IMPACT OF NITROGEN AND SULFUR FERTILIZATION ON WHEAT YIELD AND QUALITY IN 2006

E.M. Lentz and R.W. Mullen
The Ohio State University/Ohio Agricultural Research and Development Center

Introduction

Historically, wheat has not responded to supplemental sulfur (S) on fine to medium textured soils with adequate organic matter. However, improved sulfur scrubbers in the industrial sector have decreased the amount of S contributed annually by rainfall. Annual S deposition in Ohio has decreased by 50% over the last twenty-seven years (NADP, 2005). This may lead to greater demand for S in Ohio crops. Recent Ohio research showed a positive response to ammonium sulfate but did not have the parameters to establish whether it was from the S alone or from a N source less prone to loss than urea-ammonium nitrate (UAN) or urea (Lentz, 2003).

The objective of this work was to compare the impact of S as well as N application timing and source on wheat grain yield and quality. This article only discusses results from 2006; 2005 results may be found in previous proceedings (Mullen and Lentz, 2005).

Materials and Methods

In fall 2005, 'Hopewell' (a soft red winter wheat) was planted into an undisturbed soil of recently harvested soybeans at the Ohio State University/Ohio Agricultural Research and Development Center's Northwest and Western Research Stations near Hoytville and South Charleston, Ohio, respectively. Soil types were clay for the northwest site and silt loam for the western site. Soil phosphorus, potassium and pH were in the optimal range for wheat as described in the *Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat & Alfalfa* (1996). Prior to planting, 30 lb/A of N was surface applied as UAN. Treatments received 80 lb N/A and 20 or 40/A of S from the following blends: ammonium sulfate/urea, gypsum/urea, and ammonium sulfate/UAN. Checks included a zero spring N rate, 80 lb N/A as urea, and 80 lb N/A as UAN. All treatments were surface applied as a single application at green-up or early stem elongation (Feekes 6) (Large, 1954). In addition, a N response curve was established with UAN at 20 lb increments (40 to 120 lb N/A) applied at green-up.

Flag leaves were collected to determine N and S content at flowering (Feekes 10.4). Plots were approximately 10 feet wide and 75 feet long. Row spacing was 7.5 inches. The center five feet of each plot was harvested to estimate grain yield. The USDA soft wheat quality laboratory in Wooster, OH determined test weight and flour protein. Experimental design was a two factor, completely randomized block with four replications.

Results and Discussion

Wheat Grain Yield

Significant responses to N rate of application were observed at both locations (Tables 1 and 2). At both locations, all measured parameters increased as N application rate increased suggesting that N may have been limiting even at the highest rate. This may reflect significant loss of N after application, particular at the Northwest site. This would indicate that the 80 lb N/A rate used for the S treatments should not mask S benefits.

Differences among N and/or N-S sources were significant only at the Northwest location (Table 3). Sulfur treatments were not significantly less than the urea treatment at this location. At this site, the UAN treatment was significantly less than all treatments except for the 20 lb/A S treatment of UAN-ammonium sulfate In general, the UAN treatments had lower yields at this site, except for the 40 lb/A UAN-ammonium sulfate S treatment, which would have had more ammonium sulfate as a N source than the 20 lb rate. The lower yield of UAN to S treatments, but not urea would suggest a possible N loss rather than a S benefit for yield differences.

Only the Northwest site responded to application time (Tables 3 and 4). Even though actual yield difference was small between application times, it was significant. Loss of N, may account for the lower yield at greenup.

Grain Test Weight

Sulfur fertilization did not impact grain test weight at the either location (Tables 3 and 4, data not shown for Western). Applying N later significantly increased test weights at both locations (Tables 3 and 5). There were no interactions between N/S source or application time at either location.

Grain Protein

Sulfur fertilization did not affect grain protein at either location (Tables 3 and 4, data not shown for Western). Protein was increased at both sites at the later application time. There were no significant interactions at the Northwest location for N/S Source and application time. However, there was a significant interaction at the Western location.

Conclusions

The N response portion of the experiment did not appear to supply enough N at green-up to ensure N, especially at the Northwest location. This may be partially due to N loss with such an early application time and potentially due to the UAN source. Yield and grain quality were not affected by supplementing spring N with S. Grain yield was increased by delaying spring N at the Northwest location, but not at Western. Application time effects on yield may be dependent upon weather related N loss. Later applications of N may improve test weights and protein levels.

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Table 1. Main effect of N rate on wheat grain yield, test weight, grain protein, Northwest OARDC Research Station, Hoytville -- 2006.

N Rate	Grain Yield	Test Weight	Grain Protein
---lb/A---	---bu/A---	---lb/bu---	---%---
0	55	59.3	6.8
40	71	59.5	6.8
60	73	59.8	6.8
80	86	60.4	7.2
100	88	60.1	7.1
120	93	60.7	7.5
Contrasts			
Linear	**	**	**
Quadratic	NS	NS	NS

**, **, NS – significant at the 0.01, 0.05 probability level and non-significant

Table 2. Main effect of N rate on wheat grain yield, test weight, grain protein, Western OARDC Research Station, South Charleston -- 2006.

N Rate	Grain Yield	Test Weight	Grain Protein
---lb/A---	---bu/A---	---lb/bu---	---%---
0	55	60.8	6.1
40	74	61.3	6.1
60	84	61.9	6.3
80	90	61.7	6.3
100	92	61.9	6.5
120	97	62.0	6.7
Contrasts			
Linear	**	**	**
Quadratic	**	NS	*

**, *, NS – significant at the 0.01, 0.05 probability level and non-significant

Table 3. Analysis of variance table for the effects of N source and Time of N application on grain yield, test weight and protein at the Northwest and Western OARDC Research Stations, Hoytville and South Charleston, respectively -- 2006.

	Grain Yield	Grain Test Weight	Grain Protein
	---bu/A---	-----lb/bu-----	----%----
N Source			
Northwest station	**	NS	NS
Western station	NS	NS	NS
Application Time			
Northwest station	*	**	**
Western station	NS	**	**
Source X Time			
Northwest station	NS	NS	NS
Western station	NS	NS	*

**, *, NS – significant at the 0.01, 0.05 probability level and non-significant

Table 4. Response of grain yield, test weight and protein to N and S source at the Northwest OARDC Research Station, Hoytville – 2006.

N/S Source	Grain Yield	Grain Test Weight	Grain Protein
	-bu/A-	--lb/bu--	%
Urea	91.9	60.5	7.3
Urea-ammonium nitrate	85.6	60.5	7.3
20 lb S/A			
Urea/ammonium sulfate	92.0	60.4	7.1
Urea-ammonium nitrate/ammonium sulfate	88.1	60.3	7.2
Urea/gypsum	89.5	60.2	7.2
40 lb S/A			
Urea/ammonium sulfate	91.9	60.3	7.3
Urea-ammonium nitrate/ammonium sulfate	91.5	60.3	7.2
Urea/gypsum	92.7	60.3	7.3
lsd (0.05)	3.0	NS	NS

Table 5. Response of grain yield, test weight, and protein to application time of spring N-S at the Northwest and Western OARDC Research Station, Hoytville and South Charleston, respectively – 2006.

Application Time	Grain Yield	Grain Test Weight	Grain Protein
	-bu/A-	--lb/bu--	%
Northwest Station	**	*	**
Initial Greenup	89.6	60.2	7.1
Early stem elongation (Feekes GS 6)	91.2	60.5	7.4
Western Station	NS	**	**
Initial Greenup	93.8	62.1	6.6
Early stem elongation (Feekes GS 6)	94.2	62.6	7.1

** P< 0.01; * P< 0.05

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Program Chair:
Dale Leikam
Kansas State University
Manhattan, KS
(785) 532-6183
dleikam@ksu.edu

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Potash & Phosphate Institute
772 – 22nd Avenue South
Brookings, SD 57006
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