

Research lacking to back claims for foliar-applied fertilizers

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Farmers must ask at least two fundamental questions about every product they are asked to purchase and apply to their crop: What is the frequency of crop response and what is the average yield increase?

The answers to these two questions should be based on an adequate amount of unbiased, reputable research. With such a large number of crop yield enhancing products and nutrient solutions formulated for foliar application available there is no way that each product can be thoroughly researched by university scientists.

For the record, let's establish that there is not a university scientist alive that does not want to discover or recommend farming practices and products that enhance grower yields and profits. If there is a foliar applied fertilizer or biostimulant that increases crop yield 10-20 percent for minimal cost, we want to be the ones doing the research and promoting it at professional educational meetings.

A lot of phone calls have been fielded in recent weeks regarding recommendations for and the agronomic value of foliar-applied nutrient solutions and tissue testing programs. These same questions have been around for the past 50 years, but the aggressiveness at which foliar feeding and the associated products are now promoted is unparalleled.

The issue becomes even more complicated when you include "crop performance enhancing" chemicals, sometimes called biostimulants, which are often included in nutrient solutions. Both tissue testing and foliar feeding have a place in row crop agriculture in the Mid-South but they must be adequately understood to ensure that they are properly implemented.

Research lacking

Recommendations are being made to farmers based on crop tissue analysis programs offered by several farm-service providers. Farmers and consultants have shared the results and recommendations of some tissue analysis programs and the tissue nutrient concentrations used to define what is deficient or sufficient typically approximates textbook values.

We must all recognize that the textbook values that define sufficient and deficient nutrient concentrations are not always based on research. For many of the essential micronutrients

and some macronutrients, the critical concentrations are simply based on a survey of tissue collected from a large number of fields at a specific crop growth stage that generated a bell-shaped -- normal -- distribution curve.

The information from survey-based critical concentrations is agronomically interesting and useful, especially for troubleshooting field problems. However, for many nutrients, there is little or no published information showing a valid relationship between crop yield increase and tissue nutrient concentration that provides good reason for making widespread recommendations to apply a foliar- or soil-applied fertilizer that includes that nutrient.

Research-based information is a challenge to find even for the few macro- and micro-nutrients for which nutrient deficiency occurs annually and is visually evident in commercial fields. The concentration of essential nutrients in crop tissues is likely related to crop performance, however, for many of these essential nutrients, we lack proven research that defines the exact minimum nutrient concentration below which yield is harmed and verifies that a beneficial yield response to foliar feeding occurs.

As a general rule, if land grant university recommendations do not include tissue monitoring thresholds and subsequent research-based relationships showing a yield benefit from soil or foliar fertilization then we would advise you to avoid the practice or approach it with a plan to test whether a crop response occurs (e.g., perform replicated strip trials on your own farm). Over the last few years, university research programs have examined various products marketed for foliar application to several crops and we have yet to find products that produce significant yield increases beyond what a solid fertilization and crop management program provide.

Misinformation and high-pressure sales

Most of the textbook critical nutrient concentrations are specific to a particular plant part and growth stage. Any deviation from that specific plant part and growth stage may cause the critical nutrient concentration to change.

There is usually no single nutrient concentration that can be used for the duration of a growing season to define nutrient deficiency, especially during reproductive growth. For most well-fertilized and watered crops, biomass accumulation will be more rapid than nutrient uptake during much of the critical growth periods when yield potential is set and will cause plant tissue concentrations to decline continuously as the plant develops.

Many of the recommendations being made for foliar feeding simply have little defensible merit, which suggests there is a lot of misinformation being passed about or sales tactics involving ultra-high yield potential, fear of crop failure, or low cost per acre are being used to promote and sell products.

A recent tissue analysis for corn recommended the grower apply 1-2 quarts per acre of two different products near the R1 growth stage that would have added the equivalent of 0.68 pounds K₂O and 0.30 pounds Mg/acre, which represent less than 0.5 percent of the total aboveground K and Mg content required to produce the typical 220 bushels per acre corn crop. If K and Mg were indeed deficient, the amounts recommended are too small and maybe too late to benefit crop growth, development and yield in our opinion.

Micronutrients and yield

Foliar application of micronutrients is an accepted and more logical practice since much smaller amounts are needed to satisfy plant requirements -- compared to macronutrients -- but tissue testing and substantiating the need for foliar micronutrient application is not without challenges.

With the exception of a few micronutrients that are frequently deficient in particular crops (e.g., zinc in corn and rice) and have established fertilization recommendations, the problem with tissue analysis and foliar feeding of micronutrients is twofold. First, deficiencies of many of the essential micronutrients are rarely observed and there is little or no published research verifying significant yield benefits resulting from soil or foliar application. Thus, it is virtually impossible to answer the questions of what is the frequency and magnitude of benefit from fertilization with such nutrients. Second, the textbook critical tissue concentrations for all micronutrients are not always correct and many are based on the normal distribution from a survey that was previously described.

In the early 2000s, when boron deficiency of soybean was recognized as a major limitation to soybean production in parts of eastern Arkansas, research showed no consistent and significant yield benefit by rice or wheat to soil or foliar boron fertilization in the same fields where soybean showed severe deficiency the previous year. The research did show that tissue concentrations of these crops tended to be near or below the textbook critical concentration suggesting that the textbook critical concentration is likely too high for the particular crop. The textbook critical leaf boron concentrations for rice have not changed but continue to be used to make foliar recommendations to growers.

A number of the nutrient solutions marketed for foliar application contain extremely low amounts of a suite of micro and macronutrients and their application is supposed to provide some insurance that these nutrients will be plentiful enough to ensure no yield limitation.

Tissue testing is a great idea and when done properly the results can help identify potential problems that require additional research, or crop management adjustments and in some cases a research-based recommendation can be implemented to correct an existing nutrient deficiency. While we would encourage tissue analysis at the appropriate critical growth stage, mid- to late-season foliar-feeding based on tissue analysis results we believe are largely unwarranted.

The reasoning for foliar application of many nutrient solutions and biostimulants is simply based on the low application volume and low cost per acre coupled with the product being piggybacked on the field with another planned application of herbicide or fungicide (e.g., application is free).

At the end of the day, this is still a cost that slowly adds up across applications and acres and depletes funds that may be needed for fundamental components of crop management.