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Mechanism of photorespiration and its significance

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DESCRIPTION

Photorespiration is a cyclic respiration process that happens in photosynthetic cells and results in CO_2 removal. Dicker and Tio discovered the term photorespiration in tobacco plants in 1959. The phrase photorespiration is combination of two words: photo means light, and respiration means to take in O_2 and give out CO_2. Because the first stable result is phosphoglycolate, which contains two carbon molecules, photorespiration is also known as the C_2 cycle, oxidative photosynthesis cycle, or glycolate route. Photorespiration is a cyclic respiration process that happens in photosynthetic cells and results in CO_2 removal. Photorespiration occurs most commonly in C_3 plants such as beet, bean, cotton, rice, wheat, barley, and so on. Photorespiration interferes with the Calvin cycle's ability to work properly.

PHOTORESPIRATION PROCESS

When the concentration of CO_2 is low, the temperature is high, and the concentration of O_2 is high, Ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) works as an oxygenase enzyme. When the CO_2 concentration is high, the temperature is low, and the O_2 concentration is low, RuBisCO operates as carboxylase. Different stages of photorespiration occur in various cell organelles such as chloroplasts, peroxisomes, and mitochondria throughout the cycling of various organic compounds.

Chloroplast

Photorespiration begins in the chloroplast with the RuBisCO enzyme creating a link between RuBP and O_2 molecules. When RuBP binds to O_2, it breaks into phosphoglyceric acid (PGA) (3C) and phosphoglycolate (2C). The Calvin cycle makes use of PGA.

Then, in the presence of the enzyme phosphatase, 2-phosphoglycerate loses its phosphate group and is transformed into glycolate. Glycolate is released from the chloroplast and diffuses into the peroxisome.

Peroxisome

Glycolate is converted to glyoxylate and H_2O_2 by glycolate oxidase enzymes.

The enzyme glutamate-glyoxylate transaminase then catalyses a transamination process that converts glyoxylate to the amino acid glycine. This glycine will now enter the mitochondria *via* diffusion.

Mitochondria

Two glycine molecules united to generate one serine (3C) molecule and one CO_2 molecule. This CO_2 molecule is released as a result of a 25% CO_2 loss in mitochondria.

SIGNIFICANCE

Photorespiration is found exclusively in plants that have a dark reaction as part of the Calvin cycle (C_3 plants), but it is absent in C_4 plants, according to research on plants that have and do not have it. Photorespiration occurs in temperate plants; however it does not occur in tropical ones. There is no evidence of ATP production in the reaction pathway. Because this pathway occurs in a low CO_2 environment, it is thought that this mechanism was frequent in earlier evolution eras when CO_2 levels in the atmosphere were very low, and it has been inhibited as CO_2 levels in the atmosphere have increased. The presence of photorespiration reduces plant photosynthetic efficiency. Scientists are eager to create plants with lower levels of photorespiration. Genetists are working hard to create C_3 plant strains with low photorespiration rates. These attempts are being made with the understanding that this process is excess and non-essential in plants. Scientists believe that photorespiration serves a protective and supporting role in reducing oxygen harm to chloroplasts. By absorbing

O_2, the mechanism aids in the maintenance of a low oxidative state in the chloroplasts of C_3 plants. Oxygen free radicals are harmful and can damage organelles, while photorespiration keeps oxygen free radicals.