Nutrient Management of Forages and Legumes

Crop Pest Management School

Bozeman, January 6, 2010

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http://landresources.montana.edu/soilfertility

MONTANA STATE UNIVERSITY EXTENSION

AGRICULTURE

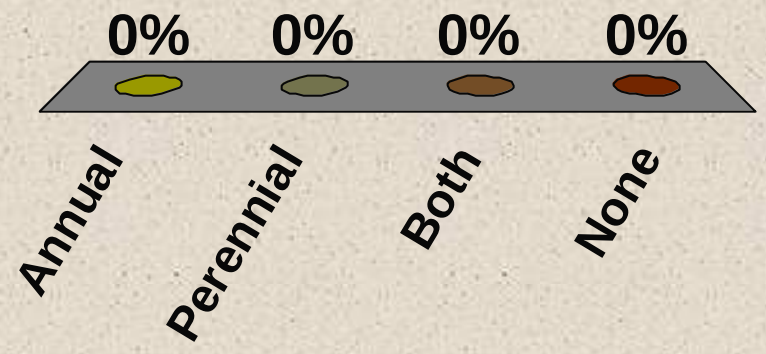
MAKING A DIFFERENCE IN MONTANA COMMUNITIES

Goals

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

Do you or your clients grow forages?

1. Annual forages
2. Perennial forages
3. Both
4. None



1. **0 of 5**

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):

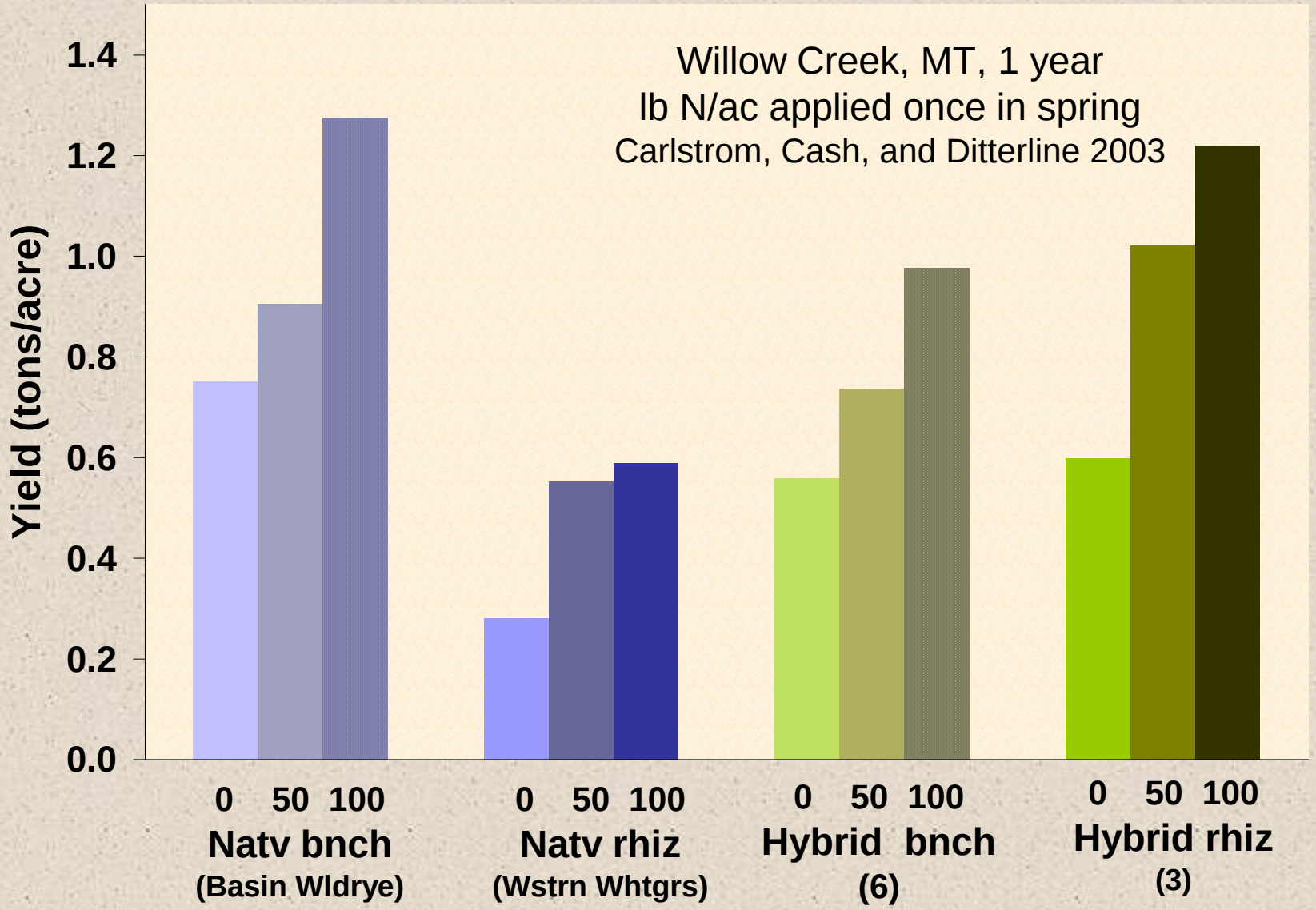
GRASS	
Yield Potential (t/a) *	Available N (lbs/a) **
1	25
2	50
3	75
4	100
5	125

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

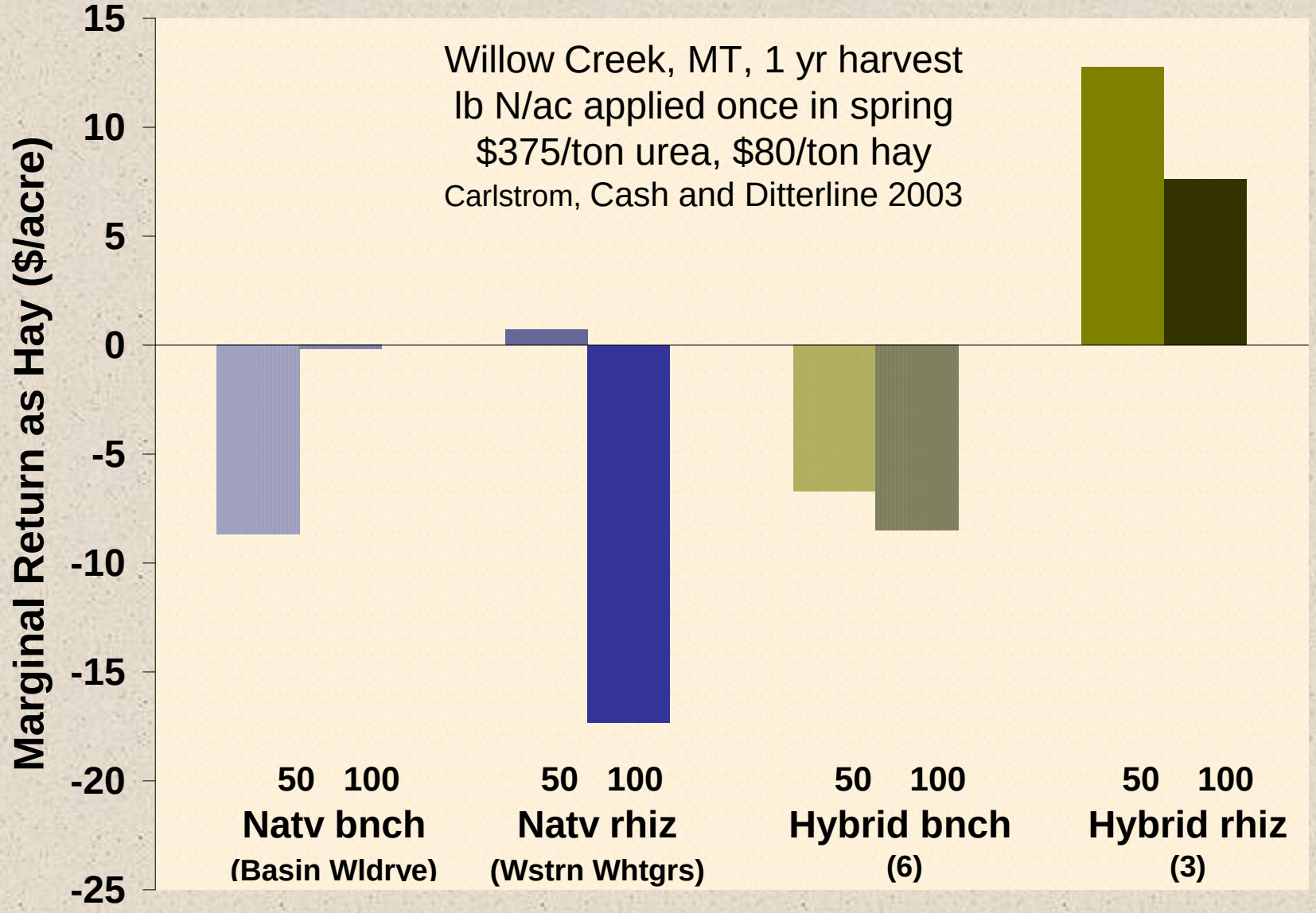
Single N application on dryland grass pasture

- near Willow Creek, MT
- 0, 50, 100 lb N/acre spring broadcast
- harvested once
- dryland grasses
  - **Natv Bnch**: Basin wldrye
  - **Natv Rhizom**: Western whtgrs
  - **Hybrid Bnch**: whtgrs (2), wldrye (4)
  - **Intro Rhizom**: whtgrs (3)

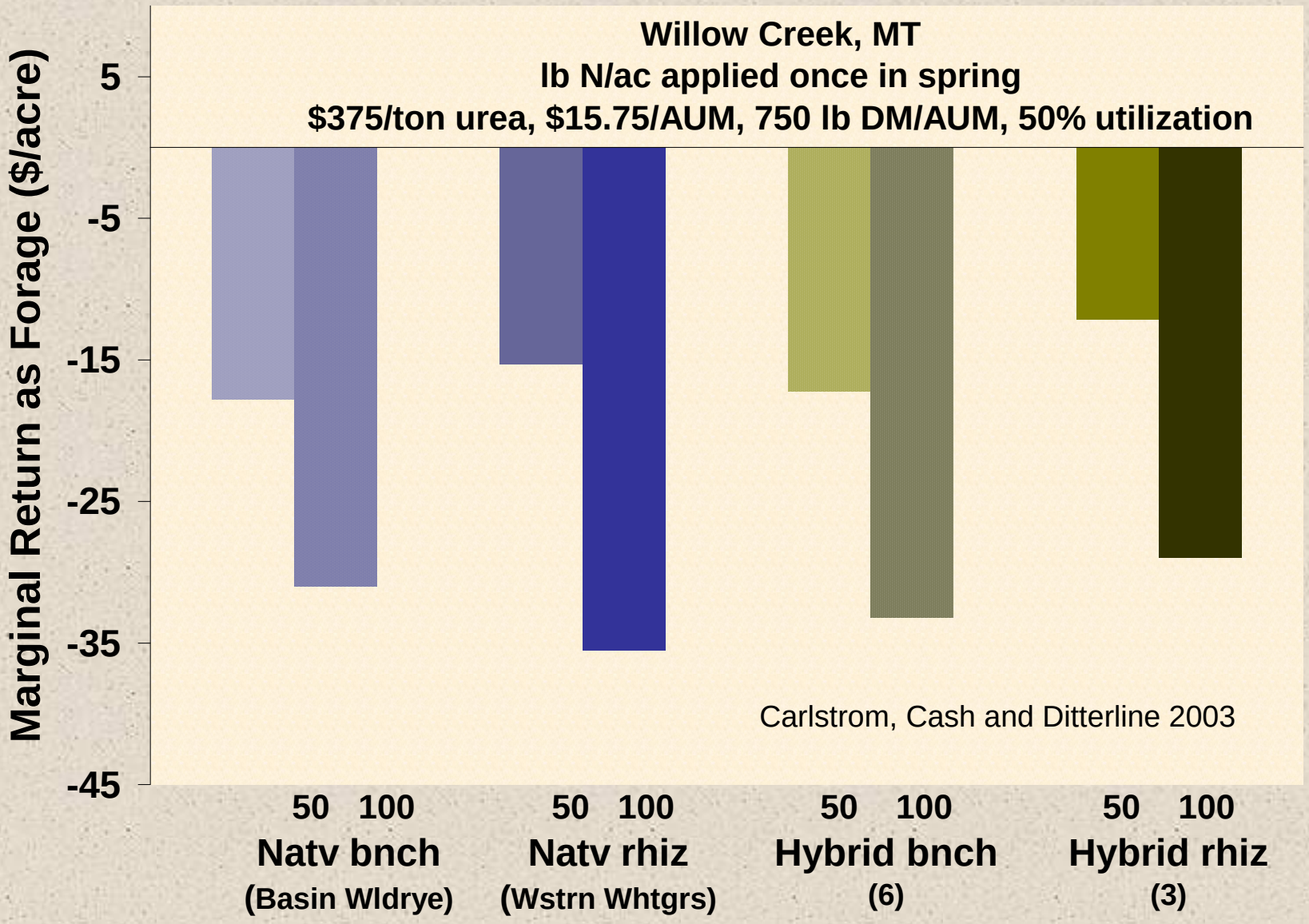
Single N application on dryland grass pasture



First year marginal return as hay



First year marginal return as forage



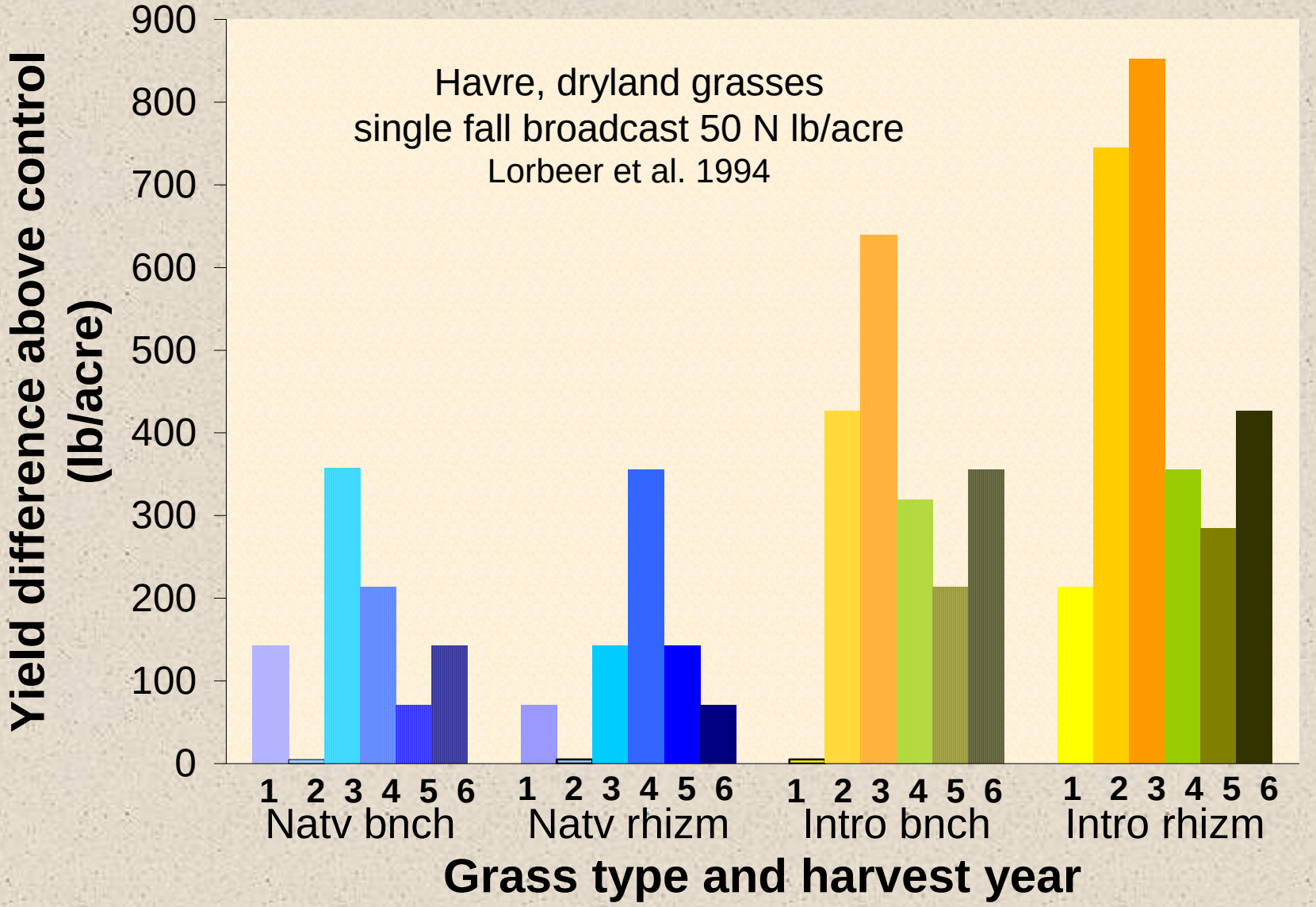
Why would anyone fertilize pasture?

Potential long term effect

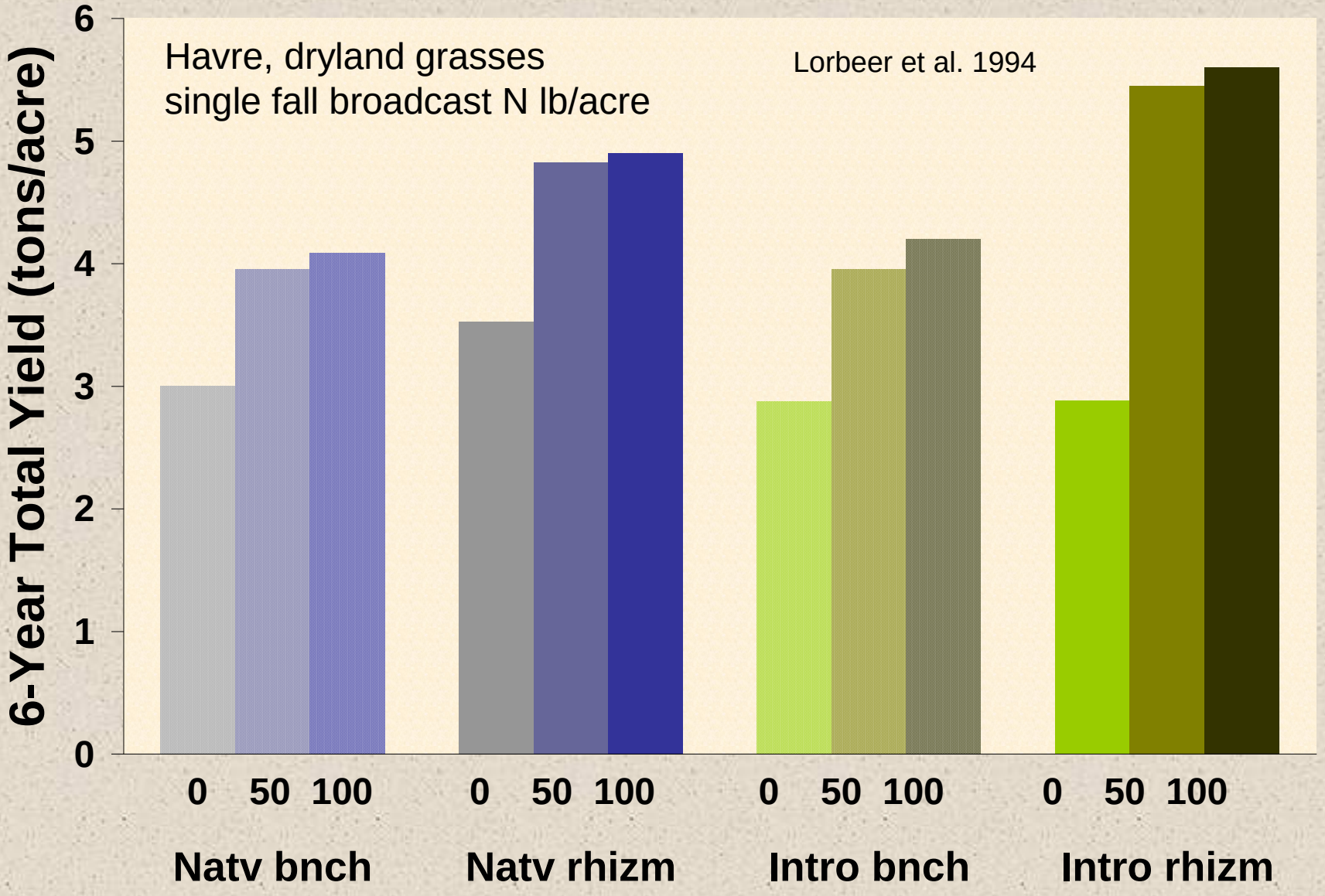
Single N application to dryland grass pasture

- near Havre, MT
- 0, 50 and 100 lb N/acre fall broadcast once
- harvested for 6 years
- dryland grasses
  - **Natv Bnch**: Basin wldrye, Beardless whtgrs, Green needlegrs, Slender whtgrs
  - **Natv Rhizom**: Thickspike whtgrs, Western whtgrs
  - **Intro Bnch**: Crested whtgrs, Russian wldrye, Tall whtgrs
  - **Intro Rhizom**: Pubescent whtgrs, Intermed whtgrs (2)

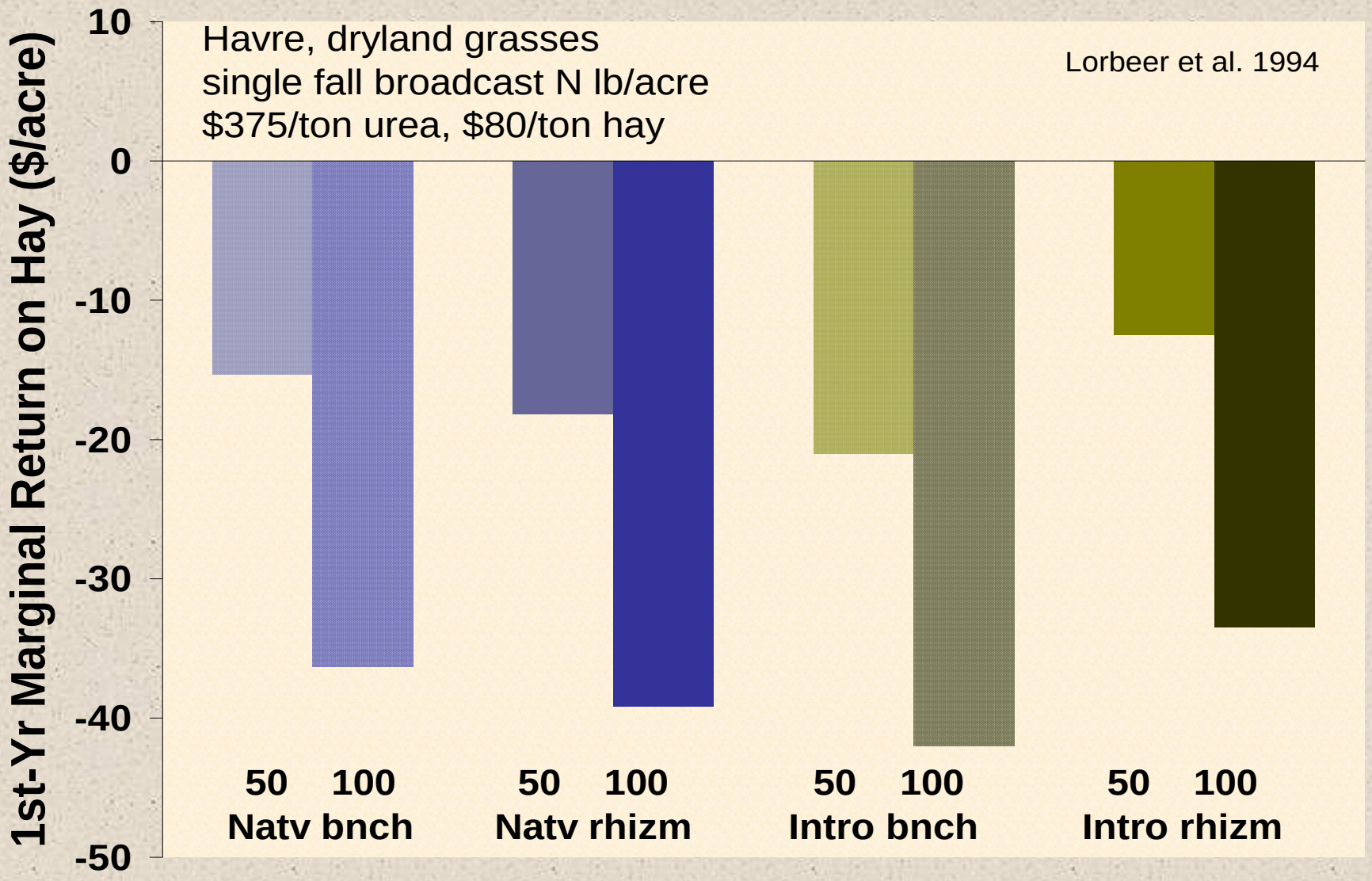
Single 50 lb N application increases yields over control on some grasses for several years



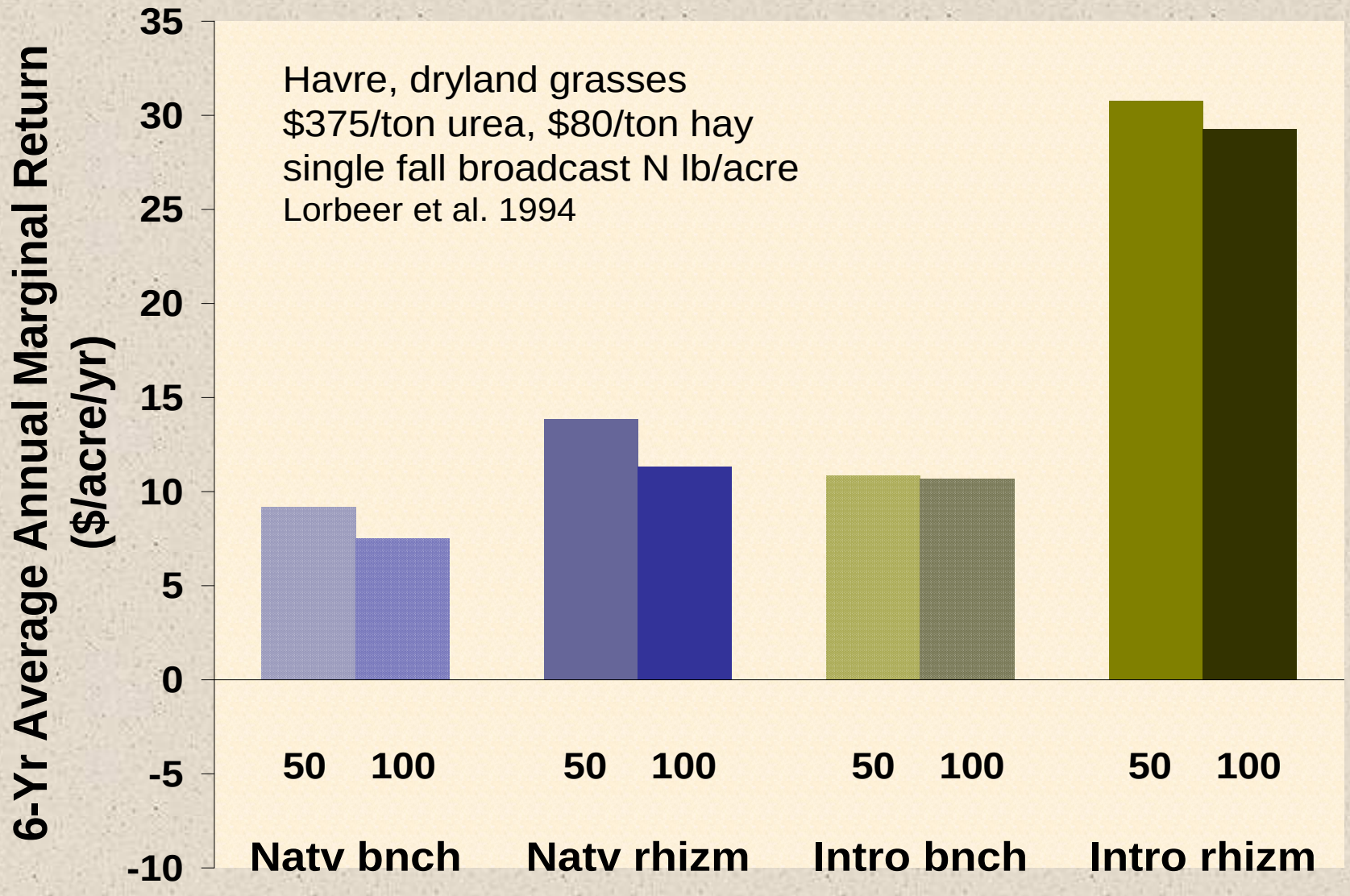
Single N application increases dryland grass yields



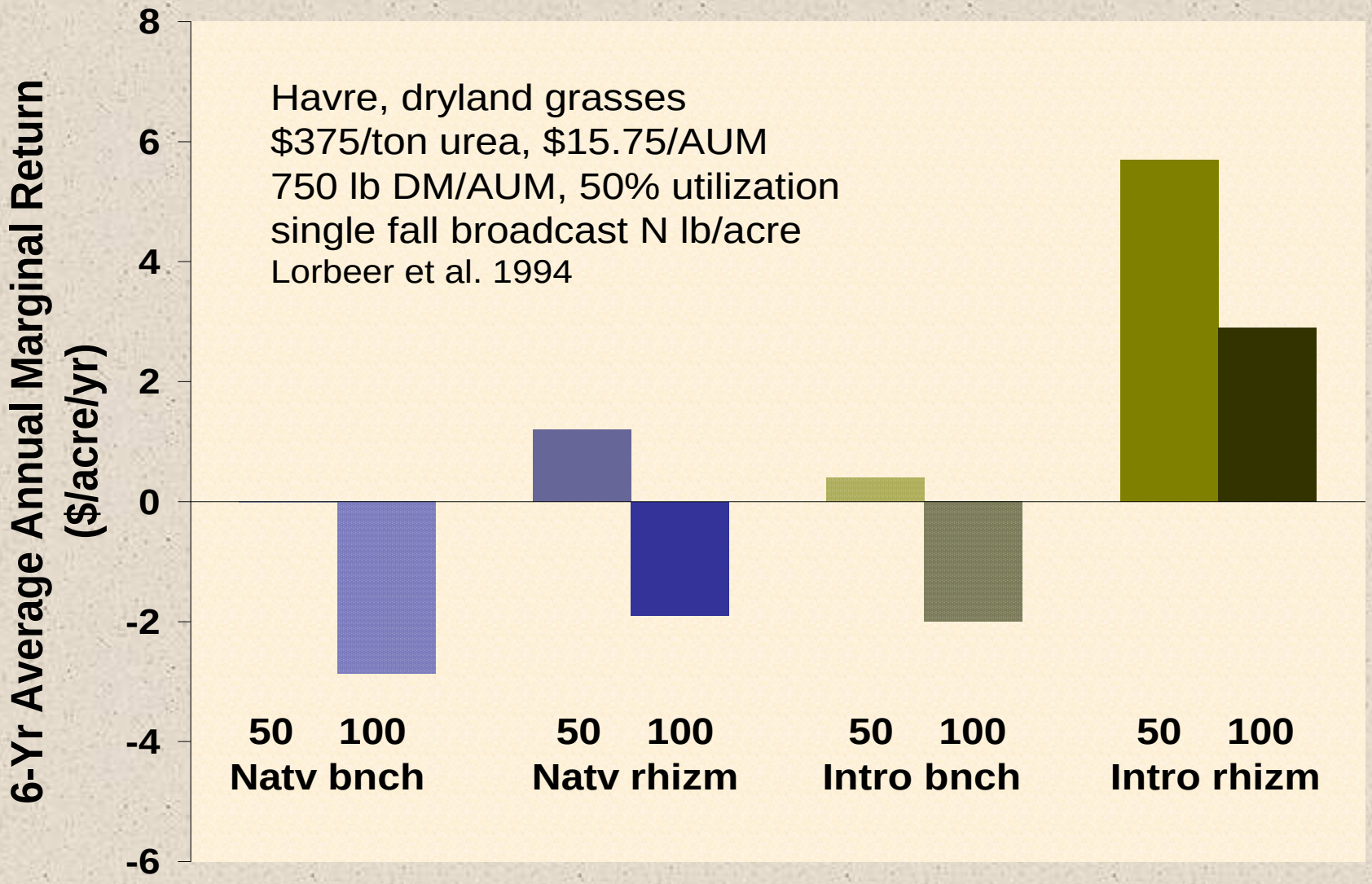
First year marginal return on dryland grass fertilization



6-yr average annual marginal return as hay

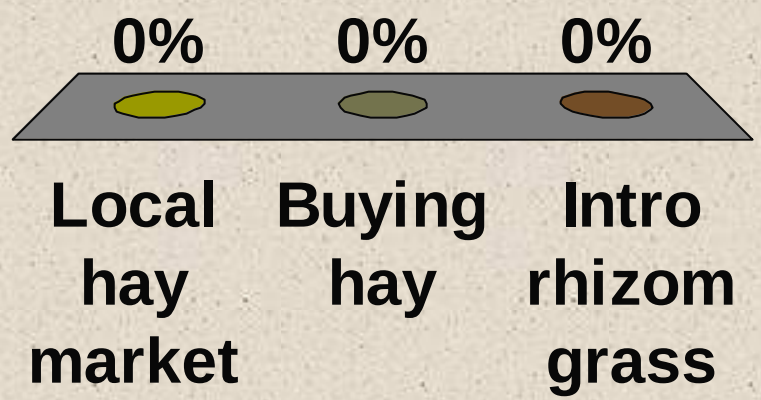


6-yr average annual marginal return on forage



Under what situation would you advise N fertilization?

1. Only if there is a local hay market
2. On any grass if individual is also buying hay
3. Only with introduced rhizomatous species



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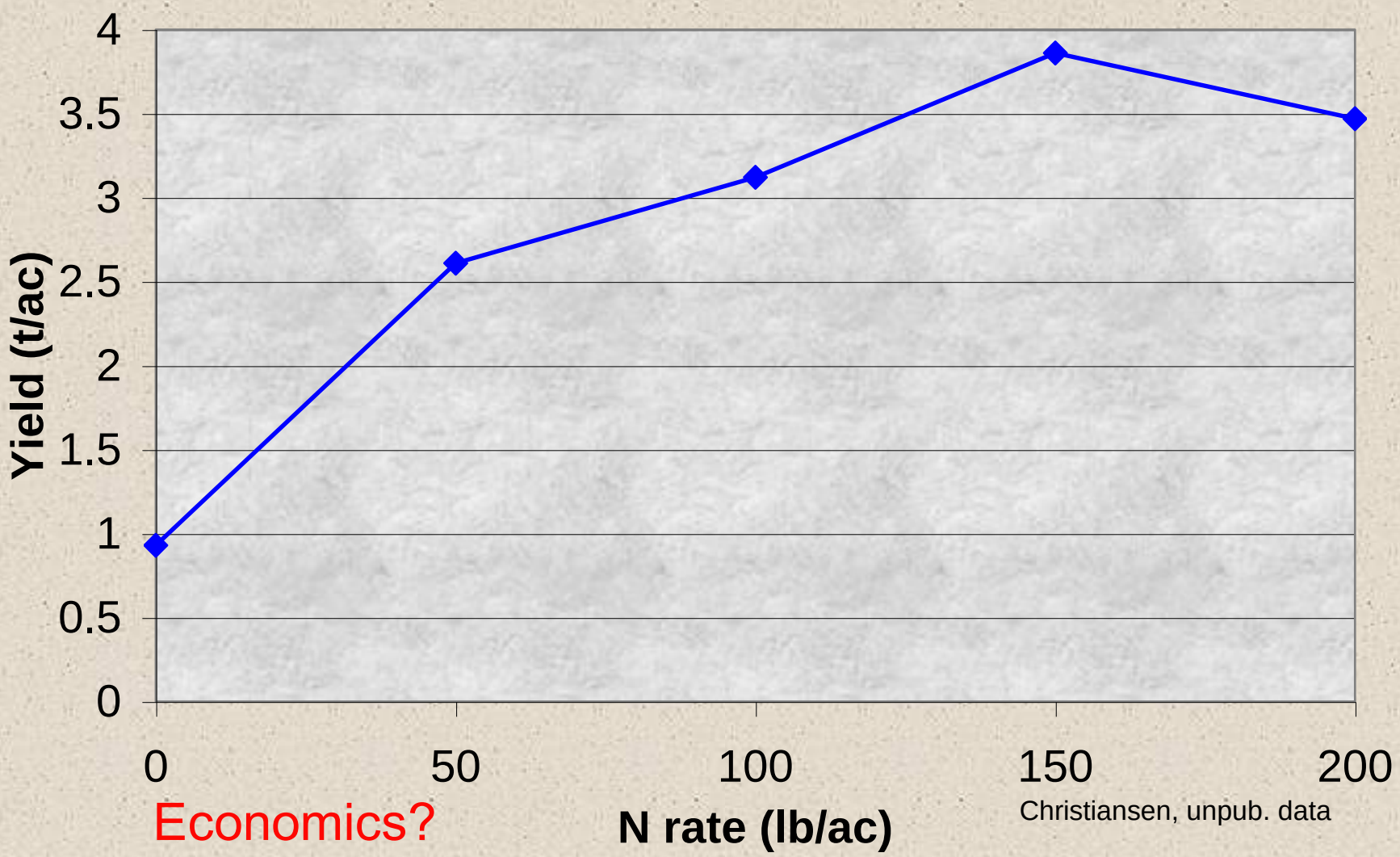
Effect of N Rate on Irrigated Western Wheatgrass, Blaine County



Economics?

Christiansen, unpub. data

QUESTIONS?

Placement

- Granular: On established forage, surface broadcast is essentially only option. Others?
- 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

Foliar application

- Some N can be absorbed through leaves
- However, most foliar applied N ends up being washed off and taken up by roots:
- Only 8-11% of foliar applied liquid urea was taken up by leaves, whereas 37-67% of soil-applied N was taken up by plant in same study (Rawluk et al., 2000).
- Risk of burn? Likely not an issue due to low rates applied (~25 lb N/t). Has anyone seen grass ‘burn’?

Timing

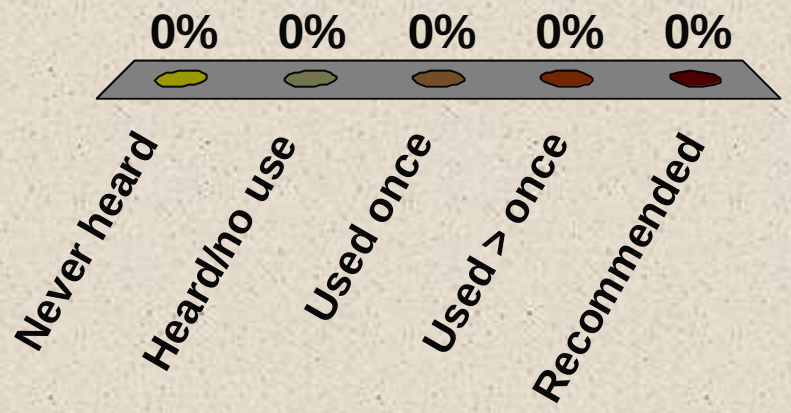
- Yield and quality are affected by timing
- Because urea may take days to weeks to become available, urea should be applied earlier than AN historically was for fast green-up (AN simply dissolves, UR requires a chemical reaction to become available).

Enhanced Efficiency Fertilizers and forage production

- Forage production lacks incorporation, and plant residue intercepts fertilizer, increasing chance for volatilization
- EEFs retain N on site by reducing losses through:
  - Stabilizing or inhibiting soil processes to extend N availability (NSN®) or reduce urea conversion to ammonia (Agrotain®: urease inhibitor – 14 days max) or ammonium to nitrate (DCD)
  - Slow release of urea through a coating (polymer coated – PCU such as ESN®, sulfur coated - SCU)

What is your experience with EEFs?

1. Never heard of them
2. Heard of them but never used
3. Have used once
4. Have used more than once
5. Have recommended their use



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Nitrogen EEF and forage production

- Can increase mid to late season cuttings and protein, and encourage uniform growth through season
- Can be blended with urea to meet goal
  - Large early crop? PCU too slow, but urease inhibitor can help reduce urea loss
  - Season-long forage or a late cutting?

    Delayed release of PCU desirable

EEFs

- Allow application flexibility - e.g. fall broadcast on coarse soil
- Are environmentally responsible but more $
- Are a Conservation Stewardship Program enhancement

Enhanced Efficiency Fertilizers (EB0188)

http://landresources.montana.edu/soilfertility

Go to Fertilizer Information

General considerations for dryland grass N fertilization

- Species response to fertilization varies greatly
- Introduced and hybrid grasses tend to respond more than native grasses
- A single moderate fertilization (50-100 lbs) may increase production for several years
- Equal amounts of total N applied once or annually over several years can yield the same total production

Other considerations for dryland grass N fertilization

- Dryland grass pasture tends to hold N on site and respond during wet years
- Protein and digestibility may improve with N added
- Net economic gain as hay, but most likely not as forage. What does this tell you?

QUESTIONS?

Phosphorus (P)

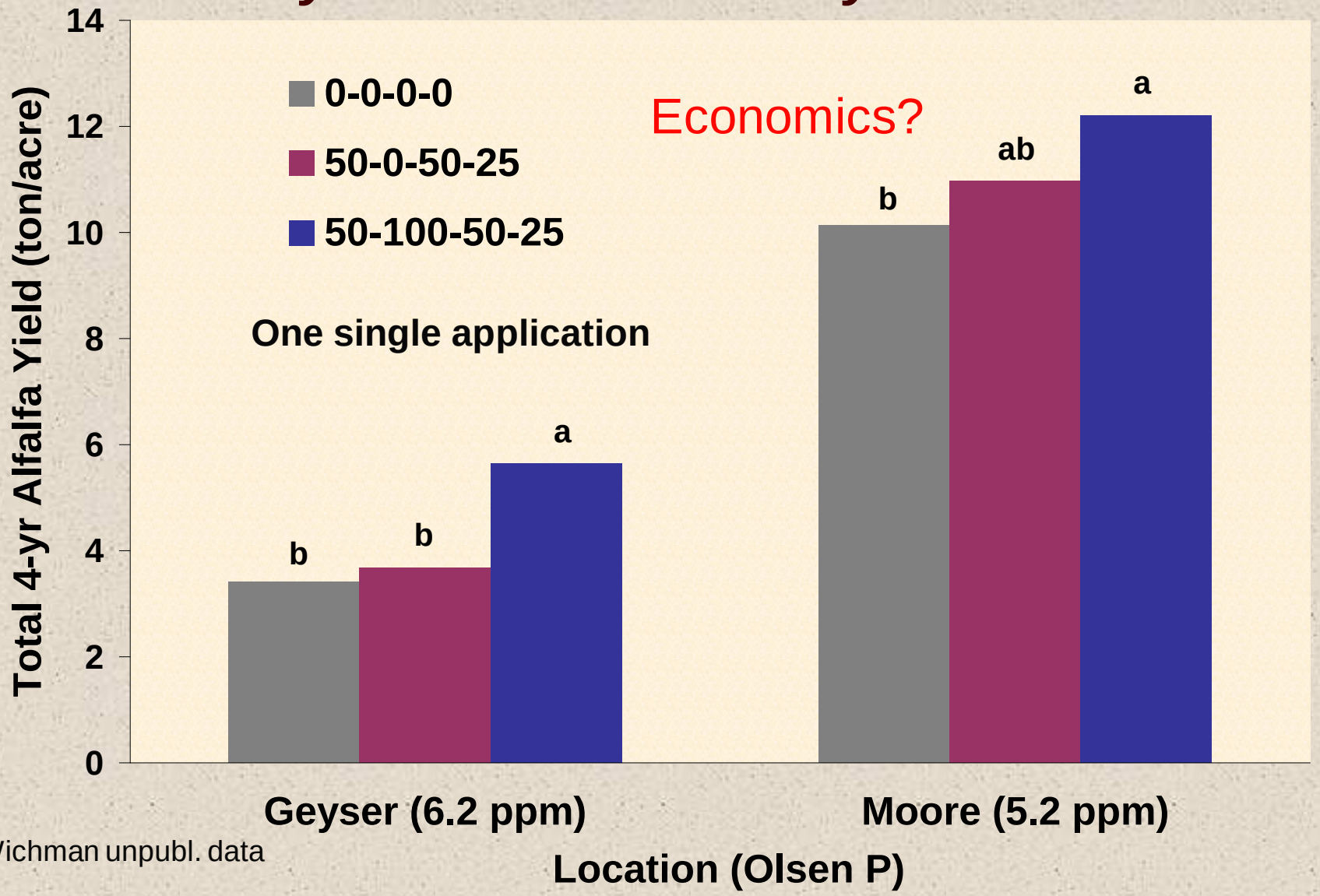
Why often deficient in Montana soils?

- 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

Single P application increases alfalfa yield for several years

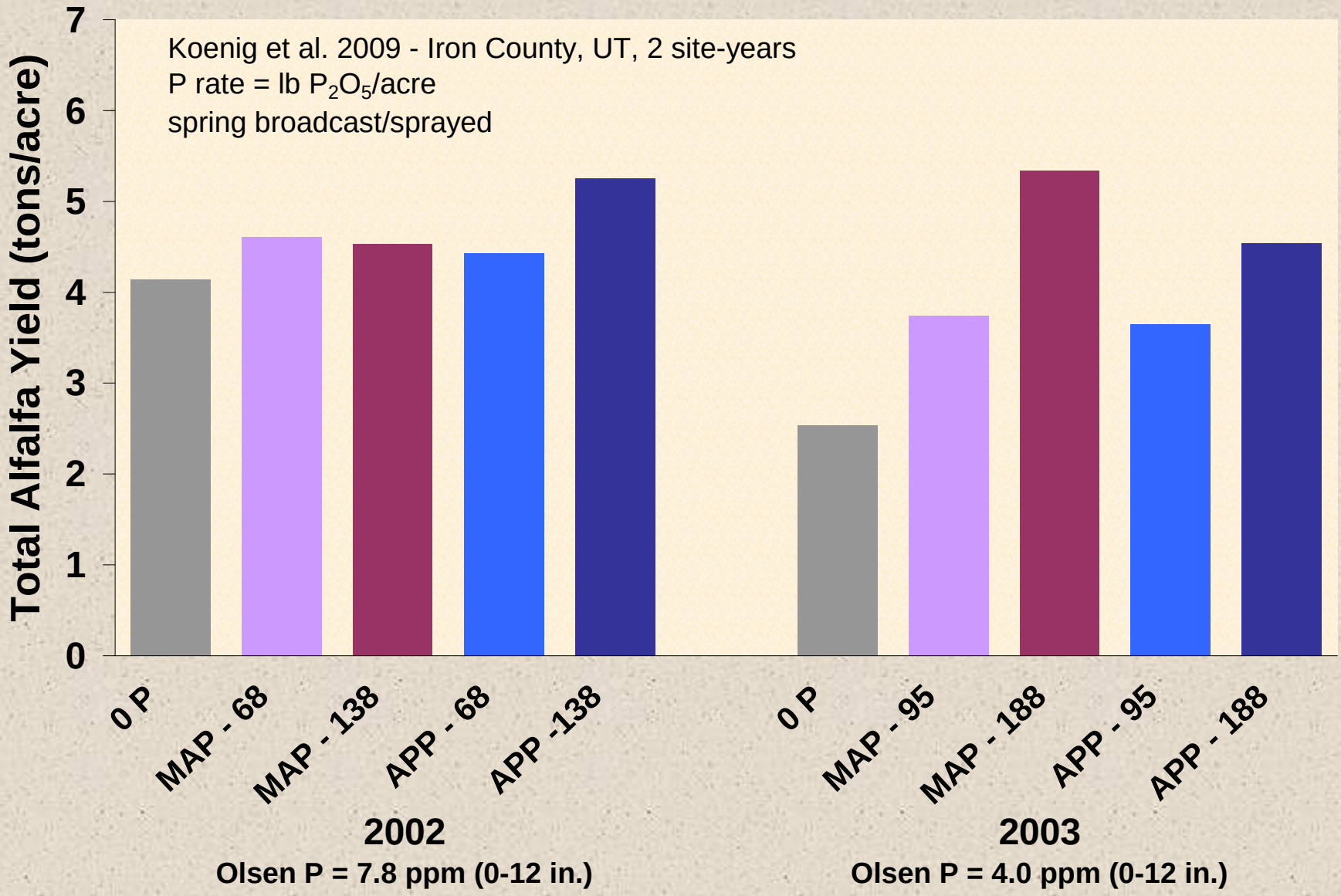


Wichman unpubl. data

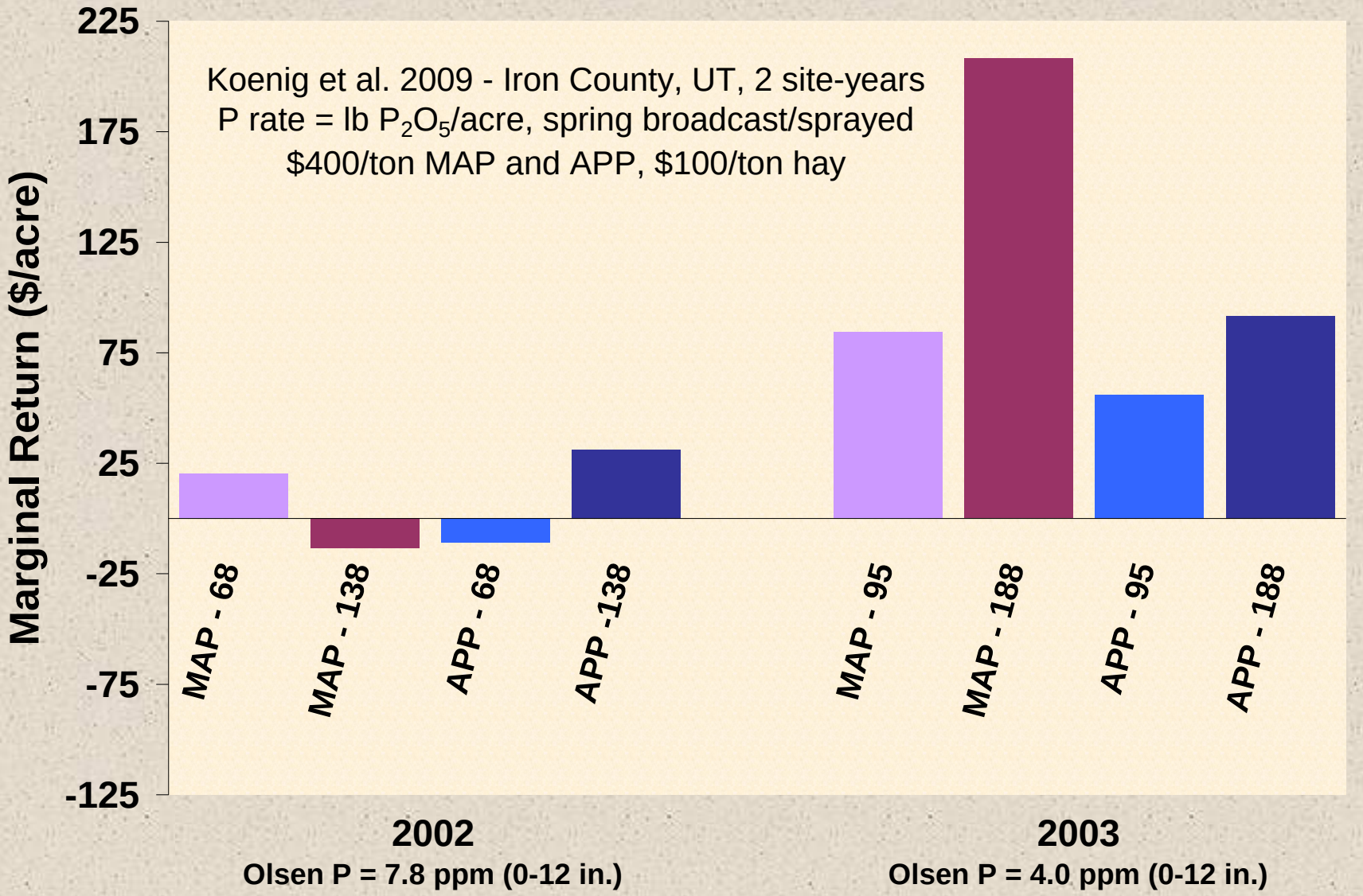
P fertilization strategy

- 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

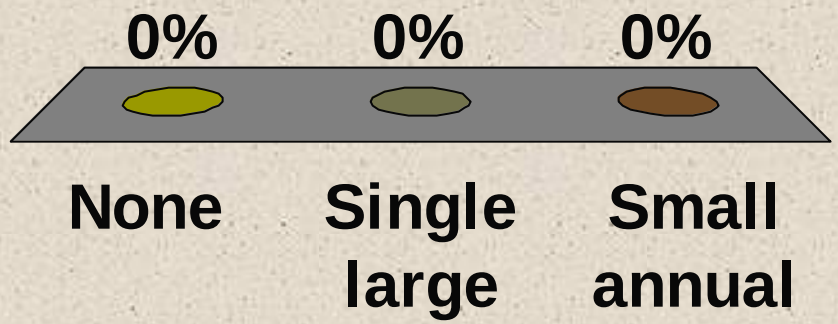


P rate and source on yield

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

What to recommend to producers when $400/ton MAP and $100/ton hay on a site with Olsen P < 8 ppm?

1. No application
2. Single large application
3. Smaller annual applications



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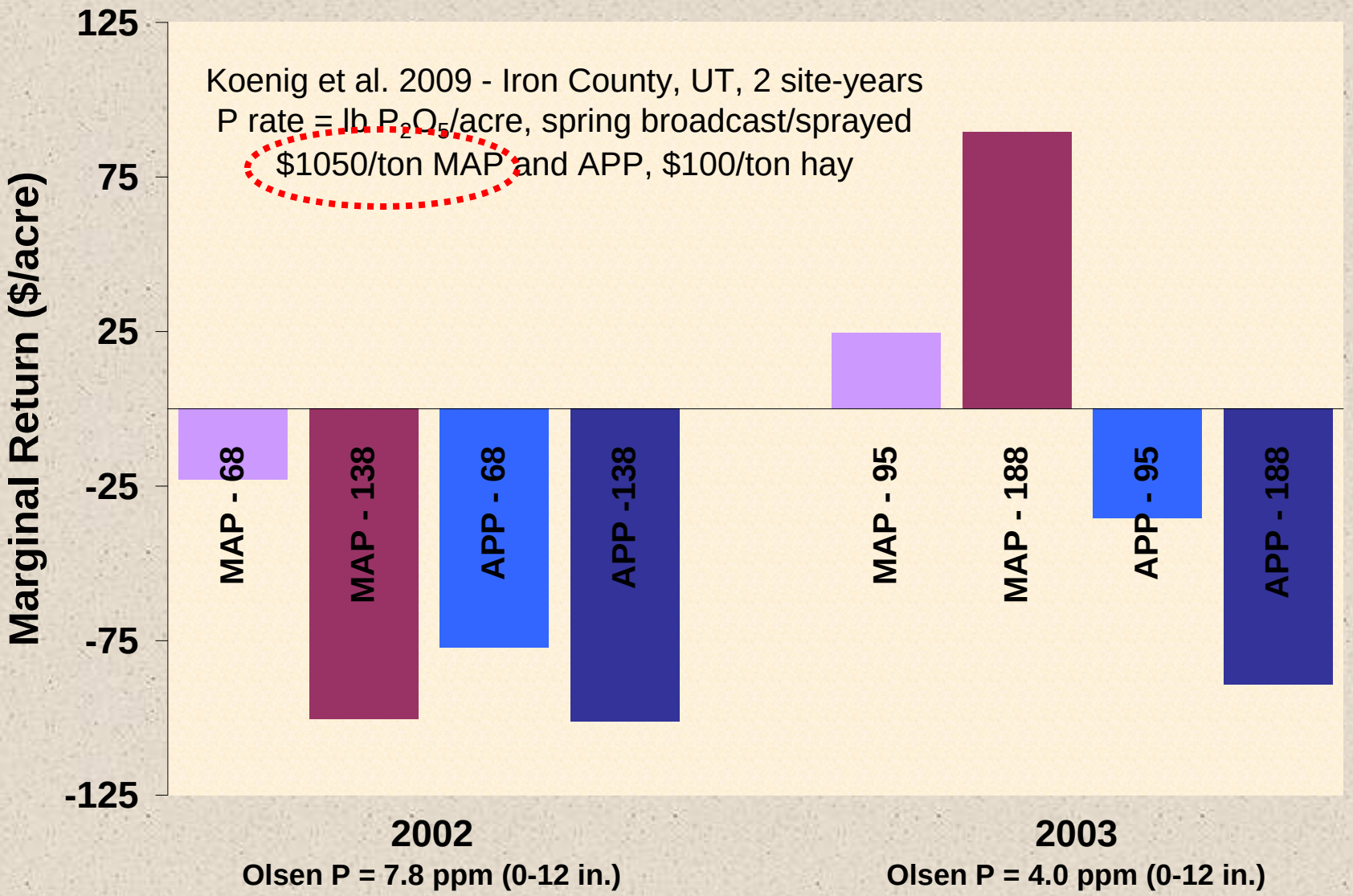
How might your recommendation be different when MAP is $1050/ton?

Marginal return on P by rate and source at high $ P



Phosphorus fertilization considerations

- Low P soil should yield higher return on P investment
- Yield response to P varies with growing conditions
- On average, MAP is more economical than APP, but not in every case

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)

Which forages have largest K needs?

K removal amounts in forage crops

Crop	Assumed Yield per Acre	K_2O removal (lb/acre)
Alfalfa	2.5 t	150
Brome grass	1.5 t	95
Orchard grass	1.5 t	75
Timothy	1.5 t	94
Corn silage	20 t	167

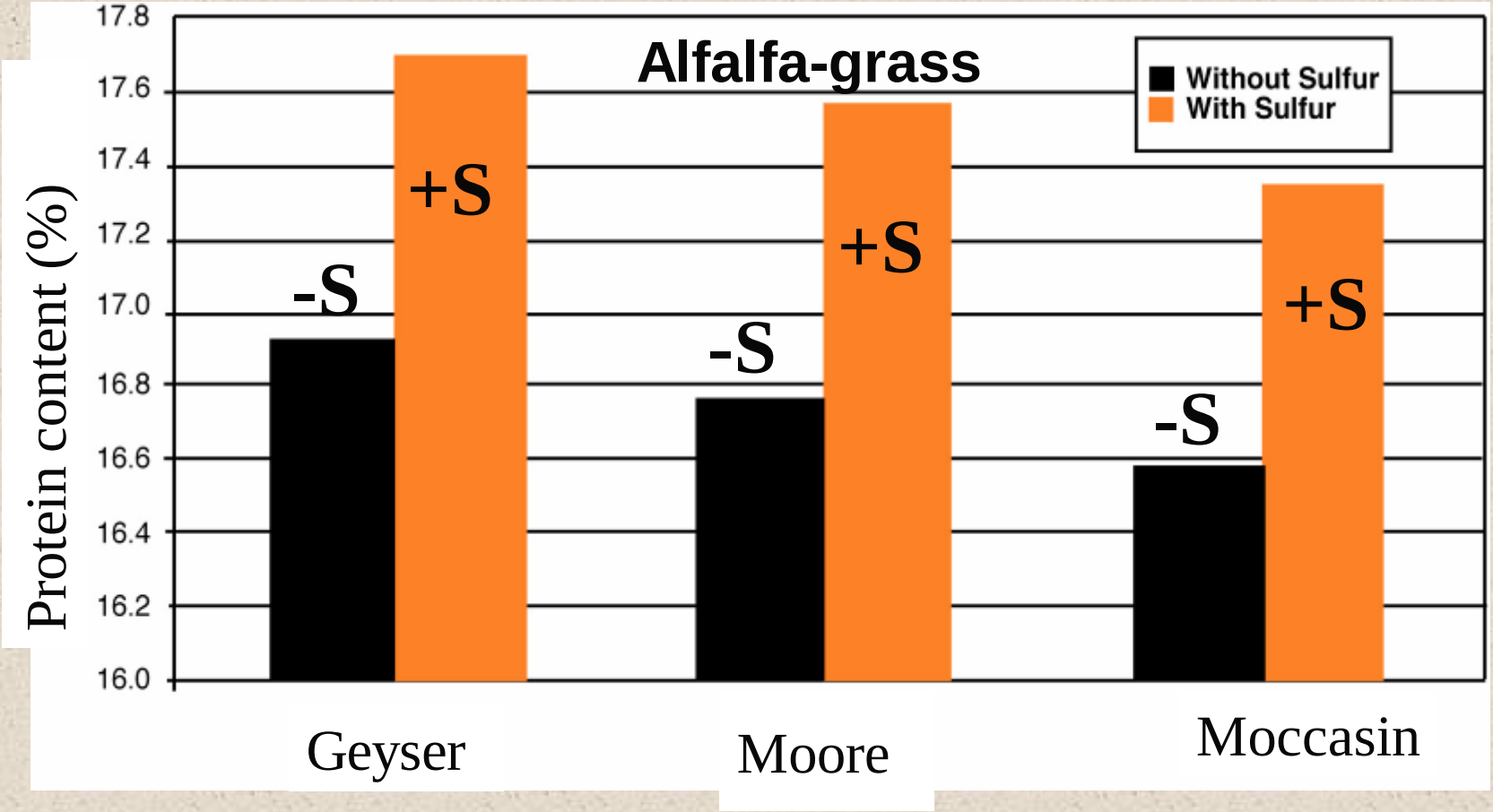
How might K, or lack of K, affect an alfalfa-hay field?

Factors decreasing S availability

1. Irrigated with low S in irrigation water
2. Sandy, acidic, or low organic matter soils
3. Cold soils
4. Soils formed from minerals low in S or far from industrial sources

Sulfur (S)

Responses seen in alfalfa-grass fields?



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

QUESTIONS ON SULFUR?

Special considerations for grass fertilization

- If sub-irrigated fertilize for high yield potential but apply P in fall
- On irrigated/wet meadows apply nutrients in spring
- Split N generally does not increase total yield
- If seeding on fallow, OM >3% provides adequate N for 2-3 years
- If N is banded or seed placed do not exceed 10-15 lb N/acre, also for P as ammonium-phosphate

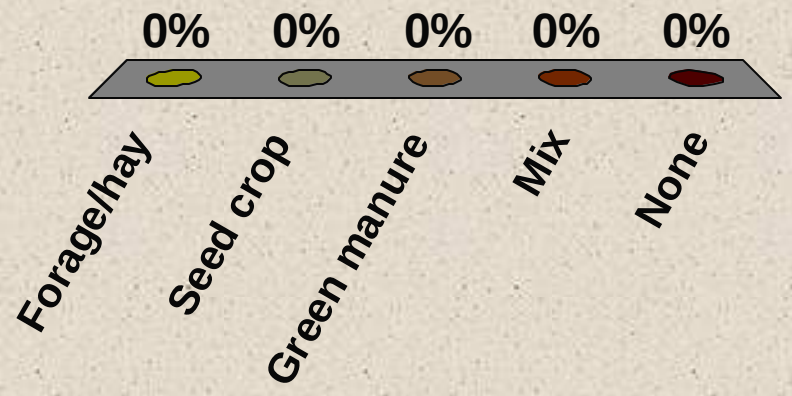
Special considerations for forage fertilization

- Broadcast most effective on perennial stands – deep banding OK on old alfalfa stands
- Late fall/early spring for cool season mix (except on sandy soil), mid-May for warm season mix
- In dryland consider ‘build up’ of P and K prior to seeding

Fertilization of annual legumes

Do you grow or advise on annual legumes for:

1. Forage/hay
2. Seed crop
3. Green manure
4. A mix of the above
5. Do not grow or advise on annual legumes



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Phosphorus and potassium uptake

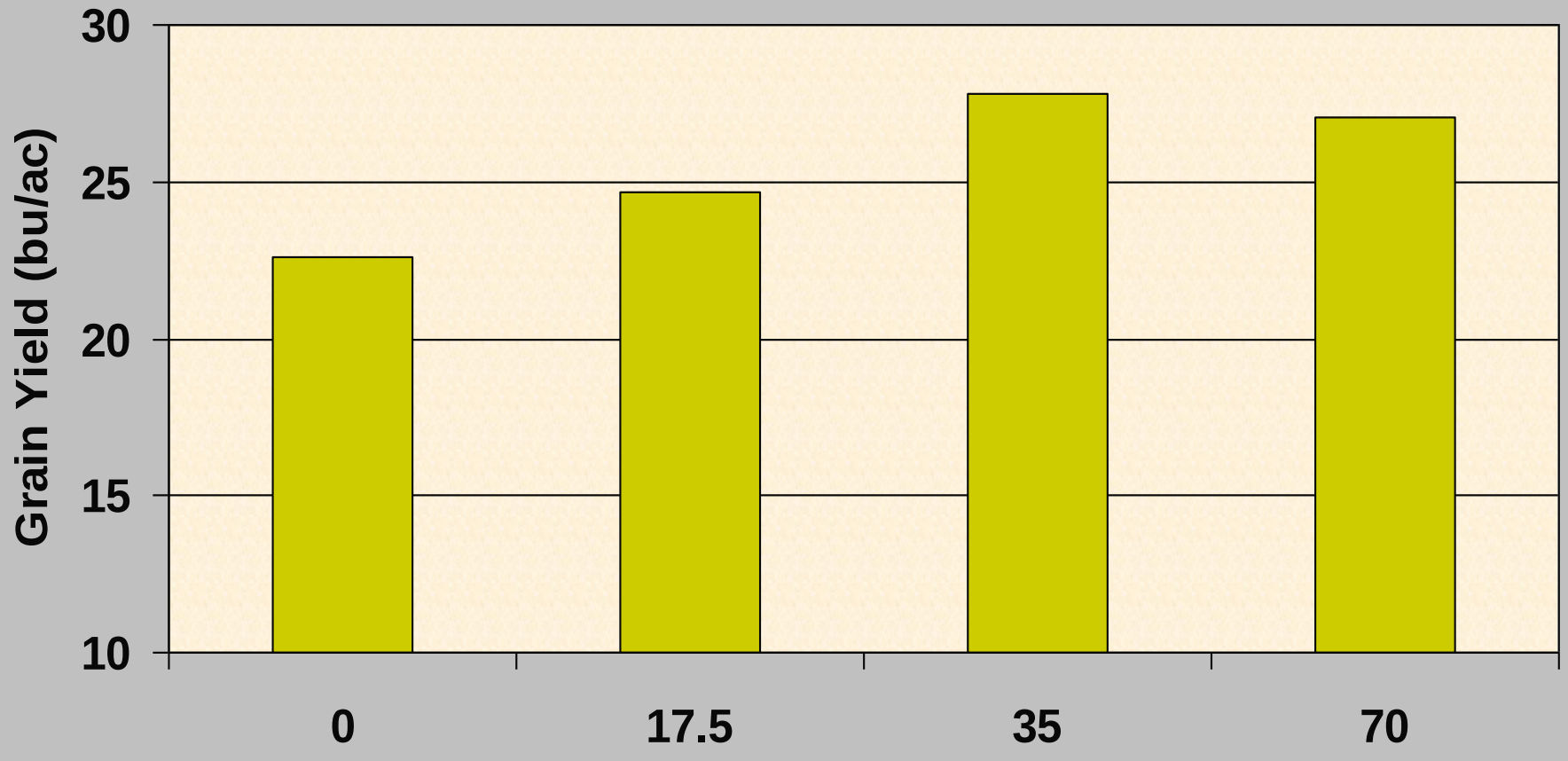
Nutrient	Peas, Lentils, Chickpeas	Wheat
Phosphorus (lb/bu)	0.67	0.62
Potassium (lb/bu)	0.87	0.38

P levels are often low in Montana (due to calcareous soils).

K levels are often moderate to high in Montana. No research located on K and legumes in region.

BOTH P and K needed for N fixation!

Effect of P on spring pea yield (2004-2005) Sidney



Olsen P = 10-14 ppm

Data from J. Waddell

Montana phosphorus fertilizer guidelines for annual legumes

Olsen P (ppm) 0 to 6 inches	Application rate (lb P_2O_5/acre)
4	30
8	25
12	20
16	15
Above 16	0 up to crop removal*

* - Assume 2/3 lb P_2O_5 per bushel of grain

Why are P fertilizer needs of annual legumes somewhat less than for small grains and oilseeds?

- Lower yields
- Annual legume roots are shallower- better able to take advantage of higher P levels in upper 6 inches
- Legumes lower soil pH, mobilizing P

Montana potassium fertilizer guidelines for annual legumes

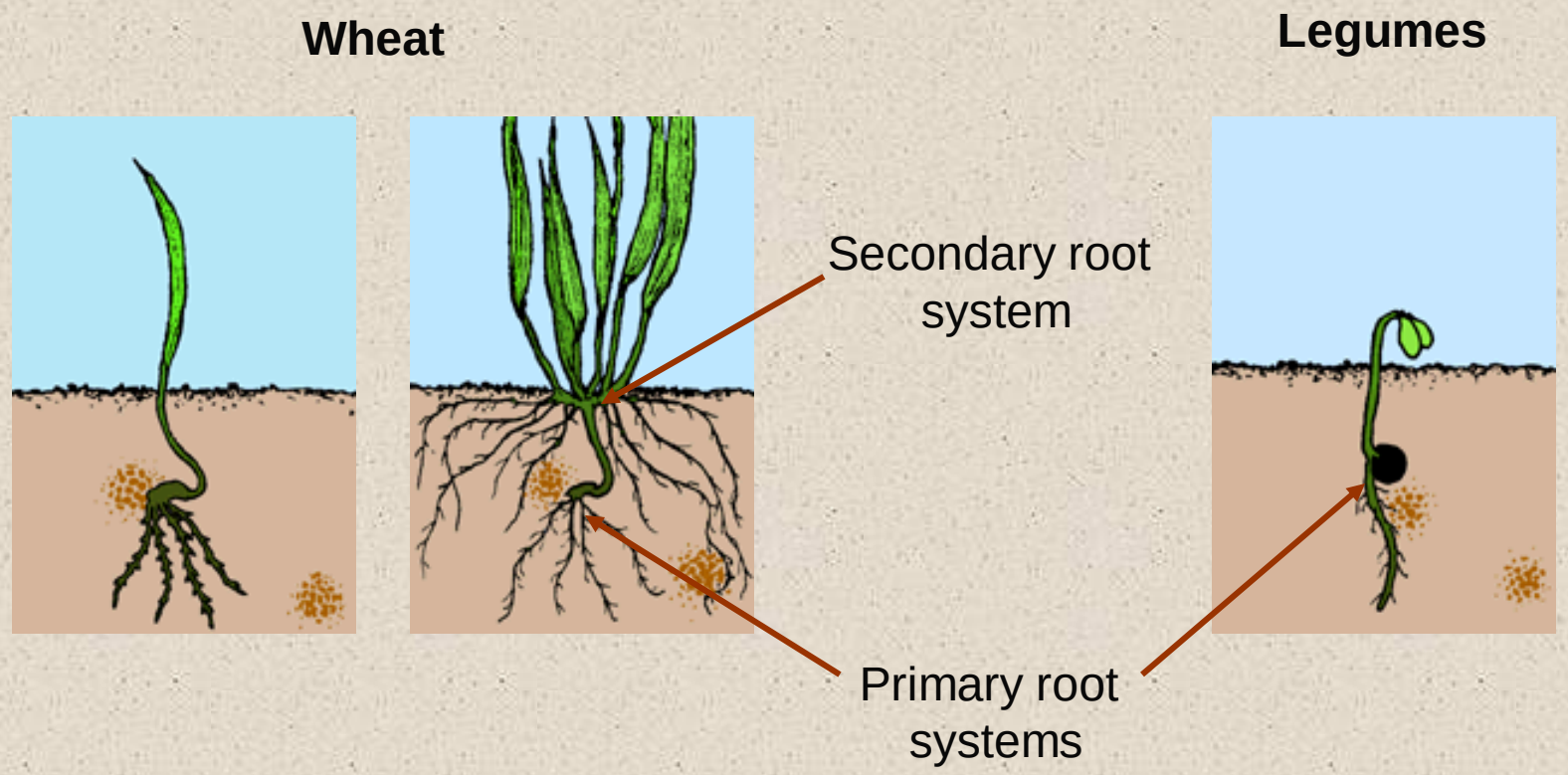
Soil Test K (ppm) 0 to 6 inches	Application rate (lb K_2O/acre)
100	35
150	30
200	25
250	20
Above 250	0 up to crop removal*

* - Assume 0.87 lb K_2O per bushel of grain

Fertilizer placement for legumes

- No nitrogen (N) or potassium (K) fertilizer with the seed
- Small amounts of phosphorus (<10 lb P_2O_5/ac) with the seed
- Ideal placement is below the seed

Rooting patterns and starter and deep band fertilizer placements



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 critical for determining fertilizer needs.

Questions?

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