Disclaimer

Mentioning of trade names or commercial products in this presentation does not necessary imply recommendation or endorsement of the product
Outline

• Where does it fit?
• Field evaluation
• Agronomic implications
Rationale for High-Speed Planter

• *Enable timely planting* during short windows of opportunity (cool and wet springs).

April 14, 2018
Rationale for High-Speed Planter

• *Enable timely planting* under short windows of opportunity (cool and wet springs).
• Overall *earlier planting* for the entire operation (soybean?)
Corn response to planting dates

Grain yield (bu/ac)

Planting Date

Source: https://cropwatch.unl.edu/how-corn-planting-date-can-affect-yield
Soybean response to planting dates
2014 & 2015

Yield (% of Max)

3 Varieties
\[ yld = -0.0093x^2 + 2.14x - 22.027, R^2 = 0.94 \]

4th Variety
\[ yld = -0.73x + 193.14, R^2 = 0.87 \]

Hall and Casteel, unpublished
Rationale for High-Speed Planter

- *Enable timely planting* under short windows of opportunity (cool and wet springs).
- Overall *earlier planting* for the entire operation (soybean?)
- *Equivalent planting progress* in “smaller fields” with fewer rows per pass compared to “larger fields” planted with wider equipment.
- *Who wouldn’t want to plant twice as fast!?!* Especially, if we don’t trade yield for speed!
Rationale for High-Speed Planter

• Enable timely planting under short windows of opportunity (cool and wet springs).
• Overall earlier planting for the entire operation (soybean?).
• Equivalent planting progress in "smaller fields" with fewer rows per pass compared to "larger fields" planted with wider equipment.
• Who wouldn't want to plant twice as fast?! Especially, if we don't trade yield for speed!
Additional requirement(s)

• Tractor power
• Starter fertilizer package – if you use one
• Logistics of planting
  • Field preparation
Seed Delivery from Metering Unit

Source: http://www.agrigold.com/Universal/Articles/National-Farm-Machinery-Show-2014/

Field Evaluation of New Planters
John Deere Exact Emerge® 1775 NT

• 2015 West Lafayette, IN: No Till planted May 24th
  • 5, 7.5, 10 mph
  • 90K, 130K seeds ac⁻¹

• 2016 Lafayette, IN: Conv. Till planted April 19th
  • 5, 7.5, 10, 12.5 mph
  • 90K, 130K, 170K seeds ac⁻¹

• 2017 LaCrosse, IN: No Till planted April 26th
  • 5, 7.5, 10, (12.5 mph attempted)
  • 70K, 90K, 130K seeds ha⁻¹
Soil Displacement with High Speed Planting

5 mph

10 mph

Soil Displacement with High Speed Planting

5 MPH

10 MPH
Seedling Emergence Measurement
Emergence Progress with Various Planting Speeds (2015)

(Kovács and Casteel, unpublished)
Emergence Progress with Various Planting Speeds (2016)

Kovács and Casteel, unpublished
## Final Plant Stand (plants ac\(^{-1}\)) at Various Planting Speed

<table>
<thead>
<tr>
<th>Speed</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mph</td>
<td>91,700</td>
<td>74,700</td>
<td>80,800 b</td>
</tr>
<tr>
<td>7.5 mph</td>
<td>95,300</td>
<td>78,400</td>
<td>83,400 b</td>
</tr>
<tr>
<td>10 mph</td>
<td>92,600</td>
<td>72,700</td>
<td>87,700 a</td>
</tr>
<tr>
<td>12.5 mph</td>
<td>-</td>
<td>67,800</td>
<td>-</td>
</tr>
</tbody>
</table>

\(p < F\)

<table>
<thead>
<tr>
<th>Speed</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>90K sds ac(^{-1})</td>
<td>77,200 b</td>
<td>54,300 c</td>
<td>71,400 b</td>
</tr>
<tr>
<td>130K sds ac(^{-1})</td>
<td>109,100 a</td>
<td>76,300 b</td>
<td>97,400 a</td>
</tr>
<tr>
<td>170K sds ac(^{-1})</td>
<td>-</td>
<td>92,000 a</td>
<td>-</td>
</tr>
</tbody>
</table>

\(p < F\)

### Seedling Rate

<table>
<thead>
<tr>
<th>Seeding Rate</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
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<td>109,100 a</td>
<td>76,300 b</td>
<td>97,400 a</td>
</tr>
<tr>
<td>170K sds ac(^{-1})</td>
<td>-</td>
<td>92,000 a</td>
<td>-</td>
</tr>
</tbody>
</table>

\(p < F\)

- \(<.0001\)
- \(<.0001\)
- \(<.0001\)
Plant available space: mean distance of nearest adjacent plants
Plant Spacing Measurement

- Plant spacing \((\text{PAS}_{\text{ref}})\) at target seeding rate

- Double: \(\text{PAS} < 0.5 \times \text{PAS}_{\text{ref}}\)
- Accurate: \(0.5 \times \text{PAS}_{\text{ref}} < \text{PAS} < 1.5 \times \text{PAS}_{\text{ref}}\)
- Missed: \(1.5 \times \text{PAS}_{\text{ref}} < \text{PAS}\)

Adapted from Kachman and Smith (1995)
Plant Spacing Distribution with Various Planting Speed

5 mph  7.5 mph  10 mph
2015

5 mph

7.5 mph

10 mph

Relative frequency (%)

Plant available spacing (cm plant$^{-1}$)

(Kovács and Casteel, unpublished)
Cold and wet emergence period

(Kovács and Casteel, unpublished)
Cold and wet emergence period

(Kovács and Casteel, unpublished)
### Grain Yield (bu ac$^{-1}$) at Various Planting Speed

<table>
<thead>
<tr>
<th>Speed</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mph</td>
<td>65.8</td>
<td>73.7</td>
<td>57.0 b</td>
</tr>
<tr>
<td>7.5 mph</td>
<td>68.8</td>
<td>74.0</td>
<td>60.4 a</td>
</tr>
<tr>
<td>10 mph</td>
<td>66.0</td>
<td>74.4</td>
<td>56.8 b</td>
</tr>
<tr>
<td>12.5 mph</td>
<td>-</td>
<td>72.7</td>
<td>-</td>
</tr>
</tbody>
</table>

$p < F$ 0.18 0.73 0.01

### Seeding Rate

<table>
<thead>
<tr>
<th>Seeding Rate</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>90K sds ac$^{-1}$</td>
<td>66.9</td>
<td>72.4</td>
<td>57.8</td>
</tr>
<tr>
<td>130K sds ac$^{-1}$</td>
<td>66.9</td>
<td>74.4</td>
<td>58.4</td>
</tr>
<tr>
<td>170K sds ac$^{-1}$</td>
<td>-</td>
<td>74.3</td>
<td>-</td>
</tr>
</tbody>
</table>

$p < F$ 0.99 0.29 0.62
High-speed Planter in Corn
Field Study in 2014

Seeding rate @34,000 plants/ac in 20” rows

Individual plant spacing ($PAS_{ref}$ 9.22 in)

<table>
<thead>
<tr>
<th>Planting speed (mph)</th>
<th>Mean (in)</th>
<th>SD (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>9.46</td>
<td>2.36</td>
</tr>
<tr>
<td>7.5</td>
<td>9.36</td>
<td>2.09</td>
</tr>
<tr>
<td>10</td>
<td>9.44</td>
<td>1.77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Planting speed (mph)</th>
<th>Population (pl/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>32,900</td>
</tr>
<tr>
<td>7.5</td>
<td>34,000</td>
</tr>
<tr>
<td>10</td>
<td>33,500</td>
</tr>
</tbody>
</table>

Source: T. Vyn, Purdue U.
2016 ExactEmerge Trial
Cooperator: Greg Gilbert, Romney, IN

Grain Yields (bu/acre)

32,000 plants/acre
Avg. grain yield = 241.4 bu/acre

38,000 plants/acre
Courtesy: T. Vyn, Purdue U.

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Ohio study in 2017

- Planter: Case IH 2150
- Seeding rate: 34,000 seeds ac$^{-1}$

Source: 2017 eField Report, Klopfenstein, theOSU
Ohio study in 2017

- Planter: Case IH 2150
- Seeding rate: 34,000 seeds ac\(^{-1}\)

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Singulation (%)</th>
<th>Spacing SD (in)</th>
<th>Spacing CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>96.6</td>
<td>1.8</td>
<td>0.29</td>
</tr>
<tr>
<td>7.5</td>
<td>96.2</td>
<td>1.9</td>
<td>0.31</td>
</tr>
<tr>
<td>10</td>
<td>95.6</td>
<td>2.0</td>
<td>0.33</td>
</tr>
<tr>
<td>12.5</td>
<td>95.8</td>
<td>2.0</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Source: 2017 eField Report, Klopfenstein, theOSU
How Important Plant Spacing Itself?
Plant Spacing Effect on Per-Plant Corn Yield

\[
y = 6.4674x + 120.79 \\
R^2 = 0.075
\]

\[
y = 7.6627x + 120.69 \\
R^2 = 0.060
\]

(Kovács et al. 2011; Kovács and Vyn, 2014)
Plant Spacing Effect on Per-Plant Corn Yield

\[ y = -24.881x + 376.03 \]
\[ R^2 = 0.350 \]

\[ y = -23.799x + 378.05 \]
\[ R^2 = 0.224 \]

* Assuming all plants would have the same ear size

(Kovács et al. 2011; Kovács and Vyn, 2014)
![Plant Spacing Effect on Grain Yield](image)

- Spatial and temporal non-uniformity
- Study conducted in Argentina (2012/13, 2013/14)

(Masino et al., 2018)
Plant Spacing Effect on Grain Yield

<table>
<thead>
<tr>
<th>Temporal distribution</th>
<th>Spatial distribution</th>
<th>Uniform</th>
<th>Non-Uniform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform</td>
<td>(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Uniform</td>
<td>(b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniform</td>
<td>(c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Uniform</td>
<td>(d)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Uniform spatial distr.</th>
<th>Non-uniform spatial distr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety 1 (MG 3)</td>
<td>45.4 b</td>
<td>42.2 c</td>
</tr>
<tr>
<td>Variety 2 (MG 4)</td>
<td>49.9 a</td>
<td>50.4 a</td>
</tr>
</tbody>
</table>

(Masino et al., 2018)
Plant Spacing Effect on Soybean Yield

(Kovács and Casteel, unpublished)
Conclusions

• Uniformity of plant distribution has not effected (corn) or slightly decreased (soybean) with increased planting speed
  • Seed distribution may have been better
  • Largest performance decline was observed at the highest seeding rate (in 2016)

• Grain yield was not affected by planting speed

• Careful setup of row cleaners at high speeds (especially in no-till conditions)
Conclusions

• Technology is capable for high-speed planting
• This is only one tool in the toolbox (how does it fit to your system?)
• Successful planting is just a step in the plant’s whole-year journey
Acknowledgement

• Dr. Tony Vyn

• Nathan Jenkins and John Deere for providing an ExactEmerge® planter and tractor

• Purdue Ag Research Centers

• Soybean Production Research Crew
  (15,000+ individual plants were measured for plant spacing)
Thank you!

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