STOMATAL DEVELOPMENT IN *CONVOLVULUS ARVENSIS* LINN.

BY G. L. SHAH

(Department of Botany, Sardar Patel University, Vallabh Vidyanagar, Gujarat, India)

Received October 21, 1967

(Communicated by Prof. V. Puri, F.A.S.C.)

ABSTRACT

The structure of stomata on the leaf, stem, petiole, peduncle, bract and sepal is described. The development has been studied in all organs except the peduncle. Three types of stomata—paracytic, anisocytic and anomocytic—occur on the leaf, bract and sepal but only the first two types are present in the remaining organs. Stomata with one or two subsidiary cells unilaterally flanking the guard cells are also found in the last two organs. In all the organs the paracytic type is by far the commonest, anomocytic one rare. An increase in number of subsidiary cells is either by their division or by the adjacent perigenes becoming subsidiary cell-like. Though there is a diversity of the structure of mature stomata on the same surface of each organ, the different types develop similarly in all organs.

INTRODUCTION

ALTHOUGH a considerable literature is now available on the structure and development of stomata on leaves of various angiosperms, only a few authors have studied them on different organs of the same plant. According to some authors (Stebbins and Khush, 1961; Gupta, Paliwal and Gupta, 1965), the ontogeny is similar in different organs of the same plant whereas others have noted that it varies from organ to organ (Tognini, 1897; Paliwal and Bhandari, 1962) and even on the same surface of an organ (Pant and Kidwai, 1964; Paliwal, 1965; Pant and Banerji, 1965; Pant and Gupta, 1966). Because of the divergent views regarding the stomatal ontogeny in different organs of the same plant, it is desirable to make a detailed study of as many species as possible before any conclusion is drawn. With this end in view the stomata were studied on the vegetative and reproductive organs of *Convolvulus arvensis*. Pant and Banerji (1965) have also described the ontogeny and structure of stomata in some members of the family Con-
vollulaceae including the present plant but their observations are mostly confined to leaves. In the present paper they have been studied on the leaf, stem, petiole, peduncle, bract and sepal. The development has been traced in all the organs except the peduncle.

**Material and Methods**

The material for the study was collected from plants growing wild in the University Campus. It was fixed in FAA. The peels of different organs in different stages of development were stained with Delafield’s hematoxylin and mounted in glycerine.

**Observations**

The stomata occur on both surfaces of a leaf, bract and sepal and are irregularly arranged but in the stem, petiole and peduncle they are oriented in the direction of the long axes of these organs. Generally they are unevenly scattered in the epidermis but sometimes they may be situated in close association also (Figs. 20, 26). Rarely in the sepal they are contiguous (Fig. 19). Paracytic, anisocytic and anomocytic stomata occur on the same surface of the leaf, bract and sepal but only the first two types are present on the stem, petiole and peduncle (Figs. 1, 4-7). Stomata with one or two subsidiary cells flanking the guard cells unilaterally are sparingly found in the bract and sepal (cf. Figs. 7, 22). In individual organs the paracytic stomata are more abundant followed by the anisocytic and anomocytic types.

Paracytic stomata may be monocyclic or amphicyclic. Generally the subsidiary cells are arranged parallel to the long axis of the stoma but sometimes they are arranged at an angle to it (Figs. 1, 4-7). In the monocyclic type the subsidiary cells may be equal or unequal. Seldom an adjacent perigene is so arranged that the stoma apparently looks anisocytic (Fig. 27). Amphicyclic paracytic stomata may be partial or complete. In the former type the stoma is flanked on one side by two subsidiary cells and on the other by one encircling cell (Figs. 7, 28), whereas in the later type there are two subsidiaries, one on either side of the stoma, often there is an outer ring of encircling cells enveloping the inner subsidiaries. All the subsidiary cells are derived from the same meristemoid which forms the guard cells (cf. Fig. 18). However the outer ring of encircling cells is composed of the surrounding epidermal cells (e) which have become subsidiary cell-like (Figs. 1, 5, 30).

In anisocytic stomata variations occur. Sometimes two of the three cells may be almost equal in size. All the cells may be arranged more or
less parallel to the long axes of the guard cells or at an angle to them (Figs. 1–3, 6–7). Rarely in leaves one, two or all the three subsidiaries enlarge simulating the epidermal cells (Fig. 24). An anisocytic stoma is seldom amphicyclic with an outer paracytic ring of subsidiary cell-like perigenous (Fig. 25).

Figs. 1–7. Fig. 1, 5, 7. Peels from the epidermis of leaf (upper), bract (lower) and sepal (lower) respectively showing distribution of stomata. Figs. 2, 4, 6. Peels from the epidermis of peduncle, stem and petiole respectively. Note a wall formation in Fig. 2. Fig. 3, An anisocytic stoma from stem.
Sometimes the subsidiary cells increase in number either by their division (Figs. 21-23) or the neighbouring perigenes assuming the form of subsidiary cells as described above (see also Fig. 29).

**Development.**—The stomatal meristemoids are generally scattered all over the surface but occasionally they may occur in groups (Figs. 10, 17). They are either triangular or rectangular in shape and have a granular cytoplasm (Figs. 8, 14). In some instances a meristemoid divides by two intersecting walls so as to form a linear row of three cells, the central cell being the smallest (Figs. 1, 10, 11, 19). The latter organizes into a stoma and the
flanking cells into the subsidiary cells. This is a monocyclic paracytic stoma. Rarely one or two curved walls are formed on the same side of the small cell (Figs. 1, 9, 15, 16). In some varieties the central small cell of the linear triad undergoes further divisions either by one or two curved walls thus either partly or completely amphicyclic stomata result (Fig. 18). In some other meristemoids three successive intersecting walls are laid down alternately on opposite sides so that the central small cell is surrounded by three unequal cells (Figs. 12, 13, 17). Such an arrangement finally results into an anisocytic stoma. In a few instances a meristemoid develops into an anomocytic stoma without undergoing any division.

Since the two guard cells and the subsidiary cells of a stomatal apparatus are derived from the same meristemoid, the development is mesogenous.

**DISCUSSION**

Though the development and structure of stomata in *Convolvulus arvensis* agree in most respects with those of Pant and Banerji (1965), they are somewhat different. (1) The stomatal development is mesogenous in all the organs investigated and not mesogenous, mesoperigenous and perigenous as described by these authors in the plants studied by them. (2) An anisocytic stoma is usually formed by three successive walls laid down alternately on the opposite sides of a meristemoid and not in a spiral sequence. (3) The subsidiary cells increase in number either by their division or by the adjacent perigenes becoming subsidiary cell-like. Similar observations have also been made in some members of Cruciferae (Paliwal, 1967) and Papilionaceae (Shah). Sometimes the perigenes are so arranged that a stoma apparently looks amphicyclic, rarely anisocytic. The division of subsidiary cells has also been reported in some members of Magnoliaceae (Rao, 1939) and *Basella rubra* (Paliwal, 1965).

The occurrence of more than one type of stomata even on the same surface of an organ has been reported in other members of Convolvulaceae (Pant and Banerji, 1965) and in several other plants such as members of the order Centrospermae (Sen, 1958), *Phyla nodiflora* (Pant and Kidwai, 1964) and some magnoliaceous members (Pant and Gupta, 1966). According to these authors they are mesogenous, mesoperigenous and perigenous.

A diversity in the structure and development of stomata in different organs of the same plant may weaken the use of stomatal characters in the phylogenetic classification, especially when it occurs on the same surface of an organ. However, in the present plant different types of stomata

---

*To be published in J. Indian bot. Soc.*
occurring on the same surface of each organ follow a similar pattern of development in all organs, thus agreeing with the observations of Stebbins and Khush (1961) and Gupta, Paliwal and Gupta (1965). Similar observations have been made by the present author on the leaves of some Papilionaceae. It, therefore, seems that the stomatal ontogeny may serve to some extent an useful purpose in classification. In fact, Gupta, Paliwal and Gupta (1965) have broadly divided the plants into two groups on the basis of stomatal ontogeny: (1) Those in which it is similar in all the organs and (2) those in which it varies from organ to organ. However it is of utmost importance to have sufficiently more information before any conclusion can be drawn.

ACKNOWLEDGEMENTS

The author is deeply grateful to Dr. V. Puri, Meerut College, Meerut, and Dr. G. S. Paliwal, Department of Botany, University of Delhi, Delhi, for critically reviewing this paper and offering valuable suggestions.

REFERENCES


