Red maple as crop trees for maple syrup production

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Red maples were not frequently tapped for syrup production in the early 20th century, as their sap tends to have lower concentrations of sugar than that of sugar maple. With production practices at the time, such as gravity sap collection with buckets and boiling unconcentrated sap in relatively inefficient evaporators, this rendered the production of syrup from red maple sap more costly and time-consuming. However, with modern maple production technologies including sap collection with vacuum tubing systems, efficient evaporators, and particularly the use of reverse osmosis to preconcentrate sap prior to evaporation, it is now possible to use red maple as a crop tree for maple syrup production efficiently and profitably.

Unlike sugar maples which grow well in a relatively narrow range of site conditions and climates, red maples are able to adapt to diverse growing conditions and climates. They can be found growing on a wide range of site conditions, from moist soils and swamps, to dry ridges and uplands (Abrams 1998, Walters and Yawney 1990). The native range of red maple is also much broader than that of sugar maple, and extends throughout warm and cool climates of the U.S., from Texas to Florida in the Southeast, through the upper Midwest and New England (Figure 1) (Godman *et al.* 1990, Walters and Yawney 1990). Because of this, red maple is abundant throughout the maple-producing region of the U.S., particularly in its southern and midwestern portions. The genetic and phenotypic plasticity of red maple that enables them to adapt to and thrive under a variety of sites and growing conditions also means that, unlike sugar maple, it is predicted to increase in prevalence in the maple-producing region of the U.S. in forest models of future climate change scenarios (Janowiak *et al.* 2018). In fact, inventories over the past several decades have already documented widespread increases of red maple throughout the eastern US (Fei and Steiner 2007). This means they are likely to be an increasingly important crop species for maple production in the future and a key to ensuring the resiliency of the maple industry in response to changing climate conditions. In addition, maintaining red maple in sugarbushes is one way to help achieve higher levels of biodiversity, a critical factor to support the resilience of these forests to stress.

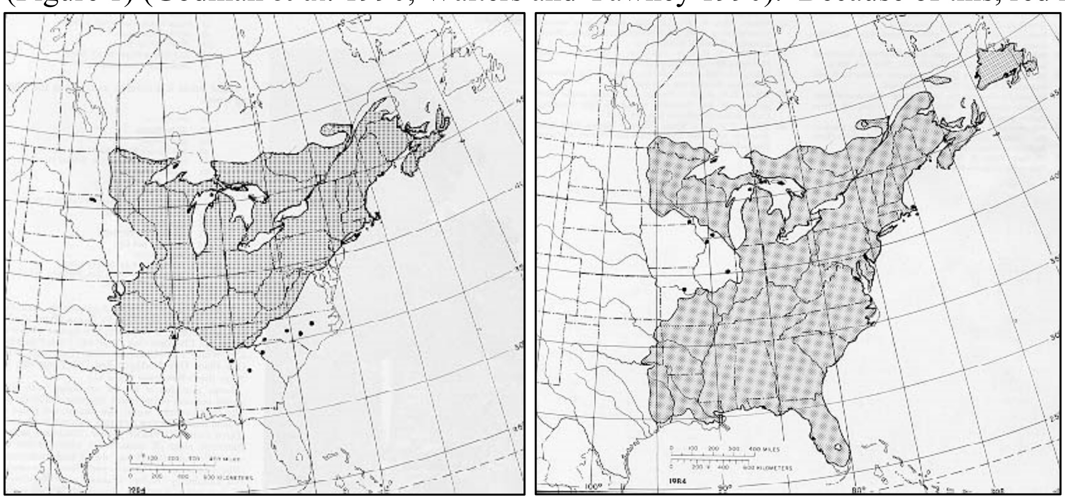

Figure 1. Native range of sugar maple (left) and red maple (right). *From:* Godman *et al.* 1990, and Walters and Yawney (1990).

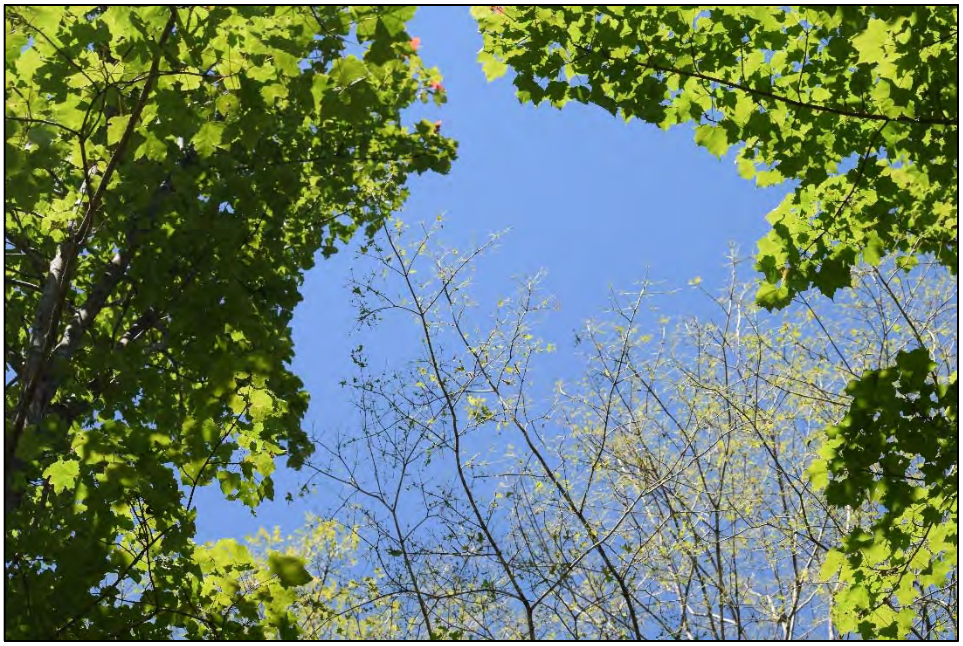

Figure 2. Healthy red maples adjacent to sugar maples defoliated by forest tent caterpillar (*Malacosoma disstria*). Red maples are not a preferred food source for this native pest, one example of how the presence of red maple can help increase the resilience of stands used for maple production. Photo: Mark Isselhardt, UVM Extension.

However, despite its abundance, wide distribution, suitability for efficient maple syrup production, and potential for providing a means to increased production and income, some producers hesitate or decide not to include red maple as crop trees in their operations, even when they are present in the stands they currently tap. There are currently two primary beliefs that exist among maple producers which underlie this decision-making:

1) "Red maple trees have low yields"

Because red maple sap tends to have lower sugar *concentrations* than sugar maple sap, it is often assumed that red maple trees have lower *overall total yields* than sugar maple. However, the lower sap sugar concentrations of red maple are typically accompanied by copious volumes of sap, ultimately resulting in similar (or equivalent) total annual yields as sugar maple. For example, there was no significant difference in the total syrup yields of red and sugar maple trees of the same diameter growing in the same stand using vacuum (28"Hg) and good sanitation and tapping practices (Figure 3). A related belief, that red maple trees stop producing sap earlier than sugar maple, was also not observed in this study. This experiment will be repeated in the 2021 production season to provide additional data on yields and sap flow timing in red maple.

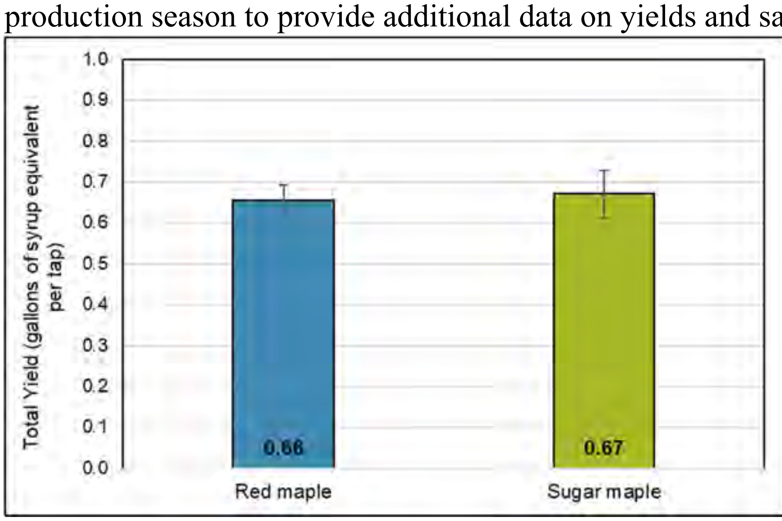

Figure 3. Mean total syrup yield of red (n=20) and sugar maple (n=17) trees from 9.0 to 12.9 inches in diameter during the 2020 production season at the University of Vermont Proctor Maple Research Center. Means were not significantly different ($p < 0.9505$, Wilcoxon Rank Sums test).

2) "Red maple sap produces off-flavored syrup"

Because red maple trees flower several weeks before vegetative bud expansion in the spring (Walters and Yawney 1990), there is also a belief that red maple sap will produce "buddy" off-flavored syrup (an off-flavor typically associated with the late portion of the maple production season when leaf buds begin to initiate expansion) earlier than sugar maples growing in the same stand. There is also some belief that syrup made from red maple sap has generally inferior flavor. However, producer experience as well as pilot experiments conducted with small quantities of sap under laboratory conditions indicate that syrup produced with red maple sap has flavor indistinguishable from that produced with sugar maple sap and does not produce buddy off-flavor any earlier than sugar maple, even after floral buds are observed swelling. An ongoing study at the Proctor Maple Research Center will provide scientific data to more rigorously address these beliefs about red maple and syrup flavor. The flavor of syrup produced simultaneously under identical conditions in commercial evaporators with pure red and sugar maple sap from the same stand will be assessed to determine if there are any general differences in flavor, or any difference in the prevalence or timing of buddy off-flavor.

Although the current evidence to refute the beliefs which deter producers from including red maples as crop trees is fairly strong, currently ongoing multi-season research will solidify the knowledge in this area. This factsheet will be updated with results from that research as they become available.

Other Considerations

Although yields and flavor from red maple are likely similar to those of sugar maple, it should be kept in mind that they are different species with different life histories and optimum conditions for growth and health, and possible differences in their responses to tapping. First, the characteristics that allow red maple to compete on a wider range of sites also mean that silvicultural prescriptions and management strategies differ in relation to sugar maple. Also, the higher volumes of sap produced by red maple necessitate adjustments in mainline size for stands with a large amount of red maple.

Further, red maples are known to be sensitive to injury, and often develop large areas of discoloration (wood that is nonconductive to sap) in response to branch stubs and other injuries (Walters and Yawney 1990). When these occur at an early stage of development, they can coalesce to form large central columns of discolored wood

Figure 4. Example of a large central column of nonconductive, discolored wood (and resulting shallow sapwood depth) in red maple. Limited data suggests this phenotype is not predictable by bark characteristics (Wilmot 2016). Photo: Joël Boutin.

(Shigo 1965). These factors have several potential impacts with respect to tapping and sap collection. First, some red maples can have a small amount of sapwood relative to the central column of discolored, nonconductive wood (NCW) (Figure 4).

This could result in lower sap yields from trees with this phenotype due to simply a lower volume of conductive sapwood, though no data currently exist to support or refute this. The shallower depth of sapwood in trees with this phenotype also increases the chances tapholes will intercept this central NCW, reducing sap yields and also causing the resulting NCW column from the taphole wound to be much larger than that from a taphole drilled into clear sapwood. Tapholes drilled into NCW from previous branch scars or other injuries will also have this result, and so the tendency for red maple to generate large columns of NCW from these injuries could potentially further increase the chances that tapholes in red maples generate larger amounts of NCW. It should be noted, however, that tapholes drilled into clear sapwood in red maples appear to generate similar amounts of NCW as in sugar maple (Wilmot 2016). These factors might ultimately impact the tapping practices required to obtain optimum yields from red maple over the long-term (shallower tapping depths, etc.). Further research is necessary to quantify and assess these factors to enable data-based recommendations.

Questions? Contact Abby van den Berg: Abby.vandenBerg@uvm.edu

Acknowledgements

Funding for this project was made possible by the U.S. Department of Agriculture's (USDA) Agricultural Marketing Service through grant AM190100XXXXG069, awarded to the University of Vermont Proctor Maple Research Center. The contents are solely the responsibility of the contributors and do not necessarily represent the official views of the USDA.

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