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Abstract

Due to an increase in air pollutants, heavy metal contaminates, and other adverse ecological conditions that plants near a road endure, it was hypothesized that plant species situated near a road would have a **detectable** decrease in photosynthetic performance when compared to plants away from the road. This investigation evaluated the in vivo photosynthetic status of two Malasma Laurina pairs with differing microhabitats, adjacent to the Pacific Coast Highway and 100 meters away from a Pacific Coast Highway. Maximum quantum yield and stomatal conductance measurements were recorded for each group. On average, the maximum quantum yield was greater on plants near the road.

Introduction

A major impact on the environment is that of roads and their associated vehicular traffic. As the construction and widening of roads continues at a rapid rate, it is important to have an understanding of how it will affect the surrounding ecosystems. The extent to which emissions and ecological disturbances extending from a road have been heavily researched, (Spellerburg,1998). Previous studies have shown that dust and gaseous pollutants adversely affect plant growth (Sarkar, Banerjee &Mukherji (1989). Other researchers have found that road pollutants may cause physiological stress in some plants and make them more susceptible to pest attack (Braun & Fluckigers, 1984). This investigation tests the hypothesis that proximity near a road has adverse effects on the photosynthetic capabilities of plants. This hypothesis was tested by measuring the maximum quantum yield and stomatal conductance of two plant groups, near the road and away from the road.

Methods

To examine plant health our team tested four individual *Malosma laurina* plants for stomatal conductance and maximum quantum yield. Initially, two plants of similar height were selected near the road, and 2 plants were chosen exactly 100 meters from the edge of the Pacific Coast Highway. Data was collected once a day for five days at 4:00 pm. Dark adapting cuvettes, for the Pulse-modulated Fluorometer, were placed on six leaves per individual plant (three cuvettes in the shade and three in direct sunlight), and were allowed to sit for 20 minutes. The Decagon Leaf Porometer was used on three leaves per plant, collecting data on stomatal conductance (measured in $\mu mol/m^2s^-$) and leaf temperature. After 20 minutes, the Opti-Sciences Pulse-modulated Fluorometer was connected to each dark-adapting cuvette and the maximum quantum yield (fv/fm) for PSII in each leaf was recorded. Additional data on individual plant height were taken once, using a meter stick.

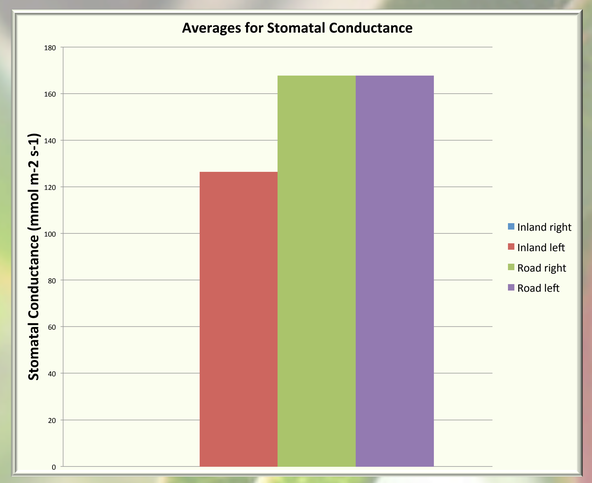

Figure 1: Averages for Stomatal Conductance-Porometer Readings. Leaves *Malosma laurina* plants growing near the road showed porometer readings that were higher on average than the porometer readings of the *M. laurina* leaves of plants growing 100 meters inland from the road.

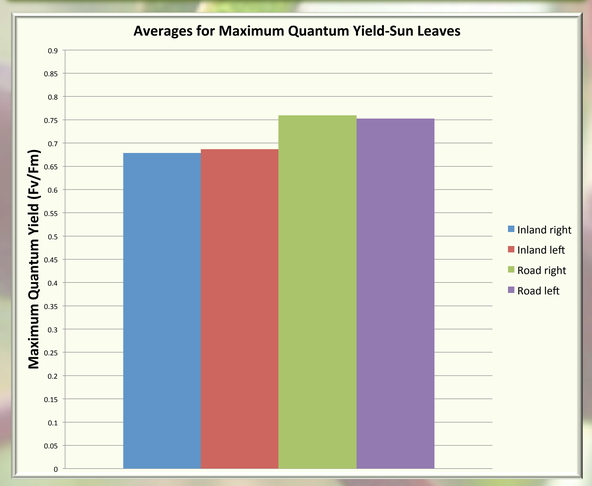

Figure 2: Average for Maximum Quantum Yield (Fv/Fm) for Sun Leaves.
Leaves of *Malosma laurina* in the sun on plants near the road showed a higher maximum quantum yield (Fv/Fm) than did the *M. laurina* leaves of the plants located 100 meters inland from the road.

Results

Figure 1 is a graphical representation of the averages of porometer readings on the leaves of *Malosma laurina* plants tested. The leaves of *M. laurina* growing close to the road showed higher stomatal conductance than did the leaves of *M. laurina* growing 100 meters away from the Pacific Coast Highway. The largest average difference between the stomatal conductance's of *M. laurina* growing close to the road and *M. laurina* growing 100 meters away from the road was 41.35 mmol $m^{-2}s^{-1}$, as can be seen in Figure 1.

The quantum yield (Fv/Fm) of the leaves of *Malosma laurina* by the road showed a higher quantum yield than the leaves of *M. laurina* located 100 meters away and in the sun at the time of measurement. The largest average difference between the sun leaf quantum yields of the leaves growing near the road and those growing 100 meters inland from the road was 0.081.

Similarly, the quantum yield (Fv/Fm) of leaves of *M. laurina* in the shade (by the road) showed a higher quantum yield than the leaves 100 meters away from the road and in the shade at the time of measurement.

To sum up, sun leaves of plants by the road had 9.7% higher Fv/Fm values, and shade leaves had 5.63% higher Fv/Fm values than the plants further into Bluff's Park. C

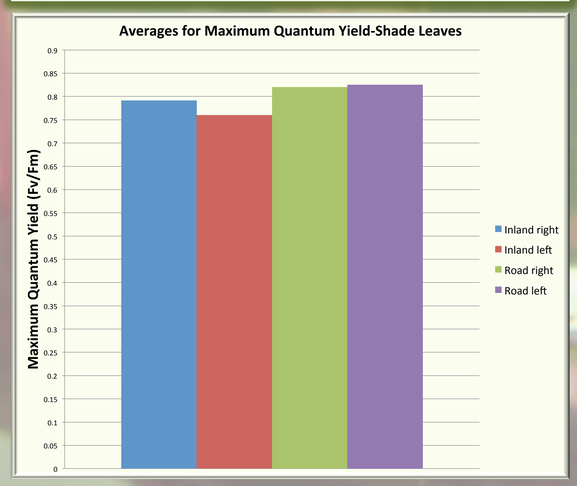

Figure 3: Averages for Maximum Quantum Yield (Fv/Fm) for Shade.
Leaves of *Malosma laurina* in the shade on plants near the road showed a higher maximum quantum yield (Fv/Fm) than did the *M. laurina* leaves in the shade of the plants located 100 meters inland from the road.

Discussion

The averages of our data did not show any significant correlation between plant health and distance from the Highway. Although *M. laurina* in the sun by the road averaged 9.7% higher maximum quantum yield (Fv/Fm) than their 100-meter-from-the-road counterparts, and *M. laurina* in the shade averaged an Fv/Fm that was 5.63% higher, the results over five days were not high enough to conclusively prove that *M. laurina* grows healthier next to a the Pacific Coast Highway. If anything, our data shows only a minor difference in health (>10% difference). Porometer data was also inconclusive. It can be pointed out that four of the five days resulted in a roadside specimen having the highest stomatal conductance reading (the exception being day two, which showed the inland-right plant to have the highest stomatal conductance). However, the Porometer data is far too random to make any assumptions about overall health of the plants.

A very simple way to correct this experiment, in the future, would be to take many more data samples. The literature suggested that there should be significant differences in plant health between plants growing near a Highway and those growing +100 meters from it. If the study were to be repeated it should be conducted over the course of several months, if not a year. Also, it was observed in the field that plants farther from the highway exhibited more foliage death, and what appeared to be intervenial chlorosis, or the deficiency of minerals in parenchyma cells between leaf veins. Further research should be conducted on soil pH along side the Pacific Coast Highway versus soil pH 100 meters from the road and mineral content in stated areas to see if there are any correlations.

Conclusions

- *Malosma laurina* growing on the edge of the Pacific Coast Highway exhibited an average Maximum Quantum Yield that was 7.6% higher than those growing 100 meters from the edge of the Highway.
- Decagon Porometer data did not support any distinct correlation between *M. laurina* leaf health and distance from the Pacific Coast Highway.
- The data did not support the hypothesis that *Malosma laurina* leaves are less healthy when growing by the side of the Pacific Coast Highway, as opposed to growing a certain gradient (+100 meters) away from the edge of the Highway.
- Leaves of plants growing +100 meters from the edge of the Pacific Coast Highway exhibited more extensive leaf death and yellowing, and exhibited numerous brown spots that were rarely seen on leaves of *M. laurina* specimens near the road. Another suggested field study would be on the pH and soil mineral content near the Pacific Coast Highway and +100 meters away.

Acknowledgements

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