

Proper Implementation of Precision Ag. Technologies for Conducting On-Farm Research

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Discussion Outline

- Precision Ag Background
- Technology Limitations
 - GPS/GNSS sensors
 - Variable-Rate Technology (VRT)
 - Map-based application
 - On-the-go application
 - Automatic section control (ASC)
 - Yield Monitors
- On-Farm Research Considerations



Equipment and Controls



Equipment Size Continues to Increase

Advancement in GPS/GNSS Technology



Individual Nozzle Control using Auto-Swath Technology



On-the-Go Sensing



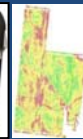
Image courtesy of Purdue University

History of Precision Ag

Data Collection

Steering Control & Variable-Rate

Implement Control



1992

1997

2002

2007

Current US Precision Ag. Trends

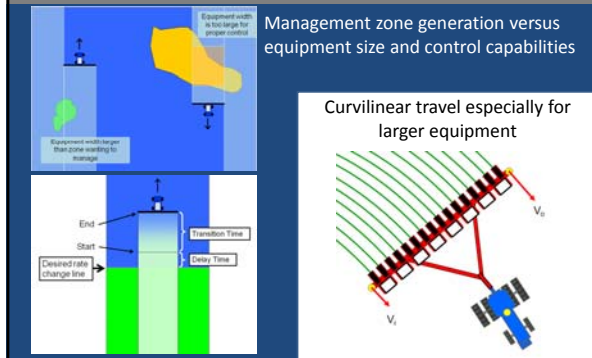
- *Machine Control*
 - Autoguidance and Lightbars
 - Auto-swath control
 - Strip tillage, fertilizing, and planting
 - Implement control on sloped fields
- *Demand for high-level GPS accuracy (few inches - RTK)*
- *Input Management*
 - Precise fertilizer and pesticide application
 - Variable-rate fertilizer, seeding, etc.
- *Solutions for information management*

Current emphasis on automating machine / implement control

Payback for Precision Ag Systems

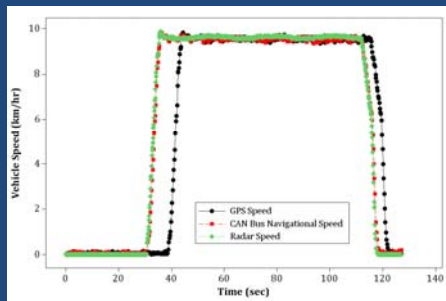
- Cash Methods
 - **Reduced pass-to-pass overlap** with guidance systems
 - **Reducing headland overlap** with automatic section control reduces input use.
 - **Improved crop yield** response from accurate input placement (fertilizer rate, seeding rate, etc.)
- Non-Cash Methods
 - Reduced operator fatigue
 - Better data and decision management
 - Identify yield limiting problems

Management Considerations



RESULTS

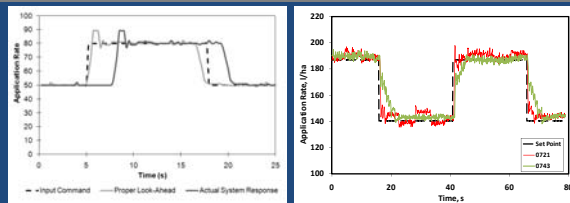
GPS Dynamic Velocity Response



Single-base vs. Real-time Networks

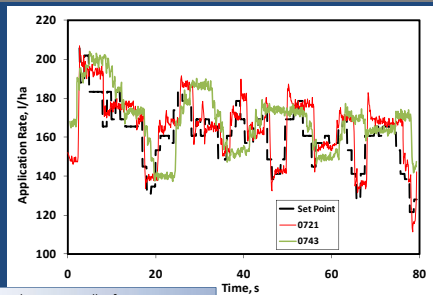
- DOT CORS across the US have several mount point and correction format options.
- Popular among RTK adopters
- Iowa DOT CORS
 - Static accuracy (2DRMS)
 - CMR+ (single-base): 3.02-cm horizontal; 4.27-cm vertical
 - iMAX (network solution): 3.68-cm horizontal; 7.14-cm vertical
 - 24-hour RTK fix
 - CMR+ 99.8%
 - iMAX 98.5%
- Satellite commonality between rover and base station(s) critical for maintaining RTK fix solutions at rover.
- GPS vs. GNSS

Variable-rate Controller Response



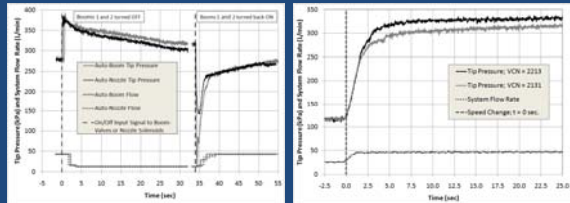
- Response varies for increasing vs. decreasing rates
- Time require to make rate change
- Setup impacts performance

On-the-Go Sensor Based Controller



- 1-Hz update to controller from sensors
- Controller unable to accurately respond
- Note the differences in controller settings

Auto-Swath on Sprayers



- System flow rate (feedback to controller) does not respond to nozzle response
- Controller setting impacts response

Sprayer Off-Rate Errors



Variable-Rate Technology



- Variable-rate application of dry fertilizer
- 1-acre grids
- 5-sec increasing and 8-sec decreasing rate-change response
- Off-rate error typically unknown to operator and farm manager.

Yield Monitors

- Slope impacts mass flow measurements (12%)
- Time delays for material movement through harvester exist
- Quick acceleration impacts mass flow / volume estimates.



Considerations for PA Research

- Realistic expectations
 - Misperceptions can lead to incorrect decisions
 - Plot work versus field-scale work
- TLC for technology
 - Requires proper setup, calibration and implementation
 - Periodic system checks
- RTK data source (reliability and accuracy)
- Management zones
 - Size and shape
 - Control resolution of equipment
- Avoid stopping or quick acceleration within plots
- PA technologies can be powerful tools
 - Limitations and operational constraints must be understood.

Questions



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