Managing Lodging Risk Through Agronomic Management

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Yield Potential in Spring Wheat

- Average yield increase of **1.4% per year** since 1991 in MB + SK

Fig. 2. “Yield values” for issues of the Manitoba and Saskatchewan Seed Guides based on the average of the cultivar least squares means for those CWRS varieties present in each issue and plotted against the year of publication.
Spring Wheat Yield - Municipality of Lorne

Yield (bu/ac)

1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017

MASC Variety Yield Data: https://www.masc.mb.ca/masc.nsf/mmpp_browser_varytess.html
2017 Spring Wheat Yields in Brunkild, MB

Full Project Report Available:
## Optimum N Rate for High Yielding S.Wheat in MB

<table>
<thead>
<tr>
<th>Site-year</th>
<th>Total N @ Economic Optimum</th>
<th>Yield at Optimum N Rate</th>
<th>Nitrogen Supply per bushel</th>
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<tr>
<td>Carman 2016</td>
<td>187</td>
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<tr>
<td>Grosse Isle 2017</td>
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Optimum soil test N + Fertilizer N per bushel = 2 lb N/bu
How do Plants Lodge?

**Cost of Lodging**
- Yield losses of 10 – 40% (up to 80% in extreme cases)
- Kernel weight decreases of 8 – 15%
- Decreased milling and baking quality
- Increased presence of mycotoxins
- Cost of harvesting increases up to 50%
- Cost of drying increases from 20-30%  
  (Rademacher 2016)
Stem Lodging

Stem Leverage > Stem Strength

Berry et al. 2014.

Figure 3  Brackling in winter barley.

http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=100201
Root Lodging

Plant Leverage > Anchorage Strength

Berry et al. 2014

Ground level

spread

depth

Figure 4  Root lodging in winter barley.
## Variety Descriptions

### Canada Western Red Spring

<table>
<thead>
<tr>
<th>Class/Variety</th>
<th>Site Years Tested</th>
<th>Yield bu/acre</th>
<th>Protein %</th>
<th>Maturity +/− 99 days</th>
<th>Height +/− 81 cm</th>
<th>Spike Awned</th>
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<th>Sprouting</th>
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Nitrogen Management

High levels of residual N or spring applied N increase risk of lodging

- Thick dense heavy canopies
- Decreased stem strength
- Increased tillering

Avoiding excessive N application rates and/or delaying a portion of N to later in season may reduce unnecessary canopy growth and decrease lodging risk

In-season split N applications at Carman and Brunkild 2016 – 2017 field trials

[Bar charts showing yield and protein percentage comparisons between different N application rates and split times.]
Plant Density

• High plant densities are related to increased risk of root lodging → reduce anchorage strength

• Current MB Agriculture recommendations are to aim for a plant density for a plant population of 230 – 280 plants/m²

• Industry recommends increased seeding rates for reduced tillering to promote a uniform stand for fusarium head blight (FHB) fungicide application timing

Note: Seeding rates should be targeted towards a desired plant density, taking into considerations TWK, germination % and expected mortality of variety and seeding system
Plant Growth Regulators (PGR)

Gibberellic Acid (GA) Inhibitors

- PGRs can reduce lodging risk by decreasing plant height
- GA inhibitors reduce shoot length by decreasing cell elongation and rate of cell division (Rademacher 2000)
- Allow for adjustments to the crop according to growing conditions

Manipulator 620

- Engage Agro
- Active: Chlormequat chloride
- Not register for use in barley and oats
- No registered tank mix partners

Moddus/Palisade

- Syngenta
- Active: Trinexapac-ethyl
- NOT currently registered in Canada
- Anticipated Mid-2019 registration (2020 growing season)
Gibberellin Biosynthesis Pathway

Geranylgeranyl-DP

ent-Copalylyl-DP

ent-Kaurene

ent-Kaurenoic Acid

GA_{12}-aldehyde

GA_{12}

GA_{53}

GA_{19}

GA_{20}

GA_{1}

(Active Form)

Chlormequat chloride (Manipulator)

Trinexapac-ethyl (Moddus/Palisade)

Modified from Rademacher 2015
Agronomic Management Practices to Reduce Lodging in Spring Wheat

Small Plot Study 2018 - 2019

Determine how agronomic management alters crop canopy structure and development, and resulting lodging and grain yield and quality

- Varietal Selection
- Nitrogen Management
- Planting Density
- PGR Application
- Management Interactions
Variety x N Management x PGR

Experiment #1

Varieties (3):
• Brandon (CWRS)
• Prosper (CNHR)
• Cameron (CWRS)

Nitrogen Management (5):
• Check: 0 lbs N/ac
• Standard Rate for high yield: 140 lbs N/ac
• Reduced Rate: 70 lbs N/ac
• Split N Application: 70 + 70 (Flag Leaf) lbs N/ac
• Controlled Release N: 40:100 urea:ESN blend lbs N/ac

Plant Growth Regulator (+/-)
• Chlormequat chloride (Manipulator)
  - Gibberellic acid biosynthesis Inhibitor
N Timing x Plant Density x PGR
Experiment #2

Nitrogen Timing (2)
• Entirely at planting (140)
• Split application (70+70 FL)

Plant Density (3)
• Low (150 plant/m²)
• Recommended (250 plants/m²)
• High (350 plants/m²)

Plant Growth Regulator (+/-)
• Chlormequat chloride (Manipulator)
  - Gibberellic acid biosynthesis Inhibitor
Preliminary Results: Lodging

No Lodging in 2018 Trials
Preliminary Results: Stalk Strength

• Collaboration with U of Minnesota
• Measured at Maturity
• Measures resistance to displacement from vertical position
Preliminary Results: Stalk Strength

Experiment 1

Variety

P-value: 0.6231

No significant Interactions between Variety, N Management and PGR

N Management

P-value: 0.0080

No significant Interactions between Variety, N Management and PGR

Manipulator

P-value: 0.5720
Preliminary Results: Stalk Strength

Experiment 2

No significant interaction between plant density and N timing or PGR
Preliminary Results: Grain Yield + Protein

Experiment 1

Variety

No significant Interactions between Variety, N Management and PGR
Preliminary Results: Grain Yield + Protein

Experiment 1

No significant Interactions between Variety, N Management and PGR
Preliminary Results: Grain Yield + Protein

Experiment 1

No significant Interactions between Variety, N Management and PGR

PGR: Manipulator

P-value < 0.0001

P-value 0.0002

Yield (bu/ac)

Protein (%)

PGR (-)

PGR (+)

PGR (-)

PGR (+)
Preliminary Results: Grain Yield + Protein

Experiment 2

No significant interaction between plant density and N timing or PGR
Preliminary Results: Grain Yield + Protein

Experiment 2

Nitrogen Timing * PGR

No significant interaction between plant density and N timing or PGR
What we learned from 2018:

• We currently cannot relate management practices to field lodging due to lack of lodging during the 2018 Season
• Reducing seeding rates and PGR applications (spring applied N only) increased stalk strength (Exp. 2)
• Grain yield was increased by PGR application in Exp. 1 only
• Grain protein content was increased by split N applications, but decreased by PGR applications and reduced rates of N.

LOTS of Data Still to Come

Nitrogen Use Efficiency: N uptake and partitioning patterns
Canopy Structure: Heights, tillering, dry matter partitioning
Plant Morphology: Stem diameter, internode length, structural rooting width and depth
Stem Structural Composition: Lignin, Cellulose, Hemicellulose

2019 Field Season
Acknowledgements

- Manitoba Wheat and Barley Growers Association
- Andy Keen
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- Engage Argo
- Manitoba Agriculture
- Koch Fertilizer
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- Corinne Bernard, Patrick Muller, Brandi Van de Velde, Katrina Van de Velde
- Codi Hennan, Stephanie Dheilly, Berni Jungreithmeier, Nate Ort
Questions?

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