An Economic Approach to Wheat Production

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WARC General Manager

Record Breaking Yields

- **246 bu/ac** – Northeast England in 2015
  - 277 bu/ac N fertilizer split in 4 apps., 165 lb/ac seeding rate, 4 fungicide applications, 4 PGR application
- **154 bu/ac** Shawridge Farms – Ontario
  - Early seeding
  - 7 inch rows
  - Total 160 to 190 lb/ac N and 30 lb/ac S
    - 60 to 70% at stem elongation
  - Two pass late fungicide system
- **249.68 bu/ac** from 29.39 acres
  - Eric and Maxine Watson, New Zealand
  - February 2017 (Winter Wheat)

Northumberland grower breaks world wheat yield record

Monday 21 September 2015 15:43 David Jones

Northumberland grower Rod Smith has beaten the world wheat yield record by a whisker after an ideal growing season with plenty of sunshine and low disease levels.

Harvesting only 10 days after Tim Lamyman's record crop in Lincolnshire, Mr Smith recorded a yield of 16.52t/ha on his farm overlooking Holy Island on the Northumberland coast.

He achieved this bumper yield with inputs similar to those used commercially across the farm, which helped push his average winter wheat yields to above 14t/ha this summer.

Agrii agronomist Andrew Wallace (left), Rod Smith (centre) with Eric Horsburgh (Agrii)

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Average Canadian vs. Sask. Wheat Yields

45.9	44.3
bu/ac	bu/ac
Canada	Saskatchewan

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New Zealand & Ontario vs. Saskatchewan

What's Common

- Early seeding
- Feed Varieties
- High Seeding Rates
- Focus on Head Development
  - Increased Nitrogen
  - Multiple Fungicide Passes

What's Different

- Water Availability
- Growing Season
- Plant Growth Regulator
- Intensive Management

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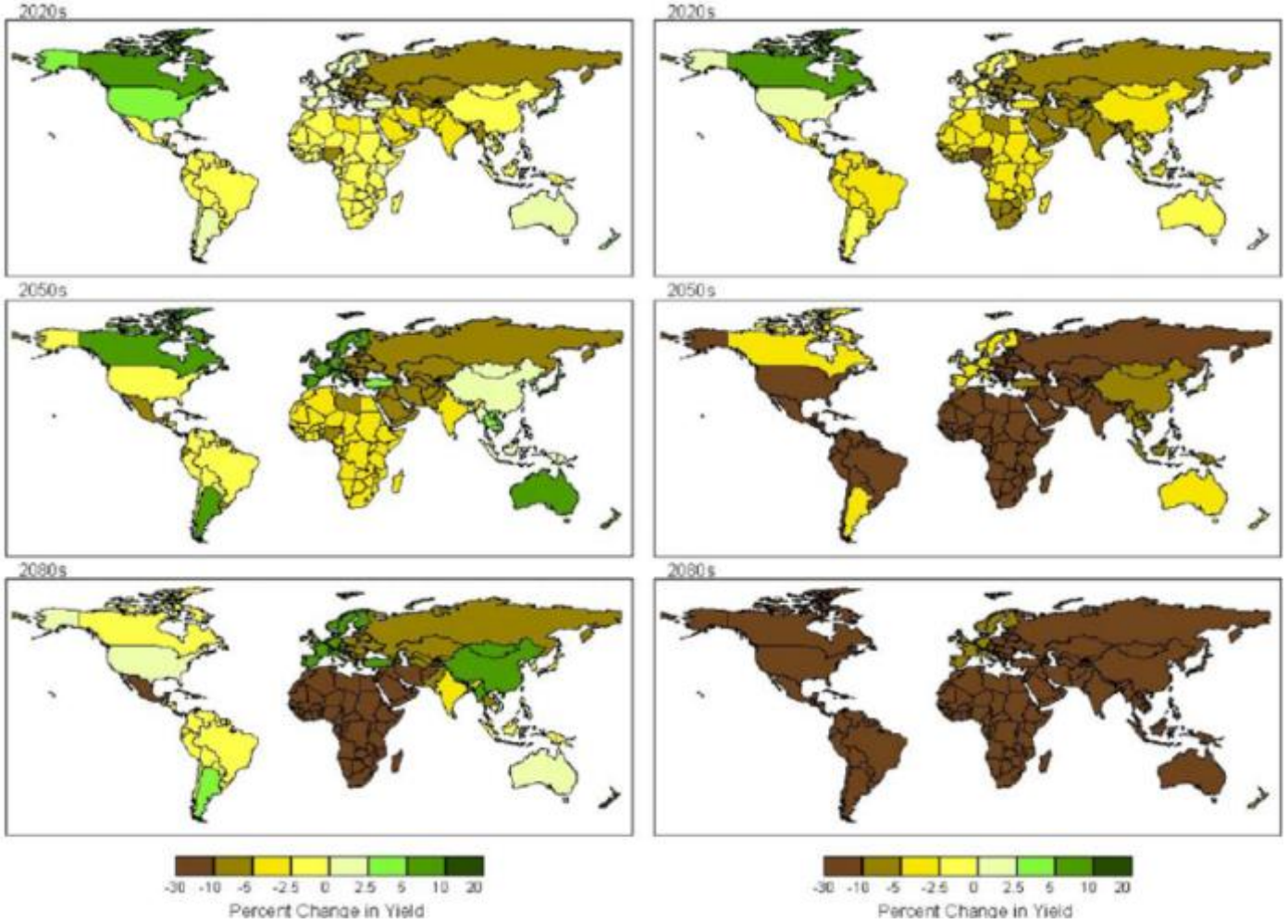
The Importance of an Ultra-Early Seeding System

- The effect of climate change on wheat in Canada:

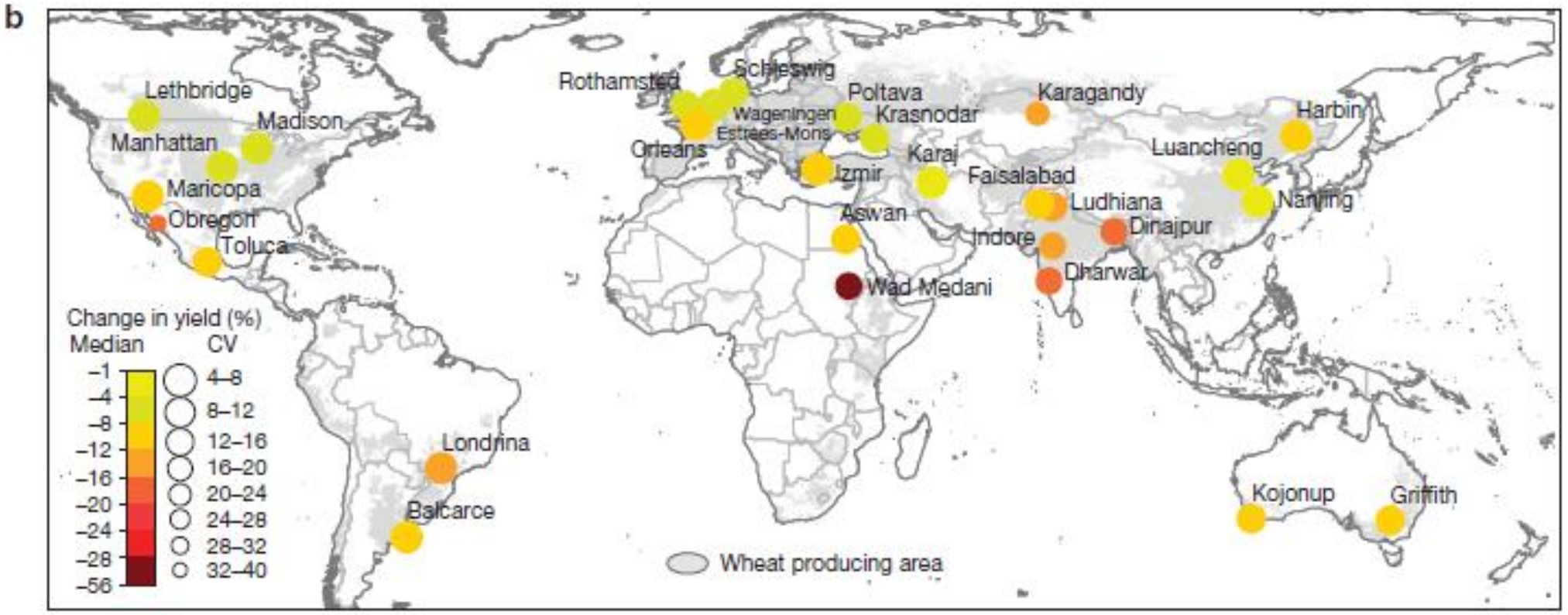


Atmospheric CO_2 concentration ↑

Temperature ↑

Precipitation (decreased in growing season) ↓

The Effect of Climate Change on Wheat in Canada



Wheat yield from 1981-2010 from the median yield of 30 modelling systems **with a 2°C** temperature increase.

From Asseng et al. 2014.

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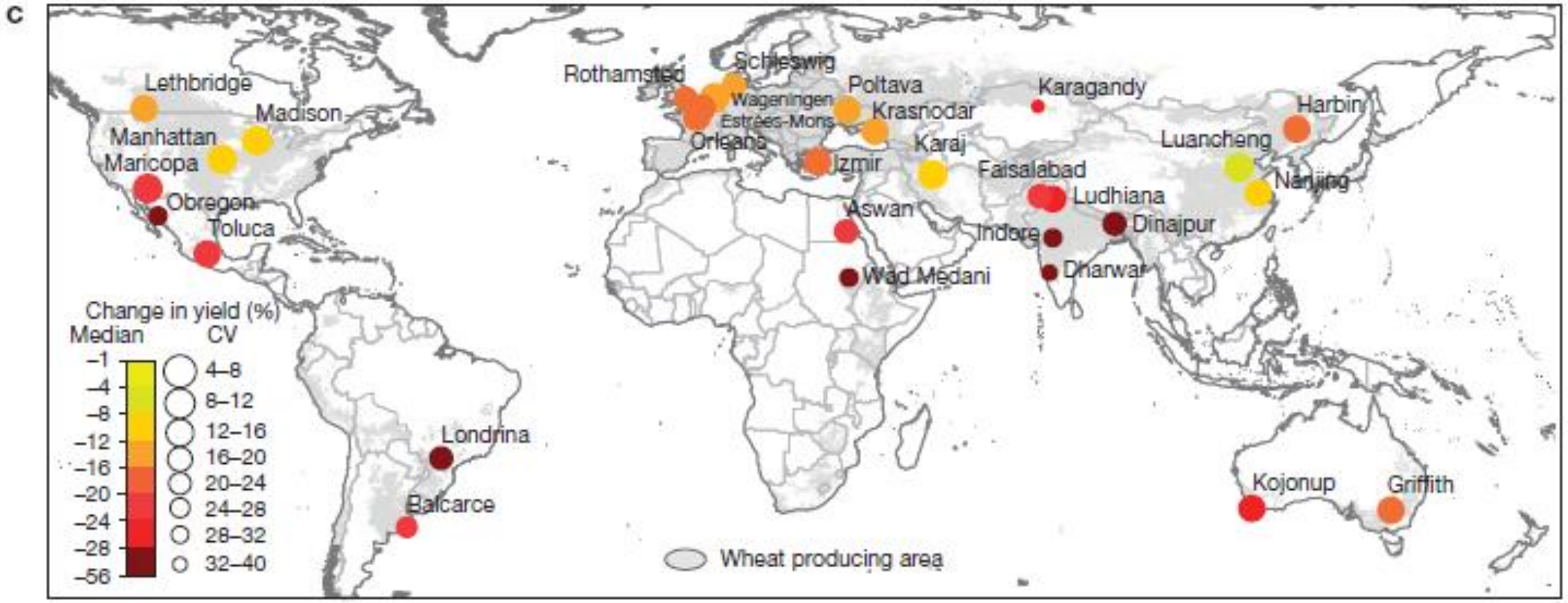
The Effect of Climate Change on Wheat in Canada



Wheat yield from 1981-2010 from the median yield of 30 modelling systems **with a 4°C** temperature increase.

From Asseng et al. 2014.

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Effect of Climate Change in Canada on Wheat

- Canadian Studies show similar results:
- Lychuk et al. 2017 ran seven climate scenarios for Scott, SK.
- 4 of 7 indicated decreases in wheat yield.
  - Increased daily heat extremes.
  - Greater maximum temperatures.

- Several other studies have indicated the average planting window in **Canada** and the **Northern U.S.** has **moved earlier in the season**. (Lanning et al. 2012, Lanning et al. 2010, He et al. 2012 & He et al. 2012a).
- Studies results have indicated moving seeding dates **7-11** and **10-12** days earlier than conventional timing has **no negative effects.**

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Early vs. Late Seeding

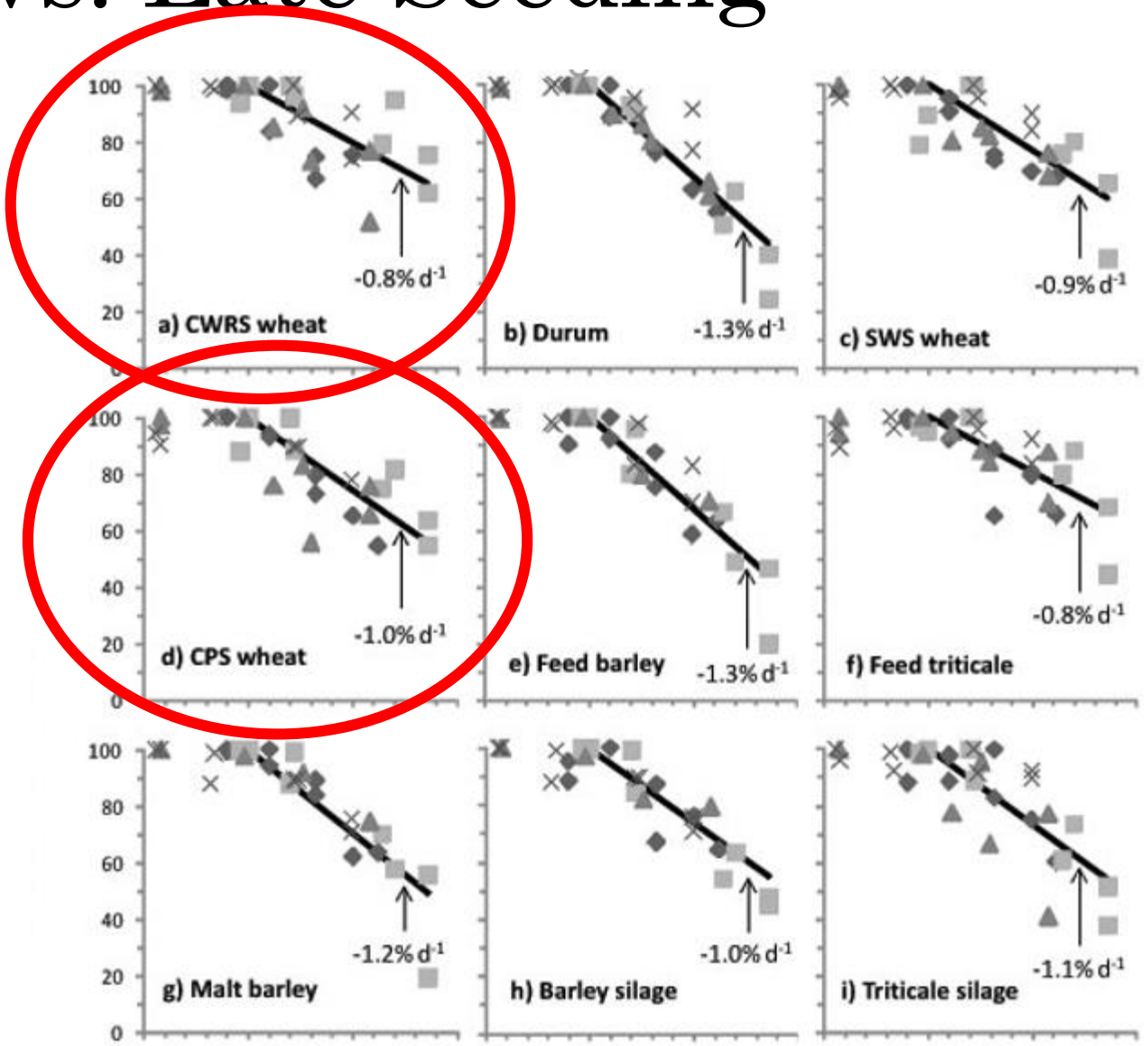
Southern Alberta:

- Targeted Seeding Date
  - After April 30th

- CWRS: -0.8% yield decrease per day
- CPS :-0.1% yield decrease per day

WHY?

- Increased solar capture
- Flowering prior to intense heat
- Utilizing early spring moisture



Alberta Agriculture and Forestry, 2009

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Dormant Seeding?

- What is it?
  - Fall planting Nov to Dec.
  - soil conditions inhibit immediate seed germination
- Where is it done?
  - Dakota Lakes, North Dakota
  - South Dakota
  - Ontario
- Conditions for dormant seeding:
  - Field free of deep, wet snow
  - Field-dry soil
  - Seeding Depth: 1 to 1.5 inches
  - No-till> Stale Seed Bed
  - Seed Treatment
  - Higher Seeding Rates

- 29% yield increase was associated with dormant seeding vs. normal seeding (April 1st) (Beck, 2009)

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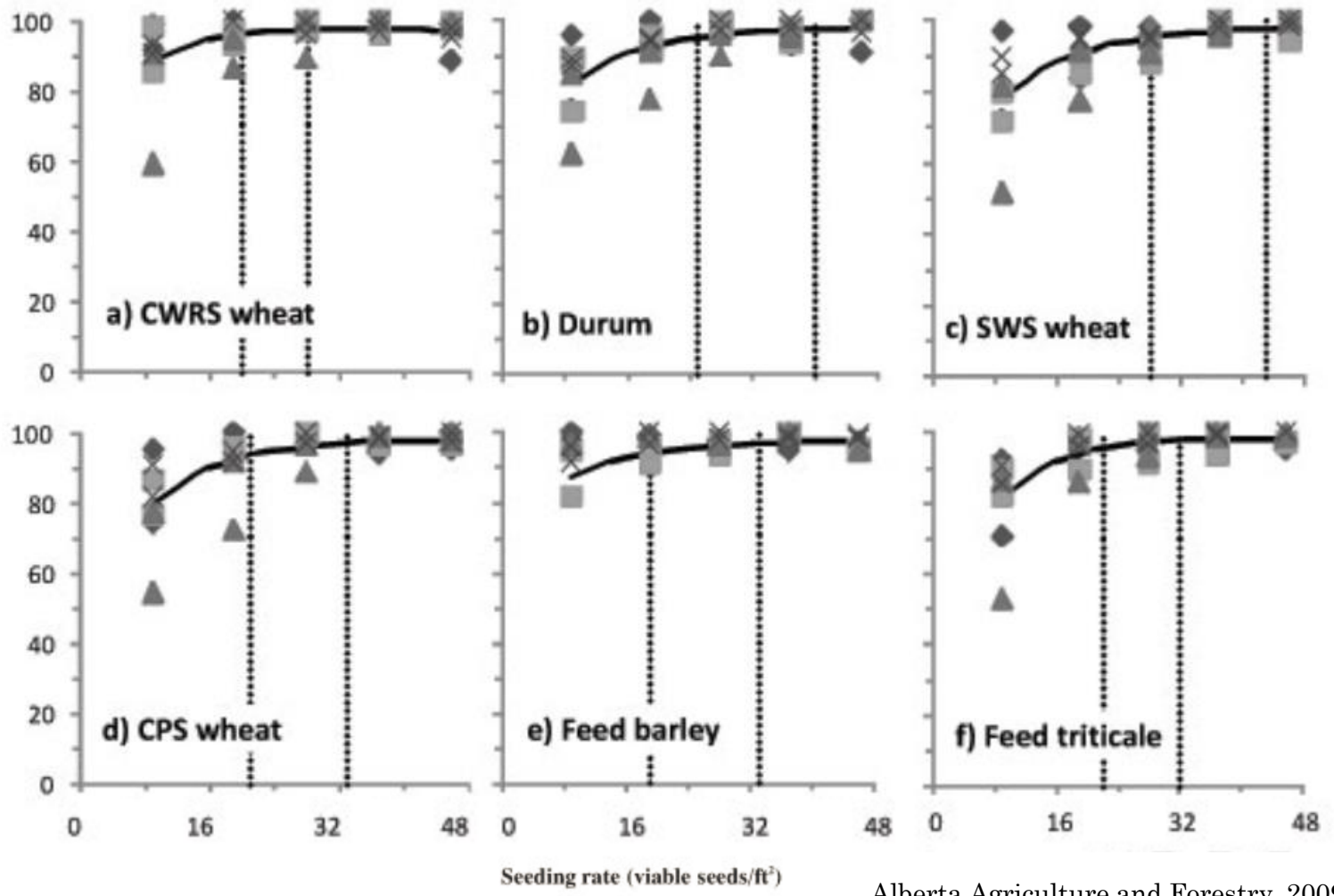
Higher Yields = Higher Seeding Rates?

Current Recommendations:

- CWRS Wheat
  - 200 to 300 seeds/m^2
- CPS Wheat
  - 250 to 400 seeds/m^2
- Soft White Wheat
  - 300 to 450 seeds/m^2



Alberta Agriculture and Forestry, 2009

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Optimal Seeding Rate for Spring Wheat

- Years: 2012 – 2013
- Location: Scott, Prince Albert, Indian Head, Swift Current, and Melfort
- Variety: Unity VB (CWRS)

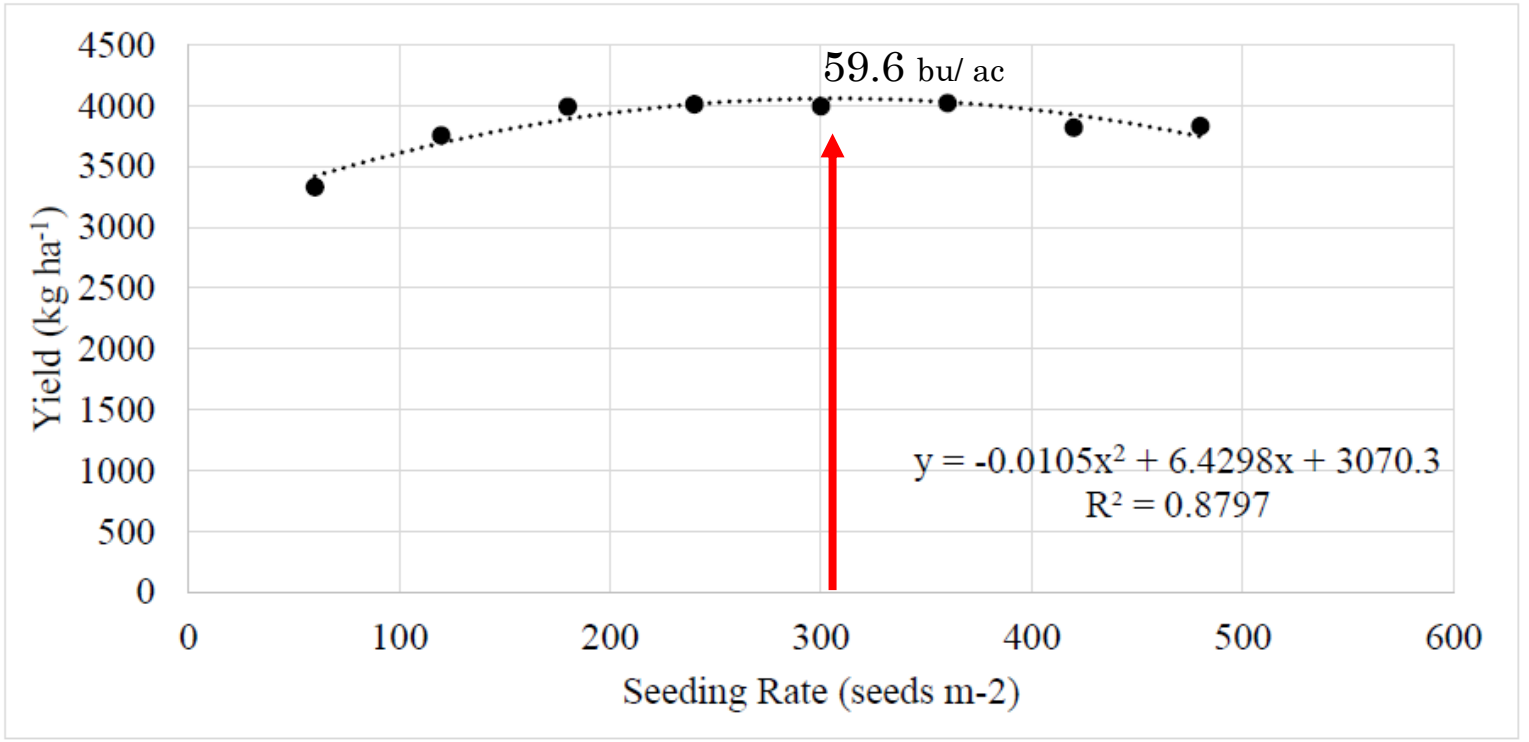

Figure 1: The relationship between seeding rate and grain yield (combined means of eight site years). Maximum grain yield achieved at 306 seeds m^{-2}.

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Optimal Seeding Rate for Spring Wheat

- Max yield (59.6 bu/ ac) @ 306 seeds /m^2
- Max net returns @ 238-292 seeds /m^2

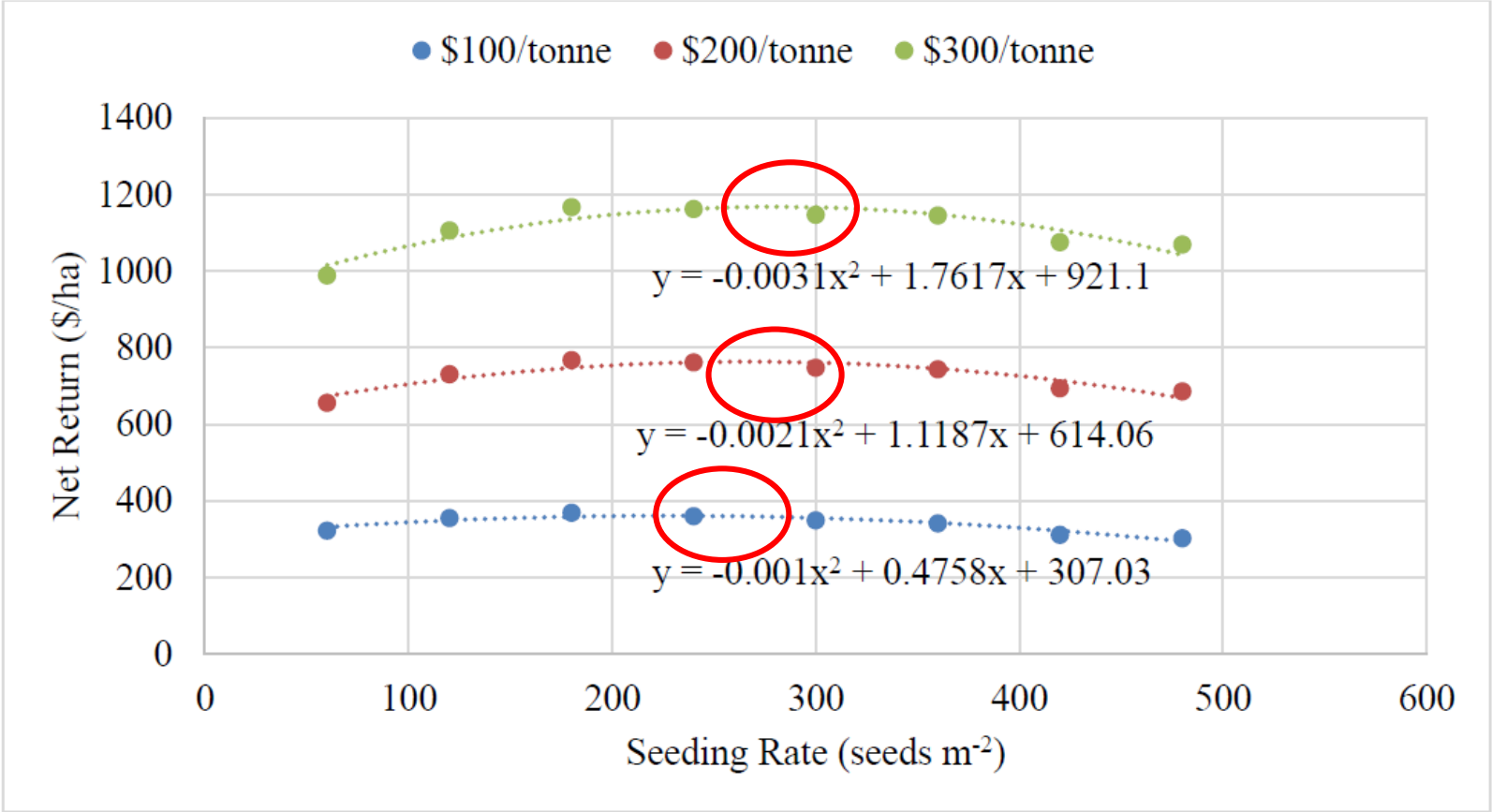

Figure 5. Net return of spring wheat at various seeding rates and grain prices at seed cost of $13/bu. Maximum economic return 238, 266 and 284 at seeds m^{-2} when grain prices are $100, $200 or $300 tonne^{-1}, respectively.

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Effect of High Seeding Rates

Benefits:

- Reduced tillering
  - Duration of disease exposure
  - Uniform growth staging
- Improved weed control
- Better solar light capture

- Excessive lodging
  - Manage N applications
  - Utilize lodge resistant varieties
  - Plant growth regulators

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Calculating Your Seeding Rate

SEED RATE CALCULATOR	
Enter desired plant density (plants /m^{-2})	300
Enter seed thousand kernel weight (grams)	41.8
Weight (grams per seed)	0.0418
Seed survival (.8-1.0)	0.88
Seed Rate (kg/ha)	143
Seed Rate (lb/acre)	**127**

SEED RATE CALCULATOR	
Desired plant density (plants /m^{-2})	250
Seed thousand kernel weight (grams)	41.8
Weight (grams per seed)	0.0418
Seed survival (.8-1.0)	0.88
Seed Rate (kg/ha)	119
Seed Rate (lb/acre)	**106**

- Know your TKW – it can make a difference!
  - 41.4 KTW = 105 lb / ac @ 250 seeds per sq. meter
  - 31.6 KTW = 80 lb / ac @ 250 seeds per sq. meter

Yield Components – Focus on Head Development

$$\frac{plants}{m^2} * \frac{heads}{plants} * \frac{florets}{head} * \frac{seeds}{floret} * \frac{g}{1000\ seeds} = Yield$$

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Timing of Nitrogen

- Why is timing important?
- Nitrogen Partitioning: Yield vs. Protein
  1. soil uptake of soil nitrate prior to flowering YIELD
  2. remobilization of stored vegetative N prior to flowering YIELD
     - (65- 86% total N grain filling)
  3. uptake of N after anthesis PROTEIN

Protein

- Dribble Band vs. Foliar Application
  - Foliar Application: only 4-27% uptake < 32-70% soil application
  - Dribble Band: reduce leaf burn, reduce N volatilization, improved NUE

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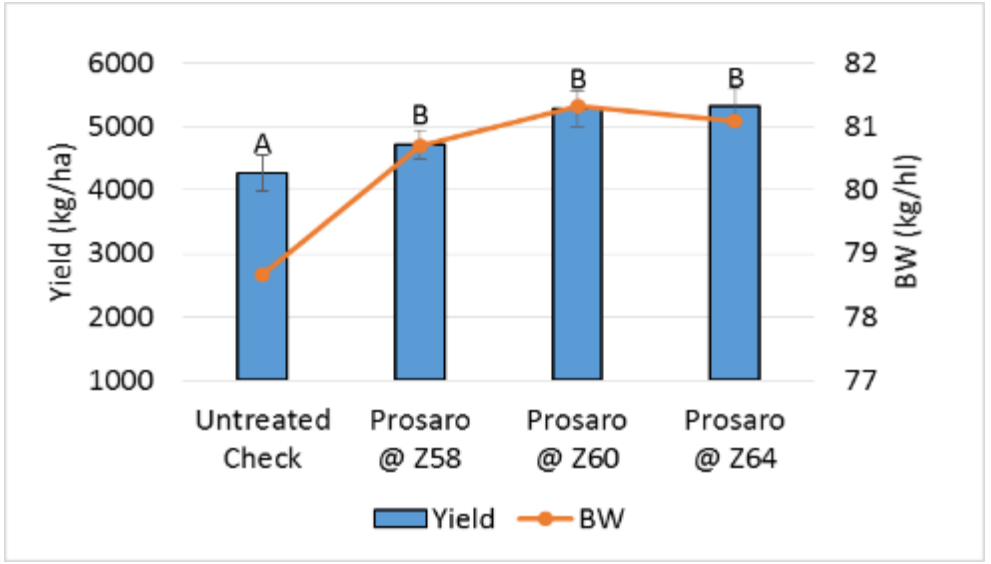
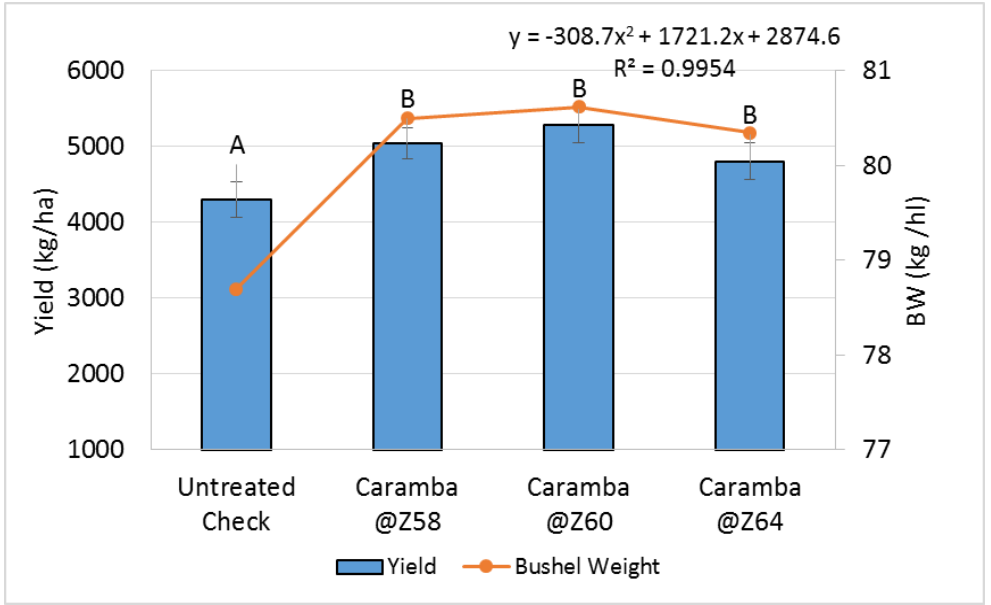
Van Sanford, D. A. and MacKown, C. T. 1987
Spiertz, J. H. J. and de Vos, N. M. 1983
Bly AG, Woodard HJ. Foliar nitrogen application timing influence on grain yield and protein concentration of hard red winter and spring wheat. Agronomy Journal. 2003 Mar 1;95(2):335-8.

Fungicides: To Spray or Not to Spray

- Factors:
  - Canopy Density
    - Higher Seeding Rate= More Uniform
    - Denser Canopy = Increased Disease Pressure
  - Varietal Selection
    - MS > MR
  - Application Timing
    - Yield Benefit?
      - Z58 to Z64 > Z38 soft white wheat

Figure 1. Wheat developmental stages. From left to right: flag leaf (Z38), late heading (Z58), full heading but no flowering (Z60), mid flower (Z64)





Standard Fungicide Application

0° & 18 inches above canopy
"Herbicide" type application

30° Forward & 8 inches above canopy
"Targeting head" type application

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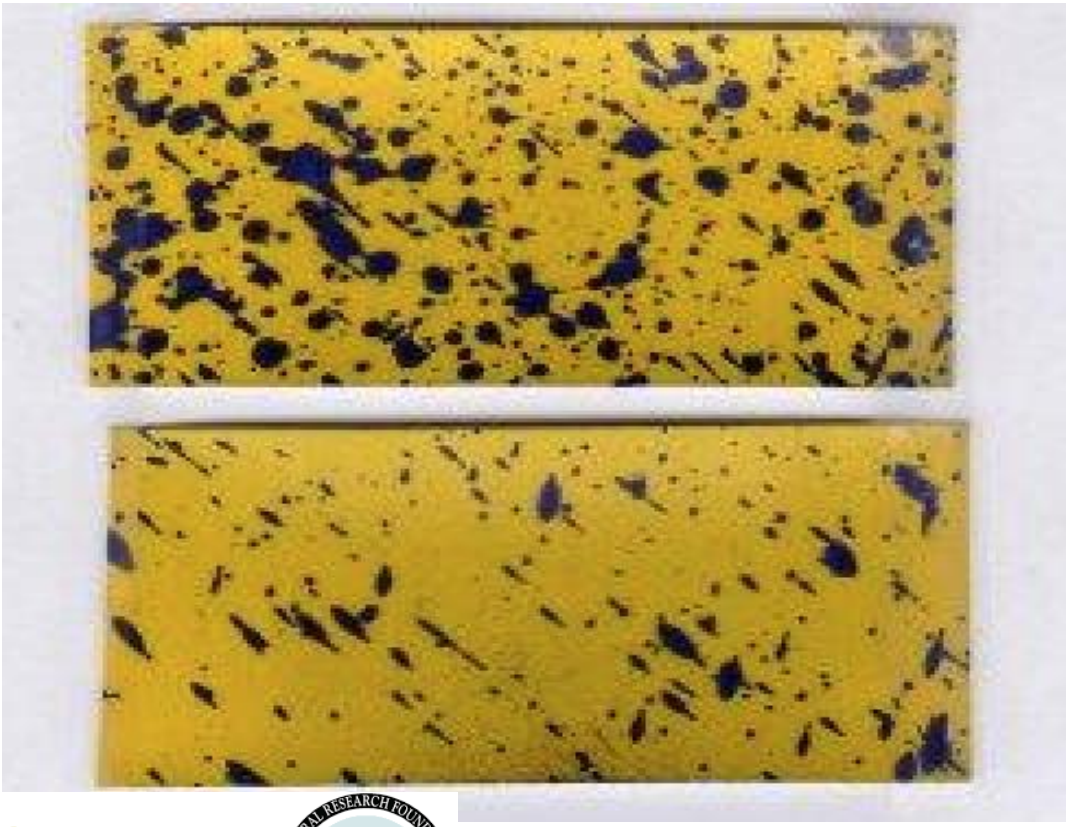
Top strip – facing direction of travel

Improved Fungicide

Dual Nozzles & 8 inches above canopy
"Excellent" Fusarium application



Dual Nozzles & 18 inches above canopy
"Sub-optimal" Fusarium application

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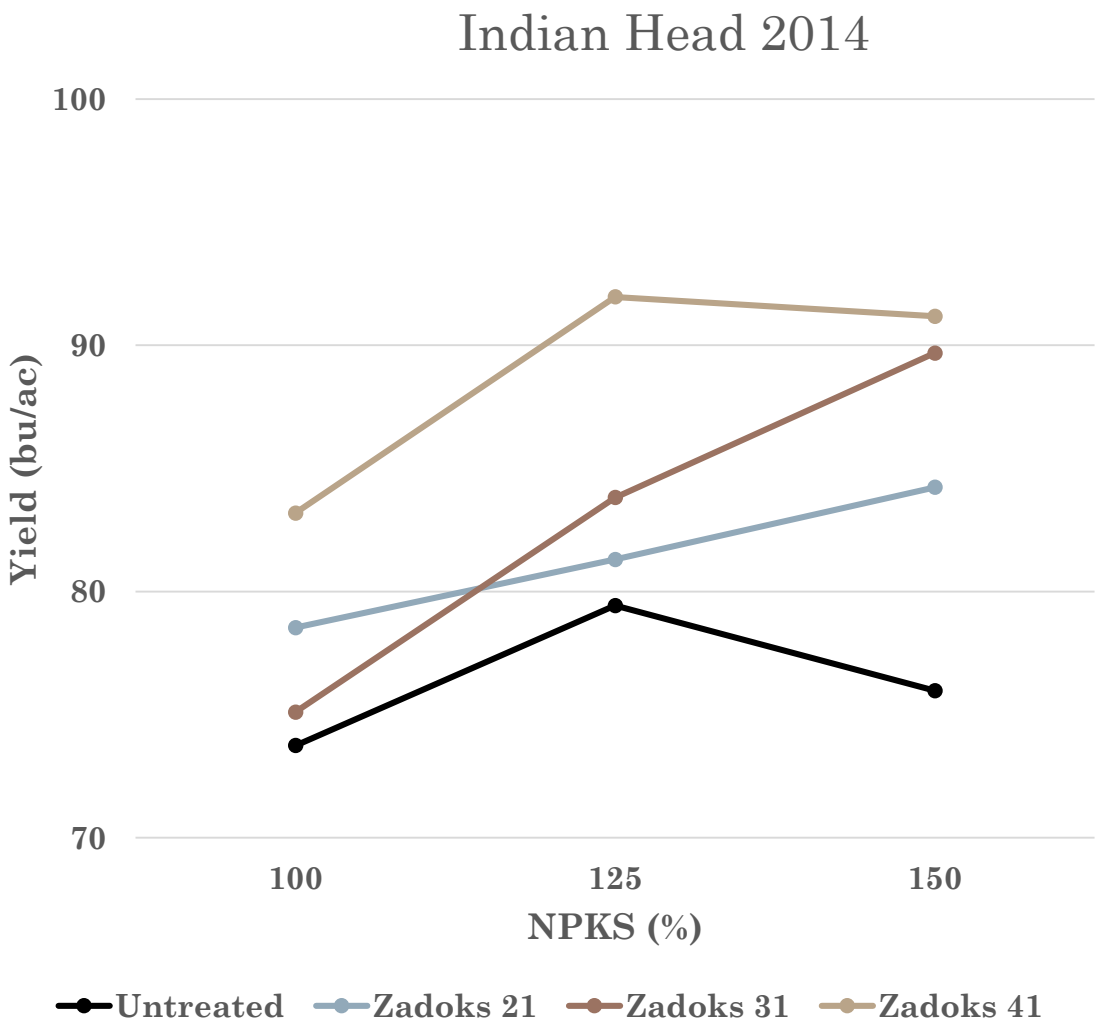
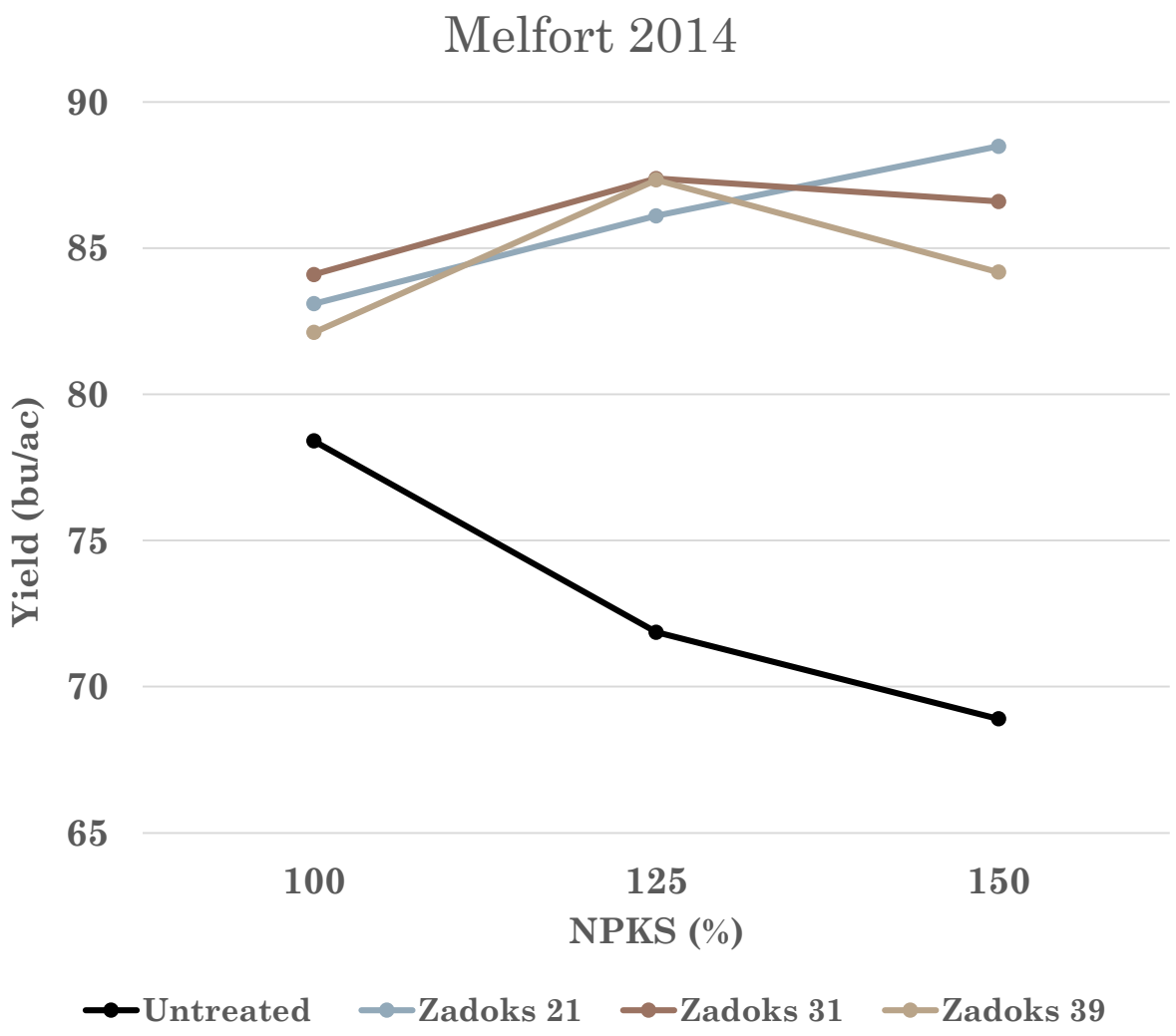
Top strip – facing direction of travel

PGRs in Wheat Production





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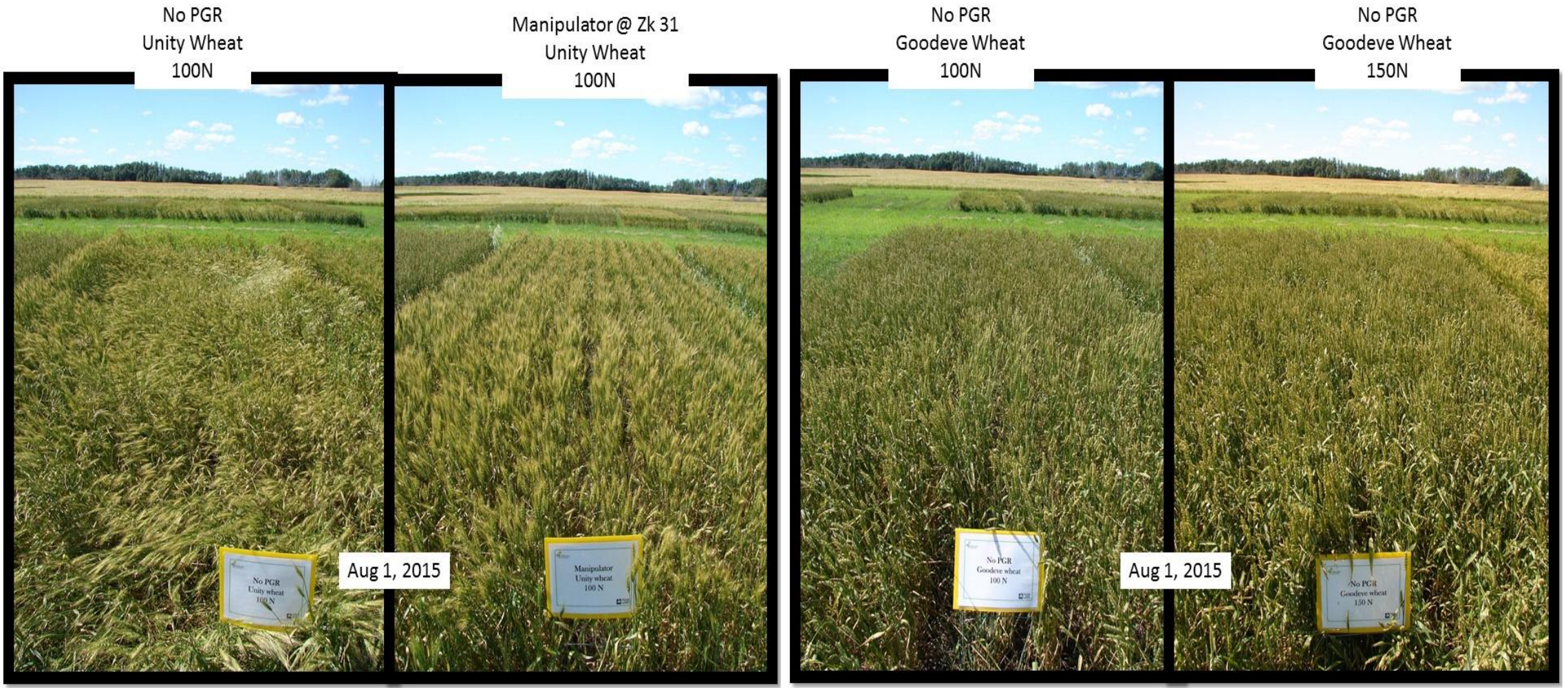
PGRs in Wheat Production



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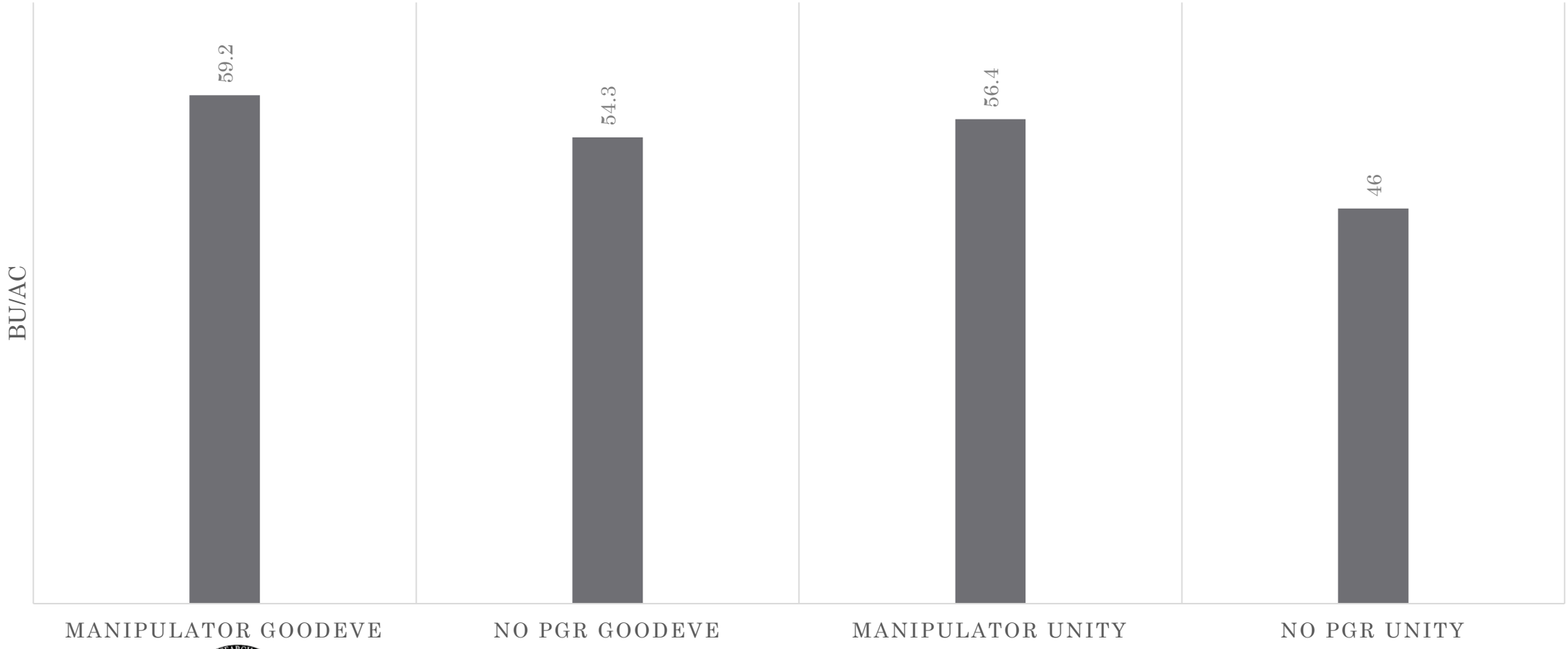
PGRs in Wheat Production

INFLUENCE OF PGR AND VARIETY AVERAGED OVER N RATE ON WHEAT YIELD.



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Why Not Intensively Manage Wheat?

- Poor economics?
- Not enough time?
- Logistic issues?

- Should different classes of wheat be managed differently?
- Does it differ between soil classes?
- Where are the best economic returns?

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Input Study: Intensive Wheat Management

Big Thank You to the Funders and Project Leads: Jessica Pratchler and Stu Brandt

Sask Wheat Development Commission

Government of Saskatchewan
Ministry of Agriculture

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Growing Forward 2

- **Collaborators:**

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Wheatland Conservation Area Inc.

WCA

Input Study: Intensive Wheat Management

- To enhance wheat profitability by incorporating some or all components of intensive wheat management
- To identify how wheat classes and varieties are affected by enhanced wheat management
- To identify how these interactions vary in response to the various soil and climatic conditions across Saskatchewan
- To identify input combinations provide optimal yields and quality, while minimizing cost

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Input Study: Intensive Wheat Management

- Sites: Indian Head, Melfort, Scott, Swift Current, and Yorkton
- RBCD with 4 replicates
- Years: **2017**, 2018, and 2019
- Treatments: 6 Wheat Varieties x 3 Management Strategies
  - 18 treatments
- Data Collection
  - Plant Density
  - Days to Maturity
  - Yield
  - Quality (TKW, Bushel Weights, Protein, %FDK, DON)

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Input Study: Intensive Wheat Management

Cultivar	Class	Fusarium Resistance	Lodging resistance	Maturity	Yield	Protein
Carberry	CWRS	MR	Very Good	99	100	14.6
AAC Cameron VB	CWRS	I	Fair	-2	118	-0.7
CDC Utmost VB	CWRS	MS	Fair	-2	112	-0.4
AC Andrew	CWSWS	I	Very Good	+2	137	NA
SY Rowyn	CPSR	MR	Fair	-1	107	-1.1
AC Ryley	CPSR	MS	Poor	-2	110	-1.2

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Input Study: Intensive Wheat Management

Management	Seed Treatment	Seeding Rate (seeds/m^2)	N fertility (lb/ac N)	P fertility (lb/ac P_2O_5)	Fungicide @ Flag Leaf	Fungicide @ Anthesis	PGR App.
Conventional	No	200	75	25	No	No	No
Enhanced	No	300	98	33	No	Yes	No
Intensive	Yes	360	120	40	Yes	Yes	Yes

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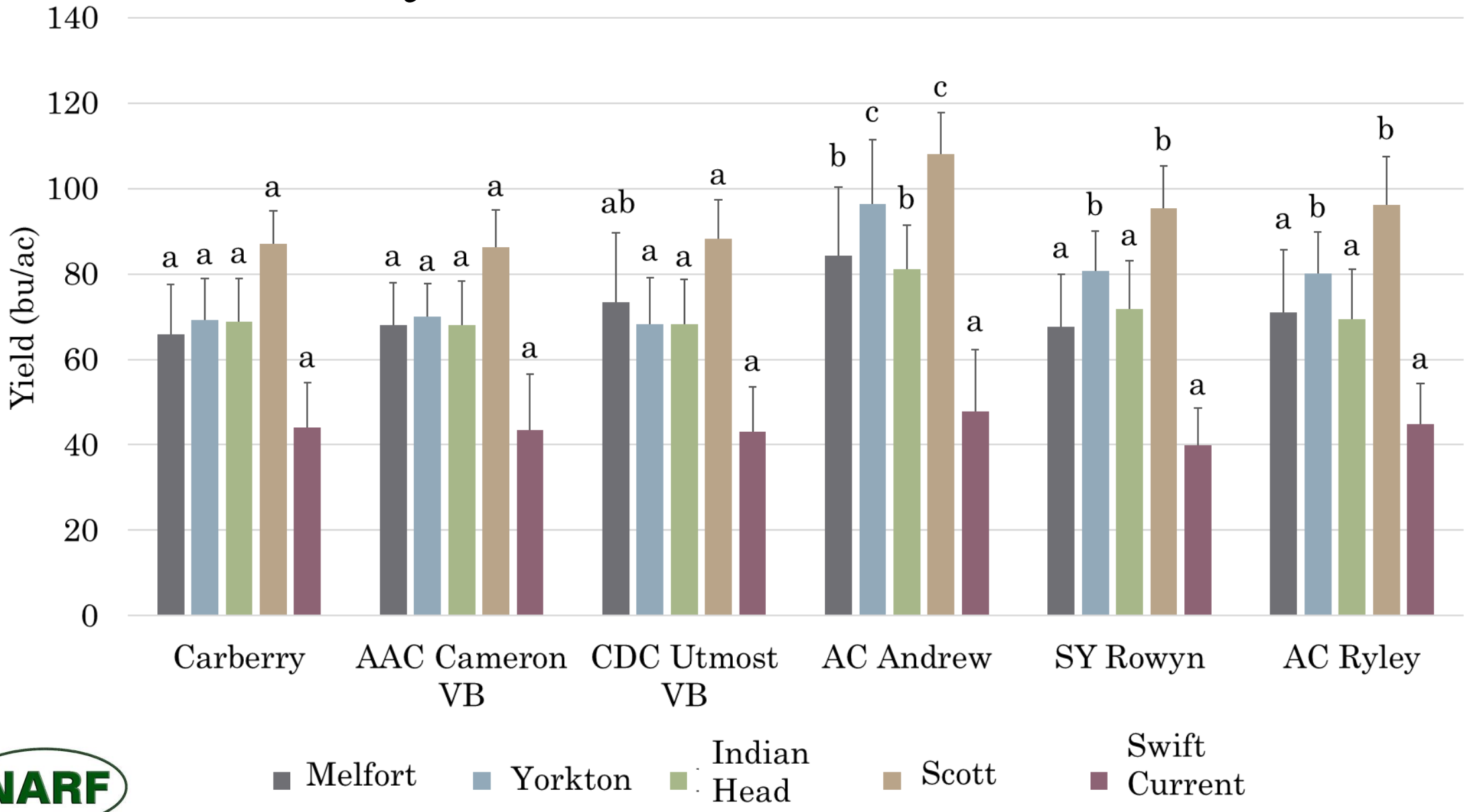
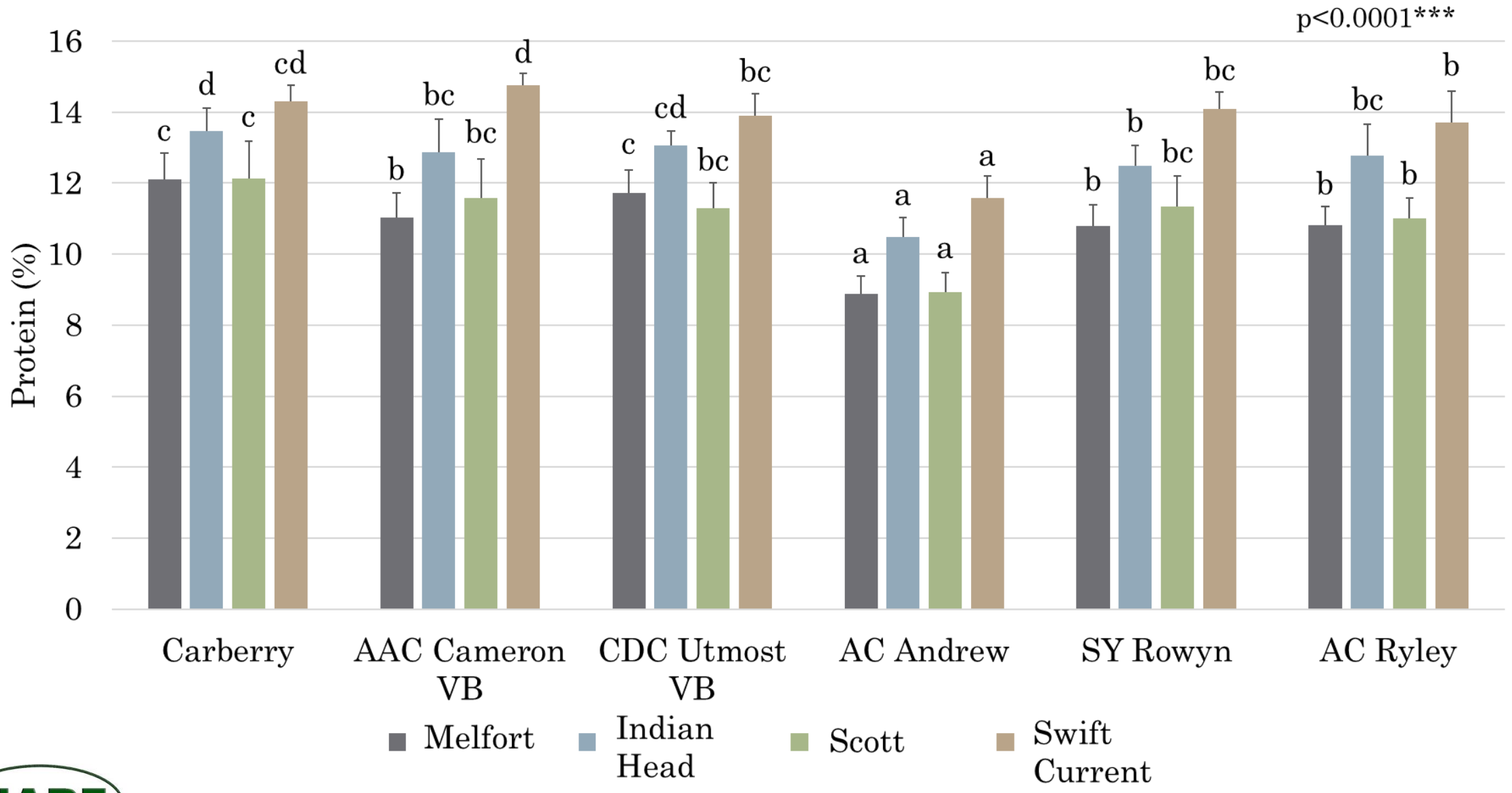
Preliminary Results: Varietal Effect on Yield



Preliminary Results: Varietal Effect on Protein



Swift Current >Indian Head > Scott ≥ Melfort

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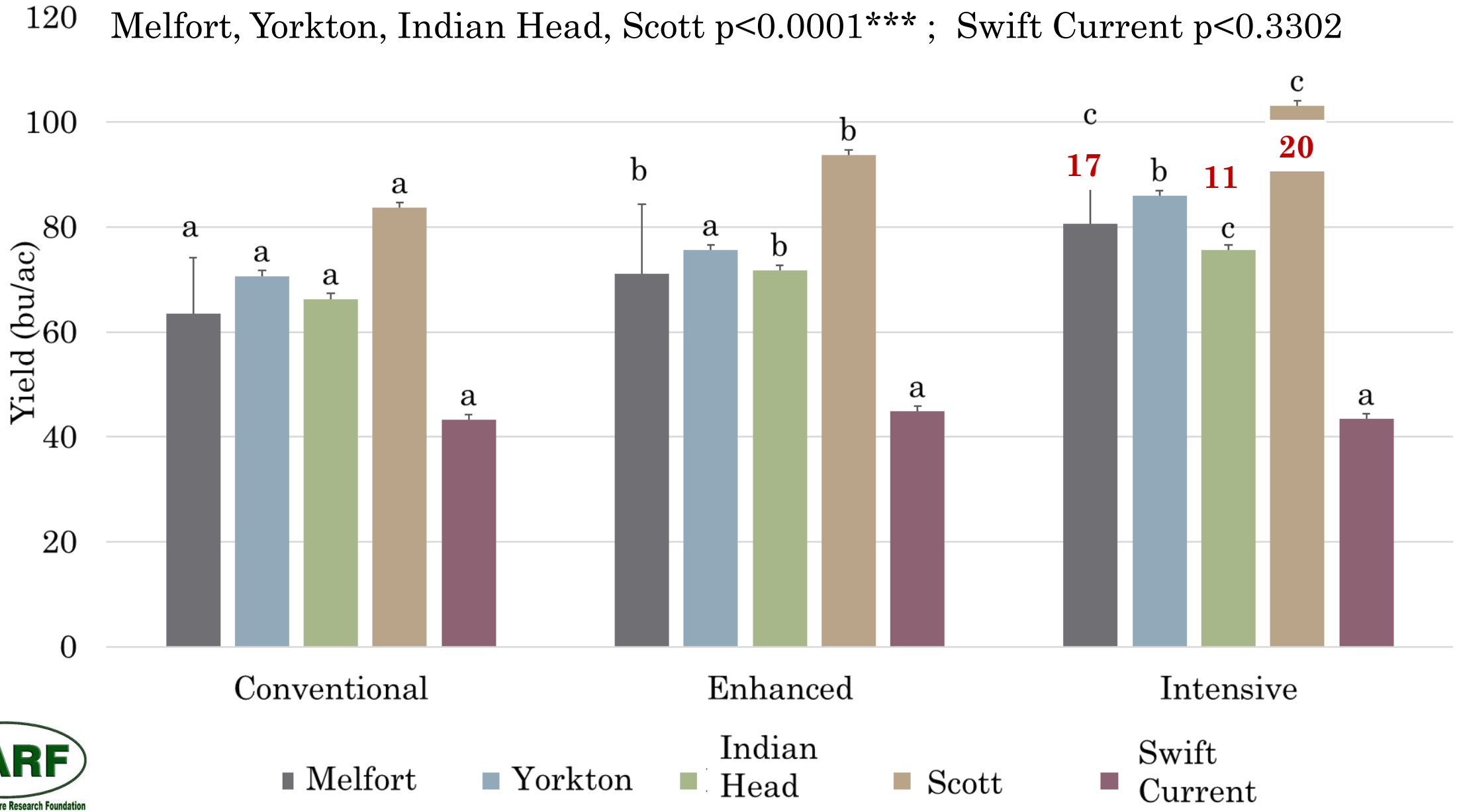
Preliminary Results: Management Strategy on Yield

Melfort, Yorkton, Indian Head, Scott p<0.0001*** ; Swift Current p<0.3302



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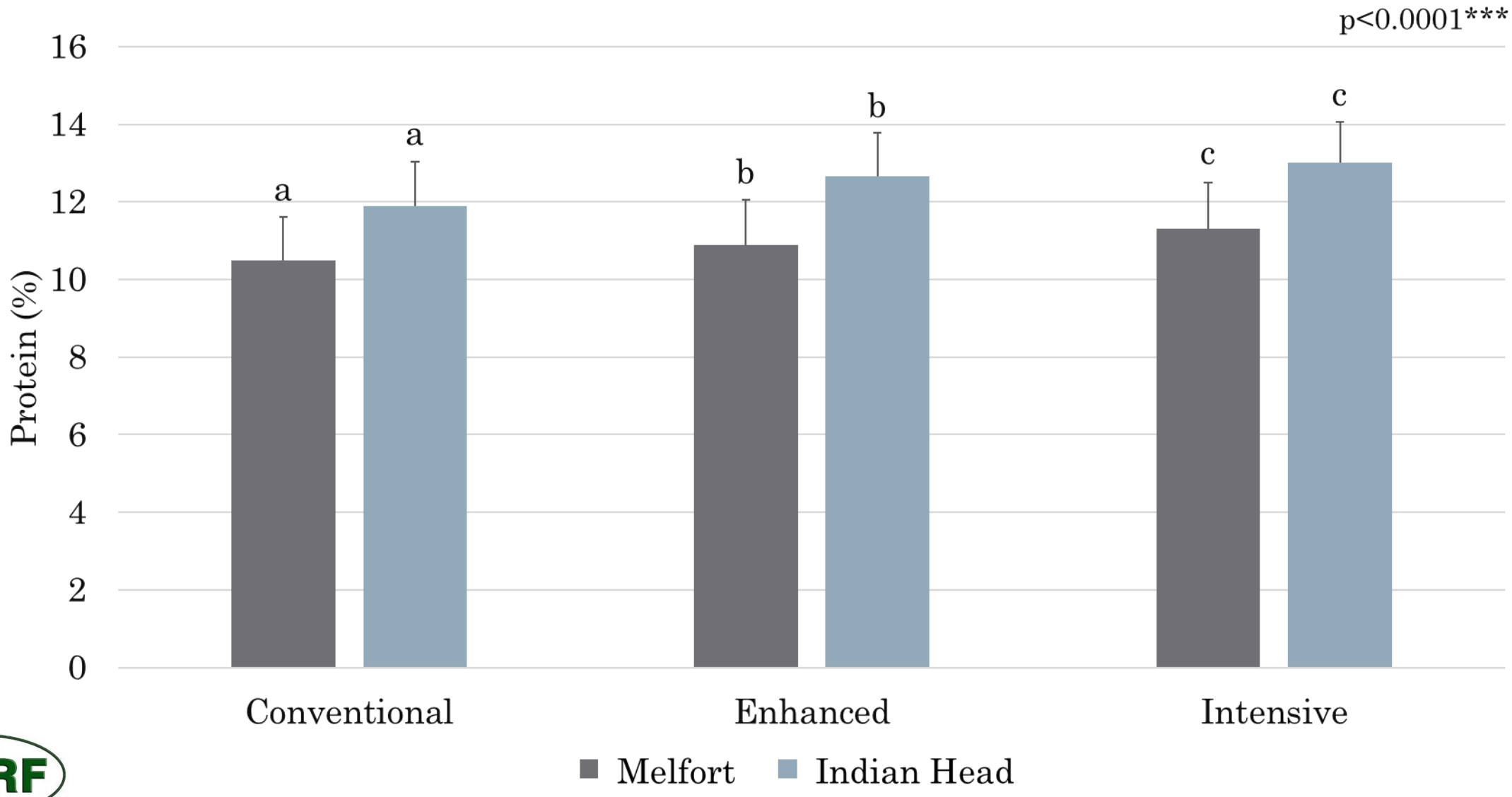
Preliminary Results: Management Strategy on Protein



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Seed Cost Expenses at Scott, SK 2017

Seed Cost (s/m2)	lb/ac	Cost of CWRS Wheat	0.225 ($13.5)
200	73	$16.43	
300	110	$24.75	
360	132	$29.70	
Seed Cost (s/m2)	lb/ac	Cost of CPSR Wheat	0.175 ($10.50)
200	73	$12.78	
300	110	$19.25	
360	132	$23.10	
Seed Cost (s/m2)	lb/ac	Cost of CWSWS Wheat	0.179 ($10.75)
200	73	$13.07	
300	109	$19.51	
360	131	$23.45	

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Production Costs based on Dark Brown Soil Zone

	Conventional $ / ac		Enhanced $ / ac		Intensive $ / ac
Seed Treatment	0		0		5.56
N Fert	36.2	1.3x	47.1	1.6x	58.0
P Fert	14.6	1.3x	18.9	1.6x	23.3
Herbicide	31.0		31.0		31.0
Fungicide	0.0		15.5		25.5
PGR	0.0		0.0		10.0
Fuel Costs	19.35		19.35		19.35
Custom Spraying Costs	0		6.50		13
Cost of Spraying	0		4		8
Suggested Labour Costs	18.75		18.75		18.75

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http://publications.gov.sk.ca/documents/20/105224-Crop%20Planning%20Guide%202018%20FINAL%20(All).pdf

Gross Revenue Based on Production Expenses Including Custom Spraying

		Yield (bu/ac)	$ / bu	Net Revenue	Production Expenses	Gross Revenue	
CWRS	Conventional	66	$ 6.50	431.0	117.6	313.4	
	Enhanced	75	$ 6.50	486.2	163.1	323.1	**$10/ac**
	Intensive	81	$ 6.50	524.9	215.4	309.5	
CWSWS	Conventional	83	$6.00	499.8	114.2	385.6	**$7/ac**
	Enhanced	92	$6.00	550.8	157.9	392.9	
	Intensive	100	$6.00	601.8	209.1	392.7	
CPSR	Conventional	72	$6.25	451.6	113.9	337.6	**$22/ac**
	Enhanced	81	$6.25	504.7	157.6	347.0	**$12/ac**
	Intensive	91	$6.25	568.4	208.8	359.6	

*Market price is based on protein of 13.5%; ⁺Market price is based on protein between 9-11%; ^Market price based on protein of 13.0%

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Gross Revenue Based on Production Expenses Producer Spraying Costs

		Yield (bu/ac)	$ / bu	Net Revenue	Production Expenses	Gross Revenue	
CWRS	Conventional	66	$6.50	431.0	117.6	313.4	
	Enhanced	75	$6.50	486.2	160.6	325.6	**$12/ac**
	Intensive	81	$6.50	524.9	210.4	314.5	
CWSWS	Conventional	83	$6.00	499.8	114.2	385.6	**$12/ac**
	Enhanced	92	$6.00	550.8	155.4	395.4	
	Intensive	100	$6.00	601.8	204.1	397.7	
CPSR	Conventional	72	$6.25	451.5625	113.9	337.6	**$27/ac**
	Enhanced	81	$6.25	504.6875	155.1	349.5	**$15/ac**
	Intensive	91	$6.25	568.4375	203.8	364.6	

8⁺ bu

*Market price is based on protein of 13.5%; ⁺Market price is based on protein between 9-11%; ^Market price based on protein of 13.0%

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Take Home Message

- CWRS: Enhanced > Conventional = Intensive
  - Over estimated our prices due to lower proteins – protein discounts?
- CWSWS: Intensive ≥ Enhanced > Conventional
  - Proteins were within malting barley 9-11%
  - Highest overall returns compared to CWRS ($75/ ac) ; CPSR ($42/ac)
- CPSR: Intensive> Enhanced > Conventional
  - CPSR highly sensitive to intensive management
  - Over estimated our prices due to lower proteins – protein discounts?
- Custom Spraying vs. Producer Spraying: - $2.5 / ac enhanced ; - $5 / ac intensive
  - EXCEPT CWRS Intensive: additional - $4 / ac loss
- **Environmental Conditions: Relatively dry year**

Management strategy may be wheat class dependent on a economic basis

What's Next?

- Multiple Sites and Years- Will the trend change?
- Split applications of N?
- Ultra - Early Seeding & Dormant Seeding
- Combination of Ultra – Early Seeding and Management Techniques

Thank You!

Agriculture and Agri-Food Canada

- Agriculture Development Fund (ADF)
- Saskatchewan Wheat Development Commission
- NARF Technical and Summer Staff
- Western Applied Research Corporation
- East Central Research Foundation
- Indian Head Agricultural Research Foundation
- Wheatland Conservation Area

Government of Saskatchewan
Ministry of Agriculture

Saskatchewan Ministry of Agriculture and the Canada-Saskatchew an Growing Forward 2 bi-lateral agreement.

Sask Wheat DEVELOPMENT COMMISSION

https://www.westernappliedresearch.com/

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Questions?

Crop Opportunity
March 13th
Dekker Centre, North Battleford

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