

STUDIES ON FOLIAR EPIDERMAL FEATURES IN SOME EUPHORBIACEAE

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The paper deals with detailed structure of foliar stomata and other epidermal features of 17 species belonging 17 genera of the family Euphorbiaceae. Anomocytic stomatal type is predominant, while other types such as paracytic, hexacytic and anisocytic are also noted on the same foliar surface in different combinations. In majority of taxa, the leaves are hypostomatic, while in few they are amphistomatic. Distribution of stomata, stomatal index, stomatal frequency, stomatal size and other cell wall contours are described in detail.

Keywords: Euphorbiaceae; Foliar epidermis.

Introduction

The importance of epidermal features in taxonomy and phylogeny of flowering plants is widely known. Foliar epidermal features of some euphorbiaceous taxa have been investigated¹⁻⁵. The present authors extended observations on 17 unstudied genera of this family, the results of which are being presented here.

Material and Methods

The plants were collected from various places at Nakane Dam, Harsul Forest, Radhanagari, and Dajipur Forest in Maharashtra state. They were also obtained from Government Botanical Garden, Ootakamund (Tamil Nadu). Healthy herbarium materials were received from S I N U Botanical Herbarium, Singapore and Rancho Santa Ana Botanic Garden, Claremont U. S. A. Preserved plant materials were obtained from Auckland War Memorial Museum Auckland, New Zealand.

For the stomatal and epidermal tissues, the fresh, preserved and herbarium materials were used. In case of herbarium materials, the leaves were boiled in water for about 5-10 minutes. The chemical method was followed for the separation of peels. Diluted nitric acid and chromic acid (5-10%) were used in different proportions. In some cases using Three Acid Treatment (TAT) Method⁶, epidermal peels were stained in safranin (1%) and mounted in glycerin and made semi-permanent slides by ringing with nail paints. In case of exceptionally hairy leaves, the hairs were removed prior to separation of epidermal peels by covering the leaf surface with "Stick Fast" (Enelbee Company Jogeshwary, Mumbai) and gently peeling off

the gum dried. Similarly, Wellcol, a synthetic gum, and rubber solution were used for getting the peels. In some cases Favicol (Pidillite Industries, Mumbai) was gently applied on the leaf surface and allowed to dry for 2-3 minutes and gently peeled off the Favicol film⁷.

The terms used for describing stomata are that of Metcalfe and Chalk¹, and Stace⁸. The typification of subsidiary cells followed is that of Ramayya⁹ and Rajgopal⁹. C-Type (common subsidiary): Collateral—subsidiary which abuts on one or more adjacent stomata, but not any other cells; F-Type (free subsidiary): subsidiary neither abuts on another stomata for allo—subsidiaries; Fc—Foot cell of trichome; G—Giant stomata; Gl—Gland; P—Papillae; S. I.—Stomatal Index; Str.—Striations.

< ——— > - Indicates relation between trichome and stomata.

Observations

Stomatal index, frequency and size were recorded and presented in Tables 1-3.

1. *Acalypha indica* Linn.

Leaves hypostomatic.

Leaf—Adaxial: Epidermal cells chlorophyllous, sides mostly 5-6, rarely 4, undulate, sinuses mostly U-shaped (Fig.1).

Leaf—Abaxial: Stomata mostly paracytic, distribution random, orientation on intercostal region. S. I. = 10.64. subsidiaries mostly C-type, walls undulate, sinuses mostly U-shaped, sides mostly 4-5. Guard cells elliptical, pore-wide. Epidermal cells undulate, sides 6-8, rarely 5 (Fig.2).

Table 1. Observations : stomatal index.

Sr. No.	Name of Plants	Upper Epidermis		Lower Epidermis	
		On / Around Vein	Intercoastal	On / Around Vein	Intercoastal
1	<i>Acalypha indica</i>	A	A	A	10.64
2	<i>Actephila excelsa</i>	A	A	A	14.73
3	<i>Aporosa lindleyana</i>	A	A	9.4	13.3
4	<i>Breynia nivosa</i>	A	A	6.28	12.23
5	<i>Bridelia stipularis</i>	A	A	9.28	14.23
6	<i>Chrozophora rottleri</i>	3.4	8.4	8.96	13.75
7	<i>Dimorphocalyx lawianus</i>	7.44	A	10.35	14.93
8	<i>Drypetes venusta</i>	A	A	A	12.77
9	<i>Euphorbia leucocephala</i>	A	A	A	12.35
10	<i>Glochidion neilgherrense</i>	A	A	10.64	13.31
11	<i>Homalanthus populifolius</i>	A	A	6.78	11.17
12	<i>Hura crepitans</i>	A	A	9.35	12.78
13	<i>Macaranga peltata</i>	A	A	11.25	16.78
14	<i>Sapium insigne</i>	A	A	9.78	16.96
15	<i>Simmondsia chinensis</i>	3.41	7.28	8.37	11.35
16	<i>Tragia involucrata</i>	A	A	A	12.24
17	<i>Trewia polycarpa</i>	A	A	8.96	14.64

Table 2. Observations : stomatal frequency (per sq. cm.).

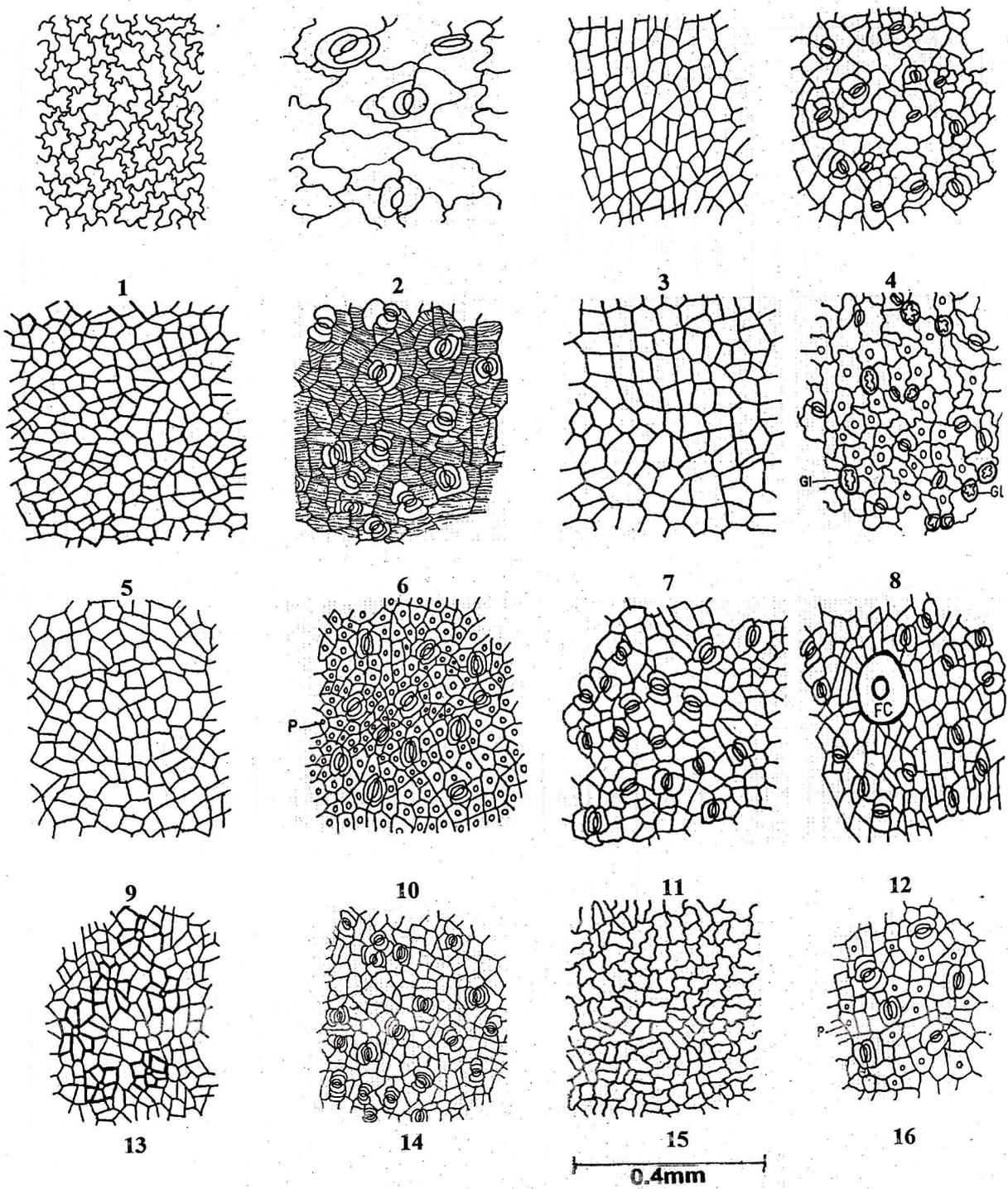
Sr. No.	Name of Plants	Upper Epidermis		Lower Epidermis	
		On / Around Vein	Intercoastal	On / Around Vein	Intercoastal
1	<i>Acalypha indica</i>	A	A	A	1.5
2	<i>Actephila excelsa</i>	A	A	1.2	3.4
3	<i>Aporosa lindleyana</i>	A	A	0.9	2.2
4	<i>Breynia nivosa</i>	A	A	A	0.9
5	<i>Bridelia stipularis</i>	A	A	A	1.8
6	<i>Chrozophora rottleri</i>	1.3	2.5	2	2.8
7	<i>Dimorphocalyx lawianus</i>	0.9	A	1	1.3
8	<i>Drypetes venusta</i>	A	A	A	1.4
9	<i>Euphorbia leucocephala</i>	A	A	A	1.1
10	<i>Glochidion neilgherrense</i>	A	A	1.3	3
11	<i>Homalanthus populifolius</i>	A	A	0.9	2.3
12	<i>Hura crepitans</i>	A	A	A	2.4
13	<i>Macaranga peltata</i>	A	A	A	2.5
14	<i>Sapium insigne</i>	A	A	0.7	2.5
15	<i>Simmondsia chinensis</i>	1.5	A	1	2.6
16	<i>Tragia involucrata</i>	A	A	A	2.2
17	<i>Trewia polycarpa</i>	A	A	1	

The figures relate to a mean of ten counts; A – Absent.

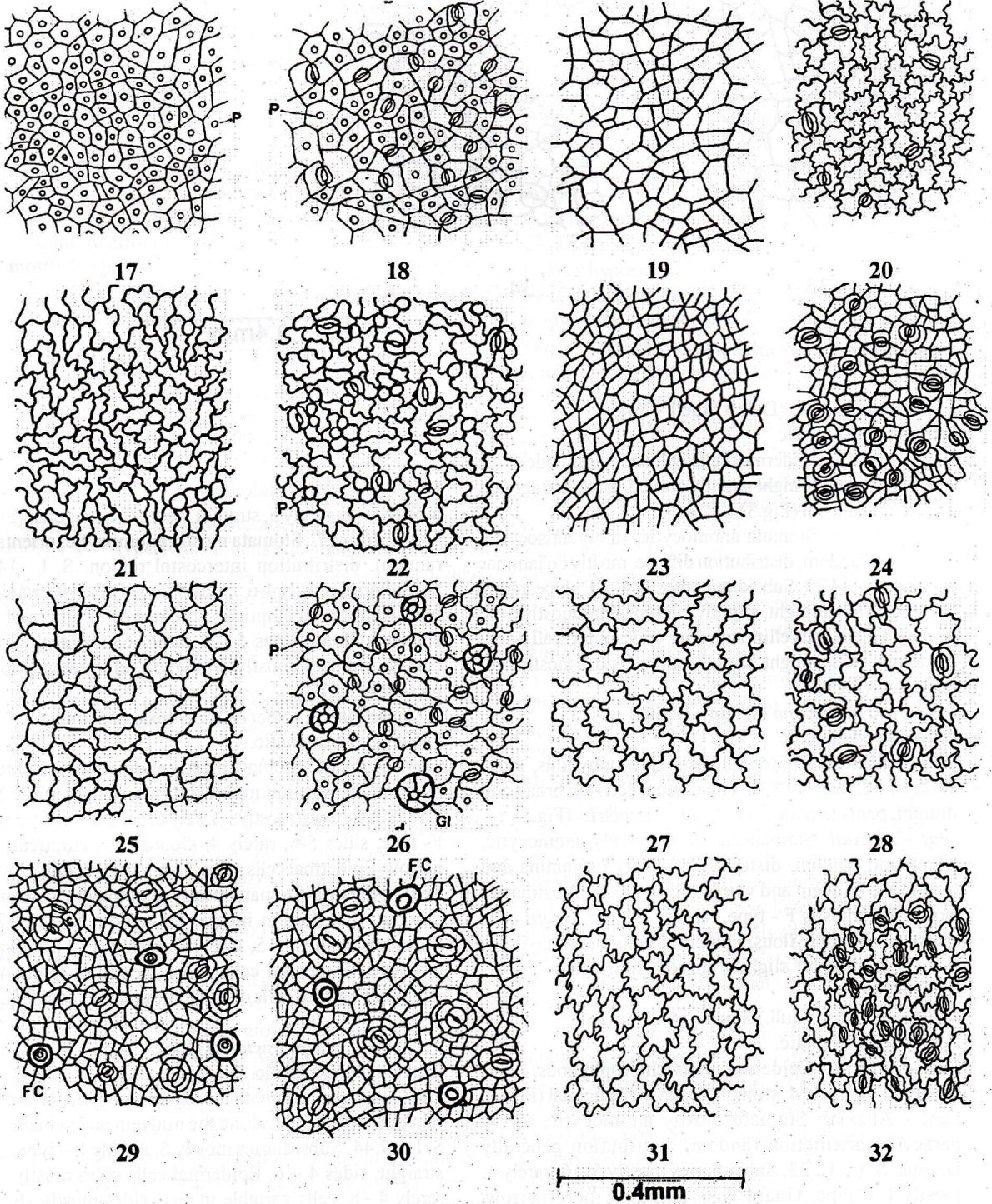
Table 3. Size of stomata (μ).

Sr. No.	Name of Plants	Upper Epidermis							Lower Epidermis								
		Length In Range (Stomata)	Mean	Breadth in Range (Stomata)	Mean	Length In Range (Stomata)	Mean	Mean Length in Range (Pore)	Mean	Length In Range (Stomata)	Mean	Breadth in Range (Stomata)	Mean	Length in Range (Pore)	Mean	Breadth in Range (Stomata)	Mean
1	<i>Acalypha indica</i>	A	A	A	A	A	A	A	A	3-6	4.8	2-4	3.1	1-2	2	1-2	1.1
2	<i>Actephila excelsa</i>	A	A	A	A	A	A	A	A	13-17	15	9-16	11.7	4.8	6.2	1-3	2.6
3	<i>Aporosa lindleyana</i>	A	A	A	A	A	A	A	A	16-18	16.8	12-14	12.5	5-7	6	2-4	2.7
4	<i>Breynia nivosa</i>	A	A	A	A	A	A	A	A	16-18	16.8	12-14	12.5	5-7	6	2-4	2.7
5	<i>Bridelia stipularis</i>	A	A	A	A	A	A	A	A	9-10	9.8	6-7	6.9	5-6	5.4	1-2	1.4
6	<i>Chrozophora rotleri</i>	13-15	13.9	9-11	10.3	9-12	10.3	1-2	1.5	13-15	14	9-12	11.3	8-12	9.9	1-2	1.6
7	<i>Dimorphocalyx lawianus</i>	10-12	10.8	6-8	7.1	5-7	6	1-3	1.9	11-18	14	9-13	11	5-7	6.2	1-3	2.2
8	<i>Drypetes venusta</i>	A	A	A	A	A	A	A	A	13-18	16.2	10-12	11	4-7	5.6	1-3	2.1
9	<i>Euphorbia leucopcephala</i>	A	A	A	A	A	A	A	A	10-12	11	10-12	11.1	5-6	5.3	1-2	1.5
10	<i>Glochidion neilgherrence</i>	A	A	A	A	A	A	A	A	10-15	13.5	10-12	10.5	3-5	5.3	1-2	1.3
11	<i>Homalanthus populifolius</i>	A	A	A	A	A	A	A	A	13-16	14.4	10-12	11.2	10-13	11.5	2-3	2.1
12	<i>Hura crepitans</i>	A	A	A	A	A	A	A	A	11-14	12.5	10-12	11	5-8	6	1-2	1.6
13	<i>Macaranga peltata</i>	A	A	A	A	A	A	A	A	10-13	11	8-10	8.9	6-9	6.4	1-3	2.5
14	<i>Sapium insigne</i>	A	A	A	A	A	A	A	A	12-15	14	7-10	9.2	5-8	6.9	1-2	1.7
15	<i>Simmondsia chinensis</i>	12-15	13.7	10-12	11.5	8-10	9.4	2-3	2.5	13-14	13.5	12-13	12.5	9-10	9.7	2-3	1.5
16	<i>Tragia involucrata</i>	A	A	A	A	A	A	A	A	15-18	16.7	12-14	12.9	7-9	8.4	1-2	1.5
17	<i>Trewia polycarpa</i>	A	A	A	A	A	A	A	A	12-14	13.1	10-12	11.5	5-7	5.8	1-2	1.3

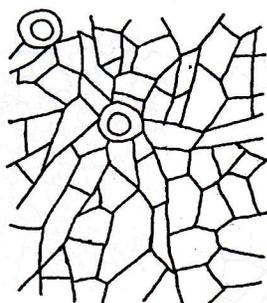
*The figures relate to a mean of ten counts; A - Absent



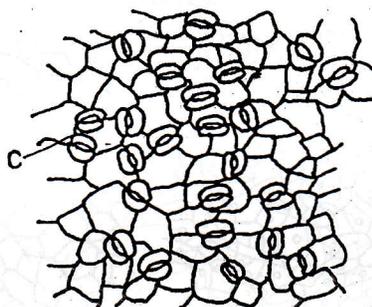
Figs.1-16. *Acalypha indica* 1 - 2; *Actephila excelsa* 3 - 4; *Aporosa lindleyana*; 5 - 6; *Breynia nivosa* 7 - 8; *Bridelia stipularis* 9 - 10; *Chrozophora rottleri* 11 - 12; *Dimorphocalyx lawianus* 13 - 14; *Drypetes venusta* 15 - 16.



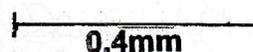
Figs.17-32. *Euphorbia leucocephala* 17-18; *Glochidion neilgherrense* 19-20; *Homalanthus populifolius* 21-22; *Hura crepitans* 23-24; *Macaranga peltata* 25-26; *Sapium insigne* 27-28; *Simmondsia chinensis* 29-30; *Tragia involucrata* 31-32.



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Figs. *Trewia polycarpa* 33–34.2. *Actephila excelsa* (Dalz.) Muell. – Arg.

Leaves hypostomatic.

Leaf – Adaxial: Epidermal cells chlorophyllous, sides 4-6, mostly 6, mostly straight slightly curved, thick, tetragonal, penta to hexagonal (Fig.3).

Leaf – Abaxial: Stomata anomocytic, rarely anisocytic; orientation random, distribution diffuse, mostly on laminar region. S. I. – 14.73. Subsidiaries mostly 4-5, F-type, rarely C-type. Walls straight, slightly curved, sides mostly 5-6, rarely 4. Guard cells elliptical, pore wide, outer wall thick. Epidermal cells straight, slightly curved, sides mostly 5-6, rarely 4-8 (Fig.4).

3. *Aporosa lindleyana* (Wight.) Baillon

Leaves hypostomatic.

Leaf – Adaxial: Epidermal cells chlorophyllous, sides mostly 4-6, rarely 7-8, few epidermal cells are broad and straight, penta to octagonal, few isodiametric. (Fig.5)

Leaf – Abaxial: Stomata hexacytic, rarely anomocytic, orientation random, distribution mostly on lamina and around the midvein and veinlet. S. I. – 19.3. Subsidiaries mostly 2-4, mostly F-type, rarely C-type. Guard cells elliptical, chlorophyllous. Epidermal cells chlorophyllous, sides 5-8, straight, slightly curved, sinuses mostly V-shaped (Fig. 6).

4. *Breynia nivos* (Bull.) Small

Leaves hypostomatic.

Leaf – Adaxial: Epidermal cells chlorophyllous, sides mostly 5-6, rarely 4, straight, penta to hexagonal (Fig.7).

Leaf – Abaxial: Stomata mostly anomocytic, rarely paracytic, orientation random, distribution generally laminar. S. I. – 12.23. Subsidiaries mostly 5-6, rarely 4, mostly F-type. Guard cells elliptical, pore narrow. Epidermal cells undulate, sinuses mostly U-shaped, sides 5-7, rarely 4, many secretary cavities present along lamina

(Fig.8).

5. *Bridelia stipularis* Blume

Leaves hypostomatic.

Leaf – Adaxial: Epidermal cells chlorophyllous, sides mostly 5-6, rarely 5, straight, penta to hexagonal (Fig 9).

Leaf – Abaxial: Stomata mostly anomocytic; orientation random, distribution intercostal region. S. I. -14.23. Subsidiaries mostly 4-6, rarely 5, mostly F-type, rarely C-type, Guard cells elliptical, pore narrow. Epidermal cells chlorophyllous, sides 5-7, rarely 6, straight, slightly curved, sinuses mostly V-shaped, elongated papillae present. (Fig. 10).

6. *Chrozophora rottleri* (Geis.) Juss. ex Spreng.

Leaves amphistomatic.

Leaf – Adaxial: Stomata mostly anomocytic, orientation random, distribution mainly on intercostal region. S. I.-7.15. Subsidiaries mostly 5, rarely 6, Mostly C-type, rarely F-type, sides 5-6, rarely 4. Guard cells elliptical, pore narrow. Epidermal cells sides 5-6, rarely 4 (Fig. 11).

Leaf – Abaxial: Stomata mostly anomocytic, orientation random, distribution intercostal region. S. I. – 12.46. Subsidiaries mostly 5, rarely 4, mostly F-type, rarely C-type. Epidermal cells, sides mostly 6, rarely 4-5, straight. Few foot cells of trichomes on intercostal region. (Fig.12)

7. *Dimorphocalyx lawianus* Hook.

Leaves amphistomatic.

Leaf – Adaxial: Stomata mostly anomocytic, orientation random, distribution along the midvein and veinlets only. S. I. – 7.44. Subsidiaries mostly 5, mostly F-type, walls straight, sides 4-6. Epidermal cells sides mostly 5-6, rarely 4-8, cells variable in size, sides mostly straight, rarely undulate (Fig.13).

Leaf – Abaxial: Stomata mostly hexacytic, orientation

laminar, distribution around midvein and veinlet, orientation – random. S. I. – 14.93. Subsidiaries mostly 6, mostly F-type, sides mostly 5–6, undulate. Guard cells elliptical pore wide, inner wall thick, sinuses mostly V, rarely U-shaped (Fig. 14).

8. *Drypetes venusta* (Wight.) Pax & Hoffm.

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous. Sides 4–6, undulate, sinuses U-shaped, rarely V-shaped (Fig. 15).

Leaf-Abaxial: Stomata mostly anisocytic, Orientation random, distribution laminar. S. I. – 12.77. Subsidiaries mostly 2, rarely 4–6, predominantly F-type, straight, cells 4–5. Guard cells elliptical, pore wide. Epidermal cells side 4–6, rarely 7, walls straight (Fig. 16).

9. *Euphorbia leucocephala* Lottsy

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous, sides mostly 5–6, rarely 4, straight, penta to hexagonal, some elongated finger-like papillae seen (Fig. 17).

Leaf-Abaxial: Stomata mostly anomocytic, rarely paracytic, orientation random, distribution generally laminar. S. I. – 12.35. Subsidiaries mostly 5–6, rarely 4, mostly F-type. Guard cells elliptical, pore narrow. Epidermal cells undulate, sinuses mostly U-shaped, sides 5–7, rarely 4, dense elongated finger-like papillae present (Fig. 18).

10. *Glochidion neilgherrense* Wight

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous, sides-6–7, rarely 4, mostly penta to hexagonal, few isodiametric (Fig. 19).

Leaf-Abaxial: Stomata mostly anomocytic; not clearly distinct, orientation random, distribution mostly on lamina. S.I. – 13.31. Subsidiaries mostly 4–5, F-type, sides mostly 5–6, mostly undulate. Guard cells elliptical, pore wide, inner wall thick, sinuses mostly U shaped. Epidermal cells sides 6–8, undulate (Fig. 20).

11. *Homalanthus populifolius* Graham

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cell chlorophyllous, sides 4–6, undulate, sinuses mostly U-shaped (Fig. 21).

Leaf-Abaxial: Stomata mostly anomocytic, rarely paracytic, rarely gaint stomata found on lamina, orientation random, distribution mostly on lamina, midvein and veinlet. S. I. – 11.17. Subsidiaries mostly 4–5, rarely 2, mostly F-type, undulate, sides mostly 5–6 rarely 3. Guard cells elliptical, pore narrow. Epidermal cells undulate, sinuses U-shaped, sides mostly 5–6, rarely 4 (Fig. 22).

12. *Hura crepitans* Linn.

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous, sides mostly 5–6, straight, penta to hexagonal, few isodiametric (Fig. 23).

Leaf-Abaxial: Stomata mostly anomocytic, rarely paracytic, orientation random, distribution diffuse, mostly laminar. S. I. – 12.78. Subsidiaries mostly 5, rarely 4, mostly F-type, rarely C-type. Walls straight, few slightly curved, sides mostly 5–6, rarely 4. Guard cells elliptical, few pores wide. Epidermal cells straight, slightly undulate, sides mostly 4–6, rarely 4 (Fig. 24).

13. *Macaranga peltata* Muell – Arg.

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous, sides 4–6, undulate, sinuses mostly U-shaped (Fig. 25).

Leaf-Adaxial: Stomata mostly anomocytic, orientation random, distribution intercostal region. S. I. – 16.78. Subsidiaries mostly 4–6, rarely 5, mostly F-type, rarely C-type, Guard cells elliptical, pore narrow. Epidermal cells chlorophyllous, sides 5–7, rarely 6, straight, slightly curved, sinuses mostly V-shaped, dense elongated papillae present surrounding the glands on intercostal region (Fig. 26).

14. *Sapium insigne* Benth.

Leaves hypostomatic.

Leaf-Adaxial: Epidermal cells chlorophyllous. Cells undulate, sides mostly 5–7, sinuses mostly U-shaped (Fig. 27).

Leaf-Abaxial: Stomata mostly anomocytic, rarely paracytic, orientation random, distribution on laminar region. S. I. – 16.96. Subsidiaries mostly 4–5, rarely 6, sinuses mostly U-shaped, sides mostly 6, rarely 4. Epidermal cells undulate, sides 6–7, rarely 5 (Fig. 28).

15. *Simmondsia chinensis* (Link.) C. K. Schneid

Leaves amphistomatic.

Leaf-Adaxial: Stomata mostly anisocytic; orientation random, distribution mostly on lamina and veinlets. S. I. – 7.28. Subsidiaries 4–5. F as well as C-type, walls straight, sides 4–5, rarely 6. Guard cells elliptical, pore wide, outer wall thick. Epidermal cells sides mostly 4–6, rarely 4–5, walls straight, thick. Few foot cells of trichomes present (Fig. 29).

Leaf-Abaxial: Stomata mostly anisocytic, mostly contiguous, orientation random, distribution laminar. S. I. – 11.35. Subsidiaries mostly 4–6, rarely 7, Mostly F-type, rarely C-type, walls straight, sides 4–6, thick. Guard cells elliptical, pore wide. Epidermal cells mostly 4–6, rarely 5, thick. (Fig. 30)

16. *Tragia involucrata* Smith

Leaves hypostomatic.

Leaf-Abaxial: Epidermal cells chlorophyllous, sides 3–

4, curved, tetragonal, cross walls oblique, cells striated (Fig.31).

Leaf - Abaxial: Stomata mostly paracytic, orientation random, distribution mostly on laminar region. S. I. - 12.24. Subsidiaries mostly 4-5, rarely 3, mostly F-type, rarely C-type. Guard cells elliptical, pore narrow. Undulate, sinuses mostly U-shaped, sides mostly 6-8, rarely 5. Epidermal cells undulate, sides mostly 5-7 (Fig.32).

17. *Trewia polycarpa* Benth.

Leaves hypostomatic.

Leaf - Adaxial: Epidermal cells chlorophyllous, sides mostly 4-5, rarely 4, straight, tetra to pentagonal. Some cells elongated as well as tapering at one end. Prominent foot cells of trichomes present (Fig.33).

Leaf - Abaxial: Stomata mostly anomocytic, contiguous, orientation random, distribution intercostal region. S. I. - 14.64. Guard cells elliptical, pore wide. Subsidiaries mostly 4-5, rarely 3, mostly F-type, rarely C-type. Sides mostly 5-6, rarely 4. Epidermal cells mostly straight, sides 5-6, rarely 4 (Fig.34).

Discussion

Epidermal features of 17 euphorbiaceous species belonging to 17 genera have been investigated. The leaves are mostly hypostomatic, except few e.g. *Chrozophora rotleri*, *Dimorphocalyx lawianus* and *Simmondsia chinensis*. The stomata predominantly anomocytic in the species studied. The other stomatal types such as paracytic, anisocytic and hexacytic are found on the same foliar surface in some taxa. The number of subsidiary cells range from 2 to 5, rarely 6. The cell walls in majority of species are straight. They are wavy to undulate on adaxial surface in case of *Macaranga peltata* and *Tragia involucrata*, whereas they are undulate on abaxially in case of *Breynia nivos*, *Drypetes venusta*, *Euphorbia leucocephala*, *Glochidion neilgherrense*, and *Hura crepitans*. In case of *Sapium insigne*, *Dimorphocalyx lawianus* epidermal cells are undulate on both surfaces. Cuticular papillae are noticed on either sides e.g. *Breynia nivos*, *Euphorbia leucocephala*, *Macaranga peltata*. They are more frequent on the abaxial foliar surface than the adaxial ones. Stomatal abnormalities are also observed in few taxa. They belong to the category of contiguous stomata. Two to three adjacent stomata about each other laterally e.g. *Simmondsia chinensis*. Out of 17 species studied only two species viz., *Breynia nivos* and *Macaranga peltata* show presence of glands on abaxial foliar surface. The presence of former is unnoted, whereas they are documented in the taxonomic accounts^{10,11}. The glands present in case of *Macaranga peltata* are very conspicuous and disc-shaped.

Generally, the guard cells are elliptical in outline, rarely they are circular e.g. *Trewia polycarpa*. The guard cells are chlorophyllous. The walls of guard cells are unevenly thick. In few cases the innerwalls are usually thick. In few cases the innerwalls of guard cells are very thick e.g. *Dimorphocalyx lawianus*, *Glochidion neilgherrense*. The outer wall of guard cells are very thick viz. *Actephila excelsa* and *Simmondsia chinensis*. The subsidiaries are generally 4-5, these number are, however encountered especially in case of anomocytic type of stomata. Rarely, they are more than 6 e.g. *Breynia nivos*, *Dimorphocalyx lawianus*, *Glochidion hohenckeri*, and *Simmondsia chinensis*. Ramayya and Rajagopal⁹ recognised different seven types of subsidiaries cells. They belong to exclusively F-type, rarely exclusively C-type are also noted e.g. *Actephila excelsa*, *Aporosa lindleyana*, *Breynia nivos*, *Chrozophora rotleri*, *Hura crepitans*, *Simmondsia chinensis*, *Tragia involucrata* and *Trewia polycarpa*. However, in some cases, both types occur on the same surface viz. *Agrostistachys indica*. The walls of subsidiaries are straight, rarely otherwise e.g. *Dimorphocalyx lawianus*, *Drypetes venusta*, *Hura crepitans* and *Simmondsia chinensis*.

The highest stomatal index is 16.96 found in *Sapium insigne*, whereas it is the lowest 10.64 in case of *Acalypha indica*. The biggest stomata 13.9 μ is observed in *Chrozophora rotleri*, whereas the smallest stoma on the same adaxial surface is 7.1 μ in *Dimorphocalyx lawianus*. The biggest stomata 16.7 μ is observed on abaxial surface in *Tragia involucrata*, whereas the smallest on the same abaxial surface is 4.8 μ in *Acalypha indica*.

Vesque¹² conceived stomatal characteristic more valuable in systematic deductions. However, subsequent studies revealed different stomatal types occurring on the same side of organ. Still, the predominant condition of stomatal type may be conveniently employed for taxonomic delineations. Occurrence of more than one type of stomata is thought as a reflection of precarious balance between the influences operating at a level of meristemoid which tend to cause the formation of stomatal mother cells on the one hand and the influence operating at the level of organ involved in the orientation of cell division on the other hand.^{13,14} The present authors also end to support to this viewpoint. These investigations confirms their observations.

Metcalfe and Chalk¹ recorded cuticular striations radiating from the two sides of the stomata on abaxial surface of *Excaecaria agallocha*. Raju and Rao⁴ observed striations in the species of *Antidesma*, *Bischofia*, *Croton*, *Dalechampia*, *Excaecaria*, *Homonoia*, *Hura*, *Jatropha*,

Ricinus, *Sebastiania*, *Tragia* and *Trewia*. Rao¹⁵ also noted them in the genus *Hevea*. These authors critically observed the distribution of striations. Inamdar and Gangadhara⁵, noted striations in case of *Croton bonplandianum*, *Tragia cannabina*, *T. mollurina*, *Trewia polycarpa*, *Jatropha panduraefolia* and *Dalechampia scadens*. These are shown in their illustration, however, they made no reference about their occurrence. They are likewise noted by Dehgan² and Rao and Raju^{16,17}.

Acknowledgement

Junior author (H. A. T.) is thankful to Dr. S.R.Yadav, Department of Botany, Delhi University, Delhi. Mohamad Iqbal, Curator, Government Botanical Garden (Ootakamund, Tamil Nadu). Steinman Victor, Rancho Santa Ana Botanic Garden Claremont (U. S. A.). R. O. Gardner, Auckland War Memorial Museum Auckland (New Zealand) for help in identification and collection of some plant materials. He is grateful Principal Prof. V. N. Suryavanshi, Collegues of Botany Dept. of H.P.T./R.Y.K. College, Nashik, for necessary facilities and encouragement.

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