CONTINUED FIELD EVALUATION OF NITROGEN AND ZINC RATES IN A COTTON/CORN ROTATION

M. Wayne Ebelhar
Richard E. Turner
Mississippi State University
Stoneville, MS

Abstract

Zinc deficiency symptoms in cotton include leaves that appear leathery and upturned and have been observed in the younger leaves in the upper part of the canopy. Other deficiency symptoms may include short internodes (rosetting) small or stunted leaves with interveinal chlorosis and a bronzed appearance. Zinc (Zn^{2+}) is not readily translocated in plant tissue and which leads to zinc deficiency symptoms occurring in the younger leaves of corn. Typically a broad band of white to yellowish-white tissue occurs on both sides of the leaf midrib beginning at the base but may not reach all the way to the leaf tip. These nutrient deficiency symptoms have become more evident in recent years as growers have shifted from cotton to more grain crops (corn and soybean). In an effort to look at both cotton and corn response to added zinc, multi-year field studies were initiated to evaluate the interaction of nitrogen (N) rates and zinc (Zn) rates for both cotton and corn grown in rotation. The treatment combinations for corn included a factorial (4x4) arrangement of N rates (160, 200, 240, and 280 lb N/acre) and Zn rates (0, 5, 10, and 15 lb Zn/acre) arranged in a randomized complete block (RCB) design with five replications. The cotton study was similar with the same Zn rates but lower N rates (30, 60, 90 and 120 lb N/acre). Nitrogen applications of urea-ammonium nitrate (UAN) solution followed corn planting with a uniform rate (120 lb N/acre) applied just after planting and the remaining N applied as a sidedress application at the 5-6 leaf stage. For cotton, the early N was applied at either 30 or 60 lb N/acre with the remainder again applied as a sidedress (rate determined by protocol treatment). All N applications were band-applied to both sides of the row. Zinc was applied as zinc sulfate (35.5% Zn) dissolved in water and applied as a solution with the same liquid applicator as used for nitrogen. Corn and cotton are rotated each year with the high N rates for both corn and cotton staying in the same spot. The same was true for zinc.

Prior to the initiation of the study, soil samples indicated soil pH in the 5.4 to 5.9 range with some samples going as low as 4.8. Extractable phosphorus levels ranged from 95 to 164 and averaged 132 lb/acre. Potassium levels were 270 and 326 lb K/acre with organic matter at 0.45 or 0.62% depending on the test site. Organic matter levels continued to be low even though field was in a corn/cotton rotation. To date, no P or K was added to either study site. Zinc levels were as low as 0.6 lb/acre prior to the study initiation. Both corn and cotton were grown with uniform cultural practices across the field. The center two rows of each plot was harvested with commercial harvesters adapted to plot harvest. Grain samples and seedcotton samples were collected at the time of harvest and used to determine harvest moisture, bushel test weight, and Seed Index for corn. Seedcotton grab samples were ginned through a 10-saw micro-gin to determine the lint percentage and lint yields based on weight from the seedcotton harvest. All data were summarized and subjected to an analysis of variance with mean separation by Fisher's Protected Least Significant Difference (LSD).

Discussion has been limited to the results from the cotton study for this report. There was no significant interaction between N rates and Zn rates in any of the first three years of the study (2016-2018) allowing for evaluation of main effects. It should be noted that in the rotation between corn and cotton, the low N rates and low Zn rates are the same giving an additive effect. For example, plots receiving the high Zn rate have received 45 lb Zn/acre in the three years while the low Zn plots have received no fertilizer Zn.

Cotton yields in 2016 ranged from 765 to 1092 lb lint/acre within the 16 treatments. When averaged across zinc levels, there was a significant N rate response. Lint yields were 780, 940, 1005 and 1008 lb lint/acre. There was no additional yield response above the 90 lb N/acre rate. In 2016, there was a trend (Prob. > F = 0.0743) toward increased cotton yields with increasing Zn rates but there was no significant increase at the 5% level (apriori level of significance). Cotton lint yields in 2017 were also significantly increased with N rates up to 60 lb N/acre but no response above 60 lb N/acre observed. Lint yields were 1172, 1309, 1335, and 1322 for the 30, 60, 90, and 120 lb N/acre rates, respectively (averaged across Zn rates). Overall lint yields range from 1120 to 1365 lb lint/acre in the study. The first 5 lb Zn/acre increment significantly increased lint yield (Prob. > F = 0.0280) but additional Zn application produced no further increase. The 2018 cotton yields ranged from a low of 916 lb lint/acre to a high of 1356 lb lint/acre. As in previous years, the N rate by Zn rate interaction was not significant. There was no response

to N rates in 2018 when averaged across Zn levels (Prob. > F = 0.1198). This is probably related to the changes made in the N treatments due to an error early in the season. Yields were 1170, 1237, 1217, and 1156 lb lint/acre for the 30, 60, 90, and 120 lb N/acre rates, respectively (averaged across Zn rates). The zinc response in 2018 was the greatest observed to date. The cotton lint yields were 985, 1206, 1261, and 1329 lb lint/acre for the 0, 5, 10, and 15 lb Zn/acre rates, respectively (Prob. > F = <0.0001).

After three years, soil test zinc is building while P levels continue to decline. There has also been some increase in soil organic matter and sulfate sulfur levels. Prior to the 2019 growing season, 2 tons/acre of agricultural lime will be applied. It appears that low pH may be restricting corn production while having less influence on cotton but still limiting. With P levels going down, Zn availability may also be increased. Zinc availability largely depends on soil texture, organic matter, pH, phosphorus levels and weather conditions. Foliar applications of Zn can be an option in cotton systems since cotton has a smaller root system and limited Zn mobility in soils.