# Mid- to Late-season N Application

## Ag Agent Update, April 11, 2013

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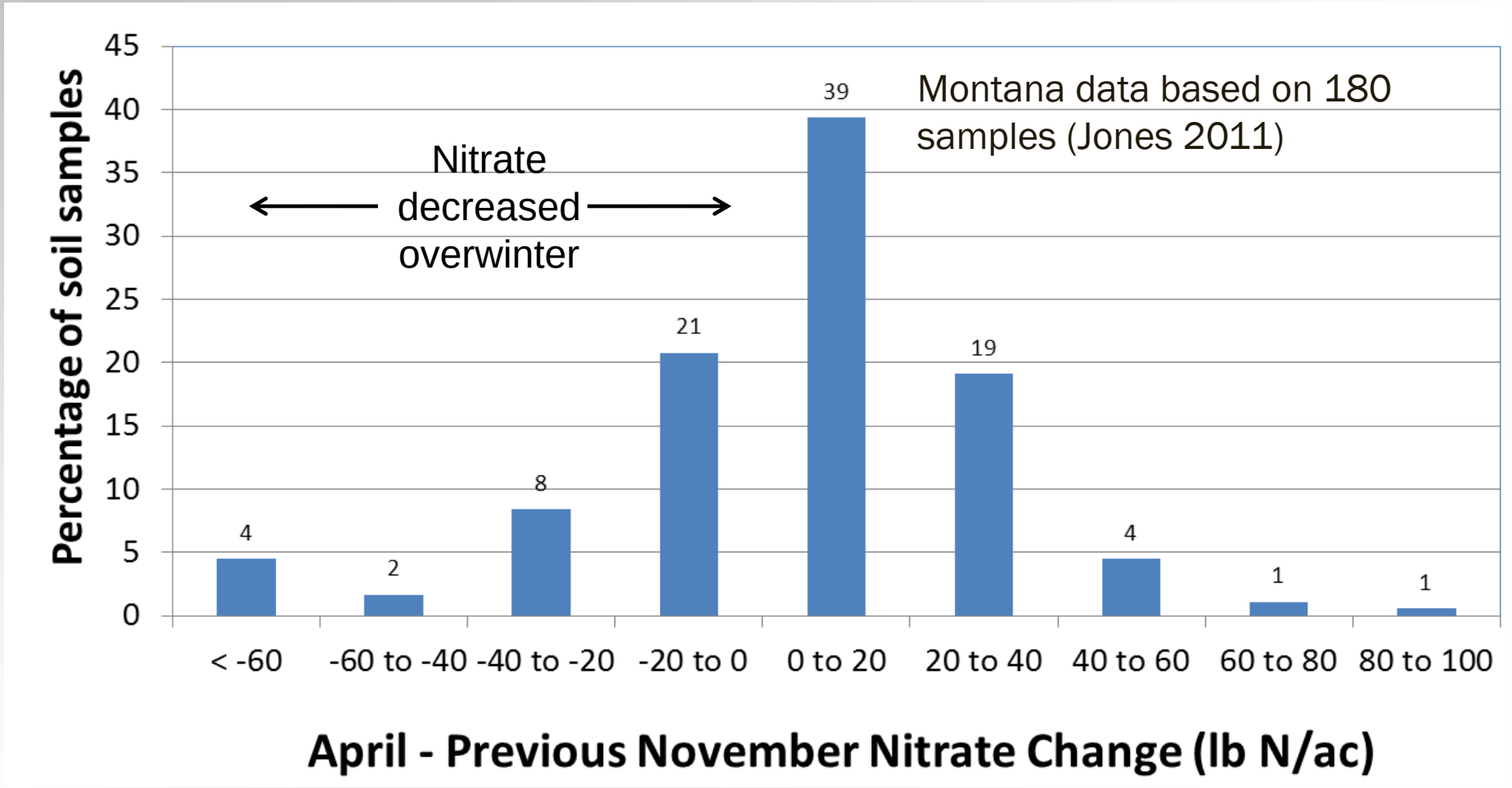
AGRICULTURE

MAKING A DIFFERENCE IN MONTANA COMMUNITIES

# Today's objectives

- Look at options for mid- to late-season N applications
  - First determine if necessary for optimizing yield & profit (begin with a valid soil nitrate test)
  - Rate, timing, and source effect on yield and protein
  - Leaf burn
- Provide you with pertinent soil fertility data and resources that you can share immediately with your growers

# Use spring soil nitrate instead of fall nitrate when possible




Take home message: Nitrate loss overwinter will result in under-fertilization

Introduction | WW Yield Response | WW Protein Response | Net Revenue From Fertilizer | Net Revenue Versus Yield

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# Economic Analysis of Fertilizer Application Rates for Winter Wheat in Montana.

- Steps to Use Program
- Introduction
- Step 1 - Yields
- Step 2 - Protein
- Step 3 - Net Revenue
- Step 4 - Revenue vs Yield


This program was developed to aid the agriculture industry in optimizing nitrogen fertilizer application on Winter Wheat after fallow. The model used to estimate the economic optimal allocation of nitrogen fertilizer requires the user specify a minimal set of input values for their location. The model was developed as a statewide application, but the user must keep in mind that many variables will affect their final results and this model can not incorporate all of those individual variables. Because the model allows the user to set their expected yield goal, it allows the individual user to determine a cap on the estimated yield response from the application of nitrogen fertilizer, considering ALL of the user specific knowledge and conditions for an individual producer's site. The yield and protein models are based on a best fit regression analysis of plot research performed in Montana from 1970 to 2006 on research plots, and included approximately 70 site years for winter wheat. Actual N needed to optimize yield on your farm/site may vary from that predicted due to differences in soil depth, texture, and climate.

This model is not valid for recrop winter wheat.

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The F11 key will toggle (switch on and off) the screen space from normal to maximum viewable area.

http://www.montana.edu/softwaredownloads/software/SWFertilizerEconomics.swf

# Optimize fertilizer N rate

## Danger of aggressive N fertilization?

Hot dry season, low protein discounts, lower net returns, and higher leaching/volatilization N losses.

In wet year if all N is applied early can lead to excess tiller production and decreased yields.

## Strategy to avoid this possibility?

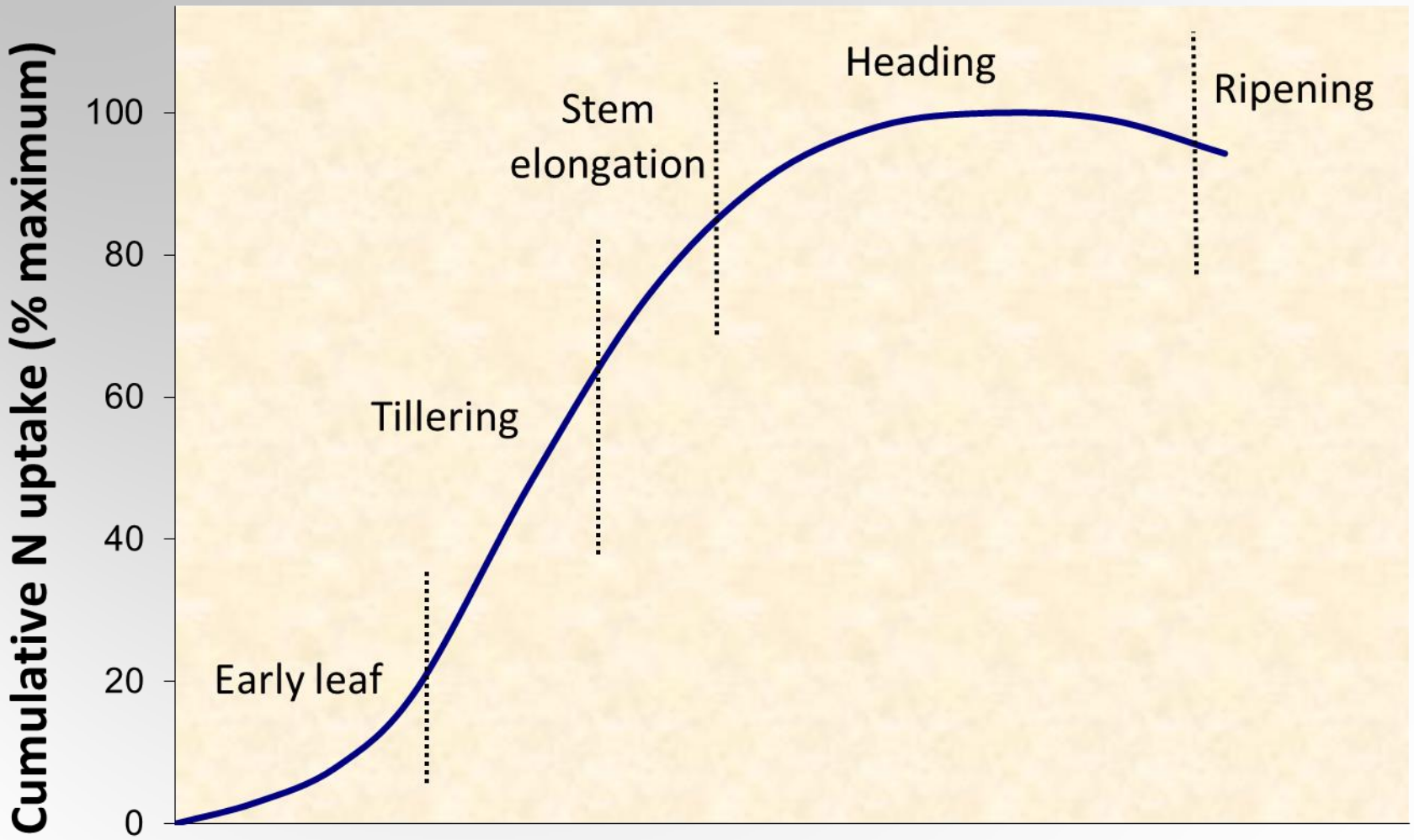
Use a conservative pre-plant N rate

Apply a 2nd application if needed

# 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. Later applications have less chance of causing lodging
3. Later applications have a better chance of making protein rather than yield

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



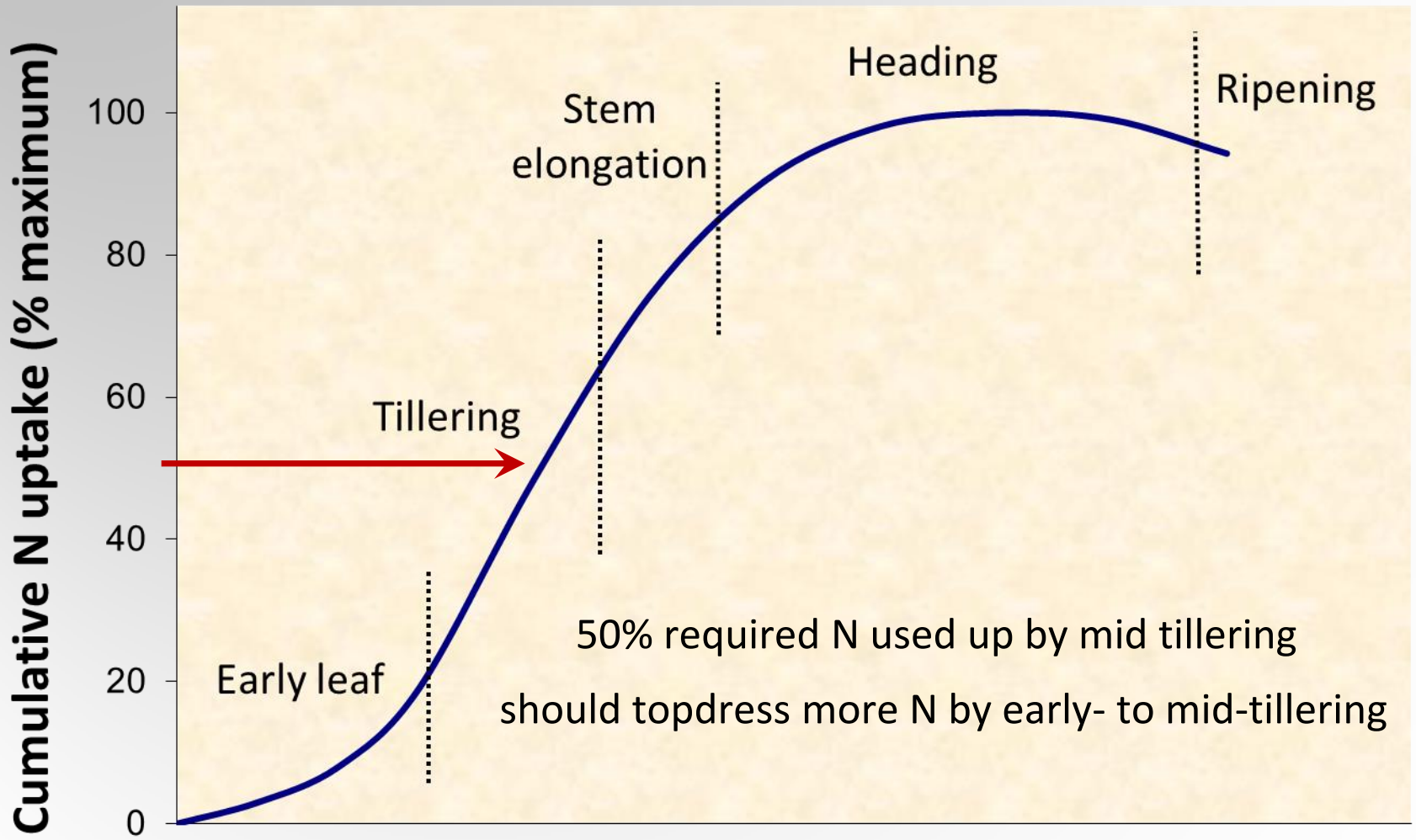

More info in Nutrient Uptake Timing (EB0191)

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

Winter wheat example on per acre basis:

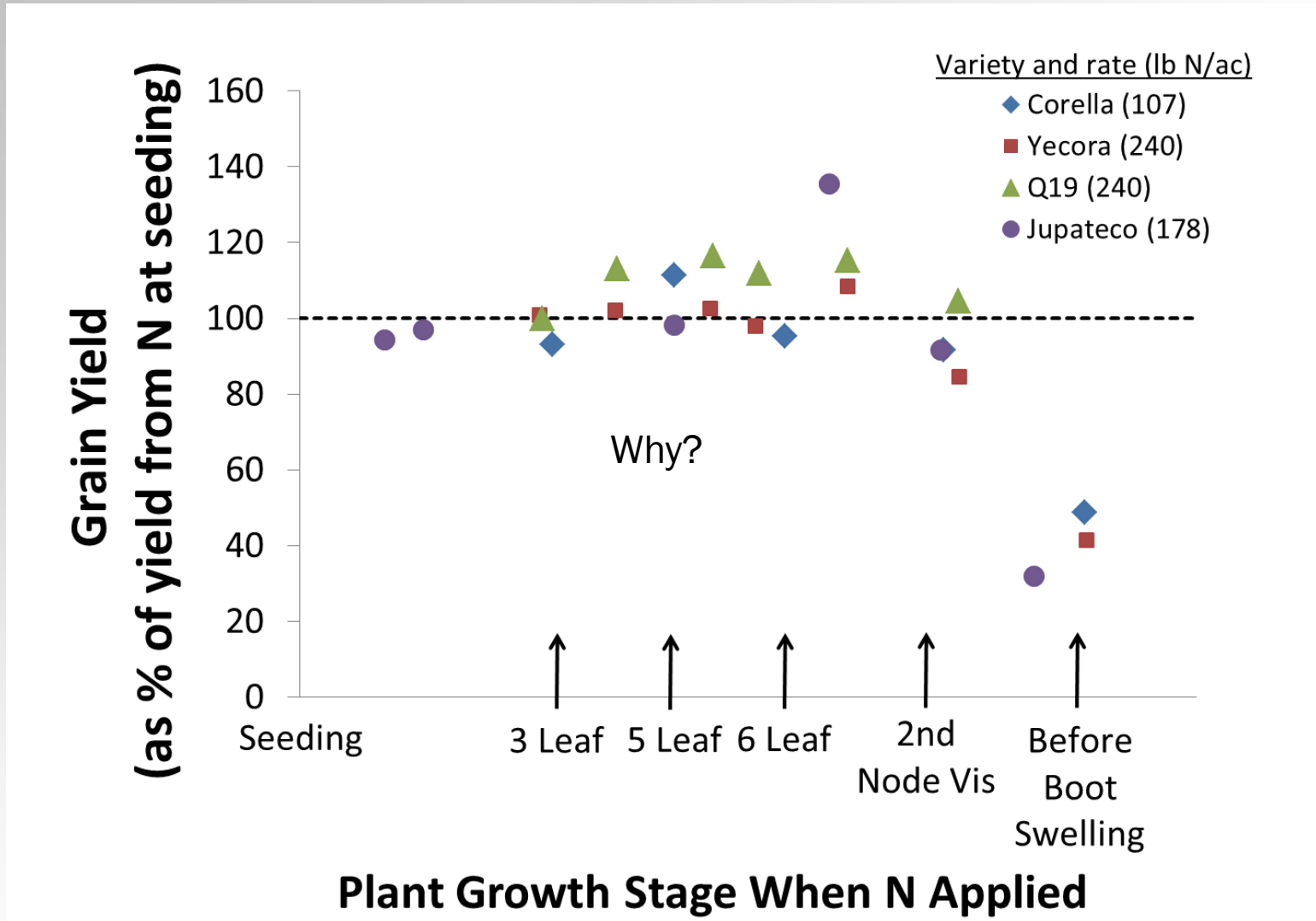
- Yield goal: 40 bu, ~100 lb N total need - 40 lb N in soil = 60 lb N applied in fall
- Wet spring doubles yield potential. Need an additional 100 lb N.
- Question: How late could additional N be applied w/o hurting yield?

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



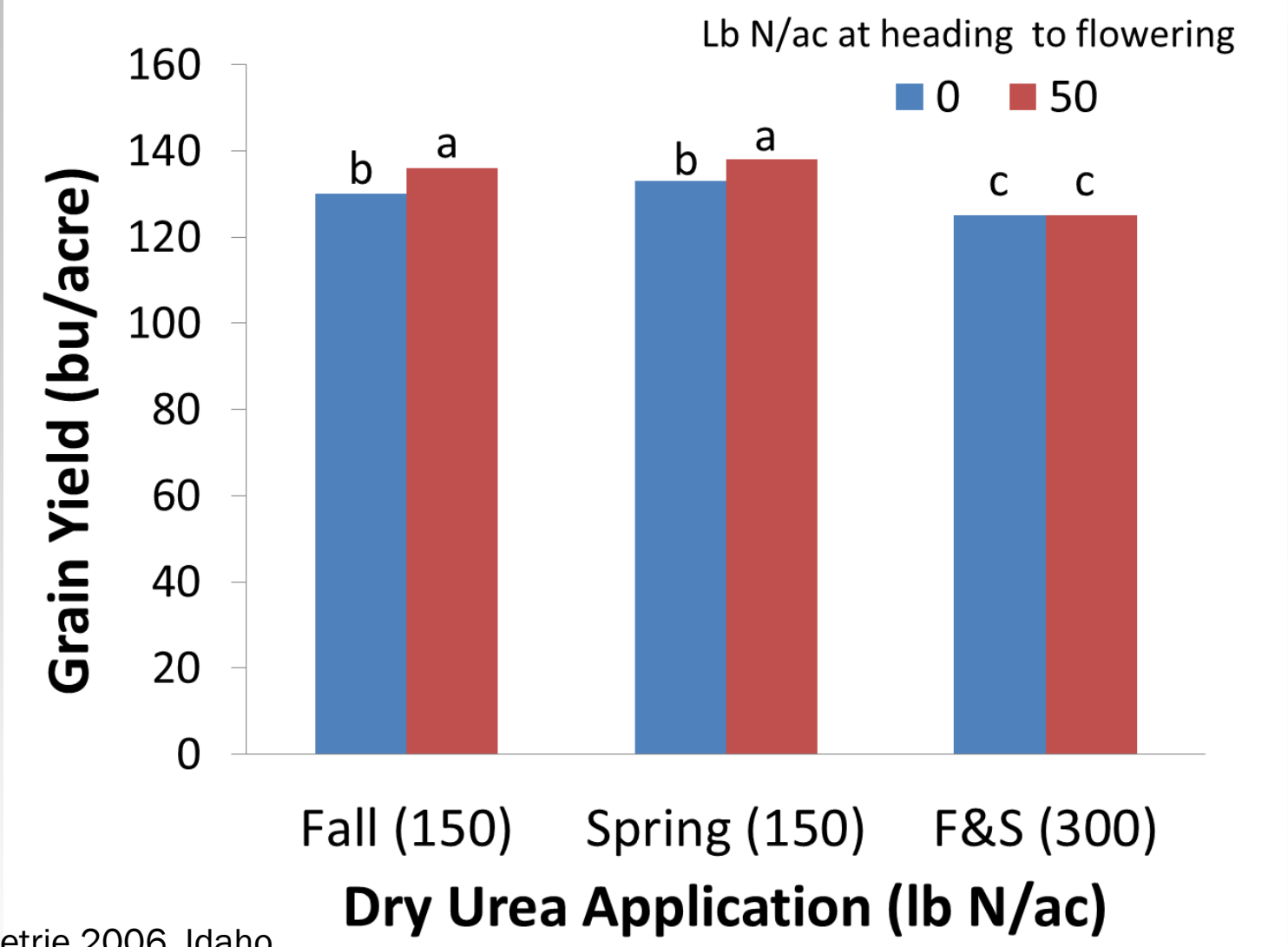

More info in Nutrient Uptake Timing (EB0191)

# Yield increase is highest when N is applied mid- to late-tillering, before stem elongation for irrigated winter wheat




Fischer 1993
irrigated WW, Australia and Mexico

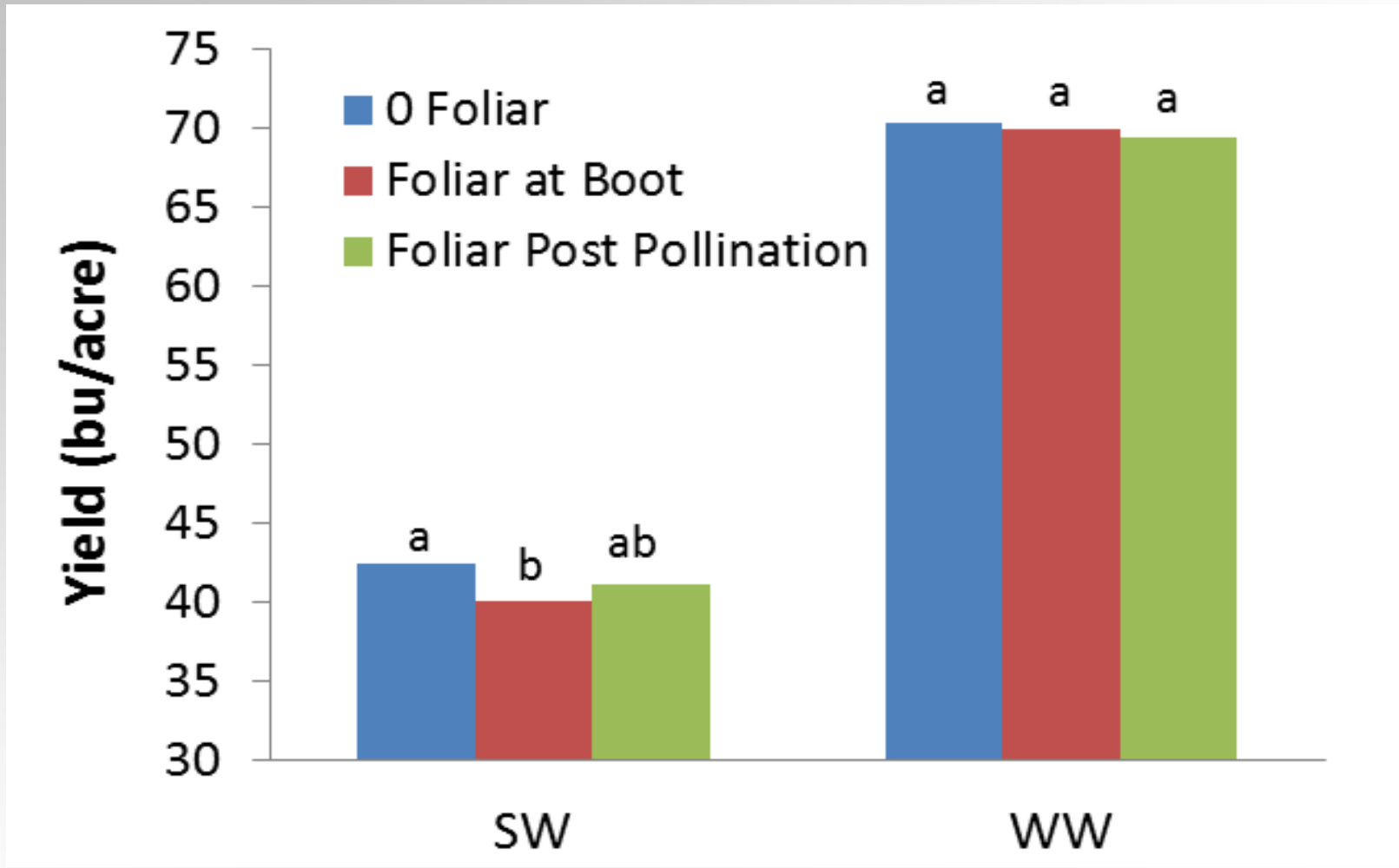
# Urea applied between heading and flowering may increase yield in irrigated WW




Brown & Petrie 2006, Idaho

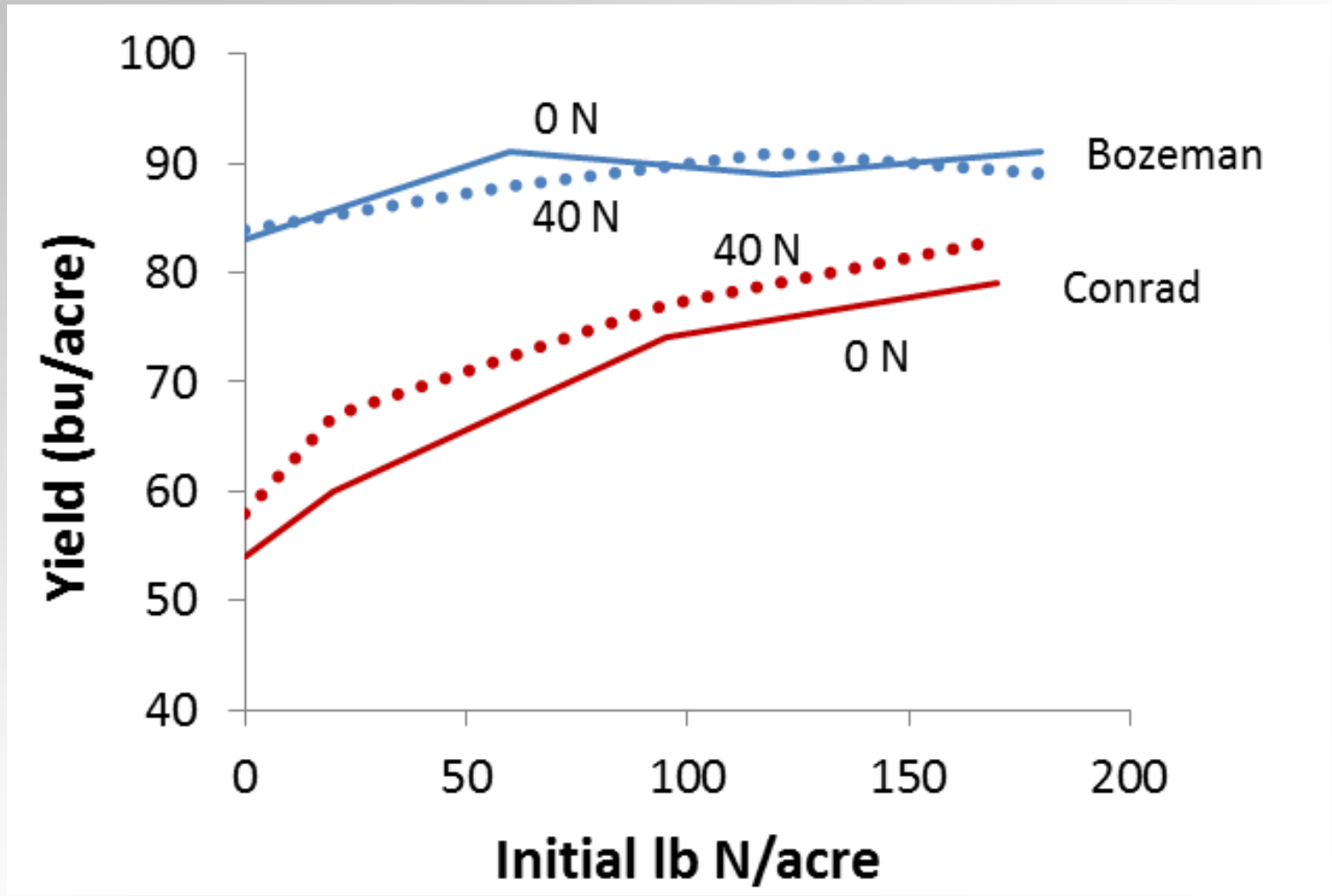
Fall pre-plant was incorporated, late N incorporated with irrigation

# Mid to late-season foliar N did not increase dryland WW yields, decreased dryland SW yields when applied at boot stage




Bly & Woodard 2003, ND
preplant N for 50 bu/ac yield, 30 lb N/acre foliar

# 40 lb N/acre applied at heading increases yield on irrigated SW if initial N is limiting




Fertilizer Fact No. 11

# Questions on Timing?

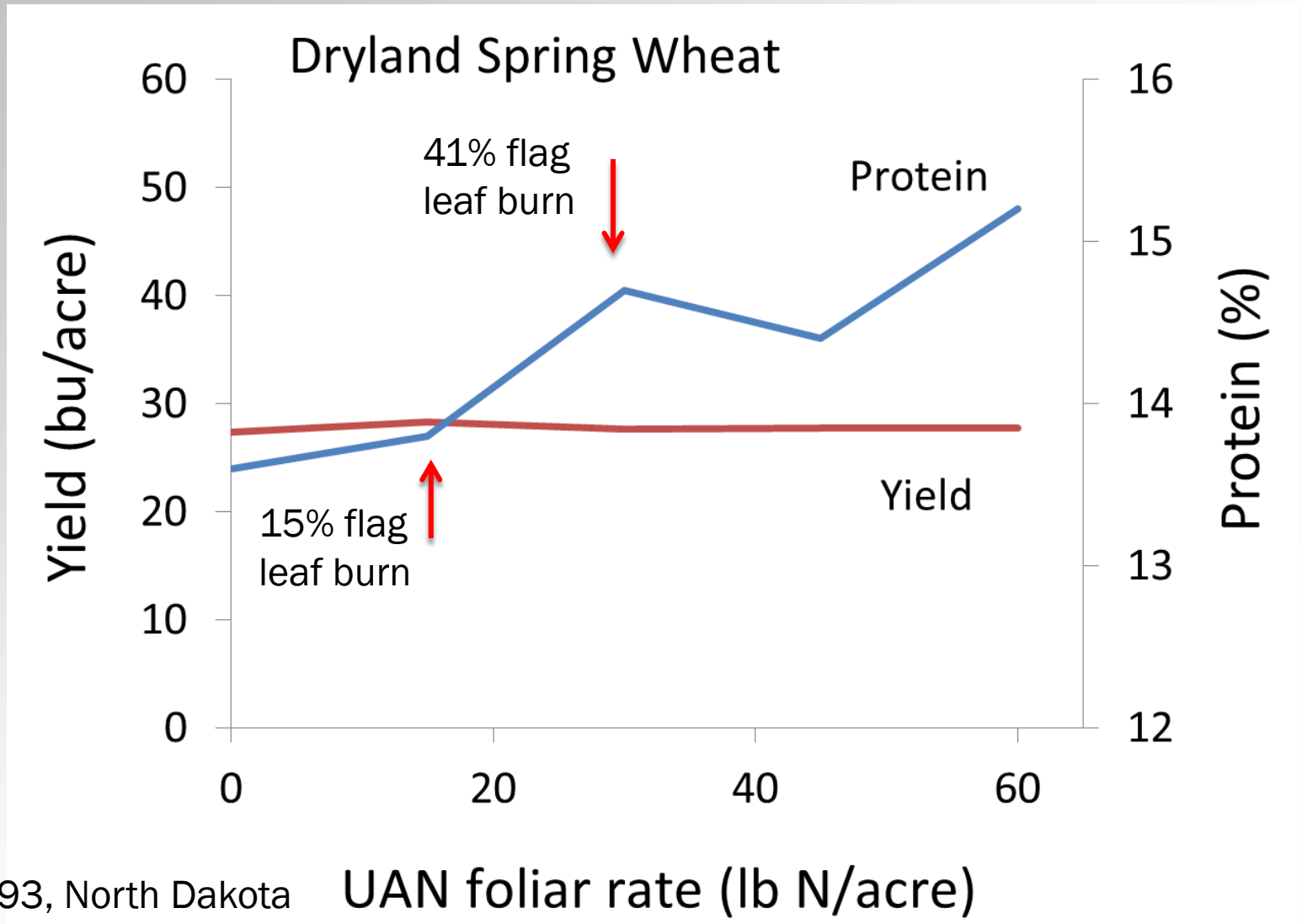
# Foliar

# UAN volatilization with and without Agrotain®

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

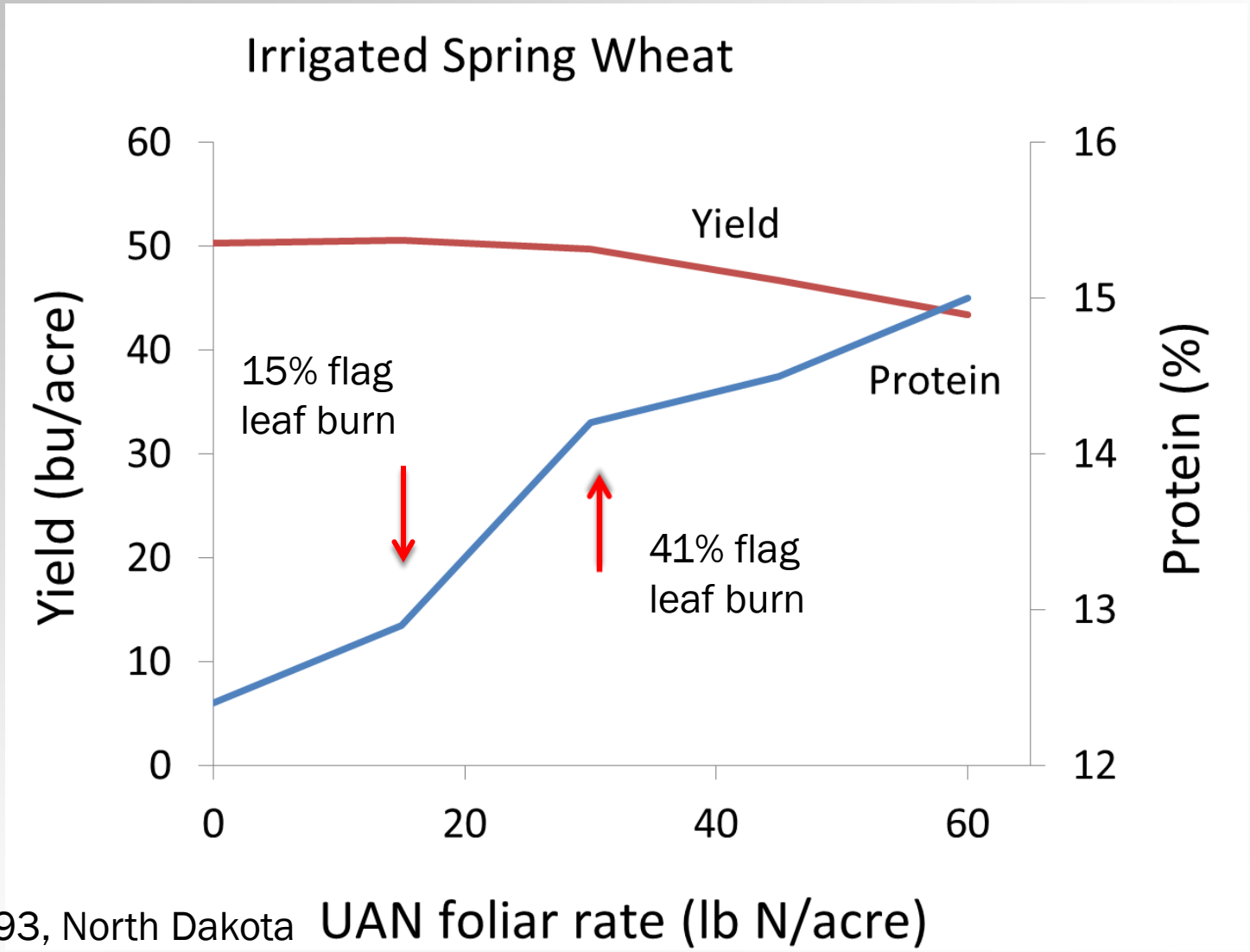
Grant et al. 1996, Manitoba

# 30 lb N/ac produced biggest incremental protein increase when applied 7 - 10 days after flowering in dryland SW




Endres 1993, North Dakota
Pre-plant N for 40 bu/ac yield

# Up to 30 lb foliar N/acre may increase protein without decreasing yield when applied 7-10 days after flowering in irrig. SW




Endres 1993, North Dakota
Pre-plant N for 40 bu/ac yield

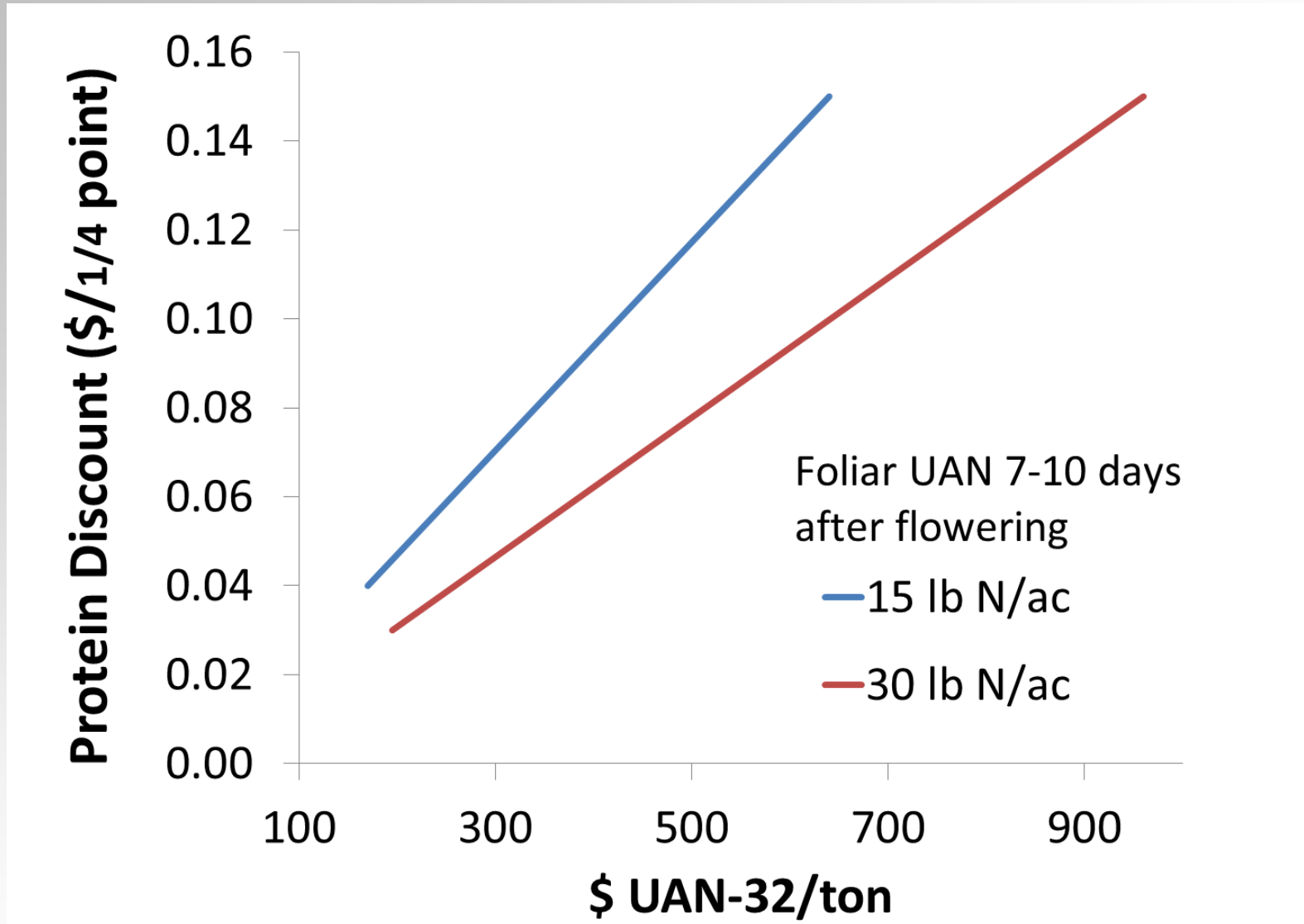
# Economics on Irrigated SW from ND study

- Using April 2013 prices:
  UAN-32 $545/ton = $0.85 /lb N
  SW $8.34/bu for 14%, 3.8¢ per ¼ point discount
- A gain of 1.5% point protein with 30 lb N/acre foliar UAN in a 50 bu/acre crop

30 lb N/acre = $25.50/acre cost of UAN
12.5% protein = $8.34 – (6 x $0.038) = $8.11/bu = 405.60/acre
14% protein = $8.34/bu = $417/acre
$417 - $405.60 - $25.50 = $14.10 loss/acre

No guarantee! If excess is not used then it may volatilize or leach into groundwater.
However, if grain protein discount goes up to 9 cents per ¼ point, then it should pay.

# Protein discount at which increased revenue equals cost of late-season UAN used to increase protein

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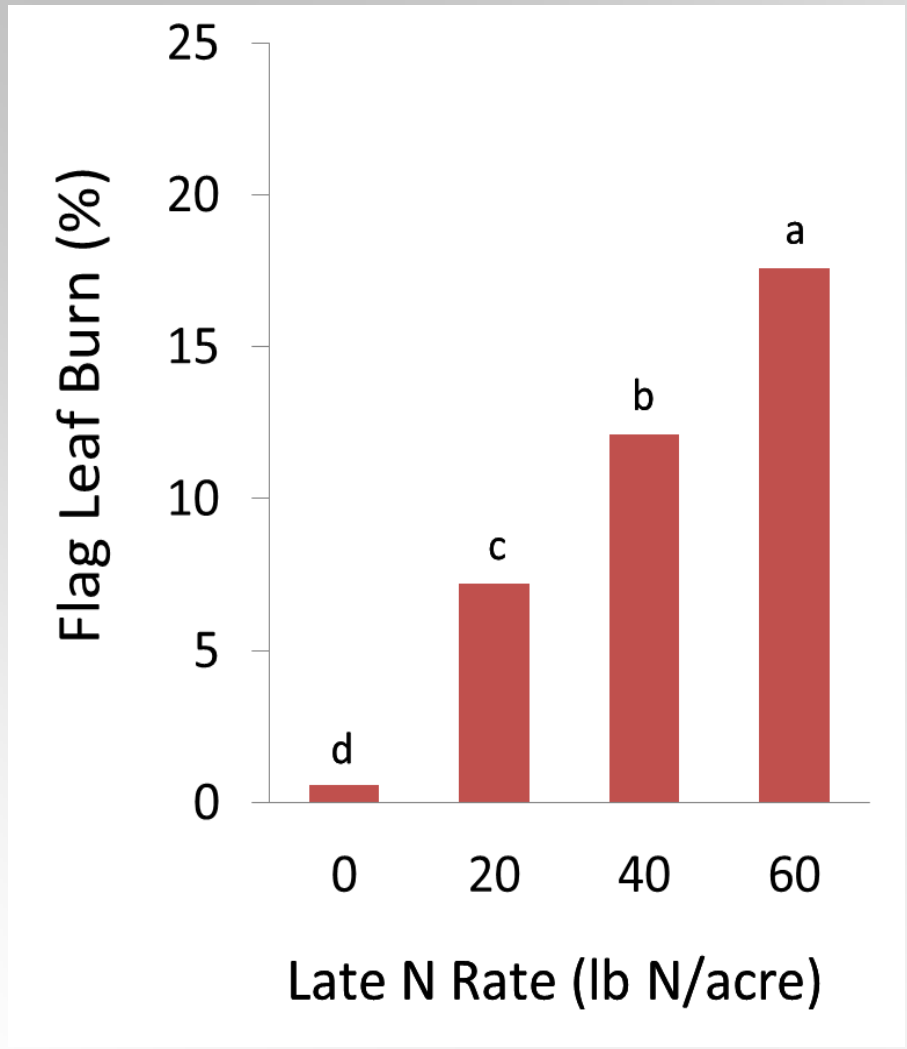
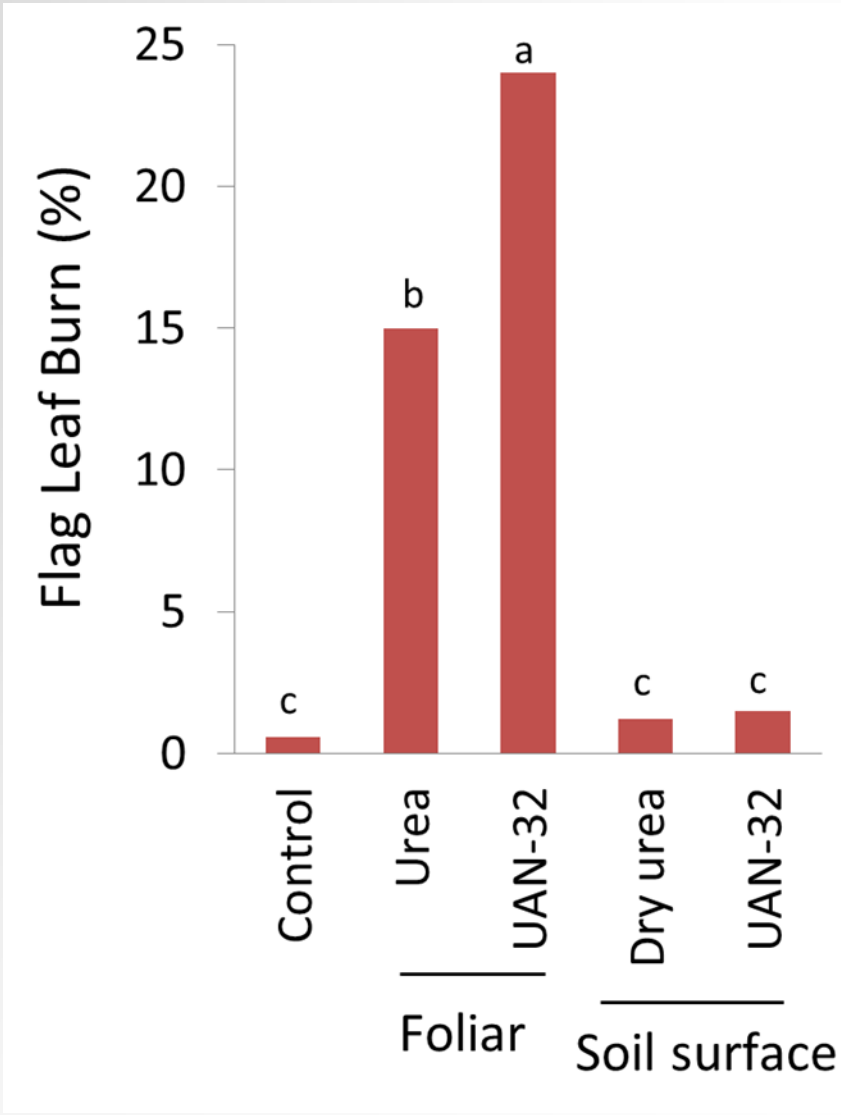
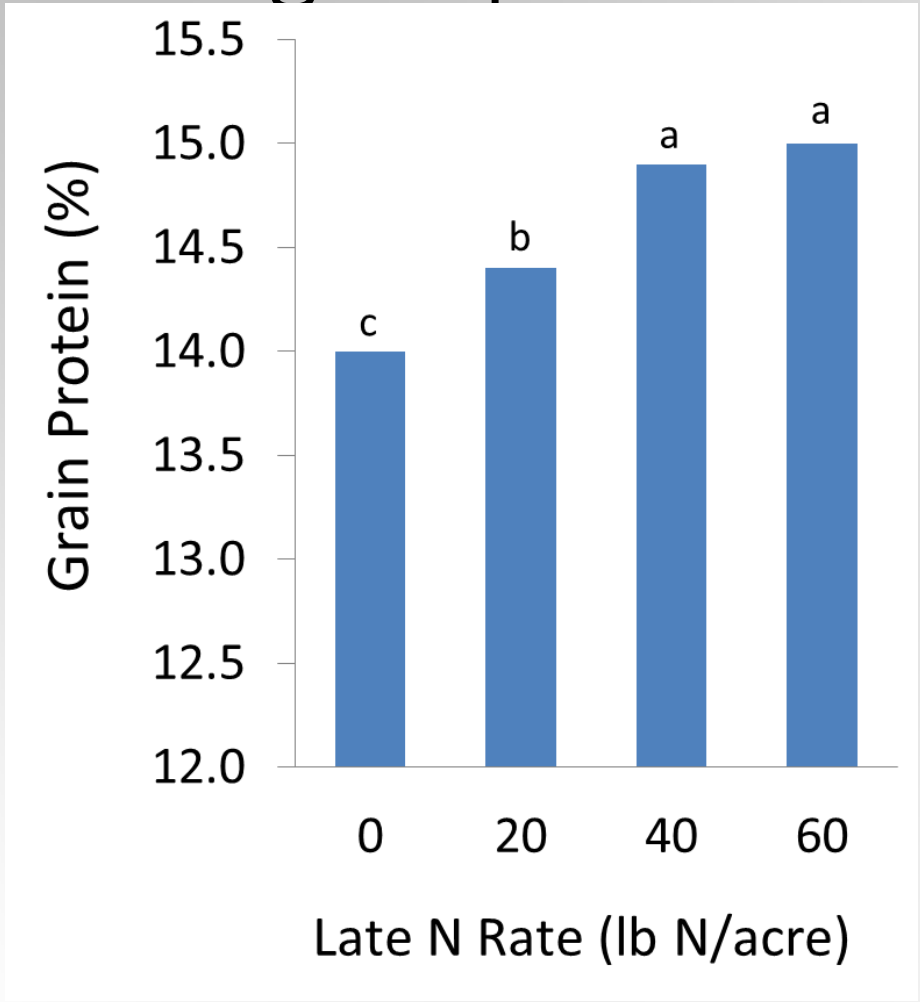
# Foliar rate and source effect on irrigated spring wheat leaf burn

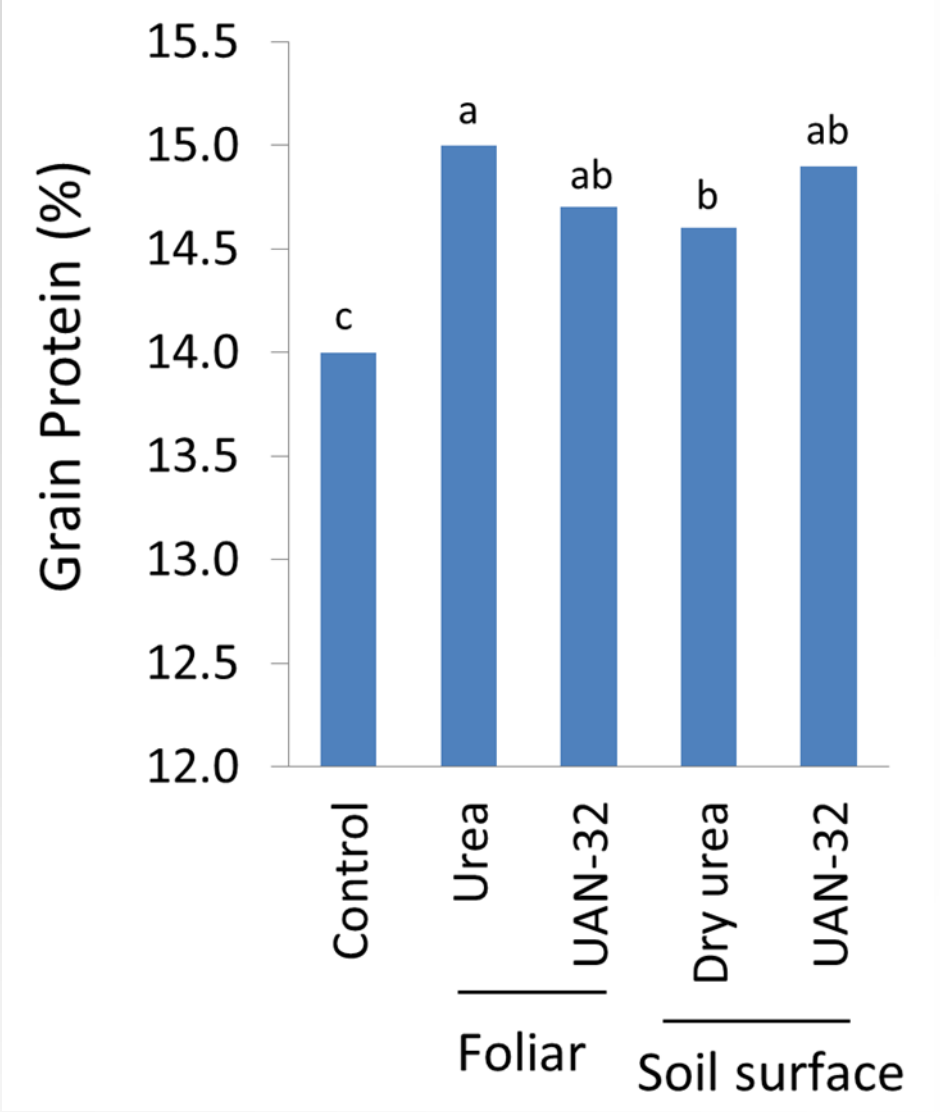



Brown 1995, Idaho, Irrigated SW
All received top-dress at tillering to produce 120 bu/ac, Yield NS

# Foliar rate and source effect on irrigated spring wheat grain protein




Brown 1995, Idaho, Irrigated SW
All received top-dress at tillering to produce 120 bu/ac, Yield NS

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

| Treatment | Leaf burn (%) | protein (%) |
|---|---|---|
| Check | 2.6c | 14.7c |
| 30 lb N just before anthesis | 19.2a | 15.0b |
| 30 lb N 5 days after anthesis | 19.2a | 15.0b |
| 15 lb N each just before and 5 days after anthesis | 14.2ab | 15.0b |
| 15 lb N each 5 and 10 days after anthesis | 11.4b | 15.2a |

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

# 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.

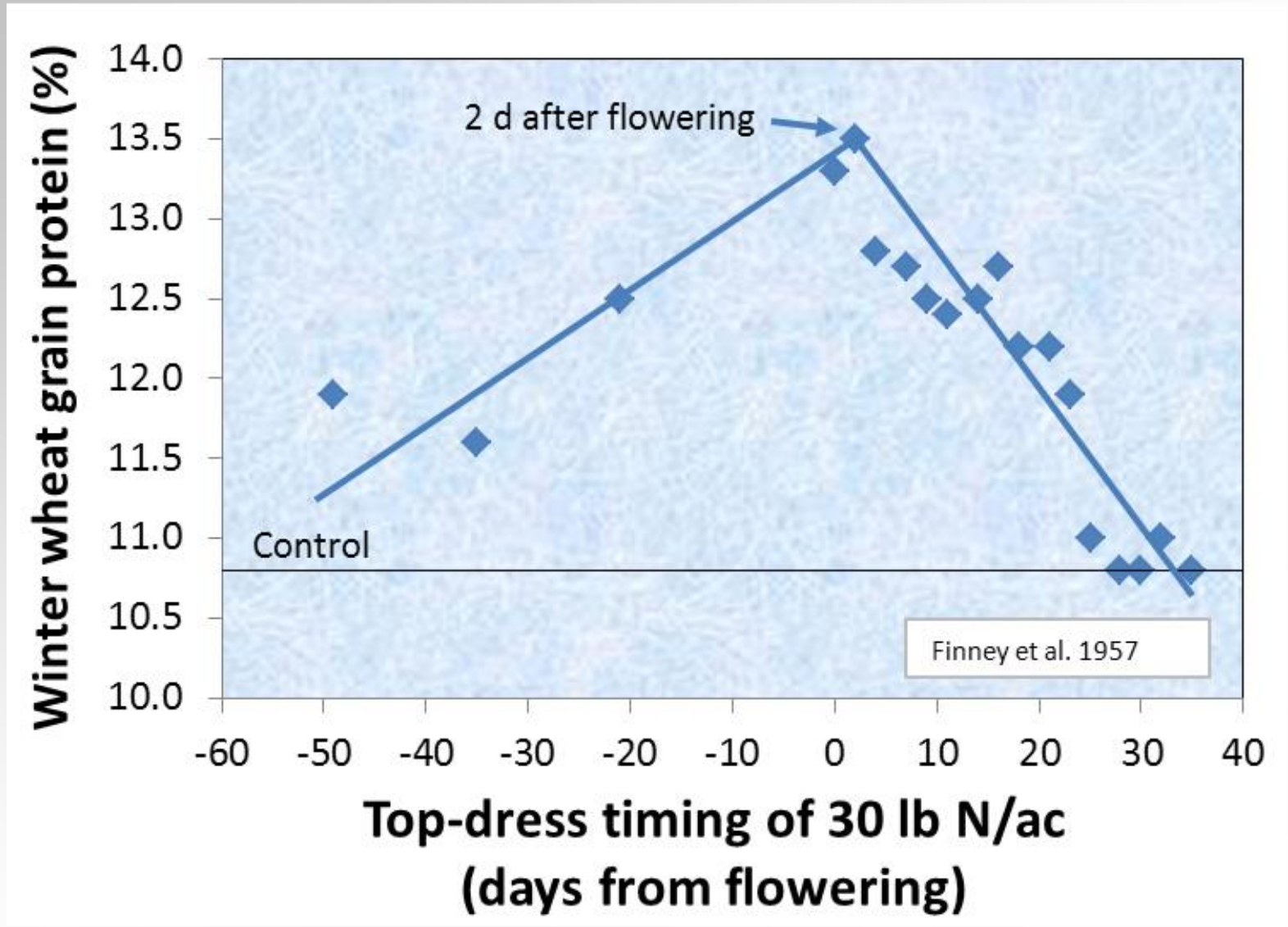
Brown & Long 1988, Parma, ID, irrigated winter wheat

# Foliar N facts and recommendations

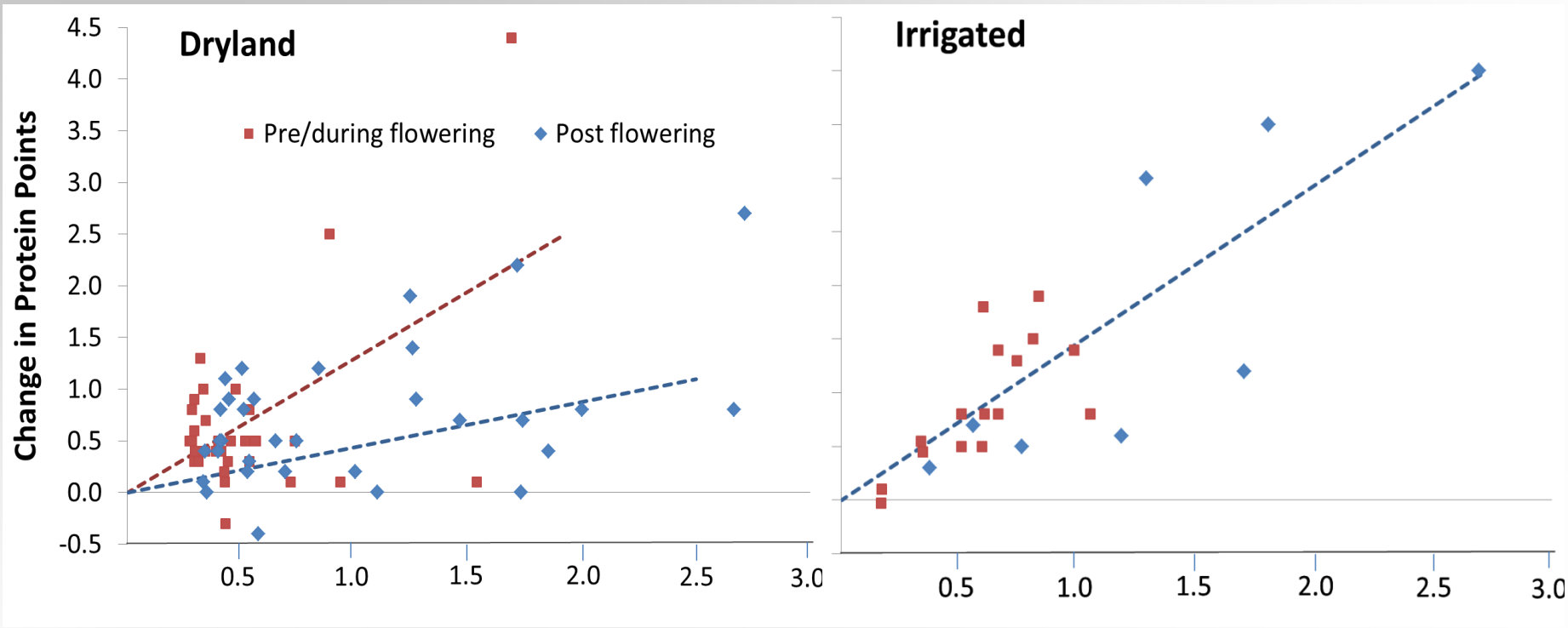
- Apply enough water to avoid leaf burn
- Only 8-11% of foliar applied liquid urea was taken up by leaves, whereas 37-67% of soil applied N was taken up by plant in same study (Rawluk et al. 2000)
- ½ inch rain (have you been living right?) or irrigation to soak into soil
- Leaf damage increased with:
  - Surfactant + more than 20 lb N/ac of 28-0-0 UAN
  - Urea + Agrotain®
  - Sulfur
- If scab risk, do not irrigate within 5 days of flower

# Questions on Foliar N Applications?

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

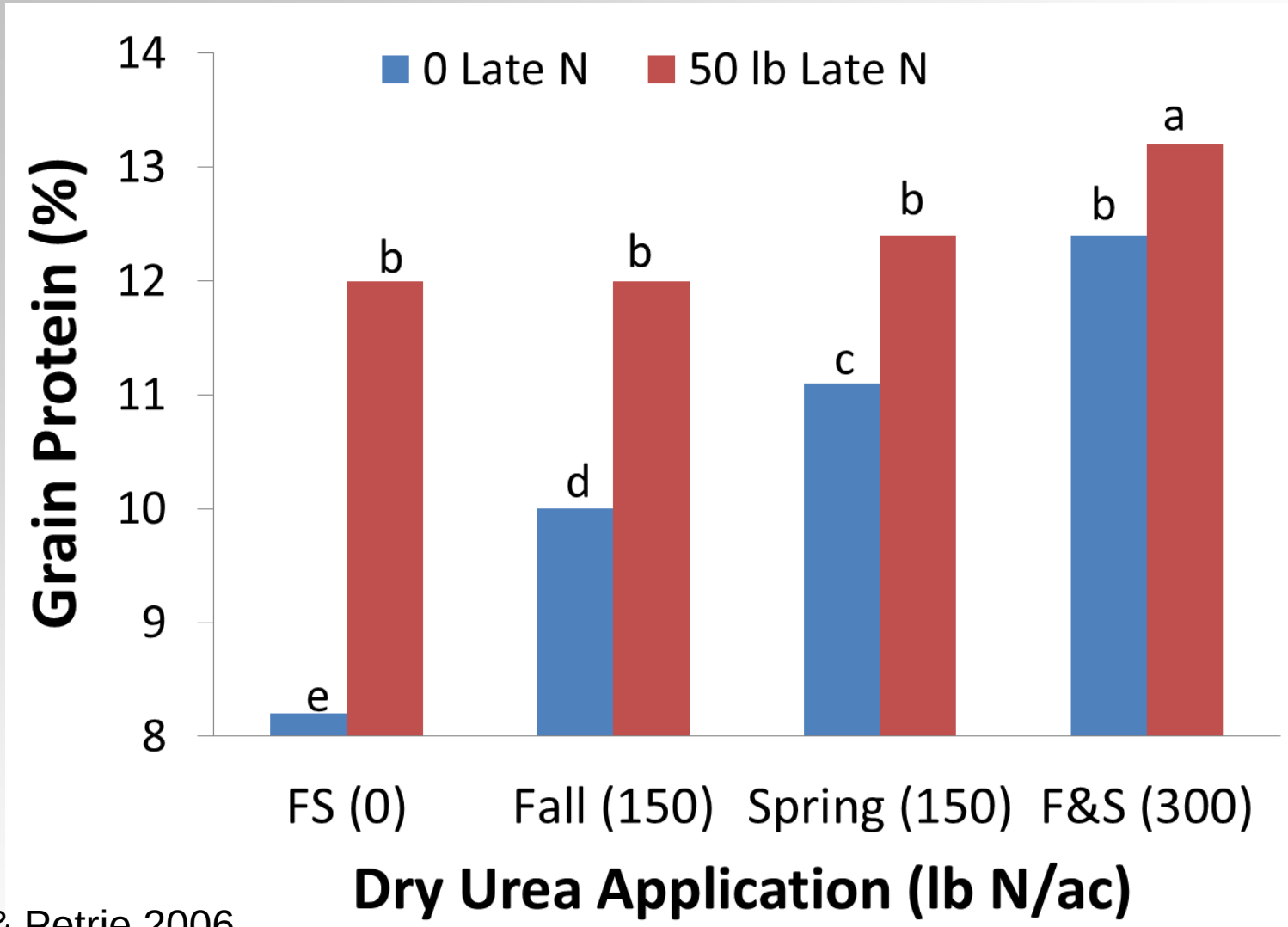


# In-season N rate, timing, and dryland vs. irrigation affects protein boost




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

# Urea applied between heading and flowering (Feekes 10.2 - 10.5) increases protein in irrigated winter wheat



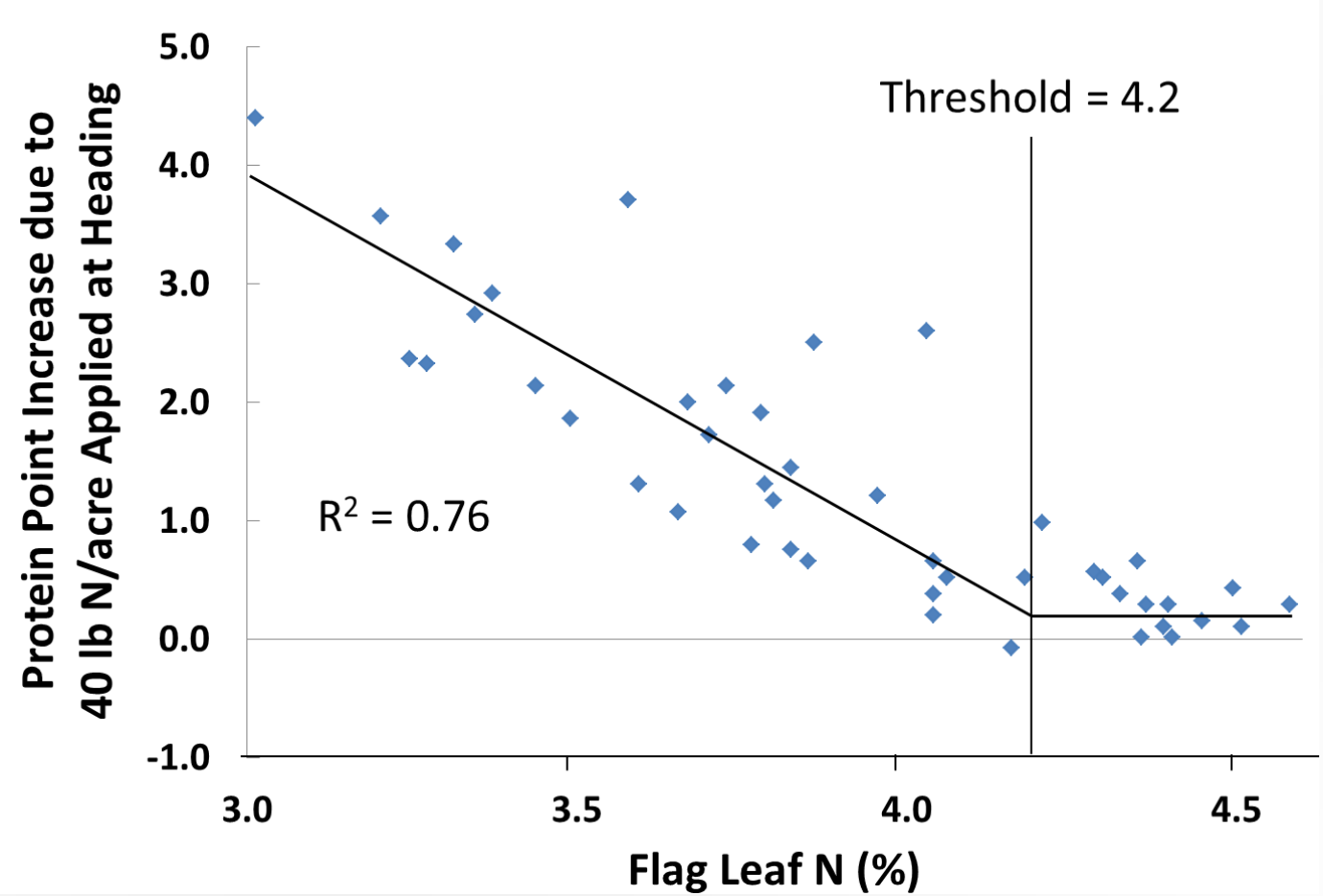

Brown & Petrie 2006
Idaho, fall pre-plant incorporated, late N incorporated with irrigation

# How should your growers decide whether to apply late-season N?

Ask them:

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).
- Need: N cost/discount {($/lb N)/(protein discount per point)}
- Critical FLN = 4.2 – {13.3(N cost/discount)/(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 N cost/discount = 1.5 (May 2012) and yield = 50 bu/ac, critical FLN = 3.9%.
  - Example 2: If N cost/discount= 4.5 (current) and yield = 50 bu/ac, critical FLN = 3.0% (rarely this low).
- Bottom line: need far lower FLN to justify top-dressing for protein IF ratio of fertilizer cost to discount is high.

# 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?
Watrous, SK, 1920s