ORCHARD NUTRITIONAL PROGRAMS

Determination of Nutritional Needs

Orchardists must make an annual judgment regarding the nutritional status of their trees. They must decide whether to continue with the past year's program or to modify it in some manner that will improve the growth of their trees or the quantity and quality of the fruit produced.

Nutritional requirements can be determined by leaf analysis, soil analysis, and observation of tree performance. All three should be used. Soil analysis is of value in determining the acidity of the soil and the lime required to adjust the pH to 6.5. Leaf analysis is the best tool available for the determination of fertilizer needs of established plantings. Leaf analysis is useful in diagnosing an existing nutritional problem, but more importantly it can be used to detect approaching excesses or shortages, and corrections can be made before symptoms occur. Leaf analysis has proven to be an excellent guide for the economical use of fertilizers. A test every 3 years may be sufficient if trees are making good growth. However, when growth is poor, annual tests may be advisable. Orchard observations that should be taken into account when planning a fertility program include shoot growth, leaf color, crop size, and crop quality (color, corking, storage behavior).

The nutrients that are most commonly supplied to Virginia and West Virginia orchards are nitrogen, calcium, and boron (Table 23).

NITROGEN

Young, non-bearing apple trees will benefit from a ground application plus several foliar applications of nitrogen per season. Apply 20 to 40 pounds of actual nitrogen per acre to the soil about a month before bloom. To each pesticide spray through mid-July add 4 pounds of urea per 100 gallons on a dilute basis (Table 23). These early-season foliar nitrogen applications may improve fruit size, shoot growth, and flower bud formation for the following season. Avoid late-season nitrogen applications because fruit may remain green and red color development may be retarded.

On mature trees, nitrogen needs are generally met by late-winter or early-spring soil applications. Where trees are not growing too vigorously, urea at the rate of 4 pounds per 100 gallons on a dilute basis can be added to each spray from petal fall through mid-June.

CALCIUM

To obtain high quality fruit with good market acceptance, growers must maintain adequate calcium levels in their fruit. Low fruit calcium is associated with two major problems - cork spot and bitter pit.

Cork spot shows up as a shallow depression in the fruit surface, which when peeled has brown, firm corky tissue that is harder than the flesh. This corky area will usually extend into the flesh. Cork spot can also be internal in Yorks. The problem is associated with early-season water stress, irregular cropping, excessive tree vigor and poor nutrition. The disorder is initiated by midseason and does not develop after harvest.

Bitter pit is characterized by numerous small sunken pits of collapsed tissue softer than the apple flesh. Most pits are just beneath the skin, mostly on the blossom end of the fruit. The problem is associated with late-season moisture stress conditions, and fruit harvested too early is more prone. Bitter pit does not usually develop until after harvest.

The maintenance of adequate levels of calcium in the fruit to minimize losses from cork spot and bitter pit requires the use of a season-long management program. This program should include soil pH levels at 6.5 or higher, the encouragement of even, annual cropping by thinning, and the avoidance of excessive pruning and fertilization that stimulate too much growth. Most importantly, calcium should be included in each cover spray throughout the season.

Cork spot may have been misdiagnosed in the past. Research from the USDA in West Virginia indicates that late summer and fall stink bug feeding injury can produce symptoms very similar to cork spot. Symptoms appear as circular discolored depressions on fruit skin with corky flesh immediately below skin that develops within a day of feeding. Corking can extend up to $^1/_4$ inch into the flesh. Feeding punctures may be only visible with magnification and may occur anywhere on fruit, single or multiple damage sites. If multiple damage sites, they are often clustered. Damage takes place from mid-July until harvest.

CALCIUM SPRAYS

Rate: Calcium can be applied in cover sprays at the rate of 2 to 8 pounds of calcium chloride per acre (for a total of 15 to 50 pounds per acre per year) (Table 23). At 15-19 pounds per acre per year, some cork spot and bitter pit control will be achieved, but storage life will not be enhanced. The standard rate to apply in blocks where these disorders are chronic is 20-29 pounds per acre per year. The 30-39 pound rates will give fairly good control of corking and bitter pitting most

years. The 40-50 pound rates may increase storage life in addition to providing good control of cork spot and bitter pit. The higher rates can cause foliage burn and should not be reapplied unless at least 1/2 inch of rain has fallen since the last application.

Timing: All cover sprays.

Gallons Per Acre: No restrictions. Applications of as little as 20 gal per acre have been effective.

Compatibility: At the rates recommended, calcium chloride and/or Solubor may be mixed with spray oil (Superior 70 sec), with WP formulations, or with EC formulations of the more common fruit pesticides. Do not premix calcium chloride with Solubor in a small volume of water before adding to the tank, when both materials are to be applied together. ALWAYS DISSOLVE CALCIUM CHLORIDE IN A PAIL OF WATER and add this last, when the spray tank is nearly full, to insure that the calcium chloride is completely dissolved before spraying begins.

Additives: Surfactants are not needed when calcium chloride is applied with regular cover sprays.

Temperature: Spray on days when the temperature will not exceed 90°F.

Leaf Injury: Some leaf injury may occur from calcium sprays made after wet, cool springs or during hot, dry summers. When injury is noticed, reduce calcium chloride to one-half rate in the next spray.

Corrosion: Calcium chloride can corrode equipment (by keeping it wet). Be sure all parts of the sprayer and the tractor are rinsed thoroughly with water following each use.

BORON

Boron is frequently deficient in Virginia and West Virginia apple orchards. The first symptom of a boron deficiency is usually internal cork. Scattered areas of brown corky tissue appear in the flesh of the fruit, often in the core area. If the deficiency becomes severe, the fruit may be misshapen with sunken corky areas.

Boron may be supplied as a foliar spray or in a soil application. Foliar sprays are the easiest method of application; however soil applications have been shown to raise calcium levels in leaf samples and have been associated with yield increases when a boron deficiency exists.

Rate: Generally, boron levels can be maintained with a single application of 3 to 4 pounds per acre of Solubor at petal fall or first cover (Table 23). Rates of application to the soil are generally 1.5-2.5 pounds of actual boron per acre per year. Soil and leaf analyses should be used to determine optimum rates and methods of application.

Precaution: Do not premix boron with calcium chloride in a small volume of water because of boron precipitation.

Toxicity: Peaches are very sensitive to excess boron; therefore, boron should not be applied unless it is certain that a deficiency exists. Pears can be sprayed with Solubor at the same rate as apples. Excessive boron can kill young apple and pear trees.

Table 23. Recommended Rates and Materials for Nutrient Sprays.

Material	Rate of Application (lb per acre)	Timing
Urea	6 to 12	After bloom but not later than second cover on bearing trees.
Calcium chloride	2 to 8	All cover sprays.
Solubor or Soil applied B	3 to 4 1.5-7.5 actual B	Petal fall and first cover. Before bloom.

To insure proper vegetative growth and good fruit quality, it is best to apply solubor at full bloom plus soil applications made every year to every 3 years at the rates listed below for three different boron fertilizers. It is important not to apply too much boron because it can cause abnormal fruit maturation and injure trees. Rates of boron application to the soil should be adjusted for tree age.

Tree age (years)	Pound per acre per year			Pounds per acre per 3 years		
	Borate 46	Borate 65	Borax	Borate 46	Borate 65	Borax
1 - 3	0	0	0	0	0	0
4 - 6	1.3	0.8	1.7	4	2.5	5
7 - 9	2.6	1.7	3.0	8	5	9
10 - 12	3.3	2.5	4.0	10	7.5	12
13 - 15	5.0	3.3	6.3	15	10	19
16 +	8.0	6.0	10.3	25	18	31

Magnesium. Sometimes soil and leaf levels of magnesium are low. Depending on the situation there are several ways to improve magnesium nutrition.

a. When soil tests indicate low pH and a need for lime, the type of lime applied should be based on soil calcium and magnesium levels. Where calcium levels are rated as Medium or higher (M + to VH), and magnesium is rated as Medium or lower (M – to L -), choose a high-magnesium limestone or dolomitic lime. Regardless of soil calcium levels, when magnesium is rated as Medium or higher (M + to VH), use calcitic limestone.

b. If soil or leaf analyses indicate that potassium and magnesium are both low, use potassium magnesium sulfate as the source of potassium.

c. If leaf analysis indicates that only magnesium is low, apply 2 to 3 sprays of Epsom Salts (15 lbs per 100 gallons dilute equivalent) at petal fall, 1 to 2 weeks after petal fall, and 2 to 3 weeks after petal fall.

Manganese. Sometimes, especially in peach orchards, manganese deficiency appears as intervienal chlorosis, where leaf tissue between the veins becomes yellow or light green. Symptoms appear first on mid-shoot and older leaves. When leaf symptoms or leaf analysis indicates a need for manganese apply a spray of manganese sulfate (4 lbs per 100 gallons dilute equivalent) 1 to 2 weeks after petal fall or whenever the symptoms appear. Symptoms usually disappear within a few weeks of application.