NUTRIENT MANAGEMENT guide

EM 8712
June 1998

Apples

T. Righetti, K. Wilder, R. Stebbins, D. Burkhart, and J. Hart

Observations of annual growth and size and color of leaves and fruit are helpful in determining fertilizer needs. In addition, leaf analysis indicates which elements are present in adequate, deficient, or excessive amounts. Soil analysis is useful in predicting the need for lime applications.

Suspect a nutrient deficiency if poor tree performance is not primarily due to lack of pruning, poor pollination, disease, winter injury, deep cultivation, insects, physical injury, moisture, rodents, poor weather, or poor soil drainage.

Nitrogen (N)

Apply N according to terminal growth. Young trees should grow 18 to 30 inches annually. Injury to 1- and 2-year-old trees can occur if N is applied in a band around the tree. The rates in Table 1 are based on 108 to 218 trees/a.

Table 1.—N application rates for apples.

Tree age	Apply this amount of N (lb/tree)	(oz/tree)
1	0 to 1/8	2
2	1/4	4
3 to 5	1/4 to 1/3	4 to 5
6 to 7	1/3 to 1/2	6 to 8

The overall vigor of the tree is the best indication of nitrogen status. N concentration should be interpreted with an assessment of tree vigor (Table 2):

- Above-normal N and high vigor indicate over-fertilization of N.
- Below-normal N and low vigor indicate a need for additional nitrogen.
- Above-normal N and low vigor suggest another growth-limiting factor.
- Below-normal N and high vigor can occur on trees with little or no crop.

Table 2.—Leaf analysis guide for apples: N application based on % leaf N in August.*

Golden Delicious	Nonspur Delicious, others	Newtown	Possible interpretation
below 1.6	below 1.6	below 1.5	deficiency
1.6 to 1.8	1.6 to 2.0	1.5 to 2.3	below normal
1.8 to 2.0	2.0 to 2.3	2.3 to 2.6	normal
above 2.0	above 2.3	above 2.6	above normal

*Mature trees—in sod

Excess N produces poor-quality, bitter pit, green goldens and other yellows, and late-coloring nonspur reds. Apply little or no nitrogen to orchards where trees are crowded and pruning to restrict tree size is required.

Apply N in a 2- to 3-foot band under the drip line, or increase by 20 to 30 percent for a broadcast application. Adjust rates according to results of application in previous years. Less N is needed in clean cultivated orchards. The amount of N required ranges from none to about 2 lb/tree, assuming 108 to 218 trees/a.

Higher density plantings with dwarf trees require less N per tree but have similar per-acre requirements.

N applications should be made after leaf fall in autumn and before petal fall in spring. Early fall application can increase danger of winter freeze damage in areas in which subzero temperatures may occur.

Phosphorus (P)

Table 3.—P application rates for apples.

If % leaf P in August is	Possible interpretation	Apply this amount of P_2O_5 (lb/tree)
below 0.12	deficiency	10 to 15
0.12 to 0.14	below normal	6 to 10
above 0.14	normal	0

Tim Righetti, professor of horticulture; Kris Wilder, former research assistant in soil science; Robert Stebbins, Extension horticulture specialist emeritus; David Burkhart, former Extension agent, Hood River County; and John Hart, Extension soil scientist, Oregon State University.

OREGON STATE UNIVERSITY EXTENSION SERVICE

Sulfur (S)

Table 4.—S application rates for apples.

If % leaf S in August is	Possible interpretation	Apply this amount of S (lb/tree)
below 0.13	deficiency	1
0.13 to 0.16	below normal	0.5
above 0.16	normal	0

Deficiencies of P and S seldom are observed in Oregon apple orchards.

Potassium (K)

K deficiency is rare in Oregon apple orchards. Since K applications tend to reduce magnesium uptake, do not apply K unless leaf analysis indicates a deficient or borderline level of K (Table 5).

Table 5.—Leaf analysis guide for K application for apples.

If % leaf K in August is	Possible interpretation	Apply this amount of K_2O (lb/tree)
below 0.9	deficiency	10 to 15
0.9 to 1.2	below normal	6 to 10
above 1.2	above normal	0

Low K levels can be caused by either excessive crop loads or water stress, and do not necessarily reflect a need to initiate K fertilization programs. Even when low levels are due to K deficiency, K levels in the leaves often do not increase until the year following application. A single application usually is effective for 2 or more years. Preferably, drill K 6 to 8 inches deep in the root zone, or place a band on the soil surface at the drip line. The band should be 2 inches wide for every pound of K_2O per tree.

Potassium source is not critical, but chloride toxicity can occur if muriate of potash (KCl) is used and subsequent rainfall or irrigation is inadequate to leach chloride out of the surface soil.

Magnesium (Mg)

Mg deficiency symptoms appear as blotchy dead areas on older leaves in late summer and fall. Where Mg is needed, broadcast 1 T/a of dolomite (Table 6). Dolomite also reduces soil acidity. Vigorous, young Newtown trees often show Mg deficiency symptoms, which may disappear in later years even without application of Mg.

Table 6.—Leaf analysis guide for Mg application for apples.

If % leaf Mg in August is	Possible interpretation
below 0.18	deficiency
0.18 to 0.22	below normal
above 0.22	normal

Lime

Liming of orchard soils is most effective if the lime is mixed into the soil to as great a depth as feasible during the preparation of the land for planting. The application of lime is not suggested if the soil pH is 5.6 or higher.

The liming rate is based on dry 100-score lime (Table 7). Mix lime into the soil at least several weeks before planting. A lime application is effective for several years.

Table 7.—Lime application rates for apples.

If the SMP buffer test for lime is	Apply this amount of lime (T/a)
below 5.2	4 to 5
5.2 to 5.5	3 to 4
5.5 to 5.8	2 to 3
5.8 to 6.2	1 to 2
above 6.2	0

Topdress rates

Monitor tissue manganese (Mn) in established orchards as an indicator of declining soil pH and the need for a soil test. Figure 1 shows leaf Mn increasing as soil pH decreases in several Hood River County apple orchards. Normal apple leaf Mn is 15 to 50 ppm. When tissue Mn exceeds 100 ppm, sample soil for determination of pH.

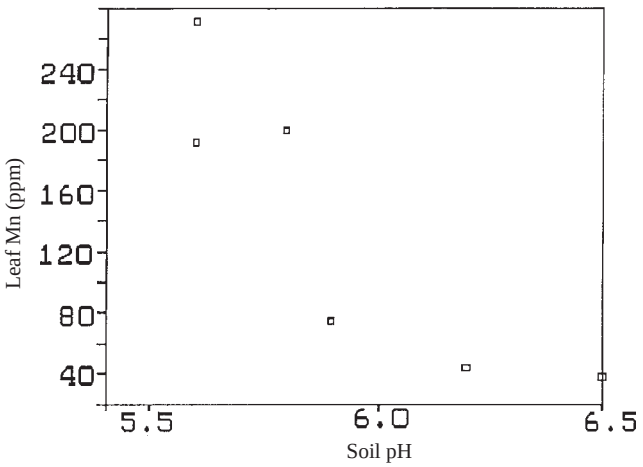

Figure 1.—Relationship between leaf Mn and soil pH in Hood River County apple orchards.

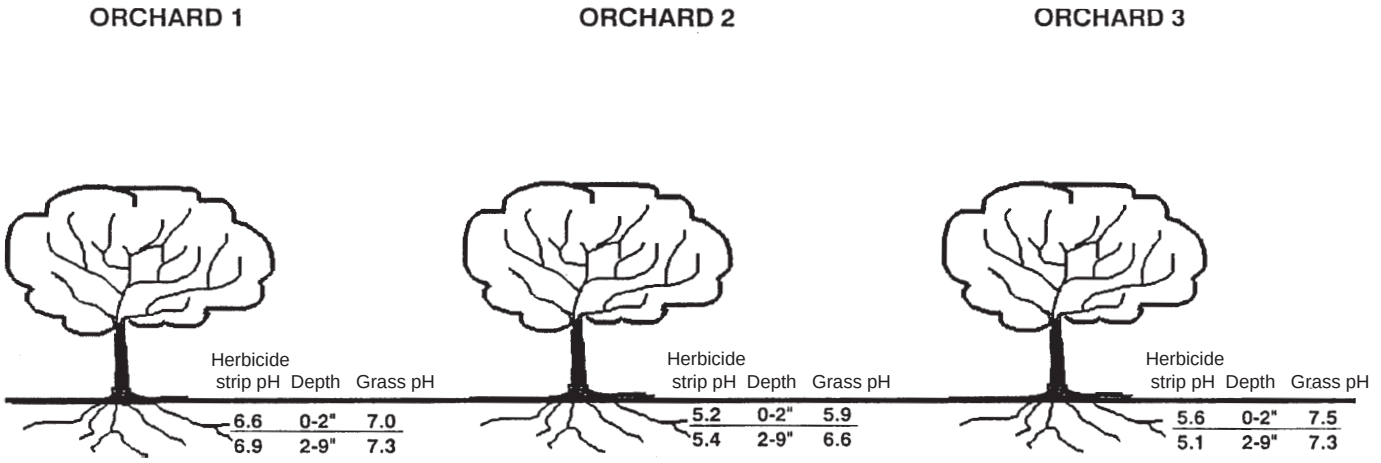

Figure 2.—Effect of soil sample depth and location on soil pH.

The soil pH value determined by a laboratory depends on the way the soil sample is obtained. Figure 2 shows the differences in orchard soil pH with soil depth and location where the sample was obtained. Soil pH in the grass area between tree rows always was higher than soil pH in the herbicide strip under the tree drip line. Soil pH in the surface 2 inches generally is lower than in the soil below this depth.

Sample soil from the area that you plan to lime, generally the herbicide strip. Use a soil sampling probe to obtain samples. Segregate soil from the upper 2 or 3 inches from soil at greater depths. Send both samples to a laboratory for determination of soil pH.

If the soil pH is below 5.6, top dress 1 to 2 tons lime/a. Lime is not soluble and will not move readily into the soil. Applications of 1 to 2 tons/a of lime will move into the soil approximately 1 inch the year following application. If your orchard has an active population of earthworms, they will mix the lime substantially deeper than 1 inch. Lime applications in filbert orchards were monitored for change in soil pH. Earthworms mixed top-dressed lime to a depth of more than 8 inches.

Soil pH changes seasonally. The lowest soil pH is found in the late summer or early fall. Samples taken in late winter or early spring have the highest pH. The average seasonal fluctuation of soil pH is 0.3 to 0.5 units, with changes of 1 pH unit not uncommon. If soil is sampled for a determination of pH, take the samples the same time each year.

Boron

Do not apply B to nonbearing trees. Reduce rates by one-half or more for young bearing trees since trees are easily injured by excessive B. (See Table 8.)

Table 8.—Leaf analysis guide for B application for apples.

If leaf B is (ppm)	Possible interpretation	Apply this amount of B* (lb/tree)
below 20	deficiency	0.10 to 0.15
20 to 30	below normal	0.10
30 to 80	normal	0.10**
80 to 100	above normal	0
above 100	excess	0

*Most commercial products are about 20% B (0.10 lb B fertilizer = 0.02 lb actual B).
**Maintenance application every 3 years

A spray application may give more rapid recovery than soil application. One preventive spray per year has been as effective as periodic soil applications. Spray at rate of 8 lb sodium pentaborate/acre. Spray twice if deficiency has occurred; fall application (before leaves drop) plus pre-bloom application (3 to 4 days before blossoms open) or pre-bloom application plus first cover spray.

Zinc (Zn)

Deficiency symptoms are helpful in diagnosing the need for Zn. Shoots have a tuft or rosette of comparatively larger leaves at the tip with smaller, narrow, sometimes chlorotic leaves below. If several elements are deficient, symptoms may not be clearly recognized. If leaf Zn levels in August are below 15 ppm, a deficiency may be more likely to occur the following spring.

Dormant sprays: Apply Zn sulfate at rate of 15 lb Zn (40 lb of 36% Zn sulfate crystals or 13 gal liquid Zn sulfate)/acre. Make the dormant application as late as possible in the dormant season before any visible green appears. *(Caution:* Be sure all crystals of Zn have dissolved before spraying.) Proprietary foliar nutrient sprays containing Zn may be used in summer. Follow recommendations on the label.

Apply after harvest when leaves are still green and active. Apply 10 lb Zn (25 lb 36% crystals or 8 gal liquid)/acre. For nonbearing trees, apply Zn sulfate spray, using approximately 0.5 lb Zn (1.5 lb 36% crystals or 0.5 gal liquid)/100 gal of spray to nonbearing trees as soon as deficiency is recognized. Thoroughly wet foliage. A spray of Zn chelate at 2 to 3 lb/100 gal 10 to 14 days following petal fall may be substituted for dormant Zn sulfate spray. In severe cases, a second spray may be required.

For More Information

OSU Extension Service publications

Fertilizer and Lime Materials, FG 52, by J. Hart (reprinted 1998). No charge.

A List of Analytical Laboratories Serving Oregon, EM 8677, by J. Hart (reprinted 1998). No charge.

Nutrient Disorders in Tree Fruits, PNW 121, by N.R. Benson, C.G. Woodbridge, and R.D. Bartram (reprinted 1994). $1.00

To order copies of the above publications, send the complete title and series number to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
541-737-2513
Fax: 541-737-0817

You may order up to six no-charge publications without charge. If you request seven or more no-charge publications, include 25 cents for each publication beyond six.

You can access this publication, as well as our Education Materials catalog and many of our other publications via our Web site at **eesc.orst.edu**

Other publications

Liming for Filbert Production in Western Oregon, CI 650, by L.C. Baron and E.H. Gardner (Oregon Agricultural Experiment Station, 1975).

Tree Fruit Nutrition: A Comprehensive Manual of Deciduous Tree Fruit Nutrient Needs, A.B. Peterson and R.G. Stevens, eds. (Good Fruit Grower, Yakima, WA, 1994).

Tree Fruit Nutrition—1983 Shortcourse Proceedings , R.G. Stevens and R.B. Tukey, eds. (Washington State University Cooperative Extension, Pullman, WA, 1983).

Tissue values are based on methods used in the OSU Department of Crop and Soil Science Central Analytical Laboratory. Revised N recommendations are based on N tissue analysis groupings from Department of Horticulture Plant Analysis Laboratory data. Other recommendations are based on Extension experience and grower observation of fertilizer response.

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties. Oregon State University Extension Service offers educational programs, activities, and materials—*without regard to race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, and disabled veteran or Vietnam-era veteran status*—as required by Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973. Oregon State University Extension Service is an Equal Opportunity Employer.

Published June 1998. Replaces FG 23 (revised 1989).