

SWEET MAPLES *reprinted from Farming, the Journal of Northeast Agriculture March, 2010*

Any sugarmaker who has spent some time in the woods with a refractometer or sap hydrometer knows that some trees yield sweeter sap than others. Armed with this knowledge, how do we identify the superior trees, short of testing the sap from every one of them? What causes the sap to be sweeter in some trees, or in some stands, and can we do something to influence sap sweetness? These are questions that sugarmakers and researchers have pondered for decades, and the answers could have a significant effect on the economics of a maple operation. Unfortunately, while what we know about this subject could fill a refractometer cup, what we still don't know could fill a four gallon bucket.

In the 1956 publication "Variation in sugar content of maple sap," Fred Taylor demonstrated that there were such things as sweet trees. Taylor, one of the founders of the UVM Proctor Maple Research Center, sampled thousands of maples in nine Vermont sugarbushes over a 12 year period and concluded the following: individual trees in a stand may differ by 2% or 3% sap sugar, and individual sugarbushes may differ from each other by as much as 2% sap sugar. Despite these differences, and despite the factors (most of which are still unknown) that cause season-to-season variability, as well as within-season variability, the trees in a sugarbush that have the highest sap sugar content one year relative to their neighbors will usually have the highest sugar content every year. The same is true for whole collections of trees in a sugarbush.

There have been numerous studies that have used physical characteristics of sugar maples in an attempt to find clues that would aid in the identification of sweet trees. Many variables have been considered, e.g. growth rate, dates of leaf opening and leaf fall, crown width and live crown ratio. None of these variables has proved to be particularly useful as an indicator of sap sweetness. A study of characteristics of young sugar maples by Fred Laing, former director of the Proctor Center, and statistician Diantha Howard concluded that only sap testing, which can be started at a very early age in sapling-sized trees, gave reliable answers as to whether or not a particular young tree would be a sweet tree. Sap testing of young trees is an important for determining which trees to thin and which to save as future crop trees.

One theory about sap sugar that has persisted among maple producers is that "stressed" trees tend to have sweeter sap. Stress could be interpreted in many ways—trees that show considerable branch dieback, that are in stands grazed by cows, that have been defoliated in the summer, or that grow in nutrient poor soils are all examples of what could be considered stressed trees. In the early 1990's I led a study of seven Northern Vermont sugarbushes in which stands of varying states of health, soil nutrient status, density, and tree age were examined. We sampled the sap from 116 trees multiple times per year for 3 successive years. We found that branch dieback was not related to sap sugar content, i.e. trees with poor crowns were

no more and no less sweet than their healthy neighbors. We also found no relationship between sap sweetness and canopy “transparency,” which is a measure of the leaf density in the crown. This finding has been supported by other researchers in additional studies, but it is somewhat counterintuitive when one considers that the sugar we remove in the spring was manufactured in the leaves in the previous growing season, and greater leaf density should lead to more stored sugar. Tree diameter was a fair predictor of sap sweetness; for example trees that averaged over 3% sap sugar were generally over 24 inches dbh. The individual sugarbushes ranged from an average of 1.6% sap sugar at the least sweet site, to 2.6% at the sweetest site. The stand with the most trees per acre was the least sweet and the site with the fewest trees was the sweetest—which follows the widely observed trend for more open grown trees with large crowns to have higher sap sugar than trees in a closed canopy with small crowns. For the stands that were intermediate between the densest and least dense, there was no relationship between trees per acre and average sweetness. Stands with poor soil nutrition were no more or less likely to be sweet than stands on richer soils, and two years after fertilizing portions of each stand we did not find any improvement (or any change at all) in sap sugar relative to unfertilized plots in these stands. Other fertilization studies have shown little or no improvement in sap sugar, although fertilization has been shown to improve the vigor of trees in some declining stands, thereby improving the long term sustainability of these stands for continued sap production.

This brings us back to the 4 gallon bucket of things we don’t know about sap sweetness. While it is possible to identify the sweet trees through sap testing, the reasons why certain trees are sweet may be mostly genetic, and finding those genes may be no easy matter. Anatomical examination of sweet and non-sweet trees, such as measurement of the ray cells that store starch, may be of some limited usefulness (in the lab, not in the field) in helping to understand sap sugar content. The total amount of sugar stored in the tree, as indicated by root starch or other tests, may not be closely related to the variation in the amount of sap sugar in the spring. This column did not discuss the year-to-year variability of sap sweetness over a wide range of locations, whereby many sugarmakers will remark “it’s a sweet year” or “sweetness is very low this year,” which is an interesting and poorly understood subject, nor did it discuss the possible reasons why one tree will yield twice the volume of sap as a neighboring tree. As always, there are more maple mysteries for us to ponder.