Ivy Plants.

Prediction:

I predict that the ivy plant that grows on the south side of the wall will be smaller than the north facing ivy. This is because they have less limiting factors affecting them such as availability of light. The south side ivy have no problem with availability of light as the earth is tilted on its axis facing the sun, so this side has more sunlight. The purpose of the leaves to be able to photosynthesise, so I think that the north leaves will be bigger in size as they need a larger surface area in order to photosynthesise at the same rate as the smaller south ivy.

Conclusion:

For the ivy growing on the north side of the wall the results are generally very varied. The graphs show skewed results, as there is an uneven distribution of growth by the plant, and there is no pattern between the data collected. Between 50-80mm on the north petiole length there are more results, with the highest amount being 6 petioles at 75-80mm in length. The north leaf length has the most in the group 30-35mm with 11 petioles in this category. Again there is an uneven distribution, but the numbers seem to decline, as the length gets bigger. The common width is between 40-45mm with 9 and most of the ivy plants having a leaf width of 35-70mm before we see a significant decline at 70-75mm with only one plant.

The ivy growing on the south side has results, which aren't as varied as the north side ivy. There is a much more even distribution amongst the plants. This suggests to me that they have less limiting factors acting against them. These limiting factors can affect he rate of photosynthesis in a plant, these factors can be light intensity, carbon dioxide levels and temperature. The equation for photosynthesis is:

$$CO_2 + H_2O \xrightarrow{\text{Light}} O_2 + C_6H_{12}O_6$$

This equation shows that you need the input variables, which in this case is carbon dioxide and water to produce the output variables that are oxygen and glucose. Both light intensity and carbon dioxide levels feature in the equation but temperature doesn't. However photosynthesis is driven by enzymes that work better in warmer conditions, but if the temperature is too hot they become denatured and therefore cannot carry out their function.

The south petiole length of 25-30 mm and 30-35mm have the same number of ivy, which is 11. With 20-25mm and 35-40mm with 9 and 8. This instantly shows a different picture to the north graphs as their results didn't steadily increase and decrease but grew statically and erratically. The south leaf width between 30-35mm there was 14 plants, this was the highest number in the group and the south leaf length had also 14 plants but this time in the 35-40mm group.

If I compare the highest number of results for leaf length, with and petiole for the north and south. I can see that there is a considerable amount of difference in the sizes of the leaf.

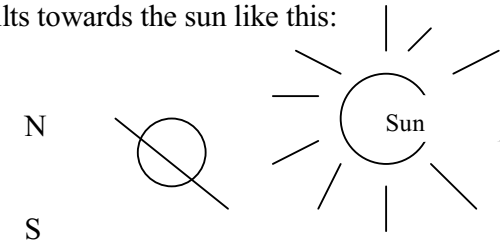
	North		South	
Petiole	*75-80mm*	6/50	*25-30mm 30-35mm*	11/50
Width	*40-45mm*	9/50	*30-35mm*	14/50
Length	*30-35mm*	11/50	*35-40mm*	14/50

Using this table I can see that the south side growing ivy has grown at similar sizes ranging from about 25-40mm. Whilst the north side ivy ranges from 30-80mm which is a 50mm difference on the north side and 15mm on the south side. This tells me that there are more limiting factors affecting the ivy plants on the north side of the wall.

Factors affecting the growth of the ivy on the north side of the wall can be temperature, water and carbon dioxide. All these factors are needed in photosynthesis as shown by the equation.

$$CO_2 + H_2O \xrightarrow{\text{Light}} O_2 + C_6H_{12}O_6$$

Plants need to photosynthesise they use the energy for carbohydrates, proteins and fats. If there is an increase or decrease in temperature the enzymes that catalyse this process are denatured. This means that photosynthesis is affected. Also plants need sunlight to photosynthesise so as there is more sunlight on the south side of the wall. I know this as the sun tilts towards the sun like this:



This can show why the petiole lengths are longer as they need to grow longer so that their leaves can reach the sunlight to photosynthesise. This agrees with my prediction as I said that the south side plants would be smaller than the north side plants. This is also proven by the averages of each category shown below in a table.

Averages	North ivy	South ivy
Petiole length	75.1	31.8
Leaf length	46.9	34.66
Leaf width	61.36	31.96

In each category the averages show that the North ivy has a larger petiole length, leaf length and width, as it has had to adapt to its surroundings due to factors affecting it. So this table of results shows that my prediction is correct, as the ivy on the south side of the wall is smaller than the north facing ivy.

Transpiration can also be another limiting factor in this process. Transpiration is the loss of water from a plant. It is caused by evaporation of water from inside the leaves via the stomata. The biggest rate of transpiration occurs in hot, dry and windy conditions. To prevent this from occurring plants have a waxy layer (cuticle) on their leaves, which stops them losing too much water. You will find the plants in hot climates have to adapt by having a thicker layer of wax. This can affect the ivy leave because there will be more water vapour on the south side as temperature is higher, so the air is more saturated causing less transpiration to occur. The north leaves have a large surface area that can aid transpiration but they have long petioles that restrict surface area to make transpiration more difficult, this is an example of a plant adapting to its environment. So the north ivy leaves are more varied than the south as shown by the results, proving my prediction correct.

The results confirm that my prediction is correct. This is due to the earth's tilt on its axis causing the availability of sunlight to be more limited on the north side. This caused the north ivy to grow larger leaves and petioles to deal with the situation, as they would need a bigger surface area to trap the sunlight for the photosynthesis process and longer petioles to reach the sunlight on the south side of the wall. This is shown by the results, which is portrayed by the graphs. In conclusion the petiole lengths, leaf widths and lengths are larger on the north facing ivy wall than the south facing ivy wall, due to the North side being in shadow because of the Earth's axis. Which in turn causes the lengths to be longer and bigger to be able to complete the photosynthesis reaction with the sunlight obtained.

Evaluation

The results show that the generally the sizes of the south ivy are smaller than the north ivy. This is due to the position of the leaves on the wall and what factors have affected their growth. The most important factor that I think caused a difference in these plants is the availability of sunlight due to their position, north or south. This is devised on the fact that my results only show the sizes that the leaves and petioles grew to. If the experiment was done again, then temperature and availability of sunlight could be measured. I would measure sunlight and temperature levels with the use of a solar meter. If the levels recorded were different for example the south receives more sunlight and has a higher temperature this would justify my conclusion. As I said that there are more limiting factors affecting the north ivy plant and sunlight is needed for photosynthesis, and temperature to catalyse the enzymes needed for photosynthesis. This is shown by the results, as the north petiole lengths are longer as they need to grow further to reach the sunlight.

As I myself did not carry out the experiment I have to take into consideration that it was done as a fair test and with the same variables used each time, for example the same ivy plant used to measure leaf length and width and petiole length. From my graphs I can see that there are some anomalous results, the results of the north petiole length for example. The results seem to increase to a peak of 6 between 75-80mm but the next group between 80-85mm there are no results. But this could be to due to inaccurate measurement of the plant or an error in the data collected. Also another reason for anomalous results is genetic difference, which could be due to the limiting factors that have affect the north ivy plants. As the leaves generally have to grow longer and larger to obtain sunlight for photosynthesis, so some of the leaves may

grow to excess, likewise they may not even grow to the average size at all because of this. Also if the leaves were picked randomly from the top or bottom of the plant this would too make a difference as the top leaves would have more sunlight available meaning they would have a smaller surface area. Finally the results given were as whole numbers so there could be a degree of inaccuracy if decimal places were not used. However as my prediction agreed with the results obtained, I would say that the experiment was successful as my hypothesis that the south side ivy plant would be smaller was correct. This enabled me to write a conclusion with the scientific evidence needed to prove my prediction correct. There was enough data given for me to have some good graphs with many different groups and sizes. This too helped to conclude that my hypothesis is correct; as I could determine a ratio, averages and percentages, and also see whether the south plants were smaller than the north plants or vice versa.

To ensure that the measurements recorded were accurate, if I were to do the experiment again, I would increase the sample size from fifty to hundred to get a wider range of results that can prove to be more accurate. Again the averages, ratios and percentages would be recorded to see if they coincided with the prediction. Also I could test the pH of the soil where the ivy plants grow as this too can be a factor that can limit or aid growth, for example if the soil was to acidic or alkaline. I would collect soil samples from each side of the wall and filter them through filter paper into a water beaker. I would then use universal indicator and see what colour the soil changes. I would compare the colours against a pH chart. If they were different then this result would support the conclusion as this could affect the process of photosynthesis. The colour of the leaves can be recorded against for example a colour chart also the total height can be measured, this can also show the amount of chlorophyll in the plant, which is also needed in photosynthesis. This too can support the conclusion, as I know from my results that the north ivy leaves were bigger in size thus having a larger surface area. The larger surface area could mean that there is more chlorophyll present or the same amount present as the smaller south ivy leaf, if that is the case than genetic variation has occurred and the plant has had to adapt to its surroundings. The total height of the north and south ivy plants can be subtracted to note the difference. Also the location where the plant is growing for example under a tree at the top or bottom of a hill. All these factors can help further the investigation to determine why the dimensions of the north and south ivy plants differ.

By Amareen Bhambra.11B.