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Difference in Water Status between Oak Trees (Quercus berberidifolia) with Brown and Green Leaves During Severe Drought

Mia Bryant
Pepperdine University

Hannah Dario
Pepperdine University

Cameron Kline
Pepperdine University

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Mia Bryant, Hannah Dario and Cameron Kline
Mentor: Dr. Stephen D. Davis
Pepperdine University, 24255 Pacific Coast Highway, Malibu, CA 90263

Abstract

In this experiment, we examined cavitation in *Quercus berberidifolia* plants. We hypothesized that as the amount of water stress increases, then the pressure to cause embolism will decrease. We thought this because as a plant loses more water, the more air bubbles will form within the plant and therefore the pressure to cause this will decrease. We tested this hypothesis by comparing dry *Quercus berberidifolia* to more hydrated *Quercus berberidifolia* in Tapia Park, near Malibu, California. We measured and compared these plants by the use of the Scholander Pressure chamber and a parometer. In the end, we discovered that our hypothesis was correct. Our data showed us that less hydrated plants that had more water stress had a lower atmospheric pressure than the more hydrated plants.

Introduction

An increasing problem around in the world is drought. This is most evident in the Santa Monica Mountains. In this Mediterranean style climate, there are consistent periods of drought which are increasing throughout the years. These dry conditions cause the chaparral vegetation to become less hydrated and as a result cavitation occurs. Cavitation in a plant is when the loss of water causes an empty space or a low pressure bubble to form.

Through investigating the relationship between water stress and the amount of pressure for embolism to occur, we can understand more the impact of cavitation of leaves, and the drought impacts on plants in the chaparral environment. In this experiment, we observed and tested the extent of cavitation in *Quercus agrifolia.* We compared dry *Quercus agrifolia* with more hydrated *Quercus agrifolia*. We hypothesized that as the amount of water stress increases, then the pressure to cause embolism will decrease. We tested this hypothesis through four different tests with the use of a Scholander pressure chamber, parometer, and a fluorometer. These tests were all conducted Tapia Park, near Malibu, California.

Methods

1. 

Figure 1. Data was collected by using the Scholander Hammel pressure chamber to measure the pressure inside the leaf before it was cut from the original shrub oak.

2. 

Figure 2. With the use of a parometer, we measured the temperature of the green and brown leaves along with their conductance at consistent temperatures.

3. Fluorescence was also measured using a fluorometer to measure the light reflection of green and brown leaves.

Results

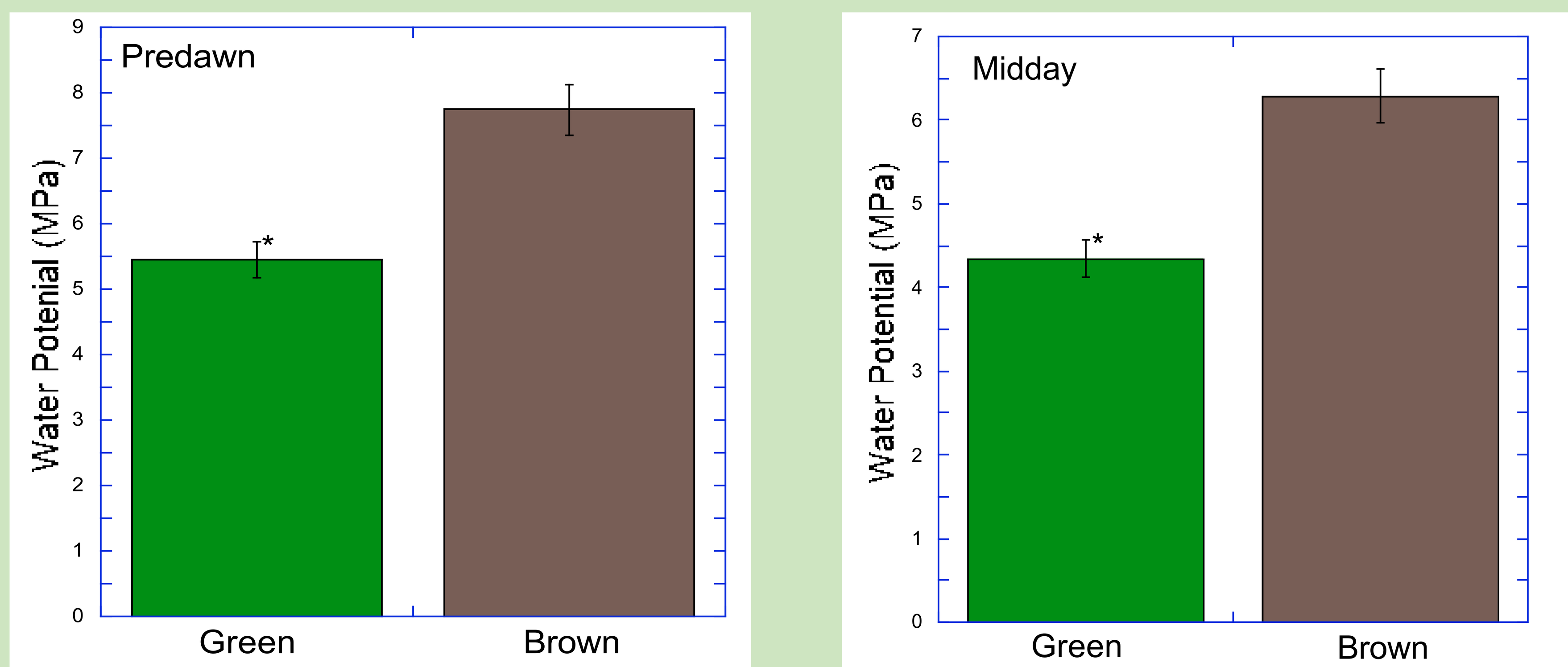

Figure 3. Mean water potential at Predawn and Midday comparing shrub oaks with green leaves versus ones with brown leaves, growing at Tapia Park near Malibu, California. Error bars represent ± 1 SE, n = 6 and an asterisk indicates significant difference between plants with green leaves versus brown leaves by Student T-test, $p < 0.05$.

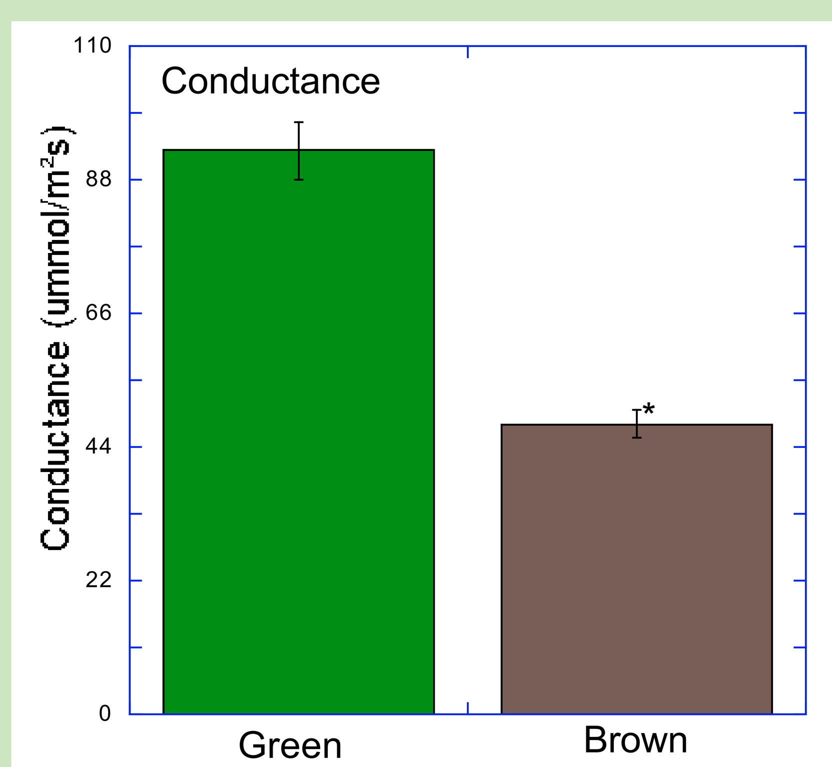

Figure 4. The conductance of green leaves compared to brown leaves of the shrub oak, taken at Tapia Park near Malibu, California. Error bars represent ± 1 SE, n = 6 and an asterisk indicates significant difference between plants with green leaves versus plants with brown leaves by Student t-test, $p < 0.05$.

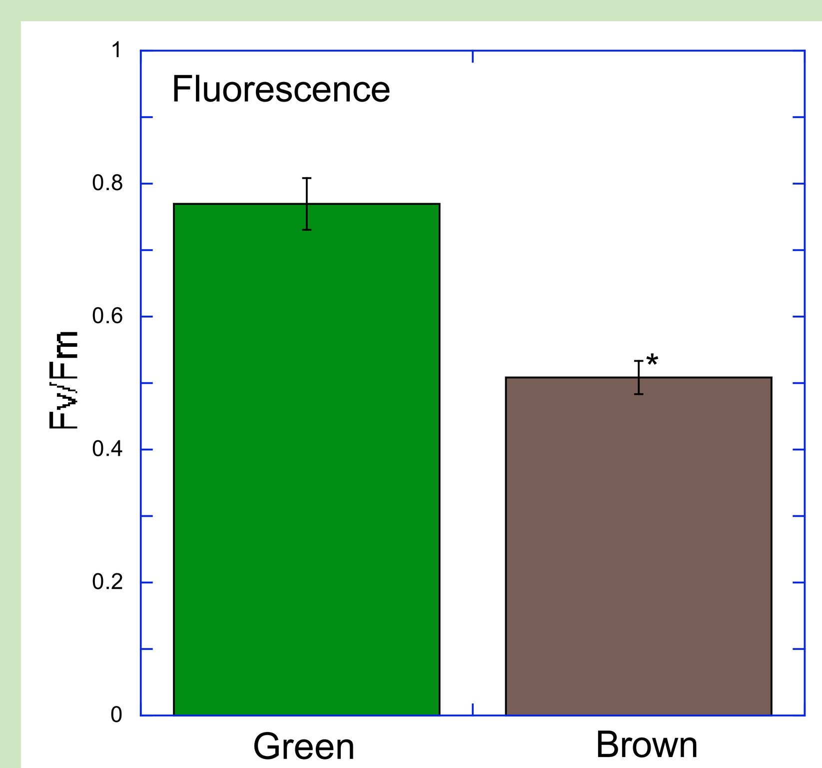

Figure 3. Fluorescence comparing shrub oaks with green leaves versus shrub oaks with brown leaves, taken at Tapia Park near Malibu, California. Error bars represent ± 1 SE, n = 18 and an asterisk indicates significant difference between plants with green leaves versus plants with brown leaves by student t-test, $p < 0.05$.

Discussion

- Dry chaparral species that are getting significantly dryer
- There was a significant difference between green stems and brown stems regarding the atmospheric pressure at which the stems fall off
- Data showed that the pressure was higher in brown leaves at pre-dawn and mid-day
- The pressure at which the stem was cut is measured in bars at atmospheric pressure

Conclusion

We have concluded that the atmospheric pressure at which plant stems and leaves are falling off to further the plant survival. The plants with brown and green leaves show significantly different pressures. In order to determine whether the change in pressure was significant, we ran tests and acquired data. As these plants get dryer, the pressure at which they fall off increased.

References

McDowell, Nate, William T. Pockman, Craig D. Allen, David D. Breshears, Neil Cobb, Thomas Kolb, Jennifer Plaut et al. 2008. "Mechanisms of plant survival and mortality during drought: why do some plants survive while others succumb to drought?." *New Phytologist* 178, no. 4: 719-739.