



Site-Specific Nutrient Interactions Provide New Opportunities

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CROP YIELD is the ultimate integrator of all of the factors and forces acting on the crop. Too often we focus on the yield effects from these individual factors without considering the influence one has on the response to another. For example, the optimum nitrogen (N) rate for corn is determined by running field trials with plots or strips with several different rates of N, and measuring the yields of each.

That seems simple until we try to repeat the same test on a different field and realize that the level of potassium (K) in the soil has a great effect on not only the yield level attained, but also on the N level at which the optimum rate is achieved. **Figure 1** illustrates this interaction effect.

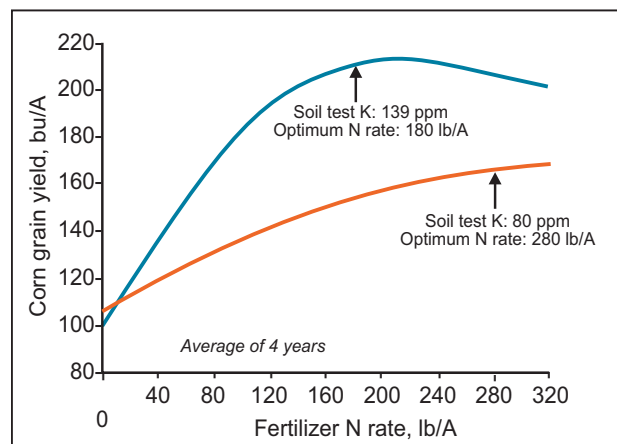


Figure 1. Response of corn yield to applied N fertilizer at different K soil test levels.

At the higher soil test K, the optimum yield was reached with much lower N, and it was at a much higher yield level. This relationship points out the importance of knowing the levels of each nutrient in studies where the best rate for any individual nutrient is being investigated. It also is important to try to manage **all** nutrients at their optimum levels to ensure that the most efficient use of all of the others will be realized.

This example is especially important to Midwest farmers, where K levels have been steadily declining in recent years, to the point where deficiency symptoms have been widely reported in the field. It is a simple and economical problem to fix, and fixing it can substantially improve efficiency in crop use of other inputs, such as N and water.

Weather conditions affect the responses to nutrients and their interactions. In a drought year, highest soybean yields result where P and K soil tests are at a high level (**Figure 2.**)

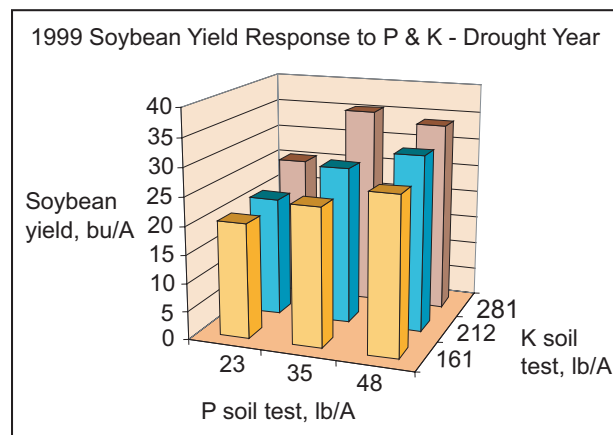


Figure 2. Interaction of P and K soil test affecting soybean yield in a drought year. (Johnson, Ohio)

Historically, farmers and their advisers have tried to manage nutrients according to the average soil test levels for the field. With the availability of site-specific technology, however, it is now possible to manage on a much smaller scale, using management zones. The zones are based on some level of knowledge of the variability within the field, so that nutrient application rates can be based on that information. Correcting K levels within the field to be sure K is adequate in all management zones, for example, also helps provide for the most efficient use of N applied. Management zones for nutrients may be simple uniform grids, or they may be areas defined by soil type, topography, soil test levels, or yield levels. Any known source of within-field yield variability is a potential factor that could be used for defining zones.

Yield losses occur long before any visible nutrient deficiencies are noted. If deficiency symptoms are apparent, corrective action is urgent. It is poor management to allow deficiency of a low-cost nutrient like K to rob profits and reduce efficiency of other production inputs. By correcting areas of the fields that are deficient, variability can often be reduced...making more uniform management possible in the future. In other cases, it may be more important to manage the different zones differently rather than attempt to make the field more uniform. In either case, site-specific management of the field helps improve the yield and profitability of the whole field. Even if this

improves income and profits by only a few dollars an acre, aggregated over a whole farm and over several years, site-specific management can substantially improve yields and profits, and can help make the management system more environmentally friendly.

Even if soil tests are in the desired range, late-season shortages can occur due to roots becoming less effective in uptake. In other cases, dry weather may reduce the ability of the roots to absorb nutrients from the upper part of the root zone. If the lower part of the soil profile is short on nutrients, deficiencies can occur even if the soil test level is adequate at the normal sampling depth. To address such a situation, there may be value in attempting to build soil tests lower in the profile. Researchers and farmers are experimenting with deep placement equipment to establish zones of higher soil tests at a depth of 6 to 12 in. Some of these systems use controlled traffic patterns to be sure the seed is planted directly over the fertilizer band. This work is ongoing. Preliminary results indicate a yield advantage may be realized in some years, but not necessarily every year. Of course, this will depend upon the growing season, the physical characteristics of the soil, and the existing nutrient supply in the soil profile. When it comes to this more intensive level of nutrient management, the proper plan for any field is site-specific.

Similar interactions occur among other nutrients. A good soil testing program can help sort out the situation for a given field. Selected deep samples and plant tissue samples late in the season can help identify special needs. Intensity and frequency of the sampling needed will depend upon the amount of variability within the field. Carefully mapping this variability provides an important resource for nutrient management decisions.

Careful yield mapping is also important. Because yield integrates all of the production factors, it is important to have a good understanding of yield variability within the field. Yield monitors on the harvester allow collection of a large number of data points, geographically referenced for each field. The value increases with each year added to the database. These data points show basic variability and

also track variability in crop removal for future nutrient recommendations.

Technologies such as electrical conductivity measurement and various kinds of remote sensing also help define management zones with spatially intensive data. Many of these data sets of themselves have limited utility, but they become valuable when combined with other data to help define the spatial structure of the variability in the field. Understanding that structure is the key to successful site-specific management.

Site-specific management is a relatively new concept, yet it is based upon traditional principles, just applied on a smaller area. The merging of modern electronic tools with tried and true agronomy provides the power of decades of research and experience being applied on a finer management scale. This kind of intensive, science-based management is where the potential for improving yields and consistency in crop production. The future competitiveness of the North American farmer in the world market depends on more farmers adopting site-specific management.

As fall work progresses, the plan should include preparing to collect the most detailed yield measurements that can be taken. Some sources of variability will be obvious. Identifying others may take some detailed analysis of several data layers. Soil testing helps uncover some of the key interactions that may be limiting yield. Those should be managed carefully to minimize yield limiting situations. **With this approach, site-specific management technology will come into play as an essential part of the toolbox for farmers and their advisers.** ■

For additional details and resources on this topic, visit these websites:

>www.ppi-ppic.org<
>www.ppi-far.org<
>www.farmresearch.com<

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