Sulfur Fertilization for Corn

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Introduction

Iowa State University research has provided valuable information about phosphorus (P), potassium (K), and sulfur (S) management for corn and soybeans. Although there is a great deal of recent information for P and K, the research on effects of S on corn or soybean yield was conducted by the late Dr. John Webb during the 80s. Unpublished summarized information from long-term experiments conducted on five Iowa State University research farms (including one at the old Northwest Research Farm) showed no statistically significant response to S by either corn or soybeans. Almost a decade has passed since these experiments were conducted, however. Continuous crop removal of S may have reduced the soil capacity to supply S for crops. On the other hand, a marked reduction in S content of coal used in power plants, other industrial processes, and gasoline may have reduced atmospheric S inputs to soils. Moreover, no Iowa research has focused on the application of S combined with K or other nutrients. A study was initiated in 1995 at the Doon research farm to compare the influence of a S-K-Mg fertilizer (Sulpomag) on corn and soybean yields with the effects of either S or K fertilizer applied alone.

Description of the Study

This study was conducted from 1995 to 1999 in a Moody soil. Corn was grown in 30-inch rows each year in rotation with soybeans in two similar and adjacent experiments. The first year, in 1995, corn was planted in a single experiment. In 1996, soybeans were planted in the old experiment and corn was planted in a new adjacent experiment. Crops were alternated between both experiments until the 1999 season. Soil-test P of the sites varied from low to optimum and soil-test K varied from high to very high over the experimental area. Soil pH was slightly acid (6.5) and soil S was not measured. The treatments were applied only for corn and were reapplied each season. Only corn yields were evaluated. There were four treatments. One treatment (Sulpomag) consisted of 273 lb/acre of Sul-Po-Mag fertilizer, which has 22% S, 22% K_2O, and 11% MgO. Thus, this treatment applied 60 lb S/acre, 60 lb K_2O/acre, and 30 lb MgO/acre. The other three treatments were 60 lb S/acre as elemental S fertilizer (S), 60 lb K_2O/acre of potassium chloride fertilizer (K), and 60 lb K_2O/acre plus 60 lb S/acre (KS). These treatments were arranged as a completely randomized block design with four replications. All fertilizers were broadcast by hand and incorporated into the soils by disking in spring. All treatments received uniform rates of P and nitrogen (N) fertilizers.

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Results

The data in Table 1 show the corn yields (corrected to 15.5% moisture) observed from 1995 to 1999. In 1995, the three treatments that included S yielded slightly more than the K only treatment and did not differ among themselves. The average difference (6.5 bu/acre) was statistically significant at the 5% probability level. These results suggest that there was no response to the K or magnesium in the Sulpomag, and that any yield advantage of this fertilizer compared with the K only treatment was due to the S content.

The results for each of the other four years of research showed no statistically significant responses, however. The yield trends observed in these years were not consistent over time. For example, in 1997 and 1998 the results tended to be similar to the 1995 results. The treatment with only K was the lowest, and those with S were the highest. In 1996 and 1999, however, this trend was not observed. The Sulpomag and K treatments produced the lowest yields in 1996, and the K alone treatment produced the highest yield in 1999.

Table 1. Corn yield responses to S fertilization observed from 1995 to 1999.

	Growing season					
Treatment	1995	1996	1997	1998	1999	5-year mean
	---------- Corn yield (bu/acre) ----------					
Sulpomag	139.6	153.0	133.0	143.7	121.7	138.2
K + S	140.2	159.4	129.5	134.7	127.0	138.2
S	137.3	158.1	128.9	140.2	124.8	137.9
K	132.5	153.6	124.7	133.2	132.0	135.2
Statistics	*	NS	NS	NS	NS	NS

* = Significant response to S ($P \leq 0.05$) and NS = no significant difference.

Soil test S in the 6-inch layer of plots that received no S was low (5 to 8 ppm by the monocalcium phosphate extractant). Fertilization with the two S sources increased soil-test S to high levels (19 to 46 ppm). Soil testing for S is not a reliable diagnostic tool, however. Field response studies very often have shown no yield response of corn or soybeans in low testing soils. Many universities do not make S recommendations based on a soil test for S (including Iowa State University) or use it only for sandy soils.

A study of the five-year yield averages showed no statistical differences between treatments. However, the three treatments that included S produced slightly higher yields than the K alone treatment (2.9 bu/acre more). Although this difference could not be confirmed statistically, it agrees with the statistical difference observed in 1995 and with trends observed in 1997 and 1998. Moreover, the small difference still exists (2.1 bu/acre) when the 1995 data (the only year with statistically significant response) are not considered in the average.

Conclusions

The results of this five-year experiment showed that sulfur fertilization in soils similar to those in this study is likely to increase corn yields in some years, but responses will be small and inconsistent. The expected average response across many years will be about 3 bu/acre. This yield difference may or may not pay for the costs of the material applied. Producers should carefully consider expected grain prices, the cost of the S source used, and the application costs.