



## SOIL, WATER AND PLANT TISSUE TESTING IN UTAH ORCHARDS

*Richard T. Koenig*, Extension Soil Specialist  
*Thor Lindstrom*, Fruit Tree Research  
Technician

December 2001

AG-FG-02

### INTRODUCTION

Fruit trees require the appropriate soil and irrigation water conditions, as well as proper fertilization, in order to maximize fruit yield and quality. Diagnosing soil, water and plant fertility conditions involves testing each component at the appropriate time during orchard development. Soil testing is important before establishing an orchard to evaluate initial site conditions and take any corrective action before trees are planted, and at regular intervals to determine if soil conditions are changing. Irrigation water testing is important to evaluate the quality and limitations of a water source prior to its use on trees, and periodically to determine if water quality is changing. Finally, plant tissue (“leaf”) testing is the most reliable and timely indicator of fruit tree nutrient status in orchards and should be done on an annual basis or more frequently if problems arise.

#### The Orchard Fertility Series

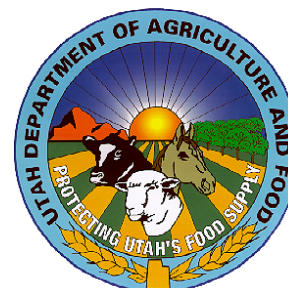
The orchard fertility series consists of several bulletins from Utah State University Cooperative Extension describing the latest information on soil and fertilizer management for fruit trees. The guides are available in printed form from your local county Extension office, or on the Internet at <http://extension.usu.edu> under Agriculture Publications.

### SOIL TESTING IN UTAH ORCHARDS

Soil testing is one important tool used to evaluate the suitability of a new site for an orchard. Many soils in Utah have high levels of soluble salts (“salinity”) and/or high pH. Either condition can reduce tree vigor and fruit production and, at extremely high levels, can

#### ACKNOWLEDGMENTS

Publication of this series of Utah State University Extension fertilizer guides is made possible by a grant from the Utah Department of Agriculture and Food through the Cooperative Fertilizer Checkoff Research and Education Program.



cause complete orchard failure. Texture is also an important characteristic of orchard soils. Fruit trees generally perform well in soils with adequate drainage, such as sandy or loam-textured soils. Soil nutrient levels also influence fruit tree production. Deficiencies in soil nutrient levels can be corrected much more easily by diagnosing the problem through soil sampling and incorporating the appropriate nutrients before planting trees.

Soil properties can vary across an orchard site. Therefore, proper sampling techniques are important to ensure a representative sample is collected for analysis. Variability is addressed by sampling different areas separately, and collecting a composite sample within each area. Inspect the site for any obvious visual differences in soil type or condition. For example, if soil from one area appears to be higher in clay and/or is darker than the remainder of the site, sample this area separately. Within similar areas, collect a minimum of five soil samples or one sample for each two acres of the orchard. Collect the samples to a depth of 12 inches (one foot). Place these samples in a clean plastic (not metal) bucket and mix well. Remove approximately 1 pint of soil and place it into a plastic bag to submit to the lab for analysis. Your local county Extension office has additional information on soil sampling and mailers used to submit samples.

Soil tests for texture, pH, salinity, phosphorus, potassium, zinc and manganese should be conducted to evaluate the suitability of a new site prior to planting trees. These analyses may cost up to \$25 per sample and includes interpretations of test results and recommendations. A more complete analysis including the parameters mentioned above as well as sulfur, organic matter, and nitrate-nitrogen may cost up to \$50 per sample. The cost of soil testing is small relative to the investment made in trees at the time of planting.

Periodic soil sampling after the orchard is established can also help monitor changes in soil properties before they begin affecting tree growth. Maintain records of soil properties from the initial sampling and compare these results to samples collected every three to five years to determine if pH, salinity, or nutrient levels are changing over time as a result of management practices.

## **WATER TESTING IN UTAH ORCHARDS**

Irrigation water is required to ensure optimum tree yield and fruit quality. Like soils, irrigation water quality varies significantly throughout Utah. High levels of soluble salts (salinity), carbonate, bicarbonate, sodium, chloride and boron can be found in many shallow wells and surface water sources. An irrigation water quality analysis prior to establishing an orchard can indicate whether the water is acceptable, marginal or unacceptable for use on fruit trees. Water sources can also change over time. Periodic testing can indicate whether problems are developing with a water source before they begin affecting trees.

Sample irrigation water directly from the source. If the source is a well, pump the well for a minimum of one hour to ensure the sample is representative of the well water. Sample canal waters at the point of diversion for the orchard.

Use a clean plastic bottle with a minimum one pint volume to collect the sample. Rinse the bottle a minimum of three times in the water before taking the sample. Cap the sample and mail or deliver it to the lab immediately. If necessary, keep the sample refrigerated until it can be taken to the lab. Irrigation water samples should be analyzed for salinity, carbonate and bicarbonate, sodium, calcium, magnesium, boron, chloride and sodium adsorption ration (SAR). These analyses may cost \$18 per sample and include an evaluation of the suitability of the water source for use in irrigating orchards.

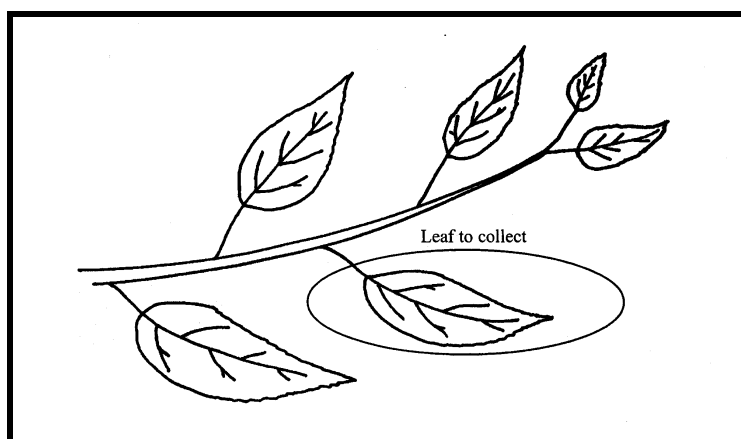
## PLANT TISSUE TESTING IN UTAH ORCHARDS

Leaf analysis is the most reliable indicator of fruit tree nutrient status. Leaf analysis is also useful in differentiating between nutritional problems and disease symptoms. Considerable research has been conducted to identify critical nutrient concentrations in leaves of various fruit tree species. When properly sampled and analyzed, leaf tissue nutrient levels can be compared to historic critical nutrient concentrations to identify deficient, adequate and excess levels.

Leaf nutrient concentrations vary throughout the growing season. For routine tissue testing in orchards, leaf samples should be collected between July 15 and August 15. This is the standard growth window where most critical nutrient concentration research information is available for Utah. When sampling an orchard, select five trees of the same variety within a block no larger than five acres. Do not include trees with obvious visual problems. Sample problem trees and different varieties separately. Randomly collect 10 to 20 leaves per tree from shoulder height, selecting leaves from the center of the current season's growth (Figure 1).

Tissue analysis can also be used to diagnose problems occurring during the growing season. If one or more trees appear abnormal and samples cannot be collected during the normal July 15 to August 15 window, the collection of paired samples greatly enhances the diagnostic value of tissue testing. Paired sampling allows the analytical lab and grower to compare the nutrient status of healthy trees to abnormal ones at times outside the normal sampling window. To collect paired samples, select 10 to 20 leaves from several abnormal trees and combine them into one composite sample. Also collect 10 to 20 leaves from normal trees of the same variety growing in the same area and combine these into one composite sample.

Leaves are typically covered with a fine layer of dust that may influence the tissue analysis. Rinse collected leaves for 30 seconds in clean running water and allow to air dry before submitting samples for analysis. Mail or transport the samples as soon as possible after collection. If delayed, refrigerate samples. Request a complete analysis of each fruit tree tissue sample, including nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg),



**Figure 1.** Photograph and diagram indicating the correct location to collect leaf samples.

sulfur (S), iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn). A complete analysis may cost \$25 per sample and includes interpretations and fertilizer recommendations.

### **FOR MORE INFORMATION**

The Utah State University Analytical Laboratory regularly tests soil, irrigation water and plant tissue samples from orchards. Contact your local county Extension office for copies of lab information forms and mailers, or contact the USU Analytical Laboratory directly at (435) 797-2217. Other labs in your area may also analyze samples. Check the yellow pages and contact the lab before submitting samples to make sure they are familiar with orchard sampling and interpreting the results.

### **FOR FURTHER READING**

Mills, H.A. and J.B. Jones. 1996. **Plant Analysis Handbook II**. A practical sampling, analysis and interpretation guide. Micro Macro Publishing, Jefferson City, MO.

Righetti, T.L., K.L. Wilder, and G.A. Cummings. 1990. Plant analysis as an aid in fertilizing orchards. Chapter 22 in R.L. Westerman (Ed) **Soil Testing and Plant Analysis**. Soil Science Society of America Book Series No. 3. Soil Science Society of America, Madison, WI.

Walker, D.R., R.L. Smith, S.D. Seeley, R.E. Lamborn, A.R. Halvorson, and J.L. Anderson. 1979. Fertilization of fruit crops. Utah State University Extension Leaflet #106.

Walker, D.R., A.H. Hatch, and T. Lindstrom. 1989. Fertilization of fruit crops. Chapter 4 in **The Utah Fertilizer Guide**. Utah State University Extension, Extension circular 431.

<p>Utah State University is an affirmative action/equal opportunity institution. Issued in furtherance of Cooperative Extension work. Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Jack M. Payne, Vice President and Director, Cooperative Extension Service, Utah State University. (EP/12-01/DF)</p>
--