

Tapping Below the Lateral Line for a Sustainable Use of Maple Resource

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Each year, several tens of millions maple trees are tapped in North America for maple syrup production. Over the years, tapping techniques have evolved with a focus on efficiency, profitability, and long-term resource protection. Traditionally, tapping has been done by drilling into the maples in the spring to collect sap and using a tubing system, above the lateral tube to ensure a sufficient slope for the natural flow of sap into the lateral tube. This practice also aimed to prevent sap from flowing back into the taps as temperatures dropped at the end of the day. However, in recent years, some producers have seen the benefit of tapping maples below the lateral line for multiple reasons. The main reason is to access a larger area of healthy wood on the trunk. This is because the maple tree produces a compartmentalization zone inside the trunk following tapping, which isolates the wound left by the tap hole. This internal zone then becomes unproductive for future taps

as sap can no longer circulate normally. In sugarbushes where maple growth is slow, years of tapping above the lateral line have multiplied, or the size and/or number of taps per year were high, the availability of healthy wood for tapping becomes limited, and the likelihood of tapping into compartmentalized, non-productive wood is higher, which penalizes sap collection. By opting for a tapping pattern that respects the necessary spacing of taps from year to year based on their size and number, the likelihood of tapping into compartmentalized wood is minimized. If, in addition, the tapping area is expanded by allowing tapping below the lateral line, the exploitation of the trunk surface is further optimized, ensuring the sustainability of sap collection.

All this, of course, is provided that tapping below the lateral line is as effective as above it. Tapping below the lateral line could create low points where sap can stagnate in the tubing,

possibly promoting microbial growth and penalizing sap collection. This is particularly the case when this sap can return into the tap hole due to the suction caused by negative temperatures. To investigate the effectiveness of tapping below the lateral line, Centre ACER, in collaboration with maple syrup advisors from MAPAQ and the Club d'encadrement technique en acériculture de l'Est, recently conducted and published a study (Rademacher

et al. 2024. Tapping below the lateral line does not reduce maple sap yield or quality. *Trees, Forests and People*, 18: 100712).

As part of this study, sap was collected under high vacuum with 5/16" diameter tubing in two sugarbushes where taps were made at different heights above and below the lateral line for two harvest years (Fig. 1).

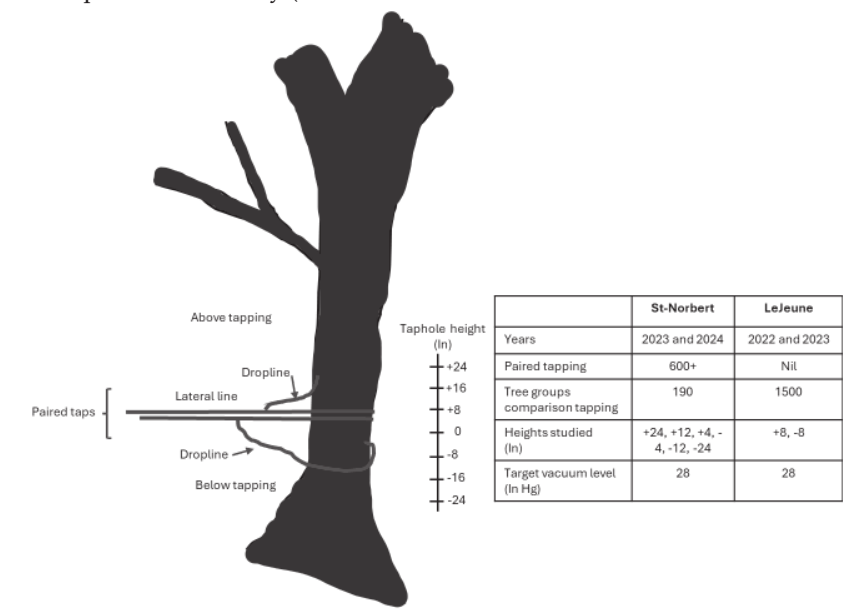


Figure 1. Illustration (not to scale) of the experimental setup at the Centre ACER sugarbush in St-Norbert d'Arthabaska (paired tapping) and the one associated with Club d'encadrement technique en acériculture de l'Est in Lejeune (individual tapping), showing the distribution of tap heights and other conditions of the experiment.

For some systems, one independent line connected taps above the lateral line and another connected taps on the same trees below the lateral line in a pairwise setup. For other systems, a line reached taps above the lateral line for a group of trees (control) while another line of the same system and completely comparable to the control line reached taps below the lateral line for a different but comparable group of trees in a control and treatment setup. The heights of the taps relative to the lateral line were measured (Fig. 2a) and varied depending on the line, the sugarbush (St-Norbert or Lejeune), and the production season (2022 to 2024). All

taps made below the lateral line were done carefully, forming a loop with the drop line to ensure a certain slope for the sap to exit the spout (Fig. 2b). For monitoring the setup, the volume of sap collected daily from each line was measured using calibrated water meters, as well as the °Brix of the sap. Additionally, sap samples were taken in St.-Norbert at different times of the season to measure its pH and microbial contamination level by Adenosine Triphosphate (ATP) bioluminescence. These latter measurements were made to evaluate the quality of the sap from the different treatments.

a)



b)



Figure 2. Measurement of tap height relative to the lateral line (a) and tapping below the lateral line by forming a loop with the dropline (b).

The results showed a very slight increase and decrease in the average volume of sap collected for taps placed at extreme heights, 24 In above and below the lateral line. However, the statistical analysis shows that these differences are marginal and that overall, there is no clear trend of the effect of tap height on the volume of sap collected above

and below the lateral line (Fig. 3a). In these experiments, it was mainly found that maintaining the vacuum at the desired high level of roughly 28 InHg had was more important for the volume of sap collected than the relative tapping height, which confirms the importance of high-level vacuum from previously studies (Lagacé et al. 2019).

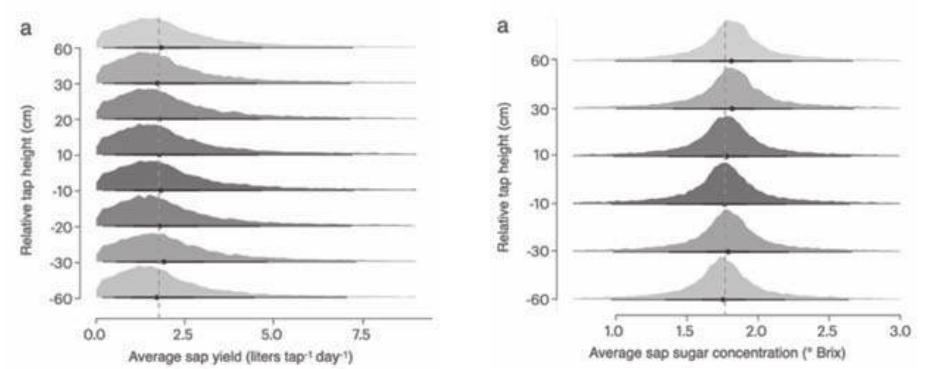


Figure 3. Results on the volume of sap collected (a) and the °Brix of sap (b) based on the different tap heights relative to the lateral line. Black dots show the average treatment effect at all treatment heights and the gray dashed line shows the global mean.

Similarly, the statistical analysis showed a slight increase in the °Brix of the sap for taps placed above the lateral line without this difference being statistically significant (Fig. 3b). The measured differences were small and within the precision of the refractometer and were also consistent with the previously reported trend of a slight increase in sugar concentration depending higher up on the trunk (Rademacher et al. 2023).

microbial counts by ATP bioluminescence and sap pH showed once again that there is little change in sap quality (both ATP and pH) whether tapping above or below the lateral line. It should be noted, however, that the results were obtained for taps placed below the lateral line, forming a loop with the drop of these taps and a high vacuum level. It can be assumed that the loop may have influenced the results obtained without being able to categorically confirm it, as no results were obtained with taps without a loop with the drop line. This effect would need to be confirmed

Regarding the effect of tap height on sap quality, the results (not shown) of

by other trials. Equally, the results may well differ with lower or no vacuum, as this would possibly increase backflow into the tap hole. Under the tested conditions, however, tapping below the lateral line does not significantly affect the quality of the sap collected.

The results of this study show that there is no significant effect of tapping below the lateral line in terms of productivity at the tap (sap volume and °Brix) or sap quality (ATP and pH). Other parameters are, however, highlighted in the study and should be considered when tapping below the lateral line. For example, the length of the drop must be sufficient to reach the parts of the trunk below the lateral line and form a loop with the drop line. Additionally, extra care must be taken when tapping below the lateral line to prevent poor tapping resulting from non-ergonomic operator positioning. A quality tap hole is essential for maintaining high levels of vacuum and optimal sap collection. Finally, the height of the lateral tube and the thickness of the snow cover during the tapping period will impact the decision to tap below the lateral line. For some seasons, it will be more prudent not to tap below the lateral line for these reasons. Overall, the results of this study indicate that there are no major negative consequences to tapping below the lateral line and suggest the possibility of increasing the tapping area to optimize the sustainable exploitation of the maple resource. This project was funded with the participation of the Quebec Ministry of Agriculture, Fisheries and Food through the Canadian Partnership for Sustainable Agriculture.

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