

Strategies to Stretch your Phosphorus Fertilizer Dollar

Prepared for Judith Basin County –
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What do you grow?

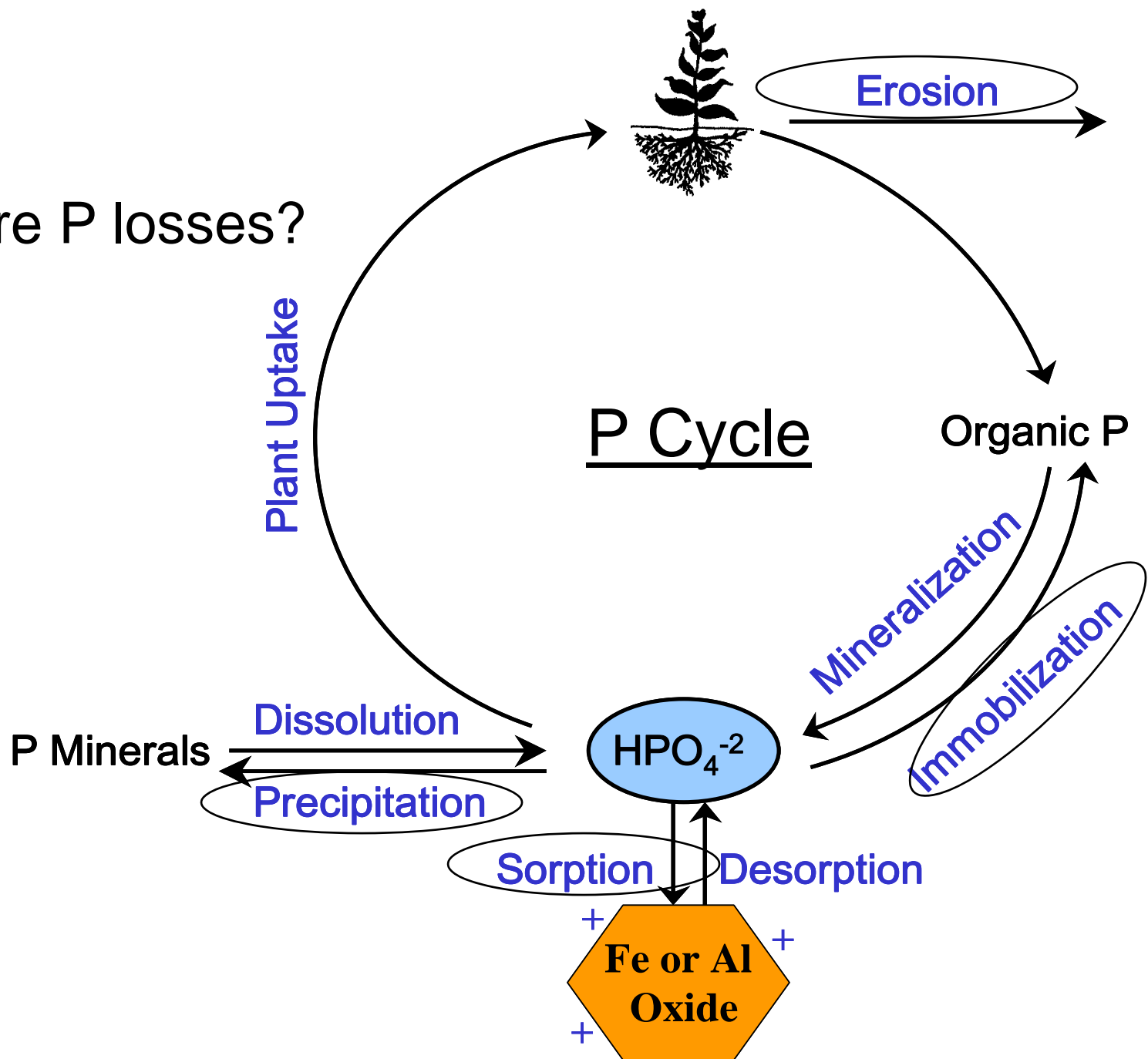
- Forages?
- Small Grains?
- Others?



Objectives

- Show phosphorus cycle and relevance
- Discuss:
 - Rates
 - Source: Liquid vs Granular vs “Avail”
 - Placement
 - Timing
 - Previous Crop Effects

What are P losses?



Soluble P concentrations in soil are generally very low (0.01 – 0.1 parts per million) due to:

1. Precipitation of poorly soluble calcium phosphate minerals. This is very relevant in this region's high pH, calcareous soils.
2. Strong sorption to manganese, aluminum, and iron oxides and hydroxides (example: rust). This process increases at low pH so is only an issue in small areas of Montana.

At what pH levels would you likely need to fertilize with more P?



If you want more information on P cycling, go to
MSU Extension's publication at:

<http://www.montana.edu/wwwpb/pubs/mt44494.pdf>

Determining P Application Rate (from EB 161)

1. **Sufficiency Approach** – Do you want to apply minimum necessary to maximize yield in most years? *If so, use Table 18 (P).*
2. **Maintenance Approach** – Do you want to replace the nutrients removed at harvest? *If so, use Table 21.*
3. **Build Approach** – Do you want to build your soil P, to minimize yield losses and save on fertilizer in future years? *If so, add amounts from 1 and 2.*

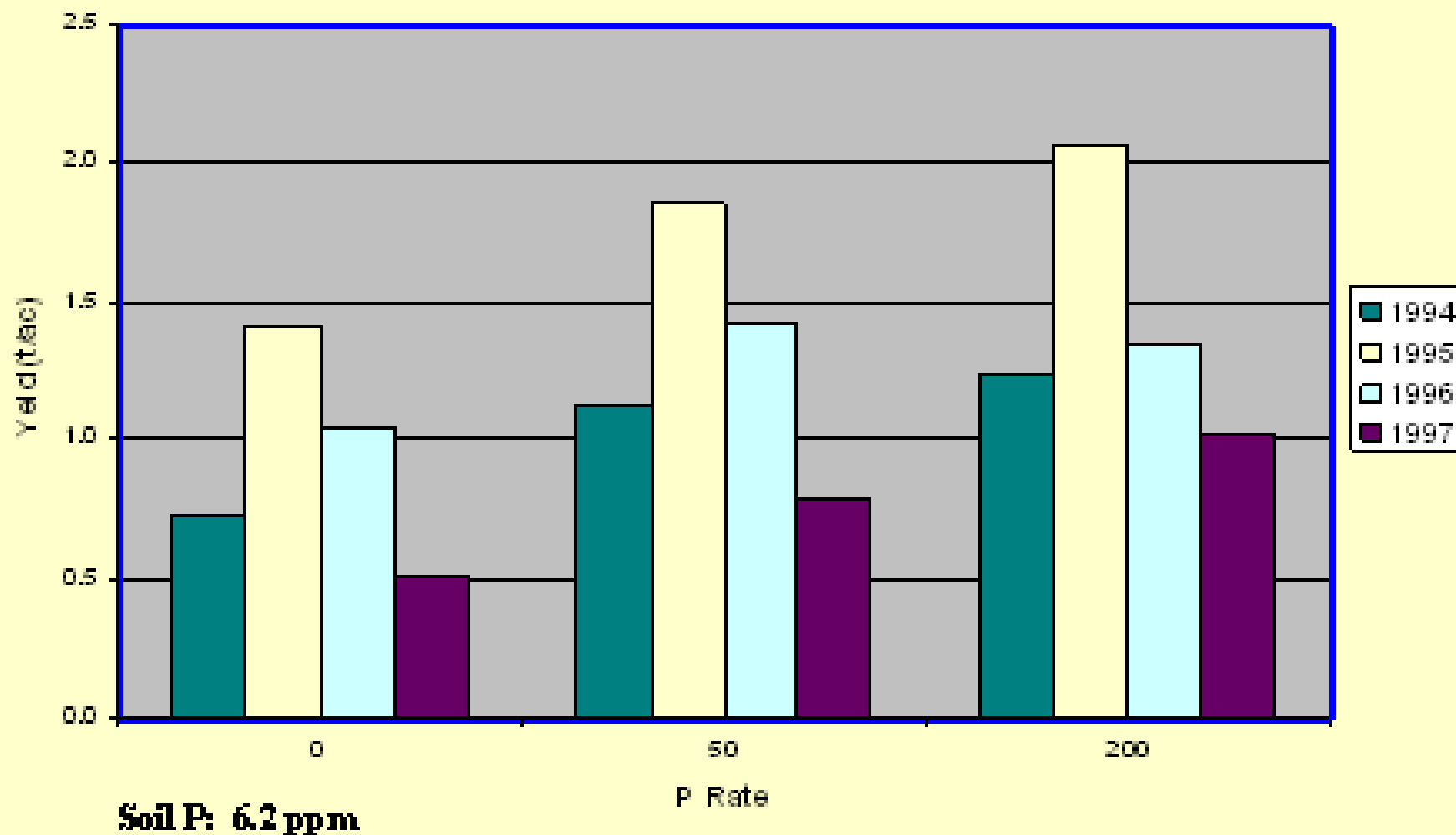
What might your answer depend upon?

Rate

From Fertilizer Guidelines for Montana Crops
(EB 161)

Crop	Olsen P Soil Test Level (ppm)				
	0	4	8	12	16*
	P Fertilizer Rate (lbs P ₂ O ₅ /a)				
Wheat-Spring	50	45	35	30	20
Wheat-Winter	55	50	45	40	35

Multi-year Summary of Alfalfa Response to Applied P Broadcast Trial, Geysers, Montana



P Source options

- Monoammonium P (MAP)
- Diammonium P (DAP)
- Liquids (generally more expensive than MAP and DAP)

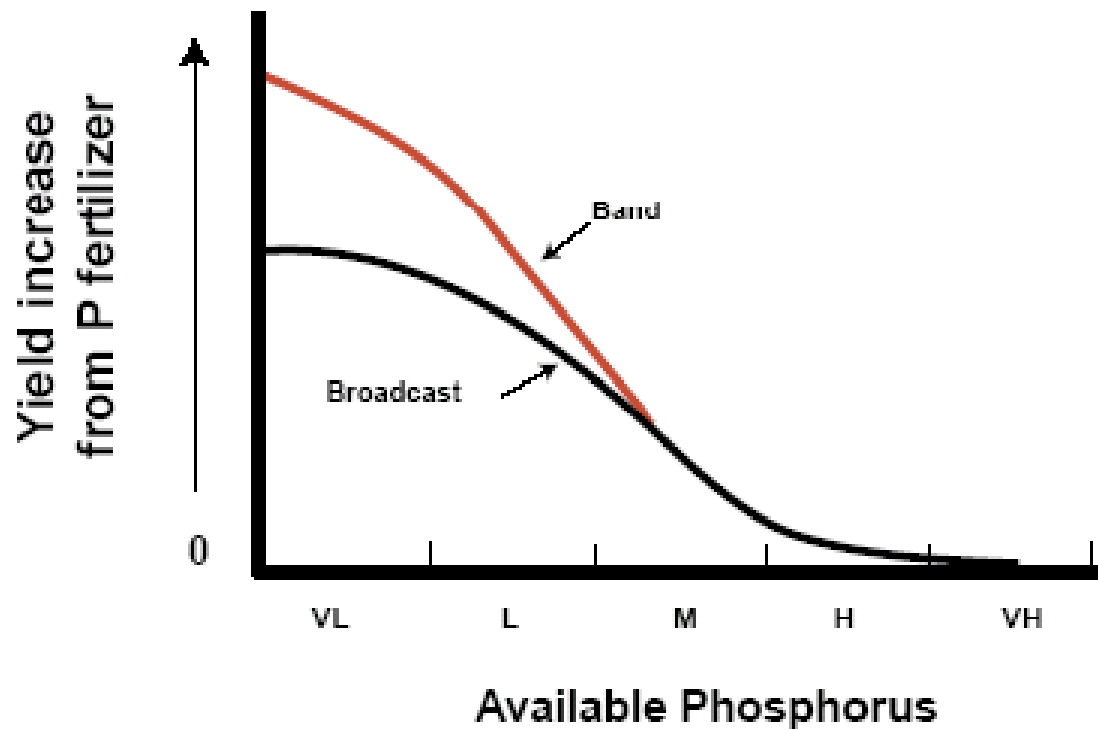
Generally no yield differences between sources.

Exception: Liquids can produce higher yields on highly calcareous soils (> 20% CaCO₃)

Avail by Specialty Fertilizer Products: An “Enhanced Efficiency Fertilizer”

Limited work done on Avail for cereals in the western U.S. (none on SFP’s website)

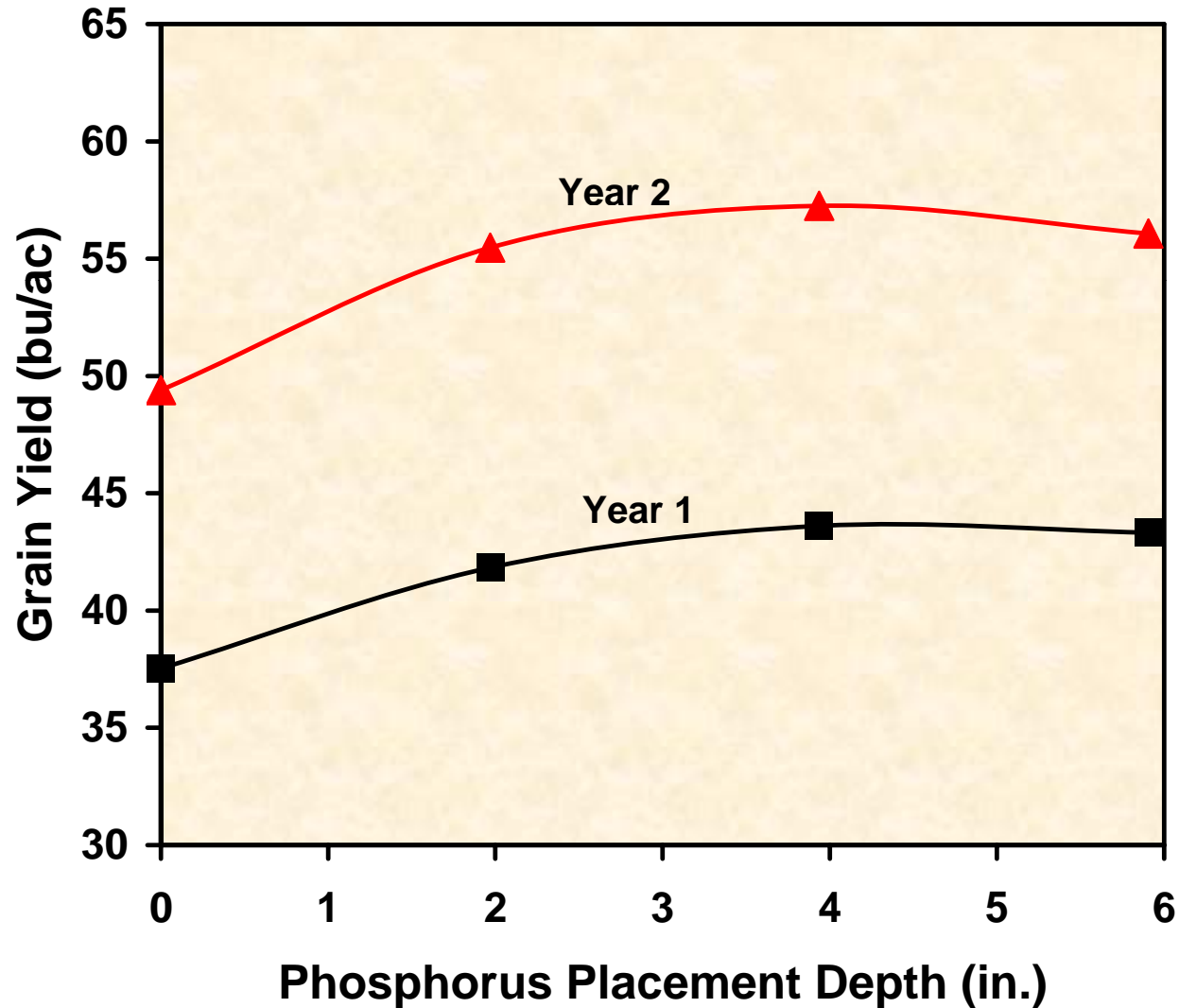
Placement: Banding vs Broadcast



Banding P is much more effective than banding N, because P is much more immobile in the soil.

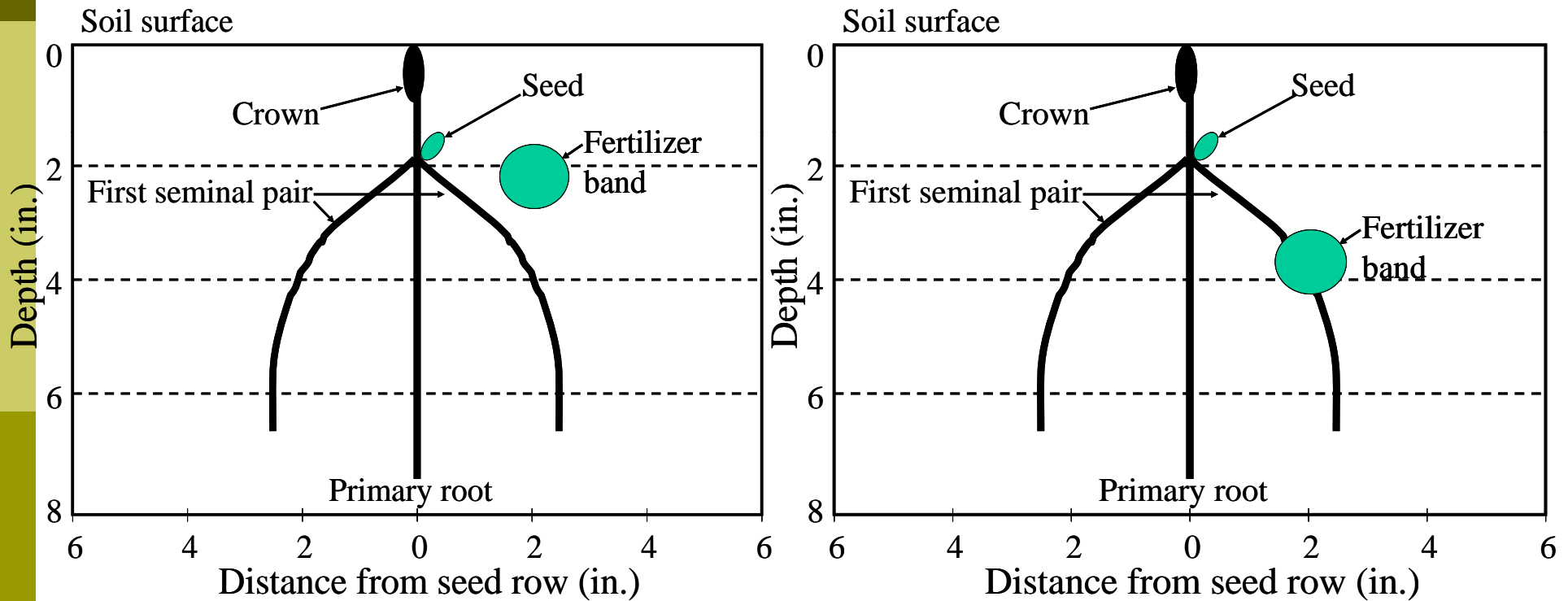
Figure 7. The advantages of P banding are greatest when STP levels are very low (VL) to low (L). From Randall and Hoefft (1988).

Effect of P banding depth on winter wheat grain yield

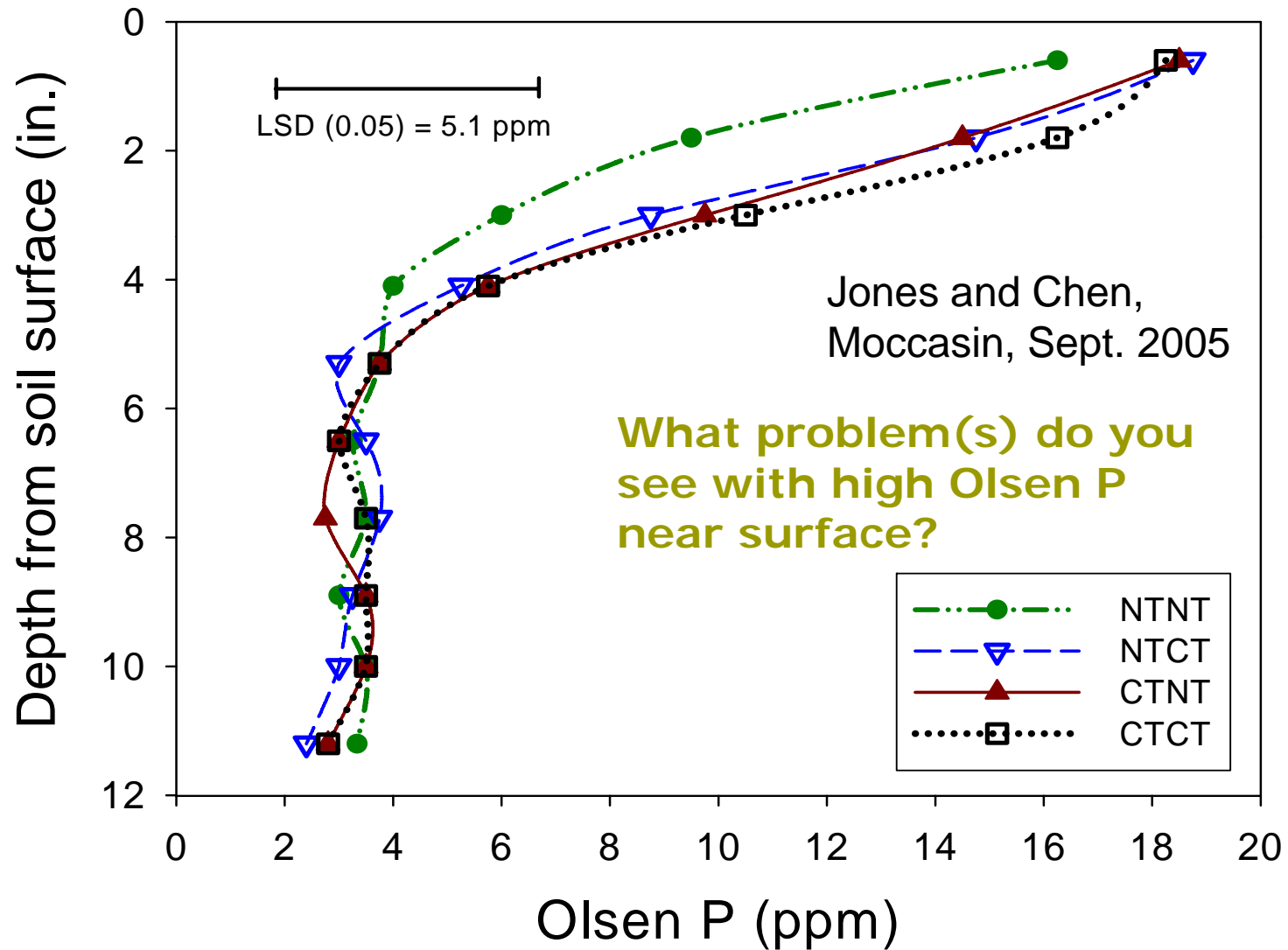


McConnell
et al. 1996

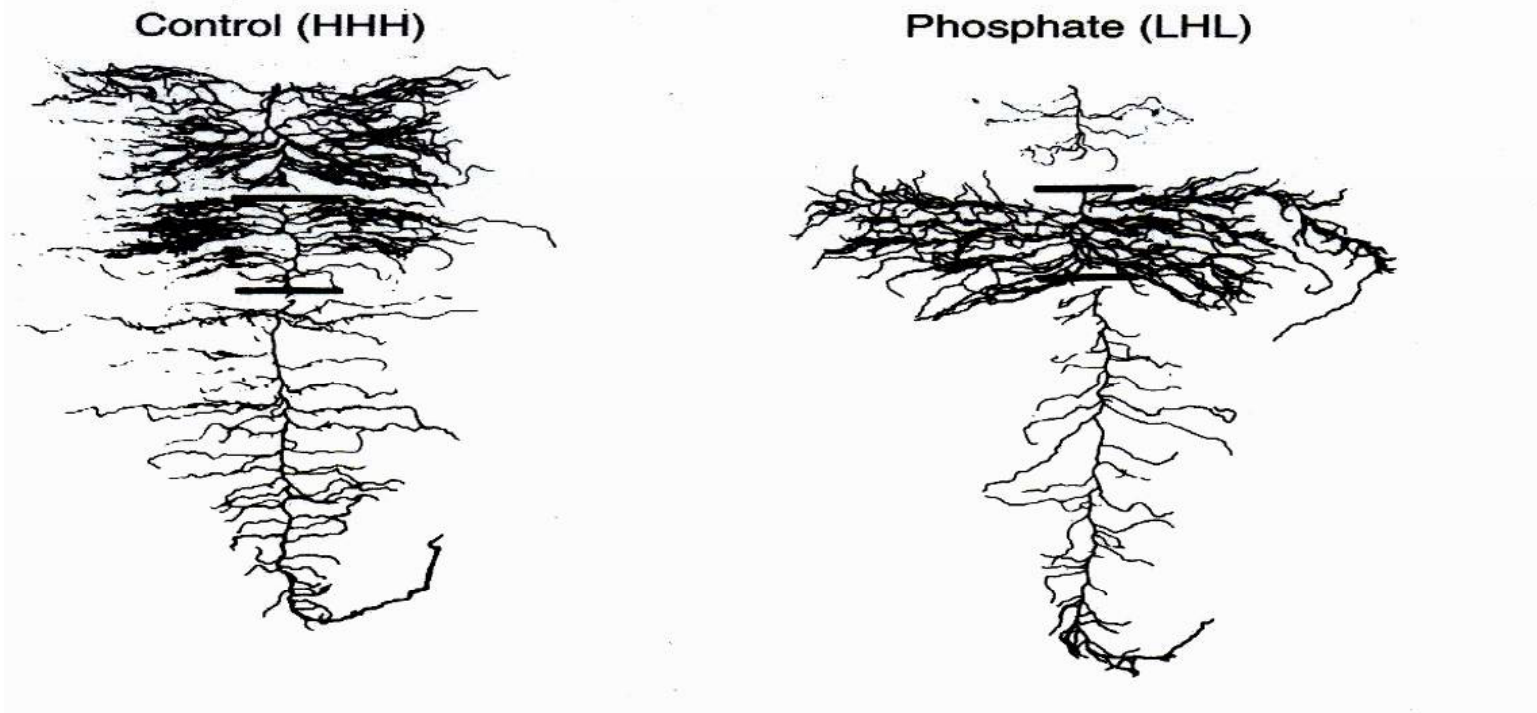
Effect of P banding depth on small grains



Vertical Olsen P Distribution at Moccasin



How do localized concentrations of nutrients affect root distribution?



(Drew, 1975)

Slide 15

CJ35

Try adding some questions to the slides to make more interactive. Meaning a follow up question here is Why does this matter?

Clain Jones, 10/26/2007

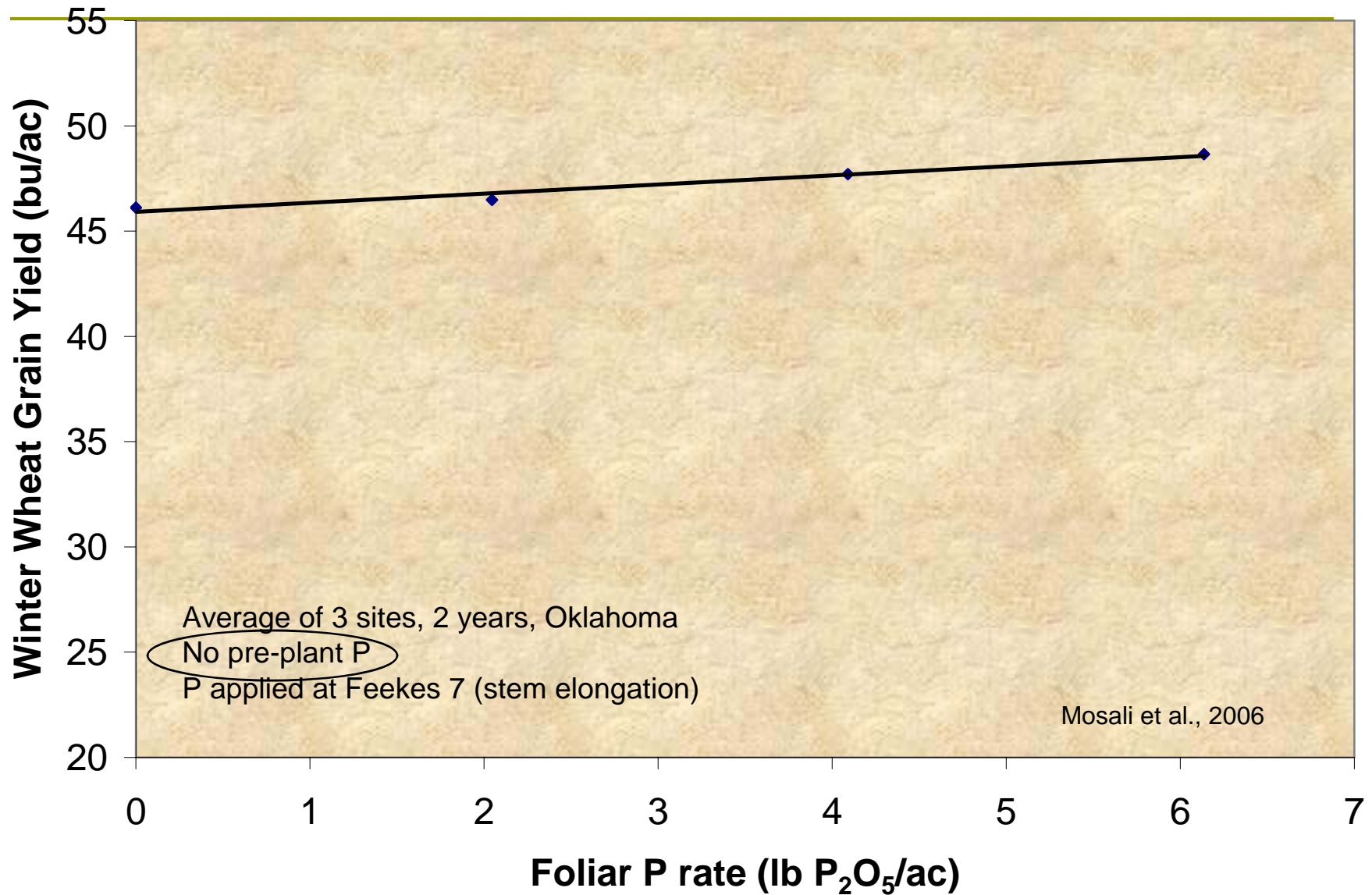


QUESTIONS?

Timing

- ❑ Ideally we would apply P directly to the root zone right before peak P uptake
- ❑ Not practical, so best to apply P at time of seeding (with or below seed)
- ❑ On pastures, P responses are better with Fall application. Why?
- ❑ Value of Foliar P?

Effect of Foliar P on Winter Wheat Grain Yield



Questions so far?



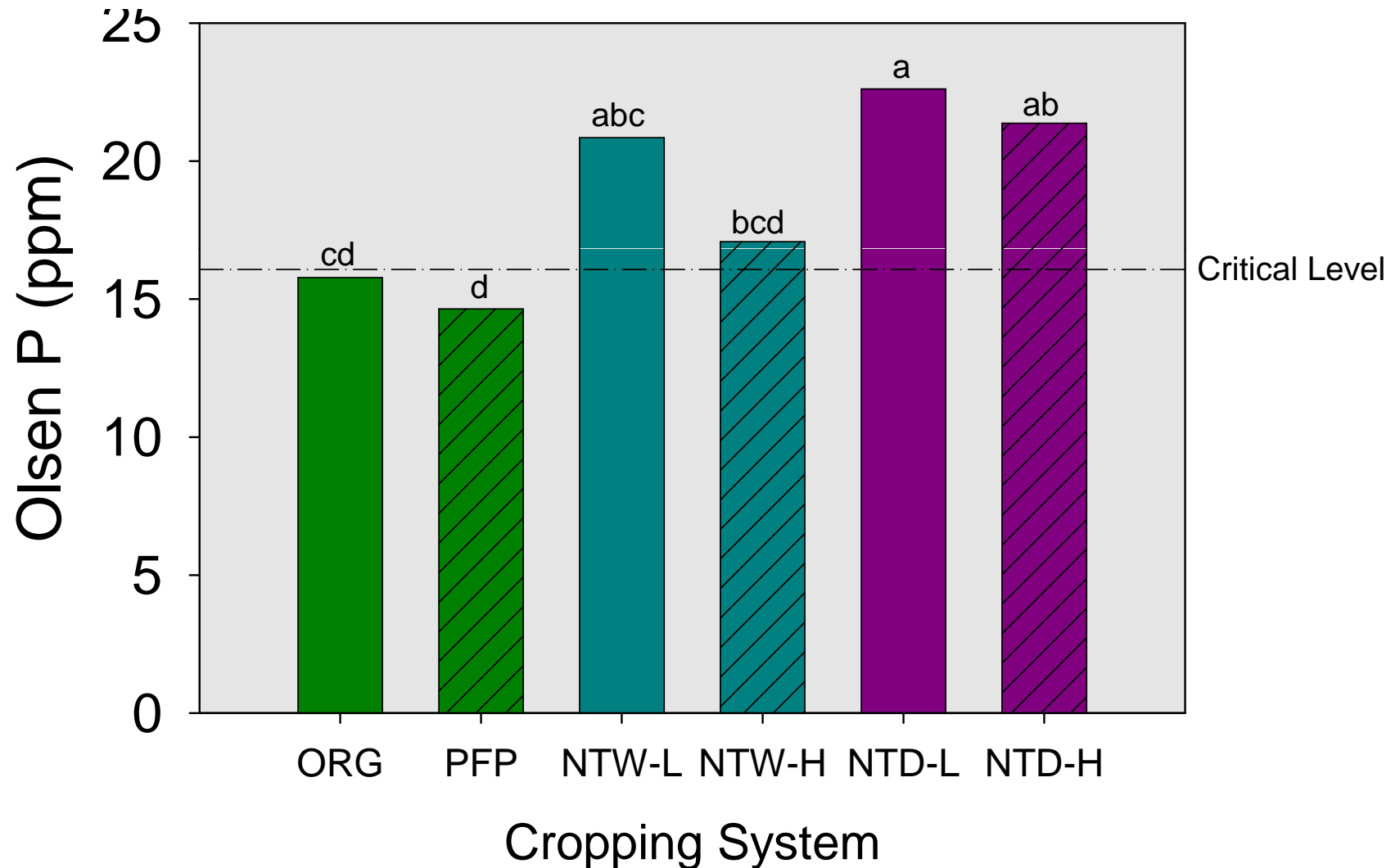


Does crop rotation and/or previous
crop affect P availability?

Bozeman Crop Diversification Rotation Study (CDRS)

- ❑ Study initiated at Agronomy Post Farm in 2000 (6 miles west of Bozeman)
- ❑ 17 treatments with 4 year rotations (4 reps)
- ❑ 1 organic (ORG) rotation (no inputs). N fertility: one winter pea green manure and one lentil rotation (harvested for grain)
- ❑ 1 pesticide free production (PFP) rotation
- ❑ 8 fertilized no-till/fertilized rotations including winter wheat based (NTW) and diverse (NTD) with both low (L) and high (H) N rates.

CDRS: Olsen P Comparison – Top 6 inches (March 2007)



Crop species that can help dissolve phosphorus minerals

Buckwheat



Legumes



Some Mustards



Question: Can green manures help dissolve rock phosphate fertilizer to increase organic winter wheat grain yields in Montana?



Methods

- Location: Organic small grain farm, Big Sandy, MT
- History: Managed organically with intermittent legume green manures for 21 years. No inputs.
- Upper 6 inch soil pH: 6.6
- Upper 6 inch Olsen P: 16.1 ppm



Methods

- First Year (2006) Crop Treatments:

 - Buckwheat (*Mancan*)

 - Yellow Mustard (*AC Base*)

 - Spring pea (*Arvika*)

 - Fallow

- April 2006 Broadcast-Incorporated RP (0-2.1-0)

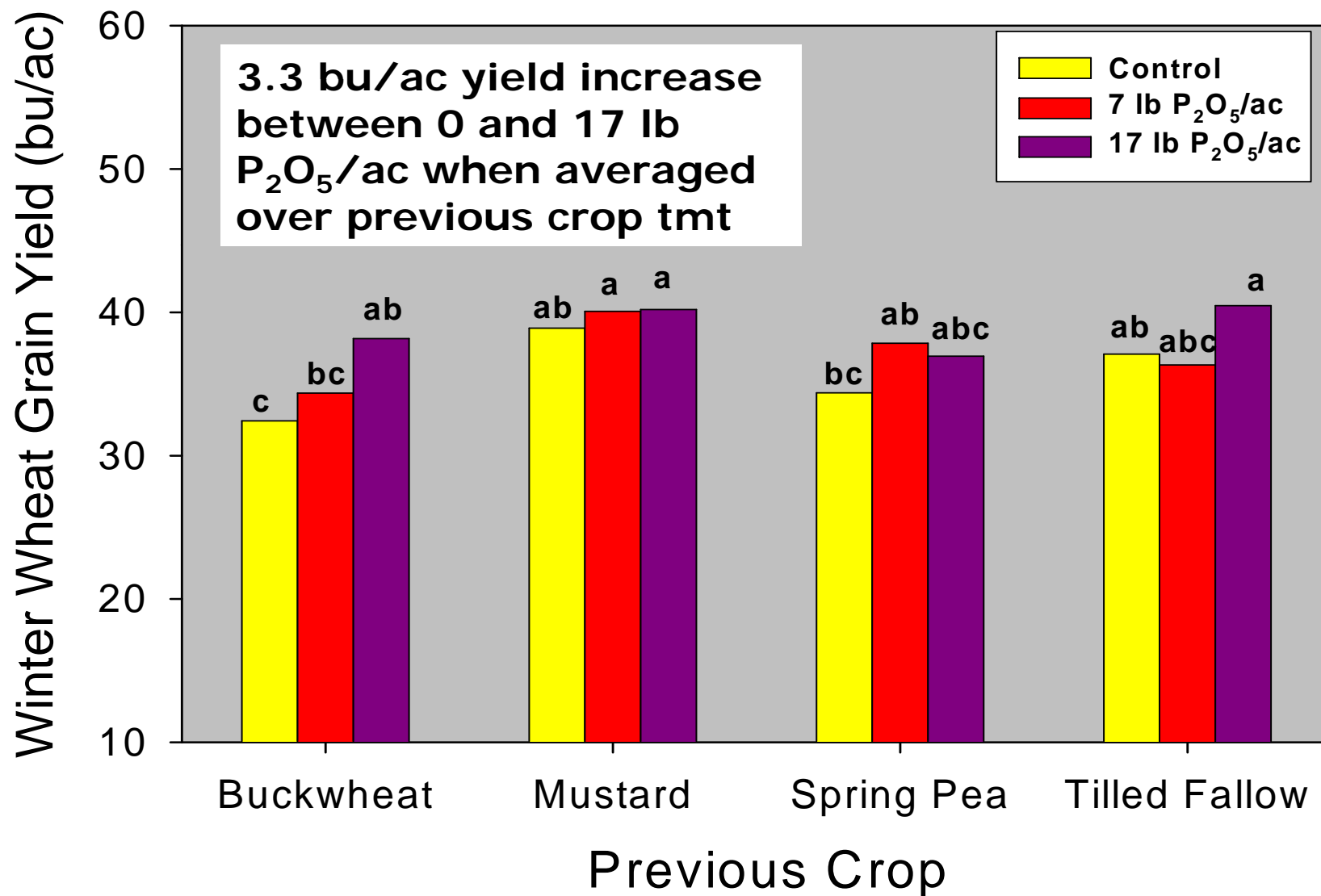
 - Treatments: 0, 7, 17 lb available P_2O_5 /ac

- Second Year Crop: Winter wheat (*Tiber*)

Big Sandy Green Manure Study



Effect of green manure crop and rock phosphate on subsequent winter wheat grain yield, Big Sandy: 2007





Summary

- ❑ Optimizing P use is important especially in times of high P fertilizer costs.
- ❑ Rates will vary depending on your goal (sufficiency, maintenance, or build)
- ❑ Banding is more efficient than broadcast P
- ❑ P is most effective when applied at time of seeding
- ❑ Foliar P may slightly increase yield, but likely not worth it.
- ❑ Although some crops can dissolve P minerals, the effect doesn't appear to transfer to the next crop.

For more Information:

Soil Fertility Website:

<http://landresources.montana.edu/soilfertility>

Questions?