

Organic fertilization in a Sugarbush

Foreword

Through a program called “Improvement and Development of Sugar Bush Resources”, professional foresters and researchers of the Faculty of forestry (*Université de Moncton, Campus d’Edmundston*) conducted organic fertilization tests in a sugarbush in order to study the effects on tree vigour and sugar production. This technical guide aims to explain the method for organic fertilization and helps producers recognize signs that would indicate that this method is required to help improve vigour and sugar production in their sugarbush.

Why should we be interested in organic fertilization in sugar maple stands?

Phenomena of sugar maple stands deterioration:

- The most wide spread phenomena severely affecting the health of maple stands in eastern Canada during the last 30 years.
- The problem is characterized by the loss of soil fertility which results in a lost of tree vigour and growth.
- Signs of the problem can be detected by the loss of foliage and the opening of the forest canopy.
- There is also an increase in the regeneration of American beech to the detriment of the sugar maple.

****Adequate fertilization is a solution that helps restore tree health and vigour in maple sands****

Advantages of fertilization:

- Improves soil fertility for several years.
- Increases the vigour of the trees.
- Increases diameter growth.
- Increases the volume of sap flowing from the trees.
- Increases maple sugar regeneration to the detriment of the American beech.

Warning:

An adequate fertilization is helpful, but an excessive fertilization can have a negative effect, including:

- Loss in productivity.
- A toxic environment and an unbalanced chemical structure.
- Pollution of surface water and even the water table.

How?

Creating a fertilization program for your sugarbush

1 - Is it necessary to fertilize?

To determine if it is necessary to fertilize, it is important to evaluate the health of your sugarbush and verify the presences of symptoms indicating a loss of tree vigour.

When?

- Between mid June and mid August.

How?

- **Forest inventory** to determine health of the sugar maple stand by evaluating the dieback in the crown and the transparency of the canopy.
- **Leaf sampling (optional): this method enables to evaluate the nutritional status of the trees but is more time consuming and costly. Analysis of the results is also a bit more complex. Leaf sampling consists of:**

- Collect foliage from a certain number of trees (10 to 15 leaves per side of the tree and collect leaves on 3 sides = 30 to 45 leaves per tree).
- Collect foliage in the upper third of the crown (good sun exposure).
****Foliage collection can be done with a 12 gauge shotgun. Small branches are shot off and leaves are collected when they fall to the ground.****
- Dry leaves in an incubator at 60°C for 48 hours.
- Grind the leaves and place them in paper bags with proper identification.
- Send samplings to the plant and soil analysis lab in Fredericton. Cost will range between 25 and 30\$ to determine the nutritional status of the samples.

****If you are interested in utilizing this method to better understand the nutritional status of you sugarbush, contact the specialists at the Faculty of Forestry (Université de Moncton, campus d'Edmundston).****

Inventory procedure to help evaluate the health of the sugarbush:

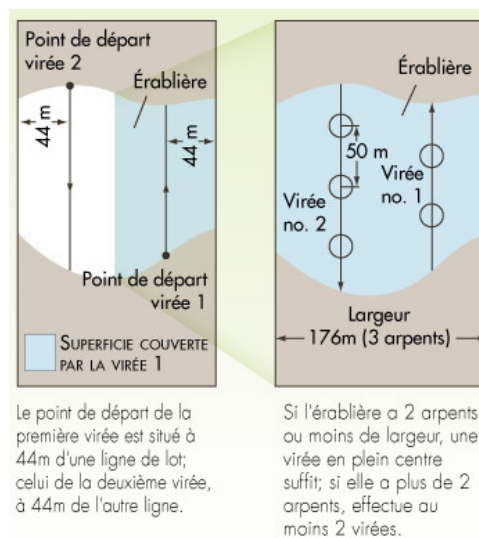
Material:

- Binoculars to better observe the canopy.
- Compass and/or GPS.
- Map of the area.
- Topofil/GPS to measure distances.
- Tally sheet and pencil.
- A cord of 11.28 m to establish circular sample plots.
- Forestry spray paint to indicate the trees that have been inventoried.

i. Establishing the forest inventory plan

- With the help of your map of the area, establish your inventory lines.
- It is recommended to establish a 400 m² (11.28 m radius) plot at each 50 m distance on your inventory line.
- The minimal density of the inventory line should be 1 per every 116 m width.

Oftentimes, woodlots are 176 m wide. It is recommended to plan 2 inventory lines per woodlot. To calculate the position of the inventory lines in relation to the edge of the woodlot, you should divide the width by two and multiply by the number of inventory lines. So, for a woodlot of 176 m width with 2 inventory lines, we would use the following formula: $176 \text{ m} / (2 \times 2) = 44 \text{ m}$ from each line and the edge of the woodlot.



Position of the inventory lines and the sample plots

ii. Proceed to data collection:

- With the help of a GPS or by measuring the distance from the edge of the woodlot, go to the starting point of your inventory layout plan.
- Take the azimuth from your map and walk a distance of 50 m in that direction. The end of the 50 m represents the center of the first sample plot.
- Delimit the sample plot with the help of the cord of 11.28 m: data on the health of all maples bigger (or equal) than 9.1 cm that fall within the limit of the sample plot should be taken.
- Go to the next sample plot 50 m away and repeat, so on and so forth.

How to evaluate the health of (deterioration class) of trees?

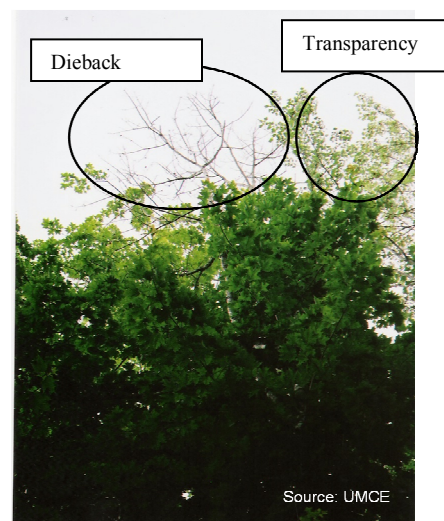
- With the help of an evaluation grid enabling the establishment of a deterioration class by evaluating the following characteristics:

- **Transparency of the crown:** relative size of the leaves; verify if there are groups of leaves smaller than normal in the same tree.
- **Dieback:** estimate the percentage of dead small branches in the crown.

- Each tree from each sample plot is evaluated and categorized in a deterioration class.

- The data is then compiled.

****It is necessary to fertilize when the majority of the maple trees are situated in classes 3 (moderate) or 4 (severe).****



Note: The procedure is summarized. Please refer to the technical guide on multi-resource inventory for more details. It might be advisable to **communicate with a specialist** to help you with establishing your inventory grid and to evaluate transparency and dieback.

Guide to help estimate deterioration classes

Description	Category (Mader and Thompson)	Vigour classes
Trees are healthy; leaves have a regular size and a dark rich colour. There is less than 10% of dieback in the crown.	1	Healthy
There is mortality in the crown; there are discoloured, abnormally small or deformed leaves.	2	Light
There is mortality in the crown; there are discoloured, abnormally small or deformed leaves in 26 to 50% of the crown.	3	Moderate
More than 50% of the crown has mortality, discoloration, or abnormally small leaves. But the presence of leaves indicate the tree is still alive.	4	Severe
Dead but still upright. No live branches. The phloem under the bark has brown streaks. There might be presence of epicormic branches on the trunk.	5	Dead

Adapted from:

Anonyme 1989. Manual on methodologies and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. United Nations Environment Program (UNEP) and United Nations Economic Commission for Europe (UN-ECE), Hamburg, Germany.

Mader DL et BW Thompson. 1969. Foliar and soil nutrients in relation to sugar maple decline. Soil Science Society of America Proceedings 33:794-800.

2 - Choice and purchase of fertilizer

Choosing the source of the fertilizer

Organic fertilizers come from vegetative or animal matter. They include mostly composts and manure.

Advantages of using organic fertilizers compared to chemical fertilizers:

- Source is natural.
- Better accepted by society for environmental reasons.
- Enable the insertion of rich organic matter with a slow release.
- Add value to animal waste since it is considered to be a major source of pollution.
- Minimal risk of applying too much fertilizer compared to chemical products in which the concentration of nutrients is very high.

From a practical point of view, the fertilizer must be:

- Available in the region.
- Easy to spread:
 - This will ease the employee's task. Spreading fertilizer in a maple stand is largely done by hand.
 - This will also ensure a uniform distribution of the nutrients within the soil: humid material has a tendency to create clumps and is more difficult to spread evenly; use dry fertilizer.

During our trials, the following products were tested:

- **Nutriwave** (Chicken manure, aged, dried and transformed into pellets):
 - NPK (nitrogen, phosphorus, potassium): 4-1-2.
 - natural solid product with practically no odor.
 - nutrients are easily available for the plants.



Supplier: Envirem Technologies Inc., St-François, N.-B.

This product is interesting as it is semi-composted and is available as pellets. The product is easy to handle, very clean compared to fresh or liquid manure and represents a very low risk of contamination which is important since maple syrup is a food product.

- **Dolomite Lime**

- Increases the pH of the soil.
- Contains magnesium (Mg) and calcium (Ca).
- Helps fight against the acidification of the soils.

Supplier: Long Fertilizer, Clair, N.-B. (506) 992-2133.

** Other fertilizers are available depending on the availability and your needs. Contact various suppliers for information on their products.**

3- Fertilize the site

When?

- End of May beginning of June.
- Before the appearance of the ground vegetation, which facilitate the process.
- Enables the trees to utilize the added nutrients during the growing season.
- Frequency varies depending on the severity of the problem, but hypothetically fertilization could be done every 5 years.

It is advisable to fertilize only a part of the sugarbush to start off. The effect of the fertilization could be evaluated (tree vigour and volume of sap) and compared to the part of the sugarbush that has not received treatment. This would give an indication if the investment is worth it or not.

To do this:

- You can fertilize an area where you can isolate the sap collection in order to draw comparisons.
- You need to know the volume of sap from the fertilized and non fertilized areas.
- Contact us; we can help you establish a follow-up program after fertilization.

How much fertilizer should be applied?

No chart exists on organic fertilization, but liming is well known. The recommended amount corresponds to the one that was applied during our trials and it can change depending on the conditions of your sugarbush. Three treatments were compared:

1. Nutriwave 4-1-2 (3 tons/ha to have 125 kg of N/ha).
2. Nutriwave 4-1-2 (6 tons/ha to have 250 kg of N/ha).
3. **Nutriwave 4-1-2 (6 tons/ha to have 250 kg N/ha) + dolomite lime (2 tons/ha)***

* Best treatment.

Where:

Nutriwave: 250 kg N/ha equals to 50 kg of Nutriwave/tree (approx. 2 bags/tree) since a radius of 5 m around the tree has been fertilized. This is where the maximum amount of nutrient absorbing roots are found.

Dolomite Lime: 15.7 kg/tree. Each bag weighed 25 kg.

How?

The amount of fertilizer to apply is based on the initial diagnostic and the surface area to be treated. Based on that information, you can order the proper amount of fertilizer.

It is more cost effective to order large industrial sized bags of fertilizer than small bags. However, the transportation of these bags require particular equipment.

➤ transport and unload the fertilizers:



➤ Transfer fertilizers in the most appropriate containers to make it easy to spread in the sugarbush.



Issues with mechanization

Up until now, no machine is adapted to spread organic fertilizer in a sugar bush. Some trials have been done, but nothing definitive exists.

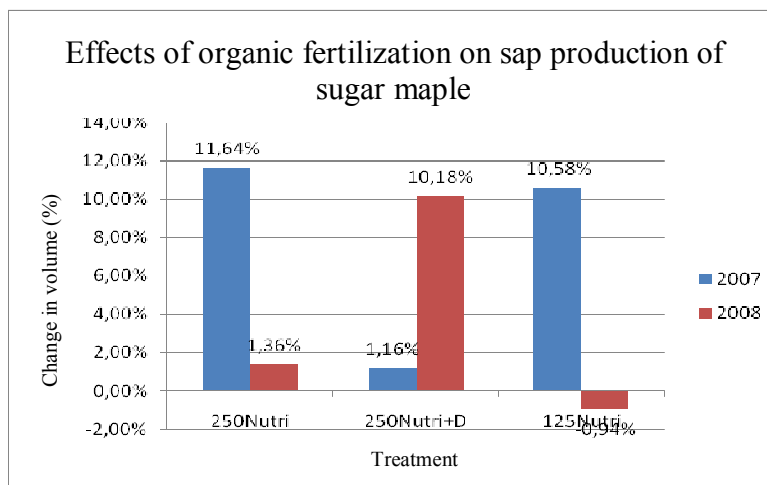
However, in Sweden, some machines are used to spread fertilizer in Norway spruce plantations. It might be feasible to fertilize mechanically every 10 years, during the time the producer renews its sap collection system.

- Spread fertilizers around each tree at a radius of 5 m.

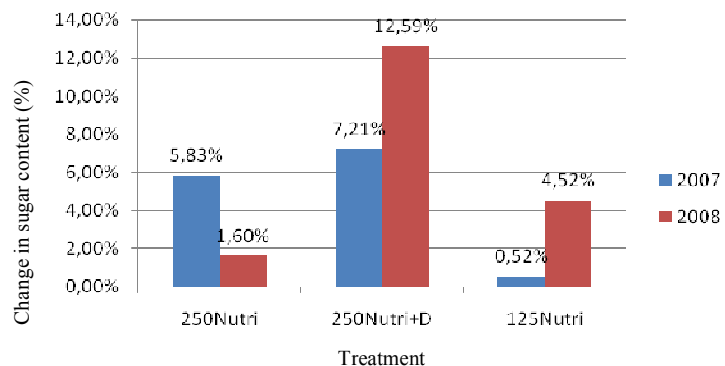


4 - Effects of the fertilization in our trials

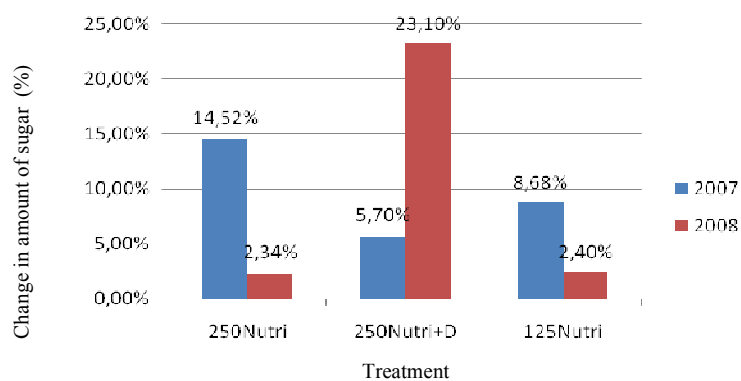
The following graphs show preliminary results of these tests. Although preliminary, these results are interesting. The treatment of 250 kg N/ha of chicken manure (6 tons/ha of Nutriwave) combined with 2 tones /ha of dolomite lime appears to be the treatment that substantially increases sugar production, up to 23%, during the second season after treatment.



Effects of organic fertilization on sugar content in the of sugar maple



Effects of organic fertilization on the production of sugar in sugar maple



Costs Evaluation

Costs associated with fertilization vary enormously based on the health of the sugarbush and the objectives of the owner. It is therefore necessary to consult a specialist before adventuring into an organic fertilization program. Detailed costs are mentioned for information purposes only. Hourly wages for employees are estimated at 25\$/h which includes travel.

Organic Fertilization of a Sugarbush

Costs of inventory

Consultation		100\$/ha
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Costs for fertilizers

Lime (7.50\$ per 25 kg bag)	2 t/ha ¹	600\$/ha
Nutriwave 4-1-2 (85\$ per ton)		
1- 250 kg		
N/ha	6t/ha	510\$/ha
2- 125 kg		
N/ha	3t/ha	255\$/ha

Costs to fertilize

Workers (2 persons @ 25\$/h ²)	65h/ha/person	3250\$ /ha
Material ³		0\$/ha
Total		4715\$/ha

¹ Quantity can change based on the health of the sugarbush and objectives of owner.

² Includes travel.

³ Usually sugar maple producers have the necessary equipment.

Additional Information and Resources

This guide is presented by the Faculty of Forestry of the *Université de Moncton - Campus d'Edmundston* through a program called "Improvement and Development of Sugarbush Resources". The main objective of the program is to optimize the economic model of sugarbushes in New Brunswick by investing in development, research and technology transfer. Specifically, the program aims to meet the following objectives:

- Diversify production and find innovative new products for commercialization;
- Technology and knowledge transfer;
- Training and professionalization of the workforce.

The goal of this technical guide is to transfer knowledge acquired from recent tests conducted within the context of this program. Additional information has been added from different sources which are cited in the bibliography.

Conferences and workshops are available at the *Montagne Verte* sugarbush. Moreover, other forestry extension materials in different aspects of the program are available for interested people. Other technical guides about the cultivation of American ginseng, wild Indian cucumber, cultivation of mushrooms and multi-resource inventory are also available. For more information, contact Jeff Levesque or consult our web site at www.umce.ca/foresterie/erabliere.

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<http://www.apbb.qc.ca/>

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Miller, I., Lachance, D., Burkman, W.B. et Allen, D.C. 1991. North American Sugar Maple Decline Project: Organization and field methods (NAMP). USDA Forest Service, Northeastern Forest Experiment Station, Radnor, PA. General Technical Report NE-154. 26 p.

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