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EPIDERMAL MORPHOLOGY AND STOMATOGENESIS IN SOME MEMBERS OF COMBRETACEAE

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The present study is concerned with the foliar epidermal morphology and stomatogenesis in five species belonging to the family Combretaceae. Four types of hairs and six types of stomata are encountered. In transection guard cells are small, oval and vertically embedded in the subsidiary cells throughout their length with thin, short outer and inner cuticular ledges. Stomata develop perigenously in all the species. The taxonomic significance of the stomatal ontogeny and morphology (in side view) is brought out.

Keywords: combretaceae; Epidermal morphology; Stomatogenesis; Taxonomy.

Introduction

According to Metcalfe and Chalk[1] stomata are ranunculaceous and are usually confined to the lower surface but they are also present on the upper side as well in some species. Stace[2-4] brought out the taxonomic significance of leaf epidermis in Combretaceae. Epidermal morphology, stomatal ontogeny and diagnostic importance of some species of *Terminalia* has been studied[5-7]. The present paper deals with stomatal ontogeny and mature epidermis in five species belonging to five genera of Combretaceae.

Materials and Methods

Leaves of different ages of *Calycopteris floribunda* (Roxb.) Poirt, *Anogeissus latifolia* (DC) Wallich ex. Beddome, *Combretum ovalifolium* Roxb. (Tirupathi Hills, Andrapradesh), *Lumnitzera racemosa* Willd. (Pitchavaram, Tamil Nadu) and *Quisqualis Indica* L. (Pondicherry) were collected and fixed in FAA. Epidermal peels of young and mature leaves were obtained by employing customary methods. Young leaves were also cleared using NaOH (10%) and Chloral Hydrate solutions (Saturated). The peels and cleared leaves were stained with aqueous safranin (1%), mounted in 50% glycerine and sealed with DPX. Microtome transections were also employed in this study.

Observations and discussion

Epidermal features (non-costal cells, stomata and hairs) of the five species are presented in table1. Costal cells (Fig.1A1) are distinct over mid-rib and lateral veins in all the species except *Lumnitzera racemosa* where the costal cells are distinct only over mid rib (Fig.1N). Non-costal cells (Figs. 1A, B, H, I, O, P, V, W, Y, C1) are small to large and variously shaped with straight to sinuous and thin or thick walls (Table1). The present study confirms the four types of hairs (Figs. 1C-F, T, U, A1, B1) which were recorded earliler[1]. As reported earlier, Three species viz. *Anogeissus latifolia, Combretum ovalifolium* and *lumnitzera racemosa* are amphistomatic[1,3] and the other two are hypostomatic. Out of three species the leaves of *L. racemosa* are epi-amphistomatic while those of other two species are hypo-amphistomatic[9]. Metcalfe and Chalk[1] and Stace[2,3] reported ranunculaceous stomata in the above genera. However, Stace[3] recorded cyclocytic stomata in *Lumnitzera racemosa*. The present study records six stomatal types viz. aniso-, tetra-, anomo-, dia-, para-, and stephanocytic. (Figs. 1A. H, I, J, O, P, W, Y). Anisocytic type is more frequent in *Calycopteris floribunda* and *Anogeissus latifolia,* tetracytic type more frequent in *Lumnitzera recemosa* and *combretum ovalifolium* and anomocytic ones in *Quisqualis indica* (Table 1). In addition to the above stomatal types, para (*Anogeissus latifolia,* Fig.1J), dia- (*A. latifolia* and *Calycopteris floribunda.* Fig. 1G) and stephanocytic[10], (*L. racemosa, C. ovalifolium;* Fig.IW) are rarely seen. The cyclocytic stomata of *L. racemosa* reported

by Stace[3] are found to be aniso- and tetracytic types in view of the fact that subsidiary cells are never flat and are only 3 or 4 in number. Stomatal peculiarities such as T-shaped thickenings in one or both poles (*C. floribunda* and *A. latifolia;* Figs. 1A, H, J) and peg- like extensions (*C.floribunda;* Fig. IA) have already been reported[11]. In addition, stomatal abnormalities such as shrivelled stomata, stomata with degenerated guard cells (stomatal holes) and contiguous stomata are infrequently seen (Figs. 1 Q-S,Z.)

In transection the epidermis of both surfaces is 1- layered with thin and lamellar cuticle in all the species (Fig.I.M.) Abaxial cells are small and tabular while the adaxial cells are slightly large and deep except in *L. racemosa* where it is reverse. As it has been reported in *Terminalia* Spp[8]. guard cells are small, oval and vertically embedded in the subsidiary cells throughout their length.

Stomata originate in two stages separated by an interval of time; thus they are termed as stomata of earlier origin and stomata of later origin (Figs. IG, K, L, X). Stomatogenetic studies in some members of Myrtales[12] have brought out that the stomata of earlier and later origin either develop perigenously or those of first cetegory are derived perigenously from alabrate meristemoids while the later ones mesoperigenously or mesogenously from uni-or dolabrate meristemoids. In the presently studied species, the stomata of both origin develop perigenously from alabrate meristemoids. A protodermal cell divides unequally to produce a small and a distinct meristemoid with a large nucleus and dense cytoplasm and a large vacuolated sister cell. The meristemoid acts directly as guard cell mother cell (GMC) and divides equally to two give rise to guard cells (Figs. 1G, K, L, X).

The stomata are dia-, para-,aniso-, tetra- and anomocytic types (Figs. 1G, K, L, X) based on the nature of intersection of meristemoid producing wall of protodermal cell, as reported in *Terminalia* spp.[7-8]

Of 44 species belonging to 8 genera[13] stomatal ontogeny has been traced so far in 12 species belonging to 6 genera including *Terminalia*[7-8]. The present study confirms that the family is homogenous in view of the fact that the members are not only uniform in wood structure (except *Strephonema* [1,14]), occurrence of mesophyll druses[15], seed coat structure[16] and embryology (except *Guiera*[17]) but also in the stomatal development and morphology of guard cells in side view.

According to Stace[3] mangroves of different families do show some common epidermal features. However, the mangrove members of any one family show close resemblance to the non-mangroves of the same family than to mangroves of other families. The above view is substantiated by the present observations. *L. recemosa,* a mangrove member of Combretaceae closely resembles the non-mangroves of the same family. However, it shares certain common features with mangroves of other families viz. Lythraceae and Rhizophoraceae[12].

Figs.1. Leaf epidermis. A - G. *Calycopteris floribunda;* A - F. Mature epidermis; A, C,G. Abaxial. A. Non-costal region; C. unicellular non-glandular conical hair; G. Development of stoma; B, D, E, F. Adaxial; B. Non-costal region; D, E. Short uniseriate glandular clavate hair; D. side view; E. Surface View; F. Macroform sub-sessile glandular peltate hair; H -M. *Anogeissus latifolia;* H - J Mature epidermis; H, J, K, L. Abaxial; H, J. Non-costal region K, L. Development of stomata; I. Adaxial non-costal region. M. Transection. N -S. *Lumnitzera racemosa* - Mature epidermis; N, O. Abaxial; N. costal region; O. Non-costal region; P - S. Adaxial - Non-costal region; T - X. *Combretum ovalifolium.* T - W. Mature epidermis; T, U, W, X. Abaxial; T, U. Macroform sub-sessile glandular peltate hair; T. Transection; U. Surface view; W. Non-costal region; X. Development stages of stomata; V. adaxial-non-costal region; Y - Z, A1 _ C1. Quisqualis Indica. Y, Z. Abaxial-non-costal region; A1 - C1. Adaxical; a1 - Costal region showing short uniseriate glandular cuneate hair (side view); B1. The same in surface view; C1. Non-costal region. (am, anomocytic stoma; an, anisocytic stoma; di, diacytic stoma; gmc, guard cell mother cell; il, inner cuticular ledge; m, meristemoid; o1, outer cuticular ledge; pa, paracytic stoma; pt, polar thickening; sc, sister cell; se, stoma of earlier origin; st, stephanocytic stoma; ts, tetracytic stoma.

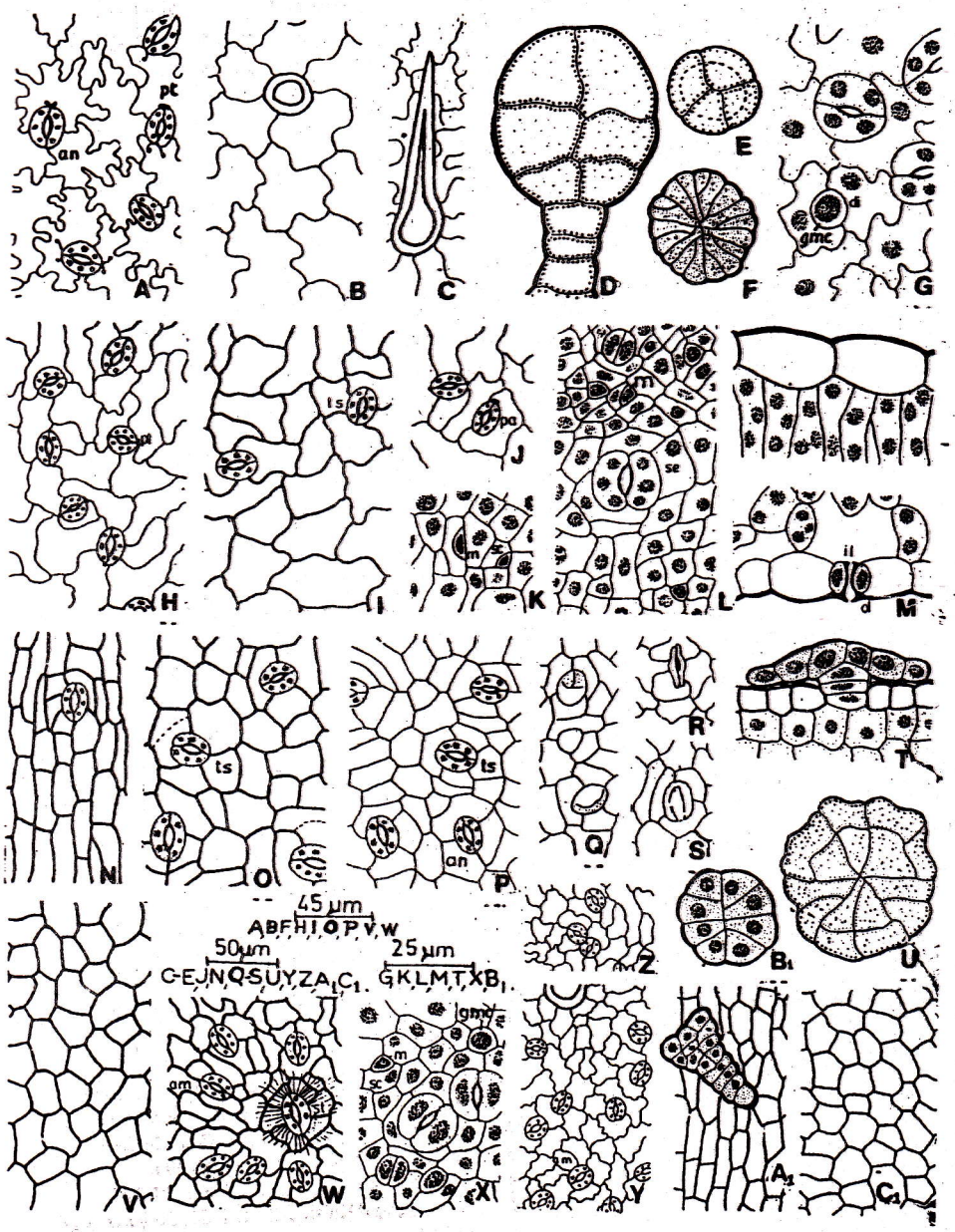
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Table 1. Non-costal cells, stomata and hairs of Combretaceae.

S. No.	Name of Species	SUR	Non-costal cells		STOMATA						Measurement (µm)	Hairs
			Nature of wall	Size	Frequency /m.m^2	Types in Percentage					L x B	
						Aniso-	Tetra-	Anomo-	Para-	Dia-	Step hano-	
1.	Calycopteris floribunda	Ab	Sinuous, thin	62 x 32 ±0.62 ± 1.6	141 + 10	62	29	9	-	few		29 x 21 ±1.2 ± 0.0	1 +++
		Ad	Sinuous, thin	67 x 34 ±2.0 ± 1.7	-								1 +++ 2+++,4+
2.	Anooeissus latifolia	Ab	Arched to slightly sinuous, thin	51 x 19 ±5.6 ± 1.2	271 ± 11	59	32	9	few	few		29 x 18 ±1.8 ±0.6	1++
		Ad	Slightly sinuous, thick	61 x 31 ±5.0 ±2.2	44 ± 00	82	18	-	-	-		29 x 19 ±1.8 ± 1.2	
3.	Lumnitzera racemosa	Ab	Straight to arched, thick	46 x 22 ±1.9 ± 0.6	103 ± 4	20	69	11	-	-	few	34 x 18 ±1.1 ±1.0	
		Ad	Straight to arched, thin	41 x 19 ±3 ± 0.7	162 ± 6	25	66	9			few	31 x 20 ±1.1 ±0.6	
4.	Combretum ovalifolium	Ab	Arched, thick	34 x 14 ±3.5 ±0.95	212 ±9	32	40	28			few	30 x 17 ±2.8 ±0.5	2+++
		Ad	Straight to arched, thick	32 x 18 ±2.4 ±1.00	33 ± 7	12	66	22				31 x 22 ±1.0 ±0.6	2+
5.	Quisqualis indica	Ab	sinuous, thin	19 x 13 ±0.7 ±0.8	431 ± 17	16	30	54				18 x 14 ±1.0 ±1.1	1+++ 3++
		Ad	Straight, slightly, thick	32 x 17.5 ±2.4 ±1.00									1+ 3+

1. Unicellular non-glandular conical hair; 2. Macroform sub-sessile glandular peltate hair; 3. Short uniseriate glandular cuneate hair; 4. Short uniseriate glandular clavate hair; Ab - Abaxial; Ad - Adaxial; sur - surface; L - Length; B - Breath; +, Infrequent; ++, Less frequent; +++, Frequent.

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