INFLUENCE OF FOLIAR SULFUR, CHLORIDE AND NITROGEN ON WINTER WHEAT GRAIN YIELD AND TOTAL NITROGEN

S. Dhital[1], B. Chim[2], J. Mullock[1], and W. Raun[1].
[1]Department of Plant and Soil Sciences, Oklahoma State University
[2]Department of Crop, Soil and Environmental Sciences, Virginia Tech

INTRODUCTION

Optimum use of nitrogen (N) is a key component in improving grain yield and quality in winter wheat (Triticum aestivum L.). The combined effect of other nutrients with N can have a positive impact on crop production. Use of sulfur (S) and chloride (Cl) with N could assist in optimizing wheat grain yield and grain protein.

OBJECTIVE

Determine the synergistic effects of foliar N, S, and Cl and the benefits of applying foliar N before flowering on winter wheat grain yields.

MATERIALS AND METHODS

- Three site-years: Lake Carl Blackwell (**LCB**, 2011) and Lahoma (**LAH**, 2011 & 2012).
- Treatment structure: RCBD with 4 replications and 16 treatments.
- Preplant N : Urea Ammonium Nitrate (UAN) 0, 40, 80 kg N ha^{-1}.
- Foliar N : UAN & NSURE (10 & 20 kg N ha^{-1}).
- S source: Gypsum (6 kg S ha^{-1}).
- Cl source: $CaCl_2$ (10 kg Cl ha^{-1}).
- All foliar ferilizers were dissolved in water and applied at flag leaf growth stage using CO_2 backpack sprayer.
- Soil level of Nitrate N, Ammonium N, Chloride and Sulfur were analyzed.
- Grain yield (**GY**) and total N (**TN**) determined in each plot.
- Data analyzed using non-orthogonal contrasts and Paired T-tests to determine effects of N, S, and Cl.

CO_2 Backpack Sprayer

Winter wheat at flag leaf stage, LAH (2012)

RESULTS

Table 1. Treatment means for grain yield and Grain N, LCB (2011), LAH (2011 & 2012), OK.

Foliar N Source	Preplant N	Foliar N	Foliar S	LCB, 2011		LAH, 2011		LAH, 2012	
	kg ha^{-1}			GY	TN	GY	TN	GY	TN
					%	kg ha^{-1}	%	kg ha^{-1}	%
Check	0	0	0	2025	1.44	1752	1.71	692	1.91
Check	40	0	0	2603	1.54	1851	1.77	1085	2.04
UAN	40	10	0	2812	1.65	2100	1.78	1147	2.06
UAN	40	10	6	2411	1.66	2190	1.73	1027	2.02
N-SURE	40	10	0	2708	1.71	2073	1.82	1144	1.98
UAN	40	20	0	2851	1.74	1926	1.78	1005	2.12
UAN	40	20	6	2738	1.75	2072	1.77	1070	2.20
N-SURE	40	20	0	2520	1.66	2489	1.81	1262	2.14
Check	80	0	0	2758	1.82	2604	1.90	1364	2.09
UAN	80	10	0	2343	1.58	2641	1.92	1445	2.08
UAN	80	10	6	2588	1.74	2907	1.87	1501	2.15
N-SURE	80	10	0	2236	1.74	2638	1.83	1416	2.16
UAN	80	10	0	3202	1.71	2292	1.93	1027	2.32
UAN	80	20	6	2497	1.86	2391	1.94	1359	2.29
N-SURE	80	20	0	2411	1.69	2701	1.96	1203	2.23
N-SURE	80	20	6	2605	1.77	2620	1.90	1383	2.22
			CV, %	11	6	15	4	18	5
			SED	131	0	115	0	72.83	0.20

SED - Standard error of difference between two equally replicated means
CV - Coefficient of Variance

- LCB (2011) had highest GY but lowest TN and LAH (2012) had lowest GY with highest TN (Table 1).
- Results for LAH (2011 & 2012) showed significant yield response to foliar Cl.

- Yield at LAH 2012 (Table 1) was lower due to a dry fall, poor plant stands and late spring freezes in February and March.

Wheat plant stand at Feekes 7 growth stage LAH (2012)

Feekes 3 growth stage, LAH (2011)

Feekes 4 growth stage wheat, LCB (2011)

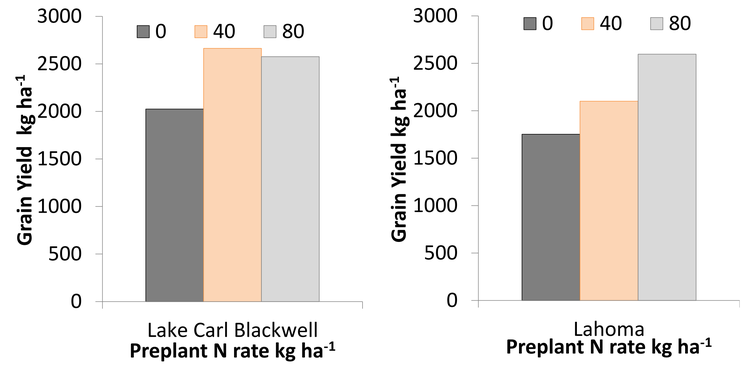

Figure 1. Grain yield response to preplant N rate, LCB and LAH, OK (2011)

- Quadratic increase in yield with increased preplant N rate at LCB (Figure 1).
- At LAH a linear increase in yield with increasing preplant N rate was observed for 2011 (Figure 1) and 2012.

Table 2. ANOVA , main effects and interactions of preplant N, foliar N, and foliar S on winter wheat grain yield and total N.

Sources of Variation	df	LAH (2011)		LCB (2011)		LAH (2012)	
		GY	TN	GY	TN	GY	TN
		P-value					
Pre N	2	<0.0001***	0.0007***	0.3911	0.0130*	0.1501	0.0533*
Fol N	2	0.3361	0.7951	0.761	0.234	0.84	0.0349*
Fol S	1	0.6617	0.3737	0.9064	0.1191	0.8796	0.789
Pre N *Fol N	2	0.6625	0.5171	0.9345	0.4441	0.9641	0.3301
Fol N *Fol S	1	0.5154	0.3659	0.8869	0.2548	0.7875	0.5169
Pre N *Fol S	1	0.852	0.5182	0.8889	0.8896	0.946	0.2709
Pre N *Fol N*Fol S	1	0.6486	0.9479	0.7886	0.8191	0.7101	0.8986

*,*** significant at P≤0.05, highly significant at P ≤0.05 and 0.01 respectively.

- Grain yield was significant with preplant N at LAH only (Table 2).
- Significant differences in total N as a function of preplant N and Foliar N were found at LAH (2012) (Table 2).
- Interactions between preplant N, foliar N, foliar S were not significant (Table 2).

CONCLUSIONS

- When grain yields were higher total N levels were lower.
- Response of preplant N observed at both locations.
- No response to Foliar S at both locations.
- Yield response to foliar Cl found at LAH only.
- Interactions were not significant.