Overwinter Soil Nitrate Changes and Implications

Montana Agri-business Association Convention

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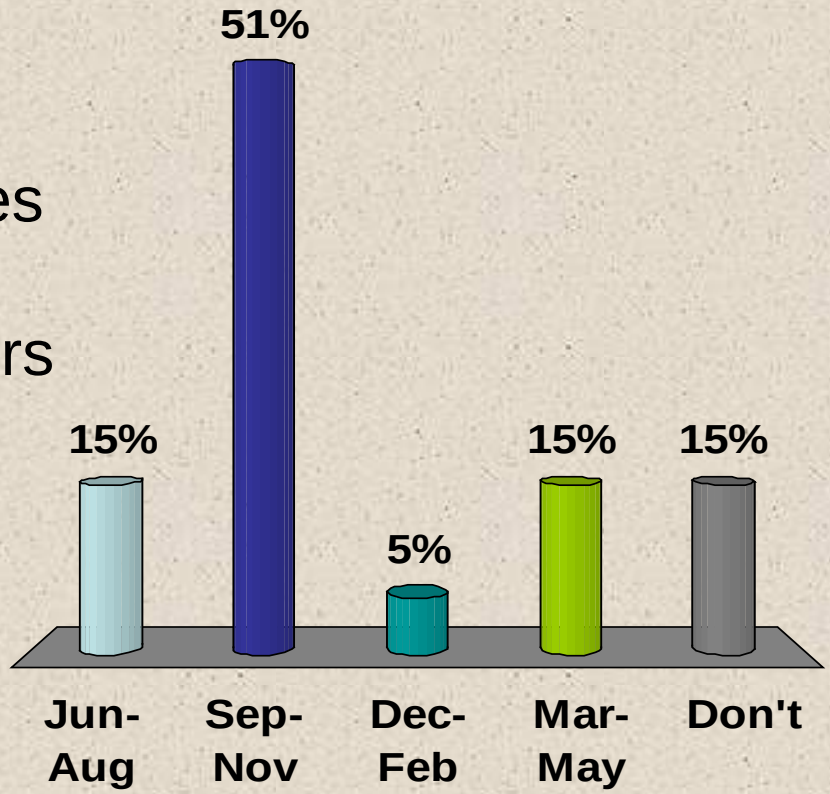
MONTANA STATE UNIVERSITY EXTENSION

Background

- Nitrogen fertilizer guidelines are based on spring soil samples for nitrate in Montana
- BUT, most sampling in MT occurs from late summer to late fall

Based on 35 ‘clicker’ responses at MABA 2010 Convention, when asked when crop advisers do most of their soil sampling:



Background, Continued

- Previous research suggested that nitrate changes could be substantial (up to 33 lb N/ac) from late summer to early spring (Miller et al. 2006)
- Study undertaken to see how nitrate changes vary with previous crop, soil, climate, year and location across Montana
- Ideally develop a regression equation so a crop adviser who samples in Fall could adjust N rates
- Funding provided by Fertilizer Check-off

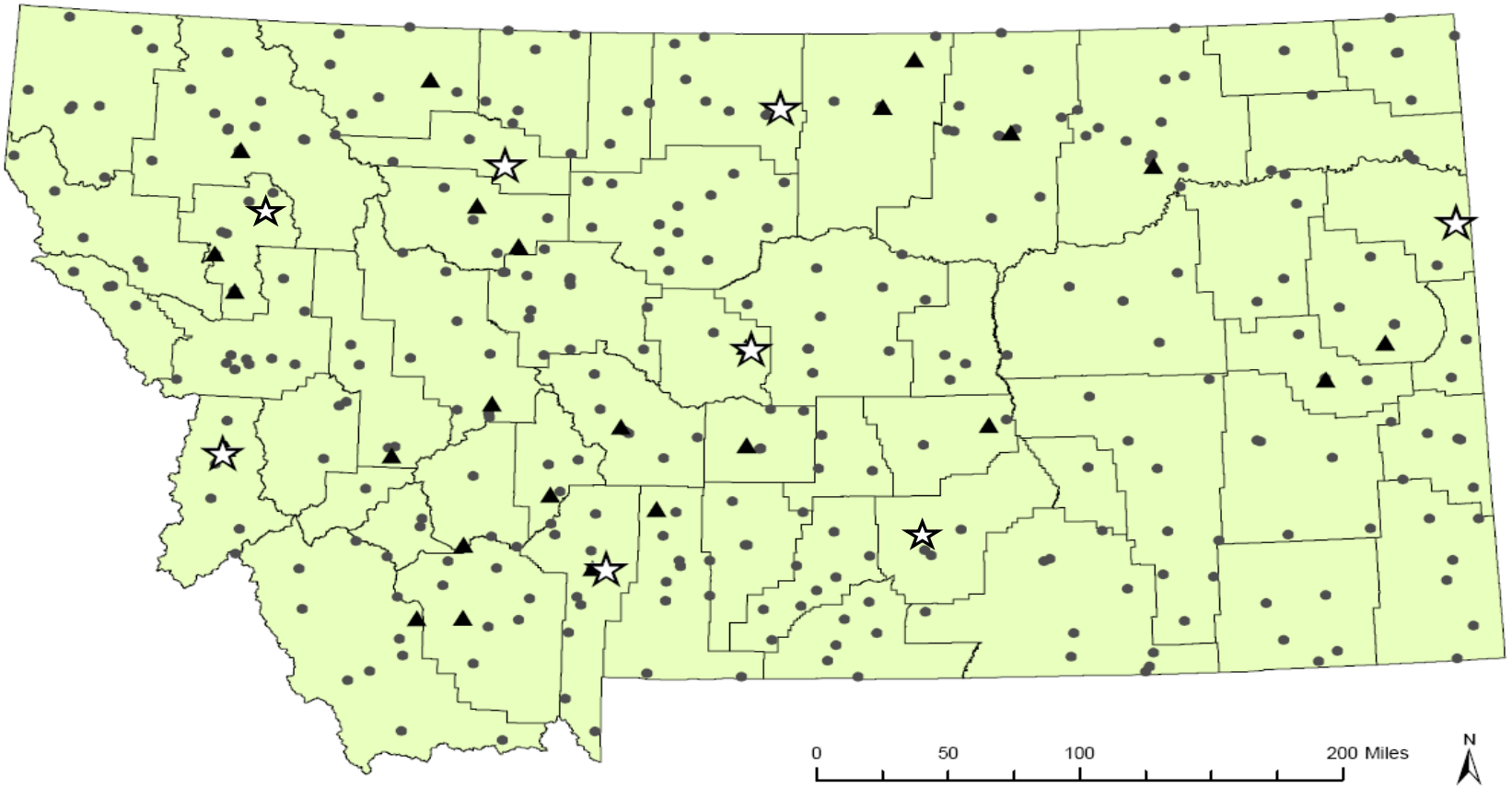
Methods

Soil samples collected:

3 Sampling Times	**Aug/Early Sep, mid Nov, early Apr***
8 Locations	**Each Ag Res Center, plus Post Farm**
4 Previous Crops	**A. legume, cool season oilseed, sm grain, fallow**
3 Seasons	**07-08, 08-09, 09-10**
2 Depths	**0 to 6, 6 to 24 in.**
2 Replicates	**For each previous crop**

* at the Post Farm, samples were also collected monthly between late summer and mid November

Sampling Sites



☆ Sampling Locations

▲ Agrimet Weather Stations

• NCDC Weather Stations

Map by Sara Copeland

Sources:
http://www.wrcc.dri.edu/inventory/inventact.html
http://nris.mt.gov/gis/

Methods

Analyses:

August Analyses		November and April Analyses
0 to 6 in.	6 to 24 in.	both depths
Nitrate-N Soil texture Soil water content O.M. pH Electrical conductivity Olsen P Exchangeable K	Nitrate-N Soil texture Soil water content	Nitrate-N Soil water content

Modeling Methods

Added monthly precipitation and average air temperature for each site-year to database.

Developed regression models for the nitrate changes based on full data set.

Form:

Nitrate change = a + b1*x1 +…+ bn*xn

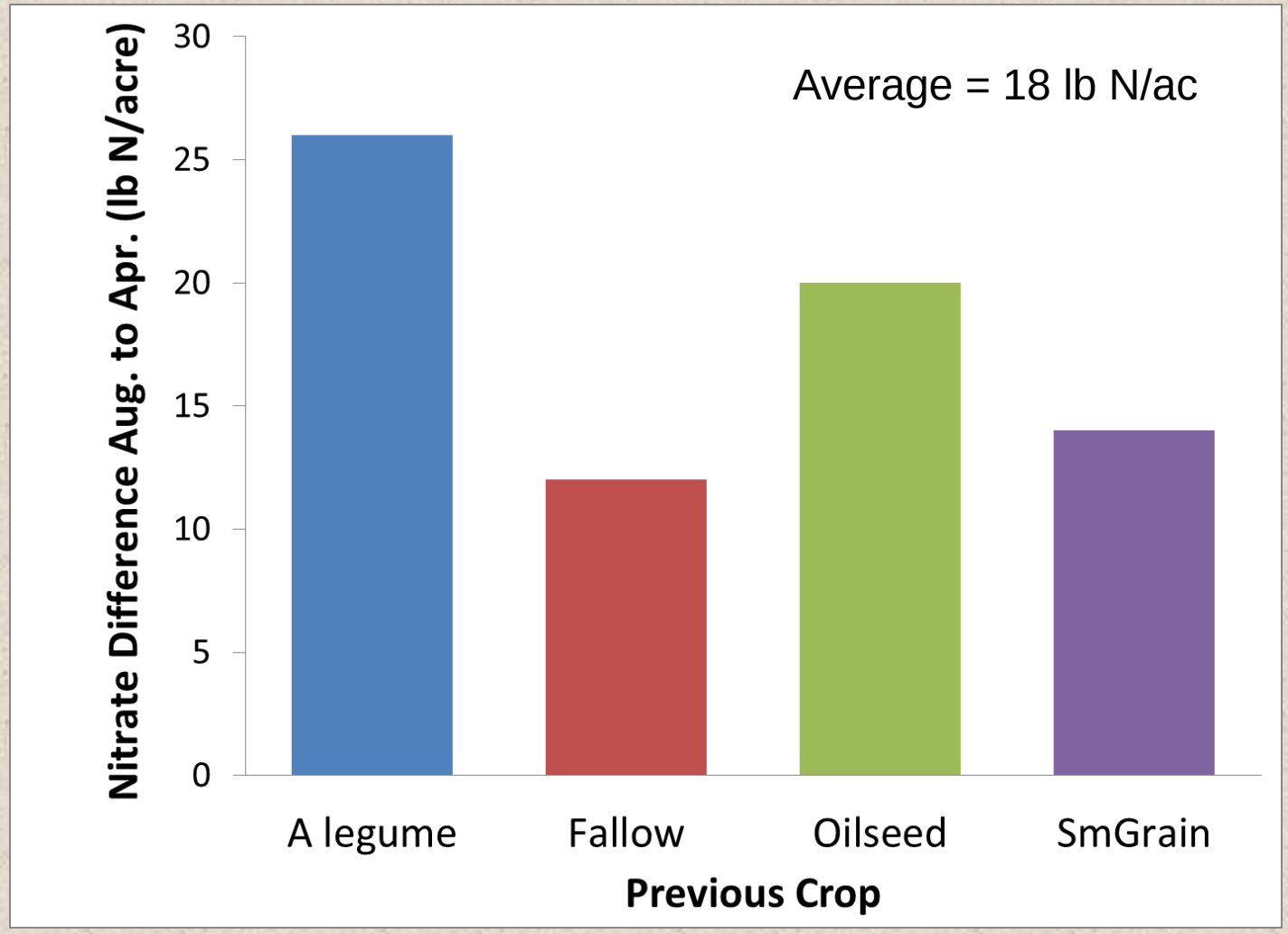
Where

a is the intercept

b's are coefficients (slopes)

x's are values of each variable (O.M., pH, precip etc)

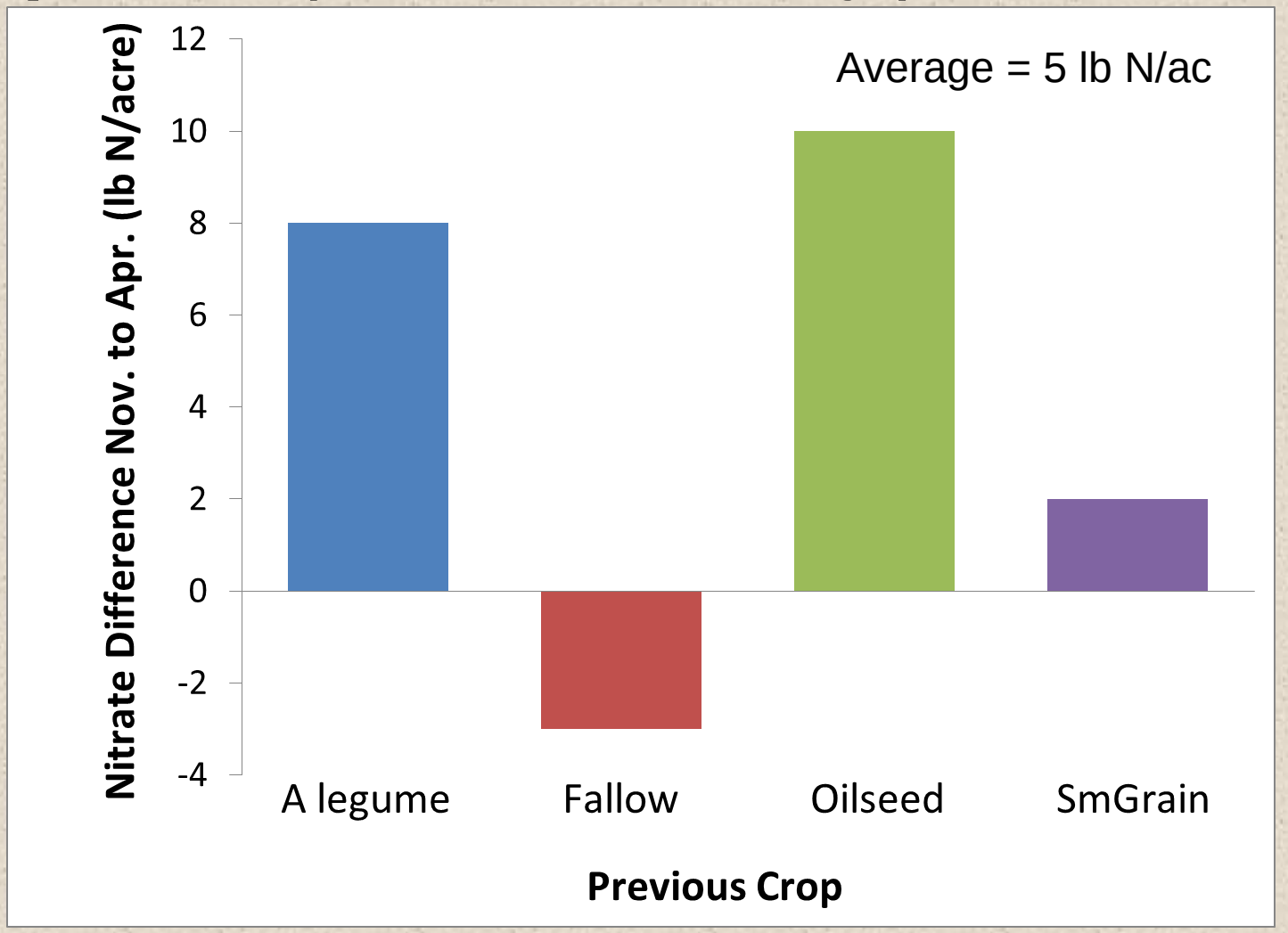
Changes in soil nitrate-N from **August to April** in top 2 feet of soil by *previous crop*



Jones unpubl data.

Averaged over 8 sites and 3 years. **Previous crop effect was significant.**

Changes in soil nitrate-N from **November to April** in top 2 feet of soil by *previous crop*



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Why was previous crop statistically important for Aug to Apr nitrate changes, but not for Nov to Apr nitrate changes?

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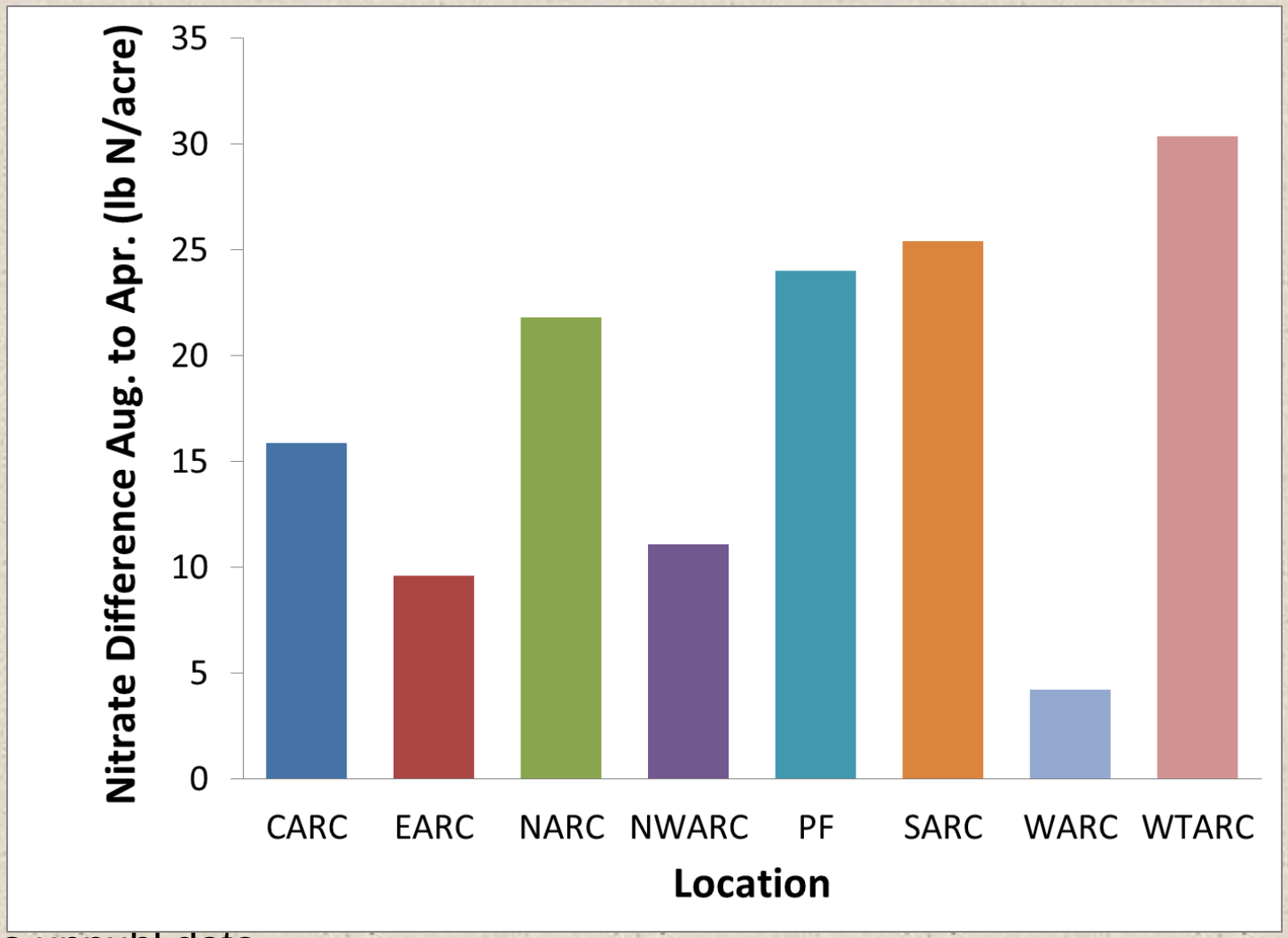

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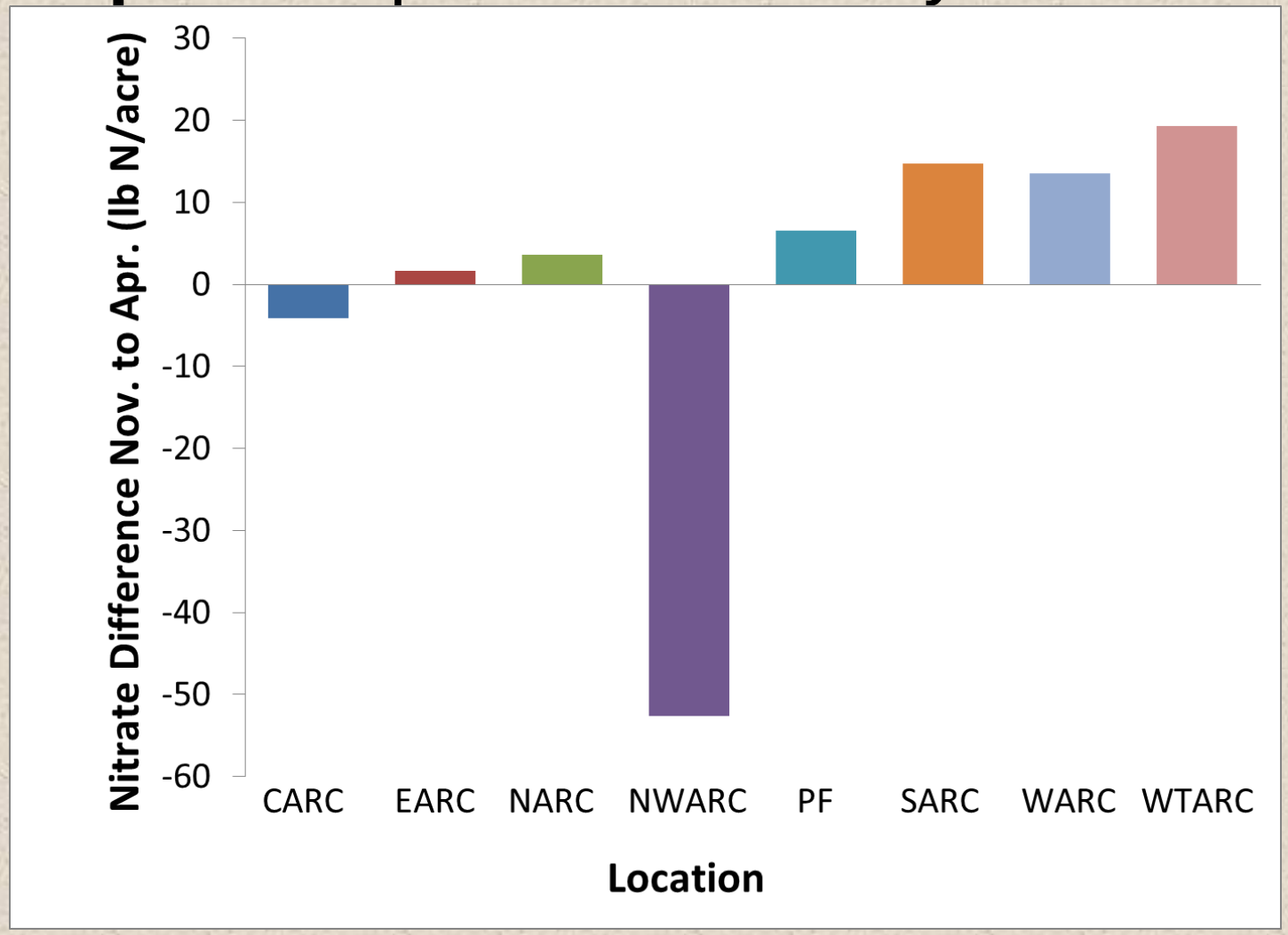
Changes in soil nitrate-N from **November to April** in top 2 feet of soil by *location*



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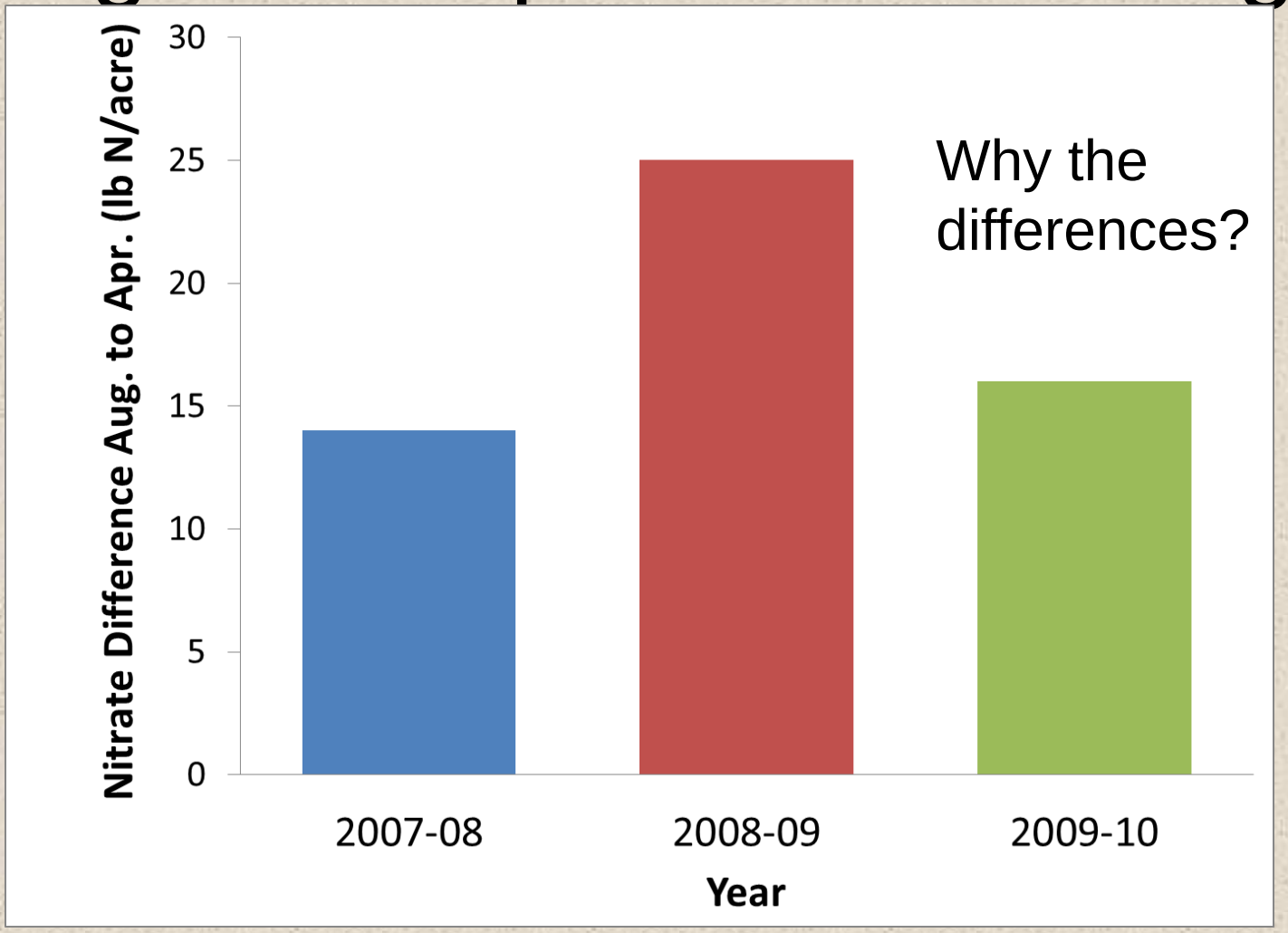
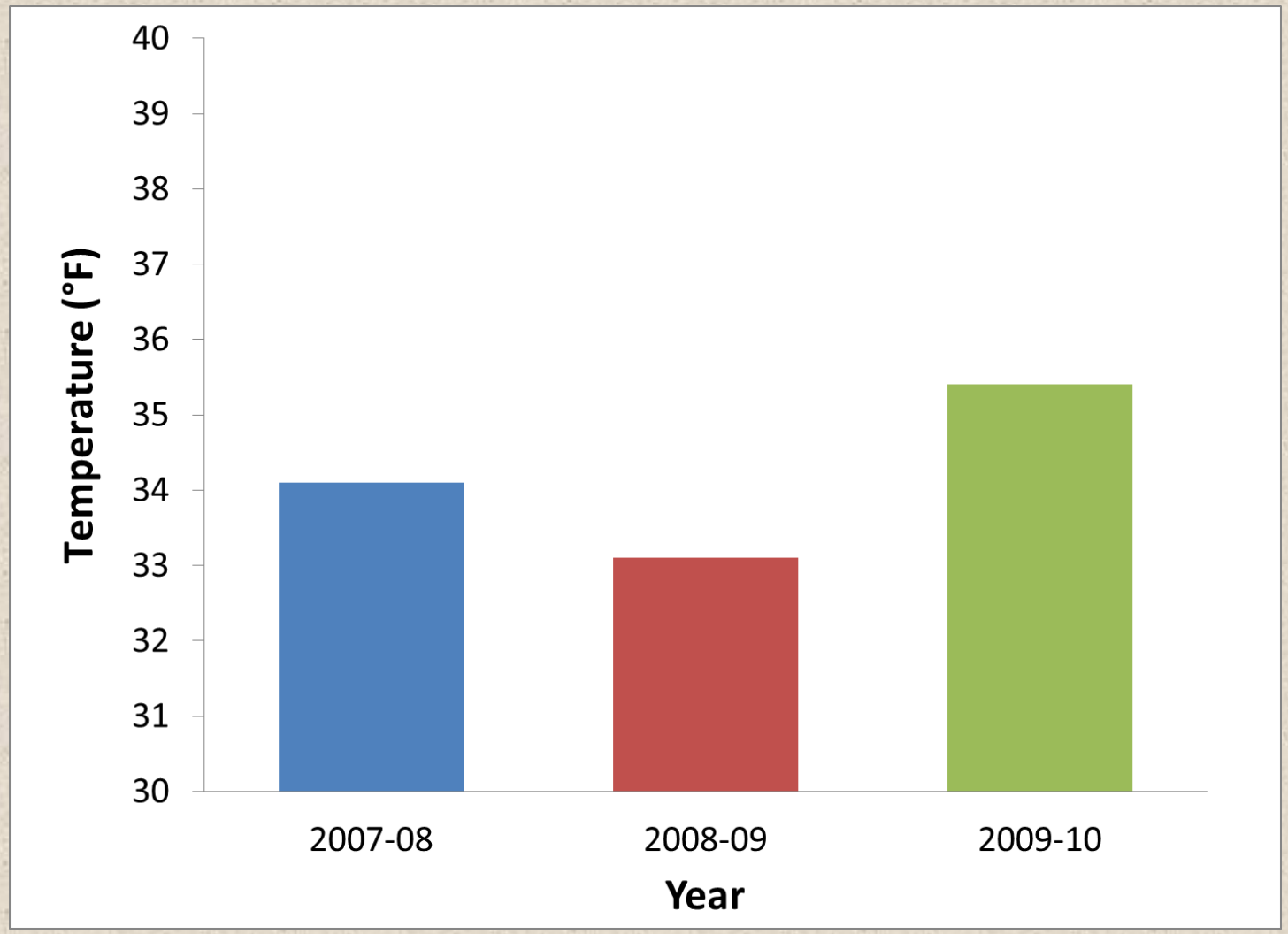
Questions so far?

Year to Year variability in August to April nitrate change

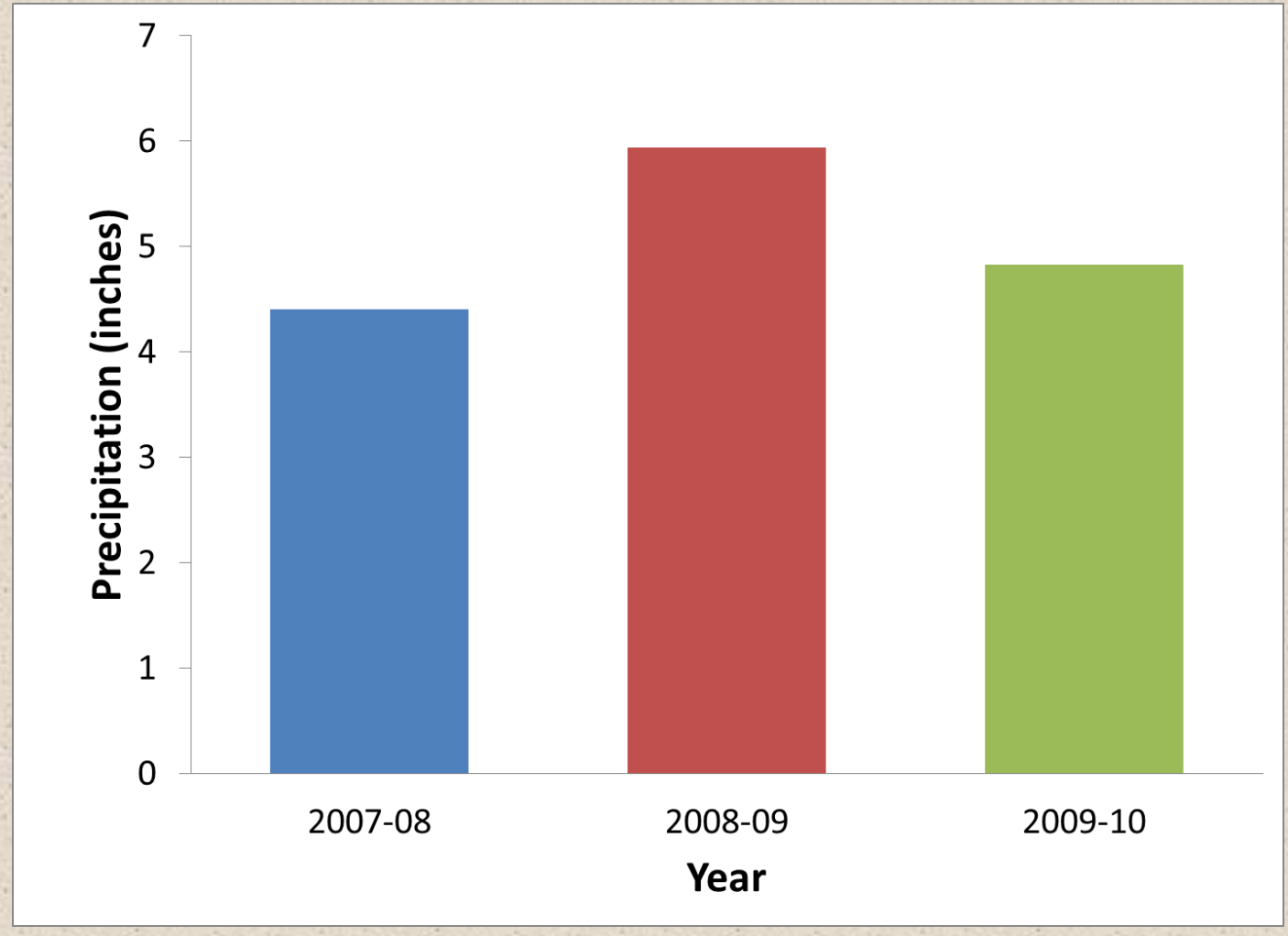


Year had a significant effect on nitrate change

Average Temperature (September to March) by Year (averaged over location)



Total Precipitation (September to March) by Year (averaged over location)



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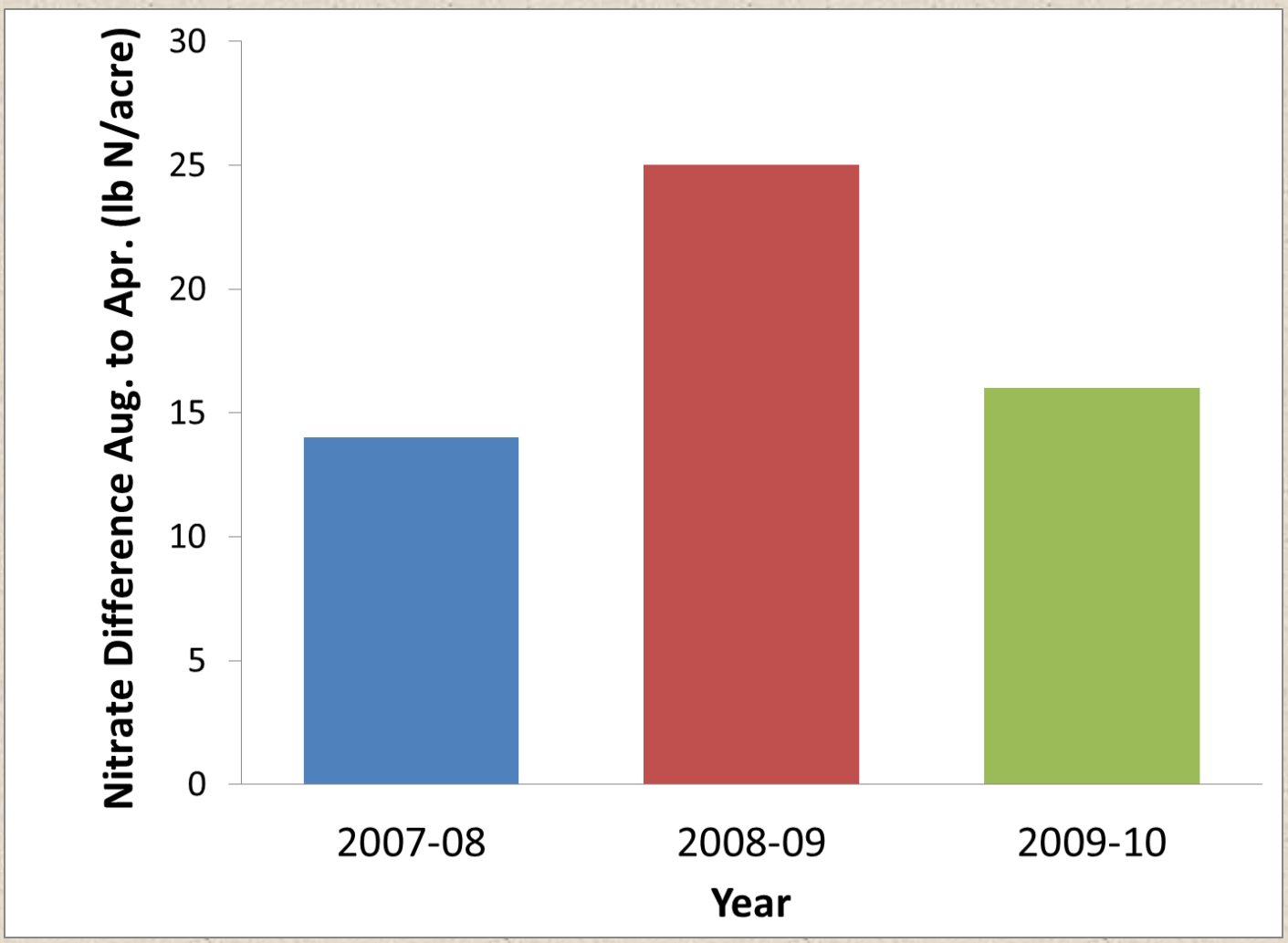
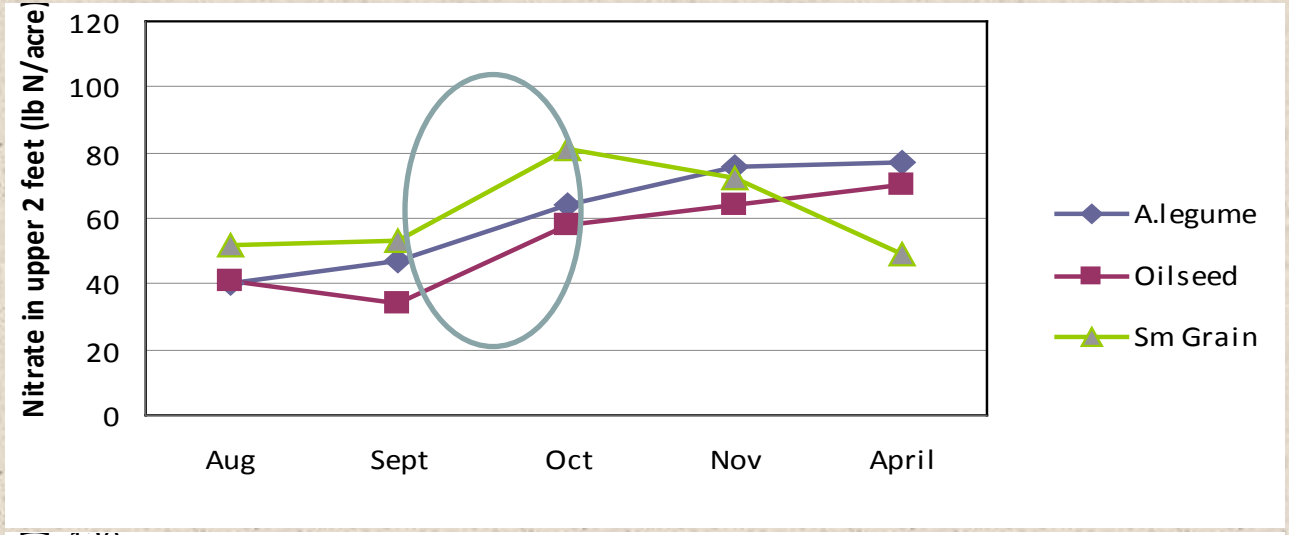


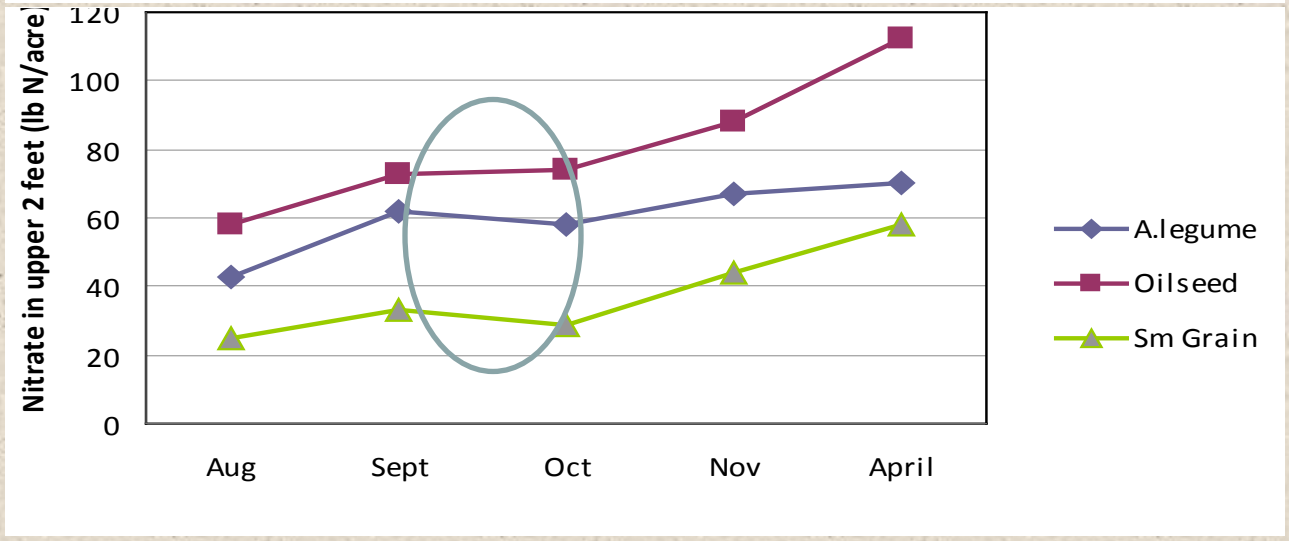
Monthly nitrate-N changes at Agronomy Post Farm

2007-8



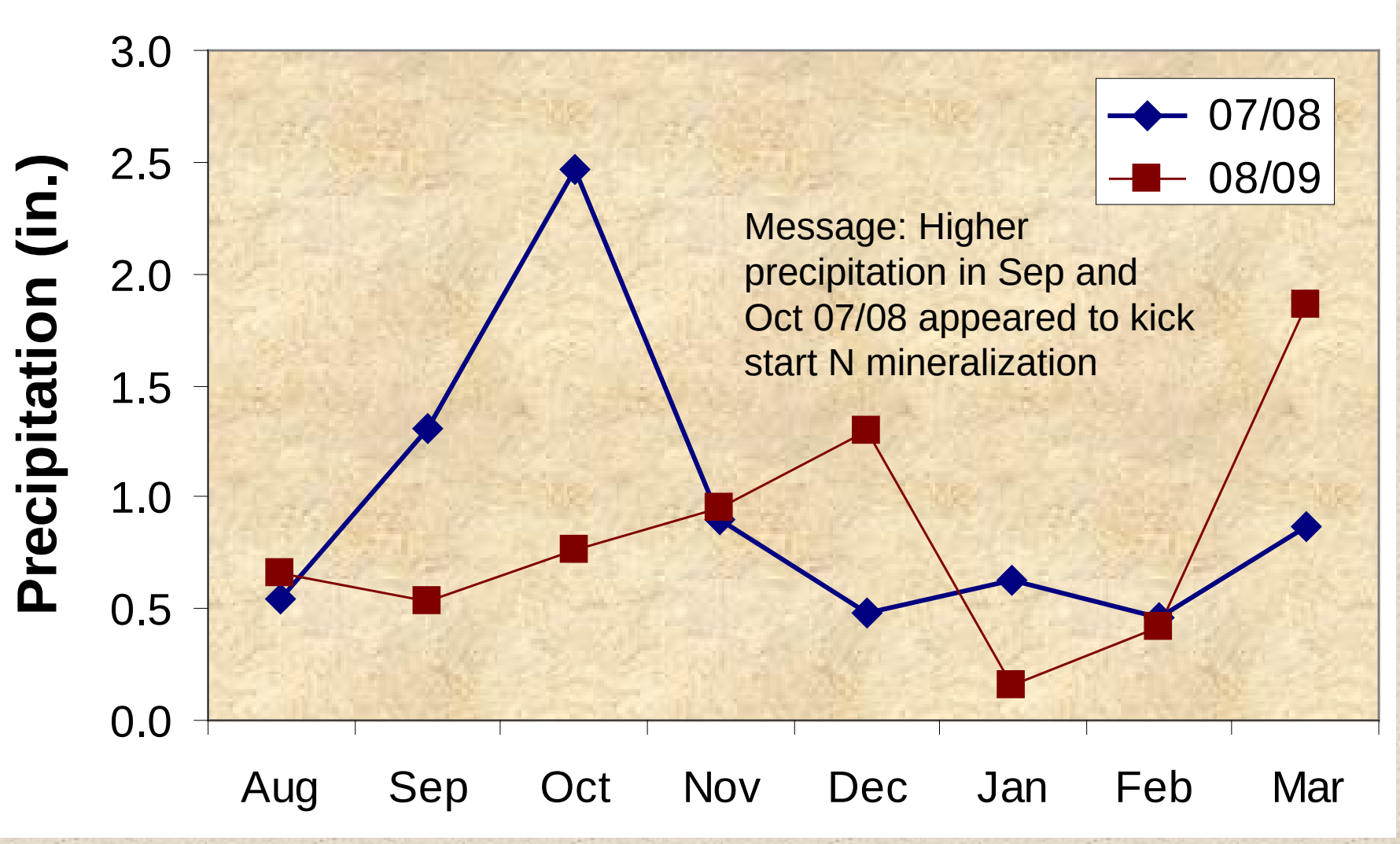
NOTE: Average October and April nitrate almost identical

2008-9



NOTE: Nitrate increased ~ 30 lb N/ac from October to April

Precipitation at the Post Farm



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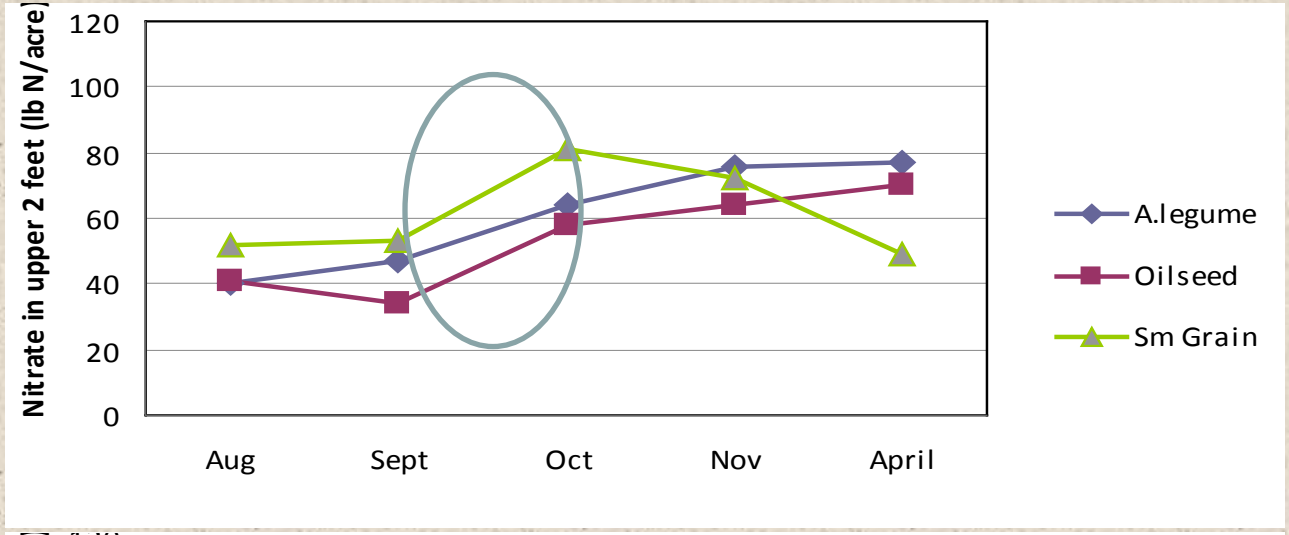

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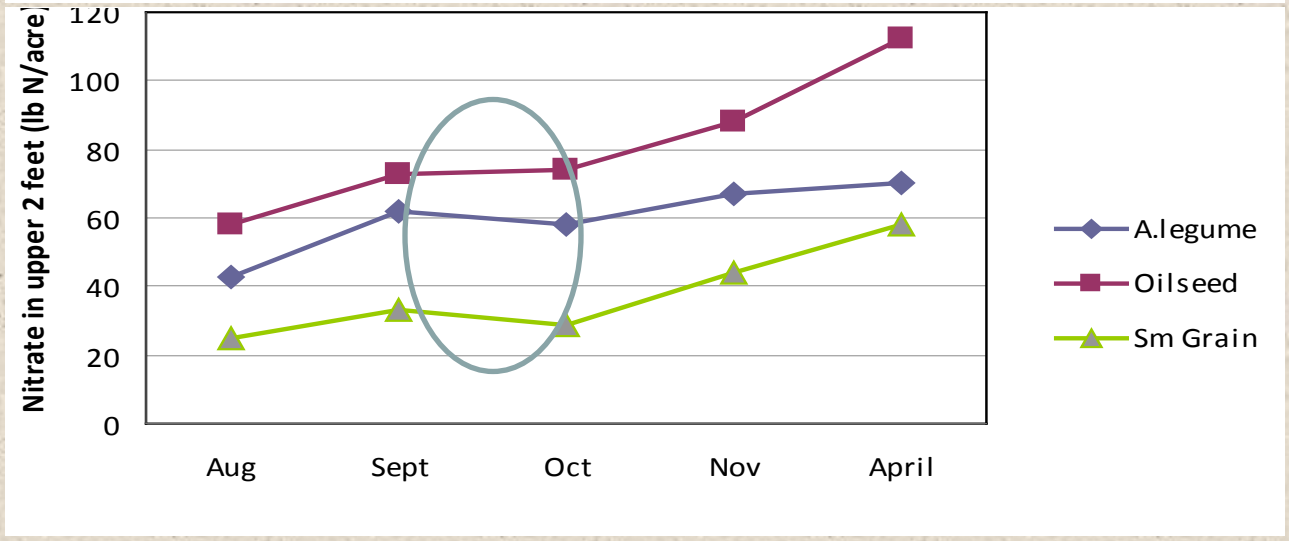

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Questions so far?

August to April Model Findings

- Initial nitrate-N level, soil depth, Olsen P, previous crop, and year were all found to be important

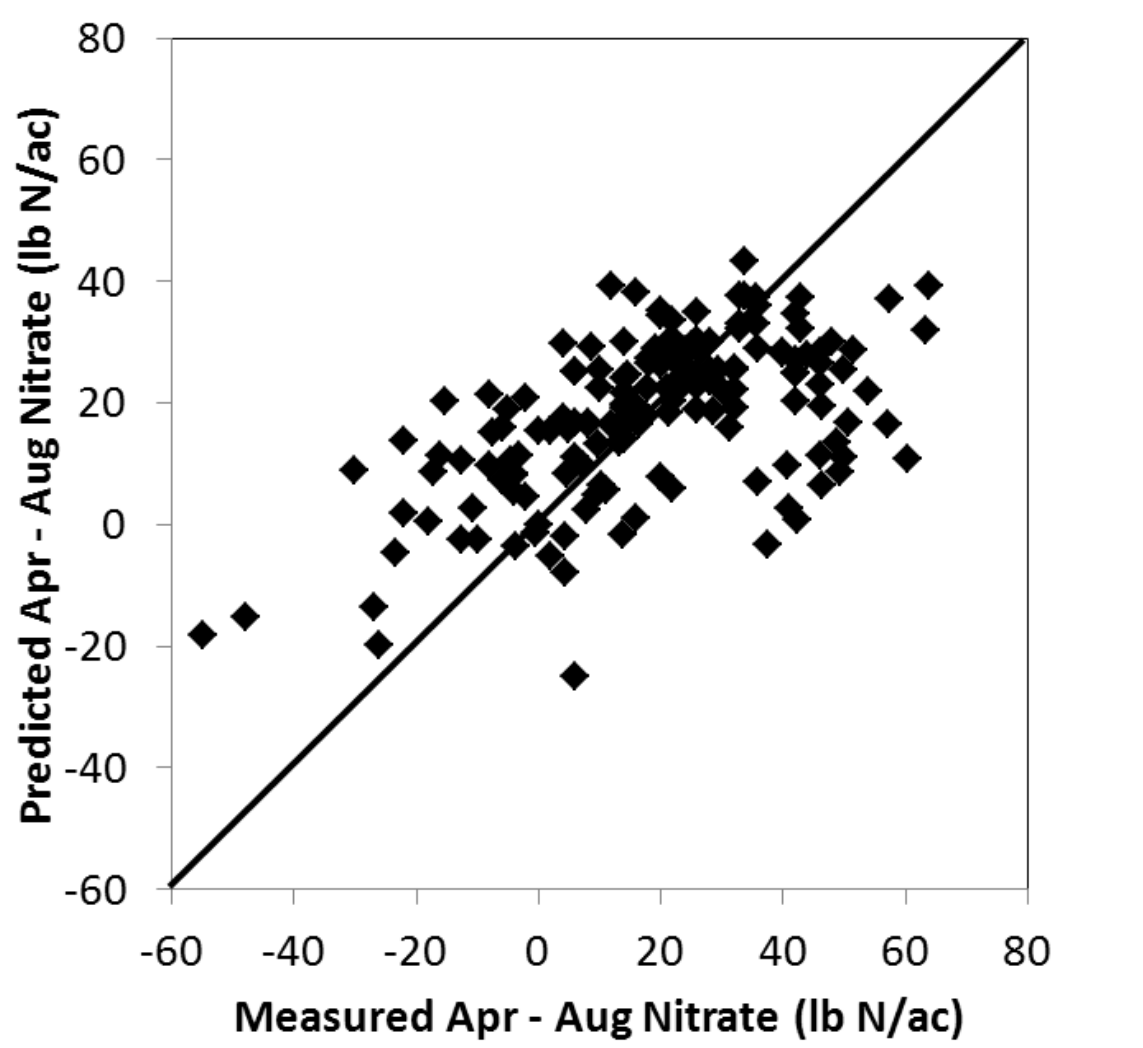
  Specifically, *higher* Aug nitrate related to *lower* nitrate changes (more there to lose, offsetting N mineralization)

  Lower soil depth related to *lower* nitrate changes

  Higher Olsen P related to *lower* nitrate changes (?)

- Climate, texture, water content, pH etc were found to NOT be important (!)

Predicted vs Measured April minus August nitrate change



1. Unfortunately, model not accurate enough to have confidence in using it.
2. Large range in nitrate changes suggests Aug sampling may be too early

November to April Model Findings

- Initial nitrate-N level, soil depth, surface pH, precipitation, and year were all important

  Again, *higher* Aug nitrate related to *lower* nitrate changes, and l*ower* soil depth related to *lower* nitrate changes

  Higher pH related to *higher* nitrate changes

  Higher **Aug to Feb** precipitation related to *lower* nitrate changes (suggesting leaching offset mineralization OR precip speeded up mineralization before November?)

- Temperature, texture, water content, Olsen P etc were found to not be important

As a crop adviser what could you do with this information?

- Sample later in fall IF practical
- On coarser soils with high nitrate levels, consider increasing recommended N rate to account for nitrate loss.
- Consider an N ‘credit’ IF sample Sep or earlier, especially after a broadleaf crop.
- Use adjusted soil nitrate levels in MSU’s economic N rate calculator for small grains on fallow to maximize grower’s bottom line.

http://www.montana.edu/softwaredownloads/softwa...

Winter Wheat Economic N Rate Calculator

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

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Funded by Montana Fertilizer Checkoff Dollars

Available Soil Nitrate - Lbs./Ac. 40

Level of Organic Matter (O.M.) 2.0

Maximum Potential Yield 50

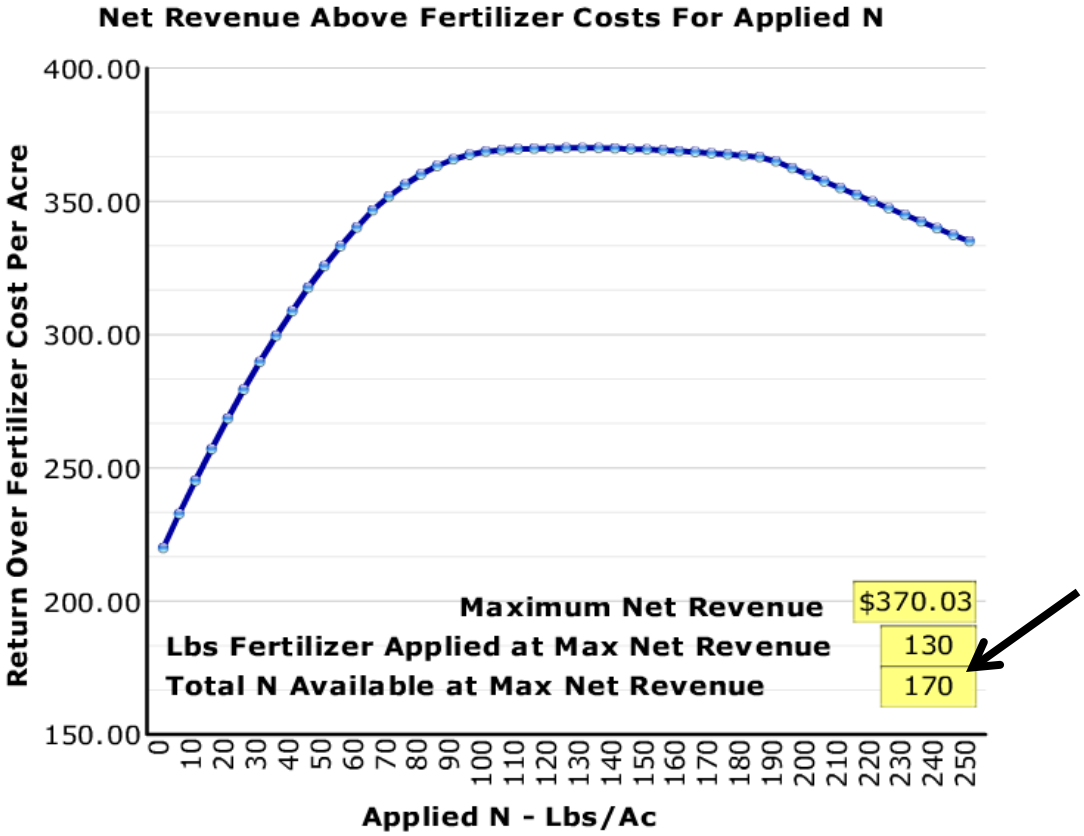
Wheat Price for 12.5% Protein Winter Wheat $8.00

Nitrogen Price Per Pound Active Ingredient $0.500

Protein Discount Per One Quarter Point $0.150

Protein Premium Per One Quarter Point $0.120

Please note that this graph is dynamic. As you move one or more of the sliders to change values for a selected parameter, the graph will rescale itself to show results for the parameters you have changed.



The horizontal axis is Lbs/Acre of applied N, NOT total N. However, total N (soil N + applied N) is used to calculate the values shown in the graphs.

IF credited 10 lb N/ac for Aug to Apr nitrate change AND used this model:
Recommended available N rate = (170 lb N – 10 lb N)/50 bu = <u>3.2 lb N/bu</u>

Summary

- Nitrate levels increased on average by 18 lb N/ac from Aug to Apr, and were highly variable
- Nitrate changes after mid November are much smaller (~5 lb N/ac), but also highly variable
- High nitrate levels on shallow coarse soils can be lost, resulting in under-fertilization
- Sampling later in Fall will better represent spring nitrate levels

For more information

- Soil fertility website:

  http://landresources.montana.edu/soilfertility

- Overwinter nitrate change study report:

  go to **Reports** on above site

- Small grains nitrogen economic calculator:

  go to **Fertilizer Information** and then **Fertilizer Economics** on above site

Questions?