Evaluation of Fertility Strategies Aimed at Enhancing Crop Production on a Hillside with Eroded Soil

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Soil erosion is a common problem on slopes and hilltops. Top soil is often lost very quickly from those areas. In theory, increasing fertility of such fields would add more organic matter and carbon to the soil, improving soil properties in the long run. For this reason, different strategies were employed on a hilltop of a farm in Hurdsfield, ND. As indicated by low organic matter, high pH and very light color, we presumed that most of the top soil was missing (N = 13.3, K = 422, S = 29.3, Zn = 0.7 lbs./ac, OM = 2.5%, and pH =8.3). The area was under no-till management during the time of observation. Ten treatments were applied before the 2014 growing season to increase yield and biomass. Yield data for the 2014 and 2015 growing seasons was collected. In the fall of 2013 manure was applied at three N rates (50, 100 and 150 lbs N/ac). A cover crop mix was applied that fall, but hardly any of it emerged. In the spring of 2014, before planting, the synthetic fertilizer treatments were applied. These treatments included nitrogen as urea, phosphorus as P_2O_5, sulfur as ammonium sulfate and zinc as zinc sulfate.

In 2014, the area was planted to spring wheat, and it was planted to black beans the following year. Yield data was collected in both years to assess the lingering effects of fertility treatments.

Results

There were significant differences between treatments in 2014 (Table 1). However, there was great variability in the data because soil fertility was strongly affected by the terrain. For this reason, multiple linear regression was used with the inclusion of range (slope position). It was found that the best predictors of yields in order of significance were fertilizer type (manure or synthetic), and range with yields increasing with manure application and decreasing with elevation. All other variables (N rate, P, S and Zn application) were excluded from the model using backward elimination. Therefore, it can be stated with confidence that manure, regardless of rates, made an impact on the yields, but the same cannot be stated about the other treatments.

Table 1. Treatment structure and yields of 2014 spring wheat and 2015 black beans.

Trt no.	Treatment name	N-rate	Sulfur	Zn	P	Spring wheat yield (bu/ac)	Black bean yield (bu/ac)
1	Check	0	10 lbs S	1 lb/A	20 lbs P	23.0	2.4
2	Urea 50	50	10 lbs S	1 lb/A	20 lbs P	30.7	2.2
3	Urea 100	100	10 lbs S	1 lb/A	20 lbs P	29.0	2.1
4	Urea 150	150	10 lbs S	1 lb/A	20 lbs P	35.6	2.8
5	Manure 50	50				38.0	3.6
6	Manure 100	100				42.8	2.9
7	Manure 150	150				48.9	2.7
8	Urea 150	150		1 lb/A	20 lbs P	24.1	2.1
9	Urea 150	150	10 lbs S		20 lbs P	35.9	2.3
10	Urea 150	150	10 lbs S	1 lb/A		27.3	2.1
C.V. (%)						25.9	42.8
LSD (0.05)						14.8	NS

Yields for black beans in 2015 had a high correlation with the spring wheat yields of 2014. Using multiple linear regression, it was found that type of fertilizer was still significant at the 0.1 level, and range was significant at the 0.05 level. This shows that the effect of manure, while it carried over slightly to the next year, was overshadowed by the fertility effect of slope position.

In effect, this means we were unable to make a lasting impact on yields and soil fertility with synthetic fertilizer. Manure treatments were the only treatments to have a measurable positive effect.