Managing Lodging Risk Through Agronomic Management

Amy Mangin
PhD. Student
Dept. Plant Science
University of Manitoba

Yield Potential in Spring Wheat

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

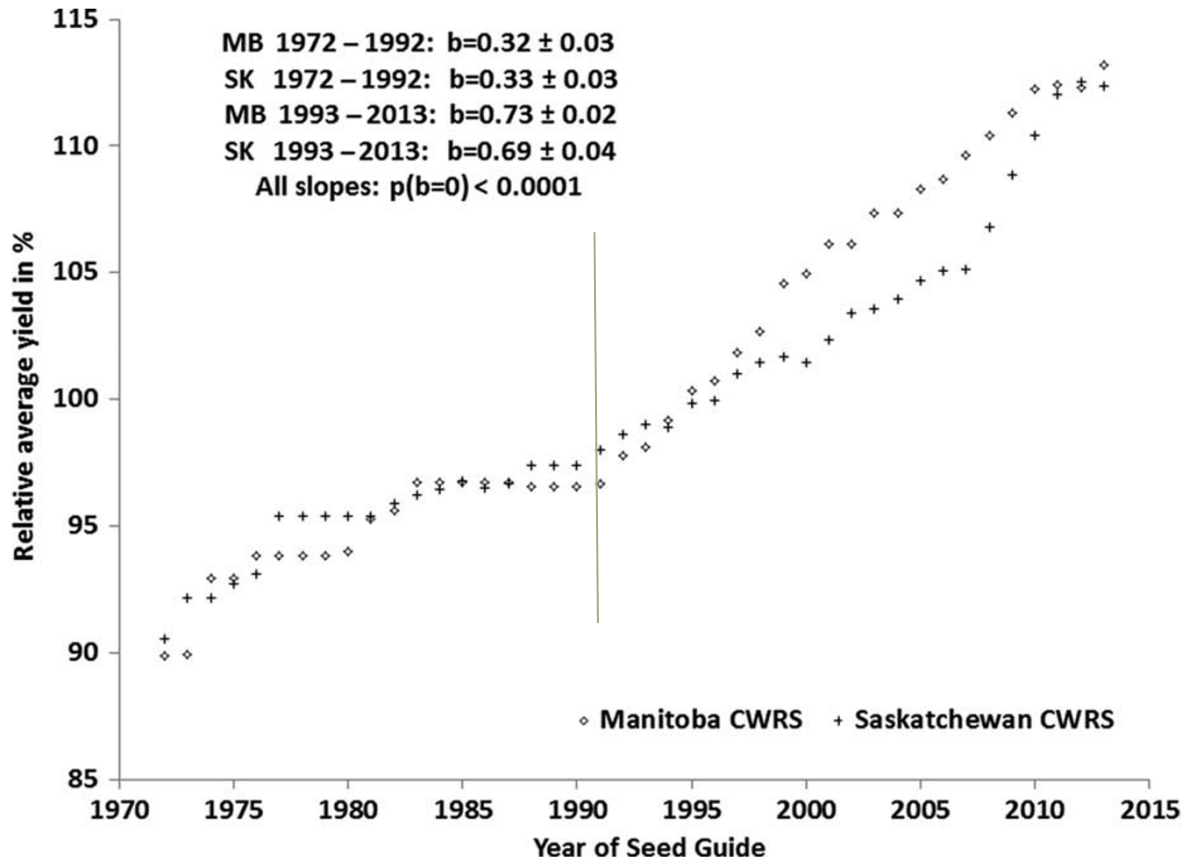
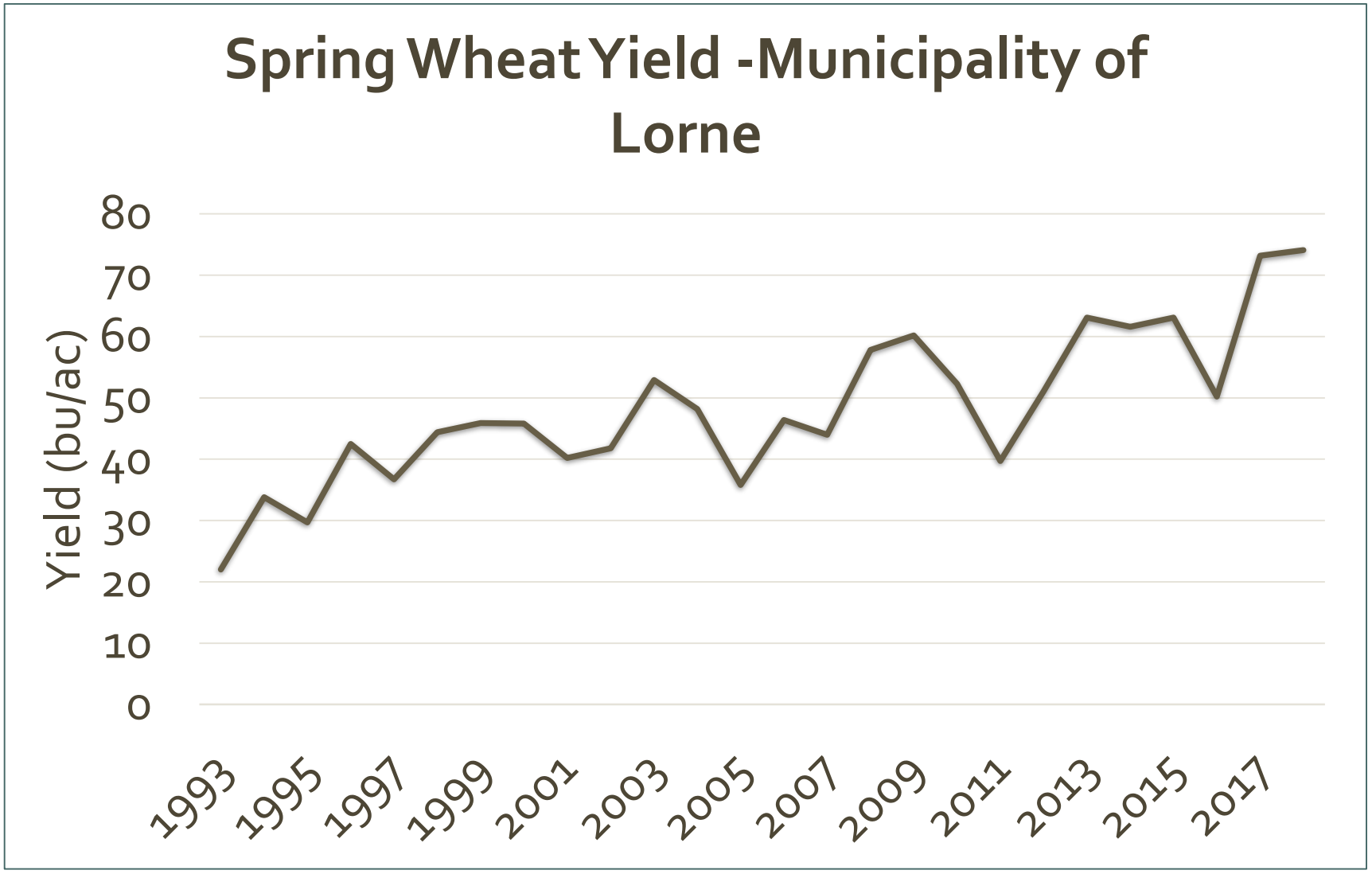


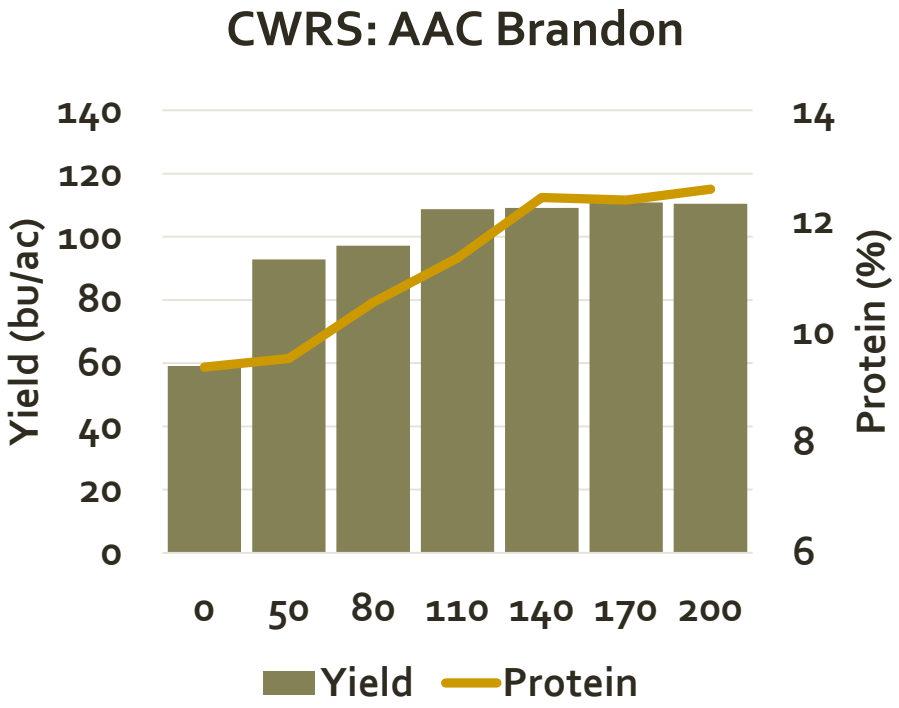
Fig. 2. "Yield values" for issues of the Manitoba and Saskatchewan Seed Guides based on the average of the cultivar least squares means for those CWRS varieties present in each issue and plotted against the year of publication.

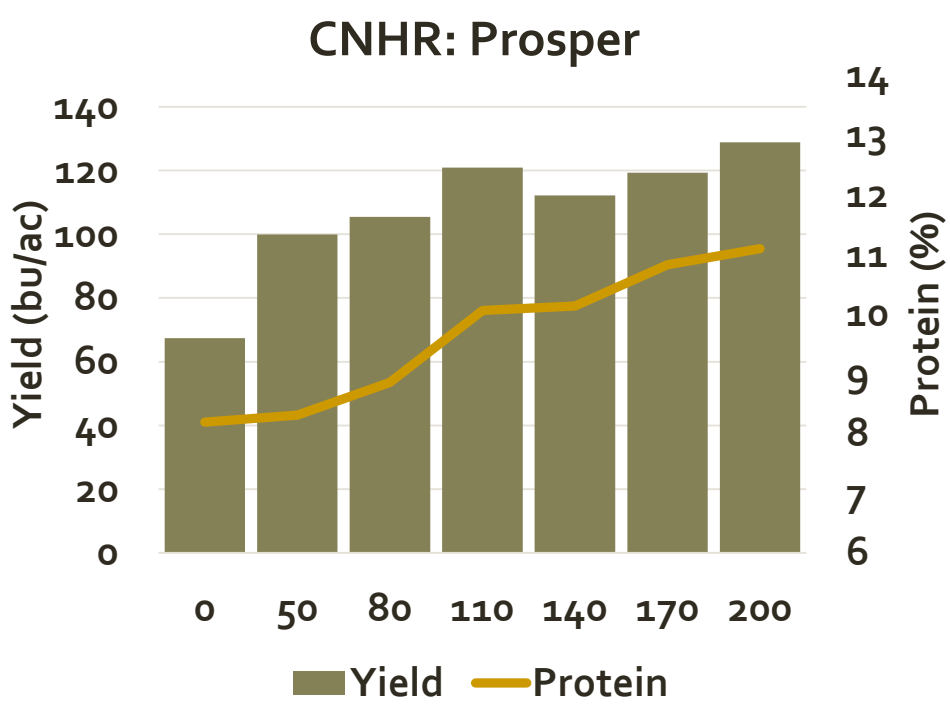
Thomas and Graft 2014 (Can J Plant Sci)



MASC Variety Yield Data: https://www.masc.mb.ca/masc.nsf/mmpp_browser_variety.html

2017 Spring Wheat Yields in Brunkild, MB





Full Project Report Available:
http://www.mbwheatandbarley.ca/wp-content/uploads/2018/05/Mangin-Flaten-N-mgmt-for-HY-wheat-project-revised-technical-report-2018-03-31.pdf

Optimum N Rate for High Yielding S.Wheat in MB

Site-year	Total N @ Economic Optimum	Yield at Optimum N Rate	Nitrogen Supply per bushel
		bu/ac	lbs. N/bu
Carman 2016	187	62	3.0
Brunkild 2016	180	75	2.4
Carman 2017	183	96	1.9
Brunkild 2017	183	110	1.7
Melita 2016	123	60	2.1
Carberry 2016	139	95	1.5
Melita 2017	151	74	2.0
Grosse Isle 2017	175	75	2.3

Hail Damaged

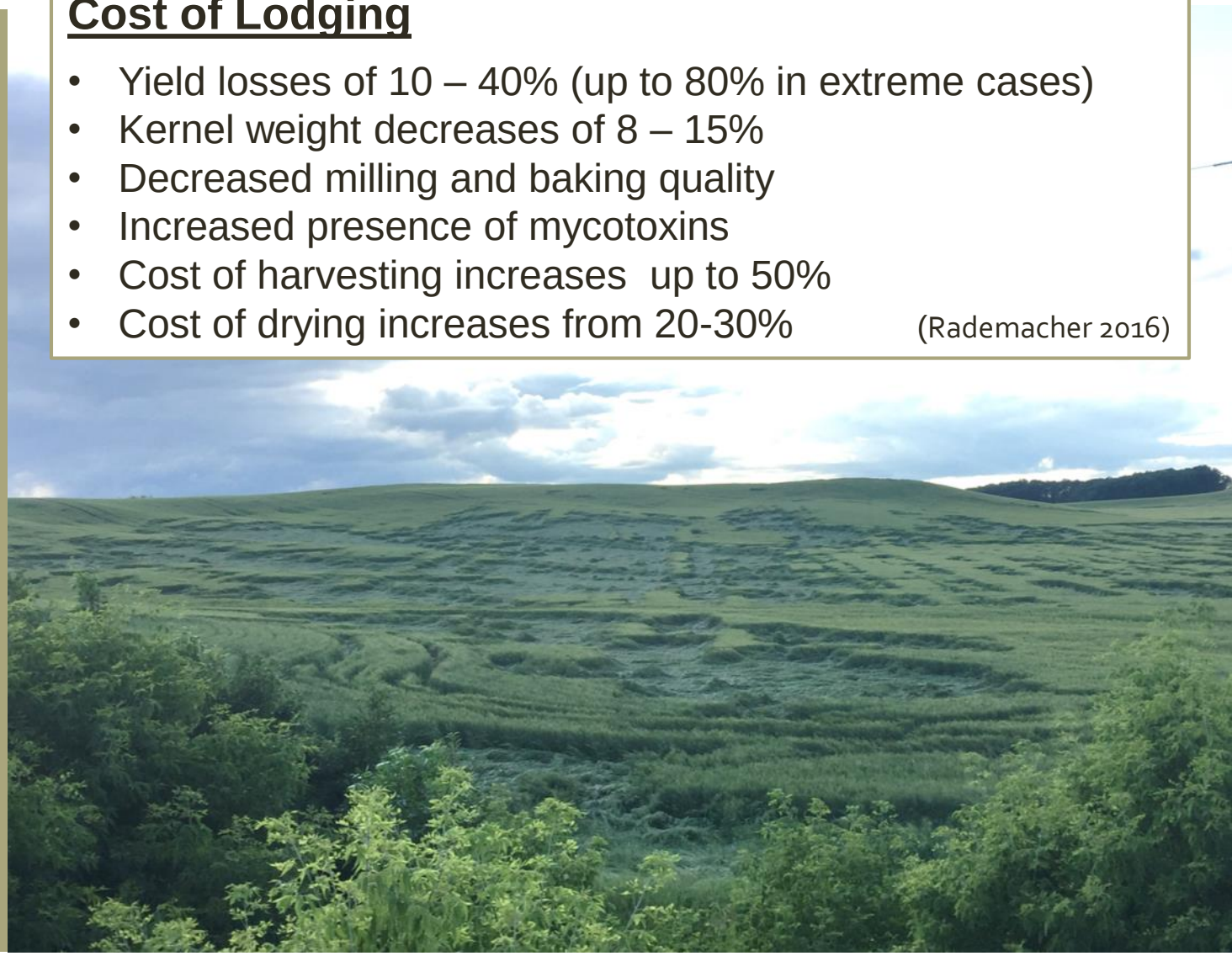
Optimum soil test N + Fertilizer N per bushel = 2 lb N/bu

How do Plants Lodge?

Cost of Lodging

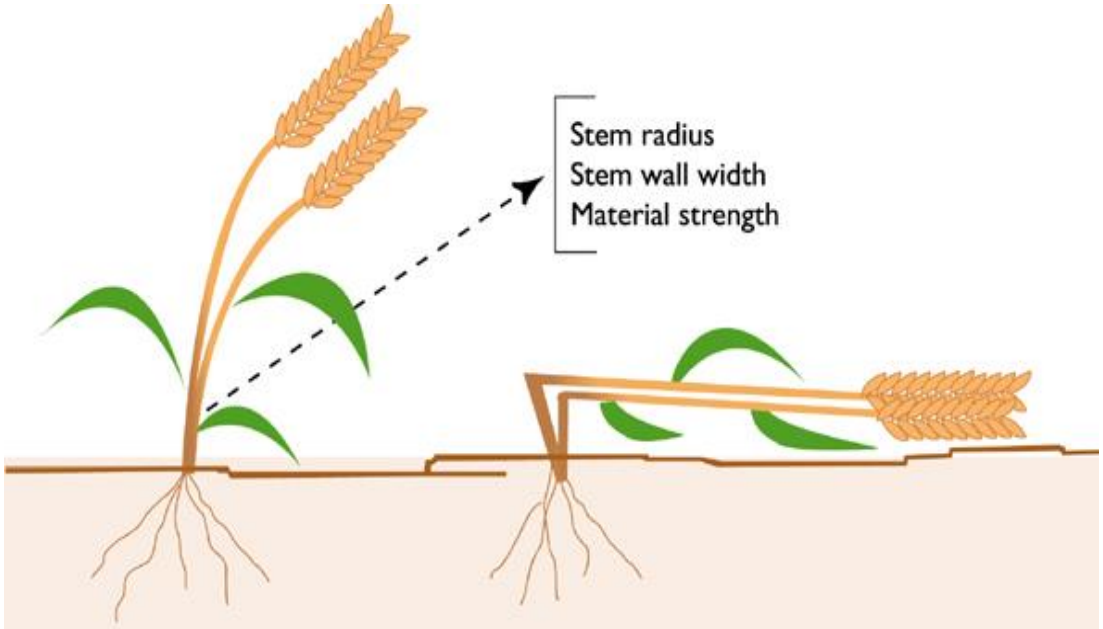
- Yield losses of 10 – 40% (up to 80% in extreme cases)
- Kernel weight decreases of 8 – 15%
- Decreased milling and baking quality
- Increased presence of mycotoxins
- Cost of harvesting increases up to 50%
- Cost of drying increases from 20-30%

(Rademacher 2016)



Stem Lodging

Stem Leverage > Stem Strength



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

Berry et al. 2014.

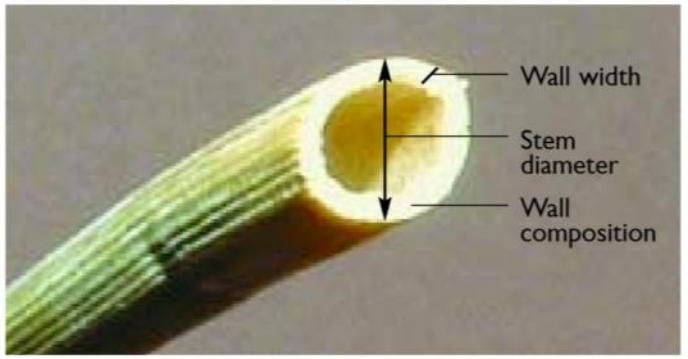
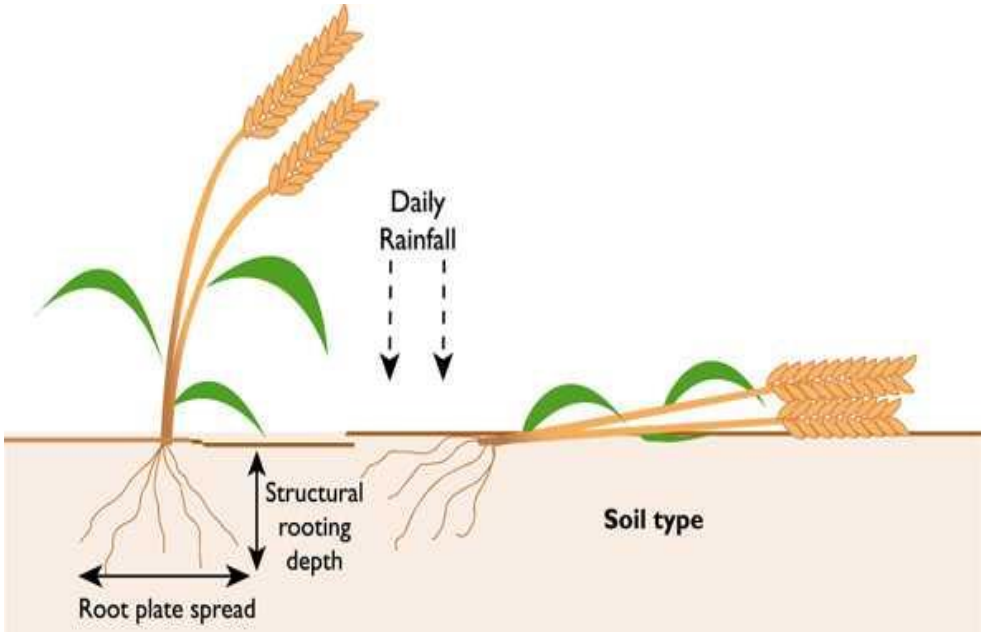


Figure 3 Brackling in winter barley.

Root Lodging

Plant Leverage > Anchorage Strength



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

Berry et al. 2014

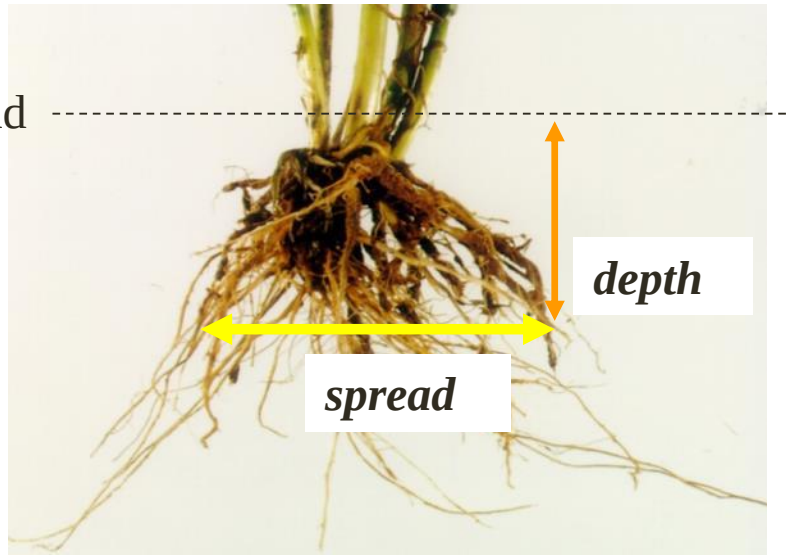


Figure 4 Root lodging in winter barley.

Variety Descriptions

Class/Variety	Site Years Tested	Yield bu/acre	Protein %	Maturity +/- 99 days	Height +/- 81 cm	Spike Awned	Lodging	Resistance Level: Sprouting	Loose Smut	Common Bunt	Leaf[1] Spots	S
Canada Western Red Spring												
5604HR CL	40	66	14.5	-1	10	Y	G	G	MS	I	MS	
5605HR CL	32	66	14.7	1	10	Y	VG	F	R	MR	MS	
AAC Alida VB	19	67	14.5	2	6	Y	VG	VG	R	I	MS	
AAC Bailey	28	55	14.9	-1	13	N	G	G	MS	MR	I	
AAC Brandon	60	69	14.2	2	0	Y	VG	P	MR	S	I	
AAC Cameron VB	34	73	13.9	1	13	Y	G	F	S	R	I	
AAC Connery	32	61	14.9	1	3	N	VG	G	MR	I	I	
AAC Elie	44	68	14.3	2	-3	Y	VG	F	I	I	I	
AAC Jatharia VB	33	73	14.3	1	13	Y	G	G	S	MS	I	
AAC LeRoy VB	6	73	14.3	0	7	Y	G	G	—	I	MS	
AAC Magnet	6	66	14.0	0	8	Y	G	G	—	S	MS	
AAC Prevail VB	44	66	14.1	1	18	N	G	G	S	S	MS	
AAC Redberry	32	68	14.3	0	8	Y	G	G	R	I	MS	
AAC Redwater	43	64	14.5	-2	8	Y	G	VG	MS	I	MS	
AAC Starbuck VB	6	73	14.5	1	1	Y	G	—	MR	S	S	
AAC Tisdale	32	67	15.1	1	8	Y	G	F	MR	MR	MS	
AAC Viewfield	45	70	14.3	3	-5	Y	VG	G	S	MR	I	
AAC W1876	32	62	15.1	3	3	Y	VG	F	I	I	MS	
AAC Warman VB	19	68	14.4	0	12	Y	G	—	MR	S	I	
AAC Wheatland VB	6	74	14.3	1	0	Y	VG	—	R	MR	S	
AC Domain	2	65	15.3	-2	10	N	VG	VG	R	I	S	
Carberry	110	66	14.5	2	0	Y	VG	F	MR	R	MS	

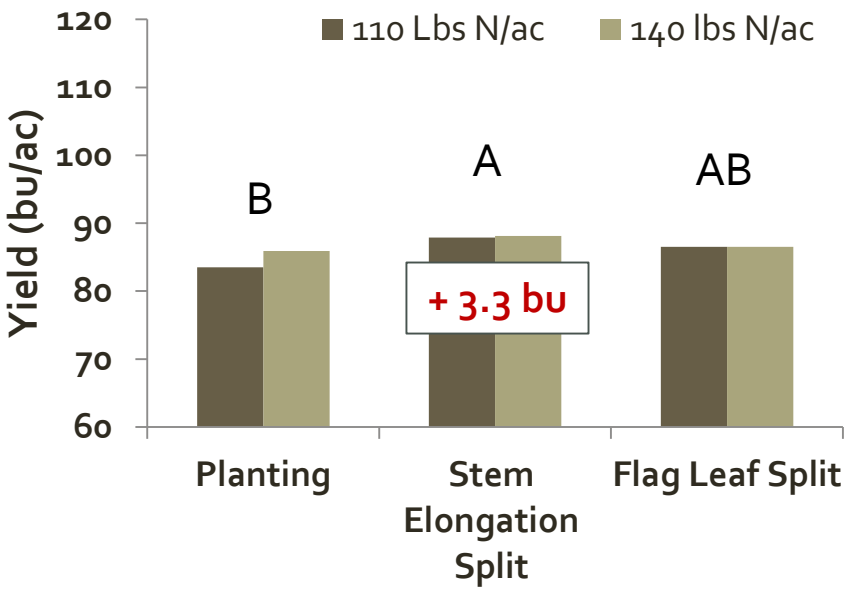
Nitrogen Management

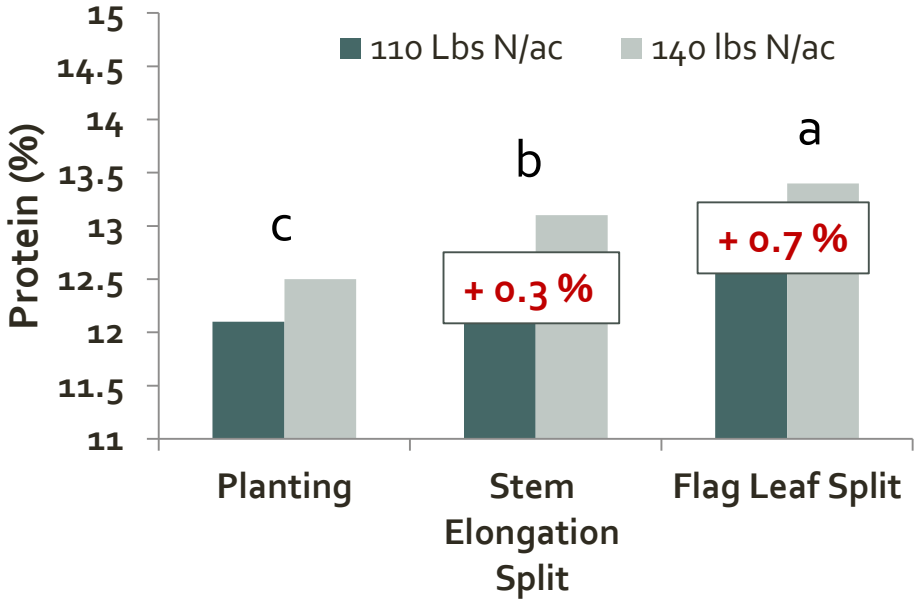
High levels of residual N or spring applied N increase risk of lodging

- 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





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/m^2
- 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

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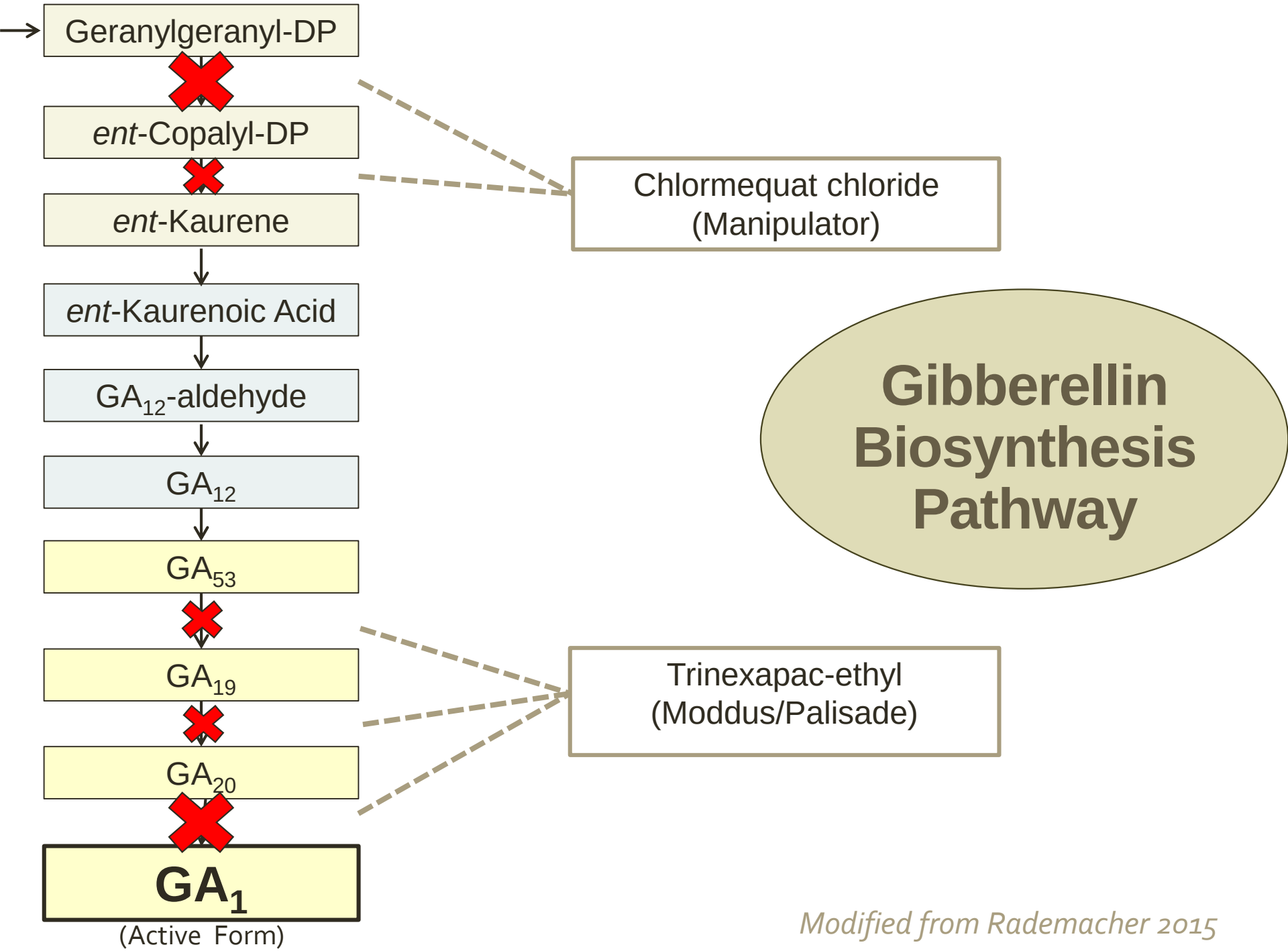
Manipulator 620

- 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)



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/m^2)
- Recommended (250 plants/m^2)
- High (350 plants/m^2)

Plant Growth Regulator (+/-)

- Chlormequat chloride (Manipulator)
  - Gibberellic acid biosynthesis Inhibitor

Preliminary Results: Lodging

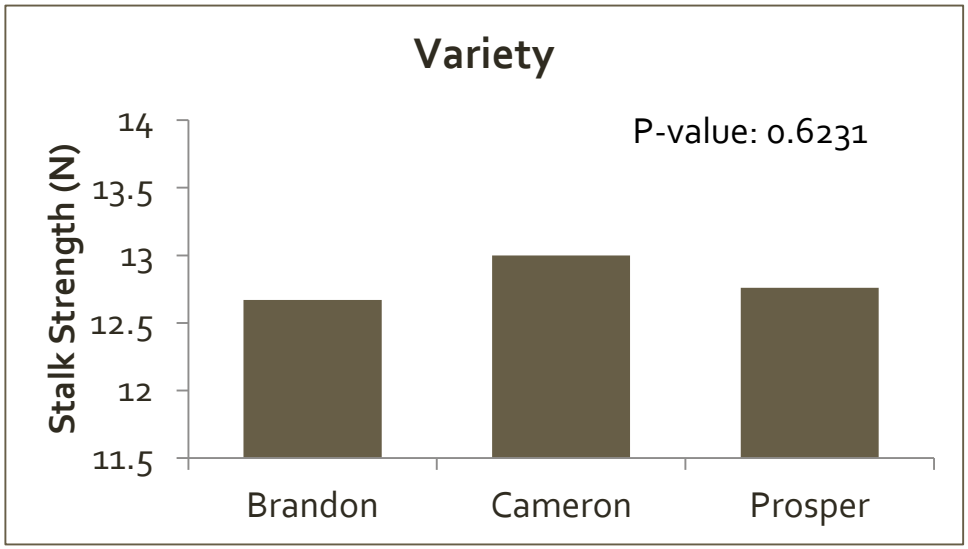
No Lodging in 2018 Trials

Preliminary Results: Stalk Strength

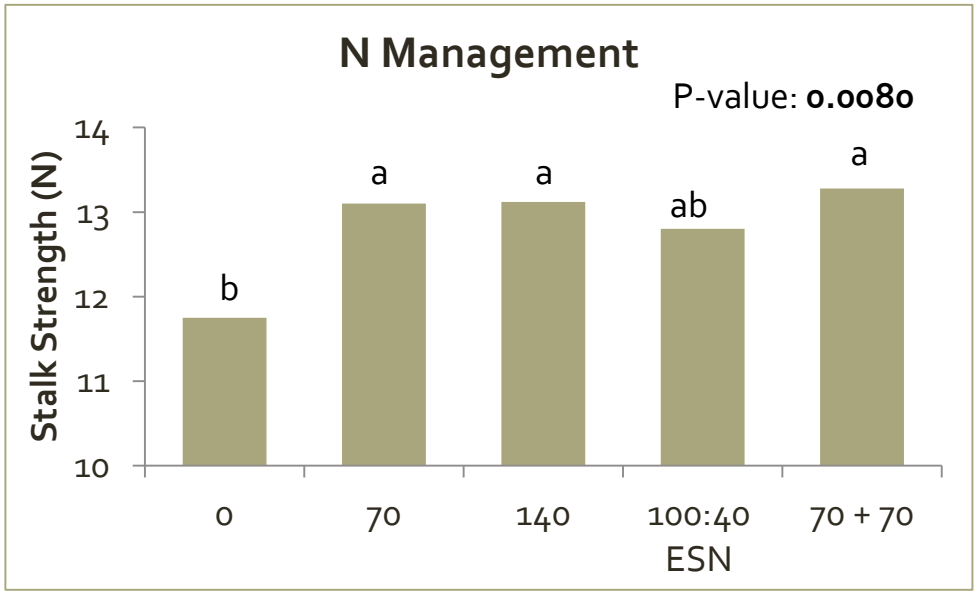
- Collaboration with U of Minnesota
- Measured at Maturity
- Measures resistance to displacement from vertical position

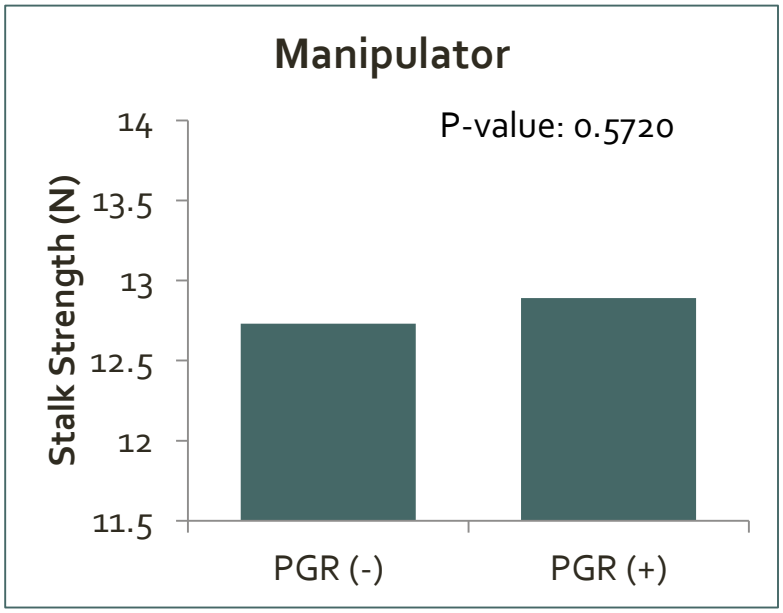
Preliminary Results: Stalk Strength

Experiment 1



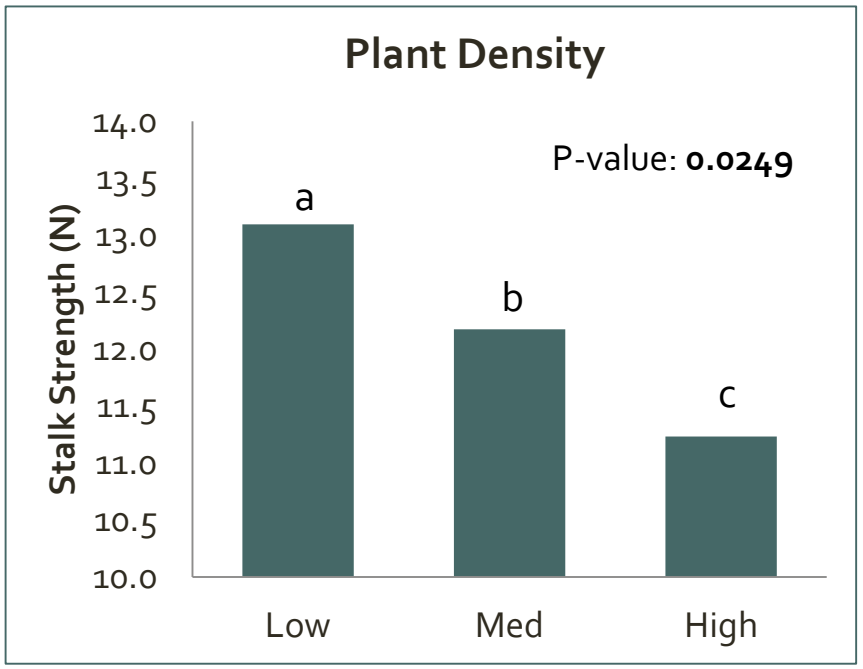
No significant Interactions between Variety, N Management and PGR

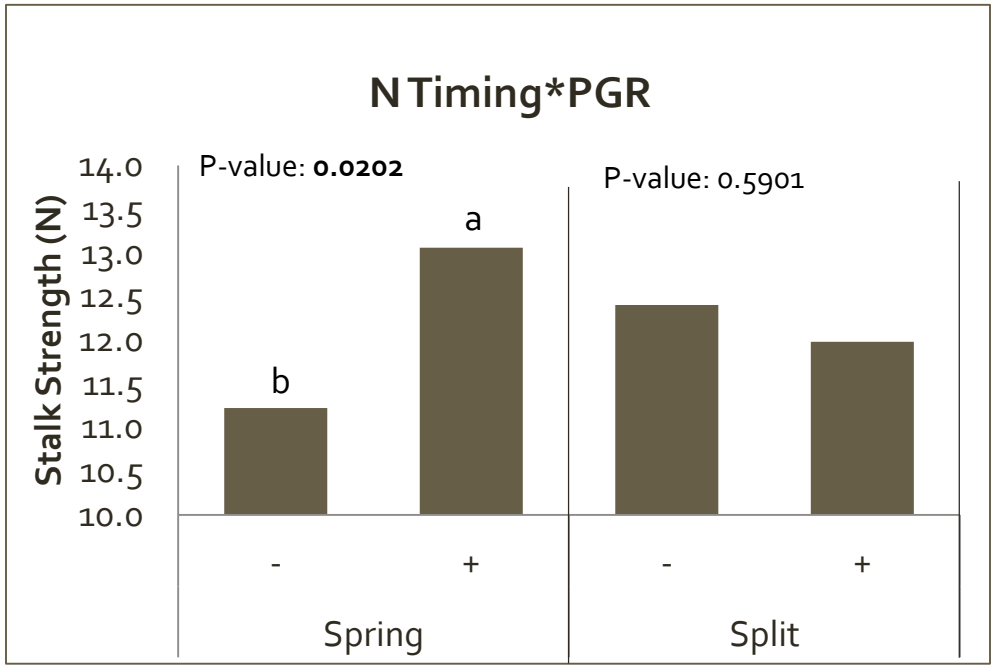




Preliminary Results: Stalk Strength

Experiment 2



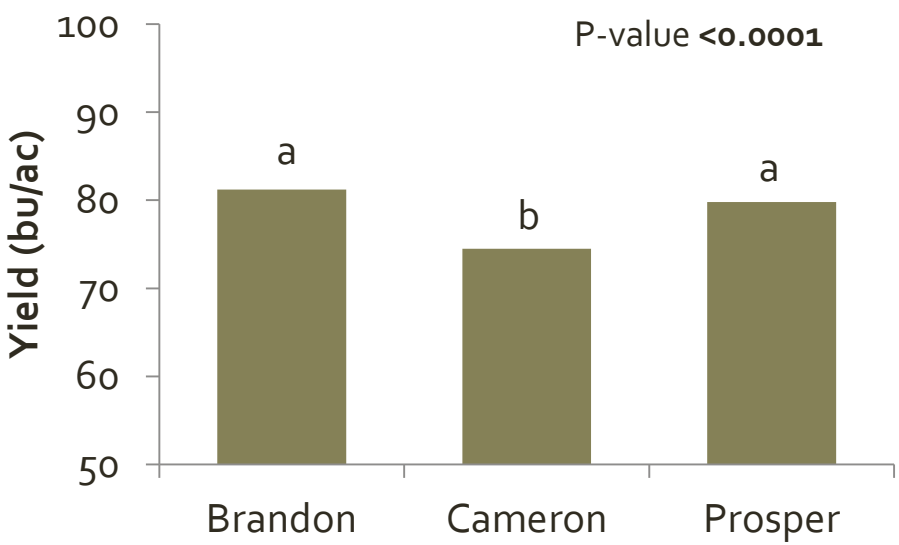


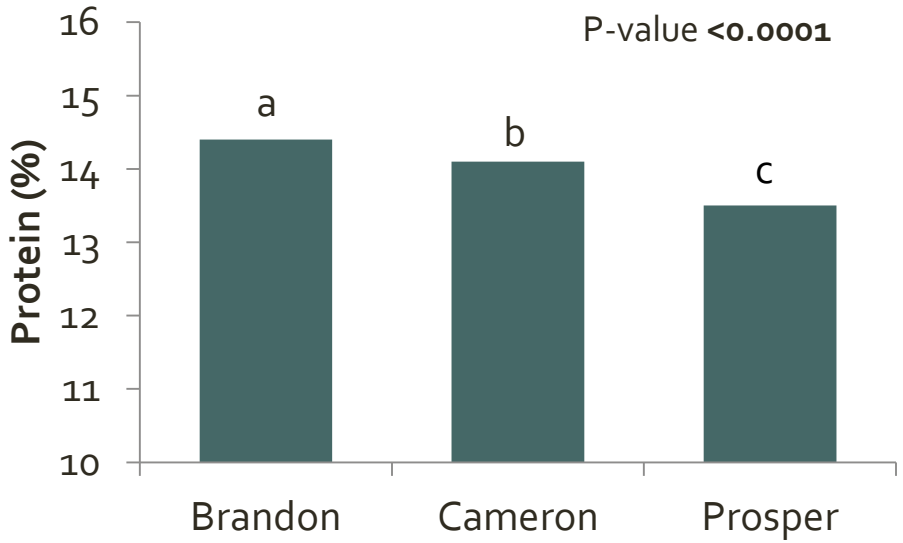
No significant interaction between plant density and N timing or PGR

Preliminary Results: Grain Yield + Protein

Experiment 1

Variety



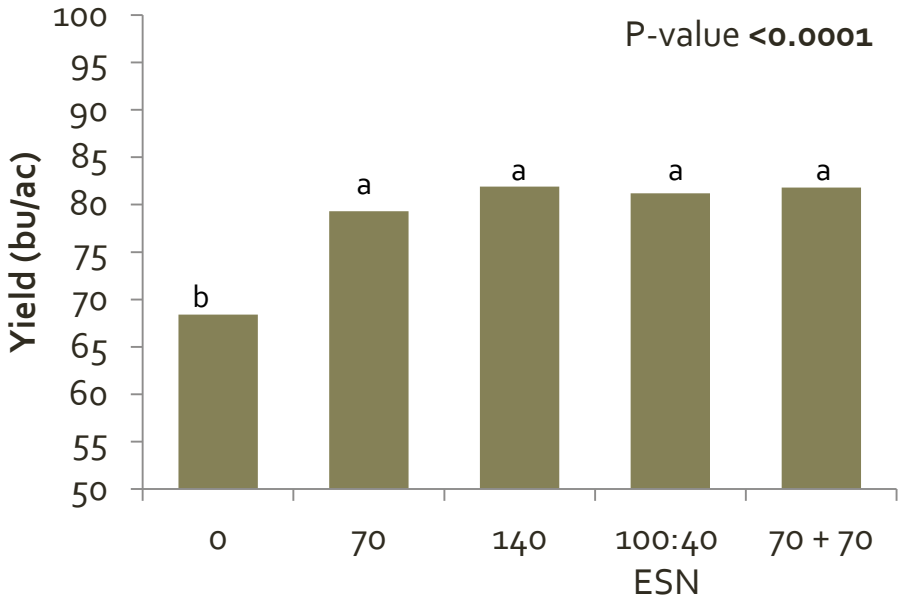


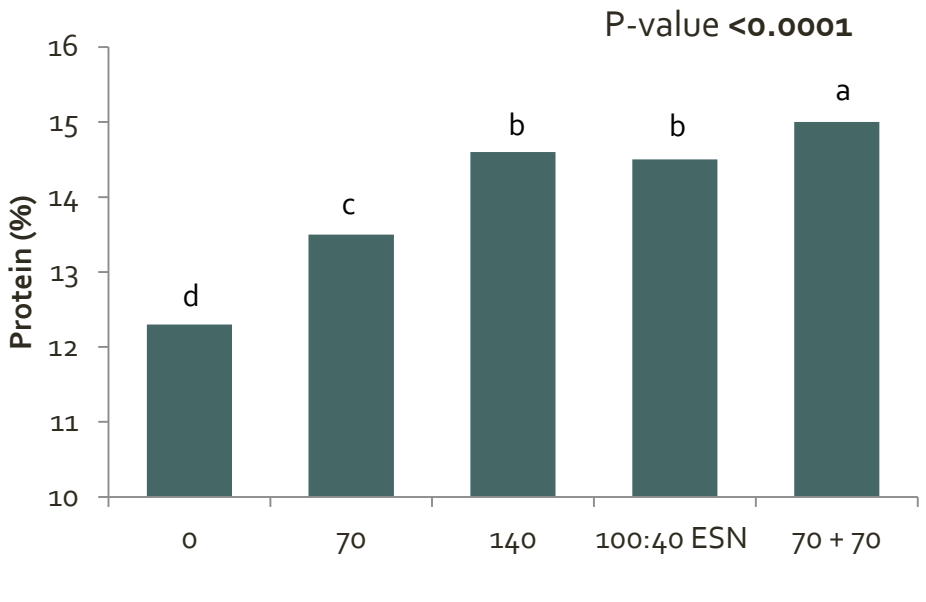
No significant Interactions between Variety, N Management and PGR

Preliminary Results: Grain Yield + Protein

Experiment 1

Nitrogen Management



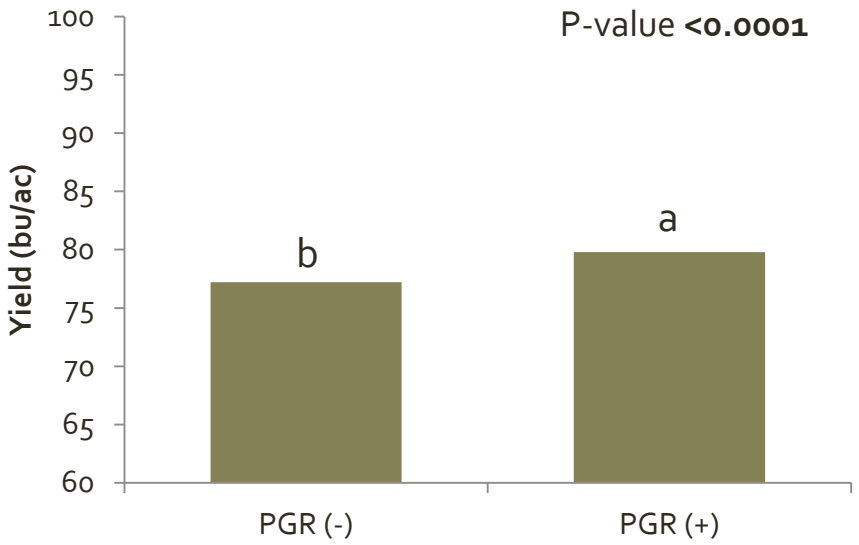


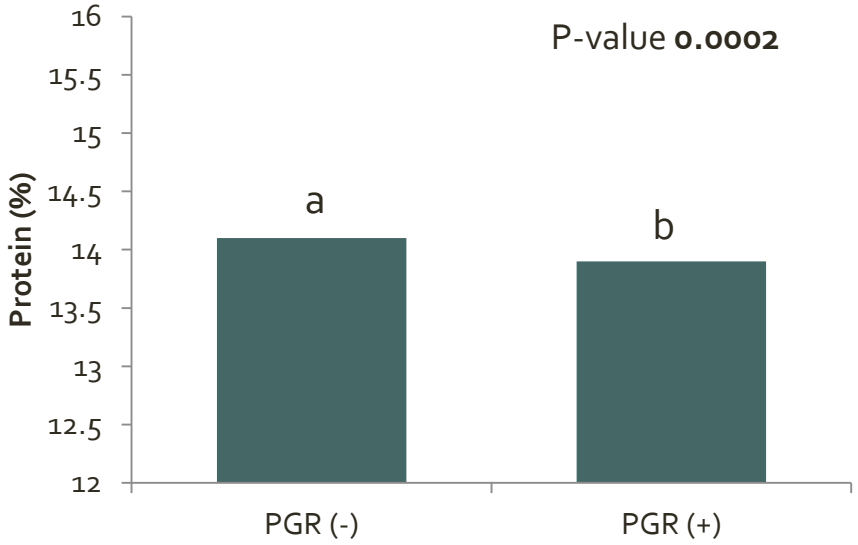
No significant Interactions between Variety, N Management and PGR

Preliminary Results: Grain Yield + Protein

Experiment 1

PGR: Manipulator



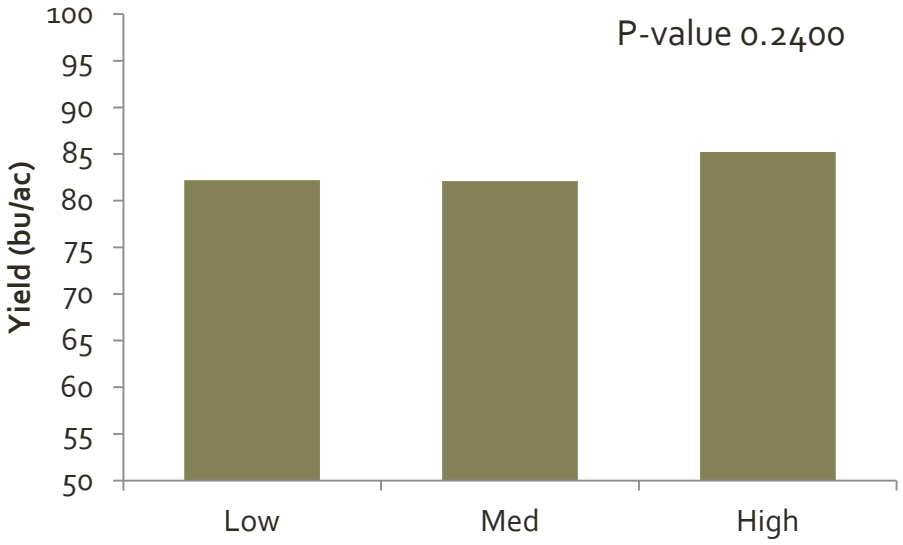


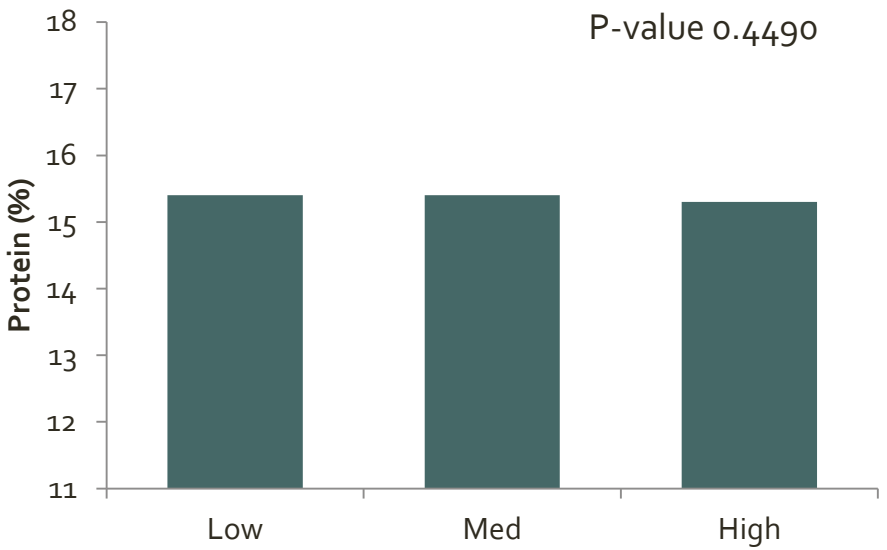
No significant Interactions between Variety, N Management and PGR

Preliminary Results: Grain Yield + Protein

Experiment 2

Plant Density



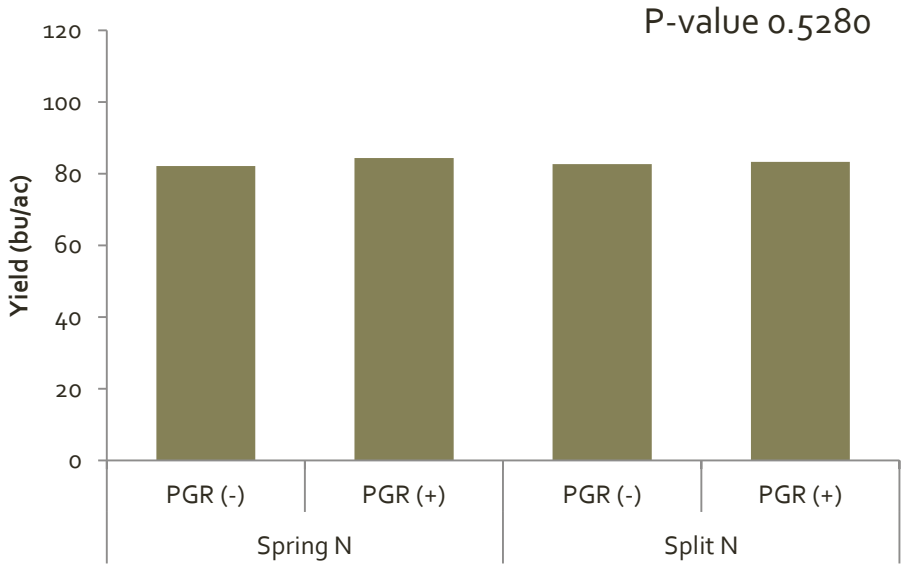


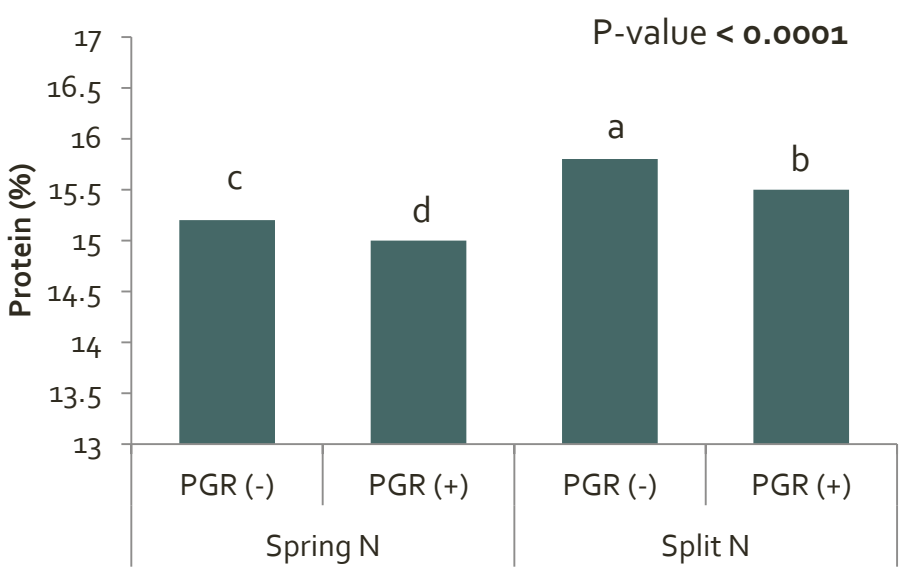
No significant interaction between plant density and N timing or PGR

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
- U of M Ian Morrison Research Station: Alvin Iverson
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Amy Mangin
Dept. Plant Science
University of Manitoba
Ummangia@MyUmanitoba.ca
(204) 384-1196

Questions?