A Study of leaf characteristics between deciduous Blue Oak (*Quercus douglasii*) and evergreen Coast Live Oak (*Quercus agrifolia*) Trees

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Abstract

This study compared the leaf characteristics of Coast Live Oak (Quercus agrifolia Nee) with Blue Oak (Quercus douglasii) in a common garden, as well as monitored Q. douglasii in the Tonzi Field. In the common garden experiment, we examined the chlorophyll content, stomatal conductance (mmol/m^{2}s^1) Figure 2., leaf mass per area (LMA), leaf absorptance (α), and diameter at breast height (DBH) of the tree. This increased our understanding of the different strategies, deciduous versus evergreen forests, for survival in the Mediterranean region of California. An understanding of how deciduous and evergreen trees differ in leaf function is critical to understanding how efficiently each type of tree utilizes their resources to survive the severe summer drought and how well each could adapt to climate changes. We found that leaves from Q. Douglasii differed in leaf size, stomatal conductance and LMA. The Stomatal conductance of the Q. agrifolia Nee was higher compared to Q. Douglasii.

A rigorous seasonal study was performed on four Q. Douglasii trees to monitor the leaf characteristics through time. We examined the stomatal conductance, chlorophyll content, LMA, DBH, and absorptance. We also measured these parameters on a transect to study spatial variation. We found that leaves are thickest when they first emerge and as the area increases, the thickness decreases until they reach their maximum area. We also concluded that leaf absorption of blue light was higher compared to red light in Q. Douglasii. This gave us a better understanding on how deciduous trees like the Q. Douglasii perform to survive the severe climate changes.

Methods

The first portion of the on going study was conducted in a blue oak savanna in Ione, CA, where the dominant tree specie is Q. Douglasii. An intense study was performed in four main Q. Douglasii to monitor the leaf characteristics through time.

The second portion of this experiment was a common garden experiment which was conducted in the botanical Garden at UC Berkeley. We examined the chlorophyll content, stomatal conductance (mmol/m^{2}s^1), leaf mass per area (LMA), leaf absorptance (α), and diameter at breast height (DBH) of Q. Douglasii and Q. agrifolia Nee just like the experiment that was performed in the Tonzi field. The stomatal conductance was measured using a porometer while the leaves were attached to the branches. Then, the chlorophyll profile of the leaves was measured using a chlorophyll meter. The leaves could be either attached or detached from the branch. The leaves were then brought back to the lab where the area of each leaf was calculated using a leaf area meter(LI-3100C). The leaves were then left in the oven over a forty-eight hour period to extract the remains of water content in the leaves to get an accurate mass reading.

The Tonzi experiment was performed exactly as the common garden experiment at the UC Berkeley Botanical Garden, but intensely studied through time. Leaves were then taken from the tree- that was rigorously studied that day. – measured reflection and transmission with the integrating sphere to calculate absorptance.

Findings

•The leaves are thickest as they first appear but as the area increases of the leaf the thickness begins to decrease until it reaches its maximum area.

•In the common garden experiment the *Q. Douglasii* had a higher stomatal conductance than *Q. agrifolia Nee.*

•The leaves of the *Q. agrifolia Nee* are bigger and have a higher mass than *Q. Douglasii.*

• (Tonzi Experiment) Leaves absorb blue light more compared to red light.

•Stomatal conductance varied from day to day due to the fluctuation of temperature changes. The readings were higher during cooler days.

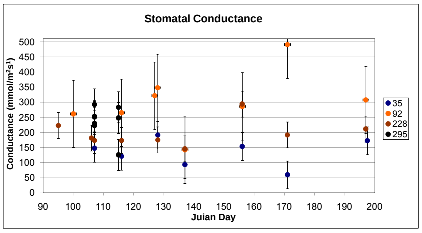

Figure 1. Seasonal Leaf Stomatal Conductance. Stomatal Conductance (mmol/m^{2}s^1) is shown by the day of year for four trees. Stomatal Conductance reading s fluctuated by tree depending on the ambient temperature that the tree has been experiencing.

This picture illustrates the porometer-that reads the Stomatal conductance of leaves- being used by me at the Tonzi Field.

These two pictures illustrate the seasonal changes in the Tonzi Field and the tower where it measures the Eddy Covariance and Co_2 content of the canopy.

This picture illustrates a chlorophyll meter being used at the Tonzi Field.

Conclusion

The blue Oak and Coast Live oak trees are able to respond and withstand severe droughts. Deciduous trees vary in certain leaf characteristics compared to evergreen trees. For example Q. douglasii has a higher stomatal conductance then Q. agrifolia nee. Also the leaf area and mass of the Q. agrifolia nee tend to be larger than Q. douglasii. Yet, they both are able to utilize their resources efficiently enough to produce healthy leaves that maintain a healthy tree.

Data

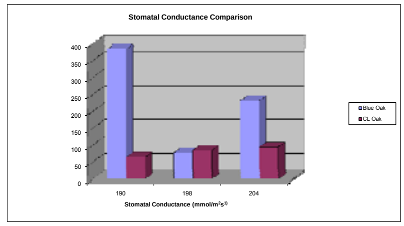

Figure 2 (Common Garden Experiment). Comparison of stomatal conductance between Q. agrifolia Nee and Q. douglasii . The stomatal conductance was higher in Q. douglasii than in Q. agrifolia Nee leaves.

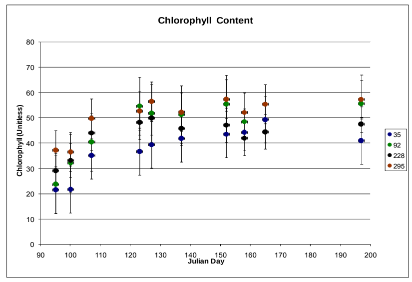

Figure 3. Seasonal Leaf Chlorophyll Profile. Chlorophyll content (unit-less) is shown by the day of year for four trees. Leaves Contain less chlorophyll when they first come out and then as the seasons begin to change the leafs produce more chlorophyll then it begins to decline.

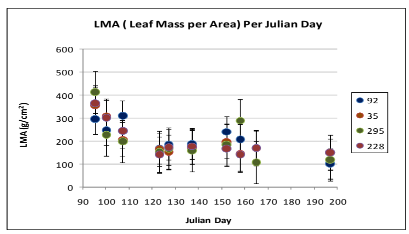

Figure 4. Seasonal changes in leaf thickness. Leaf mass per area (g/cm^2) is shown by the day of year for four trees. Leaves are thickest when they first come out and then as the area increases, the thickness decreases until they reach their maximum area.

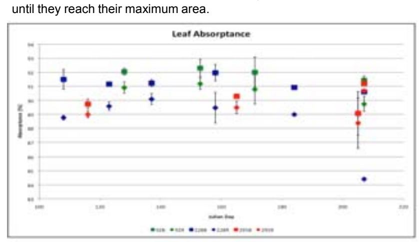

Figure 5. Seasonal changes in leaf absorption. Absorption (%) is shown by the day of year for four trees. Leaf absorption of blue light was higher compared to red light absorption.

References

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