Transpiration lab-6

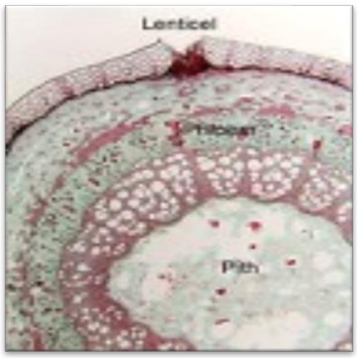
- Transpiration is the process of water movement through a plant and its evaporation from aerial parts, such as leaves, stems and flowers.
- A single plant losses more than 95% of the water which absorbs through roots.
- For every gram of organic matter made by the plant, approximately 500 g of water is absorbed by the roots, transported through the plant body and lost to the atmosphere.

Transpiration occurs through

- Lenticles: Lenticular Transpiration (0.1%)
- Cuticle: Cuticular Transpiration (3-10%)
- Stomata: stomatal transpiration (> 90%)

Lenticular Transpiration:

- Transpiration occurs through lenticels, the small opening in the corky tissue covering stems and twigs.



Cuticular Transpiration:

- Transpiration that occurs through the cuticle or cracks of thin cuticle layer of leaves and stems is said to be cuticular transpiration. This is a day-night process.
- This type of transpiration depends upon the thickness of the cuticle and presence or absence of wax coating on the surface of the leaves. Xerophytic plants generally have very thick cuticle and wax coating on the leaves and stem in order to check cuticular transpiration

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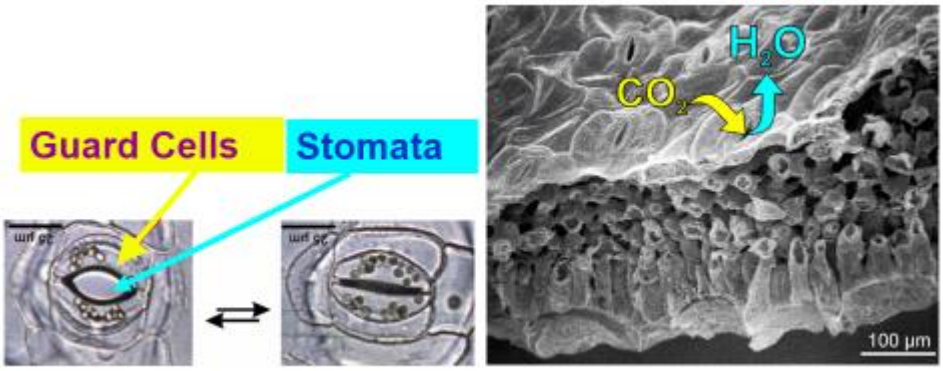
Stomatal Transpiration:

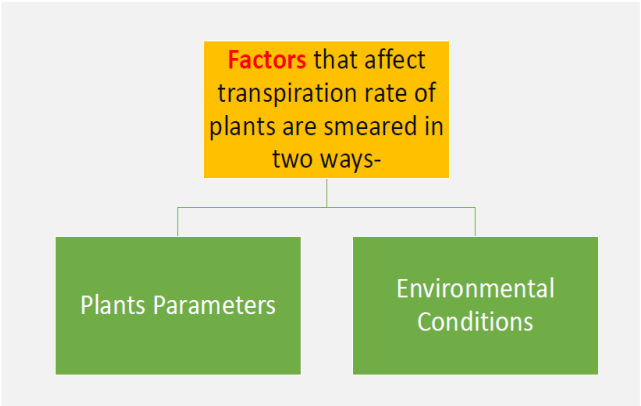
- Transpiration that occurs through stomata called stomatal transpiration. This type of transpiration only occurs in its presence of sunlight (in daytime). Because stomata open in the present of sunlight and close in the darkness



Why?

- The water potential of the air (ψ_w) is always very negative (more negative than the plant). This is why there is a tendency to lose water by transpiration.
- In another word, the concentration of water is very low in air.

Factors affecting transpiration



Plant Parameters

Stomata: When stomata are open, transpiration rates increase; when they are closed, transpiration rates decrease.

Number and position of Stomata: More stomata will provide more pores for transpiration. Most dicots have more stomates in the lower part of the leaf.

Number of Leaves: More leaves mean a bigger surface area and stomata for transpiration.

Cuticle: The thicker the cuticle layer on a leaf surface, the slower the transpiration rate.

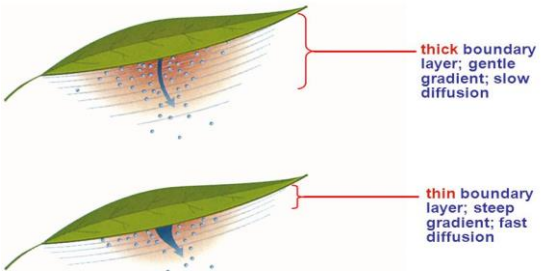
Leaf Area (Transpiring Area): A plant with large leaf area will show more transpiration than another plant with less leaf area

Root/Shoot Ratio: A low root/shoot ratio decreases the rate of transpiration while a high ratio increases the rate of transpiration

Plant Parameters

Leaf Modifications: Formation of prickles, leaf spines, scaly leaves, phyllodes, phylloclades, are all modifications found in xerophytes to reduce transpiration.

Stationary layer and Hair: The hair insulates the surface of the leaf from air currents and air temperature. They hold a stationary layer of air (also called boundary layer). The thicker the boundary or stationary layer, the lower is the rate of transpiration. It is because the leaf will first lose water to stationary layer and from there it would travel to the outside.



Environmental conditions

Temperature: An increase in the air temperature warms the water inside the leaves more quickly causing it to evaporate faster.

Light intensity: it warms the leaves up faster. It also cause the stomata to open, thus more transpiration occurs during the day and the rate is higher on a sunny day compared to a cold dull day.

Relative humidity: low humid air means less water molecules in the air and around the leaf. This keeps the concentration gradient and assists faster transpiration.

Wind and air movement: windy air or fast movements increases the transpiration rate. Windy air disturbs the boundary layer of the leaf which exposes the leaf to non-boundary air.

Soil Moisture: the drier the soil the less the transpiration.

Importance of Transpiration

- It creates negative pressure gradient that helps draw water and minerals up through the plant from its roots.
- Helps to keep the plant cool on hot weather- a method of evaporating cooling.

- Supports photosynthesis and encourages the exchange of gases, helping maintain levels of CO2 and O2 in the atmosphere.
- It also plays a significant part in Global Hydrological Cycle.

Experiment:

- To demonstrate the transpiration from the leaf surface, four dicot leaves are taken. Both the surfaces of the A leaf, lower surface (with stomata) of B leaf, upper surface (without stomata) of C leaf are vaselined. The Vaseline is not applied on the D leaf. Now, as shown in the figure the leaves are hanged so that they may transpire freely.

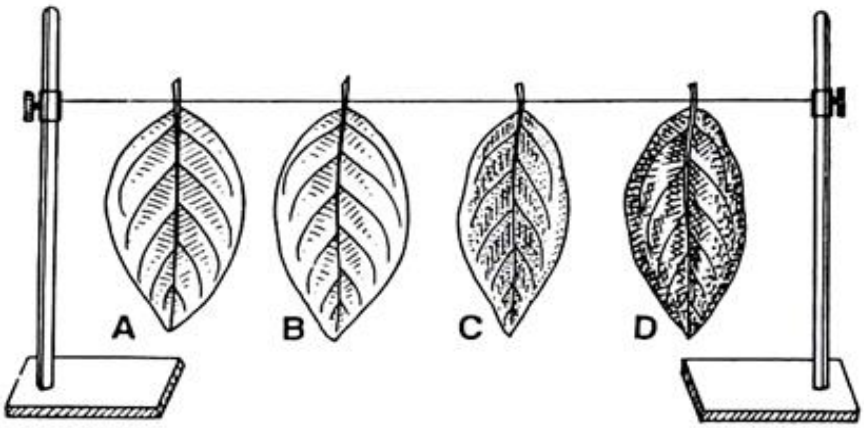


Fig. 2.24. Comparison of transpiration. Demonstration by four leaves.