C_4 Photosynthesis

C_3 Plants

In normal process of photosynthesis a 3-C compound called PGA is formed as the first detected product of photosynthesis (CO_2 fixation) and therefore these plants are called C_3 Plants.

C_4 Plants

There are some plants growing in dry and hot conditions producing a 4-C compound called oxaloacetate as the first product of CO_2 fixation in dark reactions of photosynthesis. These plants are called C_4 plants and this type of photosynthesis is called C_4 photosynthesis.

Difference Between C_3 And C_4 Plants

1. Fixation Of CO_2

ENZYME

C_3 plants use rubisco to react CO_2 with RuBP

On the other hand C_4 Plants use another enzyme called pepco (phosphoenolpyruvate carboxylase) to fix CO_2

to a compound called phosphoenol pyruvate (PEP). This molecule is reduced to another molecule called malate. The malate carries CO_2 to the special type of cells called bundle sheath cells where Calvin cycle proceeds.

2. PRESENCE OF CHLOROPLAST

In C_3 Plants chloroplasts are present only in mesophyll cells of leaf.

However in a C_4 Plant chloroplasts are present both in mesophyll cells and in bundle sheath cell.

3. CALVIN CYCLE

In a C_3 plant all the mesophyll cells carry out Calvin cycle by fixing CO_2 and producing glucose.

In a C_4 plant the mesophyll cells only fix CO_2 by using pepco while the bundle sheath cells carry out Calvin cycle producing glucose.

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Process Of C_4 Photosynthesis

Two steps of C_4 Photosynthesis that occur in the mesophyll cells are the light-dependent reactions and a preliminary fixation of CO_2 into a molecule called malate. CO_2 is released from malate in the bundle sheath cells, where it is fixed again by Rubisco and the Calvin-Benson cycle. The PEP is then recycled back to the mesophyll cells, and the carbohydrate products of photosynthesis are distributed through the plant.

Importance Of C_4 Photosynthesis

1. C_4 plants prevent photorespiration even in dry and hot environment as pepco doesnot bind to O_2 irrespective of the concentration of CO_2.

2. In C_4 plants the rate of photosynthesis remains high even when the stomata are closed and temperature is high.

3. The rate of CO_2 fixation is also high as compared to C_3 plants.

4. C_4 cycle is basically an adoptibility of C_4 plants to carry out CO_2 fixation in dry and hot condition and to reduce the rate of photorespiration.

EXAMPLES OF C_4 PLANTS

Examples of C_4 plants are sugar cane, maize etc.

In the chloroplast of mesophyll cells CO_2 and PEP reacts with the help of enzyme pepco and produce Oxaloacetate (4-C). $NADPH_2$ reduces oxaloacetate to malate. Malate travels to chloroplast of bundle sheath cells and decarboxylase removes the CO_2 and produces Pyruvic Acid.

The chloroplast within the bundle sheath cells is so carefully protected from the presence of O_2 by the concentric ring of mesophyll cells surrounding them. So the bundle sheath cells is purely surrounding by CO_2 with no O_2. The CO_2 enters the Calvin Cycle within the chloroplast of the bundle sheath cells