



# EXPERIMENT

6

## Aim

**The comparative study of the rate of transpiration in the upper and lower surfaces of the leaves.**

## THEORY

Transpiration is the loss of water in the form of vapour from the aerial parts of a plant. Transpiration mainly occurs through the minute pores on the surface of leaves called stomata. It occurs mostly during day-time when temperature is comparatively high and stomata are open. About 85% of transpiration takes place through stomata and is called stomatal transpiration. The number of stomata present on the two surfaces of the leaves differ in most of the plants. Some amount of water is also lost through cuticles and this type of transpiration is called cuticular transpiration. The rate of transpiration from the two surfaces of a leaf can be studied by comparing the loss of water vapour from the upper and lower surfaces of the leaf.

Transpiration can be easily demonstrated by cobalt chloride paper test. Cobalt chloride is blue coloured in anhydrous (dry) form but turns pink when it comes in contact with water. This property of cobalt chloride is used to demonstrate that water is lost during transpiration. The time taken for cobalt chloride paper to change colour on the upper and lower surfaces of leaf shows the difference in transpiration rate at both the surfaces. Less time taken by the leaves to change the colour shows higher rate of transpiration. The cobalt chloride paper turns pink much faster at lower surface than upper surface because number of stomata are more in lower epidermis than in the upper epidermis. The lower surface of a dorsiventral leaf (dicot leaf) transpires through stomatal transpiration while, the upper surface performs only cuticular transpiration. However, this method is suitable only for comparing rather than measuring the rate of transpiration. Usually the rate of transpiration is measured by potometer which estimates water loss by weighing.

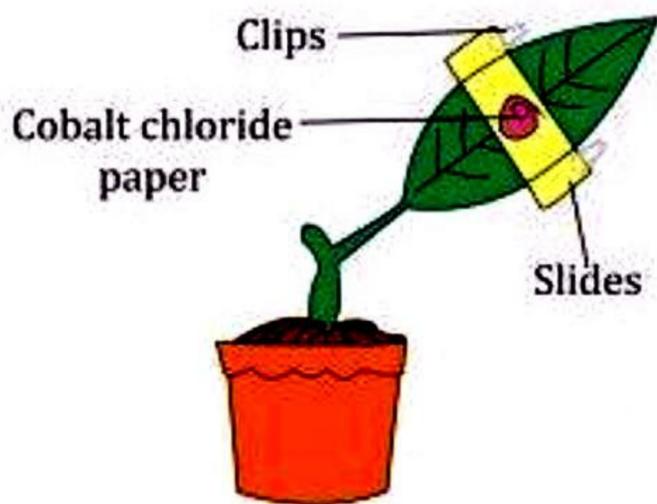
## MATERIAL REQUIRED

A broad-leaved potted plant, filter paper, beakers, test tubes, 100 ml measuring cylinder, 5% cobalt chloride solution, blotting sheets, hot plate/oven, forceps, wire gauze, petridishes, vaseline, cello tape, dessicator, slides, rubber bands or clips, etc.

## PROCEDURE

1. Prepare 100 ml of 5% cobalt chloride solution by dissolving 5g of cobalt chloride in 100 ml distilled water.
2. Cut small strips of filter paper and immerse them in cobalt chloride solution taken in a petridish for 3-5 minutes.
3. Transfer the soaked strips on a wire gauze with the help of forceps to allow excess  $\text{CoCl}_2$  solution to drain off.
4. Now, dry the filter paper strip on hot plate or oven but take care that strips should not get burned or charred. These anhydrous cobalt chloride coated strips will appear blue in colour.
5. Store this cobalt chloride coated strips in a dessicator.
6. Select a leaf of a potted plant and blot the leaf dry from both the sides with the help of blotting sheets.
7. Keep one dry cobalt chloride paper strip on the upper surface of leaf and stick it with the help of cello tape.
8. Likewise, stick another strip of cobalt chloride ( $\text{CoCl}_2$ ) paper on the lower surface of leaf.

9. Hold the leaf in position with the help of two slides and clips. Apply vaseline around the slide's edges to make it airtight.



10. Now, place the potted plant in sunlight.

11. Note down the time and keep observing after every 2 minutes till the strips turn pink.

### OBSERVATION

Observe the colour of cobalt chloride paper attached to both surfaces of leaf at regular intervals and note down your observations in the table given below.

Name of plant	Time taken for change of the colour from blue to pink (in minutes)										
		2	4	6	8	10	12	14	16	18	20
Upper epidermis											
Lower epidermis											

### RESULT

Rate of transpiration or rate of loss of water is higher at lower surface of leaf than the upper surface, the filter paper attached to the lower surface turns pink much faster than the strip on the upper surface.

### PRECAUTIONS

1. Broad leaved, well-watered potted plant should be taken for the experiment.
2. The cobalt chloride paper should be handled with dry hands.
3. The leaf surface must be wiped and dried before putting the cobalt chloride paper.
4. Equal sized strips should be placed on both the surfaces.
5. The slides that fix the cobalt chloride strips over leaves should be sealed by vaseline. This will ensure that no air or water can enter through the spaces of slide and cobalt chloride paper changes its colour due to the loss of water through transpiration only.

## VIVA VOCE

**Q1. How do plants loose water from their body?**

**Ans.** The plants loose water from their body surface in the form of water vapours through stomata. This process is called transpiration

**Q2. Which part of the plant loose maximum amount of water?**

**Ans.** Leaves have maximum number of stomata, so they loose maximum amount of water (in water

vapour form).

**Q3. Why do we use cobalt chloride in the experiment?**

**Ans.** It is because it changes its colour (blue to pink) when comes in contact with water.

**Q4. Which cells of stomatal apparatus regulate stomatal opening and closing?**

**Ans.** Guard cells

**Q5. Why is transpiration said to be a necessary evil?**

**Ans.** Transpiration is called as a necessary evil because most of the water absorbed by the plant is lost by this process. This process is necessary for absorption of water and minerals from soil as it exerts transpirational pull for ascent of sap and also provides cooling effect in plants.

**Q6. What is the disadvantage of transpiration?**

**Ans.** Very high rate of transpiration causes wilting of leaves and finally the plants. Most of the xerophytes develop structural modifications to check excessive transpiration.

**Q7. Which inorganic ion helps in the process of stomatal opening and closing?**

**Ans.** Potassium ion( $K^+$ ) helps in the process of stomatal opening and closing.

**Q8. How is root pressure related to transpiration?**

**Ans.** The positive hydrostatic pressure within the root system due to the active absorption of water is called root pressure. It is created due to loss of water by leaves through transpiration.

**Q9. What will happen to the plant if the rate of transpiration exceeds the amount of water absorbed?**

**Ans.** If the rate of transpiration exceeds the amount of water absorbed, the plant will wilt or may even die if the condition continues for a longer period of time.

**Q10. Name some external factors that affect the rate of transpiration.**

**Ans.** Light, temperature, wind and humidity are the external factors that affect the rate of transpiration.

**Q11. What will happen to the root pressure if plant is transpiring rapidly?**

**Ans.** If plant is transpiring rapidly, it will not show any root pressure instead, negative pressure is observed.

**Q12. Name the various types of transpiration.**

**Ans.** The various types of transpiration are be

- (i) Lenticular transpiration through lenticels.
- (ii) Stomatal transpiration through stomata.
- (iii) Cuticular transpiration through cuticles.

**Q13. Why are the number of stomata greater on the lower surface than the upper surface of a leaf?**

**Ans.** If large number of stomata will occur on upper surface (direct exposure to sunlight), it would lead to great amount of water loss through transpiration. Therefore, in order to avoid excessive transpiration, stomata are present in greater number on the lower surface of leaf.

**Q14. Which surface of a leaf shows higher rate of transpiration?**

**Ans.** Lower surface of leaf shows higher rate of transpiration.

**Q15. What is the reason for the colour change observed in cobalt chloride paper?**

**Ans.** Blue colour of anhydrous cobalt chloride turns pink when it comes in contact with water. This property of cobalt chloride is used to demonstrate that water is lost during transpiration.