Micronutrients Are The Key To Better Yields

Experts say that utilizing the smallest nutrients can unlock the greatest potential

BY LARRY COOPER, WITH DR. RITA ABI-GHANEM

SCIENCE has identified 17 essential nutrients for healthy plant growth. Of these, eight nutrients are required in smaller amounts (boron, chlorine, copper, iron, manganese, molybdenum, nickel and zinc), dubbed micronutrients — as well as several elements that have been identified as non-essential, yet beneficial such as cobalt, silicon, selenium, vanadium, etc.

Micronutrients can sometimes be treated as an afterthought. However, in many ways micronutrients hold the key to how well the other nutrients are used and how well the plant grows, develops and yields.

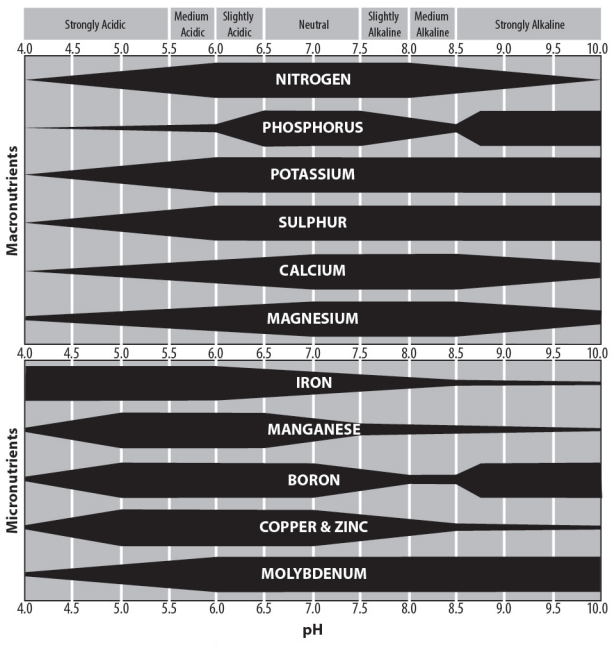
Micronutrients are known to play many complex roles in plant development and health. Micronutrients promote the strong, steady growth of crops that produce higher yields and increase harvest quality — maximizing a plant's genetic potential. In particular, their presence can have a great impact on root development, fruit setting and grain filling, seed viability and plant vigor and health.

Micronutrient deficiency or toxicity can result in stunted growth, low yields, dieback and even plant death. They also benefit plants indirectly by feeding the microorganisms in the soil that perform important steps in various nutrient cycles of the soil-plant root system.

Increasing evidence indicates that crops grown in soils with low levels of micronutrients may not provide sufficient human dietary levels of certain elements, even though the crops show no visual signs of deficiency themselves. In 2000, the *World Health Report* identified iron and zinc deficiencies as being among the world's most serious health risk factors. Micronutrient malnutrition is known or suspected to contribute to a wide range of impairments including reduced resistance to infections, learning disabilities and stunted development/growth of infants and children.

FIGURE 1. Available Macro- and Micronutrients in Relation to Soil pH.

Modifed from Truog E. (1947). Soil reaction influence on availability of plant nutrients. *Soil Science Society Proceedings of 1946. 11-C, 305-308*



The Relationship With Soil

Micronutrients occur naturally in soil minerals, which gradually break down from rock minerals and release in forms that are available to plants. A critically important concept is that of their availability to plants. Micronutrients can sometimes be present in soils but not in a chemical form that roots are able to absorb. Soil physical characteristics and environmental conditions play key roles in determining when and how available soil nutrients — especially micronutrients — are to plants.

For example, acid leaching can remove micronutrients from the soil, as can intensive cropping. Also, excessive use of phosphate fertilizers can diminish the availability of some micronutrients, particularly iron and zinc.

In other cases, extremes in soil pH can result in reduced micronutrient availability (see Figure 1) or even cause micronutrient toxicity. Most plants have a pH range "sweet spot" in which the micronutrients in the soil are soluble enough to satisfy plant needs without becoming so soluble as to become toxic.

The soil itself matters as well. Soils very low or very high in organic matter or with sandy texture or heavy clay can result in micronutrient imbalance. Soil erosion can carry

away humus and organic matter in which some micronutrients are held. Cold, wet soils can result in slowing or stopping plant root development.

Because micronutrients are required in very small amounts for adequate nutrition, the range between "enough" micronutrient and "too much" micronutrient can be a lot more narrow than for macronutrients. Micronutrient toxicities that occur can damage or retard plant growth and affect yield. Toxicities rarely result from over-fertilization: They are more commonly associated with contaminations such as from concentrated wastewater, waste sludges being continuously applied or from the excessive application of copper- or zinc-containing fungicides. Contaminated irrigation water can also be a source of micronutrient toxicity.

Common Deficiencies

Some crops and soil types are more prone to certain types of micronutrient deficiency than others. Examples would include boron deficiency in alfalfa, copper deficiency in wheat, corn and soybeans and molybdenum deficiency in soybeans.

Zinc deficiencies frequently occur on calcareous, high-pH, sandy texture, high phosphorus and eroded soils. Poorly drained soils may also be deficient.

Some of the more common symptoms to look for include stunted growth, delayed maturation, yellowing and wilted leaves (particularly younger leaves), dead growing points and increased root disease. These symptoms often occur in irregular patches within fields and can have a drought-like appearance. Keep in mind that there can sometimes be a "hidden hunger" for micronutrients present, in which crops don't show any overt symptoms until decreased yields are observed at harvest.

Users can perform soil tests to determine micronutrient needs.

While visual symptoms and suspect soil conditions can raise the possibility of micronutrition deficiency, the best approach to identifying a problem and implementing a viable solution lies in regular tissue and soil testing. A local lab or extension office can guide producers through the process, but there are strengths and limitations of each.

Soil testing can only measure the quantity of nutrients

Na Churs

identified as present through analytical methods, not their total levels nor their availability to plants. By combining annual soil testing with regular plant-tissue analysis, ag retailers and their grower-customers can create nutrient ratios providing a much more accurate diagnosis of deficiencies that may be present and the best prescription for addressing those deficiencies.

Timing is also an important element. Testing during early to mid-season plant growth can give time to correct a problem, whereas tissue samples taken during later stages of growth are good to determine corrective actions for the next crop.

If you are dealing with a suspected problem, take plant and soil samples from both the affected areas and the unaffected areas. A comparison of results can help create a much clearer picture of the problem and the actions that should be taken.

Following The 4Rs

Once the need for a micronutrient supplement has been determined, the next steps are clearly identified by the industry standards set out in the 4Rs of Nutrient Stewardship. These include determining the Right Source for supplying the target nutrient, applying the Right Rate for optimal benefit, at the Right Time of application during day, growth stage or the growing season. A detailed discussion of those three Rs is beyond the scope of this article. However, we will further expound upon the fourth R, Right Place, which addresses the application placement and method.

Considering Application Methods

The application method involves whether a producer wants to apply a product directly to the soil (like banding or sidedressing), directly to the plant surface (such as foliar spray) or through the irrigation water (fertigation). Conventional application of fertilizers to soils is most common prior to planting, using ground equipment for spreading or spraying onto the soil. At planting or post-emergence, banding or sidedressing of liquids or granular nutrients are common. Soil-applied fertilization places the nutrients directly in the soil where the soil can buffer and store them and make them available to the crop as needed.

Fertigation, on the other hand, provides the additional utility of applying nutrients at critical periods of crop water demand, which gets to the soil but can also penetrate leaves without the risk of ground equipment compacting the soil or damaging plants (so called “iron blight”). One disadvantage here is that some fertilizers can corrode or stop-up irrigation equipment or may require the expense of specialized equipment for the irrigation system.

Foliar sprays are also well-suited for the application of micronutrients. High-quality sources of micronutrients are able to permeate and diffuse through the leaf surface into the plant. Advantages to foliar sprays are that a uniform field application is easily obtained, nutrient application rates may be lower than rates used for soil application, nutrients may be “piggy-backed” with other crop protection applications to reduce application costs, and the response to the applied nutrient can be almost immediate. Thus, micronutrient deficiencies identified during the growing season can be

quickly corrected.

An additional benefit is that foliar applications bypass any limitations on soil nutrient availability that may be present due to pH issues. However, foliar sprays may not be as effective on younger plants that have less leaf surface area, may result in leaf burn if salt concentrations of the spray are too high, and may leave very little residual effect to replenish the soil for the next planting.

Developing A Micronutrient Plan

It makes sense to have a comprehensive micronutrient plan in place to ensure that you are getting the best crop yields for your money and the extra effort invested. Remember — if you allow micronutrient deficiencies to become a limiting factor in crop development, further application of water, macronutrient fertilizers and other resources/time may give a limited return or be wasted.

Planning begins by knowing which of your fields and which of your crops are most susceptible to micronutrient deficiencies and by routinely conducting soil and tissue tests. When problems are identified and successfully treated, you must keep good records of what was done for future reference. It is also essential to continuously monitor your fields for possible future micronutrient problems. Be aware of any special physical or environmental conditions that may affect future micronutrient availability to your crop.

Micronutrient needs vary with the type of soil, crop planted, available nutrient source and whether or not the crop is irrigated or on dry land. For more specific recommendations, review resources that apply to your locale and discuss your test analyses with your county extension office and your ag retailer. It is important to find the best micronutrient solutions — including the correct amounts and application timing — to help you reach a complete and healthy balance of all the essential nutrients needed for vigorous crop growth and optimal yield.

Cooper is communications manager at Bio Huma Netics, Inc., the maker of the Huma Gro family of products. Dr. Abi-Ghanem is senior director of research and development at Bio Huma Netics and adjunct faculty at Washington State University.