

Topic: Transpiration
B.Sc. Botany (Sub.) II
Group: C
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Transpiration

The loss of water in the form of vapours from the living tissues of aerial parts of the plant is known as transpiration. It is generally the evaporation of water from the surface of the leaves. During the process of transpiration, water molecules in the plant tissues are removed from the aerial parts of the plants. Only a small amount of water absorbed by the plants is utilized in growth and development. The rest is eliminated in the form of transpiration.

Types of Transpiration

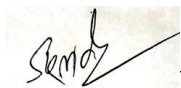
There are three different types of transpiration in plants:

i. Stomatal Transpiration

It is the loss of water which occurs through specialized apertures, which are present in leaves called stomata. In herbaceous plants the stomata can also occur in the epidermis of green stem. It accounts for 80-90% of the total water loss from the plants.

ii. Lenticular Transpiration

Lenticels are minute openings in the bark of branches and twigs. Evaporation of water from the lenticels of the plants is known as lenticular transpiration. Lenticels are not present in all the plants. A minimal amount of water is lost through lenticels.



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iii. Cuticular Transpiration

It is the evaporation of water from the cuticle of the plants. The cuticle is a waxy covering on the surface of the leaves of the plants. About 5-10% of the water from the leaves is lost through cuticular transpiration. During dry conditions when the stomata are closed, more water is transpired through the cuticles.

Factors Affecting Transpiration in Plants

Different factors affecting the rate of transpiration are-

Cellular Factors

The cellular factors affecting the rate of transpiration are:

1. The orientation of leaf,
2. The water status of the plant,
3. Structural Peculiarities of the leaf,
4. Total number and distribution of stomata in a leaf.

Environmental Factors

The environmental factors affecting the rate of transpiration are:

1. Light,
2. Humidity,
3. Temperature,
4. Atmospheric pressure,
5. Wind speed or velocity.

Relative Humidity

The amount of water vapour present in the air at a particular time and temperature is expressed as a percentage of the amount required for saturation at the same temperature. The rate of transpiration is inversely proportional to relative humidity. More the relative humidity less is the transpiration rate.



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Temperature

A high temperature lowers the relative humidity and opens the stomata even in darkness. As a result, the rate of transpiration increases.

Light

The stomata open during the day and close in the dark. Presence of light is directly proportional to the rate of transpiration.

Air

If the air is still, the transpiration rate is low. This is because the water vapour accumulates around the transpiring organs and reduces the diffusion pressure deficit of the air.

If the air is moving the saturated air around the leaves is removed and the transpiration rate increases.

Water Availability

The transpiration rate is directly proportional to the absorption of water by the roots from the soil. A decrease in water absorption causes the closure of stomata and wilting, thereby reducing the rate of transpiration.

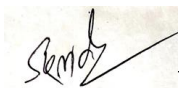
Surface Area of the Leaves

A leaf having more surface area will show more transpiration rate than the leaf with a lesser surface area.

Ascent of Saps

When water evaporates through the leaves, a pull is created through the xylem, and water moves back to the leaves. This is known as the transpiration pull.

The ascent of sap that is driven by transpiration depends on the following properties of water:



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- Cohesion – This is the mutual attraction between molecules of water.
- Adhesion – The attraction of water molecules towards polar surfaces.
- Surface tension – The molecules of water are more attracted to each other in the liquid phase than in the gas phase.

Opening and Closing of Stomata during transpiration

Stomata are specialized epidermal structures that are essential for plant survive and productivity. These structures consist of a pair of guard cells around a pore. It remains open during the daytime and closed at night. The reason for the opening and closing of this structure is the turgidity of guard cells.

The interior wall of the guard cells present towards the aperture is dense and flexible. The stomata open when the turgidity of the guard cells increases. The exterior walls bulge out, and the interior walls form a crescent shape.

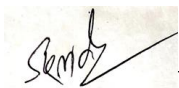
The orientation of the microfibrils in the guard cells also plays an important role in the opening of the stomata. The radial orientation of the microfibrils makes it easier for the stomata to open. The stomata close when the turgidity of the guard cells decreases due to the water loss and the interior walls form a crescent shape retrieve their original shape.

In dicots, the lower side of leaves have more stomata while in monocots, both the sides have an equal number of stomata.

Significance of Transpiration in Plants

The significance of transpiration is explained below:

- Transpiration helps in the conduction of water and minerals to different parts of the plants.
- Due to the continuous elimination of water from the plant body, there is a balance of water maintained within the plant.
- It maintains osmosis and keeps the cells rigid.



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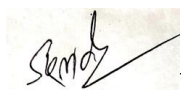
- A suction force is created by transpiration that helps in the upward movement of water in the plants.
- Certain hydrophilic salts are accumulated on the surface of the leaves, which keeps the leaves moist.
- It maintains the turgidity of the cells and helps in cell division.
- Optimum transpiration helps in the proper growth of the plants.
- The cooling effect of a tree is due to the evaporation of water from its leaves.

In addition to the significance, transpiration has a few drawbacks-

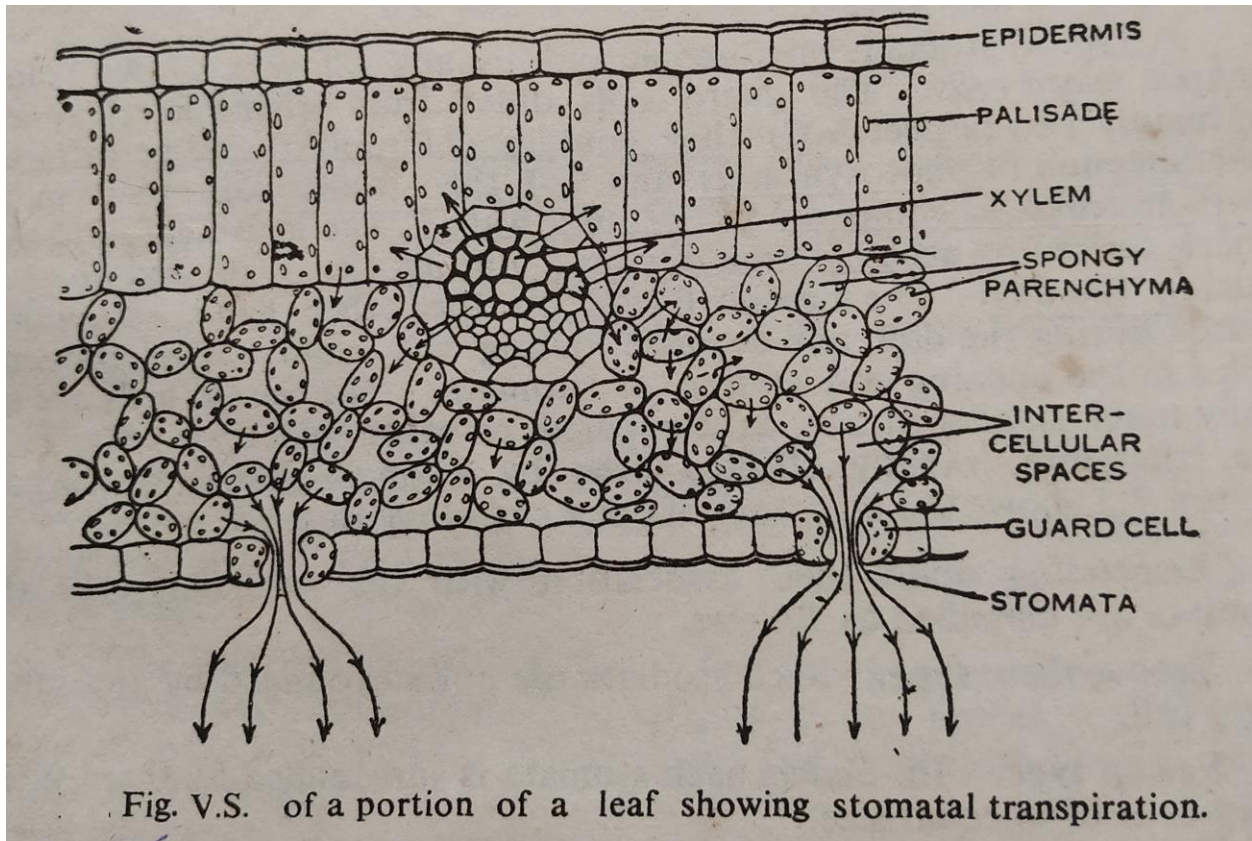
- Transpiration slows down if the transpired water is not compensated by absorption from the soil.
- A lot of energy is released during transpiration.
- Plenty of unnecessary water is absorbed by the plants during the process.

Conclusion

Transpiration in plants is a crucial process. In the absence of transpiration, excess water will get accumulated in the plant cells, and the cells will eventually burst. More than 10% of the earth's moisture is from transpiration. It is known to be a part of the water cycle.



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