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

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

Equipment and Controls
• Advancement in GPS/GNSS Technology
  — Equipment Size Continues to Increase
  — Individual Nozzle Control using Auto-Swath Technology
  — On-the-Go Sensing

Equipment and Controls

History of Precision Ag
• Data Collection
• Steering Control & Variable-Rate
• Implement Control

History of Precision Ag

Current US Precision Ag. Trends
• Machine Control
  — Autoguidance and Lightbars
  — Auto-swatch 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

Current US Precision Ag. Trends

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**

Management zone generation versus equipment size and control capabilities

Curvilinear travel especially for larger equipment

**RESULTS**

**GPS Dynamic Velocity Response**

Quick acceleration can generate lag in GPS speed

**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-S swath on Sprayers

- System flow rate (feedback to controller) does no 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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