Stomata Density in Shade vs Sun Leaves

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Introduction

Plants are autotrophic eukaryotes; they make their own food and have a nucleus and membrane-bound organelles. There are many different types of plants and different ways to group plants for example, vascular plants like ferns which have a specialized vascular system that transports water and food and nonvascular plants like mosses which do not have any specialized tissues for transportation (Mpala Live, 2022). Another example of grouping is sun and shade plants, some plants will grow in direct sunlight, and some will grow in the shade.

Photosynthesis is a process where plants take in carbon dioxide and water and make oxygen and energy. (National Geographic Society, 2019)

Stomata are an essential structure for plants, it helps plants exchange carbon dioxide and water vapor. In many plants, stomata are usually open during the day because that is when photosynthesis is occurring, and the stomata close during the night. When the stomata are open is allows carbon dioxide to enter and water and free oxygen to leave. Environmental factors like temperate, water availability, light may affect stomatal development.

My group studied the effects of environmental variation on stomata density. More specifically the difference between stomata density in leaves of plants that are entirely in the sun and in the shade. Sun and shade plants have differences. According to Science and Plants for Schools, shade leaves are larger in area, thinner, and have larger stomata than sun leaves. So, they can collect as much light as possible. Their stomata are larger to help compensate for the loss of sunlight (Setiawati et al., 2018). Sun leaves are thicker than shade leaves because they develop an extra layer of leaf cells.

Without stomata plants would not be able to photosynthesize because it would not be possible to exchanges gases, Photosynthesis is a crucial process for not only plants but life on Earth, it releases oxygen into our atmosphere which is a necessity for the survival of life, and it provides energy for food chains. Also, photosynthesis is important for plants it is how they make their food, and without photosynthesis there would be no plants. We (humans) depend on plants for food and "…other necessities of life as well—fuel, the fibers used to make clothing and other products, building materials, and pharmaceuticals" (Freeman et al., 2016).

Natural disasters like droughts and floods can affect the environment that plants live in. Also, climate change has increased global temperature which has made harsher environments for plants to live in (National Park Service, 2021). Because the environment affects photosynthesis, and stomata play an important role for photosynthesis we can study how stomatal density is affected by environmental factors more specifically sunlight vs no sunlight. We can come up with a correlation and relationship which can help us understand and maybe manufacture and come up with solutions and different ways for plants to live in these harsh environments. For example, if we find that plants have higher stomatal density which helps them do more photosynthesis in the shade, we can start installing roofs or some type of cover to help the plan photosynthesize more. If we can find ways to help plants survive more this will help us (humans) get the things we need from plants.

Prediction

If I compare the density of stomata in ten different sun and shade leaves, I will find that the sun leaves will have a higher mean density of stomata than the shade leaves.

Method

To obtain our data, we first had to collect samples for our leaves. We collected all our samples from gardens and plants around the Montgomery College campus, we collected 24 samples in total 12 for the sun leaves and 12 for the shade leaves. We made sure to collect samples for leaves that specifically are only in then sunlight and shade. For the shade plants we looked in spots where the building would block sunlight from shining on the plants. We also looked where there is a roof or some sort of cover over the plants. For sun leaves we looked in places where there were no roofs and more towards a field or the outside perimeter of the campus where there would be no physical shade possible. We made sure that for each group we had a different species of plant to ensure variability.

To be able to count the stomata we needed to make leaf impressions. To make the impressions we used nail polish. We painted a thick layer of nail polish on the underside of each leaf and placed a square of clear tape on the layer of the nail polish. We then peeled the tape and placed it on a clean slide. We made sure to mark each slide, so we did not lose track of the groups.

We then looked at each slide under the microscope and looked for an area with the highest stomata density. For each slide we used only the 40X objective lens to count the density. We counted all the stomata for each slide and recorded the data on a table, we counted each slide three times and used the highest count for each slide.

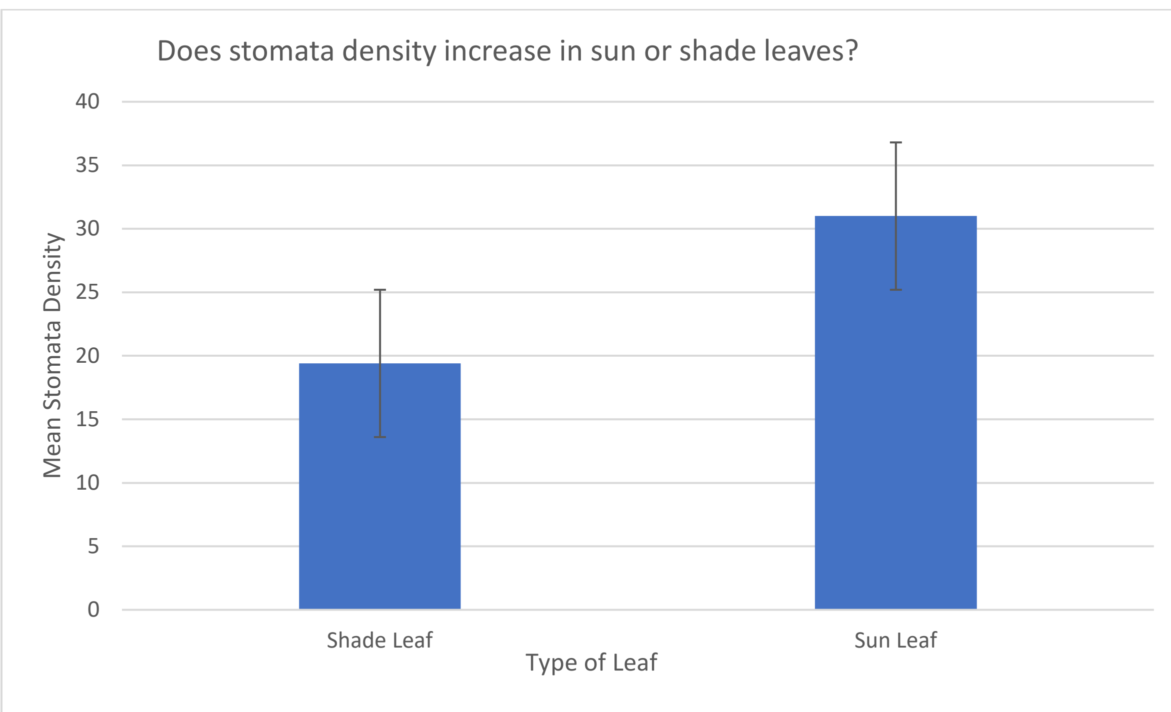
Results

We found that the mean stomata density of the shade leaves was 19.4 and the mean stomata density of the sun leaves was 31. We found that the highest number of stomata in the sun leaves was 73 and the lowest was 12. We found that the highest number of stomata in shade leaves was 37 and the lowest was 11. We found that the t-test p-value was 0.0328.

Table

Leaf Impression Number	Stomata Density of Shade Leaf	Stomata Density of Sun Leaf
1	14	73
2	15	33
3	25	28
4	22	33
5	11	16
6	14	25
7	21	28
8	22	12
9	37	27
10	13	35
Mean	19.4	31
T-test p-value	0.032826664	

Graph



Discussion

We found that the mean stomata density in sun leaves was higher than in shade leaves. This is because plants will adapt to different environmental factors to help them survive in different areas. According to (Texas A&M AgriLife Extension, 2020) 70 degrees and 80 degrees °F are range for when plants grow best. To help them survive better in a higher range of temperature the plants that are in the sunlight have adapted to have a larger density of stomata in their leaves. This change will occur in the stomatal density because it will help plants to manipulate their leaf temperature as when the stomata open water will evaporate cooling the leaf down. Plants need to cool down because important structures like their cytochromes, pigments, and membrane proteins (Vatnick, 2004) will get damaged from high temperatures. Plants that are in sun light will do more photosynthesis, and therefore will do more gas exchange, more gas exchange means more stomata, so we found that mean was higher in sun leaves because they are doing more photosynthesis than plants that are in shade.

The data does support my hypothesis, we see this because the mean stomata density in sun leaves is 31 which is higher than the mean stomata density in shade leaves which is 19. Also, the t-test p-value was 0.0328. The p-value is less than 0.05, we so reject null hypothesis that there are equal amounts of stomata in the sun and shade leaves which supports my hypothesis.

Although we tried collected 12 samples for each group, we were not able to use all 12 because the leaf was too waxy or too little to obtain a leaf impression, so we had to throw them away. Also, one leaf did not transfer well after peeling the tape none of the nail polish transferred well. Other than completing the experiment with more caution, controlling more variables will ensure a more account experiment. Choosing plants that are the same age can help make the experiment more accurate. If the plants are different ages that may affect the stomatal density maybe the older one will have less stomatal density or vice versa due to again cells. Also making sure that all the plants have received the same amount of water, since some of the plants collected were under a roof or a shade of some sort no rain would reach them which may be a factor in their stomatal density.

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