Kansas Agricultural Experiment Station Research Reports

Volume 1
Issue 3 *Kansas Fertilizer Research*

Article 10

January 2015

Corn Response to Foliar-Applied Zinc Fertilizers

A. Lamb
Kansas State University, guslamb@ksu.edu

N. O. Nelson
Kansas State University

Recommended Citation

Lamb, A. and Nelson, N. O. (2015) "Corn Response to Foliar-Applied Zinc Fertilizers," *Kansas Agricultural Experiment Station Research Reports*: Vol. 1: Iss. 3. https://doi.org/10.4148/2378-5977.1035

Corn Response to Foliar-Applied Zinc Fertilizers

A. Lamb and N. Nelson

Summary
This study was conducted to determine corn response to three foliar-applied zinc sources. The study was conducted on dryland corn in Manhattan, KS, during the 2014 growing season. Yields were low as a result of very low precipitation during pollination and grain fill. There was no yield response to foliar-applied Zn; however, grain analysis show significant increases in grain Zn concentration from foliar-applied Zn. Foliar-applied Zn products are effective for increasing Zn uptake in corn. Additional studies need to be conducted to determine the yield response.

Introduction
Research has recently shown that zinc is one of the most commonly deficient micronutrients in corn. Zinc plays a critical role because it is needed to produce chlorophyll and is necessary for cell elongation. The synthesis of growth hormones and certain cell proteins also relies on sufficient zinc levels. Little research has been conducted relating foliar application of zinc to increased corn yield.

Procedures
The plots used in this experiment were located at the Kansas State University Agronomy Farm. The predominant soil across the plots was an eroded Smolan silt loam with slopes ranging from 1 to 3%. Corn was planted on April 11, 2014 at 21,000 seeds/a. All plots received 5.8 lb/a of nitrogen (N) and 20 lb/a of P_2O_5 as ammonium polyphosphate at planting, and all plots received 116 lb/a N as urea ammonium nitrate on April 8, 2014.

This experiment was a randomized block design with four replications. A total of three zinc sources were applied along with a control. Three different rates were applied for each zinc source. With three zinc sources at three different rates and a control, each replication contained 10 plots. Each plot measured 10 ft × 30 ft. The three zinc sources used were Citri-Chelated Zinc (Winfield Solutions, Shoreview, MN), zinc sulfate ($ZnSO_4 \cdot 7H_2O$), and Black Label Zn (Loveland Products, Loveland, CO). Fertilizer grades for Citri-Che and Black Label were 6-0-0-10 (N-P-K-Zn) and 6-20-0-0.77, respectively. Powdered zinc sulfate heptahydrate was mixed with water to achieve the desired zinc application rates for the zinc sulfate treatment. Three different rates of 0.22, 0.67, and 1.34 lb Zn/a were used for zinc sulfate and Citri-Che. Because the rate of 1.34 lb Zn/a was unattainable with Black Label, rates of 0.22, 0.45, and 0.67 lb Zn/a were used for Black Label. Three composite soil samples consisting of 15 cores each were taken from each block prior to application for initial soil conditions. All treatments were foliar-applied with a backpack sprayer during the last week of June including the control, to which distilled water was applied. Treatments were applied when the corn was at growth stages V7–V8. Whole-plant samples were taken for tissue analysis preapplication. Chlorophyll measurements were taken three weeks after the treatments were applied. On August 29, 40 row ft of corn was harvested for yield determination. Grain from each plot was analyzed for Zn concentration.

The area's weather began the summer as generally cool, but there was little precipitation. Although precipitation was sufficient in early summer (mid-May to mid-June), only 1.3 in. of precipitation fell June 16 through August 5, which resulted in drought stress and low yields.

Results

Initial soil sampling showed commensurate nutrient concentrations in soil across replications (Table 1). The concentration of DTPA Zn in the soil ranged from 0.4 to 0.8 ppm, which is below the critical soil test value of 1.0 ppm Zn. Therefore, we would expect a crop response to Zn applications. However, whole-plant sampling prior to application showed an average Zn concentration of 47.1 ppm with a standard deviation of 4.6 ppm (Table 2). This is below the critical level of zinc in plant tissue, so application of fertilizer would not be expected to increase yield. No significant treatment effects were observed on chlorophyll content (SPAD reading) and grain yield (Table 2), but the lack of response to treatments may be owing to the drought stress, which resulted in low overall yield (Table 2). Analysis of grain samples revealed an expected increasing Zn concentration in grain tissue with increasing Zn application. Zinc concentration with the largest increase was seen with 1.3 lb/a Zn applied as zinc sulfate. This result indicates that the foliar-applied Zn sources effectively increased Zn uptake by corn. Additional studies need to be conducted to evaluate treatment response in more favorable growing conditions.

Table 1. Soil analysis (0–6 in.)

Block	Organic matter	pH	Buffer pH	Mehlich-3 phosphorus	Exch. potassium	DTPA zinc[1]
	%			ppm	ppm	ppm
100	2.14	6.01	6.54	5.7	240	0.4 (0.02)
200	2.38	5.76	6.47	8.0	245	0.5 (0.09)
300	2.64	5.69	6.36	8.5	246	0.7 (0.02)
400	2.76	5.67	6.31	7.4	284	0.8 (0.06)

[1] Average of three samples; standard deviation in parentheses.

Table 2. Effects of foliar zinc application on leaf chlorophyll content (SPAD reading), grain yield, and zinc concentration in corn grain

Product	Rate, lb/a zinc	SPAD reading	Grain yield, bu/a	Zinc concentration, ppm	
				leaf[1]	grain
None (control)	0	50	91	46	17.3
CitriChe[2]	0.22	51	93		17.7
CitriChe	0.67	49	75	48	18.2
CitriChe	1.3	51	90		19.6
Black Label[3]	0.22	50	85		17.2
Black Label	0.45	49	92	50	19.6
Black Label	0.67	50	78		17.8
Zinc sulfate	0.22	51	95		17.5
Zinc sulfate	0.67	51	100	45	18.1
Zinc sulfate	1.3	49	84		20.4
LSD		NS	NS	NS	1.9

[1] Leaf tissue concentrations are at growth stage V7 and prior to treatment application.
[2] Loveland Products, Loveland, CO.
[3] Winfield Solutions, Shoreview, MN.