4R Nutrient Management Trials:
How Do We Choose the Right Rs?

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INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

15-03-2022

AGVISE Canada Seminar
Portage la Prairie, MB

Presentation Overview

1. **4R Nitrogen Management in Spring Wheat**
   - Indian Head, 2017-21
2. **Canola Seed Safety & Yield Response to Varying Phosphorus Forms**
   - Multiple locations, 2020-21
3. **Malting Barley & Wheat Response to Potash Rate & Placement**
   - Multiple locations, 2021

Demonstrating 4R Nitrogen Fertilizer Management Principles in CWRS Wheat (Indian Head 2017-21)

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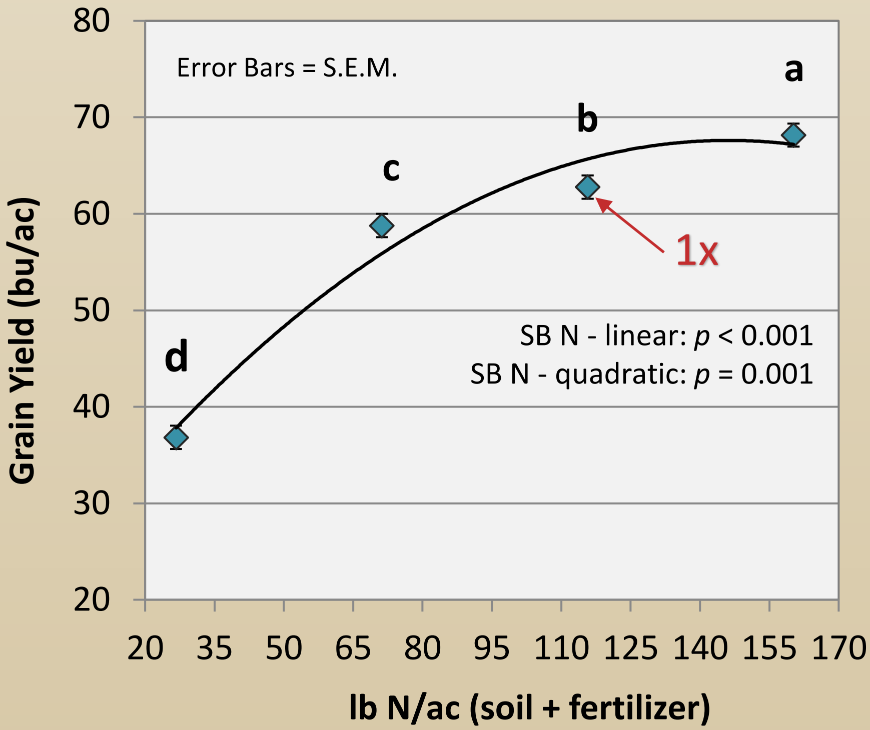
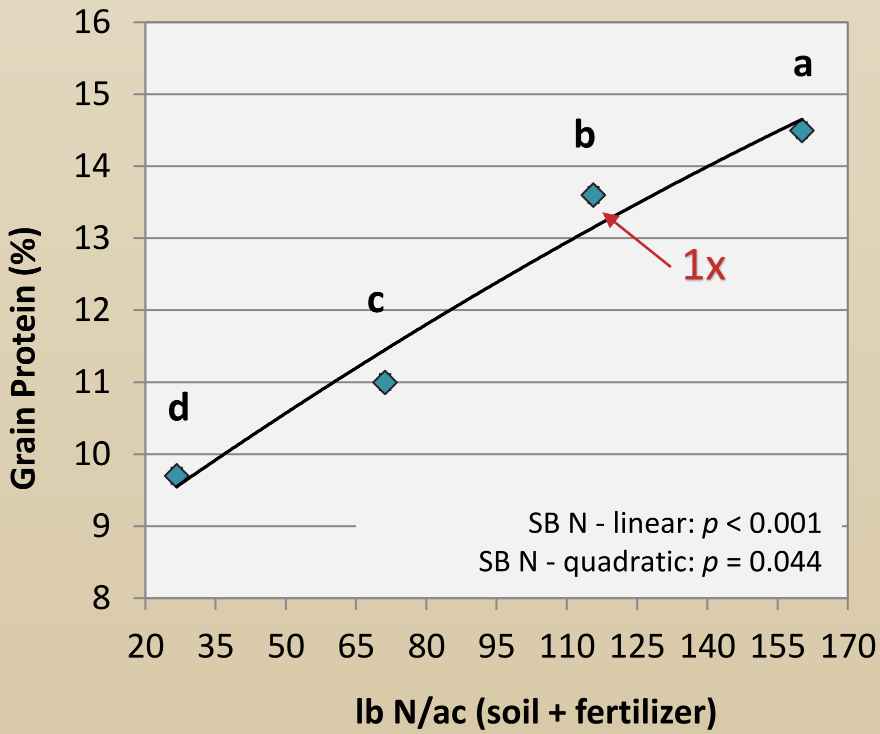
4R Nitrogen Treatments: Indian Head 2017

#	Form	Timing / Placement	Rate *
1	Urea	Side-band	1.0x May 5
2	Urea	Spring Surface Broadcast	1.0x
3	UAN (Urea Ammonium-Nitrate)	Spring Surface Dribble-band	1.0x May-4
4	NBPT (Agrotain®)	Spring Surface Broadcast	1.0x
5	DCD+NBPT (SUPERU®)	Spring Surface Broadcast	1.0x
6	Urea	50:50 Split (side-band : in-crop)	1.0x
7	UAN (Urea Ammonium-Nitrate)	50:50 Split	1.0x May-5/ Jun-20
8	NBPT (Agrotain®)	50:50 Split	1.0x
9	DCD+NBPT (SUPERU®)	50:50 Split	1.0x

* 1x = 116lb N/ac (soil + fertilizer)

Nitrogen Rate Effects on Wheat Yield & Protein (Indian Head 2017)



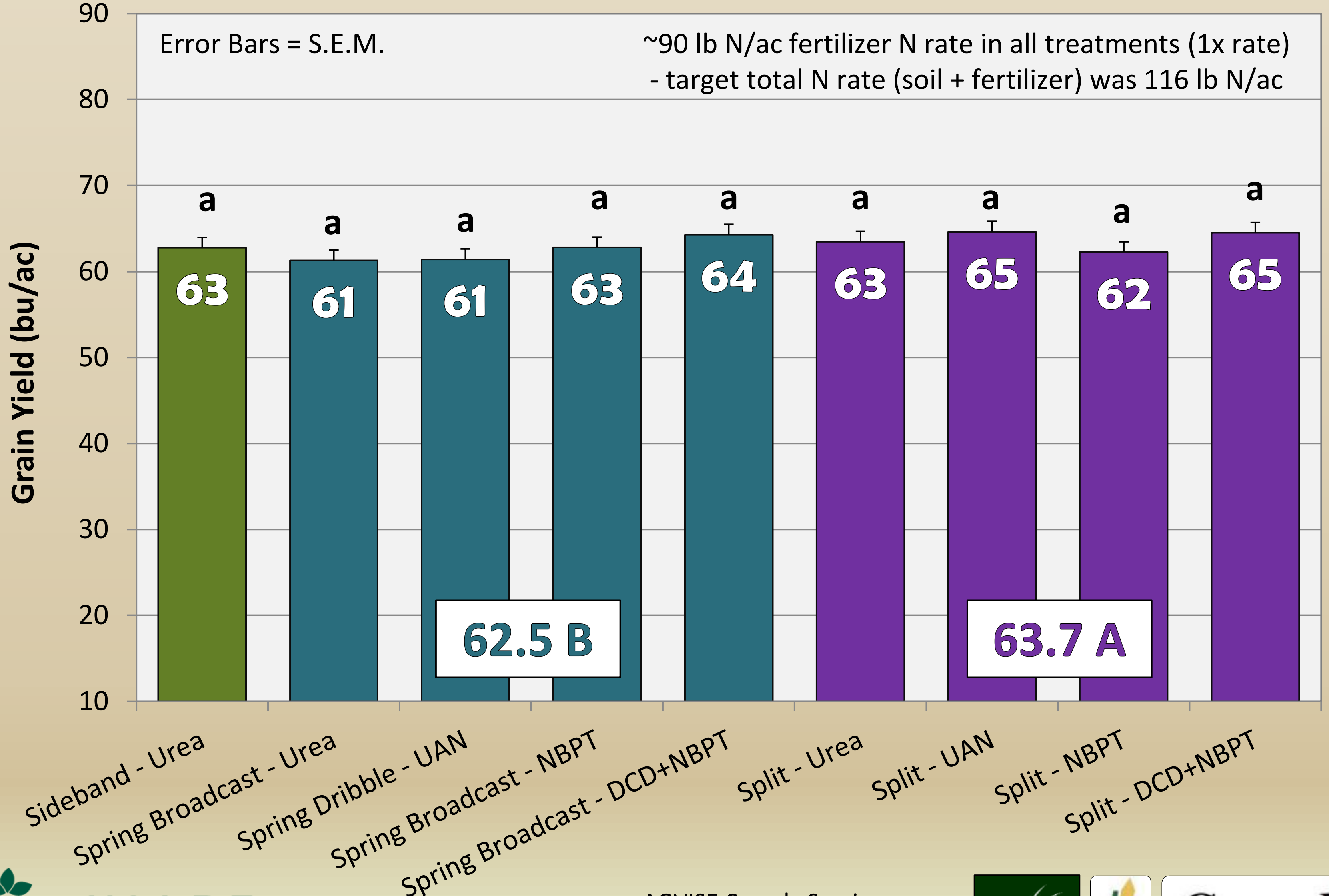


N Source = Side-banded Urea

Residual NO_3-N = 27 lb/ac (fall composite)

N Management Effects on Wheat Yield

Indian Head 2017



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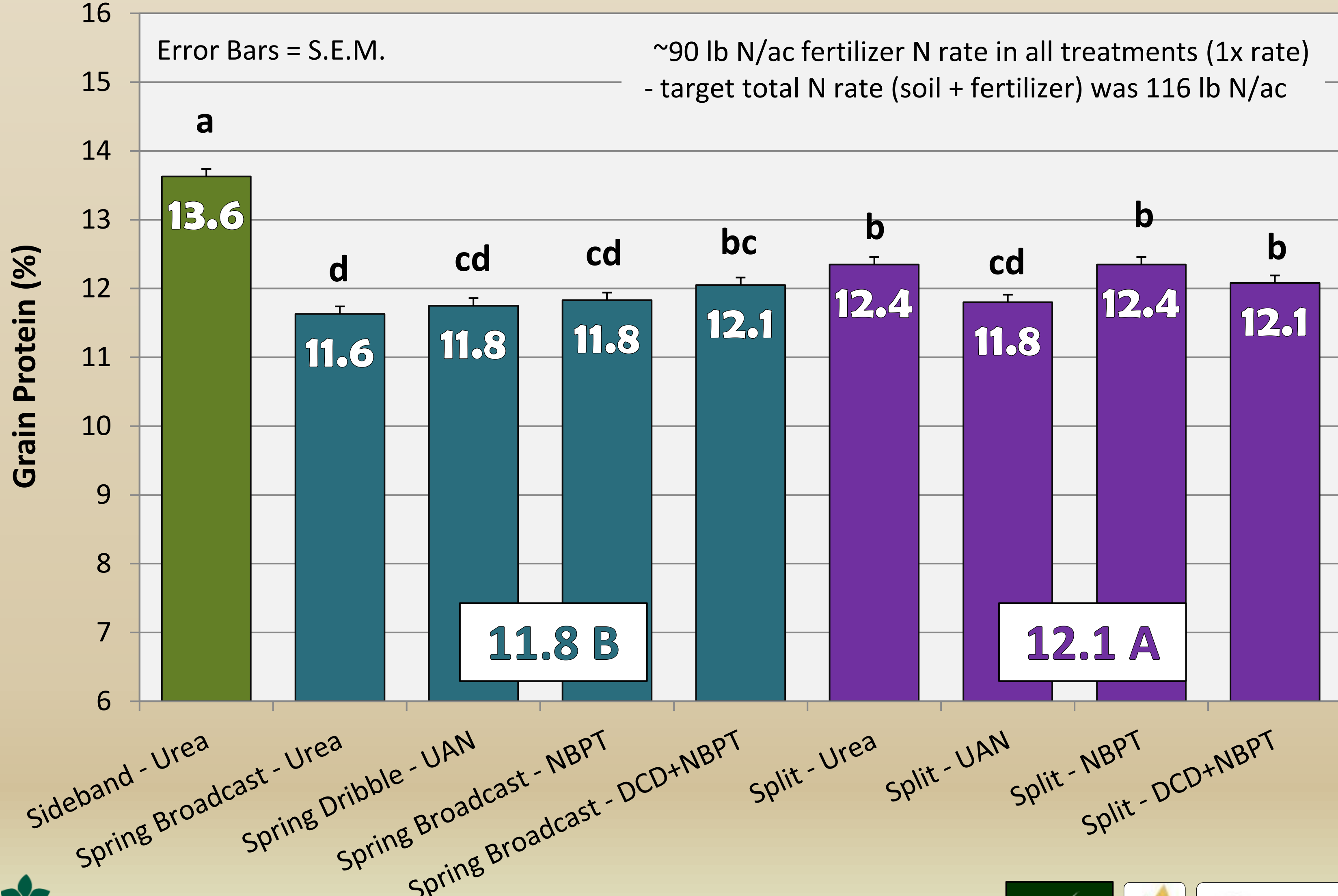
N Management Effects on Wheat Protein

Indian Head 2017

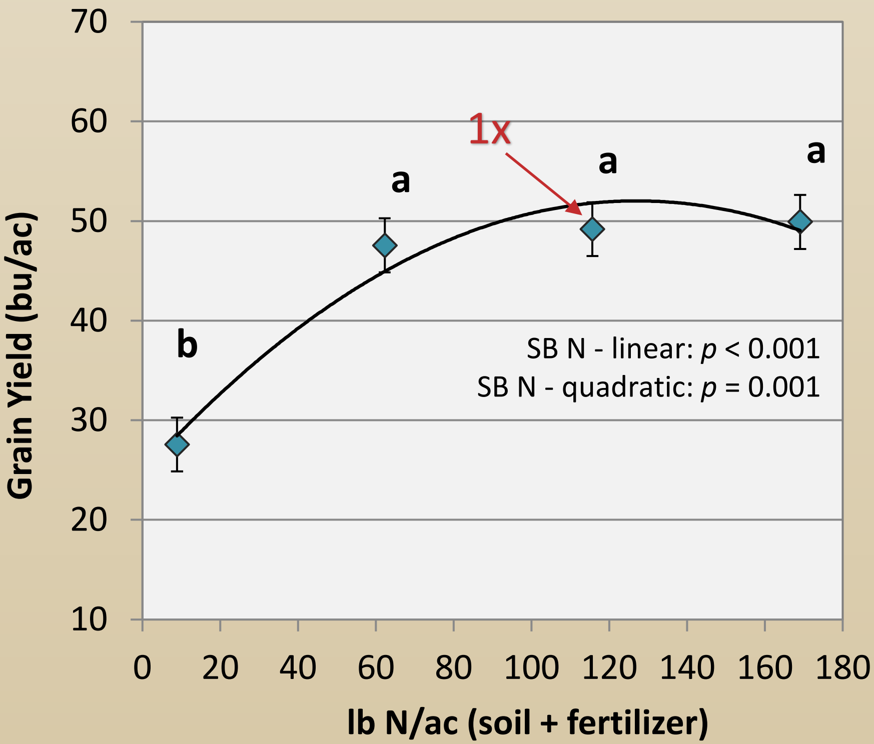


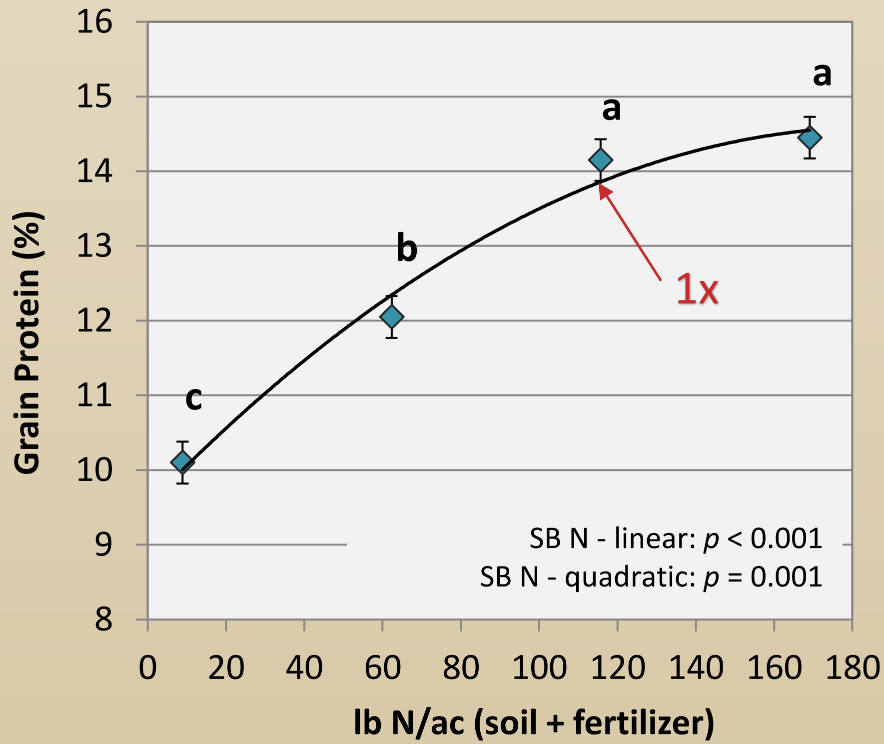
4R Nitrogen Treatments: Indian Head 2018

#	Form	Timing / Placement	Rate *	
1	Urea	Side-band	1.0x	
2	NBPT (Agrotain®)	Side-band	1.0x	May 16
3	DCD+NBPT (SUPERU®)	Side-band	1.0x	
4	Urea	Fall Surface Broadcast	1.0x	
5	NBPT (Agrotain®)	Fall Surface Broadcast	1.0x	Oct 17
6	DCD+NBPT (SUPERU®)	Fall Surface Broadcast	1.0x	
7	Urea	Fall In-Soil Band	1.0x	
8	NBPT (Agrotain®)	Fall In-Soil Band	1.0x	Oct 17
9	DCD+NBPT (SUPERU®)	Fall In-Soil Band	1.0x	

* 1x = 116 lb/ac (soil + fertilizer)

Nitrogen Rate Effects on Wheat Yield & Protein (Indian Head 2018)



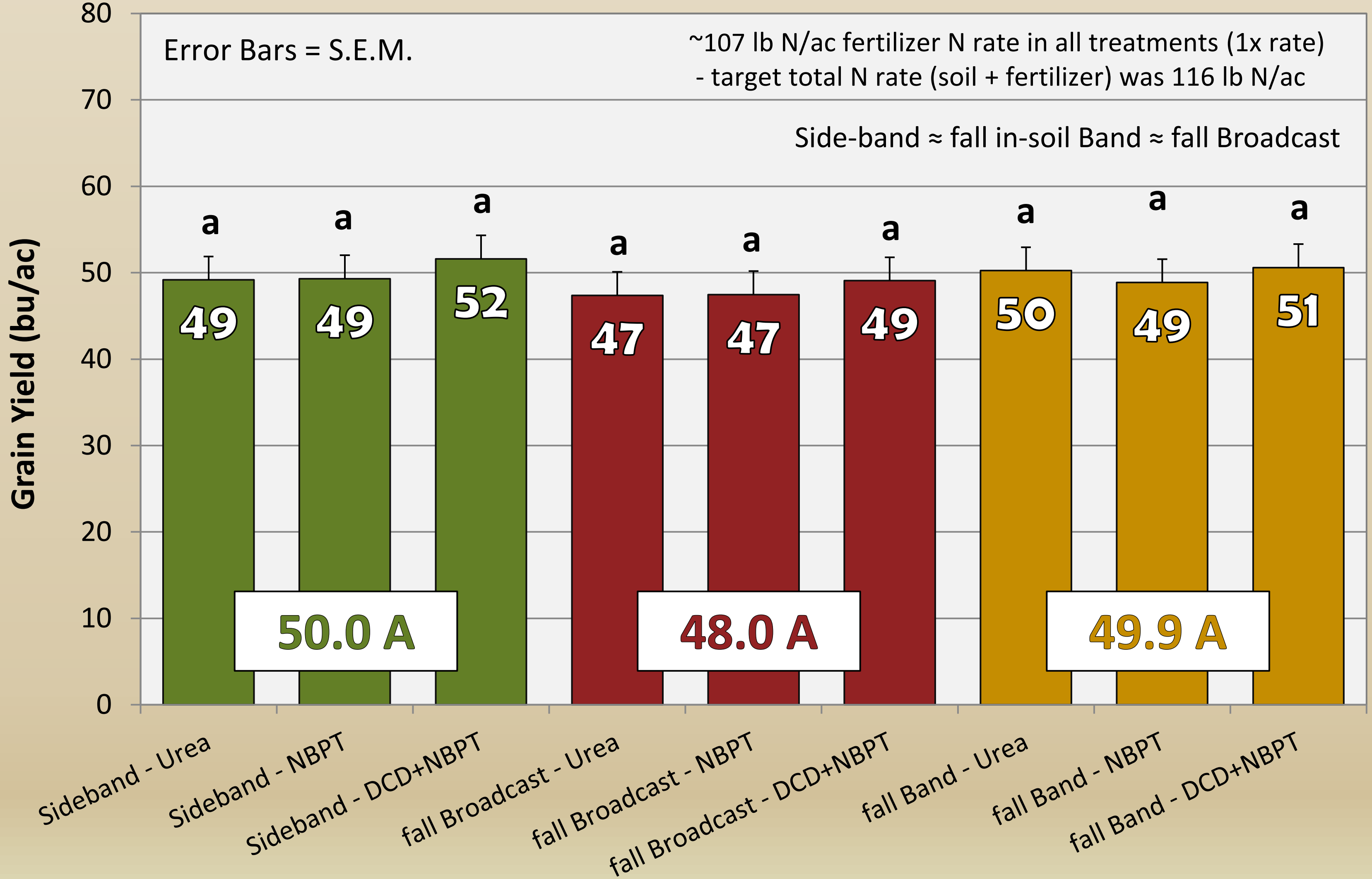


N Source = Side-banded Urea

Residual NO_3-N = 9 lb/ac (fall composite)

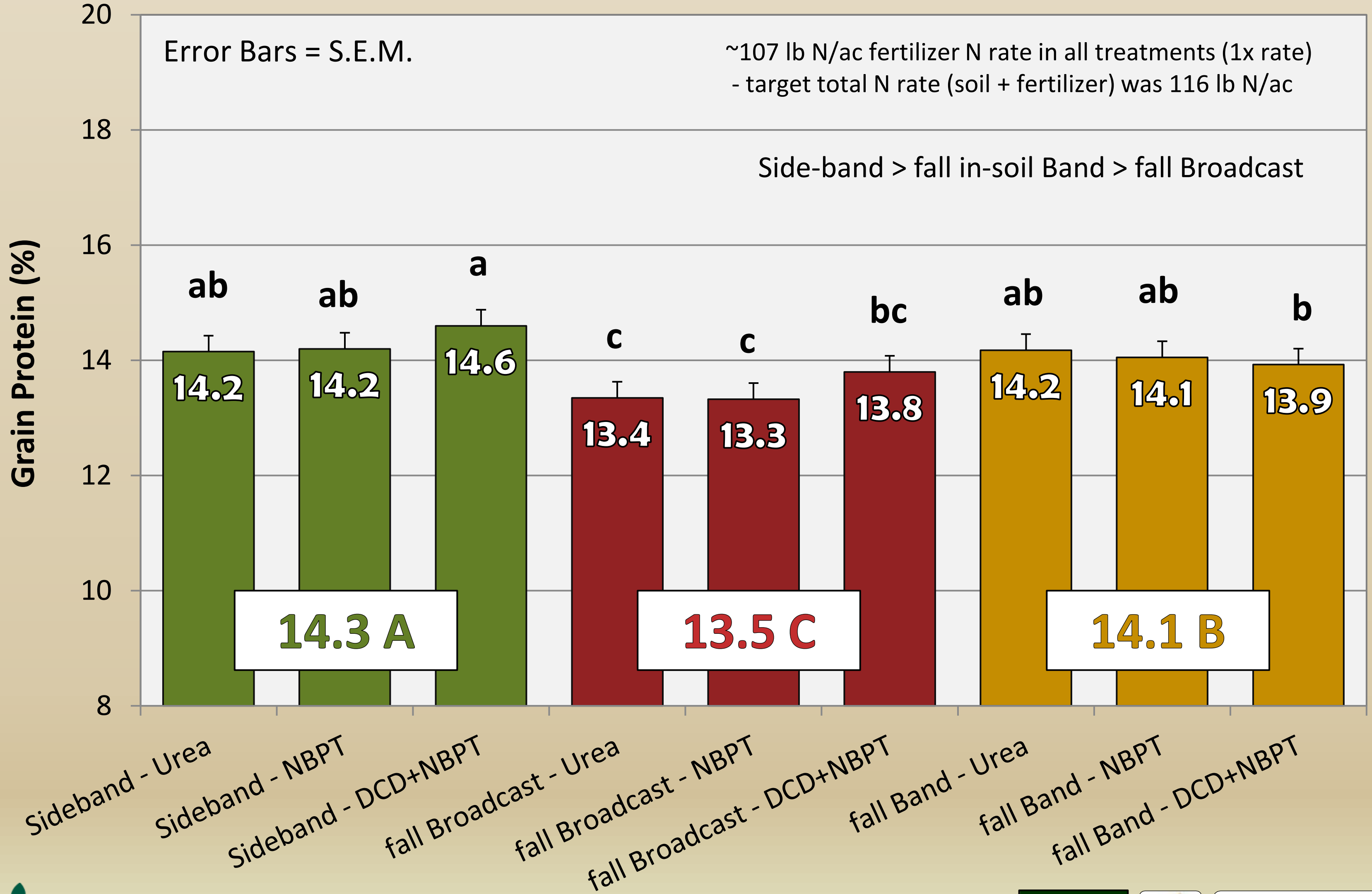
N Management Effects on Wheat Yield

Indian Head 2018



N Management Effects on Wheat Protein

Indian Head 2018

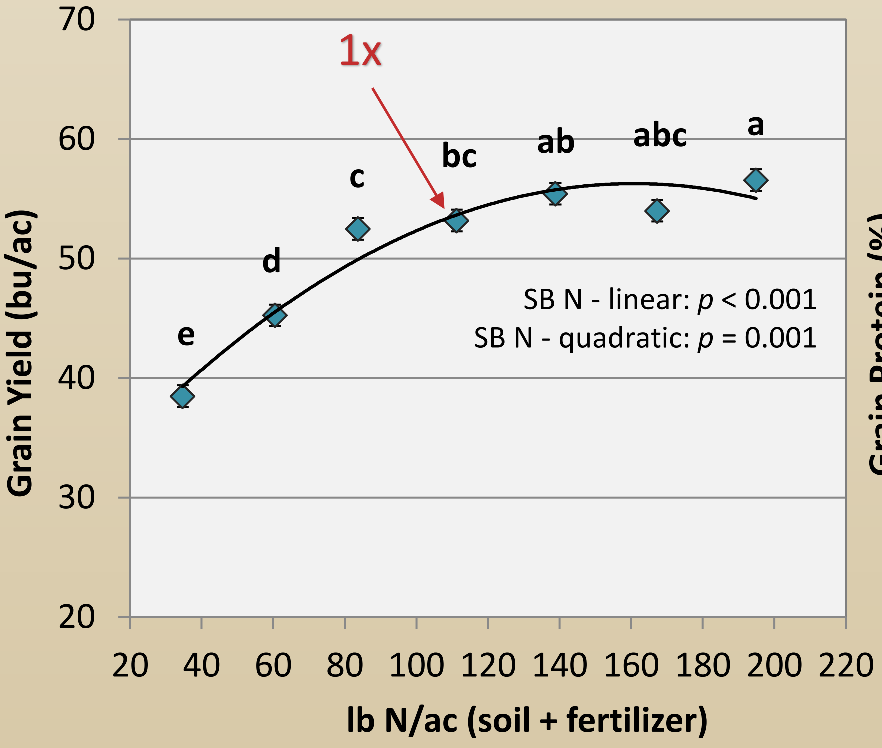


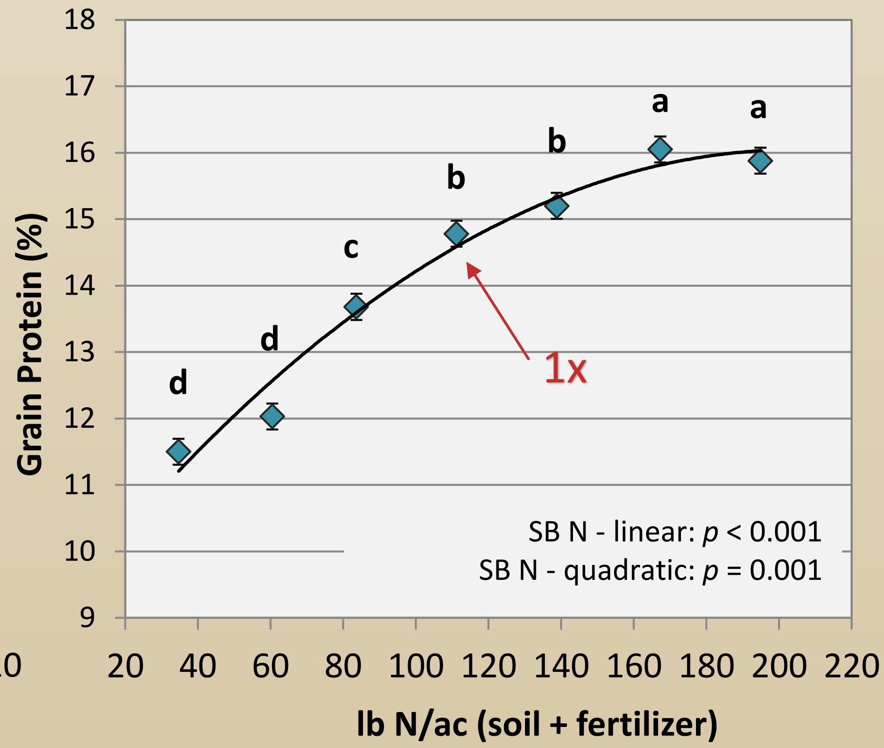
4R Nitrogen Treatments: Indian Head 2019

#	Form	Timing / Placement		Rate *
1	Urea	Side-band		1.0x
2	ESN® polymer coated urea	Side-band	May	1.0x
3	Agrotain® treated urea	Side-band	6	1.0x
4	SuperUrea®	Side-band		1.0x
5	Urea	Fall Surface Broadcast		1.0x
6	ESN® polymer coated urea	Fall Surface Broadcast	Oct	1.0x
7	Agrotain® treated urea	Fall Surface Broadcast	9	1.0x
8	SuperUrea®	Fall Surface Broadcast		1.0x
9	Urea	Spring Surface Broadcast (pre-seed)		1.0x
10	ESN® polymer coated urea	Spring Surface Broadcast	May	1.0x
11	Agrotain® treated urea	Spring Surface Broadcast	4	1.0x
12	SuperUrea®	Spring Surface Broadcast		1.0x

* 1x = 111 lb/ac (soil + fertilizer)

Nitrogen Rate Effects on Wheat Yield & Protein (Indian Head 2019)

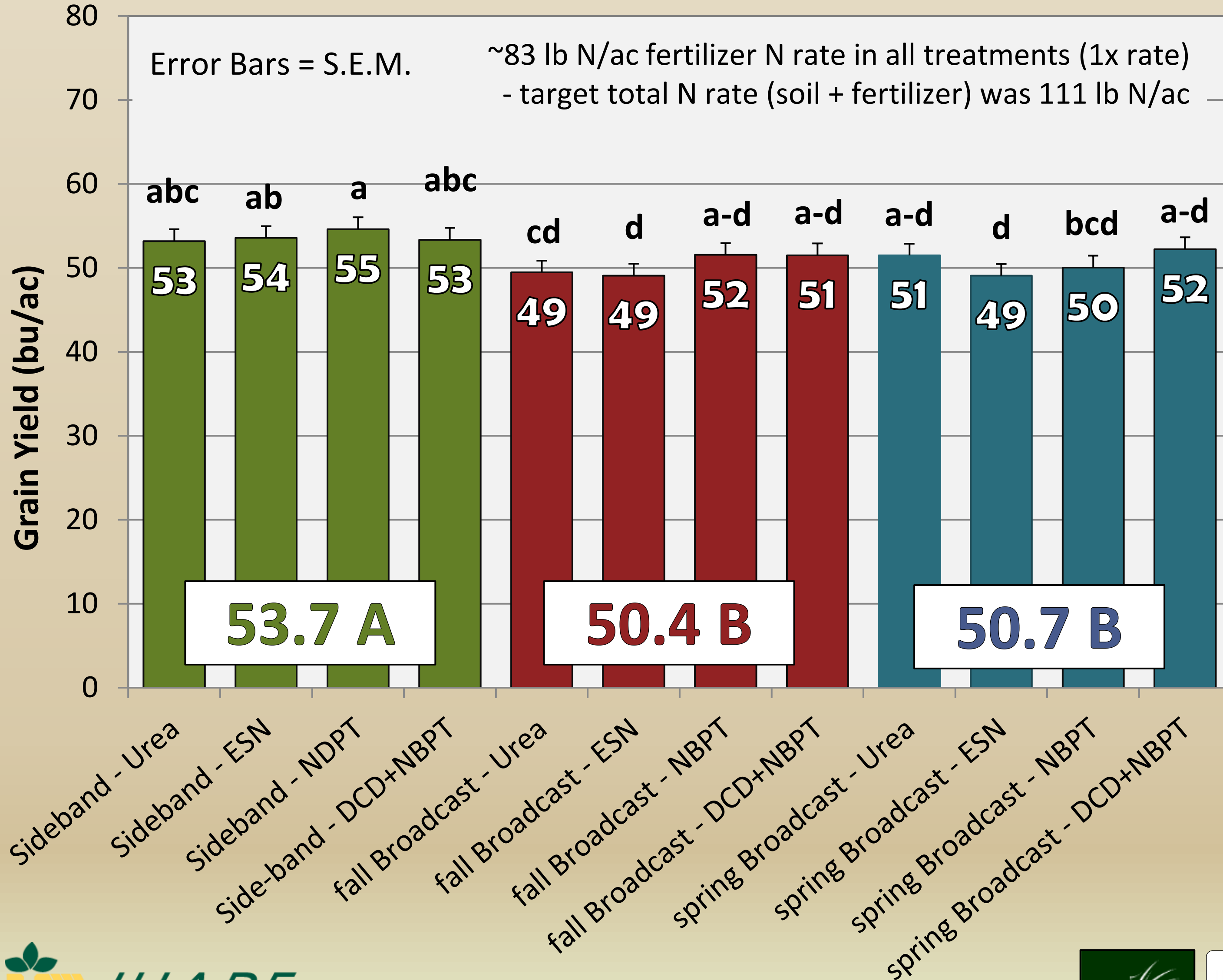




N Source = Side-banded Urea

Residual NO_3-N = 35 lb/ac (fall composite, includes N from MAP)

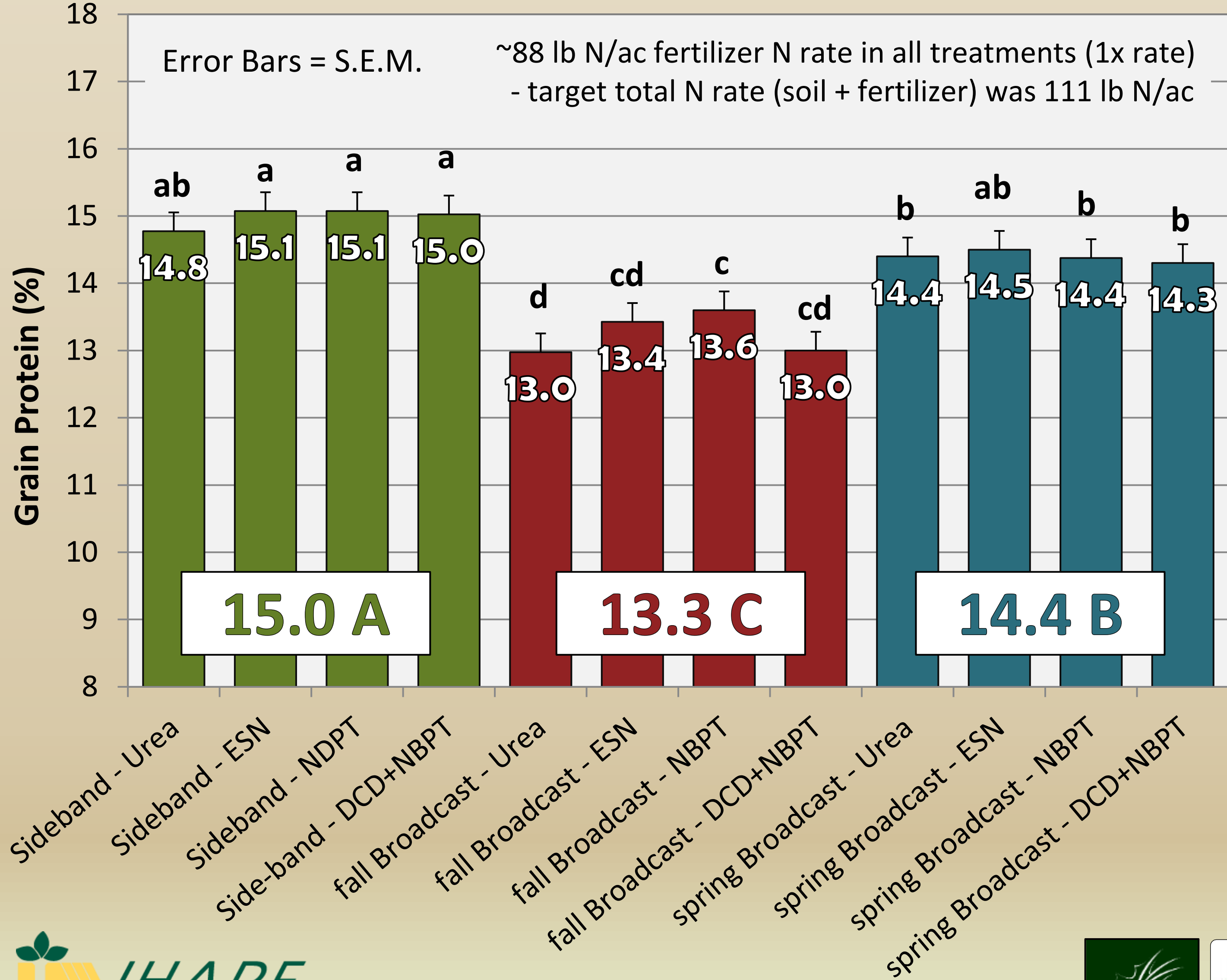
N Management Effects on Wheat Yield
Indian Head 2019



Source	Pr > F
Form (F)	0.392
Time / Place (TP)	0.003
F x TP	0.719

N Management Effects on Wheat Protein

Indian Head 2019



Source	Pr > F
Form (F)	0.232
Time / Place (TP)	<0.001
F x TP	0.750

4R Nitrogen Treatments: Indian Head 2020-21

#	Form	Timing / Placement	Rate (soil + fertilizer)
1	N/A	N/A	6 lb N/ac (from MAP) + Residual†
2	Untreated Urea	Side-Band (≈1.5" depth)	147 lb N/ac (High N – 1.5x rate)
3	Untreated Urea	Side-Band (≈1.5" depth)	98 lb N/ac (1.0x rate)
4	Untreated Urea	Fall Surface Broadcast	98 lb N/ac (1.0x rate)
5	Untreated Urea	Spring Surface Broadcast	98 lb N/ac (1.0x rate)
6	Untreated Urea	Fall Deep Band (≈2.3")	98 lb N/ac (1.0x rate)
7	Untreated Urea	Fall Shallow Band (≈1")	98 lb N/ac (1.0x rate)
8	DCD + NBPT (SUPERU®)	Side-Band (≈1.5" depth)	147 lb N/ac (High N – 1.5x rate)
9	DCD + NBPT	Side-Band (≈1.5" depth)	98 lb N/ac (1.0x rate)
10	DCD + NBPT	Fall Surface Broadcast	98 lb N/ac (1.0x rate)
11	DCD + NBPT	Spring Surface Broadcast	98 lb N/ac (1.0x rate)
12	DCD + NBPT	Fall Deep Band (≈2.3")	98 lb N/ac (1.0x rate)
13	DCD + NBPT	Fall Shallow Band (≈1")	98 lb N/ac (1.0x rate)

†Residual NO_3-N (0-24"): 8 lb/ac in 2019-20 and 14 lb/ac in 2020-21

4R Nitrogen Treatments: Indian Head 2020-21

Relevant Weather & Soil Test Information

Year	Prev. Sep	Prev. Oct	May	June	July	August	May-Aug
	-- Mean Temperature (°C) --						
2020	11.9	1.0	10.7	15.6	18.4	17.9	15.7 (101%)
2021	11.5	1.4	9.0	17.7	20.3	17.1	16.0 (103%)
LT	11.5	4.0	10.8	15.8	18.2	17.4	15.6
	-- Total Precipitation (mm) --						
2020	120.8	10.4	27.3	23.5	37.7	24.9	113 (46%)
2021	15.0	3.8	81.6	62.9	51.2	99.4	295 (121%)
LT	35.3	24.9	51.8	77.4	63.8	51.2	244

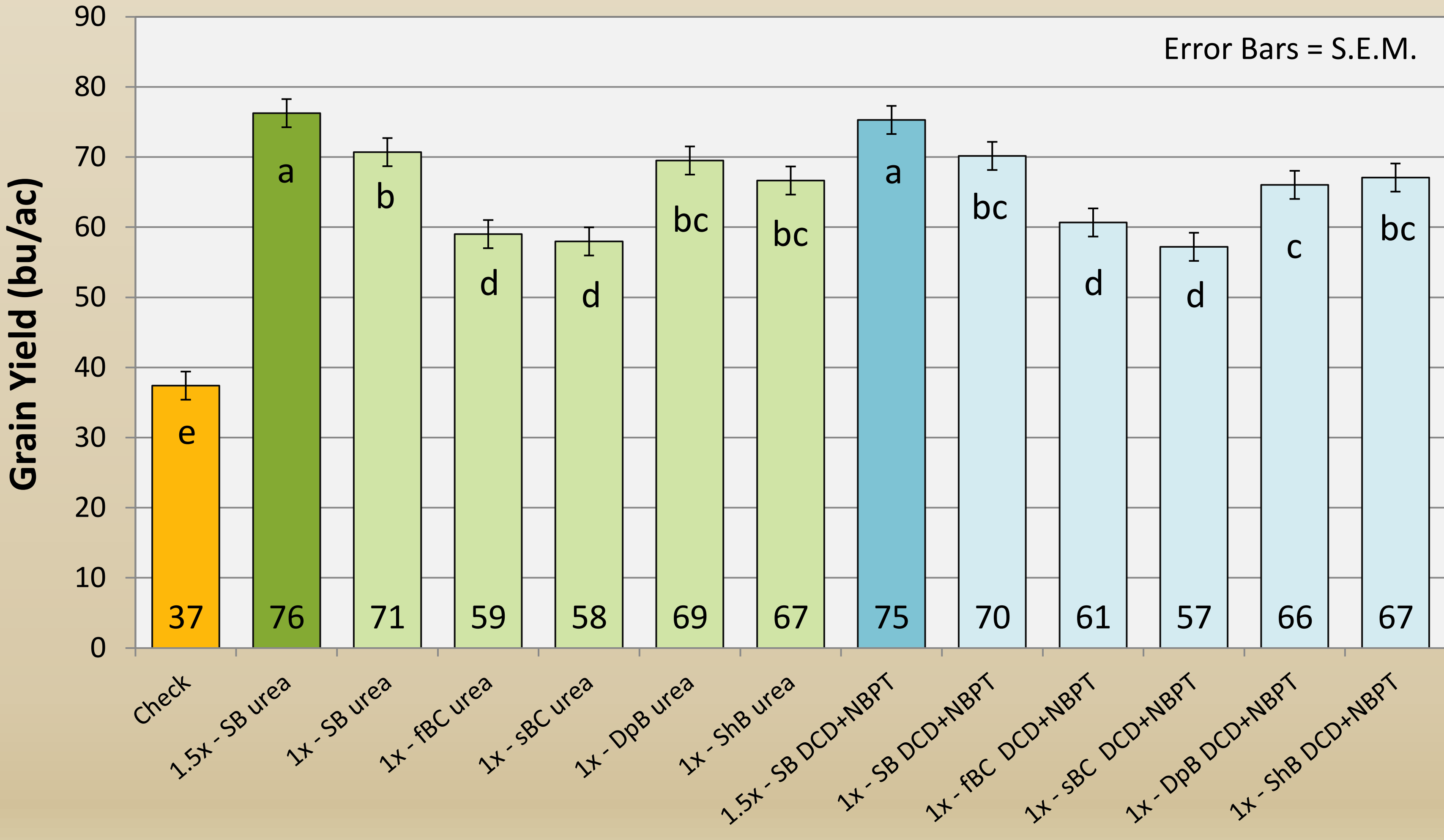
2019-20: Wet soil preceding fall N applications but limited precipitation following both fall the & spring applications – extremely dry growing season

2020-21: Extremely dry fall & early spring but 80 mm of rain received starting 12 days after spring broadcast applications – variable moisture conditions through the 2021 growing season

Residual N: Consistently low with 8-14 lb NO_3-N/ac in fall composites

N Management Effects on Wheat Yield

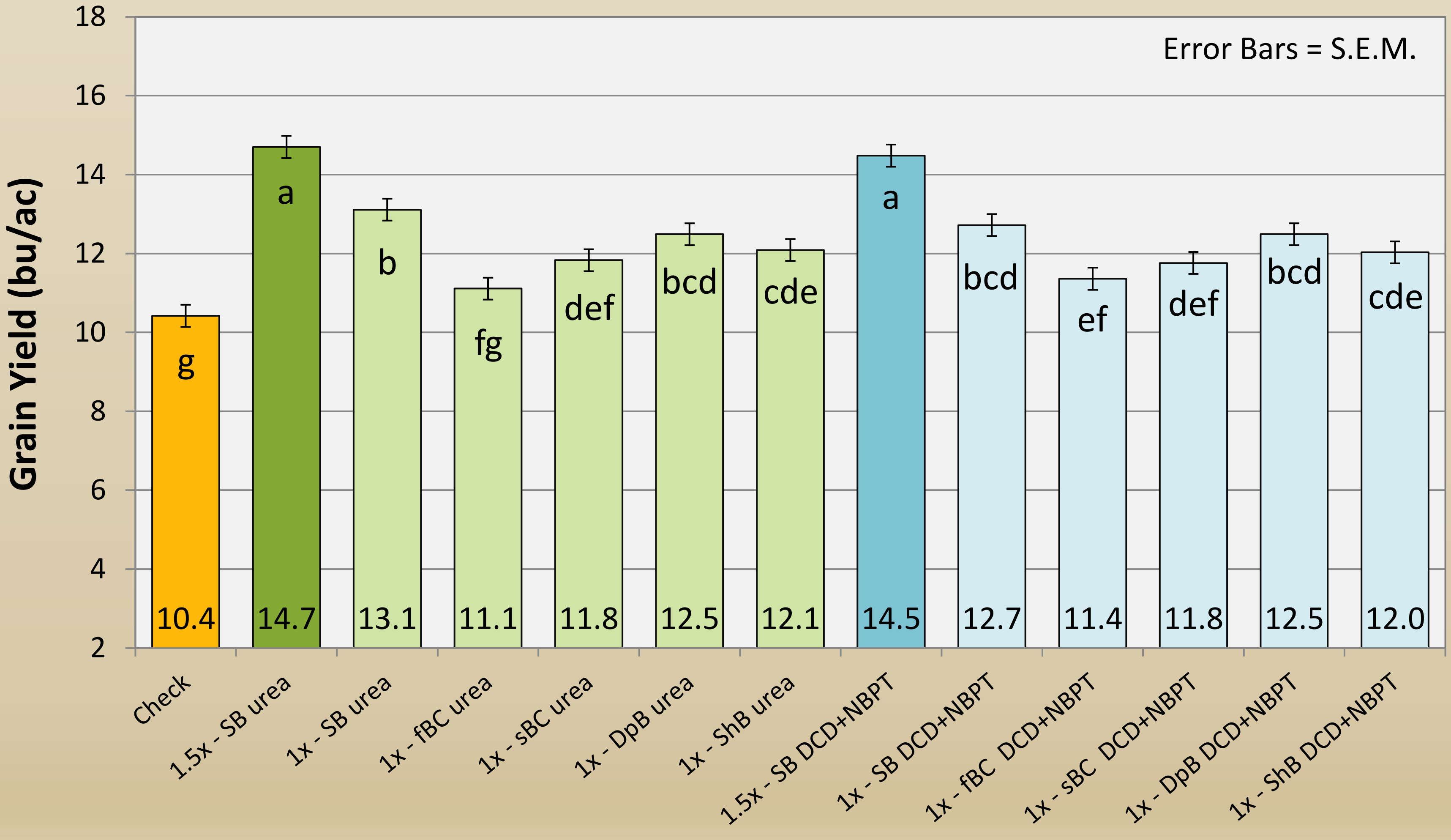
Indian Head 2020



SB – Side Band   fBC – fall Broadcast   sBC – spring Broadcast   DpB – fall Deep Band   ShB – fall shallow band

N Management Effects on Wheat Protein

Indian Head 2020



SB – Side Band   fBC – fall Broadcast   sBC – spring Broadcast   DpB – fall Deep Band   ShB – fall shallow band

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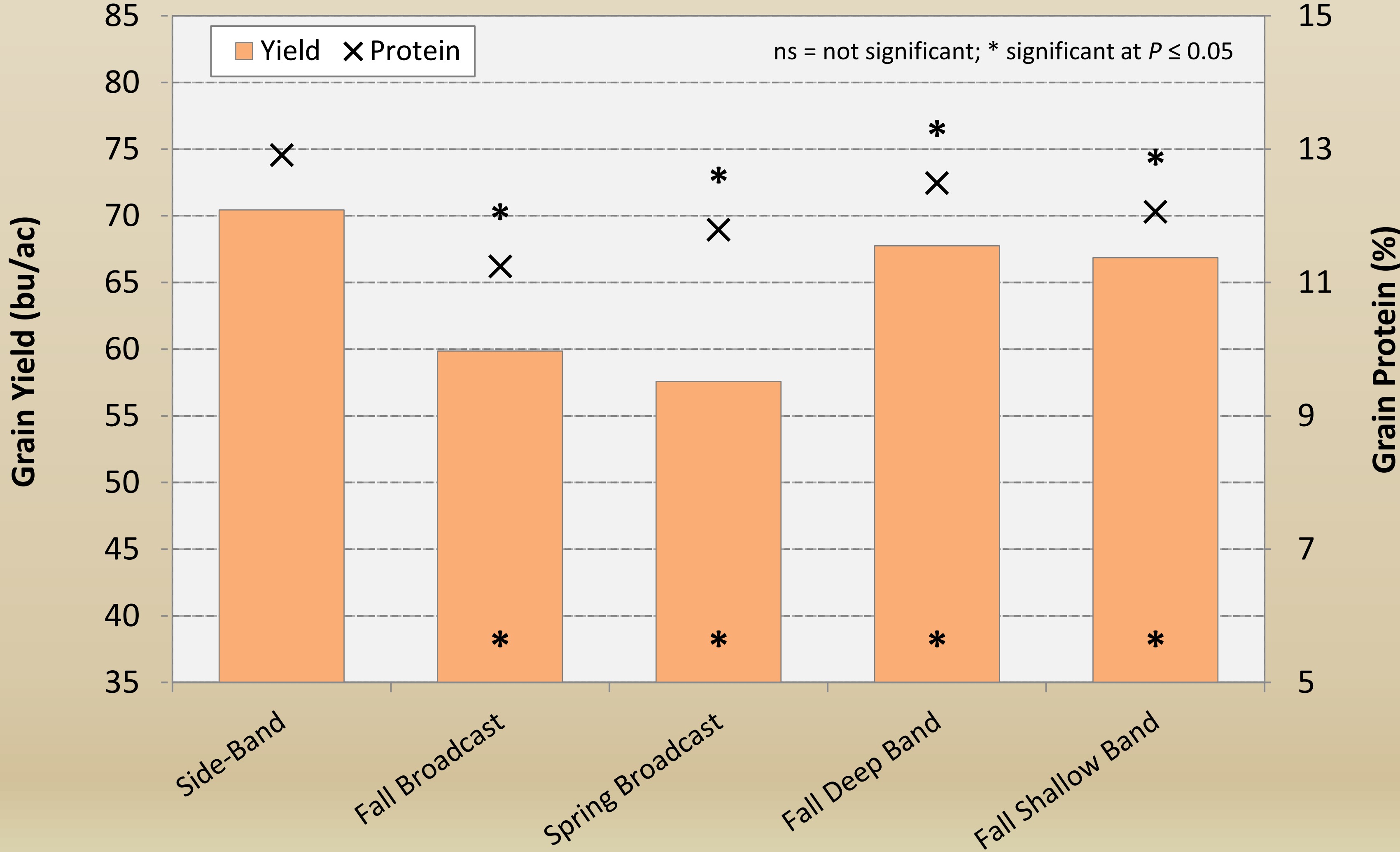
Predetermined Contrast Comparisons

Two-Pass vs. Sideband (2020)



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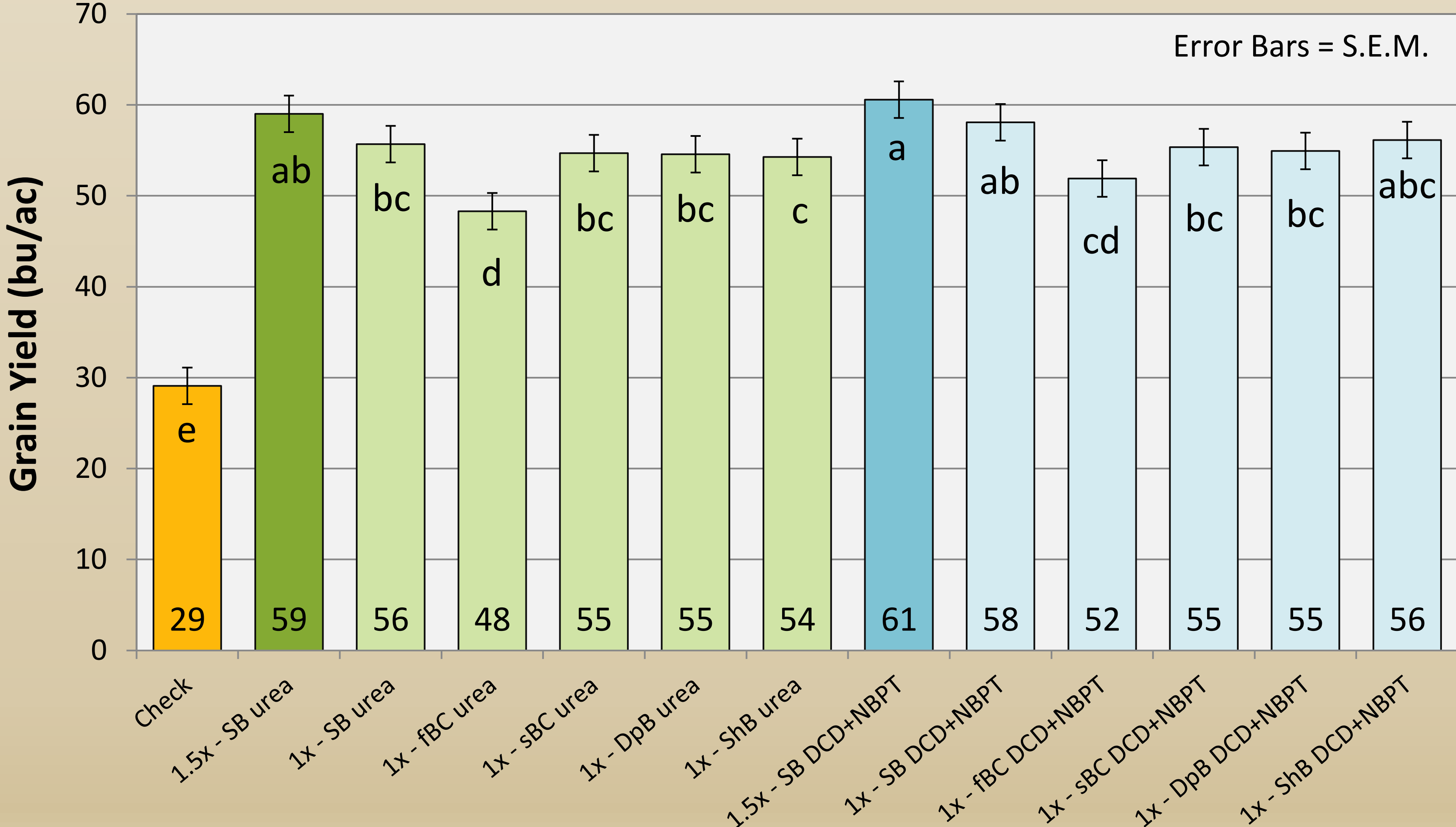
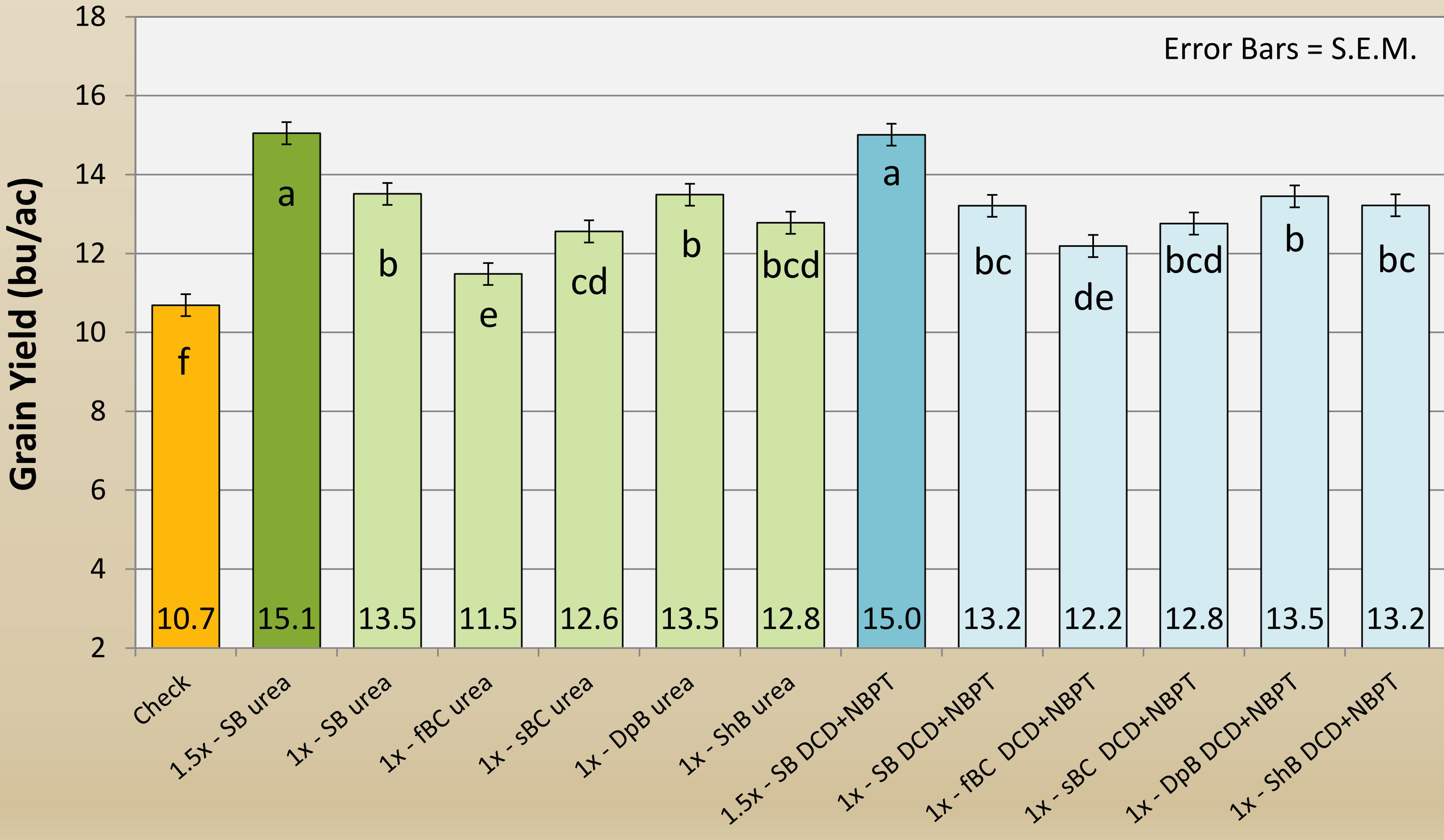
N Management Effects on Wheat Yield
Indian Head 2021



SB – Side Band fBC – fall Broadcast sBC – spring Broadcast DpB – fall Deep Band ShB – fall shallow band

N Management Effects on Wheat Protein

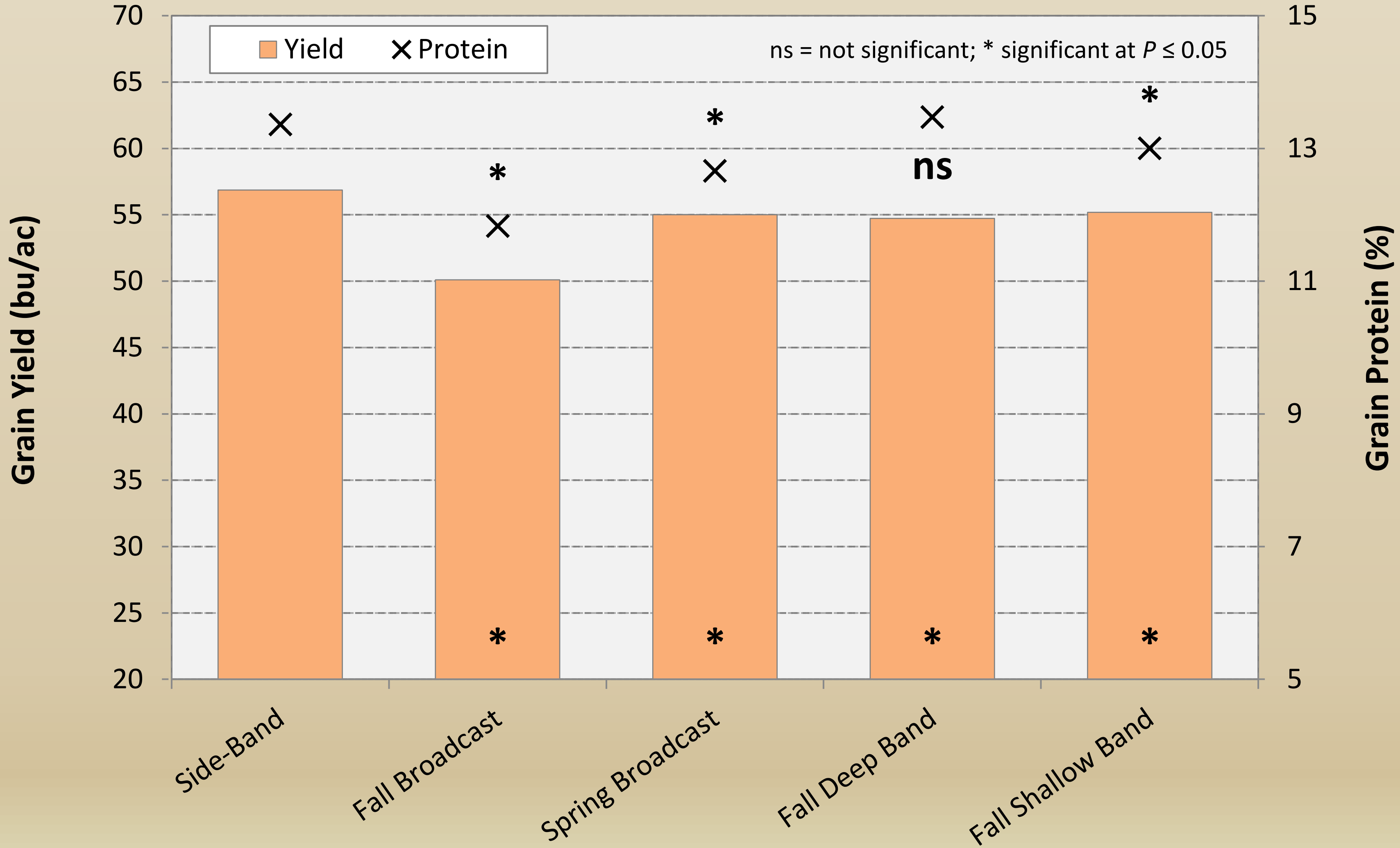
Indian Head 2021



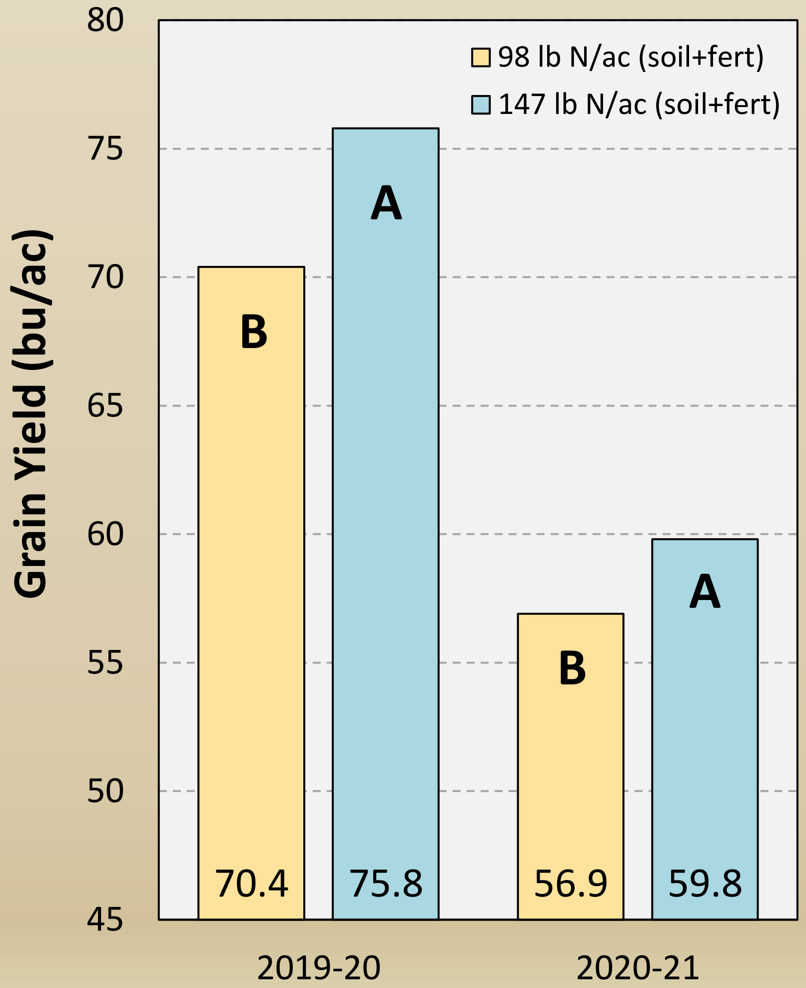
SB – Side Band fBC – fall Broadcast sBC – spring Broadcast DpB – fall Deep Band ShB – fall shallow band

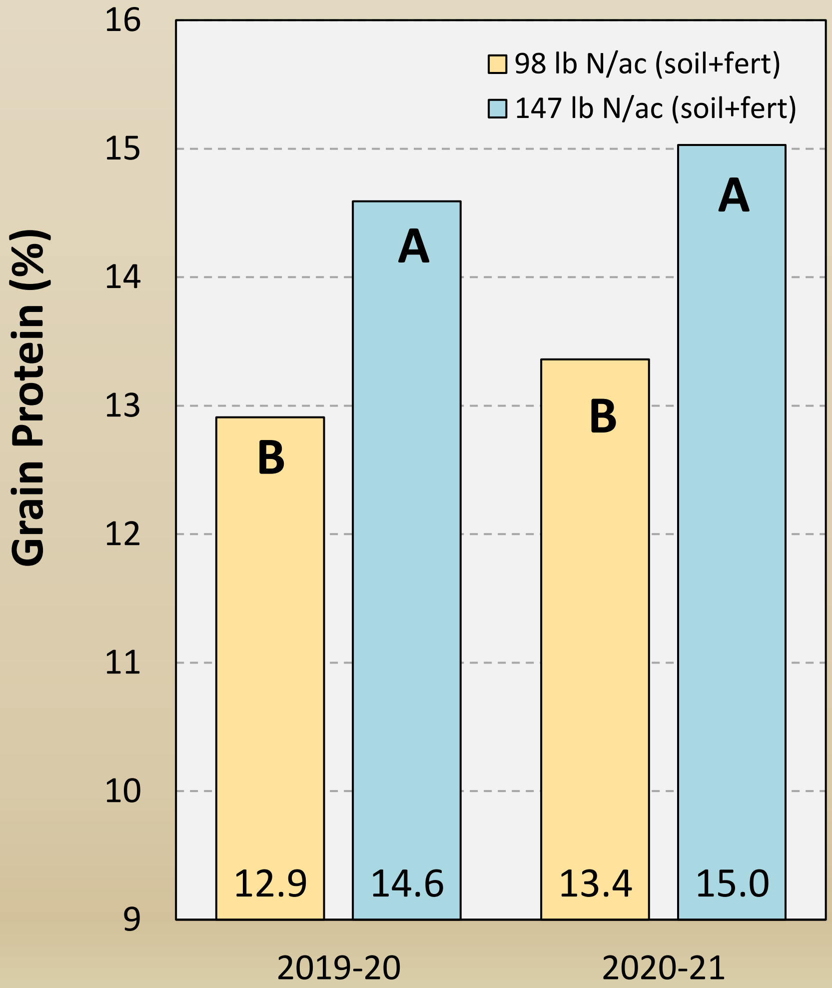
Predetermined Contrast Comparisons

Two-Pass vs. Sideband (2021)



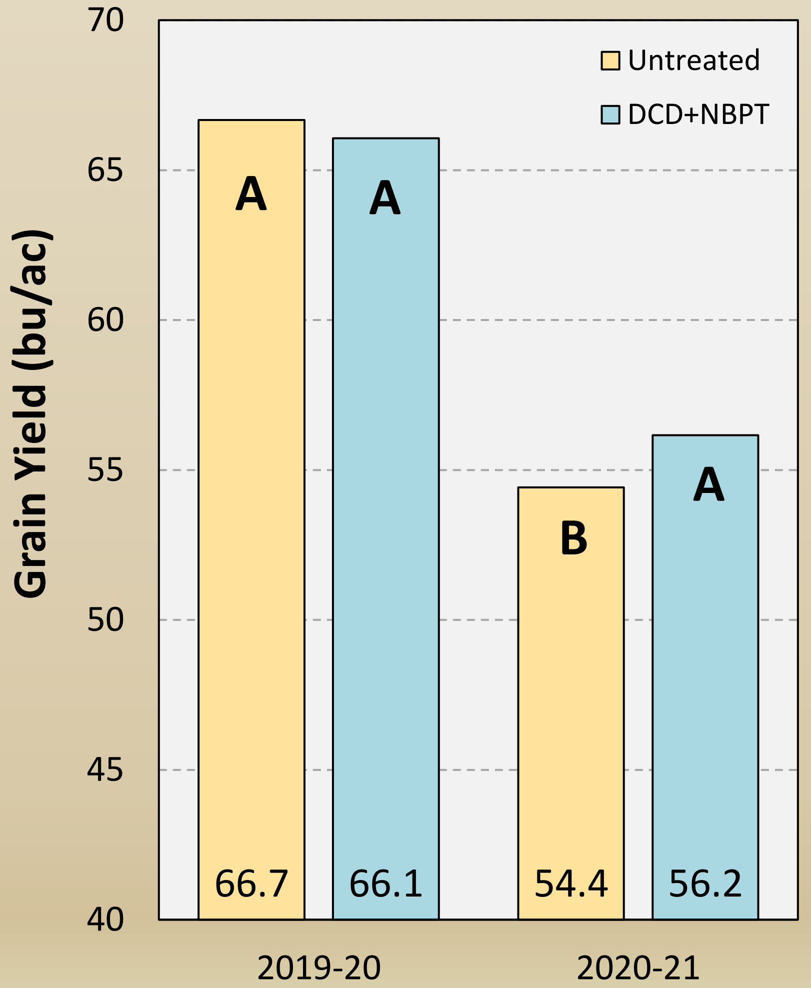
Predetermined Contrast Comparisons
1x Side Band (3,9) versus 1.5x Side Band (2,8)

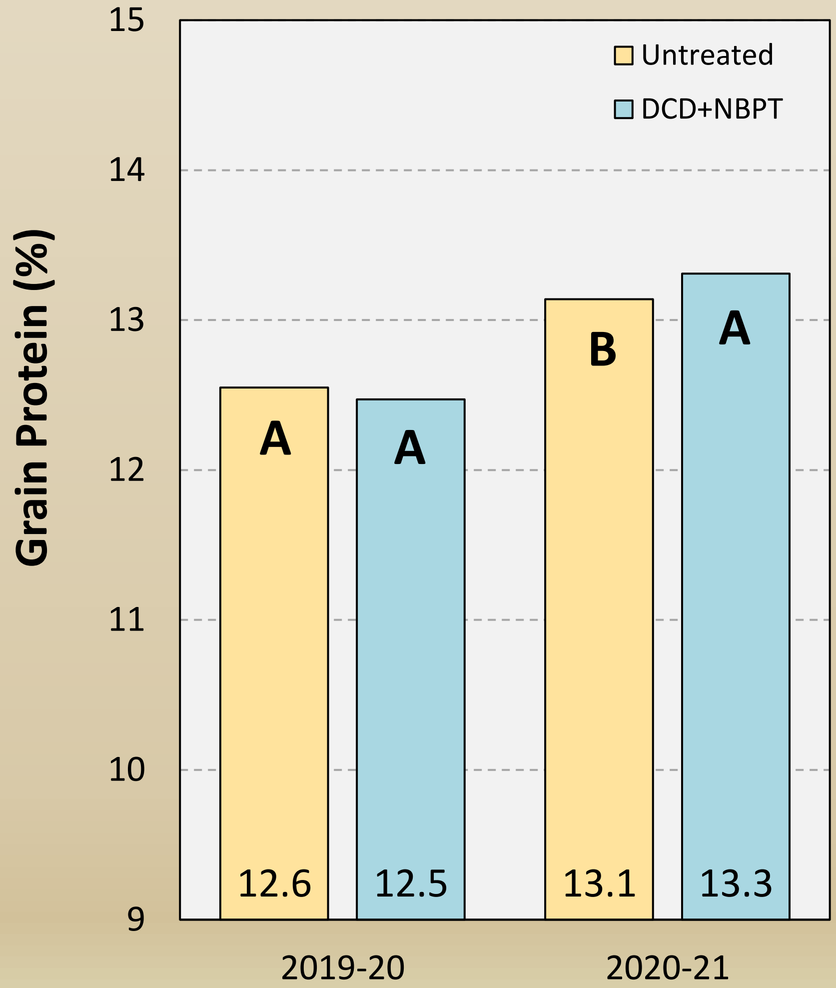




Predetermined Contrast Comparisons

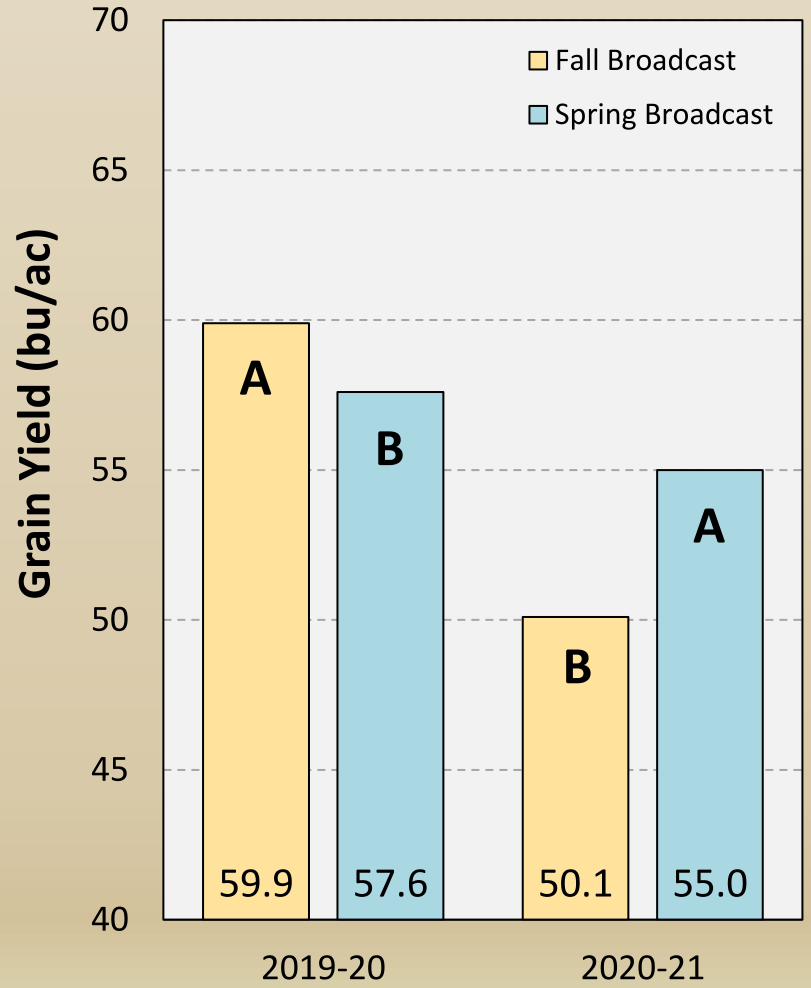
Untreated Urea (2-7) versus DCD+NDPT (8-13)

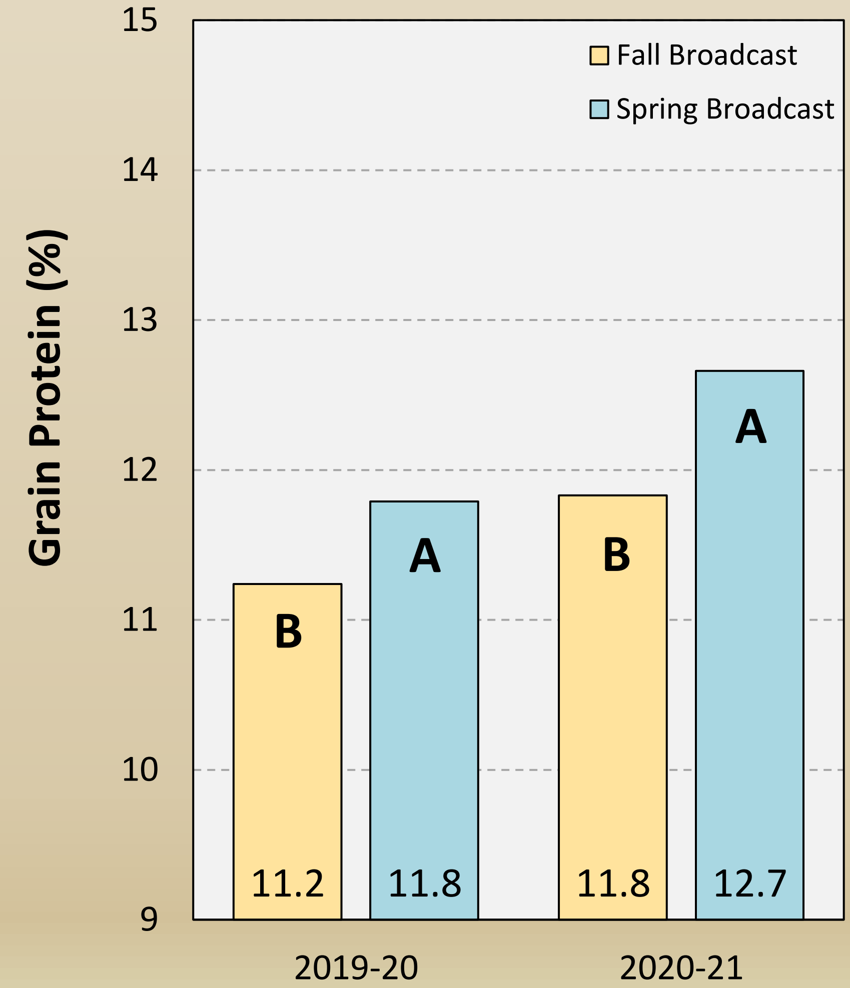




Predetermined Contrast Comparisons

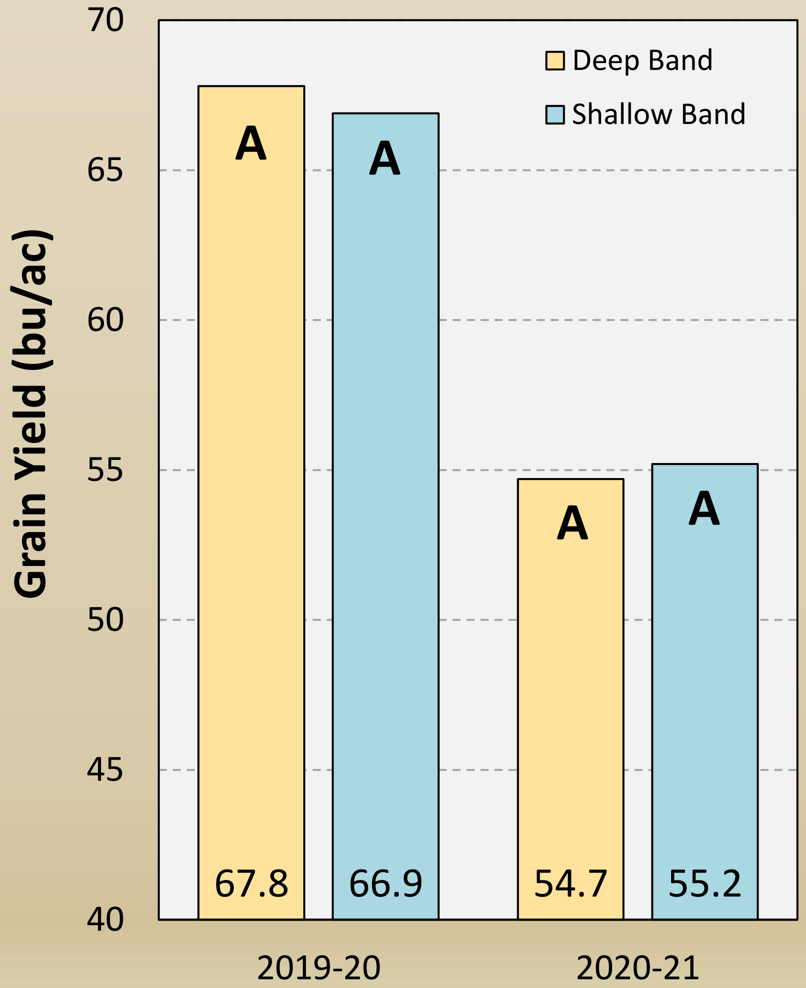
Spring Broadcast (5,11) versus Fall Broadcast (4,10)

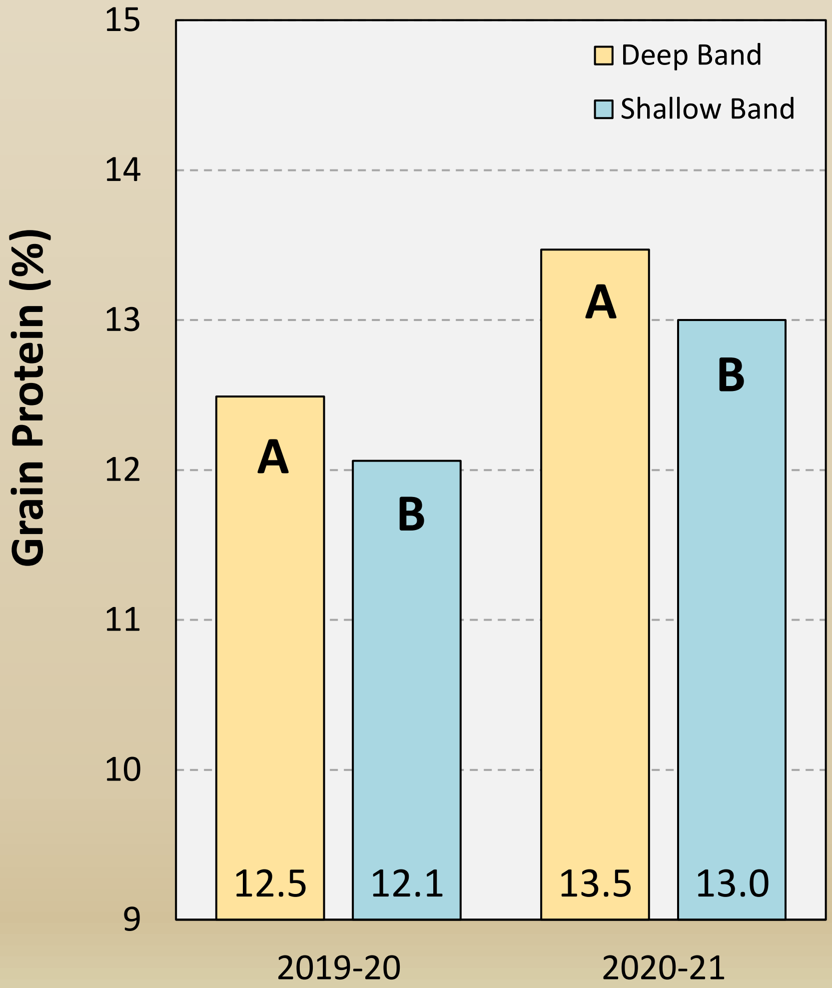




Predetermined Contrast Comparisons

Fall Deep Band (6,12) versus Fall Shallow Band (7,13)

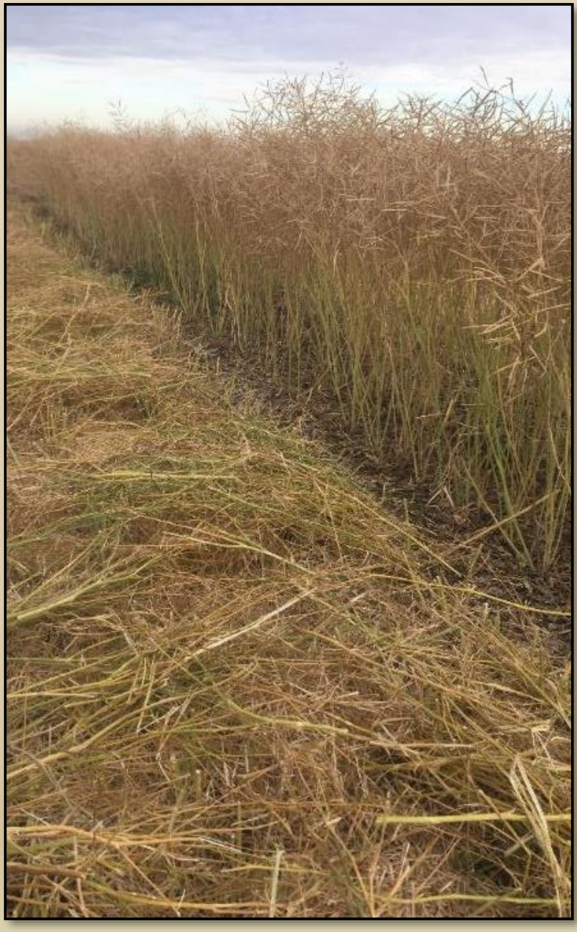




4R N Management Principles: Conclusions

- Relative performance of N management strategies varies with environment, but it has been repeatedly shown that single-pass seeding-fertilization is hard to improve upon for spring crops in western Canada, over a wide range of conditions
- Reasons for utilizing alternative N management strategies have more to do with improving seeding logistics, taking advantage of lower fertilizer prices in the fall, & mitigating risk (i.e., deferring N application under severe drought) than agronomy; but flexibility is important for farmers in this regard
- Enhanced efficiency or controlled release N forms can reduce the risks associated with less optimal timing/placement options, but do not usually close the gap entirely & timing/placement is more important than formulation for minimizing losses & maximizing crop utilization
- Deeper placement of banded fertilizer can be advantageous; however, the difference between shallow vs. deep banding is much less than shallow banding vs. broadcasting
- Split-applications have greater potential to be truly beneficial in wetter and warmer environments where the potential for losses, yields, & total N requirements are all higher, the growing season is longer & the risks of in-crop N being stranded (due to dry weather) are lower

Canola Seed Safety & Yield Response to Various Phosphorus Fertilizer Forms (multi-site 2020-21)



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Canola Seed Safety & Yield Response to Various Phosphorus Forms (2020-21)

Objectives: To demonstrate canola establishment & yield response to increasing rates of seed-placed phosphorus fertilizer for various formulations

Locations: Indian Head (2020 & 2021), Melfort (2021), Outlook (2021), Redvers (2021), Scott (2020 & 2021), Swift Current (2020 & 2021), & Yorkton (2021)

Treatments: 4 formulations x 3 rates plus a 0 P control treatment

Formulations

1) Monoammonium Phosphate (**MAP**; 11-52-0)
2) MicroEssentials® **S15** (13-33-0-15)
3) Crystal Green® (**Struvite**; 5-28-0 + 10% Mg)
4) 50:50 MAP:Struvite (**Blend**; 8-40-0 + 5% Mg)

*** Salt Index values are MAP=27, S15=21, Struvite=8**

Rates

1) 22 lb P_2O_5/ac
2) 40 lb P_2O_5/ac
3) 58 lb P_2O_5/ac

Data Collection: Emergence & final densities, maturity, & yield

Note: All P fertilizer was seed-placed, urea & ammonium sulphate were side-banded

Growing Season Weather

Location – Year	Avg. Temperature (°C)	Total Precipitation (mm)
Indian Head – 2020	15.7 **(101%)**	113 **(46%)**
Indian Head – 2021	16.0 **(103%)**	295 **(121%)**
Indian Head – LT [Z]	15.6	244
Melfort – 2021	16.2 **(106%)**	139 **(61%)**
Melfort – LT	15.2	226
Outlook [Y] – 2021	17.1 **(106%)**	96 **(47%)** + 208 irrigation
Outlook – LT	16.1	205
Redvers – 2021	16.8 **(105%)**	247 **(93%)**
Redvers – LT	16.0	267
Scott – 2020	14.6 **(98%)**	258 **(114%)**
Scott – 2021	15.8 **(107%)**	149 **(66%)**
Scott – LT	14.8	227
Swift Current – 2020	15.9 **(100%)**	157 **(83%)**
Swift Current – 2021	16.8 **(106%)**	147 **(78%)**
Swift Current – LT	15.8	188
Yorkton – 2021	16.5 **(109%)**	148 **(54%)**
Yorkton – LT	15.2	272

LT – Long-Term (1981-2010); Outlook site received supplemental irrigation

AGVISE Laboratories Soil Test Info (0-6")

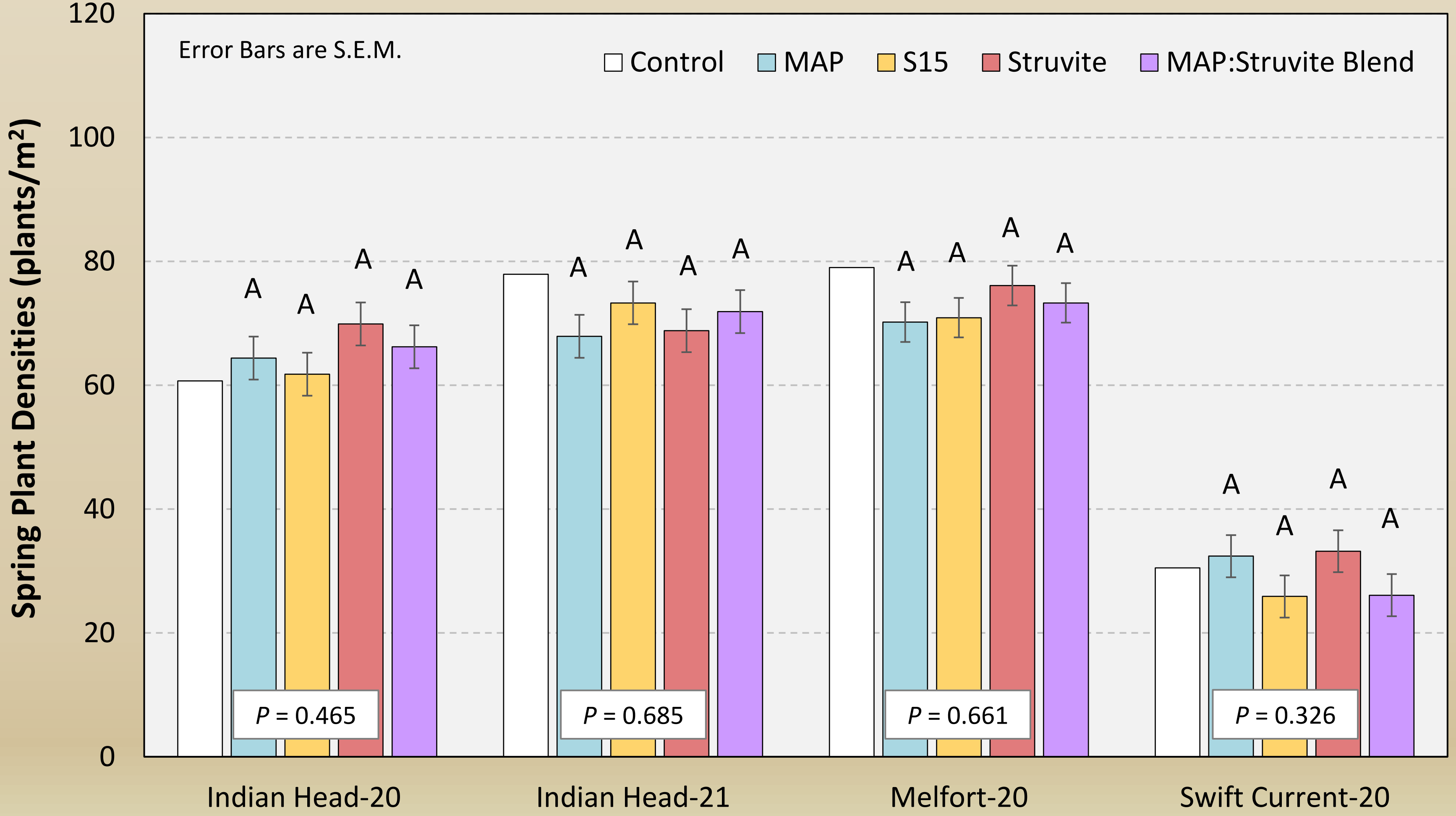
Location – Year	pH	SOM (%)	CEC (meq)	Olsen-P (ppm)
Indian Head – 2020	7.9	5.2	40.6	7
Indian Head – 2021	7.8	4.8	47.2	8
Melfort – 2021	5.9	12.1	n/a	8
Outlook – 2021	7.9	2.7	19.9	11
Redvers – 2021	8.0	3.6	34.6	6
Scott – 2020	6.4	4.0	13.3	12
Scott – 2021	5.5	4.4	15.7	6
Swift Current – 2020	6.6	2.8	n/a	10
Swift Current – 2021	6.5	2.4	n/a	16
Yorkton – 2021	7.1	4.7	22.1	13

F-test Results x Site: Spring Plant Density

Location – Year	Form	Rate	Form × Rate	Entry
	------------------------------ Pr > F (p-value) ------------------------------			
Indian Head – 2020	ns	ns	ns	ns
Indian Head – 2021	ns	ns	ns	ns
Melfort – 2021	ns	ns	ns	ns
Outlook – 2021	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Redvers – 2021	**0.059**	ns	**0.009**	**0.008**
Scott – 2020	**0.037**	ns	ns	ns
Scott – 2021	**<0.001**	**0.026**	**<0.001**	**<0.001**
Swift Current – 2020	ns	ns	ns	ns
Swift Current – 2021	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Yorkton – 2021	**<0.001**	ns	**<0.001**	**<0.001**

Seed-Placed P Form Effects on Canola Emergence (Non-Responsive 4/10 Sites)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



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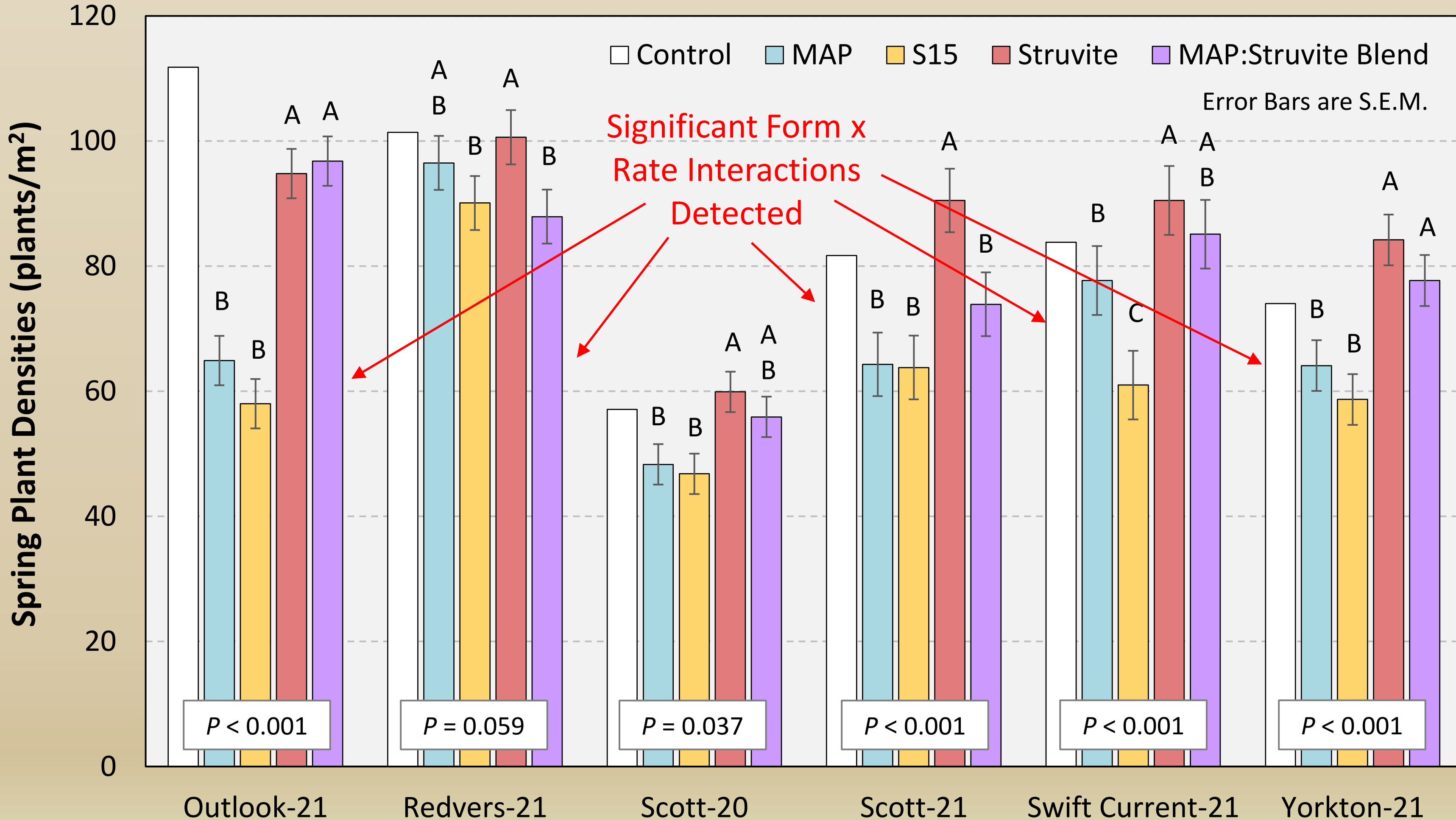
Seed-Placed P Form Effects on Canola Emergence (Responsive 6/10 Sites)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



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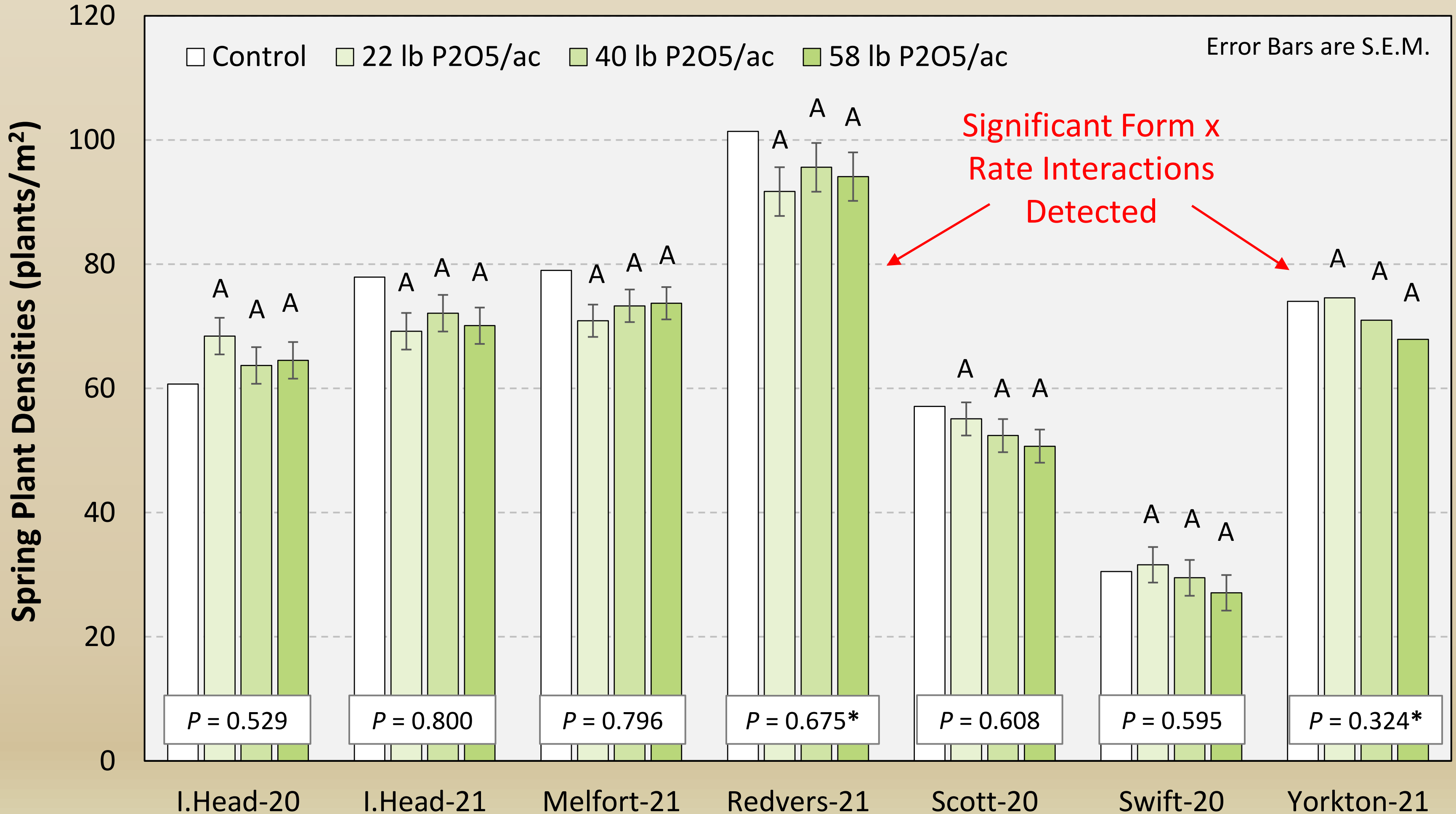
Seed-Placed P Rate Effects on Canola Emergence (Non-Responsive 7/10 Sites)

Averaged Across Four Fertilizer Formulations



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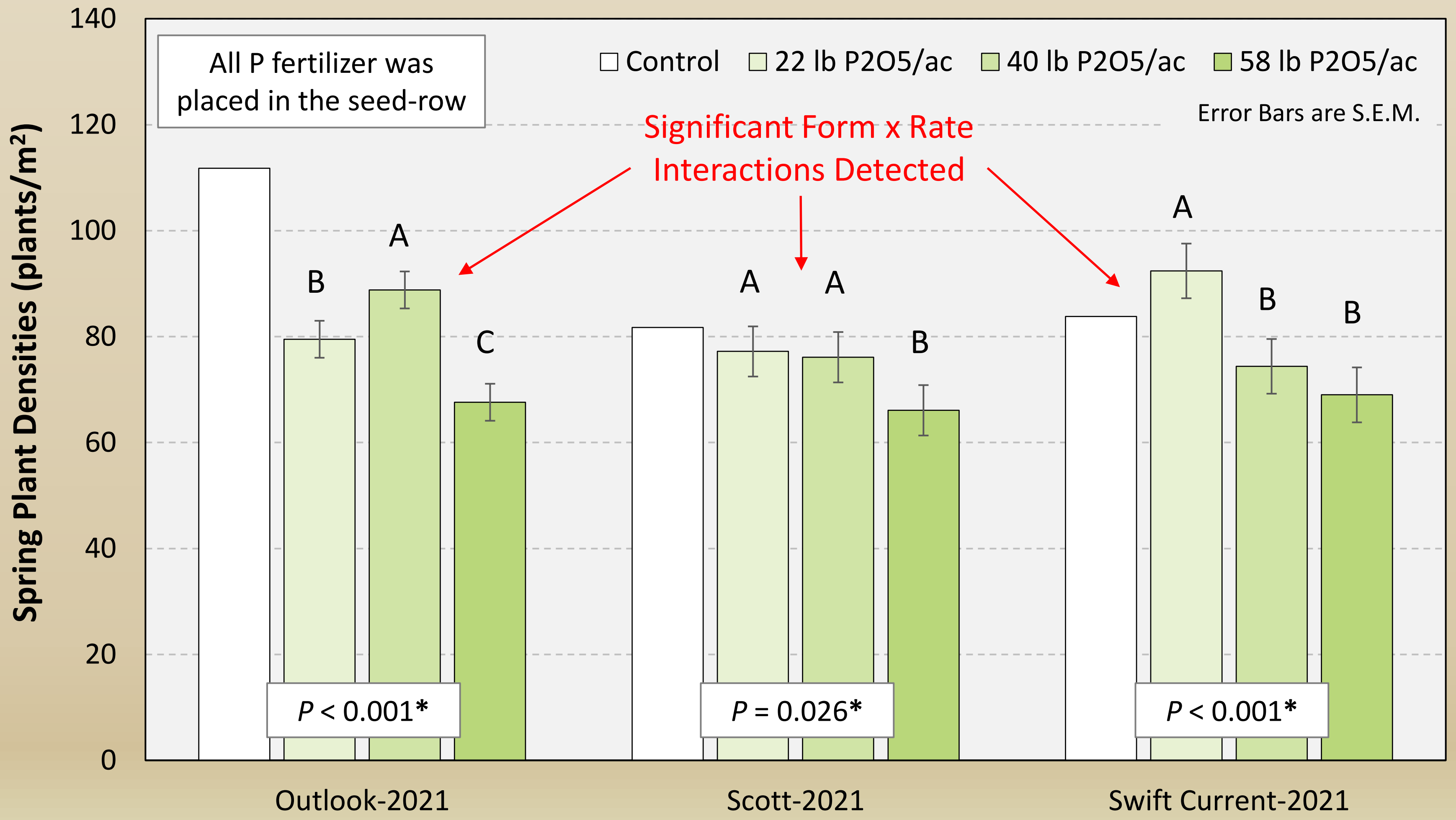
Seed-Placed P Rate Effects on Canola Emergence (Responsive 3/10 Sites)

Averaged Across Four Fertilizer Formulations



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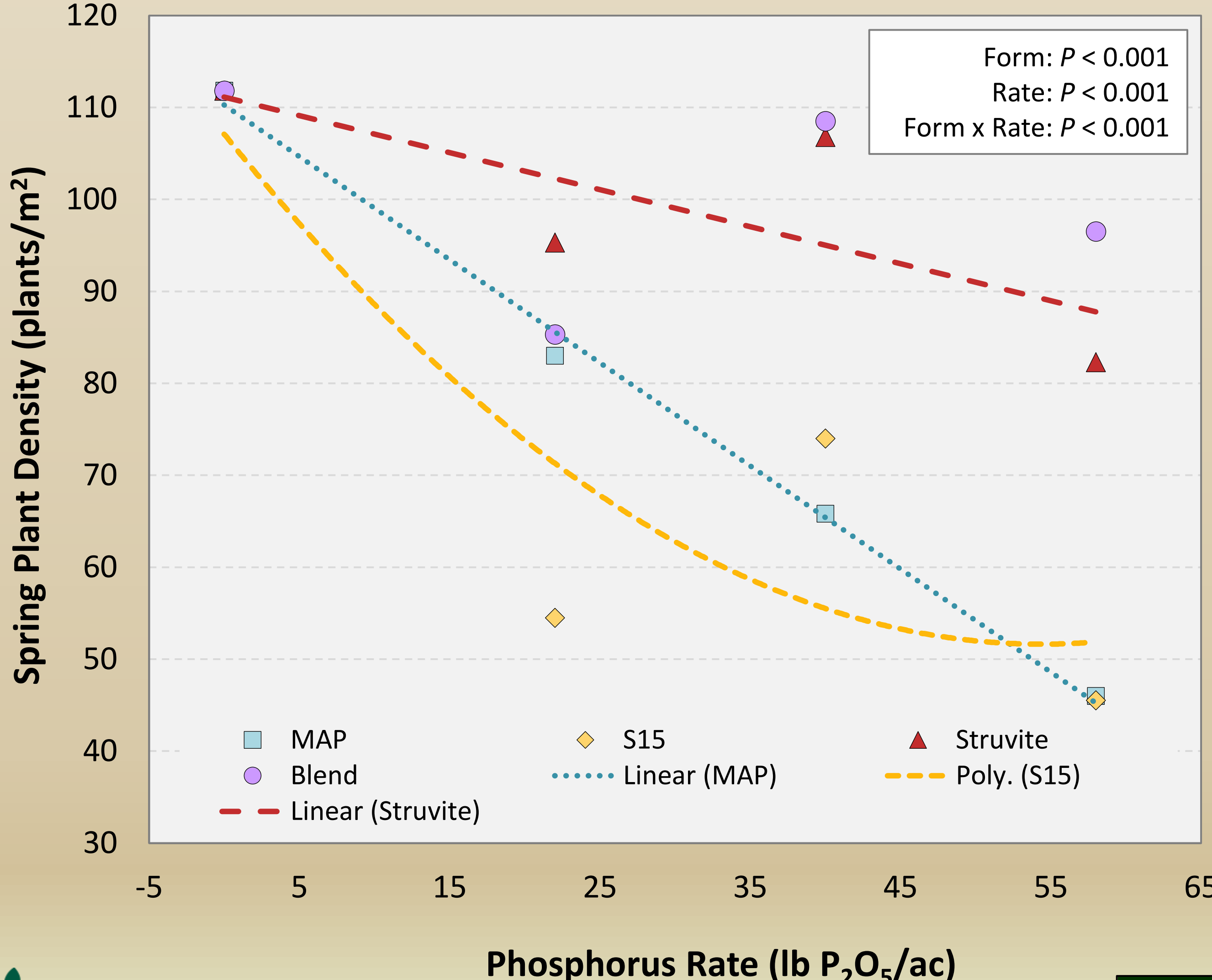
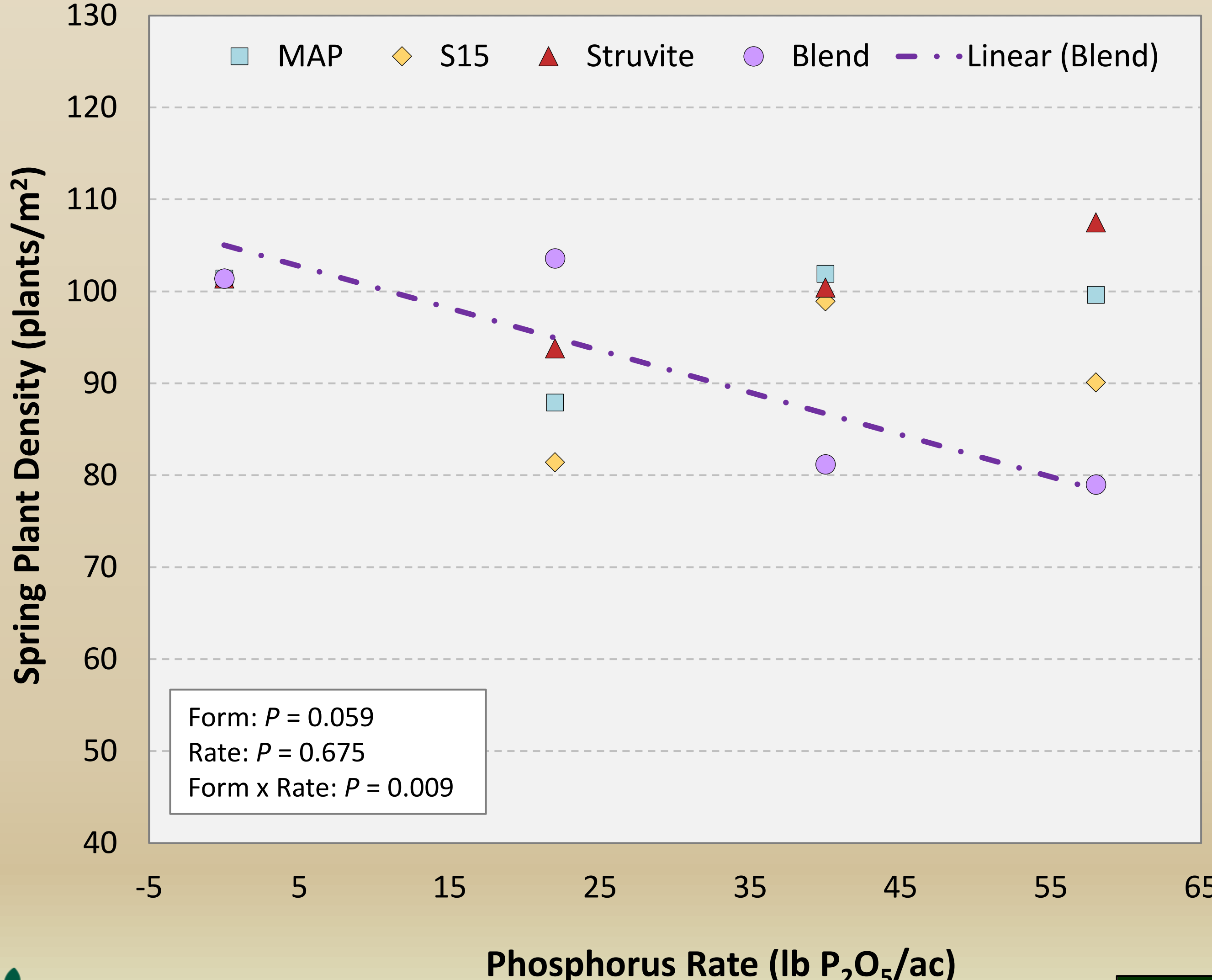
Seed-Placed P Form x Rate Effects on Canola Emergence at Outlook 2021



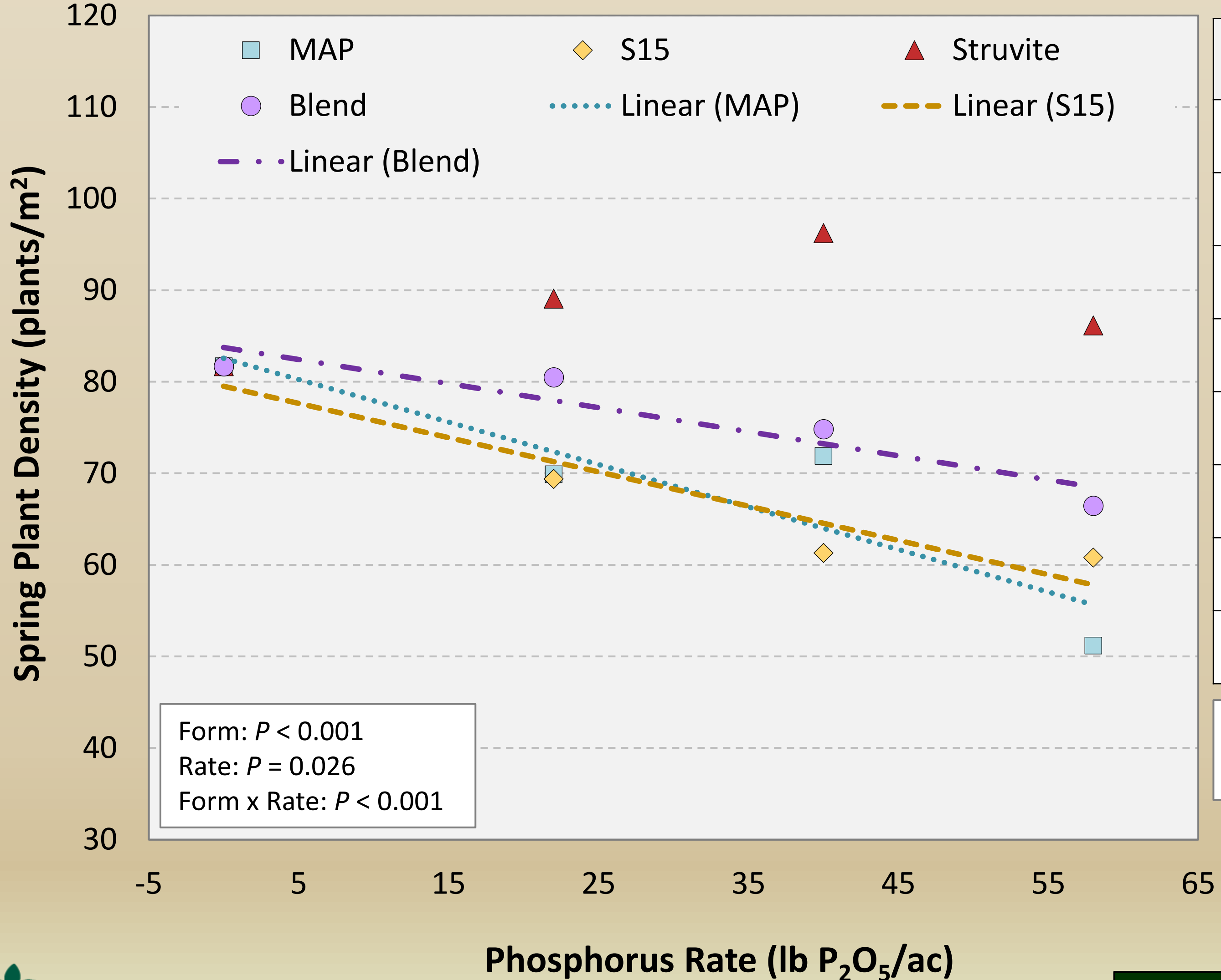
Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.733
S15 – lin	**<0.001**
S15 – quad	**0.025**
Struv – lin	**0.006**
Struv – quad	0.533
Blend – lin	0.351
Blend – quad	0.187

Seed-Placed P Form x Rate Effects on Canola Emergence at Redvers 2021



Contrast	Pr > F
MAP – lin	0.818
MAP – quad	0.307
S15 – lin	0.495
S15 – quad	0.313
Struv – lin	0.411
Struv – quad	0.210
Blend – lin	**0.002**
Blend – quad	0.526

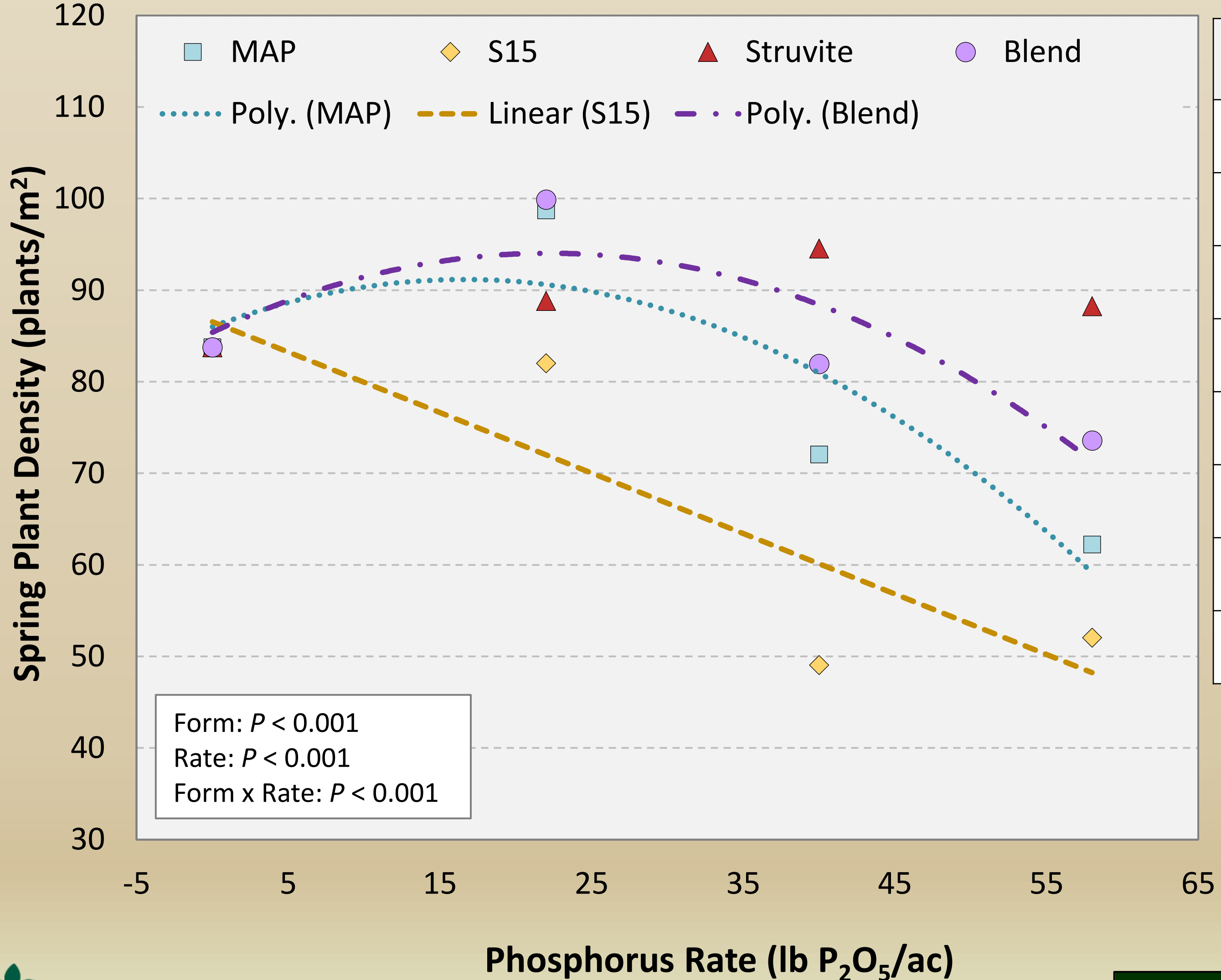
Seed-Placed P Form x Rate Effects on Canola Emergence at Scott 2021



Contrast	Pr > F
MAP – lin	**0.002**
MAP – quad	0.431
S15 – lin	**0.011**
S15 – quad	0.427
Struv – lin	0.429
Struv – quad	0.191
Blend – lin	**0.073**
Blend – quad	0.501

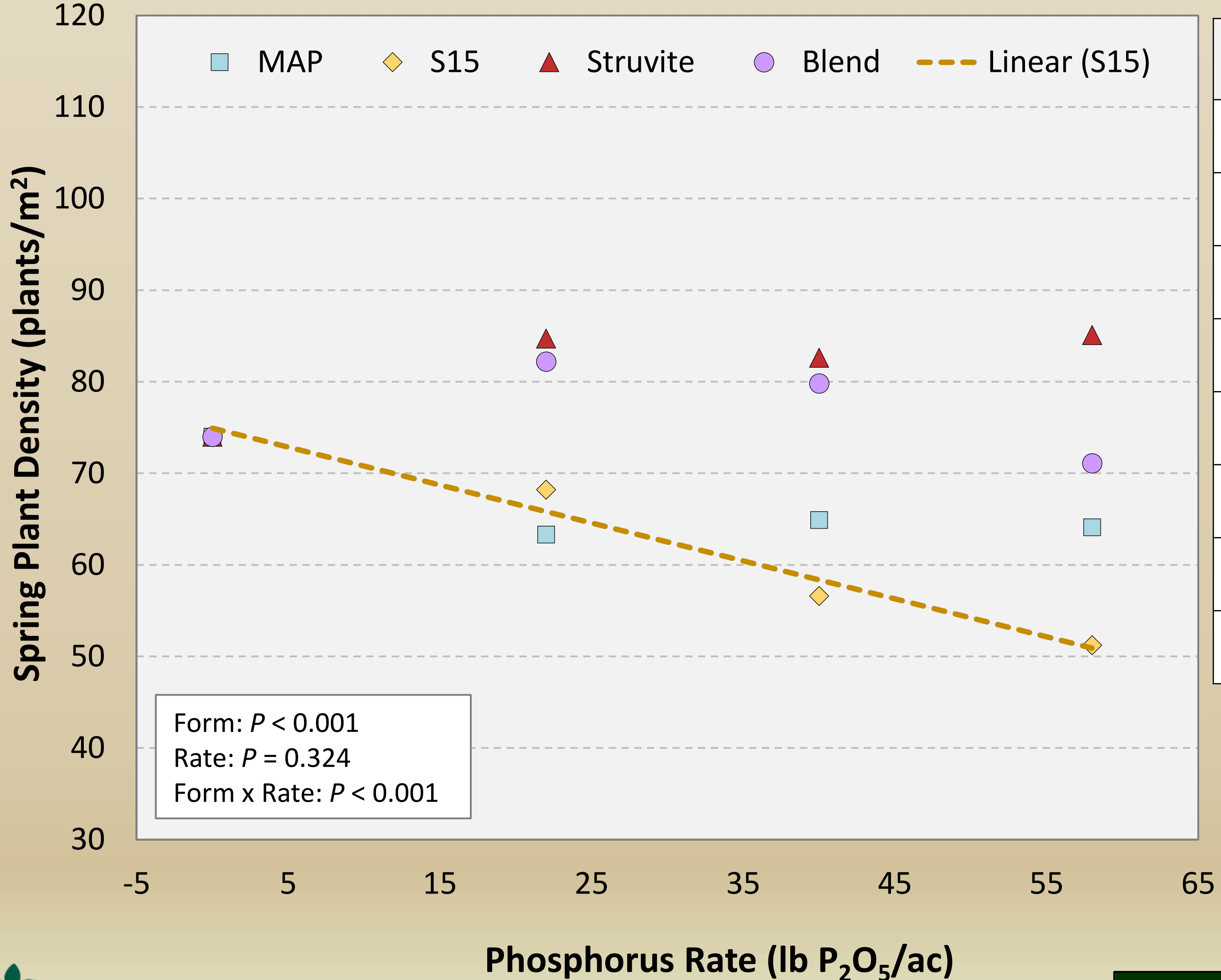
All P fertilizer was placd in the seed-row

Seed-Placed P Form x Rate Effects on Canola Emergence at Swift Current 2021



Contrast	Pr > F
MAP – lin	**0.002**
MAP – quad	**0.023**
S15 – lin	**<0.001**
S15 – quad	0.975
Struv – lin	0.473
Struv – quad	0.403
Blend – lin	0.113
Blend – quad	**0.032**

Seed-Placed P Form x Rate Effects on Canola Emergence at Yorkton 2021



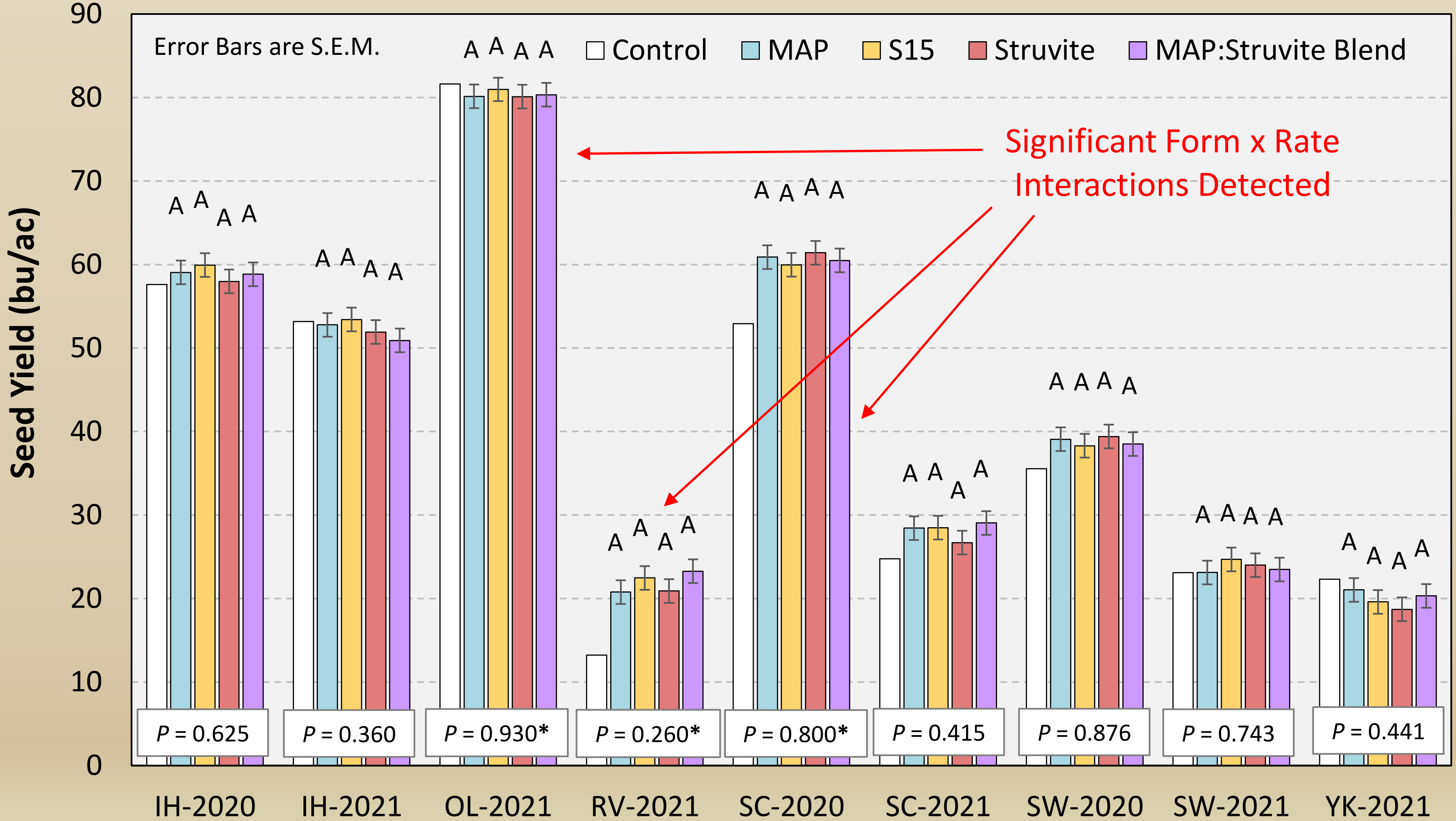
Contrast	Pr > F
MAP – lin	0.291
MAP – quad	0.441
S15 – lin	**0.005**
S15 – quad	0.882
Struv – lin	0.245
Struv – quad	0.521
Blend – lin	0.746
Blend – quad	0.169

F-Test Results x Site: Seed Yield

Location – Year	Form	Rate	Form × Rate	Entry
	------------------------------- Pr > F (p-value) -------------------------------			
Indian Head – 2020	ns	ns	ns	ns
Indian Head – 2021	ns	ns	ns	ns
Melfort – 2021	**<0.001**	**0.008**	**<0.001**	**<0.001**
Outlook – 2021	ns	ns	**<0.001**	**<0.001**
Redvers – 2021	ns	**0.004**	**0.009**	**<0.001**
Scott – 2020	ns	**0.001**	**0.045**	**<0.001**
Scott – 2021	ns	**0.022**	ns	ns
Swift Current – 2020	ns	ns	ns	ns
Swift Current – 2021	ns	ns	ns	ns
Yorkton – 2021	ns	ns	ns	ns

Seed-Placed P Form Effects on Canola Seed Yield (Non-Responsive 9/10 Sites)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



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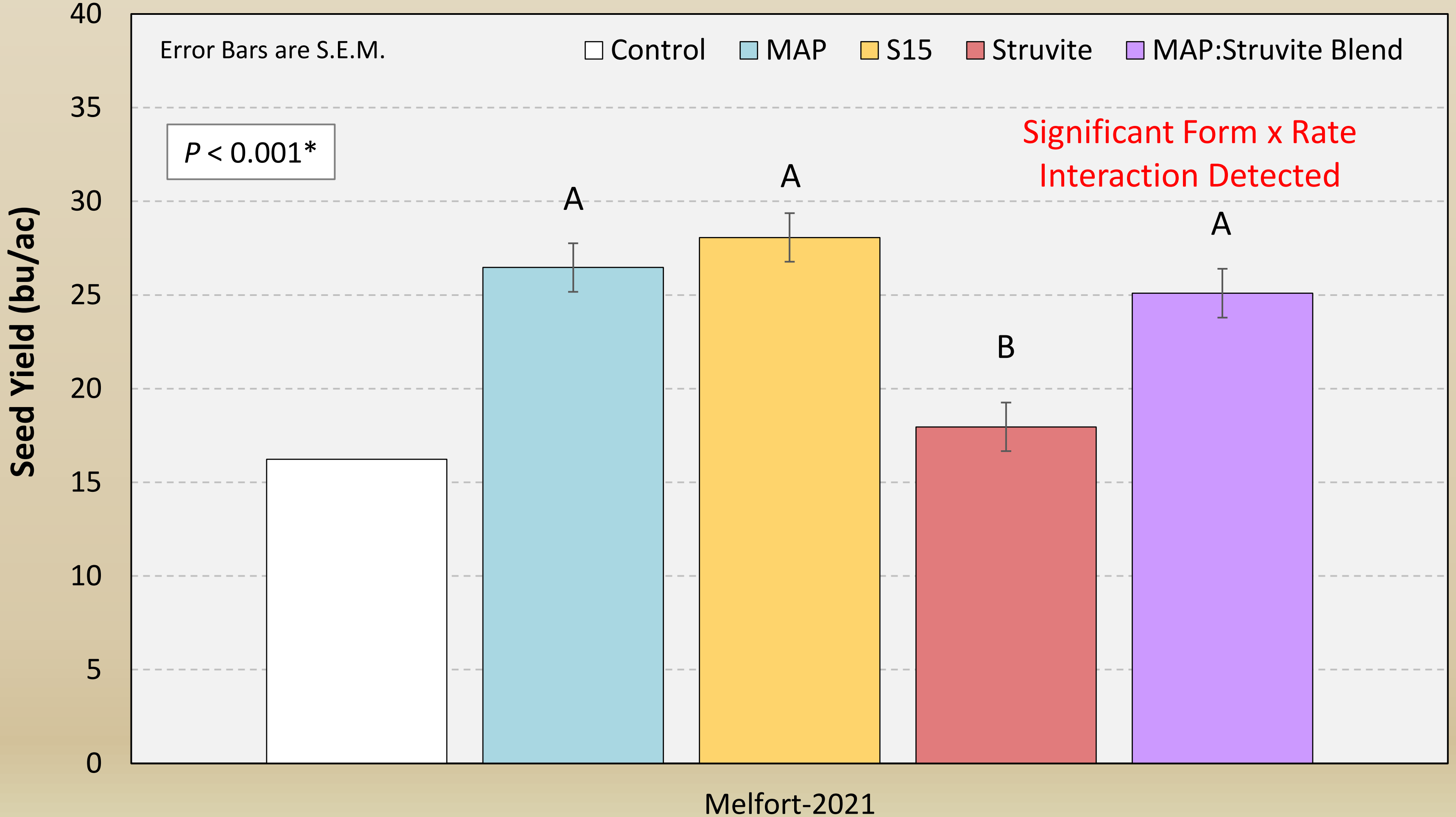
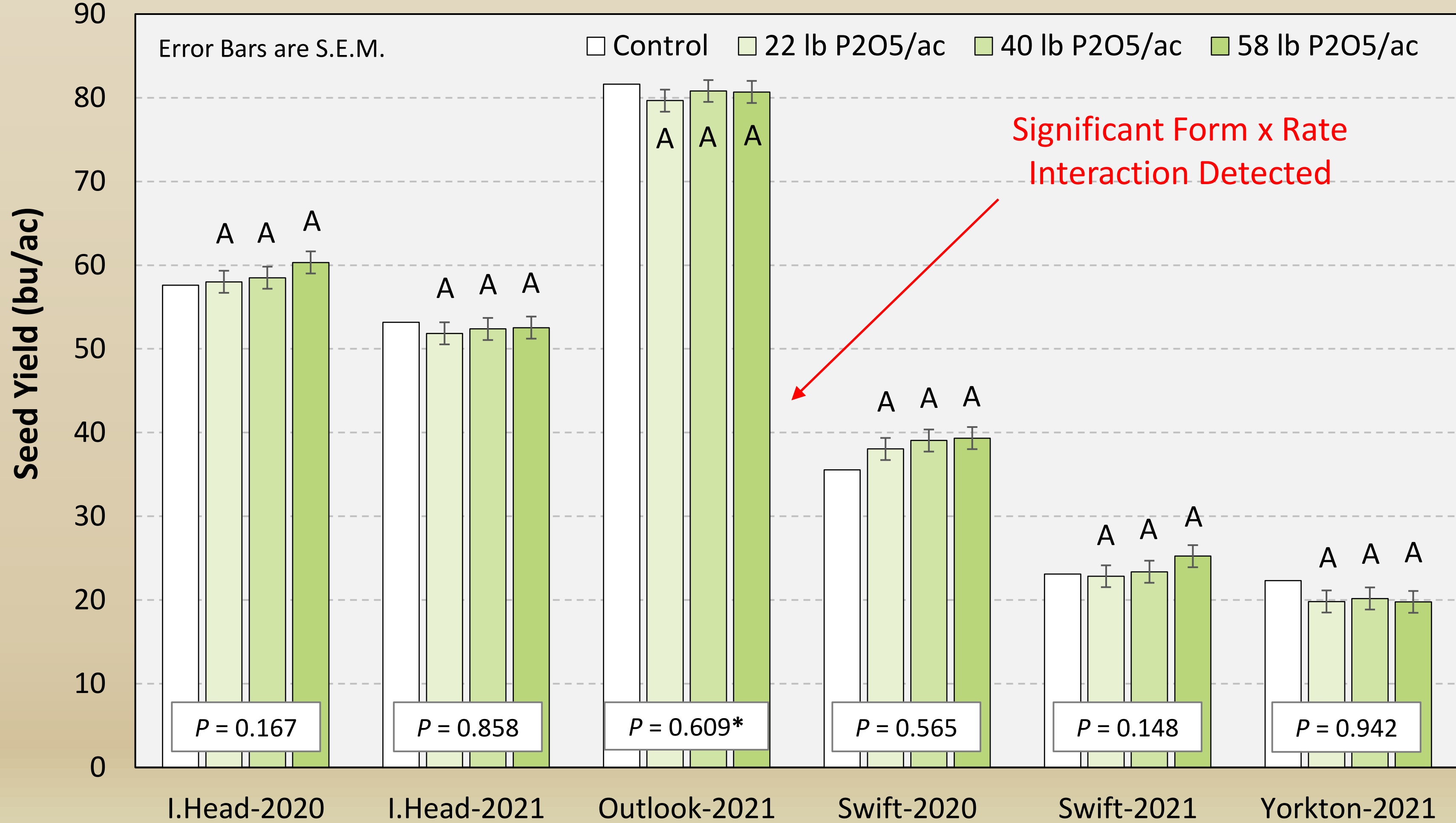
Seed-Placed P Form Effects on Canola Seed Yield (Responsive 1/10 Sites)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



Seed-Placed P Rate Effects on Canola Seed Yield (Non-Responsive 6/10 Sites)

Averaged Across Four Fertilizer Formulations



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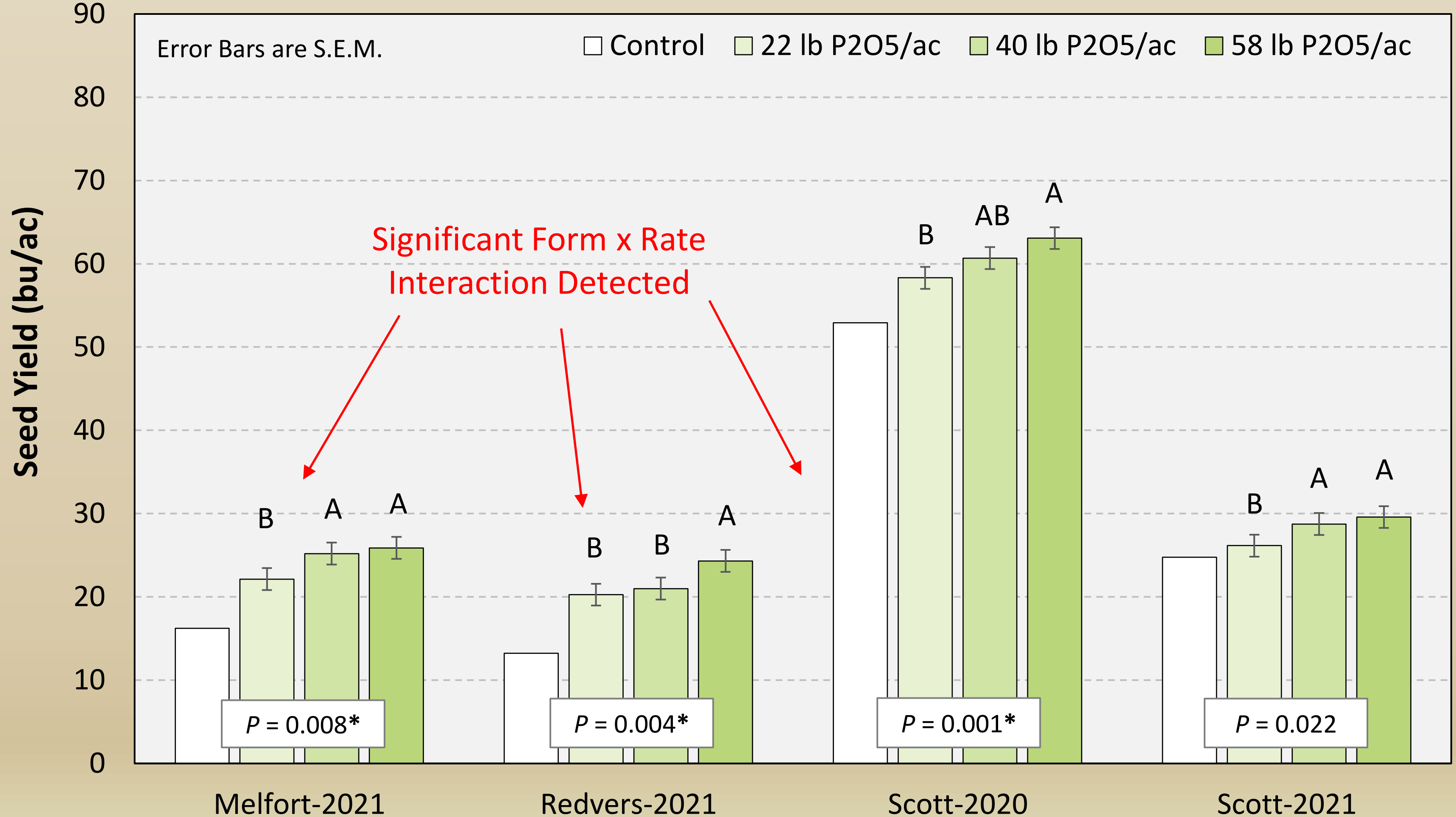
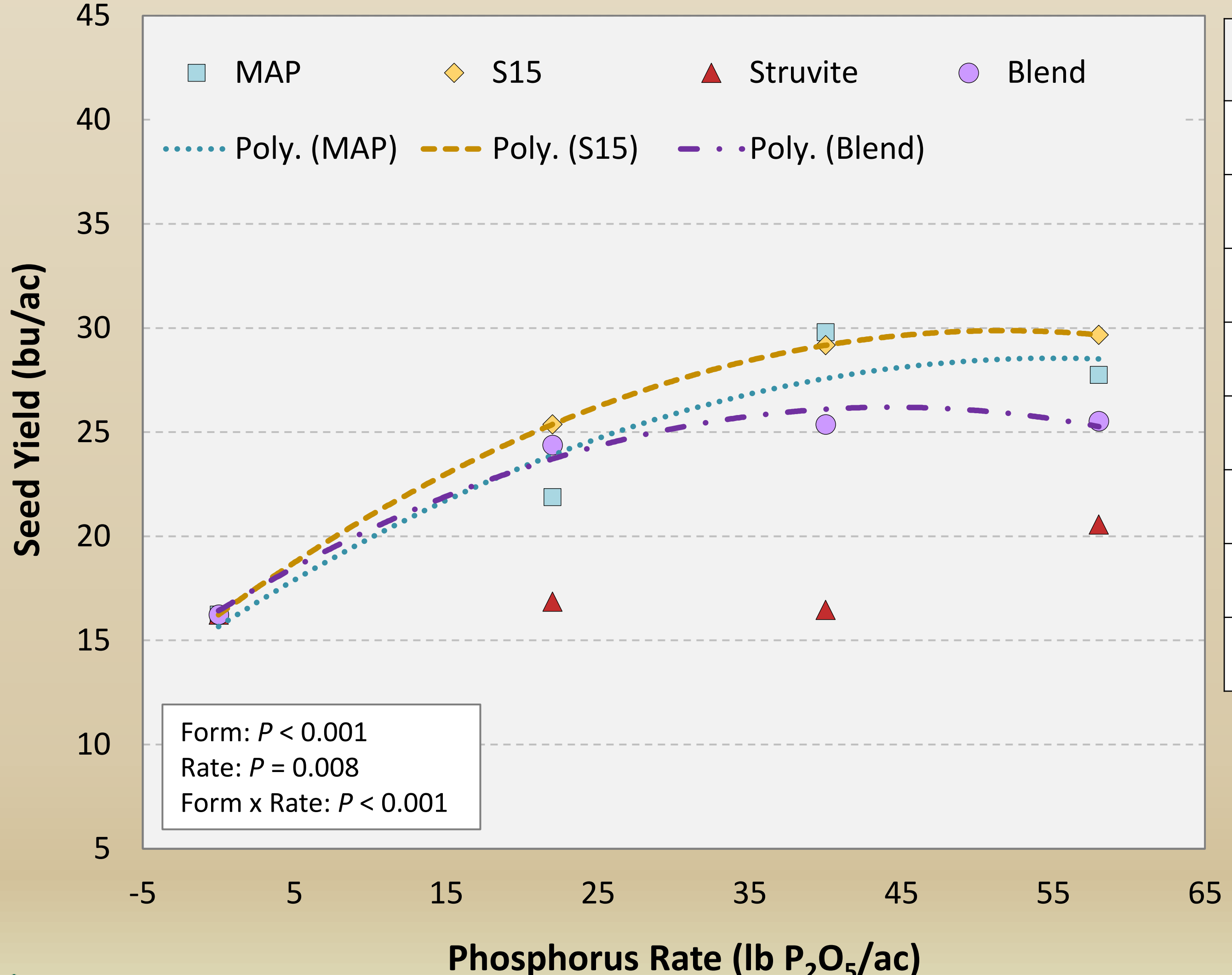
Seed-Placed P Rate Effects on Canola Seed Yield (Responsive 4/10 Sites)

Averaged Across Four Fertilizer Formulations

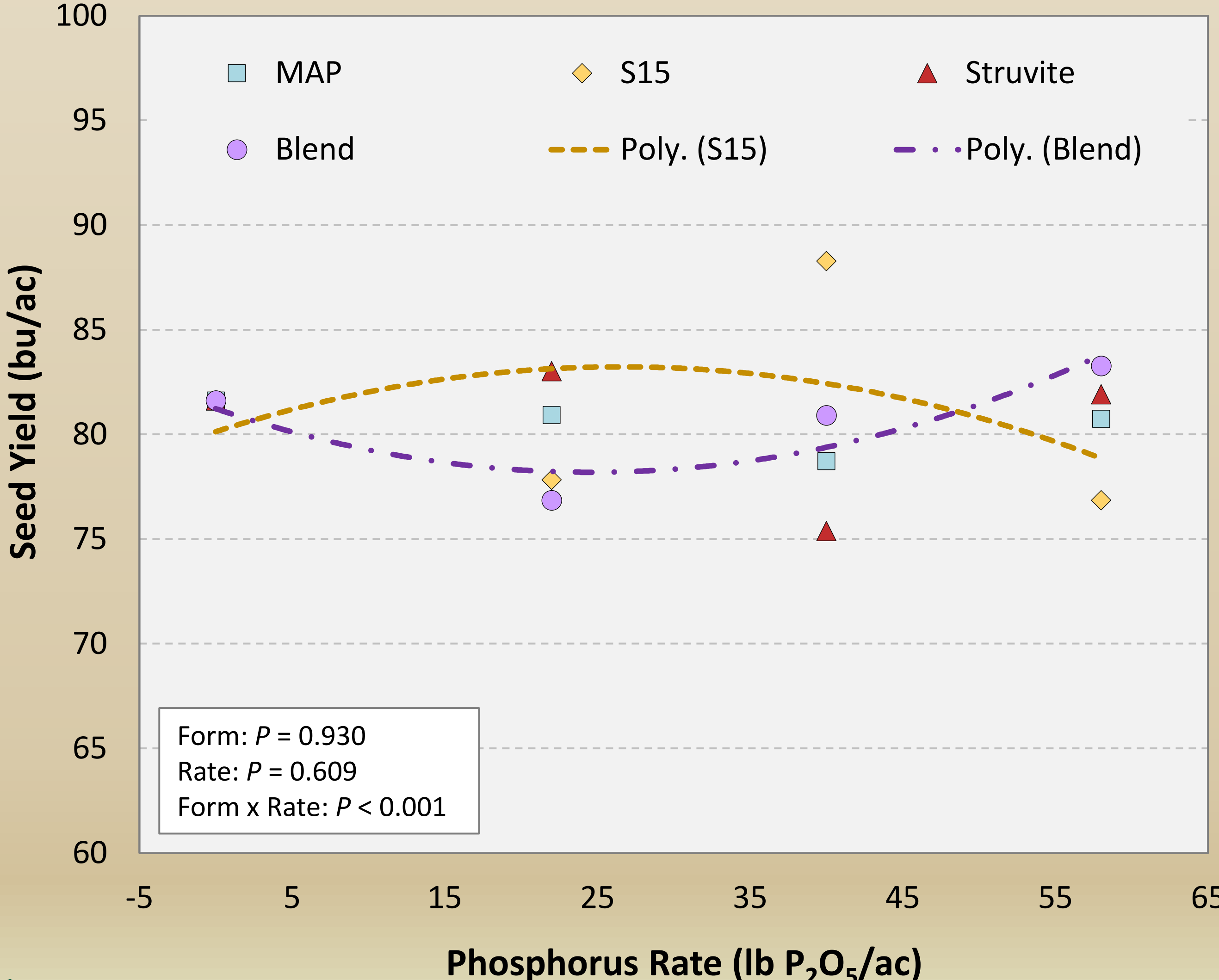


Seed-Placed P Form x Rate Effects on Canola Seed Yield at Melfort 2021



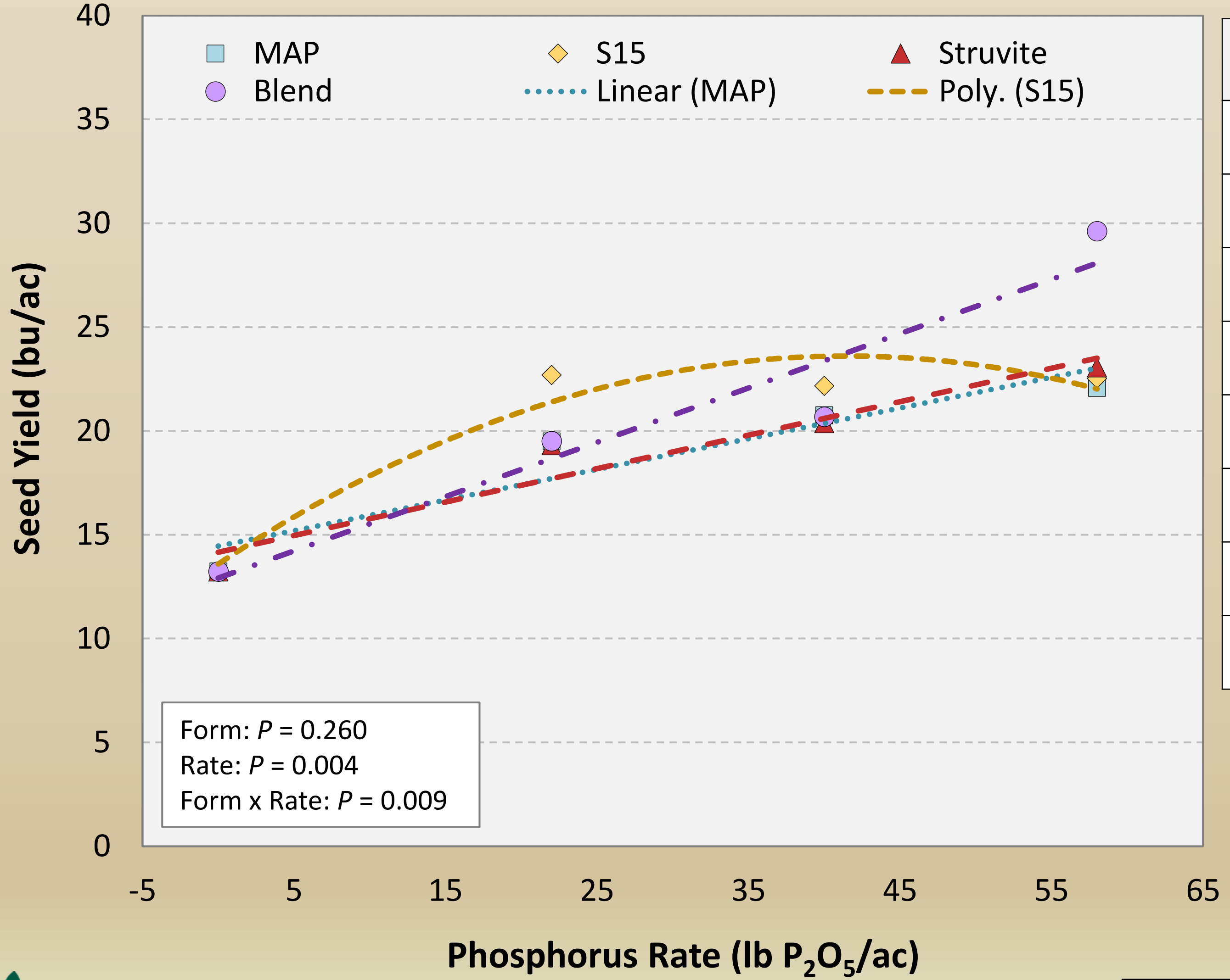
Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	**0.082**
S15 – lin	**<0.001**
S15 – quad	**0.035**
Struv – lin	0.127
Struv – quad	0.315
Blend – lin	**<0.002**
Blend – quad	**0.038**

Seed-Placed P Form x Rate Effects on Canola Seed Yield at Outlook 2021



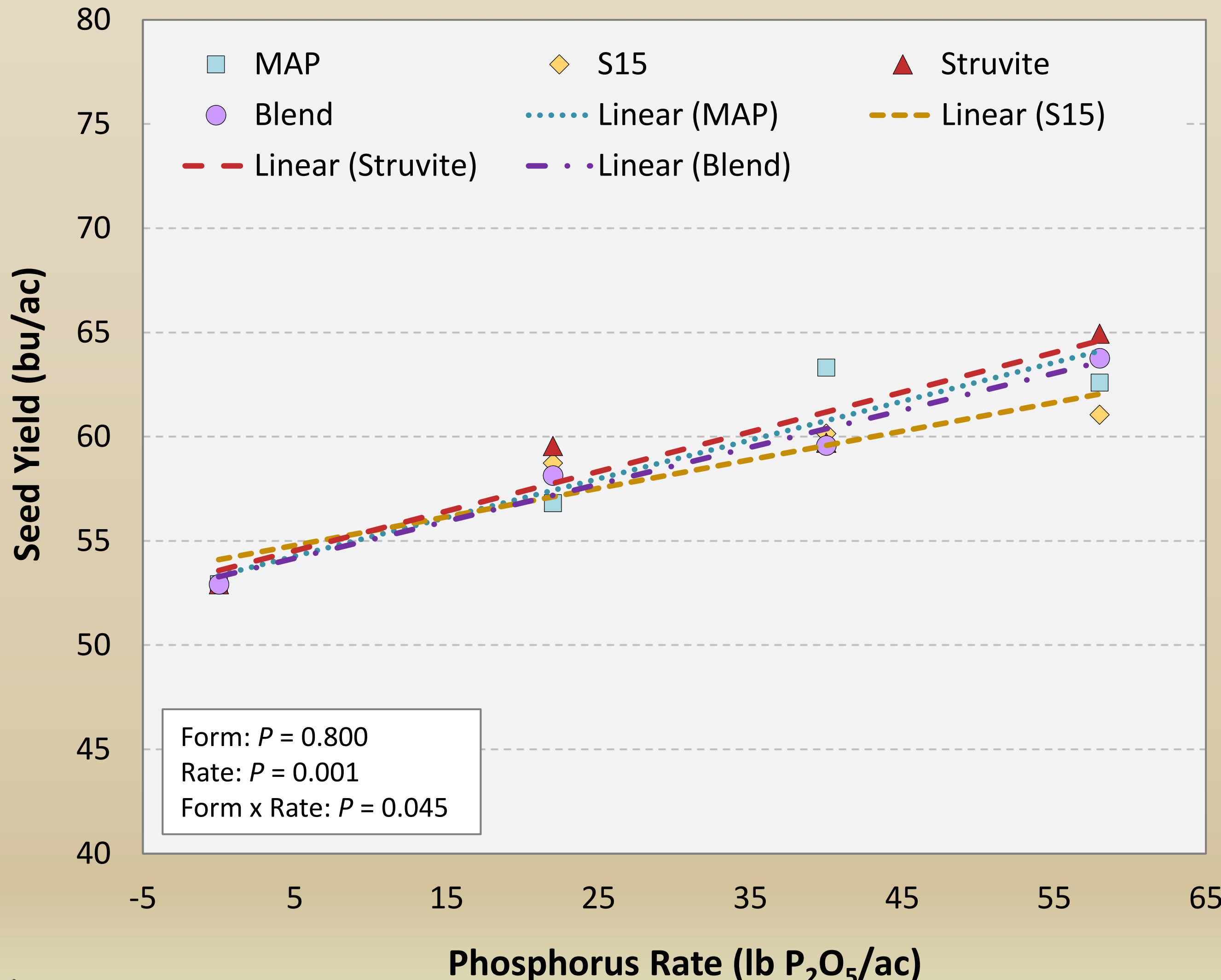
Contrast	Pr > F
MAP – lin	0.537
MAP – quad	0.501
S15 – lin	0.637
S15 – quad	**0.067**
Struv – lin	0.399
Struv – quad	0.241
Blend – lin	0.321
Blend – quad	**0.036**

Seed-Placed P Form x Rate Effects on Canola Seed Yield at Redvers 2021



Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.218
S15 – lin	**<0.001**
S15 – quad	**0.015**
Struv – lin	**<0.001**
Struv – quad	0.424
Blend – lin	**<0.001**
Blend – quad	0.338

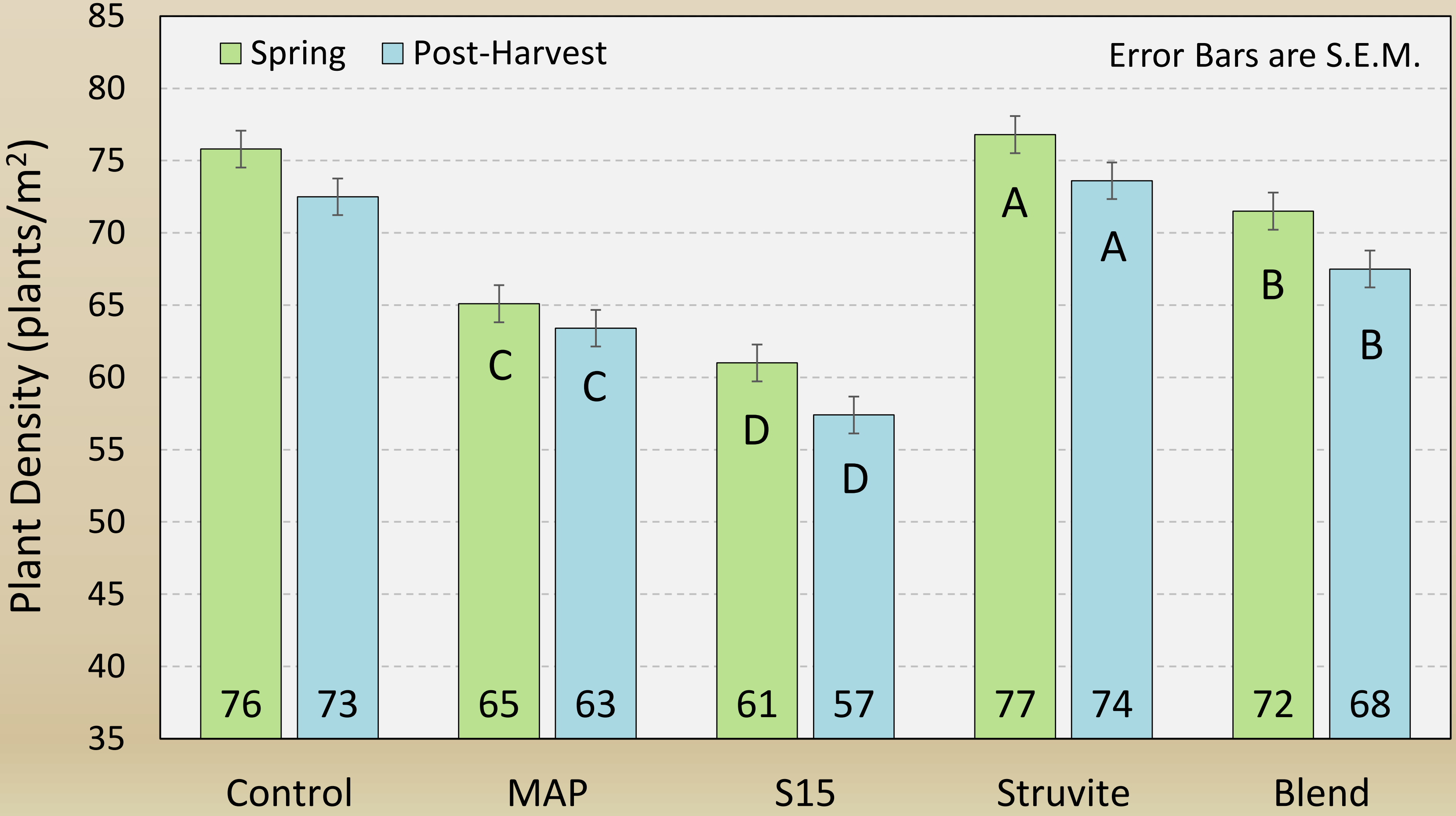
Seed-Placed P Form x Rate Effects on Canola Seed Yield at Scott 2020



Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.339
S15 – lin	**0.001**
S15 – quad	0.222
Struv – lin	**<0.001**
Struv – quad	0.805
Blend – lin	**<0.001**
Blend – quad	0.905

Seed-Placed P Form Effects on Canola Emergence & Final Densities (10 Site Average)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



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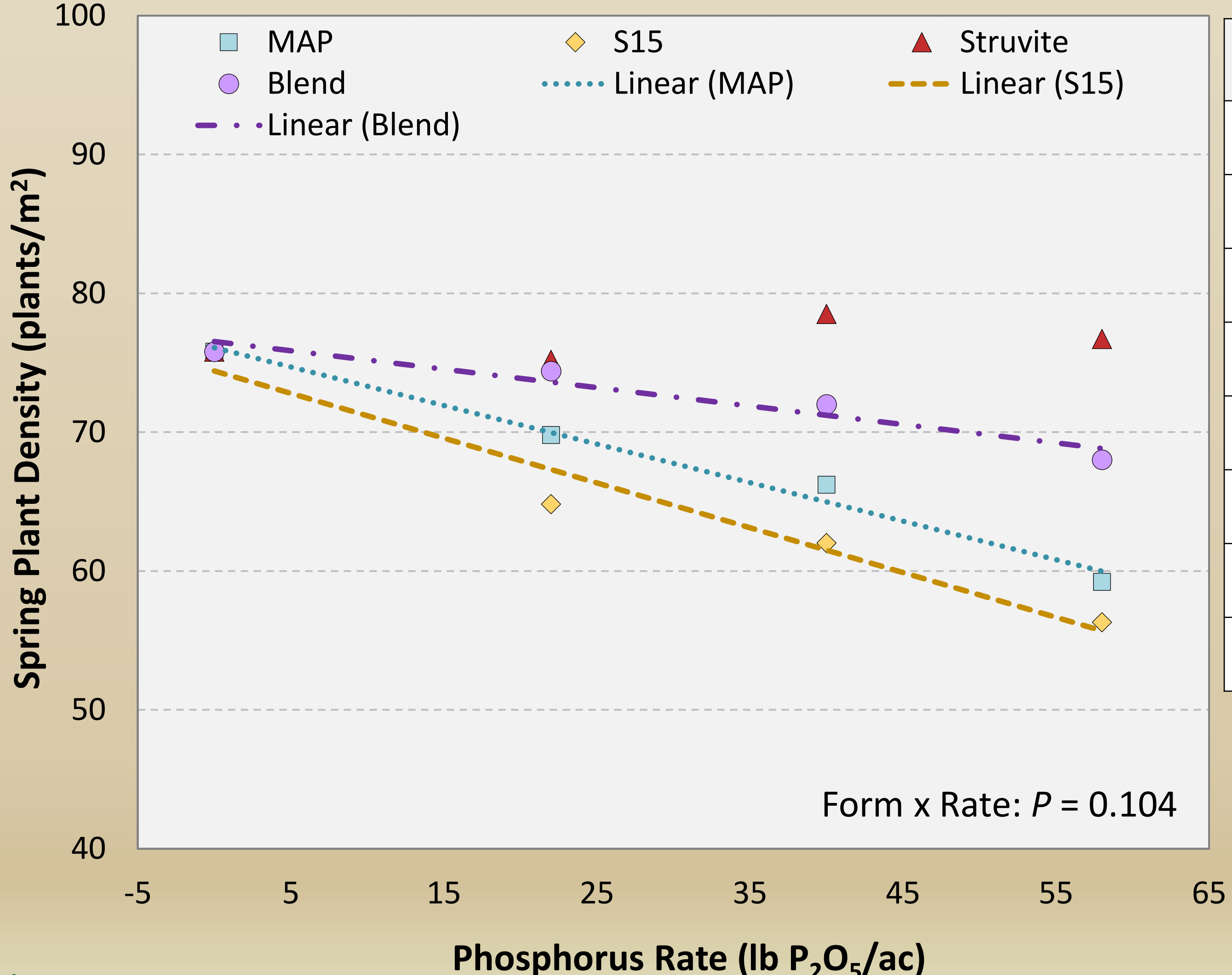
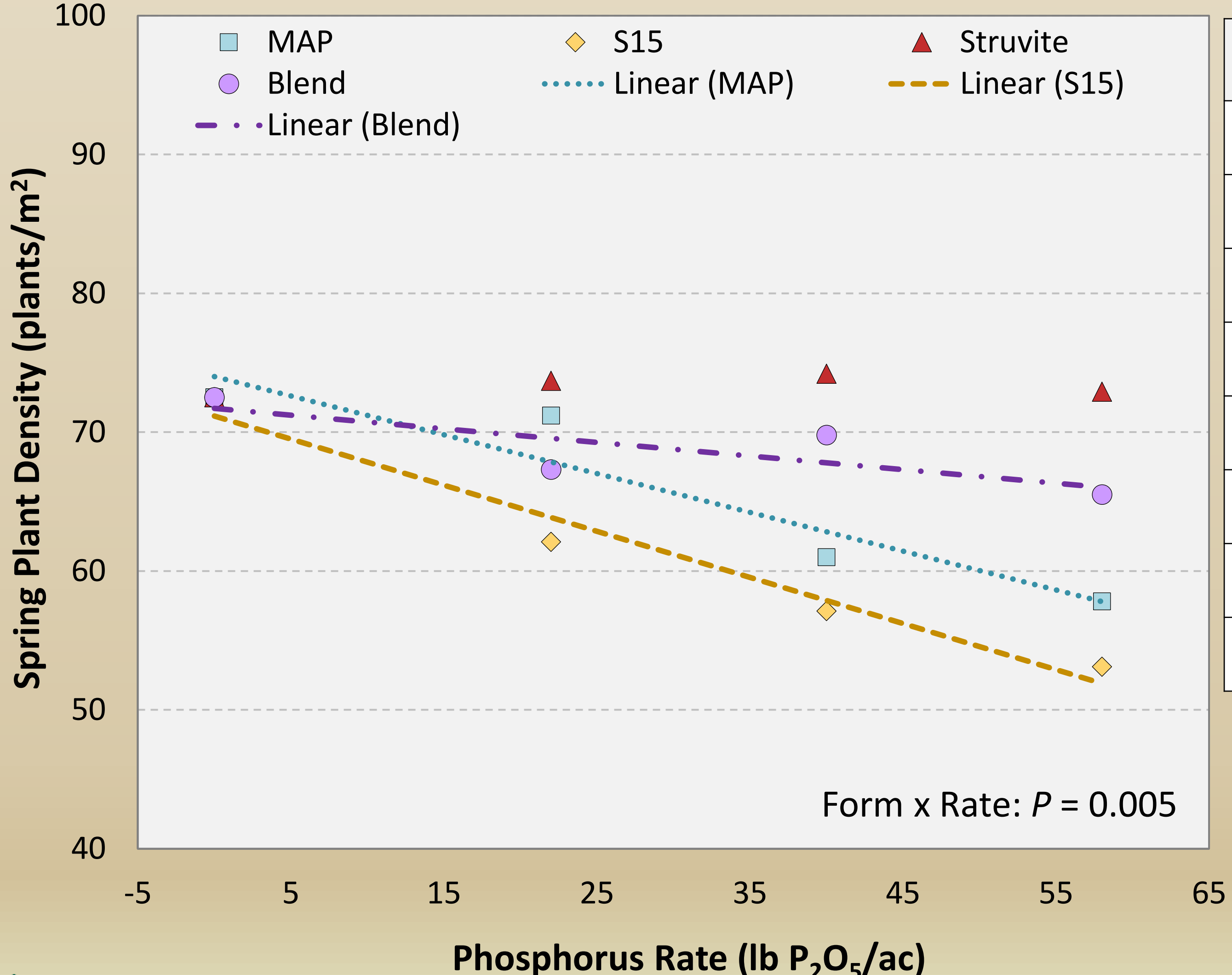
Seed-Placed P Form x Rate Effects on Spring Canola Emergence (10 Site Average)



Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.603
S15 – lin	**<0.001**
S15 – quad	0.290
Struv – lin	0.491
Struv – quad	0.837
Blend – lin	**0.005**
Blend – quad	0.410

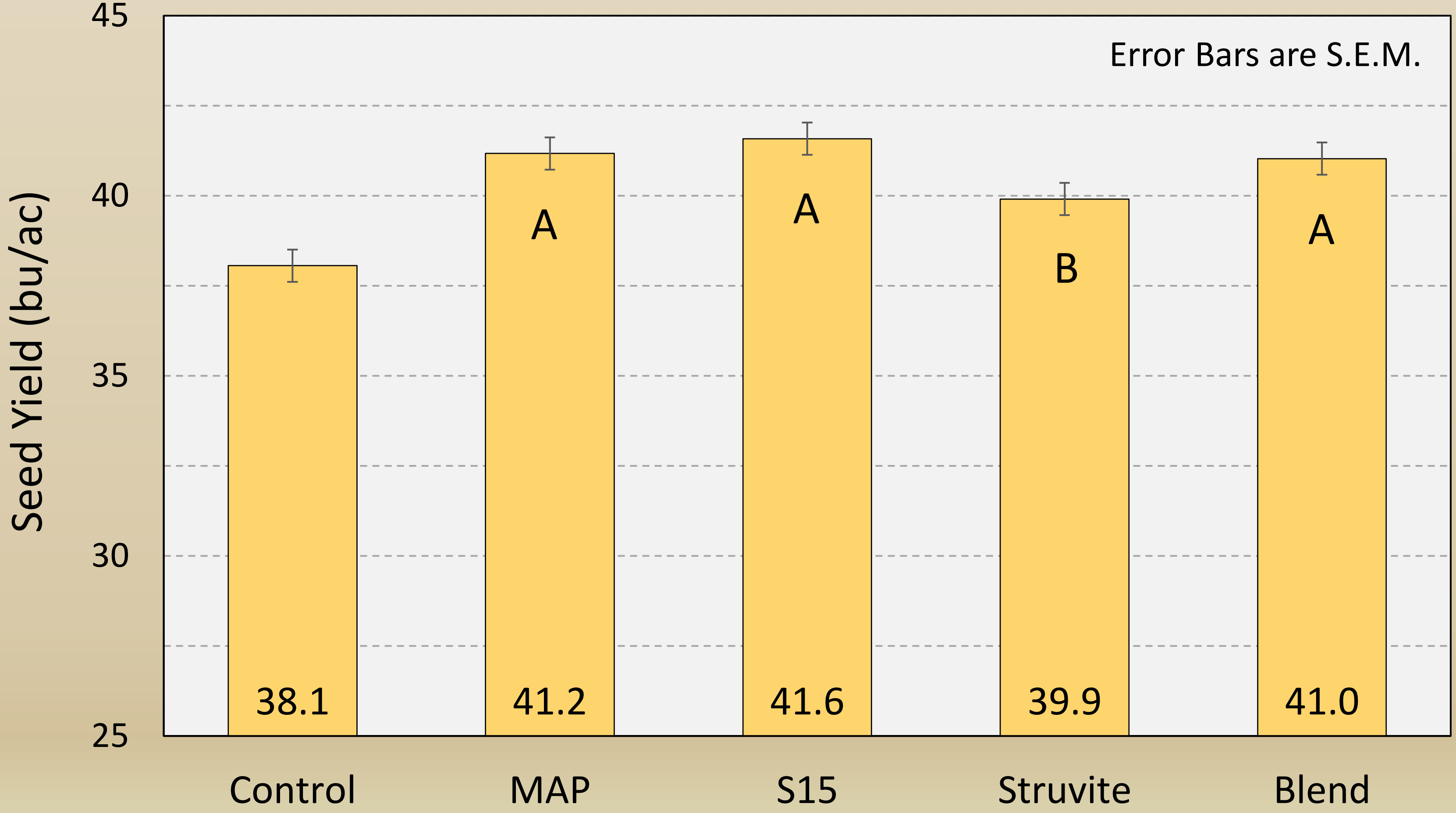
Seed-Placed P Form x Rate Effects on Final Canola Plant Densities (10 Site Average)



Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.338
S15 – lin	**<0.001**
S15 – quad	0.196
Struv – lin	0.824
Struv – quad	0.537
Blend – lin	**0.028**
Blend – quad	0.807

Seed-Placed P Form Effects on Canola Seed Yield (10 Site Average)

Averaged Across Rates of 22, 40, & 58 lb P_2O_5/ac



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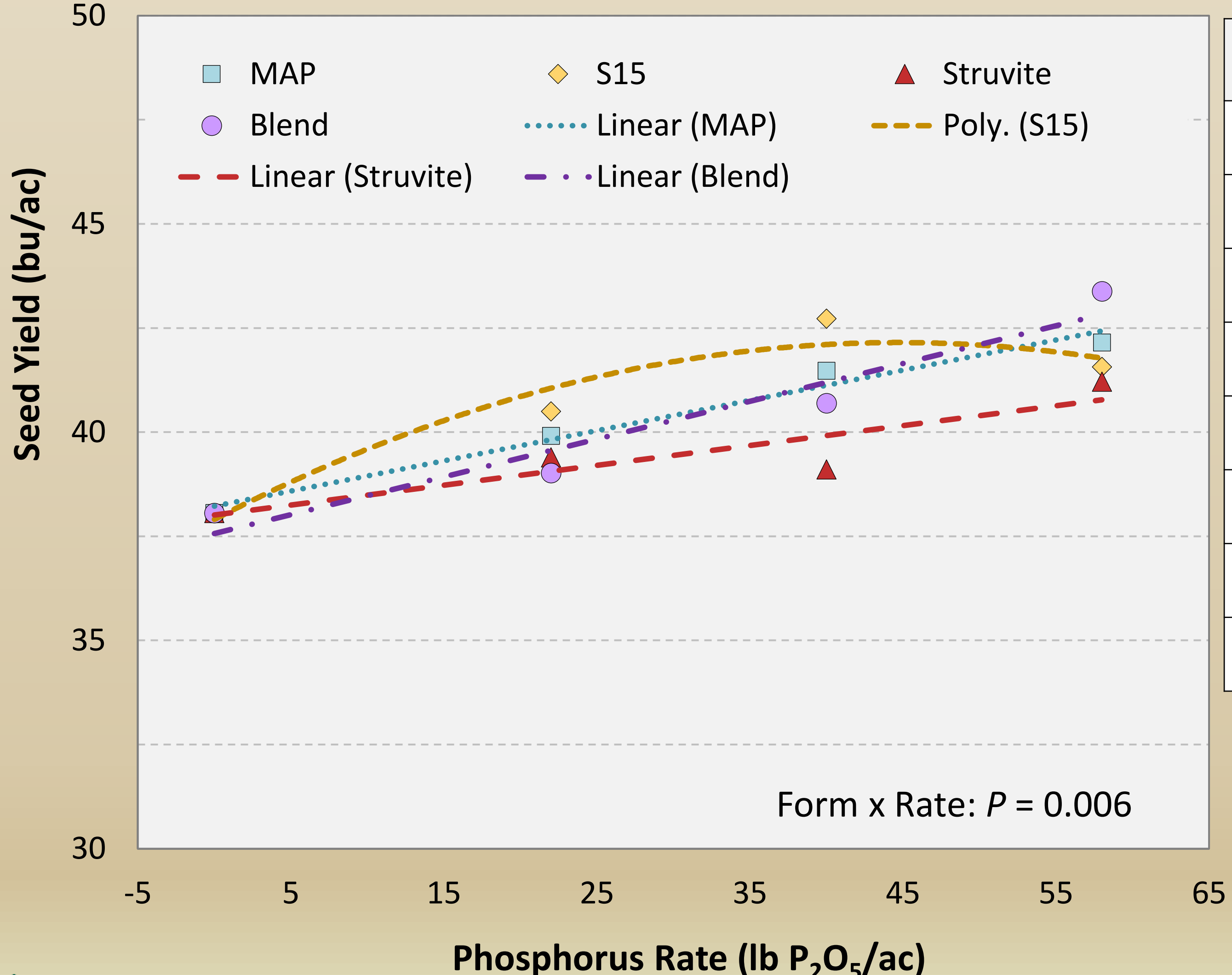
Seed-Placed P Form x Rate Effects on Canola Seed Yield (10 Site Average)



Contrast	Pr > F
MAP – lin	**<0.001**
MAP – quad	0.464
S15 – lin	**<0.001**
S15 – quad	**0.005**
Struv – lin	**<0.001**
Struv – quad	0.454
Blend – lin	**<0.001**
Blend – quad	0.059

Relative Costs of Phosphorus Formulations & Associated Marginal Profits

Fertilizer Prices [Z]	MAP	S15	Struvite	50:50 MAP:CG
\$/Mt [Z]	\$1,250	\$1,250	\$1,500	\$1,375
\$/lb P_2O_5 [Y]	\$0.97	\$1.39	\$2.37	\$1.47
% of MAP	100%	144%	246%	153%
Fertilizer Rate	**------------------------------ \$/ac marginal profits [Y] ------------------------------**			
0 P (control)	\$779			
22 lb P_2O_5/ac	\$795	\$798	**\$753**	\$766
40 lb P_2O_5/ac	**\$810**	**\$818**	\$705	\$774
58 lb P_2O_5/ac	\$807	\$770	\$705	**\$803**
Average	**\$804**	\$795	\$721	\$781

[Z] Fertilizer prices are based on retail quotes from Feb-3-2022 and actual P2O5 prices are adjusted for the N & S (where applicable) provided by each formulation. N & S prices are based on \$1145/Mt urea (46-0-0) & \$750/Mt ammonium sulfate (21-0-0-24), both of which were also quoted on Feb-3-2022.

[Y] Marginal profits are based on the quoted fertilizer prices, actual yields, & a canola price of \$900/Mt (\$20.41/bu). These values do not reflect absolute profits as they only take into account gross revenues and P_2O_5 costs, not accounting for other variable costs or any fixed costs.

Seed Safety & Yield Response to Various Phosphorus Forms: Conclusions

- Greatest overall risk of injury in coarse textured, lower organic matter soils (i.e. Swift Current, Outlook, Scott), especially when dry; we often get away with a lot on finer textured, black soils but this can be unpredictable & caution is always advised
- Struvite (alone or in blends) has an undeniable seed-safety advantage – essentially no negative effects w/high rates of pure struvite
- For those who have the ability, side-banding is a safe & effective option for P fertilizer & will often be advantageous if high rates are utilized. Mid-row banding only a viable option if combined with seed-placement. Avoid surface applications.
- Yield responses showed that all forms performed similarly in most cases; however, pure struvite has low solubility & may not always meet demands in the year of application if applied alone, especially in low P soils
- MAP is the most economical P option & is also effective, S15 is convenient (i.e. for storage, handling & as an S source) & effective, struvite advantageous from a seed safety and, depending on the source, environmental perspective but is expensive
- On average, P rates that match crop exports are also profitable; consider P fertilizer a long-term investment, even if we do not see consistent responses every year

Influence of Potassium Fertilization on Yield & Quality of Malting Barley & CWRS Wheat (multi-site 2021)

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15-03-2022

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Portage la Prairie, MB

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Influence of Potassium Fertilization on Yield & Quality of Malting Barley & CWRS Wheat

Objectives: To evaluate the effects of potassium rate & placement on both yield & quality of barley & wheat on soils with typical soil test K levels

Locations: Indian Head, Outlook (lead), Prince Albert, Redvers, Swift Current, & Yorkton (2021 only)

Treatments:

1) 0 K_2O applied (control)	**5)** 9 lb K_2O/ac side-banded
2) 9 lb K_2O/ac seed-placed	**6)** 18 lb K_2O/ac side-banded
3) 18 lb K_2O/ac seed-placed	**7)** 27 lb K_2O/ac side-banded
4) 27 lb K_2O/ac seed-placed	**8)** 18 lb K_2O/ac seed-placed + 36 lb K_2O side-banded

Data Collection: Lodging, maturity, yield, protein, test weight, thousand kernel weight, percent plump & thin kernels (barley only)

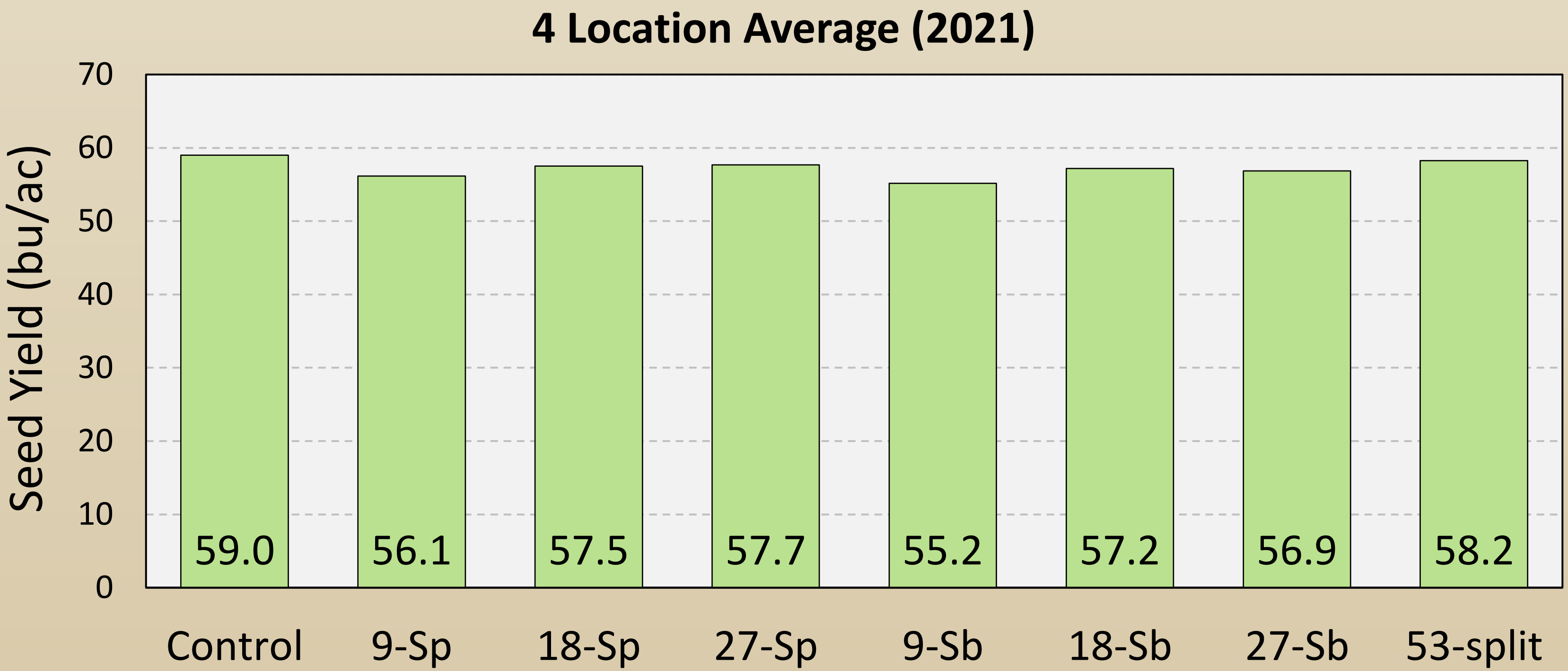
Contrasting Soil Test K_2O Supply Estimates & Fertilizer Recommendations

Trial Location	Western Ag PRS Cropcaster [Z]		AGVISE (conventional) [Y]	
	Soil K_2O lb/ac	Fertilizer K_2O Rec. (lb/ac)	Soil K_2O lb/ac (ppm)	Fertilizer K_2O Rec. (lb/ac)
Outlook	95	0	337 (189)	10
Yorkton	52	26	605 (339)	10
Redvers	27	36	288 (161)	10
Indian Head	24	50	1042 (584)	10
Swift Current	231	0	660 (370)	10
Prince Albert	108	25	388 (217)	10

[Z] PRS analyses are for the 0-4” soil depth & wheat as a test crop – values will vary with crop type & soil moisture/precipitation estimates

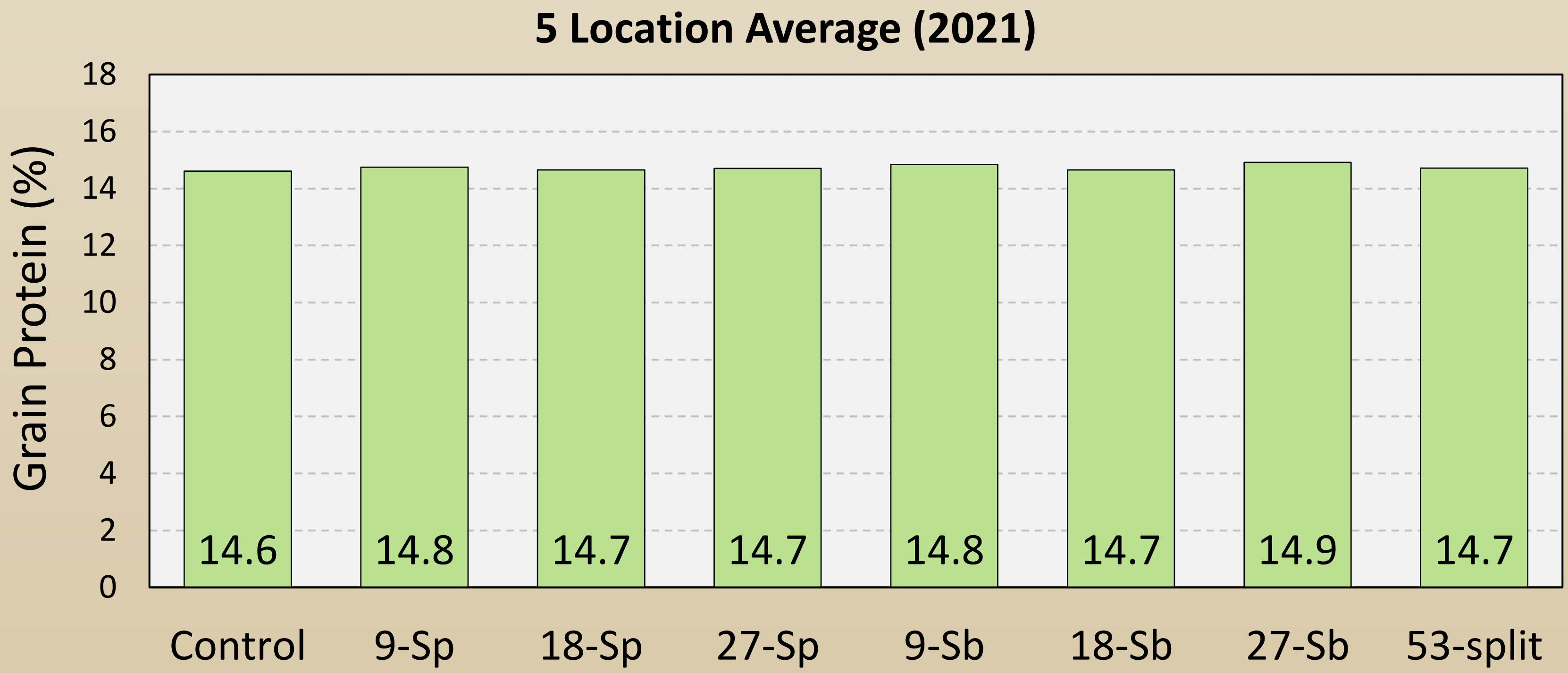
[Y] Conventional analyses results are ammonium acetate exchangeable K for the 0-6” soil depth (values in brackets are the original ppm)

Influence of Potassium Fertilizer Rate & Placement on Wheat Yield



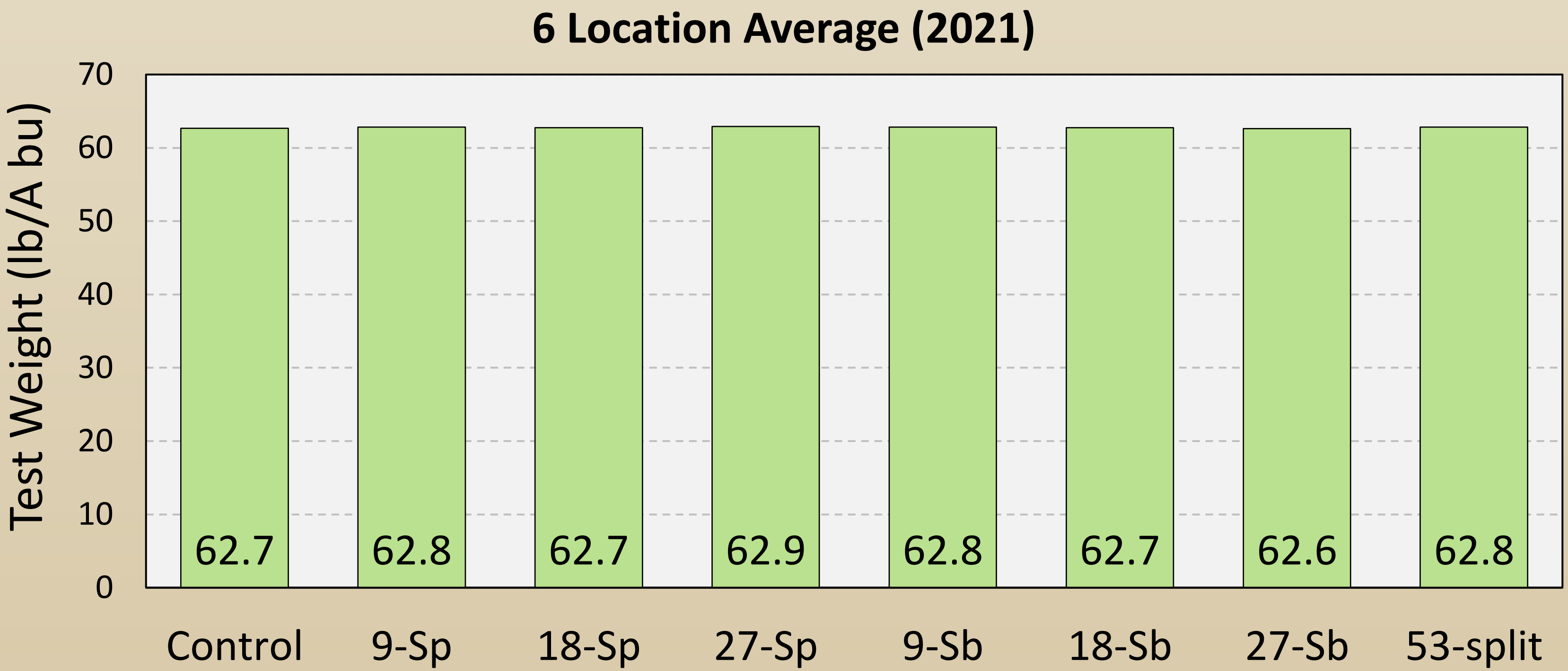
- Swift Current & Yorkton excluded from average due to high C.V. values (>15%)
- Data were analyzed separately for each location & no significant treatment effects were detected in any cases

Influence of Potassium Fertilizer Rate & Placement on Wheat Grain Protein



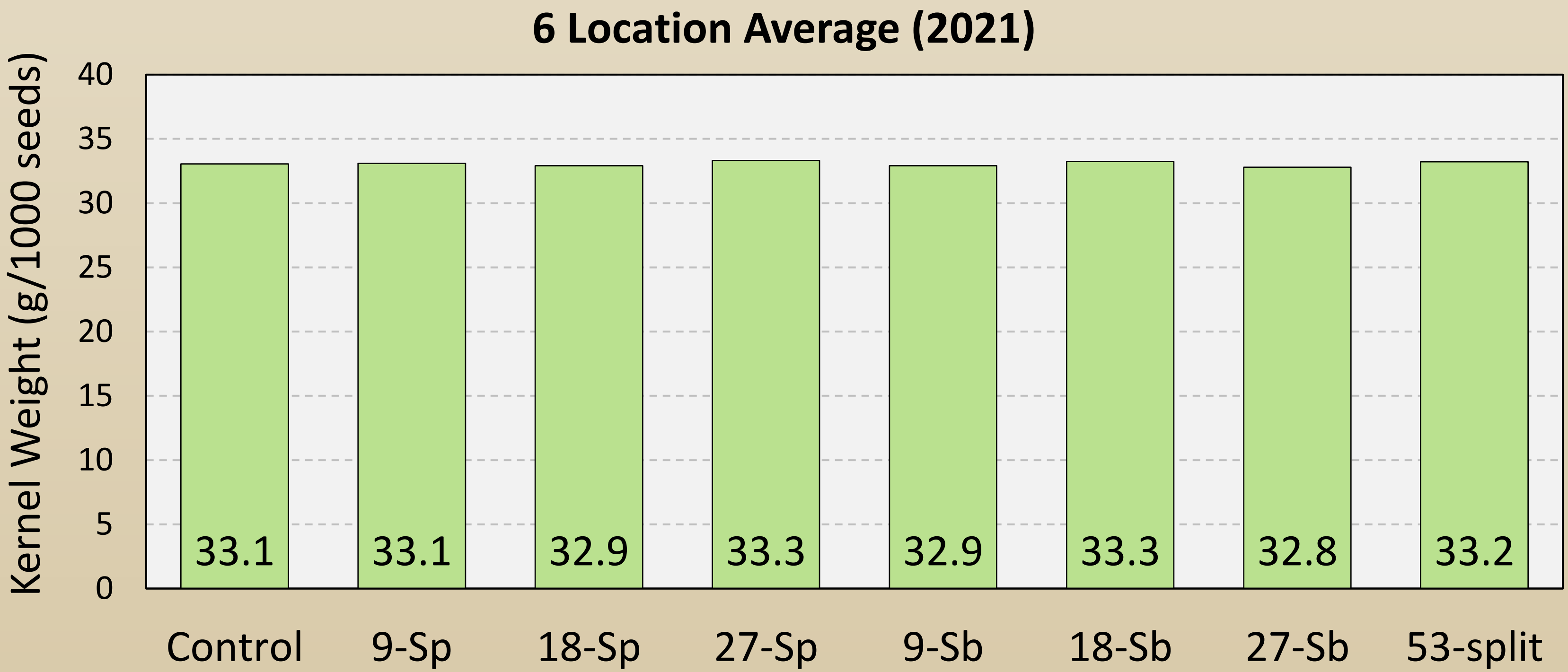
- Measurement not completed at Prince Albert
- Significant treatment effects at 1/5 locations (Indian Head); values at this site were highest in the control and lowest at the top rate of KCl, ranging from 14.7-15.1%

Influence of Potassium Fertilizer Rate & Placement on Wheat Test Weight



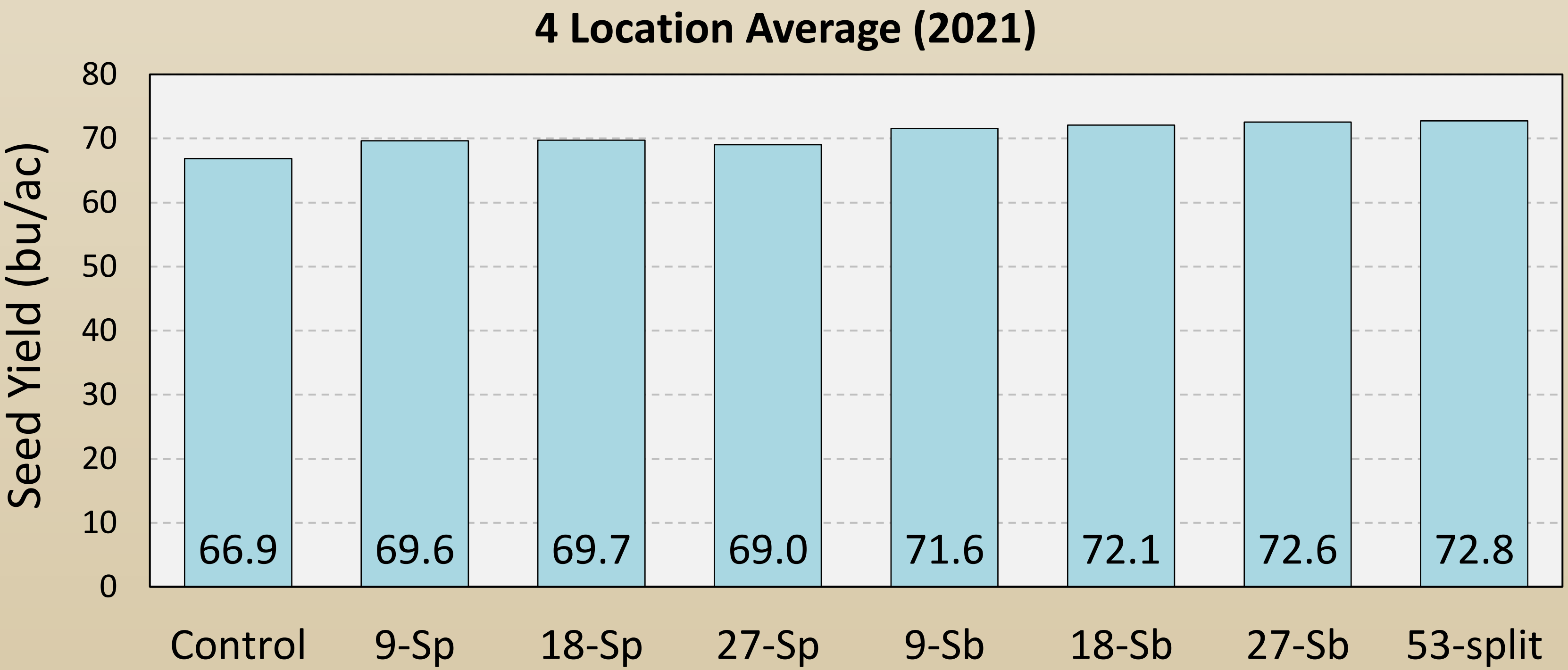
- Data were analyzed separately for each location & no significant treatment effects were detected in any cases

Influence of Potassium Fertilizer Rate & Placement on Wheat Kernel Weight



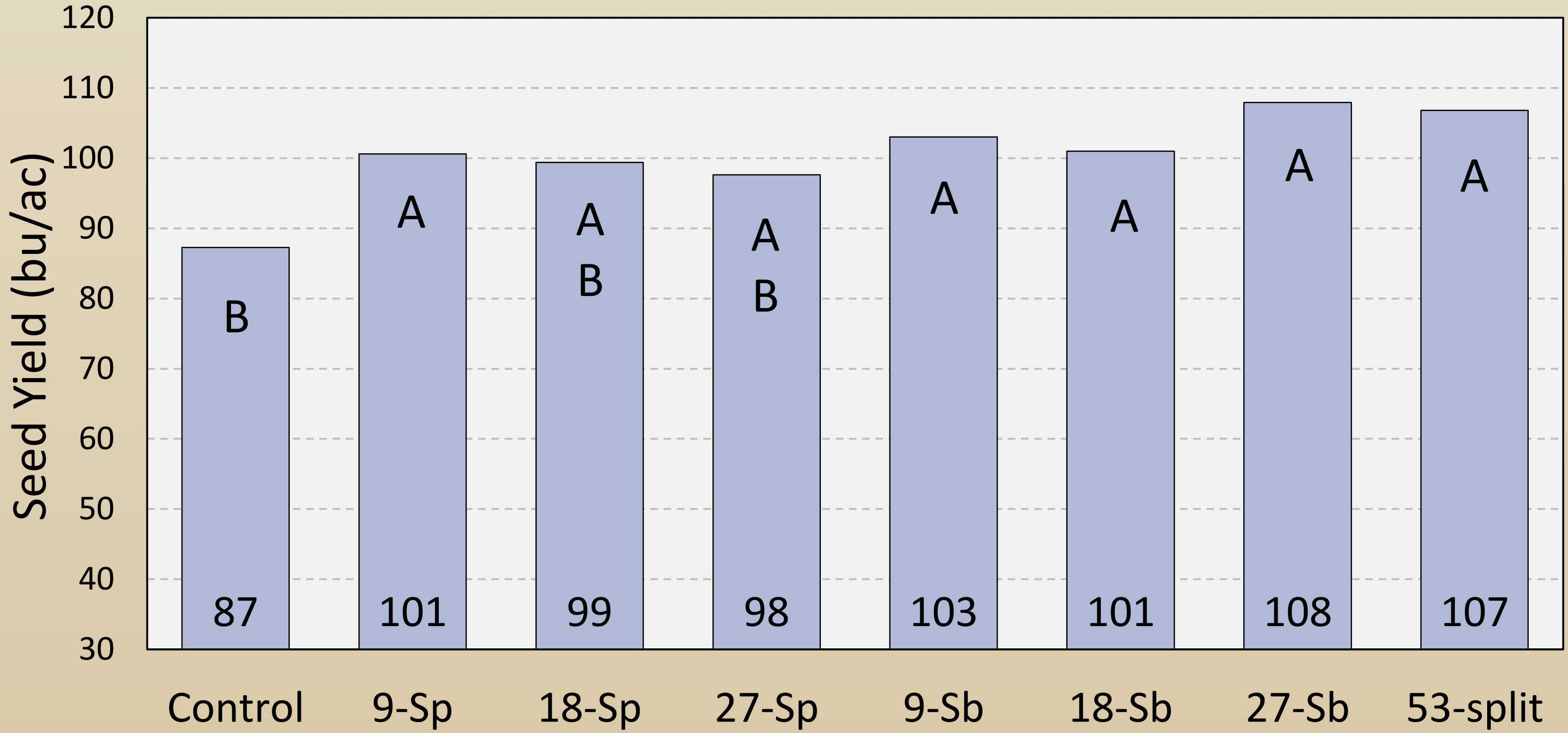
- Significant treatment effects at 1/6 locations (Swift Current) with TKW values at that site ranging from 27.4-29.4 g but no consistent trends with regard to a KCl response

Influence of Potassium Fertilizer Rate & Placement on Barley Yield



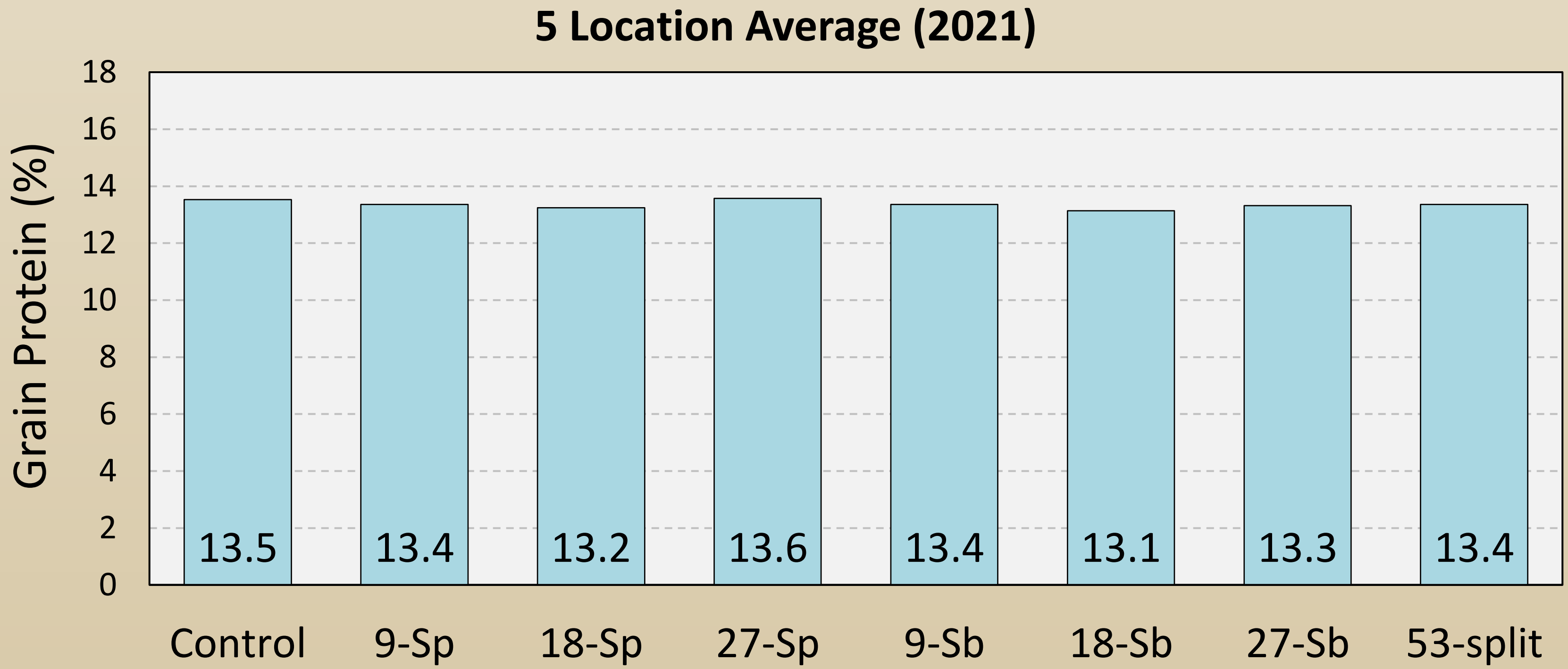
- Yorkton and Prince Albert excluded from average due to high C.V. values (>15%)
- Significant treatment effects at 1/6 locations (Outlook); relatively strong response to KCl fertilization at this site and generally better results with side-banding
- Observed trend in averaged results due almost entirely to the response at Outlook

Influence of Potassium Fertilizer Rate & Placement on Barley Yield (Outlook-2021)



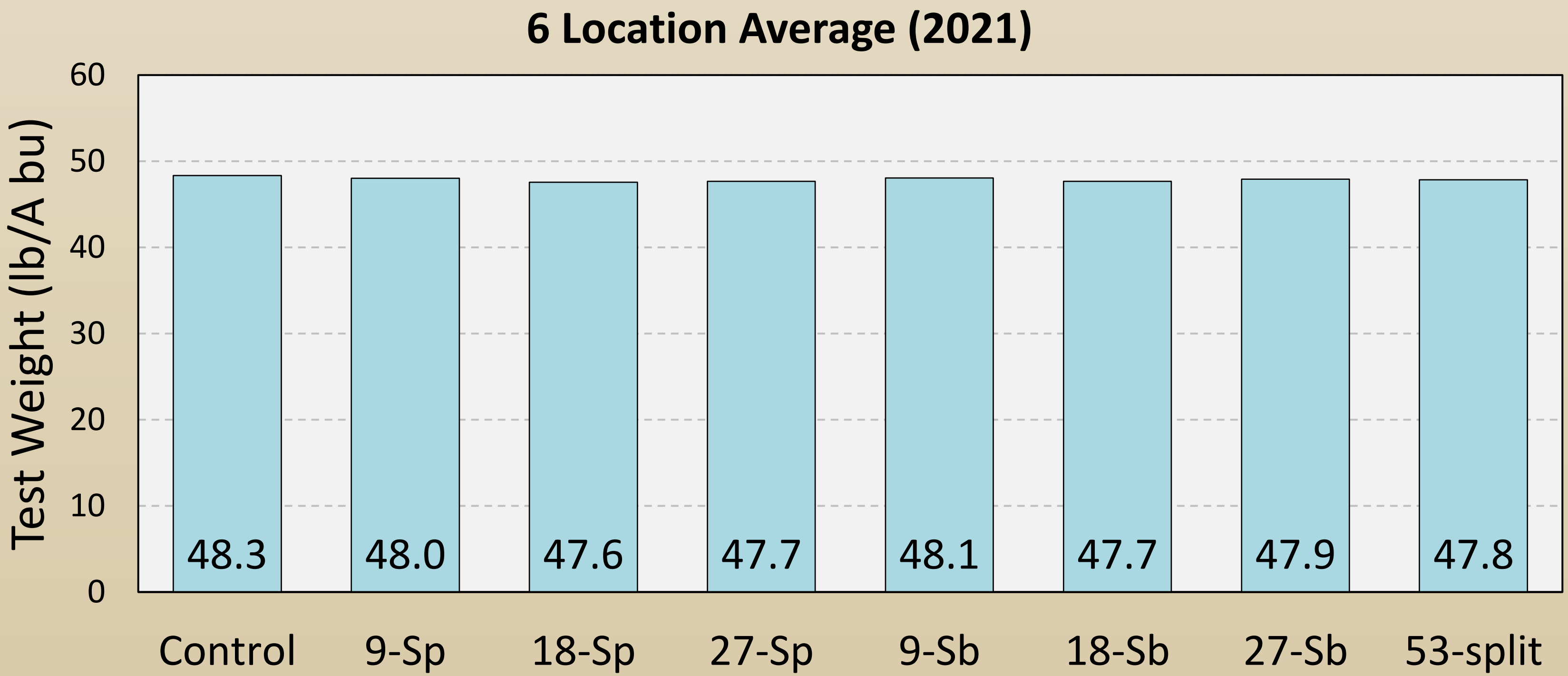
- Emergence counts were not completed, but it is possible that weaker response to higher rates of seed-placed KCl may have been due to seedling toxicity (the site had sandy soil and low organic matter)

Influence of Potassium Fertilizer Rate & Placement on Barley Grain Protein



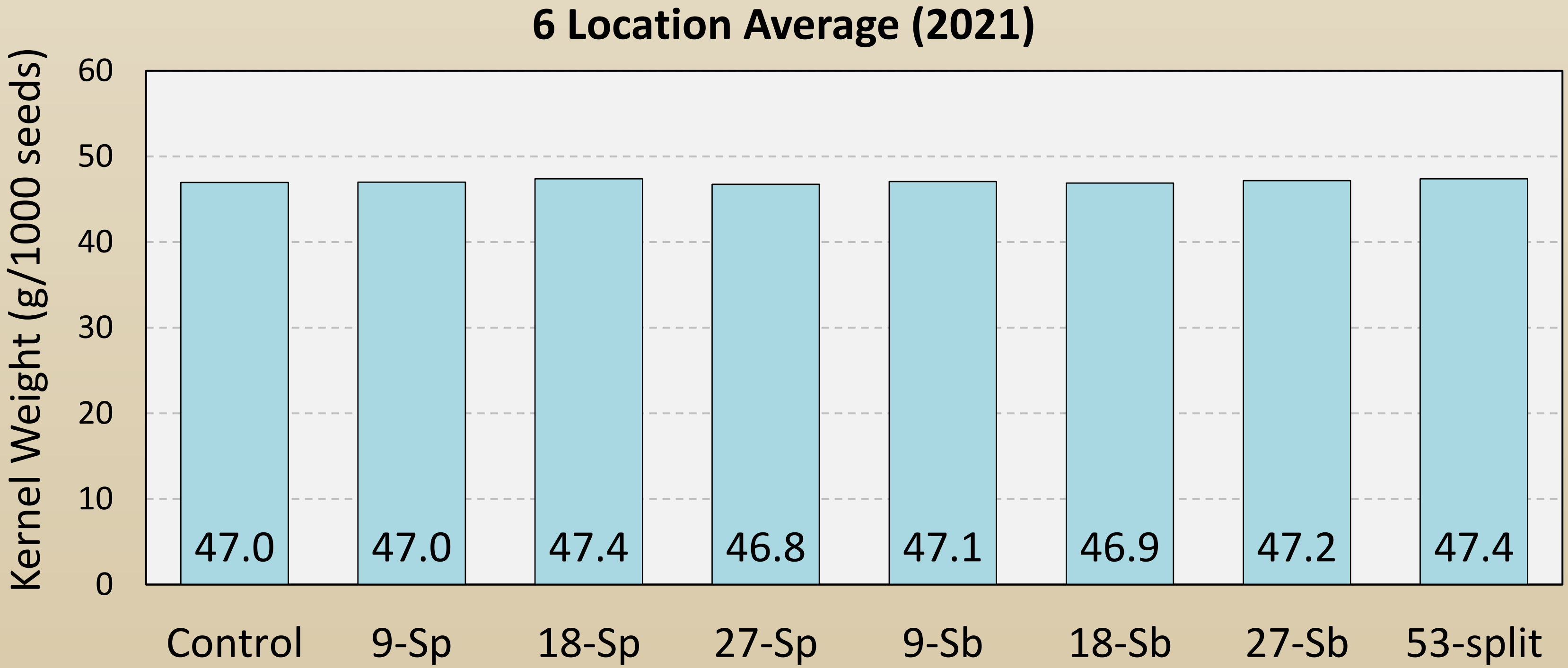
- Measurement not completed at Prince Albert
- Significant ($P \leq 0.10$) treatment effects at 2/5 locations (Outlook & Swift Current)
- Protein was inversely related to yield at Outlook; no meaningful trends were observed at Swift Current

Influence of Potassium Fertilizer Rate & Placement on Barley Test Weight



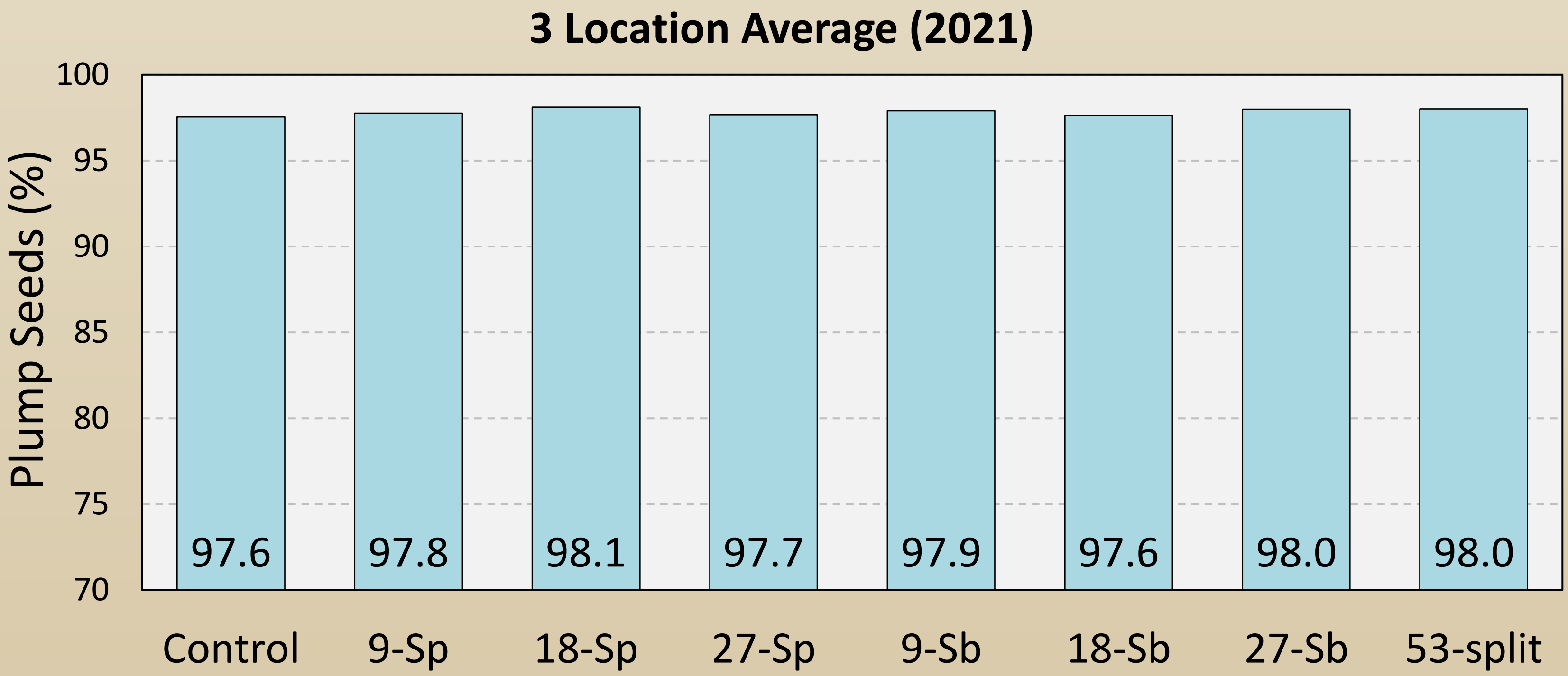
- Data were analyzed separately for each location & no significant treatment effects were detected in any cases

Influence of Potassium Fertilizer Rate & Placement on Barley Kernel Weight



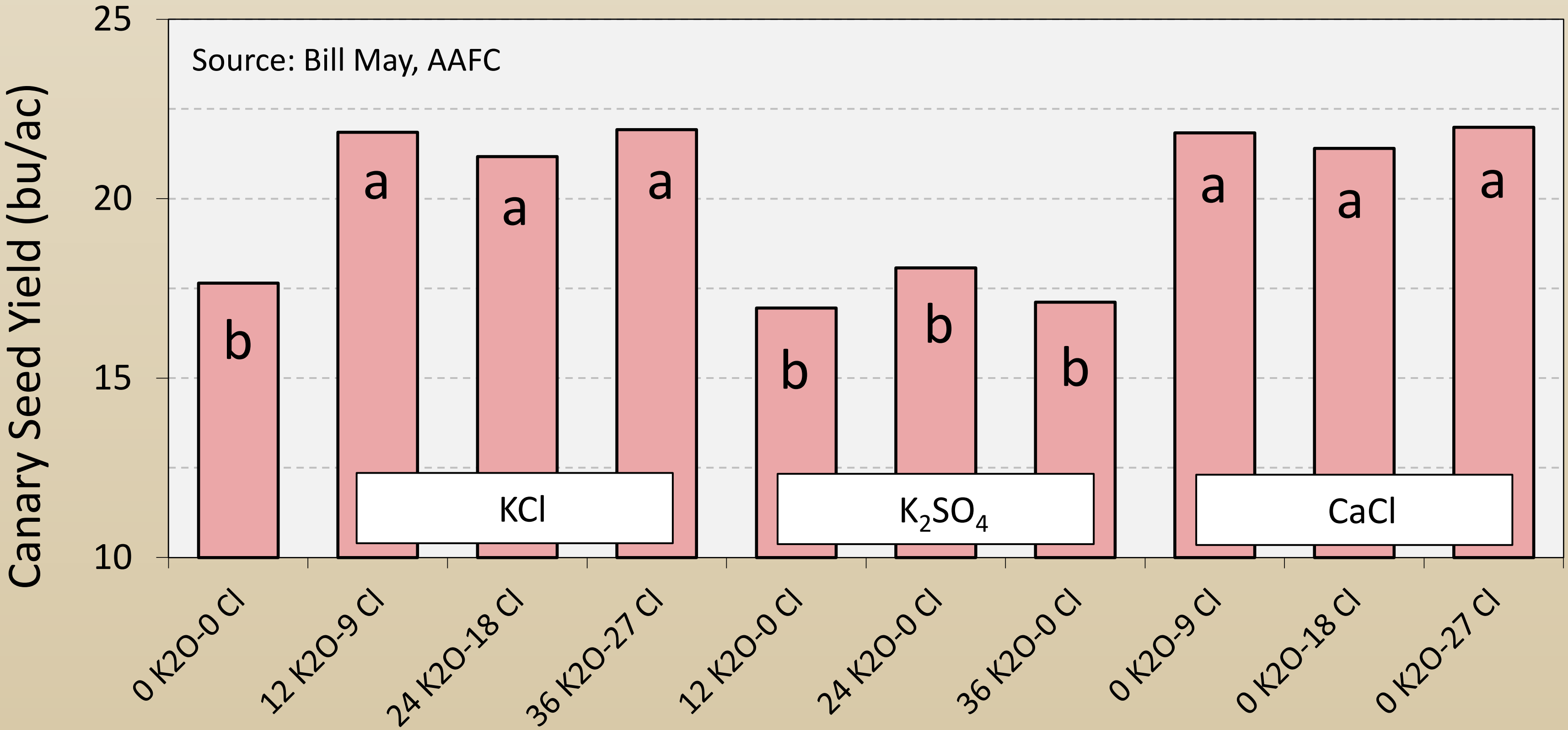
- Significant treatment effects at 1/6 locations (Indian Head)
- TKW values at Indian Head ranged from 41.7-42.8 g with a slight but inconsistent trend for higher values with KCl

Influence of Potassium Fertilizer Rate & Placement on Barley Plumpness



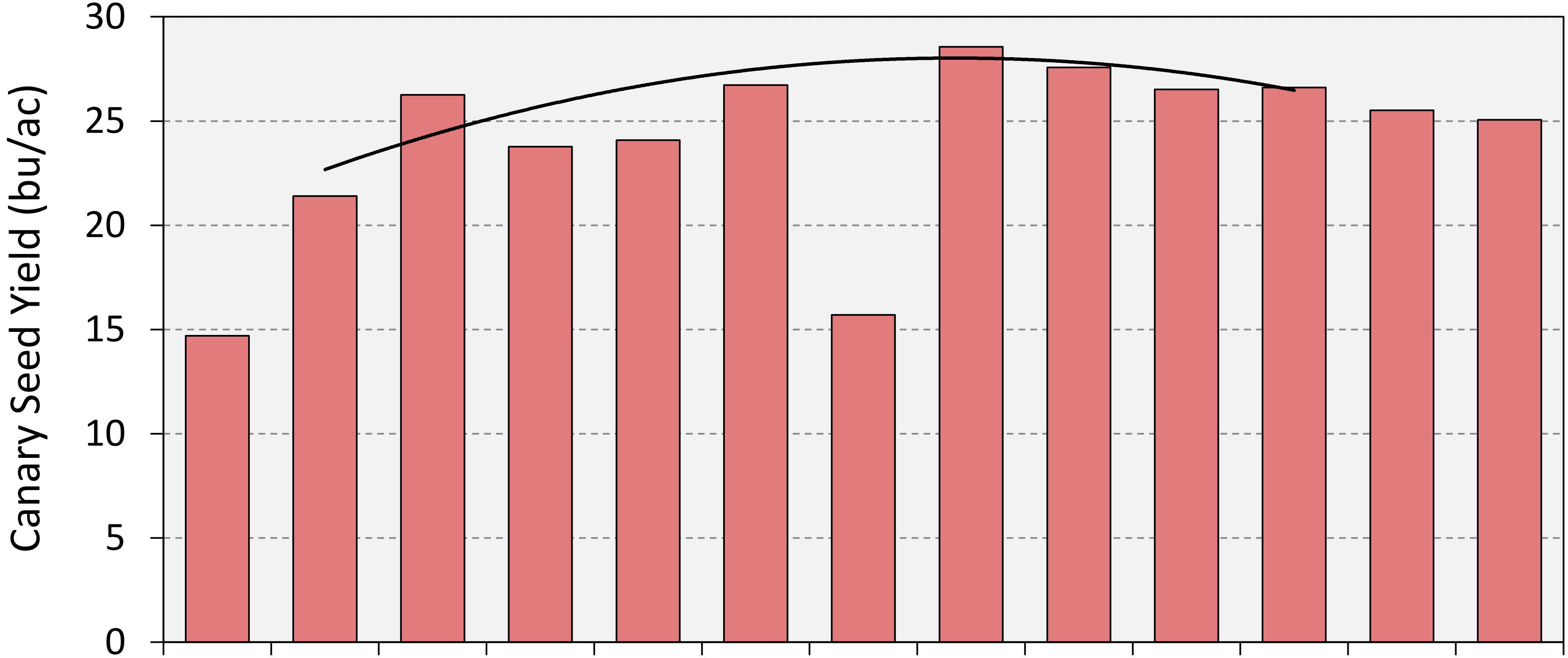
- Measurements not completed at Prince Albert, Redvers, or Swift Current.
- Significant treatment effects at 1/3 locations (Indian Head)
- Plump seeds at Indian Head ranged from 97.0-97.8% - values in the control amongst the lowest but benefits to KCl were small & inconsistent at best. No effect on thins.

Are Potash Responses in High K Soils Due to Potassium or Chloride?



- Results shown are the average of 13 site-years (both responsive & non-responsive)
- Yield increase with Cl was 21% overall & > 70% specifically for responsive sites

Chloride Responsive (7/19) Sites



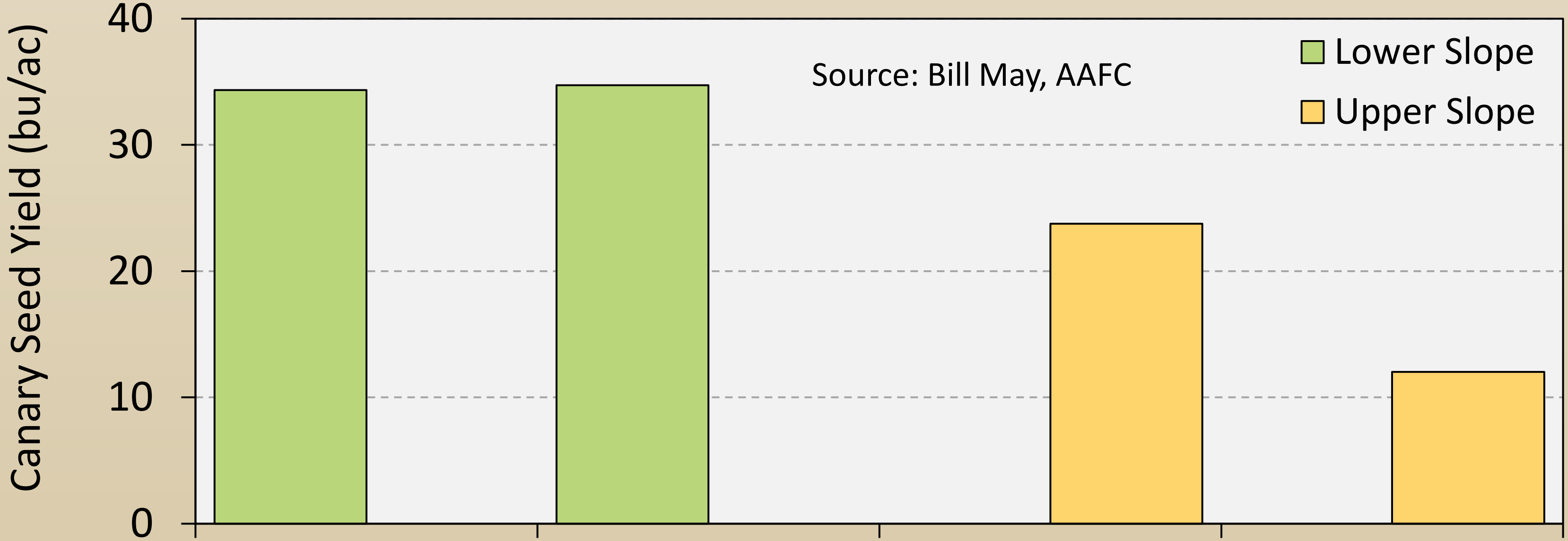
N	0	15	30	30	30	60	60	60	60	60	90	60	60
P	0	0	0	30	30	30	30	30	30	30	30	30	30
CL		18	18	18	18	18	0	18	18	18	18	KCl	CaCl
S					15	15	15	15	15	15	15	15	15
Cu								3					
Zinc									3				
Cu, Z, Mn, B										Yes	Yes		Surface

Source: Bill May, AAFC

Agriculture and Agri-Food Canada

How Does Landscape Position on a Loam Soil Affect Chloride Response?

Single Site – Oxbow Loam Near Indian Head (2019)



N	60	60	60	60
P	30	30	30	30
CL	18	0	18	0
S	15	15	15	15

Influence of Potassium Fertilization on Malting Barley & CWRS Wheat: Conclusions

- Potassium is unlikely to be limiting for most western Canadian soils but responses can occur – the most severe deficiencies occur in northern, peat soils (i.e. northeast SK & northern MB) & also coarse textured, sandy soils
- Relatively little potassium is 'mined' from soils if only the grain is removed; however, fields where straw is continually removed or where forages are harvested for hay should be monitored more closely
- Responses in high K soils may be due to physiological, environmental, or disease effects; however, most field research has found such benefits to be relatively small & infrequent
- Responses to potash application can also frequently be attributed to chloride, especially for canary seed where it is often the most limiting nutrient; however, Cl responses have also been observed in other cereals
- Similar to P, the ideal placement option is in-furrow, but only for low rates & side-banding is also a good option – if it is specifically chloride you are after, surface broadcast applications also work well

THANK YOU

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