An investigation of some factors that may influence the development of fall foliage color in Sugar Maple

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The display of fall foliage color by sugar maple (Acer saccharum) in the northeast is valued highly by both residents and non-residents. In addition, this yearly event is responsible for generating much of the region's fall tourism revenue, including an estimated $140 million for the state of Vermont alone. Despite its many benefits, few substantiated data exist regarding the exact mechanisms of fall color development. If available, data relating to the causes of differential timing and brilliance of fall foliage color could be used to make more accurate predictions, and to possibly develop procedures for manipulating fall color development on selected trees.

Most of the basic physiological processes involved in color development are known. The chlorophyll molecule begins to break down in response to lower temperatures and shorter daylengths associated with the approaching winter months. As chlorophyll breaks down, the yellow and orange carotenoid pigments are revealed. These yellow pigments are present in leaves during the entire growing season, as they aid chlorophyll in light absorption. Their presence is masked, however, by the green chlorophyll pigment. What is unclear is the cause for the formation of the red anthocyanin pigments during the late summer and early fall. These pigments yield the highly valued mosaic of colors in fall leaves of species such as sugar maple. This part of the process of fall color development, the development of anthocyanins, was the focus of this study.

From September to October 1998, foliar samples were collected from 10 sugar maple trees located at the Proctor Maple Research Center in Underhill, Vermont. Samples were analyzed for micro and macronutrient concentrations, carbohydrate content and the extent of color development. Then, simple regression was used to detect relationships between the concentrations of leaf constituents and the extent of leaf coloration.

Leaves that had high percentages of red (anthocyanin) pigment also had high concentrations of aluminum and iron, and low concentrations of starch and xylose. Leaves that were mostly green exhibited the opposite relationships with these leaf constituents. Although the statistical relationships were strong, no conclusions could be drawn from these data. Because the analysis measured the strength of the relationship between the color of a leaf and it's chemical composition at the time of collection, the data do not provide information on whether a particular constituent would be useful in the prediction of how brilliant a particular tree's foliage might be. Thus, a far more rigorous study was necessary. The subsequent study focused on the variables identified as important in the initial study at the Underhill site, and was conducted at the US Forest Service Northeastern Research Station in South Burlington, Vermont from June to November 1999. Details of the study can be found in "Fall Foliage Color Development in Sugar Maple" by A.K. van den Berg, a master's thesis located in the Research Annex of the Bailey-Howe library at the University of Vermont.

This project was made possible by support from the Vermont Monitoring Cooperative, the Proctor Maple Research Center, the US Forest Service Northeastern Research Station and a SUGR/FAME grant from the University of Vermont. Completion of this project partially fulfilled requirements for a senior honors thesis for the forestry program of the University of Vermont School of Natural Resources.