PHOTORESPIRATION

DEFINITION

Photorespiration is defined as the process in which oxygen combines with ribulose biphosphate (RuBP) in the presence of sunlight and CO_2 is produced. The process is called photorespiration bcz in the presence of light (photo), oxygen is taken up and CO_2 is evolved (respiration).

PHOTOSYNTHESIS

Photosynthesis needs optimum concentration of the requirements for normal functioning. If however one of the requirement is present in less concentration than optimum, the process of photosynthesis is affected and slows down.

RUBISCO (RUBP)

In the Dark reaction of photosynthesis, normally CO_2 combines with RuBP (carboxylation) forming PGA molecules. The process occurs in the presence of an enzyme called ribulose biphosphate carboxylate (rubisco). This enzyme can act both as carboxylate and oxygenase. Rubisco can use either CO_2 or O_2 as a substrate.

Rubisco acts. The reaction depends on the concentration of CO_2 and O_2. If the concentration of CO_2 is more, then rubisco combines with CO_2 and photosynthesis proceeds normally. On the other hand if the concentration of O_2 is more, then rubisco combines with O_2 and photorespiration occurs.

EFFECT OF DRY AND HOT WEATHER IN PLANTS

Plants have stomata for the exchange of gases. Diffusion of water vapours from leaf to the external environment also occurs through the stomata. In dry and hot weather plants close up stomata so as to conserve water. In such conditions CO_2 cannot enter the leaf and O_2 cannot leave it. Dry and hot conditions are usually accompanied by intense sunlight therefore light reaction occurs with maximum rate which results in maximum use of CO_2. Since concentration of CO_2 lowers down in the leaf, photorespiration proceeds.

STEPS OF PHOTORESPIRATION

Photorespiration occurs in three steps:

1. PRODUCTION OF GLYCOLATE

Oxygen combines with RuBP (present in stroma of chloroplast). The net result of this is that instead of producing two 3-C PGA molecules, only one molecule of PGA is produced and a toxic 2C molecule called phosphoglycolate is produced. The plant must get rid of the phosphoglycolate.

First it immediate gets rid of the phosphate group, converting the molecule to glycolate.

$$RuBP + O_2 \longrightarrow Glycolate$$

2. GLYCINE

Glycolate is then transported to the peroxisome and then converted to glycine (simplest amino acid).

$$Glycolate \longrightarrow Glycine$$

3. SERINE

Glycine is transported to mitochondria where it is converted into serine and a molecule of CO_2 is produced.

$$Glycine \longrightarrow Serine + CO_2$$

DISADVANTAGES OF PHOTORESPIRATION (CONSEQUENCES)

1. Photorespiration is just the reverse of photosynthesis hampering the fixation of CO_2 Photosynthesis.

2. The process wastes energy and does nothing to serve the needs of the plant.