Nutrient Management for Hay Production and Quality

by Clain Jones, Extension Soil Fertility Specialist
clainj@montana.edu; 406 994-6076

http://landresources.montana.edu/soilfertility

Sweet Grass County Forage Program

January 30, 2012

Goals

1. To review use of Fertilizer Guidelines to determine N and P rates on forages.
2. To present yield and economic responses of hay to N and P fertilizer
3. To provide an update on new fertilizer products that could benefit forage producers
4. To illustrate some benefits of potassium and sulfur on forages

Estimated pounds of nutrients removed by a ton of alfalfa or grass hay

	N	P_2O_5	K_2O	S
Alfalfa	48	11	53	5.5
Grass	25	10	38	2

(Fertilizer Guidelines for Montana Crops - EB 161)

How much N should be applied to alfalfa-grass stands?

Can use Fertilizer Guidelines for Montana Crops (EB 161)

ALFALFA/GRASS				
Yield Potential (t/a)*	80/20	60/40	40/60	20/80
	———N fertilizer (lbs/a)———			
1	5	10	15	20
2	10	20	30	40
3	15	30	45	60
4	20	40	60	80
5	25	50	75	100
6	30	60	90	120

Need to divide by fraction of N in fertilizer to find total fertilizer need

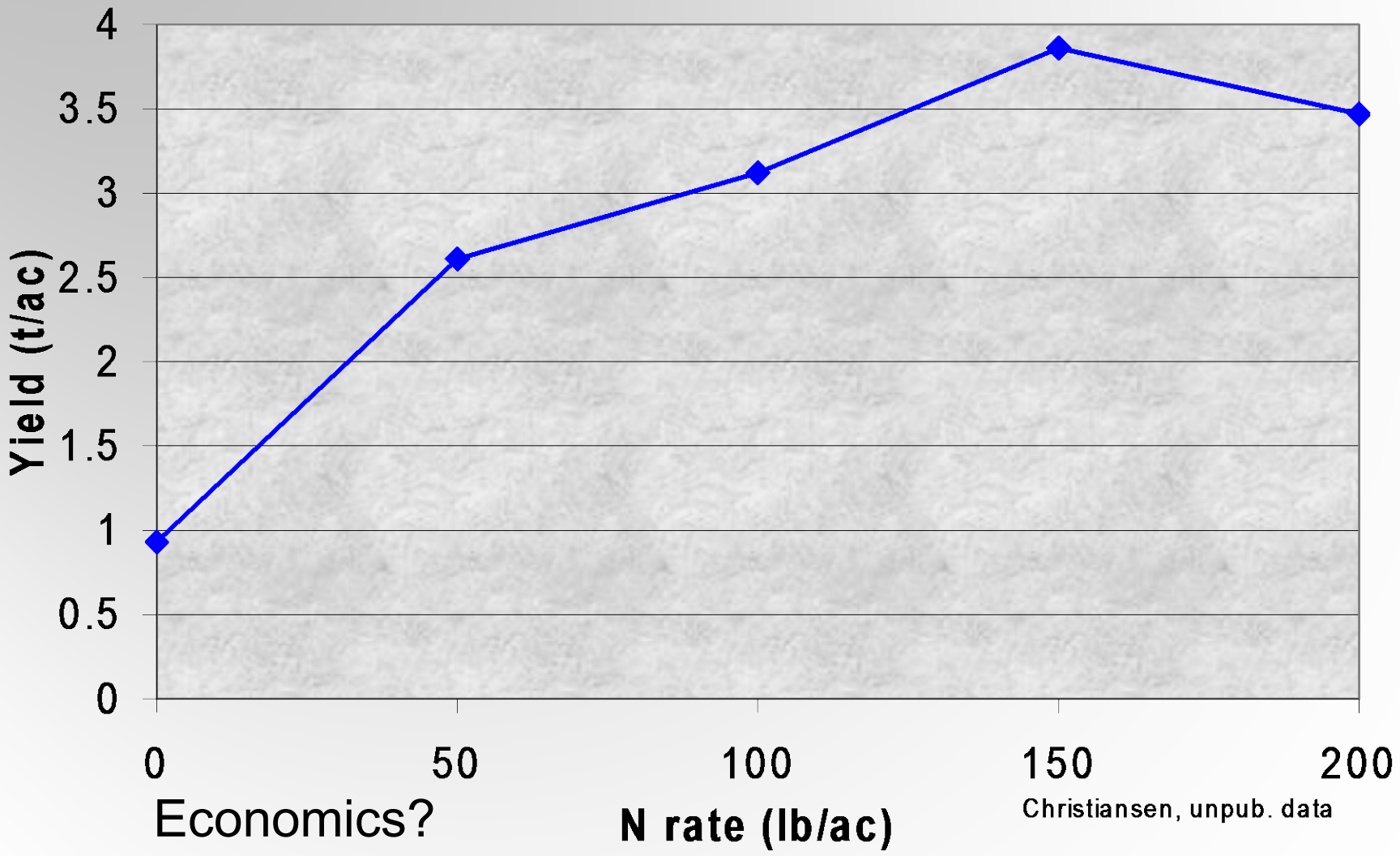
How much N should be applied to grass?

Fertilizer Guidelines for Montana Crops (EB 161):

GRASS	
Yield Potential (t/a) *	Available N (lbs/a) **
1	25
2	50
3	75
4	100
5	125

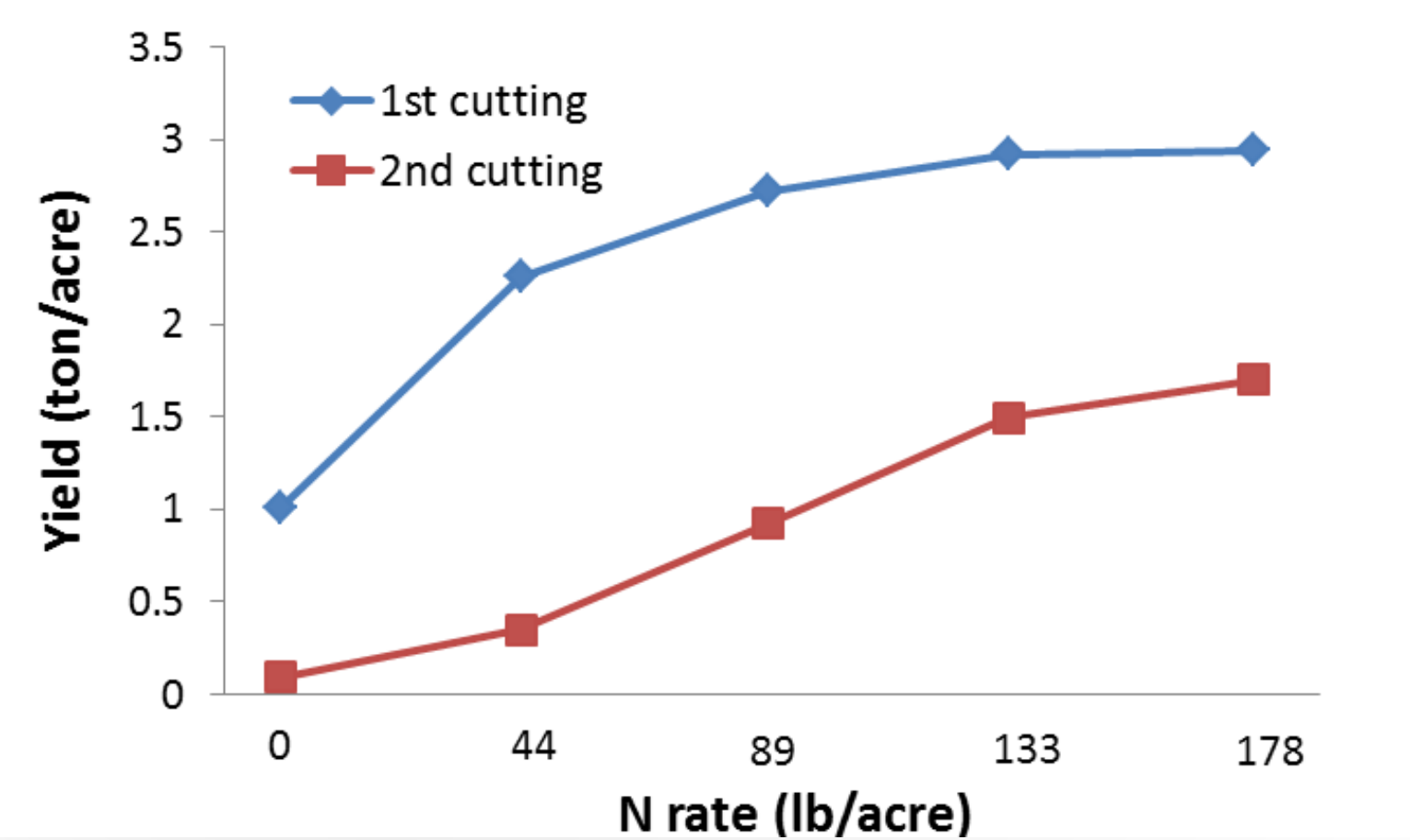
http://www.montana.edu/wwwpb/pubs/eb161.html

Effect of N rate on irrigated Western wheatgrass, Blaine county



Economics?

N for timothy hay yield



On irrigated timothy hay in Alberta (Pfiffner et al. 2007)

N for timothy hay quality

- Both green color and brown leaf ratings improved with N fertilization. 89 to 134 lb N/ac for optimal color in first cutting.
- Digestibility was unaffected by N unless very deficient

Placement

- Granular: On established forage, surface broadcast is essentially only option.
- Liquid (UAN; 32-0-0 or 28-0-0): Surface broadcast including fertigation, surface band, or knifed.

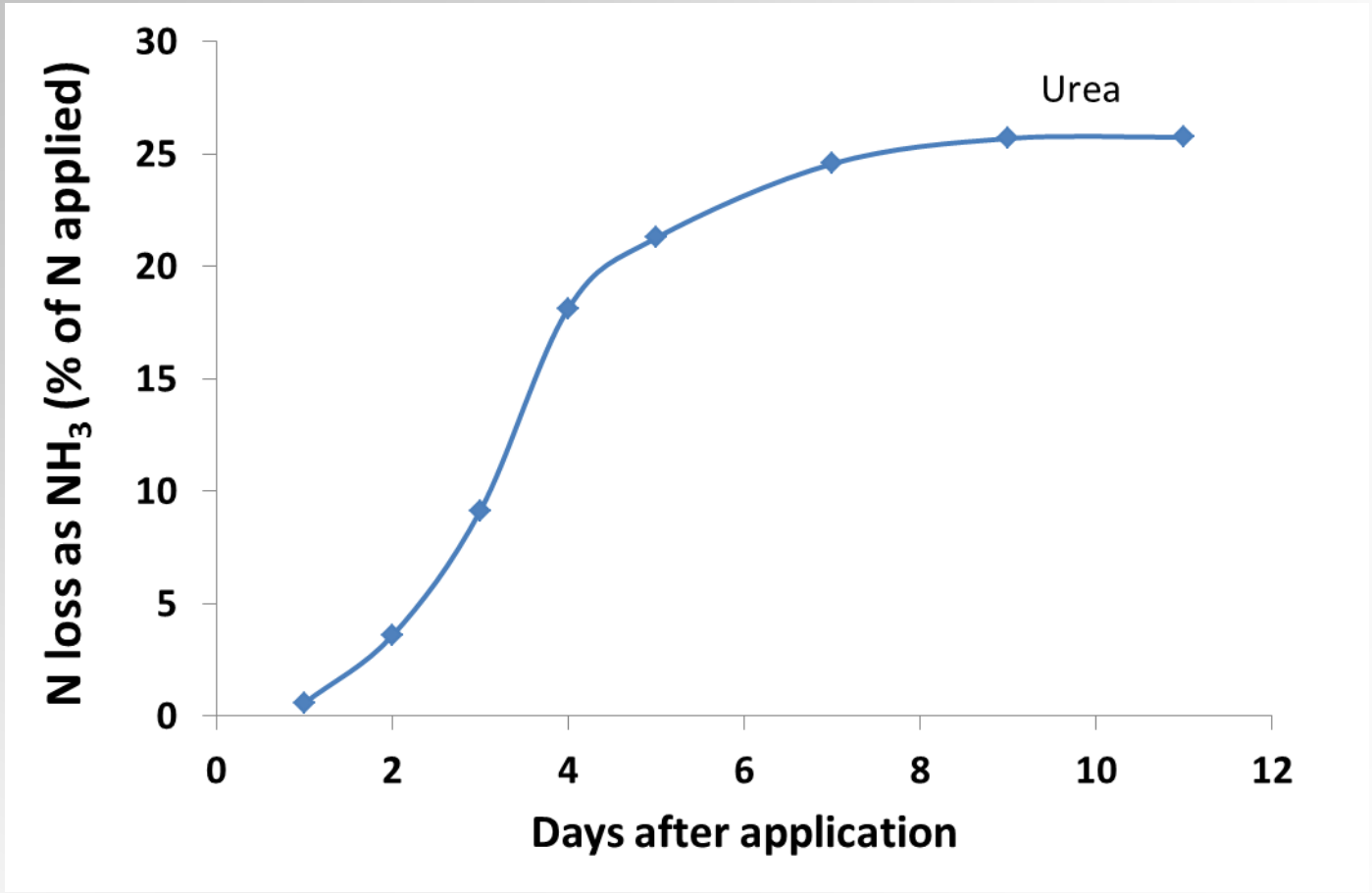
Method	Forage Yield
Broadcast	2.9 t/ac
Knife	2.8 t/ac
Surface Band	3.4 t/ac

N. Central Regional Extension Pub #326, KSU

Timing

- Yield and quality are affected by timing
- Because urea may take days to weeks to become available, urea should be applied earlier than AN historically was for fast green-up (AN simply dissolves, urea requires a chemical reaction to become available).

Volatilization losses

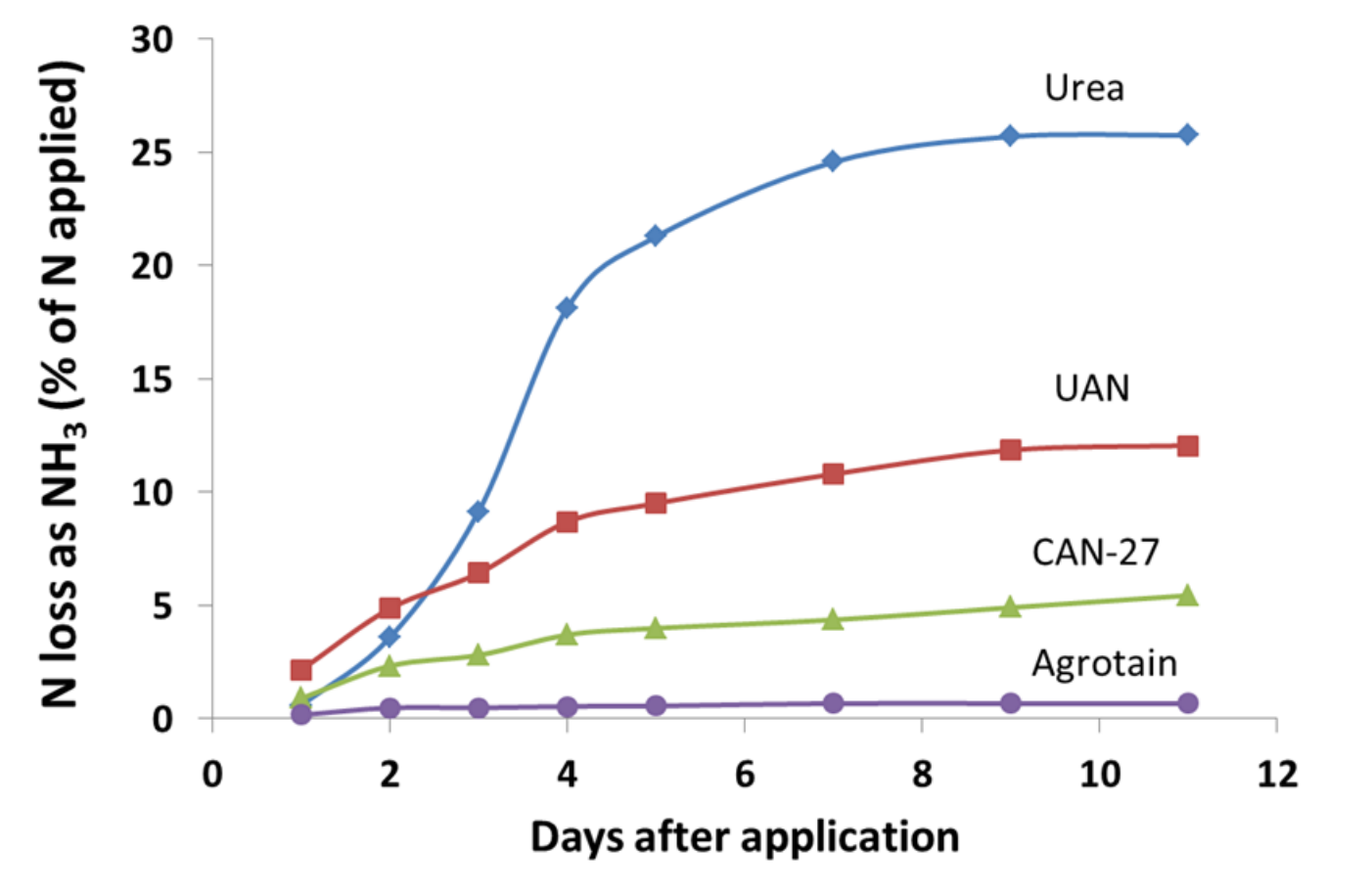


Applied to grass sod, avg. air temp 50 °F (Horneck and Holcomb)

Enhanced Efficiency Fertilizers (EEFs) and forage production

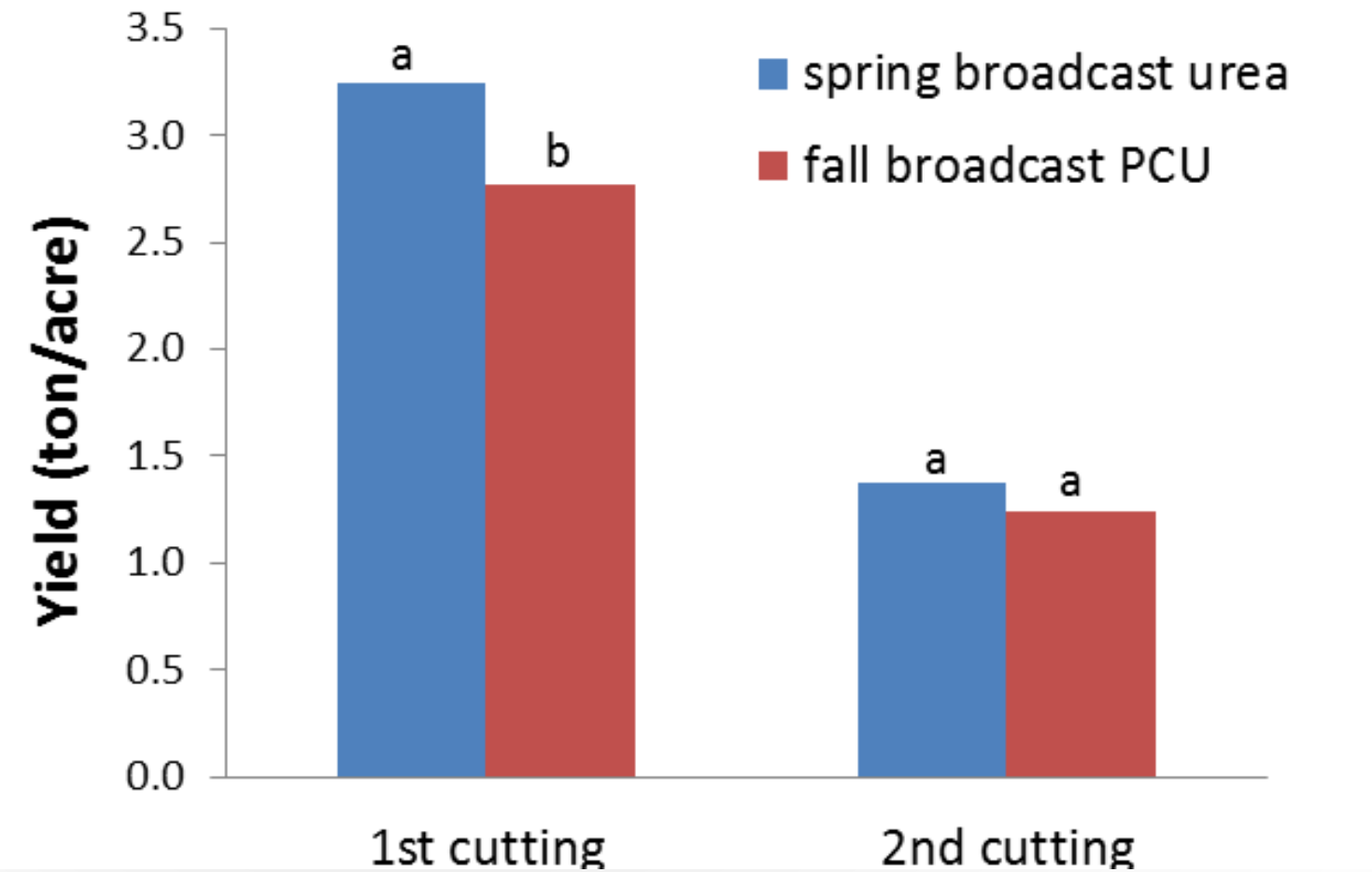
- Forage production lacks incorporation, and plant residue intercepts fertilizer, increases volatilization, and microbes can tie up N
- EEFs retain N on site by reducing loss to volatilization, leaching and N-gas
  - Stabilize or inhibit soil processes to extend N availability (NSN®), reduce urea conversion to ammonia (Agrotain®: urease inhibitor ~ 14 days) or ammonium to nitrate (DCD)
  - Slow release of urea through a coating (polymer coated – PCU such as ESN®, sulfur coated - SCU)
  - Calcium ammonium nitrate (CAN) isn't enhanced but isn't explosive either (like ammonium nitrate)

Effect of N source on volatilization losses



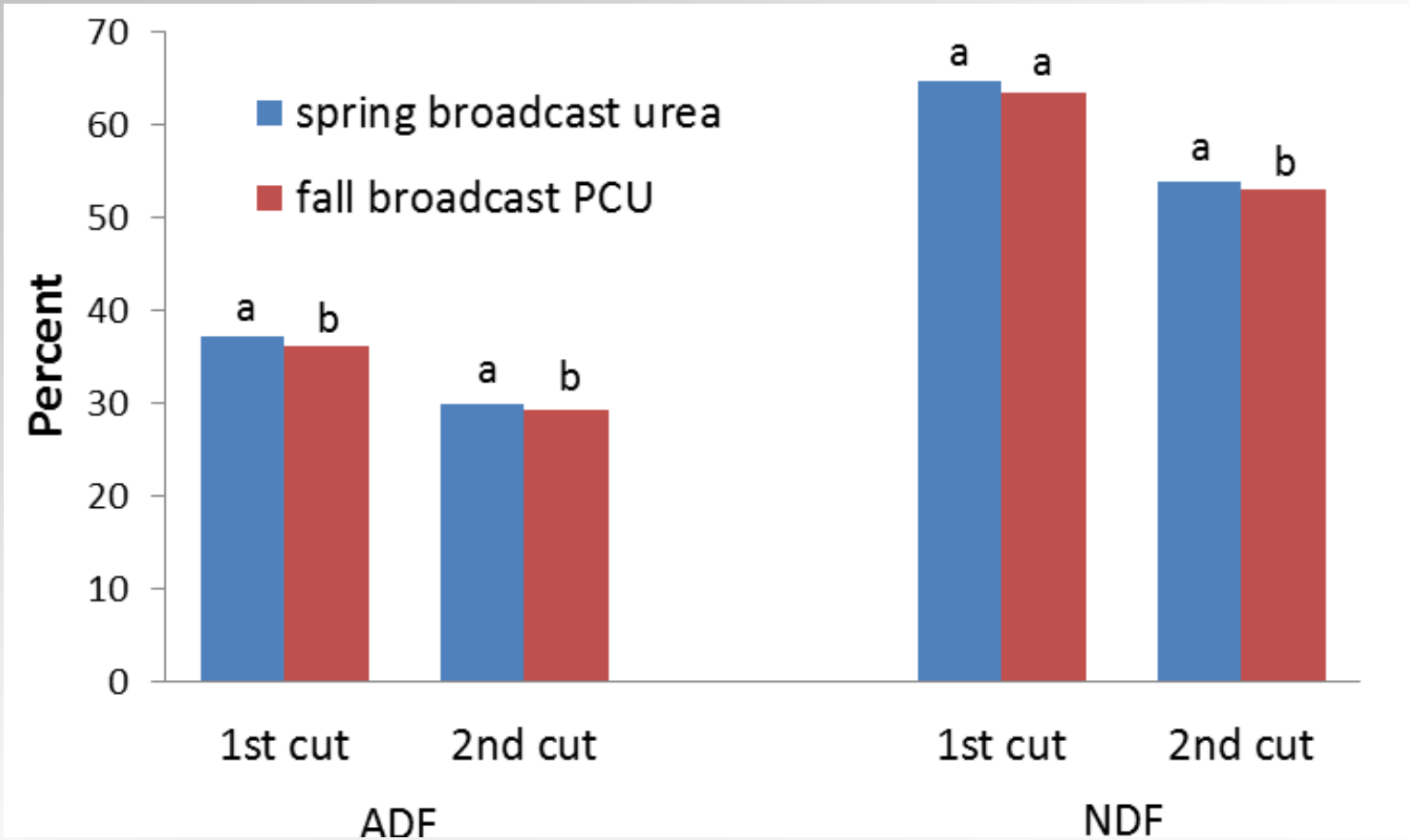
Applied to grass sod, avg. air temp 50 °F (Horneck and Holcomb)

PCU on timothy yield



PCU may be too slow release for early cuttings. (Pfiffner et al. 2007)

PCU on timothy quality



Protein was not affected by fertilizer type

Pfiffner et al. 2007

Nitrogen EEF and forage production

- Environmentally responsible but more $

- Conservation Stewardship Program incentive

Enhanced Efficiency Fertilizers (EB0188)
http://landresources.montana.edu/soilfertility

QUESTIONS?

Phosphorus (P)

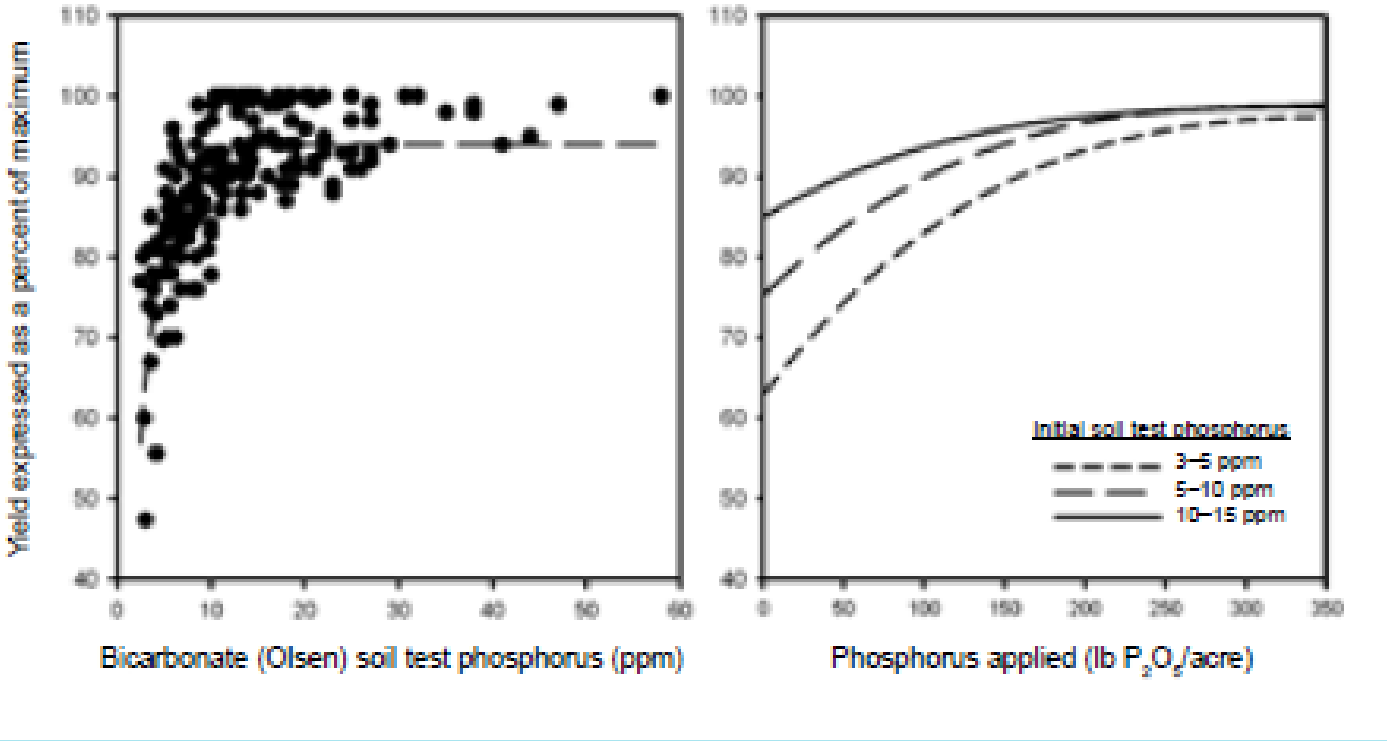
Why often deficient in Montana soils?

Binds with calcium to form poorly soluble calcium phosphate minerals

Advantages of phosphorus (and potassium, sulfur) fertilization on alfalfa-grass stand?

- Helps with N fixation in nodules
- Favors alfalfa over grass
- P improves alfalfa regrowth and recovery after cutting (IPNI)

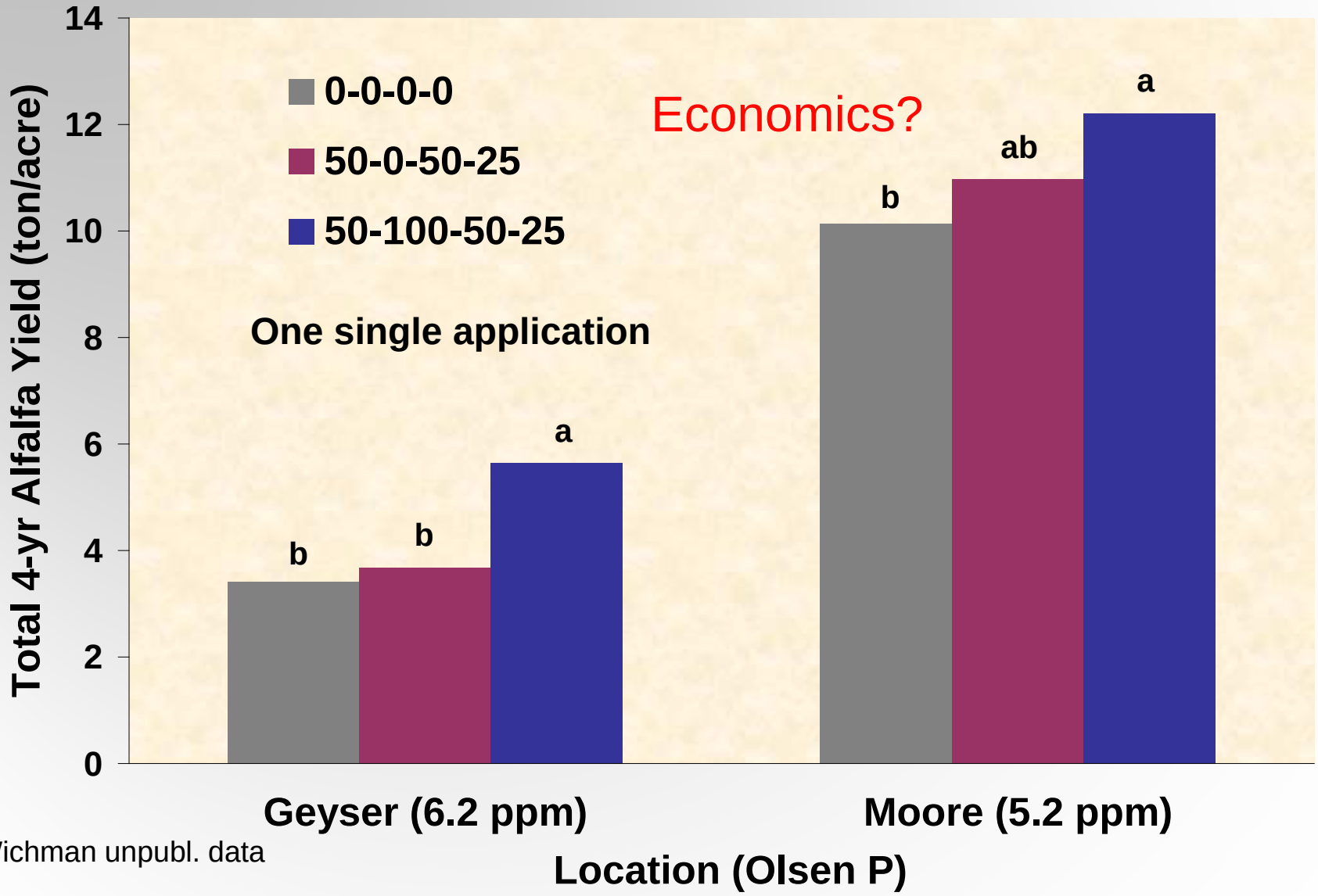
Alfalfa yield relative to soil P and P applied



Data from Koenig et al. 1999

PNW bulletin 611

Single P application increases alfalfa yield for several years

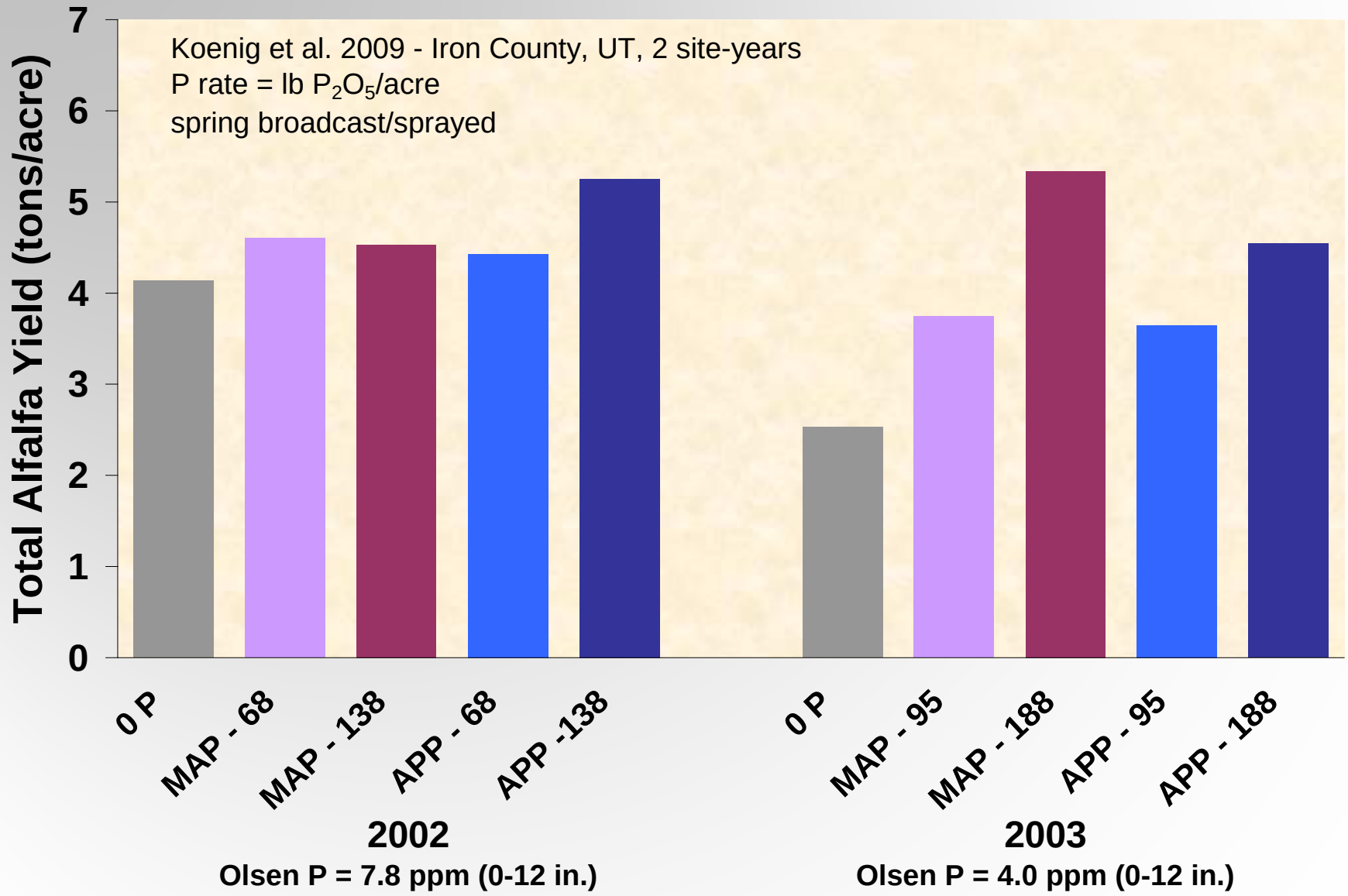


Wichman unpubl. data

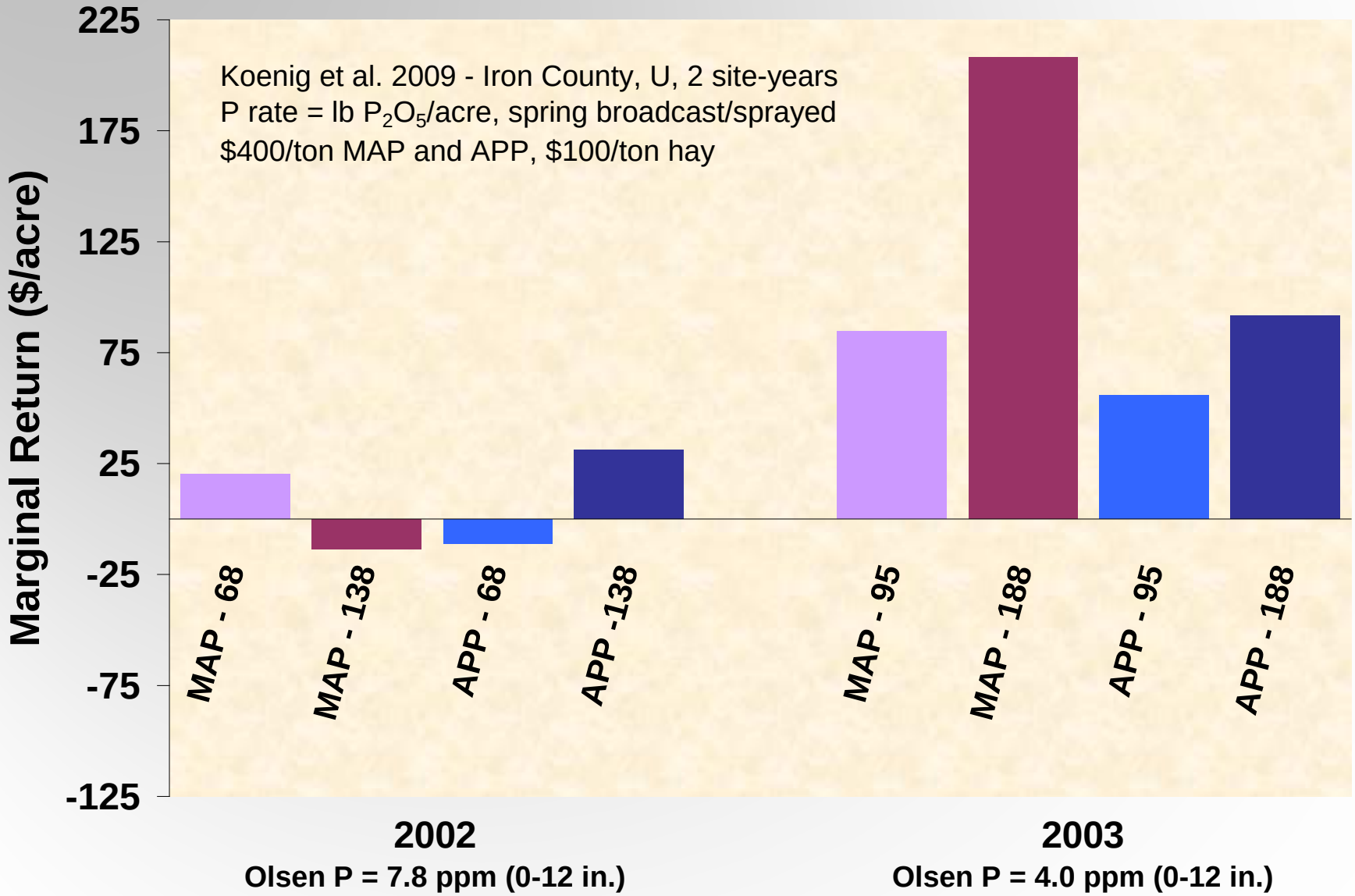
P fertilization strategy

- At $80/ton hay and $0.40/lb P, net revenue of P fertilization = $22/acre/year
- At $80/ton hay and $1.20/lb P, net revenue of P fertilization = $2/acre/year

P rate and source on alfalfa yield



Marginal return on P by rate and source



P rate and source on yield

2002		2003
yes	P > no P	*yes*
no	MAP > APP	*yes*
no	full P > $^1/_2$P	*yes*

What would you do?

@ $400/ton MAP and $100/ton hay

@ $1050/ton MAP and $100/ton hay

Single large or smaller annual applications?

P fertilization for timothy hay

- On irrigated timothy hay in Alberta (Pfiffner et al. 2007)
- If P deficient then yield response equal with 5 annual broadcast applications of 26 lb P_2O_5/ac or single pre-seeding application of 174 lb P_2O_5/ac

QUESTIONS ON NITROGEN OR PHOSPHORUS?

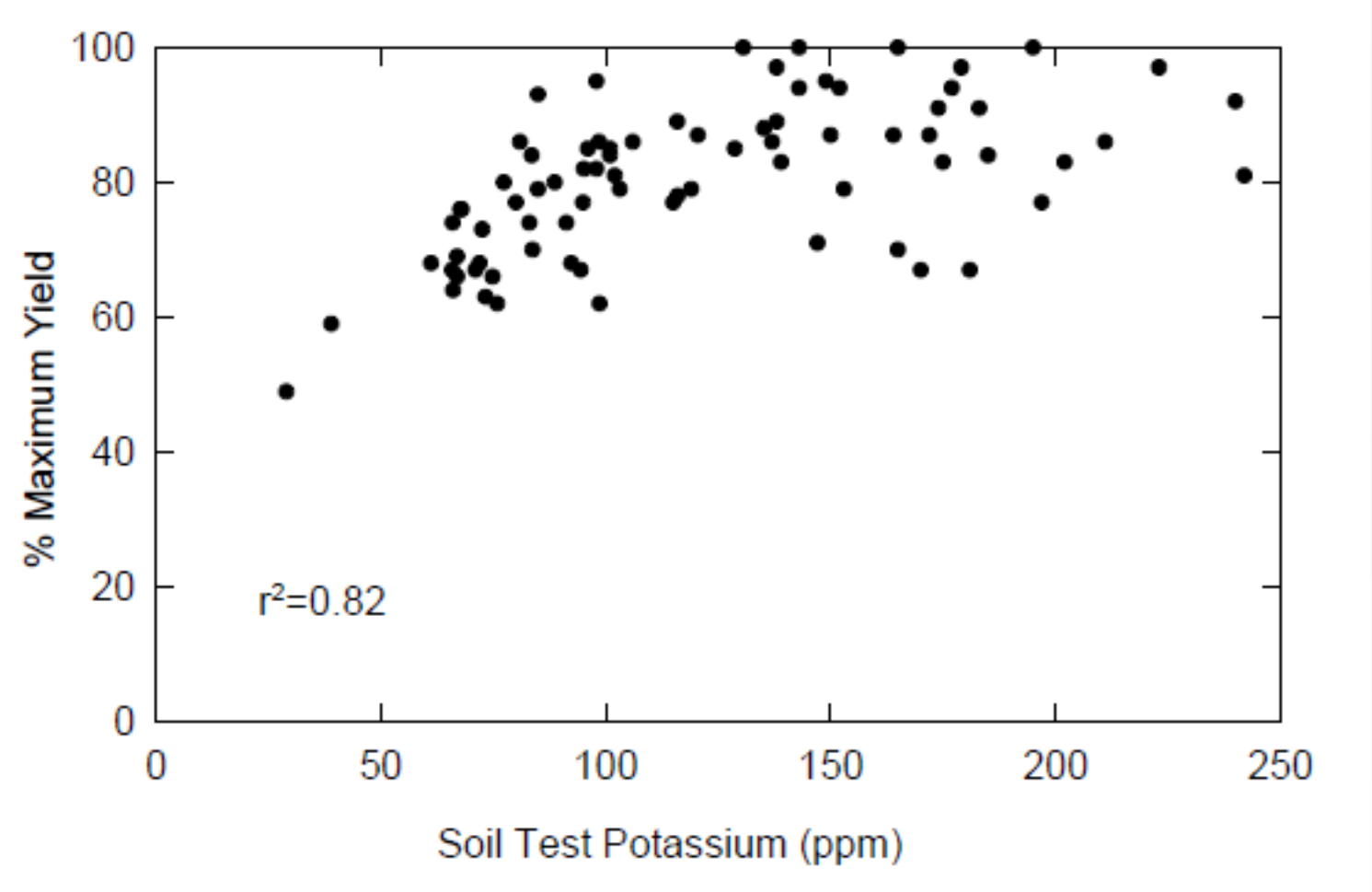
Potassium (K)

Needed in Montana?

- Useful on many soils, even some having high K values (especially in spring due to cool temperatures)
- Improved alfalfa stand persistence, shoots per plant and rhizobia bacteria activity
- Reduces leaf drop of alfalfa
- Improved resistance to plant diseases

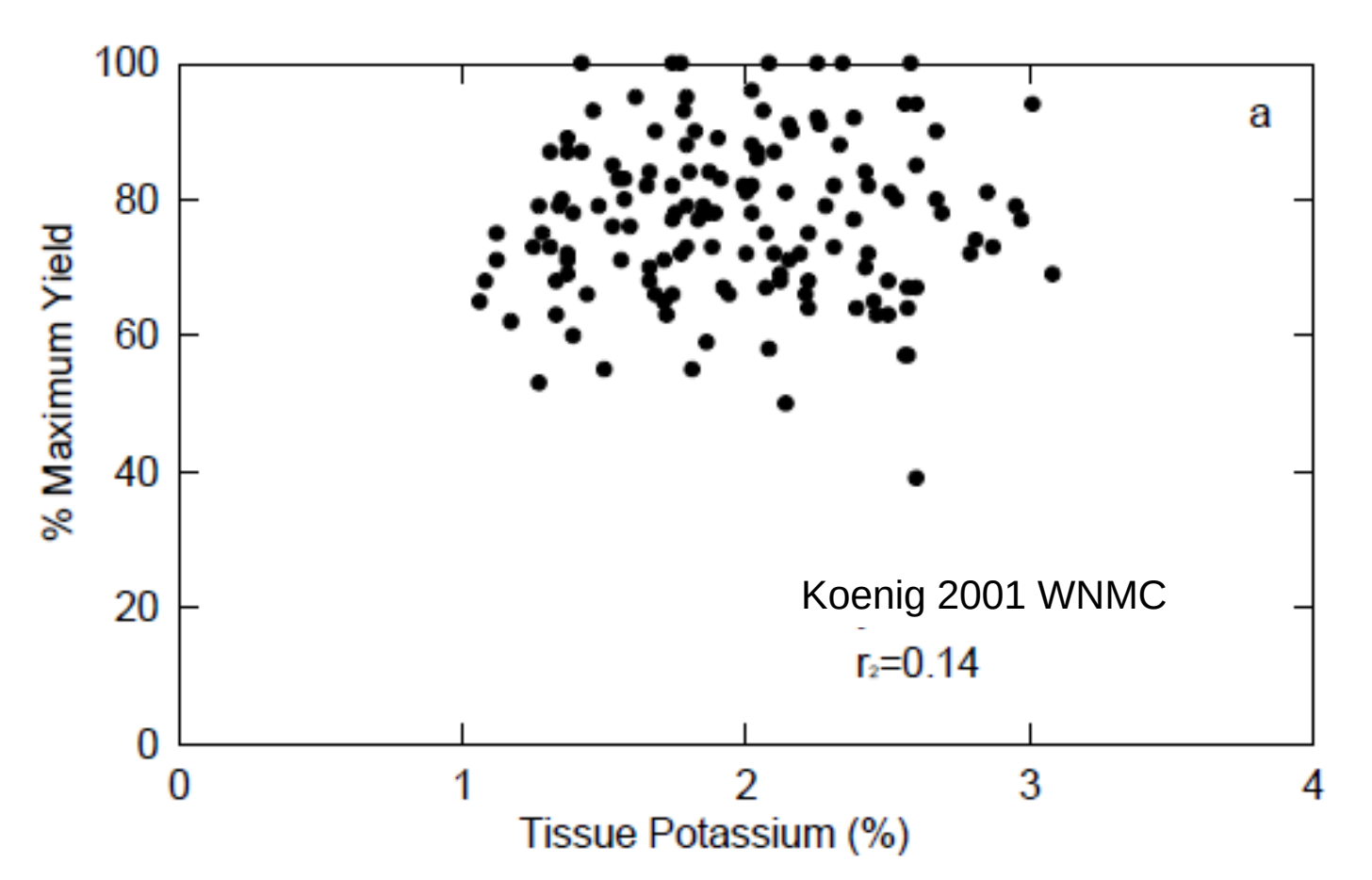
How might lack of K affect an alfalfa-hay field?

Relative alfalfa yield and soil test K



Koenig 2001 WNMC

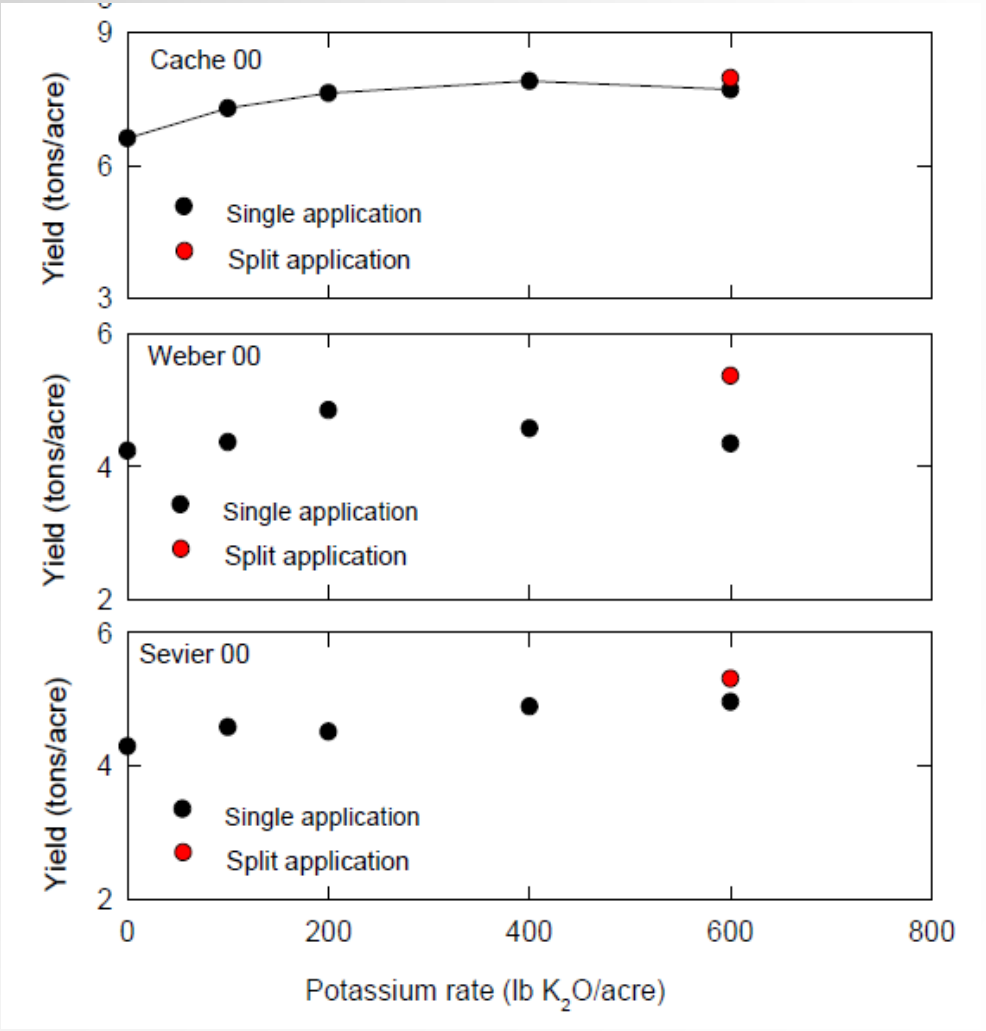
Alfalfa yield relative to tissue K



soil tests appear better indicator than tissue tests

K for alfalfa yield

- K applied in early April with or without additional application after 1st and/or 2nd cuttings
- >400 lb K_2O/acre may cause salt induced yield reduction



Koenig 2001 WNMC

Sulfur (S)

Needed in Montana?

- Useful on sandy, acidic or low organic matter soils, especially in spring due to cool temperatures
- Tissue sampling is more reliable than soil testing. If < 0.22 to 0.25% S in top 6 inches of alfalfa during early bud stage then should get a yield increase with S.

S for alfalfa yield

- In Iowa, alfalfa yield increase with gypsum (calcium sulfate) after first cutting varied by site - 0.3 ton/acre with 12 lb S/ac to 2 ton/acre with 29 lb S/ac

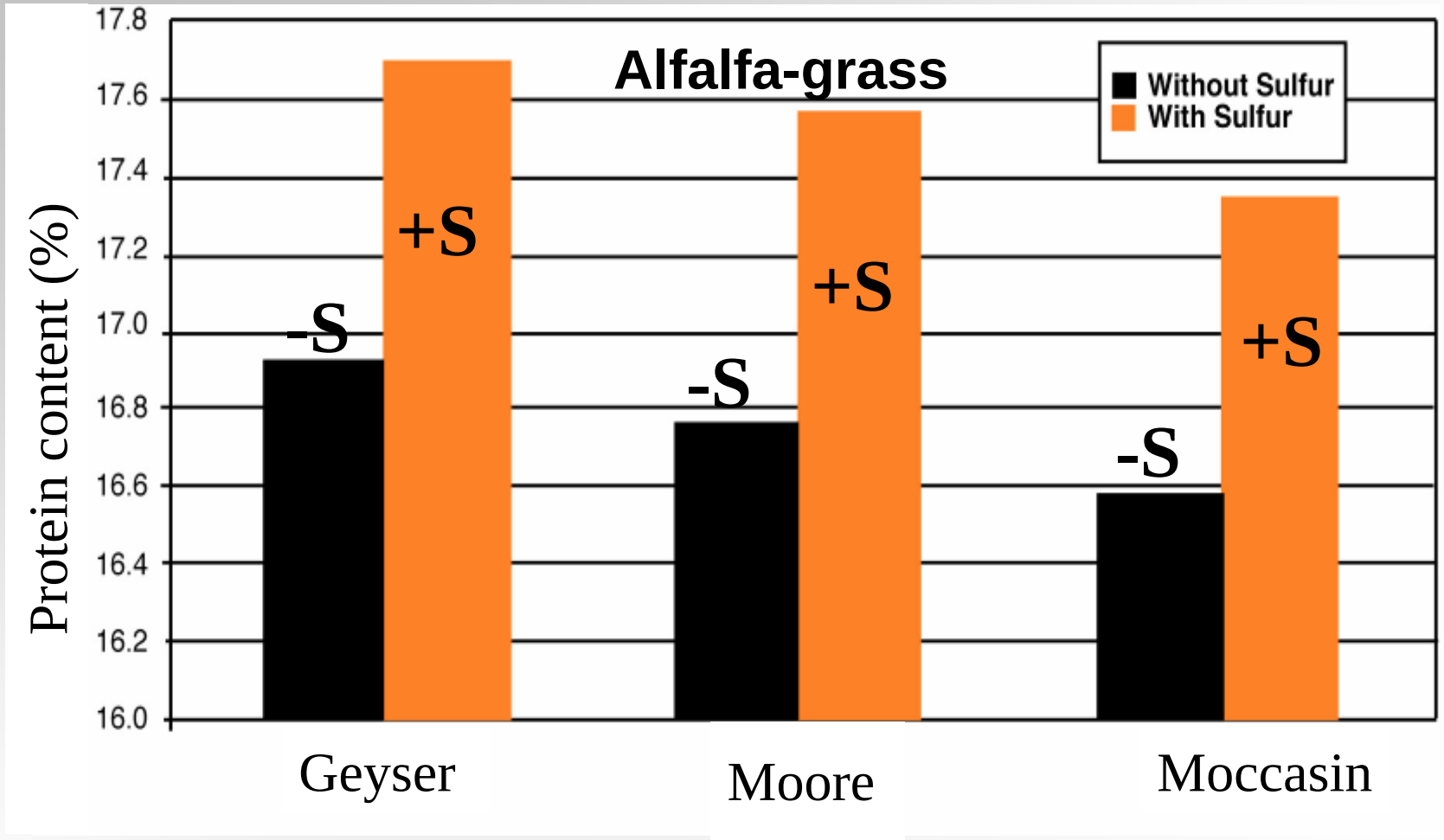
- 40 lb S/acre after 1st cutting, before regrowth, increased 2nd cutting and 1st cutting the following year

S influence on forage quality

- N conversion to protein requires S
- Increased S can lead to increased protein, digestibility and reduced nitrate concentration
- 25 lb S/ac on dryland alfalfa and alfalfa/grass mix increased forage protein 0.8 points

Sulfur (S)

Responses seen in alfalfa-grass fields?



Note: Yield increased 30% at Moccasin (See Fert. Fact 27)

Special considerations for grass fertilization

- If sub-irrigated, fertilize for high yield potential but apply P in fall
- Irrigated/wet meadows apply nutrients in spring
- Do not exceed 60 lb N/acre in the first year
- If N is banded or seed placed do not exceed 10-15 lb N/acre, also for P as ammonium-phosphate

General considerations for forage fertilization

- In dryland consider ‘build up’ of P and K prior to seeding
- Split N generally does not increase total yield
- Late fall/early spring timing for cool season mix (except on sandy soil), mid-May for warm season mix

Advantages of soil testing (even if only occasionally)

- Allows you to optimize fertilizer rates, especially in case where soil nutrient availability has been depleted or is in excess
- Can increase yield and/or save on fertilizer costs

Conclusions

- Nitrogen, phosphorus, potassium, and sulfur can all produce growth responses in Montana forage
- Economic benefits often aren’t realized in the first year (so don’t trust 1 year studies!)
- Soil testing is essential for determining fertilizer needs

Questions?

Additional info at
http://landresources.montana.edu/soilfertility