INFLUENCE OF SULFUR SOURCE ON CORN[1]

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INTRODUCTION

Sulfur is an essential plant nutrient. Medium and fine texture high organic matter soils in South Dakota usually supply adequate levels of sulfur to plants. Very sandy soils are less capable of supplying sulfur to plants but even these soils usually provide adequate sulfur for plant needs. However, in recent years above average precipitation may have caused leaching of sulfur, possibly resulting in sulfur deficiencies. In addition, spring soil temperatures have stayed cool, likely slowing decay of soil organic matter and crop residue, further reducing the available sulfur supply to plants. The increased acceptance of no-till and its' increase in surface residue cover has also increased soil moisture and reduced soil temperatures.

The objectives of this study were to determine 1) if recent environmental conditions and their impact on available sulfur were causing sulfur deficiencies and 2) if sulfur source would influence sulfur uptake by corn or grain yield.

MATERIALS AND METHODS

Five experimental sites were selected on farmer cooperator fields (Table 1). Soils at the sites ranged from loamy fine sand to silt loam. Two sites were classified as very fine sandy loam. The sand and two sandy loam sites were chosen since these soil types would more likely respond to added sulfur than heavier soils.

All sites were planted to corn by the farmer cooperators. Sulfur treatments were applied on the soil surface on May 20 which was just prior to, or at corn emergence. No tillage was done after application. Three of the sites (Sperry, Locken, Leonhart) were no-till. A general rain across the area occurred on May 22 (.50 in) and again on June 2 (1–2 inches). Rainfall continued on a regular basis and moisture conditions were excellent the entire growing season.

The sulfur treatments consisted of two rates (0 and 40 lb/a sulfur) and three materials: 1) ammonium sulfate (21-0-0-24), 2) ammonium thiosulfate (12-0-0-26) and 3) elemental sulfur (90% S). The ammonium sulfate and elemental sulfur were spread on the surface by hand and the ammonium thiosulfate broadcast on the surface with a hand sprayer. Nitrogen was balanced across the treatments with ammonium nitrate. Plot size was 20 feet by 40 feet. All treatments were replicated four times in a Latin square design.

Leaf tissue samples (leaf opposite and below top ear) were taken at silking from all plots for sulfur analysis. Grain yield was determined by hand harvesting 60 feet of row per plot.

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RESULTS AND DISCUSSION

Sulfur analysis on soil samples taken at fertilization show the test to be in or very close to the medium range (according to SDSU Fertilizer Recommendations guide) at the Sperry and Leonhart sites (Table 2). Because these are medium textured soils at the surface, recommendation for sulfur on a trial basis would have been made by the SDSU soil testing lab. The remaining three sites had very high sulfur soil tests and no sulfur fertilizer would have been recommended. The very high soil test at the Locken and Clark sites is typical of the heavy soils in the Jim River Valley of South Dakota. These two sites also had extremely high sulfur tests (888 and 1500 lb/a ft) in the 2 to 3 foot deep soil layer.

Observations during the growing season showed some striping of leaves just prior to and at tasseling at the Sperry and Locken sites in the check and elemental sulfur treatments. It appears the striping was due to sulfur deficiency since the symptoms were much less pronounced or nonexistent in the ammonium sulfate or thiosulfate treatments. Elemental sulfur was not likely to give a response when left on the soil surface since it must be oxidized by microbial activity to sulfate sulfur to be available to plants. This conversion would be very slow when this material is left on the soil surface. Sulfur from both ammonium sulfate and ammonium thiosulfate would move into soil with water and be readily available to plants.

Observations at the Leonhart and Clark sites showed no visual sulfur deficiencies or response to the applied sulfur. At the Traxinger site however, early observations (June 17) showed increased plant size and greener color in the ammonium sulfate and thiosulfate treatments. Similar observations were made at silking. Striping was not observed at this site during the growing season. Similar to the Sperry and Locken sites, the elemental sulfur spread on the surface had no effect on plant growth.

Leaf tissue analysis was consistent with visual observations in that the Sperry and Locken sites exhibited significant (0.10) treatment effects (Table 3). Overall, sulfur source influenced ear leaf S concentrations as: check = Elemental < NH_4SO_4 =ThioSO_4. The ear leaf tissue concentrations from the check treatment were lower than the sufficiency level from the SDSU Soil and Plant Analysis laboratory (0.15%) at all sites except the Clark location. Addition of 40 lb/a of sulfur from NH_4SO_4 or ThioSO_4 increased leaf S levels to or above the sufficiency level at each of these sites.

Grain yield was excellent and averaged about 150 bu/a across all sites (Table 4). Grain yield was not significantly affected by sulfur at the Sperry, Locken, Leonhart and Clark locations. The early observations of sulfur response at the Sperry and Locken sites did not follow through to yield. This may have been due to plants having access to sulfur deeper in the soil profile later in the season and mineralization of organic sulfur in soil. There was a trend toward increasing yield with sulfur at the Traxinger site (Pr > F .08) although it was not clear since one of the available sulfur sources (thiosulfate) gave a large yield increase while ammonium sulfate did not. This site was the most likely location to have a response to sulfur since it was the most coarse textured and lowest organic matter soil of the five sites.

CONCLUSIONS

These five sites appear to substantiate past experience and experimental data showing that plants most likely to respond to direct sulfur additions are grown on low organic matter, sandy soils. Heavier soils with higher organic matter, even though they may be lower in soil test sulfur earlier in season, are able to supply adequate sulfur to plants for maximum yield.

There was little relationship between S deficiency symptoms, leaf S or soil test SO_4-S and yield response from added sulfur.

Table 1. Soil Type on Sulfur Experimental Sites, Brown Co. 1997

	Soil	
Site	Name	Texture
Sperry	Eckman-Gardena	very fine sandy loam
Locken	Beotia	silt loam
Leonhart	Eckman Gardena	very fine sandy loam
Clark	Great Bend-Putney	silt loam
Traxinger	Towner-Hecla	loamy fine sand

Table 2. Soil Test Levels at Brown Co. Sulfur Study Sites, 1997

	Site				
Soil Test[1]	Sperry	Locken	Leonhart	Clark	Traxinger
Sulfate, lb/a					
0 - 1 ft	22	90	22	116	30
1 - 2 ft	4	36	8	144	24
2 - 3 ft	16	888	80	1500	136
Total	42	1014	120	1760	190
NO_3-N, lb/a 2 ft	84	133	46	86	32
Olson P, ppm	20	16	11	8	6
K, ppm	600	572	336	592	273
OM, %	3.2	2.5	1.9	3.8	1.3
pH	6.3	6.5	6.6	6.9	6.2
Salts, mmho/cm	.50	.70	.40	.80	.40

[1] Sampled 5/20/97

Table 3. Sulfur Influence on Corn Ear Leaf Sulfur Concentration, Brown Co. SD, 1997.

Sulfur Source	Sperry	Locken	Leonhart	Clark	Traxinger	Mean
	site					
	%S					
Check	0.083	0.135	0.122	0.157	0.123	0.128
Elemental	0.102	0.145	0.140	0.148	0.118	0.127
NH_4SO_4	0.150	0.168	0.145	0.155	0.163	0.156
$ThioSO_4$	0.165	0.195	0.155	0.160	0.145	0.164
C.V. %	26.6	14.9	17.8	24.0	18.7	21.9
Pr. > F	0.021	0.067	0.372	0.96	0.112	0.0003
L.S.D. (0.05)	0.053	0.038	0.040	0.065	0.041	0.025

Table 4. Sulfur Influence on Corn Yield, Brown Co. SD, 1997

Sulfur[1] Source	Sperry	Locken	Leonhart	Clark	Traxinger	Mean
	Site					
	bu/a					
Check	160	180	148	149	115	150
Elem.	161	187	135	150	111	149
NH_4SO_4	173	181	144	151	117	153
Thio SO_4	163	178	147	148	124	152
C. V. %	6.3	3.5	6.0	5.0	5.6	5.1
Pr. > F	0.34	0.29	0.23	0.95	0.08	0.32
L.S.D. (.05)	16	10	14	12	13	14
Soil Test SO_4 lb/a 2 ft.	26	126	30	260	54	

[1] 40 lb Sulfur/a

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