N-P-K-S Response Strips Applied on Farm Across Oklahoma

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Introduction

Both temporal and spatial variation play a major role in nutrient availability and improvement of current fertilizer application methods in winter wheat that could:

- 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 wheat grain prices.

However, the system had not completely recovered from the 08 price spike.

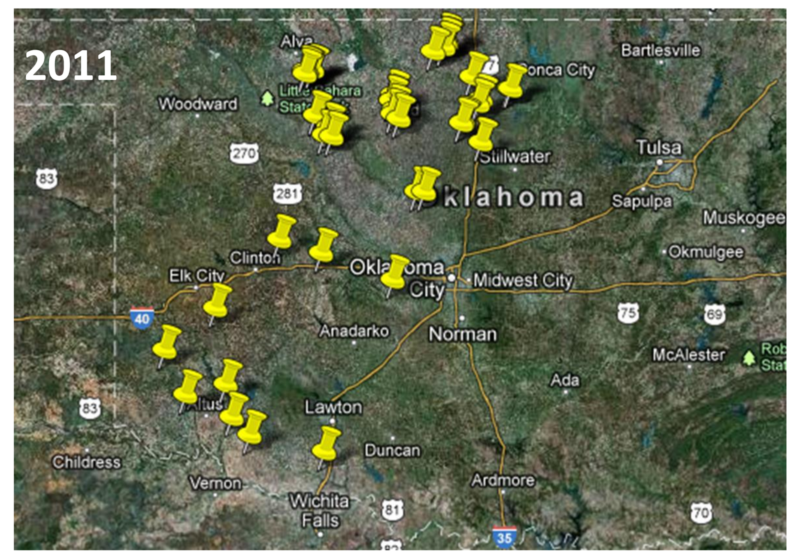
Objectives

- 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
- 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^{-1}
- 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
- 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

Figure 1. NPKS Applicator built by OSU Ag Engineering. Applicator used a PTO driven fan to blow fertilizer down boom and ground driven Gandy boxes to control fertilizer flow rate.



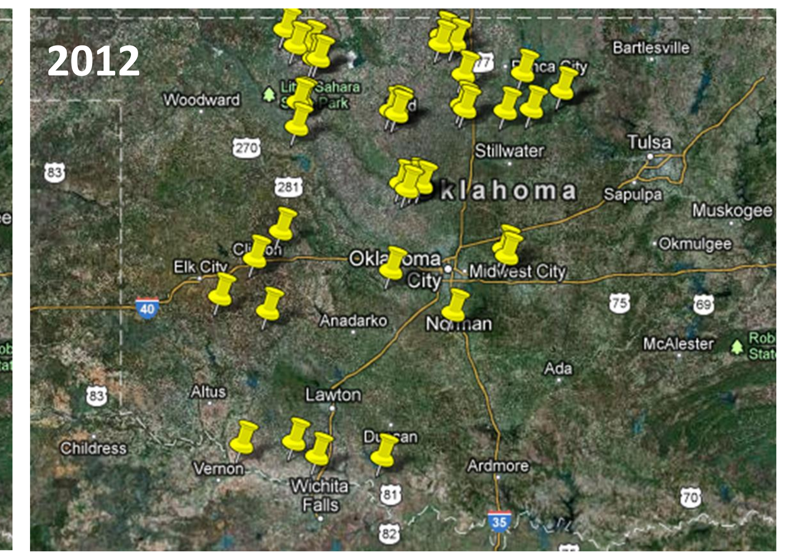


Figure 2 and 3. Locations were the NPKS response strips were applied in the falls of 2011 and 2012 respectively.

Results

Tables 1 and 2. Post-plant soil test results collected from all 80 locations. In 2012 Chloride analysis was added to explain response to 60-0-0.

2011	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

2012	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

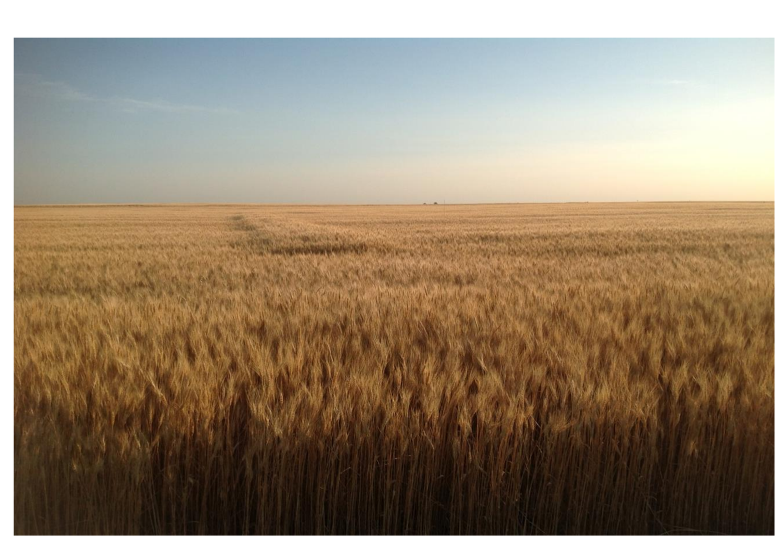
Nitrogen

Seven locations responded to additional nitrogen fertilizer

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
38	68.5	8.0	31.4	119.0	3083	4275
43	6.0	9.0	22.4	110.0	2954	5428

Nitrogen Discussion

- The average increase in yield over the 7 locations was 53.9%
- Lower N rates resulted in an average yield loss of 1377 kg ha^{-1}
- Locations 1, 14, and 43: Yield potential was under estimated and not enough N applied.
- Locations 8 and 24: No-till fields, Urea was N source, little to no rain fall except for a few small precipitation events (.2-.3 cm each). Nitrogen losses likely high.
- Location 30: Research station, no N applied in farmer practice.
- Location 38: Pre-plant soil test showed high level of residual N. Farmer cut back on pre-plant and due to late season drought did not top-dress.
- Grain N concentration increased at 22 locations
- Grain S concentration was increased at 14 locations



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Phosphorus

Seven locations responded to additional phosphorus fertilizer

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
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 Discussion

- The average increase in yield over the 7 locations was 30.9%
- Lower P rates resulted in an average yield loss of 772 kg ha^{-1}
- Of 31 locations receiving P fertilizer 22 had P applied with seed
- Locations 12,20, 55 and 56: Low soil pH and below sufficient STP. Producers applied below OSU recommend rate
- Locations 13 and 8: Producers applied below OSU rec rate
- Location 24: pH of 6.8 and high STP. Olsen showed adequate P
- Grain phosphorus content increased at 12 locations, 5 of which had an increased in yield

Potassium

Three locations responded to additional potassium fertilizer

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}
4	7.2		191.5	0.0	134	2366	3196
12	-		119	0.0	134	3679	4405
33	11.4	15.8	169.5	0.0	134	2384	3109

Potassium Discussion

- The average increase in yield over the 3 locations was 28.4%
- Not applying K fertilizer resulted in an average yield loss of 760 kg ha^{-1}
- Locations 4 and 33 adequate in K and Cl.
- Location 12, K level is 98.8% sufficient.
- Drought induced response?
- No increase in grain K concentration at any location.

Sulfur

No locations responded to additional sulfur fertilizer

Sulfur Discussion

- Location 35 had Lowest STS level 4.4 ppm in 0-15cm.
- Grain S increase at 5 sites while grain N was increased at 1 location.

Conclusions

- ***N*, the N-Rich Strip would have aided in identifying N deficiencies at all locations**
- ***P*, under application especially on low pH soils**
- ***K*, potentially drought and or genetics involved**
- **S, big push for S fertilizer sales, yet high levels of soil S in Oklahoma**
- **Soil testing and OSU recs would have helped on P and provided guidance on S**
- **Impact, most producers implemented changes in fertilizer management strategies the next year**