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Grant W. Thomas
University of Kentucky

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Effectiveness of Surface Application of Phosphorus and Potassium on Yield of No-Till Corn Grown on Soils Testing Low or Medium Below a Depth of 3 Inches.

Grant W. Thomas, Gerald R. Haszler and Raymond Thompson

Distribution of Soil Test P and K Levels in Soil Following Surface Application

When crops are grown continuously under no-tillage or very minimum tillage, there is a tendency for phosphorus (P) and potassium (K) to become concentrated at or near the soil surface. This occurs when P and K fertilizers are broadcast on the surface and not mixed with the soil as would occur with plowing. The result is a stratification of P and K such that the surface few inches become very high in those nutrients, but soil test levels remain largely unaffected below that. The question is whether high yields of no-till crops can be obtained under these conditions.

A number of investigators have expressed the opinion that such stratification decreases the plant availability of P and K, especially in dry years when the surface soil dries out and slows uptake of P and K. An opposing view is that P and K are more available in the surface of a soil because there is less clay, more organic matter and, with no-tillage, generally more water in the surface few inches of soil. Thus, greater mixing would only reduce availability of P and K. There is ample evidence indicating more efficient crop uptake of surface-applied fertilizer P.

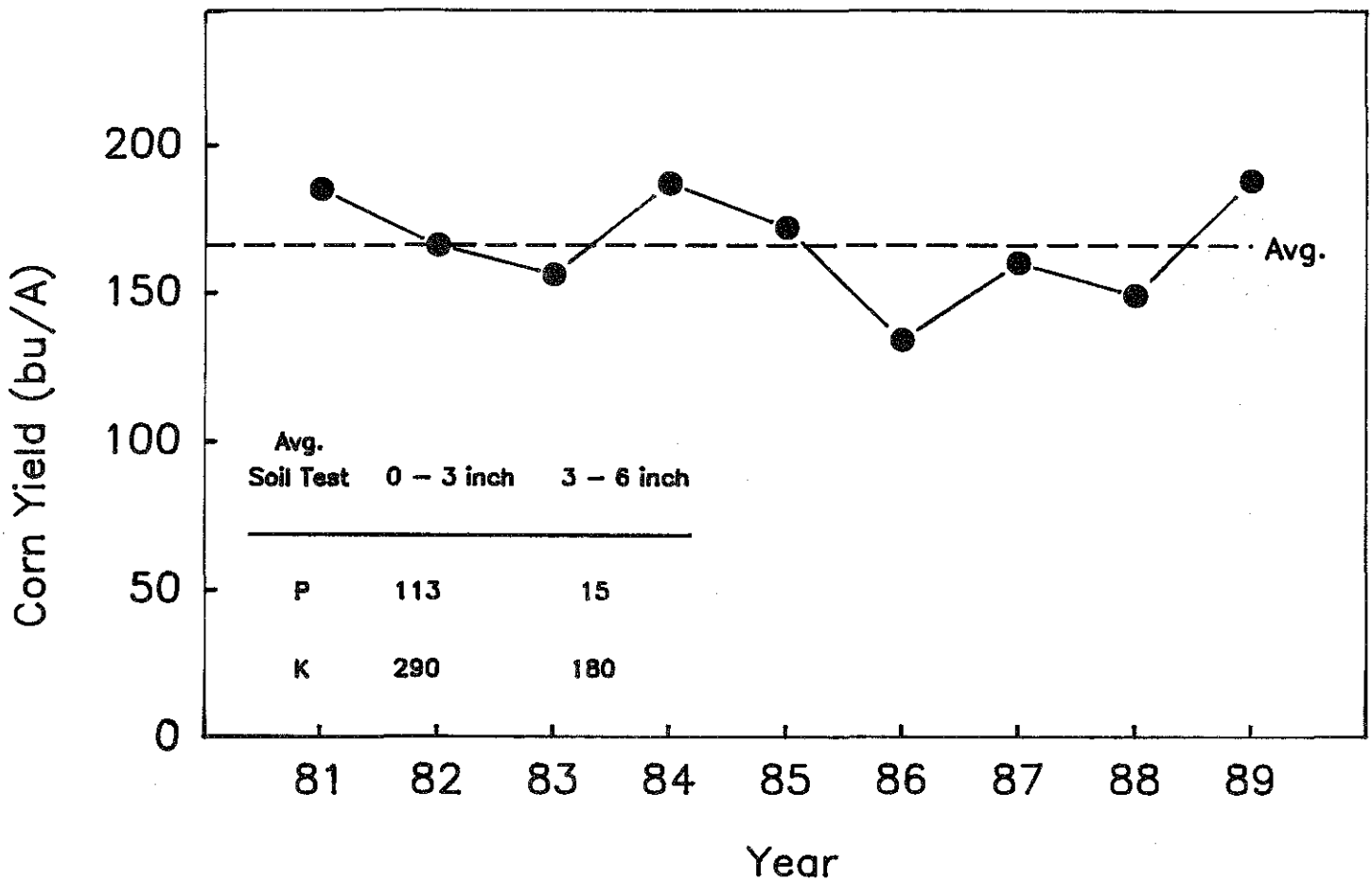
No-Till Corn Yields on Soils with Stratified P and K.

We studied P and K concentrations in soil samples from 0-to 3 and 3-to 6-inch depths taken from fields planted to no-tillage corn in Russell County, Kentucky. The levels of both P and K were variable from one field to another but, in every case, they were much higher in the surface 0 to 3 inches than in the 3- to 6-inch depth. Soil-test P and K and corn yields are shown in table 1. Phosphorus ranged from medium to very high (40 to 134) in the 0-to 3-inch layer and was low in four samples and medium in one sample (16 to 40) of the 3-to 6-inch layer. Potassium ranged from low to very high (126 to 369) in the 0-to 3-inch layer and from low to medium (81 to 256) in the 3 to 6 inch layer. Corn yields ranged from 150 to 216 bu per acre, with an average of 178 bu per acre.

Table 1. Corn Yields and Soil Test Levels for P and K in Russell County: 0-to 3-and 3-to 6-inch Samples

| Soil Type | Fertilizer N Applied | Year | Soil Test Values | | | | Corn Yield bu/A |
|--------------------------|----------------------|------|------------------|-----|---------------|-----|-----------------|
| | | | 0 to 3 inches | | 3 to 6 inches | | |
| | | | P | K | P | K | |
| Lonewood loam I | 150 | 1987 | 40 | 126 | 24 | 81 | 150 |
| II | 150 | 1989 | 40 | 301 | 16 | 198 | 216 |
| III | 180 | 1989 | 134 | 218 | 40 | 147 | 181 |
| Mountainview silt loam I | 150 | 1989 | 92 | 369 | 30 | 256 | 165 |
| II | 180 | 1989 | 50 | 308 | 24 | 215 | 177 |

Figure 1: Corn Yields During a 9-Year Study (No P or K Applied After 1987)





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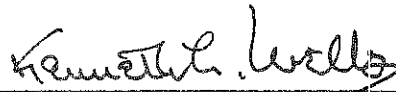
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It is obvious from such high yields that the corn was not detrimentally affected by the low P and K levels in the 3-to 6- inch soil depths. It appears that the high concentrations in the 0-to 3-inch layer were sufficient for high corn yields regardless of the level below 3 inches. The highest yield was obtained on a soil with a level of medium P and high K in the 0-to- 3-inch depth underlain by low P and medium K in the 3-to 6-inch depth. This was the state corn yield contest winner in 1989.

A study by Wells, Rice and Thom on a Pope silt loam soil at Quicksand, KY showed similar results. In continuous no-till corn for 9 years, soil test P averaged 113 and 15 for 0-to 3-and 3-to 6-inch samples, respectively, and K was 290 and 180, respectively. In spite of the low values for P in the 3-to 6-inch layer, corn yields averaged 166 bu per acre for the 9 consecutive years, and yields in the three most favorable years were 185, 187 and 188 bu per acre. Moreover, no P or K was applied in 1988 or 1989, and yields did not decline. The results are shown Fig. 1.

Summary

Research on several sites in Russell County and 9 years of yield data from a study at Quicksand, KY on soils which test low in P and K in the 3-to 6-inch depth indicate that it is not necessary to have high levels of P and K below 3 inches depth to obtain high yields of corn.. It also is not necessary to have very high levels in the 0-to 3-inch depth to make high yields. The state 1989 corn yield contest winning yield of 216 bu per acre was produced on a soil testing 40 and 16 for P and 301 and 198 for K for the 0-to 3-and 3-to 6-inch soil depths, respectively. These results also confirm that soil samples taken from 0-to 3 or 4-inch depth, as recommended for no-till crops, give correct values for optimum fertilization.



Extension Soils Specialist, and Editor, SSNV