Wheat (Triticum aestivum) cultivar response to chlormequat chloride (Manipulator®) treatment

By: Andrew Reddekopp
PLSC 494.6
Why did I choose this research topic?

- Field scale trials
- Benefit to local producers
- Lodging becoming more of a consistent issue
- Manipulator® was new to Canada
- Chance to work on a topic that has very little previous research
Project Background

Plant Growth Regulators

- Modify plant hormone balances \( \text{(Espindula et al., 2009)} \)
- Reduce shoot length in crop production \( \text{(Shekoofa & Emam, 2008)} \)
- Used for decades in intensive European cereal production \( \text{(Rademacher, 2009)} \)
- PGRs used extensively in horticulture industry \( \text{(Taiz et al., 2015)} \)
Project Background

Chlormequat chloride

- Inhibits the production of gibberellins (a plant hormone) (Tolbert, 1960)
- Specifically interrupts the activity of copalyl-diphosphate synthase and ent-kaurene synthase (Taiz et al., 2015)
- Reduces stem height (Shekoofa & Emam, 2008)
- Increases stem strength (Miranzadeh et al., 2011)
Objective & Hypothesis

- Analyze hard red spring wheat (*Triticum aestivum*) cultivar response to chlormequat chloride (Manipulator®) treatment

- Cultivars will respond differently and there will be a difference in a minimum of one of the seven parameters
Materials and Methods

Wheat Cultivars:
- AC Carberry, CDC Morris, AC Harvest, AC Lillian, AC Elsa

Design:
- Randomized complete block at field scale with one treatment compared to a control
- 4 replicates of each treatment in randomized strip pattern
- 3 sites at different locations for each cultivar
Materials and Methods

Treatment:
- 174 g ae ha\(^{-1}\) (0.7 L/ac) chlormequat chloride @ 94 L/ha water volume

Stage:
- ZS 30-32

Measurements:
- Grain yield, plant height at maturity, lodging score, protein content, moisture content, test weight and overall grade
## Statistical Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DF</th>
<th>F Value</th>
<th>P Value</th>
<th>DF</th>
<th>F Value</th>
<th>P Value</th>
<th>DF</th>
<th>F Value</th>
<th>P Value</th>
<th>DF</th>
<th>F Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivar</td>
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<td>28.97</td>
<td>&lt;.0001</td>
<td>4</td>
<td>17.51</td>
<td>&lt;.0001</td>
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<td>20.05</td>
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<tr>
<td>Cultivar x Treatment</td>
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<td>0.1839</td>
<td>4</td>
<td>8.27</td>
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<td>3.42</td>
<td>0.0171</td>
<td>4</td>
<td>3.93</td>
<td>0.0089</td>
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<table>
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<th>Parameter</th>
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<th>P Value</th>
<th>DF</th>
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<th>F Value</th>
<th>P Value</th>
<th>DF</th>
<th>F Value</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Cultivar</td>
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<td>11.76</td>
<td>&lt;.0001</td>
<td>4</td>
<td>22.04</td>
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<td>4</td>
<td>32.64</td>
<td>&lt;.0001</td>
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<tr>
<td>Treatment</td>
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<td>1.51</td>
<td>0.2295</td>
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<td>0.06</td>
<td>0.8098</td>
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<td>Cultivar x Treatment</td>
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<td>0.09</td>
<td>0.9864</td>
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</table>
The graph shows the lodging score (0-9) for different cultivars under treated and untreated conditions. The cultivars include All Cultivars, AC Carberry, AC Elsa, AC Harvest, AC Lillian, and CDC Morris. The treated conditions show lower lodging scores compared to the untreated conditions, indicating a reduction in lodging due to treatment. AC Lillian has the highest lodging score under the untreated condition, while all other cultivars have lower scores under both treated and untreated conditions.
CDC Morris

Treated  Untreated  Treated  Untreated
AC Lillian

Untreated   Treated   Untreated   Treated
AC Lillian

Untreated  Treated  Untreated  Treated
The bar graph represents the protein content (%) for different cultivars in both treated and untreated conditions. The cultivars include All Cultivars, AC Carberry, AC Elsa, AC Harvest, AC Lillian, and CDC Morris. The graph shows a comparison between treated and untreated samples for each cultivar.
Seed Moisture Content (%)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Treated</th>
<th>Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cultivars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Carberry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Elsa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Harvest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Lillian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDC Morris</td>
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</table>
## Profitability

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Yield Increase</th>
<th>Wheat Price</th>
<th>Revenue Increase</th>
<th>Application Cost</th>
<th>Net Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg/ha</td>
<td>bu/ac</td>
<td>$/kg</td>
<td>$/bu</td>
<td>$/ha</td>
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<tr>
<td>Lillian</td>
<td>527</td>
<td>7.9</td>
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<td>CDC Morris</td>
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<td>4.7</td>
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<td>6.50</td>
<td>74.52</td>
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<td>6.50</td>
<td>73.56</td>
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<td>Harvest</td>
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<td>6.50</td>
<td>53.98</td>
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<td>3.3</td>
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<td>6.50</td>
<td>52.78</td>
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</tbody>
</table>
Conclusions & Relevance

- Chlormequat chloride response varied depending on wheat cultivar.

- Cultivar x treatment interaction observed for plant height, lodging severity, protein content, and seed moisture content.

- Significant differences occurred between treated and untreated for yield, plant height, lodging and protein.
Conclusions & Relevance

- Economic benefit of chlormequat chloride was greatest when lodging was severe, but was profitable even when no lodging occurred.

- Intensive wheat production systems are most likely to benefit from the use of chlormequat chloride.
References

Thank you!

- Grower Partners – Wayne Andres, Peter Unruh, Jason Feitsma, Nic Wiens
- EngageAgro – Phil Bernardin
- Wendland Ag Services Ltd
- Dr. Chris Willenborg & Eric Johnson
Questions?