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Corn Yield Response to Sulfur Applied with Nitrogen Fertilizer

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Abstract

The objective of this study was to evaluate the effect of nitrogen (N) with added sulfur (S) fertilizer on corn yield. The treatments included 1) a control with no sulfur and no nitrogen; 2) urea ammonium nitrate (UAN) (180 lb N/a; 0 lb S/a); and 3) UAN plus ammonium thiosulfate (ATS) (180 lb N/a; 15 lb S/a). Both the UAN and UAN+ATS were balanced to 180 lb N/a. These three treatments were evaluated at two locations in 2019 and three locations in 2020. Preliminary results show that yield trended upward with the application of nitrogen plus sulfur fertilization over N alone, and the potential response to S was affected by soil characteristics and S supply from irrigation water.

Keywords

sulfur, nitrogen, corn

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Summary

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Introduction

Nitrogen and sulfur are two essential nutrients for corn, and understanding the dynamics between these two nutrients is essential for optimizing corn production. Over the past decade, there has been much emphasis placed on sulfur deficiency. This is largely due to decreased atmospheric deposition and increased crop removal due to higher yields (Camberato and Casteel, 2017). With these deficiencies facilitating sulfur amendments to the soil, there is further interest in understanding how nitrogen and sulfur affect yield. The objective of this study was to evaluate corn yield with the application of nitrogen, with added sulfur.

Procedures

Field experiments were completed at two research locations in 2019 and three locations in 2020. Initial soil samples were taken prior to fertilization and were collected at the 0- to 6-in. and 0- to 24-in. and evaluated for various soil parameters (Table 1). Three treatments were evaluated, including 1) a control (No N/ No S); 2) urea ammonium nitrate (180 lb N/a; 0 lb S/a); 3) and urea ammonium nitrate plus ammonium thiosulfate (180 lb N/a;15 lb S/a). Both the UAN and UAN+ATS were balanced to a nitrogen rate of 180 lb N/a. The location near Rossville was irrigated with about 4.0 in. in 2019 and 2020; the Scandia location also received about 4.0 in. of irrigation water. Based on water analysis, these locations received about 5- to 10-lb of S with the irrigation water. The Belleville and Ashland locations were rainfed. Harvest grain weight, test weight, and moisture were used to calculate yield that was moisture-corrected to 15.5%. All statistical analyses were completed in SAS (SAS Institute, 2013) using the generalized linear mixed model (GLIMMIX) procedure.

Results

Initial results show the average corn yield increased significantly with UAN and UAN+ATS compared to the control treatment at all 5 locations and average across locations (Figure 1). The Ashland location in 2020 showed significant increases in yield with the UAN treatment and from the UAN+ATS treatment (Figure 1). The other locations didn't show a significant increase with sulfur application. This indicates that even though the application of sulfur is needed in many fields, corn may not always be responsive to S applications in all fields.

The non-responsive locations to the additional S with ATS generally have higher soil organic matter (OM), fine-textured soil, as well as higher cation exchange capacity (CEC) values (Table 1). Also, S supplied with the irrigation water was likely a key factor for locations that could be considered potentially responsive to S (low CEC, coarse-textured soil, and low OM) (e.g., Rossville). These results showed that irrigation water and soil characteristics can both contribute to S response in corn.

References

Camberato, J. and S. Casteel. 2017. Purdue University Department of Agronomy Soil Fertility Update Sulfur deficiency, pp. 1-6.

SAS Institute. 2013. The SAS system for Windows. Version 9.4. SAS Inst., Cary, NC.

Table 1. Location information and preliminary soil test results

		Profile (0–24 in.)				Surface (0–6 in.)			
Location	**Year**	**NO_3**	**NH_4**	**S**	**CEC**	**OM**	**Sand**	**Silt**	**Clay**
		----------- ppm -----------			Meq $100g^{-1}$	------------------ % ------------------			
Rossville*	2019	7.1	2.1	1.3	7.0	1.5	55	36	9
Scandia*	2019	5.9	4.0	6.2	17.2	3.4	15	65	20
Ashland	2020	10	3.1	2.3	7.8	1.4	68	24	8
Belleville	2020	11	7.3	4.3	24.5	2.8	14	62	24
Rossville*	2020	7.3	3.4	1.4	12.3	1.5	40	50	10

* Irrigated locations. Analysis of irrigation water showed some level of S supply.
CEC = cation exchange capacity. OM = organic matter.

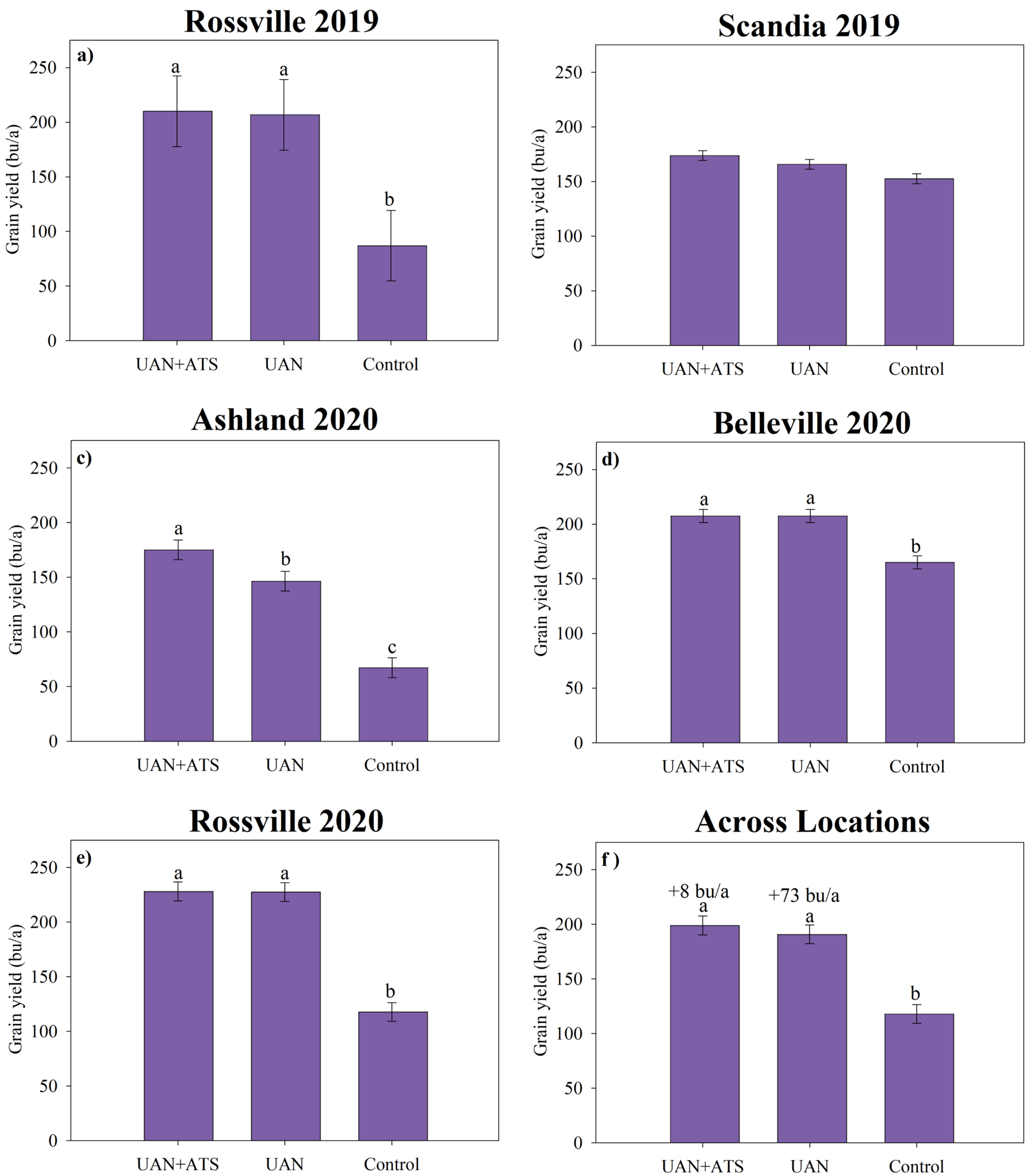

Figure 1. Grain yield for all five locations and average across locations in Kansas. Error bars indicate standard error of the mean and mean values followed by the same letter are statistically different (P < 0.05). Treatments: 1) a control with no sulfur and no nitrogen; 2) urea ammonium nitrate (UAN) (180 lb N/a; 0 lb S/a); and 3) UAN plus ammonium thiosulfate (ATS) (180 lb N/a; 15 lb S/a).