24. Measurement of the rate of transpiration using potometer

A simple experiment is described below to demonstrate
how the rate of transpiration of common plants found in
Hong Kong can be determined with the use of potometer.
Moreover, students can also be given the opportunity to
estimate the stomatal density of leaves from different
plants to evaluate the relationship between different
transpiration rates and this morphological feature.

A. Estimation of transpiration rate using a potometer
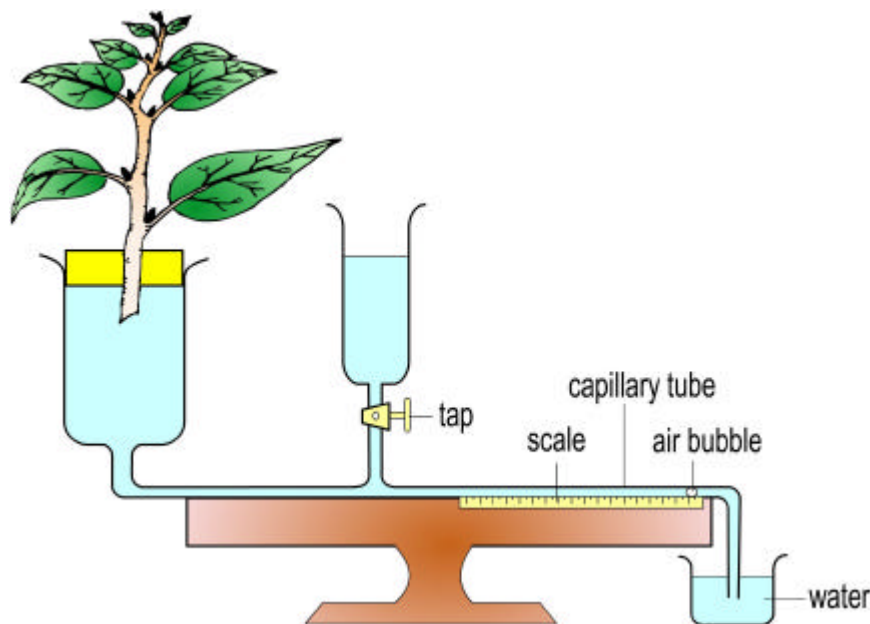

Fig. 1 Experimental set up

Procedure
1. Use a sharp razor blade to cut a leafy shoot under water.
2. Insert the leafy shoot through the hole of the stopper
    provided with the potometer.
3. Fill the potometer with water and fit the stopper holding
    the leafy shoot to the apparatus.
4. Use vaseline to seal all the connections of the apparatus.

5. Trap an air bubble in the capillary tube by the following procedures:

  - dip the end of the capillary tube into a beaker of water,
  - close the tap of the reservoir,
  - take away the beaker of water and allow the plant to transpire for a while, and
  - re-immerse the capillary tube into the beaker of water again.

6. Wait for about 5 minutes for the plant to equilibrate.

7. Estimate the rate of transpiration by measuring the distance moved by the air bubble per unit time. Take another measurement, and average the two readings.

8. Find out the total leaf surface area of the experimental plant using a graph paper.

9. Transpiration rate can be expressed in terms of water transpired per unit time per unit area of leaf surface.

10. If time permits, estimate the rate under different environmental conditions, e.g. under direct incandescent light illumination, under low light condition, in rapid air movement (provided by a fan) or in still air.

Note

1. The total surface area of leaf should include the areas of both upper and lower surfaces.

2. This potometer only measures the rate of water uptake, it cannot find out the actual transpiration rate.

3. The volume of water transpired can be estimated using the formula below:

Distance moved by air bubble $= d$ cm

Cross-sectional area of capillary tube $= a$ cm^2

Volume of water transpired (V) $= d \times a$ cm^3

B. **Estimation of stomatal density on leaf surface**

Procedure

1. Use a needle or a pair of fine forceps to make a shallow cut on the lower surface of the leaf.

2. Use a pair of fine forceps to peel off the lower epidermis.

3. Mount the epidermis in a drop of water on a slide.

4. Using 100x magnification, move the slide to find a portion which occupies the entire field of view, count the number of stomata within the area occupied.

5. Repeat step (4) 3-5 times to obtain a good average value.

6. Repeat steps (1) to (5) for the upper epidermis of the same leaf.

7. Given a copper wire of known diameter, estimate the area covered by the microscope field of view at 100x magnification.

8. Calculate the stomatal density of the upper and lower epidermis of the plant.

Note

1. Plant materials suitable for this experiment are: *Hibiscus rosa-sinensis, Ligustrum sinense, Bauhinia blakeana* and *Ficus microcarpa.*

2. If it is difficult to obtain the epidermis by the method described above, then try the nail varnish method as mentioned in *Practical work 6* of this *Resource Kit.*

3. Alternative method for estimating the diameter is given in *Practical work 5* of this *Resource Kit.*