Chlorophyll transfers H+ electrons by a process known as resonance transfer across thylakoid membranes to P700 and P680 type chlorophyll a molecules. Chlorophyll, with the aid of enzymes, converts light energy into chemical energy by a complex series of processes of oxidation involving loss of electrons. In these processes carbon dioxide and water are converted to glucose and oxygen.

aim

I aim to investigate the effects of the quantity of light and thus the light intensity on the rate of photosynthesis in Elodea.

Background

Photosynthesis is the production of food compounds from carbon dioxide and water by green plants using energy from sunlight, absorbed by chlorophyll ie. Photosynthesis is how plants feed.

$C_6H_{12}O_6 + 6O_2 \square 6CO_2 + 6H_2O$

Raw materials Products

ie. Green plants make organic substances from inorganic substances.

In order to keep the equation for photosynthesis simple, glucose is shown as the only food compound produced. However, this does not mean that glucose is not the only food compound produced.

The process of taking in and giving out gases is known as gaseous exchange. When green plants photosynthesise, they take in CO_2 and give out O_2. This only happens in daylight when light is available as an energy supply. The exchange of gases in green plants in light is the opposite of that of animals; however this does not mean that green plants do not respire. During daylight, plants photosynthesise and respire at the same time, hence all CO_2 produced by the plant during respiration is transformed into O_2 and food (and thus energy) for the plant. It is only when the rate of photosynthesis is greater than the rate of respiration that CO_2 will be taken in and excess O_2 given out.

ie. In darkness O_2 is taken in and CO_2 is given out - there is no p/s; in dim light the rate of respiration and p/s is equal - there is no gaseous exchange with the air; in bright light however p/s is faster than respiration and thus O_2 is given out - CO_2 is taken in to use for p/s and the CO_2 made from the plant's respiration is also used to make O_2.

ie. The more light (the higher the light intensity), the greater the rate of p/s - unto the LSP [see below].

If a plant is given plenty of sunlight, carbon dioxide and water, the limit on the rate of p/s is the ability of the plant to absorb these materials and make them react. (eg. total number and capacity of chloroplasts and the physical limitation of carbon dioxide diffusion.) Most of the time plants DO NOT have an unlimited supply and so the rate of p/s is not as high as it might be.

Blackman's Law states that:

"The factor in least supply will be the limiting factor."

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As the light intensity (LI) increases, the rate of p/s increases, until the plant is photosynthesising as fast as it can - the LSP - Light Saturation Point. When the LSP is reached, plants cannot photosynthesise any faster, even when the light gets brighter. From this point on, according to Blackman's Law, the factor in least supply will be the limiting factor ie. either CO2, H2O or temperature will be the limiting factor.

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As the amount of CO2 available increases, the rate of p/s increases, until the plant is photosynthesising as fast as it can - the CSP - CO2 Saturation Point. If both CO2 and light supply are increased together, the rate of p/s will level out. Henceforth it is limited, according to Blackman's Law, by the factor in least supply, either H2O or temperature. however there is a physical limitation of the carbon dioxide diffusion and the plant's sunlight absorption.

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At a lower temperature, the rate of p/s is increasing with increasing LI or CO2 availability, but the LSP or CSP is quickly reached. At a higher temperature, the rate of p/s increased further and reaches the LSP / CSP slower. Thus we can se that temperature affects the rate of p/s - it is higher at higher temperatures.