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# Measuring Performance of a Weedy Species (*Nicotiana glauca*) vs. a Native Species (*Venegasia carpesioides*) on the Pepperdine Campus

PEPPERDINE  
UNIVERSITY

Emily J. Blair, Zach G. Coffman, and Celina Y. Jones

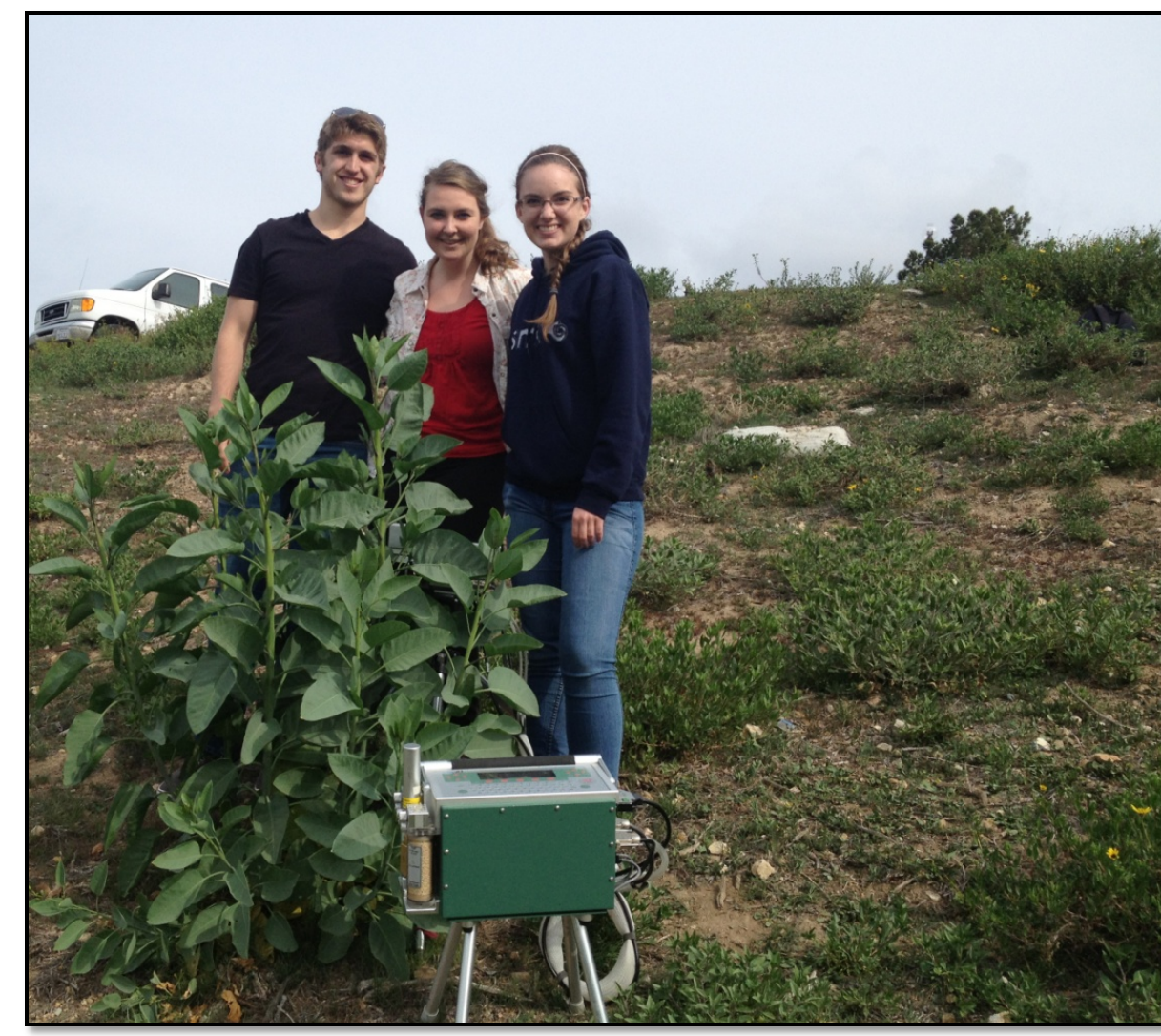
## Abstract

This study investigated four different mechanisms of growth performance of a native chaparral species, *Venegasia carpesioides*, and a weedy species, *Nicotiana glauca*. The research group hypothesized that one or more of the following variables would be higher for the weedy species than the native species: photosynthetic rate, conductance, fluorescence, and electron transport rate (ETR). This hypothesis was formulated in order to provide a plausible explanation for why weedy species often outcompete native species when grown in proximity to each other, especially in a chaparral environment experiencing drought conditions. This hypothesis was tested by obtaining two groups of each species and testing these variables using a LI-6400XT gas exchange system. The results obtained showed that the photosynthetic rate, fluorescence, and ETR were higher for the native plant species than for the weedy plant species; a Student t-Test showing statistically significant differences between those values, while there was no statistically significant difference for conductance between the two species. Using *Nicotiana glauca* and *Venegasia carpesioides* as model specimens, the results did not support our hypothesis that weedy plant species outcompete native plant species by one of the four mechanistic variables measured.

## Introduction

Weeds are unwanted herbaceous plants that tend to outcompete or hinder the development of native species and natural ecosystems (Harlan *et al.* 1965). They are becoming increasingly problematic to natural environments. Biological control measures have begun in Hawaii to combat the rising issue that weeds present to native species (Markin *et al.* 1992). As weeds present a real threat to native populations, this group intends to study factors that may influence the success of weedy species over native species. The exact biological factors that contribute to the weed's success over the native's success remain unknown and future research is needed (Maillet *et al.* 2002). To try to determine some of the factors that may contribute to a weed's success, fluorescence and electron transport rate were examined to understand if photorespiration has any influence. The effect of stomatal conductance has been studied to show that the stomata fix carbon so that it is more readily available for photosynthesis. It was concluded that the conductance rate should be higher in plants with higher photosynthesis (Wong *et al.* 1979). This group intends to measure conductance and photosynthesis to determine if they affect the weed's capability to survive over the non-weed. Invasive plants in Hawaii have been found to have higher levels of photosynthesis and stronger photorespiration capabilities than native Hawaiian plants, which contributes to higher growth rates (Pattison *et al.* 1998). At Pepperdine University, a similar idea was tested to determine if weeds outperform native species in regards to photosynthesis, conductance, fluorescence, and electron transport rate, rather than just the photosynthesis and photorespiration. We hypothesized that *Nicotiana glauca*, a weed species common to Malibu, would have higher rates in one or more of the following rates than *Venegasia carpesioides*, a native species to Malibu: photosynthesis, conductance, fluorescence, and electron transport. This was tested by recording the above listed values with the LI-6400XT. Statistical analysis was then calculated to determine if there was a statistically significant difference between the weed and the native species.

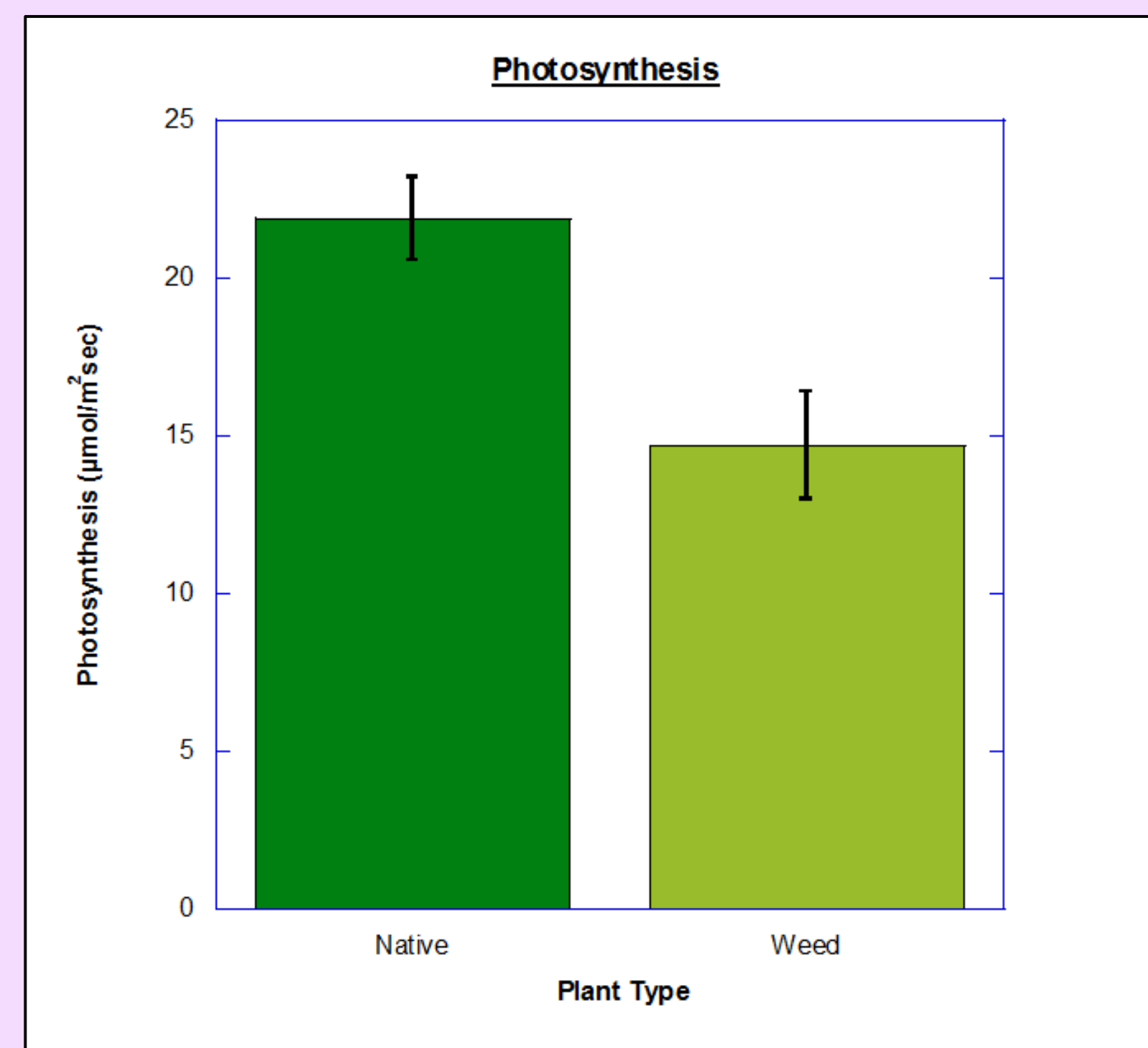
## Materials and Methods



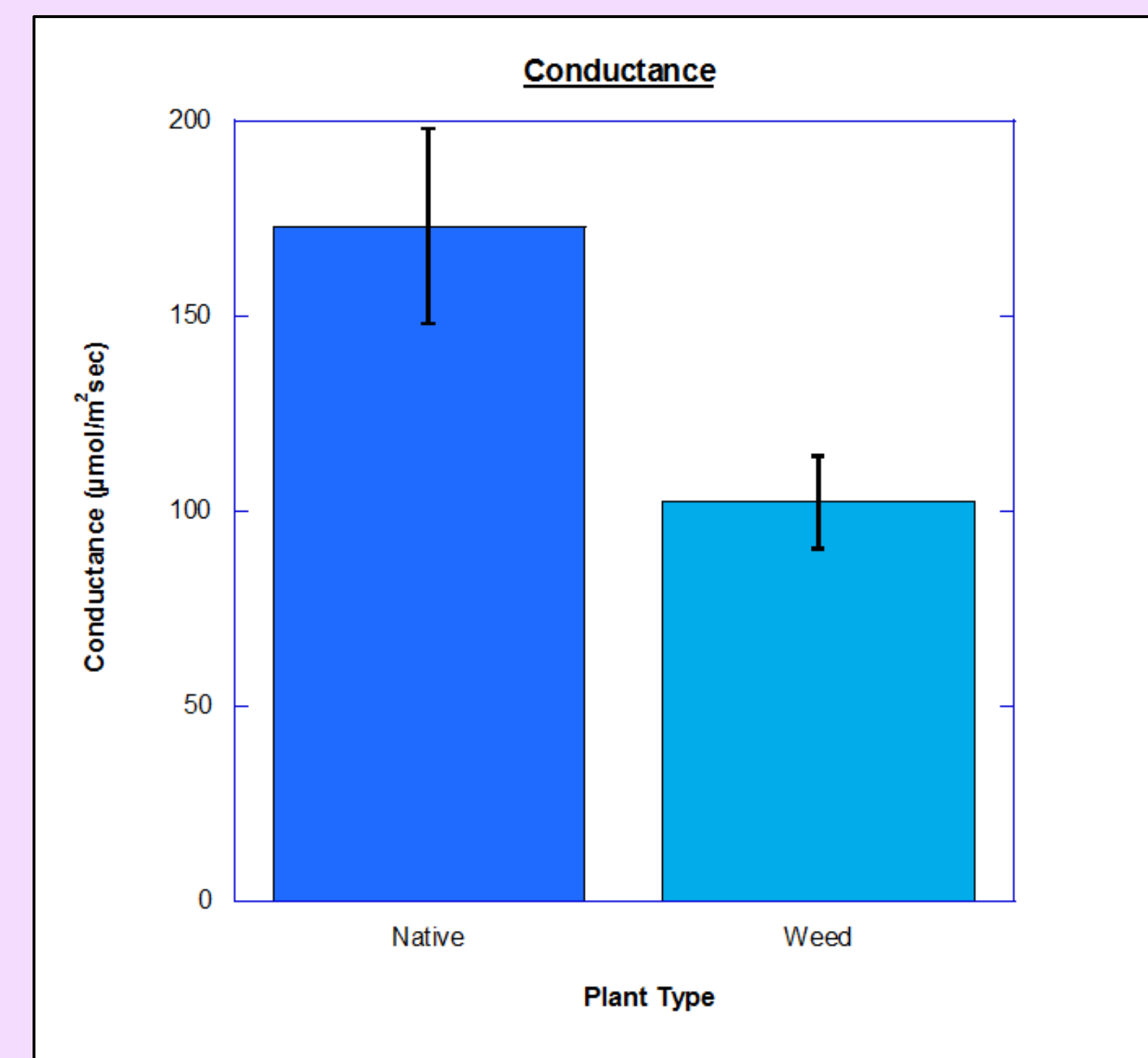
To test our hypothesis that weedy plants would have higher photosynthesis, conductance, fluorescence, or ETR we used the LI-6400XT to find each of these values. Our study site was the hill adjacent to Chapel Lot West, Pepperdine University-Seaver College. We sampled three leaves from three different plants of each species from 9 AM to 12 PM. After gathering data we created a graph of each factor and ran a Student t-Test on each to determine whether or not they were statistically different.



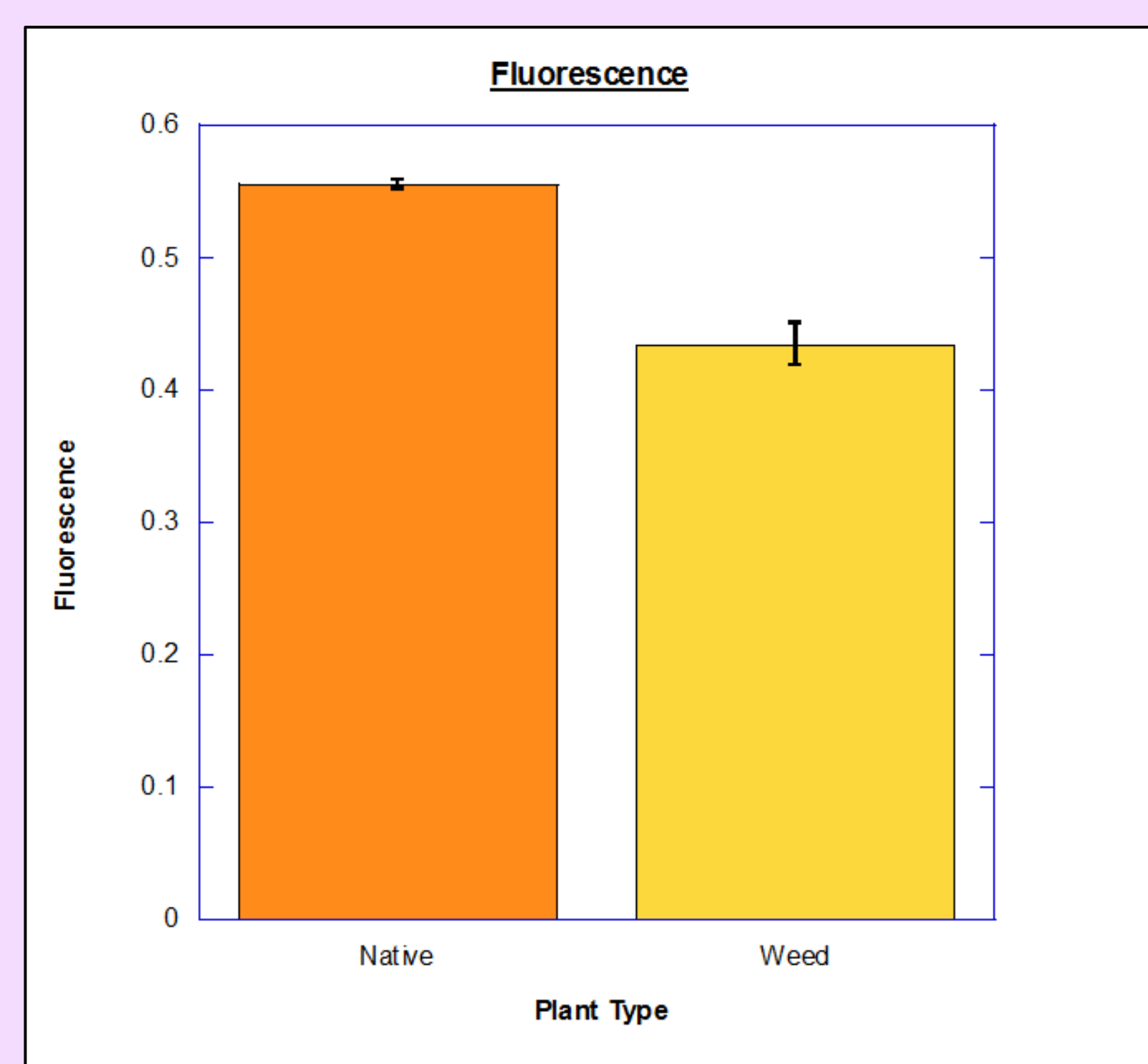
## Results



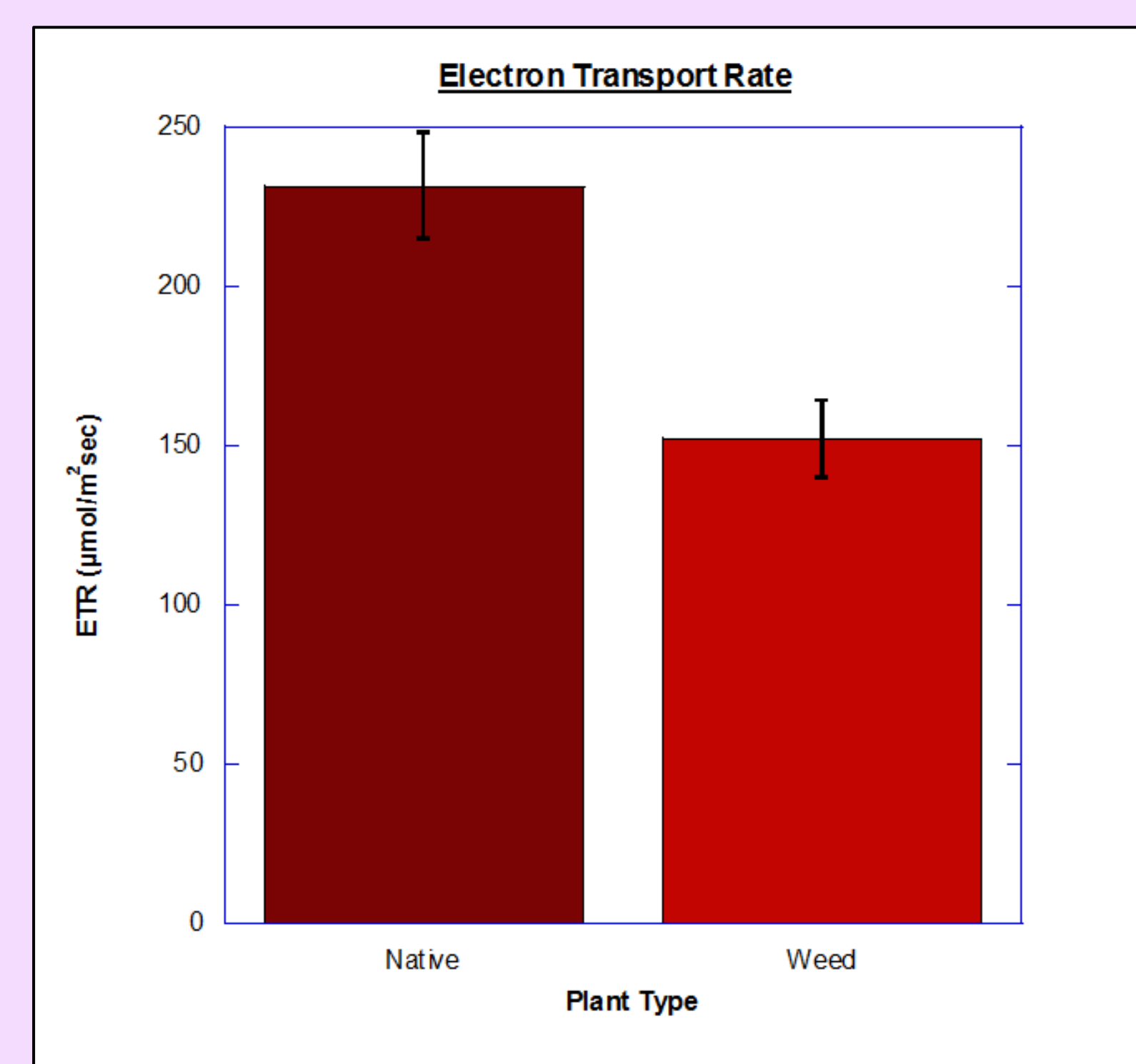
**Figure 1:** Rates of photosynthesis for *V. carpesioides* and *N. glauca*. Error bars show deviation from the mean. The difference between the native and the weed was determined to be statistically significant after running the Student t-Test because  $p < 0.05$ .



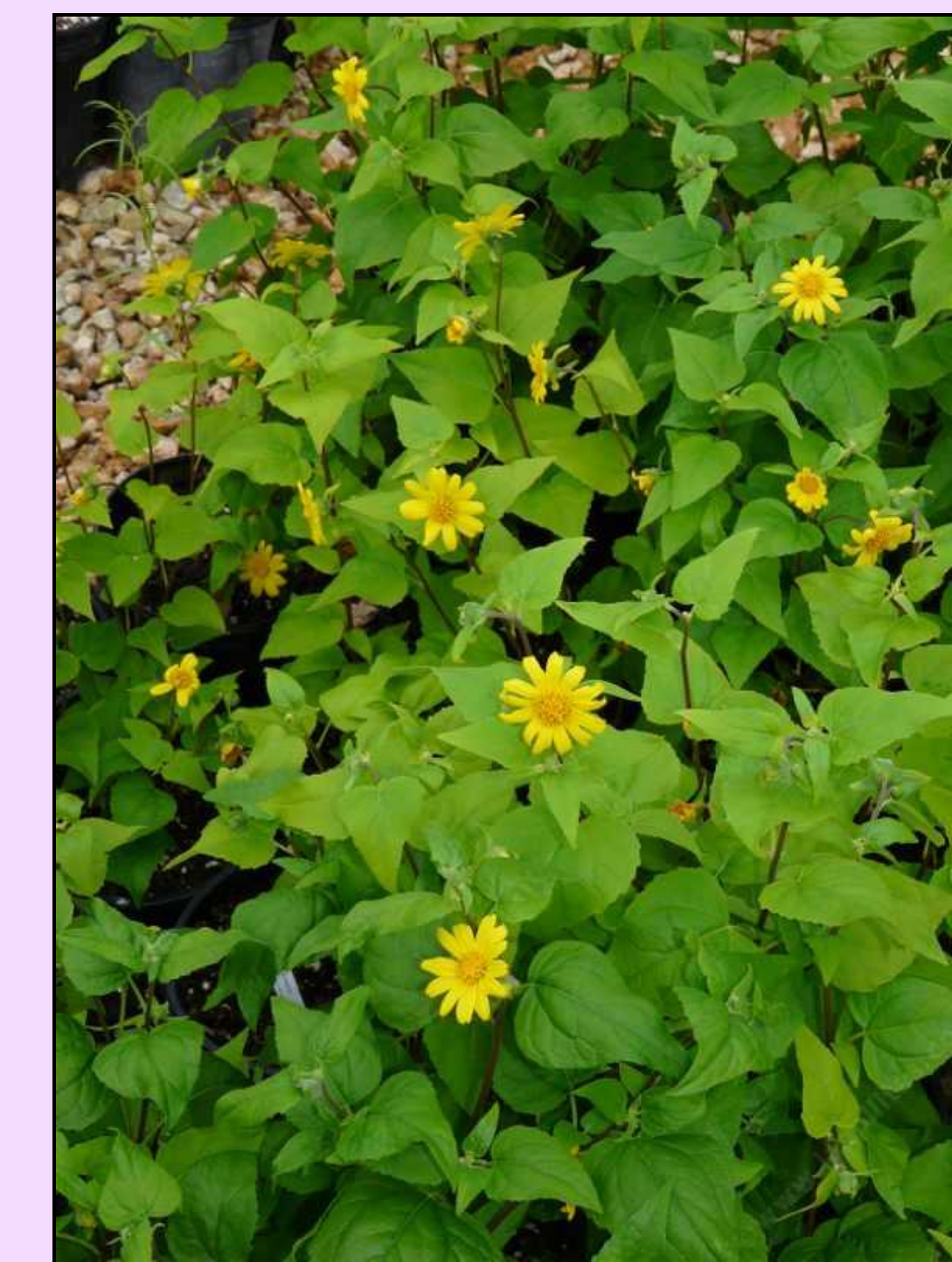
**Figure 2:** Rates of conductance for *V. carpesioides* and *N. glauca*. Error bars show deviation from the mean. The difference between the native and the weed was determined to not be statistically significant after running the Student t-Test because  $p > 0.05$ .



**Figure 3:** Fluorescence measured for *V. carpesioides* and *N. glauca*. Error bars show deviation from the mean. The difference between the native and the weed was determined to be statistically significant after running the Student t-Test because  $p < 0.05$ .



**Figure 4:** Electron Transport Rate for *V. carpesioides* and *N. glauca*. Error bars show deviation from the mean. The difference between the native and the weed was determined to be statistically significant after running the Student t-Test because  $p < 0.05$ .



Native Species  
(*Venegasia carpesioides*)



Non-native Species  
(*Nicotiana glauca*)

## Discussion

When comparing the native species *Venegasia carpesioides* (Canyon Sunflower) to the weedy species *Nicotiana glauca* (Wild Tree Tobacco), four different variables were measured. These variables were photosynthetic rate, conduction, fluorescence, and electron transport rate (ETR). Overall, the data obtained and analyzed by a Student t-Test showed that the native species had higher photosynthetic rates, fluorescence, and ETR. All of these values were statistically different between the two species ( $p < 0.05$ ). However, there was no statistical difference for the conductance rates between the native and weedy species ( $p > 0.05$ ). This did not support our hypothesis that weedy plant species outcompete native plant species by one of the four mechanistic variables tested. Thus, in three of the four variables tested, the exception being conductance, the native *Venegasia sp.* performed better than the weedy *Nicotiana sp.* In *Economic Botany*, Harlan defined weeds as unwanted plants that outcompete native plants; however, our data seemed to disagree with this in regards to photosynthesis, fluorescence, and ETR. From this, we determined that Harlan may have chosen other markers to determine the success of the plant. Additionally we concluded that measuring our plants during the early morning may have affected the quality of the data. The morning we collected data was very cloudy. It had also been previously found that stomata conductance is higher when photosynthesis is higher. Our data seemed to agree with this. After running the Student t-Test, we determined that photosynthesis was higher in the native, but there was no significant difference in the conductance. This could be because the size of the sample was too small, and more subjects would be necessary to have a stronger data set. We also think that the specific species measured may not agree with the overall trend between native and weedy species. Finally, native plants tend to be more well-adapted to their environment than weedy plants. The harsh drought that has been affecting southern California since last fall may have caused these native plants to perform better than the non-native plants since the weeds may be more sensitive to water stress.

## Literature Cited

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## Conclusion

- Photosynthesis, fluorescence, and ETR were significantly higher in the native *Venegasia carpesioides* than in the weed, *Nicotiana glauca*.
- Conductance was found to have no significant difference between the weed and the native plant.
- In the future, the data should be taken at multiple times during the day and of multiple species of both weedy and native plants to minimize confounding factors.
- During harsh drought, native species tend to be more successful than non-native species.

## Acknowledgements

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