Maximizing Wheat Yield with Precision Planting and Agronomic Management

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Wheat Yield Potential

Goal: Design a canopy structure that maximizes:
- Light Interception
- Resource Use Efficiency

Components:
- Planting method: seed placement, stand establishment
  - Seeding depth
  - Seed-to-seed spacing
  - Row spacing
- Seeding rates
- Variety selection (leaf angle, tillering)
- Planting time
Wheat Seed Placement

**Conventional drill** with rotating gear that “spills” seed into the drop tube.

**Precision planter** with vacuum that picks up individual seeds and drops one seed at a time down the drop tube.
Uniform Seed Placement

- Variable planting depth
- Skips and doubles

- Uniform planting depth
- Uniform seed to seed spacing (singulation)
Target: Uniform Depth and Singulation

- More uniform placing of plants within row (less gaps)
- More uniform number of tillers/plant (4-5)
- More uniform planting = more uniform head emergence (better head scab control?)
- Are we there yet??
Project Objectives

Seed drill
7.5” Row Spacing

1 million seeds/acre

Precision Planter
7.5” Row Spacing

0.4 in/seed

0.8 in/seed

2 million seeds/acre

Precision Planter
5” Row Spacing

0.6 in/seed

1.3 in/seed

Objective #1

Objective #2
Objectives and hypothesis

- Compare seed placement accuracy of conventional drill to available PP technology. *Hypothesis: Precision planter will result in more accurate seed placement (depth and spacing) than the seed drill.*

- Determine the optimum row spacing and population in wheat planted with PP. *Hypothesis: Narrow rows at lower population will produce higher yield compared to wider rows at higher populations.*

- Quantify the response to seeding density in wheat varieties with differing growth habits. *Hypothesis: Wheat variety with narrow leaf angle and erect growth will perform better under higher seeding rate.*
Project Details

Trial locations:
- MSU Mason farm, Lansing, MI
- SVREC, Frankenmuth, MI

Years
- 2018-19 (2017-18 as prelim. research)
- 2019-20

Split plot design
- Main plots:
  - Seed drill (7.5”)
  - Precision planter, 4 spacings (5”, 7.5”, 10”, 15”)
- Sub plots:
  - Seeding rate- 0.5, 1.0, 1.5, and 2.0 million seeds/acre
Variables Measured

- Stand count
- Seed placement
  - Seeding depth
  - Seed-to-seed spacing
- Canopy light interception
  - Canopy closure
  - Leaf area index (LAI)
- Tillering and plant uniformity (~10 plants)
- Yield components: 1-2 m row per plot
  - Spikes per unit area
  - Kernels per spike
  - Thousand kernel weight (TKW)
  - Total biomass and harvest index
- Harvest: grain yield, moisture, TW
- Quality
Variability in Seed Placement

DRILL

PLANTER
Planter reduced variability in seeding depth by **59%**

Variability in seed-seed spacing was reduced by **17%**
Planter Configuration

15 inch row spacing
2 million seeds per acre
0.2 in/seed

10 inch row spacing
1 million seeds per acre
0.4 in/seed

7.5 inch row spacing
0.3 in/seed

5 inch row spacing
0.6 in/seed

0.8 in/seed
May 8, 2020

7.5” spacing: 76%

5” spacing: 92%

10” spacing: 76%

15” spacing: 67%

June 10 - 77%

Others >95%
Row Spacing vs Yield - 2019

Campus and SVREC 2019

\[ y = 0.1872x^2 - 7.1886x + 156.05 \]

\[ R^2 = 0.5602 \]

↑ yield, ↓ cost in narrow rows

Drill = 100 bu/acre

↓ yield penalty, cost in wide rows
Row Spacing vs Yield- 2020

Mason and SVREC 2020

\[ y = -0.0484x^2 - 1.285x + 127.53 \]

\[ R^2 = 0.4225 \]

- Lower yields?
- Hot, dry weather in grain fill vs 2019?
- Seed depth?
Row Spacing vs Yield - 2020

Mason 2020
\[ y = -0.1987x^2 + 1.7544x + 115.02 \]
\[ R^2 = 0.4793 \]

SVREC 2020
\[ y = 0.1197x^2 - 4.6756x + 141.24 \]
\[ R^2 = 0.4113 \]
2020 Equipment comparison

![Bar chart showing yield (bu/ac) for different equipment types: Almaco, Horsch-No Sing., Horsch-Sing., Monosem. The chart indicates that Almaco has a lower yield labeled as 'B', while Horsch-No Sing., Horsch-Sing., and Monosem have the same high yield labeled as 'A'.]
Take Home Messages

- Narrow row spacing in wheat production can lead to increased yield potential (more uniform plant spacings)

- Potential for reduction in seeding rate (<1.5 m seeds/ac) without limiting yield (≤ 1.0 m in 15” rows)

- Improved seed placement (seeding depth, spacing) at planting can lead to increase in crop uniformity and overall yield potential

- Optimize current planter configuration vs invest in new planting technology to be used for multiple crops
## Precision Planting - Current and Future?

<table>
<thead>
<tr>
<th></th>
<th>Seed drill 7.5“ Row Spacing</th>
<th>Precision Planter 7.5“ Row Spacing</th>
<th>Precision Planter 5“ Row Spacing</th>
<th>Future? Robotics</th>
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<tbody>
<tr>
<td>2 million seeds/acre</td>
<td><img src="image1.png" alt="Diagram" /> 0.4 in/seed</td>
<td><img src="image2.png" alt="Diagram" /> 0.4 in/seed</td>
<td><img src="image3.png" alt="Diagram" /> 0.6 in/seed</td>
<td><img src="image4.png" alt="Diagram" /> 2D vs 3D distribution</td>
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<tr>
<td>1 million seeds/acre</td>
<td><img src="image5.png" alt="Diagram" /> 0.8 in/seed</td>
<td><img src="image6.png" alt="Diagram" /> 1.3 in/seed</td>
<td><img src="image7.png" alt="Diagram" /></td>
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