STUDIES ON LEAF ARCHITECTURAL PATTERN AND CUTICULAR FEATURES OF SOME MEMBERS OF MIMOSOIDEAE

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Abstract

This paper describes leaf morphology, venation pattern and cuticular features of seven genera and 10 species of the Indian Mimosoideae collected from Burdwan District of West Bengal. It has been observed that different parameters of leaf morphology and anatomy help in the identification of taxa up to generic and specific level. Further, the leaf architectural pattern specially in regard to their secondary vein can be correlated with their basic chromosome numbers.

Introduction

The subfamily Mimosoideae is represented by about 56 genera and 2,800 species (Bentham & Hooker, 1862-1883). Previously no work has been done on the leaf architecture and cuticular features of the Indian Mimosoideae. However, Leelavathi, Ramayya and Prabhakar (1980) described foliar stomatal distribution patterns in Leguminosae and discussed their taxonomic significance and Leelavathi and Ramayya (1982) described trichomes in relation to taxonomy (Mimosoideae). Therefore, the present investigation on leaf architectural pattern adds new informations about their taxonomic value of the leaf architectural pattern. Metcalfe and Chalk (1950) gave only general information regarding cuticular features in this subfamily. Shah *et al.* (1972) worked on epidermal structure and stomatal ontogeny in some Mimosaceae.

Material and method

Materials included here were collected from twelve different localities encompassing north, south, east, west and central part within the district of Burdwan. For studying external morphology of leaf the following criteria were taken into consideration : leaf simple or compound, petiolate or sessile; if compound pinnate or digitate and number of pinnation; shape and form, surface of lamina or leaf-rachis, base, margin and apex. Variations within these features from one taxa to another are taxonomically useful.

For studying leaf architectural pattern fresh or dried leaves were treated with 5% NaOH solution for bleaching. The duration of treatment in NaOH solution varied from 24 to 36 hours depending on the texture of the leaf. Thereafter, the materials were transferred to chloral hydrate solution (Foster, 1952; Hickey, 1973). Finally the materials were stained in 1% aqueous safranin solution followed by gradual dehydration through ethanol grades. Leaves were mounted in canada-balsam either in parts or in full depending on the size of the leaf.

For cuticular preparation fresh or dried leaves were kept in 10% nitric acid for 24 to 48 hours. Maceration time was varied depending on the thickness of cuticle.

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After maceration leaves were washed thoroughly in water to make them acid free. These were then treated with 5% KOH or NaOH solution for 2-5 minutes. Then washed thoroughly to make them alkali free. By incision on two sides of the leaf, the two cuticles were separated by means of fine needle. This operation was performed with a little water all round the leaf. Finally the cuticles (abaxial & adaxial surfaces) were separately mounted in glycerine jelly for microscopic observations.

The taxa have been arranged here according to the classification of Bentham and Hooker (L.C.).

Description

MIMOSOIDEAE

1. *Prosopis juliflora* Dc.
Text-figs. 1-8

Leaves compound, bi-pinnate, leaflets stalked surface of the leaf-rachis hairy, pinnules asymmetrical (base only) in shape, oblong in form, base acute, margin entire, apex mucronate. Pinnule-architecture multicostate with 3 primary veins of acrodromous perfect type. Secondary veins 6-8 pairs in number and arranged in brochidodromous pattern. Reticulation up to 5th order of veinlets; areole formation mostly by 3rd and 4th order of veinlets, shape of the areole irregular, areoles mostly without or with one free vein ending; free vein endings formed by 5th order of veinlets, traverse up to 3/4th of the areole, consisting of 2-3 rows of tracheids, ensheathed by more or less isodiametric parenchymatous cells; the very tips mostly curved and swollen. Marginal ultimate venation complete and looped.

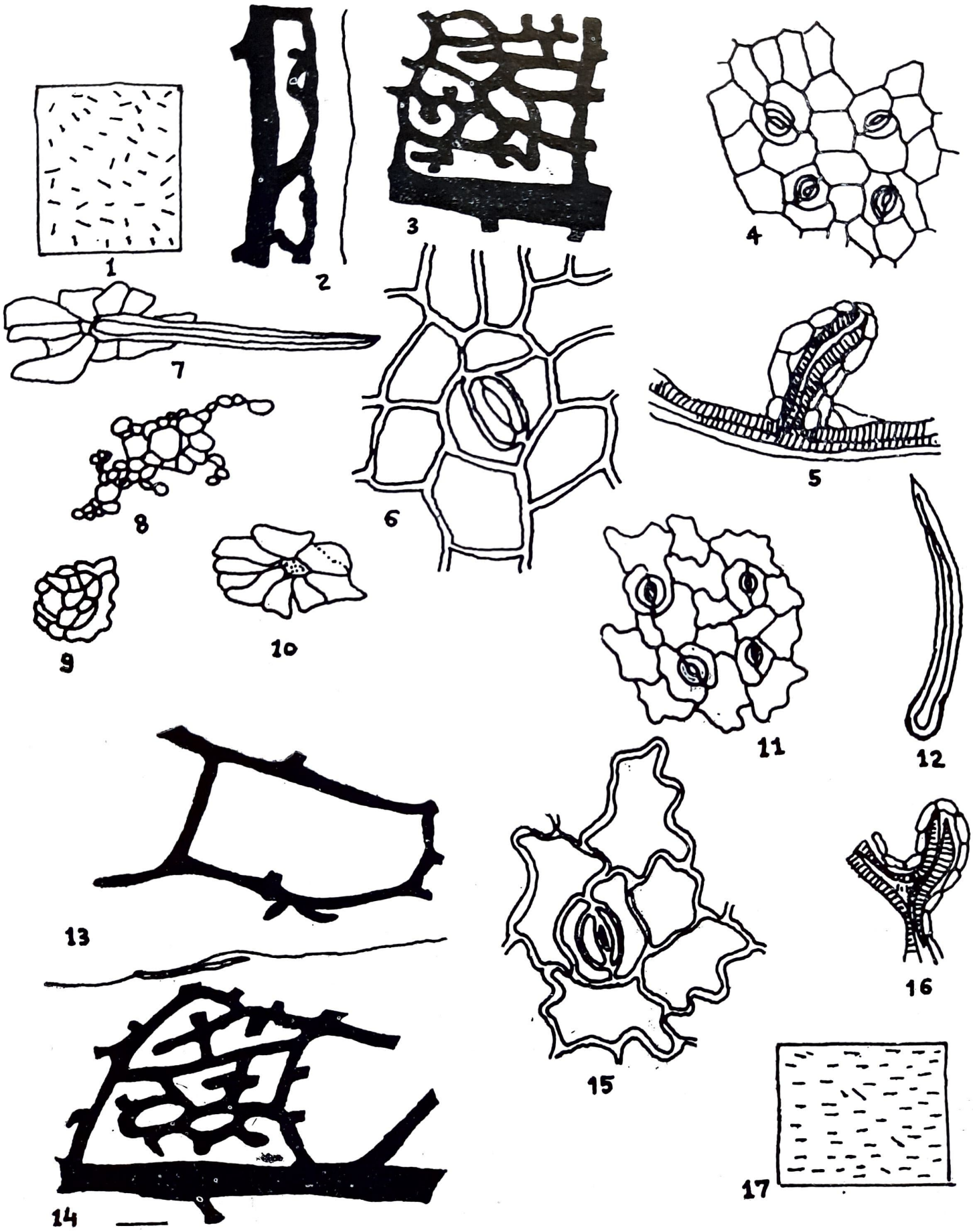
Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata, stomatal apparatus containing 2-3 subsidiary cells, guard cells not sunken but cutinised Stomata present all over, irregularly arranged, variously oriented. Stomatal index 23.80. Ordinary epidermal cells pentagonal or plygonal in shape, randomly arranged and straight walled. Trichomes of two types : i) nonglandular, uniseriate, with prominent base and pointed apex; ii) branched or palmately devided glandular type. Upper surface shows similar types of stomata, stomatal apparatus, arrangement and orientation of the stomata, to those present in the lower surface. Stomatal index 10.13. Nature of the epidermal cells and trichomes similar to those present in the lower surface.

Prosopis juliflora (1-8) : 1,

Text-fig. 1—Lower cuticle showing the distribution pattern of stomata ×50, 2. Marginal venation pattern ×50, 3. Areolar venation ×150, 4. Lower epidermis showing a few stomata and epidermal cells ×250, 5. Vein ending showing number of tracheids and the nature of sheath ×250, 6. A single stomatal apparatus and a few ordinary epidermal cells enlarged ×500, 7. A non-glandular trichome ×250, 8. Glandular trichome ×250.

Laucaena glauca(9-17) :

9. A single glandular trichome ×250, 10. Same in another view ×250, 11. Lower cuticle showing a few stomata and epidermal cells ×250, 12. Non-glandular trichome ×250, 13. A portion of marginal venation enlarged ×50, 14. Areolar venation pattern ×50, 15. A single stoma enlarged ×500, 16. A single vein ending showing number of tracheids and sheath ×250, and 17. Distribution of stomata in lower cuticle ×50.



Text-fig. 1

2. *Leucaena glauca* Benth
Text-figs. 9-17.

Leaves compound, pinnules not stalked, surface of the leaf-rachis smooth; pinnules asymmetrical in shape, oblong narrow in form, base acute, margin entire and the apex acute. Pinnule-architecture multicostate reticulate with 3 primary veins of acrodromous imperfect type. Secondary veins many in number and arranged in brochidodromous pattern. Reticulation up to 6th order of veinlets; areole formation mostly by 3rd and 4th or by 4th category of veins only, shape of the areole variable, areoles with mostly one free vein ending; free vein endings formed by 5th or by 6th order of veinlets, traverse 1/3-1/2 of the areole, consisting of 2 rows of tracheids, ensheathed by isodiametric parenchymatous cells; the very tips mostly curved, swollen, branched or un-branched. Marginal ultimate venation nearly complete and looped.

Pinnules amphistomatic, lower surface showing mostly paracytic type of stomata, stomatal apparatus containing 2-3 subsidiary cells; guard cells not sunken but cutinised. Stomata present all over, except on primary veins, irregularly arranged, oriented parallel to the long axis of the primary veins. Stomatal index 13.73.

Ordinary epidermal cells irregular in shape, randomly arranged and sinuous walled. Trichomes of two types: i) unicellular, nonglandular, conical-shaped with prominent base and pointed apex; and ii) multicellular glandular type.

Upper surface shows similar types of stomata and stomatal apparatus to those present in the lower surface. Stomata present all over, irreguarly arranged, oriented parallel to the long axis of the primary veins. Stomatal index 4.34. Nature of the epidermal cells and trichomes similar to those present in the lower surface.

3. *Mimosa pudica* Linn.
Pl. 1, Fig. 4

Leaves compound, bipinnate, leaflets stalked, surface of the leaf-rachis bristly; pinnules asymmetrical in shape, narrow-oblong in form, base obtuse, margin entire, apex mucronate. Pinnule-architecture multicostate reticulate with 3-4 primary veins of acrodromous perfect type. Secondary veins 5-8 pairs in number and arranged in brochidodromous pattern. Reticulation up to 5th order of veinlets; areole formation mostly by 3rd and 4th order of veinlets, shape of the areole quadriangular or polygonal, areoles mostly without or with one free vein endings; free vein endings formed by 4th or 5th order of veinlets, traverse up to 1/2-3/4th of the areole, consisting of 1-2 rows of tracheids, vetn endings not covered by sheath but prismatic crystals present at lower category of veins; the tips mostly straight or simply curved, swollen mostly unbranched, very rarely branched twice. Marginal ultimate venation complete and in somewhere it is looped.

Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata; stomatal apparatus containing 2 subsidiary cells of which one small and the other large; guard cells not sunken but thinly cutinised. Stomata present all over, except on midvein, irregularly arranged, oriented parallel to the long axis of the lamina. Stomatal index 30.70. Ordinary epidermal cells irregular in shape, randomly arranged and sinuous walled. Trichomes of three types: i) glandular, multicellular, uniseriate stalked with a spherical head; ii) nonglandular, uniseriate with prominent base (of 2 celled), sunken in the epidermis, and pointed apex; iii) multicellular shaggy type. In the upper surface, types of stomata, stomatal apparatus, arrangement and orientation of the stomata similar to

those present in the lower surface. Epidermal cells irregular in shape and undulate walled. Trichomes similar to those present in the lower surface.

4. *Mimosa rubicaulis* Lam
Pl. 1, Fig. 3

Leaves compound, bi-pinnate; leaflets stalked, surface of the leaf-rachis is hairy, leaflets asymmetrical in shape, oblong or obovate in form, base rounded, margin entire, apex rounded. Pinnule-architecture multicostate reticulate with 3 primary veins of acrodromous perfect type. Secondary veins many in number and arranged in brochidodromous pattern. Reticulation up to 6th order of veinlets; areole formation mostly by 4th and 5th order of veinles, shape of the areole rectangular or pentagonal or various type, areoles mostly with one free vein ending, free vein endings formed by 5th or 6th order of veinlets, traverse 1/3-1/2 of the areole, consisting of 1-2 rows of tracheids, vein endings not sheathed, but crystals present at each category of veins; the very tips mostly swollen, straight or simply curved, unbranched or very rarely branched twice. Marginal ultimate venation nearly complete and in somewhere it is looped.

Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata; stomatal apparatus containing 2-subsidiary cells of which one smaller than the other, guard cells not sunken but thinly cutinised. Stomata present all over, irregularly arranged, oriented parallel to the long axis of the primary veins only. Stomatal index 15.41. Ordinary epidermal cells rectangular or polygonal in shape, randomly arranged and straight walled. Trichomes nonglandular, 1-2 celled with thickened base and pointed apex. In the upper surface, types of stomata and stomatal apparatus similar to those present in the lower surface. Stomata present all over, irregularly arranged, variously oriented. Stomatal index 6.08. Nature of the epidermal cells and trichomes similar to those present in the lower surface.

5. *Acacia auriculiformis* A. Cunn. ex. Benth. in Hook.
Pl. 1, Fig. 6

Phyllodes simple, stalked; surface of the leaf-rachis hairy; phyllodes asymmetrical in shape, oblong-lorate in form, base acute, margin entire, apex acute. Phyllode-architecture multicostate with 5 primary veins of parallelodromous type. Secondary veins many and arranged parallelly. Reticulation up to 4th order of veinlets, areoles formed by 2nd and 3rd category of veinlets, shape of the areole mostly rectangular or variable, areoles mostly without or rarely with one free vein ending; free vein endings formed by 4th order of veinlets, traverse 1/2-3/4th of the areole, consisting of 2 rows of tracheids, all categories of veins, except vein endings, ensheathed by parenchymatous cells; prismatic crystals present at each category of veins; the very tips mostly swollen. Marginal ultimate venation complete and fimbrial vein formed. Phyllodes amphistomatic; lower surface showing mostly paracytic to amphiparacytic type of stomata; stomatal apparatus containing 2-4 subsidiary cells; guard cells not sunken but cutinised. Stomata present all over, except on midvein and primary lateral veins, irregularly arranged, oriented parallel to the long axis of the phyllode. Stomatal index 9.0. Ordinary epidermal cells polygonal or irregular in shape, randomly arranged and straight or slightly undulate walled. Trichomes peltate, glandular, with various-sized heads. In the upper surface, types of stomata, stomatal apparatus and arrangement similar

to those of the lower surface. Stomata present all over, except on midvein and primary lateral veins; irregularly arranged and variously oriented. Stomatal index 8.0. Nature of the epidermal cells and trichomes similar to those present in the lower surface.

6. *Acacia arabica* Willd.
Pl. 1, Fig. 5

Leaves compound, bipinnate; pinnules stalked; surface of leaf-rachis hairy, pinnules asymmetrical in shape, narrow-oblong in form, base obtuse, margin entire, apex acute. Pinnule-architecture multicostate with 3 primary veins of acrodromous (basal) imperfect type. Secondary veins 4-6 pairs in number and arranged in brochidodromous pattern. Reticulation up to 5th order of veinlets; areole formation mostly by 3rd and 4th order of veinlets, shape of the areole mostly polygonal, areoles with mostly one free vein ending; free vein endings formed by 5th order of veinlets, traverse 1/2 of the areole, consisting of 2 rows of trachieds, ensheathed by rectangular sclerenchymatous cells; the very tips mostly curved and not swollen. Marginal ultimate venation nearly complete and looped.

Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata; stomatal apparatus containing 2-3 subsidiary cells; guard cells not sunken but thinly cutinised. Stomata present all over, except on midvein, irregularly arranged, variously oriented. Stomatal index 23.28.

Ordinary epidermal cells polygonal in shape, randomly arranged and slightly undulate walled. Trichomes unicellular or multicellular, nonglandular, uniseriate conical shaped, attached in the margin of the pinnules only. In the upper surface, types of stomata and stomatal apparatus similar to those in the lower surface. Stomata present all over, irregularly arranged, variously oriented. Stomatal index 10.85. Epidermal cells polygonal in shape, larger than those present in the lower surface, randomly arranged and sinuous walled. Trichomes similar to those in the lower surface.

7. *Acacia continna* DC.
Pl. 1, Fig. 7

Leaves compound, bipinnate, leaflets stalked, surface of leaf-rachis hairy; pinnules asymmetrical in shape, oblong in form, base obtuse, margin entire, apex acute. Pinnule-architecture multicostate reticulate with 3-4 primary veins of acrodromous imperfect type. Secondary veins 4-8 pairs in number and of brochidodromous type. Reticulation up to 6th order of veinlets; areole formation mostly by 4th and 5th order of veinlets, shape of the areole quadrangular or polygonal, areole with mostly one free vein ending; free vein endings formed by 5th or 6th order of veinlets, traverse up to 3/4th of the areole, consisting of 2 rows of tracheids, ensheathed by isodiametric parenchymatous cells; the tips mostly straight, not swollen, unbranched. Marginal ultimate venation complete and looped.

Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata; stomatal apparatus containing 2-3 subsidiary cells; guard cells not sunken but thinly cutinised. Stomata present all over except on midvein and primary lateral veins, irregularly arranged, variously oriented. Stomatal index 43.83. Ordinary epidermal cells polygonal in shape, randomly arranged and sinuous walled. Trichomes mostly unicellular, rarely 2-3 celled, uniseriate, nonglandular with thickened base and actute apex. Upper surface also shows paracytic type of stomata, stomatal apparatus containing 2

subsidiary cells; not sunken but cutinised. Stomata present only on either side of the veins, irregularly arranged, oriented parallel to the veins. Nature of epidermal cells and trichomes similar to those in the lower surface. But frequency of the trichome is very low. Epidermal cell-walls ridged.

8. *Albizia lebbek* (L) Benth.
Pl. 1, Fig. 8

Leaves compound, bipinnate, leaflets stalked, surface of the leaf-rachis hairy; pinnules asymmetrical in shape, oblong in form, base acute, margin entire and the apex obtuse or retuse. Pinnule-architecture unicostate reticulate with 6-10 pairs of secondaries. Secondary veins of brochidodromous type; reticulation up to 6th order of veinlets; areole formation mostly by 4th and 5th order of veinlets, shape of the areole mostly pentagonal or polygonal, areoles with mostly one free vein ending; free vein endings formed by 6th order of veinlets, traverse 3/4th of the areole, consisting of 2-4 rows of tracheids, branched (twice to many) or unbranched; ensheathed by parenchymatous cells; the tips mostly swollen and curved. Marginal ultimate venation complete and almost fimbrial vein formed. Pinnules amphistomatic; lower surface showing mostly paracytic type of stomata; stomatal apparatus containing 2 subsidiary cells; guard cells not sunken but cutinised. Stomata present all over except on midvein, irregularly arranged, variously oriented. Stomatal index 25.56.

Ordinary epidermal cells irregular in shape, randomly arranged and sinuous walled. Trichomes unicellular, nonglandular, conical shaped, thick-walled, straight; but bases not thickened. In the upper surface, types of stomata and stomatal apparatus similar to those in the lower surface. Stomata present only on the midvein, longitudinally arranged, oriented parallel to the midvein. Epidermal cells irregular in shape, randomly arranged and the cell walls sinuous and ridged. Rod-like ornamentation present on the surface of the cell-wall. Trichomes similar to those present in the lower surface.

9. *Samania saman* (Jacq.) Merr.
Pl. 1, Fig. 2

Leaves compound, bipinnate; leaflets stalked, surface of leaf-rachis hairy; pinnules asymmetrical in shape, lanceolate in form, base acute or cuneate, margin entire, apex acute. Pinnules-architecture unicostate reticulate with 6-8 pairs of secondaries. Secondary veins of brochidodromous type; reticulation up to 5th order of veinlets; areole formation mostly by 3rd; 4th order of veinlets, shape of the areole pentagonal, areoles with mostly one free vein ending; free vein endings formed by 5th order of veinlets, traverse half of the areole, consisting of 2-3 rows of tracheids, branched twice or unbranched, ensheathed by parenchymatous cells; the tips mostly swollen and slightly curved. Marginal ultimate venation complete and looped.

Pinnules hypostomatic; lower surface showing mostly paracytic to amphiparocytic type of stomata; stomatal apparatus containing 2-4 subsidiary cells; guard cells not sunken but thinly cutinised. Stomata present all over, except on veins (i.e. only on the alveolar zones), irregularly arranged variously oriented. Stomatal index 25.0. Ordinary epidermal cells irregular in shape, randomly arranged and sinuous walled. Ring-like ornamentation present on the surface of the epidermal cell. Trichomes unicellular, nonglandular, conical or cylindrical shaped with acute apex and thickened base. Uniseriate, multicellular,

macroform, conical shaped trichomes also present. In the upper surface, epidermal cells irregular in shape, randomly arranged, undulate walled and without any ornamentation. Nature of trichomes similar to those present in the lower surface; but smaller in size.

10. *Pithecolobium dulce* Benth.
Pl. 1, Fig. 3

Leaves compound, bipinnate, leaf-lets stalked, surface of the leaf-rachis hairy; pinnules asymmetrical in shape, oblong in form, base acute, margin entire, apex acute or obtuse. Pinnule-architecture unicostate reticulate with 7-9 pairs of secondaries. Secondary veins of brochidodromous type; reticulation up to 6th order of veinlets; areole formation mostly by 4th and 5th order of veinlets, shape of the areole variable, areoles with mostly one free vein ending; free vein endings formed by 6th or 5th order of veinlets, traverse upto 1/2-3/4 of the areole, consisting of 2 rows of tracheids, vein endings not sheathed but crystals present at each category of veins ; the tips not swollen, branched or unbranched; curved and diminishing into fine reticulum. Marginal ultimate venation complete and looped.

Pinnules amphistomatic; lower surface showing mostly paracytic to amphiparacytic type of stomata; stomatal apparatus containing 2-4 subsidiary cells, guard cells not sunken but thinly cutinised. Stomata present all over, except on midvein and primary lateral veins, irregularly arranged, variously oriented. Stomatal index 24.72. Ordinary epidermal cells irregular in shape, randomly arranged and sinuous walled. Trichomes unicellular, nonglandular, with thickened base, straight and conical type. In the upper surface, types of stomata and stomatal apparatus similar to those present in the lower surface. Stomata present only on midvein and primary lateral veins, irregularly arranged, variously oriented. Nature of the epidermal cells and trichomes similar to those present in the lower surface.

Discussion

In the present investigation seven genera and 10 species of the subfamily Mimosoideae have been investigated in respect of their major and minor venation patterns, epidermal features and the external morphology of the leaves. It has been observed that all the species investigated possess bipinnate leaves except in *Mimosa pudica* and pinnae are stalked except in *Leucaena glauca*. The surface of pinnae is hairy in *Prosopis juliflora*, *Mimosa rubicaulis*, *Acacia arabica*, *A. concinna*, *Albizia lebbek*, *Samania saman* and *Pithecolobium dulce*, smooth in *Leucaena glauca*, *Acacia auriculiformis* (phyllode) and bristly in *Mimosa pudica*. The shape of pinnae varies from asymmetrical, narrow-oblong or obovate to lanceolate. The base of the pinnae may be acute, obtuse or rounded and the apex which is mucronate (*Prosopis juliflora*, *Mimosa pudica*), acute (*Leucaena glauca*, *Acacia arabica*, *A. concinna*, *A. auriculiformis*, *Samania saman*), rounded (*Mimosa rubicaulis*), obtuse or retuse (*Albizia lebbek*) and acute or obtuse (*Pithecolobium dulce*).

While studying the range of leaf architectural pattern 9 different parameters have been taken into consideration (Table II, Dilcher, 1974; Hickey, 1973). The species studied here have multicostate venation in their pinnae except *Albizia lebbek*, *Samania saman* and *Pithecolobium dulce*. The number of primaries are mostly three (rarely 3-4) and the nature of the primaries are acrodromous perfect or acrodromous imperfect type. There are variations in number of secondaries (4-8 pairs, 6-8 pairs, 7-9 pairs to many),

Table 1—Showing range of leaf morphological characters in 10 species of the sub-family Mimosoideae

Name of the plant	Simple or compound	Petiolate or sessile	If compound pinnate or digitate and number of pinnation	Shape and form	Surface of lamina or leaf rachis	Base	Margin	Apex
1 2	3	4	5	6	7	8	9	10
Mimosoideae								
Tribe :								
Mimoseae :								
1. *Prosopis juliflora*	Compound	Stalked	Bi-pinnate	Asymmetrical, (base only) oblong	Hairy	Acute	Entire	Mucronate
2. *Leucaena glauca*	Compound	Pinnule without stalk	Bi-pinnate	Asymmetrical, oblong narrow	Smooth	Acute	Entire	Acute
3. *Mimosa pudica*	Compound	Stalked	Digitately Pinnate, Pinnae-bipinnate	Asymmetrical, narrow-oblong	Bristly	Obtuse	Entire	Mucronate
4. *M. rubicaulis*	Compound	Stalked	Bi-pinnate	Asymmetrical, narrow-oblong	Hairy	Rounded	Entire	Rounded
Tribe-Acacieae								
5. *Acacia arabica*	Compound	Stalked	Bi-pinnate	Asymmetrical, narrow-oblong	Hairy	Obtuse	Entire	Acute
6. *Acacia auriculiformis* (Phyllode)	Simple	Stalked		Asymmetrical oblong lorate	Smooth	Acute	Entire	Acute
7. *A. concinna*	Compound	Stalked	Bi-pinnate	Asymmetrical, oblong	Hairy	Obtuse	Entire	Acute
8. *Albizia lebbek*	Compound	Stalked	Bi-pinnate	Asymmetrical, oblong	Hairy	Acute	Entire	Obtuse or retuse
9. *Samania saman*	Compound	Stalked	Bi-pinnate	Asymmetrical, lanceolate	Hairy	Acute or cuneate	Entire	Acute
10. *Pithecolobium dulce*	Compound	Stalked	Bi-pinnate	Asymmetrical oblong	Hairy	Acute	Entire	Acute or obtuse

Table 2—Showing range of leaf architectural pattern of 10 species of the sub-family Mimosoideae

Name of Plant	Unicostate or multicostate	No. of secondaries & their nature	Reticulation is upto	Areole formation by	Shape of areole	Areole mostly with (No. of vein ending)	Free vein ending consisting of tracheids in rows	Tips of vein endings	Marginal ultimate venation
1	2	3	4	5	6	7	8	9	10
1. *Prosopis juliflora*	Multicostate No. of Pri-3 Acrodromous perfect	6-8 pairs Brochidodromous	5th	3rd & 4th	Irregular	0—1	2—3	Curved, swollen	Complete and looped
2. *Leucaena glauca*	Multicostate, Many, No. of Pri-3 Acrodromous imperfect	Many, Brochidodromous	6th	3rd & 4th or 4th category only	Polygonal	One	2	Curved, branched or unbranched, swollen	Nearly complete and looped
3. *Mimosa pudica*	Multicostate, No. of Pri-3-4 Brochidodromous acrodromous perfect	5-8 pairs Brochidodromous	5th	3rd & 4th	Quadrangular to Polygonal	0—1	One, rarely two	Straight, curved, swollen, unbranched	Complete and somewhat looped
4. *M. rubicaulis*	Multicostatte, No. of Pri-3 Acrodromous perfect	Many, Brochidodromous	6th	4th & 5th	Rectangular to Polygonal	One	1—2	Swollen, straight or simply curved, unbranched	Nearly complete and somewhat looped
5. *Acacia auriculiformis*	Multicostate, No. of Pri-5 Parallelodromous	Many, Parallely arranged	4th	2nd & 3rd	Rectangular or irregular	0—1	2	Swollen	Complete, fimbrial vein formed
6. *A. arabica*	Multicostate, No. of Pri-3 Acrodromous (basal) imperfect	4-6 Brochidodromous	5th	3rd & 4th	Polygonal	One	2	Not swollen, curved, branched, or unbranched	Nearly complete and looped.

7. *A. concinna*	Multicostate, No. of Pri-3-4, Acrodromous imperfect	4-8 pairs, Brochidodromous	6th	5th & 4th	Polygonal or Quadrangular	One	2	Straight, not curved and swollen, unbranched	Complete and looped
8. *Albizia lebbek*	Unicostate	6-10 pairs, Brochidodromous	6th	4th & 5th	Pentagonal or Polygonal	One	2—4	Swollen, curved branched or unbranched	Complete and looped, almost fimbrial vein formed
9. *Samania saman*	Unicostate	6-8 pairs, Brochidodromous	5th	3rd & 4th	Pentagonal	One	2-3	Swollen, slightly curved, branched or unbranched	Complete and looped
10. *Pithecolobium dulce*	Unicostate	7-9 pairs, Brochidodromous	6th	4th & 5th	Variable	One	2	Not swollen, branched or unbranched, diminishes into fine reticulum, curved.	Complete and looped

No. of Pri—Number of Primary veins.

but they are uniformly brochidodromous. The level of areole formation in pinnae is variable in taxa. It occurs between 3rd, 4th and 5th level. Similarly the shape of the areole formation varies from irregular, rectangular, polygonal or pentagonal. Each areole has one vein ending.

In studying cuticular features 7 different parameters (Table 3) have been used for detailed analysis. Pinnae are amphistomatic except in *Samania saman* (Table 3). The stomatal types are mostly paracytic. The shape of the epidermal cells, the distribution of stomata in lower and upper epidermis are often different within the same species. However, the trichomes are similar on both the surfaces in all the species studied here except in *Albizia lebbek*. Thus taken all the characters together, i.e. the external morphology of the leaf, venation pattern and epidermal features, it is possible to identify different genera and species belong to this subfamily (Key I).

The basic chromosome number in this subfamily (family) is thirteen. The nature is uniformly brochidodromous in taxa investigated. Therefore it appears that there are correlations between the basic chromosome number and the nature of secondary veins in various taxa. The authors have previously reported the same thing (in press) while investigating the venation patterns of members of Papilionoideae. However, we would like to give a word of caution here regarding this aspect. The family Leguminosae has about 12000 species and in the present investigation only 61 species have been studied and therefore investigation on various taxa of this family on architectural pattern is needed to confirm the observations firmly.

Artificial key for the identification of some genera and species of Mimosoideae on the basis of leaf characters :

1. Leaves compound, bipinnate
   - i) Pinnae unicostate — *Albizia lebbek, Samania saman, Pithceolobium dulce*
   - ii) Secondary veins brochidodromous — Marginal vein complete and looped; almost fimbrial vein formed — *Albizia lebbek*
   - iii) Marginal vein complete and looped — *Samania saman* and *Pithecolobium dulce*
   - iv) Pinnules amphistomatic — *Pithecolobium dulce*
   - iv) Pinnules hypostomatic — *Samania saman*
   - i) Pinnae multicostate; primary veins acrodromous perfect type — *Prosopis juliflora, Mimosa pudica* and *M. rubicaulis*
   - v) Hairs glandular, branched or palmately divided — *Prosopis juliflora*
   - v) Hairs glandular, with uniseriate stalk and spherical heads or nonglandular or multicellular shaggy type — *Mimosa pudica*
   - v) Hairs 1-2 celled, nonglandular, uniseriate; glandular hairs absent — *M. rubicaulis*
   - ii) Multicostate; primary veins acrodromous imperfect — *Leucaena glauca, Acacia arabica, A. concinna*

Table 3—Showing range of cuticular features of 10 species of the sub-family Mimosoideae

Name of Plant	Amphistomatic or hyposto-matic	Type of stomata and their distribution pattern ; arrangement, orientation and stomatal index (S.I.)		Shape and nature of cell-wall of epidermal cells		Trichome and its nature	
		Lower surface	Upper surface	Lower surface	Upper surface	Lower surface	Upper surface
1	2	3	4	5	6	7	8
Mimosoideae :							
Tribe : Mimoseae							
1. *Prosopis juliflora*	Amphisto-matic	Paracytic; stomata all over, irregularly arranged, variously oriented. S.I. 23.80	Similar type and stomatal distribu-tion pattern. S.I. 10.13.	Pentagonal to polygonal, straight	Pentagonal to hexagonal, straight	Glandular, palmately divided or bran-ched type rarely non-glandular uni-seriate type.	Simllar type
2. *Leucaena glauca*	Amphisto-matic	Paracytic, stomata all over, except on primary veins, irre-gularly arranged, oriented almost parallel to the long axis of the primary veins. S.I. 13.73.	Paracytic, stomata all over, irregu-larly arranged, oriented almost parallel to the long axis of primary and secondary veins. S. I. 4.34.	Irregular, sinuous	Irregular, sinuous	Nonglandular, uni-cellular, conical type and glandular multicellular type	Similar
3. *Mimosa pudica*	Amphisto-matic	Paracytic, stomata allover, except on midvein, irregula-rly arranged, oriented parallel to the long axis of lamina. S. I. 30-97.	Paracytic) stomata all over except on midvein irregular-ly arranged, orie-nted parallei to the long axis of the lamina. S. I. 17.8	Irregular; sinuous	Irregular undula-ted	Unglandular, uni-seriate, with promi-nent base of two-celis and multi-cellular shaggy type	Similar
4. *M. rubicaulis*	Amphisto-matic	Paracytic; stomata all over, irregu-larly arranged,	Paracytic; stomata all over, irregu-larly arranged,	Rectangular to polygonal; straight	Irregular, rectan-gular or penta-gonal; straight	Nonglandular, 1-2 celled, uniser-iate	Similar

Table—3 *Contd.*.

2	1	3	4	5	6	7	8
		oriented parallel to the long axis of the primary veins only. S. I. 15.41.	variously oriented S. I. 6.06				
Tribe : Acacieae							
5. *Acacia auriculiformis*	Amphistomatic	Paracytic to amphiparacytic: stomata all over, except on midvein and primary lateral veins irregularly arranged, variously oriented. S.I. 9.0	Similar type and stomatal distribution pattern. S.I. 8.0.	Polygonal or irregular; straight or slightly undulated.	Similar	Glandular peltate, with heads of various sizes	Similar
6. *A. arabica*	Amphistomatic	Paracytic, stomata all over, except on midvein irregularly arranged, variously oriented. S.I. 23.28	Paracytic; stomata all over, irregularly arranged, variously oriented. S.I. 10.85	Polygonal; slightly undulated	Polygonal; sinuous	Nonglandular, uniseriate, conical type	Similar
7. *A. concinna*	Amphistomatic	Paracytic; stomata all over, except on midvein and primary lateral veins irregularly arranged, variously oriented. SI. 43.83	Paracytic; stomata only on either side of the veins, irregularly arranged, variously oriented.	Polygonal; sinuous	Polygonal; sinuous and ridged.	Nonglandular, mostly unicellular, rarely 2-3 celled, uniseriate	Similar type but frequency low
8. *Albizia lebbek*	Amhistomatic	Paracytic, stomata all over, except on midvein, irregularly arranged, variously oriented.	Paracytic; stomata only on the midrib, longitudinally arranged, oriented parallel to the midrib.	Irregular; sinuous; ring-like ornamentation present	Irregular; sinuous; rod-like ornamentation present	Nonglandular unicellular, conical type	Nonglandular unicellular, straight

9. *Samania saman*	Hypostomatic	Paracytic to amphiparacytic; stomata all over, except on veins, irregularly arranged, variously oriented. S.I. 25.0	Nil	Irregular; sinuous; ring-like ornamentation present.	Irregular; undulated	Nonglandular, unicellular, conical, cylindrical and macrofom conical type	Similar type
10. *Pithecolobium dulce*	Amphistomatic	Paracytic to amphiparacytic; stomata all over, except on midvein and primary lateral veins, irregularly arranged, variously oriented. S.I. 24.72.	Paracytic; stomata only on midvein and primary lateral veins, irregularly arranged, variously oriented.	Irregular, sinuous	Irregular, sinuous	Nonglandular, unicellular, straight or conical	Similar

v) Hairs unicellular, nonglandular and multiseriate glandular type — *Leucaena glauca*
v) Hairs unicellular, nonglandular, found in the margin of the leaflets only — *Acacia arabica*
v) Hairs unicellular or multicellular (1-3 celled) uniseriate, nonglandular type — *Acacia concinna*
ii) Multicostate, primary veins parallelodromous — *Acacia auriculiformis* (phyllode)

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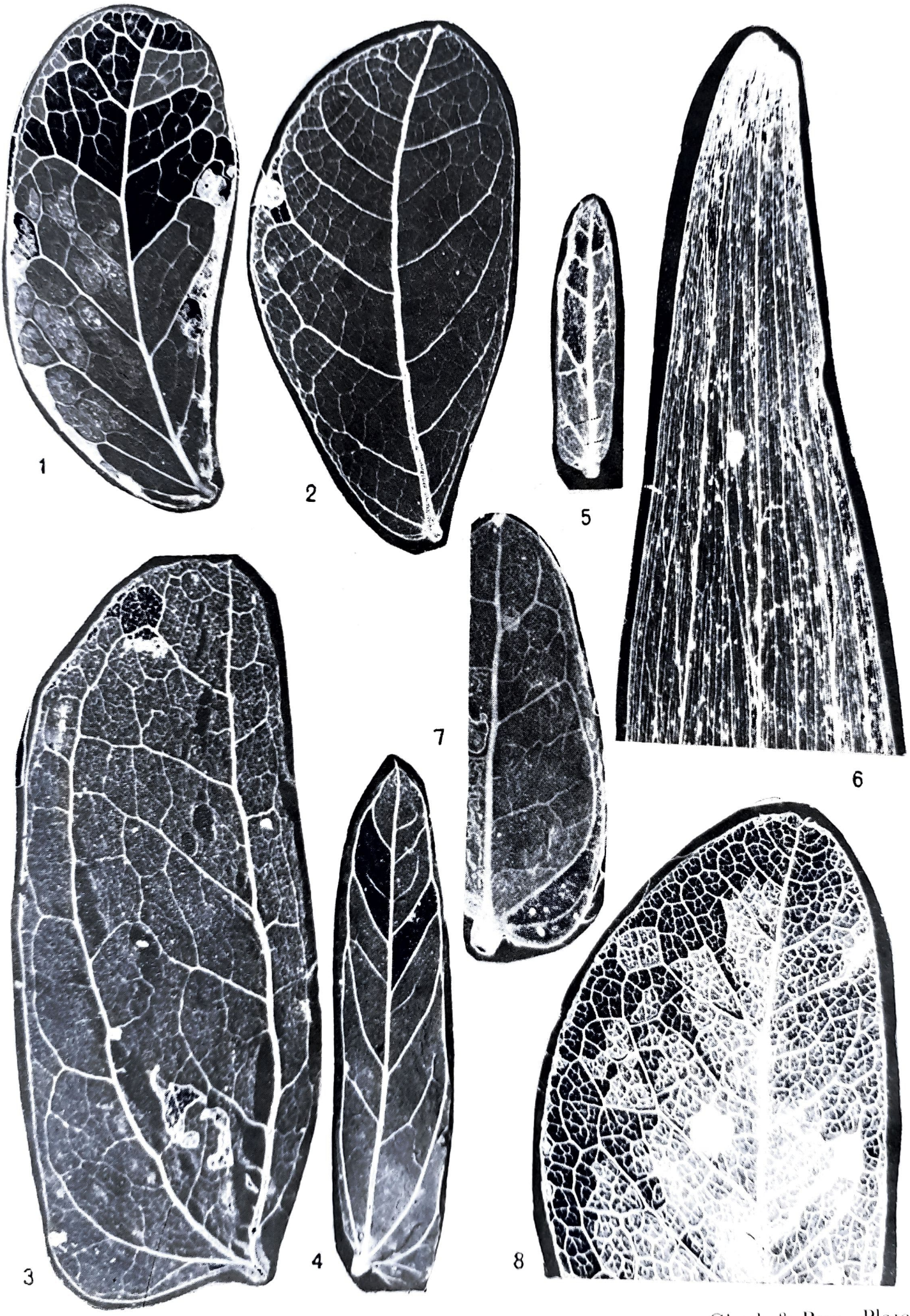
Explanation of Plate

1. *Pithecolobium dulce* venation pattern × 5.
2. *Samania saman* showing major and minor veins × 3.
3. *Mimosa rubicaulis* showing minor and major venation × 10.
4. *Mimosa pudica* showing venation pattern × 8.
5. *Acacia arabica* showing venation pattern × 10.
6. *Acacia auriculiformis* part of phyllode showing venation × 5.
7. *Acacia concinna* showing major and minor veins × 8.
8. *Albizzia lebbek* showing details of major, minor and marginal veins × 8.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