Protecting Your Water and Air Resources

Montana Agri-Business Association Convention
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MONTANA STATE UNIVERSITY EXTENSION

Objectives Today

- Discuss potential water quality issues from agriculture
- Discuss management practices to protect water resources
- Show research results on effects of practices on water quality, nutrient losses, grain yield, and grain protein

Question

- How many of you work with both fertilizer and manure (nutrient management plans, feedlot manure management, application rates…)?
- How many of you work with fertilizer and not manure?

Potential water quality issues from agriculture

- Surface water eutrophication
  - Runoff of N and P from fertilizer and manure
  - Deposition of volatilized ammonia and wind eroded soil in water
- Other surface water issues: *E. coli*, sediment, etc.
  - Cattle in streams
  - Erosion from corrals, range, pasture, cropland
- Groundwater contamination: N and pesticide leaching
  - Fertilizer, manure, and organic matter decomposition
  - Pesticide application

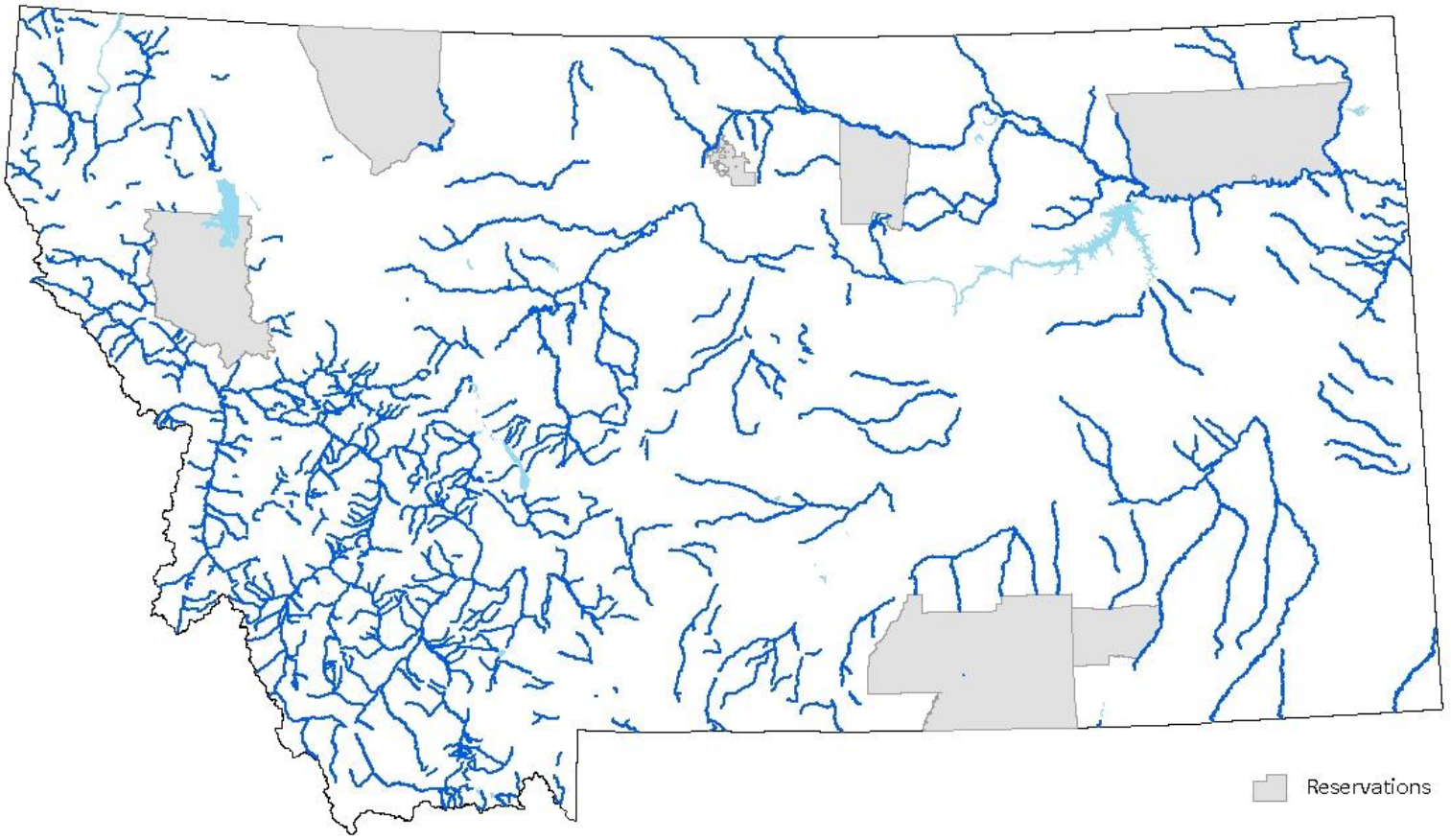
Is surface water impairment an issue in Montana?

- Of 1152 streams and lakes ("assessment units") in Montana, about ½ (584) are designated as "impaired" by the Dept. of Environmental Quality

- The top three water quality pollutants causing impairment to streams:
  - Sediment (448 streams)
  - Phosphorus (221)
  - Nitrogen (197)

DEQ, 2012

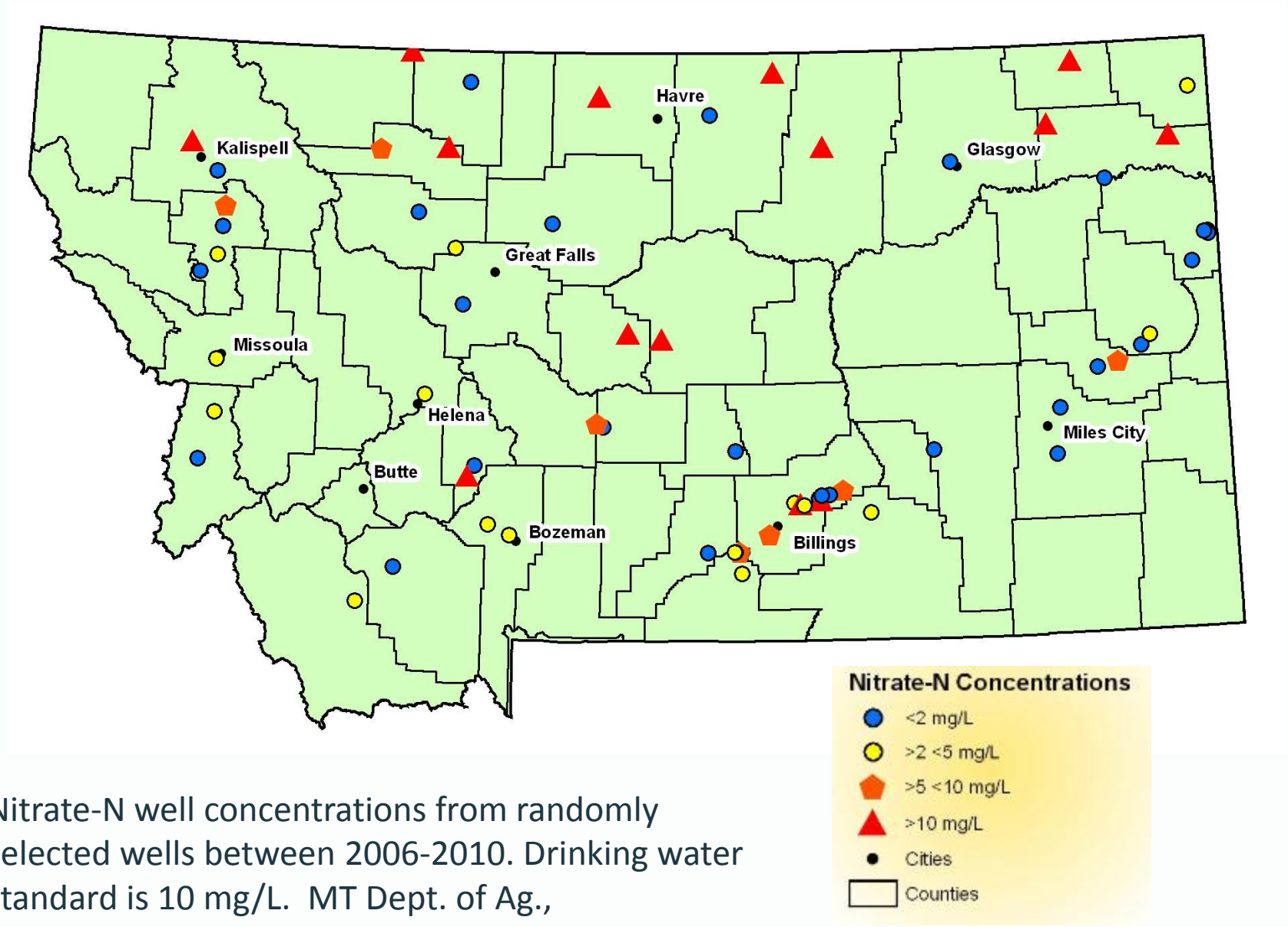
Impaired water bodies in Montana (DEQ, 2012)



100 Miles

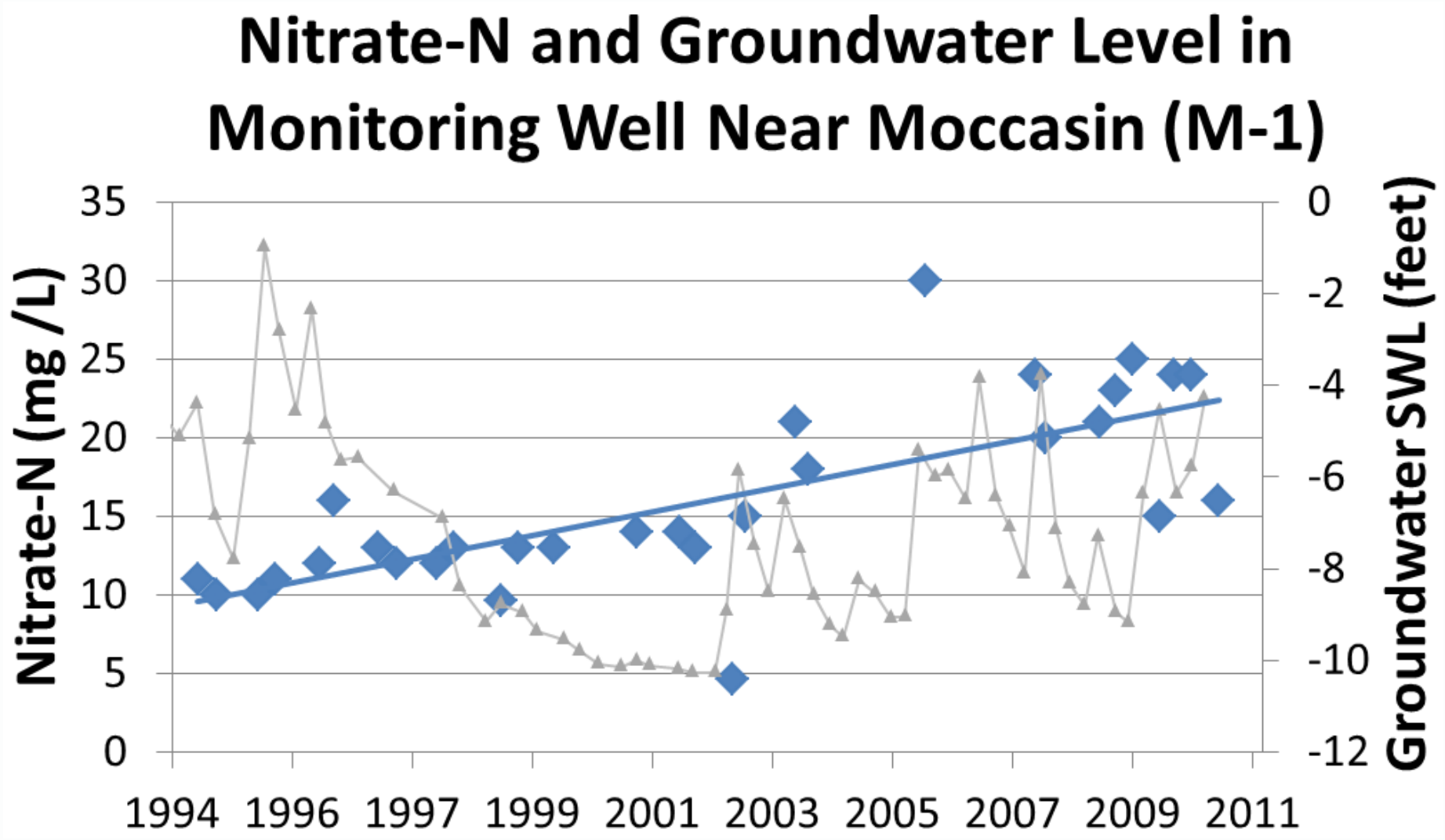
Waterbodies shown are those reported as either Category 4A or Category 5 in the 2012 Water Quality Integrated Report.
4A - All TMDLs required to rectify all identified threats or impairments have been completed and approved.
5 - One or more applicable beneficial uses are impaired or threatened and a TMDL is required.
For more information visit: http://cwaic.mt.gov/

Where in Montana is nitrate in groundwater a big issue?



Nitrate-N well concentrations from randomly selected wells between 2006-2010. Drinking water standard is 10 mg/L. MT Dept. of Ag., Groundwater Protection Program

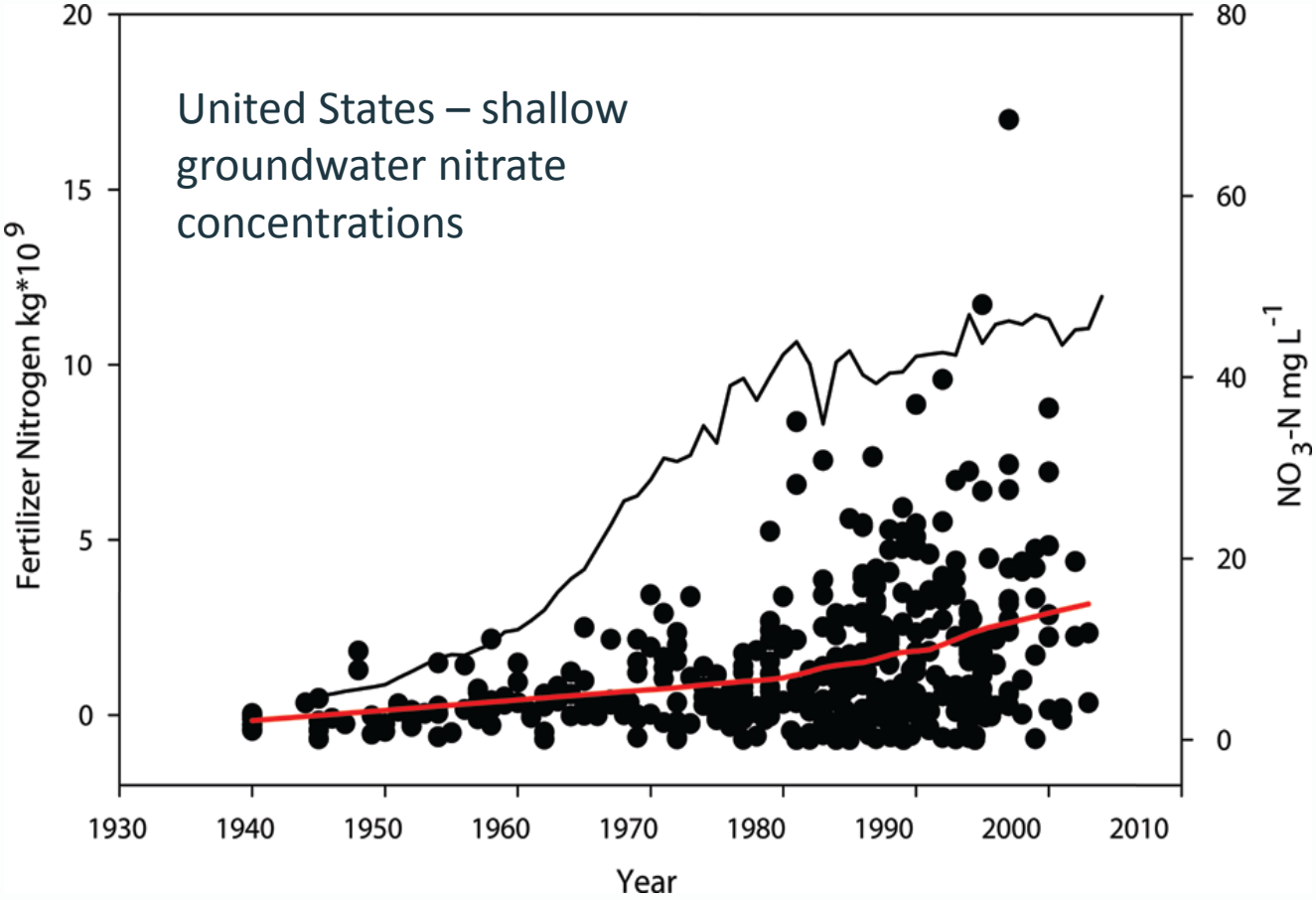
Judith Basin, Montana
Trend in Groundwater Nitrate Concentrations



Montana Dept. of Agriculture

Effects of Nutrients on Water Quality – Nitrate in Groundwater

- Human and livestock health issue



Puckett et al. 2011. ES&T. 45:839-844.

Pesticides in MT groundwater

- What pesticides are detected?

  Examples: imazamethabenz-methyl (Assert) , chlorsulfuron (Telar), clopyralid (Curtail)

  Mainly on coarse or shallow soils (ex: Judith Basin, Fairfield Bench)

- Are they a health issue?

  Unlikely as generally well below drinking water standards

Management to decrease runoff and erosion (reduces sediment, nutrient, and pesticide movement)

- Minimize tillage
- Rotate with perennial crops
- Recrop rather than fallow
- Manage irrigation
- Use high residue crops (wheat, not lentil)

Management to decrease N and P in runoff from fertilizer

- Incorporate or subsurface band
- If broadcast, avoid gullies and steep areas if possible
- Consider variable rate to avoid concentrating nutrients in low yielding areas

Management factors to decrease surface water contamination from manure

In a feedlot or corral setting:

- Keep clean water clean - don't let clean water run through feed lots or corrals
  - Roof runoff – install gutters and divert away
  - Runoff from upslope – use berms or ditches to divert away
- Implement vegetative buffer strips between feeding areas and surface water.
  - Any separation distance can help
  - Optimal distance depends on slope and soil texture
  - Ideally, runoff from the corral completely infiltrates before reaching the stream

Keep clean water clean

Photo 1. Rills in field north of Stone Creek Road 6/12/06

Photo 2. Signs of OLF initiated from roof runoff 6/12/06

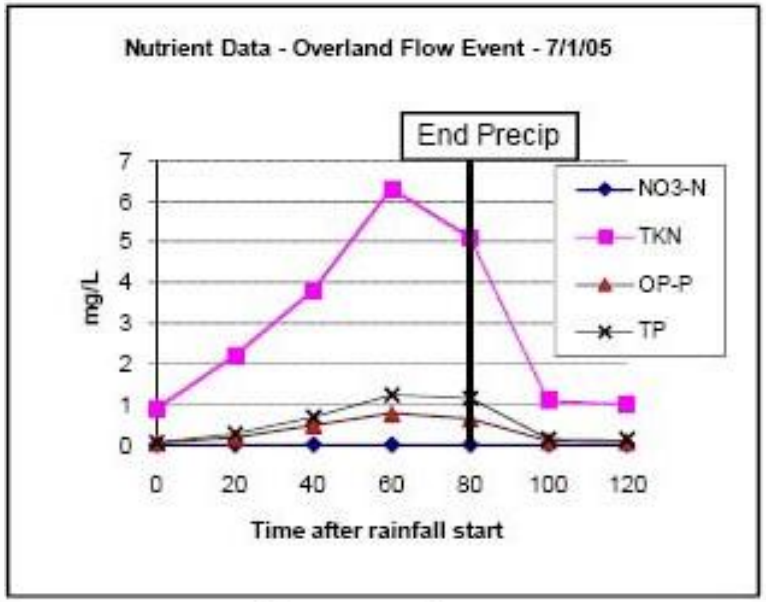
Photo 3. Signs of OLF initiated from roof runoff 6/12/06

Photo 4. Signs of OLF from AFO reaching stream 6/12/06

Buffers

Buffers decrease nutrients in runoff

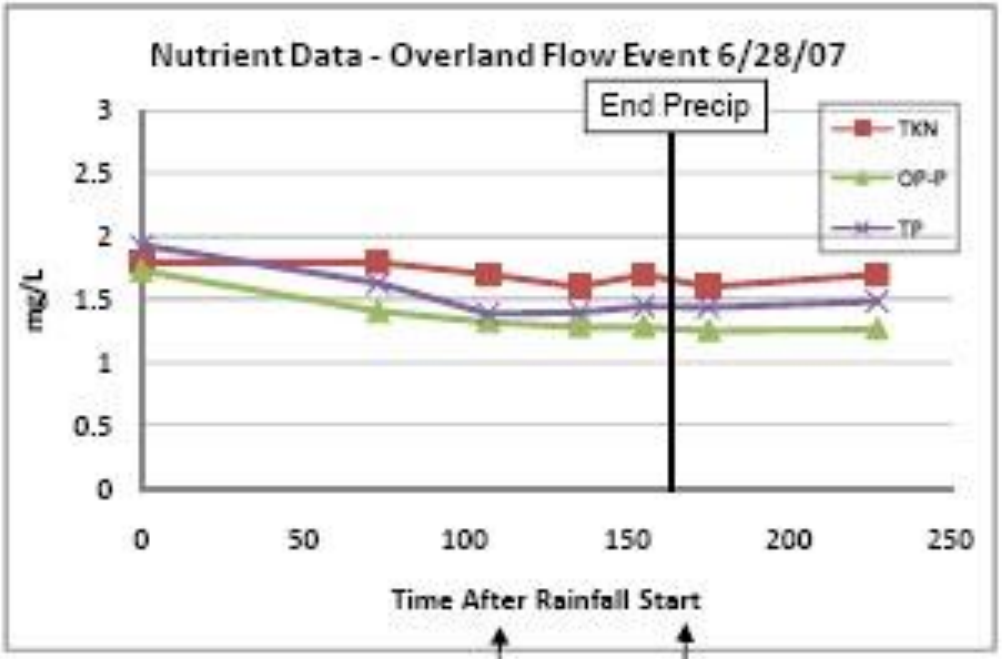
Pre-buffer



Sample directly from Overland Flow @ T = 33
NH4-N = 3.3
NO3-N = 0.21
TKN = 161.0
OP-P = 17.0
TP = 17.0

Sample directly from Overland Flow @ T = 70
NH4-N = 2.8
NO3-N = 0.45
TKN = 115.0
OP-P = 16.2
TP = 18.6

Post-buffer



Sample directly from Overland Flow @ T = 118
NH4-N = 0.8 mg/L
NO3-N = 0.7 mg/L
TKN = 19.5 mg/L
OP-P = 6.59 mg/L
TP = 7.39 mg/L

Sample directly from Overland Flow @ T = 165
NH4-N = 0.4 mg/L
NO3-N = <0.05 mg/L
TKN = 9.8 mg/L
OP-P = 4.5 mg/L
TP = 4.76 mg/L

Sigler, unpub. data

Management factors to decrease surface water contamination from manure

In a range or pasture setting:

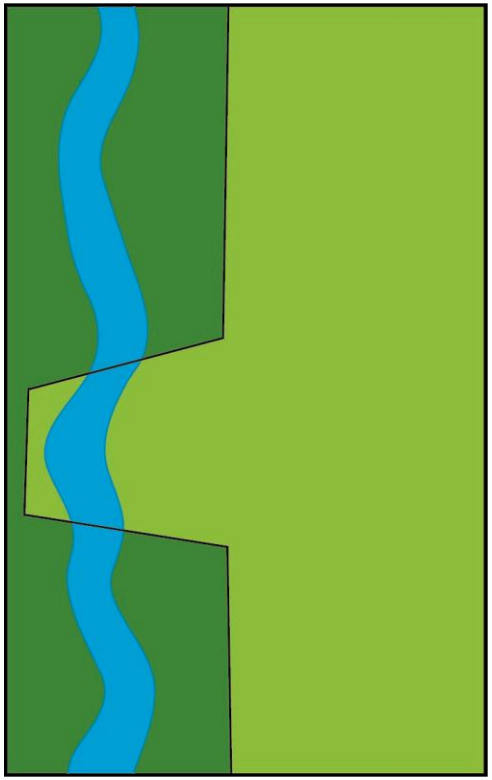
- Install off stream water sources
  - Livestock often prefer off-stream water if it means staying out of the mud
  - Help distribute forage use more evenly by providing water at distant locations
- Consider riparian fencing and rotations
  - Grazing riparian pastures for short intense periods during drier periods can reduce bank erosion while still utilizing forage and controlling weeds

Management factors to decrease surface water contamination from manure

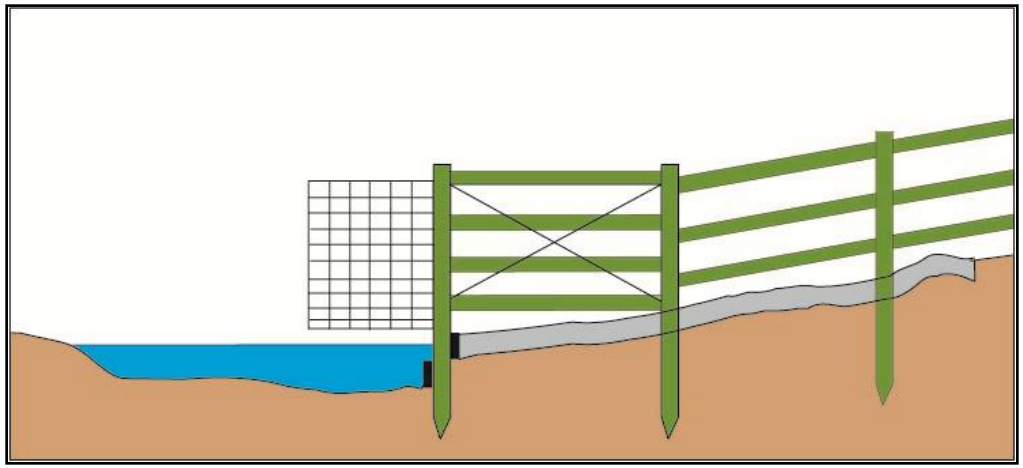
In a range or pasture setting:

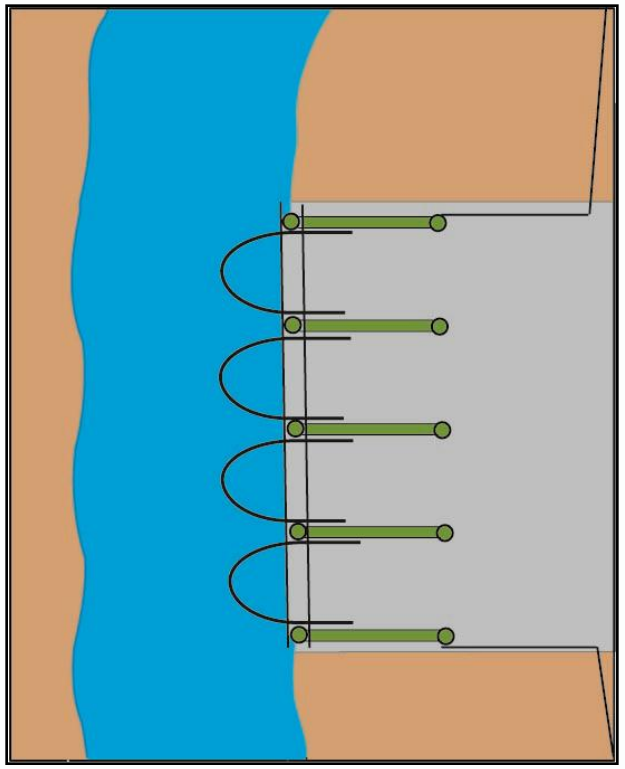
- If off-stream water is not possible, limit access with water gaps.
  - Locate and construct water gaps in stable locations on the stream

Traditional Water Gap



Armored Stanchion





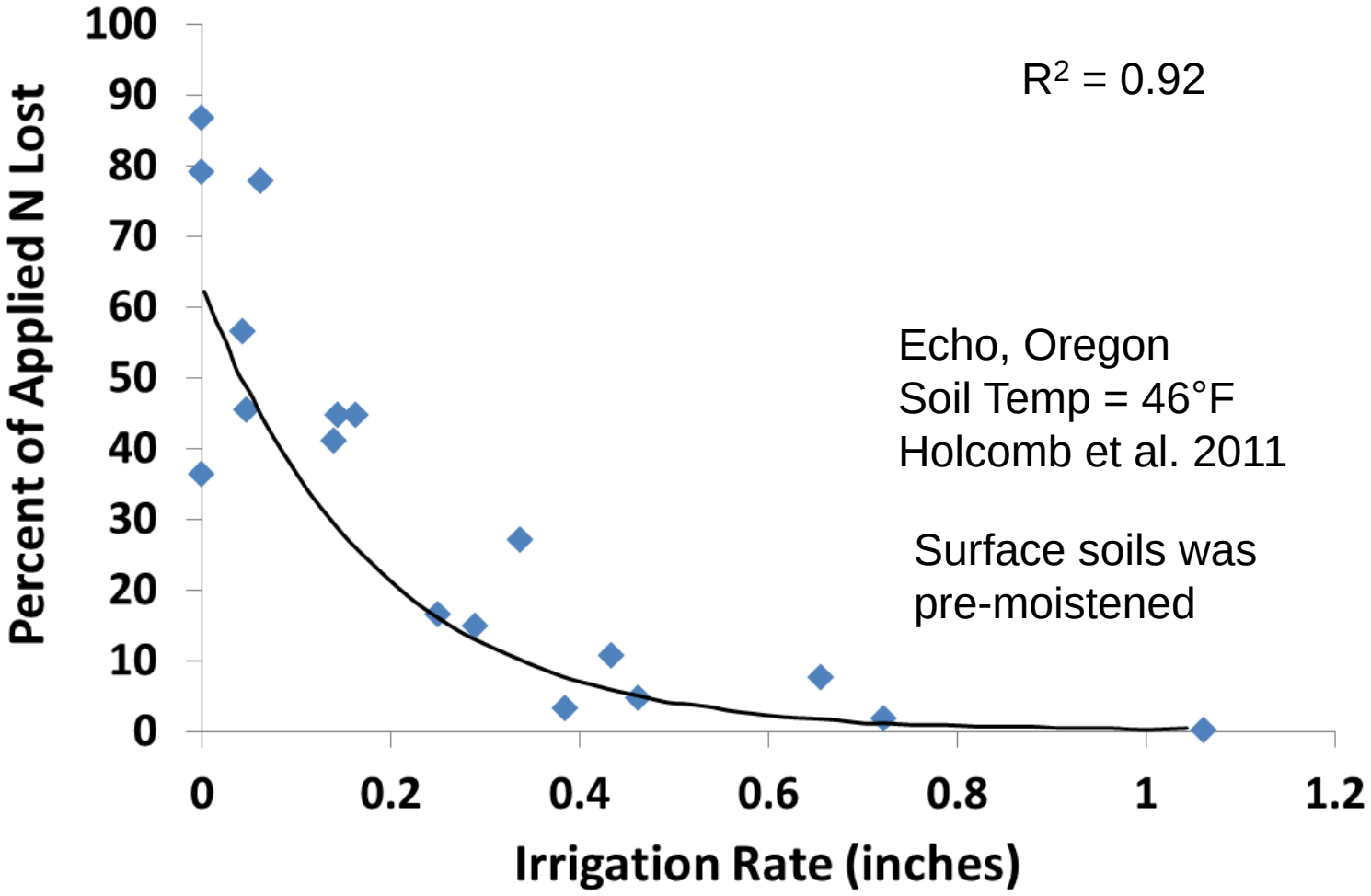
Dramatically (2 fold to >1000 fold) decrease sediment, *E. coli* and nutrient load to stream. Sigler, 2008.

QUESTIONS SO FAR?

Practices to decrease volatilization from N fertilizers, especially urea

- Incorporate with tillage if possible
- Apply to dry, cool, but thawed ground
- Apply prior to a large (> 0.5”) moisture event
- Use a protected product (e.g. Agrotain ® = NBPT) if can’t apply during low risk periods

Effect of irrigation amount on urea volatilization



N volatilization loss (%) in Montana

Broadcast

Season	No. trials	Fertilization dates	Urea	Agrotain®
Fall	6	Oct 6 – Nov 29	3.1 – 31.3	1.4 – 5.9
Winter	5	Dec 30 – March 5	13.0 – 44.1	4.1 – 11.9
Spring	6	March 25 - April 24	6.1 – 39.9	1.7 – 18.1
Average			**18.8**	**6.7**

wide range in N loss amounts

For specifics see Fertilizer Facts 59 and 60

North-central, central and southwest MT
Engel et al. 2011

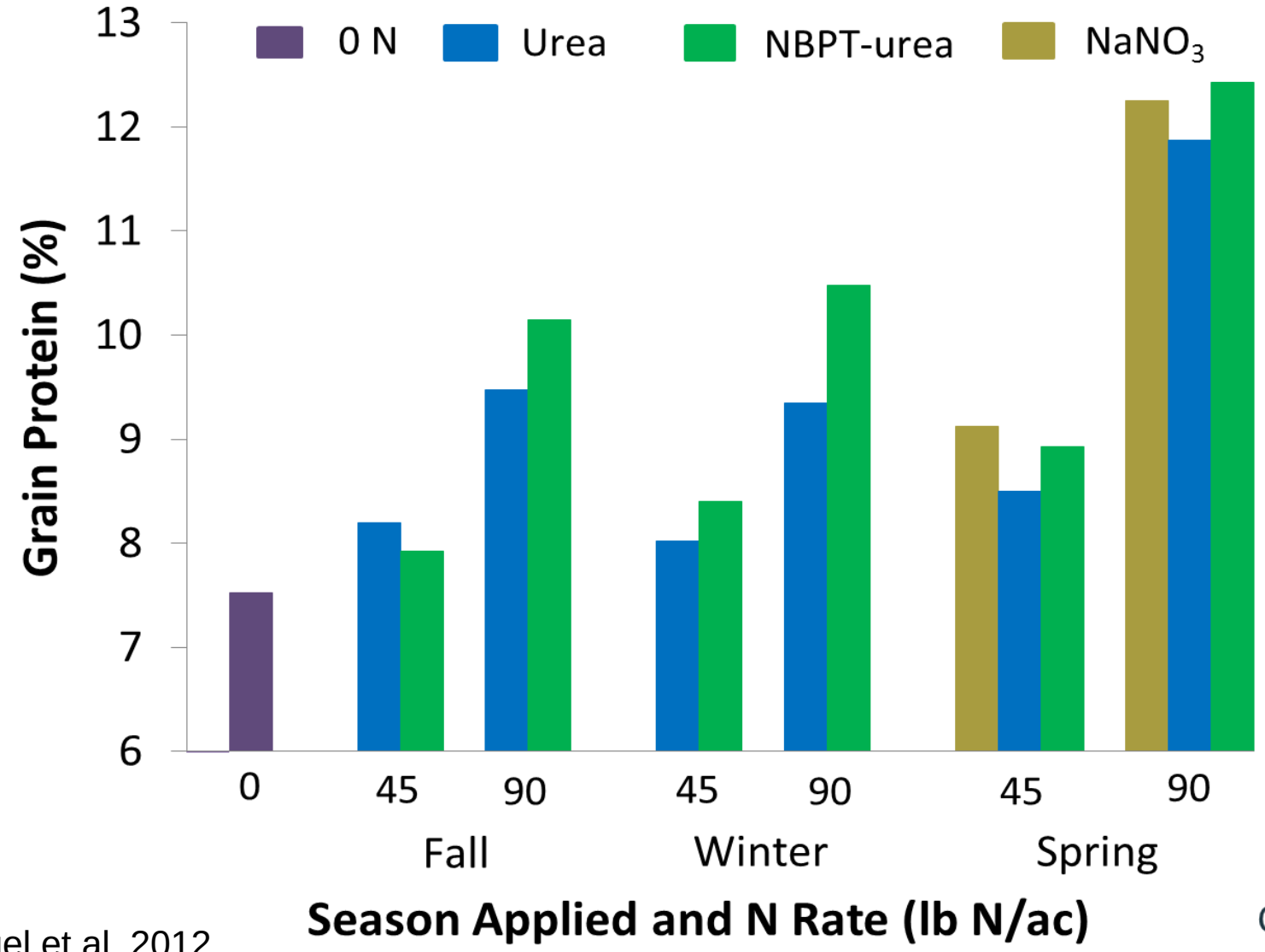
Are yield and protein affected by application timing, source, or volatilization loss?

- Location: Central MT (Coffee Creek)
- On the same field in 2011/2012, compared:

  Timing: Fall, winter, spring
  Source: Urea vs. NBPT–urea (Agrotain®) vs. $NaNO_3$ (doesn't volatilize)

- Measured in plots:
  Winter wheat grain yield
  Grain protein

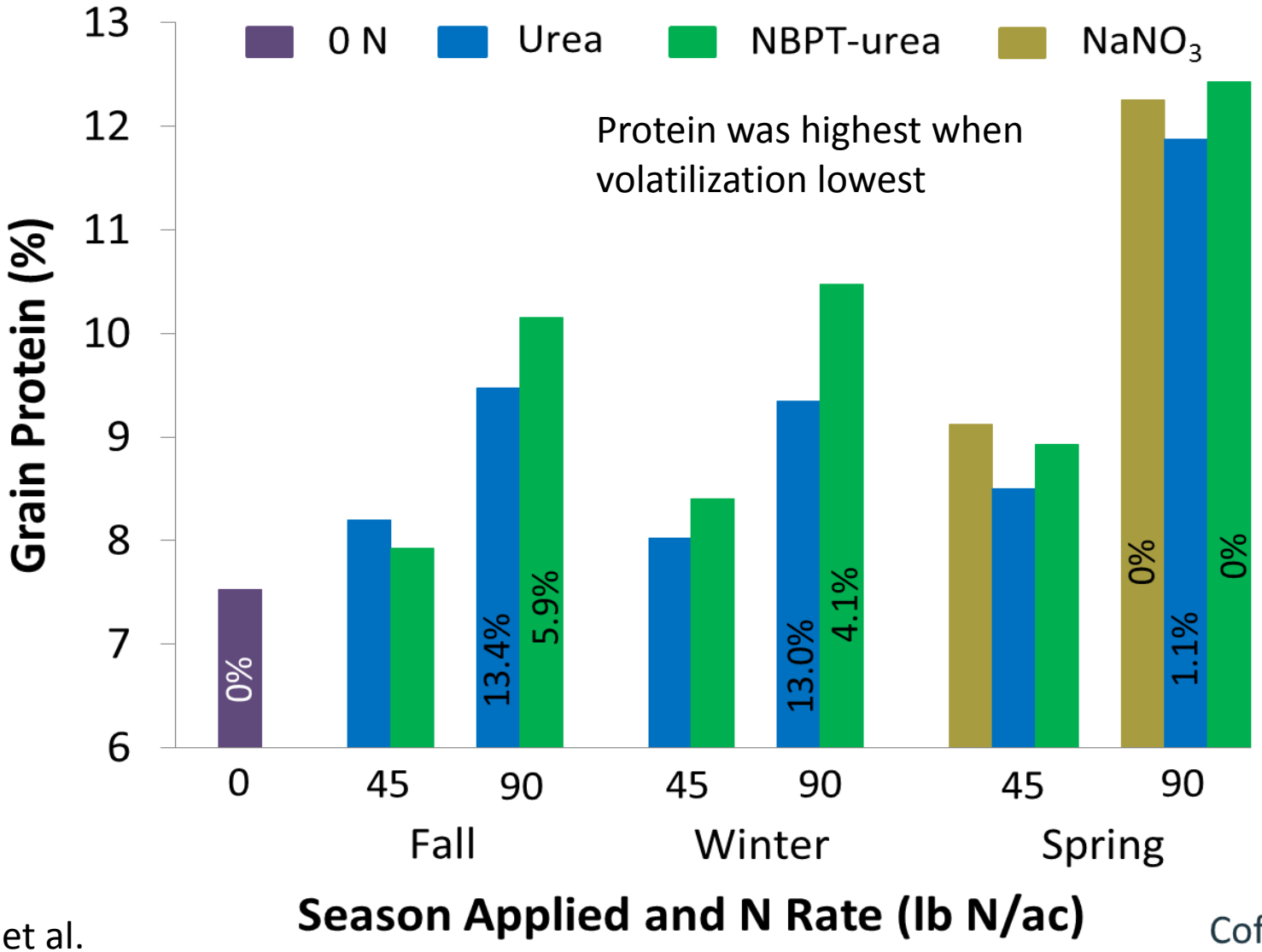
Source, application rate and timing affect protein



Engel et al. 2012
unpub data

Coffee Creek,
MT, 2012

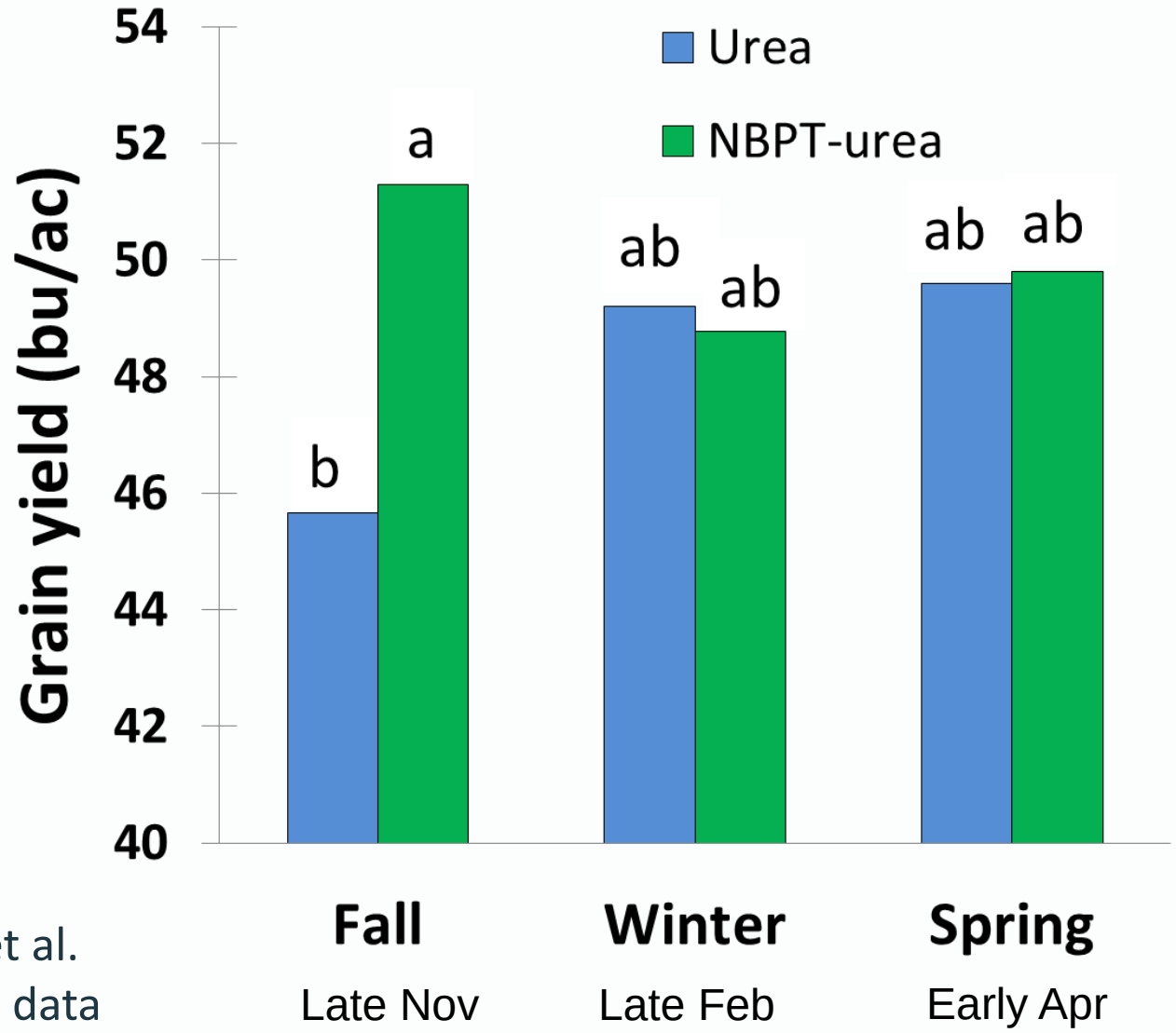
Volatilization affects protein



Engel et al.
unpub. data

Coffee Creek, MT, 2012

N application timing and source (urea or NBPT-urea) effect on winter wheat grain yield

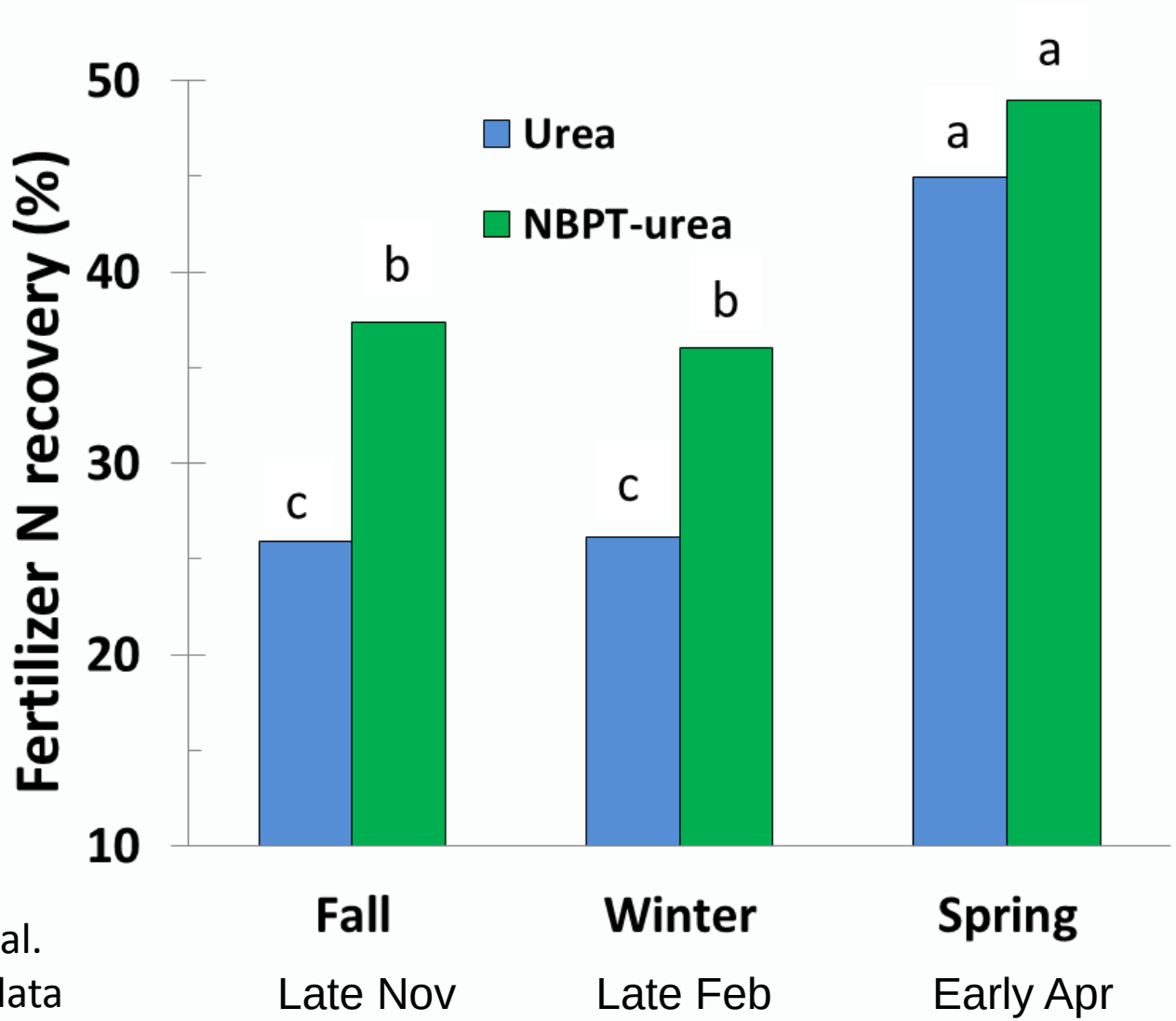


Averages are for both N rates

Engel et al. unpub. data

Coffee Creek, MT, 2012

N application timing and source (urea and NBPT-urea) effect on fertilizer N recovery in winter wheat grain



Averages are for both N rates

Take home:
More volatilization equals substantially lower N recovery

Engel et al. unpub. data

Coffee Creek, MT, 2012

Timing and source affect volatilization, protein, and yield

- Spring application produced highest protein and lowest volatilization loss (1%) probably because rained ¾ inch shortly after application
- NBPT increased protein by reducing volatilization
- Fall application without NBPT had lowest yield (due to both volatilization and tie-up?)
- NBPT increased yield only for fall treatment (water may have limited grain yield more than N due to dry summer)
- N fertilizer recovery (using a tracer) was highest for spring application and agreed with volatilization amounts

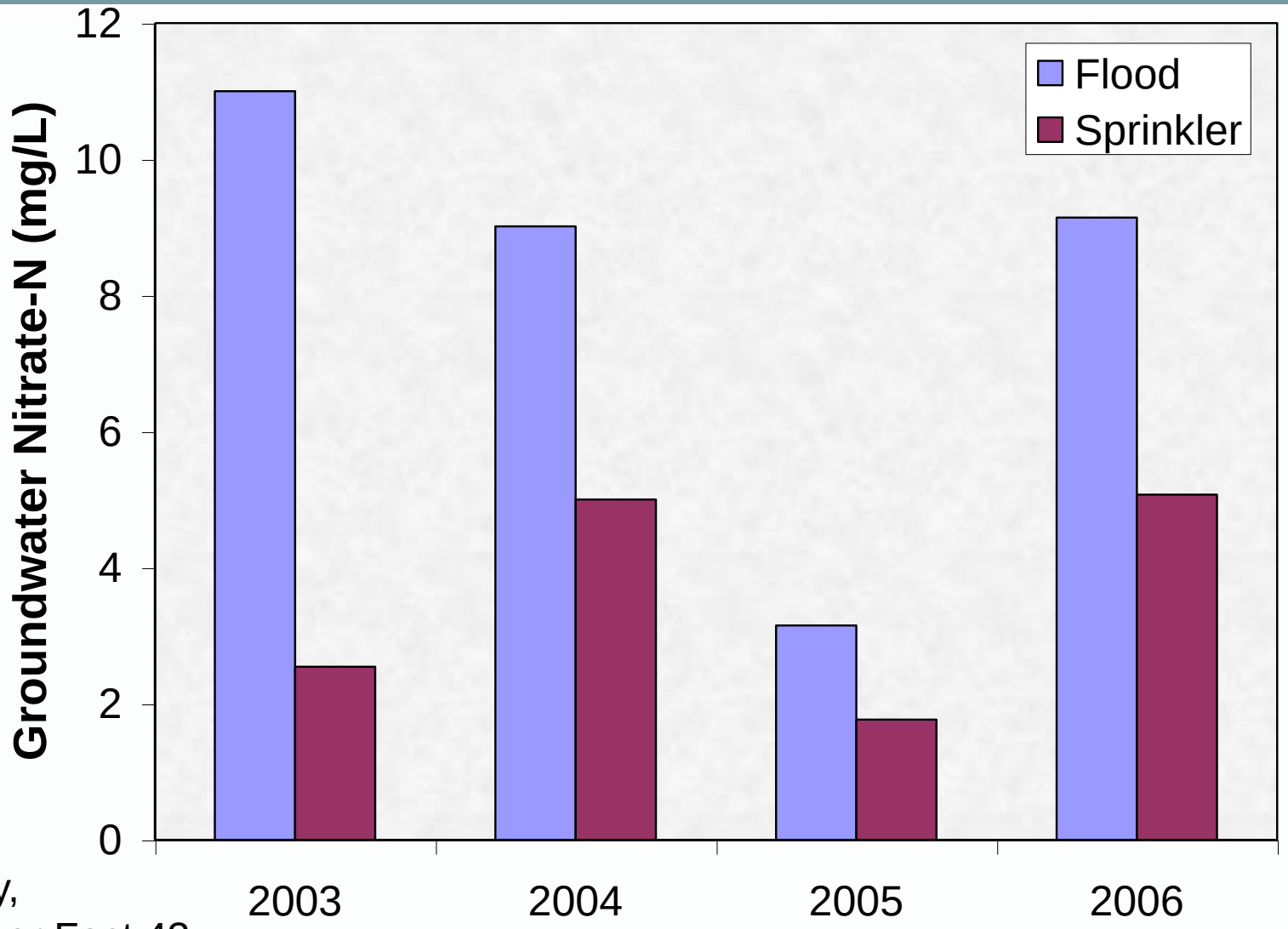
Crop management factors to decrease leaching of N (and pesticides)

- Carefully manage irrigation, especially on coarse soils
- Consider sprinkler instead of flood irrigation
- 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

N management factors to decrease N leaching

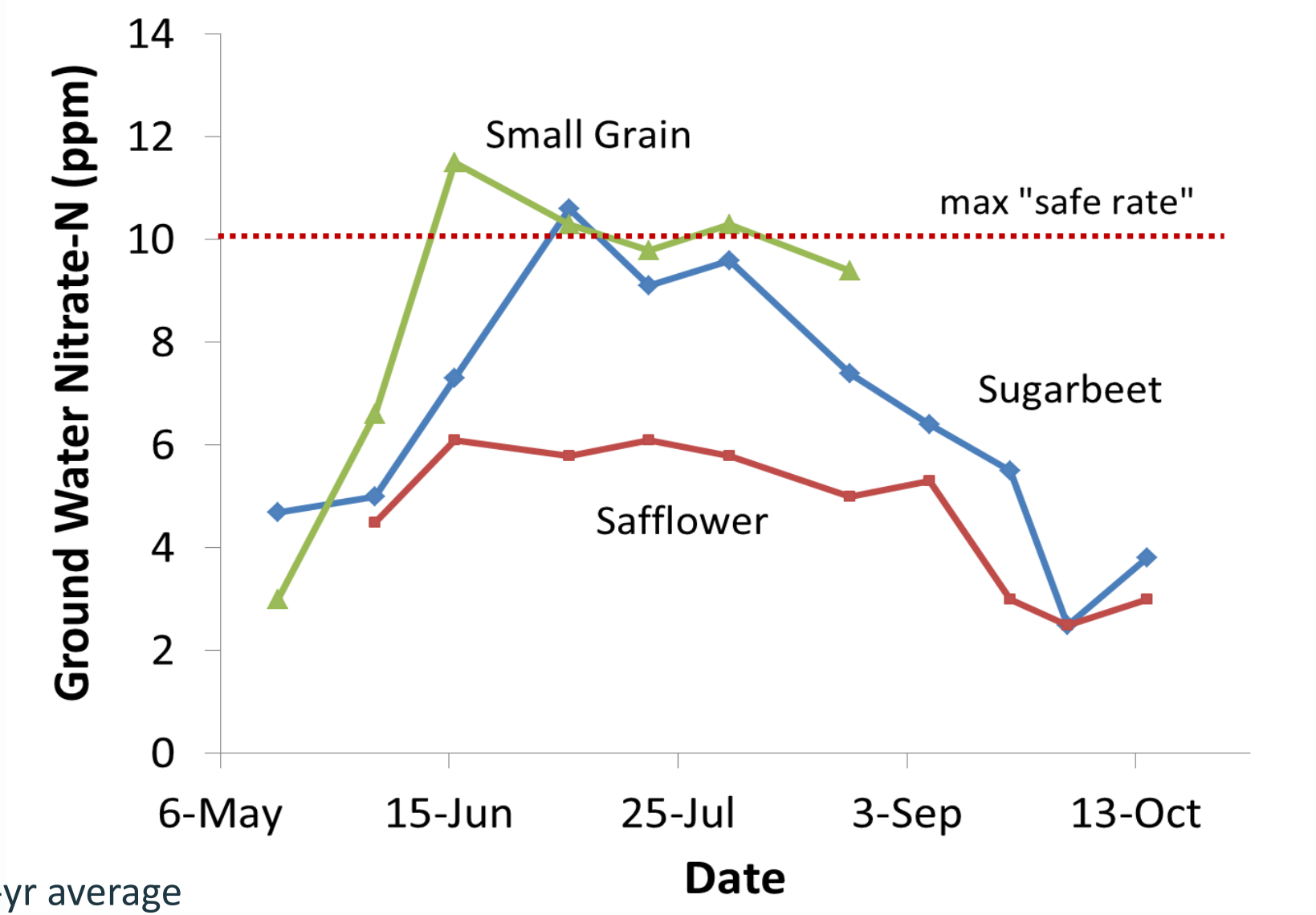
- Apply N based on spring soil test ESPECIALLY if have > 50 lb N/acre in fall AND soils less than 2 ft deep
- Split N application to match plant needs
- Consider applying less N in areas that yield less or have shallow soils (variable rate application)
- Use an enhanced efficiency fertilizer?

Effect of Irrigation System on Average Groundwater Nitrate Levels



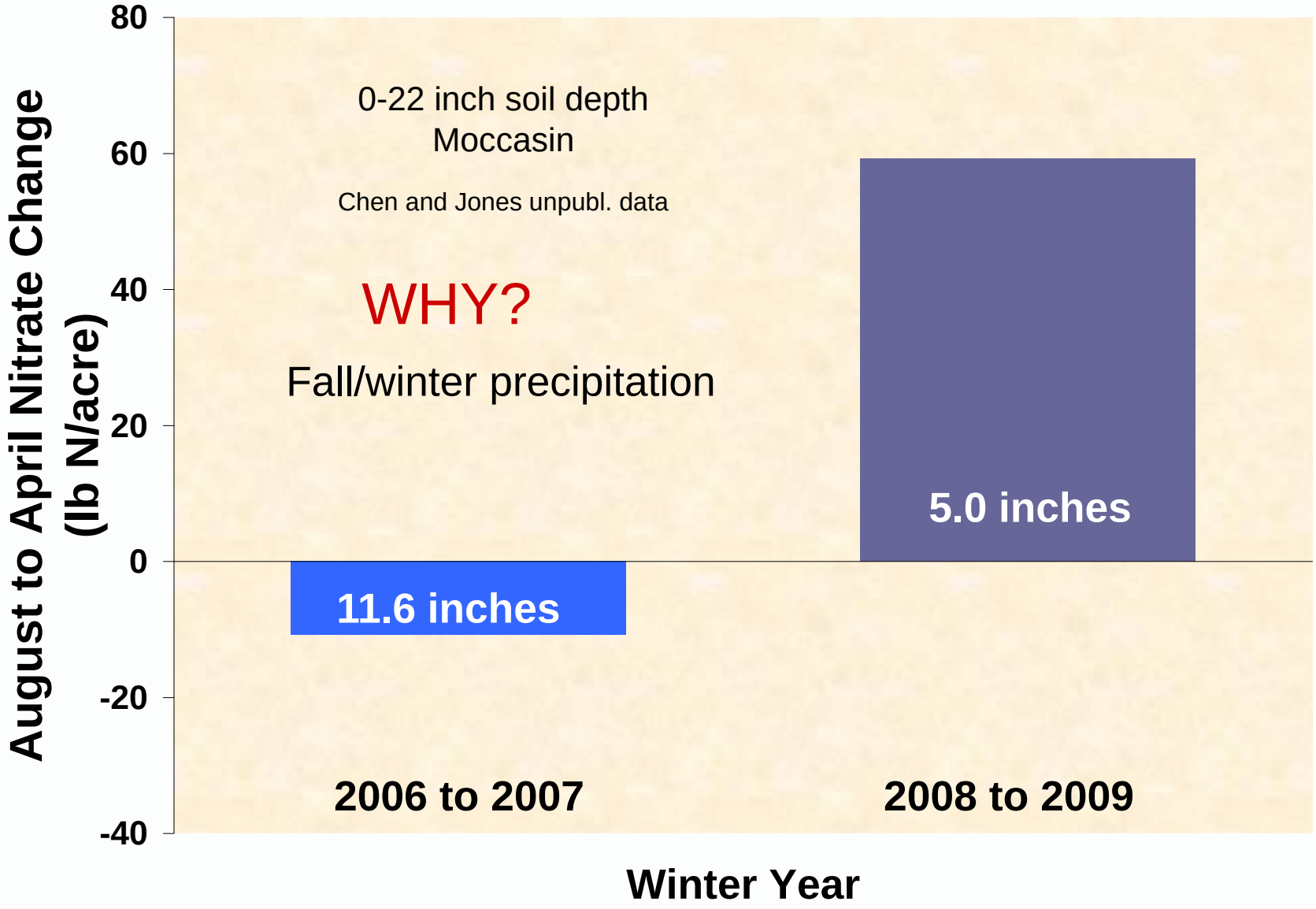
Sidney, Fertilizer Fact 43

Groundwater Nitrate-N as affected by Crop



6-yr average
Sidney, MT, Fertilizer Fact 9

Why is spring soil sampling better than late summer/early fall?



Placement, timing, and source study at Moccasin

- Worst-case scenario for leaching – soils ~ 18” deep. 21.6 inches of precipitation from Oct 2010 to Sep 2011
- Timing: Fall vs spring
- Placement: Broadcast, seed-placed
- Sources (selected, for all see Fertilizer Fact 62):

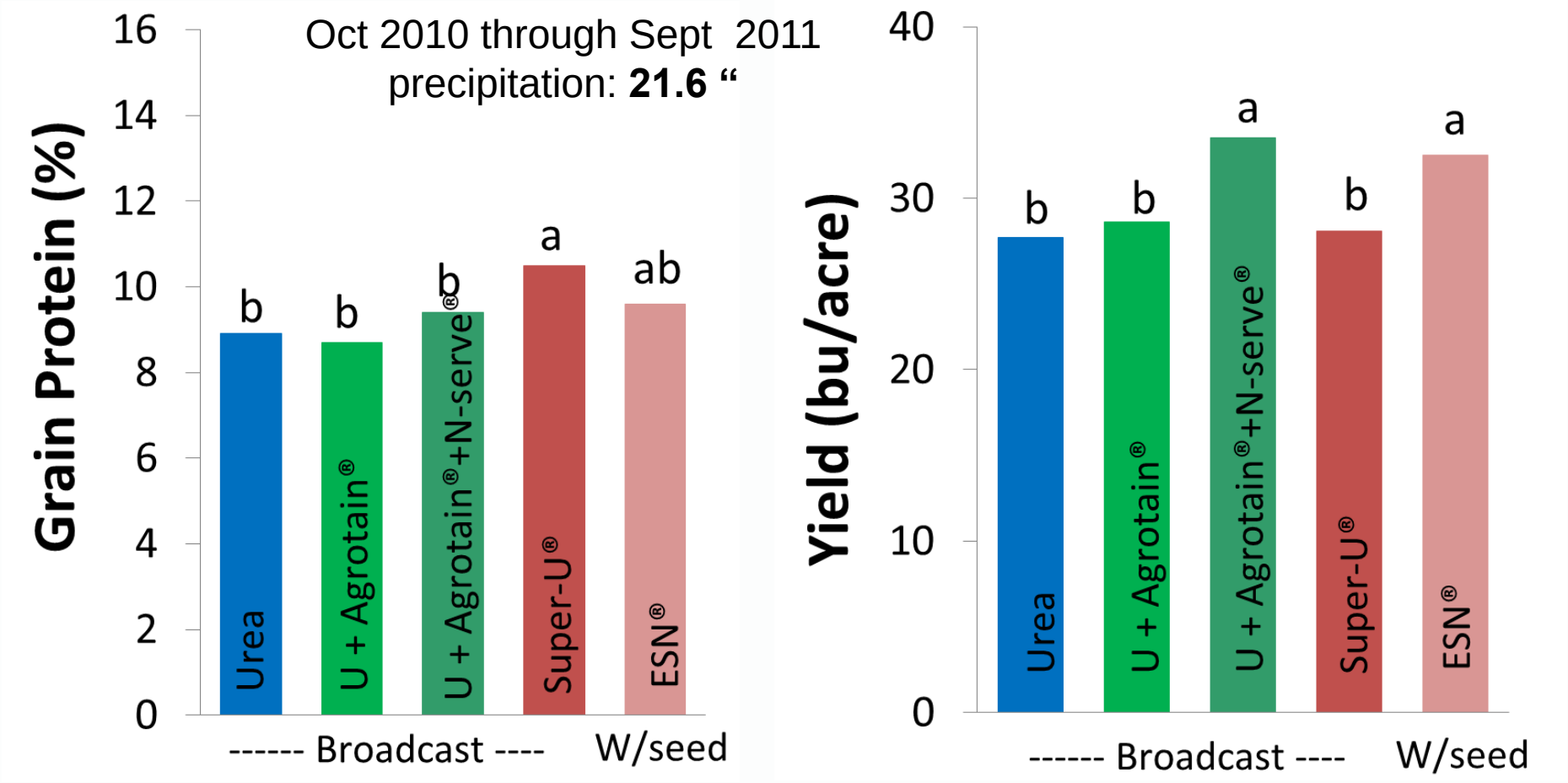
  Regular urea

  Super U (w/ urease and nitrification inhibitors)

  Urea mixed with Agrotain® and N-serve® (nit inhib)

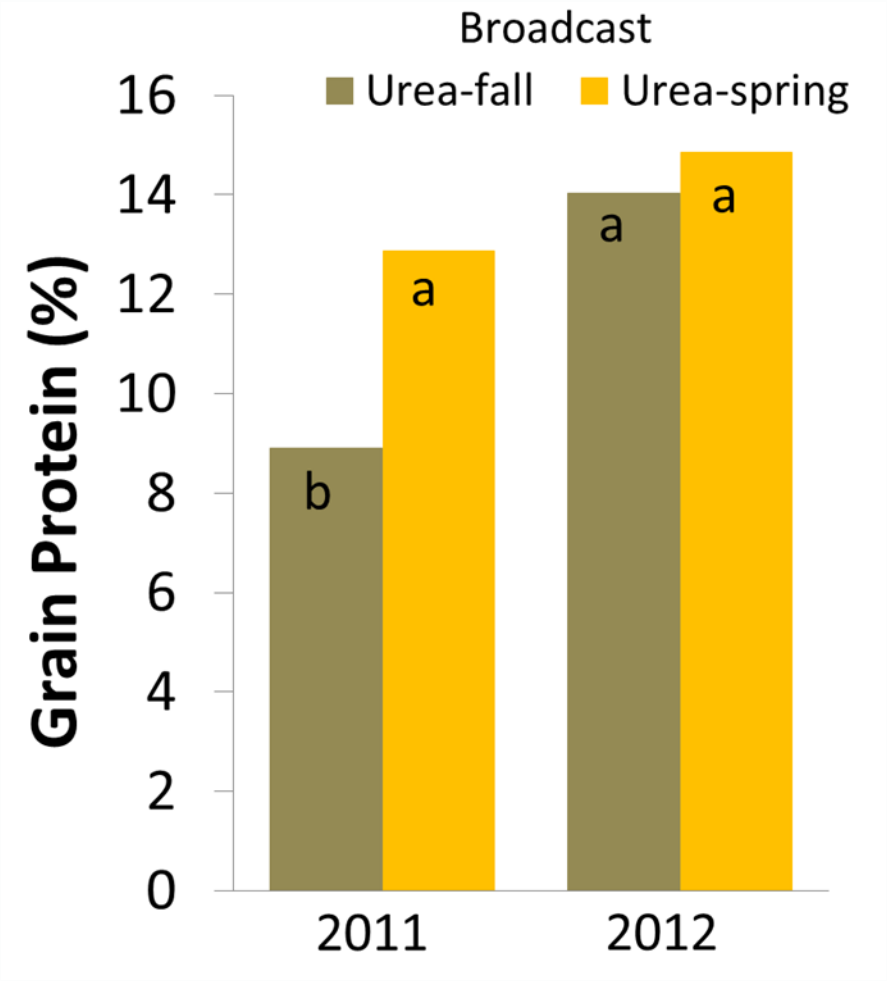
  ESN® with seed (only in fall)

Effect of source and placement (fall applied) on grain yield under high risk leaching conditions

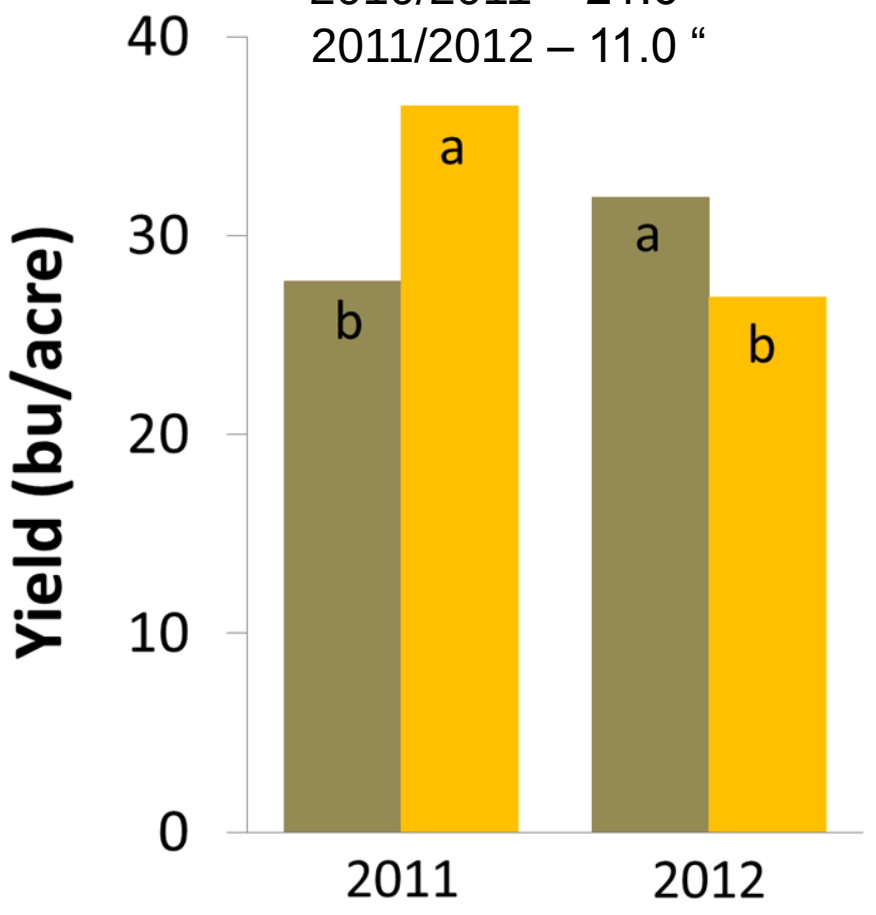


Fertilizer Fact 62, Moccasin, MT

Effect of N application timing on winter wheat grain protein and yield



Oct through Sept precipitation
2010/2011 – 21.6 “
2011/2012 – 11.0 “



Fertilizer Fact 62, Moccasin, MT

Take home messages of Moccasin Study

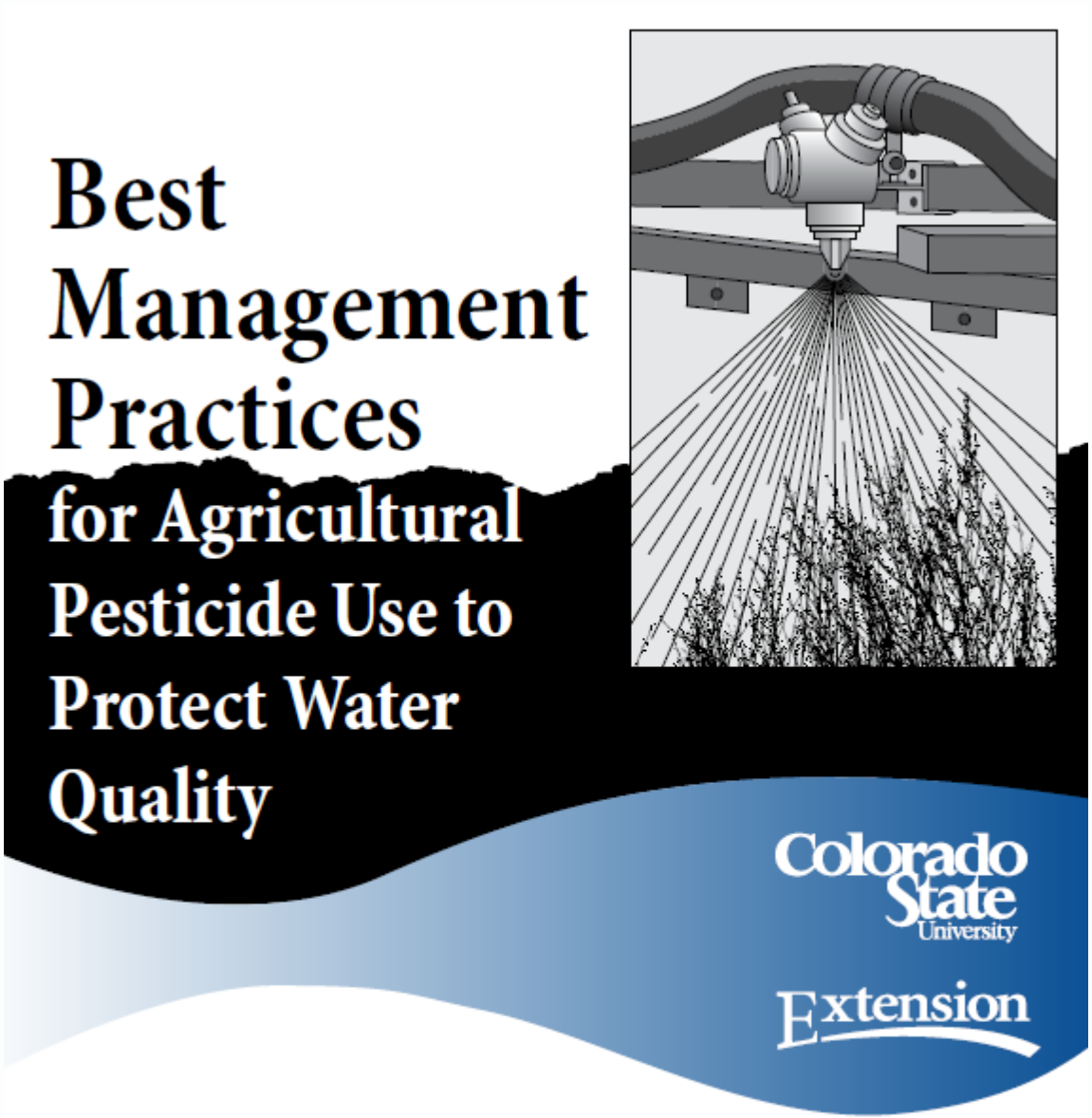
- In wet year, enhanced efficiency fertilizers produced similar or higher yields and protein as conventional urea
- In wet year, spring application greatly increased yield and protein compared to fall application
- In dry year, yields and protein were similar for EEFs and conventional urea (data not shown)
- In dry year, the reverse was true

Practices to decrease pesticide leaching

- If have options, select pesticides with low leaching potential especially on shallow or coarse soils.
- Examples:

Pesticide name	Pesticide Leaching Potential
Roundup (glyphosate)	Very low
Prowl (pendimethalin)	Low
2,4-D	Intermediate
Tordon (picloram)	High

- Can use NRCS pesticide screening tool (WIN-PST) or CSU's Bulletin #XCM-177



http://www.ext.colostate.edu/pubs/crops/xcm177.pdf

Conclusions

- Minimizing runoff and erosion from fields should decrease sediment, N, and P entering surface water
- Spring application of N, split applications, recropping, and rotating with deep rooted crops should decrease N leaching
- Enhanced efficiency fertilizers may or may not decrease N losses, and increase yield/protein, depending on climate and soil characteristics
- Pesticide leaching is less of an issue than nitrate issue but can be managed through pesticide selection

Additional info at:

http://landresources.montana.edu/soilfertility

Practices to Increase Wheat Grain Protein (bulletin)
Ammonia Volatilization (2 bulletins coming soon)
Other soil fertility publications
Go to “Extension Publications”

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

Ammonia volatilization taped presentation:
Go to “Ammonia Volatilization”

This presentation: Go to “Presentations”

QUESTIONS?