## CHAPTER – 5

## TRANSPIRATION

### P. 64 Check Your Progress 1

**A. Answer these questions.**

1. The loss of water as water vapour from the aerial parts of plants is called transpiration.
2. Refer Table 5.1, Page 61 of the Textbook.
3. In an experimental set-up, polythene bags are tied around the plant. Drops of water vapour appear on the inner side of polythene bag tied around the plant (experimental set-up) if kept in sunlight for 2-3 hours. This happens due to saturation of water vapour given out by the leaves. The experiment shows that water vapour is given out during transpiration.
4. Maximum transpiration occurs through stomata on the leaves, i.e., stomatal transpiration. Lenticular transpiration shows the minimum rate of transpiration which accounts for only 0.1% of the total transpiration.
5. Xylem tissue
6. The flaccidity and turgidity of guard cells regulates stomatal transpiration.

### P. 68 Check Your Progress 2

**A. Answer these questions.**

1. Cobalt chloride paper acts as an indicator of moisture. It is blue when dry but becomes pink when exposed to moisture. Therefore, it is used to demonstrate transpiration by leaves.
2. Limitations of using a potometer:
   - It is very difficult to introduce bubble in the capillary tube.
   - Any change in external temperature may affect the position of air bubble in the capillary tube.
3. **a.** Moving air sweeps away the water vapour in the air outside the stomata. This speeds up diffusion of water vapour from stomata. Thus, the rate of transpiration increases with the velocity of wind.

   **b.** Shortage of water in the soil affects the water supply to the leaf and in turn the stomata close and the leaf wilts. This reduces the rate of transpiration.

   **c.** High humidity in the air on a cloudy day reduces the rate of outward diffusion of water from the sub-stomatal cavity and reduces the rate of transpiration because the air is already laden with the water vapour.

   **d.** Decrease in atmospheric pressure increases diffusion of water vapour from stomata. The lower the atmospheric pressure, the greater is the rate of evaporation of water from leaves.

   **e.** High temperature increases rate of transpiration by providing the latent heat of vaporization.
4. Two adaptations in plants to reduce transpiration:
   - The stomata may be sunken or covered by hair as in oleander.
   - The number of stomata may be reduced as in xerophytes, e.g. cactus.
5. Two advantages of transpiration to the plants:
   - **Removal of excess water:** Plants absorb far more amount of water than is actually required by them. Thus, transpiration helps in removing excess of water.
   - **Cooling effect:** Solar heat during summers increases the temperature of plants which may be dangerous to the plants. Transpiration helps in reducing temperature of the leaf surface by evaporation of water vapour from it, which in turn cools the plant.
6. Transpiration is the process by which plants loose excess water from their body through stomatal pore in the gaseous state. It is useful because when water in gaseous form are released, it moves upwards and accumulates in the cloud. This will cause rain to occur in the earth.
7. Hydathodes are the structures that discharge water from the interior of the leaf to its surface in a process called guttation.

### P. 69 Exercises

#### I. Multiple-Choice Questions

**A. Choose the most appropriate answer.**

| | | | | |
|---|---|---|---|---|
| **1.** a | **2.** d | **3.** c | **4.** d | **5.** a |
| **6.** a | **7.** b | **8.** c | **9.** b | **10.** a |

#### II. Assertion–Reason Type Questions

**A. 1.** b **2.** b **3.** b **4.** c

#### III. Very Short Answer Type Questions

**A. Name the following.**

1. Guttation
2. Potometer
3. Ganong's potometer
4. Lenticels
5. Cuticular transpiration
6. Exosmosis
7. Hydathodes
8. Oleander

**B. Complete the following paragraph by filling in the blanks (1) to (5) with appropriate words.**

1. transpiration
2. stomata
3. thick
4. sunken
5. potometer

**C. Match the items in Column A with those in Column B and write down the matching pairs.**

**A.** 1. b 2. d 3. c 4. a 5. e

**D. Find the odd-one out.**

Phagocytosis

**E. Rewrite the following terms in a correct order so as to be in a logical sequence.**

1. Upper epidermis, palisade tissue, spongy cells, substomatal space, stoma
2. Soil water, root hair, cortical cells, endodermis, xylem

## IV. Short Answer Type Questions

**A. Define the following terms.**

1. **Transpiration:** The loss of water as water vapour from the aerial parts of plants is called transpiration.
2. **Guttation:** Guttation is loss of water from the leaf margins of plants in the form of droplets during hot and humid conditions.
3. **Bleeding:** During injury to certain plant tissues, the plant sap escapes (bleeds) from the ruptured or cut surface of the plant. This is brought about by the root pressure generated by the plant.

**B. Give suitable explanations for the following.**

1. Moving air sweeps away the water vapour in the air outside the stomata. This speeds up diffusion of water vapour from stomata. Thus, the rate of transpiration increases with the velocity of wind . This is the reason why a higher rate of transpiration is recorded on a windy day rather than on a calm day.
2. During the day, the cell-sap concentration becomes high due to the accumulation of sugar in the guard cells as a result of photosynthesis. This results into movement of water into guard cells from the neighbouring cells. This makes the guard cells turgid and guard cells bulge out and pull apart their inner walls and stomata open.
3. The leaves of certain plants such as balsam, wilt during midday (mostly during summers) inspite of being well-watered, but recover in the evening. This is because of the high rate of vaporization of water during midday, the rate of transpiration is higher than the rate of absorption of water. Thus, the stomata become flaccid (lose turgidity) and close and the leaves wilt.
4. More transpiration occurs from the lower surface of a dicot leaf on a relatively dry and non-cloudy day. This is because dicot leaf has more stomata on lower surface and very few on the upper surface.

**C. State the exact location and main function of the following.**

1. **Lenticels:** Location – Stem; Function: Lenticular transpiration
2. **Guard cells:** Location- Leaf surface; Function – Opening and closing of stomata
3. **Hydathodes:** Location – Leaf margins; Function – Guttation
4. **Xylem:** Location – Vascular bundle; Function – Transport of water

**D. Answer these questions.**

1. Please refer to Table 5.1 from page 61 of textbook
2. Guttation is loss of water from the leaf margins of plants in the form of droplets during hot and humid conditions.

   Please refer Table 5.2 from Pg 68 of textbook.
3. On the basis of occurrence from different regions of a plant, transpiration is of three types:
   - i. Stomatal transpiration (from the leaves through the stomata)
   - ii. Cuticular transpiration (from the waxy cuticle layer of leaves and stems)
   - iii. Lenticular transpiration (from the lenticels present on the surface of old stems)

   Stomatal transpiration shows maximum rate of transpiration.

   Lenticular transpiration shows minimum rate of transpiration.
4. Xylem tissue is responsible for movement of water from stems to leaves.
5. Lenticular transpiration occurs through the lenticels which are special openings on the older stem in place of stomata. The lenticular transpiration accounts for only 0.1% of the total transpiration. It continues day and night because lenticels do not close. They remain open always. In lenticular transpiration, water from cell surface facing the lenticels evaporates

directly. Plants have an internal mechanism of controlling stomatal transpiration by adjusting the size of stomata whereas, this does not happen in cuticular or lenticular transpiration. Cuticular transpiration accounts for 3–10% of the total transpiration.

### V. Long Answer Type Questions

**A. Answer these questions.**

**1.** Three factors that increase the rate of transpiration:

- The humidity of the atmosphere affects the rate of diffusion of water vapour from the stomata. Low humidity in the atmosphere increases the rate of transpiration.
- High temperature increases rate of transpiration by providing the latent heat of vaporization.
- A decrease in atmospheric pressure increases diffusion of water vapour from stomata. The lower the atmospheric pressure, the greater is the rate of evaporation of water from leaves. Thus, the rate of transpiration increases with the decrease in atmospheric pressure.

**2.** Three factors that decrease the rate of transpiration:

- High humidity in the air reduces the rate of outward diffusion of water from the sub-stomatal cavity and reduces the rate of transpiration, because the air is already laden with water vapour.
- Low temperature reduces evaporation and so also transpiration.
- Carbon dioxide concentration also plays a vital role in rate of transpiration. If the increase in the concentration of carbon dioxide is more than the normal (0.03%), the stomata closes. This reduces the rate of transpiration.

**3.** Stomata are minute openings found in the epidermis of leaves, stem and in some cases even flowers. Each stoma contains a pore surrounded by two guard cells. Both guard cells are firmly joined at both ends but separate in the mid-region of their length. Stomata are mostly present on the lower epidermis of the leaf. The open stomata account for diffusion of water vapour through them. During the day, the cell-sap concentration becomes high due to the accumulation of sugar in the guard cells as a result of photosynthesis. This results into movement of water into guard cells from the neighbouring cells. This makes the guard cells turgid and guard cells bulge out and pull apart their inner walls and stomata open. If the availability of water is reduced, the guard cells lose their turgidity and they become flaccid (lose turgidity) by exosmosis of water from guard cells. This leads to the closing of stomata and transpiration stops.

**4.** The water vapour escapes from the stomata by the process of diffusion. The molecules of water move from the region of their higher concentration to the region of their lower concentration.

Refer to Fig 5.4a. from page 62 of the textbook.

**5.** Accumulation of water droplets on the surface of leaves early in the morning is due to guttation. Guttation is exudation of water droplets on the leaf margins of plants during hot and humid conditions as on the leaves of banana plant. It is caused due to root pressure. When rate of transpiration is low, the roots of some plants keep on accumulating minerals and absorbing water. Thus, more water enters the leaves than is transpired. As a result, the excess water is forced out through specialized structures on the margins of the leaves.

### VI. Structured/ Application/Skill Type Questions

**A. 1.** Stomata with their guard cells

**2. i.** Chloroplast

**ii.** Thick inner wall

**iii.** Nucleus

**iv.** Guard cell outer wall

**v.** Stomatal opening

**3.** In figure **P** the stoma is open whereas in figure **Q** the stoma is closed.

**4.** The open stomata account for diffusion of water vapour through them. During the day, the cell-sap concentration becomes high due to the accumulation of sugar in the guard cells as a result of photosynthesis. This results into movement of water into guard cells from the neighbouring cells. This makes the guard cells turgid and guard cells bulge out and pull apart their inner walls and stomata open. If the availability of water is reduced, the guard cells lose their turgidity and they become flaccid (lose turgidity) by exosmosis of water from guard cells. This leads to the closing of stomata and transpiration stops.

**B. 1.** To measure the rate of transpiration by weighing method.

**2.** To prevent evaporation.

**3.** We would observe a loss in the level of water and loss in the weight of plant in first test tube.

4. The loss in the weight of the plant is due to loss of water by the shoot due to transpiration.
5. The test tube without a plant was taken as a control experiment to show no change in the water level (with oil on the surface) if there is absence of shoot.

**C.** 1. The process shown by arrows is called stomatal transpiration through a leaf. The loss of water as water vapour from the leaves through the stomata is called stomatal transpiration.

2. **i** – Stomata

   **ii** – Palisade mesophyll tissue

   **iii** – Xylem vessel

3. The stages of stomatal transpiration occurring in **i** and **ii** are as follows:
   - The water is absorbed by root hair from the soil. This water then moves up through xylem vessels [iii] via stem into the mesophyll cells of the leaves through veins.
   - The mesophyll cells [ii] in the leaves have large number of intercellular spaces. These cells give out some water as a thin film.
   - The water from this thin film evaporates in the form of water vapour. The water vapour formed then saturates the air in the intercellular spaces.
   - This water vapour then accumulates and reaches the substomatal space through various connecting intercellular spaces by diffusion. The water vapour escapes from the stomata [i] by the process of diffusion.

**D.** 1. The process being studied is transpiration. The loss of water as water vapour from the aerial parts of plants is called transpiration.

2. To prevent evaporation of water from the soil.

3. Control – A polythene bag with its mouth tied.

4. Benefits of transpiration:
   - Transpiration helps in the ascent of sap in plants.
   - Transpiration contributes to lowering of the temperature.

5. Adaptations in plants to reduce excessive transpiration:
   - The stomata may be sunken or covered.
   - The number of stomata may be reduced as in xerpohytes.
   - The leaves may become narrow to reduce leaf surface area.

**E.** 1. The aim of this experiment is to show that more transpiration occurs from the lower surface of a leaf.

2. Blue

3. To prevent the exposure of cobalt chloride to the atmosphere.

4. The cobalt chloride paper on the lower surface of the leaf turns pink very fast and the paper on the upper surface of the leaf remains blue for a longer time because more transpiration occurs from the lower surface of leaves.

5. The process shown in the experiment is transpiration. The loss of water as water vapour from the aerial parts of plants is called transpiration. More transpiration occurs through the lower surface of leaves (dicots).

**F.** 1. The apparatus is Ganong's potometer.

2. Limitations of this apparatus
   - It is very difficult to introduce air bubble in the capillary tube.
   - The twig does not remain alive for a long time.

3. The phenomenon studied during the experiment is to measure the volume of water uptake by plant during transpiration.

4. The reservoir is used to adjust the position of air bubble in graduated capillary tube.

5. As the twig transpires, water vapour is lost and the coloured water from the beaker rises up. The air bubble which was introduced moves forward in the capillary tube. The reading in the capillary tube gives the volume of water lost in a given time.

6. Stomata