Quantitative Aerial Imagery as a Metric for Field Research

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Presentation Goals

• Introduction to Buckeye Ag

• UAV-Imaging – Scouting from a bird’s-eye view

• Aerial NDVI – Quantifying aerial plot data

• Case Studies – Practical Application of Aerial Imaging

• Questions
• Family-owned CRO, founded in 2004
• Conduct 350-400 research trials per season
• Corn, Soybean, Winter Wheat, Alfalfa, and Sorghum
• Emphasis on high-quality, scalable research
• Product Efficacy Studies, Genetic Yield Trials, GMO-Regulated, GLP Residue
### Buckeye Ag Testing – Trial Capabilities / Demand

<table>
<thead>
<tr>
<th>VARIABLE TESTED</th>
<th>TRIAL COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOLIAR APPLICATIONS</td>
<td>119</td>
</tr>
<tr>
<td>SEED TREATMENT</td>
<td>104</td>
</tr>
<tr>
<td>LIQUID IN FURROW</td>
<td>84</td>
</tr>
<tr>
<td>GENETICS/YIELD</td>
<td>38</td>
</tr>
<tr>
<td>NITROGEN MANAGEMENT</td>
<td>31</td>
</tr>
<tr>
<td>DRY GRANULAR FERTILIZERS</td>
<td>26</td>
</tr>
<tr>
<td>GMO / GLP / STEWARDSHIP</td>
<td>16</td>
</tr>
<tr>
<td>FIELD DAY / DEMO PLOTS</td>
<td>16</td>
</tr>
<tr>
<td>SILAGE</td>
<td>16</td>
</tr>
<tr>
<td>HERBICIDE</td>
<td>11</td>
</tr>
</tbody>
</table>
Imaging as a Research Tool

A

YFP-Rab7  CD4  HLA-A2  Merge  DIC

B

nef-  nef+

Plasma Membrane

HA-A2 - 15  CD4 - 10

MVBs  Golgi/TGN

https://doi.org/10.1371/journal.ppat.1000131

https://doi.org/10.1371/journal.pone.0007634
Field Scouting and Qualitative Assessments from the Air
Identify Field Effects & Non-Uniformity

DRAINAGE TILE LINES

NATURAL TERRAIN/SLOPE
Assessing Crop Response and Stand Reduction

**Phytotoxicity**

**Herbicide Efficacy**

**Soil-borne Disease**

**Fertility Response**

* Non-Inoculated Control Plots
Moving Beyond Pretty Pictures

Semi-Quantitative Analysis
Precision Ag Field Operations

GPS-Enabled Field Equipment

- Precision plot planters
- Maintenance implements (tillage, spraying, fertilization)

Uniform Field Maintenance
Weed Free / Systematic Cultivation
Quantitative Aerial Imaging - Step 1: Acquire Images

Equipment

DJI Matrice 100
SlantRange3p
DJI Inspire 1 V2.0
Zenmuse X3
Parrot Sequoia

Flight Planning (Drone Deploy)
Orthomosaics – NDVI and Visible Reflectance Maps

Parrot Sequoia (7.8 cm/pixel)  Zenmuse X3 (3.1 cm/pixel)
Step 3: Converting Images into Quantitative Data

Aerial NDVI: Sum of all pixel values per plot

<table>
<thead>
<tr>
<th>Aerial NDVI</th>
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</thead>
<tbody>
<tr>
<td>10,741</td>
</tr>
<tr>
<td>7,590</td>
</tr>
<tr>
<td>32,715</td>
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<tr>
<td>13,931</td>
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</tbody>
</table>
Soft Red Winter Wheat Fertility Response

Case Study #1
**N-P-K Fertility - Soft Red Winter Wheat**

**Trial Layout**

**Post-greenup aerial imaging 4/18/17**

**Multispectral aerial imaging – NDVI 4/18/17**

**Pre-harvest aerial imaging 6/22/17**

**Yield Map 6/28/17**
Relative Trend analysis - Soft Red Winter Wheat

IMAGING

AERIAL NDVI

RELATIVE UNITS

YIELD DATA

BUSHELS/ACRE

MID-APRIL

JULY

1/29/2018

www.buckeyeagtesting.com
Corn Hybrid & Seed Treatment Trials: Emergent Stand and Vigor

Case Study #2
Buckeye Ag Testing - 2017 Research Trial Demand

**Stand Counts**: 154

**Plot Ratings**:
- Vigor, Phytox, Staygreen, etc: 128
- Plant Hts, Pod Cts, Stem Diam.: 79

**Soil Sampling**: 51

**Measurements**:
- Plant Hts, Pod Cts, Stem Diam.: 49

**Plot Pictures**: 42

**NDVI**: 49

**Tissue Sampling**: 70

**Disease/Insect Ratings**: 39

**Lodging**: 55

**Emergent Stand**: 154

**Vegetative Vigor**: 128
Measurements from High-Resolution Image Data

V5 Corn

Vigor/Phytox

Stand
Aerial NDVI vs Yield Outcomes

CORN HYBRIDS - GENETIC VARIANTS

CORN SEED TREATMENTS

Aerial NDVI (V6) vs Yield

\[ y = 472.45x - 30101 \]

\[ R^2 = 0.27999 \]

R = 0.729

R = 0.53
Conclusions

• Multispectral aerial imaging combined with precision field management allows semi-quantitative measurements for small plot research

• Aerial NDVI can be used to evaluate product performance at key timepoints during the growing season

• Aerial NDVI was shown to correlate with final yield outcomes for a variety of field trials

• You should consider working with Buckeye Ag next season
If these slides have piqued your interest...

PLEASE CONTACT ME!

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