2010

Post-fire Alterations in Mechanical Strength of Leaves in Heteromeles Arbutifolia

Andrew Hair  
Pepperdine University

Madeline DiLascia  
Pepperdine University

Nick Novella  
Pepperdine University

Taylor Wurdeman  
Pepperdine University

Follow this and additional works at: https://digitalcommons.pepperdine.edu/sturesearch

Part of the Plant Biology Commons

Recommended Citation
Hair, Andrew; DiLascia, Madeline; Novella, Nick; and Wurdeman, Taylor, "Post-fire Alterations in Mechanical Strength of Leaves in Heteromeles Arbutifolia" (2010). Pepperdine University, Featured Research. Paper 17.  
https://digitalcommons.pepperdine.edu/sturesearch/17

This Article is brought to you for free and open access by the Undergraduate Student Research at Pepperdine Digital Commons. It has been accepted for inclusion in Featured Research by an authorized administrator of Pepperdine Digital Commons. For more information, please contact Katrina.Gallardo@pepperdine.edu, anna.speth@pepperdine.edu, linhgavin.do@pepperdine.edu.
Post-fire Alterations in Mechanical Strength of Leaves in *Heteromeles arbutifolia*

Andrew Hair, Madeline DiLascia, Nick Novella, Taylor Wurdeman
Division of Natural Science, Pepperdine University, Malibu, CA 90263

Abstract:
Wildfires in the Santa Monica mountains in Southern California burn down a decent percentage of the local vegetation. However, some plants like *Heteromeles arbutifolia*, are considered to be resprouters because they return a mere two years after being burnt down. It is hypothesized that the artificially browsed resprout leaves will have a lower tensile strength than both the young and adult leaves because they use a lower amount of carbohydrates per unit-leaf-area. Data showed that although there was a slight difference between the young leaves and the adult leaves of the *Heteromeles*, there was no statistically significant difference between the young leaves and the resprout artificially browsed leaves. This demonstrates the fact that the Young’s Modulus of the tensile strength of the young leaves is approximately equal to that of the browsed leaves. The hypothesis that the browsed leaves will be weaker than the young and adult leaves can therefore be rejected.

Introduction:
The Mediterranean-type climate of the Southern California coast produces an environment prone to frequent, intense fires during the long dry summers that characterize this climate. These fires can devastate the coastal mountains, leaving the land barren with only charred remains where lush vegetation once thrived. However, after only a short time, the recently burned land blooms green with new growth. This is because the flora in this region has adapted to these fires, so they can survive or reproduce through the fire. In *Heteromeles arbutifolia*, fire actually stimulates sexual and asexual reproduction, despite a reduction in density (Arévalo 2009). Nowhere are these adaptations more evident than in the chaparral plants native to the area of the Santa Monica Mountains. Many of these plants are able to resprout after their shoots are destroyed by fire using carbohydrates stored in extensive root systems.

One such species, Hollywood (Heteromeles arbutifolia), stores carbohydrates in a large root ball beneath the ground just under the base of the shoot. While resprouting, the plant has no photosynthetic tissue because all of its carbohydrates in a large root burl beneath the ground just under the base of the shoot. This demonstrates the fact that the Young’s Modulus of the tensile strength of leaves from post-fire leaves would be less than that of young leaves from a fully-grown plant. It was hypothesized that the mechanical strength from post-fire leaves would be less than that of both the adult leaves and young leaves from the fully-grown plant. While data initially showed that there was a difference between post-fire and young leaves, a two-sample t-test demonstrated that there was no statistical difference between the two values. Young’s Modulus (N/mm²) was used for all statistical tests of significance. The null hypothesis was that there would be no difference between the leaves of the post-fire plant and the young leaves. The null hypothesis cannot be rejected, because the p-value was .3230 (the p-value must be below .05 to be rejected). A two-sample t-test was repeated for young leaves versus adult leaves, and the p-value was found to be .0017. This shows that while there is a significant difference between young leaves and adult leaves, there is no statistically relevant difference between post-fire and young leaves.

Materials and Methods:
The first thing that was done was to acquire samples. Two adult leaves and two young leaves were taken from three different shrubs at the lacrosse field on Pepperdine’s campus. All the samples were sun leaves and at least 12 cm in width. At the base of each shrub the soil hydration was read using a probe. A quantum sensor was used to measure light intensity on the leaves. This reading was taken from directly overhead the leaves that were going to be used. The final readings taken were temperature and relative humidity. The area of the chosen leaves was found by running through the machine in the projects lab. The length, width, and thicknesses of top, middle, and bottom were measured for every specimen. The leaves were placed into the Instron in the Biomechanics lab and the clamps were securely fastened. This constituted the preliminary trial. Once the data was put together it was determined that the temperature, humidity, light level, area, and soil hydration were not integral to the experiment.

Two young leaves and two adult leaves were taken from the same three shrubs at the lacrosse field. These were considered the adult leaves and young leaves for our experiment. The resprout leaves were acquired from Iolana’s plot by the tower and Admissions building. Length, width and the three thicknesses were measured for all these leaves as well. One by one, they were put through the Instron as tensile strengths were being measured. From these Instron readings came the data for our experiment.

Conclusions:
The findings of this investigation did not reflect a significant difference in mechanical strength of leaves from artificially browsed *Heteromeles arbutifolia* versus young leaves from an adult *Heteromeles arbutifolia* plant. This shows that leaves from resprouting *Heteromeles arbutifolia* are not more vulnerable to damage than leaves from an adult plant. As far as our data shows, special measures do not need to be taken to protect resprouts of *Heteromeles arbutifolia* from physical damage. Our next step would be to measure the thickness of cell walls in parenchyma cells of leaves to determine whether cell walls are thinner in post-fire leaves than in leaves from adult plants. This should show whether the post-fire leaves use less cellulose.

References: