Impact of Automatic Section Control for the Southern US

13th Annual Kansas Precision Agriculture Technologies Conference

IMPACT OF AUTOMATIC SECTION CONTROL ON AG SPRAYER PERFORMANCE

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Alabama Case Study for Automatic Section Control

• 1 to 12% input savings per pass across field
  – AVG: 4.4% (7% for some operations)
• Savings:
  – AVG: $4.83/ac/yr (5 boom-section sprayer & 12-row planter)
  – AVG: $8.36/ac/yr if Nitrogen included
  – Highest savings in irrigated corn: $11-13/ac/yr
• Payback period: < 2 yrs

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Model to Estimate Savings

Development of a simple index:
1. Based on field geometry
2. Estimate overlap savings

Today’s Discussion

• Automatic Section Control
  – Rationale
  – Testing Methods
  – Lab and field testing
  – What we have learned
  – Future efforts
• Final thoughts

Pressure Variability???
**Impact of Automatic Section Control for the Southern US**

**Field Boundaries in the South**

- Irregular shaped
- Varying terrain
- Environmental structures (waterways, terraces, buffer strips, etc.)

**Automatic Section Control**

- Automatic ON / OFF of sections or individual nozzles
- Reduces 1) overlap and 2) application in unwanted areas (waterways, buffer strips, etc.).
- Environmental stewardship – Alabama NRCS EQIP

**Spray Control System with Automatic Section Control**

- Boundary Map
- Controller + Software
- GPS Receiver
- An-Applied Map
- Sprayer performance with all this technology?

**Test Setup**

- Captian Nozzle Solenoids
- Pressure Transducers mounted along boom.

**Data Collection - Lab**

- Our Controller
- Minimize the influence of field, operator, and other variables.
- Focus on impact of auto-swath and plumbing.
- Can prescribe field maneuvers and common situations

**Lab Results**

- Auto-nozzle response different from Auto-Boom
- Response different for turning ON versus OFF
- Valve Control Number (VCN) impacts system response
- Controller unable to respond in certain conditions
- Tip flow stabilization
  - Range: 2 to 10 seconds
  - Majority between 19 and 30 seconds
- System flow stabilization
  - Range: 1 to 4 seconds

- Large difference between tip and system response
  - Suggests regulating valve responds quickly but tip flow stabilization occurs well after valve has adjusted to desired rate.
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Tip vs. System Flow Response

Auto-boom vs. Auto-nozzle

Tip Response Results

Valve Cal. Number

2123 versus 2213

System flow does not correspond to tip response.

Difference exists

Results

Auto-Boom - Point Rows

% Difference between Desired and Actual tip flow

Results

Auto-Nozzle: Point Rows

% Difference between Desired and Actual tip flow

Field Testing

Collaboration with University of Kentucky

FIELD TESTING

Field Testing

Buffer Strip

• 100 ft swath
• 15 to 18 mph
• 30-channel control
• Capstan nozzle solenoids
• Post-herbicide application
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Auto-swath Engagement
- Illustration of 3 adjacent passes
- Outside nozzles snapping On/Off
  - Entire boom impacted by On/Off
  - Tremendous tip flow variability
- Need to consider resolution; can impact application efficacy

Flow Meter Calibration...
- Tip performance satisfactory (<5%)
- Technology issue!
- Boom pressure variability...
  - Acceleration
  - Effects tip performance
  - Pump speed adjusting accordingly
- Why?
  - Extended response
  - Need to further study

Rectangular Field
- Tip Uniformity
- Rate Error

Research Efforts
- Minimize off-target application
- Need quality data
  - Accurate as-applied maps
- Make good informed management decisions.
- Environmental stewardship / public education
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Field Results

- Tip flow uniformity (CV) varies across a boom
  - Ground speed variations
  - Auto-swath engagement
- Flow meter calibration is critical!
- Rate error occurs more frequently than expected (as-applied data?)
- Further advance control algorithms

What have we learned?

- Differences between auto-nozzle and auto-boom
- System flow does not represent tip response
- Purchase a controller with flow compensation
- System response impacted by:
  - Valve control number (VCN)
  - Acceleration
  - Auto-swath technology engagement (resolution?)

Future Work

- Additional field testing
- Hose / tube compliance testing
- “Smart” control algorithms
- Auto-calibration (automatic and dynamic)?

Final Thoughts...

- Realistic expectations – misperceptions can lead to incorrect decisions
- TLC for technology
  - Requires proper setup and implementation
  - Periodic system checks
- Additional R&D needed to fully capture perceived benefits of technology
- **GOAL:** Use PA Technologies to improve production and not profitability - this approach will lead to profitability

Thank-You

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Improving producer profitability and environmental stewardship

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