FERTILIZER TIMING AND PLACEMENT

Extension Agent Agronomy College

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Clain Jones

clainj@montana.edu 994-6076

Goal

- Describe optimal fertilization timing and placement for different nutrients, sources, and production objectives

Mobility in soil of selected nutrients

Mobile (and soluble)	Relatively immobile	Very immobile (and insoluble)
Nitrogen (as nitrate)	Potassium	Phosphorus
Sulfur	Nitrogen (as ammonium)	Copper
Boron		Iron
Chloride		Manganese
		Zinc

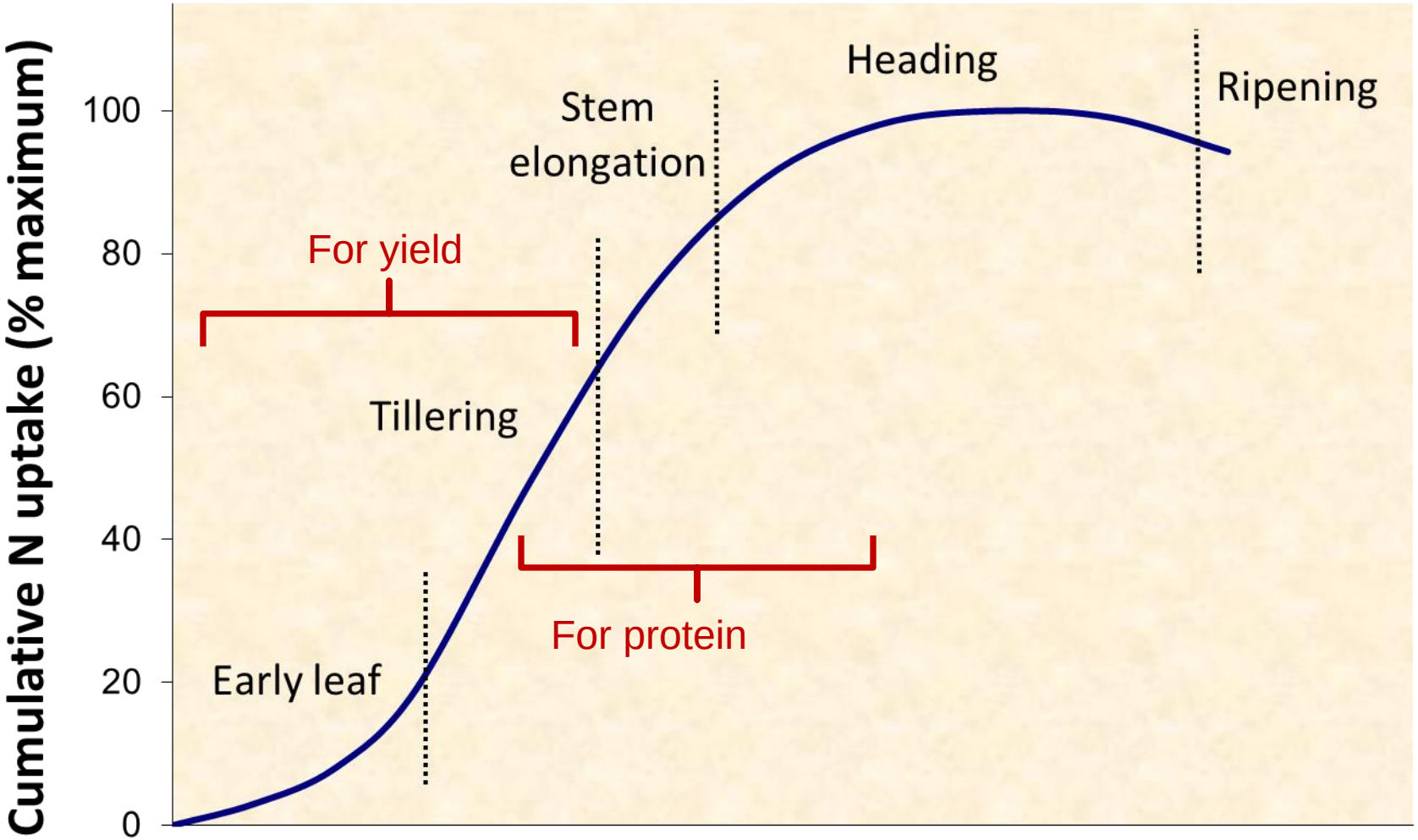
Why important?

Indication of leaching potential which influences timing and affects optimum fertilizer placement

Timing depends on source

- Slowly available (Manure, slow-release N, phosphate rock, Ca-phosphate, elemental sulfate, Ca-sulfate, oxysulfate forms of microminerals)
  - take time to become available
  - apply well before needed – e.g. fall
  - can build soil levels
  - less expensive per unit (except with N)
- Readily available (urea, ammonium, chelated or sulfate forms, phosphate)
  - Apply when needed – e.g. spring
  - foliar/liquid options
  - more expensive per unit (except with N)

Timing depends on source – N must be *available* to benefit yield and protein

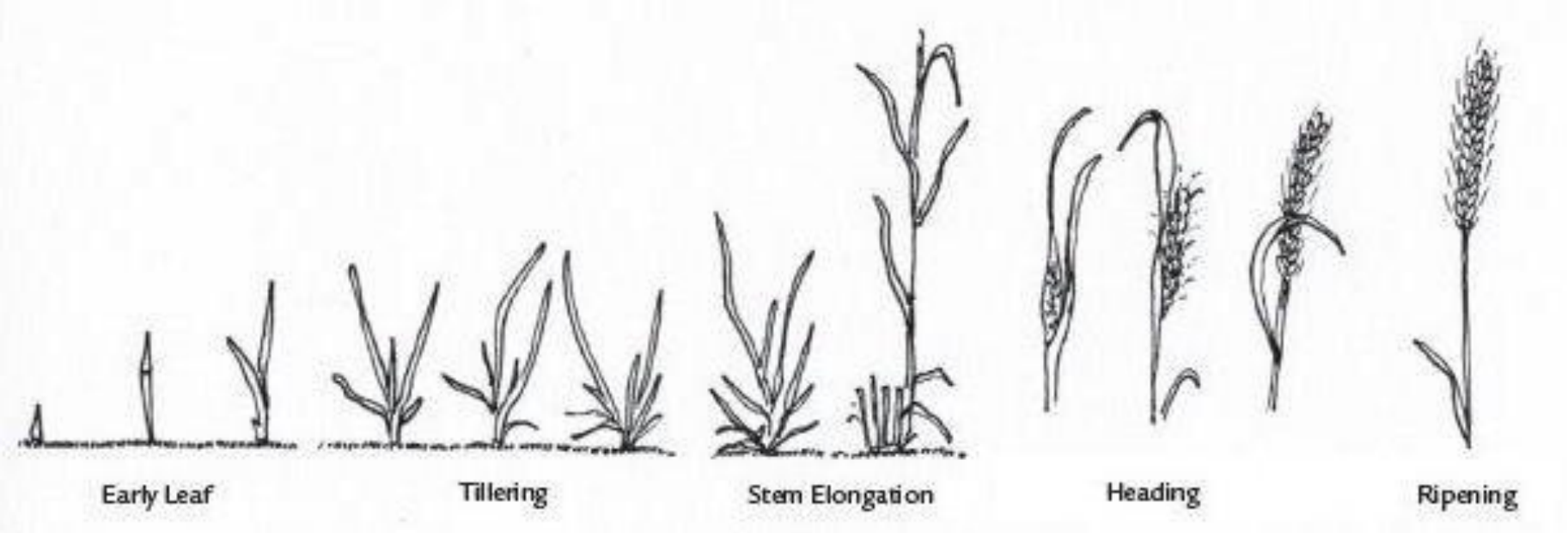


More info in *Nutrient Uptake Timing* (EB0191)

N availability affects yield and protein

Added N increases no. tillers and kernels per head
Grain will use N from stems/leaves to make protein

Added N goes to protein

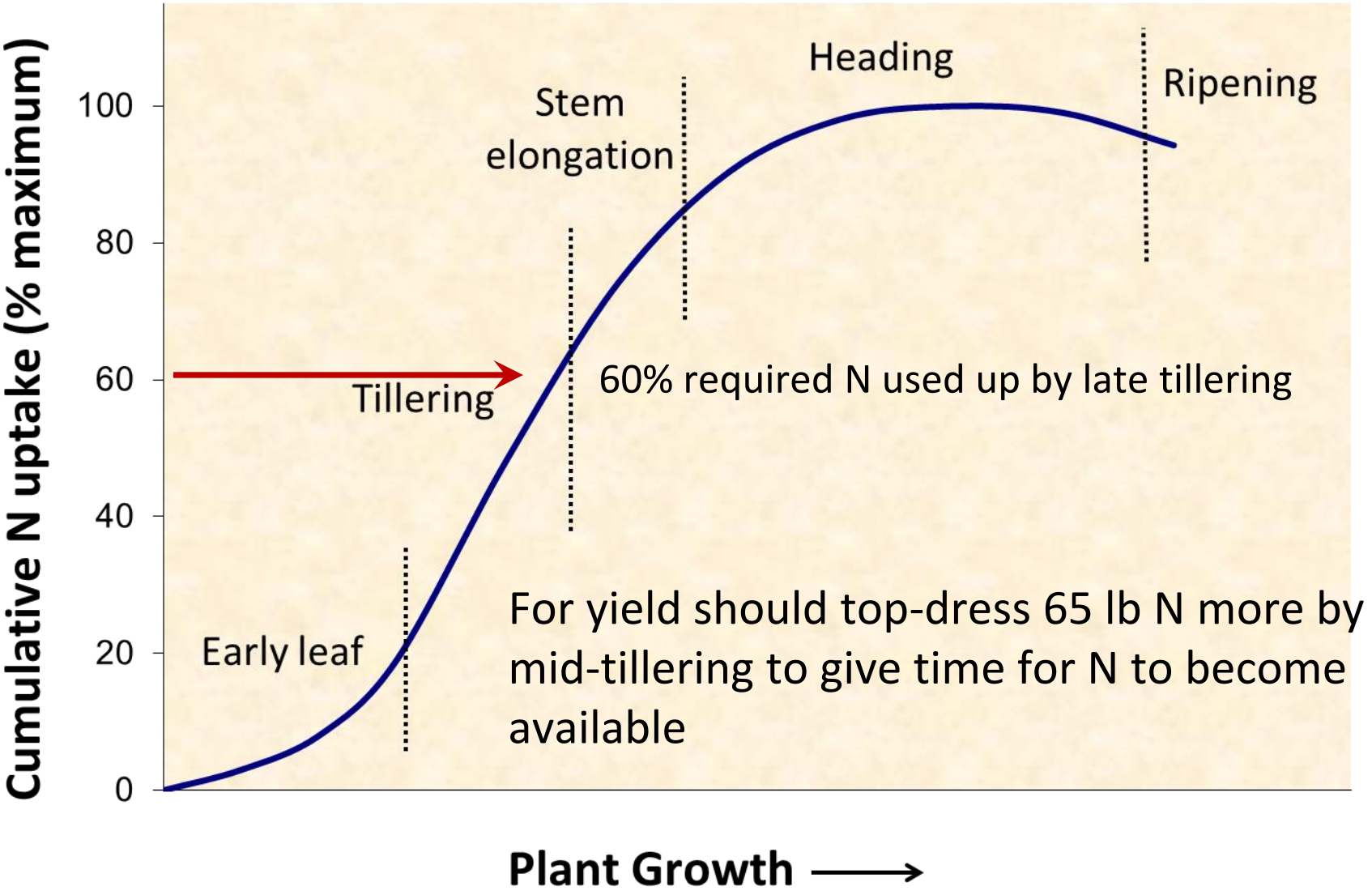


Use Nutrient Uptake figure to time top-dress

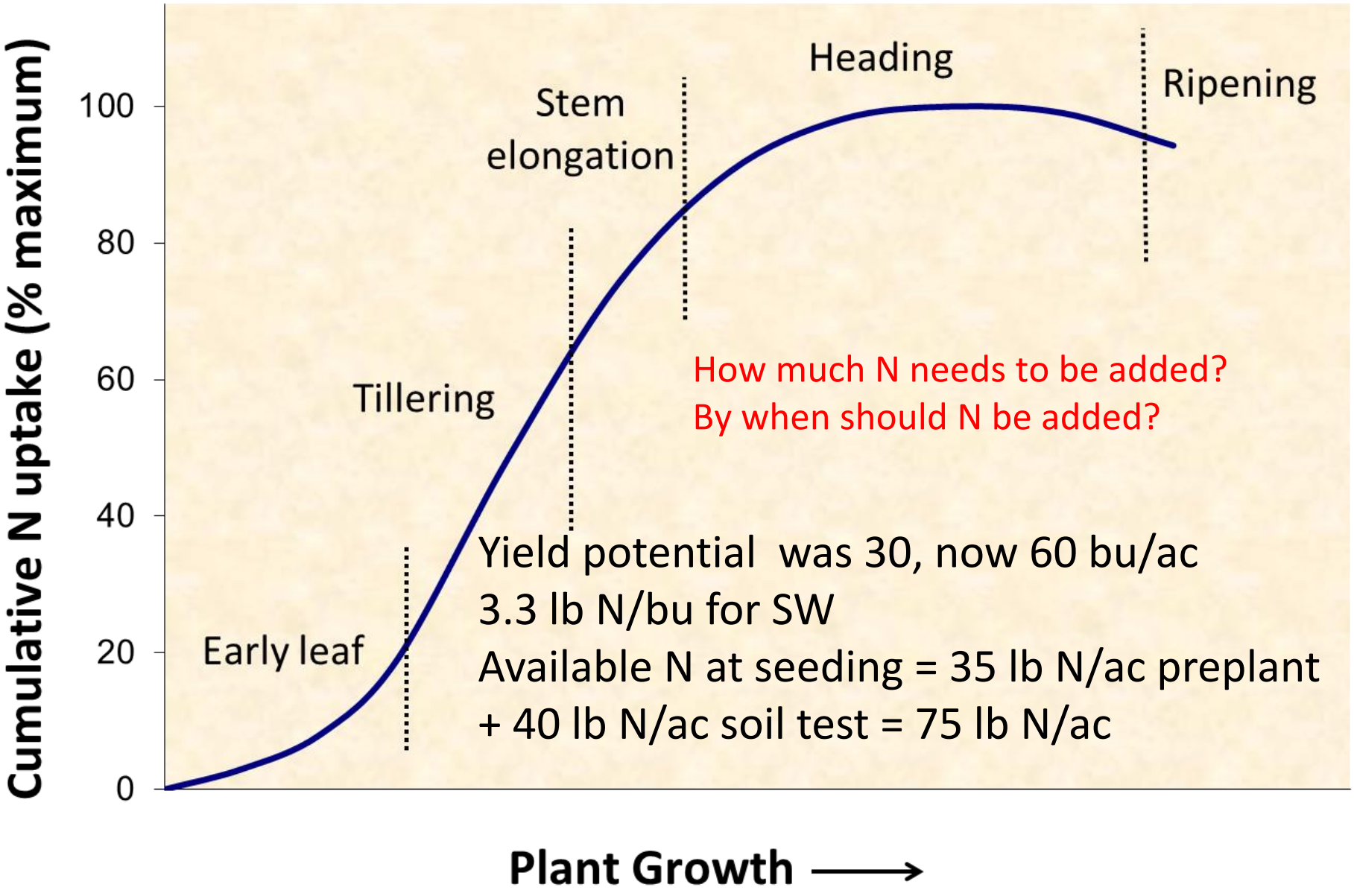
Example on per acre basis:

- 165 lb N total need
- 40 lb N in soil + 60 lb preplant N = 100 lb N = 60% total N required (100/165)
- (165 – 100) = 65 lb N needed to top-dress

Top-dress amount and timing based on wheat growth stage



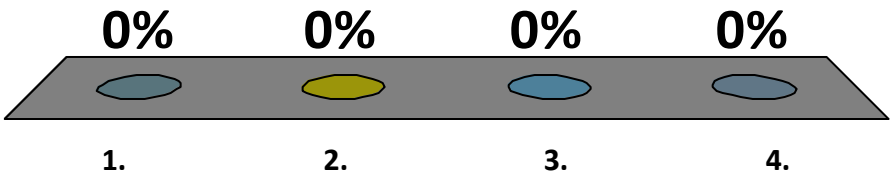
Your turn: It rains 6 more inches in May than average



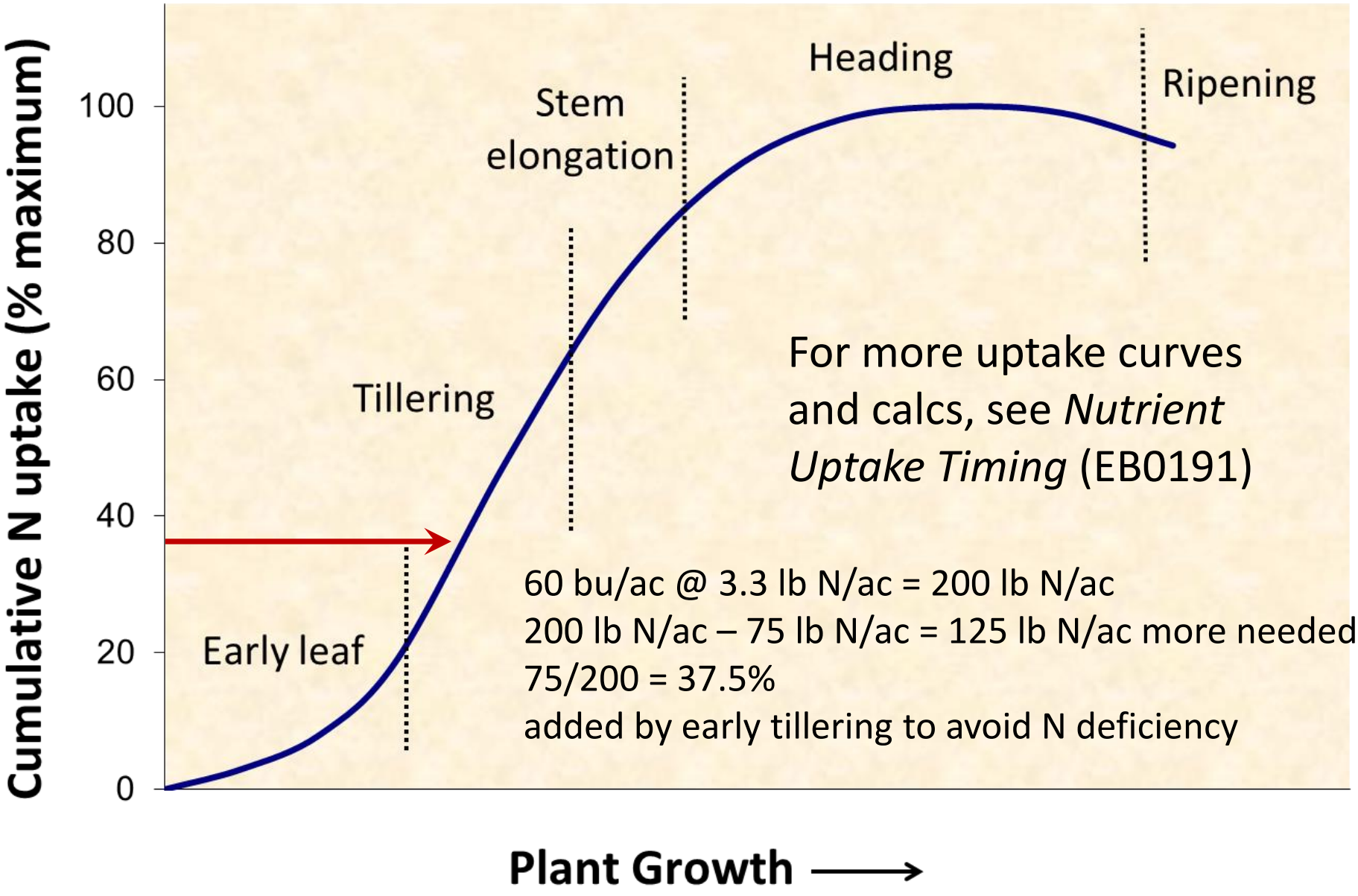
How much N needs to be top-dressed and by when if just do one top-dress?

1. 125 lb N/ac by early tillering
2. 125 lb N/ac by mid-tillering
3. 125 lb N/ac by mid-stem elongation
4. You are tough out of luck

Response Counter



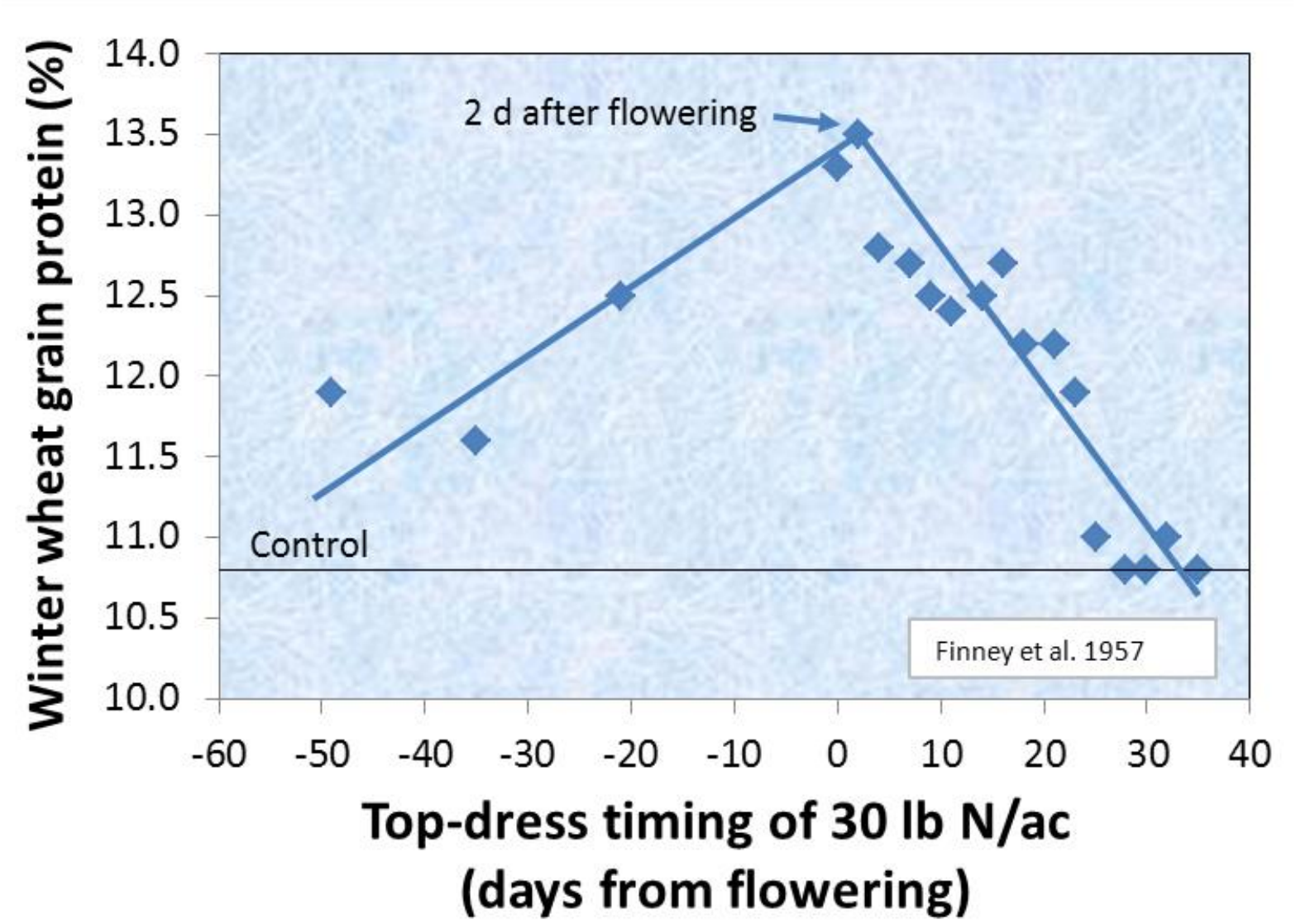
Answer


Cumulative N uptake (% maximum)
100
80
60
40
20
0
Heading
Ripening
Stem elongation
Tillering
Early leaf
Plant Growth
For more uptake curves and calcs, see *Nutrient Uptake Timing* (EB0191)
60 bu/ac @ 3.3 lb N/ac = 200 lb N/ac
200 lb N/ac – 75 lb N/ac = 125 lb N/ac more needed
75/200 = 37.5%
added by early tillering to avoid N deficiency

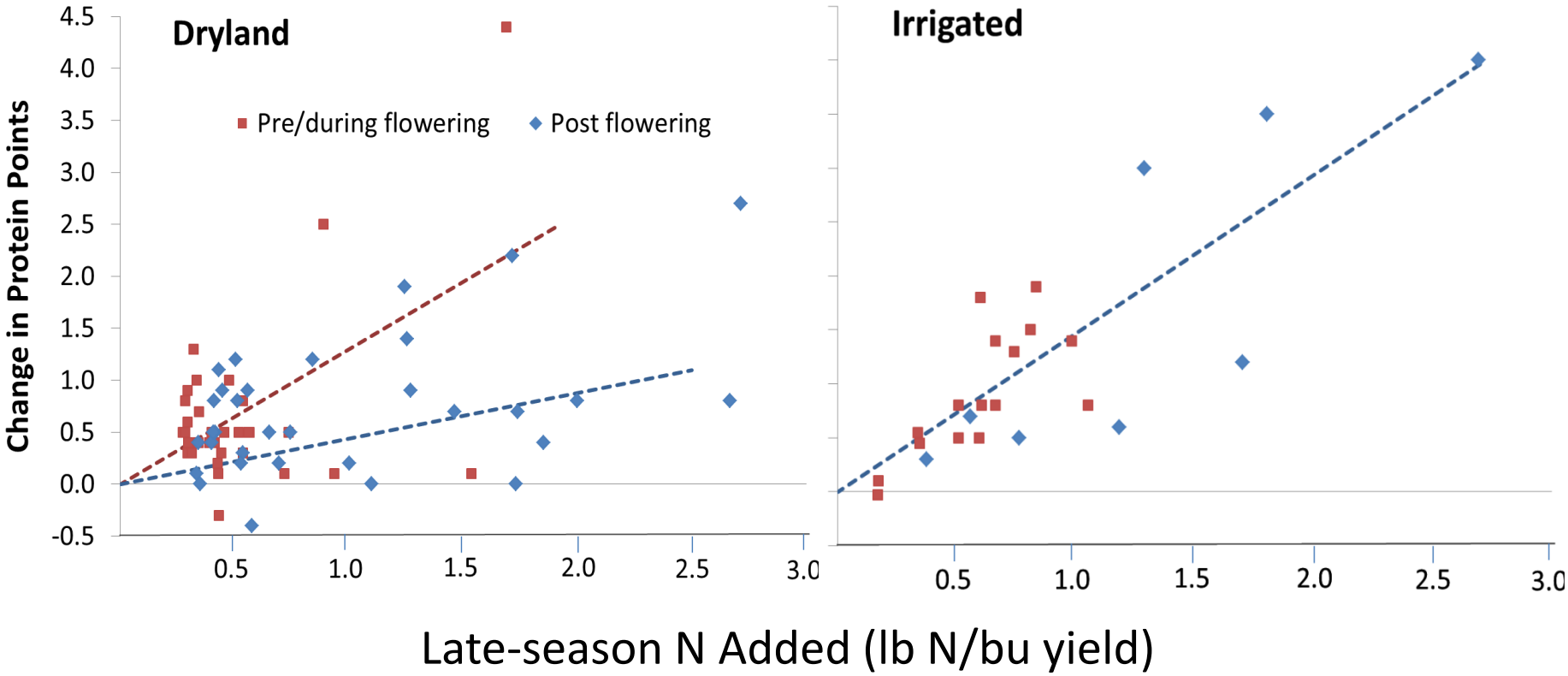
Split/In-season N Applications

- Fall broadcast supplies early growth needs
- In-season adjustment for estimated yield potential based on precip to date
  - Don’t apply 2nd application if dry
  - Apply large 2nd application if wet
- Later applications:
  - less chance of causing lodging
  - Potential to increase protein rather than yield

When should late-season N be applied to maximize grain protein?

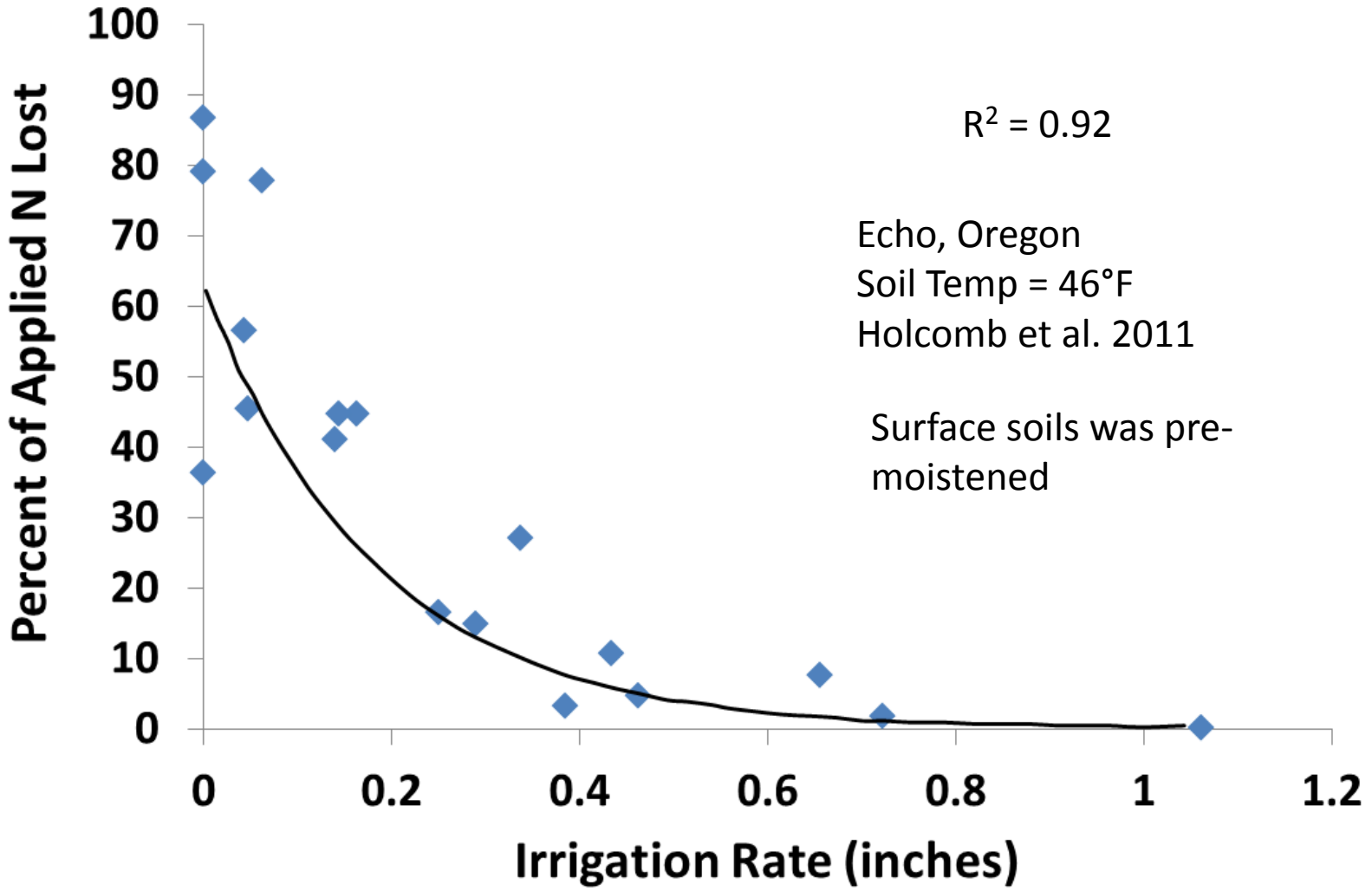


In-season N rate, timing, and dryland vs. irrigation affects protein boost



Ability to incorporate with rain or irrigation more important than exact timing at flowering

Broadcast before rain or irrigation (to minimize volatilization loss)



Take home message on N timing

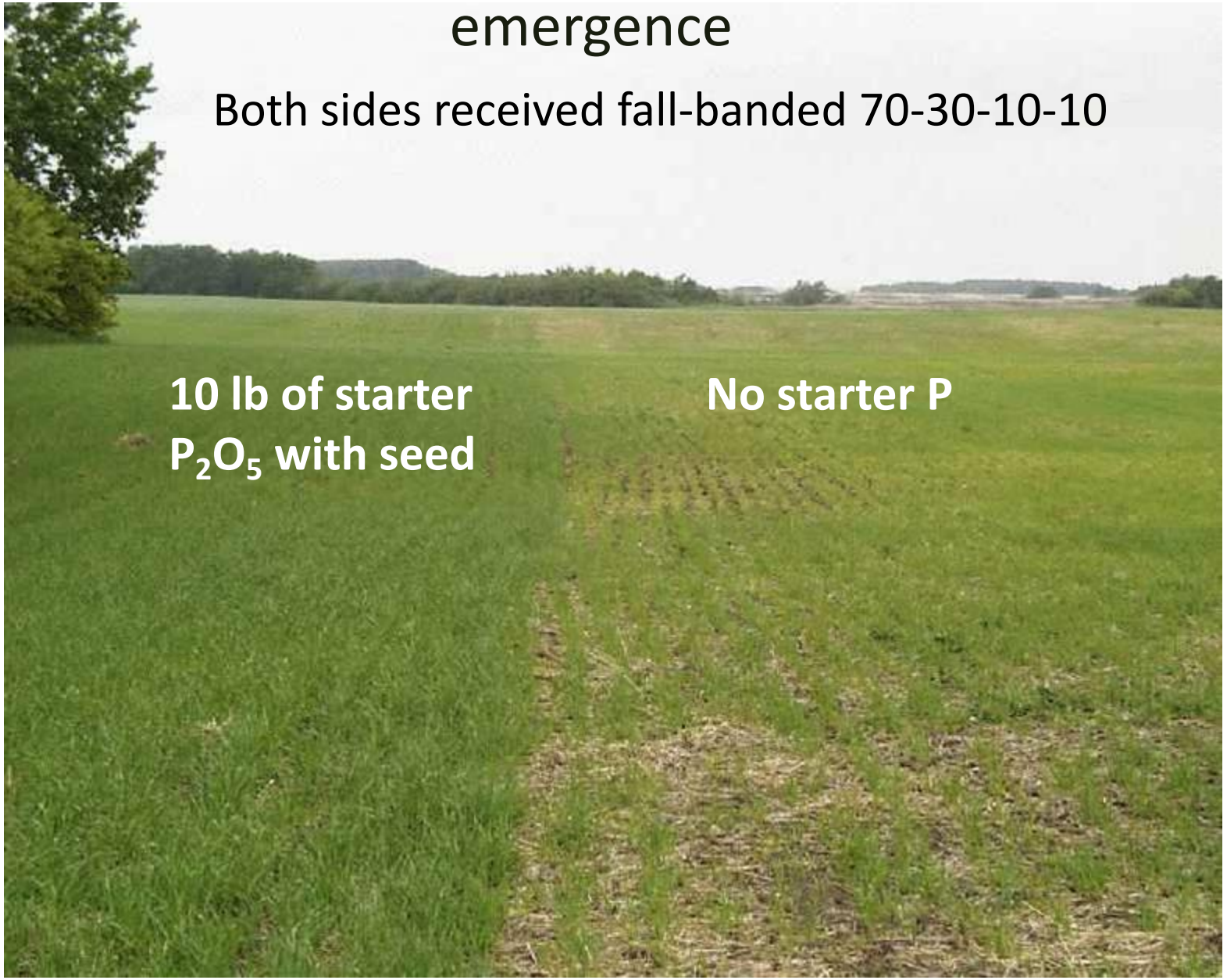
- Need sufficient N at tillering/stem elongation because of high N demand
- For protein boost, consider applying additional N
  - If you have a way to apply without physically damaging crop
  - If indicated by flag leaf N level (see Fertilizer Fact #12)
  - Irrigated – ideally during flowering
  - Dryland – more important to get incorporation with > 0.5” rain event than “correct” timing
- In-season foliar – minimize leaf burn (see Sources presentation)

Questions on N timing?

Phosphorus

- P is immobile and gets tied up in soil
- For cereal grains, consider starter (pop-up)
- For legumes:
  - Build P up before seeding perennials, or in the alternate crop year for annual legumes
  - On established alfalfa stands
    - Apply several years worth at one time
    - Apply after last cutting yet before fall period of re-growth to feed root reserves

Impact of starter P in a cool spring on spring wheat emergence



K timing

Is relatively immobile – what is best timing?

- For cereal grains: subsurface band or broadcast at seeding
- For legumes:
  - split between first and after last cutting to minimize luxury consumption of first harvest
  - apply after last cutting and before fall period of re-growth to feed root reserves

S timing

- In-season applications of ammonium thiosulfate and ammonium sulfate, can rapidly correct sulfur deficiency.
- Sulfate fertilizers not suggested for fall application. May leach overwinter.
- Elemental S slow to supply plant available S. Apply in fall or before seeding to become available before peak demands. Will supply crop for > 2-3 years.

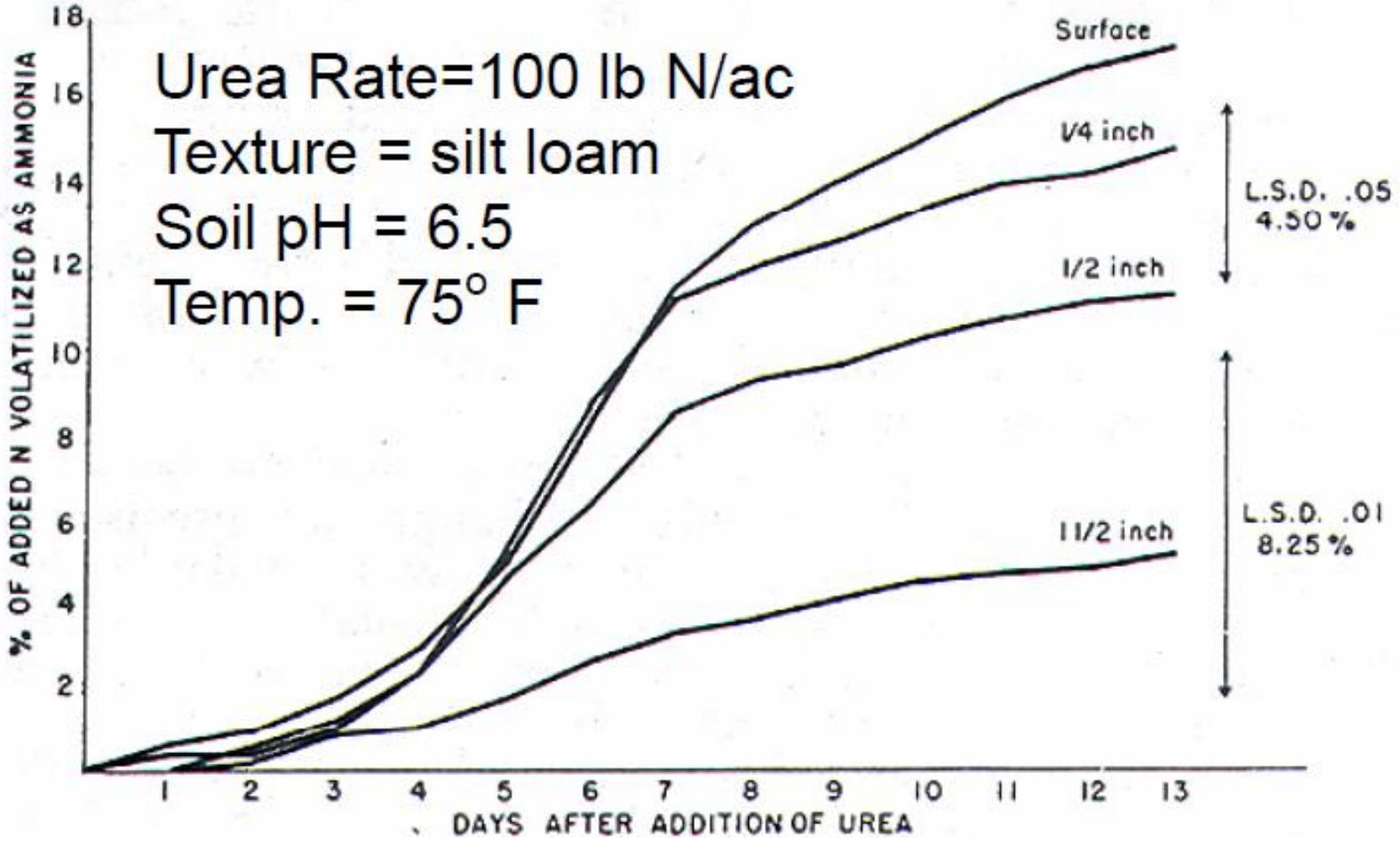
Questions on P, K and S timing?

Placement

N placement

- In general, subsurface placement/incorporation of N fertilizer decreases losses and increases availability

Incorporation depth on volatilization



Ernst & Massey 1960, lab

N seed placed

- Fertilizer is salty and can prevent germination if too close to seed
- As opener width goes up, or row spacing goes down, safe rates increase
  - A larger opener spreads out fertilizer, decreasing salt concentrations
  - Narrow rows = less N per row (10 lb N/ac max at wide row spacing)

Approximate safe rates of urea N (lb N/acre) to seed place with cereal grains

Soil texture	1” spread (disk or knife)			2” spread (spoon or hoe)			3” spread (sweep)		
	Row spacing			Row spacing			Row spacing		
	6	9	12	6	9	12	6	9	12
	%SBU[1.]			%SBU			%SBU		
	17	11	8	33	22	17	50	33	25
Light (sandy loam)	20	17	15	30	25	20	40	30	25
Medium (loam to clay loam)	30	25	20	40	35	30	50	40	35
Heavy (clay)	35	30	30	50	40	35	60	50	40

From: Saskatchewan Ministry of Ag

1. SBU = (seed row width/row spacing) x 100

How compare with MSU guideline’s?

A note on legumes and N

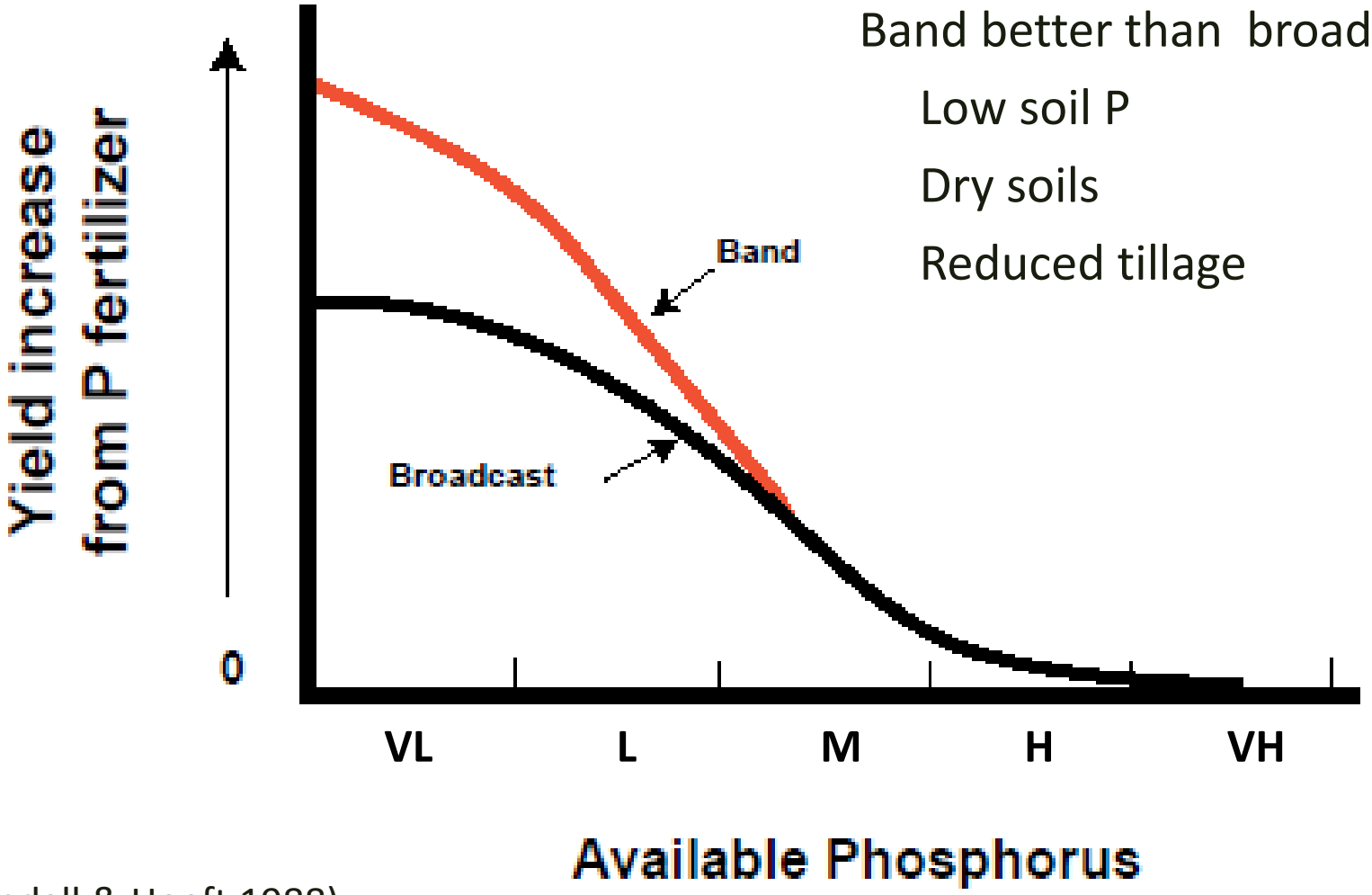
10 – 20 lb N/acre can be top-dressed or placed away from the seed to boost seedlings towards N-fixation, especially if soil N < 15-20 lb N/acre

Placement of phosphate and KCl

- Incorporate prior to seeding
- Place in rooting zone at seeding
  - Advantage – fast uptake in spring
  - Disadvantage– dry out soil and can cause poor germination

- Avoid seedling burn
  - <20 lb P_2O_5/acre MAP 0 DAP with seed
  - <10-15 lb N plus K_2O with seed

P band vs. broadcast



Band better than broadcast:

- Low soil P
- Dry soils
- Reduced tillage

(Randall & Hoeft 1988)

Micronutrient fertilizer application timing and method

Timing

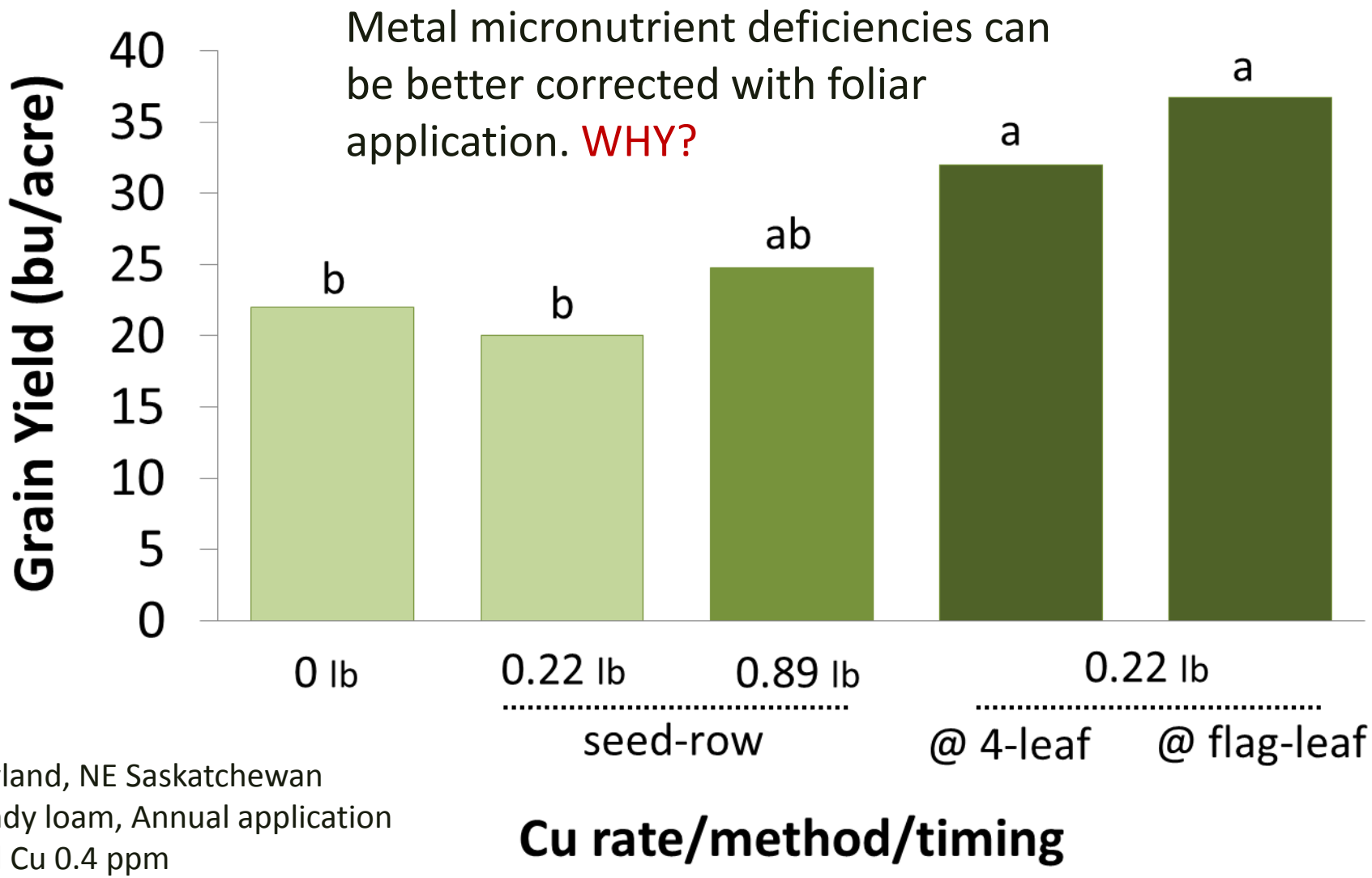
- Borate, chelated or sulfate forms: Spring
- Oxysulfate forms: Fall

Method

- Preferred method is broadcast and incorporated – except iron is best as chelated, foliar
- Seed-placed and subsurface band is generally not recommended (due to toxicity)
- Foliar applications use less than ½ the suggested rate. Can be done with borate, and chelated copper, iron, manganese and zinc

Karamanos 2000, Gerwing and Gelderman 2005

Copper Rate, Method and Timing Effects SW Grain Yield



Dryland, NE Saskatchewan
Sandy loam, Annual application
Soil Cu 0.4 ppm
Malhi et al. 2005

Summary

- Slowly available sources - apply well before early plant growth
- Readily available sources - apply just before rapid plant growth
- N for grain protein - apply near flowering
- Build up P and K to supply legumes
- Mobile nutrients can be broadcast
- Urea should be incorporated, watered or placed beneath soil surface
- Non-mobile nutrients should be placed near rooting area

Questions?

For more information see MSU Extension's

Fertilizer Placement and Timing (4449-11)

http://landresources.montana.edu/nm/

MT Cool-Season Pulse Production Guide (EB0210)

Nutrient Uptake Timing (EB0191)

Practices to Increase Wheat Grain Protein (EB0206)
http://landresources.montana.edu/soilfertility/

Flag Leaf Diagnosis of Grain Protein Response to Late-season N application in Irrigated Spring Wheat (FFact # 12) http://landresources.montana.edu/fertilizerfacts/