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CORN RESPONSE TO ZINC ON HIGH pH SOILS

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Corn is the most responsive to zinc of all agronomic crops grown in Kentucky. Zinc deficiency can occur most often in soil of the Inner Bluegrass and in south central Kentucky. This deficiency is most likely when these soils have a high pH, although such factors as high phosphorus, low organic matter, and loss of topsoil through erosion or construction can increase deficiency symptoms. Also, zinc deficiency is more prevalent during a cool, wet spring with symptoms often disappearing when the soils become warmer and drier. Zinc is a very immobile element, thus roots must grow throughout the root zone in order to take up enough available zinc.

Most of the earlier research with zinc application on corn in Kentucky occurred on soils high in pH and very high in phosphorus. However, many of the south central Kentucky soils have a high pH without the very high phosphorus. A research area in Jackson County was located within a field with a high pH due to overliming, and on which zinc deficiency symptoms had been observed.

Field Study

The field study with conventionally tilled corn was located on an Allegheny loam soil in Jackson County for three years (1987, 1988 and 1989) that had been previously overlimed.

Treatments consisted of four zinc application rates for two years, 1987 and 1988, followed by a residual year (1989) with no further applications. Zinc rates, as zinc sulfate, of 0, 10, 20 and 30 lbs Zn/A were broadcast on the surface and disced in prior to planting. Soil samples were taken before zinc treatment in the spring of 1987 and each fall following corn harvest. Ear leaf samples were taken at tassel initiation and analyzed for zinc. Corn yields were determined following harvest each fall. The entire plot area received 160 lbs N/A, 120 lbs K2O/A, and 25 lbs Mg/A each year. All other practices consistent with conventional tillage and corn production were followed for the three years.

Study Results

Initial soil test results were as follows for the plot area: pH - 7.3, P - 79, K - 64, and Mg - 45. Table 1 lists the zinc soil test results as extracted by both 0.1 N HCl (the former Soil Test Lab extractant) and Mehlich 3 (the new Soil Test Lab extractant) solutions. A correlation of $r = 0.98$ existed between the two methods.

Table 1. Soil test Zn as determined by two extractants.

Zn Trt.	Soil sampling dates 4/87	10/87	11/88	11/89
	- - - - - - lbs Zn/A - - - - - -			
	0.1 N HCl solution			
0	2.3	2.5	3.1	2.8
10	2.3	3.7	7.2	14.9
20	2.2	5.0	11.9	15.7
30	2.2	17.1	19.4	12.0
	Mehlich 3 solution			
0	3.1	3.3	3.5	3.3
10	3.3	5.2	7.6	16.5
20	3.0	6.1	12.4	17.7
30	3.0	20.4	19.8	14.0

The data indicates that on these high pH soils the Mehlich 3 solution extracted slightly more zinc than the HCl solution. Extractable zinc by both solutions increased following the residual year for the rates of 10 and 20 lbs Zn/A rates which may be related to a carryover of undissolved zinc sulfate resulting from high soil pH (7.3).

Table 2. Corn yields following zinc application and a residual year.

Zn Trt. (1987 & 1988) lbs Zn/A	Corn Yield (15.5% mois.) 1987	1988	1989	Mean
	- - - - - Bu/A - - - - -			
0	151	125	112	129
10	147	125	114	129
20	160	130	140	143
30	177	133	131	147

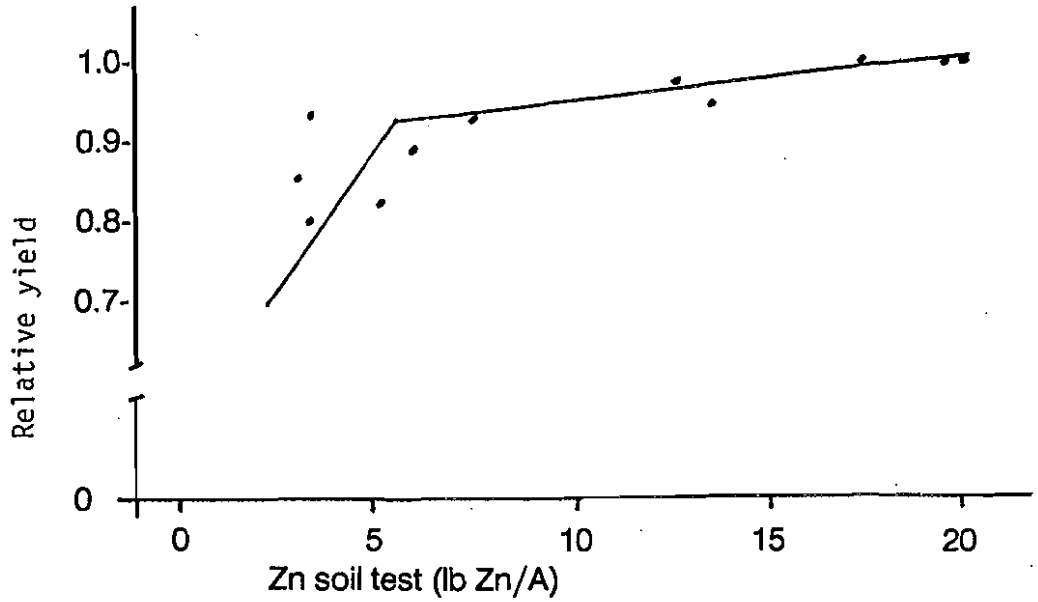
The data for corn yield indicate that zinc applications of 20 lbs/A or greater resulted in yield increases over the check. There appeared to be no additional yield increase when more than 20 lbs Zn/A was applied following either the years of application (1987 & 1988) or the residual year (1989). Additionally, it was noted that the two years of application provided enough available zinc to increase corn yields during the residual year.

Table 3. Ear leaf Zn concentration at silk initiation following Zn application and a residual year.

Zn Trt. lbs Zn/A	Zn concentration 1987	1988	1989
	- - - - - - - ppm Zn - - - - - -		
0	13.7	16.6	26.8
10	14.8	17.4	28.6
20	17.6	20.3	37.5
30	22.3	23.0	39.8

Zinc concentration in the ear leaf increased each year regardless of treatment level, and increased with increasing zinc application rate for each year. The largest increases occurred when 20 lbs Zn/A or more was applied. A number of research studies have indicated that ear leaf zinc levels above 15 ppm are adequate for good corn growth. This was achieved on all treatments except two during 1987.

The decisions involved in making a fertilizer recommendation from a soil test are based on the relationship of soil test levels to crop yields. Shown below is the relationship of soil test zinc as extracted by the Mehlich 3 solution to the relative corn yields obtained in this study.



The soil test zinc level occurring at the intersection of the two lines (about 5.5 lbs Zn / A) is slightly above the current recommended soil test range in AGR - 1 for corn (P = about 50 and pH = 7.2 - 7.6 for this study). When soil test Zn was below the values at the intersection, corn yields increased sharply with added zinc. When soil test Zn values were above those at the intersection, corn yields continued to increase but at a much slower rate.

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