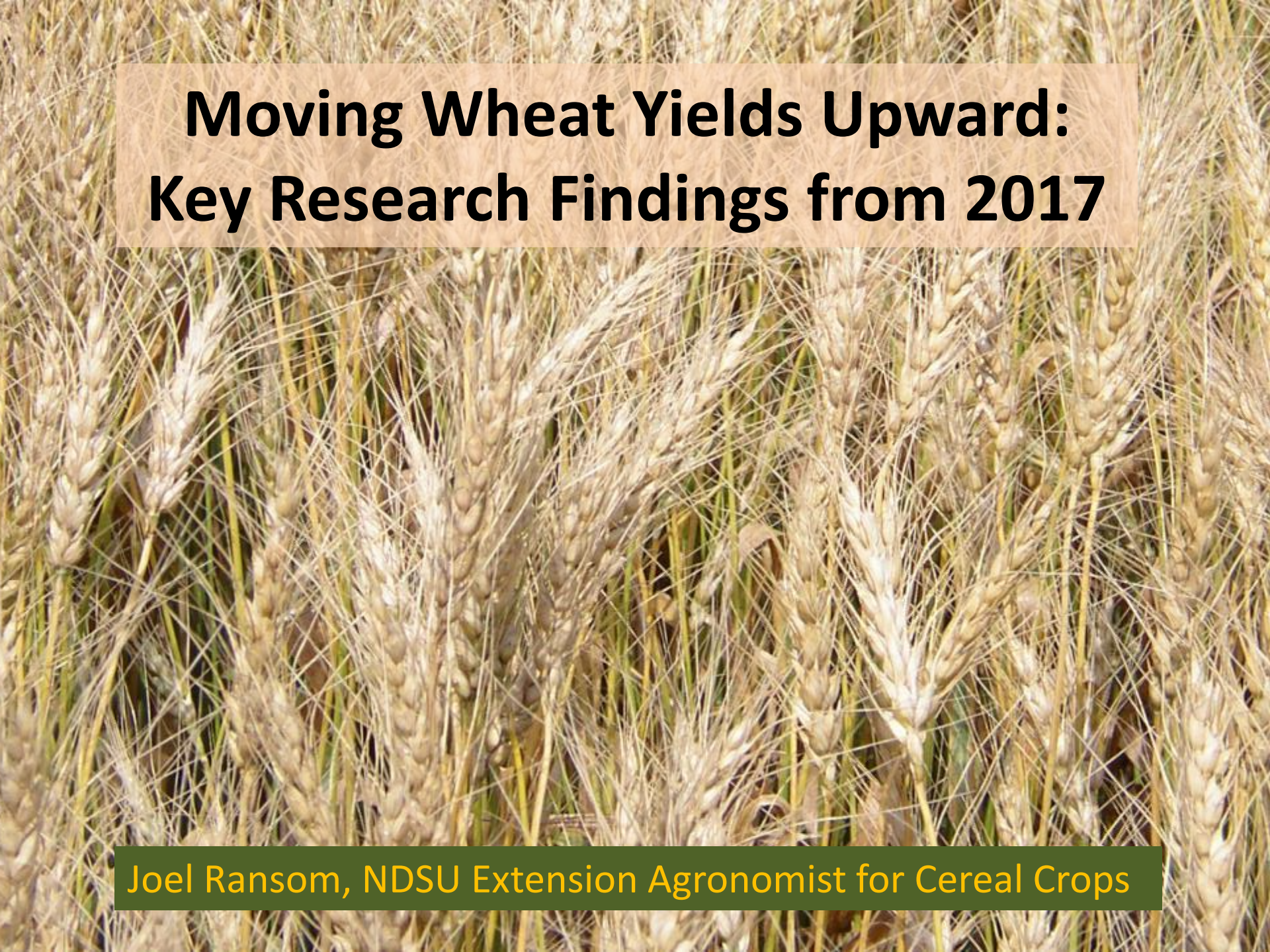
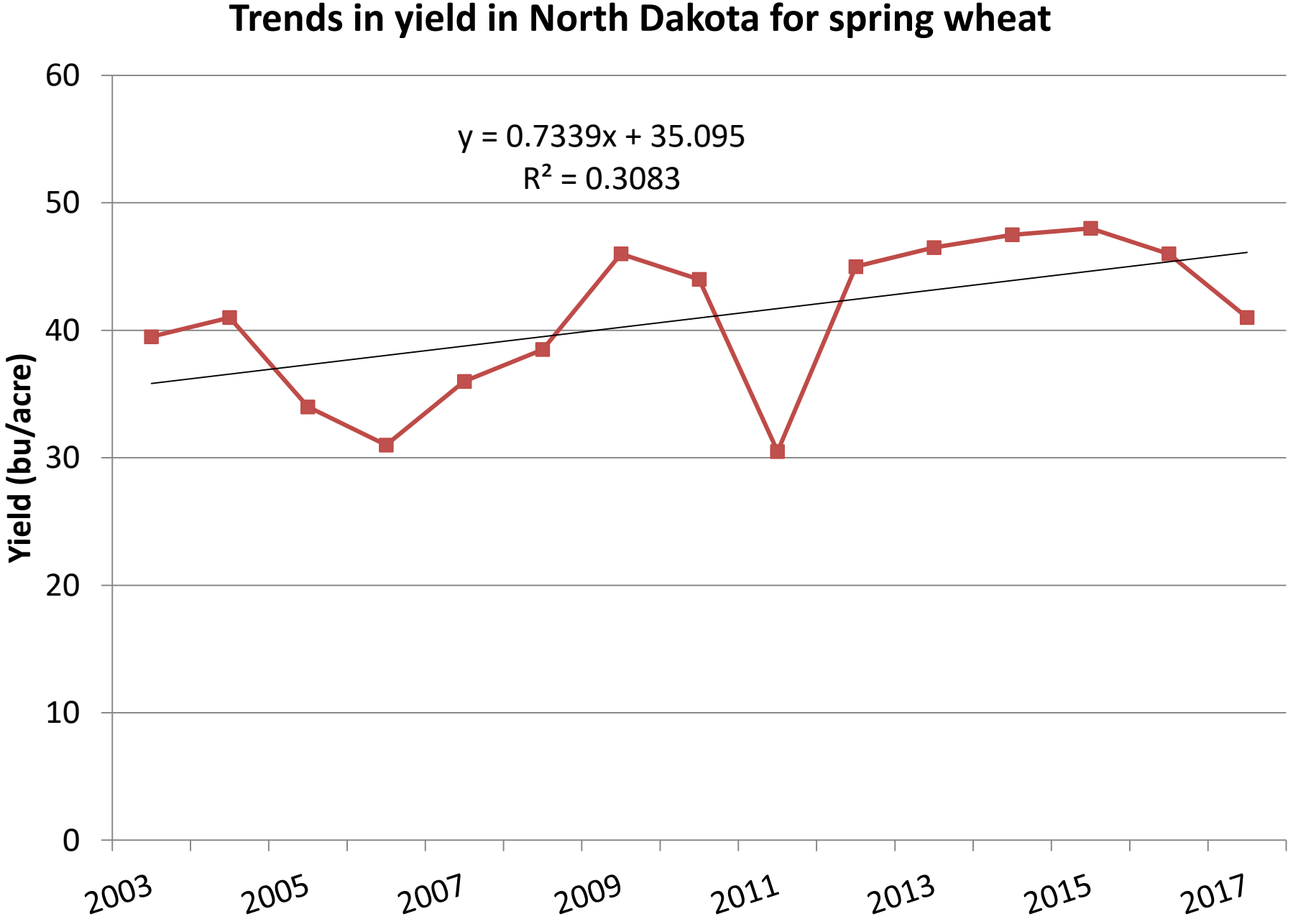


Moving Wheat Yields Upward: Key Research Findings from 2017

Joel Ransom, NDSU Extension Agronomist for Cereal Crops


Trends in yield in North Dakota for spring wheat
y = 0.7339x + 35.095
R² = 0.3083
Yield (bu/acre)
60
50
40
30
20
10
0
2003
2005
2007
2009
2011
2013
2015
2017

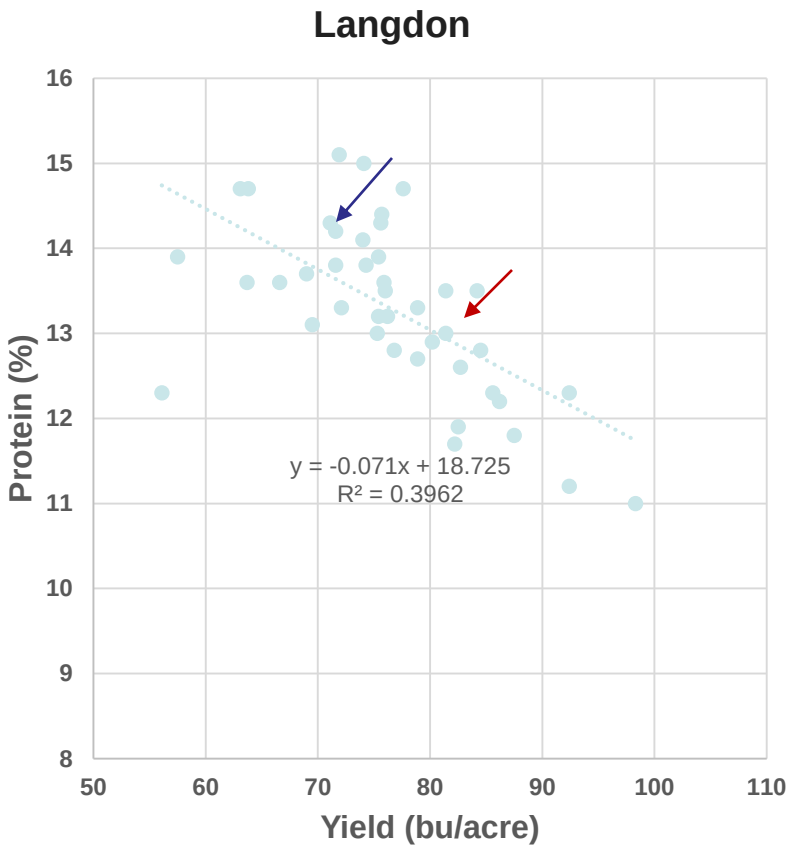
Steps to sustaining yield gains (and profitability) in wheat – recent research findings

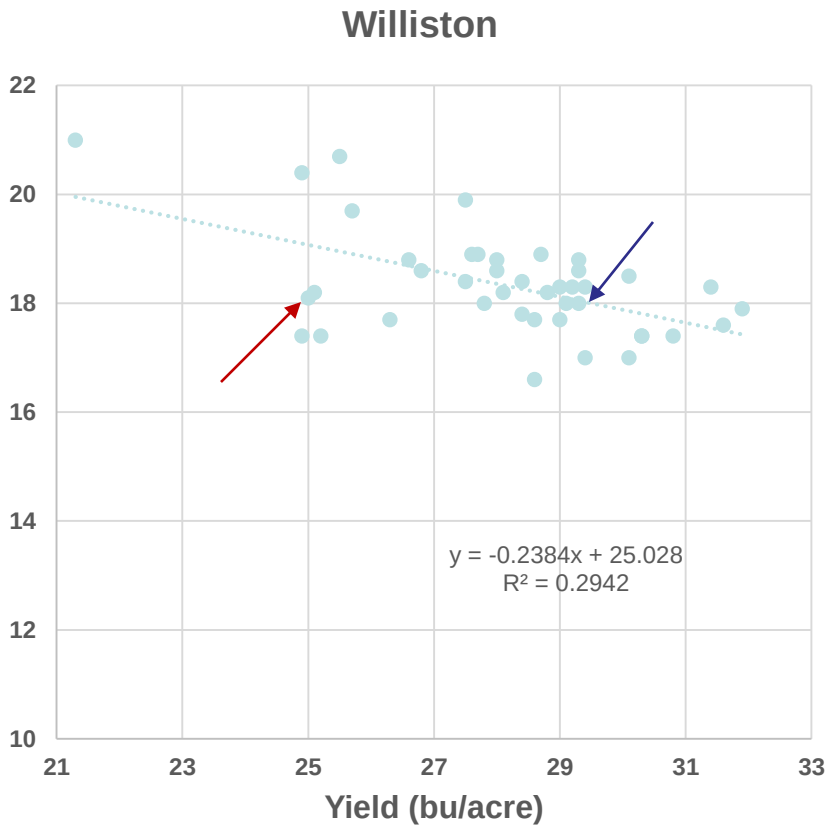
- Careful selection of new varieties that offer improved yield, protein and other traits
  - Balancing yield and protein
  - Consider other traits
- Adjust seeding rate to the environment and variety used
- Carefully manage inputs
  - Fertilizer N
  - Fungicides
  - Growth regulators

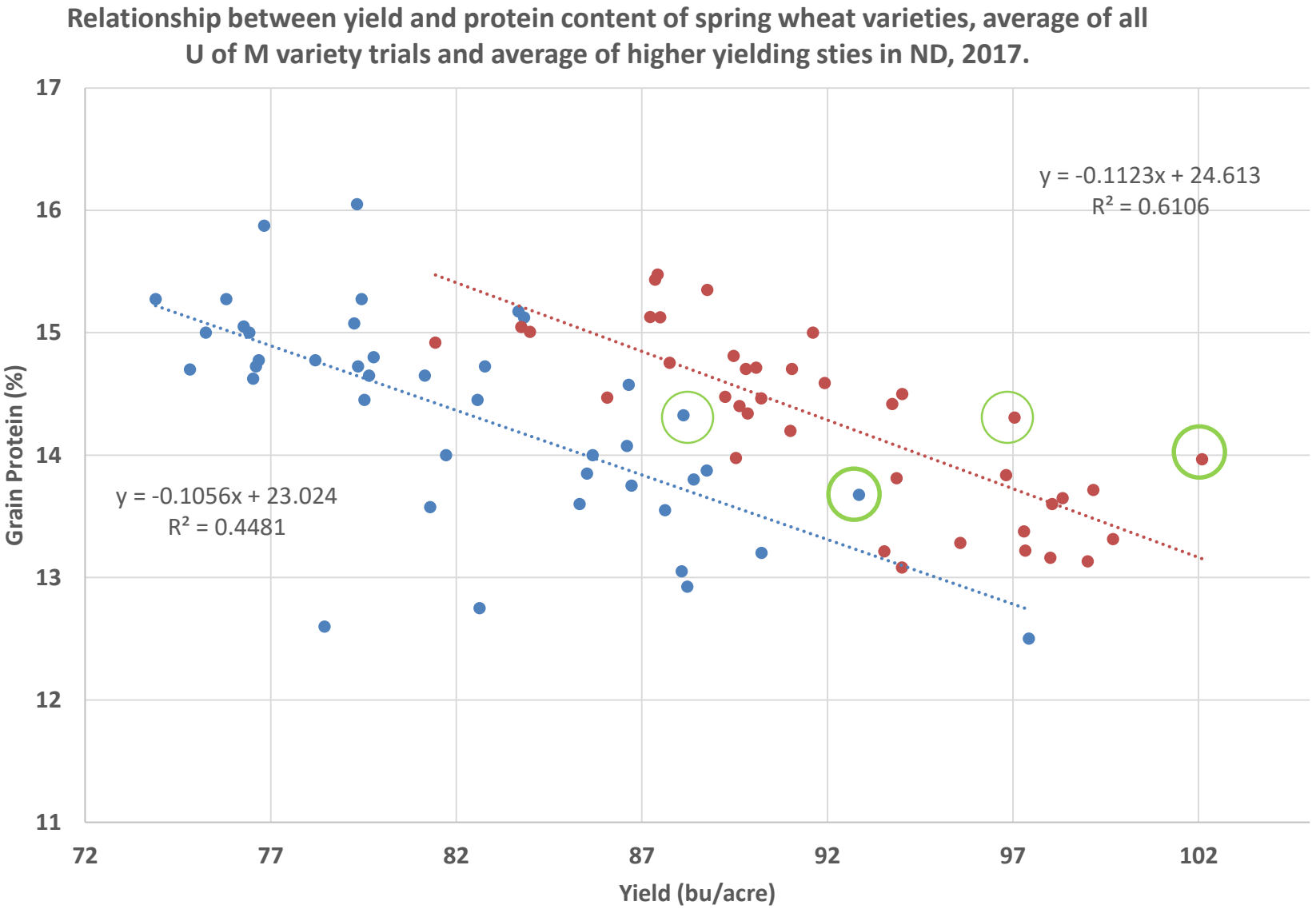
Variety selection

- Foundational for yield improvement
- Many new varieties to choose from, meeting requirements of most environments
- Key steps to variety selectin
  - Yield and yield stability (> environments > ability to predict stability)
  - Balance yield with protein requirements and extrapolate based on results from your farm
  - Consider for other traits (i.e. disease and lodging resistances)

Relationship between yield and protein for varieties in state yield trials, Langdon and Williston, 2017.






Relationship between yield and protein content of spring wheat varieties, average of all U of M variety trials and average of higher yielding sties in ND, 2017.
Grain Protein (%)
17
16
15
14
13
12
11
72
77
82
87
92
97
102
Yield (bu/acre)
y = -0.1123x + 24.613
R² = 0.6106
y = -0.1056x + 23.024
R² = 0.4481

Rank of varieties for yield and partial returns, average of lower yielding environments in ND variety trials, 2017

Cultivar	Yield	Protein
TCG-Spitfire	46.4	15.6
WB9719	45.4	15.6
Shelly	45.0	15.5
WB9653	44.2	15.9
Prevail	43.7	15.2
Prosper	43.3	15.2
SY-Valda	42.7	15.9
WB-Mayville	42.7	15.7
WB9590	42.6	16.1
AFK-Astro	42.6	14.4
LCS Trigger	42.5	15.4
Rollag	42.5	16.1
Elgin-ND	42.4	16.1
Barlow	42.3	16.0
SY-Soren	42.0	16.4

Cultivar	Yield	Protein	Return
TCG-Climax	41.1	17.3	303
TCG-Spitfire	46.4	15.6	303
Bolles	40.3	17.4	298
WB9719	45.4	15.6	295
WB9653	44.2	15.9	294
Shelly	45.0	15.5	291
SY Ingmar	41.9	16.5	291
SY-Soren	42.0	16.4	289
WB9590	42.6	16.1	289
HRS 3616	42.0	16.3	288
Rollag	42.5	16.1	287
Lang-MN	41.0	16.6	286
Elgin-ND	42.4	16.1	285
SY-Valda	42.7	15.9	285
HRS 3419	41.8	16.2	285

$5.7 per bu and $0.10 per fifth protein

VARIETY TRIAL RESULTS

test_weight
protein_percent
*bushels_acre

*2017
2016
2015

Search Results

Clear head-to-head comparison

This data is for the time period last_3_years

Yield. Bushels per Acre

The average number of bushels that can be expected from each acre of farmed land.

Variety	1-yr (x)	2-yr (x)	3-yr (x)	Prosper (x)	Casselton (x)	Dazey (x)	Carrington (x)	Park River (x)	Wishek (x)	Cavalier (x)	Langdon (x)	Cando (x)	McLean County (x)	Minot (x)	Mohall (x)	Hettinger (x)	Dickinson (x)
Bolles	60.2	60.0	60.3	74.8	97.8	83.5	60.0	85.5	37.1	76.2	74.1	50.3	18.6	48.6	68.7	32.8	34.4
Elgin	63.7	65.0	64.3	81.5	91.3	90.5	57.7	90.0	32.8	80.3	81.4	61.2	20.3	50.8	79.1	38.4	36.2
Shelly	68.0	--	--	93.6	101.1	96.7	66.3	86.9	42.3	88.3	81.4	62.8	19.9	47.1	82.4	43.9	39.3
LSD:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Compare Selected

VARIETY TRIAL RESULTS

test_weight
*protein_percent
bushels_acre

*2017
2016
2015

Search Results

Clear head-to-head comparison

This data is for the time period last_3_years

Protein: Percent of Mass

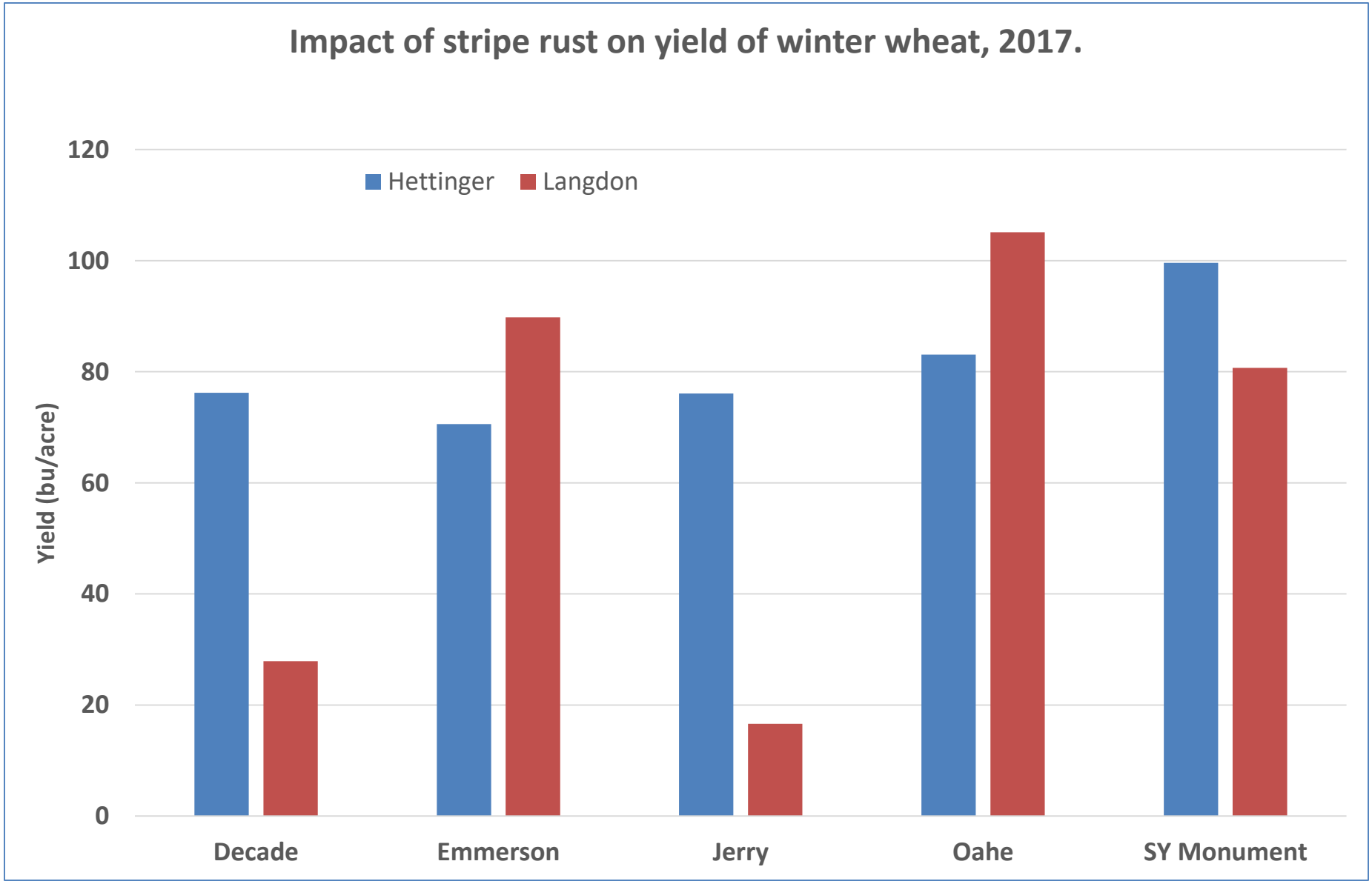
The average percentage of protein usable for baking. 12% or greater is required for export to many countries.

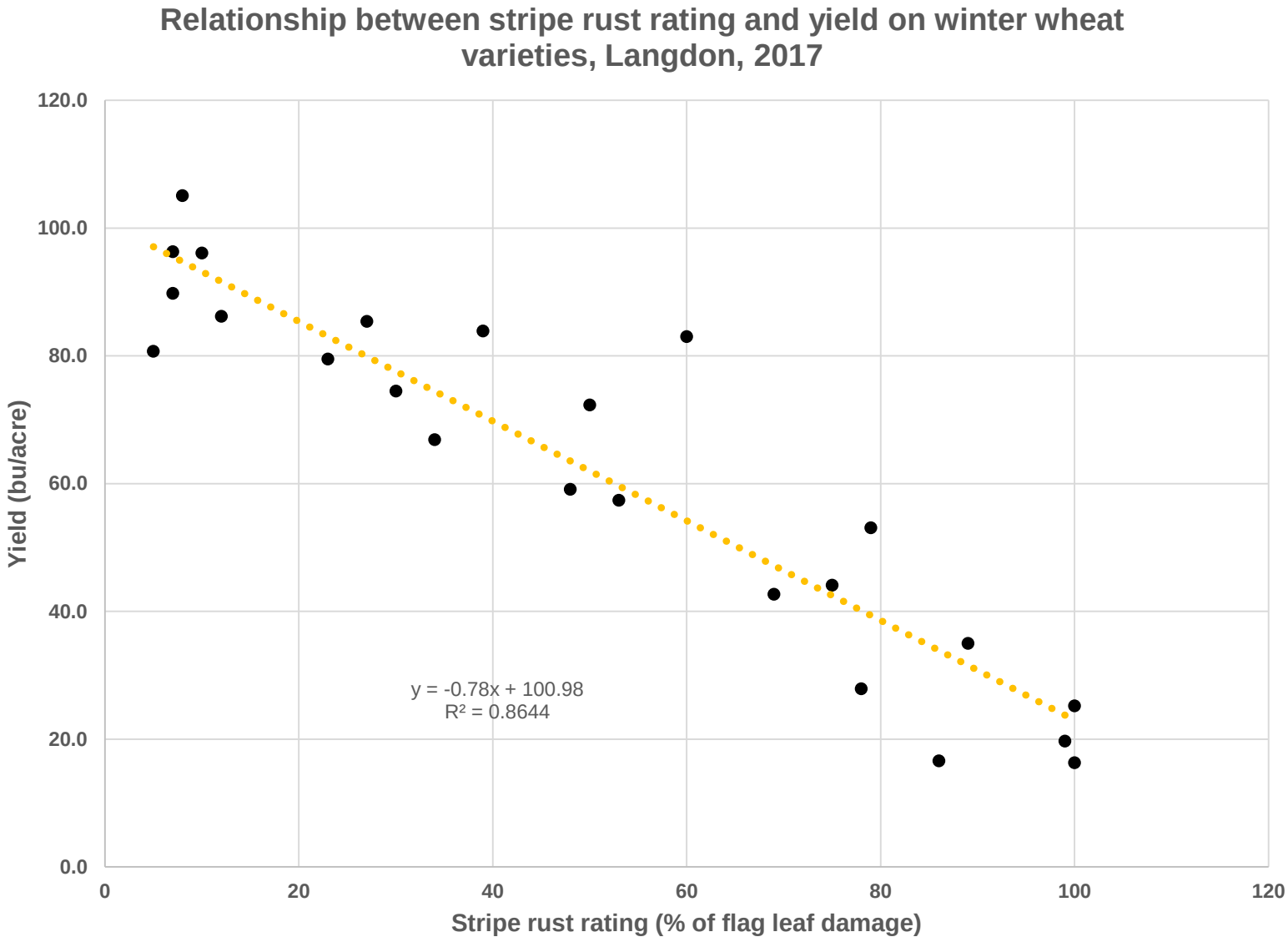
Variety	1-yr (x)	2-yr (x)	3-yr (x)	Prosper (x)	Casselton (x)	Dazey (x)	Carrington (x)	Park River (x)	Wishek (x)	Cavalier (x)	Langdon (x)	Cando (x)	McLean County (x)	Minot (x)	Mohall (x)	Hettinger (x)	Dickir (x)
Bolles	17.7	16.8	--	16.3	16.6	16.9	16.1	14.9	37.1	15.3	15.0	16.3	16.7	17.3	15.5	15.5	
Elgin	16.0	15.2	--	14.9	14.9	14.9	14.8	14.3	32.8	13.8	13.5	14.3	15.5	15.8	14.0	13.8	
Shelly	16.1	--	--	14.0	13.7	13.6	14.5	13.4	42.3	13.2	13.0	14.3	15.5	15.2	13.1	13.0	
LSD:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Compare Selected

This project is supported by NDSU, UMN, and the Minnesota Wheat Research and Promotion Council

Know the strengths and weaknesses of your varieties and have a strategy for dealing with weakness (i.e. susceptibility to diseases, lodging potential, etc.)



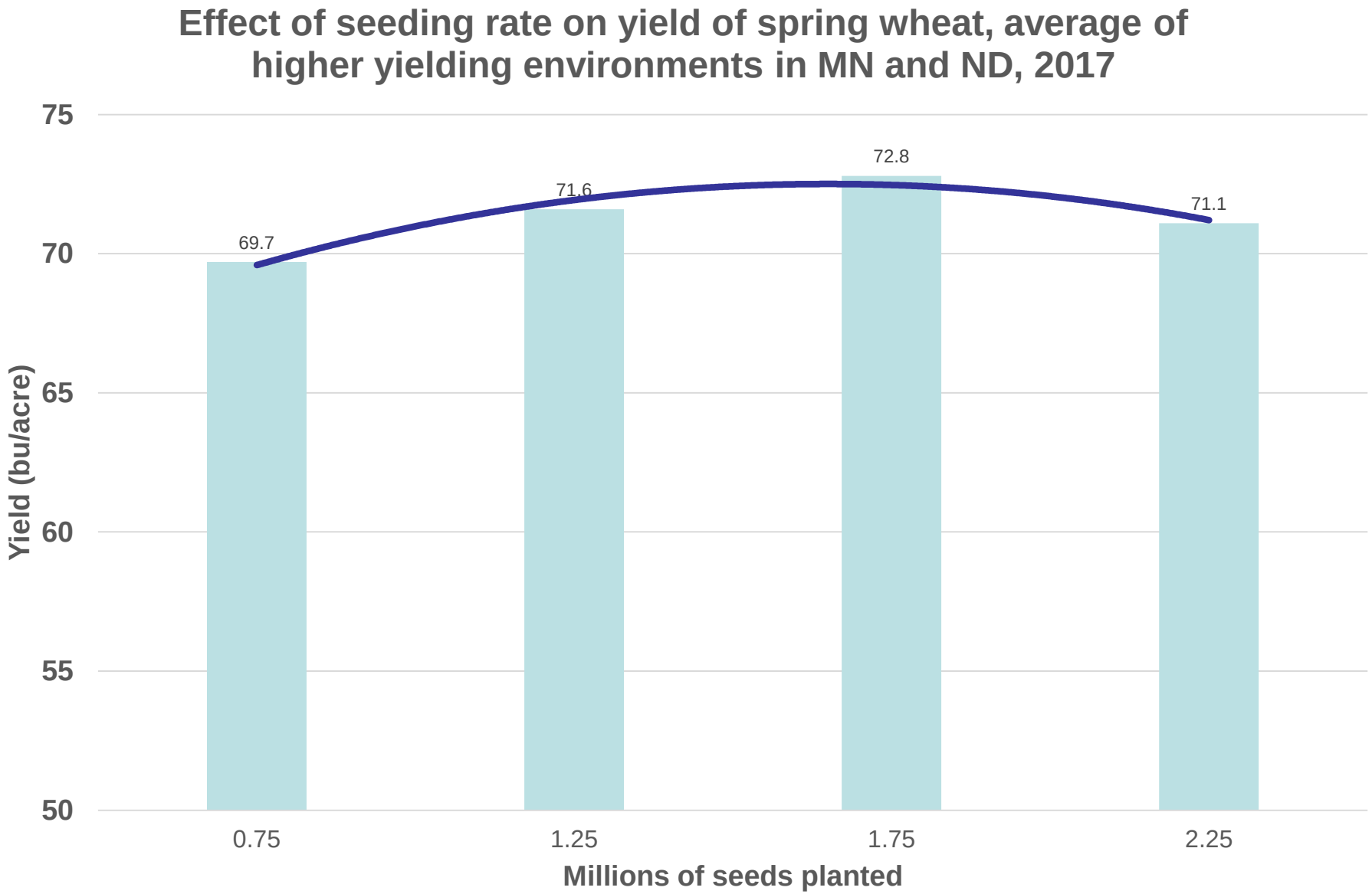

Relationship between stripe rust rating and yield on winter wheat varieties, Langdon, 2017
Yield (bu/acre)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
20
40
60
80
100
120
Stripe rust rating (% of flag leaf damage)
y = -0.78x + 100.98
R² = 0.8644

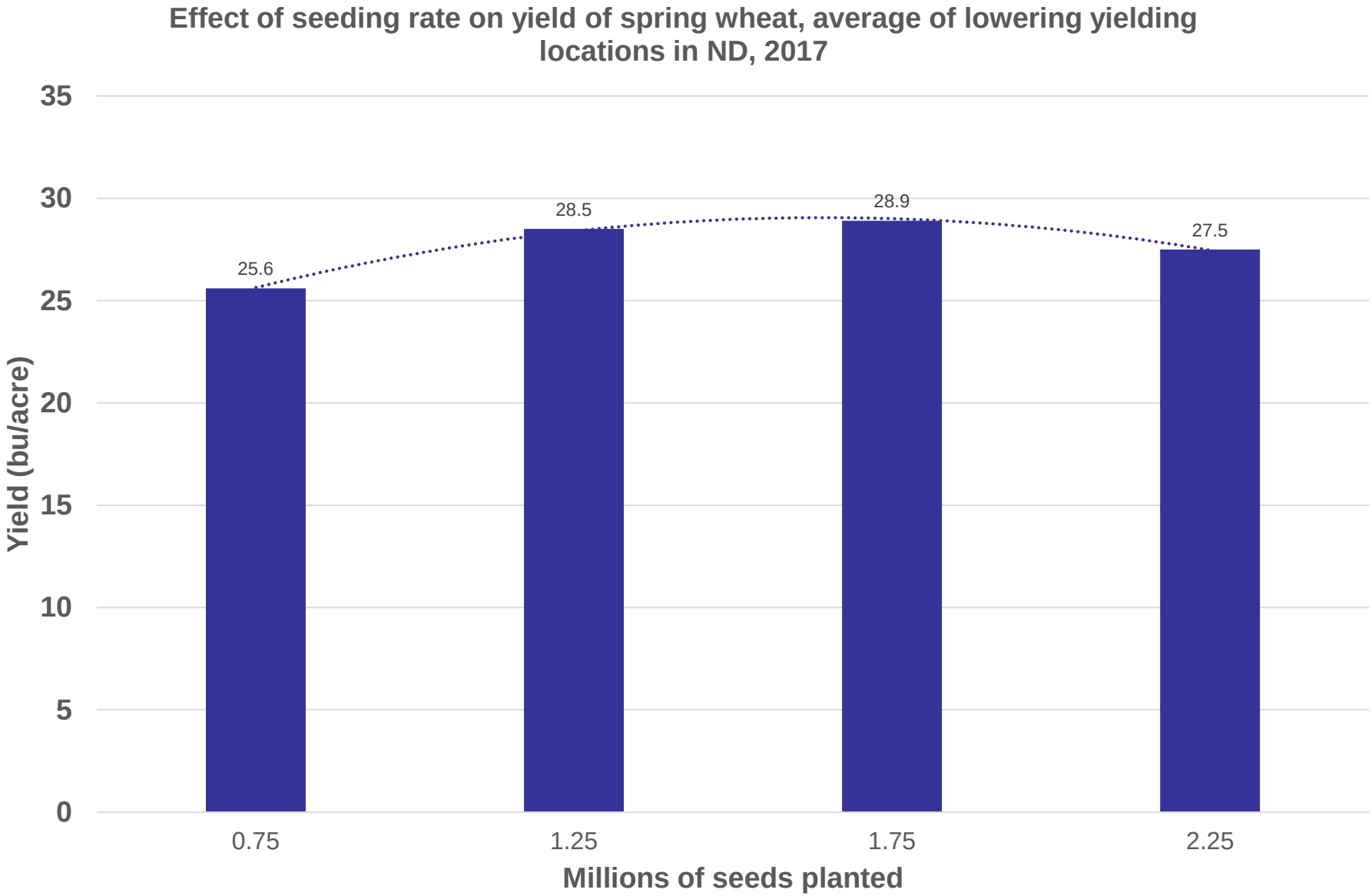
What did we learn about variety selection?

- We can expect increased productivity from newer varieties (for yield and protein)
- Select a yield an protein profile that matches your farm and expected market value
- Use multi-locational data when possible
- Know the disease and lodging traits of potential varieties.
- Routinely add new varieties to your farm to capture the value from newer genetics

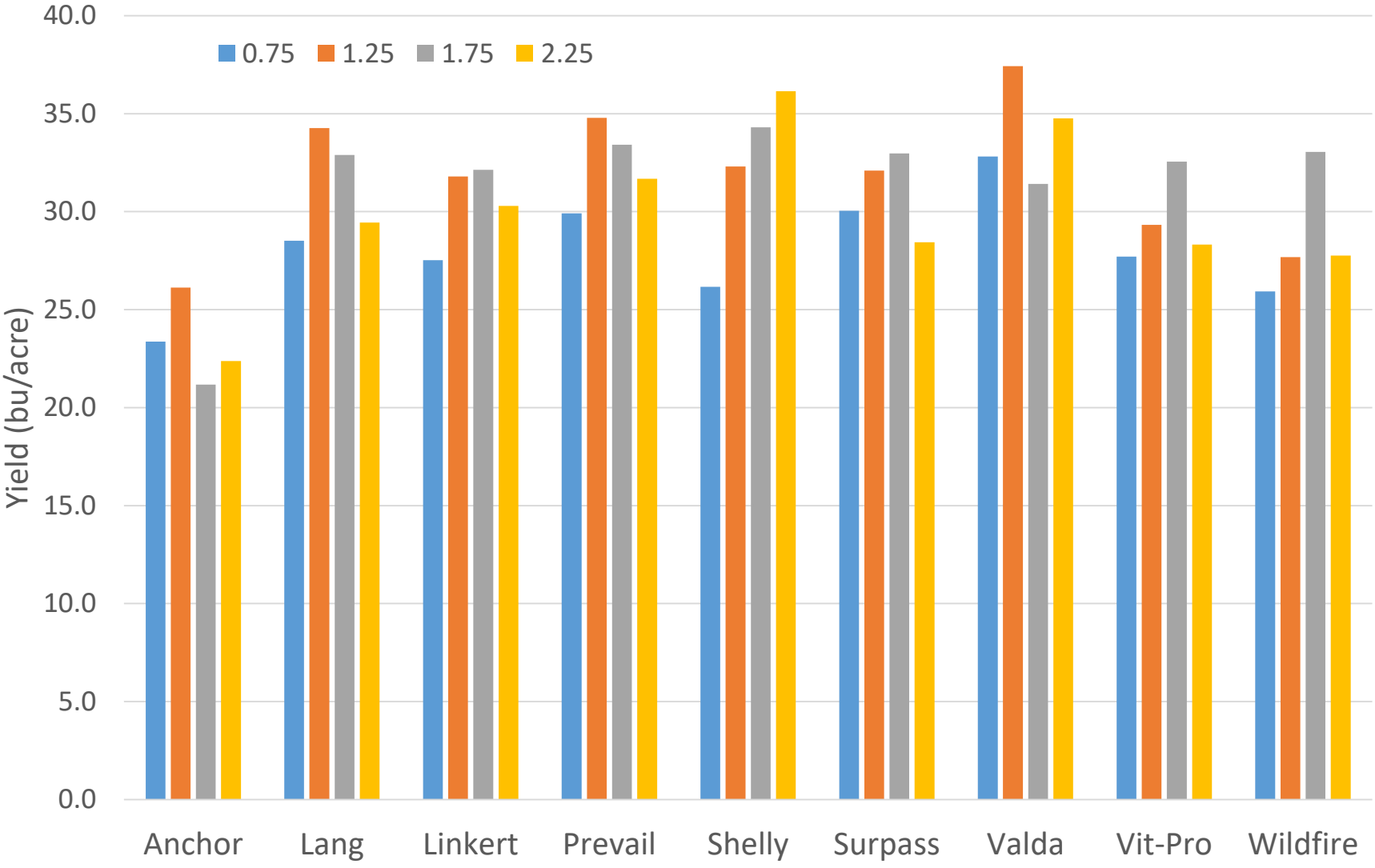
To sustain yield gains with new varieties, do we need higher seeding rates?

- Gains in yield potential in corn hybrids achieved only with higher populations
- Wheat is a smaller plant and regulates crowding or gaps with tillering
  - Does having fewer tillers increase yields by having more larger main stems
  - With fewer tillers can we get better coverage of FHB fungicides
- Several on station and on-farm seeding rate trials were conducted in 2017


Effect of seeding rate on yield of spring wheat, average of higher yielding environments in MN and ND, 2017
75
70
65
60
55
50
Yield (bu/acre)
69.7
71.6
72.8
71.1
0.75
1.25
1.75
2.25
Millions of seeds planted


Effect of seeding rate on yield of spring wheat, average of lowering yielding locations in ND, 2017
35
30
25
20
15
10
5
0
Yield (bu/acre)
25.6
28.5
28.9
27.5
0.75
1.25
1.75
2.25
Millions of seeds planted

Effect of seeding rate on yield of selected HRS wheat varieties, average of lower yielding locations, 2017.



Effect of seeding rate on percent emergence, average of locations, SY Valda and Linkert,2017

Seeding Rate	Linkert		SY Valda	
	Average	Range	Average	Range
	---(Percent of viable seeds that emerged)---			
1.0 million	100	69-116	82	61-112
1.5 million	93	77-104	76	65-106
2.0 million	89	77-102	79	58-117

Effect of seeding rate on stems per acre and stems per plant, average of locations, Linkert and SY Valda.

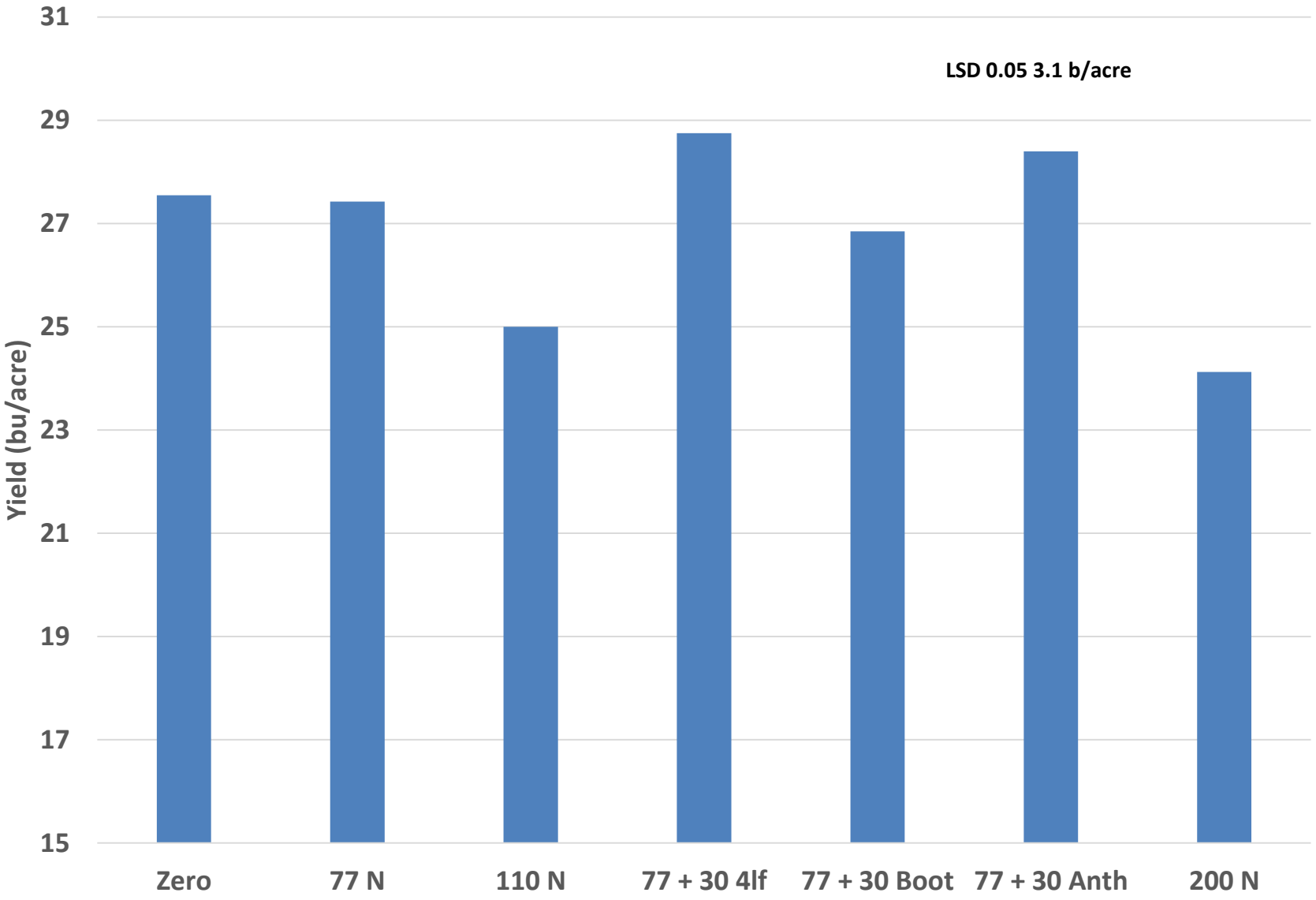
Seeding Rate	Linkert			SY Valda		
Seeds per acre	Stems/ acre (million)	Stems per plant	Spike weight (gm)	Stems/ acre (million)	Stems per plant	Spike weight (gm)
1.0 million	2.73	2.8	0.80	3.12	3.9	0.84
1.5 million	2.81	2.0	0.78	3.44	3.1	0.74
2.0 million	2.84	1.6	0.77	3.50	2.3	0.73

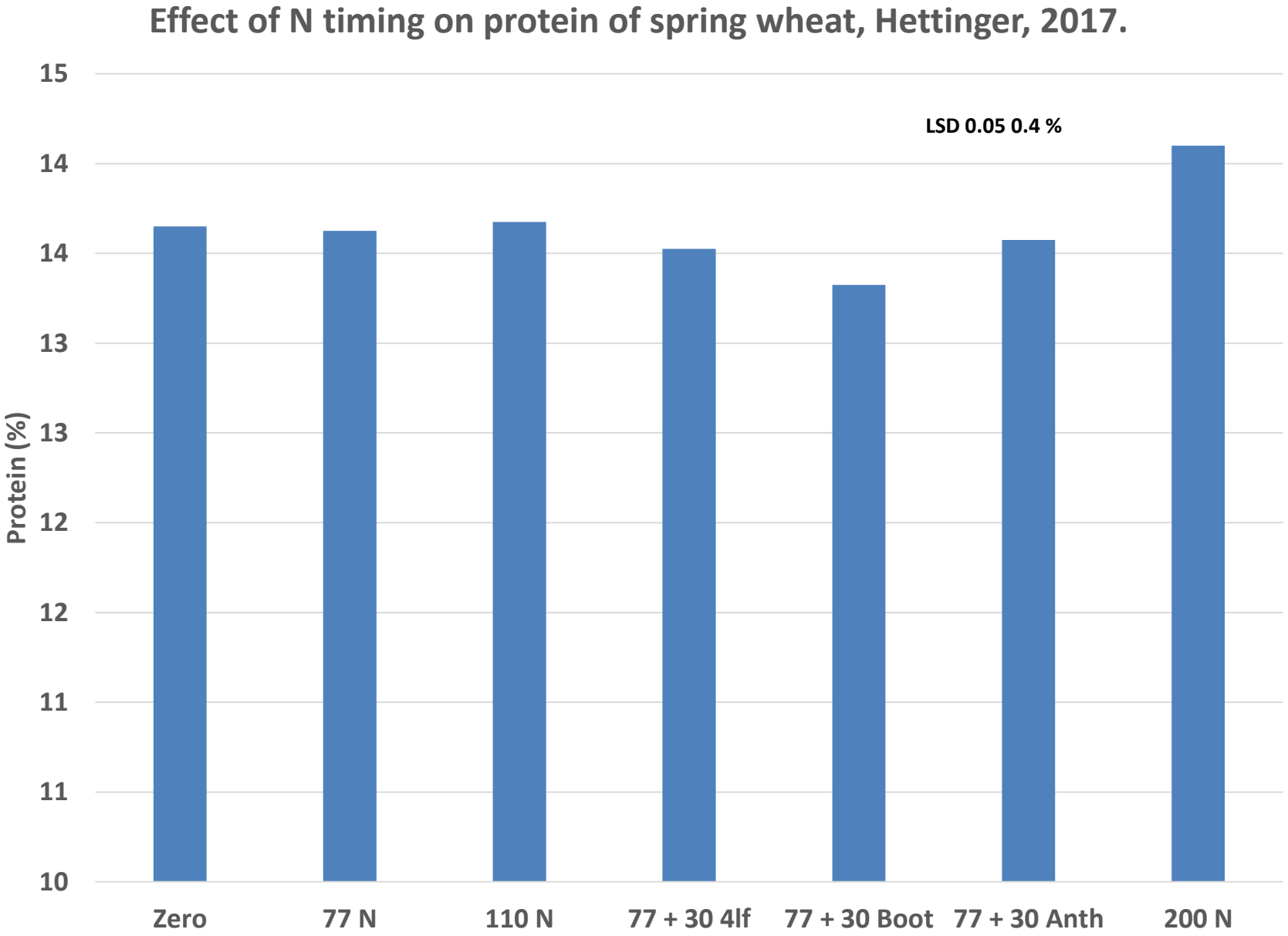
Summary on seeding rates

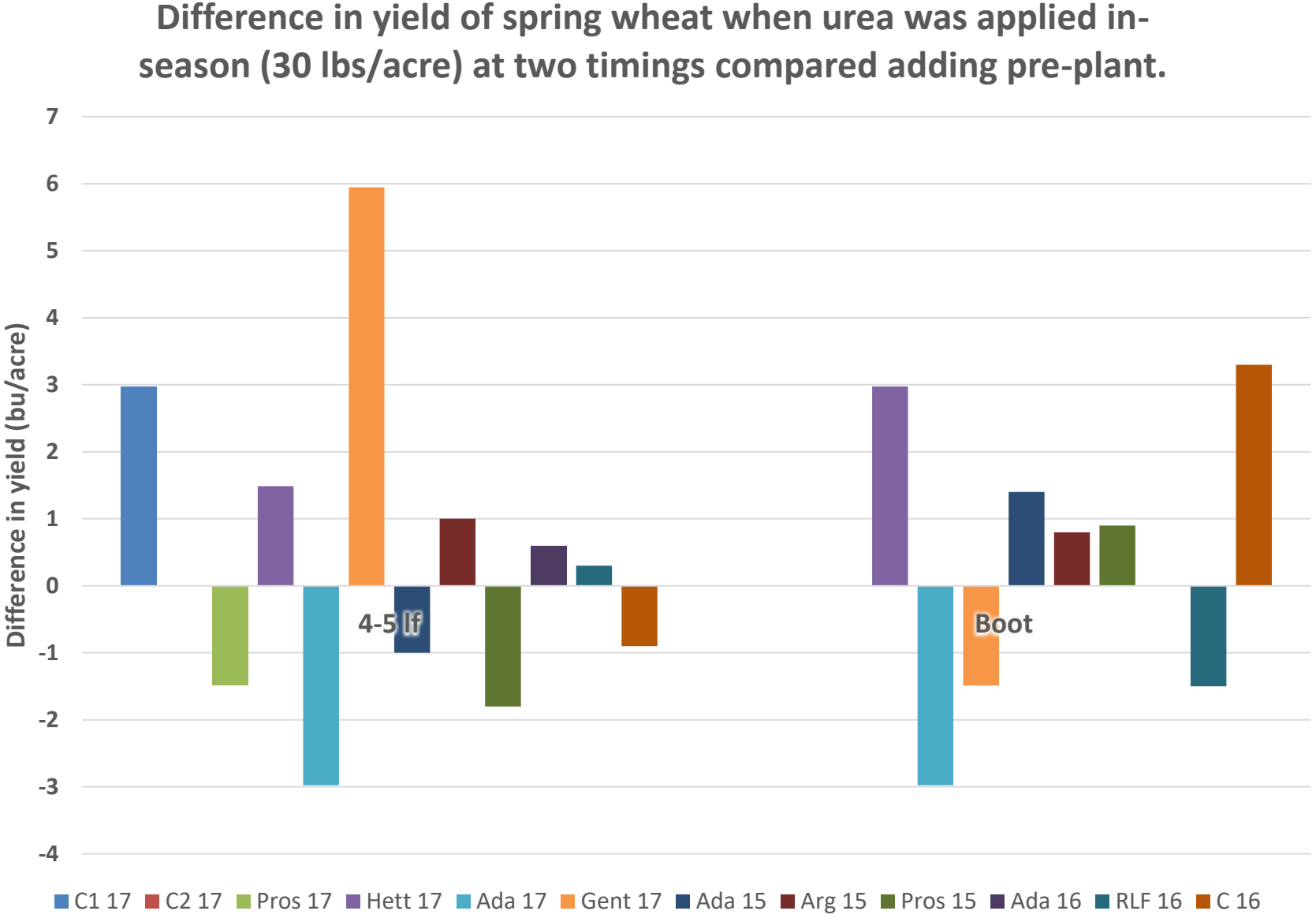
- Increasing seeding rate beyond current recommendation (1.2-1.6 million seeds) does not provide for a consistent biological response regardless of variety
- Varietal response to seeding rate not consistent (need more data), but propensity to lodging and optimum seeding rate appear to be negatively related
- Tillering potential of a variety was not a major factor in determining the optimum seeding rate this year, but high tillering varieties had lower optimum seeding rates last year.
- Higher seeding rates increase the proportion of main stems, but also reduces spike size and tends to increase lodging.

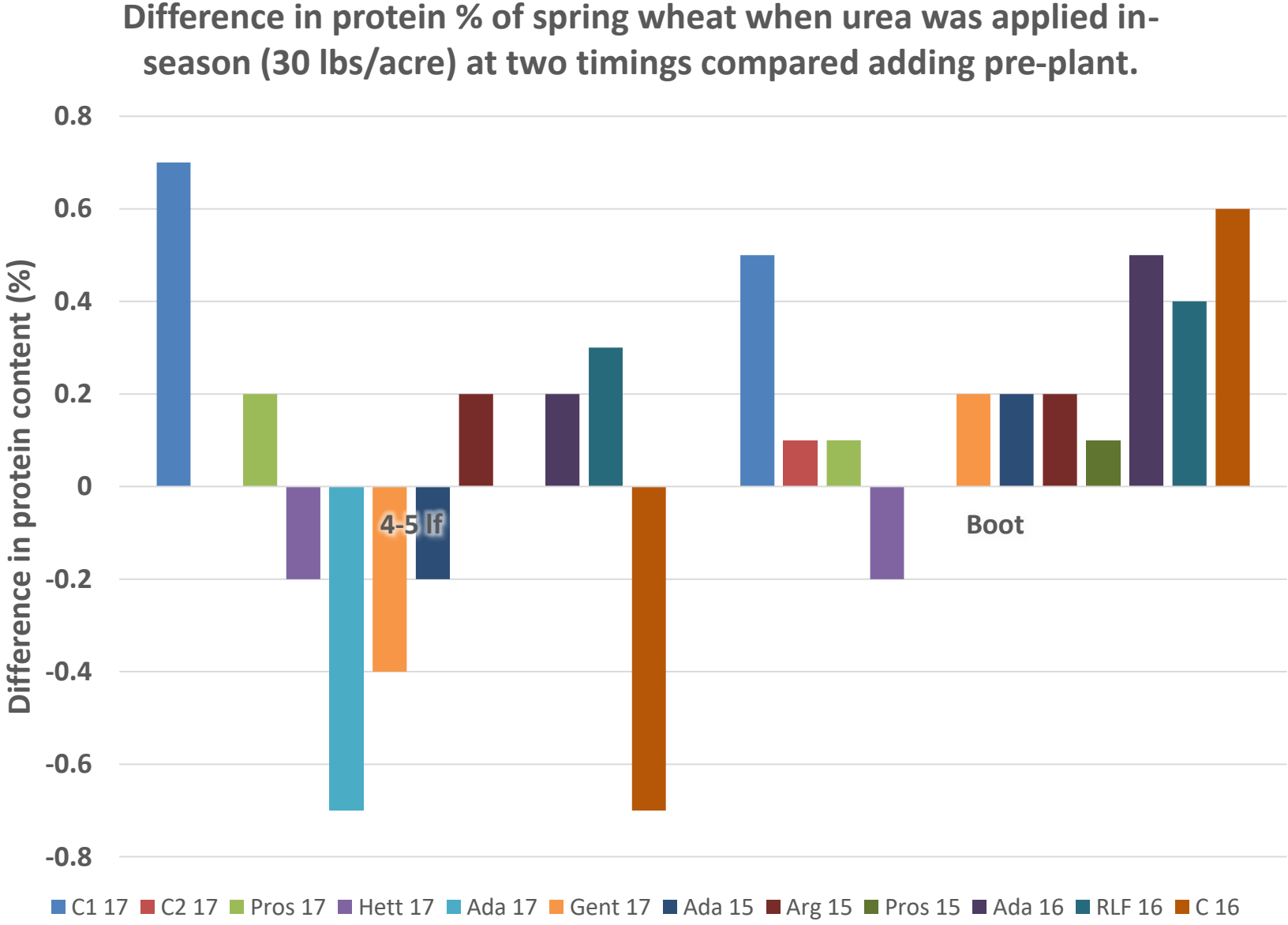
Carefully mange inputs

- Nitrogen fertilizer, critical for yield and protein
- Can we gain efficiencies with in-season applications or with a slow release product like ESN?

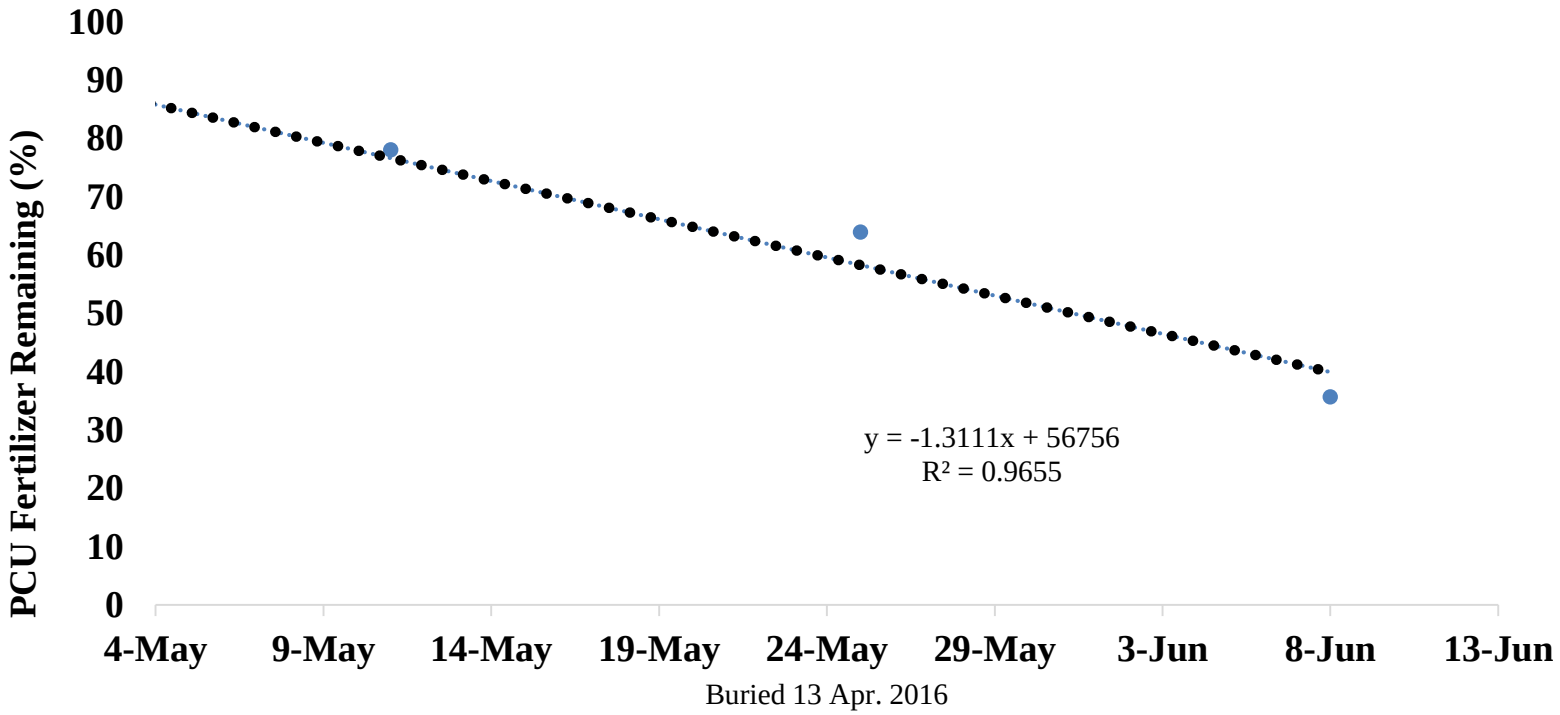

Effect of N timing on yield of spring wheat, Hettinger, 2017.
LSD 0.05 3.1 b/acre
Yield (bu/acre)
31
29
27
25
23
21
19
17
15
Zero
77 N
110 N
77 + 30 4lf
77 + 30 Boot
77 + 30 Anth
200 N


Effect of N timing on protein of spring wheat, Hettinger, 2017.
LSD 0.05 0.4 %
Protein (%)
15
14
14
13
13
12
12
11
11
10
Zero
77 N
110 N
77 + 30 4lf
77 + 30 Boot
77 + 30 Anth
200 N

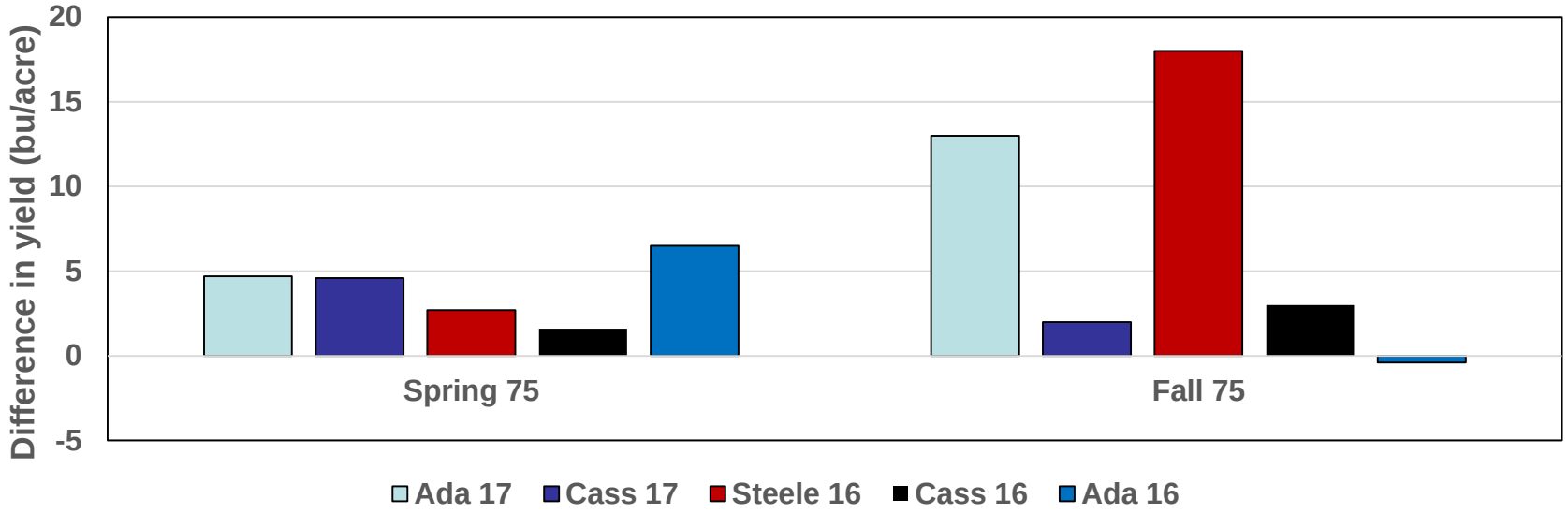

Difference in yield of spring wheat when urea was applied in-season (30 lbs/acre) at two timings compared adding pre-plant.
Difference in yield (bu/acre)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
4-5 lf
Boot
C1 17
C2 17
Pros 17
Hett 17
Ada 17
Gent 17
Ada 15
Arg 15
Pros 15
Ada 16
RLF 16
C 16


Difference in protein % of spring wheat when urea was applied in-season (30 lbs/acre) at two timings compared adding pre-plant.
Difference in protein content (%)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
4-5 lf
Boot
C1 17
C2 17
Pros 17
Hett 17
Ada 17
Gent 17
Ada 15
Arg 15
Pros 15
Ada 16
RLF 16
C 16

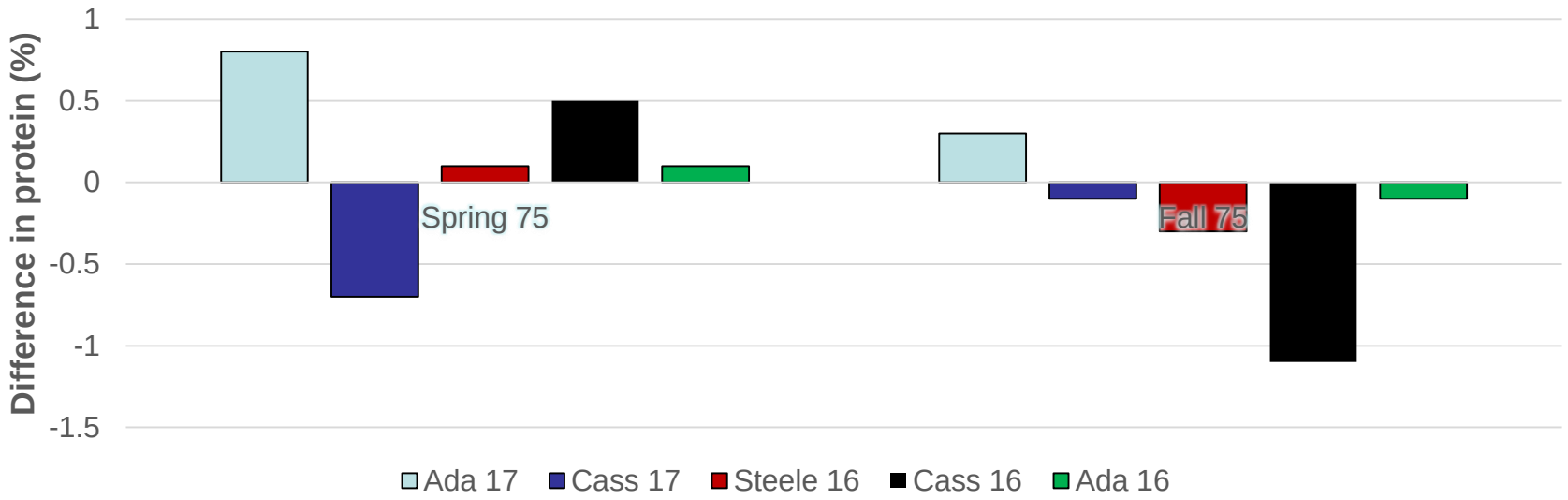
Release of N from ESN, Casselton, 2016



Difference in yield between N sources (ESN – urea) at 75% optimum and two timings, five environments 2016-17.



Difference in grain protein % between N sources (ESN – urea) at two rates and two timings, five environments 2016-17.



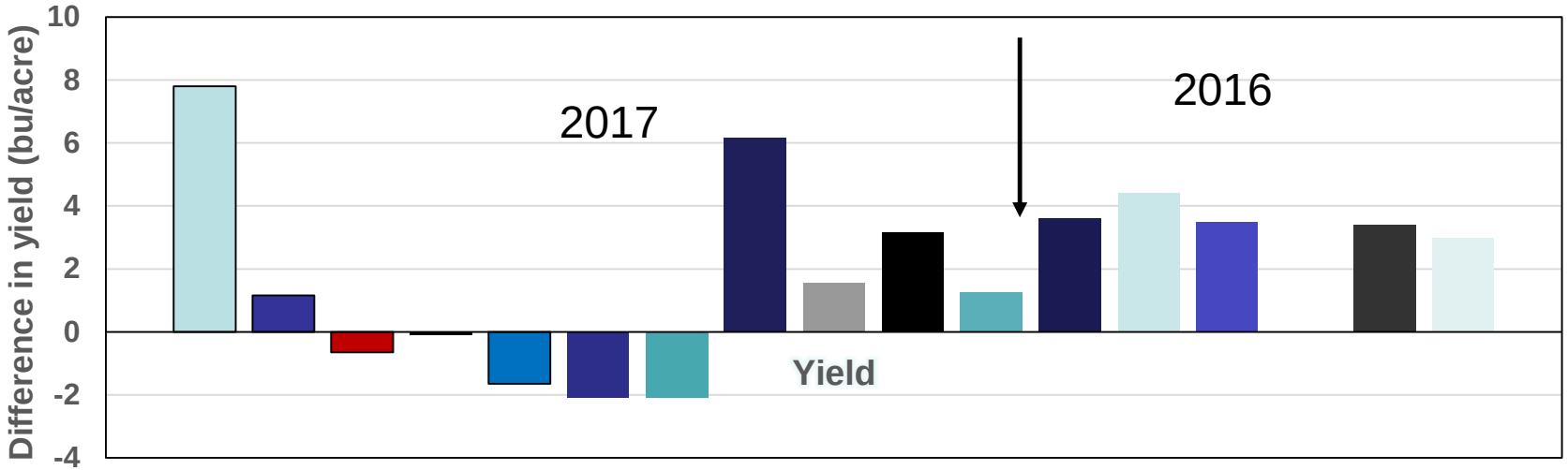
N management

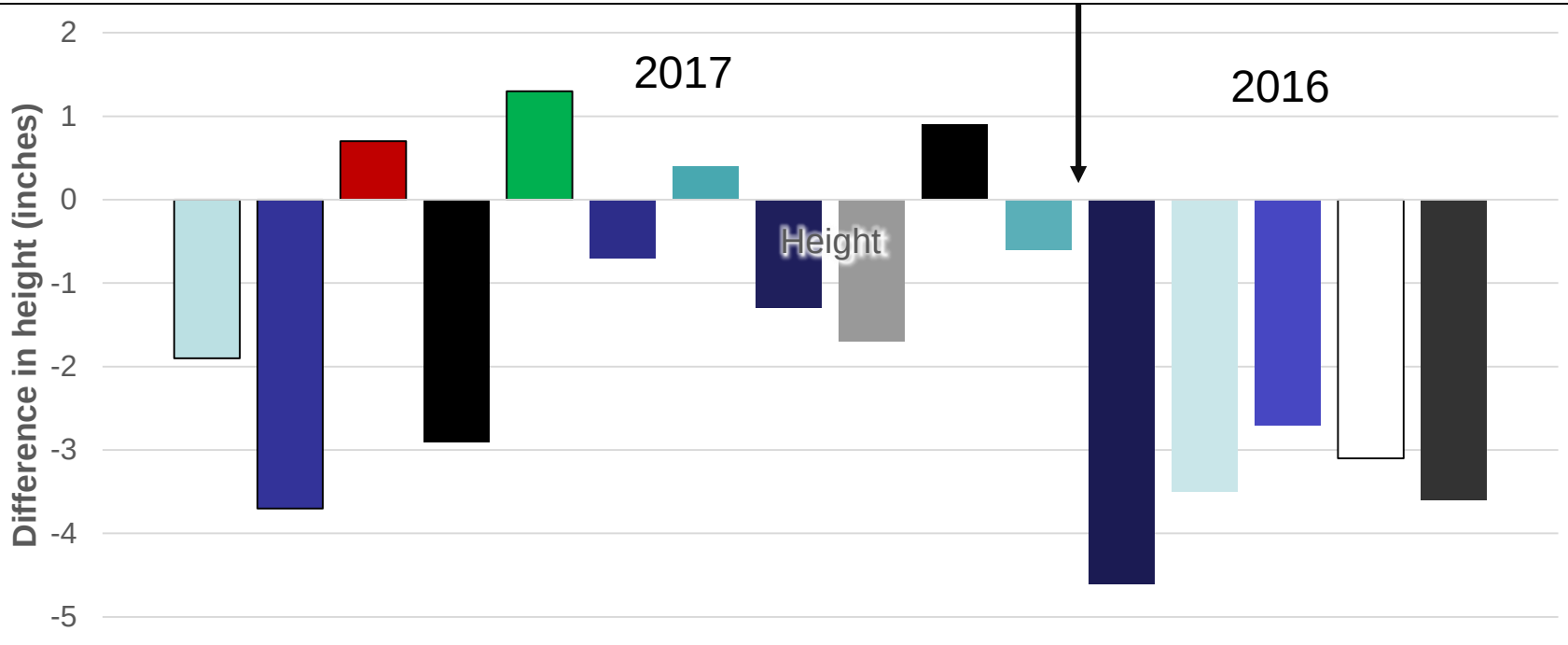
- Response in yield to split applications of N variable
  - Depend on pre-plant rates and plan accordingly
- Increase in protein with boot stage application modest (bump from boot stage < that post anthesis
- ESN response depended on environment
- Useful for seasons and soils > N loss
- No data on impact splits and ESN on lodging

Growth regulators to reduce lodging

With higher yields & higher N rates, lodging can significantly reduce yield and increase time needed for harvest

Difference (treatment – no treatment) in yield and plant height with application of Palisade at Feekes 7 (two nodes visible), on-farm trials in northern MN, 2016 & 2017.





Small plot research, 2017, two locations in ND, two varieties and two fertilizer levels.

	Prosper		
	Ht (in)	Yield (bu/a)	Stem dia
Control	28.2	61.5	2.58
Palisade 14 oz, (1st node)	27.5	61.8	2.65
	Steele County		
Control	30	56.0	2.62
Palisade 14 oz, (1st node)	28	55.0	2.68

Use of growth regulators

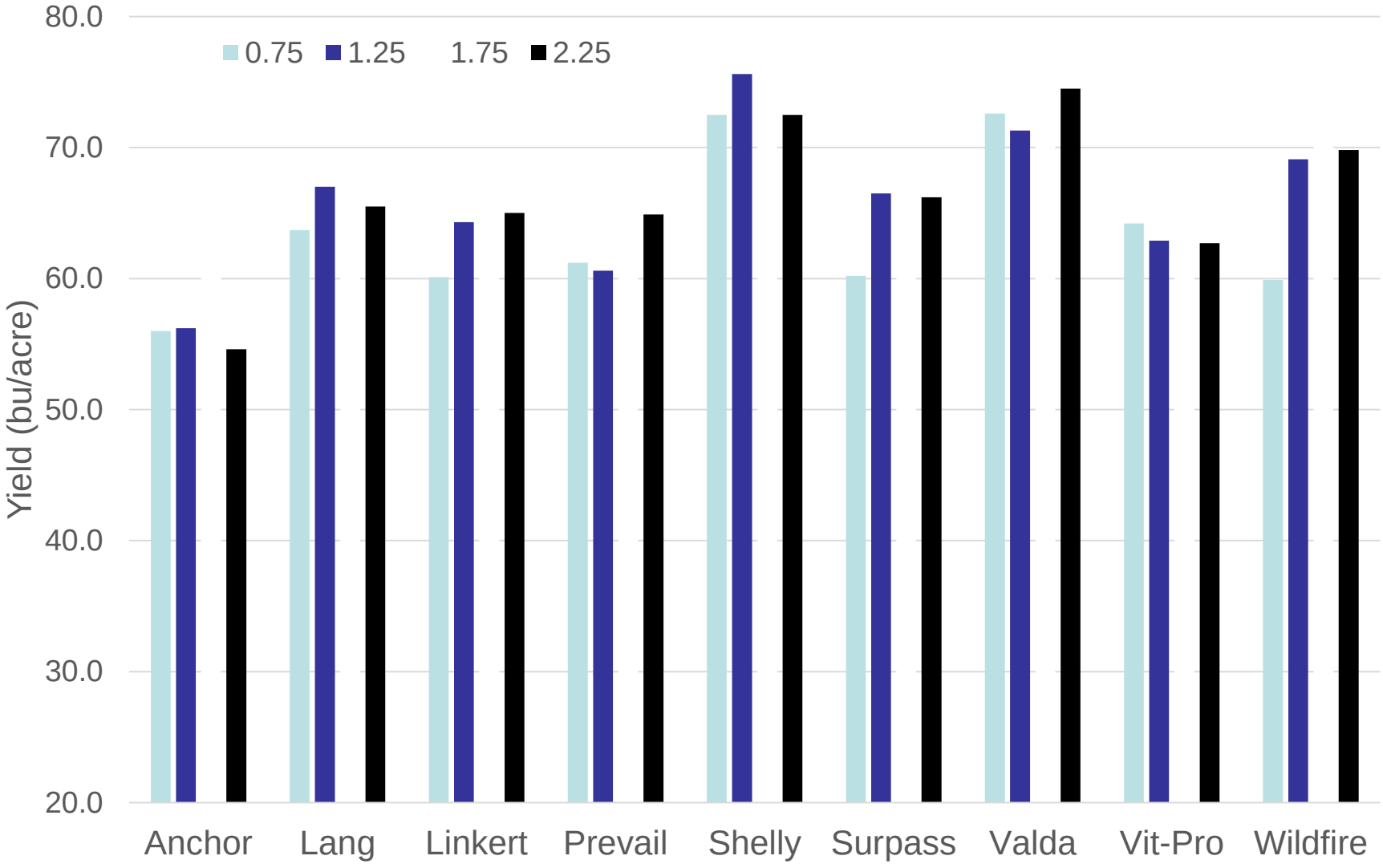
- Palisades has the potential for reducing height, thicken stems and reducing lodging
- Environment plays a significant role in the response of spring wheat to this treatment
- Given inconsistency, consider use of a more lodging resistant variety rather than PGR

Conclusions

- Excellent potential for continued increases in wheat productivity
- Research in 2017 demonstrated the value of careful variety selection (most especially when water not too limiting)
- Staying with current seeding rate recommendations
- Most N pre-plant – carefully determine rate
  - Splits and ESN for locations prone to losses
- Palisade can reduce plant ht, but variety selection and lower seeding rate may be more profitable way to managing lodging

Questions?

Effect of seeding rate on yield of selected HRS wheat varieties, average of higher yielding locations, 2017.



Rank of varieties for yield and partial returns, average of high yielding environments in ND variety trials, 2017

Cultivar	Yield	Protein
LCS Trigger	97.4	12.5
SY-Valda	92.9	13.7
LCS Prime	90.2	13.2
Shelly	88.8	13.9
WB9653	88.4	13.8
HRS 3419	88.2	12.9
HRS 3530	88.1	14.3
Faller	88.1	13.1
Prosper	87.6	13.6
HRS 3504	86.7	13.8
LCS Rebel	86.7	14.6
Surpass	86.6	14.1
HRS 3100	85.7	14.0
Prevail	85.5	13.9
MS Chevelle	85.3	13.6

Cultivar	Yield	Protein	Return
Bolles	79.3	16.1	533.5
WB9479	83.7	15.2	526.1
Lang-MN	83.8	15.1	525.0
LCS Rebel	86.7	14.6	518.8
HRS 3530	88.1	14.3	516.6
SY-Valda	92.9	13.7	514.2
TCG-Climax	76.8	15.9	509.9
HRS 3616	79.5	15.3	503.5
WB9590	82.8	14.7	501.8
Shelly	88.8	13.9	500.3
Surpass	86.6	14.1	496.9
WB9653	88.4	13.8	495.0
Rollag	79.3	15.1	494.3
LCS Breakaway	82.6	14.5	489.3
Elgin-ND	81.2	14.7	488.9

$5.70 per bu and $0.10 per fifth protein