Does Light Intensity Affect the Rate of Photosynthesis?

Background Knowledge

From a previous experiment I have performed I know that if you increase the light intensity on a plant the rate of photosynthesis will increase with it. I also know that light intensity is a limiting factor that affects the rate of photosynthesis. This means that if you increase the amount of carbon dioxide that it receives and also the amount of water the rate will not increase any more until you increase the light intensity. Other limiting factors are temperature and amount of water. When a plant is taken away from light the rate of photosynthesis rapidly decrease. This is because light is a main factor in photosynthesis. It is so important that if the plant is without light for to long it will die.
The formula for photosynthesis is:
Carbon Dioxide + Water + Sunlight = Oxygen + Glucose + Energy.
The balanced symbol equation for this is:
$6CO_2 + 6H_2O + \text{Sunlight} = C_6H_{12}O_6 + 6O_2$

Prediction

I predict that when you increase the light intensity on the plant the rate of photosynthesis will increase. When the level of gas produced levels out then the maximum light intensity has been reached. This means that it will need more carbon dioxide, water or a temperature nearer the optimum for the plant. I also so predict that if you double the light intensity you will double the rate of photosynthesis. This makes sense because you will be providing the plant with twice the amount of light so in theory the rate of photosynthesis will double. A high light intensity will give more light to the chloroplasts and enable them to produce more oxygen (as a waste product) and more glucose for energy. A lower intensity will have the opposite affect. It will mean that the chloroplasts will have less light and not produce more oxygen and glucose. With this information in mind I will say that light intensity is directly proportional to the rate of photosynthesis.

Preliminary Work

For my preliminary work I need to find suitable values for the value of Sodium Carbonate and for the temperature. I will try several different values for each to find the optimum values. I will be keeping the light intensity the same for all of the experiments.

Preliminary Results

Intensity	$NaHCO_3$	Temperature(ºC)	Length Of Bubble(mm)
50	0.2%	5	1.2
50	0.2%	10	4
50	0.2%	15	23
50	0.2%	19	40
50	0.2%	20	41
50	0.2%	21	40
50	0.2%	25	25
50	0.2%	30	6

From these results I can say that the optimum temperature for this experiment is 20ºC

Light Intensity	$NaHCO_3$	Temperature(ºC)	Length Of Bubble(mm)
100	0.2%	20	64
100	0.4%	20	70

From these results I can say that the optimum percentage concentration would be 0.2%. This is because the results are contained to a set boundary that can be measured easy and there is a smaller risk of the results running off the scale.

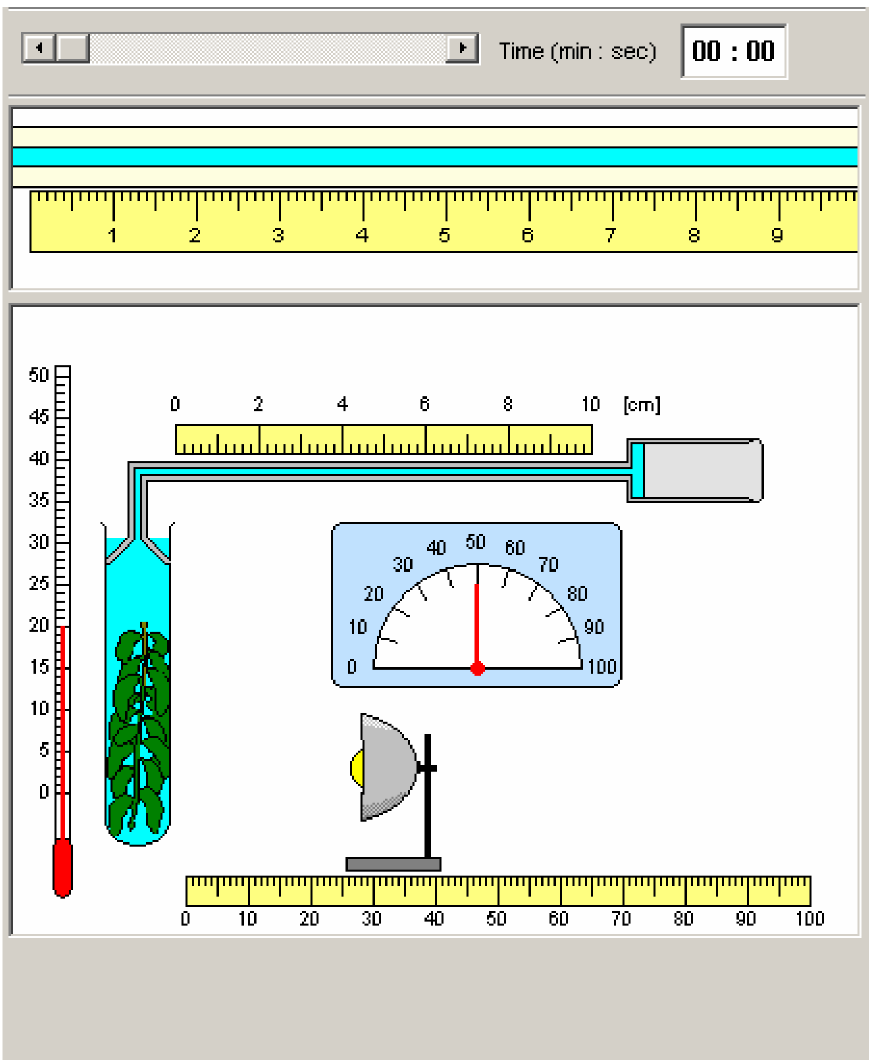
Variables Table

Variable Name	Variable Type	Values	Reason
Values of Light intensity	Input	10,20,30,40, 50,60,70,80, 90,100	Easiest values to measure and gather results from. 10 values because plenty of time to plot results
Amount of $NaCO_3$	Control	0.2%	Optimum Value found from my preliminary work
Volume of Water	Control	Cm3	This is decided by the program and is not given
Temperature	Control	20	Optimum Value found from my preliminary work
Volume of gas Produced	Outcome	Cm3	This is the point of the experiment so these values are unknown

Plan

We will be using a computer simulator to perform this experiment. We will enter what we require (the temperature, the amount of sodium hydrogen carbonate) and adjust the light intensity. We must keep the temperature and the concentration of the sodium hydrogen carbonate the same so that the experiment remains fair. If we adjust the values of these then it will affect our readings and our test will not be a fair one. The program we are using has the ability to generate anomalous results. This means that there is as much chance of there being an error in these results as there is in performing the experiment in real life.
Change the light intensity for each value chosen and repeat each value 3 times. The values selected are 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100. Therefore there will be 30 results by the end of the experiment. We have the ability to use 10 different values for light intensity as it takes far less time to record each result as you are able to speed up the simulation of the experiment, thus get more results in the time allowed.

Diagram



Results

Light Intensity	Length (mm)				NaCO3 %
	Repeat 1	Repeat 2	Repeat 3	Average	
10	20	21	20	20.3	0.2
20	35	33	35	34.3	0.2
30	40	41	42	41.0	0.2
40	45	45	46	45.3	0.2
50	50	50	52	50.7	0.2
60	55	54	56	55.0	0.2
70	59	58	60	59.0	0.2
80	61	62	63	62.0	0.2
90	62	62	63	62.3	0.2
100	63	63	64	63.3	0.2

Conclusion

From my results I can say that my prediction is correct. The data shows light intensity increasing along with the amount of gas produced. The volume of gas produced levels off near the top as the plant needs more carbon dioxide/water/a better optimum temperature to produce an increasing value for carbon dioxide (keeps rising). My prediction is partially supported by my results. It is only partially supported by the results because I proved the first part of my prediction because my results clearly show an increase in the amount of gas produced as the light intensity increases. However if you double the light intensity you do not double the rate of photosynthesis. This is because there are other factors involved that would affect the rate so it would not neccessary double the rate. The line I have drawn on my graph goes through all of the points on the graph with some of them passing through the error bars. This shows that my results are very accurate. At the most there is only a 5% inaccuracy in the results as the smallest scale division on the ruler was 1mm and my smallest value was 20mm so this accounts for a 5% inaccuracy. This means that my results have a very good chance of being accurate.

Evaluation

For this experiment we used the computer software package 'science investigation 2' .The method that we used to record our data was a very quick and easy method to use. We were able to record the data much easier than performing the experiment as a practical. The computer generated results were very reliable as we were able to control every aspect of the experiment that we desired. We could keep the temperature and sodium bicarbonate levels constant and change the light intensity to exact values.
The computer made it easy to read off values as it had a ruler with a 'bubble' to help you read off exact values. This is clearly shown in my diagram. The computer programme is also very good and fair as

it generates anomalous results. This means the results obtained will not be perfect and therefore there is still some work for us to do. As the computer was able to generate accurate and anomalous results for different light intensities I feel that the method that i chose for this was the best possible. As anomalous results are created and because the experiment takes less time to perform we could have taken more results to make our experiment even more accurate as we would have more values to compare and find averages.

The evidence I have collected I feel was ideal as it enabled us to find any anomalies that there were and I was able to make comparisons with my prediction. My prediction is supported by the data I obtained which sows that my experiment was a success.

To make the test even more accurate we could perform the experiment practically using all of the same values as used by the computer and compare the results with the computer generated ones and see what differenced that there may be.