

[Notes from a talk given to the Royal Society of WA by Dr. Saupe, 15 May 2006]

Maple syrup is not just about pancakes!

Dr Stephen Saupe is Professor of Biology at the College of Saint Benedict, Saint John's University, Collegetown, Maine, U.S.A. For the past 5 years, he has been Syrup Master of the University's Maple Syrup operation.

Sugar maples are one of the few truly North American crops used today (others include pecans, blueberries, cranberries and sunflowers).

The sap of sugar maples on average is about 2% sugar concentration, about double that of most other trees. Hundreds of years ago, Indians of northeastern North America discovered how to concentrate this sap into crystallised sugar, which could be stored. They would make a gash into the bark of the tree, insert something like a sumac twig to guide the sap into containers made of hollow logs or sheets of birch bark. They would then heat the sap by dropping hot rocks into the sap to boil off the water, until it crystallised. European settlers copied the Indians, to garner a valuable food resource.

It is not an easy task!

First, you have to find your tree. Sugar maple buds are distinctive, but maple trees can be quite large, mixed in with many other large trees in the forest, so only large trunks are visible (you have to learn to distinguish the bark).

Second, weather conditions have to be just right. Maple sap only flows when the tree is dormant, when there are warm days above 0°C and cold nights below 0°C. The cells of sugar maples have an unusual property; they contain air-filled hollow cells (fibres, walls, spaces). There is no sap flow without freezing at night. If it is too warm, the tree doesn't fill with water (dormant trees have no leaves to bring water in through the roots).

Summary of weather conditions:

- cold night → gas contracts in stem → reduces pressure → stem fills with water from roots → water freezes in hollow cells (fibres, walls, spaces) and traps gases in ice bubbles.
- warm day → ice melts → gas expands → pressure increases → pushes sap out of the xylem cells.
- no flow if consistently above freezing because stem doesn't refill with water.
- no flow if consistently below freezing because ice bubbles don't melt and gas pressure doesn't increase in the stem.
- no flow when buds burst – sap pulled upward to leaves by normal mechanism of water transport in the xylem (Transpiration-Cohesion Theory).

Birch trees also have a sweet sap which is sometimes collected to make syrup, but the trees have a different manner of taking water in through the roots.

Third, a spile, or tap, is inserted into the tree. There are several ways to do this, such as a brace and bit or a small, portable drill. A hole 7/16 th of an inch is drilled at an upward angle to a depth of 1 1/2 to 2 inches into the sapwood, or xylem (rare exception to the rule that sugars are transported in the phloem). The spile should fit snugly, but not too tightly, into the hole. Trees smaller than 12 inches in diameter are not tapped, and trees greater

than 18 inches can have 2 taps.

Tap holes should heal over by the next season, and new holes are made a short distance away in a spiral pattern to avoid the old holes. The height of the holes is related to the depth of snow cover.



Sugar Maple tree with collection buckets.

Fourth, a bucket or bag is hung on the spile to collect the sap, which can drip out at one or two drips per second on a warm, sunny day. Sap flows for only a few hours in a day. Squirrels can be a nuisance. Grey squirrels have learned to chew on the collecting bags or vacuum tubes to get at the sweet sap, and red squirrels like to eat the inner bark of maples and can strip seriously large areas from the tree, which hinders or kills the trees.

Fifth, the sap is collected and transported to a sugar shack for processing. Large commercial syrup operations dispense with buckets and bags, and simply run tubing from the

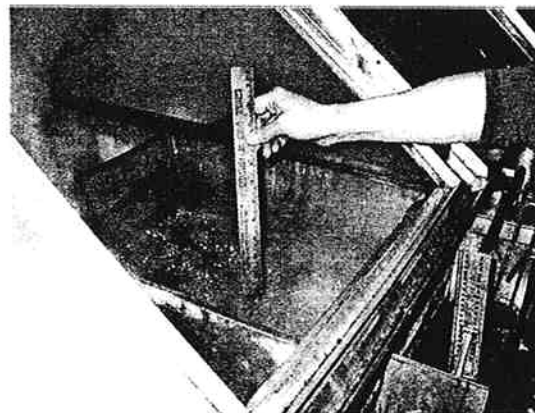
holes directly into vats in the sugar shack, up to a kilometer away with the assistance of vacuum pumps.

Saint John's still operates its maple syrup business, begun in 1942 and inspired by the shortage of sugar during the war, in the old fashioned way that was originally established by Benedictine monks.

Inside the sugar shack, the barrels of sap, transported by tractors, are filtered and poured into evaporator pans. The evaporator is quite large, 4' by 16', where the sap flows slowly through a maze-like arrangement of trays over a wood-fired furnace. It is a continuous flow process: sap in at one end, syrup (almost finished) coming out the other end. It has to flow at the correct depth (too shallow and it burns, too deep and it doesn't evaporate sufficiently and takes longer). This arrangement can cook off 200 gallons of water per hour, which makes 5 gallons of syrup.

It takes 1 cord of wood to make 25 gallons of syrup. A cord of wood is a stack 4' high, 4' wide, and 8' long. They use mainly oak for burning, and also ironwood and maple.

They measure the readiness of the syrup with a hydrometer or a thermometer (syrup is cooked to 7°F above 212°F - the boiling point of water). This nearly finished syrup is



The depth of the sap is continually monitored

filtered again to remove mineral salts which have precipitated (sugar sand). The syrup is then put in a smaller pan above a propane flame to cook to the finish, 66 Brix, 35.6 Baume, 87.2% solids.

The finished syrup is 98% sucrose, with traces of amino acids, malic and citric acids and mineral salts, mainly calcium. It takes approximately 43 gallons of sap to make 1 gallon of syrup

The government specifies the quality standards for maple syrup based on colour and flavour. There are 4 grades which can be sold. Grade A Light Amber is the best quality. The lower grades are darker in colour. The flavour is mainly a result of the cooking process, being slightly caramelised. Flavour is also influenced by the season - early season being lighter than later.

The rapid processing of sap produces a better quality syrup. The sap is sterile inside the tree, but it rapidly becomes contaminated with microbes, lowering quality. It can be stored only briefly at a cool temperature. UV light can be used to sterilise it. The sap can also be processed with reverse osmosis to remove part of the water. This reduces the heating period.

The quantity of syrup produced depends on the number of taps and the weather. The last several years have been poor years. Saint John's placed 600 taps in 2005 to produce 45 gallons, and 800 taps in 2006 to produce 120 gallons. Their 'sugarbush' contains several hundred maple trees in an area of about 5,000 square metres. The sucrose content of the trees ranges from 0.8 to 7.3%, to give a mean of 3.22%.

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[www.sinkswatch.org]

10 things you should know about tree 'offsets'

Planting large quantities of trees has come to be seen as a 'good' thing. However, there are contraindications for certain kinds of large plantings.

'Good' plantings include farmers planting a certain percentage of their land for the purpose of lowering groundwater, creating windbreaks, or income-producing activity.

The 'bad' kind of plantings are those that impose a massive monoculture, which some people now term 'green deserts', as they disrupt local ecology. Offenders in this regard include companies offering tax avoidance schemes which buy up entire farms and displace the people who lived and worked there. The loss of population destroys small communities: local businesses and services wither away. This has happened already in parts of the southwest of WA and in Tasmania. In many cases, valuable agricultural land disappears, perhaps forever, just because cash-starved farmers sell up to the big companies.

It is possible that some large-scale plantings, such as that being done in China to combat desertification are 'good,' but it really depends upon the human and social impact: are people being displaced? Are communities becoming ghost towns? Is valuable agricultural land being lost? Some sort of socially-responsible balance is required, especially when you consider the emerging information that tree planting isn't a real solution to the increasing amount of greenhouse gases in our atmosphere.