



## PROCTOR MAPLE RESEARCH CENTER

### FOOD SAFETY / SAP & SYRUP CHEMISTRY

**Effects of Air Injection on Syrup Chemistry, Quality, and Flavor:** Air injection is a relatively new maple syrup manufacturing technique. We compared syrup produced in paired evaporators – one equipped with air injection and one without. In general, syrup produced with air injection was lighter in color, but did not differ in most respects from syrup produced without air injection. *van den Berg, Isselhardt, Perkins* USDA – Ongoing

**Characterizing and Reducing “Metabolism” Off-Flavor in Maple Syrup:** There is currently no identifiable cause for “metabolism”, an off-flavor which occasionally develops in maple syrup, which reduces its marketability. Our research aims to identify the compounds in maple syrup that are responsible for metabolism off-flavors. Once identified, it may be possible to develop better strategies to cope with or reduce the occurrence of this problem. *Perkins, van den Berg, Isselhardt*. USDA – Ongoing

**Adulteration and Contamination in Maple Syrup:** Lead can be a contaminant of maple syrup. Our goal is to reduce lead levels in syrup by identifying the sources of lead in maple equipment and altering production practices to reduce contamination of sap and syrup where it occurs. We are also interested in identifying natural levels of paraformaldehyde in maple sap and the influence of PF use on the level of formaldehyde in the finished product. Finally, we are developing methods to detect various types of adulteration of pure maple syrup. *Perkins, Wilmot, van den Berg* USDA – Completed

### PRODUCTION OF SAP AND SYRUP / MAPLE EQUIPMENT

**Comparison of Tubing and Installation Methods in a Field Environment:** This study compares the materials and methods of vacuum tubing installations of three equipment manufacturers. The participants were assigned approximately 200 taps within the sugarbush at The Proctor Center and asked to install a tubing system. Sap quantity, quality, longevity, maintainability, and costs are being recorded with the goal of deciding which is the most efficient and cost effective. The study is currently in its third year. *Perkins, Stowe, Isselhardt*. NAMSC, CCMSMA – Ongoing

**Strategies for Maintaining High Sap Yields in Vacuum Tubing Operations:** After high production rates for a few years, sap yield typically steadily decreases in maple tubing system operations. The reasons for this are not clearly understood. This project seeks to identify economical methods to maintain high sap yields over the lifetime of tubing systems using various equipment replacement and management strategies. *Perkins, Stowe, Wilmot* HATCH, EXT, NAMSC, CCMSMA – Ongoing

**Sugar Sand, Scale, and Evaporator Cleaning:** Strong chemicals (primarily acids) are being increasingly used to clean scale (niter) deposits from evaporators. This project is investigating the chemical nature of maple niter as well as developing and evaluating possible methods to reduce the use of chemicals in cleaning. *Isselhardt, van den Berg, Stowe, Perkins* USDA – Ongoing

**High Vacuum Effects on Sap Production and Wounding:** Sap production is linearly related to vacuum level: higher levels of vacuum yields higher sap production. Vacuum level (up to 21” Hg) does not significantly affect sugar content or sap chemistry, and does not increase the level of internal damage in trees. *Perkins, van den Berg, Stowe, Wilmot, Isselhardt* USDA – Completed

**Effects of Forest Fertilization in Sugarbushes:** “Fertilization of Sugarbushes” was published in October 2004 which describes fertilization research conducted by PMRC staff between 1988 and 2003, as well as offering instructions and recommendations for sugarmakers who wish to fertilize their land. The brochure contains information about the potential geographical range of nutrient-deficient soils, tips on evaluating stand nutrition by recognizing key indicator plants, and considerations for sugarmakers who wish to certify their syrup as organic. *Wilmot, Perkins* USDA, FREEMAN FDN, NAMSC – Completed

**Evaluation of Small Spouts:** This study compares sap production and wounding using normal and small spouts. Under most conditions, sap yield was roughly the same for either size spout using vacuum, but was slightly less for small spouts with gravity flow. In large trees under gravity or vacuum, wood discoloration from small taphole wounds was somewhat less than internal damage caused by large tapholes. *Perkins, Wilmot, Stowe, van den Berg, Isselhardt* CCMSMA, NAMSC – Completed



**The Timing of Tapping under Gravity and Vacuum.** During the last 2 decades, periods of above-freezing temperatures in January and February have caused many sugarmakers to consider abandoning their traditional March tapping date. Two separate studies, one with gravity sap collection and one with sap collection under high vacuum, were conducted to study the effects of differential timing of tapping on overall yields. Gravity collection showed similar seasonal yields for taps placed either February 1 or March 1 during the 2000-2002 seasons. Vacuum collection, studied for the first time in 2006, showed that sap could be collected for over 12 weeks from some tapholes. Yields from taps placed in late January exceeded those from taps placed in late February or mid-March during this unusually warm winter. Continued research in future years will again examine the effects of differential tapping dates using vacuum collection. *Wilmot* EXT, AES, NAMSC – Ongoing

**Vented versus Closed 5/16" Tubing:** Venting of tubing systems was recommended early in the history of tubing development. While sap runs faster through vented compared to non-vented tubing systems, venting of tubing resulted in a 32% loss of sap production, probably due to faster drying of tapholes and loss of natural vacuum. *Stowe, Isselhardt* NAMSC – Completed.

**Optimum Number of Spouts per 5/16" Line under Vacuum:** We compared sap production from tubing installations with 1, 5, 10, and 15 spouts per 5/16" line. Single tap setups produced the greatest amount of sap, with lesser amounts from the 10 tap (20% reduction) and 15 tap (28% reduction) lines. Length of lateral line appears to have little effect on vacuum transfer as long as the number of taps on that line are kept within recommended levels. *Stowe, Isselhardt, van den Berg, Perkins* NAMSC – Completed

### MAPLE PHYSIOLOGY & GENETICS

**Meteorological Influences on Stem Pressure and Sap Flow in Sugar Maple:** Cold nights and warm days will always provide the conditions necessary for good sap runs, but changes in global climate could affect the timing and success of sugaring in the Northeast. Using electronic sensors, we can measure air, wood and soil temperatures, as well as stem pressures and sap flow in sugar maple. Real time data are shown our web site each spring. Our collection of data contributes to our long term goal of constructing computer models relating sap flow to meteorological conditions. *Wilmot, Perkins* AES, EXT – Ongoing

**Relationship Between Tapholes on Opposite Sides of a Tree: What Area of a Tree Contributes Sap to a Taphole?** Using electronic sensors which can measure pressure in different parts of the trunk, we experimented with trees of various sizes to determine the timing and extent of sap movement toward an open taphole. Results have shown that the general behavior of sap movement is similar under both gravity and vacuum, but vacuum draws sap from a larger area of the wood, and affects areas of the trunk more rapidly than gravity. Results suggest that there is considerable sap movement in a horizontal direction, therefore tapholes on opposite sides of the tree may draw from the same area of wood depending on duration of the flow event. *Wilmot* UVM EXT AES – Ongoing

**Fall Coloration in Sugar Maple:** While important economically and scientifically, the process of fall coloration in sugar maple has not been widely studied. Our current research aims to improve the basic understanding of the process and identify factors that may be valuable in predicting the timing and quality of fall coloration. Specifically, anthocyanin pigments and their function and relation to physiological processes during fall senescence will be examined. *van den Berg* AES – Ongoing

### FOREST ECOLOGY & HEALTH

**Effects of Ice Storm Damage on Carbohydrate Reserves, Growth, and Survival in Sugar Maple:** The Ice Storm of 1998 caused extensive damage to sugarbushes in New England, New York, and Canada. The loss of crowns resulted in depleted carbohydrate reserves in heavily damaged trees for two-three years after damage. The amount of carbohydrates stored in wood and root tissue was related to the amount of crown loss. This research is aimed at improving knowledge of how crown loss affects tree carbon reserves, sap production, growth, and survival in ice-storm-affected areas. *Perkins, Wilmot, van den Berg* VTFRP – Completed

**Effects of Global Change on the Maple Sugaring Industry:** This research examined the effects of global warming on timing of sap production in the northeast. Surveys of sugarmakers were used to determine changes in season open, season close, and duration of the sugaring season. Throughout the northeast U.S., the sugaring season is starting significantly earlier than it did 40 years ago, and the duration has decreased by an average of 10%. *Perkins, Wilmot* HATCH, NAMSC, DOE EPSCoR – Completed

**Acid Rain Effects on Forested Ecosystems:** Forest decline was a major concern throughout the 1980's and in the early 1990's. While the Clean Air Act of 1990 addressed some aspects of pollution, acid rain does continue to fall. Long-term vegetation plots on Camels Hump Mtn. are measured periodically to determine forest health and growth. *Perkins, van den Berg* EPA – Ongoing

#### UVM PMRC Scientists & Staff

*Timothy Perkins, Ph.D. – Director / Research Associate Professor*

*Brian Stowe, B.S.F. – Sugaring Operations & Lands Manager*

*Abby van den Berg, Ph.D. – Research Associate*

*Mark Isselhardt, B.S.F. – Research Technician*

#### Affiliated Staff

*Miriam Pendleton, B.A. – UVM Vermont Monitoring Cooperative*

#### UVM Maple Extension Specialists

*Timothy Wilmot, M.S. – PMRC, Underhill Ctr.*

*George Cook – Morrisville*

#### Questions? Send mail to:

*Proctor Maple Research Center, P.O. Box 233, Underhill Ctr, VT 05490*

*Phone: (802)899-9926, Fax: (802)899-5007, email: pmrc@uvm.edu*

<http://www.uvm.edu/~pmrc>



#### FUNDING SOURCE

NAMSC = North American Maple Syrup Council EPA = US Environmental Protection Agency  
USDA = US Department of Agriculture CCMSMA = Chittenden Co. Maple Sugar Makers Association  
HATCH = USDA Hatch AES = UVM Agricultural Experiment Station EXT = UVM Extension  
VTFPR = Vermont Department of Forests, Parks & Recreation