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The foliar epidermal studies in some hitherto unstudied Euphorbiaceae

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ABSTRACT

The paper is aimed at revealing various cellular structures, contours of foliar epidermis and foliar stomata of hitherto unstudied 17 species belonging 17 genera of the euphorbiaceous taxa. This information will be useful to reach sound taxonomic and phylogenetic deductions. Epidermal peels removed by TAT method or using Wellcol or Favicol were stained by safranin and fast green combination making semi permanent slides then camera lucida drawings provided to enlightened their structures. 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 in present study.

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Introduction

Family Euphorbiaceae, the spurge family, consisting of about 322 genera and about 8910 species are predominantly cosmopolitan with strongest representation in the humid tropical and subtropical region of both hemisphere (Webster, 1987;1994). It is the sixth largest family in the world (Radclifff - Smith, 1987) and occupies the seventh position in Indian flora. Euphorbiaceae characterised by the unisexual and mostly apetalous flowers, floral glands, the tricarpellary syncarpous pistil and schizocarpic capsular with three cocci and persistent columella or rarely with drupeceous fruits, the interrelationships among the genera are not sufficiently understood.

The family is largely complex and forms a heterogenous assemblage of diverse growth forms and morphological features. It also includes many economic important species. The family Euphorbiaceae is included in the order Unisexuales by Bentham in Bentham and Hooker (1880), under Geraniales by Pax (1890) and in the Euphorbiales by Hutchinson (1969), Dahlgreen (1975; 1983), Thorne (1968; 1983), Takhtajan (1980) and Cronquist (1981). Later treatments Pax and Hoffmann (1931), Hurusawa (1954) and Webster (1975, 1994) many of his great ideas can be seen survive as a solid foundation.

Inspite of the numerous usages to which members of Euphorbiaceae have been put in the past, much research have been done on the use of anatomical features in the delineation and classification of the various taxa in this family as whole. Previous work basically developed stem and wood anatomy by Webster (1975), Mennega (1987, 2005), Hayden (1994), Hayden and Hayden (2000), Westra and Koek - Noorman (2004). Floral anatomy by Haber (1925), Nair and Abraham (1962), Venkata Rao (1971), Ehler (1974). Leaf anatomy by Kakkar and Paliwal (1972), Miller and Webster (1962), Olowokudejo (1993). Leaf venation by Levin (1986, a, b, c) Sehgal and Paliwal (1974), Hickey and Wolfe (1975). Trichomes by Mueller (1865), Inamdar and Gangadhara (1977), Cutler (1968), Kakkar and Paliwal (1974)

The importance of epidermal features in taxonomy and phylogeny of flowering plants is widely known. The use of data generated from leaf epidermal surfaces in resolving the taxonomy of taxa has gained much recognition for a long time. Foliar epidermal features of some euphorbiaceous taxa have been investigated (Aworinde *et. al.*, 2008; Baruah and Nath, 1997; Dehgan, 1980; Inamdar and Gangadhara, 1978; Metcalfe and Chalk, 1950; Raju and Rao, 1977, 1987; Rao and Raju, 1975 a, b; 1976, Laura Moreira *et. al.*, 2008 and Thakur and Patil, 2008). The present study described the leaf epidermal morphology in 17 unstudied genera of family Euphorbiaceae with the aim of providing useful taxonomic data that would give further insight into proper classification, delineation and identification of the studied taxa.

Materials 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) Method (Rammayya and Vanaja, 1979). 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 film (Nayeem and Dalvi 1989). All prepared slides, herbarium and plant material deposited in working laboratory of Postgraduate Department of Botany, H.P.T. Arts and R.Y.K. Science College Nasik (M.S.), India

The stomatal index (S. I.) was calculated as defined by Salisbury (1927, 1932). viz.,

$$S.\ I. = \frac{S}{E + S} \times 100$$

Where "S" is the number of the stomata per unit and "E" is the number of epidermal cells in the same area (including guard cell). Stomatal frequency was calculated as defined by Ghosh and Davis (1973).

Stomatal frequency = Number of stomata per unit area. Stomatal frequency and stomatal index have been calculated out of 10 readings. The magnification of the eyepiece used for the stomatal count were 5X, 10X, 15X with objective 10X and 45X. The line and cellular sketches were drawn using prism type of camera lucida. They were inked by using Camligraph or Rotring isographs technical pens with 0.1, 0.2, 0.3, 0.4, 0.5 points.

The terms used for describing stomata are that of Metcalfe and Chalk (1950), Van Cotthem (1970) and Stace (1965). The typification of subsidiary cells followed is that of Ramayya and Rajgopal (1980). Stomatal Index calculated as defined by Salisbury (1927,1932). Stomata and trichome relationships are decided as per Rajgopal and Pochaiah (1983).

Category 1: Often more than one cell covers the free zone between a trichome and stomata.

Category 2: Mostly one cell covers the free zone between trichome and stomata.

Category 3: No free zone present as the stomata itself abuts the trichome.

Terminology related to epidermis is followed that of Shanmukha Rao (1987) and for trichomes mainly after Ramayya (1962, 1972).

Observations (Results)

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)**.

2. ***Actephila excelsa*** (Dalz.) Muell. – Arg.

Leaves hypostomatic.

Leaf – Adaxial:

Epidermal cells chlorophyllus, 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 nivosa*** (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 and 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 leucocephalus* Lotsy

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 giant 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.

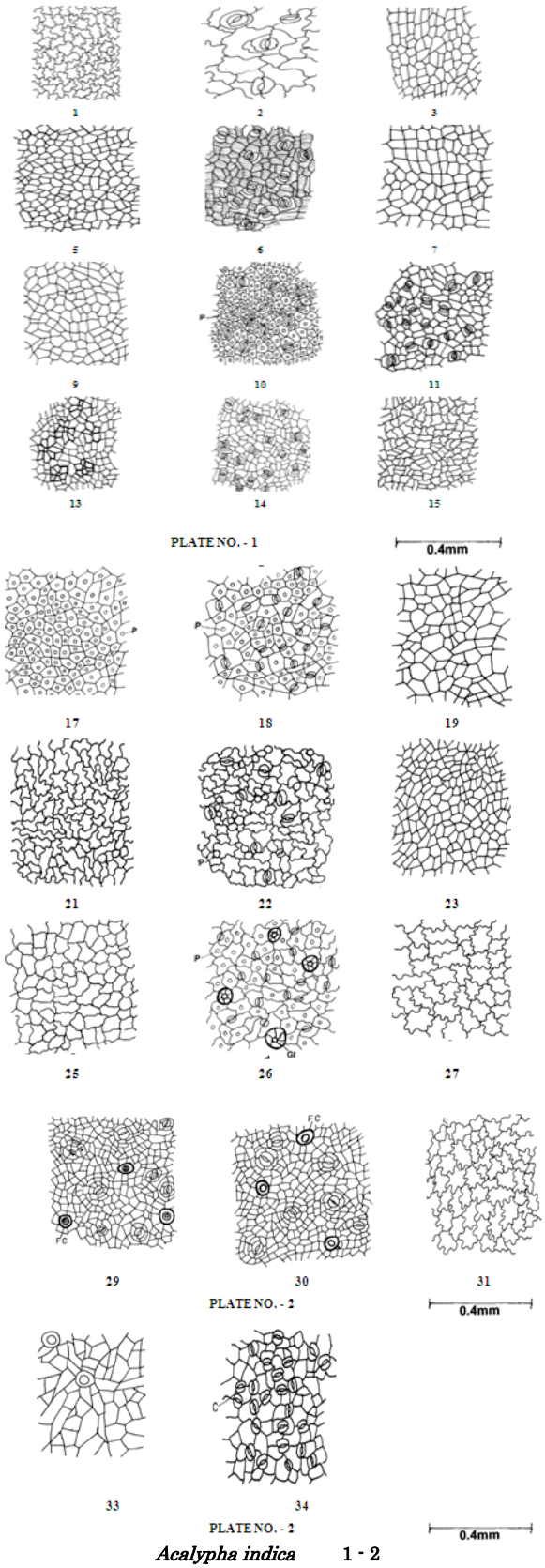
Leaves hypostomatic.

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 mostlly 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).**



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
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
Trewia polycarpa	33 – 34

C – Type (common subsidiary): Collalo – subsidiary which abutes on one or more adjacent stomata, but not any other cells.
F – Type (free subsidiary): subsidiary neither abutes 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.

Discussion

Epidermal features of 17 euphorbiaceous species belonging to 17 genera have been investigated. The leaves are mostly hypostomatic, except few e.g. *Chrozophora rottleri*, *Dimorphocalyx lawianus* and *Simmondsia chinensis*. The stomata are 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 nivosa*, *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 nivosa*, *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 abut each other laterally e.g. *Simmondsia chinensis*. Out of 17 species studied only two species viz., *Breynia nivosa* 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 (cf. Hooker, 1885; Cooke, 1958). 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 neilgherrence*. The outer wall of guard cells is 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 nivosa*, *Dimorphocalyx lawianus*, *Glochidion hohenckeri*, and *Simmondsia chinensis*. Ramayya and Rajagopal (1980) 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 nivosa*, *Chrozophora rottleri*, *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* (Table No. 1). The highest stomatal frequency is 3.4 found in *Actephila excelsa*, whereas it is lowest 0.9 in case of *Breynia nivosa* (Table No. 2). The biggest stomata 13.9 µ is observed in *Chrozophora rottleri*, 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* (Table No. 3).

Vesque (1889) 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 (Guyot *et. al.*1968, Humbert and Guyot 1969). The present authors also end to support to this viewpoint. These investigations confirm their observations.

Metcalfe and Chalk (1950) recorded cuticular striations radiating from the two sides of the stomata on abaxial surface of *Exacecaria agallocha*. Raju and Rao (1977) observed striations in the species of *Antidesma*, *Bischofia*, *Croton*, *Dalechampia*, *Excaecaria*, *Homonoia*, *Hura*, *Jatropha*, *Ricinus*, *Sebastinia*, *Tragia* and *Trewia*. Rao (1963) also noted them in the genus *Hevea*. These authors critically observed the distribution of striations. Inamdar and Gangadhara (1978), 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 Dehgan (1980) and Rao and Raju (1975 a , b).

Table No. 1: Stomatal Index

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

Table No. 2: Stomatal Frequency (per sq. cm.)

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

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

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Table No. 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 (Pore)	Mean	Breadth in Range (Stomata)	Mean	Length In Range (Stomata)	Mean	Breadth in Range (Stomata	Mean	Length in Range (Pore)	Mean	Breadth in Range (Stomata)	Mean
1	Acalypha indica	A	A	A	A	A	A	A	A	3 – 6	4.8	2 - 4	3.1	1 - 2	2	1 - 2	1.1
2	Actephila excelsa	A	A	A	A	A	A	A	A	13-17	15	9-16	11.7	4-8	6.2	1 - 3	2.6
3	Aporosa lindleyana	A	A	A	A	A	A	A	A	16-18	16.8	12-14	12.5	5-7	6	2 - 4	2.7
4	Breynia nivosa	A	A	A	A	A	A	A	A	16-18	16.8	12-14	12.5	5-7	6	2-4	2.7
5	Bridelia stipularis	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	Chrozophora rottleri	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	Dimorphocalyx lawianus	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	Drypetes venusta	A	A	A	A	A	A	A	A	13-18	16.2	10-12	11	4-7	5.6	1-3	2.1
9	Euphorbia leucocephala	A	A	A	A	A	A	A	A	10-12	11	10-12	11.1	5-6	5.3	1-2	1.5
10	Glochidion neilgherrense	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	Homalanthus populifolius	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	Hura crepitans	A	A	A	A	A	A	A	A	11-14	12.5	10-12	11	5-8	6	1-2	1.6
13	Macaranga peltata	A	A	A	A	A	A	A	A	10-13	11	8-10	8.9	6-9	6.4	1-3	2.5
14	Sapium insigne	A	A	A	A	A	A	A	A	12-15	14	7-10	9.2	5-8	6.9	1-2	1.7
15	Simmondsia chinensis	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	Tragia involucrata	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	Trewia polycarpa	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

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Conclusion

Leaf epidermal characters are of taxonomy significance in the members of the family Euphorbiaceae. With this they can be separated and distinguished based on their stomata, epidermal cells as these features which are being influenced by environmental factors are present on almost every leaf surface. Therefore the stomata, epidermal cells are micro morphological features on leaves epidermal surfaces and can be used to identify, separate or distinguish different plant species.

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