Managing Fertility in Bramble Crops

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Basic Soil Fertility Concepts

Managing plant and soil fertility in bramble crops is important for optimum production. Nutrient management is not an easy proposition as it varies from farm to farm, and even from site to site on the same farm. Soil variability, along with differences in management practices and weather make it impossible to have a menu driven protocol for farmers to follow. Farmers need to make changes according to specific situations and in order to do that they need to know the basics of nutrient management as it pertains to bramble crops.

The nutrient availability of soils is less understood by farmers than the physical differences between soil types i.e. water and nutrient retention. Soil nutrient tests are used to measure the plant-available nutrients in the soil. They do not measure the total nutrients in the soil, which often is significantly higher than what is available. The type of soil influences how much nutrients are available. If soil particles are small (clay), soil nutrient availability is higher, but those same soils may contain high levels of certain nutrients that block availability of certain nutrients.

Nutrients are available to plants as individual ions with either a positive charge (cation) or a negative charge (anion). The charge impacts how the ion behaves in the soil, for instance ammonium (NH_4^+) is retained by soil adsorption and nitrate (NO_3^-) is often leached despite the fact that both of these forms of N are available to plants. As the plant absorbs the ammonium cation, it excretes one H^+ proton so that there is a neutral charge in the plant. As those positively charged protons accumulate in the soil, the soil pH (a measure of soil acidity) drops and thus alters the availability of other plant nutrients. This is when lime and sulfur come into use. Bramble crops need a soil pH of 6.0 – 6.5, forgiving really, but when even the type of fertilizer one uses could alter the ability of the plant to access nutrients it becomes clear that soil fertility management is a challenging endeavor.

Diagnosing Nutrient Problems

Visual diagnosis is the most common means of detection of fertility problems, but it is the least reliable. Plant symptoms like poor plant vigor, pale leaf color, and distorted fruit are also symptoms of some pest and cultural problems as well as the result of many different nutrient deficiencies or toxicities. Designing a nutrient program by visual symptoms alone will likely be ineffective. Instead, growers should become familiar and comfortable with laboratory analyses. Consistent use of soil tests and foliar analysis can reveal the information necessary for good nutrient management.

- Soil Tests estimate the amount of nutrients available to plants. In order to be effective, soil test samples must be taken correctly. Farmers should be mindful of soil changes within a field and understand that in those cases, two soil tests should be done. Soil tests should be conducted in the fall of the year prior to planting. This allows nutrients and other amendments to be added and incorporated adequately before planting begins. Nitrogen is the exception to this rule. Soil test results from one lab to another cannot be compared because the extraction methods vary. Similarly, the extraction methods used for macronutrients are not appropriate for estimating levels of micronutrients, and often micronutrients cause the most problem in bramble plantings.
- Plant Tissue Testing measures the exact amount of nutrients in the plant part that was submitted at that point in time. Recommendations are based on the levels of these nutrients at specific times of the year. Depending upon the lab that you choose, sufficiency levels for a relatively "minor" crop like brambles may or may not be based on known ranges for raspberries/blackberries. However, if you refer to known sufficiency ranges separate from your lab, you can ensure that you are basing your management on research supported data. See Table 1. for sufficiency ranges.
- Plant sap testing is a new way to track N availability without waiting for results, but this does require time and regularity.

Table 1. Sufficiency ranges for foliar nutrient level in bramble leaves in midsummer (perennial systems).*

Nutrient	Deficient below	Sufficient	Excess
N %	1.9	2.0-3.0	4.0
P %	0.20	0.25-0.40	0.50
K %	1.3	1.5-2.5	3.5
Ca %	0.5	0.6-2.0	2.5
Mg %	0.25	0.6-0.9	1.0
S %	0.35	0.4-0.6	0.8
B (ppm)	23	30-70	90
Fe (ppm)	40	60-250	350
Mn (ppm)	35	50-200	350
Cu (ppm)	3	6-20	30
Zn (ppm)	10	20-50	80

* Raspberry and Blackberry Production Guide: For the Northeast, NRAES-35

A combination of soil testing and tissue analysis along with good visual observation of the crop response to fertilizer is the best approach to assessing nutrient status. Growers should test the soil prior to planting and make amendments according to recommendations. When the plant reaches maturity, conduct a foliar tissue test a minimum of every other year. Conduct soil tests every 3 years. Be alert for problems or changes that occur to the crop during the growing season.

Nutrients Required for Optimum Growth

Nitrogen makes up 2-3% of bramble plant dry matter. According to Table 1, if bramble leaf nitrogen is less than 1.9% N the plant is deficient and likely not very productive. Signs of N

deficiency are yellow leaf color and/or tips of older leaves turning red. N toxicity is a problem if the tissue test reveals greater than 3% N resulting in plants that appear too vigorous, with few flower buds.

In newly planted fields, Calcium Nitrate is the fertilizer of choice because it has a readily available form of N that does not volatilize. In established fields ammonium nitrate supplies a quick Nitrate response and a slow release response due to the ammonium. This material has become less available than in the past, due to its explosive characteristics. Urea then is the least expensive N source, but it is subject to volatilization unless incorporated. Foliar urea can only be used in small doses, less than 2 pounds per acre of actual N. For information on N guidelines for berries, refer to Table 2.

Table 2. Nitrogen guidelines for raspberries*

Age of Planting (yrs)	Amount/Timing (actual N)	N source	Comments
Summer-bearing			
0	25-35 lb/A 4 weeks after planting	Calcium nitrate	Avoid touching plants with fertilizer after planting
1	35-55 lb/A May, or split between May and June	Urea, ammonium nitrate	Use higher amount on sandier soils or if using irrigation
2+	40-80 lb/A May or split between May and June	Urea, ammonium nitrate	Use higher amount on sandier soils or if using irrigation
Fall bearing			
0	25 lb/A 4 weeks after planting and in August	Calcium nitrate	Avoid touching plants with fertilizer after planting
1	50-80 lb/A split between May and June	Urea, ammonium nitrate	Use higher amount on sandier soils or if using irrigation
2+	70-100 lb/A split between May and June	Urea, ammonium nitrate	Use higher amount on sandier soils or if using irrigation. Adjust in response to leaf analysis

*Raspberry and Blackberry Production Guide: For the Northeast, NRAES-35

The other macro nutrients critical to bramble growth and development are Phosphorus (P) and Potassium (K). Uptake of both of these nutrients is primarily through diffusion, so the increased advantage of a large plant root mass will aid uptake.
Berries tend to have a low demand for P relative to other crops, and given that soil pH impacts P availability – pH needs to be close to 6.5 - most fields in the Northeast are not deficient. Too much P however, can interfere with micronutrient uptake. When applying P through a drip system, be aware that many sources of P are incompatible with other fertilizers.

Brambles have a relatively high demand for K and the availability of the K in the soil is very dependent on soil chemistry. Increasing soil organic matter will help to increase the exchange capacity of the soil. Pre-plant incorporation of K is the most effective, while fertigation can be used to supply potassium during the season to established plantings. Potassium levels in leaves tend to fluctuate during the season dropping as crop load increases. Adding K during the season is sometimes necessary. Potassium sulfate or potassium magnesium sulfate are the best sources of potassium for brambles. Muriate of potash is inexpensive, but it has chloride in it that causes problems with brambles.

More specific information about micro nutrients and soil management can be found in the Raspberry and Blackberry Production Guide – NRAES-35.