Northern New York Agricultural Development Program

2013 FINAL REPORT

Increasing Sap Yields and Profitability in Maple Sugaring Operations Through Optimum Dropline/Spout Management

Project Leaders
Michael Farrell, NNY Maple Specialist, Cornell Uihlein Maple Research Forest, Lake Placid, NY
Brian Chabot, Professor, Cornell University

Collaborators
Amy Ivy, Cornell Cooperative Extension (CCE) Clinton County
Michele Ledoux, CCE Lewis County
Richard Gast, CCE Franklin County

Cooperating Producers
Parker Family Maple Farm
CCE St. Lawrence County
Cornell Uihlein Maple Research Forest, Lake Placid, NY

BACKGROUND

Tubing systems with vacuum substantially increase maple sap yields. However, they are expensive to install and sap yields decrease each year of use. Research has determined that the losses are due to bacterial and yeast build up in the tubing, especially in spouts and droplines, that transfers to the tap hole.

Research at the University of Vermont Proctor Center (UVM) has shown that if no efforts are taken to replace different components of the tubing system, within 5 years a producer will collect 50% of what a new system can achieve.

Researchers at UVM and Cornell have been exploring different methods for replacing critical components such as the droplines (~30" of tubing that connects the spout to the lateral line tubing), the spout, adding a disposable spout extension to an existing spout, or using a check-valve spout extension in order to maintain high sap yields. Several of these methods are promising, but there have been conflicting results regarding the effectiveness of each strategy.

The various methods also differ greatly in the time and costs needed to carry them out, so we need a better understanding of the benefit/cost ratio for implementation.

Furthermore, all of the studies were done in controlled experiments with a limited number of trees.

Although maple producers look to researchers for information and guidance, many maple producers are reluctant to try a strategy until a "real producer" has tried it in their sugarbush and experienced positive results. Consequently, each of our NNY Agricultural Development projects has involved producer collaboration and extension education programs.

In 2011-2012, we worked with the Parker Family Maple Farm in West Chazy (Clinton County) using research protocols to determine the performance of different spout and dropline systems in producer sugarbushes. The Parkers tried eight combinations of spouts and droplines in their operation and measured the total amount of sap flow every time a load of sap was picked up and transferred to the sugarhouse.

The first year of their trials showed promising results and began to identify what the best spout/dropline combinations may be. This project continued the Parker experiments and expanded the research to other producers in NNY during the 2013 sap season.

The proposed research determined the costs and benefits of annually replacing droplines and spouts, the Leader check valve, and some other promising approaches. These were tested against controls using no replacements or replacements on a less frequent basis.

Our goal was to provide data for commercial operations and across a major maple-producing region with very different environments. Since tubing systems require a lot of plastic and are expensive and time consuming to install, producers need the best approaches to maintaining high sap yields without extensive investment in new tubing materials.

By determining which strategy for replacing tubing components and spouts can yield the greatest return on investment in time and material, maple producers throughout NNY will be able to optimize sap yield while potentially minimizing the cost of replacing of plastic tubing and spouts.

METHODS

We attempted to identify producer collaborators in each NNY county based on past project collaborations and communicating through the Adirondack, St. Lawrence and Lewis County producer associations. Unfortunately we didn't learn that the project would be funded until very close to the beginning of the sap season so we had trouble lining up collaborators that had the right set-up in place to be able to carry out the research. We wound up using sugarbushes at the CCE St Lawrence County Extension Learning Farm in Canton, Parker Family Maple Farm in West Chazy, and the Uihlein Forest in Lake Placid.

Each of the producers involved first mapped their tubing systems, counting the exact number of taps in each sampling unit, and installed a volume measuring meter for each unit.

Each collaborator developed a personalized plan for how to incorporate new droplines and/or spouts into their management plans.

Producers followed a protocol for measuring the total sap volume and sugar content during regular intervals throughout the sugaring season. Each collaborator recorded the vacuum level, as shown on the vacuum gauge at the sap extractor, every time measurements were taken. The amount of sap collected based on a change in spout and/or dropline was also measured against the cost in materials and time needed to install a particular method, allowing us to determine the most profitable strategy.

RESULTS
NOTE: See Figures/Tables separately at www.nnyagdev.org/index.php/mapleforest/maple/
Section A represents 1-year-old dropline with new smart spout
Section B: New dropline with new smart spout
Section C: 2-year-old dropline vacuum with clear check valve
Section D: 2-year-old droplines, clear check value, no vacuum, gravity line

We obtained results for 2013 at the Uihlein Forest and CCE St Lawrence maple site. For the Parker Family Maple Farm, we also leveraged grant funding provided by NESARE over 2011-2013. Although this report includes **data from CCE St. Lawrence (Figure 1)** and the **Uihlein Maple Research Forest (Figure 2),** the focus is on the Parker Family Maple Farm since it spans three seasons and therefore includes more meaningful results.

Figures 3-5 display the running totals of sap production per tap at seven distinct sugarbushes for 2011-2013.

> Tables 1 and 2 contain information on the year that the tubing system was put in,
> the number of taps it contains, the spout and dropline replacement strategy for each season,
> the gallons of sap collected per taphole for each year, and
> an economic analysis of the sap production figures for each sugarbush.

For each year, the individual sugarbushes were compared to the top performing sugarbush during that season. There is a column depicting the gallons of sap produced per taphole as a percentage of the sap produced by the best sugarbush for that season.

The Parkers also kept track of the cost of materials and labor for replacing droplines or spouts. The internal value of a gallon of sap was determined to be $0.50/gallon when taking into account the value of the finished syrup and processing costs involved in converting sap to syrup. Using these data, it was possible to determine the net profits of implementing a specific dropline or spout replacement as well as the profit that was potentially missed by not implementing the best strategy for that year.

2011 was an excellent season with nearly all of the tubing systems yielding at least 18 gallons of sap per tap with a maximum of 22 gallons/tap in two sugarbushes.

The only system that didn't perform well was the Hatchery, as that yielded just 14 gallons of sap per tap, only 63% the amount from the best performing sugarbush. The Hatchery sugarbush was the only one to not include any type of modern techniques; the Parkers simply put a 'sanitary spout extension' on the end of an old dropline and spout, which had been considered a best practice until about 5 years ago. Based on other research, we expect that this would perform better than just an old spout and dropline, but it greatly underperformed all other strategies that included using check valves, new clear spouts, and/or dropline replacements.

In this (2011) season, the two best performing sugarbushes had check-valve spout adapters on one-year-old droplines and new clear spouts on new droplines.

The Parker's experience with the Hatchery sugarbush provided solid evidence that using one of the old techniques is simply too expensive to implement. Considering that the Hatchery only produced 63% of the amount of sap as the top-performing sugarbush, the Parkers essentially missed out on $3.90 worth of syrup from each taphole had they had put in a new spout and dropline. With over

3,000 taps in this sugarbush, the potential profits missed totaled over $12,000. Since they used the Hatchery sugarbush in 2011 as a 'control', it proved to be an expensive research project!

2012 was a difficult season for maple syrup production in northern NY and much of the northeast. The temperatures reached nearly 80^{O}F for nearly a week in the middle of March, causing almost all of the taps in the region to quit well in advance of the normal ending time. Three of the sugarbushes stopped producing sap during this weather, yet four of them were able to continue producing sap into early April.

In fact, the Hatchery sugarbush, which produced the lowest yields in 2011 with sanitary tip extensions, produced the most sap per tap with new spouts and drops in 2012, surpassing all other sugarbushes in the last week of production.

Other sugarbushes that continued to produce sap into April had either brand new droplines or 1 year old droplines with clear polycarbonate spouts.

Although the Hatchery sugarbush produced the greatest yields, the net profit was the highest on the Recore sugarbush. The Parkers had replaced the droplines in the Recore sugarbush the year before, so the droplines were only 1 year old and they only had to spend $0.18 on a new clear spout compared to $1.53 for a new spout and dropline in the Hatchery sugarbush. Although Hatchery did produce an extra 2 gallons of sap, the fact that they spent less money in Recore made it slight more profitable by a margin of $0.35/tap.

2013 was another great year for syrup production. The season was interrupted with a long cold spell in March, yet relatively cool weather persisted throughout the month of April, leading to a long season of sap flow.

One of the most interesting results was the tremendous output of the Southwoods sugarbush. As the name implies, Southwoods is on a south facing slope; it contains some of the healthiest trees that usually produce very well, yet the southfacing aspect makes is vulnerable to warmups that hasten the taphole drying process.

In 2011 and 2012, Southwoods performed relatively well with check-valve spout adapters on relatively old droplines, producing average results in 2011 and the second best results in 2012.

For 2013, they replaced the droplines and used regular clear polycarbonate spouts. This resulted in a staggering increase in sap production, catapulting Southwoods to the front of the pack. However, they spent $1.52 to install new spouts and droplines in Southwoods yet only spent $0.18 for a new clear spout in the Atwood sugarbush, since they had replaced the droplines there the previous year. Atwoods produced 2 gallons less sap than Southwoods, but since they invested much less time and money in the Atwood sugarbush, it wound up being more profitable than the Southwoods sugarbush by $0.35/tap.

CONCLUSIONS/OUTCOMES/IMPACTS

This project helped to reinforce several guidelines for maintaining optimum yields from maple tubing systems:

- New droplines and spouts produce excellent yields, but perhaps not the highest profit
- Producers are losing income if they just use very old droplines and spouts.
- It is important to use a new spout every year though the type of new spout on new droplines does not seem to matter
- Check-valve spouts may improve yields on old (more than several years) drops, but evidence is not clear; more research needed.

- The cost of drop replacement may not be offset by increased yields if the droplines are relatively new (less than 3 years old). The breakeven period for replacing droplines is likely a few years, though more research is necessary.
- It is very difficult to get reliable information from the type of comparisons producers are able to do by comparing a small number of stands. To compare treatments for whole stands, we first need to "calibrate" stands for several years to ensure that the differences in yields can be attributed to a certain type of spout or dropline replacement and not other factors.

OUTREACH

In October 2013, we conducted three workshops at sugarbush locations to highlight this research project and demonstrate cost-effective techniques for maintaining high yields in a vacuum tubing system. The locations included the CCE St Lawrence County Extension Learning Farm, Moon Valley Maple at Titus Mountain, and Parker Family Maple Farm. All of these workshops were well attended with over 200 producers participating, though we had to cancel scheduled workshops in Lewis County and at the Uihlein Forest due to low registration.

Results were also presented at many conferences and workshops in 2014 that maple producers attend, including the NYS Maple Conference held in Verona and regional maple schools in Lowville, Gouverneur, and Brushton. Two articles were submitted to The Maple News describing outcomes from this research project.

NEXT STEPS

Many maple producers are now replacing droplines on a regular basis, yet they don't yet know how often that should be. At the Uihlein Forest and the Parkers we will continue to record the amount of sap coming from each sugarbush to determine if replacing droplines is necessary every year or if it can be done every 2-4 years.

It is well known that sugarmakers will get a big boost in sap yield by replacing droplines every year, yet it's not clear whether or not that will be a cost-effective strategy, given the high labor and material cost of doing so. However, replacing droplines that are more than 4 years old will increase sap yields enough to offset the costs of replacement.

We also need to determine more cost-effective ways to clean tubing in order to minimize the amount of time, money, and resources that is used to replace the droplines so often. UVM and Cornell currently have a joint research project underway examining modern tubing cleaning methods and the effect it has on sap yield.

ACKNOWLEDGEMENTS

This research was supported by the Northern New York Agricultural Development Program (www.nnyagdev.org) and Northeast SARE (Sustainable Agriculture Research & Education).

PUBLICATIONS

Farrell, M. 2014. Parker Family Maple Farm Completes Research Project on Spout/Dropline Replacement Strategy. The Maple News. January 2014.

Farrell, M. 2014. Determining the value of sap you produce: how to do it and why it matters. The Maple News. February 2014.

CONTACT:

Michael Farrell, Ph.D.
The Henry II and Mildred A. Uihlein Director of The Uihlein Forest
Cornell University Department of Natural Resources
157 Bear Cub Lane, Lake Placid, NY 12946
mlf36@cornell.edu
http://maple.dnr.cornell.edu
Office: (518) 523 9337 Cell: (518) 637 7000