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# Leaf Architecture of Philippine Shorea species (Dipterocarpaceae)

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## Abstract

*The leaf architecture of ten Shorea species (Dipterocarpaceae) was studied. A dichotomous key was constructed based mainly on the leaf architecture character states that were measured and described. The most useful character to delineate these Shorea species is on areolation. Other useful characters are blade class, laminar ratio, base angle, apex angle, base shape, apex shape, vein spacing and vein angle. These morphometrics showed unifying and distinguishing diagnostic character states that are good taxonomic markers for the description and identification of Shorea species in the Philippines.*

**Keywords:** Leaf architecture, character states, Shorea, Dipterocarpaceae and Malvales.

## Introduction

Leaf surface characters are very important morphological features worthy of closer examination[1]. Plant morphology is as important as animal morphology as far as characterization is concerned[2]. Of remarkable relevance are leaf architectural characters, specifically the venation patterns.

Venation patterns are significant characteristics used to resolve many controversies in plant taxonomy[3]. Though leaves are generally neglected in taxonomy, leaf morphology has been demonstrated to be very useful in paleobotany[4,5] and studies illustrated the use of leaf architecture in delineating species of Psychotria (Rubiaceae)[6], Epipremnum and Rhaphidophora (Arecaceae)[7] and Philippine Cinnamomun species[8]. Leaf architecture studies also demonstrated the relevance of lumping Tiliaceae, Malvaceae, Bombacaceae and Sterculiaceae to one family Malvaceae sensu APG[3].

The present study deals with the leaf architecture of Shorea, a genus of Dipterocarpaceae (The Philippine mahogany). Shorea is a good source of timber, food for wild animals and probably other uses like medicine as in other plants unknown to many[9,10]. Shorea is a vulnerable genus because of deforestation and cutting for its valuable timber as in many other species and genera[11]. Shorea flowers in every 3 years[12], posing difficulty in species identification. The use of leaf architecture characters of Shorea may have a promising relevance in the taxonomy of the genus. It is therefore the purpose of this study to determine whether leaf architecture characters can successfully delineate Shorea species.

## Material and Methods

Leaf specimens of 10 Shorea species were examined in this study namely; Shorea almon (figure 1) S. guiso (figure 2), S. contorta (figure 3), S. polysperma (figure 4), S. ovata (figure 5), S. malibato (figure 6), S. assamica (figure 7), S. astylosa (figure 8), S. polita (figure 9) and S. palosapis (figure 10). At least 10 leaf samples per species were collected from the College of Forestry and Natural Resources campus, University of the Philippines Los Baños. The specimens were oven dried for three days at the Department of Forest Biological Sciences, Botany Laboratory. Leaf morphological characteristics such as organization, venation, margin, length and width were then observed and measured. The leaf architecture of each species was described following standard and tested procedures[4] (figure 11) and a dichotomous key was then provided.

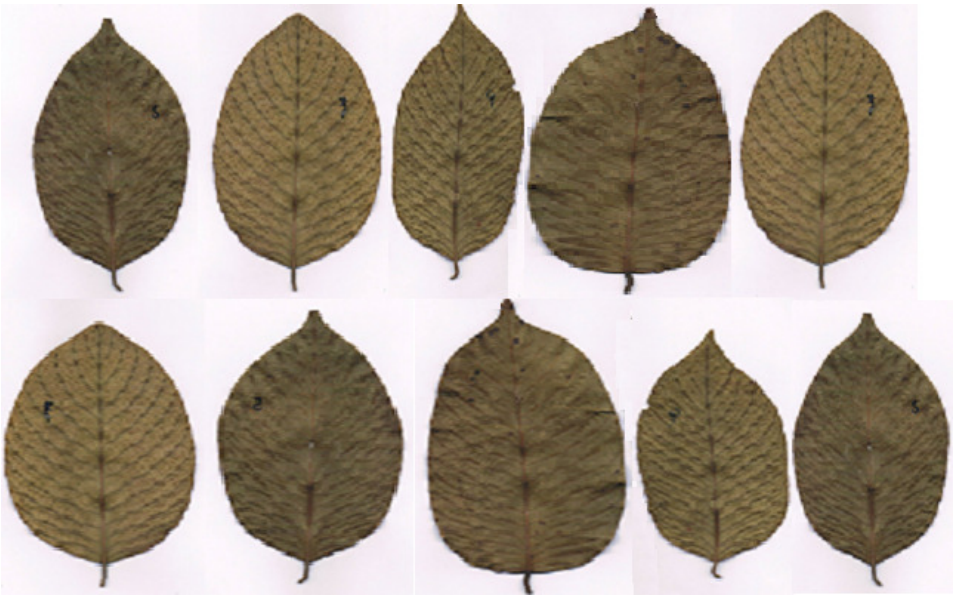
## Results and Discussion

The Philippine Shorea species examined in this study exhibited unifying features (table 1) such as the following: simple leaves, alternate phyllotaxy, swollen petiole base that is marginally attached, entire with unlobed leaf margin, pinnate type of primary veins and weak brochidodromous, secondary vein, uniform secondary veins angle and vein spacing, sinuous vein course and vein angle, increasing basally vein angle variability and looped ultimate marginal venation.

It was found out that venation characters such vein spacing, vein angle, intersecondary veins, quarternary veins and areolation were useful taxonomic markers. Other distinctive characters that were also useful were blade class, base angle, base shape, and apex angle and apex shape. These leaf architecture characters that were measured and described were useful in delineating certain plant taxa for many studies as well[3,6-8].

Among the ten species, only Shorea almon possessed strong intersecondary veins which can be a good distinguishing feature against the other species and distinct in the genus Shorea. The

intersecondary veins however, were not distinct for Shorea contorta, S. polysperma, S. ovata, S. malibato, S. assamica, S. astylosa, S. polita and S. palosapis. Closer examination, however, revealed that S. guiso had no intersecondary veins.



**Figure–1**
**Leaf samples of Shorea almon**

**Figure–2**
**Leaf samples of Shorea guiso**

**Figure–3**
**Leaf samples of Shorea contorta**

**Figure–4**
**Leaf samples of Shorea polysperma**

**Figure–5**
**Leaf samples of Shorea ovate**

**Figure–6**
**Leaf samples of Shorea malibato**

**Figure–7**
**Leaf samples of Shorea assamica**

**Figure–8**
**Leaf samples of Shorea astylosa**

**Figure–9**
**Leaf samples of Shorea polita**

**Figure–10**
**Leaf samples of Shorea palosapis**

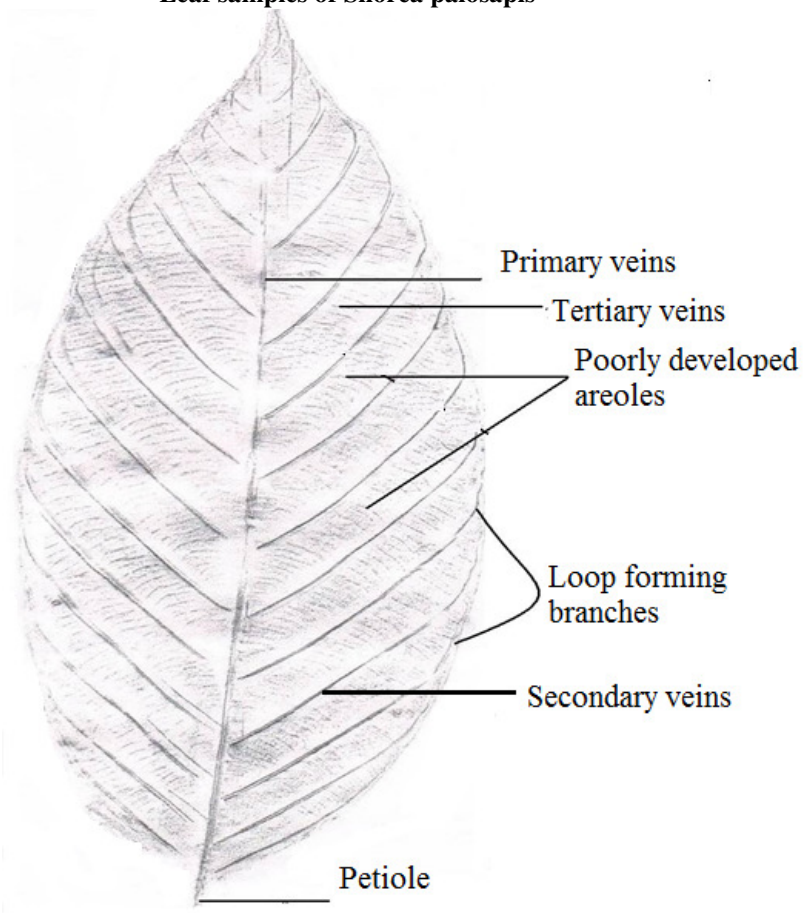



**Figure-11**
**Typical leaf architecture of the ten Shorea species**

**Table – 1**
**Leaf architecture of the ten Shorea species**

| Species | Area ($mm^2$) | Blade class | Laminar ratio | Base shape | Apex shape | Inter-secondary veins | $4^0$ Vein category | Areolation |
|---|---|---|---|---|---|---|---|---|
| Shorea almon | 4045.39 | notophyll | 0.60 | truncate | acuminate | strong | opposite percurrent | moderately developed |
| Shorea guiso | 5511.15 | mesophyll | 1.07 | rounded | straight to acuminate | absent | opposite percurrent | poorly developed |
| Shorea. contorta | 5830.74 | mesophyll | 4.45 | rounded | acuminate | weak | alternate percurrent | well-developed |
| Shorea polysperma | 7418.37 | mesophyll | 0.35 | convex | acuminate | weak | alternate percurrent | well-developed |
| Shorea ovata | 4159.42 | mesophyll | 0.39 | rounded | acuminate | weak | dichotomizing | poorly developed |
| Shorea malibato | 3479.64 | mesophyll | 0.38 | rounded | acuminate | weak | dichotomizing | poorly developed |
| Shorea assamica | 15984.1 | mesophyll | 0.44 | rounded | acuminate to convex | weak | alternate percurrent | poorly developed |
| Shorea astylosa | 5289.98 | mesophyll | 0.35 | convex | acuminate | weak | dichotomizing | poorly developed |
| Shorea polita | 3908.98 | notophyll | 0.70 | rounded | rounded | weak | dichotomizing | poorly developed |
| Shorea palosapis | 12313.8 | mesophyll | 0.39 | truncate to cordate | acuminate | weak | dichotomizing | poorly developed |

It was also found out that quarternary venation was a good taxonomic marker for Shorea (table 1). Among the ten species, only S. guiso and S. almon had opposite percurrent quarternary veins. Shorea ovata, S. malibato, S. astylosa, S. polita and S. palosapis were similar in terms of having dichotomizing quarternary veins while Shorea contorta, Shorea polysperma and Shorea assamica were similar in having alternate percurrent quarternary veins.

On leaf areolation, Shorea almon had moderately developed areoles. Shorea contorta and S. polysperma had well developed areoles. The remaining Shorea guiso, S. malibato, S. assamica ssp. philippinensis, S. palosapis, S. astylosa and S. ovata have poorly developed areoles. On ultimate marginal venation, the ten Shorea species had been observed to have looped type of marginal veins.

Other useful distinctive characters were blade class, base angle, base shape, and apex angle and apex shape. It was found out that most of the species had acute apex angle except for Shorea almon. The dominant base shape of the species in the genus Shorea was round except for Shorea assamica and S. astylosa which had convex base shape and the species S. palosapis with truncate base shape.

Dichotomous key of Shorea species
1 Intersecondary veins distinct…… Shorea almon
1 Intersecondary veins not distinct…2
2 Quaternary veins opposite percurrent……Shorea guiso
2 Quaternary veins not opposite percurrent ……3
3 Areolation well developed……Shorea contorta
3 Areolation not well developed ……4
4 Apex angle convex……Shorea astylosa
4 Apex angle not convex……5
5 Apex shape rounded……Shorea polita
5 Apex shape not rounded……6
6 Vein spacing increasing toward base ……Shorea malibato
6 Vein spacing not increasing toward base…7
7 Vein angle decreasing toward base ……Shorea assamica ssp. Philippinensis
7 Vein angle not decreasing towards base……8
8 Base angle obtuse……Shorea polysperma
8 Base angle not obtuse……9
9 Base shape rounded ……...……Shorea ovata
9 Base shape not rounded ……...…….. 10
10 Apex angle acute..…… Shorea palosapis

## Conclusion

The paper demostrated the use and importance of the leaf surface particularly leaf architecture in delineating Shorea almon, S. guiso, S. contorta, S. polysperma, S. ovata, S. malibato, S. assamica, S. astylosa, S. polita and S. palosapis. The findings indicated that absence of reproductive structures is no longer a hindrance in easily identifying Shorea species. Important leaf architectural characters for Shorea included intersecondary venation, quarternary venation and areolation.

Leaf architecture should be done for many other species as well, especially those which have reproductive structures only in certain times of the year or worse, those with reproductive

structures only once in every 2 or more years, posing more difficulty in identification.

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