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COMPARATIVE ACCOUNT OF PLANTS OF MIMOSACEAE WITH REFERENCE TO THE LEAF DIVERSITY

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ABSTRACT:
Family Mimosaceae is an important family of order Fabales with twelve genera in the Nagpur district. Present study enumerated 12 genera and 25 species and 2 subspecies from Nagpur city. Out of all studied species, 40% members belong to genus *Acacia.* Leaves of Mimosaceae showed many distinct features. The comparative morphological study of leaves revealed that the number of pairs of pinnae and pinnules show major variation pattern. The pinnule apex, margin, shape, surface, stipules, petiole and the presence of glands on petiole and on rachis all vary from species to species. Bipinnately compound, hooked thorn or stipular spines, slender- pubescent petioles, acute or mucronate apex, linear-oblong shape, glabrous upper surface are some of the common characters reported. Whereas, adnate and intrapetiolar stipules, prickly and modified petioles, emarginate apex, entire-ciliate margin, elliptic oblong or obovate shape, glaucous and coriaceous surface etc. are not common.

Key words: - ***Fabales, Mimosaceae, Nagpur city, Leguminosae, Leaf diversity.***

INTRODUCTION:

Order Fabales is one of the largest order of Angiospermic plants. It consists of Mimosaceae, Caesalpiniaceae & Fabaceae (Papilionaceae) families. The family Mimosaceae is widely distributed in the tropical and subtropical regions. Mimosaceae family is comparatively small that represents 82 genera and more than 3200 species worldwide (Raes et. al., 2013; Yahara et. al., 2013). Mimosaceae is characterized by having actinomorphic flowers rather than zygomorphic.

Leaves are generally ignored in taxonomic studies and also in comparative morphological studies. Most of the researchers pay more attention towards the reproductive or floristic features of plants (Hickey, 1973). Recent studies on leaf, reveal that leaves are also very distinct from one to another and may play a vital role in classification or taxonomic studies (Caballero & Aranda, 2010). Various morphological characters of leaf used in plant identification (Waldchen, et. al., 2018). Family Mimosaceae were studied and recorded for their diversity in different regions of the world. The main focus of the previous investigation is to prepare taxonomic records, collect information about floral morphology and anatomical variations. Very less data is available regarding the variation on the basis of leaf in family Mimosaceae. This study was undertaken to survey on the leaf-characteristics of family Mimosaceae in the Nagpur city of Maharashtra (India).

Leaves are an important organ of plants which perform photosynthesis in most of the plants. It also performs transpiration. Besides their similar functions they show several structural variations (Gardner et al., 2008). Leaves are divided into two basic types i.e. simple and compound. Compound leaves are widely present. Many researchers believed that the compound leaf arises from the

numerous incisions to simple leaves (Champagne & Sinha, 2004).

The compound leaf in the family Mimosaceae is somewhat unique in entire angiosperms. In this family leaves are pinnately compound. Almost all members show paripinnate and bipinnate compound leaves. The main axis of pinnate leaves are known as rachis; the lateral axis i.e. rachillae, which bears pinnules. In most of the species of family Mimosaceae having sessile or petiolulate pinnules. Petiolule is a short petiole like structure which is attached with rachillae. Many members of the family bear stipular spines or thorns. Spines, thorns or prickles shows characteristic and structural variations (Simpson, 2010). A few species of Mimosaceae show seismonastic movements (e.g. *Mimosa pudica)* while a few like *Albizia sp.* show nyctinastic movements (Wilkinson, 1983).

Nagpur city is rich in biodiversity in the composition of plants (Chaturvedi et al., 2013). For the very first time 6 genera and 10 species were enlisted from Nagpur and Telangkheri farm (Graham, 1911). Later on several researchers reported numerous members of family mimosaceae (Thakre & Shrinivasu, 2016; Thakre & Srinivasu, 2013; Ugemuge, 1986). The recent investigation reported 11 genera, 24 species and 2 subspecies of family mimosaceae and *Acacia* is the dominant genus of the family (Dulare et al., 2021). The previous investigations are mainly based on taxonomic, anatomical, embryological or ethnobotanical point of view. On the basis of leaf morphology no evident research has been done earlier.

In present investigation, there are 12 genera and 25 species and 2 subspecies were recorded and studied. Various characters are observed and compared on the basis of leaf morphology. This study will help in the identification & comparative models of the taxa.

MATERIALS AND METHODS

Extensive visits to different localities of Nagpur city have been made during all the seasons from 2019 to 2021. The present investigation covers almost 220.8 sq. km of area (Map:1). During each visit a voucher specimens were collected for laboratory analysis. All collected samples along with serial numbers were recorded in a field diary. In the field book observations were recorded like habit, form, and other features like vegetative, reproductive etc. All the collected specimens are properly dried, pressed, pasted and preserved on herbarium sheets using standard methods (Maden, 2004) along with their identification and authentication. Plant identification and authentication has been done by using valid literatures, Floras, research articles etc., (Bentham, G.; Hooker, 1865; Naik, 1998; Singh, N. P.; Karthikeyan, 2000; Talbot, 1976; Ugemuge, 1986). Each specimen was observed carefully and compared on the basis of several morphological aspects. The collection of this herbarium has been compared with the herbarium of PGT Dept. of Botany, RTM Nagpur University Nagpur. The basic and the available tools have been used for comparative account of leaf morphology. In present investigation, various characters are observed and compared on the basis of leaf morphology along with insertion of leaves, type of leaf, phyllotaxy, structure and type of stipule, structure of petiole, base of petiole, number of pinnae, number of pinnules, apex of pinnules, base of pinnules, margin of pinnules, venation, surface of leaf etc.

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Map 1: Nagpur City Map showing working zones

RESULT & DISCUSSION :

Present investigation enumerated list of features and their comparison on the basis of leaves. There were total 25 species under observation and comparison, out of which 10 species are of *Acacia.* The plants of family mimosaceae are mostly trees or shrubs, but a few plants like *Mimosa pudica* and *Neptunia triquetra* showed herbaceous nature. Leaves of mimosaceae showed pinnately compound leaves which are bipinnate with variations among different species. (Table No.1)

The observed species of Mimosaceae showed alternate phyllotaxy. Most of the members have a unicostate reticulate type of venation in pinnules. In *Acacia auriculiformis*, petioles are modified into phyllodes which showed multicostate parallel convergent venation. Almost all members except *A. auriculiformis* having pulvinus base of petiole, while *A. auriculiformis* shows attenuate base of petiole. Insertion of leaves are Cauline or Ramal type. In *Acacia campbelli, A. farnesiana, Dichrostachys cinera, Mimosa pudica, M. rubicaulis* and *Neptunia triquetra* having Cauline and Ramal type leaf insertion, while rest of the members showed Ramal type of insertion. In a few species like *Acacia farnesiana* and *A. ferruginea* two or more leaves arise from each successive node. The rest of the members bear one leaf at each node.

Many species showed stipular spines which are variable in length and size; in species like *Acacia catechu, A. ferruginea* stipules are present in the form of hooked thorns. In *Mimosa hamata* and *M. pudica* shows prickly stipules while some are exstipulate in *Acacia auriculiformis, Adenanthera pavonina, Albizia lebbeck, A. procera,* or caducous in *Leucaena latisiliqua.* In present investigation, different types of stipules are observed on the basis of position of stipule. In *Mimosa hamata,* stipules are intrapetiolar while in *Mimosa pudica* and *M. rubicaulis* having lateral stipules. In *Calliandra emarginata* stipules are intrapetiolar while in *Calliandra surinamensis* the stipules are adnate type. The basal type of stipules occur in *Neptunia triquetra* whereas in *Parkia biglandulosa* and *Dichrostachys cinera* the stipules are scale-like. In *Acacia tomentosa*, stipules made a bunchy structure.

In the family Mimosaceae, petiole also showed variation. In most of the members petioles are slender and long but in *Acacia auriculiformis* it is flat, falcate and narrow towards the both ends. It is known as phyllodes which perform photosynthesis and transpiration. Petioles of several species showed the presence of a flat or cup shaped gland. The position and shape of glands may vary in different species. Majority of members which having the gland on petiole, it was at middle of petiole but in *Albizia lebbeck* and *A. procera,* a large, ovate, flat gland and elliptic, flat gland present near the base of petiole respectively. Cup shaped glands also present in between the pairs of pinnae. In *Acacia leucophloea, A. pennata, Albizia lebbeck* and *Dichrostachys cinera*, peltate or cup shaped gland present between each pair of pinnae, while in *Acacia nilotica ssp. astrigens, A. nilotica ssp. nilotica, A. tomentosa, etc.* having glands in between uppermost pairs. *Acacia catechu* and

Mimosa hamata show prickles or spines on rachis ventrally.

The number of pinnae and pinnules also showed much diversity according to the species (Table No.2 and Graph 1, 2). The pinnules are variable in size and shape. Apex of pinnules is mostly acute or mucronate, while in a few species it is obtuse or retuse. Apex of pinnules slightly emarginate or acute in *Calliandra emarginata.* The common character found in all members of selected genera are oblique base of pinnules. The margin of pinnules in most species is entire, but in *Acacia catechu, A. tomentosa* and *Mimosa rubicaulis* the margin is entire-ciliate. In majority of genera, the shape of pinnules are linear-oblong. In the *Adenanthera pavonina, Pithecellobium dulce*, *Mimosa hamata* and *Calliandra surinamensis,* pinnules are elliptically obovate or oblong, while in *Samanea saman, Calliandra emarginata* the pinnules are obliquely-obovate and elliptic obliquely-obovate respectively. Surface of the leaves also show variations in the selected genera. In most of the species, an upper surface is glabrous or glabrascent and lower surface is mostly pubescent. These findings with reference to the leaf diversity is found similar to the earlier work of Ugemuge, (1986); Naik, (1998) except some stipular, petiolar and numeral variations in pinnae and pinnules.

CONCLUSION:

Plants show mostly a ramal insertion, bipinnate compound leaf; phyllotaxy alternate. Almost 50% of the plants are with hooked thorn or stipular spines, while adnate and intrapetiolar stipules are not common. In most of the plants, petioles are slender, long and pubescent, while prickly and modified petioles are rare in family. Though the leaves are bipinnately compound but, there is a great variation and diversity in number of pinnae and pinnules pairs. Apex of pinnules is mostly acute or mucronate, whereas emarginate apex is not common. Base of the pinnules are almost oblique. Margin of the pinnule is mostly entire whereas entire-ciliate is rare. The shape is mostly linear-oblong while elliptic oblong or obovate is not so common. Surface of pinnules is mostly glabrous above and pubescent beneath, while glaucous, coreaceous is not common. Stipular modifications like spines, hooked thorns, petiolar glands, their position and numeral diversity in pinnae and pinnules, oblique base of pinnules are the distinct leaf characters of the family Mimosaceae. However, the characters such as bipinnate leaves, leaf insertion, shape and surface are also common in Caesalpiniaceae and Fabaceae.

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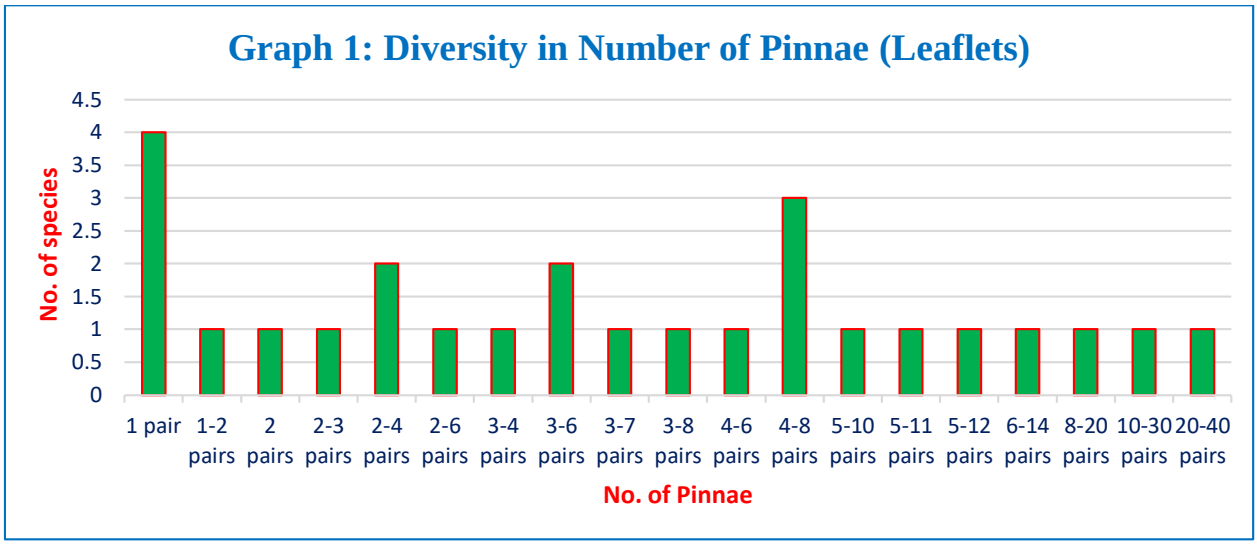

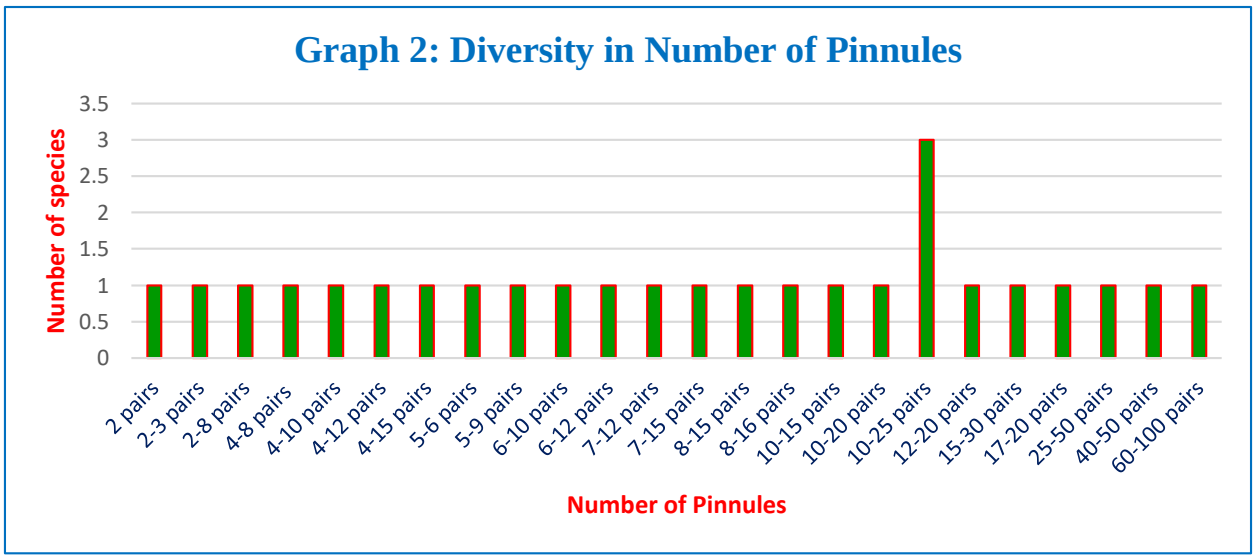

Table: 1 : **Leaf morphology**

Sr. no.	Scientific Name of Plants	Insertion	Phyllotaxy	Type of leaf	Stipules	Petiole
1	*Acacia auriculiformis* A. Cunn.	Ramal	Alternate	Bipinnate	Exstipulate	Modify into phyllode, flat, falcate, 8-20 cm long, 1-3 cm broad
2	*Acacia campbelli* Arn.	Caulin e/ Ramal	Alternate	Bipinnate	Stipular spines along with hairy appendages	Slender, pubescent, 1-2 cm, Large gland on middle
3	*Acacia catechu* (L.F.) Willd.	Ramal	Alternate	Bipinnate	Hooked Thorns	slender, pubescent, 1-3 cm, Large flat gland on middle

4	*Acacia farnesiana* (L.) Willd.	Ramal	Alternate	Bipinnate	Stipular spines	Slender, pubescent, 1-2 cm, quadrangular
5	*Acacia ferruginea* DC.	Ramal	Alternate	Bipinnate	Hooked stipular spines	Slender, flat, 1-3 cm, with gland
6	*Acacia leucophloea* (Roxb.) Willd	Ramal	Alternate	Bipinnate	Stipular spines, short, straight, in variable length	Long, slender, pubescent, with gland
7	*Acacia nilotica* (L.) Willd. Ssp. *astringens* (Schum. & Thonn) Roberty.	Ramal	Alternate	Bipinnate	Stipular spines, white, stout, long	Slender, pubescent, 2-3 cm, with flat gland
8	*Acacia nilotica* (L.) Willd. Ssp. *indica* (Bth.) Brenan.	Ramal	Alternate	Bipinnate	Stipular spines, variable, straight	Slender pubescent, 2-3 cm, with flat gland
9	*Acacia pennata* (L.) Willd.	Ramal	Alternate	Bipinnate	Hooked or straight prickles	Slender, pubescent, 2-3 cm, with flat gland
10	*Acacia tomentosa* Willd.	Ramal	Alternate	Bipinnate	Stipular spines, straight	Slender, thick, tomentose, 1-2 cm long
11	*Adenanthera pavonina* L.	Ramal	Alternate	Bipinnate	Exstipulate	Long, slender, glabrous, 5-8 cm
12	*Albizia lebbeck* (L.) Willd. Var.*lebbeck*	Ramal	Alternate	Bipinnate	Exstipulate	Long, slender, pubescent, 4-6 cm long, flat gland at base
13	*Albizia procera* (Roxb.) Bth.	Ramal	Alternate	Bipinnate	Exstipulate	Long, slender, seriate, 4-8 cm, elliptic gland at base
14	*Dichrostachys cinera* (L.) var.*indica* Brenan & Brumit.	Ramal / caulin e	Alternate	Bipinnate	Scaly paired stipules	Short, slender, 1-2 cm, with minute gland, pubescent
15	*Leucaena latisiliqua* (L.) Gills.	Ramal	Alternate	Bipinnate	Exstipulate / caducous	Long, slender, 3-6 cm, glabrous, with flat gland at middle
16	*Mimosa hamata* Willd.	Ramal	Alternate	Bipinnate	Intrapetiolar	Long, slender, prickly, 2-3

17	*Mimosa pudica* L.	Caulin e/ ramal	Alternate	Bipinnate (sensitive)	Lateral, Bristly paired stipules	Long, slender, pubescent, sensitive hairs, 2-4 cm
18	*Mimosa rubicaulis* Lam.	Caulin e/ ramal	Alternate	Bipinnate	prickly, stipules subulate	Short, slender, prickly, pubescent, 2-3 cm
19	*Neptunia triquetra* (Vahl.) Btm.	Caulin e/ ramal	Alternate	Bipinnate	Basal Stipules, obliquely ovate	Short, slender, 0.5-2 cm, pubescent, pink
20	*Parkia biglandulosa* Wight & Arn.	Ramal	Alternate	Bipinnate	Scaly	Long, slender, pubescent, 4-10 cm
21	*Pithecellobium dulce* (Roxb.) Btm.	Ramal	Alternate	Bipinnate	Stipular spines	Long, slender, glabrous, 3-5 cm
22	*Prosopis cineraria* (L.) Druce.	Ramal	Alternate	Bipinnate	Stipular spines	Long, slender, pubescent, 2-3 cm
23	*Prosopis juliflora* (Swartz.) DC.	Ramal	Alternate	Bipinnate	Stipular spines short, stout, straight	Long, slender, pubescent, 2-4 cm
24	*Samanea saman* (Jacq.) Merr.	Ramal	Alternate	Bipinnate	Exstipulate	Long, slender, glabrous, 4-8 cm
25	*Calliandra surinamensis* Benth.	Ramal	Alternate	Bipinnate	Adnate	Short, slender, glabrous, 0.5-2 cm
26	*Calliandra emarginata* Benth.	Ramal	Alternate	Bipinnate	Intrapetiolar	Short, stout, pubescent, upto 1 cm

Table: 2 : **Leaf morphology**

Sr. no.	Scientific Name of Plants	Pinnae	Pinnules	Apex of pinnules	Base of pinnule	Margin (Pinnule)	Shape (Pinnule)	Surface
1	*Acacia auriculiformis* A. Cunn.	1 pair	5-6 pairs	Obtuse, attenuate	Oblique	Entire	Linear-oblong	Thick-coreaceous
2	*Acacia campbelli* Arn.	4-6 pairs	6-12 pairs	Acute	Oblique	Entire	Linear-oblong	Pubescent
3	*Acacia catechu* (L.F.) Willd.	10-30 pairs	25-50 pairs	Acute or subacute	Oblique	Entire, ciliate	linear, sessile	Glabrous above, Pubescent beneath
4	*Acacia farnesiana* (L.) Willd.	4-8 Pairs	10-20 pairs	Acute	Oblique	Entire	Linear-oblong	Glaucous above, paler beneath
5	*Acacia ferruginea* DC.	3-6 pairs	10-25 pairs	Mucronate or Mucronulate	Oblique	Entire	Linear-oblong	Glabrous

6	*Acacia leucophloea* (Roxb.) Willd	5-12 Pairs	15-30 pairs	Acute or obtuse	Oblique	Entire	Linear-oblong	Coreaceous, pubescent
7	*Acacia nilotica* (L.) Willd. Ssp. *astringens* (Schum. & Thonn) Roberty.	3-8 pairs	10-25 pairs	Mucronate	Oblique	Entire	Linear-oblong	Glabrous
8	*Acacia nilotica* (L.) Willd. Ssp. *indica* (Bth.) Brenan.	4-8 Pairs	10-25 pairs	Acute or suboptuse	Oblique	Entire	Linear-oblong	Glabrous
9	*Acacia pennata* (L.) Willd.	8-20 pairs	40-50 pairs	Acute or obtuse	Oblique	Entire	Linear, oblong	Glabrous or ciliate
10	*Acacia tomentosa* Willd.	5-10 pairs	8-16 pairs	Acute	Oblique	Entire, ciliate	Linear-oblong	Tomentose
11	*Adenanthera pavonina* L.	3-6 pairs	4-8 pairs	Obtuse	Oblique	Entire	Elliptic, Obovate, oblong	Glabrous above, glaucous beneath
12	*Albizia lebbeck* (L.) Willd. Var.*lebbeck*	2-4 pairs	5-9 pairs	Retuse or obtuse	Oblique	Entire	Elliptic, oblong	Glabrous above, Glabrascent beneath
13	*Albizia procera* (Roxb.) Bth.	2-6 pairs	4-12 pairs	Obtuse or emarginate	Oblique	Entire	Linear-Oblong	Glabrous above, pubescent beneath
14	*Dichrostachys cinera* (L.) var.*indica* Brenan & Brumit.	6-14 pairs	7-15 pairs	Acute or obtuse	Oblique	Entire	Linear-oblong	Glabrous above, pubescent beneath
15	*Leucaena latisiliqua* (L.) Gills.	4-8 Pairs	10-15 pairs	Acute	Oblique	Entire	Linear, membranous	Glaucous above, finely pubescent beneath
16	*Mimosa hamata* Willd.	3-4 pairs	4-10 pairs	Acute, mucronate	Oblique	Entire	Ovate-oblong	Glabrous above, pubescent beneath
17	*Mimosa pudica* L.	1-2 pairs	12-20 pairs	Acute or obtuse	Oblique	Entire	Linear-oblong	Glabrous above, pubescent beneath
18	*Mimosa rubicaulis* Lam.	5-11 pairs	8-15 pairs	Acute	Oblique	Entire, ciliate	Linear-oblong	Glabrous above, pubescent beneath
19	*Neptunia triquetra* (Vahl.) Btm.	2-3 pairs	4-15 pairs	Mucronate or Obtuse	Oblique	Entire	Linear-oblong	Glabrous or glaucous
20	*Parkia biglandulosa* Wight & Arn.	20-40 pairs	60-100 pairs	Mucronate	Oblique	Entire	Linear, oblong	Glabrous above, pubescent beneath
21	*Pithecellobium dulce* (Roxb.) Btm.	1 pair	2 pairs	Obtuse or retuse	Oblique	Entire	Obovate, oblong	Subcoreaceous, glabrous

22	*Prosopis cineraria* (L.) Druce.	2 pairs	7-12 pairs	Acute or mucronate	Oblique	Entire	Linear, oblong	Glabrous
23	*Prosopis juliflora* (Swartz.) DC.	2-4 pairs	17-20 pairs	Obtuse	Oblique	Entire	Linear, oblong	Glabrous
24	*Samanea saman* (Jacq.) Merr.	3-7 pairs	2-8 pairs	Acute or obtuse	Oblique	Entire	Elliptic, rhombo id	Glabrous, shiny
25	*Calliandra surinamensis* Benth.	1 pair	6-10 pairs	Acute or obtuse or sliglitly emarginate	Oblique	Entire	Elliptic or oblique ly obovate (Kidney shape)	Glaucous or glabrous
26	*Calliandra emarginata* Benth.	1 pair	2pairs, 1 odd pinnule	Acute or mucronate	Oblique	Entire	Elliptic ally oblong	Glabrous