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

Precision Planter
7.5” Row Spacing

Precision Planter
5” Row Spacing

2 million seeds/acre

1 million seeds/acre

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

5” spacing  15” spacing
Variability in Seed Placement
Planter reduced variability in seeding depth by **59%**

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

2 million seeds per acre

15 inch row spacing

1 million seeds per acre

10 inch row spacing

5 inch row spacing

7.5 inch row spacing

0.4 in/seed

0.6 in/seed

0.8 in/seed

0.2 in/seed

0.3 in/seed

0.4 in/seed

7.5 inch row spacing
### May 8, 2020

<table>
<thead>
<tr>
<th>Spacing</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>7.5”</td>
<td>76%</td>
</tr>
<tr>
<td>5”</td>
<td>92%</td>
</tr>
<tr>
<td>10”</td>
<td>76%</td>
</tr>
<tr>
<td>15”</td>
<td>67%</td>
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</tbody>
</table>

June 10- 77%
Others >95%
Row Spacing vs Yield - 2019

Campus and SVREC 2019

\[
y = 0.1872x^2 - 7.1886x + 156.05 \\
R^2 = 0.5602
\]

- \(\uparrow\) yield, \(\downarrow\) cost in narrow rows
- \(\downarrow\) yield penalty, cost in wide rows

Drill = 100 bu/ac
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

![Chart showing equipment comparison](chart.png)
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?

Seed drill
7.5” Row Spacing

Precision Planter
7.5” Row Spacing

Precision Planter
5” Row Spacing

Future?
Robotics

2 million seeds/acre

1 million seeds/acre

0.4 in/seed

0.8 in/seed

0.6 in/seed

1.3 in/seed

2D vs 3D distribution