

EXPERIMENT

5

Aim

To study the distribution of stomata on the upper and lower surfaces of the leaves.

THEORY

Stomata are the minute pores present in the epidermal layer of the leaves of a flowering plant. Stoma (sing) is surrounded by two specialised epidermal cells called guard cells, which enclose an aperture in the centre called the stomatal aperture. These guard cells in dicots are kidney-shaped or bean-shaped structures, and contain chloroplast. These are able to carry out photosynthesis guard cells are dumb-bell shaped in monocot leaves. Water is released through the stomata into the atmosphere in the form of water vapour through the process called transpiration. Besides this, the exchange of oxygen and carbon dioxide in the leaf also occurs through the stomata.

Plants are divided into different categories on the basis of distribution of stomata.

1. **Water lily type:** Stomata are present only on the upper surface of leaf, e.g. water lily and most of the aquatic floating plants.
2. **Apple type:** Stomata are present only on the lower surface of leaf, e.g. apple
3. **Potato type:** Stomata are present on both surfaces of leaf but are more on lower surface, e.g. potato, pea, tomato and many other dicots.
4. **Potamogeton type:** Stomata are either absent or vestigial, e.g. Potamogeton.

Number of Stomata in Plants

Stomata vary in number from one type of plant to another. In isobilateral or monocot leaves, approximately same number of stomata are found in upper and lower surfaces, i.e. equal on both the surfaces, while in dorsiventral leaves or in dicot leaves, the number of stomata is very few on upper surface than the lower surface of a leaf. The number of stomata ranges from a few thousand to over 1,00,000 per cm² area of the leaf and occupy 1-3% of the total leaf surface. Stomatal index is the percentage number of stomata as compared to all the epidermal cells in a unit area of leaf, i.e.

$$\text{Stomatal index} = \frac{\text{Number of stomata}}{\text{Number of stomata} + \text{Number of epidermal cells}} \times 100$$

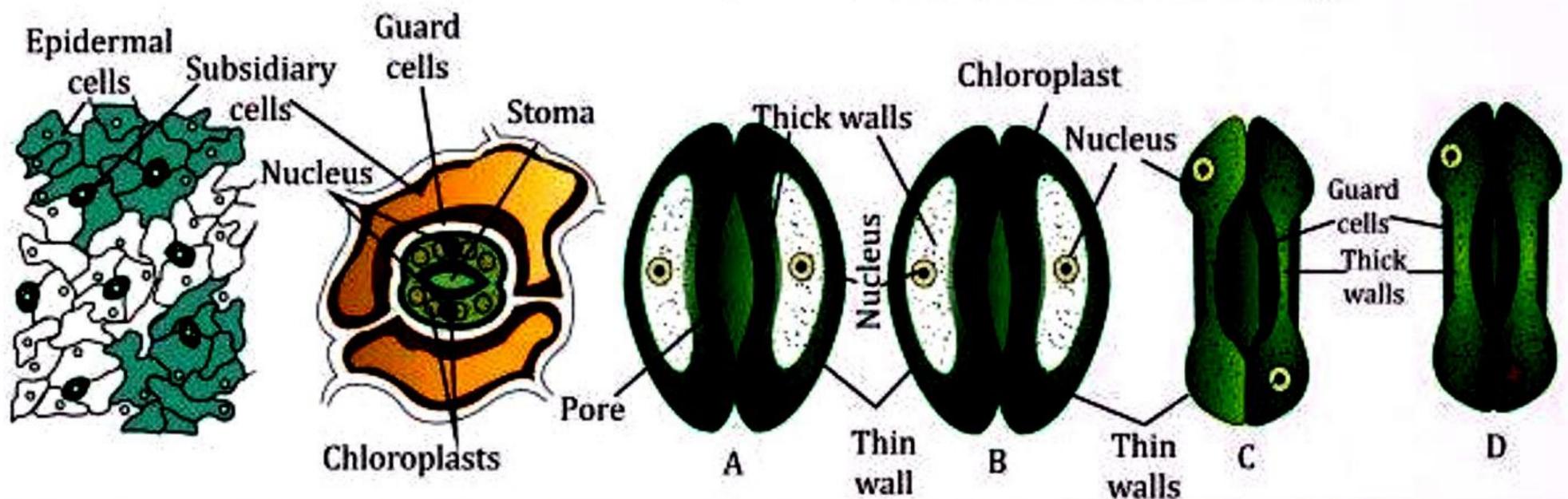
MATERIAL REQUIRED

Fresh leaves of one monocot (e.g. lily) and two dicots (e.g. Petunia) plants, forceps, needles, blade, blotting paper, brush, watch glasses or petridishes, beaker, glass slides, coverslips, safranin, glycerine, water, etc.

PROCEDURE

1. Take out the epidermal peels from the upper and lower surfaces of leaf of a monocot and dicot plant and put them in water in separate watch glasses and mark them clearly as A and B. The peels can be taken out by tearing the leaf obliquely with a single jerk or scraping it with blade.
2. Now, place the two pieces of peel on the separate glass slides and stain them with safranin by adding few drops of stain.

- Remove the extra stain with the help of blotting paper.
- Cut a small rectangular or square piece from each peel and put them on separate slides.
- Put a drop of glycerine on the slides over the peel and carefully cover the peels with cover slips, so as to avoid air bubbles. Remove extra glycerine by blotting paper.
- Observe the slides under high power microscope.
- Note the absence or presence of stomata by counting the number of stomata and epidermal cells in the microscopic field from both sides of the leaf.
- You will also observe open or closed stoma as shown in fig below.
- Calculate the stomatal index with the help of formula for monocot and dicot leaf separately.



S.No.	Name of plant	No. of stomata in the microscopic field secondary impression (Moulds)					Average No. of Stomata	Shape of guard cells
		I	II	III	IV	V		
1.	Dicot plant							
	(a) upper surface							
	(b) lower surface							
2.	Monocot Plant							
	(a) upper surface							
	(b) lower surface							

RESULT

Dicot leaf (Petunia) has more number of stomata on the lower surface than on upper surface, while, monocot leaf (lily) has equal number of stomata on both the surfaces of leaf.

PRECAUTIONS

- The peel should be taken out by tearing the leaf obliquely with a single jerk or scraping it with blade.
- A small rectangular or square piece of peel should be used for the study.
- The peel should immediately be transferred into water else it may get plasmolysed or dried and no structure will then be seen in the peel.
- Use brush and needles to transfer the peel from the petridish to the slide.
- Over-staining of peel should also be avoided as it may not give the accurate count of stomata.
- Excess glycerine should be removed by using blotting paper.
- The slides used for mounting should be cleaned properly.

VIVA VOCE

Q1. How is gaseous exchange become possible in plants?

Ans. The plant leaves have tiny pores on their surfaces called stomata. Plants exchange gases through them.

Q2. Name the tissue where stomata are present.

Ans. Stomata are present on the epidermal tissue of leaf.

Q3. Do all plants have stomata?

Ans. Yes, but few exceptions are there. The submerged aquatic plants do not have stomatal structures.

Q4. Name the cells which make stomatal apparatus in terrestrial plants.

Ans. Guard cells, subsidiary cells.

Q5. Do all cells of stomatal apparatus possess chlorophyll?

Ans. No, subsidiary cells do not have chlorophyll

Q6. Name the process by which plants lose water in the form of vapour.

Ans. The process of loss of water in the form of vapour from the aerial parts of a plant is called transpiration.

Q7. In which type of plants, stomata are in large number at the upper surface of leaf?

Ans. In dicot plants, the stomata are found in large number at the upper surface of leaf.

Q8. When do stomata open in plants?

Ans. Stomata open during daytime in plants.

Q9. How does the transpiration help plants?

Ans. Transpiration helps in absorption of water and ascent of sap. Transpiration also provides cooling effect in plant, thus protects it from harmful effect of sun.

Q10. Name the specialised cells that are responsible for opening and closing of stomata.

Ans. Guard cells are the specialised cells, that surround the stomatal pore and are responsible for opening and closing of stomata.

Q11. Name the processes that will be affected, if stomata were not present in leaves.

Ans. If the stomata were not present in the leaves, then the process of transpiration and gaseous exchange will be affected.

Q12. How does the guard cell in plants, differ from epidermal cells?

Ans. Guard cells have thick wall and are bean-shaped, do while epidermal cells are thin walled and are rectangular or barrel-shaped cells

Q13. In land plants, stomata are generally more on the lower epidermis than on upper epidermis. What is the advantage?

Ans. Land plants have more stomata on the lower surface than upper surface of leaves, so as to avoid much water loss due to transpiration as, the upper surface of leaf is in direct contact with air and sunlight.