verifica la comprensione

Leggi il brano e rispondi alle domande.

Factors that influence the rate of photosynthesis.

The complex mechanism of photosynthesis includes a photochemical, or light-dependent, stage and an enzymatic, or dark, stage that involves chemical reactions. These stages can be distinguished by studying the rates of photosynthesis at various degrees of light saturation (*i.e.,* intensity) and at different temperatures. Over a range of moderate temperatures and at low to medium light intensities (relative to the normal range of the plant species), the rate of photosynthesis increases as the intensity increases and is independent of temperature.

As the light intensity increases to higher levels, however, the rate becomes increasingly dependent on temperature and less dependent on intensity; light «saturation» is achieved at a specific light intensity, and the rate then is dependent only on temperature if all other factors are constant. In the light-dependent range before saturation, therefore, the rate of photosynthesis is determined by the rates of photochemical steps. At high light intensities, some of the chemical reactions of the dark stage become rate-limiting. At light saturation, rate increases with temperature until a point is reached beyond which no further rate increase can occur.

In many land plants, moreover, a process called *photorespiration* occurs at high light intensities and temperatures. Photorespiration competes with photosynthesis and limits further increases in the rate of photosynthesis, especially if the supply of water is limited.

Included among the rate-limiting steps of the dark stage of photosynthesis are the chemical reactions by which organic compounds are formed using carbon dioxide as a carbon source. The rates of these reactions can be increased somewhat by increasing the carbon dioxide concentration. During the past century, the level of carbon dioxide in the atmosphere has been rising due to the extensive combustion of fossil fuels. The atmospheric level of carbon dioxide climbed from about 0.028 percent in 1860 to 0.0315 percent by 1958 (when improved measurements began), and to 0.034 percent by 1981. This increase in carbon dioxide directly increases plant photosynthesis, but the size of the increase depends on the species and physiological condition of the plant. Furthermore, if increasing levels of atmospheric carbon dioxide result in climatic changes, including increased global temperatures as some meteorologists predict, these changes will affect photosynthesis rates.

For land plants, water availability can function as a limiting factor in photosynthesis and plant growth. Besides the requirement for water in the photosynthetic reaction itself, water is transpired from the leaves; that is, water evaporates from the leaves to the atmosphere via the stomates. These stomates are small openings through the leaf epidermis, or outer skin; they permit the entry of carbon dioxide but also allow the exit of water vapour. The stomates open and close according to the physiological needs of the leaf. In hot and arid climates the stomates may close to conserve water, but this closure limits the entry of carbon dioxide and hence the rate of photosynthesis, while the wasteful process of photorespiration may increase. If the level of carbon dioxide in the atmosphere increases, more carbon dioxide could enter through a smaller opening of the stomates, so that more photosynthesis could occur with a given supply of water.

Several minerals are required for healthy plant growth and for maximum rates of photosynthesis. Nitrate or ammonia, sulfate, phosphate, iron, magnesium, and potassium are required in substantial amounts for the synthesis of amino acids, proteins, coenzymes, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA), chlorophyll and other pigments, and other essential plant constituents. Smaller amounts of such elements as manganese, copper, and chlorine are required in photosynthesis. Some other trace elements are needed for various nonphotosynthetic functions in plants.

(www.britannica.com)

a) What factors influence the rate of photosynthesis and plant growth?
b) Why can excessively high global temperatures act as a limiting factor in photosynthesis?
c) What minerals are required for healthy plant growth? Why are they necessary?