Nutrient Management in Brambles

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Brambles or "caneberries" (raspberry and blackberry) are important crops in the United States with a reported 11,900 acres of blackberry in 2005 and 16,400 and 1,650 acres of red and black raspberry in 2014, respectively. There were also 495 and 663 acres of organic blackberry and raspberry, respectively, in the United States in 2008.

The unique growth habit of caneberries, where nutrients are accumulated in the primocanes, crown, and roots and are lost in the fruit, floricanes, and leaves (in autumn), makes nutrient management somewhat difficult. In the spring, growth of fruiting laterals and fruit is very dependent upon nutrient reserves stored in the floricanes, crown, and roots and on additional nutrients available from soil or new fertilizer. However, new primocane growth in the spring is most dependent on nutrients available in the soil or from fertilization. Good nutrient management programs are thus important for sustained growth and production.

In order to gain benefits from fertilization, crop management—from selecting certified plants to good irrigation and pest management—must be appropriate and timely. Proper fertilization or excess fertilizer will not compensate for poor growth that is caused by other management problems, or disease, weed, or insect problems. Soil properties such as low pH and/or poor drainage can limit plant growth and yield.

The goal of fertilizing any high-value crop is to supply the plant with ample nutrition in advance of demand, thereby removing nutrient limitations to yield and quality. Important considerations include the economic return from the fertilizer investment, environmental stewardship, and government regulations. A fertilizer application should produce measurable changes in plant growth or nutrient status, or otherwise benefit the crop in a measurable way. The increased fruit yield or quality produces a return on the investment.

Growers, with the assistance of local Extension agents and field representatives, should consider the nutrient needs of each field or type of caneberry (e.g., summer-bearing or primocane-fruiting cultivars). Key questions that need to be answered with regard to any nutrient management program are: How much nutrient should be applied? When is the best time to apply the nutrient? What is the best source of the nutrient for the plant? And what is the best method to apply the nutrient?

Soil and tissue sample analyses help in determining appropriate nutrient applications. Keeping records of weather, yield, disease and insect problems, and nutrient application rates and timing will help in interpreting soil and tissue analysis data over time. Observations of annual growth (visual assessments of cane number, diameter, and height, and fruiting lateral length), leaf color, and fruit quality (amount of rot, drupelet set, and firmness), in addition to yield, will also help in adjusting nutrient management programs as needed.

Soil sampling. Soil testing is important to adjust nutrients prior to planting, if needed. This not only gets the plants off to a good start, but incorporation of nutrients or amendments is very effective for those that are immobile or do not move readily into the rooting zone with a surface application (e.g. lime). Take soil samples well in advance of planting so that pH can be adjusted if needed (e.g. sample in early fall for spring planting) – it takes time for incorporated lime or sulfur to react and change soil pH. Use the deficiency levels of nutrients in the soil in Table 1 as a guide. A range in deficiency levels is provided, as there is no absolute value and ideal levels may depend on growing region or soil type. If a nutrient is not listed, no standards are available and plant tissue nutrient status should be used to assess nutrient needs after planting. Any needed nutrients should be applied as a broadcast application to the entire field and then incorporated.

Table 1. Suggested nutrient levels for soil in caneberry plantings

Nutrient	Deficient at less than (ppm)
Phosphorus (P; Bray)	20 to 40
Phosphorus (Olsen)	10 to 20
Potassium (K)	150 to 350
Calcium (Ca)	1000
Magnesium (Mg)	120
Manganese (Mn)	20 to 60
Boron (B)	0.5 to 1.0

As soil pH increases, the solubility of Fe, Zn, and Mn decreases. The concentration of Mn and Fe can reach levels that are deficient, causing yellowing of leaves. While the ideal caneberry soil has a pH between about 5.6 and 6.8, commercial production is possible on sites with pH values slightly higher or lower. As soils become alkaline (pH values above 7.0), deficiencies of Fe, Mn, B and Zn can occur.

After planting, periodic soil analyses can be helpful in diagnosing problems, such as low or high soil pH or the presence of excessive salts. Collect soil samples every two to three years to monitor changes in soil nutrient status. In established fields, sample soil at the same time of year, so that years can be more easily compared. Soil pH fluctuates over the season. Do not collect soil samples in spring, right after fertilization has occurred. The irrigation wetting front, fertigation, and band applications of fertilizer affect soil sample results. Collect soil samples in the plant row (where the fertilizer is applied) and, in drip irrigated fields, sample within a few inches of a drip emitter in all sub-sample locations. If mulch is present, remove the mulch layer before taking the soil sample.

Tissue testing. Leaf tissue analysis provides information on the nutrient content of the plant. The results of tissue analysis, when compared with published standards, indicate which elements the tissues contain in adequate, deficient, or excessive amounts. Routine tissue analysis can help in detecting low nutrient concentrations before visible symptoms or yield reduction occur. Tissue analysis is a valuable tool to help diagnose visible plant problems and to evaluate fertilizer programs. Sometimes, even when the soil nutrient content is adequate, the plant is not able to take up the nutrients required (e.g., when soil pH is incorrect; in dry or waterlogged soils; during cool weather; and under certain cultural issues such as with too much or insufficient irrigation). However, using tissue test results to anticipate current-season fertilizer needs does not work well for perennial crops such as caneberries. In part, this is due to the minimal short-term effects of fertilizer on yield. Changes in tissue nutrient concentrations may not be observed for 1 to 2 years after fertilization. In addition, primocanes, which respond to new fertilizer nutrients, do not fruit until the following year in summer-bearing types. Delays in plant uptake are common, particularly when relatively immobile materials, such as phosphorus, potassium, and lime, are topdressed. The only exception is for correction of micronutrient deficiencies (e.g. boron) and N deficiency, where corrections can be made quite quickly. However, in general, leaf testing is more of a tool to assess how the nutrient management program may need to be changed for sustainable growth and production.

In caneberries, primocane leaf tissue nutrient concentration changes throughout the season. The recommended time of sampling leaves for tissue analysis is related to a period of time when the leaf nutrient concentration is most stable. In addition to changing over the growing season, tissue nutrient levels will also change with location or age of the leaf and what type of leaf it is. For example, results from floricane leaves will be different than primocane leaves and older primocane leaves will have different levels of many nutrients than younger leaves. Always sample cultivars separately as they differ in nutrient concentration. Collect leaves that are free of disease or other damage if possible and a sample that represents the entire block/field. In summer-bearing raspberry and blackberry, collect primocane leaves in late-July to early August. In primocane-fruiting blackberry, collect primocane leaf samples during the bloom to green fruit stage of development.

In summer-bearing caneberry cultivars, sample the most-recent, fully expanded leaves from primocanes – about 1 ft from the tip of the cane. In primocane-fruiting cultivars, sample fully-expanded leaves from below the fruiting tip (red raspberry) or from primocane branches (blackberry & black raspberry). Compare primocane tissue samples, taken at the correct time, with published sufficiency levels (Table 2).

If a nutrient is deficient and observations of growth or plant performance indicate fertilizer is needed, apply the correct product (source of nutrient) and at the right time to make the nutrient available for plant uptake.

Table 2. Recommended primocane leaf nutrient sufficiency levels for raspberry and blackberry when sampled in late-July to early-August in Oregon, May to August in California, and the first week of August in northeastern United States. In Oregon, the recommendations are to use whole leaves – petioles included – and to leave them unwashed. In California, there are no specifications for leaf petioles or washing. In the northeast, recommendations include petiole removal and leaf washing.

Nutrient	Oregon[z]	California[y]	Northeastern U.S.[x]
Nitrogen (%)	2.3 to 3.0	2.0 to 3.0	2.0 to 3.0
Phosphorus (%)	0.19 to 0.45	0.25 to 0.40	0.25 to 0.40
Potassium (%)	1.3 to 2.0	1.5 to 2.5	1.5 to 2.5
Calcium (%)	0.6 to 2.0	0.6 to 2.5	0.6 to 2.0
Magnesium (%)	0.3 to 0.6	0.3 to 0.9	0.6 to 0.9
Sulfur (%)	0.1 to 0.2	-	0.4 to 0.6
Manganese (ppm)[w]	50 to 300	50 to 200	50 to 200
Boron (ppm)	30 to 70	30 to 50	30 to 70
Iron (ppm)	60 to 250	50 to 200	60 to 250
Zinc (ppm)	15 to 50	20 to 50	20 to 50
Copper (ppm)	6 to 20	7 to 50	6 to 20

[z]Hart et al. (2006); [y]Bolda et al. (2012); [x]Bushway et al. (2008).

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