Agronomic Update: What we Learned in 2019

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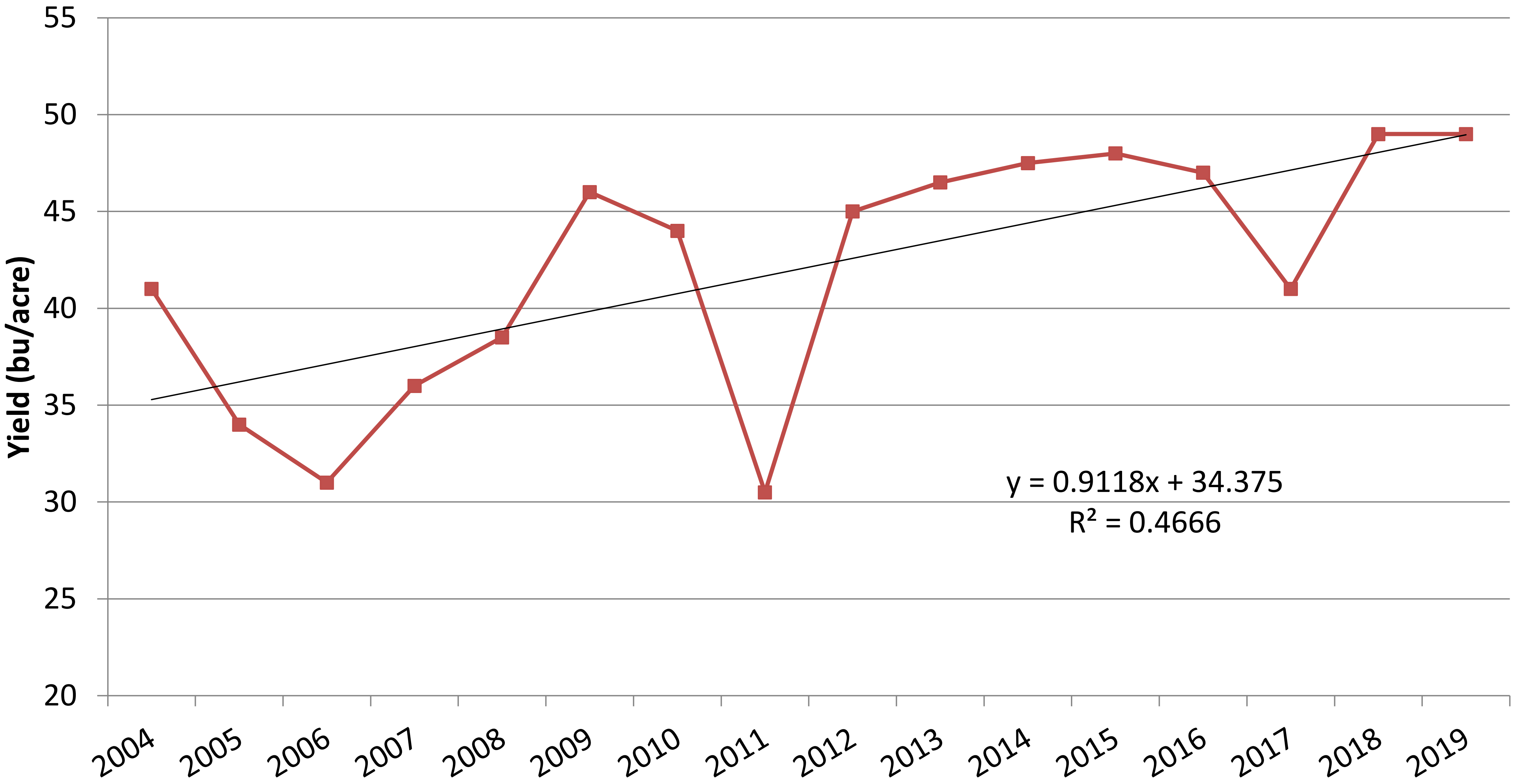
NDSU | EXTENSION

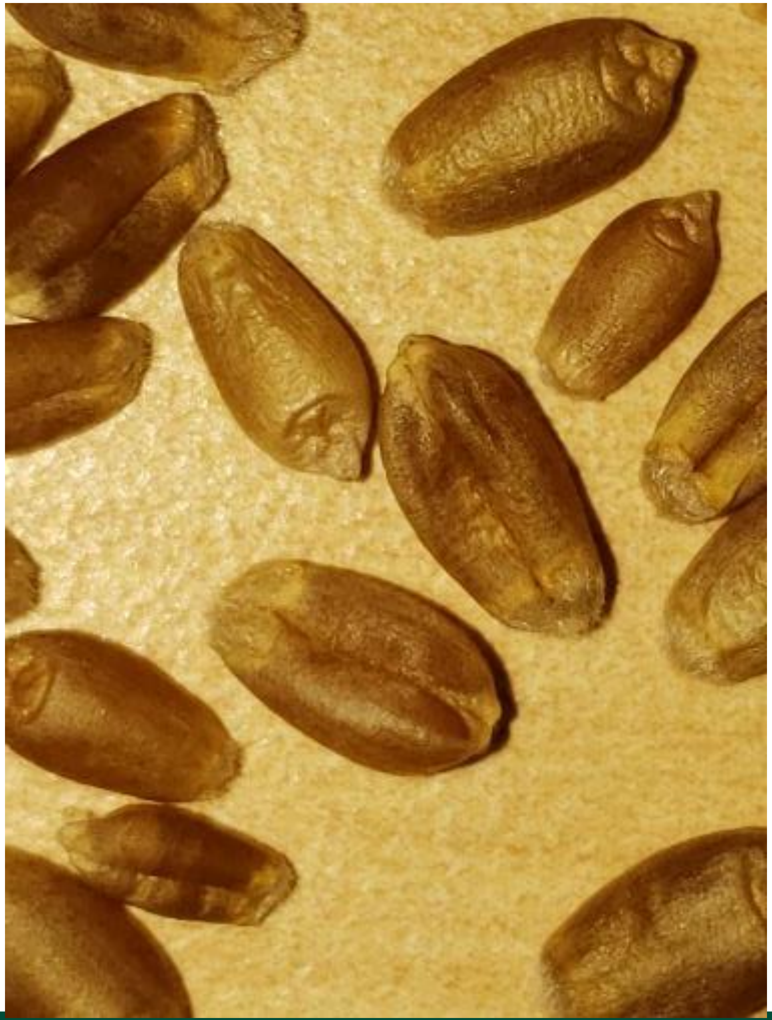
Topics to be covered

- Low Falling Numbers
  - Using damaged seed lots
- Seeding rate
- Within field protein variability
- Growth regulators

Given the challenges, yield was relatively good (on trend line) for the state as a whole. Quality was down in some areas.



Important quality issue was low falling number



Two potential reasons for low FN

- Pre-harvest sprouting – grain exposed to sufficient moisture after maturing prior to harvest to start sprouting.
- Late maturity alpha amylase (LMA) – caused by a large temperature decrease (or increase) during grain maturation (10-20 or 26-30 days past pollen shed).

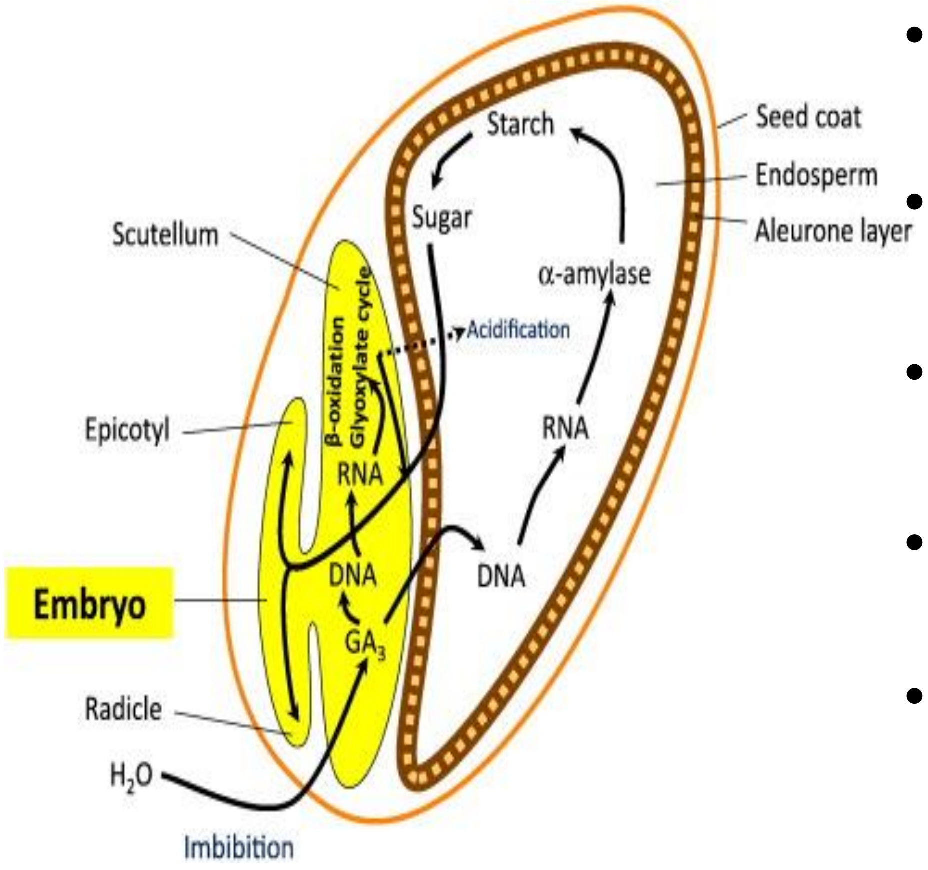
Causes of pre-harvest sprouting

- Rainfall or high humidity on grain that is mature and has passed through an after-ripening stage.
- Sensitivity to pre-harvest sprouting is variety specific.
- Reasonably good scores on sensitivity are available from screening at U of M
- Most NDSU varieties are fairly resistant to pre-harvest sprouting, but with the right conditions they will sprout
- Avoid growing varieties with PHS scores > 2
- Can sprouted kernels be used as seed?

Pre-Harvest Sprouting

- Caused by repeated wetting and drying after seed maturation
- Severity depends on:
  - Genotype – level of dormancy
  - Duration of wet conditions
  - Severity of wet conditions
  - Stage of maturity

Metabolic Processes in Germination



- Imbibition triggers GA_3 transport to aleurone layer
- GA_3 activates production of ∝-amylase
- ∝-amylase hydrolyses amylose and amylopectin
- Sucrose fuels germination
- Some protein degradation needed for synthesis of enzymes

Source: Cell signaling mechanisms and metabolic regulation of germination and dormancy in barley seeds. Ma et.al. 2017

Is there genetic variability to pre-harvest sprouting?

Ratings for some commonly grown varieties (1 best, 9 worst). Data collected by Spring Wheat Breeding Program, Univ of Minnesota.

Rating	Varieties
1	Bolles, Faller, Glenn, Lang-MN, Linkert, MN-Washburn, ND-Vitpro, Prosper, Shelly, SY Soren, WB9653
2	Barlow, Elgin ND, Prosper, SY Ingmar, SY Valda, WB9590
3	SY Rowyn, TCG-Spitfire, WB Mayville, WB9479
5	Boost

PHS resistance

(Cornell Univ.)

- Abscisic acid (ABA) is essential for seed maturation and enforces a period of seed dormancy.
- ABA levels decline as grain matures and after ripening.
- Red seed pigments slow the decline of ABA.
- Temperature during grain fill affects ABA levels.

Late maturity alpha amylase

- Little is known about the genetic control of late maturity alpha amylase in currently used varieties
- Genetic factors have been identified in other regions of the world and research is needed to characterize our pool of varieties
- Though genetic mechanism can help reduce problems of low falling numbers, the major factor associated with this problem is the environment

Preharvest Sprouting
KSU Trial Results

Factor	Means Across Sprout Levels		
	Low	Moderate	Severe
Mean Falling Number	376	220	90
% Germ after harvest	97	95	92
Greenhouse emerg. 1.25 in	91	88	79
Greenhouse emerg. 2.5 in	81	67	65
Greenhouse emerg. 3.75 in	44	35	20
Field emergence (1.5 in)	68	69	59
Yield (bu/ac)	81	82	77

Source: Planting wheat seed damaged by sprouting before harvest. Foster et.al. Kansas AES 1997

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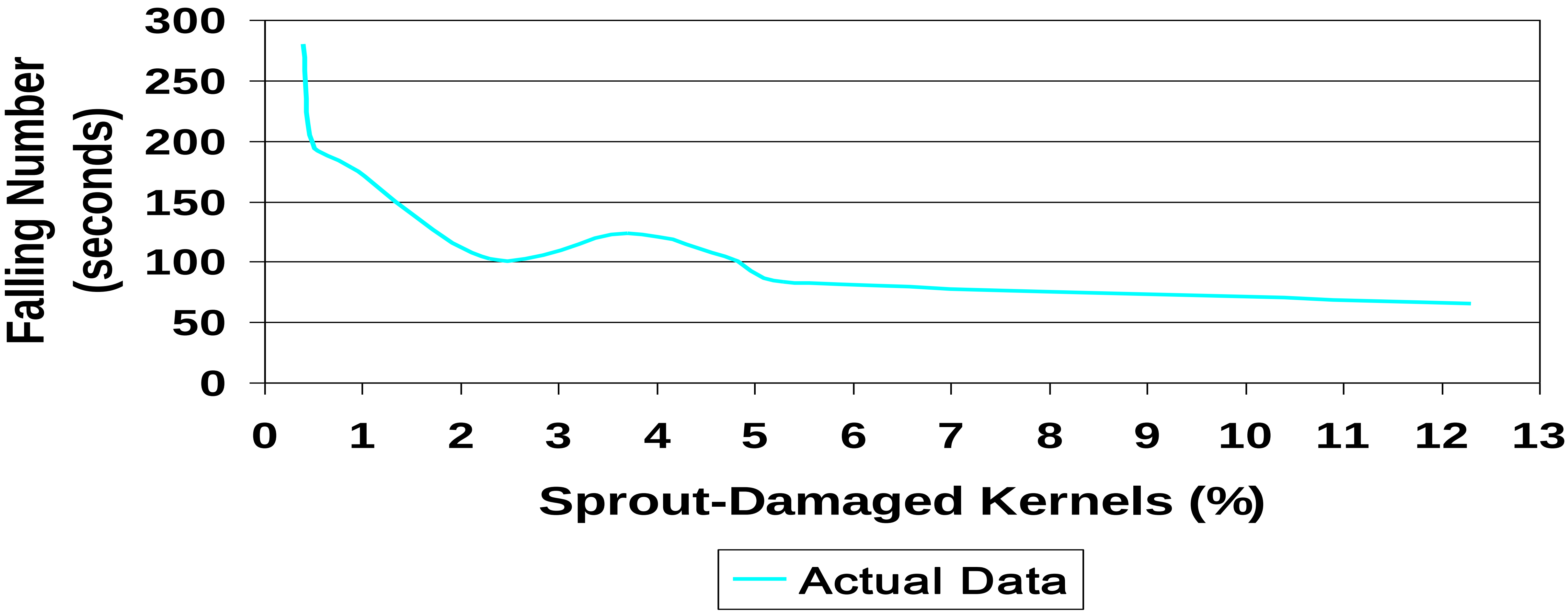
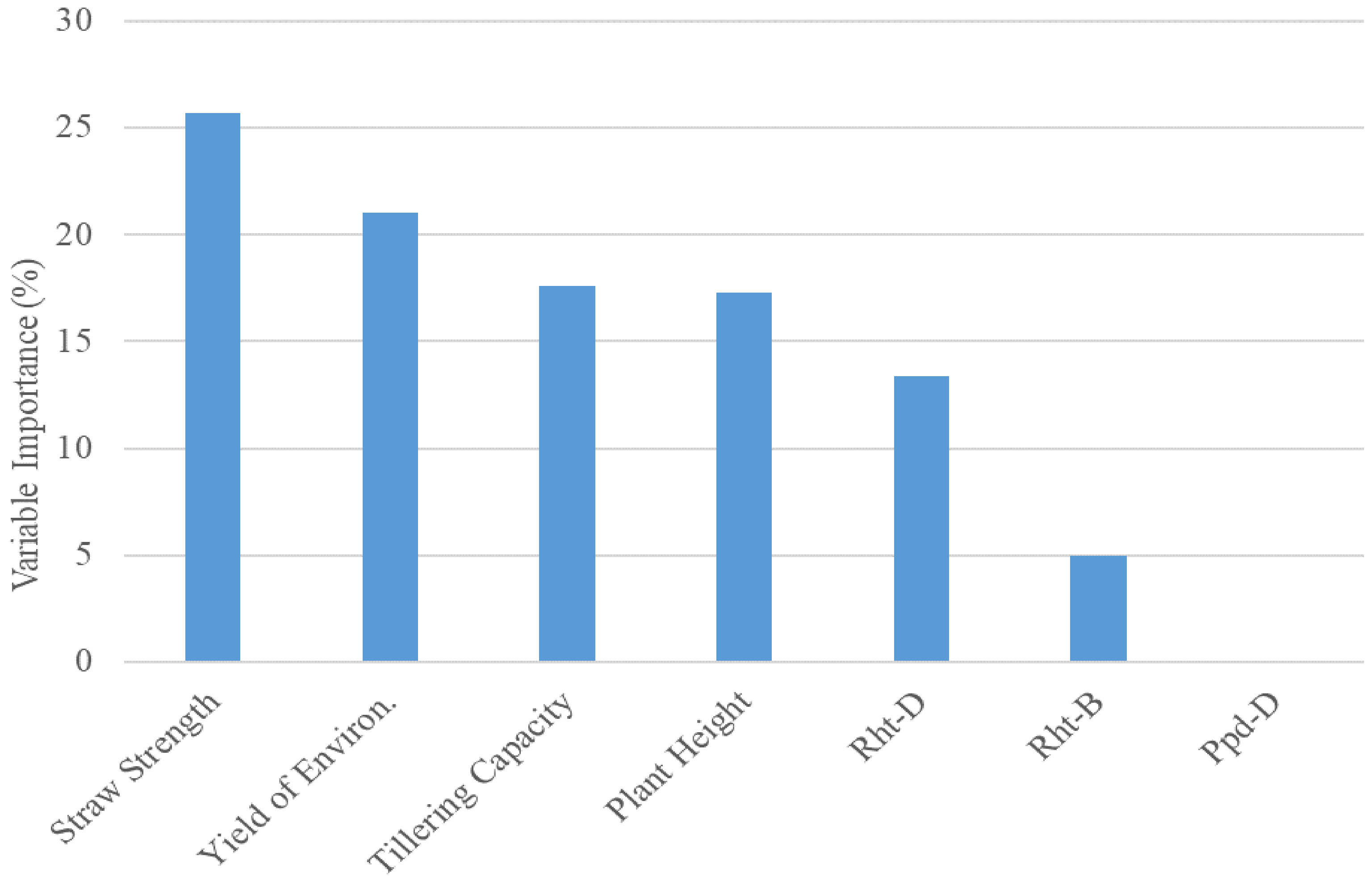
Blending sprouted damaged seed with good seed is not recommended.



Estimating an optimum seeding rate for new varieties. Factors that affect seeding rate:

- Genotype:
  - Daylength sensitivity
  - Semi-dwarf stature
- Phenotype
  - Plant height
  - Straw strength
  - Tillering capacity
- Genotype x Environment Interaction
  - Latitude/longitude
  - Planting date

Important Model Parameters



Supporting research was directed toward quantifying tillering characteristics of varieties

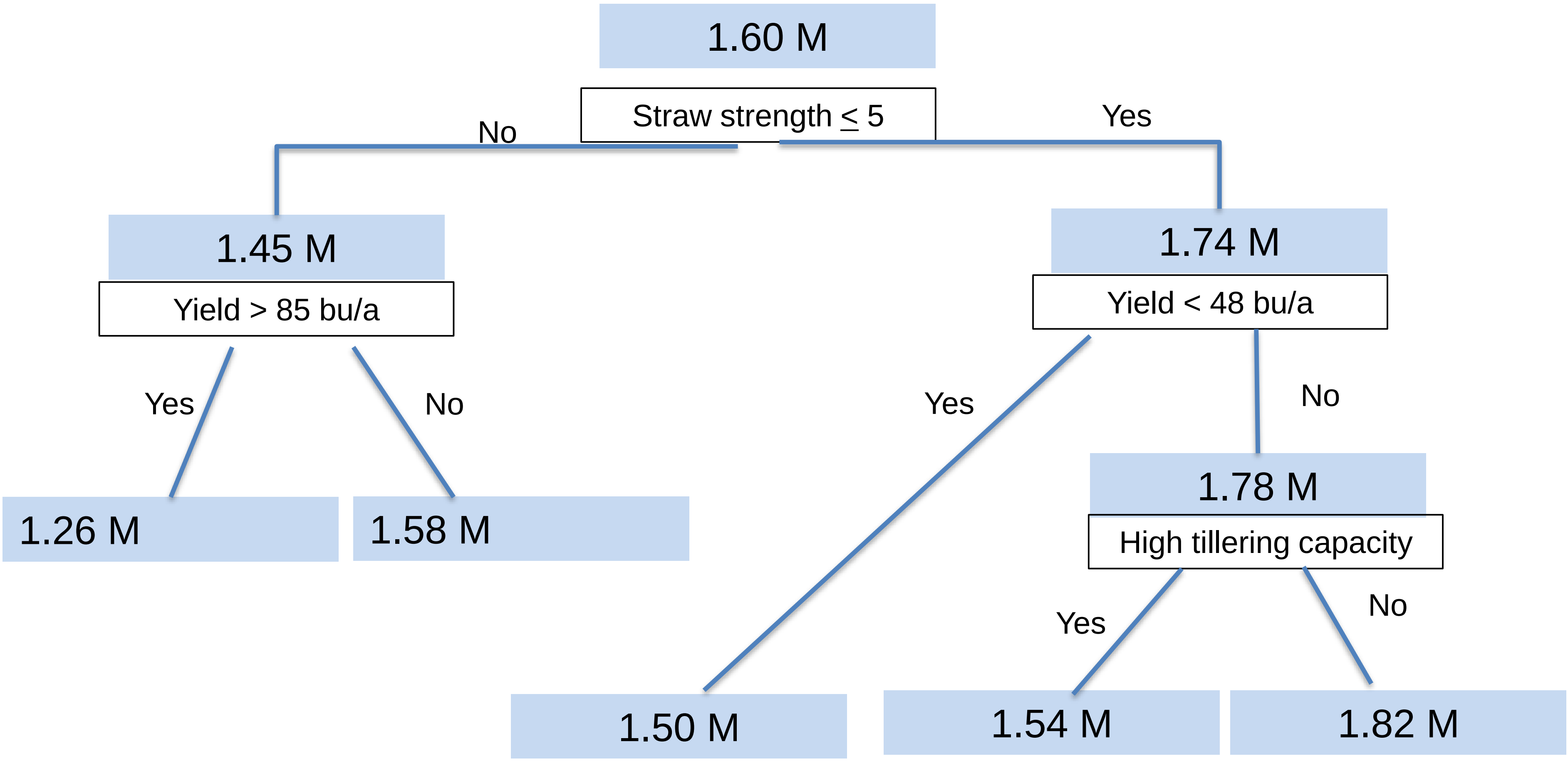
Cultivar tillering capacity of spaced planted varieties

Cultivar	Photoperiod response	Dwarfing gene		Spikes plant^{-1}	
Wildfire	Sensitive	*Rht-B1*		18.9	L
SY Valda	Insensitive	*Rht-D1*		19.5	L
Linkert	Insensitive	*Rht-D1*		19.5	L
Anchor	Sensitive	*Rht-D1*		21.0	M
Surpass	Insensitive	*Wild-type*		21.3	M
Prevail	Sensitive	*Wild-type*		23.4	M
Lang-MN	Sensitive	*Wild-type*		23.4	M
Shelly	Insensitive	*Rht-B1*		25.9	H
ND VitPro	Insensitive	*Rht-B1*		25.9	H

Findings

- Tillering capacity is rarely quantified in newly released varieties but is a key feature of predicting optimum seeding rates in varieties
- Seeding a low population then thinning was found to be a useful method to rate tillering capacity
- *Ppd-D1b* + *Rht-B1b* appears to be related to high tillering
- NDSU should characterize new varieties for tillering

Decision tree for guidance including tillering capacity of optimum seeding rate of new varieties.



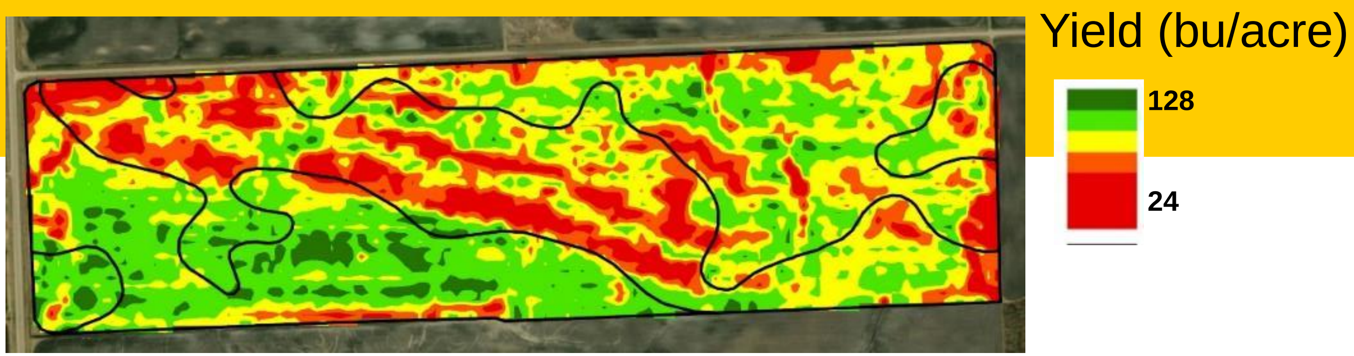
Comments on seeding rates

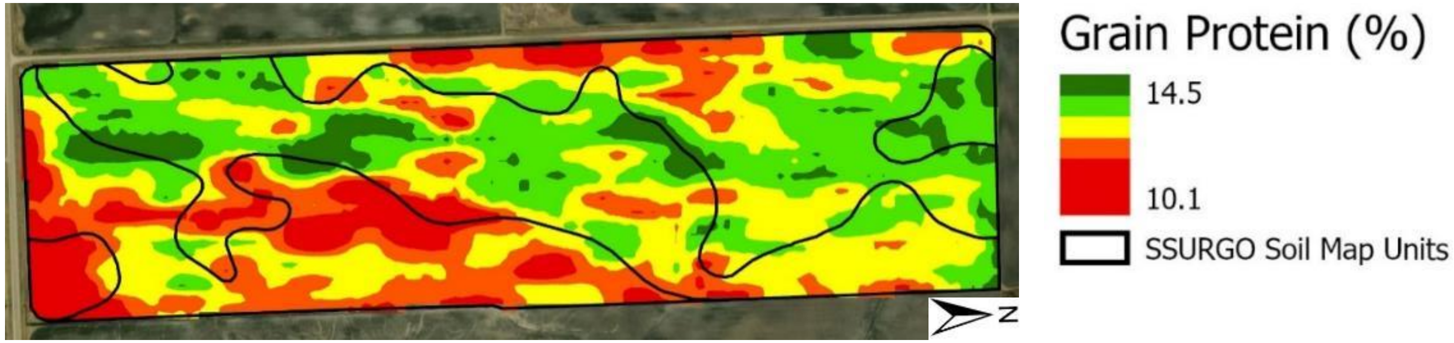
- Use seed counts not weight
- Optimum rates (OR) means exceeding OR = less yield just like seeding less than OR
- Factors to consider when adjusting:
  - Yield potential of environment
  - Straw strength
  - Tillering capacity

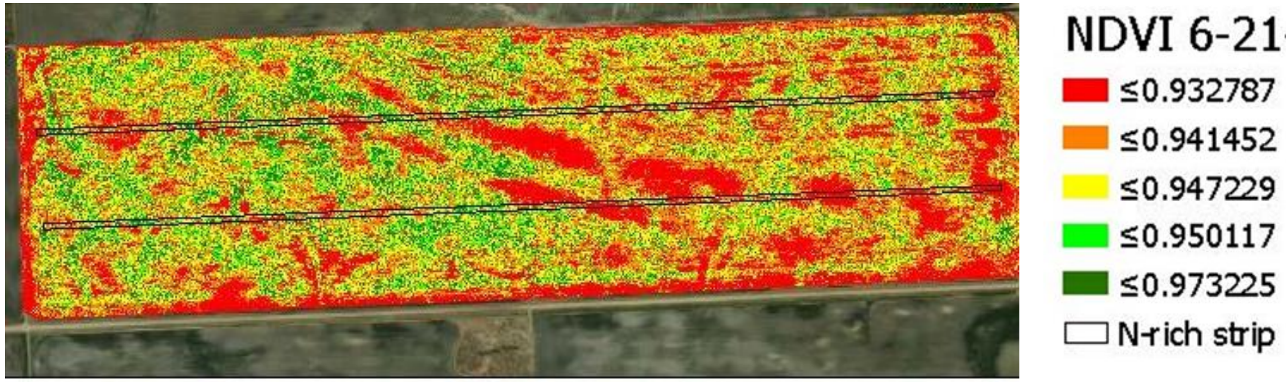
Measuring within field variability of protein

- Why
  - Quantify how variable protein is
  - Understand underlying factors that influence protein within a field
  - Develop strategies for more efficiently managing fields for protein
- How:
  - Combine mounted protein sensors coupled with GPS allows for mapping

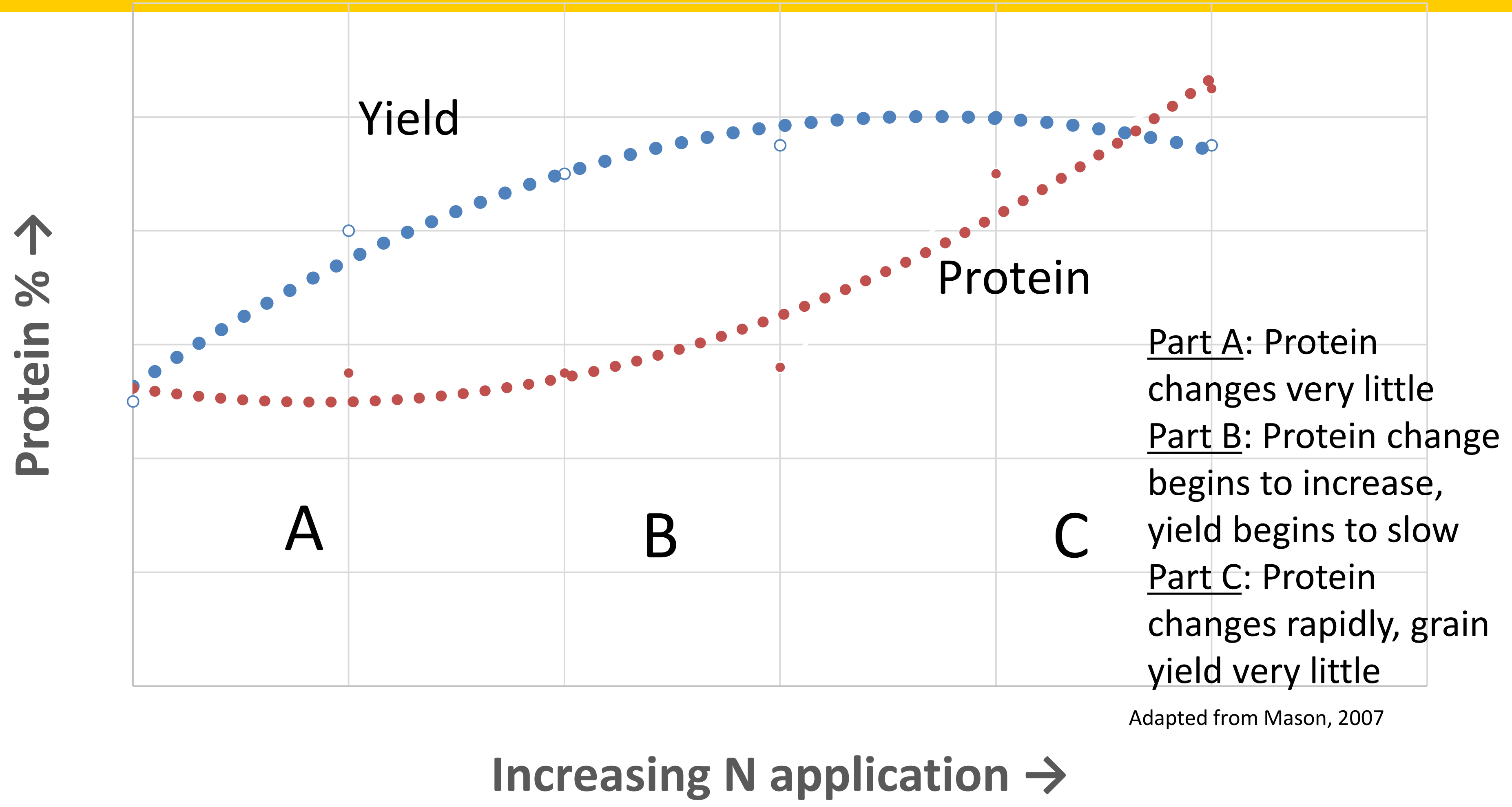
Relation between yield, protein & NDVI







Conceptual model of grain yield and grain protein relationship



Part A: Protein changes very little
Part B: Protein change begins to increase, yield begins to slow
Part C: Protein changes rapidly, grain yield very little

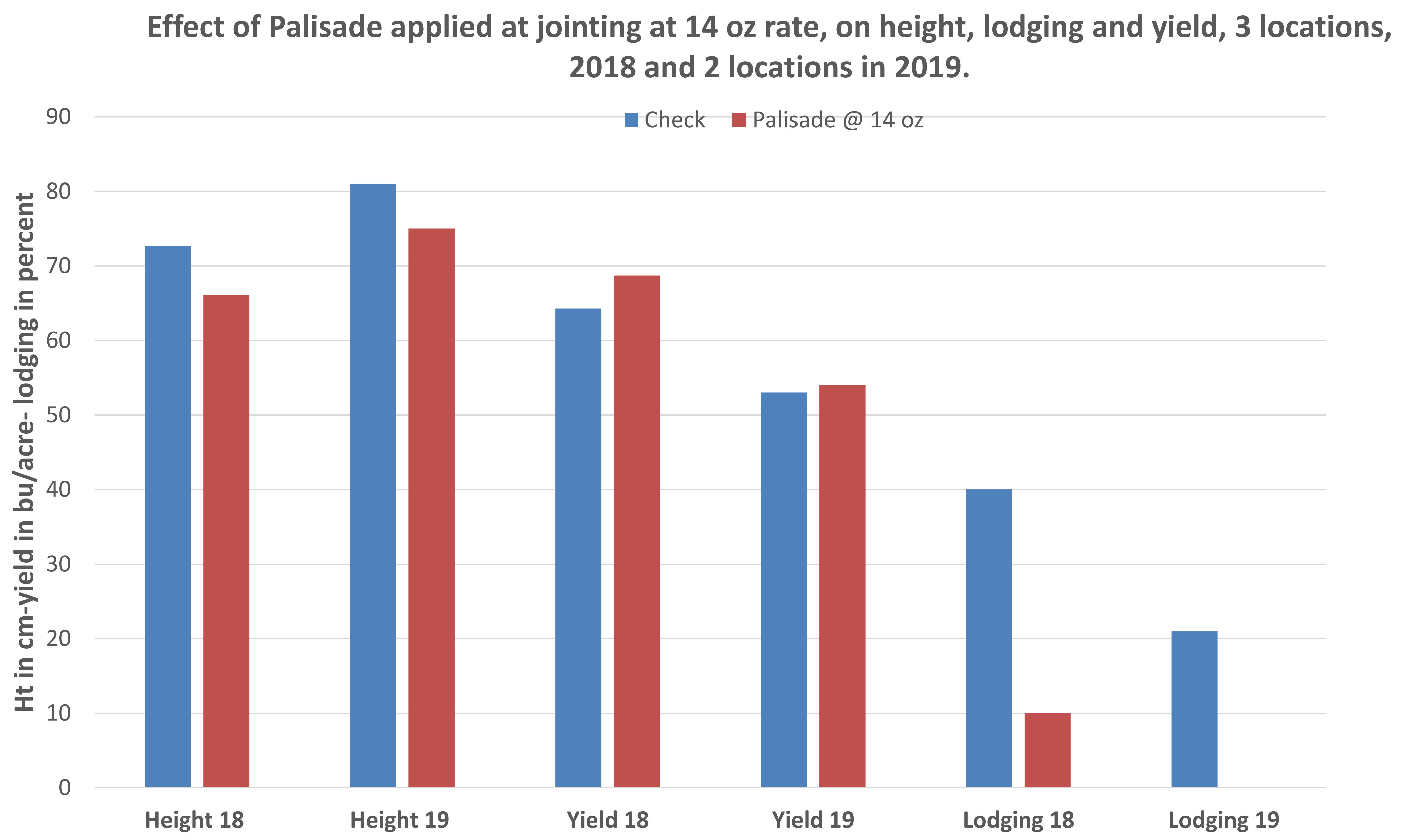
Adapted from Mason, 2007

Conclusions

- Yield monitor maps can be useful in predicting protein variability in field
- Relationship between yield and protein is quite high
- Adding extra N to high yielding zones will likely improve overall protein more than applying it uniformly
- For fields with variable soils, variable rate applications of N may be profitable especially when managing for protein and achieving protein is a challenge

Growth regulators to reduce lodging

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


Effect of Palisade applied at jointing at 14 oz rate, on height, lodging and yield, 3 locations, 2018 and 2 locations in 2019.
Check
Palisade @ 14 oz
Ht in cm-yield in bu/acre- lodging in percent
0
10
20
30
40
50
60
70
80
90
Height 18
Height 19
Yield 18
Yield 19
Lodging 18
Lodging 19

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

- PGR has the potential for reducing lodging, but value marginal when yields and potential for lodging are modest
- Managing lodging by selecting varieties with lodging scores less than 5 and using recommended seeding rates is often the most profitable