Diagnosing Nutritional Status of Fruit Crops

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Understanding nutrient requirements of perennial fruit crops is a challenge to both new and experienced growers. The nutritional requirements of the crop are dependent on factors such as soil fertility, weather, planting age and crop load, all of which change over time. Therefore, the amount of nutrients the grower needs to provide the crop may also change over time. As the soil is the 'storehouse' for nutrients, the best approach to meeting the nutritional requirements is to establish your crop in fertile, well drained soils with the appropriate soil pH. Once the crop is planted, routine evaluation of plant nutrient status and soil composition are essential to developing sustainable nutrient management practices.

There are three tools that fruit growers should utilize to help evaluate the nutritional status of fruit crops:

1) **Visual Symptoms**

There is really no 'test' that can replace the value of walking your rows and spending some one-on-one time with your crop. Nutritional deficiencies or toxicities often exhibit subtle symptoms early on that require close attention…things you may not see from the seat of the tractor! While visual monitoring is important, there are disadvantages to only using this approach. The first is that many symptoms of nutrient deficiencies (or toxicities) can look very similar and can even be confused with disease, insect or environmental stresses, therefore it can be difficult to identify the primary problem. The second is that by the time the symptoms are noticed, there has usually been some impact on the crop.

2) **Tissue Analysis**

Tissue analysis is perhaps the most important tool that growers have in assessing the nutritional status of fruit crops and should be done every 1-3 years. A tissue analysis provides the grower with a chemical analysis of the concentration of individual nutrients in a growing crop. This can provide a more accurate understanding of nutrient status than visual diagnosis and can identify low nutrient levels before any significant crop impact occurs. Tissue analysis is typically done late in the season and is therefore used to inform nutrient management decisions for the following season.

Collecting a tissue sample.

A tissue analysis is only useful if the tissue was sampled properly. Nutrient levels in plant tissues can change dramatically depending on the plant part sampled, stage of growth and location on the plant. For each crop, a 'standard' nutrient content has been developed based on a particular stage of growth and plant part. Recommendations are made by comparing the submitted tissue sample to the standard, therefore, the analysis is only meaningful if the tissue was sampled at the same stage of growth and from the same plant part as the standard. There are three key factors in taking a proper sample:

1) *Sample at the right time.* Be sure to collect the tissue sample at the proper time as nutrient levels in plant tissue can change dramatically throughout the season. For example, N levels are typically quite high in the spring, level off at a lower concentration in mid-season and then drop off dramatically in late summer and fall before the leaves drop. A leaf sample that is taken during the spring and compared to a standard that was taken at mid-season will show excessive N and a sample collected in the fall would show a deficiency even if was adequate during the season.
2) *Sample the right plant part.* Nutrient levels are also different depending on the plant part sampled. For example, N content of old leaves is much lower than new leaves because N will move out of the leaf as it begins to die, therefore sampling old leaves may indicate a N deficiency whereas younger leaves will indicate adequate amounts. It is essential to take the sample at the correct time and from the correct plant part to avoid incorrect interpretations. Table 1 outlines the plant part and time of year that should be sampled for different fruit crops.
3) *Take a representative sample.* Collect tissue from the entire field rather than from one corner or one row. If you have a large farm, divide it into 'management units' that you typically manage in the same way and submit one sample from each unit. Walk through the planting in a 'W' or 'Z' pattern collecting samples from all areas of the field. Avoid diseased, insect infested, damaged or abnormal plants. If you are submitting abnormal tissue to diagnose a problem, include a sample of 'normal' tissue for comparison. See Table 1 for minimum amounts of tissue to sample. If you have multiple varieties, submit a separate sample for each variety.

Submitting the sample. Any soil or foreign material should be dusted off the sample, but do not wash the leaves as this can result in the loss of soluble nutrients. If you are mailing the sample, let the tissue air dry for one day to prevent the tissue from molding during transport. Mail the sample in a paper envelope, do not use cellophane or plastic as these can promote molding. If possible, mail the samples early in the week to avoid having the sample sit in the post office over the weekend. Be sure to record the sample date, field identification, crop type and any other information that the lab might need for the best interpretation of results.

Table 1. Proper sampling time and plant part for fruit crop tissue analysis

Crop	Stage of Growth	Plant Part	Min. # of plants to sample
Apples, pears, cherries, plums, apricots	Current seasons shoots, July 1-15th	Fully expanded leaves from midpoint of new shoots	4 leaves from each of 10 trees
Raspberries (fall or summer)	August 10- Labor Day	Leaf blade and petiole, #5-12 from the shoot tip	2-3 leaves from each of 10 canes
Strawberries	July 15-Aug.15	Most recently fully expanded leaves and petioles	2 leaves from each of 20-25 plants

Grapes	Bearing vines, mid-July to mid-August	Petioles from leaves 5-7 leaves from the shoot tip	2 petioles from 40-75 vines (varieties with small petioles should have 150-200 petioles)
	Full Bloom (primarily for N and B)	Petioles from leaves opposite from basal (first) flower cluster.	
Blueberries	Late July-Early August	Leaves from the middle of current seasons shoots	2-3 leaves from 25-30 plants
Cranberries	Mid-August to Mid-July	Current seasons growth on vegetative and fruiting uprights	50-100 uprights (1-1/2 cups)

3) Soil Analysis

Soil testing is a valuable tool that can give information about the pH of the soil, organic matter content and can estimate the supply of nutrients in the soil available to plants. A soil analysis should always be done prior to planting as this is the best time to incorporate necessary soil amendments. Soil pH is a critical factor in nutrient management. Most fruit crops need a well drained soil with a pH between 6 and 7. Blueberries and cranberries are both members of the Ericaceae plant family (same family as rhododendrons and azaleas) and these prefer soils with a pH of 4.5-5.5. Providing the correct soil pH is a critical part of meeting the crops nutritional requirements, as soil pH directly affects nutrient availability to the plants. If the soil pH is too high or too low, the nutrients may be in the soil but are not available to the crop, therefore adding more fertilizer will not solve the problem. It is possible to adjust soil pH with the use of lime (to increase pH) or sulfur (to decrease pH), however, this is best used to make minor adjustments. Taking soil samples every 2-3 years can help monitor soil pH and ensure you are in the optimal range.

Soil analysis is also useful to inform about the amount of organic matter in the soil. Fruit crops benefit greatly from organic matter as it contributes to nutrient availability by improving soil structure, moisture retention and serves as a nutrient 'reservoir'.

Regular soil sampling can be used to identify trends in nutrient levels of the soil. For example, if you observe increasing amounts of phosphorus in the soil, you may consider reducing the amount of P fertilizer you are applying. Nutrient concentrations reported in the soil analysis have a poor relationship with the nutrient levels in plant tissue of perennial fruit crops. Therefore, soil testing alone should not be used to determine crop nutrient requirements. Soil analysis is most useful when coupled with a plant tissue analysis.

<u>Collecting a Soil Sample</u>

Soil samples should be collected from the same area as the tissue samples. Collect the soil sample to the side of the plants. Do not collect soil samples from the middle between the rows. For

tree fruits, take the soil from the area within the drip line but free of vegetation. Cranberry soil samples should be collected throughout the bed. Collect samples from the entire area, do not sample from only one row or section. As you walk through the area, take 8-10 samples with a soil probe, trowel or small shovel to a depth of about 6 inches. Mix all the samples together and place about 1 cup of soil in a soil sample bag or plastic bag. Record the field identification, crop and sampling date and send in to the lab for analysis.

Interpreting Soil and Tissue Analysis Results

The report you receive from the lab will show the concentrations of various nutrients in the tissue and soil and an indication if the nutrient level is deficient, sufficient or high. The interpretation is based on a comparison with a 'standard' that has been developed through experimentation on a certain stage of growth and plant part, so the results are only meaningful if the sample was collected properly! To best understand the nutrient status of the crop, review the tissue and soil analysis together.

Providing nutrients efficiently and effectively to fruit crops is a challenging yet critical component of crop production. Routine soil and tissue analysis can allow you to monitor the nutrient status of the crop, prevent deficiencies, evaluate current production practices and reduce unnecessary nutrient applications.

Contact your county extension office for information on labs that provide soil and tissue analysis.