Brain Builders Coaching Center

Class-X

Transpiration

Transpiration is a very useful process for plants. It serves two key purposes:

1. Creating suction force in the stem to absorb water and minerals.
2. Cooling the plant in hot weather.

Transpiration

- Transpiration is the evaporative loss of water from the aerial parts (leaves and stem) of the plant.
- OR: Loss of water in the form of water vapour from the leaves and aerial parts of the plant.

Process:

- Plants absorb water from their roots, which is conducted upwards through the stem to leaves.
- Only 2% is used in photosynthesis and other functions.
- Remaining 98% is lost as water vapour through transpiration.

Demonstration of transpiration

Experiment 1: Using Polythene Bag

- Cover a well-watered plant with a transparent polythene bag and tie it around the stem base.
- Leave in sunlight. Water droplets appear inside due to water vapour.

Experiment 2: Using Cobalt Chloride Paper (Setup A, B, C)

- Setup A: Plant in a polythene bag. Water vapour condenses.
- Setup B: Cobalt chloride paper turns pink (moisture).
- Setup C (control): No plant. Cobalt paper remains blue.

Conclusion:

- Water is lost as vapour from plant leaves due to transpiration.

Cobalt Chloride Paper:

- Blue when dry
- Pink when moist

Measurement of transpiration

1. Weighing Method

- Weigh the potted plant before and after a few hours.
- Water loss = weight difference due to transpiration.

2. Potometer Method

- Measures rate of water intake, assumed equal to transpiration.
- Ganong's Potometer: A twig is fixed in an apparatus with water. An air bubble moves through a capillary tube.

Note: Potometers do not measure actual loss but water intake.

Limitations of Potometer:

1. Difficult to introduce air bubble.
2. Twig may not stay fresh.
3. Room temperature changes can affect the air bubble.

Kinds of transpiration

(i) Stomatal Transpiration:

- From leaves via stomata.
- Major type of transpiration.

(ii) Cuticular Transpiration:

- From surface of leaves and stems.
- Through cuticle layer (waxy).
- Thicker cuticle = less transpiration.

(iii) Lenticular Transpiration:

- From old stem surfaces through lenticels.
- Lenticels never close.

Mechanism of stomatal transpiration

Structure of Stomata:

- Minute openings on epidermis.
- Surrounded by guard cells.

Process:

1. Water from roots reaches mesophyll cells.
2. Water moves out from cells to intercellular spaces.
3. Vapour moves to sub-stomatal space.
4. Diffuses out through stomata.

More Transpiration:

- From undersurface of leaves (more stomata).

Stomatal Regulation:

- Guard cells become turgid (open) or flaccid (closed).

Experiment

- Cobalt paper turns pink on lower surface faster (proves more stomata below).

Factors affecting transpiration

A. External Factors:

1. Sunlight → More sunlight, more stomatal opening.
2. Temperature → High temp increases evaporation.
3. Wind → High wind = more transpiration.
4. Humidity → High humidity = less transpiration.
5. CO_2 Concentration → High CO_2 = less stomatal opening.
6. Atmospheric Pressure → Low pressure = more evaporation.

B. Internal Factor:

- Water content in leaf → Low water = stomata close.

Adaptations to reduce transpiration

1. Sunken stomata – Stomata lie deep in pits, which trap moist air and reduce water loss. Example: *Nerium*.
2. Few stomata – Having fewer stomata reduces the chances of water escaping.

3. Narrow leaves – Thin or needle-like leaves reduce surface area, lowering transpiration. Example: Pine.
4. Rolled leaves – Leaves may roll inward to trap humid air inside and reduce water loss. Common in dry grasses.
5. Spines or no leaves – Leaves are reduced to spines or absent, like in cacti, to reduce transpiration. Photosynthesis happens in the stem.
6. Thick cuticle – A waxy covering prevents water loss and reflects sunlight. Example: Aloe vera.
7. Hairy leaves – Tiny hairs on leaves trap moisture and reflect heat. Example: *Calotropis*.
8. Multiple epidermis – Extra layers of epidermal cells reduce water evaporation.
9. Succulent tissues – Some plants store water in thick stems or leaves. Example: *Opuntia*, *Bryophyllum*.

Significance of transpiration

1. Cooling Effect:

- Evaporation cools leaves on hot days.

2. Suction Force (Ascent of Sap):

- Loss of water increases osmotic pressure.
- Water is pulled from roots to leaves.

3. Distribution of Water & Minerals:

- Ensures flow from roots to upper parts.

Direct water loss: guttation & bleeding

Guttation:

- Water lost in liquid form.
- Through hydathodes at leaf edges.
- Occurs at night/early morning in humid conditions.
- Common in banana, strawberry.

Bleeding:

- Loss of sap due to injury.
- Root pressure forces sap out.

Evaporation vs Transpiration

Evaporation	Transpiration
From water bodies	From plant surfaces
Controlled by temperature/humidity	Controlled by internal/external factors
Fast process	Slow process

Transpiration vs Guttation

Transpiration	Guttation
Vapour form	Liquid form
Via stomata, lenticels	Via hydathodes
Daytime	Night/Early morning
No minerals	Minerals present
Regulated	Not regulated