Increasing Syrup Production by Re-tapping During the Sap Season

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Production yield of maple syrup is directly correlated with seasonal weather patterns and tapping procedures. Changes in climate have altered weather patterns during the maple tapping season and pose a threat of impacting maple producers' yields. Recent maple sugaring seasons have seen increased amounts of thawing earlier in the winter, followed by extended freezes and later thaw-outs. For example, the 2018 maple season saw a thaw that allowed sap to run at the end of February that was followed with a cold period with slowed sap flow for a few weeks (Orefice 2018).

This flux in weather across the maple season has extended the duration of the sap season and warmer weather earlier in the season can increase microbial growth, slowing the flow of sap in a taphole. Producers are challenged to capture both early and late runs and must try to anticipate future weather patterns to optimize their sugar yield. Maple producers who tap earlier in the season risk the chance of their taphole drying up due to microbial plugging later in the season when the sap is still flowing. This can force a producer to consider re-tapping their trees to extend their production. However, solid evidence to support the effectiveness of this method was not previously available. Producers who wait to tap risk missing out on early season high quality sap and productive runs that could be a significant portion of the sap season. Either scenario risks the chance of losing out on profits in a maple sugaring operation. Choosing the optimum time to tap is uncertain and it is impossible to predict weather patterns for the maple sap season.

Work done at the Uihlein Maple Research Forest in Lake Placid during the 2018 and 2019 maple syrup season looked at timing of tapping to best capture the most amount of sap. During this study it was found that trees tapped in late March did not yield as much syrup since they missed early sap runs. Trees tapped in January were able to capture early season sap runs but yield diminished slightly near the end of the season due to microbial plugging (Orefice, 2018).

If a maple producer were to tap earlier in the winter, they could come back later that same season and re-tap by moving the spout to a new taphole or add an additional tap on a different drop line to capture maximum sap yields late in the season. This would allow a producer to more sap over a longer season. If the re-tapped hole were directly above the preliminary taphole, less damage would be created within the tree by theoretically staying within the same stain column of wood. However, not enough data has previously been collected to determine whether the effort and added cost of re-tapping would bring a return on the investment, and colder climate patterns of

Northern New York present new challenges which have not been studied.

Methods:

With funding from the Northern NY Agriculture Development Program, feasibility of re-tapping maple trees during the sap season was tested in 2019 and 2020 at Cornell University's Uihlein Maple Research Forest in Lake Placid, NY using four treatments (Table 1). Each treatment was replicated three times with five trees tapped for each treatment per replicate. All trees were under vacuum with only one tap per tree, except for the treatments that were re-tapped later in the season. Each tree was taped using 5/16 inch spouts and tubing. Spouts were brand new each season while lateral and dropline tubing had been used for three seasons prior to the start of the project. Installing used tubing was intentional to replicate a more realistic scenario of a sugarbush and would provide a higher inoculation of microbes later in the season.

Treatment one was tapped February 4, 2019 or January 22, 2020 and then pulled and tapped into a new taphole on April 15, 2019 or March 30, 2020, drilled 8" above the initial taphole. This new tap was into new wood that had not been compartmentalized into a dead zone and so, in theory, did not create additional damage within the tree. During the following growing season, the tree would compartmentalize this area of the tree creating a dead zone. Re-tapping was initiated when the slightest reduction in sap flow was noticed (drastically different each season).

Treatment two was also tapped February 4, 2019 or January 22, 2020 with an additional taphole added directly above on April 15, 2019 or March 30, 2020. In this treatment the original spout stayed in the original taphole and a second spout with its own drop line was added to the new taphole.

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Treatment 1: Trees tapped February 4 (2019) or January 22 (2020). Original tap pulled and inserted into a new taphole directly above initial tap, just before sap flow slowed (April 15 in 2019 and March 30 in 2020).

Treatment 2: Trees tapped February 4 (2019) or January 22 (2020) and tap left in the tree all year. Additional tap added directly above initial tap, just before sap flow slowed (April 15 in 2019 and March 30 in 2020).

Treatment 3: Trees tapped February 4 (2019) or January 22 (2020) and left in all season.

Treatment 4: Trees tapped on March 1 (2019 & 2020) and left in all season.

Table 1: Breakdown of experimental treatments.

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Treatment three and four were considered control treatments. Treatment three was tapped February 4, 2019 or January 22, 2020, the same time as treatment one and two but was not re-tapped later in the season. Treatment four was tapped later in the winter on March 1 in both years. This treatment ran the risk of missing potentially earlier season sap runs, particularly in 2020, but could flow better later in the season. Sap volume and sap sweetness was captured for each replicated treatment each time the sap ran.

Results

The sap flow season of 2019 had some small warm-ups starting in early February but these were not significant. Actual heavy sap flow did not start till late March and ended by April 19, barely lasting five weeks. Results of the study from 2019 at the Uihlein Maple Research Forest showed that re-tapping trees with a new taphole or adding a second spout later in the season was not effective for increasing syrup production. Instead, high vacuum and limiting the time tapholes were open proved to be more effective. Oddly, the greatest amount of syrup per tap was produced by control treatment four when the trees were tapped March 1 and not re-tapped; a 25% increase in syrup production over trees tapped in early February and not re-tapped (treatment 3). Trees that had a second dropline and spout added near the end of the season (treatment 2) was the second best treatment, with an 18.5% increase in syrup production over trees that were tapped at the same time but were not re-tapped late in the season. The first treatment where the spout was pulled near the end of the season and inserted into a

brand new taphole produced 5% less syrup per tap even though the spout was in a brand new taphole the last few days of the season. One theory was that the reduction in sap production could be a result of the old taphole acting as a vacuum leak as the old taphole was not plugged. Loss in vacuum was observed during the second year.

Results in 2020 were slightly different but showed similar trends. Significant sap flow started a month sooner in 2020 (end of February compared to end of March in 2019) yet lasted a couple of days longer than the 2019 season. This extension in the heavy maple sap flow season was perfect for testing re-tapping. Again, the most amount of syrup per tap was produced when we waited to tap the trees on March 1 (treatment 4), producing 29% more syrup per tap than trees tapped on January 22. Different in 2020 was that the trees that were tapped on January 22 and then had a second, new tap added on March 30, just before sap flow slowed (treatment 2), produced equal amounts of syrup per tap as treatment four (28% more syrup per tap than not re-tapping). However, even during this longer season, the added work and supplies did not yield more syrup per tap than just waiting to tap (table 2). Instead, a negative gain in value is created once time and materials are factored in. Pulling the spout before sap flow slowed and moving it to a new taphole (treatment 1) provided 19% more syrup per tap than not re-tapping but not as effective as waiting to tap right as the season gets underway. When the spouts were pulled and inserted into a new taphole, loss in vacuum from the old, open taphole was witnessed.

Discussion

At the conclusion of this study the results were not as expected. Even the

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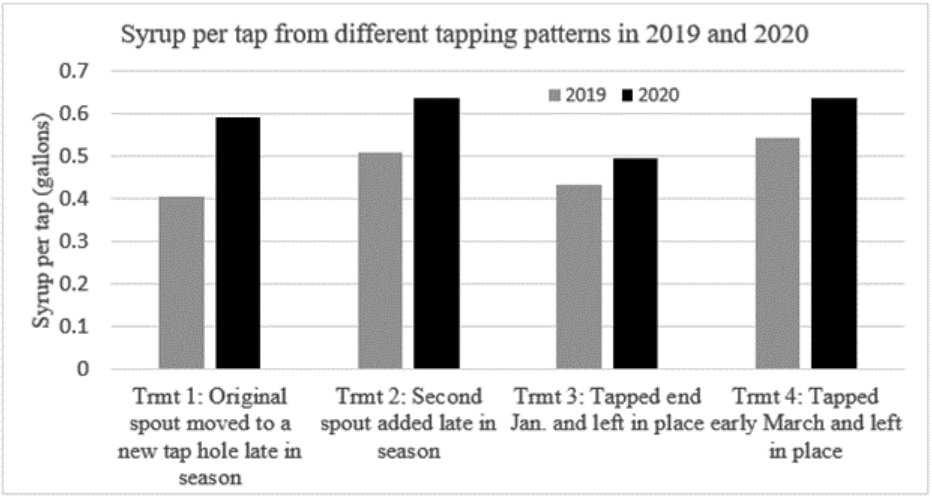

Figure 1: Average syrup production per tap under differing re-tapping (treatment 1 & 2) and control treatments (treatment 3 & 4) at the Cornell University Uihlein Maple Research Forest in 2019 and 2020. Refer to Table 1 for full treatment descriptions.

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longer maple season of 2020 did not prove to show a huge benefit of re-tapping. Although going back and re-tapping by adding a second drop line with a new spout produced an average of 23% more syrup per tap, once time and material was factored into the equation there was a loss of $0.73 per tap (table 2). The added material includes a new spout ($0.20), dropline tubing ($0.25), and an additional T-fitting ($0.30). Although the dropline and T-fitting could be used for a few seasons there is still added time and that dropline must be capped off completely to prevent vacuum loss.

When we waited to tap the trees on March 1, despite missing a few runs, there was still 27% more syrup per tap, an additional $2.94 worth of syrup per tap than trees that were tapped at the end of January, without additional la-

Increase in value of different tapping patterns tested

	Trmt 1: Original spout moved to a new taphole late in season	Trmt 2: Second spout added late in season	Trmt 3: Tapped end Jan. and left in place	Trmt 4: Tapped early March and left in place
Average gallons syrup per tap in 2019 & 2020	0.498 gal.	0.572 gal.	0.464 gal.	0.590 gal.
Additional gallons of syrup per tap than trees tapped at the end of Jan.	0.034 gal.	0.108 gal.	----	0.126 gal.
Additional pounds of syrup per tap than trees tapped at the end of Jan.	0.38 lb.	1.20 lb.	----	1.40 lb.
Value of additional syrup @ US$2.10/lb.	$0.80	$2.52	----	$2.94
Estimated additional labor cost to re-tap*	$1.50	$2.50	$0	$0
Added material cost to re-tap**	$0	$0.75	$0	$0
Total added value of re-tapping after time and material	**$-0.70**	**$-0.73**	**$0**	**$2.94**

Table 2: Comparison of the increase in value created by tapping early and then re-tapping or waiting to tap right before the season started. The only situation where value is gained and not lost is when we waited to tap the trees right as the season was starting. Note that this was tested on used tubing, and no cleaning or check valve spouts were used. Presumably, different results would be achieved if different sanitation methods were used. *Based on a value of $30 an hour with an estimate of 3 minutes to pull a spout and insert into a new hole and 5 min to add an additional dropline with a new spout and tap into a new hole. **Added material costs for adding a second dropline and spout include costs of a new spout, dropline tubing, and a T-fitting.

bor costs of going back out to re-tap (table 2). Pulling the spout and inserting it into a new taphole produced only 7% more syrup per tap on average across the two seasons. Although no additional materials were needed there were still added labor costs. Once labor costs were incorporated there was a loss of $0.70 per tap by going back out to re-tap, less of a loss than adding the second spout. Pulling the spout and inserting it into a new taphole (treatment 3) produced less syrup than trees not re-tapped in 2019 which lowered the two-year average. If you consider the longer 2020 season alone, when an additional 19% of syrup was produced, an added value of $0.75 per tap was achieved after labor costs. Additional seasons of testing are needed to see if this increase in value holds true.

It is important to note that this research was tested on previously used tubing with new spouts each season, which is more than likely why the later tapped trees were more effective than either of the re-tapping procedures. Using new tubing would more than likely produce different results. However, having new tubing is not feasible each year and this study likely represents a more realistic application. This evidence further emphasizes the importance of preserving taphole cleanliness.

Similar results were seen in our 2018 and 2019 timing of tapping research where we tapped trees in January, at the end of February, and in late March. In this study we found that trees tapped at the end of February (close to March 1) had the highest production in sap, however trees tapped in later January were not significantly different in their production volume. The primary reason for not having a production difference is that this study was performed on tubing that was brand new in 2018. Trees tapped in late March missed out on runs and were not as productive.

Although our research showed more syrup per tap was achieved by waiting to tap on March 1 in Northern New York, this is not realistic for most maple operations of any substantial size. Even operations with a thousand taps need to start tapping weeks prior to the start of the season to ensure taps are in before the season starts. As an alternative to re-tapping, it is recommended to increase sanitary practices in your tubing to limit microbe growth within any tapholes drilled well before the season starts. Although not tested in this study, check valve spouts would prevent back-flow of sap and microbes and presumably produce more sap per tap

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on trees tapped early. The additional $0.25 cost for the check valve spout is much cheaper than the labor and material costs of retapping later in the season.

All this research was done within the Uihlein Sugarbush in Lake Placid, NY, a northern forest with extremely cold winters, deep snowpack, and a maple season that starts later than southern maple producing regions. In areas where heavy sap flow starts in January followed by intermittent freeze-thaw cycles, re-tapping could provide more of a benefit than in maple producing regions similar to Lake Placid.

Conclusions

Due to the additional costs, re-tapping was found not to be cost effective or worthwhile for maple producers in northern forests. Waiting to tap the trees closer to the start of the sap season was shown to be more effective for increased sap production and did not require additional time or materials. At this time, it is not recommended to re-tap maple trees unless a clear slowdown of sap flow is observed. If a producer does re-tap, my recommendation would be to pull the spout and re-insert it into a new taphole. Although the increase in production may not be as high as adding an additional new spout, an added cost of additional materials would not be necessary. Instead of retapping, maple producers should consider practices that prevent contamination of the taphole such as check-valve spouts, new droplines, or cleaning.

For More Information:

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Reference

Orefice, J. (2018) "Timing of tapping of maple, birch, in N. Adirondacks" Maple Syrup Digest June/July 2018 p 7.

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