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Corn Response to Zinc Fertilizer in Iowa

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Abstract
The solubility of zinc (Zn) is less in soils with a pH above 7.5 than in soils with a lower pH. In Iowa there are several soil associations that contain high pH spots within fields where the surrounding soil pH is slightly acid. It is reasonable to expect that Zn availability, due to a difference in solubility, is different in the two areas. We now have the technology to differentially spread fertilizer within different areas of a field. The objectives of this study were to find grain yield responses to Zn fertilizers within fields, and define the soil characteristics in responsive areas.

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Corn Response to Zinc Fertilizer in Iowa

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Introduction

The solubility of zinc (Zn) is less in soils with a pH above 7.5 than in soils with a lower pH. In Iowa there are several soil associations that contain high pH spots within fields where the surrounding soil pH is slightly acid. It is reasonable to expect that Zn availability, due to a difference in solubility, is different in the two areas. We now have the technology to differentially spread fertilizer within different areas of a field. The objectives of this study were to find grain yield responses to Zn fertilizers within fields, and define the soil characteristics in responsive areas.

Materials and Methods

Experimental Set-up. Treatments were paired with and without Zn and applied to the corn in long strips (10 ft X 500 – 1,000 ft). Each treatment was replicated four to six times. Zn was applied as zinc sulfate (36% Zn) at a rate of 5 lb. Zn/acre in a 2 X 2 starter placement. The test plots were maintained according to the cultural practices used by each of the participating producers. The producers also chose the corn hybrids. The Zn site information is shown in Table 1.

Soil Series. Soil series were identified using standard county soil surveys, followed by field and laboratory verification. The critical field verification needed was distinguishing alkaline and acid soil. Soil samples were taken every 25 ft to a depth of 6 in. The samples were analyzed for percent organic matter, pH, phosphorus, potassium, and Zn concentration. The analyses were preformed using standard, published procedures. Areas in which the soil series did not align were not analyzed for yield differences. Finally, the treatment pairs were divided into harvest plots consisting of two subplots: one with Zn added and one without.

Grain. Grain was harvested from the two middle rows of each subplot. Yields were adjusted to a 15.5% moisture content.

Results and Discussion

In this study, significant yield decreases occurred on some soils due to Zn application (Table 2). No significant yield increases occurred (Table 2). Negative yield responses occurred on soils in one of two situations: on soils with high soil test Zn (Zn > 0.8 ppm) or on soils with low soil test Zn (Zn <= 0.8 ppm) and high pH (pH>= 7) (Table 2). As found in other studies yield responses to Zn were variable. Yield decreases did not occur on all soils that had a high soil test Zn or on all soils with low soil test Zn and high pH. Furthermore, corn yield responses were not consistent on similar soil series among sites. This variability could be due to inherent differences among soil series or because the corn hybrids differed between sites. In this study Zn was applied in a 2 x 2 band during planting at a rate of 5 lbs. Zn/ acre. Based on these results this type of Zn application would have little agronomic benefit in Iowa. Finally, corn yield responses to variable Zn application throughout a field would be unpredictable.

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Table. 1 Zinc site information.

Site	Producer	Year	County	strip length ft	Hybrid	Plant Date	Harvest Date
1	Producer	1998	Wright	900	P 3730	5/5/02	10/11/02
2	Producer	1998	Hancock	1260	P 3489	5/6/02	10/23/02
3	ISU Research Farm	1998	Hancock	600	P 3563	5/6/02	-
4	ISU Research Farm	1999	Pottawattamie	525	GH9230BT	5/15/03	9/29/03
5	ISU Research Farm	1999	O'Brien	600	DK 477	5/12/03	11/26/03
6	Hovey	1999	Webster	650	G 8704	5/6/03	11/27/03
7	ISU Research Farm	1999	Hancock	490	P 3563	5/5/03	10/13/03
8	Rietema	1999	Hancock	1000	P 3489	5/5/03	10/15/03
9	ISU Research Farm	2000	O'Brien	600	DK 537	4/29/04	10/13/04
10	ISU Research Farm	2000	Hancock	500	P3563	4/26/04	9/30/04
11	Producer	2000	Hancock	1200	P3489	4/26/04	10/7/04

DK = DeKalb, G = Garst, GH = Golden Harvest, P = Pioneer

Table 2. Zinc Study years 1998, 1999, and 2000; soil test results and statistically significant yield responses.

Site	Year	Soil	Soil Zn ppm	Soil pH	Soil P ppm	Soil OM %	Yield (w/ Zn) - Yield (no Zn) bu/acre
1	1998	Nicollet	high	low	27	5	-4.3
1	1998	Webster	high	high	22	8	ns
2	1998	Nicollet	high	high	32	6	ns
3*	1998	.	.	.	.	.	.
4	1999	Marshall	high	high	66	4	-32
4	1999	Marshall	low	low	28	3	ns
4	1999	Marshall	high	low	28	3	ns
5	1999	Primghar	high	low	30	5	ns
5	1999	Sac	low	low	16	5	ns
6	1999	Canisteo	high	high	24	8	ns
6	1999	Nicollet	high	high	43	6	ns
7	1999	Nicollet	low	high	11	5	ns
7	1999	Nicollet	low	low	12	5	ns
8	1999	Canisteo	low	high	10	8	ns
8	1999	Harps	low	high	23	5	-22
8	1999	Nicollet	high	high	52	8	ns
8	1999	Okobji	low	high	2	9	-15
8	1999	Okobji	high	high	10	9	ns
9	2000	Galva	low	low	11	5	ns
9	2000	Galva	high	low	10	5	ns
9	2000	Primghar	high	low	8	5	ns
10	2000	Canasteo	high	low	28	7	-10
10	2000	Clarion	high	low	21	5	ns
11	2000	Canisteo	low	high	9	7	ns
11	2000	Harps	low	high	8	9	-26
11	2000	Okobji	low	high	8	9	ns

* = plots destroyed by extensive wind damage, ns = not statistically significant, low pH : < 7.0, high pH : >=7.0, low Zn ppm: <= 0.8 ppm, high Zn ppm: >0.8 ppm