Physiological Set-Ups

Experiment 5.1

To demonstrate suction due to transpiration.

The set up (simple potometer) includes a hollow glass tube with one end submerged in a trough containing mercury and the other end fitted with the shoot of an actively transpiring plant (such as guava, sunflower or geranium) under airtight conditions (Figure E5.1). Rise in the level of mercury column after some time period (30 min or so) indicates suction due to transpiration.

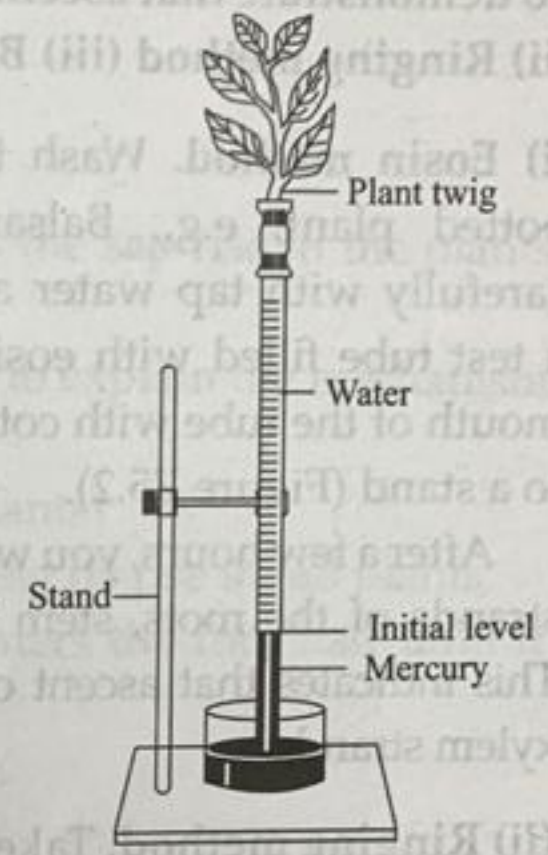

Figure E5.1 Demonstration of suction due to transpiration.

$$\text{Water lifting power of transpiration} = \pi r^2 h \times d$$

where r = radius of the capillary tube

h = rise of mercury level (height)

d = relative density of mercury (13.6 g)

As the plant transpires actively in nature, water is lifted upwards as a continuous column. Water column does not collapse because of strong cohesive force among the water molecules as well as great adhesive force between water molecules and the hydrophilic walls of the tracheary elements. The continuous water column exists between the roots and the transpiring parts of the plant (i.e. leaves). Thus due to transpiration, a suction force or transpiration pull develops in the leaves which is transmitted below to the roots *via* stem, resulting in water uptake from the soil.

Questions

1. List the factors affecting the process being demonstrated.
2. Explain the various forces involved in this physiological process.
3. What will happen if the leaves are smeared with grease or wax?
4. Why is mercury used in the set up?
5. Why does mercury-water move as an unbroken column?
6. What will happen if the set up is shifted in the humid environment?
7. Which plant hormone regulates stomatal closure during water deficit conditions?
8. Can 'guttation' be observed in the twig used in the set up?

9. How would you differentiate between samples of guttation water and transpired water?
10. What results do you expect, if the plant material in the set up is replaced by (i) wet sponge (ii) dry sponge (iii) unglazed porous pot.
11. Explain the significance of the process.