Fertility needs in high-yielding corn production

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Although advances in agronomy, breeding, and biotechnology have dramatically increased corn grain yields, soil test values indicate that producers may not be supplying optimal nutrient levels. Moreover, many current nutrient recommendations, developed decades ago using outdated agronomic management practices and lower-yielding, non-transgenic hybrids, may need adjusting.

Researchers with the University of Illinois Crop Physiology Laboratory have been re-evaluating nutrient uptake and partitioning in modern corn hybrids.

"Current fertilization practices may not match the uptake capabilities of hybrids that contain transgenic insect protection and that are grown at planting densities that increase by about 400 plants per acre per year," said U of I Ph.D. student Ross Bender. "Nutrient recommendations may not be calibrated to modern, higher-yielding genetics and management."

The study examined six hybrids, each with transgenic insect protection, at two Illinois locations, DeKalb and Urbana. Researchers sampled plant tissues at six incrementally spaced growth stages. They separated them into their different fractions (leaves, stems, cobs, grain) to determine season-long nutrient accumulation, utilization, and movement.

Although maximum uptake rates were found to be nutrient-specific, they generally occurred during late vegetative growth. This was also the period of greatest dry matter production, an approximate 10-day interval

from V10 to V14. Relative to total uptake, however, uptake of phosphorus (P), sulfur (S), and zinc (Zn) was greater during grain fill than during vegetative growth. The study also showed that the key periods for micronutrient uptake were narrower than those for macronutrients.

"The implications of the data are numerous," said Matias Ruffo, a co-author of the paper and worldwide agronomy manager at The Mosaic Company. "It is necessary that producers understand the timing and duration of nutrient accumulation. Synchronizing fertilizer applications with periods of maximum nutrient uptake is critical to achieving the best fertilizer use efficiency."

Jason Haegele, another co-author of the paper and post-doctoral research associate at the U of I added, "Although macro- and micronutrients are both essential for plant growth and development, two major aspects of plant nutrition are important to better determine which nutrients require the greatest attention: the amount of a nutrient needed for production, or total uptake, and the amount of that nutrient that accumulates in the grain."

Study results indicated that high amounts of nitrogen (N), potassium (K), P, and S are needed, with applications made during key growth stages to maximize crop growth. Moreover, adequately accounting for nutrients with high harvest index values the proportion of total nutrient uptake present in corn grain), such as N, P, S, and Zn, which are removed from production fields via the grain, is vital to maintaining long-term soil productivity.

In Illinois, it is common to apply all the P in a corn-soybean rotation prior to the corn production year.

"Although farmers in Illinois fertilize, on average, approximately 93

pounds of P2O5 per acre for corn, the estimated 80 percent of soybean fields receiving no additional phosphorus would have only 13 pounds per acre remaining for the following year's soybean production," said Fred Below, professor of crop physiology. "Not only is this inadequate for even minimal soybean yield goals, but these data suggest a looming soil fertility crisis if fertilizer usage rates are not adjusted as productivity increases."

Integration of new findings will allow producers to match plant nutritional needs with the right nutrient source and right rate applied at the right time and right place. The same team of scientists is collaborating on a follow-up study investigating the seasonal patterns of nutrient accumulation and utilization in soybean production.

"Although nutrient management is a complex process, a greater understanding of the physiology of nutrient accumulation and utilization is critical to maximize the inherent yield potential of corn," concluded Bender.

"Nutrient uptake, partitioning, and remobilization in modern, transgenic insect-protected maize hybrids" by Ross R. Bender, Jason W. Haegele, Matias L. Ruffo and Fred E. Below was published in the January 2013 edition of *Agronomy Journal* (105:161-170). It is an open-access article available at: https://www.agronomy.org/publications/aj/articles/105/1/161. An abbreviated version of this article, entitled "Modern corn hybrids' nutrient uptake patterns," was published in *Better Crops with Plant Food* (available at: http://www.ipni.net/publication/bettercrops).

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