2023 IHARF Agronomy Update

Chris Holzapfel, Research Manager

Indian Head Agricultural Research Foundation

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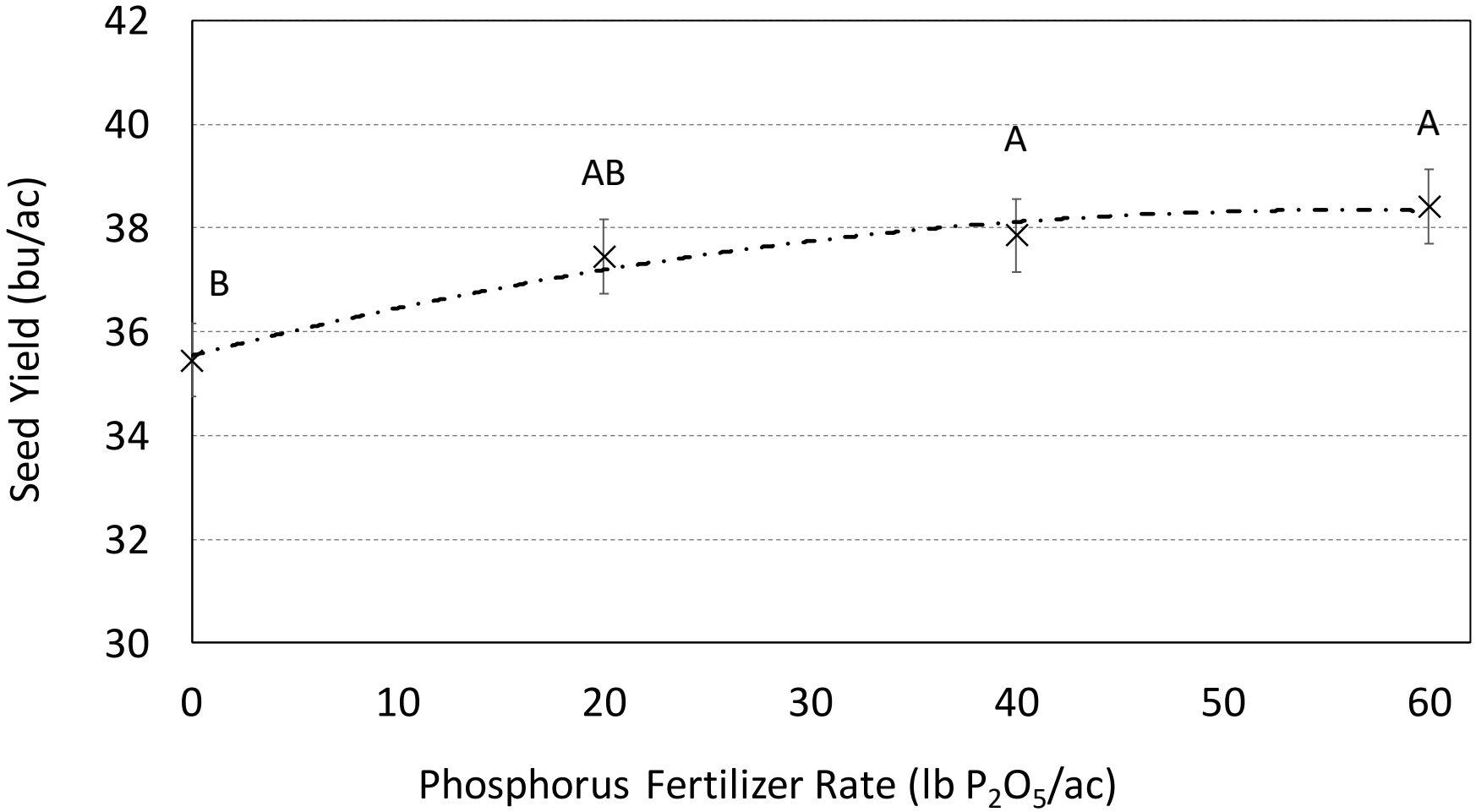
Topics to Cover

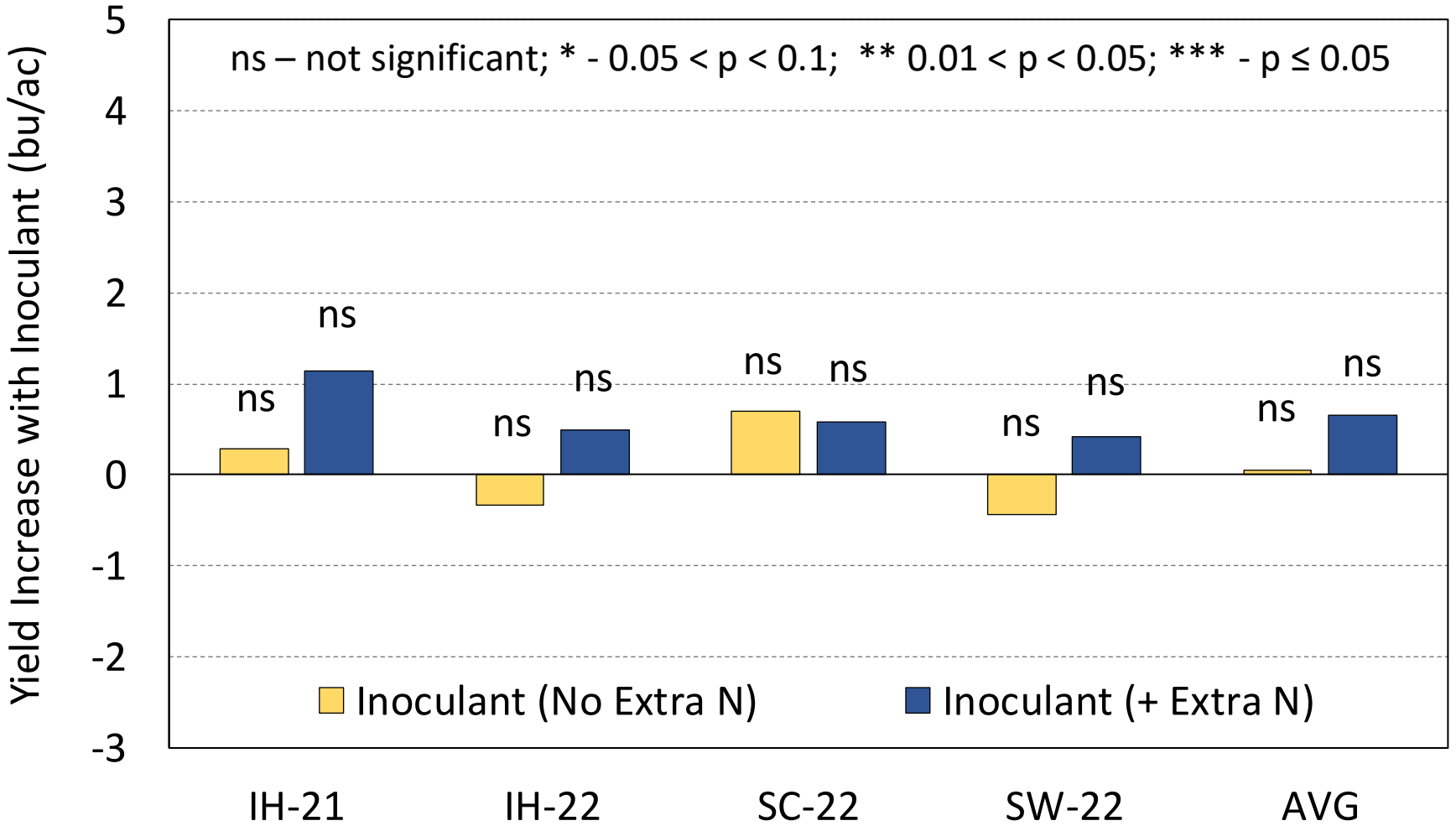
1. Past Lentil Fertility Recap & Response to High Levels of Residual Soil Nitrogen
2. Wheat & Canola Response to Foliar-Applied N-Fixing Biologicals
3. Canola Response to Various Side-banded N Formulations & 4R N Management Strategies
4. Spring Wheat Response to Seeding Rates Under Dry Conditions
5. Response of Different Spring Wheat Varieties to Available Plant Growth Regulator Options

Lentil Seed Yield Response to Phosphorus Rate (4-Site Average)



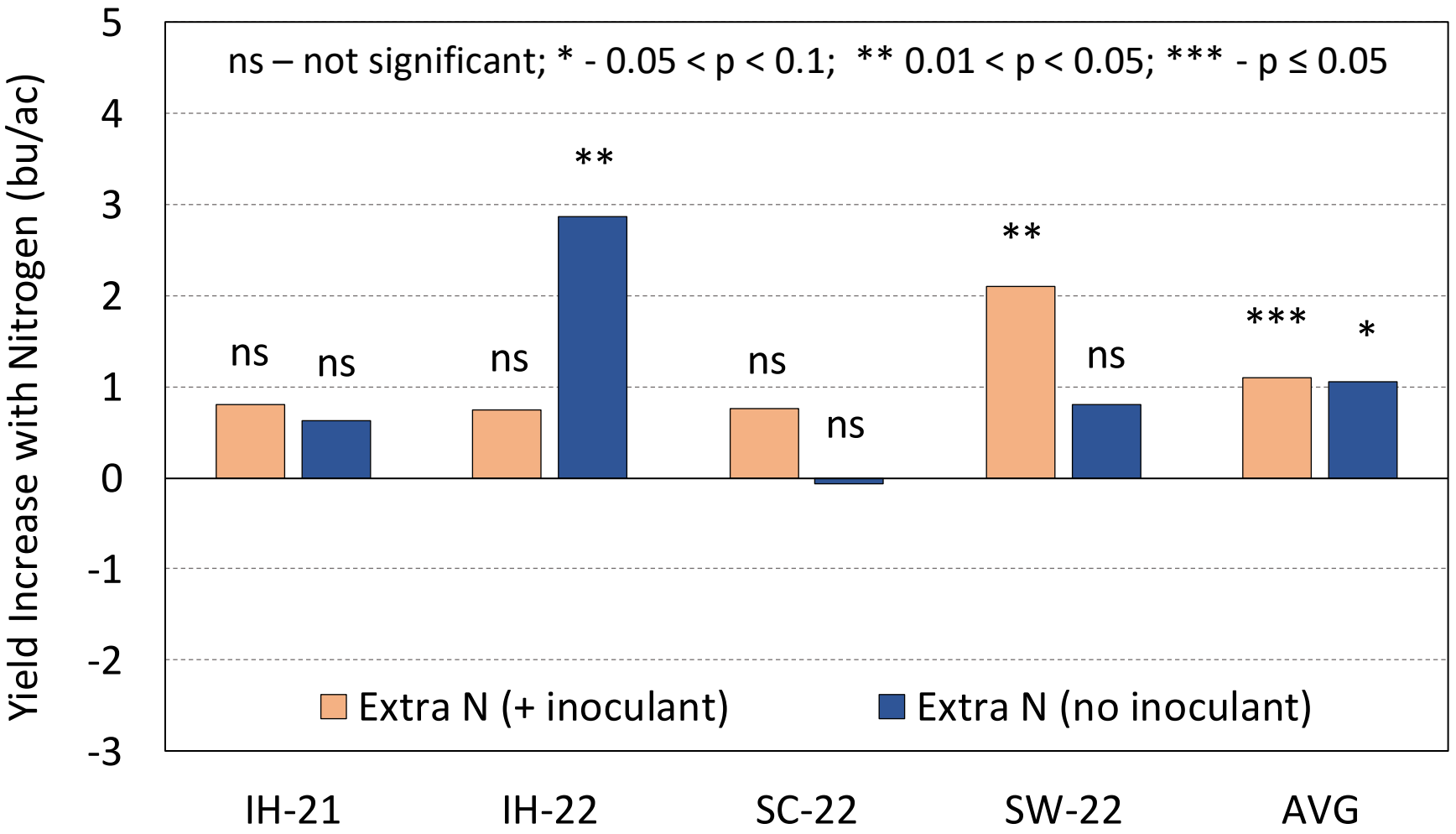
Contrast	Pr > F
AVG linear	**<0.001**
AVG quadratic	0.114

Inoculant Effects on Lentil Seed Yield



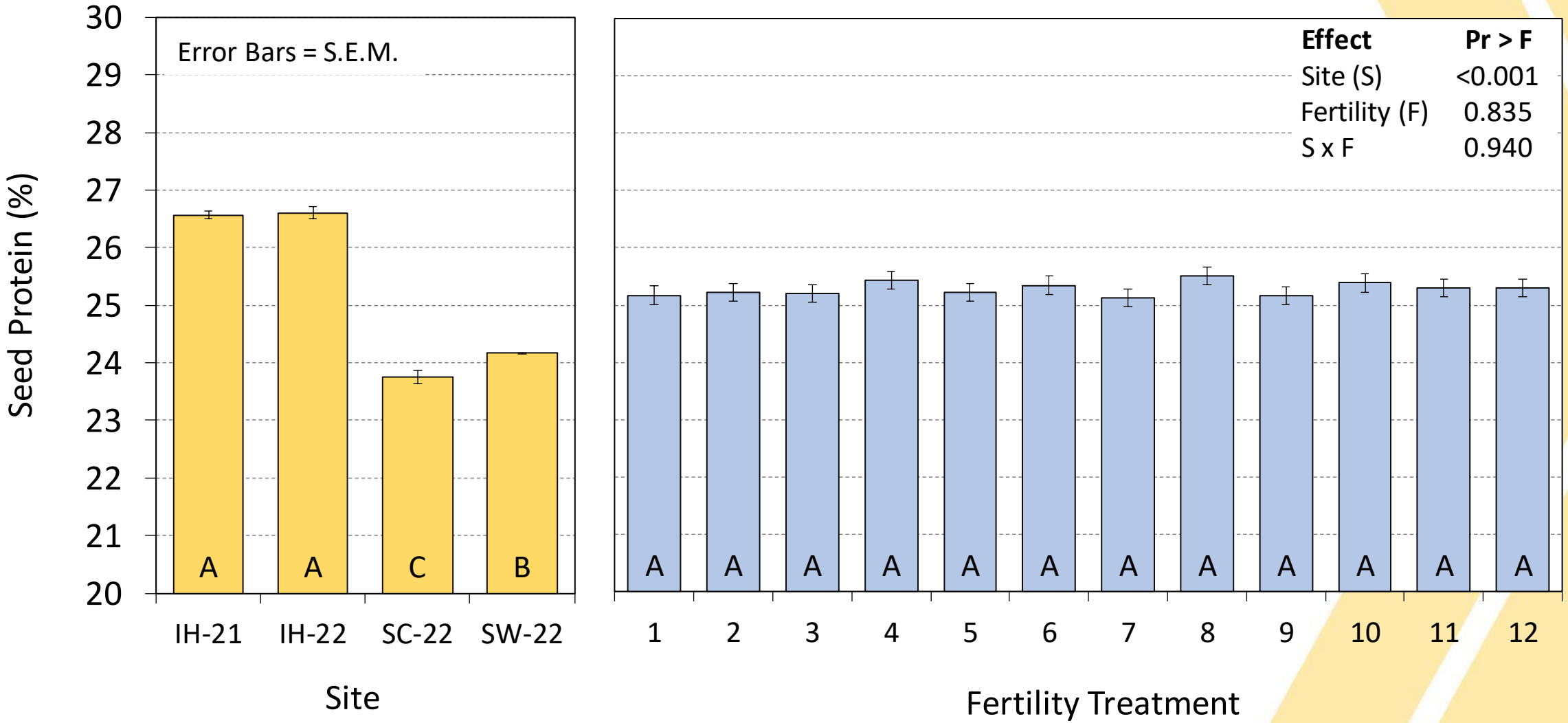
Inoculant Contrast	Pr > F
IH-21 (no extra N)	0.701
IH-21 (+ extra N)	0.217
IH-22 (no extra N)	0.645
IH-22 (+ extra N)	0.589
SC-22 (no extra N)	0.348
SC-22 (+ extra N)	0.534
SW-22 (no extra N)	0.556
SW-22 (+ extra N)	0.649
AVG (no extra N)	0.891
AVG (+ extra N)	0.155

Nitrogen Effects on Lentil Seed Yield



Inoculant Contrast	Pr > F
IH-21 (no extra N)	0.253
IH-21 (+ extra N)	0.576
IH-22 (no extra N)	0.229
IH-22 (+ extra N)	0.012
SC-22 (no extra N)	0.459
SC-22 (+ extra N)	0.962
SW-22 (no extra N)	0.017
SW-22 (+ extra N)	0.472
AVG (no extra N)	0.007
AVG (+ extra N)	0.060

Site & Fertility Effects on Lentil Protein



Lentil Response to Soil Residual Nitrogen & Rhizobial Inoculation (ongoing)

Objectives: To demonstrate the response of small red & large green lentil to rhizobial inoculant & varying soil residual N representing low, elevated, & extreme levels

Locations: Indian Head, Scott, & Swift Current (2021-22)

Treatments (3 Residual N Levels x 2 Inoculant Treatments x 2 Lentil Classes):

Residual N Levels	Inoculant	Lentil Class
1) Low (soil N only)	1) None	1) Small Red
2) Elevated (100 lb N/ac [Z])	2) Granular	2) Large Green
3) Extreme (200 lb N/ac [Z])		

[Z] Fall Soil NO_3-N + broadcast urea

Data Collection:

1) Actual residual soil N, emergence, biomass yield, seed yield, & protein

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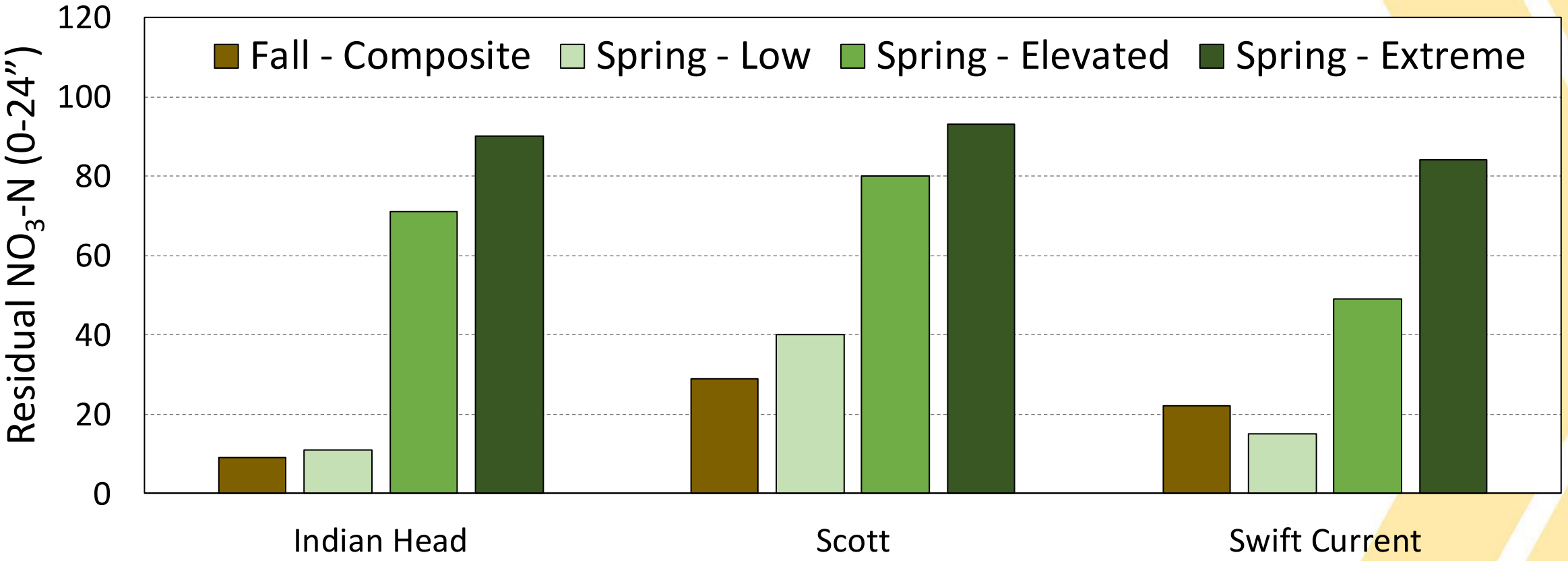
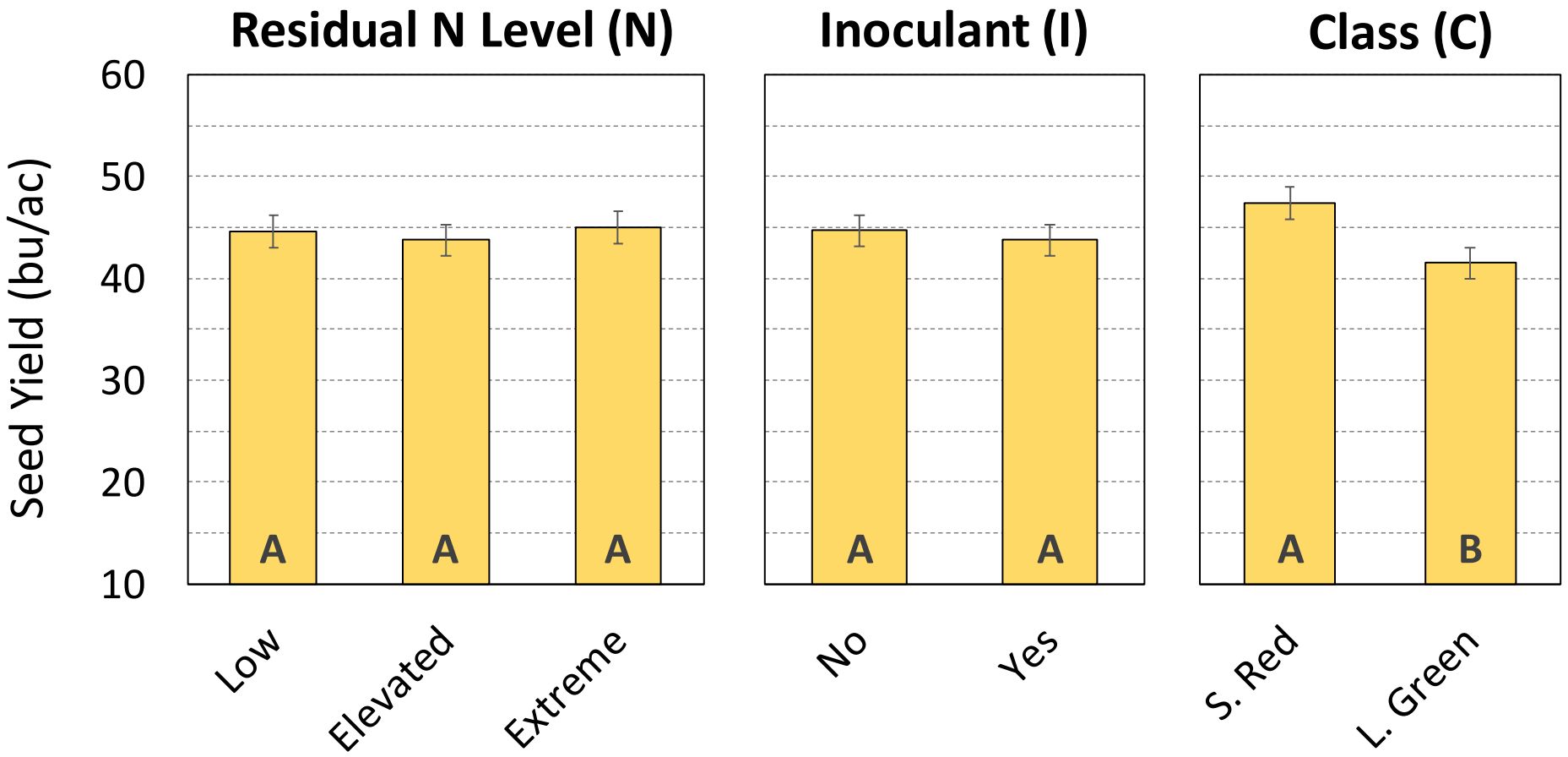
Actual Residual Nitrate Levels



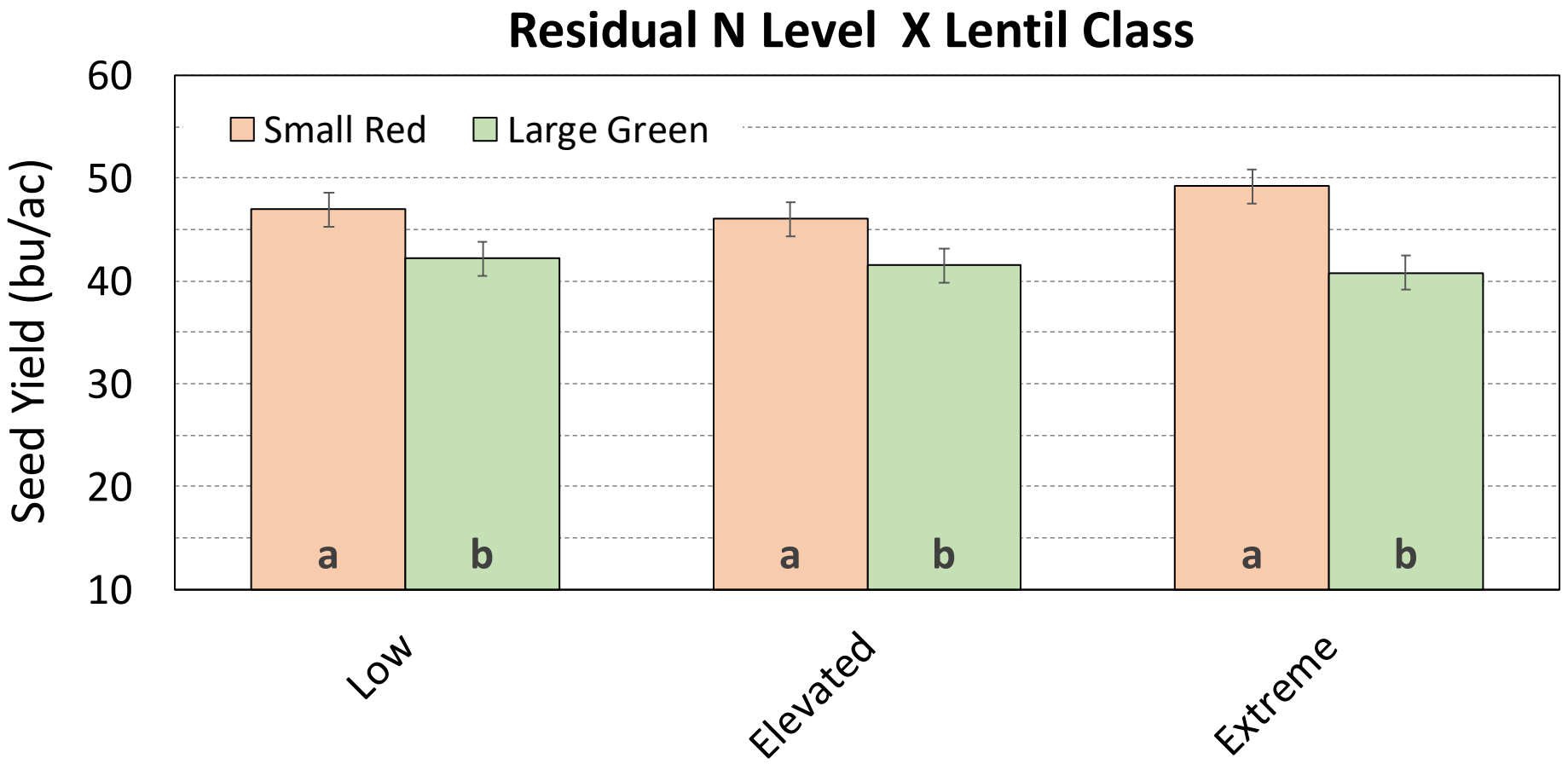
Fall site composites were used to adjust the broadcast N rates for establishing the different residual N treatments – it is likely that not all the N had converted to nitrate by seeding time, particularly at the extreme level, & was not detected in the spring soil analyses

Residual N, Inoculant, & Class Effects on Lentil Seed Yield – Indian Head



Effect	Pr > F
Nitrogen (N)	0.339
Inoculant (I)	0.507
Class (C)	<0.001
N x I	0.885
N x C	0.049
I x C	0.212
N x I x C	0.890

Residual N by Class Effects on Lentil Seed Yield – Indian Head



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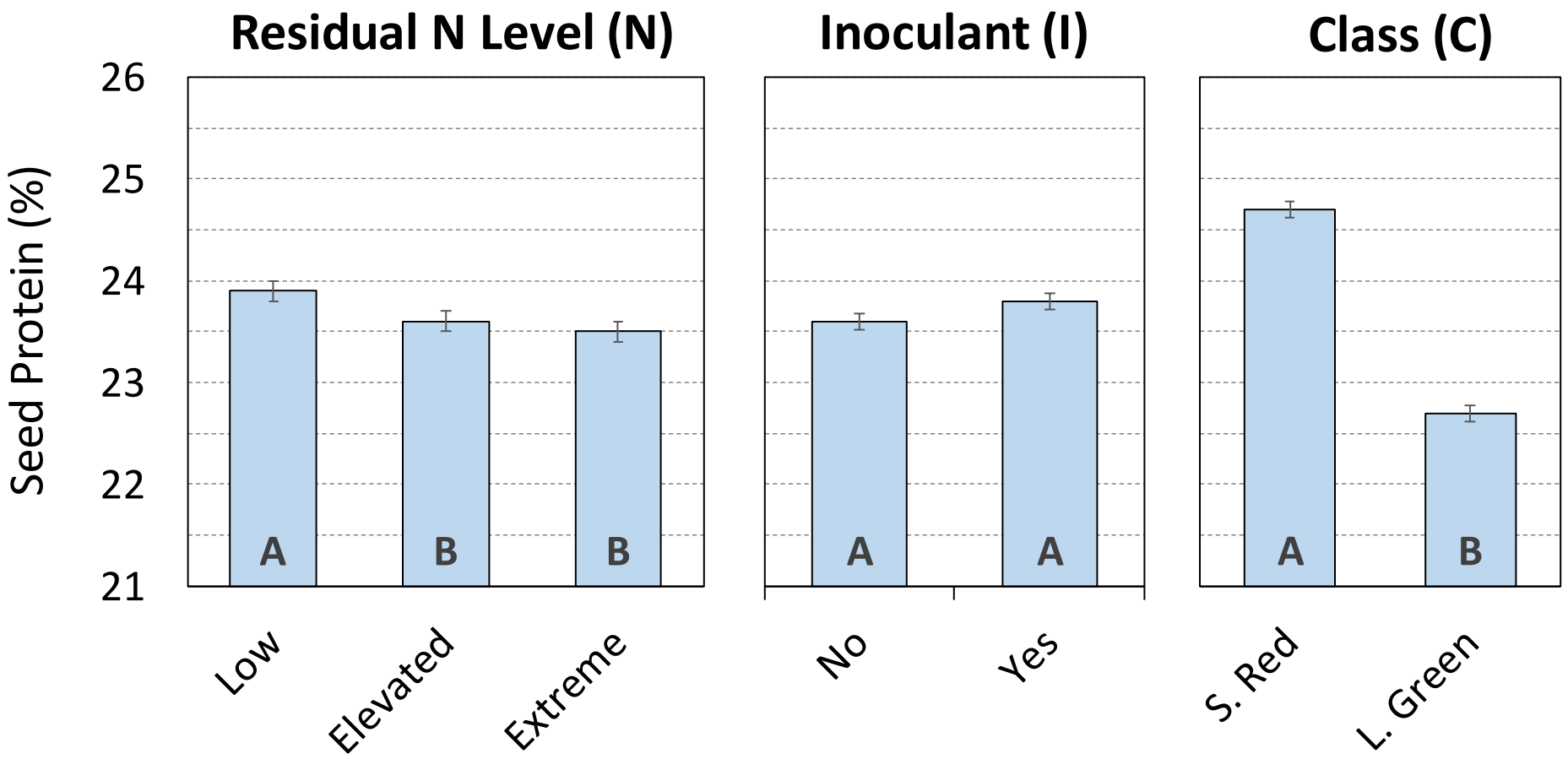
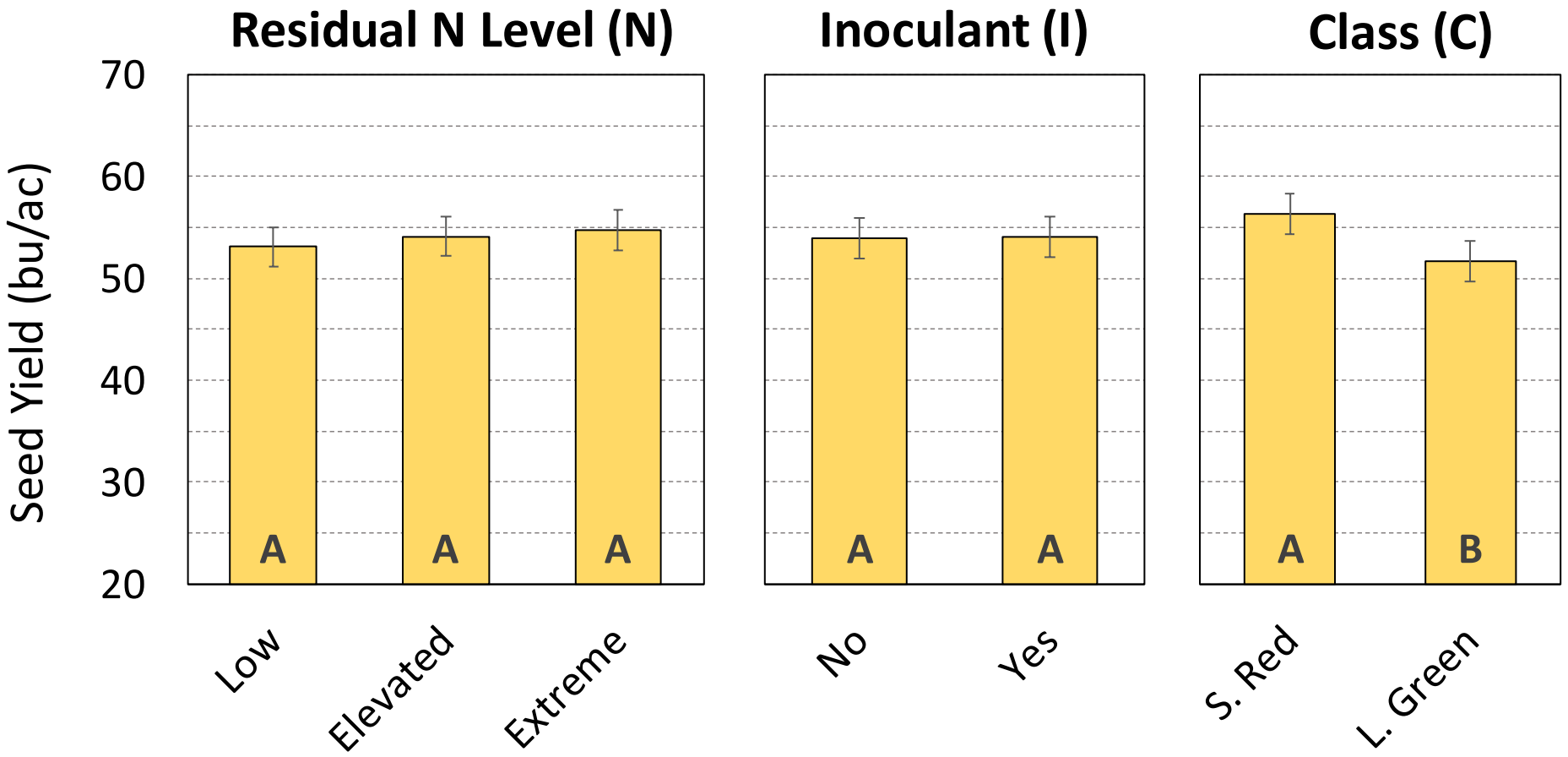
Residual N, Inoculant, & Class Effects on Lentil Seed Protein – Indian Head



Effect	Pr > F
Nitrogen (N)	0.019
Inoculant (I)	0.070
Class (C)	<0.001
N x I	0.903
N x C	0.637
I x C	0.886
N x I x C	0.267

Residual N, Inoculant, & Class Effects on Lentil Seed Yield – Scott



Effect	Pr > F
Nitrogen (N)	0.558
Inoculant (I)	0.890
Class (C)	<0.001
N x I	0.056
N x C	0.120
I x C	0.662
N x I x C	0.190

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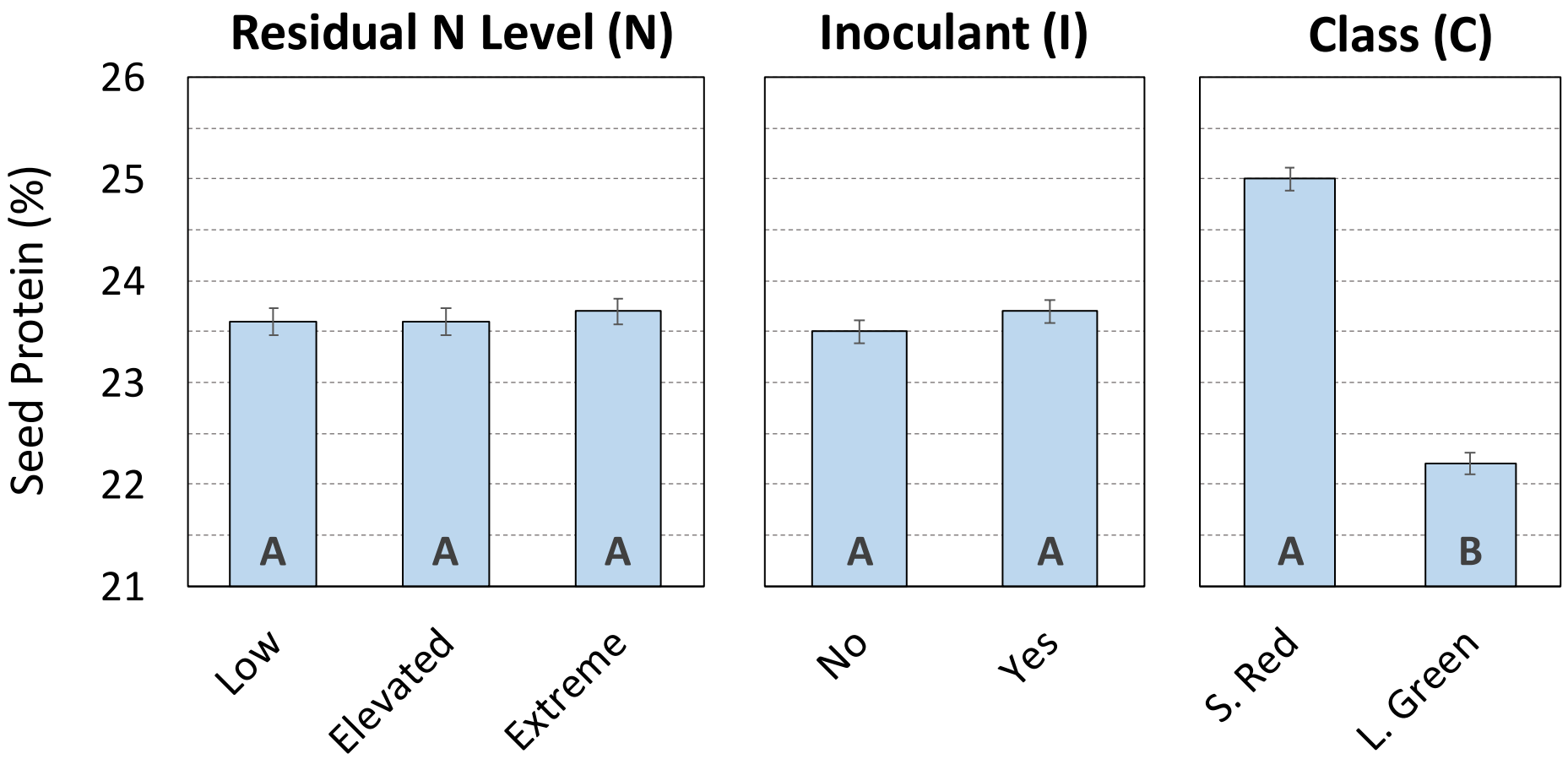
Residual N, Inoculant, & Class Effects on Lentil Seed Protein – Scott



Effect	Pr > F
Nitrogen (N)	0.894
Inoculant (I)	0.092
Class (C)	<0.001
N x I	0.134
N x C	0.180
I x C	0.662
N x I x C	0.034

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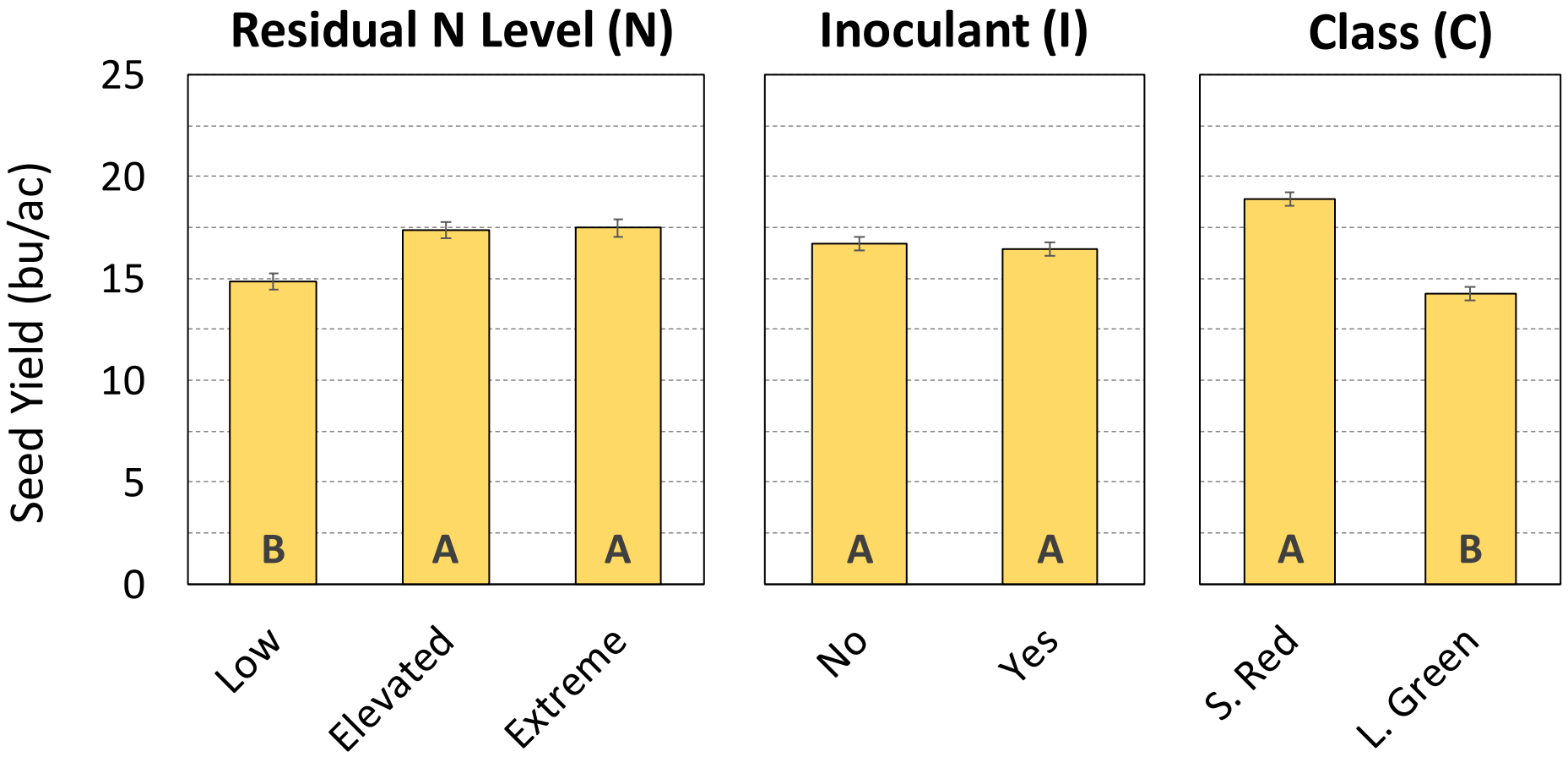
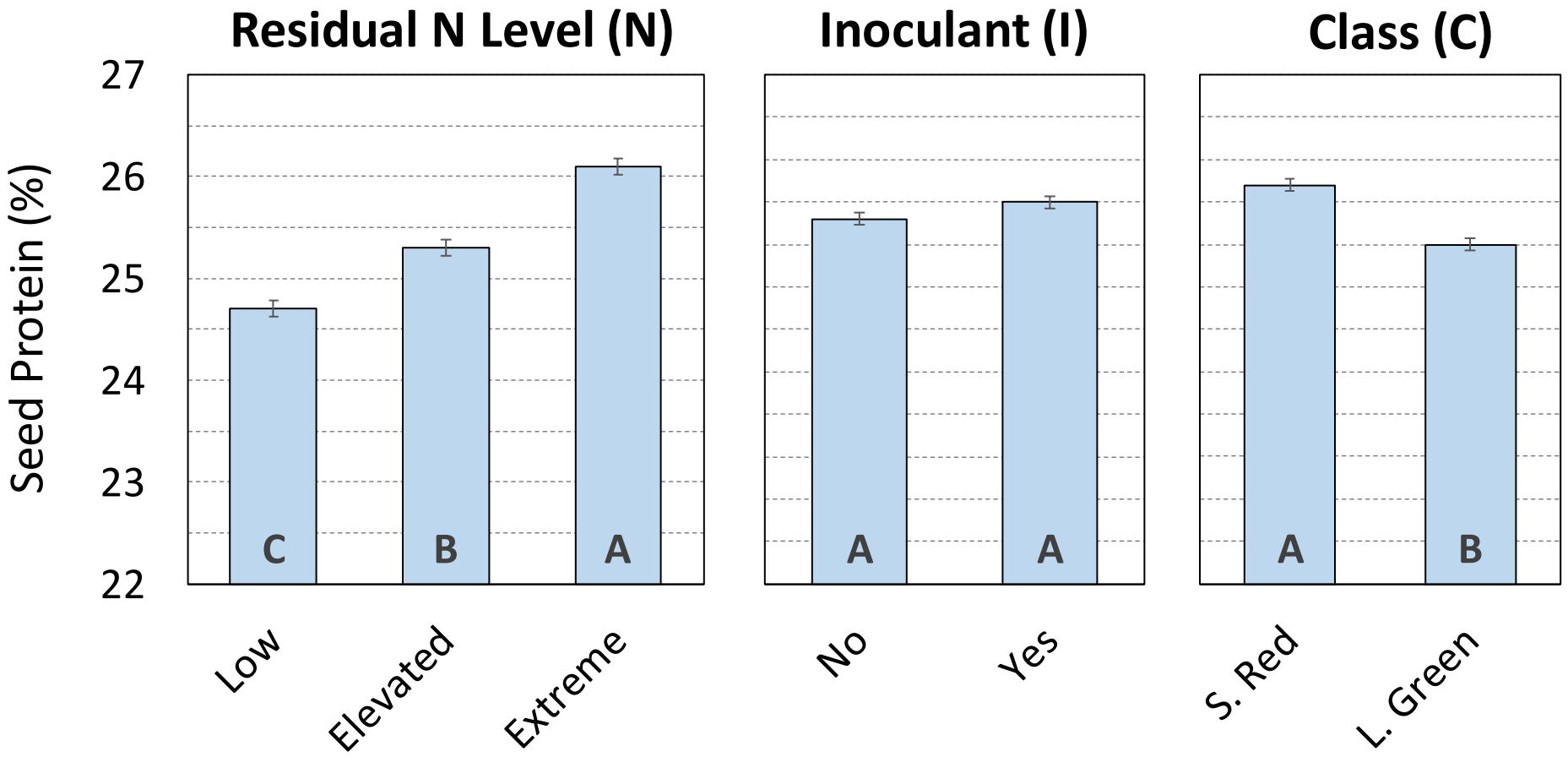
Residual N, Inoculant, & Class Effects on Lentil Seed Yield – Swift Current



Effect	Pr > F
Nitrogen (N)	<0.001
Inoculant (I)	0.586
Class (C)	<0.001
N x I	0.451
N x C	0.925
I x C	0.463
N x I x C	0.418

Residual N, Inoculant, & Class Effects on Lentil Seed Protein – Swift Current



Effect	Pr > F
Nitrogen (N)	<0.001
Inoculant (I)	0.111
Class (C)	<0.001
N x I	0.815
N x C	0.041
I x C	0.357
N x I x C	0.266

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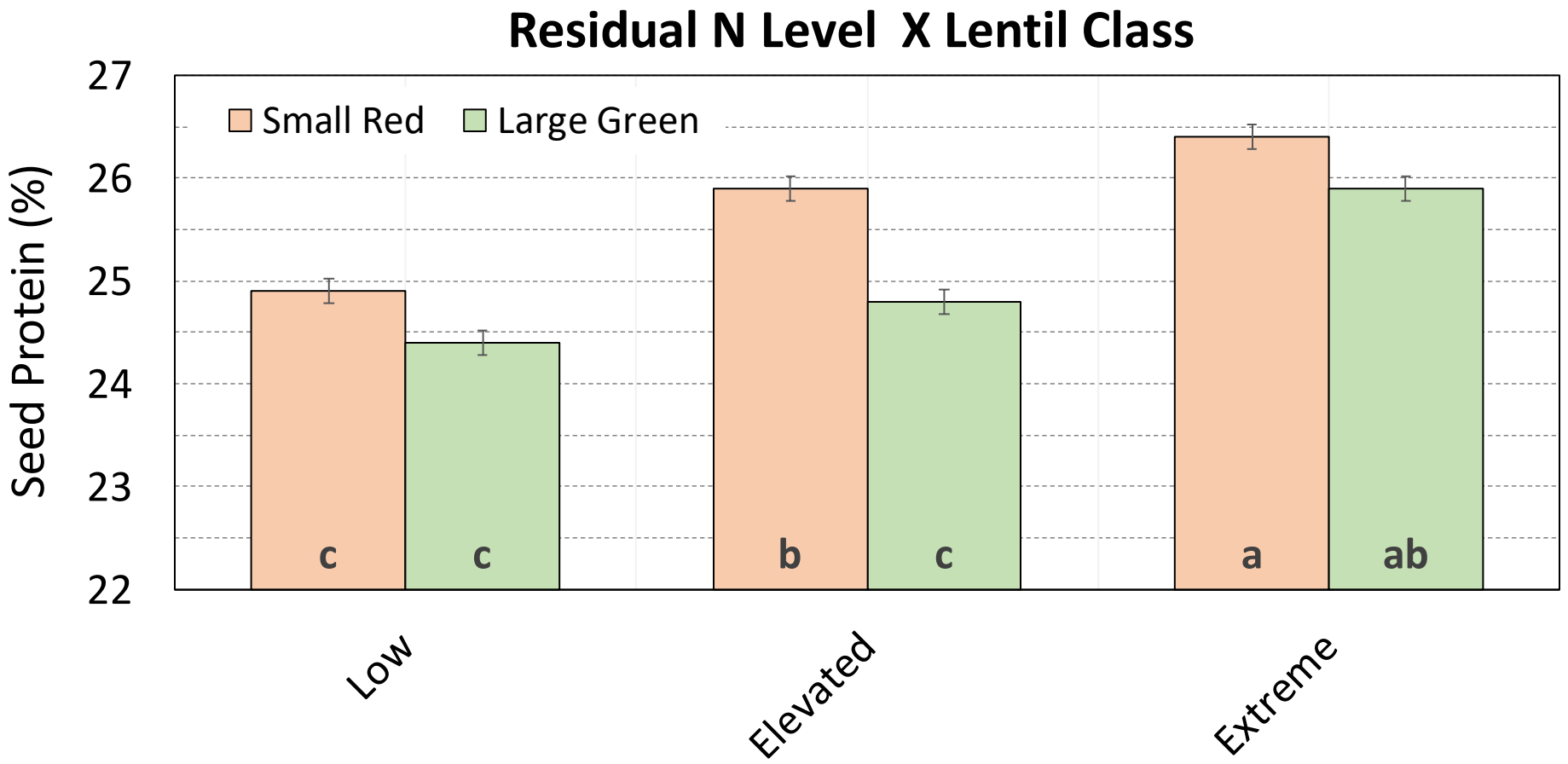
Residual N by Class Effects on Lentil Seed Protein – Swift Current



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Inoculant (I)	0.111
Class (C)	<0.001
N x I	0.815
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N x I x C	0.266

Lentil Fertility: Take Home Messages

- On average, P rates that come close to matching crop removal (~1 lb P_2O_5/bu) are likely to be economically optimal; however lower rates likely adequate in high P soils (i.e., 15-20 ppm or more)
- The N provided by P/S fertilizer products will usually be sufficient, with the occasional exception of coarse textured, low O.M., low residual N soils (i.e., dry Brown soil zone)
  - No evidence of in-crop N being beneficial, & the practical utility of rescue applications in the event of a nodulation failure is limited by narrow windows for application timing and the need for precipitation to move N into the rooting zone
- While lentils are unlikely to benefit from high residual N to the extent of crops like wheat or canola, preliminary results suggest the risk of planting lentils into high N soils is low & may likely even beneficial in low OM, coarse soils
- Difficult to demonstrate responses in fields with history of pea/lentil; however, still recommend inoculation due to importance of N fixation & potential spatial/temporal variability in response

Efficacy of Foliar-Applied Nitrogen Fixing Biological Products for Wheat & Canola

Objectives: To demonstrate the effects of commercially available N-fixing bacteria products on yield & quality of both wheat & canola under varying fertility & contrasting environments

Treatments (3 N Levels x 3 Foliar):

N Levels (soil + fert)	Foliar Treatment
1) Low (45-53 lb N/ac)	UTC (nil)
2) Mid (89-98 lb N/ac)	Envita®(95 ml/ac)
3) High (134-142 lb N/ac)	Utrisha™-N (135 g/ac)

NOTE: Treatments applied at 4-6 leaf stage in distilled water, with 0.1% Agrol 90 included with Envita®

Locations:

1) Indian Head
2) Melfort
3) Outlook
4) Prince Albert
5) Redvers
6) Scott
7) Swift Current
8) Yorkton

Data Collection:

1) Emergence
2) Seed Yield
3) Seed Protein
4) Seed Oil (canola)

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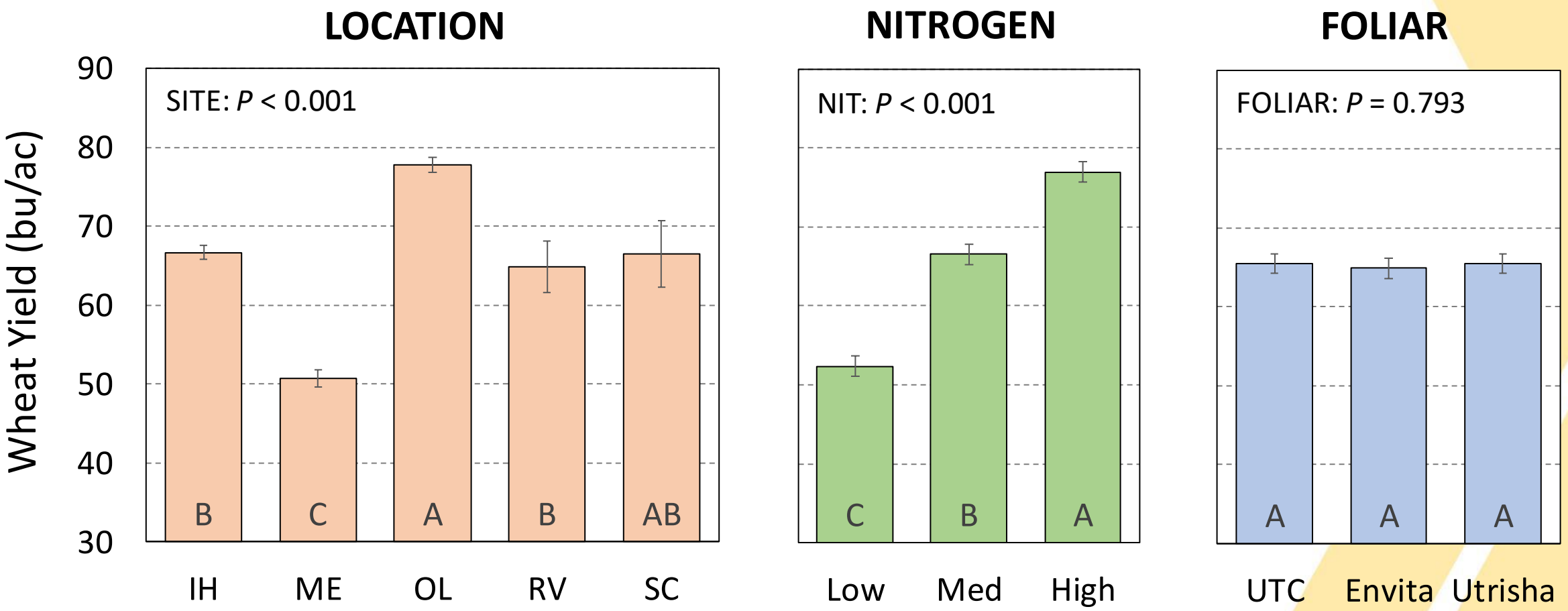
Tests of Fixed Effects: Wheat 2023
(Indian Head, Melfort, Outlook, Redvers, & Scott)

Effect	Plant Density	Grain Yield	Grain Protein
Site (S)	***	***	***
Nitrogen (N)	***	***	***
S × N	ns	***	***
Foliar Trt (F)	–	ns	ns
S × F	–	ns	ns
N × F	–	ns	ns
S × N × F	–	ns	ns

ns – $P > 0.1$; * – $0.1 > P > 0.05$; ** – $0.05 > P > 0.01$; *** – $P < 0.01$

Location, Nitrogen Level & Foliar Treatment Effects on Spring Wheat Grain Yield (5 Locations)



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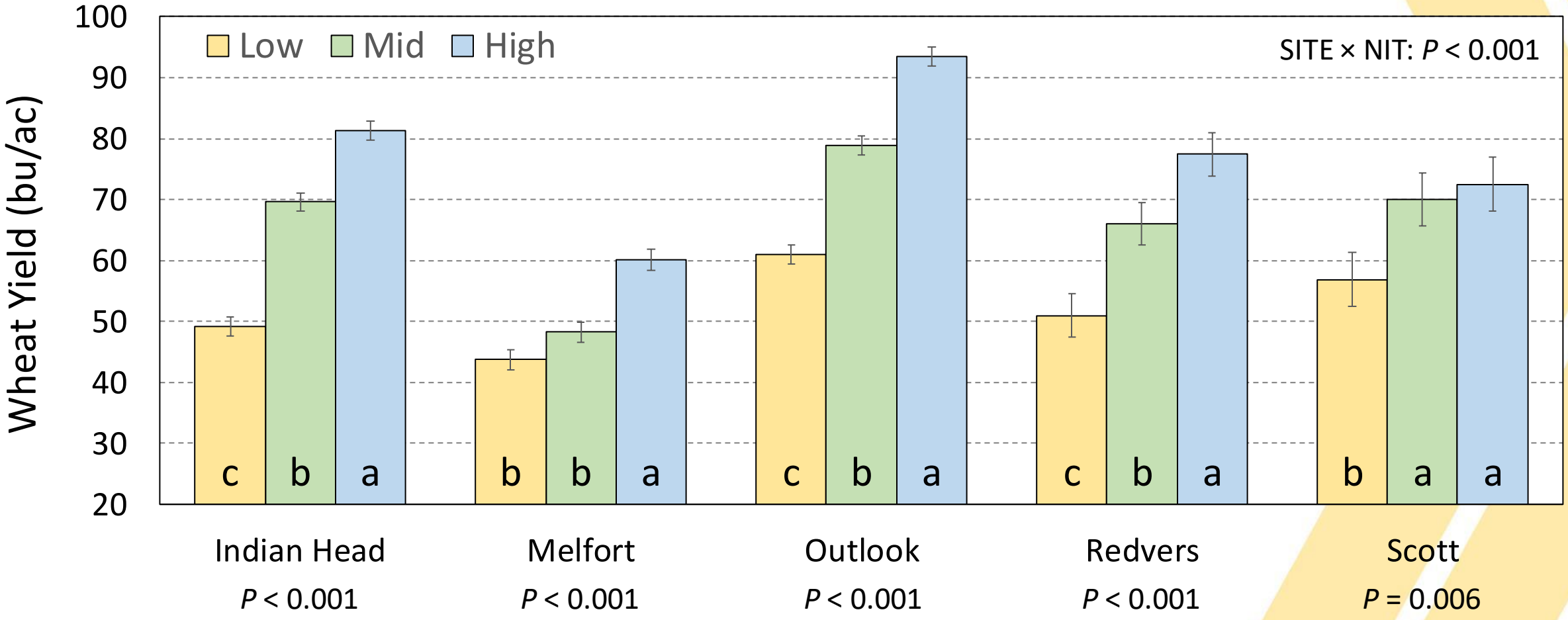
Location x Nitrogen Fertility Level Effects on Spring Wheat Grain Yield (5 Locations)



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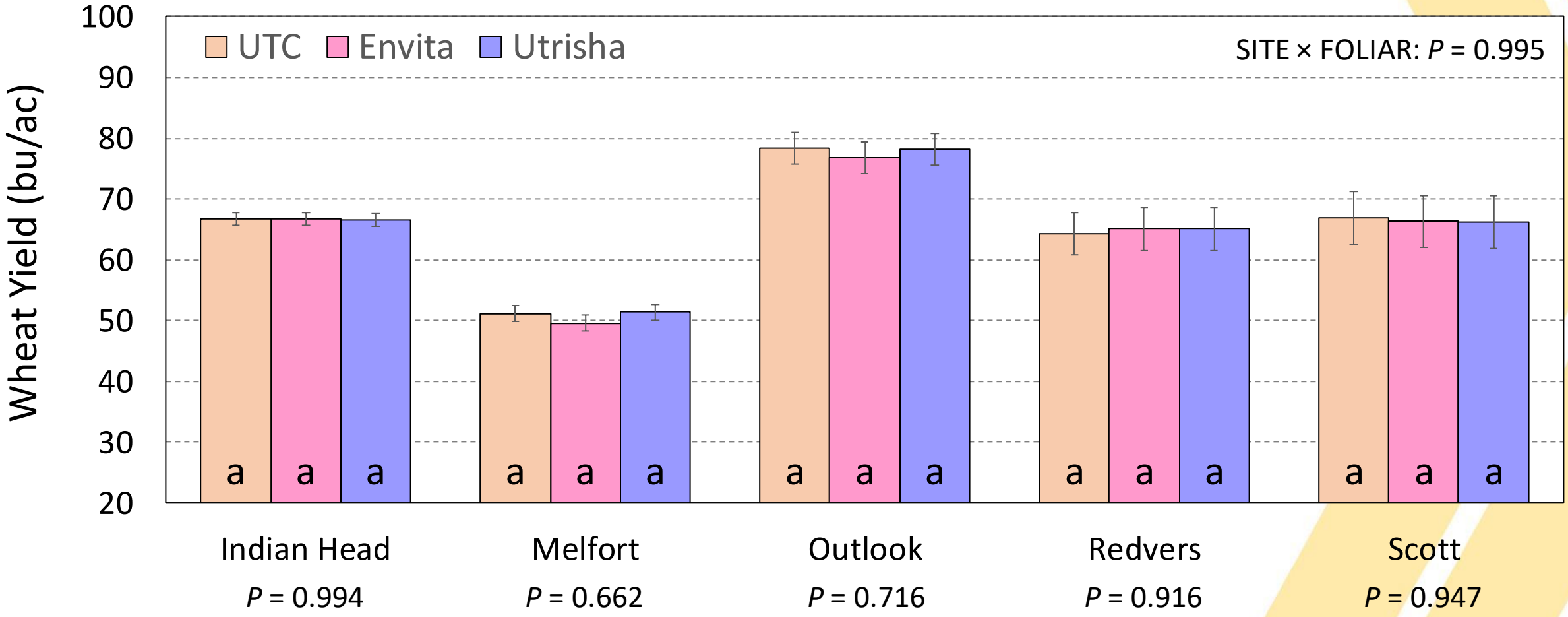
Location x Foliar Treatment Effects on Spring Wheat Grain Yield (5 Locations)



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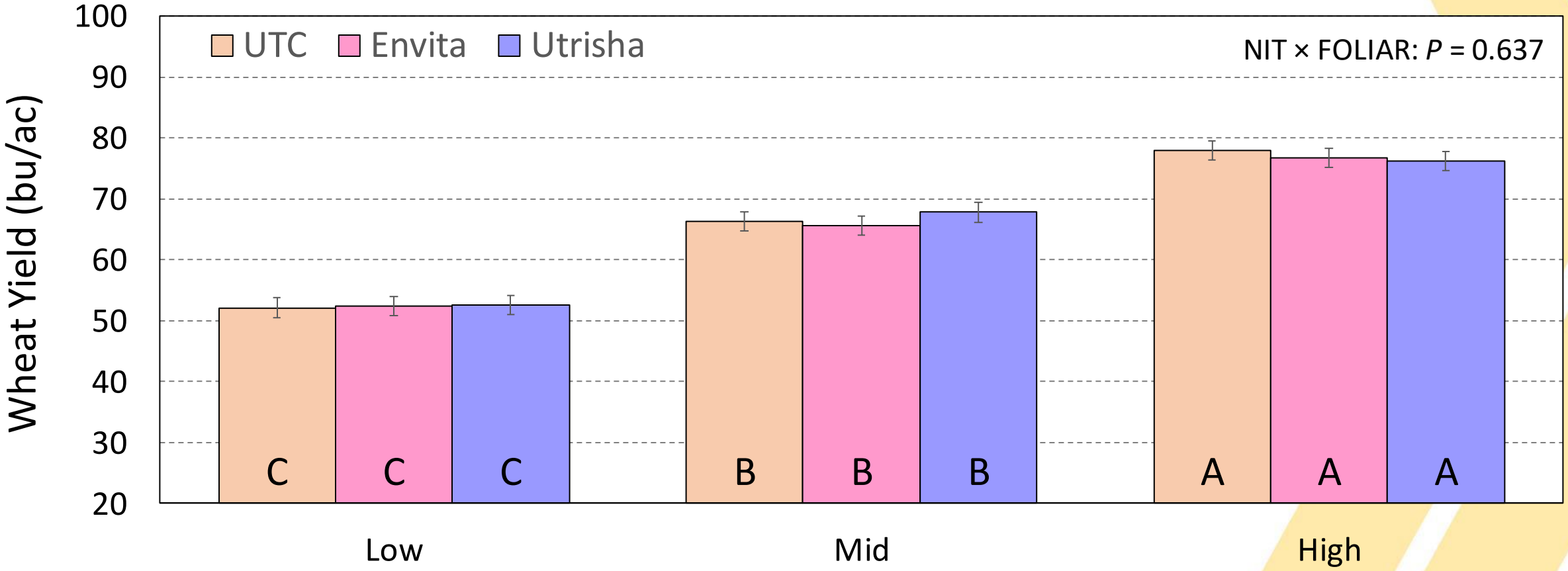
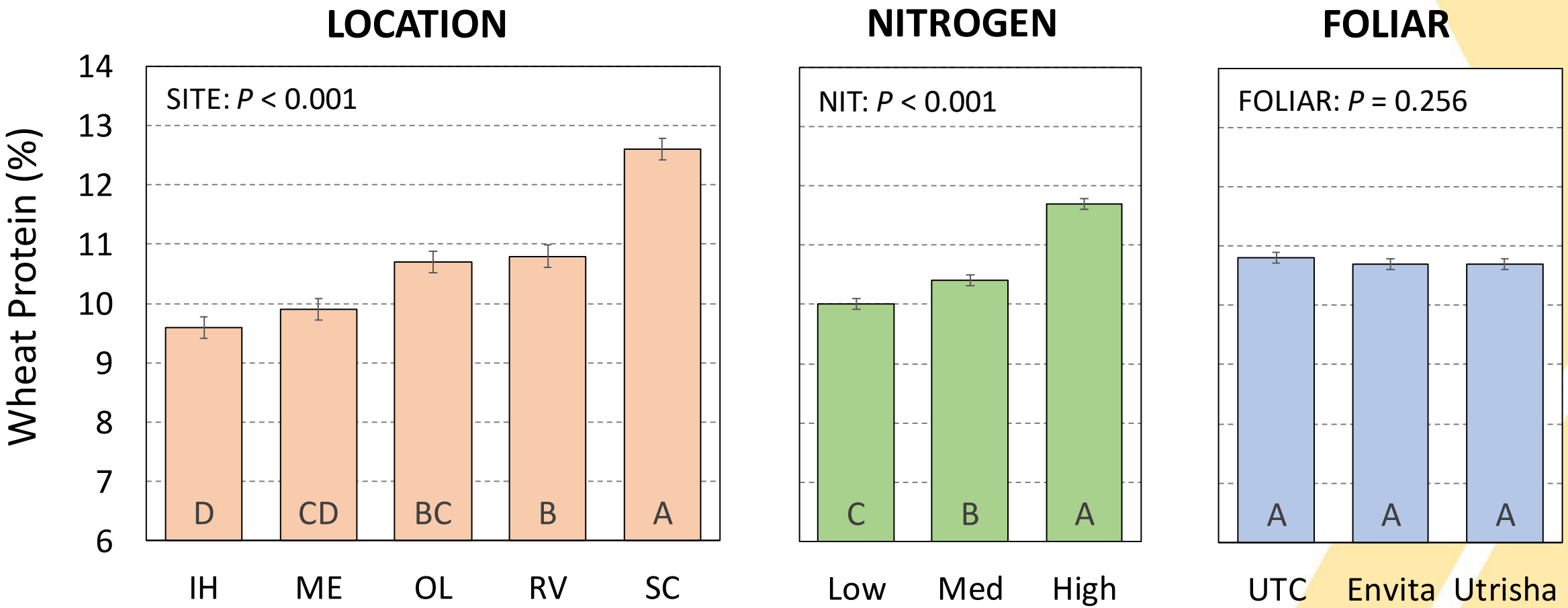
Nitrogen Fertility Level x Foliar Treatment Effects on Spring Wheat Grain Yield

(Five Location Average)



Location, Nitrogen Level & Foliar Treatment Effects on Spring Wheat Grain Protein (5 Locations)



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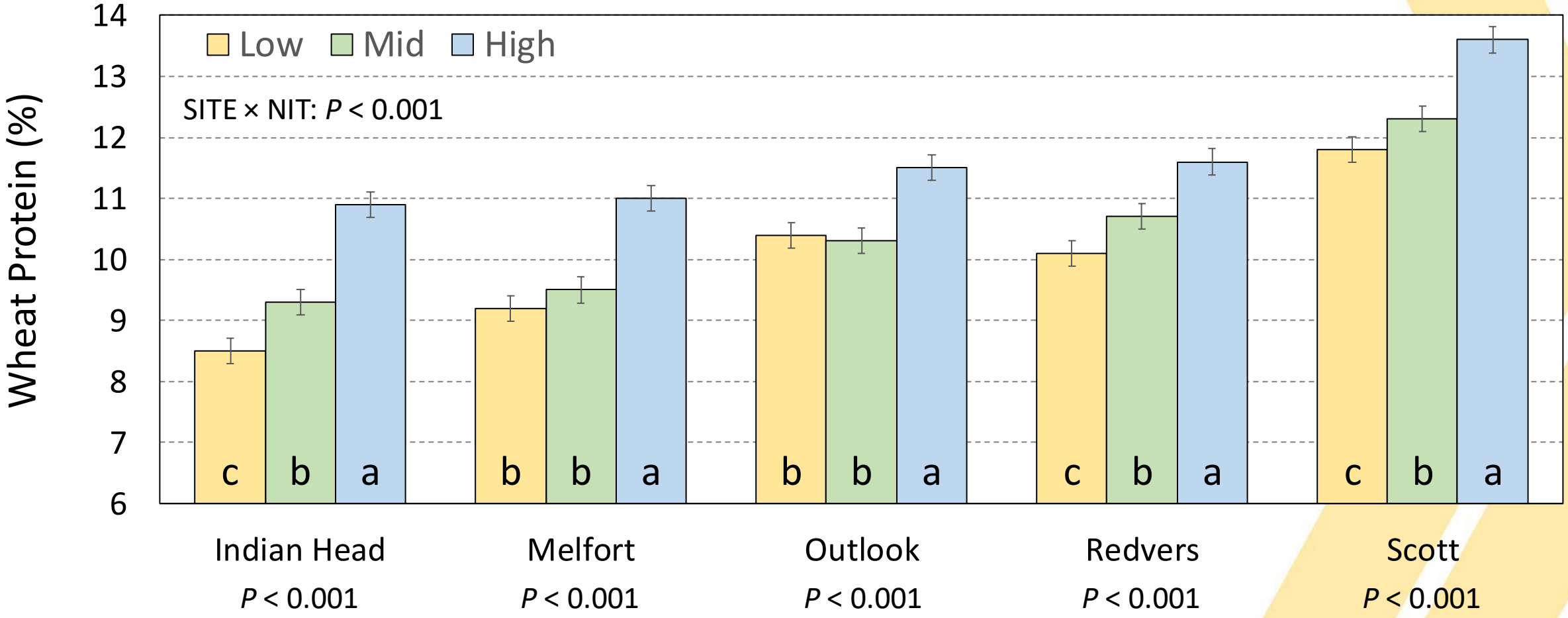
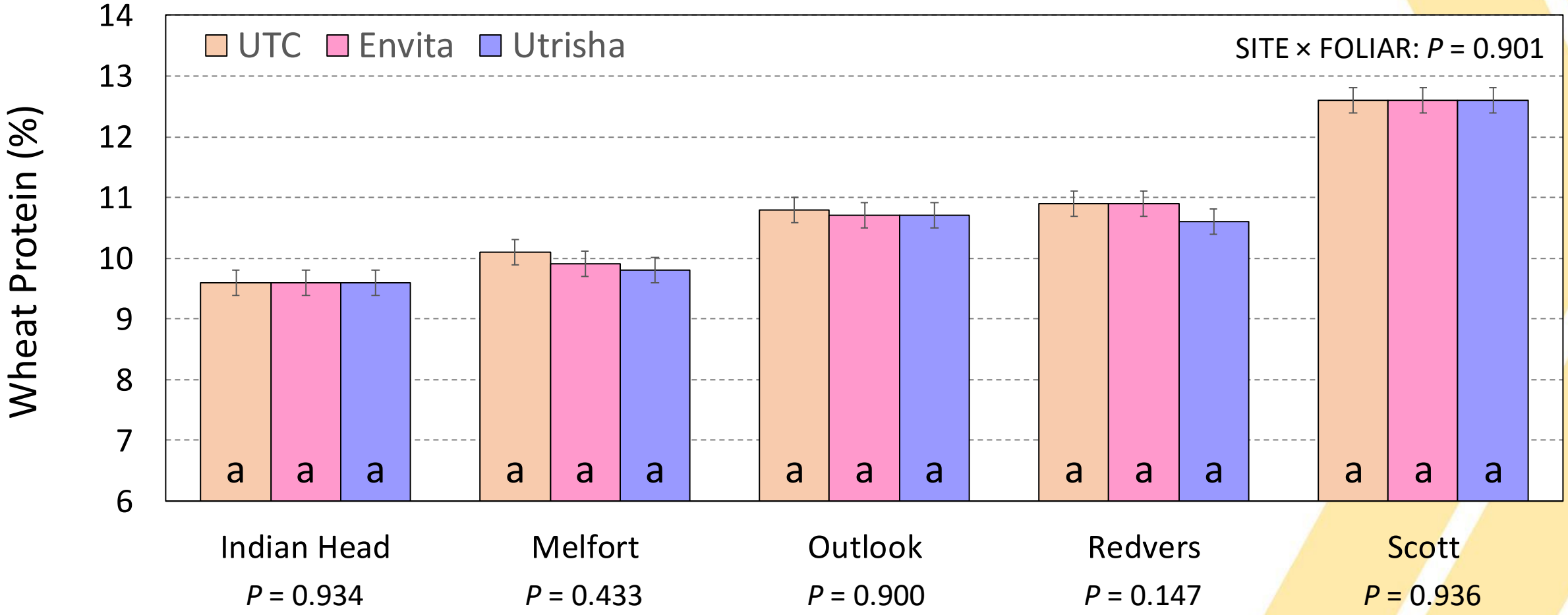
Location x Nitrogen Fertility Level Effects on Spring Wheat Grain Protein (5 Locations)



Location x Foliar Treatment Effects on Spring Wheat Grain Protein (5 Locations)



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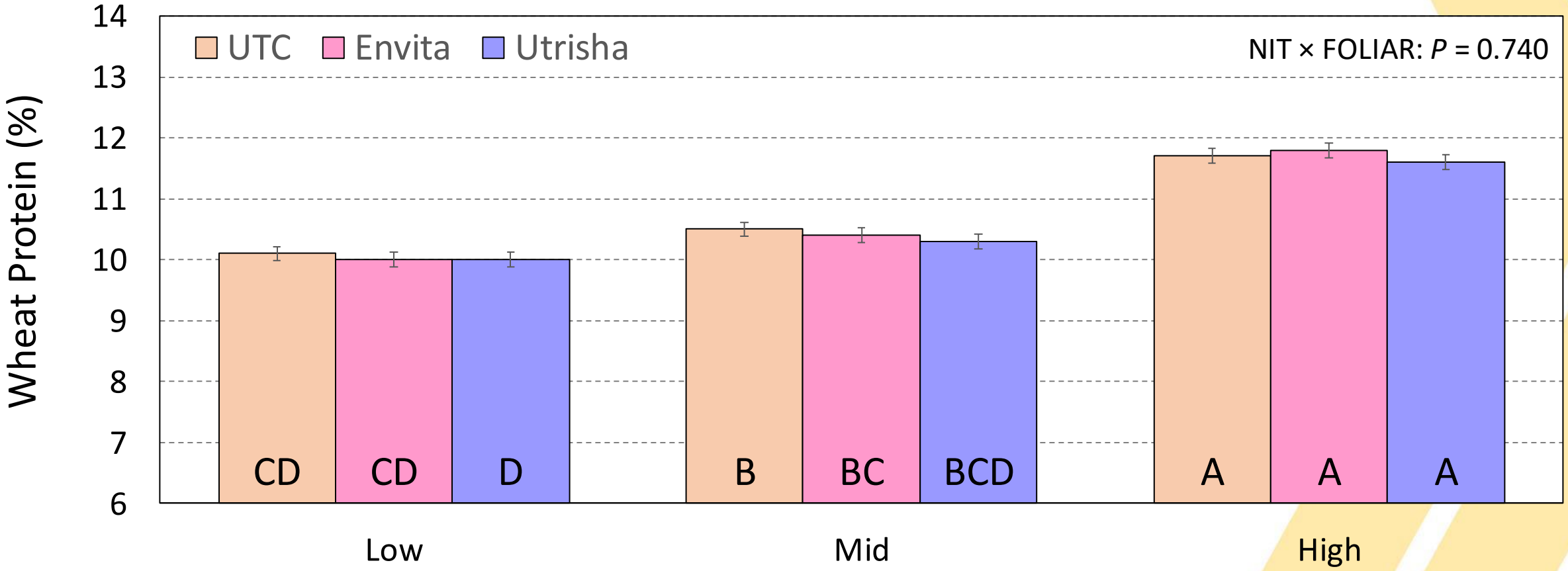
Nitrogen Fertility Level x Foliar Treatment Effects on Spring Wheat Grain Protein (Five Location Average)



Tests of Fixed Effects: Canola 2023

(Indian Head, Melfort, Outlook, Redvers, & Yorkton)

Effect	Plant Density	Seed Yield	Seed Protein	Seed Oil
Site (S)	***	***	***	***
Nitrogen (N)	**	***	***	***
S × N	ns	ns	***	***
Foliar Trt (F)	–	ns	ns	ns
S × F	–	*	ns	ns
N × F	–	ns	ns	ns
S × N × F	–	ns	ns	*

ns – $P > 0.1$; * – $0.1 > P > 0.05$; ** – $0.05 > P > 0.01$; *** – $P < 0.01$

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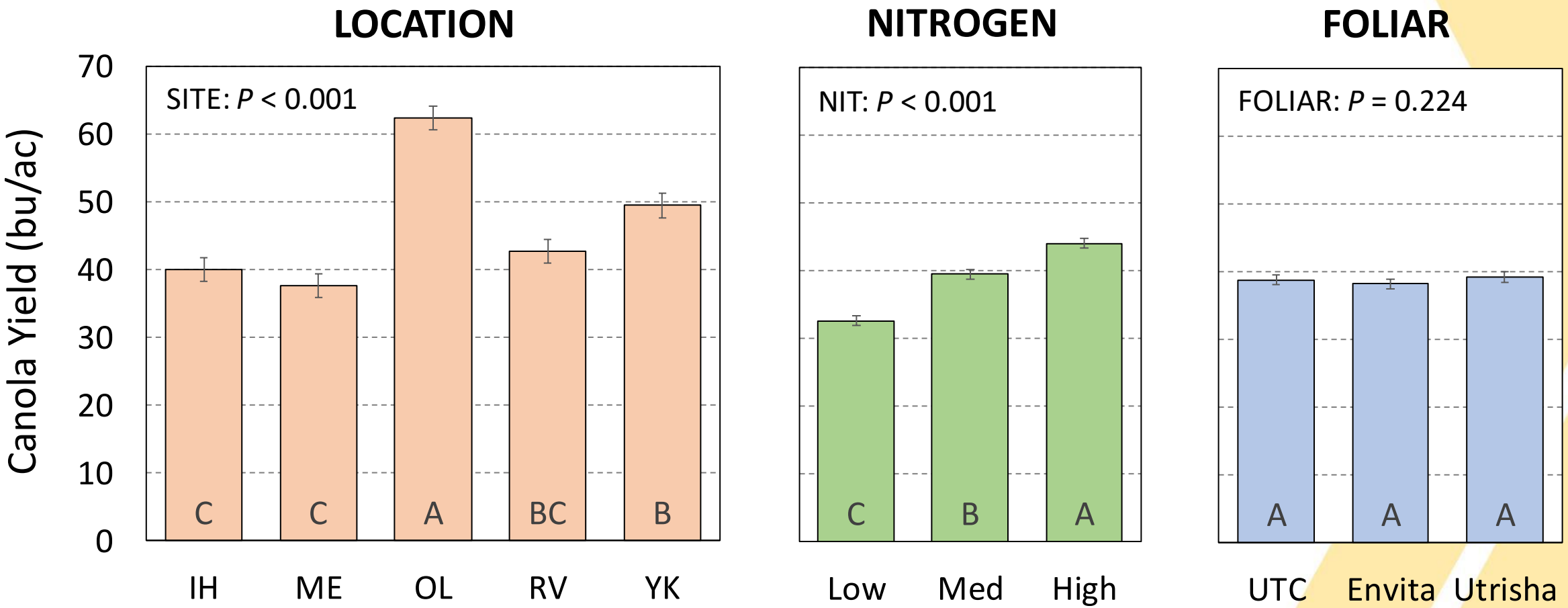
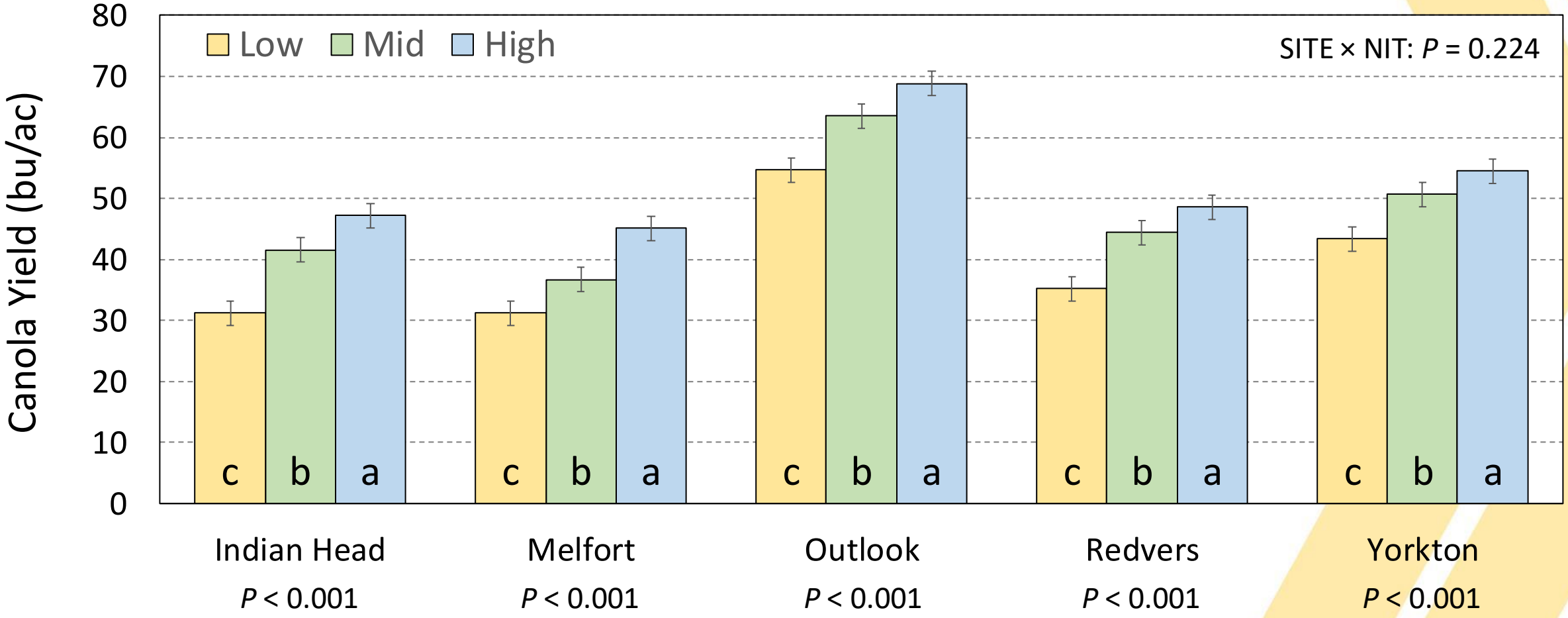
Location, Nitrogen Rate & Foliar Treatment Effects on Canola Seed Yield (5 Locations)



Location x Nitrogen Fertility Level Effects on Canola Seed Yield (5 Locations)



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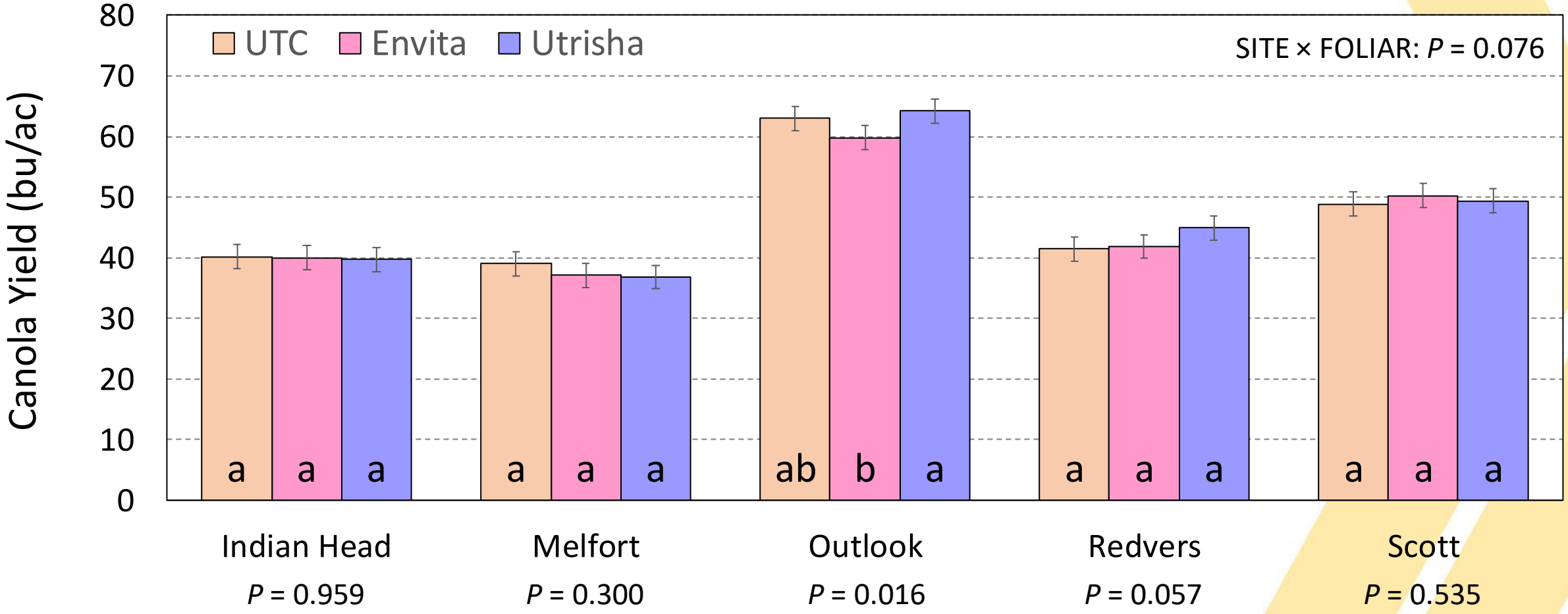
Location x Foliar Treatment Effects on Canola Seed Yield (5 Locations)



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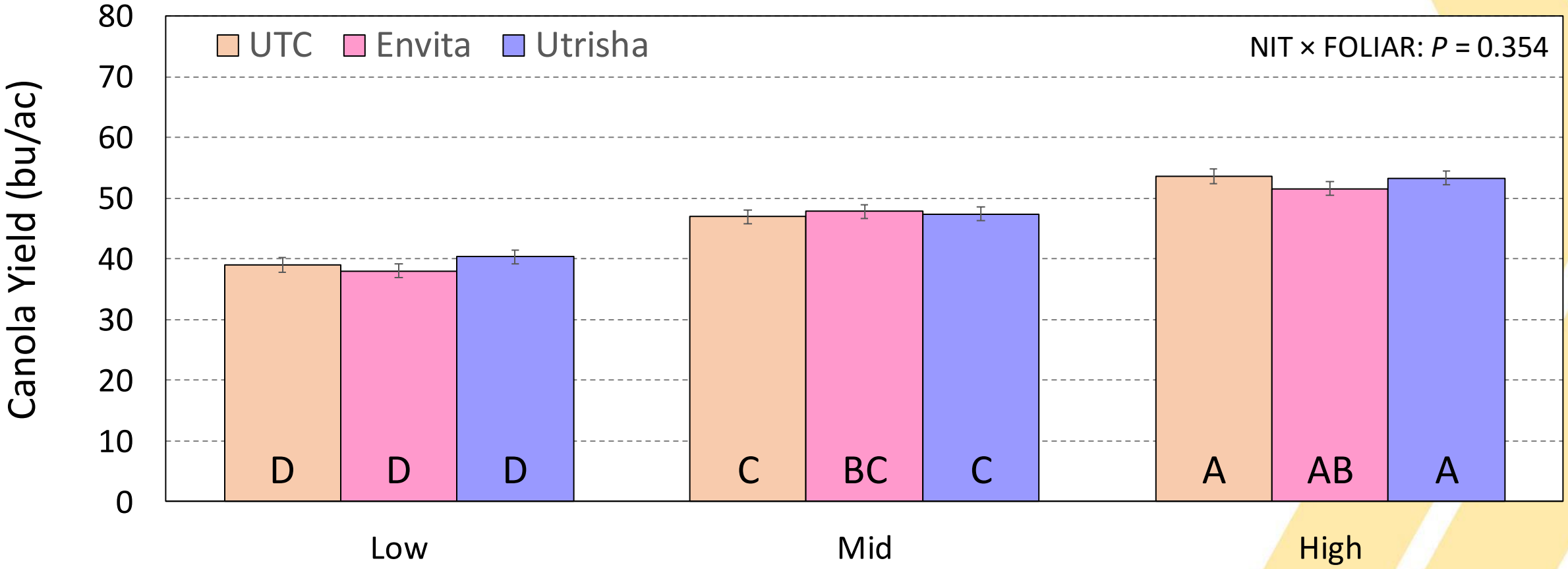
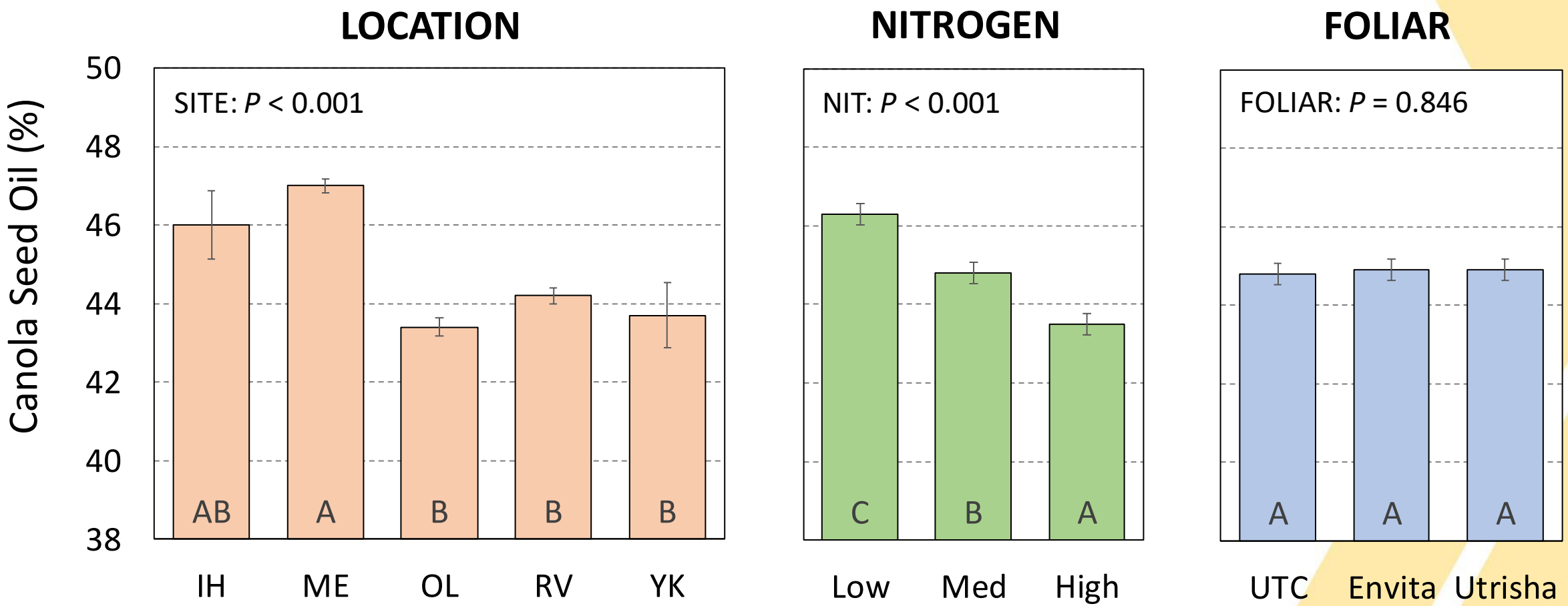
Nitrogen Fertility Level x Foliar Treatment Effects on Canola Seed Yield

(Five Location Average)



Location, Nitrogen Rate & Foliar Treatment Effects on Canola Seed Oil Content (5 Locations)



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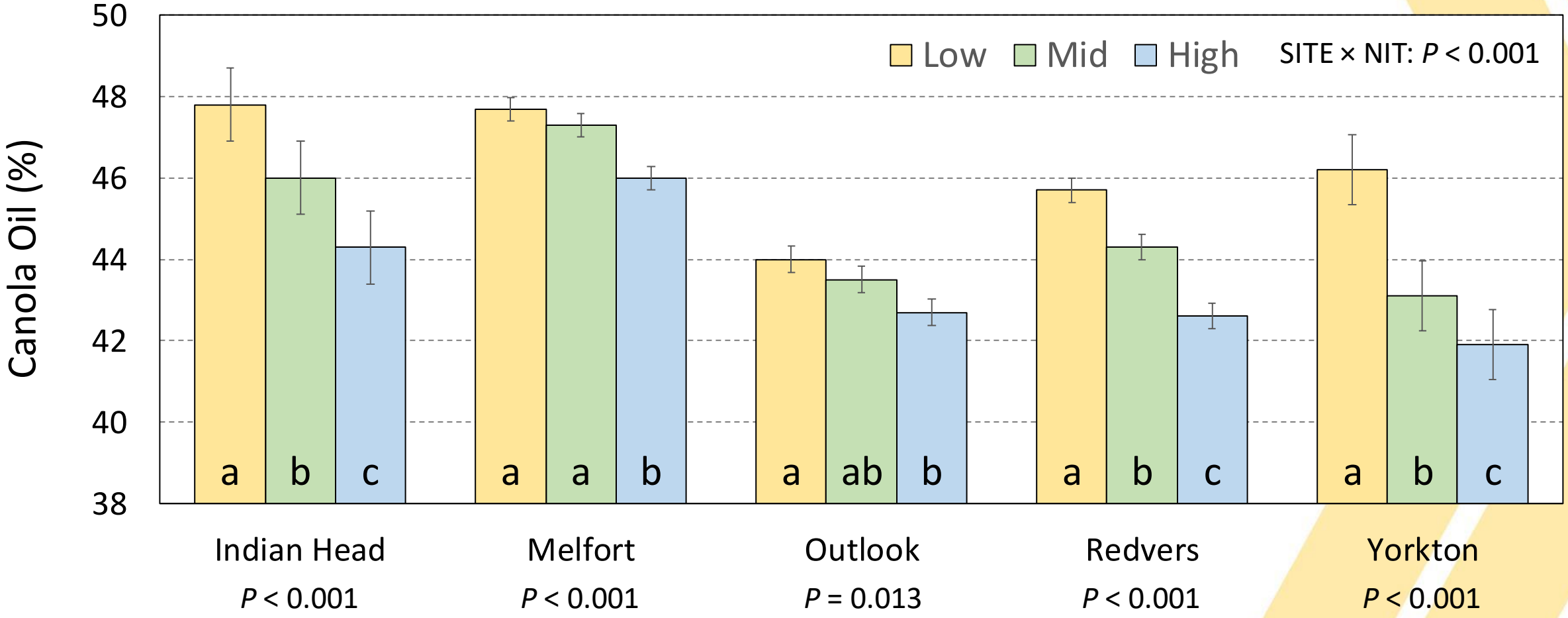
Location x Nitrogen Fertility Level Effects on Canola Seed Oil (5 Locations)



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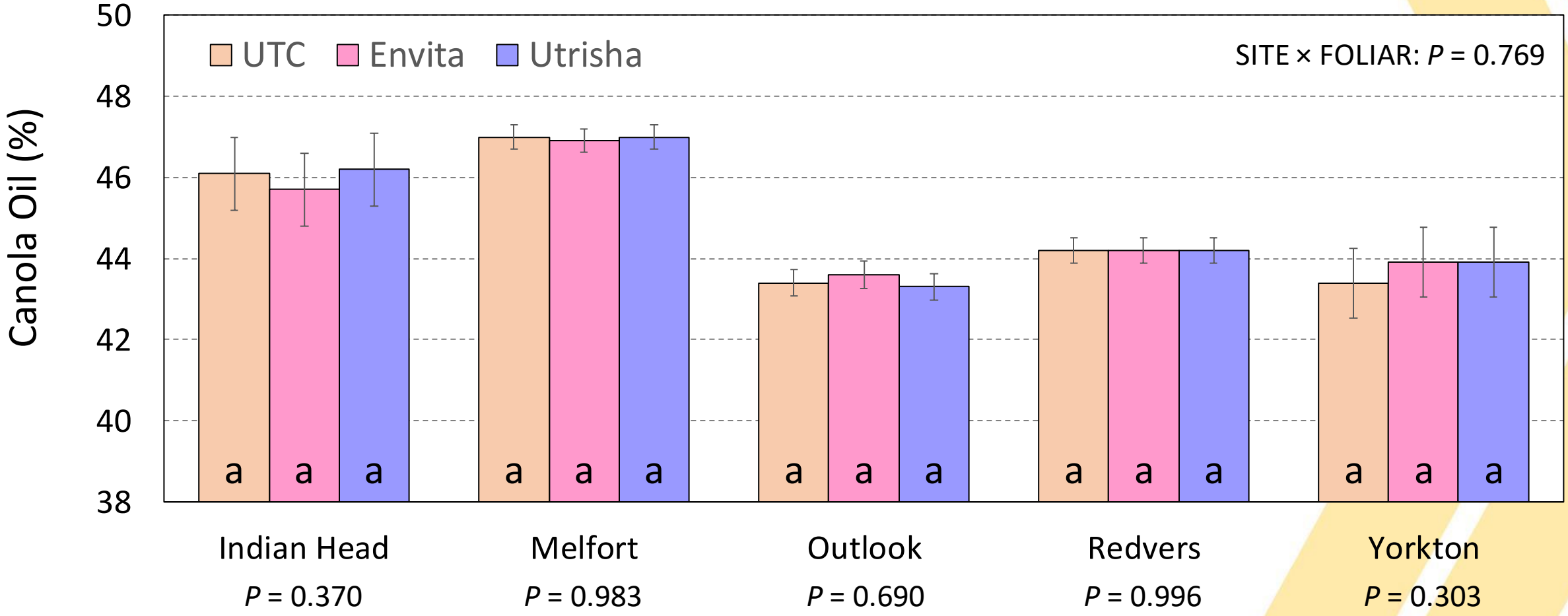
Location x Foliar Treatment Effects on Canola Seed Oil (5 Locations)



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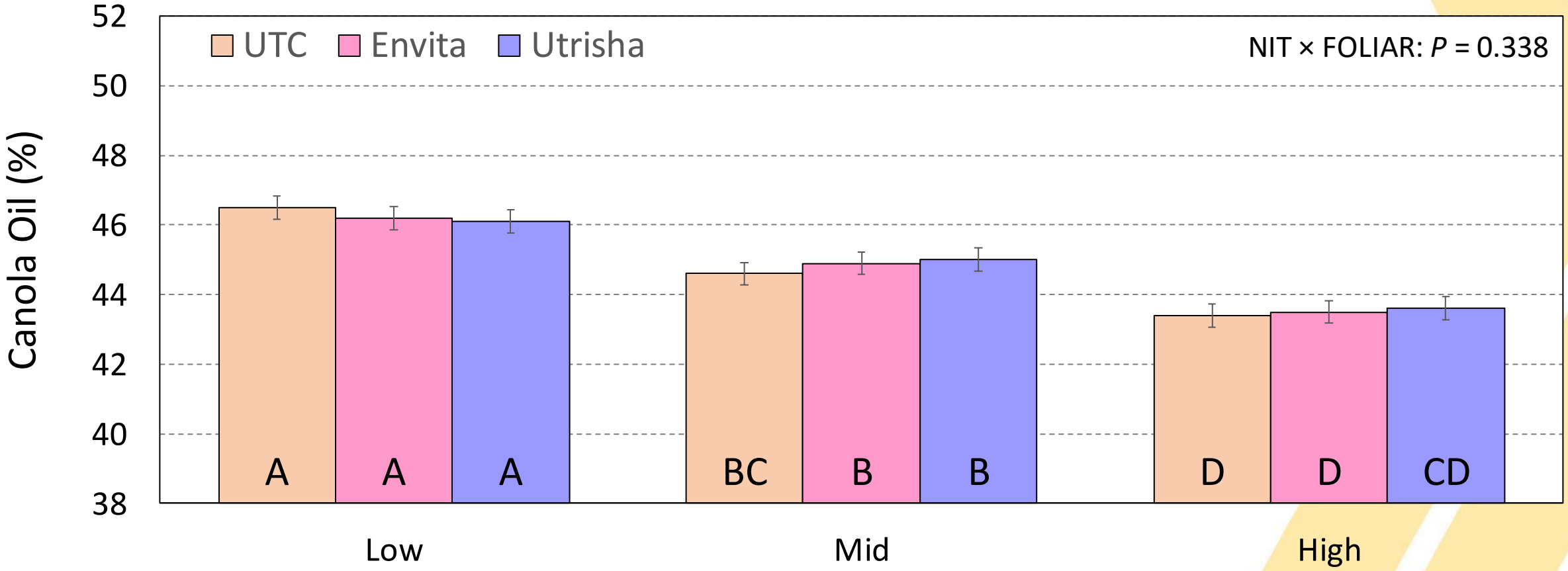
Nitrogen Fertility Level x Foliar Treatment Effects on Canola Seed Oil

(Five Location Average)



Canola Response to Side-Banded Enhanced Efficiency Nitrogen Formulations & Blends

Objectives: To demonstrate the canola response & agronomic N-use efficiency of contrasting N fertilizer forms and blends under side-band placement

Treatments:

1) Control (21 lb N/ac)
2) Low N – urea (67 N)
3) Med N – urea (111 N)
4) High N – urea (156 N)
5) Med N – 50% ESN®
6) Med N – 75% ESN®
7) Med N – 100% ESN® (polymer)
8) Med N – ANVOL® (urease)
9) Med N – eNtrench™ (nitrification)
10) Med N – SUPERU (dual)

Locations:

1) Indian Head - 2023

Data Collection:

1) Emergence
2) Seed Yield
3) Seed Protein/Oil
4) Agronomic NUE

Note: All N side-banded & rates include 21 lb N/ac from soil NO_3-N & 11-52-0 fertilizer

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Side-banded Nitrogen Rate & Formulation Effects on Canola Seed Yield (IH-23)

Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
Rate – lin	<0.001
Rate – quad	0.009

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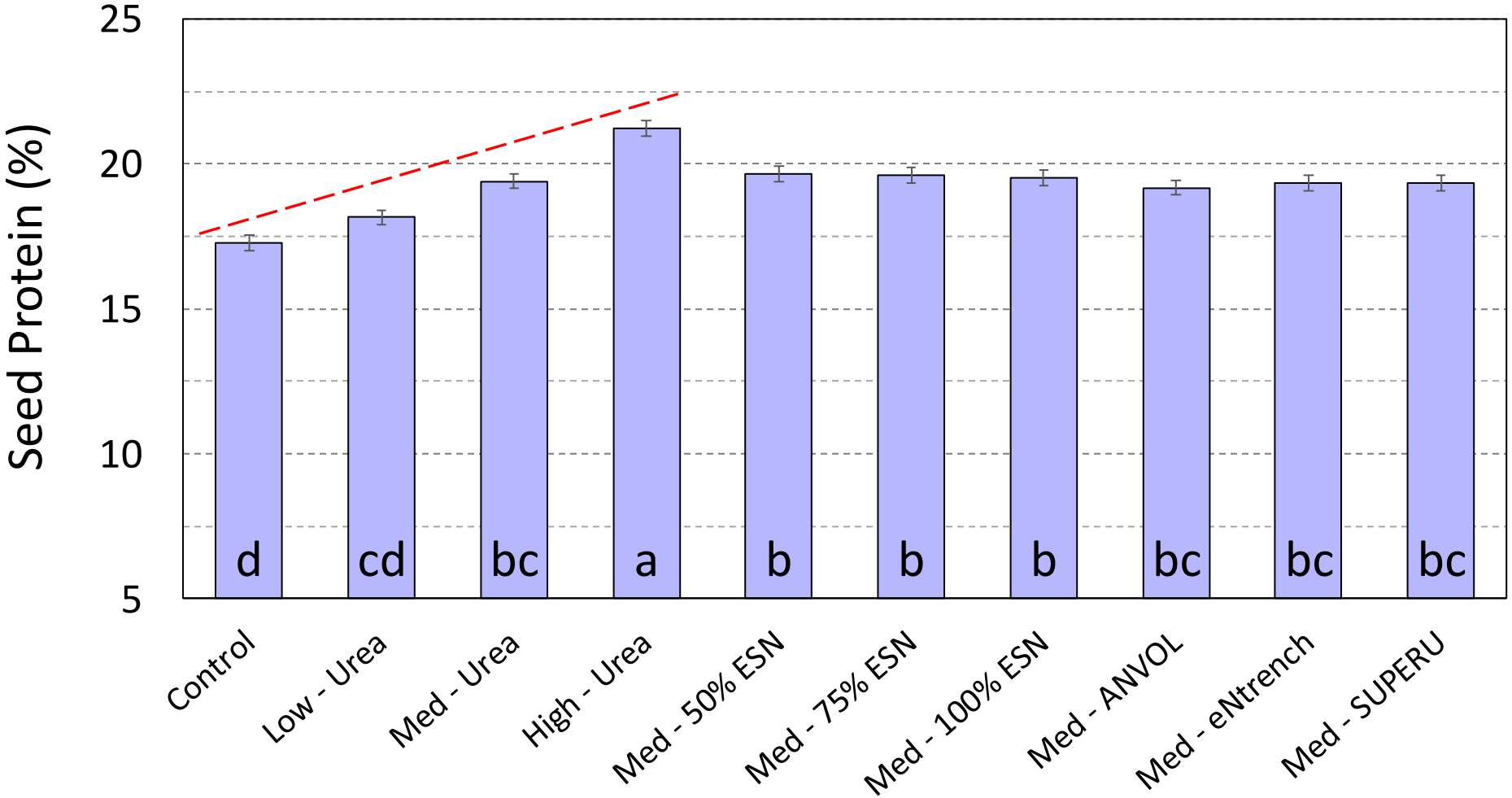
Side-banded Nitrogen Rate & Formulation Effects on Canola Seed Protein (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
Rate – lin	<0.001
Rate – quad	0.086

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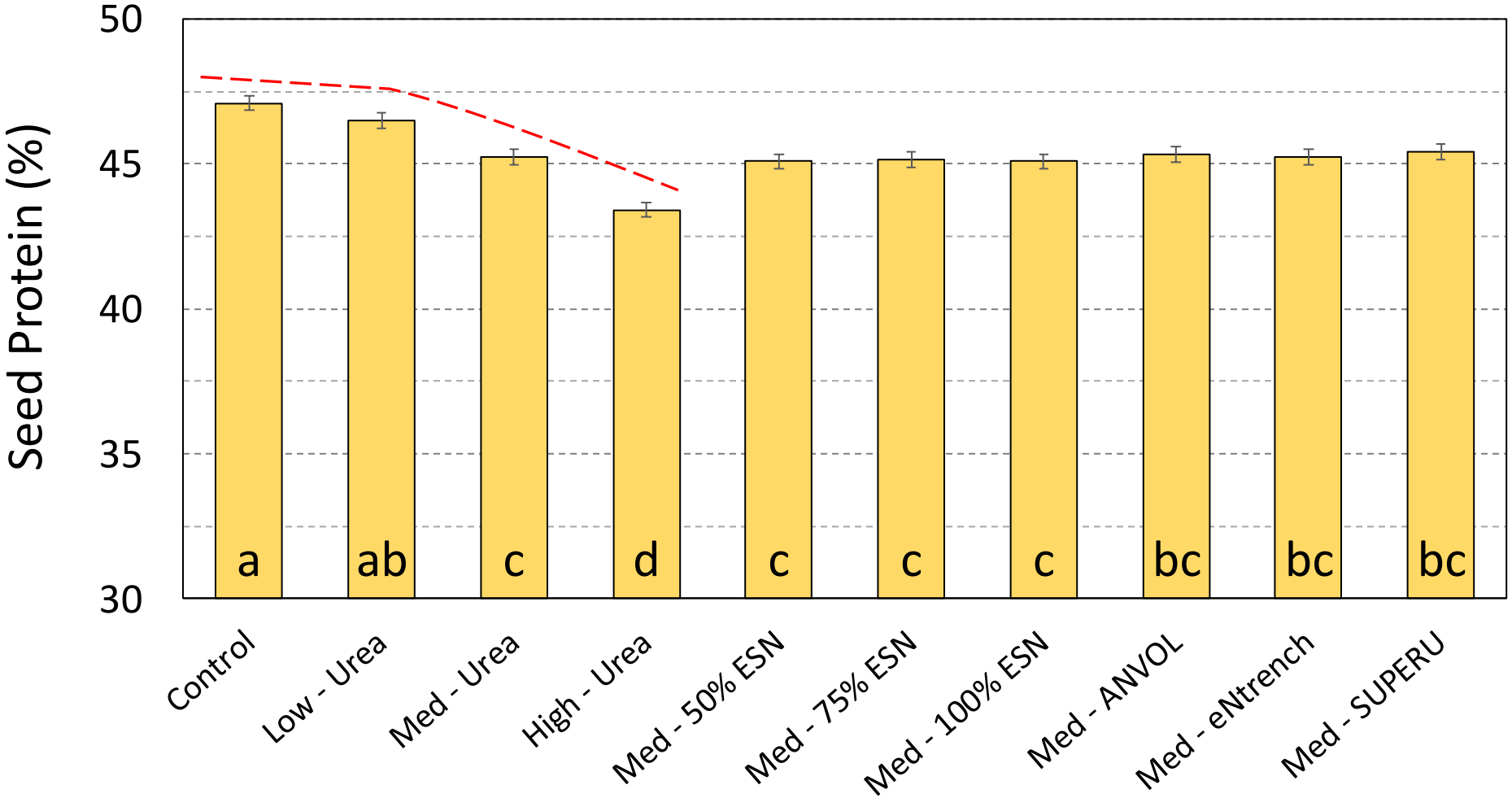
Side-banded Nitrogen Rate & Formulation Effects on Canola Seed Oil (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
Rate – lin	<0.001
Rate – quad	0.027

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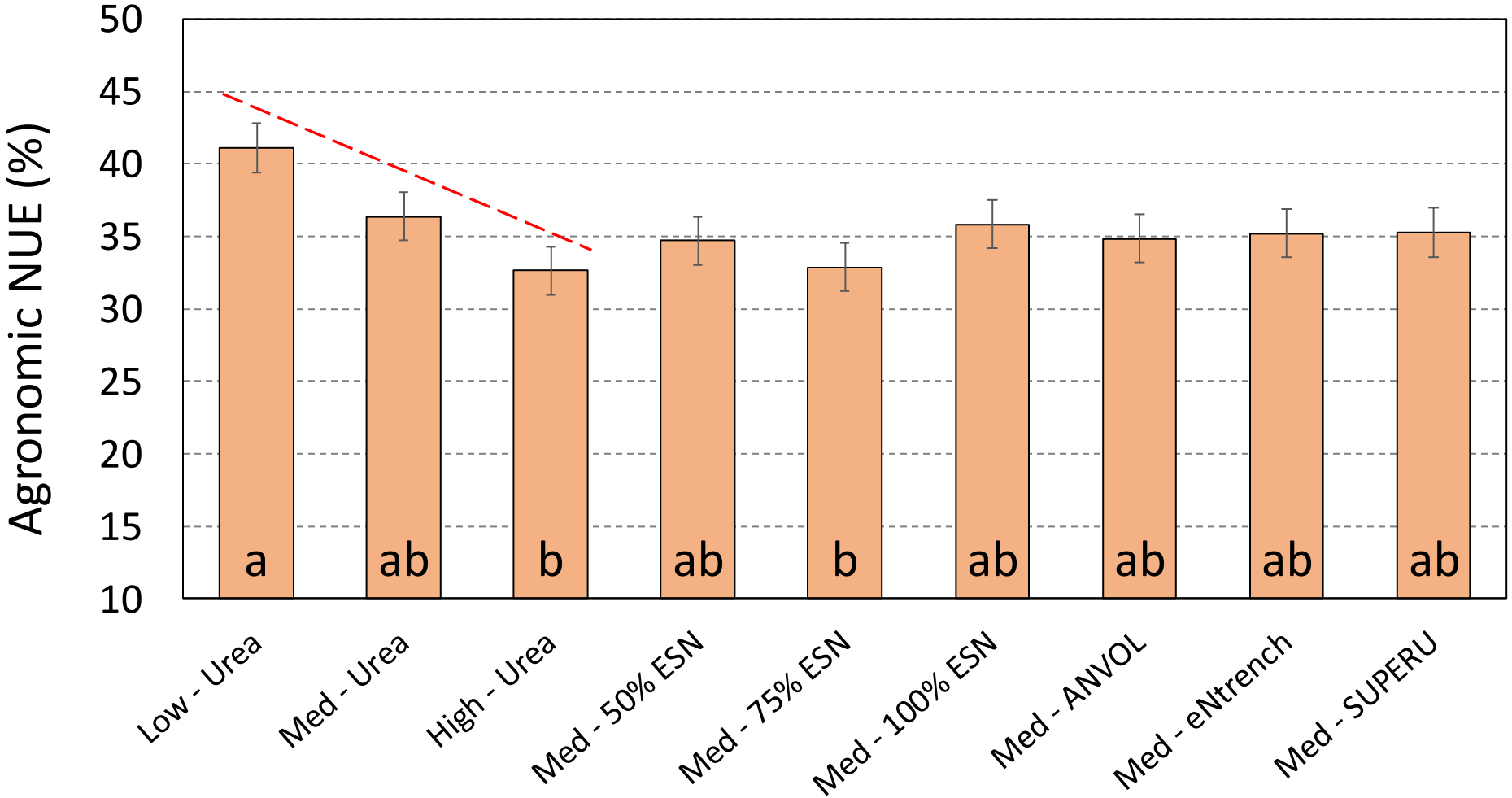
Side-banded Nitrogen Rate & Formulation Effects on Agronomic NUE in Canola (IH-23)



Effect	Pr > F
Overall	0.438
Check vs rest	–
Rate – lin	0.002
Rate – quad	0.812

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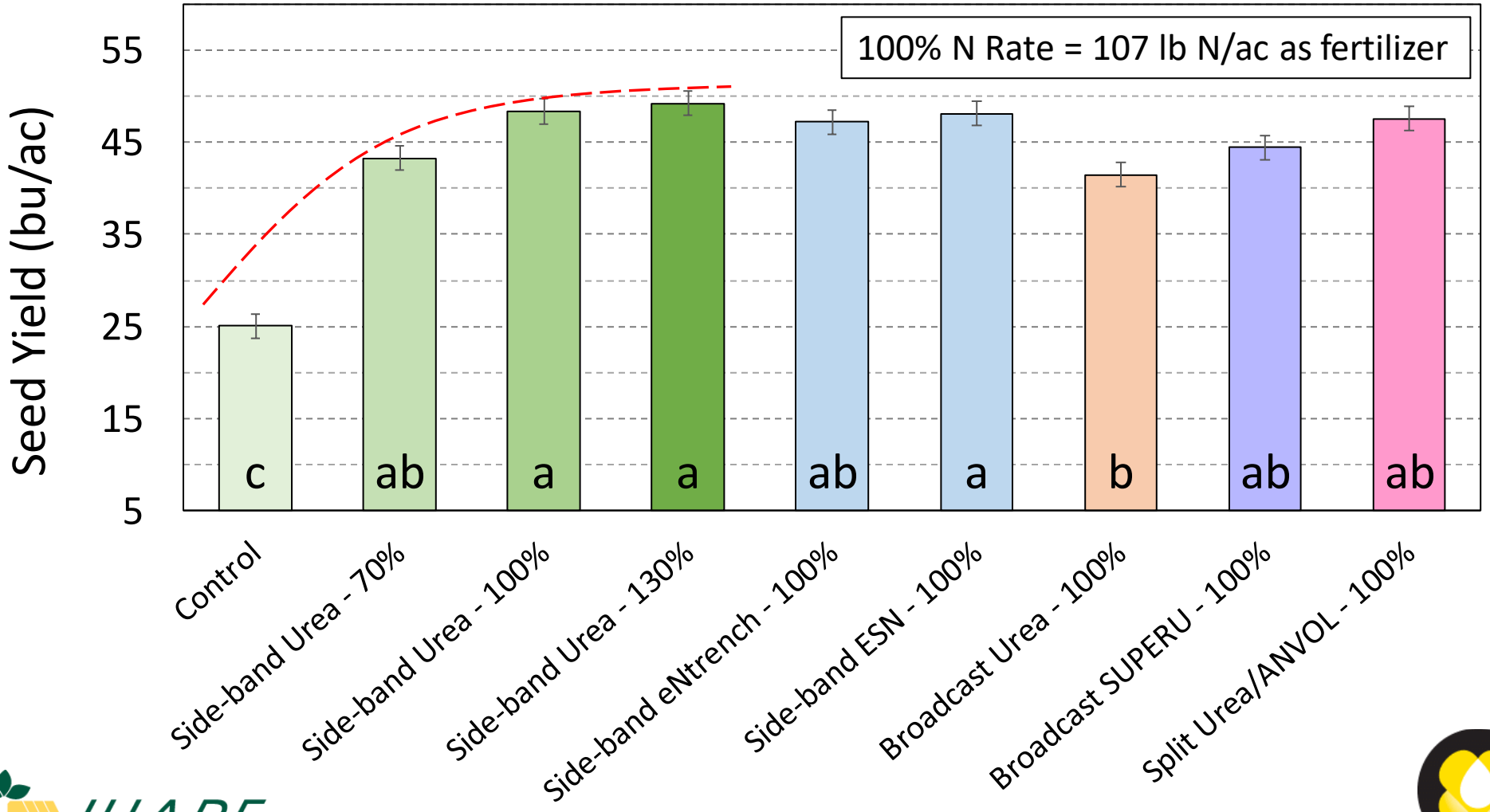
Canola Council of Canada 4R N Management Demo: Effects on Canola Seed Yield (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
BC Urea vs SU	0.129
Rate – lin	<0.001
Rate – quad	<0.001

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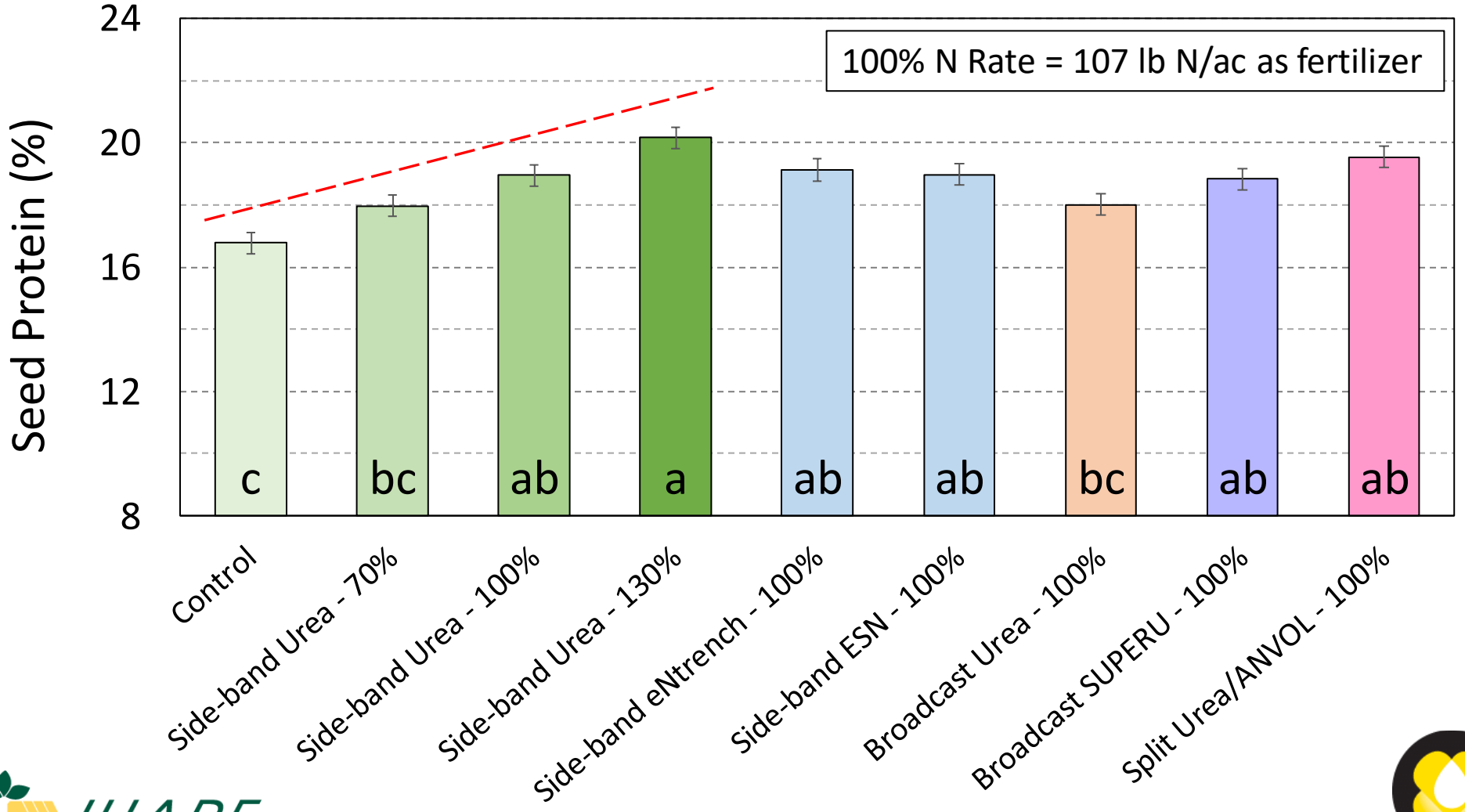
Canola Council of Canada 4R N Management Demo: Effects on Canola Seed Protein (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
BC Urea vs SU	0.129
Rate – lin	<0.001
Rate – quad	0.140

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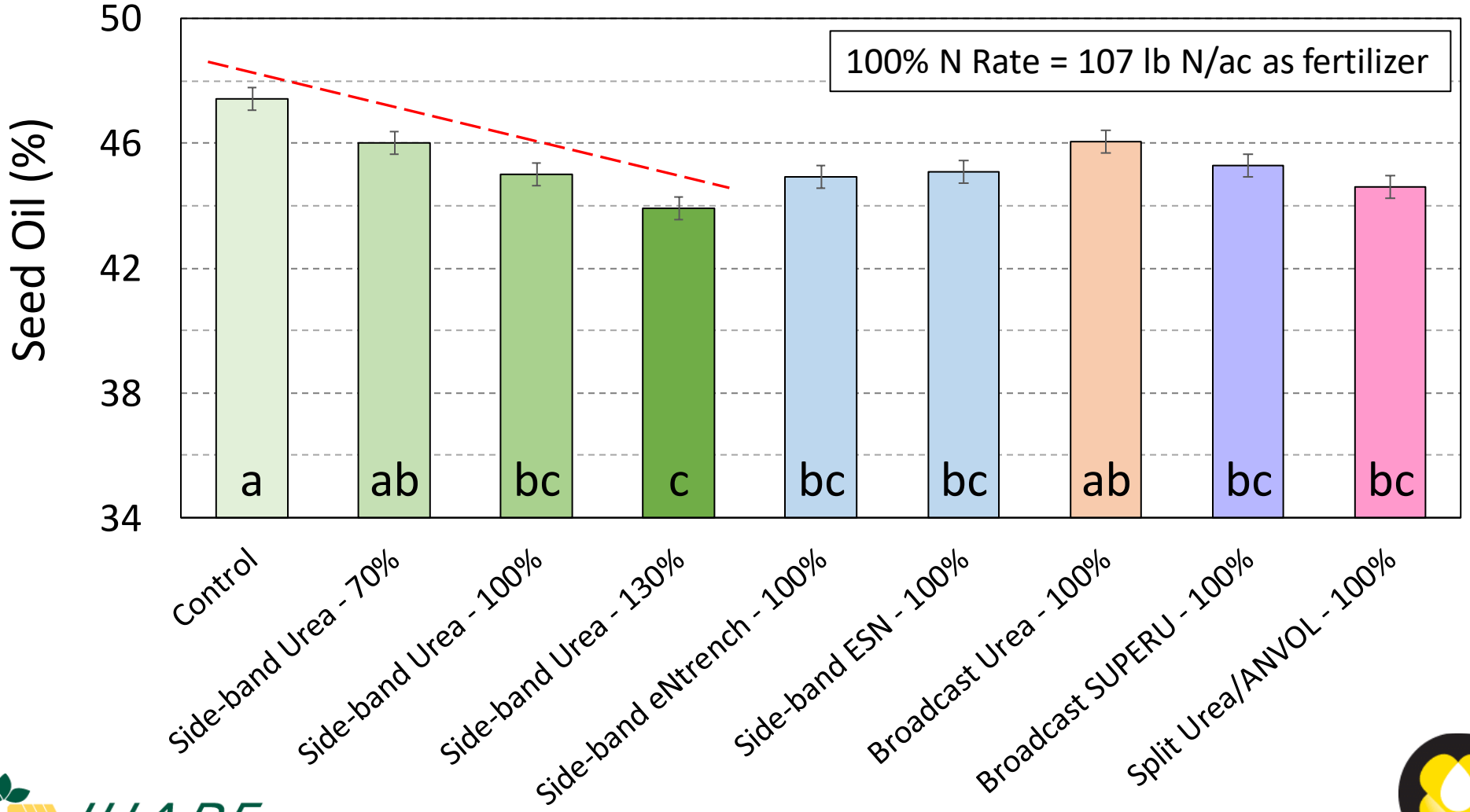
Canola Council of Canada 4R N Management Demo: Effects on Canola Seed Oil (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	<0.001
BC Urea vs SU	0.147
Rate – lin	<0.001
Rate – quad	0.271

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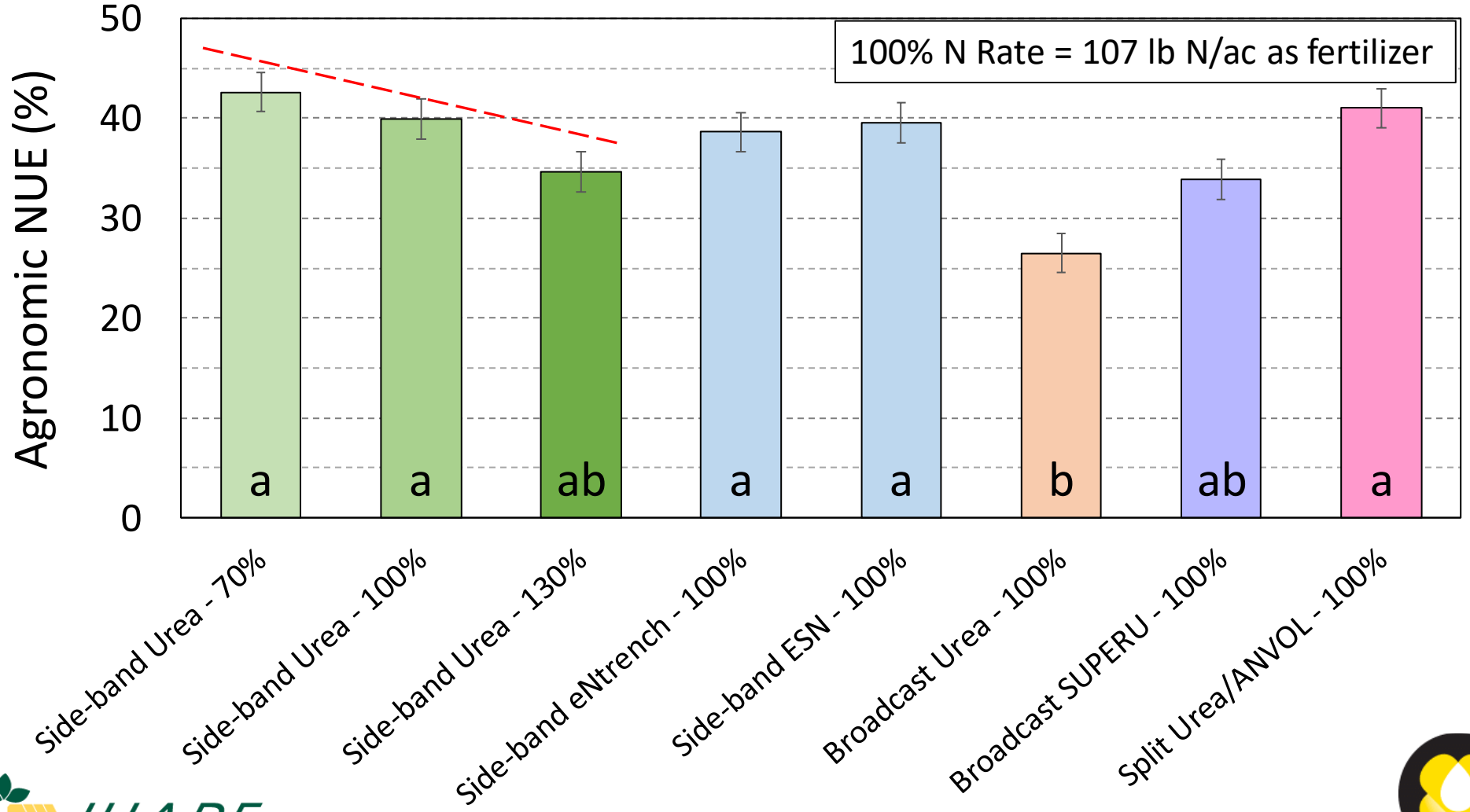
Canola Council of Canada 4R N Management Demo: Effects on ANUE in Canola (IH-23)



Effect	Pr > F
Overall	<0.001
Check vs rest	–
BC Urea vs SU	0.016
Rate – lin	0.009
Rate – quad	0.601

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Nitrogen Trials: Take Home Messages from the 2023 Growing Season

- Biologicals failed to provide any measurable or compelling N benefits, regardless of product, crop type, environment, or background N fertility level
- With side-band placement, effects on yield, protein, oil, & ANUE were similar regardless of N form
- With low growing season precipitation but good initial soil moisture, spring broadcasting generally performed poorly relative to side-banding but there was an advantage to SUPERU with broadcasting
- Agronomically, split-applications performed as well as but not better than side-banding when 70% of the N was applied up front & a urease inhibitor was used with the top-dressed N
  - Economics would have favoured 100% side-banding due to lower fertilizer & application costs
  - Nearby wheat plots visibly suffered when less N was applied during seeding and/or topdressing was postponed until the early reproductive (boot) stage

Evaluating Seeding Rates of CWRS Wheat Under Various Environmental Conditions

Objectives: To determine the ideal seeding wheat of hard red spring wheat under a wide range of Saskatchewan conditions

Seeding Rate Treatments):

#	seeds/m²	seeds/ft²	lb/ac
1	108	10	39
2	163	15	59
3	217	20	78
4	272	25	99
5	326	30	118
6	378	35	137
7	432	40	157

Locations:

1) Scott (lead)
2) Indian Head
3) Yorkton
4) Swift Current
5) Melfort
6) Prince Albert

Data Collection:

1) Plant Density
2) Spike Density
3) Spikes/plant
4) Grain Yield
5) TKW
6) Kernels/Spike
7) Test Weight
8) Protein

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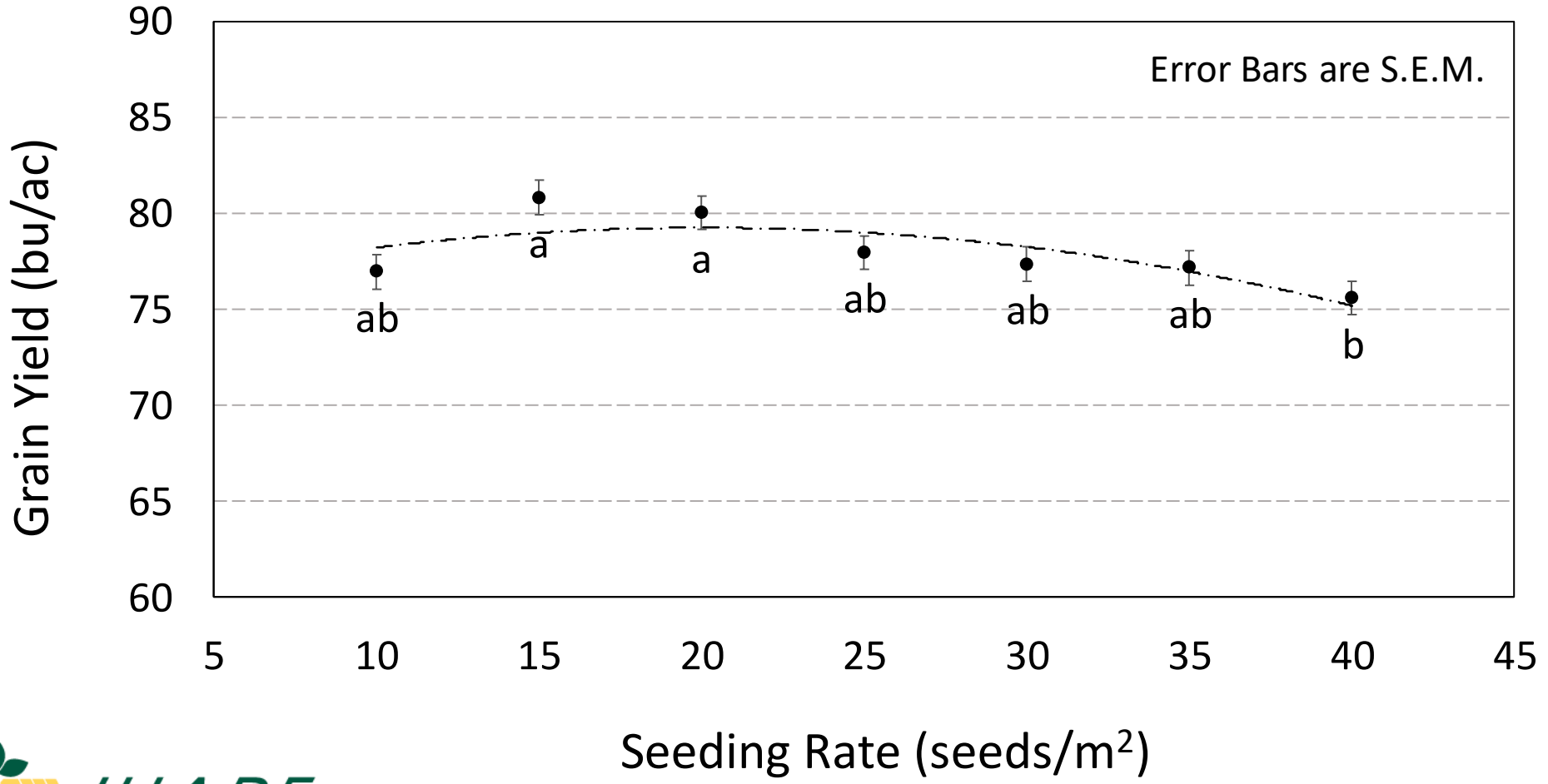
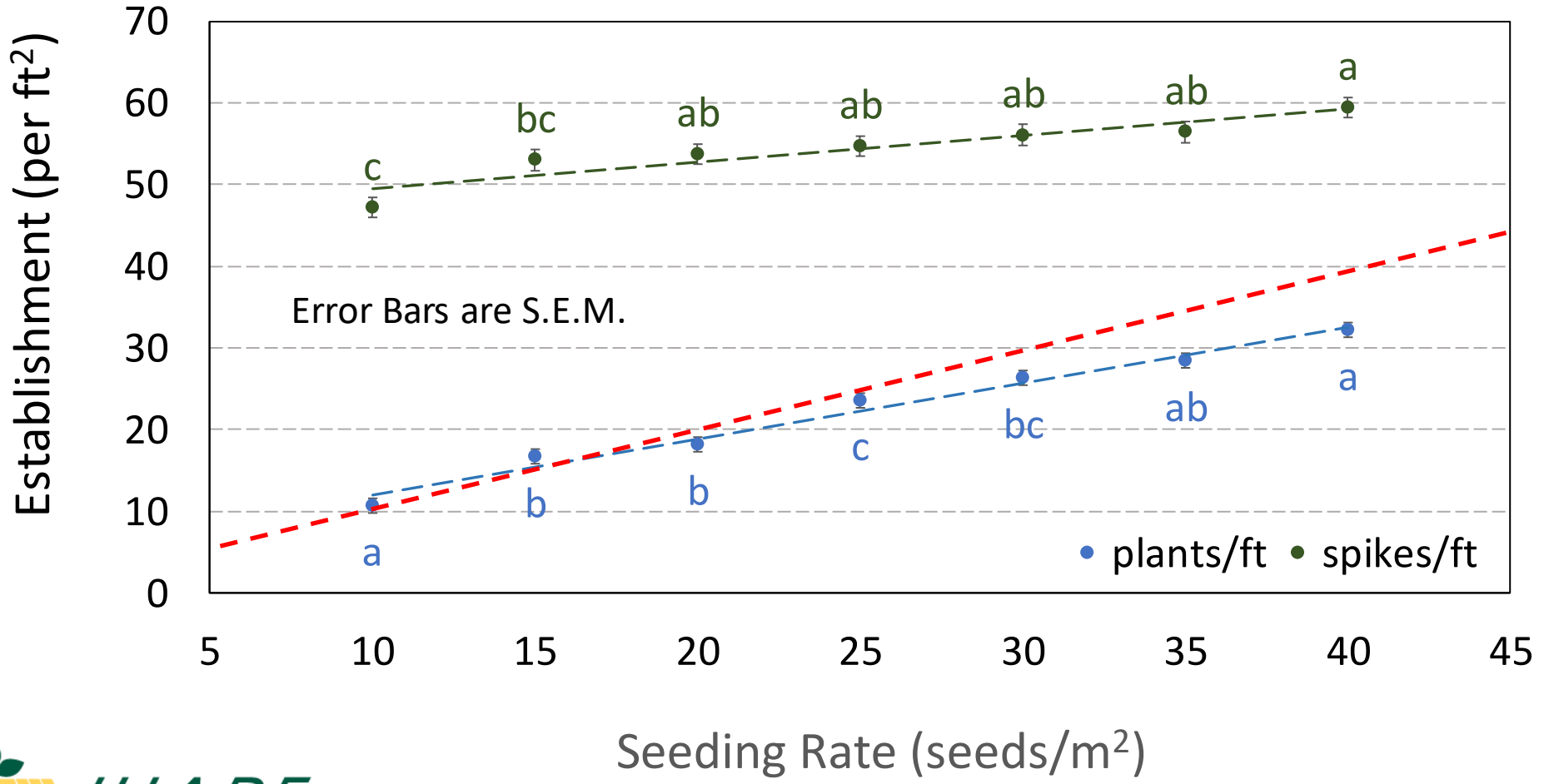
Seeding Rate Effects on Grain Yield in CWRS Wheat (Indian Head 2023)



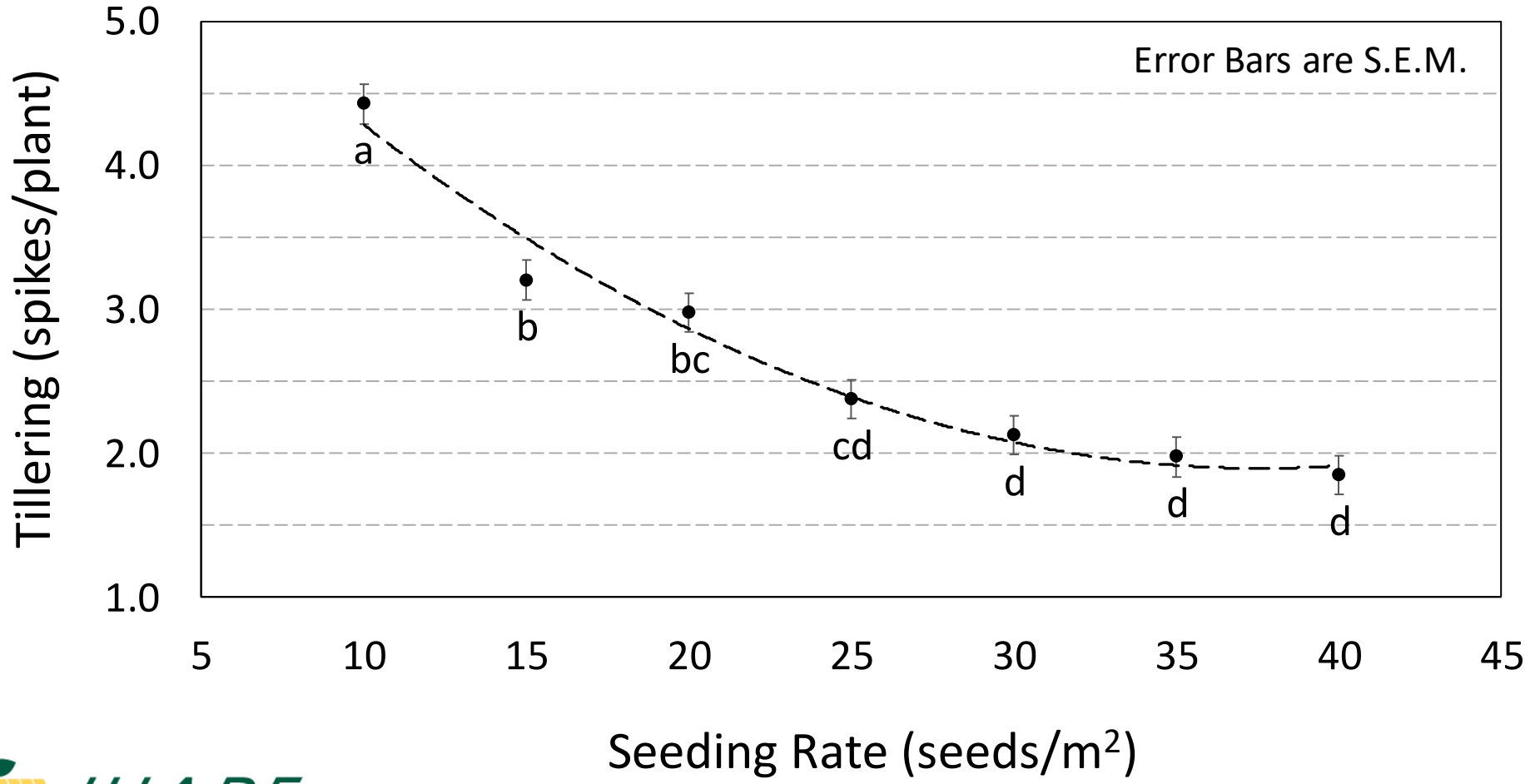
Effect (plants)	Pr > F
Overall	0.007
SR – lin	0.007
SR – quad	0.016

Seeding Rate Effects on CWRS Wheat Plant & Spike Density (Indian Head 2023)



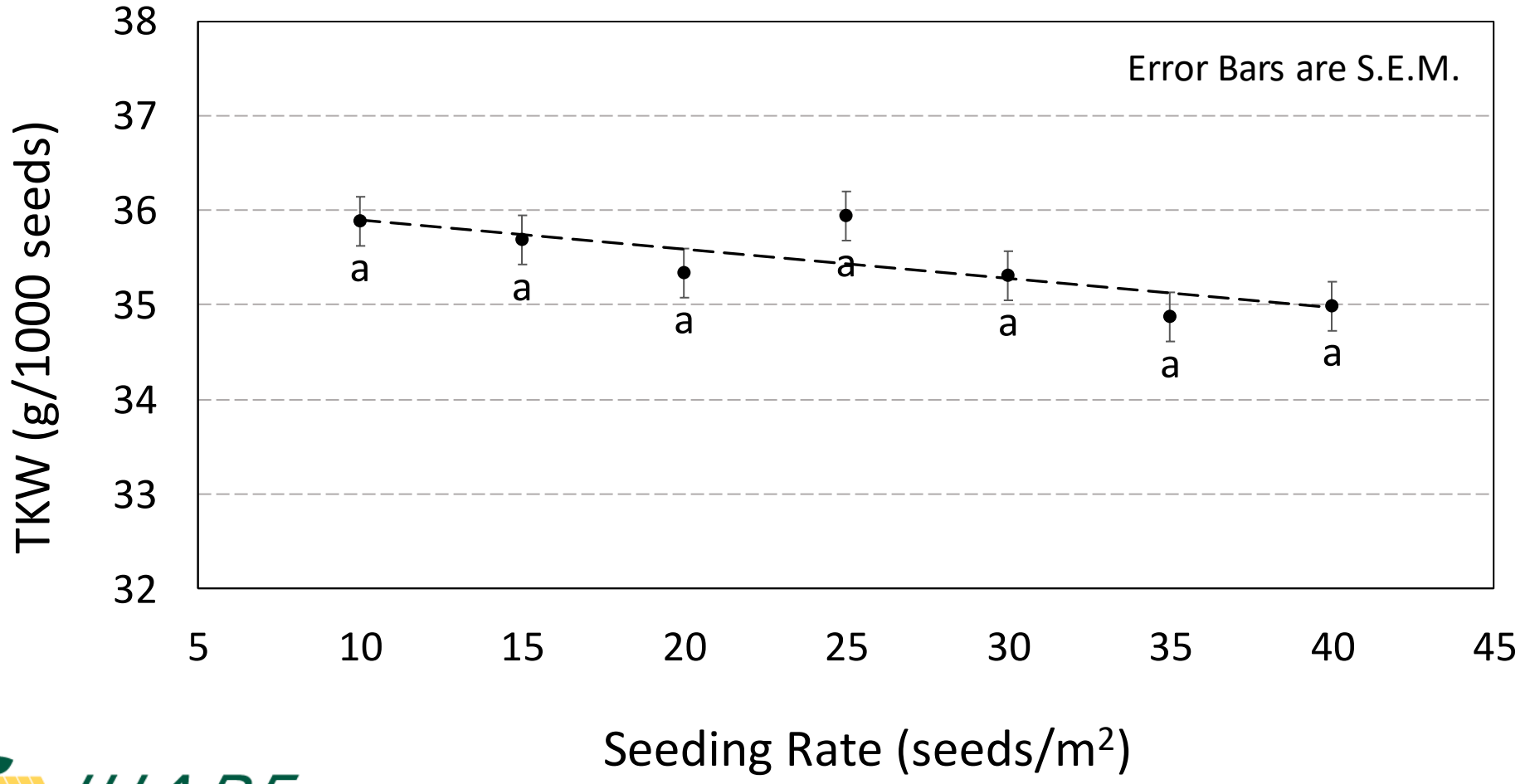
Effect (plants)	Pr > F
Overall	<0.001
SR – lin	<0.001
SR – quad	0.120
Effect (spikes)	**Pr > F**
Overall	<0.001
SR – lin	<0.001
SR – quad	0.211

Seeding Rate Effects on Tillering in CWRS Wheat (Indian Head 2023)



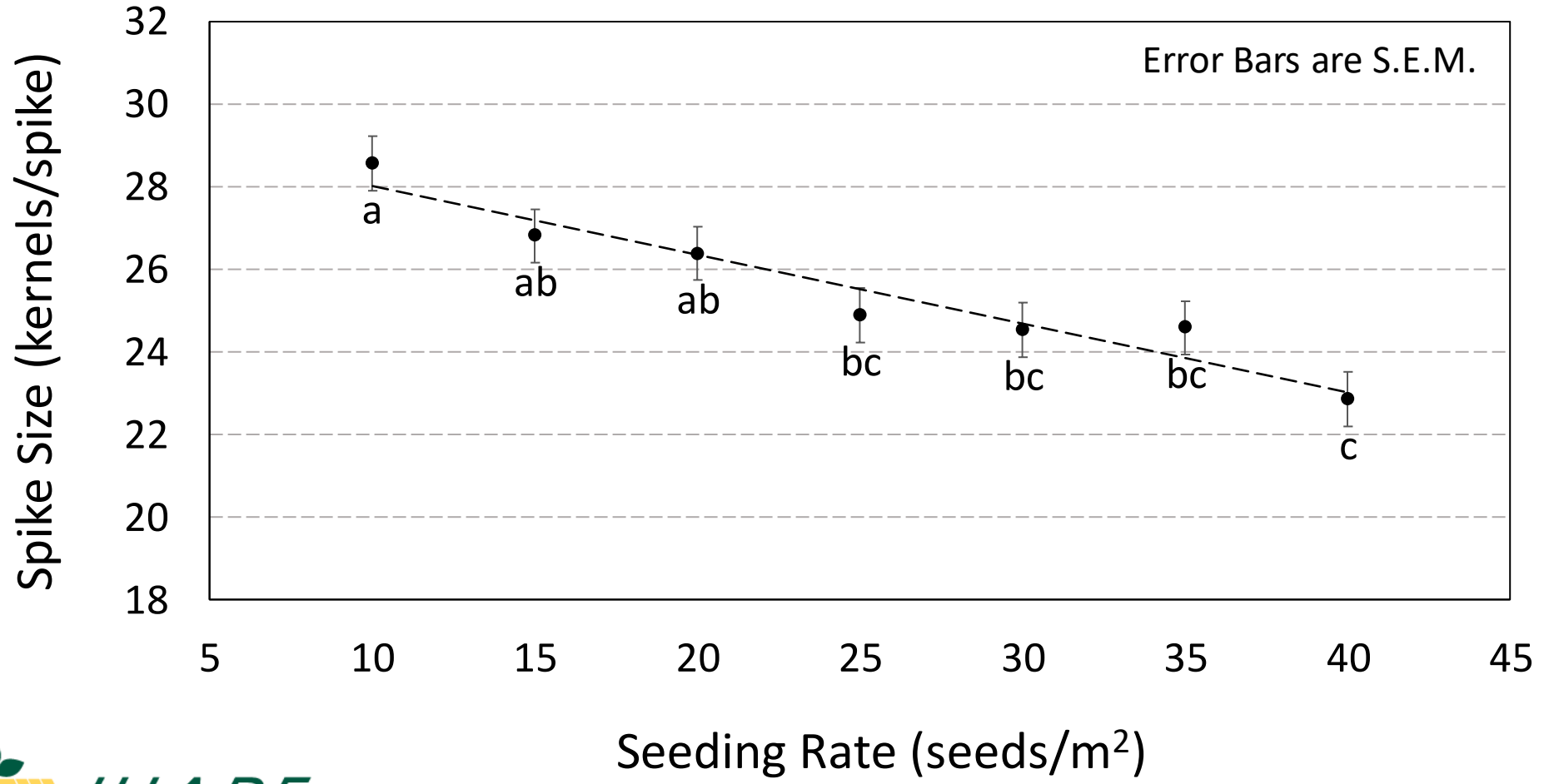
Effect (plants)	Pr > F
Overall	<0.001
SR – lin	<0.001
SR – quad	<0.001

Seeding Rate Effects on Kernel Weight in CWRS Wheat (Indian Head 2023)



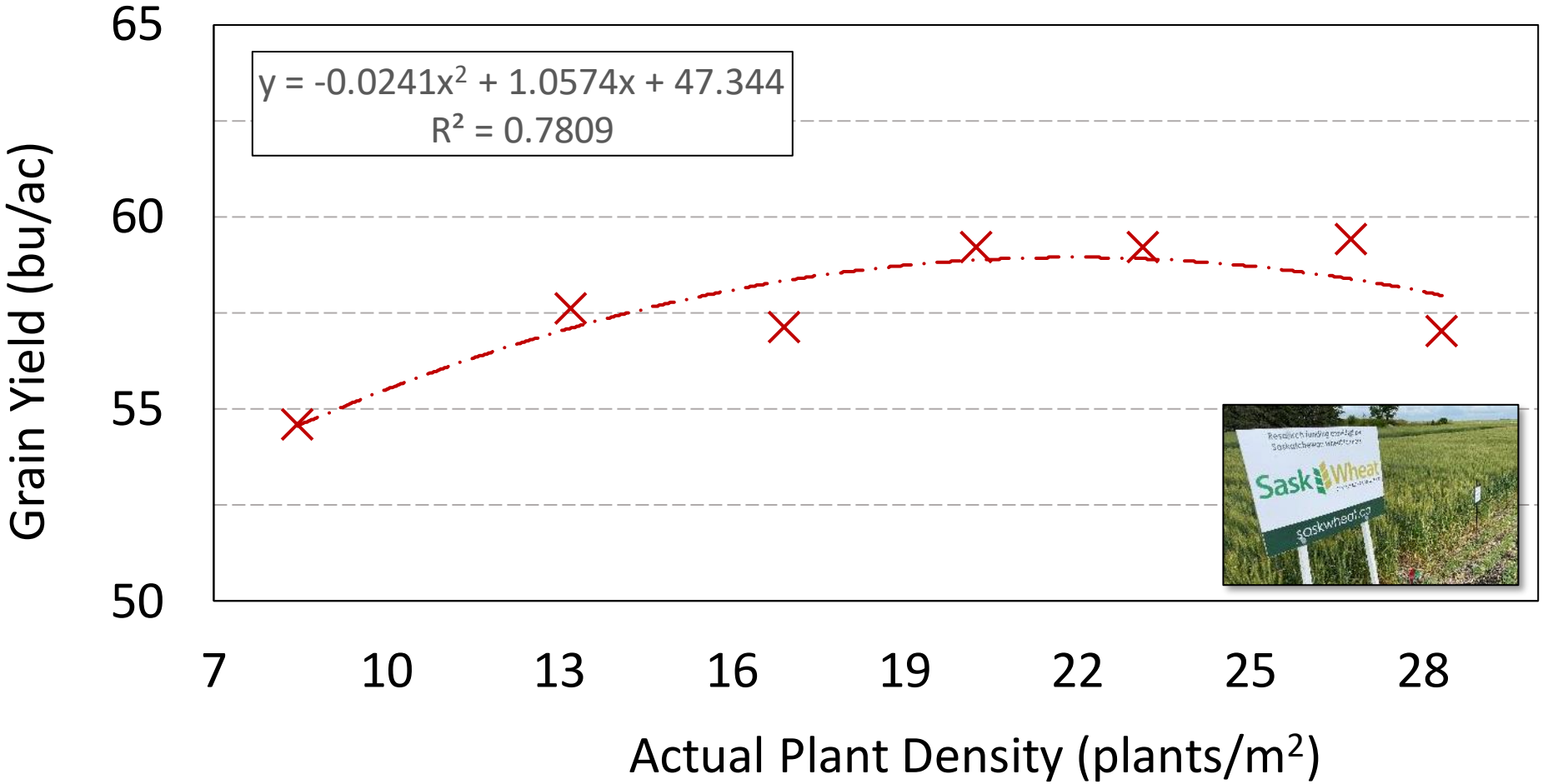
Effect (plants)	Pr > F
Overall	0.052
SR – lin	0.005
SR – quad	0.594

Seeding Rate Effects on Spike Size in CWRS Wheat (Indian Head 2023)



Effect (plants)	Pr > F
Overall	0.052
SR – lin	0.005
SR – quad	0.594

Plant Density vs Grain Yield for CWRS Wheat Under Dry Conditions (6 Sites)



plants/ft	bu/ac
14	57.4
15	57.8
16	58.1
17	58.4
18	58.6
19	58.7
20	**58.9**
21	58.9
22	58.9
23	58.9

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Varietal Differences in Response to PGR Options for CWRS Wheat in Saskatchewan

Objectives: To demonstrate the response of current & common CWRS wheat varieties to plant growth regulators registered for use in spring wheat.

Treatments (4 varieties x 3 PGR):

Varieties (Lodging)	PGR
1) AAC Brandon (G)	1) UTC
2) AAC Alida (VG)	2) Manipulator®
3) AAC Redberry (F)	3) Moddus®
4) AAC Starbuck (F)	

Locations:

1) Melfort (lead)
2) Scott
3) Indian Head
4) Yorkton
5) Outlook
6) Prince Albert

Data Collection:

1) Emergence
2) Height
3) Lodging
4) Maturity
5) Test Weight
6) TKW
7) Protein

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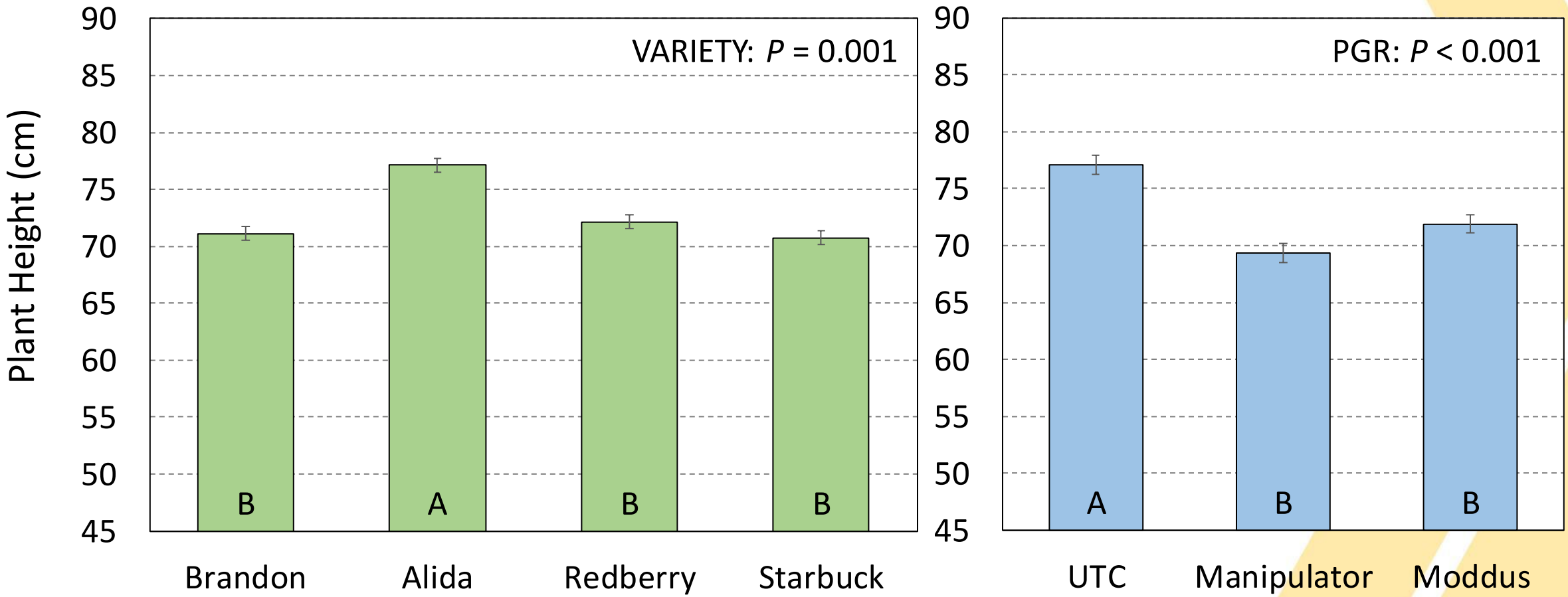
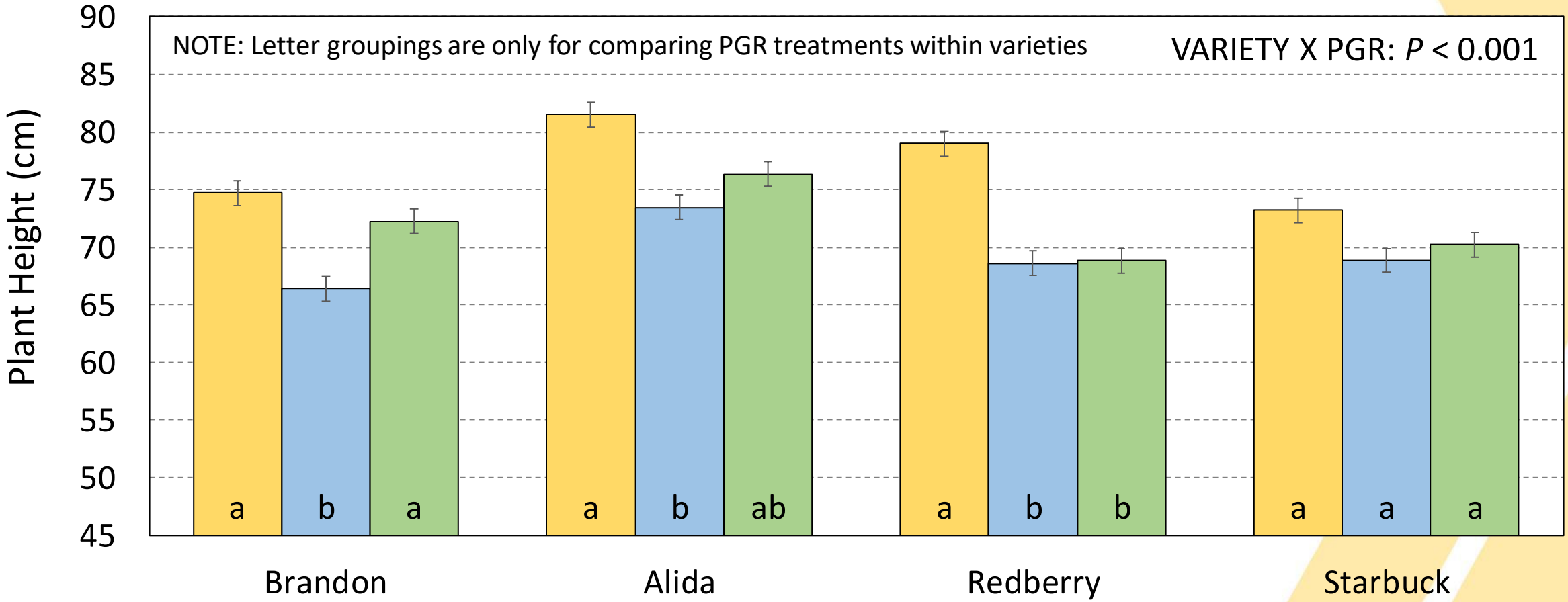
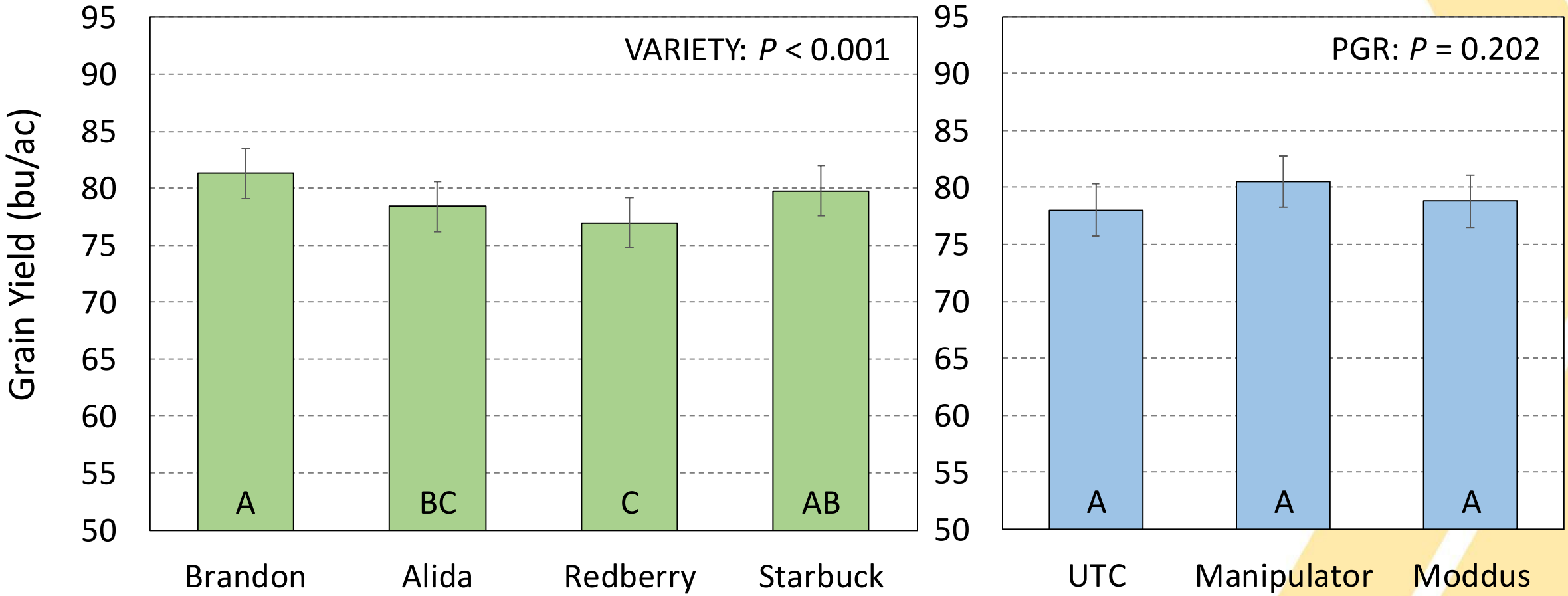
Variety & PGR Effects on Spring Wheat Plant Height (Indian Head-2023)



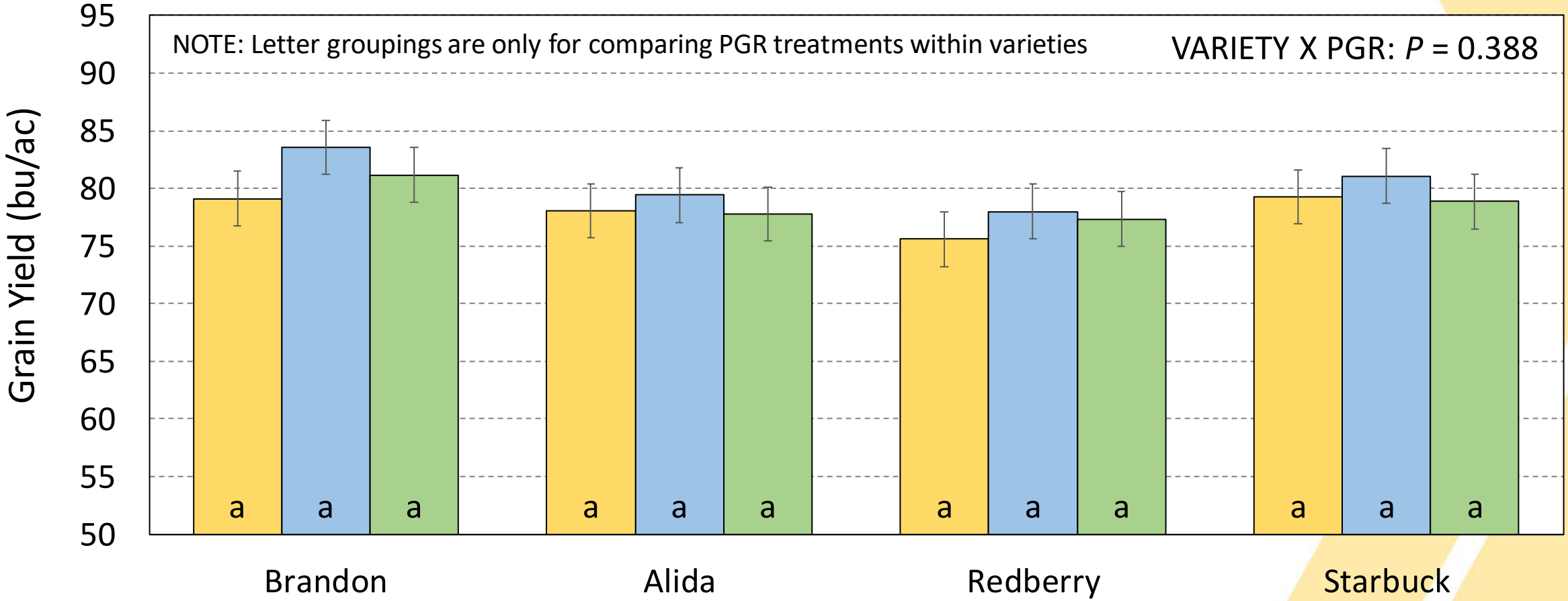
Variety × PGR Effects on Spring Wheat Plant Height (Indian Head-2023)



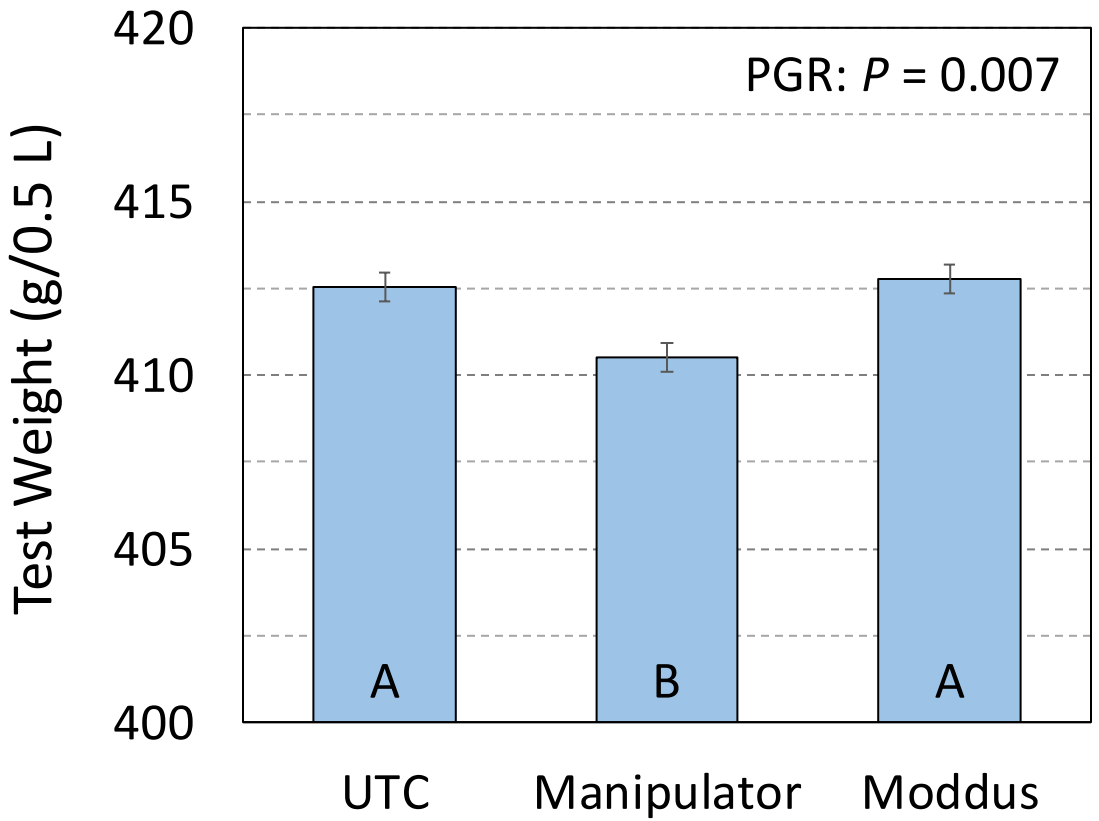
Variety & PGR Effects on Spring Wheat Grain Yield (Indian Head-2023)

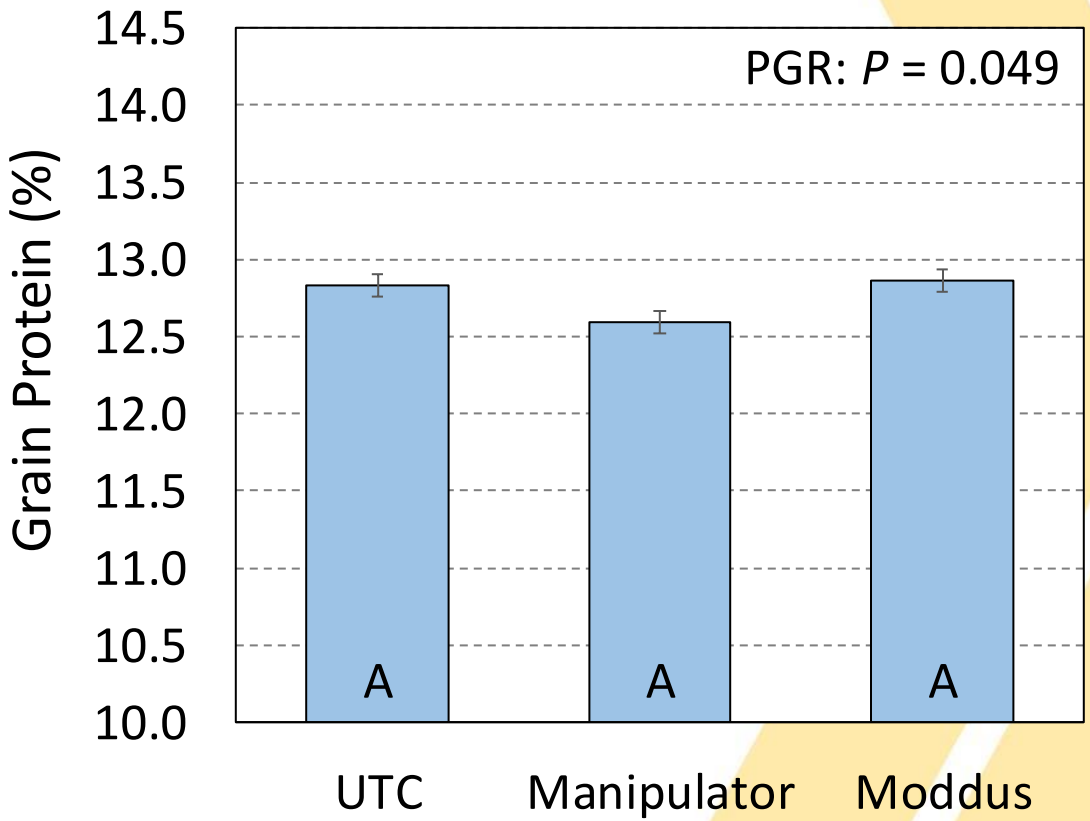


Variety × PGR Effects on Spring Wheat Grain Yield (Indian Head-2023)



PGR Effects on Spring Wheat Plant Test Weight & Protein (Indian Head-2023)





Note: Variety effect was significant for both variables but there was no VAR × PGR interaction

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THANK YOU

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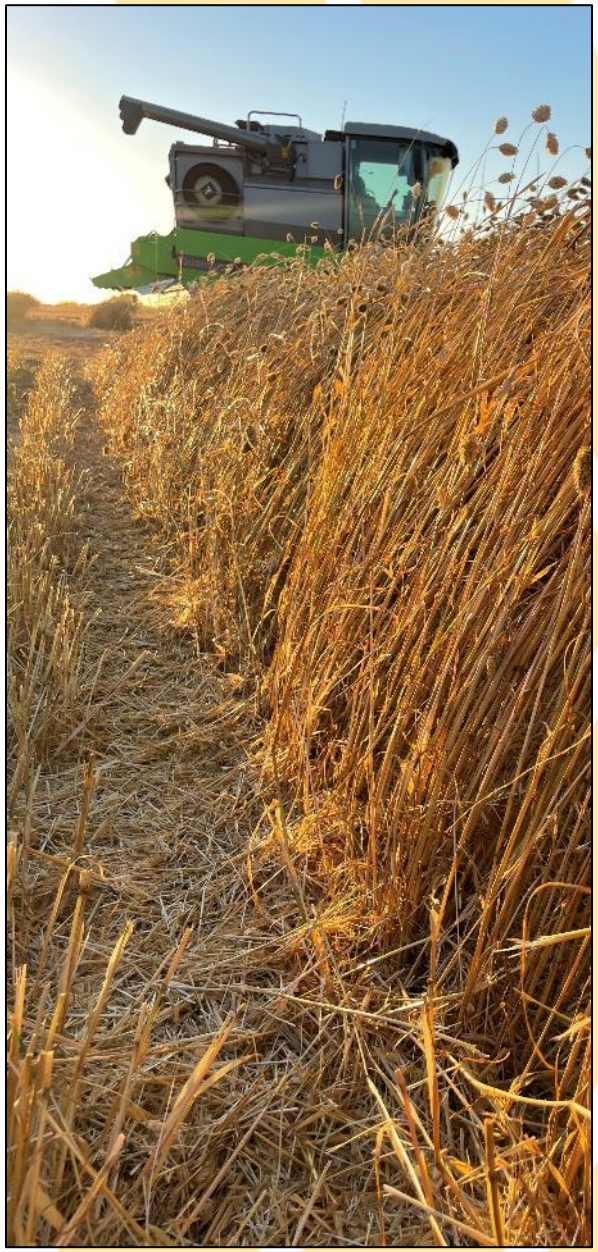

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