Plant Nutrition

Nutritional requirements of fruit trees differ from those of agronomic crops, cover crops, and orchard sod.

Growers may estimate fruit trees' nutritional needs through leaf and soil analysis, tree growth and cropping, and past experience. Since fruit trees are a perennial crop, leaf or foliar analysis is the most accurate way to determine nutritional status of an orchard. Factors such as rootstock, crop load, soil type, and weather conditions influence whether or not trees are absorbing enough nutrients to produce maximum yields of high-quality fruit.

Foliar analysis can also be of value in diagnosing the cause(s) of abnormalities in plant growth or fruit development. While only a single sample may be needed, paired samples, one from normal foliage and one from abnormal foliage, are frequently helpful. Foliar analysis, particularly if done over a period of years, can warn of an approaching deficiency or toxicity before the plant shows any visible symptoms.

Nitrogen deficiency symptoms on peach, which can be prevented by leaf analysis and block-specific fertilization.

Soil analyses, on the other hand, are not nearly as accurate in determining the nutritional status of an orchard. They do, however, play an important role in fertility programs when used in specific situations. In established orchards the main value of a soil test is to monitor soil pH. A soil test should also always be taken before an orchard is planted, since it is much easier to adjust nutrient levels before the trees are established. Renovating older orchards disturbs the subsoil enough to alter the soil test results. Therefore, when removing an old orchard for replanting, it is best to collect a soil sample after all the roots have been removed and any grading or soil disturbance has been completed.

Occasionally, soil and leaf analyses may offer opposing recommendations for fertilizing with phosphorus, potassium, and magnesium. If this occurs, follow the recommendations listed on the leaf analysis. However, if the soil analysis recommends lime, lime should always be applied.

Determining Tree Nutritional Status through Foliar Analysis

What is foliar analysis?

Foliar analysis is the process whereby leaves from fruit trees are dried, ground, and chemically analyzed for their nutrient content. Nitrogen, phosphorus, potassium, calcium, magnesium, iron, copper, boron, and manganese are among the elements tested for. A foliar analysis can help determine what fertilizer(s) a grower needs to apply. Unlike soil tests, which only show what is in the ground, a leaf analysis shows what the trees actually absorbed. Soil tests do not typically give accurate measurements of nitrogen or the minor elements.

When to collect samples

Specific guidelines must be followed when collecting a leaf sample for analysis. The first is timing. Leaves should be collected starting around mid-July until approximately mid-August. Samples are collected then because the nutrient levels in fruit trees are the most stable at that time. Earlier in the season, trees are actively growing and transporting nutrients up into the leaves; later in the season, senescence is beginning and nutrients are being transported out of leaves. To avoid contamination (see below), samples should be collected as long as possible after a cover spray or just before a cover spray.

Frequency of sampling

To gain the most benefit from a foliar analysis program, we recommend sampling each block of your orchard at least once every three years. A good method is to divide your orchard into thirds and sample one third each year.

Collecting the sample

Healthy leaves should be collected from the midsection of the current season's growth, located about midway on the tree or chest high on large trees, and at a representative height of the majority of foliage on young, small or dwarf trees. Similar to the procedure for taking a soil sample, randomly walk through your orchard and pull leaves from trees until you have approximately 60 to 70 leaves. No more than two leaves should be taken from an individual terminal shoot. Alternatively, you can select 8 to 10 trees in a block that are uniform and typical of the entire block and collect an equal number of leaves from the chosen trees.

We strongly recommend that you collect leaves from one cultivar on one rootstock in a similar soil type. The next best sample comes from one cultivar on one rootstock and, finally, from a single cultivar. We do not recommend collecting leaves from several cultivars to be mixed into a single sample. Do not mix leaves from young and old trees of the same cultivar. Younger trees will have distinctly different nutritional requirements than older mature trees. Make sure you fill out the informational sheet accompanying the leaf sample as completely and accurately as possible. The information is used in making a recommendation.

Contaminated leaf samples

Certain fungicides contain trace amounts of the minor elements. This becomes evident when the leaf analysis reports unusually high levels of elements such as manganese or zinc. The following fungicides contain both manganese and zinc: Dithane and Manzate, and Penncozeb. Fungicides containing zinc only include Ziram and Polyram.

Some growers might think that washing the leaves will help; it does if you do it right. But most growers are not equipped to wash leaves properly. Washing involves using a 0.1 percent soap solution and triple rinsing in distilled water. Most attempts to wash leaves will only produce greater contamination.

Interpreting foliar analyses

Table 1-2 lists the standard nutrient values used to interpret leaf tissue analysis results. The ranges outlined in the table cover the levels within which various kinds of fruit will grow, flower, and fruit sufficiently to produce high-quality commercial crops. The range for nitrogen, however, is purposely broad owing to factors such as tree age, fruit use, and fruit cultivar. Nitrogen should be higher for young nonbearing fruit trees.

Source: Penn State Tree Fruit Production Guide. (Updated December 2015).

Table 1–2. Nutritional ranges used to interpret leaf analysis values for apples, peaches, nectarines, pears, and cherries.

	Deficient Dry matter (%)	Low Dry matter (%)	Normal Dry matter (%)	High Dry matter (%)
Nitrogen	<1.60	<1.80	1.80–2.80	>2.80
Phosphorus	<0.11	<0.15	0.15–0.30	>0.30
Potassium	<0.70	<1.20	1.20–2.00	>2.00
Calcium	<0.31	<1.30	1.30–3.00	>3.00
Magnesium	<0.03	<0.20	0.20–0.40	>0.40
	ppm			
Manganese	<5	<22	22–140	>140
Iron	<25	<40	40–100	>100
Copper	<4	<6	6–25	>25
Boron	<11	<35	35–80	>80
Zinc	<6	<20	20–200	>200

Apples

	Deficient Dry matter (%)	Low Dry matter (%)	Normal Dry matter (%)	High Dry matter (%)
Nitrogen	<2.00	<2.50	2.50–3.40	>3.40
Phosphorus	<0.10	<0.15	0.15–0.30	>0.30
Potassium	<1.70	<2.10	2.10–3.00	>3.00
Calcium	<0.50	<1.90	1.90–3.50	>3.50
Magnesium	<0.03	<0.20	0.20–0.40	>0.40
	ppm			
Manganese	<10	<19	19–150	>150
Iron	<40	<51	51–200	>200
Copper	<4	<6	6–25	>25
Boron	<11	<25	25–50	>50
Zinc	<6	<20	20–200	>200

Peaches and Nectarines

	Deficient Dry matter (%)	Low Dry matter (%)	Normal Dry matter (%)	High Dry matter (%)
Nitrogen	<1.35	<1.60	1.60–2.40	>2.40
Phosphorus	<0.15	<0.18	0.18–0.26	>0.26
Potassium	<0.16	<0.20	0.20–2.00	>2.00
Calcium	<0.10	<1.30	1.30–3.00	>3.00
Magnesium	<0.05	<0.30	0.30–0.60	>0.60
	ppm			
Manganese	<5	<20	20–200	>200
Iron	<40	<50	50–400	>400
Copper	<2	<6	6–25	>25
Boron	<5	<35	35–80	>80
Zinc	<5	<20	20–200	>200

Pears

	Deficient Dry matter (%)	Low Dry matter (%)	Normal Dry matter (%)	High Dry matter (%)
Nitrogen	<2.00	<2.30	2.30–3.30	>3.30
Phosphorus	<0.20	<0.23	0.23–0.38	>0.38
Potassium	<0.80	<1.00	1.00–1.90	>1.90
Calcium	<0.30	<1.60	1.60–2.60	>2.60
Magnesium	<0.03	<0.49	0.49–0.65	>0.65
	ppm			
Manganese	<5	<18	18–150	>150
Iron	<40	<50	50–250	>250
Copper	<3	<6	6–25	>25
Boron	<5	<39	39–80	>80
Zinc	<5	<20	20–200	>200

Cherries

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