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Sulfur Fertilizer Application to Corn and Soybean

John E. Sawyer
Iowa State University, jsawyer@iastate.edu

Daniel W. Barker
Iowa State University, dbarker@iastate.edu

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Abstract
Historically, sulfur (S) application has not been recommended on Iowa soils for corn and soybean production. Soil supply or combination from sources such as manure or precipitation has met crop S needs. However, soil S levels or supply may become depleted with prolonged crop removal, sulfate leaching, low precipitation deposition, and declining soil organic matter. The objective of this study was to determine if corn and soybean yields would respond to S fertilizer rate and material at multiple sites across Iowa soils and climatic conditions.

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John E. Sawyer, associate professor
Daniel Barker, research associate
Department of Agronomy

Introduction

Historically, sulfur (S) application has not been recommended on Iowa soils for corn and soybean production. Soil supply or combination from sources such as manure or precipitation has met crop S needs. However, soil S levels or supply may become depleted with prolonged crop removal, sulfate leaching, low precipitation deposition, and declining soil organic matter. The objective of this study was to determine if corn and soybean yields would respond to S fertilizer rate and material at multiple sites across Iowa soils and climatic conditions.

Materials and Methods

This study was conducted at six Iowa State University research and demonstration farms in 2000 and 2001. Calcium sulfate and elemental S fertilizers were broadcast-applied to corn and soybean at rates of 0, 10, 20, and 40 lb S/acre in the spring of 2000. The sulfur fertilizers were either incorporated with spring tillage or left on the soil surface if the site used no-till. Corn and soybean crops were rotated in each study area, and the residual response to S fertilizers applied in 2000 was measured in 2001.

A complete factorial arrangement of treatments was replicated four times in a randomized complete block design. Plot size was 15 or 20 feet wide (depending on location) by 50 feet long.

Corn ear leaf greenness was measured with a SPAD chlorophyll meter at tassel (VT growth stage). The middle three to six rows (varied by location) were harvested the length of the plots with plot combines. Grain yields were corrected to standard moisture. Soil samples were collected prior to planting at depths of 0–6, 6–12, 12–24, and 24–36 inches and analyzed for sulfate-S.

Results and Discussion

Sulfur fertilizer applied in 2000 had no statistically significant effect on corn or soybean grain yield at any site in 2001 (Tables 1 and 2). Corn ear leaf greenness did not change by S applications at most locations. Ear leaf greenness did increase with CaS compared with elemental S at the Ames location (Table 3), although the difference was small and the SPAD readings were high for both sources.

High winds and plant lodging may have contributed to variability in corn yields at Kanawha. At Ames, corn plants showed early season yellowing and leaf striping on the zero-rate plots. However, visual symptoms disappeared as the season progressed and did not result in yield difference.

Soil sulfur levels (extractable sulfate-S by the monocalcium phosphate method) in the spring of 2000 were variable between sites and depths (Table 4). Although extractable levels in the 0-6 inch depth at several sites were lower than reported critical levels, there was no response in crop yield. This illustrates a common result in S research trials—that soils high in sulfate-S levels indicate no response to applied S. At the same time, low sulfate-S levels cannot reliably predict a response to applied S.

Lack of grain yield increase to applied S measured both years in this study is consistent with results of previous work conducted in Iowa.

Acknowledgments

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Table 1. Effect of sulfur source and rate applied in 2000 on corn grain yield in 2001.

	Ames		Atlantic		Crawfordsville		Doon		Kanawha		Castana	
S Rate	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S
lb S/acre	bu/acre											
0	159	159	147	147	118	111	145	142	164	173	--	--
10	154	156	145	152	110	109	138	141	169	177	--	--
20	158	164	148	147	113	117	141	138	175	177	--	--
40	155	153	147	147	118	108	143	144	180	166	--	--
	NS		NS		NS		NS		NS		--	

CaS = calcium sulfate; S = elemental sulfur; sulfur fertilizers applied spring 2000.
NS: not significant at the 0.05 probability level.
Iowa State University, 2001.

Table 2. Effect of sulfur source and rate applied in 2000 on soybean grain yield in 2001.

	Ames		Atlantic		Crawfordsville		Doon		Kanawha		Castana	
S Rate	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S
lb S/acre	bu/acre											
0	40.3	38.3	46.7	43.9	54.8	54.5	44.8	44.2	53.5	53.7	44.3	43.1
10	40.5	40.2	44.7	45.0	54.7	54.5	43.2	43.4	52.6	52.3	44.5	46.5
20	39.4	41.1	45.5	46.5	56.5	57.1	42.3	43.6	51.4	52.7	42.7	47.3
40	39.4	39.5	45.8	46.4	54.3	54.2	40.9	44.6	51.8	52.3	44.0	40.3
	NS		NS		NS		NS		NS		NS	

CaS = calcium sulfate; S = elemental sulfur; sulfur fertilizers applied spring 2000.
NS: not significant at the 0.05 probability level.
Iowa State University, 2001.

Table 3. Effect of sulfur source and rate applied in 2000 on corn ear leaf greenness (VT stage) in 2001.

	Ames		Atlantic		Crawfordsville		Doon		Kanawha		Castana	
S Rate	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S	CaS	S
lb S/acre	SPAD Units											
0	62.0	61.9	59.7	58.1	62.3	63.0	61.2	60.7	63.4	64.4	--	--
10	62.6	61.9	59.7	60.8	63.1	62.8	61.4	60.8	63.7	62.3	--	--
20	63.7	62.3	56.8	60.8	61.7	60.6	60.4	61.0	63.2	63.5	--	--
40	63.0	61.2	59.9	58.2	62.0	62.0	61.3	61.3	63.5	63.6	--	--
	*		NS		NS		NS		NS		--	

CaS = calcium sulfate; S = elemental sulfur; sulfur fertilizers applied spring 2000.
*significant material effect ($P \leq 0.05$) NS: not significant at the 0.05 probability level.
Iowa State University, 2001.

Table 4. Extractable S concentration by the monocalcium phosphate sulfate-S soil test method, spring 2000.

Sample	Ames		Atlantic		Crawfordsville		Doon		Kanawha		Castana	
Depth	C	S	C	S	C	S	C	S	C	S	C	S
inches	ppm											
0-6	23	13	8	11	6	7	2	11	7	7	4	--
6-12	6	6	11	5	2	4	2	4	4	7	5	--
12-24	9	25	7	7	2	5	8	7	10	15	2	--
24-36	13	42	7	16	3	2	--	--	9	10	4	--

C = Corn; S = Soybean.
Soil samples collected spring 2000.
Iowa State University, 2001.