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Leaf architectural studies in *Phyllanthus* L. (Phyllanthaceae) from Arunachal part of Eastern Himalaya in India

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Abstract

Leaf architectural characters of seven species of Phyllanthus L. (Phyllanthaceae) were studied on the basis of foliar morphometric characters. The characters studied include leaf attachment, petiole features, laminar shape, apex and base shape including angles, margin type, blade class vein category etc. Estimation of vein islet number and minor venation details like the areole size, absolute vein islet and vein termination number were recorded and distinct description based on the leaf architectural traits for each species have been done. The quantitative data revealed some distinct variation among the species with some expressing close relatedness. A dichotomous key for the species have been constructed and relationships among the taxa have been represented through a dendrogram.

Keywords: Leaf, architecture, *phyllanthus,* Arunachal, Eastern Himalaya.

Introduction

The family Phyllanthaceae Martynov is a group of flowering plants with maximum distribution along the tropics including the south-temperate zone with sparse distribution towards the north-temperate[1]. The family is predominant in the Paleotropical, Neotropical, Cape and Australian biogeographic regions[2] with habits predominantly of shrubs and small trees and rarely of herbs[3]. Phyllanthaceae is the second largest segregate of Euphorbiaceae *sensu lato* comprising of about 2000 species further grouped into 54 to 60 genera[4]. The genera are further grouped into two monophyletic sub-families and ten distinctly defined monophyletic tribes[3]. The family has been segregated into 10 sub-genera and 50 sections based on nrITS and plastid *mat K*sequence studies[5].

Some major genera under the family include *Cleistanthus* with about 140 species, *Antidesma* (100 spp.), *Aporosa* (90 spp.), *Uapaca* (60 spp.), *Baccaurea* and *Bridelia* with about 50 species each[6].

The genus *Phyllanthus* was first described by Linnaeus[7] and as per Mabberley[8], the genus is represented by 750 – 800 species distributed globally with 51 species under 6 sub-genera found in India out of which 18 species are endemic[9].

In angiosperms, majority of the dicotyledonous taxa has a consistent pattern of leaf architecture and method of describing leaf shape, size, marginal configuration, gland characters, venation patterns etc. is of immense importance for both extinct and extant taxa[10]. Leaves are anatomically much varied organs and shows significant variations both between and within genera and specific occasionally in familial lines[11].

Over the years, foliar architecture study has proven useful in identification of living as well as fossil angiospermic species[12]. The pattern of leaf reticulation is evident to be the result of evolutionary convergence in leaf form[13]. In plants, the diversity in form and function of leaf corresponds to high diversity in geometry of venation network[14]. Taxonomic study involving the study of morphological characters of flower and fruit have been playing key role in identification of plants since long. Compared to floral and fruit characters, leaves are generally given less priority in taxonomic and comparative studies due to detailed characterization of different leaf attributes[15]. Leaves of cretaceous and tertiary angiosperms that were studied[16], proved to be an ecologically significant in understanding the semi-quantitative proxy measurements of plant evolutionary patterns[17].

The present study deals with leaf architecture of seven species of *Phyllanthus* L. Phyllanthaceae, to understand and delineate the foliar micro-morphological characters based on morphometry, venation pattern, marginal ultimate venation, areolation, apex and base shape including angles, leaf texture, appearance of tertiary and quaternary veins, vein angles etc. and thereby draw taxonomic discourses for easy identification at the species level.

Materials and methods

The present work on leaf architecture of some species of *Phyllanthus* L. has been carried out with specimens collected from the North-east Indian state of Arunachal Pradesh located at 26°28'N – 29°36'N Latitudes and 91°30'E – 97°30'E Longitudes (Figure-1).

The seven species under study were *Phyllanthus amarus* Schumach. & Thonn., *Phyllanthus emblica* L., *Phyllanthus fraternus* G.L. Webster, *Phyllanthus myrtifolius* (Wight) Mull. Arg., *Phyllanthus reticulatus* Poir., *Phyllanthus urinaria* L. and *Phyllanthus virgatus* G. Frost.

For studying the morphometric characters, guidelines prescribed in the *Manual of Leaf Architecture*[18] was followed where laminar area was calculated by measuring the leaf length and width (mm) and thereby dividing the product by ⅔. On the basis of laminar size, the type of blade class was determined with leaf apex and base angles measured using a protractor. Detailed venation architecture was analysed following the method[19].The specimens were immersed in 2.5 % NaOH solution for about 5 – 12 days or until the leaf lamina appeared clear. The leaves were then washed with water to remove the traces of NaOH and were further cleared with soft brush without damaging the leaf tissue. If the leaf remained unclear, it was boiled in lactic acid to attain the desired level of clearing[20]. The leaf skeleton of each specimen was stained with safranin, dehydrated through ethanol grades and mounted in DPX[21].

The processed specimens were observed under Olympus compound microscope followed by detailed observation in Leitz, Stereoscopic Microscope for understanding various qualitative as well as quantitative foliar characters.

Using the stage micrometer and the camera lucida, the area of the total microscopic field was determined. For each species, area of the lamina (A), vein islet number (*vi*) and vein termination (*vt*) were recorded. Three such drawings were made, one from each of the apex, middle and basal portion of the lamina. The numbers of vein islets were then divided by the total area of the microscopic field to determine the number of the vein-islets per sqmm[22]. In case of incomplete vein-islets, two incomplete vein-islets were considered as one for the ease of calculation. Areole size in mm^2 was also determined with the help of ocular micrometer.

The Absolute vein islet number (A_{vi}) and absolute vein termination number (A_{vt}) were calculated[23].

A_{vi}= A x *vi*, where A_{vi} is the absolute vein islet number per area of the lamina. A is laminar area in mm^2 and *vi* is the average vein islet number/mm^2, A_{vt} = A x *vt*, where A_{vt} is the absolute vein islet termination number per area of the lamina. A is laminar area in mm^2 and *vt* is the average vein islet termination number/mm^2.

Dendrogram based on Bray-Curtis cluster analysis was prepared analyzing the leaf architecture characters using PAST *ver.* 3.24.

A dichotomous key was prepared on the basis of diagnostic descriptions made for each taxa under study.

Results and discussion

All the studied tax a showed simple leaf with alternate phyllotaxy and swollen petiole base. The lamina margin was observed to be entire and among the general features exhibited, secondary vein category, tertiary vein angle variability, vein islets count and areolation characteristics proved to be useful in distinguishing them. The macro-morphological characters especially the blade class, lamina ratio, margin type and the differences in the venation pattern at second and third degree category served as important features for taxonomic segregation (Tables-1-4).

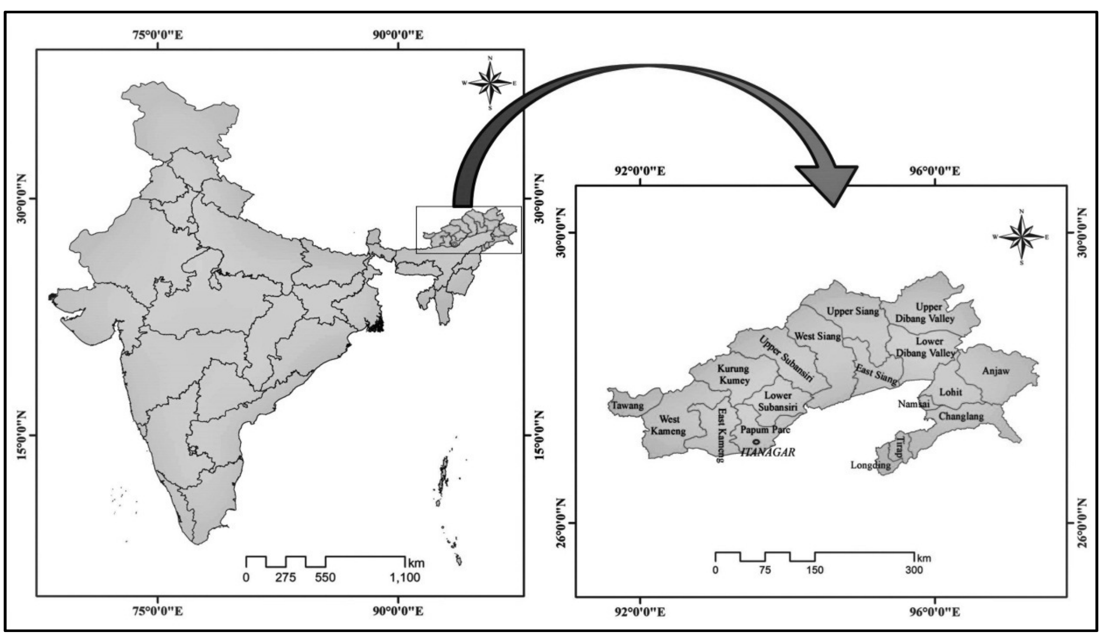

Figure-1: Map showing study area.

Phyllanthus amarus Schumach. and Thonn.: Leaves alternate, blade class leptophyll; petiole with swollen base; lamina oblong, 7 – 9 x 3 – 4.5mm, entire, rounded apex with minute mucro, base rounded, slightly oblique with acute base angle; secondary veins festooned brochidodromous with more than one additional sets of loops outside the main brochidodromous; irregular 2° vein spacing and uniform 2° vein angle; tertiary veins randomly reticulate where tertiaries anastomose with 2° and other 3° veins at random angles; weak intersecondaries, poorly developed areoles and fusion of high order veins with those running close to the margin forming fimbrial veins (Figure-2A).

Indian distribution: Throughout the country mainly in tropical and subtropical region.

Global distribution: Pantropical and sub-tropical regions.

Phyllanthus emblica L.: Leaves alternate, blade class nanophyll; petiole with swollen base; lamina oblong, 14–15 x 3 – 4mm, entire, rounded apex with minute mucro, base rounded with acute angle; secondary veins terminates to a strong vein closely parallel to the leaf margin classified as intra-marginal vein with irregular 2° vein spacing and uniform 2° vein angle; tertiary veins random reticulate where tertiaries anastomose with 2° and other 3° veins at random angles; strong intersecondaries, moderately developed areoles and fusion of high order veins with those runningclose to the margin forming fimbrial veins (Figure-2B).

Indian distribution: Cultivated throughout the country including Andaman Islands in warmer areas. Also common in the wild.

Global distribution: Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh, Thailand, China, W. Malaysia, Lesser Sunda Islands.

Phyllanthus myrtifolius (Wight) Mull. Arg.: Leaves alternate, blade class nanophyll; petiole with swollen base; lamina elliptic, 10–12 x 3–5mm, entire, apex convex and with acute angle, base cuneate with acute angle; secondary veins festooned brochidodromous with more than one additional sets of loops outside the main brochidodromous; irregular 2° vein spacing and 2° vein angle smoothly decreasing downward; tertiary veins random reticulate where tertiaries anastomose with 2° and other 3° veins at random angles; weak intersecondaries, with moderately developed areoles, marginal ultimate veins recurved to form loop (Figure-2C).

Indian distribution: Commonly grown in gardens as low hedge plant in warm regions.

Global distribution: Widely grown in pantropical regions.

Phyllanthus fraternus Webs.: Leaves simple, alternate, sessile, blade class nanophyll; lamina elliptic, 8–9 x 3–5mm, slightly oblique, entire, apex convex and with broader angle, base rounded, slightly oblique, with acute angle; secondary veins with more than one additional sets of loops outside the main brochidodromous; irregular discontinuity; tertiary veins intersect between secondaries with an abrupt angular discontinuity; intersecondaries absent, poorly developed areoles and fusion of high order veins with those running close to the margin forming fimbrial veins (Figure-2D).

Indian distribution: Throughout the country in warmer places.

Global distribution: Pakistan, Bangladesh, Nepal, West Indies, Africa; a pantropical weed.

Phyllanthus reticulatus Poir.: Leaves simple, alternate, blade class nanophyll; petiole with swollen base; lamina elliptic, 17–19 x 9–10mm, entire, apex rounded-obtuse and with broader angle, base rounded with obtuse angle; secondary veins joined together forming prominent arches, brochidodromous with irregular 2° vein spacing and uniform 2° vein angle; tertiary veins dichotomizing with weak intersecondaries; poorly developed areoles and fusion of high order veins with those running close to the margin forming fimbrial veins (Figure-2E).

Indian distribution: Throughout the country including Andaman & Nicobar Islands in warmer areas.

Global distribution: Pakistan, Nepal, Bhutan, Sri Lanka, S.E. Asia, Tropical China, Malaysia, Australia, Tropical Africa.

Phyllanthus urinaria L.: Leaves simple, alternate; blade class nanophyll; petiole with swollen base; lamina oblong, 13–15x 4–5mm, symmetric, entire, apex convex-rounded and with acute angle, base rounded with acute angle; secondary veins brochidodromous, joined together forming prominent arches; irregular 2° vein angle and spacing abruptly increasing towards the base; Tertiary veins intersect between secondaries with an abrupt angular discontinuity; weak intersecondaries, poorly developed areoles and marginal ultimate vein recurved to form loops (Figure-2G).

Indian distribution: Almost throughout the country including Andaman and Nicobar Islands.

Global distribution: Native of southern Asia but now widespread in tropical and subtropical regions.

Phyllanthus virgatus G. Forst.: Leaves simple, alternate, blade class nanophyll; petiole with swollen base; lamina narrowly ovate-oblong, 15–17 x 4–5 mm, entire, apex convex-obtuse with acute angle and a minute mucro, base rounded with acute angle; secondary veins joined together forming prominent arches, brochidodromous with irregular 2° vein spacing with uniform angle; tertiary veins randomly reticulate where tertiaries anastomose with 2° and other 3° veins at random angles; no intersecondaries, poorly developed areoles and marginal ultimate veins recurved to form loop (Figure-2F).

Indian distribution: Throughout the country including Andaman & Nicobar Islands.

Global distribution: Mainly distributed in Sri Lanka to SE Asia, S. China, Indo-China and Malaysia.

Table-1: Foliar morphometric characters of the studied species.

Species	Leaf attachment	Leaf organization	Petiole features	Mean laminar length (mm)	Mean laminar width (mm)	Mean laminar area (mm^2)
Phyllanthus amarus	Alternate	Simple	Base swollen	8.5	3.75	21.12
Phyllanthus emblica	Alternate	Simple	Base swollen	14.5	3.5	33.6
Phyllanthus fraternus	Alternate	Simple	Sessile	8.8	3.5	29.5
Phyllanthus myrtifolius	Alternate	Simple	Base swollen	10.5	4.0	27.72
Phyllanthus reticulatus	Alternate	Simple	Base swollen	18.0	10.0	118.8
Phyllanthus urinaria	Alternate	Simple	Base swollen	14.0	4.5	40.92
Phyllanthus virgatus	Alternate	Simple	Base swollen	16.0	4.5	47.52

Table-2: Foliar morphometric characters of the studied species.

Species	Petiole length (mm)	Blade class	Laminar Shape	Laminar L:B ratio	Apex shape	Apex angle	Base shape	Base angle	Margin type
Phyllanthus amarus	0.5	Leptophyll	Oblong	2.66:1	Rounded	Acute	Rounded	Acute	Entire
Phyllanthus emblica	1.0	Nanophyll	Oblong	4.14:1	Convex	Acute	Rounded	Acute	Entire
Phyllanthus fraternus	Sessile	Nanophyll	Oblong	2.51:1	Convex	acute	Rounded	Acute	Entire
Phyllanthus myrtifolius	0.1	Nanophyll	Elliptic	2.62:1	Convex	Acute	Cuneate	Acute	Entire
Phyllanthus reticulatus	2.5	Nanophyll	Elliptic	1.8:1	Rounded	Acute	Rounded	Obtuse	Entire
Phyllanthus urinaria	1.0	Nanophyll	Oblong	3.11:1	Convex	Acute	Rounded	Acute	Entire
Phyllanthus virgatus	0.1	Nanophyll	Oblong	3.55:1	Convex	Acute	Rounded	Acute	Entire

Table-3A: Micro-morphological characters of veins from the studied species.

Specimen	1°vein category	2°vein category	2°vein spacing	2°vein angle	Inter 2°vein	3°vein category
Phyllanthus amarus	Pinnate	Festooned brochidodromous	Irregular	Uniform	Weak intersecondaries	Random reticulate
Phyllanthus emblica	Pinnate	Intramarginal vein	Irregular	Uniform	Strong intersecondaries	Random reticulate
Phyllanthus fraternus	Pinnate	Festooned brochidodromous	Irregular	Uniform	Absent intersecondaries	Alternate percurrent
Phyllanthus myrtifolius	Pinnate	Festooned brochidodromous	Irregular	Smoothly decreasing towards base	Weak intersecondaries	Random reticulate
Phyllanthus reticulatus	Pinnate	Brochidodromous	Irregular	Uniform	Weak intersecondaries	Dichotomizing
Phyllanthus urinaria	Pinnate	Brochidodromous	Irregular	Abruptly increasing towards base	Weak intersecondaries	Alternate percurrent
Phyllanthus virgatus	Pinnate	Brochidodromous	Irregular	Uniform	Absent intersecondaries	Random reticulate

Table-3B: Micro-morphological characters of veins from the studied species.

Specimen	3°vein angle	3° vein angle variability	4°vein category	Areolation	Marginal Ultimate Venation
Phyllanthus amarus	Perpendi cular	Inconsistent	Absent	Poorly developed	Fimbrial vein
Phyllanthus emblica	Obtuse	Inconsistent	Dichotomizing	Moderately developed	Fimbrial vein
Phyllanthus fraternus	Obtuse	Inconsistent	Absent	Poorly developed	Fimbrial vein
Phyllanthus myrtifolius	Obtuse	Inconsistent	Dichotomizing	Moderately developed	Looped
Phyllanthus reticulatus	Obtuse	Inconsistent	Regular polygonal	Poorly developed	Fimbrial vein
Phyllanthus urinaria	Obtuse	Inconsistent	Absent	Poorly developed	Looped
Phyllanthus virgatus	Obtuse	Inconsistent	Dichotomizing	Poorly developed	Looped

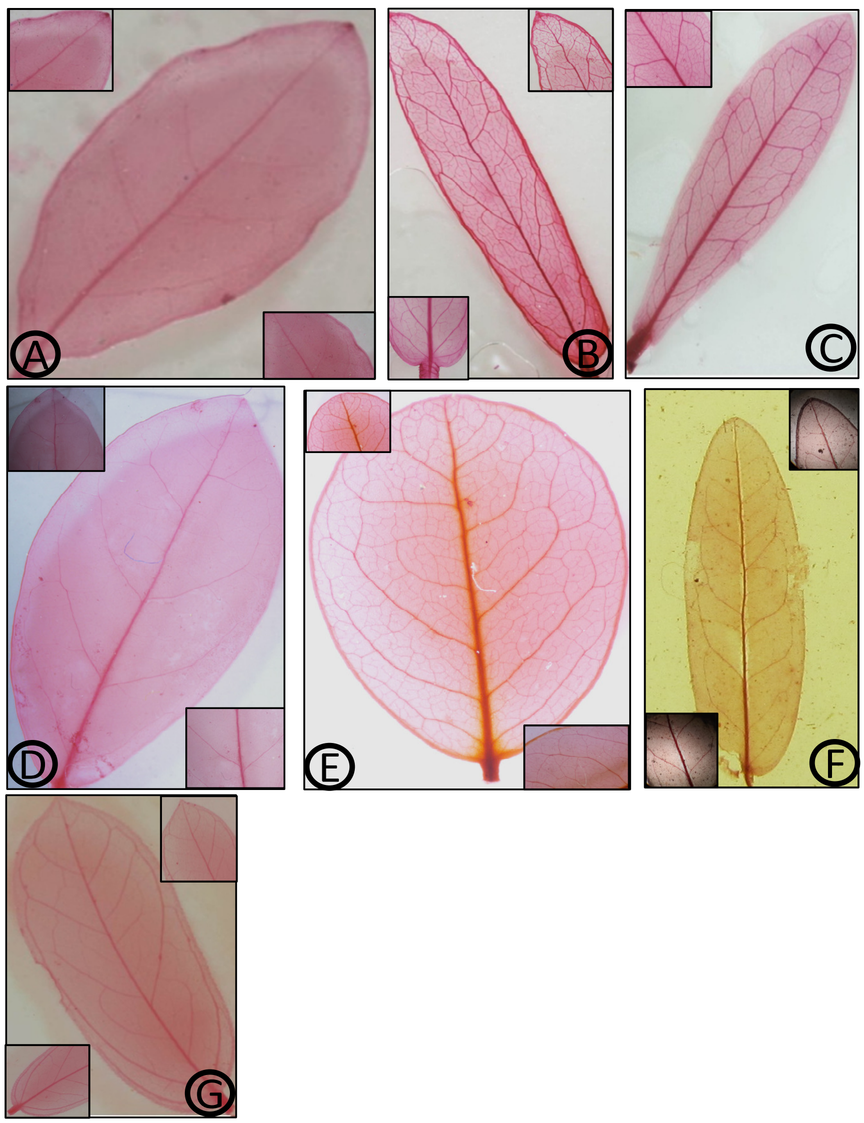

Figure-2: A. *P. amarus;* B. *P. emblica;* C. *P.myrtifolius;* D. *P. fraternus;* E. *P.reticulatus;* F. *P. virgatus;* G. *P. urinaria.*

Table-4: Quantitative characters of leaf venation from the studied species.

Species	Leaf area /mm^2	No of veins on one side	Angle between 1° - 2° veins	Average Vein islets/ mm^2 (A/M/B)	Vein islets termination number	Average size of areole/ mm^2	Absolute vein islets number	Absolute vein islet termination number
Phyllanthus amarus	21.12	10-12	20 – 25	4/5/4.3	2 – 3	0.114 ±0.030	93.77	52.8
Phyllanthus emblica	33.6	16-20	30 – 70	3.33/4.66/3.66	2 – 3	0.065±0.005	130.36	84.0
Phyllanthus fraternus	29.5	10-12	20 – 39	5/6.33/5.66	2 – 3	0.105±0.031	166.97	73.75
Phyllanthus myrtifolius	27.72	18-20	60 – 72	5/6/5.66	3 – 4	0.045±0.007	153.8	97.02
Phyllanthus reticulatus	118.8	12-14	30 – 40	3/4/3.33	2 – 3	0.06±0.002	408.67	297.0
Phyllanthus urinaria	40.92	12-15	43 – 50	3.66/5.66/5	3 – 4	0.097±0.006	195.18	143.22
Phyllanthus virgatus	47.52	12-14	48 – 60	1/3/2.66	2 – 3	0.742±0.120	126.4	118.8

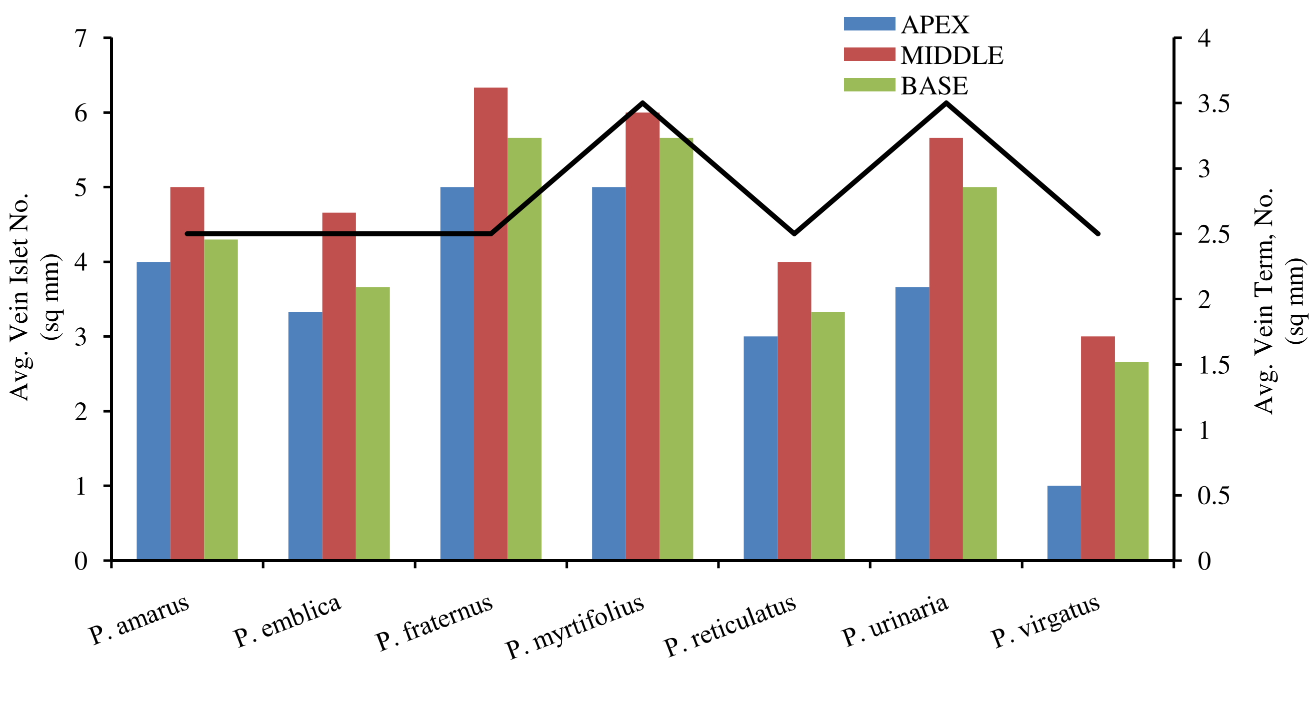

Figure-3: Graph showing average vein islet and vein termination number.

The dendogram based on Bray-Curtis cluster analysis were basically based on the quantitative morphometric and minor venation traits that include mean lamina length, breadth and area, and vein islet number per sq mm of leaf surface, areole size, angle of variation between 1° and 2° veins, absolute vein islet number and absolute vein termination number. On the basis of these quantitative foliar morphometric characters for seven species of *Phyllanthus,* majority of species have common ancestral line with *Phyllanthus emblica* showing more than 90% similarity to *Phyllanthus myrtifolius* and above 85% with *Phyllanthus virgatus.* More than 80% similarity have also been observed between *Phyllanthus amarus* and rest of the species excluding *Phyllanthus reticulatus* which remains out-grouped from the clade showing less than 60% similarity with the other six species under study (Figure-4).

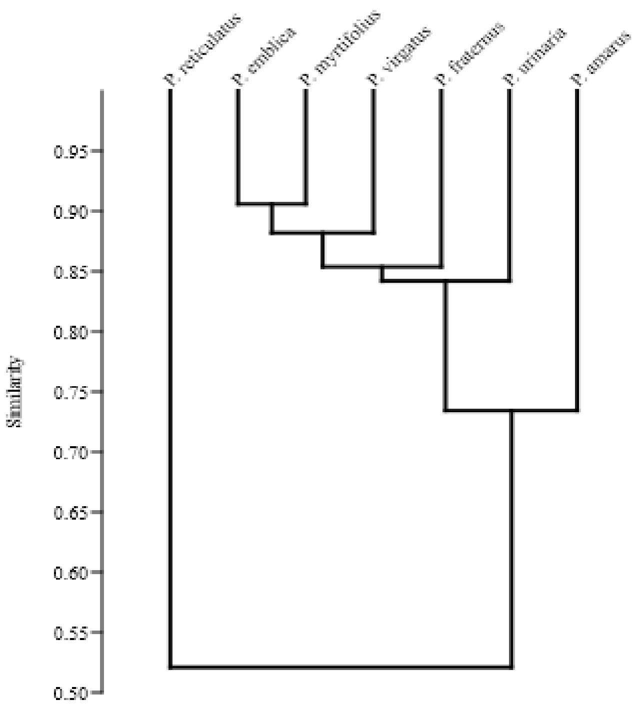

Figure-4: Dendrogram based on cluster analysis obtained from quantitative morphometric characters.

Key to seven species of Phyllanthus L. using leaf architectural characters

1a. Leaf organization simple, lamina elliptic…………………2
1b. Leaf organization simple, lamina oblong…………………3
2a. Leaf base cuneate, apex convex…… *Phyllanthus myrtifolius*
2b. Leaf base rounded, apex rounded.…*Phyllanthus reticulatus*
3a. Leaf base rounded, apex rounded or convex,1° vein order pinnate, 2° vein order Festooned brochidodromous…..............4
3b. Leaf base rounded, apex convex…………………………..5
4a.Leaf apex rounded, 1°vein order pinnate, 2°vein order festooned brochidodromous, 3° vein order random reticulate, weak intersecondaries ………………….*Phyllanthusamarus*
4b. Leaf apex convex, 1° vein order pinnate, 2° vein order festooned brochidodromous, 3° vein order alternate percurrent, intersecondaries absent......................*Phyllanthusfraternus*
5a. 1° vein order pinnate, 2° vein order intramarginal, stronginter secondaries....*Phyllanthus emblica*
5b. 1° vein order pinnate, 2° vein order brochidodromous, intersecondaries weak or absent……………………….…….6
6a. 2° vein order brochidodromous, intersecondaries weak, 2° vein angle abruptly increasing towards the base……………....................*Phyllanthus urinaria*
6b. 2° vein orderbrochidodromous, intersecondaries absent, 2° vein angle uniform …………………....*Phyllanthus virgatus*

Discussion: Leaf lamina is functionally significant part of a plant that plays a direct role in carbon assimilation, magnifying the biomass allocation to lamina and diminishing its support investment[24]. As most of the dicotyledonous taxa possesses consistent leaf architectural pattern, a thorough study on foliar morphometry is utmost important to understand both phylogenetic as well as ecological studies[25]. Leaf shape has a major impact on the support investment of common laminar area and laminar mass[26]. Species with larger leaves and with less xylem has an added advantage to flourish well in humid and non-stressful environmental conditions[27]. In the present study, the lamina shapes were mostly oblong in *P. amarus, P. emblica, P. fraternus, P. urinaria* and *P. virgatus,* whereas it was elliptic only in *P. myrtifolius* and *P. reticulatus*. The laminar apex angle was acute for all the species and the apex shape was mostly convex, with *P. amarus* and *P. reticulatus* with rounded apex.

Leaf venation patterns and their shapes are strongly correlated[28]. The characters are also responsible for both mechanical support as well as translocation of water and nutrients to long distance including photo assimilates[29]. The primary vein category in the studied species have been found to be pinnate in all the species whereas the secondary vein category varied from festooned brochidodromous in species like *P. amarus, P. myrtifolius* and *P. fraternus* with brochidodromous in *P. reticulatus*, *P. virgatus* and *P. urinaria.* However, the venation was intramarginal in *P. emblica.* Simple leaves with entire margins and brochidodromous venation reflects the primitive pattern of angiosperms[30]. In extant arborescent, the brochidodromous venation was more typical in tropical floras whereas non-brochidodromous in northern temperate floras[31].

Variation in leaf venation patterns can provide significant data that can be used in group identification[32]. Works on leaf architecture on Brassicaceae showed craspedodromous or pinnate-festooned brochidodromous type of major venation pattern[33]. The major venation patterns observed in the family Acanthaceae were pinnate craspedodromous in *Acanthus ilicifolius* and acrodromousin *Lepidagathis trinervis*[34]. Studies on leaf architecture of *Quercus*[35] and *Quercus* sub-genus *Cyclobalanopsis*[36] represent some species with brochidodromous leaf venation with less specialized venation in subgenus *Cyclobalanopsis.* Based on such work, it was presumed that the brochidodromous venation type is relatively primitive while eucamptodromous venation as advanced. Third degree venation category exhibited reticulate type and reticulate orthogonal formed a distinguishing feature in delineating certain varieties of *Mangifera indica*[37]. The present study showed third degree vein category as random reticulates in *P. amarus*, *P. emblica*, *P. myrtifolius, P. virgatus*; alternate percurrent in *P. fraternus*and *P. urinaria* and dichotomizing in *P. reticulatus*.
Morphologically, the first recognizable vein order is the pro-cambium of midvein (primary vein). In continuity with the midvein, the secondary veins are formed, appearing acropetal, basipetalor divergent patterns depending upon the species[38]. The usual trend of evolution is represented by regular increase in both low and high order venation, as proven by the leaves of fossil angiosperms[39]. A significant aspect of leaf architecture is the minor venation pattern that constitutes the tertiary veins and the next order of finer branches that arises[30]. The angle of divergence of lower order veins in the leaf is valuable for

optimizing the unfolding process with respect to time, energy and geometry[40]. The major function of marginal leaf venation is to avoid desiccation[41]. The development of high fluid pressure has also been illustrated[42]. The marginal vein supplies sufficient water to the margin that with maximum water stress and hence advantageous for both mechanical stability and water supply[43]. The present study showed looped marginal ultimate venation pattern in *P. myrtifolius, P. fraternus*, *P. virgatus* and *P. urinaria* and presence of fimbrial vein in *P. amarus*, *P. emblica*, and *P. reticulatus.*

Leaf areoles are minute tissue areas in leaf that remains surrounded by the fourth and fifth degree veins and can have diverse shapes and arrangements. The formation of incomplete and irregularly shaped with randomly distributed areoles was observed in the Myrtaceae family[44]. Based on the development pattern of areole the species can be differentiated into groups. The study on leaf venation of some medicinal species of *Bauhinia* segregated the species into three main groups[47]. The studied *Phyllanthus* species can be differentiated broadly into two groups based on the areole structure. Moderately developed in *P. emblica, P. myrtifolius* and poorly developed in *P. amarus*, *P. reticulatus*, *P. fraternus, P. virgatus* and almost lacking in *P. urinaria.* The shapes were quadrangular, pentagonal to irregular and the size range varied from maximum in *P. virgatus* followed by *P. amarus*and *P. fraternus*. Smaller areoles were observed in *P. urinaria, P. emblica*, *P. reticulatus* and *P. myrtifolius.*

The vein islet number can be specific for a species and could be significant for understanding diagnostic character[46]. Vein islet and termination values are important parameters in evaluating the pharmacognostic characters of crude drugs from important medicinal plants[47]. The vein-islets number count from apex, middle and base portion of the lamina were estimated for the species. The maximum vein islets number count was observed from middle and basal portion and minimum from apex of the lamina. The average vein islet number per mm^2 was highest in *P. fraternus* and least in *P. virgatus.* However, the maximum count of absolute vein islet number was recorded in *P. reticulates* followed by *P. urinaria* and least count was observed in *P. amarus* (Figure-2).

Conclusion

Among the seven species of *Phyllanthus* L. of Phyllanthaceae studied, it poses some difficulties to segregate these plants solely on the basis of superficial leaf morphology. By observing the detail foliar morphometric characters with the help of simple devices like dissecting and compound light microscope, some valuable data that has been generated absolutely serves as important tool for their recognition at the species level. The differences in vein architecture have been categorized at one to four degree levels. The major and minor venation details have been presented. The result of this study could be immensely significant in plant taxonomy and morpho-systematics, especially in dealing with non-reproductive plant parts and in the overlapping species complex.

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