

EPIDERMAL STRUCTURES OF ARACEAE-I *DIEFFENBACHIA* SCHOTT

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ABSTRACT

The epidermal characters in eighteen species of *Dieffenbachia* Schott of the Araceae have been described. The stomata develop either tetra-perigenously or di-perigenously. Morphological and taxonomical importance of the epidermal characters within the genus has been discussed.

INTRODUCTION

The epidermis of *Dieffenbachia* Schott does not seem to have been so far studied. PANT AND KIDWAI (1966) have investigated the ontogeny of stomata in the Spathiflorae. The present study deals with the leaf epidermis in eighteen species and varieties of the genus *Dieffenbachia*.

MATERIAL AND METHOD

The material for the present investigation was largely obtained from the National Botanical Research Institute and Government Horticulture Garden, Lucknow. Peels of fresh, mature leaves were stained with Sudan IV and mounted in glycerine jelly. For the study of ontogeny of stomata, leaves in various stages of development were fixed in a mixture of Chrome-acetic acid. These peels were then stained in Haidenhains-Iron Haematoxylin and mounted in Canada balsam. Terminology used here is the same as suggested by FRYNS -CLAESSENS AND VAN-COTTHEM (1973) and DILCHER (1974).

DESCRIPTION

The leaves of *Dieffenbachia*, studied here, are large, solitary, shiny with few stomata.

Cuticle thickness—Cuticle is moderately thick; it is thicker on the upper surface of the leaf than on the lower.

Epidermal cells—Epidermal cells of the two surfaces of the leaves are quite distinct in a majority of species. Upper epidermal cells are usually hexagonal or polygonal and are smooth-walled. In some varieties striations are quite frequent. At places, cells are thick-walled and occur in groups. Lower epidermal cells are of various shapes; they are polygonal or irregular, either smooth or sinuous walled. They are smaller than the upper ones. The marginal cells are thick walled and much smaller than the other cells. Cells on the veins are elongated or rectangular and those on the larger veins, thick-walled.

Stomata—Stomata are generally present on both the surfaces but are less frequent on the upper surface. They are irregularly distributed. Distribution and size of stomata is important in distinguishing species and even varieties. In some species stomata may be quite large. Stomata commonly with two terminal subsidiary cells

and two lateral subsidiaries, are present. The latter in some varieties may be four in number are always larger than the former. Guard cells occur usually in pairs, in some species being slightly thick-walled.

Abnormal stomata—In some taxa contiguous stomata have been observed. Giant stomata are absent.

Trichomes—They are present only in *D. fenmanii* and *D. arvida* on their veins. The trichomes observed are unicellular usually narrow, long and show striations. Trichomes bases are usually rounded.

SYSTEMATIC DESCRIPTION

Dieffenbachia Schott

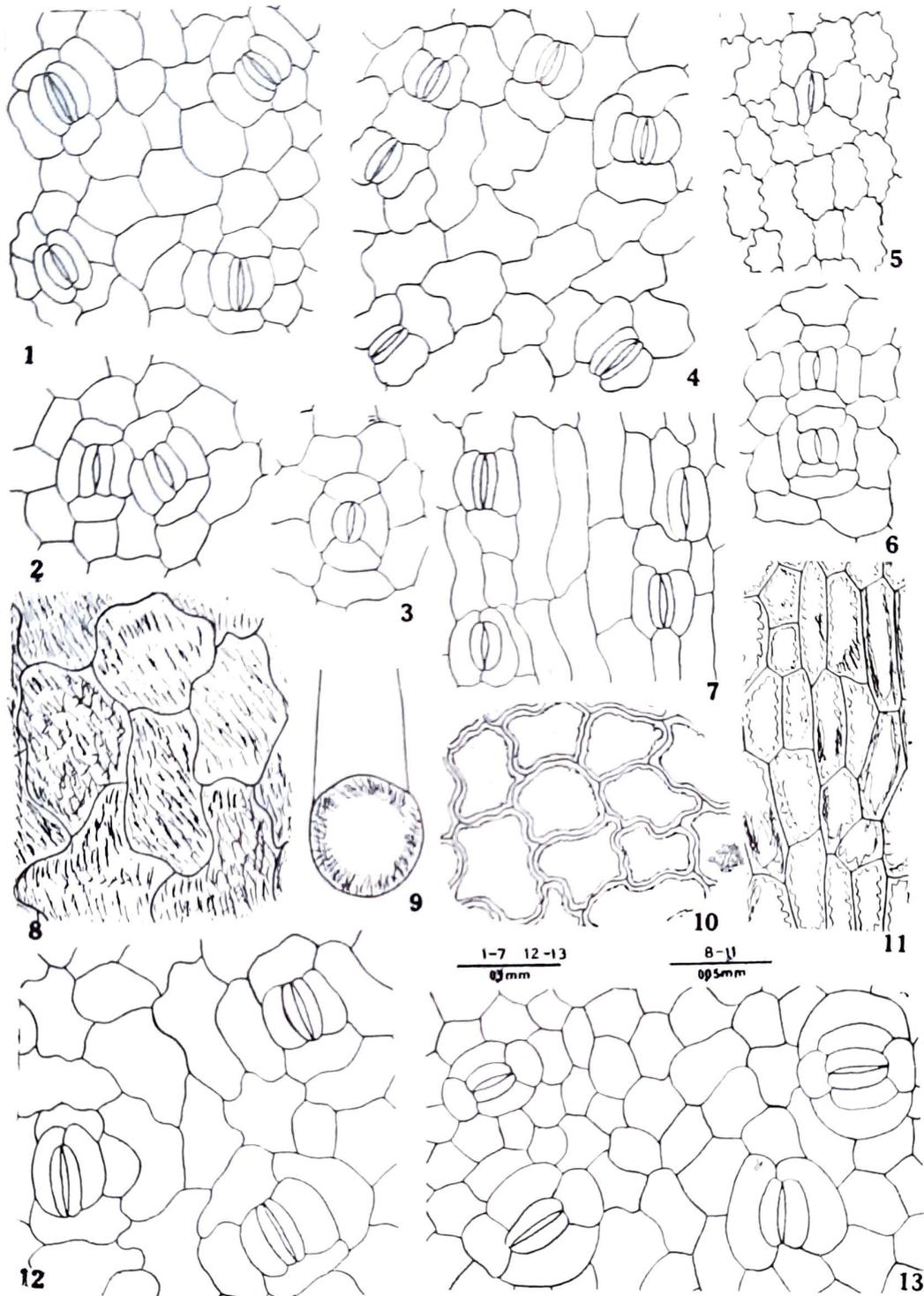
D. fournieri Hort.

Text-figs. 34, 36-38, 42

Leaves hypostomatic. Epidermal cells with uniformly thickened walls on the lower surface, but with irregularly thickened walls on the upper surface, marginal cells elongated but thin-walled. Stomata restricted to the lower surface, usually tetracytic, rarely paracytic. Trichomes absent.

EXPLANATION OF TEXT-FIGURES

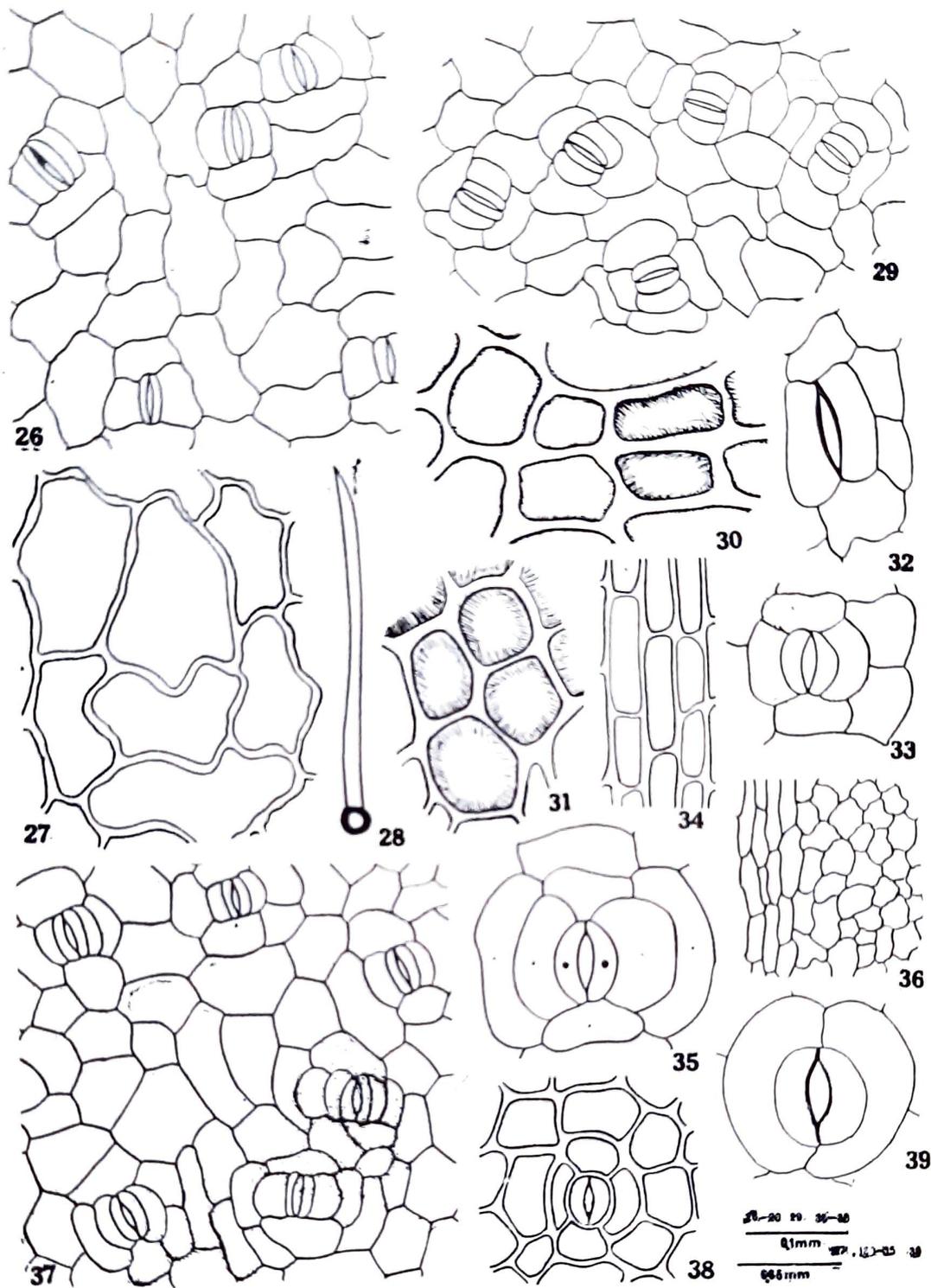
Fig. 1 Stomata and epidermal cells of *Dieffenbachia picta* var. *vindis*; Fig. 2—Contiguous stomata of *D. picta* var. *vindis*; Fig. 3—Tetracytic stoma of *D. picta* var. *vindis*; Fig. 4—Stomata and epidermal cells of *D. picta* var. *baraquiniana*; Fig. 5—Degenerated stoma and epidermal cell on upper surface of *D. picta* var. *baraquiniana*; Fig. 6—Contiguous stomata of *D. picta* var. *baraquiniana*; Fig. 7—Stomata and epidermal cells of *D. seguine* var. *nobilis*; Fig. 8—Upper epidermal cells showing striations of *D. exotica*; Fig. 9—Trichome base showing striations of *D. exotica*; Fig. 10—Upper epidermal cells showing sinuous walls and striations of *D. imperiales*; Fig. 11—Lower epidermal cells showing wall structures of *D. imperiales*; Fig. 12—Stomata and epidermal cells of *D. tropis*; Fig. 13—Stomata and epidermal cells of *D. amoena*; Fig. 14—Stomata and epidermal cells of *D. imperiales*; Fig. 15—Tetracytic stoma showing striations arising from the subsidiary cells of *D. imperiales*; Fig. 16—Stomata and epidermal cells of *D. sequinairarala*; Fig. 17—Stomata and epidermal cells of *D. bausei*; Fig. 18—Epidermal cells showing smooth walls of *D. picta* var. *memoria*; Fig. 19—Tetracytic stoma showing striations arising from the subsidiary cells of *D. picta* var. *memoria*; Fig. 20—Paracytic stoma of *D. picta* var. *memoria*; Fig. 21—Tetracytic stoma showing thickening on the outer wall of guard cells of *D. picta* var. *memoria*; Fig. 22—Stomata and epidermal cells of *D. arvida*; Fig. 23—Contiguous stomata of *D. jenmanii*; Fig. 24—Tetracytic stomata placed end to ends in rows of *D. jenmanii*; Fig. 25—Stomata and epidermal cells of *D. picta* var. *memoria*; Fig. 26—Stomata and epidermal cells of *D. jenmanii*; Fig. 27—Epidermal cells showing sinuous walls of *D. jenmanii*; Fig. 28—Trichome of *D. jenmanii*; Fig. 29—Stomata and epidermal cells of *D. splendens*; Figs. 30, 32—Epidermal cells showing striations of upper and lower surface respectively of *D. splendens*; Fig. 31—Degenerated stoma of *D. jenmanii*; Fig. 33—Tetracytic stoma showing striations arising from all subsidiary cells of *D. splendens*; Fig. 34—Elongated epidermal cells showing smooth walls on veins of *D. fournieri*; Fig. 35—Stoma showing two terminal and four lateral subsidiary cells of *D. splendens*; Fig. 36—epidermal cells of *D. fournieri*; Fig. 37—Stomata and epidermal cells of *D. fournieri*; Fig. 38—Stoma of *D. fournieri*; Fig. 39—Stoma showing thickening on the inner walls of the guard cells of *D. splendens*; Fig. 40—Stomata and epidermal cells of *D. angustifolia*; Fig. 41—Stomata and epidermal cells of *D. picta* var. *rudrochers*; Fig. 42—Contiguous stomata of *D. fournieri*; Fig. 43—Stoma and smooth walled epidermal cells of *D. angustifolia*; Fig. 44—Epidermal cells of the young leaf showing various stages of stomatal development; Fig. 45—Mature tetracytic stoma; Fig. 46—Meristemoid divides by two walls to form two lateral cells; Fig. 47—Guard cell mother cell surrounded by subsidiary cells; Fig. 48—young tetracytic stoma; Fig. 49—Central guard cell mother cell and two lateral cells; Fig. 50—Mature stoma showing two terminal and four lateral subsidiary cells; Fig. 51—Meristemoid showing first division; Fig. 52—Meristemoid showing nucleus and dense cytoplasm; Fig. 53—Mature tetracytic stoma; Fig. 54—Mature tetracytic stoma showing subsidiary cells almost equal in size.



D. splendens Bull.

Text-figs. 29-31, 33, 35, 39

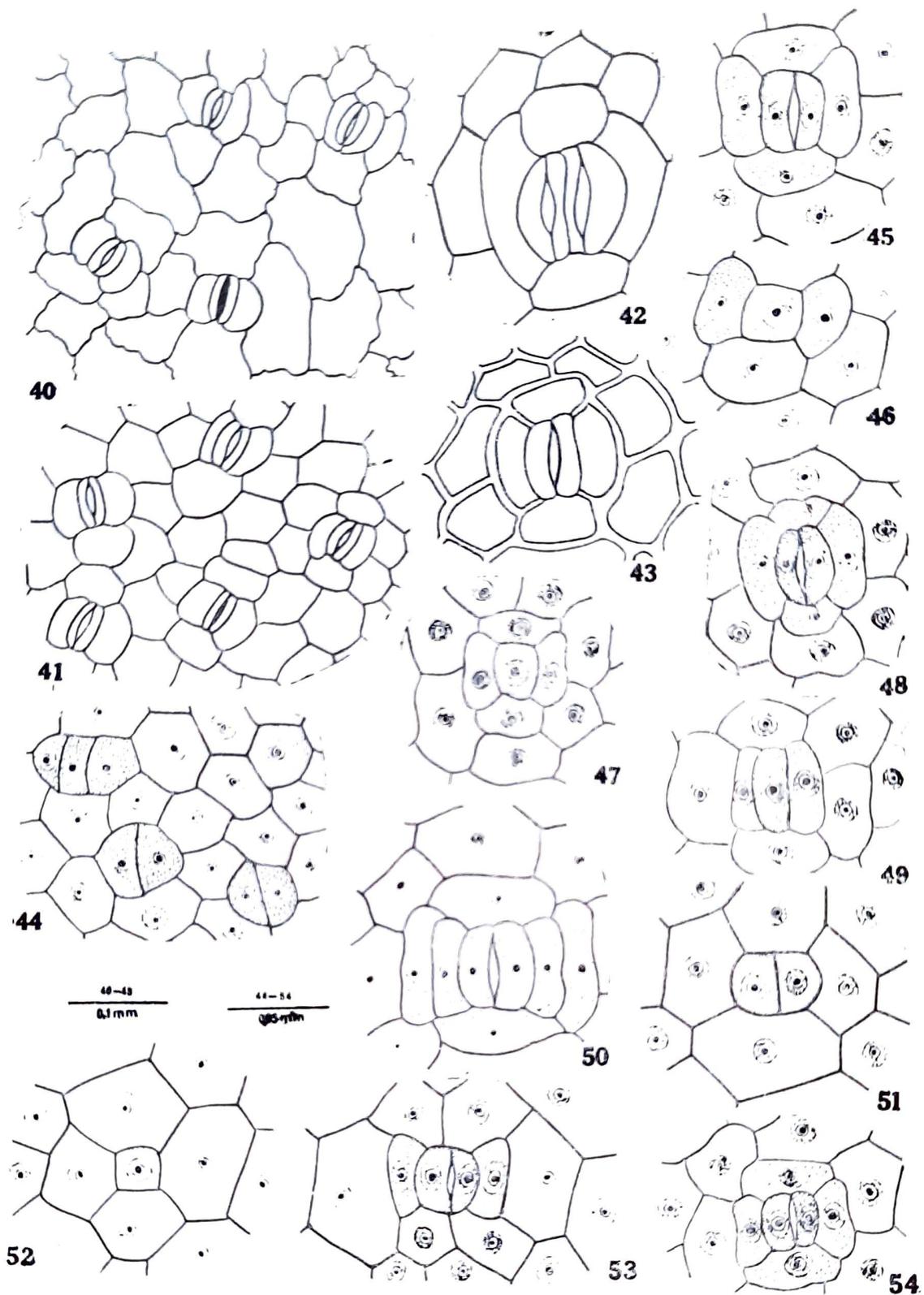
Leaves amphistomatic. Epidermal cells penta, hexa-or polygonal cell walls straight and quite thick. Striations common on the epidermal cells, and on terminal cells of the stomata. Stomata on the upper surface, usually tetracytic, lateral subsidiary cells two or three on either side of the guard cells. Trichomes absent.



D. imperiales Linden & Andri

Text-figs. 10, 11, 14, 15

Leaves amphistomatic. Epidermal cells irregular thick and smooth-walled upper surface, penta or polygonal, thick and smooth-walled on the lower surface; elongated with tapering ends on the veins. Stomata very few on the upper surface; usually tetracytic, striations common arising from the subsidiary cells. Trichomes absent.



***D. picta* var. *bausei* Engler**

Text-fig. 17

Leaves amphistomatic. Epidermal cells polygonal with smooth walls; upper epidermal cells usually penta or hexagonal. Stomata very few on the upper surface, quite large, tetracytic. Trichomes absent.

D. picta var. **baraquiniana**

Text-figs. 4-6

Leaves amphistomatic. Epidermal cells irregular, sinuous, on the upper surface, polygonal, smooth-walled, on the lower surface, tetracytic; degenerated stomata (Text-fig. 5). Common on upper surface; contiguous stomata seen at places. Trichomes absent.

D. picta var. **superba**

Leaves amphistomatic. Epidermal cells variable penta-hexa-or polygonal. Stomata tetracytic or hexacytic, moderate-sized, frequency low, trichomes absent.

D. picta var. **vindis**

Text-figs. 1-3

Leaves amphistomatic. Epidermal cells penta or hexagonal smooth-walled. Stomata commonly tetracytic or hexacytic; contiguous stomata common, trichomes absent.

D. picta var. **memoria**

Text-figs. 18-21, 25

Leaves amphistomatic. Epidermal cells variable penta to polygonal; upper epidermal cells pentagonal with thick and smooth walls. Stomata usually tetracytic; guard cells show thickenings on the outer walls; striations arise from the lateral subsidiary cells; trichomes absent.

D. picta var. **rudrochers**

Text-fig. 41

Leaves amphistomatic. Epidermal cells polygonal on the lower surface; irregular smooth-walled on the upper surface. Stomata small, tetracytic, few on the upper surface. Trichome absent.

D. arvida

Text-fig. 22

Leaves amphistomatic. Epidermal cells hexa to polygonal, thick and smooth-walled. Stomata small, tetracytic, frequency very low on the upper surface. Trichomes present but their frequency very low, long and uni-cellular, bases round and thick-walled.

D. amoena

Text-fig. 13

Leaves amphistomatic. Epidermal cells irregular with smooth wall; elongated on the veins. Stomata usually tetracytic or paracytic; surrounded by large number of lateral subsidiary cells. Trichomes absent.

D. sequinarirarala

Text-fig. 16

Leaves amphistomatic. Epidermal cells penta to polygonal, thick and smooth walled. Stomata usually tetracytic rarely paracytic, regularly distributed. Striations common in the epidermal cells. Trichomes absent.

D. angustifolia

Text-figs. 40, 43

Leaves amphistomatic. Epidermal cells variable, upper epidermal cells irregular, thick and smooth-walled. Stomata usually tetracytic, rarely paracytic, large and 2 to 3 cells apart. Trichomes absent.

D. tropis

Text-fig. 12

Leaves amphistomatic. Epidermal cells irregular, thick and smooth-walled. Stomata quite large; generally two cells apart; tetracytic. Trichomes absent.

D. exotica

Text-figs. 8-9

Leaves amphistomatic. Epidermal cells irregular thick and with sinuous walls. Stomata moderate-sized; tetracytic. Striations common all over the upper surface. Trichomes absent.

D. seguine Schott.

D. seguine var. **nobilis**

Text-fig. 7

Leaves amphistomatic. Epidermal cells elongated, thick and smooth-walled. Stomata regularly arranged; usually paracytic and tetracytic. Trichomes absent.

D. seguine var. **liturata**

As in the above variety but stomata irregular in distribution.

ONTOGENY OF STOMATA

Protoderm cells occur scattered all over the epidermis of young leaves (Text-figs. 44, 52). These cells divide transversely to produce a small and a large cell (Text-figs. 44, 51). The large cell does not divide further and remains as an ordinary epidermal cell while the smaller functions as a meristemoid. It divides in various planes resulting in two smaller cells either at polar ends or laterally. The middle cell then divides by two successive vertical walls to produce a large guard cell-mother-cell is surrounded by two polar and two lateral cells (Text-fig. 47). The guard cell-mother cell then divides by vertical division resulting in formation of a mature stoma with two guard cells, two polar and two lateral subsidiary cells (Text-figs. 45, 48, 54).

In some taxa, the polar and lateral subsidiary cells divide further resulting in the formation of stomata which have six subsidiaries, four lying polar and two lateral or four lateral and two polar subsidiaries (Text-fig. 50).

Diperigenous—Guard cell-mother cell divides to produce two guard cells, the lateral subsidiary cells are derived from epidermal cells (Text-fig. 49). The subsidiaries are parallel to the guard cells and stoma appearing as a paracytic type (Text-fig. 53). Sometimes lateral subsidiaries divide to produce four lateral perigenous subsidiaries. Such stomata are common in this genus.

The present study is suggestive of certain characters common to all species of *Dieffenbachia* examined by us. These are:

- (i) Stomata occur on both the surfaces of the leaf.
- (ii) Frequency of stomata is very low on the upper surface.
- (iii) Stomata are usually tetracytic.
- (iv) Epidermal cells are generally large, thick and smooth-walled.
- (v) Stomata develop mostly by tetra-perigenous or diperigenous methods.

Some species show distinctive characters, such as stomata are confined to lower surface only as in *D. furnieri*, but in all other species they are distributed on both the surfaces. Stomata are mostly irregularly distributed, but in *D. sequine* var. *nobilis*, *D. sequine* var. *litorata*, *D. jenmanii* and *D. arvida* they are in distinct files, further, trichomes are absent in the former two species while in the other two they are fairly common. Stomata are commonly tetracytic but in *D. amoena*, *D. sequinarivoralis* and *D. angustifolia*, they are both tetracytic and paracytic while in *D. picta* var. *superba* and *D. picta* var. *vindis*, they are tetracytic and hexacytic.

Stomata in this genus develop mostly tetra-perigenously and diperigenously (FRYNS-CLAESSENS & VAN-COTTHEM, 1973). Development of stomata is uniform throughout the genus. In some species stomata develop diperigenously but their frequency is very low.

Developmental patterns of stomata in monocotyledons have been studied by TOMLINSON (1974). He recorded tetracytic stomata in monocots and discussed their taxonomic importance. Our studies on structures and developmental patterns of stomata in *Dieffenbachia* are in agreement with those of TOMLINSON (1974).

Even though species of *Dieffenbachia* grow under varied environmental conditions yet their epidermal features are nearly constant for each species. Distinctive features of each species are shown in table 1.

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Table 1. Stomata

Name of the species	Occurrence	Type	Frequency		Size in μm	Stomatal Index	Trichomes	Remarks
			Upper	Lower				
1. <i>D. splendens</i>	LW up	Te	7	140	33×26	73	—	Striations common on the epidermal cells and stomata
2. <i>D. imperiales</i>	LW up	Te	6	96	40×30	80	—	Striations common and seen arising from subsidiary cells.
3. <i>D. picta-bausei</i>	LW up	Te	5	90	31×23	80	—	Stomata moderate
4. <i>D. picta-barauiniiana</i>	LW up	Te	15	60	33×36	78	—	Degenerated stomata common on the upper surface.
5. <i>D. picta—memoria</i>	LW up	Te	10	80	26×20	68	—	Guard cells show thickening
6. <i>D. picta—rodgers</i>	LW up	Te	30	82	43×33	82	—	Size of stomata moderate
7. <i>D. arida</i>	LW up	Te	4	55	43×26	78	+nt unicellular uniseriate frequency low	Trichome bases round and thick-walled
8. <i>D. jemanii</i>	LW up	Te	10	58	53×46	78	+nt uniseriate base rounded	Contiguous and degenerated stomata common
9. <i>D. exotica</i>	LW up	Te	10	60	63×43	83	—	Stomata quite large
10. <i>D. exotica</i>	LW up	Te	12	88	40×26	82	—	Epidermal cells sinuous-walled, striations common all over upper surface
11. <i>D. seguine-liturata</i>	LW up	Te	10	105	29×24	72	—	Stomata small not in regular file
12. <i>D. seguine-nobiles</i>	LW up	Te	8	60	37×30	80	—	Stomata regularly arranged

13. <i>D. amoena</i>	LW up	Te pa	12	50	40 × 33	80	—	Many subsidiary cells
14. <i>D. seguinarioides</i>	LW up	Te pa	15	130	40 × 40	74	—	Regular distribution of stomata
15. <i>D. angustifolia</i>	LW up	Te pa	10	45	37 × 28	81	—	Epidermal cells irregular and thick-walled
16. <i>D. foornieri</i>	LW	Te pa	12	80	36 × 33	76	—	Epidermal cells irregularly thickened
17. <i>D. picta-superba</i>	LW up	Te He	20	120	30 × 20	77	—	Stomatal frequency high
18. <i>D. picta-vindis</i>	LW up	Te He	8	64	40 × 33	75	—	Contiguous stomata common

LW, Lower surface; up, Upper surface; pa, paracytic stomata; Te, Tetracytic stomata; He, Hexacytic stomata; +nt, present; —nt, absent.