Maximizing Yield Potential in Winter Wheat through Precision Planting and Agronomic Management

MWP Tracking Number: 17-03-07-CS

Researchers:
Kalvin Canfield, Graduate Student, canfie34@msu.edu, 989-724-8361
Maninder Singh, MSU Cropping Systems Agronomist, msingh@msu.edu, 517-775-8174
Dennis Pennington, MSU Wheat Specialist, pennin34@msu.edu, 269-832-0497

Date: December 31, 2019

Project goals and value for Michigan Wheat Growers
Uniform spatial distribution of plants resulting from precise placement of seed can lead to improved resource use efficiency and plant health by equally sharing plant growth resources such as water, nutrients, and sunlight and reducing plant-to-plant competition, potentially resulting in low input costs and increased yield. Farmers are trying to utilize the precision planting technology that they already have for small grains. This project will help them determine the optimum configuration for their planter and/or if they need to invest in other planter technology. 2019-20 growing season will be the third year for main objectives of this project; additional work related to equipment comparison and variety evaluation has been included based on lessons learned from initial results. Additional funding support from project GREEEN and MCIA along with in-kind support from Horsch shows the overall interest and expanded scope of this project and continued support from MWP will help conduct and deliver research results to Michigan wheat growers.

Results of Project
The first objective of this project is to evaluate Precision Planting (PP) and conventional drill (Drill) technologies. Data collection included stand counts, plant to plant spacing, seeding depth, yield and yield components.

<table>
<thead>
<tr>
<th></th>
<th>Yield (bu/a)</th>
<th>Stand/acre</th>
<th>Heads/ft²</th>
<th>Seeds/head</th>
<th>TKW</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5&quot;PP</td>
<td>106.9</td>
<td>A</td>
<td>873,863</td>
<td>A</td>
<td>32.1</td>
</tr>
<tr>
<td>7.5&quot;Drill</td>
<td>98.1</td>
<td>B</td>
<td>759,420</td>
<td>B</td>
<td>35.1</td>
</tr>
</tbody>
</table>

Looking only at the 7.5” row spacing at Mason in 2019, the PP yielded 106.9 bu/a compared to the conventional drill at 98.1 bu/a, an increase of 8.8 bu/a (9%). Averaged over all planting populations, the PP had higher final plant stand counts as well (see table). Yield components evaluated include heads per ft², seeds per head and thousand kernel weight (TKW). These three components make up the final yield. For these components, heads per ft² and seeds per head were not different between the two planting technologies. However, TKW was 6.9% higher in the PP compared to the drill and could explain increase in overall yield with PP. It is important to note that this is just one year of data from one location. This is the second year of a three-year project. Stay tuned for the year 3 (2019-20 season) report and the overall project final report.
The second objective of this study was to compare the seed placement accuracy of PP and conventional drill technology in terms of seed-to-seed spacing within a row and seed depth placement. Seed to seed spacing was measured by laying a ruler down in two rows and marking where each emerged plant was. The space between each plant can then be obtained. Ideally, the spacing between each plant would be identical if all seeds were precisely spaced. Coefficient of Variation (CV) is a statistical measure of how much variability there is. The lower the CV, the lower the amount of variability in plant-to-plant spacing.

Figure 1. Plant to plant accuracy of PP and drill planters.

![Figure 1](image1.png)

The CV of plant-to-plant spacing (Figure 1) was higher in drill compared to the PP, indicating the spacing between plants was more variable in plots planted with the drill. Across all seeding rates, PP reduced CV of plant-to-plant spacing by 17% over drill. Seeding depth was measured by digging plants in one meter of row and measuring the distance between the top of the seed and the soil surface. Again, ideally the depth of each seed would be the same. However, the CV of seed depth was higher in drill compared to the PP (Figure 2). Across all seeding rates, PP reduced CV of seeding depth by 59%.

Figure 2. Seeding depth accuracy of PP and drill planters.

![Figure 2](image2.png)

A third objective was to measure the impact of row spacing and plant populations on grain yield. Row spacings of 5”, 7.5”, 10” and 15” and populations of 0.5, 1.0, 1.5 and 2.0 million seeds per acre were evaluated. These were planted with the Monosem 4NG precision planter. An additional row spacing treatment was added that included the 7.5” row spacing conventional drill (objective 1).

Yield data from Mason in 2019 had a significant row spacing, population and interaction effect. This interaction effect signifies that the response of seeding rate varied based on the row spacing used. Mean separations for the interaction is presented in figure 3. The highest yield attained was 5” row spacing at the 2.0 million seeding rate at 134 bushels per acre. In general, for most row spacings yield increased with seeding rate except in 10” row spacing. Narrow row spacing outperformed wider row spacing (Figure 4). In 2019, the average wheat yield in Ingham County (where trial was located) was 72.5 bushels per acre, or 61.5 bushels per acre lower than the highest yield achieved in this trial. While this is one year of data from one location, it appears that precision planting along with narrow row spacing certainly has promise for increasing wheat yields. Second location (SVREC) showed similar trends including yields beyond 120 bu/a with 5” row spacing, though response to seeding rate was minimal (data not shown).
Summary
From two years of looking at precision planting wheat, we have learned that Michigan wheat growers looking to increase wheat yields should consider the use of precision planting technology on their farms. Increased singulation and uniform seeding depths leads to increased resource use efficiency and the potential for higher yields. Michigan wheat growers that are looking to reduce cost and maintain yields should consider lowering seeding rates. Preliminary data shows yield does not
significant increase when seeding rates are higher than 1.5 million seeds per acre. Narrow row spacing tends to increase yield potential over wide row spacings.

**Recommendations from Project**

This is year two of a three-year project. Grower recommendations will be included in the year three final report as that will be the end of the project.

**Future work**

The third year of this project has been funded in partnership with the Michigan Wheat Program and MSU’s Project GREEEN. Year three research plots were planted in fall of 2019. Stand counts, plant to plant spacing and seeding depth data has already been collected. After harvest in 2020, final data will be collated, analyzed and submitted in the final report. In addition, graduate student Kalvin Canfield is expected to graduate in December 2020. Two journal articles are planned from this project as well. Data from this project will be presented at winter grower meetings, field days and posted on the MSU Wheat and Agronomy webpages.

**Project Changes**

There are no project changes to report. This project is on track.

**Budget narrative**

The budget for this project is on track. No major changes to the budget are needed.

**Intellectual property**

None.

**Approach to Disseminate Research**

Two journal articles are planned from this project as well. Data from this project has been presented at winter grower meetings and field days, and American Society of Agronomy’s annual meetings. After third and final year of project, research results will be posted on the MSU Wheat and Agronomy webpages. An article for the Wheat Wisdom newsletter can be submitted in any month.