Prediction

The prediction which was made before carrying out an experiment to find out how light intensity affects photosynthesis goes as follows;

"Doubling the surface of the plant will double the amount of photosynthesis.

And if the amount of light int ensity is doubled, the amount of photosynthesis doubles, until photosynthesis cannot go any faster for that surface area or amount of light.

The rate of increase will then slowly decrease until it's constant."

There are four factors which affect the rate of photosynthesis. These are illustrated below;

- Temperature
- Concentration of Carbon Dioxide
- Light Intensity
- Water

Photosynthesis is the process by which green plants trap light energy from the Sun. This energy is then used to produce a series of chemical reactions in the plant, which then lead to the formation of carbohydrates.

These occur in the form of glucose, which provide basic food for both plants and animals.

Photosynthetic pigments are the pigments within the plant which are responsible for capturing light energy. The primary one of these is chlorophyll.

The following are two different forms (word and chemical) of the equation which shows the reactions occurring in photosynthesis;

Carbon Dioxide + Water → Oxygen + Glucose

$6CO_2$ + $6H_2O$ → $C_6H_{12}O_6$ + $6O_2$

Photosynthesis works better in warm weather, and research shows that if the temperature in which the plant remains is raised by 10°c, then the rate of photosynthesis is doubled.

However, when the plant's surrounding temperature exceeds 40°c, the rate of photosynthesis slows down and then stops. This is because the enzymes in the plant which help with photosynthesis cannot work in these conditions.

Only 1% of the water which enters the plant through the root hairs is used as a raw material for photosynthesis. Another source of water is the product of respiration.

A leaf needs to absorb sufficient sunlight and carbon dioxide for its purposes without drying out; dry air causes a plant to transpire so that water evaporates through the stomata in the leaves.

Results

After the experiment was carried out, the following results were obtained.

Distance of Lamp (cm)	Light Units	Amount of Gas Collected in 15mins (cm^3)	
		1g Pondweed	2g Pondweed
40	17	3.0	6.2
30	23	6.5	7.3
20	35	10.8	18.3
10	45	12.3	17.0

Distance of Lamp (cm)	Light Units	Amount of Gas Collected in 15mins (cm^3)	
		1g Pondweed	2g Pondweed
40	17	3.2	5.9
30	23	6.3	7.9
20	35	10.6	16.2
10	45	12.4	18.2

After looking at both sets of results, I found an average amount of gas collected for each light intensity.
These results are shown on a graph on the following page.
Below is the table of results in which the averages are shown.

Distance of Lamp (cm)	Light Units	Amount of Gas Collected in 15mins (cm^3)	
		1g Pondweed	2g Pondweed
40	17	3.1	6.0
30	23	6.4	7.6
20	35	10.7	18.3
10	45	12.4	17.0

Conclusions

From looking at the graph on the previous page, I have noticed that it follows the shape of a curve, and that after half way, this begins to get less steep.
This happens because a limiting factor is beginning to slow the rate down. The possible limiting factors in this experiment are Carbon Dioxide, because this, along with light and temperature, are needed for the production of carbohydrates – energy for the plant.

In experiments to determine rates of photosynthesis, it is observed that the rate slows down and eventually stops as the level of light decreases. Because there is light present in this experiment, the limiting factor must be Carbon Dioxide.

Low temperature would also limit the rate, but this is also present, as the lamp used in the experiment radiates heat as well as giving off light.

As much of the Carbon Dioxide gas present in the water has been used up, there isn't a great deal left for the plant to take from its surroundings, therefore limiting the rate of photosynthesis.

The following set of additions show how doubling the amount of light has an effect on the rate of photosynthesis. This is shown by the amount of photosynthesis at Light Unit 17 being doubled, and then being checked against the rate of photosynthesis for Light Unit 35, which is double the light intensity.
This will then show whether or not the prediction was correct.

17 X 2 = 34 . 35

At Light Unit 17, amount of gas collected is 3.2cm^3.
This doubled is 6.4cm^3.
At Light Unit 35, amount of gas collected is 10.6cm^3.
This shows that for 1g of pondweed, the prediction was incorrect.

17 X 2 = 34 . 35

At Light Unit 17, amount of gas collected is 5.9cm^3.
This doubled is 11.8cm^3.
At Light Unit 35, the amount of gas collected is 16.2cm^3.
This shows that for 2g of pondweed, the prediction was incorrect.

However, when looking at the results, although the rate is not doubled, there is a significant increase of photosynthesis when the light intensity is reached, and there is a slowing down in the rate towards the end of the experiment, showing the limiting factor coming in to play.

Evaluation

From looking at the apparatus used was set up, I think that improvements could be made.
There is another experiment which could be done which would obtain the same types of results desired, only in a more reliable and accurate way.

The pondweed used would be of the same variety as before – Canadian pondweed. This is very dark green, as it contains a lot of chlorophyll, therefore being useful in an experiment looking at reactions of plants with light in photosynthesis.

Overall, when looking at the graphs, there is a general pattern between them (apart from the anomalous results explained below), and it can be seen that when light intensity is increased, the rate of photosynthesis does also, but this has not been strongly shown enough to conclude proof to the initial prediction.

The anomalous results which occurred could be due to any conditions which have changed. For example, the conditions within the experiment which aren't to be changed deliberately (temperature, amount of Carbon Dioxide in the plant's surroundings, amount of water available to the plant) haven't remained constant for this particular section.
Either that, or the results have been measured incorrectly when recording them.

To obtain more evidence that could be used in providing a more solid conclusion of the prediction, the experiment would have to be carried out again, using the method illustrated above, and more rigorous checks would need to be made more regularly so as to avoid many of the same kinds of anomalous results.