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Is there a correlation between Water Potential and Mechanical Strength of stems of Malosma laurina?

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Abstract

The purpose of this experiment was to see if there was a correlation between water potential and the stem mechanical strength of the *Malosma laurina.* This experiment was conducted with the use of a Scholander-Hammel pressure chamber to find water potential and the Instron 5500 to test the mechanical strength of the stems. After analysis of the data, there was no direct correlation between water potential and the mechanical strength of stems of *Malosma laurina.*

Introduction

The Mediterranean biome covers about 5 percent of the earth's surface, but constitutes for about 20 percent of the earth's total species. This biome is categorized by hot dry summers and wet winters. For covering only 5 percent of the surface of the earth, it contributes immensely to the earth's global species diversity. California's coast is one of five Mediterranean biomes. Due to global warming and arson, there have been more incidents of wildfires, which have been hurting the species of coastal California's Mediterranean biome. Due to the overall drier conditions of California, the issue of plant drought has never been more important. *Malosma laurina* is one of the abundant chaparral plant of the California Mediterranean biome. Stem mechanical strength is determined by multiple factors such as the composition of cell wall, number of layers in the cell wall, arrangement of cellulose fibers, and how much space the cell walls actually take up (Chu, J). With drought comes stomatal closure and leaf growth inhibition, which can result in cell dehydration, xylem cavitation and death (Chaves, M). Our group predicted that there will be a correlation between the species' water potential and mechanical strength of the stem due to a study showing increased cavitation resistance was correlated with increased mechanical strength (Jacobsen, A). By studying the correlation between the species' water potential and mechanical strength of its stems, we will have knowledge on how the plant's stems react mechanically to drought. This will be useful information in trying to sustain the *Malosma laurina* and eventually other species of the coastal California Mediterranean biome. The hypothesis was tested by finding the water potentials of five dehydrated samples of *Malosma laurina* and five hydrated samples. The samples then were tested to find out their mechanical strength. An analysis was then conducted to see whether or not a correlation existed between water potential and mechanical strength.

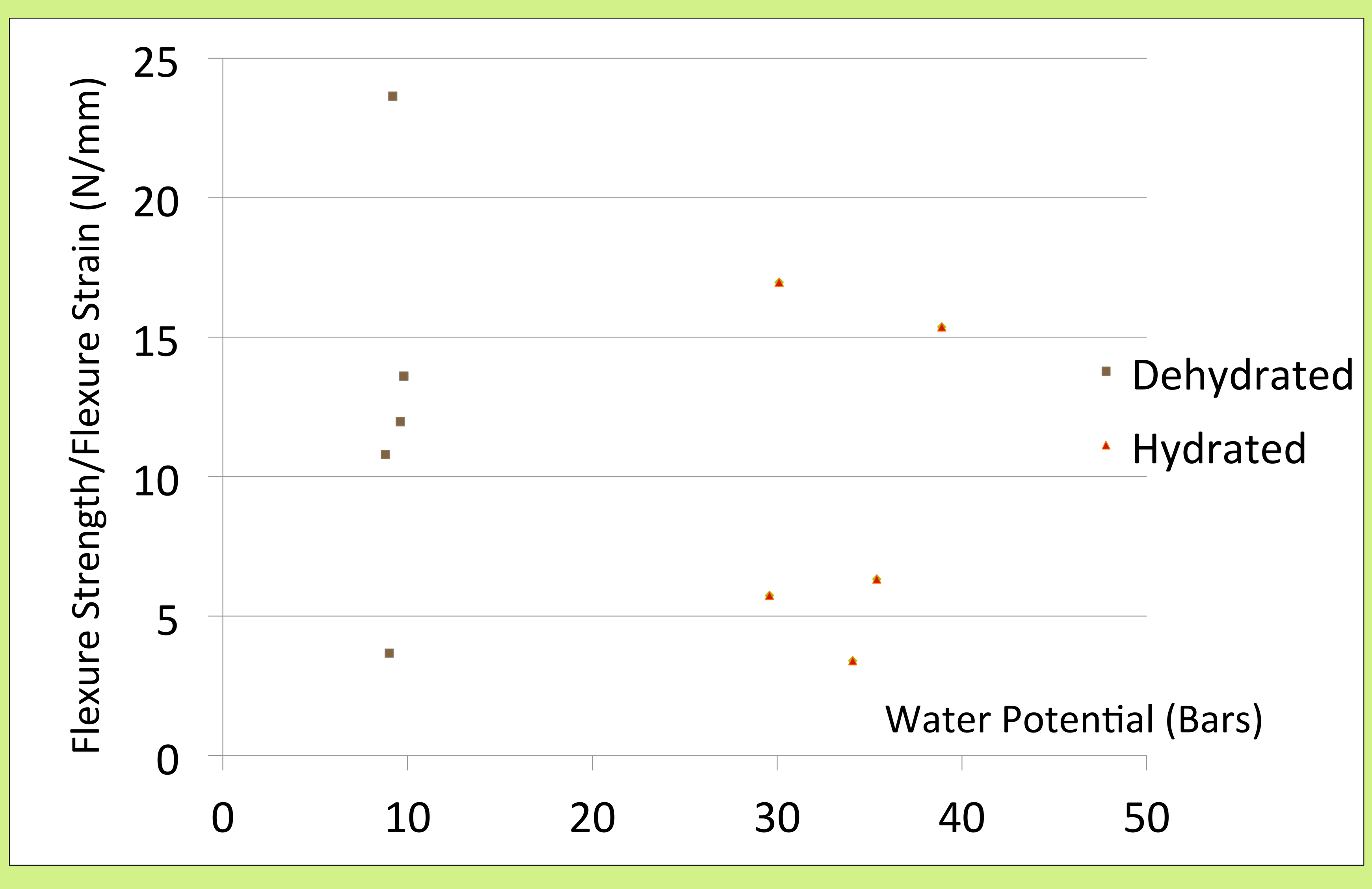
Methods

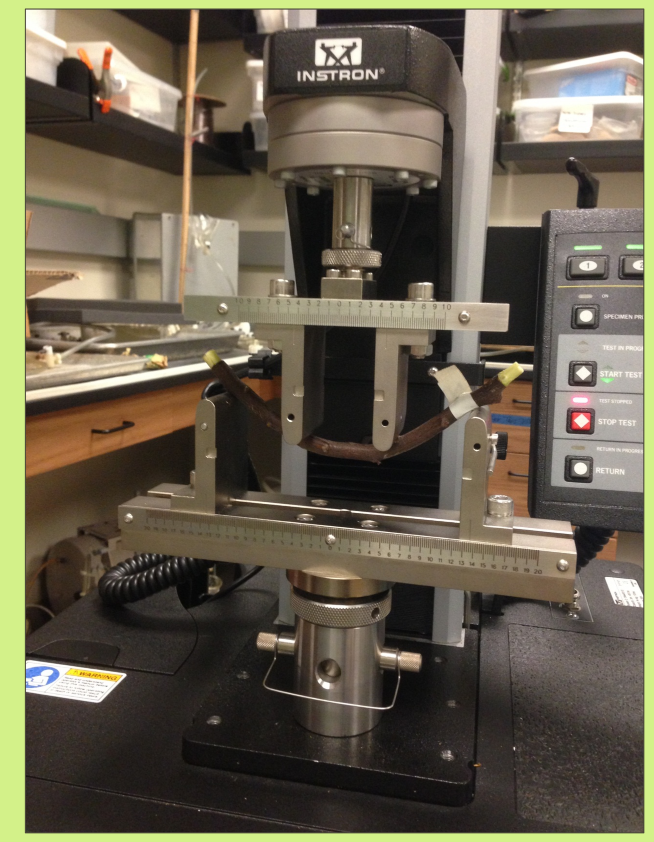
Samples of *Malosma laurina* were collected from the Dana Martel Trail on the Pepperdine University campus. Ten samples were collected from ten different *Malosma laurina plants.* Samples with similar stem sizes and location relative to the base of the plant were chosen in order to have consistency. Five were collected, bagged, and stored in a ice chest to begin experimentation immediately while the other five were set out to dry for 24 hours. The Scholander-Hammel pressure chamber was used with the leaves to test water potential. The Instron 5500 was then used to measure the modulus of elasticity, maximum flexure load, modulus of rupture, modulus of elasticity with bark, and the modulus of rupture with bark. The same process with the pressure chamber and Instron were conducted on the five dehydrated samples after the twenty four hours (in order to ensure dehydration). The results were then put into a graph (water potential in bars versus flexure strength/flexure strain in N/mm) and a two paired t-test was conducted for analysis.

Table 1. Summary of data collected.

	Hydrated		Dehydrated	
	Water Potential (bars)	(N/mm)	Water Potential (bars)	(N/mm)
Sample 1	9	3.67877	34.1	3.4
Sample 2	9.2	23.63228	38.9	15.36202
Sample 3	8.8	10.79077	35.4	6.32809
Sample 4	9.6	11.97723	30.1	16.9644
Sample 5	9.8	13.59924	29.6	5.74198
Mean	9.28	12.735658	33.62	9.559298
Standard Deviation	0.414728827	7.174035954	3.867428086	6.153387115

Graph 1. Water Potential (bars) versus Mechanical Strength (N/mm).





Literature Cited

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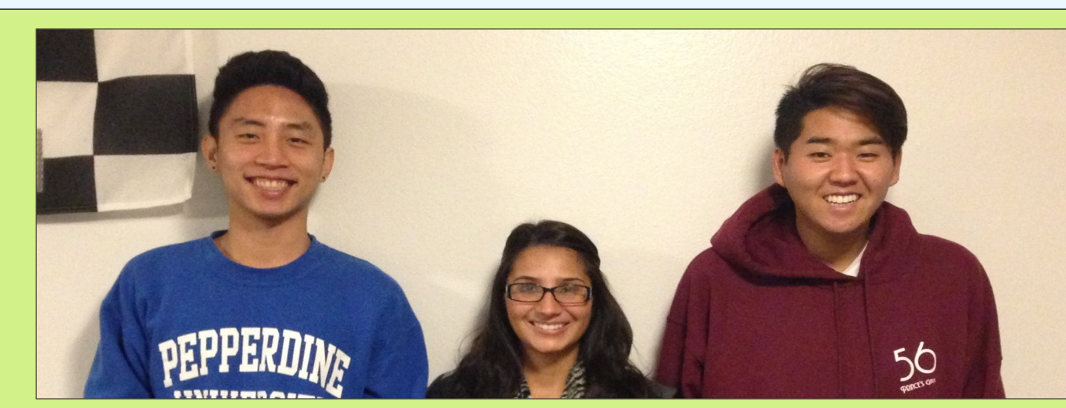
Results

Graph 1 plots water potential versus mechanical strength; there is no visual pattern in the graph that shows a correlation. Table 1 represents the collected data with averages and standard deviations. After conducting the paired t-test (two tail=0.272, >0.05), it was calculated however that there is no correlation between water potential and stem mechanical strength of *M. laurina.*

Discussion

The objective of this research experiment, whch was to see if there was a correlation between water potential and stem mechanical strength of *M. laurina,* was achieved. After statistical analysis, there was no correlation between water potential and the stem mechanical strength (ratio of flexure strength to flexure strain). The two paired t-test shows that there is no direct correlation between water potential and mechanical strength. The two tail t value was 0.272; it needed to be below 0.05 in order to prove that there was a correlation. Through this experiment, it can be thought that stem mechanical strength of *M. laurina* is not a clear result of the hydrated status of the plant. Stem mechanical strength can be affected by so many other factors that would need further experimentation with a bigger testing pool.



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