Stimulating Interest in and Adoption of Precision Agriculture Methods on Small Farm Operations

A Discussion of the Jefferson County Experience

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2005 Monroe County WV Case Study by Wickline and Fullen

- Pasture
- 75 acres
- 47 samples (1.6 acres per sample)
- Precision Sampling Recommended:
  - .13 tons more 18-46-0
  - 2.7 tons less 0-0-60
- Savings of $41.00 in 2005

Extension Provides Incentive to Do More

A $2,000 WVU Extension Demonstration Grant in 2006
Completed in Three Counties
to demonstrate an advantage of precision soil sampling over conventional soil sampling
Focus on Jefferson County

Demonstration Farm: Meadow Green Farm

- Beef and Hay Farm
- Three Fields
- 36 acres in demonstration
- Rotational Grazing, Hay unrolled for winter feeding
- Annual Soil Sampling and Nutrient Application
- Areas of Animal Concentration

Variability
Areas of Animal Concentration

Soil Sample Results

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>pH</th>
<th>Phosphorous</th>
<th>Potassium</th>
<th>Magnesium</th>
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<tbody>
<tr>
<td>17</td>
<td>7.2</td>
<td>121</td>
<td>561</td>
<td>914</td>
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<tr>
<td>19</td>
<td>7.1</td>
<td>157</td>
<td>1918</td>
<td>865</td>
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<tr>
<td>20</td>
<td>6.9</td>
<td>142</td>
<td>989</td>
<td>619</td>
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</table>

Recommendations

<table>
<thead>
<tr>
<th>Field Number</th>
<th>Acres</th>
<th>Lime Recommendations (tons)</th>
<th>18-46-0 Recommendations (pounds)</th>
<th>0-0-60 Recommendations (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendations Based on Conventional Soil Testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>12.6</td>
<td>0</td>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>8.9</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Recommendations Based on Precision Soil Testing</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14.1</td>
<td>7</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>12.6</td>
<td>7</td>
<td>922</td>
<td>525</td>
</tr>
<tr>
<td>3</td>
<td>8.9</td>
<td>3</td>
<td>0</td>
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</tbody>
</table>
2007

- High Cost of Fertilizer
- High Value of Corn, Soybeans and Hay
- Extension Agent Recruited Producers to Expand this Program

2007 Demonstration

- Goal: 40 acres per farm on ten farms
- Select a variety of agriculture enterprises
- Farmers paid for service (soil sampling and analysis)
- Extension paid for conventional soil sampling and analysis

2007 Demonstration

Tim Fullen

- Certified Crop Advisor
- Used zone sampling techniques since the late 1990’s
- Pulled all samples using a Simple Simon sampler which provides a consistent depth.
- Provided producers with recommendations and developed soil content and application maps
Spring of 2007

Twelve Farms
670 acres
Corn, Soybean, Hay land, and Pasture

Why Were Producers Interested?

- Value of Crops
- Value of Commercial Fertilizer
- Discovering field level variability in soil fertility
- Early Adopters

Jefferson County Results
Conventional Samples

- Field Size – Under 40 Acres?
- 33 Fields
  - Maximum Size: 35 acres
  - Minimum Size: 5.03 acres
  - Average Size: 19.35 acres
- Number of Cores?
  - In most cases more than 1 per 2 acres
Jefferson County Results

Precision

- 344 Samples were pulled and analyzed
- Max Acres: 3.75
- Min Acres: .87
- Average: 1.82 acres per sample

Consistency

- All samples, both Precision and Conventional, pulled with Simple Simon Soil Sampler.
- All samples were at least one pound in weight
- All samples were sent to Waters Agricultural Laboratory

Soils

- 669.28 acres were sampled both precision and conventional.
- 21 Different Soil Classifications
- Yield Potential
  - Alfalfa
    - 4 – 10 tons per acre
  - Tall Grass/Legume Hay
    - 3 – 7 tons per acre
  - Corn Grain
    - 110 – 180 bushels per acre
Results

- Maps in printed and electronic form were distributed to each producer
- Maps provided actual levels of nutrients
  - pH
  - Phosphorous, Potassium, Sulfur and Magnesium

Precision Results

- Recommendations provided:
  - Lime
  - $\text{P}_2\text{O}_5$ : 18-46-0 or 0-46-0
  - $\text{K}_2\text{O}$ : 0-0-60
  - Magnesium
  - Sulfur

Variation in Soil Nutrient Levels

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Ph Level</th>
<th>Calcium Level</th>
<th>Phosphorous Level</th>
<th>Potassium Level</th>
<th>Magnesium Level</th>
<th>Sulfur Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>6.35</td>
<td>3536.18</td>
<td>79.64</td>
<td>373.64</td>
<td>342.12</td>
<td>13.2</td>
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<tr>
<td>Minimum</td>
<td>5.3</td>
<td>1534</td>
<td>13</td>
<td>145</td>
<td>151</td>
<td>3</td>
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<tr>
<td>Maximum</td>
<td>7.3</td>
<td>15674</td>
<td>360</td>
<td>857</td>
<td>578</td>
<td>36</td>
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<tr>
<td>Difference</td>
<td>2</td>
<td>14140</td>
<td>347</td>
<td>712</td>
<td>427</td>
<td>33</td>
</tr>
</tbody>
</table>

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<th>Sulfur Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision Samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>6.31</td>
<td>2968.23</td>
<td>85.36</td>
<td>392.8</td>
<td>330.2</td>
<td>14.12</td>
</tr>
<tr>
<td>Minimum</td>
<td>5.0</td>
<td>878</td>
<td>9</td>
<td>104</td>
<td>87</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>7.9</td>
<td>16764</td>
<td>600</td>
<td>2476</td>
<td>1072</td>
<td>46</td>
</tr>
<tr>
<td>Difference</td>
<td>2.9</td>
<td>15886</td>
<td>591</td>
<td>2372</td>
<td>985</td>
<td>43</td>
</tr>
</tbody>
</table>
Overall Results
Precision Recommendations vs. Conventional Recommendations

- More Lime would have been applied to more acres
- More Phosphorous would have been applied to less acres
- Less Potash would have been applied to less acres

Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Conventional</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Sampling and Analysis through a Commercial Lab</td>
<td>$3.00 per acre</td>
<td>$8.00 per acre</td>
</tr>
<tr>
<td>Lime Spreading</td>
<td>$22.00 per ton</td>
<td>$10.00 per acre</td>
</tr>
<tr>
<td>Fertilizer Spreading</td>
<td>$7.50 per acre</td>
<td>$10.00 per acre</td>
</tr>
<tr>
<td>18-46-0</td>
<td>$778.00 per ton</td>
<td>$778.00 per ton</td>
</tr>
<tr>
<td>0-0-60</td>
<td>$490.00 per ton</td>
<td>$490.00 per ton</td>
</tr>
<tr>
<td>Lime</td>
<td>$10.00 per ton</td>
<td>$10.00 per ton</td>
</tr>
</tbody>
</table>

Percent of Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Conventional</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Sampling and Analysis through a Commercial Lab</td>
<td>5.25%</td>
<td>10.16%</td>
</tr>
<tr>
<td>Lime Spreading</td>
<td>20.38%</td>
<td>9.81%</td>
</tr>
<tr>
<td>Fertilizer Spreading</td>
<td>12.33%</td>
<td>10.26%</td>
</tr>
<tr>
<td>18-46-0</td>
<td>42.10%</td>
<td>50.16%</td>
</tr>
<tr>
<td>0-0-60</td>
<td>19.93%</td>
<td>11.24%</td>
</tr>
<tr>
<td>Lime</td>
<td>8.37%</td>
<td>8.37%</td>
</tr>
</tbody>
</table>
Economics

- Only one farm would have realized a savings by using precision sampling and application over conventional sampling and application.
- That farm would have realized a $17.61 per acre savings. The other eleven farms had an expense by using this precision technology.
- The cost per acre ranged from $5.06 per acre to $65.89 per acre.
- The average cost among all twelve farms was $21.61 per acre.
- This was mostly due to the additional lime and diammonium phosphate (DAP) applied based on precision recommendations.

Extension Outreach Impact

- Extension has:
  - published articles in two newsletters,
  - talked to producers one on one,
  - written three publications,
  - Made seven presentations to various groups and
  - Held two field days for farmers and certified crop advisors

I have previously used precision tools (soil sampling, application, variable rate planting, GPS referenced yield monitor, or light bar).

- Strongly Agree: 19%
- Agree: 23.8%
- Neutral: 0%
- Disagree: 9.5%
- Strongly Disagree: 47.6%
I will use some form of Precision Agriculture in the next 6 months.

- Strongly Agree: 26.5%
- Agree: 28.5%
- Neutral: 11.8%
- Disagree: 2.9%
- Strongly Disagree: 2.9%

I would use some form of Precision Agriculture in the next 6 months if there was a 50% cost share.

- Strongly Agree: 55.9%
- Agree: 26.5%
- Neutral: 11.8%
- Disagree: 2.9%
- Strongly Disagree: 2.9%

I would purchase a piece of Precision Agriculture Equipment if there was a 50% cost share.

- Strongly Agree: 84.4%
- Agree: 66.7%
- Neutral: 16.7%
- Disagree: 6.7%
- Strongly Disagree: 0%
I am most interested in learning more about:

- Precision Sampling/Application: 31%
- Electro Conductivity Survey: 10.3%
- Yield Monitors: 10.3%
- Variable Rate Planting: 0%
- Auto-Steering: 17.2%
- Light Bar: 6.9%
- None of the above: 13.8%

Extension Outreach

- Farmer to farmer encouragement expanded acres
- over 2000 acres (a 298% increase from the original acres) have been sampled on a total of twenty-one farms in two states in less than 2 years.
- Ten of the twenty-one farms precision applied lime and two farms precision applied phosphorous
- one farm precision applied lime, phosphorous and potash.

Extension Outreach Impact

Producers have utilized the information generated to distribute nutrients in nontraditional ways
- Changing where mineral feeders are in fields
- Changing hay feeding locations
- Create Hay Yield Maps
- Using maps to change poultry litter and commercial fertilizer spreading patterns
- Using maps to subdivide fields for conventional application of commercial fertilizer
Extension Outreach Impact

- Have expanded the use of other precision agriculture tools on the farm
  - Five yield monitors
  - Two track bars to spread poultry litter
  - One hand held GPS unit
  - Variable corn population and nitrogen application based on population

Variable Rate Corn Population\Nitrogen Application

Variable Rate Corn Population\Nitrogen Application

Variable Rate Corn Population\Nitrogen Application

Variable Rate Corn Population\Nitrogen Application
Extension Outreach Impact

• A Conservation Incentive Grant has been submitted under the Chesapeake Bay
• Precision Nutrient Management on Small Farms
  – Cost Share on Precision Sampling and Variable Rate Application
  – Cost Share on Equipment for Producers
  – Cost Share to Custom Applicators
  Waiting…Waiting… Waiting…..

Many Thanks

• Tim Fullen, Allegheny Ag
• Brian Wickline, Extension Agent
• Tom Basden, WVU Extension Specialist
• Ed Rayburn, WVU Extension Specialist
• More than 20 Agricultural Producers

Questions?

Before

After