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Balanced Fertility Management: A Key to Nutrient Use Efficiency

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A balanced fertility program is essential for optimizing yields, increasing profits, and improving the efficiency of fertilizer applications. For non-legumes, nitrogen (N) may be the most common limiting nutrient. However, without balanced nutrition, fertilizer N applications may be less efficient, and part of the fertilizer investment is wasted. To address these issues, a four-year study was conducted on a Crosby silt loam soil near Springfield, Ohio. The study examined four preplant N rates: 0, 80, 160, and 240 lb/A. In addition, several soil potassium (K) levels were included to test how K and N interacted to influence corn grain yield, N uptake efficiency, and soil N levels after harvest.

Balanced fertilization practices produce higher yields, greater profitability, and improved environmental protection: goals which every top producer should strive to achieve.

The effects of K and N on corn grain yield are presented in **Figure 1**. In considering only the effects of N, corn grain yields were highest at rates of at least 160 lb/A. However, the yields attainable at this level of fertilizer N increased as the K level of the soil became greater. The highest yields occurred when the soil K levels were at least 232 lb/A. These results demonstrate that higher levels of soil K are necessary to ensure that crop yields reach their fullest potential.

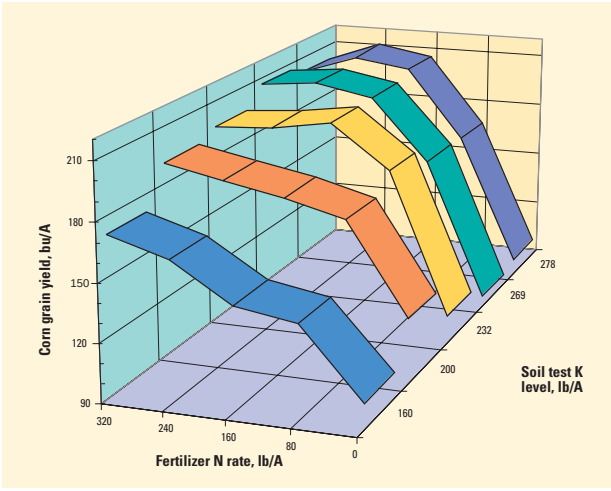

Figure 1. Corn grain yield response to fertilizer N rates and soil test K levels on a Crosby silt loam soil near Springfield, OH.

Nitrogen and K also complement each other to optimize the efficiency of N fertilizer applications. The percentage of the fertilizer N used by each acre of corn was calculated for each level of applied N as well as each soil K level. These data are plotted in **Figure 2**. The most noticeable result is that the percentage of applied N fertilizer used by the corn crop decreased with greater N

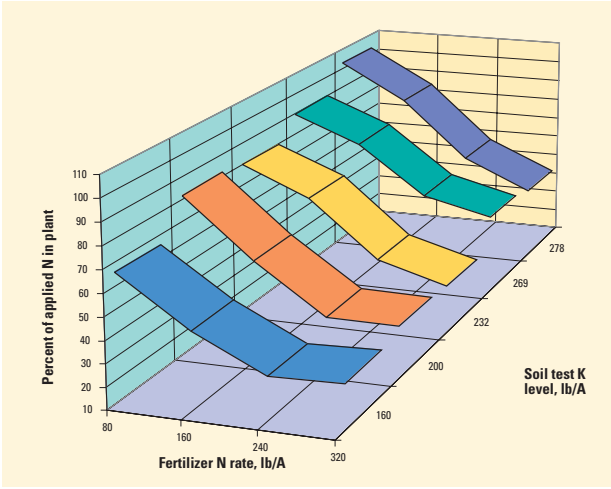

Figure 2. The effect of fertilizer N rates and soil test K levels on the N uptake efficiency of a corn crop grown on a Crosby silt loam soil near Springfield, OH.

rates. This occurred because the amount of N taken up by the crop initially increased as increasing amounts of fertilizer were applied; however, as N rates continued to increase, crop uptake began to reach a plateau. When N uptake reached this maximum, lower percentages of fertilizer N were utilized.

The effects of K are also evident. Higher levels of soil K resulted in greater use of applied N fertilizer by the corn crop. Other data from this experiment (not presented here) showed that K did not increase fodder N uptake significantly, but it did produce significant increases in N uptake by the grain. The removal of N by the grain was therefore most likely responsible for the observed increases in whole plant uptake of N with increased K levels in the soil.

So far, increased soil K levels have been shown to improve the efficiency of fertilizer N utilization and to increase the yields attainable at higher N rates. Both of these effects may work together to reduce the quantity of N fertilizer remaining in the soil after harvest. **Figure 3** shows the percentage of applied N fertilizer remaining in the top 3 ft. of soil after grain harvest for five different soil test K levels. Higher soil K levels resulted in a smaller percentage of the applied N fertilizer remaining in the soil. These lower levels may have resulted from the greater fertilizer N removal by corn growing on the areas with higher K levels.

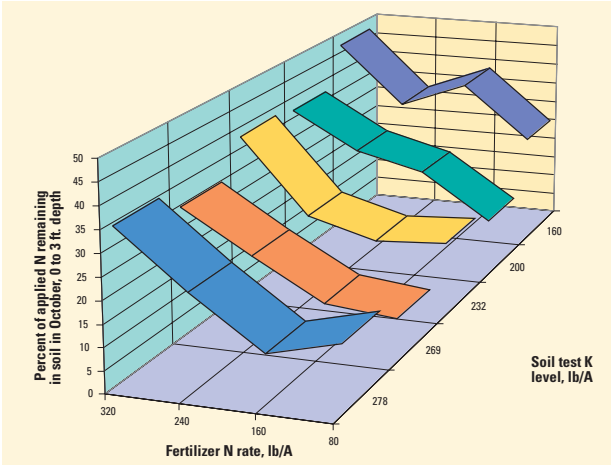

Figure 3. The effects of N rates and soil test K levels on the percent of applied fertilizer N remaining in the upper 3 ft. of a Crosby silt loam soil in October after corn grain harvest.

The data from this study also show that N and K work together to maximize profitability. The change in yield response to increasing fertilizer N applications was calculated for each soil K level. Income generated or lost from each fertilizer increment was based upon a price of $2.90/bu for corn and $0.25/lb of N for fertilizer.

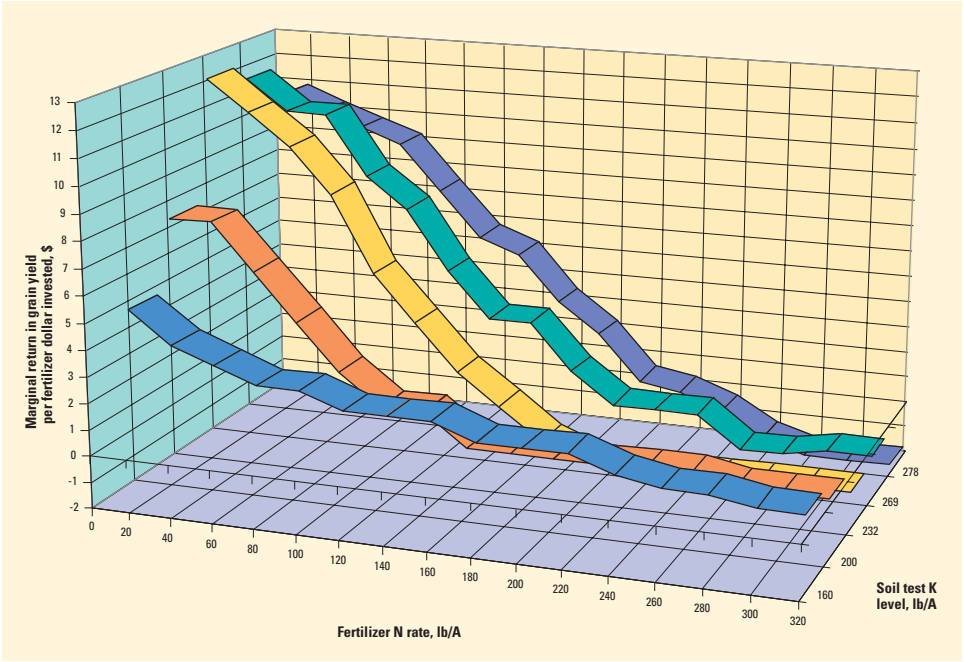

Figure 4. Marginal returns to N fertilizer investment for incremental changes in N rate at different soil test K levels (corn grain price set at $2.90/bu and fertilizer N fixed at 25¢/lb).

The income from yield was compared to the investment in fertilizer N.

The results of this analysis are plotted in **Figure 4**. The most evident feature of this graph is the well-known relationship that marginal return is highest at the initial increments of fertilizer N, but begins to reach a plateau at higher fertilizer N levels. The data clearly show that higher levels of soil K greatly increase the marginal returns from applications. This response is directly related to the heightened yield response at the higher soil K levels. Eventually, N additions either produce no additional profit or begin to reduce profit. Higher soil test K levels allow corn to achieve its maximum profitability at lower N rates.

The results from this study have several implications for N and K management. When N and K work together, yields and N uptake are superior to those arising from N alone. Higher K levels also reduce the amount of fertilizer N needed to maximize profitability. The increased yields and N levels in the crop lead to a more efficient use of applied N fertilizer. When more of the N fertilizer is used by the crop, less is left over in the soil after harvest. Reduced soil N levels mean reduced chances for groundwater contamination through runoff or leaching. BC

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