Nutrient Management in Organic Systems

Prepared for Organic Awareness Workshop-2009

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MONTANA STATE UNIVERSITY EXTENSION

Objectives

- Discuss nutrient dilemma facing organic farmers
- Show Montana research results on the effect of long term organic farming on soil nutrient status
- Show effects of green manures and organic P fertilizers on subsequent yields and nutrient availability
- Discuss recommendations based on different goals

Who was at my presentation at MOA last year?

There are 14 mineral nutrients that have been found to be essential for growth of most plants:

Macronutrients	Micronutrients
Nitrogen (N)	**Boron (B)**
Phosphorus (P)	**Chloride (Cl)**
Potassium (K)	**Copper (Cu)**
Sulfur (S)	**Iron (Fe)**
Calcium (Ca)	**Manganese (Mn)**
Magnesium (Mg)	Molybdenum (Mo)
	Nickel (Ni)
	Zinc (Zn)

The macronutrients are simply needed in larger amounts by the plant than the micronutrients.

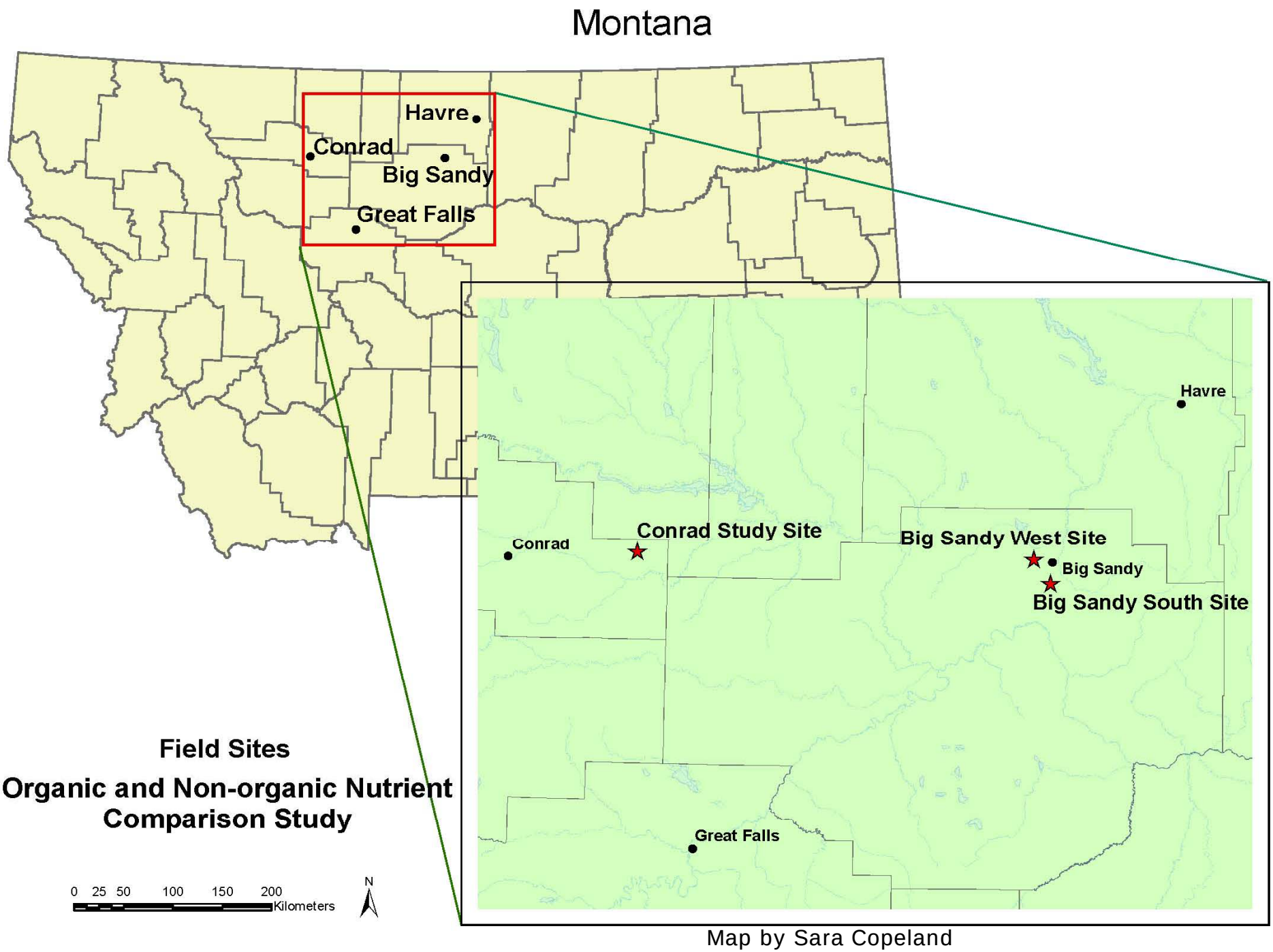
Nutrient deficiencies of the bolded nutrients have been observed in Montana

How many of these 14 can be ‘grown’ (and won’t need to be replaced with fertilizer)?

Question: Are available and total nutrient levels decreasing in organic systems in Montana?

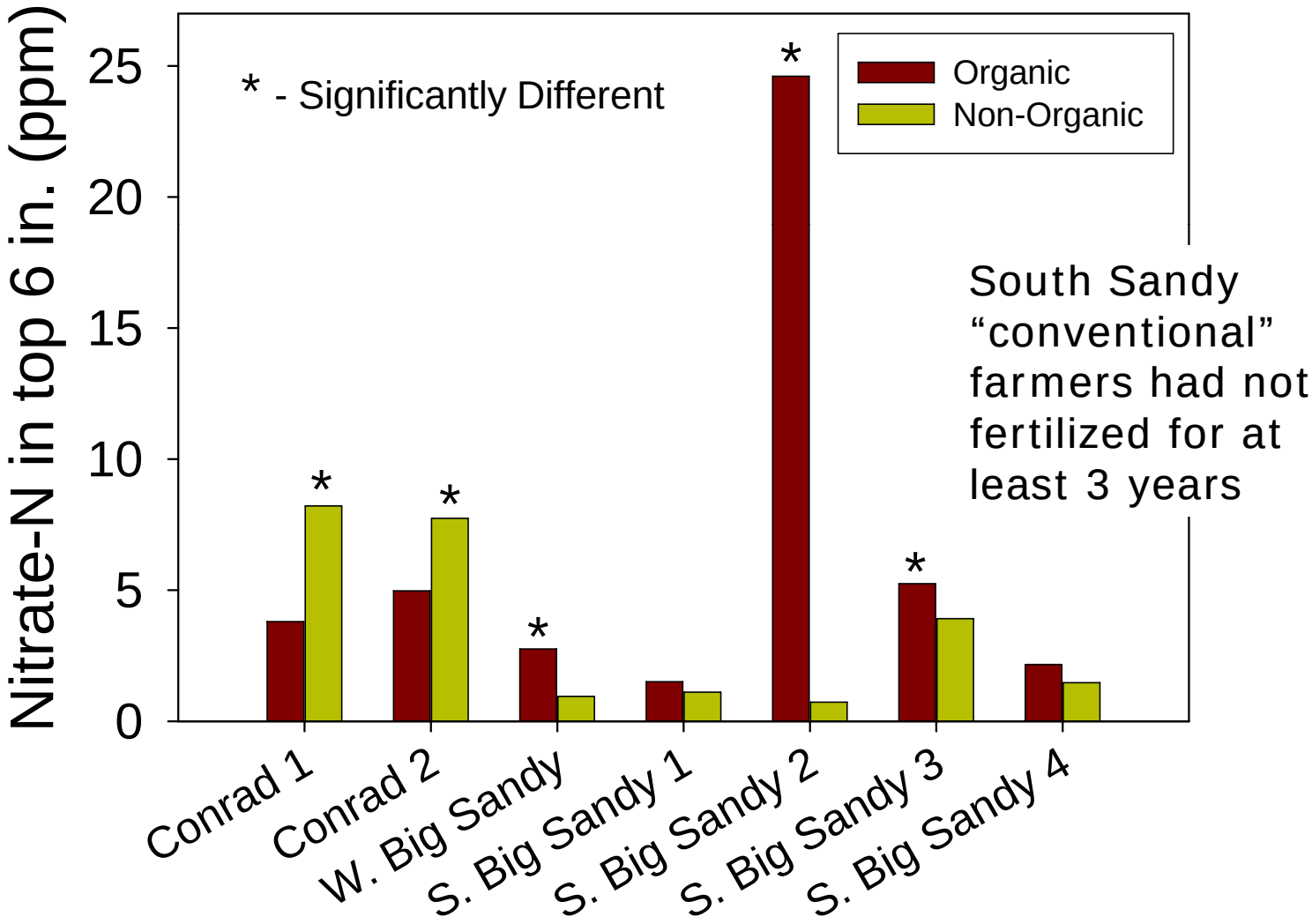
‘Across the Fenceline’ (ATF) Study

- Three organic grain farms in Golden Triangle identified that had more than 8 years of organic farming history
- Top 6 inches sampled Spring 2007 on both organic and non-organic no-till side of 7 total ‘fencelines’

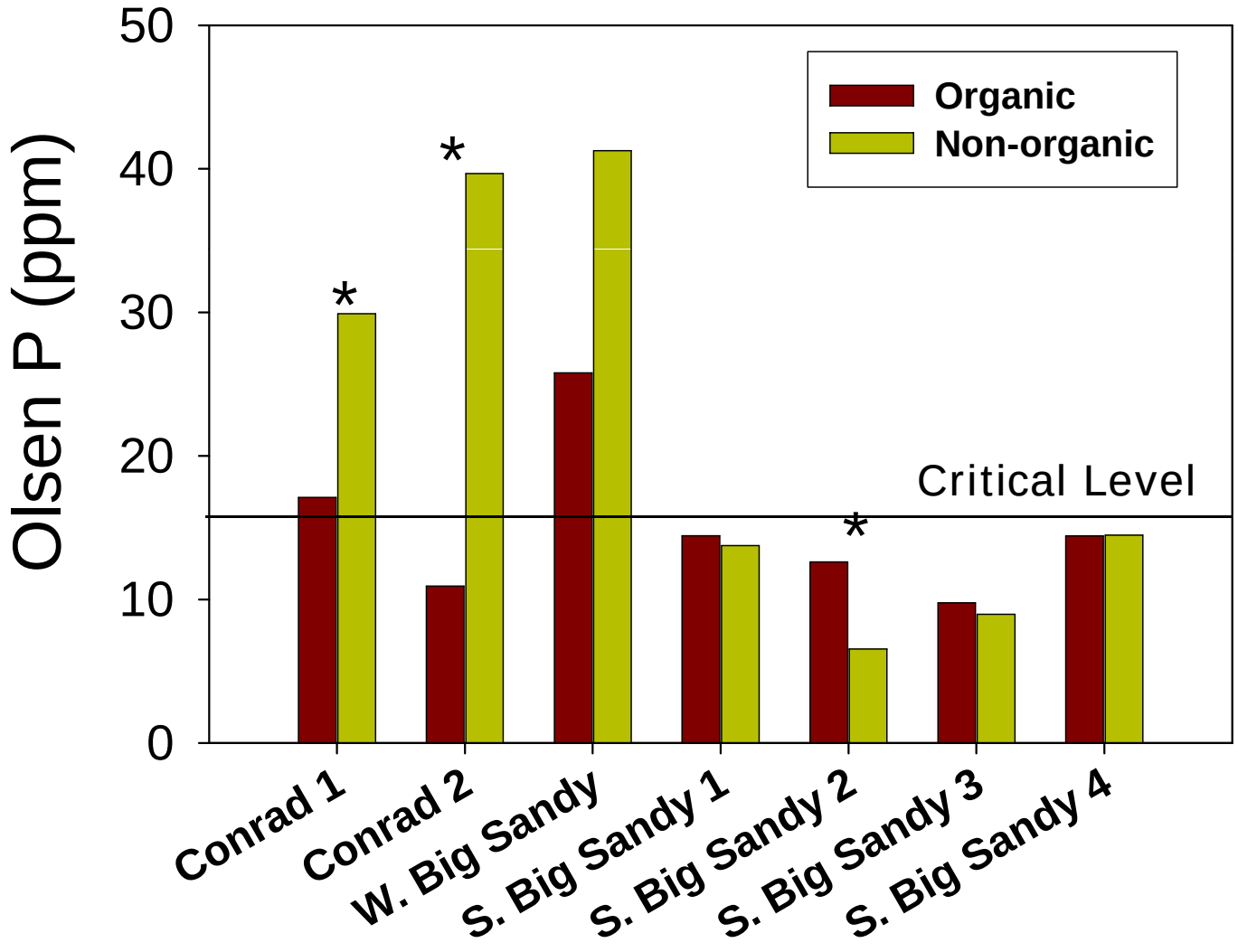


Map by Sara Copeland

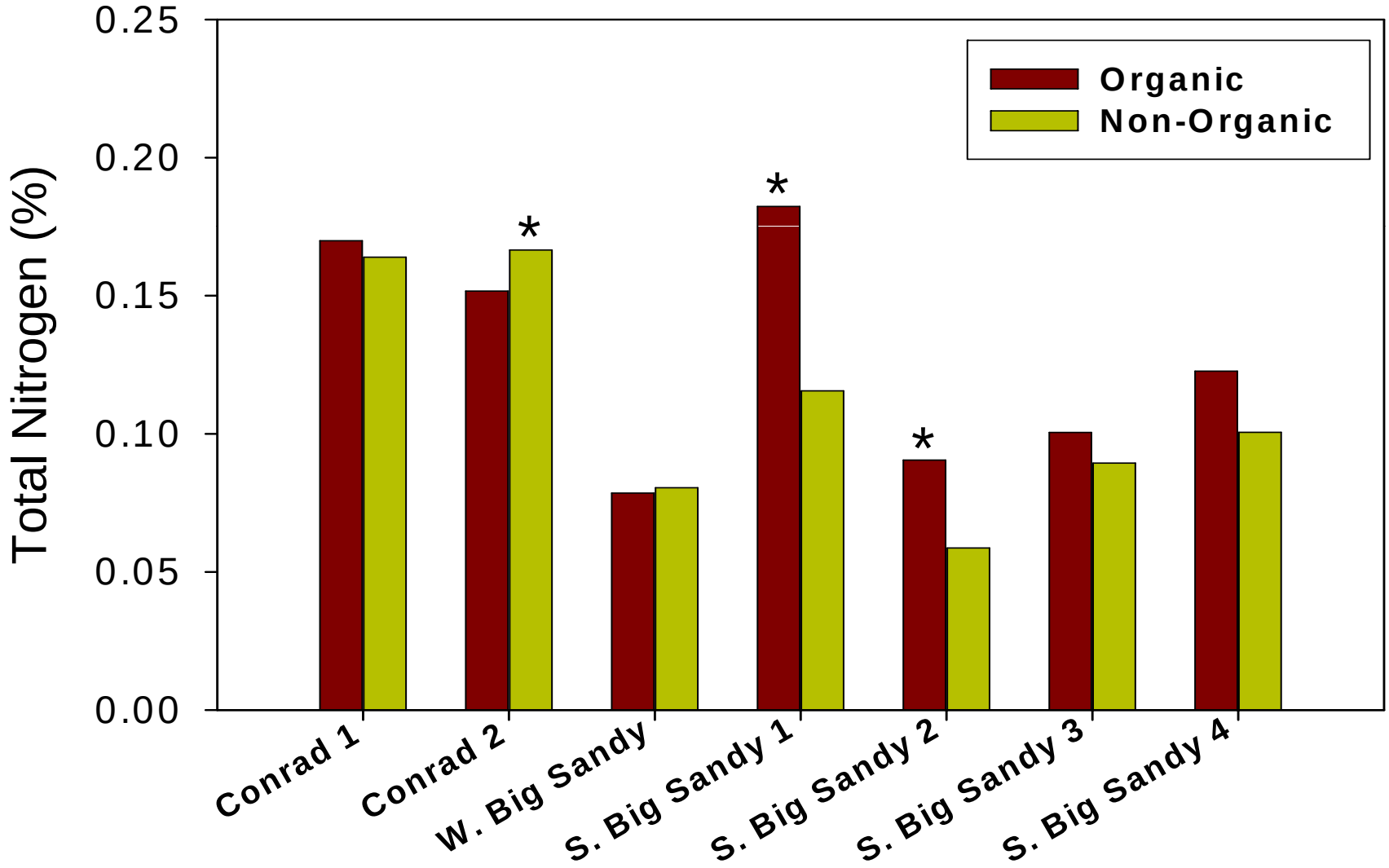
ATF: Nitrate-Nitrogen Comparison, 2007



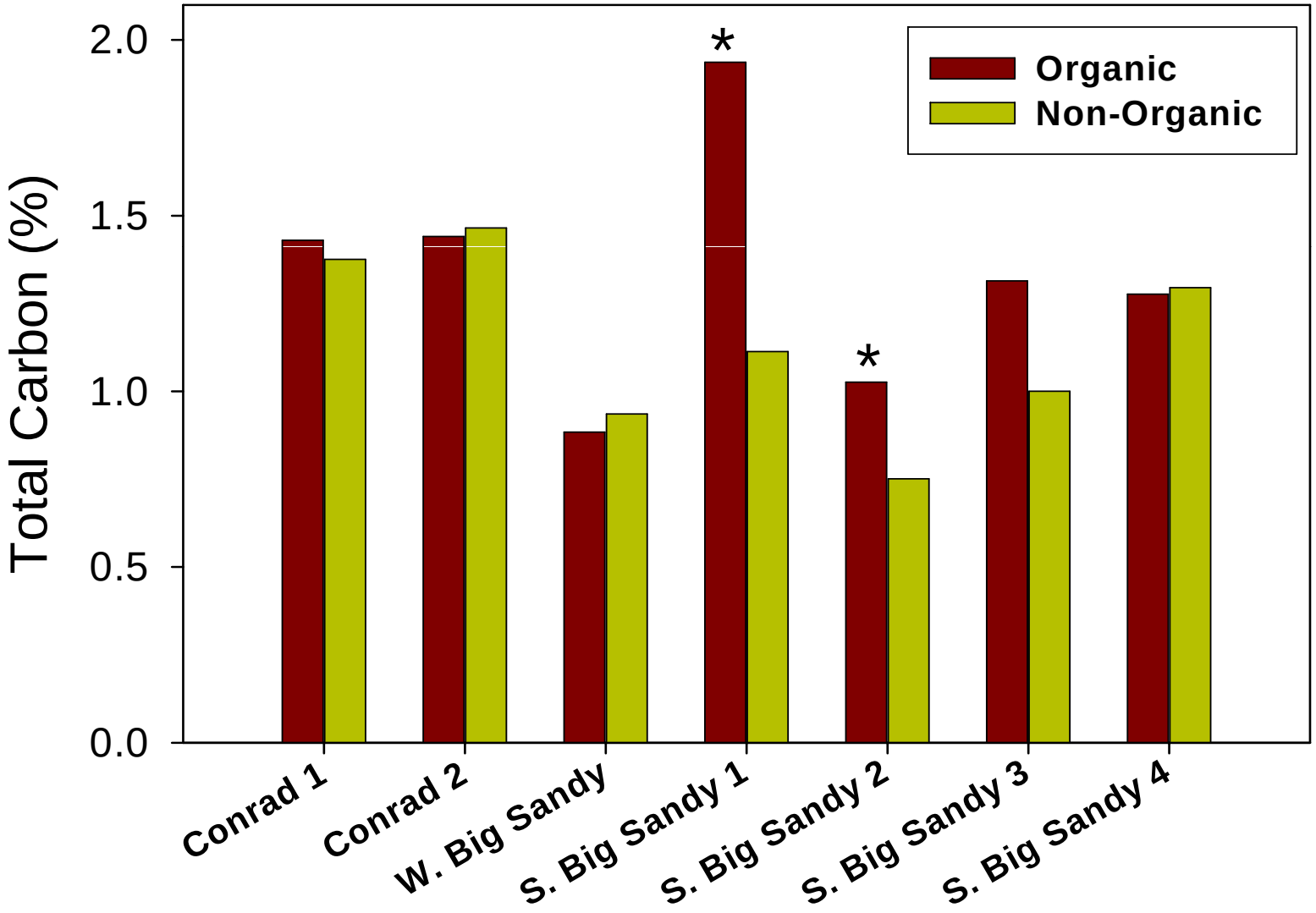
ATF: Olsen P Comparison, 2007



ATF: Total Nitrogen Comparison, 2007 (top 6 inches)

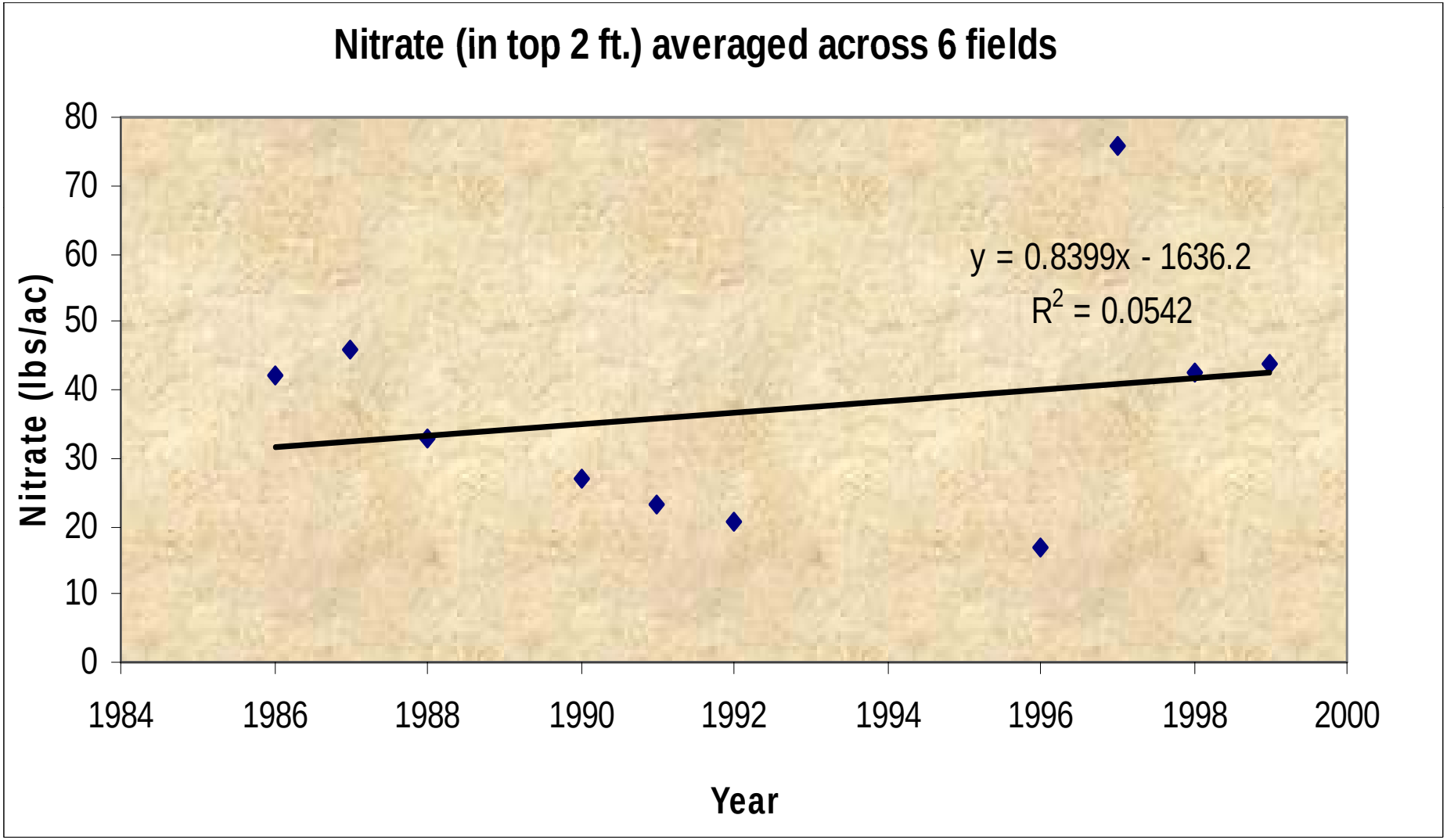


ATF: Total Carbon Comparison, 2007 (top 6 inches)

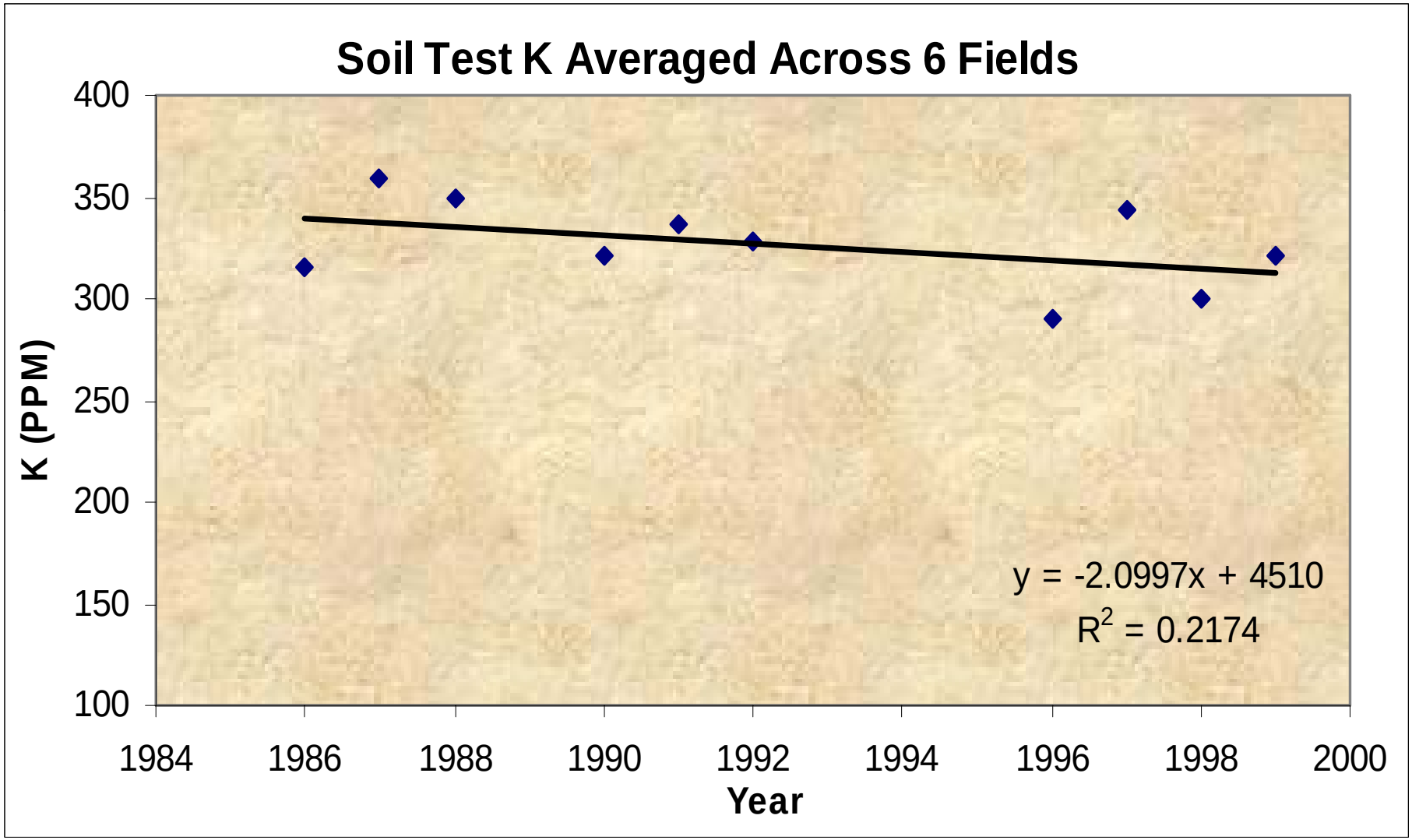


Problem with fenceline studies?

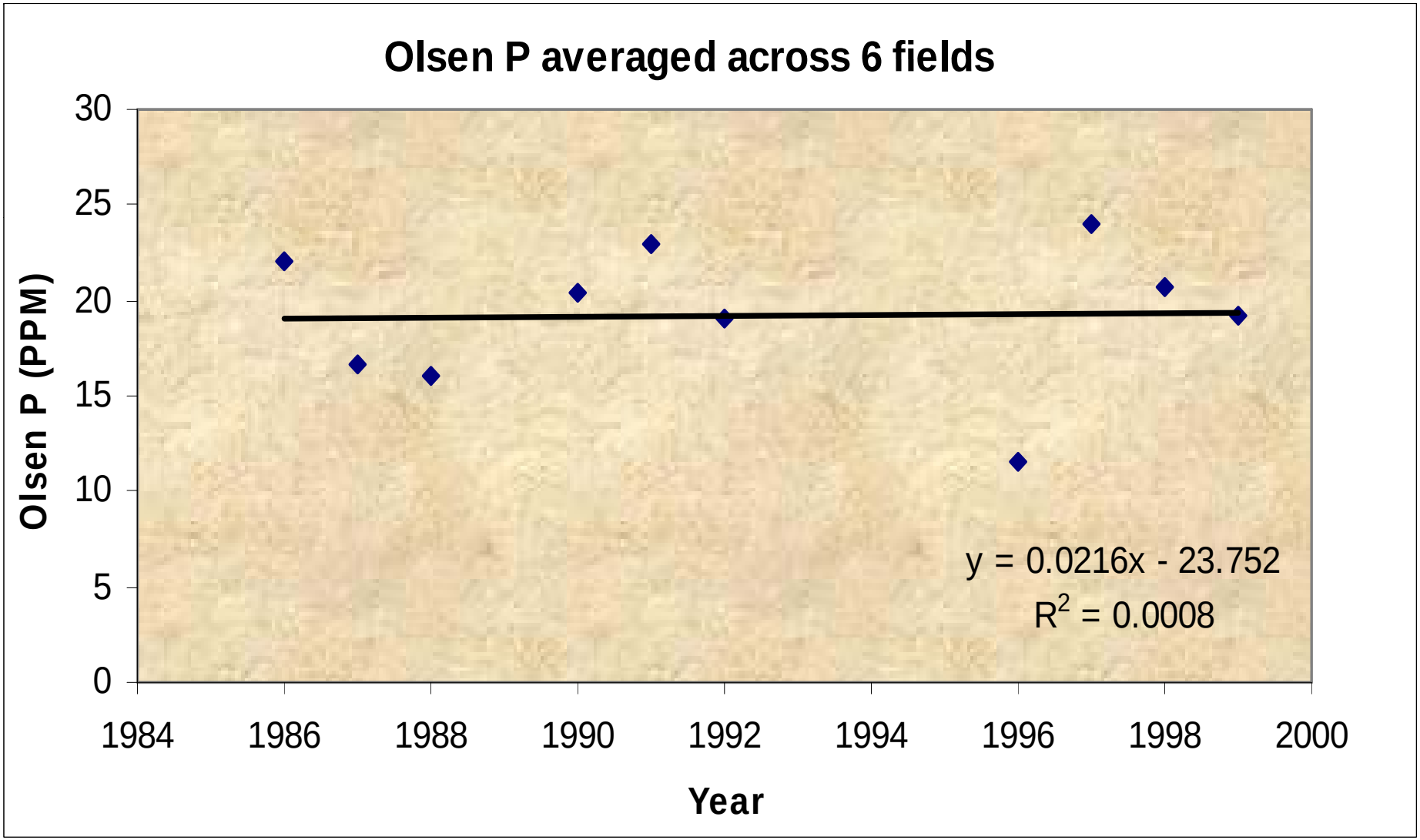
Nitrate Concentrations over time in Organic Fields in South Big Sandy



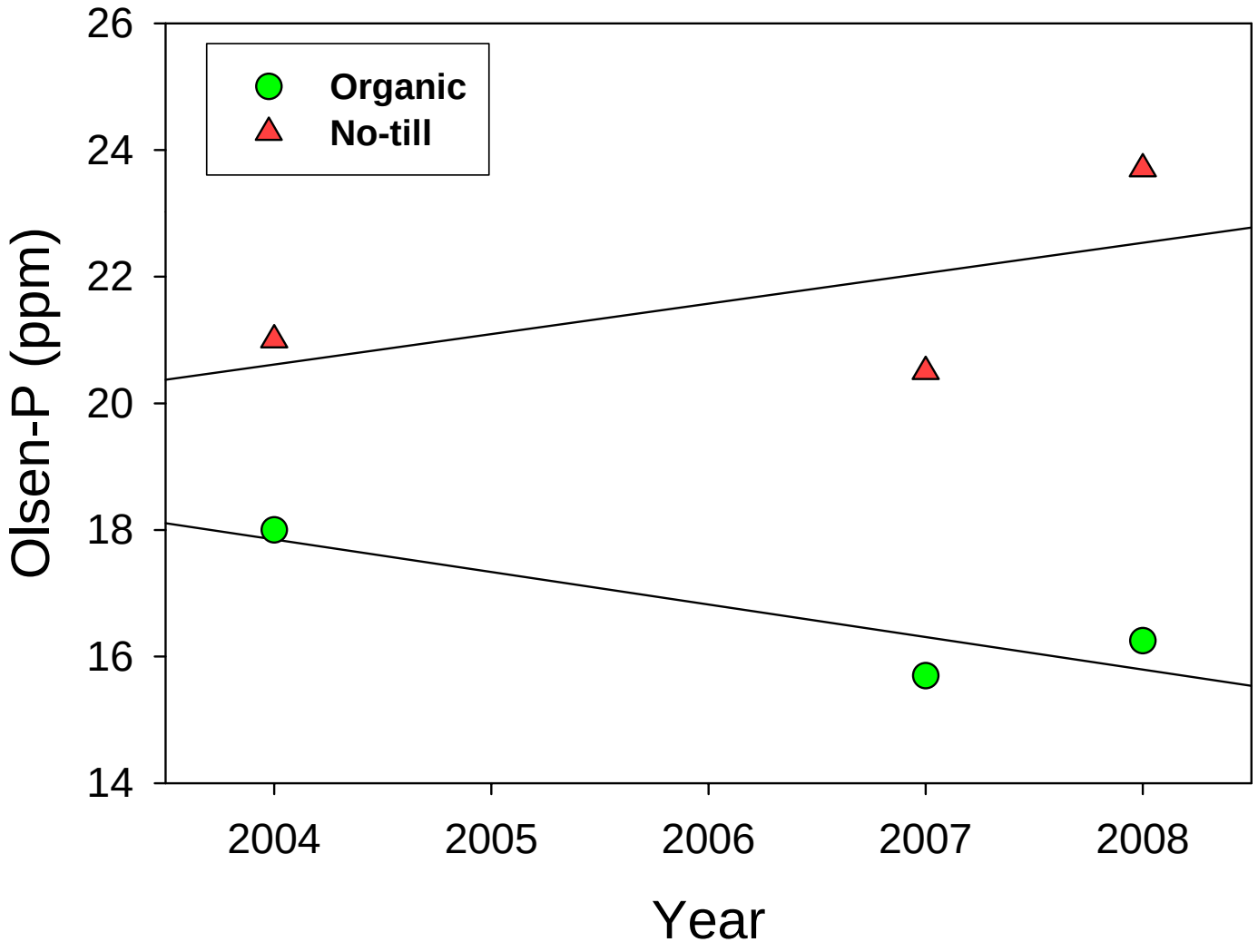
Available K Concentrations over time in Organic Fields in South Big Sandy



Olsen P Concentrations over time in Organic Fields in South Big Sandy



Olsen P changes in Bozeman plot study (CDRS: 2000-present)



Questions so far?

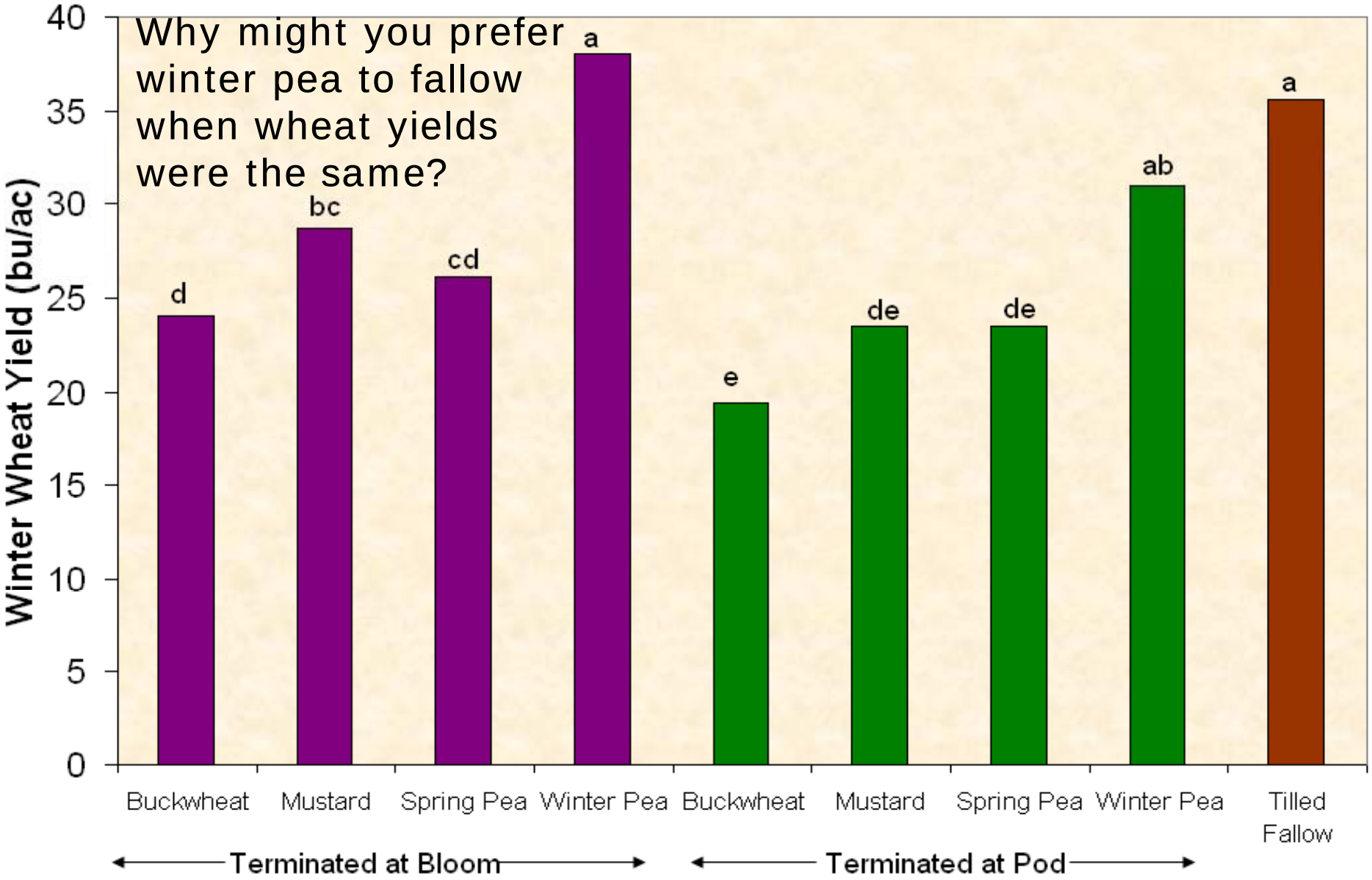
What are options for increasing soil fertility on Montana's organic farms?

- Livestock manure (problems?)
- Green manures
- Organic fertilizers (rock phosphate, bonemeal, etc.)

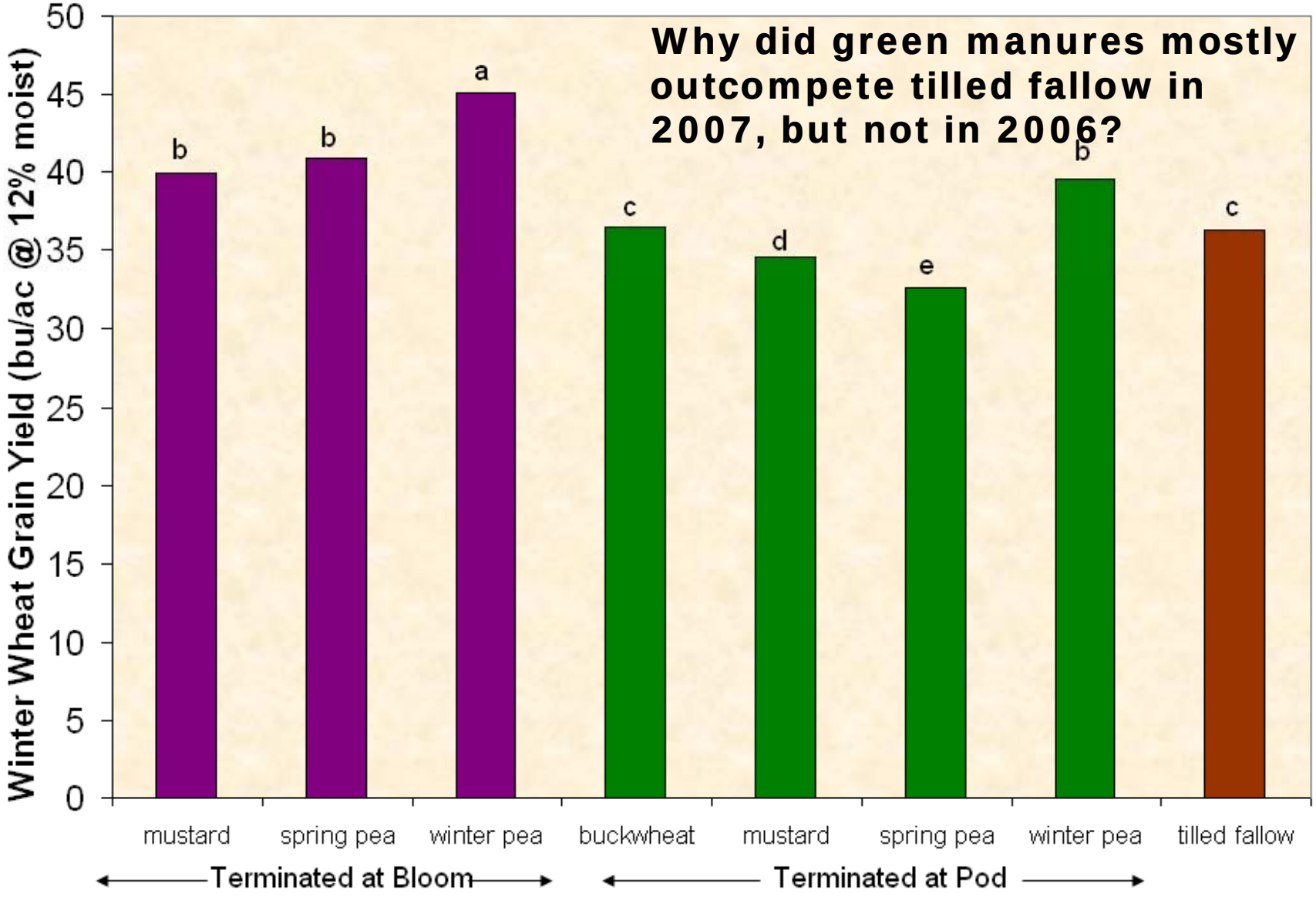
Green Manures (ex: alfalfa, clover, pea, buckwheat)

- Positive: Most replenish N supply w/ N fixation
- Positive: May increase P availability?
- Negative: No immediate economic benefit
- Negative: Use soil water, especially perennial legumes

Effect of Green Manure and Termination Timing on Winter Wheat Yields at Big Sandy: **2006**



Effect of Green Manure and Termination Timing on Winter Wheat Grain Yield at Big Sandy: **2007**



WW yield was higher when green manure terminated at bloom

- Why might you want to terminate at pod anyway?

Questions so far?

Phosphorus can not be ‘grown’, needs to be eventually replaced

- In short term, green manures may be able to make P more available.
- In long term, organic P fertilizers such as rock phosphate, bone meal, or manure will need to be added.
- Only about 50-100 years of P left in Montana soils at typical removal rates. Yields will suffer well before this point.

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:

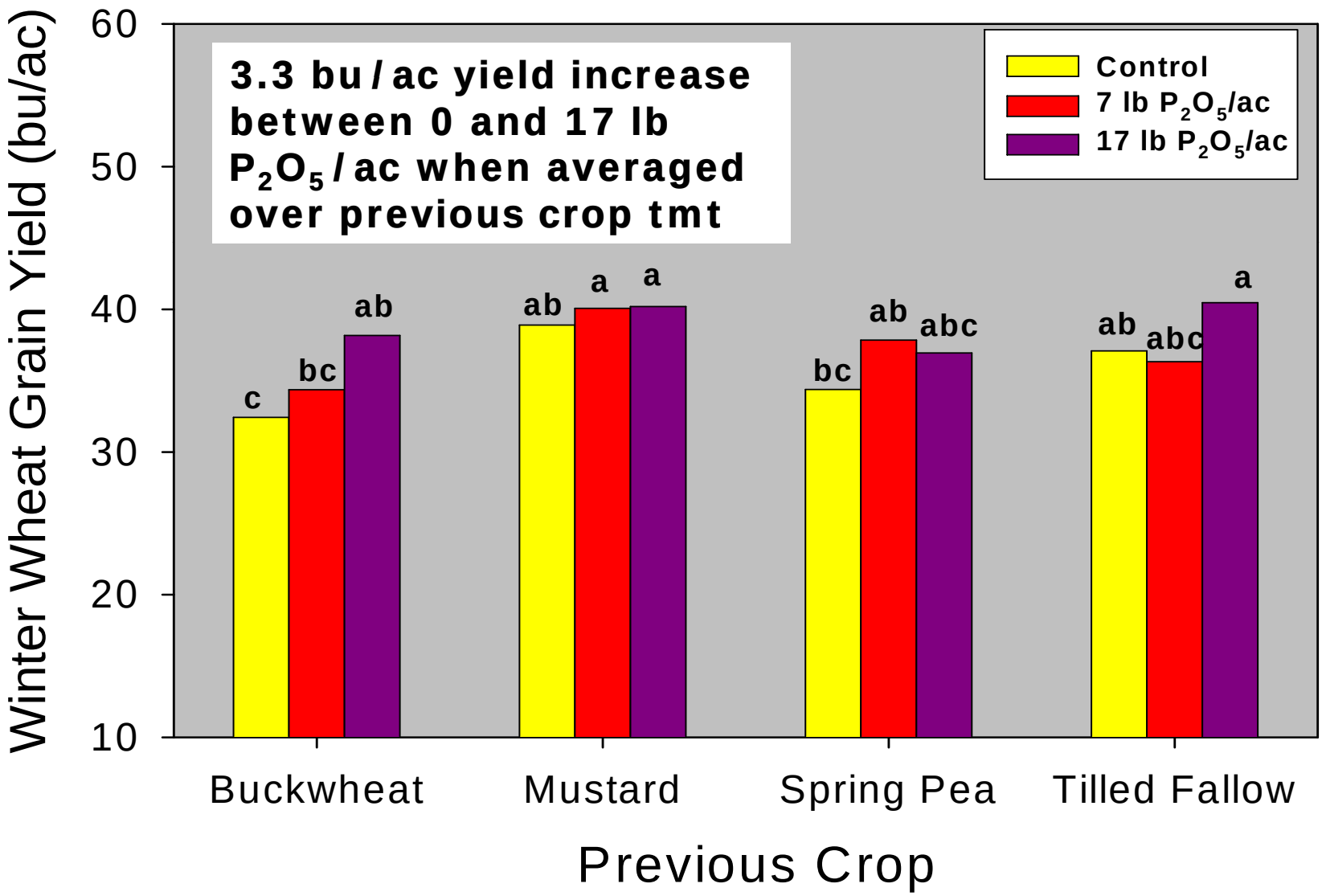
  Buckwheat (*Mancan*)
  Yellow Mustard (*AC Base*)
  Spring pea (*Arvika*)
  Fallow

- 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

- Organic farmers appear to be maintaining or increasing their soil N levels compared to non-organic systems.
- Soil phosphorus levels were generally lower in long-term organic than non-organic systems.
- Winter wheat yields following winter pea green manure were as high or higher than following fallow at Big Sandy.
- Green manures fertilized with rock phosphate did not significantly increase subsequent winter wheat grain yield (or P uptake) compared to fallow.
- Rock phosphate slightly improved yields when applied well before crop, but likely not economical at moderate to high Olsen P levels.

Overall Summary

- Maintaining nutrient availability is important on organic farms to optimize yield and quality.
- Diverse crop rotations have many benefits, but do not appear to be able to substantially offset lack of P fertilizer.
- Soil (or tissue) nutrient levels should be monitored periodically to determine if a nutrient deficiency exists.
- Increasing the frequency of legume green manures can be used to increase N availability, and rock phosphate, bone meal, manure, or possibly buckwheat (?) can be used to increase P availability.

For more Information:

Soil Fertility Website:
http://landresources.montana.edu/soilfertility

Questions?