



Plant Water Relation

POINT TO REMEMBER

Translocation : Transport of substances in plants over longer distances through the vascular tissue (Xylem and Phloem) is called translocation.

Means of transport : The transport of material into and out of the cells is carried out by a number of methods. These are diffusion, facilitated diffusion and active transport.

Diffusion : Diffusion occurs from region of higher concentration to region of lower concentration across the permeable membrane. It is passive and slow process. No energy expenditure takes place.

Facilitated diffusion : The diffusion of hydrophilic substances along the concentration gradient through fixed membrane transport protein without involving energy expenditure is called facilitated diffusion. For this the membrane possess aquaporins and ion channels. No energy is utilized in this process.

Methods of Facilitated Diffusion

Symport	Antiport	Uniport
(Two molecules cross the membrane in the same direction at the same time.)	(Two molecules move in opposite direction at the same time.)	(Single molecule moves across membrane independent of other molecules.)

Active transport : Active transport is carried by the movable carrier proteins (pumps) of membrane. Active transport uses energy to pump molecules against a concentration gradient from a low concentration to high concentration (uphill-transport). It is faster than passive transport.

Water potential : The chemical potential of water is called water potential. It is denoted by Ψ_w (Psi) and measured in pascals (Pa). The water potential of a cell is affected by solute potential (Ψ_s) and pressure potential (Ψ_p).

$$\Psi_w = \Psi_s + \Psi_p$$

Water potential of pure water at standard temperature which is not under any pressure is taken to be zero (by convention).



Osmosis : Osmosis is movement of solvent or water molecules from the region of their higher diffusion pressure or free energy to the region of their lower diffusion pressure or free energy across a semi-permeable membrane.

Water molecules move from higher water potential to lower water potential until equilibrium is reached.

Plasmolysis : Process of shrinkage of protoplasm in a cell due to exosmosis in hypertonic solution.

Casparian strip : It is the tangential as well as radial walls of endodermal cells having the deposition of water impermeable suberin.

Imbibition : Imbibition is the phenomenon of adsorption of water or any other liquid by the solid particles of a substance without forming a solution.

Some examples of Imbibition :

- (i) If a dry piece of wood is placed in water, it swells and increases in its volume.
- (ii) If dry gum or pieces of agar-agar are placed in water, they swell and their volume increases.
- (iii) When seeds are placed in water they swell up.

Mass flow : Mass flow is the movement of substances (water, minerals and food) in bulk from one point to another as a result of pressure differences between two points.

Transport of water in plants : Water is absorbed by root hairs, then water moves upto xylem by two pathways – apoplast and symplast pathway.

The transport of water to the tops of trees occurs through xylem vessels. The forces of adhesion and cohesion maintain a thin and unbroken columns of water in the capillaries of xylem vessels through which it travels upward. Water is mainly pulled by transpiration from leaves.

(Cohesion-tension-transpiration pull Model)

Root pressure : A hydrostatic pressure existing in roots which pushes the water up in xylem vessels.

Guttation : The water loss in its liquid phase at night and early morning through special openings of vein near the tip of leaves.

Transpiration : The loss of water through stomata of leaves and other aerial parts of plants in form of water vapour.



Factors affecting transpiration : Temperature, light, humidity, wind speed, number and distribution of stomata, water status of plant.

Uptake and transport of mineral nutrients : Ions are absorbed by the roots by passive and active transport. The active uptake of ions require ATP energy. Specific proteins in membranes of root hair cells actively pump ions from the soil into the cytoplasm of epidermal cells and then xylem. The further transport of ions to all parts of the plant is carried through the transpiration stream.

The Pressure or Mass Flow Hypothesis : The glucose is prepared at the source by the process of photosynthesis and is converted to sucrose (sugar). This sugar is then moved into sieve tube cells by active transport. It produces hyper-tonic condition in phloem. Water in the adjacent xylem moves into phloem by osmosis. Due to osmotic (turgor) pressure, the phloem sap moves to the areas of lower pressure.

At the sink, osmotic pressure is decreased. The incoming sugar is actively transported out of the phloem and removed as complex carbohydrates (sucrose). As the sugar is removed, the osmotic pressure decreases, the water moves out of the phloem and returns to the xylem.

