EFFECTS OF NEIGHBORING NON-MAPLE TREES ON SUGAR MAPLE TREES (*ACER SACCHARUM*)

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ABSTRACT

We hypothesized that the nearest non-Sugar Maple (SM) Tree had an effect on the concentration of sugar in Sugar Maple trees because of interspecific competition. Recently, the Sugar Maple trees were tapped and the sugar water was collected. After harvesting, the concentration of sugar was measured through the use of a refractometer. The circumference and height of each tapped tree was taken. The circumference and height of the nearest non-SM tree were also taken. Finally, the last measurement taken was the distance between the Sugar Maple tree and the non-SM tree. All of these values were compared with sugar concentration and none were found to be significant. It can thus be concluded that the non-SM trees do not affect the sugar water of Sugar Maple trees.

*Keywords: Acer saccharum, interspecific competition, sugar concentration, sugar maple trees*

INTRODUCTION

Tapping of Sugar Maple trees is a common pastime in areas where these trees are common. It is a popular event because after the sugar water is collected, it can be turned into delicious maple syrup. In fact, the Native Americans and early New Englanders would commonly harvest and refine the sugar water because it was their only means to produce sugar (Reidel and Richardson, 2002).

In order to collect sugar water from the Sugar Maple trees, they must first be tapped. The best time to tap a tree starts around mid-February to late March and can go until late April or May. The length of time that the sugar water flows depends on the weather conditions and topography of the area. Trees at higher elevations, in cold valleys, or on north-facing slopes are best tapped later in the season. The best weather conditions that permit favorable flow of the sugar water are when it is sunny, the daytime temperature is a little above freezing, and the nighttime temperature is well below freezing. It is suggested that the use of galvanized buckets with covers and
spouts (taps) are the best devices for collecting the sugar water because this allows for the tapped sugar water to run into each bucket without constant monitoring (Reidel and Richardson, 2002).

The best way to convert the sugar water into maple syrup is by boiling it in an evaporator. The length of this process depends on barometric pressure and boiling temperature, which generally takes a few hours before the syrup even starts to form. The boiling of sugar water is an art because there is the chance of boiling too fast, which could burn the syrup and break the evaporator, or boiling too slowly, which could produce a lower quality of syrup (Reidel and Richardson, 2002).

However, in the case of our study, before the sugar water was turned into syrup, the concentration of sugar was measured by a refractometer, whose accuracy and precision is between ± 0.1 and ± 0.2 Brix units. This Brix scale is the scale specifically used to measure sugar content. In order to take a reading, the sugar water is placed in a well and the reading is taken from underneath the sample to ensure accuracy. Another means of ensuring accuracy is that the refractometer has a scale or correction factor that aids in the calculation of the fluid concentration (Canter, 2009).

We specifically studied potential effects of interspecific competition between sugar maple trees and non-SM trees. We hypothesized that increased densities of nearby non-SM trees would reduce the concentration of sugar water produced by sugar maple trees because of competition for water, light, and nutrients. With reduced densities of competing trees, an abundance of resources should minimize interspecific competition (Jose, Gillespie, and Pallardy, 2004).

FIELD SITE

During March 2009 samples were collected from Sugar Maple trees at Grove Farm at Raystown Field Station in Huntingdon, Pennsylvania. The grove had a great abundance of Sugar Maple trees, which were easily accessible for our study. There were pre-tapped trees by the Juniata College Sapsuckers Club in which thirty were selected for comparison.

MATERIALS AND METHODS

Thirty random Sugar Maple trees and the closest neighboring non-maple tree were selected for comparison in Grove Farm. A laser rangefinder was used to first determine the height of the Sugar Maple tree and the non-SM tree. Using a metric tape measure, the circumference of the trees and the distances between both species was measured.

Least squares regression analysis was used to compare sugar concentration with seven other variables: height and circumference of a Maple tree, height and circumference of the nearest non-Maple tree, distance between the Maple tree and the nearest non-Maple tree, and the ratio of the heights and circumferences of the non-Maple tree in relation to the Maple tree.

RESULTS

The correlation between sugar water concentration and the distance to the nearest non-maple tree was nonsignificant ($r^2 = 0.001$, $P = 0.890$), meaning that 0.10% of the data was explained. All other correlations between sugar water concentration and the other variables were insignificant, as well (see Table 1).
Table 1. This regression analysis summary table includes the p-values and $R^2$ values of the sugar water concentration from Sugar Maple trees against seven different variables: Distance to nearest non-maple tree, maple circumference, non-maple tree circumference, maple tree height, non-maple tree height, the ratio of non-maple/maple height and the ratio of non-maple/maple circumference.

<table>
<thead>
<tr>
<th></th>
<th>Dist. To Nearest Non-Maple</th>
<th>Maple Circum</th>
<th>Non-Maple Circum</th>
<th>Maple Height</th>
<th>Non-Maple Height</th>
<th>Non-Maple/Maple Height</th>
<th>Non-Maple/Maple Circum</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Value</td>
<td>0.890</td>
<td>0.517</td>
<td>0.307</td>
<td>0.974</td>
<td>0.548</td>
<td>0.548</td>
<td>0.451</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.001</td>
<td>0.015</td>
<td>0.037</td>
<td>0.000</td>
<td>0.013</td>
<td>0.013</td>
<td>0.020</td>
</tr>
<tr>
<td>Significant</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The results from the regression analysis indicate that there were no significant correlations between the distance, height or circumference of non-SM trees and the concentration of sugar water in Maple trees. All of the p-values were high above the 0.05 level of significance making all of the gathered data insignificant. If the outcome had been that there was a significant correlation between any of the variables mentioned in Table 1, it could be assumed that there was interspecific competition between the neighboring non-SM and the Maples. The results suggest that there was no competition for water or nutrients that would, in turn, decrease the concentration of the sugar water from the Sugar Maples. There were very few non-SM trees and the ones found were visibly underdeveloped and shorter in height. Our original assumption was that the small stature and small circumference of these non-SM would have little or no correlation with the sugar water concentrations of the Maples. Our results supported this so the null hypothesis was accepted.

Interspecific competition would be evident if any of the aforementioned variables decreased the concentration of sugar water in the Maples. A few explanations could account for why this did not occur at Grove Farm. One explanation could be that the root systems of the non-Maples grew further into the ground while the Maple tree root systems were higher toward the surface which prevented competition for limiting nutrients that way. Another explanation could be that the Maple trees were so much bigger than the non-SM trees that they were taking nutrients away from the non-Maple trees, causing them to be smaller. If that is the case, there may have been greater interspecific competition from the Maple trees on the non-SM trees, thus explaining why the non-SM were less abundant.

The lack of significance in the results could be due to error while gathering the data. As a point of possible error, the laser rangefinder was not producing consistent measurements for every tree and distance. The measurements were taken multiple times to ensure the most accurate readings. Another source of error could be tree identification. The data were taken in the winter season when the trees lacked buds. Due to this, the Maple and non-Maple trees were differentiated by the appearance and texture of the bark.
ACKNOWLEDGEMENTS

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LITERATURE CITED

