

Management Options for Small-Scale Sugar Bush Operations

Part III – Sugar Bush Safety and Liability By Mark Richardson

This is the third article in a four-part series on how to manage the small-scale sugar bush. Part I focused on traditional management activities like planning, thinning and crop tree selection. Part II introduced various aspects of sugar bush health and how it influences long-term sustainability. Part III focuses on some activities associated “working” a sugar bush each spring: collecting sap, tapping practices and processing sap into maple products. Sugar bush health and safety and liability issues are also introduced. Part VI will discuss some general facts about maple that may be of interest to all landowners: Why does sap flow from maple trees and not others? How is syrup graded? What makes syrup tastes so good? Why do maple trees dominate this part of North America?

Introduction

If you ask just about any Canadian where maple syrup comes from, they will probably answer: maple syrup is made by boiling sap. Even though they may be living far outside the maple region or they might never buy or consume

maple syrup most people know that pure maple syrup is made by removing water from maple sap. Although this may sound like a pretty simple process, making a product that is high in quality, safe to consume and sell, and economical to produce, takes know-how and in some cases, doesn't come cheaply.

Maple sap, when it leaves the tree, is predominantly water with only a minor component of solids (usually in the two to three percent range). Although these solids are mostly made up of sugars, there are a number other compounds including amino acids, organic acids, phenolic compounds, hormones, minerals and salts, which factor into the biological process of breaking dormancy each spring after a long cold winter. It is these compounds which give maple syrup its characteristic maple flavour and it is these compounds combined with processing techniques that ultimately shape the final quality of the product.

The techniques you employ while operating your small-scale sugar

bush each spring will have a direct effect on such things as product quality and quantity, sugar bush health and financial returns on investment of time and money. Although the process of making maple syrup may be relatively simple, the techniques and skill needed are not. Experience is the best teacher, and although it would not be possible in one article to describe all the best management practices associated with operating a sugar bush, there are a number of important areas to consider.

The rest of this article is dedicated to introducing some (but not all) of the best management practices (BMPs) associated with tapping trees, collecting sap, processing sap into syrup and producing a high-quality product that is safe to consume.

Tapping Maple Trees

How many taps per tree – the number of taps per tree should be governed by two main factors: the diameter of the tree at breast height (DBH) or 1.3 meters from the ground, and a tree's health or

vigour. Tapping a tree can be thought of as the controlled wounding of that tree, and even though a tap hole is not nearly as difficult to recover from as crown breakage or stem damage (especially at the base of the tree) inappropriate tapping practices can be responsible for tree decline and reduced sap flow. In short this really means don't over-tap your maples.

There are two possible scenarios. If the tree is healthy and growing well, meaning that it has a full crown and no obvious signs of decline, use Table 1 as the guide for determining the number of tap holes. If on the other hand, your trees are not healthy and declining, or if your trees look healthy, but there was a drought or significant insect defoliation during the previous summer, use Table 2 as your guide. If you are in doubt, be on the safe side and use Table 2.

Tap hole size – in order to collect sap you have to channel the flow out of the tap hole into some form of container. The size of the hole drilled into the tree is dependent on the type of spile chosen. There are many different

Table 1: The normal tapping rule for healthy trees

No. of Taps	Tree DBH in cm	
	Lower	Upper
1	25	36
2	37	49
3	49	63
4	>64	

Table 2: The conservative tapping rule for unhealthy trees

No. of Taps	Tree DBH in cm	
	Lower	Upper
1	30	46
2	> 46	

types of spiles or taps on the market today, and a maple equipment dealer can help you decide which is appropriate for your operation. Traditional metal or plastic spiles are 7/16 inches in diameter; however, new spiles that are smaller in diameter are also available. In theory, a smaller diameter hole should help the tree in two ways. It should help reduce the time needed for the tree to heal itself by sealing off the hole with new wood. And, secondly, it should reduce the size of the stain column that develops internally as the tree compartmentalizes an area of wood behind the hole to protect it from infection. There are a number of ongoing studies to determine how these smaller spiles impact on tree health and sap flow.

Currently the industry standard continues to be the 7/16-inch spile, although many producers are experimenting with the smaller diameter taps. If you choose to use the new type of spiles, continue to follow the appropriate tapping rule described in the previous section.

Tap hole location – it is also critically important to properly distribute tap holes around the tree. Avoid drilling within 15 cm (6 inches) horizontally and 60 cm (24 inches) vertically from any existing open tap hole. Try to avoid drilling tap holes when temperatures are well below zero. Cambial cracking can slow tap hole healing and reduce current and future sap flow.

Other tapping BMPs – keep the tap hole depth to a

maximum of 2.5 inch or 6.4 cm; angle tap holes slightly upward (10 degrees from the horizontal); use only sharp drill bits which cut a clean hole; and don't overset the spile into the tree (a gentle tap to ensure that it is set is all that is needed).

Collecting Sap

Sap needs to be collected and stored before it can be processed into maple syrup, and to do this you will need to use some sort of collection system. There are really only two main types: buckets and tubing or a combination of both.

Tubing – tubing systems connect each tap to a main or intermediate storage container. Tubing has been around since the 1950s and is now used commonly throughout the maple industry. Most large producers now use some form of tubing system to collect their sap. A tubing system can either be gravity driven, where sap exits a tree and flows downhill to a storage facility, or vacuum driven, where the air pressure inside the tubing is reduced, allowing for sap to exit the tree and flow (still downhill) to a pump where

it is then redirected to a storage facility. Vacuums don't actually suck the sap out of the tree as the name suggests. Sap flow, in part, is controlled by air pressure, and reducing air pressure allows sap to flow from the tree. In Part IV of this article I will discuss the mechanisms of sap flow.

One of the main benefits of using tubing is the reduction in labour needed to collect sap. Depending on the topographic layout of the sugar bush, a well-designed tubing system, even for the small-scale producer, can dramatically reduce the day-to-day activity associated with gathering sap. In addition, tubing can help minimize the chance of site and tree damage during the early spring, a time when the sugar bush is at its most vulnerable state.

A tubing system is hard to install, and depending on the layout of the sugar bush, can be initially quite costly to purchase. Each operation is different, and the reader is encouraged to seek the advice of experienced producers before purchasing tubing equipment.

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Buckets – buckets have been around in one form or another since Aboriginals first discovered sweet maple sap. A metal spile (usually) with a hook on it is installed in a tap hole. The hook allows for the easy installation and removal of a bucket, which needs to be emptied frequently when the sap is flowing. Buckets come in any number of different sizes, shapes and materials. It is, however, critically important to ensure that the buckets are food grade, meaning that they are not contaminating the sap with unwanted substances like lead. Buckets work well when there are only a few; however, they can be problematic when you tap a large number of trees or when help is scarce. Driving through the sugar bush with a tractor and trailer also increases the chances of damaging the woodlot.

Processing Sap

Sap needs to be processed into maple syrup, and whether it is done on the kitchen stove or on a dedicated evaporator, it is important to size your operation to your needs and to the number of taps you are planning to install.

The evaporator (or arch) looks like a complicated piece of machinery (and it can be); however, for the small-scale operator or hobbyist, it works on a very simple principle. Intense heat is applied causing the sap to boil, which removes most of the water and concentrates the sugars and other solids mentioned earlier.

Raw sap usually flows in at one end where it moves along a series of channels (baffles) until the sugars and solids have been sufficiently concentrated. This creates a density gradient between the unprocessed sap at the back of the pan (~ 2.5% solids) and the processed syrup at the front of the pan (66% solids). This is really the best way to make high-quality syrup; boiling in a pot or in a flat pan without baffles requires the reduced sap be constantly diluted with new sap as the water is removed. This

reduces the grade of the final product, which can be very dark.

The modern evaporator comes in a number of different sizes and configurations. Again, it is a good idea to seek the advice of an experienced syrup producer before purchasing. It is critically important to size your evaporator to your current and future needs. The amount of time spent making syrup is a function of the number of taps and the size of the evaporator

– undersize the evaporator or oversize the number of taps and it becomes very difficult to keep up with the sap flow. Long boil times can quickly reduce the enjoyment of making syrup and increase the potential for mistakes or accidents.

There are a number of good references that will help the novice producer work through the operational planning stage. One publication in particular, the North American Maple Syrup Producers Manual provides an all-

Table 3: Ontario syrup grades

Grade	Colour Classes	Characteristics
Canada No.1	Extra Light Light Medium	<ul style="list-style-type: none"> Free from fermentation Uniform in colour Free from cloudiness or turbidity Flavour characteristic to colour class Free from objectionable odour
Canada No. 2 or Ontario Amber	Amber	<ul style="list-style-type: none"> Free from fermentation Uniform in colour Free from cloudiness or turbidity Flavour characteristic to colour class Free from objectionable odour
Canada No. 3	Dark	<ul style="list-style-type: none"> Has a characteristic maple flavour Free from objectionable odour or taste other than a trace of caramel, buddy or sappy taste

encompassing discussion on processing raw sap into maple syrup.

Syrup Quality

Anyone who makes maple syrup wants to make the best quality product possible. It is important to understand that quality does not just mean good-tasting syrup, the product also has to be safe to consume. If you are planning to sell your syrup, there are a few additional requirements that you will have to meet – all

syrup sold in Ontario must be graded and labeled according to the Farm Products Grades and Sales Act, Regulation 386. Maple equipment producers sell syrup grading kits and labels. Table 3 describes the current grading system used in Ontario.

Lead in Maple Syrup

While grading based on flavour, density and colour is important, it does not account for potential contaminants in syrup. Lead in particular has

become a major public health concern for the maple syrup industry and for Ontario producers in particular. Health Canada sets health and safety standards for food products and has determined that there is no minimum safe level for lead. Lead is a potent toxin where even trace amounts can pose a health hazard to humans. This is especially true for children who can suffer severe nervous system and cognitive development problems.

Normal lead levels in maple syrup are low. However, the process of removing approximately 97% of the water from raw sap concentrates not only the sugars and organic molecules, which give maple its characteristic flavour, but the other undesirable trace elements like lead and other heavy metals. Lead contamination in maple syrup is introduced from two main sources:

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1. Tree roots and foliage can absorb lead, which is then passed on into the sap. Lead can occur in the environment naturally in some types of rock or during the breakdown of uranium. In addition, atmospheric lead from car and smelter emissions has been detected in some trees. Generally, environmental absorption is responsible for very low levels of contamination.

2. Lead is introduced to the sap during the collection and boiling process. Lead contained in collection and production equipment can leach out when it comes in contact with acidic sap. The majority of the contamination happens in this manner.

It is critically important to test equipment for lead. This is especially true for the small-scale producer who may have purchased used pans and whose family and friends may be consuming most of the product. Most lead comes from the solder used to weld the pans together, although the

pans themselves may also be made from metals containing lead. Easy to use lead test kits are available from equipment dealers and possibly hardware stores. If you have a lead problem then there are steps you can take to help mitigate the amount of contamination; however, the best step (by far!) is to replace them with lead-free pans. Contact the Ontario Ministry of Agriculture and Food for additional information. If you learn one thing from these articles please let it be – don't take chances with lead.

Sugar Bush Health and Safety

Liability – it is best to assume that you are liable for what happens on your property and for this reason all producers should contact their insurance company to ensure that they have appropriate insurance coverage for their operation. This is especially true for those operations that may be selling syrup at the sugar camp. Protect yourself and your investment.

Operating safely – maple operations involve a

significant amount of hard manual labour often around machinery or heat sources. For this reason it is important to operate as safely as possible. The following are a number of general safety tips that can be applied to any operation regardless of size.

- Get proper training on all equipment – chainsaws, evaporators, etc.;
- Use the right tool for the job;
- Never work alone and always have the ability to call for help;
- Keep cool water on hand;

- Have a comprehensive first aid kit;
- Keep fire extinguishers on hand;
- Inform workers and visitors of potential hazards;
- Don't work when you are tired; and
- Seek advice when needed.

To comment on this article please contact the author, Mark Richardson, Project Forester for the Eastern Ontario Model Forest, at <mrichardson@eomf.on.ca> or call (613) 258-8416.



Common Forest Insects and Diseases (Part IV)

Part IV of the series, "Common Forest Insects and Diseases" features two pests that are associated with hardwood species – particularly sugar (hard) maple. They are the maple borer and Armillaria root rot.

Sugar Maple Borer

Scientific name: *Glycobius speciosus*

Type of injury: Borer insect.

Distribution: This insect is found throughout the range of sugar maple.

Hosts (in Ontario): Sugar maple is the only host.

Identification and

damage: This is one of the most destructive insects affecting sugar maple. Infected trees will have a J-shaped lateral wound on the bole caused by the larvae tunneling between the bark and the wood tissue. Over time the wound will show as a callus growth on the bole