AcademicPres

Available online at www.notulaebotanicae.ro

Print ISSN 0255-965X; Electronic ISSN 1842-4309

Not. Bot. Hort. Agrobot. Cluj 37 (2) 2009, 47-51

Notulae Botanicae Horti Agrobotanici Cluj-Napoca

Comparative Foliar Epidermal Studies in *Desmostachya* L. Species, Family Poaceae

Vinay Madhukar RAOLE, Rinku Jitendrakumar DESAI

Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara – 390 002, India; vmraole@rediffmail.com

Abstract

The new species *Desmostachya pingalaiae* Raole & R. J. Desai has been described recently, even though micro-morphological studies were not carried out yet. As micro-morphological knowledge is not available at the moment for *D. pingalaiae*, comparative analysis in genus *Desmostachya* L. was carried out on both leaf epidermises, with the aim of determining the patterns of variation in their epidermal characteristics and assessing their value in species identification. Comparative foliar analysis was carried out by using light microscopy, following routine scraping method. The significant diagnostic character for the identification of *D. bipinnata* is the presence of frequently distributed macrohairs on abaxial epidermis, while for *D. pingalaiae* is the existence of papillae, flanking the long cells. Silica bodies and papillae, along with routine micro-morphological features, are reported for the first time for *D. pingalaiae*. Even more, micro-morphological characters are also helpful for the identification of closely related species of the genus *Desmostachya* L.

Keywords: foliar epidermis, *Desmostachya*, macro hair, papillae, micro hair, silica bodies

Introduction

The *Desmostachya* genus has been classified and described under *Cynodonteae* and *Chloridoideae*, by Clayton and Renvoize (1986), Tzvelev (1989) and Grass Phylogeny Working Group (2001) respectively. Plants belonging to this genus occur naturally in varied climatic conditions in Asia, and they are mostly recorded in the South East Asian region. Drub, a perennial grass of near-coastal and inland deserts, is a potential fodder crop for either saline soils or for the ones where only brackish water is present. The species have a thick root stock, sending out rhizomes in all directions which make it quite tough and have a great environmental value due to the fact that plants can be used for landscaping or rehabilitation of damaged ecosystems (Gulzar *et al.*, 2007).

Watson and Dalwitz (1992 onwards) gave micro morphological characterization for *Desmostachya bipinnata* (L.) Stapf. in particular. Apart from that, most of the world data base describes and gives information for only one species of the genus *Desmostachya*, respectively *D. bipinnata* (L.) Stapf. Recently, authors have described a new species of *Desmostachya pingalaiae* Raole & R. J. Desai from the state of Gujarat, India. Diagnostic differences between species can be noticed in the height of the plant, size of the leaves, the structure and size of the spikelets, the shape of the palea, lemma and glumes, the length of the gynoecium and styles which are long and do not fuse (Raole and Desai, 2008). Newly described species is quite restricted to the alluvial soil and not recorded in any another area than the type locality.

Of all the non-reproductive organs, the leaf is the most widely used in plant taxonomy (Stace, 1984). Srivastava (1978) described the leaf epidermis as the second most important character after cytology for solving taxonomic problem. Metcalfe (1960) has described comprehensive general account of anatomy and micro-morphology for *Poaceae* members; also leaf anatomy for tribe eragrosteae was studied in particular by Renvoize (1983). Earlier, Significance of microhairs as known from the work of Amarshinghe and Watson (1990). Borre and Watson (1994) have also prearranged the infrageneric segregation of *Eragrostis* on the basis of micro-morphological characters.

The present investigation aimed to evaluate and utilize the variation of internal structures and characterization for the above mentioned two species. The study will be useful in determination of the patterns of variation in epidermal characteristics, assessing their value in species identification and classification, and also in establishing the taxonomic relationships between the two species of *Desmostachya*.

Materials and methods

Both species of *Desmostachya* i.e. *D. bipinnata* and *D. pingalaiae* were collected from the natural vegetation in Navasari district, Gujarat, India. Details of the voucher specimens are deposited in BARO herbarium (Department of Botany, Faculty of Science, The Maharaja Sayajirao

Tab. 1. Descriptive statistics of leaf epidermal attributes of *D. bipinnata* (L.) Stapf.

Trait	Minimum (µ)		Maximum (µ)		Mean (µ)		Standard Dev. (µ)		Standard Error (µ)	
	ad	Ab	Ad	ab	Ad	Ab	ad	ab	ad	ab
Length of stoma	15	12	17	17	16.0	14.0	1.0	1.0	± 0.71	± 0.71
Width of stoma	10	10	12	12	11.0	11.0	2.0	2.0	± 1.42	± 1.42
Length of long cells	30	40	37	50	33.5	45.0	3.5	5.0	± 2.48	± 3.55
Width of long cells	5	8	8	10	6.5	9.0	1.5	1.0	± 1.06	± 0.71
Length of short cells	5	5	8	8	6.5	6.5	1.5	1.5	± 1.06	± 1.06
Width of short cells	8	8	10	10	9.0	9.0	1.0	1.0	± 1.06	± 1.06
Length of Interstomatal cell	15	30	20	37	17.5	33.5	2.5	3.5	± 1.77	± 2.48
Width of Interstomatal cell	8	10	10	12	9.0	11.0	1.0	1.0	± 0.71	± 0.71

University of Baroda, Vadodara-390002, Gujarat, India) with Accession number RJD/23 and RJD/31, and photographs of inflorescence is shown in Fig. 1.

For micro-morphological study, the leaves from the middle of the culms (3rd and 5th) were used throughout preparation. The peels were made by scraping pieces of fresh or softened dried leaves (Glycerine: Water mixture) with the help of safety razor blade ; the samples were stained with saffranin and phenol, to be mounted in glycerine (Hilu and Randall, 1984). Adaxial and abaxial leaf surfaces from both species were studied at ×400 magnification. Individual cells were identified and measured by micrometer. 20-25; peels were made from each species from several dozen of leaves. All peels were examined and the representative areas were photographed using Leica research microscope, with ×40 objective as given in fig 2. Final counts of different cells (average of 50 observations) are summarized in Tab. 1 and Tab. 2, following Folorunso and Oyetunji (2007) method for calculation.

Results and discussion

The characteristic epidermal micro-morphological features for both taxa have been depicted in the Fig. 1 and numerical variation represented in Tab.1 and Tab. 2 respectively.

Desmostachya bipinnata (L.) Stapf.

Long cells: Rectangular; thick walls, sinuous; 6-10 rows between veins; inter stomatal cells relatively short with concave ends; Papillae not seen. Short cells: Present over and between veins, solitary / paired. Anticlinal walls: Straight. Stomata: Large, frequent, subsidiary cells triangular, 1-3 banded between veins. Macrohairs: Present frequently on abaxial side with pointed tip, elongated swollen bases; very frequent to numerous and arranged in rows, 40-50 × 10-12 µ. Microhairs: Bicellular with rounded-dome shaped cap cell, 23-25 × 5-8 µ, Width/ Length ratio 0.32.Silica bodies: Saddle shaped, alternate with short cell files of the costal zones and in 1-3-5 rows over veins, 5-8 × 8-10 µ (Fig. 2. A, B, C, D).

Desmostachya pingalaiae Raole & R. J. Desai

Long cells: Rectangular; thick walls, sinuous; 4-10 rows between veins; interstomatal cells relatively short with concave ends; Papillae present (only on abaxial epidermis). Short cells: Present over and between veins, solitary / paired. Anticlinal walls: Straight. Stomata: Large, frequent, subsidiary cells triangular-tall dome shaped, 1-2 banded between veins. Macrohairs: Not seen. Microhairs: Bicellular with rounded-dome shaped cap cell, 23-25 × 5-8 µ, Width/Length ratio 0.32. Silica bodies: Saddle shaped, alternate with short cell files of the costal zones and in 1-3 rows over veins, 5-8 × 8-10 µ (Fig. 2. E, F, G, H).

Tab. 2. Descriptive statistics of leaf epidermal attributes of *D. pingalaiae* Raole & R. J. Desai

Trait	Minimum (µ)		Maximum (µ)		Mean (µ)		Standard Dev. (µ)		Standard Error (µ)	
	ad	ab	ad	ab	Ad	Ab	ad	ab	ad	ab
Length of stoma	15	15	17	17	16	16	1.0	1.0	± 0.71	± 0.71
Width of stoma	12	12	15	15	13.5	13.5	1.5	1.5	± 1.06	± 1.06
Length of long cells	30	30	37	37	33.5	33.5	3.5	3.5	± 2.48	± 2.48
Width of long cells	10	10	12	12	11	11	1.0	1.0	± 0.71	± 0.71
Length of short cells	3	3	5	5	4	4	1.0	1.0	± 0.71	± 0.71
Width of short cells	8	8	10	10	9	9	1.0	1.0	± 0.71	± 0.71
Length of Interstomatal cell	12	12	15	15	13.5	13.5	1.5	1.5	± 1.06	± 1.06
Width of Interstomatal cell	8	8	10	10	9	9	1.0	1.0	± 0.71	± 0.71

ad = Adaxial , ab = Abaxial

Watson and Dallwitz (1992 onwards) have given the importance to abaxial epidermal peel studies for most of the grasses. In this report we have considered leaf epidermises for comparison of both species. Adaxial leaf epidermis of *D. bipinnata* and *D. pingalaiae* are similar regarding the position and the shape of the long cells, silica bodies and veins. Short cells and anticlinal walls are also analogous in both species. Adaxial leaf epidermis of *D. bipinnata* and *D. pingalaiae* are similar in the position and the shape of the long cells, silica bodies and veins. Short cells and anticlinal walls are analogous in both species. By and large, stomata are of paracytic but, 1-3 banded in *D. bipinnata* and 1-2 banded in *D. pingalaiae*. While, silica bodies are saddle shaped and distributed all over in both species with the variation of distribution over veins and its orientation. Abaxial epidermal cells for both species are alike regarding long and short cells; the exception of these similarities is marked by (1) the presence of the papillae only on the epidermis of *D. pingalaiae* (Fig. 1. G and H): it is simple and arranged regularly on the long cells, and (2) the presence of macrohair on the epidermis of *D. bipinnata*, which have pointed tip and elongated swollen bases (Fig. 1. A and B).

Fig. 1. Details of Inflorescence A. *Desmostachya bipinnata* (L.) Stapf.; B. *Desmostachya pingalaiae* Raole & R. J. Desai sp. nov. (Bar= 2cm, Arrow shows the spikelet details)

Leaf epidermal attributes of both species are quite similar regarding the length and width of the stomata, while the length and width of the long and short cells, along with length of the interstomatal cells are quite different. In *D. bipinnata* the size of the earlier described characters are larger in comparison to *D. pingalaiae*. Moreover, Standerd deviation also reflects the same, i.e. 1.5μ for length of the long cells, 0.5 μ for length of the short cells and 2.0μ for length of the interstomatal cells (Tab. 1 and Tab. 2). Epidermal features, especially those of the abaxial epidermis, are more useful for the assessment of both taxa at species level, and are also helpful for taxonomic considerations. Therefore, studies on micro-morphological characters also confirmed the formation of new species i. e. *Desmostachya* pingalaiae Raole & R. J. Desai.

Conclusions

On the basis of the inflorescence colour and size of the spikelet, both species are segregated. Both species of *Desmostachya* depict overall similarity in leaf epidermal attributes. But in relation to size of micromorphological characters, little differences are recorded. Important identification character for the taxa *D. bipinnata* is the presence of frequently distributed macrohairs on the abaxial epidermis only. While for *D. pingalaiae* the representative feature is the papillae flanking the long cells. Thus, micromorphological characters presented in the current study sustain the difference between the two species of *Desmostachya* L., separated on the basis of key given below:

Macrohairs present, papillae absent
- *Desmostachya bipinnata* (L.) Stapf.

Macrohairs absent, Papillae present
-*Desmostachya pingalaiae* Raole & R. J. Desai

Acknowledgement

The authors are thankful to Prof. Arun Arya, The Head, Department of Botany, for encouragement and providing necessary laboratory facilities.

References

Acedo, C. and F. Llamas (2001). Variation of micromorphological characters of lemma and palea in the genus *Bromus* (*Poaceae*). Ann. Bot. Fennici. 38:1-14.

Amarasinghe, V. and L. Watson (1990). Taxonomic Significance of Microhair Morphology in the Genus *Eragrostis* Beauv. (*Poaceae*). Taxon. 39:59-65.

Borre, A. V. and L. Watson (1994). The infrageneric classification of Eragrostis (Poaceae). Taxon. 43:383-422.

Clayton, W. D. and S. A. Renvoize (1986). Genera Graminum: Grasses of the world. Kew Bulletin additional series XIII, Royal Botanical Gardens, Kew, London.

Folorunso, A. E. and O. A. Oyetunji (2007). Comparative foliar epidermal studies in *Cymbopogon citrates* (Stapf.) and *Cymbopogon giganteus* (Hochst.) Chiov. In Nigeria. Not.

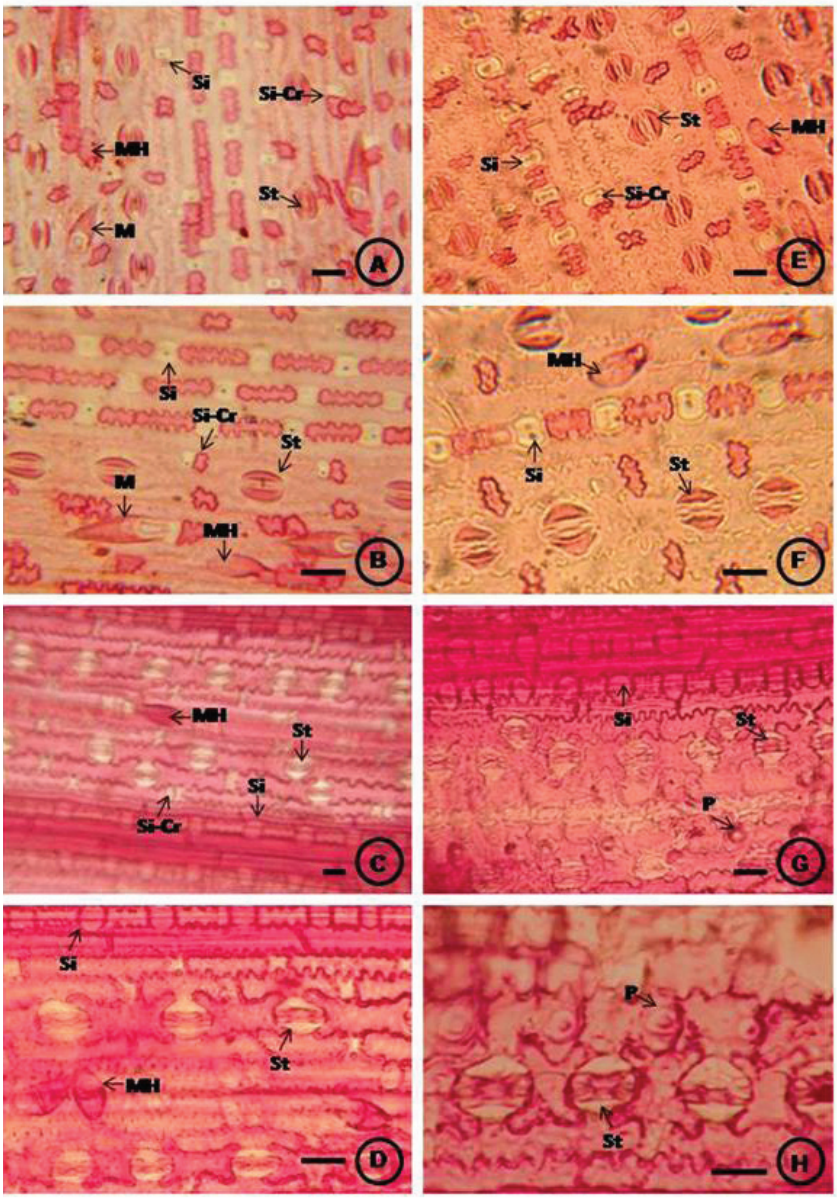

Fig. 2. Photomicrographs of leaf blade

A. Abaxial surface of *D. bipinnata* showing distribution of Microhair, Macro hairs, stomata, Silica cells and silica-Cork pair cells.

B. Abaxial surface of *D. bipinnata* showing distribution of Microhair, Macro hairs, stomata, Silica cells and short cells (in enlarged view).

C. Adaxial surface of *D. bipinnata* showing distribution of Microhair, stomata, Silica cells and silica-Cork pair cells.

D. Adaxial surface of *D. bipinnata* showing distribution of Microhair, stomata and Silica cells (in enlarged view).

E. Abaxial surface of *D. pingalaiae* showing distribution of Microhair, stomata, Silica cells and silica-Cork pair cells.

F. Abaxial surface of *D. pingalaiae* showing distribution of Microhair, stomata and Silica cells (in enlarged view).

D. Adaxial surface of *D. pingalaiae* showing distribution of stomata, Silica cells and Papillae.

H. Adaxial surface of *D. pingalaiae* showing distribution of stomata and Papillae (in enlarged view)

(Bar = 15μ; Fig. legends. St: Stomata, MH: Microhair, Si: Silica cell, Si-Cr: Silica-Cork pair, M: Macro hair, P: Papillae).

Bot. Hort. Agrobot. Cluj. 35(2):8-15.

Gulzar, S., M. A. Khan and X. Liu (2007). Seed Germination Strategies of *Desmostachya bipinnata*: A Fodder Crop for Saline Soils. Rangeland Ecol. Manage. 60:401-407.

GPWG (Grass Phylogeny Working Group) (2001). Phylogeny and subfamilial classification of the grasses (*Poaceae*). Ann. Misso. Bot. Gar. 88: 373-457.

Hilu, K. W. and J. L. Randall (1984). Convenient Method for Studying Grass Leaf epidermis. Taxon. 33:413-415.

Metcalfe, C. R. (1960). Anatomy of the *Monocotyledons* I-Gramineae, Oxford University Press, London.

Raole, V. M. and R. J. Desai (2008). *Desmostachya pingalaiae* sp. nov. from Gujarat, India. Nordic J. of Bot. 26(3-4):196-198.

Renvoize, S. A. (1983). A survey of leaf blade anatomy in grasses. I. *Andropogoneae*, Kew Bull. 37:315-321.

Srivastava, A. K. (1978). Study of leaf epidermis in the genus *Digitaria* Rich (*Gramineae*), J. Ind. Bot. Soc. 37:155-160.

Stace, C. A. (1984). The taxonomic importance of the leaf surface. vol. 25. In: V. H. Heywood and D. M. Moore (Eds.). Current Concepts in Plant Taxonomy Systematic Association Special, Academic Press, London and Orlando.

Tzvelev, N. N. (1989). The system of grasses (*Poaceae*) and their evolution. Bot. Rev. 55(3):141-204.

Watson, L. and M. J. Dallwitz (1992 onwards). The grass genera of the world: descriptions, illustrations, identification, and information retrieval; including synonyms, morphology, anatomy, physiology, phytochemistry, cytology, classification, pathogens, world and local distribution, and references.