

# Precision Agriculture in the United States: Trends and Technologies

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# 4R Nutrient Stewardship

- The foundation of fertilizer BMPs and efficient nutrient management can be aptly described as following the “4Rs” ...

Applying the *Right Source*  
at the *Right Rate* at the  
*Right Time*  
and in the *Right Place*

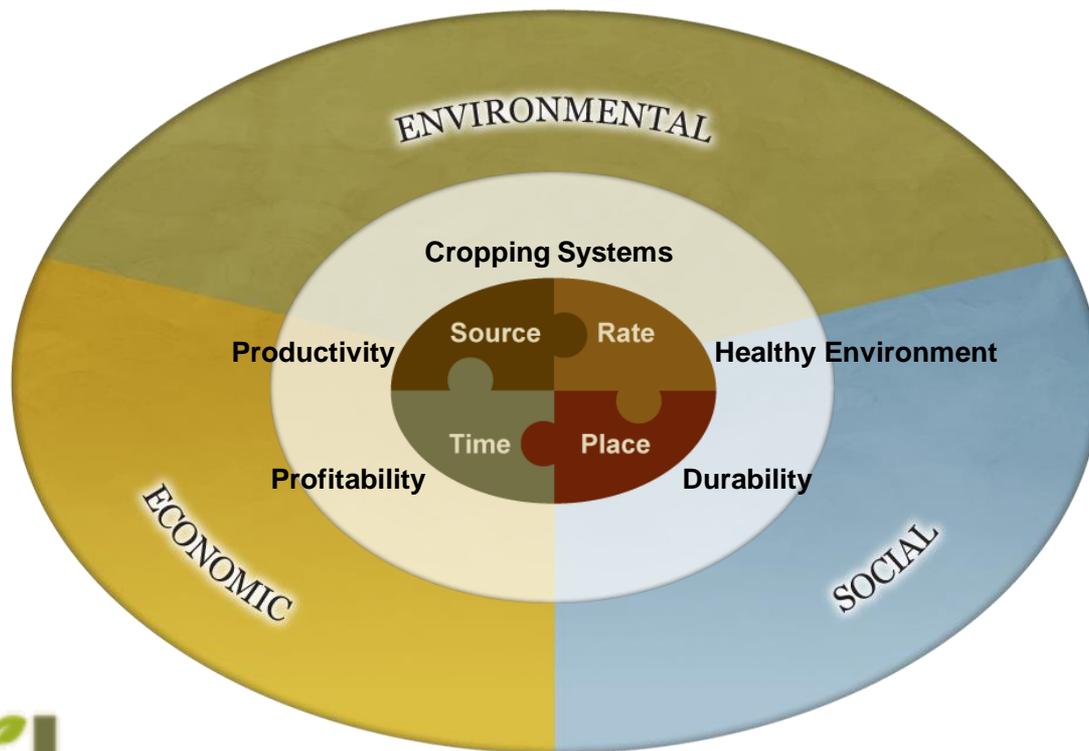
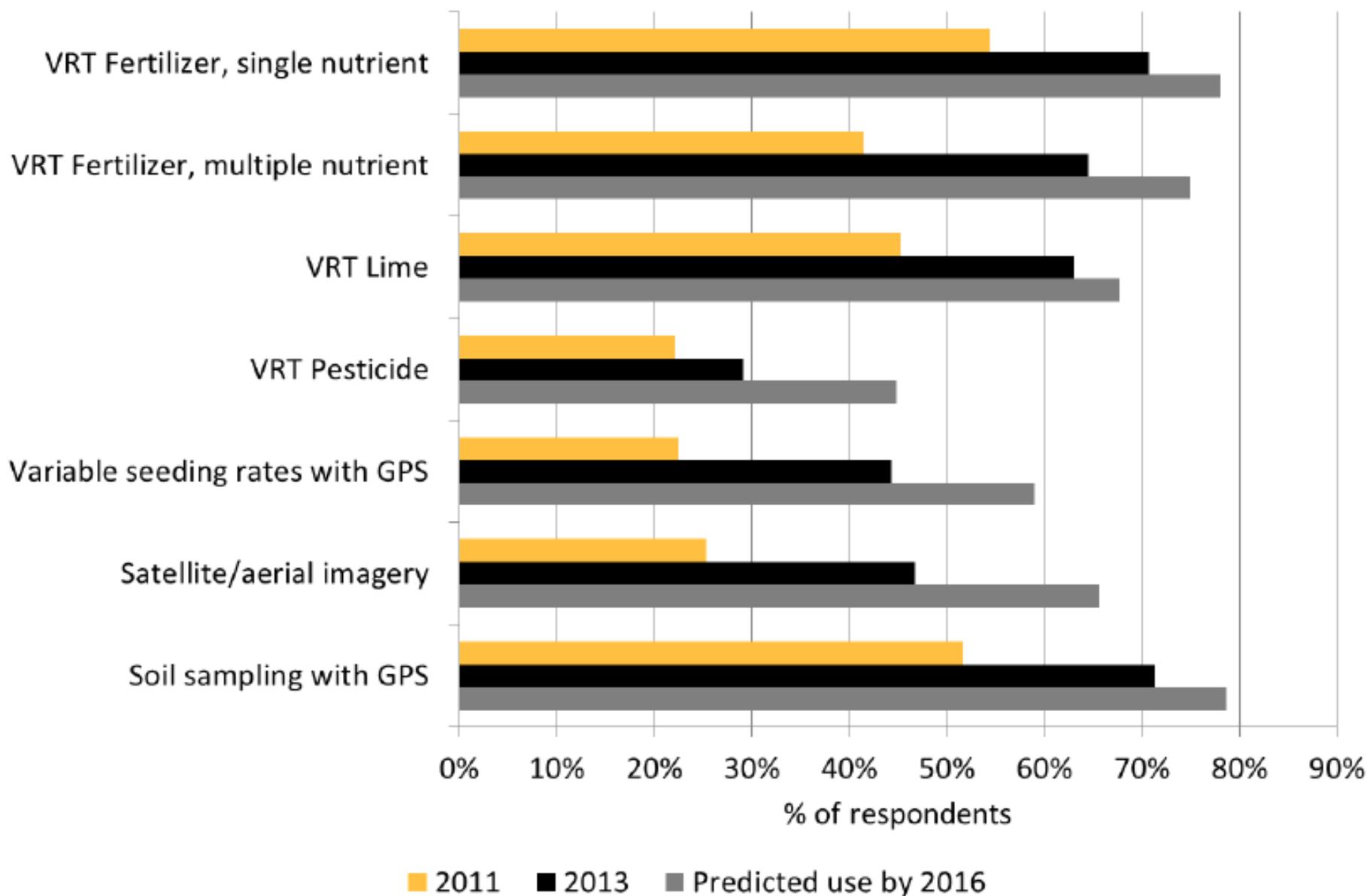


Figure 2. Precision Service offered by Dealerships

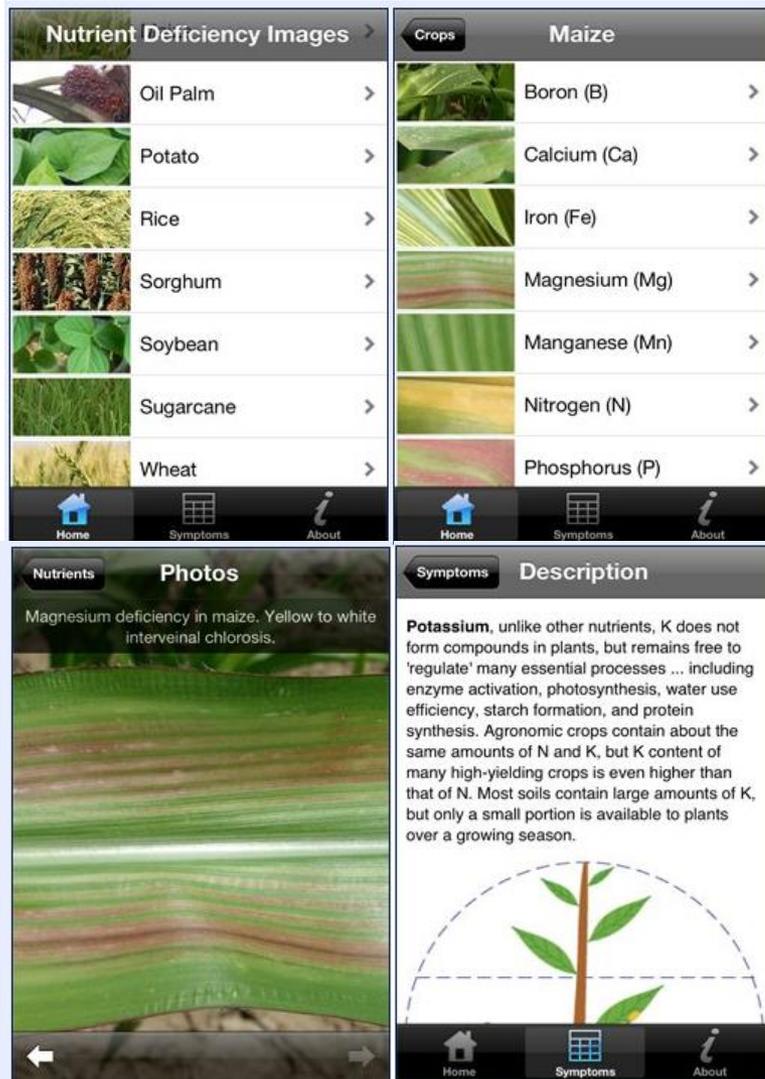


# Trends in USA Precision Agriculture

- PA technologies and practices continue to grow throughout the agricultural world
- Practices that were once considered “precision” are now viewed as business-as-usual
- Top Five Trends of 2013
  1. Mobile Devices
  2. Database Integration
  3. Variable-Rate Applications
  4. In-Cab Solutions
  5. Unmanned Aerial Vehicles



# Top Trend #1: Mobile Devices



- **Identification tools**
  - Weeds, Nutrient Deficiency, Pests
- **Input Calculators**
  - Seed, Chemical, Fertilizer



- News, Weather, Market Updates

The screenshot displays a mobile news application interface for 'DTN/The Progressive Farmer'. The top navigation bar includes the app name, a location pin, and the time '3:55 PM'. The main content area is divided into several sections:

- Latest:** A vertical list of news articles with thumbnails and titles, including 'Urban Chickens: The Po...', 'Soybean School: Introdu...', 'Soybean School: Aphid...', 'Tractor Boy Song Is A...', 'Canola School: The Bes...', 'Corn School - Using Fu...', and 'Understanding Orange...'.
- Post:** A featured article titled 'Corn School: How to Scout for & Control Western Bean Cutworm' dated July 5, 2013, 10:48 AM. The text discusses pest management in corn crops, mentioning Tracy Baute, a field crop entomologist with the Food/Minister of Rural Affairs. It includes a link for more corn school episodes.
- Market Data:** A section showing prices for various commodities:
 

<b>Elec. Corn</b>	<b>Elec. Live Cattle</b>
Last: 701.4	Last: 122.100
Change: -152	Change: 0.175
High: 720.4	High: 122.300
Low: 700.4	Low: 121.150

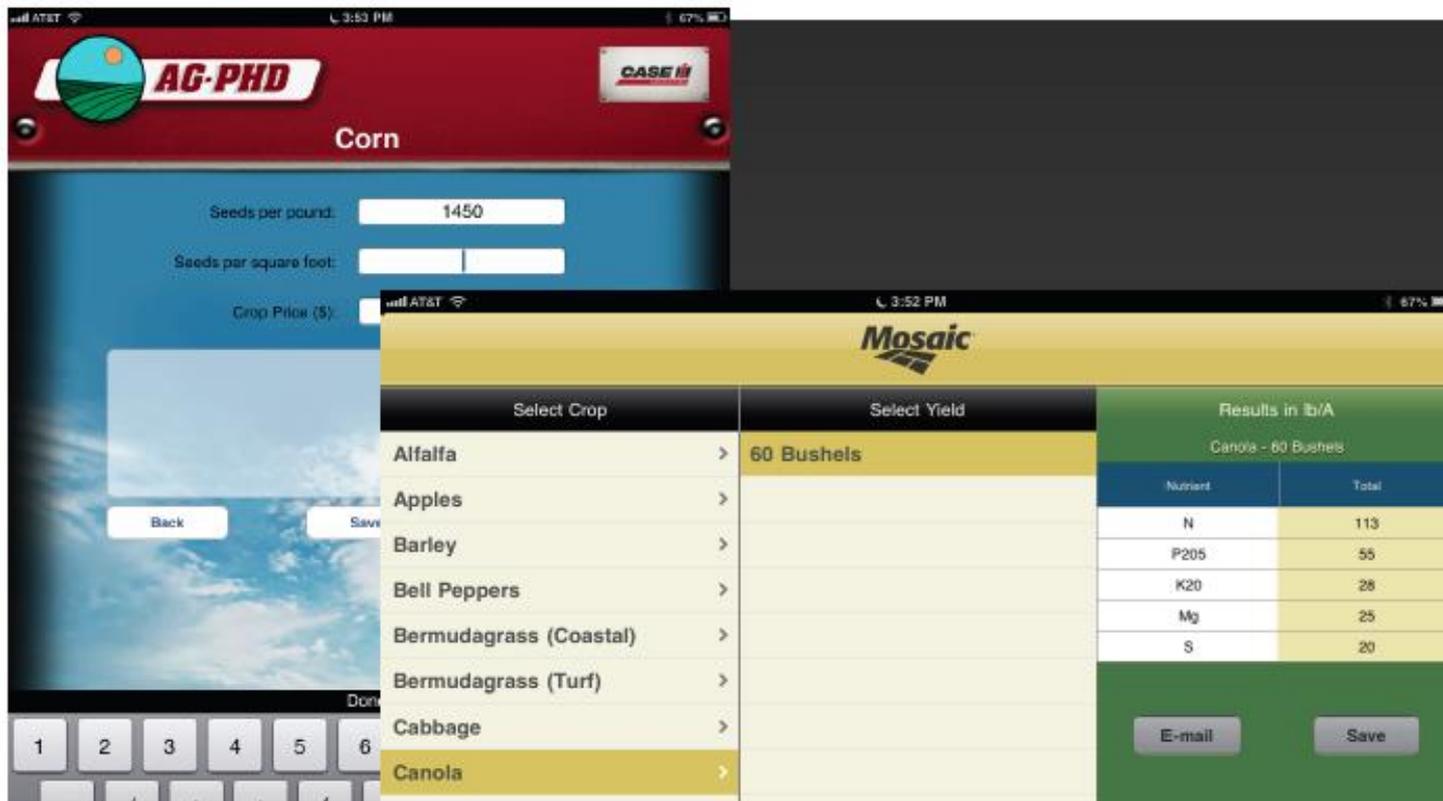
<b>Elec. Soybeans</b>	<b>Elec. Feeder Cattle</b>
Last: 1557.2	Last: 150.400
Change: -370	Change: 0.275
High: 1612.0	High: 150.425
Low: 1534.4	Low: 149.950

<b>Elec. Wheat</b>	<b>Elec. Lean Hogs</b>
Last: 675.4	Last: 105.100
Change: -3.0	Change: -0.025
High: 685.0	High: 105.200
Low: 679.4	Low: 101.800
- Weather:** A weather widget for Stillwater, OK, showing 'Sunny 97°F' and a 5-day forecast: 50°, 91°, 96°, 93°, 98°.
- Market News:** A section titled 'U.S. Stocks Fluctuate on Fed Officials' Comments, Up's Forecast' dated July 12 (Bloomberg), discussing market movements related to Federal Reserve policy.
- Other Widgets:** Includes a 'POWERFUL PROTECTION' advertisement for Guardol, a 'Midwest Urged to be Alert' article, and a 'Conservation Works Where Used' article.

The bottom navigation bar contains icons for Home, Search, and other app functions.

- **Other Calculators**
  - Plant Population, Nutrient Removal

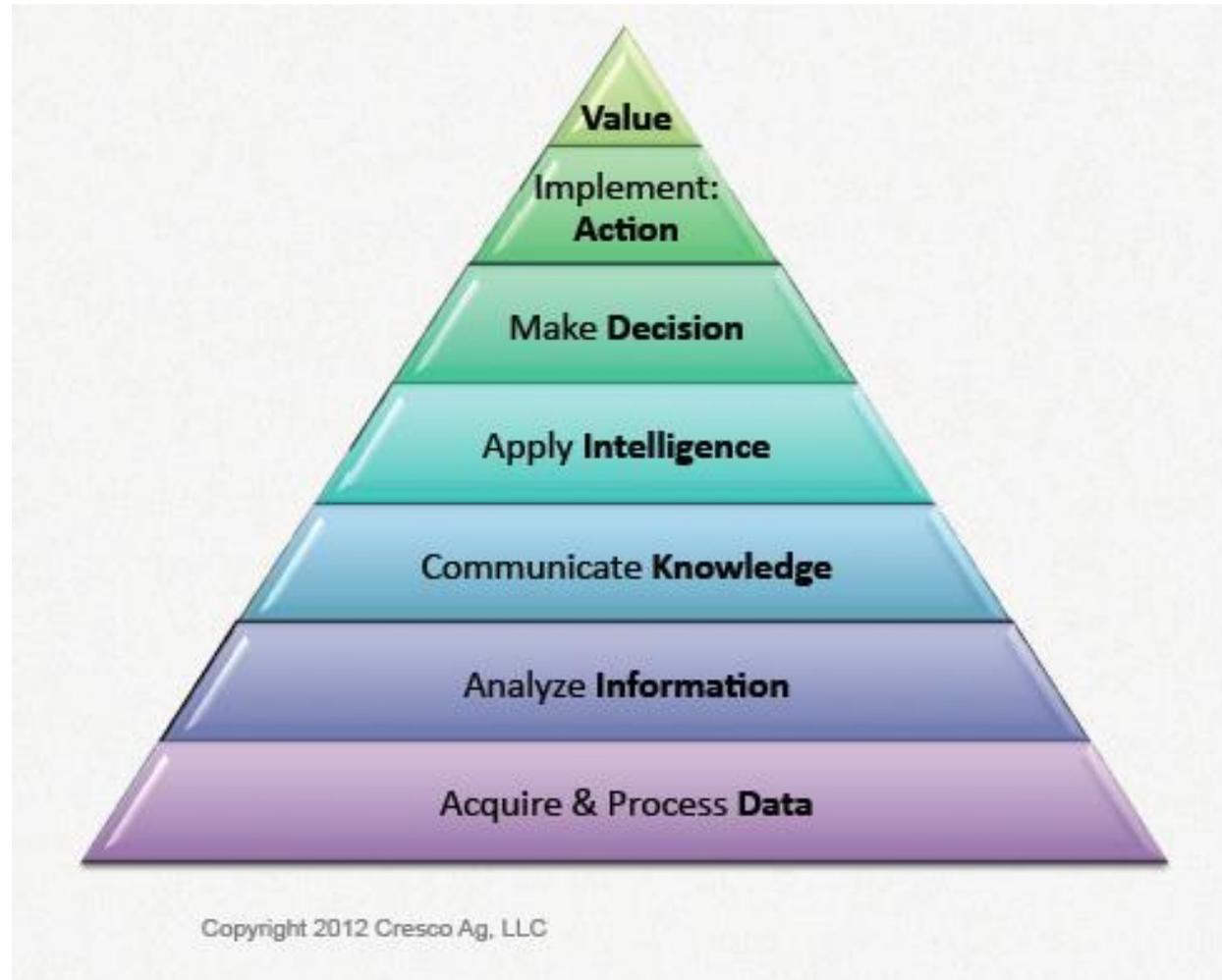


# Top Trend #2: Database Integration

- Compatibility of tools
- Integration of outside data
- Improvements in decision making
- Wireless data transfer



# Data have no value...



# Top Trend #3: Variable Rate Applications

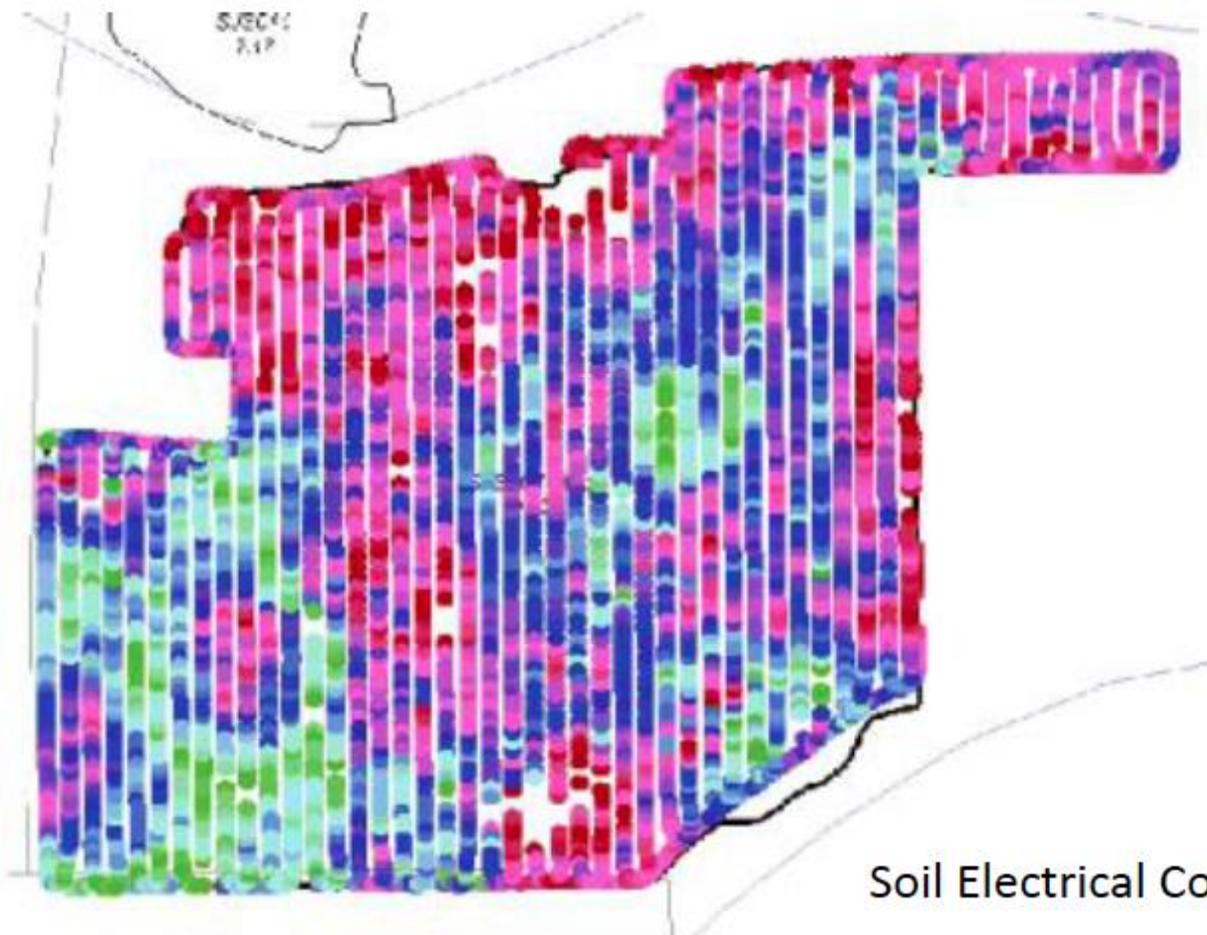
- Application based on field and crop variability
- Apply only what is needed
- Deliver inputs more accurately



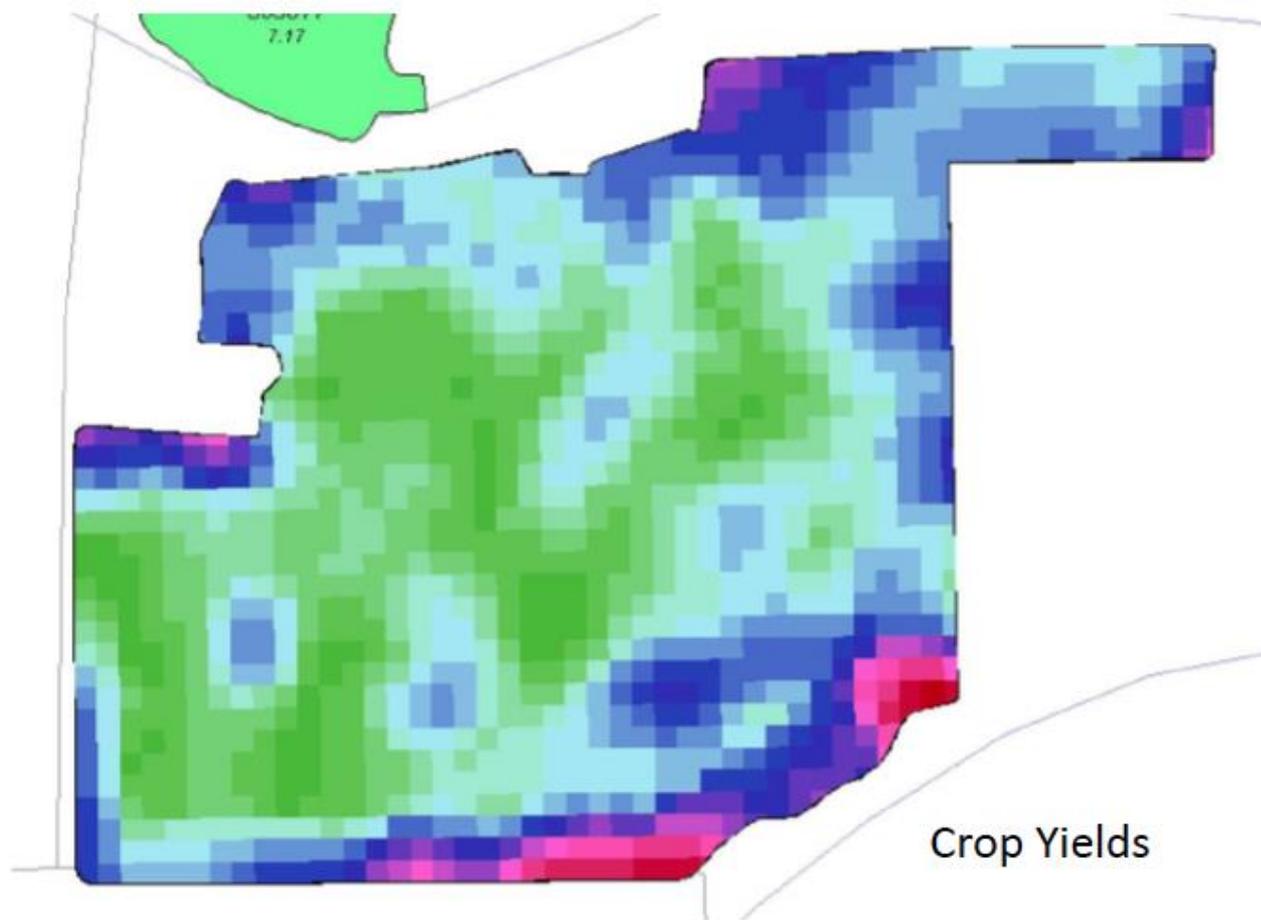
Applying only what the plant needs,  
or soil can handle.



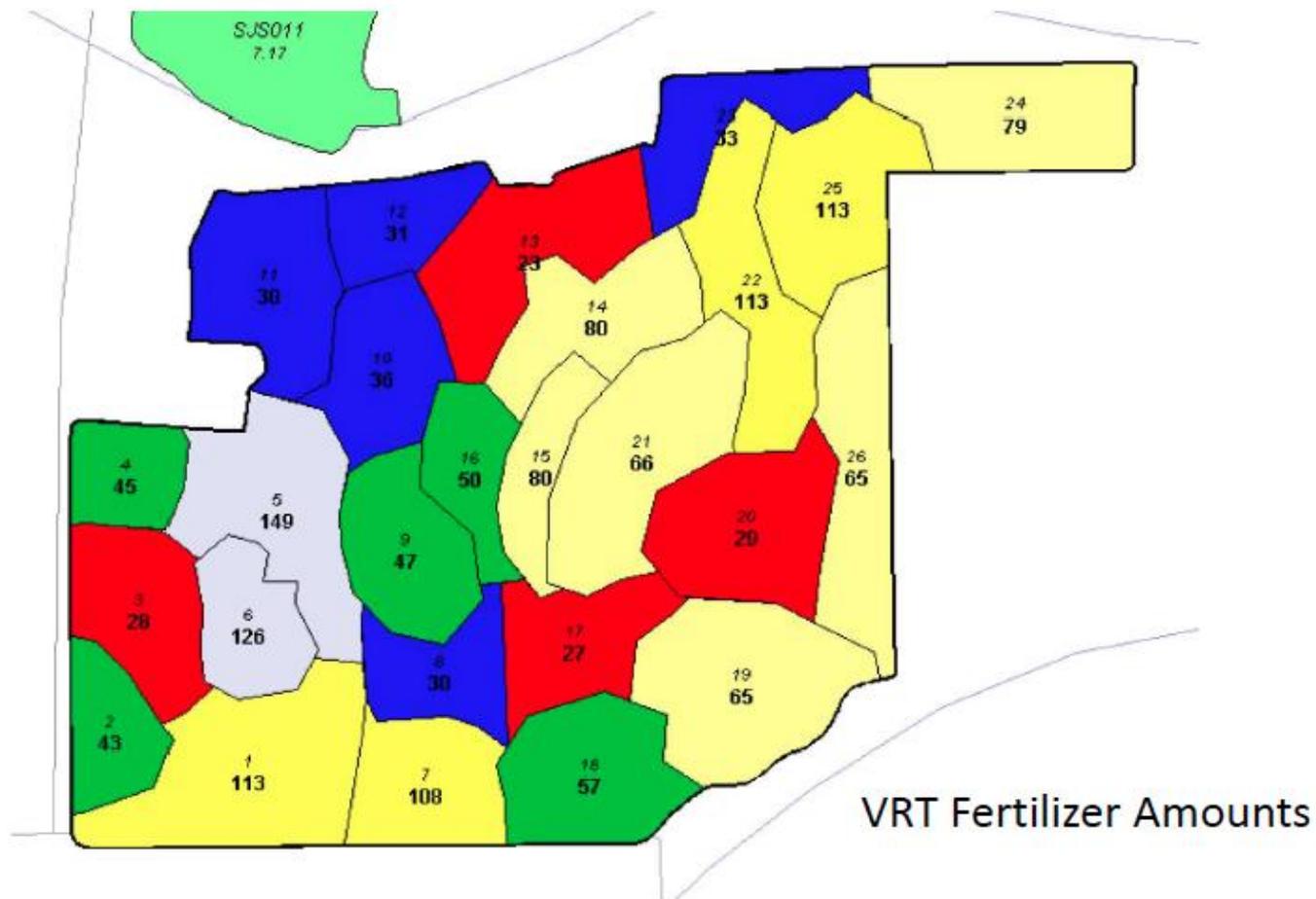
# Crop Environments are Variable



# Crop Outputs are Variable



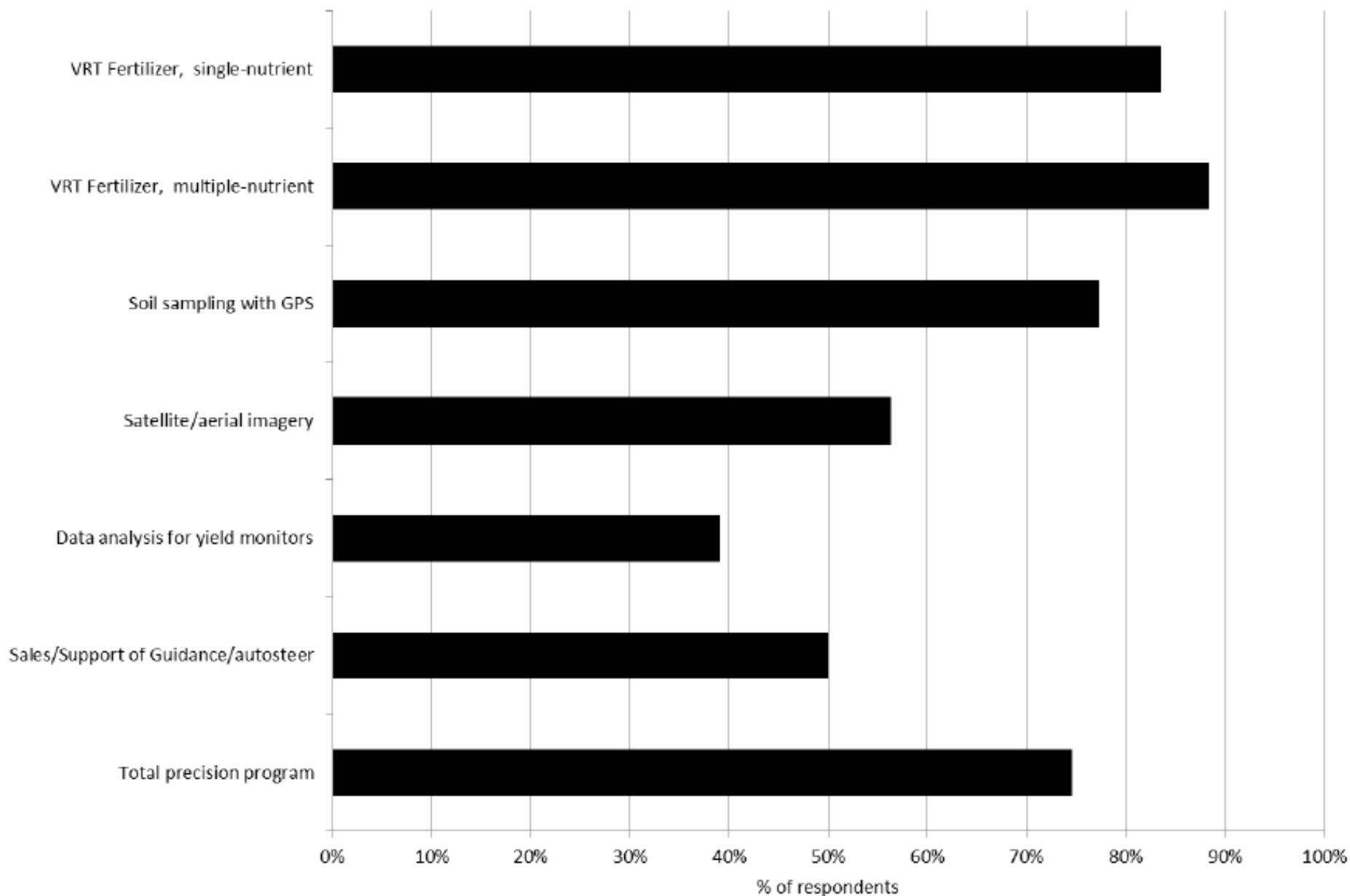
# Crop Inputs are Variable



# Economics of Guidance are Relatively Easy to Quantify

- Existing equipment overlap  
    vs. Equipment overlap with guidance
- Implement width
- Acres/hectares
- Costs of inputs: fertilizer, seed, pesticides, fuel, labor, equipment
- Cost/life of guidance system

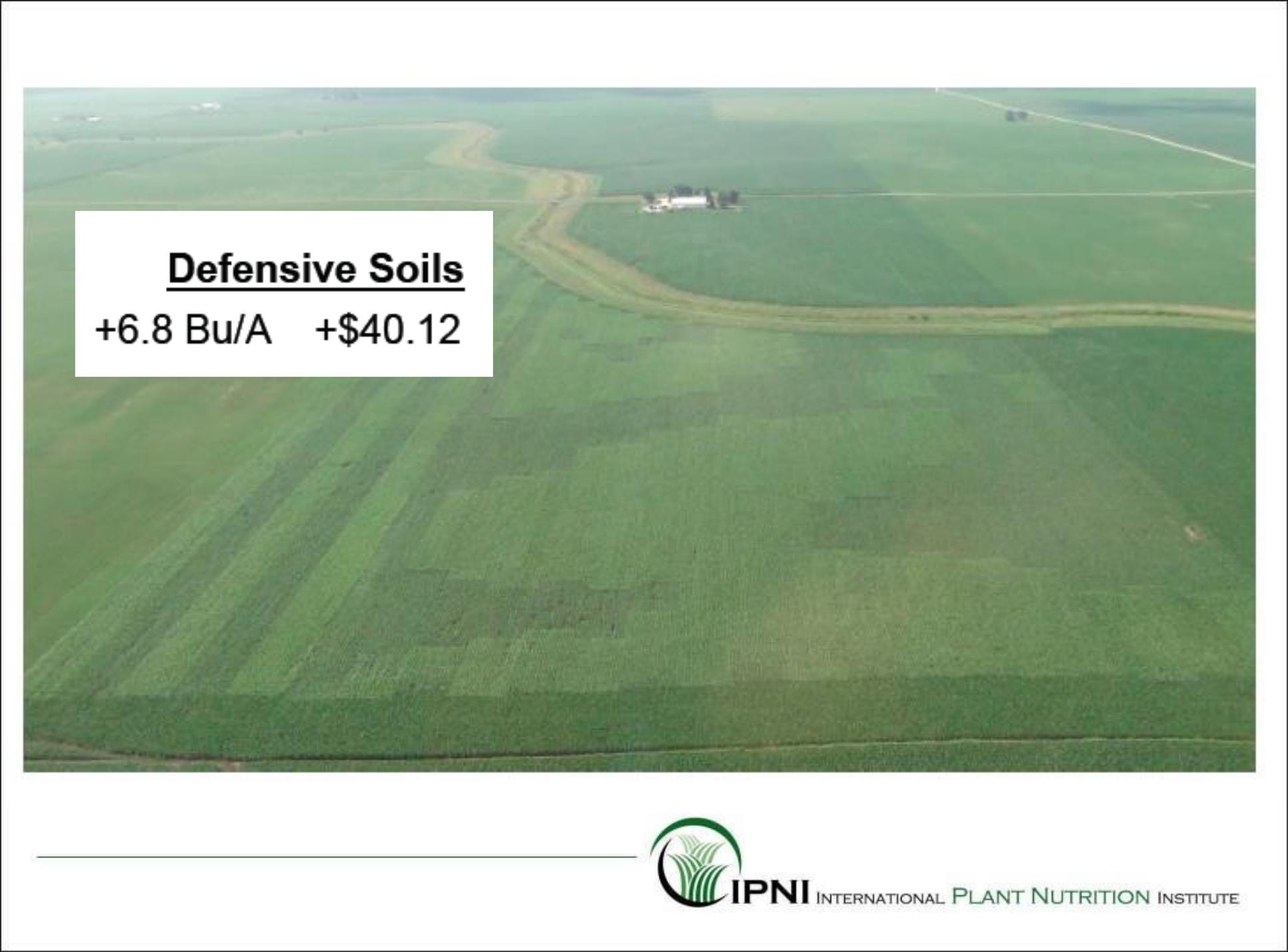
Figure 3. Dealerships Generating a Profit for Precision Services



# Variable Hybrid Planter







**Defensive Soils**

+6.8 Bu/A    +\$40.12



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# Variable-Rate Seeding

VR seeding as opposed to planting  
whole field at 64K

% of land with  
low yield  
potential

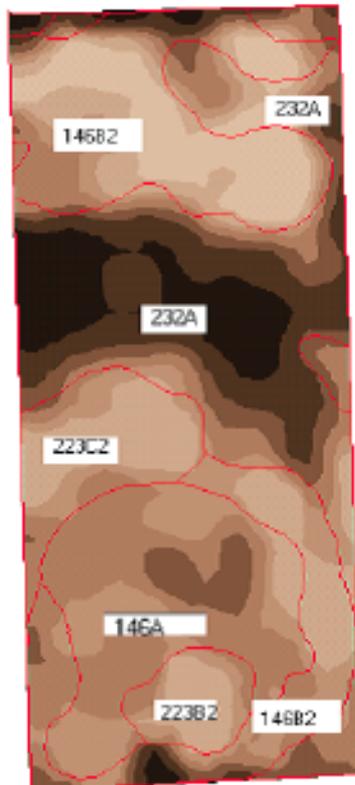
VR Seeding  
Savings

-----\$/ha-----

5%	0.32
10%	0.74
25%	11.68
50%	30.01
75%	48.04



# VARIABLE HYBRID PLANTING



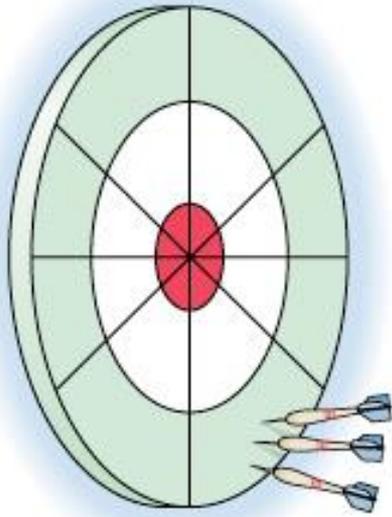
**Management zones are key to success**

**Spatial locations are needed of:**

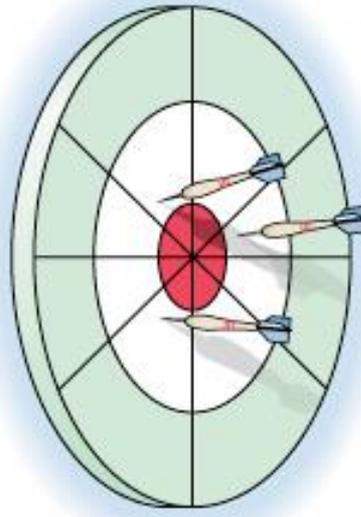
- High yielding zones
- Low yielding zones

**Without management zones, variable hybrid planters are worthless**

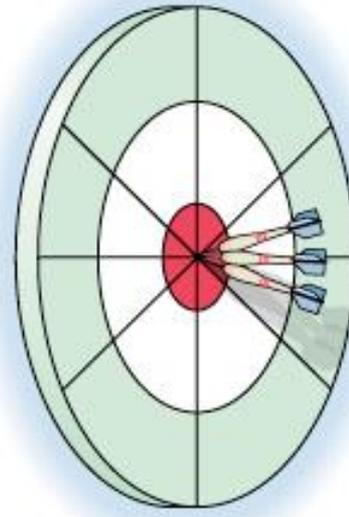
# Accuracy and Precision



**(b)** Low accuracy  
High precision

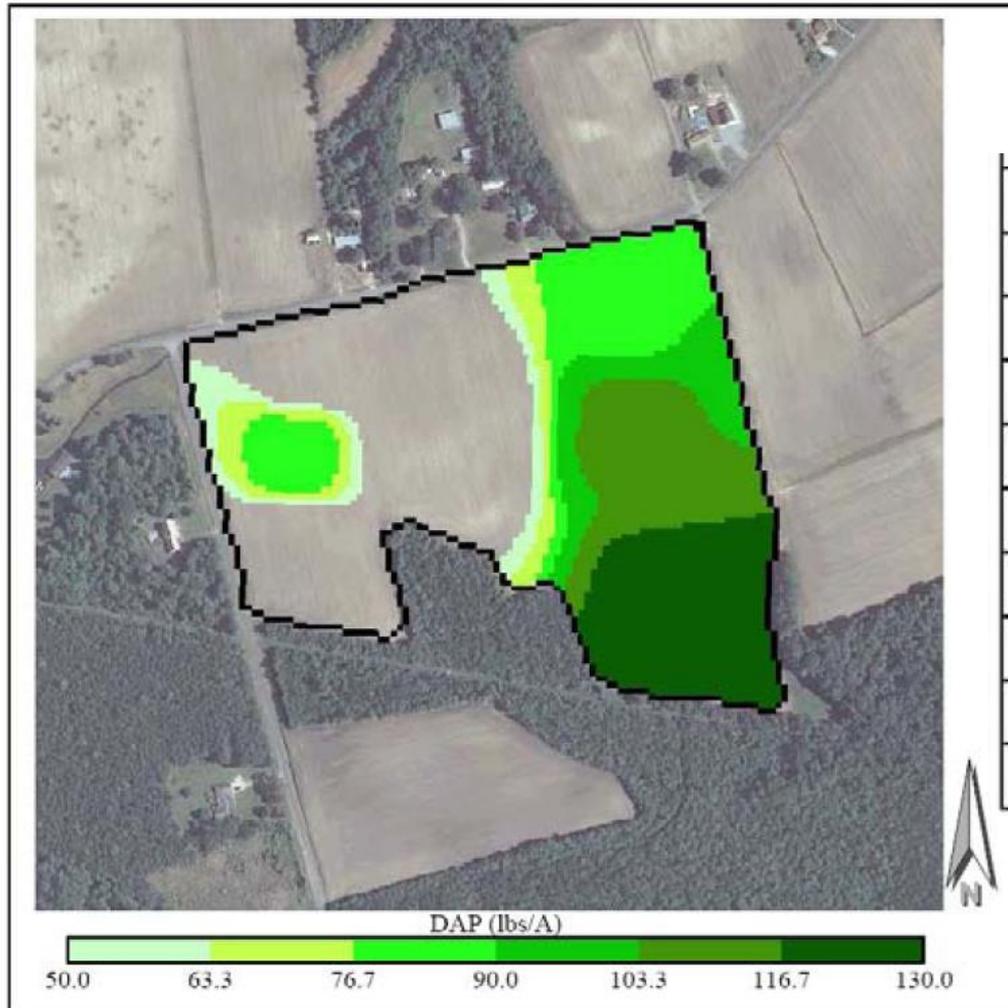


**(c)** High accuracy  
Low precision



**(d)** High accuracy  
High precision

# Map-Based VR Nutrient Application

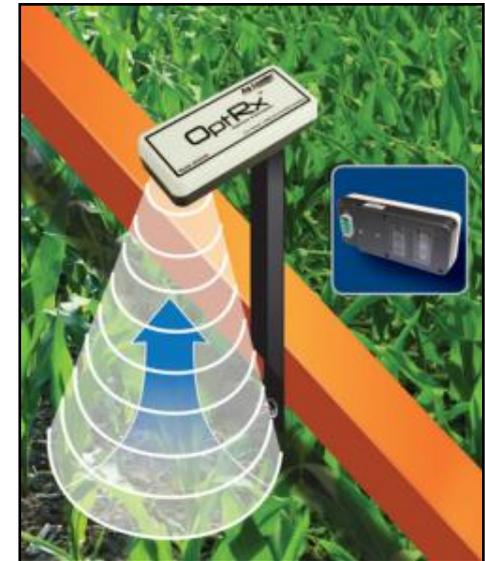


Product	
Addition/Deduction(lbs/ac):	None Entered
Percent of Original App:	100%
Minimum Application Rate:	54 kg/ha
Maximum Application Rate:	145 kg/ha
Field Average Rate:	108 kg/ha
Total Applied Acreage:	8.3 ha
Total Field Acreage:	13.1 ha
Total Field Acreage(lbs):	2001.6
Total Field Acreage(tons):	1.00

# Up and Coming Technology: Crop Sensors



**GreenSeeker®**  
Variable Rate Application and  
Mapping Systems



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# Crop Sensor Uses

- Nitrogen application in corn and wheat
- Weed pressure mapping
- Plant growth regulator and defoliant applications in cotton
- Stress and damage in soybeans and peanuts

# Top Trend #4: In-Cab Solutions

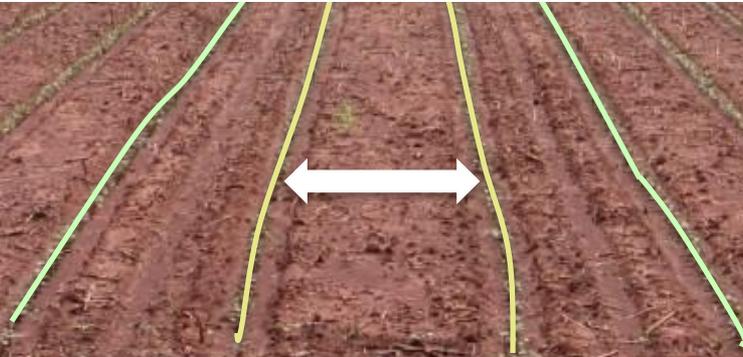
- Automated Guidance
- Boom Section Control



# Automated Guidance

## – Yield decreased

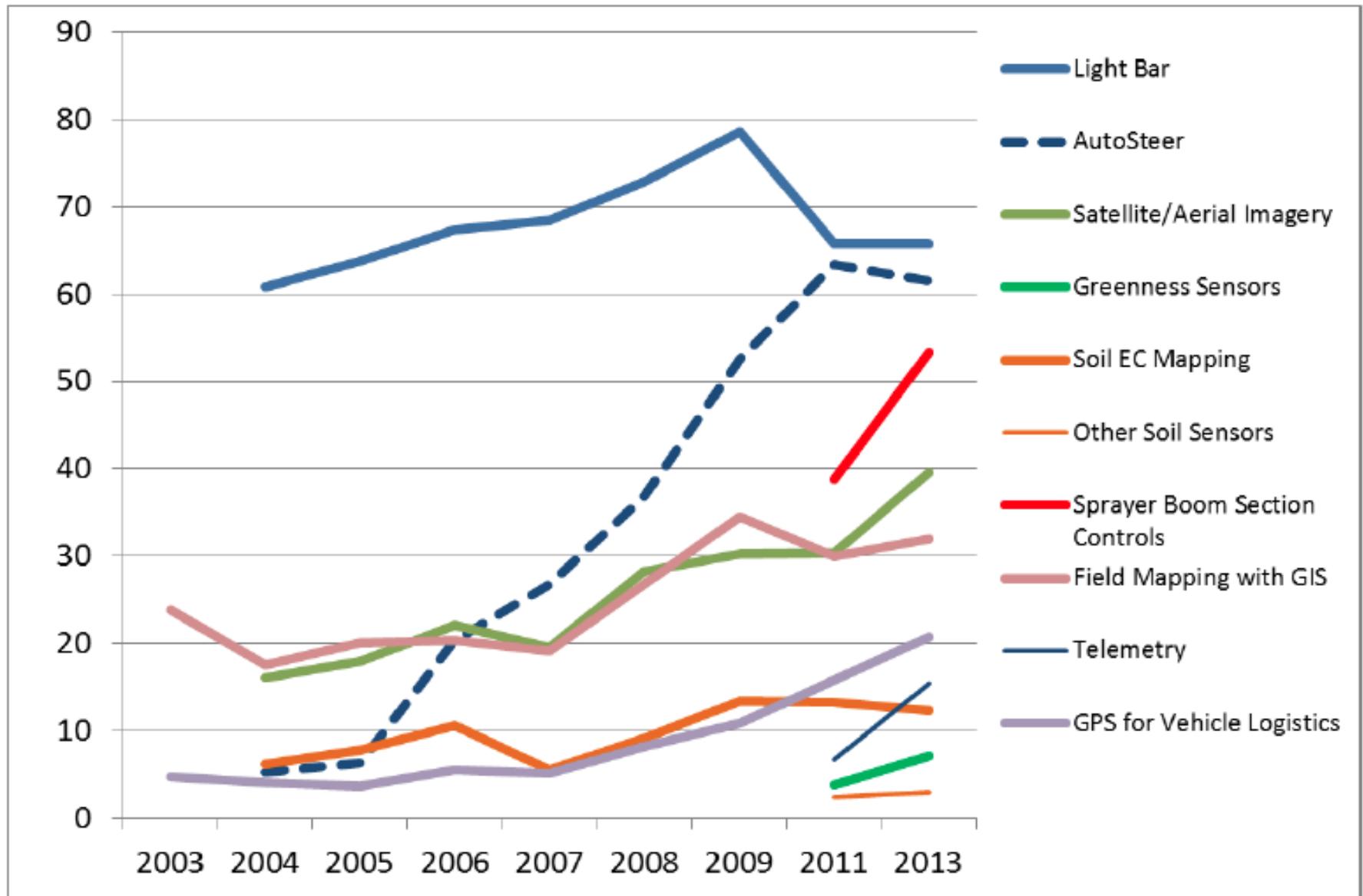
- 16% when row 2-inches off center
- >30% when row 9-inches off center



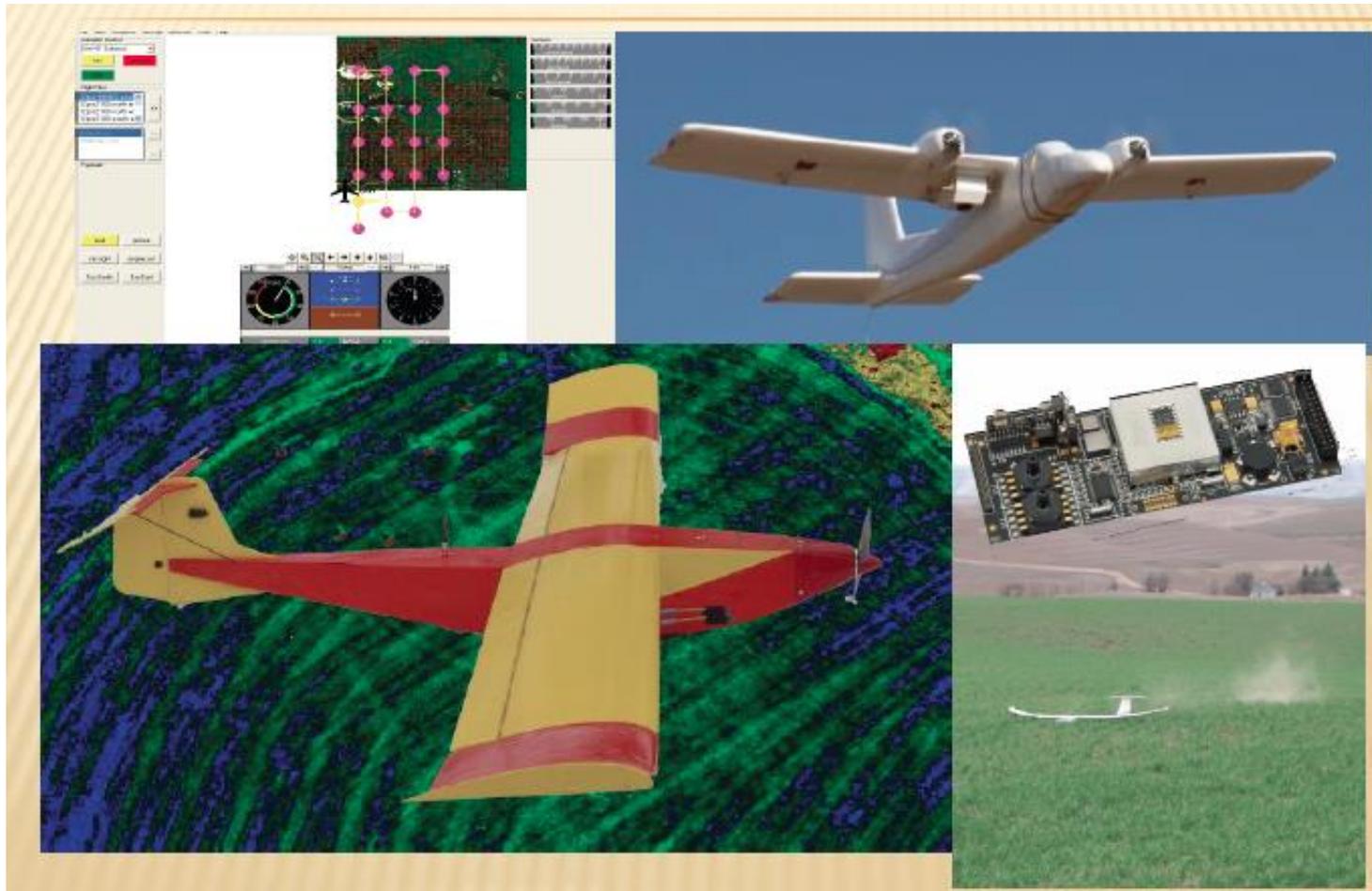
# Boom Section Control



# Dealer Use Over Time



# Top Trend #5: Unmanned Aerial Vehicles (UAV)



# WHAT IS A UAV?

- ❖ Flies Autonomously
- ❖ On Demand
- ❖ Flies Under Cloud Cover
- ❖ Battery Powered
- ❖ Remote sensing
- ❖ Higher Resolution
- ❖ Lower cost for data



# Unmanned Aerial Vehicle

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DraganFly X6

<http://www.draganfly.com>



eBee

<http://www.sensefly.com>



MicroDrone MD4-200

<http://www.microdrones.com>



Yamaha

Fixed-wing



Cropcam



Raven



WASP III

# Potential Applications

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- Crop Scouting
- Bare soil imagery
- Irrigation and drainage planning
- Yield estimation and monitoring
- Inventory
- Diagnostic of herbicide injury in crops
- Selection of plants for further breeding
- Sampling plant pathogens in the air
- Academic and extension education

NDVI Camera

# UAV Sensors



Tau 640 thermal imaging camera



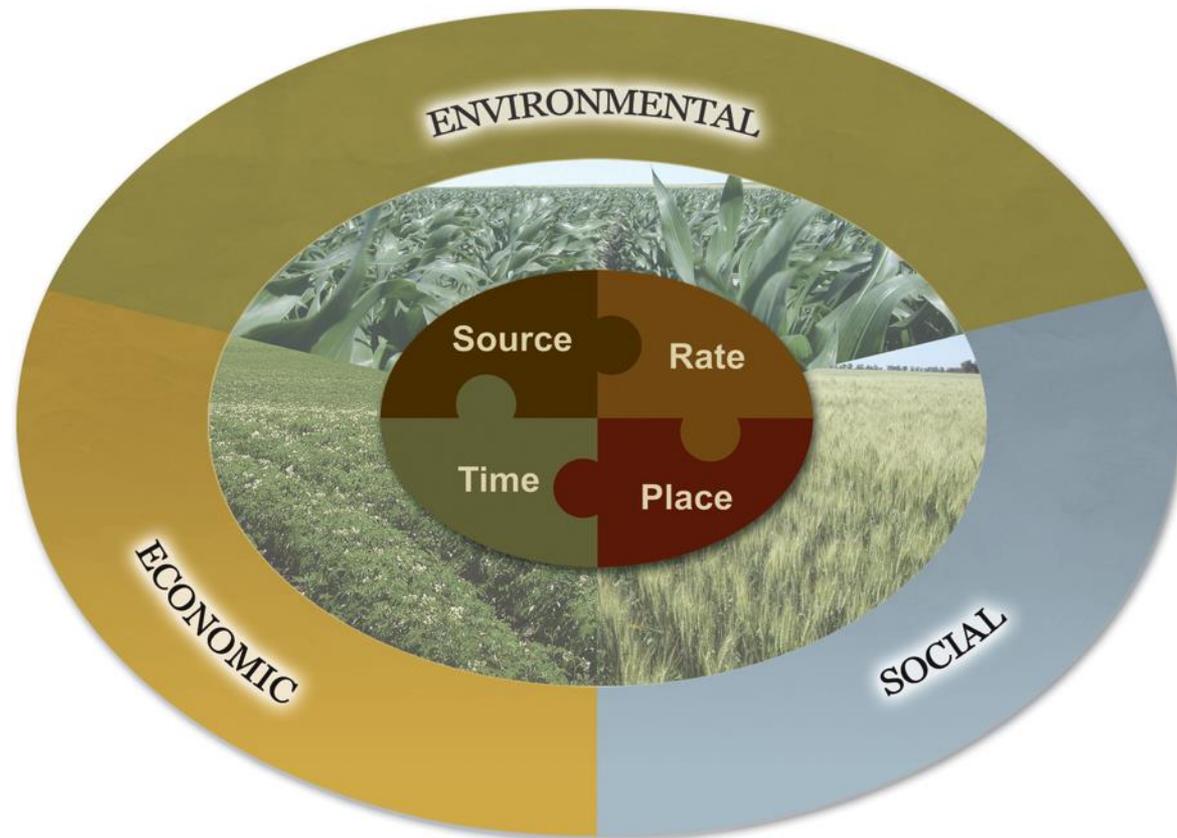
Multispectral camera array (MCA) imaging sensor

# Future for UAVs

- UAV has a lot of potential applications in agriculture and horticulture crops
  - Small farms
- More research is needed
  - Develop tools and techniques
- Rules and regulations are not clear
- Lots of excitement among growers

# 4R is Precision Nutrient Management

- Implementing precision agriculture technologies within the context of 4R nutrient stewardship is an efficient and effective way to help meet the environmental, economic, and social goals of sustainable agricultural systems





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*Thank You*

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