

Q. 1. By looking at a plant externally can you tell whether a plant is C_3 or C_4 ? Why and how?

ANSWER:-

Plants adapted to dry tropical climates may utilize the C_4 pathway, but they lack distinct external morphological features that differentiate them from C_3 plants. Therefore, it is not possible to determine whether a plant follows the C_3 or C_4 pathway solely based on its external appearance.

Q. 2. By looking at which internal structure of a plant can you tell whether a plant is C_3 or C_4 ? Explain.

ANSWER:-

C_4 plants exhibit Kranz anatomy, which distinguishes them from C_3 plants. They possess specialized bundle sheath cells surrounding the vascular bundles, with each bundle sheath cell containing chloroplasts. In C_4 plants, mesophyll cells lack differentiation into spongy and palisade parenchyma and have fewer intercellular spaces, although they still contain chloroplasts. In contrast, C_3 plants lack chloroplasts in their bundle sheath cells, and their mesophyll cells are differentiated into spongy and palisade parenchyma. Therefore, examining the internal structure of the leaf can determine whether the plant is C_3 or C_4 .

Q. 3. Even though a very few cells in a C_4 plant carry out the biosynthetic – Calvin pathway, yet they are highly productive. Can you discuss why?

ANSWER:-

Plant productivity can be assessed by measuring the rate of photosynthesis, which is directly proportional to the amount of carbon dioxide in the plant. Although only a few cells in C_4 plants participate in the biosynthetic pathway, they are highly productive due to the following reasons:

- They possess a mechanism that elevates the CO_2 concentration at the enzyme's site.
- CO_2 is released as mesophyll cells are broken down in the bundle sheath cells, increasing intracellular CO_2 levels.
- Rubisco primarily acts as a carboxylase, reducing its oxygenase activity.
- Enhanced photosynthesis efficiency makes C_4 plants more productive.



- Q. 4. RuBisCO is an enzyme that acts both as a carboxylase and oxygenase. Why do you think RuBisCO carries out more carboxylation in C_4 plants?**

ANSWER:-

RUBISCO has a much greater affinity for CO_2 than for oxygen. The enzyme's ability to bind is influenced by the concentrations of CO_2 and oxygen. In C_4 plants, mesophyll cells do not contain RUBISCO, but it is present in the bundle sheath cells surrounding the vascular bundles, where the Calvin cycle occurs.

RUBISCO acts as an oxygenase when oxygen concentration is high and as a carboxylase when CO_2 concentration is high. In the mesophyll cells, the primary CO_2 acceptor is a three-carbon compound called phosphoenol pyruvate, which is converted into a four-carbon compound, oxaloacetic acid (OAA). This is then converted into malic acid, which is transported to the bundle sheath cells. There, it undergoes decarboxylation, and the released CO_2 is fixed through the Calvin cycle, preventing RUBISCO from functioning as an oxygenase.

- Q. 5. Suppose there were plants that had a high concentration of Chlorophyll b, but lacked chlorophyll a, would it carry out photosynthesis? Then why do plants have chlorophyll b and other accessory pigments?**

ANSWER:-

Photosynthesis cannot occur without chlorophyll-a, as it serves as the reaction center that converts solar energy into chemical energy. While chlorophyll is the primary pigment responsible for capturing sunlight, accessory pigments such as chlorophyll-b, xanthophylls, and carotenoids also absorb sunlight and transfer the energy to chlorophyll-a.

- Q. 6. Why is the colour of a leaf kept in the dark frequently yellow, or pale green? Which pigment do you think is more stable?**

ANSWER:-

In the absence of light, chlorophyll cannot absorb energy, leading to a loss of stability and causing the leaf to turn yellow. This indicates that carotenoids, which provide the yellow coloration, are more stable.

- Q. 7. Look at leaves of the same plant on the shady side and compare it with the leaves on the sunny side. Or compare the potted plants kept in the sunlight with those in the shade. Which of them has leaves that are darker green ? Why?**

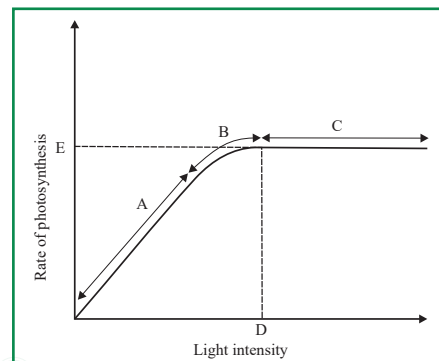
ANSWER:-

Leaves in shaded areas receive less sunlight for photosynthesis compared to those exposed to direct sunlight. To compensate, shaded leaves contain more chlorophyll for efficient photosynthesis. In bright light, chloroplasts in mesophyll cells are arranged irregularly and in vertical stacks along the walls. Additionally, in strong light, photooxidation of chloroplasts occurs, while in shaded areas,



non-oxidative processes take place. As a result, plants in the shade have darker green leaves due to the higher concentration of chlorophyll.

Q. 8. Figure 11.10 shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following questions:



- At which point/s (A, B or C) in the curve is light a limiting factor?
- What could be the limiting factor/s in region A?
- What do C and D represent on the curve?

ANSWER:-

- Light becomes a limiting factor at point A and at 50% of point B, as the photosynthetic rate increases with higher light intensity.
- In region A, light, CO_2 , and H_2O could all be limiting factors.
- Point C represents a stage where light is no longer a limiting factor, and point D indicates the point beyond which light intensity no longer affects the photosynthetic rate.

Q. 9. Give comparison between the following:

- C_3 and C_4 pathways
- Cyclic and non-cyclic photophosphorylation
- Anatomy of leaf in C_3 and C_4 plants

ANSWER:-

(a) C_3 and C_4 pathways

C_3 pathway	C_4 pathway
RUBP acts as the primary acceptor of CO_2	PEP serves as the primary acceptor of CO_2
The first stable product is 3-Phosphoglycerate	The first stable product is Oxaloacetic acid.
This process takes place in the mesophyll cells of the leaves.	This process occurs in both mesophyll cells and bundle sheath cells.
Carbon fixation is a slower process.	Carbon fixation occurs more rapidly.

(b) Cyclic and non-cyclic photophosphorylation

Cyclic Photophosphorylation	Non-Cyclic Photophosphorylation
Takes place solely in Photosystem-I.	Occurs in both Photosystem-I and II.
Only ATP is produced.	Both ATP and NADPH ₂ are produced.
Water is not split, so no Oxygen is released.	Water is split, resulting in Oxygen production.
Electrons circulate in a closed loop.	Electrons do not circulate in a closed loop.



(c) Anatomy of leaf in C_3 and C_4 plants

Anatomy of leaf in C_3 plants	Anatomy of leaf in C_4 plants
Lack Kranz anatomy.	Possess Kranz anatomy
Chloroplasts are not dimorphic.	Chloroplasts are dimorphic and arranged centripetally. Bundle sheath cells are larger in size.
Mesophyll cells contain intercellular spaces.	Mesophyll cells lack intercellular spaces.

