Soil fertility and fertilizers for wild blueberry production

Introduction

The wild blueberry is a perennial plant which grows naturally on a variety of soil types, but is most commonly found on dry and acid soils which have a low organic matter. Acid soils, by their nature, have a very low soil nutrient content. While most other agricultural crops would perform very poorly in this soil type, the wild blueberry plants have adapted. Despite the minimal nutritional requirement of the plants; however, research has demonstrated that they respond positively to the addition of synthetic or organic fertilizers.

Factors affecting the base fertility of wild blueberry fields

Depending on the region, soil types can vary greatly. The southern barrens of the Pennfield region have sandy loam soils, with relatively high levels of slowly-decomposing organic matter, and medium levels of the major soil nutrients. By contrast, the barrens of the northeastern part of the province tend to have much lower levels of organic matter and lower base soil fertility. Soils in this region tend to require greater quantities of fertilizers.

Components of soil fertility

Knowledge of various soil components associated with fertility is useful in measuring the fertility status of a wild blueberry stand. Four of the most useful measurable components are: soil organic matter, soil acidity (pH), macronutrients, and minor nutrients.

1. **Soil organic matter.** This phrase refers to the component of the soil which does not have a mineral origin; instead, it consists of material of biological origin which has achieved a certain level of decomposition. The wild blueberry gets all or most of its nutrient from the organic matter layer of the soil. It is also the organic matter that holds water for most of the plant's moisture requirement. A 1992 survey in New Brunswick revealed organic matter levels varied between 2.5 and 12%. The lower levels were associated with many soils of the Acadian Peninsula, Kent County and central New Brunswick. Intensive and successive burning of wild blueberry fields may affect the organic matter, and indirectly affects the level of nutrient availability to the plant. Currently in NB, the organic matter of the soil cannot provide all of the nutrients required by the plant for optimum growth and productivity of the wild blueberry fields.

2. **Soil acidity (pH)**. Soil acidity is often expressed as a value on a scale called the pH. The pH measure acidity on a scale from 1 to 14, with 1 being very acidic and 14 being very alkaline. The pH values found in New Brunswick's wild blueberry soils range from 3.9 to 5.3. For many years, the optimum pH for wild blueberry production was thought to be between

4.6 and 5.2. However, in a recent study in Maine, it was demonstrated that a pH of 4.0 did not have no negative effect on the growth and productivity of the wild blueberry. In conclusion, it is now accepted that all values of pH between 4.2 and 5.2 are adequate for wild blueberry production.

3. **Macronutrients.** Macronutrients are those nutrients which are found in relatively large quantities in plants. They include the major three nutrients often used in common fertilizer formulations (e.g.17-17-17), which are: Nitrogen, Phosphorus, and Potassium, (also referred to as N-P-K). Macronutrients also include Calcium (Ca), Magnesium (Mg) and Sulfur (S). Their role is thought to be very important in wild blueberry nutrition.

    a. **Nitrogen:** This element is responsible for the growth and dark green color of plants. It is released when organic matter decomposes. In soils with low organic matter content, the release rate is generally insufficient for optimum growth or high yield potential. There is an obvious nitrogen deficiency when a high density of short plants with small, pale green leaves can be observed. Such plants are more subject to infection by Septoria leaf spot. However, too much nitrogen reduces productivity potential and increases plant susceptibility to Valdensinia leaf spot and tip midge damage.

    a. **Phosphorus:** Phosphorus is also an important plant nutrient, especially in the most active growing plant parts like stem tips, flowers, seeds and young roots. Phosphorus deficiency can be visually diagnosed in wild blueberry fields, when premature leaf reddening or purple blotches are observed.

    Phosphorus availability is also linked to the mineralization of organic matter. Owing to low pH, phosphorus availability is limited because this element is tied up with iron and aluminium oxides. In nature, the wild blueberry can use organic phosphorus because of the plant's association with the fungus mycorrhiza. The symbiosis between these two species supplies the wild blueberry with phosphorus, nitrogen, and water and enables the fungus to use the products of photosynthesis to survive.

    Phosphorous is a common component in fertilizer recommendations, and has been shown to be useful as a "pickup" fertilizer in fields with a low phosphorus level. It may also prove to be useful when plants have undergone a lot of stress like land leveling or winter damage to roots.

    b. **Potassium.** Relatively little research work has been done on potassium nutrition of wild blueberries, though it might be assumed from work on other crops that this nutrient plays some role in winter hardiness and storage organs like the rhizomes. The level of this plant nutrient is always lower in sandy soils. In NB conditions, very little potassium deficiency has been observed. Leaf diagnosis is the only method to determine if there are any deficiencies.

4. **Micronutrients.** Micronutrients in plants are those nutrients which are essential, but are only required in very small amounts. In wild blueberry production, only the effect of the micronutrients Boron (B), Calcium (Ca), Magnesium (Mg) and Zinc (Zn) have been investigated in preliminary studies. Successive research trials have not demonstrated any

benefits of adding micronutrients. Currently, standards for the minimum concentration of micro nutrients are being re-evaluated by the industry. Some other wild blueberry production regions have recently modified their standards to adequately reflect their growing conditions. More information will be provided later in this factsheet. In NB, the only micro nutrient recommended with a fertilizer blend is Boron. Soil concentration of boron is very low in our soils and Boron has also been diagnosed as being deficient in leaf tissue analysis.

Diagnosing the nutrient status of wild blueberry fields

Short plant stature and the smallness of the leaves are an indication of poor nutrient status in some fields, but sometimes this can only be appreciated by someone who has seen several other fields which have a better nutrient status. While the presence of premature reddening can also indicate nutrient deficiencies in a field, there are a few other conditions like winter damage to roots that can also cause plants to look unhealthy.

A reliable tool for assessing the nutrient status of a field is leaf tissue analysis. When leaf tissues are sampled at “tip dieback” in the sprout year (refer to Factsheet D.1.0). The nutrient content of the leaves are compared to the reference values as reported in Table 1. The results of a survey conducted by Dr. Charles Karemanagingo (non-published) resulted in revised nutrient levels in wild blueberry plants in NB. The revised values are presented in Table 1.

Table 1. Reference value for minimum and maximum nutrient level concentration in leaf tissue analysis.

	Macro nutrients (%)					Micro nutrients (ppm)				
	N	P	K	Ca	Mg	B	Cu	Zn	Fe	Mn
From	1.7	.12	.40	.37	.13	21	3	15	19	750
To	2.2	.18	.60	.65	.25	40	6	20	70	1490

Soil sampling to determine soil nutrients and pH is required. It is beneficial to know the pH and initial fertility of wild blueberry field when planning to develop a new field. A periodic soil test is also required., Although there are no reference tables, the soil test provides information for the development of a good fertility program.

Future directions in fertilizing wild blueberry fields

The fertilization strategy currently used by most producers consists of one application of fertilizer during the sprout year. The amounts applied are intended to provide the nutrient needs for the entire production cycle (two years in New Brunswick). In newly developed fields, the amounts of N, P, and K applied can be uniform or higher in P and K, since the aim of the proposed strategy is to raise the base fertility level of these elements from very low to moderate. After a few production cycles, the application rate of these three elements are based mainly on nitrogen requirements and vary from region to region or within a region. After a few production cycles, the nitrogen input is reduced if excessive plant growth is observed. It is also common practice to add Boron in each production cycle.

Special attention to nitrogen management is essential to optimize productivity without creating situations that lead to production problems. Table 2 provides an overview of the effects of nitrogen deficiency or excess.

Table 2. Effects of nitrogen deficiency or excess on crops

Nitrogen deficiency	Nitrogen excess
Short stems	Excessive plant growth
Poor vigour	Decrease in number of buds
Few or no buds	Increase in risk of winter frost damage
Increased susceptibility to Septoria leaf spot	Lower yields
Premature leave fall in crop year	Increased branching of main stem
Lower yields	Increased susceptibility to Botrytis blight owing to denser canopy
Reduced fruit size	Increased susceptibility to certain insects (tip midge and plant bug)
	Increased susceptibility to Valdensinia leaf spot
	Greater difficulty during harvest

More and more questions are being asked about the benefits of split fertilizer applications in the crop year or throughout the cycle. Studies conducted in Quebec and Newfoundland have shown that, from an environmental standpoint as well as in terms of effective fertilizer utilization, there can be benefits to splitting, without compromising productivity. However, research is needed to determine the acceptable levels of splitting under our conditions.

Form of nutrients

The wild blueberry prefers to get its nitrogen in ammonia form. That is why fertilizers containing nitrates must be avoided. The forms of nitrogen most commonly used are ammonium sulfate (21-0-0), monoammonium phosphate (11-52-0), and diammonium phosphate (18-46-0). The last two forms of nitrogen also supply phosphorus. Although urea contributes slightly to raising pH during hydrolysis, urea (46-0-0) is still an acceptable form of nitrogen. The cost of the potential components in the formulation must be taken into consideration when choosing a form of nitrogen. Potassium sulfate (0-0-50) must be given priority when selecting a source of potassium because the chlorine contained in potassium chloride (0-0-60) can hamper root development.

Future directions in fertilizing blueberry fields

Some aspects of macronutrient management should be studied under New Brunswick conditions. Improved macronutrient management might make it possible to leave less of an environment footprint and rationalize current recommendations. Here are the main areas of interest for research on fertilizing blueberry fields:

1- Effect of split nitrogen applications during the crop year on potential yield and current yield.

2- Effect of split nitrogen applications over the two years of the production cycle.

3- Optimum rate of P and K needed to maintain fields in full production (following research in Quebec, the rates of P and K were decreased without affecting potential yield or current yield).

Reference

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