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Micromorphological and Macromorphological studies on leaves of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L. and *Pisum sativum* L. of subfamily Faboideae of family Fabaceae Lindl.

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ABSTRACT

Plant taxonomy is a branch of botany that deals with identification, classification and nomenclature of plants. All the four genus discussed in this paper belong to subfamily Faboideae according to the APG IV classification. Most taxonomic keys that are available for Family Fabaceae Lindl. are based on floral characters for which plants will have to be in their reproductive phase. Flowering phase for most members of the concerned family lasts for a maximum of four months, therefore the plant is mostly found in its vegetative phase and lack of a taxonomic key solely based on vegetative characters can delay the identification process. The solution to this could be achieved by developing a valid taxonomic key using leaf morphological characters. Studies incorporating the varied and unique architecture of each leaf or leaflet may prove to be an important breakthrough to help identify plants in any season and help pace up the related research works. These can also provide adequate information in paleobotanical fields concerning fossils discovered in the form of leaves. Comparision of tree constructed based on the cladistics with the molecular key may help validate the results

Key Words - Leaf morphology, *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L., *Pisum sativum* L., Faboideae, Fabaceae Lindl.

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INTRODUCTION

Butea monosperma (Lam.) Taub. locally known as Palash, *Dalbergia sissoo* Roxb. locally known as Shisham, *Phaseolus vulgaris* L. locally known as Bean and *Pisum sativum* L. locally known as Matar are very common members of Family Fabaceae Lindl. found throughout Jharkhand, India. *Butea monosperma* (Lam.) Taub.is the state flower of Jharkhand and is used in the preparation of natural dye. The wood of *Dalbergia sissoo* Roxb. is used in furniture making while *Phaseolus vulgaris* L. and *Pisum sativum* L. are majorly grown for their fruits. Family Fabaceae Lindl. is the 3rd largest family of angiosperms having diverse members with cosmopolitan distribution and varied habits. It was earlier known as Family Leguminosae Jussieu and placed in order Rosales. The nomenclature of family Leguminosae Jussieu was not in accordance with the rules of nomenclature and failed to fulfill two major criterias required in the nomenclature of the taxonomic rank family. APG III classification (2009) assigned the family an independent order Fabales which has remained unaltered in the APG IV classification which came out in 2016.

MATERIALS & METHOD

Fresh leaves of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb*., Phaseolus vulgaris* L. and *Pisum sativum* L. were collected from different localities of Ranchi, Jharkhand, India. The quantitative and qualitative morphological characters were observed on fresh leaves while the micro-morphological details were studied from leaves that were cleared by soaking them in Franklin's solution at room temperature for up to 24 hours. The leaves were rinsed with water, placed in a weak solution of sodium hypochlorite and observed under the compound microscope.

DNA alignment was done using MEGA11 software. The FASTA sequence was obtained from NCBI website.

In order to construct the cladogram and molecular tree PAST3 software and MEGA11 software were used respectively. Taxonomic key based on leaf characters were contrcuted using valid Operational Taxonomic units that could successfully provide charcters with two distinct variations.

OBSERVATIONS

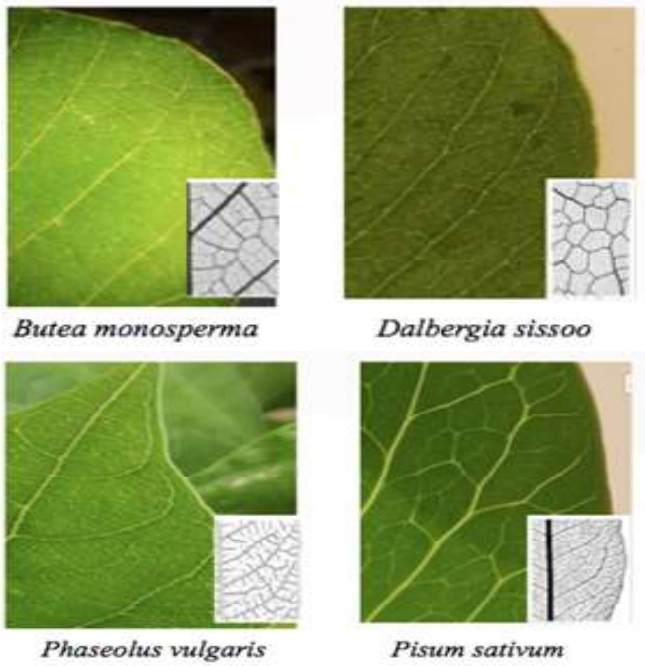
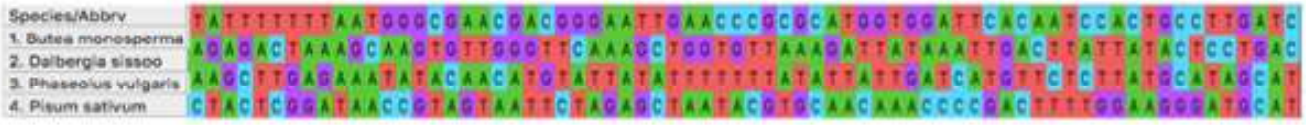


Figure 1: Leaves of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L. and *Pisum sativum* L. showing the vein category

Table 1: Quantitative and qualitative morphological characters in the leaves of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb*., Phaseolus vulgaris* L. and *Pisum sativum* L.

	Butea monosperma	*Dalbergia sissoo* Roxb	*Phaseolus vulgaris*	*Pisum sativum* L.
Blade class	Mesophyll	Microphyll- Notophyll	Notophyll	Nanophyll - Microphyll
Laminar shape	Obovate	Elliptic	Ovate	Elliptic
Laminar symmetry	Lateral leaflets asymmetrical	Symmetrical	Lateral leaflets asymmetrical	Symmetrical
Leaf Tendril	Absent	Absent	Absent	Present
Leaf type	Imparipinnate	Imparipinnate	Imparipinnate	Paripinnate
Leaflet apex	Acute	Acuminate	Acuminate	Obtuse
Leaflet base	Obtuse	Acute	Obtuse	Acute
Leaflet base shape	Concavo- convex	Convex	Convex	Convex
Leaflet margin	Entire	Entire	Entire	Serrate
Leaflet organization	Opposite	Alternate	Opposite	Opposite
Leaflet shape	Ovate	Oblong	Ovate	Ovate
Leaflets per leaf	3	3 to 5	3	4 to 6
No. of leaflets	3	5	3	6
Rachis	Straight	Zig-zag	Straight	Straight
Stiple	Present	Absent	Present	Absent
Stipule type	Lateral	Lateral	Lateral	Foliaceous
Vein category	Alternate percurrent	Regular polygonal reticulate	Dichotomizing	Random reticulate

Figure 2: DNA alignment of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L. and *Pisum sativum* L.



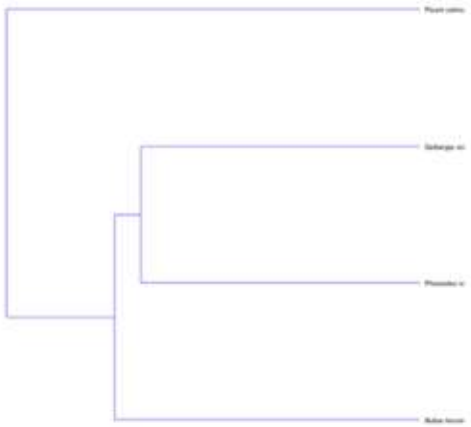


Figure 3: Cladogram of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L. and *Pisum sativum* L.

Figure 4: Molecular tree of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb., *Phaseolus vulgaris* L. and *Pisum sativum* L.

Key to the genus based on leaf characters:

Leaf margin entire

Blade class Mesophyll…….. *Butea monosperma* (Lam.) Taub.,

Blade class Notophyll/Microphyll

Vein category Regular polygonal reticulate ……. *Dalbergia sissoo* Roxb

Vein category Dichotomizing …….. *Phaseolus vulgaris* L.

Leaf margin serrate ……. *Pisum sativum* L.

The study successfully supported the taxonomic value of classical taxonomy as an essential tool for identification of *Butea monosperma* (Lam.) Taub., *Dalbergia sissoo* Roxb*., Phaseolus vulgaris* L. and *Pisum sativum* L. using micromorphological and micromorphological characters of leaves. It was seen that

Pisum sativum L. is an outgroup in both the cladogram and molecular tree but in case of *Phaseolus vulgaris* L., according to the molecular tree *Butea monosperma* (Lam.) Taub. is the more closely related than *Dalbergia sissoo* Roxb. as suggested by the Cladogram. This might be ruled out if more Operational Taxonomic Units are taxen into account. The taxonomic key contructed using only leaf characters can help identify plants during all seasons as well as aid to identify fragments of leaves which could be of great help in the field of paleobotany or forensics.

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