

Fertilizer Guide

South Coastal Oregon CRANBERRIES

This fertilizer guide provides information for cranberry fertilization in Coos and Curry Counties where cranberries are planted in irrigated beds of sandy loam soil. Uniform irrigation is essential for optimum cranberry growth since moist but not saturated soils are required.

The goal of cranberry 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. Growers should consider the fertilizer needs of each cranberry bed rather than treating their entire acreage the same way.

Foliar fertilization of cranberries is practiced by growers with little evidence supporting its benefits. Although fertilizers may enter through leaves, there is little information about how this compares to standard practices.

Fertilizer need should be determined through soil and tissue analyses in conjunction with weather records, crop yield and fruit quality, and an assessment of pest problems. Production costs, environmental stewardship, and governmental regulation should also be considered. Fertilization should be based on yield or quality response, experience, and economics.

Plants indicate low nutrient supply through reduced growth and yield. Reduced nutrient supply below crop demand can lead to visible nutrient deficiency symptoms. Routine collection and analysis of soil and tissue samples are helpful in detecting low nutrient concentration before visible symptoms and yield reduction occur. An Extension publication, FG 74, *Analytical Laboratories Serving Oregon*, provides information about laboratories that offer soil and tissue testing services. It is available in local Extension offices or can be ordered from OSU Agricultural Communications. See the *For More Information* section for ordering instructions.

Soil and Tissue Sampling

Obtain soil samples during the dormant season after flood management and before bud break. Sampling depth should be 4 inches on new or young beds or 6 inches including surface duff on mature, well established beds. Obtain 10 to 12 cores from the same area that tissue samples are taken. Avoid poorly drained areas, high spots or other nonrepresentative areas. Sample problem areas separately. Routinely test soil for pH, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), boron (B), and zinc (Zn).

In addition to soil testing, tissue analyses are used to help assess fertilizer requirements during the following growing season. A cranberry tissue sample is obtained by clipping current season growth from just above the berries on fruit bearing uprights. Twenty tips each from 10 locations representative of the bed are needed. The total sample will consist of 200 tips per bed. Do not wash the sample or separate leaves and stems before submission of the tissue sample to the laboratory. Collect tissue samples during mid-August to mid-September, prior to harvest.

Routinely analyze cranberry tissue for total nitrogen (N), P, K, Ca, Mg, sulfur (S), B, Zn, copper (Cu), and manganese (Mn). Many laboratories provide analyses for additional micronutrients such as iron (Fe). These other analyses may be helpful in problem or "troubleshooting" situations but are difficult to interpret from routine sampling.

Using Soil and Tissue Tests

Cranberry tissue test values for N, P, K, and S are divided into below normal, normal, and above normal categories. Tissue concentrations for Ca, Mg, B, and Zn, are placed into only two categories, sufficient and deficient. If a tissue concentration is below normal or deficient, fertilization with the appropriate nutrient is recommended. The categories are based on nutrient ranges from other cranberry growing areas, grower observations, Oregon cranberry tissue analyses, and limited Oregon field trials.

Annual monitoring of soil and leaf tissue is suggested. In addition, recording data on fertilizer applications, weather, and yield would be helpful. Soil and tissue analyses won't identify an exact amount of fertilizer to apply. However, they are useful for evaluating nutrient sufficiency and fertilizer applications. Soil and tissue tests are best used to evaluate a program of several years duration rather than for a single year. Therefore, record keeping is a vital component of soil and tissue analyses interpretation.

Insufficient nutrition is only one cause of reduced yields. Saturated or dry soils, high temperatures, frost, shading, weed, insect or disease pressure or herbicide injury also reduce yields. Fertilization will not compensate for these problems. If adequate nutrition is present, fertilizing is an unnecessary expense and potentially detrimental to the environment.



The standard fertilization schemes that follow involve a series of applications that can be modified depending on soil and plant analyses, vigor, and crop performance.

Fertilization of a perennial crop such as cranberries may not affect tissue analysis levels for 1 to 2 years after application.

Nitrogen (N)

Bearing beds

Adequate tissue N levels are necessary to maintain growth, crop production, and flower bud development for next year's crop. Excess N leads to excessively vegetative growth, which 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 does not indicate whether N fertilization is required but can be used with an assessment of plant growth and productivity to determine N status.

Nitrogen fertilization rates are based primarily on field observation and to a lesser extent on plant analysis. Nitrogen concentration should be interpreted with an assessment of plant vigor. Normal growth for flowering uprights is 2 to 4 inches per year. Flowering upright growth less than 2 inches is below normal. Conversely, flowering upright growth greater than 4 inches is above normal.

Above normal N and high vigor indicate over fertilization of N. Below normal N and low vigor indicate a need for more N. Above normal N and low vigor suggest another growth limiting factor such as poor drainage. Below normal N and high vigor can occur in beds with little or no crop. Table 1 provides a guide to cranberry N tissue concentrations.

Table 1. Percent leaf N for mature beds in August-September. Standards for McFarlin, Stevens, and Crowley cultivars combined on a dry weight basis.

% Leaf N	Status
Under 0.90	Below Normal
0.90 - 1.25	Normal
Over 1.25	Above Normal

Cranberries respond best to ammonium N. Usually, broadcast applications of dry materials are spread more evenly than applications made through sprinkler systems. To avoid plant injury, apply materials to dry vines, then rinse with irrigation water.

At fruit set and sizing time, growers should observe terminal leaves on flowering uprights turn from a healthy green color to a pale yellowish green. Growers should also notice terminal leaf margins turn red and leaf bases and mid-ribs remain green. These natural signals of stress indicate normal nutrient flow from current season growth to developing fruit. Recent research supports these observations.

For most beds, optimum timing of N for fruit set, berry size and bud initiation appears to be from when berries are pea-sized until the last flower falls, a period of 3 to 4 weeks.

For established plantings of 'Crowley' and 'McFarlin', if the bed is not over vegetative, apply 5 to 10 lb N/a at late hook/early bloom stage. Nitrogen applied between popcorn and

early bloom often produces excessive growth, especially during cloudy or rainy periods. Withhold further N until berries are pea or marble size throughout the field, then apply 10 to 20 lb N/a. For 'Stevens', wait until pea sized berry stage occurs before beginning N fertilization. Blossoms will still be present in the field at this time. Earlier N fertilization produces excessive vegetative growth.

Apply 10 to 20 lb N/a every 7 to 14 days until berry sizing appears complete. An alternative is to apply 20 lb N/a twice at 2 week intervals during the same period. Rate of N will vary depending upon crop potential and stress conditions such as herbicide use, frost injury, and drainage. A final application of 5 to 10 lb N/a may be applied in late July to early August to maintain plant vigor and to further encourage bud development. Nitrogen fertilization after fruit is sized should be reduced, since research has shown that little N is taken up in cranberry plant tissues and fruit at that time. Use bee activity during bloom to help determine N timing. Make final N applications 1 to 3 weeks after bee activity stops.

Where vines are weak or stressed, however, a post-harvest application of 5 lb N/a may be helpful. Heavy applications of N late in the season encourage berry rot, delay ripening and color development, and stimulate bud growth, increasing the risk of winter injury.

New Beds

For new plantings (first year), apply 5 to 10 lb N/a when $\frac{1}{4}$ inch of growth is observed. Then apply 10 lb N/a no more than every other week until September or until appropriate vigor and runner growth is achieved. New beds are fertilized to encourage rapid soil coverage and root growth for early establishment and to discourage weed competition.

Irrigate to maintain a moist but not wet soil environment. If water puddles consistently, adjust sprinklers, reduce irrigation amounts, or improve drainage. Cranberries may die or lose vigor if standing water is chronic. Establishment is achieved when runners generate new uprights and terminal buds. When sufficient uprights and buds have been formed, apply N according to the scheme outlined for bearing beds.

Phosphorus (P)

In established beds, apply P at the white bud/popcorn stage in late March or early April according to table 2. Where vines are weak, a post-harvest application of 10 to 20 lb P_2O_5/a may be helpful.

Efficient use of P fertilizer depends on fertilizer placement as P is not mobile in soil. The fibrous root system of cranberry develops in the top 1 to 3 inches of soil. Therefore, on new plantings, apply $\frac{1}{2}$ to $\frac{2}{3}$ of the P fertilizer before the final sand layer if that sand layer is only 2 to 3 inches deep. Apply the remaining P after scattering vines but before disking.

Phosphorus could also be applied just before vines are scattered and disked. If vines have already been planted, split the P applications in the first year, applying half as growth starts and half at midseason.

Table 2. Cranberry phosphorus sufficiency and fertilizer recommendations based on soil and tissue tests.

<u>If the Bray soil test for P is (ppm)</u>	<u>If % Plant P in Aug-Sept is</u>	<u>Status</u>
0 - 15	Under 0.10	Below Normal
15 - 30	0.10 - 0.25	Normal
Over 30	Over 0.25	Above Normal

<u>If cranberry status is</u>	<u>Broadcast this amount of P₂O₅ (lb/a)</u>
Below Normal	40 - 80
Normal	0 - 40
Above Normal	0

Potassium (K)

An adequate supply of K is needed for the high K requirement of young leaves and berries. Multiple applications of K fertilizer are recommended to compensate for leaching in sandy soils. If dry K fertilizers are applied, rinse material from foliage with irrigation to prevent fertilizer burn.

Table 3. Cranberry potassium sufficiency and fertilizer recommendations based on soil and tissue analysis.

<u>*If the soil test for K is (ppm)</u>	<u>If % Plant K in Aug-Sept is</u>	<u>Status</u>
0 - 50	Under 0.40	Below Normal
50 - 100	0.40 - 0.65	Normal
Over 100	Over 0.65	Above Normal

<u>If cranberry status is</u>	<u>Broadcast this amount of K₂O (lb/a)</u>
Below Normal	60 - 100
Normal	0 - 60
Above Normal	0

When K is required, apply 25 percent of the total to be applied at white bud/popcorn stage in late March or early April, 25 percent at hook stage in May, 25 percent at mid-fruit set stage in late June - early July, and 25 percent at late-fruit set stage in late July to early August. Where vines are weak, a postharvest application of 10 to 20 lb K₂O/a may be helpful. Amounts to apply can be determined from table 3.

Sulfur (S)

Plant analysis is used for prediction of cranberry S needs.

Table 4. Cranberry sulfur sufficiency based on tissue analysis.

<u>If % Plant S in Aug-Sept is:</u>	<u>Status</u>
Under 0.10	Below Normal
0.10 - 0.30	Normal
Over 0.30	Above Normal

Fertilizer materials used to supply the other nutrients normally contain more than adequate S. Therefore separate applications of S are not recommended.

pH

Cranberries grow best in south coastal Oregon between pH 4.5 and 5.5. Treatments to change pH status of cranberry beds are usually not advised since native soils are in this pH range.

Calcium (Ca)

Sufficient Ca may be supplied by 0-45-0 (12 to 14 percent Ca) fertilizer and bordeaux fungicide. Apply Ca as gypsum (calcium sulfate) between white bud/popcorn and roughneck stages according to table 5. Caution: excess soil calcium could enhance unwanted legumes ability to invade cranberry beds.

Table 5. Cranberry calcium sufficiency and fertilizer recommendations based on soil and tissue analysis.

<u>* If the Ca soil test is (meq/100g)</u>	<u>If % Plant Ca in Aug-Sept is</u>	<u>Apply this amount of gypsum (lb/a)</u>
Under 0.50	Under 0.60	100

Magnesium (Mg)

Little is known about Mg nutrition of cranberries, and, according to Eck in *The American Cranberry*, no reports of yield or growth increases to Mg applications have been published. Eck also reports that blueberries grown on the same soil as cranberries sometimes exhibit Mg deficiency symptoms. The limited growth of cranberries compared to blueberries may be one factor in the lower Mg requirement of cranberries. In addition, the evergreen growth habit of cranberries may allow Mg to be translocated from old to new growth.

Though little information on cranberry Mg nutrition exists, the choice of 0.15 percent tissue Mg from a late summer sampling is supported by tissue analyses summaries and is consistent throughout North American growing regions. Analyses of Oregon cranberry tissue from 1974 to 1988 show most samples were between 0.17 and 0.24 percent Mg. Only 2 percent of the samples were below 0.17 percent.

South coastal Oregon cranberries are routinely fertilized with Mg. If Mg is deficient, a greater distribution of tissue Mg concentration would be expected. Low tissue Mg can be caused by Ca and K fertilization and reflected by high tissue Ca and K concentration. In this situation, reduce Ca and K applications. Apply Mg at white bud/popcorn stage according to table 6:

Table 6. Cranberry magnesium sufficiency and fertilizer recommendations based on soil and tissue analysis.

<u>*If the Mg soil test is (meq/100g)</u>	<u>If % Plant Mg in Aug-Sept is</u>	<u>Broadcast this amount of Mg (lbs/a)</u>
Under 0.30	Under 0.15	20

Boron (B)

Boron can be toxic to cranberries if applied in excess. Apply B only when the need is indicated by soil or plant analysis. An annual maintenance application is suggested unless soil and plant analyses indicate above normal amounts. Use a soluble form of B broadcast by sprayer or sprinkler. Do not mix it with copper materials. Apply between roughneck and early bloom.

Table 7. Cranberry boron sufficiency and fertilizer recommendations based on soil and tissue analysis.

<u>*If the B soil test is (ppm)</u>	<u>If Plant B in Aug-Sept is (ppm)</u>	<u>Apply this amount of B (lb/a)</u>
Under 0.50	Under 25	1

Zinc (Zn)

Soluble forms, such as zinc sulfate or chelate, can be applied by sprayer or sprinkler. Apply only when needed between roughneck and early bloom.

Table 8. Cranberry zinc sufficiency and fertilizer recommendations based on soil and tissue analysis.

If the DTPA soil test for Zn is (ppm)	If Plant Zn in Aug-Sept is (ppm)	Apply this amount of Zn (lb/a)
Under 0.80	Under 15	1 to 2

GUIDE TO TIMING OF CRANBERRY FERTILIZATION IN BEARING BEDS

Nutrient	White Bud / Popcorn	Roughneck	Late Hook/ Early Bloom	Mid-Fruit Set	Late Fruit Set	Bud Development	Post-Harvest
	lb/a						
Nitrogen (N)	a		5 - 10	10 - 20	10 - 20		0 - 5b
Phosphorus (P ₂ O ₅)	0 - 80						0 - 20b
Potassium (K ₂ O)	0 - 25		0 - 25	0 - 25	0 - 25		0 - 20b
Calcium (Ca)	x _____ 0 - 100 ^c _____ x ^d (as gypsum)						
Magnesium (Mg)	0 - 20						
Boron (B)		x _____ 0 - 1 _____ x ^d					
Zinc (Zn)		x _____ 0 - 2 _____ x ^d					

- a Apply 5 to 10 lb N/a if vines are weak. Excess growth can occur in warm and wet weather for beds with duff buildup. Avoid early N treatments in second year beds if first year growth was abundant. Also, avoid early N use on 'Stevens'.
- b Post-harvest fertilization usually is not needed. However, apply immediately after harvest if the vines are weak.
- c Apply 100 lb calcium sulfate/a (gypsum) if needed. Gypsum contains 19 to 23 percent calcium.
- d Apply during the period marked between X's or according to the product label. Post-bloom applications are not recommended.

For More Information

To order FG 74, *Analytical Laboratories Serving Oregon*, write Publications Orders, Agricultural Communications, Oregon State University, Administrative Services A422, Corvallis, OR 97331-2119. There is no charge for this publication.

Birrenkott, B. A., C. A. Henson, and E. J. Stang. 1991. *Carbohydrate Levels and the Development of Fruit in Cranberry*. J. Amer. Soc. Hort. Sci. 116(2):174-178.

Caruso, F. L., A. L. Averill, I. E. Demoranville, R. M. Devlin and C. J. DeMoranville. 1993. In: M. M. Averill (ed.) *Cranberry 1993 Chart Book, Management Guide for Massachusetts*. A joint publication of the Cranberry Experiment Station, MA Agricultural Experiment Station, and Coop. Extension, East Wareham, MA.

Chaplin, M. H. and L. W. Martin. 1979. *Seasonal Changes in Leaf Element Content of Cranberry, Vaccinium Macrocarpon Ait.* Commun. in Soil Sci. and Plant Analysis, 10(6):895-902.

Eaton, G. W. 1971. *Effect of N, P, and K Fertilizer Applications on Cranberry Leaf Nutrient Composition, Fruit Color and Yield in a Mature Bog*. J. Amer. Soc. Hort. Sci. 96(4):430-433.

Eck, P. 1971. *Cranberry Growth and Composition as Influenced by Nitrogen Treatment*. HortScience 6(1):38-39.

Eck, Paul. 1990. *The American Cranberry*. Rutgers University Press, New Brunswick, NJ.

Galletta, G. J. D. G. Himelrick, (ed), and L. Chandler (illust). 1990. *Small Fruit Crop Management*. Prentice Hall, Englewood Cliffs, NJ.

Roper, T. and S. Coombs. 1992. *Nutrient Status of Wisconsin Cranberries*. Cranberries: The National Cranberry Magazine, 15(2):11-15.

Roper, T. 1992. *Cranberry Soil and Tissue Analysis: Diagnostic Tools*. The Wisconsin Cranberry IPM Newsletter. A joint publication of the University of Wisconsin, Ocean Spray Cranberries, Inc., The Wisconsin Cranberry Board, Inc., Cliffstar Corporation, and private crop consulting services, Madison, WI. 6(7):1-2.

Torio, J. C. and P. Eck. 1969. *Nitrogen, Phosphorus, Potassium and Sulfur Nutrition of the Cranberry in Sand Culture*. J. Amer. Soc. Hort. Sci. 94(6):622-625.

Wood, J. H., L. Warner, and W. L. Powers. 1950. *Preliminary Report, Water and Nutrient Relations for Cranberries*. Oregon State College Extension Service, Experiment Station Soils Department. (Now Oregon State University, Corvallis, OR).



Arthur Poole, Extension agent, Coos County; John Hart, Extension soil scientist; Tim Righetti, professor of horticulture; and Bernadine Strik, Extension horticulture specialist; Oregon State University. Tissue and soil analyses are based on procedures used by OSU. Soil Mg, Ca, and K are determined from an ammonium acetate extraction. Boron is extracted with hot water and Zn from a DTPA extraction. N recommendations are based on tissue analysis groupings from Plant Analysis Laboratory data and field research. Other recommendations are based on Extension experience and grower observation.