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It Takes More Than Just NPK

Soil moisture, drainage, compaction, pH, and micronutrients are all factors that, if ignored, can limit the potential of NPK.

Summary: Precision agriculture is more than the application of NPK. It requires looking at other factors such as drainage, pH, compaction, soil moisture, and micronutrients. Gathering information through soil testing, tissue analysis, past crop experience, trials, and production levels, enables you to make informed and precise recommendations to help top growers achieve cost-effective increases in yield. The right approach corrects damaging nutrient deficiencies and cultural practices that can hurt your growers. It helps them to focus on more effective ways to use their resources.

Nitrogen, phosphorus, and potassium (NPK) are often the first three factors considered when making recommendations to growers. Stopping here, however, can be costly. The benefits of NPK can be diminished if you overlook other critical elements such as soil moisture, drainage, compaction, pH, and micronutrients. To take your recommendations and your growers to the level of true precision agriculture, you need to determine how these factors are impacting the individual grower.

While all the elements are essential, focus of this discussion will be on those "micro" elements we call micronutrients:

- Zinc (Zn)
- Boron (B)
- Copper (C)
- Iron (Fe)
- Manganese (Mn)
- Molybdenum (Mo)
- Chloride (Cl)

Normally, yield responses to micronutrients are in the range of 10 to 15 percent, which can be significant. Any one micronutrient can limit growth and yield when it is present in deficient amounts. Thus, fine-tuning micronutrient recommendations can potentially give your top growers an added yield advantage.

First order of business will be to look at wrong and right ways to approach the requisites for making recommendations on micronutrients.

Wrong way

Shotgun. Using this approach you simply apply them all and forget about it. Fine and dandy if your grower has money to burn!

Wait and see. By the time you see signs, it will be too late to save the yield. Yield loss also can occur without symptoms because of hidden hunger.

Shortchange. Here you cheat yourself and your grower by limiting yourself to a plant analysis, which by itself won't give you enough information.

Head in sand. You write off micronutrients as too expensive. This head-in-the-sand approach only hurts your growers.

Right way

Inquire. First make a determination of the full range of major, secondary, and micronutrients required for the particular crop being grown.

Table 1. Micronutrient sensitivity of major crops, Vaughan, Harris Laboratories.

Nutrient	Most sensitive field crops	Soil conditions most likely deficient
Zinc	Corn	Soil test <1.5 ppm High pH Cool, wet soil Low organic matter
Boron	Alfalfa Sugar beets	Soil test <1.0 ppm Sandy Low organic matter High pH
Copper	Wheat Peanuts	Soil test <0.3 ppm High organic matter
Iron	Beans Millet Sorghum	Soil test <4.0 ppm High pH High carbonates
Manganese	Navy beans Oats Soybeans	Soil test <2.0 ppm High pH
Molybdenum	Alfalfa Peas	Soil test <0.1 ppm High pH
Chloride	Cereals	Soil test <7.0 ppm Dryland soils testing high in K

Collect information for application rates needed via:
- soil tests
- tissue analysis
- past experience
- trial tests
- production level

This approach enables you to make informed, precise and effective recommendations that are tailored to each grower's needs and resources.

Putting it together

Now that we've briefly explored the wrong and right ways to make recommendations for micronutrients, let us look at the various elements involved in properly approaching micronutrient recommendations.

Crop sensitivity or response to micronutrients is one consideration. It varies by crop. The first two columns of Table 1 list the micronutrient sensitivity of major crops.

When making recommendations for corn, for example, note that the focus is on zinc. Other nutrients are important, but corn is much less responsive to applications of other micronutrients because it generally can find what it needs in the soil.

Soil tests help you determine if nutrients needed by crops are available in the soil. The third column in Table 1 shows potentially critical soil test levels and soil conditions that aggravate the deficiency.

If a soil test indicates that the nutrient level is less than the amount shown in the table and the crop is sensitive to that nutrient, then plants should respond positively to applications of the nutrient. However, soil condition also must be considered.

Soil conditions—including texture, pH, moisture, and organic matter content—influence nutrient availability and can indicate potential deficiencies. In general, sandy soils tend to be more deficient than heavier textured soils. High pH reduces the availability of most Zn, Mn, Cu, Fe, and B.

Soils with less than one percent organic matter are prone to nutrient deficiencies. Soils with more than four percent tend to be less responsive to micronutrients.

When a soil test shows a borderline level of a nutrient but the soil conditions are good (for example, with high organic content and neutral pH), you probably don't need to add more.

However, if soil conditions are unfavorable, such as sandy with high pH, adding more nutrient might be advisable.

Tissue analysis is a powerful diagnostic tool that shows what plants are actually absorbing. It also makes an effective complement to a soil test.

A soil test can be used to predict what is available, but it is based on assumptions that can differ between grower situations, including: adequate moisture, healthy roots, average field conditions, no compaction, and average subsoil fertility.

A tissue analysis tells more about the soil's physical and biological properties, moisture content, and subsoil fertility. It can also indicate hidden hungers for nutrients and deficiencies that may not be visual but still reduce yield.

A tissue analysis shows whether soil test assumptions are valid by showing how well recommendations based on the test actually worked. Information from a tissue analysis can help you fine-tune a soil test program and make more effective recommendations.

Past experience with nutrient deficiencies in sensitive crops can help you make recommendations as well. For example, if your grower noticed a Mn deficiency in last year's soybeans and is switching to oats, which are sensitive to Mn, you will want to add Mn this year.

However, if he is switching to corn, this deficiency may not be an issue unless it was pronounced.

Knowledge of the field—including terraced areas low in organic matter, or sandy or eroded areas where nutrients are probably low—also can be factored into your recommendations.

Monitoring. Adding micronutrients to test strips is a cost-effective way to gather information about how crops in a particular situation respond to micronutrients. This tool is especially useful in places where micronutrients have never been tried or applied.

By using information gathered by yield monitors, you can determine if adding a nutrient is a good investment for the grower rather than paying to cover a whole field and hoping it works.

Management. If a grower is producing below-average yields, less than 100 bu/A of corn or 30 bu/A of soybeans, he needs to correct other yield-robbing factors before worrying about micronutrients. The exception would be situations where chronic deficiencies exist in certain fields.

However, focusing on lime, hybrids, plant populations, weed control, tillage, and timeliness of operations will be a much better use of the average grower's resources. The effect of micronutrients on yield is often less than 10 bu/A—an extra edge for a top producer, but a waste of money for the average grower.

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