

Optimizing Oat Yield, Quality and Standability in Central Alberta



**Prairie Oat Growers Association
17th Annual Conference
Banff, Alberta -- December 4, 2014**

Sheri Strydhorst, PhD, Research Scientist, Alberta Agriculture & Rural Development

Joseph Aidoo, MSc Student, University of Alberta;

Linda Hall, Professor, University of Alberta

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

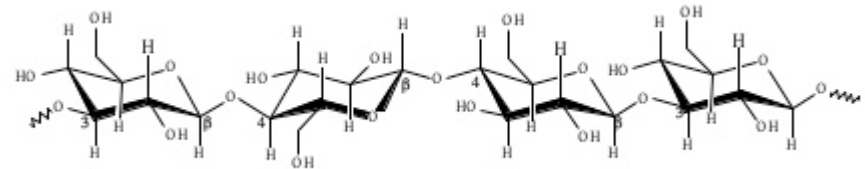


- 5 year average Alberta oat yield is 79 bu/ac
 - The crop's estimated yield potential is above 200 bu/ac in cool wet conditions.
- Alberta oats are currently sold into the feed and pony markets.
 - They are excluded from milling markets due to grain quality concerns
- Alberta's climate is suitable for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



	2013 AFSC Avg Yield (bu/ac)	2013 AFSC Insured Acres	% of Acres
AC Morgan	105	102507	58%
Derby	94	21198	12%
AC Mustang	84	19344	11%
CDC Baler	75	7804	4%
Waldern	68	6296	4%
Calibre	67	3480	2%
CDC S0-I	97	2809	2%
Triactor	109	2054	1%
Grizzly	82	1389	1%
Cascade	57	1132	1%
7600M	74	692	0%
Murphy	81	454	0%
Jordan	112	472	0%
AC Juniper	68	387	0%
Foothill	69	283	0%
Total	96	175327	100%

β -glucans in oat



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

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



- Generally no premium for high Beta-glucan, but Quaker will pay a premium for *CDC Morrison*

Oat varieties

Variety	β glucan (% dry weight)	Yield (bu/ac)	Height (cm)	Test weight (lb/bu)	Resistance to lodging [†]	Maturity rating [‡]
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
 - Thousand kernel weight
 - β -glucan content(Fan et.al,2009)
- But causes:
 - Lodging
 - Decreases test weight
- Low nitrogen fertilizer rates may reducing lodging and yield



Plant Growth Regulators (PGRs)

- 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).
- The primary use of PGRs is as a harvest management aid.





**Do all
species
respond
to
PGRs
the
same?**

Ontario study with CCC (Manipulator) found...

- Wheat was the most responsive
- Barley intermediate response
- Oats were the least responsive

Cultivar	Height (cm)		% reduction	
	Check	Treated		
Barley				
Bonanza	80.8	69.1	14.5	11.6%
Paragon	73.4	64.8	17.8	
Herta	75.4	73.7	2.4	
Oats				
Garry	102.4	93.7	8.5	8.8%
Scott	101.6	98.3	3.3	
Gemini	105.2	89.9	14.5	
Wheat				
Selkirk	80.8	59.7	26.2	29.8%
Opal	81.0	53.8	33.4	

11.6%

8.8%

29.8%



Site Descriptions



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_2O_5 /acre	23 lbs P_2O_5 /acre
Potassium	8 lbs K_2O /acre	0 lbs K_2O /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	193 bu/ac		221 bu/ac		n/a	

Growing Degree Days - 2014

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

Slide 18

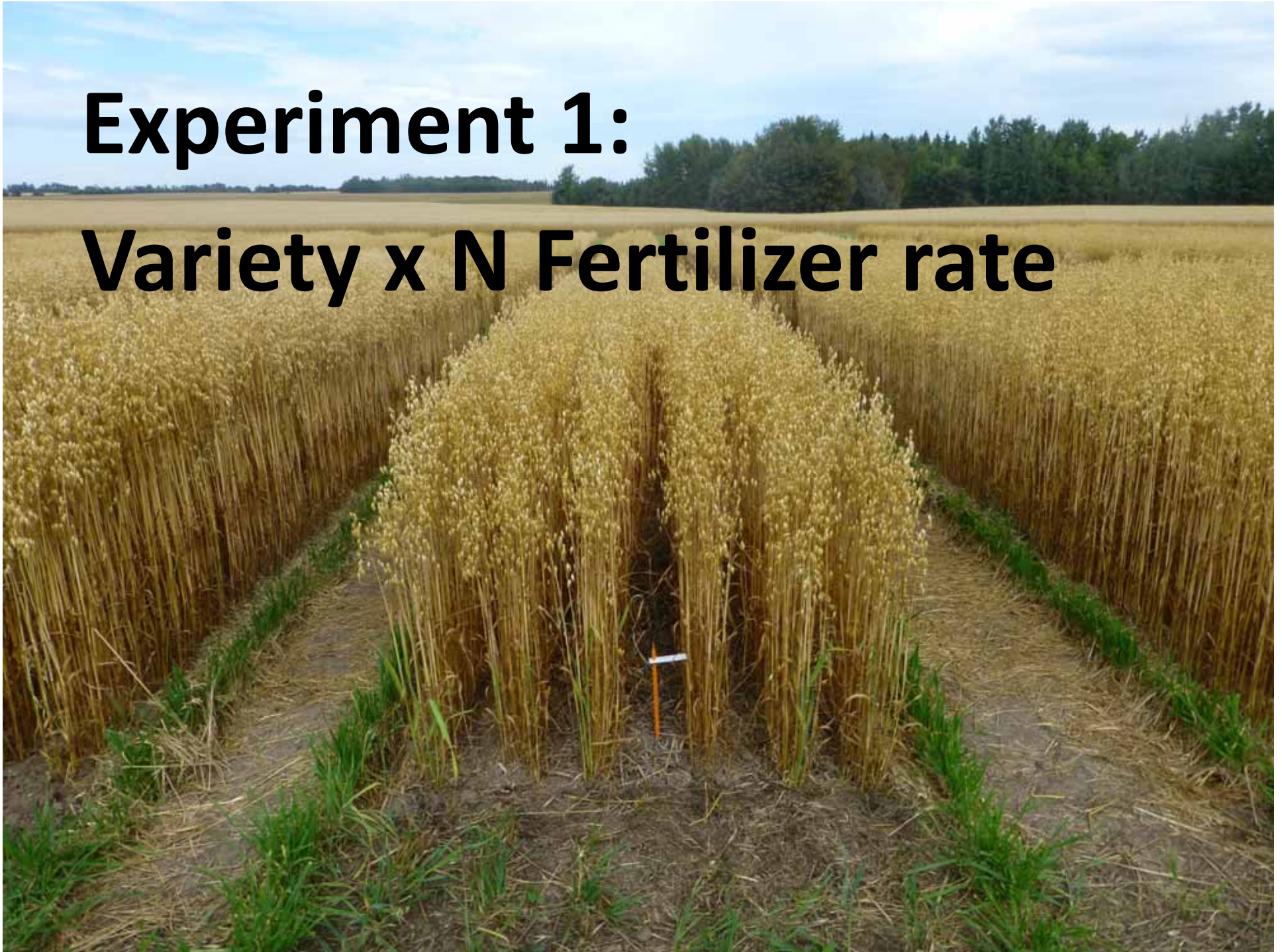
s2

Joseph, could you please complete this?

sher.strydhorst, 21/11/2014

Experiment 1:

Variety x N Fertilizer rate

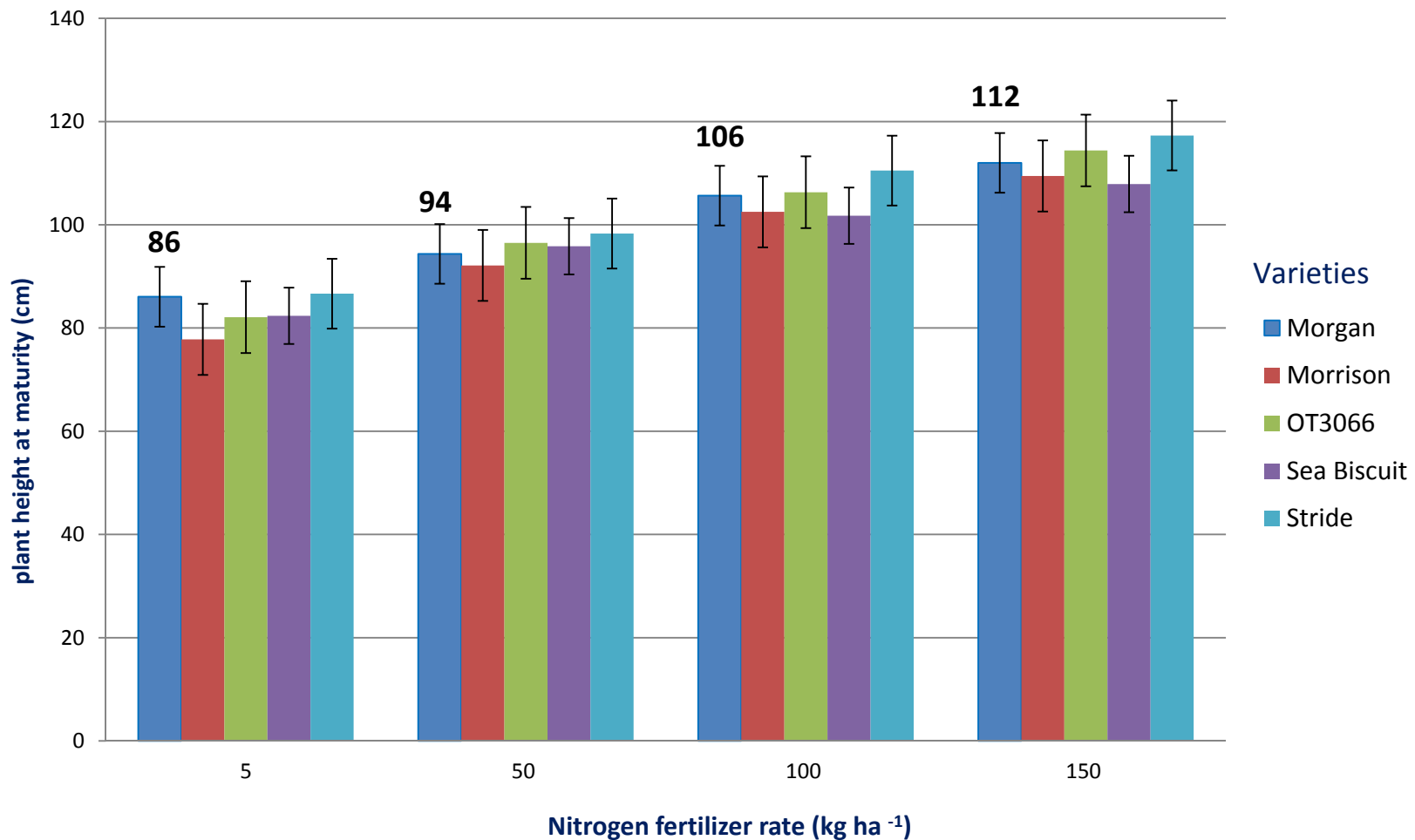


Experiment 1: Objectives

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

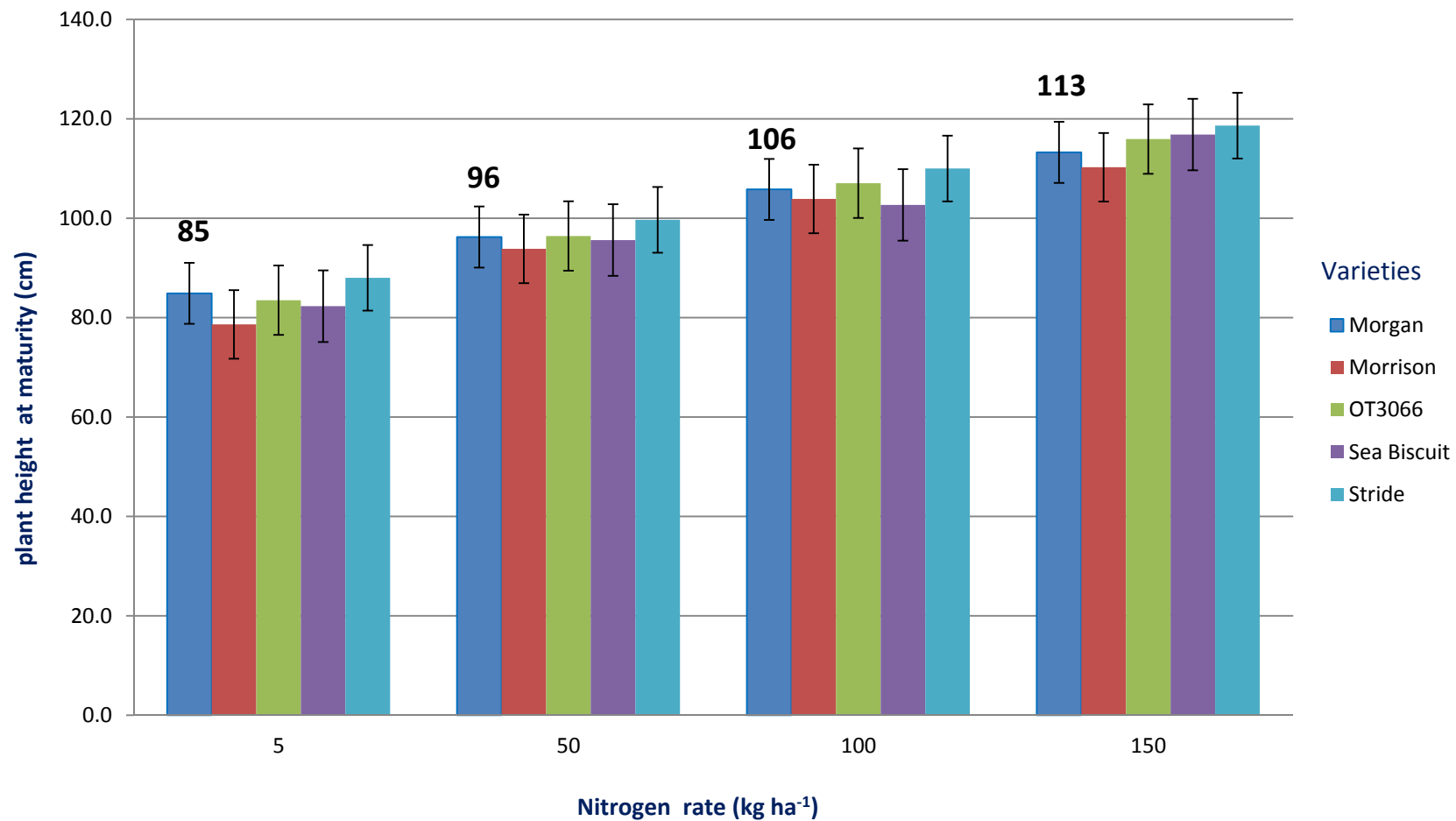
Experiment 1: St. Albert- Height response



All varieties got taller as N fertilizer rate increased

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

Experiment 1: Barrhead- Height response



All varieties got taller as N fertilizer rate increased

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

Experiment 1: Lodging rating @ Maturity

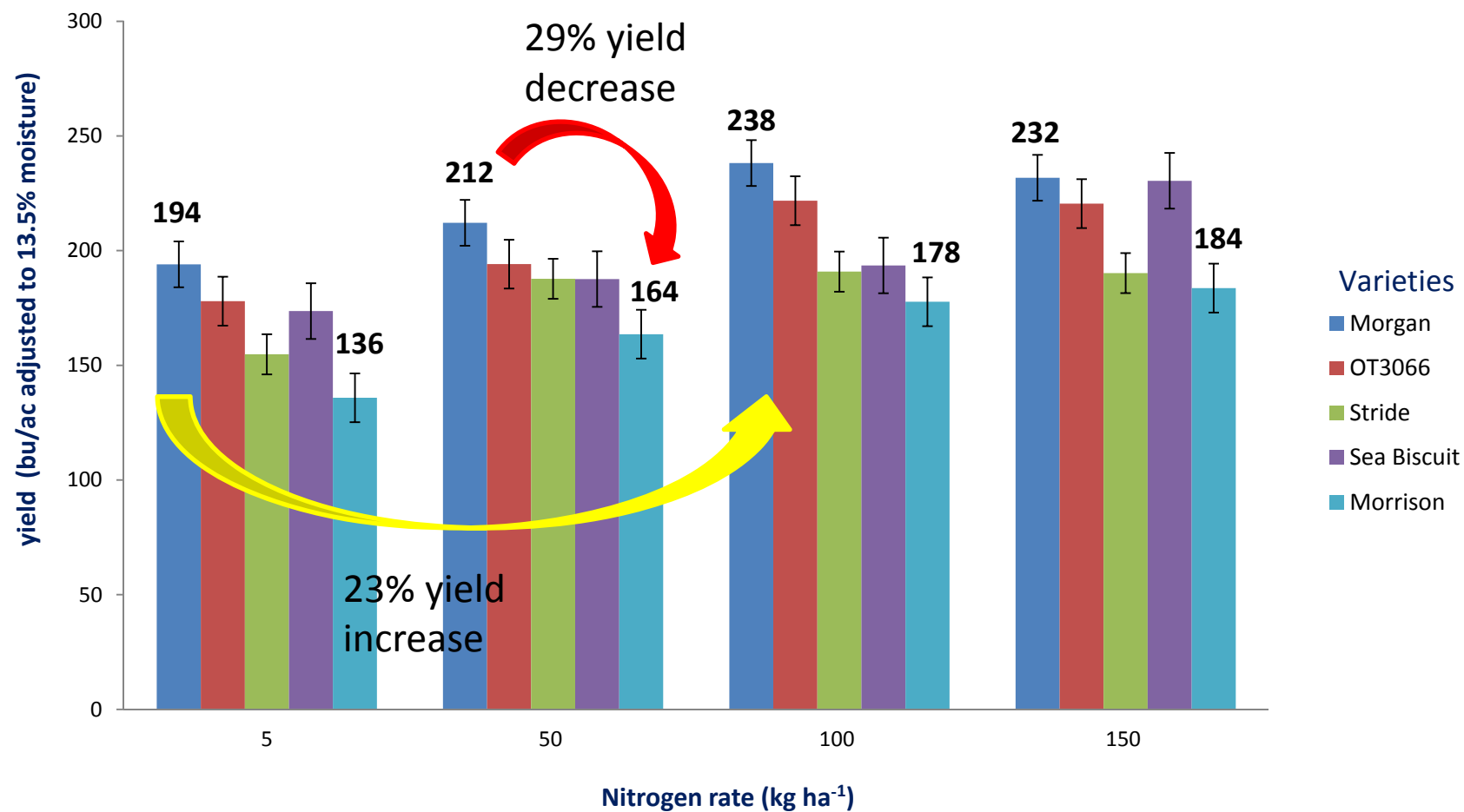
Nitrogen Rate (kg ha ⁻¹)	Morgan	OT 3066	Stride	Sea Biscuit	CDC Morrison
	Barrhead				
5	1	1	1	1	1
50	1	1	1	1	1
100	1	1	1	1	1
150	1	1.25	1.5	1	1
	St Albert				
5	1	1	1	1	1
50	1	1.3	1.3	1.3	1
100	1.2	1.2	1.7	1.7	1.2
150	1.5	1.2	2.7	2.2	1.5

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

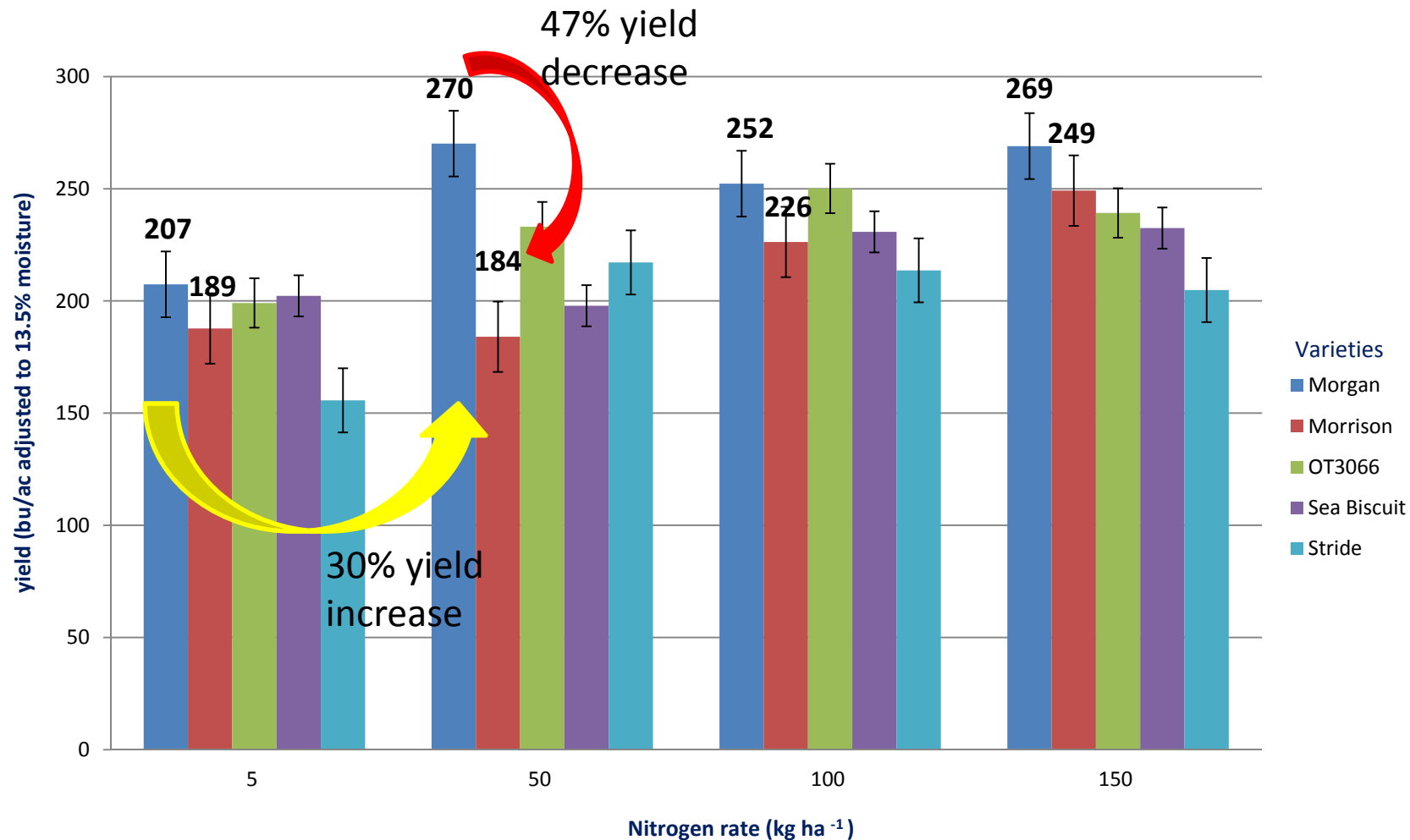
Slide 24

s19

Was the yeild data adjusted to a constant mositure content. If so which mositure content and please note it in the units on the y axis

sheri.strydhorst, 21/11/2014

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

Experiment 1: Barrhead - % Yield increase

Nitrogen Rate (kg ha ⁻¹)	Morgan	OT 3066	Stride	Sea Biscuit	Morrison	Average
	% Yield increase over 5 kg N/ha treatment					
50	9	8	13	21	21	14
100	23	24	22	23	31	25
150	20	23	26	22	35	25

- 100 kg N/ha seems to give the highest yields for Morgan, OT 3066 and Sea Biscuit
- 150 kg N/ha seems to give the highest yields for Stride and Morrison

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

Experiment 1: St Albert - % Yield increase

Nitrogen Rate (kg ha ⁻¹)	Morgan	OT 3066	Stride	Sea Biscuit	Morrison	Average
	% Yield increase over 5 kg N/ha treatment					
50	30	17	40	-2	-2	17
100	22	26	37	14	20	24
150	30	20	31	15	32	26

- 50 kg N/ha seems to produce the highest yields for Morgan and Stride
- 100 kg N/ha seems to give the highest yields for OT 3066 and Sea Biscuit
- 150 kg N/ha seems to give the highest yields for Morrison

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

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

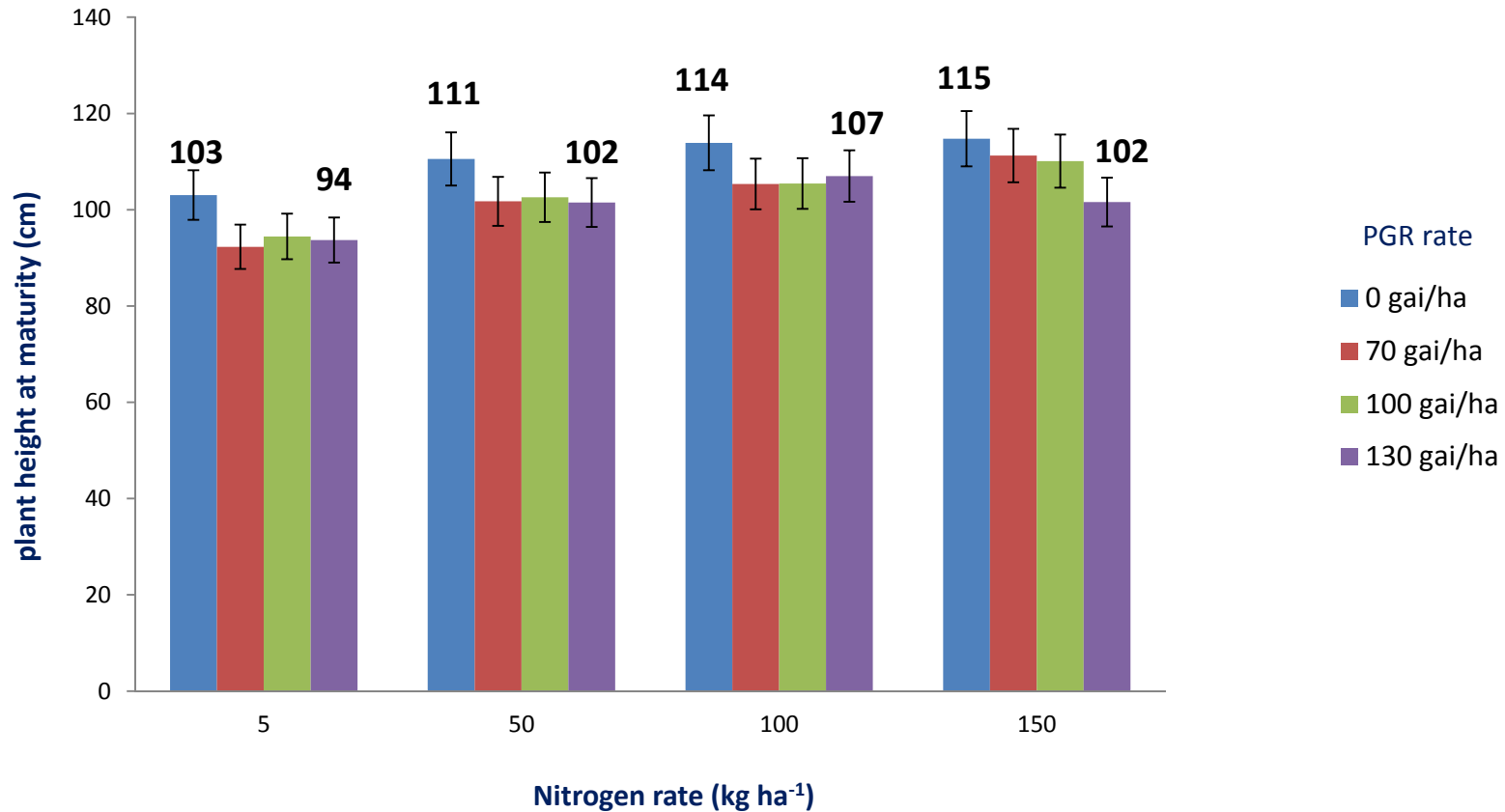


Experiment 2: Objectives

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 gai 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)

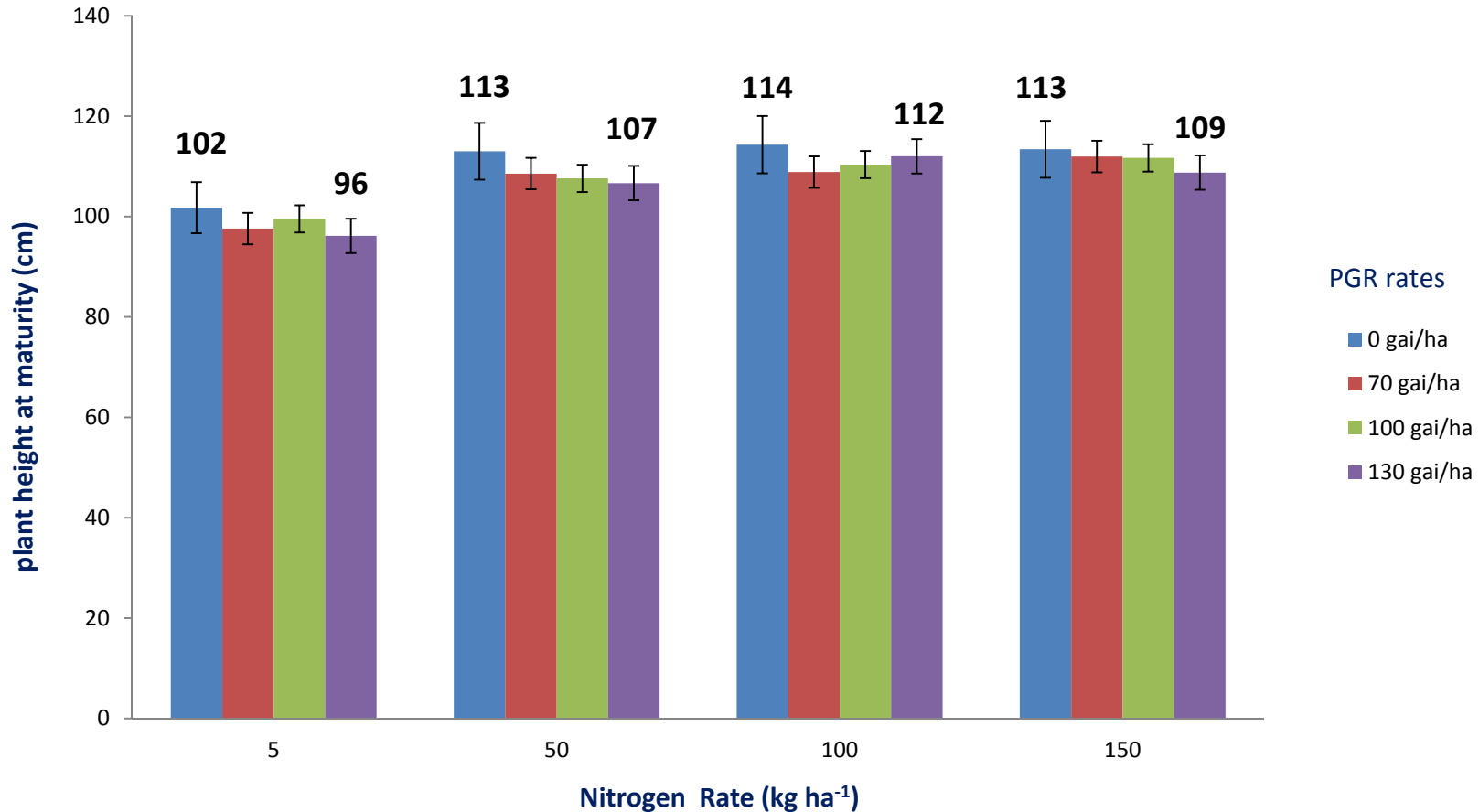
Experiment 2: St. Albert - Height response @ Maturity



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: Lodging rating @ Maturity

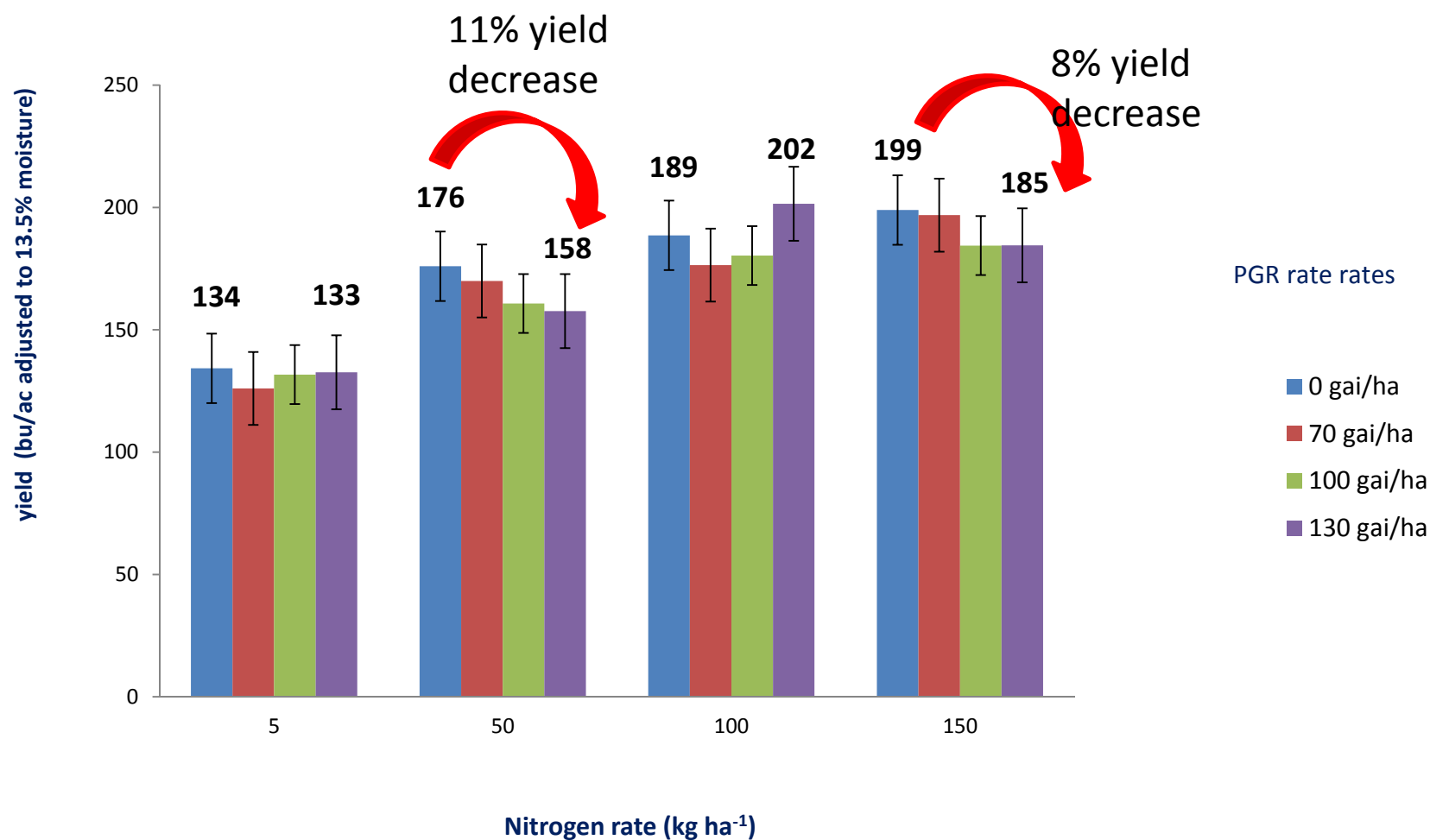
Nitrogen Rate (kg ha ⁻¹)	0 gai ha ⁻¹	70 gai ha ⁻¹	100 gai ha ⁻¹	130 gai ha ⁻¹
	Barrhead			
5	1	1	1	1
50	1	1	1	1
100	1.25	1	1	1
150	1.5	1.5	2	1
	St Albert			
5	1	1	1	1
50	1	1	1	1
100	1	1	1	1
150	1	1	1	1

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 both sites
- 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

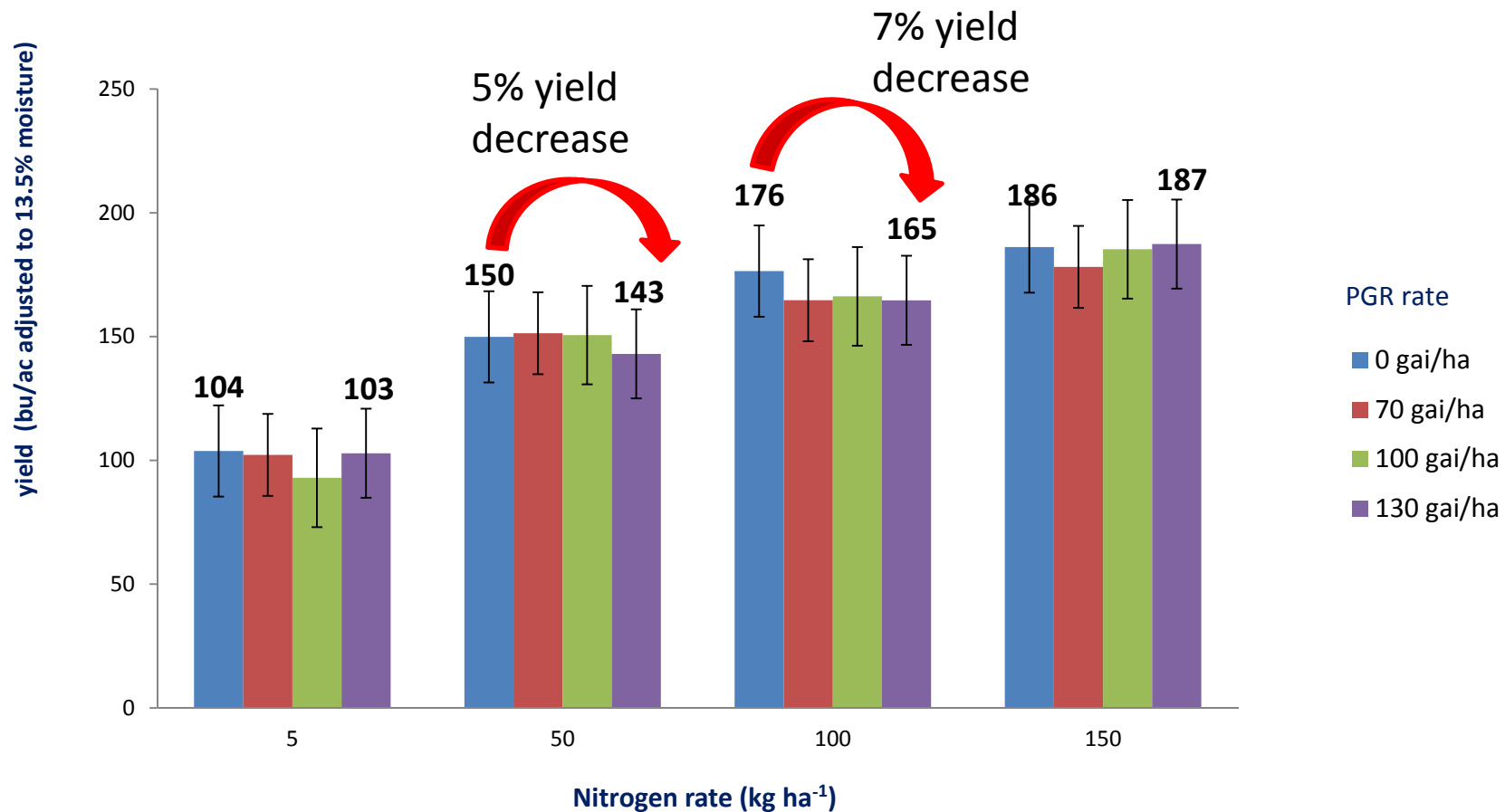
Experiment 2: Barrhead- Yield response



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

There were some yield decreases with PGR use, statistics must be run to see if the decreases are significant

Experiment 2: St. Albert- Yield response



There were some yield decreases with PGR use, statistics must be run to see if the decreases are significant

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

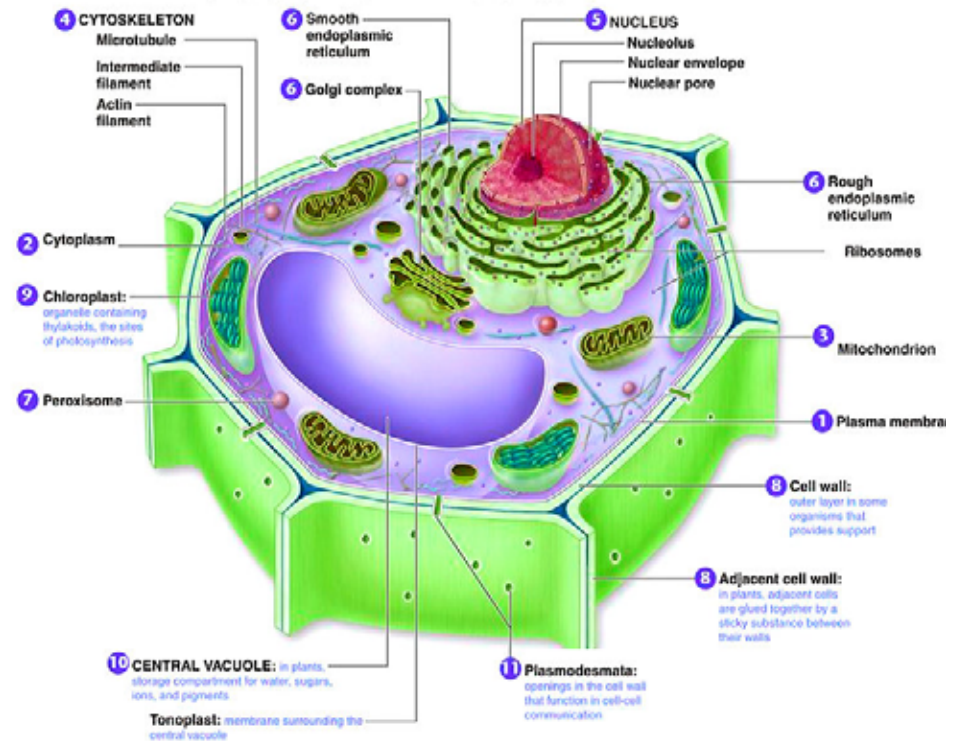
Why did PGR cause yield decreases?

- Is it the correct timing for Alberta conditions?
- Cultivar dependent responses?
- Environmental stress?
- PGR is interacting with other plant hormones?



What are PGRs?

- Plant Growth Regulators
- Synthetic compounds that impact hormonal activity to beneficially modify plant growth and development
- Effective at low concentrations & break-down rapidly
- Many economically important PGRs work by reducing cell elongation and lowering the rate of cell division



<http://chartdiagram.com/tag/plant-cell-diagram/>

2 Main PGR Groups:

- Ethylene releasing compounds
 - i.e. Ethephon (also blocks auxin transport)
- Inhibitors of GA biosynthesis
 - i.e. Chlormequat-Chloride & Trinexapac-Ethyl