

... Tree Marking continued

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*Promoting a Healthy Forest Through Tree Marking.* A copy of this new extension note is available free from the LandOwner Resource Centre by calling (613) 692-2360 or it can be downloaded from the Internet at [www.lronline.com](http://www.lronline.com).

**Acknowledgements** – information included in this article, in part, was based

on a presentation made by Martin Streit, Domtar (Cornwall) at a recent landowner workshop (Apple Hill, ON).

### Footnotes

<sup>1</sup> Stumpage – is the price paid (i.e. dollar value per cord, tonne or thousand board feet) to a woodlot owner by a contractor/logger for the right to harvest trees.

<sup>2</sup> Mill gate price – is the price paid by the mill for logs delivered to the mill.

<sup>3</sup> Cutting cycle – is the planned interval between major harvesting operations in the same stand.

## Management Options for Small-Scale Sugar Bush Operations


**Part IV – Maple Facts** By Mark Richardson

This is the fourth and final article in the series on managing 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 focused on some activities associated with “working” a sugar bush each spring: collecting sap, tapping practices and processing sap into maple products. In this last part, some general facts on maple are introduced, and although they may not be critical to the operation of the small-scale sugarbush, they may be of interest to producers or woodlot owners.

### Why does sap flow from maple trees?


From early March until mid-April, many farmers, rural landowners and cottagers are celebrating an age-old tradition by tapping maple trees, collecting sap and making maple syrup. While most people are aware that maple sap flows from maple trees, few can tell you how it flows or why it flows in maples but not in many other species. There is good reason for this – sap flow is a complex physical and chemical process that is not totally understood by the scientific community. Although there has been a lot of research into sap flow mechanisms, there are still some unanswered

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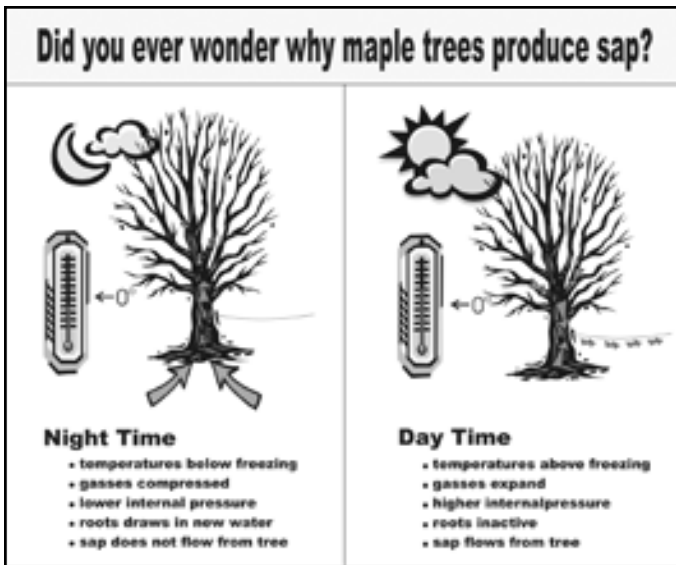


Figure 1: Sap flow in sugar maple.

questions. Nonetheless, sap does flow from maple trees each spring and most of the major mechanisms that govern why it flows are documented.

The following is a general summary of what we know about sap flow mechanisms. It is also explained in Figure 1.

1. The ambient air temperature needs to cycle above and below the freezing point for sap to flow out of a tap hole. This explains why sap “runs” for only a short time of the year; there are only a few weeks in the spring and the fall when the nights dip below zero and the days warm to above zero. The ideal temperature range is somewhere between -5°C and +5°C. If the cycle is interrupted by longer

periods of above or below zero, then so will the flow of sap be affected. Generally, as the days and nights continue to warm the quality and quantity of sap begins to decrease; sap collection usually stops as the buds begin to swell and flush.

2. Stems and branches are made up of a number of different cells and cellular structures. Maple trees have an internal cellular structure that is unlike many other hardwood species. The fibre cells, which surround the vessel cells in the xylem (outer wood below bark), contain a relatively high concentration of carbon dioxide (CO<sub>2</sub>). This may be a by-product of cellular metabolism. Vessel cells, which transport fluids

throughout the tree, have a low concentration of CO<sub>2</sub> and are generally filled with sap. This is the opposite of many other trees like oak, ash and elm.

3. As temperatures fall, CO<sub>2</sub> within the fibre cells goes into solution or is compressed by the formation of frost and ice crystals. This reduces pressure within the stem, which then draws sap from the surrounding wood. Eventually as the process continues, water is drawn in through the roots to in effect, “recharge” the system.

4. When the temperature warms, the compressed gas comes out of solution and there is an increase in pressure within the stem of the tree. If the pressure rises above the external barometric air pressure, sap in the vessel cells is pushed out of the tree through a tap hole. Sap from above the tap hole may also drain out under the pull of gravity once the tree thaws. A tap hole (or another wound) is needed for the sap to move within the tree; in its absence stem pressures would increase and decrease with the changing temperatures,

but sap would not move. Many people believe that modern vacuum systems actually suck the sap out of the tree - this is not true. Vacuum reduces the air pressure inside the tap hole. If the internal pressure of the stem is higher than the external pressure inside the tap hole, sap is pushed out through CO<sub>2</sub> expansion within the tree.

5. Sap movement after the tree has broken dormancy happens for a completely different reason. In the summer after leaf out, water is drawn through the roots, up the stem and out of the leaves through the process of transpiration. It is the cohesive nature of the billions of water molecules moving through very small diameter vessels that allows the tree to lift water up in a column against the force of gravity. This could be considered an open system as opposed to the closed system of a dormant maple.

6. In order for this process to work, the sap needs to contain sucrose and the cells need to be

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living; it will not happen with wood and water alone. The reason for this has yet to be adequately determined.

## Where does maple grow and is maple syrup made throughout this region?

Sugar maple is a native hardwood species that grows over a wide geographic area of eastern North America. It is generally restricted to areas with cool, moist climates and grows best in areas that receive about 50 inches of precipitation per year. It can grow on a wide number of sites where the average winter temperature ranges from  $-18^{\circ}\text{C}$  to  $10^{\circ}\text{C}$ , and the average summer temperature ranges from  $16^{\circ}\text{C}$  to  $27^{\circ}\text{C}$ ; in these areas the length of the growing season can range from 80 to 260 days.

Figure 2 shows the native range of the species and the approximate range where the majority of the maple syrup is produced. Other areas throughout the range of the species do produce maple syrup, but most of the producers are located in Ontario, Quebec, New York, Vermont and New Hampshire. Maple



Figure 2: The growing range of sugar maple.

syrup can be produced throughout the native range of the species wherever the climate allows for the cycle of freezing and thawing described earlier. It is this combination of climate and species range that governs where maple syrup can be made. It is impossible to collect maple sap in areas where the average winter temperature is above zero.

There is considerable evidence to suggest that our climate is changing. Stronger and more frequent storms as well as wetter, milder winters will have an impact on the maple producing industry. We may see a geographic shift in the main maple producing region as new areas of production appear

and/or it becomes more difficult to produce syrup in established areas.

## What is the chemical composition of maple syrup?

The following table lists the natural composition of pure maple syrup. It was adapted from an article in the *National Maple Syrup Digest* 14(2):12. One tablespoon of maple syrup has about 50 calories of energy, which comes entirely from sugars.

It is this rich blend of sugars, organic and amino acids and minerals that gives maple syrup its characteristic “maple” taste. Production methods and varying concentrations

of the individual ingredients can cause some variation in taste across the maple producing region.

## How is maple syrup graded?

Maple syrup is graded by colour or the amount of light transmittance through it. The Canada Agricultural Products Act lists a number of Maple Products Regulations that introduce and define Canadian maple syrup grading standards. There are three grades and five colour classes identified for Canadian maple syrup. Characteristics of each grade are described in the following table (Table 2).

It is important to note that only colour and a taste characteristic to its colour separate Canada No. 1 from Canada No. 2 maple syrup. In Ontario, producers may sell Canada No. 2 syrup as Ontario Amber at the farm gate or production facility. Canada No. 3 is dark syrup, which can have an off flavour. Canada No.3 may also be lighter syrup with a trace of caramel buddy or sappy flavour as well.

These lower-grade syrups are often sold in bulk for flavourings and other industrial uses.

### What is the life history of maple?

There are a number of key characteristics that allow maple to dominate some sites over other species. These characteristics are listed below.

#### Flowering and Germination

- Trees seldom flower until they are at least 22 years old;
- Seed production can be more than 150,000 per hectare;
- Seeds (called a samara) ripen in about 16 weeks;
- Flowers are mostly wind pollinated;
- One good seed crop occurs about every 4 years;
- 95% of the seeds usually germinate; and
- Germination temperature is 1°C (the lowest of any forest species).

#### Seedling Development

- Seedlings are very shade tolerant;
- Seedlings grow best under about 65% shade;
- Trees grown in open (>55% sunlight) require more water to prevent mortality;
- Seedlings put on majority of height growth in early spring before canopy develops;
- Open planted maples tend to grow poorly if competing vegetation isn't suppressed;
- Planting in late fall or early spring is ideal; and
- Closer spacing is recommended –to prevent forking problems.

#### Growth and Yield

- Early growth is slow under normal conditions;
- Younger seedlings are sensitive to moisture problems due to shallow roots;
- Seedlings grown in more open conditions have deeper roots;

- Height growth in polewood starts when the buds leaf out;
- Height growth is completed in 15 weeks; most of it occurs in first five weeks;
- Diameter growth completed in 14 to 17 weeks, 80% done in 8 weeks;
- Trees are classified as very shade tolerant;
- Under 25% sunlight can reach maximum photosynthetic capability;
- A mature stand may grow for 300 to 400 years;
- It may reach 27 to 37 metres;
- It can reach 76 to 91 cm in diameter; and
- Yields in mixed forests but predominantly sugar maple can be 216 m<sup>3</sup>/ha or 14,000 board feet per acre.

#### Response to Disturbance:

##### Fire:

- The amount of sugar maple increases during long fire intervals.

- Maple has proliferated in areas where fires have been historically suppressed.
- Fires in mature maple stands are rare because leaf litter is usually moist; and
- Sugar maple is fire sensitive due to its thin bark.

#### Weather:

- Sugar maple is extremely sensitive to flooding during the growing season; and
- Sugar maple is susceptible to winter sunscald and ice damage.

#### Air pollution:

- Sugar maple is tolerant to ozone, sulphur dioxide, and hydrogen fluoride; and
- Sugar maple is intolerant of salt spray and road salt.

#### Why do maple leaves change colour in the fall?

Every fall as the days shorten and the temperature decreases, all deciduous (and some

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coniferous) trees undergo a sometimes spectacular transformation into dormancy. Light is made up of a number of waves of different frequencies. We see the reflected light that is not absorbed by an object; leaves appear green because we see the light in the green spectrum that is reflected off the leaf surface. Black objects absorb all light waves while white objects reflect all wavelengths of light. This explains why black objects in the sun are often much warmer than white objects; all the light energy is absorbed and some of it is turned into heat energy.

Leaf colour, whether green, brilliant red, yellow or brown is related to type and amount of pigments contained in the cellular structure of the leaf. We see green leaves in the summer because chlorophyll (a green reflecting pigment) dominates all other pigments. Chlorophyll absorbs red and blue wavelengths of light that are used by photosynthesis to produce sugars. Chlorophyll is also an unstable compound that

breaks down quickly and is constantly being replenished by the leaf. To make chlorophyll, a plant needs warm days and plenty of sunlight, so as the seasons change from summer to fall, a leaf is unable to replace the chlorophyll that is being broken down.

In the fall, a sugar maple tree may appear yellow or red. These colours are caused by two other types of pigments that are more stable than chlorophyll. These come to dominance in the leaf as the chlorophyll breaks down – yellow light is reflected off carotene molecules while red light is reflected off anthocyanin molecules. Carotene is another pigment that helps the leaf trap sunlight and anthocyanin is a pigment that is formed in the sap when sugar concentrations get quite high.

Autumn leaf colour is a function of both the concentration of these two leaf pigments and the weather. As the chlorophyll breaks down secondary pigments that are more stable dominate. Bright sunshine and temperatures that are just above the

freezing mark promote the development of anthocyanins within the sweet sap. Temperatures that drop below zero will reduce the amount of anthocyanin produced and cause the leaf to appear yellow.

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## Managed Forest Tax Incentive Program – August 2004 Update

In July, the Ontario Ministry of Natural Resources (MNR) released the report *EBR Review R2003005, Managed Forest Tax Incentive (MFTIP), June 2004*. This report summarizes the review of the MFTIP program that was recently completed under the Environmental Bill of Rights.

The report is a comprehensive document, and our association is still in the process of evaluating the information and the recommendations stemming from the review. Once this evaluation has been completed, we will provide the government with our response, develop a strategy on where to go from here

and we will communicate this information to OWA members.

A copy of the government report is available on MNR's Web site at <<http://ontariosforests.mnr.gov.on.ca/mftip.cfm>>. We encourage members to obtain a copy of the report and forward your comments to the OWA office. In the interim, we are providing you with the eight recommendations arising from the review.

**Recommendation #1:** Ministry of Natural Resources (MNR) and Ministry of Finance (MoF) should continue to monitor participation of landowners in MFTIP to track net participation rates and review program success parameters.