Corn Growth and Yield Response to Sulfur and Nitrogen Application on a Low-grade Slope with Eroded Soil

Szilvia Zilahi-Sebess and Jasper Teboh

A trial was designed to assess the effects of sulfur fertilization on corn grain yield at different rates of applied N on a field with a bi-directional gentle slope. Since adequate plant available sulfur is known to enhance N uptake, it was expected that adding sulfur fertilizer might interact with the crop's N response in a positive way.

Sulfur was applied as ammonium sulfate at 0, 10, 20, and 30 lbs S/ac, and N at 0, 100, and 150 lbs N/ac in a factorial arrangement with four replicates. There was a fourth N treatment with 175 lbs N/ac which was not paired with a sulfur treatment. There were 10 treatment combinations. Each plot had four rows that were 30 inches apart and 30 feet long. Phosphorus at 25 lbs/ac and 2 lbs/ac zinc were blanket-applied to each plot.

Yield results in Figure 1 show a consistent trend in N response, where yields were consistently higher at the rate of 100 lbs N than at 150 and 175 lbs N/ac. These numerical differences were however, non-significant (Table 1). There was no response to sulfur.

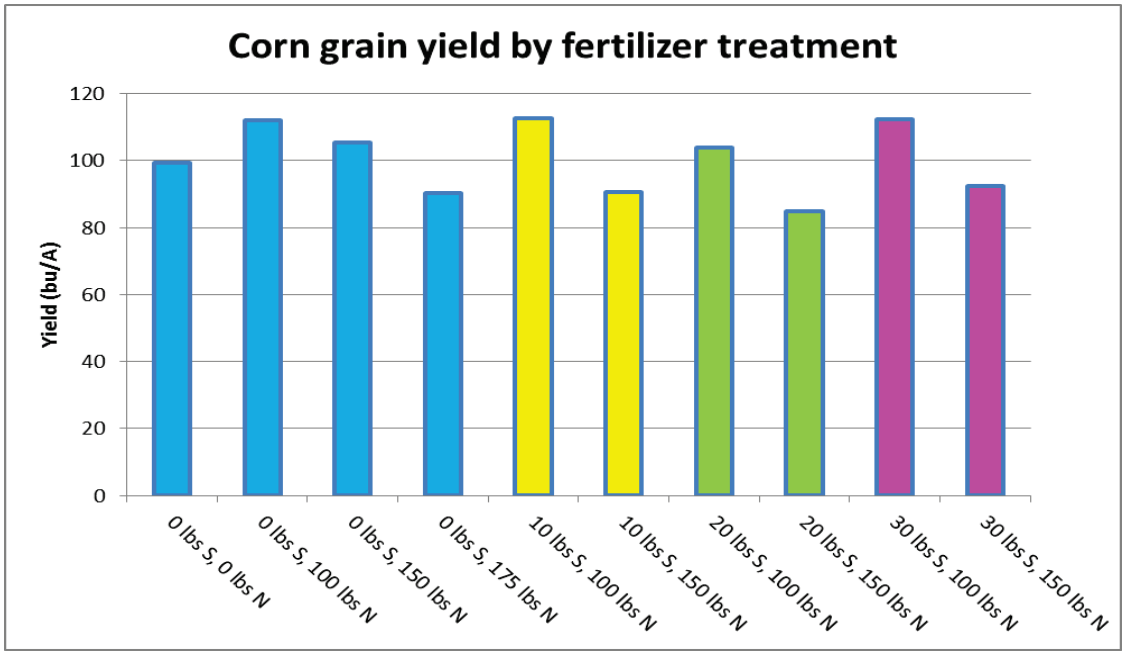

Figure 1. Corn grain yield response to combinations of sulfur and nitrogen fertilization. Differences are not significant.

Table 1. Yield response to sulfur and nitrogen fertilization of corn.

Trt no.	S Rate	N Rate	Yield
	lb/ac	lb/ac	bu/ac
1	0	0	99.3
2	0	100	112.0
3	0	150	105.4
4	0	175	90.2
5	10	100	112.8
6	20	100	90.5
7	30	100	104.0
8	10	150	84.8
9	20	150	112.3
10	30	150	92.3
C.V. (%)			37.37
LSD (0.1)			NS

After harvest, we measured the relative elevation of each plot to see whether that would help explain the high variability in the data and the lack of any significant yield response. We found that the steepest sloping point was still only 2.35 percent. However, the yields correlated very well with relative elevation (Figure 2). In fact, the yields were about 100 lbs higher at the foot of the slope than at the highest point (Figure 3).

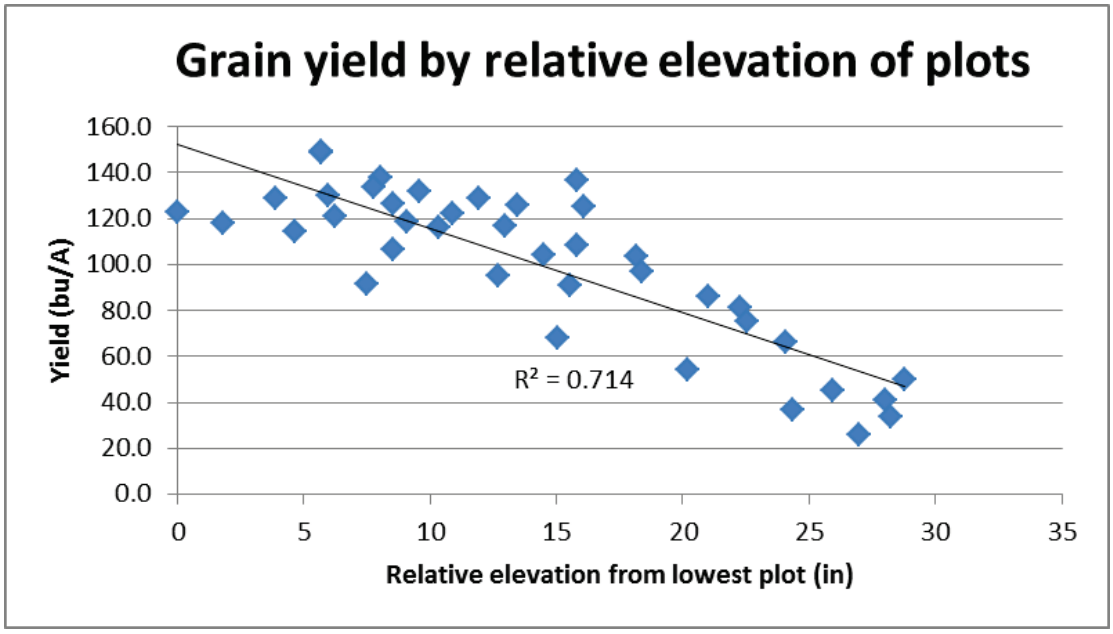

Figure 2. Correlation of grain yield to the relative elevation of each plot, where 0 inches represents the elevation of the lowest plot. Slope is significant at the 0.01 level.

Figure 3. Map of trial area drawn to scale. Each rectangle represents a plot showing yields and fertilizer applied. Colors represent elevation differences that are specified in the legend.

Shortly after harvest, we took a composite soil sample from the plots at the highest elevation (Figure 3) and compared it with the composite soil sample of the whole trial area before planting (Table 2). The high pH and low organic matter at the top of the slope indicated that most of the top soil is gone and the alkaline subsoil is exposed. Despite application of P and Zn to the plants at the V3 stage, the plants were showing P deficiency symptoms at the higher points of micro-elevation where the plants remained stunted in their growth.

Table 2. Comparison of two soil samples taken from the trial area.

	Composite soil of trial area	Highest point
Organic matter (%)	3.4	2.1
Phosphorus (ppm)	14	3
Zinc (ppm)	0.72	0.22
pH of 0-6 inches	6.6	8
pH of 6-24 inches	7.5	8.4

Soil samples taken at harvest from the high spot (Table 2) had very low levels of phosphorus and zinc despite spring fertilizer application which might indicate nutrient availability issues due to high pH. On an eroded soil like this one, there are other problems that could also affect plant growth, like the availability of moisture. A thin eroded soil might also have been more compacted from previous management, which would limit the plants' ability to grow a good root system. Since we saw yields decreasing with micro-elevation, it is reasonable to assume that there is also a gradient in soil quality along the slope lines. This emphasizes the necessity to soil sample based on landscape position and soil management history. Adding nitrogen, sulfur, phosphorus, and zinc could not restore yields on the most eroded areas. That section would likely have benefited from manure or compost application instead. The outcome of this trial shows that soil erosion is not just a problem of hilltops and can have a huge impact on yields.