Soil Fertility Update

Ag Agent Update

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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

Recent and Current Extension Projects

- *Soil Fertility Management on Organic Farms* Extension Bulletin (October 2010)
- *Crop and Fertilizer Management Practices to Reduce Nitrate Leaching* Montguide (January 2011)
- Updating *Enhanced Efficiency Fertilizers* and *Nutrient Uptake Timing Extension* Bulletins
- Updating *Nutrient Management Module 9*
- Gardening Articles in *Zone 4* (Fall 2010 and Spring 2011)
- Collaborated with NRCS on identifying practices that reduce nitrate leaching (for incentive payments)

Recent and Current Research Projects

- Overwinter nitrate-N differences (completed 3 year study, on soilfertility website)
- Nitrogen fixation of annual legumes (w/ Perry Miller)
- Urea volatilization study and producer survey (w/ Rick Engel)

The votes are in for today's topic:

Topic	Votes
1. Urea volatilization study/survey	2.6
2. Snapshot of volatilization, EEFs, overwinter nitrate study	2.7
3. Practices to increase grain protein	4.6
4. Others (cover crops, alfalfa fertilization)	1.5

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Thanks for your input.

Management practices to optimize grain protein

1. Optimize total fertilizer N rate
2. Split/in season N applications
3. Minimize N losses
4. Use an enhanced efficiency fertilizer?
5. Use legumes in rotation?

Optimize fertilizer N rate

1. Increase accuracy of soil nitrate-N levels
(affects N rate)

- Optimize number of sub-samples collected

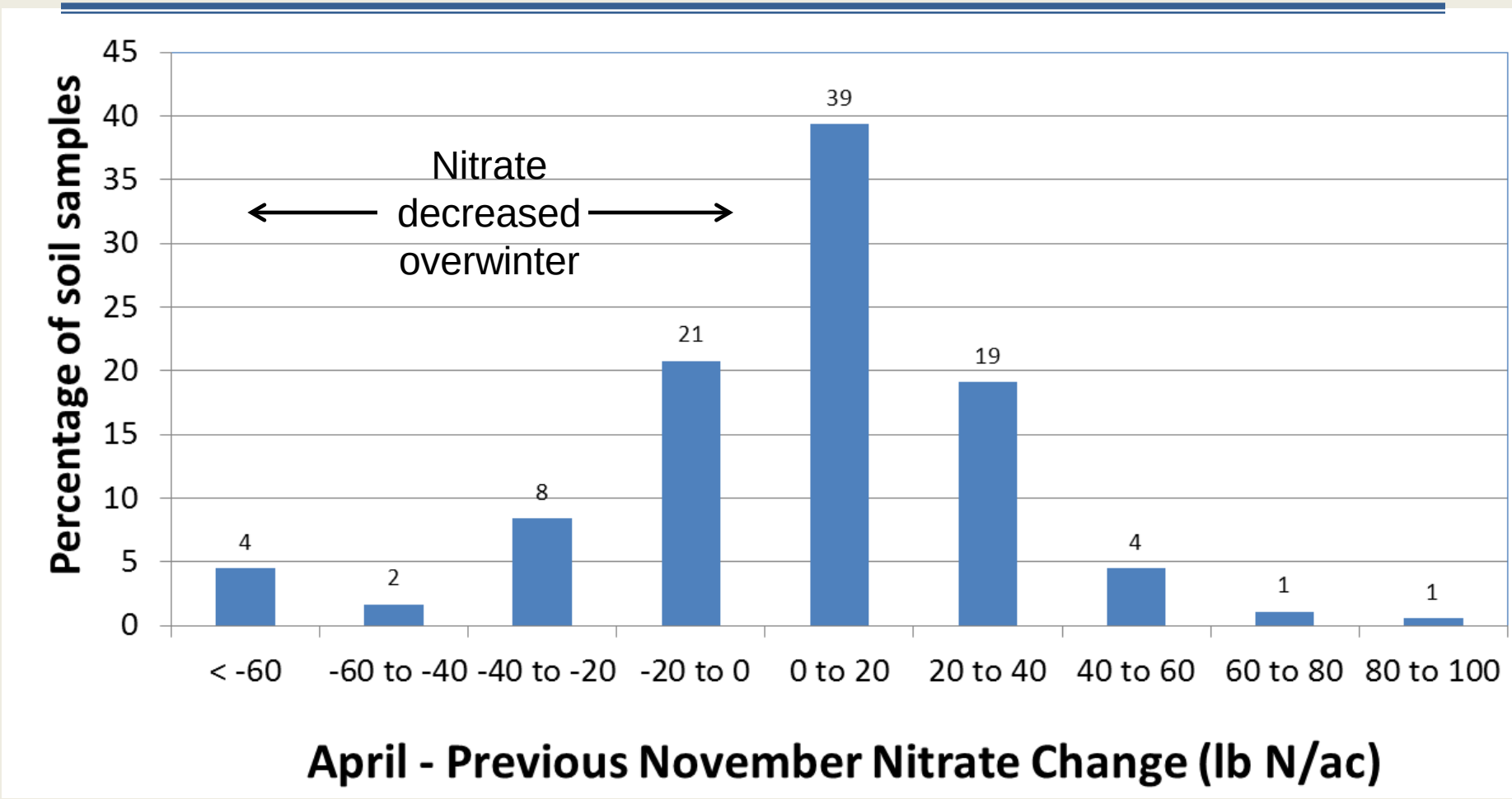
  Producer should ask crop adviser how many soils are collected per field to form a composite. Ideally it should be more than 8; more on a large field.

- Timing of sampling

  Producer should encourage crop adviser to soil sample in late winter/early spring if possible especially on shallow and/or coarse soils. Why?

November to April nitrate changes

Montana data based on 180 samples (Jones 2011)



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

Optimize fertilizer N rate (cont'd)

2. Select fertilizer N rate based on soil N+ fertilizer N per bushel of yield goal OR use economic N rate calculator.

Crop	MSU Fertilizer Guidelines	MT producers (based on survey)
Winter wheat	2.6 lb N/bu	Guesses? (n = 64)
Spring wheat	3.3 lb N/bu	Guesses? (n = 58)

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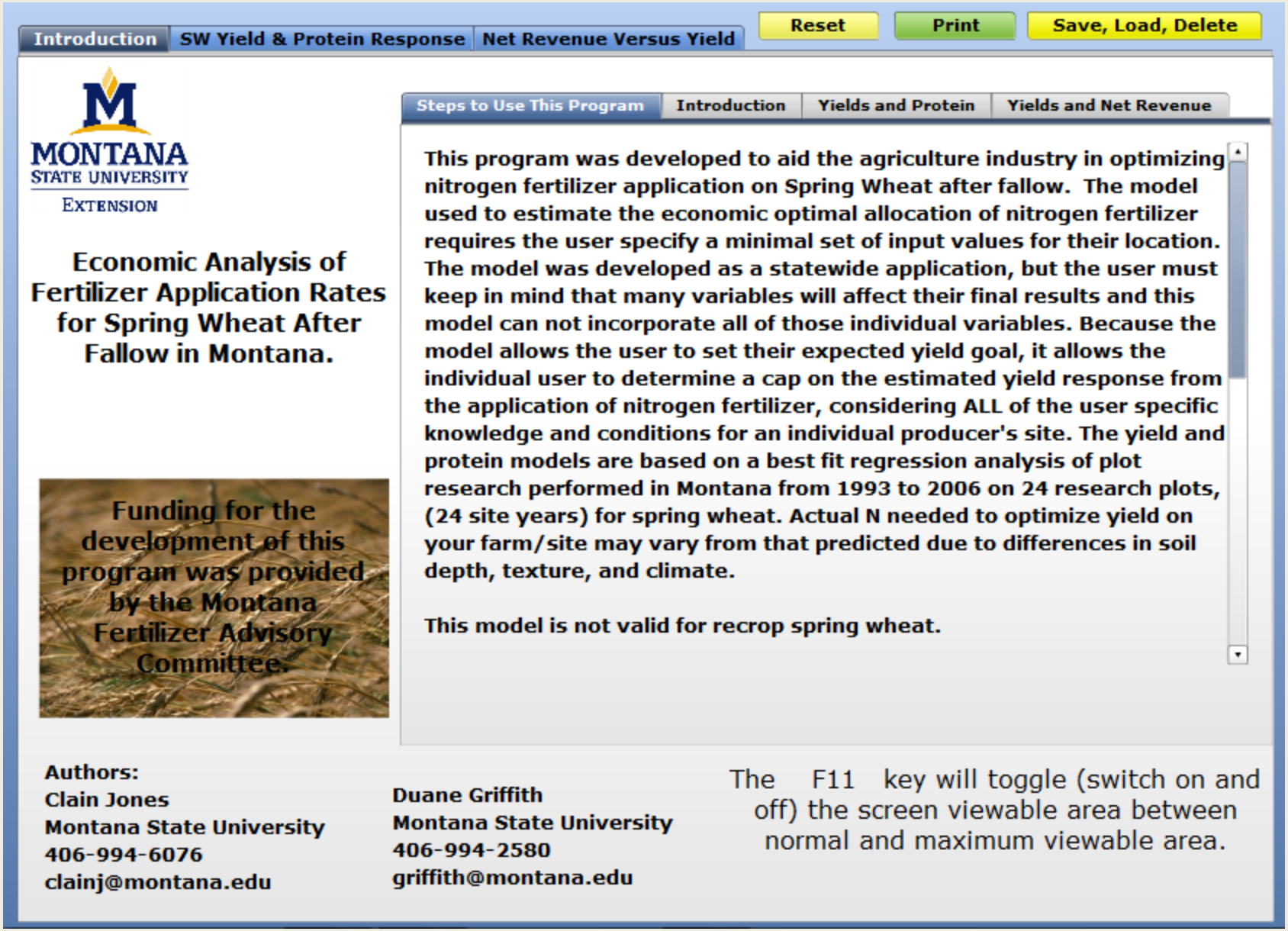
Winter wheat	2.6 lb N/bu	2.3 lb N/bu
Spring wheat	3.3 lb N/bu	2.6 lb N/bu

What is this under-fertilization costing MT spring wheat producers?

- in protein?
- in dollars?



Montana State University Extension Service

www.montana.edu/sofwaredownloads/sofware/SWFertilizerEconomics.swf

Optimize fertilizer N rate (cont'd)

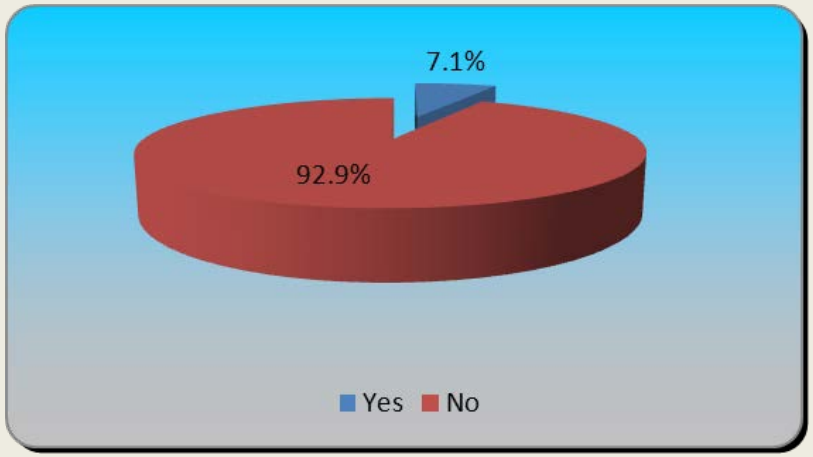
What is this under-fertilization costing MT spring wheat producers?

~$25/acre compared to fertilizer guidelines

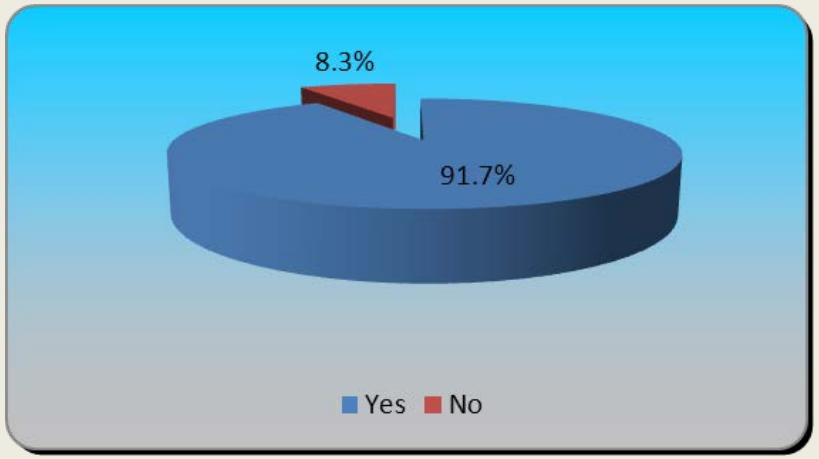
~$60/acre compared to economic calculator prediction

Tens of millions of revenue dollars statewide, tax?

Do growers know about the economic N rate calculator?



Once they've seen the model, would they use it?



Valley County 2010

Optimize fertilizer N rate (cont'd)

Danger of aggressive N fertilization?

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

Strategy to avoid this possibility?

- Use a conservative pre plant N rate
- Apply a 2nd application if needed

QUESTIONS ON OPTIMIZING FERTILIZER N RATE?

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

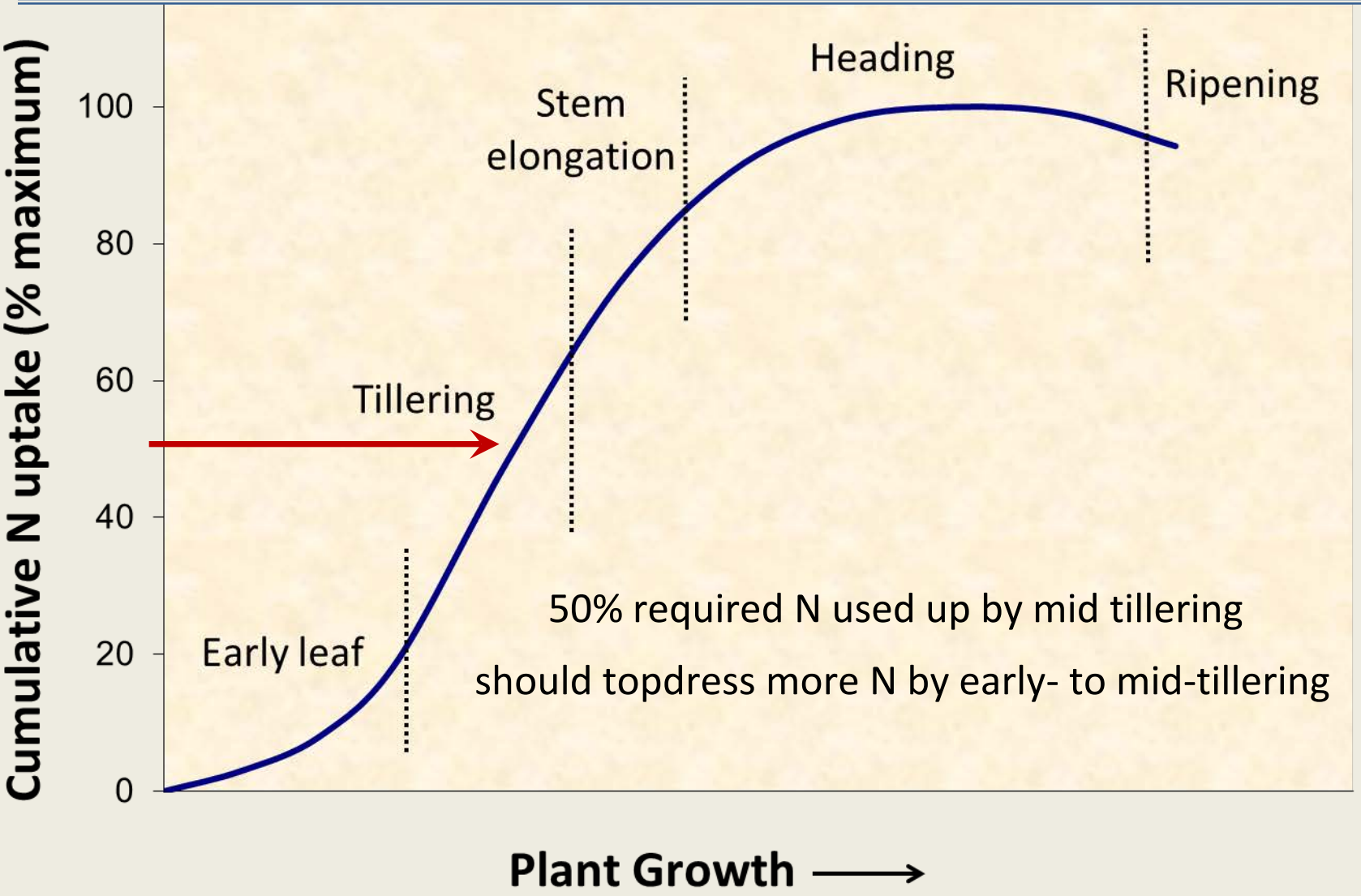
3. Later applications have a better chance of making protein rather than yield

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

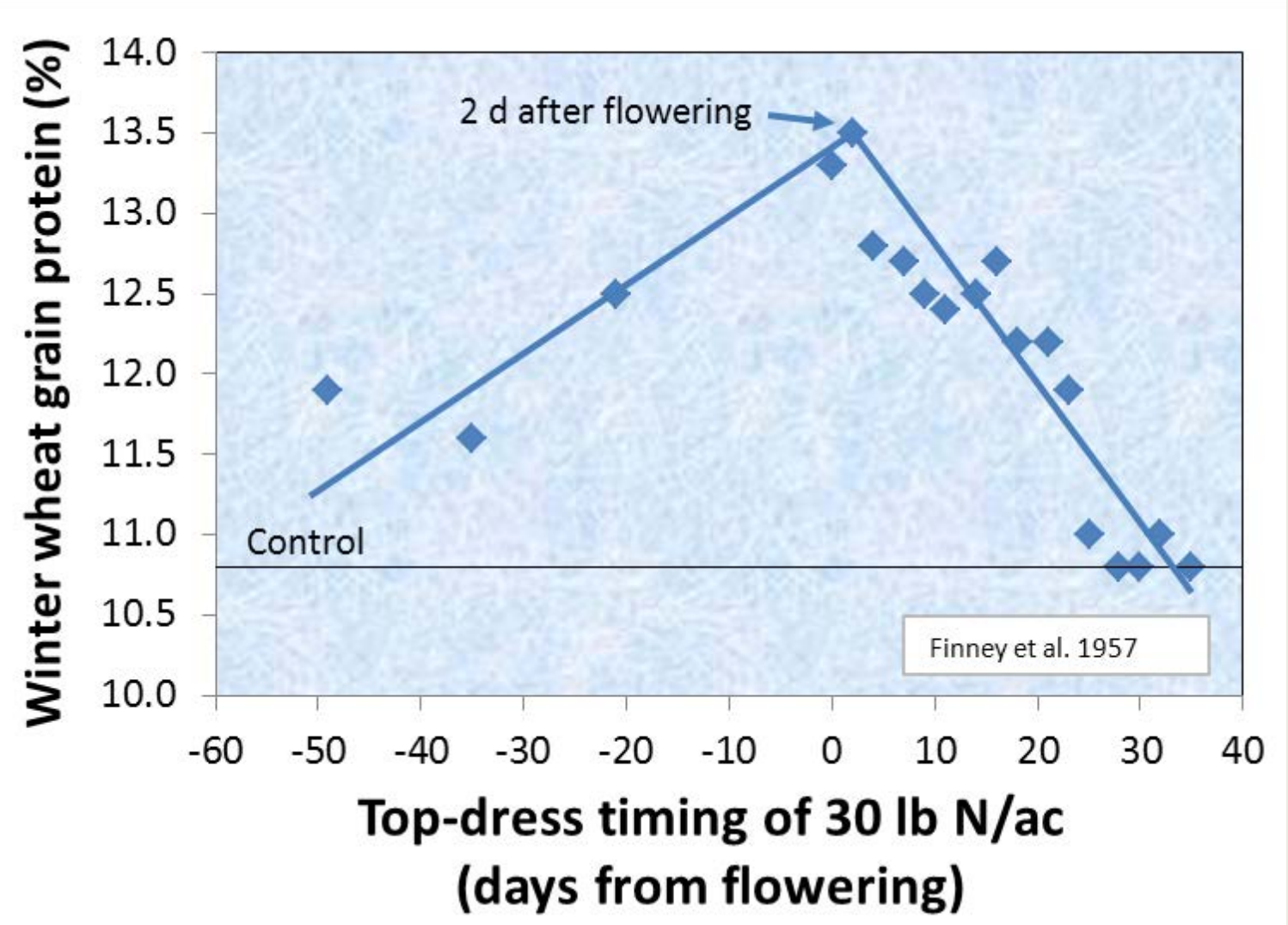
Winter wheat example on per acre basis:

- 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



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

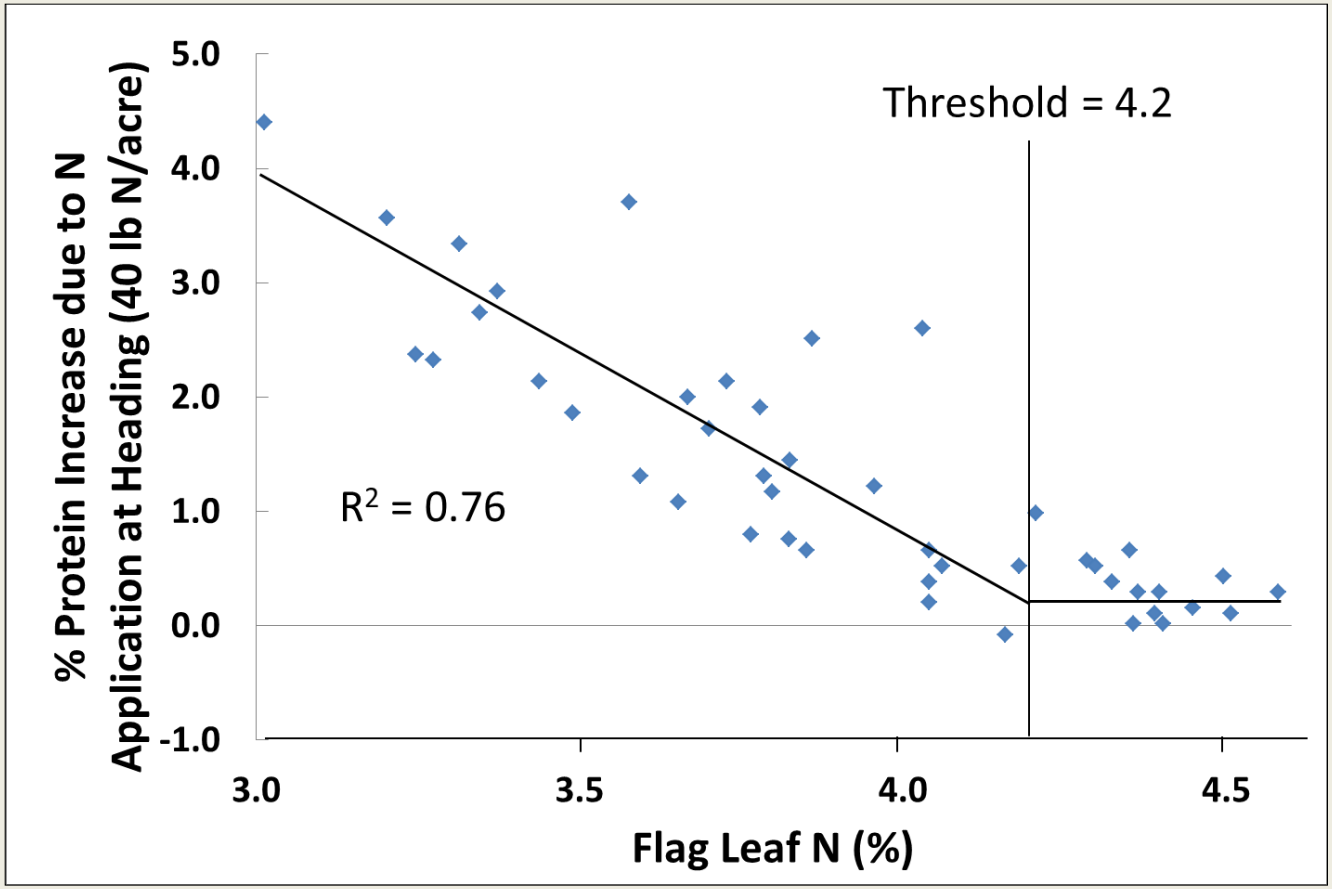


How should a grower decide whether to apply late-season N?

Ask:

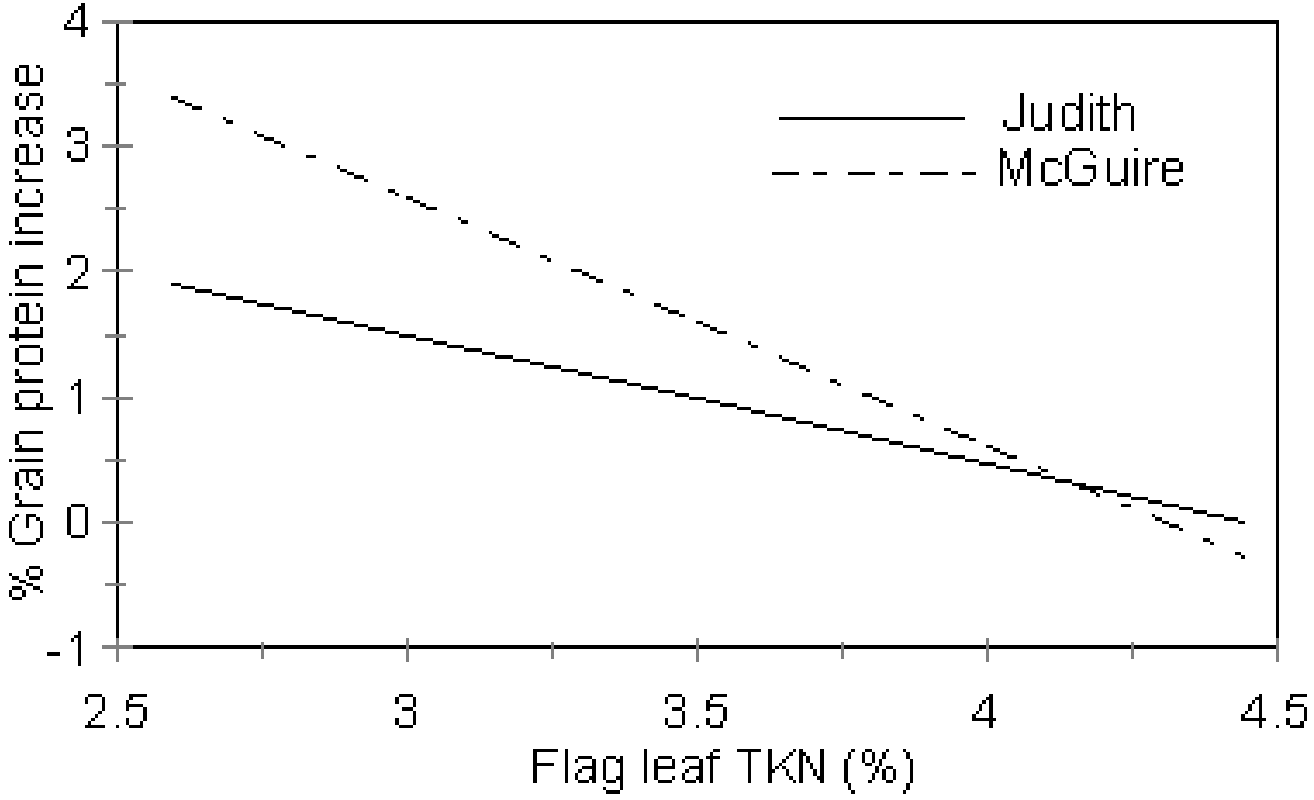
1. Does grower have a way to apply N without severely damaging crop? (e.g. fertigation, high clearance weed sprayer, fly it on)
2. Are protein discounts sufficiently high to justify cost? (calculation will depend on expected % protein boost)
3. What is the flag leaf N concentration?

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 topdressed 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 UAN and no more than 45 lb N/ac of liquid urea to minimize burn and yield loss (Brown and Long, 1988)

QUESTIONS ON SPLIT APPLICATIONS OR TOPDRESSING?

Minimizing N losses

- Potential losses:

  Volatilization

  Leaching (See Montguide)

  Denitrification (nitrate → nitrogen gas)

  Erosion

  Immobilization (tie up by microbes-not a true loss)

  Weed N uptake

- Largest loss in Montana?

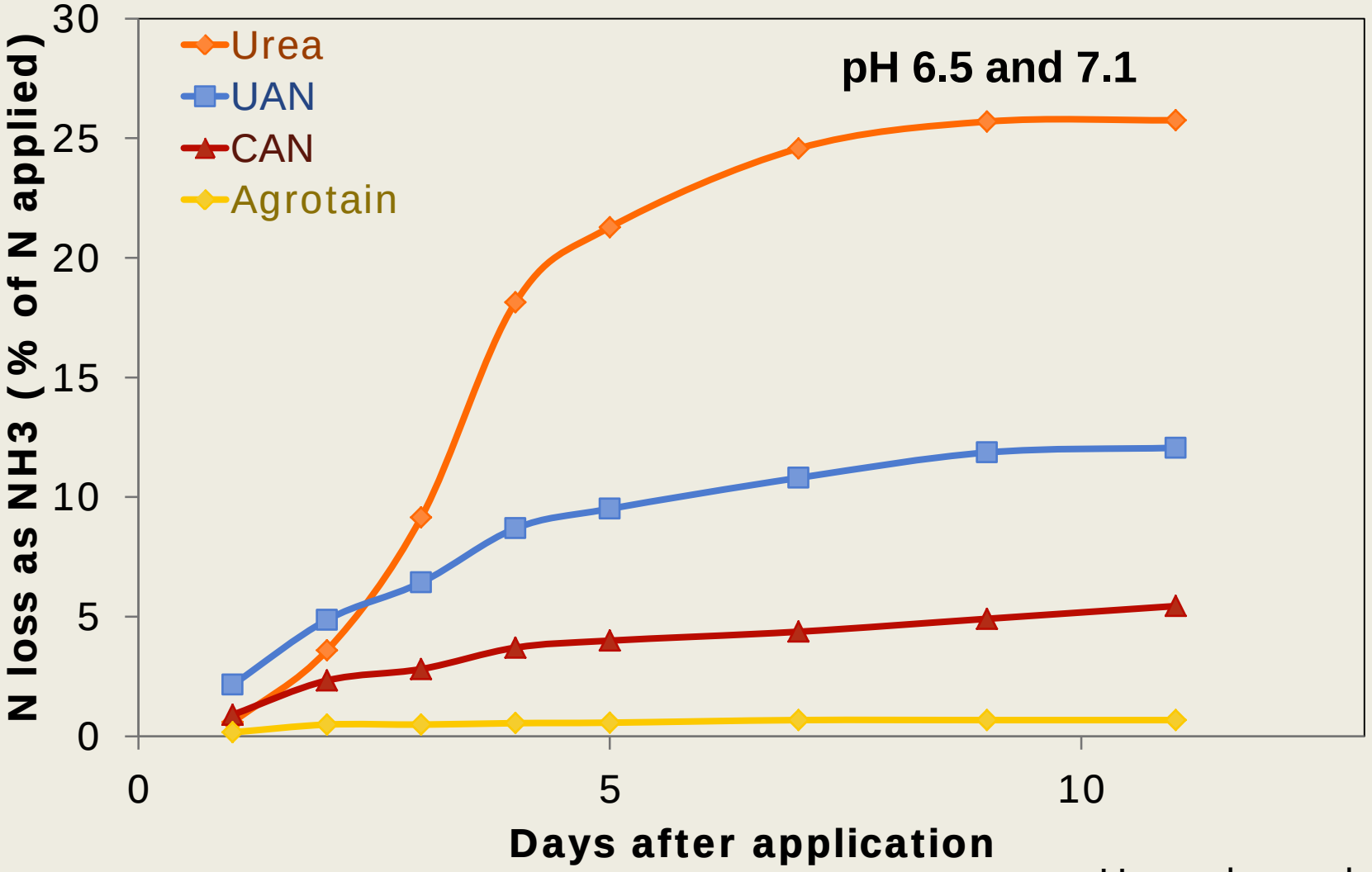
  Likely volatilization

N volatilization loss (%)

Campaign	Fertilization date	Urea	Agrotain®
1	April 3, 2008	8.4	4.4
2	Oct 8, 2008	3.1	1.4
3	Nov 14, 2008	31.5	4.0
4	March 25, 2009	35.6	18.0
5	March 26, 2009	39.9	18.1
6	Oct 6, 2009	10.7	3.3
7	Oct 13, 2009	10.4	4.8
8	Oct 19, 2009	15.7	3.4
9	Jan 27, 2010	24.3	9.3
10	Feb 26, 2010	44.1	11.9
11	March 29, 2010	6.3	1.7
12	April 20, 2010	14.7	1.4
Average		**20.4**	**6.8**

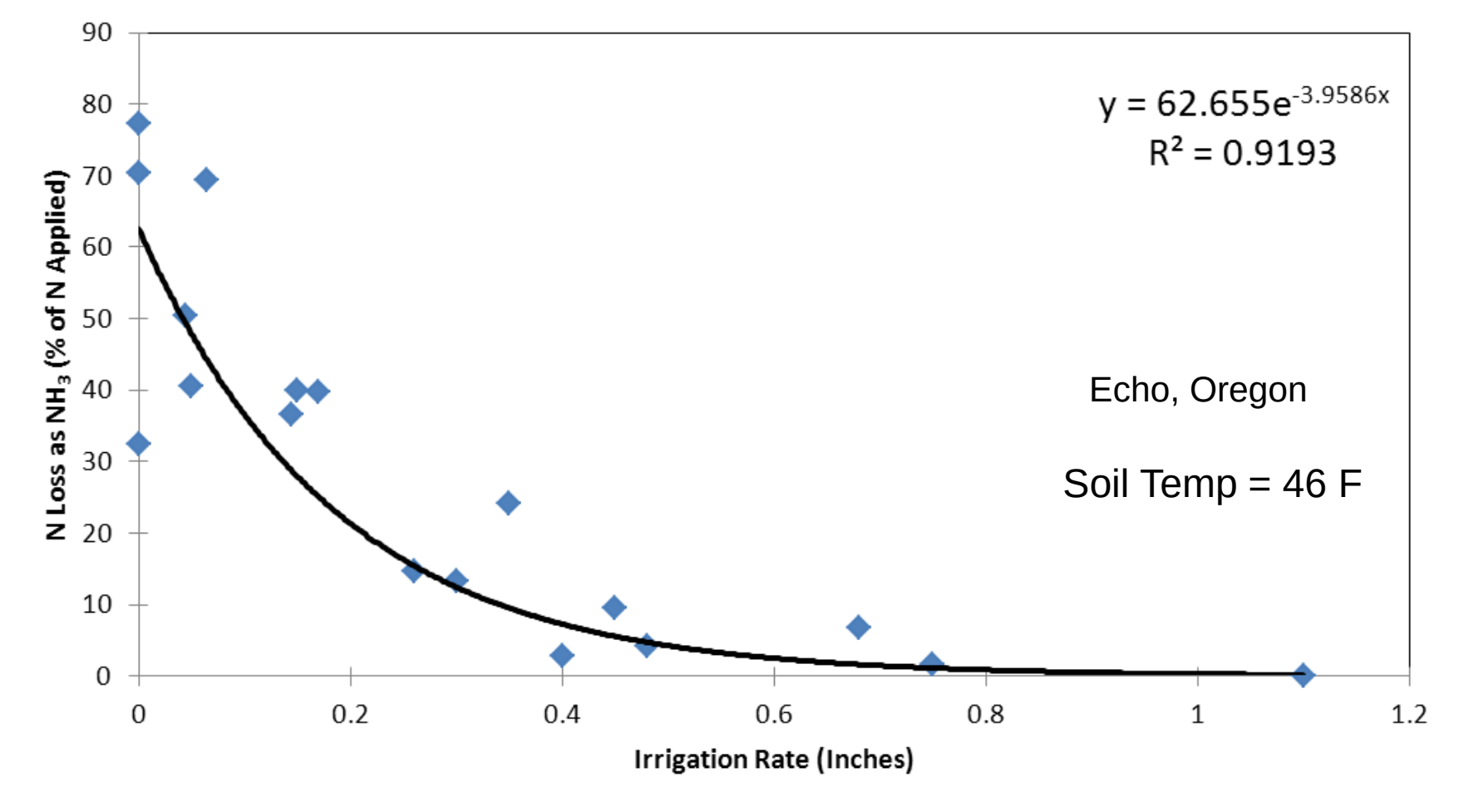
wide range in N loss amounts

Volatilization from grass
Hermiston, Oregon (150 lb N/a)

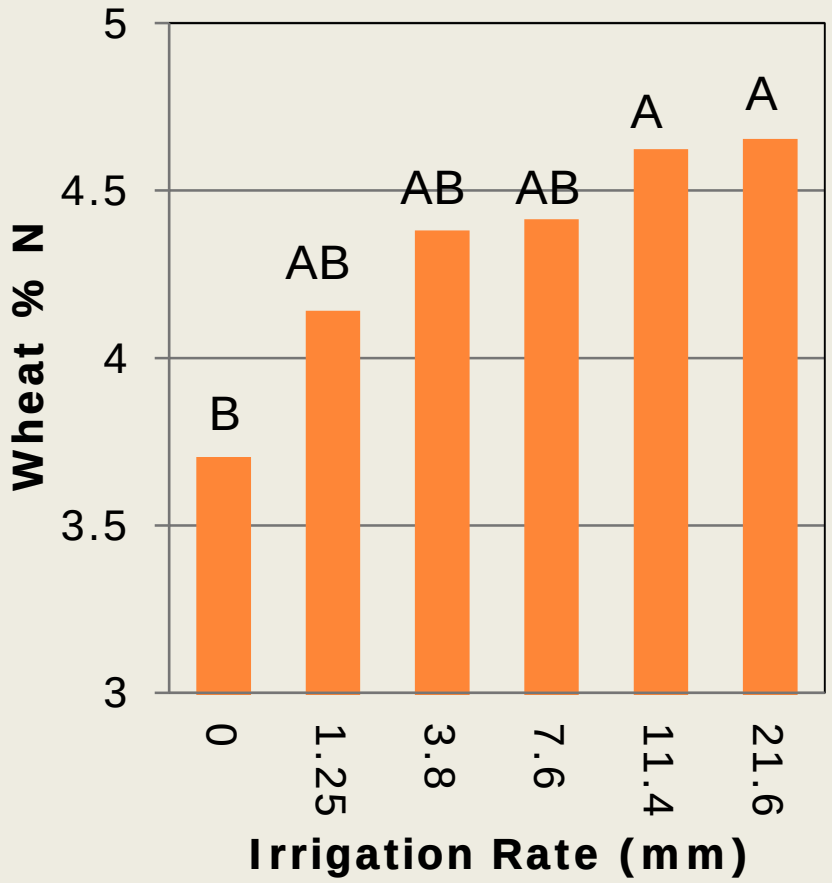


Horneck unpub data

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

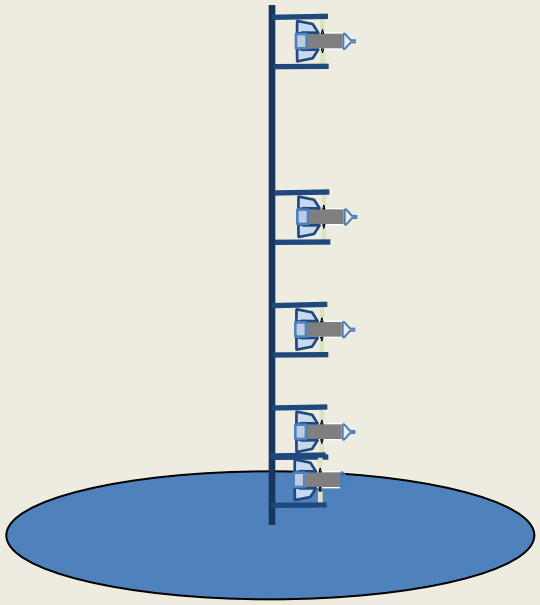


Wheat N of irrigation study

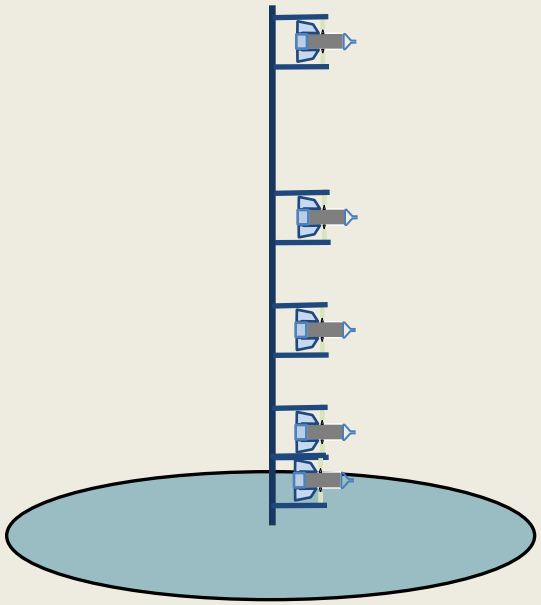


What about applying urea in front of air-drills?

Fall Campaigns



pre-plant urea



post-plant urea
'control'

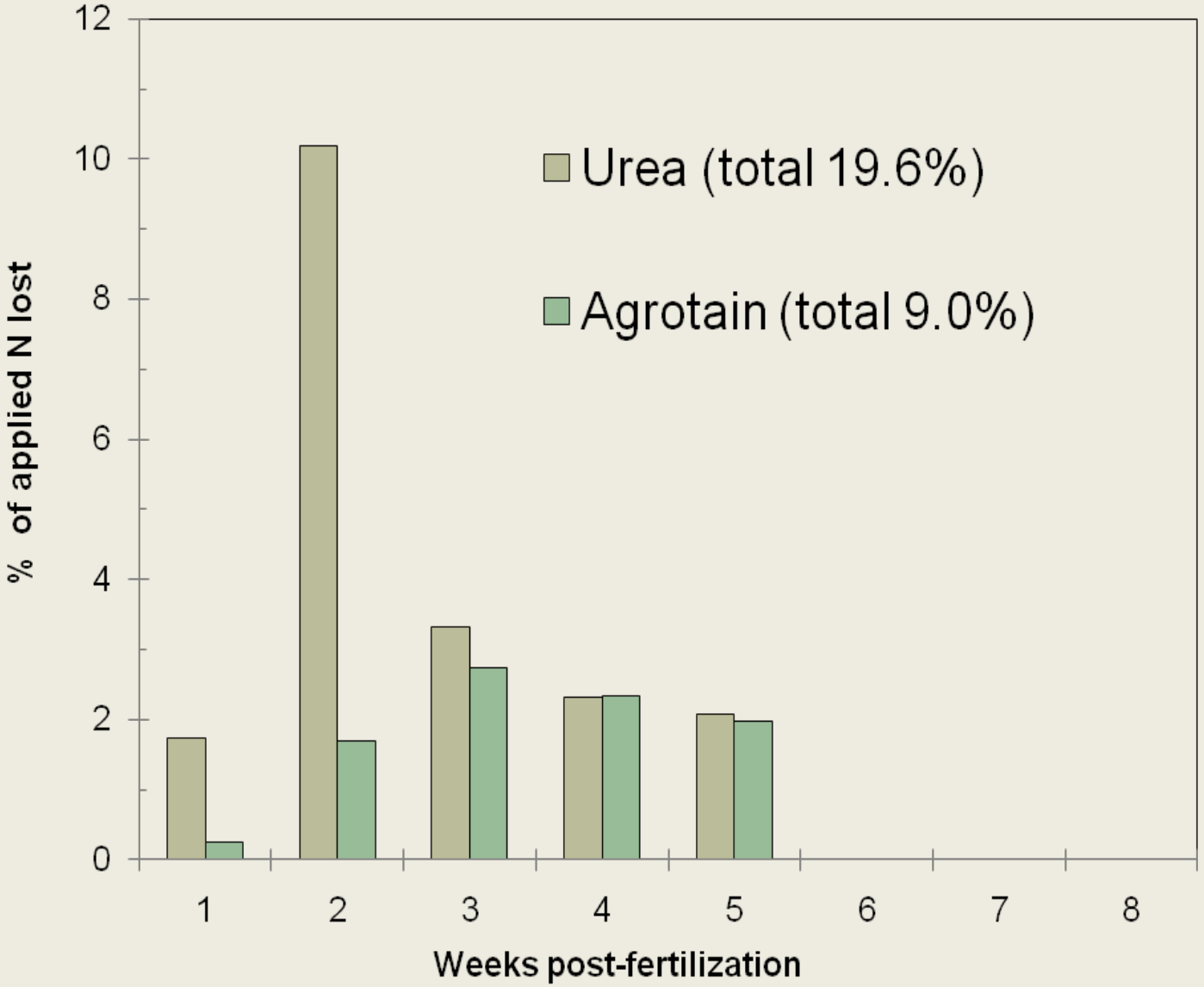
What about applying urea in front of air-drills?

Three Campaigns this Fall

Fertilization date	Cooperator	Pre-seeding	Post-seeding
September 15	McIntosh- north Havre	18.7%	13.8%
September 27	McCormick - Kremlin	20.4%	24.4%
October 7	Peterson – Cottonwood	4.1%	5.2%

Denton – March 2 – fertilizer spread

Campaign 16 - Denton site



Denton-2 wk post-fertilization

snow -cover gone

What should growers do to minimize volatilization?

1. Do not apply urea on moist ground UNLESS a snow or rainstorm is forecast to drop at least ½ inch of moisture in a day, preferably more (unlikely unfortunately!)
2. If irrigate, apply at least ½ inch of irrigation water after urea application
3. Apply urea below the surface – either in a midrow band, 2 inches from the seed or with the seed with a ‘protected’ product
4. Consider using Agrotain®, UAN, or ammonium nitrate (if available) if can’t apply during a low risk time
5. Consider seeding right after urea application to cover some urea; wider openers will help with this. (We’re currently testing effectiveness of this practice)

QUESTIONS ON UREA VOLATILIZATION?

Enhanced Efficiency Fertilizers to increase grain protein?

- Examples of N EEF products:

  Urease inhibitor: Agrotain®

  Nitrification inhibitor: NServe®

  Controlled release: Agrium's ESN® (polymer coated)

  Slow release: GP's foliar Nitamin® (30-0-0) and soil applied Nitamin Nfusion® (22-0-0) which is mixed with UAN.

- Controlled and slow release should have best chance of boosting protein

ESN® results

- Irrigated

  ESN increased furrow-irrigated winter wheat by ~1% and spring wheat grain protein by ~ 0.5% when applied pre-plant (Brown, 2006; 2008).

  ESN in sw study did no better than a split urea application.

  ESN in ww study had no effect on protein when applied late winter *and decreased yield*.

- Dryland

  ESN produced similar or lower sw grain protein than urea in both SK and AB (Malhi, 2010) for fall and spring banded applications.

  ESN produced similar ww grain protein in AB when seed-placed and lower grain protein when spring broadcast (McKenzie, 2007)

Nitamin® results

- No benefit

  Grant Jackson (2008) found no differences in irrigated spring wheat protein between Nitamin-UAN and urea in MT.

  Dave Franzen (2010) found no significant difference in protein for the majority of 8 trials on Nitamin-urea vs urea in ND.

- Benefit

  Franzen (2010) did find significantly higher sw protein with Nitamin on a sandy soil with high rainfall.

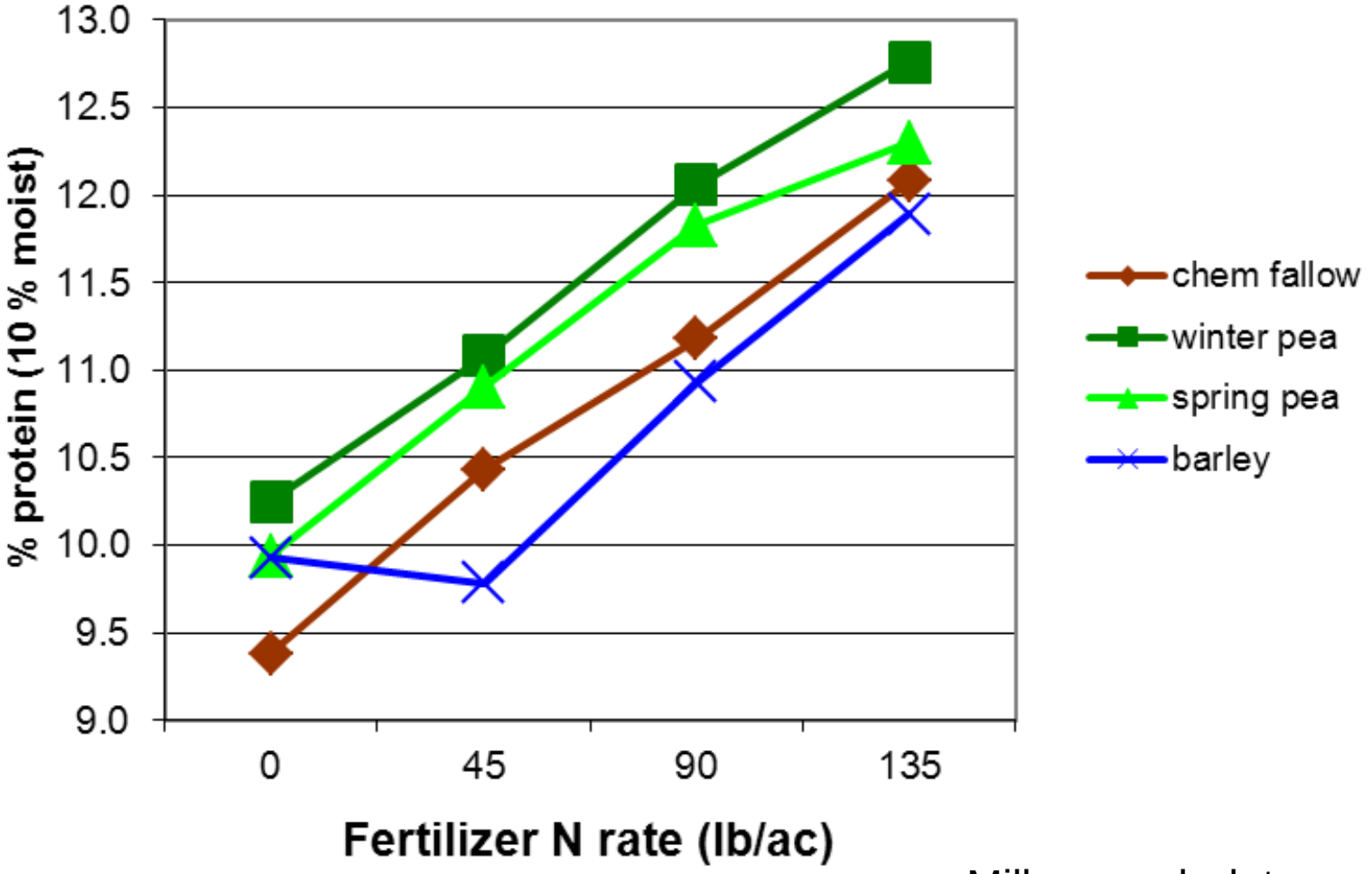
  Bly and Gelderman (2008) found significantly higher sw protein at a low Nitamin Nfusion rate (27 lb N/acre) in SD.

Recommendations on EEFs

- Urge caution especially given higher cost and lack of MT research
- See *Enhanced Efficiency Fertilizers* (EB0188) and/or request a copy of Dave Franzen's summary on N EEFs from me (has more data than EB0188)

QUESTIONS ON N ENHANCED EFFICIENCY FERTILIZERS?

Legumes in rotation w/ winter wheat?



Miller unpub data

Other practices to increase protein?

- Cultivar selection?

  Ex: Conrad

  Vida (8 yr average) = 13.8% protein

  Choteau (10 yr average) = 14.5% protein

- Others?

A challenge and an offer to you

- Work with at least one grower this year to increase his/her grain protein
- Ask about rate, timing and source of N to see what could possibly done now to boost protein.
- Encourage a strip trial with top-dressed N either applied in a strip or withheld from a strip
- I will work with you to answer questions, help design trial, determine how best to sample and analyze grain, and see if N paid for itself.

Conclusions

- Supplying sufficient pre plant N and topdressing at flower are the two most consistent strategies to boost grain protein.
- Minimizing N losses and growing wheat after annual legumes should in general both increase protein.
- Enhanced efficiency products may or may not increase grain protein and should be used cautiously given additional expense.
- Legumes grown instead of a small grain or fallow can result in a protein increase similar to about 25 lb N/ac of fertilizer.

Additional info in:

http://landresources.montana.edu/soilfertility

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

Other soil fertility publications:
Go to “Extension Publications”

Ammonia volatilization taped presentation:
Go to “Ammonia Volatilization”

This presentation: Go to Presentations.