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BIOL 1520, Section L6

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November 28th, 2017

Data Suggests Significant Difference in Rates of Transpiration and Stomata Density Between Leaves Under Wind Intensity

Abstract

We hypothesized that plants would have a higher transpiration rate and stomata density for leaves under higher wind intensity. The purpose of this experiment was to determine whether changes in wind intensity can affect transpiration or number of stomata in the plant. This is important because humans are altering environments, specifically wind, through construction of large buildings. The significance of this study was to better understand environmental factors on rates of transpiration for better agriculture practice in environments with limited water resources. The approach taken to the address the hypothesis included taking six sprigs from a *Gleditsia triacanthos* (Honey Locust) tree on the rooftop garden. Then a potometer was used to find the rate of transpiration in five minute trials for each sprig; each sprig was placed under three different trials. The three treatment trials were no wind, low setting on a fan, and high setting on the same fan. Determining stomata density was accomplished by painting clear nail polish on a leaf, drying it, and then examining the leaf under a microscope at 40X to count the stomata. Overall, the average rate of transpiration for the sprig under no wind was 0.0249 mL per minute, low wind was 0.0115 mL per minute, and high wind was 0.034 mL per minute. The statistical

analysis we used was an ANOVA and Tukey-Kramer test and the results were found to be significant ($p \approx 0.037$, $\alpha = 0.05$), and this indicated that there was a statistical difference between the means of the different groups. The Tukey-Kramer test also found that there was a significant difference between no wind vs low wind, no wind vs high wind, and low wind vs high wind. In conclusion this caused us to reject our null hypothesis and indicated that wind intensity did have an impact on rate of transpiration.

Methods

The overall experimental design was measuring rate of transpiration and stomata density of the Honey Locust tree under different wind intensities to determine whether changes in wind intensity can affect transpiration or number of stomata in the plant. Six sprigs were taken from the same section of a *Gleditsia triacanthos* (Honey Locust) tree, and their rates of transpiration were measured using a potometer. The potometer was put together under water to avoid any air bubbles from interfering with the data, and the measurements taken were readings of water that exited the potometer. Three trials were run for each sprig for five minutes. The three trials corresponded to the treatment which included the control (no wind), low wind, and high wind intensity. To measure stomatal density, a leaf was taken from each sprig and a swatch of clear nail polish was painted over the underside of the leaf. Then we conducted a leaf peel procedure to examine the leaf under a microscope at 40X, and the number of stomata in 1 cm^2 circle of the leaf were counted twice for each leaf. Then an ANOVA test was conducted on all groups and a threshold of $\alpha = 0.05$. In addition, the Tukey-Kramer test was also ran to find significant differences between pairs of treatment groups and also had a similar threshold of $\alpha = 0.05$.

Results

Overall, the rate of water loss of sprigs under high wind was higher than sprigs under low wind and no wind. The sprig under no wind was on average 0.0249 mL per minute, low wind was 0.0115 mL per minute, and high wind was 0.034 mL per minute [Fig. 1]. An average of 76 stomata were on the leaves of our plants of the wind springs and an average of 64 stomata for no wind plants [Fig. 2]. The ANOVA and Tukey-Kramer test was conducted on the rates of transpiration and the results were found to be significant ($p \approx 0.037$, $\alpha = 0.05$), and this indicated that there was a statistical difference between the means of the different groups. The Tukey-Kramer test also found that there was a significant difference between no wind vs low wind, no wind vs high wind, and low wind vs high wind [Fig. 1].

Discussion

We hypothesized that plants would have a higher transpiration rate and stomata density for leaves under higher wind intensity. The p-value from the ANOVA was 0.037 which is less than alpha value of 0.05 [Fig. 1]. Since the p-value was less than the threshold, the null hypothesis was rejected. An average of 76 stomata were on the leaves of our plants of the wind springs and an average of 64 stomata for no wind plants also corroborated our initial hypothesis [Fig. 2]. Similar results were seen by a study conducted at University of Nairobi where they were examining the effects of wind and temperature on cuticular transpiration of *Picea abies* and *Pinus cembra* found that increased wind speeds resulted in slight increases in water loss. This study directly supports our initial hypothesis. The reasoning behind these our results are that increased wind intensity most likely decreases the water potential outside the cuticles which increases the rate of transpiration due to diffusion, and this most likely could be reasons behind the study conducted at the University of Nairobi which had similar results.

Despite this data, more trials should be run to ensure accuracy in the conclusions. The focus of air being blown changed several times when the position of the fan was moved which could have affected the data. The sprig under high wind had bigger leaves and more surface area than that under low wind, which could have affected the rate of water loss. Future improvements that could be made for this experiment is conducted the experiment in a contained setting and having much more levels wind intensities. Sources of uncertainty could include the temperature of the room we were present in and the sprig's different locations on the plant could have affected the data as well. This data is important because it provides insight into how the plant responds to varying environments, and possibly a basis for growing plants in certain climates.

Figures and Tables

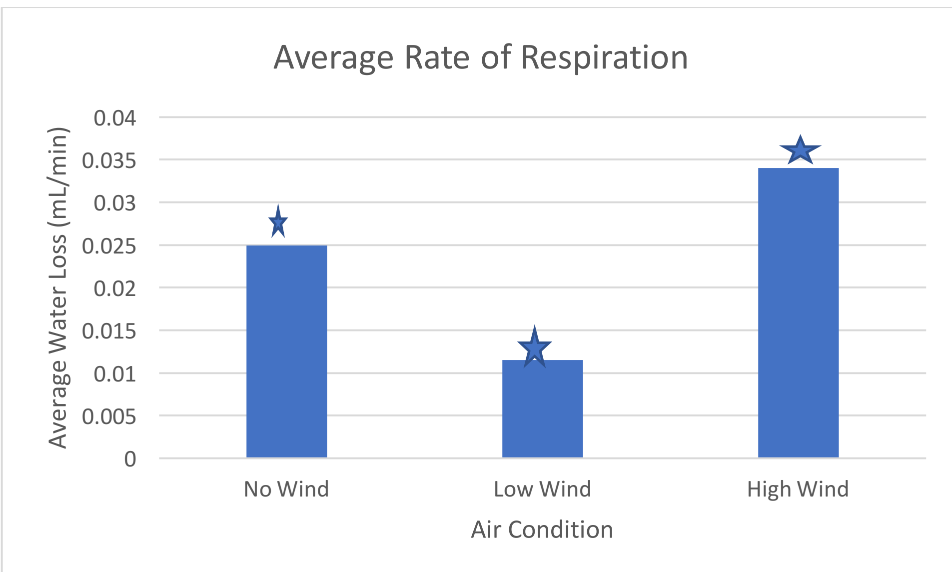

Figure 1. Average Water Loss in Leaves Under Different Wind Intensities. Six sprigs from a *Gleditsia triacanthos* (Honey Locust) tree on the rooftop garden, and then a potometer was used to find the rate of transpiration in five minute trials for each sprig; each sprig was placed under three different trials. The ANOVA found a significant difference between the means of the group ($p \approx 0.037$, $\alpha = 0.05$).

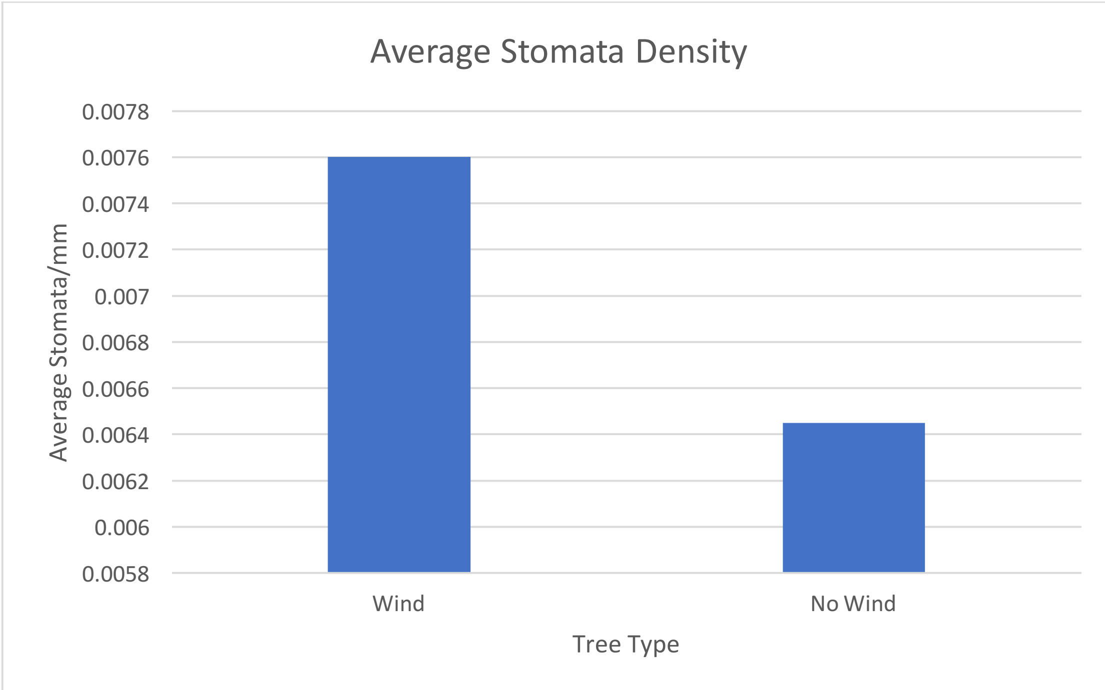

Figure 2. Average Stomata Density. We examined the leaf under a microscope at 40X, and the number of stomata in 1 cm^2 circle of the leaf were counted twice for each leaf.

References

1. Baig, M.N. & Tranquillini, W. Oecologia (1980) 47: 252. https://doi.org/10.1007/BF00346828

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Saivardhan Mada