

Use of Tissue Analyses in Woody Ornamental Nurseries¹

Thomas H. Yeager and Dewayne L. Ingram²

Determining levels of nutritional elements in woody ornamental plant tissue can be a valuable diagnostic and/or management tool for the nursery operator. However, sampling procedures must be performed correctly and at the proper time in order to obtain beneficial results. The nursery operator should not rely totally on tissue testing as a means of monitoring the nutritional status of plants. Tissue analyses should be used in conjunction with media nutritional analyses to obtain the nutritional status of the container plant system. Relying totally on media or tissue analyses for the basis of nutritional management decisions could result in improper management.

WHY USE TISSUE ANALYSIS?

Plant tissue analysis is a valuable aid for determining the nutritional status of plants for routine management purposes, for diagnosis of plant nutrient deficiency symptoms, and for determining whether a particular element(s) is being absorbed during a selected period of time. Slight deficiencies of nutrients may be limiting growth, with no apparent visual symptoms. Tissue analysis can allow the nursery operator to compare the nutritional status of the crop with past records or published ranges of

nutrient percentages as in Table 1. Such information coupled with other information such as time of year and growing medium nutritional status provide the background for correct management decisions.

Tissue analysis is useful for determining the nutritional status of plants in the fall but is most practical for plants of north Florida that do not exhibit shoot elongation during winter months. The spring growth is dependent upon the previous fall tissue nutritional levels, so it is important for plants to accumulate nutrients to a maximum in the fall without a flush occurring. Tissue analyses are used to monitor nutrient accumulation that serves as a basis for the decision as to whether additional fall fertilizer is needed for maximum spring growth.

Visual nutritional deficiency symptoms are excellent guides to deficient elements but should be verified by tissue analysis because excessive levels of one element may result in deficiency symptoms of another element. For example, high tissue phosphorus levels may be exhibited as iron deficiency although iron tissue level is adequate.

Tissue analyses are useful for determining whether the plant is absorbing a particular

-
1. This document is OHC16, one of a series of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date November 1992. Reviewed October 2003 and February 2010. Visit the EDIS Web site at <http://edis.ifas.ufl.edu>.
 2. Thomas H. Yeager, professor and database coordinator for Commercial Nursery Production; Dewayne L. Ingram, former professor, Environmental Horticulture Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Millie Ferrer-Chancy, Interim Dean

element(s), although caution should be used when interpreting results expressed as a weight percentage. The weight of tissue may be increasing at a greater rate than absorption of an element(s) and consequently the percentage of the element expressed on a dry weight basis would decrease with time. An increase in the elemental percentage along with an increase in growth (weight) indicates that the element(s) in question is being absorbed.

WHEN TO SAMPLE

Most woody plants exhibit episodic growth or flushes in which shoots elongate for two or three weeks then cease. Four or five weeks later the shoots will exhibit another flush of growth if environmental conditions are favorable. One must give particular attention to the stage of these flushes when removing leaf samples. The leaves should be removed after elongation has ceased and just as buds begin to swell prior to shoot elongation. It is very important to remove uppermost or most recently matured leaves at this time because as elongation occurs nutrients are mobilized from mature leaves to immature leaves. Consequently, the nutrient status of matured and immature leaves is changing during elongation. If leaves are not sampled as buds begin to swell prior to elongation, the elemental content of the leaves will vary due to maturity of tissue or sampling time.

HOW TO SAMPLE

The sampling procedure and number of samples will vary according to plant species, cultural and environmental factors, and purpose of analysis. Generally, plants grown under similar conditions can be treated as a group when sampling, although samples from different species should not be mixed. If plants of the same species have been grown under different cultural or environmental conditions, then each group of plants should be sampled separately. It is very important to remember a tissue sample must be representative of plants sampled.

For example, an acre of plants of the same species that have been treated similarly would require only one to three composite samples. Each sample would be composed of 20 to 30 uppermost mature

leaves selected randomly from the acre of plants. Thus, only 1 or 2 leaves for broadleaf evergreens or 1 or 2 shoot tips (1 and one-half inches long) for narrowleaf evergreens would be removed from a single plant to obtain a sample of green tissue that weighs from 3 to 10 grams.

When sampling for diagnostic purposes, obtain three samples of tissue that are the same age from aberrant and "normal" tissue. This tissue may be from the same plant or more than one plant depending upon the quantity of tissue available. If an inadequate amount of tissue is available, reduce the number of samples but be very selective when choosing tissue. Samples that represent different stages of aberrance should also be obtained to determine whether tissue elemental content changes as the aberrance progresses.

One should also be very selective when sampling from large-leaved plants. Fewer large simple leaves from a plant like loquat would comprise a sample, thus the potential for error is greater. Error can be minimized by increasing the number of samples. The large leaves of plants like palms or cycads are composed of smaller leaves called leaflets that should be sampled for tissue analysis. It is important to sample leaflets from the same position within each leaf and to sample leaves of the same maturity.

Collect tissue samples in brown paper bags and mark with appropriate identification and sampling date. Plastic bags should not be used since moisture released into the environment surrounding the tissue within the bag can not escape through the plastic and the samples would mold.

All samples should be free of insect and disease infestations or damage, and avoid samples with spray residues. Some residues and debris may be removed from foliage by wiping with a paper towel moistened with distilled water. Avoid sampling plants subjected to environmental stress or mechanical injury. Samples for routine analysis should be sent to a commercial laboratory.

INTERPRETATION

The reason or purpose for sampling must be kept in mind when comparing test results with values given in Table 1 . Compare the magnitude of table values with test results as well as the ratio between elements. For example, levels of nitrogen are about one and one-fourth times those of potassium and eight times the levels of phosphorus. Calcium percentages are about one and one-third times those of magnesium, and potassium percentages are about two to six times those of magnesium. Optimum iron levels are about two times the levels of manganese.

Seldom are all elemental test values within the ranges given in Table 1 but these values are only intended to be guidelines. Plants have different nutritional requirements so sound judgement must be used in interpreting test results. If routine sampling consistently reveals higher or lower levels than given in Table 1 , yet plant growth is better than average, establish your own tissue level guidelines for those plants. Guidelines should be established for plant categories such as broadleaf and narrowleaf evergreens, and deciduous plants. These categories may be subdivided if desired but it is important to establish categories from which representative plants will be sampled in the future. Tissue testing records established for these categories are an invaluable management aid.

Table 1.

Table 1. Elemental ranges for uppermost mature leaves of woody ornamentals.	
Element	Percent*
Nitrogen	2.0 - 2.5
Phosphorus	0.2 - 0.4
Potassium	1.5 - 2.0
Calcium	0.5 - 1.0
Magnesium	0.3 - 0.8
	Parts Per Million
Iron	100 - 200
Manganese	50 - 100
Zinc	20 - 75
Copper	5 - 10
Boron	20 - 30
Molybdenum	0.1 - 1.0
* Percent of leaf dry weight	