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Physiological Performance in Full-Sun Vs. Shaded Post-Fire *Malosma laurina* Seedlings

Lindsey A. Murphy, David C. Valencia, Catherine D. Drummond, Pepperdine University, Malibu, CA

Abstract

Post-fire *Malosma laurina* regenerates both by resprouting and by disseminating seeds. The objective of this study is to assess seedling performance either in full-sunlight or in artificially shaded treatments. By identifying under which conditions *Malosma laurina* seedlings grow more effectively, one can predict where post-fire *M. laurina* seedling communities will thrive. The methodology employed throughout this experiment began by covering existing seedlings with shade cloth held by wooden stakes. These treatments were adjacent to full-sun environments; each of which contained at least two *Malosma laurina* seedlings. Six experimental sites were set up, and the seedlings in question were monitored for growth, conductance, relative humidity, temperature, and light exposure. Water potential was also measured once at each site at the conclusion of the experiment. The results show that seedlings under a shady protection grow taller and transpire less water on average than seedlings that are exposed to full sunlight. The shaded seedlings looked healthier than their full-sun counterparts. It can be concluded that seedlings have better physiological success under shade protection than under full sun.

Methods



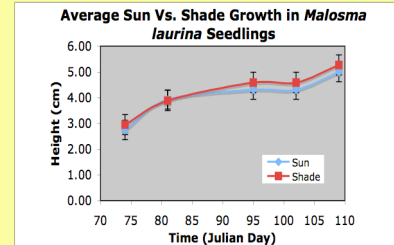
Shade cloth was stapled to stakes and draped over *M. laurina* seedlings chosen for shade treatment. The shade cloth provided an average of 95.5% protection from the sun's PAR. Six shaded sites were set up, each with two seedlings chosen for study. Near each shaded site were full-sun seedlings that were used for physiological comparison. On a weekly basis, growth, conductivity, temperature, relative humidity, and PAR (photosynthetically active radiation) were measured. A ruler was used to measure growth, a Porometer was used to measure conductivity, an IR thermometer was used to measure temperature, a ceptometer was used to measure PAR, and a hygrometer was used to measure humidity. Data was collected at both shaded and full-sun test sites weekly on Fridays at 10:30am in order to eliminate variables. The data was recorded in a notebook and then analyzed on Microsoft Excel. This information allowed us to calculate and compare the transpiration, conductance, and growth of these plants. The different sites were also monitored for seedling community success. At the completion of the study a seedling sample from each test site was placed in a pressure bomb to analyze water potential at the different sites.

Conclusions

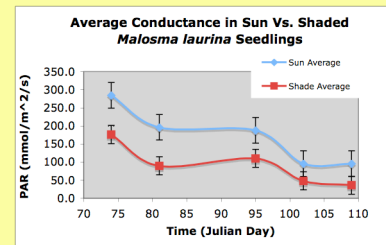
As the experiment progressed we were able to see the two treatment groups diverge in physiological health. The plants in the sun began to shrivel and die, whereas the shaded plants were healthy and green. There was also an increase in anthocyanin in the leaves of sun plants, signaling stress in these plants. However, the shaded plants rarely showed discoloration. The shade plants also exhibited more growth than the sun plants. This supports the conclusion that these plants were surviving better. The average water potential for shaded plants was -21.3 bars, whereas full-sun plants averaged -19.7 bars. These results show that plant stress was not due to different water supply. However, transpiration was increased in full-sun plants at every reading. The shaded seedlings showed less transpiration and conductance while still exhibiting increased growth compared to the full-sun seedlings. This may result from the increased leaf conductance in full-sun plants. Our data supports the idea that water stress is a factor that limits success in *M. laurina* seedlings. We found that seedlings do better when they are in a shaded location. Although our data was not significant, with further study and more accurate measurements we believe that these trends should further develop.

Introduction

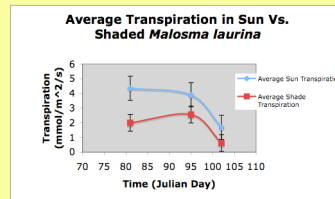
Chaparral is prevalent throughout Southern California due to its success in Mediterranean ecosystems. Within the Mediterranean ecosystem wildfires are common. In post-wildfire sites, new *M. laurina* seedlings germinate and grow alongside resprouts. According to Frazier and Davis, *M. laurina* seedlings have an extremely low success rate during drought (1988). Thomas and Davis later verified that *M. laurina* seedling success paled in comparison to analogous chaparral species (1989). This study was organized in order to follow up Frazier and Davis by attempting to reduce the threat of drought in new seedlings by limiting the intense sun exposure and therefore water loss through transpiration. We predict that those *M. laurina* seedlings will survive better with shade protection than those in direct sun. In October of 2007, a wildfire occurred throughout Malibu, CA and surrounding areas. Following this fire, seedlings and resprouts of *Malosma laurina* were easily differentiated due to the fact that the resprouts grew rapidly near charred mother plants. In order to track the progress of *M. laurina* seedlings, several seedlings were chosen on which to take measurements. Artificially shaded and full-sun test sites were set up on the hillside leading up to Pepperdine University (an area affected by the wildfire). Twenty-four plants, twelve of which were in the sun and twelve of which were protected by shade cloth were monitored for growth, conductance, relative humidity, temperature, and light exposure. This study allows for the experimenter to assess radiation stress and transpiration as a cause of seedling death.



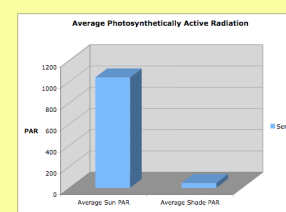
The growth rate in shade seedlings was greater than that of sun seedlings. The average sun height began at 2.74 cm and ended at 4.29 cm ($\Delta 1.55$ cm). The shade height started at 2.95 cm and ended at 5.27 cm ($\Delta 2.32$ cm).



The average conductance in these two experimental groups followed a similar pattern. The average conductance of the sun seedlings was always greater than the shaded seedlings, although this trend did not show a significant difference.



As might be expected from the conductance chart above, the average transpiration for the full-sun treatment was always higher than the transpiration for the shaded seedlings. The transpiration was calculated from the leaf temperature, air temperature, humidity, conductance, and water density values.



The average PAR under the shade cloth was 4.5% of the sunlight intensity experienced by the seedlings in the full-sun treatment (Average Tau=4.6).

Literature Cited

- Frazier, J.M. and Davis, S.D. (1988) Differential survival of chaparral seedlings during the first summer drought after wildfire. *Oecologia* 76: 215-221.
- Jacobsen, Anna L.; Pratt, R. Brandon; Davis, Stephen D. (c. 2002) Vegetation-type conversion in response to short fire return intervals in California chaparral. Unpublished: 1-16
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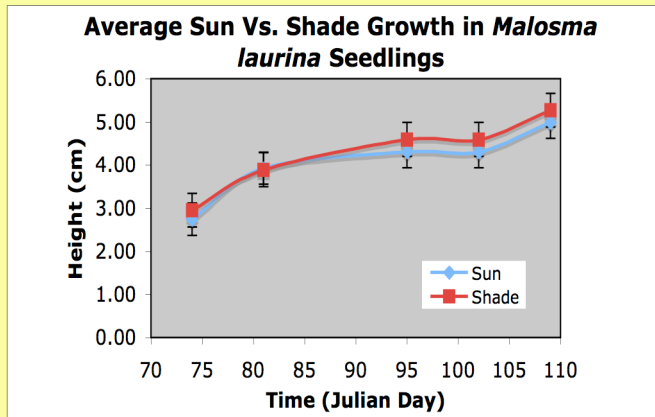
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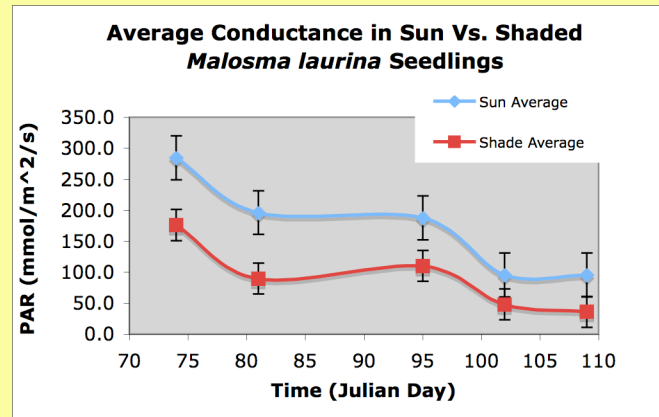
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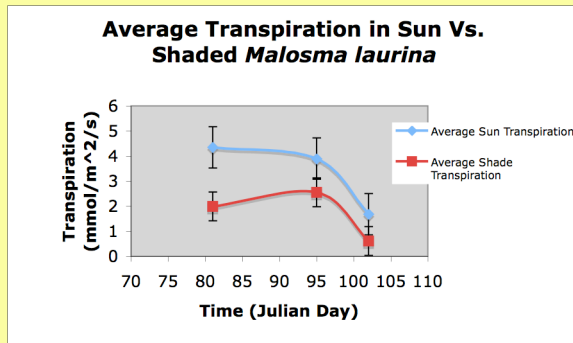
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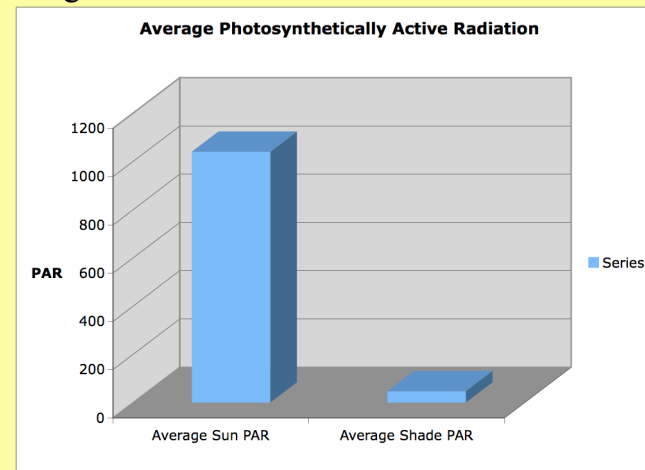
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