FERTILIZERguide
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Blueberries

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This fertilizer guide provides general information for blueberry fertilization. Growers, with the assistance of county Extension agents and field representatives, should consider fertilizer needs of each field. Routine collection and analysis of soil and tissue samples are helpful in determining fertilizer applications. Fertilization of a perennial crop such as blueberries may not be indicated by changes in tissue analysis for 1–2 years after application. This circumstance is aggravated when immobile materials (P, K, and lime) are topdressed. Soil and tissue data should be monitored along with weather records, yield, quality, disease problems, and fertilization rates and timing.

The goal of blueberry fertilization, as for any high-value crop, is to remove limitations to yield and quality by supplying the crop with ample nutrition in advance of demand. Production costs, environmental stewardship, and governmental regulation also should be considered. Fertilization should be based on yield or quality response, experience, and economics.

Little current Oregon experimental data exist linking modern cultural practices and blueberry yield. Therefore, the recommendations given in this guide incorporate Oregon research with research and recommendations from other blueberry-producing areas.

The fertilizer recommendations in this guide assume adequate weed, insect, and disease control and timely irrigation. Irrigation should be based on crop need. Fertilization beyond crop needs will not overcome inadequate management in another area.

Determine the need for fertilization by a combination of yield, growth, plant population, soil and/or plant analysis. Have a soil sample analyzed before planting to determine necessary adjustments. For example, soil pH may be too high for optimum blueberry production. To reduce soil pH, preplant application of sulfur is necessary. Applications of elements such as K and Mg are more accessible to plant roots when mixed with the soil rather than broadcast over the surface after planting.

On established plantings, leaf analysis is more useful than soil analysis. Use annual leaf analysis to determine plant nutrient concentration; soil analysis can be used every 3 or 4 years to monitor changes in soil pH, P, K, Ca, and Mg. Regular monitoring of soil pH should be a priority. Obtain soil samples from the area between the dripline and bush.

For routine leaf analysis, collect the most recent fully expanded leaves from current season shoots in late July–mid-August. Sample 5 leaves from each of at least 10 plants distributed randomly throughout the field. Sample cultivars separately. If the purpose of leaf sampling is to diagnose a suspected problem, collecting one sample from affected plants and another from apparently healthy plants often is helpful. Many laboratories can perform soil and tissue analyses. A list of analytical laboratories serving Oregon (FG 74) is available in county Extension offices and on the World Wide Web (see "For More Information," page 5.)

Nitrogen (N)

Adequate tissue N levels are necessary to maintain renewal growth, crop production, and flower bud development for next year's crop. Excess N leads to excessive vegetative growth and development of immature wood late in the season, which increases risk of winter injury; restricts flower bud formation; and delays fruit maturity. Soil testing for N is not a reliable indicator of perennial crop N status. Leaf analysis alone (Table 1) does not indicate whether N fertilization is required, but it can be used in conjunction with an assessment of plant growth and productivity to determine N status. Plant vigor is the best indicator of nitrogen status. Interpret N concentration in leaves with an assessment of vigor. Above-normal tissue N and high vigor indicate overfertilization with 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 bushes with little or no crop.

Table 1.—Blueberry leaf N sufficiency, late July–mid August sampling.

Leaf N (%)	Status
<1.50	deficient
1.51–1.75	below normal
1.76–2.00	normal
2.01–2.50	above normal
>2.50	excess

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Common N fertilizers available include: ammonium sulfate (21-0-0) [$(NH_4)_2SO_4$]; ammonium nitrate (34-0-0) [NH_4NO_3]; ammonium phosphate (11-52-0) [$NH_4H_2PO_4$]; and urea (46-0-0) [$CO(NH_2)_2$]. Both the ammonium and nitrate forms of N can be used if the soil pH is less than 5.5. However, above pH 5.5, the ammonium form, except urea, is favored. Urea nitrifies rapidly when soil pH is above 5.5 (Figure 1). Fertilizers that contain only nitrate (such as calcium nitrate) may cause injury or reduced growth and should be avoided (Eck, 1988). Any N fertilizer should be followed by rain or an irrigation within 1–2 days of surface application

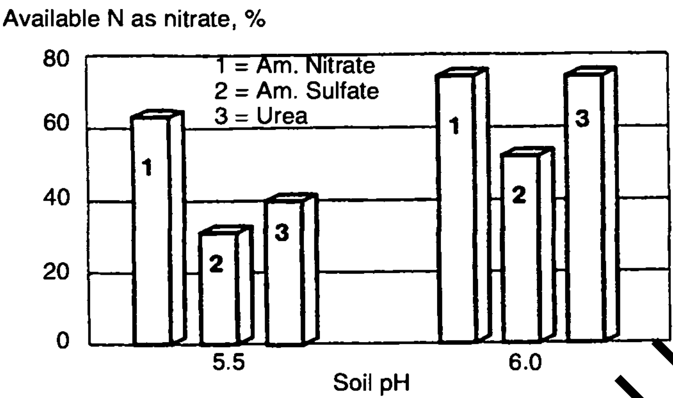

Figure 1.—Relative nitrification of N fertilizers, Hyslop Crop Science Field Laboratory, spring 1985 (140 lb N/a applied March 7; sampled April 23).

N rates for young blueberry plantings should increase with stand age (Table 2). Use caution when applying N to young blueberries, as overapplication will cause leaf burn. Apply 80–140 lb N/a to mature plantings (Table 3). Adjust fertilization based on plant age, plant spacing, N status, and visual observation of vigor and productivity.

Table 2.—Blueberry N fertilizer rate per plant and per acre from establishment (year 1) to maturity.

Year	N (oz/plant)	N (lb/a)*
1	0.2	10
2	0.3	20
3	0.5	30
4	0.8	50
5	1.0	60
6	1.1	70
7	1.4	90
8+	1.6	100

*Assuming 1,000 plants/a

Table 3.—N fertilizer rate for mature plants adjusted for spacing.

Spacing (ft)	Plants (per acre)	N rate (lb/a)
5 x 10, 6 x 8	871	90
4 x 10, 5 x 8	1,089	100
5 x 7	1,244	125
3 x 10	1,452	150

Spread fertilizer evenly under the plant canopy to ensure even growth since little lateral nutrient translocation occurs within the plant.

Split N fertilization over two or three applications. Split applications allow plants more time to absorb N before it is moved below the root zone. Blueberries are both shallow rooted and inefficient in using fertilizer N (Retamales and Hanson, 1989). Apply half before budbreak in the spring and half about 6 weeks later. Some growers split N among three applications. The last N application should be no later than July 1.

Sawdust-mulched plantings may need 50–100 percent more N, depending on the degree of sawdust decomposition. Martin and Pinkerton... Martin and Pelofske (1985) showed higher yields of mulched 'Bluecrop' plants when 125 lb N/a was applied during the first 2 production years. In subsequent years, yield was the same at the 75- and 125-lb rates, suggesting N need is less as sawdust ages.

Some growers supplement annual soil applications of N with foliar sprays during the season. Supplemental N sprays may be beneficial on N-deficient bushes, but bushes receiving appropriate soil applications of N are unlikely to respond to N sprays.

Phosphorus (P)

Symptoms of P deficiency, stunted plants with dark green-purple, small leaves, rarely are seen in the field. Effects from excessive P also are rare. P application may be justified if tissue P and/or soil P is low. See the potassium section for application information. Apply P according to Table 4.

Table 4.—P fertilization rates based on soil and late July–mid-August tissue sampling.

Soil P (Bray) (ppm)	Leaf P (%)	Apply this amount of P_2O_5 (lb/a)
0–25	<0.20	40–60
25–50	0.21–0.40	0–40
> 50	0.41–0.70	0

Various fertilizers can be used: triple superphosphate (0-45-0), ammonium phosphate (11-52-0), or ammonium phosphate sulfate (16-20-0-15). Apply the above rates for any plant population.

Potassium (K)

Potassium deficiency is relatively rare in Oregon. Leaves of K-deficient plants may develop several symptoms, including scorching along the margin, cupping and curling, and necrotic spots. Low leaf K values may be caused by poor drainage, drought, or very acid soils. Crop load also has a strong influence on leaf K levels. Ballinger (1966) found that K concentration in the berry increased dramatically as fruit matured, averaging more than 60 mg per berry when ripe. Thus, deficiency levels in leaves may occur in a heavy crop load year, with normal levels resuming after harvest. Normal August leaf K levels are 0.41–0.70 percent. If a below-normal leaf value occurs, band trial applications of 150 lb/a potassium sulfate (0-0-52) [K_2SO_4].

Avoid muriate of potash (potassium chloride), because chloride may cause reduced growth or injury to blueberries (Eck, 1988). If both K and Mg are needed, use 400 lb/a sulfate of potash-magnesia (0-0-21, 11% S, 10% Mg) [K_2SO_4, $MgSO_4$]. Blueberry yields have been shown to increase by K fertilization on various soil types if K is deficient. Use Table 5 as a guide.

Table 5.—K fertilization rates based on soil and late July–mid-August tissue sampling.

Soil test K (ppm)	Tissue K (%)	Apply this amount of K_2O (lb/a)
0–100	<0.20	75–100
101–150	0.21–0.40	0–75
>150	>0.40	0

Excess K can interfere with uptake of other elements, especially Mg. Therefore, do not apply K unless foliar analysis indicates a deficiency. Use the rates above regardless of plant population.

Both P and K are immobile. Placement in the root zone will enhance uptake. If possible, shank these elements into the soil area near the root zone in late fall or spring prior to budbreak. When N is included with P and K, apply in spring. When shanking is not possible, topdress fertilizer. Irrigate afterwards if rain does not fall in 1–2 days.

pH, Calcium (Ca), and Magnesium (Mg)

Harmer (1944) established a soil pH range of 4.0–5.2, with an optimum of 4.5–4.8 for blueberry growth and production in organic soils. The critical mineral soil pH range for Oregon is 4.5–5.5. If the soil pH is above this range, use elemental sulfur to reduce soil pH according to Table 6. Best results are obtained by applying 250 lb/a under the dripline in early spring and again in early fall until the amount shown in Table 6 has been applied. Use finely ground S for acidification. Soil pH will begin to decrease in 4–5 months. One year after the last application, sample again to determine if further acidification is necessary.

Table 6.—Amount of elemental S needed to lower soil pH to 4.5.

Current pH	Sandy soil	Loam
5.5	250	1,050
6.0	530	1,540
6.5	660	2,020
7.0	840	2,550

Keep in mind that use of ammonium sulfate fertilizer as a source of N will lower soil pH. Nitrate fertilizers, however, have little effect on soil pH. If pH is below 4.0, apply 1–2 T lime/a and retest soil pH in 8–12 months.

Although blueberries seldom are deficient in Ca, variations in leaf Ca occur. High leaf Ca concentration may be an indication of high soil Ca or high crop load. Low leaf Ca concentration may be present in heavily fertilized, vigorously growing plants, or may be a result of low soil pH. If low soil pH is suspected, check tissue Mn concentration. Abnormally high Mn (above 450 ppm) is an indication of low soil pH and low soil Ca. Normal blueberry tissue Ca is from 0.41 to 0.8 percent.

When soil sampling an established blueberry planting, keep in mind soil pH differences will occur throughout the field. Close to the plants, where N fertilizers are applied, the pH will be lower than between rows. Figure 2 relates cherry orchard soil pH variation to depth and location.

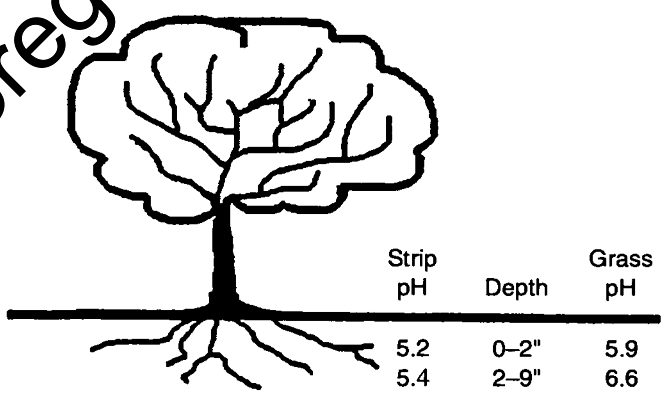

Figure 2.—Cherry orchard soil pH changes with depth and distance from fertilizer application strip.

If Ca is required and pH is below 4.0, topdress ½ to 1 T/a agricultural limestone (Ca) or dolomitic limestone (Ca + Mg), if Mg is needed as well. If Ca is needed and the pH is above 5.0, apply ½ to 1 T gypsum/a.

Normal leaf Mg levels are in the range of 0.13–0.25 percent. Excessive leaf Mg may indicate a high pH. If Mg is needed and the pH is above 5.0, apply magnesium sulfate (Epsom salts) or Sul-Po-Mag (21% K, 11% S, 10% Mg) at 500 lb/a. If the pH is below 4.0 and Mg is required, apply 1 T/a dolomite lime. The addition of Mg to the regular fertilizer program will help maintain Mg levels in the soil. Soil testing every 3–5 years allows monitoring of changes in soil Ca and Mg levels.

Apply lime, gypsum, dolomite, and magnesium sulfate in the fall to permit time for reaction with soil before the growing season. Lime reacts faster when mixed with soil. This is practical only before planting. Topdressed lime changes soil pH gradually. Monitor leaf Mn after liming. Leaf Mn should decrease after liming. Figure 3 illustrates the relationship between pH and leaf Mn.

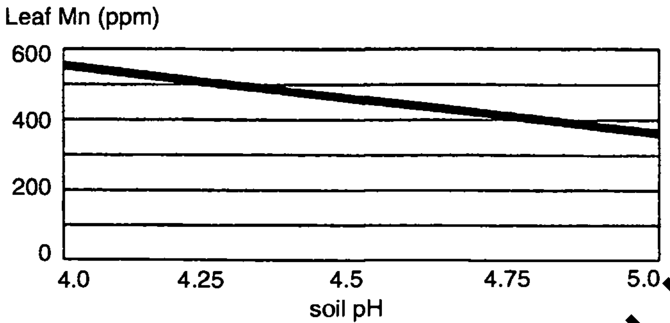

Figure 3.—The relationship of soil pH and leaf Mn in 'Bluecrop' blueberries, North Willamette Research and Extension Center, 1977–79 (Martin and Pelofske).

Sulfur (S)

Sulfur is an essential element. However, it is more commonly applied to blueberries to reduce soil pH than to correct a nutrient deficiency. Normal leaf levels for S range from 0.11–0.16 percent.

Boron (B)

Boron deficiency, which is relatively common in Oregon, causes tip dieback. Leaves close to these aborted shoot tips develop a mottled chlorosis and cupped shape. Leaf and fruit buds fail to develop in severely deficient plants. Winter injury also may be greater on B-deficient plants. Use Table 7 as a guide to fertilization.

Table 7.—Blueberry leaf B sufficiency, late July–mid August sampling.

Leaf B (ppm)	Status
<20	deficient
21–30	below normal
31–80	normal
81–150	above normal
>150	excess

If B is deficient, apply either Solubor (20% B) at 2–6 lb product/100 gallons water/a, or 10–20 lb/a Borax (11% B). Apply Solubor or an equivalent material as a foliar spray before bloom or after harvest. Apply Borax in the fall or early spring prior to rain. Many blueberry growers in Oregon follow an annual B application program of 112 lb B/a. Monitor leaf levels carefully. Excess B is toxic to plants.

Zinc (Zn)

Zn deficiencies are less common than B deficiencies in Oregon. Symptoms of Zn deficiency include short internodes and small leaves, with the youngest leaves somewhat yellow and folded upwards along the midrib. Excessive use of P sometimes may result in Zn deficiency symptoms. Zn deficiency is less common when pH is below 6.0. Normal leaf concentrations are from 8–30 ppm. If plants are deficient: (1) apply Zn chelate (14% Zn) as a foliar spray at 1 lb/100 gal water/a prior to bloom or after harvest; or (2) apply 10–30 lb/a Zn chelate or 10–30 lb/a Zn sulfate (36% Zn) to the soil.

Copper (Cu)

Symptoms of Cu deficiency include yellowing between veins of young leaves and, in severe cases, young shoot dieback. Cu deficiency may be more severe on soils high in organic matter. Normal leaf levels for Cu are from 5–15 ppm. If tissue concentration is low, use a *trial* application of copper sulfate (25% Cu). Broadcast at 30–50 lb/a or apply 1 lb/100 gal water/a as a foliar spray anytime leaves are present. Cu is very toxic at an excessive rate, so use caution and experiment on a few plants before applying to the entire field.

Iron (Fe)

Iron deficiency in leaves often is the result of a high soil pH rather than Fe deficiency in the soil. Symptoms of Fe deficiency include yellowing between leaf veins, appearing first on the younger leaves. Shoot growth and leaf size sometimes are reduced. Normal Fe leaf values are 61–200 ppm. If leaf levels are deficient, apply as iron chelate (10% Fe) at 2 lb/100 gal water/a twice as a foliar spray when leaves are present (see label) or 15–30 lb/a to the soil. A soil application of 10–20 lb/a ferrous sulfate (34% Fe) also is suitable.

For More Information

OSU Extension publications

Fertilizer and Lime Materials, FG 52, by J. Hart (Oregon State University, Corvallis, reprinted 1992). No charge.

A List of Analytical Labs Serving Oregon, FG 74, by J. Hart (Oregon State University, Corvallis, revised 1997). No charge.

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Ballinger, W.E. 1966. Seasonal trends in Wolcott Blueberry (*Vaccinium corymbosum* L.) leaf and berry composition. N.C. Agr. Exp. Sta. Tech. Bull. 173.

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These recommendations are based on research findings in many states and observations of responses in commercial plantings in Oregon, including leaf analysis. Tissue and soil analyses are based on procedures used in the OSU Central Analytical Laboratory.

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