On-Farm Sulfur Fertilization of Corn, Soybean, and Alfalfa Demonstration Trials

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Introduction

In the recent past, sulfur (S) deficiency showed up more frequently in Iowa fields. Large yield response 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, soybean, and alfalfa to S applications.

Materials and Methods

The response of corn, soybean, and alfalfa/grass to S application was investigated in five cornfields, one soybean field, and one alfalfa field in 2019 (Tables 1 and 2). None of the fields had a manure history. This was the first year of S application in all trials.

In corn Trials 1 and 2, 30 lb/acre of S as gypsum was applied to corn at V3-V5 and compared with untreated strips (Table 3). In corn Trial 3, 20 lb/acre S applied preplant was compared with 20 lb/acre preplant plus 30 lb/acre at V3. In corn Trials 4 and 5, 17 lb/acre S at V3 was compared with no S. In Trial 6, 32 lb/acre of S to V6 corn in 2018 was applied and the effect of the S on the following soybean crop was compared with no S. In the alfalfa/grass mix trial calcium sulfate (gypsum) at two rates (20 and 30 lb S/acre), and ammonium sulfate (AMS) at 20 lb/acre were broadcast June 11 after the first cutting (Table 4). The second, third, and fourth cuttings were evaluated for yield. Strips with S were compared with untreated strips.

Most 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 corn Trials 1 and 5 (Table 3). In Trial 3, there was not a significant difference in yield between corn receiving the preplant application of 20 lb/acre S compared with the preplant application of 20 lb/acre plus 30 lb/acre at V3. There was a significant increase in yield of 4 to 18 bushels/acre with the S application in Trials 2 and 4 ($P \leq 0.10$). In Trial 6, there was not a significant response of the soybean to the S application of 32 lb S/acre in 2018, but there was a 15 bushel/acre increase in the corn yield in 2018 (data not shown). In the alfalfa/grass trial, alfalfa/grass that received the 20 lb/acre as AMS yielded more than the untreated strips. There was no yield increase in the second cutting with the other sulfur applications and no yield increase with any of the applications in the third and fourth cuttings. The alfalfa/grass that received 30 lb/acre S as gypsum and 20 lb/acre as AMS yielded significantly more than the untreated strips with the total yield. There was not a significant total yield increase with the application of 20 lb/acre S as gypsum.

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, corn, and soybean 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 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. Variety, row spacing, planting date, planting population, previous crop, and tillage practices in the 2019 sulfur trials on corn and soybean.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
190401	1	Wright	Dekalb DKC 55-53 Gen SS	30	4/23/19	35,000	Corn	Conventional
190403	2	Wright	Dekalb DKC 50-08 RIB	30	4/23/19	35,500	Corn	Conventional
190404	3	Wright	Dekalb DKC 50-08 RIB	30	4/23/19	35,500	Corn	Conventional
190501	4	Boone	Kruger 4912 VT2 RIB	30	4/23/19	34,000	Corn	Fall disk rip spring field cultivate
190502	5	Boone	Agrigold A6579 VT2 RIB	30	4/23/19	34,000	Corn	Fall disk rip spring field cultivate
190709	6	Washington	Merschmans Kennedy 1936E	15	6/6/19	155,000	Corn	No-till

Table 2. Crop, planting date, and years of trial in the 2019 sulfur trial on alfalfa/grass.

Exp. no.	Trial	County	Crop	Planting date	Year
190801	1	Bremer	Alfalfa/grass	5/4/18	1

Table 3. Yield from corn and soybean sulfur trials in 2019.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
190401	1	Sulfur at 30 lb/ac at V5	200 a	0.46
		No sulfur	198 a	
190403	2	Sulfur at 30 lb/ac at V3	179 a	0.10
		No sulfur	151 a	
190404	3	Sulfur at 20 lb/ac preplant	164 a	0.18
		Sulfur at 20 lb/ac preplant plus 30 lb/ac at V3	179 a	
190501	4	Sulfur at 17 lb/ac at V3	254 a	0.03
		No sulfur	250 b	
190502	5	Sulfur at 17 lb/ac at V3	248 a	0.24
		No sulfur	242 a	
190709	6	Sulfur at 32 lb/ac applied to corn in 2018	53 a	0.95
		No sulfur	53 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 for on-farm sulfur on alfalfa/grass trial in 2019 applied after 1st cutting 6/11/19.

			Yield (tons/ac)[a]				
Exp. no.	Trial	Sulfur source and rate (lb/ac)	2nd cutting	3rd cutting	4th cutting	Total	P-value (total)[b]
190801	1	Gypsum at 20	2.0 ab	1.2 a	1.2 a	4.4 bc	<0.01
		Gypsum at 30	1.9 b	1.5 a	1.3 a	4.8 ab	
		AMS at 20	2.5 a	1.2 a	1.4 a	5.1 a	
		No Sulfur	1.6 b	1.1 a	1.3 a	4.0 c	

[a]Values denoted with the same letter within a cutting 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.