A Consultant’s Perspective on Efficiency Improvements with Precision Nutrient Management

John Shanahan - Agronomist with PG Farms

- Paul & Deb Gangwish – Owner
- Headquarters in Shelton, NE
- 11,000 acres of cropland
- Produce and harvest hybrid seed corn
- Hay and livestock production
- Trucking business
- Twenty full-time employees
About Myself

- Agronomist-PG Farms 2016 -
- Agronomist-DuPont Pioneer 2010 - 2016
- Research Agronomist-USDA-ARS & Univ. of Nebraska 1998 - 2010
- Extension Specialist-Colorado State University 1982 - 1998

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Nitrogen Management Challenge

• Nitrogen (N) fertilizer management is among most uncertain aspects of modern corn production
• Because soil N varies dynamically in response to the interaction between soils and weather, optimal N rates for any year or location in a given field varies widely
• As a result, N is often inadvertently over- and under-applied, reducing profitability

\[
N_2 (g) + 3 \text{H}_2 (g) \rightleftharpoons 2 \text{NH}_3 (g) \quad \text{Haber–Bosch process}
\]

Consumes 40% of energy budget for corn production
Key to improving N management may involve less reliance on large preplant N applications at uniform rates and greater dependence on split applications of spatially variable N rates.
PG Farms Enterprise

- **North Pod**
  - 6000 acres – No-Till
  - 80% corn & 20% soybean
  - 25.2 in. precip.
  - Yields: **210-250 bu**

- **South Pod**
  - 5000 acres – No-Till
  - 80% corn & 20% soybean
  - 26.3 in. precip.
  - Yields: **240-270 bu**
South Fields

- South Farm Soils:
  - Level to rolling terrain
  - pH: 6-8
  - Silty loam soil types
  - O.M.: 1.5-2.5%
  - CEC: 15-20 meq/100g

North Fields

- North Farms Soils:
  - Level to rolling terrain
  - pH: 6-8
  - Sandy loam soil types
  - O.M.: 0.5-1.5%
  - CEC: 5-15 meq/100g
N Applicator: Exactrix W/ Precision Control

(24 rows, 15” intervals)

Anhydrous ammonia
10 – 34 – 0
Ammonium thiosulfate

www.exactrix.com
170 lb N/Ac 4.5 inches to Side of Rows on day before fall freeze up

Bock, 2015
Planters - W/ Precision Fertilizer and Seed Control

JD 2630 Monitor

FieldView Drive
Precision Irrigation Control

Valley BaseStation3

Water, Nitrogen and Pesticide Application

Manage for Spatial Variability
Combines - W/Precision Yield Mapping

![Image of combines and precision mapping interface](image-url)
Precision Apps Reviewed

John Deere- Op Center

Climate Apps

Irrigation

Satellite Imagery

AgLeader SMS Advanced
Nitrogen Management Plan

South Farm
Applied N (260 lbs/acre)
- 90 lbs/acre Preplant N
- 170 lbs/acre Pivot N
3 applications - 30 lbs/acre @ V10, V14 & VT

North Farm
Applied N (230 lbs/acre)
- 50 lbs/acre Planter Applied N
- 180 lbs/acre Pivot N
6 applications - 30 lbs/acre @ V3, V5, V8, V14, VT, R1/R2
Goal - Maintain Season-Long Supply of N

Seasonal Nitrogen Uptake, %

- 70-80% of requirement after V8 - 10
- 40% of requirement after silking

- May
- June
- July
- Aug
- Sept
Evaluating N Management Plan

100 lbs N/acre Preplant Applied Ammonia
Monitoring Vegetative Health Using Satellite Imagery from Farmshots

Imagery Sources

Rapid Eye: 5-band multispectral image (blue, green, red, red edge, near-infrared)

North Farm

South Farm
Planet Labs in 2017

Integrated Imagery

**PlanetScope Imagery**
- 100+ Satellites
- 4 m Pixel Size
- Available from 2017
- RGB + NIR
- Tile Delivery
- GeoTiff Download

**RapidEye Imagery**
- 5 Satellites
- 5 m Pixel Size
- RGB, NIR, Red Edge
- Tile Delivery
- GeoTiff Download

**Landsat-8 L1T**
- 30 m MS Bands
- 15 m Pan Band
- TIRS
- Scene Delivery
- GeoTiff Download

Co-Registered
Remote Sensing Basics

Use of Remote Sensing Imagery for Improving Crop Management Decisions

by Bob Gunzenhauser¹ and John Shanahan²

Summary

- Remote sensing is collecting reflected light information from objects like crop canopies using remote platforms such as satellites, aircraft or ground-based platforms.

- In a 2013 pilot program, DuPont Pioneer is providing remote sensing imagery services to growers through Pioneer® Field360™ services.
  - In-season imagery from RapidEye is provided by Satshot, a national distributor.
  - This imagery can be displayed from a mobile device such as an iPad® or other tablet and can be used for directed field scouting.

- Images can be used to develop management zone-directed soil sampling schemes, validating hybrid tests or evaluating other agronomic practices on your farm.

Introduction

Remote sensing is defined as collecting information about objects (e.g., soil or crop surfaces) from remote platforms like satellites, aircraft or ground-based booms. This practice

Figure 1. Aerial color-infrared image depicting spatial variation in crop vigor for several fields. Images courtesy of Cornerstone Mapping (www.cornerstonemapping.com).
Remote Sensing Basics

NDVI = (NIR - Red) / (NIR + Red)

NDRE = Substitute Red Edge Band
Identifying N Stress with Remote Sensing

Photo taken on July 12, 2013, depicting nitrogen stress for 24-row strips receiving only 25 lbs/acre of preplant N (corn on right).
Season-long Monitoring of N stress

R16 Field

NDVI – June 23

NDVI – June 28

NDVI-July 12

Red Edge-July 12

Red Edge-July 31

High

Low
Imagery from Harris Fields

Imagery collected across entire farm encouraged us to make all 6 of planned in season N applications, including at R2.

Red Edge – July 12

Red Edge – July 31
July 21, 2016

“North Farm”
Average Yields: North vs. South
Weather - South Farm

- Wet planting conditions
- Warm night temps
Weather - North Farm

Precipitation

Accumulated Precip

Wet planting conditions

Temperatures - High And Low

Dec 31  Jan 31  Feb 29  Mar 31  Apr 30  May 31  Jun 30  Jul 31  Aug 31  Sep 30  Oct 31  Nov 30

-50  0  50  100  150
Yield Maps: North vs. South

Descartes Labs forecasts of global commodity crop production

2016 Corn & Soy Forecast for Buffalo County
As of October 11th 2016

- Corn yield: 192
- Soy yield: 64

2016 Corn & Soy Forecast for Keya Paha County
As of October 11th 2016

- Corn yield: 207
- Soy yield: 0
Comparison of Ammonia Strips Using Fieldview Reporting Tool

North Farm – R2 Field

- Ammonia

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<tr>
<th>Soil Type</th>
<th>Acres</th>
<th>Avg Yield (bu/ac)</th>
<th>Moisture</th>
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<tbody>
<tr>
<td>O’Neill fine sandy loam, 0 to 2 percent slopes</td>
<td>22.1</td>
<td>259</td>
<td>18.4</td>
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<tr>
<td>O’Neill loamy fine sand, 0 to 2 percent slopes</td>
<td>6.1</td>
<td>251</td>
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<td>Jansen-Meadin loams, 0 to 2 percent slopes</td>
<td>5.9</td>
<td>261</td>
<td>18.7</td>
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+ Ammonia

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<tbody>
<tr>
<td>O’Neill fine sandy loam, 0 to 2 percent slopes</td>
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<td>Jansen-Meadin loams, 0 to 2 percent slopes</td>
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<td>258</td>
<td>18.9</td>
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</tbody>
</table>
Yields for All Ammonia Strip Trials

![Bar chart showing yields for different fields with ammonia and without ammonia.](chart.png)
Summary/Needs

• Imagery was helpful in scheduling N application, especially at north farm
  • However, more frequent image delivery is critical
  • Should possess red-edge band
• Precision Ag Apps were helpful in summarizing yield results from on-farm trials
  • But better integration between apps needed
• N recommendation tools show promise
  • But more proof of performance needed
Thanks You

Questions?