9TH Biology Unit 9 Long - Corrected Version

Unit 9
Plant Physiology
Descriptive Questions

Introduction
Q. 1 Differentiate between autotrophic and heterotrophic organisms.
Ans.
a. Autotrophic Organisms
Definition
Autotrophic organisms obtain water, carbon dioxide and minerals from their environment and prepare their food.
Examples
Some bacteria, all algae, and all plants.
b. Heterotrophic Organisms
Definition
Heterotrophic organisms obtain their food from other organisms.
Examples
Most bacteria, and all protozoans, fungi and animals.

Nutrition in Plants
Q. 2 Define nutrition and nutrients.
Ans.

Nutrition
Nutrition means the processes in which food is prepared or obtained and converted into body substances for growth and energy.
Nutrients
Nutrients are the substances required by organisms for energy, growth, repair, and maintenance.

Q. 3 Define macronutrients and micronutrients. Explain role of mineral nutrients in plant life.
Ans.
Mineral Nutrition
These are special chemical elements absorbed from soil that are essential for the plants to grow.
Macronutrients
The minerals which are required in larger quantities are called macronutrients e.g. carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulphur, calcium, and magnesium.
Micronutrients
The minerals which are required in lower quantities are called micronutrients e.g. iron, molybdenum, boron, copper, manganese, zinc, chlorine, and nickel.
Table 9.1: Role of Mineral Nutrients in Plant Life

Macronutrients	Role in Plant Life
Carbon	Major component of all biomolecules
Hydrogen	Major component of all biomolecules

Macronutrients	Role in Plant Life
Oxygen	Major component of biomolecules, necessary for cellular respiration
Phosphorus	Component of ATP, nucleic acids, and coenzymes, necessary for seed germination, photosynthesis etc.
Potassium	Regulates the opening and closing of the stoma
Nitrogen	Component of proteins, chlorophyll and enzymes
Sulphur	Component of proteins, vitamins and enzymes
Calcium	Activates enzymes, is a structural component of cell walls, influences water movement in cells
Magnesium	Component of chlorophyll, activates many enzymes

Micronutrients	Role in Plant Life
Iron	Necessary for photosynthesis, activates many enzymes
Molybdenum	Component of the enzyme that converts nitrates to ammonia
Boron	For sugar transport, cell division, and certain enzymes
Copper	Component of several enzymes
Manganese	Involved in the activities of enzymes of photosynthesis and respiration
Zinc	Required in a large number of enzymes
Chlorine	Involved in osmosis of water
Nickel	Required in nitrogen metabolism

Q. 4 What is the role of nitrogen and magnesium in plant growth?
Ans.
a. Role of Nitrogen
i. Nitrogen is a necessary part of all proteins, enzymes and nucleic acids.
ii. It is also a part of chlorophyll.
iii. Nitrogen helps plants for rapid growth, increasing seed and fruit production and improving the quality of leaf.
iv. Plant roots absorb nitrogen in the form of nitrates.
v. Carnivorous plants trap and digest small animals. Such plants fulfil their needs of nitrogen from the prey animals.

Effects of Nitrogen Deficiency

i. Nitrogen deficiency slows down the growth of plant.

ii. It also results in insufficient production of chlorophyll and so leaves begin to turn yellow.

b. Role of Magnesium

i. Magnesium is part of the chlorophyll.

ii. It also activates many plant enzymes needed for growth.

iii. It also helps in fruit formation and germination of seeds.

iv. Plant roots absorb magnesium in ionic form (Mg^{2+}).

Effects of Magnesium Deficiency

i. If sufficient amounts of magnesium are not available, plants begin to break the chlorophyll in leaves.

ii. This causes the yellowing of leaves. After prolonged magnesium deficiency leaves may also drop.

iii. When a plant faces N or Mg deficiency, it transports these elements from older to younger leaves. So, the yellowing of leaves is seen in old leaves first. If deficiency continues, this symptom progresses to the young leaves.

Figure 9.1: (a) Chlorosis due to Nitrogen deficiency, (b) Chlorosis due to magnesium deficiency

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Transport in Plants

Q. 5 (a) What is transport in plants? How does it take place?

Ans.

Definition

Transport means the movement of substances, such as water, nutrients, hormones, and waste products within an organism.

Need of Transport

This movement is essential for cellular functions, growth, and responses to environmental changes.

Explanation

i. Plants get water and mineral nutrients (salts) from the soil. These materials are transported to the aerial parts of the body.

ii. Similarly, the food prepared by leaves is transported to other parts of the body.

iii. In all land plants (except mosses and liverworts), the transport of water, salts and food is carried out by xylem and phloem tissues.

a. Xylem is responsible for the transport of water and salts.

b. Phloem is responsible for the transport of food.

Q. 5 (b) Define the following terms:

i. Diffusion

ii. Passive Transport and Active Transport

iii. Osmosis

Ans.

Diffusion: It is the movement of molecules from an area of higher concentration to an area of lower concentration, until they are evenly spread out.

Passive Transport: It is the movement of molecules across a cell membrane from a high to a low concentration, without using energy.

Active Transport: It is the movement of molecules across a cell membrane from a low concentration to a high concentration, using energy.

Osmosis: It is the movement of water molecules through a semi-permeable membrane from a region of lower solute concentration to a region of higher solute concentration.

Q. 6 Explain the internal structure of root and describe the uptake of water and salts by roots.

Ans.

Introduction

Roots are the organs which absorb water and salts from the soil. The internal structure of a root shows the following features that help the roots to perform this function.

Internal Structure of Root

Epidermis

The outermost covering of the root i.e. epidermis is a single layer of cells.

Root Hairs

Many cells of epidermis have tiny hair-like extensions into the spaces among soil particles. These extensions called root hairs are in direct contact with soil water. Root hairs have large surface area.

Absorption and Transport of Water

The soil water has a lower concentration of salts as compared to root hairs. Root hairs take in more salts by active transport. Due to the difference in the concentration of salts in soil and root hair, water moves by osmosis (passive transport) from soil to the root hairs. From root hairs, the water with dissolved salts moves to the other cells of epidermis.

Cortex: It is broad zone of cells just inside the epidermis. Water moves from epidermis to cortex.

Endodermis: It is the innermost boundary of cortex that receives water from cortex.

Pericycle: It is a narrow layer of cells present on the inner side of endodermis.

Vascular Tissues

i. Xylem and phloem (collectively called vascular bundle) are present in the innermost region of the root.

ii. They are in the form of a rod which is connected to the similar rod in the stem.

iii. Water from pericycle moves into the xylem of root from where it will be transported to the xylem of the stem.

iv. Inside the root, water and salts take two pathways to reach the core of the root; through the cells and through cell walls and intercellular spaces.

Transpiration

Q. 7 Define transpiration. Where does it take place?

Ans.

Definition

The loss of water in the form of vapours from plant surface is called transpiration.

Occurrence

This loss may occur through stomata in leaves, through the cuticle present on leaf epidermis, or through special openings called lenticels present in the stems of some plants.

Stomatal Transpiration

Most of the transpiration occurs through stomata and is called stomatal transpiration. In leaves, water moves from the xylem into the cell walls of mesophyll cells. From the moist walls of mesophyll cells, water evaporates into the air spaces of the leaf. These water vapours then move towards the stomata and then pass to the outside air.

Q. 8 Describe the events involved in the opening and closing of stomata. / Describe the mechanism of opening and closing of stomata.

Ans.

Introduction

Stomata open and close because of changes in the turgor pressure of their guard cells. The sausage-shaped guard cells are the only epidermal cells which contain chloroplasts. Their cell wall is thicker on the inside and thinner elsewhere. When guard cells become turgid, they become bean-shaped. In

this condition, their inner walls of two guard cells move away from each other and the stoma between them opens.

Transport of Water and Salts and Transpiration Pull

Transpiration is a necessary evil. Although transpiration is the loss of water from plant but, yet it creates a pull on the water columns in the xylem tissue of leaves, stem and root. This pull is responsible for the transport of water and salts from root to leaves.

Movement of Water from Epidermal Cells to Guard Cells

a. Events during Daytime: The guard cells take in potassium ions from the surrounding cells by active transport. As a result, the solute concentration of guard cells increases as compared to the other cells of epidermis. So, water moves from epidermal cells to guard cells by osmosis.

b. Opening of Stomata

The guard cells become turgid and their inner sides move away from each other. In this way, the stoma between them opens. The solute concentration remains high in guard cells because they do photosynthesis and prepare glucose in them. So, water stays in them and they remain turgid.

c. Events during Evening: At evening, the glucose concentration falls in guard cells and potassium ions also move back to epidermal cells. As a result, water moves out from guard cells and they lose turgor. Their inner sides touch each other and the stoma closes.

Q. 9 Describe the factors affecting the rate of transpiration. / Describe temperature, wind and humidity as the factors affecting the rate of transpiration.

Ans. Transpiration is affected by several factors. For example:

- **Temperature:** Increase in temperature results in an increase in the rate of transpiration. It is due to the fact that at higher temperature, water evaporates more quickly.
- **Wind:** Wind speeds up transpiration by carrying away humid air surrounding the leaves, allowing for more water to evaporate.
- **Humidity:** The higher is humidity (the percentage of water vapour in the atmosphere), the lower is the rate of transpiration.
- **Surface Area and Distribution of Stomata:** Leaves with more surface area transpire more than the leaves with narrow blades. In most plants the number of stomata on the lower leaf surface is greater than on the upper surface. Therefore, the rate of transpiration from the lower surface is greater than from the upper surface.

Transport of Water and Salts in Plants

Q. 10 Describe the mechanism of transport of water and salts in plant.

Ans.

Introduction

Roots cannot push the absorbed water and salts to the leaves of the plant. Instead, the leaves apply a pulling force on water present in roots. The pulling force in leaves is created by the transpiration of water from their surfaces. Therefore, it is called transpirational pull.

Explanation

When mesophyll cells of leaf lose water, more water enters in them from xylem vessels. Inside xylem vessels, there is a continuous water column. This water column extends from leaves to stem and to the roots. The continuous water column is created due to three reasons:

(i) The forces of attraction among water molecules (cohesion).

(ii) The narrow diameter of xylem vessels.

(iii) The force by which water molecules are adhered to the walls of xylem vessels (adhesion).

When one water molecule moves up by the xylem of the leaf, it produces a tension on the entire water column in the xylem of leaves, stem and root. As a result, the entire water column is pulled upwards.

Q. 11 Describe the mechanism of transport of food in plants. / Describe pressure flow mechanism.

Ans.

Introduction

Inside the plant body, food is transported from one part to the other through phloem tissue. For transportation in most plants, sucrose is converted into other sugars. The mechanism of the transport of food in plants is called pressure flow mechanism.

Explanation

i. According to pressure flow mechanism, dissolved food flows from a source to a sink. The sources include photosynthetic tissues (e.g. mesophyll of leaves) and storage tissues (e.g. roots). Sinks include the sites of food utilization (e.g. growing tips of roots and stems) and the storage tissues.
ii. Xylem is a one-way passage for water and salts (from roots to leaves). Phloem is a two-way passage for food. The direction of food movement is decided by supply and demand in the sources and sinks.
iii. At the source site, food (sucrose) enters the sieve tubes of phloem by active transport. Companion cells of phloem provide energy for this transport. Due to higher solute concentration in sieve tubes than the nearby xylem tissue, water flows into sieve tubes by osmosis. In this way, the osmotic pressure in sieve tubes increases and the solution of food flows towards the sink.
iv. At the sink, sucrose is actively unloaded from the phloem cells into sink tissues. It reduces osmotic pressure in the phloem cells. So, water also flows out and moves to xylem tissue.

Q. 12 Describe the process of gaseous exchange in plants.

Ans.

During Daytime

During the day time, all plant cells are carrying out cellular respiration while their green parts are carrying out photosynthesis.

- In photosynthesis, they use carbon dioxide and release oxygen. They take carbon dioxide which they produce in respiration. They also take carbon dioxide from the environment.
- In respiration, they use oxygen produced during photosynthesis. They release carbon dioxide to the environment.

So, during daytime leaves are releasing oxygen and taking carbon dioxide from the environment.

During Night Time

During night, all cells are carrying out respiration while there is no photosynthesis. So the plant is taking in oxygen from environment and releasing carbon dioxide.

Process of Gaseous Exchange

i. Gaseous Exchange through Epidermis and Cuticle

In plants, the gaseous exchange between body and the environment occurs through the surface. The epidermis of root, stem and leaves allows the exchange of gases between the inner cells and environment. At some parts a thick cuticle is present over epidermis. It also allows the exchange of gases.

ii. Gaseous Exchange through the Leaves and Stems

In leaves and young stems, the air moves in and out through the stomata present in epidermis. Inside body, gaseous exchange occurs between cells and air.

iii. Gaseous Exchange in Woody Stems

In woody stems, the outer surface is covered by bark. Gaseous exchange cannot occur through bark. The bark contains special pores called lenticels, which allow the gaseous exchange with the environment.

Figure 9.8: Lenticels in a bark

Mechanism for Excretion

Q. 13 How do plants exchange extra water and salts from their bodies? / Describe the mechanism / adaptations in plants for excretion.

Ans.

a. Excretion of Extra Carbon dioxide and Oxygen

During the day, plants use the carbon dioxide produced in cellular respiration for photosynthesis. However, at night, when photosynthesis is not occurring, carbon dioxide becomes a waste product. Plants release this excess carbon dioxide through their general surfaces and stomata.

Similarly, the oxygen produced during photosynthesis is used for cellular respiration during the day. Excess of oxygen is released into the atmosphere through the stomata.

b. Excretion of Extra Water

Plants store large amounts of water in the vacuoles of their cells. It results in turgor, which provides support to the soft parts of plant body. If plants have extra water, they remove it in two ways.

1. Transpiration

a. **At Day:** During the day, plants remove their extra water by transpiration. There are three types of transpiration: stomatal transpiration, cuticular transpiration, and lenticular transpiration.

b. **At Night:** At night, transpiration usually does not occur because most plants have their stomata closed. If there is high water content in soil, water enters the roots and is accumulated in xylem vessels.

2. Guttation at Night

At night, when stomata are closed, many plants store excess water in their xylem tissue. This water is removed during the day. Some plants, such as grasses, have a specialized mechanism called guttation to remove excess water at night. Guttation involves the release of water droplets through small pores located at the tips or edges of leaves. This process helps to regulate the plant's water content.

Dew Formation

Guttation is different from dew formation. Dew means the water drops on the surface of leaves formed by the condensation of water vapours present in the air.

c. Excretion of other Metabolic Wastes

Plants adopt different methods to remove other metabolic wastes from their bodies.

i. Some plants can store wastes in the form of harmless crystals.

ii. Some plants keep their wastes in their leaves. When their leaves fall, the plant body also gets rid of these wastes.

iii. Some plants excrete their wastes through special pores by applying force. For example, rubber plant produces latex, keekar tree excretes gums, coniferous trees excrete resins, and ladyfinger/okra excretes mucilage.

Q. 14 Explain osmotic adjustments in mesophytes, hydrophytes, xerophytes and halophytes.

Ans. On the basis of habitats, there are four types of plants:

1. Mesophytes

Introduction

Mesophytes are the terrestrial plants which live in lands where medium quantity of water is available. They absorb water through roots.

Osmotic Adjustments

i. Most of their body surface is covered with waxy cuticle, which prevents water loss.

ii. They also control excess transpiration of water by closing their stomata.

Examples

Maize (corn), clover and rose etc. are examples of mesophytes.

2. Hydrophytes

Introduction

Hydrophytes live in freshwater (ponds, and lakes etc.) or in wet soil. In these plants, the absorption of water occurs through the whole surface.

Osmotic Adjustments

They use different ways to remove extra water from their bodies:

- Broad Leaves and large number of Stomata
  i. For example, many hydrophytes have broad leaves which float on the surface of water.
  ii. These leaves have large number of stomata on their upper surfaces. Water moves out through these stomata.

Example

The most common example of such plants is water lily.

3. Xerophytes

Introduction

Xerophytes live in extremely dry environments (deserts).

Osmotic Adjustments

i. They have deep roots to absorb water from almost dry soil.

ii. Few Stomata and Waxy Cuticle: Their body surface has very few stomata. It is also covered with thick waxy cuticle to reduce the loss of water.

iii. Succulent Organs: Some xerophytes e.g. Cacti (singular, Cactus) store water in their specialized stems or roots. Such stems or roots are soft and juicy and are called succulent organs.

Example

Examples of xerophytes include Cacti (singular Cactus).

4. Halophytes

Introduction

Halophytes live in habitats with salty waters (e.g. sea or salty marshes).

Osmotic Adjustments

i. Water tries to move out from their hypotonic bodies into the hypertonic environment. Such plants absorb salts from outside and make their bodies hypertonic. In this way, water does not move out of cells. The excess salt can be stored in cells or excreted out from salt glands on leaves.

Example

Many sea grasses are included in this group.