FARMER RESEARCH Tour

SOYBEAN QUALITY MAPPING

February 7, 2019, Ames, IA
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Brad Wirt-GIS Analyst
New NIR Grain Sensing Technologies

NIR wheat protein sensor

Wheat Protein Map in Australia
FutureFarming.com

FutureFarming.com
Collaborators

IOWA STATE UNIVERSITY

IOWA SOYBEAN ASSOCIATION

John Deere

UNITED SOYBEAN BOARD
High Density Protein Maps and Remote Sensing to Understand Soybean Protein Levels

• Drs. Matt Darr, Charles Hurburgh, John Just, and Chris Murphy, ISU, ABSE Department
• John Deere
• ISA
Objectives:

• **ISU**: Improve calibration of on-the-go NIR protein sensor

• **ISA**: Explain and predict spatial variability in protein and oil maps
Exploratory Phase: ISA Imagery Calibration Sites by Collins, IA
Calibrated NDVI: Yield, Protein, Oil

- No clear relationship between NDVI, yield, protein and oil.
Calibrated NDVI: Yield, Protein, Oil

- **Yield, 30-inch rows**
  - Black <32
  - Red 32-42
  - Green 42-51
  - Blue >51

- **Protein, 30-inch rows**
  - Black <34.8
  - Red 34.8-35.3
  - Green 35.3-36.3
  - Blue >36.3

- **Oil, 30-inch rows**
  - Black <16.7
  - Red 16.7-17.5
  - Green 17.5-18.1
  - Blue >18.1

- **Yield, 15-inch rows**
  - Black <53
  - Red 53-65
  - Green 65-74
  - Blue >74

- **Protein, 15-inch rows**

- **Oil, 15-inch rows**

**High Protein and Oil**
Main Study: ISU Fields
Lab NIR Sensor Calibration:

Fig. 1  Protein

Fig. 2  Oil
### Field Management Information

<table>
<thead>
<tr>
<th>Field</th>
<th>SOYBEAN VARIETY</th>
<th>PLANTING DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU-1</td>
<td>P28T08</td>
<td>5/23/2018</td>
</tr>
<tr>
<td>ISU-2</td>
<td>AG27X7</td>
<td>5/23/2018</td>
</tr>
<tr>
<td>ISU-3</td>
<td>ACRESDGE - 22R269</td>
<td>5/18/2018</td>
</tr>
<tr>
<td>ISU-4</td>
<td>ACRESDGE - 22R269</td>
<td>5/18/2018</td>
</tr>
<tr>
<td>ISU-5</td>
<td>AG27X7</td>
<td>5/22/2018</td>
</tr>
<tr>
<td>ISA 30-inch</td>
<td>CB28R58 / FC22R269</td>
<td>5/11/2018</td>
</tr>
<tr>
<td>ISA 15-inch</td>
<td>FC22R269</td>
<td>5/11/2018</td>
</tr>
</tbody>
</table>

ISU-all 30 inch row spacing.
Data Aggregation: 75 x 75 foot cells

Yield (bu/acre)

Protein (%)

Red, Green and NIR Reflectance

- 32.1 - 33.3
- 33.4 - 33.9
- 34.0 - 34.3
- 34.4 - 34.9
- 35.0 - 36.2

- 234 - 348
- 210 - 233
- 182 - 209
- 127 - 181
- 25 - 126
Correlation: Yield, Protein, and Oil

ISU Field 1

Yield bu/acre

Protein (%)

Oil (%)

Correlation Coefficient:

- Yield vs. Protein: 0.18
- Yield vs. Oil: -0.26
- Protein vs. Oil: -0.56

Significance Levels:
- *** indicates high significance
## Within-Field Areas with Protein (%) Content

<table>
<thead>
<tr>
<th>Field</th>
<th>Protein Range (%)</th>
<th>&lt; 34.0</th>
<th>34.0 - 34.3</th>
<th>34.3 - 34.6</th>
<th>34.6 - 35.0</th>
<th>&gt; 35.0</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU-1</td>
<td>32.9-35.3</td>
<td>31</td>
<td>32</td>
<td>21</td>
<td>13</td>
<td>3</td>
<td>1.5</td>
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<tr>
<td>ISU-2</td>
<td>32.5-35.1</td>
<td>73</td>
<td>21</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>ISU-3</td>
<td>32.7-35.4</td>
<td>46</td>
<td>27</td>
<td>15</td>
<td>10</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>ISU-4</td>
<td>33.1-36.0</td>
<td>2</td>
<td>11</td>
<td>27</td>
<td>28</td>
<td>32</td>
<td>1.2</td>
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<tr>
<td>ISU-5</td>
<td>33.2-35.4</td>
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<td>33</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
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<tr>
<td>ISA 30-inch</td>
<td>33.2-38.2</td>
<td>9</td>
<td>3</td>
<td>9</td>
<td>15</td>
<td>64</td>
<td>4.0</td>
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<tr>
<td>ISA 15-inch</td>
<td>32.8-39.0</td>
<td>13</td>
<td>0</td>
<td>5</td>
<td>21</td>
<td>61</td>
<td>3.9</td>
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</tbody>
</table>
## Within-Field Areas with Oil (%) Content

<table>
<thead>
<tr>
<th>Field</th>
<th>Oil Range</th>
<th>OIL (%)</th>
<th>CV (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 19.0</td>
<td>19.0 - 19.5</td>
<td>19.5 - 20.0</td>
</tr>
<tr>
<td>ISU-1</td>
<td>18.2-21.5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>ISU-2</td>
<td>18.7-20.9</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>ISU-3</td>
<td>18.6-20.6</td>
<td>20</td>
<td>53</td>
</tr>
<tr>
<td>ISU-4</td>
<td>18.2-20.0</td>
<td>88</td>
<td>11</td>
</tr>
<tr>
<td>ISU-5</td>
<td>18.7-20.5</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>ISA 30-inch</td>
<td>13.4-19.8</td>
<td>96</td>
<td>0</td>
</tr>
<tr>
<td>ISA 15-inch</td>
<td>13.0-20.0</td>
<td>89</td>
<td>4</td>
</tr>
</tbody>
</table>
Protein (%) by Soil Types

ISU Field 3

SoilType
- Canisteo
- Clarion
- Harps
- Nicollet
- Webster

SoilProtein (%)
Oil (%) by Soil Types

ISU Field 3
Protein and Oil Yields/Outputs in Bu/acre

ISU Field 3
Protein Yield Slope=0.34
Oil Yield Slope=0.19

ISU Field 5
Protein Yield Slope=0.34
Oil Yield Slope=0.19

Soybean Yield, bu/acre
Protein or Oil Yield, bu/acre
Protein or Oil Yield, bu/acre
Soybean Yield, bu/acre
Protein (%) Prediction: All Season Imagery + Soil Test + Soil Type

ISU Field 3

Corr = 0.56

<table>
<thead>
<tr>
<th>NDVI</th>
<th>Sept and May NDVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
</tr>
<tr>
<td>P &amp; K</td>
<td></td>
</tr>
</tbody>
</table>

**Importance**

![Importance Chart]

**Predicted Protein (%) vs. Observed Protein (%)**

![Scatter Plot]

**Correlation Coefficient**: 0.56
## Oil Prediction: All Season Imagery + Soil Test + Soil Type

### ISU Field 3

- **NDVI**: NDVI
- **P & K**: P & K

**Small Range; Prediction are not good!**

### Importance Analysis

<table>
<thead>
<tr>
<th>NDVIMay24</th>
<th>NDVIJul14</th>
<th>NDVIJul28</th>
<th>NDVIJul22</th>
<th>NDVIJul02</th>
<th>NDVIJul04</th>
<th>NDVIJul17</th>
<th>NDVIJul03</th>
<th>NDVIJul10</th>
<th>pH</th>
<th>NDVIJun13</th>
<th>NDVISep22</th>
<th>NDVIMay18</th>
<th>NDVIJun07</th>
<th>NDVIApr23</th>
</tr>
</thead>
</table>

### Scatter Plot

- **Predicted Oil (%)** vs **Observed Oil (%)**

- The scatter plot shows a correlation between predicted and observed oil percentages, indicating that the prediction model is not very accurate.
Conclusions:

• Low/Moderate variability in protein and oil content in ISU fields; moderate in ISA fields

• Late-season imagery can separate high Oil and Protein categories.
Predicted Protein and Oil Maps for 2006-2013

Rotundo et al. 2016. Crop Science
Conclusions:

• There are no premiums for better soybean quality yet.

• Soybean base price is lower in Northwest Iowa.

• But selective domestic and international soybean purchases have been done in the past.
QUESTIONS?

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