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Foliar Sampling for Fruit Crops

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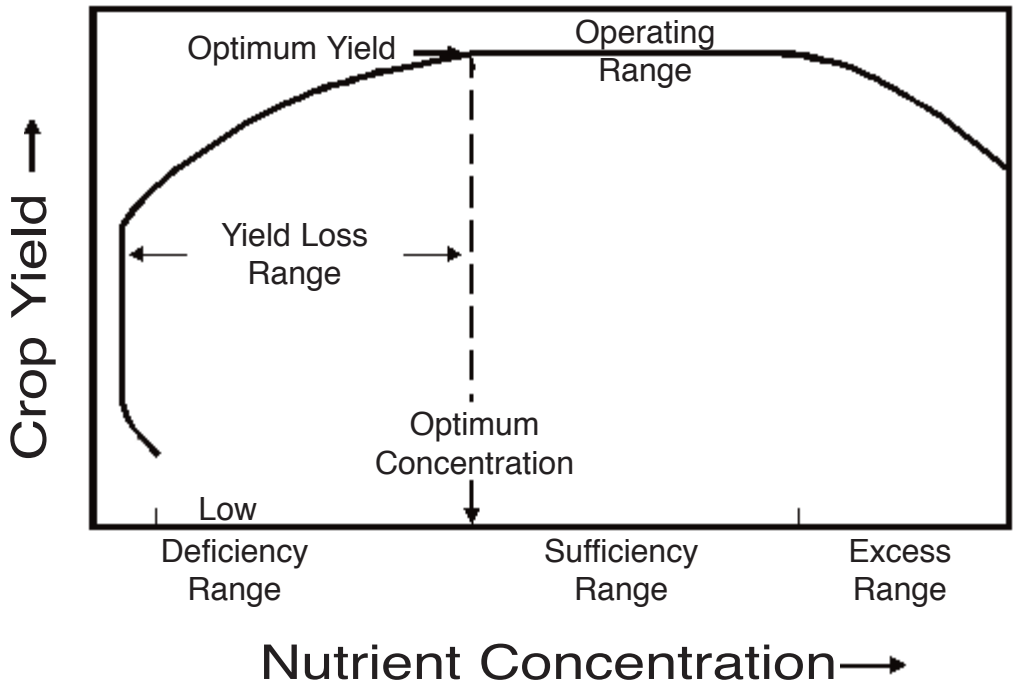
Fruits and Nuts

One valuable method to determine the nutrient status of an orchard is foliar (leaf and petiole) nutrient analysis. The results from these tests, along with the soil test, should be used as a guide in assessing the nutritional needs of the orchard and applying the correct amount of fertilizer needed for plant maintenance, growth and fruit quality. Growers routinely add fertilizer year after year without knowing what elements the plant actually needs. This practice can lead to nutritional imbalances, deficiencies or toxicities with serious consequences in yield, fruit quality and even plant death. In addition, growers waste money and contribute to groundwater pollution by applying unneeded fertilizer.

Foliar analyses tell you the actual nutrient levels in the plant. These levels are classified as *deficient*, *sufficient* and *toxic*.

The sufficient ranges of the macro and micro nutrients are the minimal critical concentrations necessary for the plant to maintain growth and productivity (Figure 1). Below and above the sufficiency ranges, nutritional disorders affect the overall performance of the plant.

Figure 1. Schematic of the Relationship Between Yield and Nutrient Concentration (Chapman 1966).



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The sufficiency ranges are based on extensive research using specific criteria such as stages of plant development and leaf position where the sample is collected. In order for the laboratory to make a successful diagnosis, the samples should be collected at the correct time and leaf position as specified in Table 1. Samples should represent the ***average*** condition within the orchard unless special samples are being taken to determine cause(s) of a distinct problem or condition. Most fruit crops are analyzed for nutrient levels in summer. Strawberries are the exception; sampling starts when spring growth begins and continues throughout flowering and harvest (approximately March 1–May 30).

General Guidelines to Use When Collecting Samples for Foliar Analysis

Contact your county Extension agent for foliar analysis kits. These kits explain in detail the sampling procedure.

- Collect samples on the dates indicated. The nutritional status changes with the different growth stages of the plants.
- Different cultivars should be sampled separately. There are variations in nutrient levels depending on cultivars.
- Leaves should be collected from shoots of average vigor (length and diameter) for the trees in the planting.
- Do not combine healthy leaves with those from plants showing definite problems.
- Single varieties growing on different soils should be collected separately.
- For trees having spurs, do not include spur leaves.
- Do not include leaves damaged by disease, insects, weather or mechanical injury.
- Remove the leaves by pulling downward so the petiole remains attached to the leaf.

Washing Foliar Samples

- Wash the samples while still fresh, ***before they wilt***. If a large number of samples are involved, they can be stored overnight in a cold storage, refrigerator or ice chest to keep them from drying out.
- Use distilled water (available at most drug stores) for rinsing the samples.
- Change the water as it becomes dirty or after 8 to 10 samples (whichever comes first).
- Shake and remove excess water.
- Spread out samples on clean paper towels until leaf surfaces are dry.
- Place leaves in a dry paper bag and immediately label the bag so that you will know where the sample came from.
- Leave top of bag open until the leaves begin to dry.
- Take the samples to your county Extension office. They will be responsible for mailing the sample(s) to the University of Arkansas Agricultural Diagnostic Services Laboratory.

Interpreting Your Results

Table 2 provides the sufficiency ranges of the macro and micro nutrients for fruit crops. When determining the nutritional status of your orchard, keep the following in mind:

- Regular sampling is more valuable than using leaf analysis only when nutritional problems are evident. A series of analyses over a period of years can indicate approaching nutritional problems.
- Increasing crop load increases the total N requirement of the trees.
- Crop load can reduce potassium (K) in the leaves.
- Often when little or no growth occurs, nutrients are concentrated in the leaves and deficiencies may not be apparent.
- Excessively vigorous trees may show deficiencies due to a dilution effect rather than an actual deficiency.
- Drought decreases the amount of nutrients being delivered to the root surface and results in nutrient deficiencies.
- Nutrient activity is often interrelated: The optimal value of one mineral element may depend on the levels of another, and modifying one nutrient will likely alter another.
  - Increasing the application of K or magnesium (Mg) is reflected not only in a decrease in the foliar concentration of the element not applied, but foliar levels of calcium (Ca) are also often decreased.
  - In the interpretation of leaf analyses, levels of K in the mid to upper portions of the sufficiency range, coupled with low foliar Ca, would warrant restriction in future use of K fertilizers.
  - In the interpretation of zinc (Zn) foliar levels, it appears that the soil Zn levels are of the utmost importance, but the uptake, translocation or utilization of Zn can be altered with an increase in the phosphorous (P) levels.

Table 1. Foliar Sampling Procedures for Fruit Crops		
Crop	**Sampling Procedure**	**When to Sample**
Apple	Select 60 to 100 leaves per sample from the middle of current-season terminal shoots. Select 1 or 2 leaves per shoot from several shoots on each of several trees exposed to light. Shoots to be sampled should be 5 to 7 feet above ground level in larger-sized trees and 3 to 6 feet above ground level in smaller-sized trees (young trees, trellised or slender spindle plantings). Sample 5 to 10 trees per acre.	Eight to ten weeks after full bloom
Blackberry	Collect 50 to 100 mature leaves from primocanes in the section 6 to 10 nodes from the terminal.	Mid to late July
Blueberry	Take 50 to 100 mature leaves from mid-portion of fruiting cane from across the field.	Collect leaves during the first two weeks after harvest.
Grape: Table, wine, juice	Collect 100 petioles from most-recent mature leaves next to fruit clusters.	Collect petioles in mid to late summer before veraison (when the fruit begins to change color).
Grape: Muscadine	Collect 50 to 100 leaves from most-recent mature leaves next to fruit clusters.	Collect leaves mid to late summer before final swell of the fruit.
Peach	Collect 50 to 100 mature leaves from the mid-portion or near base of current-season terminal growth. Sample 5 to 10 trees per acre.	Mid-season
Pear	Select 60 to 100 leaves from the middle of current-season terminal shoots. Select 1 or 2 leaves per shoot from several shoots on each of several trees exposed to light.	Eight to ten weeks after full bloom
Pecan	Sample the middle pair of leaflets from the mid-portion of terminal growth 56 to 84 days after catkin fall.	Early July to early August
Strawberry	See your county Extension agent for specific instructions for strawberry petiole analysis.	

Table 2. Macro and Micro Nutrient Sufficiency Ranges for Fruit Crops									
	Apple	Blackberry	Blueberry		Grape		Peach	Pear	Pecan
			Highbush	Rabbiteye	Wine, Table	Musca-dine			
Macronutrients									
N (%)	1.80-2.10	2.00-3.00	1.70-2.10	1.20-1.70	0.66-1.10	1.65-2.15	2.75-3.50	1.80-2.50	2.50-3.30
P (%)	0.15-0.50	0.25-0.40	0.10-0.40	0.08-0.20	0.11-0.35	0.12-0.18	0.12-0.30	0.12-0.30	0.12-0.30
K (%)	1.25-1.80	1.50-2.50	0.40-0.65	0.35-0.60	1.00-3.00	0.80-1.20	1.30-3.20	1.00-2.00	0.75-2.50
Ca (%)	1.00-2.00	0.60-2.50	0.30-0.80	0.25-0.70	1.26-3.00	0.70-1.10	1.50-2.50	1.00-2.00	0.70-1.75
Mg (%)	0.20-0.50	0.30-0.90	0.15-0.30	0.14-0.20	0.46-1.25	0.15-0.25	0.25-0.50	0.25-0.50	0.30-0.60
S (%)	NA	NA	0.12-0.20	0.11-0.25	0.13-0.35	0.15-0.60	0.12-0.40	0.10-0.30	0.20-0.50
Micronutrients									
Fe (ppm)	50-400	50-200	60-200	25-70	31-100	60-120	>60	30-150	50-300
Mn (ppm)	25-200	50-200	50-350	25-100	61-650	60-150	>20	20-200	100-800
Zn (ppm)	20-50	20-50	8-30	10-25	41-100	18-35	20-50	20-50	50-100
Cu (ppm)	5-20	7-50	5-20	2-10	6-20	5-10	5-20	5-20	6-30
B (ppm)	25-60	20-50	30-70	12-35	25-50	15-25	20-80	20-60	15-50

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