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Iron For Improved Corn Yield?

You bet. Nebraska researchers are showing that under proper ph conditions and hybrid selection, corn yield responds positively to iron applications.

Summary: *In 1993, all iron (Fe) treatments except foliar application produced significant yield increases on both hybrids selected at the 8.6 pH site in North Platte. Most Fe treatments produced significantly higher yields at the 8.2 and 8.6 pH sites but not at the 7.7 pH site. In 1994 and /995, most Fe treatments produced significantly higher yields at the 8.6 pH site. However; the tolerant hybrid selected consistently yielded higher than the non—tolerant. Proper hybrid selection and site-specific treatment on high pH areas with seed row-applied ferrous sulfate ($FeSO_4$•$7H_2O$) can significantly improve corn yields.*

The advent of variable rate technology and site-specific treatment of problem areas has rekindled interest in corn chlorosis, as well as advances in hybrid selection for tolerance to high pH conditions. The use of site-specific management and variable rate fertilizer application adds a new dimension for the economical correction of Fe chlorosis problems. Soil pH above 8.0 inhibits corn growth by disrupting chlorophyll development and producing interveinal chlorosis. Symptoms range from slight chlorosis to plant death. Prolonged chlorosis delays crop development and maturity, which reduces grain yields and producer profits. Most commercial corn breeding programs in the United States use soils with pH 7 or less, hence selection for tolerance becomes random unless specific high pH screening sites are used. Soil pH between 7.5 and 8 may cause temporary chlorosis and delayed early growth, but the extent of yield effects has not been determined, although chlorosis has been a common problem with many crops.

In Nebraska, nearly one million acres of corn are subjected to varying degrees of injury from high soil pH. Most of this acreage is in the western part of the state, but extends into eastern Nebraska in river valley soils. The high pH soil areas do not occur uniformly in fields. This complicates correction because the fertilizer treatment or hybrid selections required to produce the highest crop yields in the problem area may not be best for the remainder of the field.

Research with iron chelate on soybeans has produced significant yield increases in Nebraska. However, only limited research has been done with corn. Earlier unpublished research from North Platte suggested that seed-applied acidified ferrous sulfate/sulfide was more effective than banding the material 2 by 2 beside the seed. Application of Fe fertilizers has not been adopted by producers because of the high cost of effective Fe treatment ($20 to $40/A) and/or the loss of specific Fe products from the market. In addition, no measured soil properties provide a good indication of Fe chlorosis severity.

Studies were initiated during 1993 to determine the influence of several seed-applied Fe fertilizers on corn growth, using a tolerant and non-tolerant hybrid selected from previous research. The objective was to determine if any combination of genotypes and/or fertilizer treatments would permit corn yields on high pH soil to approach or equal the performance on lower pH (7.0 to 7.4) soil.

Methodology

Plot size was individual rows 15 feet long with row width of 30 inches. A factorial design was used, with an untreated check and four replications. In 1993 and 1994, the experiment was established on three sites within one mile of each other. In 1995, only the high pH site was used.

Hybrids. In 1993 and 1994, hybrids Pioneer brand 3362 (tolerant to high pH) and Pioneer brand 3398 (non-tolerant to high pH) were selected for the response studies. In 1995, hybrids were changed because the two selected were phased out by Pioneer. Based on other research, the new hybrids selected

Table 1. Soil properties (0-8 inches) of three experimental sites, Hergert, et al., University of Nebraska, 1993-1995.

Site	pH	OM	P	K	Zn	Fe	EC	SAR
1	8.6	17	25	768	0.78	2.9	1.1	0.71
2	8.2	15	16	544	2.35	3.6	0.6	1.24
3	7.7	20	33	587	2.65	5.7	0.7	1.48

OM = organic matter; EC = saturated paste extract electrical conductivity (mmho/cm); SAR = sodium absorption ratio.

were: Pioneer brand 3279 (somewhat tolerant to Fe chlorosis) and Pioneer brand 3489 (sensitive to Fe chlorosis).

Applications. The plot areas received 180 lbs/A of N as a preplant application in mid-April. In 1993 and 1994, a ridge-till planter was run through the areas prior to planting to block out row locations, and apply a band of 10-34-0 + 1% Zn at the rate of 10 gal/A to the side of the future seed location. In 1995, a new two-row planter was used that placed Fe fertilizer directly in the seed furrow during planting and applied 10-34-0 + 1% Zn two inches to the side of the seed.

In 1993 and 1994, two foliar sprays of 1.5% $FeSO_4 \cdot 7H_2O$, plus 5 lbs/A urea-N, were applied directly over the corn row in mid-June and early July at the rate of 20 gal/A at 20 psi.

In 1995, one foliar spray of 1.5% $FeSO_4 \cdot 7H_2O$, plus 5 lbs/A urea-N, was applied directly over the corn row in late June at the rate of 20 gal/A at 20 psi.

Planting. Corn was planted two inches deep in early May each year, using a 7-inch seed spacing.

Soil. The studies were conducted on soils ranging in pH from 7.7 to 8.6 (Table 1). Soil at the high pH site is classified as Cozad silt loam, saline-alkali and has thin bands of very high pH (>8.5) within the root zone. Soils at the calcareous and non-calcareous sites are both Cozad silt loam.

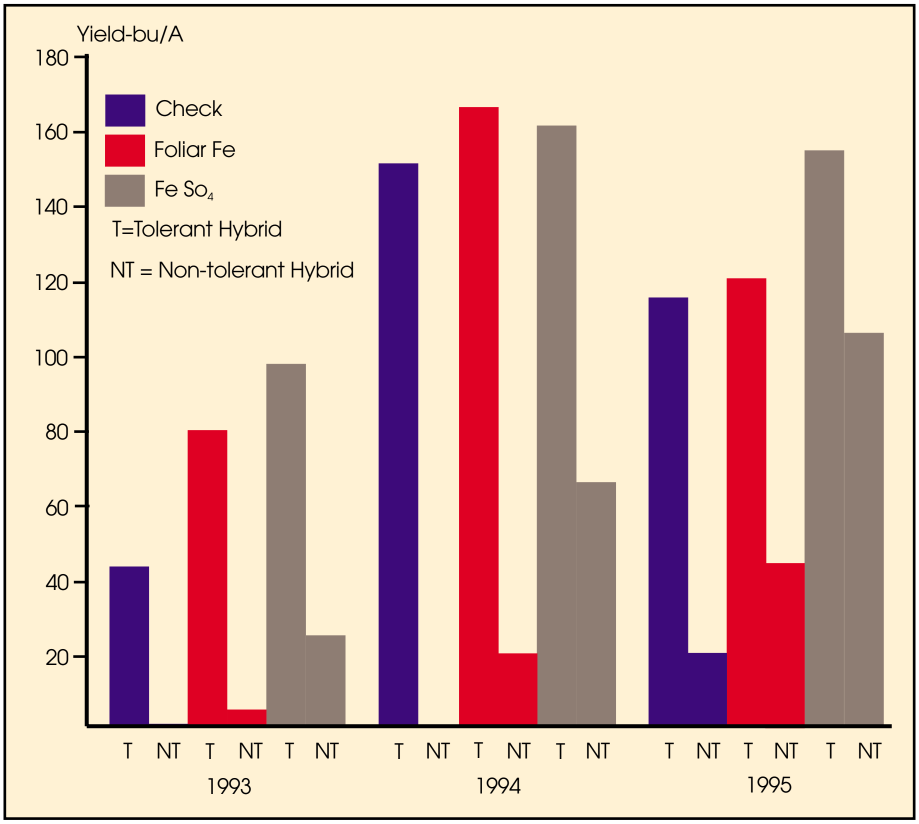

Figure 1. Effect of Fe source on grain yields of corn at Site 1, pH 8.6, Hergert, et al., University of Nebraska, 1993-1995.

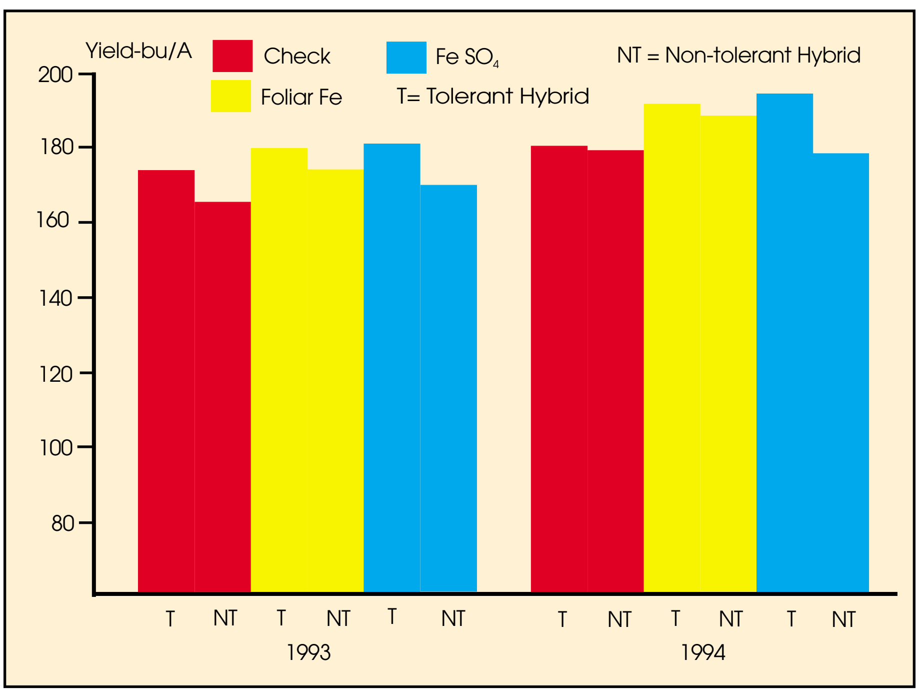

Figure 2. Effect of Fe source on grain yields of corn at Site 2, pH 8.2, Hergert, et al., University of Nebraska, 1993-1994.

Site problems

Chlorosis. Significant growth differ-ences and plant population effects among Fe treatments and hybrids were evident in 1993 and 1994 due to severe chlorosis on one high pH site, but not on the other two sites. On the high pH site, plant popula-tion of the non-tolerant hybrid was signif-icantly lower than the tolerant variety due to plant death (data not shown).

Hail storms. A hail storm in late July 1993 damaged the crop on the high pH plot (Site 1), which limited yield potential. In 1994, Site 1 was hit by hail when plants were 8 inches tall (early June) and had some further hail damage in late July. Sites 2 and 3 had

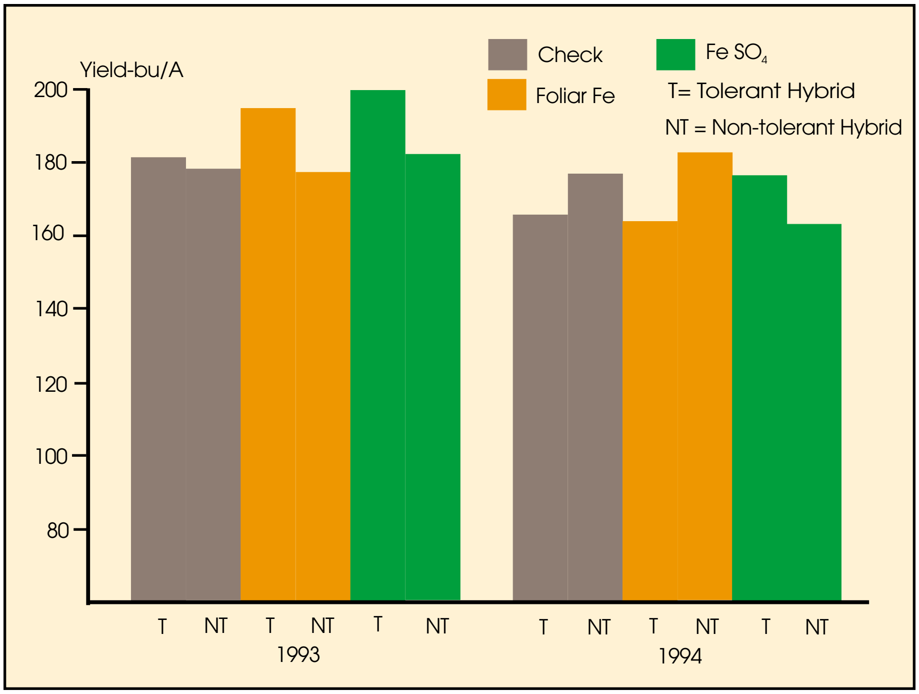

Figure 3. Effect of Fe source on grain yields of corn at Site 3, pH 7.7, Hergert, et al., University of Nebraska, 1993-1994.

severe leaf shredding from hail seven days before tasseling in late July, which decreased yield potential.

Yield response varies

1993. There were significant yield differences between hybrids at each of the three sites (Figures 1, 2, and 3). Corn yields were significantly different with Fe treatments at Site 1 (pH 8.6) and Site 2 (pH 8.2). The foliar sprays of $FeSO_4 \cdot 7H_2O$ at the 8.6 pH site (Figure 1) were effective on the tolerant but not on the non-tolerant hybrid, producing more growth and greening on the tolerant than on the non-tolerant hybrid. It is an inexpensive treatment, but may be effective only if a tolerant hybrid is planted. The seed row-applied $FeSO_4 \cdot 7H_2O$ produced more growth and chlorosis correction than the foliar treatment.

1994. Due to hail, Site 2 and Site 3 showed no significant treatment effects, but Site 1 did (Figure 1).

1995. Grain yields showed similar increases (Figure 1). The 100-lb/A rate of $FeSO_4 \cdot 7H_2O$ was sufficient to correct chlorosis on the tolerant hybrid, but the 150-lb/A rate was required for the non-tolerant hybrid. There were no marked differences in final plant population with the highest rate of $FeSO_4 \cdot 7H_2O$ (data not shown).

Chlorophyll readings

Chlorophyll meter readings were significantly increased by Fe treatment on Site 1, but not on Site 2 and Site 3. The range of chlorophyll meter readings is significantly wider than those reported for nitrogen (N) deficiency. Therefore, the readings defined chlorosis sufficiently to map chlorosis severity in whole fields that could be used as a basis for selecting different corn hybrids and Fe treatments.

Chlorophyll meters are expensive (U.S. $1,200). However, measuring plant height may provide sufficient information to produce maps of severely chlorotic sites. Correlation of plant height and chlorophyll meter readings with final grain yield of the tolerant Pioneer brand 3362 were both significant. Response was similar for the Pioneer brand 3398.

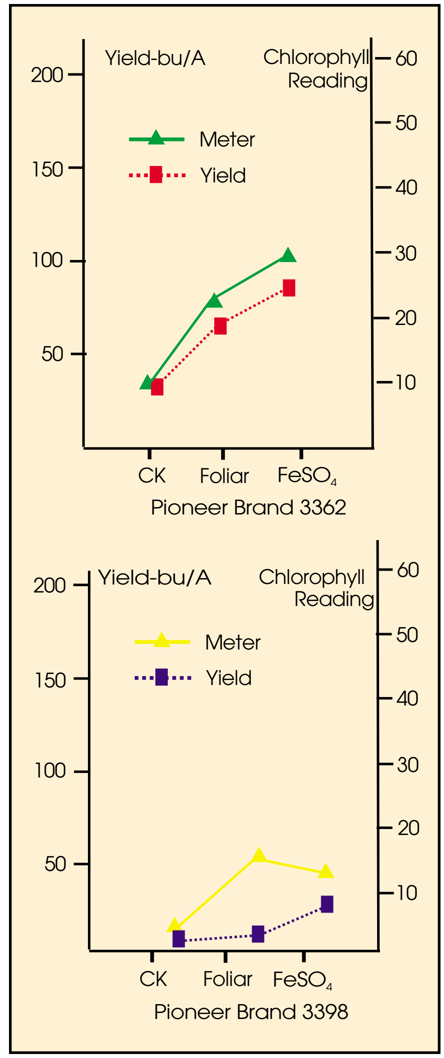

Figure 4. Effect of Fe treatment on grain yield and chlorophyll meter readings on two hybrids, Site 1, Hergert, et al., University of Nebraska, 1993.

The relationship between grain yield and mid-season chlorophyll meter readings, as influenced by Fe treatments, shows the potential for determining chlorosis severity and projected yields (Figure 4).

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