

FUTURE OF TRI-STATE FERTILIZER RECOMMENDATIONS

December 14, 2016

Steve Culman

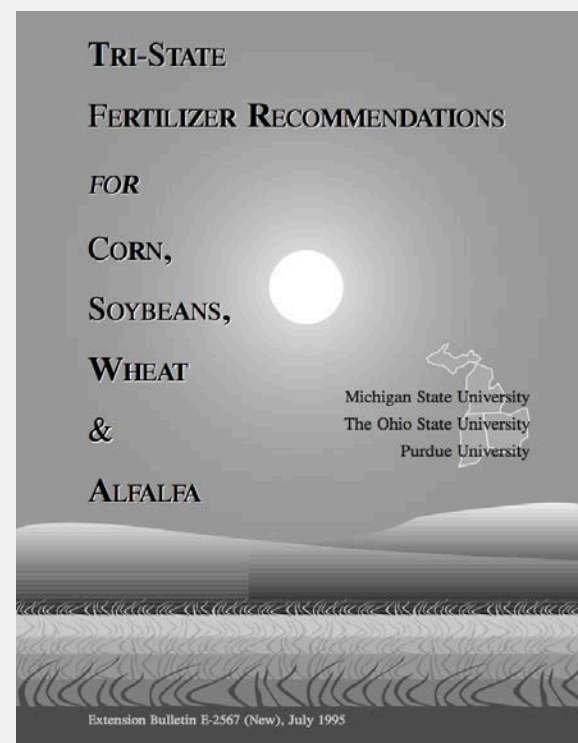
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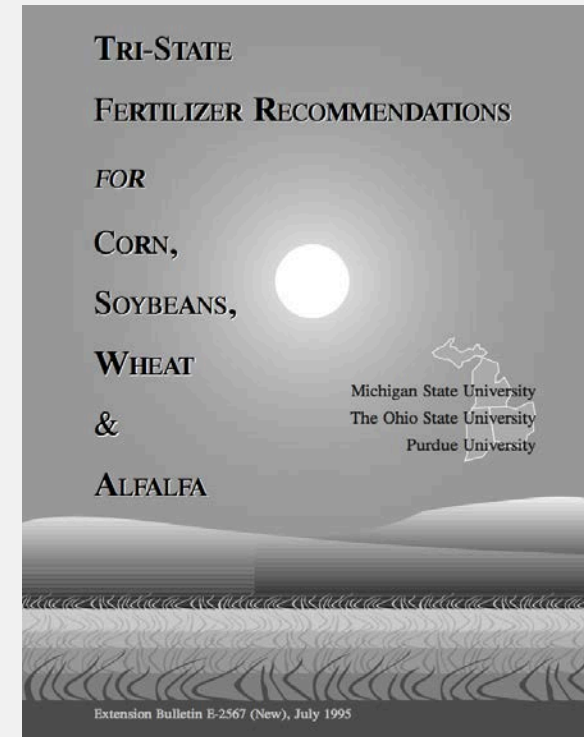
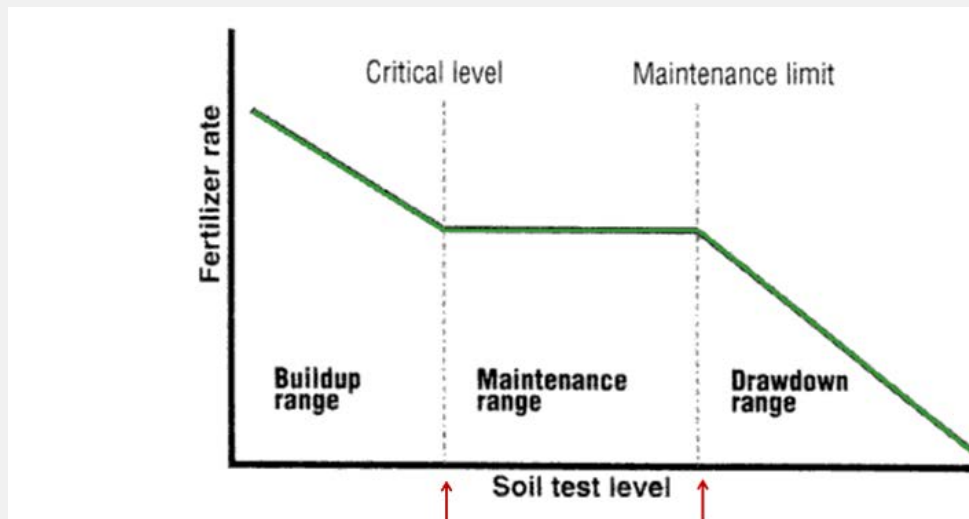
Tri-State Recommendations

- Originally Published in 1995
- Unified N, P, K recommendations for corn, soybean, wheat and alfalfa across Ohio, Michigan and Indiana
- Served as a cornerstone of fertilizer management in this region



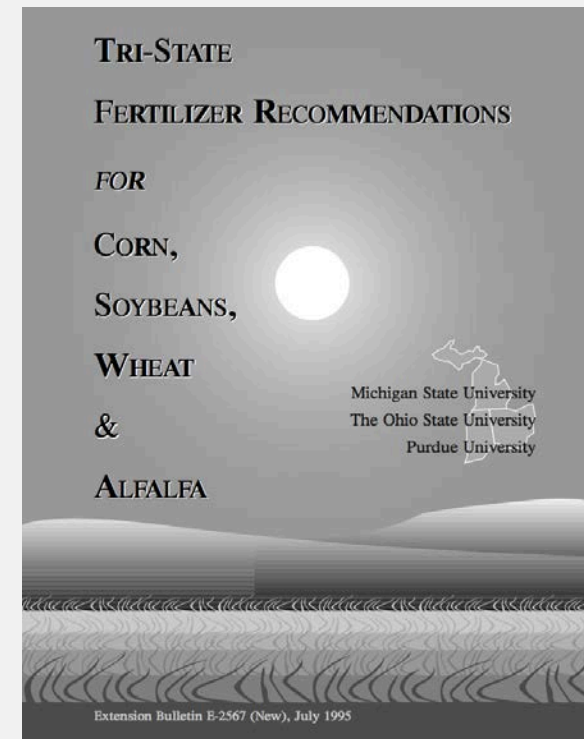
Tri-State Recommendations

- Nitrogen recommendations based on yield goals
 - Replaced by MRTN
- Phosphorus and Potassium based on build up and maintenance philosophy



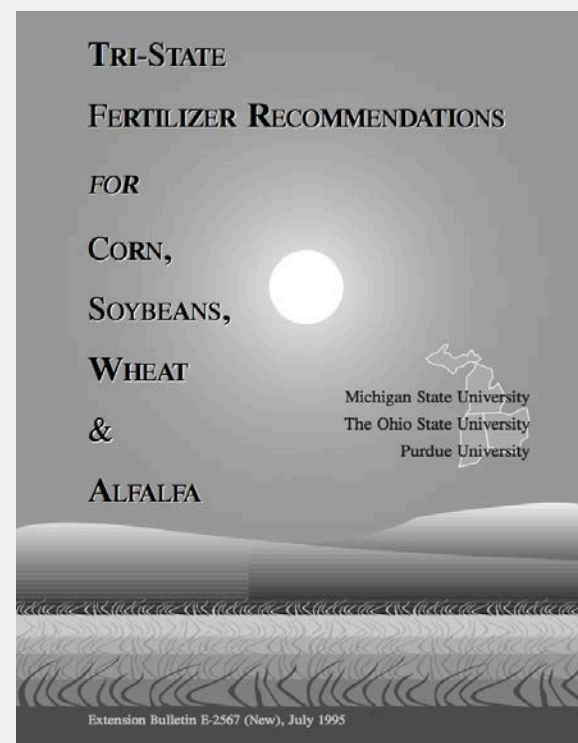
Tri-State Recommendations

- Farming has changed in 20 years
 - Increased yields
 - Increased conservation tillage
 - Adoption of round-up and Bt genetics
 - Reduced rotations
 - New pests and diseases
- In OH-IN-MI, majority of farmland is rented
 - Implications for management?
- Water quality issues has put a spotlight on nutrient management and agriculture
- Profit margins shrinking



Tri-State Recommendations

- Call to revise fertilizer recommendations
 - *Do Tri-State recs still apply to my highly productive fields?*
 - *I'm renting and don't know how long I will farm this ground. What's the minimum amount of fertilizer I can apply to get a good yield?*
 - *I am concerned about water quality and want to show that I'm doing an even better job managing nutrients on my farm.*
 - *We've moved to variable rate technology and want to dial in multiple rates within a field.*

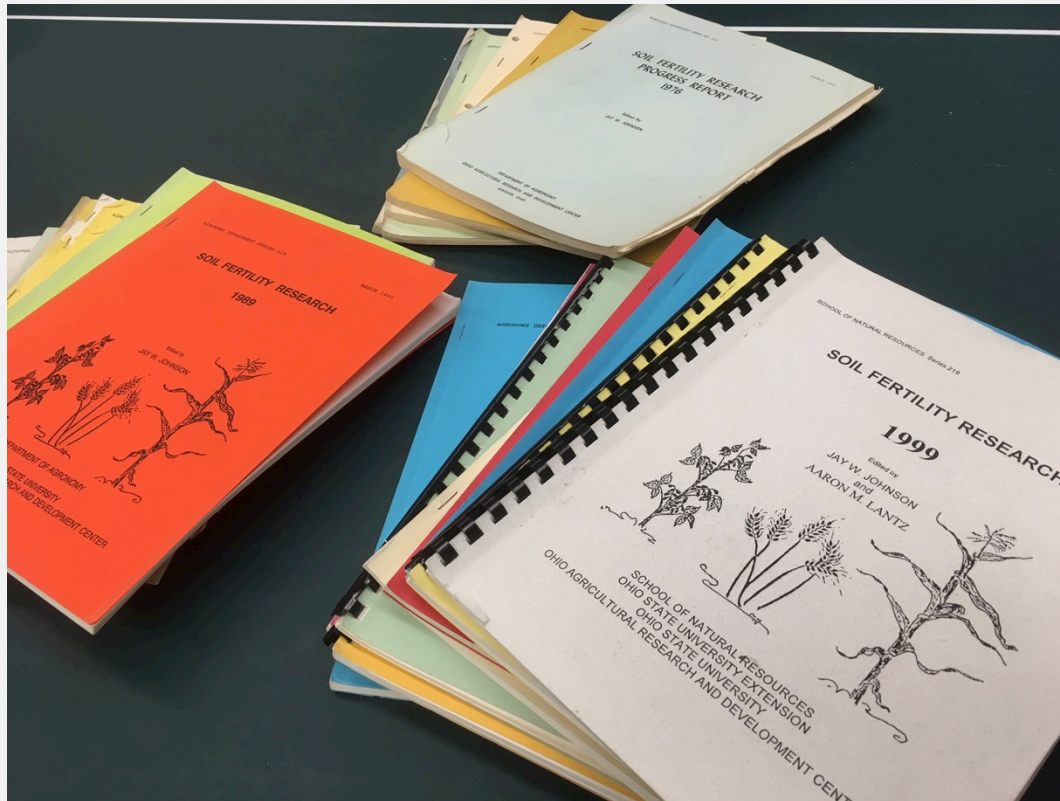


Before we know where we are going, we should probably know where we have been...

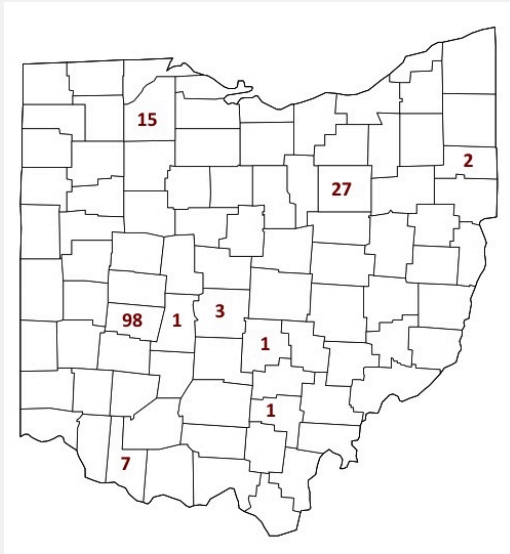
Jay Johnson – OSU Fertility Specialist

Annual Soil Fertility Reports: 1976 – 1999

- 68 P trials (site-years) conducted
- 92 K trials conducted



Ohio Data from Tri-State

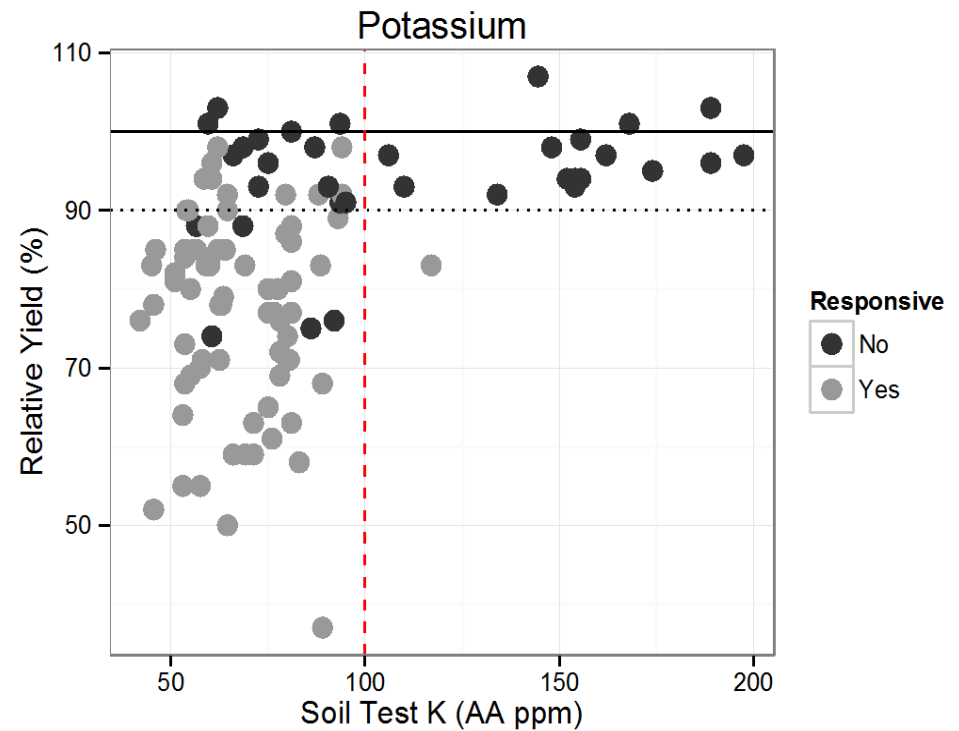
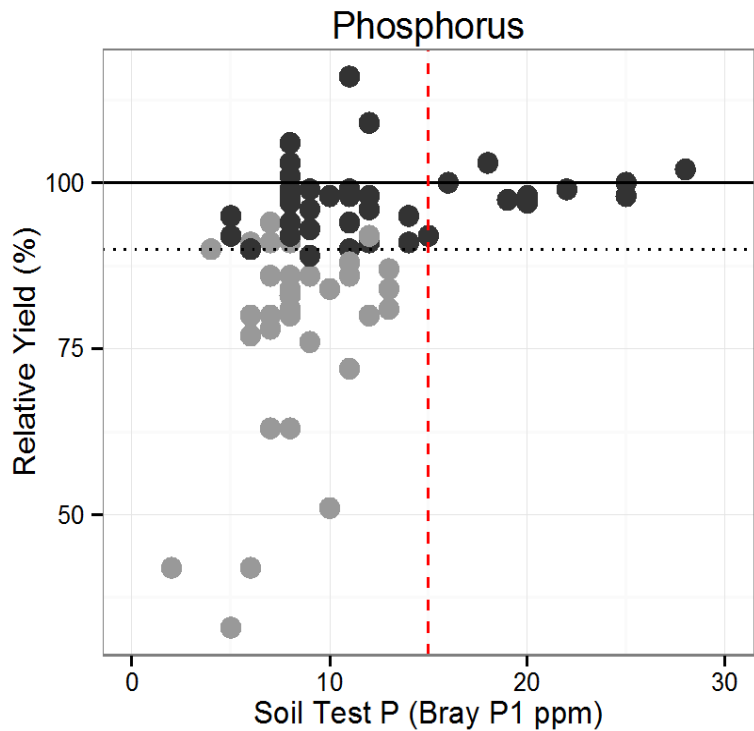


P & K trials were conducted at 9 total sites

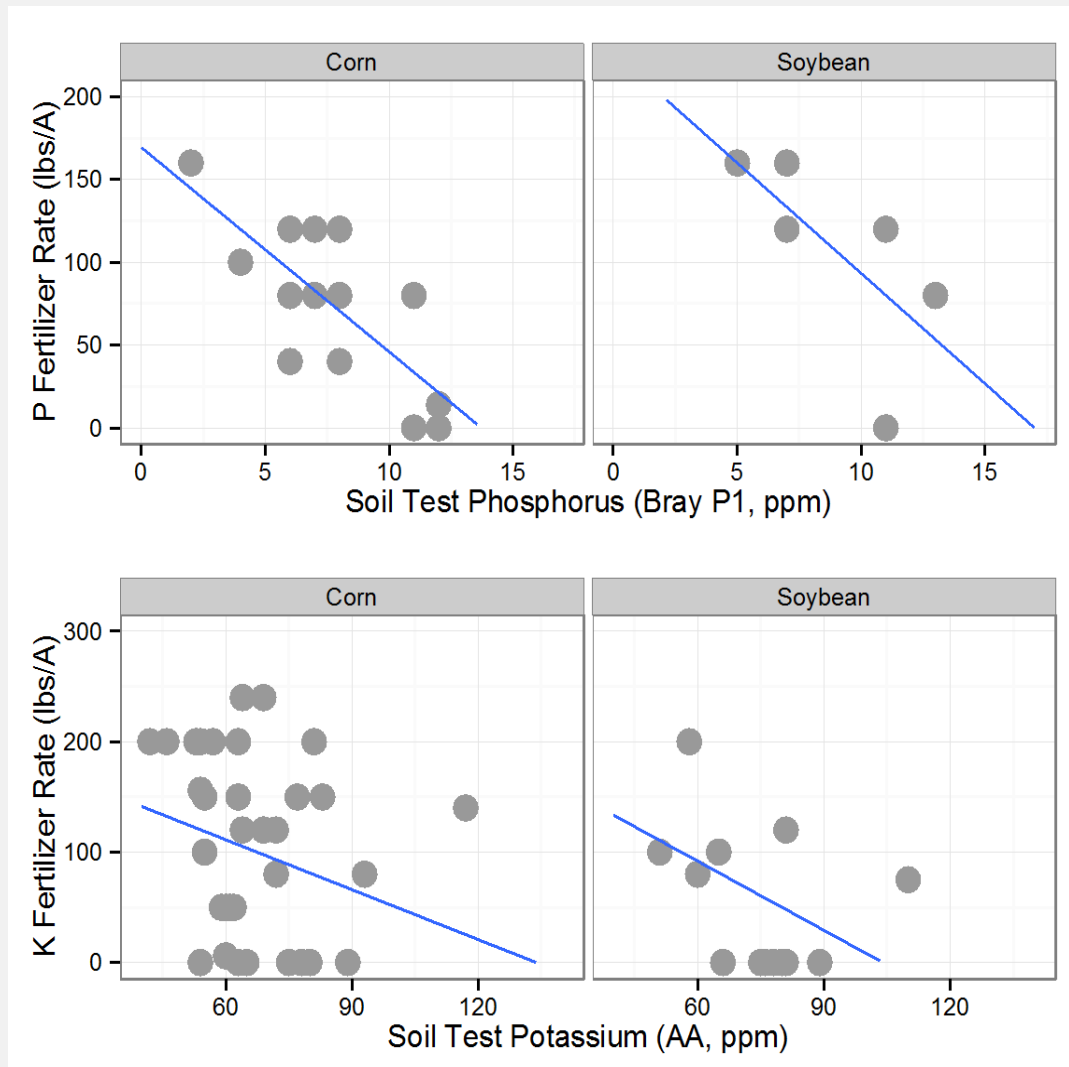
Table 1. Number of Phosphorus and Potassium Trials Conducted

	Phosphorus			Potassium		
	Corn	Soybean	Wheat	Corn	Soybean	Wheat
Responsive	20	6	4	45	16	1
Non-responsive	18	20	0	20	9	1
Total	38	26	4	65	25	2

At what soil test level should fertilizer be applied to see a yield response?



How much fertilizer should I apply?



Original Ohio Tri-State Data Summary

- 25 years of fertility studies conducted over 9 sites showed:
 - Very low probability of yield responses
 - Above 15 ppm Bray P1
 - Above 100 ppm AA for corn and soybean
 - Applying higher fertilizer rates at very low testing soils is a justified approach

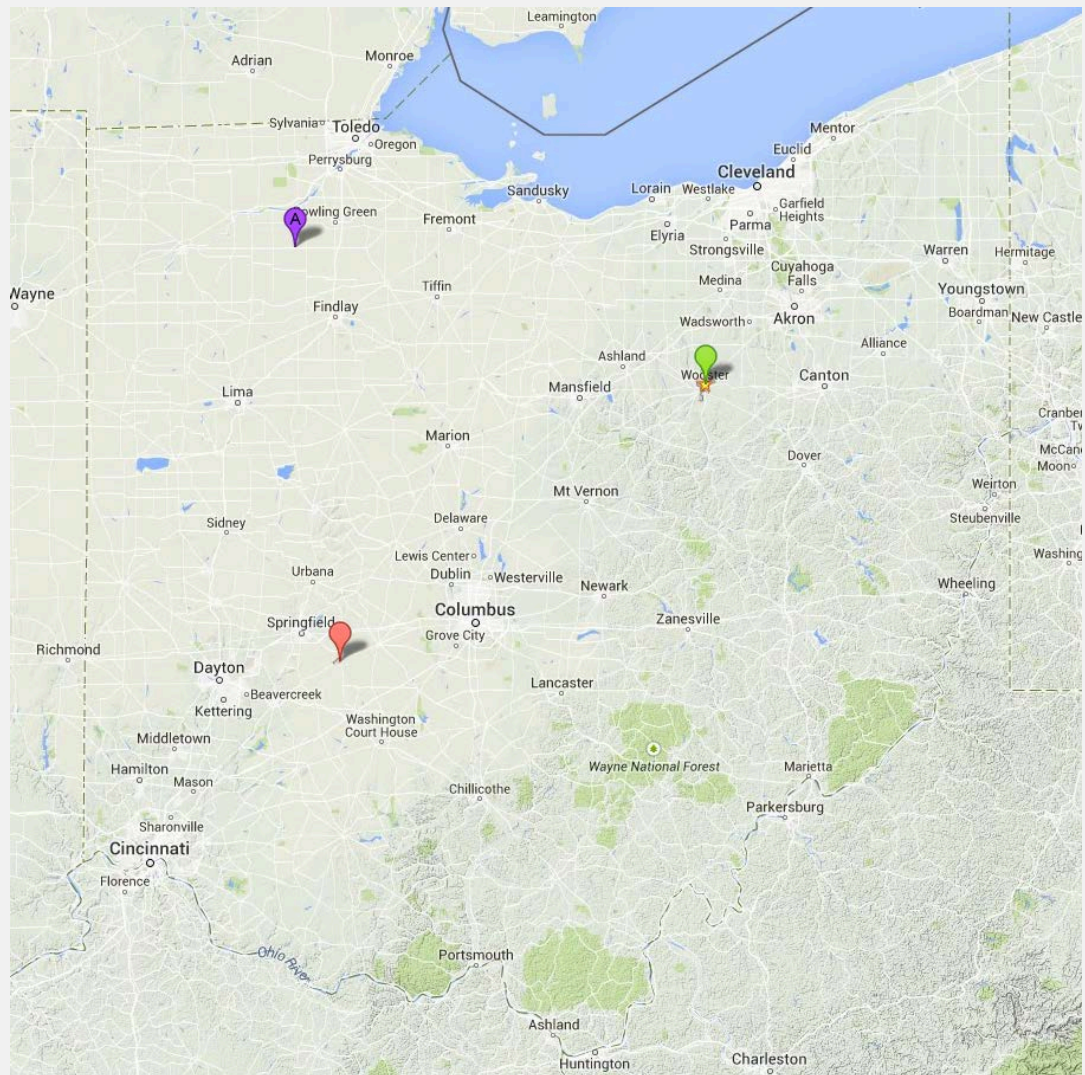
*That's great and all...
but what about data from this century??*

Long-term P & K Plots

- Clark County
- Wayne County
- Wood County

- 2006 – 2014
(9 years)

Corn-soybean &
Corn-corn-soybean



Main Objectives

1. Validate when P & K fertilization is required
 2. Examine soil test P and K trends in response to fertilization
 3. Compare the ability of soil and leaf tissue testing to predict nutrient deficiencies
- Fertilizer rate
 - P: 3 rates (0, 1x, 2x estimated removal rates)
 - K: 3 rates (0, 1x, 2x estimated removal rates)
 - N Fertilizer: 180 lbs N/A following soybeans, 210 lbs N/A following corn

Baseline Soil Data

Soil Property	Clark	Wayne	Wood
pH	6.8	5.9	6.1
CEC (meq/100g)	13	11	22
OM (%)	1.7	1.5	2.9
Bray P (ppm)	29	28	22
K (ppm)	113	113	198

Tri-State Rec Corn and Soybean Maintenance Range

- Phosphorous: 15-30 ppm Bray P
- Potassium: 100-155 ppm AA

Grain Yields (2006-2014)

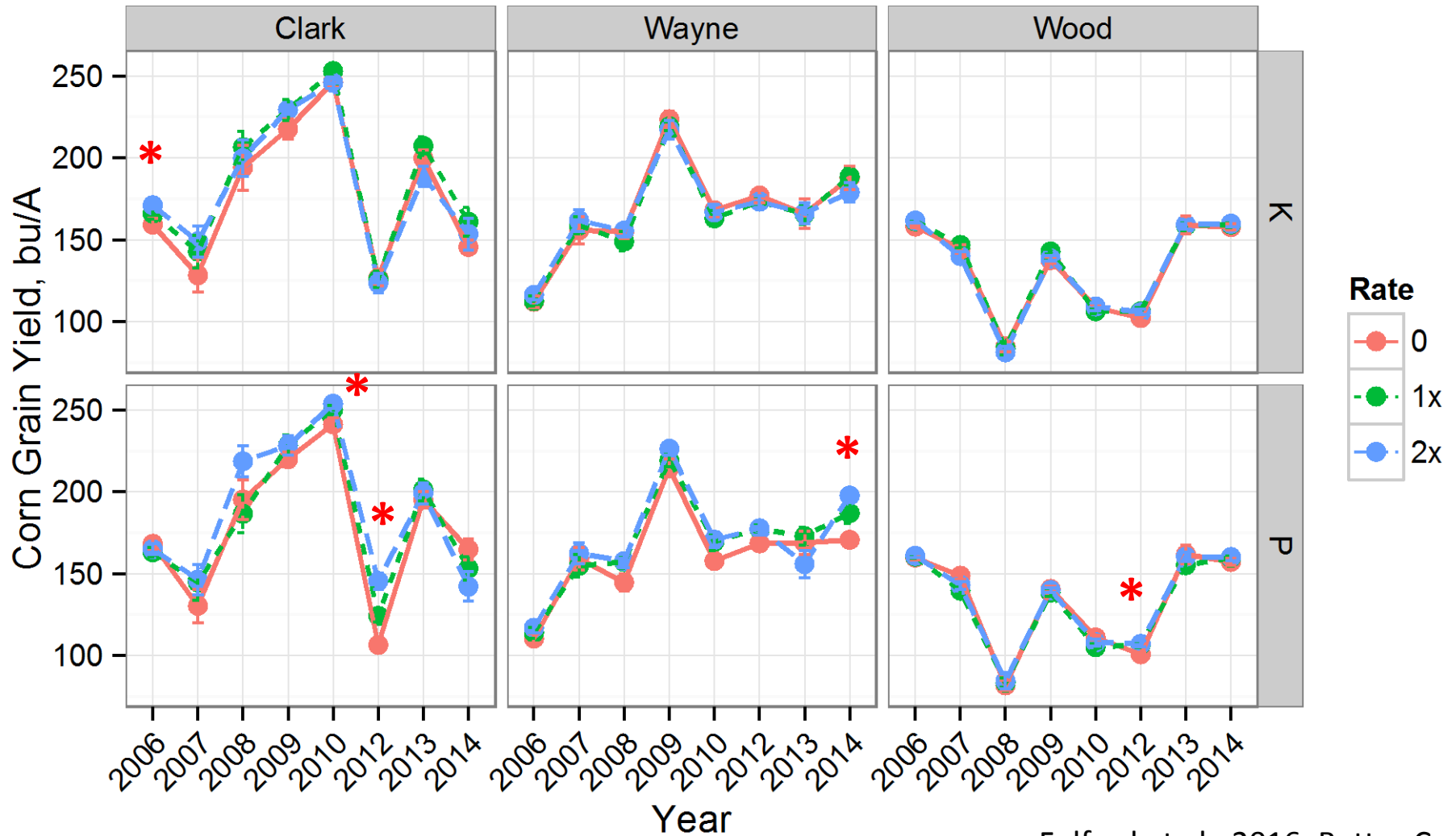
42 total comparisons of fertilized vs. unfertilized

How many comparisons responded to fertilization?

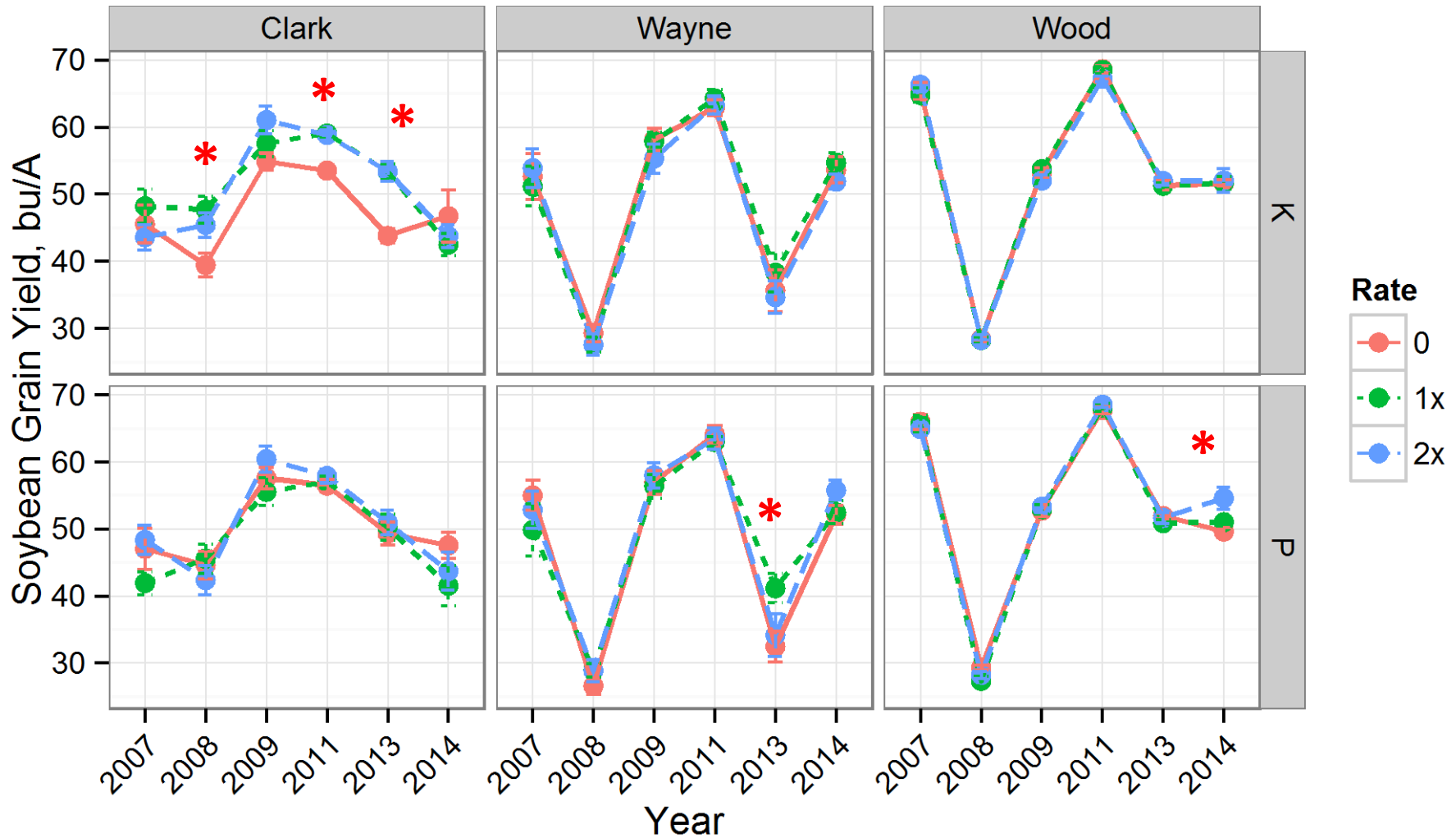
Grain Yields (2006-2014)

- 10 out of 42 responded to fertilization
- Corn positive responses to fertilization (24 site-years)
 - P: 4 site-years
 - K: 1 site-year
- Soybean positive responses to fertilization (18 site-years)
 - P: 2 site-years
 - K: 3 site-years
- 2 sites negatively responded to P

Corn Grain Yield



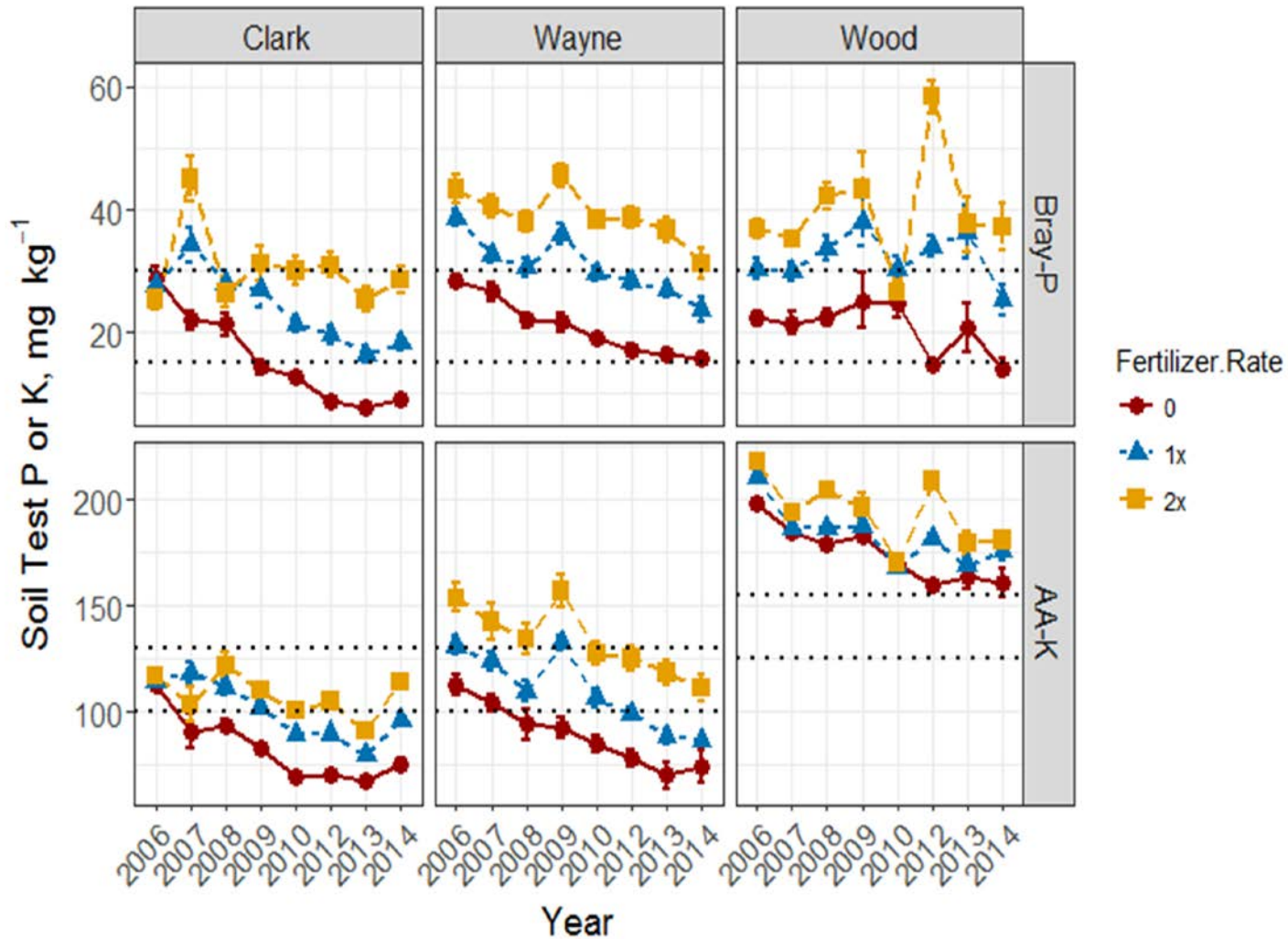
Soybean Grain Yield



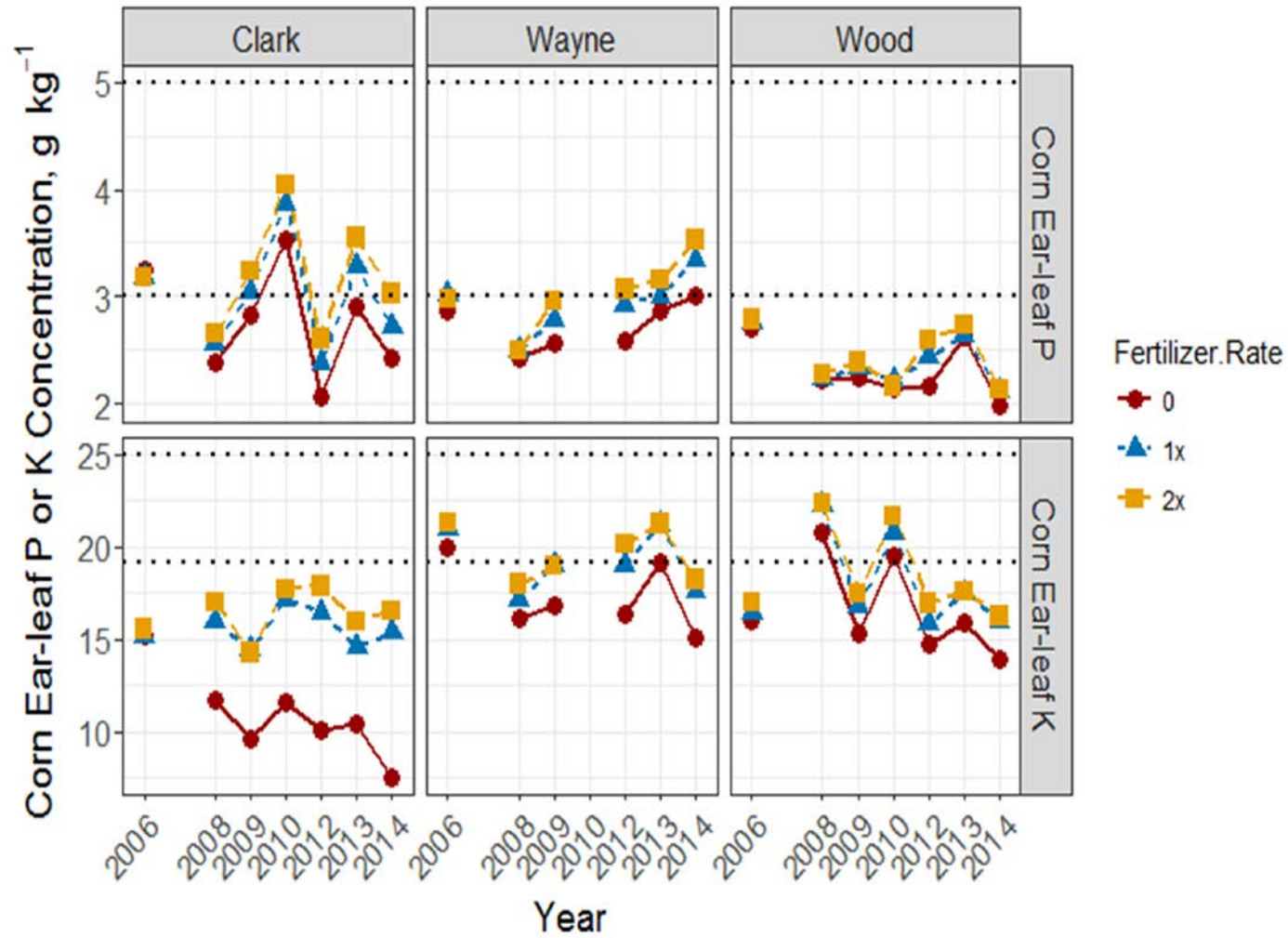
Do yield responses get stronger over time?

Nutrient	Early (2006-2008)	Mid (2009-2011)	Late (2012-2014)	Total (2006-2014)
Phosphorus	0	1	5	6 out of 42
Potassium	2	1	1	4 out of 42

Soil Test P & K Trends



Tissue Test P & K Trends



False-Predictions: Corn

Test	Site	Phosphorus		Potassium	
		Deficient	Sufficient	Deficient	Sufficient
		-----%-----			
Soil Test	Clark	93	0	100	0
	Wayne	100	2	100	0
	Wood	92	0	-	0
Leaf Tissue Test					
	Clark	93	0	100	-
	Wayne	97	0	100	0
	Wood	98	-	100	0

False-Predictions: Soybean

Test	Site	Phosphorus		Potassium	
		Deficient	Sufficient	Deficient	Sufficient
		-----%-----			
Soil Test	Clark	100	0	78	17
	Wayne	100	0	100	0
	Wood	100	10	-	0
Leaf Tissue Test	Clark	-	0	73	-
	Wayne	100	0	100	0
	Wood	-	3	100	0

P & K Trial Conclusions

- Fertilization over 9 years increased grain yields in 10 out of 42 comparisons
 - No indication that recommendations are too low
- High false prediction rates suggest:
 - Overall conservative nature of recommendations
 - Soil and tissue diagnostics may need revision to be more meaningful
- General trend in declining soil test P and K does not agree with estimated removal rates of P and K in grain
- Soil vs. Tissue Testing
 - Soil test P = better at reflecting P fertilization in both corn and soybean
 - Tissue test K = better at reflect K fertilization in soybean

What about current on-farm work?

Our Approach – An Ohio Perspective

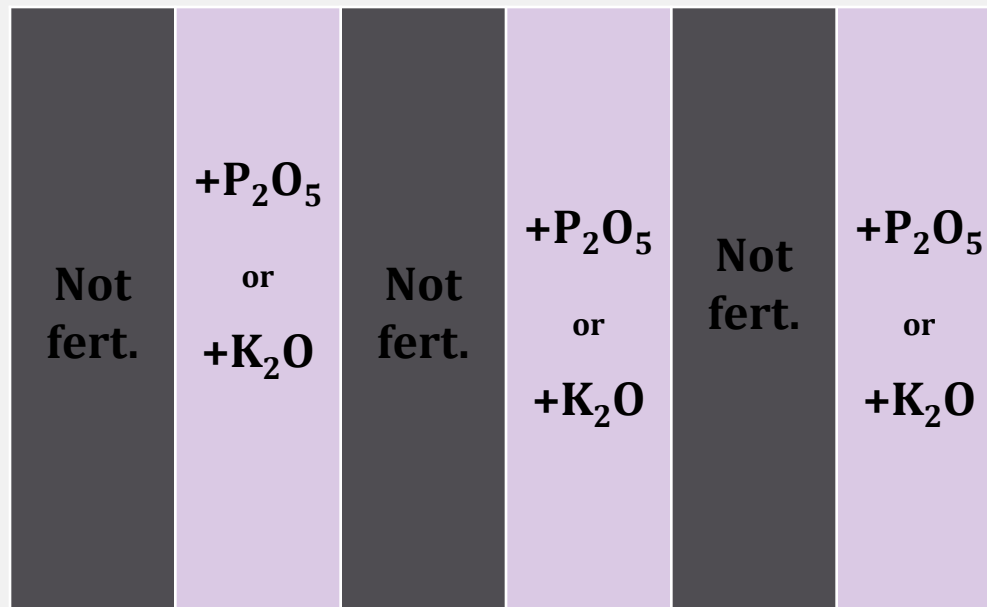
- Funding from Ohio Corn and Small Grain Marketing Programs, Ohio Soybean Council & USDA
- Majority of research in Ohio are on-farm trials, some OSU-farms
- Most robust information will come from many sites over diversity of soil types and regions in Ohio
- Working directly with growers, but also working with or ‘sub-contract’ crop consultants, ag coops, agronomists to help facilitate on-farm strip trials
- Working with variable rate trials as well

Our Approach

- All trials require:
 - Pre-fertilization soil sampling
 - Early reproductive (R1) tissue test
 - Grain yields of plots/ strips/ grid areas
- We measure:
 - Standard soil test and other simple soil measurements
 - Nutrient concentration in leaf tissue
 - Nutrient concentration in grain

Phosphorus and Potassium

- Treatments with:
 - Strips/ planter passes with no P or K applied
 - Strips/ planter passes with P and K applied as recommended or normally managed



Phosphorus and Potassium

- Re-establish critical ranges for soil test P and K levels
 - Not just build up and maintenance, but also sufficiency
 - Move STP from Bray P to Mehlich P
- Re-establish leaf critical levels for P, K and all nutrients
- Re-establish typical P and K removal rates per bushel grain

Nitrogen

- Multiple N rates (0 – 250 lbs N/ acre)
- Determine agronomic and economic optimal N rate and fit curve
- Collect as much site-specific information as possible
 - Soil test: PSNT, active organic matter fractions (ex, CO₂ burst)
 - Weather data
 - Stalk Nitrate
 - NDVI and other crop sensing technologies

Nitrogen

- All data will feed into current maximum return to nitrogen model (MRTN) for corn
 - Economic model based on maximizing profitability, not productivity
- Create an MRTN model for wheat in Ohio
- Re-establish leaf critical levels for N and all nutrients
- Re-establish typical N removal rates per bushel grain

Where are we now?

2014 – 2016 Field Seasons – 151 total trials

2014

	Nitrogen	Phosphorus	Potassium	Total Sites
Soybean		14	15	17

2015

	Nitrogen	Phosphorus	Potassium	Total Sites
Corn	19	12	9	29
Soybean		13	13	13

2016

	Nitrogen	Phosphorus	Potassium	Sulfur	Total Sites
Corn	38	22	16	3	65
Soybean		22	22		22
Wheat	2	5	5	2	5

2017...?

Where are we headed?

- IN-MI-OH State Specialists met in Fort Wayne and discussed issues with revising Tri-State Recommendations
- Intention to continue to maintain as 3-state document
- Hope to have more dynamic, living document, than a static work revisited every 20 years
- More questions than answers at this point
- Hopefully first chapters will emerge in 2018

Thank You

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