1

Nutrition in Plants

Contents of the Chapter

1.1 Introduction

All living beings, including plants, require energy to stay alive. Plants need food for their fast growth and to grow flowers and fruits.

1.2 Nutrition

In the process of gaining energy and to grow, plants consume energy providing and growth sustaining substances. This process is called nutrition. In this process, energy is gained by oxidation of carbohydrates and fat.

Nutrition is mainly of two types– autotrophic and heterotrophic.

1.3 Autotrophic Nutrition

Autotrophic nutrition is the self-dependent mode of nutrition. The chlorophyll present in green plants has the ability to conduct chemical reaction between non-carbonic substances such as water and carbon dioxide, in the presence of sunlight, to produce carbonic substances such as starch and glucose. It is for this reason that green plants are self dependent for their nutrition and are called autotrophs.

1.4 Heterotrophic Nutrition

Chlorophyll is not present in non-green plants. That's why they are unable to conduct the process of photosynthesis. For their nutrition, they are directly or indirectly dependent on green plants only. Hence, all non-green plants are not self-dependent for their nutrition. Such mode is called heterotrophic nutrition and such plants are called heterotrophs.

1.5 Nutrition in Plants

Green plants have an abundant capacity to make their own food. This process of making food is conducted in the presence of sunlight. This process is known as photosynthesis. In this process, plants make their food themselves.

Photosynthesis : The process of making their own food by green plants themselves in the presence of sunlight is called photosynthesis. In this process, plants make their food from carbon dioxide and water with the help of chlorophyll.

Generally, leaves are called food factories of plants because the beginning of making food happens in them only. All the nutrients reach different parts of a plant through the leaves only.

In the process of photosynthesis, energy is used to draw water from the soil and to separate CO_2 from air. This energy is called solar energy as the food produced in this process contains some percentage of sugar also. This sugar is called glucose also.

Green pigment is found in the leaves of green plants. This green pigment may also be found in stems and other parts of plants. It is known as chlorophyll. It is found as green balls in green cells which are called chloroplasts. These chloroplasts have the special quality of absorbing sun's energy. This energy of the sun makes glucose from water and carbon dioxide, in the presence of chlorophyll.

Glucose helps in growth and repair of wear and tear in plants. Glucose and carbohydrates, in the form of starch, reach different parts of plants i.e. glucose and

carbohydrates remain concentrated in the form of starch. It can be represented by the following reaction :

$$\underset{\text{Carbon dioxide}}{6CO_2} + \underset{\text{Water}}{6H_2O} \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6O_2}$$

Green plants are factories of food.

Leaf – Workshop of food production

Chloroplast – A unit of the workshop

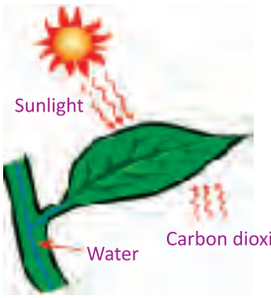
Raw materials – Carbon dioxide from atmosphere and water from soil.

Source of energy – Sunlight

Final product – Glucose

Initial product – Oxygen gas

The oxygen released during this reaction is extremely important for life.



Photosynthesis

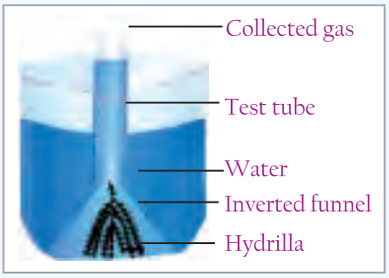
Conditions necessary for photosynthesis :

1. Presence of chlorophyll
2. Sunlight
3. Carbon dioxide
4. Water

Activity

Photosynthesis is affected by light

Fill two-thirds part of a beaker with water. Put some hydrilla plants in this beaker. Put an inverted funnel on the plants and cover them. Now, fill a test tube with water, invert it and keep it on the funnel. Then keep the whole apparatus in sunlight. We see gas bubbles coming out of the leaves of hydrilla. Now, we carry this apparatus away from sunlight and observe that bubbles become to lessen. Hence, it is proved that the rate of photosynthesis increases in the presence of sunlight.



Activity

Carbon dioxide is necessary for photosynthesis

Take a long-leaved plant in a pot. Put this plant in a dark room for 1-2 days. Fill some caustic potash in a bottle and cork it. Pluck a leaf from the plant and put it in the bottle in such a way that half of it is inside the bottle and half remains outside. Caustic potash absorbs CO_2. CO_2 cannot reach inside the bottle but the part outside the bottle gets it.

Cork the bottle and keep it in sunlight for some time. Watch the leaf for starch. We observe that the part of the leaf outside the bottle becomes black-white but the part inside the bottle remains colourless. This demonstrates that photosynthesis has not taken place in the part inside the bottle.

Activity

Oxygen is released at the time of photosynthesis

Take a beaker, put some hydrilla branches in it, keep an inverted funnel on them and put some water in the beaker.

Now, keep a water-filled test tube on the funnel and invert it.

Then keep the beaker in the sunlight. We observe that bubbles are being released from the ends of the branches and collecting at the upper end of the test tube.

Now light a matchstick and bring it near the mouth of the test tube. It keeps on burning. This proves the gas inside the test tube is oxygen.

Activity

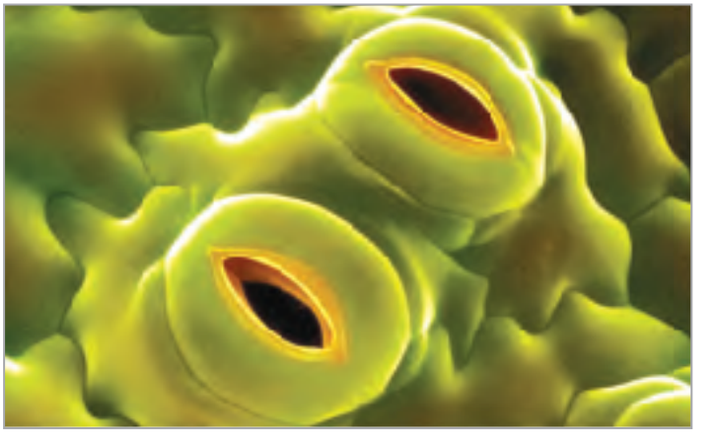
Chlorophyll is soluble in alcohol

Take some green leaves and boil them for about 5 minutes. Then put these leaves in a bowl filled with alcohol. After some time, observe the leaves and the alcohol.

The chlorophyll comes out of the green cells into the alcohol and turns its colour yellow-greenish. This proves that chlorophyll is soluble in alcohol.

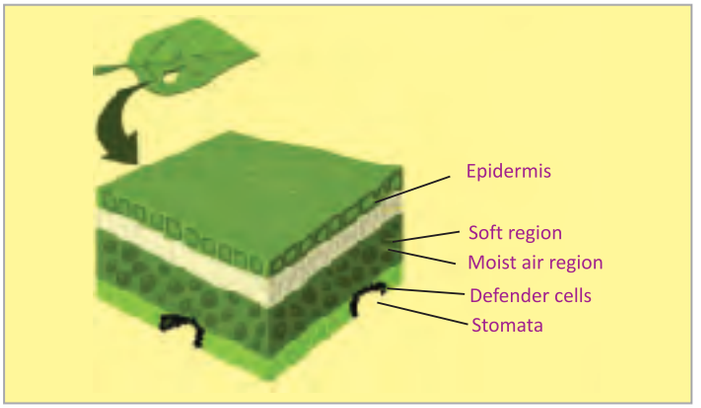
Oxygen released during the process of photosynthesis is extremely important for life :

Very small holes are found on the lower surface of the leaves, which are called stomata. CO_2 from the atmosphere enters the leaves through these stomata. Chloroplasts absorb the energy of the sun. The veins of the leaves bring water needed for photosynthesis. In this process, O_2 is released.



Stomata

Photosynthesis maintains the balance between O_2 and CO_2 in the atmosphere.



Internal structure of leaf

Interesting Fact

Chloroplasts are green ball-like structures in which a green pigment called chlorophyll is found.

Activity

Presence of chlorophyll in the leaves

Take some leaves such as basil, spinach, etc. Rub these leaves on a white paper, which becomes green in colour. This green colour demonstrates the presence of chlorophyll.

Chlorophyll is not soluble in water

Take some leaves and submerge them in a bowl filled with water. Let them remain in this state for a day. On observing the water, we find that the green colour of the leaves does not come into it. This proves that chlorophyll is not soluble in water.

Importance of Photosynthesis :

1. Photosynthesis is an extremely important process on which all the living beings are directly dependent.

2. The oxygen released during this process provides life to all living beings.

3. Photosynthesis maintains the balance between O_2 and CO_2.

4. During photosynthesis, leaves absorb energy which is stored in the form of starch and helps to make food.

Activity

Chlorophyll is required in photosynthesis

Take such leaves some parts of which are green and some yellow. Chlorophyll is found in these green parts. Put these leaves in sunlight for about 3 hours. Then, put them in heated alcohol and take them out. Wash them and put them in iodine solution. The green colour of the leaves changes to black. This proves that photosynthesis takes place only in the parts with chlorophyll. Thus, it can be said that chlorophyll is needed for photosynthesis.

1.6 Interpretation of Heterotrophic Nutrition

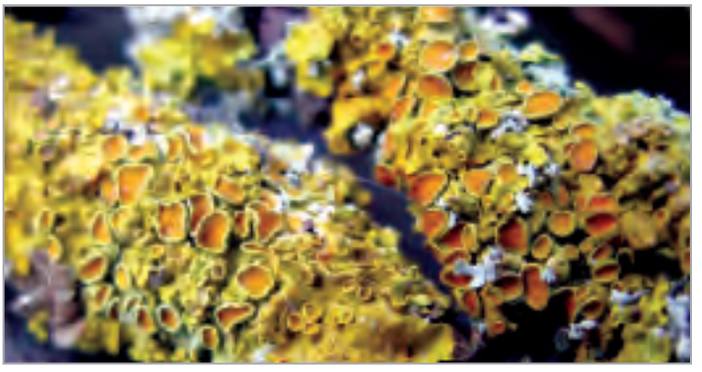
All living beings are directly or indirectly dependent on plants as they cannot make their own food. That's why they are called heterotrophs and the mode of nutrition is called heterotrophic nutrition.

Heterotrophic plants are of four types :

1. Symbiotic 2. Insectivorous 3. Saprophytic 4. Parasitic

1. Symbiotic Plants : In this kind of nutrition. two different organisms live together for mutual benefit; for example, lichen, algae and fungi live together because lichen is an autotroph and on the other hand, fungi is a saprophyte.

Lichen is a blue-green plant which grows on rocks and barks of trees whereas fungi absorbs water and mineral salts and transports it to lichen, which synthesise these into food and provides it to fungi. This way, algae and fungi are related to each other. Such a relationship is called symbiosis.



Lichen

Algae

Fungi

Interesting Fact

Sandalwood is a heterotrophic plant. It grows as minor parasite on the roots of other plants.

2. Insectivorous Plants : In such nutrition, some plants eat insects. Such plants have special structures to trap insects. These plants are green autotrophs and minor heterotrophs. These plants grow in non-fertile soils. During photosynthesis, the nutrients of the food got from insects come into plants, such as pitcher plant.

In pitcher plant, the leaf transforms to form a pitcher like structure and the rest of the leaf is transformed into a lid like structure. It can open and close the mouth of the pitcher. Inside the pitcher are hair-like structures. When any insect, attracted by the pitcher plant, enters it, the lid closes at the same time. The digestive juices secreted inside the pitcher digest the insect. Such insect eating plants are called insectivorous plants.

Pitcher plant

3. Saprophytic Plants : The nutrition received from dead and decaying matter is called saprotrophic nutrition i.e. the organisms which receive their food from dead and decaying matter and animals are called saprotrophs, such as yeast, mushroom, etc.

Mushroom

Interesting Fact

Take a bread slice and keep it on a glass plate for 2-3 days. You will observe cotton-like structures spread on the slice. After some time, the bread decays to give out bad odour.

4. Parasitic Nutrition : In such nutrition, organisms receive their food from other living beings to stay alive. Parasites want to harm the heterotroph and derive benefits from it, such as cuscuta (amarbel) which is a complete parasite. It is a yellow coloured climber which is also called dodder. It has got root like structures called suckers, using which it sucks food from other plant.

Dodder plant

Bacteria and fungi, which grow on other plants and animals, suck food from them as parasites. Parasites are causes of many diseases.

Highlights

- The process which happens after intake of food is called nutrition.
- Nutrition is of two types– autotrophic and heterotrophic.
- The process of making their own food themselves by plants is called autotrophic nutrition. It is done by process of photosynthesis.
- The plants which receive the food prepared by other plants are called heterotrophs and the process is called heterotrophic nutrition.
- In the process of photosynthesis, plants make their own food from carbon dioxide and chlorophyll.
- A green pigment is found in the leaves of green plants.
- Green pigment may also be found in stems and other parts of a plant.
- Green pigment is called chlorophyll.
- Chlorophyll is found as green balls in green cells called chloroplasts.
- Chloroplasts have the special ability to absorb sun's energy.
- Glucose helps in growth and repair of wear and tear in plants.
- Glucose and carbohydrates reach different parts of a plant in the form of starch.
- The oxygen released during the process of photosynthesis is extremely important for life.
- CO_2 from the atmosphere enters leaves through the stomata.
- Heterotrophic nutrition is of four types– symbiotic, insectivorous, saprophytic and parasitic.

Exercise

A. Tick (✓) the correct options :

1. What are those plants called which prepare their own food?
   - (a) Symbiotic ☐ (b) Parasitic ☐
   - (c) Autotrophic ☐ (d) All of these ☐
2. It is called the factory of food.
   - (a) Stem ☐ (b) Leaf ☐
   - (c) Root ☐ (d) All of these ☐
3. Non-green plants are :
   - (a) autotrophs ☐ (b) heterotrophs ☐
   - (c) parasitic ☐ (d) All of these ☐
4. Sugar for food is called :
   - (a) fructose ☐ (b) glucose ☐
   - (c) tomato ☐ (d) None of these ☐
5. Green cells are called :
   - (a) water ☐ (b) CO_2 ☐
   - (c) chloroplast ☐ (d) All of these ☐

B. Fill in the blanks :

1. Food provides _____.

2. Nutrition is of two kinds, _____ and _____.
3. Plants which receive their food from other plants are called _____.
4. The process of making food by plants is called _____.
5. Chlorophyll is not soluble in _____.

C. Very Short Answer Questions :

1. Which process is important for living beings?
2. Nutrition is of how many types?
3. What is found in the leaves of green plants? Name it.

D. Short Answer Questions :

1. Which plants cannot make their own food?
2. In whose presence does nutrition take place in plants?
3. Write the reaction for photosynthesis.
4. What is saprophytic nutrition?
5. Comment on symbiotic nutrition.

E. Long Answer Questions :

1. What is nutrition and what are its types? Explain.
2. Explain heterotrophic nutrition.
3. Oxygen released during photosynthesis is extremely important for life. Why?
4. Explain the process of photosynthesis in detail.
5. Photosynthesis is affected by sunlight. Prove it.

Project Work

- Go to the garden, collect some plants and classify nutrition in them.
- On a chart paper, depict the eating of insects by a pitcher plant.