Variable Rate Phosphorus Application: What you need to know

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Overview

- Share current on goings in US
- Phos Management Concepts
- VRT recs How and Why
- There is NOT a consensus

- Hopefully sometime down the road it causes some thought.
- Don’t Be complacent

Overview

- In past
  - Chesapeake Bay
  - Oklahoma Sues Arkansas
- News is about Lake Erie
  - Was bad,
  - Then good
  - No bad again
    - The Problem
    - The Fix?
- Impact elsewhere

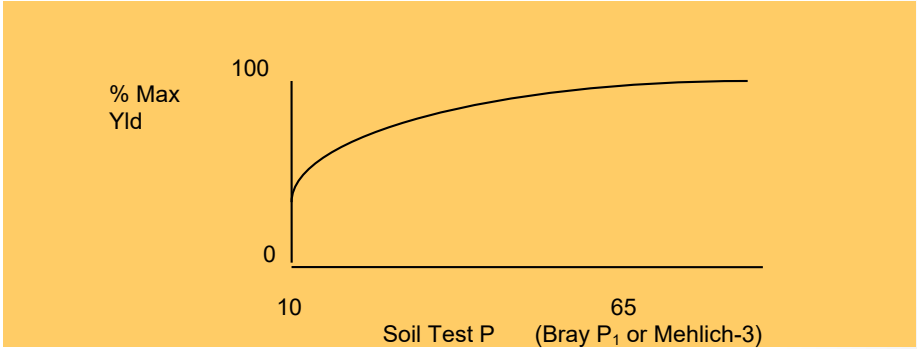
How we Do Phosphorus

Soil Testing was the basis

Determine immediately and potentially available P.

Relate back to Correlation Calibration work. (50s-60s)

“Critical” Values Est.

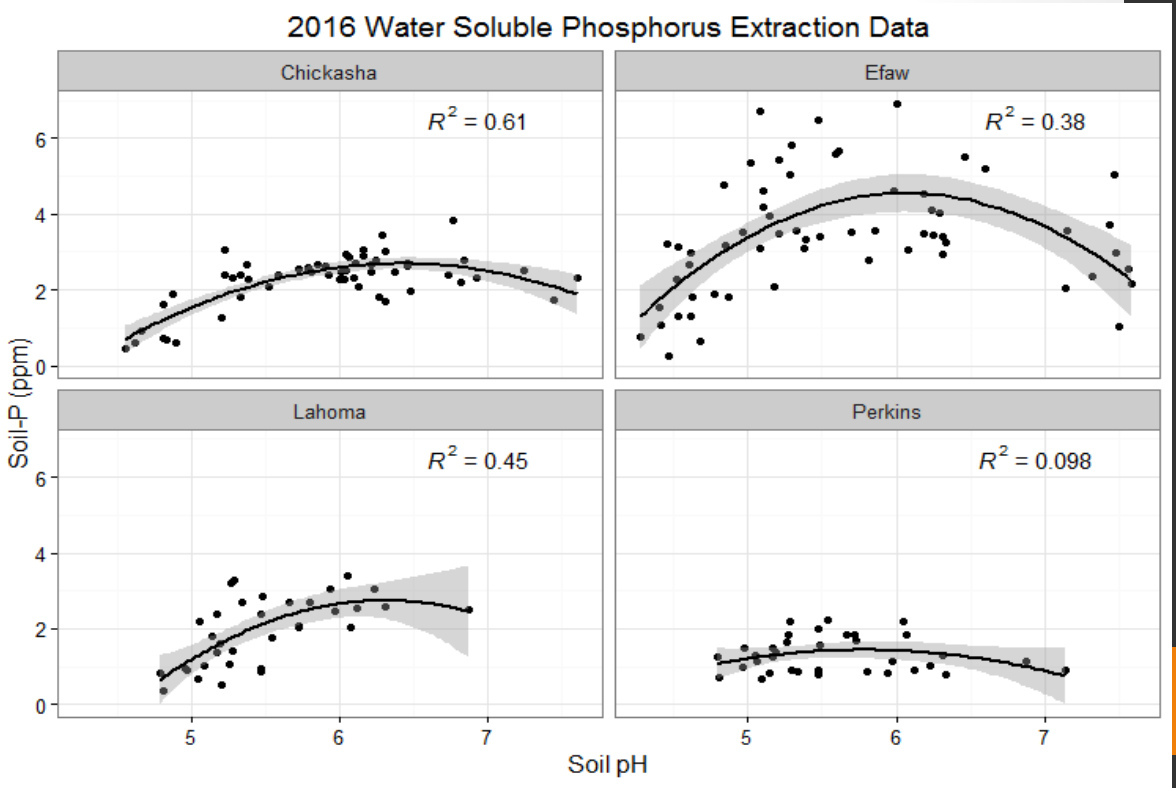


How we Do Phosphorus

Soil Testing

Multiple Extractions because of pH

- Bray
- Olsen
- Mehlich
- Resin

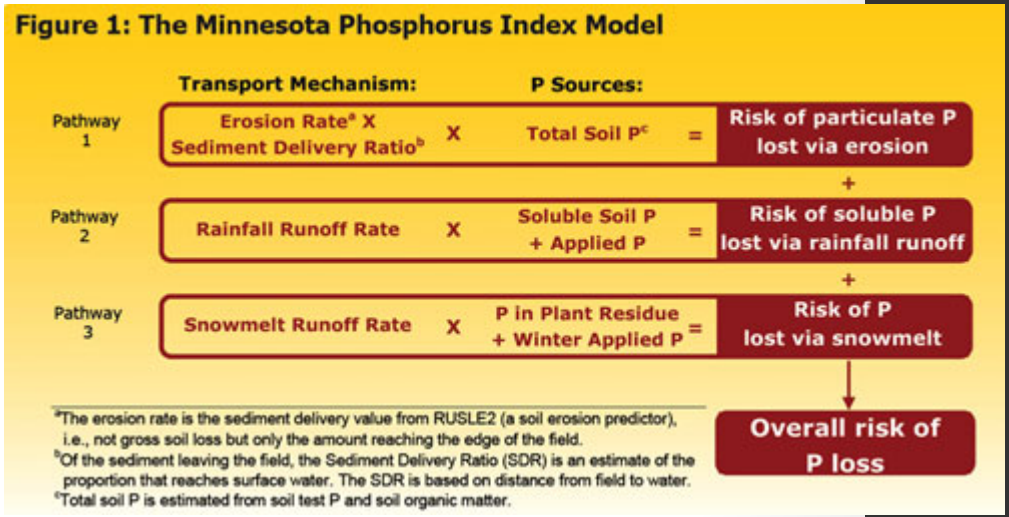


How we Do Phosphorus

Soil Testing

More Recent P Loss

P-Index – East coast early then “Poo” states.



How we Do Phosphorus Recs

- Sufficiency program

Feed the Plant

- Intended to estimate the long-term average amount of fertilizer P required to, on average, provide optimum economic return in the year of application. There is little consideration for future soil test values

	Phos Removal Per Bus.	90% Suff. ppm	Starter Rate lbs p2O5 ac -1 *Low*	*High*	P205 Rec at 90% Suff.
Wheat	0.5	18	23	40	25
Canola	0.4	20	12	25	20
Corn	0.38	18	17	25	25
Sorghum	0.42	18	17	34	25

Phosphorus Recs – Suff Does work

				Applied Phosphorus (kg P ha^{-1})										
Year	Location	OSU Rate	OSU	0	4.9	9.8	14.7	19.6	24.5	29.4	34.3	39.2	44.1	48.9
		kg P ha^{-1}	yield Mg ha^{-1}											
2014														
	Stillwater	36.2	2.93	2.84	2.71	2.57	3.01	2.85	2.88	2.43	3.02	3.00	2.86	2.50
	Red Rock 1	19.5 *	2.02 abc	1.34 c	1.46 c	1.44 c	2.02 abc	2.30 abc	1.81 bc	3.06 a	2.79 ab	2.37 abc	2.98 ab	2.84 ab
	Red Rock 2	11.3 *	3.52 abcd	2.87 d	2.99 cd	3.38 bcd	3.40 abcd	3.71 abc	3.58 abcd	3.59 abcd	4.16 a	3.83 ab	3.59 abcd	3.99 ab
	Red Rock 3	10.2 *	3.46 abcd	2.97 de	2.84 e	3.19 bcde	3.21 cde	3.93 ab	3.59 abcde	3.39 abcde	3.75 a	3.83 abc	3.68 abcd	3.76 ab
	Waukomis1	0 *	2.06 ab	1.86 b	2.39 a	1.94 b	2.06 ab	2.02 ab	2.22 ab	1.92 b	2.05 ab	2.08 ab	2.16 ab	1.98 ab
	Waukomis 2	19.6	1.82 abc	1.29 d	1.58 cd	1.68 bc	1.72 bc	1.84 abc	1.81 abc	2.03 a	1.83 abc	1.84 abc	1.97 ab	1.95 ab
2015														
	Garber	0	3.33	3.20	3.13	3.19	3.30	3.47	3.79	3.21	3.20	3.14	3.20	3.25
	Stillwater	29.4	2.23	2.34	2.53	2.24	2.75	2.60	3.74	2.72	2.68	2.97	2.84	3.03
	Waukomis 3	7.4 *	3.31	3.24	3.57	3.29	3.48	3.41	3.72	3.59	3.65	3.56	3.80	3.69

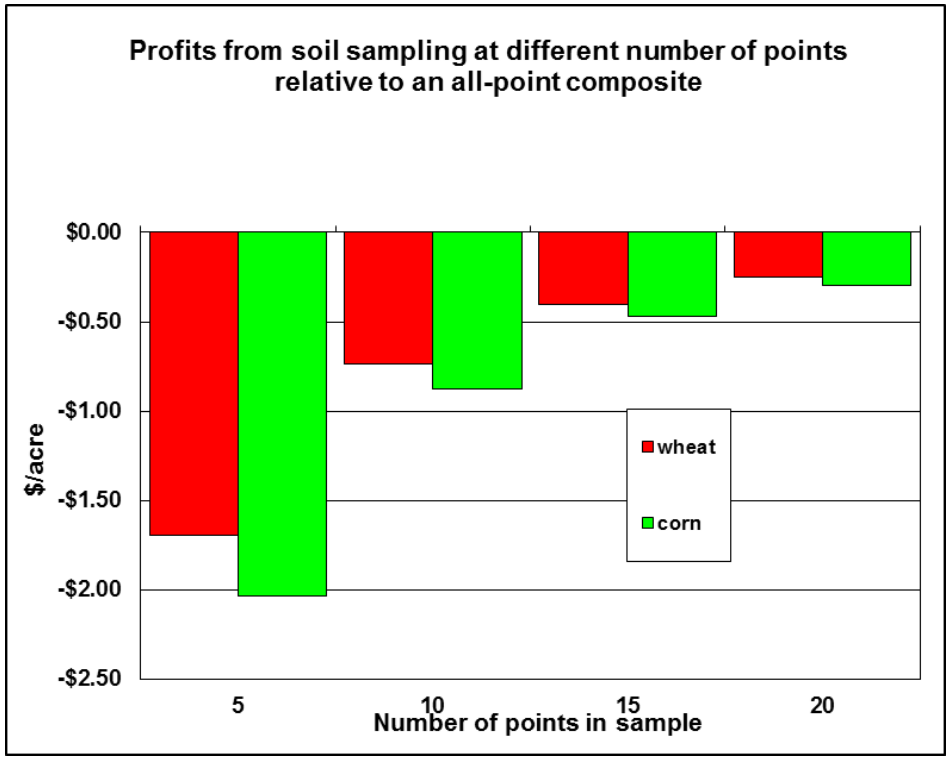
Means in each row with different lettering beneath are significantly different at $p \leq 0.05$.
OSU Rate with * indicates that current recommendations would have required an additional 14.68 kg P ha^{-1} application due to soil pH.

How we Do Phosphorus Recs

- Build-Maintain (Replacement)
- Apply enough P to or K to build soil test values to a target soil test value over a planned timeframe (e.g. 4-8 years), then maintain based on crop removal and soil test levels
- NOT intended to provide optimum economic returns in a given year, but minimize the probability the P or K will limit crop yields while providing for near maximum yield potential

Crop	Harvest unit	P in yield
Corn	Bushel	.38
Soybean	Bushel	.8
Wheat	Bushel	.5

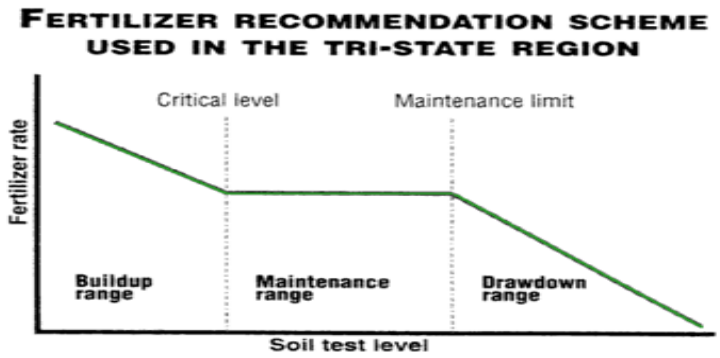
Phosphorus Recs – Suff Does work



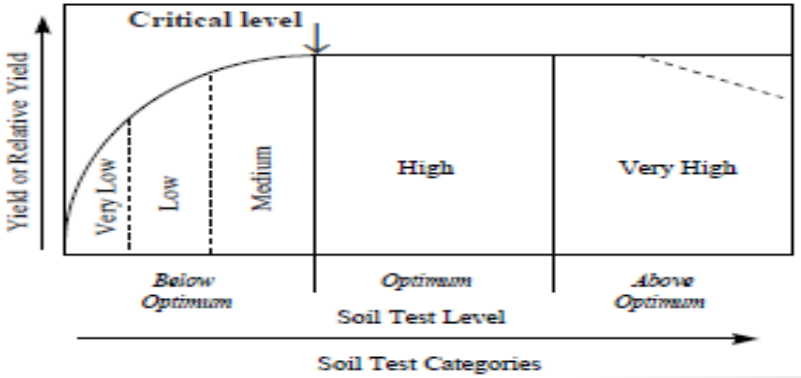
L. Haag, Wheat U - 10 Aug 2016 Wichita

How we Do Phosphorus Recs

- Build-Maintain (Replacement)
- Sounds good and makes sense right.
- If we are using this approach.
- Does rate matter.



Build-up maintain fertilizer scheme suggested by the Ohio State University.



Nutrient response curve based on soil test, Rutgers Cooperative Extension.

How we Do VRT Phosphorus Recs

- How is it done?
- Soil : Yield : Soil x Yield: Yield : Soil

- Grid/Zone Sample, Yield Goal 3-5 yr
- Grid/Zone, Multi Year Yield, 3 yr
- Grid/Zone, Update Yield each year.

How we Do VRT Phosphorus Recs

- Equation for soils below optimum is:

P Rec = (Optimum P – Observed P) *16 / build years + Crop Removal

- For soils test in the optimum range:

Prec = Crop Removal

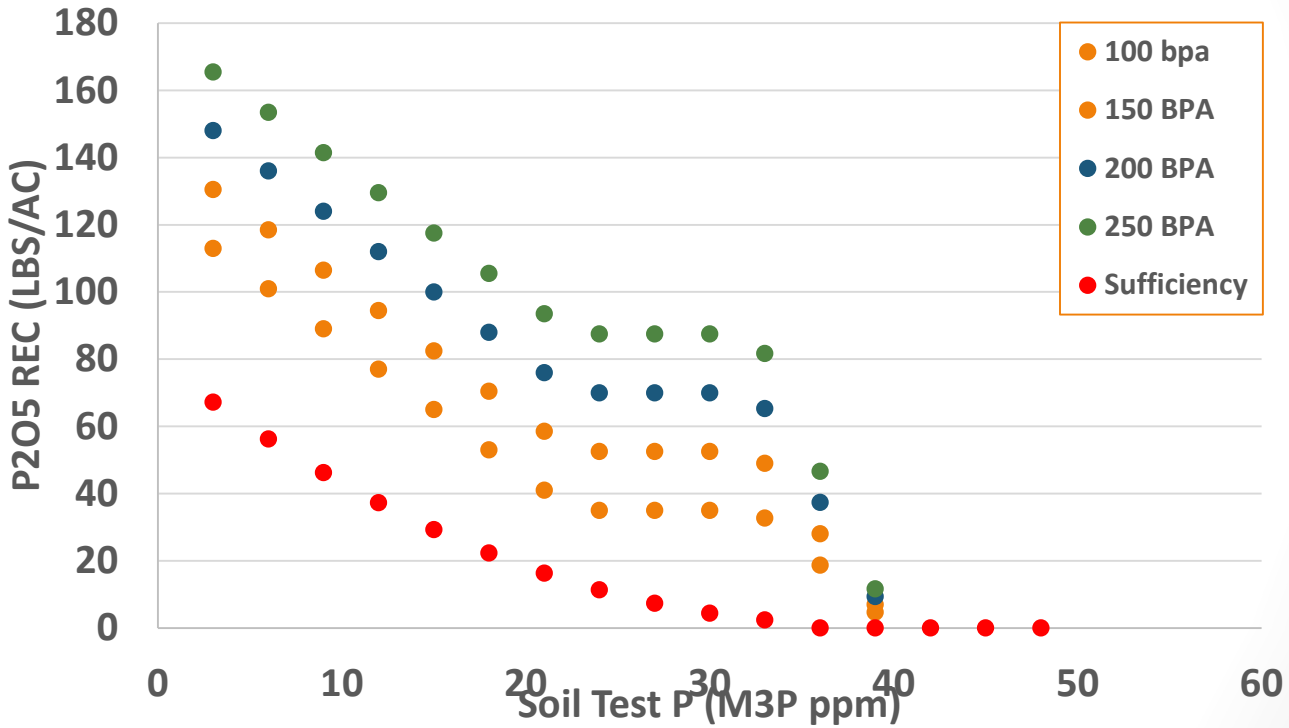
- For Soils in High Range

Prec = Crop Removal *(((Optimum P level + 12.5) – observed P)/7.5)

  - This gradually tapers the rec to 0 once we are 12.5 ppm above optimum

- Optimum Range is 22.5-27.5 ppm for Row Crops , 20-25ppm for cool season grass and similar, 15-20ppm for Warm Season grass and similar

How we Do VRT Phosphorus Recs



How we Do VRT Phosphorus Recs

- I requested grid sample data straight from producers.
- Have entered 400 fields
- The data you see is 268
- Goal 500+ fields
- Multiple Labs

- Still Requesting data

Soil Test Results

Grower: Knoche Farms
Farm: Craig
Field: BK
Area: 78.41 ac
Event Date(s): 3/6/2015

Min:	4.7	6.4	20.0	105.0	0.2
Max:	6.7	7.2	43.0	244.0	0.4
Avg:	5.3	6.6	33.2	184.7	0.3

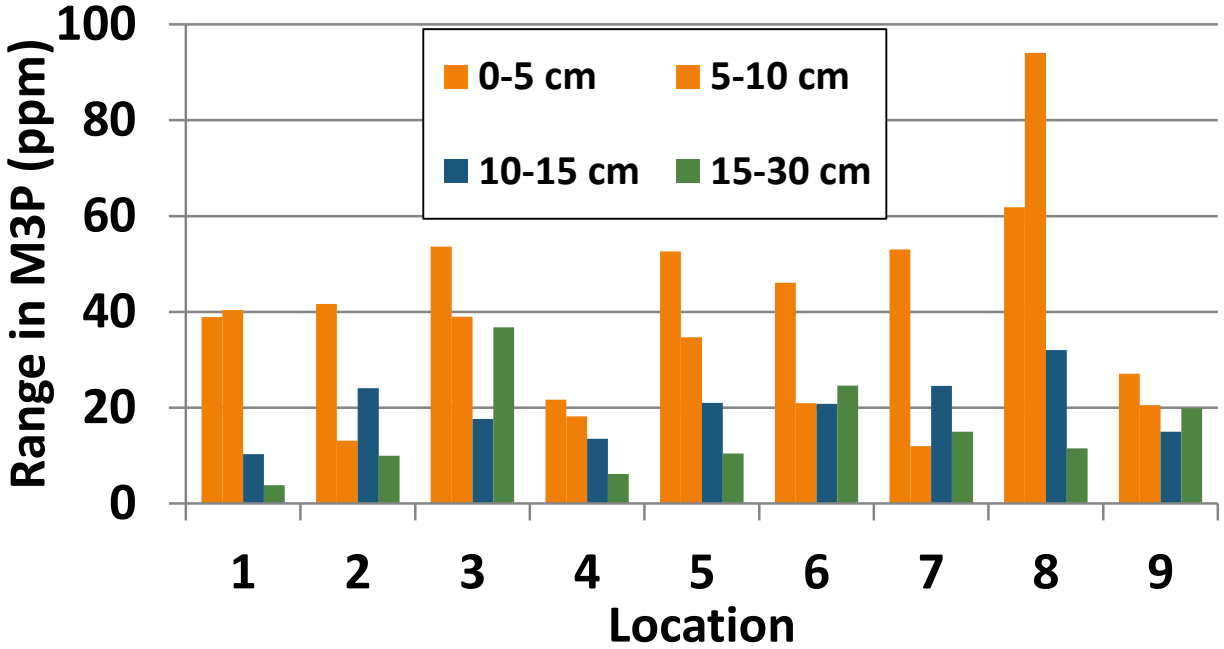
Sample ID	pH	BpH	P Mehlich III	K	Zn
1	5.4	6.7	37.0	175.0	0.3
2	5.9	6.7	27.0	204.0	0.3
3	5.1	6.6	40.0	192.0	0.3
4	4.7	6.4	39.0	171.0	0.2
5	5.5	6.6	31.0	201.0	0.2
6	6.7	7.2	40.0	184.0	0.3
7	5.2	6.6	28.0	156.0	0.2
8	5.3	6.5	35.0	208.0	0.3
9	4.8	6.4	36.0	193.0	0.2
10	5.3	6.9	20.0	105.0	0.2
11	5.1	6.5	30.0	178.0	0.3
12	5.0	6.6	31.0	175.0	0.2
13	5.5	6.7	27.0	164.0	0.3

How we Do VRT Phosphorus Recs

	Soil pH		Buffer Index		P		K	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Count	268		266		257		257	
Average	6.0	1.9	6.8	0.5	28.4	54.5	190	209
Min	4.6	0.4	5.9	0.0	4.3	4.0	28	14
Max	7.7	3.8	13	5.4	93	318	674	4640

	OM		Ca		Mg		S	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Count	176		199		233		102	
Average	2.6	2.0	1546	1877	314	351	14	26
Min	0.5	0.3	396.1	0.0	45.5	20.0	5.9	0.0
Max	123	121	5099	12750	1208	1201	87	597

How we Do VRT Phosphorus Recs

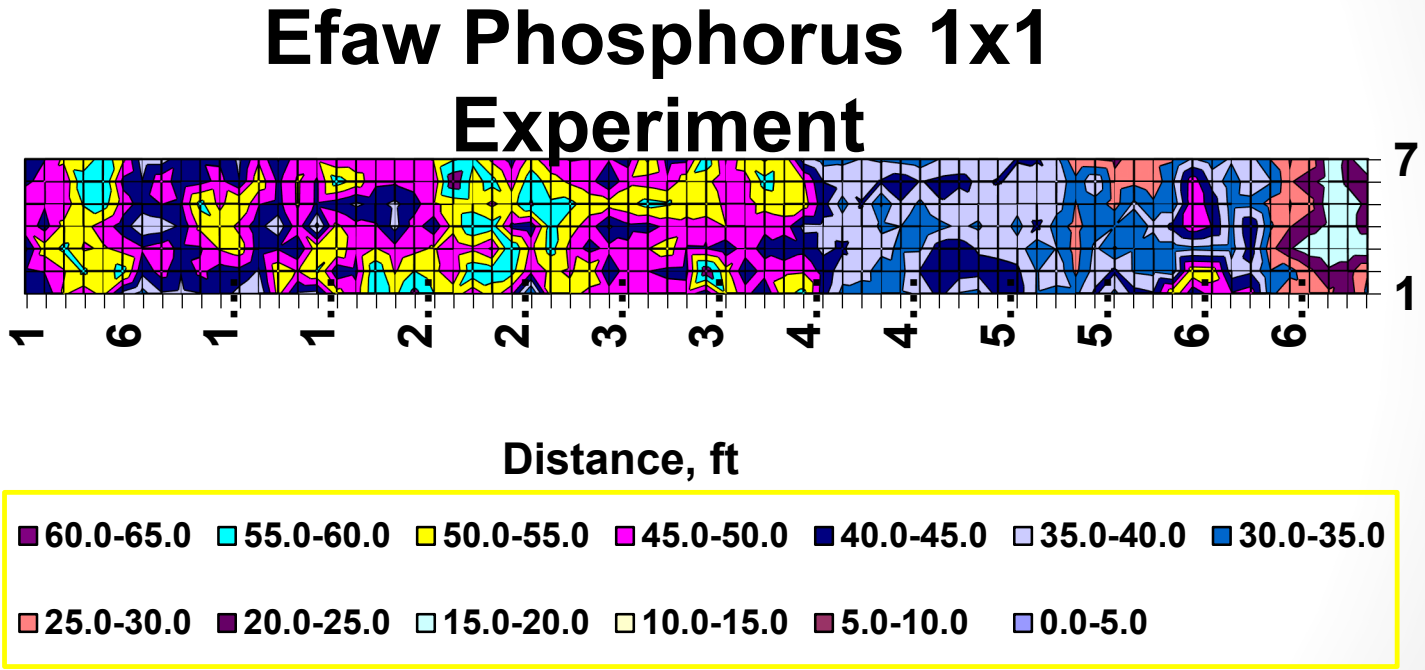


Year	Location	Sampling Depth	Mehlich III Extractable P			Soil pH		
			Min	Max	Ave	Min	Max	Ave
		cm	Mg P kg^{-1}					
2014	**Stillwater**	0 -5	***2.2***	***41.1***	11.8	***5.9***	***8.1***	6.9
		5 -10	***2.9***	***43.3***	7.3	***6.3***	***8.2***	7.3
		10 -15	2.3	12.7	4.9	6.2	5.2	7.3
		15 -30	1.5	5.3	2.7	6.6	9.1	7.8

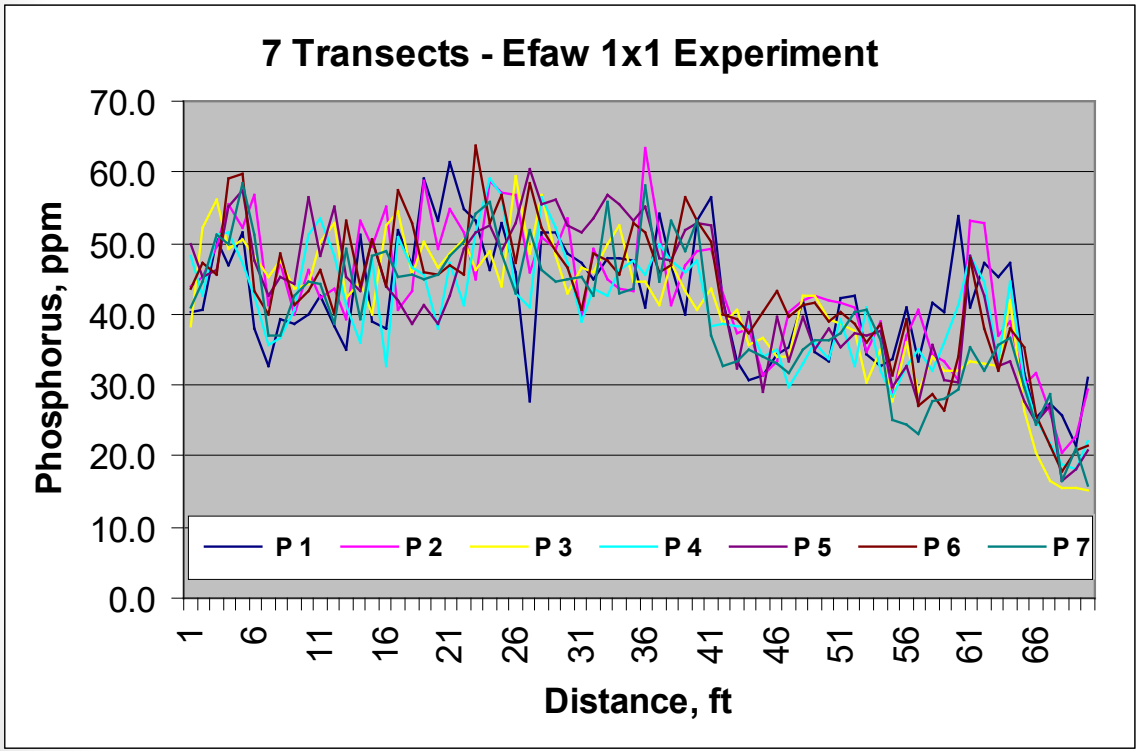
How we Do VRT Phosphorus Recs

Microvariability in Soil Test, Plant Nutrient, and Yield Parameters in Bermudagrass. 1997
W. R. Raun et al.
Vol. 62 No. 3, p. 683-690

How we Do VRT Phosphorus Recs

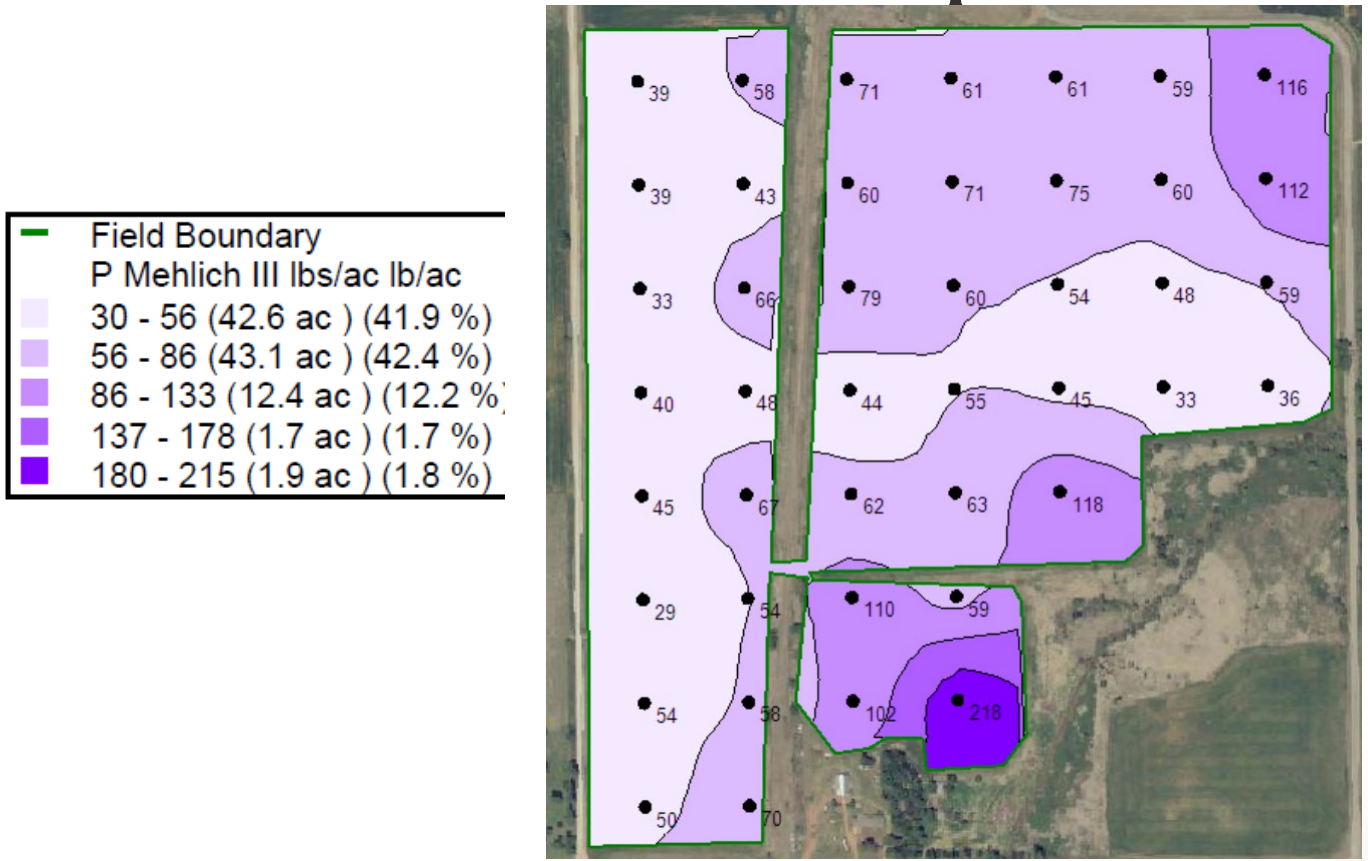


How we Do VRT Phosphorus Recs

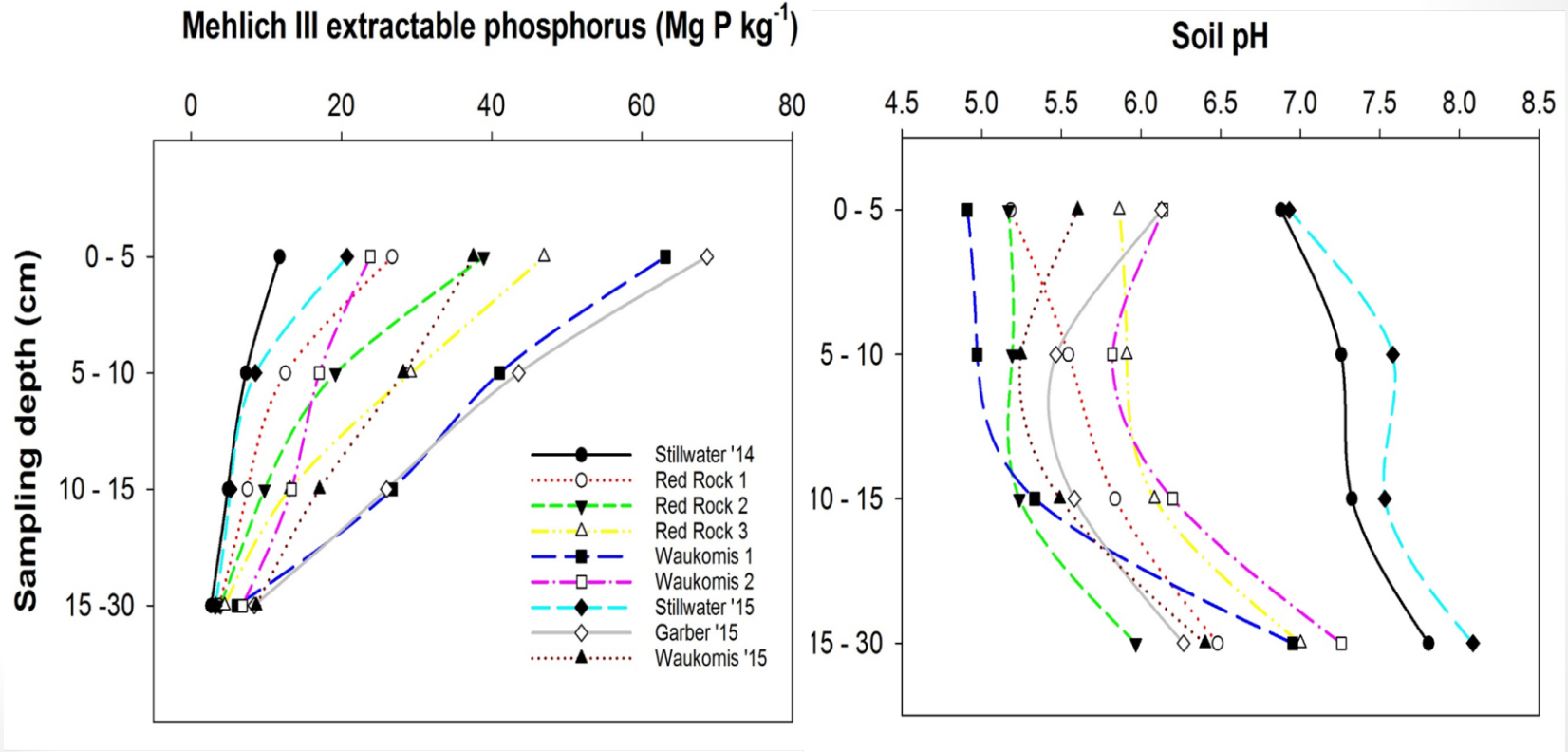


Soil pH ranged from 4.37 to 6.29 within the 2.12 by 21.33 m area at Burneyville and 5.37 to 6.34 at Efaw. **Significant differences in surface soil test analyses were found when samples were <1** m apart for both mobile and immobile nutrients

How we Do VRT Phosphorus Recs

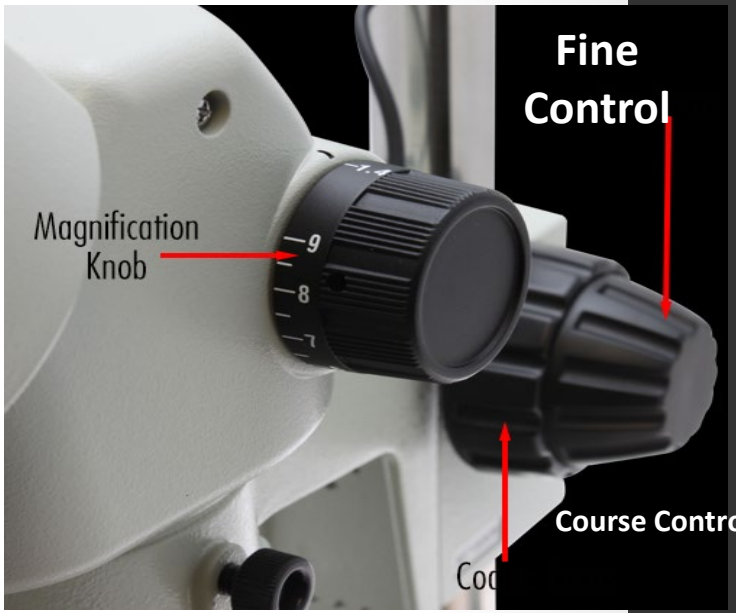


How we Do VRT Phosphorus Recs



Fine and Course Control

- Making high resolution decisions using low resolution recs.
- Recommendation maps are at < 1 acre resolution and critical value that represents a whole state.
- How Precise is that.

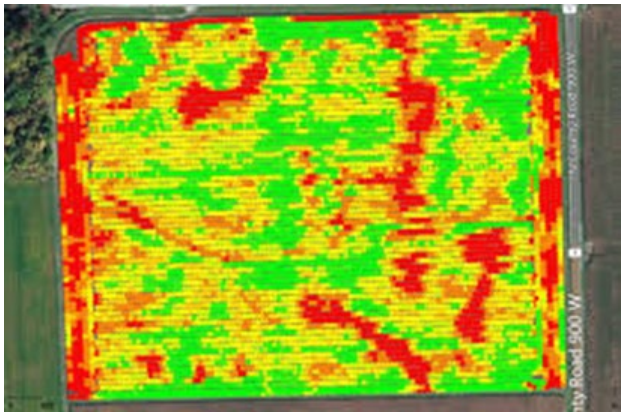


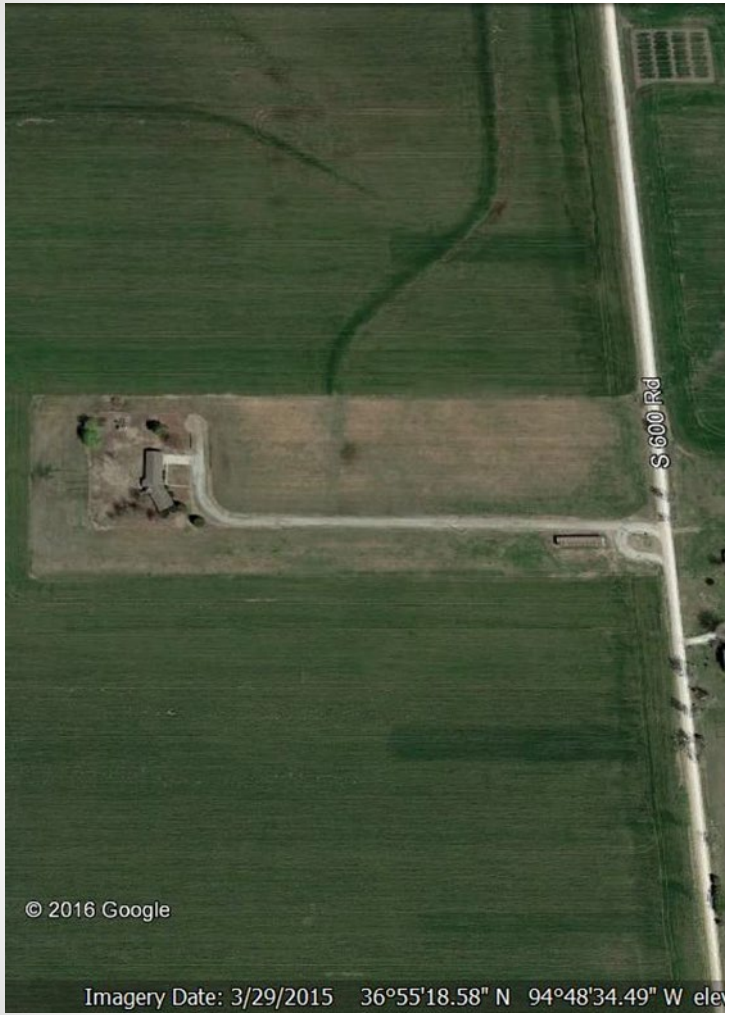
Why is Lime most Accurate VRT?

- Buffer Index
  - It measures soil respose
- P Buffer???
- Change Soil Sampling intensity from Spatial to Temporal
- Adjust P rate based on expected response and soil response.

How we Do VRT Phosphorus Recs

- Likelihood of VRT based on Sufficiency being off is high.
- Interpolation of P based on grid is a stretch.
- Yield monitor data has a higher resolution of positional accuracy.
- Current VRT using a Course Knob to adjust P.
- If replacement rates are used soil testing is essential





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