



Pears

J. Hart, T. Righetti, B. Stevens, B. Stebbins, P. Lombard, D. Burkhart, and P. Van Buskirk

Fruit tree fertilization is a standard grower practice intended to supplement soil-supplied nutrients. Both soil-applied fertilizers and nutrients stored within the tree are important. Tree reserves are the major source of nutrients for developing tissues before petal fall. Current-season growth and yield are influenced by nutritional status, which in turn is affected by prior management, fertilization, and current growing conditions. The task of recommending fertilizer rates and timings therefore is complex and challenging.

Observations of annual shoot growth, crop load, size and color of leaves, and fruit size are helpful in determining fertilizer needs. In addition, leaf analysis indicates which elements are present in adequate, deficient, or excessive amounts in established orchards. Soil sampling and testing of fields before orchard planting is recommended. Apply and incorporate K, Mg, and lime before planting. Soil analysis is useful for predicting lime and fertilizer needs for both cover crop and trees.

A nutrient deficiency may be the cause of poor tree performance, if not primarily caused by lack of pruning, poor pollination, disease, winter injury, insects, physical injury to roots or trunk, limited moisture, rodents, poor weather, and/or poor soil drainage.

Apply fertilizer based on these considerations and on the probability of an economic return from the fertilizer investment. Adding inexpensive fertilizer as insurance is not economically or environmentally sound. Excess N decreases fruit skin color, soluble solids, flavor rating, and fruit density in Anjou pears. Most N fertilizers, especially ammonium sulfate, increase soil acidity.

This fertilizer guide provides information designed to help develop fertilizer recommendations. Make adjustments in fertilizer rates for specific orchard conditions such as yield potential, microclimate, cover crop, and rootstock. Consult a field representative or your county Extension agent for more information.

Nitrogen (N)

Nitrogen fertilizer recommendations in this guide differ from those in previous editions. The purpose of this publication is to present both traditional and evolving fertilizer approaches to assist in assimilating new information. Nitrogen traditionally has been applied in spring

before bloom. N applications now are recommended 1 month prior to harvest, based on research at Oregon State University. Adoption of alternate N rates and timings should proceed gradually; monitor tissue N, tree vigor, and yield carefully to ensure compatibility with other management practices.

OSU research has shown uptake of 40–50 lb N/a as the total N requirement for high-yielding Comice pears (Figure 1). One-half of this N came from current-season fertilizer application; the remainder from the soil N pool (Figure 2). Other varieties may differ but probably not

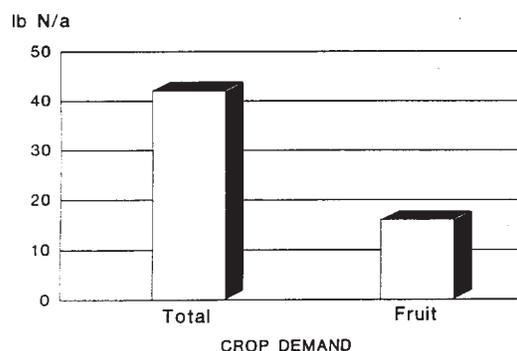


Figure 1.—Annual N demand of Comice pears.

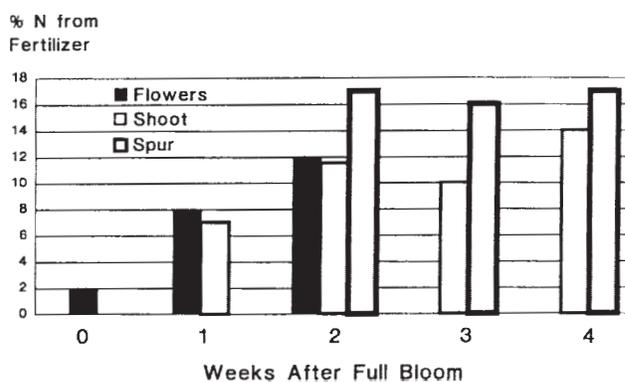


Figure 2.—Percent of the total nitrogen derived from the labeled fertilizer (NFF) in flowers, shoots, and spurs following a prebloom N application (reproduced from *Good Fruit Grower*, Oct. 15, 1990).

John Hart, Extension soil scientist, and Tim Righetti, professor of horticulture, Oregon State University; Bob Stevens, Extension soil scientist, Washington State University; Bob Stebbins, Extension tree fruit specialist emeritus, Porter Lombard, professor of horticulture emeritus, Dave Burkhart, former Extension agent, Hood River County, and Phil Van Buskirk, Extension agent, Jackson County, Oregon State University.

radically. High N rates are required because trees are inefficient in taking up N, not because N requirements are large. N uptake between leaf drop and shoot leaf emergence is minimal.

Spring growth draws N from tree reserves and only small amounts of prebloom-applied N reach newly developing tissues (Figure 2). To build reserves for the following spring while minimizing excessive vigor and fruits with high N content, late summer soil N application is suggested.

Fertilize mature trees with 100 lb N/a for normal growth and tissue N levels. Adjust this rate according to growth and tissue analysis (Table 1). The overall vigor of the tree is the best indication of nitrogen status. Pear trees more than 15 years old should make 8–10" of new growth on ends of scaffold limbs each year. Assess tree vigor to determine N concentration.

- 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 suggests another growth-limiting factor.
- Below-normal N and high vigor can occur on trees with little or no crop.

An alternative to current N fertilizer timing is to apply N to the soil 1 month before harvest. Follow with an irrigation. Reduce the soil-applied N rate accordingly if a later foliar N application is planned.

Foliar applications are helpful when tissue N is below normal. A post-harvest foliar application of 40–50 lb N/a as a 5 to 7 percent urea spray is an effective method for increasing tree N reserves. N is absorbed by leaves, then translocated to storage tissue. Either preharvest ground applications or postharvest foliar spray applications did not cause winter injury in Corvallis or Medford trials. Temperatures as low as 10°F were observed in the winter following pre- and postharvest N application.

Preharvest and foliar N fertilization are significant departures from previous spring recommendations. You may wish to test this gradually. Start with a small block of trees that is growing normally. Supplement spring fertilization with preharvest ground applications or postharvest foliar sprays. Monitor growth, tissue N, and yield. If you are satisfied with the results of this program, gradually implement new procedures in the entire orchard. Continue to monitor tree N, growth, and yield.

Table 1.—Leaf analysis guide based on % leaf N in August.

Leaf N (%)	N Status
<1.9	Shortage
1.9–2.1	Below normal
2.1–2.5	Normal
>2.5	Above normal

Apply N in the herbicide strip. If sod or grass cover is weak and you want to enhance growth, increase N rates by 40 lb/a. Apply the additional N to the sod. Additional N also may be required in orchards where weed control in tree rows is insufficient.

Young trees

Young trees should grow 18–30" annually. Apply N according to terminal growth. One- and 2-year-old trees can be injured if N is applied in a band around the tree. Spread fertilizer evenly 1–2' away from the tree trunk.

If fertilizing on a per-tree basis, divide the number of trees/a into the amount of N/a. A 6–7 year-old planting of 150 trees/a would receive $\frac{25}{150} \times 16$ (oz/lb) = 2.6 oz N/tree. To enhance vigor in young trees, spring or early summer N applications may be preferred.

N rates are on a per-acre basis, regardless of planting density. Do not increase rates for high-density plantings.

Table 2.—Pear N fertilizer recommendations based on tree age.

Tree age (years)	Apply this amount of N (lb/a)
planting–5	15–25
6–7	25–35
8–10	35–50

Phosphorus (P)

Certain P-sorbing soils of volcanic origin (for example, Parkdale, Hood River County), may require P fertilizer at planting. If the soil test P (Bray) is below 30 ppm on such soils, place $\frac{1}{8}$ to 1 lb P_2O_5 ($\frac{1}{4}$ to 2 lb, triple super phosphate, 0-45-0) in the planting hole. Cover the fertilizer with 2 to 4" of soil before planting the tree. For other soils, when the P soil test is below 15 ppm, use the same P rate and mix P fertilizer with soil as the tree is planted.

Although responses have occurred only on Parkdale soils, young trees deficient in P have responded to applications of triple super phosphate (0-45-0) at 4.5 lb/tree placed in 12"-deep holes 1' from the tree trunk. In most cases, mature pear trees deficient in phosphorus may respond to the application of mono ammonium phosphate. In cases where severe deficiency conditions exist, apply 5 to 10 lb P_2O_5 /tree in a band 4 to 6" wide about halfway between the drip line and the trunk. Any water-conserving mulching material placed over the band should increase P uptake. Assess pear P status according to guidelines in Table 3.

Table 3.—Pear leaf analysis guide for P requirement, August sampling.

Leaf P in August (%)	P status
<0.10	Shortage
0.10–0.14	Below normal
>0.14	Normal

Potassium (K)

K deficiency occurs in some Oregon pear orchards. Do not apply K unless leaf analysis indicates a need for K. Low K levels can be caused by excessive crop loads and water stress, as well as by low soil K availability. Even when low levels are caused by 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 6–8" deep in the root zone at the drip line, or place K in a 2"-wide band for each lb K₂O per tree applied on the soil surface at the drip line. Southern Oregon orchards planted in clayey soils may require 1,000–2,000 lb/a fall injected K₂SO₄ or KCl to overcome K deficiencies.

Pear tissue K concentration, yield, and fruit size responses to K fertilization vary for variety and soil type. Figure 3 illustrates Bartlett and Anjou leaf K concentration when no fertilizer, N, and N plus K were applied. Data are from the fourth year of a trial where Bartlett trees received 50 lb/a K₂SO₄ trenched in years 1 and 2 and 25 lb/a in year 3. Anjou trees received 50 lb/a K₂SO₄ in year 1 only. Tissue K concentration responded similarly to N and K applications for both pear types. Yield and fruit size responded to fertilization in the same manner as tissue K concentration. However, even though less K was applied, Anjou trees had greater K concentrations. General guidelines to fertilization can be provided but each orchardist should consider pear cultivar and monitor growth, tissue concentration, fruit size, and crop load for every planting before deciding on a fertilizer program.

Potassium source is not critical, but salt injury can occur where muriate of potash (KCl) is used and subsequent rainfall or irrigation is inadequate to leach salts from the surface root zone. See FG 52, *Fertilizer and Lime Materials*, for more information.

K can be supplied through sprinkler systems. This method is better suited for loamy or sandy soils than clayey soils. For new plantings, K should be broadcast and plowed under during land preparation. Apply K according to Table 4.

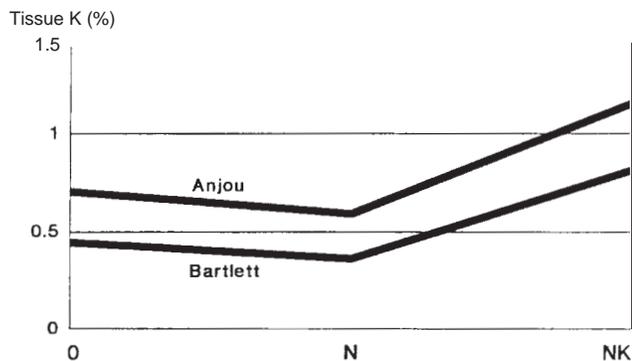


Figure 3.—Effect of K applications on K tissue concentration in Southern Oregon Bartlett and Anjou pears.

Table 4.—Pear K fertilizer recommendations using August tissue sampling or soil tests.

If acetate-extractable K is (ppm)	If leaf K is (%)	Apply K ₂ O this amount (lb/a)
0–75	<0.70	300–400
75–150	0.70–0.90	200–300
>150	>0.90	0

Sulfur (S)

Application of gypsum (calcium sulfate), ammonium sulfate, or other fertilizers that contain sulfur at a rate that supplies 50–100 lb of S per acre will correct a shortage of S. Anjou trees have a higher S requirement than other varieties. Applications of ammonium sulfate will depress soil pH.

Table 5.—Pear S fertilizer recommendations based on tissue concentration from August sampling.

If leaf S is (%)	Apply this amount S (lb/a)
<0.10	50–100
0.10–0.15	0–50
>0.15	0

Magnesium (Mg)

Bosc and Comice pears are more frequently deficient in Mg than other varieties. Where Mg and lime are needed, the Mg can be applied as dolomitic lime, which also reduces soil acidity. Low Mg may be related to low P; in this case, correct low P first. When lime is not required for a pH change and Mg is low, magnesium sulfate can be used.

For new plantings, an application of 1.5 T/a of dolomitic lime is recommended if the OSU soil test for Mg is less than 1.0 meq/100 g of soil.

Dolomite equals ground limestone in the correction of soil acidity, when adjusted for lime value. Apply dolomite in a similar manner to lime.

Boron (B)

B deficiencies can be treated with both foliar and soil applications in many orchards. Suggested soil application rates are listed in Table 6.

Do not apply B to nonbearing trees. Reduce rates per tree by one-half or more for young bearing trees since trees are easily injured by excessive B applications. Broadcast B when you apply it to the soil. Fertilizer rates in the following table are expressed in lb sodium pentaborate, not B. Apply no more than 20 lb/a sodium pentaborate. Annual foliar maintenance applications also are recommended, provided leaf B concentrations are not above normal.

Table 6.—Pear B fertilizer recommendations based on tissue concentration from August sampling.

B in leaves (ppm)	B status	Apply this amount Sodium pentaborate (lb/a)
<20	Shortage	15–20
<20–30	Below normal	15
<30–80	Normal	15*
>80	Above normal	0

*Maintenance application every 3 years.

For foliar applications, spray sodium pentaborate at 8 lb/a (1½ lb B/a) using 2 lb solubor/100 gal of water. Apply twice if deficiency has occurred: fall application (before leaves drop) plus prebloom application (3–4 days before blossoms open); or prebloom application plus first cover spray.

Zinc (Zn)

Zn deficiency in Oregon pear orchards is rare. Deficiency symptoms are the most reliable indication of need for Zn. If several elements are deficient, symptoms may not be clearly recognized. Symptoms occur early primarily in tops of trees. Shoots have a tuft or rosette of comparatively larger leaves at the tip with smaller, narrow, sometimes chlorotic leaves below.

If leaf Zn levels in August are below 17 ppm, suspect a deficiency. Soil and/or foliar applications will not correct Zn deficiency in 1 year. Apply Zn on a trial basis, while monitoring growth, yield, and tissue concentration.

Dormant sprays: Apply Zn sulfate at a rate of 15 lb Zn (45 lb of 32 percent Zn sulfate crystals or 13 gal liquid Zn sulfate)/a. Make the dormant application as late as possible in dormant season before any visible green appears. (Caution: Be sure all crystals have dissolved before spraying.) Other Zn materials that you can apply in oil also are available. **Afterharvest sprays:** Apply Zn sulfate spray, using about ½ lb Zn (1½ lb 32 percent crystals or ½ gal liquid/100 gal of spray). Foliage should be thoroughly wetted.

Other Micronutrients

Deficiencies of other micronutrients have not been observed in Oregon pear orchards.

Lime

Liming of orchard soils is most effective where the lime is mixed into the soil to as great a depth as feasible during the preparation of the land for planting. Use a lime requirement test to estimate the liming rate required to raise pH to 6.0.

For More Information

OSU Extension publications

Hart, J.H. 1990. *Fertilizer and Lime Materials*, FG 52 (Oregon State University, Corvallis, reprinted 1992).

To order copies of FG 52, send the title and series number to:
Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119

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 obtain additional copies of this publication, *Pear Fertilizer Guide*, FG 59, from your county office of the OSU Extension Service or from the Extension and Experiment Station Communications Web site at <http://www.wagcomm.ads.orst.edu/>

Other publications

Dow, I.A. 1980. *Critical nutrient ranges in Northwest crops*, WREP 43 (Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA, and the Northwest Soil and Plant Test Work Group).

Gardiner, D.T. 1989. *Phosphorus nutrition of pear seedlings with different mycorrhizae and of wheat cultivars with different efficiencies*. Ph.D. Thesis (Oregon State University, Corvallis).

Horneck, D.A., J.M. Hart, K. Topper, and B. Koepsell. 1989. *Methods of soil analysis used in the Soil Testing Laboratory at Oregon State University*, SM 89:4 (Agricultural Experiment Station, Oregon State University, Corvallis).

Lombard, P.B. 1970. Do fat K rates pay on pears? In *Better Crops with Plant Food*, No. 4 (Potash Institute of N. Am., Atlanta).

Raese, J.T. 1989. *Effect of weed control and nitrogen fertilizer rates on growth, yield, fruit quality, and mineral composition of apple and pear trees*. Proceedings 40th Annual Far West Regional Fertilizer Conference, Coeur d'Alene, ID, July 23–25, 1989.

Sanchez, E.E. and T.L. Righetti. 1990. Managing nitrogen in pears. *Good Fruit Grower*, October, 1990 (pp. 12–16).

Sanchez, E.E., T.L. Righetti, D. Sugar and P.B. Lombard. 1990. Seasonal differences, soil texture and uptake of newly absorbed nitrogen in field-grown pear trees. *J. Hort. Sci.* 65(4):395–400.

Sanchez, E.E., T.L. Righetti, D. Sugar and P.B. Lombard. 1990. Response of Comice pear trees to a postharvest urea spray. *J. Hort. Sci.* 65(5):541–546.

Stevens, R.G. and R.B. Tukey (eds.). 1983. *Tree fruit nutrition*. 1983 Shortcourse Proceedings (Washington State University Cooperative Extension).

Westwood, M.N., E.S. Degman, and J.H. Grim. 1964. *Effects of long-term fertilizer and management practices on growth and yield of pears grown in a clay adobe soil*, TB 82 (Agricultural Experiment Station, Oregon State University, Corvallis).

