Nutrient Management Strategies to Optimize Crop Yield and Profitability: Pre-Plant vs. In-Season

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Presentation Outline:

Pre-Plant Nutrient Management

- ✓ Soil Sampling – Time, Depth, & Grid Size
- ✓ P, K, and S Response Curve and Fertilizer Recommendations – Corn & Soybean

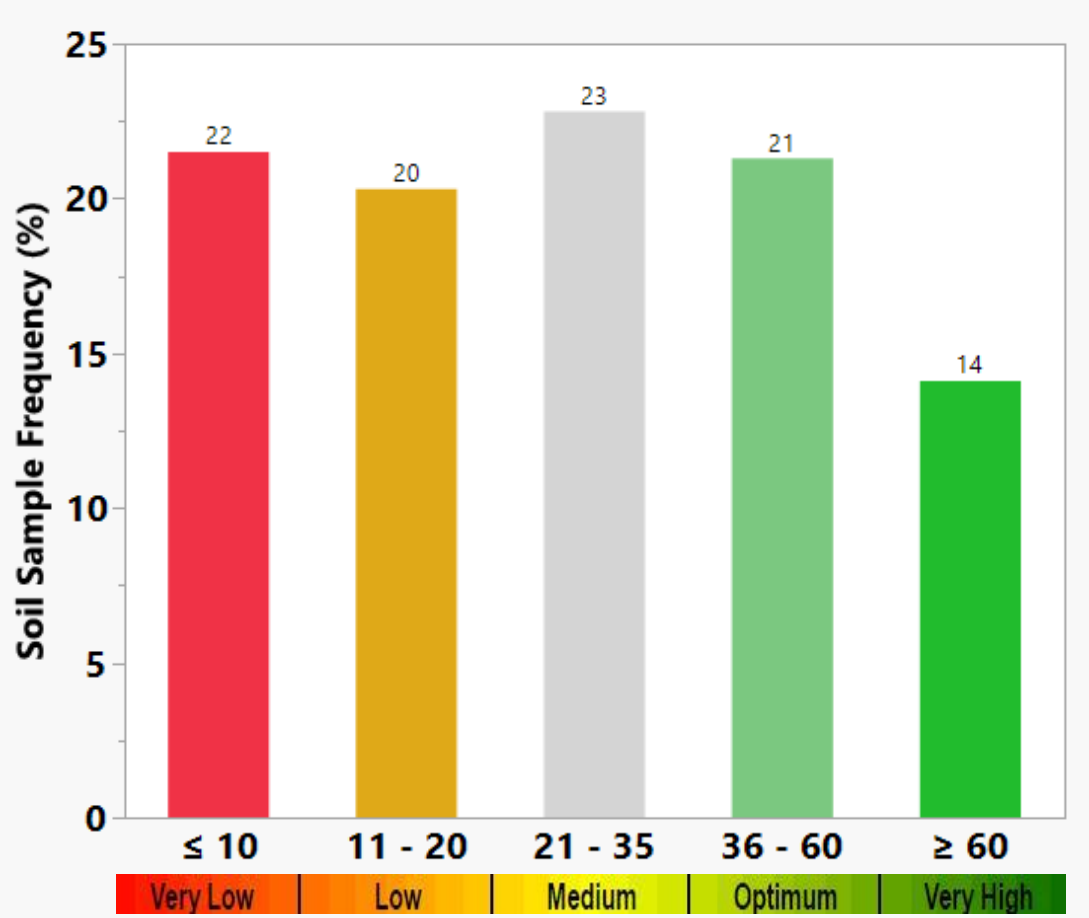
In-Season Nutrient Management

- ✓ Tissue Testing and Interpretation
- ✓ N Management – Corn
- ✓ P, K, and S Management – Corn & Soybean
- ✓ Foliar Fertilization – Corn & Soybean

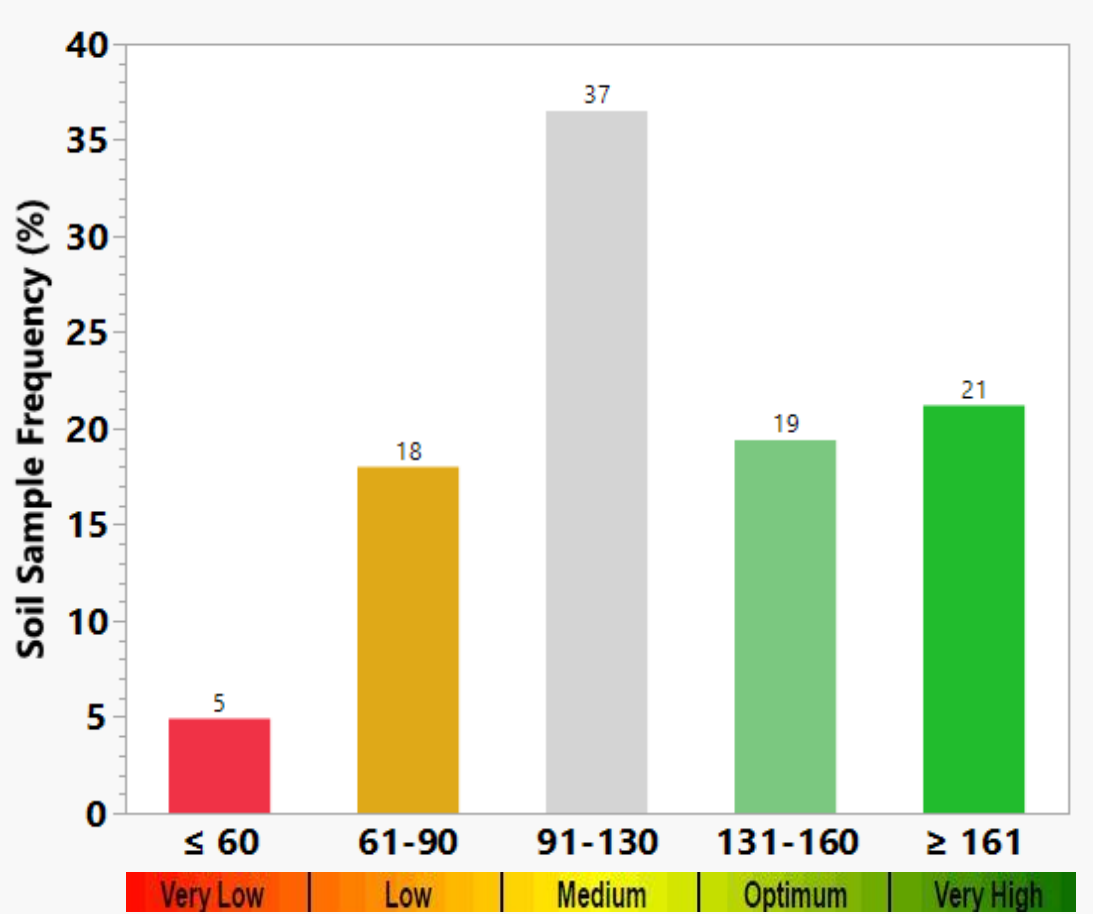
New Soil Fertility and Soil Health Reports

Current Soil-Test Phosphorus and Potassium Levels in Missouri

Average soil-test P level in ppm

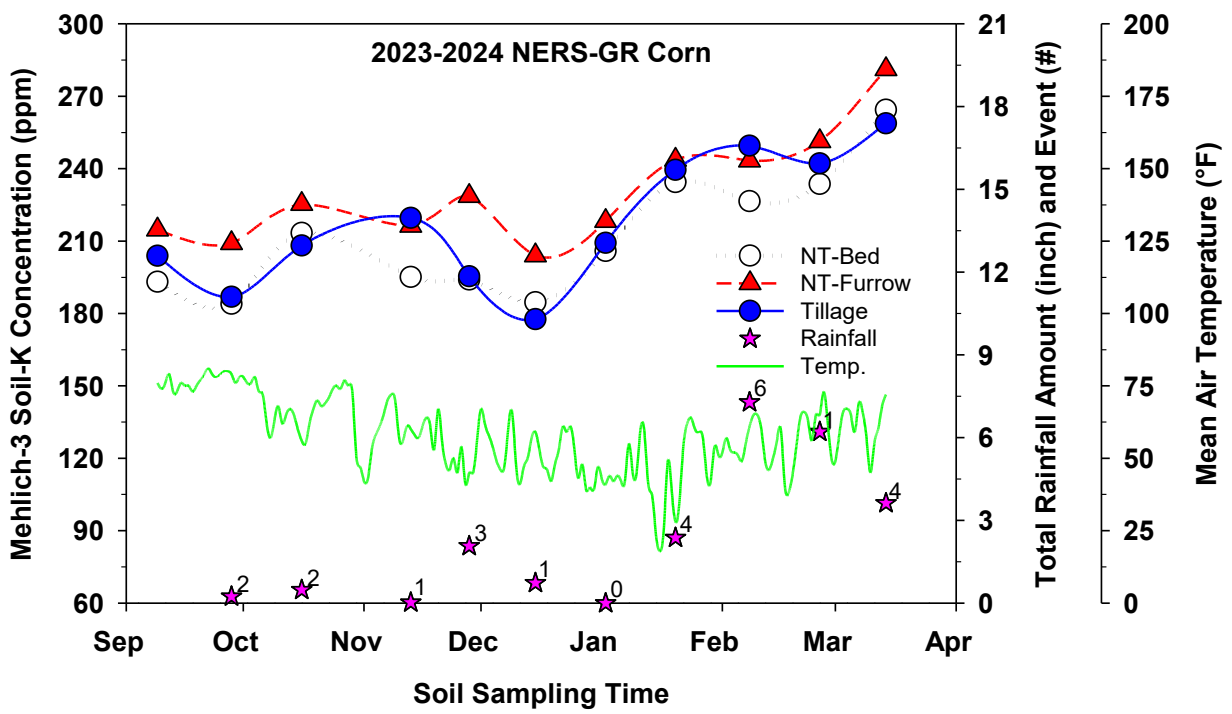


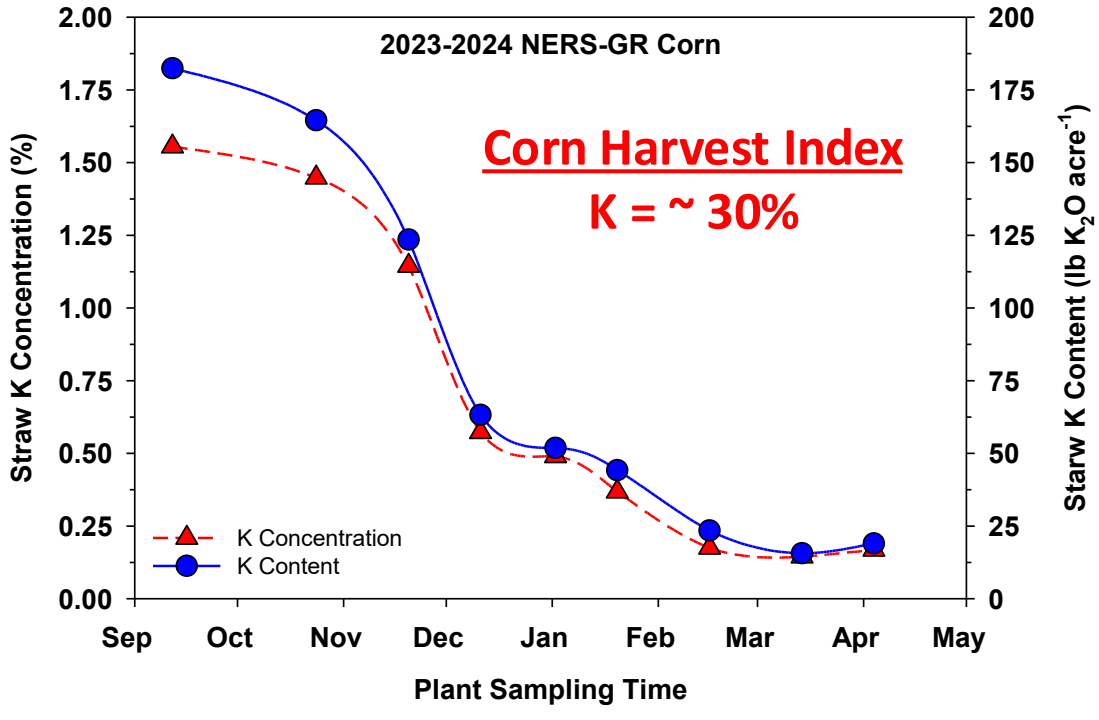
Average soil-test K level in ppm



Data Source: MU Soil and Plant Testing Laboratory (2020 – 2025)

Soil Sampling Time: Fall vs. Spring





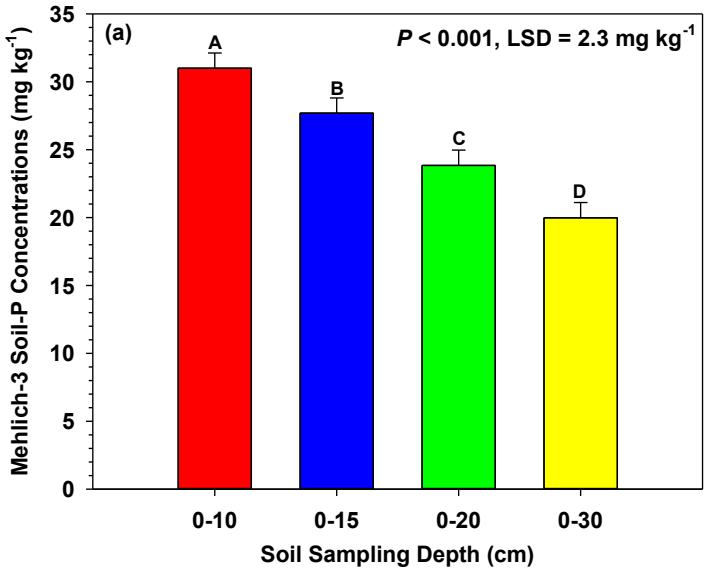
Increment of Soil-Test P and K Concentrations from Fall to Spring

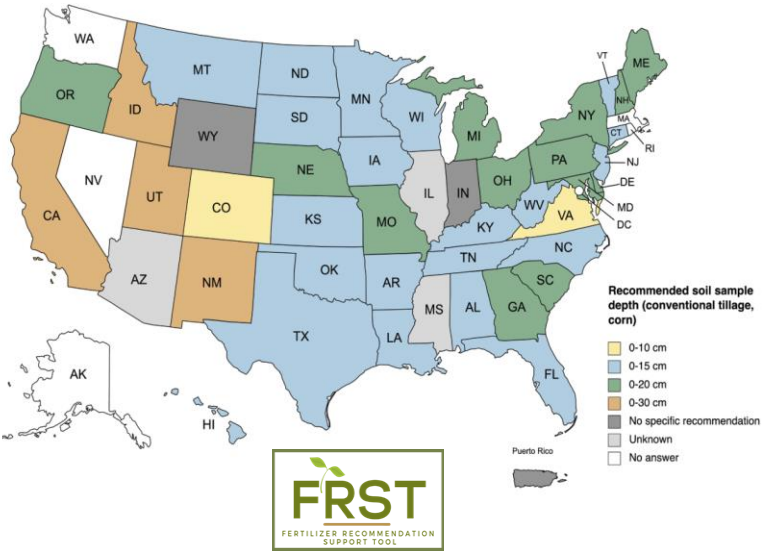
Crop	Year	Site	Soil-Test K	Soil-Test P
			Increase from Mid-Sep to Mid-March (ppm)	
Corn	2	4	**31.7**	**6.1**
			Increase from Mid-Sep to Mid-March (ppm)	
Rice	2	3	**32.5**	**9.2**
			Increase from Mid-Nov to Mid-March (ppm)	
Cotton	2	2	**23.3**	**10.6**
			Increase from Mid-Oct to Mid-March (ppm)	
Soybean	2	4	**9.0**	**6.4**

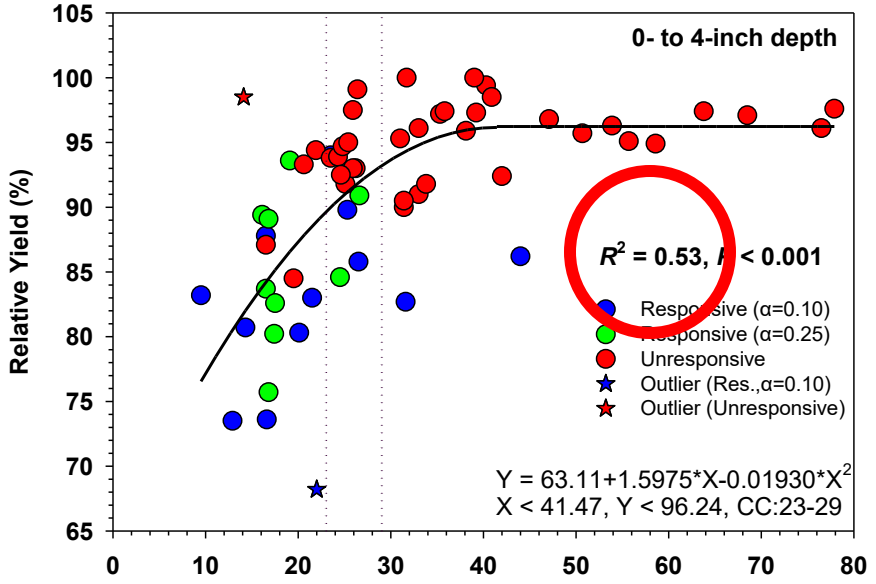
Soil-Test Level	Soil-K Conc. (ppm)	K Rate (lb K_2O ac^{-1})
Very Low	≤ 60	120
Low	61 – 90	90
Medium	91 – 130	60
Optimum	131 – 160	0
Above Optimum	≥ 161	0

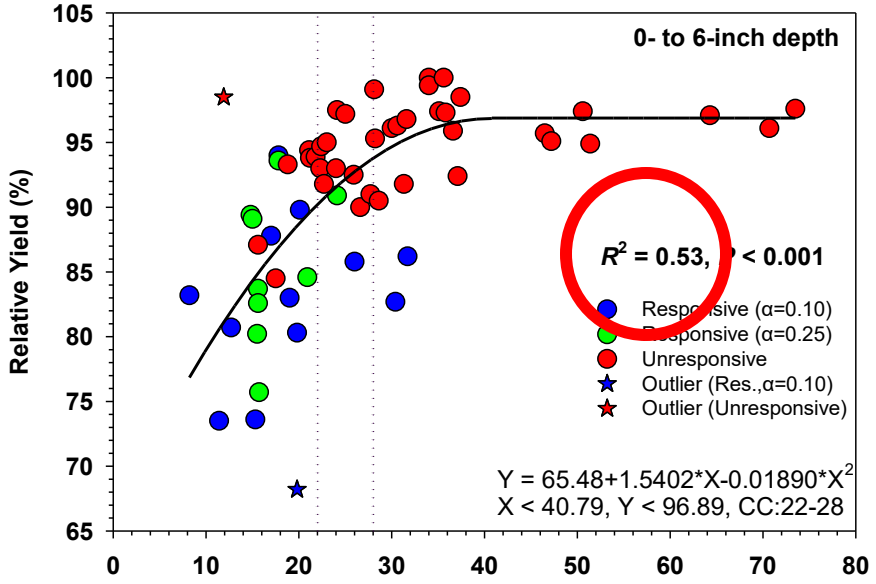
Soil-Test Level	Soil-P Conc. (ppm)	P Rate (lb P_2O_5 ac^{-1})
Very Low	≤ 10	90
Low	11 – 20	70
Medium	21 – 35	50
Optimum	36 – 60	0
Above Optimum	≥ 61	0

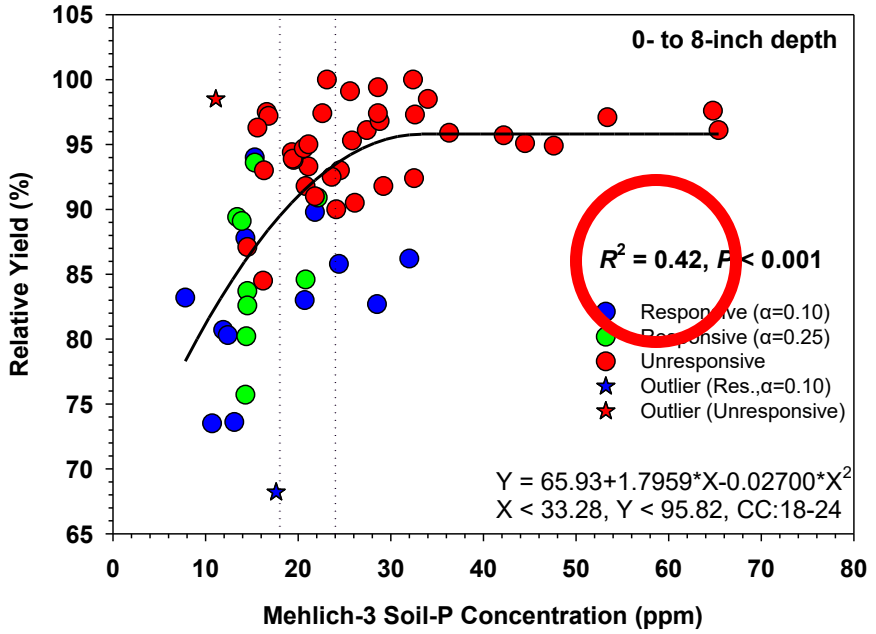
Soil Sampling Depth: 0-4, 0-6, 0-8, 0-12 inches

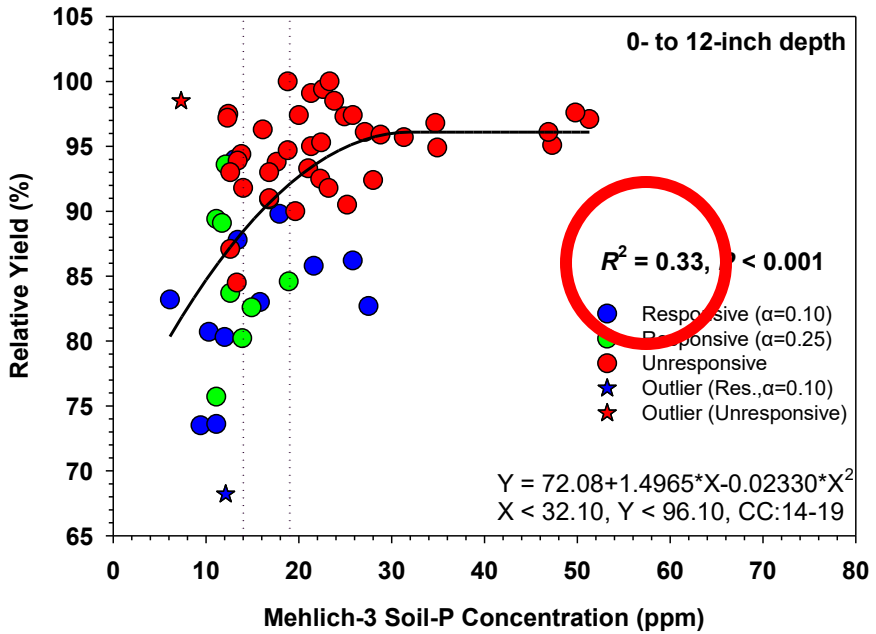








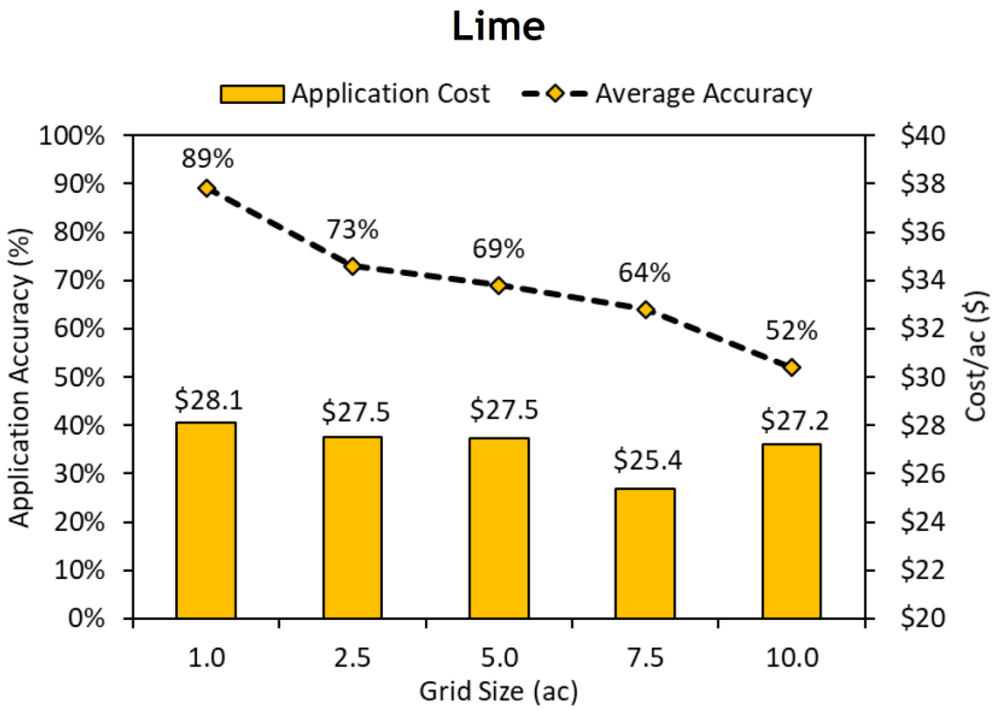


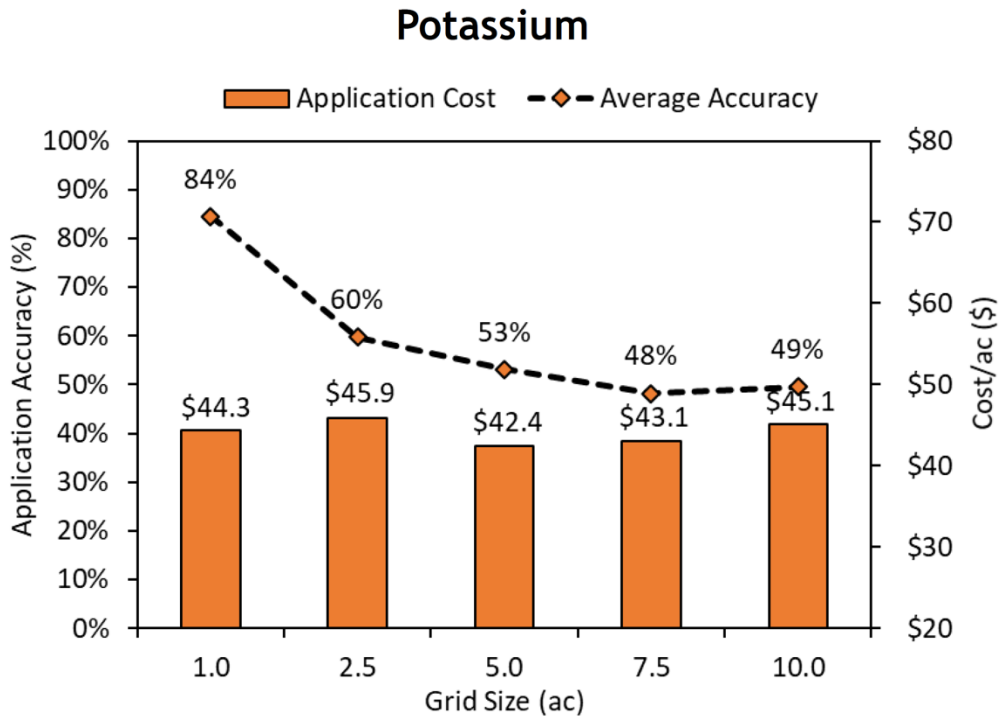


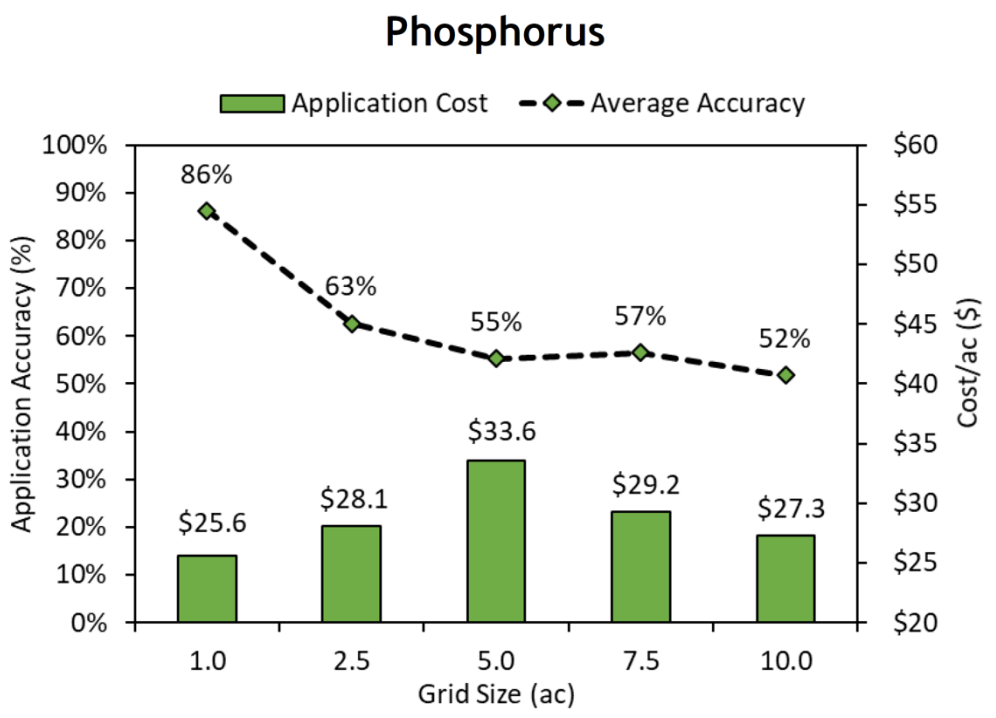
Grid Size: Representative Sample

Dr. Simer Virk (University of Georgia)

- **Not bigger than 2.5 acre grid** (1-ac is better)
- **Start with a smaller grid (1-ac)** than gradually transition to bigger grid (2.5-ac or more) or zone sampling.







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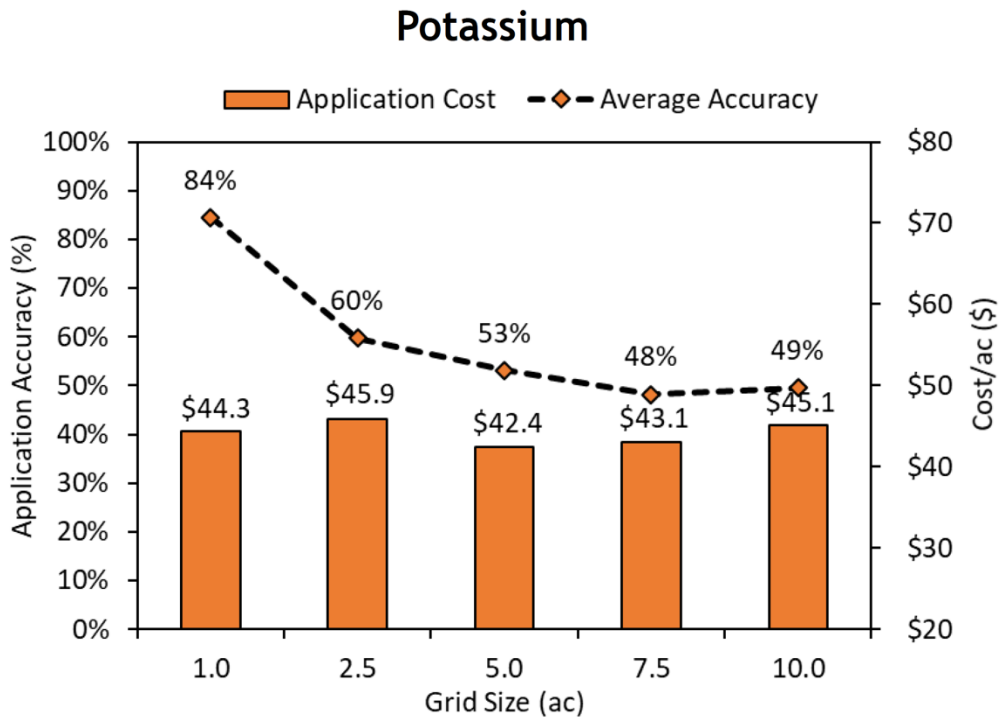


Lake Providence: 26 acres (2 samples based on soil texture)

Crop Response to Long-Term Fertility

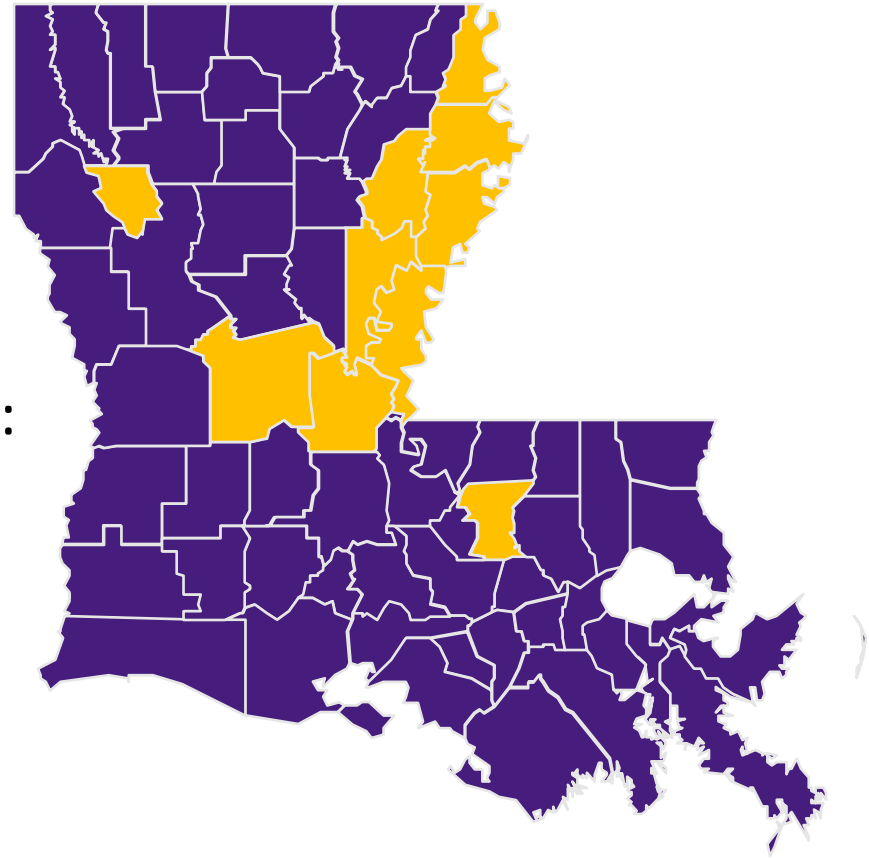
Auburn University Long-Term Fertility Study Since 1911

Treatments	Corn	Soy	Cotton
	bu/ac	bu/ac	lb/ac
Complete N-P-K-Micros	**130**	**40**	**1323**
No soil amendment	7	1	43
No lime (pH 4.5)	18	3	60
No N	**40**	**40**	**841**
No P	**48**	**15**	**619**
No K	**24**	**15**	**33**
No S	**121**	**38**	**1046**

444 Field Trials: Crop Response to P, K, and S Fertilization

- **Year, State, & Crop:** 2020 to 2024 in Louisiana for Corn, Soybean, and Cotton

- **Site-Years:** Total 444 trials for P (191), K (203), and S (50)
  - ✓ 6 LSU AgCenter research station locations
  - ✓ 12 on-farm producers' fields



- **Soil Texture:** Ranges from Sandy to Clayey soils

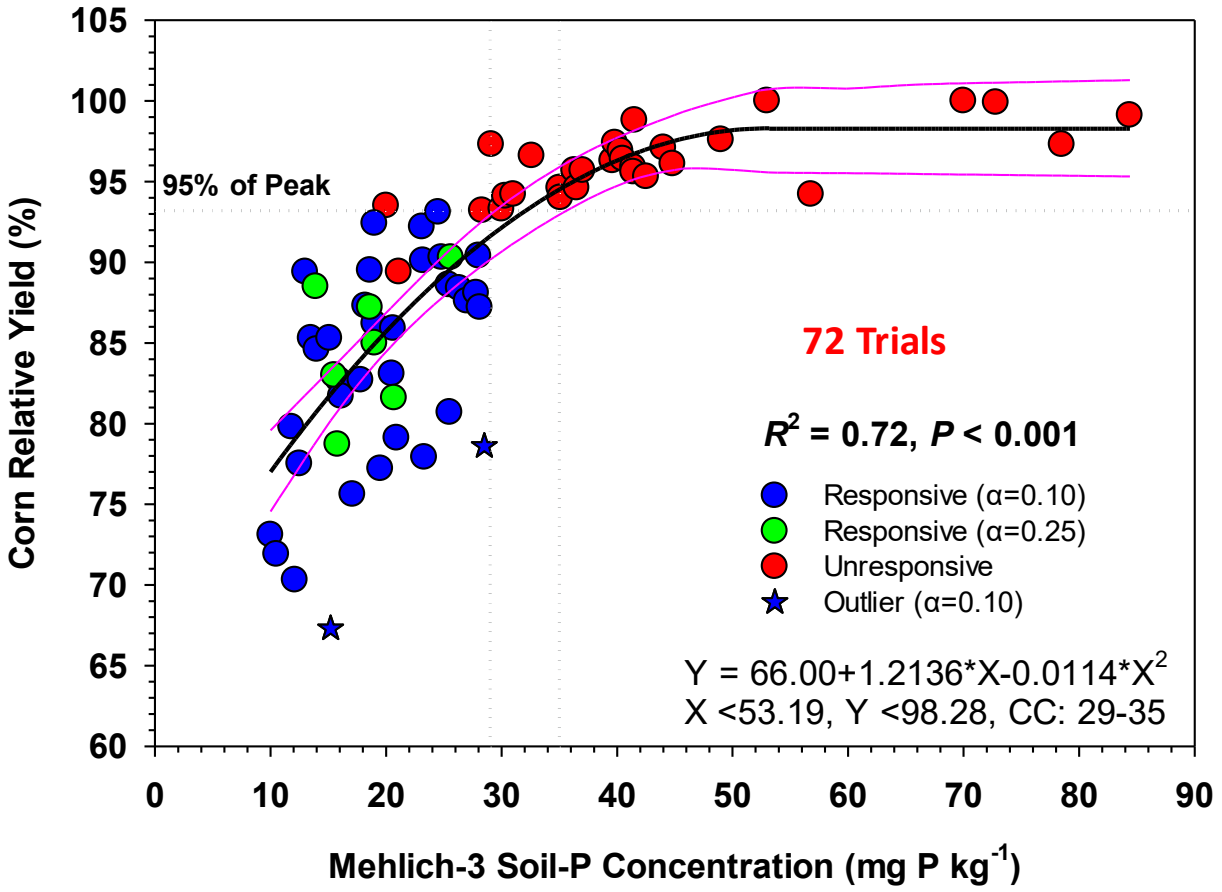
- **Fertilizer Rates:** Five P & K rates and Six S rates with 4-5 reps:
  - ✓ 0, 40, 80, 120, and 160 lb P_2O_5 or K_2O $acre^{-1}$
  - ✓ 0, 10, 20, 30, 40, and 60 lb S $acre^{-1}$

- **Soil Sampling Depth:** 0-4, 0-6, 0-8, and 0-12 inches
  - ✓ Soil P, K, and S Concentration: Mehlich-3 ICP

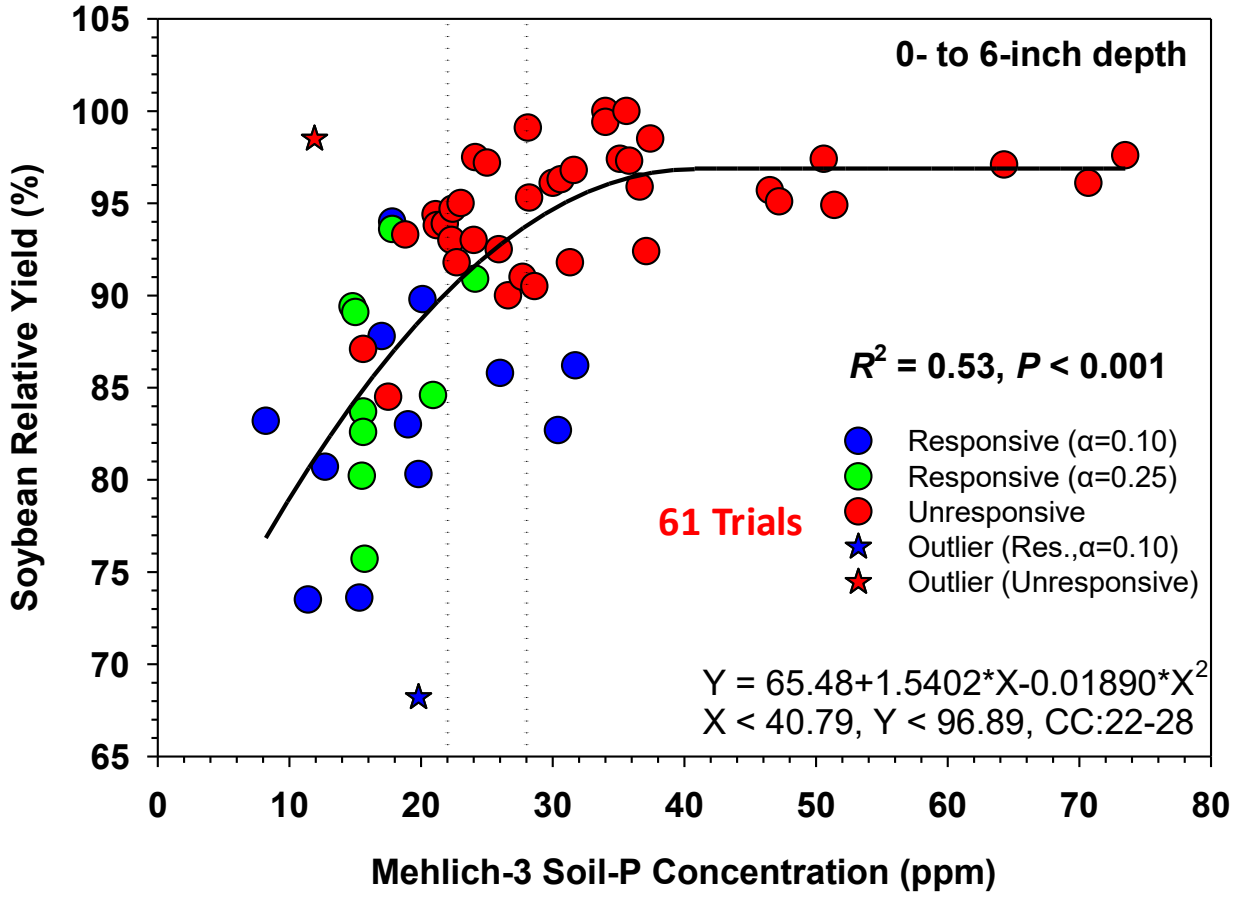
- **Plant Tissue Sampling:**
  - ✓ Corn: Uppermost mature leaves with collar at the V11-12 stage
  - ✓ Soybean & Cotton: Leaves from the 3rd node from the top at the flowering stage

Phosphorus: Crop Yield Response to Soil-Test P Concentrations

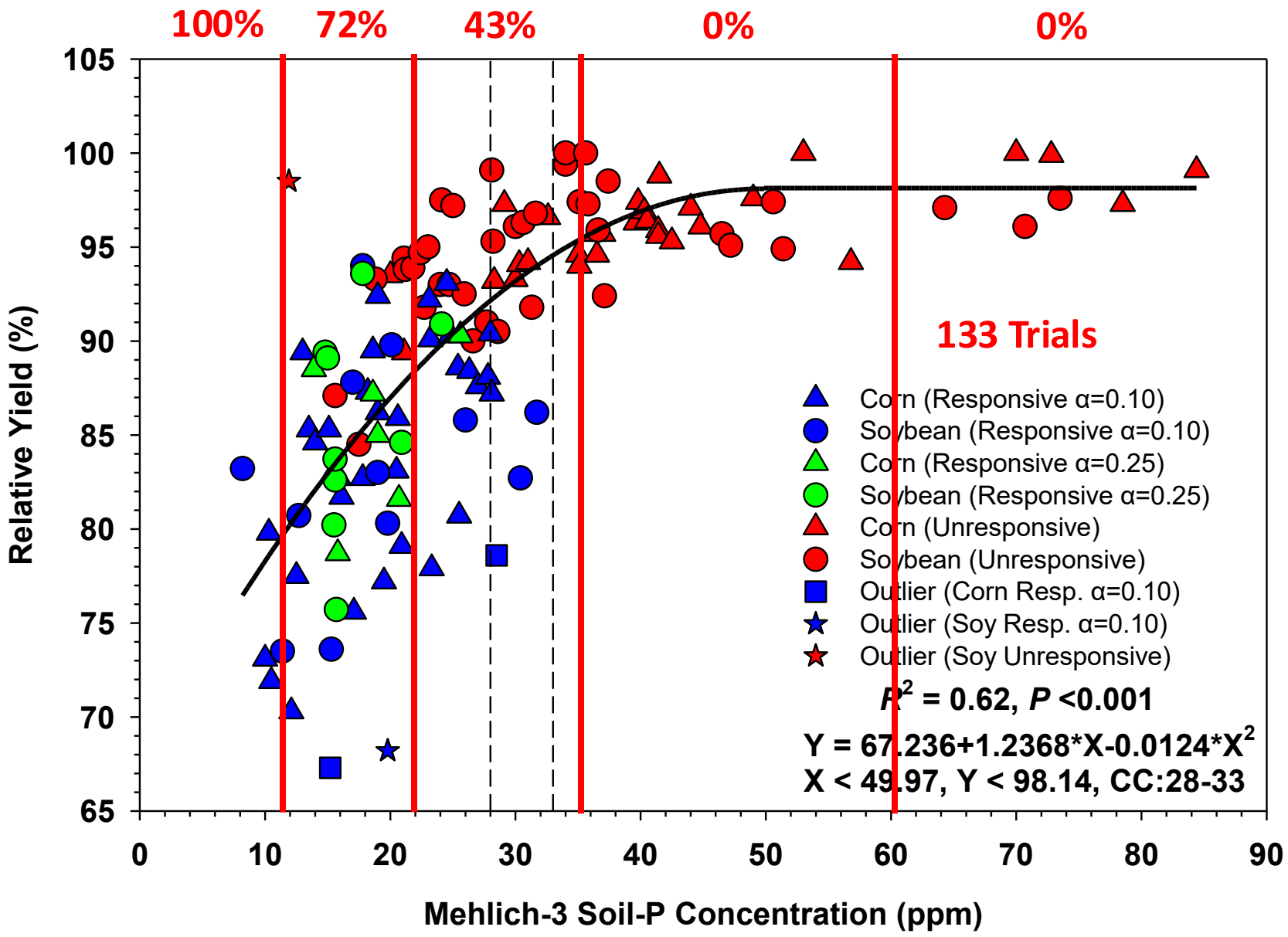
Corn



Soybean

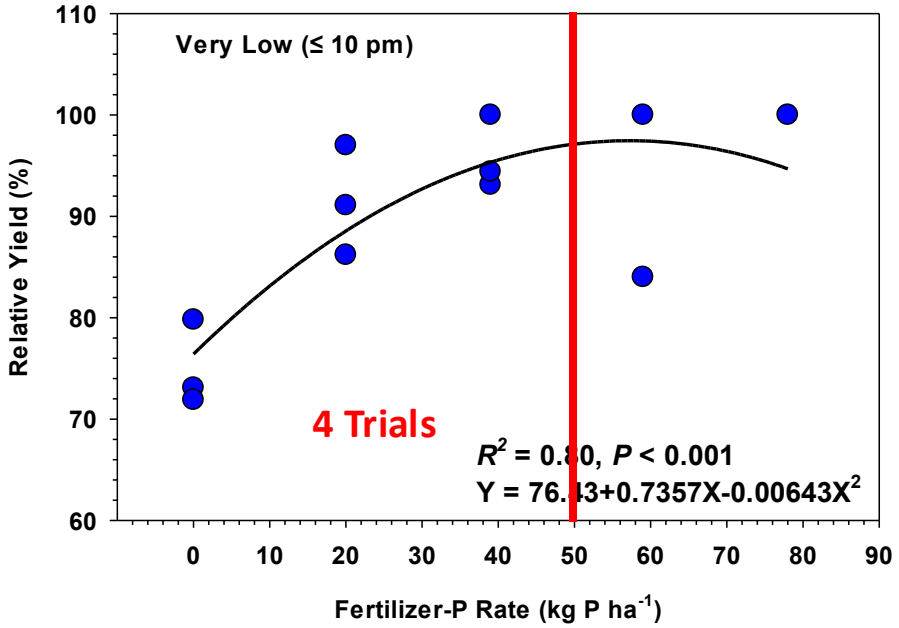


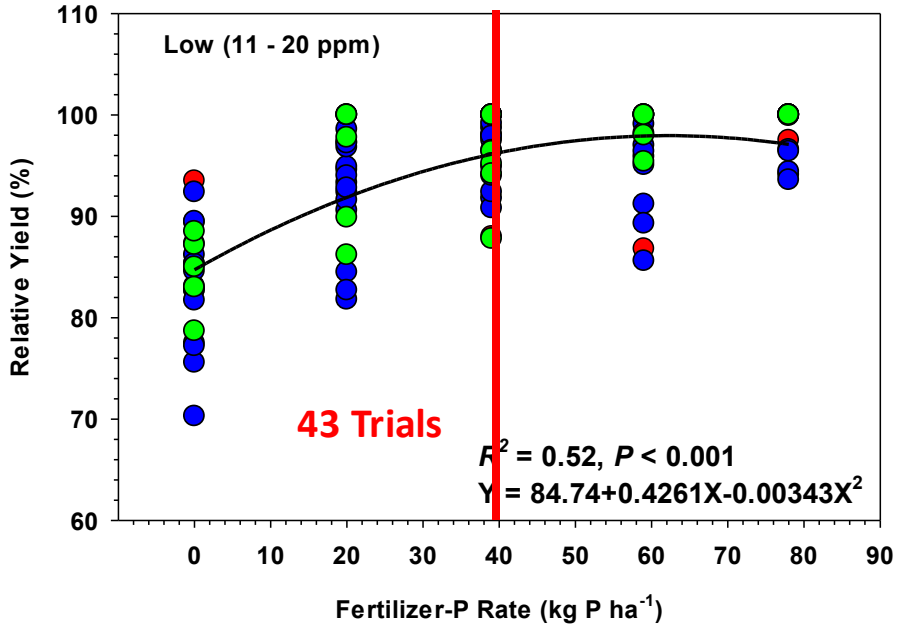
Crop Yield Response to Soil-Test P Concentrations: Corn and Soybean

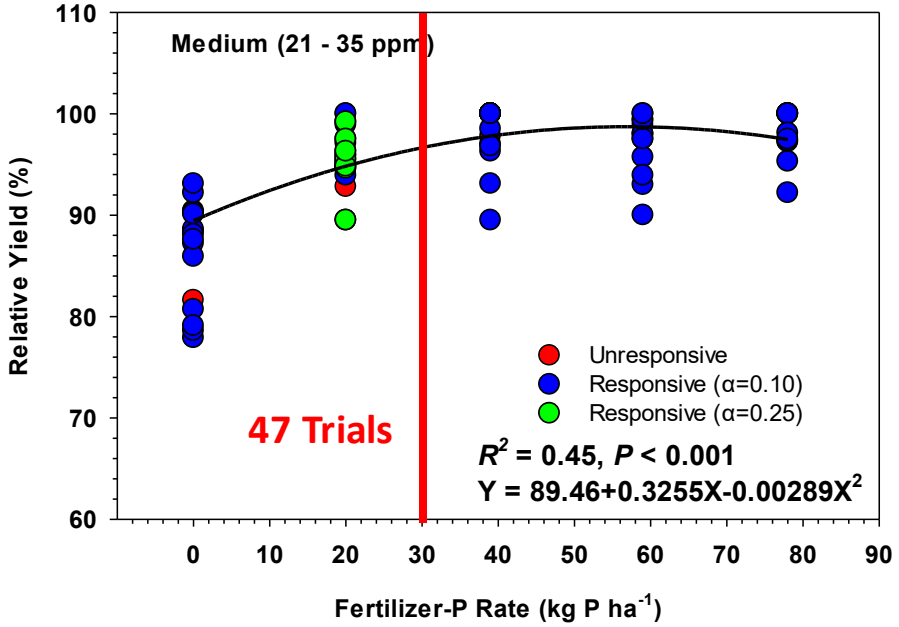


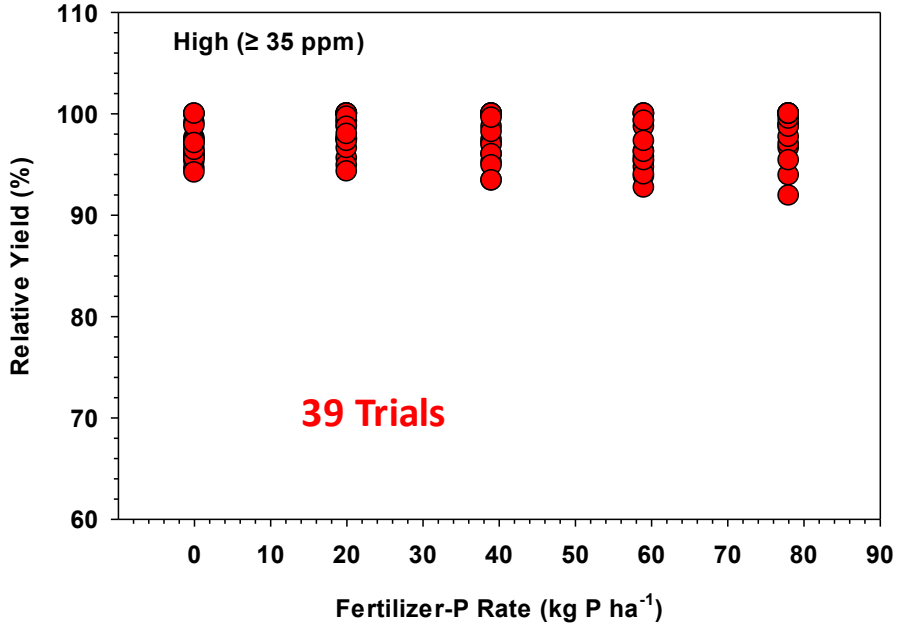
Soil-test Level	Soil-P Conc.	Total No. of Sites Tested	# of Sites Responded to P	Yield Response Frequency	Mean Yield Increase
	ppm	#	#	%	%
Very Low	≤ 10	4	4	**100**	25
Low	11–20	43	31	**72**	15
Med.	21–35	47	20	**43**	10
High	36–60	30	0	**0**	0
Very High	≥ 61	9	0	**0**	0

Calibration: Crop Response to P Fertilization at Different Soil-P Levels



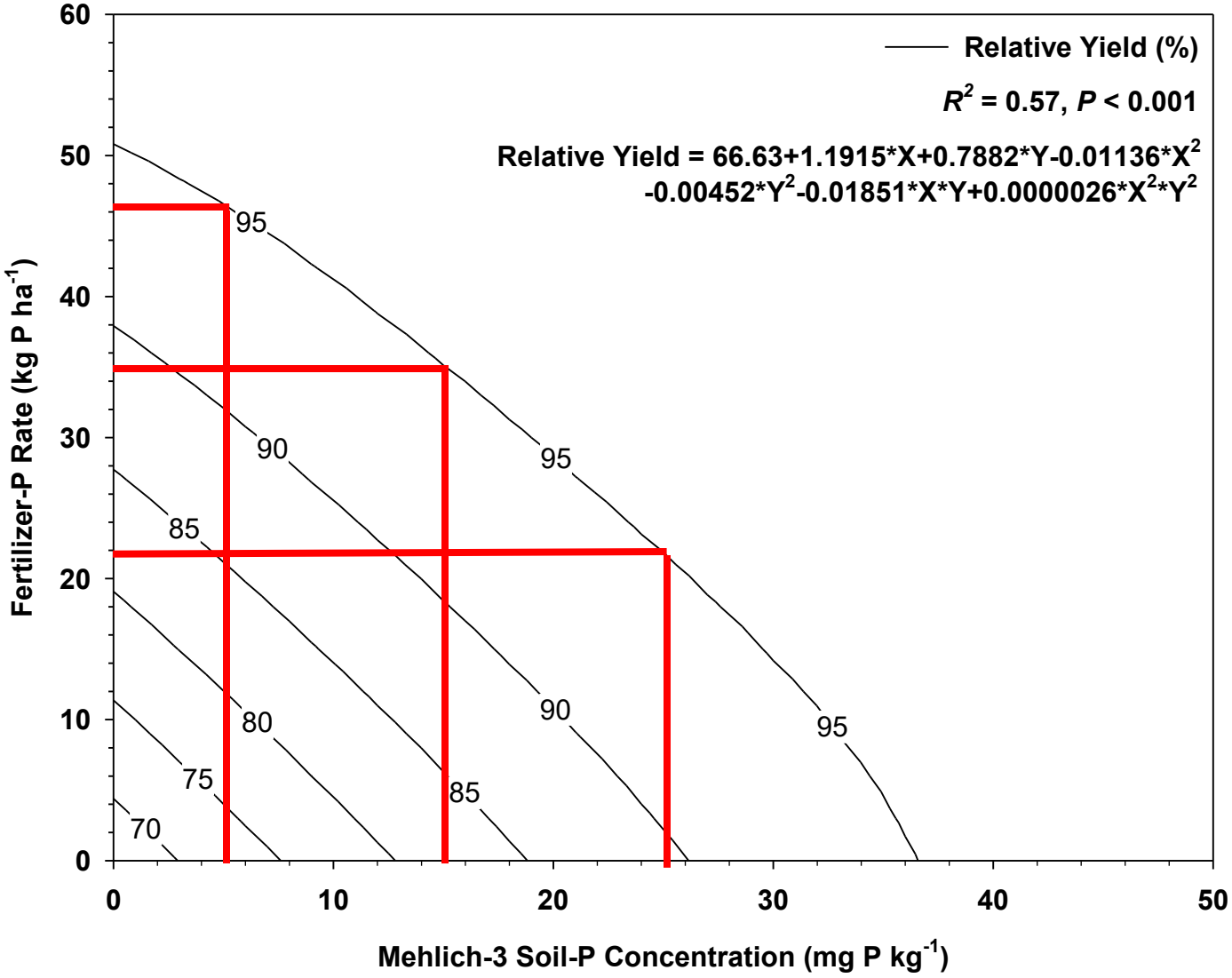






Calibration: Corn Relative Yield vs. Soil-P Conc. vs. Fertilizer-P Rate

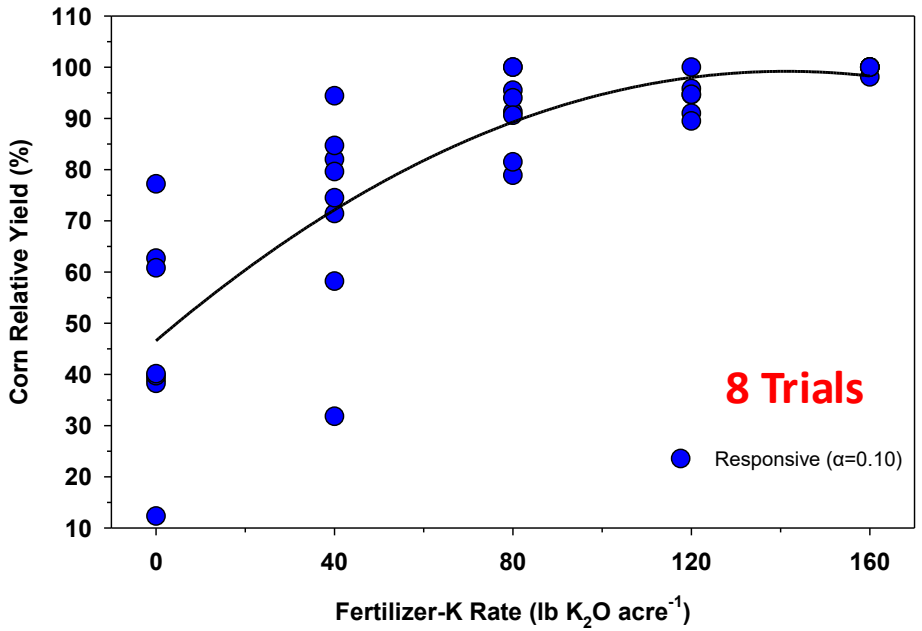
Multiple Regression: Sufficiency Philosophy

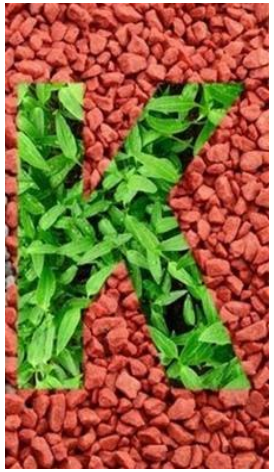


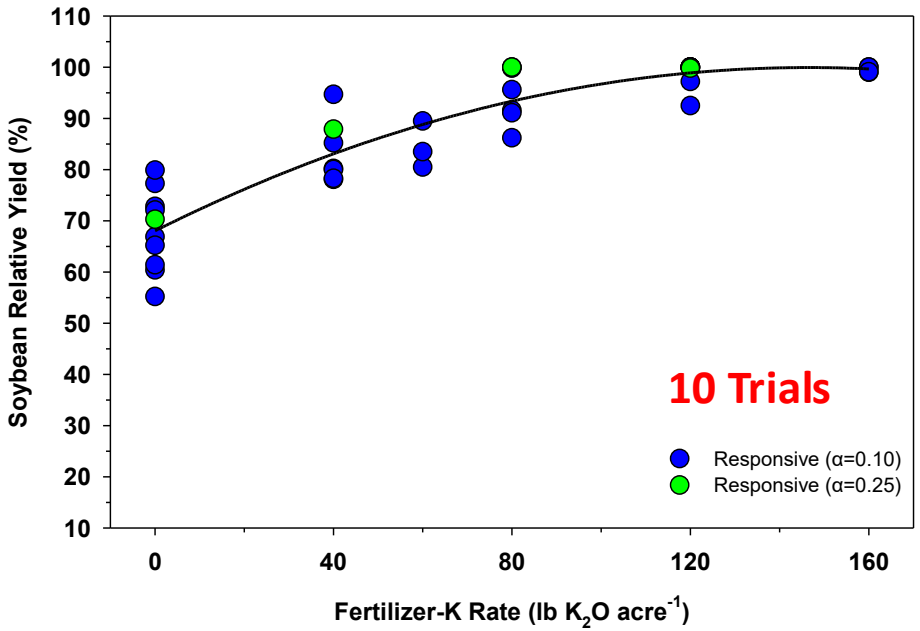
Soil-test Level	Soil-P Conc.	Recommended P Rate	
		Sufficiency	Build-Maintain
	ppm	lb P_2O_5 ac^{-1}	lb P_2O_5 ac^{-1}
Very Low (Severe deficient)	≤ 10	90	120
Low (Deficient)	11 – 20	70	100
Medium (Critical)	21 – 35	50	80
High (Optimum)	36 – 60	0	50
Very High (Above Opt.)	≥ 61	0	0

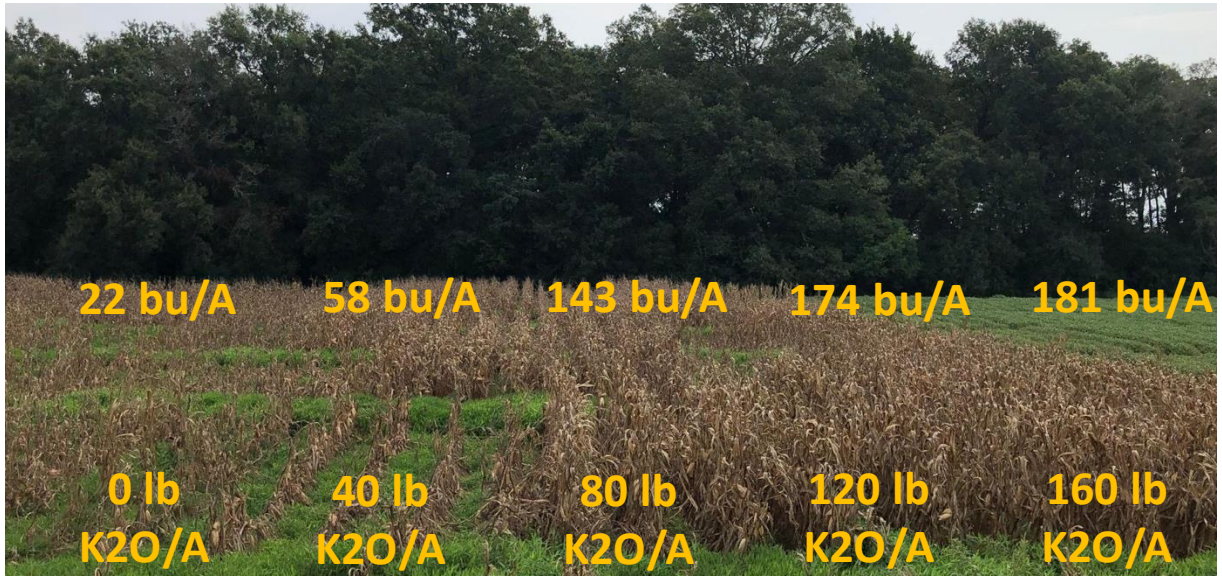
Potassium: Crop Response to Very Low K Fertility

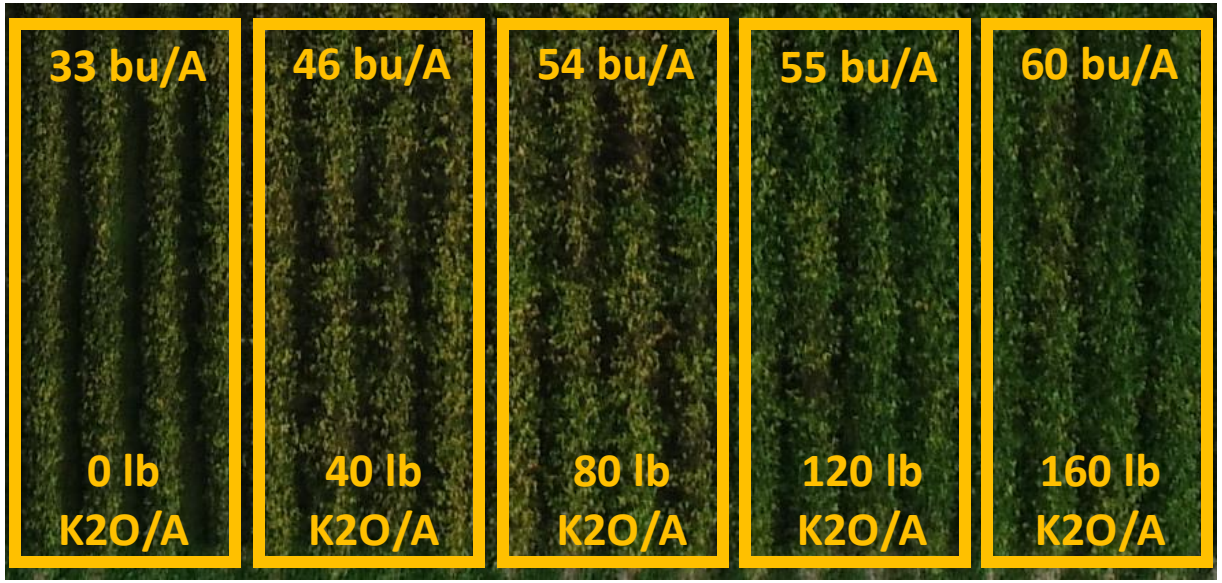
Very Low Mehlich-3 Soil K ≤ 60 mg kg^{-1}





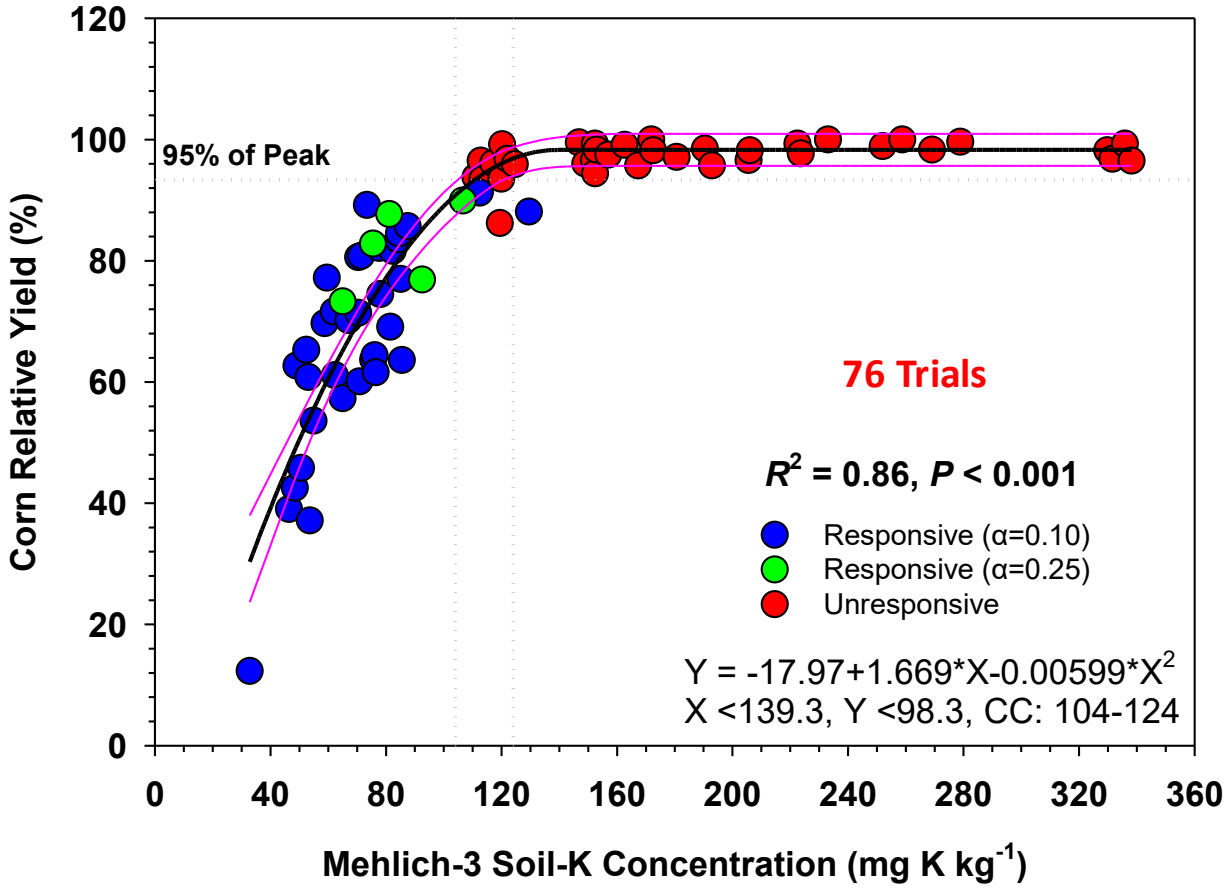




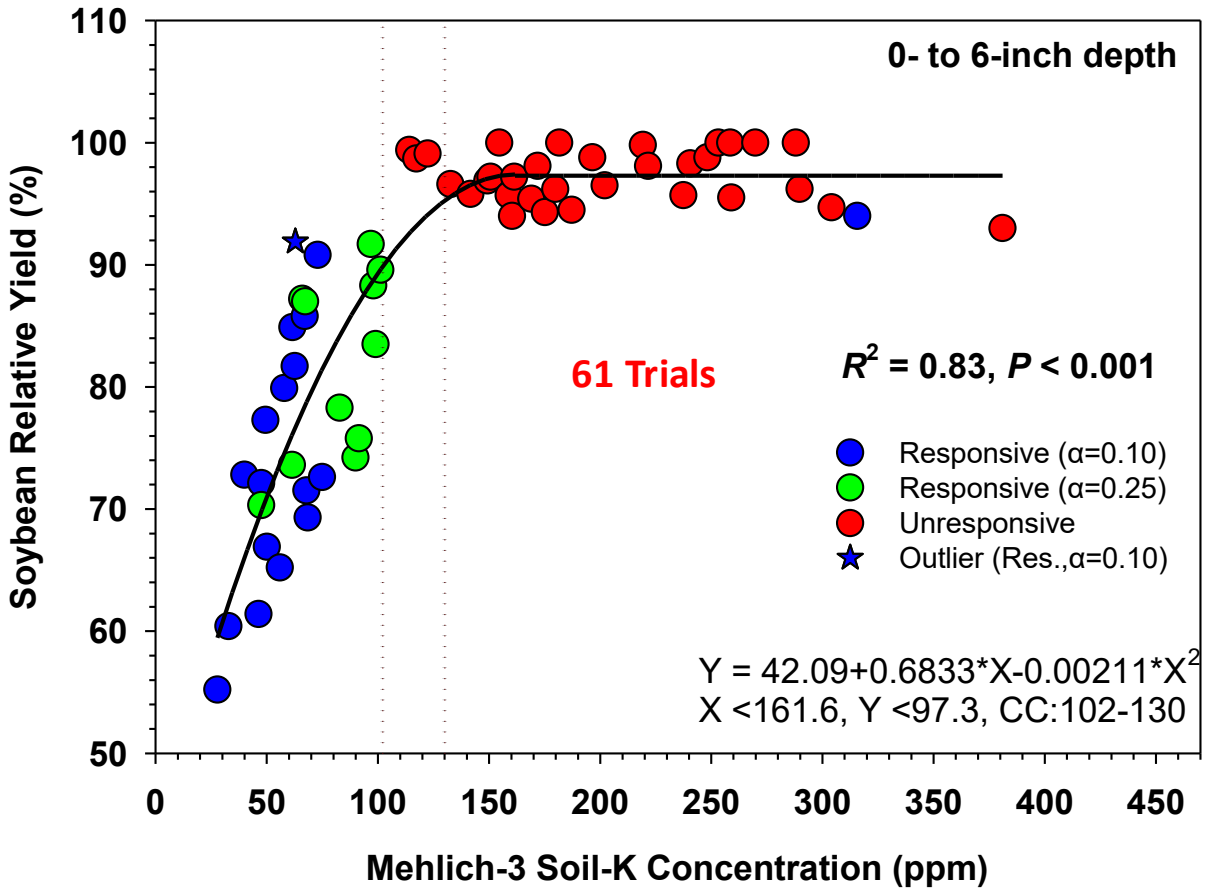


Crop Yield Response to Soil-Test K Concentrations

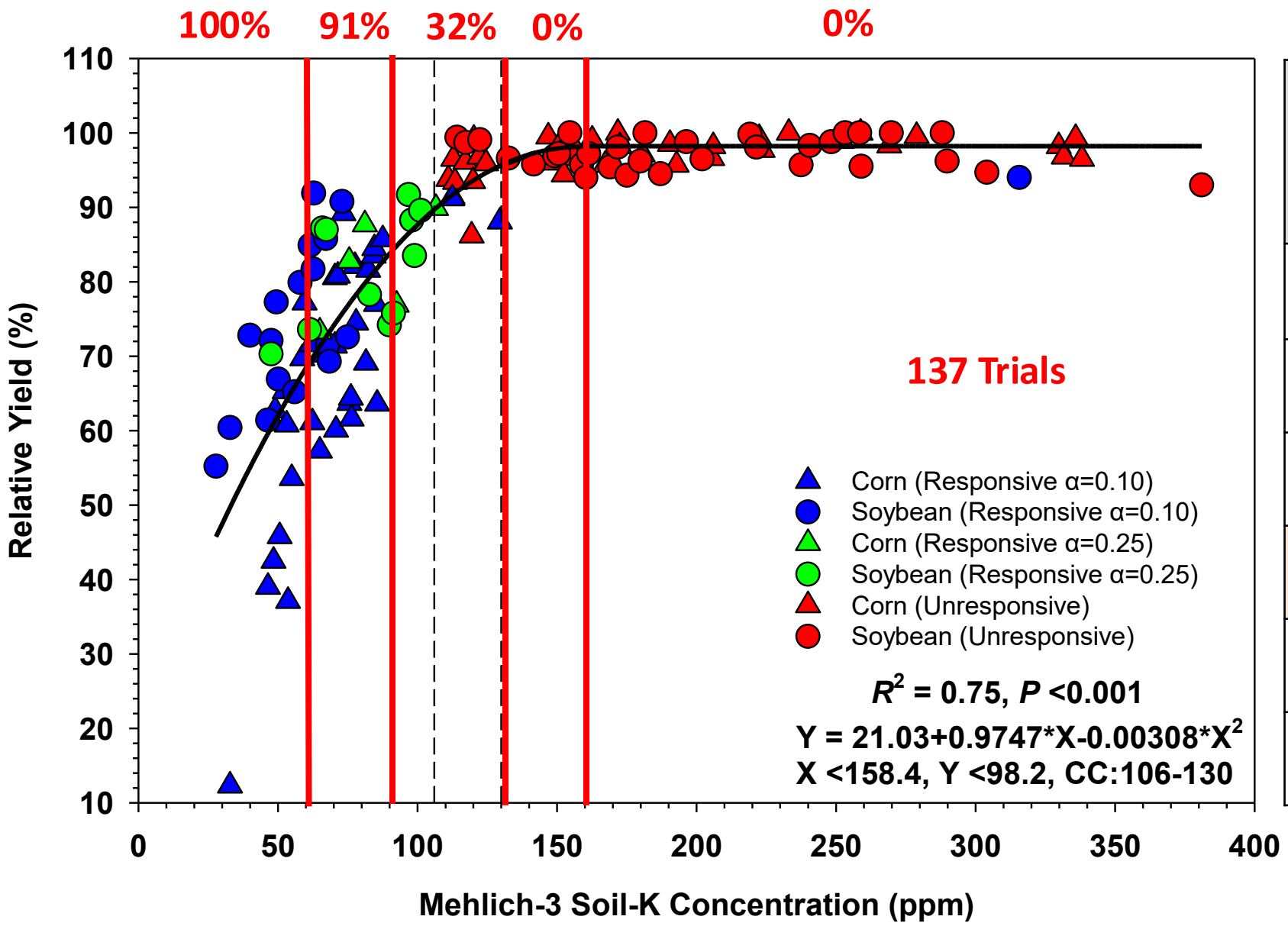
Corn



Soybean

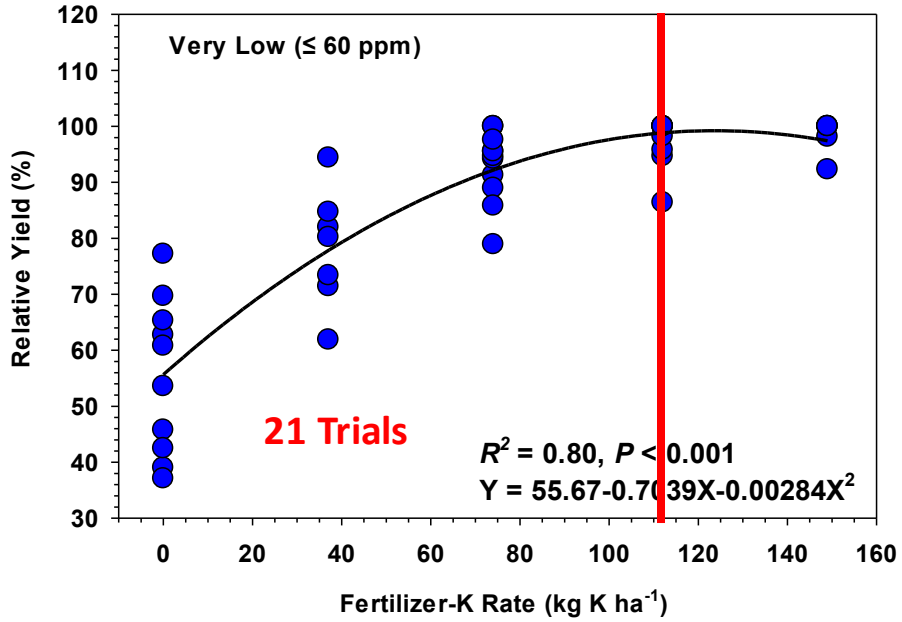


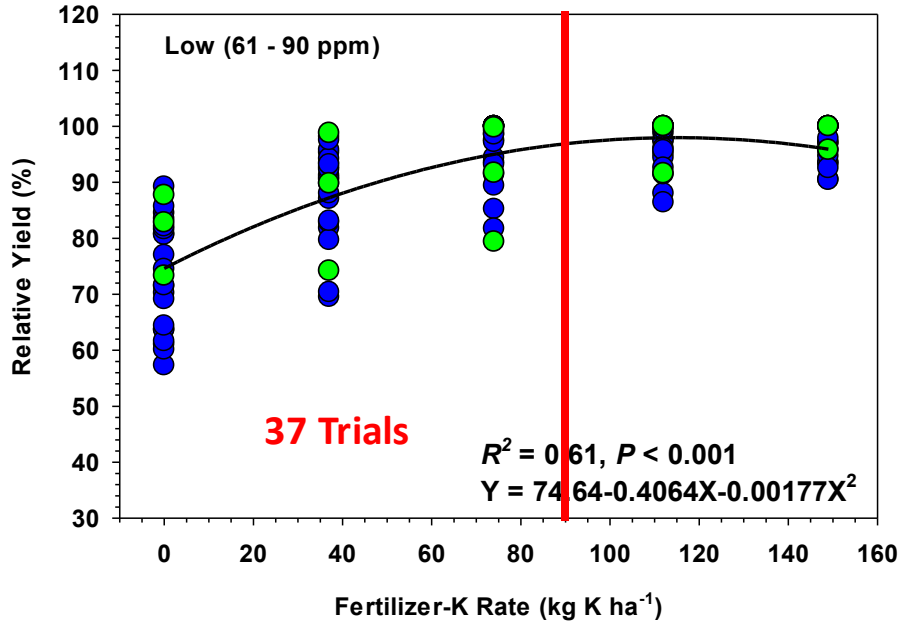
Crop Yield Response to Soil-Test K Concentrations: Corn and Soybean

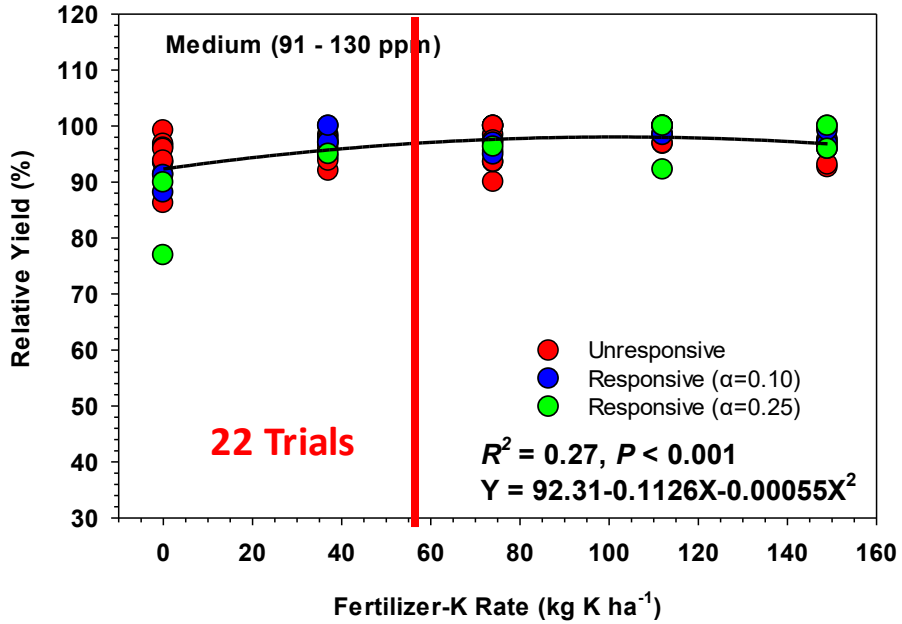


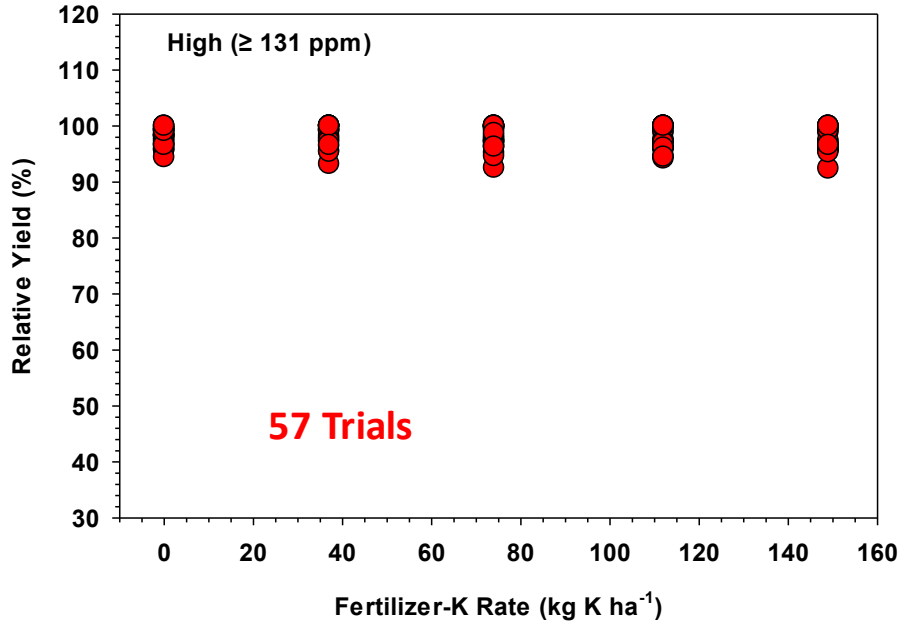
Soil-test Level	Soil-K Conc.	Total No. of Sites Tested	# of Sites Responded to K	Yield Response Frequency	Mean Yield Increase
	ppm	#	#	%	%
Very Low	≤ 60	21	21	100	45
Low	61–90	37	34	91	23
Med.	91–130	22	7	32	9
High	131–160	14	0	0	2
Very High	≥ 161	43	0	0	0

Calibration: Crop Response to K Fertilization at Different Soil-K Levels



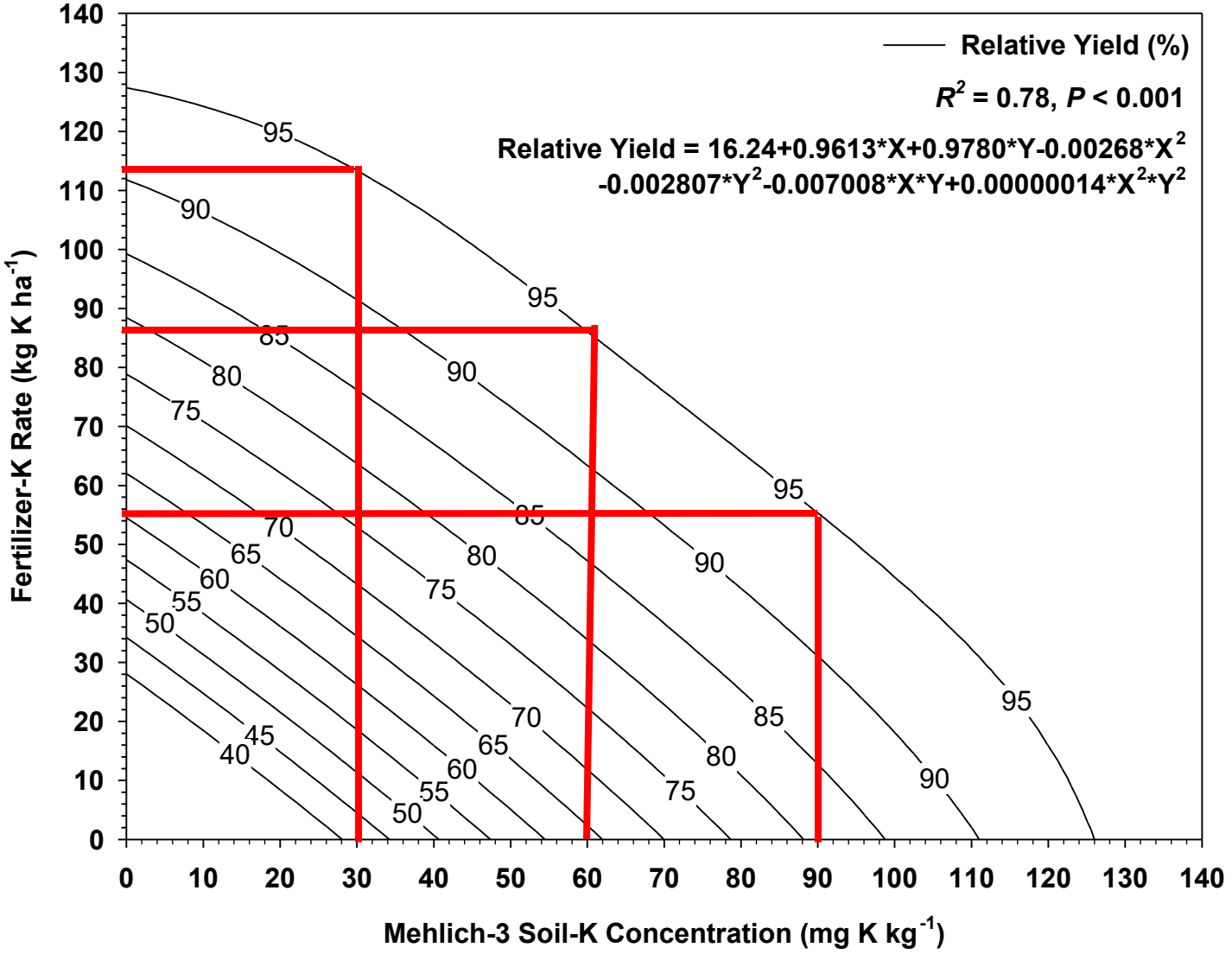






Calibration: Crop Relative Yield vs. Soil-K Conc. vs. Fertilizer-K Rate

Multiple Regression: Sufficiency Philosophy



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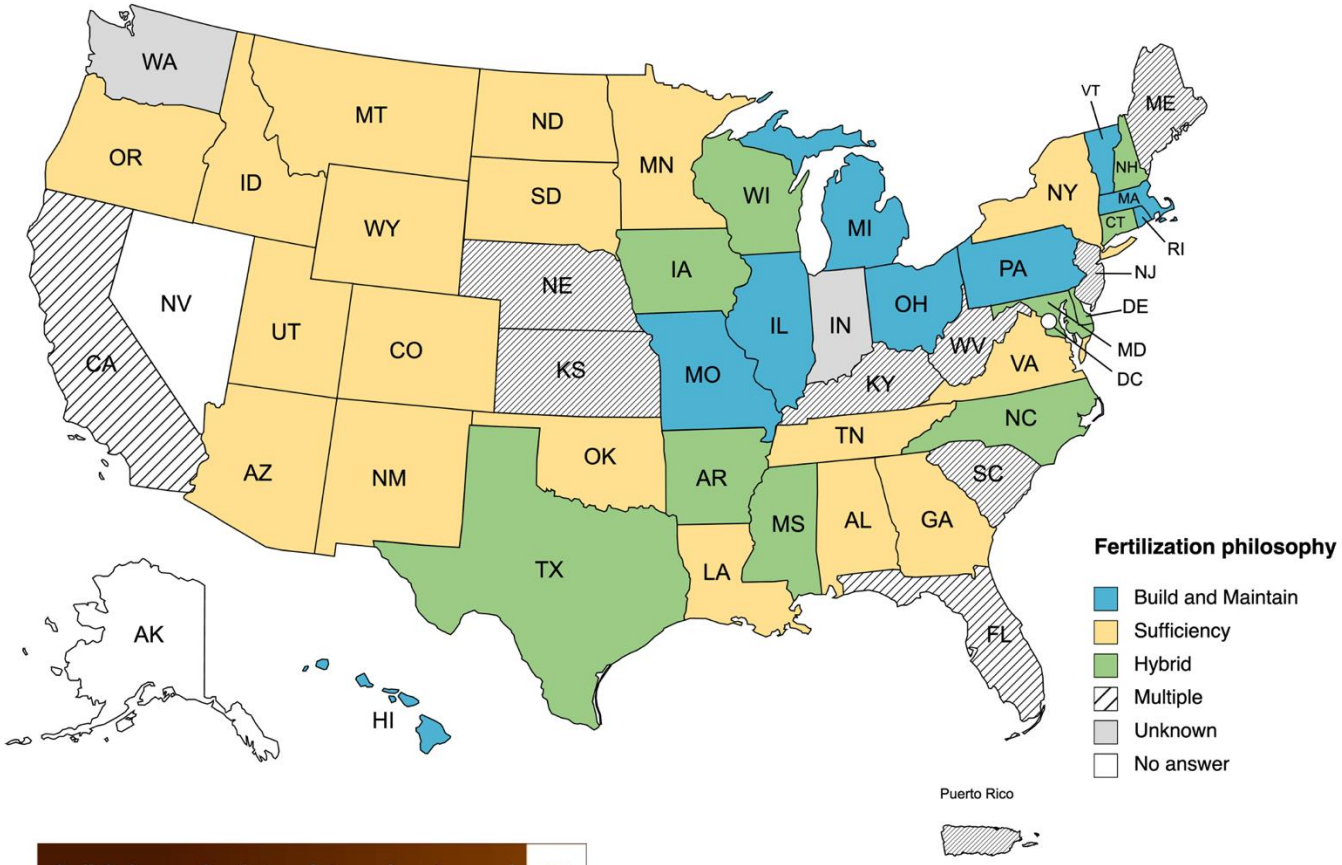
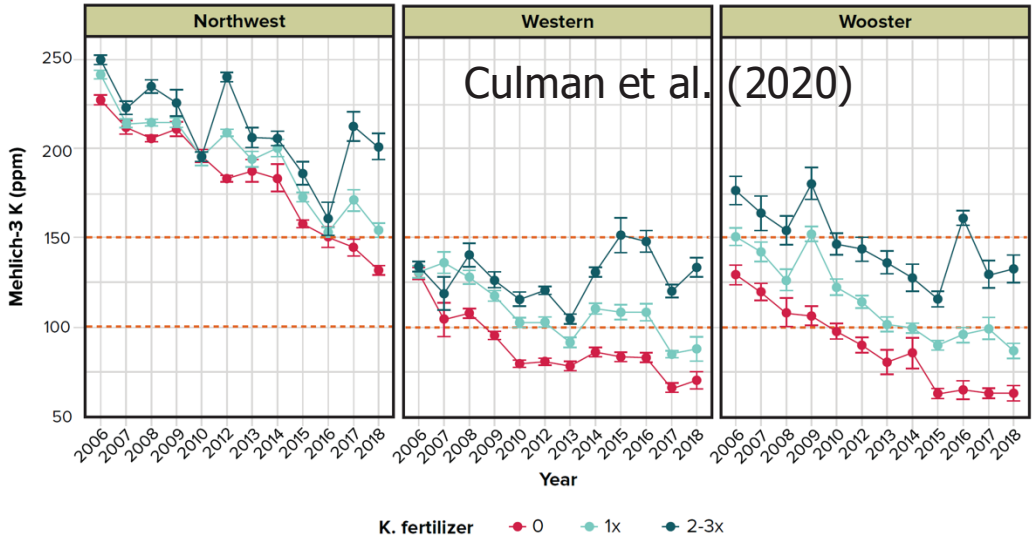
		Sufficiency	Build-Maintain
	ppm	lb K_2O ac^{-1}	lb K_2O ac^{-1}
Very Low (Severe deficient)	≤ 60	120	?
Low (Deficient)	61 – 90	90	?
Medium (Critical)	91 – 130	60	?
High (Optimum)	131–160	0	?
Very High (Above Opt.)	≥ 161	0	0

Fertilization Philosophies

Can We Build Up Soil-Test K Concentrations with Higher K Rates?





Soil Science Society of America Journal

ORIGINAL ARTICLE | Open Access

Current status of US soil test phosphorus and potassium recommendations and analytical methods

Sarah E. Lyons, Jason D. Clark, Deanna L. Osmond, Md Rasel Parvej, Austin W. Pearce, Nathan A. Slaton, John T. Spargo

First published: 27 February 2023 | https://doi.org/10.1002/saj2.20536

FRST
FERTILIZER RECOMMENDATION SUPPORT TOOL

Soil Depth	K ppm
0-6-inch	41
6-12-inch	57
12-18-inch	84
18-24-inch	80
24-30-inch	81
30-36-inch	89

Compare with MU Recommendations

Phosphorus

Soil-test Level	LA-AR M-3 Soil-P	Iowa M-3 Soil-P	Missouri B-1 Soil-P	LA-AR Suf. – BM	Iowa Corn-Soy	MO-Corn 250 bu/A	MO-Soy 70 bu/A
	ppm			lb P_2O_5 ac^{-1}			
Very Low (Severe Deficiency)	≤ 10	≤ 16	≤ 8	90 – 120	100 – 120	185	130
Low (Deficient)	11 – 20	17 – 27	9 – 12	70 – 100	70 – 85	150	95
Medium (Critical)	21 – 35	28 – 40	13 – 22	50 – 80	50 – 67	135	80
High (Optimum)	36 – 60	41 – 51	23 – 34	0 – 50	0	115	60
Very High (Above Optimum)	≥ 61	≥ 52	≥ 35	0	0	0	0

Potassium

Soil-test Level	LA-AR M-3 Soil-K	Iowa M-3 Soil-K	Missouri AA Soil-K	LA-AR Suf.	Iowa Corn-Soy	MO-Corn 250 bu/A	MO-Soy 70 bu/A
	ppm			lb K_2O ac^{-1}			
Very Low (Severe Deficiency)	≤ 60	≤ 60	≤ 45	120 – 140	145	200	225
Low (Deficient)	61 – 90	61 – 100	46 – 76	90 – 110	110	140	165
Medium (Critical)	91 – 130	101 – 150	77 – 155	60 – 80	46 – 84	115	140
High (Optimum)	131 – 160	151 – 200	156 – 202	0	0	55	70
Very High (Above Optimum)	≥ 161	≥ 201	≥ 203	0	0	0	0

How old are our MU soil-test-based P & K recommendations?

Developed based on the Alfalfa Trial conducted from 1966 to 1970

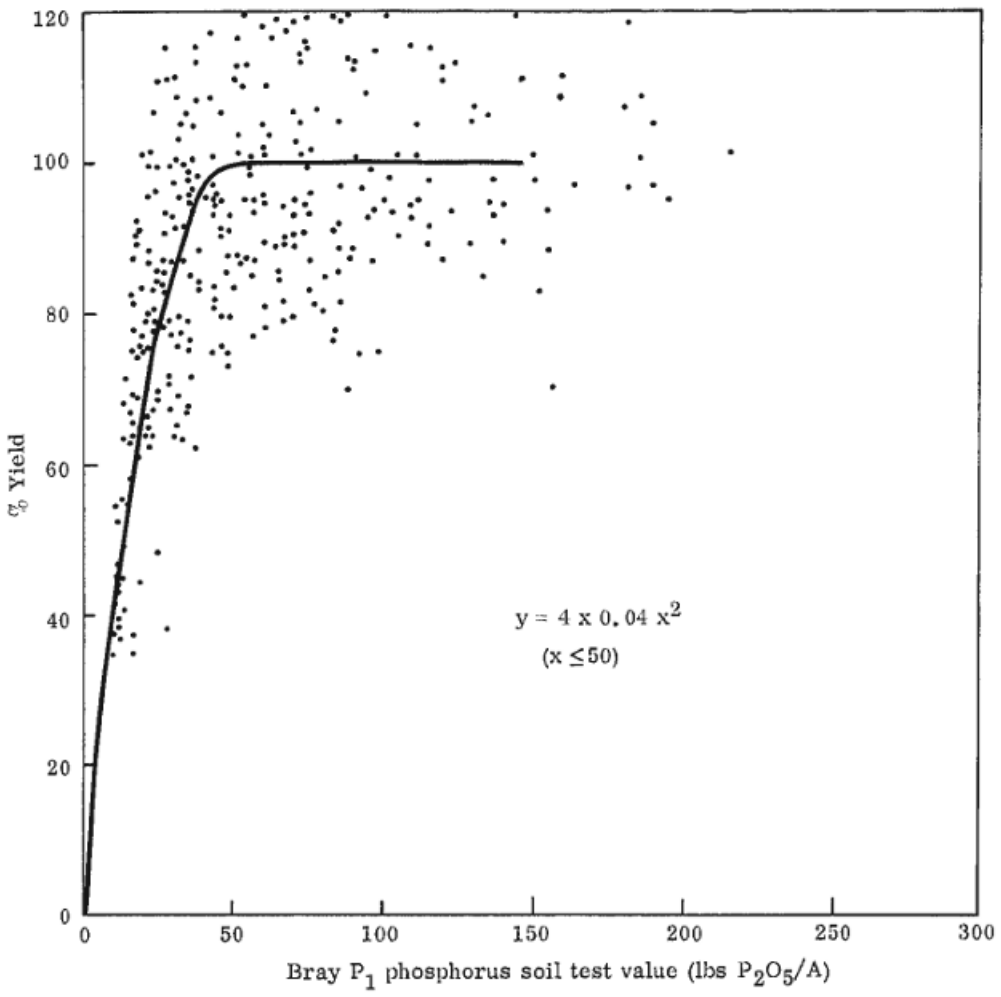


Figure 2. The relationship between the percentage yield of alfalfa-orchard grass hay and the phosphorus soil test value as measured by the Bray P_1 extracting reagent. (Purdy, Mo., 1966-1970)

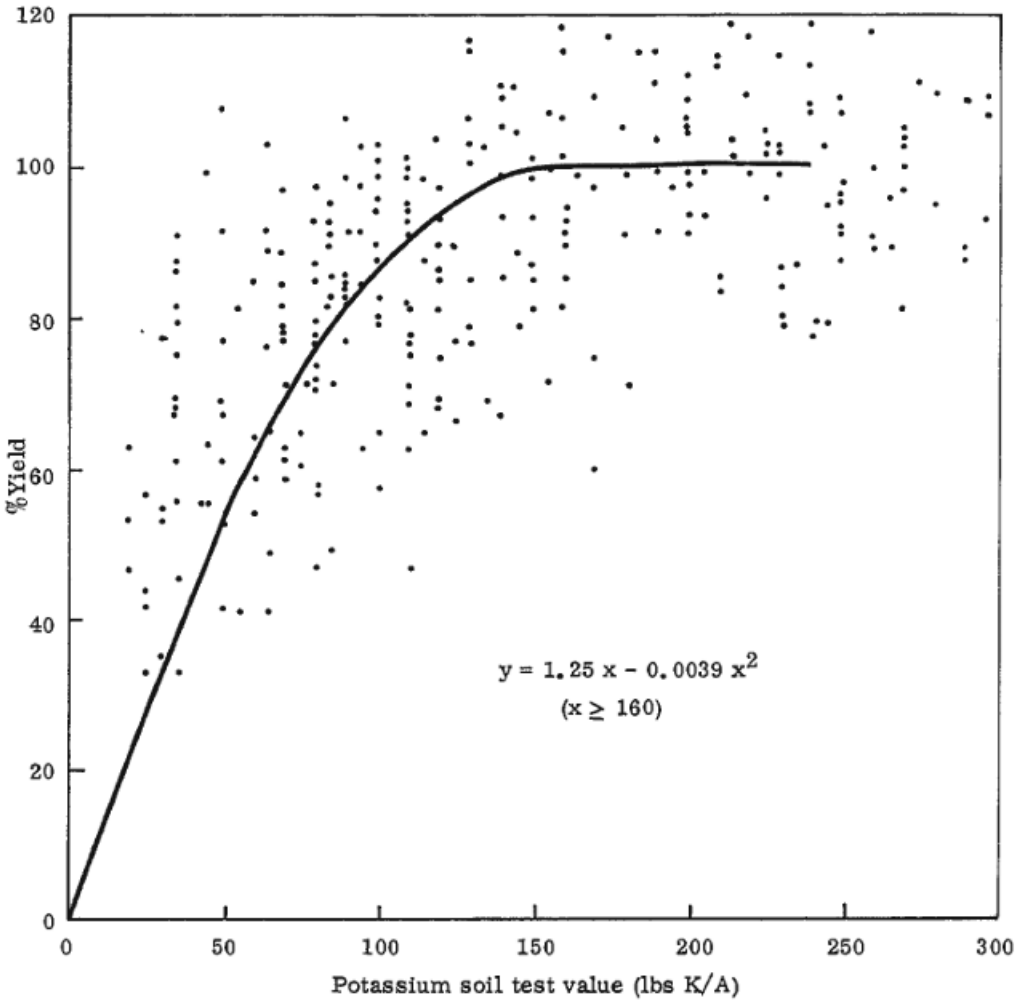
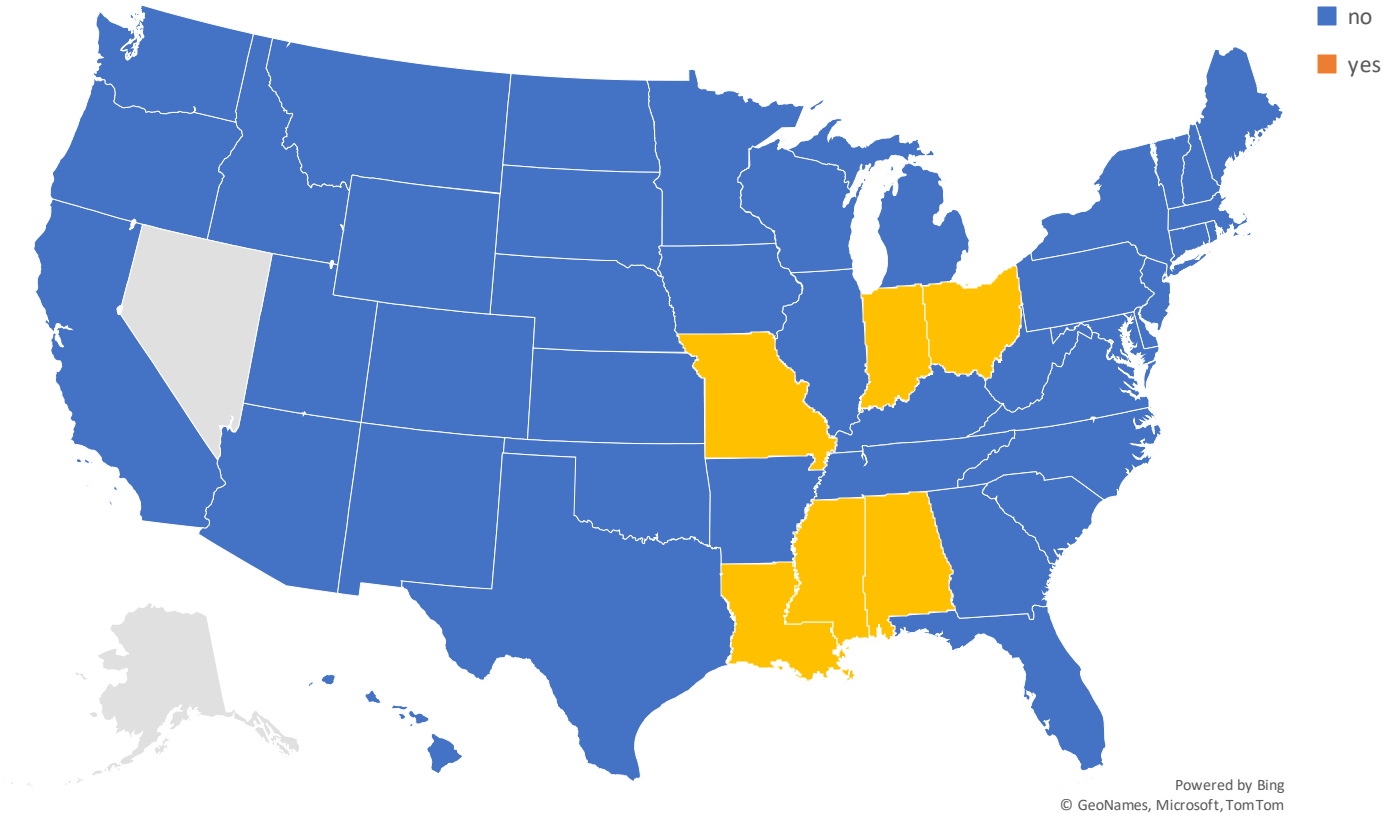


Figure 3. The relationship between the percentage yield of alfalfa-orchard grass hay and the exchangeable potassium soil test value. (Purdy, Mo., 1966-1970)

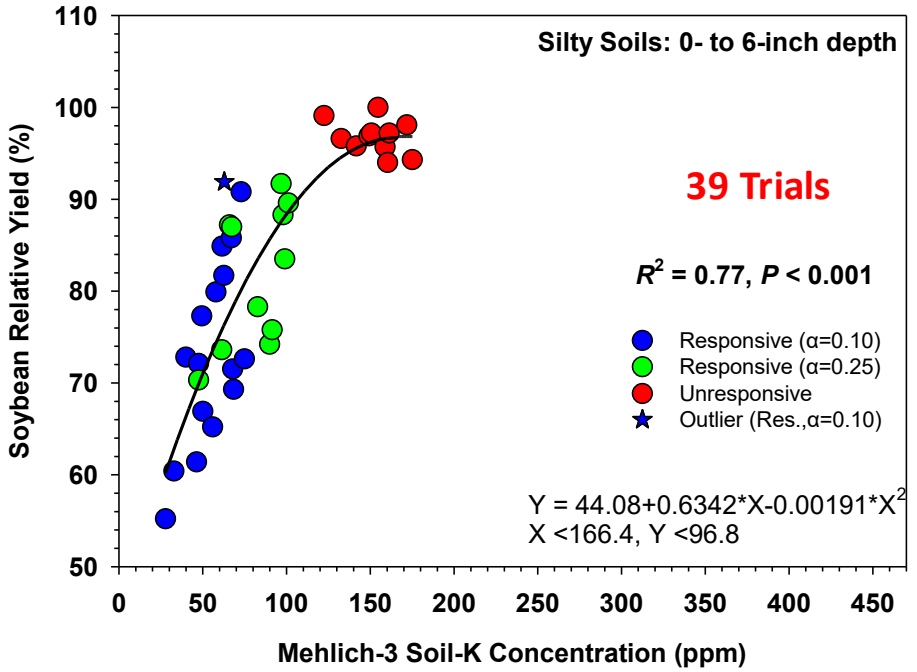
RESEARCH BULLETIN 1007 DECEMBER, 1974

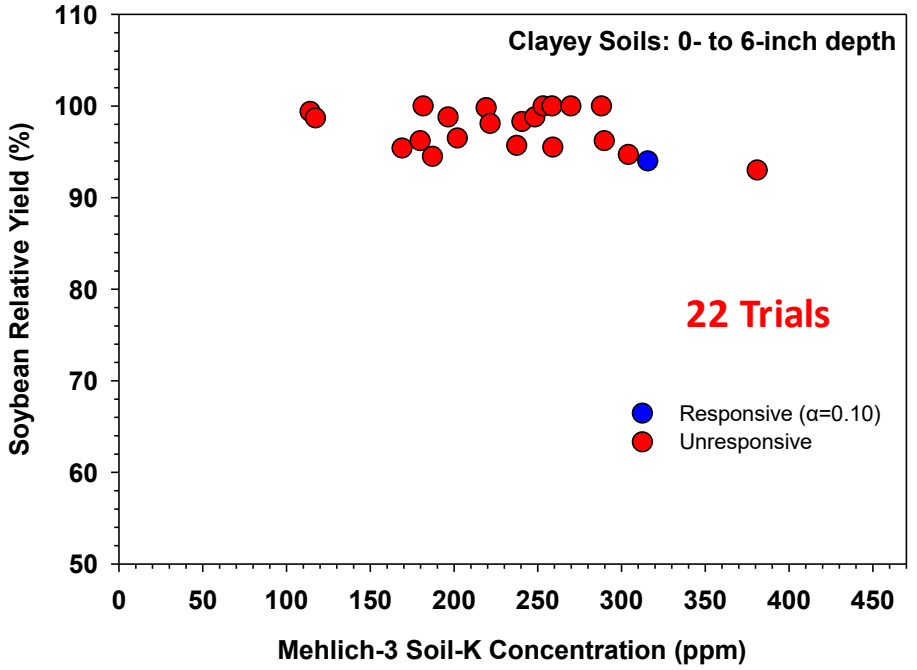
UNIVERSITY OF MISSOURI-COLUMBIA

Does K Fertilizer Recommendation Vary with Soil Texture?



FRST
FERTILIZER RECOMMENDATION SUPPORT TOOL





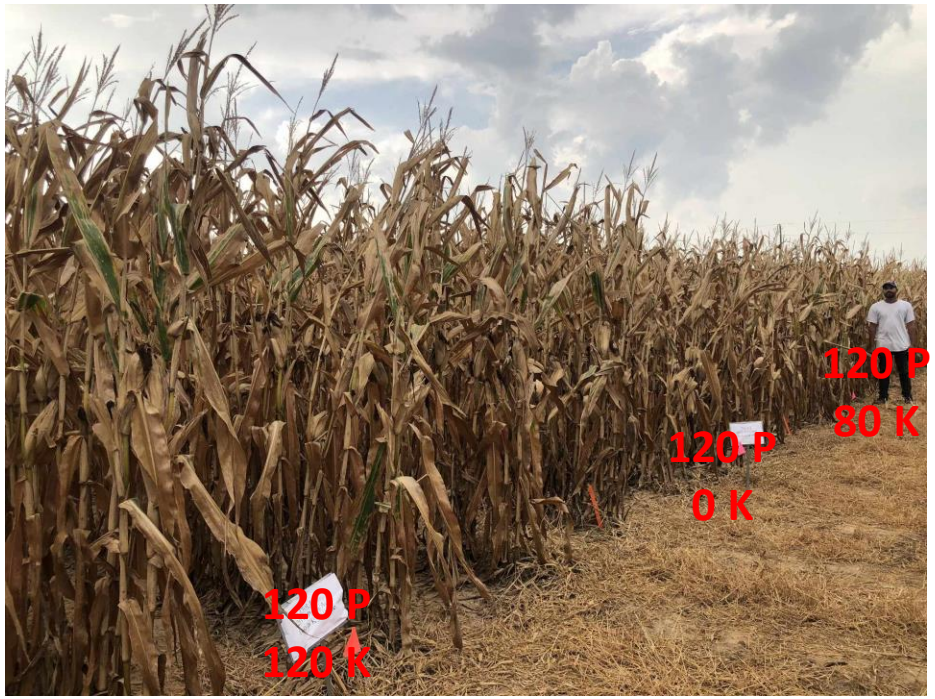
Best Nutrient Management Strategies: P x K Interaction

Both P and K Responsive Site: Soil P = 12 ppm and Soil K = 77 ppm

Recommendations: Fertilizer-P: 80 lb P_2O_5 acre^{-1} & Fertilizer-K: 90 lb K_2O acre^{-1}

P **< 0.001 and $LSD_{0.10}$ = 28.5 bu acre^{-1}**

Fertilizer-K (lb K_2O acre^{-1})	Fertilizer-P (lb P_2O_5 acre^{-1})			
	0	**40**	**80**	**120**
0	124	128	134	129
40	142	161	179	167
80	150	170	208	200
120	192	191	212	209
160	186	191	203	217



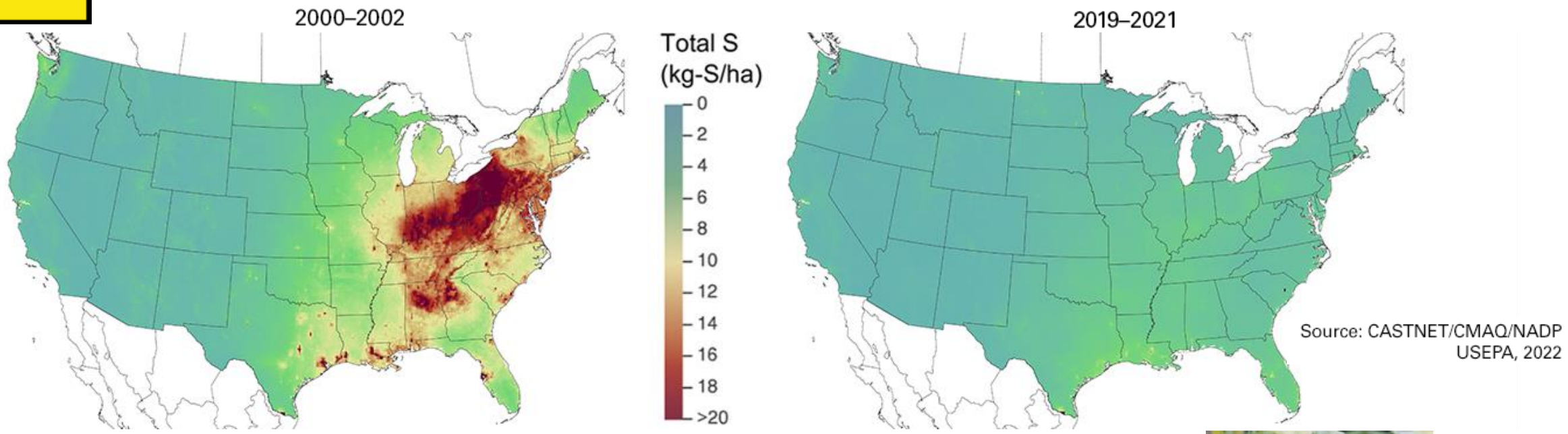
Sulfur

S

32.065

Soybean Response to Sulfur Fertilization

Atmospheric S Deposition – 90% reduction since the "Clean Air Act"



Three-Year Average of Total Sulfur Deposition

Soil Organic Matter (SOM)

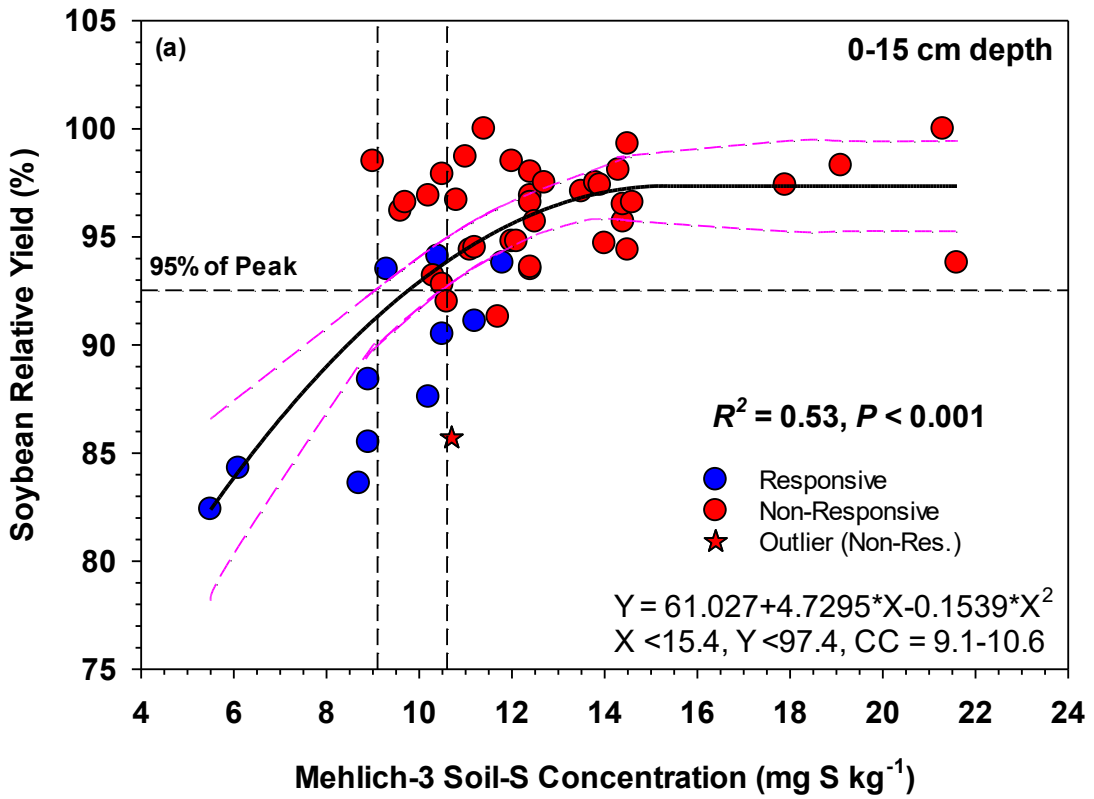
Around 95% of the total S in soils is found in organic matter

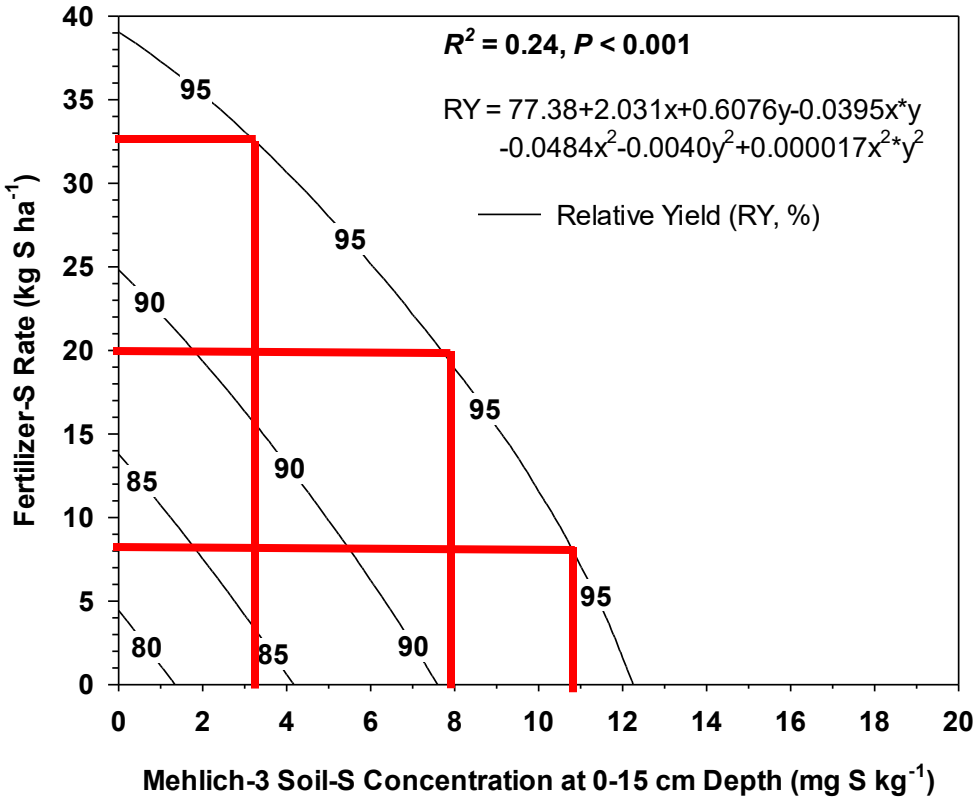
1% SOM contains >100 lbs S but releases only 3-5 lb S/acre

Others: Pesticides, Irrigation Water – very small amount

(Dr. Crozier, NC State)

Soybean Response to Sulfur Fertilization





Soil-Test Level	Mehlich-3 Soil-S Conc.	Number of Sites Tested	Mean (Range) Yield Increase from S		Yield Increase Probability	Recommended Fertilizer-S Rate
			Mean	Percentage		
	ppm	#	bushel ac^{-1}	%	%	lb S ac^{-1}
Very Low (Severe Def.)	< 6	1	3.6	18	100	30
Low (Deficient)	6 – 10	12	2.2	8	58	20
Medium (Critical)	11 – 15	33	0.4	5	9	10
High (Optimum)	16 – 20	2	0.03	2	0	0
Very High (Above Opt.)	> 20	2	0	3	0	0

In-Season Deficiency Management: Tissue Testing & Interpretation

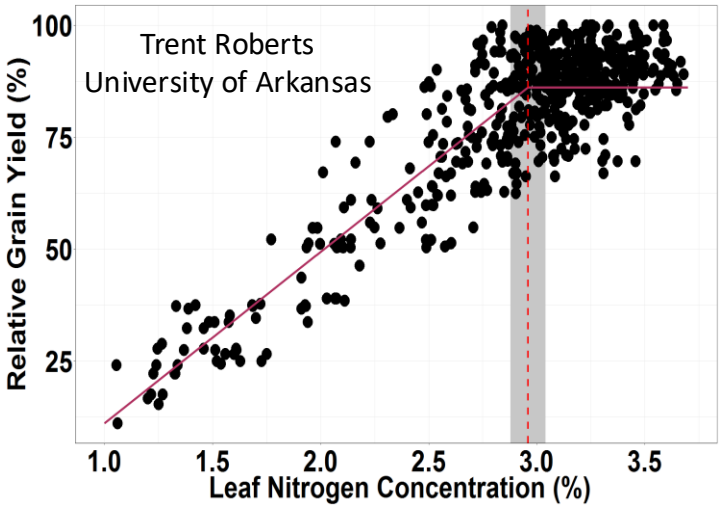


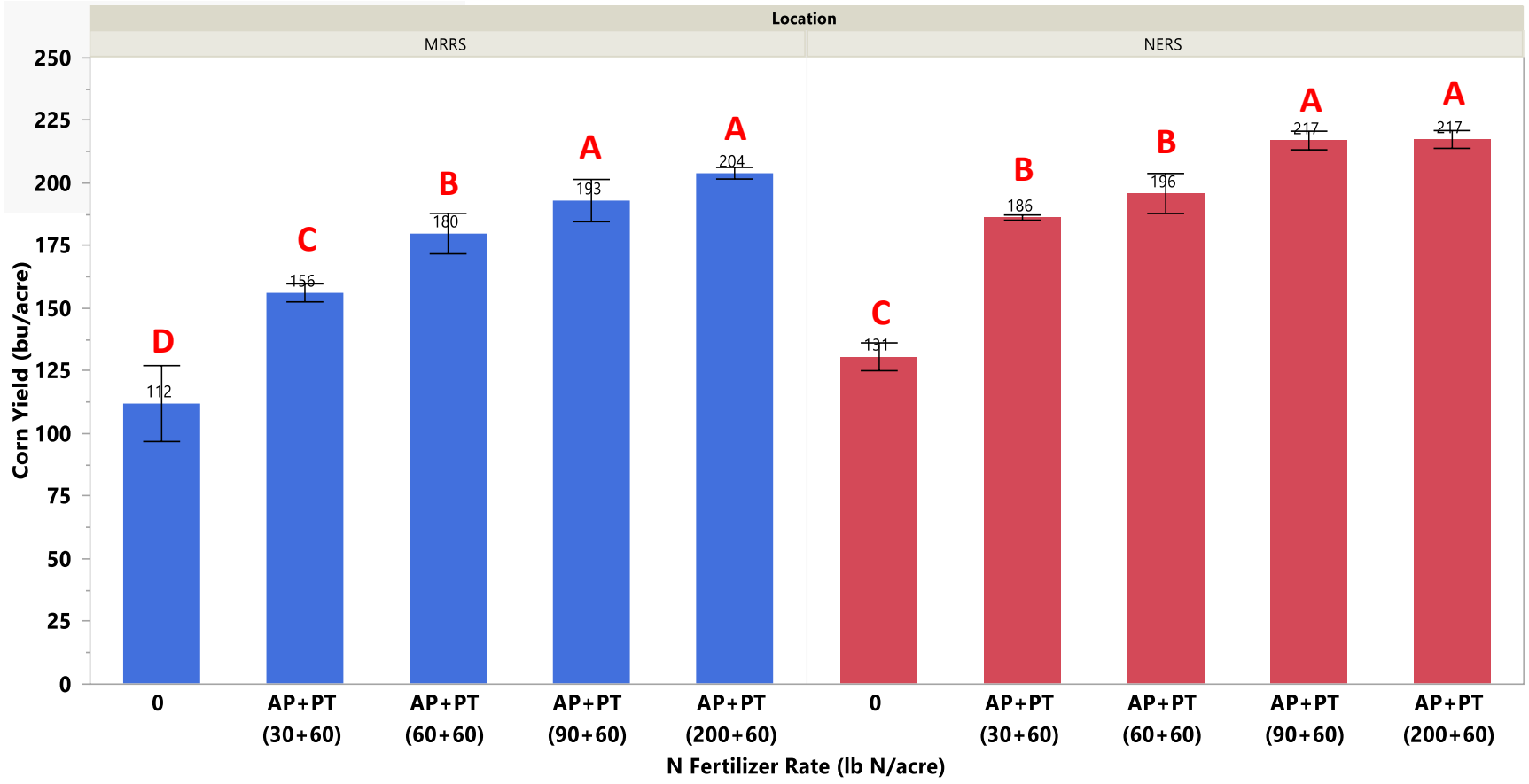

Nutrient Deficiency Diagnosis: Visual Symptom vs. Hidden Hunger



In-Season N Deficiency (Hidden Hunger) Diagnosis and Management in Corn

Tissue Sampling: Collect 12 to 15 uppermost mature leaves with Collar at the V10-13 stage



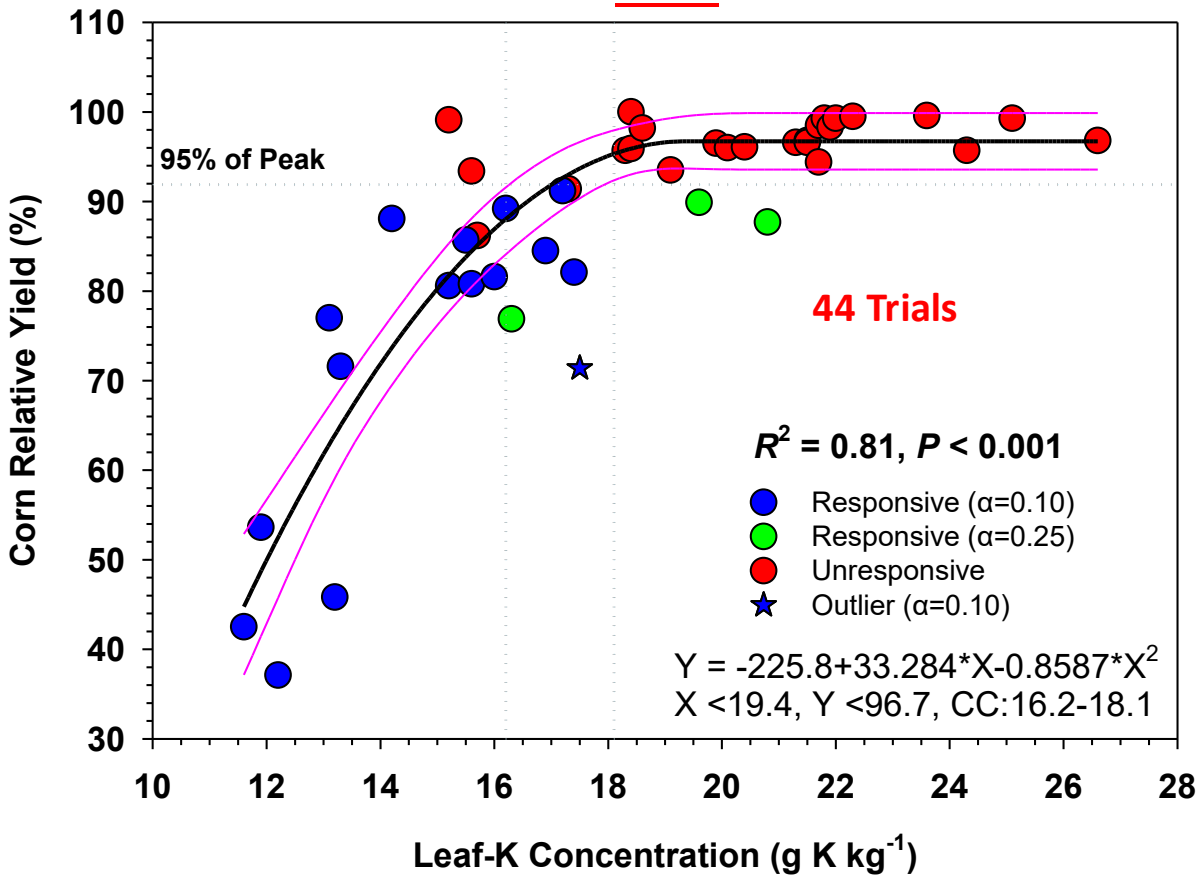


2.0%	2.2%	2.3%	2.7%	2.8%	2.3%	2.9%	2.9%	3.1%	3.2%

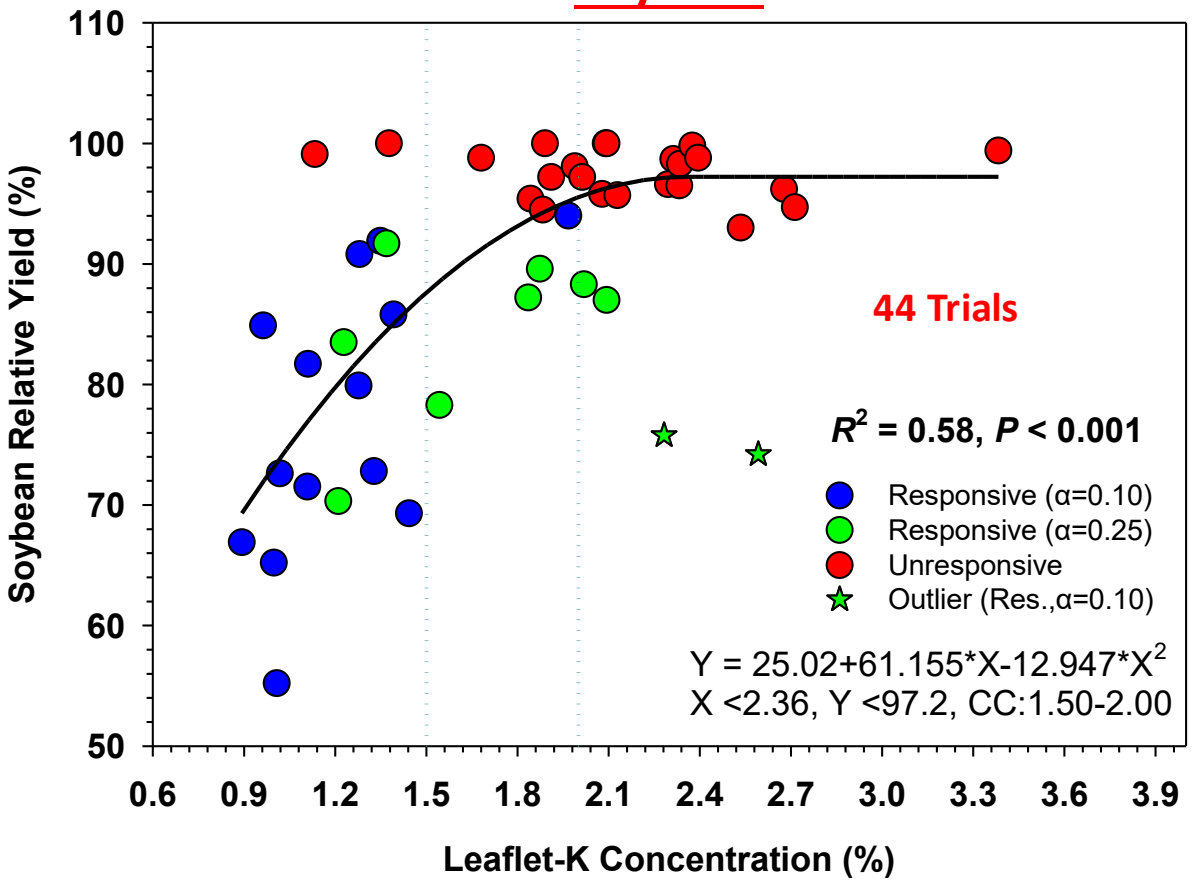
Pre-Tassel Leaf N Concentration

In-Season K Deficiency (Hidden Hunger) Diagnosis: Tissue Testing

Corn

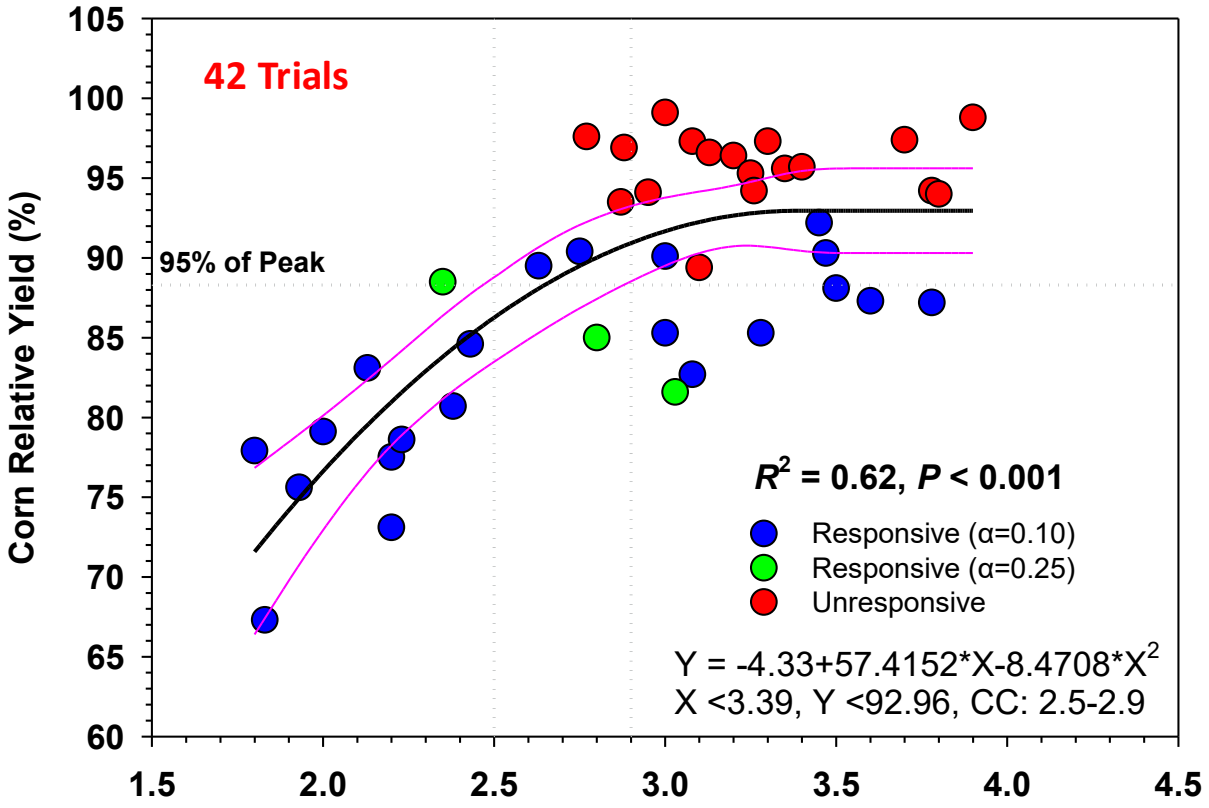


Soybean

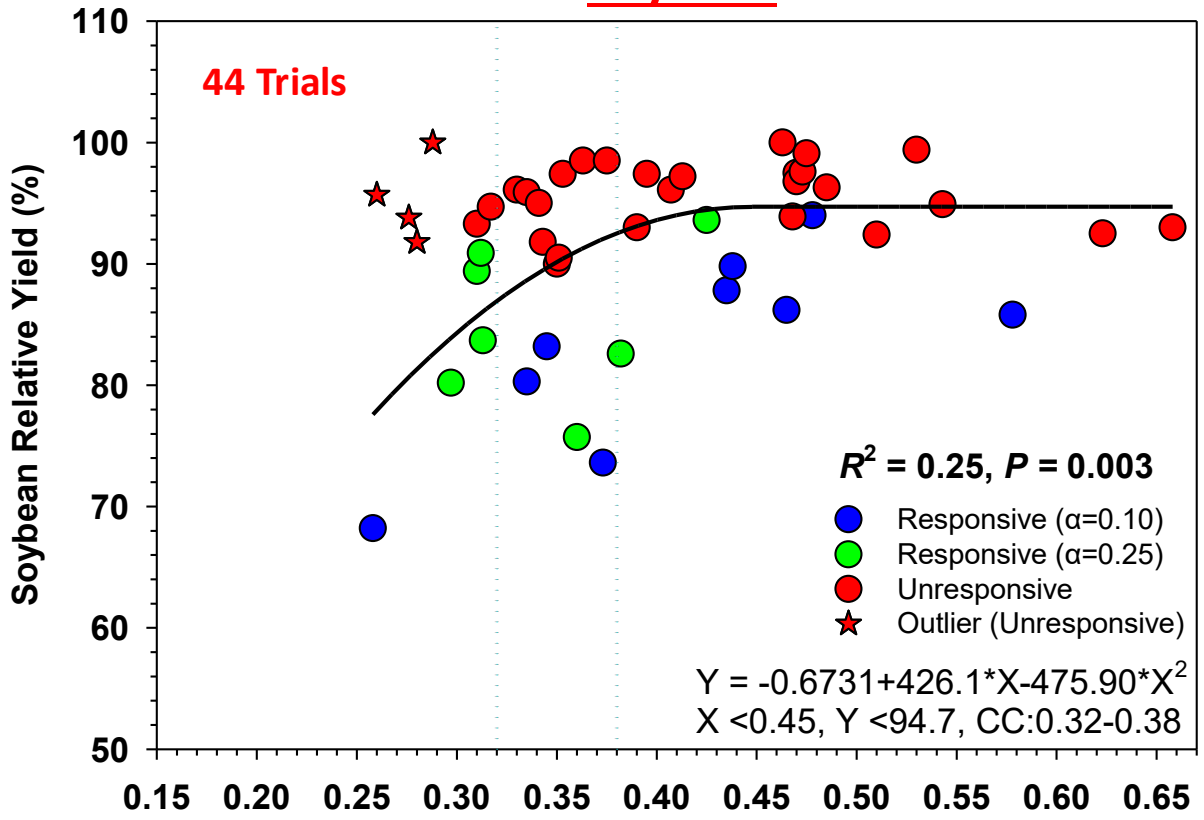


In-Season P Deficiency (Hidden Hunger) Diagnosis: Tissue Testing

Corn

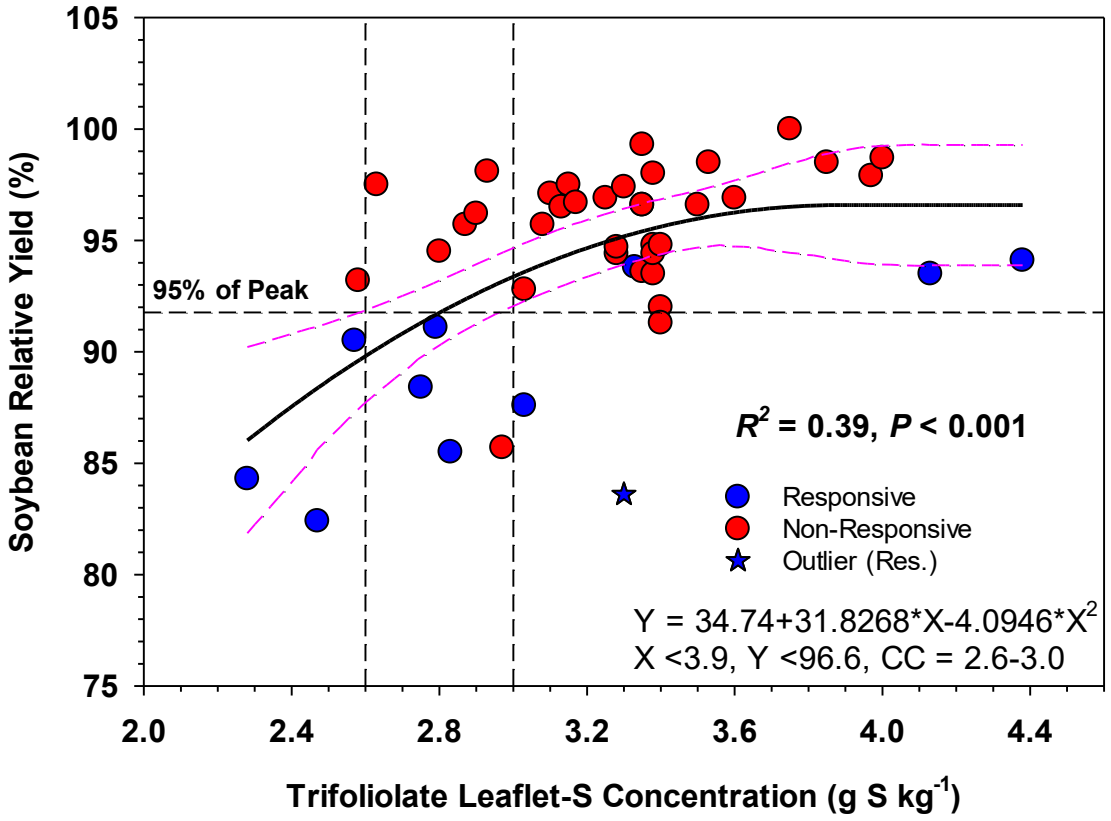


Soybean

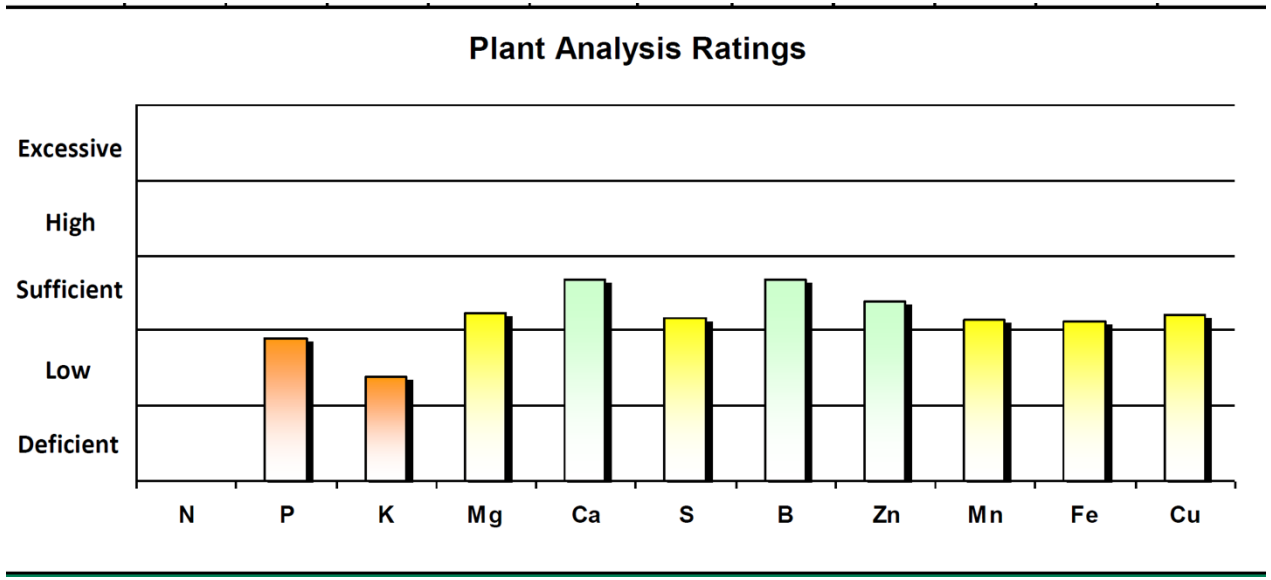


In-Season S Deficiency (Hidden Hunger) Diagnosis: Tissue Testing

Soybean



Lab Tissue Testing Interpretation



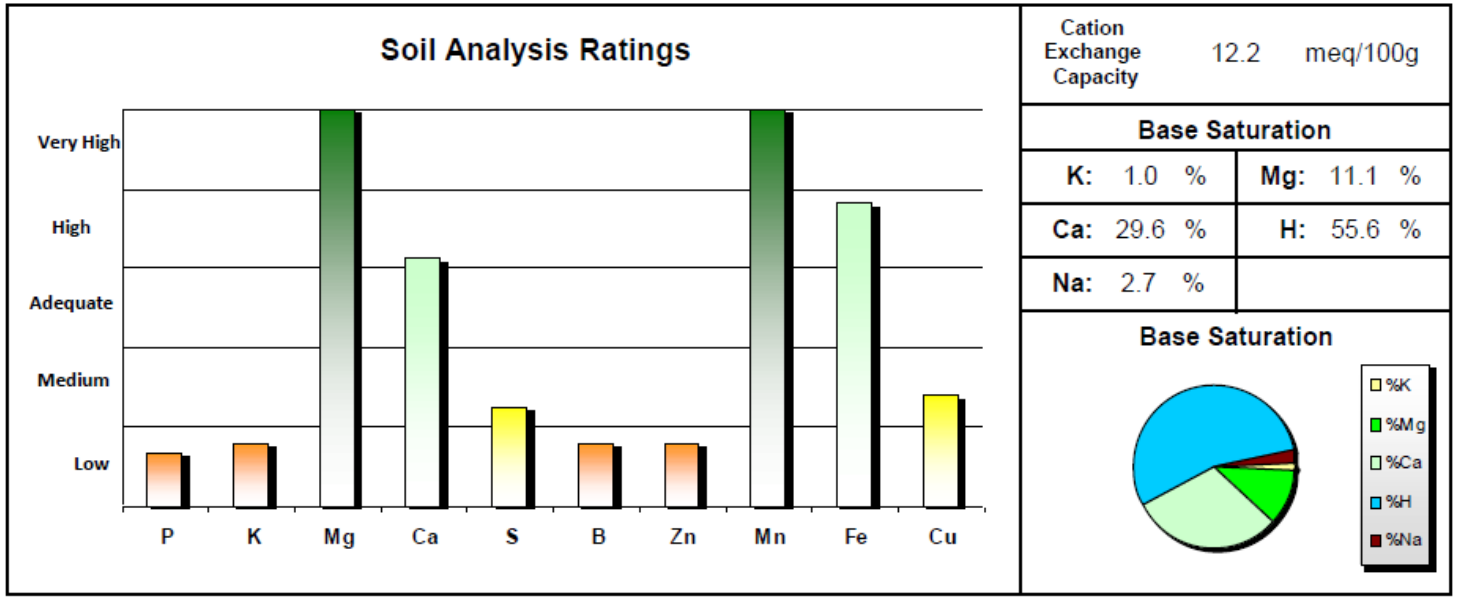
What do we know about tissue B, Zn, Mn, Fe, Cu Test

- ✓ How is it Low, Medium, or High?
- ✓ Does it mean I need to apply micronutrients if it is Low?
- ✓ If I apply micronutrients, can I get a yield response?
- ✓ Is there any correlation between yield and the tissue micronutrients test?
- ✓ How to interpret tissue test results?

Soil Testing & Micronutrients (Fe, Mn, Zn, B) Management

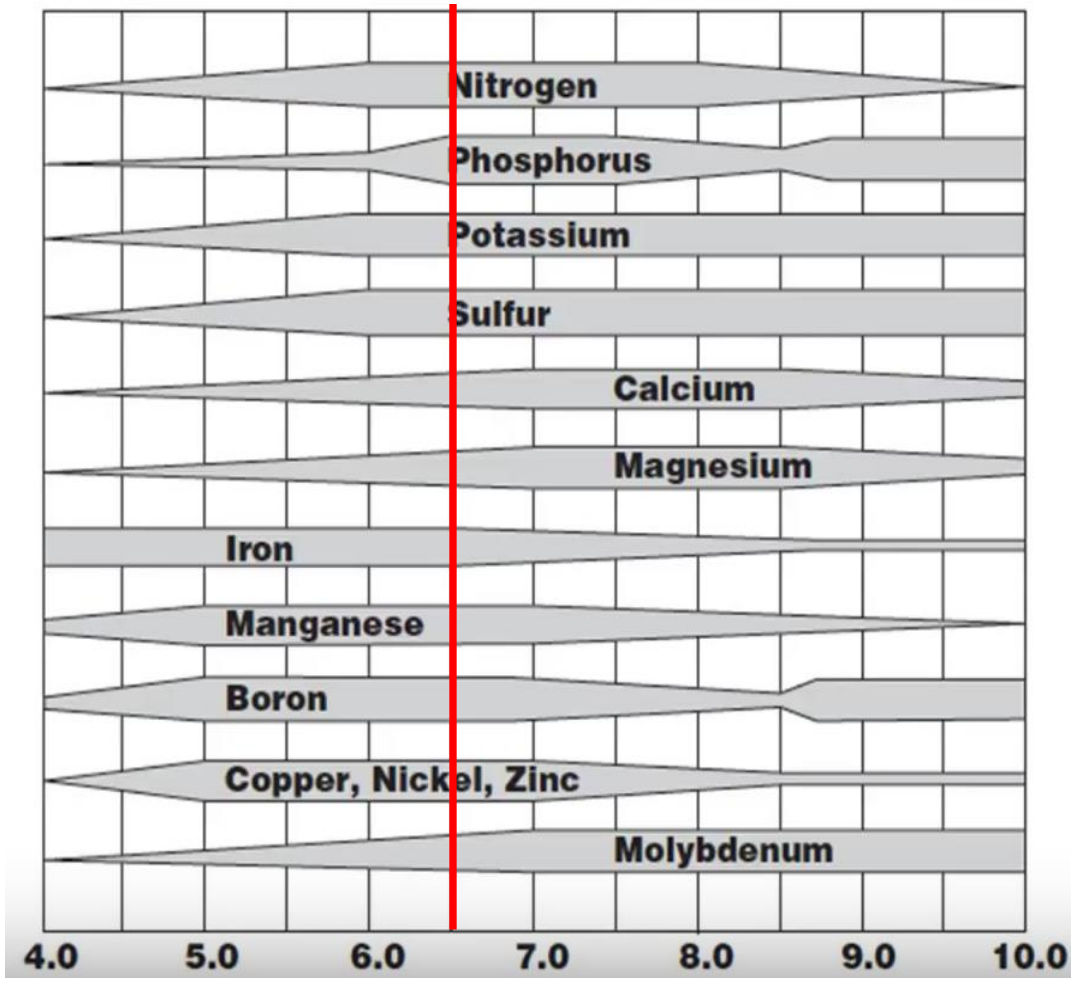
Micronutrients management is driven by soil pH but not solely by soil nutrient concentrations

Test Method: Mehlich III				Soil Laboratory Data (ppm)							Target pH 6.5
P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH SMP	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
13.5 L	49 L	163.5 VH	724 H	5.2	6.65	15.5 M	0.4 L	1.6 L	219 VH	181.5 H	1.1 M
Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs		
	76	ppm	ppm	mmhos/cm	1.65 %	16.5	ppm	ppm	meq/L		



Cation Exchange Capacity	12.2	meq/100g

Base Saturation	
K: 1.0 %	Mg: 11.1 %
Ca: 29.6 %	H: 55.6 %
Na: 2.7 %	

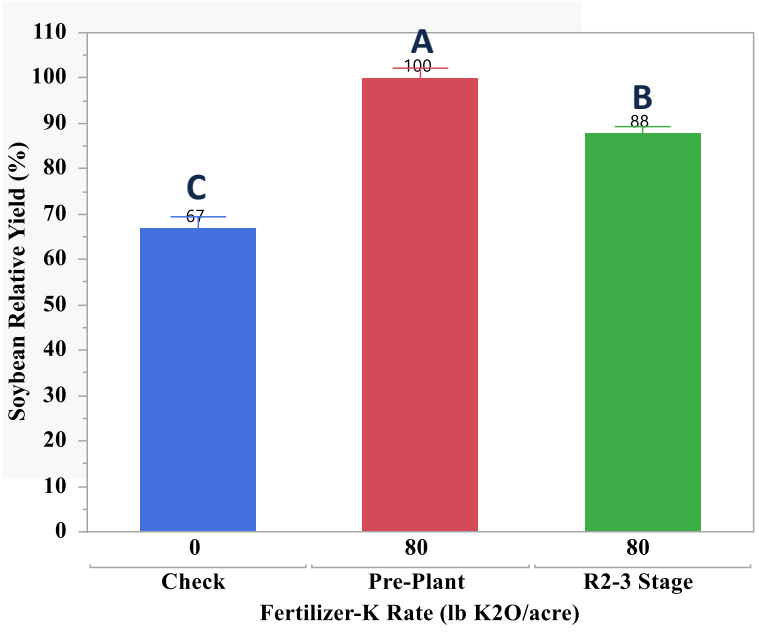


Soil pH

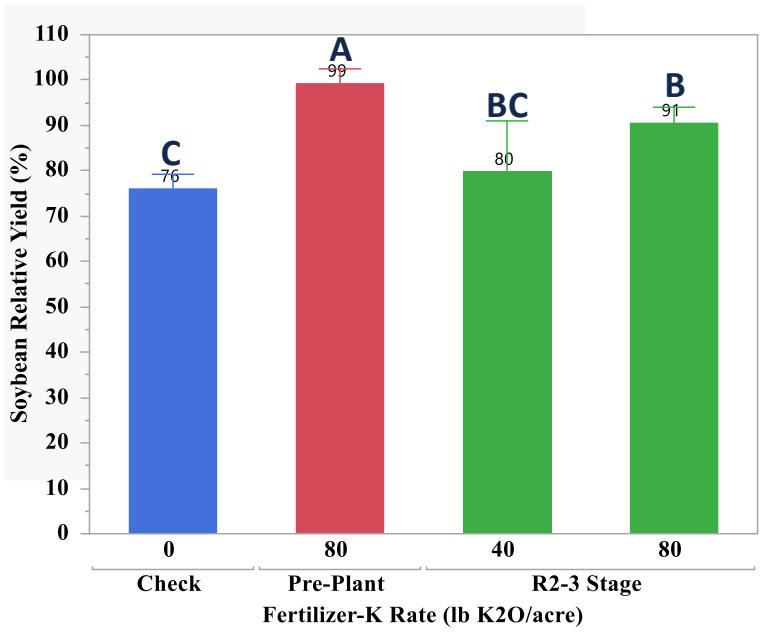
Micronutrients (Fe, Mn, Zn, B) Deficiency and Management

In-Season K Deficiency Management

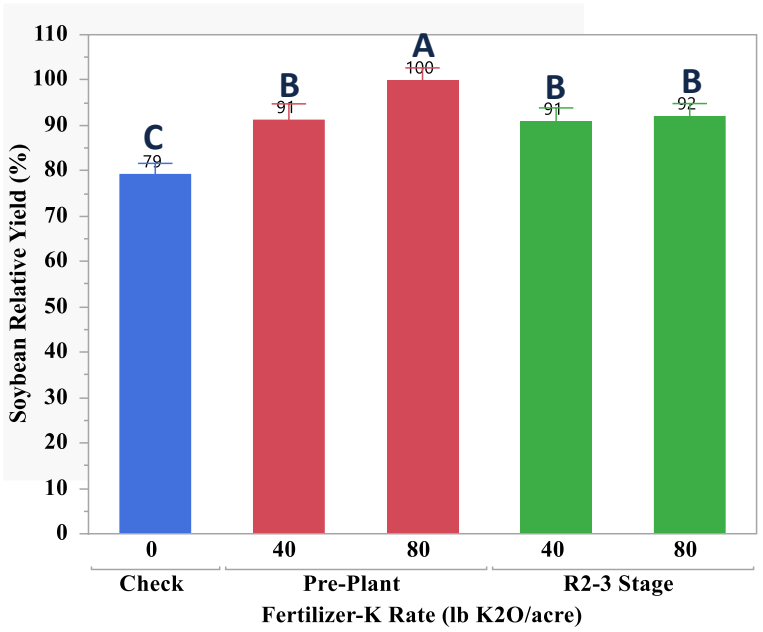
Soil K ≤ 40 ppm
2 site-years



Soil K 40-60 ppm
7 site-years



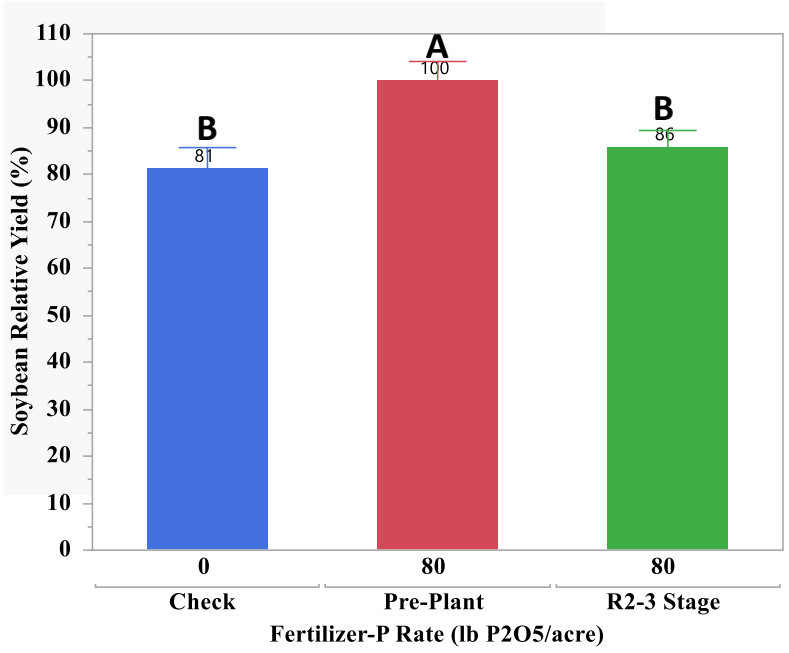
Soil K 60-75 ppm
8 site-years



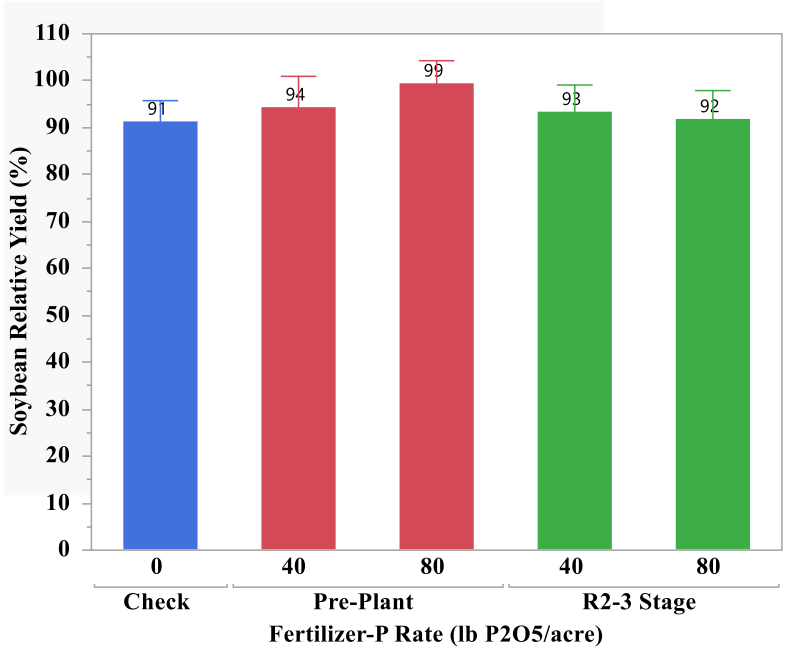
Corn followed a similar yield response pattern to in-season K fertilization

In-Season P Deficiency Management

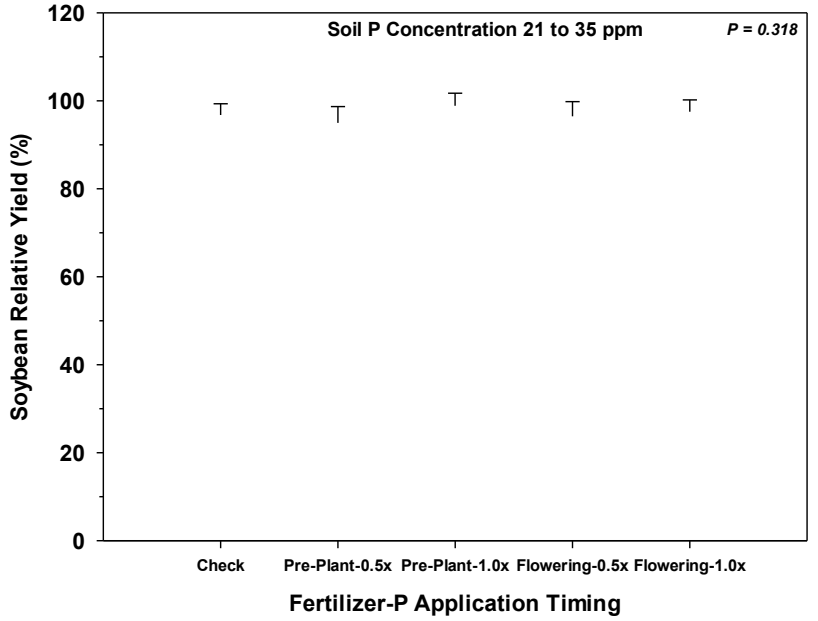
Soil P ≤ 10 ppm
3 site-years



Soil P 11-15 ppm
9 site-years



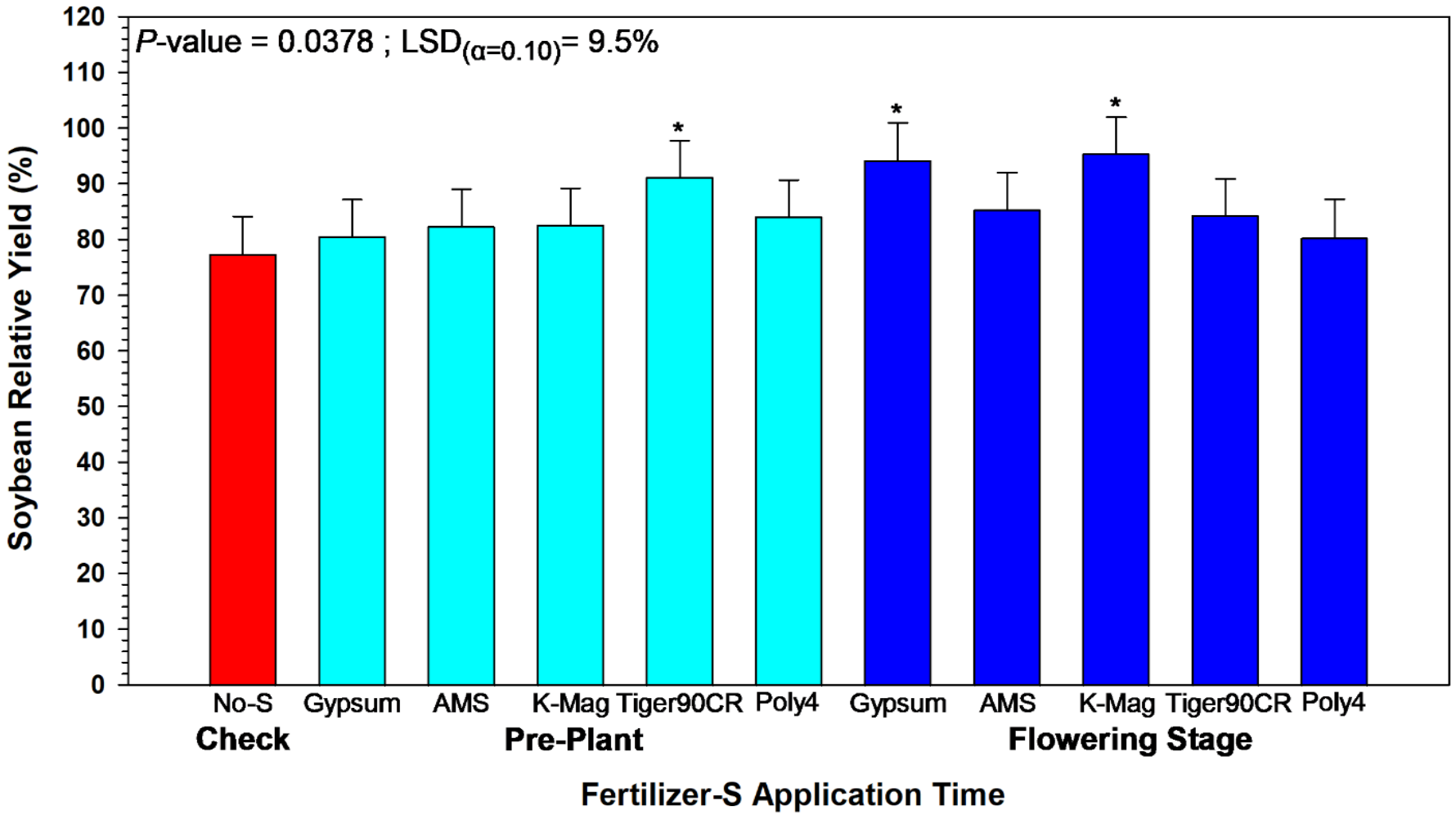
Soil P 21-35 ppm
12 site-years



Corn followed a similar yield response pattern to in-season P fertilization

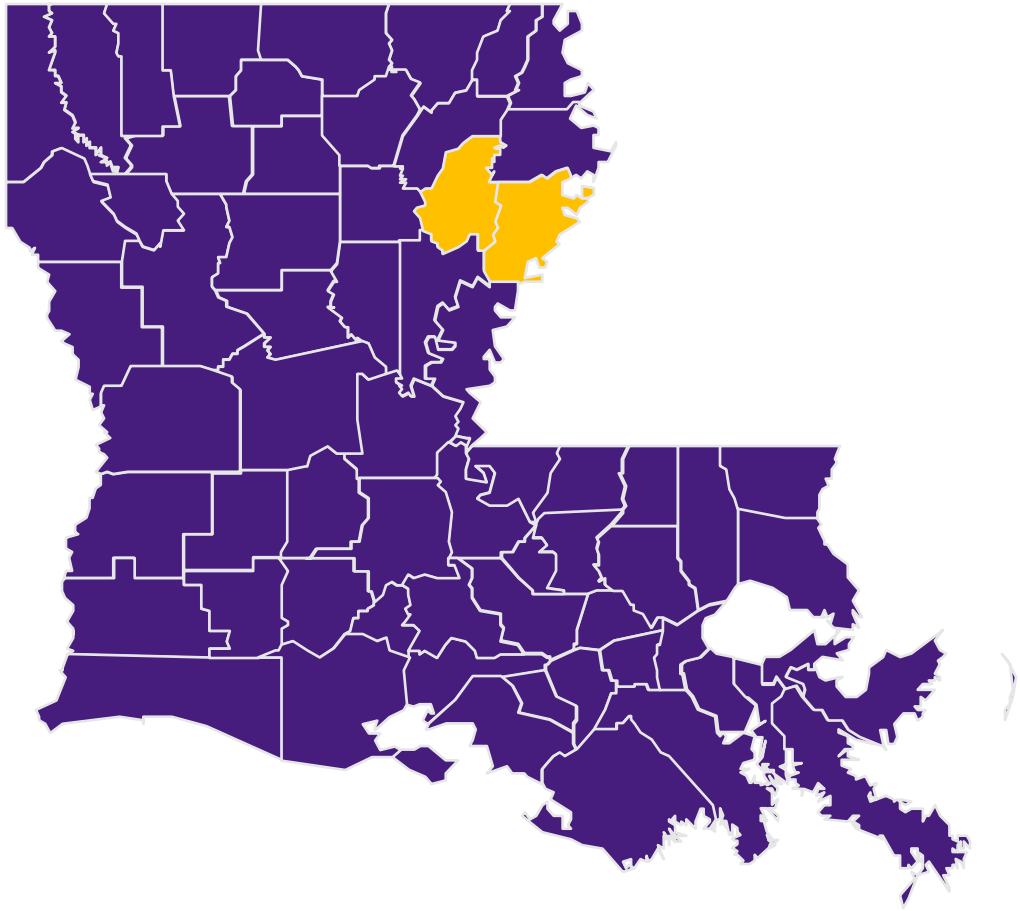
In-Season S Deficiency Management

Mehlich-3 Soil S Concentration 9-12 ppm
2 out of 9 site-years responded positively



In-Season Deficiency Management with Foliar Fertilization

- **Year & Location: 2020 to 2024**
  - ✓ Macon Ridge Research Station
  - ✓ Northeast Research Station
- **Experimental Treatments: 24**
  - ✓ Producers' Standard Check: 1
  - ✓ Granular Fertilizer Treatments: 5
  - ✓ Foliar Fertilizer Treatments: 18
    - Helena
    - Koch
    - Nachurs
    - Nutrien
    - Ouachita
    - Earth Science Lab



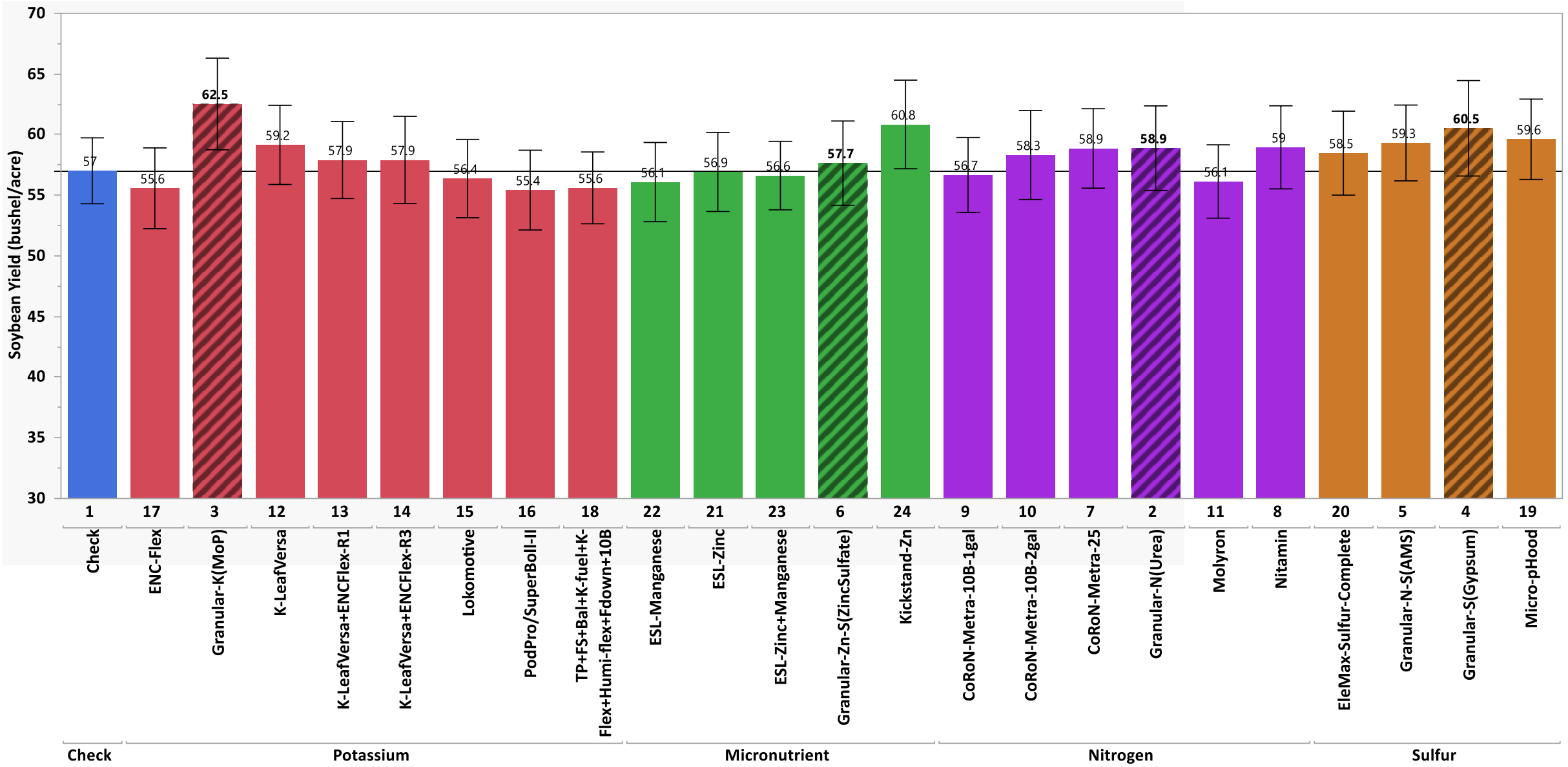
Foliar Fertilizer Treatments and Nutrient Content for Soybean

Trt #	Company	Fertilizer Name	Application Rate	Application Time
			gal or lb/ac	stage
1	Producer	Check (Producers' Std.)		
2	Specialist	Granular-N (Urea)	100.00	R2-3
3	Specialist	Granular-K (MoP)	50.00	R2-3
4	Specialist	Granular-S (Gypsum)	150.00	R2-3
5	Specialist	Granular-N+S (Am.Sulfate)	100.00	R2-3
6	Specialist	Granular-Zn+S (Zn Sulfate)	50.00	R2-3
7	Helena	CoRoN Metra 25	1.00	R2-3
8	Koch	Nitamin	4.00	R2-3 & R4-5
9	Helena	CoRoN Metra 10B-1gal	1.00	R2-3
10	Helena	CoRoN Metra 10B-2gal	2.00	R2-3
11	Ouachita	Molyron	1.00	V3-4 & R1
12	Helena	K-Leaf Versa	0.25	R1
13	Helena	K-Leaf Versa+ENC Flex-R1	0.38	R1
14	Helena	K-Leaf Versa+ENC Flex-R3	0.38	R3
15	Nutrien	Lokomotive	1.00	R2-3
16	Ouachita	Pod Pro/Super Boll II	6.00	R1 & R3
17	Helena	ENC Flex	0.13	V3-4
18	Nachurs	TO+FL+HF+BA+K-F+10B etc.	8.13	V3,R1,R2,R3,R5
19	ESL	Micro-pHood	0.75	V3-4, R1, & R3
20	Helena	EleMax Sulfur Complete	1.00	V3-4 & R1
21	ESL	ESL Zinc	0.38	V3-4, R1, & R3
22	ESL	ESL Manganese	0.38	V3-4, R1, & R3
23	ESL	ESL Zinc Manganese	0.75	V3-4, R1, & R3
24	Helena	Kickstand Zn	0.25	V3-4

Foliar Fertilizer Treatments and Nutrient Content for Soybean

Trt #	Company	Fertilizer Name	Application Rate	Application Time	Total Amount of Nutrient Applied											
					N	P2O5	K2O	Ca	Mg	S	B	Zn	Mn	Cu	Fe	Mo	Co
			gal or lb/ac	stage	lb acre^{-1}												
1	Producer	Check (Producers' Std.)															
2	Specialist	Granular-N (Urea)	100.00	R2-3	46.00	.	.	.	.	.	.	.	.	.	.	.	.
3	Specialist	Granular-K (MoP)	50.00	R2-3	.	.	30.00	.	.	.	.	.	.	.	.	.	.
4	Specialist	Granular-S (Gypsum)	150.00	R2-3	.	.	.	34.50	.	24.00	.	.	.	.	.	.	.
5	Specialist	Granular-N+S (Am.Sulfate)	100.00	R2-3	21.00	.	.	.	.	24.00	.	.	.	.	.	.	.
6	Specialist	Granular-Zn+S (Zn Sulfate)	50.00	R2-3	.	.	.	.	.	2.50	.	10.00	.	.	.	.	.
7	Helena	CoRoN Metra 25	1.00	R2-3	2.48	.	.	.	.	.	.	.	.	.	.	.	.
8	Koch	Nitamin	4.00	R2-3 & R4-5	12.60	.	.	.	.	.	.	.	.	.	.	.	.
9	Helena	CoRoN Metra 10B-1gal	1.00	R2-3	1.00	.	1.00	.	.	.	0.050	.	.	.	.	.	.
10	Helena	CoRoN Metra 10B-2gal	2.00	R2-3	2.00	.	2.00	.	.	.	0.100	.	.	.	.	.	.
11	Ouachita	Molyron	1.00	V3-4 & R1	0.99	.	.	.	.	0.27	.	.	.	.	0.421	0.00990	.
12	Helena	K-Leaf Versa	0.25	R1	.	.	0.41	.	.	.	0.001	0.001	0.001	.	.	0.00001	.
13	Helena	K-Leaf Versa+ENC Flex-R1	0.38	R1	0.14	0.07	0.88	.	.	.	0.001	0.002	0.001	.	.	0.00001	.
14	Helena	K-Leaf Versa+ENC Flex-R3	0.38	R3	0.14	0.07	0.88	.	.	.	0.001	0.002	0.001	.	.	0.00001	.
15	Nutrien	Lokomotive	1.00	R2-3	0.22	.	2.71	.	.	.	.	.	.	.	.	.	.
16	Ouachita	Pod Pro/Super Boll II	6.00	R1 & R3	2.29	.	5.72	.	.	.	0.115	0.115	.	.	.	0.01832	.
17	Helena	ENC Flex	0.13	V3-4	0.14	0.07	0.06	.	.	.	0.001	0.001	.	.	.	.	.
18	Nachurs	TO+FL+HF+BA+K-F+10B etc.	8.13	V3,R1,R2,R3,R5	4.58	5.04	9.90	.	.	0.80	0.290	0.026	0.026	0.005	.	0.00010	0.0006
19	ESL	Micro-pHood	0.75	V3-4, R1, & R3	.	.	.	.	0.13	0.65	.	0.299	0.299	.	0.043	.	.
20	Helena	EleMax Sulfur Complete	1.00	V3-4 & R1	.	.	.	.	0.08	0.15	0.050	.	0.070	.	.	0.00400	.
21	ESL	ESL Zinc	0.38	V3-4, R1, & R3	.	.	.	.	.	0.25	.	0.371	.	.	.	.	.
22	ESL	ESL Manganese	0.38	V3-4, R1, & R3	.	.	.	.	.	0.29	.	.	0.371	.	.	.	.
23	ESL	ESL Zinc Manganese	0.75	V3-4, R1, & R3	.	.	.	.	.	0.56	.	0.590	0.253	.	.	.	.
24	Helena	Kickstand Zn	0.25	V3-4	.	.	.	.	.	.	.	0.177	.	.	.	.	.

Soybean Yield Across 7 Site-Years



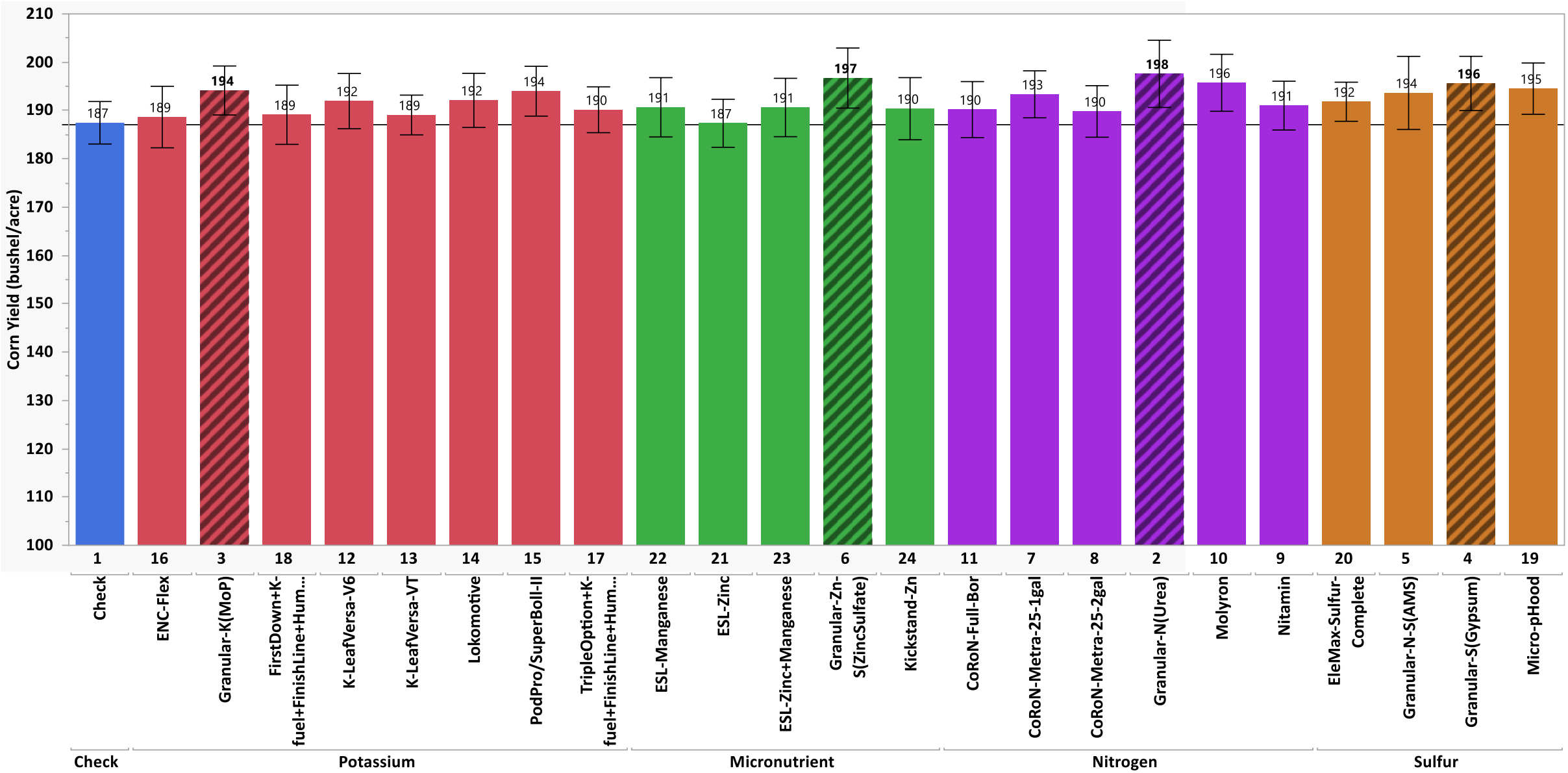
Economic Analysis for Soybean

Trt #	Company	Fertilizer Name	Application Rate	Application Time	Yield Change	G. Income @$15.0/bu	Product Price	Product Cost	Application Cost @$8/A	Net Income w/o A. Cost	Net Income w/ A. Cost	≥2 bu Yield Probability
			gal or lb/ac	stage	bu/ac	$/acre	$/unit	$/acre	$/acre	$/acre	$/acre	%
1	Producer	Check (Producers' Std.)	-	-	-	-	-	-	-	-	-	-
2	Specialist	Granular-N (Urea)	100.00	R2-3	+1.9	28.0	567/ton	28.3	8.0	**0**	**-8**	**0**
3	Specialist	Granular-K (MoP)	50.00	R2-3	+5.5	82.7	583/ton	14.6	8.0	**+68**	**+60**	**40**
4	Specialist	Granular-S (Gypsum)	150.00	R2-3	+3.5	52.6	125/ton	9.4	12.0	**+43**	**+31**	**40**
5	Specialist	Granular-N+S (Am.Sulfate)	100.00	R2-3	+2.3	34.4	528/ton	26.4	8.0	**+8**	**0**	**20**
6	Specialist	Granular-Zn+S (Zn Sulfate)	50.00	R2-3	+0.6	9.4	1.0/lb	50.0	8.0	**-41**	**-49**	**0**
7	Helena	CoRoN Metra 25	1.00	R2-3	+1.8	27.6	13.7/gal	13.7	8.0	**+14**	**+6**	**40**
8	Koch	Nitamin	4.00	R2-3 & R4-5	+1.9	29.0	20.0/gal	80.0	16.0	**-51**	**-67**	**0**
9	Helena	CoRoN Metra 10B-1gal	1.00	R2-3	-0.3	-5.2	7.35/gal	7.4	8.0	**-13**	**-21**	**20**
10	Helena	CoRoN Metra 10B-2gal	2.00	R2-3	+1.3	19.5	7.35/gal	14.7	8.0	**+5**	**-3**	**20**
11	Ouachita	Molyron	1.00	V3-4 & R1	-0.9	-13.2	20.0/gal	20.0	16.0	**-33**	**-49**	**0**
12	Helena	K-Leaf Versa	0.25	R1	+2.1	32.0	29.7/gal	3.7	8.0	**+28**	**+20**	**40**
13	Helena	K-Leaf Versa+ENC Flex-R1	0.38	R1	+0.9	13.4	27.2/gal	10.2	8.0	**+3**	**-5**	**20**
14	Helena	K-Leaf Versa+ENC Flex-R3	0.38	R3	+0.9	13.4	27.2/gal	10.2	8.0	**+3**	**-5**	**40**
15	Nutrien	Lokomotive	1.00	R2-3	-0.6	-9.6	17.5/gal	17.5	8.0	**-27**	**-35**	**0**
16	Ouachita	Pod Pro/Super Boll II	6.00	R1 & R3	-1.6	-23.9	8.0/gal	48.0	16.0	**-72**	**-88**	**20**
17	Helena	ENC Flex	0.13	V3-4	-1.4	-21.7	22.3/gal	2.8	8.0	**-24**	**-32**	**0**
18	Nachurs	TO+FL+HF+BA+K-F+10B etc.	8.13	V3,R1,R2,R3,R5	-1.4	-21.1	8.41/gal	68.4	40.0	**-89**	**-129**	**0**
19	ESL	Micro-pHood	0.75	V3-4, R1, & R3	+2.6	39.0	27.0/gal	20.3	24.0	**+19**	**-5**	**20**
20	Helena	EleMax Sulfur Complete	1.00	V3-4 & R1	+1.5	21.8	9.7/lb	9.7	16.0	**+12**	**-4**	**0**
21	ESL	ESL Zinc	0.38	V3-4, R1, & R3	-0.1	-1.5	27.0/gal	10.1	24.0	**-12**	**-36**	**0**
22	ESL	ESL Manganese	0.38	V3-4, R1, & R3	-0.9	-14.0	27.0/gal	10.1	24.0	**-24**	**-48**	**0**
23	ESL	ESL Zinc Manganese	0.75	V3-4, R1, & R3	-0.4	-5.9	27.0/gal	20.3	24.0	**-26**	**-50**	**0**
24	Helena	Kickstand Zn	0.25	V3-4	+3.8	57.3	32.2/gal	8.1	8.0	**+49**	**+41**	**40**

Foliar Fertilizer Treatments and Nutrient Content for Corn

Trt #	Company	Fertilizer Name	Application Rate	Application Time
			gal or lb/ac	stage
1	Producer	Check (Producers' Std.)		
2	Specialist	Granular-N (Urea)	100.00	V11-12
3	Specialist	Granular-K (MoP)	50.00	V11-12
4	Specialist	Granular-S (Gypsum)	150.00	V11-12
5	Specialist	Granular-N+S (Am.Sulfate)	100.00	V11-12
6	Specialist	Granular-Zn+S (Zn Sulfate)	50.00	V11-12
7	Helena	CoRoN Metra 25-1gal	1.00	V6-7
8	Helena	CoRoN Metra 25-2gal	2.00	V6-7
9	Koch	Nitamin	4.00	V6-7 & V11-12
10	Ouachita	Molyron	1.00	V6-7 & V11-12
11	Helena	CoRoN Full Bor	0.13	V6-7
12	Helena	K-Leaf Versa-V6	0.25	V6-7
13	Helena	K-Leaf Versa-V6 & V12	0.50	V6-7 & V11-12
14	Nutrien	Lokomotive	2.00	V11-12 & R1-2
15	Ouachita	Pod Pro/Super Boll II	2.00	V11-12
16	Helena	ENC Flex	0.25	V6-7
17	Nachurs	TO+FL+HF+BA+K-Fuel+10B	4.13	V6-7 & R1-2
18	Nachurs	FD+FL+HF+BA+K-Fuel+10B	4.13	V6-7 & R1-2
19	ESL	Micro-pHood	0.50	V3-4 & V6-7
20	Helena	EleMax Sulfur Complete	1.00	V6-7
21	ESL	ESL Zinc	0.25	V6-7 & V11-12
22	ESL	ESL Manganese	0.25	V6-7 & V11-12
23	ESL	ESL Zinc Manganese	0.50	V6-7 & V11-12
24	Helena	Kickstand Zn	0.25	V6-7

Corn Yield Across 7 Site-Years



Economic Analysis for Corn

Trt #	Company	Fertilizer Name	Application Rate	Application Time	Yield Change	G. Income @$6.75/bu	Product Price	Product Cost	Application Cost @$8/A	Net Income w/o A. Cost	Net Income w/ A. Cost	≥5 bu Yield Probability
			gal or lb/ac	stage	bu/ac	$/acre	$/unit	$/acre	$/acre	$/acre	$/acre	%
1	Producer	Check (Producers' Std.)	-	-	-	-	-	-	-	-	-	-
2	Specialist	Granular-N (Urea)	100.00	V11-12	+10.1	68.4	567/ton	28.3	8.0	**+40**	**+32**	40
3	Specialist	Granular-K (MoP)	50.00	V11-12	+6.7	45.1	583/ton	14.6	8.0	**+31**	**+23**	20
4	Specialist	Granular-S (Gypsum)	150.00	V11-12	+8.1	54.9	125/ton	9.4	12.0	**+46**	**+34**	20
5	Specialist	Granular-N+S (Am.Sulfate)	100.00	V11-12	+6.2	41.7	528/ton	26.4	8.0	**+15**	**+7**	20
6	Specialist	Granular-Zn+S (Zn Sulfate)	50.00	V11-12	+9.3	62.5	1.0/lb	50.0	8.0	**+12**	**+4**	40
7	Helena	CoRoN Metra 25-1gal	1.00	V6-7	+5.9	39.8	13.7/gal	13.7	8.0	**+26**	**+18**	40
8	Helena	CoRoN Metra 25-2gal	2.00	V6-7	+2.3	15.8	13.7/gal	27.5	8.0	**-12**	**-20**	40
9	Koch	Nitamin	4.00	V6-7 & V11-12	+3.6	24.0	20.0/gal	80.0	16.0	**-56**	**-72**	20
10	Ouachita	Molyron	1.00	V6-7 & V11-12	+8.3	55.8	20.0/gal	20.0	16.0	**+36**	**+20**	20
11	Helena	CoRoN Full Bor	0.13	V6-7	+2.7	18.4	30.7/gal	3.8	8.0	**+15**	**+7**	20
12	Helena	K-Leaf Versa-V6	0.25	V6-7	+4.5	30.3	29.7/gal	7.4	8.0	**+23**	**+15**	40
13	Helena	K-Leaf Versa-V6 & V12	0.50	V6-7 & V11-12	+1.6	10.9	29.7/gal	14.8	16.0	**-4**	**-20**	40
14	Nutrien	Lokomotive	2.00	V11-12 & R1-2	+4.6	31.3	17.5/gal	35.0	16.0	**-4**	**-20**	20
15	Ouachita	Pod Pro/Super Boll II	2.00	V11-12	+6.5	44.1	8.0/gal	16.0	8.0	**+28**	**+20**	20
16	Helena	ENC Flex	0.25	V6-7	+1.2	8.0	22.3/gal	5.6	8.0	**+2**	**-6**	0
17	Nachurs	TO+FL+HF+BA+K-Fuel+10B	4.13	V6-7 & R1-2	+2.7	18.1	9.3/gal	38.2	24.0	**-20**	**-44**	40
18	Nachurs	FD+FL+HF+BA+K-Fuel+10B	4.13	V6-7 & R1-2	+1.7	11.1	8.9/gal	36.6	24.0	**-25**	**-49**	0
19	ESL	Micro-pHood	0.50	V3-4 & V6-7	+7.1	47.7	27.0/gal	13.5	8.0	**+34**	**+26**	20
20	Helena	EleMax Sulfur Complete	1.00	V6-7	+4.3	29.4	9.7/lb	9.7	8.0	**+20**	**+12**	20
21	ESL	ESL Zinc	0.25	V6-7 & V11-12	-0.1	-0.7	27.0/gal	6.8	16.0	**-7**	**-23**	0
22	ESL	ESL Manganese	0.25	V6-7 & V11-12	+3.2	21.6	27.0/gal	6.8	16.0	**+15**	**-1**	20
23	ESL	ESL Zinc Manganese	0.50	V6-7 & V11-12	+3.2	21.3	27.0/gal	13.5	16.0	**+8**	**-8**	20
24	Helena	Kickstand Zn	0.25	V6-7	+2.9	19.7	32.2/gal	8.1	8.0	**+12**	**+4**	20

Take Home Messages……

1. **Soil Sampling:**
   - ✓ Sample at the 0-6 inch depth for most soil fertility and soil health tests.
   - ✓ Do not sample when it is too dry or too cold. The best time is in the Spring.
   - ✓ The higher the sample number, the more reliable the recommendation will be.
2. **Crop Response Curve (Correlation) and Recommendation (Calibration):**
   - ✓ Need to be updated with new crop genetics and the Mehlich-3 method in Missouri.
3. **Pre-Plant Soil Testing vs. In-season Soil/Tissue Testing & Interpretation:**
   - ✓ Pre-plant soil testing and fertilization are the best methods for optimizing yield.
   - ✓ Expert opinion is needed in interpreting tissue test results and recommendations.
4. **In-season Foliar Fertilization & Yield Expectation:**
   - ✓ Calculate nutrient content of foliar products and check with the crop needs before use.
5. **S will be the 4th most yield-limiting nutrient. Need new recommendations.**

New Soil Fertility Test Report

Moving to the Mehlich-3 Method in 2026

Fertilizer Calculator

Enter soil test results manually and get your recommendations.

USE FERTILIZER CALCULATOR

Working on……

- ✓ **N recommendations**
- ✓ **P & K recommendations**
- ✓ **Lime recommendations**

☑ Mehlich-3 ☐ Bray1/AA/Ca-Phosphate/DTPA/Hot Water* ◉ ppm (mg/kg) ○ lbs/acre

Soil Test Results

Test Name	Mehlich-3	B-1/AA/Ca	Rating	Test Name	Mehlich-3	DTPA/HW	Rating
Phosphorus (P) lbs/A	46.5			Zinc (Zn) ppm	1.7		
Potassium (K) lbs/A	150.0			Manganese (Mn) ppm	258.0		
Calcium (Ca) lbs/A	3189.0			Iron (Fe) ppm	315.0		
Magnesium (Mg) lbs/A	253.0			Copper (Cu) ppm	1.7		
Sodium (Na) lbs/A	8.4			Boron (B) ppm	0.1		
Sulfur (SO4-S) lbs/A	11.4			Aluminum (Al ppm)			
Soil pH (salt)	6.5			Ammonium-N (NH4-N) ppm			
Soil pH (water)				Nitrate-N (NO3-N) ppm			
Buffer pH (Woodruff)				Electrical Conductivity mmho/cm			
Neutralizable Acidity meq/100g	7.0			CEC (summation) meq/100g	25.5		
Organic Matter (LOI), %	2.4			Total N			

BS-K (%)	1.5	BS-Ca (%)	62.6	BS-Mg (%)	8.3	BS-Na (%)	0.1	BS-H (%)	27.5
Soil Texture				Sand (%)		Silt (%)		Clay (%)	

*Bray1 for P; Ammonium Acetate (AA) for K, Ca, Mg, and Na; Ca-Phosphate for S; DTPA for Zn, Mn, Fe, and Cu; Hot Water for B.

Nutrient and Lime Requirements (lbs/acre)

Cropping Options	Yield Goal	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)	Sulfur (S)	Zinc (Zn)
103 - Corn (Grain)	200	220.0	115.0	60.0	0.0	0.0
115 - Soybeans	65	0.0	80.0	90.0	0.0	0.0

LIMESTONE SUGGESTIONS: Effective Neutralizing Material (ENM):**880** Effective Magnesium(EMg):

New Soil Health Test Report

Missouri Agricultural Experiment Station
University of Missouri

Soil Health Test Report

Soil Health Assessment Center
3600 New Haven Rd, Columbia, MO 65201
(573) 882-0941

Participant	
Company:	Soil Health Assessment Center
Name:	Muhammad Rasel Parvej
Email:	mrparvej@missouri.edu
Address:	108 Waters Hall, Columbia, MO 65211
County / SWCD County:	Boone / Boone
Region:	Eastern River /Wooded Slopes

Sample Information	
Farm:	6429
Tract:	11527
Field:	6
Field Nickname:	Field in front of house
Lat / Long:	38.9518, -92.3283
SHAC ID:	CC24-0001

History	
Past Tillage:	Reduced/Conservation Tillage
Crop Rotation (Past 5y):	other
Cover Crop Used Before:	Yes, 2020,2021,2022
Manure Used Before:	Yes, Poultry
field status(Past 5y):	Grass
Last limed:	1-5 years ago

Results

	Soil Test		Soil Health Test Interpretation					Missouri Soil Status		
Soil Health Test Name	**Value**	**Score**	**1. Very Low**	**2. Low**	**3. Medium**	**4. High**	**5. Very High**	**Region Median**	**Region Percentile**	**State Median**
Total Organic Carbon (%)	1.34[a]	2	< 0.75	0.75 - 1.5	1.6 - 2.5	2.6 - 3.5	> 3.5	1.6	23	1.9
POXC Carbon (mg/kg)	411.91[b]	3	< 200	200 - 400	401 - 600	601 - 800	> 800	467.9	35	508.3
3-Day Soil Respiration (mg CO_2/kg soil)	870.30[c]	3	< 300	301 - 550	551 - 950	951 - 1300	> 1300	754.3	65	717.9
Wet Aggregate Stability (%)	50.50[d]	4	< 10	10 - 25	26 - 45	46 - 70	> 70	24.0	87	26.8
ACE Protein (g/kg soil)	4.55[e]	3	< 2.5	2.5 - 4.0	4.1 - 7.0	7.1 - 10.0	> 10.0	5.4	33	5.3
Potentially Mineralizable Nitrogen (mg/kg)	120.00[f]	4	< 30	30 - 60	61 - 100	101 - 140	> 140	77.0	92	75.0
Overall Mean Soil Health Score (Score with a decimal value > 0.75 is rounded to the next whole number)		**3.2**	**Medium**							
			< 1.76	1.76 - 2.75	2.76 - 3.75	3.76 - 4.75	> 4.75			

Soil Texture	Silt Loam
Sand (%)	**1.3**
Silt (%)	**78.9**
Clay (%)	**19.8**

*Based on >13,000 data across different soil textures in Missouri. Percentile indicates the relative position of the test result within the dataset.

Management Recommendations (For more information, please read "Interpreting Soil Health Test Report: A Guide for Missouri Farmers")

- Continue core practices: no-till, cover crops, and diverse rotations.
- Introduce multi-species cover crop mixes (legumes + grasses + brassicas).
- Optimize cover crop management, allowing more spring growth if it doesn't interfere with planting.
- Continue organic inputs, focusing on manure for stable carbon. Consider adding carbon-rich amendments (e.g., biochar) if erosion or leaching is a concern.
- Enhance nutrient cycling with practices like precision fertilization and split applications.
- Manage crop residues in place to reduce disturbance and retain carbon.
- Keep improving diversity above and below ground.
- Avoid setbacks, such as deep tillage or long bare fallow periods.
- Soil test every 3–4 years to track progress and guide inputs.

Foot Notes / Comments: a. Reduced biological and physical functioning; suboptimal productivity. Indicates recent degradation or low input history. **b.** Moderate microbial function. Can support productivity with balanced management. **c.** Functioning microbial system; moderate nutrient cycling and soil life. **d.** Stable structure; good infiltration and microbial habitats. **e.** Moderate soil protein availability; balanced biological N cycling. **f.** High N supply potential; supports reduced N fertilization.

Thank You

Muhammad Rasel Parvej

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