Data Collection and Analysis for Deploying and Assessing Multi-Hybrid Planting Applications

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Discussion Topics

• Farm scale study using multi-hybrid planter technology in:
  • Corn for optimal hybrid placement
  • Soybeans for SDS treatment application

• Multi-hybrid preparation...on farm research trials

• Parting thoughts
Farm Scale Production Benchmarking, a Case Study in Corn Production... Multi-Hybrid Planter
Objectives

• Create management zones that match spatial water distribution/water holding capacity of fields
• Assess hybrid yield by zone delineation and verify zone structure
• Determine if MH planting would be profitable
Materials and Methods: Field Sites

2016 Corn Sites
- 5 fields
- 15 different soil types
- ~200 acres

2017 Corn Sites
- 6 fields
- 13 different soil types
- ~400 acres
Materials and Methods: Zone Creation

Layers used in zone creation:

- Soil texture (EC)
- Water holding capacity
- Elevation
- Yield (multiple years)
Field Layout Examples

2017 Prescription—M40

Hybrid Placement
209
211

UNIVERSITY OF Nebraska, Lincoln

2017 Prescription—AE

Hybrid Placement
1197
A6499

UNIVERSITY OF Nebraska, Lincoln

2017 Prescription—UNL2

Hybrid Placement
11511MAQ
62-98VT2

UNIVERSITY OF Nebraska, Lincoln
2016 Yield Results Discussion

- Between 11-17 cm more rainfall than 30 year average during the growing season
- Yield gap existed between offensive and defensive zones
- DP, UNL1: Offensive hybrid whole field
- M40, SS: No difference in hybrids
  - No negative consequence for planting defensive hybrid in a wet year
### Profitability 2016

<table>
<thead>
<tr>
<th></th>
<th>Offensive Zone</th>
<th>Defensive Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M40 (2016)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>209 (Offensive)</td>
<td>$663.28</td>
<td>$625.62</td>
</tr>
<tr>
<td>211 (Defensive)</td>
<td>$649.23</td>
<td>$612.65</td>
</tr>
<tr>
<td><strong>SS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1197 (Offensive)</td>
<td>$614.16</td>
<td>$589.10</td>
</tr>
<tr>
<td>P1271 (Defensive)</td>
<td>$614.89</td>
<td>$599.92</td>
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<tr>
<td><strong>DP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1257 (Offensive)</td>
<td>$612.53</td>
<td>$619.25</td>
</tr>
<tr>
<td>P1498 (Defensive)</td>
<td>$599.24</td>
<td>$574.82</td>
</tr>
<tr>
<td><strong>UNL1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1257 (Offensive)</td>
<td>$707.38</td>
<td>$677.11</td>
</tr>
<tr>
<td>P1498 (Defensive)</td>
<td>$660.34</td>
<td>$643.25</td>
</tr>
</tbody>
</table>

- From a profitability standpoint, a single hybrid should have been planted within each field in 2016.
- Price of hybrid was a contributing factor.
2017 Yield Results Discussion

- Between 6-10 cm more rainfall than 30 year average during the growing season
- Yield gap between offensive and defensive zones
- ME, UNL3: Single hybrid whole field
- M40, AE, AW: No difference in hybrids
  - No negative consequence for planting defensive hybrid in a wet year
- UNL2: Offensive hybrid correctly placed in offensive zone, no difference in defensive zone
Profitability 2017

- From a profitability standpoint, a single hybrid should have been planted within each field in 2017
- Price of hybrid was a contributing factor

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Offensive</th>
<th>Defensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>M40 (2017)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>209 (Offensive)</td>
<td>$626.44</td>
<td>$549.29</td>
</tr>
<tr>
<td>211 (Defensive)</td>
<td>$640.17</td>
<td>$577.99</td>
</tr>
<tr>
<td>AE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1197 (Offensive)</td>
<td>$493.07</td>
<td>$493.83</td>
</tr>
<tr>
<td>A6499 (Defensive)</td>
<td>$510.08</td>
<td>$495.07</td>
</tr>
<tr>
<td>AW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5F-709 (Offensive)</td>
<td>$486.62</td>
<td>$457.12</td>
</tr>
<tr>
<td>830-39 (Defensive)</td>
<td>$466.50</td>
<td>$455.14</td>
</tr>
<tr>
<td>ME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1197 (Offensive)</td>
<td>$633.95</td>
<td>$589.69</td>
</tr>
<tr>
<td>732-99 (Defensive)</td>
<td>$620.39</td>
<td>$549.67</td>
</tr>
<tr>
<td>UNL2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>62-98 (Offensive)</td>
<td>$556.09</td>
<td>$443.74</td>
</tr>
<tr>
<td>1151 (Defensive)</td>
<td>$534.49</td>
<td>$428.06</td>
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<tr>
<td>UNL3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1257 (Offensive)</td>
<td>$440.25</td>
<td>$356.31</td>
</tr>
<tr>
<td>P1498 (Defensive)</td>
<td>$566.61</td>
<td>$478.10</td>
</tr>
</tbody>
</table>
Conclusions

• Mixed results on hybrid yield by zone delineation
• Adequate rainfall meant difficulty in testing management zones or defensive hybrids
• No yield reduction by using a defensive hybrid in a wet year in several fields
• Profitability results not necessarily correlated with yield results
• Economically, a single hybrid should have been planted in all fields
Farm Scale Production Benchmarking, a Case Study in Soybean Production... Multi-Hybrid Planter
Multi-Hybrid Application for SDS Treatment

- Sudden Death Syndrome – a soil borne disease affecting soybeans
- Overwinters in the soil and residue, may be transported on equipment
- Infection of plants occurs early in spring, cool, wet conditions favor development
- Also favored in high yielding fields, irrigated sites, higher sand contents, lower pH and high P levels
Multi-Hybrid Application for SDS Treatment

- Goal was to assess the potential return on investment (ROI) of applying non-ILeVO treated (standard) and ILeVO seed treatments in zones using multi-hybrid planter technology
- Treatment cost of ILeVO estimated at $15.17/ac
- Zones were delineated for locations where SDS pressure was noticed which would receive ILeVO seed treatment
- Kinze multi-hybrid planter was used to place treated versus non-treated seeds in prescribed locations
Multi-Hybrid Application for SDS Treatment

- Historic yield maps were used for clustering
- Ensure that the clusters most closely represented low yielding areas due to SDS (documentation by growers)
- Processed in Management Zone Analyst
- Varieties selected with excellent SDS disease resistance scores
Multi-Hybrid Application for SDS Treatment

• Notice 2 zones in prescription map:
  • “ILeVO” zone where historic SDS pressure was documented
  • “Standard” zone where SDS pressure had not been noticed
• Randomized, replicated test strips were placed throughout both zones, allowing for statistical comparison
• Marginal Net Return (MNR) was calculated based on yield, price, and cost of ILeVO treatment
Multi-Hybrid Application for SDS Treatment

- As-applied planting data were used to verify product placement
- Post-processed yield data (cleaned using USDA Yield Editor Software) used for analysis
Multi-Hybrid Application for SDS Treatment

<table>
<thead>
<tr>
<th></th>
<th>SDS Zone</th>
<th>Standard Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>WM</strong></td>
<td><strong>PM</strong></td>
</tr>
<tr>
<td>ILeVO°</td>
<td>$ 675.57</td>
<td>$ 690.99</td>
</tr>
<tr>
<td>Standard</td>
<td>$ 667.86</td>
<td>$ 670.04</td>
</tr>
<tr>
<td></td>
<td><strong>WH</strong></td>
<td><strong>NB</strong></td>
</tr>
<tr>
<td>ILeVO°</td>
<td>$ 633.33</td>
<td>$ 637.60</td>
</tr>
<tr>
<td>Standard</td>
<td>$ 621.71</td>
<td>$ 651.57</td>
</tr>
<tr>
<td></td>
<td><strong>KE</strong></td>
<td><strong>Multi-Hybrid Application for SDS Treatment</strong></td>
</tr>
<tr>
<td>ILeVO°</td>
<td>$ 592.06</td>
<td>$ 584.44</td>
</tr>
<tr>
<td>Standard</td>
<td>$ 607.79</td>
<td>$ 599.98</td>
</tr>
</tbody>
</table>

• ILeVO treatment provided the higher economic return in both field zones in two fields
• Two fields showed ILeVO had the higher marginal net return in the SDS zone only
• One field showed a loss in both zones by using the ILeVO treatment
• ILeVO resulted in a $8-$79 advantage

Marginal net return in $ per acre for hybrid and zone locations. Marginal net return calculated as bushels per acre times a market price of $9.25 per bushel and $15.17/ac ILeVO° seed treatment cost ($10.19/oz).
Breakeven Analysis – SDS Treatment in NB

- $78/acre gain by using the ILeVO treatment in the SDS zone
- $14/acre loss by using the ILeVO treatment in the standard zone
- $4,000 gained in the SDS zone by using ILeVO treatment
- Additional cost of technology could be paid off in around 5 years

<table>
<thead>
<tr>
<th>Treatment</th>
<th>SDS Zone</th>
<th>Standard Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard + ILeVO®</td>
<td>608.19</td>
<td>637.60</td>
</tr>
<tr>
<td>Marginal Net Return ($/ac)‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Treatment</td>
<td>529.74</td>
<td>651.57</td>
</tr>
<tr>
<td>Marginal Net Return ($/ac)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Marginal net return in $ per acre for hybrid and zone locations. Marginal net return calculated as bushels per acre times a market price of $9.25 per bushel and $15.17/ac ILeVO® seed treatment cost ($10.19/oz).
Multi-Hybrid Application for SDS Treatment

• The potential exists for this technology to improve production system
• Without the collection of different datasets, planning this study would not have been possible
  • Yield history
  • Documented crop scouting information
• In-season aerial imagery details locations with issues
• Could areas have been expanded based on imagery data?
Gathering Data to Begin Planning for Multi-Hybrid Applications...On Farm Research
Traditional Data Sources

- Crop performance is a critical data layer, other measures of variability would also be desirable
  - Quality yield maps
  - Soil textural variability
In Season Data Collection

• In season issues should be documented when possible
  • Georeferenced crop scouting
  • Aerial imagery from Planes, UAVs, and Satellites
    • RGB,
    • NDVI, NDRE
Making use of the Data

- The key to harnessing these datasets for making and evaluating changes lies in the analysis (data collection is only the beginning!)
- Geospatial & statistical techniques must be utilized to evaluate production changes
- Split planter datasets can be an excellent way to start analyzing in-field variability based on two different treatments before investing in multi-hybrid planters
- As with most applications, issues that are consistent year-to-year will provide best opportunities

<table>
<thead>
<tr>
<th>Hybrid Selection</th>
<th>Marginal Net Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>33D47</td>
<td>$366.23</td>
</tr>
<tr>
<td>P1498R</td>
<td>$373.34</td>
</tr>
<tr>
<td>Zone Scenario</td>
<td>$397.37</td>
</tr>
</tbody>
</table>
Making use of the Data

- Field trials must include replicated treatments organized into blocks
- Rates changes should span a wide enough range to ensure equipment can control rates at each level and a crop response can be noted
- Randomizing the order of rates within each block across the field will reduce effects of geographic variability
- The amount of data collected (or area for each treatment) should be similar across all treatments
- Resources for learning these techniques are available at: https://cropwatch.unl.edu/on-farm-research
Making use of the Data

• For product rate trials, incorporating economic estimates is critical for complete assessment

• Statistical analysis should be used to improve confidence in results

• The individual treatment strip results highlight the need for replication (one strip of three rates would not have told the whole story) within field studies

<table>
<thead>
<tr>
<th>Target Seed Populati on</th>
<th>Raw Yield Data</th>
<th>Clean Yield Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>32K</td>
<td>237</td>
<td>27</td>
</tr>
<tr>
<td>36K</td>
<td>242</td>
<td>30</td>
</tr>
<tr>
<td>40K</td>
<td>239</td>
<td>34</td>
</tr>
</tbody>
</table>
Parting thoughts...

• Multi-hybrid planting has shown the most promise in addressing concerns that consistent year to year
• Unlocking the full potential of multi-hybrid technologies will require better zone creation methodology and more data
• Quality and quantity of data is a must for zone creation...and all other management decisions
• Statistically based comparisons are a must!
• Don’t forget about financials!
Thank you

www.precisionagriculture.unl.edu
NE Extension On-Farm Research Database

- NE Extension On Farm Research Network was founded over 25 years ago
- Producers (can) bring research topics to OFRN Extension Educators for assistance
- Increasingly, digital tools are being used to implement plots or evaluate results:
  - Variety of crops each year
  - Variable-rate seeding
  - Variable-rate nutrients/fertilizer
  - Fungicide/insecticide treatments
  - In-season imagery (UAV or plane-based)
  - Yield monitors
NE Extension On-Farm Research Database

• The online database can allow for searches based on different filters
NE Extension On-Farm Research Database

- Entries data back to the early 1990s
- Reports share as much information as possible regarding background of field site and how the study was conducted
- This level of information is critical for understanding the study and those wanting to compare their own data for benchmarking!
NE Extension On-Farm Research Database

- Most recently, soybean seeding rate studies have been of major interest for those trying to determine most economical rates.
- Since 1990, 295 studies have been accomplished with cooperating producers and published online for soybeans alone.
- Irrigated & non-irrigated conditions with a variety of production systems topics:

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**Introduction:** Previous on-farm research has demonstrated that planting rates of 80,000 to 120,000 seeds/acre generally result in the highest profitability. The purpose of this study was to determine the most profitable soybean seeding rate. The populations chosen in this study are common to growers in the area. Soybeans were drilled in 10” rows on May 13, 2015.

**Results:**

<table>
<thead>
<tr>
<th>Yield (bu/ac)†</th>
<th>Moisture (%)</th>
<th>Marginal Net Return ($/ac)‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>120,000 seeds/acre</td>
<td>77 A*</td>
<td>11.7 A</td>
</tr>
<tr>
<td>150,000 seeds/acre</td>
<td>76 AB</td>
<td>11.6 A</td>
</tr>
<tr>
<td>180,000 seeds/acre</td>
<td>75 B</td>
<td>11.7 A</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.0906</td>
<td>0.8206</td>
</tr>
</tbody>
</table>

†Bushels per acre corrected to 13% moisture.

*Values with the same letter are not significantly different at a 90% confidence level.

‡Net Return based on $8.90/bu soybeans and $48/unit seed (140,000 seeds/unit).

**Summary:** No yield increase was seen for planting higher than 150,000 seeds/acre. Based on the cost of seed, planting 120,000 seeds per acre rate maximized net returns.