Precision Agriculture

**Variable-Rate Application (VRA)**

*How does it work?*

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**Topics**

- Introduction
- Application Equipment
- PA technology
- Nutrient Management (590): Variable-Rate Technology
- Pest Management (595): Auto-swath control technology
- Final Thoughts

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**NRCS EQIP Program**

*Improved environmental stewardship through improved nutrient and pesticide management.*

ISSUE: 1) Over-application of nutrients & pesticides, and 2) spraying in unwanted areas.  
SOLUTION: Variable-rate & Auto-swath Technology

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**Current PA Trends across US**

- **Machine Control**  
  - Autosteering and Lightbars  
  - Auto-swath control  
  - Strip tillage, fertilizing, and planting  
  - Implement control on sloped fields

- **Input Management**  
  - Precise fertilizer and pesticide application  
  - Variable-rate seeding  
  - Solutions for information management  
  - Demand for high-level GPS accuracy (few inches)

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**Application Equipment: Granular**

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Application Equipment: Liquid

- Self-Propelled Sprayers
- Pull-Type Applicators
- Nitrogen Side-Dress Unit

Typical Field Shape (irregular)

Inherent Field Variability

Precision Agriculture Tools and Technology

Example of Site-Specific Management

- Yield Map
- Fertility Map
- Lime Prescription Map

- Assess Variability
- Implement VRA

Desktop Software to Equipment

- Map that prescribes desired application rate needed when traversing a field
- Application equipment has a controller that:
  - interprets map
  - converts map to application action
Prescription / Application Maps

- Potash (lb/ac) example
- Maps based on soil sampling / analyses:
  - Management zones, OR
  - Grids

Note:
1. Several 0.0 lb/ac zones
2. Zero along waterways that nutrients would have been applied using uniform application.

Basics of How VRT or Auto-Swath Works...

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Nutrient Management (590)

- To encourage the adoption of variable-rate application (VRA) of nutrients

Base requirement:
- At least 1 VRA of nutrients made according to fertilizer recommendations based on grid soil samples.

What is VRT

- VRT = Variable-Rate Technology
- Any technology that enables the variable-rate application of agricultural inputs,
  OR
- Technology which permits precise application control of inputs
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Uses of VRT

**Inputs**
- Nutrients / Fertilizer
  - N, P, and K
  - Micronutrients
- Pesticides
  - Herbicides
  - Insecticides
  - Fungicides
- Lime
- Seeding
- Tillage
- Irrigation

VRT Implementation

1. **Map-based** – prescription maps
2. **Sensor-based**
   - Real-time crop or field assessment controlling input application
   - Further development in AL before adoption
3. **Manual** – operator controlled

VR Control System

**Basic Spray Control System**

Illustration of a conventional sprayer
- Tank
- Pump to send liquid to nozzles
- Flow control valve
- Flow meter

VRT at Work...

Precision Granular Applicator

In-cab VRT Controller

Prescription Map

Required Components

VRT:
- DGPS receiver
- VRT spray controller with appropriate software
- Control valve or variable-actuator (control mechanism)
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Spray Control System with VRT

- Prescription Map
- DGPS Receiver
- In-Applied Map
- Additional Components:
  - DGPS receiver
  - VRT controller
  - Feedback control loop
- Tank
- VRT Controller + Software
- Flow Control Valve
- Flow Meter
- Boom Valves
- Spray Nozzles
- Closed Loop Control

VRT Controllers

- Most current controllers are versatile.
- Multiple uses:
  - Planting
  - Spraying / Spreading
  - Side dress
  - Yield mapping

As-Applied Map: Point Data

- Legend:
  - Field B
- Illustrates:
  1. Field traverse
  2. Gradient of applied rates

As-Applied Map: Polygon Data

- Legend:
  - Boundary

As-Applied Map: Attribute Data

- INFO PROVIDED:
  1. Amount Applied
  2. Time stamp

Hardcopy Summary of Application

- AS-APPLIED DATA PROVIDED:
  1. Map
  2. Amount applied
  3. Input applied
  4. Time stamp
Benefits of VRT

**Economics**
- Increased input efficiency - apply only what is needed
- Could reduce overall amount of inputs used
- Improved in-field equipment efficiency
- Improved crop yields through optimal use of inputs

**Environmental Stewardship**
- Minimize over-application of inputs thereby reducing the risk of pesticide and fertilizer runoff or leaching into water sources,
- Reduce application in environmentally sensitive areas

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**Nutrient Management (590): Variable-Rate Technology**

**Pest Management (595): Auto-swath control technology**

**Final Thoughts**

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**Pest Management (595)**

- To encourage the adoption of PA technology for pesticide application

Requirements:
1. Use of guidance technology
2. Auto-swath control technology

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**Impact of GPS Correction**

- 2 to 12% savings per pass across field.
- Savings depends upon shape and size of fields.

- Automated boom-section or nozzle control: ON-OFF technology
- GPS and correction impacts performance.

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**What is Auto-Swath Technology...**

- Auto-swath control technology

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**Required Components**

Auto-Swath Technology:
- DGPS receiver
- Spray controller with software capable of auto-swath control
- Proper boom, nozzle, or solenoid valves

**Nozzle Control**

- Limited adoption to-date
- Further development

**Spray Control System with Auto-Swath**

1. Boundary Map
2. DGPS Receiver
3. As-Applied Map
4. Controller + Software
5. Boom Valves
6. Flow Control Valve
7. Flow Meter
8. Pump
9. Spray Nozzles

**Auto-Swath for Spreaders**

- Archived by equipment
- Provided by the farmer
  - Electronic
  - Hardcopy

**Application Maps**

1. Point, OR
2. Polygon
Hardcopy Summary of Application

APPLICATION DATA PROVIDED:
1. Map
2. Amount and input applied
3. Time stamp

Benefits of Auto-Swath Control
• Improved application efficiency & accuracy
• Reduced overlap thus reducing overall input costs
• Improved environmental stewardship
• Reduced crop damage from over-application
• Optimized operator efficiency
• Reduce operator fatigue

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Impact on NRCS Personnel
• Basic understanding of VRT and Auto-Swath control
• Receiving, reviewing and archiving as-applied maps (both hardcopy or electronic version)
• Future PA technologies to include in EQIP program
  – Auto-swath for Nutrient Management (590)
  – Site-specific pesticide application

Final Thoughts
• Precision Agriculture EQIP program will have an impact on Alabama agriculture
• VRT and Auto-Swath Technology
  – Improved environmental stewardship
  – More efficient input usage
  – Producers will see benefits (long-term)

PA Technology has improved profitability and environmental stewardship.

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