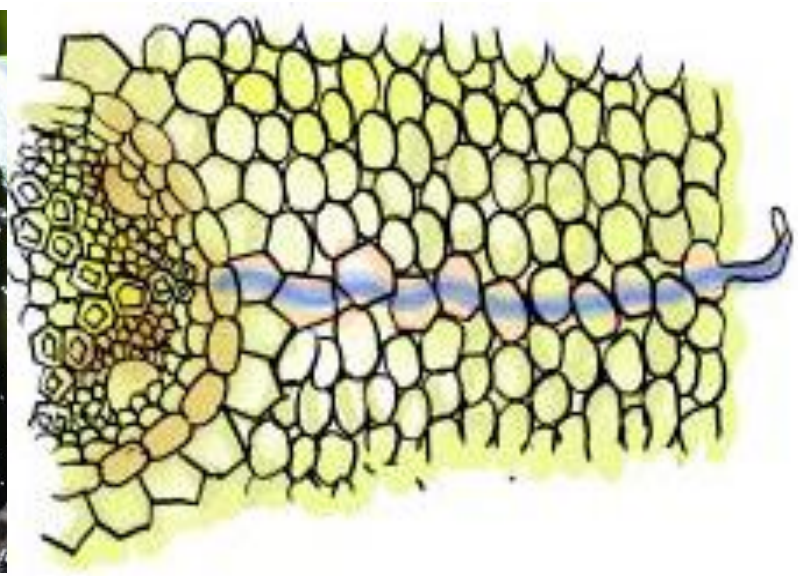
# ABSORPTION OF WATER



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**For B.Sc. Part II (Subs) Group C (Plant Physiology)**

**Lecture No.02**

➢ Plants absorb water through **root hairs** which are in contact with soil water and form a root hair zone.

➢ Root hairs are tubular hair like prolongations of the cells of the epidermal layer (when epidermis bears root hairs it is also known as **piliferous layer**) of the roots.

➢ The walls of root hairs are permeable and consist of **pectic substances** and **cellulose** which are strongly **hydrophilic** (water loving) in nature.

➢ The root hairs **lack cuticle** and provide large surface area.

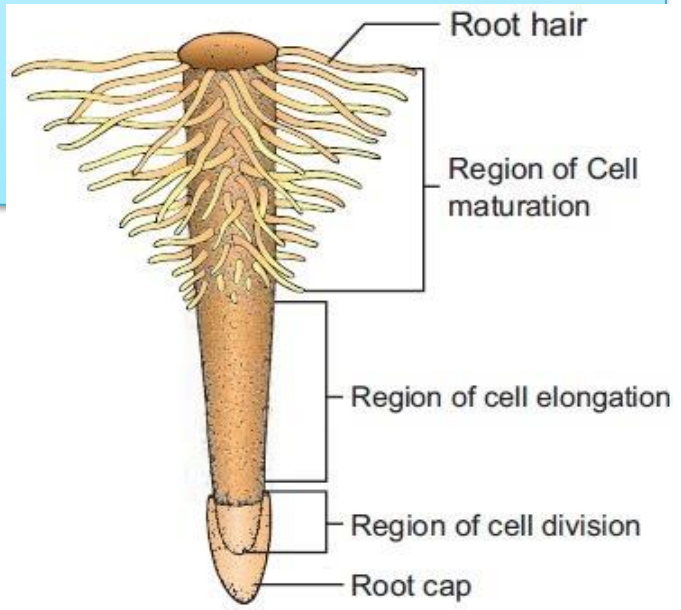


Figure. Regions of root

➢ Root hairs contain vacuoles filled with cell sap.

➢ When roots elongate, the older hairs die and new root hairs are developed so that they are in contact with fresh supplies of water in the soil.

# Mechanism of water absorption

Water absorption is of two types

(1) Active Absorption of Water

(2) Passive Absorption of Water

**Active Absorption of Water:**

In this process the root cells play active role in the absorption of water and metabolic energy released in the form of ATP during metabolic processes (respiration) is consumed.

Active absorption may be of two types

(i) Osmotic absorption i.e., when water is absorbed from the soil into the xylem of the roots according to the osmotic gradient.

(ii) Non-osmotic absorption i.e., when water is absorbed against the osmotic gradient.

- First step in the osmotic absorption of water is the imbibition of soil water by the hydrophilic cell walls of root hairs.
- Osmotic Pressure (O.P.) of the cell-sap of root hairs is usually higher than the O.P. of the soil water. Therefore, the Diffusion Pressure Deficit (D.P.D.) and the suction pressure in the root hairs become higher and water from the cell walls enters into them through plasma-membrane (semi-permeable) by osmotic diffusion.
- As a result, the O.P., suction pressure and D.P.D. of root hairs now become lower, while their turgor pressure is increased.
- Now, the cortical cells adjacent to root hairs have higher O.P., suction pressure and D.P.D. in comparison to the root hairs. Therefore, water is drawn into the adjacent cortical cells from the root-hairs by osmotic diffusion.

➢ In the same way, the water by cell to cell osmotic diffusion gradually reaches the innermost cortical cells and the endodermis. Osmotic diffusion of water into endodermis takes place through special thin walled passage cells because the other endodermal cells have casparian strips on their walls which are imperviable to water.

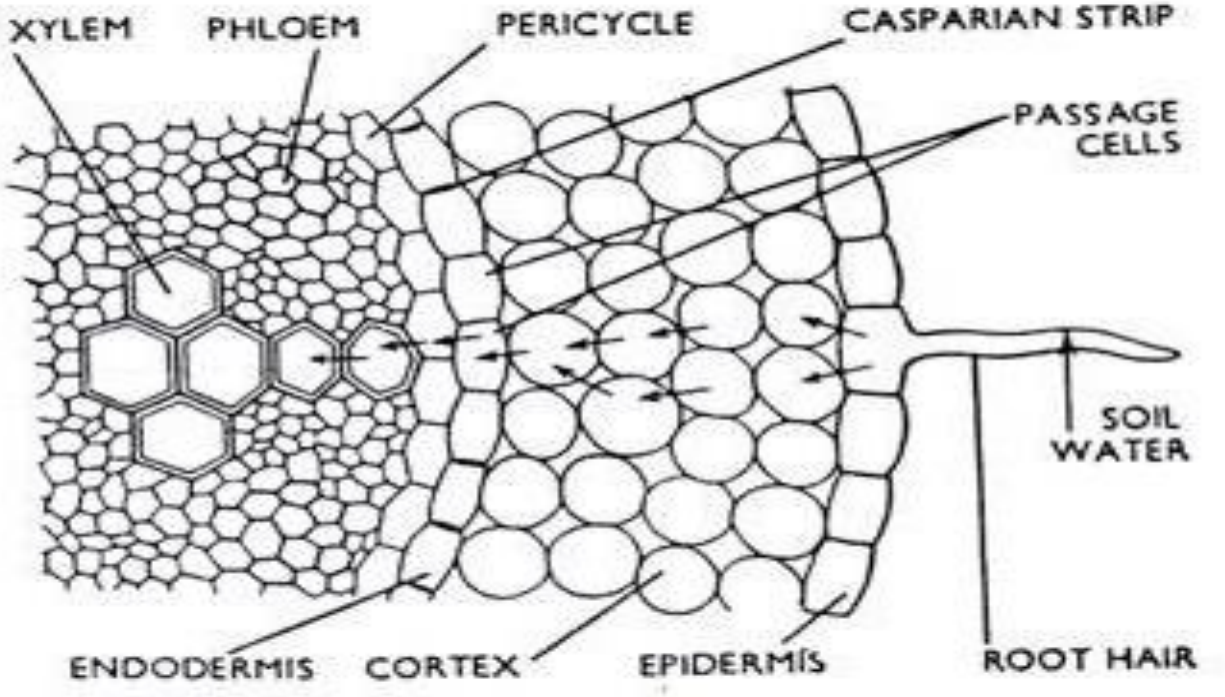


**Figure: T.S of dicot root indicating the absorption of water**

➢ Water from endodermal cells is drawn into the cells of pericycle by osmotic diffusion which now becomes turgid and their suction pressure is decreased.

➢ In the last step, water is drawn into xylem from turgid pericycle cells.

➢ It is because in absence of turgor pressure of the xylem vessels (which are non-elastic), the suction pressure of xylem vessels becomes higher than the suction pressure of the cells of the pericycle. When water enters into xylem from pericycle, a pressure is developed in the xylem of roots which can raise the water to a certain height in the xylem. This pressure is called as root pressure.

**(ii) Active Non-Osmotic Absorption of Water:**

➢ Sometimes, it has been observed that absorption of water takes place even when the O.P. of the soil water is higher than the O.P. of cell-sap.

➢ This type of absorption which is non- osmotic and against the osmotic gradient requires the expenditure of metabolic energy probably through respiration.

## 2. Passive water absorption

- Passive absorption of water takes place when rate of transpiration is usually high.
- Rapid evaporation of water from the leaves during transpiration creates a tension in water in the xylem of the leaves.
- This tension is transmitted to water in xylem of roots through the xylem of stem and the water rises upward to reach the transpiring surfaces.
- As a result, soil water enters into the cortical cells through root hairs to reach the xylem of roots to maintain the supply of water.
- The force for this entry of water is created in leaves due to rapid transpiration and hence, the root cells remain passive during this process.

During absorption of water by roots, flow of water from epidermis to endodermis takes place by three different pathway

(i) Apoplastic pathway (cell walls and intercellular spaces),

(ii) Trans-membrane pathway (by crossing the plasma membranes)

(iii) Symplast pathway (through plasmodesmata).

In the soil, water is transported predominantly by bulk flow. However, when water comes in contact with the root surface, the nature of water transport becomes more complex. From the epidermis to the endodermis of the root, there are three pathways through which water can flow the apoplast, transmembrane, and symplast pathways.

**(i) Apoplastic pathway:** In the apoplast pathway, water moves exclusively through the cell wall without crossing any membranes. The apoplast is the continuous system of cell walls and intercellular air spaces in plant tissues

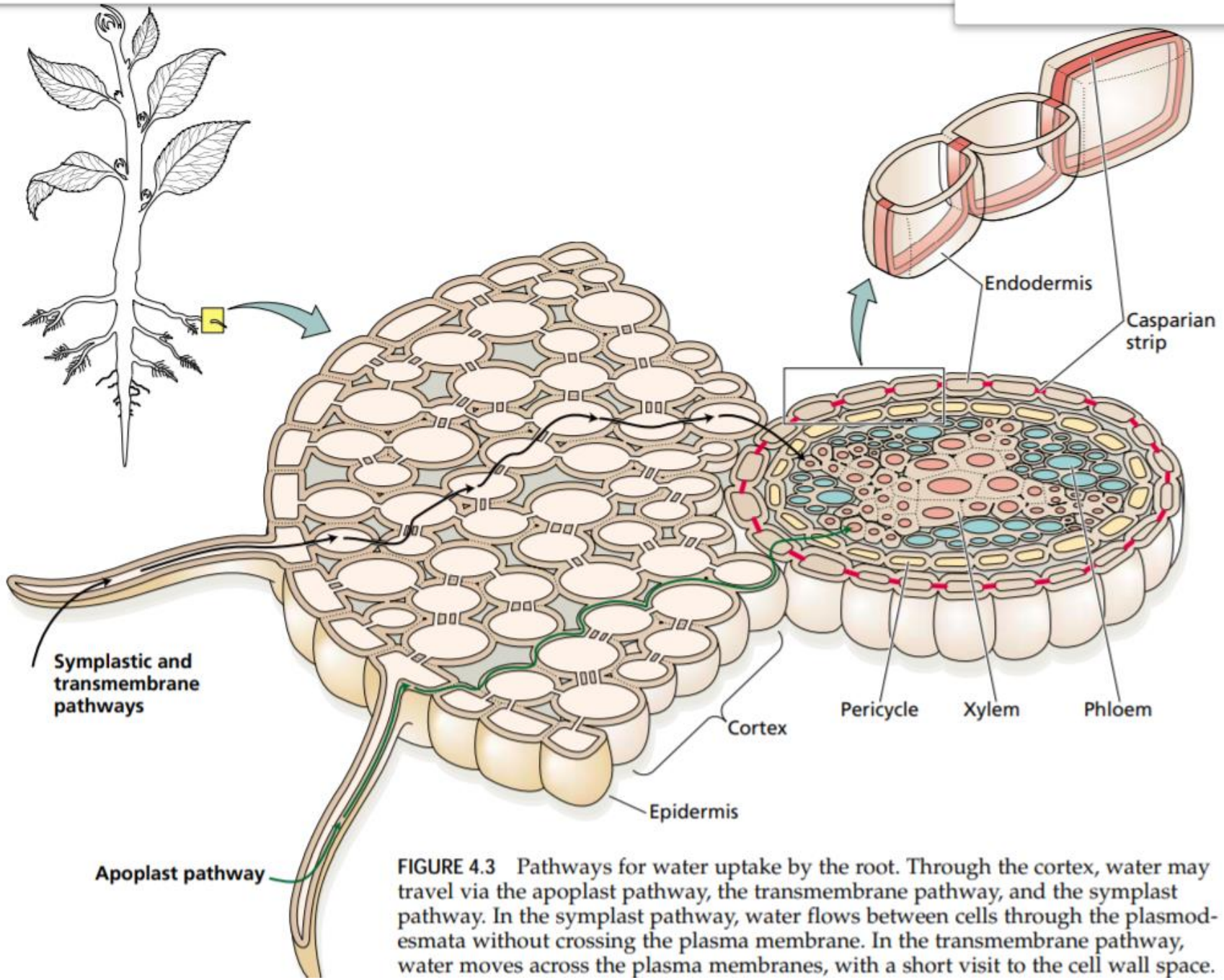


**FIGURE 4.3** Pathways for water uptake by the root. Through the cortex, water may travel via the apoplast pathway, the transmembrane pathway, and the symplast pathway. In the symplast pathway, water flows between cells through the plasmodesmata without crossing the plasma membrane. In the transmembrane pathway, water moves across the plasma membranes, with a short visit to the cell wall space.

## (ii) Trans-membrane pathway

The transmembrane pathway is the route followed by water that sequentially enters a cell on one side, exits the cell on the other side, enters the next in the series, and so on. In this pathway, water crosses at least two membranes for each cell in its path (the plasma membrane on entering and on exiting). Transport across the tonoplast may also be involved.

## (iii) Symplast pathway

In the symplast pathway, water travels from one cell to the next via the plasmodesmata. The symplast consists of the entire network of cell cytoplasm interconnected by plasmodesmata.

# Thank You !!