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# Effect of Lime on No-Tillage Corn Yields

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# AGRONOMY NOTES

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## EFFECT OF LIME ON NO-TILLAGE CORN YIELDS

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The rapidly growing popularity and adoption of no-tillage systems of corn production have required us to re-evaluate some of our long established soil fertility practices and recommendations. Recent work by researchers at Kentucky and adjacent states show that the soil surface becomes very acid after a few years of continuous no-tillage corn production. This rapid decrease in soil pH is primarily associated with surface application of nitrogen fertilizers. Most lime recommendations and related research information for row crop production are based on plow-down application. Therefore, the effectiveness of surface-applied and unincorporated lime under no-tillage systems becomes a question of concern. We conducted lime studies on no-tillage corn at Princeton and Lexington to study this situation. Results are presented below.

Lime Study at Princeton:

Field studies were initiated in 1971 at Princeton on a moderately well-drained Tilsit silt loam soil underlain by a fragipan layer at about 24 inches. This soil developed from acid sandstone and shale. The experimental design was a split-plot, randomized block with four replications. Several lime rates and frequencies of application were evaluated.

Results of soil pH measurements are presented in Table 1. The initial soil pH is an average of all plots before any lime treatments were applied in spring of 1971. The soil pH in the other columns represents the soil pH after 5 years under the various lime treatments. All plots received 200 lb N/ac, surface broadcast as ammonium nitrate about 4 weeks after planting. Surface (0-2") soil pH was significantly lowered on the no-lime plots after 5 years of continuous no-tillage corn. The treatments receiving 1.5 tons of lime per acre showed a small decrease in surface pH after 5 years (5.7 to 5.5). The 4.5 tons/ac of lime raised the pH level of the surface to 6.4. The treatment adding 1.5 tons per acre first year plus 0.5 tons per acre each subsequent year for a total of 3.5 tons per acre showed a slight pH increase after 5 years. The more frequent lime application did not seem to do a better job than the single lime application at the beginning of the 5-year period.

Table 1. Soil pH of Tilsit soil at Princeton, Ky. from different lime rates on no-tillage corn plots.

| Soil Depth (inches) | Initial* | Lime Treatment (tons/ac) Check** (0 lime) | 1.5** | 4.5** | 1.5** + 0.5 annually |
|---|---|---|---|---|---|
| 0-2 | 5.69 | 4.63 | 5.53 | 6.40 | 6.08 |
| 2-4 | 5.67 | 5.47 | 5.70 | 6.38 | 6.03 |
| 4-8 | 5.49 | 5.53 | 5.58 | 5.93 | 5.93 |
| 8-12 | 5.05 | 5.05 | 5.10 | 5.23 | 5.28 |

* Mean of all plots sampled and measured at beginning of study before making lime applications (1971).

** Mean of four replications after 5 years (1975).

The addition of lime (regardless of treatment) caused a statistically significant increase in corn grain yield, Table 2. The yield differences for frequency of lime application were not significantly different from treatments receiving lime in a single application.

Table 2. Summary of corn yields on a moderately well-drained Tilsit soil at Princeton for different lime treatments on no-tillage plots.

| Lime Treatment | Corn Yield bu/ac 1971 | 1972 | 1973 | 1974 | 1975 | Ave. |
|---|---|---|---|---|---|---|
| Check (no lime) | 65 | 113 | 118 | 105 | 106 | 101 |
| 1.5 tons/acre | 73 | 143 | 112 | 104 | 125 | 111 |
| 4.5 tons/acre | 83 | 135 | 110 | 134 | 131 | 119 |
| 1.5 tons/acre + 0.5 ton/ac/yr. annually | 71 | 140 | 117 | 104 | 110 | 108 |

* Lime requirement by soil test suggested 1.5 tons/acre of lime to adjust soil pH to 6.4.

Lime Study at Lexington:

This study was superimposed on the continuous no-tillage corn studies being conducted at Lexington. The Maury soil at this site is quite different from the Tilsit soil at Princeton. Maury soil is a red, deep, well-drained soil developed from highly phosphatic limestone. Experimental design for the study was a split-block with four replications. Plots were split in 1973 and half were limed at a rate of 3 tons per acre of commerical ag lime. The other half received no lime. Because this rate proved to be insufficient in adjusting the soil pH to desired levels, we relimed the lime plots in spring of 1975 at the rate of 5 tons per acre.

Substantial yield increases were observed for plots receiving lime, Table 3. The surface pH (0-2") of the unlimed high N rates, were lowered to a pH of 4.3. Those unlimed plots started showing visual symptoms of stunting and reduced growth in the early vegetation stages as early as 1975. The symptoms became more severe each year along with progressively poorer weed control on the acid plots each year. The abrupt changes in percent weed control between the limed and unlimed plots encouraged us to conduct additional studies on influence of lime on weed control.

Table 3. Summary of corn yields on a well-drained Maury silt loam soil at Lexington for limed and unlimed no-tillage plots.

| Year | | Nitrogen applied annually (lbs/ac) | | | |
|---|---|---|---|---|---|
| | | 0 | 75 | 150 | 300 |
| | | bu/ac | | | |
| 1974 | Limed | 89 | 154 | 165 | 167 |
| | Unlimed | 101 | 151 | 141 | 160 |
| 1975 | Limed | 60 | 97 | 100 | 106 |
| | Unlimed | 48 | 88 | 94 | 114 |
| 1976 | Limed | 69 | 144 | 155 | 170 |
| | Unlimed | 45 | 132 | 146 | 131 |
| 1977 | Limed | 58 | 106 | 109 | 115 |
| | Unlimed | 35 | 98 | 98 | 110 |
| 1978 | Limed | 32 | 78 | 85 | 99 |
| | Unlimed | 14 | 60 | 61 | 71 |
| Ave. | Limed | 67 | 116 | 123 | 131 |
| | Unlimed | 49 | 106 | 108 | 117 |

Since high rates of nitrogen normally applied at the surface for no-tillage corn produces a rapid acidification of the soil surface, lime may be a very profitable input. Because the acid-producing effect is concentrated in the soil surface under no-tillage management, neutralization of the acid condition is easier. It is concluded that surface liming is an efficient way to overcome soil acidity for no-tillage corn. Our studies show that liming without incorporation effectively corrects the acid condition and significantly increases corn yield on two Kentucky soils of quite different characteristics.

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