², Joey Shaw¹, Mark Dougherty¹, and Geoff Bland³

¹Auburn University
²USDA ARS Southeast Watershed Research Laboratory
³NASA

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Overview

- Motivation
- Objectives
- Project site and methodology
- Results
- Final Thoughts
Motivation

• Irrigation technology for small, irregular shaped fields and rolling terrain
  – Water usage
  – Sustain cotton production
  – Pressure compensated SDI tape

• In-season management
  Early detection of:
  – Crop stress
  – Irrigation issues

• Integration of technologies for site-specific management
Objectives

Evaluate

– cotton production on rolling terrain irrigated with SDI in conjunction with cover crops, and

– the use of Thermal Infrared Imagery (TIR) for in-season detection of cotton response.
Test Site

- 15-acre field located near Belle Mina, AL
  - Tennessee Valley Extension and Research Center (TVREC)

- Decatur silt loam and silt clay soils
- Slope - 1% up to 6%
Layout and Management

• SDI System
  – 1250-ft runs on 80-inch spacing
  – Installed at nominal depth of 13 inches
  – 90% pan evaporation adjusted for crop canopy
  – Wireless flow meters per plot

• Cotton
  – 40-inch row spacing
  – Tape located between alternating inter-rows
  – RTK auto-guidance used for field operations
  – Collected cotton quality samples at harvest
Experimental Design

- Randomized block
  - Irrigated vs Non-irrigated
  - Cover vs No-cover crop (Rye)
- 4 treatments with 4 replications
- 26.7 ft by 1250 ft plots
Remote Sensed Data

- UAV equipped with a TIR sensor
  - Records emittance 7-14 μm
  - 0.5-m resolution
- Collected data on July 18, 2006
  - Cotton was between 1st and peak flower
  - Percent canopy ranging from 15% to 72%
- Ground truth data collected at 48 locations
  - Stomatal conductance
  - Soil moisture content
  - Crop residue cover
  - Canopy closure
## Yield Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed Cotton (lbs/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated / Cover</td>
<td>2853&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Irrigated / No-Cover</td>
<td>2396&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Non-Irrigated / Cover</td>
<td>1098&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Non-Irrigated / No-Cover</td>
<td>941&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean yields with similar letters indicate they are not statistically different at the 90% confidence level.
## Quality Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mic.(^{*1})</th>
<th>Strength (g/Tex)(^*)</th>
<th>Uniformity (%)(^*)</th>
<th>Length (in)(^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated / Cover</td>
<td>4.4 (^a)</td>
<td>28.5 (^a)</td>
<td>83.5 (^a)</td>
<td>1.1 (^a)</td>
</tr>
<tr>
<td>Irrigated / No-Cover</td>
<td>3.9 (^b)</td>
<td>28.0 (^a)</td>
<td>82.8 (^b)</td>
<td>1.1 (^a)</td>
</tr>
<tr>
<td>Non-Irrigated / Cover</td>
<td>4.1 (^b)</td>
<td>26.1 (^b)</td>
<td>81.8 (^c)</td>
<td>1.0 (^b)</td>
</tr>
<tr>
<td>Non-Irrigated / No-Cover</td>
<td>4.1 (^b)</td>
<td>25.2 (^c)</td>
<td>81.2 (^c)</td>
<td>1.0 (^b)</td>
</tr>
</tbody>
</table>

\(^*\) Mean yields with similar letters indicate they are not statistically different at the 90% confidence level.

\(^1\) Values between 3.5 and 4.9 are not discounted at the gin.
Remote Sensed Imagery Results

- Irrigation management on canopy closure was most significant
  - 40% on irrigated treatments
  - 26% on non-irrigated treatments
- Greater canopy closure on cover treatments.
- TIR emittance correlated well with canopy cover ($r = -0.44$, alpha $< 0.05$) and stomatal conductance ($r = -0.48$, alpha $< 0.05$).

Pearson Linear Correlation Coefficient to evaluate relationships.
SDI Issues

Crimped SDI Lines

Poor Water Distribution

Yield losses up to 35% compared to adjacent rows for crimped tape.
Final Thoughts...

- Cover crops and SDI providing yield benefits
- RTK auto-guidance needed for installation and field operations
- High resolution TIR data can help manage SDI systems and cotton.
  - Identify issues in a timely fashion
  - Provide a management tool
Questions

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