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Stomatal Differences in Western Aspen and Linkage to Drought Tolerance

Brianne Palmer
Utah State University

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Brianne Palmer
Utah State University

Karen Mock
Utah State University

I. Introduction

Aspen are the most widely distributed broadleaf tree in North America .However, aspen mortality is widespread across the Intermountain West. Researchers are attempting to determine the causes of the decline and propose future methods of management.

In order to survive, plants need to take in CO_2 through pores on their leaves called stomata. When the stomata are open, the plant takes in CO_2, however, water escapes. Therefore, stomata are important in regulating the drought response in plants. The size and the density of the stomata could influence the drought tolerance of an organism.

In Utah, there are triploid (3 copies of each chromosome) and diploid (2 copies) aspen. Previous studies have shown that triploid organisms have larger cells than their diploid counterparts. This project will determine if there is a difference in stomatal size and density to assess the response of aspen to drought. Knowing which ploidy level in aspen is likely to be more drought tolerant will provide important direction to management, since forestry practices favoring diploid vs triploid are different.

II. Methods

During the summers of 2013-2015, we collected leaves from diploid and triploid aspen in Logan and near Fish Lake. To determine the ploidy level, we performed flow cytometry on dry leaves. We made cellulose acetate impressions to create microscope slides to view and measure the stomata. Using a camera attached to the microscope we were able to measure the length and density (Figure 1)

Figure 1 – Microscope images of stomata at 40x and 10x magnification.

III. Results

Based on the data from 2013-2015, (20 diploid and 9 triploid) there is a significant difference ($P < 0.01$) in the stomatal length between diploid and triploid aspen, though there is no significant difference in densities ($P=0.0684$). The triploid stomata are larger.

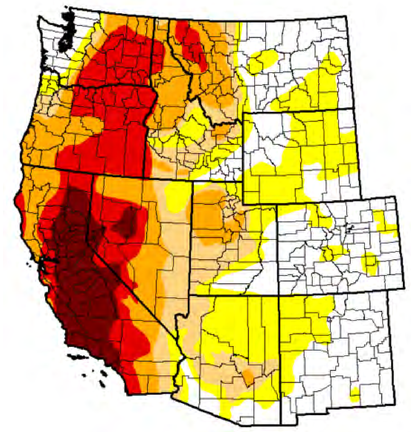
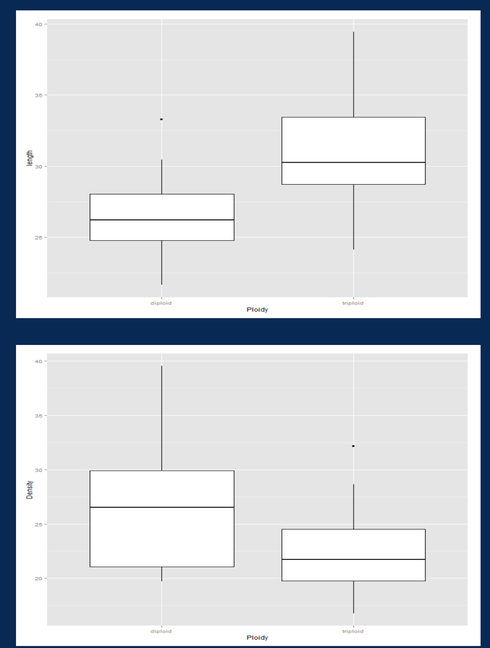


Figure 2 – Palmer Drought Index, December 1, 2015 from the Western Regional Climate Center.

Figure 3 – Stomatal length (top) and density (bottom) of diploid and triploid aspen



IV. Conclusions

My results indicate that in aspen, triploids have larger stomata than diploid aspen. With larger stomata, triploids may be more efficient photosythesizers, but they may be at a greater risk for water loss during drought.

Additionally, it may be possible to use stomatal size as a quick and cheap field test to determine ploidy. Further research should be done to assess if the difference in the size of the stomata is related to drought tolerance.

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Brianne Palmer
Utah State University
Wildland Resources
brianne.r.palmer@gmail.com