



How to Submit Plant Tissue Samples

Why Should I Do Plant Tissue Analysis?

Plants require a steady supply of essential mineral nutrients for optimum growth and development. A shortage of any nutrient can result in poor crop quality and reduced yields. Plant tissue analysis, used in combination with soil testing, is an excellent way to develop an overall soil management program while monitoring plant health and fertility.

While soil testing determines the nutrient status of the soil, plant tissue analysis shows how well crops are recovering those nutrients from the soil. "Hidden hunger" and visual deficiency symptoms can be verified, pinpointing which nutrients plants need.

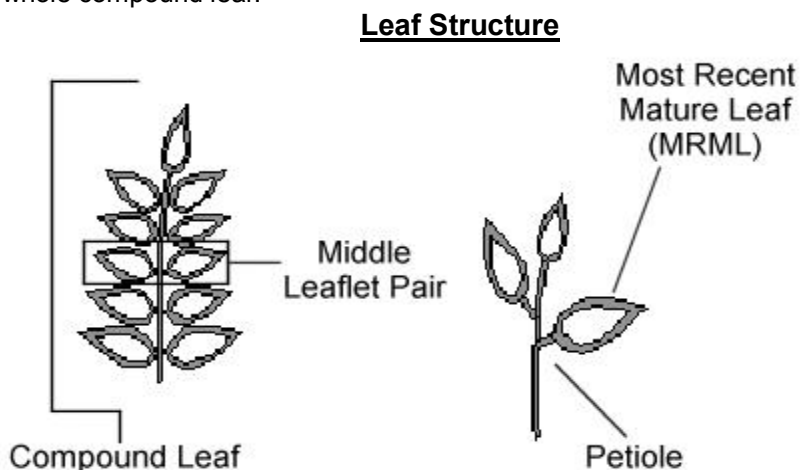
Before You Begin – A Few Words About the Importance of Proper Plant Sampling Techniques:

The plant tissue sample collection process varies from plant to plant. To take the guesswork out of the collection process, we have provided detailed information in the "What to Sample" and "How to Sample" sections below. In addition to providing some plant illustrations, we have included reference tables giving crop-by-crop specifics on when to sample, which parts of the plants to take, and how many samples are needed.

As background, here are a few basics on leaf structure. A leaf is made up of a leaf "blade" and a "petiole." The petiole is the stalk attached to the blade. A compound leaf may have several "leaflets" attached to it. In some cases, only terminal leaflets may be sampled, as is the case of walnuts and pistachios. A common error in testing tomatoes is when only leaflets are sampled instead of the whole compound leaf.

The most recent mature leaf (MRML) is the first fully expanded leaf below the growing point. It is neither dull from age nor shiny green from immaturity. For some crops, the MRML is a compound leaf. For example, the MRML on soybeans and strawberries is a trifoliate compound leaf, or three leaflets comprising one leaf.

In some crops such as cotton, grapes, potatoes, and strawberries, the petioles provide additional indications of nitrogen status. When these crops are tested, the petioles are used, in addition to the MRML.



When to Sample:

The best time of day to collect samples is between midmorning and midafternoon. Sampling during damp conditions can be done but requires extra care to prevent plant tissue from decomposing during shipping.

To monitor plant nutrient status most effectively, sampling should be done during the recommended growth stages for the specific crop. During critical periods, samples should be taken weekly or biweekly, depending on management intensity and crop value. However, to identify a specific plant-growth problem, samples should be taken whenever a problem is suspected.

What to Sample:

Proper sampling is the key to reliable plant analysis. A sample can represent the status of one plant or 20 acres of plants. The appropriate part of the plant to sample varies by crop, stage of growth, and purpose for sampling.

When sampling for problem solving, take samples from both "good" and "bad" areas. A comparison between the two groups of samples will help to pinpoint the limiting element(s). This comparative sampling will also help to factor out the influence of drought, stress, disease, or injury. Soil samples from the root zones of both "good" and "bad" plants should be taken for the most complete evaluation.



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What to Sample (Continued):

When sampling for monitoring the status of healthy plants, take samples from a uniform area. If the entire field is uniform, one sample can represent a number of acres. If there are variations in soil type, topography or crop history, take multiple samples so that each unique area is represented by its own sample.

When sampling seedlings less than 4 inches tall, take whole plants from 1 inch above the soil line. *For larger plants, the most recent mature leaf is the best indicator sample.*

The table below provides crop-by-crop specifics on when to sample, which plant parts to collect, and desirable sample sizes:

Vegetable Crops	Stage of Growth	Plant Part	No. of Plants
Asparagus	At maturity	Fern from 18-30 inches up	30 to 40
Beans (snap, limas)	Prior to, or at initial bloom, before pod set	Fully developed leaves at top of plant	20 to 30
Brussels Sprouts	At midgrowth	Young mature leaf	20 to 30
Celery	At midgrowth	Young mature leaf	20 to 30
Cucumbers	Before fruit set	Mature leaf near growing tip of plant	20 to 30
Head Crops (cabbage, cauliflower, etc.)	Before heading	Young mature leaf from center of whorl	10 to 20
Leaf Crops (collards, endive, kale, lettuce, etc.)	At midgrowth	Recently matured leaf	30 to 50
Melons (musk & water; cantaloupe, pumpkins, etc.)	Prior to initial fruit set	Mature leaf near growing tip of plant	20 to 30
Peas	Before flowering	Leaves from 3 rd to 5 th nodes from the top	40 to 60
Peppers (chili, sweet)	At midgrowth	Young mature leaf	40 to 50
Potatoes	Prior to early bloom	3 rd to 6 th leaf plus petiole from growing tip	20 to 30
Root Crops (beets, carrots, onions, radishes, turnips, etc.)	At midgrowth before root enlargement	Center mature leaves	20 to 30
Tomatoes		3 rd or 4 th leaf from the growing tip	20 to 30
Fruit and Nut Tree Crops	Stage of Growth	Plant Part	No. of Plants
Almond, apple, apricot, cherry, fig, olive, peach, pear, plum, prune	5 to 8 weeks after full bloom	4 to 8 leaves from spurs or near base of current season's growth	20 to 30
Citrus (grapefruit, lemon, lime, orange, etc.)	At midgrowth	Recently matured leaves from non-fruiting terminals	30 to 40
Pecans	6 to 8 weeks after bloom	Middle leaflet pairs from terminal shoots	30 to 40
Walnuts	6 to 8 weeks after bloom	Middle leaflet pairs from terminal shoots	30 to 40
Vine Crops	Stage of Growth	Plant Part	No. of Plants
Grapes	End of bloom period	Petioles or leaves adjacent to fruit clusters	80 to 100
Kiwi	At midgrowth	1 st to 3 rd leaves beyond fruit on fruiting canes, or mid-cane leaves on nonbearing vines	50 to 60



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Berry Crops	Stage of Growth	Plant Part	No. of Plants
Blueberries	At midgrowth	Youngest mature leaves	50 to 60
Raspberries	At midgrowth	Youngest mature leaves on laterals or "primo" canes	30 to 40
Strawberries	At midgrowth	Leaf blades without petioles from youngest mature leaves	40 to 50
Tropical Fruit Crops	Stage of Growth	Plant Part	No. of Plants
Banana	At maturity	1/3 on either side of midrib of leaf	5 to 10
Pineapples	At midgrowth	Remove midribs from leaflets – middle third section of white basal portion of last matured leaf	2 to 5
Sugarcane	Up to 4 months old	3 rd or 4 th fully developed leaf from top plant	20 to 30
Tea	At maturity	Most recently matured leaf	30 to 40
Field Crops	Stage of Growth	Plant Part	No. of Plants
Alfalfa	At bud or 1/10 bloom	Upper 1/3 of plant	30 to 40
Cover	Prior to bloom	Upper 1/3 of plant	30 to 40
Corn	Seedling stage	All of above-ground portion	20 to 30
	Prior to tasseling	1 st fully developed leaf	15 to 20
	From tasseling to silking	Leaf opposite & below ear	15 to 20
Grasses	At stage of best quality	Leaves from upper 1/3 of plant	30 to 40
Mint	At midgrowth	Young fully developed leaf	30 to 40
Small grain (barley, oats, rice, wheat, rye)	Prior to heading	Four uppermost leaves	40 to 50
Sorghum (Milo)	Before, or at heading	2 nd leaf from top of plant	20 to 30
Soybeans	Prior to, or at initial bloom, before pod set	Fully developed leaves at top of plant	20 to 30
Ornamentals and Flowers	Stage of Growth	Plant Part	No. of Plants
Azalea, begonia, bougainvillea, geranium, hydrangea, and others*	At midgrowth	Recently matured leaves from around plants	10 to 20
Deciduous trees & shrubs, vines and broadleaf evergreens	At Maturity	Most recent expanded leaves from around plants	5 to 10
Narrowleaf evergreens	At maturity	Terminal cuttings, 2 to 3 inches in length	40 to 50
Carnations	Newly planted	4 th or 5 th leaf pairs from base of plant	20 to 30
	Established	5 th or 6 th leaf pairs from base of plant	20 to 30
Chrysanthemums	Before or during early flowering	Top leaves on the flowering stem	20 to 30
Poinsettias	Before or during early flowering	Most recently matured fully expanded leaves	15 to 20
Roses	During flowering	Upper leaves on the flowering stem	25 to 30

* Information about many other floricultural plants is available upon request.



















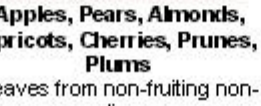


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How to Sample – Illustrations to Assist You in Taking Samples:

<p>Corn..before tasseling 1st fully developed leaf</p> 	<p>Small grains 4 uppermost leaves</p> 	<p>Rice Flag or Y leaf</p> 	<p>Alfalfa, Clover Top 6 inches or upper third</p> 	<p>Beans, Peas Recently mature trifoliate</p> 
<p>Cotton Leaves/petioles from 4th - 5th node</p> 	<p>Tomatoes, Peppers 4th - 5th leaf from tip</p> 	<p>Potatoes 4th - 5th leaf from tip</p> 	<p>Melons, Squash, Pumpkins 5th - 6th leaf from tip</p> 	
<p>Lettuce, Cabbage Wrapper leaf, heading</p> 	<p>Broccoli, Cauliflower Recently mature leaf, buttoning</p> 	<p>Carrots Tallest leaf</p> 	<p>Onions, Garlic Tallest leaf, before bulbing</p> 	<p>Beet Tallest leaf</p> 
<p>Pecans, Figs, Olives, Peaches, Hectarines Midshoot leaflets/leaves</p> 	<p>Pistachios, Walnuts, Citrus Terminal leaflets/leaves</p> 	<p>Grapes Leaves/petioles opposite basal cluster or 6th - 7th leaf from tip at fruit ripening</p> 	<p>Strawberries Early fruiting Recently mature leaf</p> 	
<p>Apples, Pears, Almonds, Apricots, Cherries, Prunes, Plums Leaves from non-fruiting non-expanding spurs</p> 				

Getting Started – The Materials You Will Need:

- Plant Tissue Sample Information Form (enclosed/attached - use 1 per sample)
- Paper bags, envelopes, or cloth bags (Do Not mail samples in plastic bags)
- Clean plastic pail (Do Not use galvanized or metal containers)
- Clean, dry soft brush or clean cloth
- Distilled or deionized water



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Taking Samples – Step-by-Step Collection Instructions:

<p><u>Step 1</u></p> <p>Fill Out <i>Plant Tissue Sample Information Form(s)</i></p>	<p>Fill out a separate <i>Plant Tissue Sample Information Form</i> for each sample you are submitting. Be sure to complete this form in as much detail as possible.</p> <ul style="list-style-type: none">Note any relevant conditions such as drought, disease, injury, pesticide, or foliar nutrient applications.Provide very specific information on stage of growth and plant part. <p>The more information you provide on this form, the more accurate our recommendations to you will be.</p>
<p><u>Step 2</u></p> <p>Collect Samples</p>	<p>Using the tables/illustrations provided in the “What to Sample” and “How to Sample” sections, collect representative samples of the leaves and petioles for your particular crops/plants.</p> <ul style="list-style-type: none">Determine how many samples to collect & what part of the plant to sample from the “What to Sample” section.Collect the tissue samples in a clean plastic pail, paper bag, or cloth bag. <u>Do not use</u> galvanized or metal containers.Detach leaves from petioles in the field to stop the translocation of nutrients. <p>(<u>Note</u>: “Midribs” are the middle ribs of large leaves such as corn, lettuce, & cabbage, and would equate to a petiole sampling)</p> <ul style="list-style-type: none">Put petioles in a separate bag.Avoid sampling plants that are damaged by disease, insects, or chemical applications.Do not include dead plants or plant materials in the samples.Do not sample very young emerging leaves.Do not sample old mature leaves or seeds unless their condition is the purpose of analysis.Avoid plants under stress from moisture or temperature extremes.When sampling seedlings less than 4 inches tall, take whole plants from 1 inch above the soil line.
<p><u>Step 3</u></p> <p>Clean the Plant Samples (if needed)</p>	<p>Samples must be kept free of soil & other contaminants that can alter results. If the plants have soil, fertilizer, dust, or spray residues on their surfaces, wipe them with a clean, dry, soft brush. A damp cloth along with distilled or deionized water may be used for samples containing excess residues. Be careful not to prolong the washing as some nutrients may be removed from the plant.</p>
<p><u>Step 4</u></p> <p>Air Dry the Plant Samples</p>	<p>To prevent decomposition and molding, air dry the plant samples before packaging.</p>
<p><u>Step 5</u></p> <p>Pack Samples for Shipping</p>	<p>Put the air-dried samples in paper bags, envelopes, or cloth bags for shipping.</p> <p><u>Note</u>: Do Not send samples before they have been air dried. Do Not use plastic bags for shipping.</p>



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Step 6 Label Bags/Envelopes	Using a permanent ink pen or pencil, clearly label each bag with your name and address. Using up to six letters or numbers, give each sample a unique identifier that will help you remember the plant or area it corresponds to such as HOUSE1, 15B, GOOD, or BAD. Write the identifying numbers/letters on the envelopes/bags <u>and</u> the <i>Plant Tissue Sample Information Form</i> . Keep a record for yourself of the location represented by each sample.
Step 7 Pack Plant Samples for Shipping	Place all plant samples in a sturdy container.
Step 8 Seal Shipping Box	Before sealing the container, enclose one completed <i>Plant Tissue Sample Information Form</i> for each sample submitted and a check payable to Timberleaf Soil Testing for the number of samples enclosed.
Step 9 Mail Box to Us	Send all soil samples & communications to: Timberleaf Soil Testing 39648 Old Spring Road Murrieta, CA 92563 Phone/Fax (951) 677-7510 E-mail tmbrlfsoiltest@verizon.net

Acknowledgement

The information charts and diagrams used in this guide were provided with permission from A&L Eastern Agricultural Laboratories, Inc., Richmond, Virginia.