2020 IHARF Agronomy Update

(1/2)

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Presentation Overview

- **4R N Management in Spring Wheat** (2020 Update)
- **Winter Wheat Response to N Rate & Management** (2019-20)
- **Field Pea Fertility** (2019-20, multiple locations)
- **Wheat Response to Various Input Combinations** (2019-20)
- **Pre-harvest Options for Flax** (2020)
- **Uptake of Elemental vs Sulphate S Over a Two-Year Period** (2012-13, Indian Head, Argentina, Brazil)

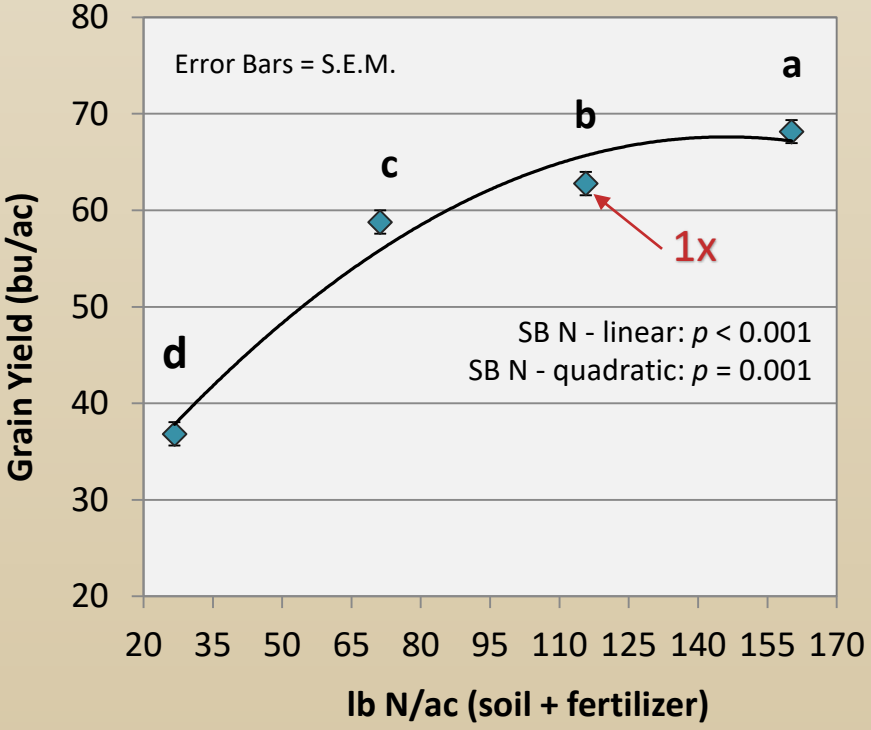
4R Nitrogen Management Principles in Spring Wheat (ADOPT-Fertilizer Canada 2017-20)

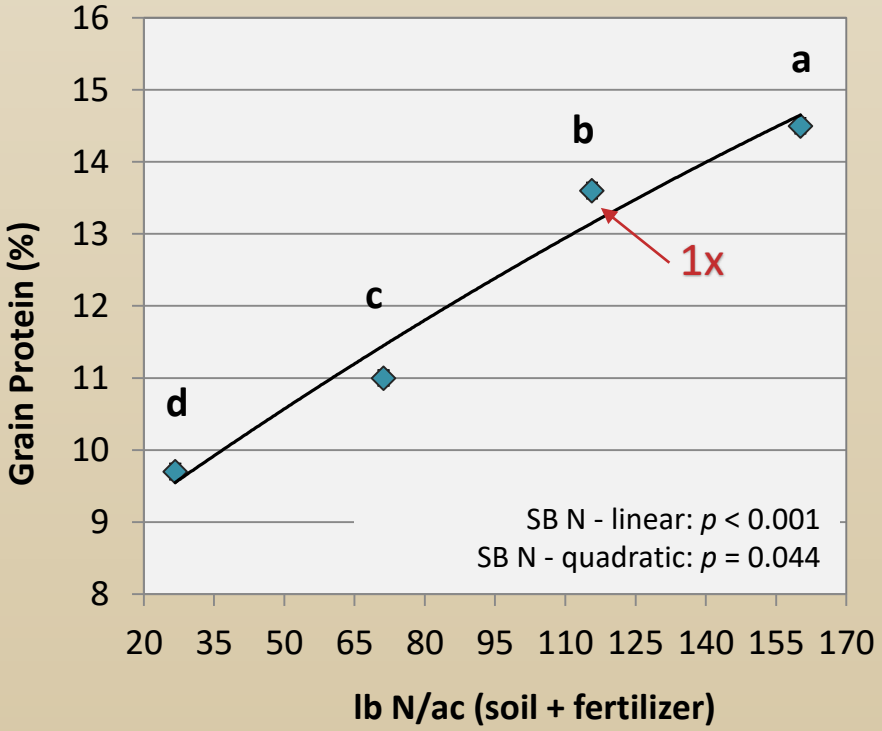
4R Nitrogen Treatments: Indian Head 2017

#	Form	Timing / Placement	Rate *
1	N/A	N/A	N/A
2	Urea (untreated)	Side-band (during seeding)	0.5x
3	Urea	Side-band	1.0x
4	Urea	Side-band	1.5x
5	Urea (Ur)	Pre-Seed Surface Broadcast	1.0x
6	Urea Ammonium-Nitrate (UAN)	Pre-Seed Surface Dribble-band	1.0x
7	Agrotain® (AT)	Pre-Seed Surface Broadcast	1.0x
8	SUPERU® (SU)	Pre-Seed Surface Broadcast	1.0x
9	Urea / Urea	50:50 Split (side-band : in-crop)	1.0x
10	Urea / UAN	50:50 Split	1.0x
11	Urea / Agrotain®	50:50 Split	1.0x
12	Urea / SUPERU®	50:50 Split	1.0x

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

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



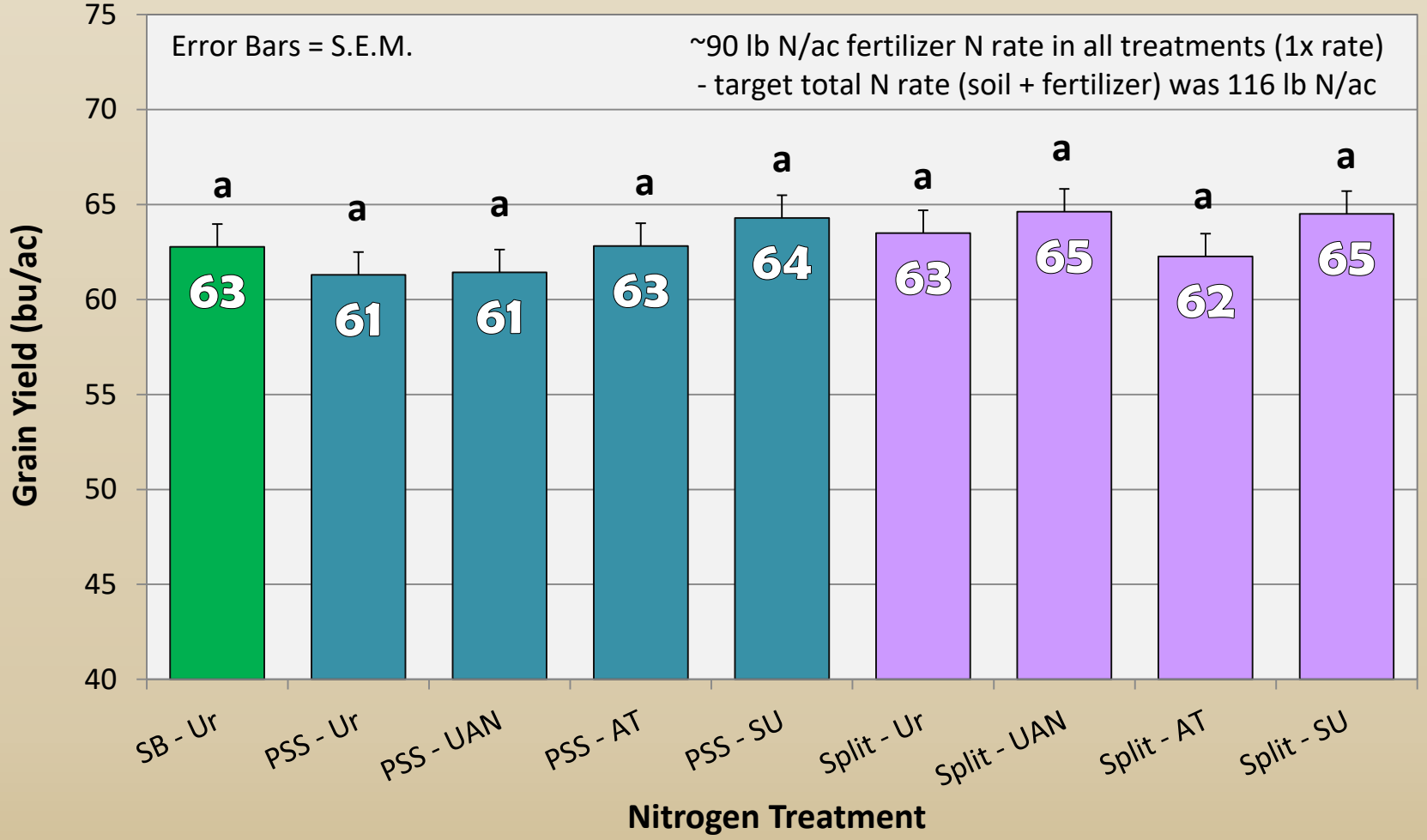


N Source = Side-banded Urea

Residual NO_3 = 27 lb/ac (fall composite)

N Management Effects on Wheat Yield

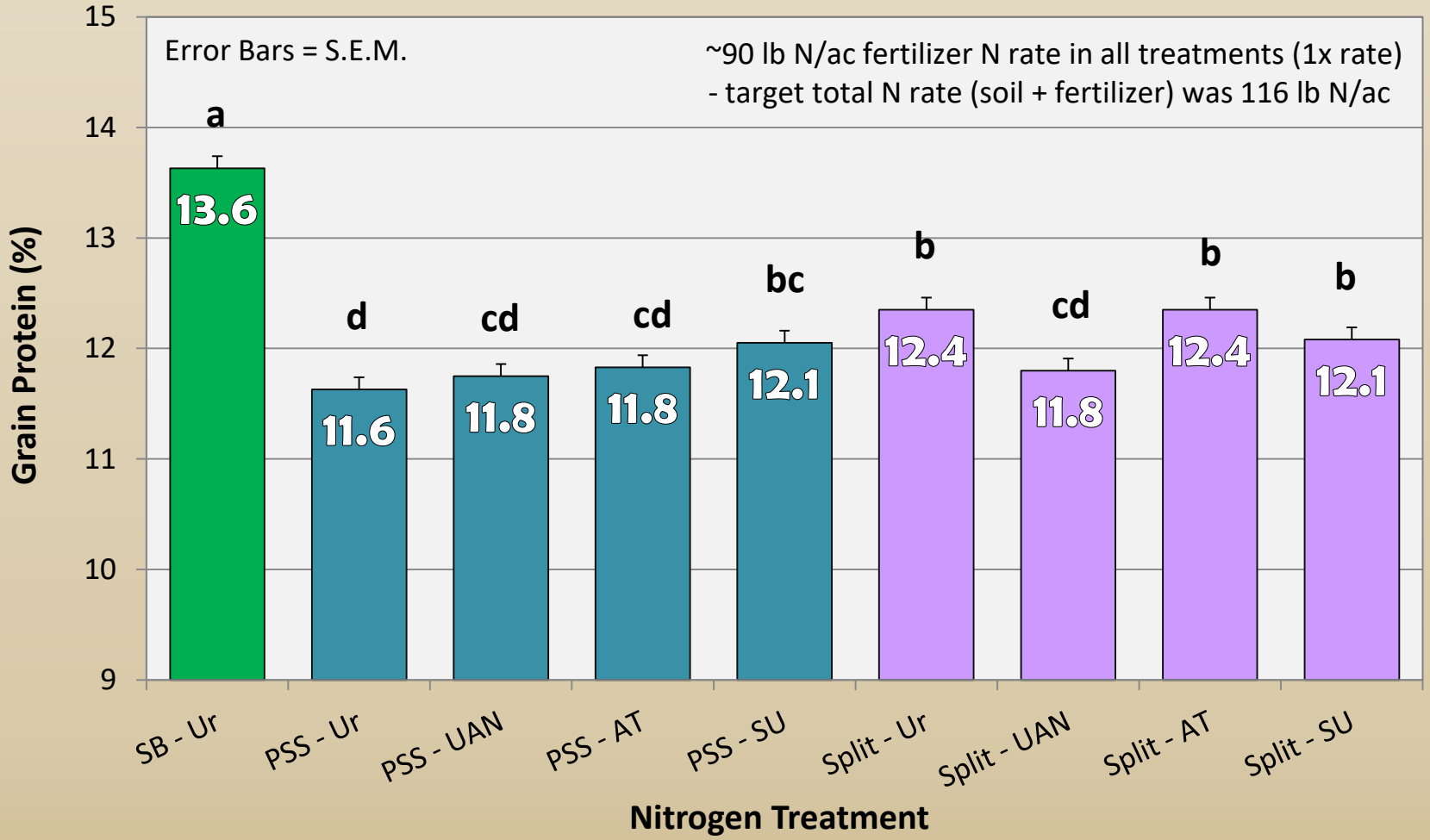
Indian Head 2017



SB – Side Band PSS – pre-seed surface Split – 50% SB urea 50% in-crop
Ur – urea UAN – urea ammonium-nitrate AT – Agrotain® SU – SUPERU®

N Management Effects on Wheat Protein

Indian Head 2017



SB – Side Band PSS – pre-seed surface Split – 50% SB urea 50% in-crop
Ur – urea UAN – urea ammonium-nitrate AT – Agrotain® SU – SUPERU®

4R Nitrogen Treatments: Indian Head 2018

#	Form	Timing / Placement	Rate *
1	N/A	N/A	N/A
2	Urea (Ur)	Side-band (SB)	0.5x
3	Urea	Side-band	1.0x
4	Urea	Side-band	1.5x
5	Agrotain® (AT)	Side-band	1.0x
6	SUPERU® (SU)	Side-band	1.0x
7	ESN® polymer coated urea	Side-band	1.0x
8	Urea	Fall Surface Broadcast	1.0x
9	Agrotain®	Fall Surface Broadcast	1.0x
10	SUPERU®	Fall Surface Broadcast	1.0x
11	Urea	Fall In-Soil Band	1.0x
12	Agrotain®	Fall In-Soil Band	1.0x
13	SUPERU®	Fall In-Soil Band	1.0x
14	ESN® polymer coated urea	Fall In-Soil Band	1.0x

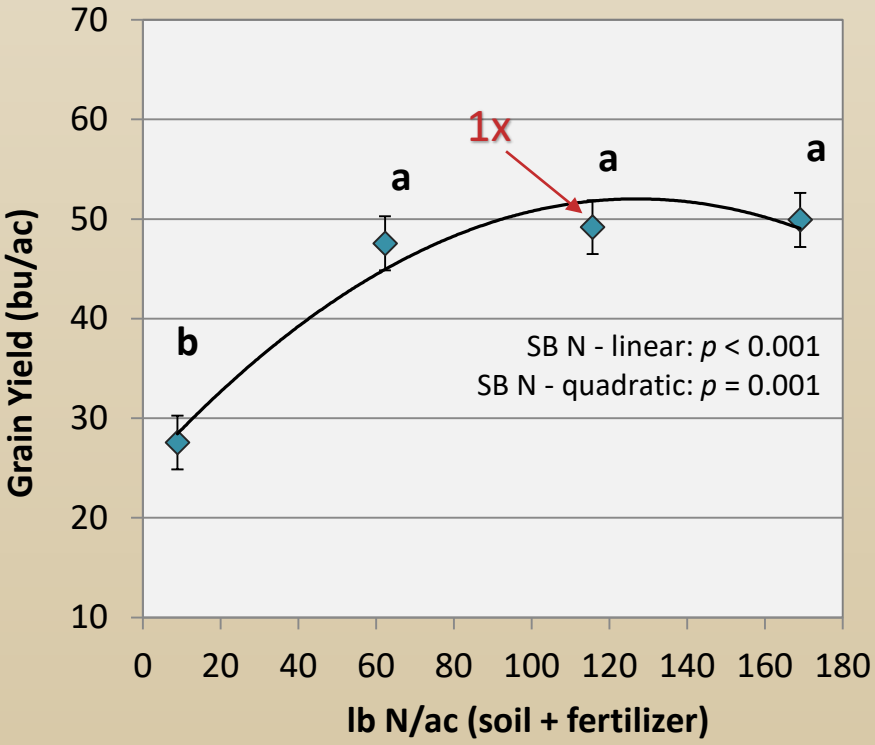
May 16

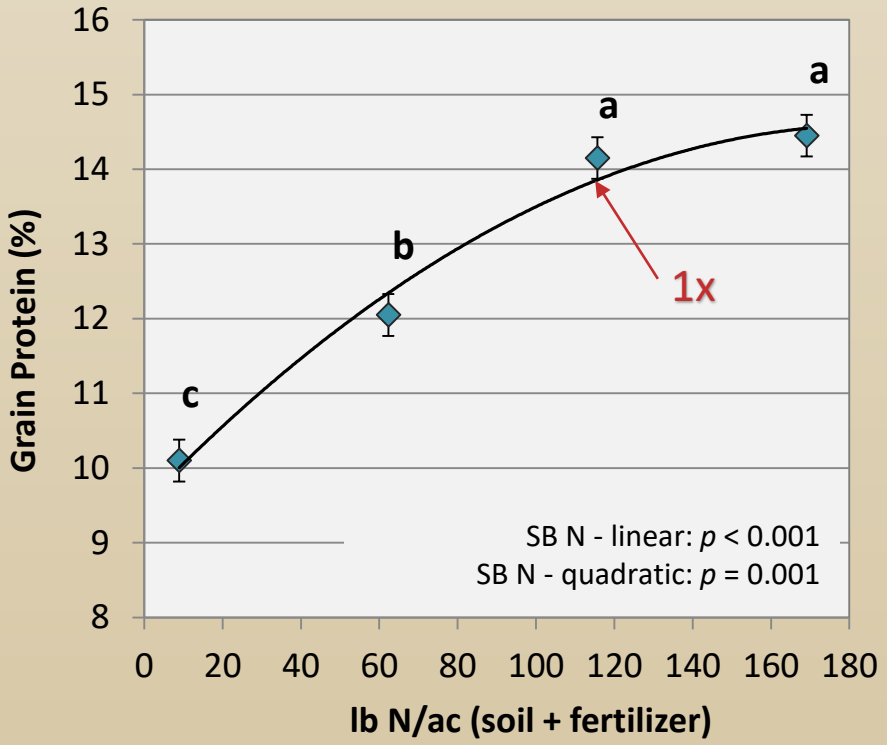
Oct 17

Oct 17

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

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



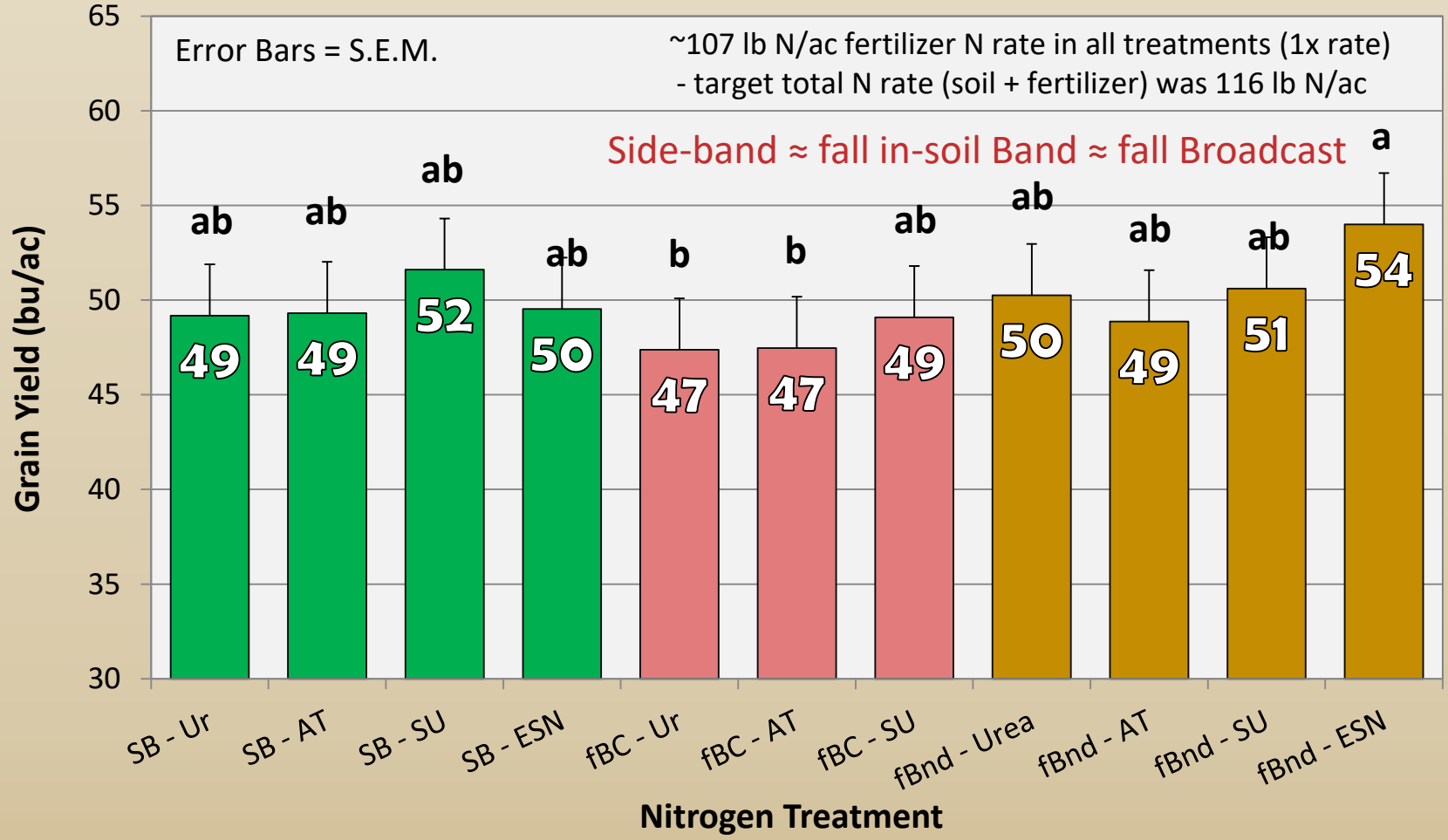


N Source = Side-banded Urea

Residual NO_3 = 9 lb/ac (fall composite)

N Management Effects on Wheat Yield

Indian Head 2018

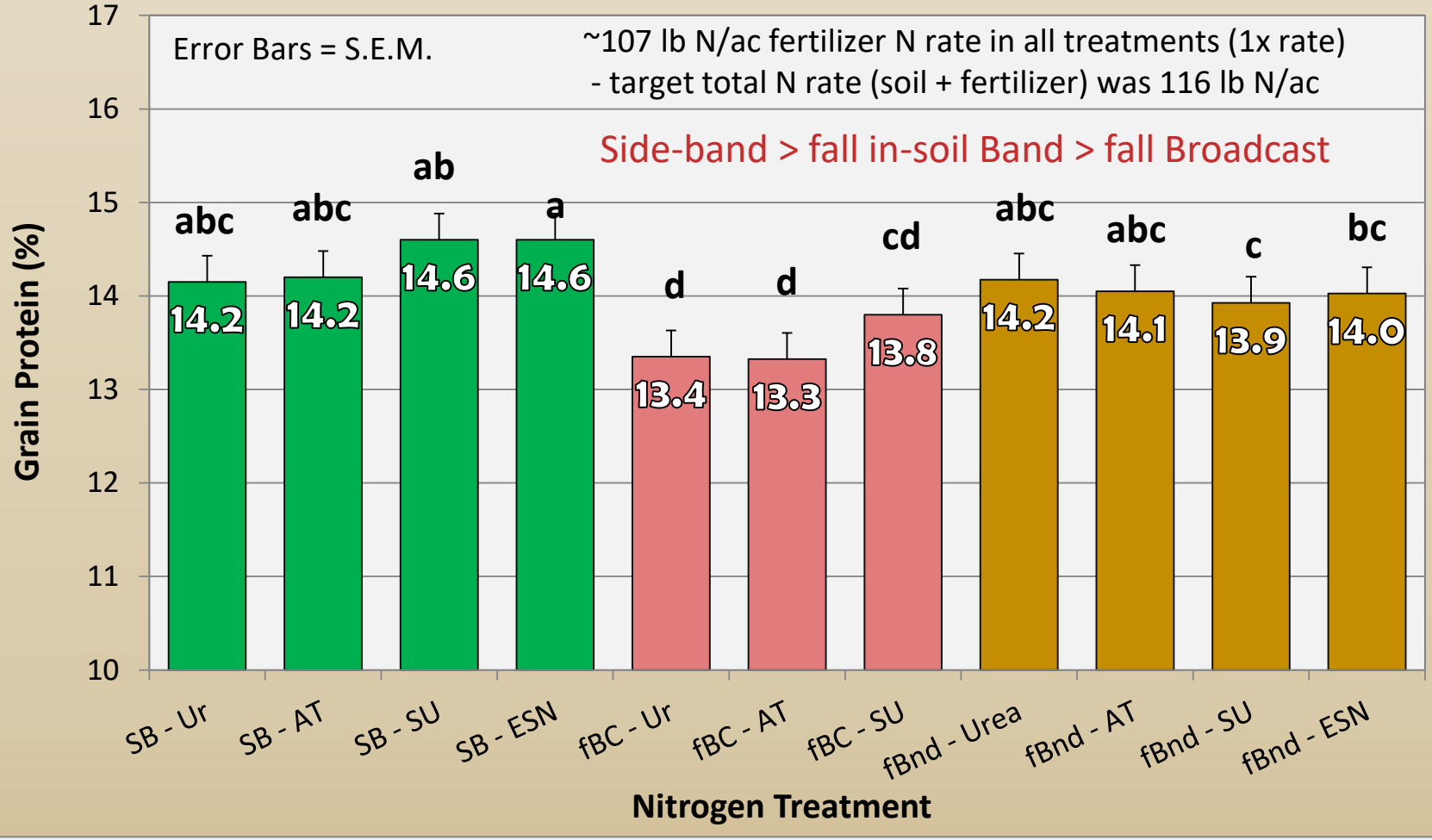


SB – Side Band fBC – fall Broadcast fBnd – fall in-soil Band

Ur – urea AT – Agrotain® SU – SUPERU® ESN® - polymer coated urea

N Management Effects on Wheat Protein

Indian Head 2018



SB – Side Band fBC – fall Broadcast fBnd – fall in-soil Band

Ur – urea AT – Agrotain® SU – SUPERU® ESN® - polymer coated urea

4R Nitrogen Treatments: Indian Head 2019

#	Form	Timing / Placement	Rate *
1	N/A	N/A	N/A
2	Urea (untreated)	Side-band (during seeding)	0.50x
3	Urea	Side-band	0.75x
4	Urea	Side-band	1.00x
5	Urea	Side-band	1.25x
6	Urea	Side-band	1.50x
7	Urea	Side-band	1.75x
8	ESN® polymer coated urea	Side-band	1.0x
9	Agrotain® treated urea	Side-band	1.0x
10	SuperUrea®	Side-band	1.0x
11	Urea	Fall Surface Broadcast	1.0x
12	ESN® polymer coated urea	Fall Surface Broadcast	1.0x
13	Agrotain® treated urea	Fall Surface Broadcast	1.0x
14	SuperUrea®	Fall Surface Broadcast	1.0x
15	Urea	Spring Surface Broadcast (pre-seed)	1.0x
16	ESN® polymer coated urea	Spring Surface Broadcast	1.0x
17	Agrotain® treated urea	Spring Surface Broadcast	1.0x
18	SuperUrea®	Spring Surface Broadcast	1.0x

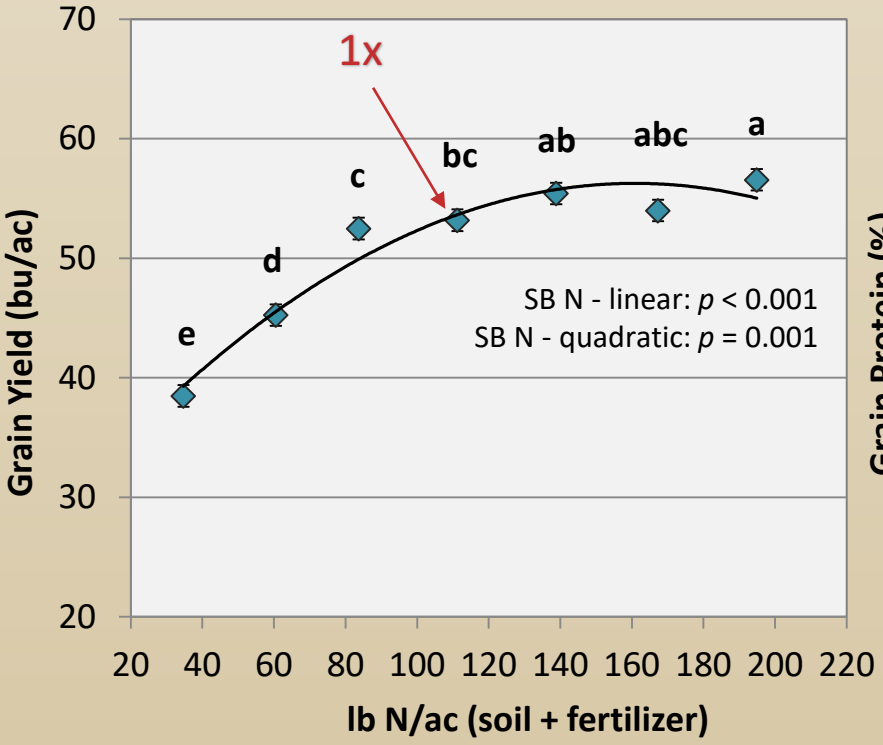
May 6

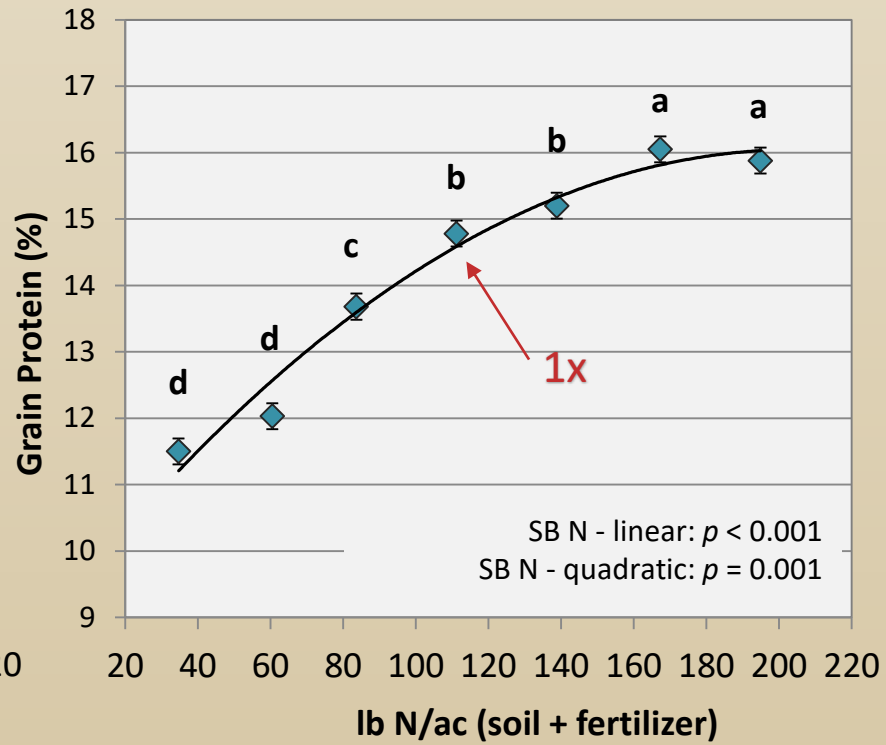
Oct 9

May 4

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

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



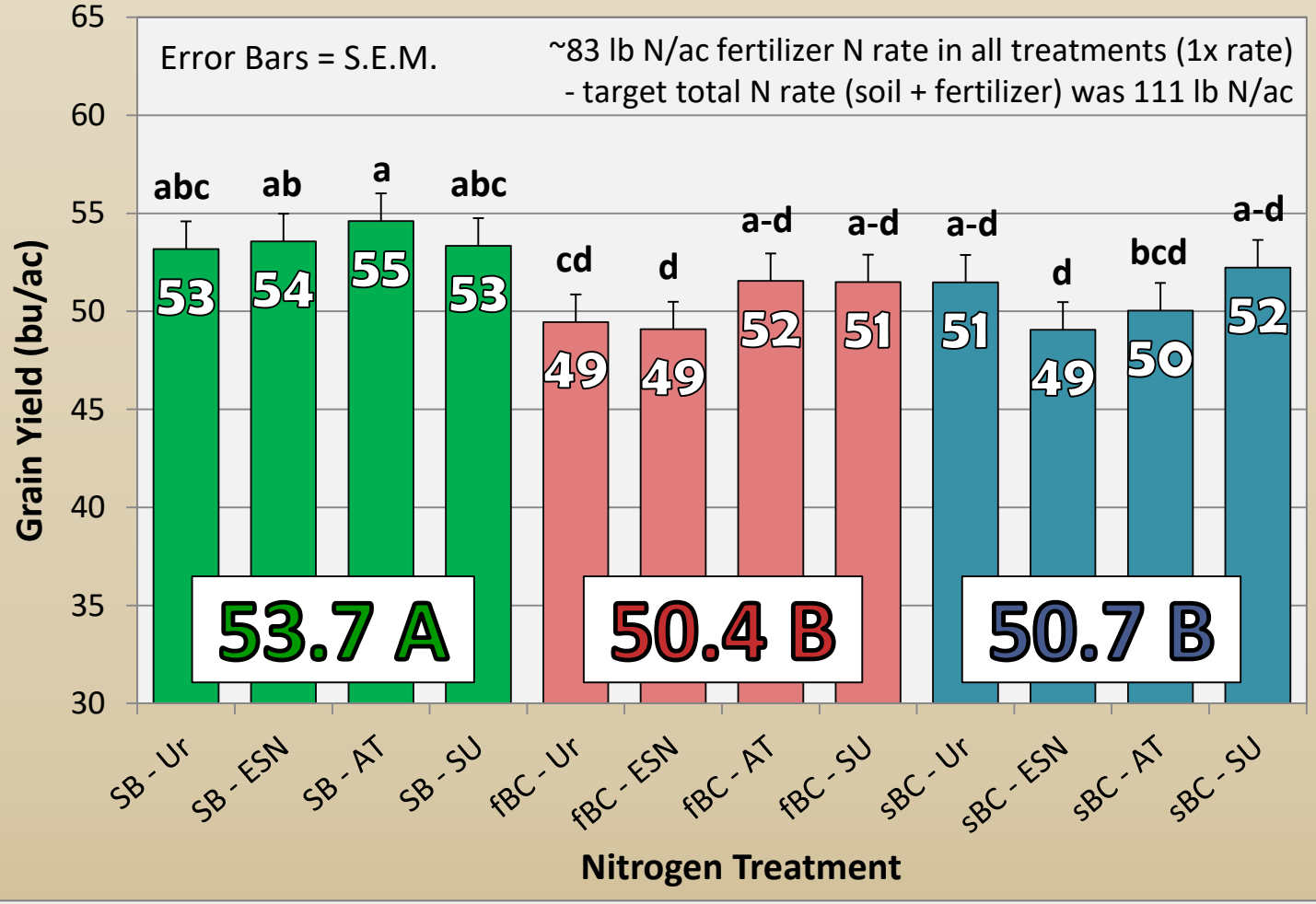


N Source = Side-banded Urea

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

N Management Effects on Wheat Yield

Indian Head 2019

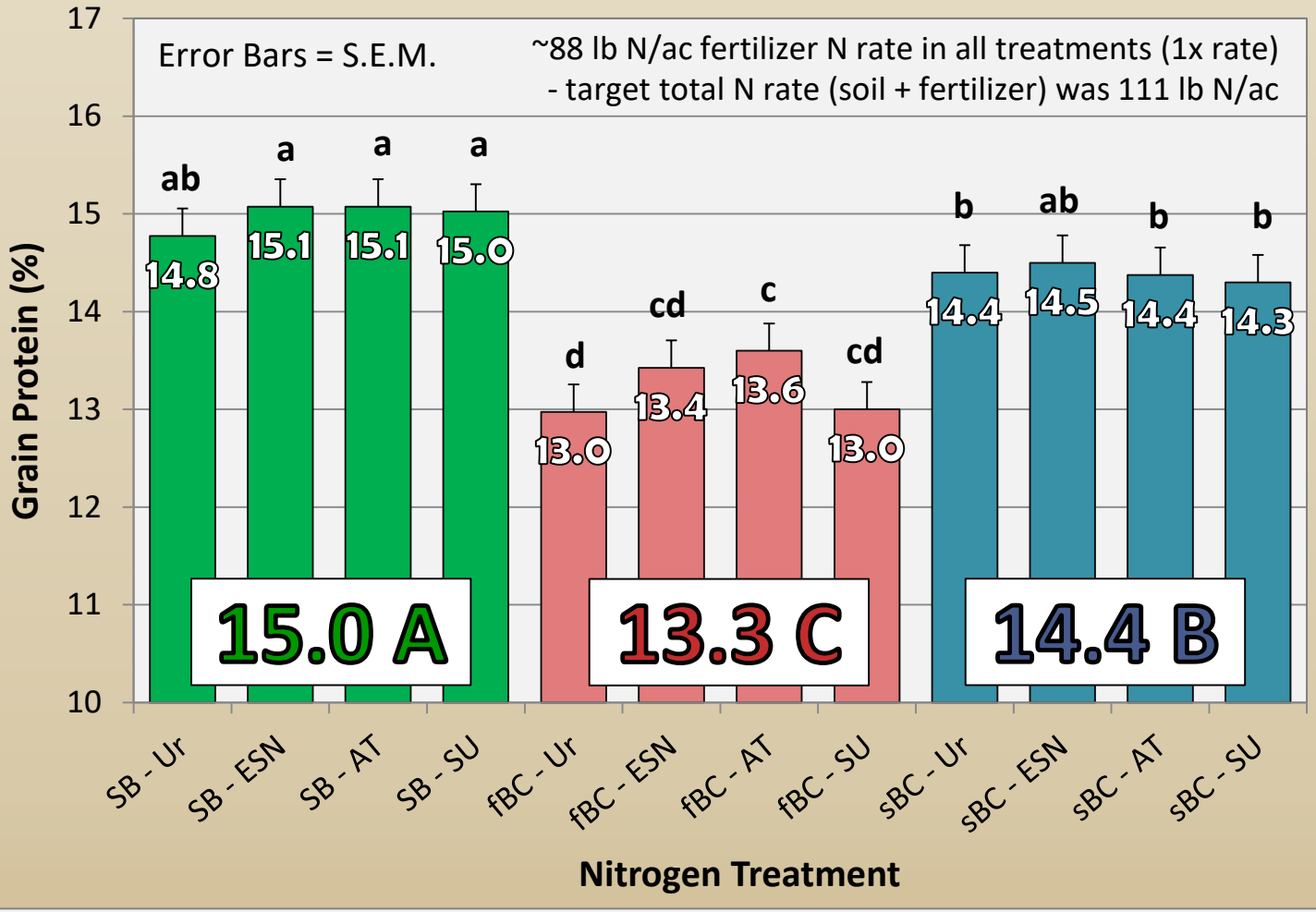


Source	Pr > F
Form (F)	0.392
Time / Place (TP)	0.003
F x TP	0.719

SB – Side Band fBC – fall Broadcast sBC – spring Broadcast
Ur – urea ESN® - polymer coated urea AT – Agrotain® SU – SUPERU®

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

SB – Side Band fBC – fall Broadcast sBC – spring Broadcast

Ur – urea ESN® - polymer coated urea AT – Agrotain® SU – SUPERU®

4R Nitrogen Treatments: Indian Head 2020

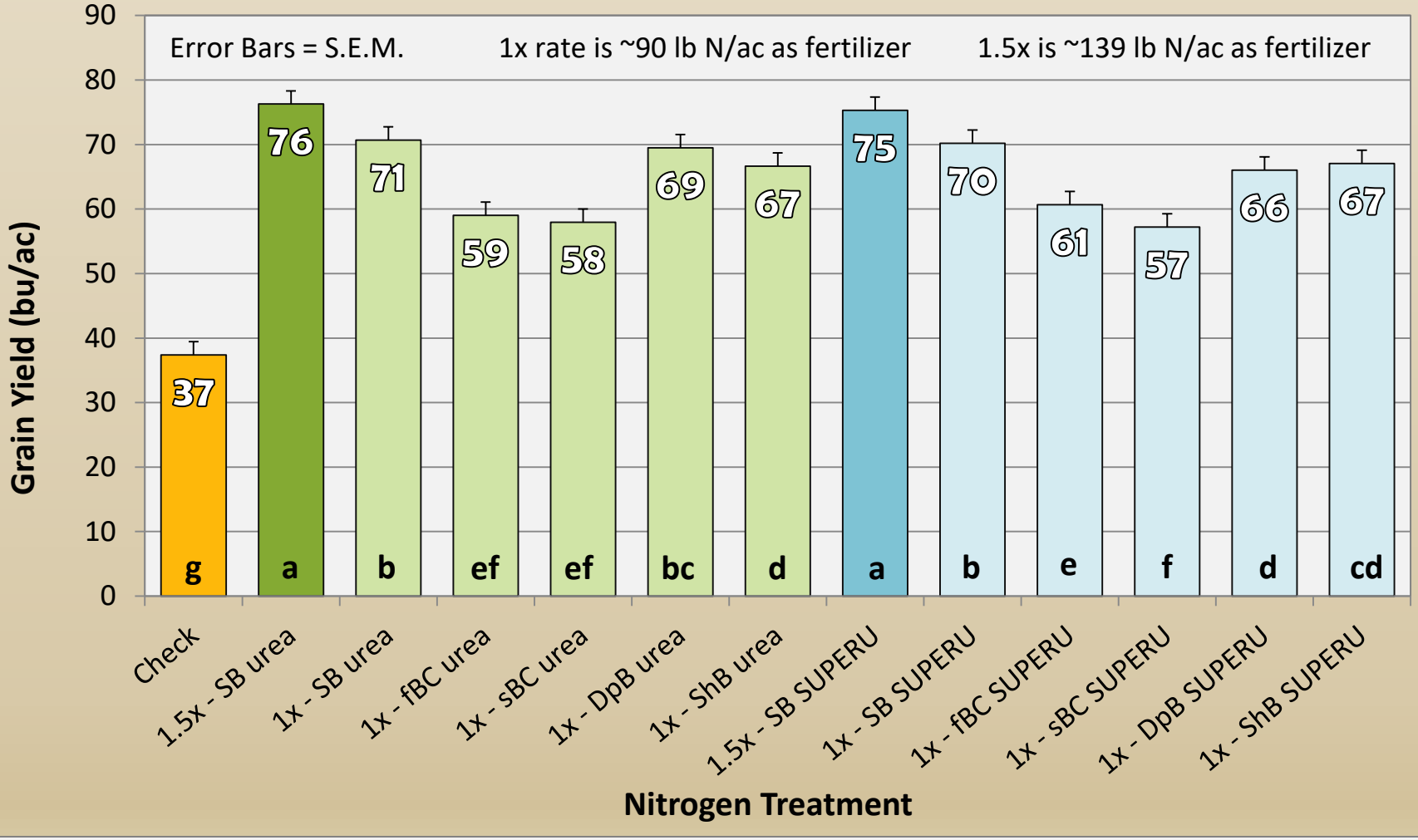
#	Form	Timing / Placement	Rate (soil + fert)
1	N/A	N/A	14 lb N/ac (6 from MAP, 8 residual)
2	Untreated Urea	Side-Band (≈1.5” depth)	147 lb N/ac (High N – 1.5x rate)
3	Untreated Urea	Side-Band (≈1.5” depth)	98 lb N/ac (1.0x rate)
4	Untreated Urea	Fall Surface Broadcast	98 lb N/ac (1.0x rate)
5	Untreated 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	SUPERU® (NBPT + DCD)	Side-Band (≈1.5” depth)	147 lb N/ac (High N – 1.5x rate)
9	SUPERU®	Side-Band (≈1.5” depth)	98 lb N/ac (1.0x rate)
10	SUPERU®	Fall Surface Broadcast	98 lb N/ac (1.0x rate)
11	SUPERU®	Spring Surface Broadcast	98 lb N/ac (1.0x rate)
12	SUPERU®	Fall Deep Band (≈2.3”)	98 lb N/ac (1.0x rate)
13	SUPERU®	Fall Shallow Band (≈1”)	98 lb N/ac (1.0x rate)

1x = 98 lb N/ac (soil + fertilizer); 1.5x = 147 lb N/ac (soil + fertilizer)

Fall applications – October 7; Spring applications – May 10; Seeding/Side-banding – May 11

N Management Effects on Wheat Yield

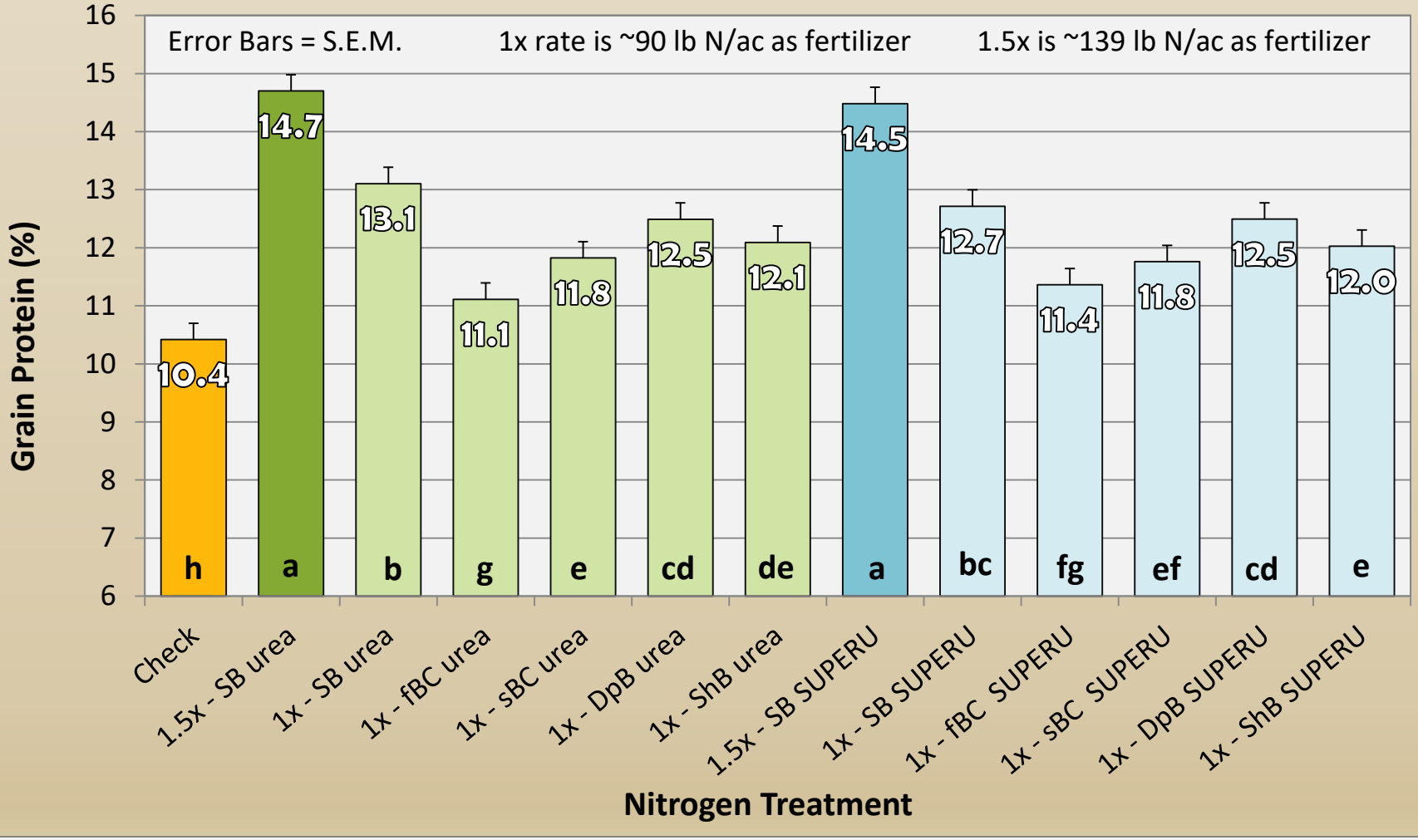
Indian Head 2020



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

4R Nitrogen Management Principles in Spring Wheat: Conclusions

- Relative performance of different N management strategies can vary with environment, but it has been shown again & again that single pass seeding-fertilization is hard to improve upon for spring crops in western Canada
- Reasons for utilizing alternative N management strategies have more to do with improving seeding logistics, taking advantage of lower fertilizer prices, & mitigating risk (i.e., deferring N application under severe drought) than agronomy but it is important for farmers to have flexibility in this regard
- Enhanced efficiency or controlled release N products can reduce the risks associated with less optimal timing/placement options, but timing/placement is usually more important than formulation when it comes to minimizing losses & maximizing crop utilization
- Split applications have greater potential to be truly beneficial in wetter and warmer environments where the potential for losses, yields, & total N requirements are higher, the growing season is longer & the risks of in-crop N being stranded (due to dry weather) are lower

Winter Wheat Nitrogen Rate, Timing, & Placement Options (2019-2020 ADOPT)

Winter Wheat Nitrogen Rate, Timing, & Placement (Indian Head 2019 & 2020)

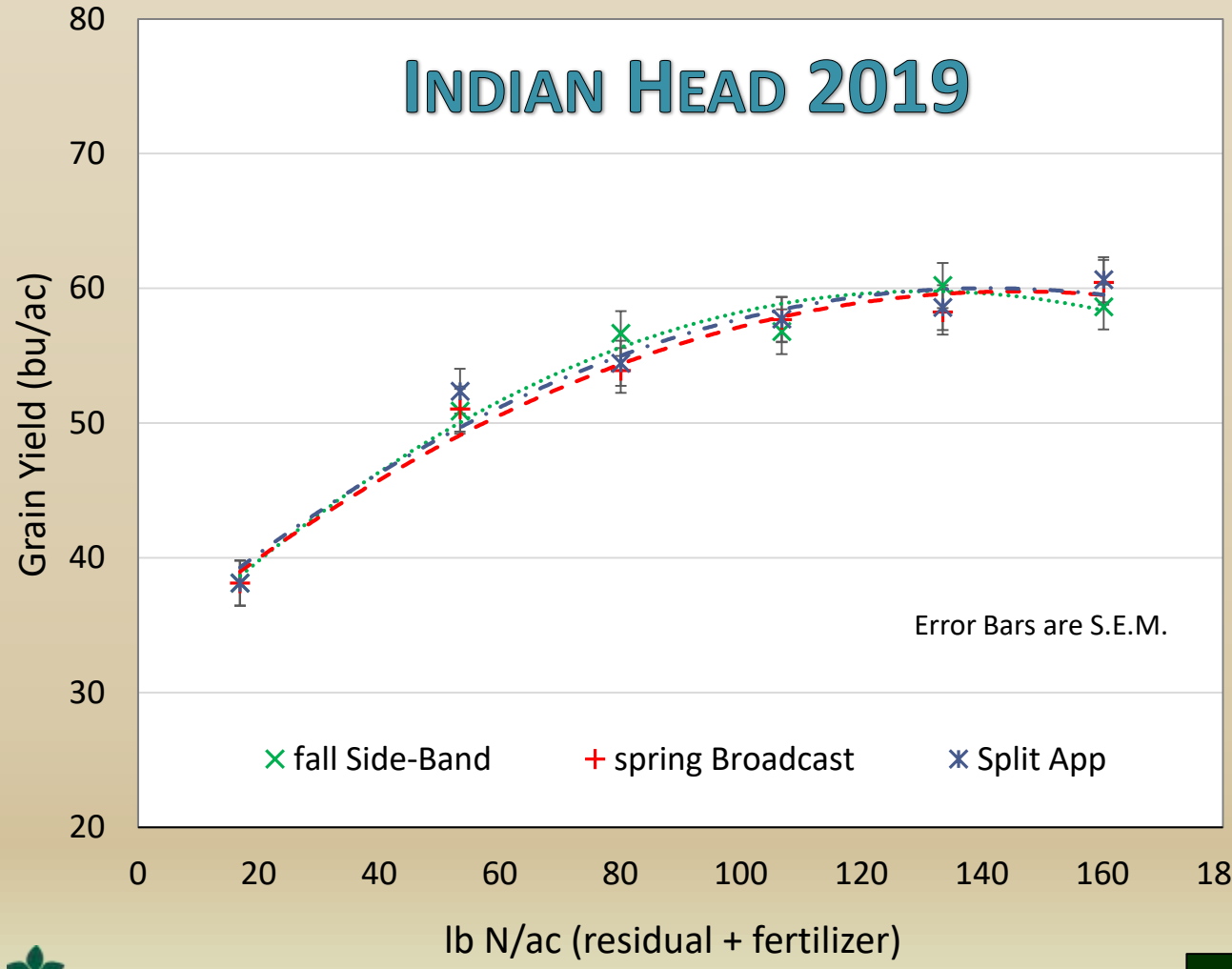
Objectives: To demonstrate winter wheat response to urea supplied using contrasting placement/timing options

Treatments: 0N control plus 53, 70, 107, 134, 160 lb N/ac (fertilizer + soil) applied as 100% side band, 100% early spring broadcast, or 50:50 split-application

Growing Season Information

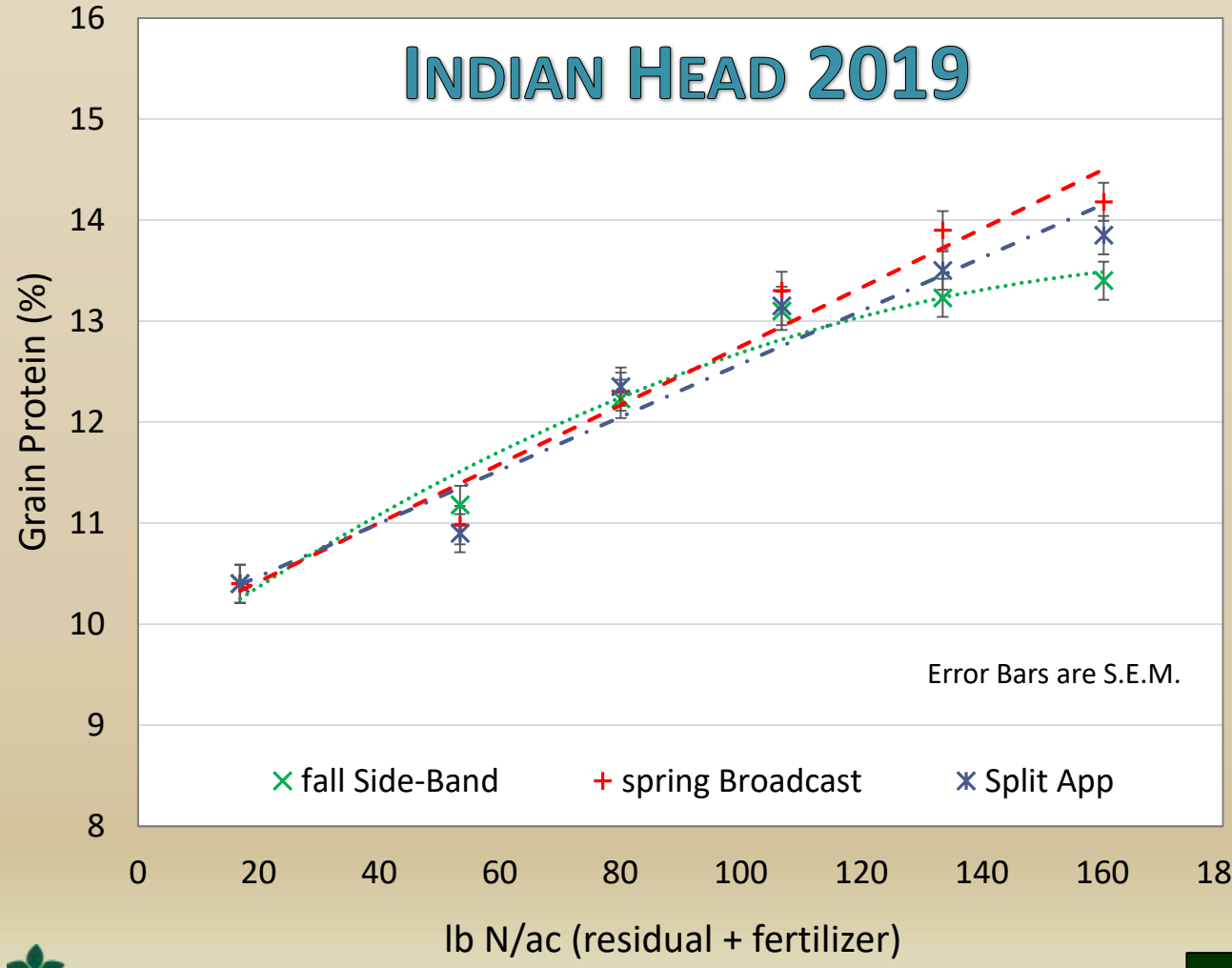
- *Seeding/Side-banding:* Seeded into moisture both years (Sep-21 and Sept-24) followed by cool, dry weather (i.e., slow conversion to NO_3-N & low risk of leaching or denitrification)
- *Spring Broadcast:* ≈ 5-6/10" of precipitation occurred within 24 hours of spring applications both years, dry growing seasons followed (51-66% of long-term average)
  - The precipitation received after spring broadcast applications was likely sufficient to move N into the soil but not completely mitigate losses
  - One potentially important difference between seasons was that spring N was applied two weeks later in 2020 (April 30) than in 2019 (April 16)

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Yield



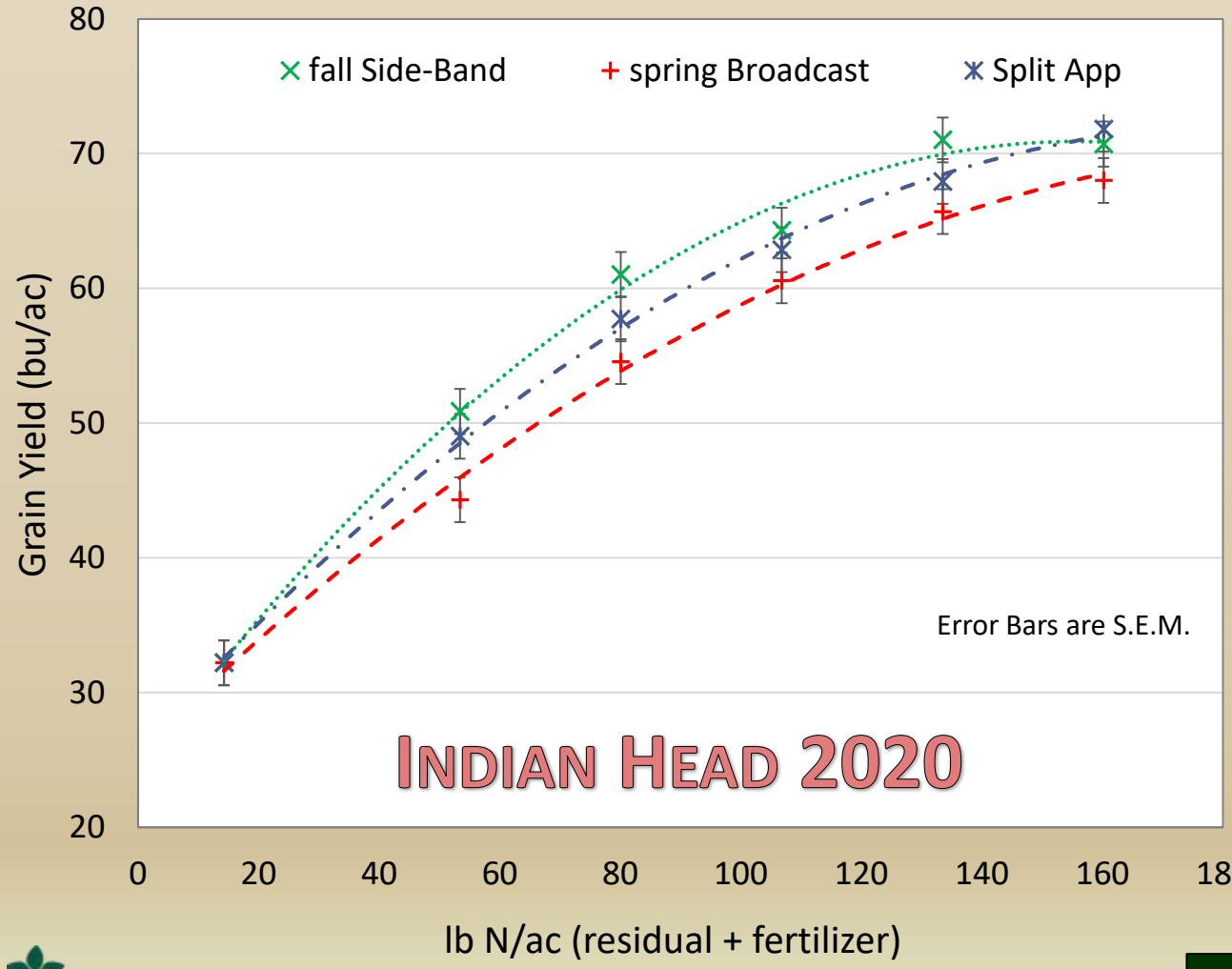
Time/Placement	bu/ac
Control	38.1
Fall Side-Band	56.6 A
Spr. Broadcast	56.3 A
Split (50/50)	56.7 A
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	<0.001
sBC – linear	<0.001
sBC – quadratic	<0.001
Split – linear	<0.001
Split – quadratic	<0.001

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Protein



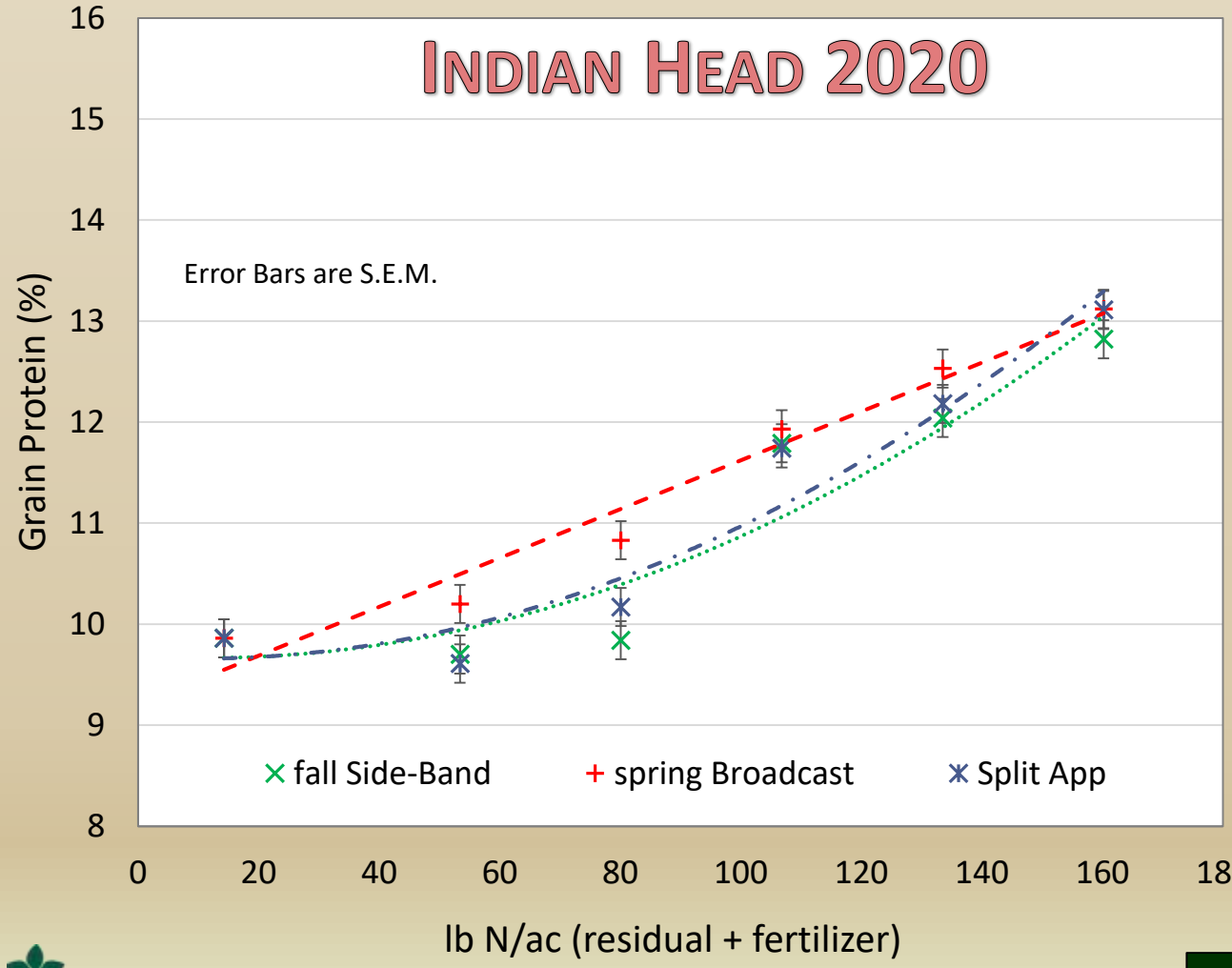
Time/Placement	%
Control	10.4
Fall Side-Band	12.6 A
Spr. Broadcast	12.9 A
Split (50/50)	12.8 A
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	0.002
sBC – linear	<0.001
sBC – quadratic	0.207
Split – linear	<0.001
Split – quadratic	0.066

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Yield



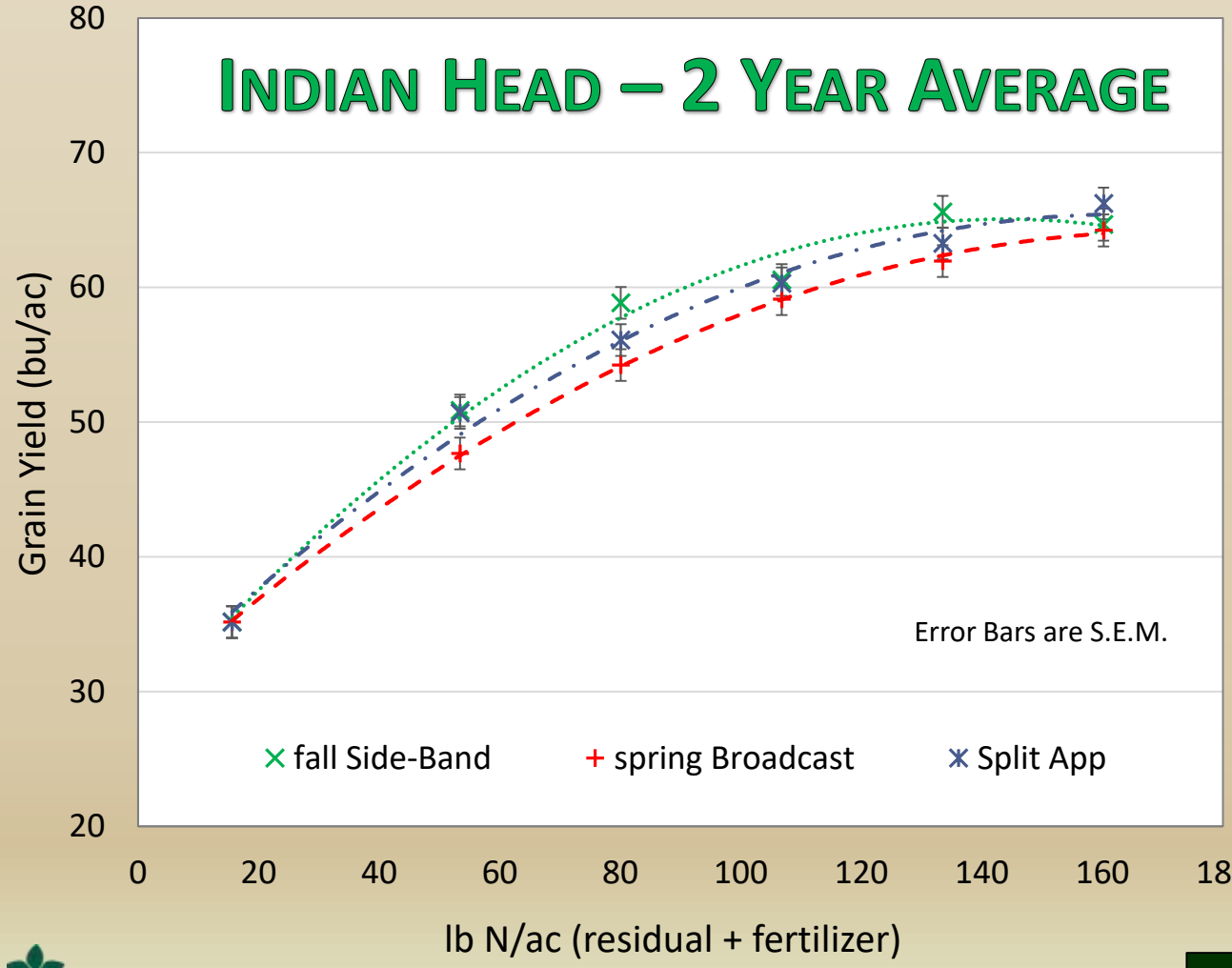
Time/Placement	bu/ac
Control	32.2
Fall Side-Band	63.6 A
Spr. Broadcast	58.6 B
Split (50/50)	61.9 A
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	<0.001
sBC – linear	<0.001
sBC – quadratic	<0.001
Split – linear	<0.001
Split – quadratic	<0.001

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Protein



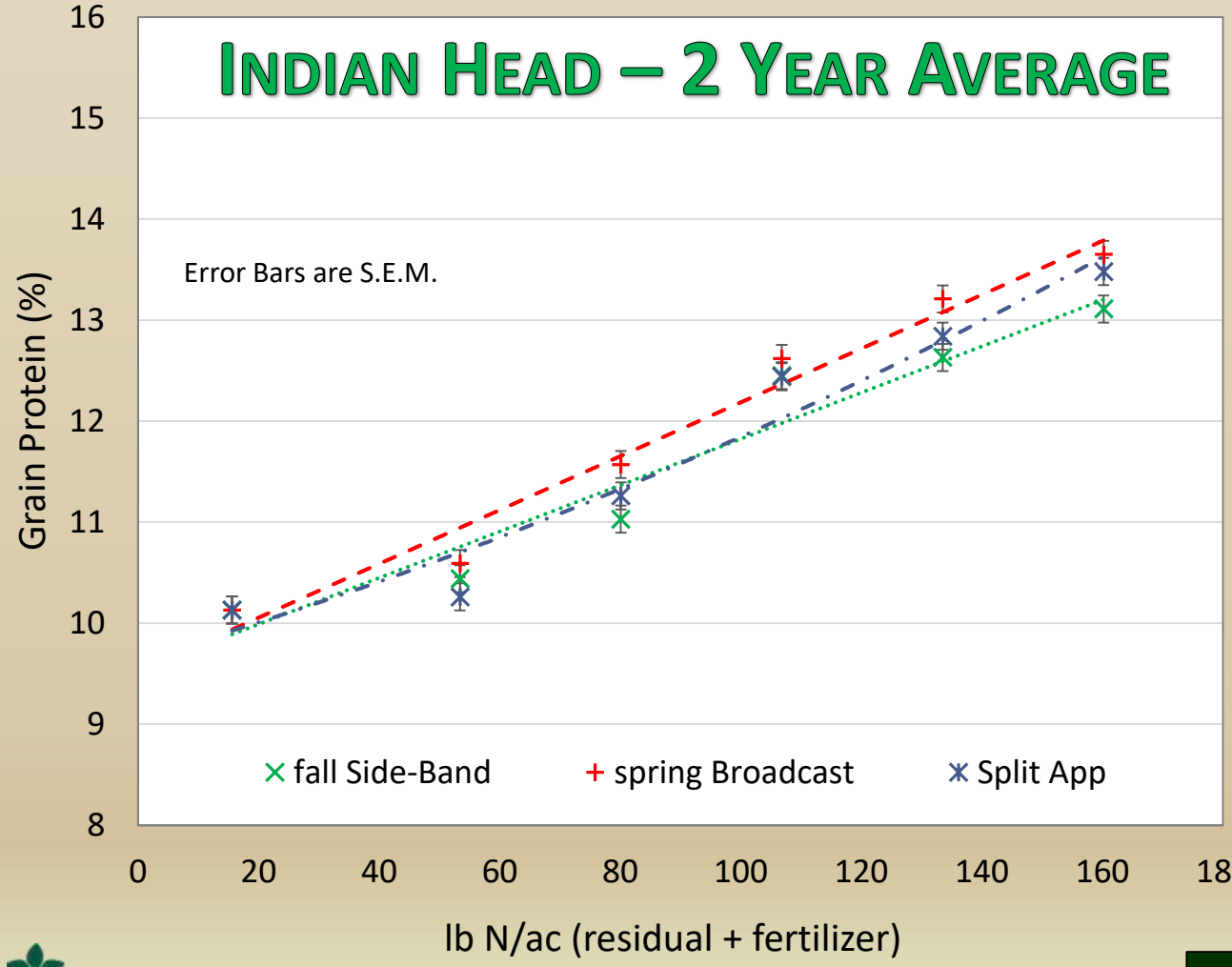
Time/Placement	%
Control	9.9
Fall Side-Band	11.2 B
Spr. Broadcast	11.7 A
Split (50/50)	11.4 B
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	<0.001
sBC – linear	<0.001
sBC – quadratic	0.062
Split – linear	<0.001
Split – quadratic	<0.001

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Yield



Time/Placement	bu/ac
Control	35.2
Fall Side-Band	60.1 A
Spr. Broadcast	57.4 A
Split (50/50)	59.3 A
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	<0.001
sBC – linear	<0.001
sBC – quadratic	<0.001
Split – linear	<0.001
Split – quadratic	<0.001

Nitrogen Rate & Placement / Timing Effects on Winter Wheat Protein



Time/Placement	%
Control	10.1
Fall Side-Band	11.9 B
Spr. Broadcast	12.3 A
Split (50/50)	12.1 A
Orthogonal Contrast	**Pr > F**
fSB – linear	<0.001
fSB – quadratic	0.297
sBC – linear	<0.001
sBC – quadratic	0.662
Split – linear	<0.001
Split – quadratic	0.037

Winter Wheat Nitrogen Rate, Timing, & Placement Options: Conclusions

- Results to date support the hypothesis that split applications are best for optimizing both yield & protein over a range of environmental conditions
- Side-banding or mid-row banding 100% of the N requirements at seeding can perform well in drier environments, especially when combined with later seeding, but still might be considered risky since winter wheat establishment can be variable under such conditions
- Deferring the crop's entire N requirements until spring is not recommended & topdressing as early in the spring as possible is critical for mitigating yield loss
- Although not addressed in the current project, enhanced efficiency N formulations can be a good fit with winter cereals (i.e., SuperU® or ESN® for fall in-soil bands; Agrotain® or similar products for spring broadcast)
- Trial established again in the fall of 2020 for a third & final growing season

Enhanced Fertility for Optimizing Field Pea Yield & Protein (SPG)

Field Pea Fertility Trials (2019 & 2020)

Locations (6):

1. **Swift Current** (dry Brown soil)
2. **Outlook** (Brown soil)
3. **Scott** (Dark Brown)
4. **Indian Head** (thin Black)
5. **Yorkton** (Black)
6. **Melfort** (moist Black)

Treatments (13):

#	lb N-P_2O_5-K_2O-S/ac
1	0-0-0-0 **(no fertilizer)**
2	15-0-0-9 **(0 P)**
3	15-18-0-9 **(18 P)**
4	15-36-0-9 **(36 P / 9 S)**
5	19-53-0-9 **(53 P)**
6	23-71-0-9 **(71 P)**
7	15-36-0-0 **(0 S)**
8	15-36-0-4 **(4 S)**
9	20-36-0-13 **(13 S)**
10	36-36-0-9 **(36 N as MAP/AS/urea)**
11[Z]	15-36-0-9 **(+ 36 N in-crop broadcast urea)**
12[Y]	36-36-0-9 **(36 N as MAP/AS/ESN)**
13[Y]	36-71-0-13 **(ultra high fertility – ESN)**

[Z] In-crop N broadcast approximately 4-5 weeks after emergence, prior to flowering

[Y] ESN (44-0-0) instead of urea as the supplemental N source in Trt #12 and 13

***All fertilizer side-banded unless otherwise indicated**

Field Pea Fertility Trials (2019 & 2020)

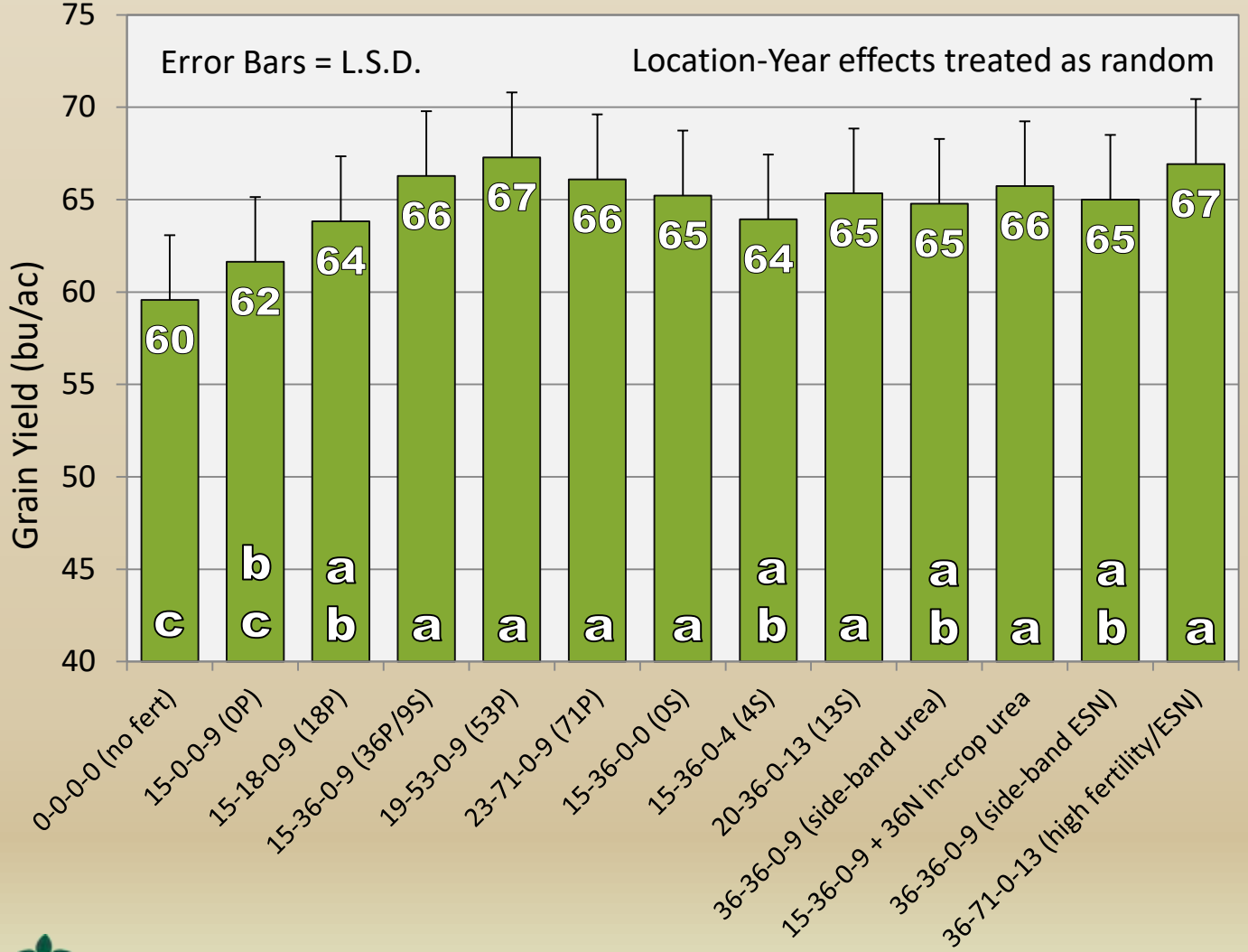
Selected Soil Test Results

Location-Year	pH	OM (%)	Olsen-P (ppm)	NO_3-N (lb/ac)	S (lb/ac)
	---------- 0-6” ----------			---------- 0-24” ----------	
Indian Head – 2019	7.7	4.7	4	24	53
Indian Head – 2020	8.0	4.1	3	28	30
Melfort – 2019	6.0	9.6	9	33 [Z]	76 [Z]
Melfort – 2020	6.0	11.7	9	52 [Z]	38 [Z]
Outlook – 2019	8.1	2.3	5	19	53 [Z]
Outlook – 2020	7.6	2.4	24	59	>162 [Z]
Scott – 2019	5.9	3.5	12	42	103
Scott – 2020	6.4	4.0	12	34	99
Swift Current – 2019	6.5	2.6	8	180	42
Swift Current – 2020	7.3	2.9	9	19 [Z]	8 [Z]
Yorkton – 2019	7.0	6.5	9	39	111
Yorkton – 2020	7.7	4.3	7	51	30 [Z]

[Z] Values are for the 0-30 cm soil depth for this attribute

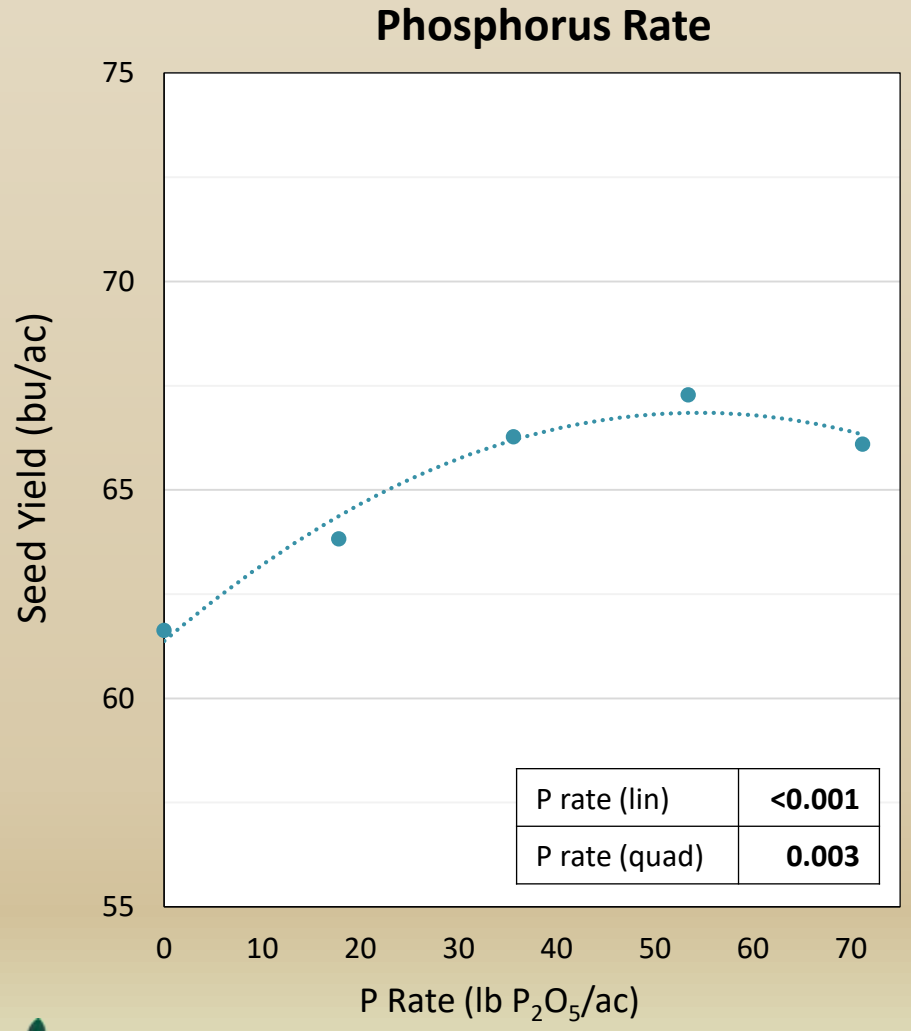
Fertility Effects on Field Pea Yield

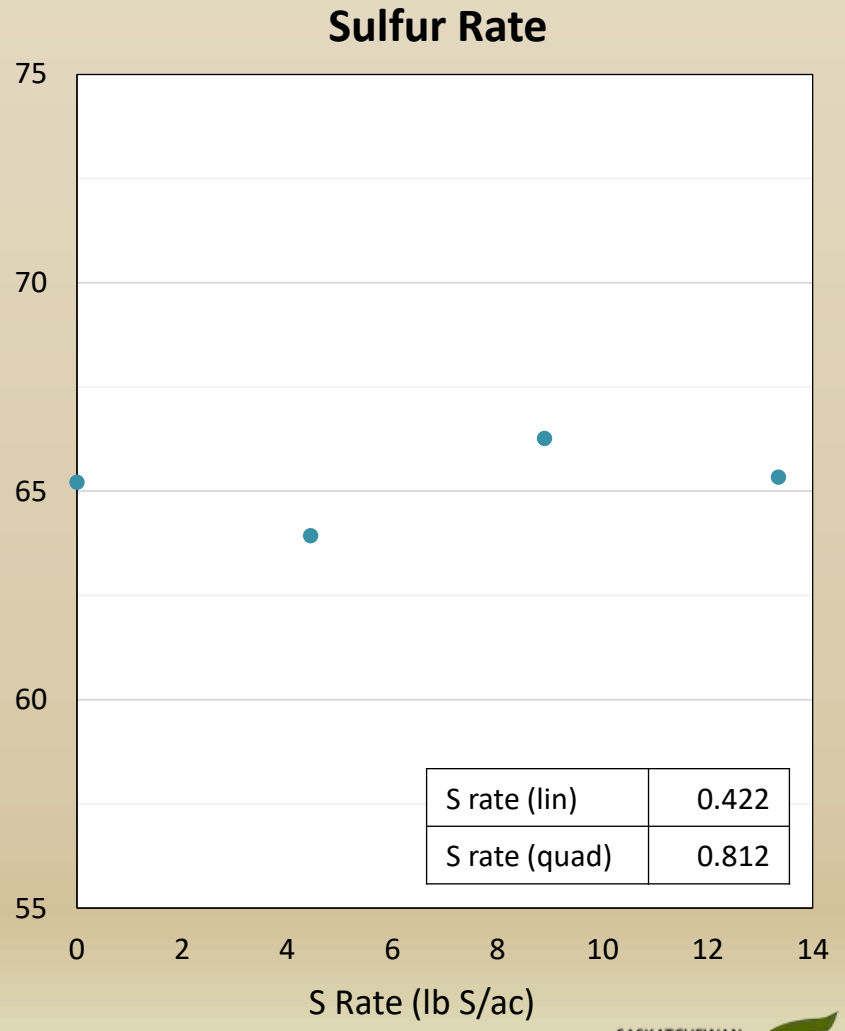
Average of 12 Location-Years (2019-20)



Source	Pr > F
Fertility (F)	**<0.001**
Check vs Fertilized	**<0.001**
Normal vs Extra N	0.202
P Rate – lin	**<0.001**
P Rate – quad	**0.004**
S Rate – lin	0.422
S Rate – quad	0.812

Field Pea Yield Response to P & S Rate
(12 Location-Year Average)

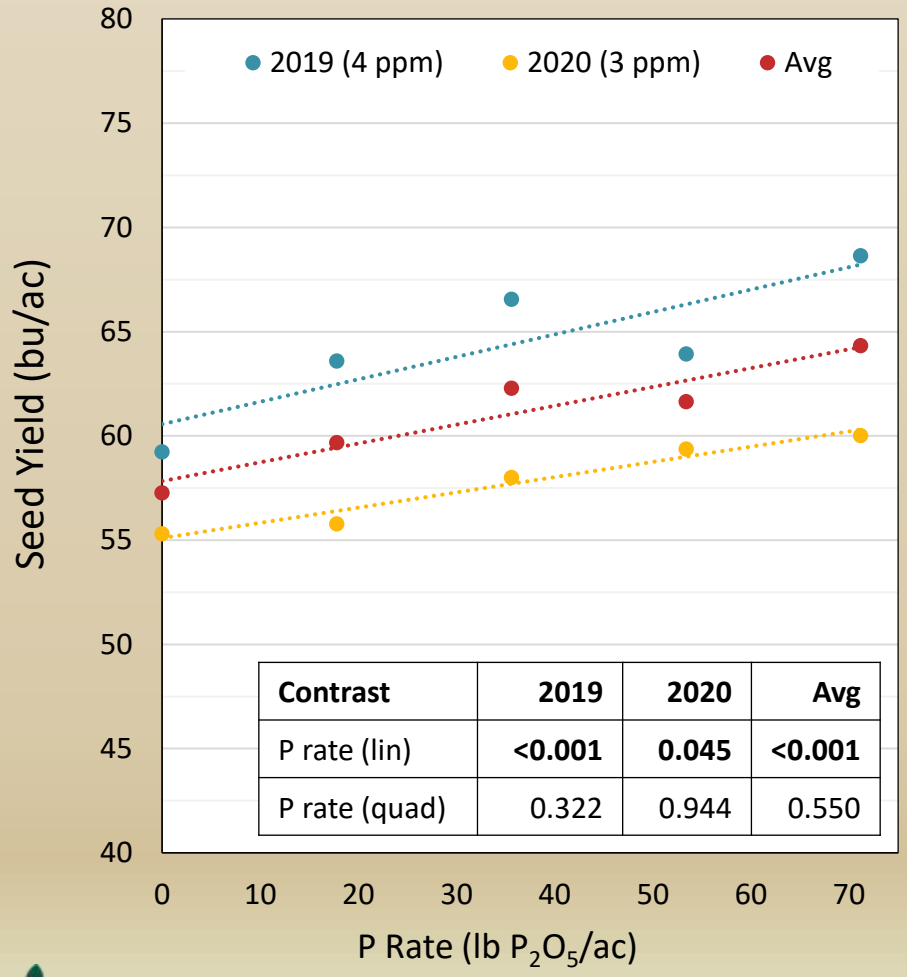




Field Pea Yield Response to P & S Rate

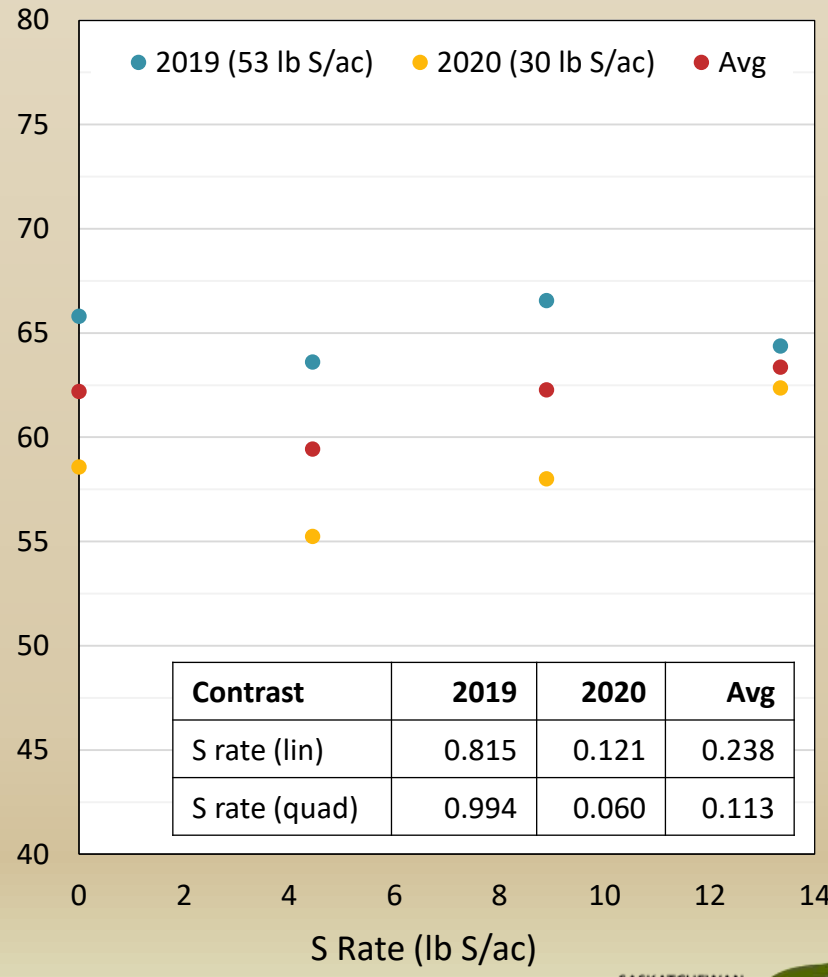
(Indian Head – thin Black, 4.1-4.7% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	**<0.001**	**0.045**	**<0.001**
P rate (quad)	0.322	0.944	0.550

Sulfur Rate

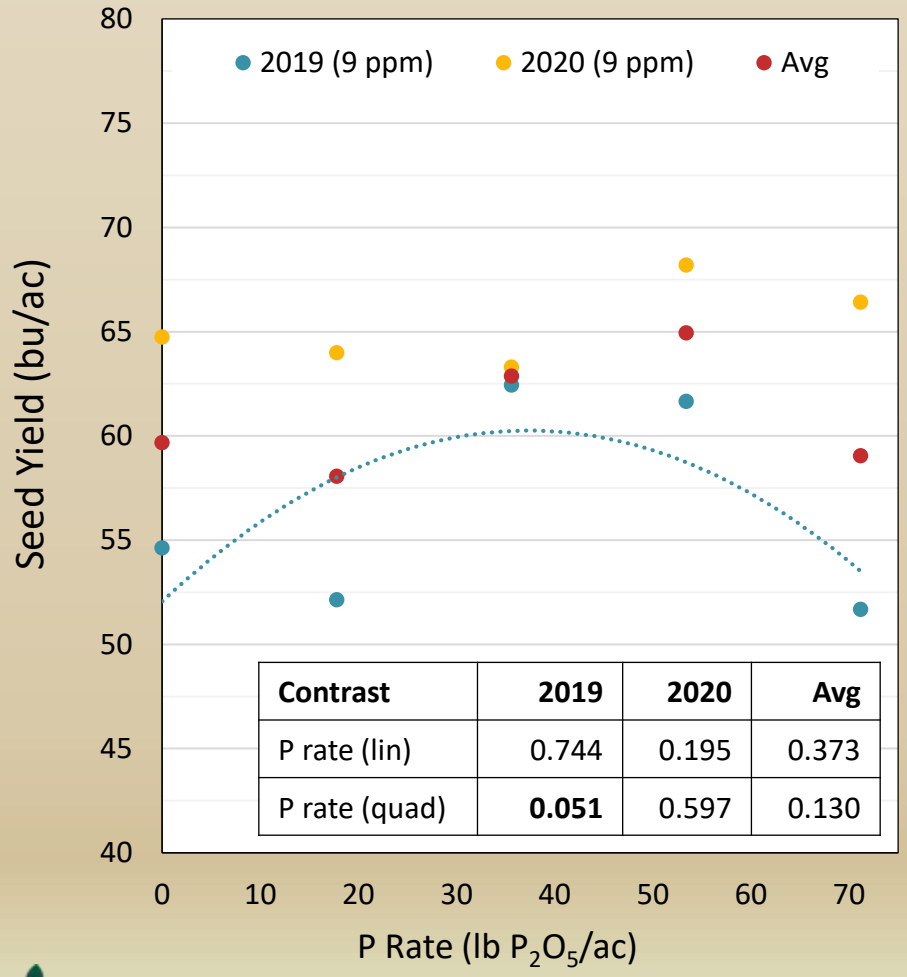


Contrast	2019	2020	Avg
S rate (lin)	0.815	0.121	0.238
S rate (quad)	0.994	0.060	0.113

Field Pea Yield Response to P & S Rate

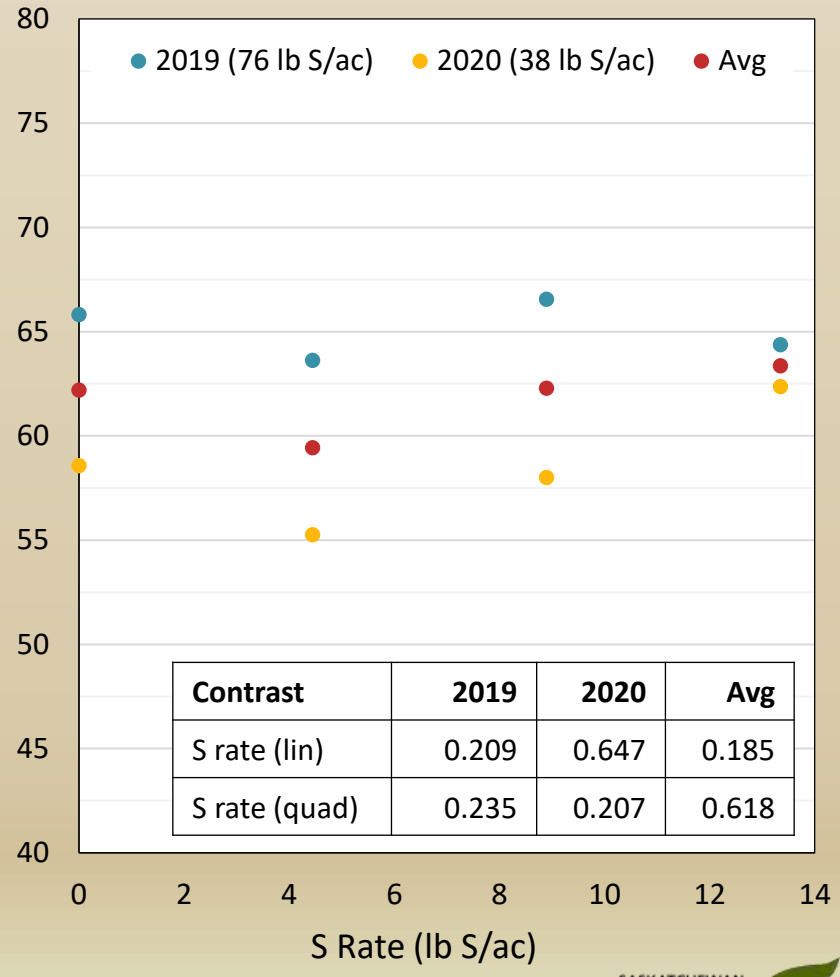
(Melfort – moist Black, 9.6-11.7% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	0.744	0.195	0.373
P rate (quad)	**0.051**	0.597	0.130

Sulfur Rate

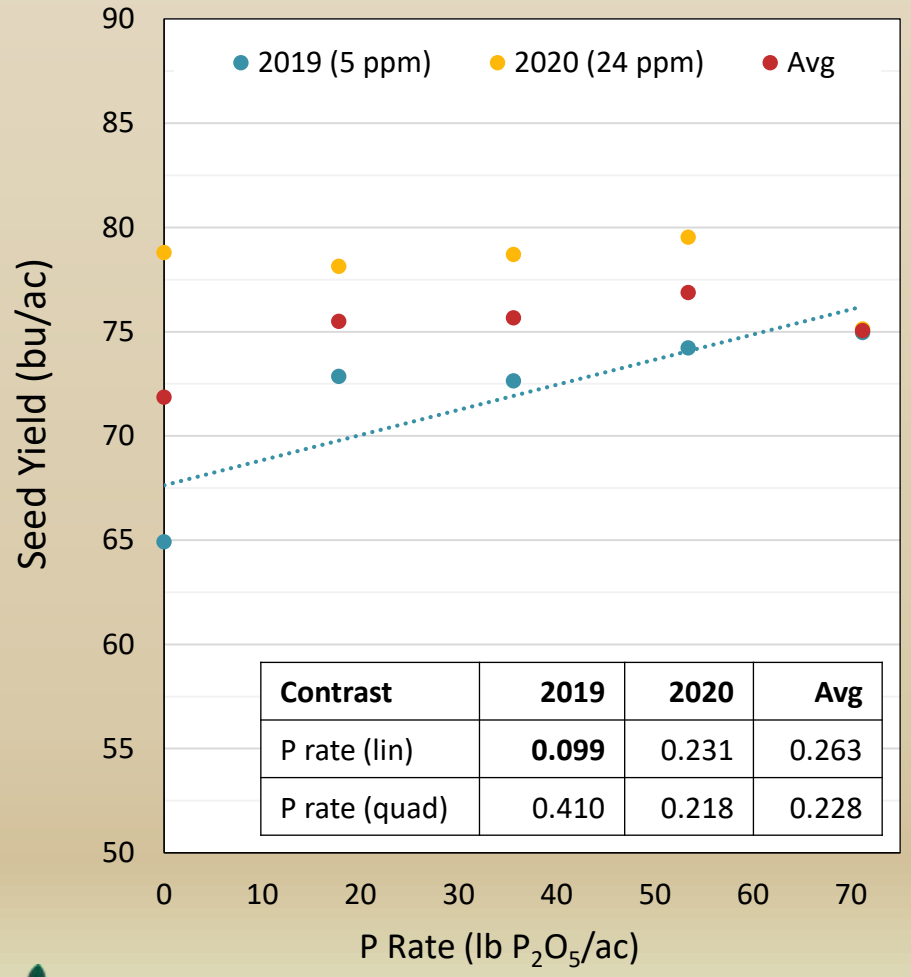


Contrast	2019	2020	Avg
S rate (lin)	0.209	0.647	0.185
S rate (quad)	0.235	0.207	0.618

Field Pea Yield Response to P & S Rate

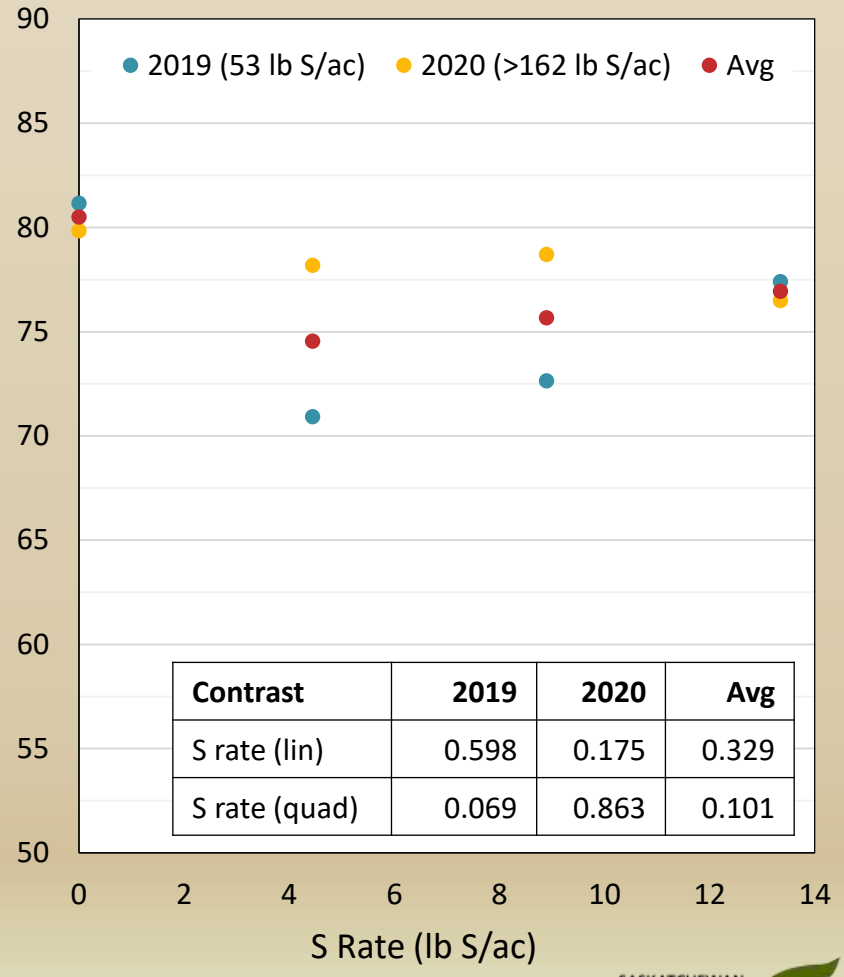
(Outlook – Brown, 2.3-2.4% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	**0.099**	0.231	0.263
P rate (quad)	0.410	0.218	0.228

Sulfur Rate

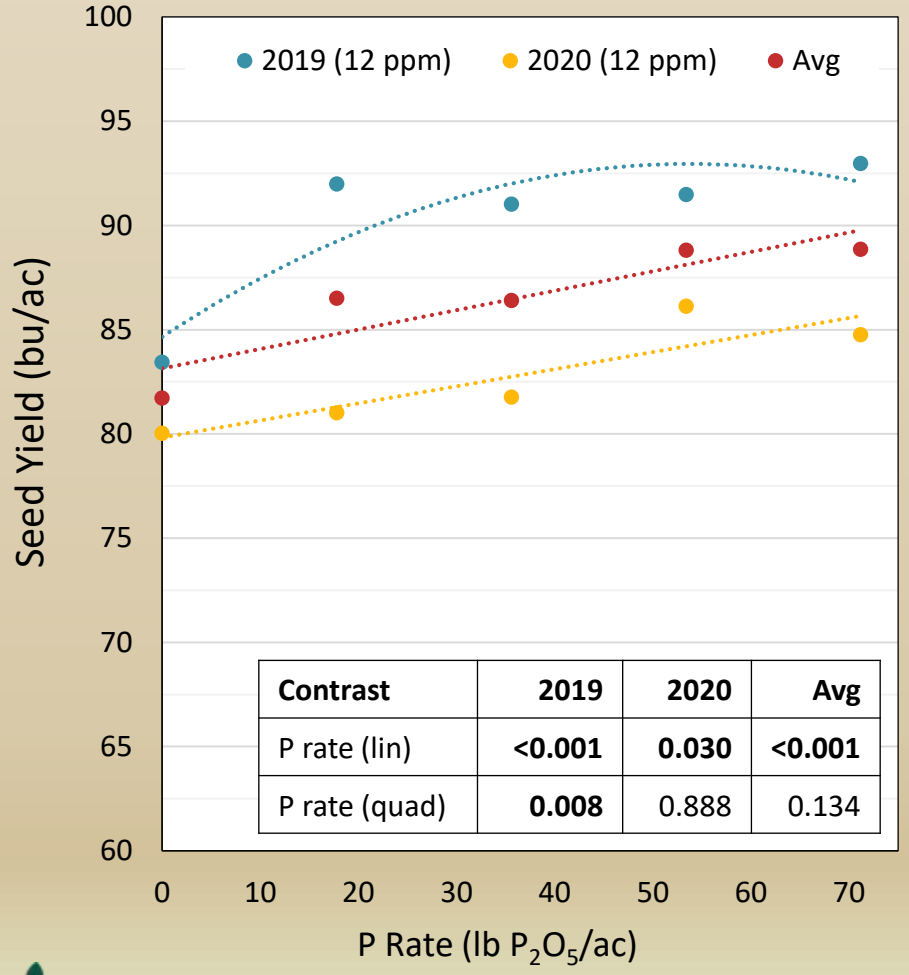


Contrast	2019	2020	Avg
S rate (lin)	0.598	0.175	0.329
S rate (quad)	0.069	0.863	0.101

Field Pea Yield Response to P & S Rate

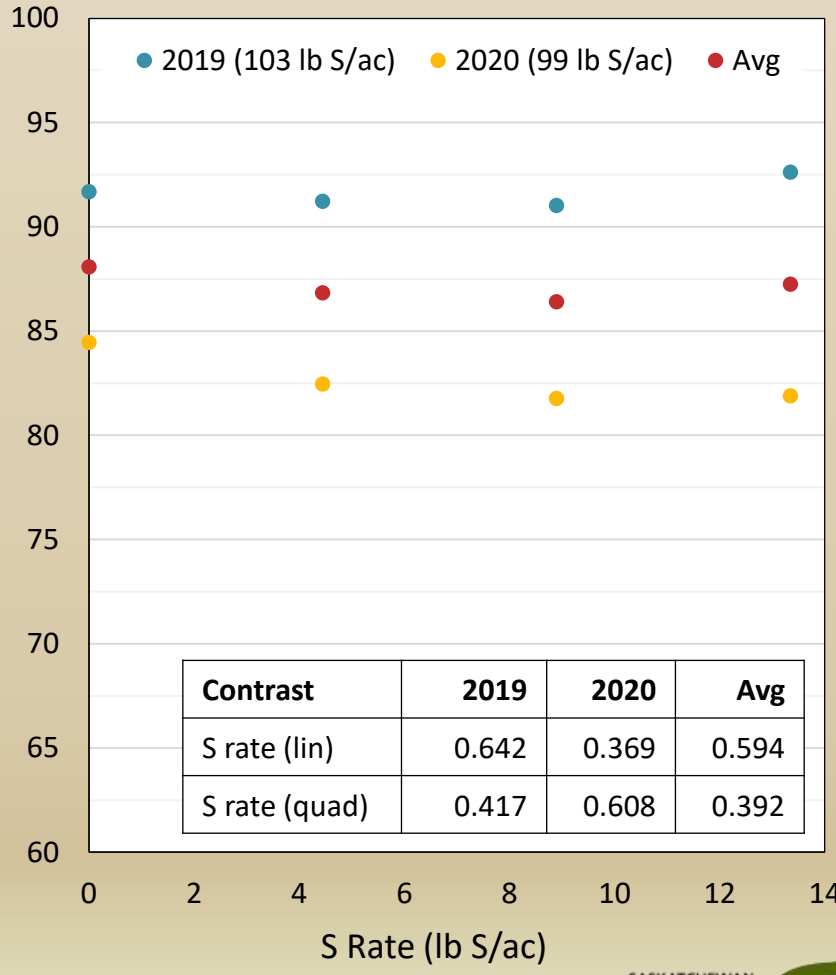
(Scott– Dark Brown, 3.5-4.0% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	**<0.001**	**0.030**	**<0.001**
P rate (quad)	**0.008**	0.888	0.134

Sulfur Rate

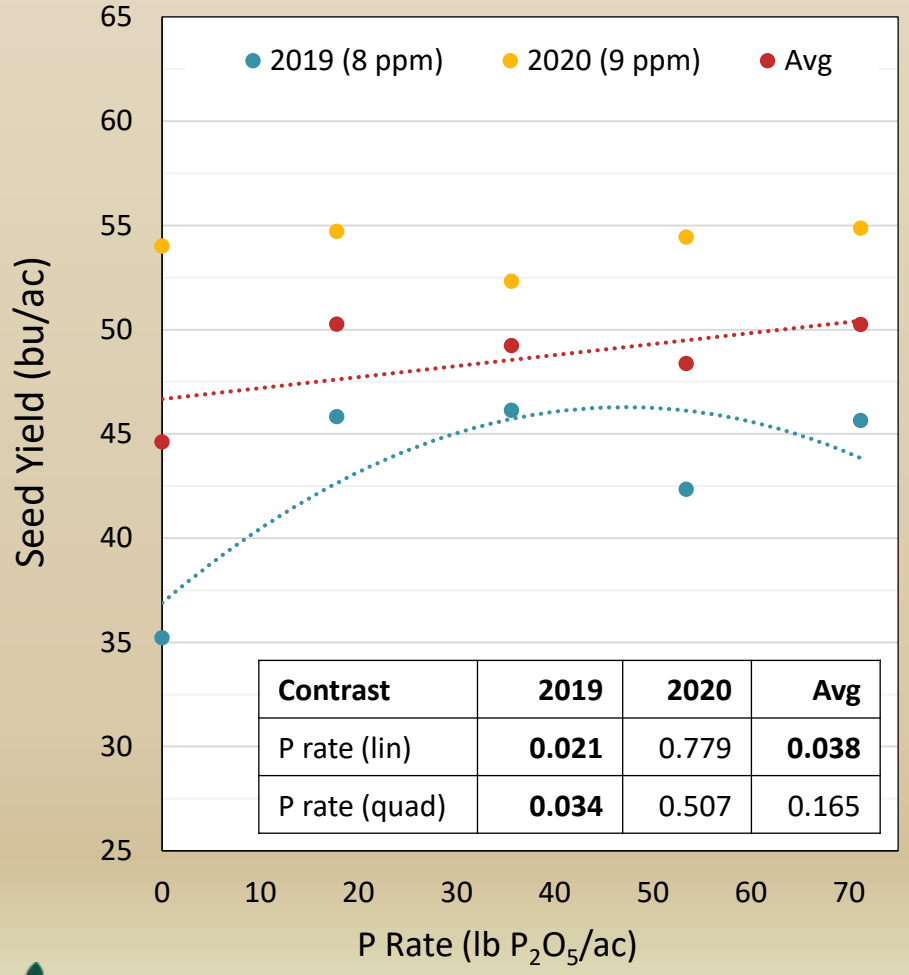


Contrast	2019	2020	Avg
S rate (lin)	0.642	0.369	0.594
S rate (quad)	0.417	0.608	0.392

Field Pea Yield Response to P & S Rate

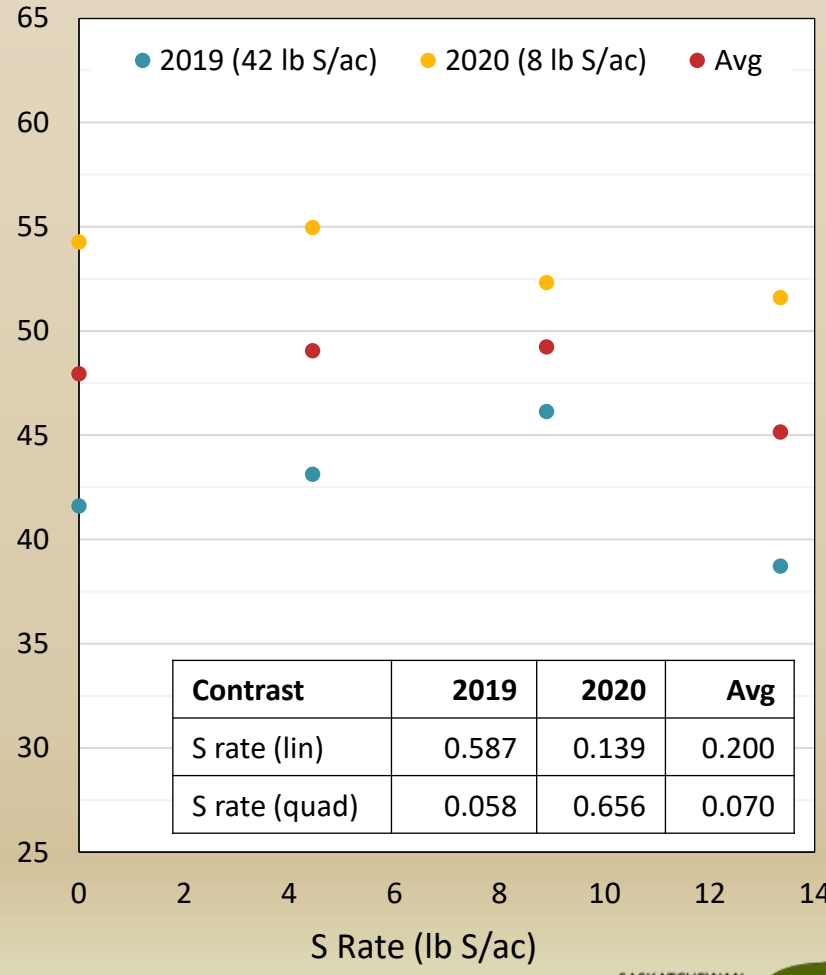
(Swift Current – dry Brown, 2.6-2.9% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	**0.021**	0.779	**0.038**
P rate (quad)	**0.034**	0.507	0.165

Sulfur Rate

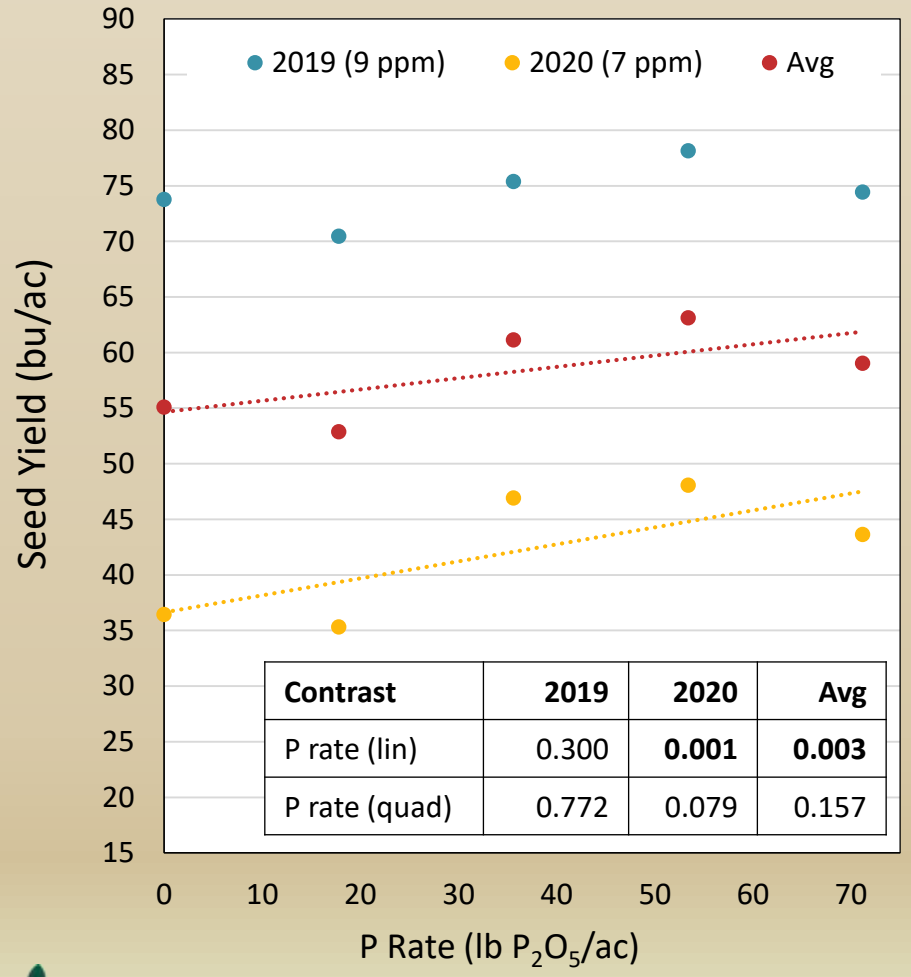


Contrast	2019	2020	Avg
S rate (lin)	0.587	0.139	0.200
S rate (quad)	0.058	0.656	0.070

Field Pea Yield Response to P & S Rate

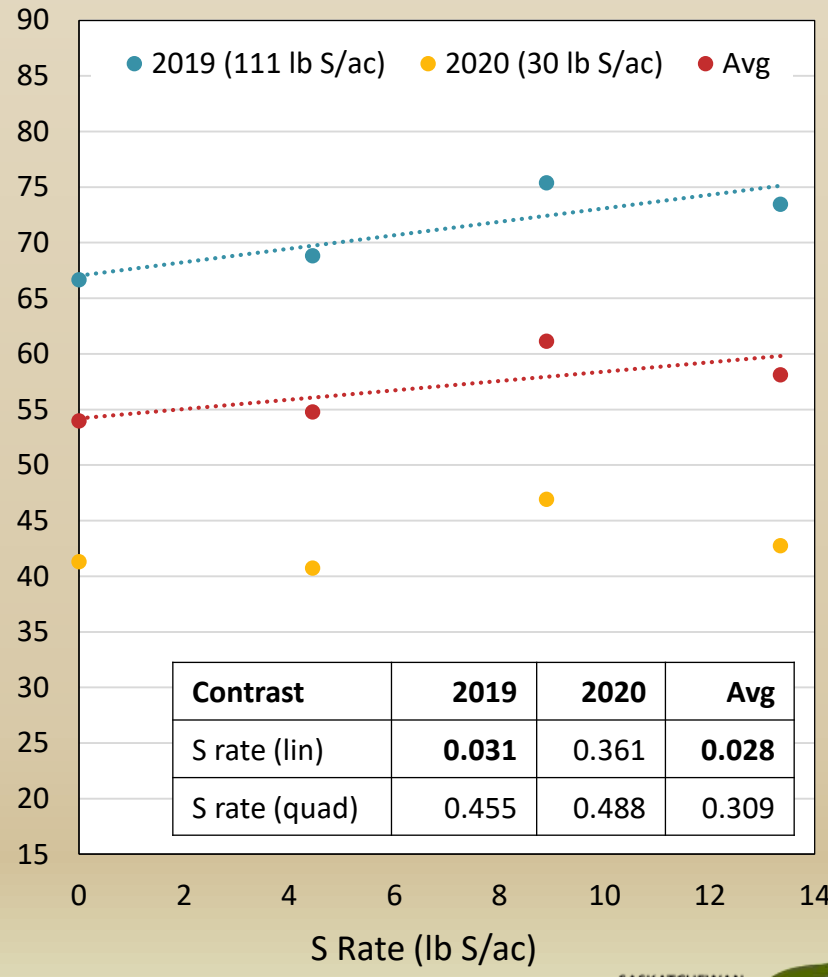
(Yorkton – Black, 4.3-6.5% OM)

Phosphorus Rate



Contrast	2019	2020	Avg
P rate (lin)	0.300	**0.001**	**0.003**
P rate (quad)	0.772	0.079	0.157

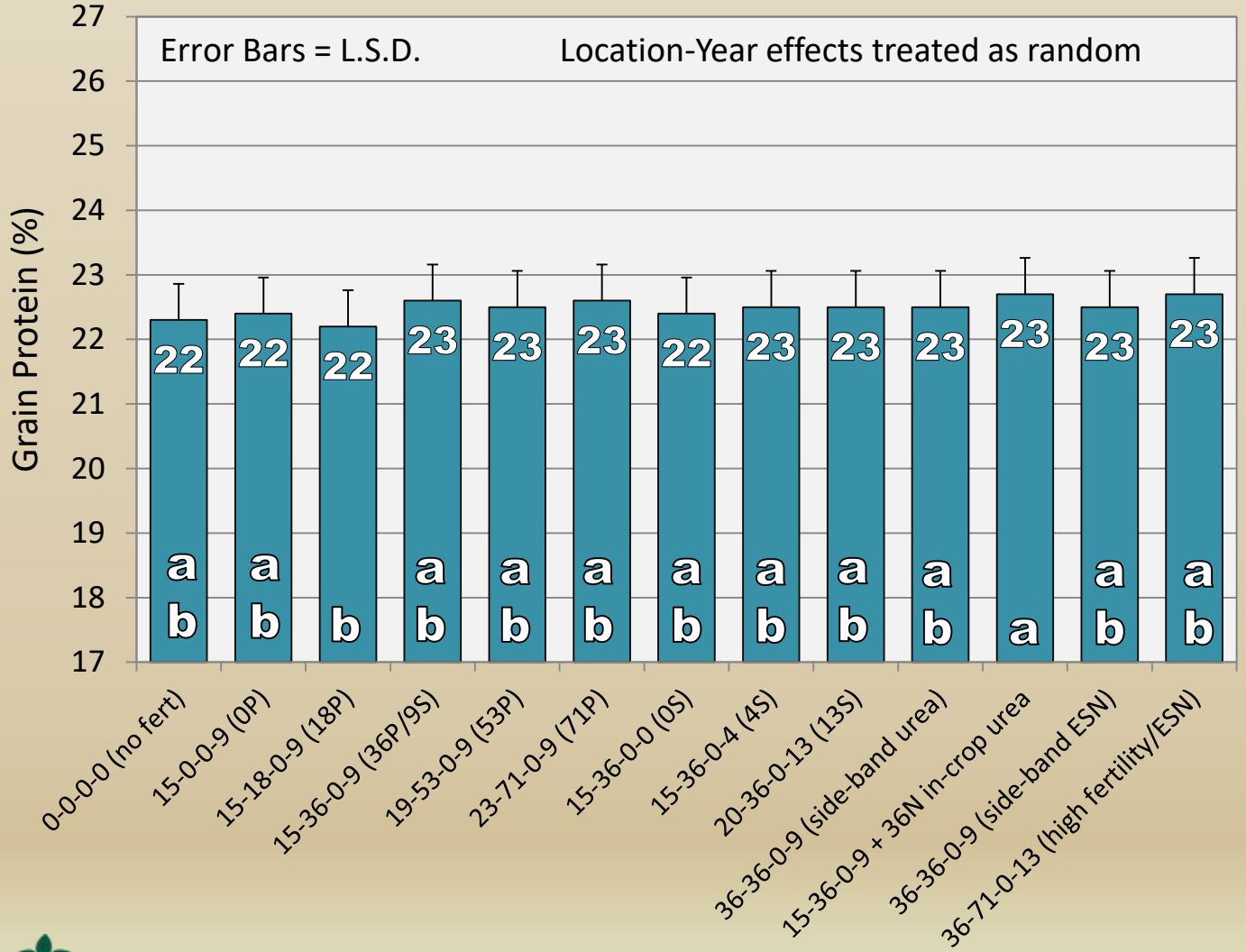
Sulfur Rate



Contrast	2019	2020	Avg
S rate (lin)	**0.031**	0.361	**0.028**
S rate (quad)	0.455	0.488	0.309

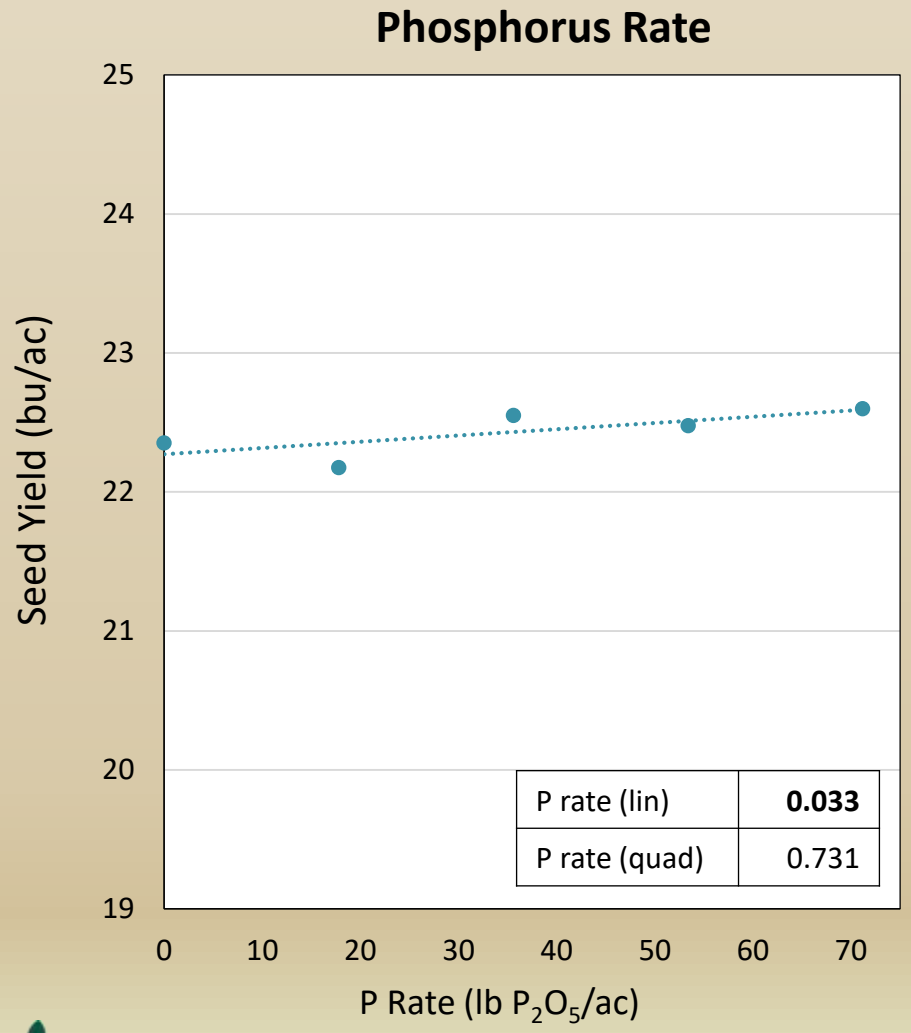
Fertility Effects on Field Pea Protein

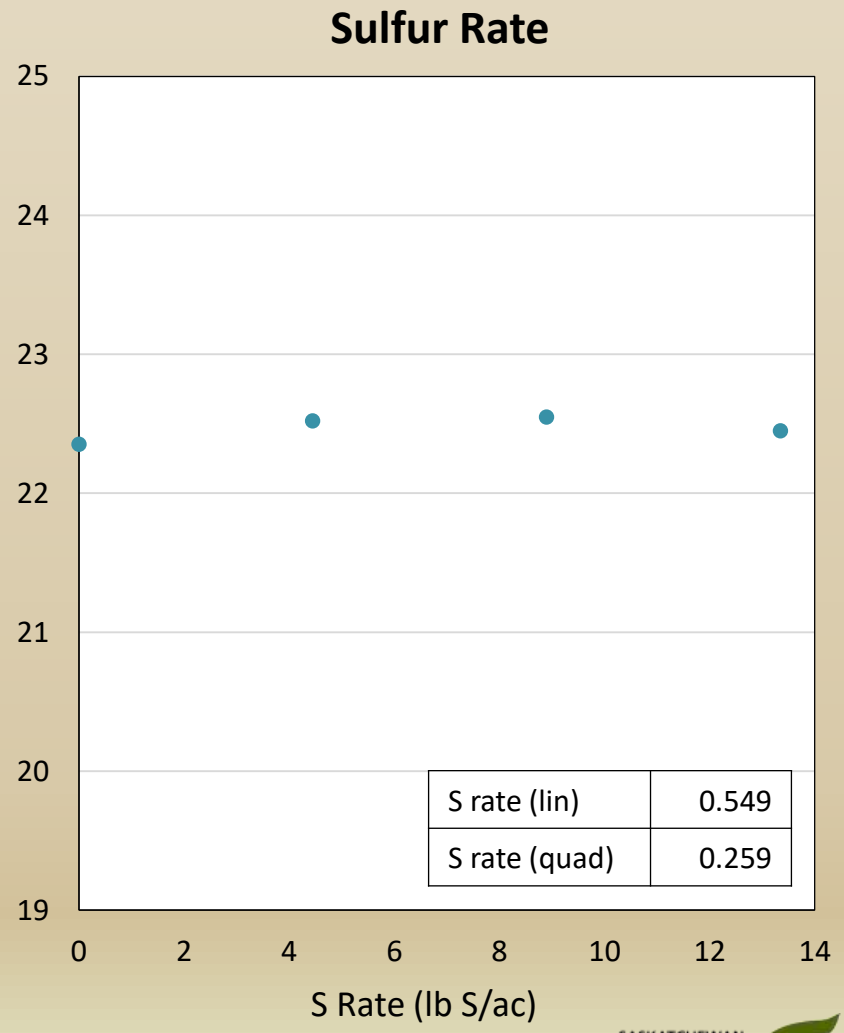
Average of 12 Location-Years (2019-20)



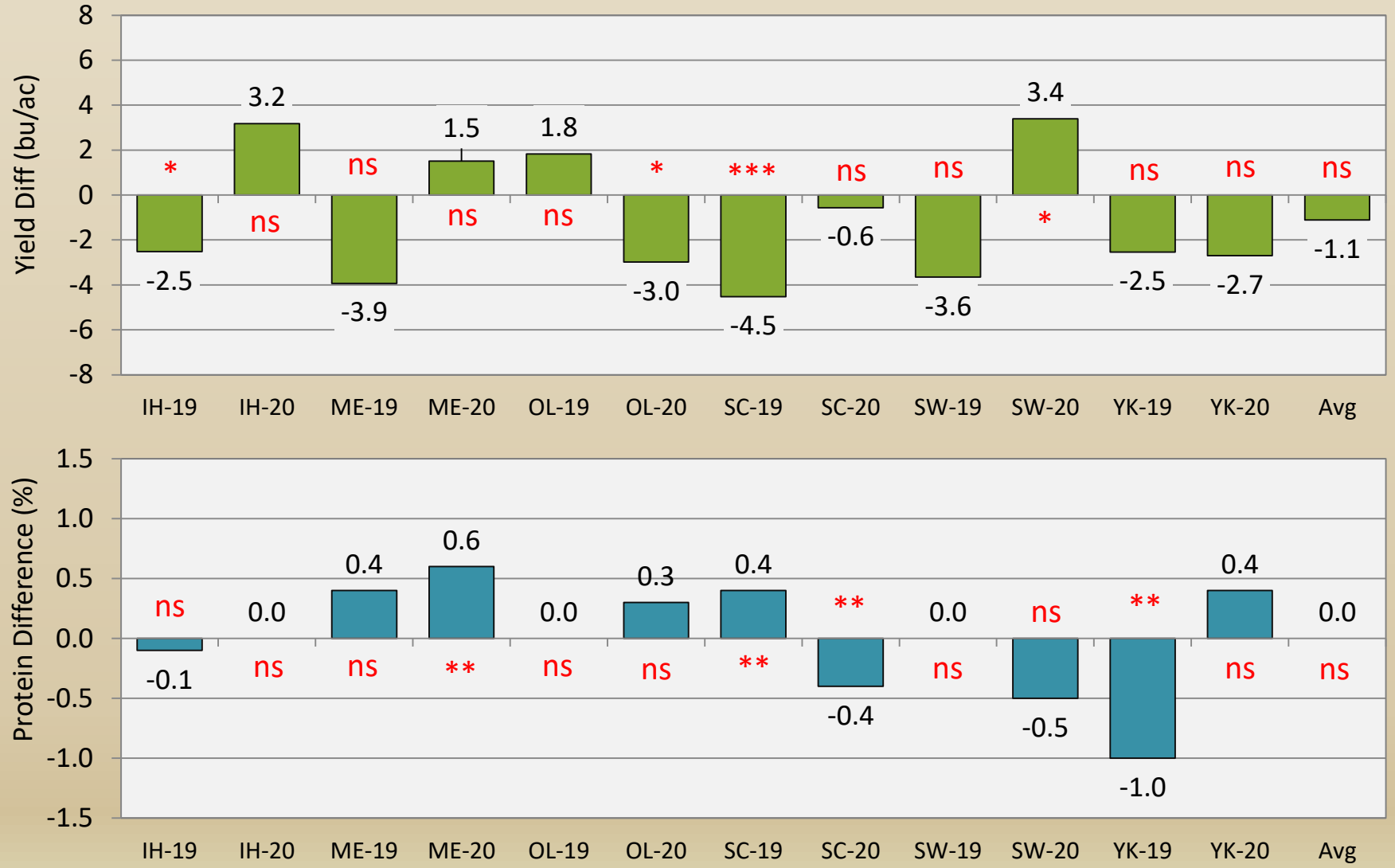
Source	Pr > F
Fertility (F)	**0.047**
Check vs Fertilized	0.065
Normal vs Extra N	0.959
P Rate – lin	**0.033**
P Rate – quad	0.731
S Rate – lin	0.549
S Rate – quad	0.259

Field Pea Protein Response to P & S Rate (12 Location-Year Average)





Field Pea Yield & Protein to Extra Nitrogen



ns – $P > 0.1$; * - $0.1 > P > 0.05$; ** - $0.05 > P > 0.01$; *** - $P \leq 0.01$

Enhanced Fertility for Field Pea Yield & Protein: Conclusions

- Soil test P levels were considered low (≤ 12 ppm Olsen-P) for 11/12 location-years & there was evidence of at least marginally significant responses at 8/11 of the low P sites
- Across all twelve location-years, P fertilization increased yields by up to 13% with an optimal rate of ≈36 lb P_2O_5/ac
- Applying a small amount of S may be advisable if deficiencies have occurred in the past or soil tests recommend doing so but S is unlikely to be an important factor limiting field pea yields in SK
- Normal rates of other fertilizer products & adequate inoculation will likely provide all the N field peas require – extra N fertilizer is as likely to have a negative impact as it is likely to be beneficial
  - Possible exception may be on coarse textured soils with low organic matter & extremely low residual N

THANK YOU

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