Agricultural Innovation Grant Project Report
Kahiltna Birchworks
Birch Syrup facility, Talkeetna Alaska
June 2012

Abstract:

In March of 2012 Kahiltna Birchworks received an Agricultural Innovation Grant to tap birch trees near Talkeetna using a state-of-the-art tubing and vacuum system. In this system 1"mainlines are strung through the forest, with lateral feeder tubing running to 3-10 trees each, and hooked to a vacuum pump and extractor. 1800 trees were tapped on this system with an average of 165 trees on 11 mainlines. In addition, 5000 trees were tapped using the tradition tap and pail method, and 3,000 trees were tapped by local sap collectors using various methods, primarily tap and bucket OR gravity tubing (no vacuum). Based on maple syrup research over many years, the expected results of the tubing and vacuum (T/V) system was to increase production while decreasing impact to both the forest ecosystem and individual trees, cut fuel consumption and labor costs, and potentially increase the length of harvest. Comparisons in sap yield between the various methods were done throughout the harvest. Results were encouraging. Sap production per tree was variable across the board, fuel and labor costs far less in the T/V system, and extension of the harvest in future years seems quite feasible. The one drawback noted is that sugar content in the sap dropped off quicker in the T/V trees than it did in the trees with pails. The possible reasons for this decline will be discussed.

Harvest re-cap and statistics:

Sap harvest began on April 17th, a bit earlier than average. There remained approximately 4 ft of snow on the ground; record snowfall had occurred throughout the winter. The tubing was still being installed; vacuum system was turned on the following day 4/18. Harvest continued through 5/9 for a total of 23 days. Though the weather was warm, we had good sap flow and relatively high sugar content throughout.

Collector	Method	# of taps	Total GALLONS	Avg. sap /tap GALLONS	Avg. Sugar content of sap	# days operating
KBW	Tubing/vacuum	1800	26,422	.64	.95 (.8-1.2)	22
KBW	Tap and pail	5000	68,788	.60	1.1 (.9-1.2)	23
Dan Oliver	Tap and bag	1600	25,811	.73	1.15 (1.1-1.2)	23
Graber family	Gravity tubing/200 bags	900-1050	8872	.55	1.05 (.9-1.2)	16
Dewey Bitler	Gravity tubing	600	8578	.65	.85 (.7-1.0)	22

Total trees tapped: 10,050

Total gallons of sap collected: 140,651

Total syrup produced: 1320 gallons

Sap to Syrup ratio: 106.5

Average gallons of sap/tree: 14

Average quantity of syrup produced/tree: 16.81 ounces

Data analysis:

Looking at the average sap/tap would indicate inconsistent results, but this data does not reflect several variables:

1. In tap and pail (or bag) areas the trees are intensively managed, and pails are removed from trees that are low producers and moved to new trees (called "re-tapping"). As the harvest progresses, this keeps both the quantity of sap and the sugar content of the sap higher. Dan Oliver was able to keep both those numbers very high as he spent more time managing his stand. There is an inverse relationship between the number of trees tapped and the ability to manage effectively. KBWs 5000 pails is the largest sample and produced a smaller sap/tap than Dan Oliver's stand of 1600 mostly due to Dan's ability to manage the smaller quantity of trees AND the ability to hand select trees to tap. Larger trees in general will produce more sap, and Dan's 240 acres is an older forest over all.
2. Trees tapped on a tubing system are not managed as above. Once the tree is tapped it is difficult to estimate sap flow, and no "re-tapping" occurs. Lines are tightened and leaks repaired, but that is the extent of the management. New lines can be added, but is not generally practical mid-harvest as it takes quite a bit of time and labor.
3. Location: Dewey Bitler had a higher sap/tap ratio but lower sugar content. Sap from Dewey's stand of trees near Meadow Lakes has been historically lower in sugar content; possibly due to local soils and other site specific conditions. However he was able to maintain good sap flow. We have also noted that high sap flow can inversely impact sugar content in the sap; possibly diluting it. This is a casual observation over years of tapping trees.

Maple producers and researchers told us that gravity tubing *without* vacuum in general does not produce as high a yield in sap as tubing with vacuum. They expected we would get a far higher yield in tubing than with pails. We did see this occur within our own stand of trees, though not as much as we anticipated: we received an average of .64 gallons/tap on the T/V trees as opposed to .6 gallons/tap on the pails. We attribute some of that disappointing number to "user error" and our learning curve for the year. Though we had an expert helping install the tubing, time became an issue as sap flow started a little quicker than we expected. As a result, the following factors likely affected our flow for the season:

a. Some of the mainlines had no slope or a slightly upward slope in some sections
b. Some trees tapped were too small, dead, or otherwise unhealthy
c. Twice the vacuum shut off without our knowledge, so we lost production for up to 24 hours.
d. We had more leaks around fittings as there was a learning curve in using the specialized tools.

One major factor, the T/V system is a *closed* system – sap flowing in a vacuum. As there is no introduction of air into the system there is no bacterial growth in the sap or the tree. Though we did not take advantage of it this year, there is great potential for increased length of harvest in tubing. The main factor that shuts down harvest (before the sap stops running and leaves emerge) is bacterial/yeast growth in the sap. We noted that the sap running in the tubing after we stopped harvest was still clear. Although the sugar content had dropped, it still would have been possible to continue harvesting the sap – possibly for another 3 days.

Cost factors

One of the main goals of using tubing and vacuum for our company is to cut costs. As we increase the number of trees we tap we have seen our efficiency and yield decrease as our costs rise – more equipment for collection, more labor, and higher fuel costs. The collection of sap from 1800 trees using our traditional tap and bucket method would require buckets and spouts, 2+ "sap suckers" (what we call our seasonal helpers) at an estimated $4,000 cost per person each year (food, housing, transportation, and wage), collection equipment for each person – a snowmachine, sled, six-wheeler, trailer, tanks, sap pump, suction hose, fittings, etc. and fuel to run the equipment, parts to repair the equipment, and general maintenance. Taking all of this into account, the estimated cost of the traditional tap and pail method for these 1800 taps for this season would be $35,000. The T/V system and the pump house built to house the equipment cost approximately $20,000. This equipment is intended to remain in place for the next 5-7 years with a relatively low cost in maintenance. Spouts are replaced annually and repairs to the tubing will be needed, but the costs of labor are far lower. The vacuum pump and extractor are powered by electricity – not fuel – at a much lower cost than the fuel needs of our traditional collection system. Over all, over the course of seven years we will cut our costs in sap collection by an estimated75%.

Environmental Factors

Tubing/vacuum extraction of sap has lower impact to the tree, the forest environment, and a lower carbon footprint. The tap used in the tree has a smaller diameter (5/16" vs. 7/16") so the impact to the tree is lower. There is little ATV use in T/V collection so the collection is gentler to the forest floor and produces far less air and noise pollution. Energy used is far lower for T/V extraction; and electricity versus gasoline is cleaner.

Other factors and drawbacks

Every method will have its drawbacks. Sugar content in sap always drops over the course of a harvest. We noticed with some surprise that the sugar content in the sap dropped more quickly in the tubing than it did in the pails. We realized the main reason is that we keep sugar content higher in the pails through the process of re-tapping (pulling taps that have stopped and tapping new, more productive trees). Re-tapping is not possible, and tapping new trees during harvest is not practical in T/V extraction and the decline must be expected and taken into account. It unfortunately results in a higher sap:syrup ratio and lower syrup production. However, lower production could be compensated for by a longer harvest.

Something can be said for the value of human observation and interaction with the trees. There is some attention to detail that does not occur with tubing and vacuum. The system is more mechanized, removing both human error and human intuition.

The biggest risk is the possibility of losing access to the trees on the T/V system before the 5-15 year life of the tubing itself. There is substantial cost in tubing and the labor to install it that ideally is amortized over those years. That is where the true cost effectiveness of the T/V system comes in.

Conclusion:

The tubing and vacuum system installed in 2012 was a successful innovation for our company. It achieved the stated goals of lower cost, lower carbon footprint, greater efficiency, and higher yield. The potential for higher yield in the future is now well understood, as is the process of installing tubing in the birch forest. This year gave us the experience and the understanding to apply to future harvests. In 2013 we intend to increase the T/V system and slowly eliminate traditional tap and pail tapping over the next few years. We will continue to increase efficiency and lower costs, continuing to produce the highest quality birch syrup in the world. As the demand for birch syrup increases worldwide, this process will make us more successful as a business with great implications for the birch syrup industry in Alaska.