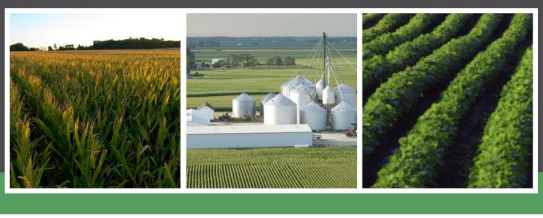

Agronomic Spotlight

Using Soil Tests to Build Proper Nutrients

- When formulating a nutrient package for high yield and sustainability, consider soil test data, the soil type, the crop to be planted, and the field's fertility history including the form of fertilizer and application methods.
- Soil tests, realistic yield goals, and nutrient removal rates can help to determine the amount of fertilizer needed.
- Tools and technologies, such as seed treatment products and nitrogen monitoring software, can help to improve nutrient availability and fertility management.

Interpreting and Using Soil Test Results

Soil tests measure plant-available soil nutrients. However, they do not measure the total amounts of nutrients in the soil because plants can access only a small portion of the nutrients in the soil, nor can they measure inputs of nitrogen and other nutrients from the mineralization (breakdown and release of nutrients) of organic matter. A soil test can measure phosphorus (P), potassium (K), and soil pH, and may also include nitrogen (N), secondary, and micronutrients as well.

The fertilizer recommendations in a soil test report are specific to the crop identified on your soil sample submission form and are based off of locally conducted nutrient response tests with representative soils of the region. In these nutrient response tests, the specific nutrient is added in increments, such as 20, 40, 60, and 80 lb/acre, to soils with known nutrient levels ranging from deficient to adequate for each nutrient of concern in order to determine the response of the crop to the fertilizer inputs. These tests are repeated at numerous locations to account for climatic and soil variations (organic matter content, texture). Yield comparisons from these test plots indicate if, and at what soil test level, a response to added fertilizer will occur based on the soils and climate of the region.

Soil tests generally indicate if the soil is: low, a fertilizer addition will likely increase growth and yield; high, a fertilizer addition is not likely to increase growth or yield; or intermediate, a fertilizer addition may increase growth or yield. This may be expanded to further categories such as: very low, low, optimum, high, and very high. As the test result for a nutrient (most notably N, P, or K) increases from very low to very high, the probability of achieving an economic yield response from an addition of that nutrient decreases from very high to very low.

Soil Test Precautions

Consider the following precautions when taking and interpreting soil test results:

Soil test values should not deviate significantly from year to year. Drastic changes may indicate an unrepresentative soil sample or improper sampling techniques. This can result in fertilizer application recommendations that are too high or too low. Be sure to follow soil sampling recommendations specific to your region for each type of test (such as sampling depth and sampling time) and take soil samples that are representative of the field.

Use caution when taking soil samples if P was previously applied in a fertilizer band. As P is relatively immobile in soil, concentrations of P may be higher where the band was placed, leading to soil tests that indicate adequate P levels when the levels are actually lower.

Flooded or saturated soils can be at risk for significant nutrient loss, particularly nitrate levels. Nitrogen application rates may need to be reevaluated if flooding occurred after a soil nitrate test was taken.

Other Yield Limiting Factors

Having soils with sufficient levels of nutrients does not guarantee that crops will be able to fully utilize them or that yield goals will be reached. Many factors can affect the availability of soil nutrients and crop uptake, and consequently, yields.

Weather and climate. Significant amounts of N can be lost due to leaching and denitrification. Nitrogen loss from microbes in the soil occurs much faster in warmer, more humid climates than in colder or dryer climates.

Soil and field characteristics. Nutrient and water retention and availability are significantly affected by the holding capacity of the soil (clay soils hold more water and have more binding sites to hold nutrients than sandy soils). Soil pH that is too high or too low can limit nutrient availability. Shallow depressions in the field where soils remain saturated and slopes where erosion occurs can also lead to nutrient tie ups and/or loss.

Weed management. Weeds compete with the cash crop for nutrients.

Insect and disease management. Insects, nematodes, and root diseases can damage the roots and hinder the plant's ability to intercept and absorb nutrients.

Realistic Yield Goals

Yields can vary from year to year due to yield limiting factors other than fertilizer application rates (as mentioned above), so applying more fertilizer likely will not improve yield above 10-20%. Thus, a realistic yield goal should not exceed 10-20% of the average yield from the last 3-5 years. Applying fertilizer above the realistic assessment of what the crop can use may result in excess fertilizer that ends up as runoff into

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groundwater and surface water, becoming an environmental pollutant and a wasted expense.

Base Fertilizer Inputs on Realistic Yield Goals

Phosphorus and Potassium. The P and K requirements for a crop are based on the composition of those nutrients in the harvested portion of the plant. For example, an average bushel of corn grain in Illinois removes approximately 0.43 lb of P_2O_5 and 0.28 lb of K_2O, so the P and K requirement for a corn crop in Illinois is approximately 0.43 lb of P_2O_5 and 0.28 lb of K_2O per bushel of expected yield.

If soil nutrients are below the critical levels, fertilizer inputs will need to be applied in order to bring the soil nutrient level to the desired values for the region (buildup); this rate will be indicated on your soil test results. Additionally, fertilizer inputs should replace what will be removed by the crop based on your yield goal (maintenance) calculated as crop removal rate (lb/bu) x yield goal (bu/acre). This is referred to as the buildup plus maintenance approach. While fertilizer applications for the buildup of nutrients will likely result in a yield response if the soil test levels were low, maintenance applications serve to maintain soil test values within acceptable ranges for the long-term.

Nutrient removal rates will vary by crop, geography, cropping practice (for example, harvesting grain versus silage), and other factors. Use local sources for nutrient removal rate estimations. Additionally, the fertilizer recommendation should take into account credits from other sources such as nutrients in irrigation water, manure applications, and mineralization from organic matter.

Nitrogen. For N, the fertilizer rate recommendations are more complicated. The current movement in N recommendations for corn is based on the principle that initial increments of N fertilizer result in large increases in grain yield, but with each succeeding increment of N added, the increase in grain yield plateaus until no further increase in yield occurs from additional N. Many states have now adopted the "maximum return to N" (MRTN) approach for corn, which is the N rate at which the maximum return to fertilizer N is reached. This strategy uses yield responses to N rates averaged over a large number of regional trials and takes into account the economics of corn commodity and fertilizer prices. As the ratio of N fertilizer cost to corn price increases, the MRTN-recommended N rate decreases. Use local data from your state as the yield potential of the soils of the region are a critical component for this recommendation. N-credits from soybean are already calculated into these recommendations and do not need to be subtracted.

Farmers in some Midwestern states should consider using the Corn Nitrogen Rate Calculator at http://extension.agron.iastate.edu/soilfertility/nrate.aspx to determine N application rates. The online tool takes into account the previous crop, expected corn price, N price, and geography when calculating the MRTN rate and the most profitable N rate range. The online tool was developed by Midwestern Universities in Illinois, Indiana, Iowa, Ohio, Minnesota, Michigan, and Wisconsin utilizing results from on-farm N studies in their respective states.

Though secondary and micronutrients are required in lower concentrations than N, P, and K, deficiencies can significantly impact crop growth and yield. Maintaining proper soil pH is the best way to promote the availability of these nutrients. Monitor the crop for deficiency symptoms and have these nutrients included in your soil test if their levels are in question.

Tools and Technologies to Improve Nutrient Availability and Fertility Management

Agricultural biological products are products derived from living organisms that are used to enhance plant productivity and fertility. These products can be seed or soil inoculants that grow with or in association with plant roots to improve plant access to and use of nutrients. Visit **www.MonsantoBioAg.com** for currently available products.

- **Nitrogen-fixing microbial inoculants** for legume crops are commercial rhizobia inoculants developed to out-perform indigenous rhizobia in the soil, providing improved nitrogen fixation.
- **Phosphate-solubilizing microbial inoculants** help to release tightly bound phosphate making it more available for the crop to use.

Seed treatment products can help maximize yield potential by protecting plant roots from damage by early-season insects, nematodes, and diseases, thereby promoting healthy root function. **Acceleron® Seed Applied Solutions** offers three tiers of seed treatment products, Basic, Standard, and Elite. Visit **www.AcceleronSAS.com** to learn more about currently available products.

Nitrogen monitoring software can help track N supplies in your fields allowing for more selective N applications which can prevent N-stress and over-applications. **Climate Fieldview™ Pro** includes a tool called **Nitrogen Advisor** that can assist decision making on which fields require more N and where more N may have been lost. The program continually collects environmental information, such as rainfall and temperature, on each field. Nitrogen needs are predicted based on application dates, crop growth stage, and weather. Visit **www.climate.com/fieldview-pro-for-your-farm/** for more information.

Contact your agronomist for additional information for analyzing your field, product selection, and product placement.

Sources

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