

## Foliar epidermal investigations in some hitherto unstudied Convolvulaceae

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### Abstract

The present paper contributes to the anatomy of the family Convolvulaceae. In all, six genera and 11 species have been surveyed for epidermal features in detail. They have been investigated covering stomatal type, index, frequency, type and number of subsidiaries, cell wall contours and cuticular striations. The leaves are amphistomatic and have commonly paracytic types, apart from rare to occasional occurrence of other stomatal types and abnormalities.

**Keywords:** Foliar, Epidermis, Convolvulaceae

### INTRODUCTION

The family Convolvulaceae consists of 50 genera 1200 species in the world (Lawrence, 1951). Anatomical investigations prior to 1950 have been summarized by Metcalfe and Chalk. Further studies by Leela and Shanmukha Rao (1994), Inamdar (1969), Pant and Banerjee (1965), Shah (1967), Inamdar and Patel (1971), Singh, Jain and Sharma (1974), Srivastava (1983), Karatela and Gill (1985), Lucansky (1986,1990), Tayade and Patil (2003) have particularly added anatomical information on the epidermis of the family. Still, there are many taxa unstudied on this line. The present investigation is an attempt to contribute to the epidermal features of such taxa.

### MATERIALS AND METHODS

The plant materials were procured from Laboratoire de phanerogamie, Paris. Anantpur district of Andhra Pradesh, Toranmal Hills, Nandurbar district, Dhule, Dhule district of Maharashtra (India). Diluted nitric acid and chromic acid (5-10%) were used in different proportions to separate peels after boiling leaf bits in water for about 5-10 minutes. Epidermal peels were stained in safranin (1%) and mounted in glycerine. The stomatal index (SI) was calculated as defined by Salisbury (1927, 1932). The line and cellular sketches were drawn using prism type Camera Lucida. The terms used for describing stomates are Metcalf and Chalk (1950), Van Cotthem (1970) and Stace (1965). The typification of subsidiary cells followed is that of Rammaya and Rajgopal (1980).

### OBSERVATIONS:

1) *Jacquemontia paniculata* Hallierf.: (Fig.1 a-b) Leaves amphistomatic.

Leaf-**adaxial**: Stomata mostly paracytic; orientation random,

distribution diffuse. S.I. 5.0. Subsidiaries 2, mostly F-type, walls undulate, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely 7, walls undulate, sinuses U-shaped. Foot cells present, striations present (Fig. a). Leaf-**abaxial**: Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 12.88 Subsidiaries 2, mostly F-type, walls undulate, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely - 7, walls undulate, sinuses U-shaped. Foot cells present, striations present (Fig.b).

2) *Merremia aegyptia* Jacq. : (Fig.2 a-b) Leaves amphistomatic.

Leaf-**adaxial**: Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 6.58. Subsidiaries 2, mostly F-type, walls undulate, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely-7, walls undulate, sinuses U-shaped. Foot cells present (Fig. a). Leaf-**abaxial**: Stomata mostly paracytic, rarely anomocytic, orientation random, distribution diffuse. S.I. 13.92. Subsidiaries 2-4, mostly F-type, walls undulate, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, walls undulate, sinuses U-shaped (Fig. b).

3) *Merremia dissecta* (Jacq.) Hall.f. : (Fig.3 a-b) Leaves amphistomatic.

Leaf-**adaxial**: Stomata mostly paracytic; rarely brachyparacytic, contiguous, orientation random, distribution diffuse. S.I. 10.33. Subsidiaries 2-3 cells, mostly F-type, rarely C-type, walls straight, sides 5-6. Guard cells chlorophyllous, sides 4-5, walls straight. Foot cells present, striations present (Fig. a). Leaf-**abaxial**: Stomata mostly paracytic; abnormal, orientation random, distribution diffuse. S.I. 13.06. Subsidiaries 2, mostly F-type, rarely C-type, sides 5-6. Stomata paracytic, orientation random, distribution all over the surface. S.I. 11.40. Subsidiaries mostly 2-3, mostly F-type, walls undulate, sinous U-shaped, sides 2-3. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides mostly 5-6 rarely-7, walls undulate, sinous U-shaped, thick walled foot cells present (Fig. d). 5-6, walls straight. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, walls straight. Foot cell present, striations

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present (Fig. b).



FIG.1 a b

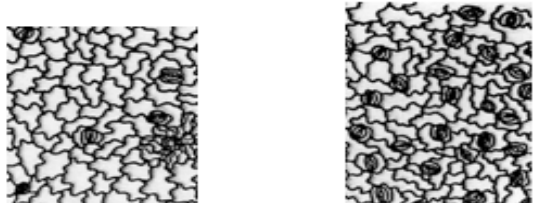


FIG.2 a b



FIG.3 a b

4) *Merremia emarginata* (Burm.f) Hall.f. : ( Fig.4 a-b) Leaves amphistomatic.

**Leaf-adaxial:** Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 12.45. Subsidiaries 2, mostly F-type, walls straight, sides 5-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely-7, walls straight. Foot cells present, striations present (Fig. a). **Leaf-abaxial:** Stomata mostly paracytic; contiguous, orientation random, distribution diffuse. S.I. 18.04. Subsidiaries 2, mostly F-type, rarely C-type, sides 5-6, walls undulate. Guard cells chlorophyllous, sides 5-6, walls undulate, sinuses U-shaped. Foot cells present, striations present (Fig. b).

5) *Merremia tridentata* Hall. f. : ( Fig.5 a-b) Leaves amphistomatic.

**Leaf-adaxial:** Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 9.94. Subsidiaries 2, mostly F-type, walls straight, sides 5-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cell chlorophyllous, sides 5-6, rarely-7, walls straight, striations present (Fig. a). **Leaf-abaxial:** Stomata paracytic; orientation random, distribution diffuse, on and around mid-vein. S.I. 13.88. Subsidiaries 2, mostly F-type, side 5-6, walls straight. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, rarely-8, walls straight, striations present (Fig. b).

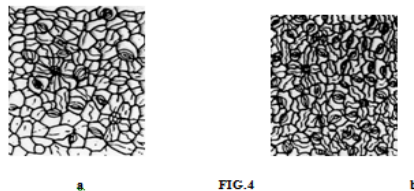


FIG.4 a b

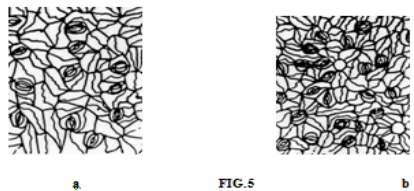


FIG.5 a b

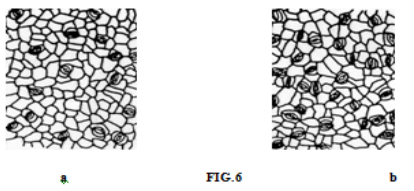


FIG.6 a b

6) *Mina lobata* Cerv.: (Fig.6 a-b) Leaves amphistomatic.

**Leaf -adaxial:** Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 8.46. Subsidiaries 2, mostly F-type, sides 3-4. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, walls straight (Fig.a). **Leaf-abaxial:** Stomata mostly paracytic, brachyparacytic and anomocytic, orientation random, distribution diffuse. S.I. 14.73. Subsidiaries 2-4, mostly F-type, walls straight, sides 3-4, rarely-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 6-7, walls straight. Foot cells present (Fig. b).

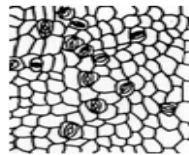
7) *Porana paniculata* Roxb.,Pl. : (Fig. 7 a-b) Leaves amphistomatic.

**Leaf- adaxial:** Stomata mostly paracytic, rarely brachyparacytic; orientation random, distribution diffuse. S.I. 9.37. Subsidiaries 2-3, mostly F-type, walls straight, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely-7, cells near mid-vein and veinlet

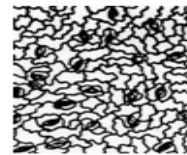
are straight, in lamina undulate ( Fig. a). **Leaf-abaxial:** Stomata mostly paracytic, rarely anisocytic and brachyparacytic, orientation random, distribution diffuse. S.I. 11.97. Subsidiaries 2-4, mostly F-type, walls undulate, sides 4-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, walls undulate, sinuses mostly U-shaped (Fig. b).

8) *Porana sericea* sp.nov. : ( Fig.8 a-b) Leaves amphistomatic.

**Leaf-adaxial:** Stomata mostly paracytic, contiguous, orientation random, distribution diffuse. S.I. 3.57. Subsidiary cells 2-3, mostly F-type, rarely C-type, walls straight, slightly undulate, sides 4-5. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6, rarely-8, walls straight or slightly undulate, stomata very rare ( Fig. a). **Leaf abaxial:** Stomata mostly paracytic; orientation random, distribution diffuse. S.I. 11.17. Subsidiary cells 2, mostly F-type, walls undulate, sides 4-5. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, walls undulate, sinuses U-shaped (Fig. b).



a



b

FIG. 7

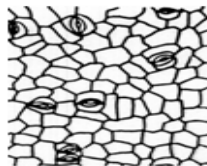


a

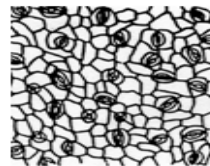


b

FIG. 8



a



b

FIG. 9

9) *Rivea hypocrateriformis* (Desr.)Choisy: (Fig. 9a-b). Leaves amphistomatic.

**Leaf -adaxial :** Stomata mostly paracytic, rarely brachyparacytic, contiguous, orientation random, distribution diffuse. S.I. 5.97. Subsidiary cells 2, mostly F-type, rarely C-type, walls straight, sides 5-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells, sides 5-8, walls straight (Fig. a). **Leaf-abaxial:** Stomata mostly paracytic, rarely anisocytic, brachyparacytic; orientation random, distribution, diffuse. S.I. 10.76. Subsidiary cells 2-4, mostly F-type, walls straight, sides 5-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, walls straight ( Fig. b).

10) *Turbina bracteata* Deroin.: (Fig. 10. a-b) Leaves amphistomatic.

**Leaf-adaxial:** Stomata mostly paracytic, rarely brachyparacytic; orientation random, distribution diffuse. S.I. 11.25. Subsidiary cell 2, mostly F-type, walls straight, sides 5-6. Guard cells chlorophyllous,

elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, walls straight. Foot cells present (Fig. a). **Leaf-abaxial:** Stomata mostly paracytic, rarely anisocytic, brachyparacytic; orientation random, distribution diffuse. S.I. 12.54. Subsidiary cells 2-3, mostly F-type, walls straight, sides 5-6. Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-7, rarely-8, walls straight. Foot cells present (Fig.b).

11) *Turbina corymbosa* (L.) Raf.: (Fig.11 a-b) Leaves amphistomatic.

**Leaf-adaxial:** Stomata mostly paracytic; orientation random, distribution diffuse. S. I. 14.10. Subsidiary cells 2, mostly F-type, walls straight, sides 2-5. Guard cells chlorophyllous. Elliptical, pore elongated. Epidermal cells chlorophyllous, sides 5-6 walls slightly undulate (Fig. a).

**Leaf-abaxial:** Stomata mostly paracytic, contiguous; orientation random, distribution diffuse. S.I. 14.82. Subsidiary cells 2, mostly F-

type, walls undulate, sides 2-5, Guard cells chlorophyllous, elliptical, pore elongated. Epidermal cell chlorophyllous, sides 5-6, rarely-7, walls undulate, sinuses U-shaped (Fig.b).

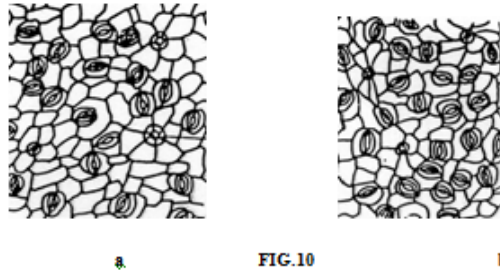


FIG.10

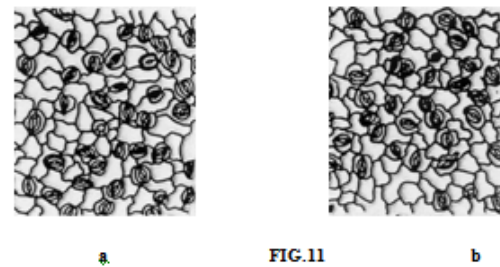


FIG.11

## DISCUSSION

The epidermal cells on both sides are usually pentagonal to hexagonal and isodiametric or uneven shaped rarely. They are rarely in the intercostal zone of septa to decagonal. Cell walls are mostly straight and occasionally undulate. The cell walls are straight on both sides in *Mina lobata*, *Rivea hypocrateriformis* and *Turbina bracteata*. The walls are undulate on both sides in *Jacquemontia paniculata*, *Merremia aegyptia*, *Porana paniculata* and *Turbina corymbosa*. The cell walls are straight on adaxial surface and undulate abaxially in *Merremia emarginata*. In few others, they are usually straight but slightly undulate. The sinuses of undulate walls are consistently U-shaped. Metcalfe and Chalk (1950) also mentioned their occurrence in some taxa. The intercostal epidermal cells are similar in size on both surfaces. In majority of species, these cells are smaller adaxially and larger abaxially in *Jacquemontia paniculata* and *Porana paniculata*. They are rarely larger adaxially and smaller abaxially in *Rivea hypocrateriformis*.

Cuticular striations occur on both foliar sides including midveins and veinlets. However, few variations in this respect are also observed. In case of *Merremia aegyptia*, on both surfaces they are present only on the cells of midvein, veinlets and foot cells of trichomes adaxially, whereas only on the cells of midvein and veinlet abaxially. Likewise, they are present only on the cells of midvein and veinlet of both surfaces in case of *Turbina corymbosa*.

The leaves in all the species investigated are amphistomatic. The stomata generally show random orientation and distributed diffusely. They are observed in the intercostal region and around the veins and veinlets also. But they are never observed on the veins and veinlets. Stomata are generally paracytic on adaxial and abaxial foliar surfaces in the taxa investigated. Different stomatal types are also observed rarely in few species. They are rarely anomocytic and brachyparacytic abaxially in *Mina lobata*. In *Porana paniculata*, brachyparacytic type rarely occur on both surfaces. Few anisocytic stomata are also observed in its lower surface. Anisocytic type on lower surface is noted in *Rivea hypocrateriformis*. In *Turbina*

*bracteata* few brachyparacytic stomata have been observed on upper surface, and anisocytic and brachyparacytic on lower surface.

Metcalf and Chalk (1950), Leela and Shanmukha Rao (1994), Inamdar (1969), Pant and Banerji (1965), Shah (1967), Inamdar and Patel (1971), Singh, Jain and Sharma (1974), Srivastava (1983), Karatela and Gill (1985) Lucansky (1986, 1990), Tayade and Patil (2003) also described the stomata in the family Convolvulaceae as paracytic and leaves amphistomatic. They also reported occurrence of anisocytic, anomocytic and brachyparacytic types rarely. The occurrence of different types of stomata on the same surface of the leaf in this family is also noted by Pant and Banerji (1965) and Shah (1967). This is also reported elsewhere in the Dicotyledonous families (Tognini 1897; Solereder 1908; Inamdar and Patel 1969; Patel and Inamdar 1971; Shah and Gopal 1971; Rajgopal 1973; Shanmukha Rao and Ramayya 1981; Raju and Rao 1977; Shah 1967). Guard cells are generally elliptical and chlorophyllous, their inner walls being generally thicker.

Ramayya and Rajagopal (1980) categorized the subsidiary cells into seven types. They are usually F-type in the species investigated. However, in some species, apart from F-type, rarely C-type is noted on one or both surfaces. In case of *Merremia dissecta*, F-type occurs predominantly and the C-type as rare on both foliar surfaces. This condition is recorded only on the upper surface in *Porana sericea*. Similarly, these types occur exclusively on the lower foliar surface in case of *Merremia emarginata*. The number of subsidiary cells is mostly two; rarely they are one, three or four depending upon the types of stomata on the foliar surface. The subsidiaries are mostly four to six sided; rarely they are two to five, three to four, three to six and six to seven sided. The walls are either straight or undulate. The walls are either straight on both foliar surfaces in *Merremia tridentata*, *Mina lobata*, *Rivea hypocrateriformis* and *Turbina corymbosa*. The walls of subsidiaries are undulate on both foliar surfaces in *Jacquemontia paniculata* and *Merremia aegyptia*. They are usually undulate only on lower foliar surface in *Porana paniculata*, *P. sericea* and *Turbina corymbosa*.



The highest stomatal index 14.10 is noted on adaxial surface in *Turbina corymbosa*, whereas it is the lowest 1.21 in case of *Rivea hypocrateriformis*. On abaxial side, the highest stomatal index is 18.04 in case of *Merremia emarginata* and the lowest is 6.10 in *Rivea hypocrateriformis* (Table.1). The highest stomatal frequency

(per sq. cm.) is 6.6 on adaxial epidermis in *Merremia emarginata*, whereas it is the lowest 0.1 in *Turbina bracteata*. The highest stomatal frequency 14 is observed in *Merremia emarginata* on abaxial epidermis, whereas it is the lowest 0.9 in case of *Merremia dissecta* and *Rivea hypocrateriformis* (Table.2).

Table-1: Stomatal Index

Sr.No	Name of Plants	Upper Epidermis	Lower Epidermis
1	<i>Jacquemontia paniculata</i> Hall.f.	5.00	12.88
2	<i>Merremia aegyptia</i> Jacq.	6.58	13.92
3	<i>Merremia dissecta</i> (Jacq.) Hall.f.	10.33	13.06
4	<i>Merremia emarginata</i> (Burm.f.) Hall.f.	12.45	18.04
5	<i>Merremia tridentate</i> Hall. f.	9.94	13.88
6	<i>Mina lobata</i> Cerv.	8.46	14.73
7	<i>Porana paniculata</i> Roxb.,PI	9.37	11.97
8	<i>Porana sericea</i> sp.nov.	3.57	11.17
9	<i>Rivea hypocrateriformis</i> (Desr.)Choisy	5.95	10.76
10	<i>Turbina bracteata</i> Deroin.	11.25	12.54
11	<i>Turbina corymbosa</i> (L.)Raf	14.10	14.82

\* The figures relate to a mean of ten counts.

Table-2: Stomatal Frequency (per sq. cm.)

Sr.No	Name of Plants	Upper Epidermis	Lower Epidermis
1	<i>Jacquemontia paniculata</i> Hall.f.	1.6	12.0
2	<i>Merremia aegyptia</i> Jacq.	2.2	10.9
3	<i>Merremia dissecta</i> (Jacq.) Hall.f.	4.7	8.2
4	<i>Merremia emarginata</i> (Burm.f.) Hall.f.	6.6	14.0
5	<i>Merremia tridentate</i> Hall. f.	4.0	10.4
6	<i>Mina lobata</i> Cerv.	4.5	10.9
7	<i>Porana paniculata</i> Roxb.,PI	4.1	6.0
8	<i>Porana sericea</i> sp.nov.	1.6	6.9
9	<i>Rivea hypocrateriformis</i> (Desr.)Choisy	2.1	5.7
10	<i>Turbina bracteata</i> Deroin.	4.3	6.6
11	<i>Turbina corymbosa</i> (L.)Raf	5.7	7.3

\* The figures relate to a mean of ten counts.

Few stomatal abnormalities are also recorded in the taxa investigated. They fall in the category of contiguous stomata. In this, two or three adjacent stomata abut each other laterally or polaro-laterally. The former is recorded in *Merremia emarginata*, *M. tridentata*, *Mina lobata*, *Porana sericea* and *Turbina corymbosa*. The latter is observed in *Jacquemontia paniculata*, *Merremia dissecta*, *Porana paniculata*, *Rivea hypocrateriformis* and *Turbina bracteata*. Stomatal abnormalities are by now are thought to be frequent in Angiosperms. They are conceived to be freaks during stomatal ontogeny.

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