Effect of Nitrogen and Sulfur Interaction on Yield of Corn

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Sulfur and N fertilizer management can be improved to optimize corn yields. This is imperative because the market price of corn grain is currently very low, N requirement by corn is high, this fertilizer input is costly, and yield response to S is infrequent due to the influence of climatic factors, soil texture, and soil organic matter content. Furthermore, N as nitrate (NO_3) and S as sulfate (SO_4) are the two major plant nutrients susceptible to leaching. S fertilization enhancement of corn N use efficiency needs further verification, and therefore research needs to be conducted to assess the effect of their interactions on corn.

Objectives

(1) Determine S fertilizer recommendation on loam soil for optimum corn production
(2) Investigate the impact of S on N use efficiency of corn

Rationale

Farmers need a clear message to better decide whether regular application of S is needed, or if a more conservative approach may serve them better. At current grain prices, input cost management decisions are key for farmers to curb expenses.

Methods

This field trial was conducted on a strip-tilled loam soil at Forman (southeast North Dakota), and on a conventional-till loam at the Carrington Research Extension Center (CREC). A 93-day corn variety was planted at Forman, and an 83-day variety at Carrington. At Forman, N rates were 0 (control), 60, 120, 180, and 240 lbs N, and the S rates were 0, 10, and 20 lbs S/ac. At Carrington, N rates were 0, 55, 110, and 140 lbs N (corresponding to 0, 50, 100, and 125% respectively, of N recommendation for the site) and S rates the same as at Forman. Nitrogen adjustment was made to account for the N supplied with the S from ammonium sulfate (AMS). Urea was the source of N. Soil N before planting was 44 lbs. Experimental design was a randomized complete block. Fertilizer treatments were broadcasted on the surface without incorporation. Five replicates were used at Forman, and four at Carrington. Best management practices were employed.

Results

Effects of N and S treatments were statistically significant for grain yields and quality at Forman. At Carrington, neither N nor S resulted in any significant yield or grain quality response, but oil content did respond. Therefore, only the results from Forman are discussed. Interaction effects of N and S were not significant (Table 1). Sulfur resulted in yield increase at each N rate (Figure 1). Application of 10 or 20 lbs of S resulted in a similar yield increase of 12 bushels from the check. In a similar study conducted last year (Teboh et al., 2016 CREC Annual Report) average yield produced at 160 lbs N/ac was 200 bushels without S, which was significantly less compared to 243 bushels at 10 lbs S, and 246 bushels at 20 lbs S. Test weight increased with the application of S. The TWT at 20 lbs S was significantly greater than without S application. At 10 lbs S, TWT mean differences were not significant from the 0 or 20 lb rates. Ear leaf S concentration was significantly increased with 20 lbs addition of S. Application of N up to 120 lbs resulted in significant yield increases. Yields increased by 27 bushels from the control treatment at 60 lbs N, and by 17 bushels from 60 to 120 lbs N/ac. Grain protein and ear leaf N showed linear increase with N rates; meanwhile increasing N rates resulted in a linear decline in starch content of the grain. Leaf N and S increased with application of both N and S respectively. Improved N use efficiency at 10 and 20 lbs S was not clearly evident as we saw in 2016. Nitrogen on the other hand, had significant effect on ear leaf S content, showing a significant difference between 0 lbs and 240 lbs N.

Corn Yield Response to N and S at Forman, 2017.

N Rates	Yield	TWT	Protein	Starch	Oil
0	168c	55.0	7.48	72.64	3.61
60	195b	55.5	7.69	72.40	3.64
120	212a	55.8	7.79	72.35	3.62
180	212a	55.4	8.21	72.08	3.61
240	222a	55.4	8.39	71.91	3.61
S Rates					
0	196b	55.1	8.05	72.17	3.60
10	208a	55.5	7.86	72.30	3.63
20	208a	55.6	7.84	72.35	3.62

Effect	Pr > F				
N Rate (N)	<.0001	0.1121	0.0063	0.0136	0.9623
S Rate (S)	0.0031	0.0501	0.5484	0.5438	0.6323
NxS Rate	0.309	0.9045	0.2836	0.0799	0.2121

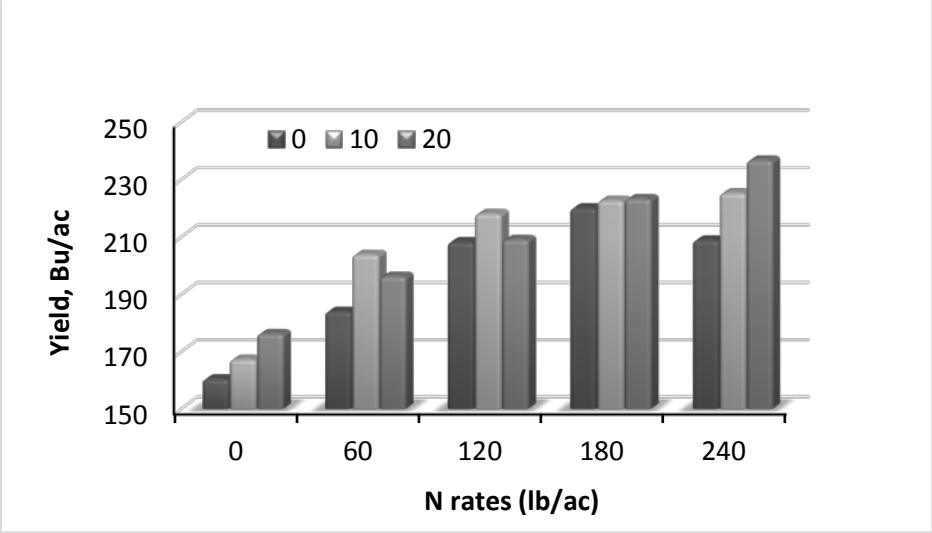

Figure 1. Corn yield response to N at three levels of S at Forman, ND.

Conclusion

Corn requires sulfur to optimize yields. It was evident from this study that application of S at 10 lbs should be enough to cause significant increase in corn yields in this loam soil. Similar to 2016, our results this year showed that yield differences were not significant between 10 and 20 lbs S. However, in years of heavy rainfall, or on sandy loams (or lighter soils with low organic matter) application of up to 15 or 20 lbs S would provide insurance to minimize S deficiency where corn yields are traditionally high, and when applied in the sulfate form. Application of 120 lbs N and 10 lbs S was enough to optimize yields at Forman.

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