Andrew Vrbka, TSA
Servi-Tech, Inc
National Alliance of Independent Crop Consultants Annual Meeting
January 20, 2011

VARIABLE RATE NITROGEN

ON THE FARM APPLICATION

- Not a new concept
- Newer equipment available making multiple application rates more manageable.
- Less need for expensive/specialized custom applications

OBJECTIVE OF VARIABLE RATE NITROGEN

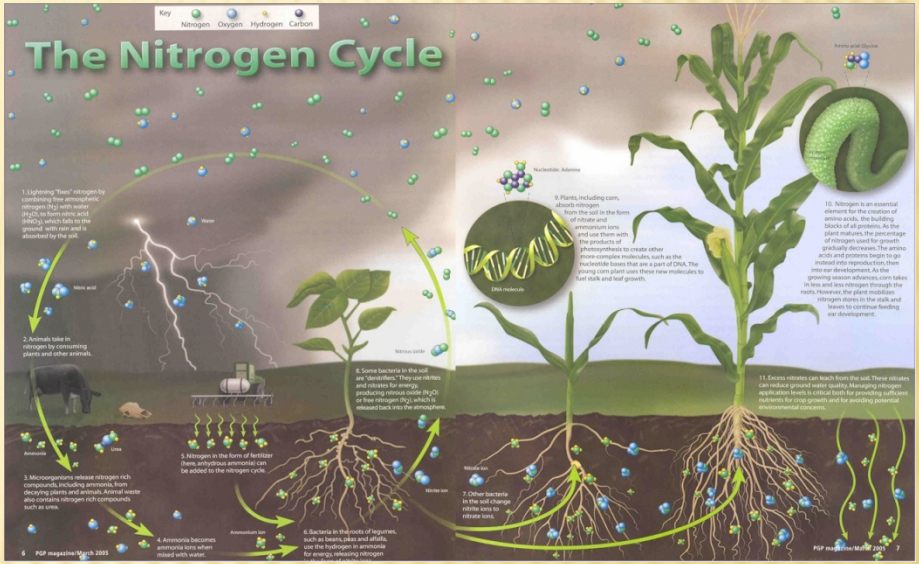
- A good Agronomic, Environmental, and Economic practice.
- Variations that affect Nitrogen efficiency.
  - Often considered by consultants when making N recommendations, though sometimes indirectly.
  - Assign a value for variations' impact, and develop a RX to maximize advantages and counter-act obstacles to N uptake and use.
- Variable Rate vs. Flat Rate application.
  - Cut Costs?
  - Increase Yields?
  - Better Utilization of our Nitrogen Inputs!

"The reason I began using VRT was the potential to increase yields with less total fertilizer applied. With the increase in both grain and fertilizer price, it made sense. I already had most of the components in place, so it was just a matter of purchasing rate controllers to tie everything together. The software has evolved to where it really hasn't become to complicated."

Doug Schardt; Thayer County Producer

WORKING WITH NITROGEN

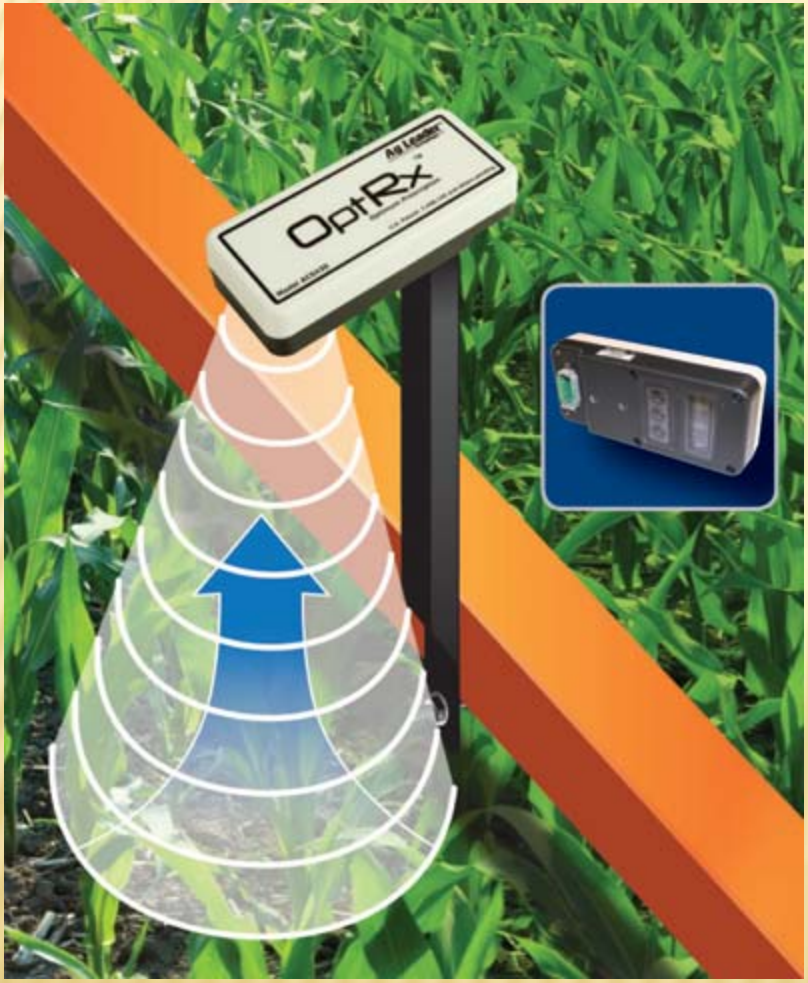
- Nitrogen Cycle
  - Mobile Nutrient
- Soil sample information
  - Timing and sampling procedure
  - Handling of the sample
  - Weather before & after sampling
- Predict what may be available, and supply the rest
- Effects of Over and Under Fertilization



"Soil nitrate analysis has been shown to be a very good tool in nitrogen management. The single soil test number itself is not enough for a consultant to make a good recommendation."

Fred Vocasek; Servi-Tech, Inc

REMOTE SENSING



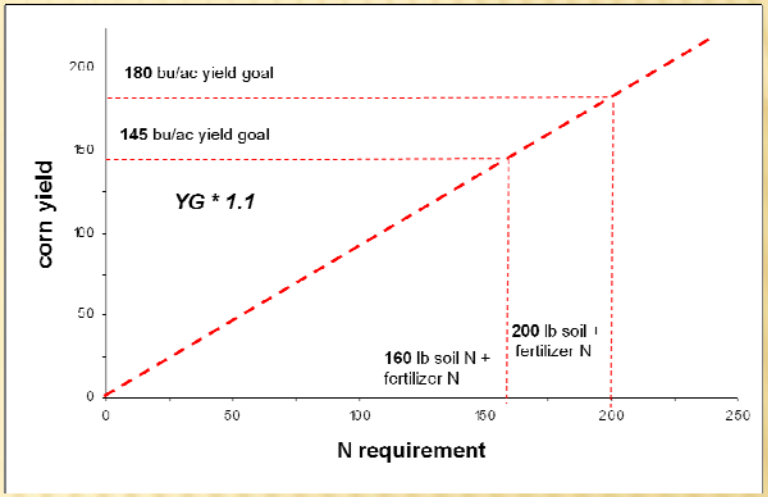
- Measures differences in crop canopy color
- On the go fertilization, An in-season application
- Requires a in field calibration strip
- Timing of application is critical and may be difficult to cover a lot of acres
- May be more useful in limiting over application of fertilizer

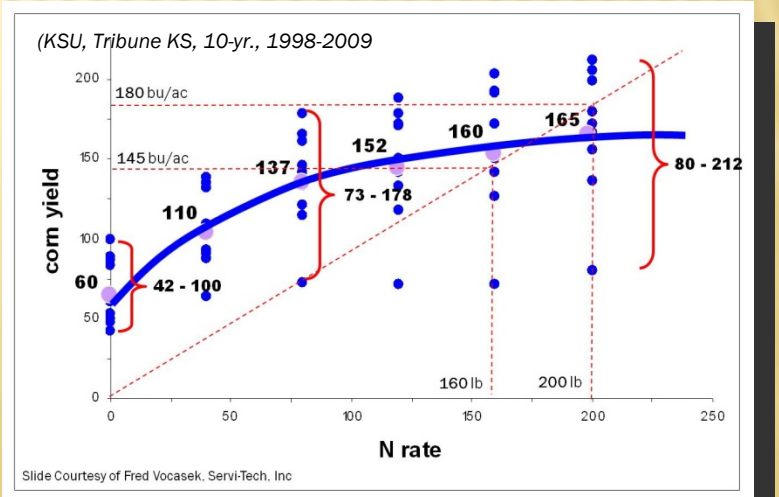
DEVELOPING A RX

- Soil Sample
- Yield Goal
- Evaluate Soils' ability to supply Nitrogen to a growing crop.
- Credits

YIELD AFFECT ON APPLICATION RATES

- Determining your Y.G.
  - 5 year History Average x 10%
- Expected Yield vs. Actual Yield
- Historical Yield
  - Analyzing the trends and not the specifics
- Developing nitrogen recommendation
  - Nitrogen Factor; How many lbs. of N to achieve desired yield





$N_{REC} = (N_{FACTOR} * YG) - SOIL\ N - N\ CREDITS$

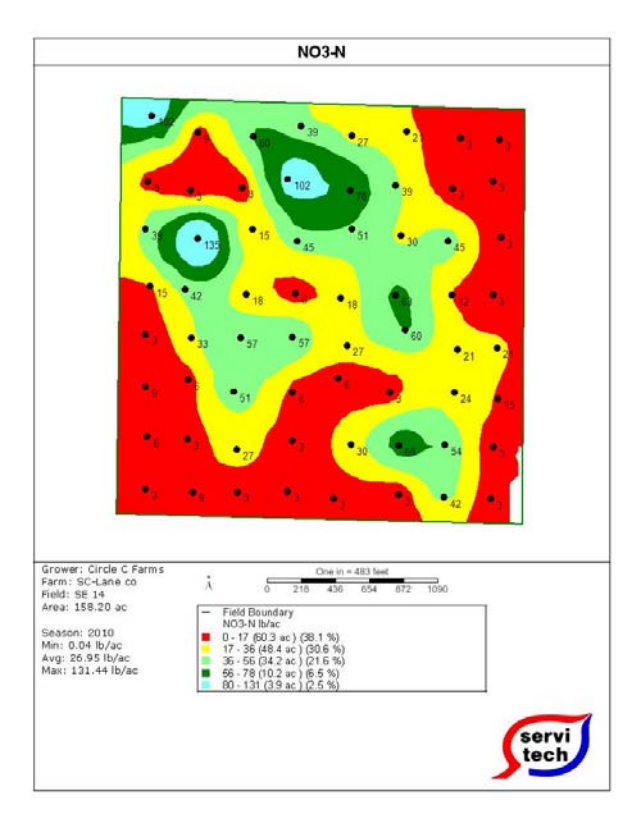
- N_{rec}: nitrogen fertilizer requirement
- N_{factor}: lb N per unit of yield
  - corn = 1.3 lb N/bu
- YG: yield goal based on history
- soil N: nitrate soil test (NO_3-N)
- N credits: nitrogen from non-fertilizer sources
  - previous legume crop
  - manure, sludge, biosolids
  - organic matter mineralization

Slide Courtesy of Fred Vocasek, Servi-Tech, Inc

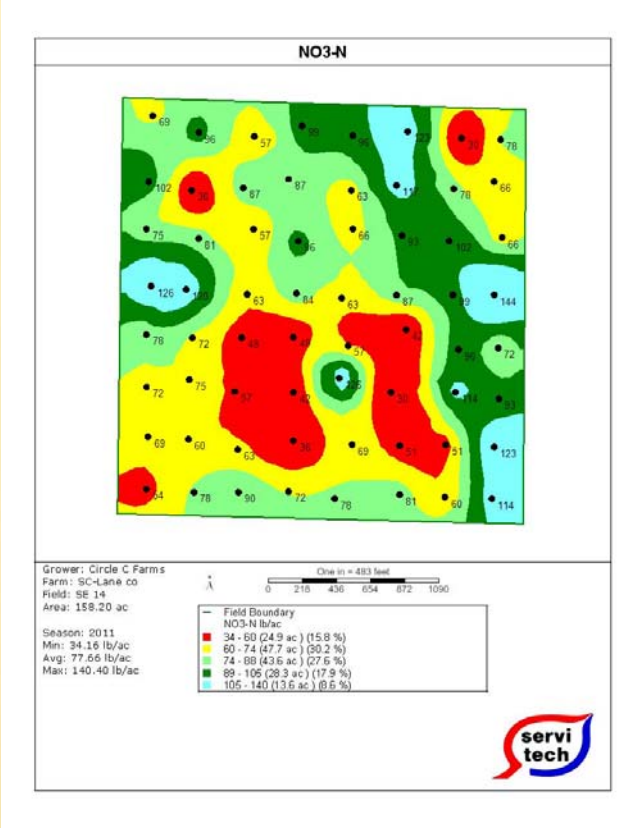
WHAT CAN THE SOIL PROVIDE?

- Soil Characteristics
  - Soil Type
  - Organic Matter Content
  - Storage Capacity
  - Interaction with plant's growth
- Current and long term weather trends
- Year to Year changes
- Historical and Recent Field Trends

2010 CROP SEASON DATA



2011 CROP SEASON DATA



Courtesy of John Payne; Servi-Tech, Inc TSA

YEAR TO YEAR VARIATIONS

NITROGEN CREDITS

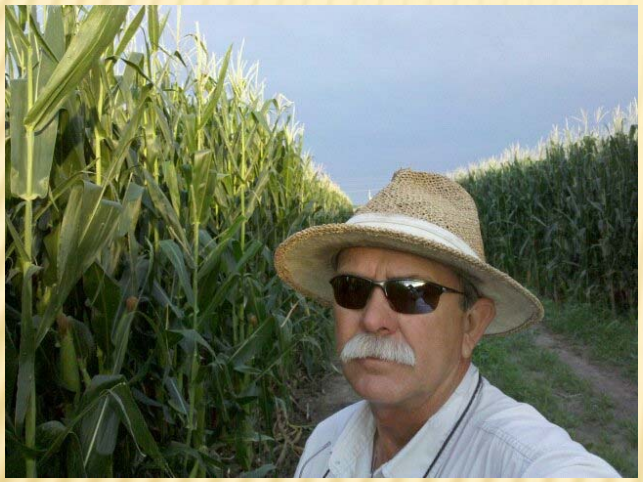
- Nitrogen available from Non-Fertilizer Sources
  - Soil Test Nitrogen
  - Legume Credit
  - Manure or Bio-Solids
  - Organic Matter

ORGANIC MATTER CREDITS

(Servi-Tech, Inc Crop File: 1.04.110 Jan 1985)

- Consists of decomposed plant material, with the largest portion being Humus which is a fairly stable compound
- Content changes very slowly
- Contains essential plant nutrients in concentrated form which is released through microbial decomposition
- Releases Nitrogen at 20-50 lbs. per Percent O.M annually
- Higher O.M. content improves Root Growth and better water and air movement through the soil

ORGANIC MATTER



"Variable rate applications of nitrogen based on organic matter is valuable to attain maximum economic corn yields on all soil types and levels of organic matter in a field.

The lower 1% OM silt loams will need about 40-50# more nitrogen than the higher 2.5 to 3% OM soils to meet the same yield goals that one tries to achieve on the higher OM soils. With proper water management, the lower OM soils will generally yield just as well with adequate nitrogen.

The dollars saved by lowering the nitrogen rates on the high OM soils can be done to show the savings and environmental stewardship by not over applying on the high OM soils."

Orvin Bontrager; Servi-Tech, Inc.

OTHER CREDITS /ADJUSTMENTS TO CONSIDER

- Environmental
  - Weather
    - Effect on Mineralization and O.M. Nutrient Release
    - Effect on Leaching
    - Timing of application
  - Irrigation
    - Nitrates in water
    - Yield stability
    - May follow a parallel trend with yield.
  - Effect of Slope, Elevation, and Soil Type
- Physical
  - Product
  - Farming Practices/Timing of application
  - How it is applied
- Economical
  - Cost of implementation
    - Price of Equipment
    - Price of Sampling, Zone management, etc.
  - Cost of application
    - Price of fertilizer

REGIONAL EQUATIONS

- Consult your University Extension for Nitrogen Fertilizer Recommendations specific for your area
- UNL Nitrogen Recommendation Equation:

  UNL Extension Publication: EC117

  http://soilfertility.unl.edu/ for Excel Spreadsheet

$$N(lb/ac)=[35 + (1.2 \times EY) - (8 \times NO_3\text{-}N\ ppm) - (0.14 \times EY \times OM) - N\ Credits] \times Price_{adj} \times Timing_{adj}$$

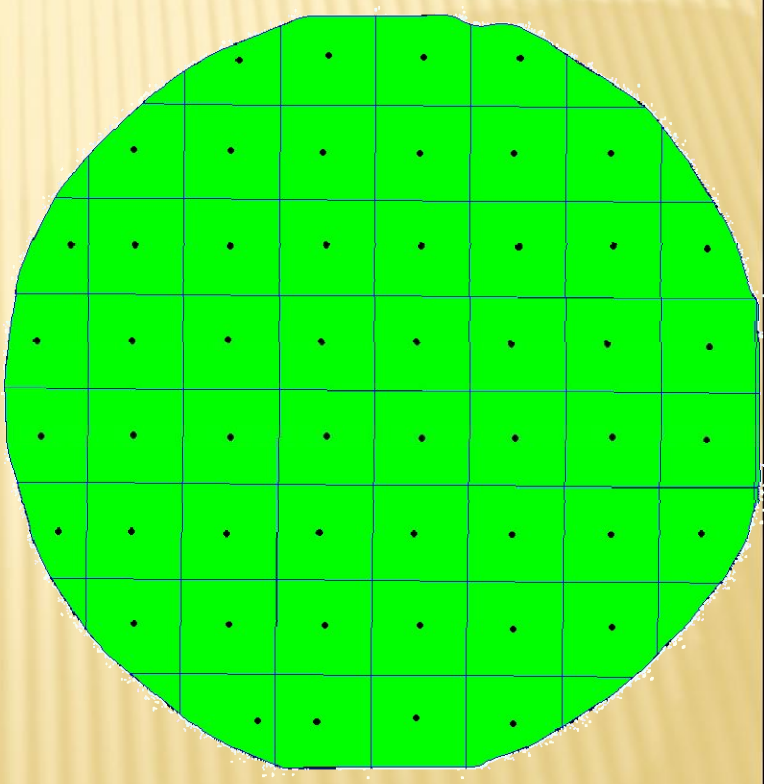
EY =Expected Yield

$Price_{adj}$= adjustment factor for price of corn and fertilizer

$Timing_{adj}$=adjustment factor for fall, spring, or split application

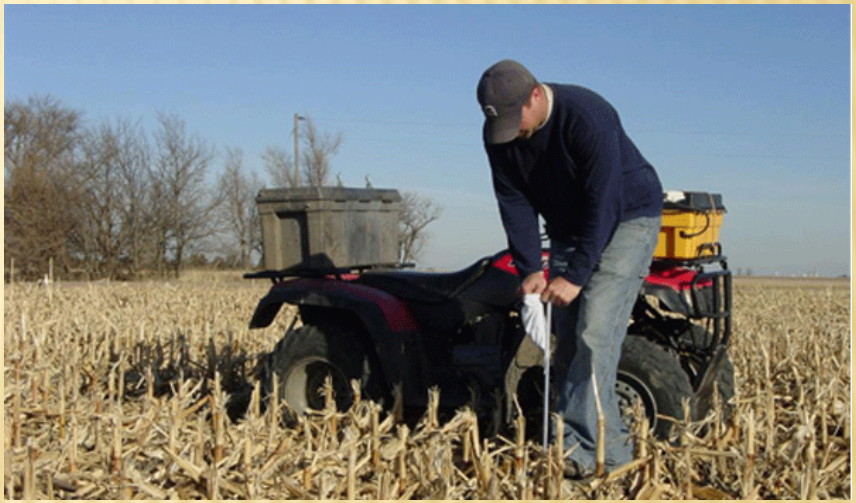
GRID SAMPLING

- Position a grid across the field, with a point within each grid.
  - Points can be moved to areas that are most representative within the grid zone.
  - Sample location is geo-referenced, and repeatable.
  - Most grid sampling is done on 2.5 acre grids.
- Composite samples of 5-8 cores are taken at each point.
- Soil samples are analyzed by a soil lab.
- Requires formula based analysis of data to create maps.
- Increases in grid size decreases variability results.



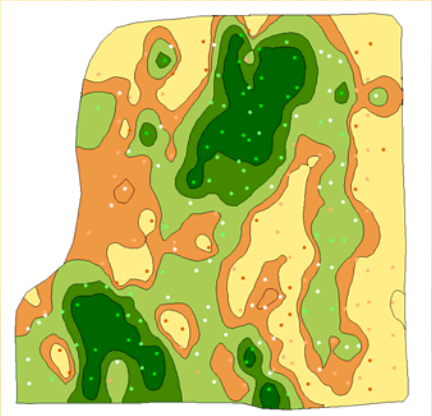
ZONE SAMPLING

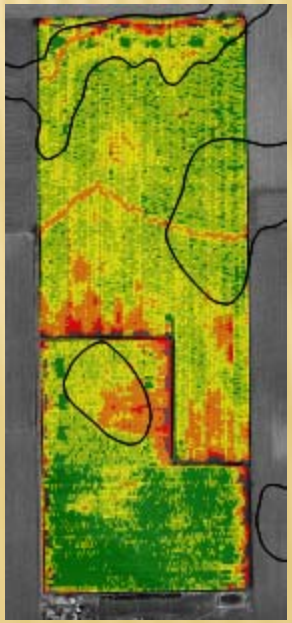
- Zone sampling targets areas of variability within a field, and group like trends together.
- Each zone is managed independently to maximize potential.
  - May have multiple yield goals one field.
  - Management may be different for each zone.
- Should use soil sampling to verify nutrient trends; taken at random within the zone
- Suggest geo-referencing each core when soil sampling.
- Zone size and shapes not always consistent.
  - Keep zone sizes manageable
  - Separate zones must be created between different crops
  - Not as consistent in finding nutrient trends compared to small acre grids.



ZONE SAMPLING

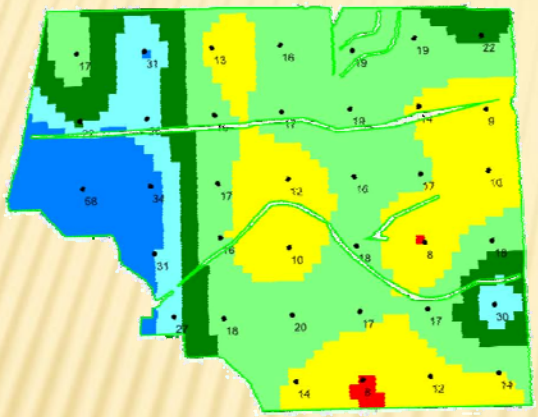
- Can be created from many sources of data
  - Yield Data, Field imagery, soil types, EC data.
- Can be created using basic software usually included with your GPS equipment purchase.
- Accuracy dependent on the quality of the data source.
  - Use relative yields in place of actual yields
  - Yield data must be “cleaned up”
  - When using imagery, the projection and resolution makes a difference.
  - Sizeable variations can occur across 1 soil type, such as EC or Organic Matter %



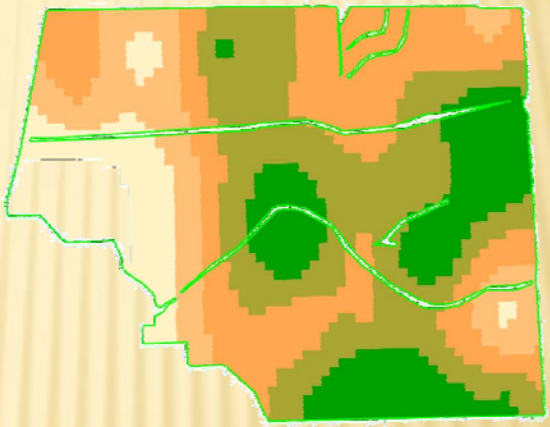


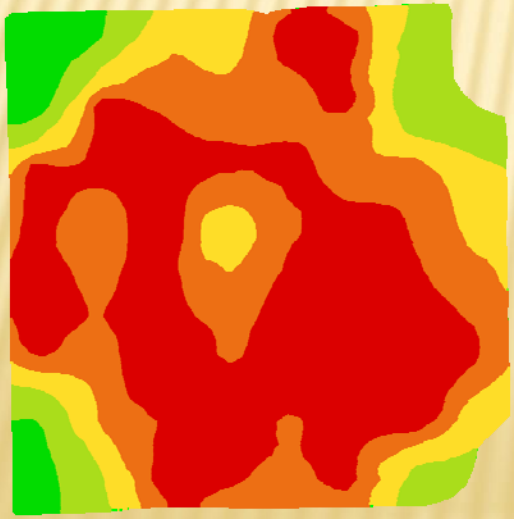
VARIABLE RATE FERTILIZER PRESCRIPTIONS

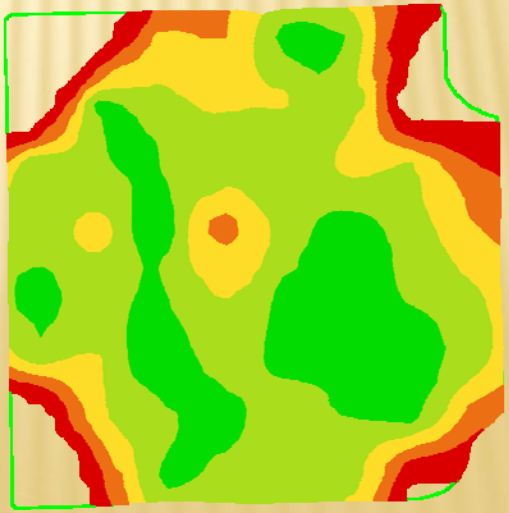
P Fertility



P Recs



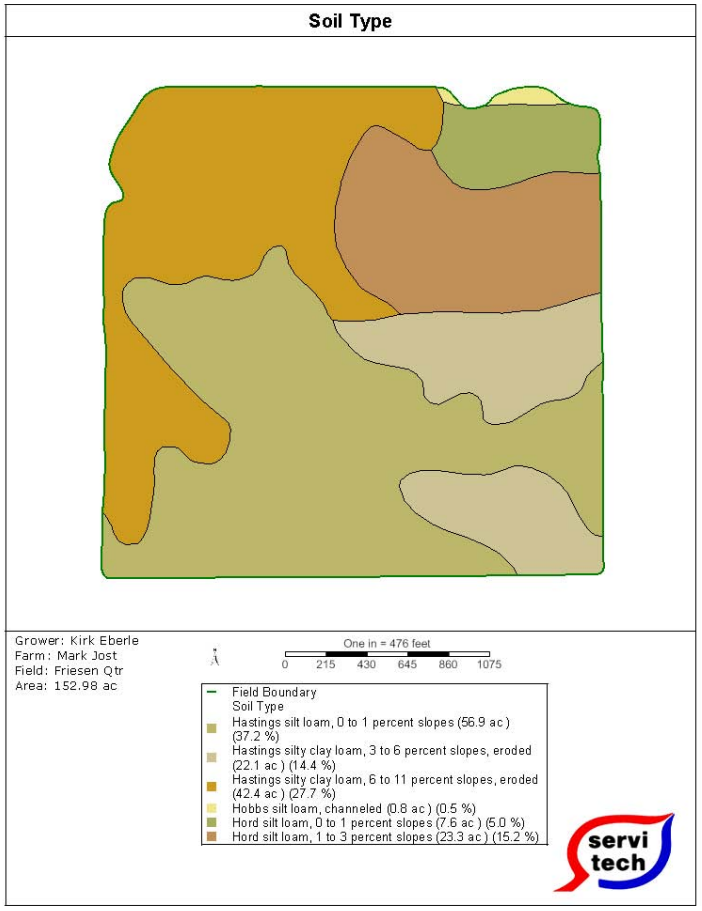


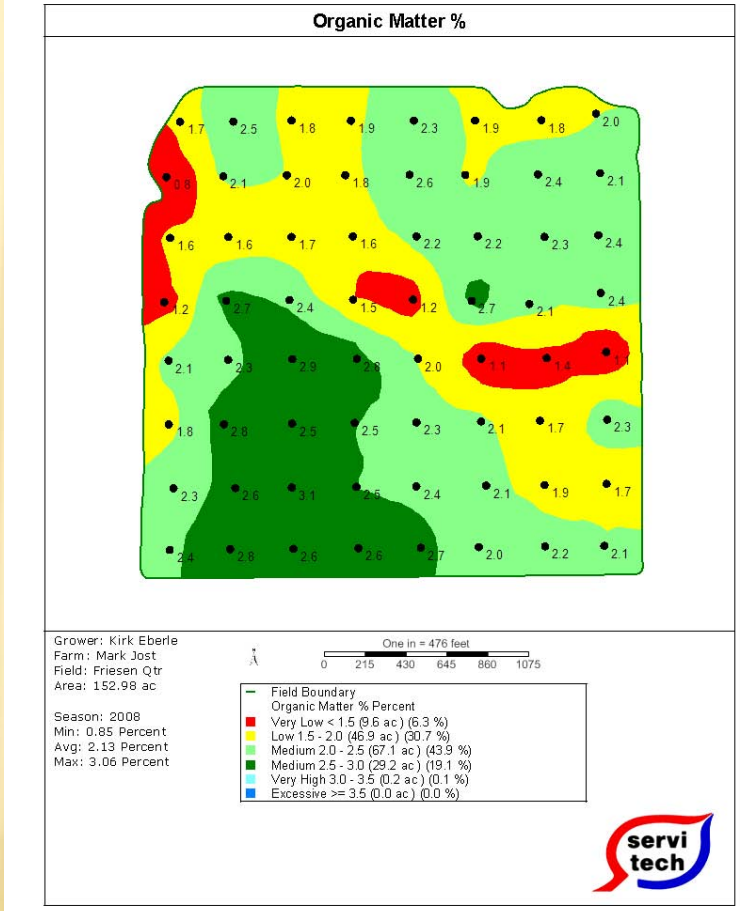


THE PLAN

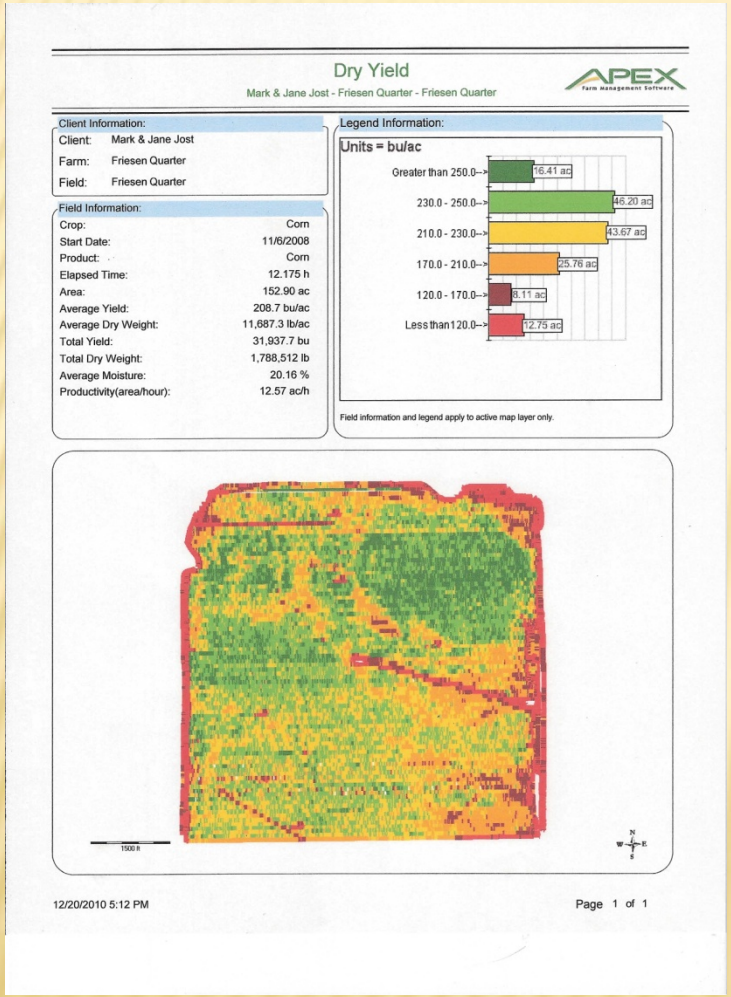
- Grid Sample
  - N, P, K, S, Zn, & O.M.
  - Annual Spread for P, K, & Zn using Grid Sample Rx.
  - Normal to spread same RX 4-5 year before Grid Sampling again.
- Zone Sample
  - Construct Management Zone from O.M. map.
  - Composite Sample within each Zone.
  - Develop Nitrogen Rx for each zone based upon Crop, Soil Results, & Yield Goal, and other variables.
- Harvest Map
  - Your Report Card

SUCCESSFUL RESULTS





SUCCESSFUL RESULTS



Dry Yield

Mark & Jane Jost - Friesen Quarter - Friesen Quarter

APEX Farm Management Software

Client Information:

Client:	Mark & Jane Jost
Farm:	Friesen Quarter
Field:	Friesen Quarter

Field Information:

Crop:	Corn
Start Date:	11/6/2008
Product:	Corn
Elapsed Time:	12.175 h
Area:	152.90 ac
Average Yield:	208.7 bu/ac
Average Dry Weight:	11,687.3 lb/ac
Total Yield:	31,937.7 bu
Total Dry Weight:	1,788,512 lb
Average Moisture:	20.16 %
Productivity(area/hour):	12.57 ac/h

Legend Information:

Units = bu/ac

Field information and legend apply to active map layer only.

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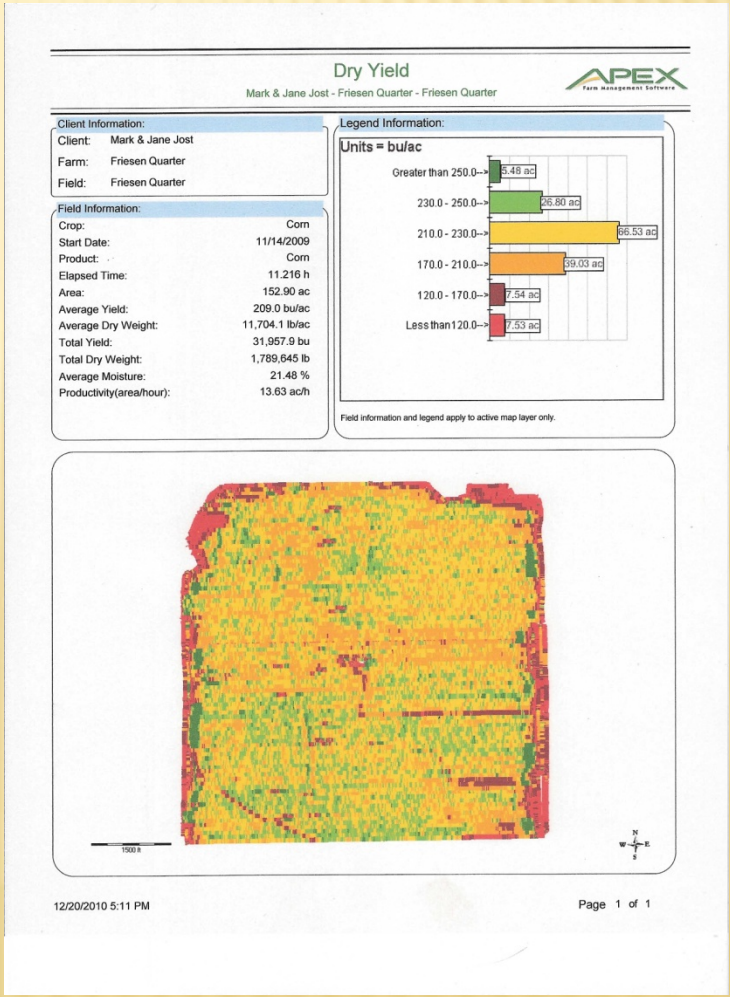

Dry Yield

Mark & Jane Jost - Friesen Quarter - Friesen Quarter

APEX Farm Management Software

Client Information:

Client:	Mark & Jane Jost
Farm:	Friesen Quarter
Field:	Friesen Quarter

Field Information:

Crop:	Corn
Start Date:	11/14/2009
Product:	Corn
Elapsed Time:	11.216 h
Area:	152.90 ac
Average Yield:	209.0 bu/ac
Average Dry Weight:	11,704.1 lb/ac
Total Yield:	31,957.9 bu
Total Dry Weight:	1,789,645 lb
Average Moisture:	21.48 %
Productivity(area/hour):	13.63 ac/h

Legend Information:

Units = bu/ac

Field information and legend apply to active map layer only.

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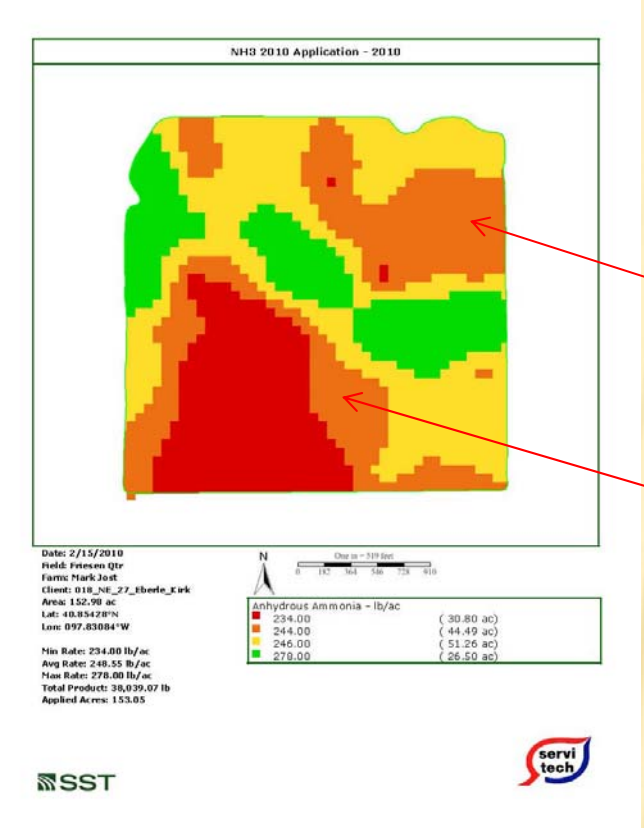
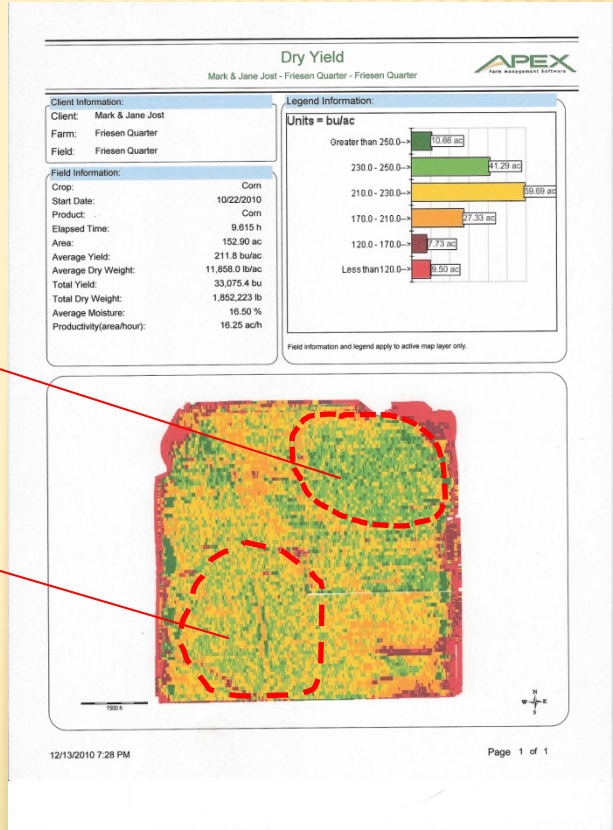
VARIABLE RATE PRESCRIPTION 2010

1) CREATED FROM O.M. MANAGEMENT ZONES
2) RATE PER ZONE WAS CALCULATED USING UNL NITROGEN CALCULATOR

HARVEST RESULTS 2010

1) MAINTAINED YIELD IN HIGHER O.M. ZONES WITH LESS N APPLIED
2) RESPONSE FROM ADDITIONAL N APPLIED IN LOWER O.M. ZONES

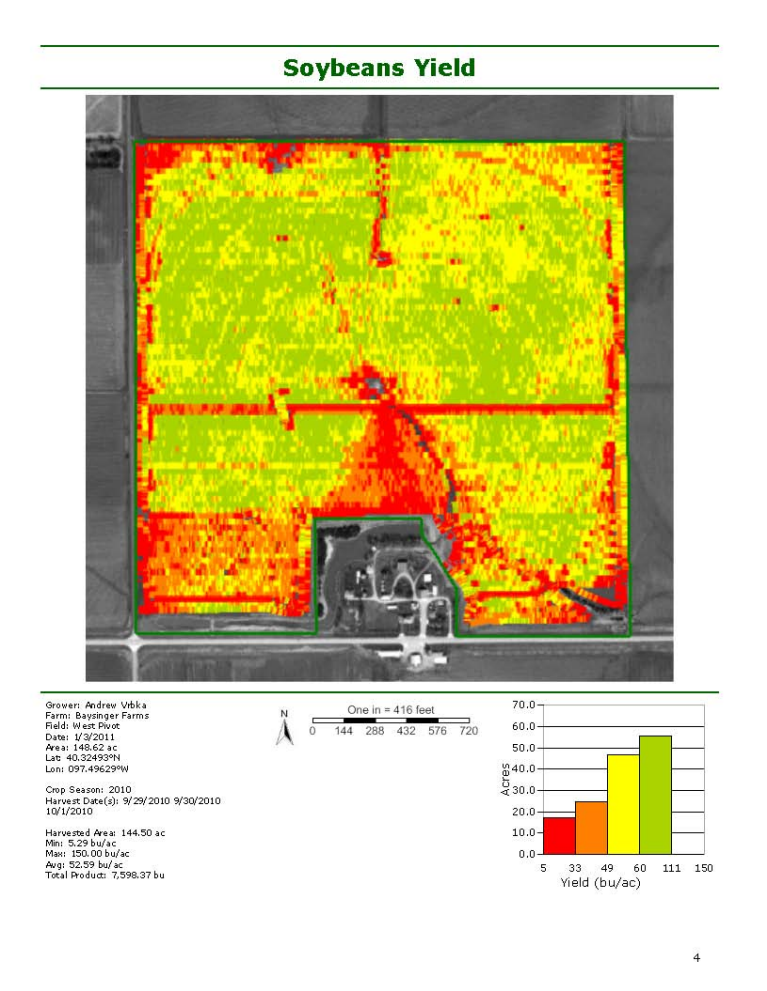




SUCCESSFUL RESULTS

FUTURE RESEARCH

- 2011 Field Trials
  - Side by side Flat Rate & Variable Rate applied N, 24 rows each, replicated across 80 acres
  - Field was grid sampled on Nov. 1, 2010, using 2.5 acre grids
  - Irrigated, with cornering system.
  - Located in Northeast Thayer County, Nebraska
  - Nitrogen will be applied Strip Till in the Spring.
  - May consider Yield Goal blocks to test possible yield increase advantages.



TESTIMONIAL

"I have been variable rate applying nitrogen and phosphorous for 3 years now, and am starting to see some real benefits.

The first thing I noticed with VRT was that I was still using the same amount of fertilizer in each field, but the application rate was varying throughout the field. I may be spending the same amount of money for fertilizer, but now I know that I am using it much more efficiently. And that has been proven by the yield monitor.

After using VRT for 3 years, I am seeing much more consistent yield from one end of the field to the other. And that has resulted in higher average yields, and that is what it is all about!"

John Workentine; Fillmore County Producer

THANK YOU

- Clark Poppert; Servi-Tech, Inc
- Orvin Bontrager; Servi-Tech, Inc
- Kirk Eberle; Servi-Tech, Inc
- Fred Vosacek; Servi-Tech, Inc
- John Payne, Brandon Thayer, Eric Klein, Ross Benisch, Ryan Meister; Servi-Tech, Inc Precision Ag Group
- Jerry Baysinger, JBI Enterprises & Baysinger Farms-Producer
- Mark Jost; Producer
- Mike Schardt; E&A Schardt-Producer
- Doug Schardt; Triple A Inc-Producer
- John Workentine; Producer