Evaluating Winter Wheat Response to additional NPKS

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Introduction

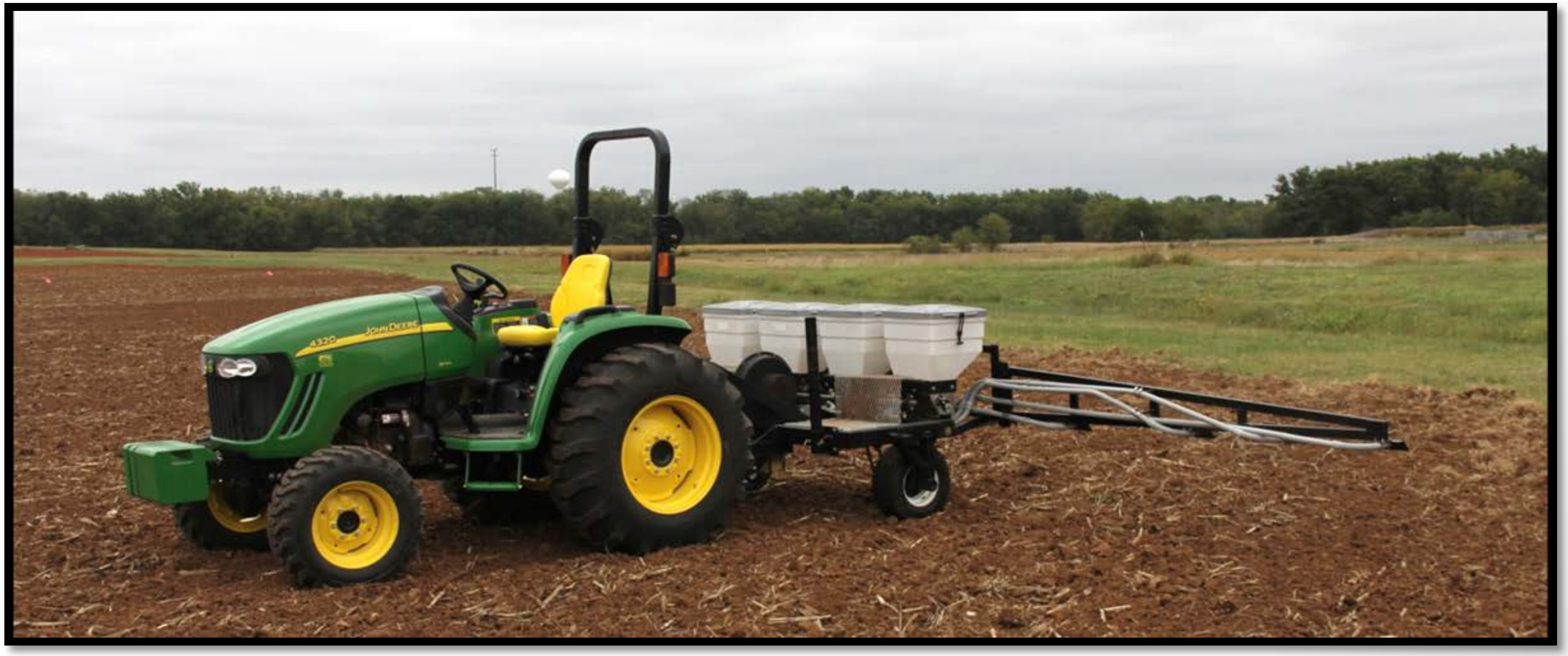
- Both temporal and spatial variation play a major role in nutrient availability
- Improvement of current fertilizer application methods would:
  - Decrease producer expenses and environmental effects when over application is common
  - Increase grain yields when under application is common
- Producers are willing to increase fertilizer inputs with an increase in grain prices
- However, The system has not recovered from 08.

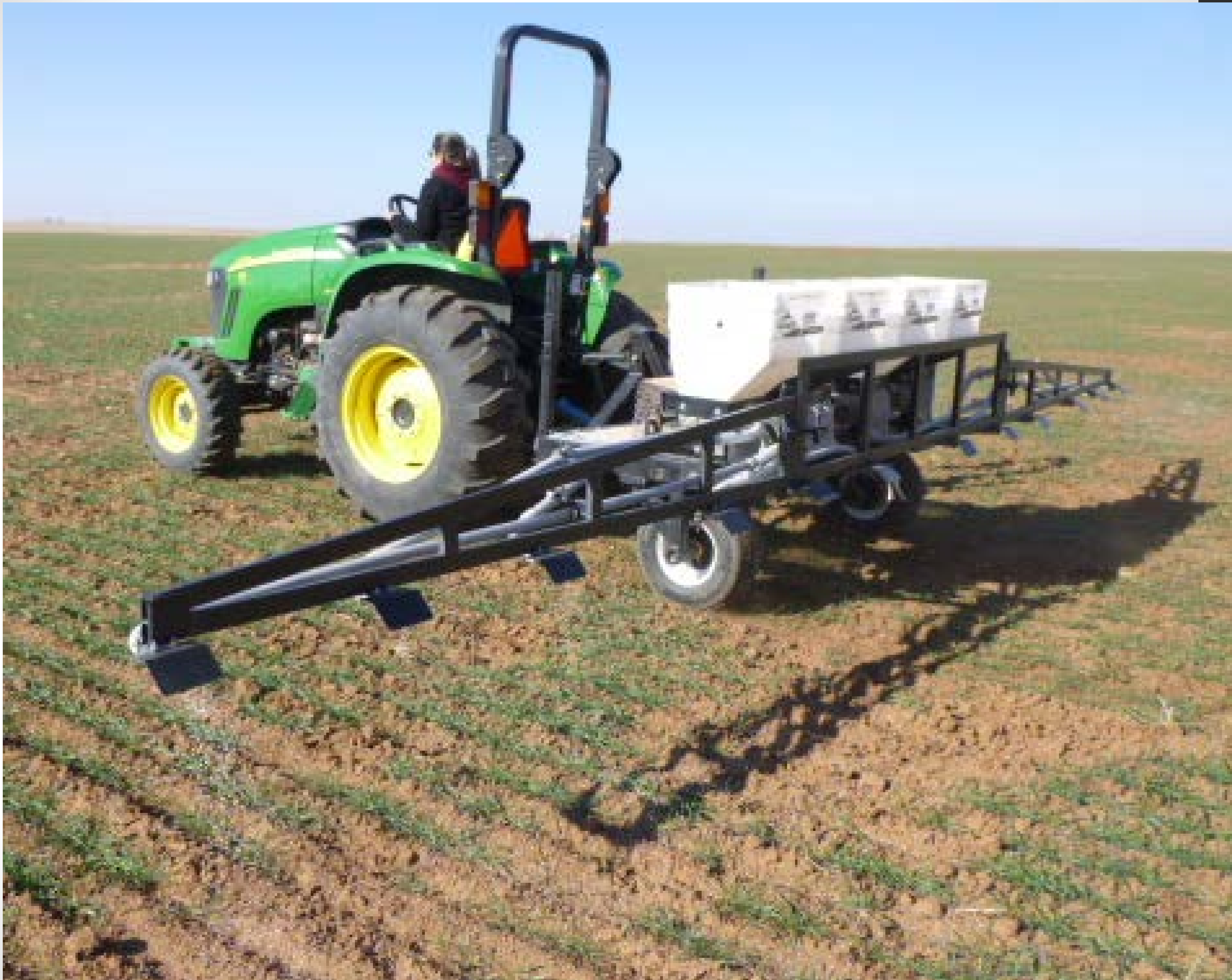
Objectives

- Highlight variability in nutrient requirements across landscapes, soil types, environments, and genotypes
- Analyze current nutrient management practices of OK winter wheat producers
- Provide better nutrient recommendations to maximize yields while minimizing inputs ?

Materials and Methods

- Applicator built by Bio-systems Ag Engineering at OSU
- Applied dry fertilizer for each strip simultaneously after emergence

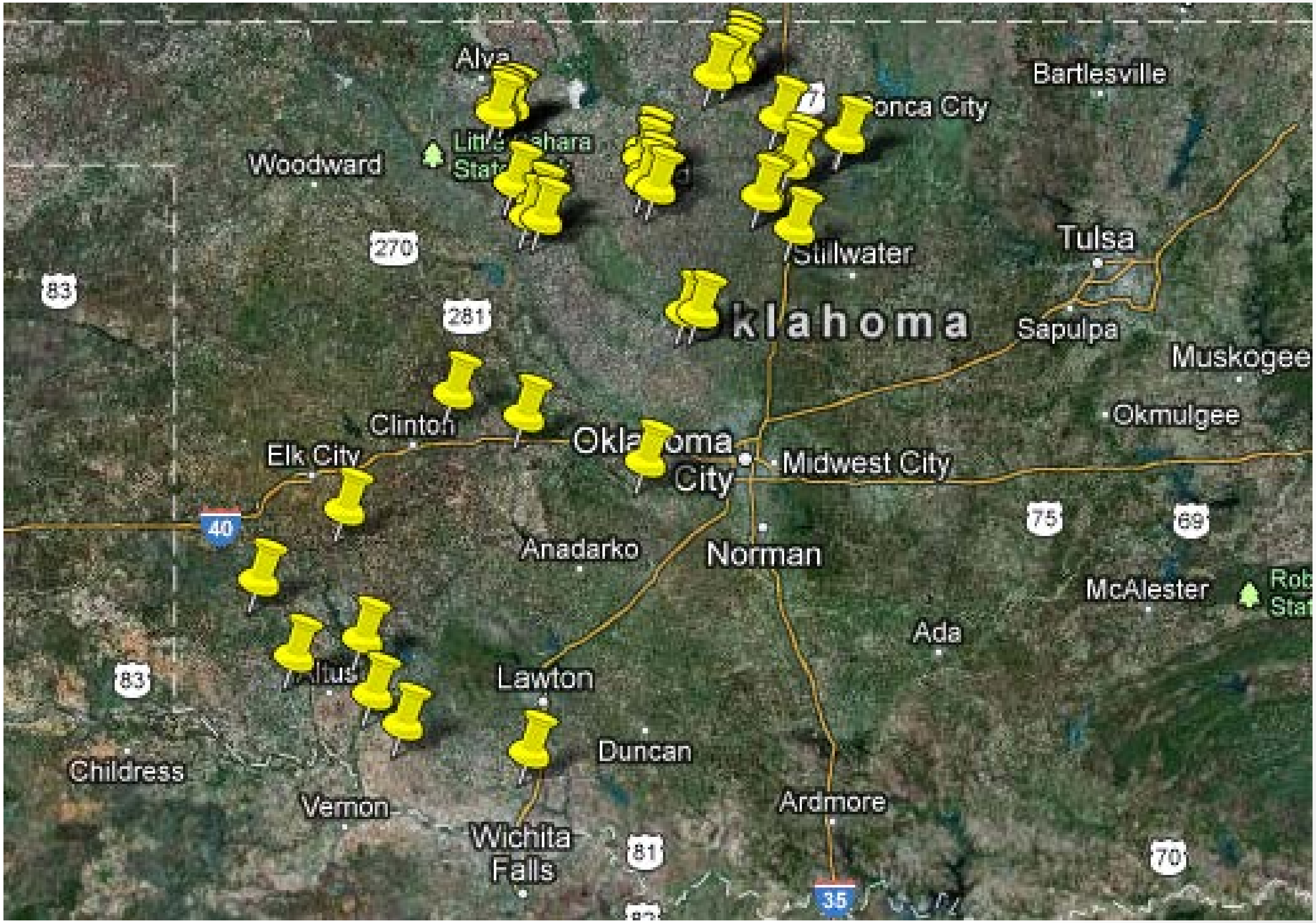




Materials and Methods

- Plots consisted of 4 parallel strips (1.8 x 30.5 m) each strip containing an individual treatment
- Treatments: urea (46-0-0), TSP (0-46-0), potash (0-0-60), and gypsum (22% Ca & 17% S) at a rate of 90.7 kg of product/ha
- Prior to application 15 soil cores were collected to obtain a composite sample at depths of 0-15 and 15-30 cm.
- Producers provided site history and current practices.

2011-12



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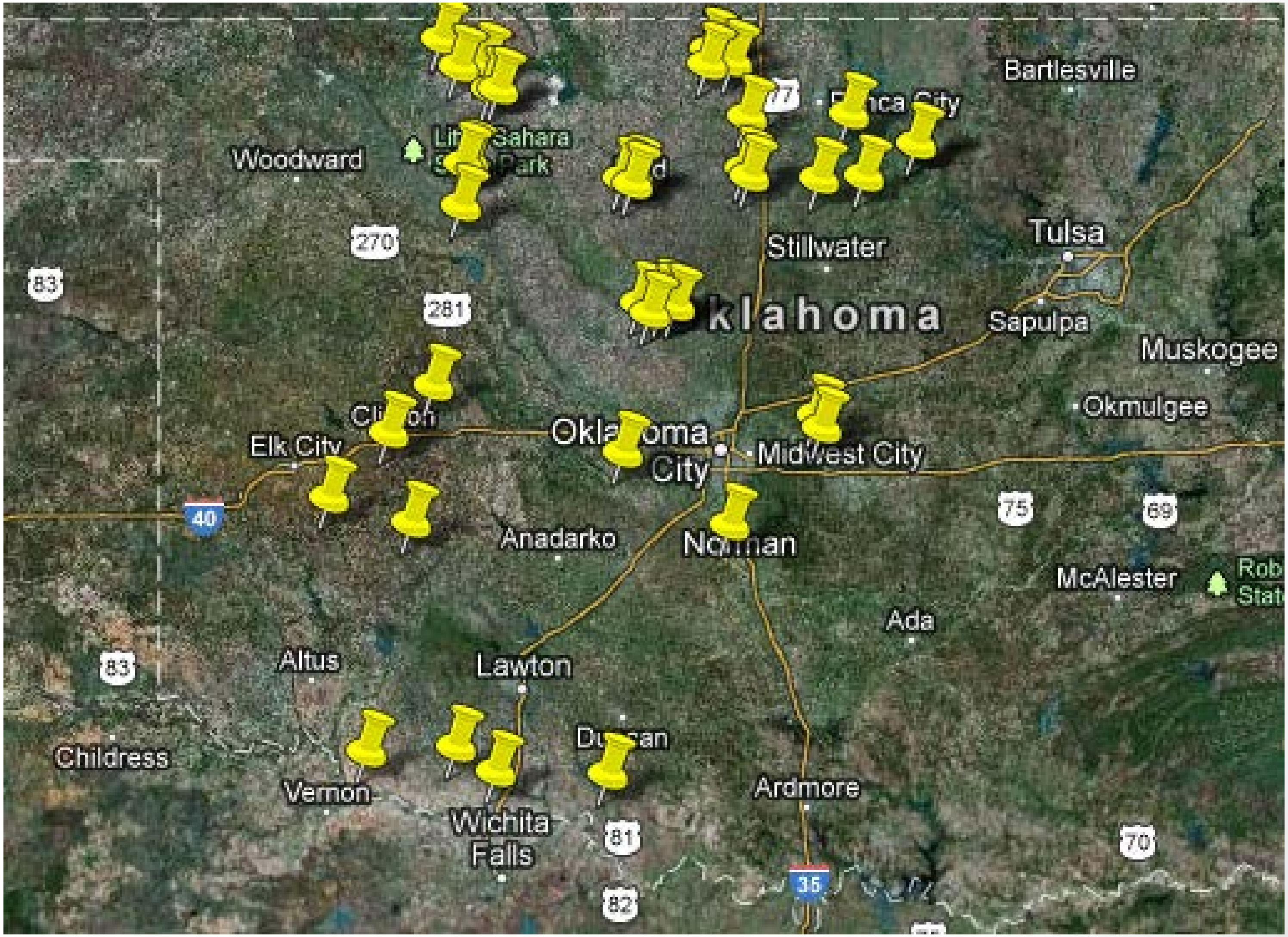
Bartlesville
Ponca City
Woodward
Tulsa
Stillwater
Oklahoma
Sapulpa
Muskogee
Okmulgee
Clinton
Elk City
Oklahoma City
Midwest City
Anadarko
Norman
McAlester
Ada
Lawton
Duncan
Childress
Vernon
Ardmore
Wichita Falls

2012-13


Bartlesville
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Muskogee
Okmulgee
Elk City
Midwest City
Anadarko
McAlester
Ada
Altus
Lawton
Childress
Vernon
Wichita Falls
Ardmore
270
281
83
40
75
69
81
70
35
82

Materials and Methods

- Of the 80 Locations established 59 were harvested.
- Four 1 m^2 sections were harvested from each strip including the Farmer's Practice
- Total biomass was hand cut at soil surface
- Samples were then dried prior to threshing and grain was collected, weighed and recorded

Initial Soil Samples

	pH	NO_3^-	NO_3^-	STP	STK	SO_4^-	SO_4^-
Depth Cm		0-15	15-45	0-15	0-15	0-15	15-45
		ppm	ppm	ppm	ppm	ppm	ppm
Average	5.8	18.0	15.4	36.6	212.6	13.0	11.6
Maximum	8.2	56.0	51.5	91.5	422.0	31.0	47.5
Minimum	4.5	3.0	2.0	9.5	119.0	4.4	5.1

	pH	NO_3^-	NO_3^-	STP	STK	SO_4^-	SO_4^-	Cl^-	Cl^-
Depth Cm		0-15	15-45	0-15	0-15	0-15	15-45	0-15	15-45
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Average	6.0	29.3	15.9	43.9	216.2	13.2	14.2	20.3	17.4
Maximum	8.2	68.5	37.5	150.0	436.0	33.0	52.5	66.7	72.8
Minimum	4.4	1.5	1.5	12.5	68.5	3.0	2.5	7.0	6.6

Soils

Location	County	Soil Series	Soil Description	Tillage Practice	Response			
					N	P	K	S
1	Cotton	Tillman	Fine, mixed, superactive, thermic Vertic Paleustolls	Conventional	*			
2	Tillman	Hollister	Fine, smectitic, thermic Typic Haplusterts					
3	Tillman	Grandfield	Fine-loamy, mixed, superactive, thermic Typic Haplustalfs					
4	Jackson	Grandfield	Fine-loamy, mixed, superactive, thermic Typic Haplustalfs				*	
5	Jackson	Tillman	Fine, mixed, superactive, thermic Vertic Paleustolls					
6	Washita	Carey	Fine-silty, mixed, superactive, thermic Typic Argiustolls					
7	Grady	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	Conventional				
8	Caddo	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till	*			
9	Custer	St. Paul	Fine-silty, mixed, superactive, thermic Pachic Argiustolls					
10	Noble	Kirkland	Fine, mixed, superactive, thermic Udertic Paleustolls	No-till				
11	Noble	Renfrow	Fine, mixed, superactive, thermic Udertic Paleustolls	Conventional				
12	Noble	Milan	Fine-loamy, mixed, superactive, thermic Udic Argiustolls	No-till		*	*	
13	Kingfisher	Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls	Conventional		*		
14	Noble	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	No-till	*			
15	Noble	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	No-till				
16	Noble	Kirkland	Fine, mixed, superactive, thermic Udertic Paleustolls	No-till				
17	Garfield	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till				
18	Garfield	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till				
19	Garfield	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	No-till				
20	Grant	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till		*		
21	Grant	Kirkland	Fine, mixed, superactive, thermic Udertic Paleustolls	No-till				
22	Grant	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till				
23	Grant	McLain	Fine, mixed, superactive, thermic Pachic Argiustolls	No-till				
24	Alfalfa	Devol	Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs		*	*		
25	Major	McLain	Fine, mixed, superactive, thermic Pachic Argiustolls					
26	Major	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls					
27	Major	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls					
28	Major	McLain	Fine, mixed, superactive, thermic Pachic Argiustolls	No-till				
29	Major	McLain	Fine, mixed, superactive, thermic Pachic Argiustolls					
30	Payne	Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls	Conventional	*			

Soils

Location	County	Soil Series	Soil Description	Tillage Practice	Response			
					N	P	K	S
31	Tillman	Hollister	Fine, smectitic, thermic Typic Haplusterts					
32	Washita	Obaro	Fine-silty, mixed, superactive, thermic Typic Haplustepts	Conventional		*		
33	Custer	St. Paul	Fine-silty, mixed, superactive, thermic Pachic Argiustolls				*	
34	Grady	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	Conventional				
35	McLain	Keokuk	Course-silty, mixed, superactive, thermic Fluventic Haplustolls	Conventional				
36	Kingfisher	Renfrow	Fine, mixed, superactive, thermic Udertic Paleustolls	Conventional				
37	Noble	Kirkland	Fine, mixed, superactive, thermic Udertic Paleustolls	Conventional				
38	Noble	Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls	Conventional	*			
39	Noble	Norge	Fine-silty, mixed, active, thermic Udic Paleustolls	No-till				
40	Garfield	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till				
41	Garfield	Grant	Fine-silty, mixed superactive, thermic Udic Argiustolls	No-till				
42	Garfield	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	No-till				
43	Woods	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	Conventional	*			
44	Woods	Burford	Fine-silty, mixed, superactive, thermic Typic Haplustepts	Conventional				
45	Woods	Bethany	Fine, mixed superactive, thermic Pachic Paleustolls	No-till				
46	Alfalfa	Devol	Course-loamy, mixed, superactive, thermic Typic Haplustalfs	No-till				
47	Alfalfa	Grant	Fine-silty, mixed, superactive, thermic Udic Argiustolls	No-till				
48	Major	Canadian	Course-loamy, mixed, superactive, thermic Udic Haplustolls	No-till				
49	Major	Reinach	Course-silty, mixed, superactive, thermic Pachic Haplustolls	No-till				
50	Major	Eda	Mixed, thermic Lamellic Ustipsamments	No-till				
51	Osage	Braman	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till				
52	Pawnee	Renfrow	Fine, mixed, superactive, thermic Udertic Paleustolls	Conventional				
53	Grant	Bethany	Fine, mixed, superactive, thermic Pachic Paleustolls	Conventional				
54	Grant	Bethany	Fine, mixed, superactive, thermic Pachic Paleustolls	No-till				
55	Grant	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till		*		
56	Grant	Pond Creek	Fine-silty, mixed, superactive, thermic Pachic Argiustolls	No-till		*		
57	Noble	Bethany	Fine, mixed, superactive, thermic Pachic Paleustolls	Conventional				
58	Pottawatomie	Asher	Fine-silty, mixed, superactive, thermic Fluventic Haplustolls	Conventional				
59	Pottawatomie	Keokuk	Course-silty, mixed, superactive, thermic Fluventic Haplustolls	conventional				


N P K S

Nitrogen

Location	Soil Test NO_3^-	Soil Test NO_3^-	Farmer Applied N	N Strip Applied N	Farmer Practice	N Rich Strip
	0-15 cm	15-45 cm			Grain Yield	
	ppm	ppm	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
1	6.0	8.0	22.4	140.9	3213	4059
8	24.0	15.0	89.8	208.3	2677	3696
14	5.5	3.0	51.5	170.0	2781	4197
24	4.5	8.0	78.4	196.9	2436	3783
30*	4.0	2.0	0.0	118.5	1589	2936

Location	Soil Test NO_3^-	Soil Test NO_3^-	Farmer Applied N	N Strip Applied N	Farmer Practice	N Rich Strip
	0-15 cm	15-45 cm			Grain Yield	
	ppm	ppm	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
38	68.5	8.0	31.4	119.0	3083	4275
43	6.0	9.0	22.4	110.0	2954	5428

Nitrogen

- 1: Under estimated YP
- 8: Urea in No-till low rain, N losses
- 14: Under estimated YP
- 24: Urea in No-till low rain, N losses
- 30: Research station
- 38: High residual N at Preplant
- 43: Under estimated YP
- N content increased at 11 and 11
- S content was increased at 8 and 6

Phosphorus

Location	pH	STP	Farmer Applied P	P Strip Applied P	Farmer Practice	P Rich Strip
		0-15 cm			Grain Yield	
		ppm	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
12	4.9	20.5	10.1	61.6	3679	4681
13	6.9	19.0	7.3	58.8	2971	3990
20	4.5	19.0	6.7	58.2	2833	4301
24	6.8	66.0	0.0	51.5	2436	3921

Location	pH	STP	Farmer Applied P	P Strip Applied P	Farmer Practice	P Rich Strip
		0-15 cm			Grain Yield	
		ppm	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
32	8.0	12.5	7.9	59.4	1671	2138
55	4.6	17.0	11.2	62.7	2980	1801
56	4.4	26.0	11.2	62.7	2138	3278

Phosphorus

- 11 of 12 applying p Banded
- 15 of 19 applying p Banded
- 12: low pH and STP OSU rec of 21, 10 applied
- 13: pH 6.9 and low STP OSU rec of 11, 8 applied ?
- 20: low pH and STP OSU rec of 25, 7 applied
- 24: pH of 6.8 and high STP. Olsen showed adequate
- 32: pH of 8 and low STP rec of 17, 8 applied broadcast
- 55: low pH and STP OSU rec of 32, 11 applied
- 56: low pH and STP OSU rec of 19, 11 applied
- 2012 P content increased at 4 sites, 2 had an increase in grain
- 2013 P content increased at 8 sites, 3 had an increase in grain

Potassium

Location	Soil Test Cl^-	STK	Farmer Applied K	K Strip Applied K	Farmer Practice	K Rich Strip
	0-15 cm	0-15 cm			Grain Yield	
	ppm	ppm	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
4	7.2	191.5	0.0	134	2366	3196
12	-	119	0.0	134	3679	4405

Location	Soil Test Cl^-	Soil Test Cl^-	STK	Farmer Applied K	K Strip Applied K	Farmer Practice	K Rich Strip
	0-15 cm	15-45 cm	0-15 cm			Grain Yield	
	ppm	ppm	ppm			kg ha^{-1}	kg ha^{-1}
33	11.4	15.8	169.5	0.0	134	2384	3109

Potassium

- 2 locations in 2012 below 100% sufficient
- 4 STK and Cl, if extrapolated, adequate Drought?
- 12 STK 98.8% suff. STP also below 100%
- 33 STK and Cl adequate Drought?
- No increase in K content

Sulfur

- Location 35, which had the minimum total SO_4-S level of 2013 harvested locations, had adequate S for a yield goal of 5376 kg ha^{-1} . Farmer practice produced a 3718 kg ha^{-1} grain yield.
- Grain S content increased at 4 and 1.
- Grain N content increase at 1 and 1,
  - Not the same site as S in 2013.
- Grain P content increased at 1 and 0 .
- 2012 The N and S were increased at location 4 and P and S were increased at location 9.

Results

- Education, Education, Education
- N, the N-Rich strip would have provided the answer at all locations.
- P, under application especially on low pH soils.
- Sale of P not recovered after the 2008 fertilizer price spike.
- K, 3 locations with no good answer.
- Could be genetics.
- S, Big push for S fertilizer, Big levels of soil S in Ok.
- Change, Most producers implemented changes next year.
- SOIL TEST, SOIL TEST, SOIL TEST
- Soil testing and OSU recs would have helped on P and provided guidance on S.

Thank you!!!

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