

STUDIES ON THE STRUCTURE AND ONTOGENY OF STOMATA AND TRICHOMES ON THE LEAVES OF SOME *SOLANUM* SPECIES

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ABSTRACT

The epidermal structure and ontogeny of stomata and trichomes on the leaves of four species of *Solanum* have been investigated. The stomata are of anomocytic type in *S. khasianum*, *S. americanum* and *S. luteum* and anisocytic type in *S. villosum*. Occasionally anomocytic and paracytic type of stomata may develop in *S. villosum* and *S. americanum* respectively. Abnormalities like stomata without pore, arrested development, contiguous stomata and stomata with single subsidiary cell have been observed. Various types of trichomes have been described.

INTRODUCTION

The genus *Solanum* L. is one of the largest in the plant kingdom being represented by about 2000 species. The epidermal structures of about 55 species described by AHMAD (1964a), CHANDRA (1967), SIDDIQUI *et al.* (1976), SEITHE (1979) and BESSIS AND GUYOT (1979) show a wide range of variations in the genus. Therefore, it was considered desirable to investigate some more species of the genus in this respect. The present communication deals with the epidermis, ontogeny and structure of stomata and trichomes on the leaves of *Solanum khasianum* Clarke, *S. americanum* Mill., *S. luteum* Mill., and *S. villosum* Moench.

MATERIAL AND METHODS

The leaves of different developmental stages were very kindly provided by Dr. Bahar A. Siddiqui of this department. The peels of epidermis were obtained following the technique of LEELAVATHI AND RAMAYYA (1975). The peels were stained in Bismark Brown, dehydrated in alcohol and mounted in canada balsam.

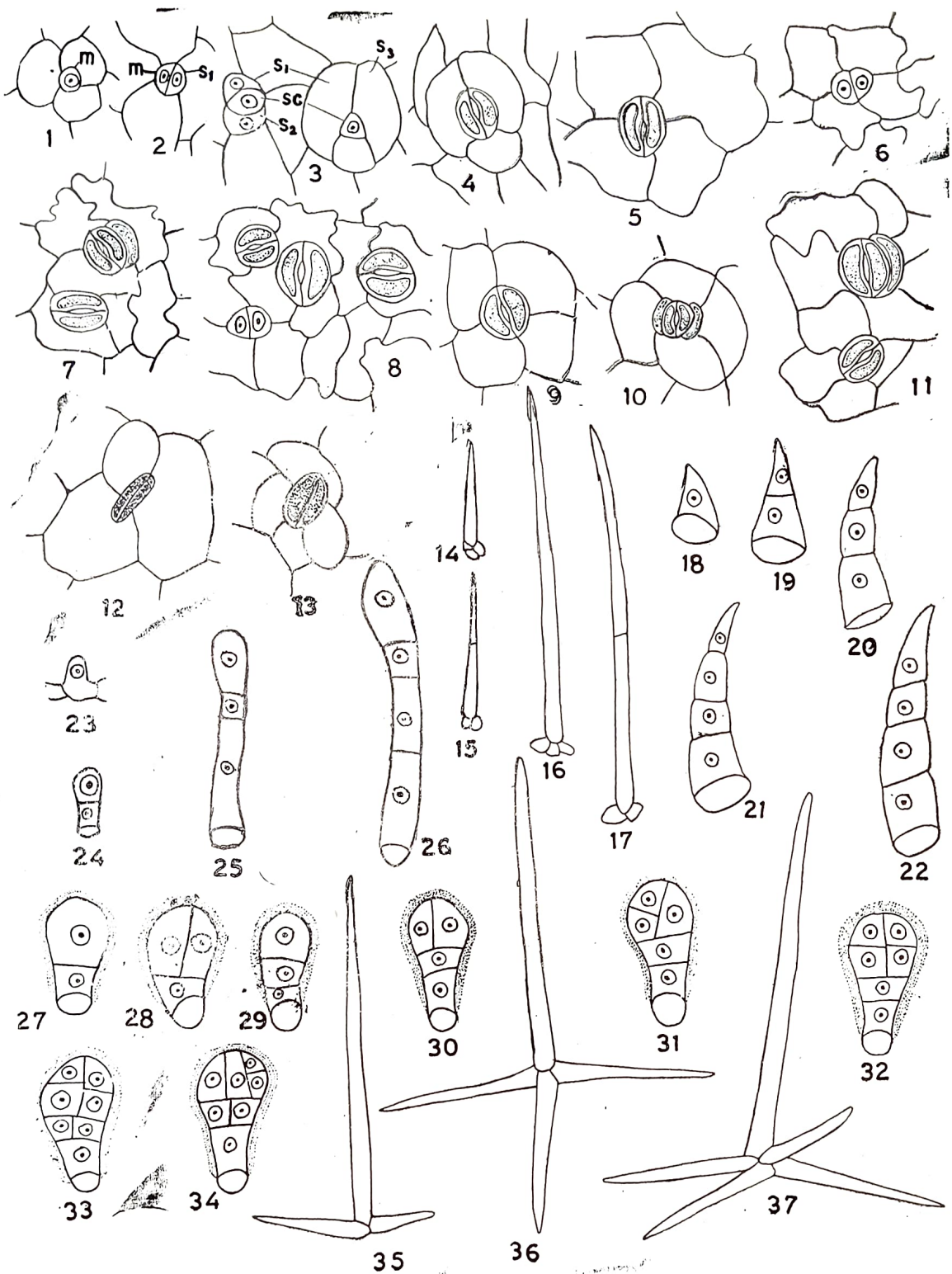
OBSERVATIONS

Mature epidermis

The epidermal cells of mature leaves show variations in size and shape. These are comparatively larger in *S. villosum* than the other species described here. The walls of the epidermal cells are sinuous or slightly sinuous in *S. khasianum* and *S. luteum* (Figs. 6-8, 11), while in *S. villosum* and *S. americanum*, the epidermal cells possess more or less straight walled cells (Figs. 1-5, 9, 10, 12, 13).

Mature stomata

The leaves are amphistomatic. The stomata are unevenly scattered and oriented variously. The stomata are generally of anomocytic type in *S. khasianum*, *S. americanum* and *S. luteum* (Figs. 8, 9, 11) and anisocytic type in *S. villosum* (Fig. 4). Occasionally the stomata may be of anomocytic and paracytic types in *S. villosum* and *S. americanum* respectively (Figs. 5, 10).



50μ 1-13, 27-34 50μ 14-17, 35-37 50μ 18-22 50μ 23-26

Figures 1-5, 12. *Solanum villosum*; Figures 6-8, 14-17, 23-26, 35-37. *S. khasianum*; Figures 9, 10, 13. *S. americanum*; Figures 11, 18-22, 27-34. *S. luteum*. Figs. 1-4. Development of anisocytic stomata. Fig. 5. Anomocytic stomata. Fig. 6. Development of anomocytic stomata. Fig. 7. Stomata with single subsidiary cell and anomocytic stomata. Fig. 8. Contiguous and anomocytic stomata. Figs. 9, 10. Anomocytic and paracytic stomata respectively. Fig. 11. Stomata with single subsidiary cell and anomocytic stomata. Fig. 12. Arrested development of stomata. Fig. 13, Stomata with pore. Figs. 14-17. Development of uniseriate 2-celled short and 2-celled long trichomes. Figs. 18-22. Development of conical trichomes. Figs. 23-26. Development of capitate glandular trichomes. Figs. 27-34. Development of 3-5 armed stellate trichomes. (m, meristemoid; S_1, S_2, S_3 , derivatives of meristemoid; sc, central cell).

Development of stomata

Anomocytic type—The stomatal meristemoid is distinguished by its triangular shape, relatively conspicuous nucleus and dense cytoplasm. The distribution of the meristemoids does not show any definite pattern. The meristemoid divides to produce two cells (Fig. 6), which differentiate as guard cells in *S. khasianum*, *S. americanum* and *S. luteum* (Figs. 7-9, 11) and occasionally in *S. villosum* (Fig. 5).

Anisocytic type—In this type, the meristemoid divides by slightly curved walls producing three unequal subsidiary cells and a central cell. The latter functions as guard mother cell. It divides to produce two guard cells. This type of development of stomata conforms to the anisocytic type and occurs in *S. villosum* (Figs. 1-4).

Paracytic type—The stomatal meristemoid divides by a slightly curved wall to produce two unequal cells. The larger, differentiates as the first subsidiary cell and the smaller one enlarges and divides into two unequal cells. The larger cell differentiates as second subsidiary cell and smaller one divides by a straight wall to produce two guard cells of equal size, which lie parallel to the subsidiary cells. Thus, the development of stomata conforms to the paracytic type in *S. americanum* (Fig. 10). In addition to the normal stomata, several abnormalities have been noted and recorded below.

Stomata without pore

The meristemoid divides normally to produce two equal guard cells. However, the stomatal aperture may not develop in *S. americanum* (Fig. 13).

Arrested development—Sometimes in *S. americanum* and *S. villosum* the stomatal development gets arrested at any stage of ontogeny. This generally happens after the formation of two guard cells. The cytoplasm degenerates and further development is arrested (Fig. 12).

Contiguous stomata—Contiguous stomata have been observed in *S. khasianum* and *S. luteum* (Fig. 8). They develop from adjacent meristemoids, which function as guard mother cells. The orientation of contiguous stomata depends upon the plane of division in the adjacent guard mother cells.

Stomata with single subsidiary cell—The stomatal meristemoid divides by a slightly curved wall to produce two unequal cells. The larger differentiates as single subsidiary cell and smaller one functions as a guard mother cell. The guard mother cell divides to produce two guard cells (Figs. 7, 11). The stomata with single subsidiary cell have been observed in the species described here.

Development of trichomes

Five types of trichomes have been observed which are described below :

Uniseriate eglandular—(a) 2-celled short—The trichome originates from protodermal cell which becomes distinct from the adjacent cell by its larger size. The trichome initially gradually elongates and divides transversely into two (Figs. 14, 15)—a lower basal and an upper terminal cell, which is sharply pointed at the free end. This type of trichome develops in *S. khasianum*. (b) 2-celled long—The development is similar to that of 2-celled short type of trichome except that they are considerably longer in size. They also develop in *S. khasianum* (Figs. 16, 17).

Multicellular uniseriate—(a) conical—The trichome initially divides transversely into an outer and a lower basal cell (Figs. 18, 19). Further transverse divisions give rise to multicellular uniseriate conical trichomes, up to 4-celled in *S. americanum* and *S. villosum* (Fig. 21) and up to 5-celled in *S. luteum* (Fig. 22). The trichomes are slightly constricted

at cross walls. (b) Cylindrical glandular—This type of trichomes have been observed in *S. khasianum*. The trichome initial divides transversely into an outer glandular and a basal cylindrical cell (Figs. 23, 24). Later, it appears that the basal cell divides producing three cells while the apical cell remains undivided. Thus the mature trichome is 4-celled, uniseriate and cylindrical glandular (Figs. 25, 26).

Capitate glandular—The trichome initial divides by a periclinal wall to form a basal and an apical cell (Fig. 27). The apical cell divides vertically earlier than the basal cell and gives rise to 2-celled head (Fig. 28). Sometimes the basal cell divides periclinally into a stalk and foot cell earlier than the apical cell (Fig. 29). The head cells divide in different planes producing several cells (Figs. 30-34). The outer walls of the trichomes are cutinized. This type of trichome develops in all the species described here.

Stellate trichome—Stellate type of the trichomes are branched, branches oriented in one plane. One of the branches is considerably longer than the remaining (Figs. 35-37). This type of trichomes have been observed in *S. khasianum* only.

DISCUSSION

The stomata in the investigated species of *Solanum* either belong to anomocytic or anisocytic type except *S. violaeifolium* and *S. swartzianum* (AHMAD, 1964a), *S. hispidum* (SIDDIQUI *et al.*, 1976) and *S. americanum*, where besides the usual type, paracytic type of stomata have also been observed. Occurrence of more than one type of stomata on the leaves of same species as described in the present materials is not uncommon in the genus. Abnormalities like stomata without pore, contiguous stomata and stomata with single subsidiary cell as described here have been reported in the genus (SIDDIQUI *et al.*, 1976). Arrested development of stomata has not been recorded earlier in the genus.

Out of the six types of trichomes recorded in the family Solanaceae (METCALFE & CHALK, 1950 ; AHMAD, 1964a), conical, cylindrical, glandular and capitate glandular trichomes have been observed in the present materials. Uniseriate eglandular 2-celled short and 2-celled long trichomes as described in *S. khasianum* have neither been reported in the genus *Solanum* nor in other genera of Solanaceae. However, this type of trichomes have been reported in *Dalbergia lanceolaria* of Papilionaceae (KOTHARI & SHAH, 1974). The three to five armed stellate trichomes with one arm significantly longer as described in *S. khasianum* have not been reported in the other species of *Solanum*. This type of trichomes have been recorded in *Cestrum euanthes* (AHMAD, 1964b). The taxonomic significance of the trichomes is undisputed (SOLEREDER, 1908 ; METCALFE & CHALK, 1950 ; SEITHE, 1979). There are about 2000 species of the genus *Solanum* and the trichomes of about 55 species only have been described. The data available is rather meagre and thus it is rather difficult to derive definite conclusions. However, it appears that some trichomes types are restricted to one or the other species while some other types are more common.

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