**F.4 Biology Ch.11 Transport of substances and Support in Plants**

Title: Factors that affect transpiration rate

**Objective:** To find out the effect of the following treatments on the transpiration rate of a leafy shoot.

**Principle:**

Transpiration from the leaf surface is mainly due to two physical processes, evaporation and diffusion, therefore any change in the environment affecting the rates of these two processes will also affect the rate of transpiration. In addition, transpiration mainly takes place through stomata, the size of stomata, which is in term affected by the light intensity will also affect the transpiration rate. The stomatal density on both sides of the leaves are also different for most terrestrial plants. Therefore the transpiration rates of a leafy shoot under different treatments can be measured and compared using a potometer.

Different types of photometer are used in this practical to determine the rate of transpiration after different treatments. When a bubble potometer is used to measure rate of transpiration, we assume

that the rate of water uptake is equal to the rate of water loss by transpiration . However if a weight potometer is used, the transpiration rate can be measured directly.

**Apparatus and Materials**: refer to p.11 to 6-11.7

**Procedure**: refer to p.11-6 to 11-7

**Results:**

Title: The transpiration rate of the leafy shoot before and after different kinds of treatments

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Treatment | Transpiration rate before treatment  (cm3/min) | Transpiration rate after treatment  (cm3/min) |
| 1 | Plastic bag | 0.02 | 0.0023 |
| 2 | Lamp | ---- | 0.0024 |
| 3 | Hair dryer | ---- | 0.06 (a leaf is blown off by strong wind) |
| 4 | Adhesive tape on upper surface | 0.018 | 0.014 (22% drop) |
| 5 | Adhesive tape on lower surface | 0.002 | 0.001 (50% drop) |
| 6 | Hair dryer | 0.03 | 0.04 |
| 7 | lamp | 0.003 | 0.002 |
| 8 | Plastic bag | 0.01 | 0.005 |

**Discussion:**

1. The leafy shoot has a lower transpiration rate after it is wrapped by a plastic bag because water vapour lost from the leaves is trapped by the plastic bag. The relative humidity inside the plastic bag is higher, this reduce the concentration gradient of water vapour across the stomata, and the rate by which the water vapour diffuses out through the stomata.
2. The leafy shoot has a higher transpiration rate after it is blown by a hair dryer because wind blows away the water vapour from the leaf surfaces rapidly. This maintains a steep concentration gradient of water vapour between the air spaces inside the leaf and the surrounding air. Therefore water vapour in the leaf diffuses out more rapidly.
3. The leafy shoot has a higher transpiration rate after it is put in front of a lamp because both the light intensity and temperature increases. A higher light intensity causes the stomata to open wider, allowing more water vapour in the air spaces to diffuse out per unit time. A higher temperature increases the rate of evaporation and the rate of diffusion of the water vapour out of the leaf.
4. The leafy shoot with adhesive tape covering the upper surface has a transpiration rate higher than that with adhesive tape covering the lower surface. This shows that this plant has a higher stomatal density on the lower surface. For most terrestrial plant, having more stomata on the lower surface than the upper surface can

reduce the total amount of water lost from the plant surface by transpiration

because the leaves have their upper surface facing the direct sunlight, thus the temperature and light intensity are higher there and the transpiration rate will be higher on the upper surface.

1. What are the possible limitations when using the above potometers to determine the transpiration rate of a plant?

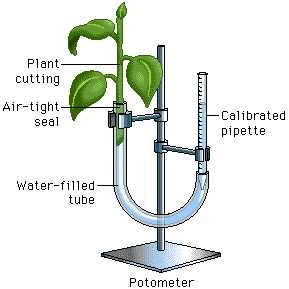
**The root system cannot be put into the potometer due to its size. Without the root system, the water uptake rate and the transpiration rate measured may be different from the natural situation.**

**When the amount of water uptake is measured instead of the weight loss as in case of bubble potometer, the rate of water uptake instead of the rate of transpiration is measured directly. The two numerical values, though very close, are not the same.**

**Conclusion:**

**The transpiration rate of a leafy shoot is higher when it is put in front of a hair dryer or a lamp. The transpiration rate is lower when it is wrapped by a plastic bag. The drop in transpiration rate is greater if the lower surface is covered by adhesive tape compared to upper surface being covered.**

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**Notes: In addition to the bubble potometer and the weight photometer, the following two photometer is also used:**

