On-Farm Sulfur Fertilization of Alfalfa and Corn Demonstration Trials

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Introduction

In the recent past, sulfur (S) deficiency showed up more frequently in Iowa fields. Large yield response occurred in corn and alfalfa fields, especially in northeast Iowa. The increase in S response is thought to be partially due to Iowa receiving less S in rainfall because of 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 six alfalfa fields and 10 corn fields in 2018 (Tables 1 and 2). None of the fields had a manure history. This was the first year sulfur was applied in alfalfa Trials 1, 2, 3, and 5, and the second year of application in Trials 4 and 6. This was the first year of application in all corn trials. In corn Trial 6, sulfur was applied to one corn field to test the response of corn to S in 2016, and the residual effect in the same field with corn in 2018.

In alfalfa Trial 1, calcium sulfate (gypsum) at two rates (17 and 34 lb S/acre), was broadcast May 1 prior to the first cutting (Table 3). In alfalfa Trials 2, 4, and 5, calcium sulfate was broadcast in mid- to late-April prior to the first cutting at 17 lb S/acre. In Trial 3, calcium sulfate was broadcast in early June prior to the second cutting at 17 lb S/acre. In Trial 6, calcium sulfate at three rates (14, 17, and 20 lb S/acre) was broadcast in late April prior to the first cutting. The first cutting was evaluated for yield in Trials 1, 2, and 6. The second and third cuttings were evaluated for yield in Trial 3. The first, second, and third cuttings were evaluated for yield in Trial 4, and four cuttings were evaluated for yield in Trial 5.

Calcium sulfate was applied preemergence to corn at the rate of 17 lb S/acre in corn Trial 1 (Table 4). In Trials 2, 3, and 4, calcium sulfate was applied to corn at V3-V4 at the rate of 17 lb S/acre. In Trial 5, elemental S was applied at 8 lb S/acre at planting to two corn hybrids. Calcium sulfate was applied in 2016 to corn at the rate of 34 lb S/acre in Trial 6. In Trial 7, calcium sulfate was applied to corn at the V6 growth stage at 34 lb S/acre. In Trials 8 and 10, calcium sulfate was applied at planting to corn at the rate of 17 lb S/acre. In Trial 9, calcium sulfate was applied prior to planting corn at the rate of 17 lb S/acre. Strips receiving the S application were compared with untreated strips. Alfalfa trials were conducted in northeast and west central Iowa, and corn trials were conducted in north-central, southeast, 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/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 in Trials 1, 2, and 6 (Table 3). There was a significant response to the application of 17 lb S/acre in Trials 3, 4, and 5 ($P \leq 0.08$). Yield response ranged from 0.7 to 2.5 tons/acre.

There was not a significant response to the S application of 17 lb S/acre in corn Trials 1, 2, 3, 4, 9, and 10 (Table 4). In Trial 5 there was not a significant response to the elemental S application at 8 lb S/acre at planting to either hybrid. In Trial 6, there was not a significant yield increase in corn in 2018 with the application of 34 lb S/acre to the 2016 corn crop. However, there was a significant corn yield increase to this application in 2016 and 2017 (data not shown). There was a significant yield increase of 15 bushels/acre with the application of 34 lb S/acre to V5 corn in Trial 7. There also was a significant yield increase of 28 bushels/acre to the application of 17 lb S/acre at planting in Trial 8.

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 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. Planting date and year of trial in the 2018 sulfur trials on alfalfa.

Exp. no.	Trial	County	Planting date	Year
180307	1	Monona	4/11/14	1
180809	2	Floyd	4/17/15	1
180810	3	Floyd	9/2/14	1
180811	4	Floyd	8/28/15	2
180819	5	Bremer	4/4/15	1
180820	6	Fayette	8/15/13	2

Table 2. Hybrid, row spacing, planting date, planting population, previous crop, and tillage practices in the 2018 sulfur trials on corn.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
180402	1	Wright	Nu Tech OA504	30	5/19/18	35,500	Soybean	Conventional
180403	2	Wright	Pioneer PO157	30	5/18/18	34,500	Soybean	Conventional
180404	3	Wright	AgriGold A629-22	30	5/19/18	35,000	Soybean	Conventional
180405	4	Kossuth	NuTech 504	30	5/10/18	35,000	Soybean	Conventional
180414	5	Wright	Prairie Hybrids 5787 & 6903	30	5/9/18	35,000	Corn	Conventional
180416	6	Wright	Dekalb DKC51-38RIB	30	5/8/18	34,500	Corn	Conventional
180709	7	Washington	Wyffels 7976RIB	30	4/26/18	35,900	Soybean	No-till
180802	8	Floyd	Phister 1740	30	5/17/18	32,000	Soybean	Chisel Plow
180804	9	Howard	Pioneer P9929 AMXT	30	5/17/18	36,000	Corn	No-till
180808	10	Floyd	Wyffels W2618RIB	30	5/7/18	36,000	Soybean	No-till

Table 3. Yield for on-farm sulfur on alfalfa trials in 2018.

				Yield (tons/ac)[a]					
Exp. no.	Trial	Sulfur rate (lb/ac)	Date of application	1st cutting	2nd cutting	3rd cutting	4th cutting	Total	P-value (total)[b]
180307	1	0		2.1 a				2.1 a	0.35
		17	5/1/18	3.0 a				3.0 a	
		34	5/1/18	2.9 a				2.9 a	
180809	2	0		2.5 a	-	-	-	2.5 a	0.27
		17	4/12/18	3.4 a	-	-	-	3.4 a	
180810	3	0		-	2.8 a	2.4 a	-	5.2 a	0.06
		17	6/8/18	-	3.4 a	2.5 a	-	5.9 a	
180811	4	0		2.5 a	2.1 a	1.8 a	-	6.4 a	0.06
		17	4/24/18	3.5 a	3.4 b	2.0 a	-	8.9 a	
180819	5	0		3.8 a	3.8 a	1.5 a	0.9 a	10.1 a	0.08
		17	4/27/18	4.4 a	4.3 a	2.1 a	1.2 a	12.0 a	
180820	6	0		4.0 a					0.39
		14	4/27/18	4.2 a					
		17	4/27/18	4.0 a					
		20	4/27/18	5.0 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 corn sulfur trials in 2018.

				Yield (bushels/ac)[a]			
Exp. no.	Trial	Sulfur rate (lb/ac)	Application timing	Sulfur	Control	Response	P-value[b]
180402	1	17	Preemergence	155	154	1	0.78
180403	2	17	V4	232	225	7	0.15
180404	3	17	V3	172	170	2	0.87
180405	4	17	V4	210	215	-5	0.50
180414	5a[c]	8	At planting	152	152	0	0.82
180414	5b[c]	8	At planting	136	141	-5	0.31
180416	6	34	2016	142	146	-4	0.29
180709	7	34	V6	236	221	15	0.02
180802	8	17	At planting	218	190	28	0.04
180804	9	17	Before planting	189	186	3	0.56
180808	10	17	At planting	181	175	6	0.20

[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.
[c]Hybrid was Prairie Hybrid 5787 in Trial 5a and Prairie Hybrid 6903 in Trial 5b.