

FOLIAR EPIDERMAL STUDIES ON SOME *Barleria* LINN. SPECIES (ACANTHACEAE)**SMITA K. LANDE¹**

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ABSTRACT

Foliar epidermis features of four species of *Barleria* Linn. (Tribe Justiceae, subtribe Barlerieae) have been studied. Along with qualitative features like distribution and type of stomata, epidermal cell shape, trichomes and cystoliths, quantitative observations like size of stomata, epidermal cells, cystolith, stomatal frequency, stomatal index and trichome length also have been made. Based on the characteristic features, a diagnostic key for identification of the studied species was prepared.

KEYWORDS : Acanthaceae, *Barleria* sp, Epidermis, Stomata, Trichomes, Cystoliths

The importance of micromorphological features for the taxonomic consideration of Angiosperms is now well established (Stace 1965, Ghose and Davis 1973, Tomlinson, 1979; Rao and Rammaya 1982, 1983, Vaikou 1987, Kotresha and Seetharam 1995, Ramaswami and Kannabiran 1996, Ogundipe & Akinrinlade, 1998; Parveen et al., 2000). Micromorphological parameters of different plant parts have been used as aids in the taxonomical recognition of species (Kathiresan et al., 2011). The foliar epidermis is one of the most noteworthy taxonomic characters from a biosystematic point of view, and taxonomic studies of a number of families are conducted on the basis of the leaf epidermis (Bhatia, 1984; Jones, 1986). The taxonomic relevance of the foliar epidermal characters of angiosperms has been well documented (Parveen et al., 2000; Celka et al., 2006; Zou et al., 2008; Yasmin et al., 2009). The leaf epidermal cells are of significant taxonomic importance; the length and width are regarded as useful aids in distinguishing varieties (Wilkins & Sabanci, 1990). Other characters with useful variation in epidermal cells include structure, orientation, undulation of the anticlinal wall, and curvature of the periclinal wall. Character size, distribution and frequency of stomata have been found to be specific to some taxa and are used as significant parameters in taxonomy as well as in phylogeny (De Bary, 1884; Metcalfe & Chalk, 1950; Stace, 1965; Paliwal, 1969; Ahmed, 1979; Rajagopal, 1979, Solereder, 1908). Stomatal complex provides taxonomically important diagnostic feature (Solereder 1908, Metcalfe and Chalk 1950). Stomatal frequency and index are physiological and ecological characters. Trichomes are recognized as

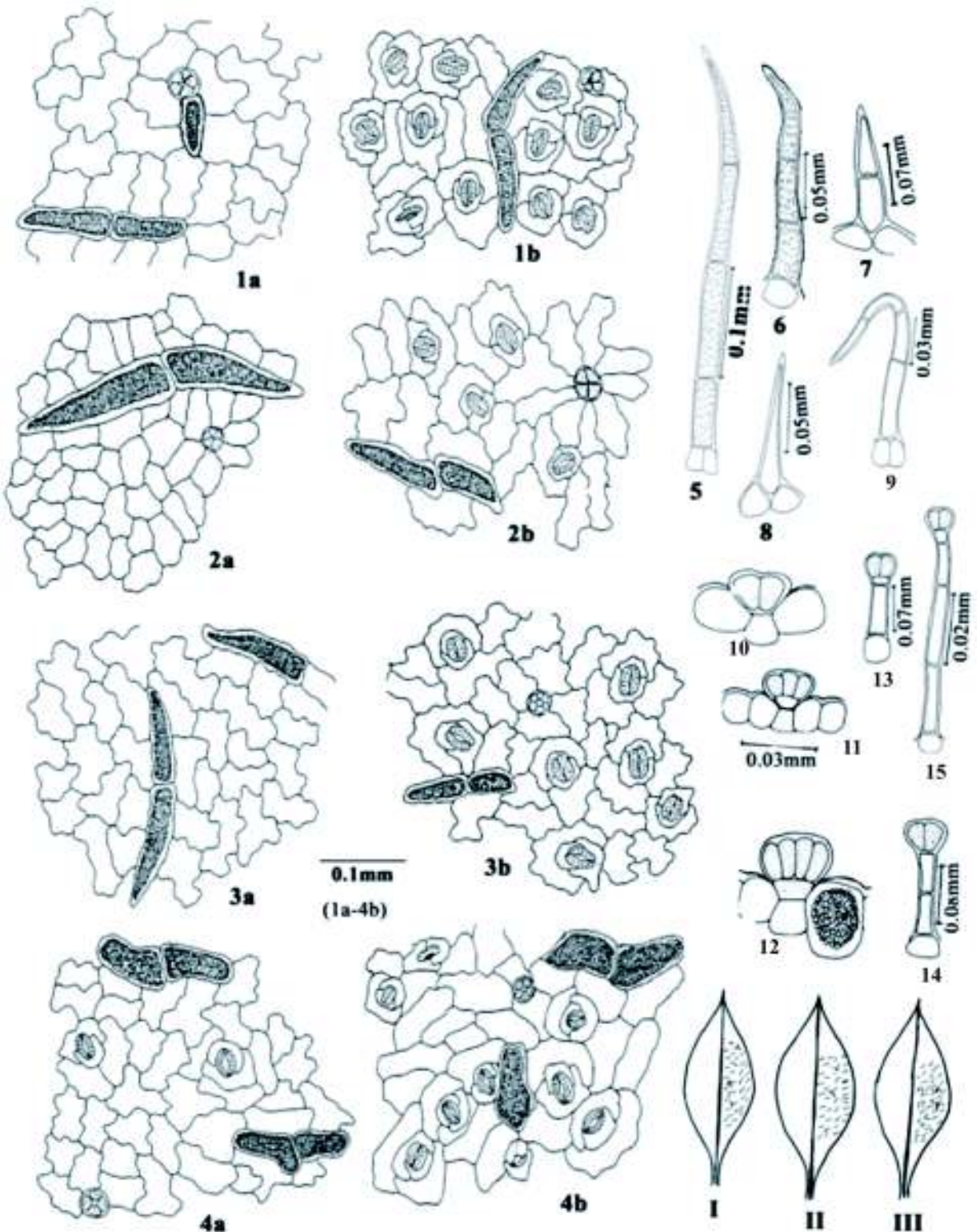
important feature in angiosperm taxonomy (Rao and Rammaya 1987). According to Lerstein and Horner (2005) plant species widely vary in macropattern of crystals and therefore should be considered as an integral part of anatomical structure.

MATERIALS AND METHODS

Tribe Justiceae consists of three subtribes: Andrographideae, Barlerieae and Eujusticeae. Following species of tribe Barlerieae were studied: *B. cristata* var. *dichotoma* (Roxb.) Prain, *B. gibsoni* Dalz., *B. montana* Nees, *B. prionities* L. Mature leaves of the plants were collected from Amravati (M.S.) and observations on fresh leaf from midway (between the leaf base - apex and margin midrib) were recorded. For this purpose the epidermis was either peeled off from leaves or scraped with razor blade or separated by maceration with dilute nitric acid. The epidermal tissue was washed thoroughly with water and stained with 1% aqueous safranin. Observations were undertaken on compound microscope and camera lucida drawings were drawn at 400X.

Epidermal cell shape, size, type of stomatal complex, size of stomata, stomatal frequency-SF (Salisbury 1927), stomatal index-SI (Salisbury 1932), cystolith size, orientation (along vertical axis of leaf from midrib to margin), types of trichomes and their length was studied. For quantitative data, observations were recorded from 15 samples, and are presented as mean \pm standard deviation (Gupta and Kapoor, 2000). The results obtained are presented in table 1.

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a- Upper epidermis, b-Lower epidermis

1. *B. cristata* var. *dichitoma*, 2. *B. gibsoni*, 3. *B. montana*, 4. *B. prionities*.

5-9 Simple trichomes, 10-15 Glandular trichomes, I-III Cystolith Orientation

Table 1 : Quantitative Data or Foliar Epidermal Features in Some Species of *Barleria*

Species	ECS (µm) L x b, L:b		SS (µm) L x b, L:b		SF/sq. mm		SI %		CS (µm) L x b	
	UE	LE	UE	LE	UE	LE	UE	LE	UE	LE
<i>B. cristata</i> var. <i>dichotoma</i>	90.41 ± 6.513 x	72.91 ± 7.505 x	-	27.08 ± 2.551	-	86.8/mm ²	-	21.05 %	115.83 ± 2.916 x	89.45 ± 4.992 x
	42.5 ± 1.103 x 33 ± 1.643µm	21.4 ± 3.710 x 21 ± 2.121 µm	-	x 20.7 ± 2.587 µm	-		-		31.25 ± 6.137 µm	± 5.371 µm
<i>B. gibsoni</i>	75.6 ± 2.178 x	91.2 ± 2.095 x	-	37.7 ± 0.322 x	-	61.4/mm ²	-	24 %	123.5 ± 6.434 x	79.5 ± 2.335 x
	35.8 ± 0.672 x 33 ± 1.643µm	40.2 ± 1.081 x 24 ± 1.641 µm	-	24.1 ± 0.276 µm	-		-		43.9 ± 0.679 µm	0.521 µm
<i>B. montana</i>	82.2 ± 1.44 x 35.4 ± 0.840 x 51 ± 1.643µm	80.2 ± 2.25 x 33.1 ± 0.754 x 63 ± 1.643 µm	-	42.2 ± 0.726 x 22.7 ± 0.276µm	-	49.2/mm ²	-	22.05 %	115.2 ± 4.517 x 33.1 ± 0.422 µm	94.5 ± 2.813 x 0.600 µm
			-		-		-			
<i>B. prionites</i>	67.5 ± 1.564 x	75.1 ± 1.277 x	38.7 ±	34.3 ± 0.315 x	7.4/mm ²	140/mm ²	11.11 %	34.61 %	85.2 ± 3.157 x	90.5 ± 2.813 x
	29.1 ± 0.496 x 27 ± 1.643µm	31.2 ± 0.642 x 18 ± 1.341 µm	0.388 x 13.0 ± 0.859 µm	12.5 ± 0.517 µm					22.3 ± 1.042 µm	1.602 µm

UE – Upper Epidermis, LE – Lower Epidermis, ECS - Epidermal Cell Size, SS - Stomatal size, SF - Stomatal Frequency, SI - Stomatal Index, CS - Cystoliths Size, L - Length, B - Breadth

RESULTS AND DISCUSSION

Cells of upper epidermis are irregular with sinuate walls. The average size of epidermal cells ranges from 67.5x29.1 μm to 90.40x42.535.4 μm in upper epidermis and 72.91x21.4 μm to 91.2x40.02 μm in lower epidermis. Largest epidermal cells were found in *B. gibsoni* (91.2x40.02 μm). While the smaller ones in *B. prionities* (67.5x29.1 μm).

Leaves are hypostomatous in all members except in *B. prionities*. The stomata are predominantly diacytic, hemibicyclic, however, combination with other types was also found to be present. In *B. prionities* paracytic stomata are present (Fig. 4b). Some stomatal abnormalities were also noted. Stomata with single guard cell are present in *B. cristata* (Fig. 1b) and stomata with single guard cell and aborted guard cell found in *B. prionities* (Fig. 4b). The average size of stomata ranges from 27.08x20.7 μm to 42.2x22.7 μm . Maximum stomatal frequency was recorded in *B. prionities* (140mm²) while minimum (49.2 mm²) in *B. montana*. Stomatal index however, ranged from 21.05% (*B. cristata*) to 34.61% (*B. prionities*). Size of epidermal cells, stomata, stomatal frequency and stomatal index remained species specific and hence are considered as leaf constants (Yasmin et al., 2009).

Both, simple as well as glandular trichomes were found to be present in all species except in *B. montana*, wherein only glandular trichomes are present. Simple trichomes are unicellular to bicellular (0.07 to 0.18mm). Glands are sessile, subsessile or with 1-4 celled stalk; heads are 4-8 celled (Fig. 11-16).

Cystolith is an important characteristic feature of Acanthaceae. Cystoliths are solitary, paired as well as 4 together arranged in crosslike manner in all the members studied. The size of cystoliths ranges from (85.2x22.3 μm to 123.5x43.9 μm) in upper epidermis while (79.5x40.8 μm to 94.5x28.5 μm) in lower epidermis; the largest and smallest being present in *B. cristata*. Orientation of cystoliths in leaf showed three patterns from midrib to margin. I. horizontal rarely oblique (*B. cristata* and *B. gibsoni*), II. Horizontaloblique (*B. montana*), III. Oblique - horizontal (*B. prionities*).

DISCUSSION

The investigated taxa showed a number of characters in the epidermal cells, stomata, and trichomes. Boodle and Fritsch, 1908; reported that the significance of differences in epidermis structure was in the shape or structure of the cell walls in some *Cassia* species. In this study the differences in the cell walls, which are of only 2 types (polygonal and sinuate) have been confirmed. The present study found that epidermal cell walls in all *Barleria* species are polygonal and sinuate, except in *B. montana* they are sinuate. Studies of stomata have great taxonomic significance for the delimitation of different levels of taxa (Kothari and Shah, 1975). According to Carpenter and Smith, 1975; variations in stomatal frequencies have taxonomic importance at a generic level. Patil and Patil, 1987; investigated stomatal distribution, frequency, index and size in the leaves of 11 species and varieties of *Chlorophytum* L. and showed that these characters were significant at the subgenus level. Carlquist (1961) emphasised the contribution stomatal size variation made in delimiting species within a genus. Major variations in stomatal frequencies of *B. montana* and *B. prionities* are also notable; the distribution of stomata is also very specific in *B. prionities*, has an amphistomatic condition (the other studied species are hypostomatic). The ratio of average length and breadth of stomatal size showed dissimilarity; thus, the species can be differentiated on the basis of all the above-mentioned characters. Trichome features are now considered important in taxonomic studies (Leelavathi and Ramayya, 1983). The present study found that *Barleria* species have both simple and glandular hairs, but the size and themorphology of the hair differ. Thus, different species of the same genus may also be identified by their distinct trichome characters. A diagnostic key has been prepared for the 4 species of *Barleria* studied, based on foliar micromorphological features.

- 1a. Leaves hypostomatous ----- 2
- 1b. Leaf amphistomatous ----- *B. prionities*
- 2a. Stomatal abnormalities present ----- *B. cristata*
- 2b. Stomatal abnormalities absent 3
- 3a. Only glandular trichomes present ----- *B. montana*
- 3b. Both simple and glandular trichomes present -----
B. gibsoni.

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