

Plant Tissue Sampling

The Benefits of Tissue Analysis for Agriculture

Plant tissue analysis may be used to assess the nutrient status and to determine the fertilizer needs of high value perennial fruit crops such as apples, blueberries and cranberries. Soil analyses may not provide appropriate results due to deep root systems, low pH values and difficulties involved with taking truly representative soil samples. It is important to identify potential nutrient deficiencies before plant symptoms develop. Corrective action may then be taken before yields have been affected. The following are examples of how incorrect levels of nitrogen can affect some crops:

- Too much nitrogen may lead to oversized, poorly coloured fruit which does not store.
- Too much nitrogen may lead to late season growth of trees or vines, inadequate hardening off, and increased winter injury.
- Too much nitrogen in apples may result in higher levels of fire blight.
- Nitrogen levels that are too low may result in poor fruit set, small fruit, pale foliage and reduced growth.

Tissue analysis is used to a lesser degree with forages and annual crops such as corn, potatoes and grain. Generally, tissue analysis with these crops is done to assess micronutrient deficiencies. Testing of petioles for nitrate, and in some cases for phosphorous, is used with potatoes throughout the growing season. Details of petiole testing are provided in the factsheet “Nitrogen Management for Potatoes: Petiole Nitrate Testing”. For those who can justify analysis costs for other annual crops, the current factsheet outlines when and what to sample, as well as the respective sufficiency ranges. In many cases annual crops can be assessed by harvest sample analysis, e.g. for forage quality and protein levels.

How Should Samples be Taken?

The assessment of crop nutrient levels must be done in relation to standard values. Such standards represent the nutrient levels that should be present at a specific time in a plant’s growth cycle. Results are likely to be more consistent when samples are taken repeatedly from the same area (i.e. plants, field or field section). For example, the same apple trees should be sampled each year, separated by variety, field or past management. Avoid combining healthy plant parts with unhealthy plant parts. Trees or plants with disease symptoms should be sampled separately. Other common tissue sampling errors include:

- not taking enough sample for the test;
- collecting chlorotic (yellow), dead, or insect damaged tissue;

- collecting plant tissue contaminated with soil or foliar fertilizer applications; and
- shipping samples in plastic bags as this often results in deterioration and rotting.

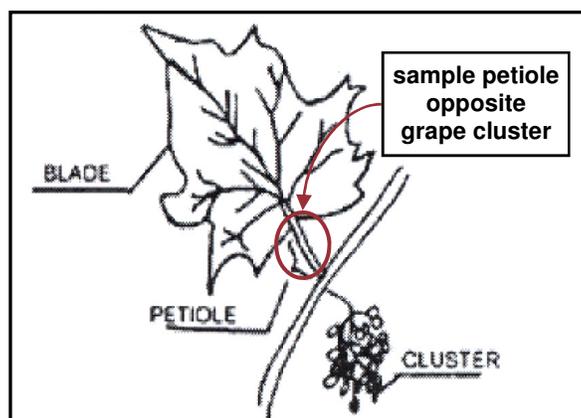


Table 1 will provide you with information on when samples should be taken. This may relate to an approximate time of the year or stage in the development of a crop. Table 1 also indicates which plant part to sample as well as the number of plant parts needed to make a representative sample for a management unit.

Samples should be taken each year until corrective action has improved the nutrient status of your crop. Sampling may then be done every two to three years to reduce costs and ensure that nutrient levels are maintained.

How to Maintain Sample Integrity from the Field to the Lab

Avoid collecting samples under wet conditions. Keep samples cool and dry and ship to the lab as soon as possible. If samples cannot be shipped fresh, they can be air dried. Samples should never be oven dried as high temperatures can affect their analysis. Avoid any potential for sample contamination and ensure samples are clearly marked with a sample number, variety, block or field number, so that results can be related to individual management units on the farm.

Interpretation of Results

Once you have your results, confirm that the crop is within the proper range for the various nutrients. Table 2 will provide you with the sufficiency range for various nutrients across several crops grown in New Brunswick and can be used as a guide to interpret the results for your operation. Consult with an agronomist regarding any necessary corrective fertilization. This may vary with the nutrient deficiency in question, production goals, products available and best practices for product application.

To further help with the interpretation of results, **farm records** should also include information regarding fertilizers applied, weather conditions, and final yields. Other factors that may affect tissue analysis results and that should thus be recorded include:

- severe pruning that can elevate nitrogen levels in a plant regardless of the fertility program;
- soil moisture supply prior to sampling that can affect results due to nutrient mobility, e.g.

potassium (K); and

- imbalance of nutrients that may result in competition between nutrients, e.g. between potassium and magnesium.

Sampling Outside of Recommended Times or Growth Stages

This may have to be done to diagnose problems in a field. In this case you won't be able to compare nutrient levels to values in Table 2, but you may be able to compare healthy growth areas to affected ones. Avoid sampling plants from within severely affected areas. Instead sample on the *border* of affected areas in addition to taking separate samples from healthy areas. Corresponding soil samples are also warranted, for pH and nutrient confirmation. Also consider the physical nature of the soil at a site. Compacted wet areas may cause plant nutrient deficiency symptoms to appear even when soil nutrient levels are adequate.

Table 1. Plant tissue analysis guidelines for various crops

Crop	Timing & Growth Stage	Plant Part	Sample Size
Apples	Last 2 weeks of July, mature trees	Leaves midway along new growth, shoulder height	5 leaves each from 20 trees (100 leaves/sample)
Blueberries – highbush	Last 2 weeks of July, mature plants	Mature leaves, ½ way down new growth	100 leaves throughout sampling area
Blueberries – lowbush	Mature plants, tip dieback	Entire stems, including leaves	50 random stems, min 250 g fresh wt.
Cereals	Zadok growth stage 32	Entire top	50 random plants, min 250 g fresh wt.
Corn	Tasselling	Ear leaf (leaf immediately below the ear)	50 ear leaves, min 250 g fresh wt.
Cranberry	Late Aug-early Sept, mature plants	Current season's upright growth	20 uprights from each of 10 locations per bed (200 uprights / sample)
Cucumbers (greenhouse)	No specific growth stage	Youngest mature or fully expanded leaf, usually the 3 rd or 4 th leaf down from the growing point	1 leaf per plant 8 – 10 plants
Grapes	10 weeks after bloom but before harvest	Petioles only opposite cluster (no leaves)	100 petioles
Potatoes ¹	Flowering	3 rd to 5 th leaf from top	50 leaves, min 250 g fresh wt.
Raspberries	New plantings 10 Aug. to 1 Sept. Established plantings, after picking, 15 Aug. to 15 Sept.	Fully developed leaf (leaf blade & petiole) from 5 th to 12 th leaf position from shoot tip, current season's growth, medium sized canes	100 leaves throughout sampling area
Strawberries	New plantings 15 Aug. to 15 Sept. Old plantings – bloom, and after picking, 15 Aug. to 15 September	Youngest mature, fully developed leaf (blade & petiole)	1 fully developed leaf (= leaf blade & petiole) per plant, 60 plants
Tomatoes (greenhouse)	No specific growth stage	Youngest mature or fully expanded leaf, usually the 4 th or 5 th leaf down from the growing pt.	1 leaf per plant 8 – 10 plants

¹ : Refer to factsheet “Nitrogen Management for Potatoes: Petiole Nitrate Testing”, Bernie Zebarth, Gilles Moreau and Charles Karemangingo, 2007.

Table 2A. Sufficiency ranges for plant tissue nutrient levels by crop (%)

Crop	%N	%P	%K	%Ca	%Mg	%S
Apples ¹	2.00-2.70	0.15-0.40	1.20-2.20	0.70-1.50	0.25-0.40	n/a
Blueberries – highbush ¹	1.70-2.30	0.15-0.40	0.36-0.70	0.30-0.80	0.12-0.30	n/a
Blueberries – lowbush ³	1.70-2.20 ⁸	0.12-0.18	0.40-0.60	0.37-0.65	0.13-0.25	n/a
Cereals ²	2.00-3.00	0.26-0.50	1.50-3.00	0.20-2.00	0.15-0.50	0.15-0.40
Corn ²	2.50-3.50	0.25-0.50	1.70-2.25	0.20-1.00	0.20-0.60	0.15-0.40
Cranberry ⁶	0.95-1.05	0.11-0.14	0.40-0.65	0.60-0.80	0.20-0.25	0.08-0.25
Cucumbers (greenhouse) ⁷	4.50-6.0	0.30-0.70	3.50-4.50	1.20-1.50	0.45-0.75	0.20-0.70
Grapes ⁴	0.70-1.30	0.15-0.40	0.80-2.50	1.00-3.00	0.50-1.50	n/a
Potatoes ²	3.00-4.50	0.25-0.50	2.00-6.00	0.50-4.00	0.50-1.50	0.20-0.50
Raspberries ⁵	2.40-2.90	0.19-0.22	1.20-1.30	0.80-1.00	0.40-0.48	0.15-0.20
Strawberries ⁵	2.10-2.90	0.24-0.30	1.20-1.70	0.60-1.00	0.30-0.50	0.25-0.35
Tomatoes (greenhouse) ⁷	3.50-5.00	0.30-0.65	3.50-4.50	1.30-3.00	0.35-1.00	0.20-1.00

Table 2B. Sufficiency ranges for plant tissue nutrient levels by crop (ppm)

Crop	B ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Mo ppm
Apples ¹	20-60	n/a	15-100	20-200	25-200	n/a
Blueberries – highbush ¹	15-50	n/a	10-100	150-500	30-100	n/a
Blueberries – lowbush ³	21-40	3-6	15-20	750-1490	19-70	n/a
Cereals ²	5-25	2.5-25	15-70	15-100	20-250	n/a
Corn ²	5-25	5-20	20-70	20-150	20-250	n/a
Cranberry ⁶	30-50	4-10	15-30	10+	40-80	n/a
Cucumbers (greenhouse) ⁷	25-85	5-35	20-70	20-300	50-300	0.1-1
Grapes ⁴	20-60	n/a	15-100	20-200	15-100	n/a
Potatoes ²	15-40	5-25	20-70	20-100	70-250	n/a
Raspberries ⁵	25-35	7-10	14-16	30-50	60-90	3-4
Strawberries ⁵	30-40	7-10	25-35	30-50	90-120	1-2
Tomatoes (greenhouse) ⁷	30-75	5-35	18-80	25-200	50-300	0.1-1

¹ OMAFRA Fruit Production Recommendations, 2006-2007

² Manitoba Soil Fertility Guide, March 2001

³ New Brunswick Department of Agriculture and Aquaculture, 2007

⁴ OMAFRA Factsheet 91-012, February 1997

⁵ L.A. Peterson, et al.

⁶ Leiby, J.D., 1993. *Cranberry Agriculture in Maine*.

The Maine Cranberry Development Committee

⁷ North Carolina Department of Agriculture, Southern Cooperative Series Bulletin #394, 2000

⁸ Nitrogen range for lowbush blueberries may be 10% higher on light textured soils such as those found in northeastern New Brunswick.