Application of Real-Time Sensor Systems for Precision Cotton Management

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Spectral Reflectance Sensing for Crop Management

1. Opportunities for Variable Rate Control of:
   - Nitrogen
   - Growth Regulators
   - Defoliants

2. Airborne Imagery for Scouting and VR application maps vs. Equipment Mounted Crop Sensors

3. Emerging Technologies
Why use remotely sensed spectral reflectance?

- Scouting **Aid** (not a replacement)

- Mid-season decisions on variable rate:
  - Nitrogen
  - Growth Regulators
  - Defoliants
Approach

Remote Sensing of Reflected Light
- Satellite Imagery
- Airborne Imagery
- Real-time on-the-go sensing (ground-based)
Reflected Light from Field (wavelength)

% Reflectance

RED

NIR

SOIL

PLANT

Reflected Light from Field (wavelength)
NDVI

Normalized Difference Vegetation Index

\[ \text{NDVI} = \text{NIR} - \text{Red} \]

\[ \text{NIR + Red} \]
Low NDVI

Lowest Biomass

Thinner Canopy

Stressed Plants

High NDVI

Highest Biomass

Thicker Healthy Canopy

Not Stressed
Multi-Spectral Remote Sensing

1/10 ac
Airborne Imagery
| Field-of-View (Resolution) |
Image Acquisition $\Rightarrow$ Variable Rate

- An image is requested \{date, field(s)\}.
- Acquisition of imagery from aircraft.
- Image is processed to create a scouting map.
- Geo-referenced image made available to consultant/producer via the internet.
Scout Maps
July 5, 2006

NDVI Map
2006 – J D

Scout Map
2006 - N-Time
Early vs. Late Season
Factors Impacting Scouting Maps

• Spatial Variability in:
  – The Crop (health)
  – Plant/Row Spacing
  – Crop Variety
  – Crop(s) within a Field (scene)
Image Acquisition → Variable Rate

- Producer scouts field with image (printed map or PDA+GPS)
- Decisions (crop consultants & producers)?
- Application map is created from scout map for producers variable rate controller or aircraft sprayer
- Application map is transferred from PC to Variable Rate Controller & application is made
Real-Time Sensing
Machine Mounted

GreenSeeker
Field-of-View
(Resolution)
Long-term N-Rate Experiment
UT Milan Experiment Station

Legend
NDVI

<table>
<thead>
<tr>
<th>NDVI Range</th>
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<tbody>
<tr>
<td>0.130 - 0.636</td>
</tr>
<tr>
<td>0.637 - 0.773</td>
</tr>
<tr>
<td>0.774 - 0.843</td>
</tr>
<tr>
<td>0.844 - 0.884</td>
</tr>
<tr>
<td>0.885 - 0.919</td>
</tr>
</tbody>
</table>
NDVI

5 reading/sec

30 lb/ac  120 lb/ac  90 lb/ac  30 lb/ac (N)
Airborne Sensing vs. Ground-Based

- Capital Investment
- Commitment to an Application
- Weather
- Producer/Consultant Involvement
- Spatial Resolution
Future

• Difference Maps
  – What has changed from the previous image?
• Integration of real-time sensing with map-based (historic) information
  – Yield maps (yield potential)
  – Soil maps (E.C.)
Crop reflectance may correlate with:
yield, available nitrogen, plant population,
growth stage, soil properties, moisture stress, etc.
Did we make the correct decision?

Cotton Yield Map

2004 Cotton
Colquitt Co. Georgia

Calvin Perry, NESPAL
Tifton, GA