



# AN INTERGENERIC COMPARATIVE STUDY OF SOME SELECTED MEMBERS OF THE FAMILY STERCULIACEAE

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**Abstract:** A comparative study was undertaken with an aim to compare morpho-anatomical characters with special emphasis on trichomes, stomatal index and stomatal patterns in some selected members of the family Sterculiaceae, which may be useful in species identification and to evaluate their significance in the taxonomy of the genus. The different taxa under investigation were *Melochia corchorifolia* Linn., *Sterculia balanghas* Linn., *Kleinhovia hospita* Linn., *Guazuma ulmifolia* Lamk. and *Helicteres isora* Linn. Even though this family has many similarities, members show remarkable variations in morphology, anatomy and stomatal index. There is observable difference in morphological features such as presence or absence of staminoids, presence of gynophore/androphore, number and arrangements of stamens etc. A small amount of variation was observed in the anatomy and variations present in the type of trichomes. By evaluating both morphological and anatomical characters the author is of the opinion that the members of the family are distinct morphologically and they show few variations among anatomical features and stomatal index.

**IndexTerms-**Comparitivemorphology,Comparitiveanatomy,Sterculiaceae,Stomatal index,Trichome.

## I. INTRODUCTION

Plant taxonomy is the branch of biological science which is concerned with identification nomenclature and classification in a system made up according to the available evidence of phylogenetic relationships Simpson (1961). According to AK Mondal "taxonomy is the theory and practice of classification", is one of the oldest fields of biological sciences. The wealth of vegetation that adorns the earth includes, a conservative estimate of about 400,000 describe species of plants, of which 286, 000 belongs to flowering plants. They show a wide diversity of form and mode of life. Some gigantic trees are attaining a height of above 100 m with very complex structure, while some of them are minute floating herbs with a very simple construction. Since the early civilization man has been absolutely dependent on plants for food shelter clothing fuel medicine paper etc. Thus the primitive man tried to group the plants according to their economic uses.

The present study aims at the intergeneric comparison of some selected members of the family Sterculiaceae with special emphasis on their morpho anatomical features. Plants are collected from different places of Alappuzha which were available during my study period.

The present study follows Bentham and Hooker's classification (1862). According to that, Sterculiaceae comes under Class: Dicotyledonae, Subclass: Polypetalae in the Series of Thalamiflorae under Order: Malvales.

The Sterculiaceae is one of the most important families among flowering plants, consisting of nearly 70 genera and 1,500 species, mainly in tropical and subtropical origin. Many of its members demonstrate medicinal properties and have been used for the treatment of various ailments and wounds. Members of this family includes trees, shrubs, dwarf shrubs, herbs and rarely climbers. They possess stellate (star shaped) hairs, fibrous stem and mucilage sacs epicalyx absent, flowers pentamerous, stamens monadelphous ditheous extrorse anthers, staminodes present. Capels 3-5, syncarpous, ovary superior, penta locular or multilocular sometimes raised above by the development of gynophore, axile placentation. Each chamber with 2 to many ovules. Fruit is typically a capsule. Seed is numerous with a fleshy endosperm.

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The study focuses on determining the intergeneric comparison at genus level using morpho-anatomical characters. The plants used for the study are *Sterculia balanghas*, Linn. *Helicteres isora* Linn., *Guazuma ulmifolia* Lamk., *Kleinhovia hospita* Linn., *Melochia corchorifolia* Linn. Local plants were selected, identified and compared using morphology and anatomy by conducting an inter-generic comparison of these species, the present work aims to explore various aspects, including morphological and anatomical features especially features of stomata.

In this study methodologies such as taxonomic examinations, morphological measurements, anatomical studies using sections and peeling of epidermis to determine stomatal density, calculation of stomatal index, stomatal types and preparation of herbarium etc. were utilized. Through a comprehensive inter-generic comparison, this study intends to uncover valuable insights into the diversity of these species.

### 1.1 Objectives

- To compare morphological features of the selected plants.
- To compare anatomical features of selected members of the family Sterculiaceae.
- To determine the stomatal density of members selected for present study.
- To calculate the stomatal index of the selected members.

## II. MATERIAL AND METHODS

III. 1. **Collection and Authentication of plant materials:**-The plants belonging to the family were collected from different localities of Cherthala during the period of March to May, 2023 at their flowering and fruiting stage

TABLE I Showing Collection details

Sl No.	Name of taxon	Place of collection	Date	Date
1	<i>Melochia Corchorifolia</i> Linn.	Kanjikuzhi, Cherthala	14-03-23	Stem hollow, cyme inflorescence
2	<i>Sterculia balanghas</i> Linn.	Pallipuram,Cherth ala	21-03-23	Tree ,creamish white flowers
3	<i>Guazuma ulmifolia</i> Lam.	S.N College campus, Cherthala	04-04-23	Tree, two whorls of stamen.
4	<i>Helicteres isora</i> Linn.	Muhamma ,Cherthala	10-04-23	Large shrub, brick red flowers ,twisted fruit.
5	<i>Kleinhovia hospita</i> Linn.	S.N College campus, Cherthala	08-05-23	Tree, Gynophore is present.

2. **Macro morphological Studies:-**From freshly collected specimens macro morphological and floral variation studies were done with the help of simple dissecting microscope morphological and related taxonomical observations of stems leaves (apex, base, margin, texture, hairiness) petiole and floral features were done.

3. **Anatomical Studies:-** Thin sections were stained in one percentage aqueous solution of safranin-o for 1-2 minutes. Carefully washed in water to remove excess stain and fluid gum and mounted in 10% glycerol on a glass slide and covered with a glass cover slip, then viewed using a student Olympus microscope. Photo micrographs were also taken.

4. **Micrometric evaluation:-** Various diagnostic microscopic characters of the leaf namely stomatal type, numbers, epidermal cell, guard cell and trichomes were analyzed.Foliar epidermal studies were carried out in order to identify the diversity and distribution of trichomes in the selected species. For this, peel method was used. Trichomes were peeled from the stem and leave using a racer blade and then placed in a glass slide stained and covered with a cover slip and observed under microscope

5. **Quantitative leaf microscopy:-** Quantitative leaf microscopy was done to determine stomatal number, epidermal cell number, stomatal density and stomatal index. For micro morphological investigations, medium sized portions of mature

The epidermal peel taken from fresh leaves were placed on a clean glass slide and observed under student Olympus microscope. The stomatal index was determined according to Metcalfe and Chalk (1979)

**Formula:** 
$$\frac{S}{E + S} \times 100$$

$$\frac{S}{E + S} \times 100 = \text{Stomatal Index (SI)}$$

$$E + S \quad 1$$

Where : S = number of stomata per unit area, E = number of epidermal cells in the same area

#### IV. RESULT AND DISCUSSIONS

The present investigation deals with an inter generic comparative study on morphology, anatomy, trichome and stomata of different taxa belonging to the family Sterculiaceae. The different taxa under investigation are *Melochia corchorifolia* Linn. *Sterculia balanghas* Linn. *Guazuma ulmifolia* Lam. *Helicteres isora* Linn. and *Kleinhovia hospita* Linn.

It has been observed during the present study that there are distinguishing similarities and differences in the Morphology, anatomy, trichomes, stomatal pattern and index of selected genera under study. Mucilage canals, presence of stellate glandular and non glandular trichomes are characteristic features of family sterculiaceae. During the present study it was observed Mucilaginous cavities present in the ground tissue of midribs and petioles of all species and according to Metcalfe & Chalk in 1950, it is of the family Sterculiaceae.

##### 3.1 Comparative morphology

TABLE II Comparison of Morphological characters

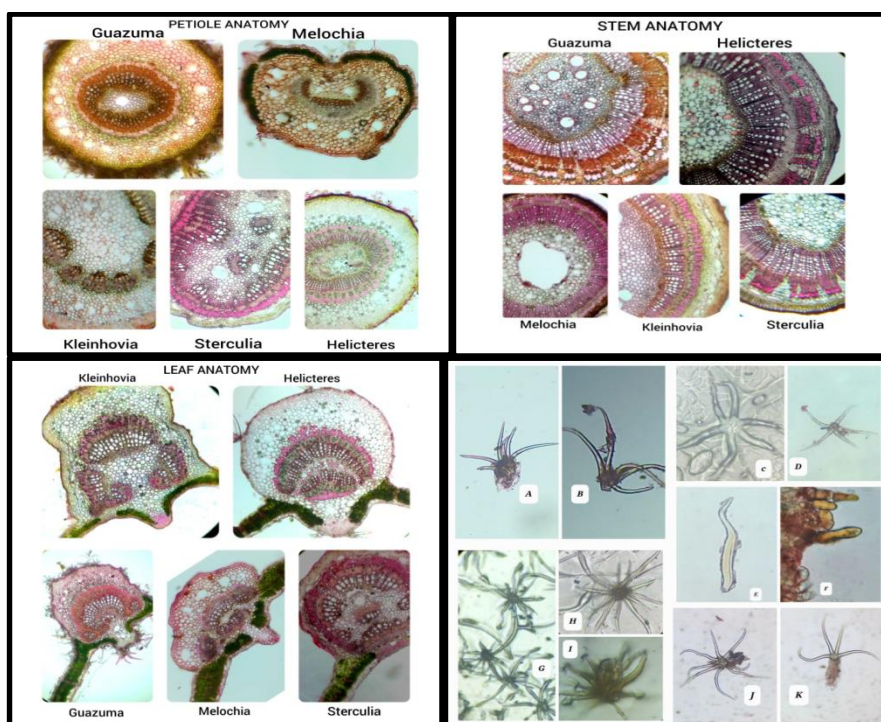
Character	<i>Melochia corchorifolia</i> L	<i>Sterculia balanghas</i> L.	<i>Kleinhovia hospita</i> L	<i>Guazuma ulmifolia</i> L.	<i>Helicteres isora</i> L.
<b>Habit</b>	Herb	Tree	Tree	Small tree	Large Shrub
<b>Stem</b>	Pubiscent	Glabrous	Pubescent	Pubescent	Pubescent
<b>Leaf type</b>	Trilobed	Simple	simple	Simple	Simple
<b>Phyllotaxy</b>	Alternate	Alternate	Alternate	Alternate	Alternate
<b>Leaf apex</b>	Acute	Acuminate	Acuminate	Acuminate	Acuminate
<b>Leaf base</b>	Trilobed	Elliptic- ovate	Cordate	Obliquely cordate	Obliquely cordate
<b>Leaf surface</b>	Sparsely pubescent both sides	Upper glabrous lower stellate pubescent.	Upper pubiscent Lower glabrous	Pubiscent	Pubiscent
<b>Inflorescence type</b>	Terminal cluster of cyme	Terminal or axillary panicles	Terminal panicles	Axillary or terminal cyme	Axillary or solitary
<b>Flower color</b>	Pink	Greenish purple	Pink	Yellow	Crimson Red

<b>No of calyx</b>	Sepals 5,fused	Sepals 5 fid	Sepals 5, free	Sepals 5,free	Seplas5 ,fused
<b>No of corolla</b>	5 petals , free	Petals 0	Petals 5 , unequal	Petals 5, free	Petals5,unequal
<b>No of stamens</b>	5 stamens	Numerous stamens	15 stamens	15 stamens	10 stamens
<b>Ovary</b>	Superior	Superior	Superior	Superior	Superior
<b>Ovules</b>	Numerous	Numerous	Numerous	Numerous	Numerous
<b>Placentation</b>	Axile	Axile	Axile	Axile	Axile
<b>Fruit type</b>	Capsule	Follicle	Capsule	Capsule	Follicle
<b>Fruit shape</b>	Sub globose	Oblong	Membranous	globose	Spirallytwisted
<b>Fruit color</b>	Green- Brown	Green-Orange-red	Green - brown	Brown to black	Green - brown-grey

The plants under the present investigation differ in many morphological features such as habit, flower colour, nature of sepals and petals and number of stamen etc.

### 3.2 COMPARATIVE ANATOMY

#### PLATE I



A-Stem Anatomy, B-Leaf Anatomy, C- Petiole Anatomy , D -Trichome Study:-A-B-Melochia

*corchorifolia* L., C-D-

*Sterculia balanghas* L., E,F-*Kleinhovia hospita* L., G-H-I-*Guazuma ulmifolia* Lamk., J-K-*Helicteres isora*

The five plants show distinguishing variations and also few similarities in stem anatomy. Out of these five plants, three exhibit secondary thickening they are *Sterculia balanghas* L., *Helicteres isora*, L. and *Guazuma ulmifolia* L. In these three plants, the epidermis is replaced by multilayered cork cells. Among the members, three plants show the presence of trichomes on their epidermis. *Helicteres* has non-glandular and unicellular stellate trichomes on its periphery. The number and shape of mucilage canals also display variation. In *Melochia*, *Sterculia*, and *Kleinhovia*, both inter-stelar and intra-stelar mucilage canals are present. In other plants, mucilage canals are crushed in the cortex. *Kleinhovia* has large mucilage canals in the pith region. In *Melochia* and *Kleinhovia*, a single-layered compactly arranged barrel-shaped endodermis which is distinct, though it is not all distinct in the other plants. Radially elongated parenchymatous pith rays are clearly visible in *Melochia* and *Helicteres*. In *Guazuma* and *Kleinhovia*, the pith is multiseriate and collenchymatous, while in *Sterculia*, it is not distinct. Additionally, *Sterculia* and *Guazuma* display secondary xylem with xylem vessels of different lumen diameter. The pith is large and irregular in *Guazuma*, whereas it's large and circular in the others. A prominent feature of *Melochia* is a large cavity at the center of the pith, distinguishing it from others. In *Guazuma* and *Helicteres*, the pith region consists of compactly arranged colored cells, which may indicate the presence of secondary metabolites. The presence of secondary metabolites in *Guazuma* and *Helicteres* reveals its phytochemical importance. (Prakash R. Kanthale et al. (2017)). The cross-sections of the stems of these plants exhibit many structural similarities. The stems of all plants have a circular outline. The epidermal part is heavily cutinized, the hypodermis is collenchymatous, and the cortex is limited.

The petiole of selected plants show variations in outline. It is irregular in *Melochia*, oval-circular in shape in *Sterculia* and *Helicteres*. Trichomes are absent in *Sterculia*, whereas non-glandular stellate trichomes are present in *Guazuma*, *Melochia*, and *Helicteres*. *Kleinhovia* is the only plant under the present study that shows unicellular glandular trichomes in its epidermis. The petiole of *Melochia* exhibits a partially collenchymatous hypodermis, followed by parenchyma where collenchymatous cells are arranged in a half-circle. The transverse section of the petiole shows crushed or limited cortex in *Sterculia* and *Kleinhovia*, while in others, a multi-layered cortex is found both intra-stelar and extra-stelar mucilage canal is found in all four plants except *Helicteres* (mucilage canals are present only in the cortical region). The endodermis is collenchymatous in *Melochia* and chlorenchymatous in *Guazuma*, whereas in others, it is not distinct. In *Kleinhovia*, sclerenchyma cells in the pericycle region are replaced by collenchyma cells. The arrangement of vascular bundles shows great variation in all selected plants. In *Melochia*, vascular bundles are arranged in a semi-lunar fashion, while a concave-convex shaped vascular bundle is present in *Sterculia*. In *Helicteres*, vascular bundles are arranged in a circular manner, and a ring-like arrangement of vascular bundles is found in *Kleinhovia* and *Guazuma*. The presence of two extra bundles is a distinguishing feature of the petiole of *Sterculia*. A large pith is commonly found in the selected plants, but there is variation. A small pith with two large mucilage canals is present in *Melochia*, whereas a small pith with a single large mucilage canal is present in *Guazuma*. Collenchymatous pith rays are only found in *Kleinhovia* and absent

in other plants. Despite the considerable variation, the petiole of the selected plants share some common characteristics: uniseriate epidermis with a thick cuticle, conjoint collateral and open vascular bundles with endarch xylem.

Leaf anatomy also possesses remarkable variations. Most of the selected plants possess an irregular midrib region, but *Helicteres* has a smooth and circular midrib. The adaxial surface of *Melochia* and abaxial surface of *Kleinhovia* have small projections or protuberances in the upper epidermis, which are parenchymatous and sclerenchymatous respectively. In *Melochia*, vascular bundles are arranged in four lobes. In *Sterculia*, vascular bundles are seen in the form of a ruptured circle, while *Kleinhovia* shows three segments of vascular strands, with the lateral ones being completely smaller than the others. *Guazuma* shows a half-circle arrangement of vascular strands. In *Helicteres*, vascular bundles are arranged into two segments. A distinguishing parenchymatous pith ray is present in the midrib of *Sterculia*, while in others, it is absent.

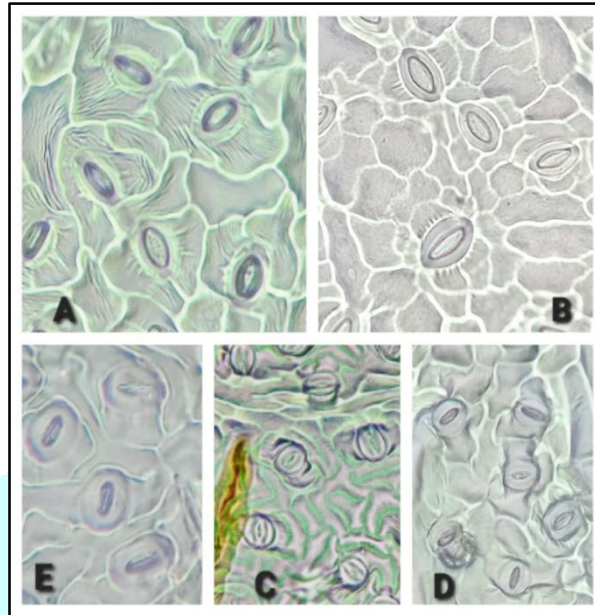
### 3.3 Trichome study

**TABLE VI: Trichome variations**

Name of plant	Trichome type	No of radiating arms
<i>Melochia Corchorifolia</i> Linn.	Nonglandular, stellate and sessile	5
<i>Sterculia balanghas</i> Linn	Non glandular Five lobed star shaped stellate hairs.	5
<i>Kleinhovia hospita</i> Linn.	Glandular, unicellular straight trichomes.	1
<i>Guazuma Ulmifolia</i> Lamk.	Non glandular stellate hairs.	10
<i>Helicteres isora</i> Linn.	Non glandular unicellular trichomes and stellate hairs	2-8

In *Melochia corchorifolia* L. trichomes were non glandular, stellate and sessile while *Sterculia balanghas* L. has shown trichomes lobed in to five, non glandular and stellate. *Kleinhovia hospita* L. Trichomes were glandular, unicellular straight and in *Guazuma ulmifolia* L. unicellular, non glandular and stellate trichomes were present on leaves and stem. It is noted that in *Helicteres isora* L. trichomes were non glandular, appressed and stellate hairs with 2-8 radiating arms.

## PLATE III-Types of stomata



**A-*Melochia corchorifolia* L., B-*Sterculia balanghas* L., C-*Kleinhovia hospita* L., D-*Guazuma ulmifolia* Lamk,  
E-*Helicteres isora* L.**

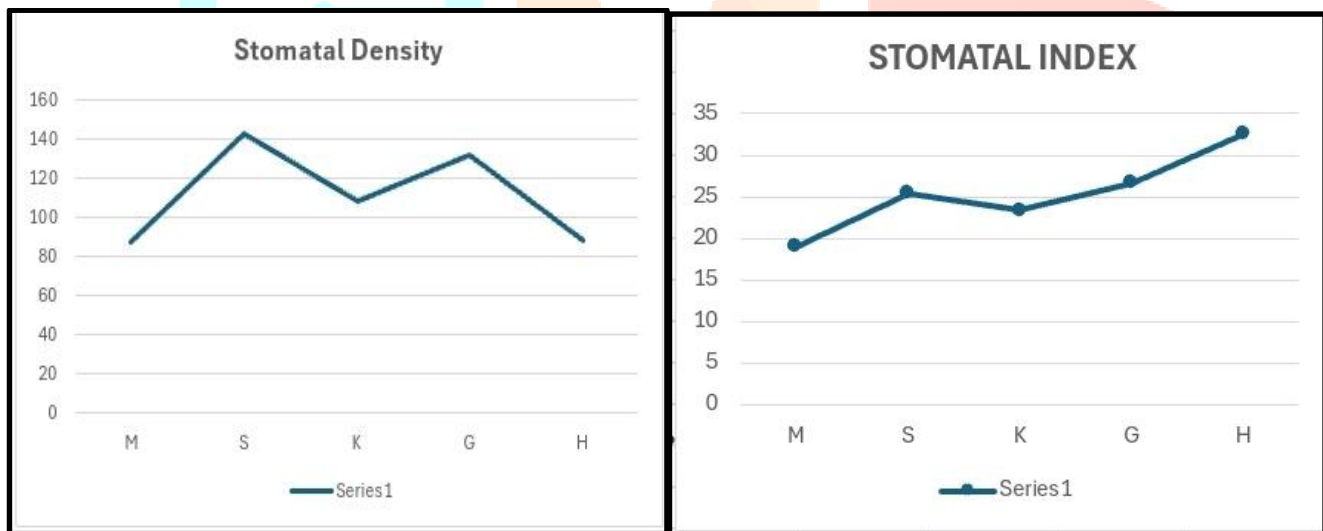
The anomocytic type of stomata observed in all the species selected for present study while stomatal size, number and epidermal cells varied across the family. Stomatal size, index and wall thickness varied greatly even within the species. (Ajuziogu et. al (2018)) Variations and similarities observed in the stomatal features provide evidence of the genetic and evolutionary relationships and therefore are of taxonomic importance. The calculation of stomatal density in five plants show variation in the number and size of stomata among the five plants under present investigation. It was found that the number of stomata in *Melochia* is lesser than that of other four plants. In *Melochia* stomata is densely packed. The highest number of stomatal density is found in *Sterculia* species (142). The stomatal density (SD), the number of the stomata per unit of leaf area, was reported to be the main factor responsible for photosynthetic activities. Higher stomatal density improves photosynthetic induction in plants is reported in many articles (Kazuma sakoda et.al (2010)). The stomatal index study also observed variations in each plant. The highest stomatal index is found in *Helicteres isora* (32.59%). The lowest index found in *Melochia corchorifolia* (19.01%).



TABLE IV-Showing Stomatal density &amp; Stomatal Index

Species	Stomatal Density	Stomatal Index(%)
<i>Melochia corchorifolia</i> L.	87.6	19.01
<i>Sterculia balanghas</i> L.	143	25.43
<i>Kleinhovia hospita</i> L.	109	23.38
<i>Guazuma ulmifolia</i> Lam.	132	26.661
<i>Helicteres isora</i> L.	88.8	32.59

Graphical representation of Stomatal Density and stomatal Index:



M- *Melochia corchorifolia* L., S- *Sterculia balanghas* L., K- *Kleinhovia hospita* L., G- *Guazuma ulmifolia* Lam.,

H- *Helicteres isora* L.

#### IV. CONCLUSIONS

All the taxa studied under Sterculiaceae possess flowers in terminal position or axillary position. Only *Melochia corchorifolia* L. shows trilobed leaf type. Others are simple leaf types. Phyllotaxy is alternate in all selected plants. All plants of Sterculiaceae under study are pubescent in nature. The number of sepals are 5 in all selected plants. Stamens are more than five in all plants except *Melochia corchorifolia* Linn. Position of the ovary is superior in all plants. In all selected plants numerous ovules with axile placentation are seen. Fruit is typically a capsule or follicle.

Anatomical comparison of stem, Petiole and leaf reveals information about variation and similarities in selected plants such as some species (*S. balanghas*, *G. ulmifolia*, *H. isora*) show secondary thickening in which epidermis is replaced by phellem or cork cells, intra-stelar and inter-stelar mucilage canals are found in *Melochia*, *sterculia* and *Kleinhovia*, it is narrow or crushed in other two plants, endodermis composed of

compactly arranged barrel shaped parenchyma in *Melochia* and *Kleinhovia*, secondary xylem shows vessels of different lumen in *Sterculia* and *Guazuma*, secondary phloem with phloem fibers are present in *sterculia* and in others it is absent, in *Melochia* large cavity is present at the center of the pith etc.

Petiole anatomy has a number of variations such as variation in outline. Most of the plants under present study trichomes are non glandular and stellate. Unicellular trichomes are found in *K. hospita*. Half circle or partially collenchymatous hypodermis is found in *Melochia* sps. Vascular bundles are arranged in various manners. Semi-lunar fashion in *Melochia*, concave -convex shape in *Sterculia* ring like in *Kleinhovia* and *Guazuma* and circular in *Helicteres*. Endodermis is not distinct in 3 species but is distinct and collenchymatous and chlorenchyma tous in *Melochia* and *Guazuma* respectively. The number of mucilage canals in the pith vary in number . Small pith with a single large mucilage canal is present in *Guazuma*, two mucilage canals in *Melochia* more than two in *Sterculia* and *Kleinhovia*, absent in *Helicteres*. *Kleinhovia* has distinct collenchymatous pith rays in others they are absent. Densely packed trichomes are present in *G. ulmifolia*. Leaf also shows remarkable variations in the arrangement of vascular bundles. Pith rays are distinct only in *Sterculia* and in others it is absent. Midrib shows various shapes. All plants have irregular midribs but *Helicteres* possess smooth and circular midribs. Densely packed trichome is seen in *G. ulmifolia* .

The plants under the present investigation showed variations in trichomes. *Kleinhovia* is the only plant under study that possesses glandular and unicellular trichomes. Whereas in others stellate trichomes are present. The stellate trichome also shows variation in their number of radiating arms. Some are sessile whereas others have radiating arms of various numbers.

Even though the nature of stomata is the same in all plants, remarkable variations noted in stomatal density and stomatal index. All the species have an anomocytic type of stomata. The stomatal number and Number of epidermal cells vary in each species. The highest number of stomatal index is found in *Helicteres isora* (32.59%). The lowest index found in *Melochia corchorifolia* (19.01%).

From the results of the present study the authors are of the opinion that the members are distinct in macro morphologic and micro morphologic characters.

## V. ACKNOWLEDGMENTS

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## REFERENCES

- AHMED, M. A., et.al (2018). Nutritive and anti-nutritive evaluation of *Kleinhovia hospita*, *Leucaena leucocephala* and *Gliricidia sepium* with respect to their effects on in vitro rumen fermentation and gas production. *Tropical Animal Science Journal*, 41(2), 128-136.
- AHMED, S. S., & RAHMAN, M. O. (2022). Taxonomic Revision of the Subfamily Sterculioideae Beilschm. In Bangladesh. *Bangladesh Journal of Plant Taxonomy*, 29(2), 373-401.
- AJUZIEOGU, G. C., et.al (2018). Comparative anatomical studies of the stomatal patterns of some tree species of

Sterculiaceae and Verbenaceae in Nigeria. *Pak. J. Bot.*, 50(2), 679-684.

AI MUQARRABUN, L. M. R., & AHMAT, N. (2015). Medicinal uses, Phytochemistry and pharmacology of family

Sterculiaceae: A review. *European journal of medicinal chemistry*, 92, 514-530.

ANAKHA, M., PRIYA, C., KURUP, S., VARGHESE, F., & HARI, N. (2022, September 23). Monogram study on

Anatomical characteristics of *Sterculia balanghas* Ait.

AWASTHI, N. (1978). Fossil wood belonging to Sterculiaceae and Lythraceae from the Cuddalore series of Pondicherry.

*Journal of Palaeosciences*, 27(1-3), 182-189.

BARNETT, L. C. (1988). *Systematics of Nesogordonia Baillon (Sterculiaceae)*. The University of Texas at Austin.

BENTHAM, G. & HOOKER, J. D., 1862-1883. *Genera Plantarum*. Vol. 1-3. London

CHATTAWAY, M. M. (1937). VII-The wood anatomy of the family Sterculiaceae. *Philosophical Transactions of the*

*Royal Society of London. Series B, Biological Sciences*, 228(554), 313-365.

CRISTÓBAL, C. L. (2001). Taxonomía del género *Helicteres* (Sterculiaceae). Revisión de las especies americanas.

*Bonplandia*, 11(1-4), 1-206.

CRISTÓBAL, C. L. (2007). Sterculiaceae de Paraguay. I. *Ayenia*, *Byttneria*, *Guazuma*, *Helicteres*, *Melochia* y *Sterculia*.

*Bonplandia*, 16(1-2), 5-142.

DAYAL, R., SINGH, A., OJHA, R. P., & MISHRA, K. P. (2015). Possible therapeutic potential of *Helicteres isora* (L.) and its mechanism of action in diseases. *Journal of Medicinal Plant Studies*, 3(2), 95-100.

DJABIR, Y. Y., ARSYAD, M. A., SARTINI, S., & LALLO, S. (2017). Potential roles of *Kleinhovia hospita* L. leaf extract in reducing doxorubicin acute hepatic, cardiac and renal toxicities in rats. *Pharmacognosy Research*, 9(2), 168.

DJABIR, Y. Y., et.al(2020). *Kleinhovia hospita* extract alleviates experimental hepatic and renal toxicities induced by a combination of antituberculosis drugs. *Journal of Herbal Pharmacology*, 10(1), 102-108.

DUKE, J. A. (2008). *Duke's handbook of medicinal plants of Latin America*. CRC press.

EOM, S. H., & NA, J. K. (2019). Leaf transcriptome data of two tropical medicinal plants: *Sterculia lanceolata* and

*Clausena excavata*. *Data in brief*, 25, 104297.

EUM, S. M., et.al(2019). Transcriptome analysis and development of SSR markers of ethnobotanical plant *Sterculia*

*lanceolata*. *Tree Genetics & Genomes*, 15, 1-12.

- FRIIS, I., & BIDGOOD, S. (1998). *Dombeya kefaensis*, sp. nov. (Sterculiaceae) from SW. Ethiopia. *Nordic Journal of Botany*, 18(2), 215-220.
- GREGORY, M., & BAAS, P. (1989). A survey of mucilage cells in vegetative organs of the dicotyledons. *Israel Journal of Botany*, 38(2-3), 125-174.
- HAMDY, R., & SHAMSO, E. (2010). Pollen morphology of Sterculiaceae (s. str.) in Egypt and its taxonomic significance. *Egyptian Journal of Botany*, 50, 103-117.
- HUNTER, J. R. (1990). The status of cacao (*Theobroma cacao*, Sterculiaceae) in the western hemisphere. *Economic Botany*, 425-439.
- HUSSIN, K. H., & SANI, Z. M. (1998). Comparative leaf anatomical studies of some *Sterculia* L. species (Sterculiaceae). *Botanical Journal of the Linnean Society*, 127(2), 159-174.
- JUDD, W. S., & Manchester, S. R. (1997). Circumscription of Malvaceae (Malvales) as determined by a preliminary cladistic analysis of morphological, anatomical, palynological, and chemical characters. *Brittonia*, 49, 384-405.
- KANTHALE, P. R., & BIRADAR, S. (2017). Pharmacognostic study of *Helicteres isora* L. Pharmaceutical and biological evaluations, 4(1), 47-51.
- KELMAN, W. M. (1991). A revision of *Fremontodendron* (Sterculiaceae). *Systematic Botany*, 3-20.