ZINC AND PHOSPHORUS FERTILIZER EXPERIMENTS WITH CORN ON RECLAIMED AND UNDISTURBED LAND

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Zinc fertilizer responses have been reported for corn on alkaline soils in the United States, (Murphy and Walsh, 1972) but experiments in North Dakota designed to calibrate soil test values showed no response to zinc by navy beans in 1982 when the soil test value was 0.5 parts per million. Corn did not respond to zinc on soil with a soil test value of 1.1 ppm (Dahnke et al., 1981, 1982). Currently, the North Dakota State University Soil Testing Laboratory does not recommend adding zinc fertilizer if the soil test is 1.0 ppm or greater. The experiments reported here were conducted to determine the effect of zinc fertilizer and applied phosphorus on the yield of corn grown on a reclaimed stripmine soil and on an undisturbed soil in western North Dakota.

MATERIALS AND METHODS

Two identical experiments were initiated in 1979, one on a reclaimed soil at the Glenharold Mine near Stanton, and the other on an undisturbed soil near the Falkirk Mine at Underwood. At Glenharold, the spoil was reshaped to a slope of approximately 9 percent and covered with about 2 feet of topsoil (mixed A and B horizon) in 1974; the area seeded to grass until the corn experiment was initiated in spring, 1979. At the Falkirk Mine, the experimental area was located on Williams loam that had been in cropland prior to initiating the experiment.

The experiments were laid out in a split block design with three replications. Main plots were rates of phosphorus and subplots were rates of zinc. Zinc fertilizer (zinc sulfate) was banded at seeding each year; phosphorus (0-44-0) fertilizer was broadcast in 1979 and banded with the zinc fertilizer in 1980 and 1981. Nitrogen fertilizer at the rate of 80 pounds nitrogen per acre on all plots was broadcast and disked into the surface soil prior to seeding each year.

At both sites, soil samples (0 to 7 inches) were taken in October 1979 after the plots were harvested. When phosphorus (P) was applied at rates of 0, 20, or 40 lbs. per acre, soil test levels were 21, 25, and 34 lbs. per acre at Falkirk, and 7, 9, and 15 lbs. per acre at Glenharold, respectively. When zinc (Zn) was applied at rates of 0, 15, or 30 lbs. per acre, soil test levels were 0.9, 11, and 15 lbs. per acre at Falkirk and 0.5, 0.9, and 1.4 lbs. per acre at Glenharold, respectively. Large variability occurred in the soil test values as a result of banding the Zn. Soil test values were determined using the sodium bicarbonate (Olsen) method for P and the DTPA method for Zn (Dahnke, 1980).

Silage yields were taken each year when the kernels were beginning to dent, and yields are reported at 70 percent moisture. Corn grain was harvested at maturity and yields are reported at 15 percent moisture.

RESULTS AND DISCUSSION

Except for 1980 silage, yields of both silage and corn grain were higher each year at the Falkirk site (Table 1). These differences in yield between locations are due to differences in moisture levels, in distribution of rainfall during the growing season, and in soil characteristics. Therefore, these data should not be used to compare the relative productive capacities of reclaimed and undisturbed soils.

The additions of P did not increase corn grain yields at either site during the course of this experiment (Table 1). Silage yields were affected by P application only in 1979 at Falkirk and at Glenharold in 1981. At Falkirk in 1979, silage yields were decreased when P was applied. The addition of 20 lbs. P at Glenharold in 1981 increased silage yields slightly, but 40 lbs. of P had no effects on yields compared to the control. The addition of P in this experiment had no overall effect on silage yields.

No yield responses for either corn grain or silage due to Zn fertilization were obtained at either site during any of the three years of the experiment. Responses to Zn have been reported to be affected by higher levels of P (Ellis et al., 1964). In this experiment, however, no significant interaction effects (PxZn) were noted. Apparently, soil Zn levels were sufficiently high so any effects on plant Zn uptake due to P levels were not apparent in yields.

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Table 1. Corn silage and grain yields from the Falkirk and Glenharold plot sites, 1979-1981.

Fertilizer Treatment		Glenharold		Falkirk	
P	Zn	Silage	Grain	Silage	Grain
lb/ac	lb/ac	t/ac	bu/ac	t/ac	bu/ac
			1979		
0	0	7.1	38	9.7	65
	15	6.8	42	9.5	55
	30	7.2	37	9.8	59
20	0	7.4	36	8.2	55
	15	5.8	28	8.4	51
	30	6.4	40	8.6	59
40	0	7.4	39	8.7	55
	15	7.7	46	8.4	59
	30	7.7	47	8.2	64
Level of Significance					
Phosphorus		n.s.	n.s.	**	n.s.
Zinc		n.s.	n.s.	n.s.	n.s.
Phos x Zn		n.s.	n.s.	n.s.	n.s.
			1980		
0	0	5.7	11	3.9	38
	7	5.0	16	4.2	43
	13	6.0	11	3.8	36
20	0	5.8	11	3.9	40
	7	4.3	10	3.7	42
	13	4.7	9	4.0	43
40	0	5.9	9	3.5	36
	7	4.3	18	4.2	41
	13	4.9	14	4.1	45
Level of Significance					
Phosphorus		n.s.	n.s.	n.s.	n.s.
Zinc		n.s.	n.s.	n.s.	n.s.
Phos x Zn		n.s.	n.s.	n.s.	n.s.
			1981		
0	0	8.3	24	12.0	81
	13	8.3	22	11.5	79
	27	9.1	23	11.6	75
20	0	9.7	27	11.2	72
	13	9.3	30	11.7	77
	27	9.9	34	10.5	75
40	0	7.9	28	11.6	84
	13	7.6	17	11.0	77
	27	8.4	19	11.2	73
Level of Significance					
Phosphorus		*	n.s.	n.s.	n.s.
Zinc		n.s.	n.s.	n.s.	n.s.
Phos x Zn		n.s.	n.s.	n.s.	n.s.

[1]Significant differences exist between treatments at the 0.05 (*) and 0.01 (**) level of confidence.

CONCLUSIONS

These results indicate that the use of Zn fertilizer for corn in western North Dakota is probably not justified on soils in the lignite mining areas which are similar to those used in this study. If Zn deficiencies are suspected, the soils should be tested.

Previous results with P fertilizer on reclaimed and undisturbed soils have indicated that the regular NDSU soil test recommendations for undisturbed soils are equally applicable to reclaimed soils (Bauer et al., 1978). The results of these experiments substantiate these earlier reports, and soil tests should always be made to determine the need for P fertilizer.

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