

Optimizing Oat Yield, Quality and Standability in Central Alberta



**Albert Oat Growers Commission
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The Oat Market

There are three main markets for oats:

1. Pony oats market
2. Milling oats market (human consumption)
3. Feed oats market



Oat production in Alberta



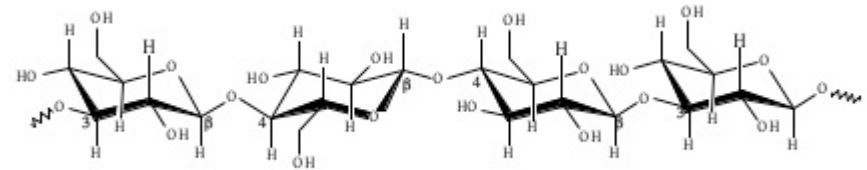
- 5 year average Alberta oat yield is 79 bu/ac
 - The crop's estimated yield potential is above 200 bu/ac in cool wet conditions.
- Alberta oats are currently sold primarily into the feed and pony markets.
 - excluded from milling markets due to grain quality
- Alberta's climate is suitable for milling oat production; however current agronomic practices and varietal choices have not produced quality required for millers.

Estimate of Production of Principal Field Crops, Alberta

Table 1: Alberta Crop Area and Yield

Crops	2013 seeded	2013 harvested	2013 yield	2014 seeded	2014 harvested	2014 yield	10 yr avg yield	yield % change
	(000' acres)	(000' acres)	bu /ac	(000' acres)	(000' acres)	bu /ac	bu /ac	2014 vs 2013
Oat	580	410	95.1	670	450	76.9	76	-19.1%
Winter wheat	155	140	68.6	165	160	56.3	52.8	-17.9%
Spring wheat	6415	6365	58.7	6045	5930	48	46.9	-18.2%
Barley	3650	3330	76.5	3300	2870	65.1	64.2	-14.9%
Dry peas	1000	995	48.8	1300	1260	41.7	39.4	-14.5%
Canola	6080	6050	43.7	6275	6200	35.3	36.1	-19.2%
Lentils	83	78	36.6	120	120	29.1	24.8	-26.3%
Fall rye	30	30	47.7	30	30	31.4	42.5	-29.2%

β -glucans in oat



<http://ceapro.com/wp-content/uploads/2012/09/Beta-glucan-corrected-Structure.jpg>

- β -glucans are soluble fibers found in the cell wall oat.
- Oat and oat by products have been helpful in the treatment of diabetes and cardiovascular disorders (Butt et al., 2008)



- Currently no premium for high β -glucan.
- *Variety choice is main determinant of β -glucan content*

Oat varieties

Variety	β glucan (% dry weight)	Yield (bu/ac)	Height (cm)	Test weight (lb/bu)	Resistance to lodging†	Maturity rating‡
AC Morgan	4.0 – 5.0	111+	92	40	VG	M
OT 3066	4.0 – 5.0	108	108	42	F	E
Stride	5.5 – 6.0	104	104	42	G	M
Sea Biscuit	5.5 – 6.0	111+	101	39	G	M
CDC Morrison	6.0 - 6.5	100	93	41	VG	E

† Lodging Resistance/Tolerance Ratings: VG = Very Good; G = Good; F = Fair; P = Poor; VP = Very Poor.

‡ Maturities: VE = Very Early; E = Early; M = Medium; L = Late and VL = Very Late.

Study Objectives

- Increase the milling quality of Alberta grown oats and the profitability of growers
- Increase awareness of varieties choices and quality parameters
- Share oat agronomic tips with growers



Agronomic Treatments



Nitrogen Fertilizer

- Increasing nitrogen fertilizer:
 - increases yield
 - β -glucan content(Fan et.al, 2009)
- But causes:
 - Lodging
 - Decreases test weight



Plant Growth Regulators (PGRs)

Plant growth regulators (PGRs) are foliar applied chemicals that alter plant metabolism, growth and development by regulating plant hormones (Rajala, 2002). **The primary use of PGRs is as a harvest management aid.**

In western Canada, *Manipulator* was recently registered (for wheat) and a 2nd PGR is in the process of registration (for wheat).

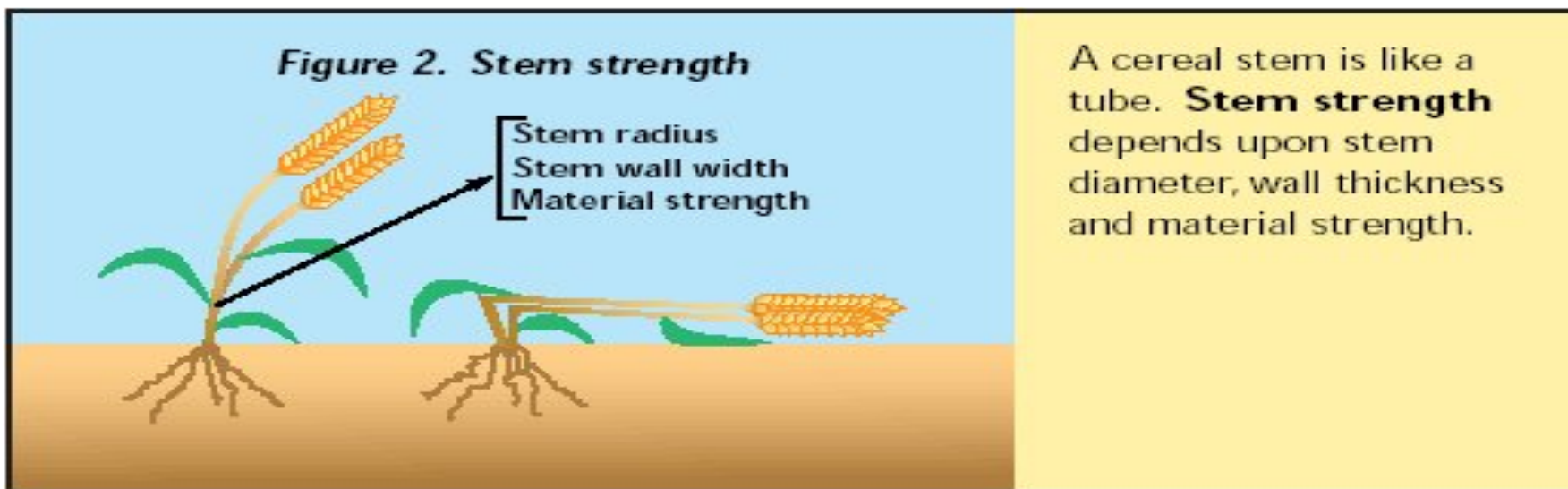
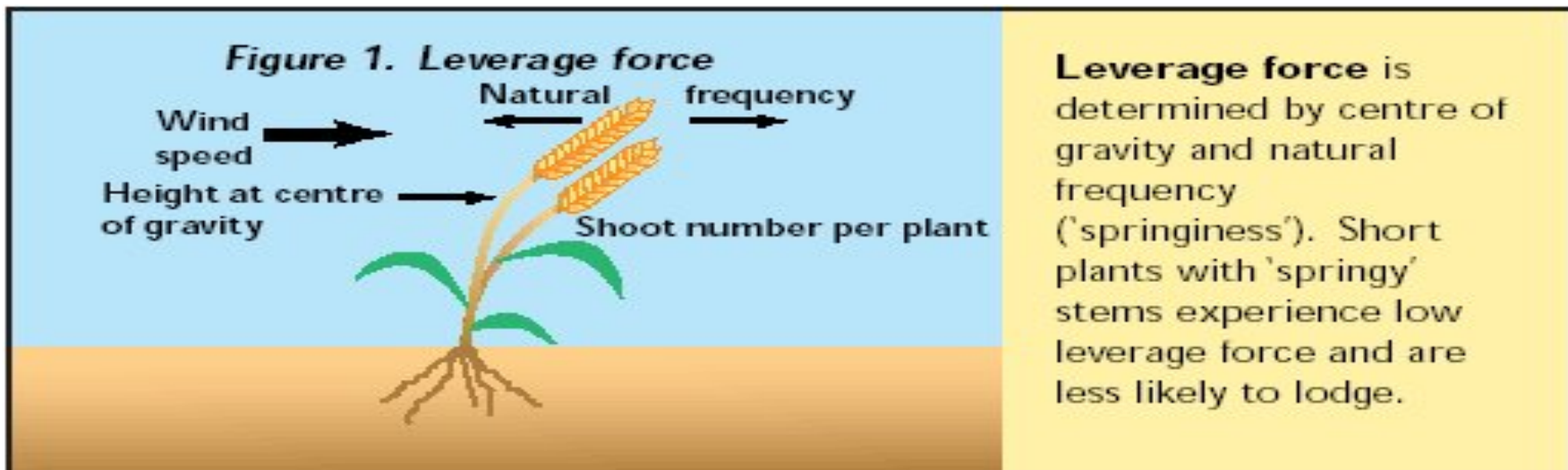
These PGRs produce shorter (2-15cm), thicker & stronger stems which reduce lodging in intensive management systems (Syngenta, 2013; Taminco, 2013).



Lodging in oat

Two forms of lodging can be seen in oat

1. Breakage at the bottom or close to the bottom as we are dealing with in this study.
2. Breakage farther up the stem. This can actually be beneficial because the panicles are then out.



Project set-up

Research sites:

- St. Albert, AB
- Barrhead, AB
- Indian head, SK

Years of research:

- 2014
- 2015
- 2016

9 site years of data



Soil test results for field sites

Barrhead

Sample Depth	Organic matter	Nitrogen ppm	Phosphorus ppm	Potassium ppm	pH	Sulphur
0-6 in	9.6	17	20	124	6.4	149
6-12 in	6.6	7	11	50	6.9	26

St. Albert

Sample Depth	Organic Matter	Nitrogen ppm	Phosphorus ppm	Potassium ppm	pH	Sulphur
0-6 in	12.6	80	39	180	5.9	13
6-12 in	n/a	67	n/a	n/a	n/a	13



Fertilizer rates, seeding and harvest dates

	Barrhead	St. Albert
Phosphorous	11 lbs P ₂ O ₅ /acre	23 lbs P ₂ O ₅ /acre
Potassium	8 lbs K ₂ O/acre	0 lbs K ₂ O/acre
Seeding date	May 13, 2014	May 14, 2014
Harvest date	September 5, 2014	September 5, 2014

Precipitation - 2014

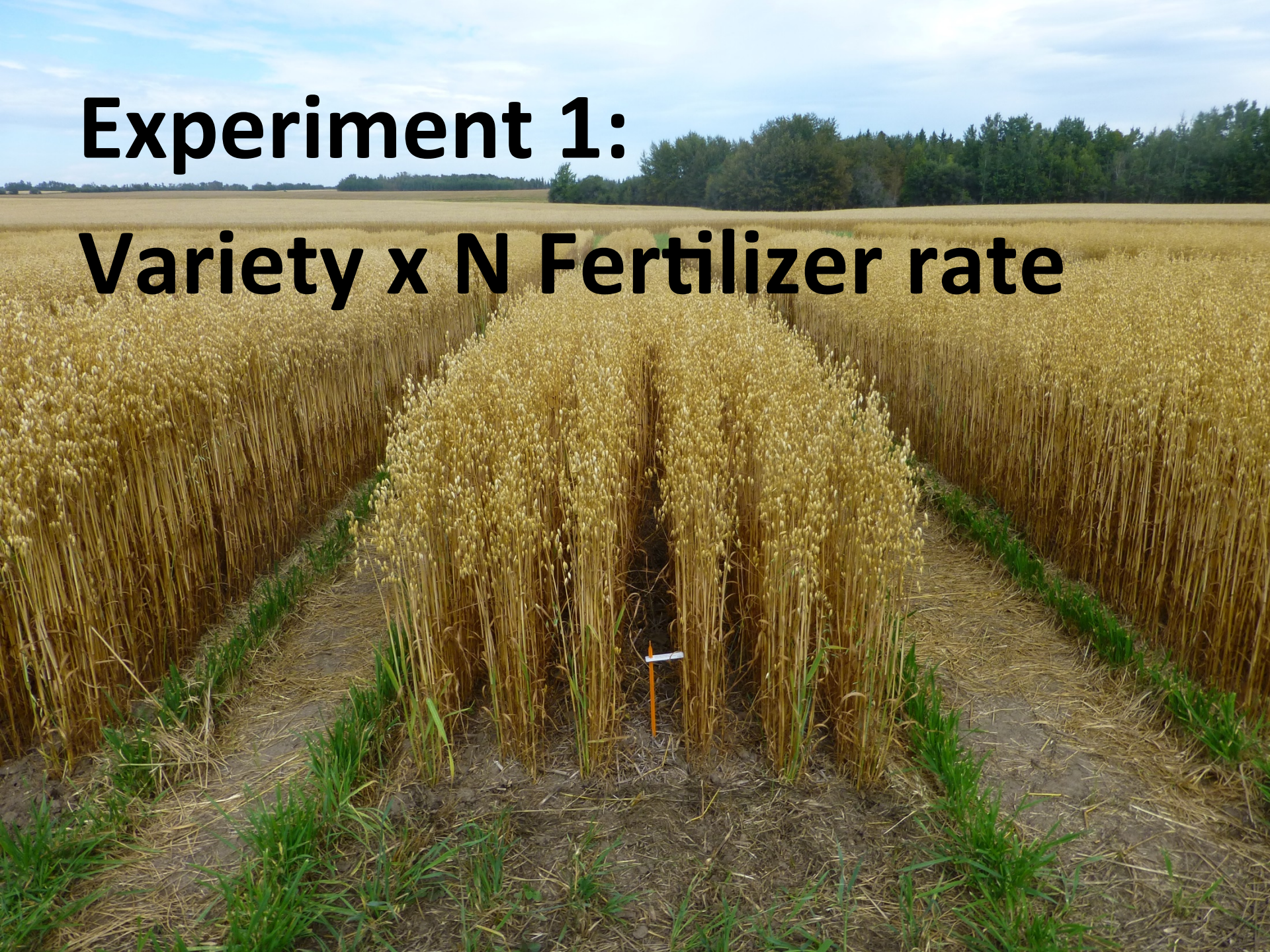
	Barrhead		St Albert		Indian Head	
	mm	inches	mm	inches	mm	inches
May	44	1.7	56	2.2	43	1.4
June	61	2.4	61	2.4	58	7.8
July	80	3.1	113	4.4	55	0.3
August	28	1.1	21	0.8	28	5.5
Sept	5	0.2	18	0.7	17	0.6
Total	218	8.6"	266	10.5"	201	8.0"
LTA	282	11.1"	269	10.6"	246	9.6"
Soil Moisture @ Seeding (0-6")	34%		Good		Good	
Seeding Date†	May 13, 2014		May 14, 2014		May 14, 2014	
Harvest Date	Sept 5, 2014		Sept 5, 2014		Sept 9, 2014	
Yield						
Variety	193 bu/ac		221 bu/ac		97 bu/ac	
PGR trial	169 bu/ac		150 bu/ac			

Growing Degree Days - 2014

	Barrhead	St Albert	Indian Head
May	141	187	251
June	272	294	106
July	411	369	40.8
August	363	337	54.2
September	31	33	176
Total	1218	1220	1000
Long Term Average	1090	1176	1000
Seeding Date	May 13, 2014	May 14, 2014	May 14, 2014
Harvest Date	Sept 5, 2014	Sept 5, 2014	Sept 9, 2014

Experiment 1:

Variety x N Fertilizer rate



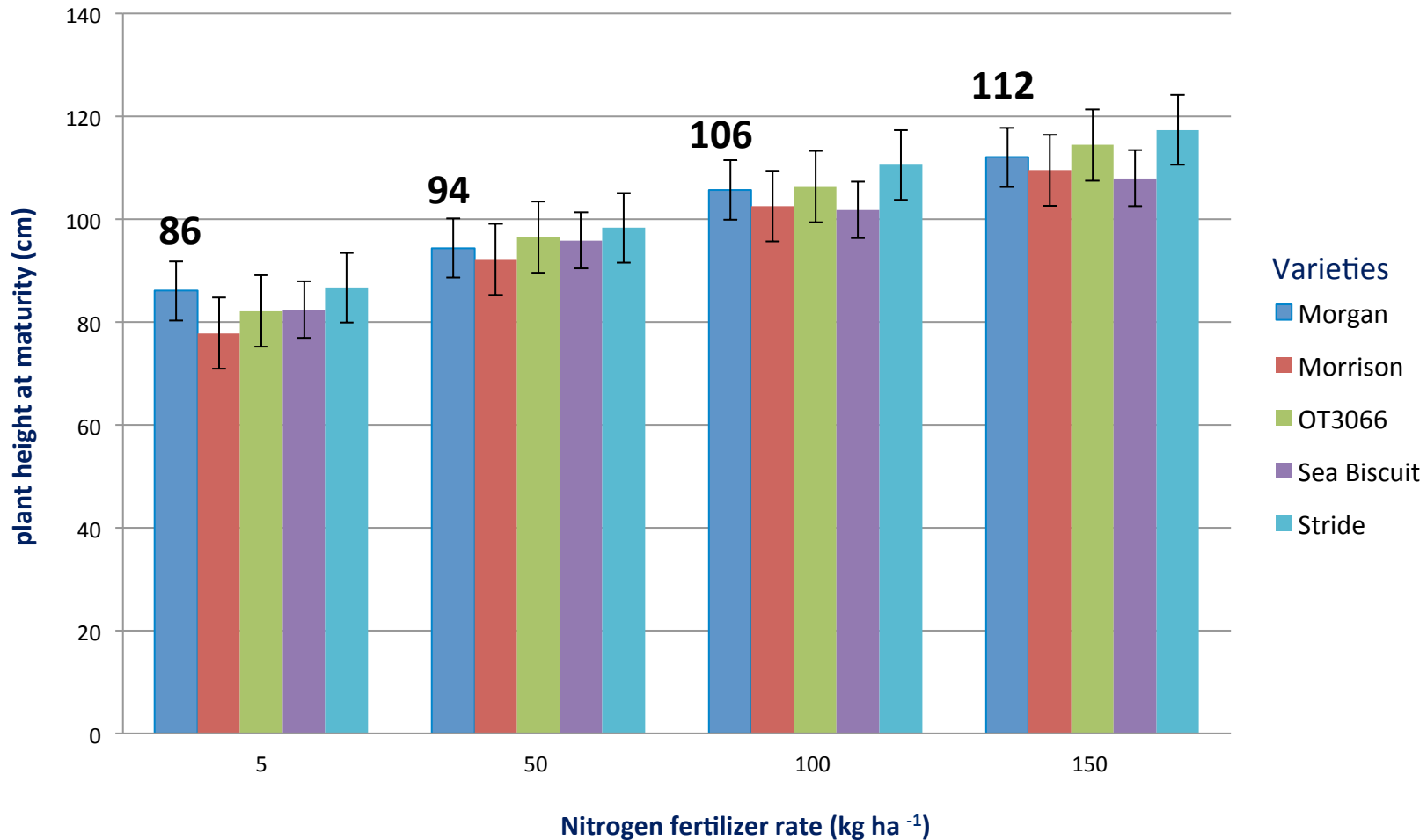
Experiment 1: Objectives



Determine the influence of oat variety and nitrogen fertilizer rate on yield, lodging and beta glucan content.

- **2 factor Randomized Complete Block Design**
- **4 replicates**
 - **Varieties: AC Morgan, OT 3066, Sea Biscuit, Stride, CDC Morrison.**
 - **N fertilizer rates: 5, 50, 100, 150 kg ha⁻¹**

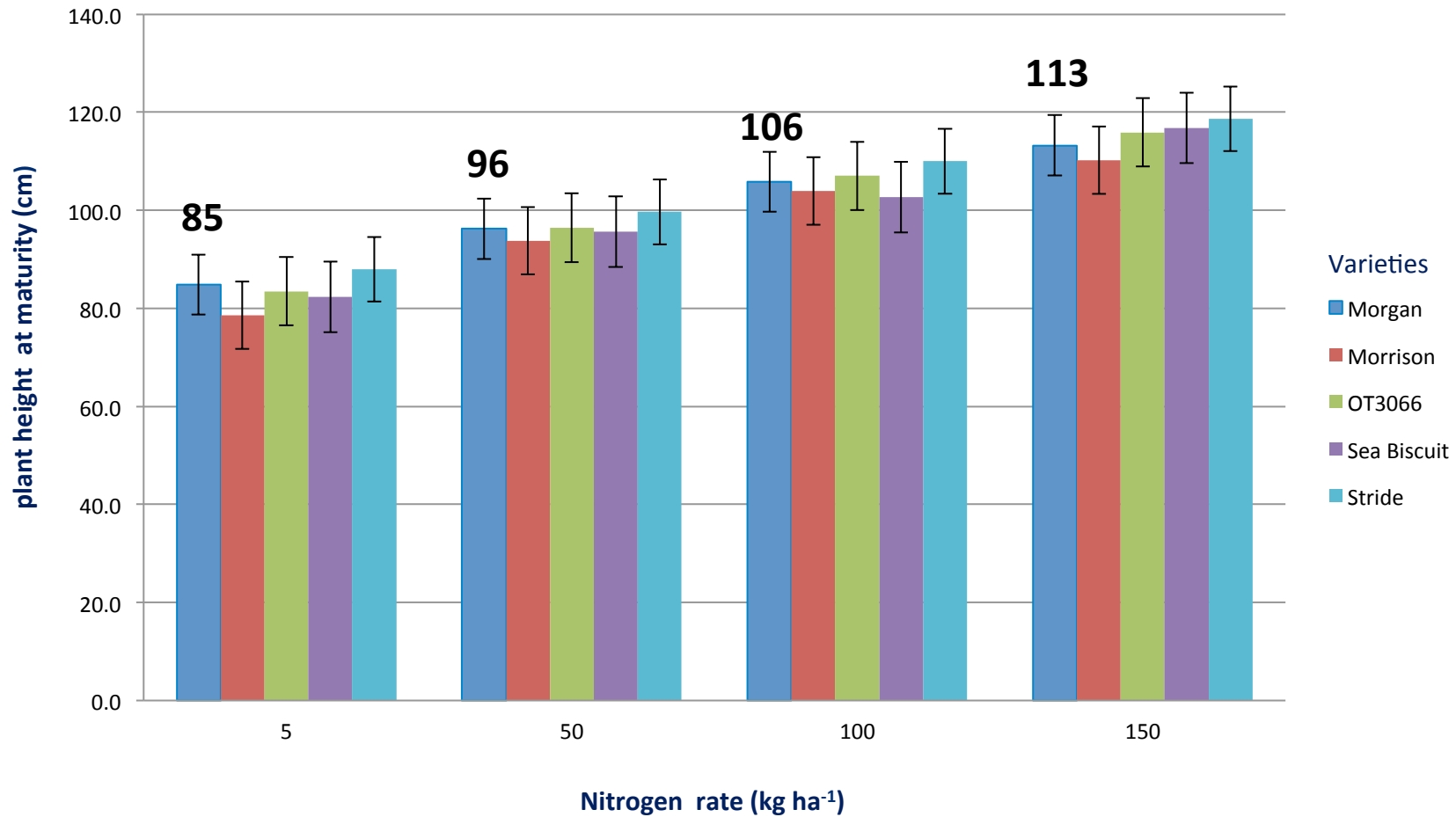
Experiment 1: St. Albert- Height response



Height increased as N fertilizer rate increased

Preliminary Results - Trends must be supported with statistics and additional years of data

Experiment 1: Barrhead- Height response



Height increased as N fertilizer rate increased

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Experiment 1: Lodging rating @ Maturity

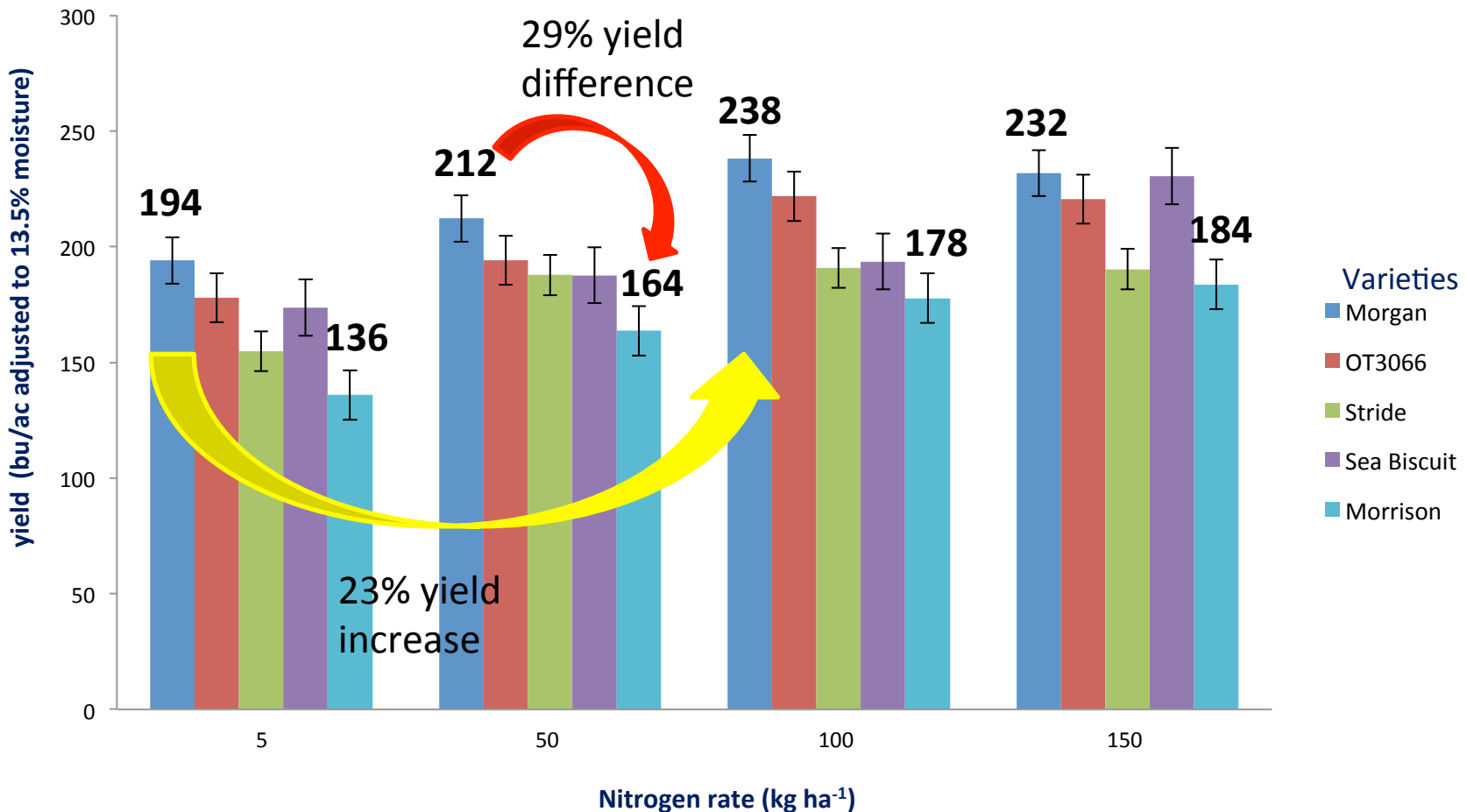
Nitrogen Rate (kg ha ⁻¹)	Morgan	OT 3066	Stride	Sea Biscuit	CDC Morrison
	Barrhead				
5	1	1	1	1	1
50	1	1	1	1	1
100	1	1	1	1	1
150	1	1.25	1.5	1	1
	St Albert				
5	1	1	1	1	1
50	1	1.3	1.3	1.3	1
100	1.2	1.2	1.7	1.7	1.2
150	1.5	1.2	2.7	2.2	1.5

Lodging rated on a 1-5 scale: 1 is upright, 2 is leaning 5-30°, 3 is leaning 30-60°, 4 is leaning at angle of +60° and 5 is plant is flat on the ground.

- More lodging at St Albert vs Barrhead
- Higher N rates increased lodging
- Stride lodged more than varieties

Preliminary Results - Trends must be supported with additional years of data

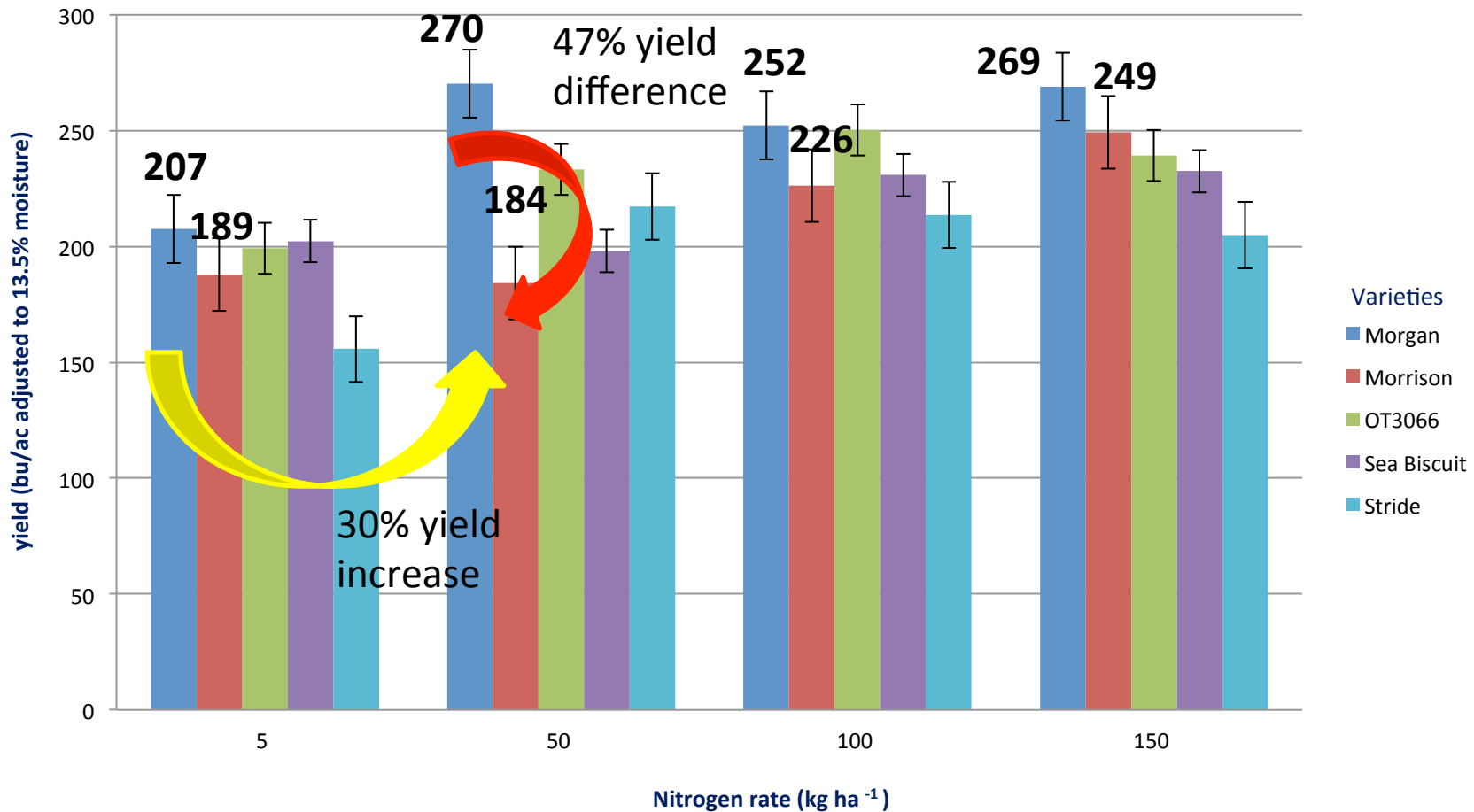
Experiment 1: Barrhead- Yield response



**Morgan was the best yielding variety;
CDC Morrison the lowest**

Preliminary Results - Trends must be supported with additional years of data

Experiment 1: St. Albert- Yield response



Morgan was the best yielding variety; Stride the lowest

Preliminary Results - Trends must be supported with additional years of data

Steps involved in β glucan analysis



De-hulling oat seed



Steaming to deactivate oat enzyme



Drying



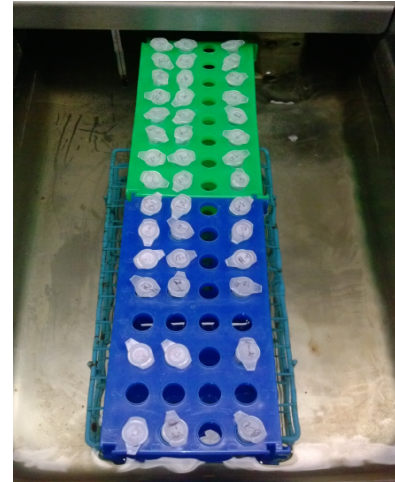
Milled oat



Addition of lichenase



Centrifugation



Heat treatment



photometer reading

Table 1. β glucan (%) of the five varieties of oat grown at St. Albert and Barrhead in 2014

Site	Barrhead	St. Albert
β glucan %		
Morrison	6.11	5.96
Morgan	3.31	3.55
OT 3066	4.22	4.81
Sea Biscuit	4.58	4.20
Stride	4.46	2.60

Trends

- As N fertilizer rates increased:
 - plant height increased
 - Some varieties (especially Stride) showed more lodging
- Varieties differed in their response to N fertilizer:
 - CDC Morrison tended to have the highest N requirements to maximize yield
 - Morgan yields were maximized with 50 or 100 kg N/ha (depending on location)



Experiment 2:

PGR x N Fertilizer rate



Experiment 2: Objectives

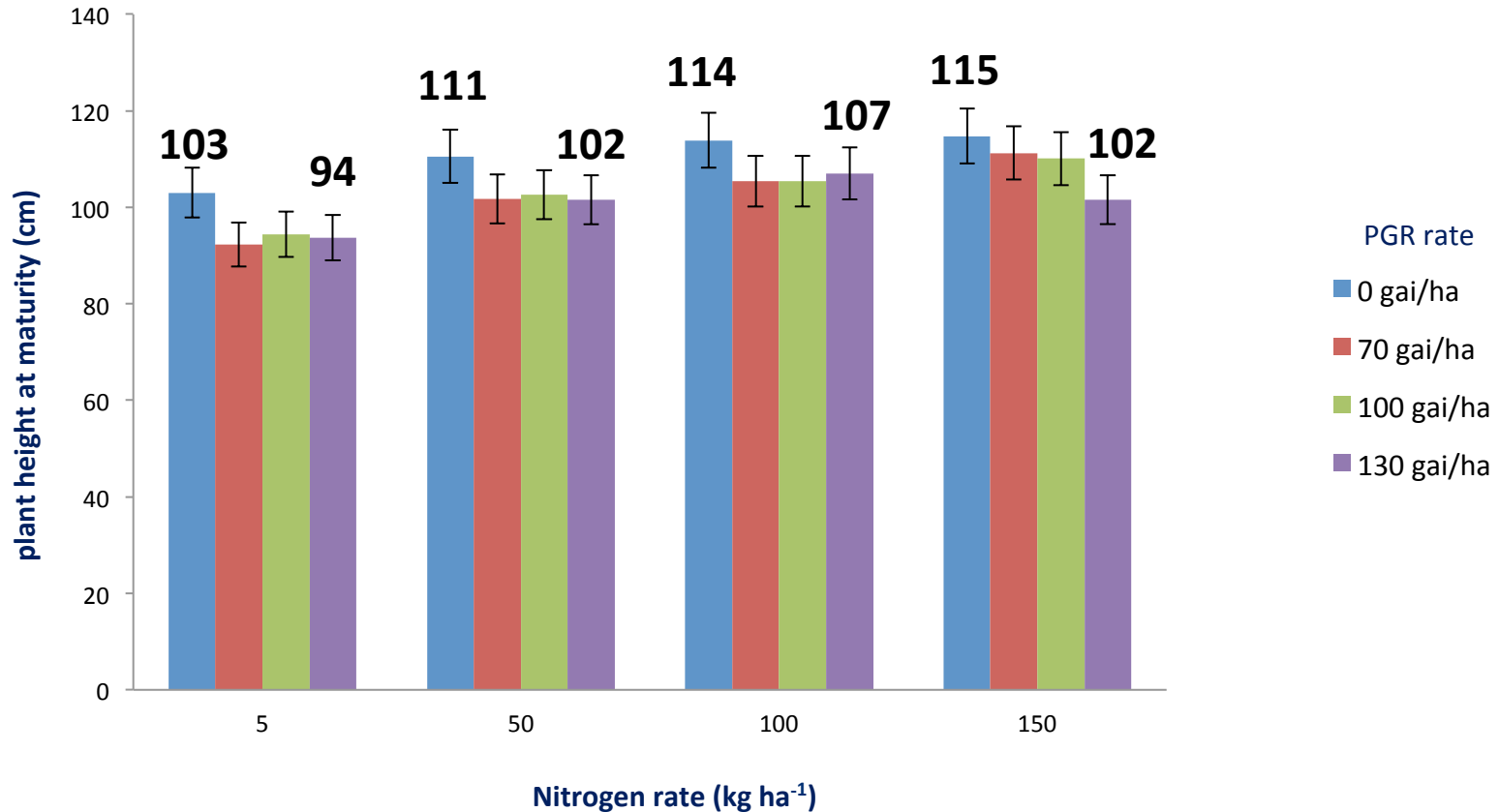
Determine the influence of plant growth regulator application on stride oat to improve harvestability

- 2 factor Randomized Complete Block Design
- 4 replicates
 - PGR rates: **0, 70, 100, 130 g ai ha⁻¹**
 - N fertilizer rates: **5, 50, 100, 150 kg ha⁻¹**
 - Oat variety: Stride (Tall variety which showed lodging tendencies at high N rates)



Plot showing height differences Stride oat 21 days after plant growth regulator application

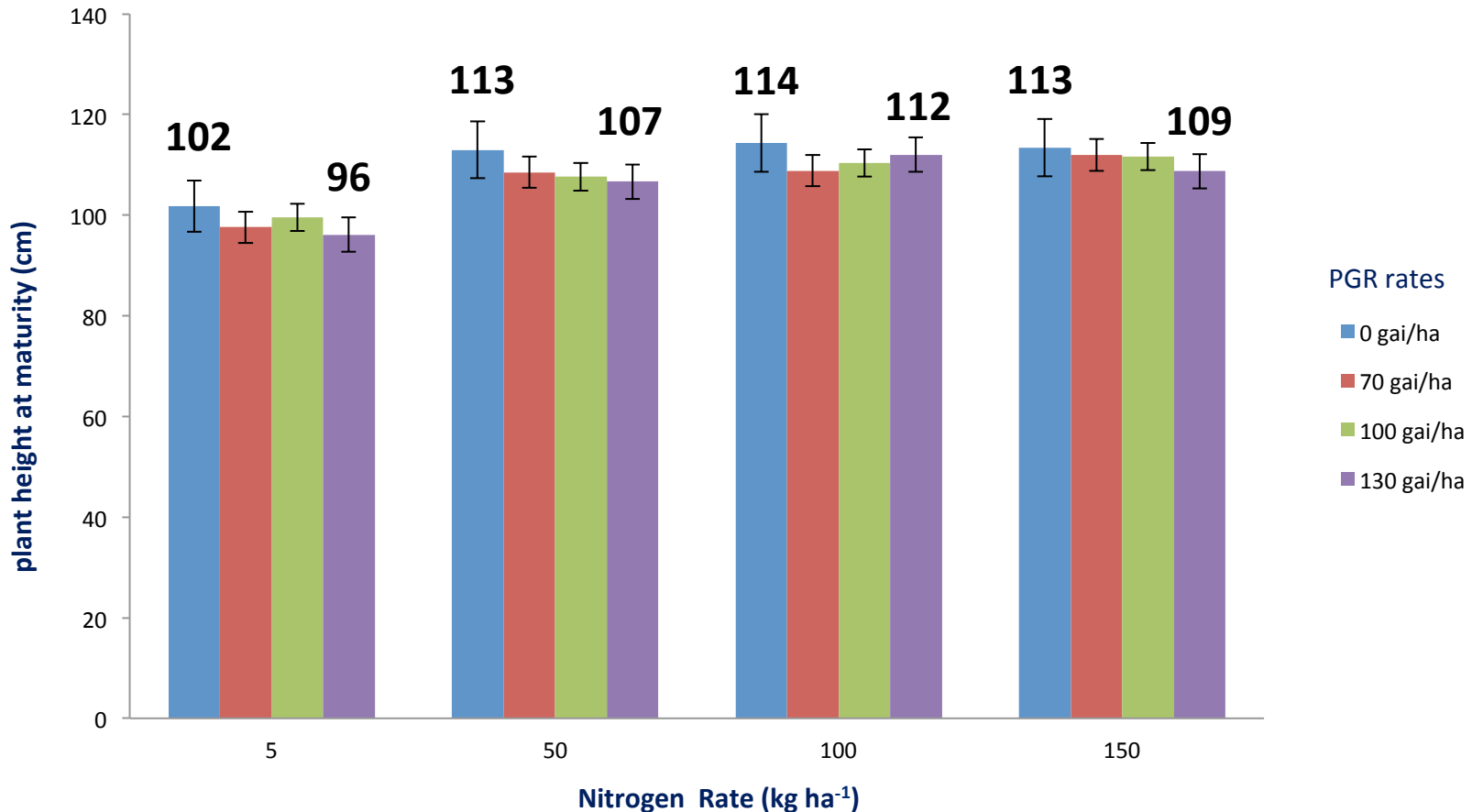
Experiment 2: St. Albert - Height response @ Maturity



Height increased as N fertilizer rate increased
The PGR reduced plant height by 7-13 cm

Preliminary Results - Trends must be supported with additional years of data

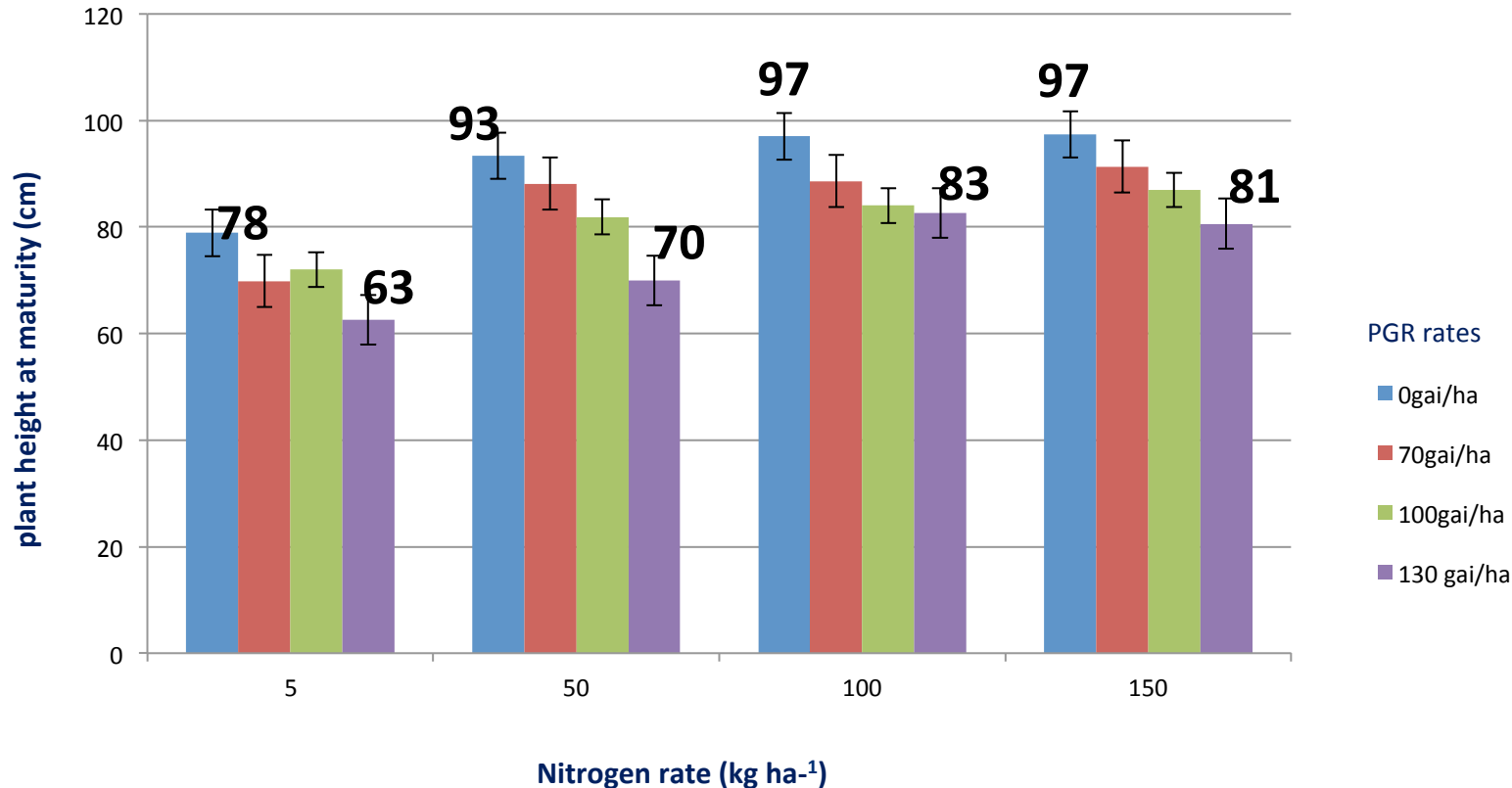
Experiment 2: Barrhead- Height response @ maturity



Height increased as N fertilizer rate increased from 5 to 50 kg N/ha
The PGR reduced plant height by 4-6 cm

Preliminary Results - Trends must be supported with additional years of data

Experiment 2: Indian Head- Height response @ maturity



Height increased as nitrogen fertilizer rate increased from 5 to 150kg
The PGR reduced plant height by 6-11cm

Preliminary Results - Trends must be supported with additional years of data

Experiment 2: Lodging rating @ Maturity

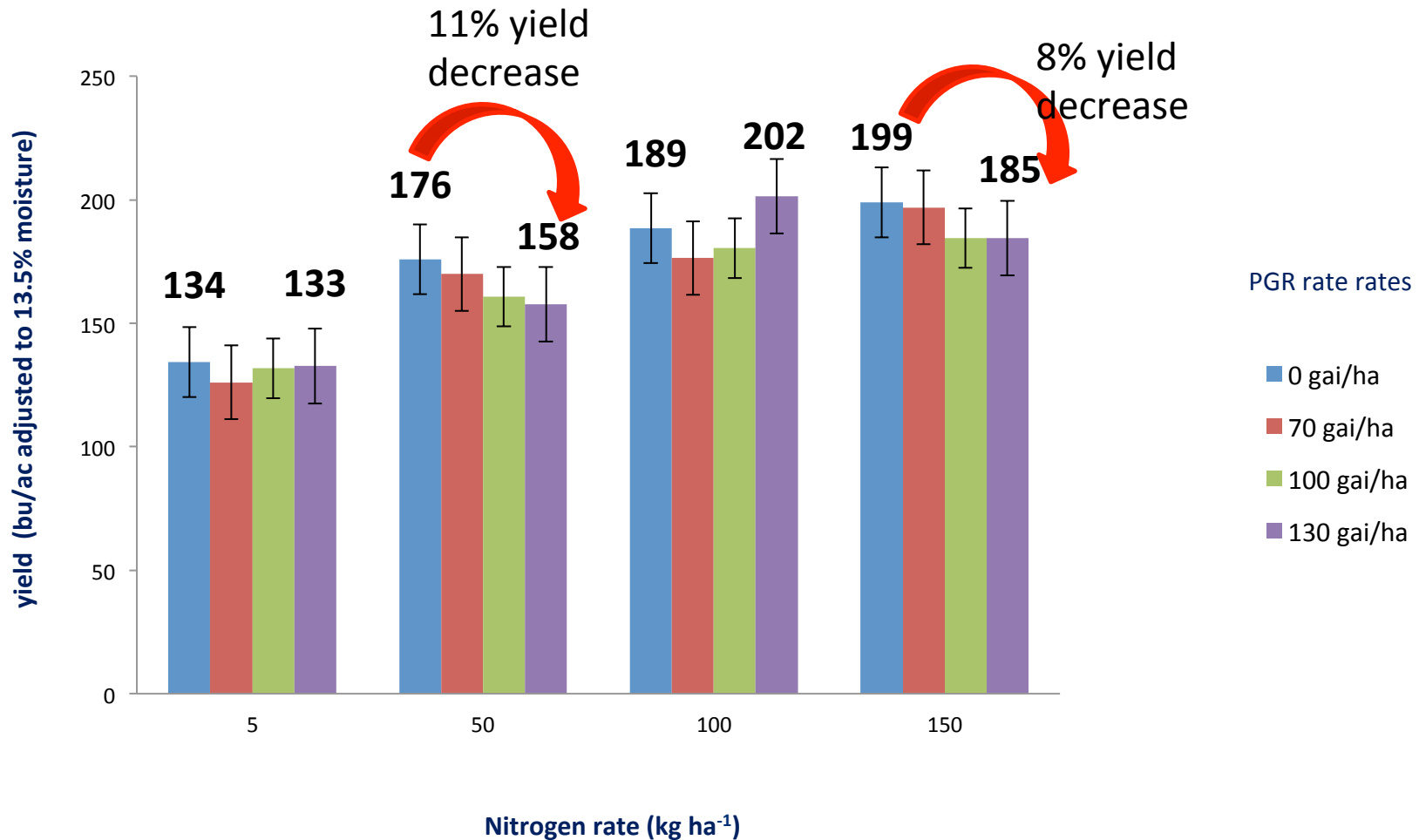
Nitrogen kg ha ⁻¹	0	70	100	130
	PGR gai ha ⁻¹			
	Barrhead			
5	1	1	1	1
50	1	1	1	1
100	1.3	1	1	1
150	1.5	1.5	2	1
	St Albert			
5	1	1	1	1
50	1	1	1	1
100	1	1	1	1
150	1	1	1	1
	Indian Head			
5	1	1	1	1
50	3.3	2.5	2.3	1.8
100	4.3	3.8	2.5	2.3
150	4.8	4.3	2.8	2.3

Lodging rated on a 1-5 scale: 1 is upright, 2 is leaning 5-30°, 3 is leaning 30-60°, 4 is leaning at angle of +60° and 5 is plant is flat on the ground.

- Minimal lodging at Barrhead and St. Albert
- Higher N rates slightly increased lodging
- Statistics need to be run to determine if the PGR reduced lodging

Preliminary Results - Trends must be supported with additional years of data

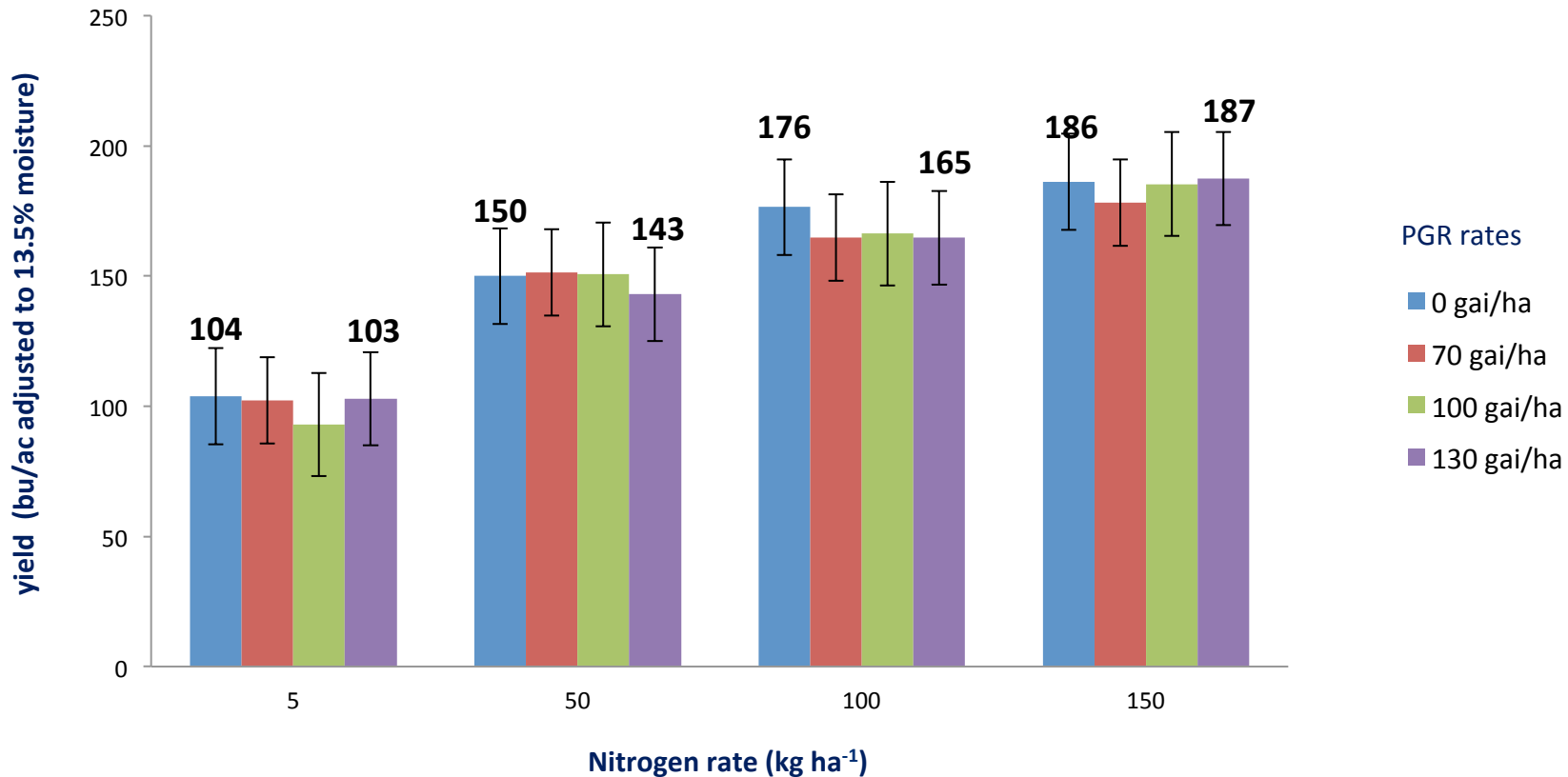
Experiment 2: Barrhead- Yield response



There were some yield decreases with PGR use, statistics suggest differences are not significant

Preliminary Results - Trends must be supported with additional years of data

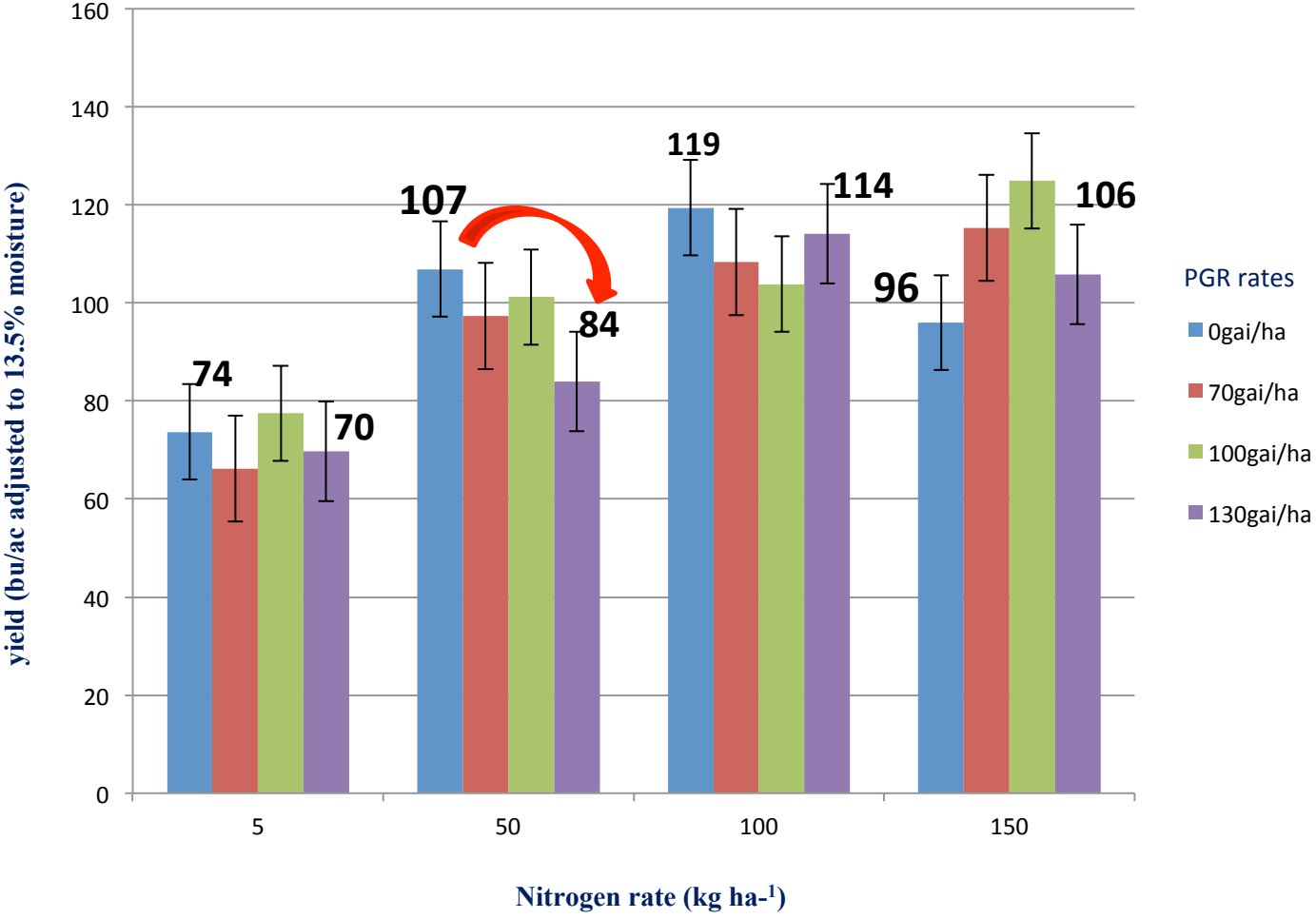
Experiment 2: St. Albert- Yield response



There were some yield decreases with PGR use, statistics suggest differences are not significant

Preliminary Results - Trends must be supported with additional years of data

Experiment 2: Indian Head -Yield response



There were some yield decreases with PGR use, statistics suggest differences are not significant

Preliminary Results - Trends must be supported with additional years of data

When to apply PGRs? GS 30-31 (June 16)



BBCH 30 Beginning of stem elongation: pseudostem and tillers erect, first internode begins to elongate, top of inflorescence at least 1cm above tillering node.

BBCH 31 First node at least 1cm above tillering node

Study Trends

- Additional site years of data are required to draw meaningful conclusions
- Unless significant price premiums are paid for high beta-glucan content, it makes no sense for growers to switch away from Morgan
- Quality analysis will help us determine agronomic practices to maximize quality, when markets are willing to pay
- PGR's need to further investigated

Obrigado!

 *Merci*

 **Gracias**

This work would not have been possible without technical support from:

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**Thank You
for Your
Time!**

Questions?