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Testing for Genomic Control of Ephemeral Leaf Phenotypes in *Artemisia tridentata*

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Abstract

Climate change is driving ever increasing ecological stresses on native plant communities. Furthering our understanding of how plants, particularly keystone species of important ecosystems, deal with these stresses will be essential for the success of conservation and restoration efforts *Artemisia tridentate* is a keystone species of western North America and has experience sharp population declines in recent decades due to human activity. During the late winter and early spring months, *A. tridentate* grows large ephemeral leaves that provide more surface area for light capture and photosynthesis while resources are abundant. Then, during the onset of drought stress during the summer months, the ephemeral leaves will drop. We hypothesize that the timing of ephemeral leaf dropping is correlated to important water use efficiency traits and are under genomic control. To test these hypotheses, plants of a population of *A. tridentate* near Marsing, ID were tracked and phenotyped from late spring though summer. Early and late ephemeral leaf dropping individuals then had their genomes sequenced for genetic association tests. We find that there are statistically significant differences for leaf phenotypes among individuals, suggesting that the water use efficiency will vary within the population. Genetic tests are on-going to determine if these traits are genetically determined.

Authors

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Background

- Big sagebrush (*Artemisia tridentata*) is a keystone species of the sagebrush steppe ecosystems and is threatened by climate change and human activity.
- Big sagebrush has two types of leaves: persistent and ephemeral. Ephemeral leaves grow during late winter and early spring, then drop during the onset of drought stress during summer months. These leaves are larger than persistent leaves and provide more surface area for light capture and photosynthesis.
- There is variation in the timing of ephemeral leaf dropping, potentially affecting drought response.
- Here, we aim to test for variation in stomatal traits on ephemeral leaves and test for genomic control of ephemeral leaf drop timing.

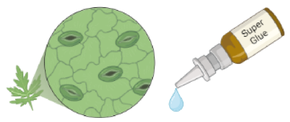
Methods

Workflow and Techniques

1 Sample Collection

- Spring ephemeral leaves from 36 plants

2 Sample Processing

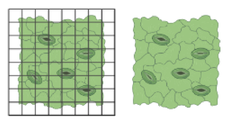


- Leaf hairs removed with spatula
- Super glue and scotch tape used to remove epidermal cells

3 Leaf Peel Imaging

- Leaf peels affixed to microscope slide
- Used Moticam Image X 3.0 software

4 Image analysis



Two type of images
- Density of stomata
- Size of stomata

Methods

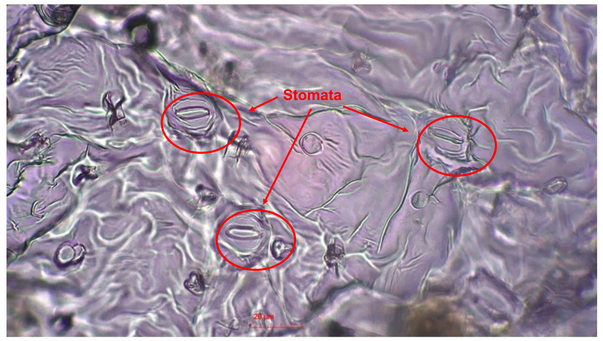


Figure 2) Example of stomatal peel image used for measuring stomata sizes. Stomata were measured from edges of the guard cells, across the stomatal pore.

Results

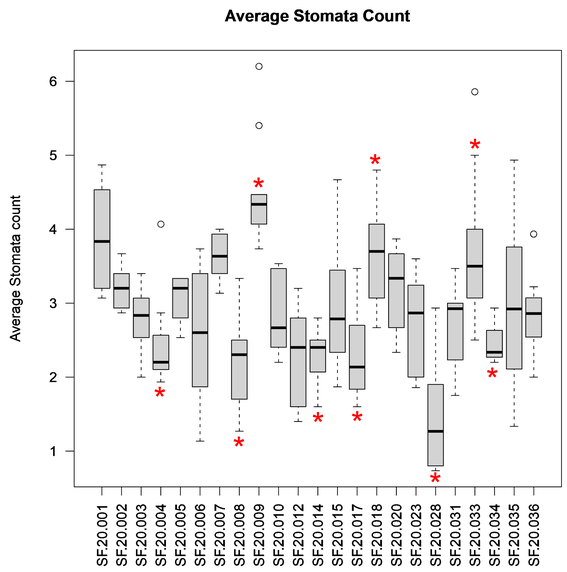


Figure 3) Boxplot showing the distributions of values for the average number of stomata per leaf sections measures. ANOVA and Tukey Honest Significant Differences tests were used to test for differences for stomata counts among samples. Statistically significant differences were found among comparisons of stomata counts.

Results

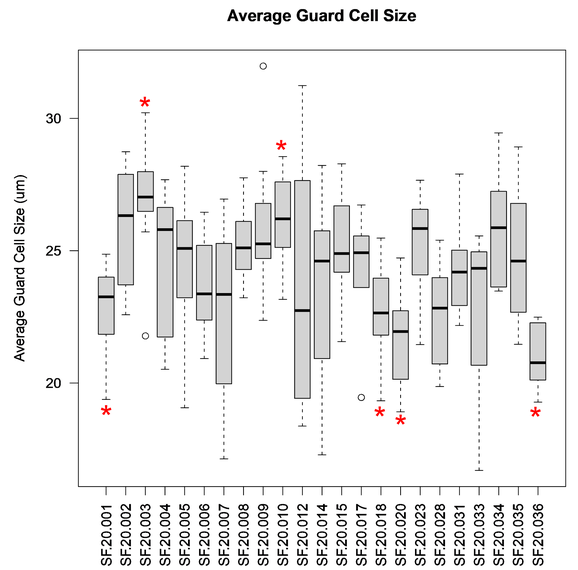


Figure 4) Boxplot showing the distributions of values for the average number of stomata size. ANOVA and Tukey Honest Significant Differences tests were used to test for differences for stomata sizes among samples. Statistically significant differences were found among comparisons of stomata sizes.

Discussion

- Statistically significant differences were identified between individuals for both stomatal size and density. This indicates that there are differences in ephemeral leaf stomata phenotypes across the plants in the field site and that these plants likely have different water use efficiencies.
- Not all individuals have been analyzed, so it is not clear yet whether these differences correlate to the timing of ephemeral leaf dropping.
- We are currently conducting genomic tests to determine if ephemeral leaf phenotypes, including stomata size, stomata density, and ephemeral leaf drop timing, are controlled by genomic mechanisms.