

Management Practices to Minimize Nitrate-N Leaching on Shallow Soils

Extension Service and Montana Department of Agriculture
Grower Workshop

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AGRICULTURE

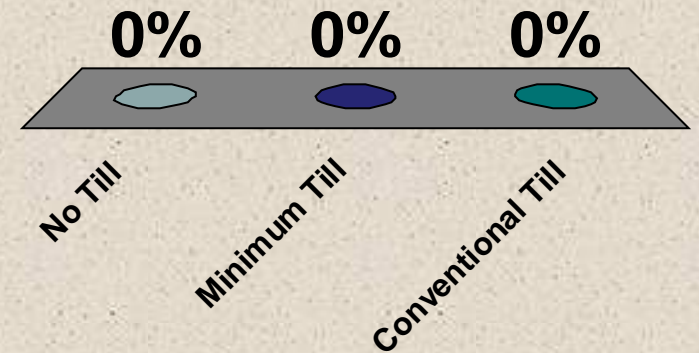
MAKING A DIFFERENCE IN MONTANA COMMUNITIES



Is more of your land...

1. No Till
2. Minimum Till
3. Conventional Till

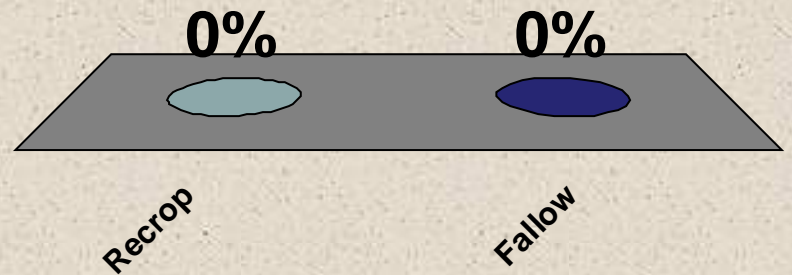
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Is most of your land recrop or fallow?

1. Recrop
2. Fallow

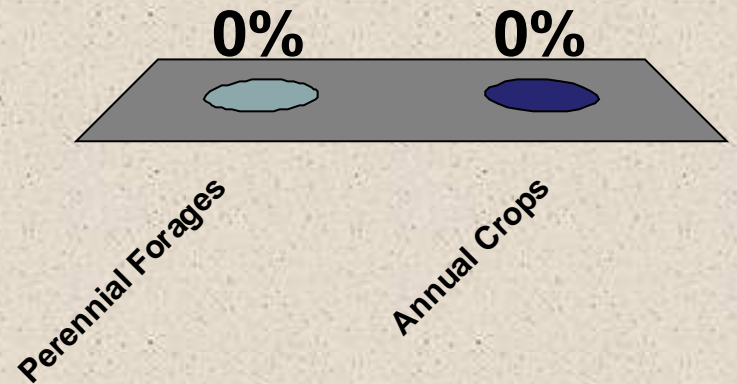
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Is more of your land...

1. Perennial Forages
2. Annual Crops

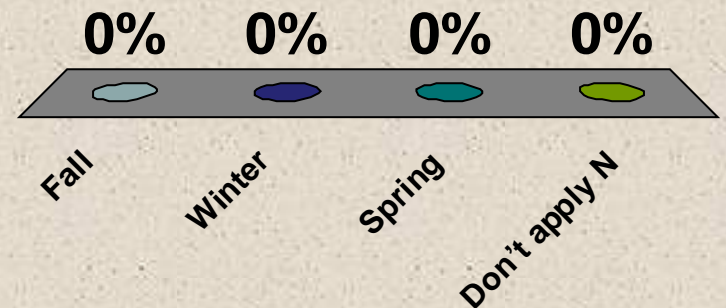
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Do you apply N in fall, winter or spring?

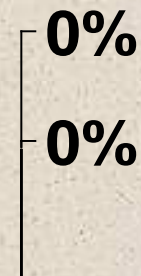
1. Fall
2. Winter
3. Spring
4. Don't apply N

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Do you apply your N once per crop, or more than once per crop?

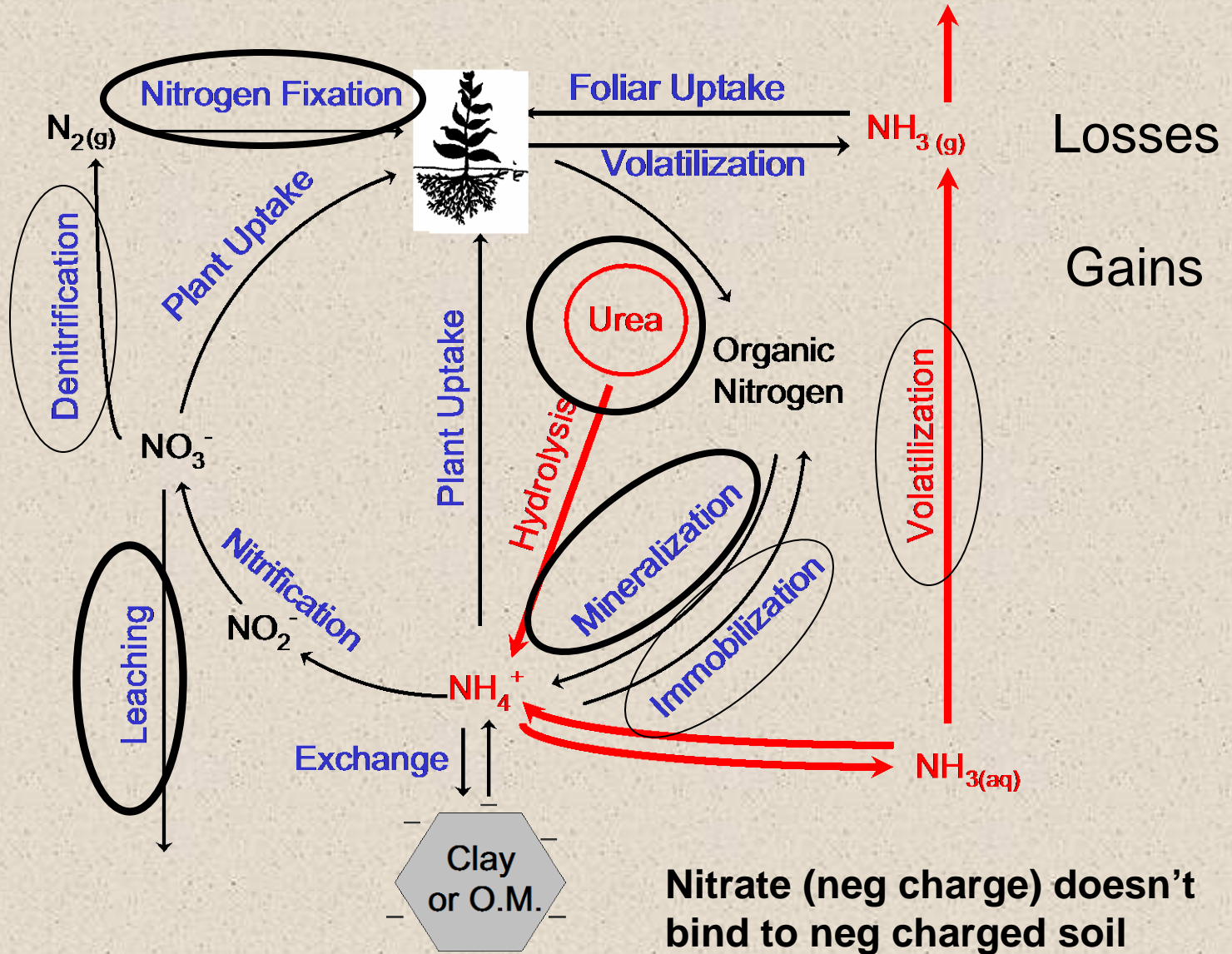
1. One time
2. More than once



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One time More than once

Nitrogen cycle



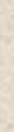
Soil factors that increase leaching

- Low SOM
- Soils with large pores
- Soils with cracks or vertical channels that connect surface to below root zone
- Shallow soils

What is the average depth of your soil (before you hit rocks, hardpan, or groundwater)?

1. less than 2 feet
2. 2 – 4 feet
3. greater than 4 feet
4. I don't know

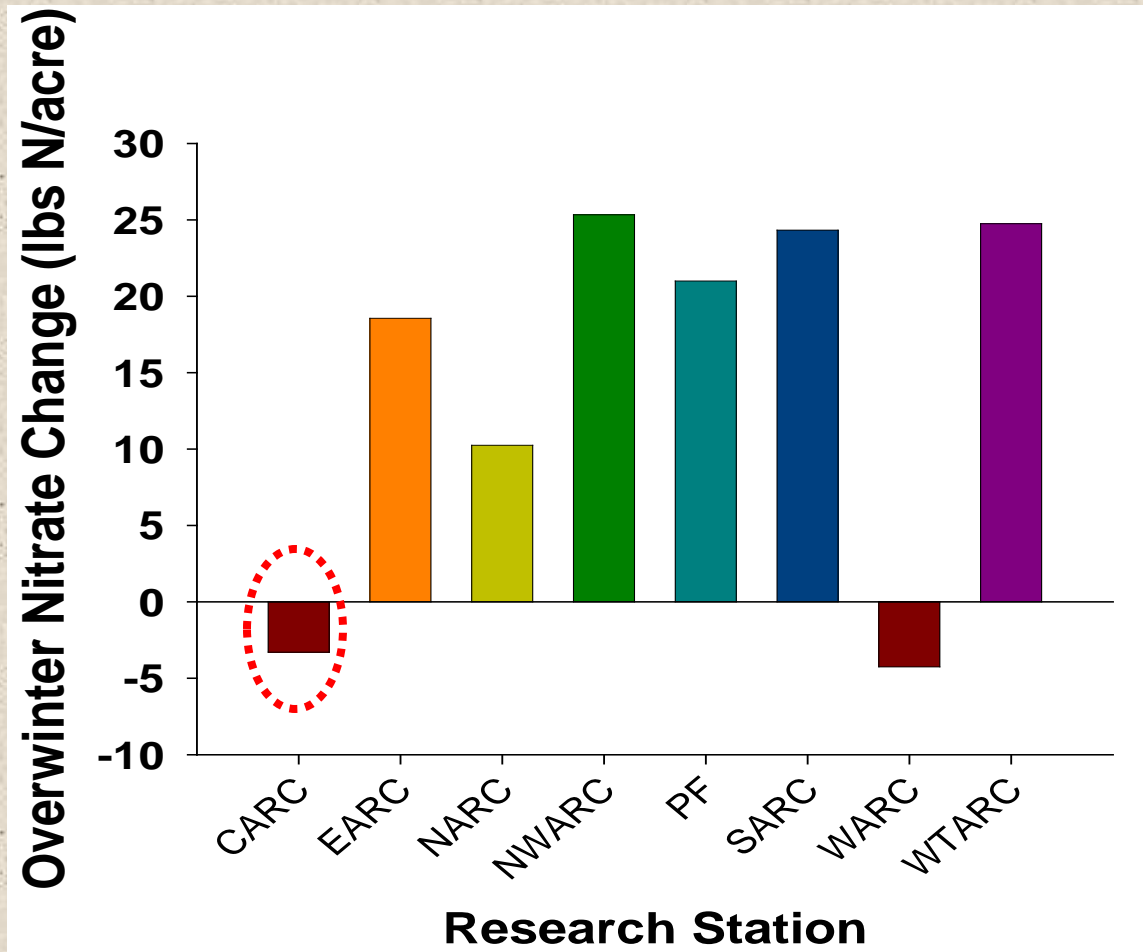
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less than 2 feet 2 – 4 feet
 greater than 4 feet I don't know

Regional change in soil nitrate from August 2007 to April 2008 in top 2 feet of soil

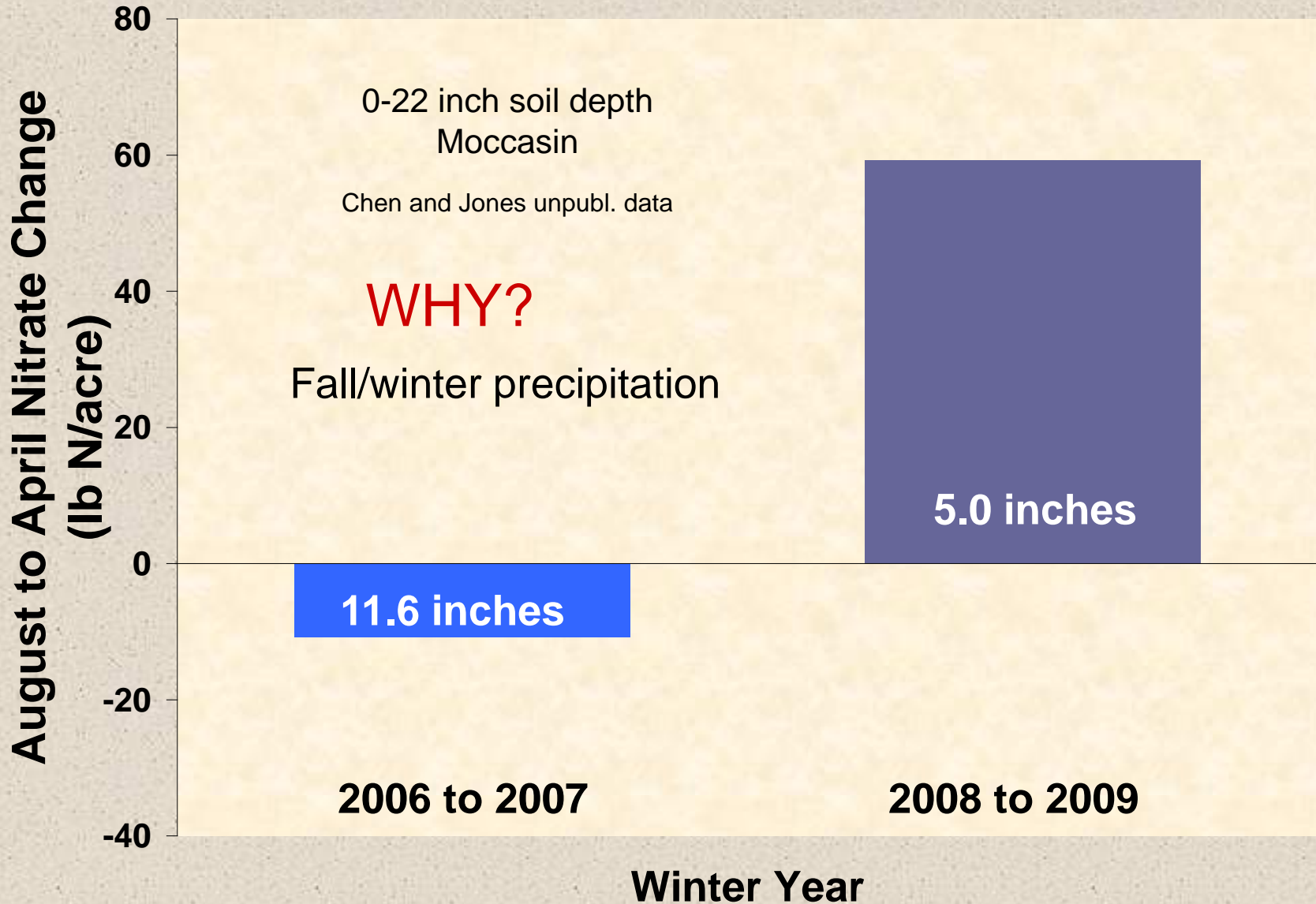


What is causing most locations to have gains?

C. Chengi unpubl data.

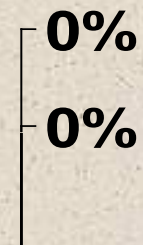
Averaged over 4 previous crops at each research station.

Is spring nitrate always less than fall nitrate at Moccasin?



Do you base your N rates on soil tests?

1. Yes
2. No



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Yes No

How should I determine my fertilizer N rates?

Soil Test

When??

Spring is best

Why??

Result if soil test too early: Fertilizing more or less than needed (\$\$)

Crop management factors to decrease N leaching

- Know your soil and yield potential for proper N management
- Recrop rather than fallow
- Reduce tillage
- Diversify to include perennial and/or deep rooted crops
- Consider legumes since don't need to fertilize w/ N
- Select appropriate variety
- Space crops for optimal yields to optimize resource use; ex. SW in 6" rows and 30 plants/ft² – Fertilizer Fact # 37
- Use variable rate technology

Long-term Effect of Cropping System on Soil Fertility

- 1983 to 2004 near Culbertson, MT
- Comparing tillage and crop
- Small-plot field trial
- Soil samples:
 - Collected in October 2004, 4-6 weeks after fall tillage
 - Taken to 8 inch depth

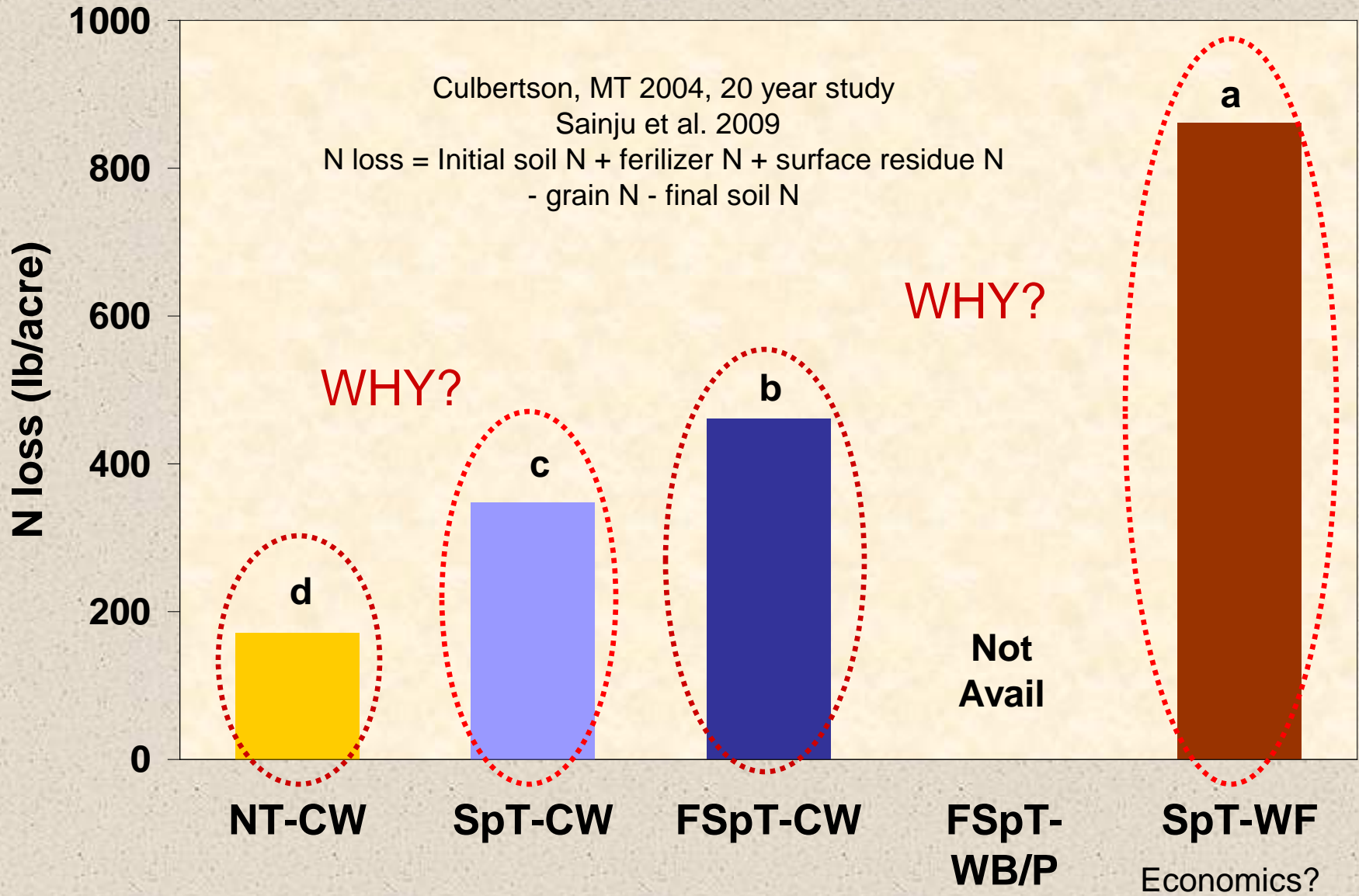
Tillage and Crop Combinations

- NT-CW : No Till-Continuous Spring Wheat
- SpT-CW: Spring Till-Continuous Sp. Wheat
- FSpT-CW:
Fall & Spring Till – Continuous Sp. Wheat
- FSpT-WB/P: Fall & Spring Till –
Wheat/Barley (17 years), Wheat/Pea (4 years)
- SpT-WF: Spring Till – Sp. Wheat/Fallow

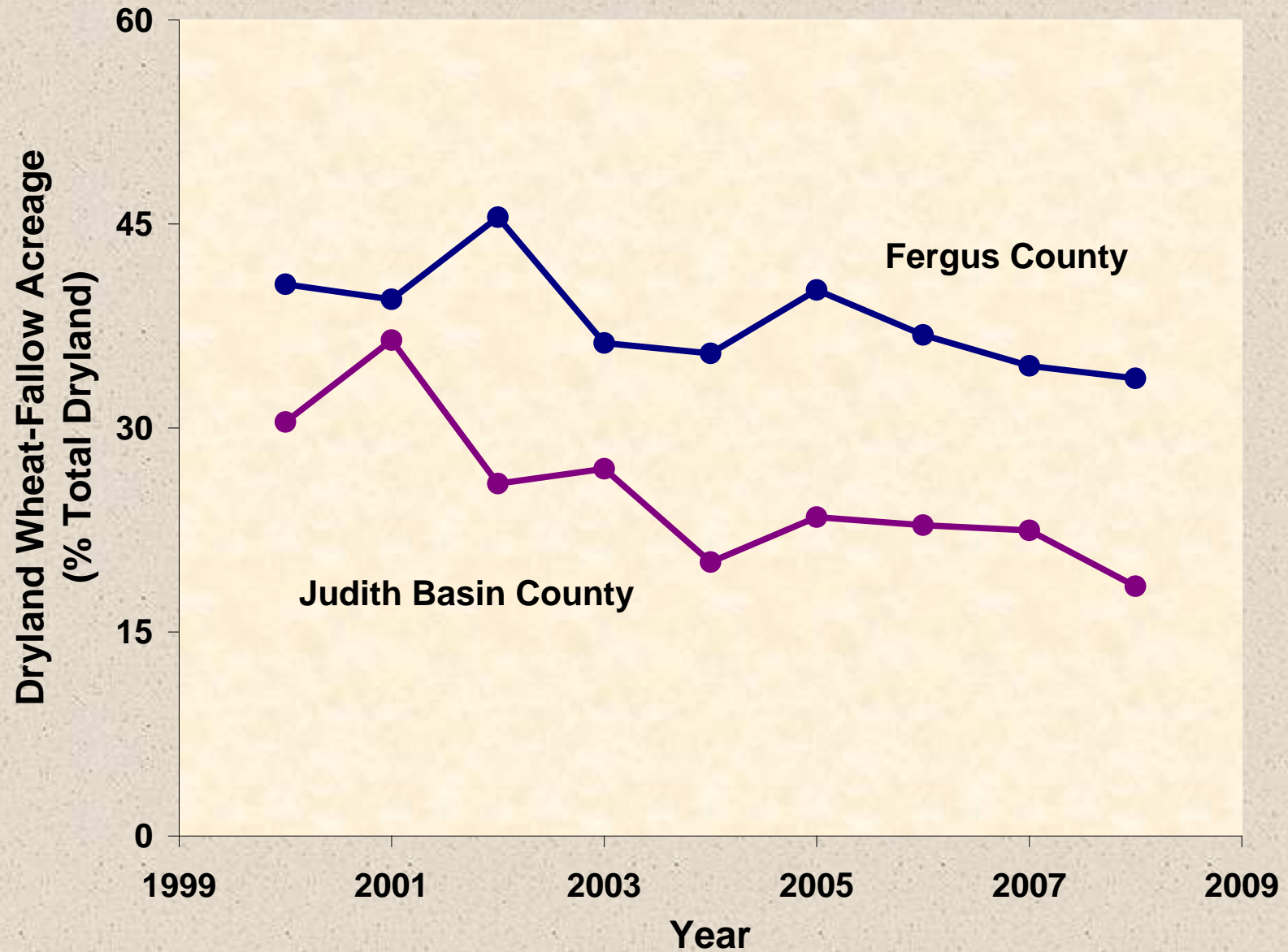
All residue was left on the field

Estimated N loss

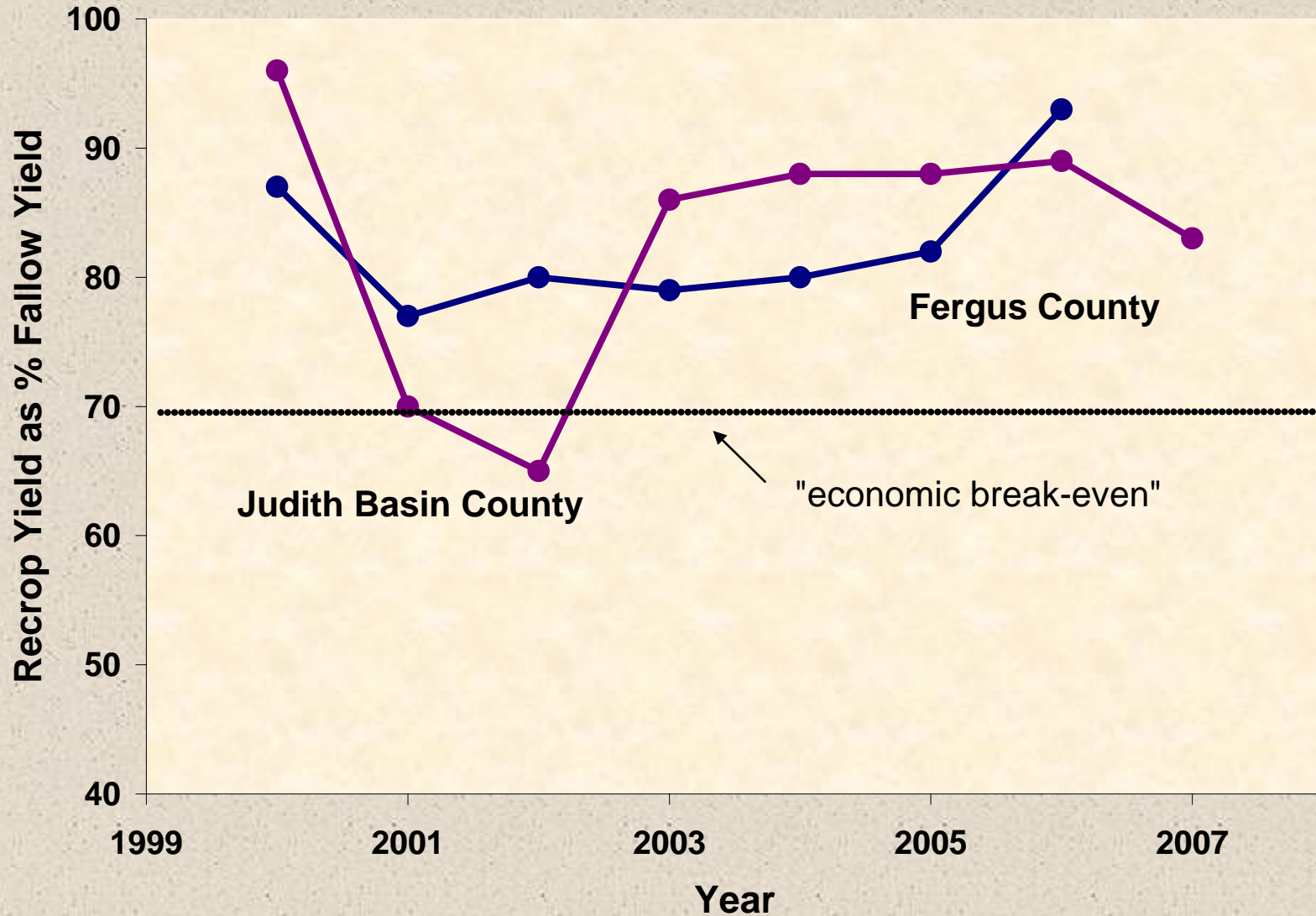
Spring 1983 to Fall 2004



Trend in acres of wheat-fallow



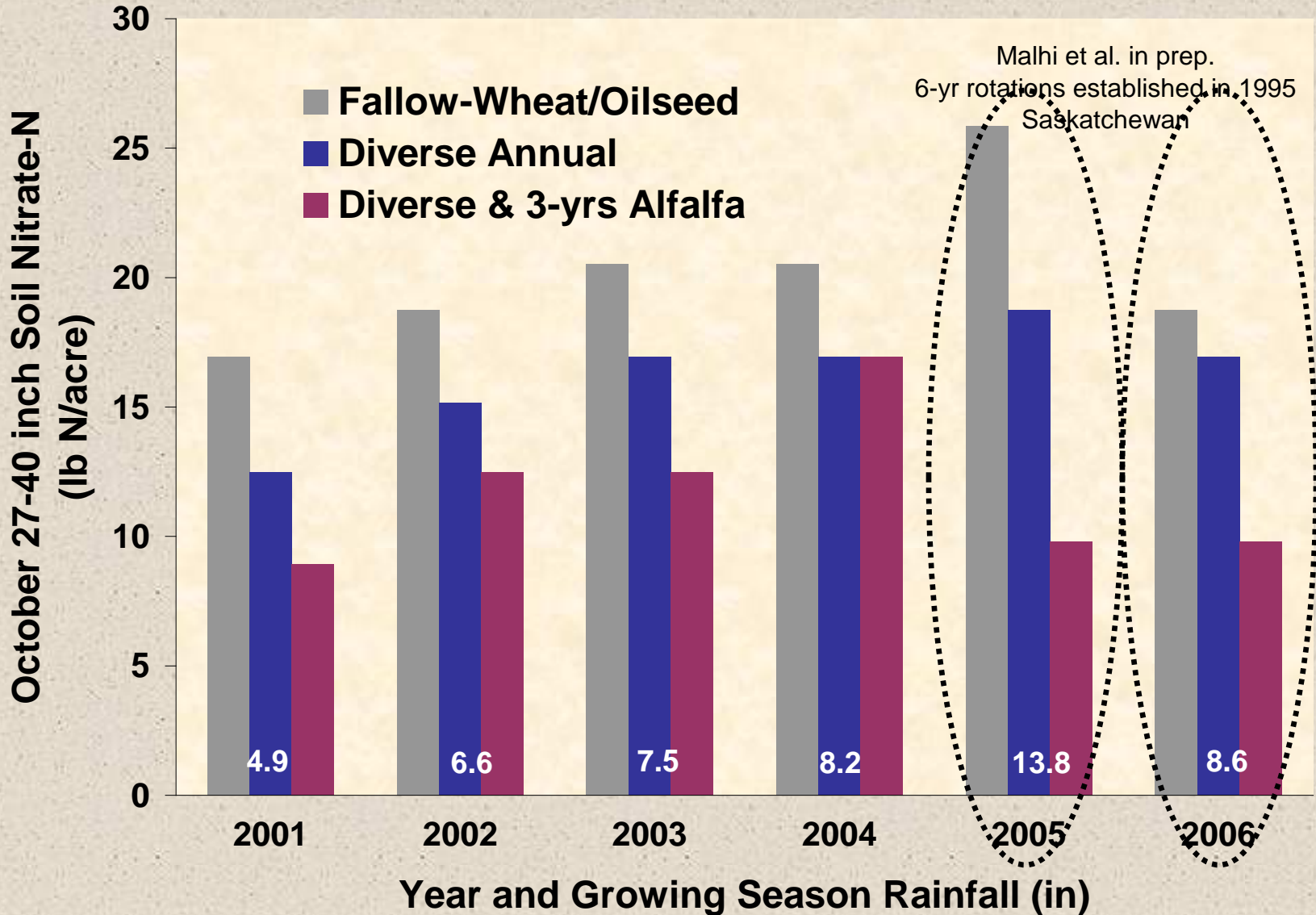
Winter wheat recrop yields as a percent of fallow yields



Does rotation affect potential for nitrate leaching?

- 6-yr rotation in SK, 2 cycles = 12 yrs
- Nitrate below 27 inches would have leached on a shallow soil
- 3 rotations
 - Fallow-W-W or F-W-mustard or F-W-canola
 - Diverse annual = rotation of pea, fall rye, wheat, barley, canola, flax, mustard
 - Diverse & alfalfa = canola or mustard-W-B-alfalfa-alfalfa hay-alfalfa hay

Diversify crop, add perennials to reduce N loss – Fall soil N



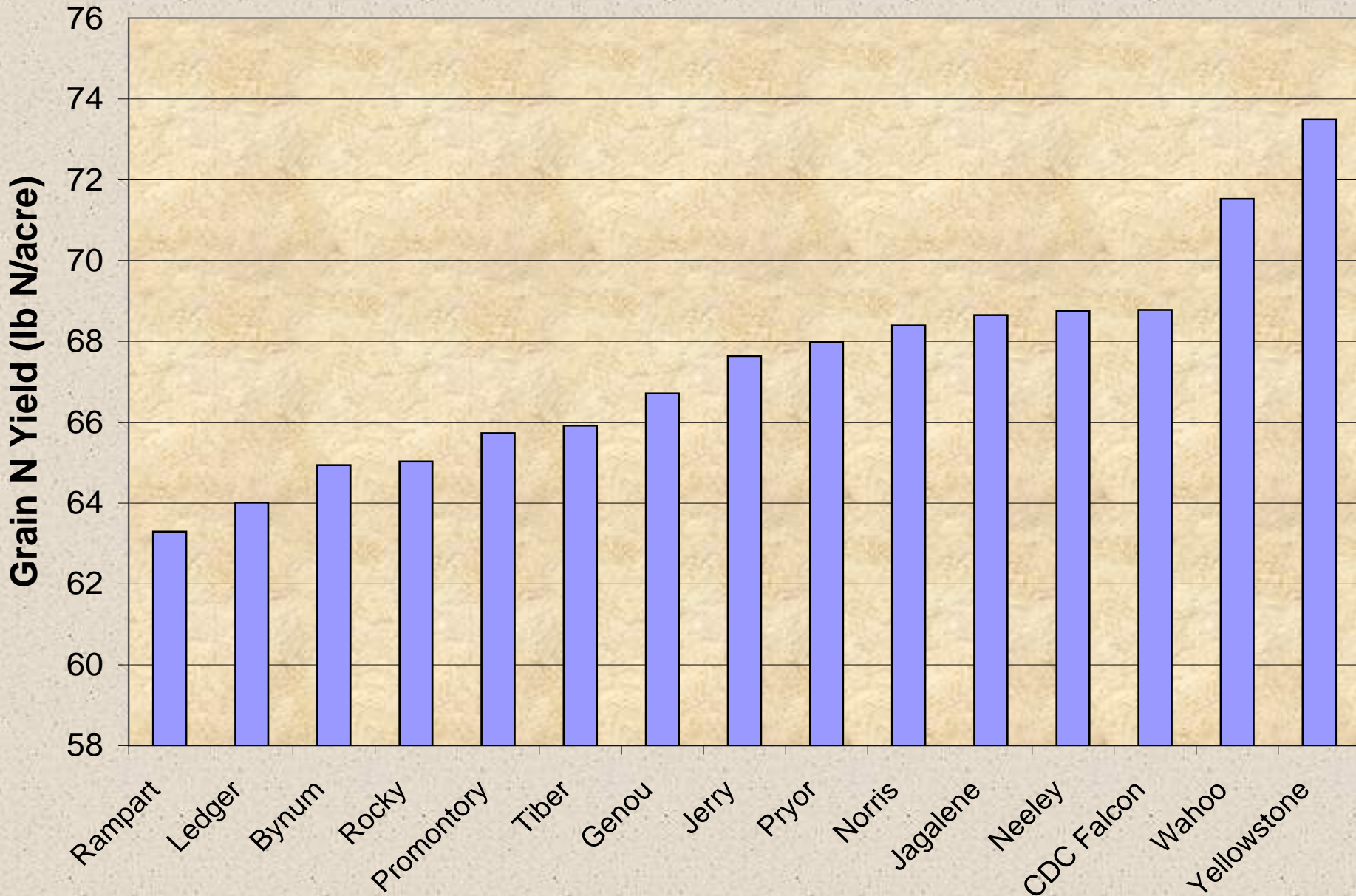
Inclusion of legumes

- Legumes are excellent N scavengers – will use much of what is in soil before ‘fix’ N
- Since legumes don’t need N fertilizer, this leaves less nitrate in soil, especially in dry year when crops don’t remove much
- Legume residues are similar to ‘slow release N fertilizers’ which can lower N fertilizer needs in long run
- Interrupt disease and insect cycles = fewer pest problems

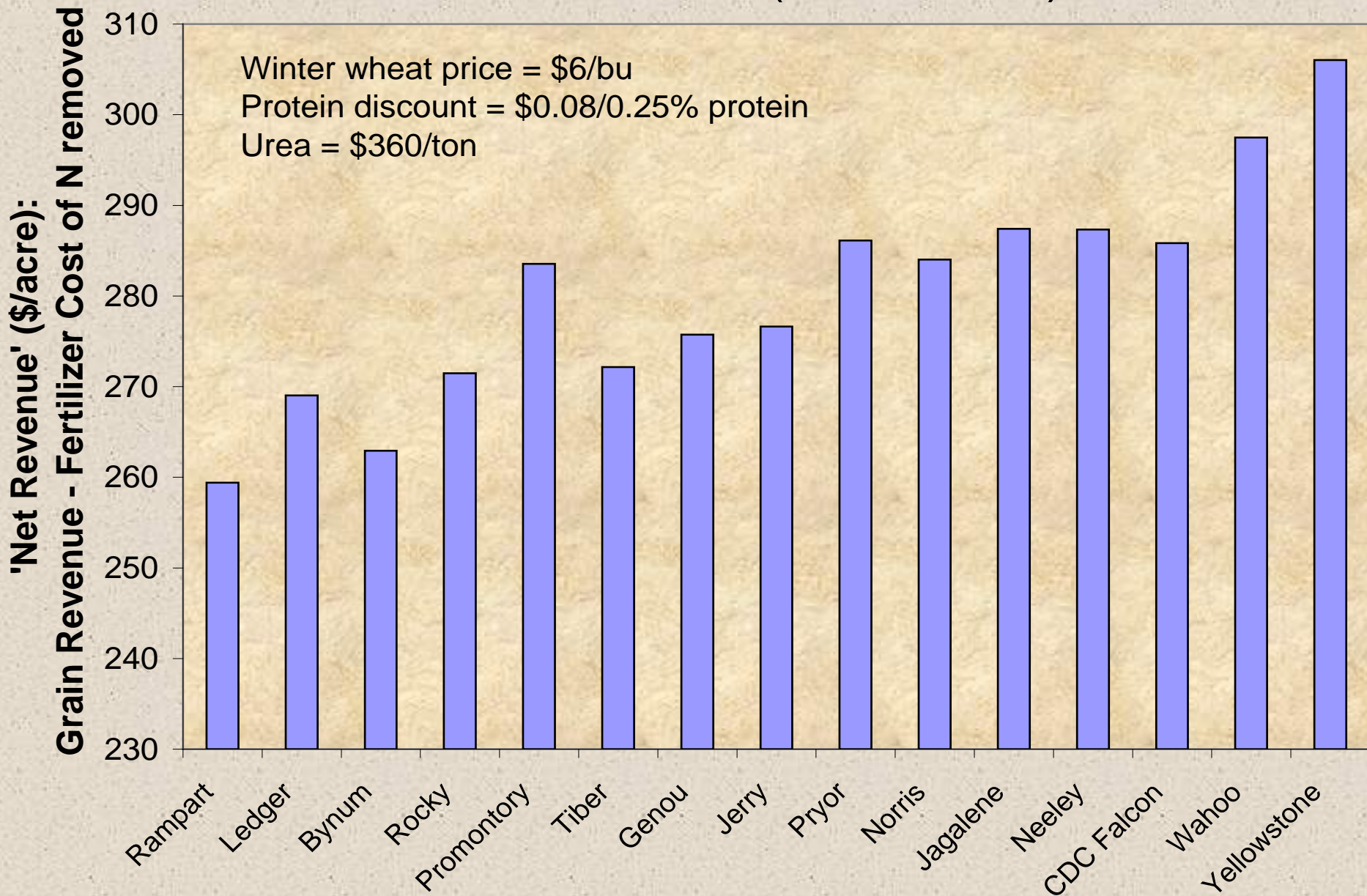
Beware of herbicides with high persistence

Do some small grain varieties
remove more N than others?

Grain N Yield for Winter Wheat Variety Trials within 50 miles of Moccasin (2007 - 2009)



Net Revenue for Winter Wheat Varieties within 50 miles of Moccasin (2007-2009)





- MSU EXTENSION
 - Cropping Systems Home
 - Variety Selection
 - Alfalfa
 - Barley
 - Camelina
 - Corn Grain
 - Spring Lentil
 - Spring Pea
 - Spring Wheat
 - Winter Wheat
 - Fertilizer Recommendation
 - Herbicide Selection
 - Water Use
 - SARC Home
- 

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EXTENSION

WINTER WHEAT VARIETIES

This is an inter-active website. With your inputs below, you can generate a table of results relative to your geographic location.

You can narrow your selection criteria by using the OPTIONS below. Check as many as you like. Best results will be found by moving back and forth between this page and the results table (use your browser's back button).

Cultivars that continue to yield near the top over multiple years and locations (higher 'N' values) increases confidence for the potential of that cultivar.

[Switch to Experiment Station Selection](#)

Find results within: miles of

Choose a parameter:

Choose year(s) 2009 2008 2007 2006 2005 2004

OPTIONS

- Cropping System All Dryland Irrigated
- Market Class All Hard Red Hard White
- Clearfield Type All No Yes

Limit by Cultivar Traits

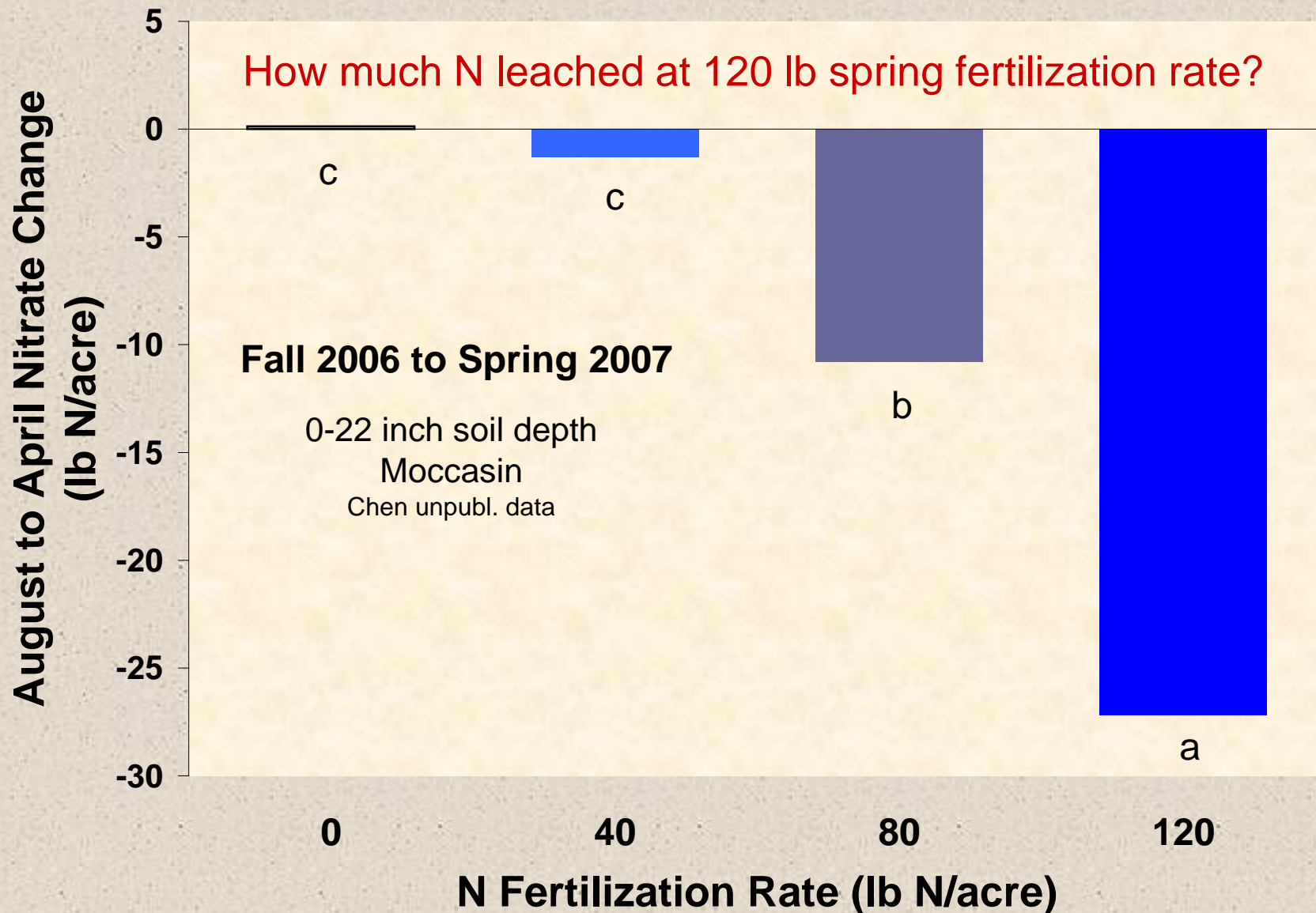
- Solid Stem
- Straw Strength
- Winter Survival
- Maturity
- Coleoptile Length
- Leaf Spot
- Stem Rust
- Stripe Rust
- Dwarf Smut
- Milling Quality
- Baking Quality

Limit By Environmental Parameters

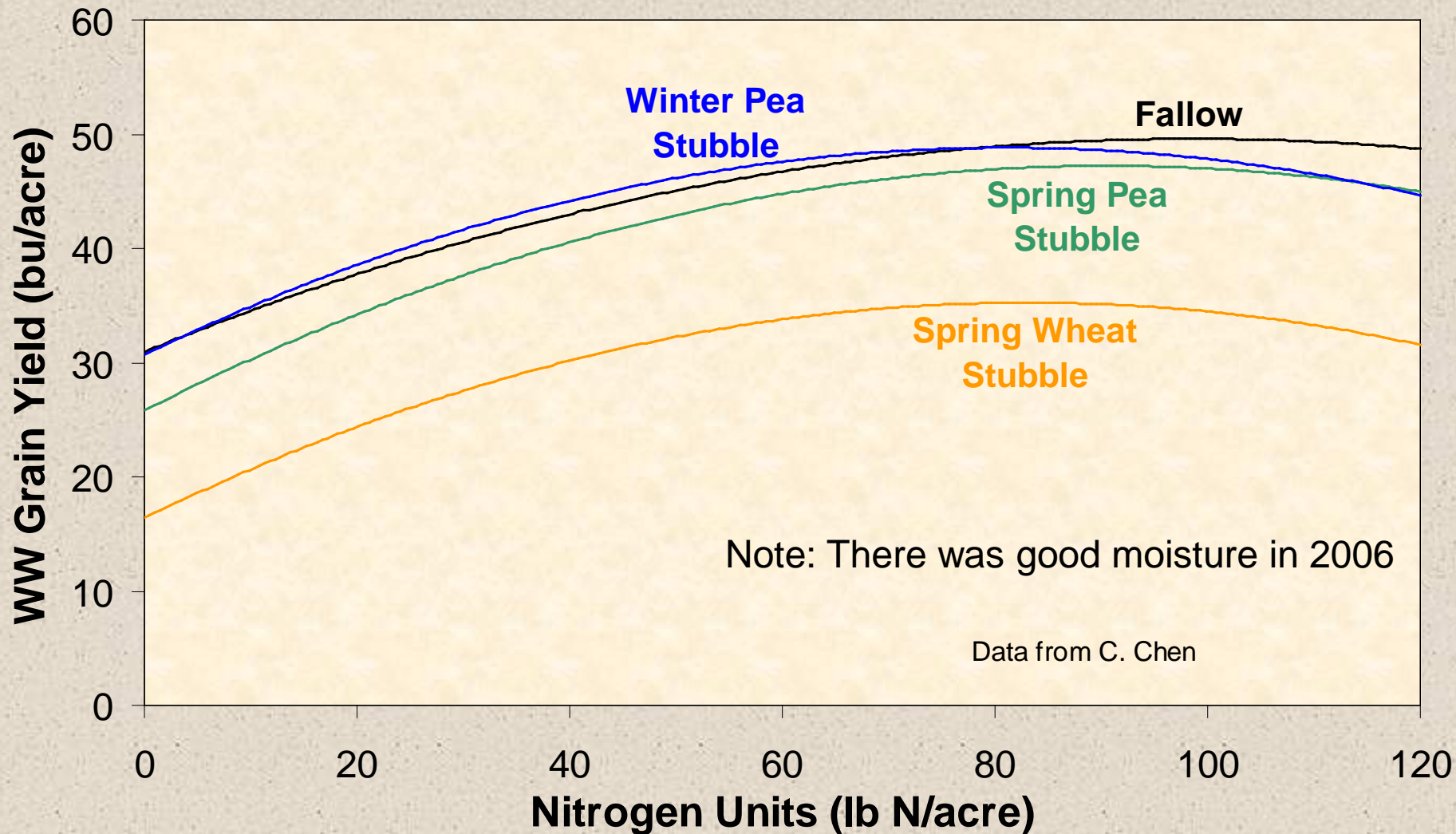
N fertilizer management factors to decrease N leaching

- Soil test so don't over-apply
- Apply in spring or slow release fertilizer in fall
- Time application as close to peak N uptake as possible
- Top dress between tillering and flowering in moist years

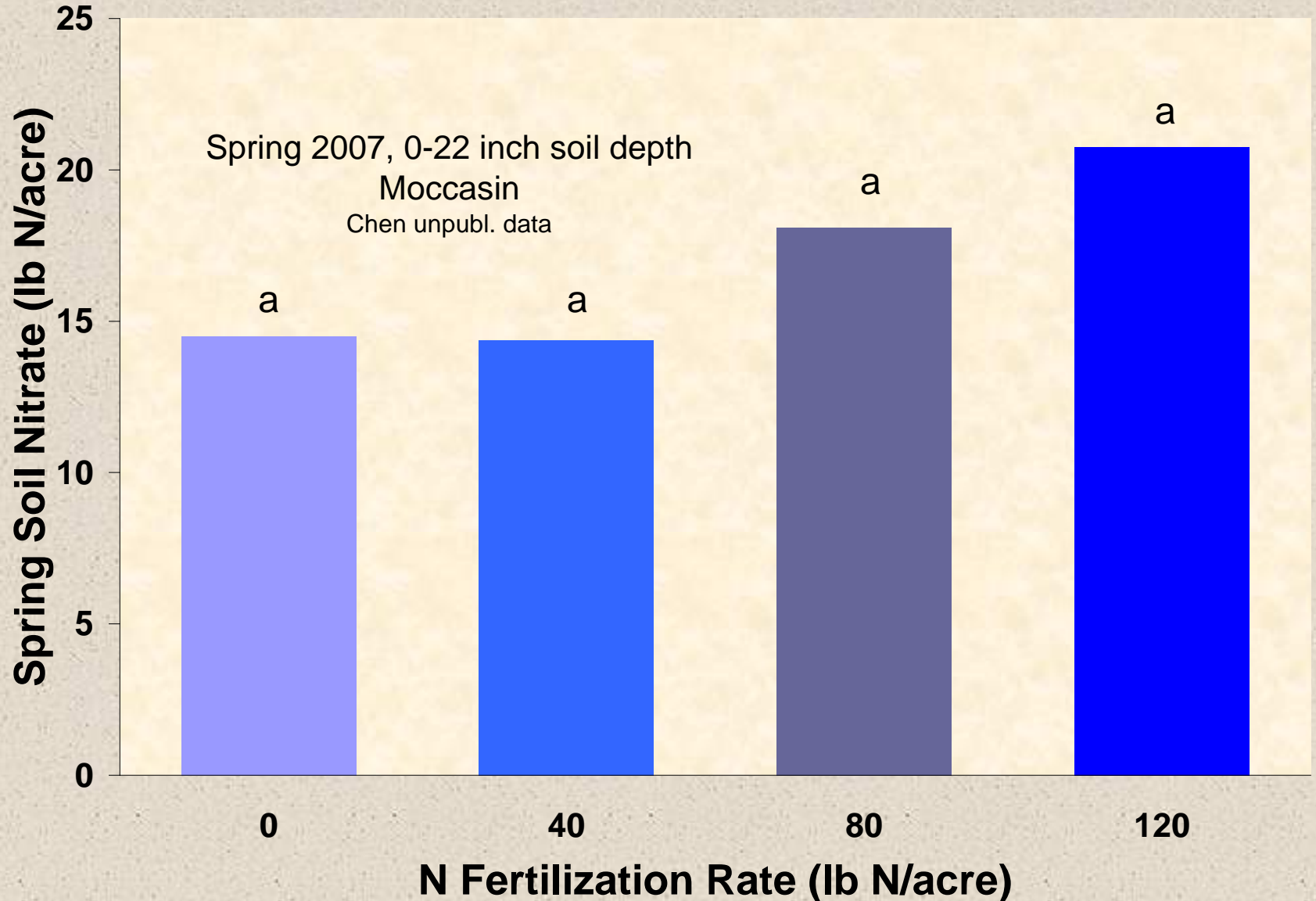
Overwinter N loss is greater when more is available to lose



Effect of previous crop and N on 2006 winter wheat grain yield (NT) Moccasin, MT



Spring soil nitrate rates are all the same



Increasing N Fertilizer Use Efficiency

Enhanced Efficiency Fertilizers

Two major types:

- slow release (ex: polymer coated or aldehyde bonded)
- inhibitors (ex: alter soil processes)

Should you consider using them?

Yes: on warm season, irrigated crops

Maybe: on cool season, dryland crops

Downside-N release often occurs too late to match N uptake

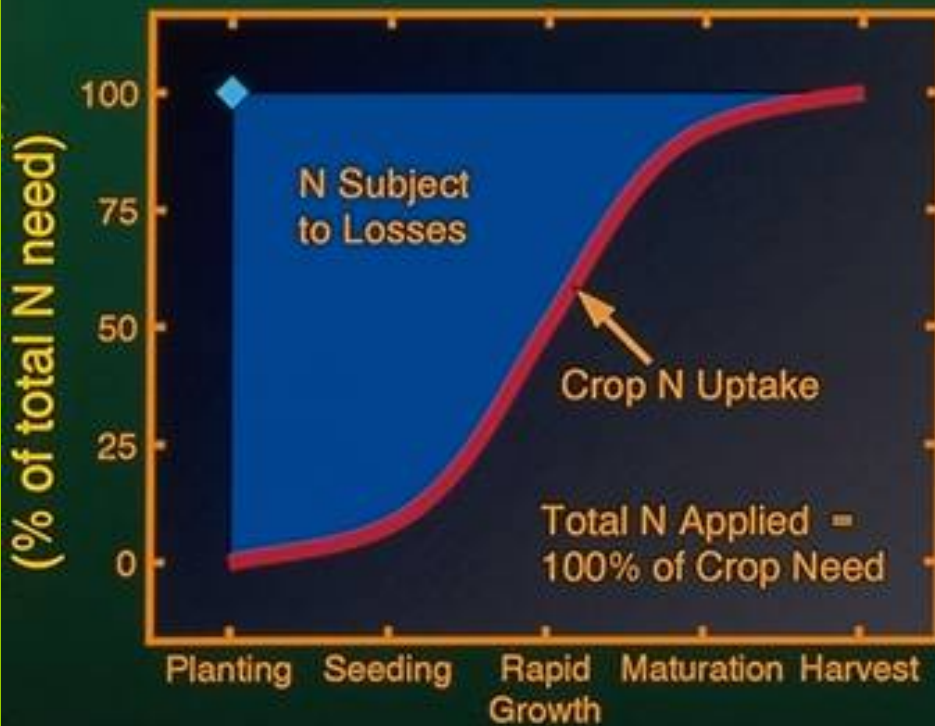
Upside-can apply ~2 – 4x as much slow release product as conventional urea directly with the seed

EEFs and leaching

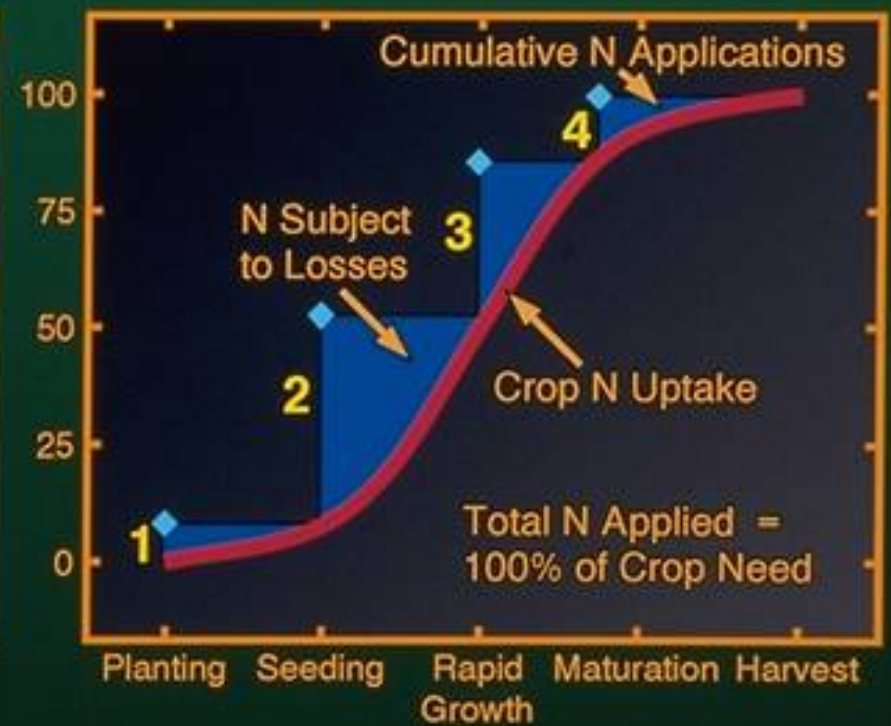
- Nitrogen use efficiency has been found to be 4 to 14% higher with CRU (Controlled Release Urea) than conventional urea. Improvement is likely due in part to reduced leaching.
- Watch for continued development of 'new and improved' products
- See *Enhanced Efficiency Fertilizers* (EB0188) for more information
<http://landresources.montana.edu/soilfertility/PDFs/EEF720.pdf>

Reduction of potential N loss through split applications

(A) Single N Application

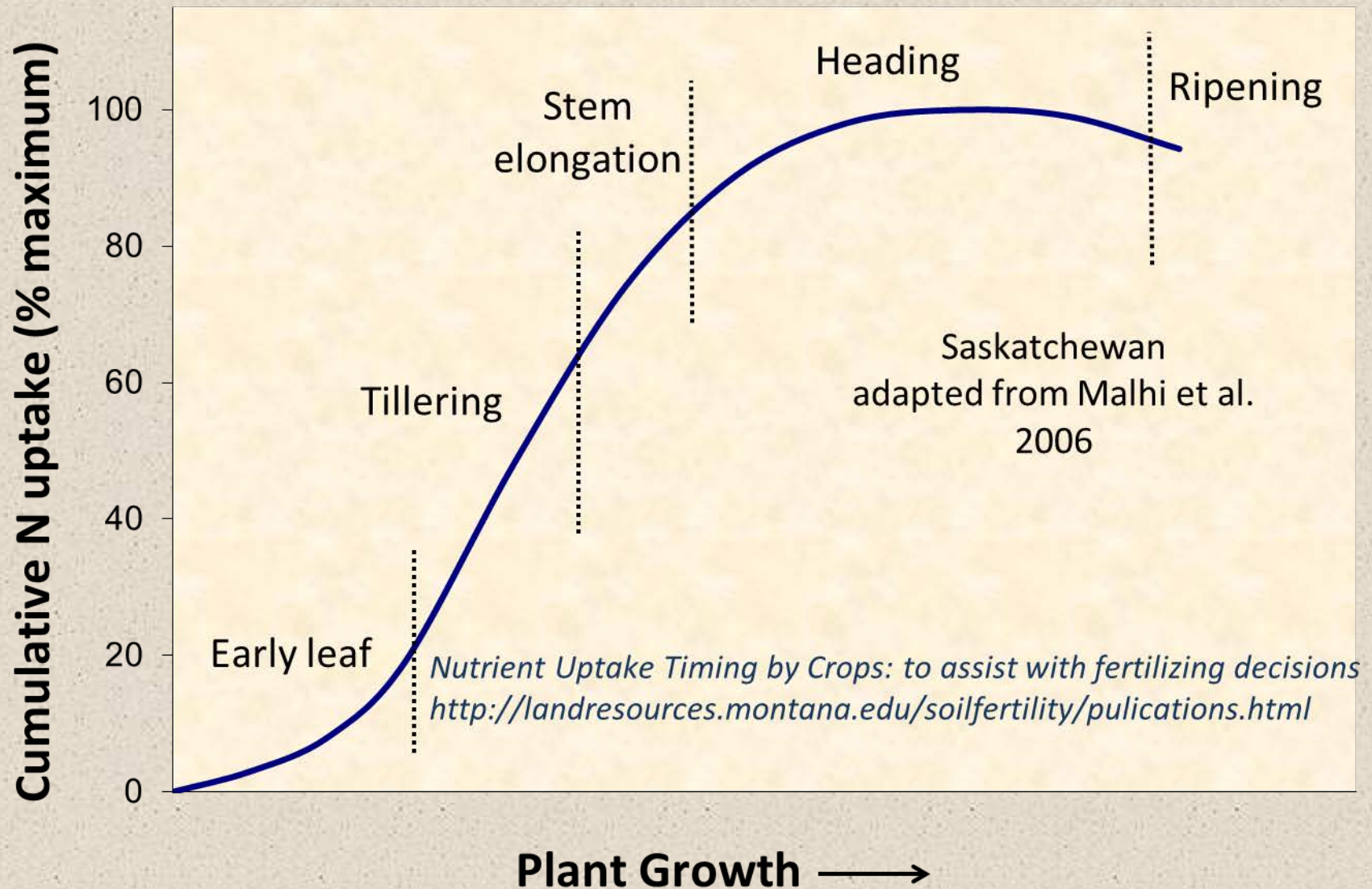


(B) Split N Applications



Crop Growing Season

Cumulative N uptake by spring wheat



Summary

Nitrate leaching is affected by both natural and human factors. For example, leaching is increased by:

- Porous and shallow soils
- Higher precipitation
- Annual cropping rather than perennial forage
- Summer fallow

Summary:

Farming practices that reduce nitrate leaching

- Include perennial forage in rotation
- Recrop rather than fallow
- Reduce tillage
- Apply N in spring according to soil test
- Split N application to match plant needs or use EEFs
- Consider applying less N in areas that yield less or have shallower soils

Other Resources

- Soil Fertility information:
<http://landresources.montana.edu/soilfertility>
- Crop Variety Selection Tool:
<http://sarc.montana.edu/php/varieties.php>

Questions?