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ALL PLANT NUTRIENTS INTERACT

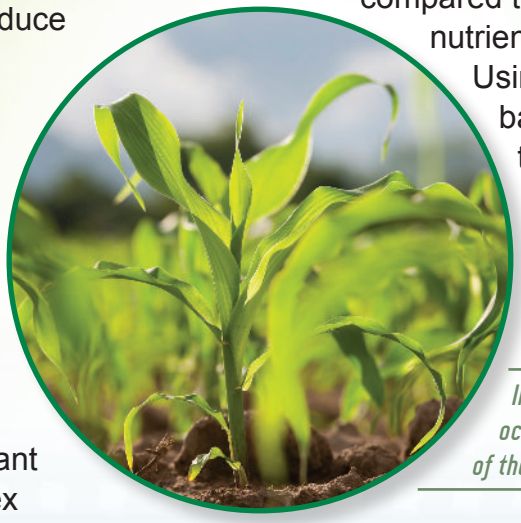
At the core of most successful crop production is allowing plants to reach their full photosynthetic potential. This simple objective is complicated by hundreds of factors, some controllable and others subject to the whims of nature.

Providing adequate nutrition is one of the controllable factors that should not be allowed to stunt plant growth and reduce the quantity and quality of harvest. Preseason nutrient planning most often focusses on alleviating each nutrient deficiency, one at a time. However, we are increasingly aware that every plant nutrient has complex interactions with other plant nutrients and they work together to boost overall plant health. These interactions are termed synergistic (acting positively together) and antagonistic (in opposition).

Nutrient interactions occur when one nutrient influences the uptake and utilization of another nutrient. Interactions are observed to occur in the soil, at the surface of the root, or within the plant. Other nutrient interactions influence crop health in less obvious ways, such as improving resistance to drought stress or susceptibility to insect damage.

Here are a few examples of nutrient interaction that illustrate the importance of this principle:

- Positive interactions between nitrogen (N) and phosphorus (P) frequently lead to higher crop yields and increased P uptake, compared to when either nutrient is used alone. Using ammonium-based fertilizer together with fertilizer P often leads to even greater P uptake and yields.



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- High application rates of potassium (K) or ammonium-based fertilizer for cool-season grasses reduces the uptake of magnesium (Mg), sometimes resulting in Mg-deficiency disorders in grazing animals. High rates of K fertilization may also limit uptake of calcium (Ca) and other cations as they compete for plant uptake.
- The proper ratio of N and sulfur (S) in plant proteins falls within a fairly narrow range. Applications of S

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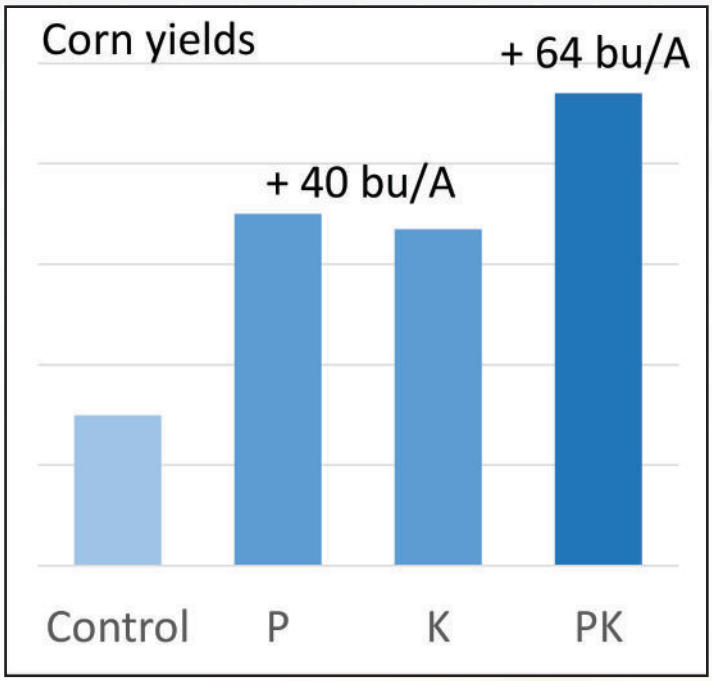
or N fertilizer alone may skew this ratio and cause a reduction in growth, yield, and harvest quality.

- Due to their chemical similarities, adding P fertilizer can release sulfate and molybdate from the surface of soil minerals, increasing their availability for plant uptake.
- The interaction between P and zinc (Zn) has been often reported, but their relationship is frequently confusing. Excessive P concentrations may result in reduced Zn uptake and yield by some plants, but this is not a universal response as it depends on the crop and growing conditions.

- Molybdenum (Mo) application to many legumes usually does not directly improve plant growth, but may enhance N fixation and plant stand longevity.

Soybeans showing molybdenum (Mo) deficiency in the foreground, compared to plants that received Mo in the background.

- Interactions between Ca and P are sometimes confusing. Both Ca and P synergistically support each other during uptake and translocation, but they can chemically precipitate to form relatively insoluble compounds in the soil.



In one typical experiment, applying P and K fertilizer together resulted in a yield-boosting interaction that resulted in more harvested corn grain than when either nutrient was applied alone.

Plants require all 14 essential mineral nutrients for normal growth, but they must be in the proper balance. Nutrients interact in synergistic and in antagonistic ways in complicated physiological and chemical reactions. These interactions can vary depending on soil properties and the specific crop. Regular analysis of soil and plant tissue is important to confirm that no individual nutrient is severely out of balance and possibly disrupting the contribution of other nutrients. Clearly, these complex nutrient interactions deserve additional examination as we push towards higher and sustainable yields.

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