Department of biology

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((Plant Physiology))

Stage (3)

((LAB - (1) -))

Introduction of Plant Physiology

By

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In plant physiology, a solution is defined as a homogeneous mixture of two or more substances, where the substance present in a larger quantity is the solvent (usually water) and the other is the solute. Solutions are classified based on their concentration, physical nature, and their biological effect on plant cells.

Types of Solutions by Concentration and Preparation :-

1. Molar Solution (M): Prepared by dissolving one gram molecular weight of the solute in a quantity of solvent and then completing the volume to exactly one liter. The required weight in grams is calculated using the formula: (Required Volume÷1000)×Molarity×Molecular Weight.

2. Molal Solution (m): Prepared by dissolving one gram molecular weight of the solute in one kilogram (or one liter) of the solvent.

3. Normal Solution (N): A solution containing one gram equivalent weight of the solute in one liter of solution.

4. Percentage Solutions: Prepared in three ways: Weight/Weight (W/W) by dissolving a specific weight of solute in a specific weight of solvent; Volume/Volume (V/V) by mixing volumes of solute and solvent; and Weight/Volume (W/V) by dissolving a weight of solute and completing the volume with distilled water to 100ml.

5. Parts Per Million (ppm): Used for precise scientific research such as hormones or vitamins; it is prepared by dissolving 1 mg of the substance in 1 liter of solvent. To prepare a dilute solution from a concentrated stock, the Dilution

Law is used: $C1 \times V1 = C\,2 \times V2$

Types of Solutions by Physical Nature

1. True Solutions: Particles are broken down into very small ions or molecules that do not settle over time and appear perfectly clear, such as sucrose or salt solutions.

2. Suspensions and Emulsions: Consist of large particles that do not dissolve but remain suspended; they are unstable and settle over time due to gravity.

3. Colloidal Systems: Particle sizes are intermediate between true solutions and suspensions; they feature electrical charges, the Tyndall effect (light scattering), and Brownian movement.

Types of Solutions by Effect on Plant Cells :-

1. Hypotonic Solution: Has a lower solute concentration than the cell sap; water enters the cell, causing it to become turgid (swollen).

2. Hypertonic Solution: Has a higher solute concentration than the cell sap; water leaves the cell, causing the cytoplasm to shrink and pull away from the cell wall, a phenomenon known as plasmolysis.

3. Isotonic Solution: The solute concentration is equal to that of the cell sap; no net water movement occurs, and the cell volume remains unchanged.

Laboratory Methods to Measure Solution Effects

• Potato Osmometer: Cavities are made in equal-sized potato cubes; one is filled with salt in a water dish, and the other with salt only. Water movement is observed via osmosis, and the potato's texture changes between wilting and swelling.

• Chardakov (Falling Drop) Method: Plant tissue is placed in a series of sucrose solutions. A drop colored with methylene blue is added to observe density changes; if the drop rises, the solution has become more concentrated (water entered the tissue); if it sinks, the solution has been diluted (water left the tissue).

• Microscopic Examination: Colored onion skin (epidermis) is used to observe the separation of the plasma membrane from the cell wall in a high-concentration salt solution, or its recovery to a normal state (deplasmolysis) when placed in distilled water.

Bending Method: Parts of a castor bean (Ricinus) plant are placed in different sugar solutions to observe the degree of tissue curvature as an indicator of water potential.