InfoAg 2018 - What Are the Critical Data Layers for Building a Field-Level Database, Today and in the Future

Dave Scheiderer
My Story

• Agronomist – 37 yrs.
• Owner (Integrated Ag Services) – 28 yrs.
• Part time farmer – 32 yrs.
• Business beliefs
  – Practical application of precision ag (PA)
  – Driven by ROI
What are the critical layers?

- Start with the basics to identify (geo-reference) the obvious yield limiting areas
- Liebig's law of the minimum

<table>
<thead>
<tr>
<th>Rank</th>
<th>Factor</th>
<th>Value</th>
<th>bu/acre</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weather</td>
<td>70+</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen</td>
<td>70</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Hybrid</td>
<td>50</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>Previous Crop</td>
<td>25</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Plant Population</td>
<td>20</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Tillage</td>
<td>15</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Growth Regulators</td>
<td>10</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Total = 260 bu 100%

Dr. Fred Below, U of Ill. - Seven Wonders of the Corn Yield World
Management Zones: **REDEFINED!**

Only Integrated Ag CPU Zones bring the highest level of precision that today’s Agriculture demands!

**Common Production Unit (CPU)**
- CPU 9: High Productivity
- CPU 8
- CPU 7
- CPU 6
- CPU 5: Medium Productivity
- CPU 4
- CPU 3
- CPU 2
- CPU 1: Low Productivity

Beginning with our HD Sample Collection, CPU’s accurately map field productivity to drive input decisions.
Common Production Units (CPU™)

- Elevation/Slope
- Normalized Yield (3-5 yrs)
- Organic matter (HD soil test)
- CEC (HD soil test)
OM - 1/8 ac. Grids
445 soil samples

OM - 1/4 ac. Grids
OM - 2.5 ac. Grids
OM - 1/2 ac. Grids

OM - 26 soil samples
OM - 113 soil samples
0.25 ac. Auto Vs. 2.5 ac. Core by Hand
Phosphorus (Bray P1)

250 soil samples

Beck’s PFR 1/4 ac. Grids
Beck’s PFR 2.5 ac. Grids

21 soil samples
Temporal Stability of Potassium

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2011
Average Soil %K: 2.433%
Minimum Soil %K: 0.00%
Maximum Soil %K: 4.700%

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2015
Average Soil %K: 2.126%
Minimum Soil %K: 1.300%
Maximum Soil %K: 4.100%
Temporal Stability of Potassium

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2015
Average Soil %K: 2.156 %
Minimum Soil %K: 1.500 %
Maximum Soil %K: 4.000 %

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2016
Average Soil %K: 1.873 %
Minimum Soil %K: 1.100 %
Maximum Soil %K: 3.800 %
Temporal Stability of Potassium

1.0 ac. Spring 2017

1.0 ac. Fall 2017

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2017
Average Soil %K: 2.879 %
Minimum Soil %K: 1.330 %
Maximum Soil %K: 5.490 %

Grower: Scheiderer Bros
Farm: Wingfield
Field: W2
Year: 2017
Average Soil %K: 2.764 %
Minimum Soil %K: 1.750 %
Maximum Soil %K: 4.210 %
What have we learned from high density (HD) soil sampling?

• Spatial Stability (space)
  – With proper sample density (data points) nutrient mapping can accurately match today’s spreading capabilities
  – Dense soil test data contain important attributes needed to build accurate management zones
  – Lowering the cost of sampling is key to economically increasing sampling density

• Temporal Stability (time)
  – Plant available nutrients can change randomly over time
  – Not as simple as fall sampling versus spring sampling to solve the problem
  – To improve temporal stability 2-4 year sampling intervals are needed, depending on sample density,
  – Use caution when doing data analysis using sparse soil test data
  – Need more research on temporal effects of soil test results!!!
Cheap data storage

8,000 (32 MB) cards = 1 (256 GB)
MOORE’S LAW

Microprocessor Transistor Counts 1971-2011 & Moore’s Law

The graph illustrates the trend of transistor counts in microprocessors over the years, showing a doubling every two years, which is consistent with Moore’s Law. The x-axis represents the date of introduction, while the y-axis shows the transistor count.
Field boundary and soil test points, good enough
High level row by row detail

- Hybrid/variety name
- Population
- Spacing
- Doubles
- Skips
- Singulation quality, etc.
- Gauge wheel pressure
- Hyd. pressure applied
Artificial Intelligence/Machine Learning

- Quantitative learning – AI/machine learning
- Thick learning – agronomist/grower relationship
Quantitative Learning
Example: Plant Stands
Future Decision Ag Drivers

• Higher resolution lower cost data collection
• Quantitative data, **not** NDVI zone creation
• Machine learning –
  – growth models to help make decisions
    • disease, weeds, insects, yield
• Autonomy
• Increase the Velocity of data

**Reduced cost, Increased Profit!**
Velocity of Data

The velocity of data increases when more uses of the data are occurring throughout the growing season.
Velocity of Data

How ADAPT works to enable data conversion

- Use data quickly to make corrective decisions
- Fast and seamless data transfer to share with many different decision tools
- Use data in modeling software many times during the growing season to validate input decisions and insure profitability (machine learning)
- Postmortem of the year’s activities to build a better plan for the next year
Thick Learning

• Growers will choose their trusted advisor to manage their PA, just as they do with their accountant
  – **Trusted advisor = Data manager**, agronomist, economist, and environmentalist
  – Ability to manage multiple data platforms, **no** single platform will prevail
• Some advisors and growers will not have the skill sets to handle this new AI frontier
  – The PA is creating a divide between those adopting this technology and those unwilling or unable to change
• Be positioned for massive consolidation and vertical integration right down to the farm
  – Could crop production become like contract livestock has become??
  – Will the “boots on the ground agronomist” become obsolete, replaced by AI and remote sensing??
How did I get here and how can I get out of this mess?
Questions
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