EPIDERMAL STRUCTURE AND ONTOGENY OF STOMATA IN *DIDYMOCARPUS*, A RARE TAXON TO RAJASTHAN FLORA

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ABSTRACT

The present paper deals with the epidermal structure and ontogeny of stomata in *Didymocarpus pygmaea* Clarke of family Gesneriaceae, a rare taxon to Rajasthan flora. The trichomes are uniseriate ranging from one to four cells in height. The leaves are hypostomatic and showing five types of stomata, viz. anisocytic, paracytic, diacytic, transitional type and anomocytic in addition to a few abnormal types. The anisocytic stomata develop anisomesogenously, the paracytic stomata paramesogenously, the diacytic stomata diamesogenously, transitional stomata mesogenously, whereas anomocytic stomata develop aperigenously.

INTRODUCTION

Epidermal studies dealing with structure and development of stomata and their bearing on the taxonomy and phylogeny of angiosperms have received much attention in the past few decades (METCALFE & CHALK 1950 ; PANT 1965 ; RAMAYYA & RAJAGOPAL 1968 ; PALIWAL 1969 ; FRYNS CLAESSENS & VAN COTTHEM 1973 ; DILCHER 1974 ; TRIVEDI & UPADHYAY 1976). The epidermal structure of family Gesneriaceae has been worked out by SOLEREDER (1912) and no work has been done until SAHASRABUDHE AND STACE (1974) on structure and development of stomata of this family. In the present paper epidermal studies have been made in the vegetative and floral organs in *Didymocarpus pygmaea* Clarke in addition to the above work.

MATERIAL AND METHOD

The present material was collected during the month of October, 1976 from the vicinity of a waterfall in Gapernath about 20 Km south of Kota. The vegetative and floral organs were fixed in acetic alcohol (1 : 3) and then stored in 70 per cent alcohol. Epidermal preparations were made from various parts of the plant. The peels were stained with safranin and Delafield hematoxylin and mounted in glycerine jelly. The terminology used here is the same as suggested by FRYNS CLAESSENS AND VAN COTTHEM (1973).

OBSERVATION

MATURE EPIDERMIS

The leaves are typically hypostomatic. The epidermal cells on either side of leaf are polygonal, isodiametric, elongated and irregularly arranged in various directions. Anticlinal and periclinal walls of upper epidermal cells are more or less straight, rarely wavy at places (Fig. 12) and cells of lower epidermis are sinuous (Fig. 1). All the vegetative and floral organs except the lower leaf surface are devoid of stomata (Table 1). The epidermal cells on the stem (Fig. 17) and carpel (Fig. 16) are rectangular, elongated and arranged in longitudinal direction.

Trichomes

Trichomes are uniseriate and unicellular to tetracellular (Figs. 2—9). The trichome base is rounded and thick walled. Trichomes are present on all vegetative and floral organs except petals and stamens.. The terminal cell is usually conical and pointed, very rarely curved (Fig. 9). The proximal cell near the trichome base is sometimes much wider than distal cell and contain dense cytoplasm (Fig. 5). Bicelled trichomes are more frequent on both the surfaces of leaf, while on petiole, calyx and gynoecium tricellular trichomes are more abundant. The unicellular trichomes are extremely rare and present only on lower surface of leaf (Table 2).

Table 1—Showing frequency and average size of epidermal cells ; stomatal frequency, stomatal Index, size of guard cells and subsidiary cells in leaf (Average of 10 observations)

Surface	No. of epidermal cell/mm2	Size of epidermal cells		Stomatal frequency /mm2	Stomatal index	Guard Cells		Subsidiary cells	
		Length	Breadth			Length	Breadth	Length	Breadth
Upper	541	151 μ	93 μ	..	..	..	..	..	..
Lower	97	142 μ	70 μ	33	25.38	34 μ	10 μ	+ 93 μ	35 μ

Table 2—Showing percentage and size of different types of hairs present on leaf, petiole, clayx and gynoecium (Average of 10 observations)

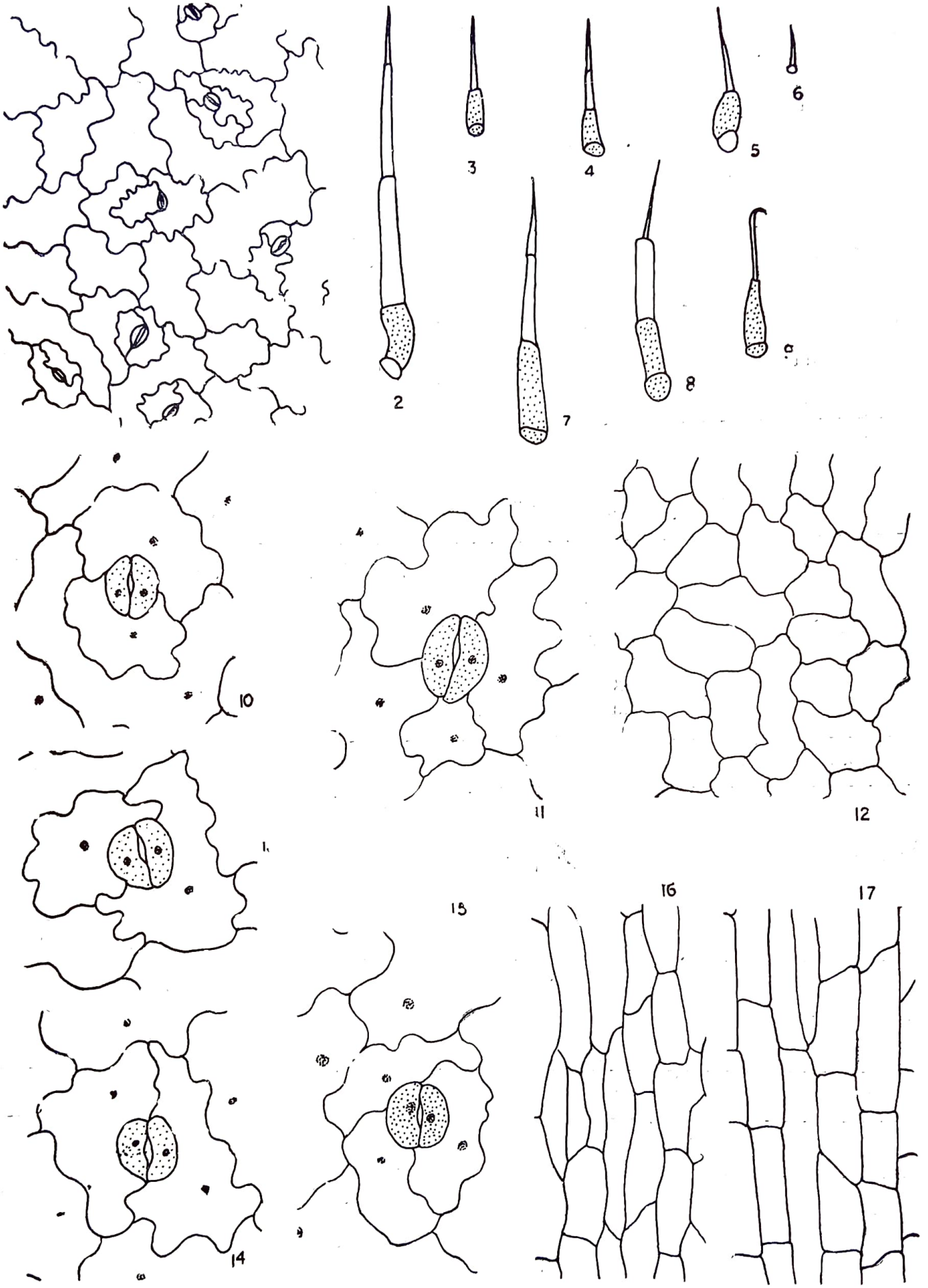
Types of hairs	Upper leaf	Lower leaf	Petiole	Calyx	Gynoecium	Size
Unicellular	..	1.54	..	..	..	93 μ
Bicellular	58.17	83.07	10.00	42.66	..	197 μ
Tricellular	29.27	13.84	83.34	49.00	84	453 μ
Tetracellular	12.56	1.55	6.66	8.34	16	685 μ

Table 3—Showing percentage of different types of stomata on lower surface of leaf (Average of 10 observations)

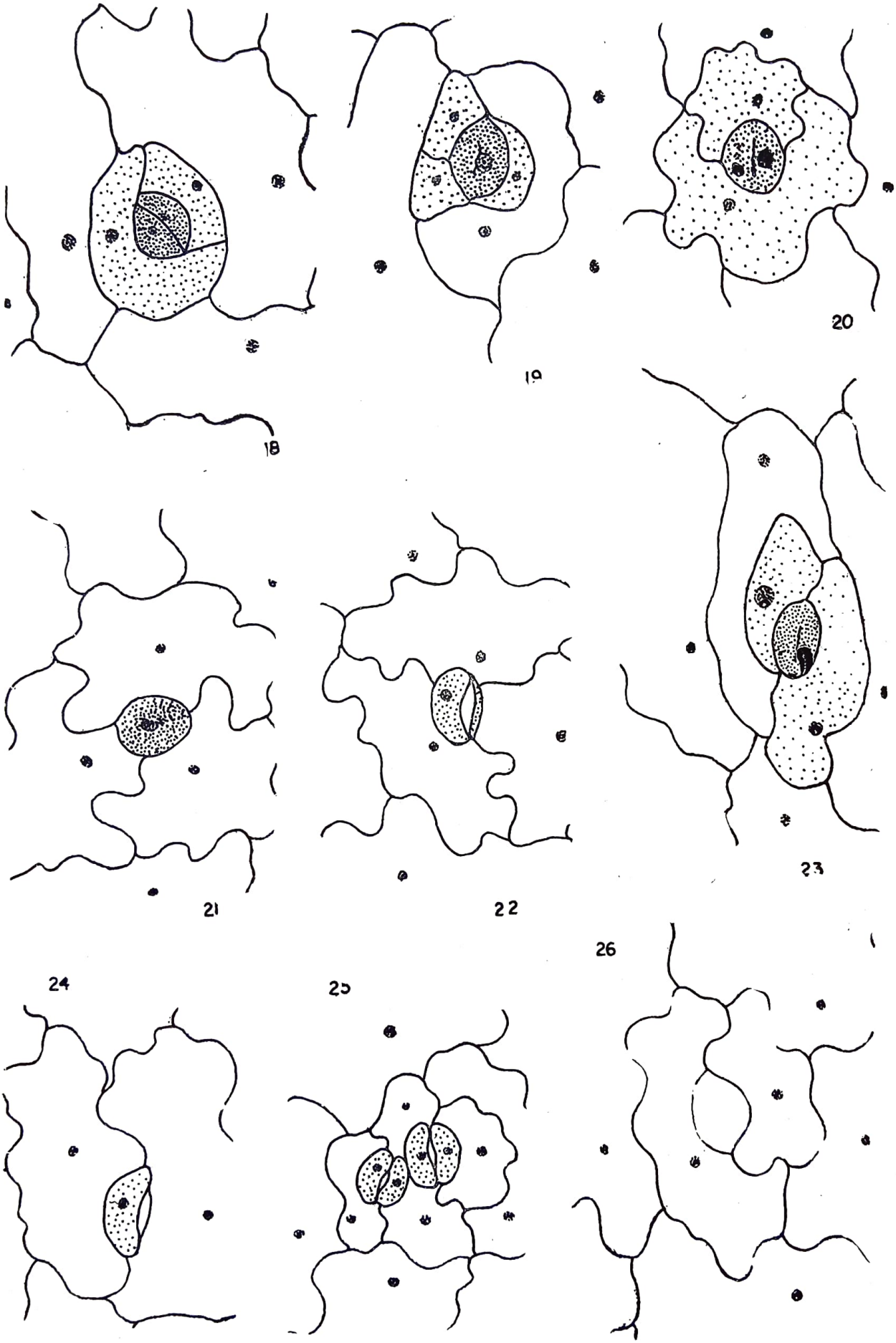
Anomocytic	Anisocytic	Paracytic	Diacytic	Transitional
1.88	7.54	42.45	17	31.13

Stomata

The mature stomata are anomocytic (Fig. 11), anisocytic (Fig. 15), paracytic (Fig. 14), diacytic (Fig. 10) and besides these transitional types of stomata are also present (Fig. 13). The paracytic stomata are quite common and anomocytic stomata are rare (Table 3). Some abnormalities have also been observed like single guard cell, stoma with unequal guard cells, contiguous stomata and arrested development of guard cell mother cell.



Text-fig. 1-17. *Didymocarpus pygmaea* (1-9, 12, 16, 17 × 100; 10, 11, 13-15 × 350). 1. Lower epidermis showing stomata and walls; 2-9. Different types of trichomes; 10. Diacytic stoma; 11. Anomocytic stoma; 12. Upper epidermis showing walls; 13. Transitional stoma; 14. Paracytic stoma; 15. Anisocytic stoma; 16. Epidermal cells on carpel; 17. Epidermal cells on stem.



Text-fig. 18-26. *Didymocarpus pygmaea* (All × 350). 18. Mesogenous development of paracytic stomata; 19. Development of anisocytic stomata; 20. Development of diacytic stomata; 21. Development of anomocytic stomata; 22. Stoma showing unequal guard cells; 23. Development of transitional stomata; 24. Stoma having single guard cell; 25. Contiguous stomata; 26. Stoma without guard cells.

Development of Stomata

The stomatal meristemoid is cut off from any of the epidermal cell in young leaves. The stomatal initial is more or less triangular and is very easily distinguishable from the adjoining epidermal cells by its dense staining properties. The ontogeny of different types of stomata is as follows :

Aperigenous—In this case the meristemoid (Fig. 21), directly functions as a guard cell mother cell without giving off any subsidiary cell and divided by straight wall forming a pair of guard cell.

Anisomesogenous—The epidermal meristemoid cut off segments from three faces (Fig. 19). The three segments become subsidiary cells at a later stage, while the central guard cell mother cell divides in the median plane forming two guard cells.

Paramesogenous—The stomatal meristemoid cuts off on either side one segment (Fig. 18). The two segments then become subsidiary cells. The central cell functions as guard cell mother cell and divides by straight median wall parallel to subsidiary cells forming two guard cells.

Diamesogenous—The stomatal meristemoid forms two subsidiary cells, but in the guard cell mother cell median wall is laid down at right angles to the subsidiary cells (Fig. 20).

Transitional stomata—These stomata are transitional between paramesogenous and diamesogenous types. Here the division of the guard cell mother cell is not at right angle to the subsidiaries as in the diamesogenous type, nor parallel to those cells as in paramesogenous type, but oblique (Fig. 23). Here the development is mesogenous.

Abnormal stomata—The abnormalities appear due to the arrest of stomatal development at various stages :

(i) Single guard cell—Here the meristemoid directly become a guard cell (Fig. 24).

(ii) Stomata with unequal guard cells—Here the guard cell mother cell divides and form unequal guard cells (Fig. 22).

(iii) Contiguous stomata—These develop from two or more adjacently placed meristemoids or sometimes two developing stomata come near each other and become contiguous as a result of readjustment during maturation (Fig. 25).

(iv) In some cases the stomatal ontogeny is arrested at different developmental stages, as a result, the guard cell mother cell and its surrounding subsidiary cells are without contents (Fig. 26).

DISCUSSION

In the present paper the development of stomata in *D. pygmaea* Clarke is described. Metcalfe and Chalk (1950) have described cruciferous (anisocytic) stomata with three subsidiary cells in members of family Gesneriaceae. Sahasrabudhe and Stace (1974) have also described only anomocytic and anisocytic stomata in this family as a whole. In the present investigation our observations differ from them. We have observed five types of stomata viz., anomocytic, anisocytic, paracytic, diacytic and transitional types on the same surface of the leaf. Fryns Claessens and Van Cotthem (1973) discussed transitional stomata under diamesogenous type. These stomata have also been reported by Pant and Kidwai (1964) and Inamdar (1969). In addition to normal stomata a few abnormalities have also been reported.

The occurrence of abnormal and more than one type of stomata on the same surface of the leaf has also been reported by many workers. In some members of Gesneriaceae Metcalfe and Chalk (1950) described the occurrence of stomata in

groups similar to those of Begoniaceae. Such types of stomatal groups have not been observed in the present taxon.

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