ASCENT OF SAP

- During absorption of water the water that enters into the root hairs ultimately reaches the xylem of root after passing through cortex, endodermis and pericycle.
- From the xylem of root, it reaches the aerial plant organs through xylem.
- This '**unidirectional upward movement of minerals and water against gravitational force from root to shoot system through xylem**' is called as ***Ascent of sap***.

Cohesion and Tension theory

- It is the most acceptable theory to understand ascent of sap in plants.
- **Dixon** and **Jolley** proposed it.
- It is based on three aspects known as
  1. Cohesion and Adhesion of water molecules, 2. Continuity of water column and
  3. Transpiration pull.
- During transpiration, mesophyll cells lose water. It results in decrease in water potential of mesophyll cells. Water of adjacent cells enters into the mesophyll cells due to establishment of water potential gradient. This gradient reaches the xylem of leaf and a tension is built up. This tension resulted due to transpiration is called as **Transpiration Pull.**
- The tension is transmitted to xylem of root via stem. It helps in continuous lifting of water column of xylem from root to leaf via stem.
- Continuity of water column is maintained in the xylem due to high cohesive force of water. The water cylinder of xylem is not pulled away from the surface of xylem vessel due to high adhesive force of water.
- In the experiment for explanation of cohesion and tension theory, a glass tube filled with water is placed in a beaker of water. A wet sponge is fixed to the free end of glass tube and kept under a running fan or in hot sun.
- The water present in the sponge is evaporated and the water present in the glass tube replaces the water. The water of beaker replaces the water of the glass tube. This is due to building up of tension between the sponge and beaker through glass tube.
- A twig cut under water to demonstrate the same can replace the moist sponge.
- Many evidences indicate the existence of tensions in the freely transpiring plants.
- A water potential gradient or tension of **1.3 Mpa** is required for raising the water to a height of **400** feet with an optimum velocity of water movement.
- Existence of **4.0 Mpa** water potential gradients was calculated in tall trees.

Objections or Demerits

- At high tensions, air bubbles are formed in the vessels. It is known as **Cavitation**. Obstruction to the flow of mineral water through xylem due to cavitation is called as **Embolism**. This objection was not explained by Dixon. It can be answered that whenever there is discontinuity in the xylem vessel, water takes a sideward course into another parallel vessel and from there it is lifted up.
- Cohesion theory states tracheids as more efficient than vessels in water conduction because the septa of tracheids provide stability to the ascending water column. But vessels are broader, have perforation plates that promote free flow of mineral water and they replaced the tracheids in course of evolution.