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Transpiration:

Transpiration is the evaporation of water from plants. Most of the water absorbed by the roots of a plants much as 99.5% is not used for growth or metabolism; it is excess water, and it leaves the plant through transpiration. Transpiration is very important for maintaining moisture conditions in the environment. As much as 10 percent of the moisture in the Earth's atmosphere is from transpiration of water by plants.

Transpiration was first measured by Stephen Hales (1677–1761), an English botanist and physiologist. He noticed that plants "imbibe" and "perspire" significant amounts of water compared to animals and created a novel method for measuring the emission of water vapor by plants. He found that transpiration occurred from the leaves and that this process encouraged a continuous upward flow of water and dissolved nutrients from the roots. Modern research has shown that as much as 99 % of the water taken in by the roots of a plant is released into the air as water vapor.

Leaf stomata are the primary sites of transpiration and consist of two guard cells that form a small pore on the surfaces of leaves. The guard cells control the opening and closing of the stomata in response to various environmental stimuli and can regulate the rate of transpiration to reduce water loss. Darkness and internal water deficit tend to close stomata and decrease transpiration; illumination,

ample water supply, and optimum temperature open stomata and increase transpiration. Many plants close their stomata under high temperature conditions to reduce evaporation or under high concentrations of carbon dioxide gas, when the plant likely has sufficient quantities for photosynthesis.

Transpiration is of three types:

1. Stomatal transpiration: Most of the transpiration takes place through stomata. Stomata are usually confined in more numbers on the lower sides of the leaves. In monocots, example grasses, they are equally distributed on both sides. While in aquatic plants with floating leaves they are present on the upper surface.

2. Cuticular transpiration: The cuticle is impervious to water, even though, some water may be lost through it. It may contribute a maximum of about 10% of the total transpiration.

3. Lenticular transpiration: Some water may be lost by woody stems through lenticels which are called as lenticular transpiration.

Mechanism of stomatal transpiration:

The mechanism of stomatal transpiration which takes place during the daytime can be studied in three steps.

(i). Osmotic diffusion of water in the leaf from xylem to intercellular space above the stomata through the mesophyll cells.

(ii). Opening and closing of stomata (stomatal movement)

(iii). Simple diffusion of water vapors from intercellular spaces to another atmosphere through stomata.

FACTORS AFFECTING TRANSPIRATION RATE

A. External factors:

1. Atmospheric humidity

In a humid atmosphere, (when relative humidity) is high), the rate of transpiration decreases. It is because the atmosphere is more saturated with moisture and retards the diffusion of water vapour from the intercellular spaces of the leaves to the outer atmosphere through stomata. In a dry atmosphere, the RH is low and the air is not saturated with moisture and hence, the rate of transpiration increases.

2. Temperature

An increase in temperature brings about an increase in the rate of transpiration by lowering the relative humidity and opening of stomata widely.

3. Wind

When wind is stagnant (not blowing), the rate of transpiration remains normal
When the wind is blowing gently, the rate of transpiration increases because it removes moisture from the vicinity of the transpiration parts of the plant thus facilitating the diffusion of water vapour from the intercellular spaces of the leaves to the outer atmosphere through stomata. When the wind is blowing violently, the rate of transpiration decreased because it creates hindrance in the outward diffusion of water vapours from the transpiring part and it may also close the stomata.

4. Light

Light increases the rate of transpiration because In light stomata open; It increases the temperature. In dark, due to closure of stomata, the stomatal transpiration is almost stopped.

5. Available soil water

Rate of transpiration will decrease if there is not enough water in the soil in such from which can be easily absorbed by the roots.

6. CO2

An increase in CO2 concentration in the atmosphere (Ova the usual concentration) more so inside the leaf, leads towards stomatal closure and hence it retards transpiration.

B. Internal factors:

1. Internal water conditions

It is very essential for transpiration. Deficiency of water in the plants will result in a decrease of transpiration rate. Increase rate of transpiration containing for longer periods often creates internal water deficit in plants because absorption of water does not keep pace with it.

2.Structural features

The number, size, position and the movement of stomata affect the rate of transpiration. In dark stomata are closed and stomatal transpiration is checked. Sunken stomata help in reducing the rate of stomatal transpiration. In xerophytes, the leaves are reduced in size or may even fall to check transpiration. Thick cuticle on the presence of a wax coating on exposed parts reduces cuticles transpiration.

Antitranspirants: A number of substances are known which when applied to the plants retard their transpiration. Such substances are called as antitranspirants. Some examples of antitranspirants are colourless plastics, silicone, oils, low viscosity waxes, phenylmercuric acetate, abscisic acid, CO2, etc. Colourless plastic, silicone oils and low viscosity waxes belong to one group as these are sprayed on the leaves, form after film which is permeable to O2 and CO2 but not to water. Fungicide phenylmercuric acetate, when applied in low concentration (10–4 m), it exercised a very little toxic effect on leaves and resulted in partial closure of stomatal pores for a period of two weeks. Similarly ABA a plant hormone also induces stomatal closure. CO2 is an effective antitranspirant. A little rise in CO2 concentration from the natural 0.03% to 0.05% induces partial closure of stomata. Its higher concentration cannot be used which results in complete closure of stomata affecting adversely the photosynthesis and respiration.

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