On-Farm Sulfur Fertilization of Alfalfa and Corn Demonstration Trials

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Introduction

In the past several years, sulfur (S) deficiency has been showing up more frequently in Iowa fields. Large yield response has especially occurred in corn and alfalfa fields in northeast Iowa. The increase in S response is thought to be partially due to Iowa receiving less S in the rainfall due to more stringent air pollution regulations, less S fertilizer applications, higher crop yields, and less widespread use of manure. Sulfur fertilizer applications can offer yield increases where S deficiencies are present. The objective of these trials was to evaluate potential for S deficiency and yield response in corn and alfalfa to S applications.

Materials and Methods

The response of alfalfa and corn to S application was investigated in seven alfalfa and alfalfa/grass hay fields and three corn fields in 2017 (Tables 1 and 2). None of the fields had a manure history. This was the first year sulfur was applied in alfalfa Trials 5, 6, and 7, and the second year of application in Trials 1-4. This was the first year of application in corn Trials 2 and 3. In corn Trial 1, sulfur was applied to one corn field with no manure history to test the response of corn to S in 2016, and the residual effect in the same field with corn in 2017.

In alfalfa Trials 1, 4, and 7, calcium sulfate (gypsum) was dribble-applied in mid-April prior to the first cutting at 17 lb S/acre. In Trial 2, calcium sulfate at three rates (14, 17, and 20 lb S/acre) were dribble-applied in mid-April prior to the first cutting. In Trial 3, calcium sulfate at three rates (14, 17, and 20 lb S/acre) were dribble-applied in mid-April prior to the first cutting and in early June prior to the second cutting. In Trial 5, calcium sulfate at three rates (9, 17, and 21 lb S/acre) were dribble-applied in mid-April prior to the first cutting. In Trial 6, calcium sulfate at three rates (9, 17, and 34 lb S/acre) were dribble-applied in mid-April prior to the first cutting. The first and third cuttings were evaluated for yield in Trials 1, 2, and 3, but only the first cutting was evaluated in Trials 4, 5,and 6, and only the third cutting in Trial 7.

Calcium sulfate was applied in 2016 to corn at the rate of 32 lb S/acre in corn Trial 1 (Table 4). In corn Trials 2 and 3, calcium sulfate was applied to corn at V5 to V6 growth stage at 17 lb S/acre. Strips receiving the S application were compared with untreated strips. All afalfa trials were conducted in northeast Iowa, and corn trials were conducted in southwest, north-central, and northeast Iowa.

All trials were conducted on-farm by farmer cooperators. Strips were arranged in a randomized complete block design with at least three replications per treatment. Strip size varied from field to field depending on field and equipment size. All strips were machine harvested for yield.

Results and Discussion

There was not a significant response to the S application in alfalfa Trials 1, 4, 5, and 6 (Table 3). There was a significant response to the application of 20 lb S/acre in Trial 2, and to the application of 17 and 20 lb S/acre in Trial 3 ($P \leq 0.03$). There also was a significant yield response to the application of 17 lb S/acre in Trial 7 ($P = 0.08$).

There was a significant yield increase of 11 bushels/acre in corn in Trial 1 with the application of 32 lb S/acre to the previous corn crop (Table 4). There also was a significant yield increase to the corn in 2016 to this application (data not shown). There was not a significant yield increase to the application of 17 lb S/acre in Trial 2, but there was a significant increase of 33 bushels/acre to this application in Trial 3. These results indicate there are alfalfa and corn fields in Iowa that could benefit from S application. However, as found in prior research, not all fields planted to alfalfa and corn will have a yield increase from S application. In prior research in Iowa, corn yield increase to a sulfur application varies, but has occurred about 50 percent of the time. Situations with a greater chance of S response include coarse textured, sideslope landscape position, eroded, low organic matter soils, reduced/no-tillage, high crop residue, no manure application, and no S applied in fertilizers. For more information on sulfur management see ISU extension publication CROP 3072 (http://www.agronext.iastate.edu/soilfertility/info/CROP3072.pdf).

NOTE: The results presented are from replicated demonstration trials. Statistics are used to detect differences at a location and should not be interpreted beyond the single location.

Table 1. Crop, planting date, and years of trial in the 2017 sulfur trials on alfalfa and alfalfa/grass hay.

Exp. no.	Trial	County	Crop	Planting date	Year
170801	1	Bremer	Alfalfa	4/4/15	2nd
170802	2	Fayette	Alfalfa	8/15/13	2nd
170803	3	Fayette	Alfalfa	8/15/13	2nd
170804	4	Floyd	Alfalfa	9/2/14	2nd
170805	5	Floyd	Alfalfa/grass	9/1/13	1st
170806	6	Floyd	Alfalfa/grass	9/22/15	1st
170809	7	Floyd	Alfalfa	9/2/14	1st

Table 2. Variety, row spacing, planting date, planting population, previous crop, and tillage practices in the 2017 sulfur trials on corn.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
170406	1	Wright	CropLand 3909mz	30	5/4/17	35,000	Corn	Conventional
170503	2	Hardin	Channel 209-51 VT2RIB	30	4/25/17	33,700	Soybean	Conventional
170604	3	Ringgold	Pioneer PI0825AM	30	5/7/17	31,000	Soybean	No-till

Table 3. Yield for on-farm sulfur on alfalfa and alfalfa/grass hay trials in 2017.

Exp. no.	Trial	Sulfur Rate (lb/ac)	Date of application	Yield (tons/ac) [a] 1st Cutting	3rd Cutting	Total	P-value (Total)[b]
170801	1	0		1.52 a	1.90 a	3.42 a	0.23
		17	4/11/17	2.14 a	2.71 a	4.85 a	
170802	2	0		3.78 a	1.20 a	4.98 a	0.03
		14	4/11/17	3.87 a	1.28 a	5.15 ab	
		17	4/11/17	3.73 a	1.49 a	5.22 ab	
		20	4/11/17	4.85 a	1.72 a	6.58 b	
170803	3	0		0.85 a	0.88 a	1.73 a	<0.01
		14	4/11/17 & 6/8/17	0.97 ab	1.10 ab	2.07 a	
		17	4/11/17 & 6/8/17	1.32 b	1.34 b	2.67 b	
		20	4/11/17 & 6/8/17	1.22 ab	1.43 b	2.65 b	
170804	4	0		2.59 a	-	2.59 a	0.54
		17	4/11/17	3.36 a	-	3.36 a	
170805	5	0		0.91 a	-	0.91 a	0.31
		9	4/23/17	1.44 a	-	1.44 a	
		17	4/23/17	1.27 a	-	1.27 a	
		21	4/23/17	1.36 a	-	1.36 a	
170806	6	0		0.79 a	-	0.79 a	0.18
		9	4/23/17	1.06 a	-	1.06 a	
		17	4/23/17	1.16 a	-	1.16 a	
		34	4/23/17	1.03 a	-	1.03 a	
170809	7	0		-	1.81 a	1.81 a	0.08
		17	4/15/17	-	2.13 a	2.13 a	

[a]Values denoted with the same letter within a trial are not statistically different at the significance level of 0.05.
[b]P-value = the calculated probability that the difference in yields can be attributed to the treatments and not other factors. For example, if a trial has a P-value of 0.10, then we are 90 percent confident the yield differences are in response to treatments. For P = 0.05, we would be 95 percent confident.

Table 4. Yield from on-farm corn sulfur trials in 2017.

Exp. no.	Trial	Sulfur Rate (lb/ac)	Application timing	Yield (bushels/ac) Sulfur	Control	Response	P-value[a]
170406	1	32	2016	264	253	11	0.01
170503	2	17	V6	238	240	-2	0.60
170604	3	17	V5	216	183	33	<0.01

[a]P-value = the calculated probability that the difference in yields can be attributed to the treatments and not other factors. For example, if a trial has a P-value of 0.10, then we are 90 percent confident the yield differences are in response to treatments. For P = 0.05, we would be 95 percent confident.