Useful Soil Testing for Efficient Water Use by Plants

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Rio Grande Regional Soil and Water Series

Optimizing Plant Growth for Efficient Water Use
Contain, retain and conserve. Water resources—worth recouping.

Sending a soil sample to an accurate laboratory for the appropriate test is an important first step, but farmers also need to know how to get the most from their soil test results. Tests vary depending on the procedures used by the lab, how results are reported, and the approach used to make recommendations. Soil testing is an important tool that helps farmers make decisions about the amount or need of fertilizers or other amendments. Because soil tests are based on very small samples that often represent many acres, the results are not as certain as farmers might like. Use common sense when interpreting soil test results.

Different labs may use varied procedures. One of the main differences is the solution used to extract soil nutrients from samples. Various extraction solutions have different chemical compositions, so final results from one lab may differ from another. A common test for phosphorus may involve the use of an acid-extraction procedure. However, in New Mexico, the Olsen test for phosphorus gives a more accurate picture of available phosphorus to plants. Besides using region-specific extraction procedures, the soil test levels must be calibrated for a reasonable crop yield response to added nutrients. These levels of yield must pertain to and be calibrated for local soils and climate.

Different labs may report soil test levels differently. Many results are listed both as a number, such as parts per million or pounds per acre, as well as a category, such as low, medium, optimum, high or very high. Others labs may use an index with nutrients expressed on a scale from 1 to 100. In addition, some labs report specific nutrients, such as phosphorus and potassium, in the elemental form. Others use the oxide forms of P_2O_5 and K_2O, which could make a difference in how much fertilizer will be ordered for a field. Further confusion may arise when some labs interchange “optimum” levels with “high” soil test results. To clarify how levels are reported, farmers should ask for more information from the lab prior to sending in the sample. Also, ask for the lab’s estimate on the probability of getting a crop response with added fertilizer to determine the needs based on a sustainable management plan.

Different labs may use similar procedures but take different approaches to making recommendations, leading to differences in suggested fertilizer needs. There are **three approaches** to fertilizer recommendations that are widely used: the deficiency correction philosophy, the maintenance philosophy and the nutrient removal or balance philosophy.

The **deficiency correction concept** resulted from research on crop response to nutrient additions in lower supply than needed for maximum growth. This approach only recommends fertilizing to the point of economic yield. The recommendations for fertilizer meet crop needs and provide some increase in soil levels. This is a practical approach for farmers who deal with short-term leases and do not want to invest in building up nutrient rates in the soil. It also works for farmers who want to limit fertilizer costs during seasonal periods when fertilizers are more expensive or in short supply. This approach tries to reach the maximum economic yield (MEY), in which the most profit is made from the fertilizer purchase for a sustainable system at that point in time.

The **maintenance concept** is used more often by commercial soil testing labs. This type of recommendation works to maintain the soil fertility level at or slightly above the point of MEY to benefit farm-

ers over a period of time. In other words, this concept considers crop maintenance plus a slight build-up approach. This is a practical method for landowners who expect to be in business for many years and, thus, can afford a bigger initial investment in fertilizer, especially if fertilizer prices are low and supplies are ample.

The **nutrient removal or balanced philosophy** suggests that for optimum crop growth there is a best ratio of basic cations and a best total base saturation for a given soil. This concept really applies only to calcium, magnesium and potassium needs in fields that require lime and does not apply to most fields in New Mexico where soil pHs exceed 7. Using the cation exchange capacity (CEC), this concept simply tries to return to the soil what is removed by the crop to maintain productivity. Unfortunately, this philosophy often over recommends nutrient needs as it does not account for the soil's ability to supply or make available nutrients to plants over time.

Labs also may use a combination of these methods, especially if targeting certain nutrients or limiting others known to be ample in certain regions. Some labs may assume that soils will not be tested annually and, thus, provide a recommendation that combines the sufficiency concept and some additional fertility for maintenance in order to cover possible needs for the next year.

Thus, a common sense approach to lab fertilizer recommendations, the current status and long-term goals of farming a particular piece of ground and the crop's value can all have an impact on the decision to apply fertilizer. Generally, the lower the crop's value, the greater the economic penalty for extra nutrient applications. As soil nutrient levels increase, there is less chance additions will always result in greater yield. Therefore, crop value greatly influences the philosophy farmers might consider using for their fields.

Most university testing labs use the sufficiency level system. However, a few university labs and many commercial labs use the build-up and maintenance system. Some university tests have shown that the sufficiency system results in using less fertilizer and tends to give higher economic returns than the build-up and maintenance system (studies conducted in Kentucky, Nebraska, Ohio and Wisconsin). For New Mexico, the sufficiency system may work well as long as testing reveals true nutrient needs through specific testing and extraction procedures, such as that needed for phosphorus.

While soil tests are common for determining fertility needs, plant tissue tests also can be used. These tests are helpful, especially when a series of historical tissue tests show plant needs through seasonal use. Useful for nutrient management in perennial crops like apple, citrus, peach, pecan and vineyards, these tests also can be used for annuals. Use leaf petiole nitrate tests to help fine-tune nitrogen needs for potatoes and petiole nitrate tests to optimize quality considerations for cotton and to optimize plant growth during the transition from vegetative to reproductive growth. For irrigated vegetables, farmers should check with their county Extension agent to find out what test is best for each crop.

Rio Grande Basin Initiative

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