Timing of Foliar Applications

Crop School

Gallatin, Madison/Jefferson, and Broadwater Extension

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MONTANA STATE UNIVERSITY EXTENSION

AGRICULTURE

MAKING A DIFFERENCE IN MONTANA COMMUNITIES

Objectives

- Discuss timing of nitrogen, phosphorus, and potassium uptake
- Show research results on the effects of:
  - Nitrogen foliar application timing on yield, protein, and weed seeds
  - Sulfur and nitrogen foliar applications on leaf burn
  - Phosphorus and micronutrient foliar applications on grain yield

Help Us Help You

- How many of you use foliar fertilizers?
- Do you use N? P? K, S or micronutrients?
- What are some of the reasons you use them?
- What are some concerns?

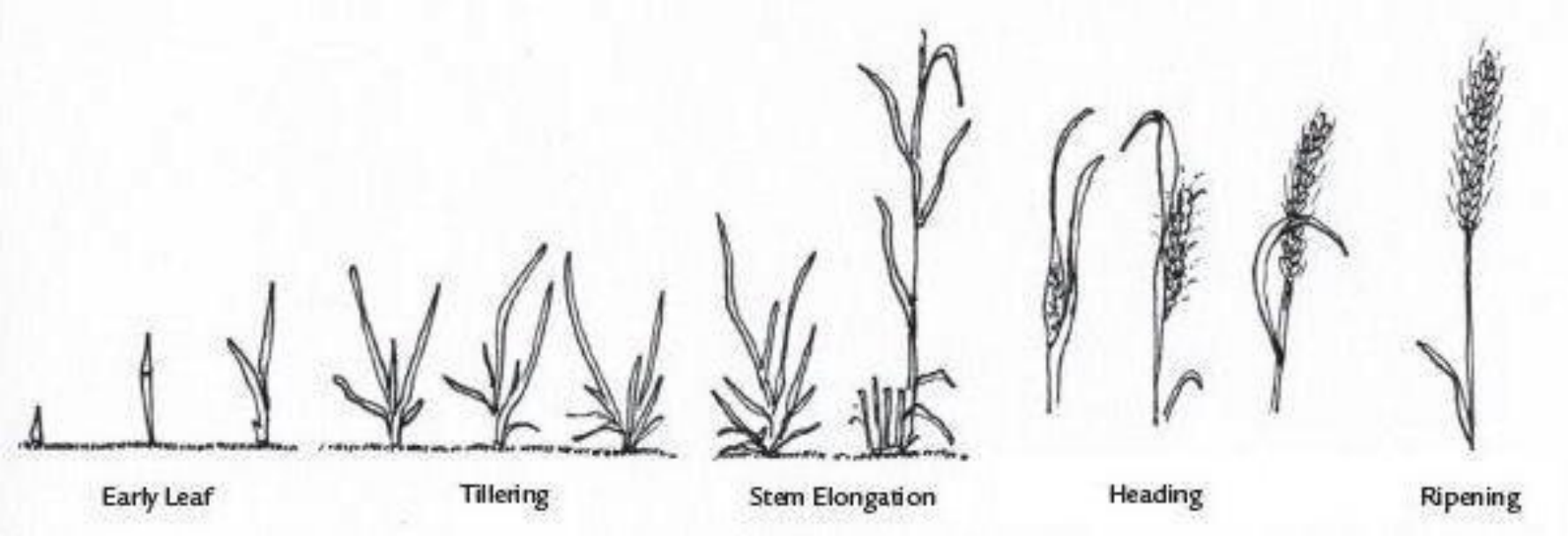
Nitrogen Topdressing and Split Applications

- How do I decide when to topdress if I don't want to hurt yields and want to maximize protein?
- First need to know how much the plant needs and when it needs it.

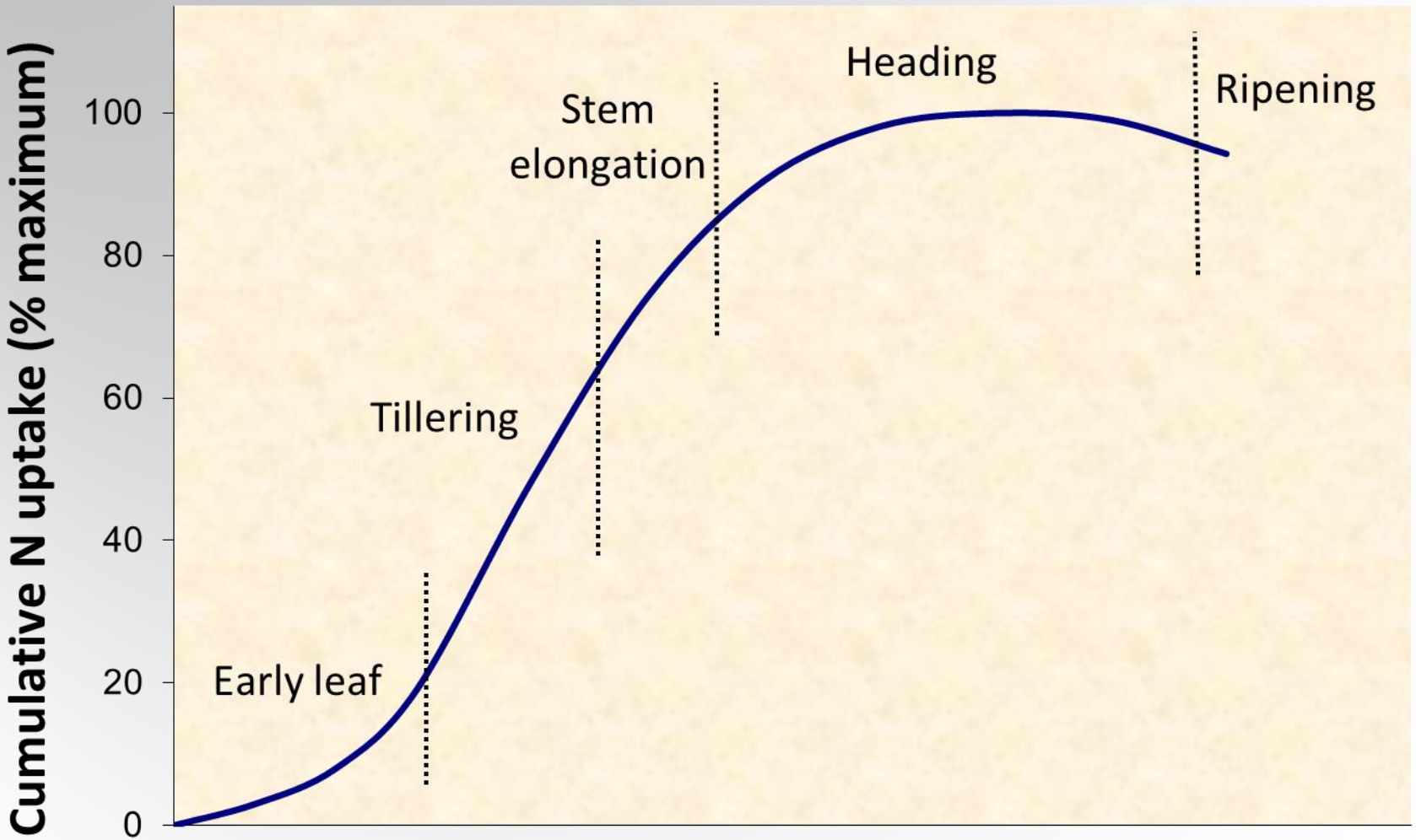
Timing: N availability affects yield and protein

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

Added N goes to protein



Top-dress amount and timing based on wheat growth stage to not hurt yield



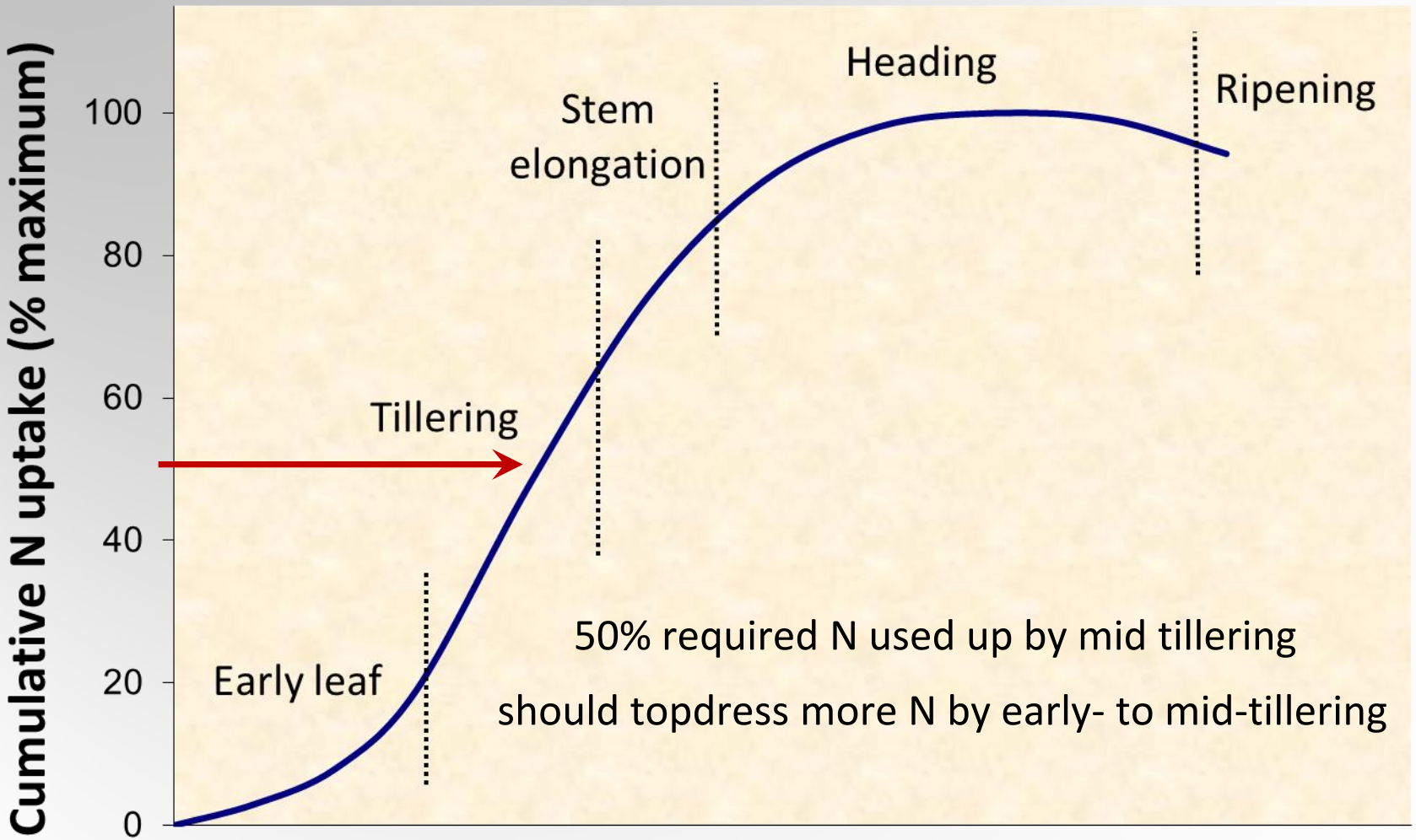
More info in Nutrient Uptake Timing (EB0191)

Using nutrient uptake figure (from EB0191) to time 2nd application

Winter wheat example on per acre basis:

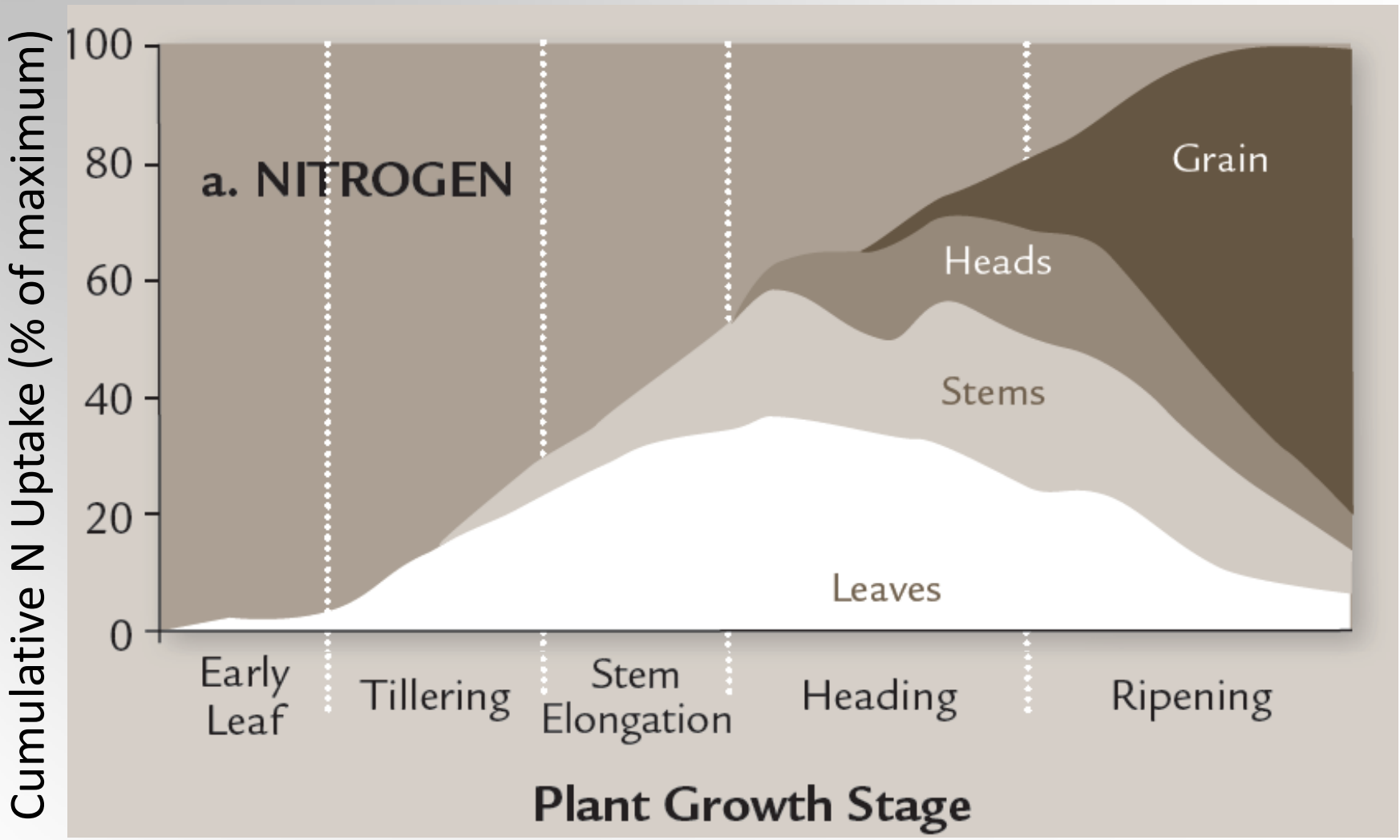
- Yield goal: 40 bu, ~100 lb N total need - 40 lb N in soil = 60 lb N applied in fall
- Wet winter and early spring doubles yield potential. Need an additional 100 lb N.
- Question: How late could additional N be applied w/o hurting yield?

Top-dress amount and timing based on wheat growth stage to not hurt yield



More info in Nutrient Uptake Timing (EB0191)

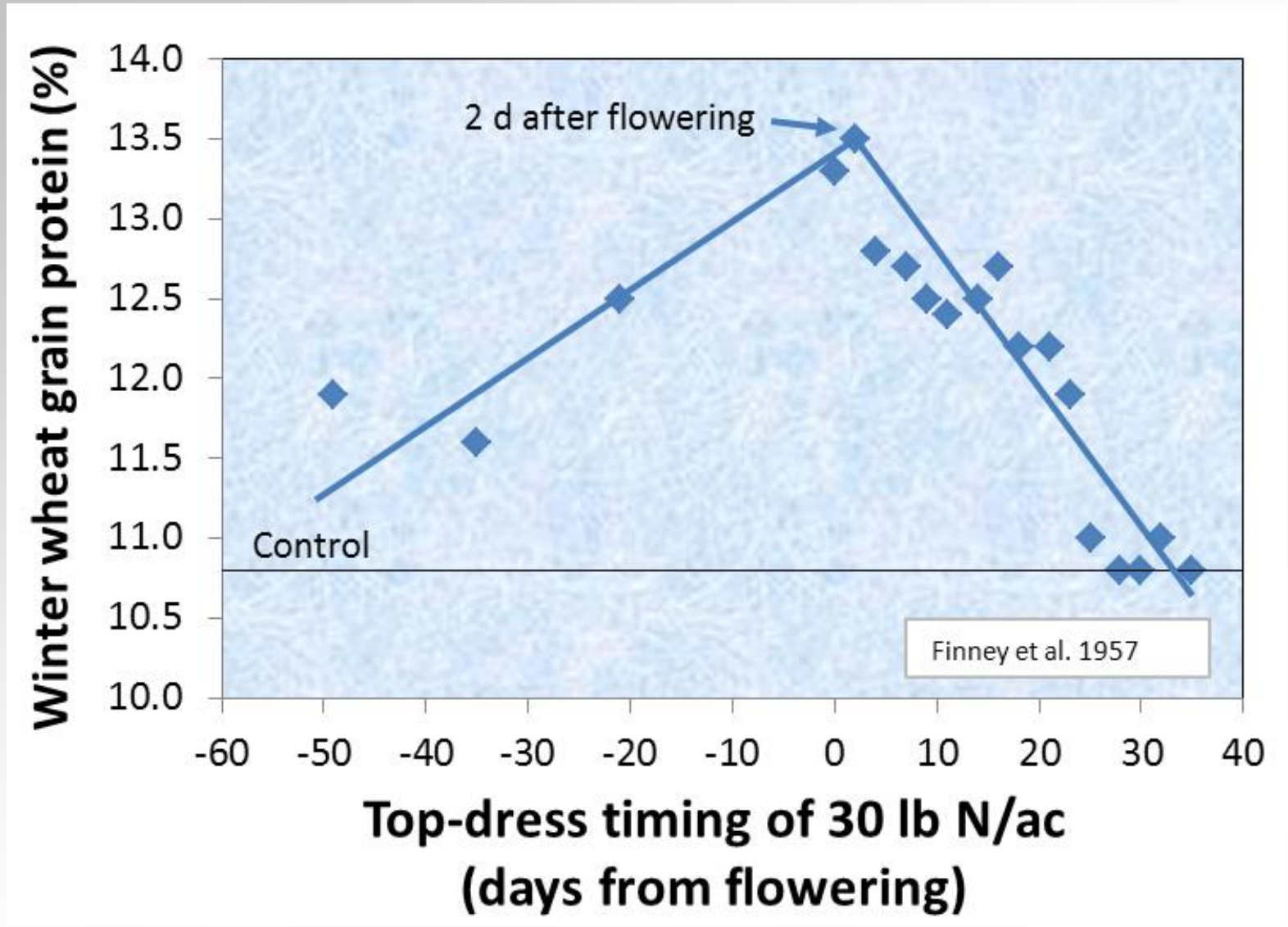
N Uptake as Wheat Grows



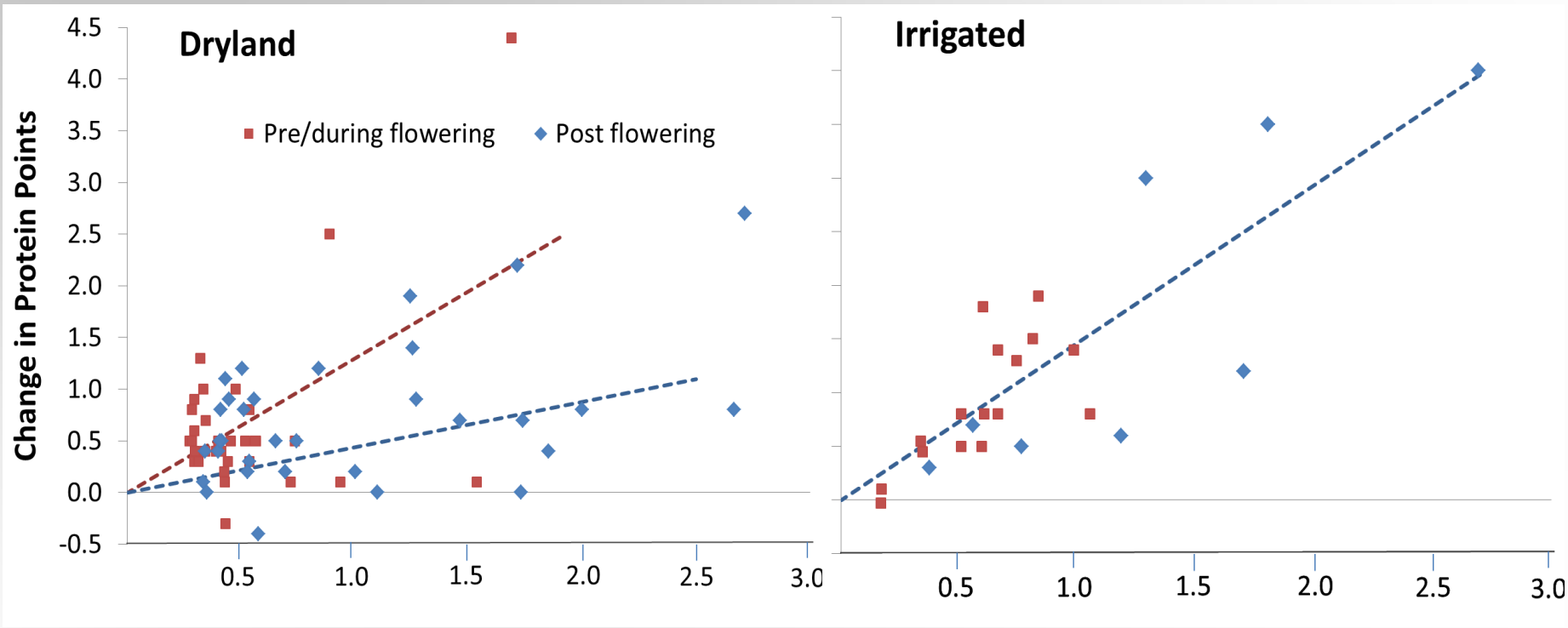
Nutrient Uptake Timing by Crops (EB0191; Miller 1994)

Gallatin Valley, irrigated

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



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



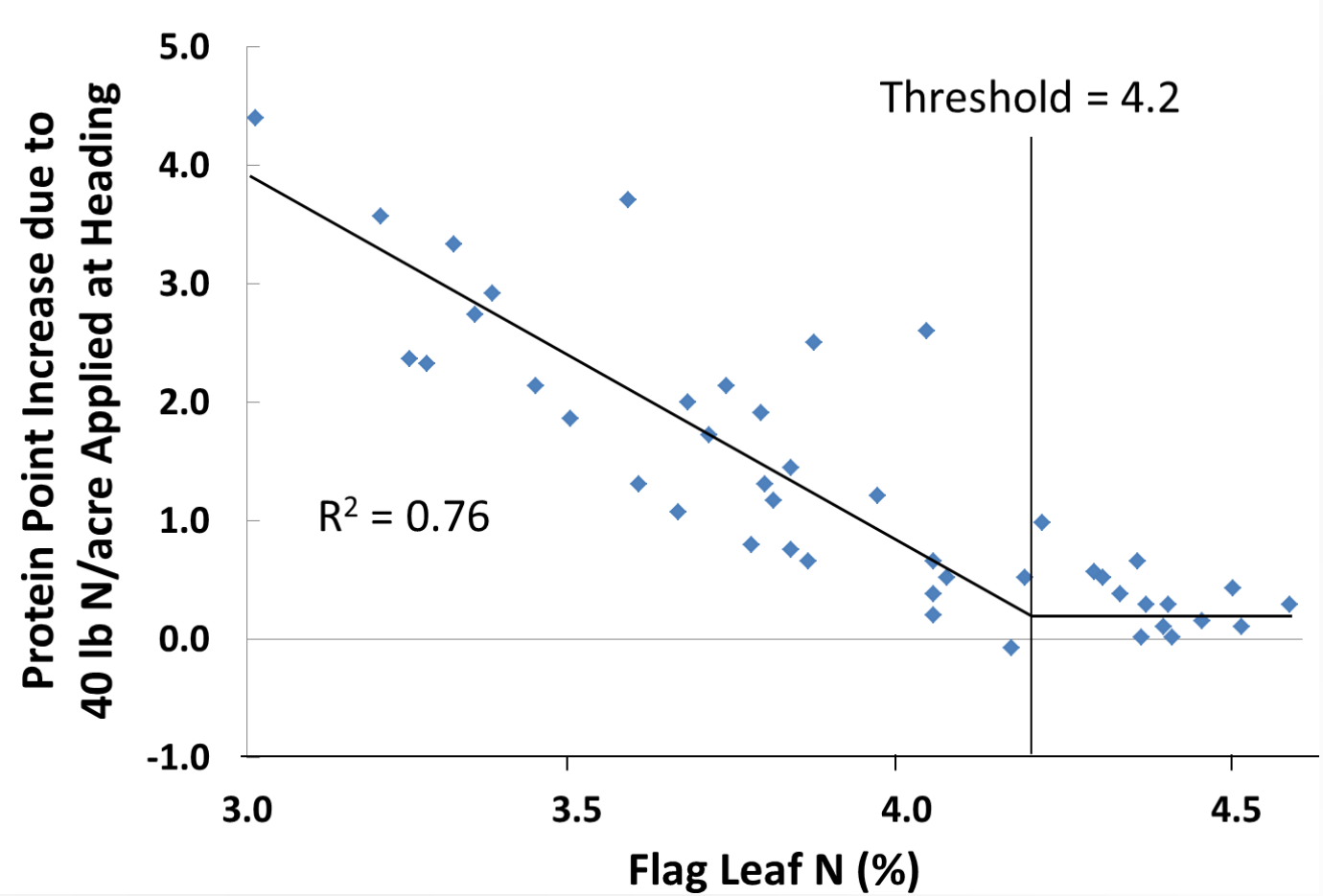
Ability to incorporate with rain or irrigation more important than exact timing at flowering

How should you decide whether to apply late-season N?

Ask:

1. Do you have a way to apply N without severely damaging crop? (e.g. fertigation, high clearance weed sprayer, fly it on)
2. Are protein discounts sufficiently high to justify cost? (calculation will depend on expected % protein boost)
3. What is the flag leaf N concentration?

Effect of top-dressing 40 lb N/acre at heading on spring wheat grain protein increase as affected by flag leaf N



Relationship between protein response to N top-dressed and flag leaf N in irrigated sw. Fertilizer Fact 12

What is the ‘critical flag leaf N’?

- Critical FLN = FLN below which should top-dress N to maximize profit (and above which should result in a loss).
- Critical FLN = 4.2 – 13.3(N cost in $/lb N)/((protein discount per point)(expected yield))
  - -13.3 is application rate from study (40 lb N/ac) divided by slope of response on previous figure (-3)
  - Example 1: If ratio of N cost to discount = 1.5 (May 2012) and yield = 50 bu/ac, critical FLN = 3.9%.
  - Example 2: If ratio of N cost to discount = 4 (current) and yield = 50 bu/ac, critical FLN = 3.2% (rarely this low).
- Bottom line: need far lower FLN to justify top-dressing for protein IF ratio of fertilizer cost to discount is high.

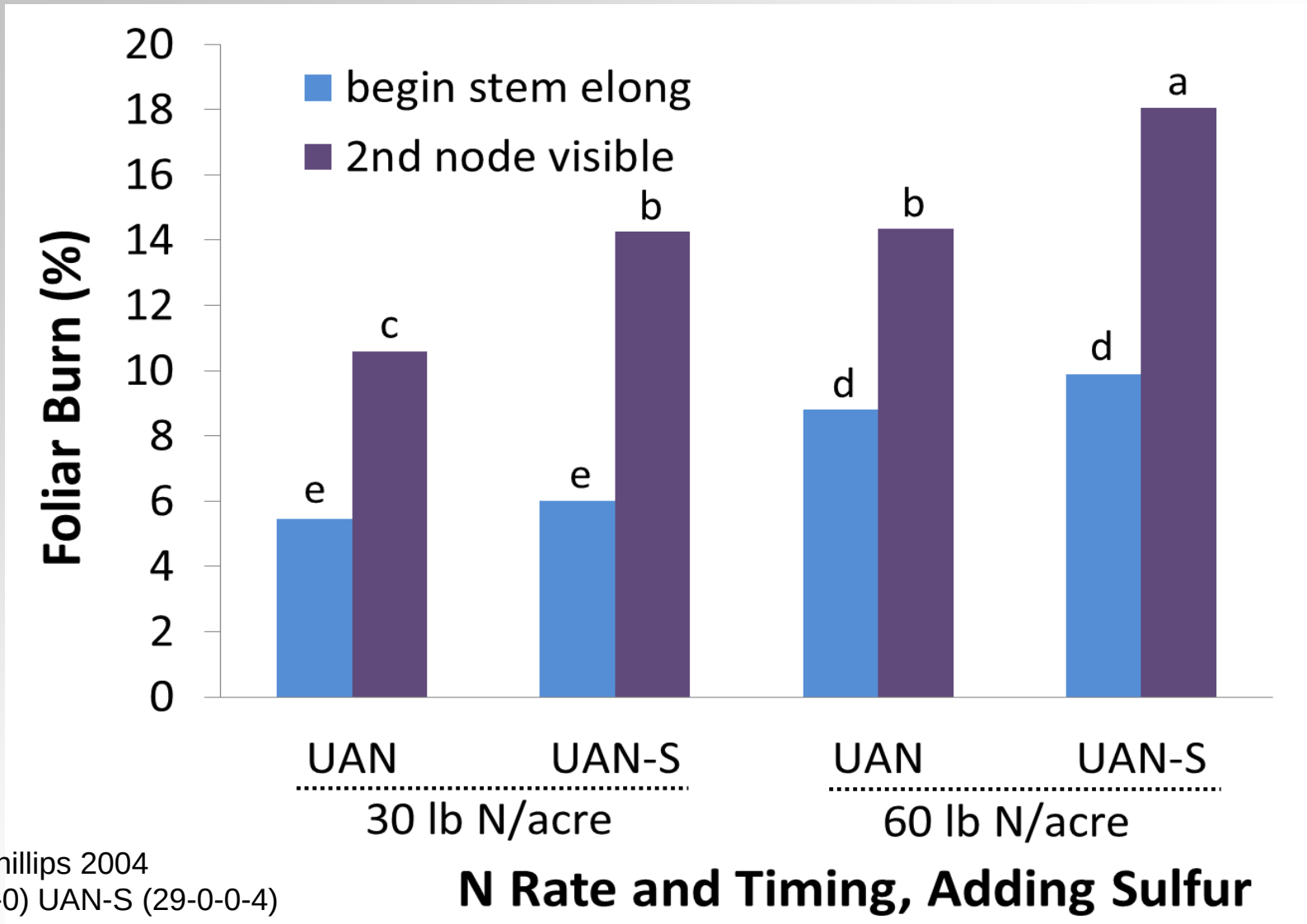
Foliar N facts and recommendations

- Only 1-16% of foliar N taken up through leaf
- Apply with ½ inch water to move into soil
- If scab risk, do not irrigate within 5 days of flower
- Leaf damage increased with:
  - Surfactant + more than 20 lb N/ac of 28-0-0 UAN
  - Urea + Agrotain®
  - Sulfur

How much N should be top-dressed at flowering?

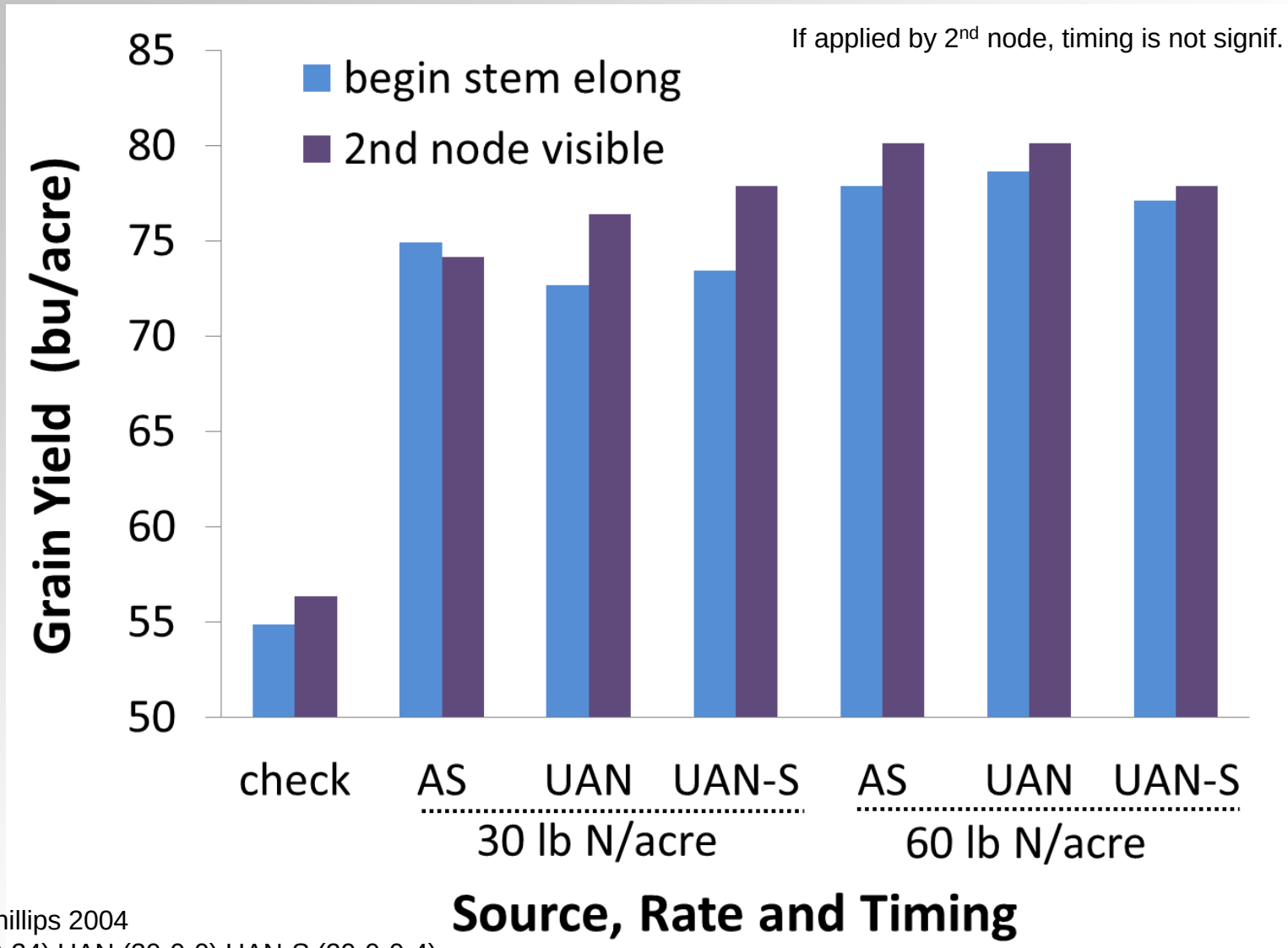
- Will depend on flag leaf N (if measured), protein discounts, and cost of application. About 20 to 30 lb N/ac is typical.
- No more than 30 lb N/ac of UAN (b/c of burn risk)
- No more than 45 lb N/ac of liquid urea to minimize burn and yield loss (Brown and Long, 1988)
- If determined that should add N, then add as much as possible w/o excessive burning for best economic rate (b/c ‘dilutes’ cost of application)

Foliar N Rate and Timing and Addition of S on WW Leaf Burn



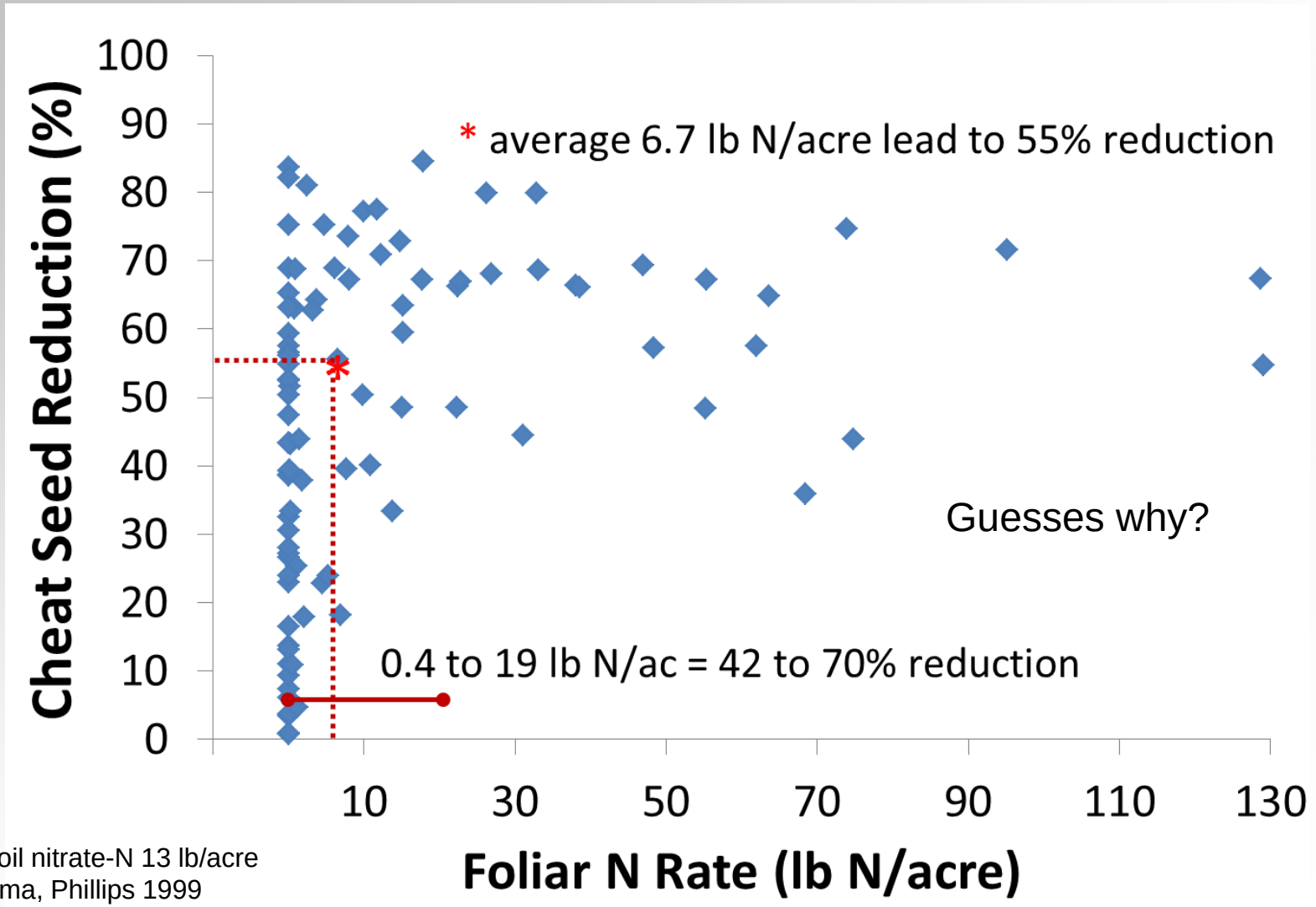
Virginia , Phillips 2004
UAN (30-0-0) UAN-S (29-0-0-4)

Foliar N Rate and Timing and Addition of S on WW Grain Yield



Virginia, Phillips 2004
AS (21-0-0-24) UAN (30-0-0) UAN-S (29-0-0-4)

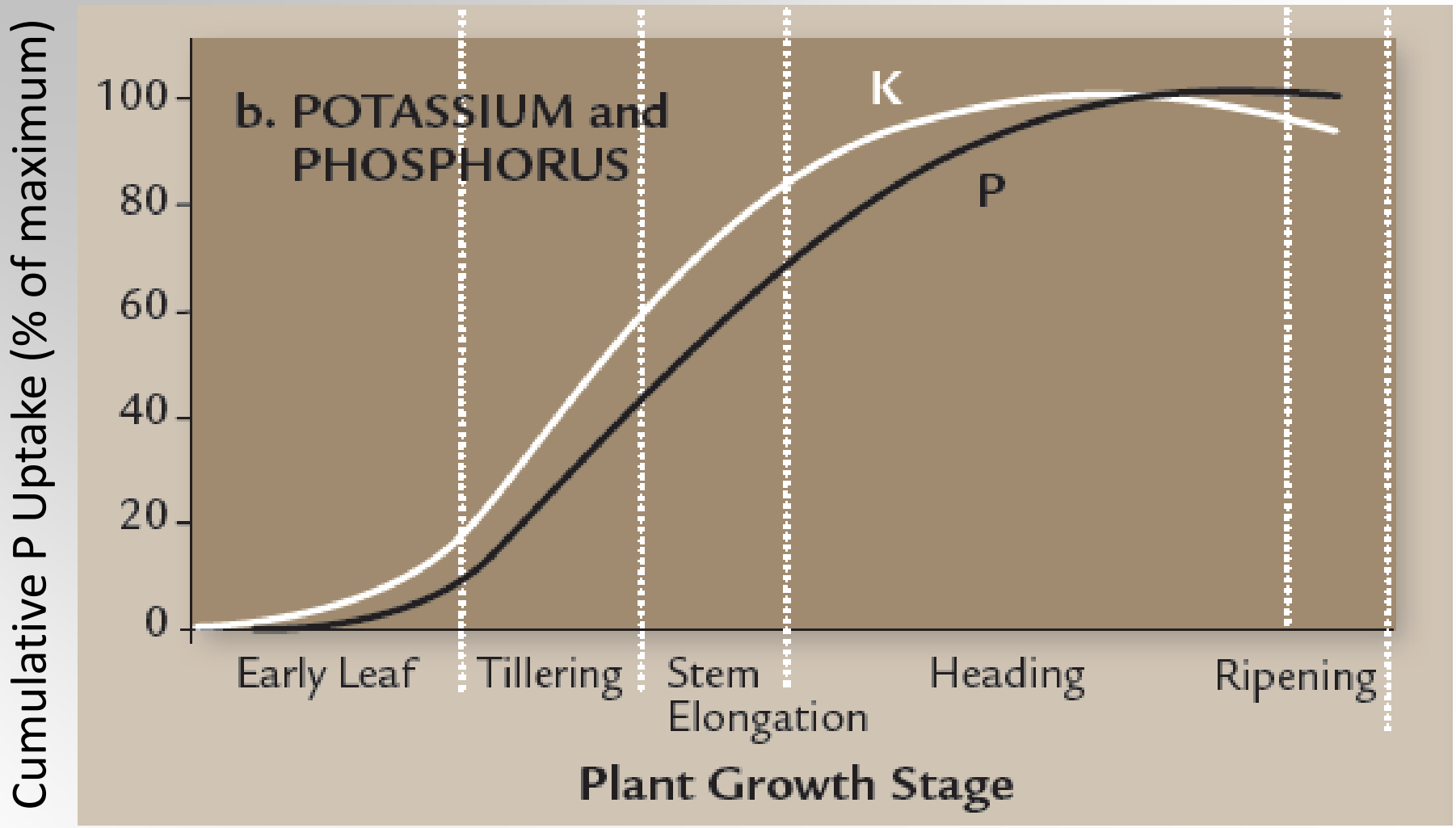
Foliar N after WW flowering but before cheat flowering reduces cheat seed production



Initial soil nitrate-N 13 lb/acre
Oklahoma, Phillips 1999

Questions on Foliar N Applications?

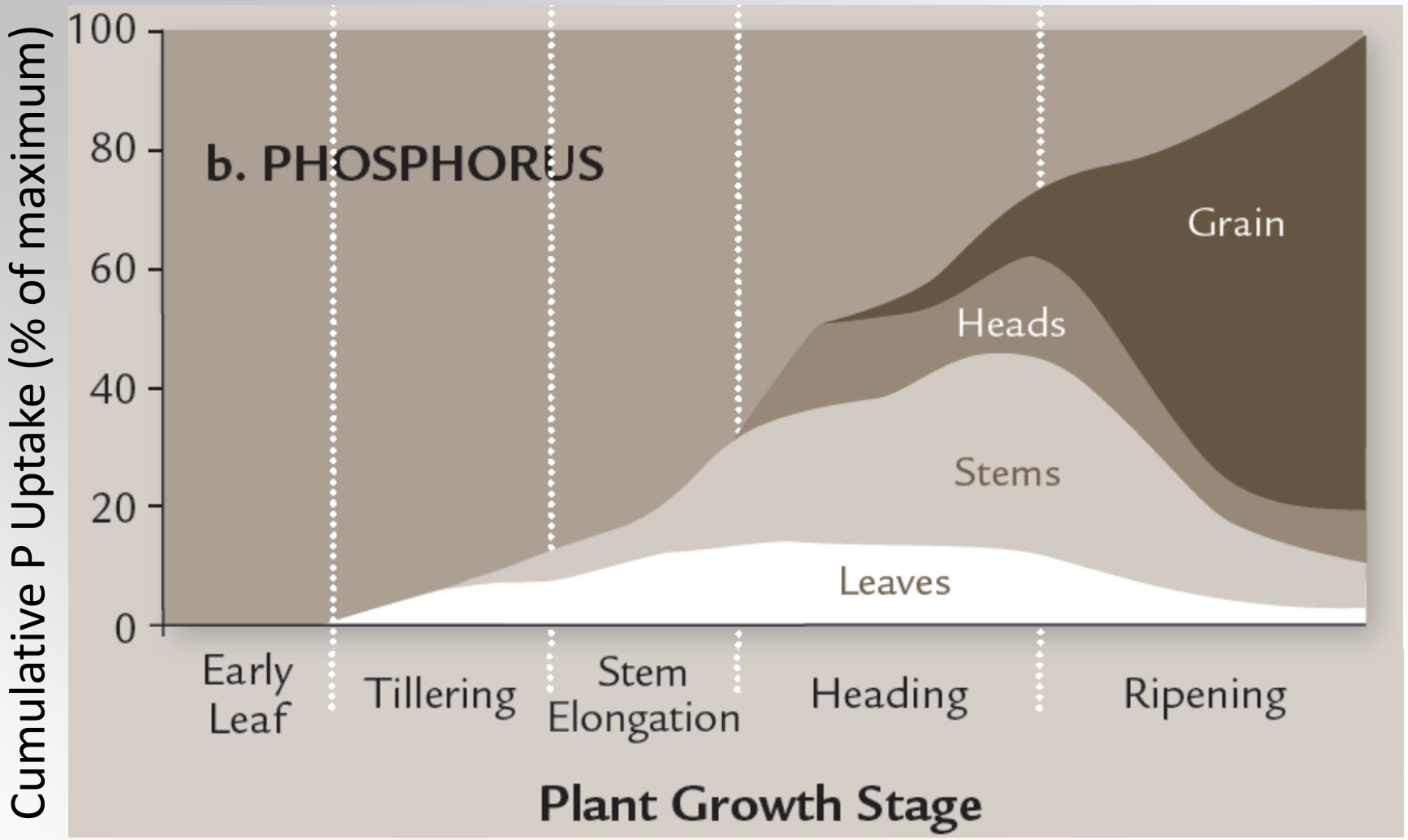
Cumulative P and K Uptake by Small Grains



Nutrient Uptake Timing by Crops:
to assist with fertilizing decisions
http://landresources.montana.edu/soilfertility

Saskatchewan, Adapted from Malhi 1998

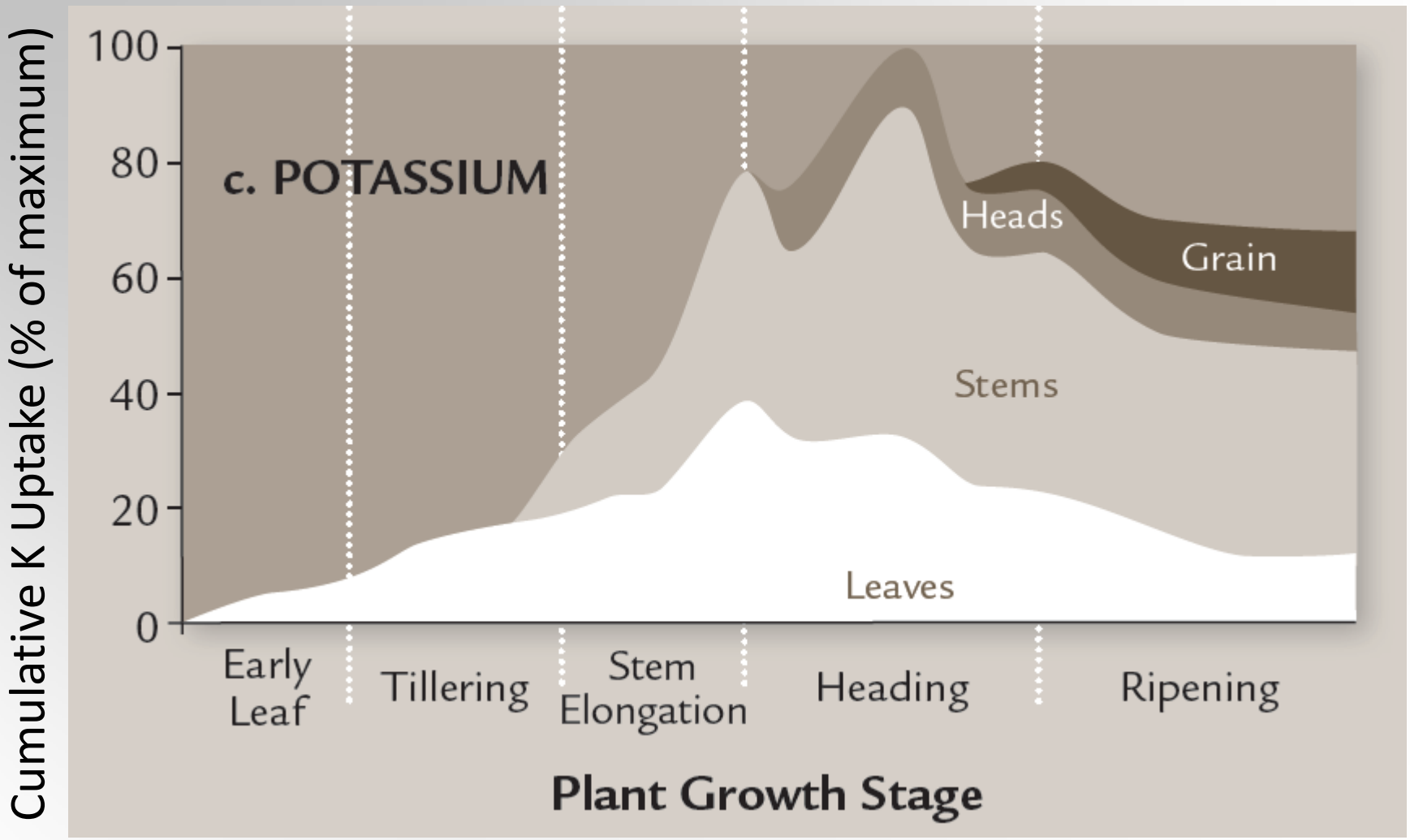
P Uptake as Wheat Grows



Nutrient Uptake Timing by Crops (EB0191; Miller 1994)

Gallatin Valley, irrigated

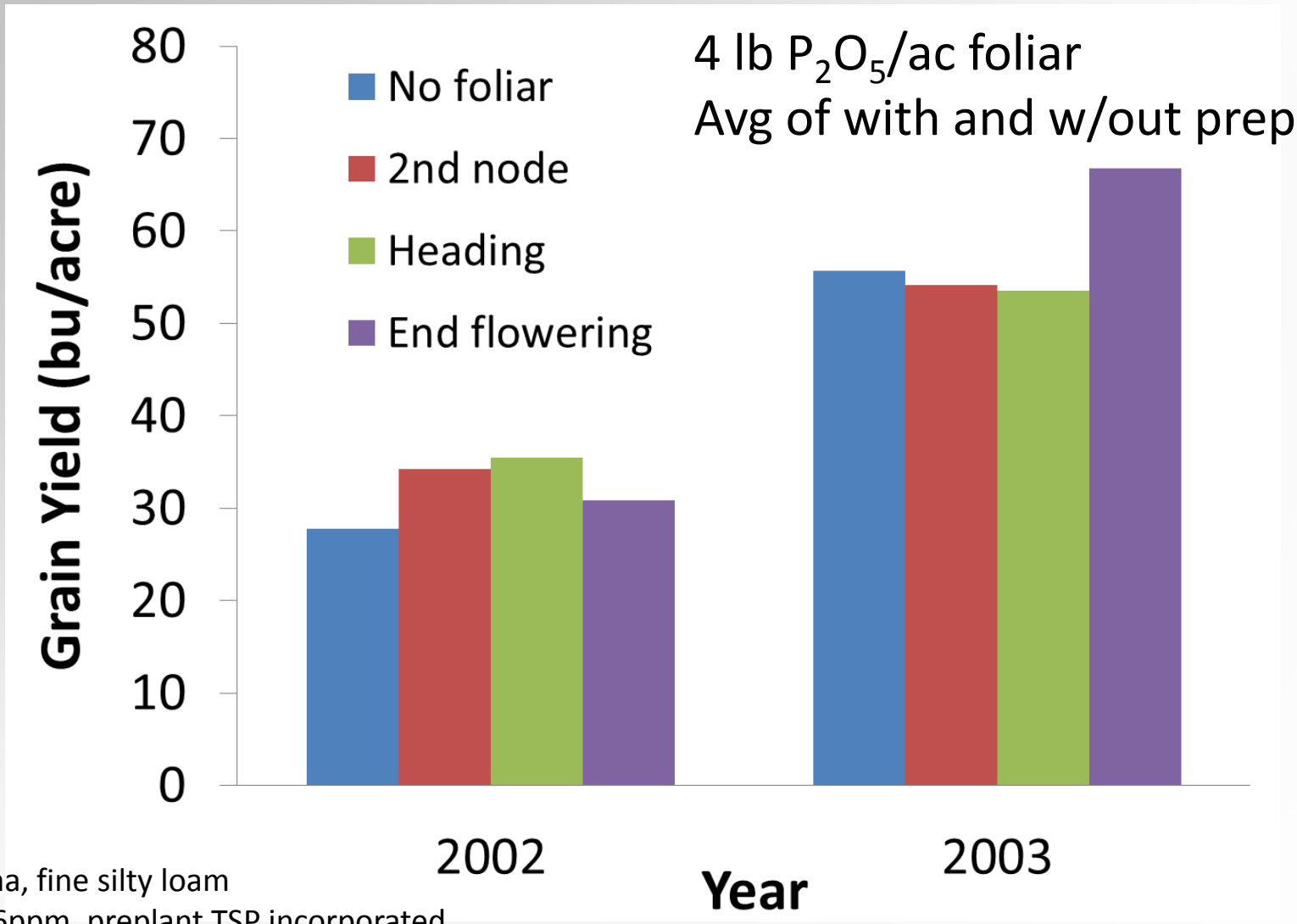
K Uptake as Wheat Grows



Nutrient Uptake Timing by Crops (EB0191; Miller 1994)

Gallatin Valley, irrigated

Timing of Foliar P Depends on Growing Conditions



Oklahoma, fine silty loam
Olsen P 6ppm, preplant TSP incorporated
Mosali 2006

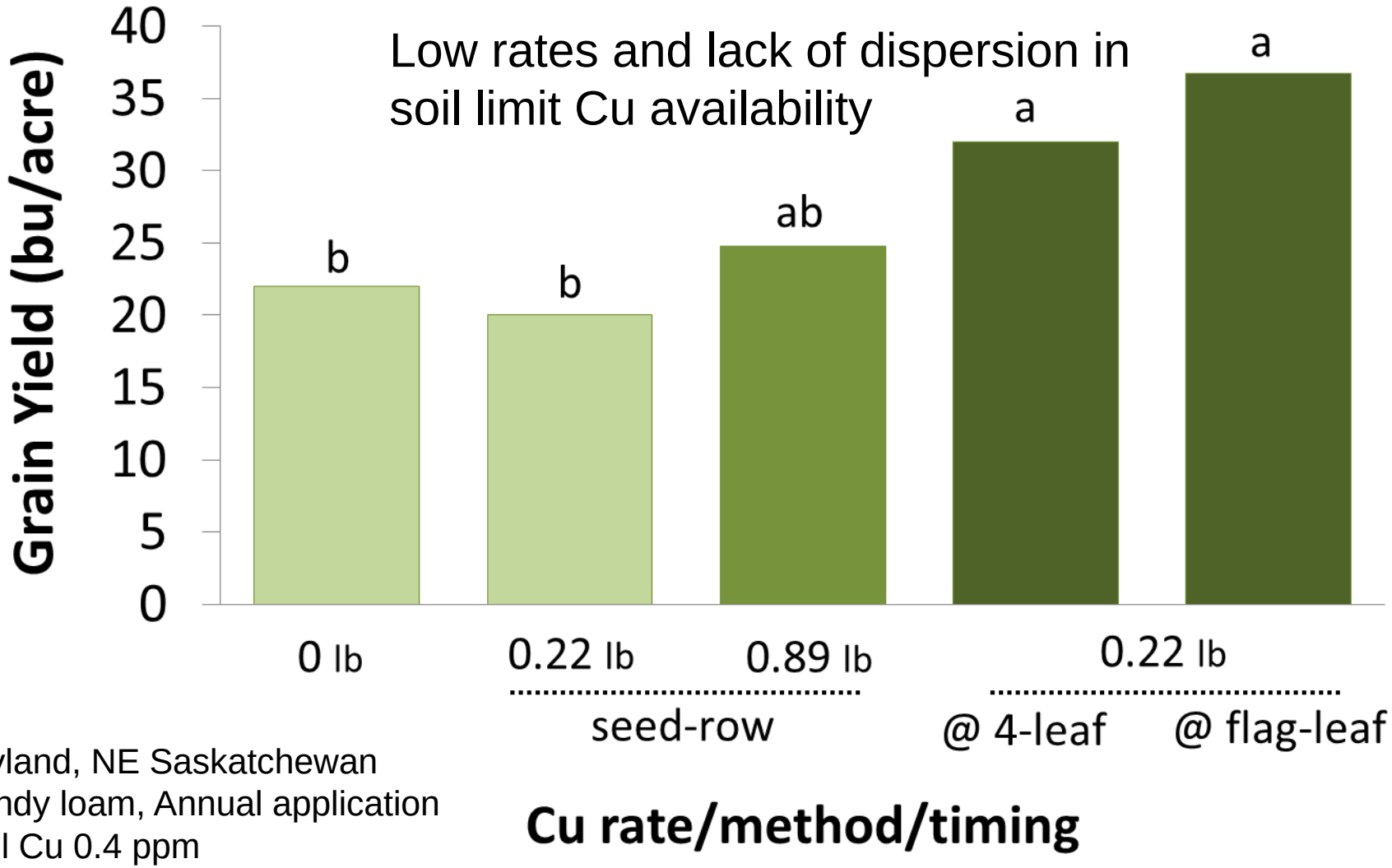
K and Micronutrients

Every article we found on foliar K was conducted on K sufficient soils w/ no to minimal benefits, as expected.

IF apply foliar K, should be by late tillering given very rapid uptake during stem elongation.

How about metal micronutrients, like copper?

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

Conclusions

- Foliar applications can increase grain yield and protein.
- N foliar applications can fairly consistently increase grain protein and sometimes increase yield.
- Decision to apply foliar N for protein, should be based on an economic ‘critical flag leaf N’ level
- N should applied before flower on dryland to maximize chance for rain event to push N into soil
- N can be applied before or after flower on irrigated soils with similar protein bump

Conclusions Continued

- N has been found to decrease weed seed production if applied just before flower
- Foliar phosphorus can increase grain yield on low P soils
- Did not locate info on foliar potassium except on high K soils
- Yield responded more to foliar copper than seed-row applied copper. Possibly similar for other metal micronutrients.

Other Resources

- Soil Fertility information: http://landresources.montana.edu/soilfertility
- Above link contains an Economic N rate calculator, Fertilizer Fact sheets, Press Releases, Extension documents like *Nutrient Uptake Timing by Crops, Enhanced Efficiency Fertilizers,* and *Practices to Increase Grain Protein* and this presentation

Questions?