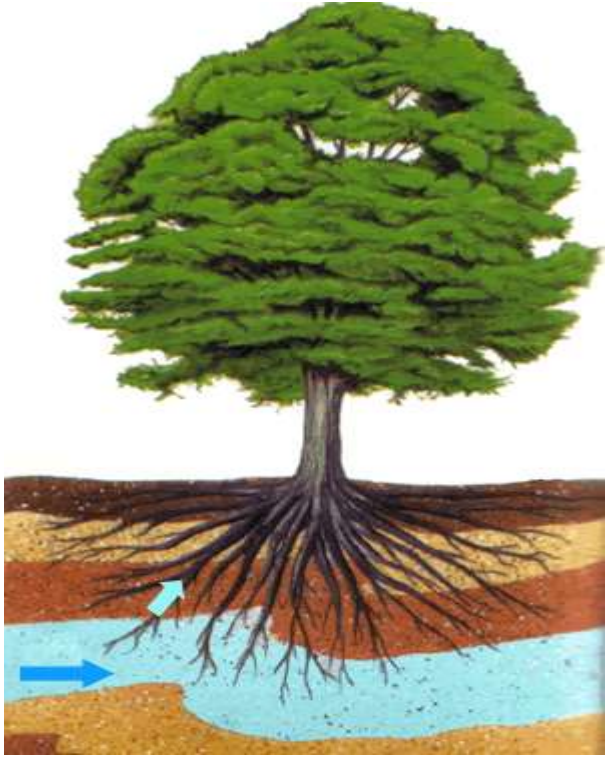
NUTAN MAHAVIDYALYA SAILU, DIST. PARBHANI



UNIT-I PLANT WATER RELATIONS

ASCENT OF SAP

DR. KANTHALE P. R.

HEAD DEPARTMENT OF BOTANY

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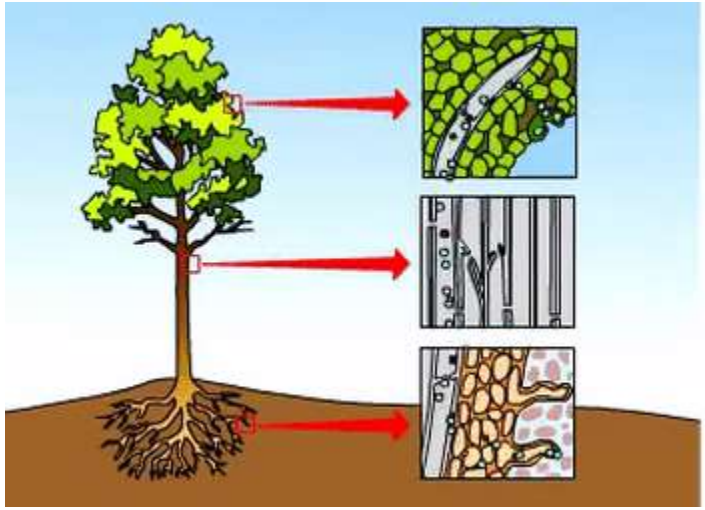
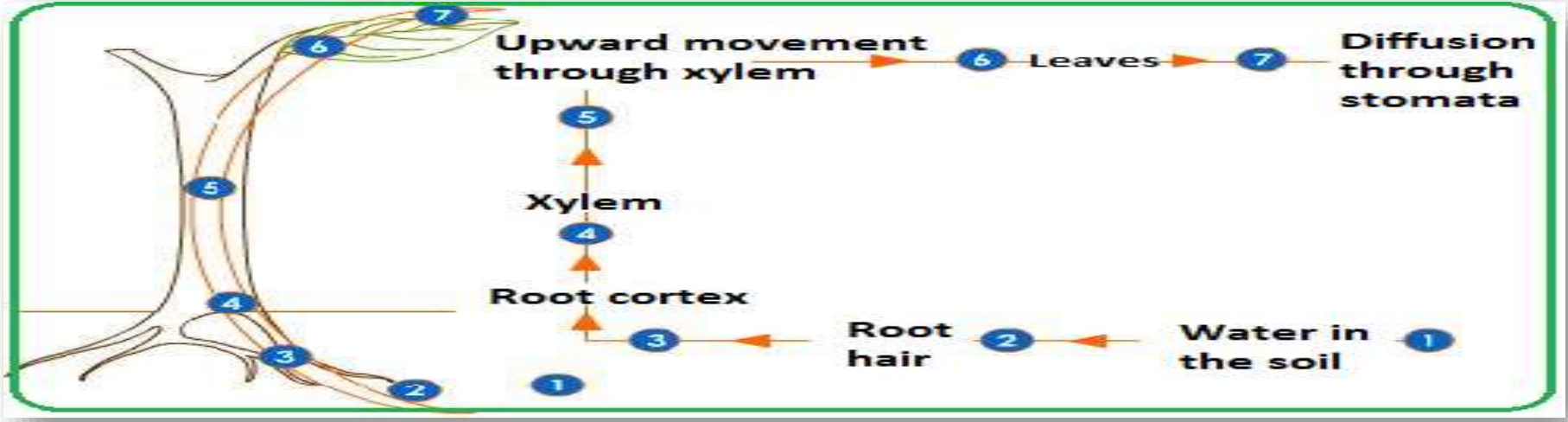
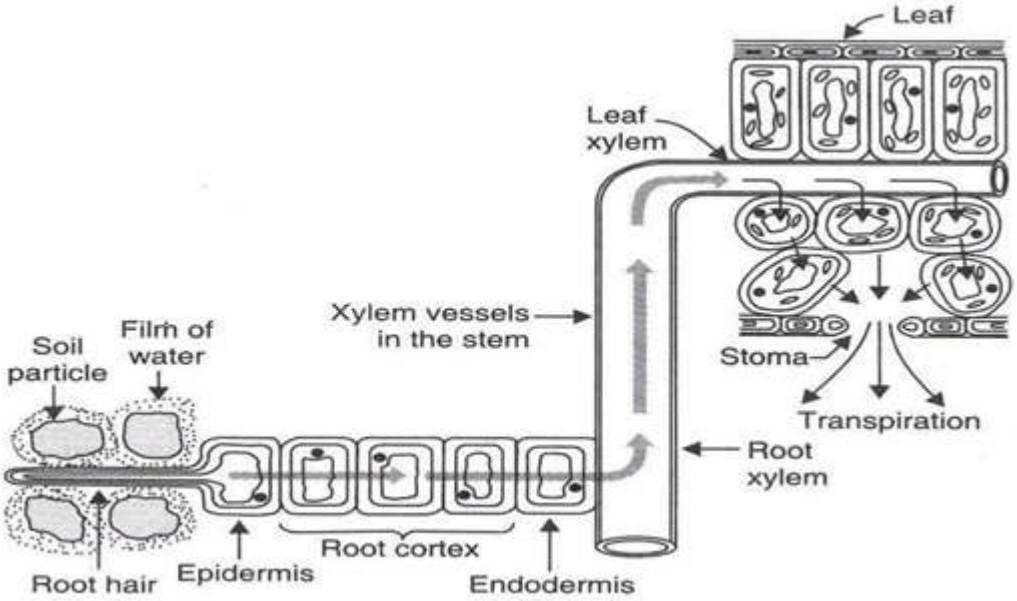
The upward movement of water is called as ascent of sap or The transport of water from root to other aerial parts like stem and leaves against gravity.



Mechanims

water mover from soil -----Root hairs-----imbibition and osmosis----- root cell , root epidermis, root cortex----xylem elements of root-----stem xylem---stem cell -----petiole----venin of leaf----mesophyll cell of leaf----- traspiration-------stomata and cuticle ----remove outside





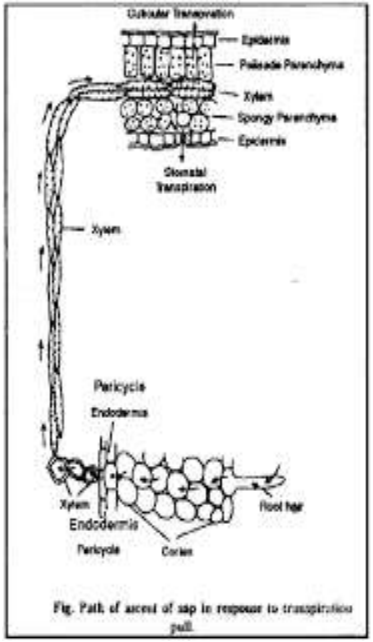
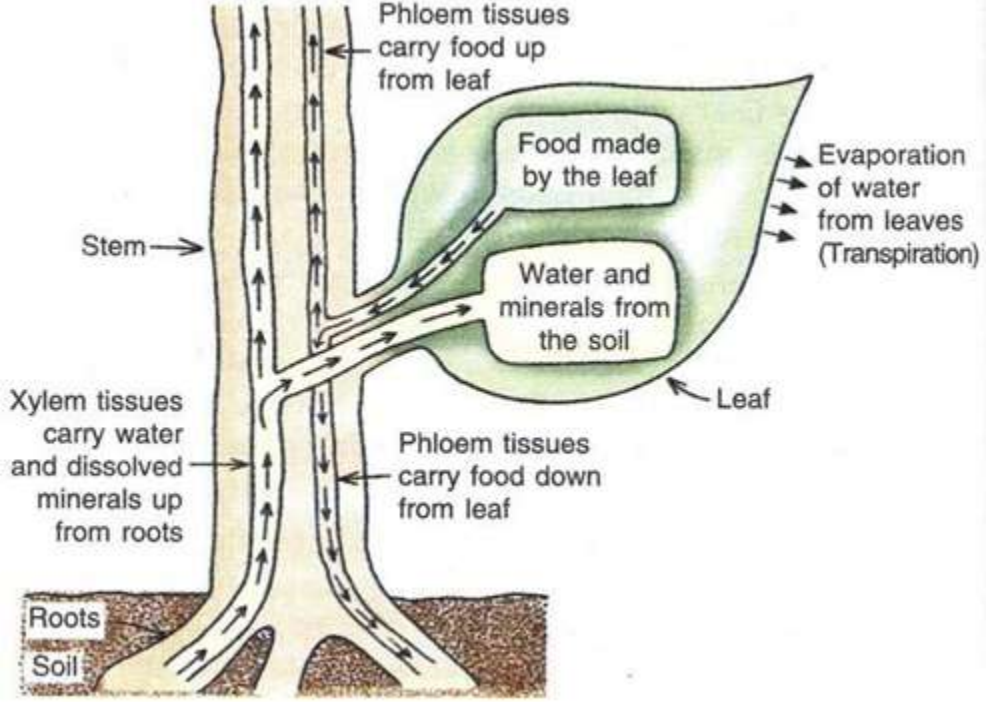
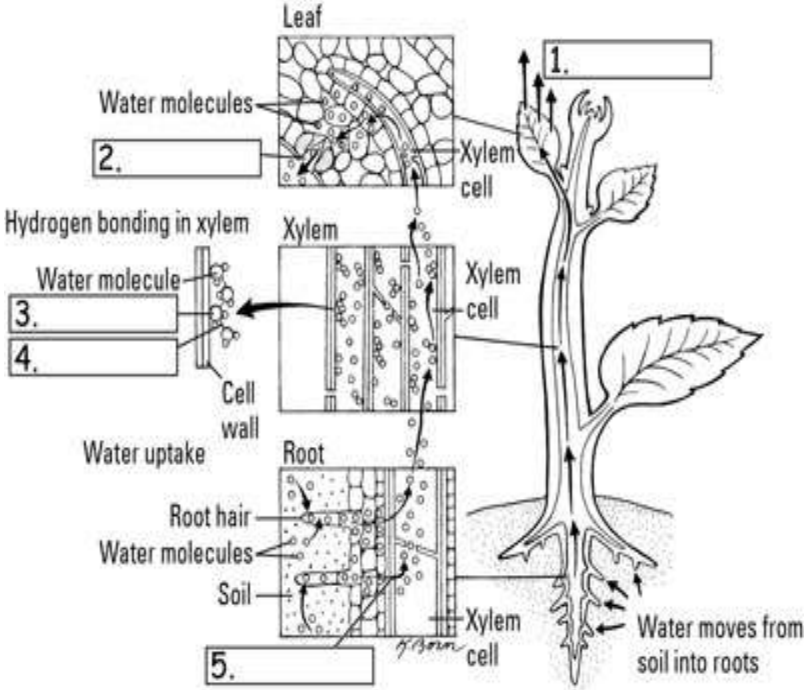


Fig. Path of ascent of sap in response to transpiration pull.


Phloem tissues carry food up from leaf
Food made by the leaf
Evaporation of water from leaves (Transpiration)
Stem
Water and minerals from the soil
Leaf
Xylem tissues carry water and dissolved minerals up from roots
Phloem tissues carry food down from leaf
Roots
Soil


Leaf
1.
Water molecules
2.
Xylem cell
Hydrogen bonding in xylem
Xylem
Water molecule
3.
4.
Xylem cell
Cell wall
Water uptake
Root
Root hair
Water molecules
Soil
5.
Xylem cell
Water moves from soil into roots

Trasnspiration pull theory or Cohesion theory

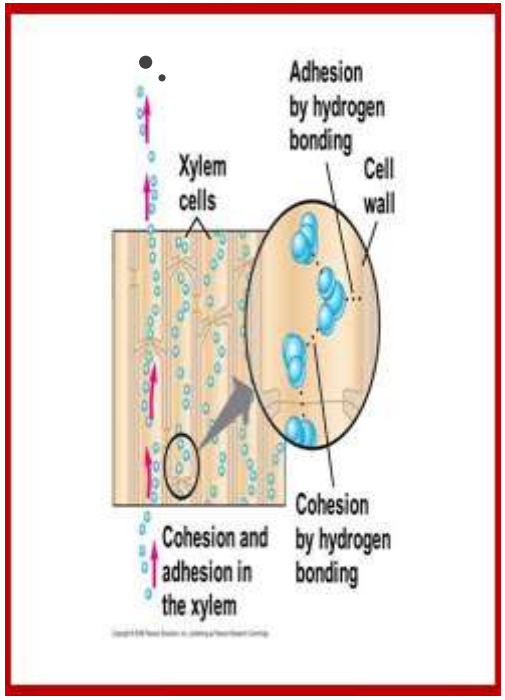
This theory was originally proposed by Dixon and Joly (1894) and greatly supported and elaborated by Dixon (1914, 1924).

This theory is based on the following features:

- Cohesive and Adhesive properties of water molecules to form a continuous water column in the xylem.

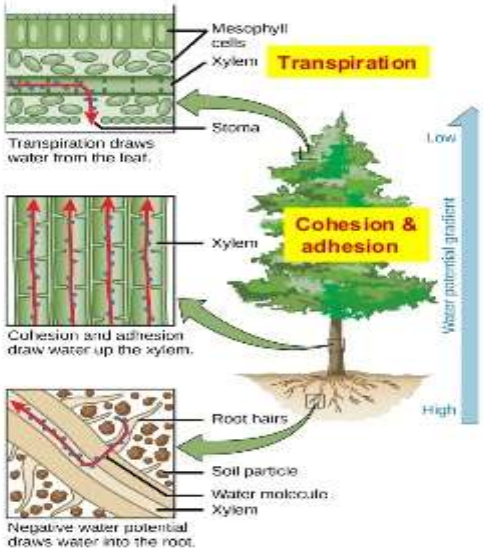
- Transpiration pull exerted on this water column

Cohesive and Adhesive properties of water molecules to form a continuous water column in the xylem

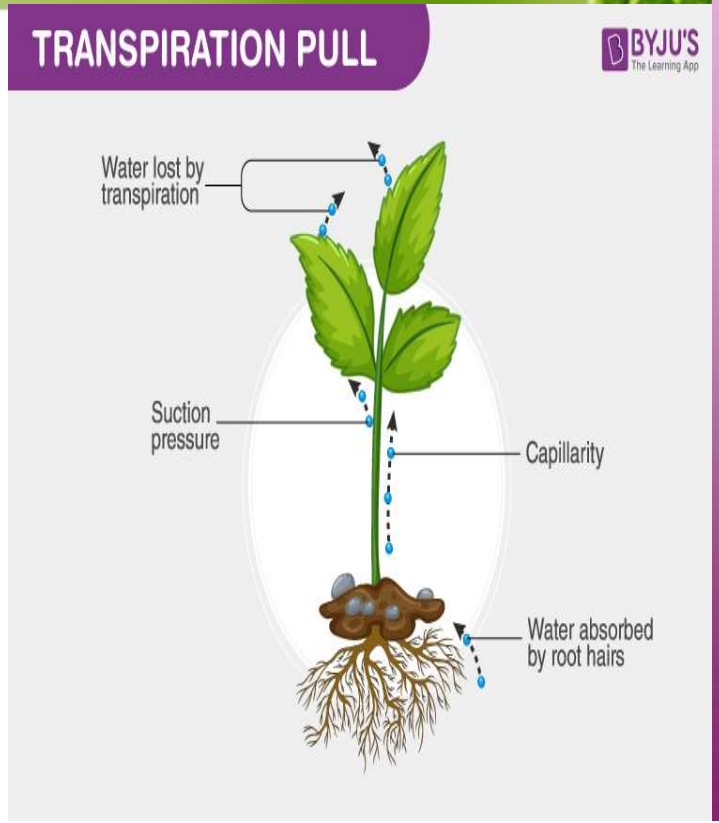


Cohesion-Tension Theory

1. As plant leaves transpire water, a tension is created that pulls water from roots to leaves.
2. This tension is maintained because water molecules display an attraction to one another called cohesion.
3. Hydrogen bonds among water molecules resist rupturing (cohesion) so water is pulled upward as a continuous fluid column
4. Water also adheres to the xylem elements in a process called adhesion.
5. Hydrogen bonds break and water molecules diffuse into the air during transpiration



Transpiration pull exerted on this water column



Transpiration pull is responsible for dragging water at the leaf end, the pull or force is transmitted down to the root through water column in the xylem elements. The continuity of water column remains intact due to the cohesion between the molecules and it act as a rope. Root simply act as a passive organ of absorption.

As transpiration proceeds, simultaneously water absorption also takes place to compensate the water loss from leaf end. Most volume of water entering plants is by means of passive absorption.

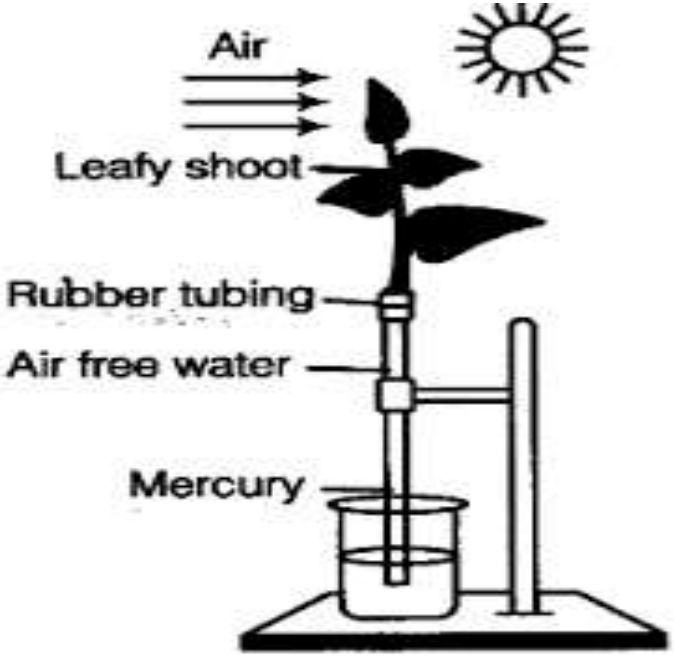
- According this theory as a result of transpiration pull pressure is exerted on the column of water in the wood vessels foromabove.

- The water vapour evaporates through stomata, the stomatal cells with draw water from the surrounding mesophyll cells, which in turn will draw water from the vacuoles of the cell.

- Thus the turgour pressure decreases and the osmotic pressure increases, resulting increases of suction pressure.

- Thus a gradient of suction pressure is developed up to leaf veins. In leaves this force may be of 10-15 atmosphere.

The evidence of transpiration pull can be shown by following experiment



A narrow vertical glass tube filled with water is placed in a mercury dish.

At the open upper end a branch is fitted and made air tight with the help of polythene sheet.

As transpiration takes place due to suction pressure developed mercury is drawn in to the tube thus water is drawn up form the tube due to trasnpirational pull.

During hot and dry days the rate of transpiration is high and the transpiration pull is also high


THANKS

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