# Potassium Interactions with Other Nutrients

Potassium affects nitrate ($NO_3$) absorption and reduction. Rapid $NO_3$ uptake depends on adequate K in the soil solution. Activity of the enzyme glutamine synthetase in wheat is lower when K is deficient.

Potassium stimulates leaf protein synthesis. Up to 65 percent of the variability in grain quality traits, such as amino acid makeup, is due to non-genetic factors, including K nutrition.

In a nutrient solution study, higher rates of K allowed for the efficient use of more nitrogen (N), which resulted in better early vegetative growth and higher grain and straw yields as K and N rates increased.

In the field, better N uptake and utilization with adequate K mean improved N use and higher yields. Crops respond to higher K levels when N is sufficient, and greater yield response to N fertilizer occurs when K is sufficient. Corn studies in Illinois and Ohio provide examples of this economically and environmentally important interaction (**Figure 1**).

Potassium (K) is unique among the essential nutrients in the diversity and number of roles it plays in plant chemical processes. To perform these varied and multiple roles, K uptake and utilization often interact with the availability and uptake of other nutrients.

## Potassium Uptake

Nitrogen form can affect K absorption. For example, tomatoes grown in nutrient solution with $NO_3$-N have shown a higher relative growth rate than plants supplied with ammonium-N ($NH_4$-N). After 4 days, the total K content decreased in $NH_4$-grown tomato plants and remained constant in those supplied with $NO_3$.

Similarly, when corn was grown with either $NH_4$ or $NO_3$ as the N source, both yield and total N uptake were lower with $NH_4$-N as the source.

However, when the highest K rate was used, vegetative growth (yield) and N and K uptake were improved with the $NH_4$-fed plants.

It is clear that K interacts with N and is important in its utilization throughout the crop growth and yield production cycle.

## Potassium-Phosphorus Interactions

Research has shown that K interacts with phosphorus (P) and that together they may interact with other nutrients. A good example is the observed reduction of P-induced zinc (Zn) deficiency of corn when available K levels are increased. Manganese (Mn) content of the corn plants also increases,

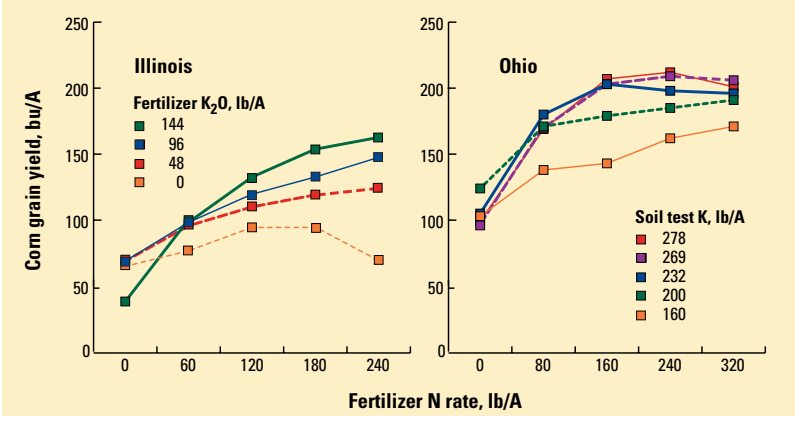


**Figure 1.** Potassium improves yield response to N fertilizer and N efficiency.

**TABLE 1.** Phosphorus and K interact for higher soybean yields.

| $P_2O_5$ | $K_2O$ | Yield, |
|---|---|---|
| lb/A | | bu/A |
| 0 | 0 | 25.8 |
| 30 | 0 | 30.8 |
| 0 | 120 | 46.2 |
| 30 | 120 | 54.9 |

**TABLE 2.** Positive P-K interaction produces higher Coastal bermudagrass yields.

| $P_2O_5$ | $K_2O$ | Yield, |
|---|---|---|
| lb/A | | tons/A |
| 0 | 0 | 2.68 |
| 0 | 360 | 2.63 |
| 230 | 0 | 3.26 |
| 230 | 360 | 4.55 |

indicating there is some relationship of K, P, Mn, and Zn in this complex effect...resulting in less severe Zn deficiency.

A more simple P-K interaction, but perhaps of more widespread importance, is their synergistic effect on yield (**Tables 1** and **2**).

In these cases, besides their individual effects on yield, P and K together produced an extra 15 percent positive yield interaction for soybeans and 50 percent for Coastal bermudagrass.

## Potassium, Calcium and Magnesium Interactions

Low magnesium (Mg) or calcium (Ca) in forages can affect animals by producing low blood serum Mg or Ca (grass tetany).

Incidence of tetany tends to be lower if forage Mg exceeds 0.2 percent and Ca exceeds 0.4 percent. High plant K can have an antagonistic effect on Mg concentrations, particularly when Mg is low in soils.

Seasonal changes in forage composition may be associated with factors such as levels and forms of N absorbed by plants. Absorption of $NH_4$-N may result in greatly reduced uptake of Ca and Mg while having lesser effects on K.

Large amounts of $NH_4$-N in the soil would have the same effect on a forage as that of K, causing depressed uptake of Ca and Mg.

Sudden rises in temperature tend to be associated with wider K/(Ca+Mg) ratios, which correspond with a higher grass tetany potential. Higher temperatures tend to increase the K uptake faster than that of Ca and Mg.

Generally, additions of K, Ca or Mg result in a lower concentration of the remaining two cations, regardless of the crop grown.

Research has shown that P fertilization of fescue pastures can significantly increase Mg and Ca contents of leaves early in the spring when the potential for tetany is highest.

## Potassium/Sulfur Interactions

Sulfur (S) nutrition of barley plants has an influence on the effect of K on Zn uptake from nutrient solutions. Apparently, good S levels along with adequate K improve Zn uptake.

## Potassium/Micronutrient Interactions

Many interactions have been reported between K and micronutrients. Some of those reported with Zn (as they have involved P and S) have already been noted. Interactions with some of the micronutrients...boron (B), iron (Fe) and molybdenum (Mo)...have resulted in decreased uptake when K was added. For others...copper (Cu), Mn and Zn...use of K has increased micronutrient utilization.

An interesting observed interaction is that between K and sodium (Na) on alfalfa. When K is deficient, the classical K deficiency symptom is quite apparent. However, for alfalfa grown on soils high in Na, the K deficiency symptom has a somewhat different appearance. See photos on page 21.

The interactions between K and micronutrients have not yet been well characterized. Further study, especially under field conditions, is necessary.

## Summary

Potassium is known to interact with almost all of the essential macronutrients, secondary nutrients, and micronutrients. Future improvements in yield and quality will require a better understanding and management of these interactions.

As livestock feeding operations, industrial uses, and food processors move to special varieties and identity-preserved marketing, nutrient effects on grain quality traits will become even more important. BC