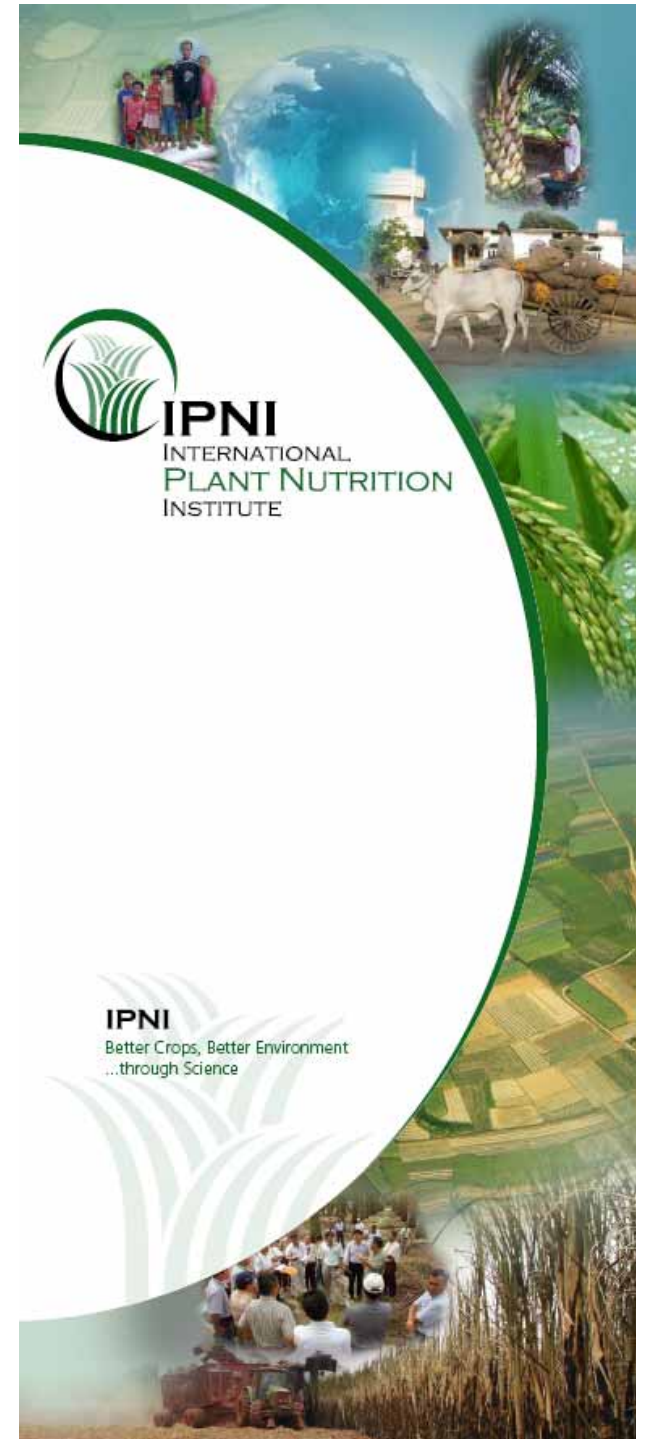


Economic Use of Immobile Nutrients

T. Scott Murrell
Director, North American Programs

8th Annual Nutrient Management Conference,
Morton, MN. 9 Feb. 2016.



Outline

- What are the risks if I skip an application?
- What will happen to soil tests if I skip an application?
- How can I get the most from banded P applications?

**What are the risks if I skip
an application?**



What information does a soil test provide?

- An index of the amount of plant-available nutrients in the soil

- This index must be correlated to yield response:

- Examine responses to nutrient additions at various soil test levels
- Conduct studies across a wide range of soil test levels and environmental conditions

Report Number: 12-34-56
Account Number: 01-0001-01

Reliable Labs, Inc.

To: Your Company Name
Rte 1
Rural City

For: New Farmer Customer
Rte 3
Rural City

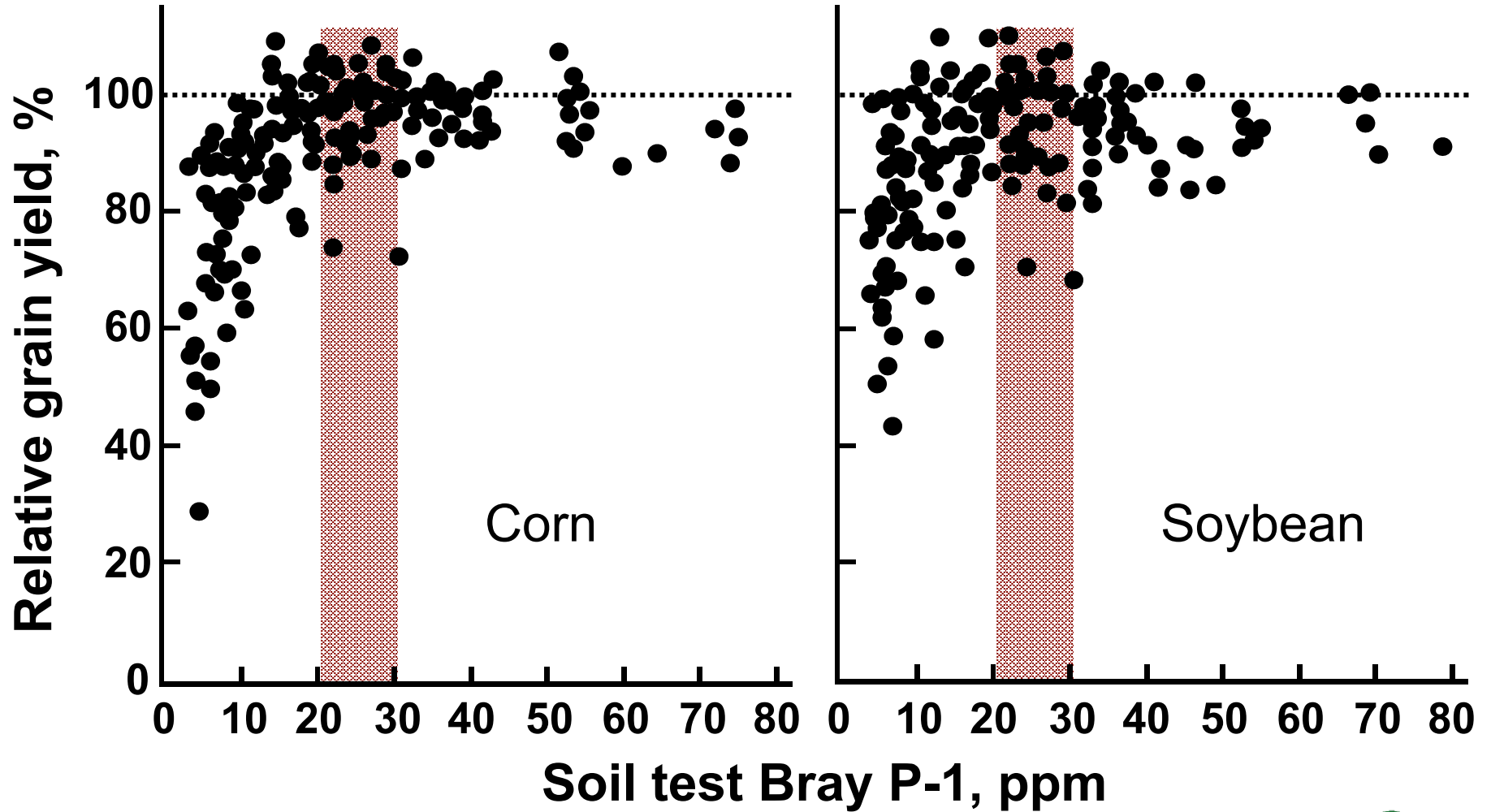
Farm: New Farm

Field: First Field

Soil Test Report

Sample number	Lab number	Organic matter (%)	Phosphorus		Potassium K (ppm)	Magnesium Mg (ppm)	Calcium Ca (ppm)	pH Soil pH	Buffer pH	Cation Exchange Capacity (meq/100g)	Percent Base Saturation			
			Bray P1 (ppm-P)	Bray P2 (ppm-P)							% K	% Mg	% Ca	% H
1	1005	2.1	22 M	35 M	119 M	195	1000	5.7	6.7	8.7	3.5	18.6	57.3	20.6
2	1006	3.1	43 H	83 VH	123 M	275	1600	6.4	6.9	11.7	2.7	19.7	68.6	9
3	1007	2.2	70 VH	104 VH	152 H	185	1100	6.3	6.9	8.3	4.7	18.6	66.2	10.5

Examples of Correlation to Yield Response: Corn and Soybean in Iowa



Probability of Crop Response:

First season after application

Soil test category	Iowa	North Dakota	South Dakota	Wisconsin
	----- (Probability of response, %) -----			
Very low	80	> 80	> 80	> 90
Low	65	50 - 80		60 - 90
Medium/Optimum	25	20 - 50	40 - 60	30 - 60
High	5	10 - 20		5 - 30
Very high	< 1	< 10	< 20	2 - 5

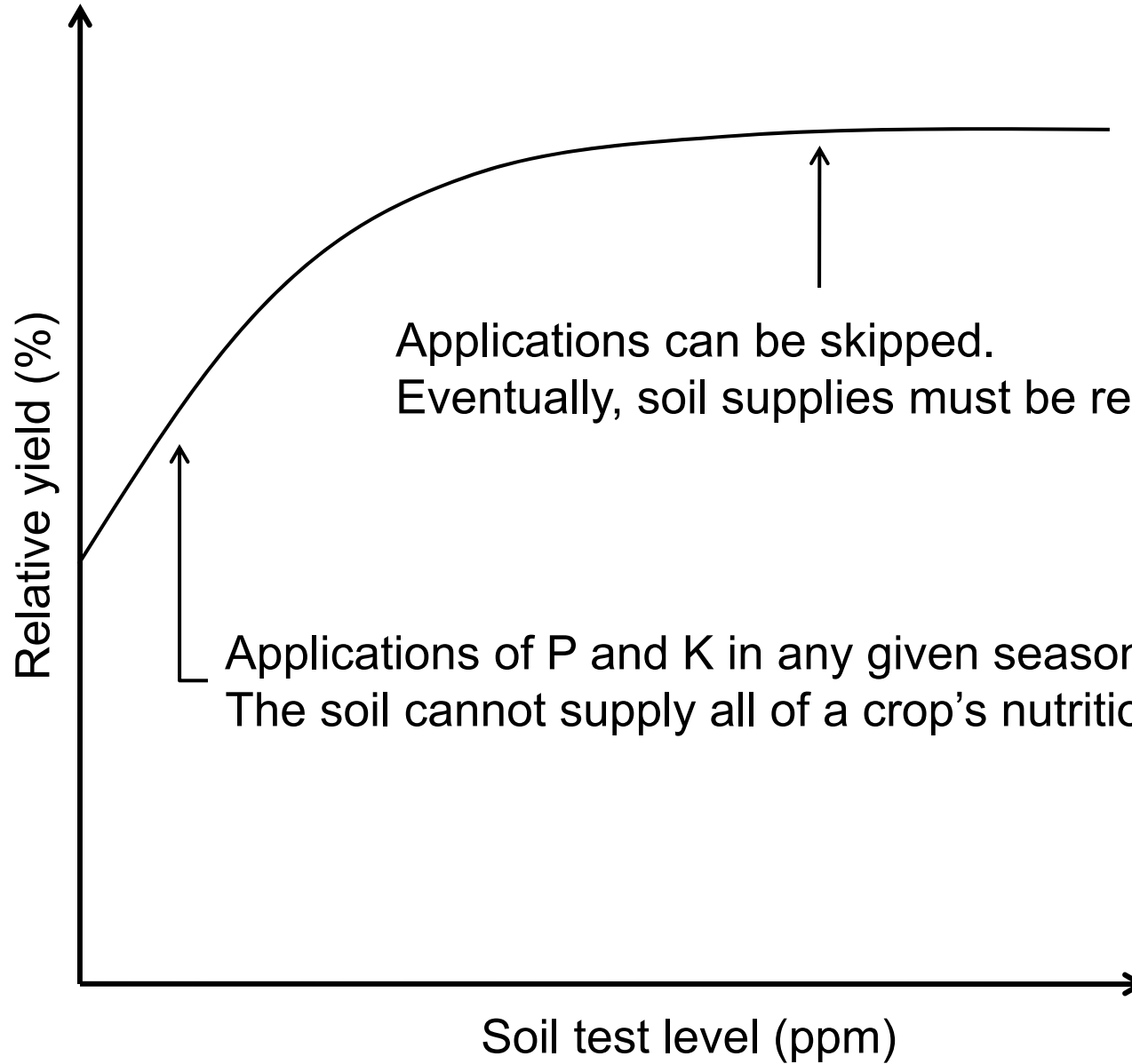
Iowa: Mallarino et al. 2013. Iowa State Univ. Coop. Ext. Bull. PM 1688.

North Dakota: Franzen, D. 2013. North Dakota State Univ. Coop. Ext. Bull. SF882 (Revised).

South Dakota: Gerwing, J. and R. Gelderman. 2005. South Dakota State Univ. Coop. Ext. Bull. EC750.

Wisconsin: Laboski et al. 2006. Univ. Wisconsin Coop. Ext. Bull. A2809.





Variable Target Soil Test Levels (ppm)

	Duration of land use (years)		
	1	4	More than 8
Capital			
Very limited	4	14	20
Limited	6	16	21
Available	9	18	22

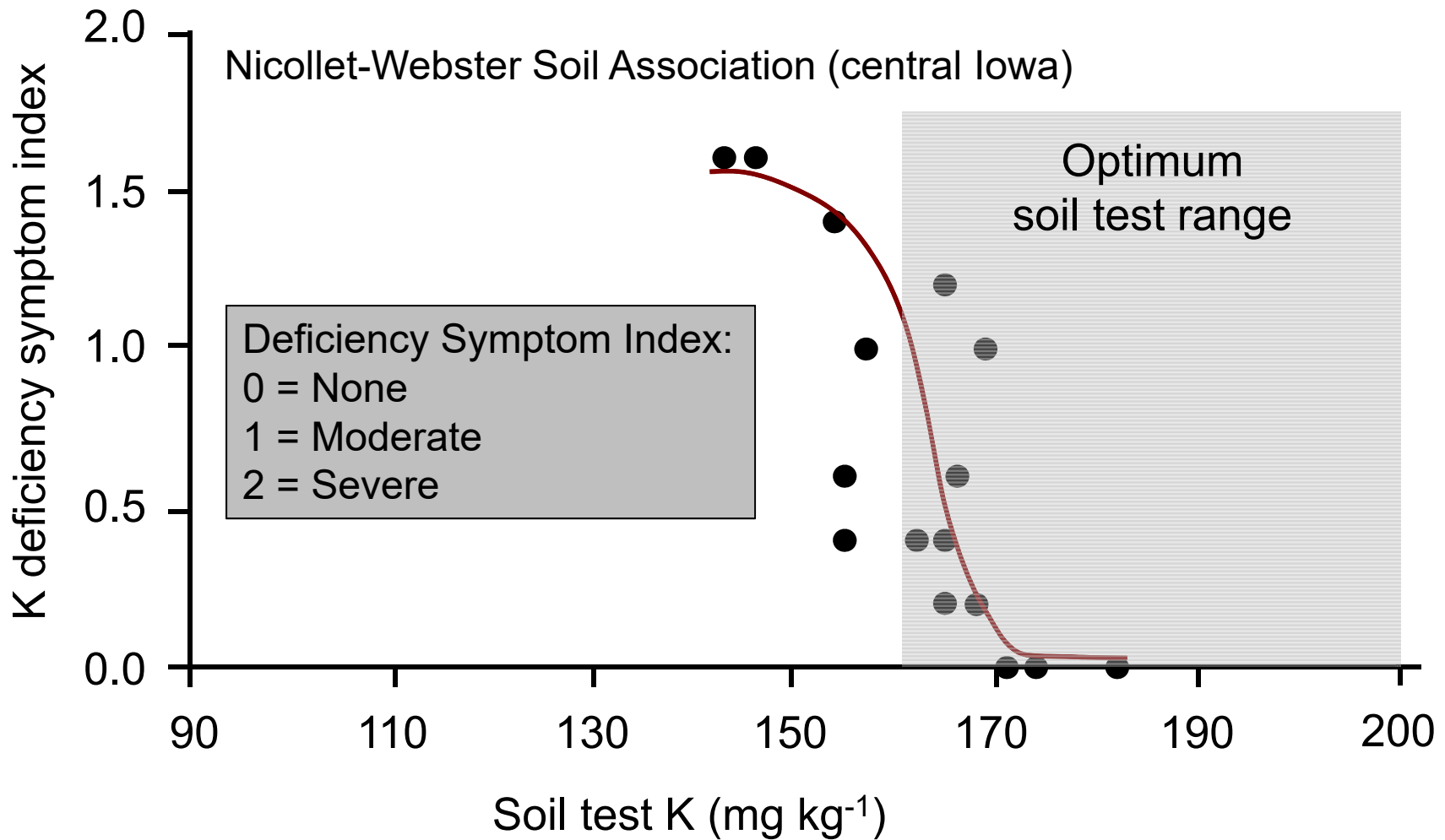
Based on PKMAN modeling approach with a visual interpretation of the Iowa State Univ. calibration data for corn

Symptoms of K deficiency:

Marginal chlorosis / necrosis on lower leaves



Iowa: Soil test interpretations are consistent with visual evidence



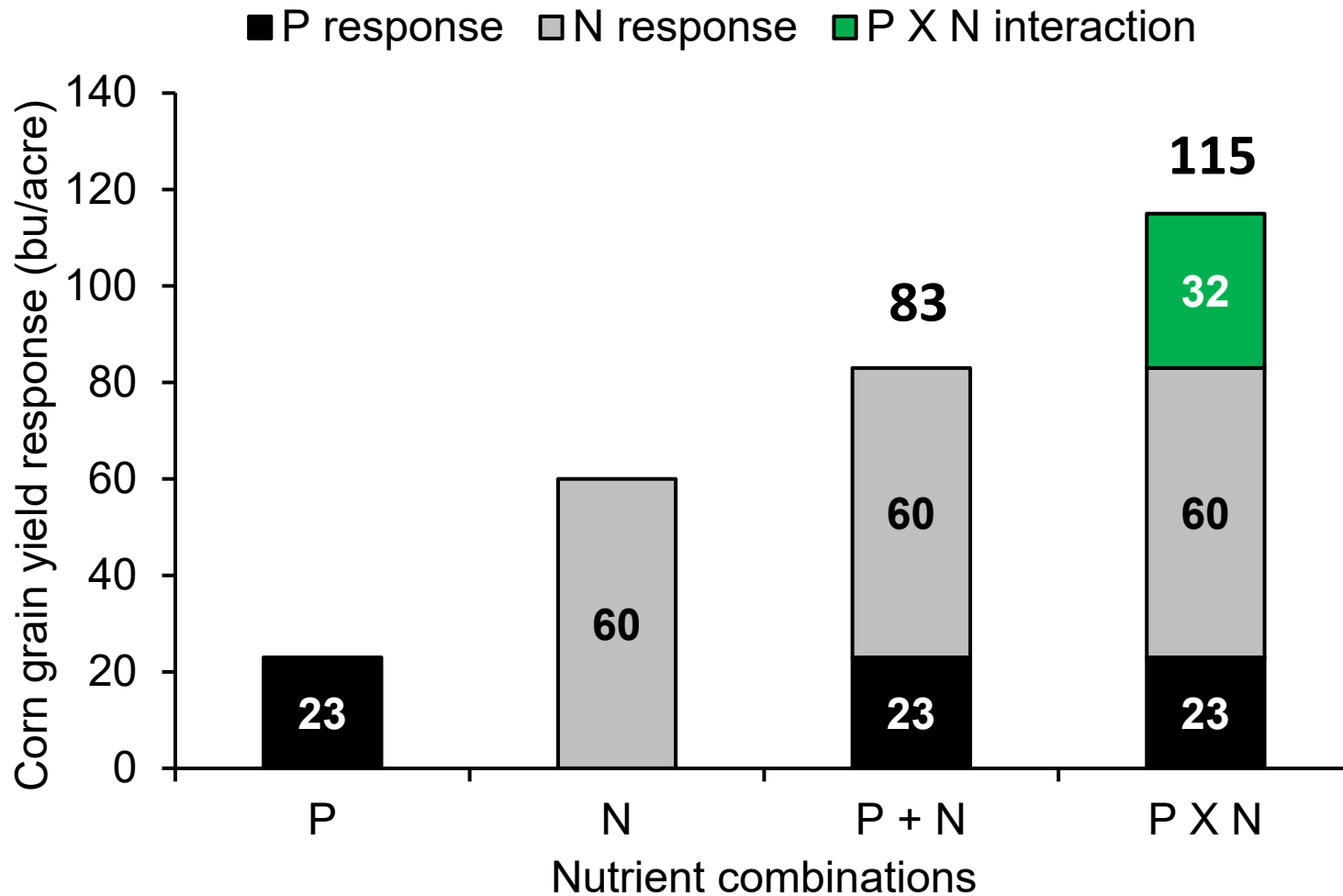
“An interaction takes place when the response of two or more inputs used in combination is unequal to the sum of the their individual responses.”

Tisdale, S.L., W.L. Nelson, and J.D. Beaton. p. 52. Soil Fertility and Fertilizers. 4th ed. Macmillan Publ. Co., New York.

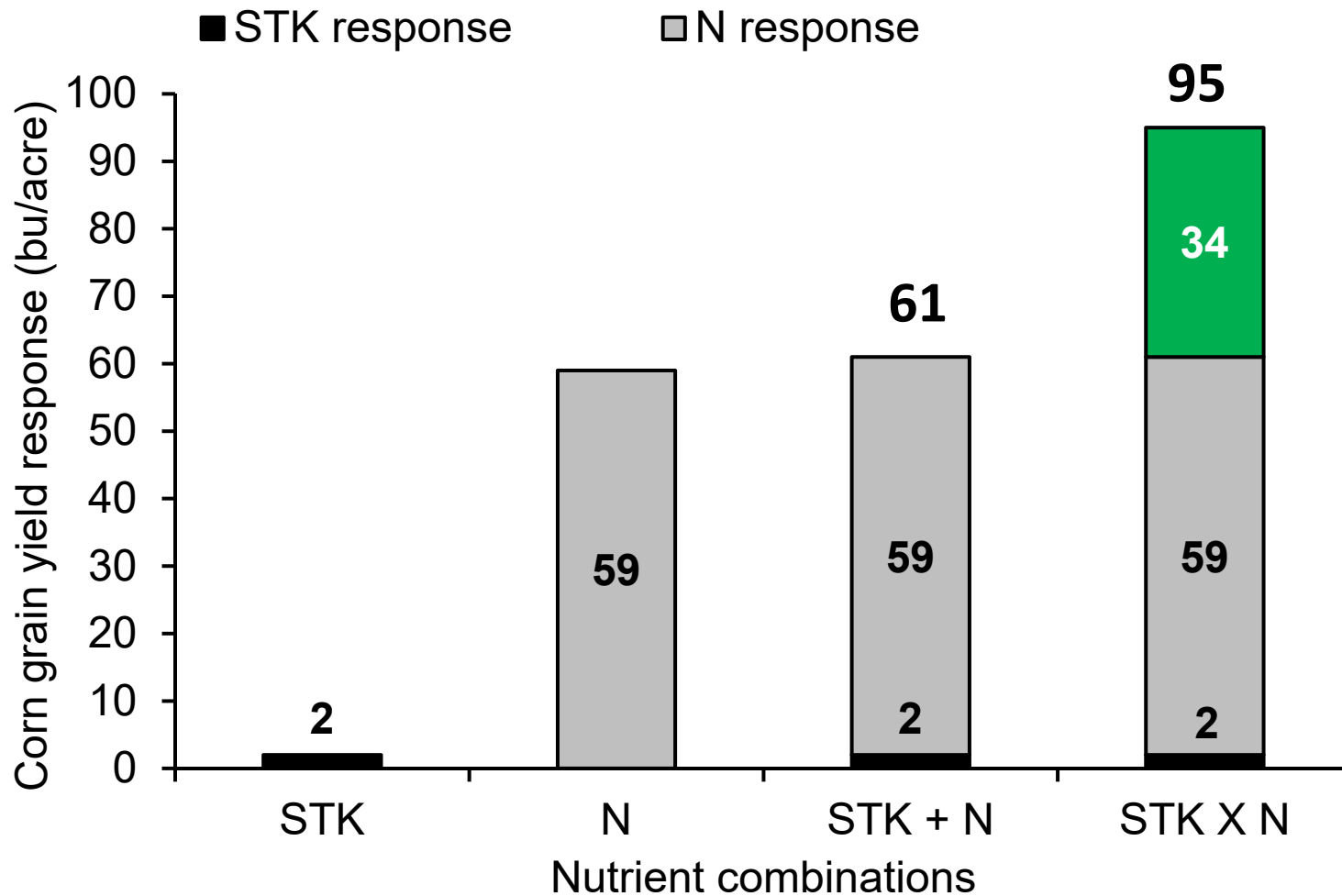


IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

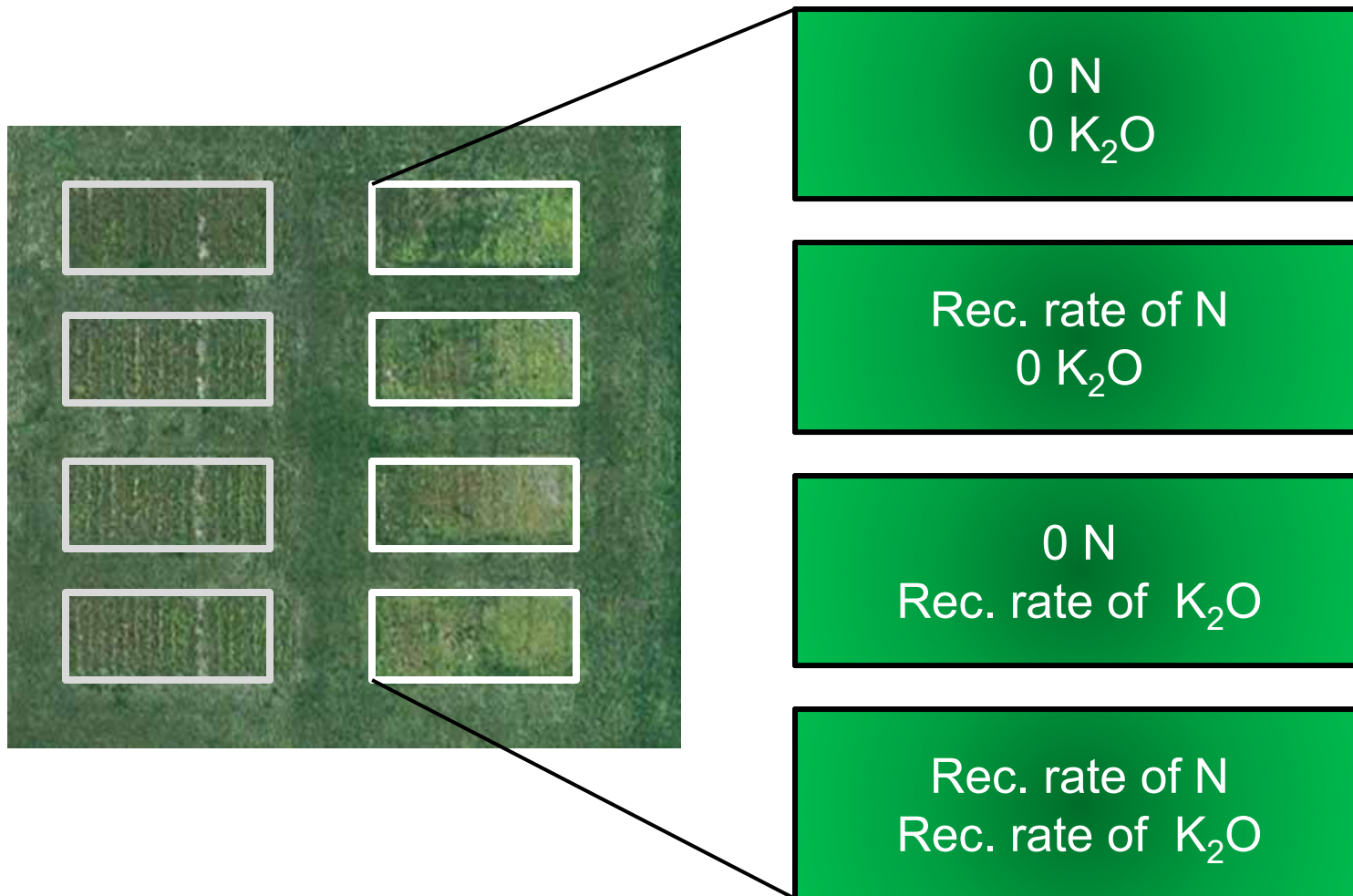
Data are from 30th year of a long-term, irrigated study in Kansas
N: 161 lb/acre
P: 40 lb P₂O₅/acre



Data are from a 4-yr. rain-fed study in Ohio
Soil test K (STK) was increased from 80 ppm to 116 ppm
N: 240 lb/acre



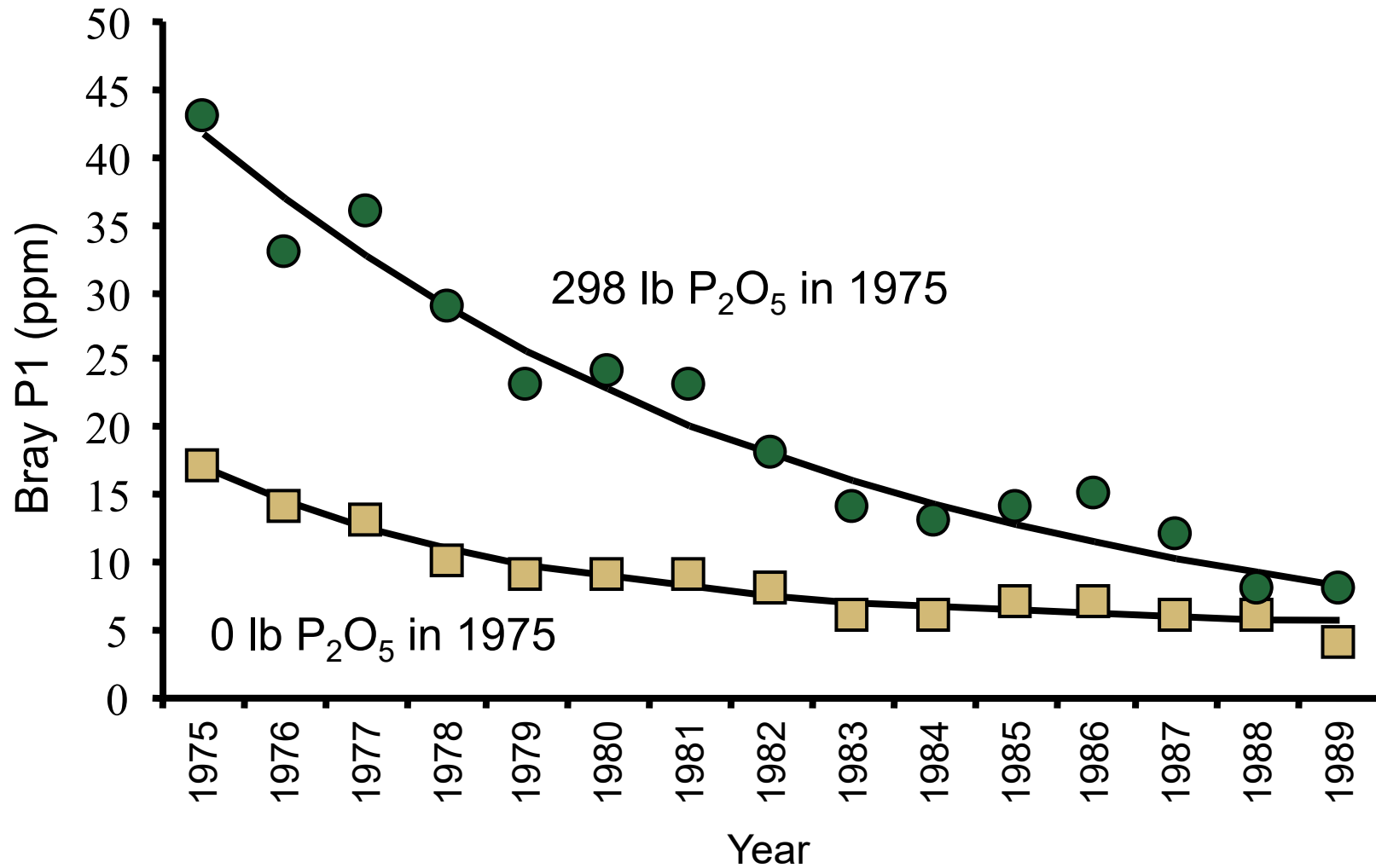
Experimental design needed to measure the interactive effect of two nutrients



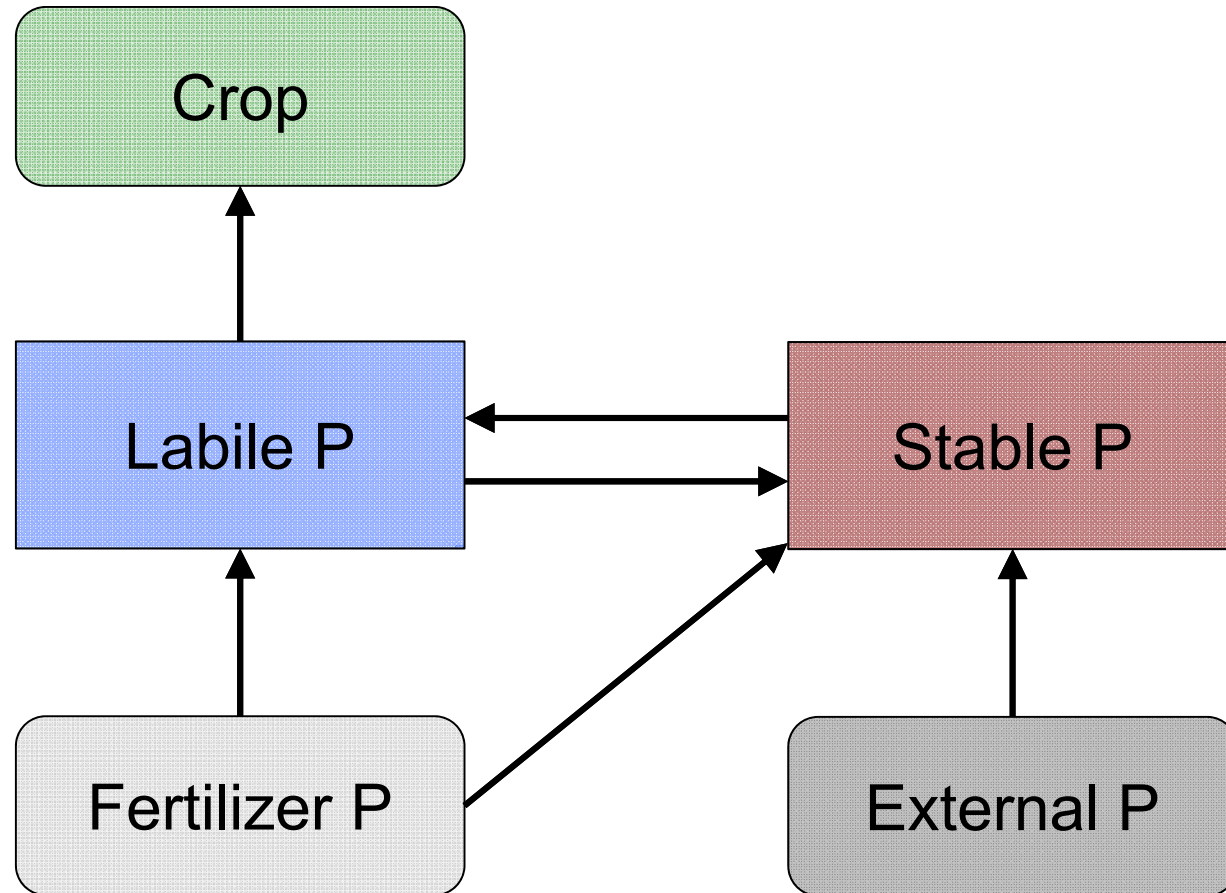
**What will happen to soil tests if
I skip an application?**



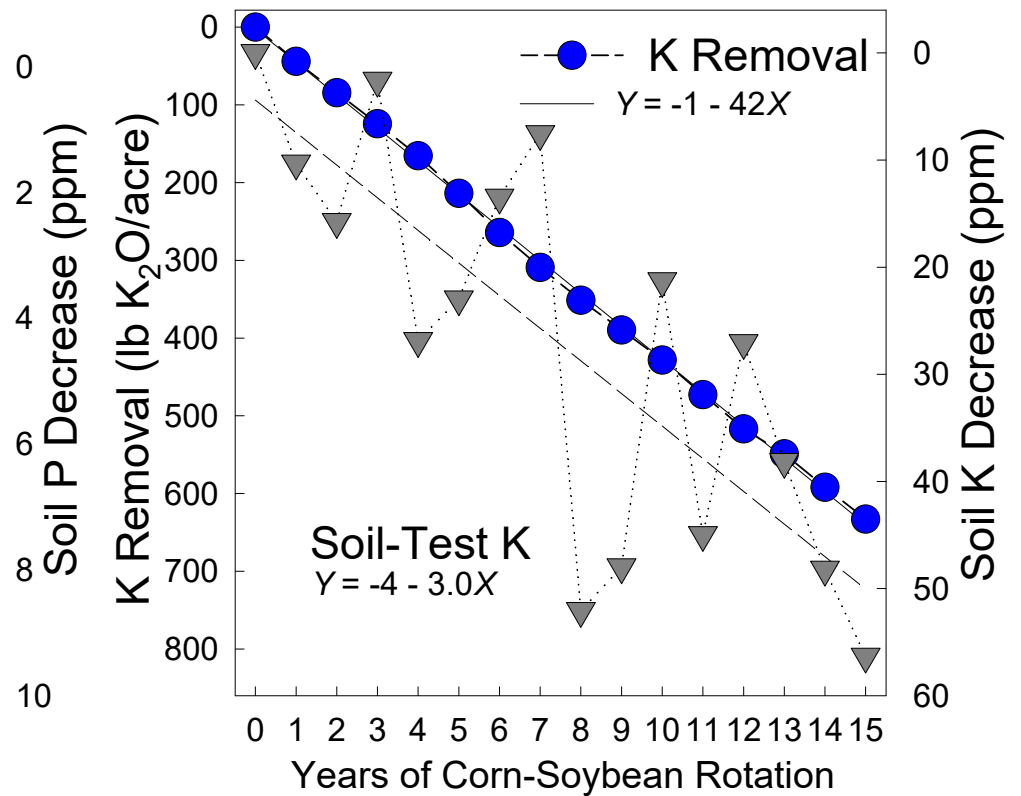
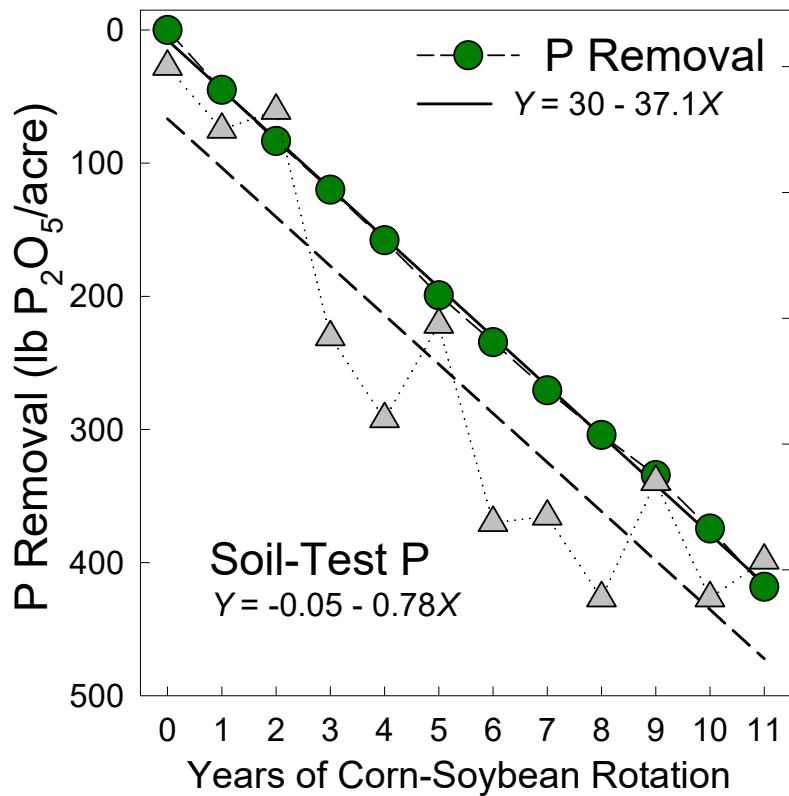
How do soil tests change with no applications?



Labile and Stable Forms of Phosphorus



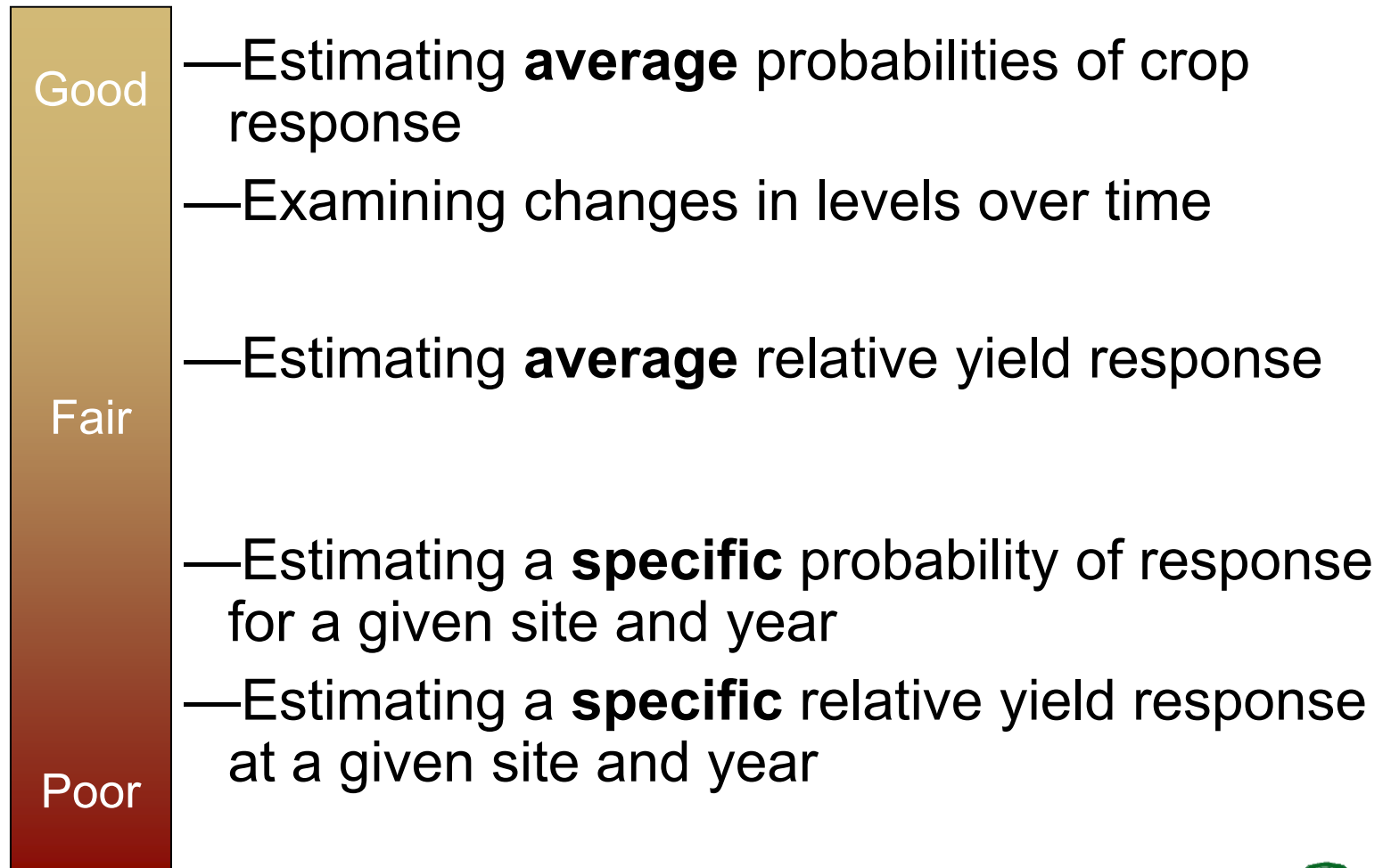
How do soil tests change with no applications?



Villavicencio and Mallarino, 2011



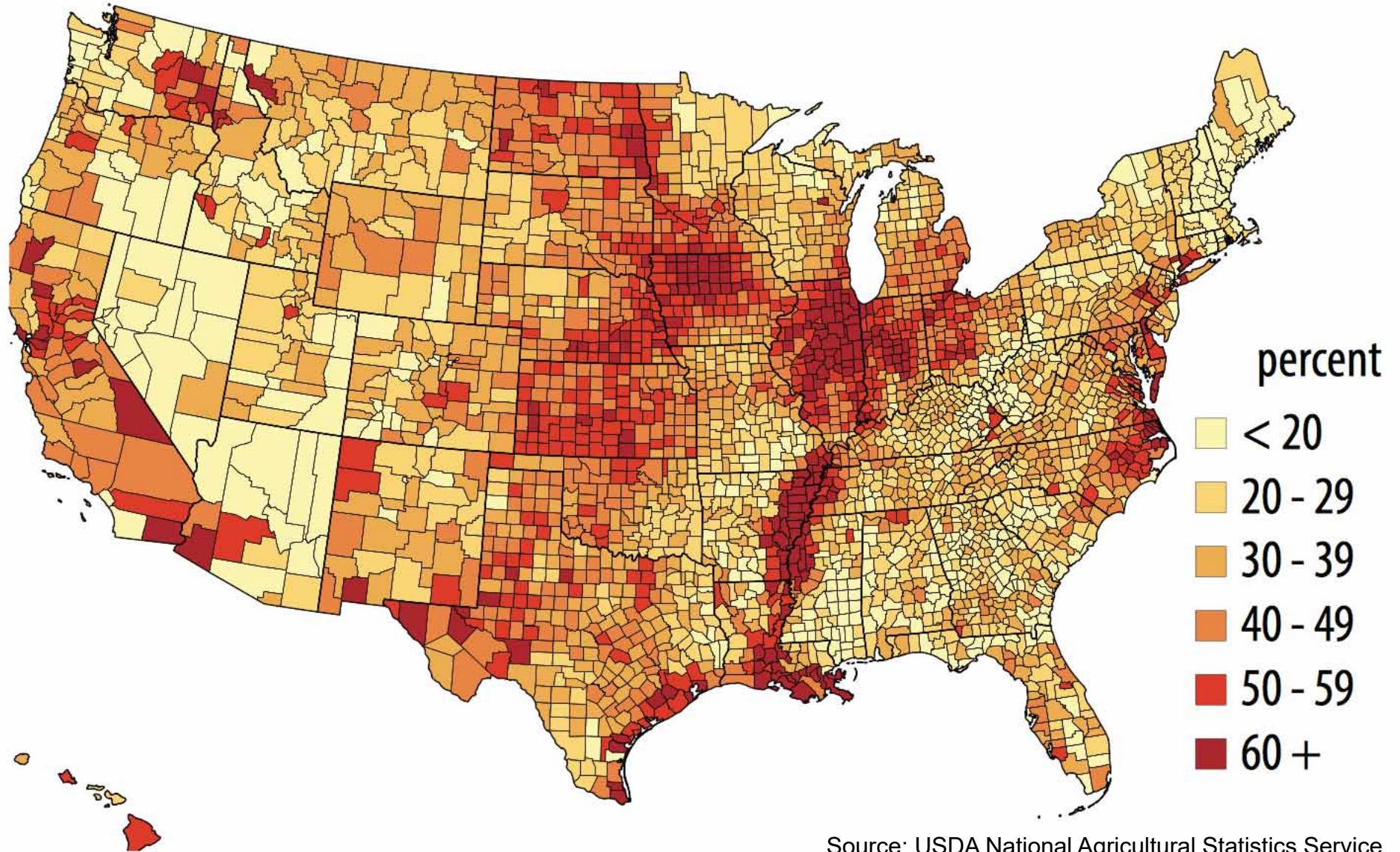
What are the best uses for soil test P information?



How can I get the most from banded P applications?

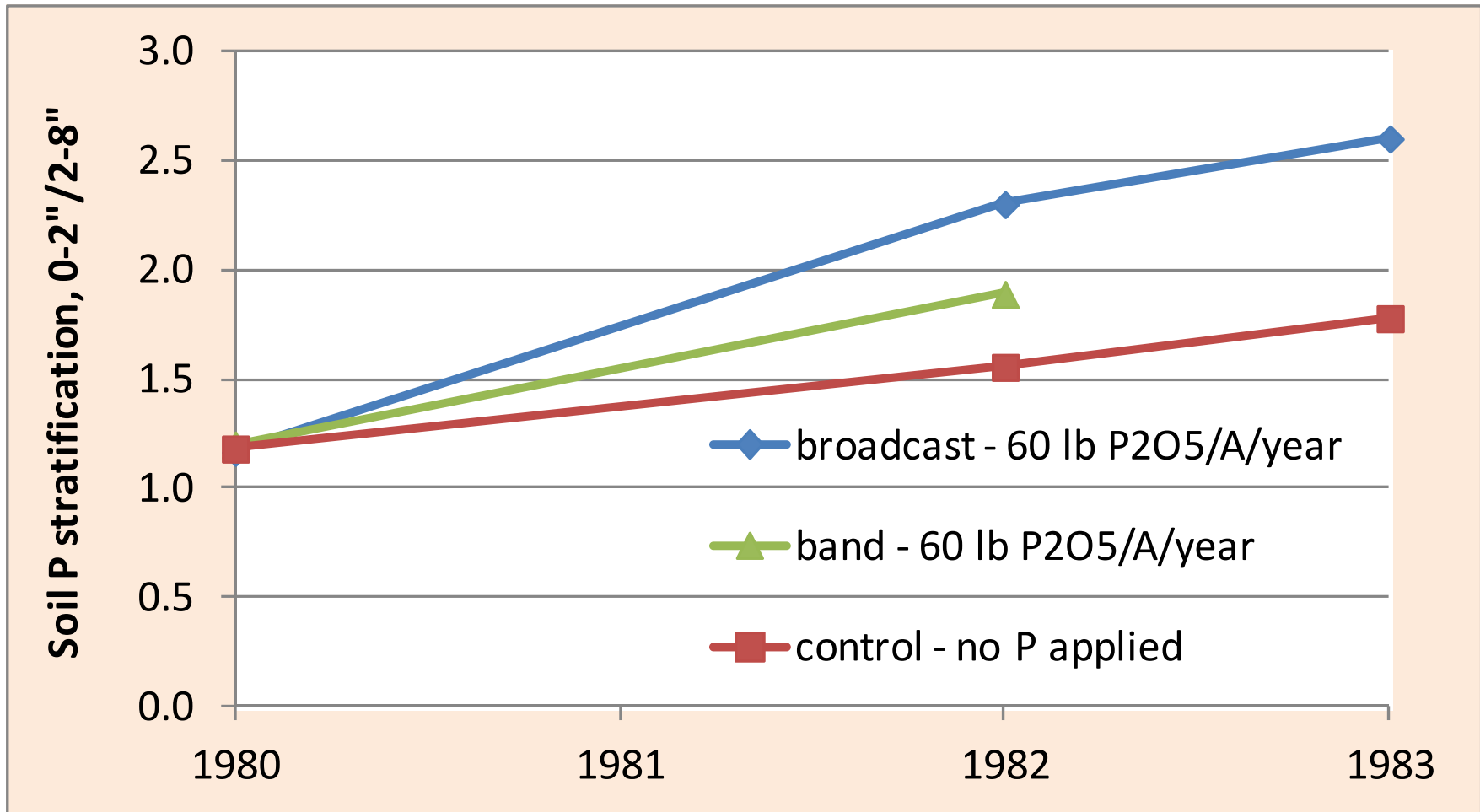


Percent of Farmland Rented or Leased (2012 Ag Census)



Source: USDA National Agricultural Statistics Service

Banding Reduces Soil Test P Stratification

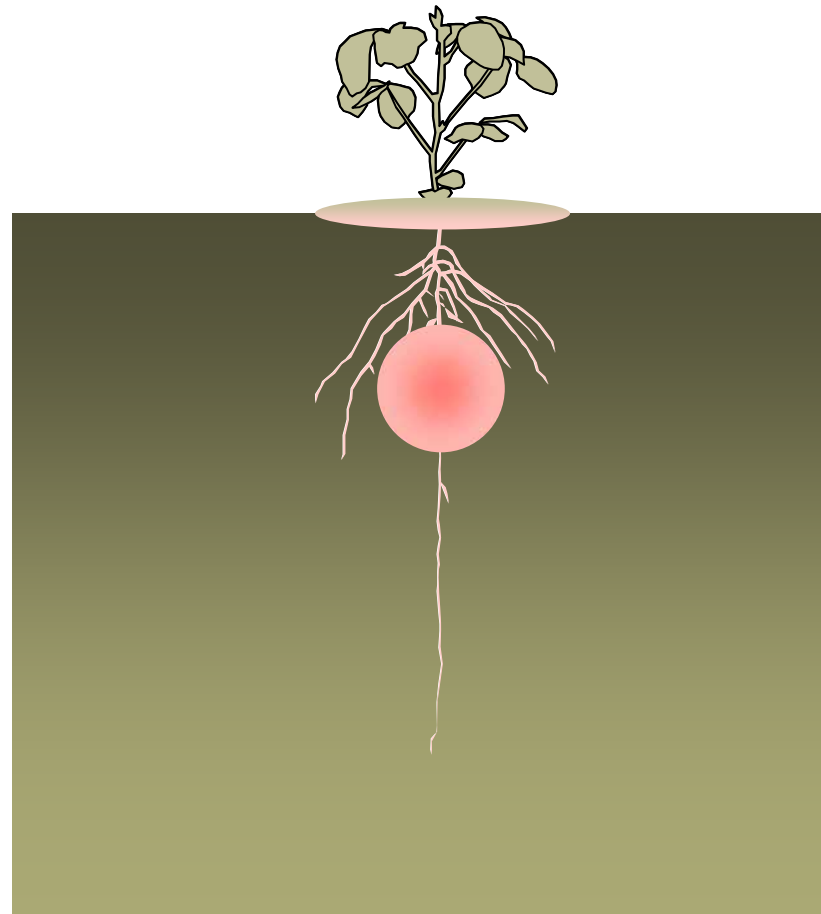


Transport of Banded Nutrients

Nutrient uptake

Deposition and leaching

Diffusion



Banding Reduces P Runoff Losses

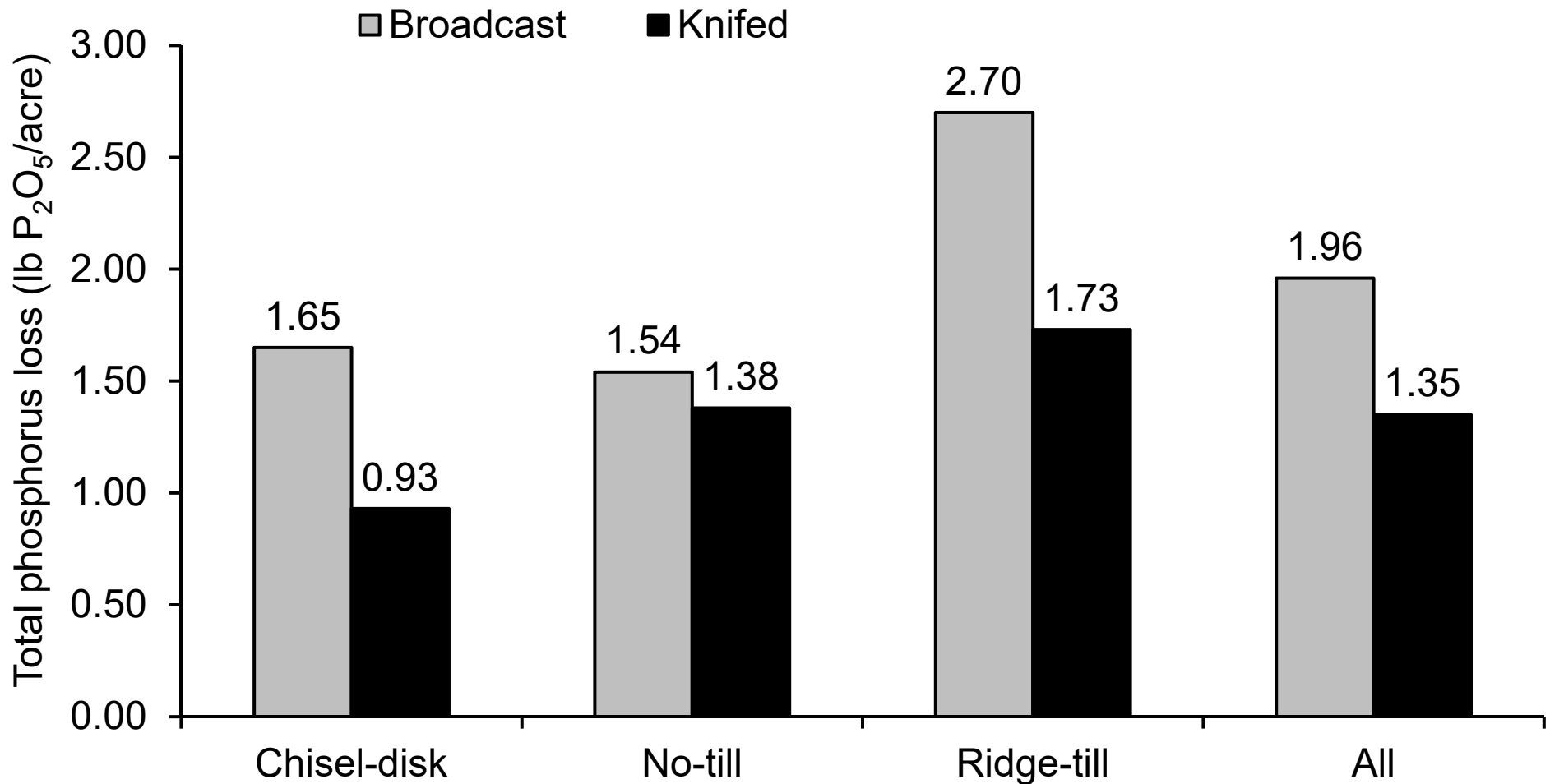
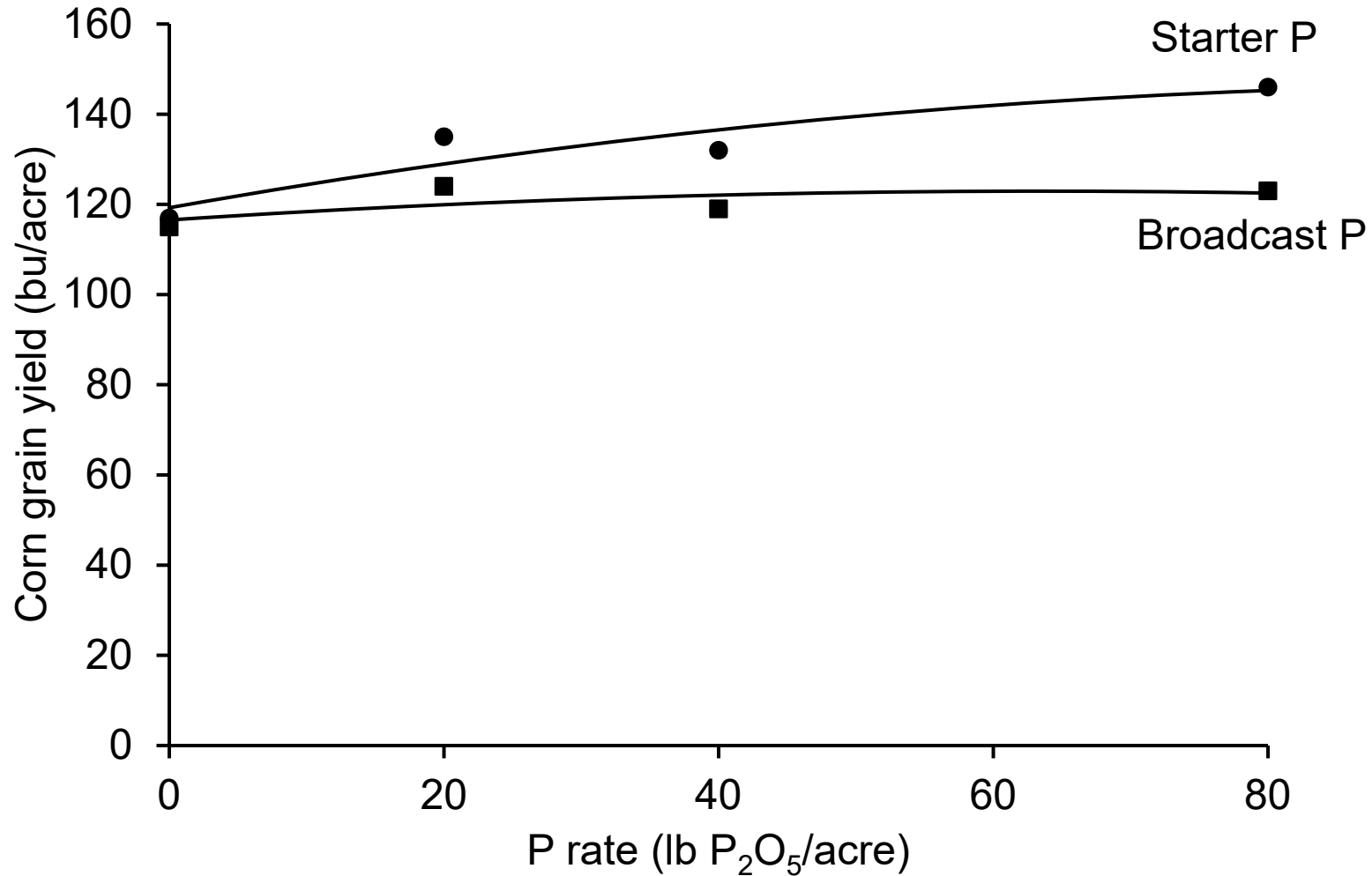




Photo: Keith McCall (NRCS)

Flooding affects next year's P placement decision

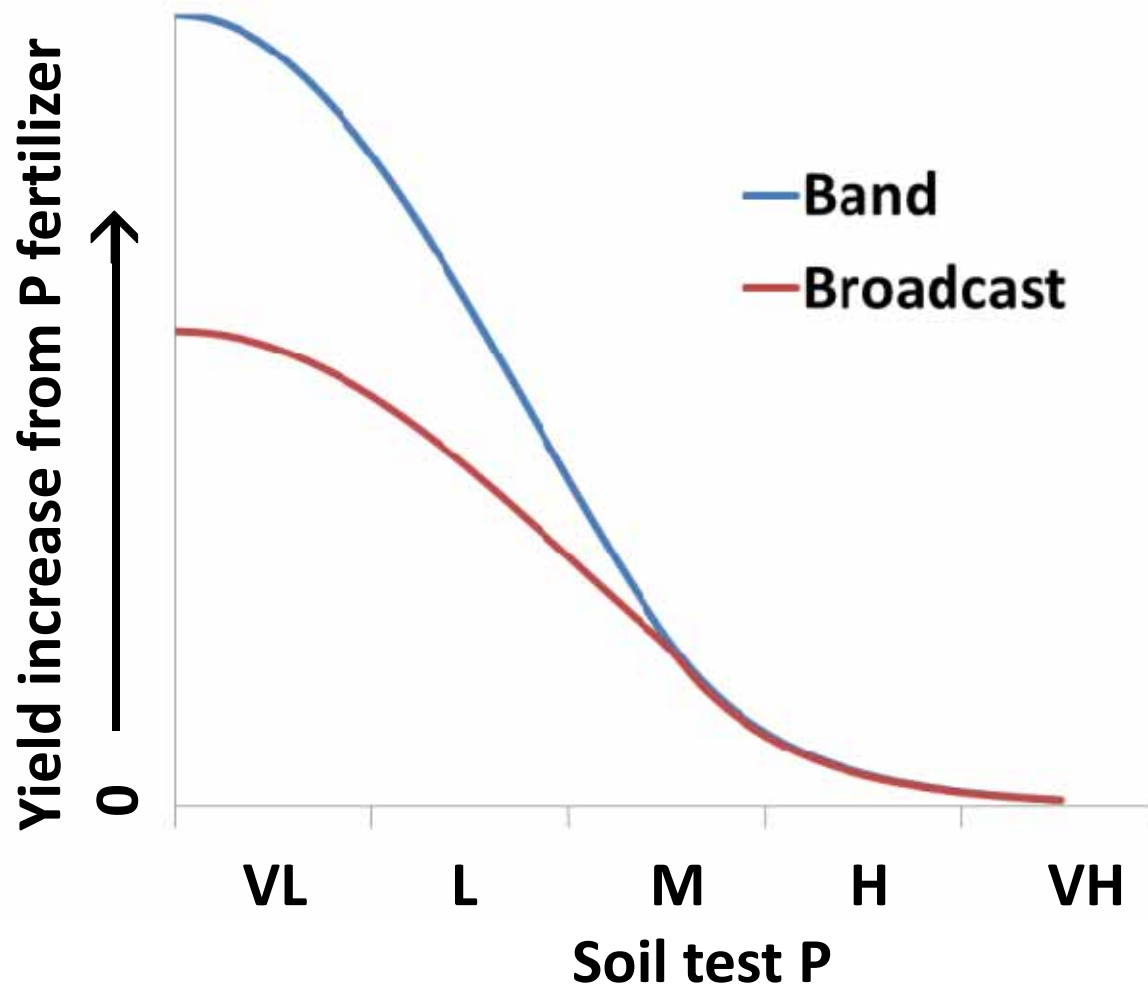
Banding Increases Yields after Flooding or Fallow



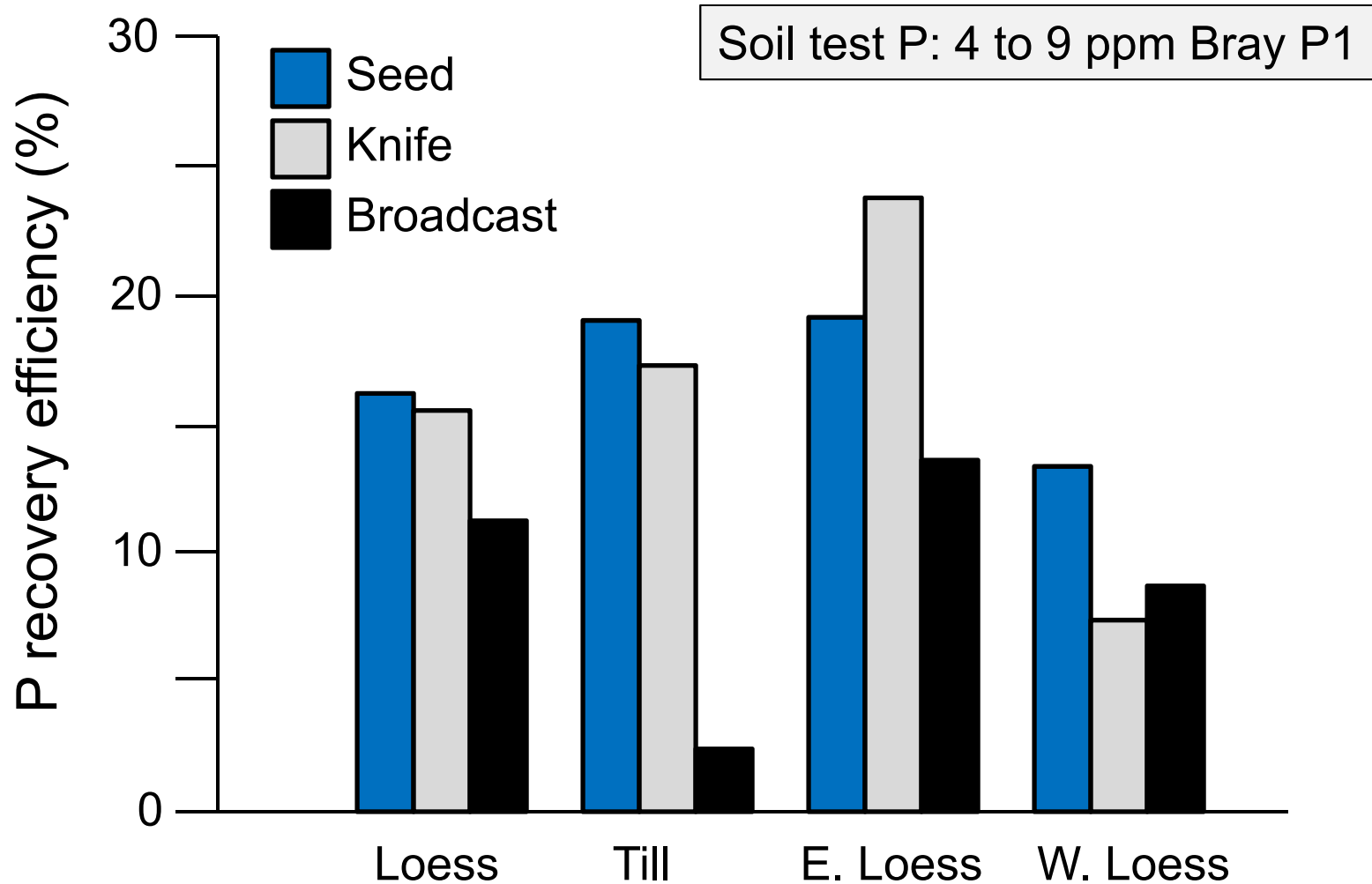
Fixen et al. referenced by Wetterauer, D.G. and R.J. Killorn. 1996. J. Prod. Agric. 9:39-41.



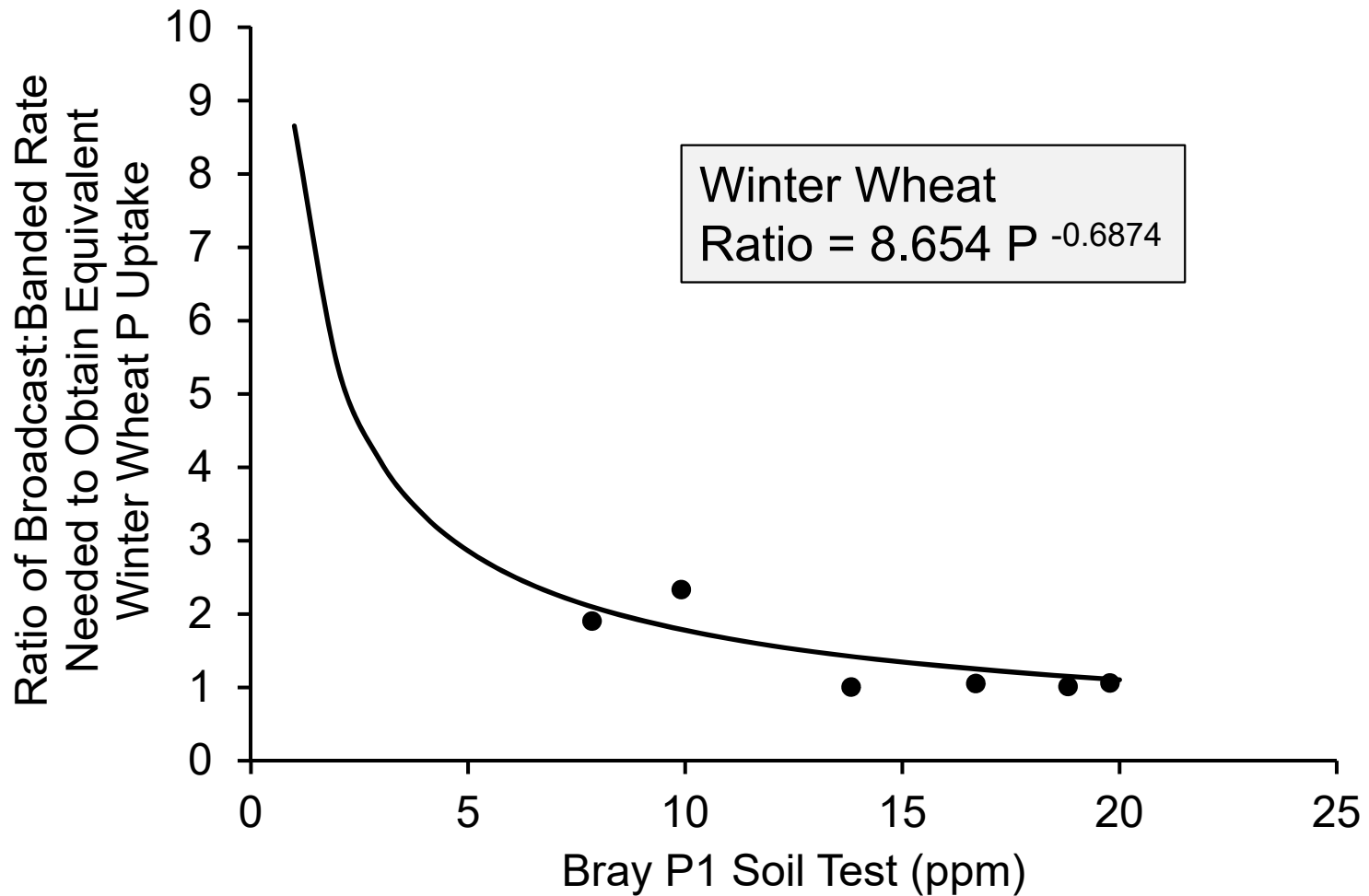
Idealized effect of placement on crop response



P recovery efficiency: *An example for winter wheat*

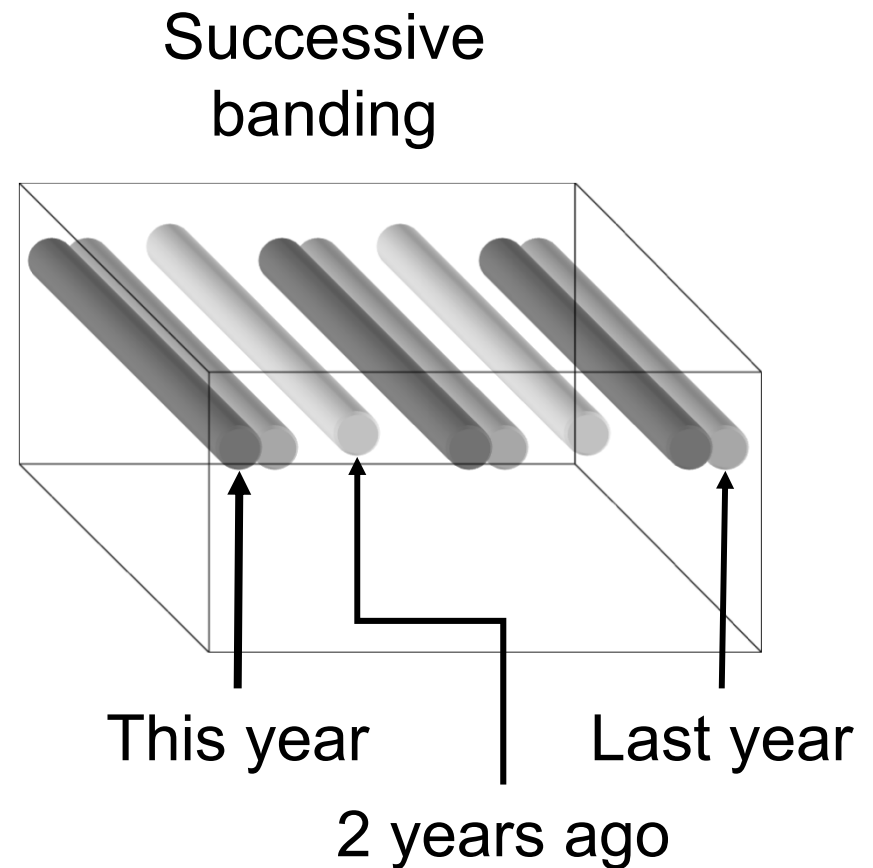


Statistically modeled relationship of broadcast and banded rate comparisons



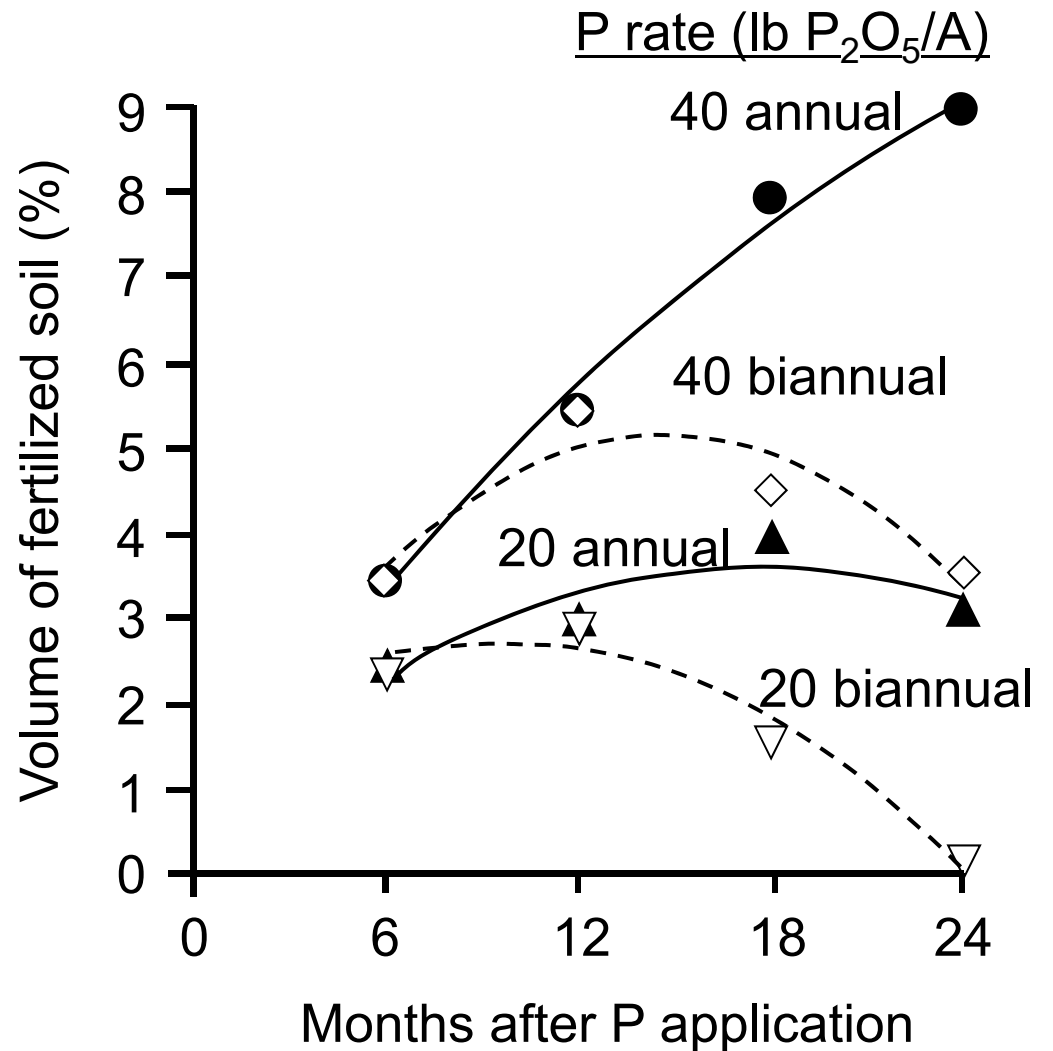
Effects of successive banding

- Effects include:
 - Increasing fertility
 - Positional availability



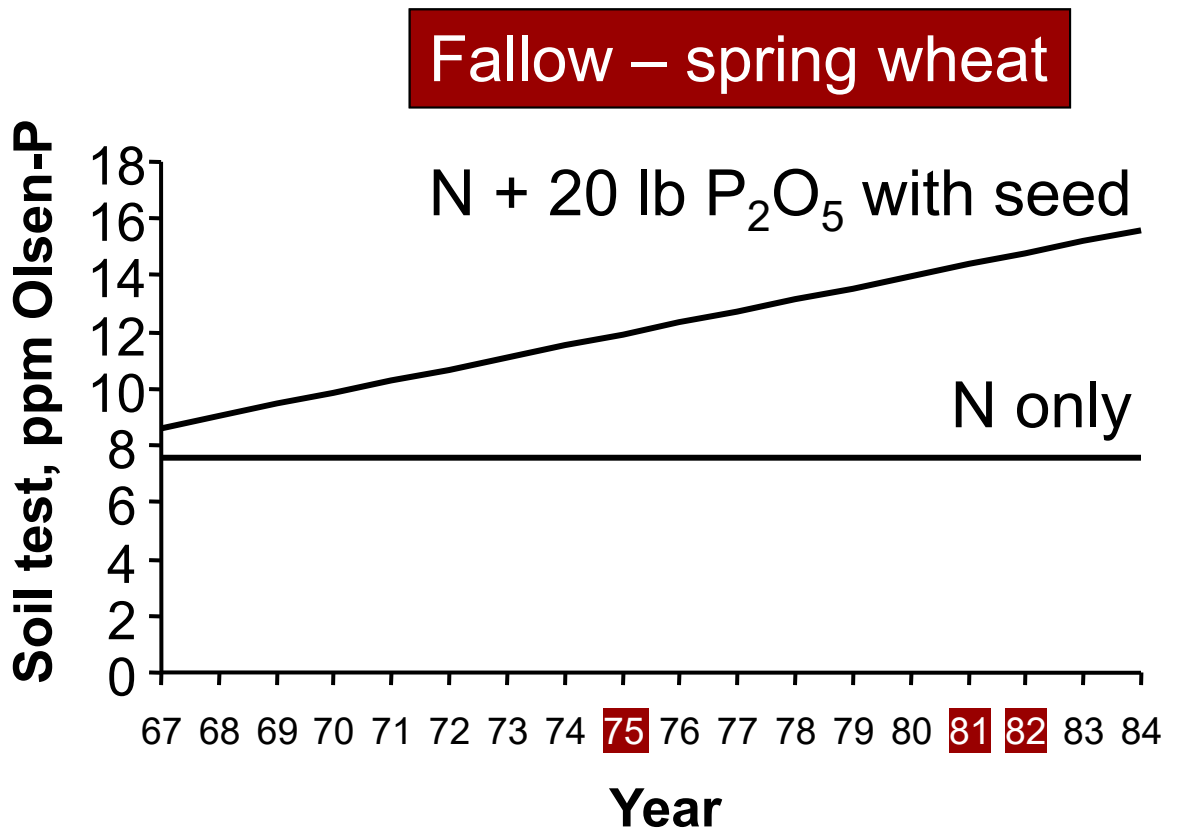
Impact of successive banding

- Mexico silty clay loam soil
- Single 20 lb/A band fertilizes 2.6% of soil volume
- Volume assumed to be additive
- Annual applications stay ahead of volumetric reductions of specific bands over time



Residual effects of successive banding

18-yr average wheat yield increase from P banded with the seed was 11.5%



yr = No yield increase from added P

Summary

- Risks to skipping an application:
 - Economic losses from yield reductions are more likely at lower soil test levels
 - Skipping a P or K application at lower soil test levels may result in a lowered effectiveness of an N application
- What happens to soil test levels if I skip an application?
 - Higher soil test levels decline more rapidly over time than lower soil test levels

Summary

- How can I get the most from banded P applications?
 - Use when soils are low testing
 - Use during unfavorable economic conditions
 - Use after fallow or flooding
 - Use where there are risks of surface runoff
 - Apply in different places over time to fertilize a greater soil volume
 - Apply every season to build fertilized soil volume (increase fertility)