

PLANT NUTRITION TODAY

2017 ISSUE 4, NO. 5

NITROGEN FERTILIZER RECOMMENDATIONS:

How Can We Improve the Guesstimate Game?

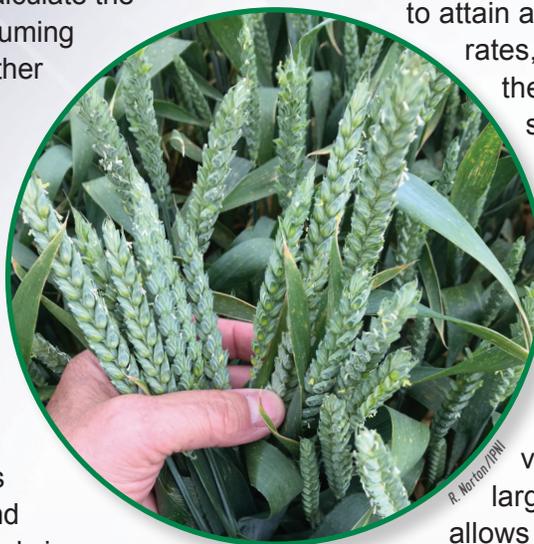
Making nitrogen (N) fertilizer recommendations is often a guesstimating game. In an ideal system, we could reliably predict the yield goal for any crop based on environmental conditions ☑. We would then multiply this optimal yield goal by a unit N requirement ☑ to calculate the total N needed, assuming no deficiencies in other nutrients, and then determine our rate of fertilizer ☑ by deducting residual soil N, in-season mineralized N, and any credits from previous crop or manures. The beauty of this approach is that it is easy to calculate and accounts for N already in the system. It is no wonder that this approach was adopted by many extension programs across the United States (Ex. 1 ☑ ; Ex. 2 ☑ ; Ex. 3 ☑). While this method can work well in some areas, such as semi-arid and arid environments, it has proven inaccurate in other areas.

Several sources of uncertainty affect the accuracy of N recommendations. Yield goals are difficult to predict based on data available to us at planting. Estimating plant available N in the system is tough in climates with variable in-season N cycling, movement, and high risk of loss. And even when residual soil N can be reliably measured or yield goals accurately predicted,

we have known for decades that the N requirement for a targeted yield can differ across complex topography or from year to year ☑.

An alternative approach is to amass hundreds of yield response data for a given region and crop rotation ☑ to attain a range of optimal N rates, which eliminates the need to soil sample in areas with unpredictable soil N. Recommended rates are thereby based on a large database of N responses which can be updated regularly under a variety of conditions. A large quantity of data also allows users to investigate how certain factors, such as previous crop, change optimal rates. However, the challenge is that yield responses can vary greatly from year to year and within a field, and so this approach is not suited for site-specific management.

On-farm field-scale fertility trials ☑ are an approach useful for informing site-specific N rates. These trials are conducted using variable rate applicators and yield monitors to characterize field-scale variability in yield responses to fertilizer N, which can then be related to other factors, such as total N supply, topography, and water or soil dynamics. Results could easily be integrated into algorithms utilizing crop models and



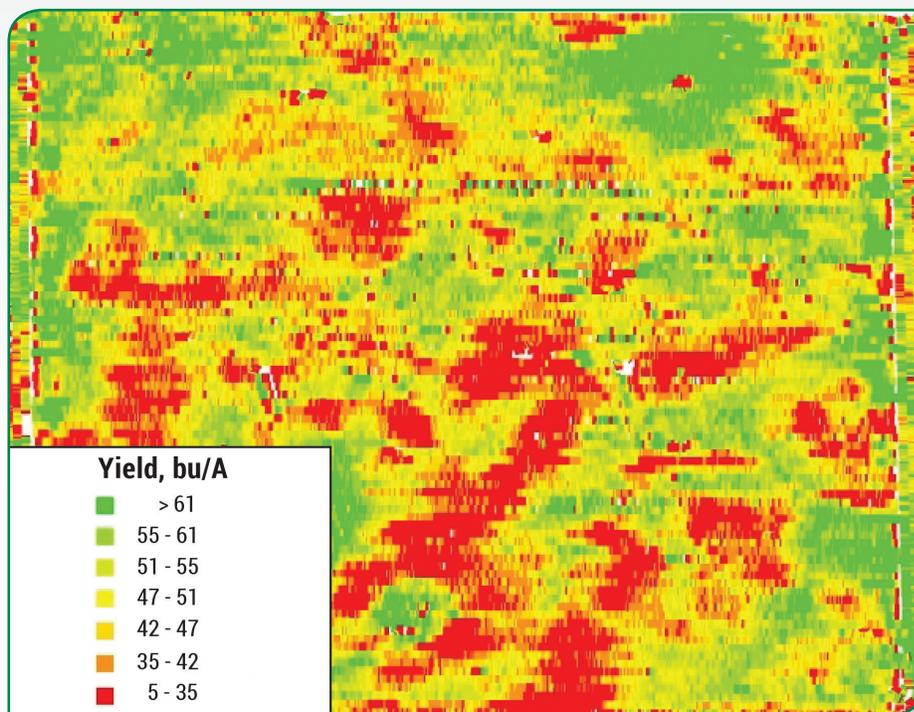
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“ Shifts in nitrogen use efficiency of newer varieties and the adoption of site-specific 4R nutrient management practices (i.e., the right source, right time, right rate, right time) gives us a reason to revisit how we make recommendations. ”

high-resolution weather and farm-level data ☑. However, yield-based N requirements may not be stable from every year even within a single location, and recommendations are only as good as the yield predictions.

A third approach is to make in-season N rate adjustments based on the crop's N status. At planting, only a portion of the N requirement is applied, and sensors are used to detect crop N deficiencies during the growing season. This approach requires implementing N-rich strips at planting ☑. Growers utilize sensor readings to estimate and compare the yield potential of enriched N strips versus their current practice, and then use algorithms to derive the optimum topdress N rates ☑. However, growers need to establish N rich strips at non-limiting N rates every year on every field, as well as have the ability to access fields to place fertilizer when and where it is needed.



Yield monitor-generated map of field-scale variability.

Even if we are confident in our fertilization recommendations, shifts in N use efficiency of newer varieties ☑ and the adoption of site-specific 4R nutrient management ☑ practices gives us a reason to reconsider how

we make recommendations. With the advancement in crop sensing technology and enhanced efficiency fertilizers, it is a good time to revisit our approaches for fine-tuning fertilizer N recommendations.