How do we catch up when lacking key nutrients
Huntley CCA and Dealer Training

August 4, 2011

by Clain Jones, Extension Soil Fertility Specialist
and Kathrin Olson-Rutz, Research Associate
clainj@montana.edu; 994-6076

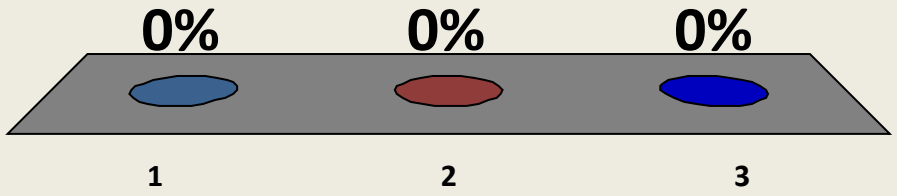
MONTANA STATE UNIVERSITY
EXTENSION

AGRICULTURE

MAKING A DIFFERENCE IN MONTANA COMMUNITIES

You have been handed these clickers because:

1. Clicker training is not just for dogs
2. Professors just have to give tests
3. They are more humane than cattle prods to keep you awake



0 of 5

Today's objectives

- Look at options for mid- to late-season nutrient adjustments
- Focus on N
  - Rate, timing and application methods
- Effectiveness of in-season P
- Discuss fertility of waterlogged soils

Split/In-season N Applications

1. By splitting N application, can better estimate yield potential based on precip to date

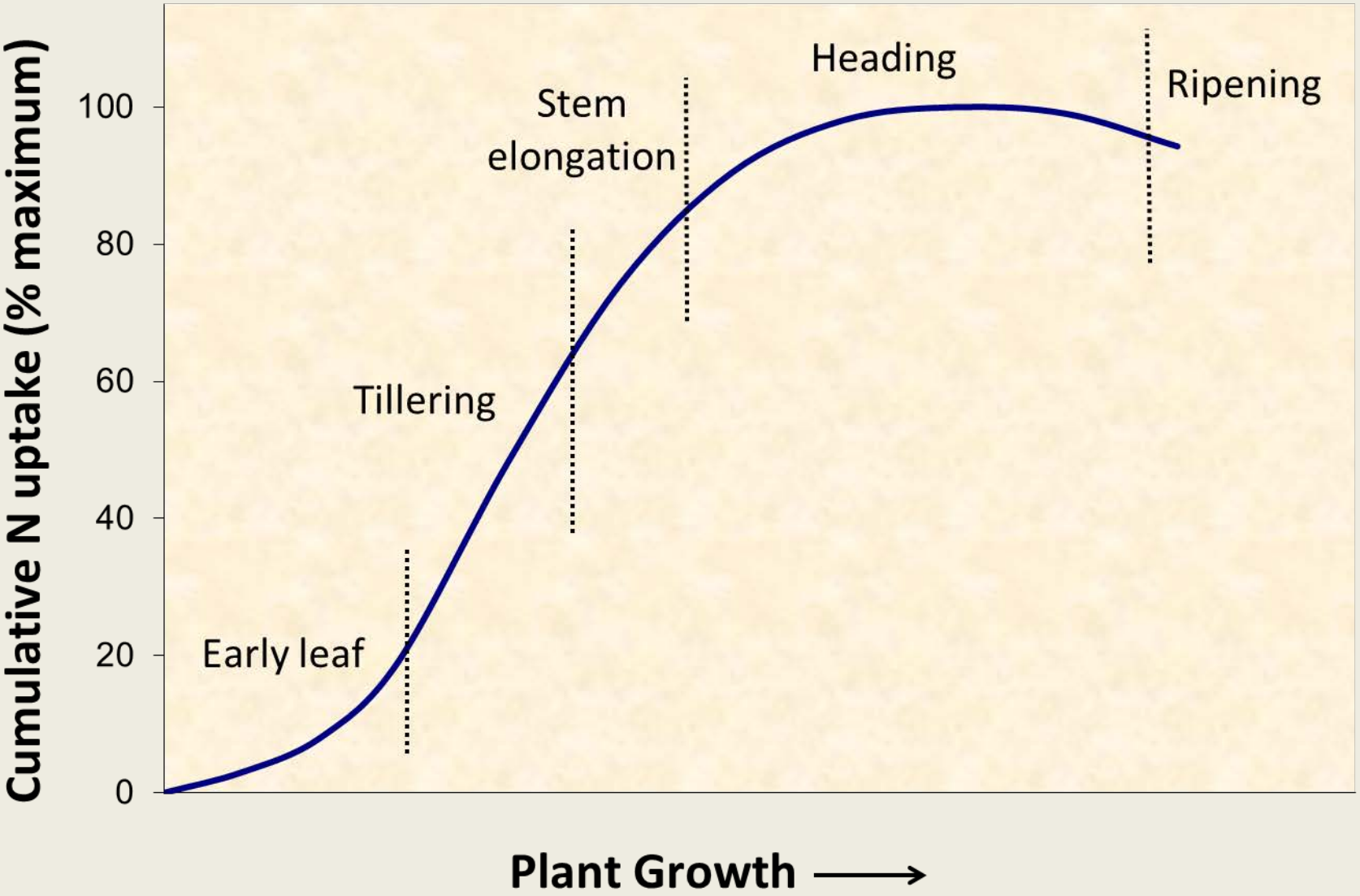
   - Don't apply 2nd application if dry

   - Apply large 2nd application if wet

2. Mid-season applications increase yield, later applications have a better chance of making protein

3. Later applications have less chance of causing lodging

Top-dress amount and timing based on wheat growth stage

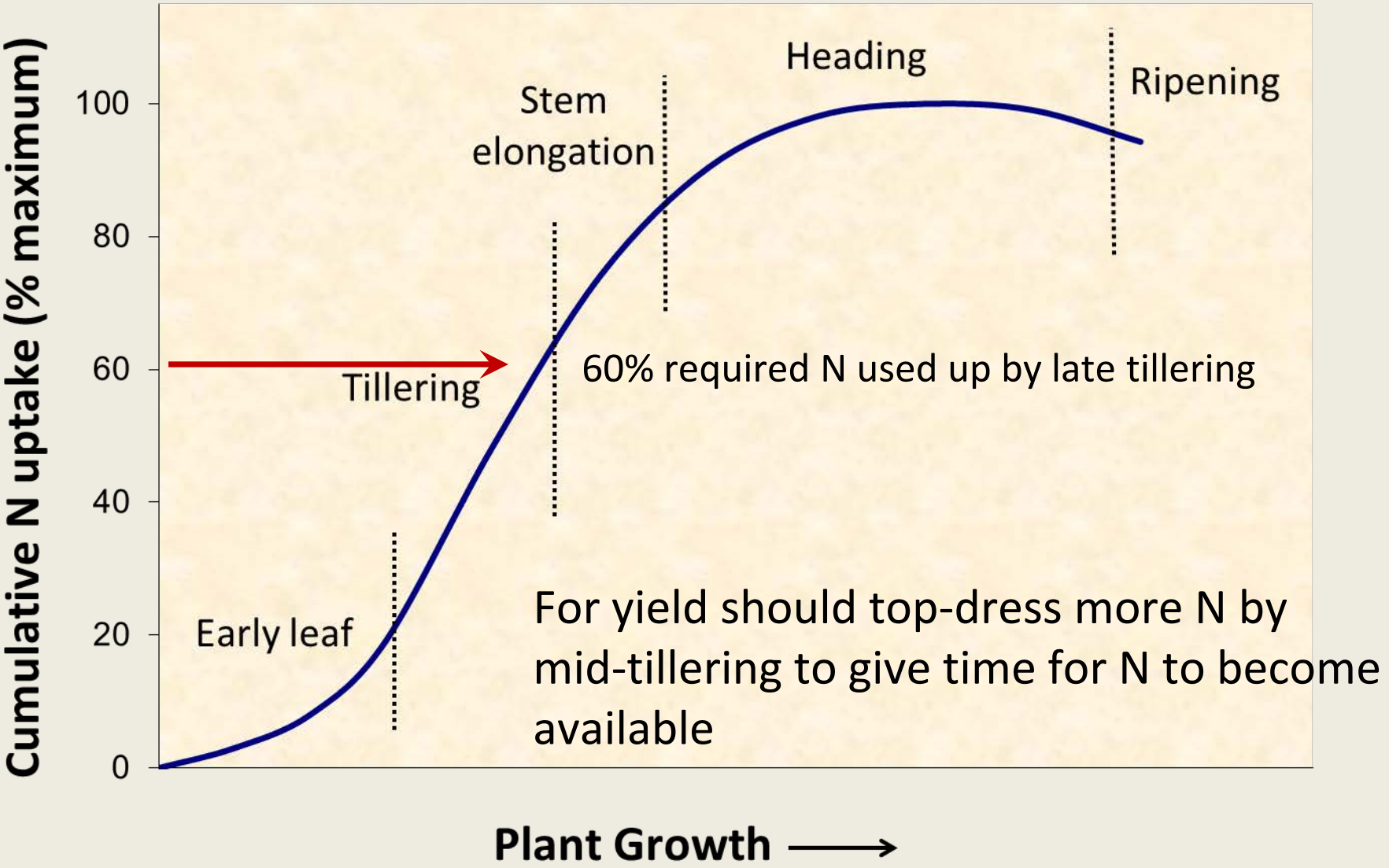


Use Nutrient Uptake figure to time top-dress

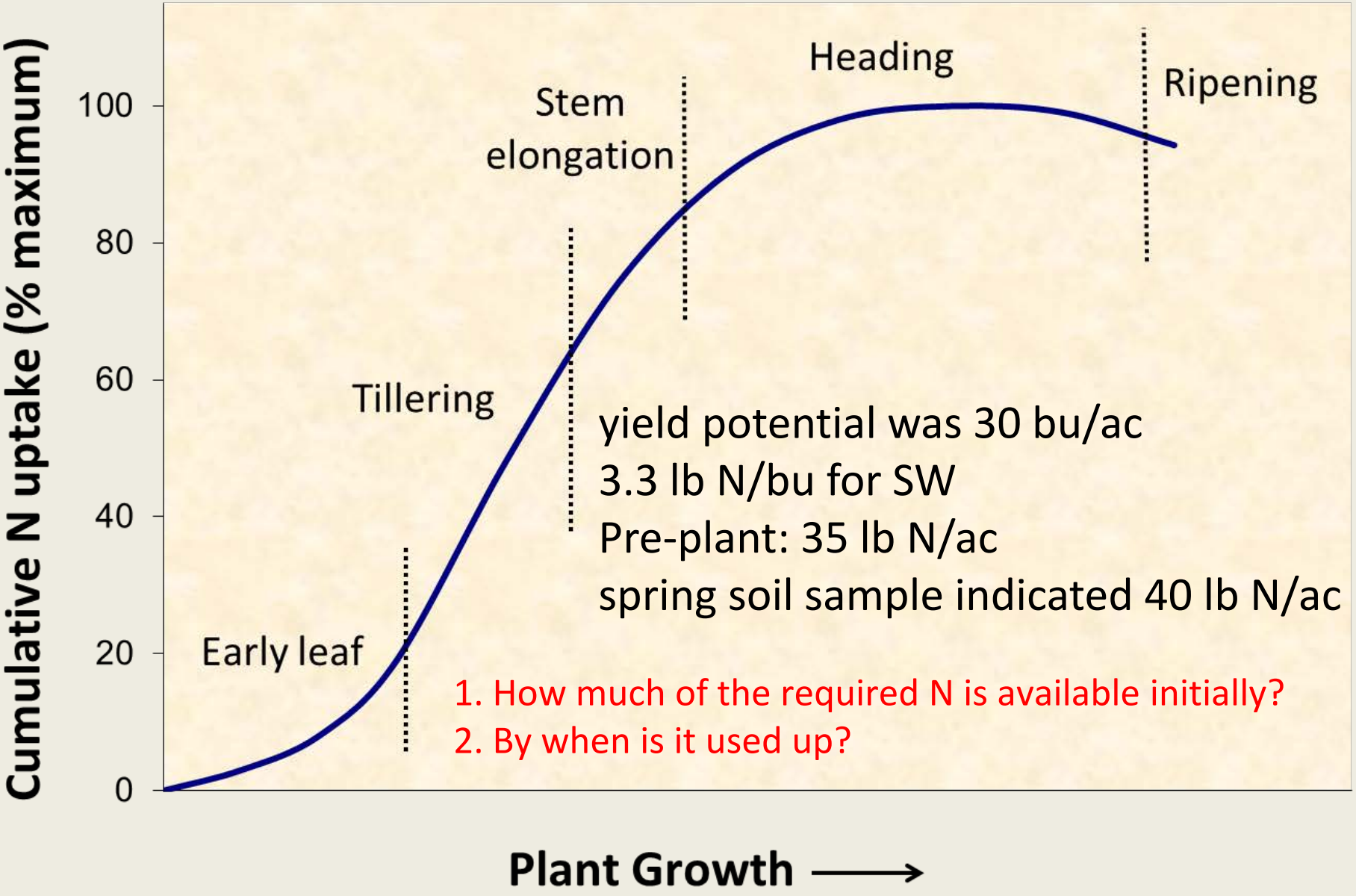
Example on per acre basis:

- 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

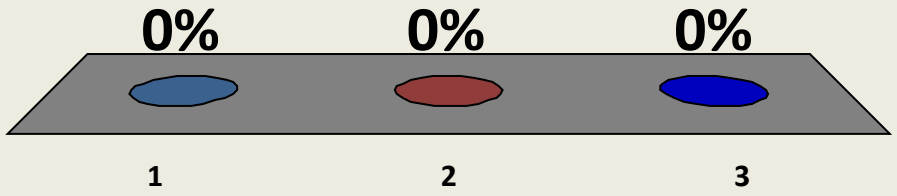


Your turn

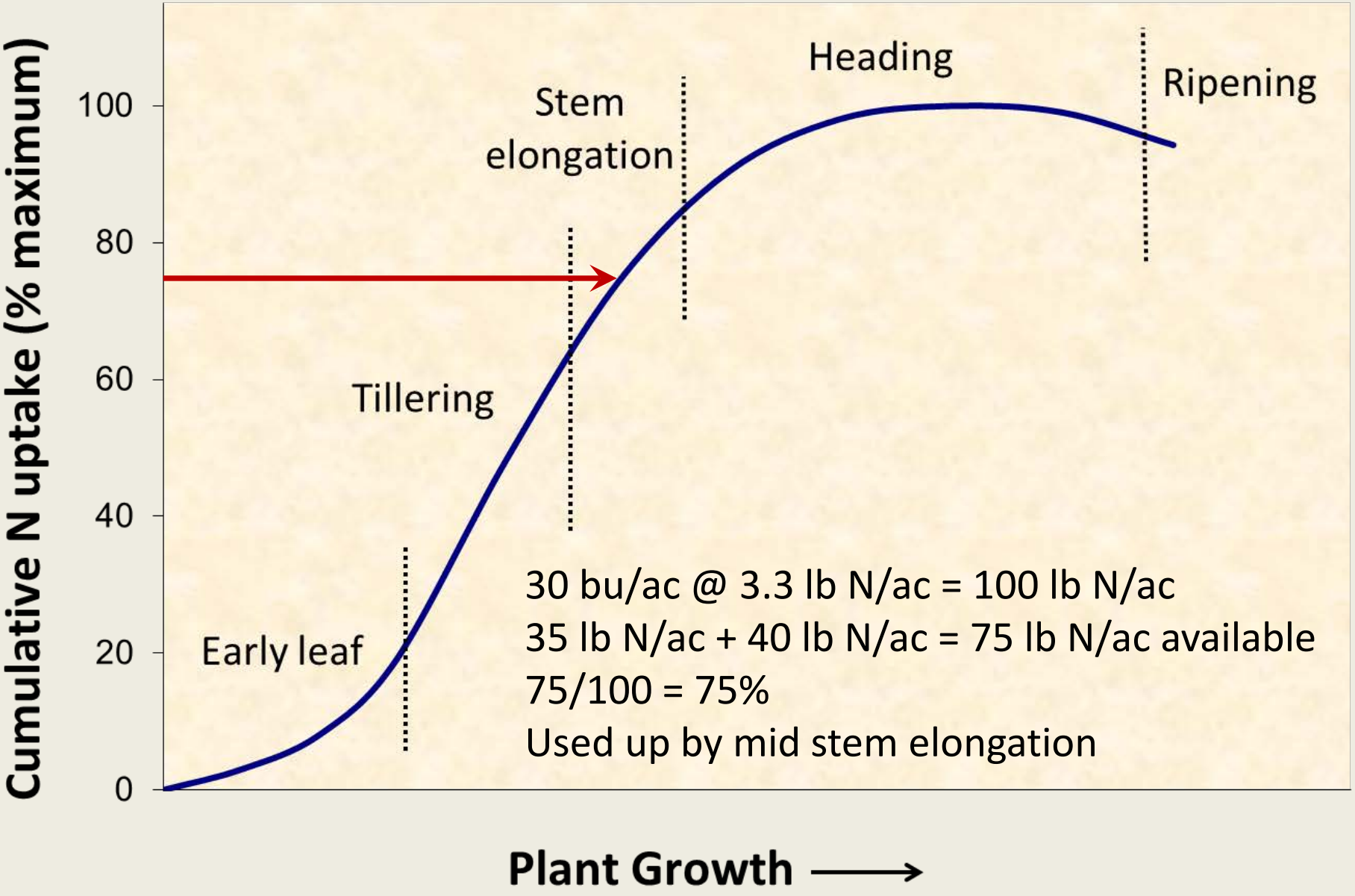

Cumulative N uptake (% maximum)
100
80
60
40
20
0
Heading
Ripening
Stem elongation
Tillering
Early leaf
yield potential was 30 bu/ac
3.3 lb N/bu for SW
Pre-plant: 35 lb N/ac
spring soil sample indicated 40 lb N/ac
1. How much of the required N is available initially?
2. By when is it used up?
Plant Growth ⟶

What % of available N is available initially and by when is it used up?

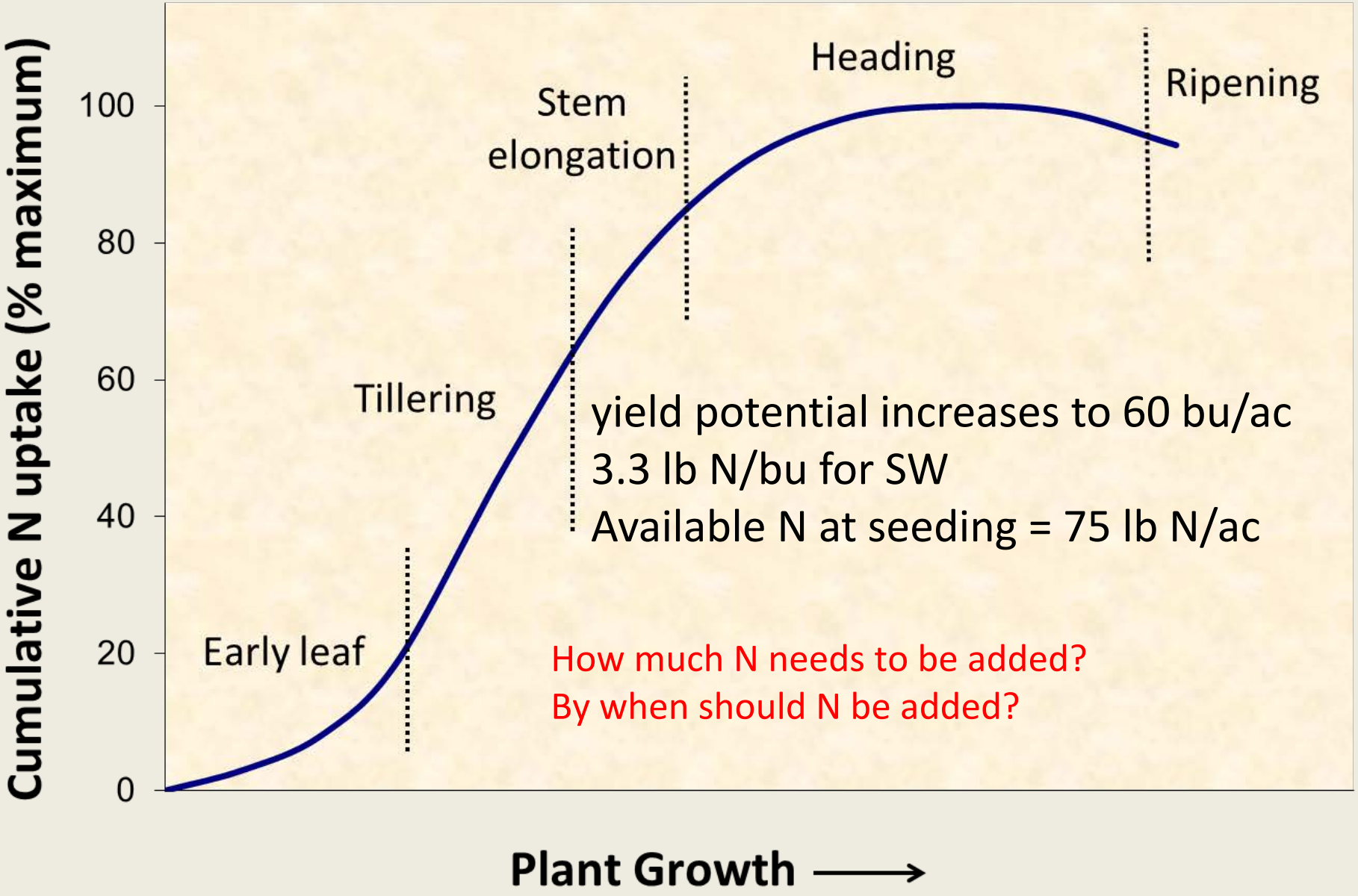
1. 25%, by early tillering
2. 50%, by mid-tillering
3. 75%, by mid stem elongation



Your turn

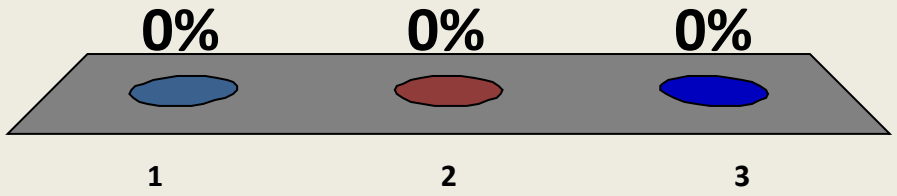

Cumulative N uptake (% maximum)
100
80
60
40
20
0
Heading
Ripening
Stem elongation
Tillering
Early leaf
30 bu/ac @ 3.3 lb N/ac = 100 lb N/ac
35 lb N/ac + 40 lb N/ac = 75 lb N/ac available
75/100 = 75%
Used up by mid stem elongation
Plant Growth ⟶

It rains 6 more inches in May than average

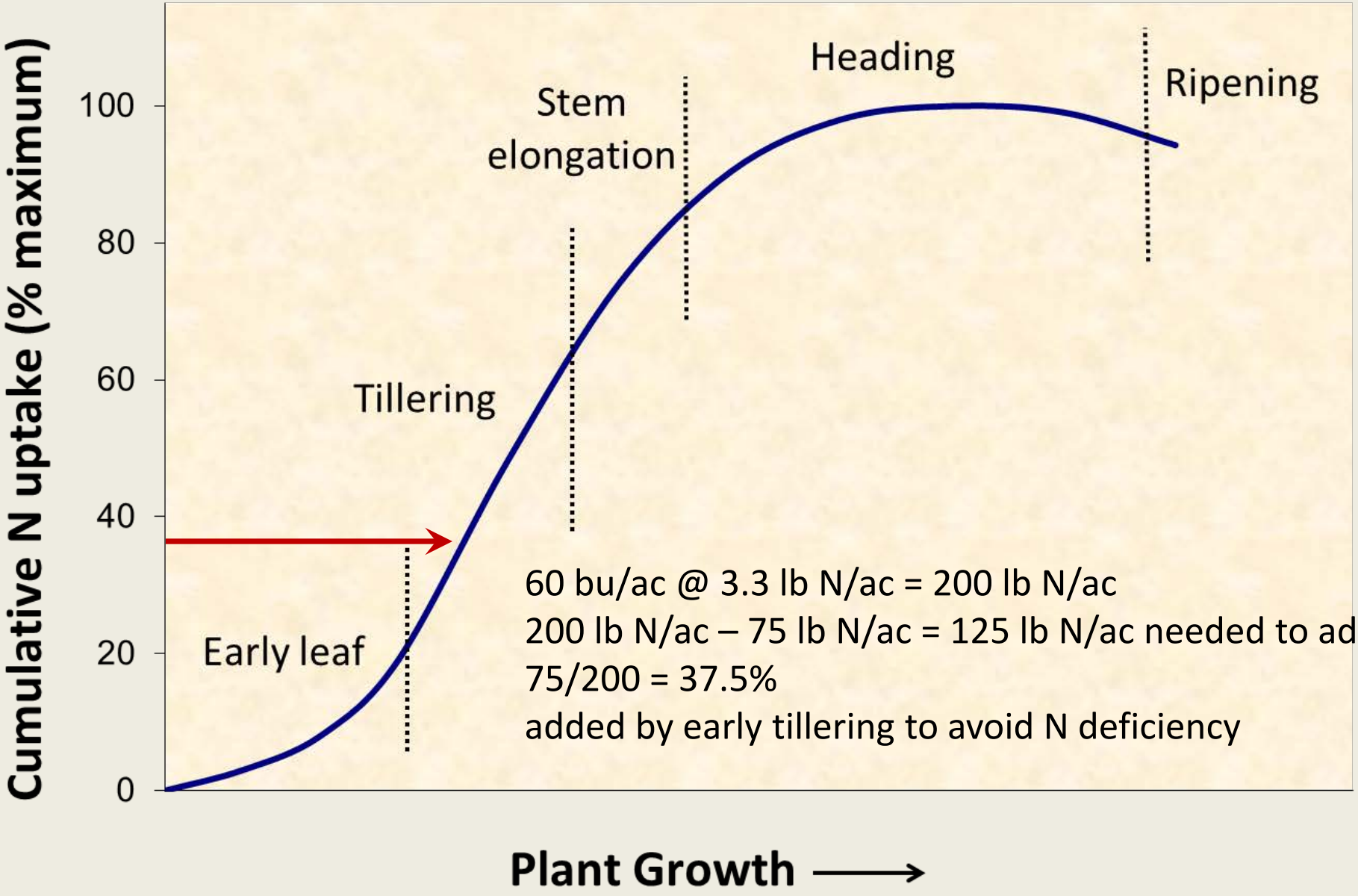


How much N needs to be top-dressed and by when if just do one top-dress?

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



Your turn



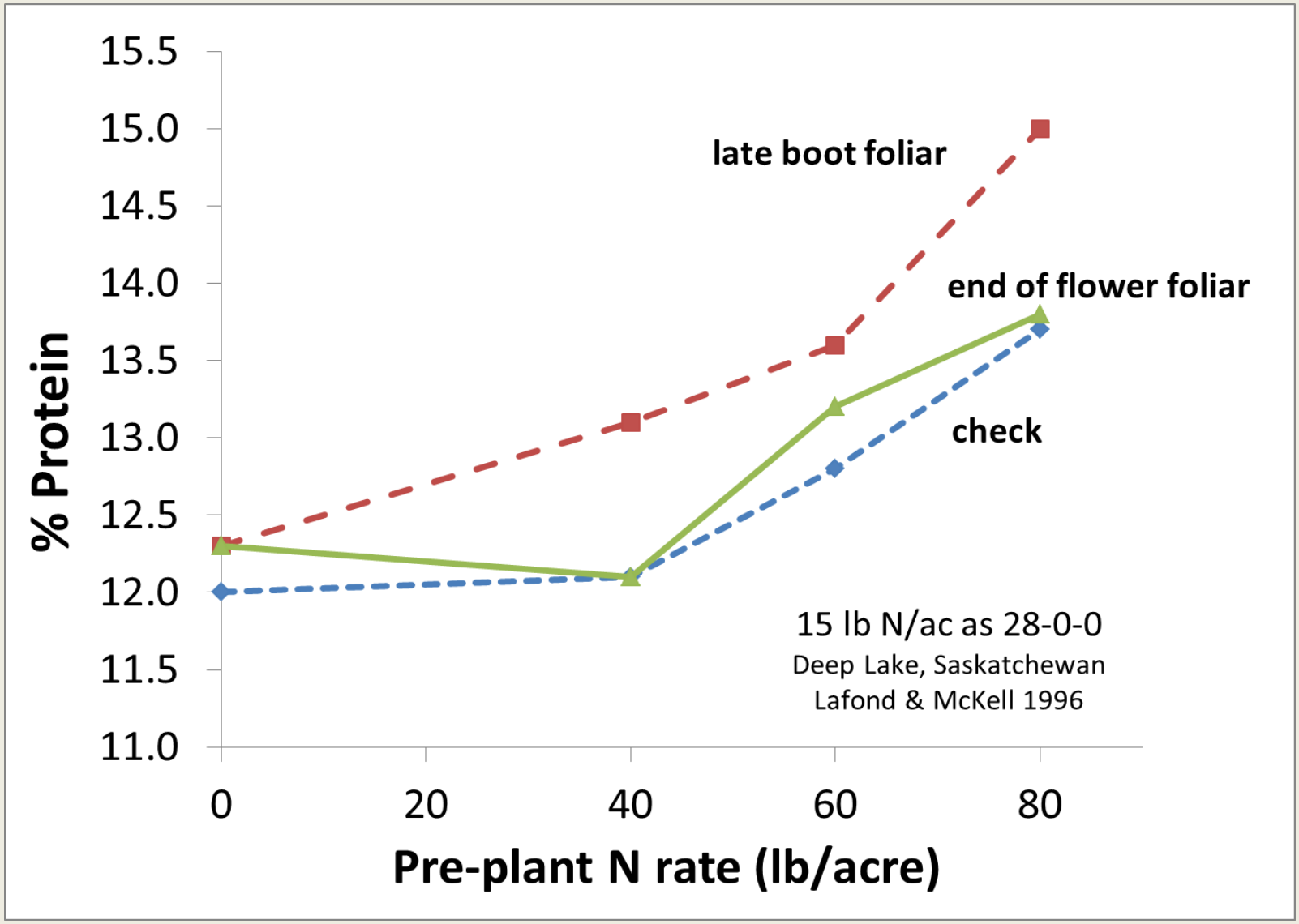
60 bu/ac @ 3.3 lb N/ac = 200 lb N/ac
200 lb N/ac – 75 lb N/ac = 125 lb N/ac needed to add
75/200 = 37.5%
added by early tillering to avoid N deficiency

How should a grower decide whether to apply late-season N?

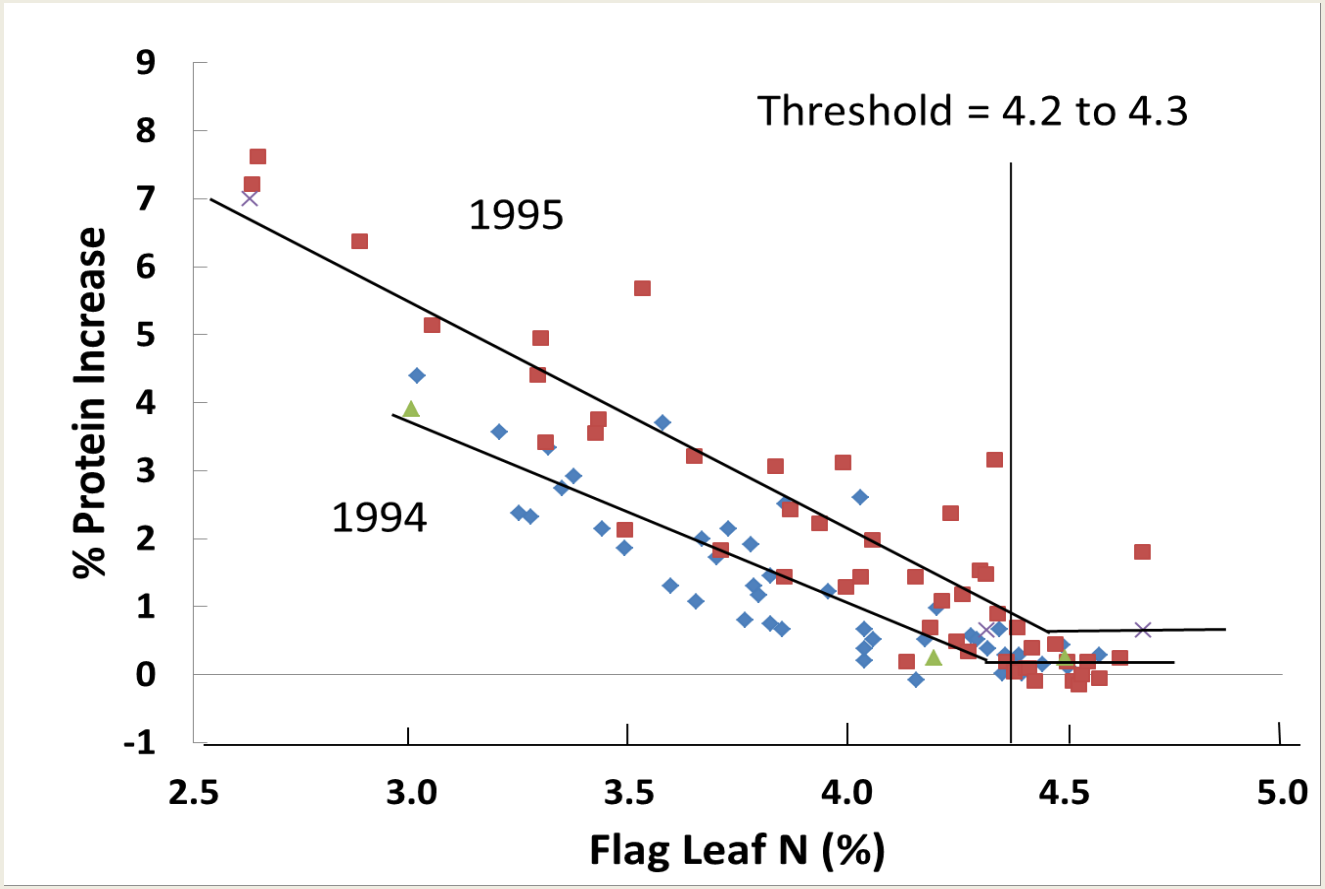
Ask:

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

Spring wheat protein response to late-season N

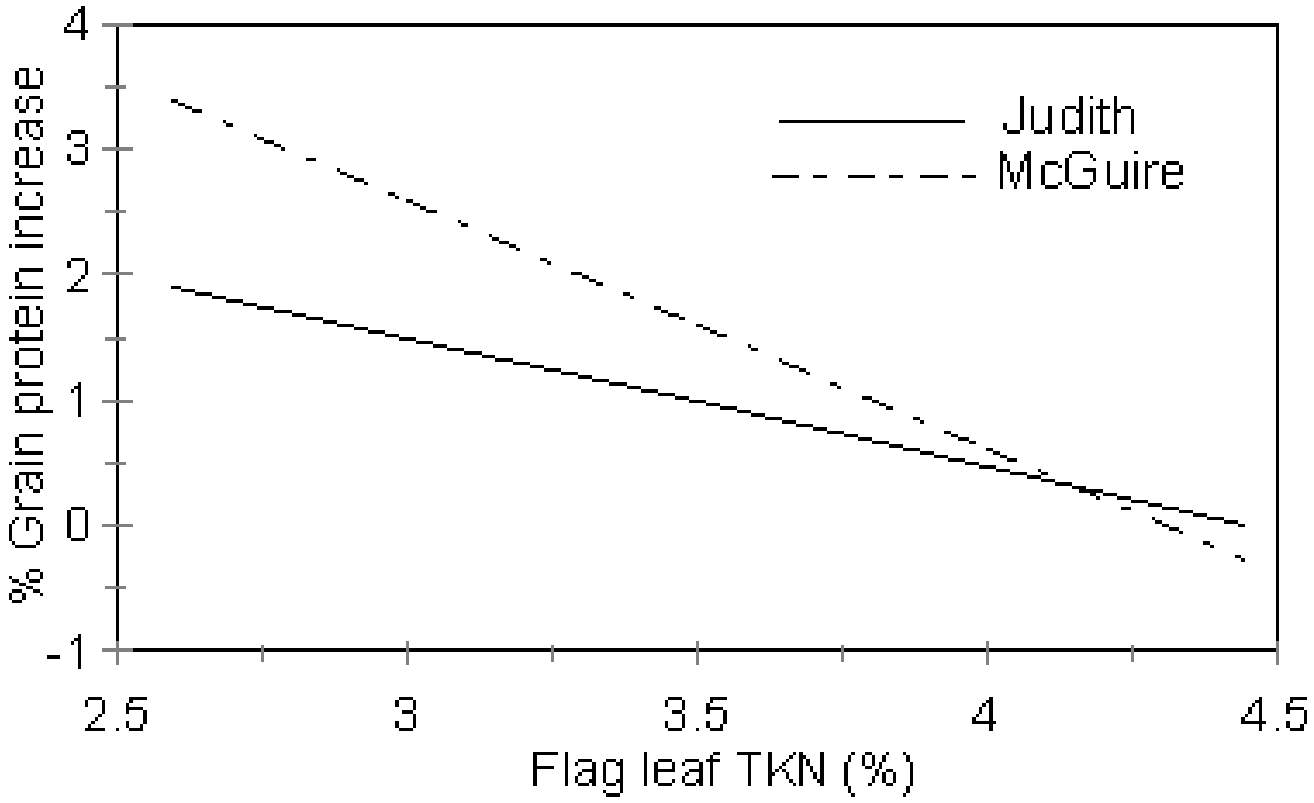


Effect of top-dressing 40 lb N/acre at heading on spring wheat grain protein increase as affected by flag leaf N



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

Effect of top-dressing 30 lb N/acre at heading on **winter wheat** grain protein increase as affected by flag leaf N



Fertilizer Fact 23

Flag leaf sampling

- When?

  Collect at first sign of flowering
- Numbers?

  Randomly select 50-75 flag leaves per field
- How and where send?

  Overnight to a lab w/ fast turnaround (e.g. Agvise Labs has a 1 day turnaround)
- Is this a common way to determine whether to topdress or is it Clain's hair brain idea?

  Agvise analyzed ~15,000 flag leaf samples in 2009 and ~30,000 in 2010 (Dietrich, pers. comm.)

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 28-0-0 and no more than 45 lb N/ac of liquid urea to minimize burn and yield loss (Brown and Long, 1988). Dilute 1:1 to reduce risk.
- If you make your own liquid urea (~15% N), beware that urea + water will lower temp to near freezing and thus not dissolve as much urea. Be patient.

Application methods

- Foliar – will discuss in more detail
- Fertigation
  - Avoids physical crop damage, rate and timing close to crop demand, drop lines to reduce leaf burn – but must soak in with sprinkler
- Ground equipment – on a field basis yield losses from ground equipment can be 1-3% (Brown et al. 2005, PNW 578)
- Furrow irrigation after granular N
  - doesn't incorporate dry N
  - may exacerbate volatilization loss
  - hard to get uniform water and/or N application
- Basin flood irrigation – better uniformity and incorporation than furrow
- Aerial

Foliar Application

- With any foliar
  - apply enough water to avoid leaf burn
  - only 8-11% of foliar applied liquid urea was taken up by leaves, whereas 37-67% of soil applied N was taken up by plant in same study (Rawluk et al. 2000)
  - ½ inch rain (have you been living right?) or irrigation to soak into soil

Source and rate of N affect leaf burn

- 32% UAN applied at heading caused more flag leaf burn and reduced grain yield more than an equal amount of N from foliar urea
- Flag leaf burn increases with N rate regardless of source, max suggested rate is 30 lb N/ac
- 32% UAN increased protein more than urea, urea more beneficial for yield.

Brown & Long 1988, Parma, ID, irrigated winter wheat

Late-season foliar UAN on spring wheat: leaf burn and wheat protein

Treatment	Leaf burn (%)	protein (%)
Check	2.6	14.7
30 lb N just before anthesis	19.2	15.0
30 lb N 5 days after anthesis	19.2	15.0
15 lb N each just before and 5 days after anthesis	14.2	15.0
15 lb N each 5 and 10 days after anthesis	11.4	15.2
No effect on yield (avg. 56 bu/ac), 1/3 of fields showed no protein response		
UAN:water 1:1, applied with “stream bar”		

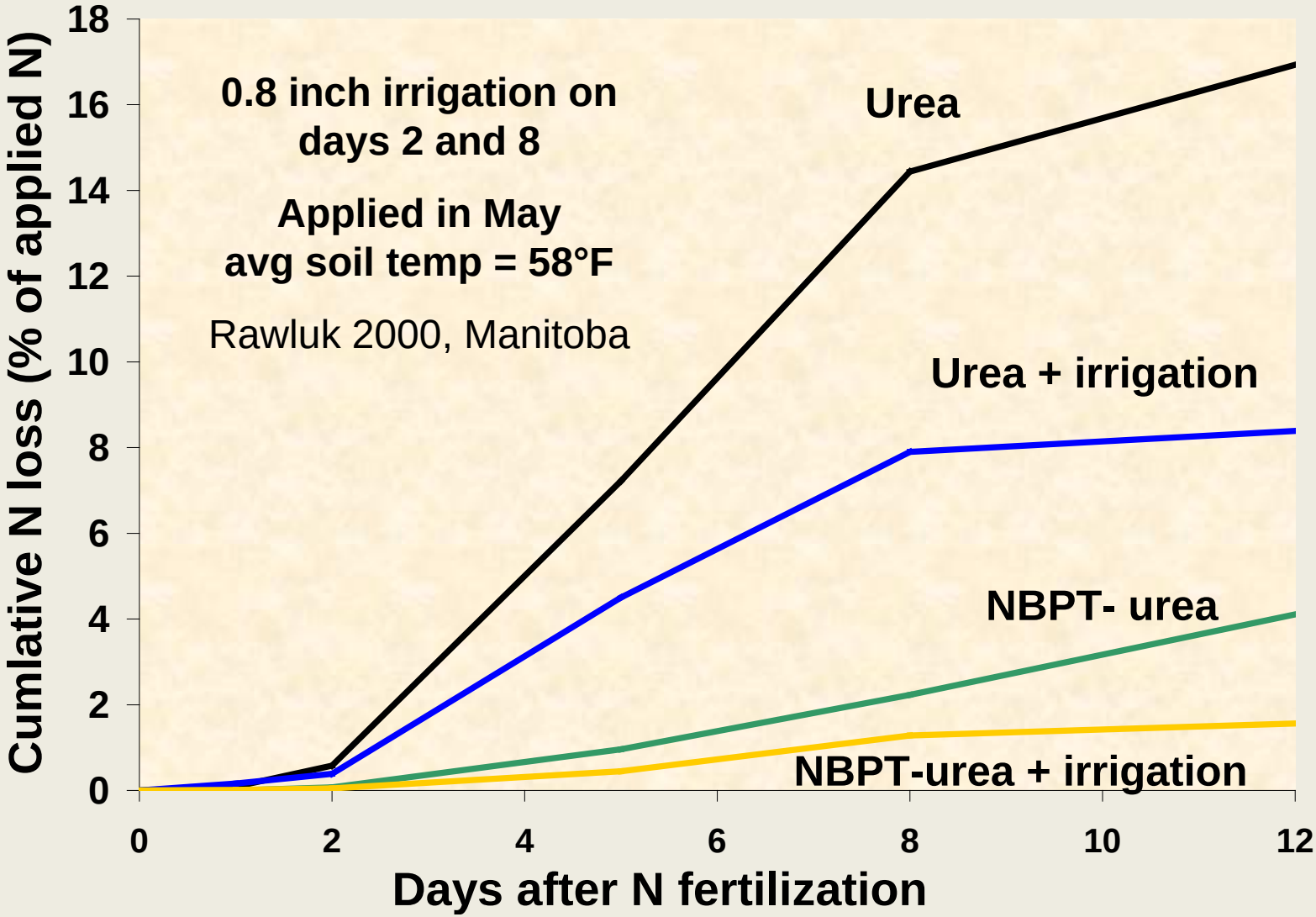
Adapted from Wiersma & Sims 2006, MN

UAN volatilization with and without NBPT

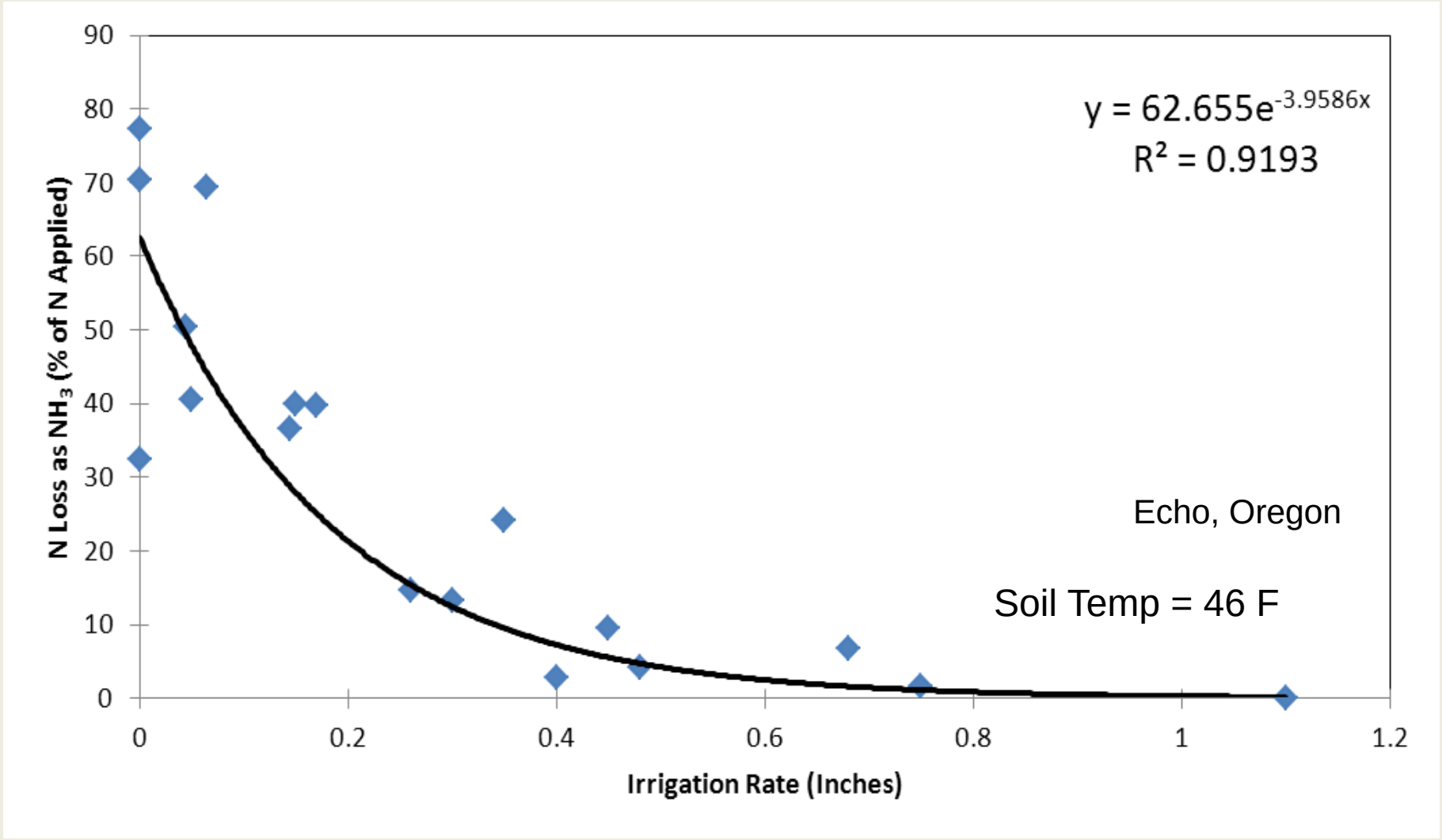
% of surface applied N volatilized over 7 days			
	Check	UAN	UAN+NBPT
May (74°F)	0	7	1
July (86°F)	0.6	50	16

Grant et al. 1996, Manitoba

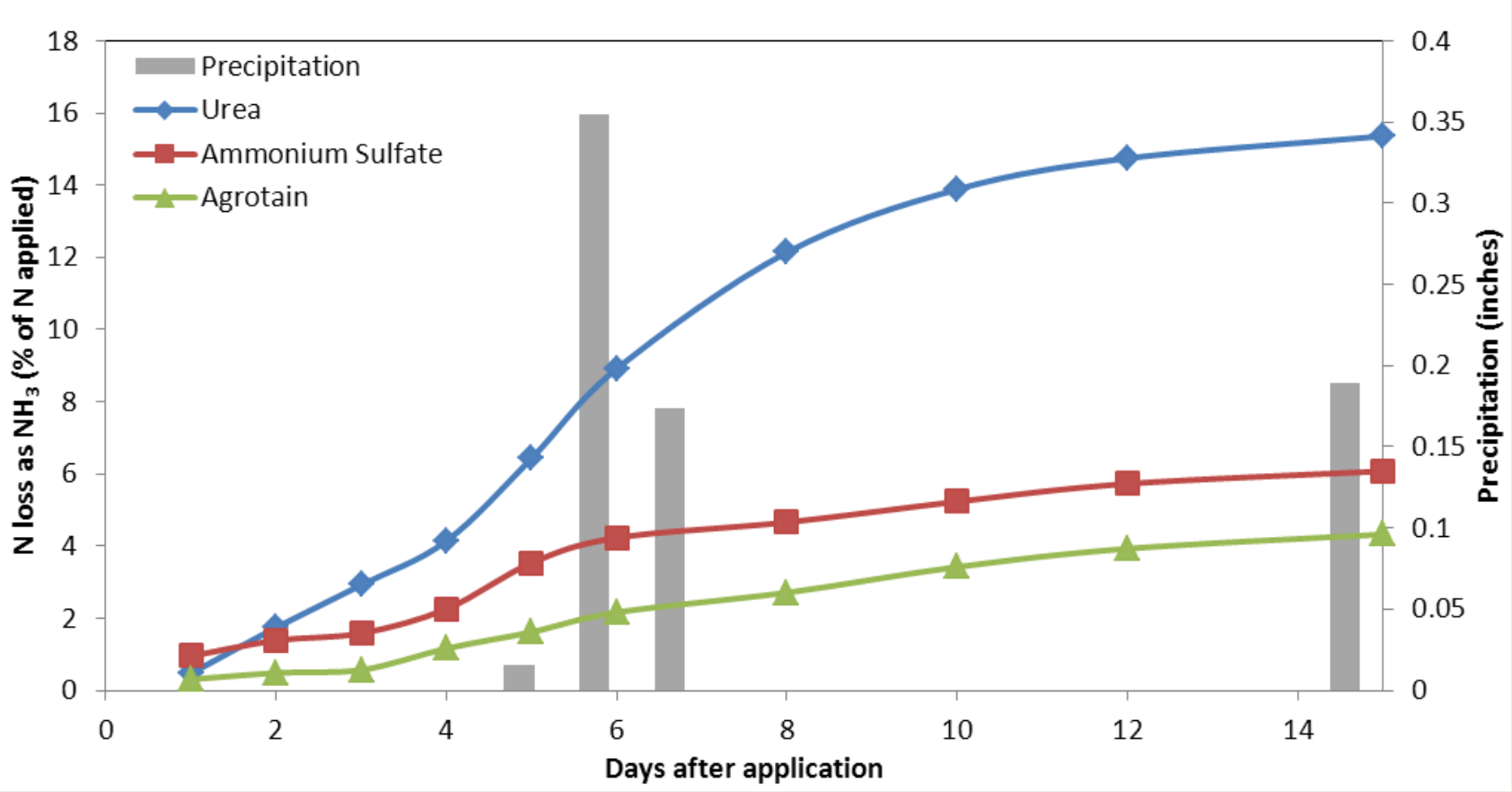
Effect of irrigation and NBPT on volatilization



Effect of irrigation rate on urea volatilization (Horneck, unpub data)



Does ½ inch of rain also stop volatilization? (Horneck unpub data)



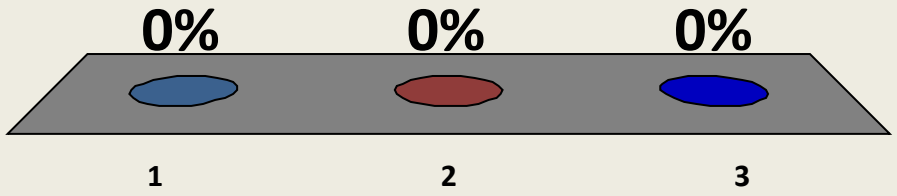
Not if spread out over 3 days

Irrigation and scab

- Ideally terminate irrigation during flowering
- A uniform stand will have a shorter susceptible period
- Risk higher with 3-4 water events from start of flowering to 3-5 days post-bloom
- Intermittent sprinkler better than continuous
- Flood better than sprinkler
- Higher infection with > 10 in. water, reduced with < 7 in. water in growing season
- Try to fill soil profile to 100% field capacity to carry through flowering without added water – possible on heavier soils, difficult in sandy soils

Have you seen wheat sterility caused by late-season N application?

1. No
2. Yes, and untreated wheat did not have the problem
3. Yes, there was not un-treated wheat to compare to



Combined N and herbicide applications

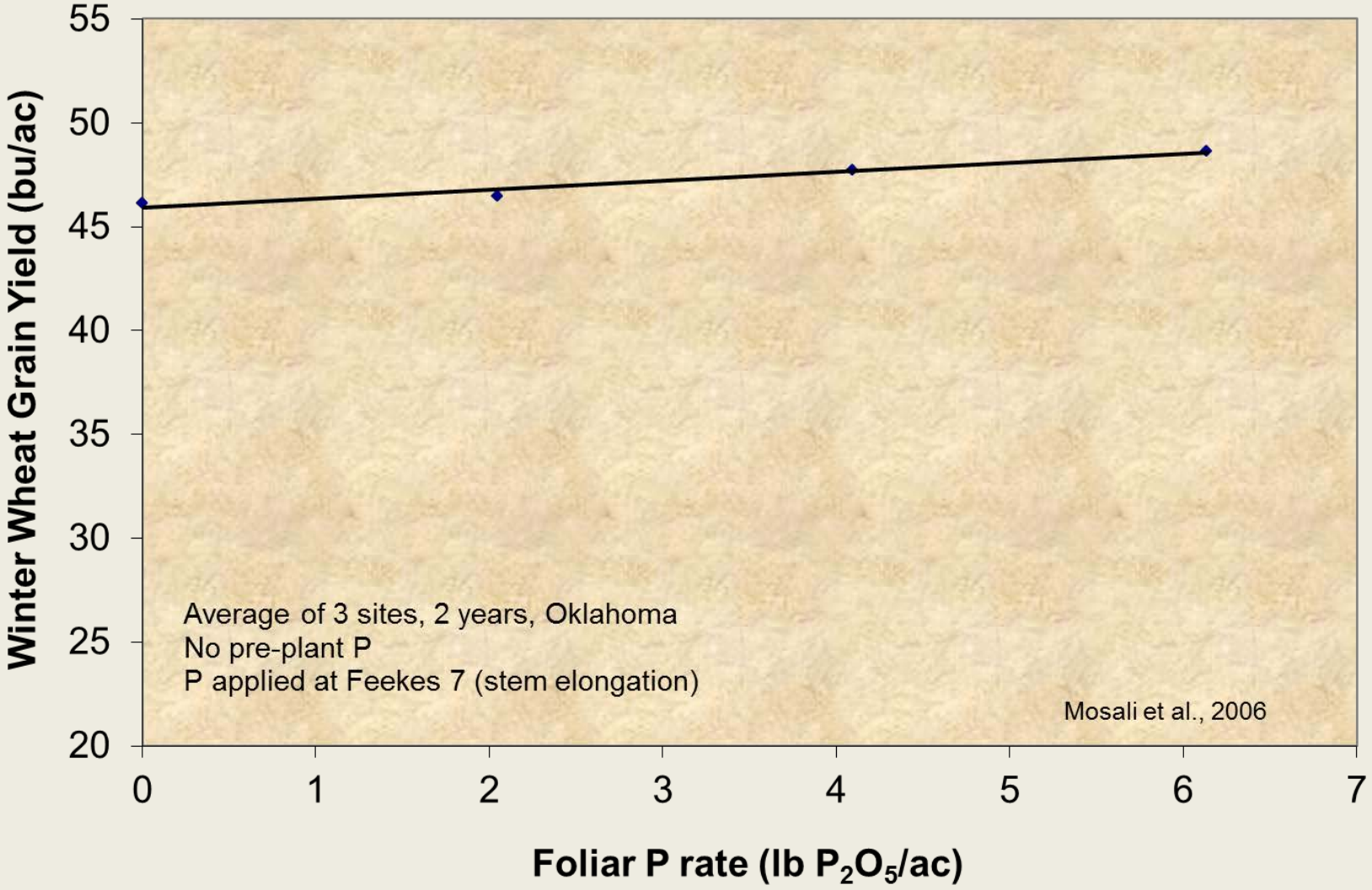
- Combining N with some herbicides for application may increase the risk leaf burn.
- Adding surfactant to some 28% UAN-herbicide combinations doubled crop injury and reduced yields.
- Use caution and consider reducing the amount of UAN.

http://fieldcrop.msu.edu/sites/fieldcrop/files/E2602.pdf
http://www.msuweeds.com/assets/Annual-Results/2010-Results/Wheat/2010ResultsWT02-10.pdf

Effectiveness of foliar P

- In lab study with P deficient plants
  - Liquid phosphate applied to flag leaf prior to anthesis, to ear at early- and mid-grain, or to roots at mid-grain did not increase grain yield (Batten 1987)
- Limited field trials

Mid-season foliar P may increase WW yield



Soil Fertility in Waterlogged Soils

What can happen in waterlogged soils

- Poor root development due to low oxygen
  - Low nutrient uptake
  - Reduced yield
- Root disease
- Surface crusting
- Nitrate leaching (coarser soils)
- Denitrification

If poor root growth decreases nutrient uptake, should you add more nutrients?

Pythium root rot on wheat

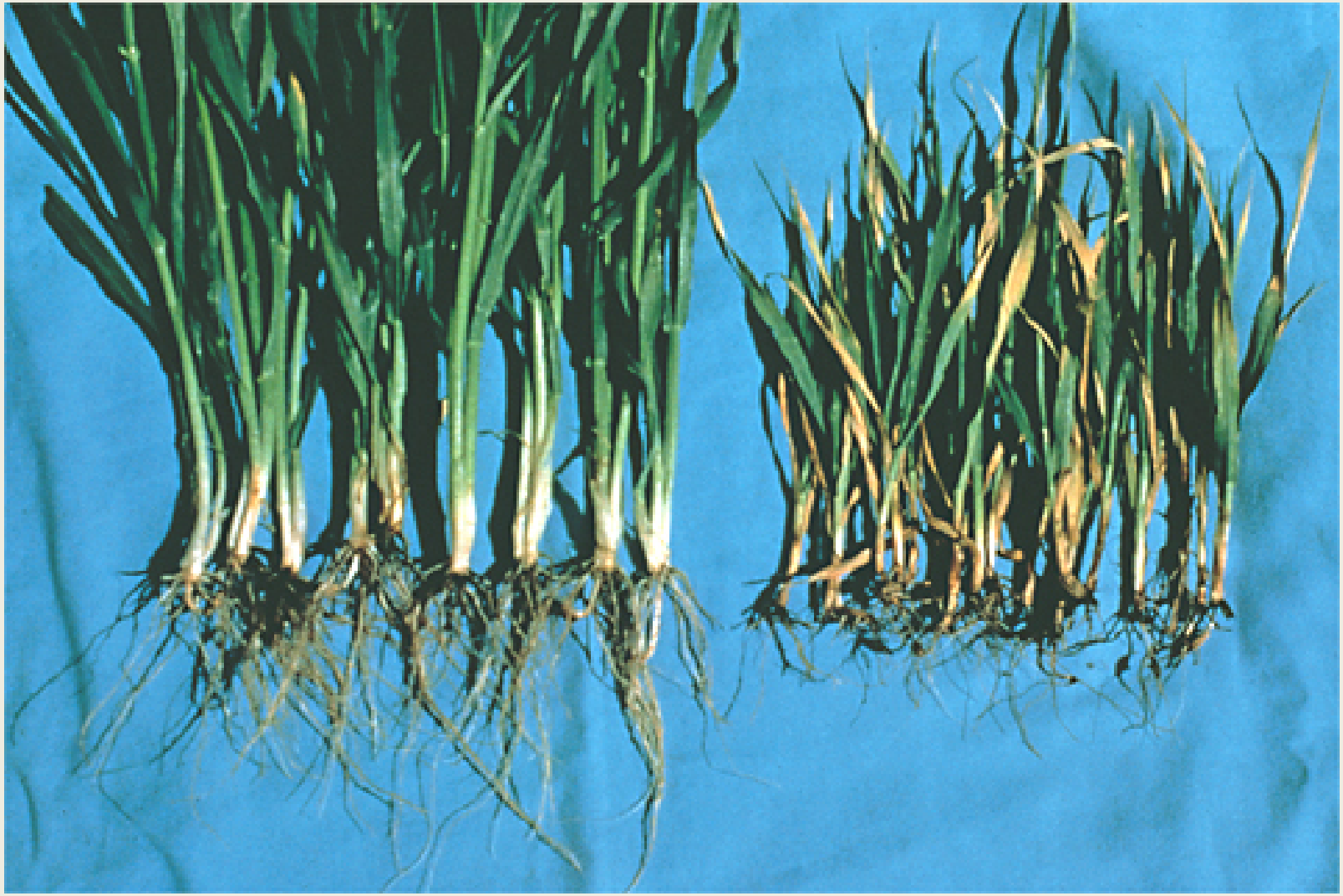


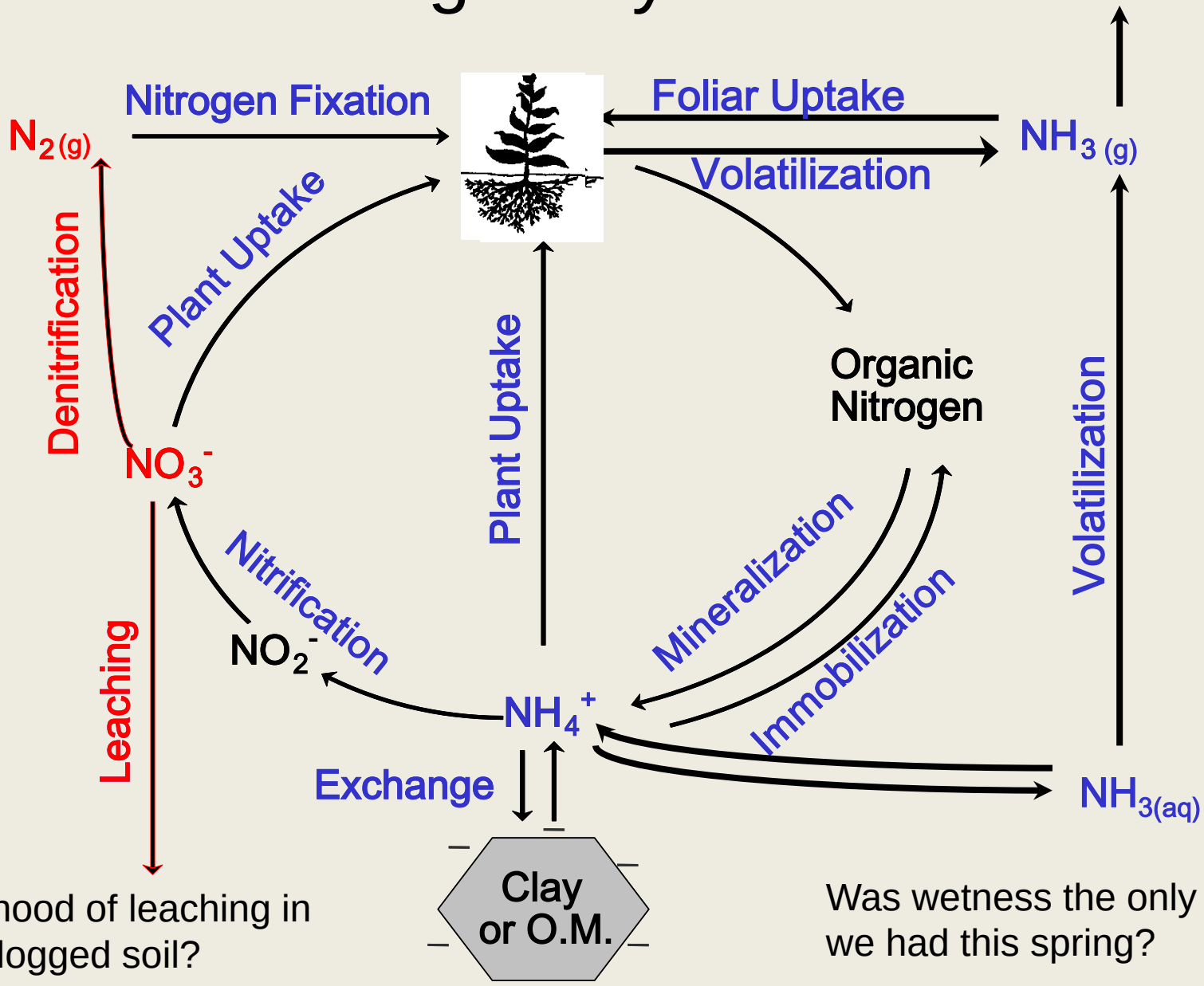
Photo courtesy of Barry Jacobsen

Aphanomyces root rot on bean

Photo courtesy of Barry Jacobsen

Field view of beans with root rot

Nitrogen Cycle



Likelihood of leaching in waterlogged soil?

Was wetness the only issue we had this spring?

Conditions that increase denitrification

- Wet
- High organic matter
- High levels of nitrate
  - urea can take ~ 1 to 5 weeks to get converted to ammonium
  - ammonium can take ~1 to 3 weeks to get converted to nitrate
- WARMTH

Note: Can lose 1 to 5% of soil nitrate *per day* from saturated soils (Ransom, NDSU).

Questions you should ask:

1. Did the waterlogged conditions occur long enough after urea application that nitrate levels were likely high?

2. Do the plants in waterlogged areas look substantially different than in other areas?

3. Are the areas large enough to warrant doing something about?

If you answered yes to each of the previous questions, then what?

- Soil test in these areas and outside for nitrate
- Apply additional N if necessary based on soil nitrate, revised yield potential, and nutrient uptake curves (from EB0191)
- Tissue test flag leaf for total N inside and outside waterlogged areas
  - apply additional N if warranted as described earlier
- Experiences with waterlogged soil fertility?

Summary

- Additional N for yield should be applied by mid-tillering, at flowering for protein
- Use flag-leaf N as indicator of potential protein response
- Foliar N should be soaked in with ½ inch of water or consider using NBPT (Agrotain®) to buy time
- Max foliar N of 30 lb N/ac to minimize yield loss from leaf burn, more caution when mixed with surfactants
- Additional N may be warranted in waterlogged areas *IF* yield potential hasn't decreased much *AND* availability has dropped substantially
- Mixed results with in-season foliar P

Additional info:

http://landresources.montana.edu/soilfertility

Fertilizer Facts and economic model:
go to “Fertilizer Information”

Other soil fertility publications:
go to “Extension Publications”

This presentation: go to “Presentations”.


Questions?
Watrous, SK, 1920's