Using Plant Tissue Analyses for Efficient Plant Growth and Water Use

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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.

Analyzing plant fertilizer needs can involve a simple chemical test on plant parts or a detailed laboratory inspection of either parts or the whole plant. A more specific analysis, which can be used in conjunction with soil analyses or for historical reference on a field for a specific crop, is used to measure certain soluble nutrients in plant cell sap. Various plant analyses can measure any or all of the elements that are soluble or part of the plant tissue. Generally, these tests are divided into tissue tests, petiole analyses or total analyses.

Plant tissue analyses can provide on-the-spot field tests. Kits vary from a few chemicals and test papers to elaborate supplies of chemicals, vials and spot plates, which are better used indoors. Nutrient levels determined from these tests are accurate only in terms of high, medium or low values.

The most general plant tissue tests available are for nitrogen, phosphorus and potassium in such crops as corn, potatoes, small grains, sorghum, tomatoes and some pasture grasses. Crops, such as alfalfa, edible beans, soybeans and some clovers, are tested for phosphorus and potassium content.

Petiole analysis, which tests for nitrogen only or nitrogen and phosphorus levels, falls between tissue testing and total analysis in accuracy. Run in a laboratory, the chemical methods used require more exacting procedures and provide a better picture of fertility needs than tissue tests. In fact, petiole analysis programs have been used successfully to monitor nitrogen levels in crops, such as cotton, grapes, lettuce, potatoes, sugarbeets and tomatoes. The quality and yield of these crops are greatly affected by nitrogen content.

Total analysis paints a very accurate picture of nutrients across a variety of crops. Using precise, analytical techniques and nutrient response data, these tests are reported in parts per million (ppm) or in percentages or both. Primary, secondary and micronutrients can be determined with these tests. The testing even can be used to determine if toxic levels of certain nonnutrient elements exist in plant material. Like the other two plant analyses, total analysis usually is done in conjunction with a soil (and, if available, irrigation water) analysis program.

All plant analyses are used primarily to evaluate the fertility status of a field for a specific crop to determine the effectiveness of the fertilizer program at a given time. A secondary purpose is to determine if specific crop production problems may be the result of excess nutrients or the presence of toxic elements. These tests also can be used to diagnose or confirm visual symptoms and to, perhaps, reveal deficiencies before a problem is visible.

Research has shown that specific plant parts should be used for specific crops (table 1), so that the plant analyses are most useful. For instance, tissue testing corn from the midrib of the leaf opposite and below the ear is a good indicator spot for phosphorus and potassium. Nitrogen testing is better on parts from the lower portion of the stalk. Remember, timing of the sampling for specific crops also is important (table 1).

Also, while plant analyses are useful and some nutrient deficiencies can be detected in annual crops in time to correct the problem, the long-term goals for soil fertilizer needs are important. It can be easy to correct nitrogen deficiencies, if they are detected early

Table 1. Plant sampling suggestions for specific crops.

Crop	Sample Timing	Plant Part Sampled	Number of Plants
Alfalfa	1/10 bloom or before	Mature leaf blades, 1/3 down plant	45-55
Cereal grains	Seedling or prior to heading	All aboveground parts	50-75
Clover	Prior to bloom	Mature leaf blades, 1/3 down plant	50-60
Corn	Seedling	All aboveground parts	25-30
	Prior to tassel	Top, first fully developed leaves	15-20
	Tassel to silk	First leaves below and and opposite the ear	15-20
Cotton	Prior to or at first bloom, when first squares appear on main stem	Youngest, fully mature leaves	30-35
Forage grasses	Before seed head emergence	Four upper most leaf blades	50-60
Peanuts	Before or at bloom	Fully developed leaves from the plant’s top	45-50
Sorghum	Before or at heading	Second leaf from the plant’s top	20-25
Soybeans	Seedlings	All aboveground parts	20-30
	Initial flowering	First fully developed leaves from the plant’s top	20-30
Sunflowers	Prior to heading	Mature leaves from plant’s top	25-30

enough. But it is more difficult to correct potassium deficiencies after a crop is established. Phosphorus and micronutrient problems are almost impossible to correct within one cropping season. On the other hand, perennial crops often can be managed just by using soil and any indicated plant analysis data.

To use plant analyses well, farmers also need to know the soil’s chemical and physical characteristics (through an intensive soil sampling program); the crop’s physiological stages and characteristics at the time of plant sampling; information about the influence of the environment on the crop sample at that time; any possible effects from irrigation water, crop management programs, chemical and physical characteristics and reactions of the fertilizer materials to be used; and even the changes in nutrient availability once the fertilizers are applied.

Collecting plants for analysis must be handled correctly. The plant samples should not be placed in a sealed plastic bag or container. Instead, a paper bag or the suggested bag from the plant analysis laboratory should be used for shipment to the lab. If mailed, place the paper bag into a box that can be shipped easily by mail without damaging the plant. Information, such as plant growth stage, specific concerns and tests requested as well as any background about previous soil samples, the environment, irrigation water, crop management and even the proposed fertilizer program, should be included with the mailing. Also, it would be helpful to ship in a separate bag to avoid cross-contmaination any example plants that do not seem to exhibit the problem. Mark the bags so the laboratory staff can easily distinguish the samples. Ship or deliver the samples to the laboratory as quickly as possible to ensure that the materials will be of good quality for testing.

In addition, if a soil sample for the area where the problem plants exist has not been analyzed within the last year, send in a representative sample to a soils laboratory to back up any information received from the plant samples and to maintain a history that could be helpful later.

Rio Grande Initiative

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