

## Comparative micromorphological studies on leaf epidermis in three species of *Mimosa* Linnaeus (Mimosaceae) from Assam, India

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### Abstract

Micromorphological investigations were carried out on three weedy widely occurring species of *Mimosa* Linnaeus (Mimosaceae) in Assam (India), namely *M. pudica* Linnaeus, *M. diplotricha* C. Wight *ex* Sauvalle var. *diplotricha* and *M. himalayana* Gamble. The present investigation revealed the nature of the upper and lower epidermal cell walls as polygonal or irregular with undulate and slightly sinuous anticlinal in *M. pudica* and *M. diplotricha* var. *diplotricha*, which is however mostly tetra or pentangular in shape with straight in *M. himalayana*. Stomata were mostly paracytic in all three species except few anisocytic stomas on both the surfaces of *M. himalayana* leaves. An artificial key has been prepared to identify these three species of *Mimosa* in Assam using investigated micromorphological characters.

**Key words:** Micromorphological, *Mimosa*, epidermal cell, taxonomy and traits.

### INTRODUCTION

Morphological characters of plants have provided the foundation and framework for Taxonomy as those can be observed and obtained easily, and are “thus used most frequently in taxonomic studies” (Radford 1986). But comprehensive taxonomic interpretation of one or the other group of plants is often possible only when a synthetic approach covering other aspects are taken into consideration. Common micromorphological traits like number of stoma per unit area length and width of stomata; stomatal frequency, stomatal indices and number of epidermal cells per unit area, etc. are often considered useful for taxonomic judgment of some taxonomic groups (Jones & Luchsinger 1987). There are some attempts to work out the foliar micromorphology of some angiospermic plants of Assam as aids to their taxonomic treatments (Goswami *et al* 2011; Baruah *et al* 2012)

The family Mimosaceae has 56 genera and 2000 species, distributed in tropical and sub-tropical countries of the world ( Vidyarthi & Tripathi 2002).The pantropical and pansubtropical genus *Mimosa* Linnaeus comprises of ca. 540 (Simon *et al.* 2011). *Mimosa* has two centers of diversification: (1) central and southern Mexico, Cuba, Hispaniola and Orinoco basin and Madagascar, and (2) southern part of South America, which includes Amazon basin, Brazilian Planalto, Paraguay, Northern Argentina and Uruguay (Barneby

1991). Five taxa viz., *Mimosa pudica* Linnaeus, *Mimosa himalayana* Gamble, *Mimosa prainiana* Gamble, *Mimosa diplotricha* var. *inermis* (Adelbert) B. Verdcourt, ***Mimosa diplotricha*** C. Wight ex Sauvalle var. ***diplotricha*** (Rajkhowa *et al* 2003) are known to occur in India. Three of these taxa viz., *Mimosa pudica*, *Mimosa himalayana* and *Mimosa diplotricha* var. *diplotricha* are known to grow in North East India including Assam (Kanjilal *et al* 1938). Most of the members of the genus *Mimosa* Linnaeus are shrubby.

The name *Mimosa* is derived from the Latin word “*mimus*” which means “Mime” i.e sensitive. *Mimosa* species are characterized by their nyctinastic movement. It is seen most especially and rapidly in *Mimosa pudica* (Arbonnier 2004). The nyctinastic movement (opening and closing) of the leaves is a circadian phenomenon and persists even when plants are continuously kept in light or in dark.

**Distribution:** Among the three species of *Mimosa* in N.E India under study, *M. himalayana* is native of Himalayan region. *M. pudica* is known to have its origin in Central America and might have introduced into this country in the 19<sup>th</sup> century. The species is widespread in tropical, subtropical and temperate areas of the world. *M. diplotricha* var. *diplotricha*, on the other hand is also a Tropical American or Brazilian species but widespread and appeared as problematic weed in many pacific Islands, almost all south East Asiatic Countries, Taiwan, Australia, Sri Lanka and African countries like Nigeria. In Assam, *M. diplotricha* var. *diplotricha* is distributed in tea gardens and sugarcane fields of central and upper Brahmaputra valley zones and also in the foothill areas of Nagaland.

**Objective:** This study is carried out with a view to identify and characterize the three common *Mimosa* species of Assam using micromorphological characters of the leaf-epidermis.

## MATERIALS AND METHODOLOGY

This study was carried out during the years 2008 – 2010. The foliar materials, both young and mature, were collected for micromorphological study and epidermal peelings from both surfaces of lamina were taken. The suitable peelings from freshly collected leaves are kept in FAA for 1 – 2 hours, washed thoroughly with water and stained with 1 % aqueous Safranin, mounted in undiluted Glycerin. The cover glass is sealed with nail polish and slides are kept ready for microscopic observations. Slides were studied under light microscope, made suitable drawings of different epidermal structures and took photographs of interesting structures.

## OBSERVATION

The characteristic epidermal features of three taxa are shown below in Figures (1a-1c, 2a-2c, 1A-1C, 2A-2C, A1-A<sub>3</sub>, B<sub>1</sub>-B<sub>3</sub>) and Tables 1 & 2. The micromorphological photographs along with description of these three taxa are elaborated below:

**Epidermis:** The upper epidermis is covered with a thin and uniform cuticle. The size of epidermal cell (EC) varies in different species and the average size is 52.6 – 44.8 x 10<sup>-4</sup> cm (L) to 25.5 – 11.6 x 10<sup>-4</sup> cm (B) in *M. pudica*; 17.7 – 14.9 x 10<sup>-4</sup> cm (L) to 11.6-11x10<sup>-4</sup>cm (B) in *M. himalayana* and 36.6 - 31.6 x 10<sup>-4</sup> cm (L) to 21.6 - 16.6 x 10<sup>-4</sup> cm (B) in *M. diplotricha* var. *diplotricha* respectively (Table - 1). The ECs are polygonal with arched or undulate and slightly sinuous anticlinal walls in *M. pudica* and *M. diplotricha* var. *diplotricha* (Fig. 1c, 1b). However, in *M. himalayana* the cells are tetra or pentangular with straight walls (Fig. 1a). The coastal area is distinct in all three species investigated and the EC of the coastal area usually elongated, straight lateral walls in *M. himalayana* (Fig. 1A) or elongated with

sinuous walls in *M. pudica* (Fig 1C). On the other hand the coastal cells are irregular with sinuous walls in *M. diplotricha* var. *diplotricha* (Fig 1B).

**Table 1.** Qualitative and Quantitative features of Upper Epidermal cells and Stomata of leaves [L = Length; B = Breadth; SF = Stomatal Frequency; SI = Stomatal Index]

Species	Epidermal Cells size		No. of Layers	Stomata			
	Intercoastal region (L x B)	Coastal region (L x B)		Type	Average Stomatal Size (L x B)	Average SI (%)	Average SF
<i>Mimosa pudica</i>	44.8x10 <sup>-4</sup> cm – 25.5x10 <sup>-4</sup> cm	52.6x10 <sup>-4</sup> cm - 11.6x10 <sup>-4</sup> cm	3	Paracytic	15.8 x 10 <sup>-4</sup> cm- 12.2 x 10 <sup>-4</sup> cm	15.07	1.97 x 10 <sup>-5</sup> cm <sup>2</sup>
<i>Mimosa himalayana</i>	17.7x10 <sup>-4</sup> cm - 11.6x10 <sup>-4</sup> cm	14.9x10 <sup>-4</sup> cm - 11.0x10 <sup>-4</sup> cm	5	Predominantly paracytic, few anisocytic	17.7 x 10 <sup>-4</sup> cm - 13.3 x 10 <sup>-4</sup> cm	3.00	1.22 x 10 <sup>-5</sup> cm <sup>2</sup>
<i>Mimosa diplotricha</i> var. <i>diplotricha</i>	36.6x10 <sup>-4</sup> cm - 21.6x10 <sup>-4</sup> cm	31.6x10 <sup>-4</sup> cm - 16.6x10 <sup>-4</sup> cm	3	Paracytic	15.8 x 10 <sup>-4</sup> cm- 10.6 x 10 <sup>-4</sup> cm	5.67	0.628 x 10 <sup>-5</sup> cm <sup>2</sup>

**Table 2.** Qualitative and Quantitative features of Lower Epidermal cells and Stomata of leaves [L = Length; B = Breadth; SF = Stomatal Frequency; SI = Stomatal Index]

Species	Epidermal Cells size		No. of Layers	Stomata			
	Intercoastal region (L x B)	Coastal region (L x B)		Type	Average Stomatal Size (L x B)	Average SI (%)	Average SF
<i>Mimosa pudica</i>	52.8x10 <sup>-4</sup> cm – 32.7x10 <sup>-4</sup> cm	51.5x10 <sup>-4</sup> cm - 14.9x10 <sup>-4</sup> cm	3	Paracytic	19.5 x 10 <sup>-4</sup> cm - 12.5 x 10 <sup>-4</sup> cm	34.63	2.68 x 10 <sup>-5</sup> cm <sup>2</sup>
<i>Mimosa himalayana</i>	19.3x10 <sup>-4</sup> cm – 12.1x10 <sup>-4</sup> cm	18.2x10 <sup>-4</sup> cm - 13.8x10 <sup>-4</sup> cm	5	Mostly paracytic, few anisocytic	19.1 x 10 <sup>-4</sup> cm- 10.6 x 10 <sup>-4</sup> cm	35.68	4.27 x 10 <sup>-5</sup> cm <sup>2</sup>
<i>Mimosa diplotricha</i> var. <i>diplotricha</i>	39.9x10 <sup>-4</sup> cm – 21.0x10 <sup>-4</sup> cm	37.1x10 <sup>-4</sup> cm - 12.2x10 <sup>-4</sup> cm	3	Paracytic	16.9 x 10 <sup>-4</sup> cm - 13.3 x 10 <sup>-4</sup> cm	15.70	4.81 x 10 <sup>-5</sup> cm <sup>2</sup>

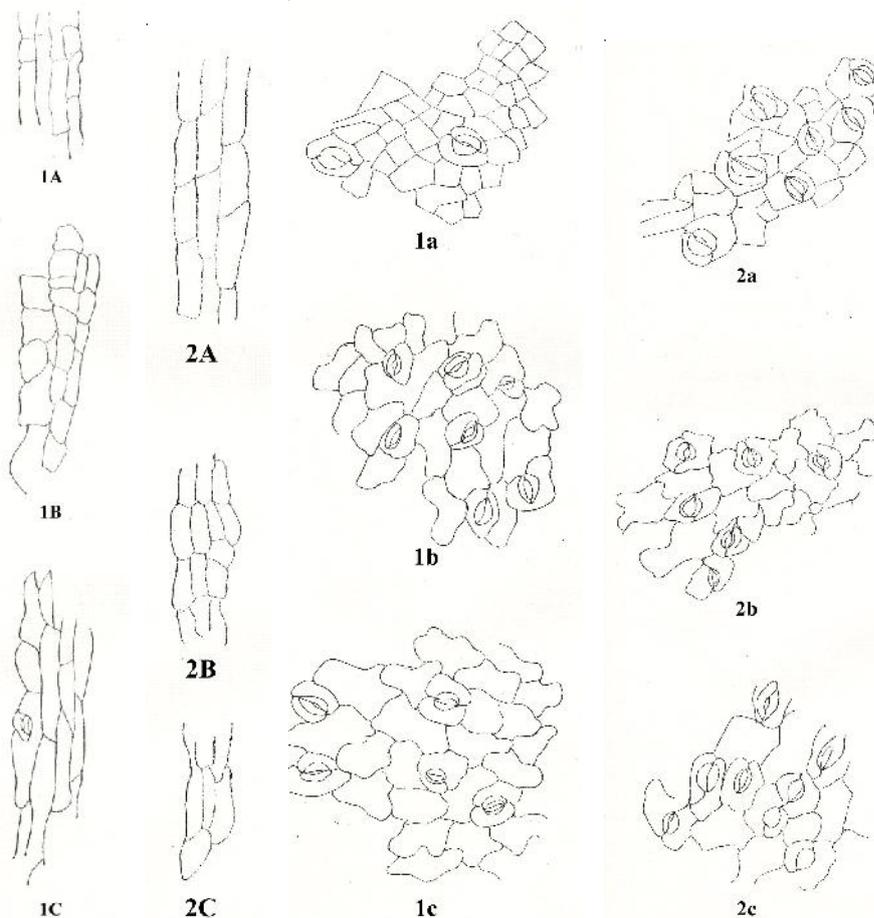
The lower epidermis is also covered by a thin cuticle. The average size of the epidermal cells are 52.6 - 51.5 x 10<sup>-4</sup> cm (L) to 32.7 - 14.8 x 10<sup>-4</sup> cm (B) in *M. pudica*, 19.3 - 18.2 x 10<sup>-4</sup> cm (L) to 13.8 - 12.1 x 10<sup>-4</sup> cm (B) in *M. himalayana* and 39.9 - 37.1 x 10<sup>-4</sup> cm (L) to 21 - 12.2 x 10<sup>-4</sup> cm (B) in *M. diplotricha* var. *diplotricha* (Table - 2). The epidermal cells are polygonal with arched or undulate anticlinal walls in *M. pudica* (Fig. 2c). In *M. diplotricha* var. *diplotricha* the cells are irregular with undulate and slightly sinuous anticlinal walls (Fig. 2b). However, in *M. himalayana* the cells are tetra to polygonal with straight, arched or undulate walls (Fig. 2a). The coastal area is distinct in all three species investigated. In all three species the epidermal cells of coastal area are usually elongated with straight lateral walls (Fig. 2A, 2B, 2C).

**Stomata:** Leaves in all the three species investigated are amphistomatic. The stomata are usually distributed in the inter-coastal areas but occasionally a few stomata may also be present in the coastal area. The frequency of stomata on the upper surface is less as compared to that of the lower surface. It shows significant variation in different parts of the same leaf and also varies in different species. On the lower surface, the frequency of stomata is more at the basal portion of leaf than that of middle and tip. On the other hand, on the upper

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surface, the frequency of stomata is more at the apical portion than that of middle and basal parts of lamina.

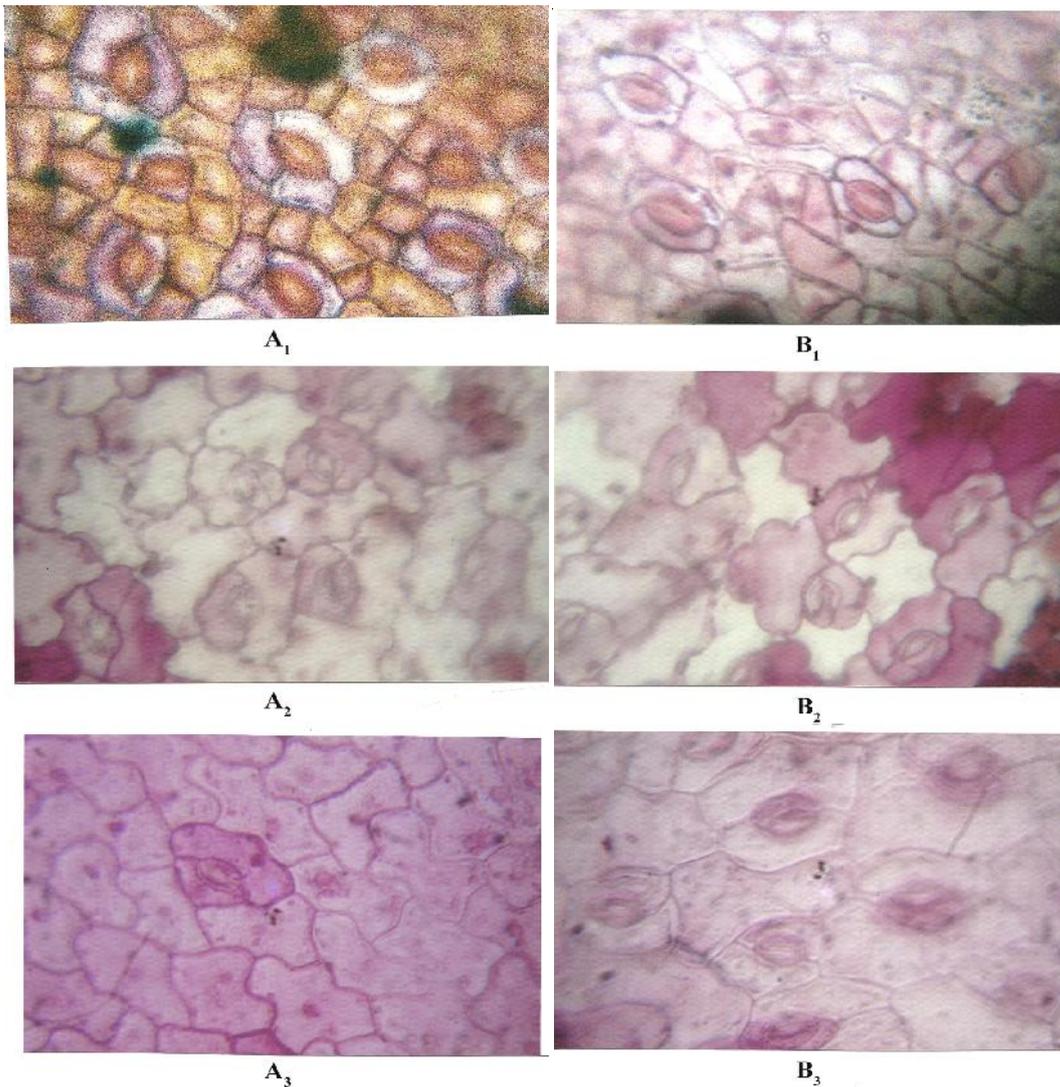
It is seen that the stomatal frequency (SF) on the lower surface of *M. pudica* is  $2.68 \times 10^{-5} \text{ cm}^{-2}$ ; *M. himalayana* is  $4.81 \times 10^{-5} \text{ cm}^{-2}$  and *M. diplotricha* var. *diplotricha* is  $4.27 \times 10^{-5} \text{ cm}^{-2}$  (Table - 2.). However, on the upper surface, the SF of *M. pudica*, *M. himalayana* and *M. diplotricha* var. *diplotricha* are  $1.97 \times 10^{-5} \text{ cm}^{-2}$ ,  $1.22 \times 10^{-5} \text{ cm}^{-2}$  and  $0.628 \times 10^{-5} \text{ cm}^{-2}$  respectively (Table - 1). On the lower surface, the stomatal index (SI) of *M. pudica*, *M. himalayana* and *M. diplotricha* var. *diplotricha* is 34.63 %, 15.73 % and 35.68 % respectively (Table - 2.). On the upper surface, the SI of *M. pudica*, *M. himalayana* and *M. diplotricha* var. *diplotricha* are 15.07 %, 3.00 % and 5.67 % respectively (Table - 1).



**PLATE I.** Camera Lucida Drawings of upper coastal epidermal cell of: 1A. *Mimosa himalayana*; 1B. *Mimosa diplotricha*; 1C. *Mimosa pudica*; 2A. *Mimosa himalayana*; 2B. *Mimosa diplotricha*; 2C. *Mimosa pudica*. Camera Lucida Drawings of upper stomatal cell of: 1a. *Mimosa himalayana*; 1b. *Mimosa diplotricha*; 1c. *Mimosa pudica*; 2a. *Mimosa himalayana*; 2b. *Mimosa diplotricha*; 2c. *Mimosa pudica*.

Four types of stomata viz. amonocytic, anisocytic, paracytic and diacytic are found in Dicotyledonous species. Of these only paracytic type of stomata are found in *M. pudica* and *M. diplotricha* var. *diplotricha* on both surfaces (Fig: 1c, 1b, 2c, 2b, A<sub>3</sub>, A<sub>2</sub>, B<sub>3</sub>, B<sub>2</sub>).

However, in *M. himalayana*, the stomata are mostly paracytic but a few are anisocytic on both surface (Fig: 1a, 2a, A<sub>1</sub>, B<sub>1</sub>).



**PLATE II.** Micro photographs showing arrangement of stomata and epidermal cells in upper leaf surface of: A<sub>1</sub>. *Mimosa himalayana*; A<sub>2</sub>. *Mimosa diplotricha* var. *diplotricha*; A<sub>3</sub>. *Mimosa pudica*. Micro photographs showing arrangement of stomata and epidermal cells in lower leaf surface of: B<sub>1</sub>. *Mimosa himalayana* ; B<sub>2</sub>. *Mimosa diplotricha* var. *diplotricha* ; B<sub>3</sub>. *Mimosa pudica*.

### Key to the Species

- 1a. Stomata predominantly paracytic, few anisocytic; epidermal cells of upper surface tetra or pentangular with straight walls ..... *M. himalayana*
- 1b. Stomata completely paracytic; epidermal cells of upper surface polygonal with arched or undulate and slightly sinuous anticlinal walls ..... 2

2a. The coastal cells of upper epidermis elongated with sinuous walls ..... *M. pudica*

2b. The coastal cells of upper epidermis irregular with sinuous walls ..... *M. diplotricha*  
var. *diplotricha*

## DISCUSSION

The present study on the comparative micromorphology of leaf epidermis of three species of *Mimosa* found in Assam has been taken up to recognize the differences in their leaf epidermis structure in these three *Mimosa* species, which might be of some use in their taxonomic delimitation. The study revealed recognizable differences of the three species studied.

Carlquist (1961) has pointed out that leaves are most varied organ of angiosperm and provide very valuable criteria for systematics of different groups. In recent years the microscopic features of leaf surfaces are increasingly used in angiosperm systematics and numerous works and have emphasized their value in delimitation at the species level in many genera (Levin 1921; Hall & Melvin 1951; Stace 1961). Metcalfe & Chalk (1983) have reported the use of epidermal characters such as leaf surface, epidermal cell wall pattern, nature of stomata as identifiable aids of some families and genera and sometimes for species. Remarks have been made by some researchers in different plants on the use of epidermal characters in taxonomy (Edeoga & Ugbo 1997; Edeoga & Ikem 2002; Chandra *et al.* 1969). Stomatal frequency is one of the most important characters in Taxonomy and Pharmacognosy (Krishnamurthy & Sundaram 1970). In the *Mimosa* species studied, the stomatal frequency varied significantly. In *M. himalayana* and *M. diplotricha* var. *diplotricha* the SF is higher than that of *M. pudica* on lower surface whereas on upper surface the SF of *M. pudica* is higher than that of *M. himalayana* and *M. diplotricha* var. *diplotricha*. From the shape of epidermal cell wall *M. pudica* and *M. diplotricha* var. *diplotricha* could be separated from *M. himalayana* due to the presence of polygonal undulate sinuous anticlinal walls.

The results obtained from the present study of the micromorphology of the three *Mimosa* species may help in segregating these taxa from other related taxa. This study apart from general morphology of these plants will help in recognition of *Mimosa* species of economic and medicinal importance.

## LITERATURE CITED

- Arbonnier, M. 2004. *Trees, Shrubs and Lianas of West African Dry Zones*. CIRAD-MARGRAF MNHN.
- Barneby, R. 1991. *Sensitivae Censitae*: A description of the genus *Mimosa* Linnaeus (Mimosaceae) in the New World. Mem. New York Bot. Gard. 65: 1 – 835.
- Baruah, S.; Borthakur, S.K & Ahmed, A. 2012. Taxonomic status of certain members of *Smilax* Linnaeus (Smilacaceae) based on their foliar epidermal structures. *Pleione* 6(1): 87 – 92.
- Carlquist, S. 1961. *Comparative plant anatomy*. Mc Graw Hill. Publ., New York.
- Chandra, V.; Kapor, S.L.; Sharma, P.L. & Kapoor, D.L. 1969. Epidermal and venation studies in Apocynaceae. *Bull. Bot. Surv. India* .11: 286 – 289.

- Edeoga, H.O. & Ugbo, H.N. 1997. Histochemical localization of calcium oxalate crystals in leaf epidermis of some *Commelina* L. (Commelinaceae) and its bearing on taxonomy. *Acta Facultatis. Gabbed.* 48: 23 – 30.
- Edeoga, H.O. & Ikem, C.I. 2002 . Tannin, saponin and calcium oxalate crystals in some Nigerian species of *Boerhavia* L. (Nyctaginaceae). *S. Afr. J. Bot.* 68: 1 – 3.
- Goswami, N.; Borthakur, S.K. & Hore, D.K. 2011. Some observations on the foliar epidermal characters of seven species of *Dioscorea* Linnaeus (Dioscoreaceae) from Assam with emphasis on Taxonomy. *Pleione* 5(2): 258 – 264.
- Hall, J.P. & Melvin, C. 1951. Vein let termination number: a new character for the differentiations of leaves. *Journ. Pharm Pharmacol.* 3: 934 – 940.
- Jones, S.B.Jr. & Luchsinger, A.E. 1987. *Plant Systematics* (2<sup>nd</sup> ed.). McGraw-Hill, Singapore.
- Kanjilal, U.N.; Kanjilal, P.C. & Das, A. 1938. *Flora of Assam*. 2: 151 – 153. Government of Assam, Shillong
- Krishnamurthy, K.H. & Sundaram, R. 1970. Histomorphology of foliar epidermis and pharmacognocny in Asclepiadaceae. *J. Ind. Bot. Soc.* 46: 160 – 168.
- Levin, F.A. 1921. Taxonomic value of vein islet areas based upon the study of the Genera *Barosma*, *Cassia*, *Erythroxylan* and *Digitallis*. *J. Pharm. Pharmacol.* 2: 17 – 43.
- Metcalf, C.R. & Chalk, L. 1983. *Anatomy of Dicotyledons*. Vol. II, 2<sup>nd</sup>. Edn. Clarendon Press, Oxford.
- Radford, A.E. 1986. *Fundamentals of Plant Systematics*, Harper & Row, New York.
- Rajkhowa, D.J.; Barua, I.C.; Kandali, R.; Yaduraju, N.T. & Deka, N.C. 2003. Agrobiology and management of *Mimosa* spp. Invited paper, (Souvenir cum abstract) *National seminar on Alien Invasive weeds in India, held at AAU, Jorhat 27-29th April*. 2003.
- Simon, M.F.; Grether, R.; Queiroz, L.P.; Särkinen, T.E.; Dutra, V.F. & Hughes, C.E. 2011. The evolutionary history of *Mimosa* (Leguminosae): Toward a phylogeny of the sensitive plants. *Amer. J. Bot.* 98(7): 1201 – 1221.
- Stace, A. 1961. Cuticular character as an aid to the taxonomy of the South West African species of *Combretum*, *Mittel. Bot Statssmml. Munch.* 4: 1 – 94.
- Vidyarthi, R.D. & Tripathi, S.C. 2002. *A Textbook of Botany*. S. Chand and Company Ltd., New Delhi.