DEVELOPMENT OF STOMATA IN LEAVES OF *MALPIGHIA GLABRA* LINN.

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ABSTRACT

The paper deals with the structure and ontogeny of stomata in leaves of *Malpighia glabra* Linn. The mature stomata are either tetracytic or show a combination of anisocytic and paracytic or anisocytic and hemiparacytic types. Developmentally they are either mesoperigenous or mesogenous.

INTRODUCTION

The structural details of foliar epidermis and stomata in plants of Malpighiaceae are described by METCALFE AND CHALK (1950) but no work has been done to study the development of stomata in the family. The present paper deals with the ontogeny of stomata in leaves of *Malpighia glabra* Linn.

MATERIAL AND METHODS

Young leaves at various developmental stages, from the plants of *Malpighia glabra*, growing in Botanical Garden of Allahabad University, were fixed in acetic acid-ethanol (1 : 3) and later preserved in 70 per cent alcohol. Development of stomata was studied by staining the epidermal peels of young leaves in acetocarmine. Observations on mature stomata were made by mounting the epidermal peels in safranin glycerine jelly.

OBSERVATIONS

MATURE STOMATA—The stomata are irregularly oriented and present on the lower surface of lamina. They are either monocyclic or partly or completely amphicyclic. The guard cells are slightly sunken below the epidermal cells. The stomata are either tetracytic (Fig. 1Q) being surrounded by two lateral and two polar neighbouring cells or show a combination of anisocytic and paracytic types (Fig. 1R) wherein the guard cells are surrounded by two parallel lying cells forming the inner ring and three unequal neighbouring cells of the outer ring. Sometimes the inner ring is incomplete and there is only one cell lying parallel to one side of the guard cells (Fig. 1S).

DEVELOPMENT OF STOMATA

(i) *Tetracytic stomata*—In a paradermal section of young leaves, straight-walled, polygonal or rectangular cells are irregularly arranged. Among these, some triangular meristemoids, are present here and there which can be readily distinguished from other cells by their deeply staining cytoplasm and prominent nuclei. These meristemoids divide by a curved wall into two cells; a larger rectangular cell and a smaller triangular meristemoid. The larger cell becomes the first neighbouring cell (Fig. 1A, B). A second curved wall is now laid down in the triangular meristemoid in such a way that a linear triad is formed wherein a central lenticular guard cell mother cell is flanked on either side by two rectangular cells which later enlarge and become the mesogene subsidiary cells (Fig. 1 B, C). The guard cell mother cell in due course, also enlarges, becomes oval and divides by a

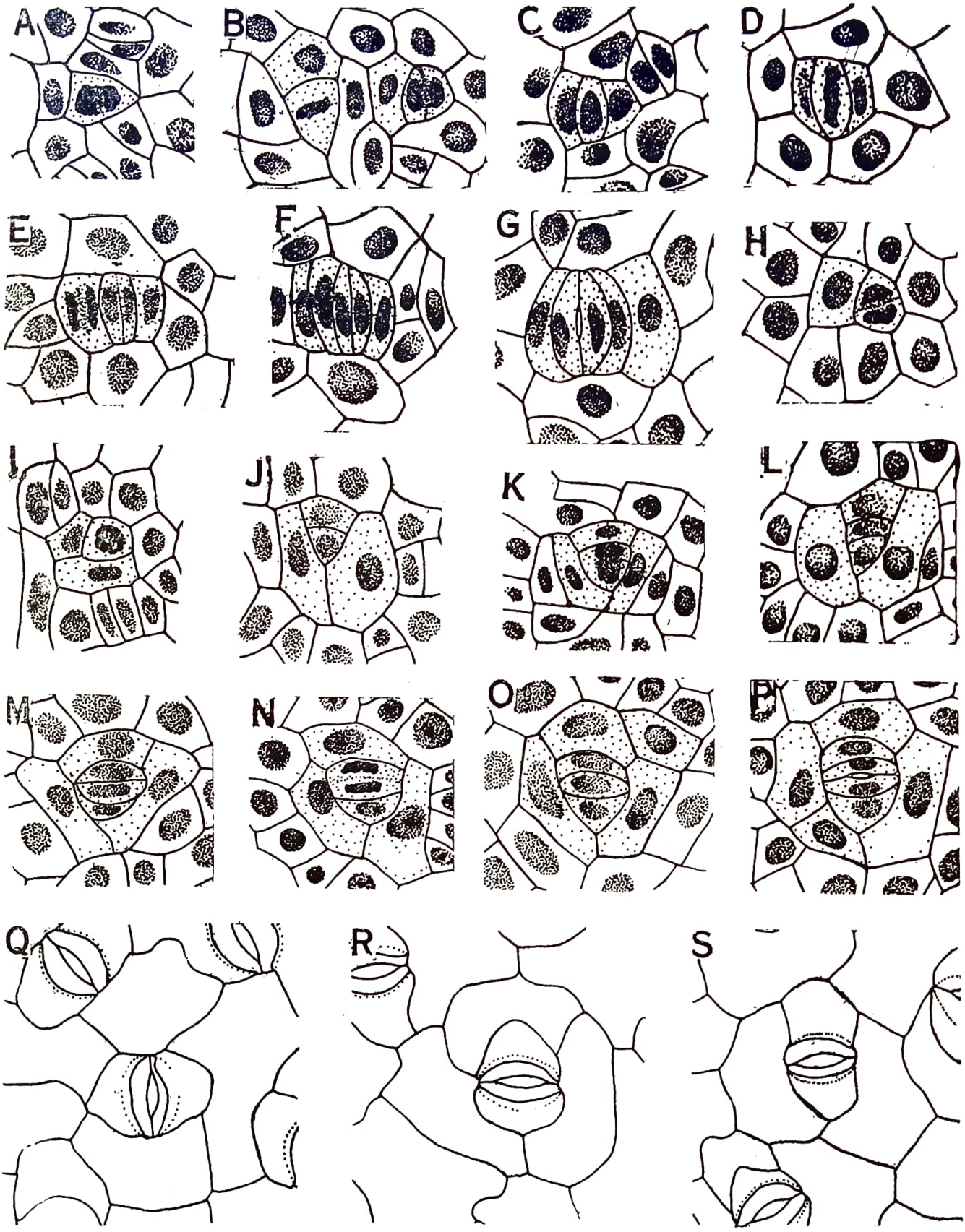

Fig. 1

straight wall into two guard cells (Fig. 1 D, E) which later become reniform and a gap appears between them. The mesogene cells in mature stomata lie almost parallel to the guard cells, but do not meet each other at the poles. The poles of guard cells are flanked by two perigene neighbouring cells. Since the polar and lateral neighbouring cells are of dual origin, the development of such tetracytic stomata is of mesoperigenous type (PANT, 1965 ; PANT & MEHRA, 1964). Sometimes, either simultaneously or after the formation of guard cells, one or both of the parallel lying mesogene cells, divide by radial wall (Fig. 1 E, F) so that a few adult stomata appear partly or completely amphicyclic (Fig. 1 G).

(ii) *Stomata showing combination of anisocytic and paracytic*—The first division of the meristemoids is like the tetracytic stomata resulting in the formation of larger rectangular neighbouring cells and a smaller triangular meristemoid (Fig. 1A). The triangular meristemoid divides by a second intersecting wall which is laid down almost perpendicular to the first one, so that a rectangular cell and a triangular meristemoid are formed. The rectangular cell thus formed is smaller than the first and becomes the second neighbouring cell (Fig. 1 H). The triangular cell divides once again by a third wall which intersects both the earlier partitions (Fig. 1 I, J), so that a third rectangular cell and a triangular meristemoid are formed. The third rectangular cell is the smallest of the three neighbouring cells formed in a spiral sequence. The triangular cell now divides by two curved walls one of which lie almost parallel to the third and the other facing it. This results in the formation of a triad in which a lenticular guard cell mother cell is flanked by two parallel lying subsidiary cells as in the formation of tetracytic stomata (Fig. 1 K-O). The central cell of the triad enlarges, becomes oval and divides by a straight wall into two guard cells and later a pore (gap) appears between them. The adult stomata thus formed, are surrounded by an inner ring of two subsidiary cells lying parallel to the guard cells and an outer ring of three unequal neighbouring cells. Since all the five cells surrounding the guard cells are derived from the same meristemoid, the development of this type of stomata is of mesogenous type.

Sometimes after the formation of the cells of the outer ring, only one curved wall is laid down either parallel to the third wall or facing it, so that a diad of two cells is formed, of which the larger one becomes the fourth neighbouring cell and the smaller triangular cell which enlarges, becomes oval and divides by a straight wall to form two guard cells as usual (Fig. 1 L,M). The adult stomata, thus formed, are surrounded by one parallel subsidiary cell (hemiparacytic) of the inner incomplete ring and an outer anisocytic ring of three neighbouring cells.

Fig. 1. *Malpighia glabra :* A—triangular meristemoid undergoing first division; B—meristemoid after cutting a larger rectangular cell, undergoing the second division; C—showing the formation of a central guard cell mother cell flanked on either side by parallel lying mesogene subsidiary cells; D—guard cell mother cell undergoing divison; E– one of the mesogene cells undergoing division; F—showing a young stoma without pore flanked by two mesogene cells one of which has divided radially; G—same as F but the stoma has developed a pore; H—showing the formation of a second curved wall perpendicular to the first; I—meristemoid undergoing third division; J—showing the formation of three unequal neighbouring cells and triangular meristemoid; K, L—showing the formation of fourth cell; M—showing a young stoma without pore after the formation of fourth cell; N—meristemoid undergoing fifth division, O—showing the formation of a linear triad surrounded by an outer anisocytic ring; P—same as O but the central guard cell mother cell has divided into two guard cells and developed a pore; Q—a mature tetracytic stoma; R—a mature stoma showing combination of paracytic and anisocytic types; S—a mature stoma showing combination of hemiparacytic and anisocytic types (A-P × 750; Q-S × 450).

SUMMARY AND DISCUSSION

The stomata in Malpighiaceae are reported to be rubiaceous (see METCALFE & CHALK, 1950), but according to my observations, there are three types of stomata in *Malpighia glabra*: (i) tetracytic ; (ii) stomata showing combination of anisocytic and paracytic and (iii) stomata showing combination of anisocytic and hemiparacytic types. The rubiaceous or paracytic stomata in Malpighiaceae are truly speaking tetracytic, because the neighbouring cells which lie parallel to the guard cells fail to meet each other at the poles and the poles in their turn are flanked by other epidermal cells (see PANT, 1965 ; PANT, NAUTIYAL AND SINGH, 1975). If the polar cells are ignored, the development of such stomata could be termed mesogenous, and the stomata would be rubiaceous (METCALFE & CHALK, 1950). But as stated earlier, the polar and lateral neighbouring cells are of dual origin. Therefore, ontogenetically they are mesoperigenous.

In the development of such stomata which show a combination of anisocytic and paracytic or hemiparacytic types, the meristemoids are basically trilabrate and cut off three unequal neighbouring cells in a spiral sequence as reported in a number of plants (see FRYNS-CLAESSENS & COTTHEM, 1973 ; VERMA, 1975). These meristemoids after cutting three cells become either unilabrate or dolabrate, as a result of which, one or two additional cells are formed which form the inner ring of subsidiary cells as reported by PANT AND BANERJI (1965) in some Convolvulaceae.

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