Journal of Ecological Research, **6**, 25-28 (2004)

SUGAR-WATER DENSITIES IN RELATION TO HEIGHT AND DIAMETER OF SUGAR-MAPLE TREES (*ACER SACCHARUM*) AT THE RAYSTOWN FIELD STATION

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ABSTRACT

The purpose of this study was to examine whether height or diameter of sugar-maple trees (*Acer saccharum*) is correlated with the sugar density of the maple sugar at the Raystown Field Station. Two studies similar to this were conducted six years ago to determine if a correlation existed. The results conflicted, so this was a follow up study to further test these findings. This study determined that there is no significant correlation between sugar density and tree height ($P = 0.069$) or tree diameter ($P = 0.145$). These findings show that tree height and tree diameter cannot be used as factors to predict sugar density.

Keywords: Acer saccharum, *maple tree, sugar density, tree diameter, tree height*

INTRODUCTION

Several years ago, two similar studies (Books et. al. 1998, Long et. al. 1998) were conducted at the Raystown Field Station to determine if there was a correlation between sugar-water concentration and tree height or diameter in sugar maple trees *(Acer saccharum).* Sugar maple trees (also known as hard or rock maple) are native to eastern North America where they are found on moist wooded slopes. They are commercially important as a source of maple syrup and lumber for furniture and flooring and ecologically important as food for deer, birds, and squirrels (Anonymous 2000). Long et. al. (1998) found a significant correlation between sugar-water density and tree diameter, whereas Booker et. al. (1998) did not. Additionally, Booker et. al. (1998) found an insignificant correlation between sugar-water density and height of the tree. The purpose of this study is to test the findings from these studies. The purpose of both previous studies was to determine if there was a size dependence of sugar density so one could visibly determine the fitness of a tree to produce sugar-water for maple sugaring. Our hypothesis was that both tree height and diameter would be significantly correlated with the sugar-water density because the larger the tree, the greater the metabolic need should be and therefore the higher the sugar water density produced. The findings of this study could determine the best type of trees to tap for maple sugaring, since high sugar-water concentrations are optimal for maple syrup making because they require less time for boiling.

FIELD SITE

This study was conducted on March 23, 2004 in the sugar grove at the Raystown Field Station on Raystown Lake in Entriken, Pennsylvania. The grove is a specific area lying between the Field Station Sugaring House and Raystown Lake. Soil in this study area is characterized as fine-loamy, mixed, and mesic (Long et. al. 1998). Additionally, a seasonal small stream runs through the center of the grove that begins at a pond behind the sugaring house and empties into the lake. On the day of our study it was a windy afternoon with mild temperatures and a partly cloudy sky, and the stream was actively running.

METHODS AND MATERIALS

We randomly sampled 27 trees in an area located between the Grove Farm building and border of Lake Raystown. Some trees were unable to be sampled because the taps had already run dry. We used a refractometer to sample the sugar water from the tree taps that were already in place from maple sugaring. Samples were taken from the taps because the sugar density of the water in the buckets could have been affected by evaporation or rain water dilution. Drops of sugar water fell freely from the taps onto the reading area of the refractometer which presented the sugar water density as percent sugar. After each reading the refractometer was cleaned with deionized water and moistened kim wipes and dried with a dry kim wipe. The refractometer was then calibrated to zero. Three measurements of sugar water concentration were taken from each tap and averaged.

Tree diameter was measured using a diameter tape that gave the girth of the tree in metric centimeters. Measurements were taken approximately 4 feet above ground level.

The height of the tree was found using a clinometer at approximately 25 feet from the tree. The distance from the tree to the observer was measured using a meter tape. Using the right hand to hold the clinometer so that the eye scope can be viewed by the right eye and the viewing window directed to the left, the clinometer value is read using both eyes. The measurement is obtained by aligning the line in the viewing window with the top of the tree. The calculation used to calculate tree height was

(distance from tree) x (percent value)

where the percent value is read from the right side of the clinometer scale (multiplied by 100) and distance from the tree was measured with a meter tape. All data was collected on the same day so that varying weather conditions could not contribute to error.

Regression analysis using Minitab® was used to evaluate the effects of tree height and tree diameter on sugar-water density. P-values less than 0.05 were considered significant.

RESULTS

Neither maple tree height nor diameter was significantly correlated with maple sugar water density (Table 1; Figures 1 and 2). P-values for both correlation analyses were greater than 0.05 (tree height P-value = 0.069, F-Value = 3.60223, and $r^2 = 0.126$; tree diameter P-value = 0.145, F-Value = 2.26858, and $r^2 = 0.083$).

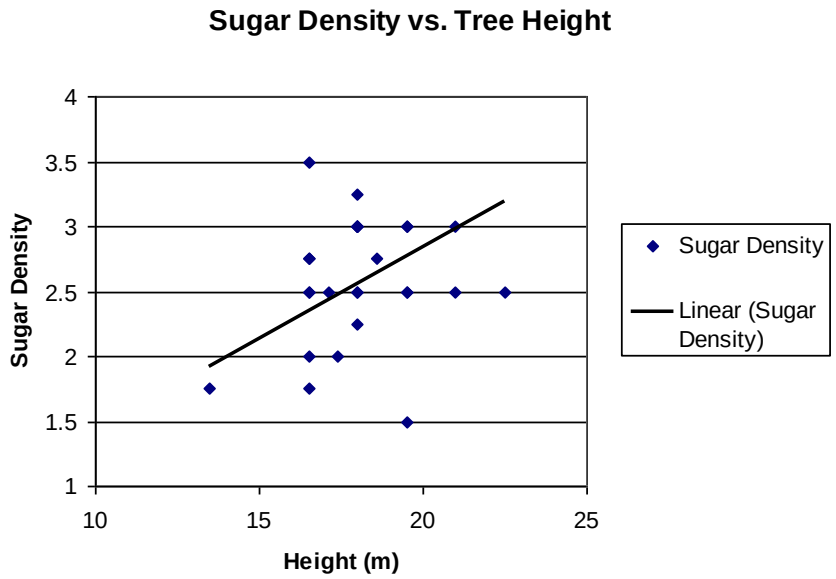

Figure 1. Sugar water density vs. maple tree height. Correlation was not significant (P > 0.05).

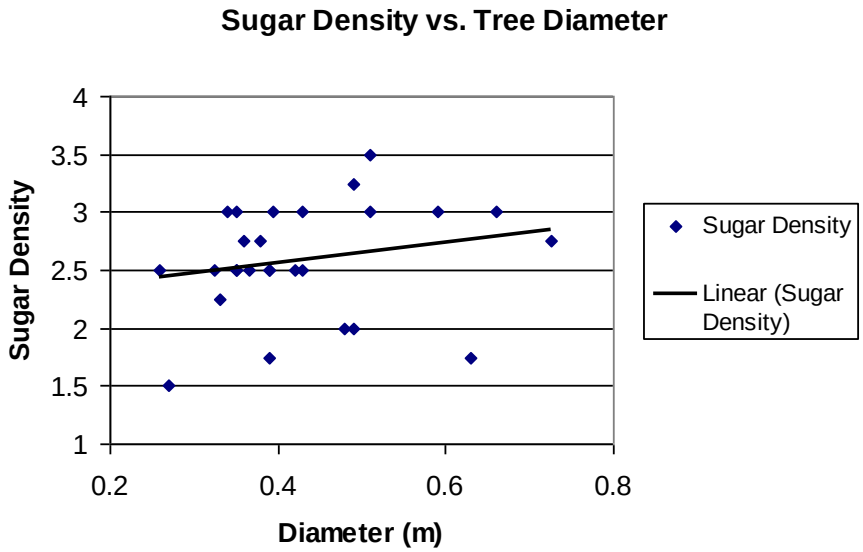

Figure 2: Sugar water density vs. maple tree diameter. Correlation was not significant (P > 0.05).

DISCUSSION

We found no significant correlation between sugar density and tree height or between sugar density and tree diameter, meaning that neither factor can be used to predict sugar density of sugar maple trees at the Raystown Field Station. This study agrees with the results of a similar study by Booker, et. al. (1998) who found no significant correlation between maple sugar density and tree height. However, it contradicts the findings of Long et. al. (1998), who found a significant correlation between maple sugar density and tree diameter.

One fault in this study may have been the time at which it was conducted. It was late in the sugaring season and many of the taps that we attempted to randomly sample were dry. This study was conducted during the same week in which the previous two studies had been conducted, but one study did reference problems with taps being dry.

An additional follow-up study would be beneficial, but conducted earlier in the season or at the sugaring season peak to more accurately analyze.

ACKNOWLEDGEMENTS

We would like to acknowledge Dr. Charles Yohn, Director of the Raystown Field Station for his assistance in explaining procedure and supplying materials for this study, and also Dr. Douglas Glazier, Professor of Ecology, for his guidance and supply of materials.

LITERATURE CITED

Anonymous. 2000. Why is sugar maple declining? Journal of Forestry. **98:** F6-F7.

Booker, G., S. Topping, D. Hornyak, and B. Ketrick. 1998. Sugar-water density is unrelated to the size of sugar-maple trees (*Acer saccharum*) at the Raystown Field Station. Journal of Ecological Research. **1**: 1-5.

Long, T., M. Wolfe, M. Moyer, and H. Sankey. 1998. Sugar-water densities in sugar-maple trees (*Acer saccharum*) at the Raystown Field Station. Journal of Ecological Research. **1**: 15-19.