Precision Agriculture in an Energy Intensive World
Energy Impacts Ag

- Energy = “Bottom-Line”
  - Transportation
  - Agro-chemicals
  - Irrigation
  - Tillage
Energy Impacts Ag

• Focus on Fertilizer
  - Prices have more than doubled since 2000
    • Natural Gas ~ 85-90% of total cost
    • Import nearly 50% of our N
    • Weak U.S. $ in a global market

Energy Impacts Ag

Cumulative U.S. Ammonia Plant Closures vs. Natural Gas Prices

Source: Blue, Johnson and Associates, Natural Gas Week and The Fertilizer Institute.

Energy Impacts Ag

• Focus on Fertilizer
  - Some good news
    • Some commodity prices of increased with Fertilizer cost.
    • EQIP Energy Cost Assistance (2006)
    • Strategies that conserve energy and the bottom-line.
Energy Impacts Ag

- Conservation Strategies
  - Nutrient Management ($85 ac\(^{-1}\))
  - Irrigation ($9-41 ac\(^{-1}\))
  - IPM ($40 ac\(^{-1}\))
  - PRECISION AGRICULTURE ($13 ac\(^{-1}\))

Precision Ag

- Tailors Inputs to Expected Outputs
- Core Component = Management Zone

Imagery

Soils

Yield
Precision Ag

- Targeted Soil Sampling
- Variable Rate:
  - Irrigation
  - Seeding
  - Harvest
  - Lime
  - Pesticides
  - Fertilizer
Delineating Management Zones

- Grid Sampling
  - Grid Cell Vs. Grid Center
Delineating Management Zones

- Grid Considerations!

- Number of Samples - Time and Expense

0.25 ac grid

0.50 ac grid

1 ac grid

Southeast Watershed Research Laboratory

United States Department Of Agriculture
Agricultural Research Service
Delineating Management Zones

- Grid Considerations!
  - Data Quality

0.25 ac grid
0.50 ac grid
1 ac grid
Delineating Management Zones

0.25 ac grid

0.50 ac grid

1 ac grid
Delineating Management Zones

• Letting Data Drive Zones
  - Greater upfront investment
    • Gathering Data
    • Analysis
    • Defining Zones
  - Kinds of Data
    • Yield Maps
    • Aerial or Satellite imagery
    • Soil and Topo Maps
    • Site History
Delineating Management Zones

YIELD

VERIS

SOIL

Early Season Image

Mid Season Image
Delineating Management Zones

YIELD

Water Content
VWC_091906
- 6.3 - 7.8
- 7.9 - 8.3
- 8.4 - 9.8
- 9.9 - 14.8
- 14.9 - 30.6
Delineating Management Zones

YIELD
A Precision Ag Example

• Objective
  - What is the integrated effect of pest pressure, fertility, and landscape position on cotton yield???
  - Can we define zones that reflect these differences?
  - Is there an overwhelming “feature” that controls “expected” yield?
A Precision Ag Example

Can we manage cotton inputs site specifically?
Reduce Input
Maximize Returns $$

MZ 1
Rate 1

MZ 2
Rate 2

MZ 3
Rate 3
A Precision Ag Example

Site: SE Coastal Plain, GA
Soil: Loamy Sand
History: Root-knot Nematode Infested
Data:
A Precision Ag Example

Correlation (r)

-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8

RKN  Elev  Slope  EC-S  EC-D  SWC  K  Ca
A Precision Ag Example

EC-deep, K, RKN = **54%** of yield variability

EC-deep = **35%** of yield variability

RKN = **12%** of yield variability
A Precision Ag Example

Lint mass (Kg/ha)
- < 1126
- 1126 - 1422
- 1422 - 1644
- 1644 - 1866

EC Deep (mS/m)
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.8
- 1.8 - 2.7
- 2.7 - 7.2
- 7.2 - 12

Log 10 RKN S2 (Second juveniles /150 cm³ soil)
- 0 - 0.4
- 0.4 - 1.2
- 1.2 - 1.9
- 1.9 - 2.7

K (Kg/ha)
- 56 - 78
- 78 - 112
- 112 - 168
In Summary

• Soil Texture is correlated with:
  - Water Availability
  - Fertility
  - Some Pests (RKN)
  - Most Importantly YIELD

• Site specific mgmt of fertilizers shows promise as a tool to minimize inputs and maximize gains.
In Summary

• Remember, tailoring inputs (fertilizer) works best when matched to **EXPECTED** yields.