

# Hazelnuts

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A comprehensive approach to nutrient management will help you ensure availability of optimum levels of nutrients for tree growth. Components of a comprehensive nutrient management strategy include:

- Soil analysis before planting (useful in predicting the need for potassium, magnesium, or lime applications)
- Observations of annual shoot growth, leaf size and color, and crop yields
- Leaf analysis (to indicate which elements are present in adequate, deficient, or excessive amounts)
- Soil test results in mature orchards

Suspect a nutrient deficiency if the cause of poor tree performance is not primarily one or more of the following: lack of pruning, soilborne pests, winter injury, poor soil drainage, physical injury, disease, poor weather, insects, poor pollination, rodents, deep cultivation, shallow soil, or limited moisture.

## Leaf tissue analysis

Sample tissue in August. Table 1 shows the critical values for various elements. Fertilizer recommendations are based on the interpretation of leaf tissue tests and observations of orchard conditions.

Table 1.—Interpretation of leaf tissue results for hazelnut.

Nutrient	Deficiency	Below normal	Normal	Above normal	Excess
<i>Nitrogen</i> (% dry weight)	<1.80	1.81–2.20	2.21–2.50	2.51–3.00	>3.00
<i>Phosphorus</i> (% dry weight)	<0.10	0.11–0.13	0.14–0.45	0.46–0.55	>0.55
<i>Potassium</i> (% dry weight)	<0.50	0.51–0.80	0.81–2.00	2.01–3.00	>3.00
<i>Sulfur</i> (% dry weight)	<0.08	0.90–0.12	0.13–0.20	0.21–0.50	>0.50
<i>Calcium</i> (% dry weight)	<0.60	0.61–1.00	1.01–2.50	2.51–3.00	>3.00
<i>Magnesium</i> (% dry weight)	<0.18	0.19–0.24	0.25–0.50	0.51–1.00	>1.00
<i>Manganese</i> (ppm dry weight)	<20	21–25	26–650	651–1,000	>1,000
<i>Iron</i> (ppm dry weight)	<40	41–50	51–400	401–500	>500
<i>Copper</i> (ppm dry weight)	<2	3–4	5–15	16–100	>100
<i>Boron</i> (ppm dry weight)	<25	26–30	31–75	76–100	>100
<i>Zinc</i> (ppm dry weight)	<10	11–15	16–60	61–100	>100



# Nitrogen (N)

## Young trees

Apply N only after 2 growing seasons have passed. Young trees should grow 18–30 inches annually.

Table 2.—Nitrogen application rates for young hazelnut trees.

Age (year)	Apply this amount of N (lb/tree)
0–2	0
3–5	0.25–0.33
6–7	0.33–0.50
8–10	0.50–0.75

## Mature trees

Research has shown that the hazelnut tree efficiently uses stored nitrogen reserves to fuel early-season growth. Very little N actually comes from fertilizer applications. See Figure 1.

The most efficient uptake of soil-applied nitrogen occurs during active spring growth (Figure 2). Apply nitrogen according to Table 3 in the spring after active tree growth has begun.

The timing of N application can have a significant effect on how the applied N is used by the tree. N applied in March tends to stimulate vigorous vegetative growth, while split applications (March and June) cause more N to be moved into the trunks and roots for storage (Figure 3).

Likewise, the timing of foliar N applications affects utilization of the applied N. July applications provide N to nuts, while post-harvest applications provide more N for bud development (Figure 4).

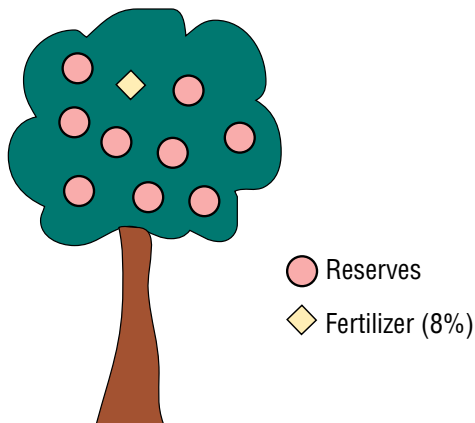


Figure 1.—Percentage of N in leaves from fertilizer and reserves in May of the year following fertilizer application. Most N used by the tree comes from stored reserves, while fertilizer provides only a small amount.

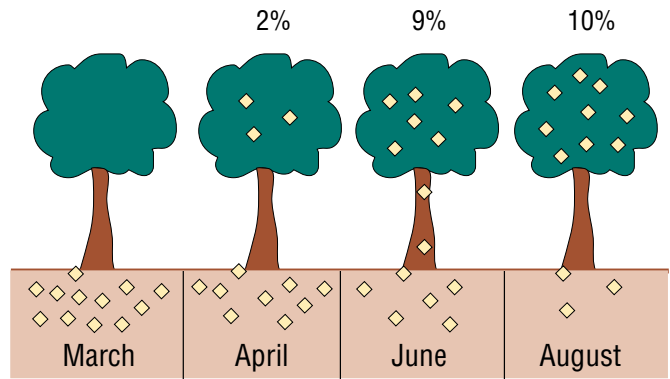


Figure 2.—Percentage of N in leaves from fertilizer applied during the current year. The tree takes up very little N until May–June. It's best to fertilize when the tree is ready to use the applied N.

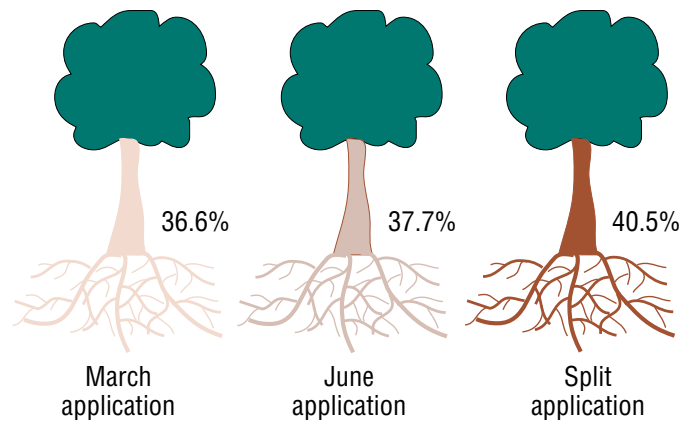


Figure 3.—Percentage of N in trunks and roots coming from applied fertilizer. More N is stored in the trunk and roots if the fertilizer application is split between March and June.

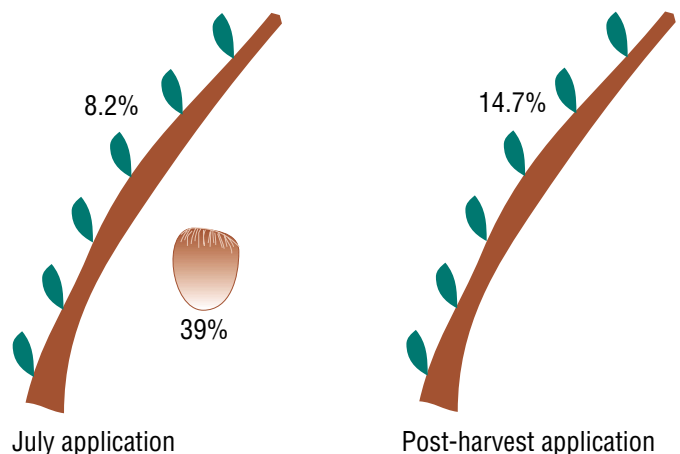


Figure 4.—The percentage of N in buds and nuts that comes from fertilizer depends on application timing. Post-harvest foliar N provides more N for bud development than does a July foliar application.

Table 3.—Leaf analysis guide for N application.

% leaf N in August	Status	Apply this amount of N (lb/tree)
Under 1.8	Severe deficiency	3.0 (2 years)
1.8–2.2	Deficiency	2.0–3.0
2.2–2.5	Optimal	1.5–2.0
Over 2.5	Excess	0

Apply N in a 1- to 2-foot band under the drip line or broadcast throughout the orchard. Increase the rate by 20–30 percent for a broadcast application. Adjust rates according to the results of leaf tissue analyses and growth response of the orchard. **Note:** Banding, over a period of years, might lead to excessively acid soil in the band.

## Phosphorus (P)

Deficiencies of P have not been observed in Oregon hazelnut orchards.

## Potassium (K)

K deficiency is common in Oregon hazelnut orchards. Fertilize according to Table 4, based on leaf tissue analysis results.

Table 4.—Leaf analysis guide for K application.

% leaf K in August	Status	Apply this amount of K <sub>2</sub> O (lb/tree)
Under 0.5	Severe deficiency	8–10
0.5–0.7	Deficiency	6–8
0.7–0.9	Borderline (test again in 1–2 years)	0
Over 1.0	Optimum	0

Place K in a band at the drip line of the tree. The band should be 1 inch wide for each pound of fertilizer applied. For example, if you apply 8–10 pounds of K<sub>2</sub>O per tree, apply it in a band that is 8–10 inches wide.

If you use muriate of potash (KCl), apply it in fall or before mid-February. Later application of muriate of potash can cause chloride toxicity due to its high chloride salt content. For applications after mid-February, use potassium sulfate instead.

Potassium levels in leaves often do not increase until the year following application. A single application usually is effective for 2 or more years. Repeated band applications on precisely the same soil increase the efficiency of K absorption.

## Boron (B)

Boron deficiency is indicated if the level in leaves is below 30 ppm. An application of 8 lb sodium pentaborate per acre in May sometimes increases nut set even in nondeficient trees. Use 2 lb sodium pentaborate per 100 gallons of water. Some phytotoxicity has been noted with leaf B levels above 200 ppm. When leaf B exceeds 200 ppm, omit the B application for 1 year.

## Magnesium (Mg)

You can correct magnesium deficiencies by applying dolomite when liming is needed. Dolomite is almost entirely magnesium carbonate, while dolomitic limestone contains up to 50 percent magnesium carbonate. Another way to correct a magnesium deficiency in a mature hazelnut orchard is to apply 30–40 lb per acre of actual magnesium, usually as potassium magnesium sulfate. Apply in a narrow band halfway between the trunk and the drip line.

## Zinc (Zn)

Zinc deficiency seldom is observed in hazelnuts. Apply zinc to a mature hazelnut orchard only if leaf tissue analysis shows a deficiency and deficiency symptoms are visible in the orchard. Zinc deficiency causes small, narrow, yellow leaves. These leaves can form in rosettes, or tufts, on the ends of new shoots. Foliar sprays of zinc are the most common way to correct zinc deficiencies.

**Dormant sprays:** Apply Zn sulfate at a 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.)

**Growing season sprays:** 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.

## Sulfur (S)

Sulfur deficiency is expressed as yellowing of the newest leaves in the orchard. It seldom is observed in Oregon hazelnut orchards. If needed, a foliar application of elemental sulfur will correct the deficiency. You also can correct the problem with soil applications that meet your other fertilizer needs, such as ammonium sulfate or potassium sulfate.

## New orchards

Soil sampling and testing of fields to be planted to hazelnuts is recommended. The Oregon State University Extension Service office in your county can provide you with soil sampling instructions and a list of private laboratories that analyze soil samples.

Preplant application and incorporation into the soil is best for some nutrient elements such as K, Mg, and lime.

## Potassium (K)

Broadcast K and plow it under during preparation of land for planting. Apply according to Table 5.

Table 5.—K application rates for new hazelnut orchards.

If soil test for K is (ppm)	Apply this amount of K <sub>2</sub> O (lb/acre)
0–75	300–400
75–150	200–300
over 150	0

## Magnesium (Mg)

Broadcast Mg and plow it under during preparation of the land for planting. If the soil test for Mg is less than 0.5 meq/100 g of soil, apply enough dolomite to lime to pH 5.6. Dolomite contains magnesium and calcium carbonate and acts in a manner similar to limestone in the correction of soil acidity.

## Lime

Apply lime if the soil pH is at or below 5.6. The buffer test will determine the amount of lime to apply (Table 6).

Table 6.—Lime application rates for hazelnut orchards.

If the buffer test for lime is	Apply this amount of lime (ton/acre)
Below 5.2	4–5
5.2–5.6	3–4
5.6–5.9	2–3
5.9–6.2	1–2

The liming rate is based on 100-score lime. Liming of orchard soils is most effective if the lime is mixed into the soil to as great a depth as feasible during preparation of the land for planting. Apply lime at least several weeks before planting. A lime application is effective for several years.

Test the soil in mature hazelnut orchards for lime requirement about every 5 years. Take several subsamples of soil throughout the orchard and combine them. Send a sample of this mixture to a private laboratory for analysis.

Fertilizer Guide 52, *Fertilizer and Lime Materials*, which is available from your local OSU Extension office, provides additional information on lime.

## For more information

*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 (revised 1997). No charge.

*Soil Sampling for Home Gardens and Small Acreages*, EC 628, by E.H. Gardner (revised 1997). No charge.

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This guide is based on research conducted by Jeff Olsen, Extension agent (horticulture), Oregon State University; John H. Painter, horticulturist, USDA (emeritus); Lloyd C. Baron, Extension agent (emeritus), Oregon State University; and on grower experience using leaf analysis as a guide. Figures 1–4 are based on data from Olsen, J.L.; Righetti, T.L.; and Sanchez, E.I., 2000. *The absorption and distribution of isotopically labeled nitrogen in the hazelnut tree following ground and foliar applications*. Proceedings of the Fifth International Symposium on Hazelnut.

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