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((Plant Physiology))

Stage (3)

((Lecture -6-))

Transpiration

By

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Transpiration

Transpiration Although large quantities of water are absorbed by plants from the soil but only a small amount of it is utilized.

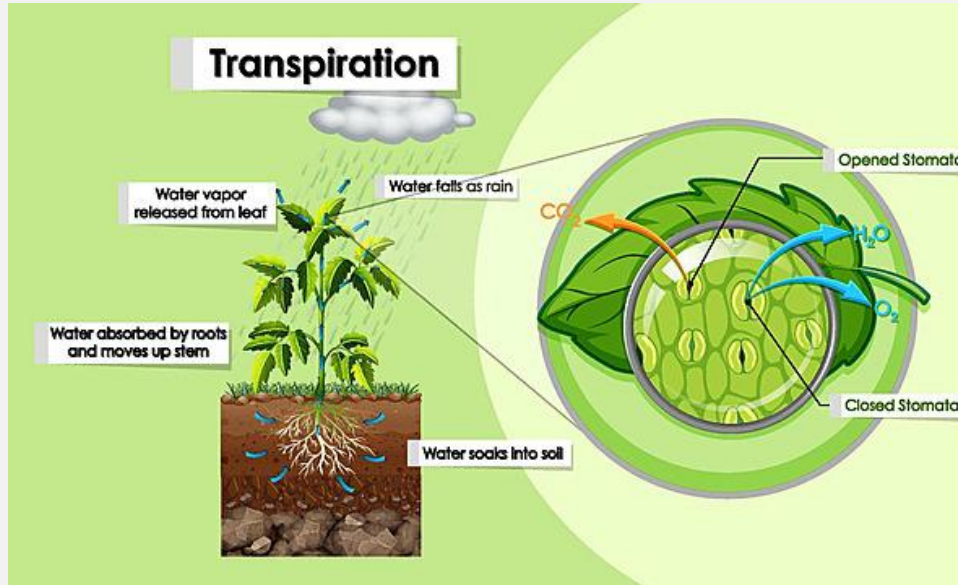
The excess of water is lost from the aerial parts of plants in the form of water vapours. This is called as transpiration.

Transpiration differs from evaporation; transpiration is a vital physiological process in plants in which water is lost from their aerial parts in the form of water vapours and for which living tissues are essential.

Evaporation on the other hand, is a purely physical process in which there is conversion of any liquid into vapours without necessarily reaching the boiling point. Kinds of transpiration:

- 1- Stomatal transpiration: Most of the transpiration takes places through stomata are usually confined in more numbers on the lower sides of the leaves.
- 2- Cuticular transpiration: Although cuticle is impervious to water still some water may be test 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.

The mechanism of opening and closing of the stomata: - It is interesting to know, how stomata respond to various factors and what effects these factors have on guard cells.



- 1- Stomata open at day time and remain closed during night times. This means that light plays an effective role.
- 2- Blue and red light of solar electro-magnetic radiation spectrum favors opening which is incidentally the action spectrum of photosynthesis. Other wave lengths of light have no significant effects.
- 3- Increased CO₂ concentration induces the closing, and decreased concentration stimulates the opening of the stomata.
- 4- Stomata begin to open when the pH of the medium is high (alkaline) and close when PH is low (acidic). During day time Starch disappears in guard cells and at night times Starch accumulates. This feature is contrary to the other mesophyll cells, where Starch disappears at nights and accumulates during day times.



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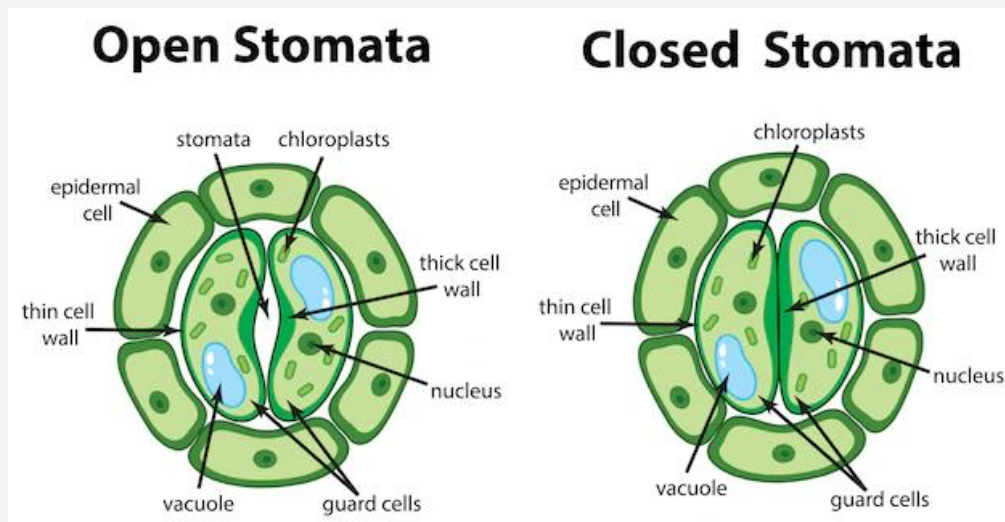


5- Influx of K^+ ions into guard cells induces the opening and efflux of K^+ favors closing.

6- Phytohormone like Cytokinin stimulates the guard cells to open and Abscissic Acid (ABA) induces the closing.

7- In succulents like cactus etc., stomata open during nights and close at day times. This is correlated to Carboxylic Acid Metabolism (CAM) where organic acids accumulate during night and the same are decarboxylated at day time. The notable organic acids synthesized are mainly Malate and Glycollate.

8- Glycollate induces the opening of stomata and glycollate oxidation favors the closing of the stomata.



Factors affecting transpiration: -

1- **Light:** Light seems to have two types of effects in stomatal opening: (a) photosynthesis may cause decreased CO_2 concentration in sub stomatal cavity and increased soluble solutes in the guard cells. (b) Light may also provide ATP for K^+ transport into guard cells.



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- 2- **Carbon dioxide:** Increase in the concentration of CO₂ over normal level (approximately 300ppm) causes stomatal closure and hence decreased rate of transpiration.
- 3- **Temperature:** Increased temperature in the range of 5 to 30 C° generally increases the rate of transpiration, as long as water does not become limiting. Temperature above 30-35 C° causes stomatal closure and decreased rate of transpiration in a number of species.
- 4- **Water stress:** If the rate of transpiration is higher than the rate of water absorption, a water deficiency is created in the plant and this causes stomatal closure. The plants wilt under such conditions.
- 5- **Humidity**
- 6- **Plant factors:**
 - (A) Plants with large leaf areas usually lose more water than those with smaller leaves.
 - (B) Leaf orientation.
 - (C) leaf size and shape.
 - (D) leaf surface characteristics affect rate of transpiration.
 - (E) Presence of thick cuticular coating on the leaf greatly reduces the rate of transpiration, because dry cuticle is impermeable to water vapours.
 - (F) The presence of hairs and scales on the surfaces of leaves often reduce the rate of transpiration as they are often covered with cuticle.