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Phosphorus source effects on dryland winter wheat in eastern Washington 1st report

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Acknowledgments

- Fluid Fertilizer Foundation for funding
- Western Laboratories for tissue analysis
- International Plant Nutrition Institute for earlier funding of a longer term, basic research effort

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Wheat production in WA

- 1.25 M acres in 2007; higher in 2008
  - $12.50/bu common soft white ($9.25 Aug)
  - $19.25/bu dark northern spring ($11.50 Aug)
- Mediterranean climate (70% of precip. Nov-April)
- Yields highly dependent on precipitation and stored soil moisture
  - <30 to >130 bu/acre dryland; >100 bu/ac irrigated
- Fluids are alive and well in this area
  - N, P, S, Cl, other micros

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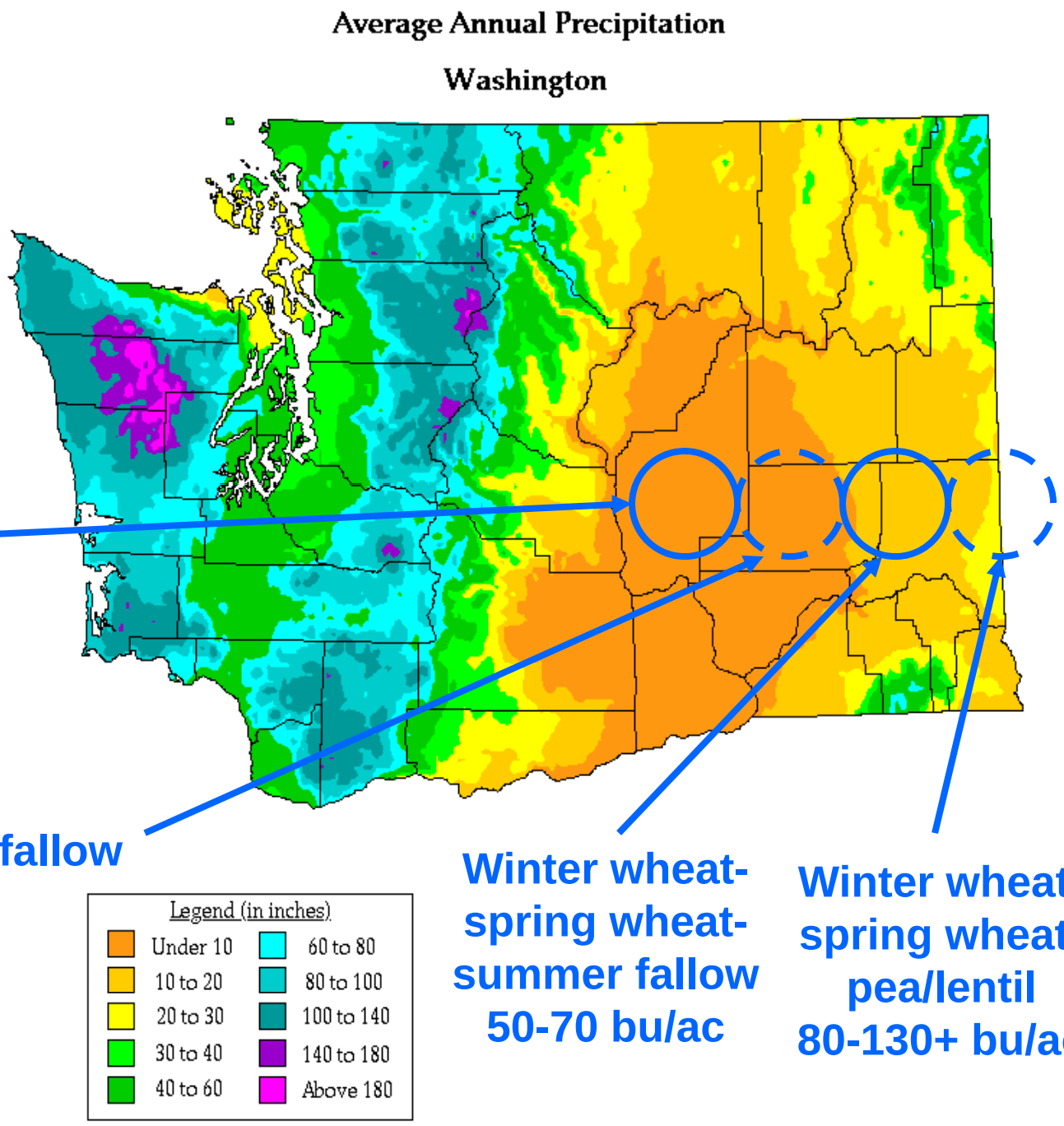

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Low rainfall zone, crop-fallow rotations

Fertilizer applied in May/June of fallow year

Seeding occurs in August

<u>Low rainfall, summer fallow areas</u>

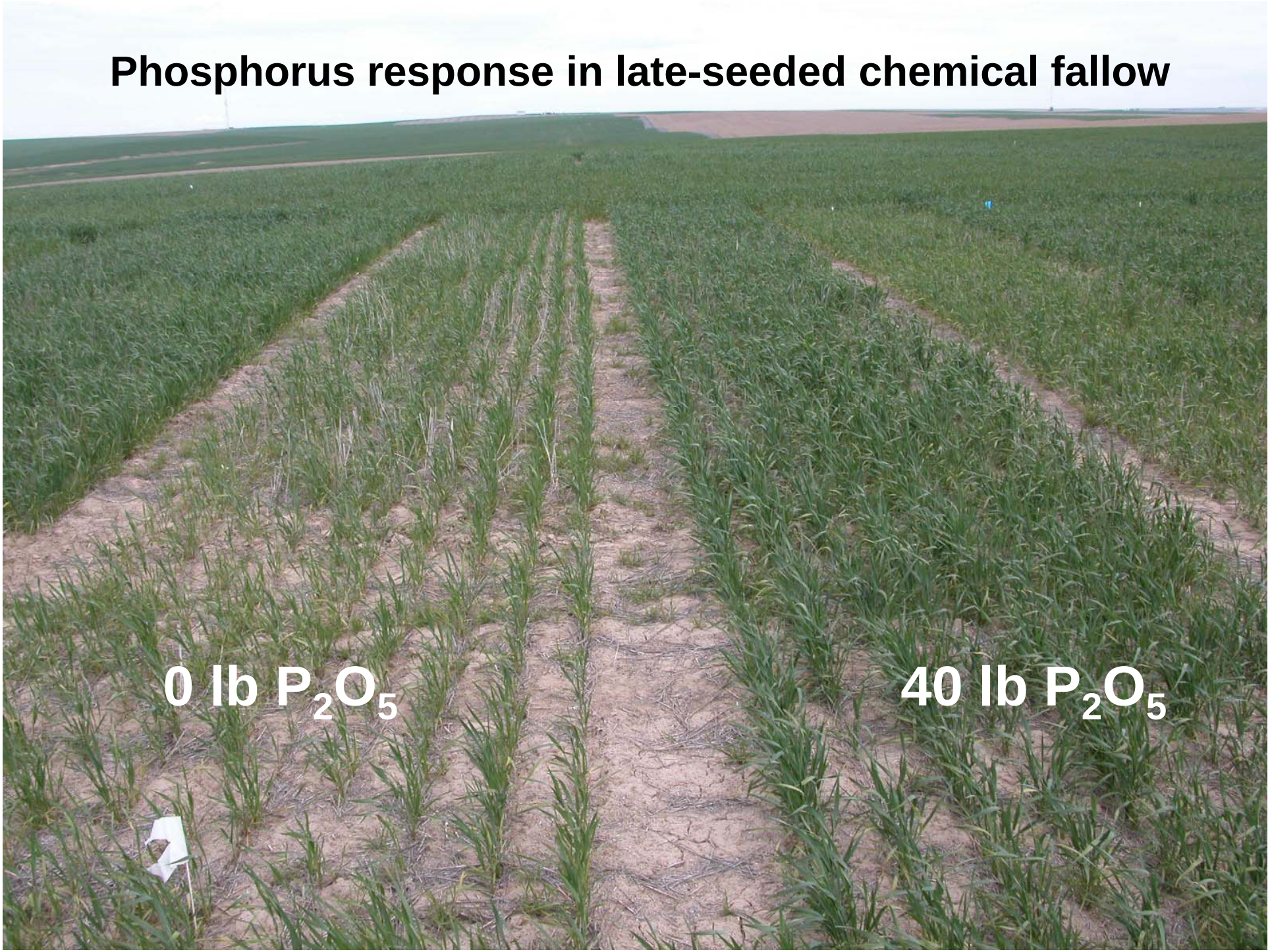
Few use phosphorus in traditional tillage fallow

Many claim no benefit or return on investment

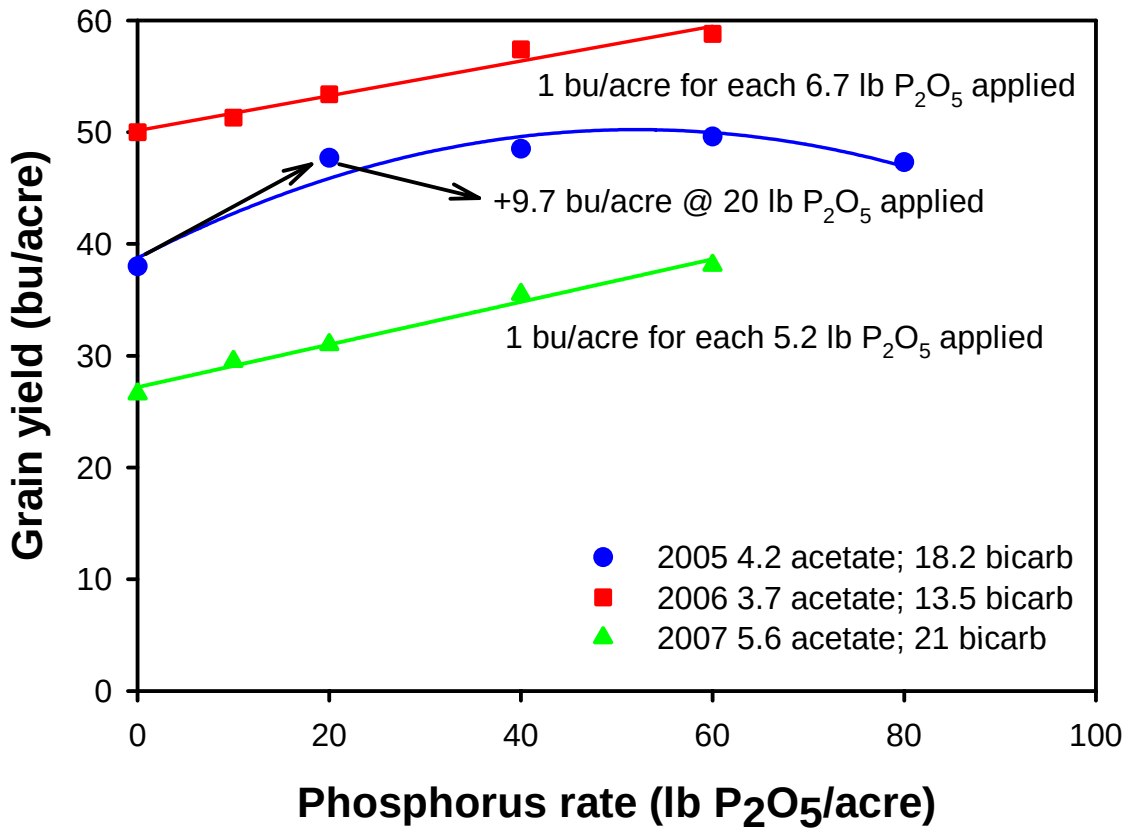
This may be an issue of timing and method of application

More use phosphorus in chemical fallow

Phosphorus response in late-seeded chemical fallow

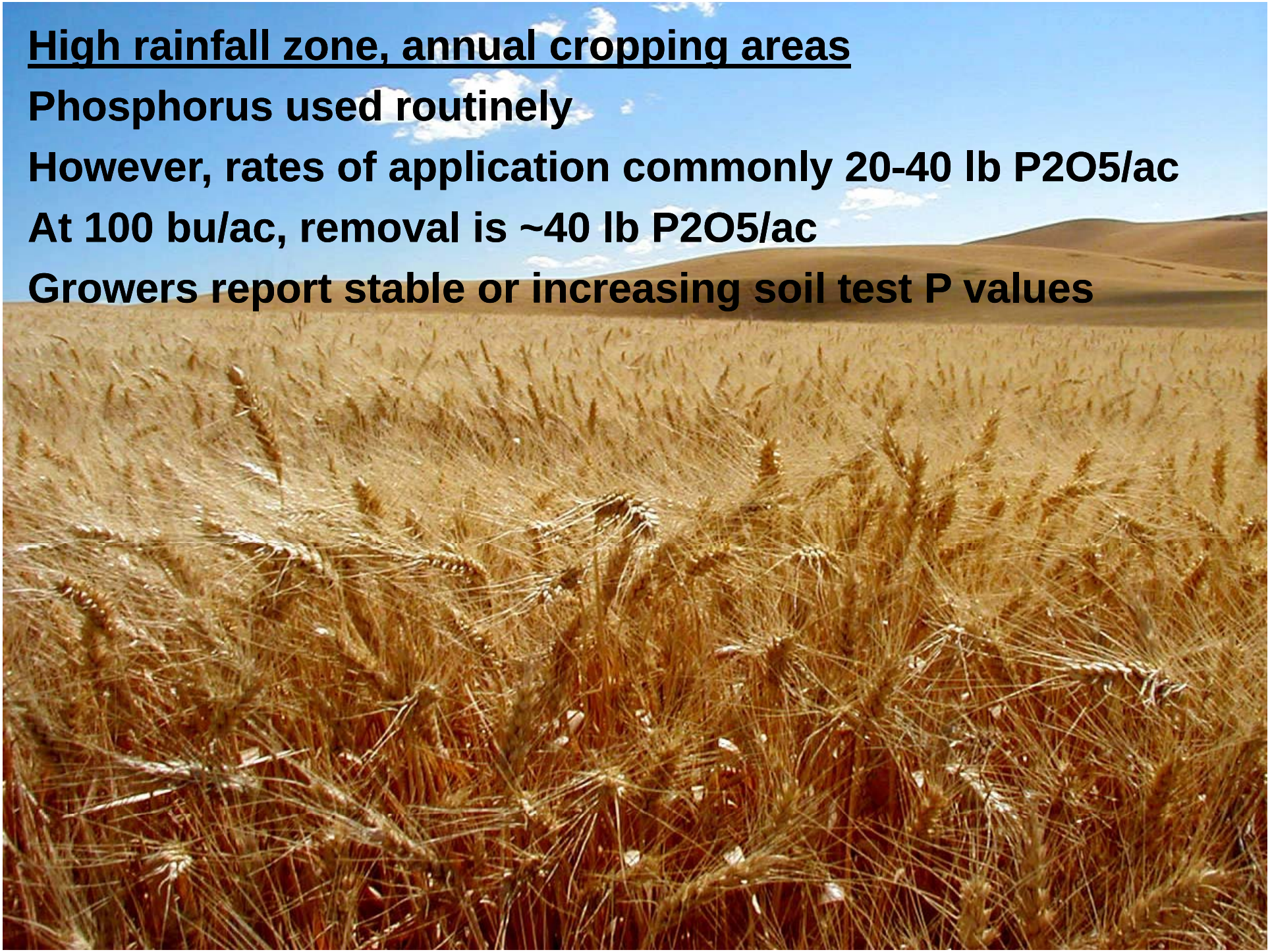


Chemical fallow P responses



High rainfall zone

farming in 3 dimensions



High rainfall zone, annual cropping areas

Phosphorus used routinely

However, rates of application commonly 20-40 lb P2O5/ac

At 100 bu/ac, removal is ~40 lb P2O5/ac

Growers report stable or increasing soil test P values

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Objective

- Evaluate winter wheat responses to P in wheat-fallow and annual cropping zones
  - Compare sources (dry vs. fluid)
  - Dispel myths
  - Document and explain observations of growers

  - Long term: improve recommendations
    - Soil test method
    - Precision management

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Brief methods

- 2 low rainfall zone locations x 2 years
- 2 high rainfall zone locations x 1 year
- P source-rates
  - 0, 10, 20 and 40 lb P_2O_5/ac fluid APP
  - 20 lb P_2O_5/ac as dry MAP
- Deep band application at or shortly before planting
- Biomass yield
- Tissue P (pending)
- Grain yield and test weight at maturity

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Soil Test Phosphorus (0 to 12-inch depth)

Location	Year	Acetate P, ppm	Bicarbonate P, ppm
Lind	2005-06	7.3	12.1
	2006-07	3.9	11.0
Ralston	2005-06	5.8	17.8
	2006-07	5.5	22.5
Johnson	2006-07	7.0	24.5
Colfax	2006-07	4.0	21.8

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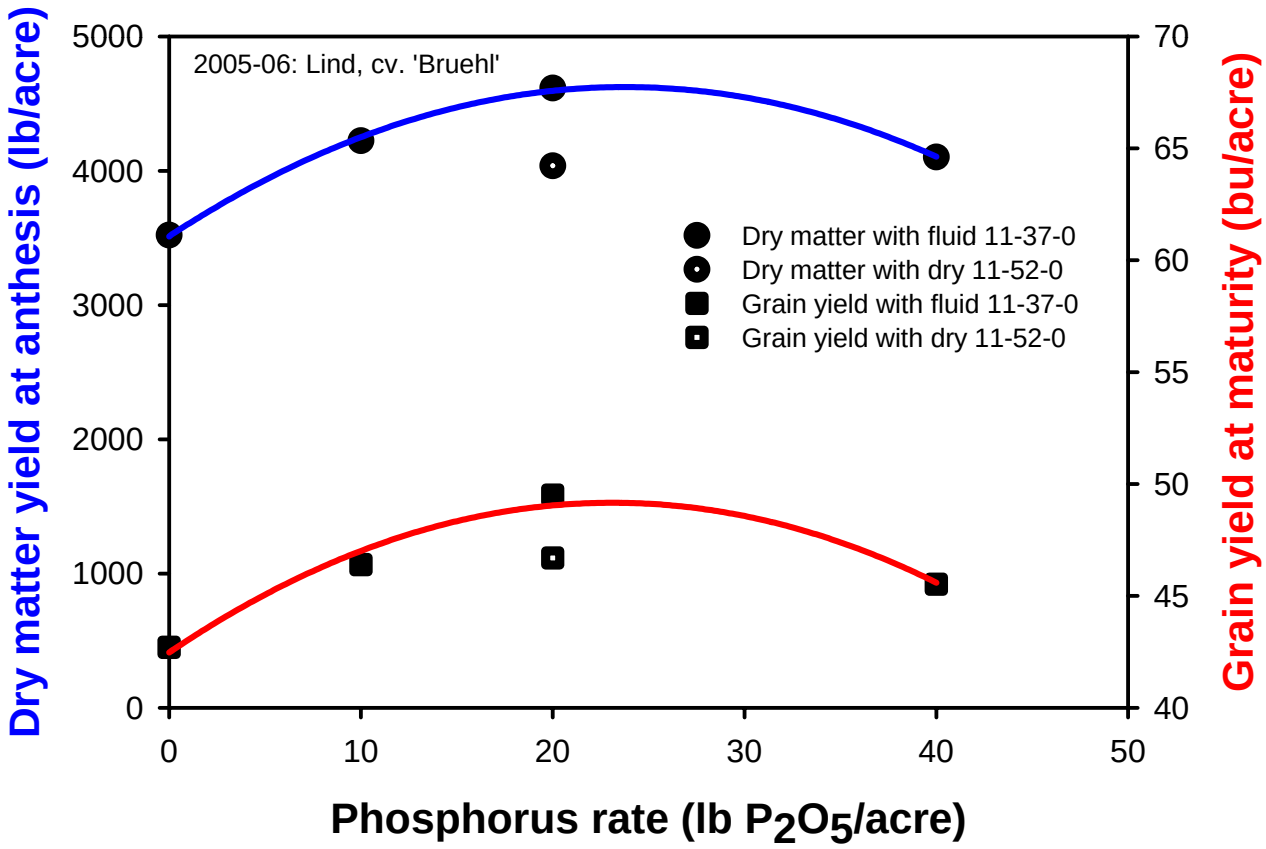
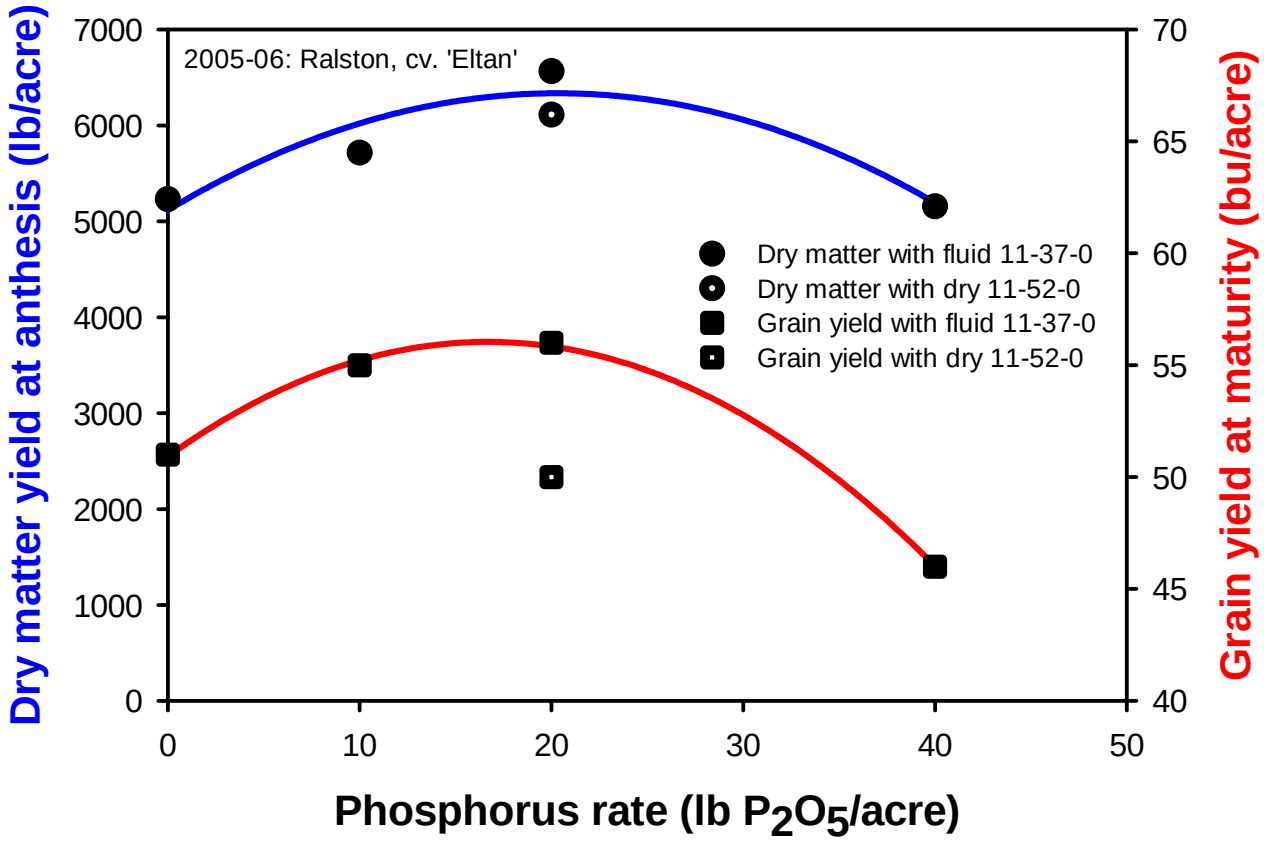
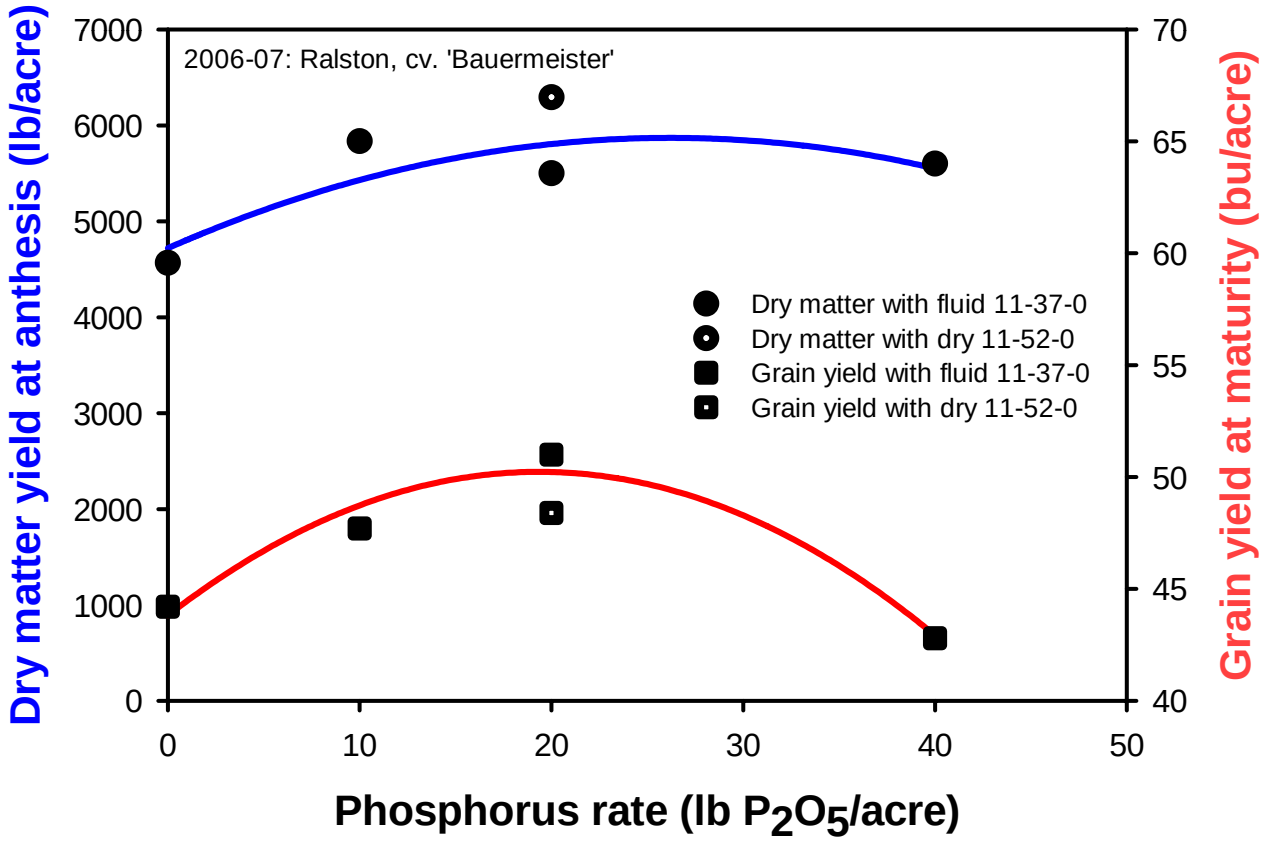
Lind low rainfall zone site in 2006



Ralston low rainfall zone site in 2006



Ralston low rainfall zone site in 2007



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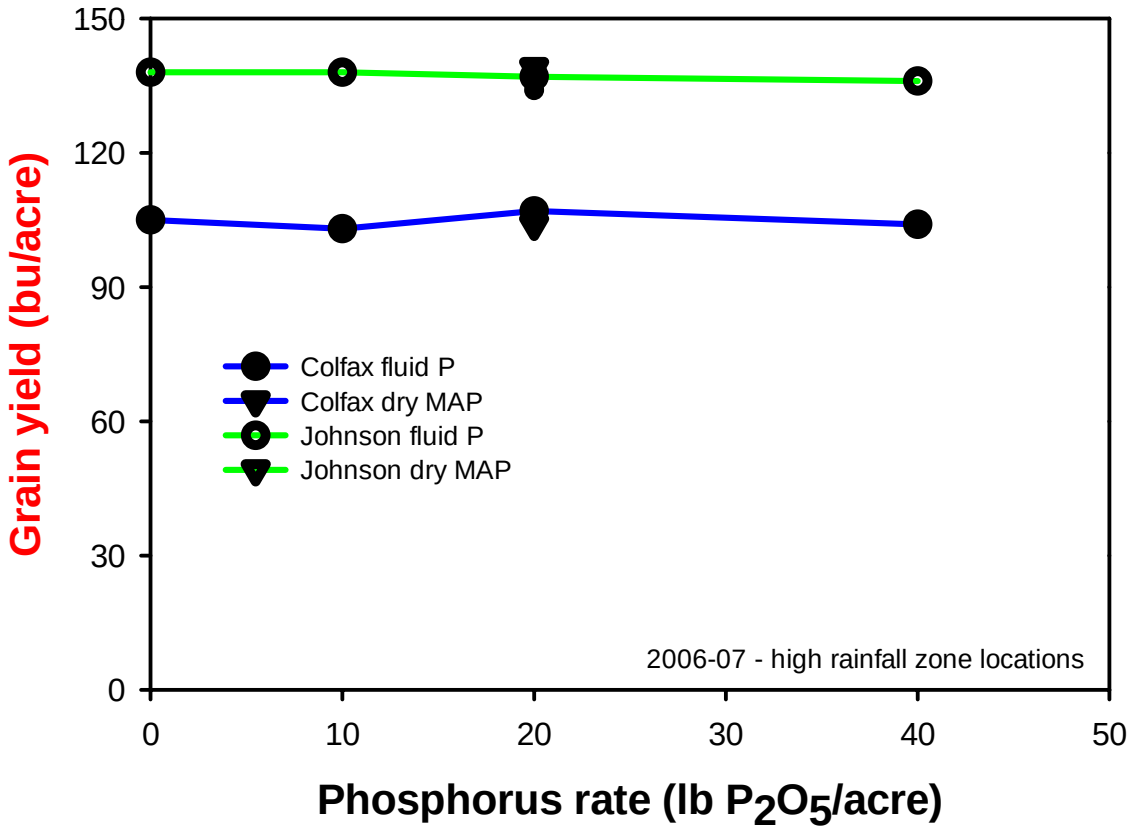
Why a negative response to higher rates of P?

- Crop-fallow rotations are moisture limited
- Excessive vegetative growth can be detrimental
  - Leads to “haying off”
  - Early depletion of stored soil moisture leading to stress during grain filling

High rainfall zone - no response to P



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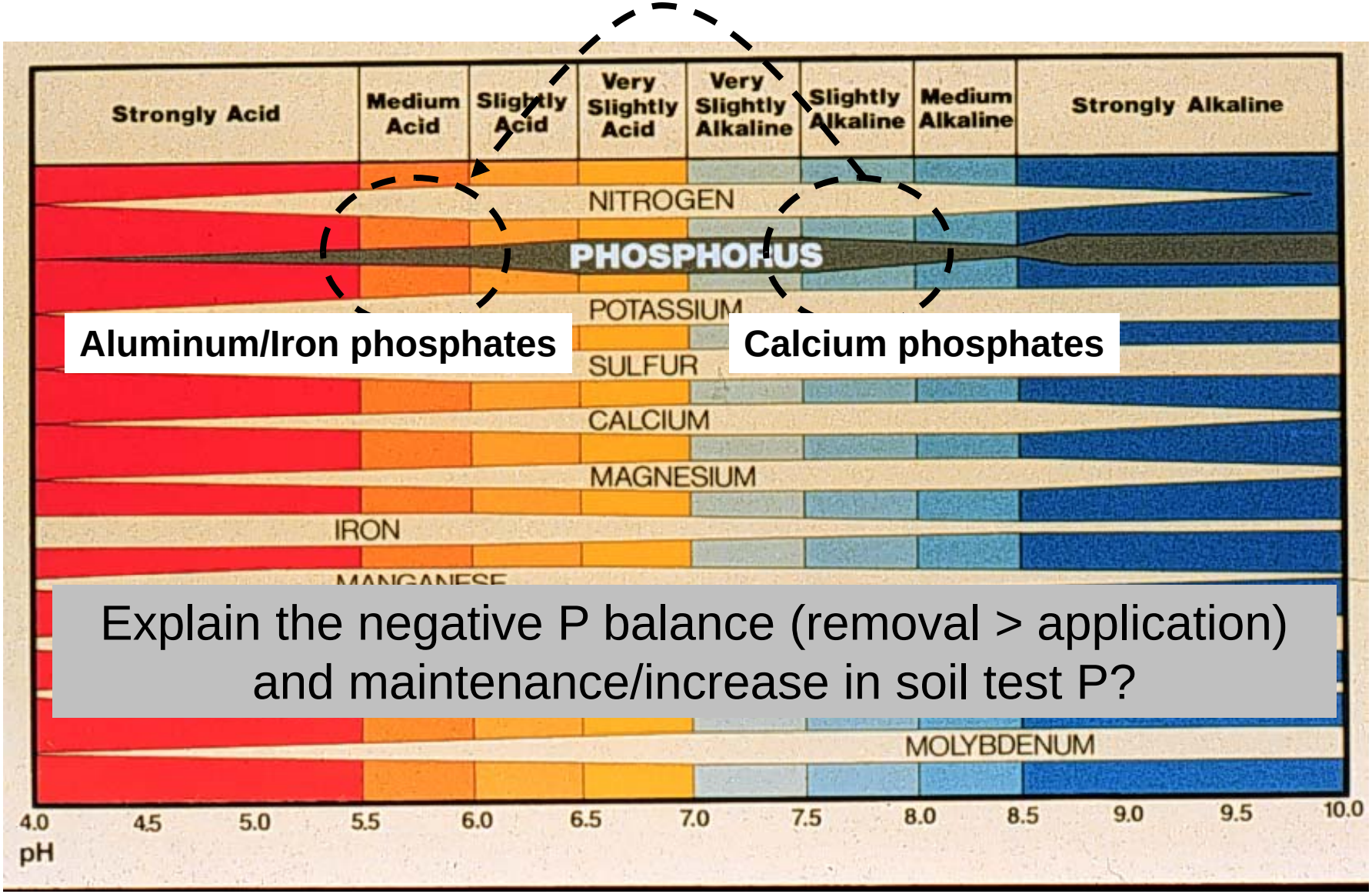
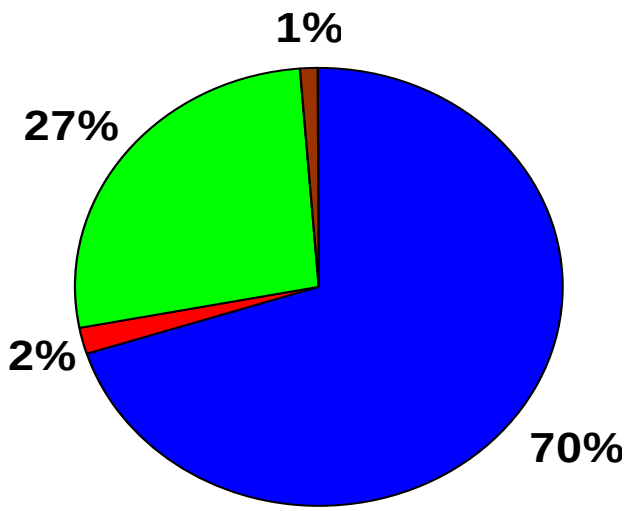
Recently acidified soils

- Soil pH 6.5-7.6 in original 1970s surveys; 5-6 now
- Transition-phase chemistries?
- Thermodynamics predict dissolution of calcium phosphates and formation of iron/aluminum phosphates
- Kinetics?



Explain the negative P balance (removal > application) and maintenance/increase in soil test P?

Forms of soil phosphorus



Average of 10 samples from eastern WA; average pH = 5.4

Phosphorus mineral stability diagram

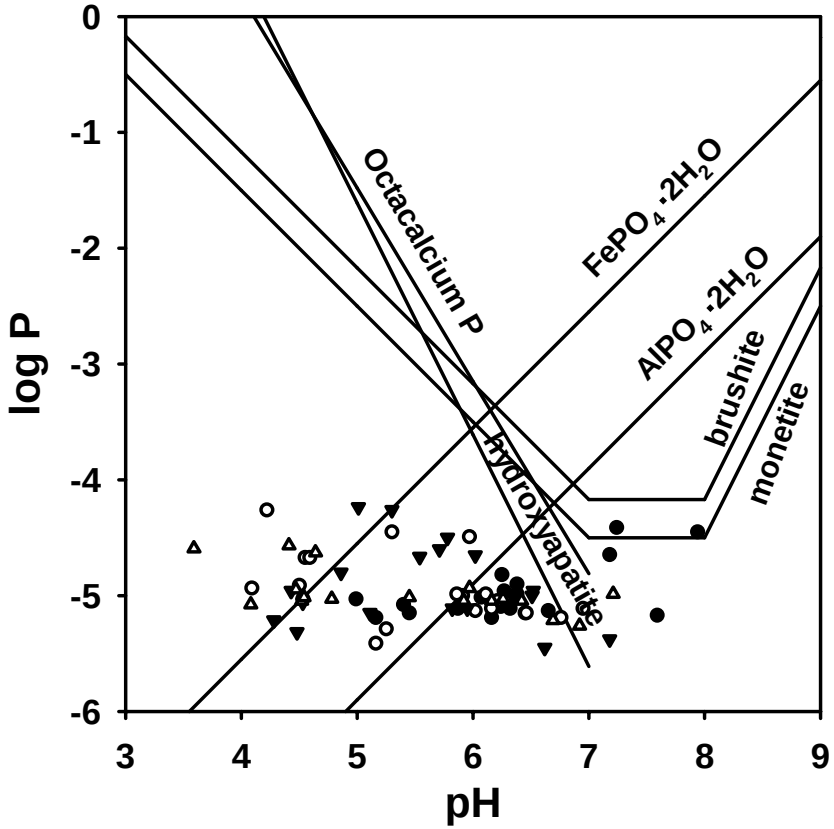
Water and dilute $CaCl_2$ extracts

Equilibrium P activities

Data don't fall along any line

P sorption to oxide surfaces?

Kinetics?



Summary

- Good evidence for response to moderate rates of P in low rainfall, crop-fallow areas
  - Some responses to dry MAP above 0 P control, but fluid P is clearly an advantage here
- No response to applied P in one year in high rainfall zone
  - P must be necessary with high rates of removal
- Questions on soil test methods
- Still working to explain chemistry


Questions?