On-Farm Sulfur Fertilization of Alfalfa and Corn 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 seven corn fields in 2016 (Tables 1 and 2). None of the fields had a manure history, and this was the first year sulfur was applied to all of the fields.

In alfalfa Trial 1, three rates of calcium sulfate (14, 17, and 20 lb S/acre) were dribble-applied in early April prior to the first cutting. In Trial 2, three rates of calcium sulfate (14, 17, and 20 lb S/acre) were applied in early April prior to the first cutting and in mid-May after the first cutting. In Trials 3 and 4, calcium sulfate was dribble-applied at 17 lb S/acre in mid-April prior to the first cutting. In Trials 5 and 6, calcium sulfate at 30 lb S/acre was applied in mid-June, four to six weeks prior to the second cutting. Each cutting was evaluated for yield in Trials 1, 2, 3, and 4, but only the second cutting evaluated in Trials 5, 6, and 7.

Sulfur was applied prior to corn emergence in corn Trials 2, 3, and 4 and at V1 to V5 growth stage in Trials 1, 5, 6, and 7 (Table 4). Calcium sulfate (gypsum) was dribble-applied to the soil at the rate of 17 lb S/acre in corn Trials 2, 3, 4, 5, and 6 and at 32 lb/acre in Trials 1 and 7. Strips receiving the S application were compared with untreated strips. Trials were conducted in southwest, central, 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, except alfalfa Trial 7, which was hand harvested.

Results and Discussion

There was a significant response to the S application with the second alfalfa cutting in Trials 1 and 4 (Table 3). The total yield for the season with the strips receiving S was not significantly higher than the untreated strips in any of the trials at $P = 0.05$, but there was a trend for a yield increase with several of the trials.

There was a significant yield increase of 16 to 26 bushels/acre in corn in Trials 1, 5, 6, and 7 with the application of 17-32 lb S/acre when corn was at the V1 to V5 growth stage (Table 4). There was a significant yield decrease of 12 bushels/acre in Trial 4 with the application of 17 lb S/acre to the soil prior to corn emergence ($P = 0.07$). 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, there has been a corn yield increase to a sulfur application about 57 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, 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.).

Table 1. Crop and planting date in the 2016 sulfur trials on alfalfa and alfalfa/grass hay.

Exp. no.	Trial	County	Crop	Planting date
160801	1	Fayette	Alfalfa/grass	8/15/13
160802	2	Fayette	Alfalfa/grass	8/15/13
160809	3	Floyd	Alfalfa/grass	9/2/14
160820	4	Bremer	Alfalfa	4/4/15
160416	5	Wright	Alfalfa/grass	2013
160417	6	Wright	Alfalfa	2013
160614	7	Cass	Alfalfa	2013

Table 2. Variety, row spacing, planting date, planting population, previous crop, and tillage practices in the 2016 sulfur trials on corn.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
160413	1	Wright	Croplan 4199 SSRIB	30	4/16/16	35,000	Corn	Conventional
160504	2	Story	Curry 729-96	30	4/19/16	35,000	Soybean	Spring field cultivate
160505	3	Story	Curry 729-96	30	4/19/16	35,000	Soybean	Spring field cultivate
160506	4	Story	Curry 729-96	30	4/19/16	35,000	Soybean	Spring field cultivate
160644	5	Pottawattamie	Epley E109R3-3000GT	30	5/8/16	30,600	Soybean	No-till
160656	6	Ringgold	Pioneer P15555CHR	30	5/6/16	32,000	Soybean	No-till
160401	7	Wright	Pioneer P9929AMX	30	4/16/16	35,000	Corn	Conventional

Table 3. Yield for on-farm sulfur on alfalfa and alfalfa/grass hay trials in 2016.

				Yield (tons dry wt/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]**
160801	1	0		1.21 a	1.07 a	2.54 a	1.96 a	6.78 a	0.14
		14	4/4/16	174 a	1.36 b	2.79 a	2.23 a	8.12 a	
		17	4/4/16	1.71 a	1.46 b	3.27 a	3.16 a	9.60 a	
		20	4/4/16	1.56 a	1.36 b	3.42 a	3.19 a	9.53 a	
160802	2	0		1.37 a	1.10 a	0.55 a	0.45 a	3.46 a	0.80
		14 + 14	4/4/ & 5/20	1.51 a	1.06 a	0.82 a	0.62 a	4.00 a	
		17 + 17	4/4 & 5/20	1.36 a	1.37 a	0.94 a	0.61 a	4.19 a	
		20 + 20	4/4 & 5/20	1.55 a	1.14 a	1.01 a	0.77 a	4.45 a	
160809	3	0		2.39 a	1.94 a	1.59 a	-	6.33 a	0.44
		17	4/19/16	2.47 a	2.40 a	1.85 a	-	6.87 a	
160820	4	0		4.02 a	2.96 a	1.30 a	2.24 a	10.51 a	0.21
		17	4/21/16	4.15 a	3.84 b	1.17 a	2.48 a	11.63 a	
160416	5	0		-	2.07 a	-	-	-	0.13
		30	6/13/16	-	3.36 a	-	-	-	
160417	6	0		-	1.8 a	-	-	-	0.38
		30	6/13/16	-	3.1 a	-	-	-	
160614	7	0		-	2.97 a	-	-	-	0.74
		17	6/13/16	-	3.33 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. For trials 5, 6, and 7, the value given is for the 2nd cutting, the only cutting where yields were measured.

Table 4. Yield from on-farm corn sulfur trials in 2016.

				Yield (bu/ac)			
Exp. no.	**Trial**	**Sulfur rate (lb/ac)**	**Application timing**	**Sulfur**	**Control**	**Response**	**P-value[a]**
160413	1	32	V1	234	208	26	0.02
160504	2	17	Pre-emergence	173	178	-5	0.60
160505	3	17	Pre-emergence	165	170	-5	0.41
160506	4	17	Pre-emergence	168	180	-12	0.07
160644	5	17	V5	210	185	25	<0.01
160656	6	17	V4	220	195	25	<0.01
160401	7	32	V1	230	214	16	0.04

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