MAPLE SYRUP PRODUCTION

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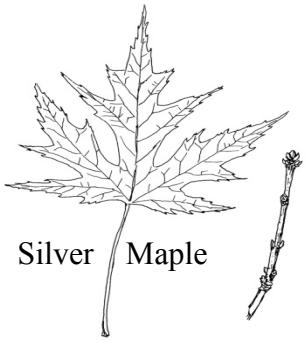
Maple syrup (a uniquely American crop) is one of our oldest agriculture commodities. The Northeast US and Canada are at the center of the maple world. Iowa has a few commercial producers in the Northeastern part of the state. The number of hobby "sugar makers" continues to grow, in part, because there are now several equipment manufacturers who specialize in producing hobby scale maple evaporators as well as the small quantities of essential components needed to make high quality syrup (taps, buckets, etc). More information on maple supplies can be found online at www.forestry.iastate.edu.

Making maple syrup is a very labor intensive process. Each potential producer must carefully analyze their individual situation and scale production accordingly. The best advice is to start small with minimal investments and grow in production size as you learn the maple trade and have a better understanding of all that is involved.

Maple species

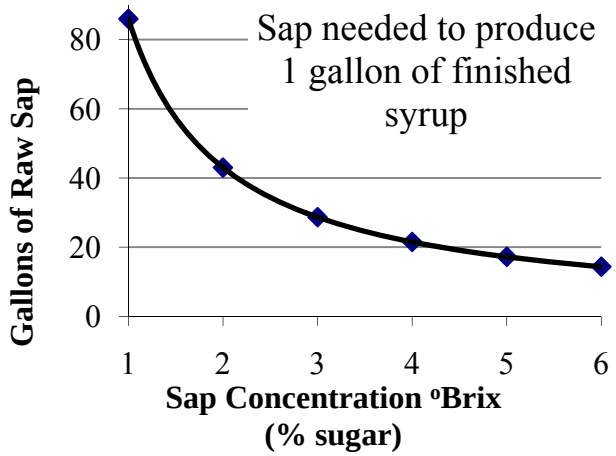
The first step along the road to making maple syrup is to identify if you have maples trees that are large enough to tap.

Sugar Maple



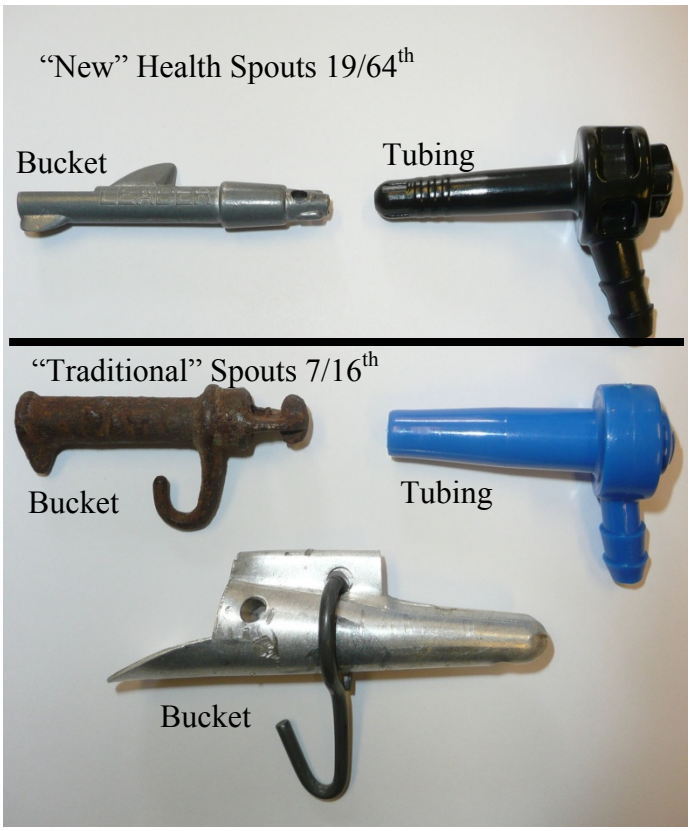
Silver Maple

Maple syrup can be made from all maple species (sugar maple, black maple, red maple, silver maple and boxelder) but they are not created equally. Sugar and black maple sap has higher sugar concentrations, (2-3%), than silver maple (1.5-1.75%), and box elder (1%). Why does the type of maple species matter? The "Rule of 86" in sugar making states that at 1% sugar concentration you would need to collect and reduce, on average, 86 gallons of raw sap to make one gallon of finished syrup. At 2% sugar concentration you would only need to boil off 43 gallons of sap to make one gallon of syrup. Unless you want to spend days -instead of hours boiling the sap down into syrup, you should always aim to tap the sweetest trees available!



SAP COLLECTION

After identifying your maple trees, the next step in sap collection is to purchase spiles (taps, spouts) and buckets. These should be sanitized with a weak clorox solution prior to use and rinsed thoroughly. If you are using the "old" style of spiles they will require a 7/16th inch drill bit, where as the new "health" spiles are smaller and only require a 19/64th inch drill bit. Trees are normally tapped on the south or west side of the tree trunk to take advantage of the warming that occurs as the sun hits the bark. The hole should be drilled at a slight upwards angle to help the sap flow from the tree and

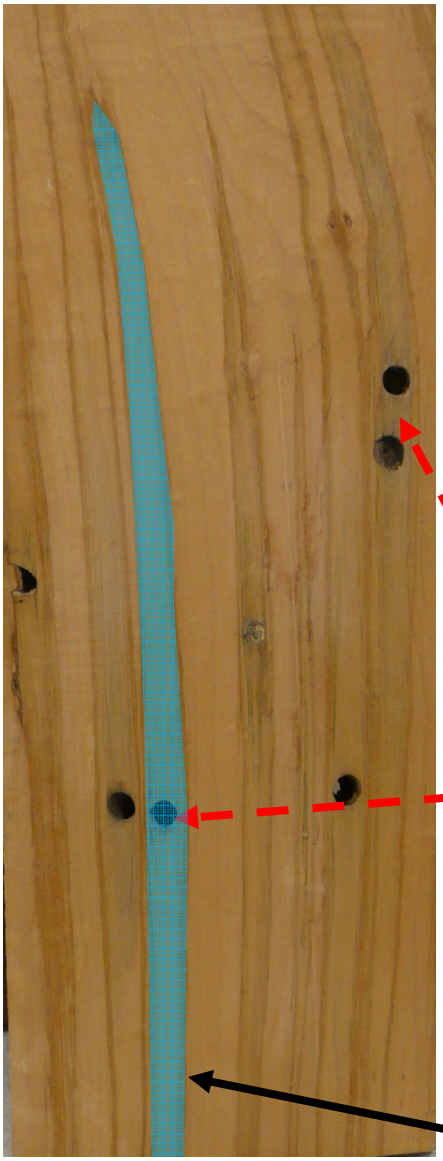


should only extend 1.5 - 2 inches into the tree. If you use a cordless drill, be sure to go slow and use a slow speed wood bit. Too fast and you can actually burn, or cauterize, the inside of the tap hole, which can greatly reduce the volume of sap you will get. If your tree has been tapped in the past **Do Not** place a new tap hole directly above or below the old hole. It is recommended that you move two inches to the right or left and two inches up or down to tap "new" white wood. Each year, continue to move around the tree in the same direction and you will always tap good sap producing areas.

Tapping guidelines help to ensure that your trees are not over-tapped (over tapping can cause undue injury to the tree). A healthy tree that is tapped using the following guidelines should seal over the tap hole in one to two growing seasons. **Do Not** put anything in the tap hole to "help" the tree "heal", as this foreign object can create more problems, such as being a source for decay.

Tapping Guidelines:
1 tap for trees 10-15 inches in diameter,
2 taps for 16-20 inch trees,
3 taps for 21-25 inch trees and,
4 taps for trees ≥ 25 inches in diameter.

Trees are usually tapped before the sap begins to run; thus care needs to be taken when you drive the spile into the frozen tree. Driven too hard, the tree's cambial layer will crack causing a loss of sap and a delay in the healing process. Sap collection generally begins in Iowa in late February or early March and lasts for approximately three weeks. The season may be shorter if you are tapping silver maple trees, which have a tendency to break bud and begin to grow before sugar maples. No matter what species of maple tree you tap, once a tree breaks bud, the chemistry of the sap changes and the syrup will have an "off" flavor. This flavor is commonly referred to as "buddy" syrup. Once this happens, the season is over.



This "Sap Stained" board shows old tap holes and the zone of wood that sap was extracted from. Each hole = 1 year of tapping. Sap zone extends 12-18" above and below each tap hole.

As an Example never tap directly above or below an old tap hole. Sap flow is compromised in these areas. Always move two inches right or left and two inches up or down from the old tap hole. These tap holes are a **Too Close**.

Sap zone
(shaded in light blue)

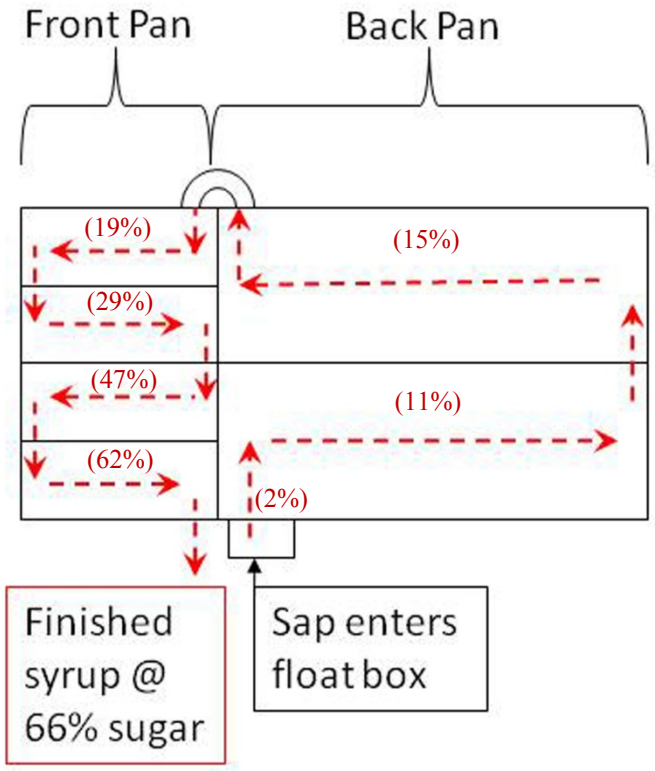
SAP STORAGE

Because maple sap has a sugar content near 2% it needs to be handled as a perishable commodity. The warmer the air temperature, the faster the sap will spoil. Bacterial growth begins when sap is above freezing and the longer the sap sits before processing, the darker the finished syrup will be. Storing sap in large plastic or stainless steel tanks that are kept near freezing will prolong the "shelf life". The best advice is to process the sap within 24-48 hours to ensure a good quality syrup is produced.

***Remember**, if sap freezes in your holding tank remove the chunks of ice and discard them. The ice chunks will be mostly water and the liquid sap that is left in the tank will be more concentrated (requiring less boiling time to reach 66% sugar). **Do Not** let sap freeze in the buckets on the trees as they are not designed to handle the pressures associated with ice expansion.*

EVAPORATION

Finished maple syrup is approximately 66% sugar, and this reduction, or concentration, of sap is accomplished by boiling the sap. Flat pans with a large surface area-to-volume ratio can be used to batch produce maple syrup. At the hobby scale, the use of a flat pan over a hearth of concrete blocks is still a great way to boil sap into syrup. Because the sap boils longer on a flat pan (until a sufficient amount is ready to finish in a smaller, more controllable pan) it is usually darker and has a more robust maple flavor than todays modern evaporator. The tradeoff of having syrup that is darker and more labor/fuel intensive is that the setup costs a fraction of a new modern evaporator. The first continuous-flow evaporators came onto the market in the 1860's and the design is still in use today. This system normally has two pans that sit on a closed arch where the fire and heat can be contained and utilized more efficiently. In the back pan, a series of sap filled flues rapidly boil water off from the sap as heat and flames race between the flues. A float system accurately feeds raw sap into a back pan to maintain a constant level of liquid across both the back and front pans. As the sap begins to concentrate, a sugar gradient forms in the pans as the thicker syrup moves to the front pan, which can have 3-4 sectional divisions. As the syrup passes along the front pan sections, it is exposed to the hottest part of the fire and the caramelization process helps to complete the color and taste of the syrup. As syrup becomes more concentrated it also becomes more volatile. At this stage it is easy to burn the maple syrup and /or boil it over. Using a commercially available defoamer to break the surface tension of the syrup bubbles will help to reduce burning of the maple syrup. Once the syrup reaches the last section it is drawn off at $7^{1/4}$ degrees F above the boiling point of water.



Continuous flow evaporator diagram. Numbers represent % sugar at that location in the evaporator.

For a hobby producer in Iowa, at minimum you will need a flat pan that is preferably made out of welded stainless steel with 6-8" tall sides (to minimize boil-over), a heat source (usually wood or LP gas), syrup filters, sap, an accurate candy thermometer that can be adjusted for barometric pressure, bottles, seals and labels. While larger continuous evaporators can cost several thousand dollars, used equipment can be purchased online or modified from other uses (5 gallon food grade buckets from your local grocery store instead of commercially produced sap buckets).

Most cost estimates in publications do not include the labor for sap collection and evaporation or the energy costs for the evaporator (wood, LP). Maple syrup production is very labor intensive. At the hobby scale, having your friends and family involved in the process will help offset the workload. Talk to your local tree care companies or town crews about obtaining the wood waste from their local jobs. This can be a great source of wood and the crews can reduce their hauling and dumping fees. At the end of the season a gift of syrup goes a long way toward. securing all the firewood you will ever need for next year.

YIELD & CARE OF FINISHED SYRUP

Yield of syrup varies from season to season and from tree to tree. In Iowa, the average yield of syrup per tap can be from one pint to one quart. In addition, there are some quality differences between species as some sugar makers report a different flavor when boxelder sap is boiled. The color of syrup can range from light to dark and it is this "light transmittance" that is used to grade the syrup. *Remember that all pure maple syrup has to be 66% sugar and these grades only refer to the syrup's color.*

(Light, Medium, Dark, Grade B Cooking, and Grade C commercial are shown from L to R in the above photo)

Because the boiling point of water changes as the barometric pressure changes, all syrup should be checked for the proper density with a hydrometer. After the density check, the hot syrup should be filtered to remove any particulates (sugar sand, dust, fly ash, etc.), graded and bottled hot. Hot canning will sterilize the container, and seal the product into the container, which does not need to be refrigerated until it is opened. Syrup that is canned in glass jars may darken over time as light tends to degrade the color of syrup. Storing canned syrup in a dark, cool cellar will prolong the color "shelf life". Because maple syrup is a food product, licensing and permits through the Iowa Department of Agriculture may be required.

END OF THE SEASON

Once the buds have broken and the syrup has taken on the "buddy" flavor, the work of making syrup is almost over. All taps need to be carefully removed from the tree before the new cambial growth begins just beneath the bark. All metal buckets, taps, holding tanks, and evaporator pans should be cleaned with a weak unscented bleach solution, rinsed thoroughly and stored in a clean, dry area until next year. If you use plastic taps, tubing, and buckets rinse the washing solution extra thoroughly as mice and squirrels love to chew on plastic that has the salty bleach residue. If possible, store all plastic objects in mouse/squirrel proof containers.

Both sap yield and sugar content can be improved through sugarbush management. Forestry practices which promote crown development will increase the yield and sugar content. Periodic thinning of trees that are spaced too close together will enable the remaining trees to grow fast, store sugars, and produce more and sweeter sap. In general a sugar bush should have 50-60 trees per acre (trees spaced roughly 28ft apart). Future publications will focus directly on sugarbush management, utilization of riparian trees, and value added maple products

Reference Materials: North American Maple Syrup Producers Manual 2nd Edition. Heiligmann, Koelling, & Perkins. Published by The Ohio State University.

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