



Department of biology



Department of biology

2025-2026

((Plant Physiology))

Stage (3)

((Lecture -4-))

Imbibition

By

Asst. Lec. Zainab Nadhum Aziz



Department of biology



Imbibition: Certain substances if placed in a particular liquid absorb it and swell up. For example, when some pieces of gum or a piece of dry wood or dry seeds are placed in water they absorb the water quickly and swell up considerably so that their volume is increased. These substances are called as imbibants and the phenomenon as imbibition. There exists certain force of attraction in between the imbibant and the imbibed substance. In plants, this is because of the presence of a large number of hydrophilic colloids both in living as well as dead

cells in the form of proteins, carbohydrates such as starch, cellulose, pectic substances which have strong attraction towards water.

***Imbibition plays a very important role in the life of the plants:**

1- The first step in the absorption of water by the roots of higher plants is the imbibition of water by the cell walls of the root hairs.

2- Imbibition of water is very essential for dry seeds before they start germination.

As a result of imbibition, a pressure is developed which is called as imbibition pressure. The magnitude of this pressure is tremendous if the imbibant is confined and allowed to imbibe so much so that a rock can be splitted if some dry wooden pieces are inserted in a small crack in that rock and then soaked with water.

Using thermodynamic terminology, water moves by imbibition into a substance only when its water potential exceeds that of the imbibant.



Absorption of water

In higher plants water is absorbed through root hairs which are in contact with soil water and **form a root hair zone** a little behind the root tips.

When roots elongate, the older hair 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 is of two types:**

1- Active absorption of water. In this process the root cells play active role in the absorption of water and metabolic energy released through respiration is consumed.

***Active absorption may be of two kinds:**

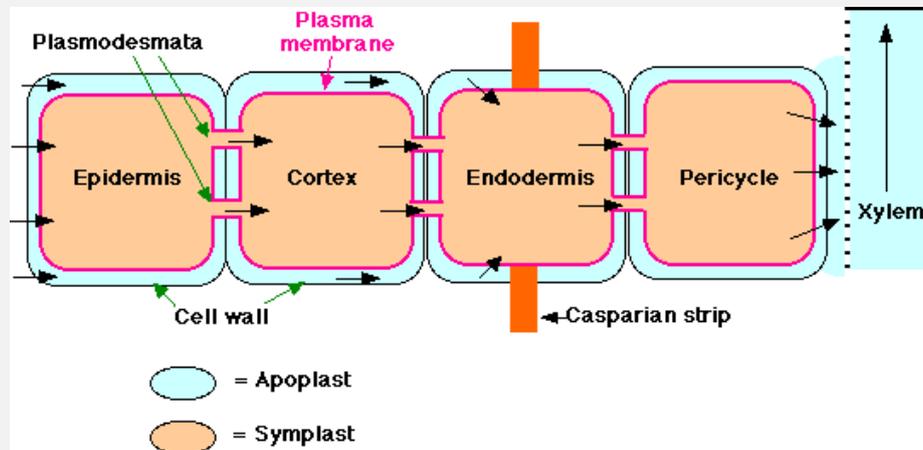
- a- Osmotic absorption, when water is absorbed from the soil into the xylem of the roots according to the osmotic gradient.
- b- Non-osmotic absorption, when water is absorbed against the osmotic gradient.

2- Passive absorption of water. It is mainly due to transpiration, the root cells do not play active role and remain passive.

Active absorption of water: - 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. There for the water potential Ψ_w in the root hairs become lower than Ψ_w of soil water, and water from the cell walls enters into them through plasma-membrane by osmotic diffusion. Now the cortical cells adjacent to root hairs have higher O.P. (lower Ψ_w) 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 inner most cortical cells and the endodermis. Osmotic diffusion of water into endodermis takes place through special thin walled passage cells because the other endodermis cells have casparian strips on their walls which are impervious to water. Water from endodermal cells is drawn into the cells of pericycle by osmotic diffusion, which now become turgid and their water potential Ψ_w is increased. In the last step, water is drawn into xylem from turgid pericycle cells.

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. Following evidences support this view:



Department of biology



- 1- The factors which inhibit respiration also decrease water absorption.
- 2- Poisons which retard metabolic activities of the root cells also retard water absorption.
- 3- Auxins (growth hormones) which increase metabolic activities of the cells stimulate absorption of water.

Passive absorption of water: -

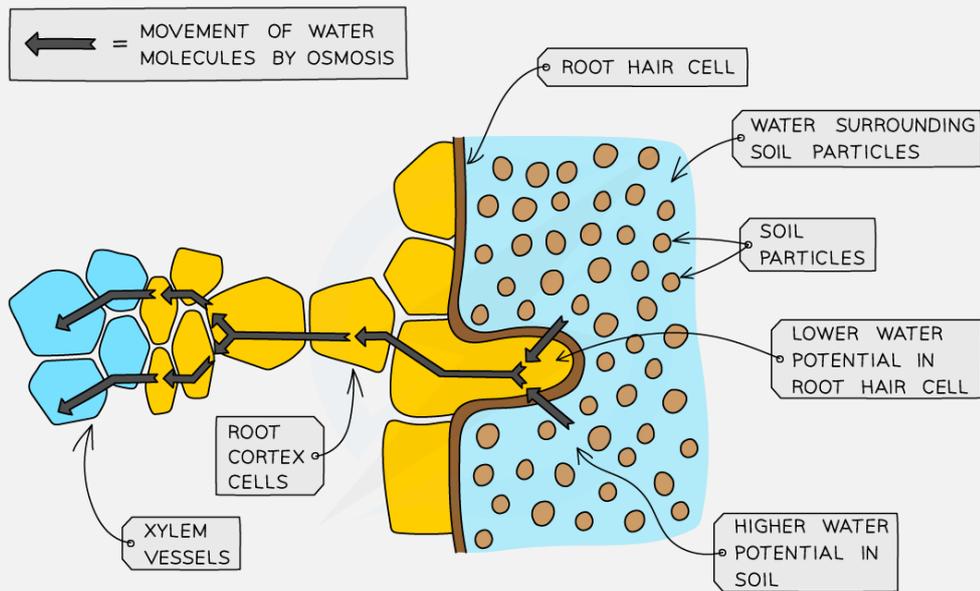
Passive absorption of water takes place when rate of transpiration is usually high. Rapid evaporation of water from the leaves during transpiration creates a tension in water in the xylem of the leaves. This tension is transmitted to water in xylem of roots through the xylem of stem and the water rises 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.

Pathway of water in root: -

During absorption of water by roots, the flow of water from epidermis to endodermis may take place through, three different pathways: -

- 1- Apoplastic pathway (cell walls and intercellular spaces).
- 2- Transmembrane pathway (by crossing the plasma membranes).
- 3- Symplastic pathway (through plasmodesmata).

A combination of these three pathways is responsible for transport of water across the root.



Copyright © Save My Exams. All Rights Reserved

 save my exams

External factors affecting absorption of water: -

- 1- **Available soil water:** Sufficient amount of water should be present in the soil in such form which can easily be absorbed by the plants. Increased amount of water in the soil (flood) results in poor aeration of the soil which retards metabolic activities of root cells like respiration and hence, the rate of water absorption is also retarded.
- 2- **Concentration of the soil solution:** Increased concentration of soil solution (due to the presence of more salts in the soil) results in higher osmotic pressure. If the O.P. of soil solution will become higher than the O.P. of cell sap in root cells, the water absorption will be greatly suppressed. Therefore, absorption of water is poor in alkaline soils and marshes.
- 3- **Soil air:** Absorption of water is retarded in poorly aerated soils because in such soils the accumulation of CO_2 will retard the metabolic activities of the roots like respiration.



Department of biology



4- **Soil temperature:** Increase in soil temperature up to 30°C favors water absorption. At higher temperatures water absorption is decreased. At low temp, also water absorption decreases so much so that at about 0°C it is almost checked.

This is probably because at low temp:

- 1- The viscosity of water and protoplasm is increased.
- 2- Permeability of cell membranes is decreased.
- 3- Metabolic activities of root cells are decreased.
- 4- Growth and elongation of roots are checked.