

Influence of Potassium, Sulfur and Zinc Fertilizer On Corn and Soybean Grown on High Testing Soil

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ABSTRACT

The influence of potassium, sulfur and zinc fertilizer on corn and soybean yields grown on high testing soils was studied at two locations in Eastern South Dakota over a period of six years. Treatments were 50 lb/a K₂O, 25 lb/a sulfur and 5 lb/a zinc. The treatments were applied to the same plots at each location every year. Soil test levels were in the high range for all elements in question and additional nutrients would not have been recommended by the South Dakota State University Soil Testing Lab. There was no significant (.05 level) increases in yield of either corn or soybean at either location. These results were consistent with previous studies on high testing soils and current fertilizer recommendations made by South Dakota State University.

INTRODUCTION

Some farmers in South Dakota are using potassium, sulfur and zinc fertilizer on soils with high soil tests. Research by soil fertility staff at South Dakota State University during the last 30 years has not shown consistent economical responses to these fertilizer nutrients when soil test levels are high. The South Dakota State University Soil Testing Lab, therefore, does not recommend they be applied as fertilizer unless soil test levels are lower than critical levels. The studies reported on here were established to show the effects of each of these commonly used nutrients on corn and soybean yields when applied to high testing soils.

MATERIALS AND METHODS

Two experimental sites were established, one on the Southeast (SE) Experiment Farm near Beresford in 1988 and another on the agronomy farm near the South Dakota State University campus at Brookings in 1990. Fertilizer treatments have continued at each location on the same plots since establishment. A corn-soybean rotation was followed at both locations.

The soil at the SE farm site is an Egan silty clay loam. Egan soils are well drained soils formed in silty drift over glacial till. The soil at the Brookings Agronomy farm is classified as a Vienna loam. Vienna soils are well drained medium textured loam and clay loam soils formed from glacial till. Both soils are typical upland soils for their respective areas in the state.

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Fertilizer treatments were 50 lbs K₂O as 0-0-60, 25 lbs sulfur as ammonium sulfate on corn and elemental sulfur on soybean and 5 lbs zinc as zinc sulfate at both locations. The fertilizer treatments were applied each spring since the establishment year (1988 at Beresford and 1990 at Brookings) on the same plots. All fertilizer materials were broadcast and followed by field cultivation or disking for incorporation. Nitrogen and phosphorus were applied as needed according to soil tests. A randomized complete block design with four replications was used at both sites. Plot size was 15 by 50 feet at Beresford and 20 by 40 feet at Brookings.

Adapted corn hybrids and soybean varieties were planted in 30 inch rows. Weeds were controlled with herbicides and cultivation as needed. Yields were determined at Beresford by combine harvesting 3 rows 50 foot long per plot. At Brookings corn yields were determined by hand harvesting 40 feet of row per plot and soybeans were harvested with a small plot combine.

Soil was sampled each fall or spring prior to fertilization to a depth of 6 inches in all plots. The check and sulfur treatments were also sampled to a depth of 2 feet for sulfate sulfur and nitrate nitrogen.

RESULTS AND DISCUSSION

Soil test results from potassium, sulfur and zinc analysis for samples taken from 1991 to 1994 are summarized in table 1. Potassium soil tests were in the very high range (>160 ppm) and no response to potassium would be expected. The 50 pound annual application of potassium increased the soil test slightly at Beresford but had no measurable effect at the Brookings site.

Table 1. Soil Tests, Potassium, Sulfur and Zinc Studies, Beresford and Brookings, 1991 - 1994

Soil Test	Beresford		Brookings	
	Check	Treatment ¹	Check	Treatment ¹
Potassium, ppm ⁽²⁾	244	279	184	186
SO ₄ -S, lb/a-2 ft ⁽³⁾	48	78	26	38
Zinc, ppm ⁽²⁾	0.86	3.56	1.05	3.54

^{1/} annual application of 50 lb/a K₂O, 25 lb/a sulfur and 25 lb/a zinc, 1988-1993 at Beresford and 1990-1993 at Brookings.

^{2/} 1991 - 1994 average

^{3/} 1992 - 1994 average

The average sulfur soil test in the check treatment from 1991 - 1994 was in the very high range (>40 lb/a-2 ft) at Beresford and the medium range (20-26 lb/a-2 ft) at Brookings (Table 1). The sulfur soil test varied with climatic conditions however, and for one site year (Beresford 1994) the test was only 8 lb/a-2 ft. That low test was likely due to leaching of sulfate sulfur during the extremely wet years of 1992 and 1993. A recommendation for sulfur fertilizer on a trial basis would have been made for that site year. Otherwise no sulfur would have been recommended at either location by SDSU. The 25 pound sulfur applications increased the average sulfur soil test at both locations.

At the initiation of the study, the zinc soil test was in the high range (0.75-1.00 ppm) at Beresford and in the very high range (>1.0 ppm) at Brookings (Table 1). No zinc would be recommended for either location, however the 0.86 ppm test at Beresford was only slightly above a "medium" test level where a zinc recommendation would have been made for corn by South Dakota State University. Five pounds of zinc applied annually from 1988 at Beresford and 1990 at Brookings increased soil test levels more than 2.5 ppm at both locations.

Corn and soybean grain yields for both locations are listed in tables 2 and 3. Corn yields averaged close to 145 bu/a and soybean about 38 bu/a over both locations and all years except 1988 when there was extreme drought at Beresford and corn yields were less than 20 bu/a. The 1988 yields were not included in this paper.

Table 2. Corn and Soybean Grain Yields from the Potassium, Sulfur and Zinc Study on High Testing Soil, Beresford, SD, 1989-1994

Treatment	Bean 1989	Corn 1990	Bean 1991	Corn 1992	Bean 1993	Corn 1994
lb/a/yr	----- bu/a -----					
Check	24	99	30	147	43	161
50 Potassium	26	101	30	149	42	158
25 Sulfur	26	107	29	156	42	157
5 Zinc	25	102	31	144	44	163
Sig (.05)	NS	NS	NS	NS	NS	NS

TABLE 3. Corn and Soybean Grain Yields from the Potassium, Sulfur and Zinc Study on High Testing Soil, Brookings, SD 1990-1994

Treatment	Corn 1990	Bean 1991	Corn 1992	Bean 1993	Corn 1994
lb/a/yr	-----		bu/a	-----	
Check	154	56	143	39	166
50 Potassium	156	56	136	40	184
25 Sulfur	151	56	135	38	170
5 Zinc	152	58	137	38	171
Sig (.05)	NS	NS	NS	NS	NS

Although there were differences in actual measured yields between treatments in any given year, they were not significant (.05 level) at either location in any year. The variability, however has been interpreted by producers examining individual year data as yield increases when a given fertilizer treatment yield was higher than the check yield. Care must be taken to look at all years data before calculating profits. For example, the 1994 corn yield in the zinc treatment at Brookings was 5 bushels higher than the check (171 vs. 166 bu/a). When these same plots were in corn in 1992, the check yield was 7 bushels higher than the zinc treatment (143 vs 137 bu/a). When all six site years of corn are combined, both the check and zinc treatments averaged 145 bushels corn per acre.

The lack of yield increases from these nutrients at these locations was consistent with previous studies on high testing soils and with current fertilizer recommendations made by South Dakota State University.

More details about these studies can be found in annual progress reports published in the South Dakota State University Plant Science Department Soil/Water Science Research Technical bulletins number 99 (1991-1994) and number 97 (1990). In 1988 and 1989, the results were published in the South Dakota State University Plant Science Department Soil Fertility Progress Reports.

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