ONTOGENY OF STOMATA IN LEAVES OF *RUMEX DENTATUS* LINN.

B. K. VERMA

Department of Botany, Allahabad University, Allahabad

ABSTRACT

The structure and ontogeny of stomata in leaves of *Rumex dentatus* Linn. are described. The mature stomata may be anomocytic, anisocytic, paracytic, diacytic or they may be transitional between paracytic and diacytic types. Ontogenetically they are either mesogenous or mesoperigenous.

INTRODUCTION

According to METCALFE AND CHALK (1950) the stomata of Polygonaceae are mostly ranunculaceous and rarely rubiaceous as in *Oxytheca* and *Triplaris*. INAMDAR (1969 b, 1970) who has described the epidermal structure and ontogeny of stomata in some members of Polygonaceae including *Rumex dentatus* Linn. collected from Mount Abu, Mahabaleshwar, Mussoorie and Gujarat, India, reports the presence of anisocytic, anomocytic and paracytic stomata. During my work on ontogeny of foliar stomata in plants of Polygonaceae growing at Allahabad, I observed some additional stages in development of stomata in *Rumex dentatus* Linn. The paper aims at furnishing the additional informations regarding the ontogeny of foliar stomata in *Rumex dentatus* Linn. and to fill in the lacunae in our knowledge.

MATERIAL AND METHODS

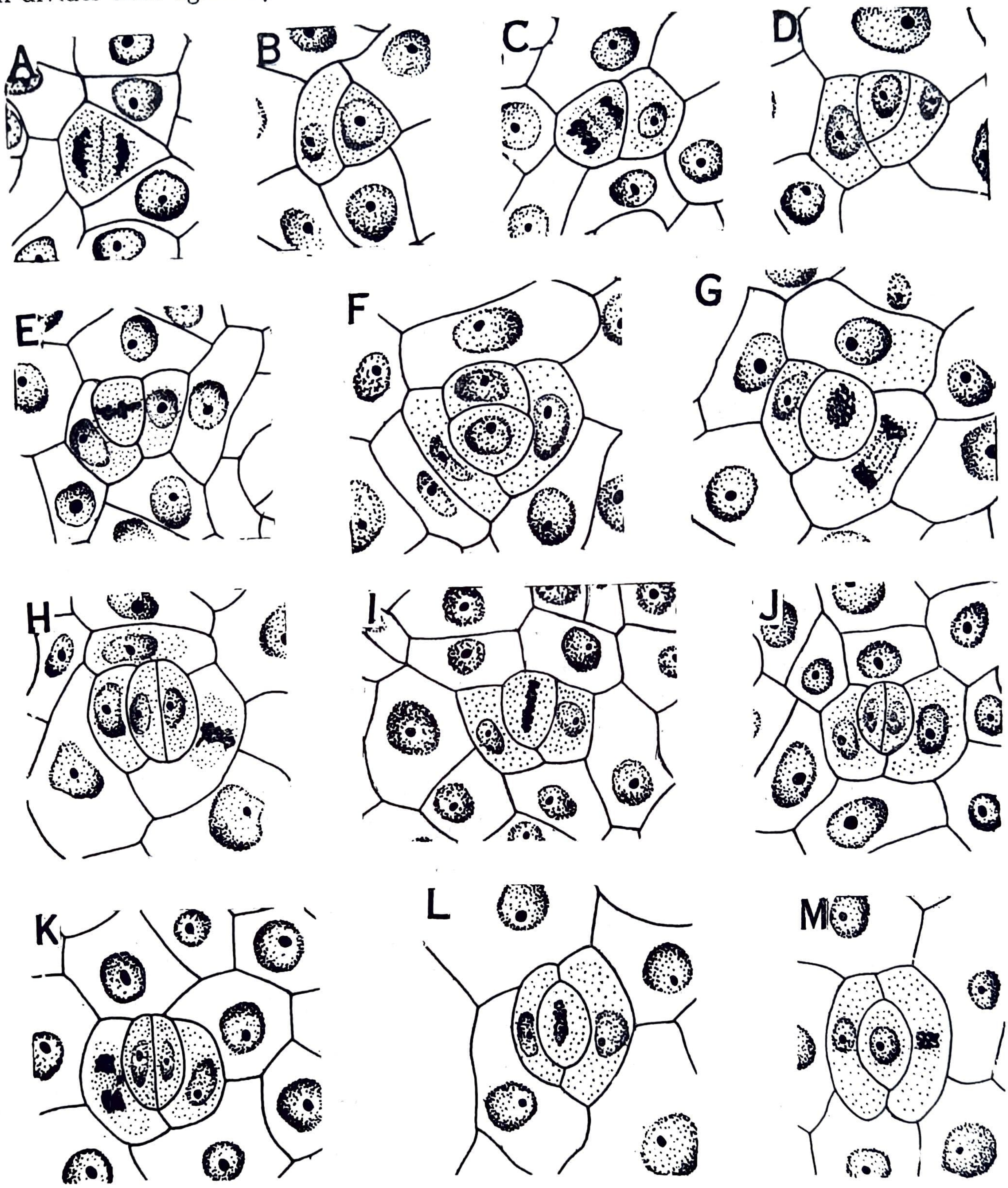
Young leaves of *Rumex dentatus* Linn. were collected from Botanical Garden of Allahabad University and fixed in acetic acid—ethanol (1 : 3). Developmental stages of the stomata were studied by preparing acetocarmine mounts of the dissected epidermis of fixed young leaves. Observations on mature stomata were made by mounting the epidermal peels in safranin-glycerine jelly.

OBSERVATIONS

MATURE STOMATA—The stomata which are irregularly orientated are found on both surfaces of leaves. They are either monocyclic or partly or completely amphicyclic. Their guard cells are slightly sunken below the level of epidermal cells. Three types of stomata, *viz*. anisocytic, anomocytic and paracytic, are of common occurrence in the leaves of *Rumex dentatus* Linn. (as described by INAMDAR, 1970). Out of these about 65% stomata are anisocytic, 23 % anomocytic and 11% paracytic. In addition a few diacytic and transitional stomata between diacytic and paracytic types were also recognised.

DEVELOPMENT OF STOMATA

(I) ANISOCYTIC AND ANOMOCYTIC STOMATA—Anticlinal walls of epidermal cells in young leaves of *Rumex dentatus* Linn. are straight. The cells are polygonal or rectangular and irregularly arranged. Among these are present scattered triangular cells which act as the meristemoids and can be easily recognised by their deeply staining cytoplasm and more prominent nuclei. During their first division a curved wall segments the meristemoids into two unequal cells: a larger rectangular cell which becomes the first neighbouring cell and a smaller triangular cell or meristemoid (Text-fig. 1 A, B) which retains the capacity of further division. A second intersecting curved wall is now laid down almost at right angle to the first. This division like the first, results in the formation of a rectangular cell and a triangular cell. The rectangular cell thus formed is smaller than the first one and becomes the second neighbouring cell (Text-fig. 1 C, D). The newly formed triangular cell divides once again by a wall intersecting both the earlier partitions (Text-fig. 1 E, F).



Text-fig. 1. *Rumex dentatus*: A—showing a triangular meristemoid undergoing first division; B—showing the formation of a rectangular cell and a triangular meristemoid after first division; C—showing the second division of the meristemoid; D—showing the formation of a second rectangular cell and a triangular cell; E—showing the third division of the meristemoid; F—showing the formation of a third rectangular cell and a triangular meristemoid; G—showing simultaneous division of the guard cell mother cell and one of the neighbouring cells; H—showing a young stoma without an intervening pore surrounded by a ring of three unequally neighbouring cells; I—showing the division of the triangular meristemoid into two guard cells after cutting only two mesogene neighbouring cells both of which meet at one pole of the stoma. The other pole is surrounded by two perigene neighbouring cells; J—a young stoma without any intervening pore surrounded by two mesogene and one perigene neighbouring cells; K—same as J but one of the mesogene neighbouring cells undergoing division; L—showing the division of the guard cell mother cell of a paracytic stoma; M—showing the division of a subsidiary cell of a paracytic stoma. (All ×750).

As a result, a third rectangular and a central triangular cell are formed. The rectangular cell becomes the third and smallest neighbouring cell and the triangular cell now acts as guard cell mother cell. It usually enlarges, becomes oval and divides by a straight wall, into two equal guard cells. Later the guard cells assume their characteristic kidney shaped form and develop a gap (pore) between them. The neighbouring cells often divide by radial, oblique or tangential walls either before or after the formation of the guard cells. Sometimes there is simultaneous division of the guard cell mother cell and neighbouring cell (Text-fig. 1 G). As a result the adult stoma may appear anomocytic or occasionally amphicyclic.

Sometimes after cutting only two rectangular cells the triangular meristemoid starts behaving as guard cell mother cell (Text-fig. 1 I, J). It enlarges, becomes oval and divides into two guard cells as usual. The stomata thus formed are flanked by two mesogene neighbouring cells which meet each other only at one pole of the guard cells and one or two perigene, neighbouring cells which happen to be present on the opposite pole. The mesogene neighbouring cells sometimes divide as described earlier (Text-fig. 1 K). The adult stomata which are anomocytic are thus surrounded by two or three mesogene and one or two perigene neighbouring cells (Text-fig. 2 J).

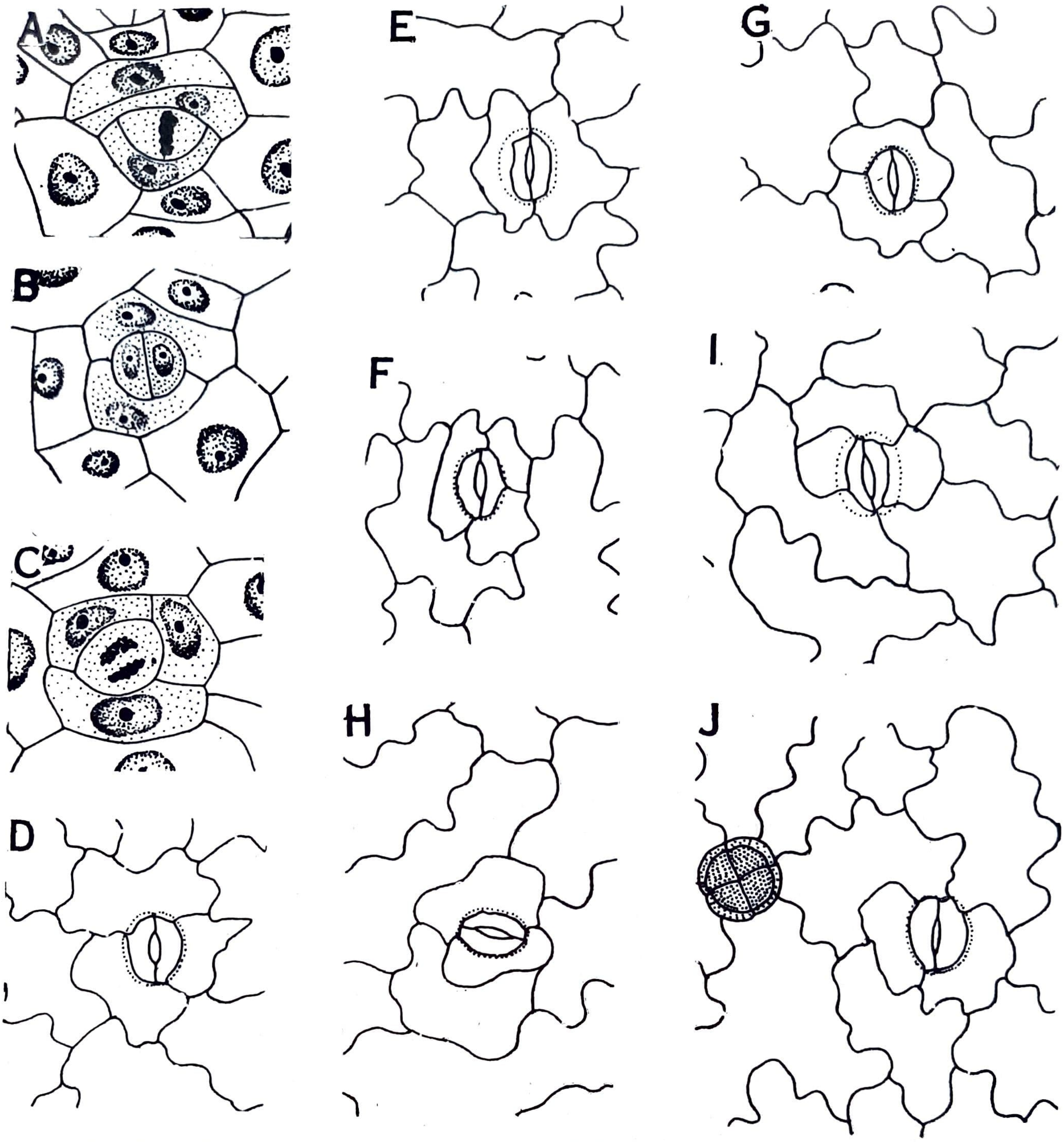
(II) Paracytic Stomata—The triangular meristemoid divides by a curved wall into a larger rectangular cell and a smaller triangular cell as usual. A second curved wall is now laid down completely intersecting the first, in such a way that a linear triad is formed in which a central lenticular guard cell mother cell is surrounded by two mesogene subsidiary cells. The guard cell mother cell enlarges and divides in a longitudinal plane resulting in the formation of two guard cells. The adult stomata are thus surrounded by two parallel subsidiary cells which meet each other on both poles of the stomata. Sometimes one of the two subsidiary cells divides and hence the adult stoma has three neighbouring cells instead of two (Text-figs. 1, L, M,; 2 E, F).

(III) Diacytic Stomata—The division of the meristemoid is similar to that which gives rise to a paracytic stoma. A linear triad is likewise formed. But in this case the central guard cell mother cell instead of dividing longitudinally divides in a plane at right angle to the subsidiary cells to form a pair of guard cells. Sometimes one of the subsidiaries divides longitudinally and hence the adult stoma is flanked by two subsidiary cells placed at right angle to the guard cells and an encircling cell (Text-figs. 2 A, B, G).

(IV) Transitional Stomata Between Paracytic and Diacytic—Here again the meristemoids cut off two mesogene subsidiary cells as in paracytic and diacytic stomata. But the guard cell mother cell divides in an oblique plane forming a pair of guard cells. Sometimes one of the subsidiaries divide by a transverse or oblique wall. The three subsidaries thus formed may undergo readjustment and make the stoma anisocytic (Text-figs. 2 C, H).

SUMMARY AND DISCUSSION

Inamdar (1970) has shown that *Rumex dentatus* Linn. along with other plants of Polygonaceae shows diversity only in structure of stomata like those reported by Pant and Kidwai (1964), Paliwal (1965) and Inamdar (1968, 1969 b). But the present study has clearly brought out the fact that *Rumex dentatus* Linn. shows diversity not only in the stomatal structure but also in the development of the same type of stomata. The anomocytic stomata of *Rumex dentatus* Linn. are perigenous in development as reported by Inamdar (1970). On the other hand according to my observations, such stomata of *Rumex dentatus*



Text-fig. 2. *Rumex dentatus:* A—showing the division of the guard cell mother cell of a diacytic stoma; B—a young diacytic stoma without an intervening pore; C—showing the division of the guard cell mother cell of a stoma transitional between diacytic and paracytic types. The larger subsidiary cell is seen divided by a transverse wall making the stoma anisocytic; D—an anisocytic stoma; E—a paracytic stoma; F—originally a paracytic stoma which becomes anisocytic by the division of one of the subsidiary cells; G—a diacytic stoma; H—a stoma transitional between paracytic and diacytic; I, J—anomocytic stomata. (A— C ×750; D—J× 300).

Linn. are either mesogenous or mesoperigenous and develop in more than one way. In the first instance the development of the anomocytic stomata of *Rumex dentatus* Linn. is like that of the anisocytic stomata of Crassulaceae (Strasburger, 1866; Yarbrough, 1934; Inamdar & Patel, 1970); *Notonia grandiflora* (Pant & Verma, 1963); *Phyla nodiflora* (Pant & Kidwai, 1964); some members of Rubiaceae (Pant & Mehra, 1965); Convolvulaceae (Pant & Banerji, 1965); Cruciferae (Pant & Kidwai, 1967; Paliwal, 1967); Verbenaceae (Inamdar, 1969 a) and Polygonaceae (Inamdar, 1970) where the meristemoid is trilabrate, divides in a spiral sequence and the mode of development conforms to the mesogenous type. However, in *Rumex dentatus* Linn., the three unequal neighbouring cells divide in various planes and the mature stomata become typically anomocytic like, which has not been reported by INAMDAR (1970). Secondly by suppression of the third division the meristemoid cuts off only two mesogene neighbouring cells which meet only at one pole of the stomata and the other pole is surrounded by one or two perigene neighbouring cells. The adult anomocytic stomata of this type are thus meso-perigenous in development.

The anisocytic stomata of *Rumex dentatus* Linn., likewise develop in two ways: either from trilabrate meristemoids like the mesogenous anomocytic stomata or from dolabrate meristemoids which give rise either to a paracytic stoma or a stoma transitional between paracytic and diacytic types. In the former case the suppression of any further division in the three unequal neighbouring cells make the adult stomata typically anisocytic as reported by INAMDAR (1970). On the other hand, in the latter case, one of the subsidiaries divides and as a result the mature stomata become surrounded by three neighbouring cells.

The development of the diacytic stomata is similar to that of Acanthaceae (PALIWAL, 1966), Verbenaceae (INAMDAR, 1969a), Polygonales and Centrospermae (INAMDAR, 1969 b). However, in *Rumex dentatus*, one of the subsidiaries divides in a longitudinal plane, making the mature stomata flanked on one side by an encircling cell. The presence and development of diacytic stomata has not been reported by INAMDAR (1970).

The paracytic stomata develop in the same way as described by PANT AND MEHRA (1965) in some Rubiaceae, and PALIWAL AND BHANDARI (1962) in some Magnoliaceae. But as pointed out earlier, in *Rumex dentatus* Linn. one of the subsidiary cells sometimes divides by a transverse wall and hence the mature stomata become somewhat anisocytic. Such paracytic stomata where the subsidiaries fail to meet either at one or both the poles (INAMDAR, 1970) may very well be categorised as anomocytic as pointed out earlier in the present paper or tetracytic as stated by PANT (1965) respectively.

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