Sampling for Plant Tissue Analysis

Cooperative Extension Service
College of Agriculture and Home Economics

Guide A-123

Robert Flynn, Extension Agronomy Specialist
Shane T. Ball, Extension Agronomy Specialist
R.D. Baker, Extension Agronomist

This publication is scheduled to be updated and reissued 6/04.

Of the many factors affecting crop quality and yield, fertility is one of the most important. It is fortunate that producers can control fertility by managing the plant's nutritional status. Nutrient status is an unseen factor in plant growth, except when imbalances become so severe that visual symptoms appear on the plant.

The only way to know whether a crop is adequately nourished is to have the plant tissue analyzed during the growing season. Plant tissue analysis is offered by NMSU's Soil, Plant, and Air Testing Laboratory.

WHAT PLANT TISSUE ANALYSIS SHOWS

Plant tissue analysis shows the nutrient status of plants at the time of sampling. This, in turn, shows whether soil nutrient supplies are adequate. In addition, plant tissue analysis will detect unseen deficiencies and may confirm visual symptoms of deficiencies. Toxic levels also may be detected. Though usually used as a diagnostic tool for future correction of nutrient problems, plant tissue analysis from young plants will allow a corrective fertilizer application that same season.

Not all abnormal appearances are due to a deficiency. Some may be due to too much of certain elements. Also, symptoms of one deficiency may look like those of another. A plant tissue analysis can pinpoint the cause, if it is nutritional. A plant analysis is of little value if the plants come from fields that are infested with weeds, insects, disease organisms; if the plants are stressed for moisture; or if plants have some mechanical injury.

The most important use of plant analysis is as a monitoring tool for determining the adequacy of current fertilization practices. Sampling a crop periodically during the season or once each year provides a record of its nutrient content that can be used through the growing season or from year to year. With soil test information and a plant analysis report, a producer can closely tailor fertilization practices to specific soil-plant needs.

It also may be possible to prevent nutrient stress in a crop if the plant analysis indicates a potential problem developing early in the season. Corrective measures can be applied during the season or, if the crop is perennial, during the next year. Combined with data from a soil analysis, a tissue analysis is an important tool in determining nutrient requirements of a crop. By request, the following elements can be determined in a plant sample:

Nitrogen	Sulfur	Boron
Phosphorus	Iron	Sodium
Potassium	Copper	Chlorine
Calcium	Zinc	Molybdenum
Magnesium	Manganese	

Levels of elements such as cadmium, lead, arsenic, and selenium also can be examined. See table 1 for sufficiency levels of plant nutrients.

COLLECTING AND PREPARING THE SAMPLE

If you suspect a nutrient deficiency:

1) Sample when the symptom first appears (see table 2 for deficiency symptoms).
2) In the same field or area, collect similar samples of plant materials from plants that appear abnormal.
3) Make sure that the symptoms are not due to a factor unrelated to plant nutrition.

The parts of plants to sample depend on the plant and its growth stage. Table 3 lists the best parts to sample for common crops (see also fig. 1). More specific sampling strategies may be necessary for cotton and peppers (chile). Also, many devices are available

for a "quick test" of the plant nitrogen status. Chlorophyll meters for certain crops can be used to predict the cost/benefit of additional nitrogen fertilizer.

Instructions for petiole or leaf sampling may differ. Also, comparing samples from both a "good" and a "bad" area often helps in determining corrective action. If specific sampling guidelines are not given here, collect recently mature leaves just below the growing point from at least 10 plants.

When gathering the tissue sample in the field, use a clean container. A plastic pail or a paper bag works best. Never use a metal container because it can contaminate the sample.

If the plant samples have soil, fertilizer, dust, or spray residues on them, they will need to be cleaned. A dry brush works best, but for stubborn residues, wipe the samples with a damp cloth or wash them with distilled or deionized water. However, do not prolong the washing because it can leach nutrients out of the tissue.

Air-dry the samples in the shade, not in the sun. To prevent contamination, place the dried samples into clean paper bags or envelops for mailing to the laboratory. Never place fresh plant tissue samples in plastic bags for mailing. The plastic bags do not allow the samples to dry, so they may decompose. It is also a good idea to take a soil sample in the same vicinity as the plant sample because the soil test may help to interpret the plant tissue analysis readings. Mail the samples to: Soil, Water, and Air Testing Laboratory / New Mexico State University / Gerald Thomas Hall, room 269 / P.O. Box 30003, MSC 3Q / Las Cruces, NM 88003.

A nominal fee will be charged. Your county Extension agent can provide further details.

Provide Information with the Sample

When mailing samples to the laboratory, be sure to provide the following information:

- Type of crop.
- Variety.
- Soil type (if known).
- Current crop fertilization and management practices (such as stand, kinds and rates of fertilizer, method of fertilizer application).
- Last year's crop fertilization practices and yield.
- Irrigation frequency and quality of irrigation water.
- Visual appearance of crop.
- Insect and disease problems (if any).

This information is necessary for sound interpretation of the plant tissue analysis.

Things to Avoid

Do not sample the following:

- Young, emerging leaves; old, mature leaves; and seeds. These plant parts usually are not suitable because they are not likely to reflect the nutrient status of the whole plant.
- Diseased or dead plants.
- Plants that have insect or mechanical damage.
- A single plant showing visual deficiency symptoms, unless it is possible to sample normal plants from an adjacent area in the field. Normal plants give a reference to help interpret the chemical analysis of the deficient plant sample.

Table 1. Sufficiency levels of plant nutrients for crops at growth stages shown in table 3.*

	Sufficiency levels						
Element	Corn	Grain sorghum	Soybeans	Small grains	Peanuts	Alfalfa	Bermuda grass
Nitrogen, %	2.7–3.5	3.3–4.0	4.2–5.5	1.7–3.0	3.5–4.5	4.5–5.0	2.5–3.0
Phosphorus, %	.25–.40	.20–.35	.26–.50	.20–.50	.20–.35	.26–.70	.26–.32
Potassium, %	1.7–2.5	1.4–2.5	1.7–2.5	1.5–3.0	1.7–3.0	2.0–3.5	1.8–2.1
Calcium, %	.21–1.0	.30–.60	.36–2.0	.20–.50	1.25–1.75	.50–3.0	—
Magnesium, %	.21–.60	.20–.50	.26–1.0	.15–.50	.30–.80	.30–1.0	—
Sulfur, %	—	—	—	.15–.40	.20–.30	.26–.50	.15–.20
Boron, ppm	4–25	1–10	21–55	5–10	20–50	30–80	—
Copper, ppm	6–20	2–7	10–30	5–25	10–50	7–30	—
Iron, ppm	21–250	65–100	51–350	50–150	100–350	—	—
Manganese, ppm	20–150	8–190	21–100	25–100	100–350	31–100	—
Zinc, ppm	20–70	15–30	21–50	15–70	20–50	21–70	—

*Adapted from *Soil Fertility Handbook,* Oklahoma State University.

Table 2. General symptoms of nutrient deficiency in plants.

Nitrogen: Plant light green, lower leaves yellow to light brown, stalks short and slender, plants stunted.

Phosphorus: Plants dark green, often developing red and purple pigments; lower leaves sometimes yellow; plants stunted.

Potassium: Spots of dead tissue, usually at the tips and between the veins; marked margins of leaves.

Magnesium: Mottled or chlorotic leaves, which typically redden; leaf tips and margins turned or cupped upward.

Calcium: Young leaves of terminal bud hooded; with severe deficiency, dying buds; dying back at the tips and margins of the leaf.

Sulfur: In young leaves, veins and tissue between veins are light green.

Iron: Young leaves are chlorotic, with principal veins typically green; stalks short and slender.

Zinc: Leaf spots on older leaves, with spots rapidly enlarging and generally involving the area between the veins; thick leaves; stalks with shortened internodes.

Boron: Young leaves of the terminal bud are light green at the base; the bud eventually dies.

Copper: Young leaves are permanently wilted, with spotty or marked chlorosis.

Manganese: Spots of dead tissue scattered over the leaf; smallest veins tend to remain green.

Table 3. Tissue sampling techniques for specific plants.

FIELD CROPS

Crop	When to sample	Where to sample	Number to sample
Alfalfa	Early bloom	Top 6 inches or upper third of plant	12–30
Canola	Before seed set	Recently mature leaf	60–70
Clover	Before bloom	Upper 1/3 of plant	30–40
Corn/sweet corn	Seedling stage	All above-ground portions	15–20
	OR		
	Before tasseling	First fully developed leaf from the top of the plant	15–20
	OR		12–20
	Tasseling to silking	Leaf opposite and below ear	
Cotton	Full bloom	Recently mature leaf from main stem	40–50
Grasses/ forage mixes	Stage of best quality (before seed emerges)	Upper 4 leaves	30–40
Peanuts	Before or at bloom	Recently mature leaves	40–50
Small grains (barley, oats, wheat, rye, rice)	Seedling stage	All above-ground portions	25–40
	Before heading	4 uppermost leaf blades	25–40
Sorghum (milo)	Before or at heading	2nd leaf from top of plant	20–30
Soybeans	Before or at bloom	Recently mature, trifoliate leaves from the top of the plant	20–30
Sugar beets	Midseason	Recently mature leaf at center of whorl	25–30
Sunflowers	Before heading	Recently mature leaf	20–30

VEGETABLE CROPS

Crop	When to sample	Where to sample	Number to sample
Asparagus	Maturity	Fern, 18–30 inches above ground line	10–30
Beans	Seedling stage	All above-ground portions	20–30
	OR Before or at bloom	Recently mature leaf	20–30
Broccoli	Before heading	Recently mature leaf	12–20
Brussels sprouts	Midseason	Recently mature leaf	12–20
Celery	Midseason	Outer petiole of recently mature leaf	12–20
Cucumbers	Before fruit set	Recently mature leaf	12–20
Head crops (cabbage, cauliflower)	Before heading	Recently mature leaf at center of whorl	12–20
Leaf crops (such as lettuce, spinach)	Midseason	Recently mature leaf	12–20
Melons	Before fruit set	Recently mature leaf	12–20
Peas	Before or at bloom	Leaves from 3rd node from top	40–60
Peppers	Midseason	Recently mature leaf	25–50
Potatoes	Before or at bloom	3rd to 6th leaf from growing tip	25–30
Sweet potatoes	Midseason or before root enlargement	3rd to 6th leaf from tip center or mature leaves	20–30 25–35
Root/bulb crops (such as carrots, beets, onions)	Midseason before root or bulb enlargement	Recently mature leaf	20–30
Tomatoes (field)	Midbloom	3rd to 4th leaf from growing tip	15–20
Tomatoes (trellis or indeterminate)	Midbloom from 1st to 6th cluster stage	Petiole of leaf below or opposite top cluster	12–20

ORNAMENTALS AND FLOWERS

Crop	When to sample	Where to sample	Number to sample
Carnations	Newly planted	4th to 5th leaf pair from base	20–30
	Established	5th to 6th leaf pair from base	20–30
Chrysanthemums	Before or at bloom	Top leaves on flowering stem	20–30
Ornamental trees and shrubs	Current year's growth	Recently mature leaf	30–70
Poinsettias	Before or at bloom	Recently mature leaf	15–20
Roses	At bloom	Recently mature compound leaf on flowering stem	25–30
Turf	Active growth	Leaf blades. Avoid soil contamination.	2 cups

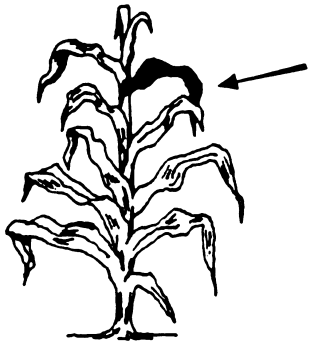
FRUIT AND NUT CROPS

Crop	When to sample	Where to sample	Number to sample
Apples, pears, almonds, apricots, cherries, prunes, plums	Midseason (June-July)	Leaves from current season's nonfruiting, nonexpanding spurs	50–100
Peaches and nectarines	Midseason (June-July)	Midshoot leaflets/leaves	25–100
Grapes	At bloom	Petioles or leaves adjacent to basal clusters at bloom	50–100
Pecans	Midseason	Midshoot leaflets/leaves	25–60
Pistachios	Mid- to ate season (August)	Terminal leaflets from nonfruiting shoots	25–60
Raspberries	Midseason	Recently mature leaves from laterals of primocanes	30–50
Strawberries	Midseason	Recently mature leaves	25–40
Walnuts	Midseason (June-July)	Terminal leaflets/leaves from nonfruiting shoots	25–40

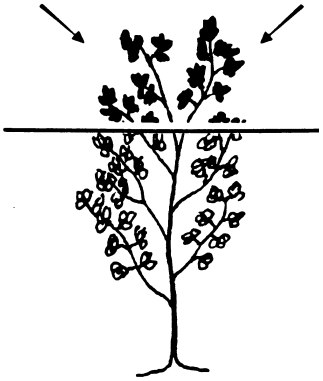
Figure 1. Desired sampling location for common crops.

Adapted from *Reference Guide for Plant Tissue Analysis*, Analytical Laboratories, Inc.

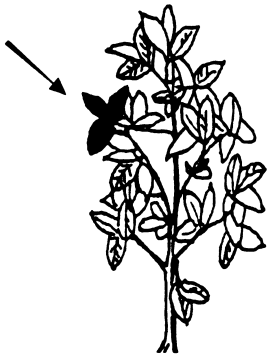
Corn…before tasseling
Collect the first fully developed leaves from the top of 15–20 plants. (If the plant is less than 12 inches tall, collect all of the above-ground portion.)



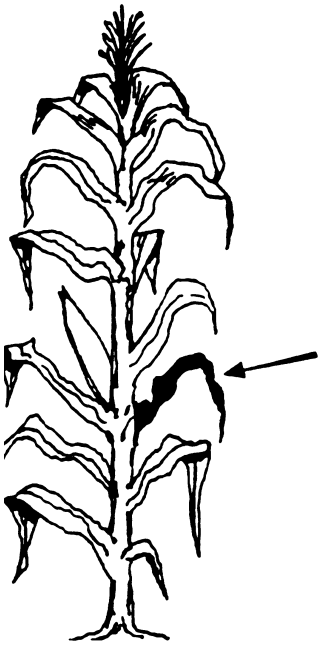
Alfalfa
Collect the top 6 inches or upper third of the plant at early bloom.



Soybeans
Collect recently mature trifoliate leaves from the top of 20–30 plants before or during bloom. (In the seedling stage, collect all of the above-ground portion of the plant.)

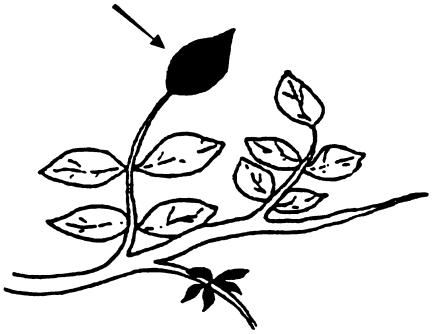


Corn…from tasseling to silking
Collect the leaves below and opposite from the ear of 15–20 plants.

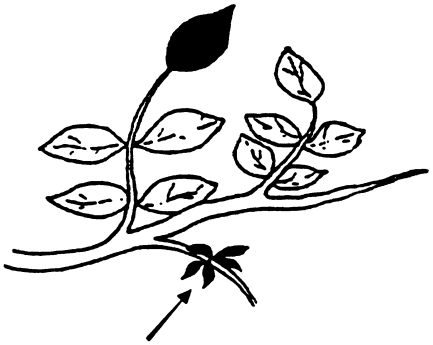


Sorghum
Collect the second leaf from the top of 20–30 plants before or at heading.

Pistachios and Walnuts
Collect terminal leaflets/leaves from nonfruiting shoots at mid- to late season.

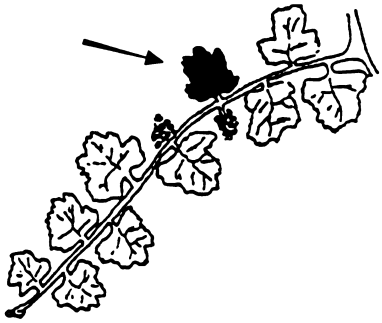


Apples, Pears, Almonds, Apricots, Cherries, Prunes, Plums
Collect the leaves from the current season's nonfruiting, nonexpanding spurs at midseason.

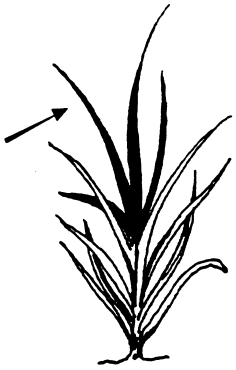


Pecans, Peaches, and Nectarines
Collect the midshoot leaflets/leaves at midseason.

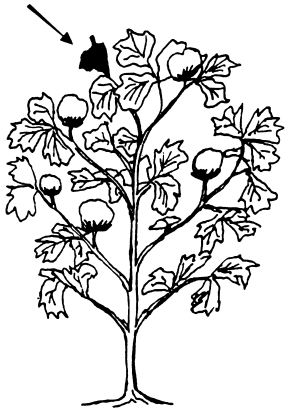
Grapes
Collect the petioles or leaves adjacent to basal clusters at bloom.



Small grains
Collect the four uppermost leaf blades from the top of 25–40 plants. Sample should equal 2 cups. (In the seedling stage, collect all of the above-ground portion.)



Cotton
Collect recently mature leaves from the main stem on 40 to 50 plants selected at random at full bloom.



**Originally written by Larry J. Cihacek and Ricardo E. Gomez.*

New Mexico State University is an equal opportunity/affirmative action employer and educator. NMSU and the U.S. Department of Agriculture cooperating.

Revised June 1999 **Las Cruces, NM**
5C