Deborah Sides 10JL

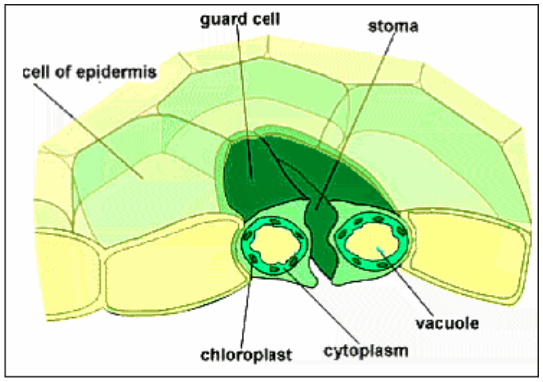
INVESTIGATING THE AMOUNT OF STOMATA ON A VARIETY OF DIFFERENT SIZED LEAVES

Introduction

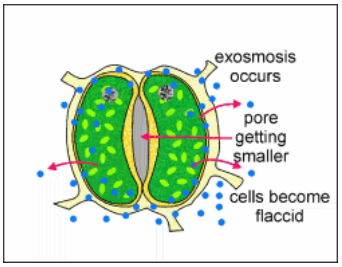
During this experiment I am going to investigate the stomata on a large leaf and a small leaf from the same plant to compare the amount of stomata per mm². The stomata are small openings found in the lower epidermis of leaves. Each stoma is surrounded by two bean-shaped guard cells containing chloroplasts. A stoma is a very efficient structure because it can control the rate of transpiration (water loss) and the exchange of gases. When it closes, no transpiration occurs. When it opens, transpiration takes place. The stomata open to allow carbon dioxide into the leaf for photosynthesis and to allow oxygen out.

How Stomata work:

The opening and closing of the stomata is controlled by changes in pressure within the guard cells. Photosynthesis occurs in the chloroplasts of the guard cells. Sugars, formed during the day in chloroplasts, lower the pressure in the guard cells. The carbon dioxide amount is low, causing the pH to rise to more alkaline. The low carbon dioxide level means the guard cells have to absorb water from the surrounding epidermal cells. The pressure in the cells increases, causing them to become hard. Pressure occurs on the thin, outer walls, which pull and stretch outwards. The thick, inner walls stretch, pulling away from the pore, causing it to open. This means the stomata is now open for transpiration and the exchange of gases. When it becomes night transpiration stops and the stomata must close again. Respiration begins to occur within the leaf. This increases the carbon dioxide concentration which causes the pH to become more acid. This causes the sugars to change into starch, reducing the pressure of the guard cells and the cells become soft. The thin outer walls lose pressure which causes the thick inner walls to close, meaning the stoma is now closed and now more water is lost, therefore controlling the balance of water within a leaf.



A cross-section of stomata



Prediction

I predict that the bigger leaves will have more stomata because it is the bigger leaves that help most during photosynthesis. The smaller leaves are not as important therefore they will not need as many stomata per mm². The bigger leaves are more important to the plant as they have a larger surface area which means that they can absorb much more sunlight than the smaller leaves, therefore they need more stomata to control the water levels. I think that the number of stomata per mm² in each size of leaf will vary quite a bit because I think that the younger leaf will not need near as many of stomata as the younger leaf as I think that transpiration is less important to a younger leaf.

Method

1. First of all I am going to collect two leaves from the same plant. The leaves I will use are from the plant Tradascantia. I am going to obtain a larger leaf and a smaller leaf enabling me to compare them.
2. I am then going to use clear nail polish to paint a thick layer of varnish on the underside of the leaf. I am going to paint 5 dots which will give me a wider range of results enabling me to make sure that the test is fair and I am able to spot any odd results. Each dot is going to be around 1mm² though this may have to be reduced if the leaf is too small.
3. I am then going to allow the nail varnish to dry for 15 minutes to make sure it is dried completely.
4. When the nail varnish is completely dry I am going to peel it off using a pair of forceps.
5. When the nail varnish has been removed from the leaf I am going to place it on a microscopic slide and then keep it in place using a section of clear sticky tape fixed over the sample.
6. I am then going to place the slide under a microscope at a magnification of 40x to get the best results.
7. I am then going to study the stomata and I am then going to use some mm² acetate to count how many stomata there are per mm². I will then record my results in a table and show my results on a graph.

Results

On graph paper

Analysis/Conclusion

By looking at my results I can draw out a number of conclusions that involve the number of stomata per mm² on the underside of two different sized leaves.

Firstly I am going to look at my results which show how many stomata per mm² on each patch on both the bigger and smaller leaf. Straight away I can see that the bigger leaf has more stomata per mm² than the smaller leaf. This links back to my prediction as I predicted that the bigger leaf would need more stomata for transpiration and the exchange of gases. The bigger leaves will absorb much more sunlight as they have a bigger surface area consequently they have more chloroplasts. Therefore they must be able to take in lots more water to keep the water levels in the leaf balanced. The bigger leaves also need a larger surface area for the exchange of gases during photosynthesis. They need to produce as much food as possible therefore it is important that these leaves absorb as much carbon dioxide as possible. The bigger leaves therefore need more stomata to increase the amount of gases that can be exchanged and to have a more controlled water balance.

The next thing I noticed that within each leaf all the results where very similar and compact, there was not a wide range of results. In the bigger leaf the range was 3 and in the smaller leaf the range was 4. This shows that in different parts of the leaf the amount of stomata per mm² stays the same. There was some variable which shows that different parts of the plant do have different numbers of stomata per mm² but the difference is not very significant. It also shows that my results where accurate and I had no odd results.

I am also able to look at the averages for each leaf and I can see that the averages for the two leaves do not differ very much. The average number of stomata per mm² for the bigger leaf is 14 and the average number of stomata per mm² for the smaller leaf was 10. I expected a much bigger difference between these numbers as I thought that the number of stomata would vary much more.

The plants where being kept in a warm dry environment and this will have made the plants transpire more. When I looked at the stomata I saw that all the stomata were open which plant the plant was transpiring. If this continued and the plant was not watered the plant would begin to wilt because it is losing more water than is being taken in.

Another observation that I made while studying the stomata is that the stomata in the bigger leaf where much more raised, where as the stomata in the smaller leaf were much flatter. This shows that the smaller leaf was transpiring more at the time than the bigger leaf. During transpiration the pressure in the cells increases, causing them to become hard. This causes the thin outer walls to pull and stretch outwards and the thick, inner walls stretch, pulling away from the pore, causing it to open. This would give the appearance of the stomata being much flatter as they are stretched out.

Evaluation

I think my experiment worked quite well, but I don't think the results where accurate enough. I think one reason for this is because we were rushed for time which meant we could only count the stomata once so mistakes could have been made and we weren't able to double-check our results. Also we had very limited results which meant it was harder to draw a conclusion from the results we did have. By looking at me results I did not notice any odd results as by doing 5 patches from each leaf I am able to see that they were all very similar. Something that I was surprised about was that there was not a great difference between the averages. One reason this may be because the size of the leaves did not vary as much which would be needed to see a considerable difference. If I was to do this experiment again I would vary the size of the leaves much more to see if that made more of a considerable difference. Because the results are so similar, I have realised that it is just as important for younger leaves to transpire as much as it is for the older and bigger leaves.

I could have improved my experiment by planning more as I was unaware that it would take so long so I don't think I used my time very wisely which meant I was unable to get adequate results, I thought I would be able to get a lot more done. I was absent for one lesson which also meant I was unable to take part in some of the results collecting. I would also select more samples from the same type of plant so that my results would cover a larger area. It would also make my results fairer because taking results from lots of different leaves would mean that any leaves that had maybe less water or where dying would be able to be noticed and the results would not be noted from that particular leaf. From the experiment I did there could be the problem that maybe one of the leaves was less strong than the other and this may affect the amount of stomata per mm^2 so my experiment could be more accurate. This may also be another reason that there wasn't a great difference between the number of stomata per mm^2 on the small leaf and the number of stomata per mm^2 on the bigger leaf.

I think that my readings were adequate enough to be able to see that a bigger leaf does have more stomata but I would have to carry out further experiments to investigate this further and perhaps get a clearer conclusion.

I would be able to extend this experiment with a different investigation by testing leaves from other plants and seeing if the plants environment affects the number of stomata. By carrying out this investigation it would provide me with a much clearer idea of how stomata work and what affects them, whether it is size of leaf, environment or a combination of other things as well.