

STUDY ON TAXONOMIC CHARACTERS AND PHYLOGENETIC POSITIONS OF SPECIES UNDER DENDROCALAMUS (POACEAE) IN DIFFERENT REGIONS OF MYANMAR

Thida Hlaing¹

Abstract

In the present research, bamboo plants of the family Poaceae (Gramineae) in Myanmar. Totally 12 genera were described. Most of the bamboos are naturally distributed in higher or lowland of mountain range. The morphological characters of collected species were based on morphology of culm, culm sheath and leaves. According to the phylogenetic study, the phylogenetic positions of genera *Dendrocalamus* have been studied by constructing Dendrogram.

Keywords: Taxonomy, culm, culm sheath and leaves.

Introduction

Bamboo is well known plant all over the world, particularly in Asian and African countries. Most botanists place them in the tribe. Bambuseae within the grass family Poaceae formally called Gramineae. They are worldwide distributed with about 80 genera and about 1000 species. These are about 200 species and 20 genera are found in South-East Asia. In Myanmar, bamboo were found as 18 genera and about 100 species (Hundley & chit koko 1987) Kress *et.al* (2003) recorded 17 genera and 92 species in Myanmar.

Bamboos have evolved to cover a wide range of climates from tropical areas to temperate ones, from plains to high mountains. Some species even occur in the cold temperate zones or on mountains as high as 4,500m above sea level. Geographic distribution of bamboo worldwide may fall into three major regions; namely, the Asian - Pacific Region, the Americas Region and the African Regions. (Yang 2010)

The geographical distribution of bamboo is greatly influenced by human activities. There are about 29 species of *Dandrocalamus* growing in

¹ Dr., Associate Professor, Department of Botany, University of Taunggyi

South-East Asia, mainly occurring in the lowlands from the Indian subcontinent to Indo-China and Peninsular Malaysia. *Dendrocalamus* Nees comprises 52 species and is distributed from China to India, Myanmar, Thailand, Indo China and Malaysia through Papua New Guinea. A genus containing the largest of all bamboo species, forming clump up to 30m tall. (Stapleton 1994)

Bamboo is an essential part of life for many people around the world. It is used in many ways, including structural support for housing, furniture, musical instruments, toys and innumerable small articles. Bamboo also have ornamental use in landscape gardens and windbreaks (Camus 1913).

Bamboo is used in Chinese medicine for treating infections and healing. It is a low-calorie source of potassium. It is known for its sweet taste and as a good source of nutrients and protein. (Ghosh 2008)

The present work deal with the taxonomic characters and phylogenetic positions of genera *Dendrocalamus* in different regions. The aim and objectives of present work are to identify the taxonomic character of bamboo in phylogenetic relationship among the genera *Dendrocalamus* to disseminate the knowledge of more complete taxonomical characters of bamboo resources plants.

Materials and Methods

1. Morphology

In this study, all the members of the family Poaceae (Tribe-Bambuseae) were collected from different regions of Myanmar. All the collected specimens were recorded and the collected places were determined by using a Global Positioning System (GPS) device. Plant collection and preservation technique were used to make the herbarium specimens. The collected specimens were identified by the culms, culm sheath and leaves referring to the book of Hooker (1897), Stapleton (1994), Wong (1995),

Dransfield (1995) and Shouliang *et al.* (2006). The morphological record of all the collected species were stated in figures of photographs.

Phylogenetic Studies

The phylogenetic relationships between these species were to be examined. The classical phylogenetic tree is accomplished by Bor (1960) and Shouliang *et al.* (2006).

The phylogenetic relation was studied basing on morphological characteristics of peculiar plant parts. The individual characters are designated as primitive, derived, or advanced. The selected characters needed in score making for the preparation of phylogenetic scheme are (A) Nature of Rhizome type, (B) Branches type, (C) Culm hollowness, (D) Culm wall thickness, (E) Culm nodes, (F) Culm with white ring, (G) Culm sheath thickness (H) Shape of culm sheath, (I) Ligule, (J) Auricle of culm sheath, (K) Bristles of culm sheath (L) Leaf shape, (M) Ligule of leaf and (N) Leaf auricle. The score of primitive character is 0, intermediate character is 0.5 and advanced character is 1.

Based on the total score of study characters the dendrogram was constructed by using IBM SPSS version 21. The method of data analysis of cluster method was nearest neighbour and Euclidean distance. According from the resulting dendrogram, it can be estimated that which are related among those studied genera or species.

The assessments of primitive and advanced characters are linked with the nature of Rhizome type, culm, culm sheath and leaves as shown in Table 1.

Table 1. Categories of Bamboo Used in Score Making for the Preparation of Phylogenetic Scheme

Category	Primitive score (0)	Intermediate score (0.5)	Advanced score (1)
A Rhizome	monopodial	-	sympodial
B Branches type	simple	moderate	much branches
C Culm hollowness	solid	nearly solid	hollow
D Culm wall thickness	thick	-	thin
E Culm nodes	non swollen	swollen	with thorn
F White ring	none	present	present in adventitious root
G Culm sheath thickness	thick	-	thin
H Shape of culm sheath	cylindrical/ narrow/ linear	triangular/ elongate	oblong/ elliptic / lanceolate/ ovate
I Ligule	none	short/ present	long
J Auricle of culm sheath	none	equal/ short/ long	unequal
K Bristles of culm sheath	none	short	dense
L Leaf shape	narrow/linear	lanceolate	oblong/ ovate
M Ligule of leaves	none	short	long
N Leaf auricle	none	short	long

Results

In the present study a total of twelve genera belonging to the tribe Bambuseae were recorded. The list of the collective genera was arranged according to shouliang *et al.* 2006 and the species of each genus by alphabetical order was shown in Table 2. The resulting species are systematically described and the phylogenies of collected genera based on morphology are also mentioned (Table 3, figure 3).

Table 2. List of Collected Bamboo

No.	Scientific Name	Local Name	Locality	GPS data
1.	<i>Dendrocalamus asper</i> (Schultes) Badzer ex Heyne.	Tawwa	Mogok Township	N 22°53'5.46" E 96°29'45.2"
2.	<i>Dendrocalamus brandisii</i> (Munro) Kurz	Lephettaungwa	Pindaya Township	N 20°50'48.08" E 96°40'57.94"
3.	<i>Dendrocalamus calostachyus</i> (Kurz) Kwz	Wagyi	Kalaw Township	N 20°33'25.04" E 96°36'47.30"
4.	<i>Dendrocalamus copelandii</i> Gamble ex Brandis	Leikwa	Kalaw Township	N 20°33'25.02" E 96°36'47.30"
5.	<i>Dendrocalamus giganteus</i> Wallich ex Munro	Wabogyi	Nyaungshwe Township	N 20°38'55" E 96°56'9.02"
6.	<i>Dendrocalamus hamiltonii</i> Nees & Arnolt ex Munro	Wabomyetsan gyi	Naypyitaw Township	N 19°57'9.49" E 95°53'15.8"
7.	<i>Dendrocalamus latiflorus</i> Munro	Wani	Nyaungshwe Township	N 20°37'20.28" E 96°56'56.72"
8.	<i>Dendrocalamus longispathus</i> Kurz	Wanet	Magway Township	N 20°10'56.26" E 94°50'53.43"
9.	<i>Dendrocalamus membranaceus</i> Munro	Waya	Kalaw Township	N 21°8'50.6" E 96°26'33.39"
10.	<i>Dendrocalamus messri</i> Blatter & Nees	Waphayaung	Banmauk Township	N 20°33'25.02" E 96°36'47.30"
11.	<i>Dendrocalamus pendulus</i> Ridley	Walaw	Ywangan Township	N 24°24'7" E 95°49'15"
12.	<i>Dendrocalamus strictus</i> (Roxb) Nees	Hmgynwa	Padan Township	N 19°51'34.22" E 94°26'37.55"

1. *Dendrocalamus asper* (Schultes f.) Backer ex Heyne, Nutt. pl. Ned. Ind, ed. 2, vol. 1:30/ 1927. (Figure. 1)

Bambusa asper Schultes, f. 1830.

Evergreen, loosely tufted, rhizome sympodial, about 20 m height. Culms erect with pendulous tip, 15-20 m long, 10-30 cm in diameter, hollow; walls 3-5 mm thin; nodes not swollen; internodes 25-45 cm long, dark green, glabrous, smooth, white ring absent with white hairs below them, basal nodes with short aerial roots. Culm sheaths caducous, broadly triangular, 20-40 cm long, 20-25 cm wide, thickly leathery, young plant green turning yellow at the age, covered with dark brown hairs on the side, glabrous on the back; blades lanceolate, 20-30 cm long, erect, without auricle and without bristles, acuminate at the apex; ligules short, about 2 mm long, wavy with a ciliate margin. Leaves 3- to 10- grouped at the end of a branched.

2. *Dendrocalamus brandisii* (Munro) Kurz, Prelim Rep. Forest Pegu 94. 1875. (Figure. 2)

Bambusa brandisii Munro, Trans. L. Soc. Landon 26: 109. 1868.

Evergreen, loosely tufted, rhizome sympodial, about 25 m height. Culms erect with pendulous tip, 10-30 m long, 10-25 cm in diameter, hollow; walls 2.5-5 mm thin; nodes swollen; internodes 10-40 cm long, arch-grey to dull green, glabrous, white ring present. Culm sheaths deciduous, broadly lanceolate-oblong, 30-50 cm long, 20-35 cm wide, leathery thick, orange to bright yellow covered with shiny black hairs when young. Culm sheaths more longer than culm blade; blades lanceolate to long acuminate, 10-17 cm long, reflexed or nearly erect, with short bristle, acuminate at the apex; ligules short continuous with the sheath top, about 1-2 mm long, margin deeply dentate, auricle short. Leaves 3- to 10- grouped at the tip of the branched.

3. *Dendrocalamus calostachyus*(Kurz) Kurz, Prelim Rep. Forest Pegu 94. 1875. (Figure. 3)

Bambusa calastachya Kurz, J.Asiat. Soc. Bengal, pl 2, Nat-Hist 42247.1873.

Evergreen, loosely tufted, rhizome sympodial, about 24 m height. Culms erect, tall, about 21-24 m long, 12- 20cm in diameter, hollow; wall 2-4 mm thin; nodes not swollen and annulate; internodes 15-35 cm long, lower most shortest, distally pubescent, white ring present. Culm sheaths broadly ovate, 20-27 cm long, 13-35 cm wide, leathery, thick, pubescent covered with oppressed tawny hairs, truncate at the apex, orange-brown coloured with pale brown hairs on young culm-sheath; blades linear-lanceolate, 6-8 cm long, erect, without bristles, pale brown coloured; ligules short, about 2 mm long and lines of dark hairs, entire with short auricle. Leaves 5-to20- grouped at the end of a branched.

4. *Dendrocalamus copelandii*(Gamble ex Brandis) N.H. Xia & Stapleton, KewBull52 (2) : 484. 1997 (Figure. 4)

Bambusa copelandii Gamble ex Brandis, Indian Trees: 671. 1906.

Evergreen, loosely tufted, large bamboo, rhizome sympodial, about 30 m height. Culms straight and erect, about 15-30 cm long, 10-35 cm in diameter, hollow; walls 2-3 mm thin; nodes not swollen; internodes 10-40 cm long, lower ones without hairs covered with copicuous white wax when young, furry, white ring absent. Culm sheaths broadly ovate-oblong, 25 - 40 cm long, 42-55 cm wide, thick, deciduous to persistent, coriaceous, reddish brown coloured when young covered with brown hairs, turning straw-coloured with age, glabrous, apex convexly horizontal; blades lanceolate, 10-25 cm long, erect to spreading, with auricles, continuing from the base of culm-sheath blades as fleshy, crisped lobes without bristles; ligules short, 2 mm long. Leaves 3- to 16- grouped at the tip of the branched.

6. *Dendrocalamus giganteus* Wallich ex Munro, Trans L. Soc. 26: 150. 1868. (Figure.5)

Bambusa giganteus Hook.f., Fl. Br. Ind. 7: 406. 1897.

Evergreen, densely tufted, rhizome sympodial, the giant bamboo about 30 m height. Culms wide, pale thin wax with arching tip, 30-35 m long, 20 - 30 cm in diameter, hollow; walls 2-4 mm thin; nodes not swollen; internode 20-50 cm long, dark green, furry, covered with a white waxy layer when young, white ring present. Culm sheaths caducous, , broadly ovate-lanceolate, 20-50 cm long, 25-50 cm wide, thickly leathery, whitish to greyish green when young turning pale brown with age, with dark brown hairs on the back; blades reflexed, ovate-lanceolate, 10-30 cm long, with auricles without bristle, acuminate at the apex, pale brown coloured; ligule long, about 12 mm long, serrulate. Leaves 3- to 12- grouped at the tip of the branched.

7. *Dendrocalamus hamiltonii* Nees & Arnott ex. Munro Trans. L. Soc. Landon 26: 151. 1868. (Figure. 6)

Evergreen, a large densely tufted, rhizome sympodial, about 25 m height. Culms erect and drooping at the top, 20-25 cm long, 15-25 cm diameter, hollow; walls 2-3 mm thick; nodes not swollen; internodes 40-50 cm long, green, glabrous, smooth, covered with a white waxy layer when young, white ring present with hairs below them, basal nodes with short aerial roots. Culm sheaths glabrous, deciduous, broadly ovate, 30-45 cm long, 15-25 cm wide, thick, greyish white coloured with pale brown hairs on young culm sheath, turning green with age, glabrous; blade ovate lanceolate, 20-25 cm long, erect, without auricle acuminate at the apex with long bristle, pale black coloured; ligules long, about 4 mm long with margin waxy and desticulate. Leaves 3- to 5- grouped at the tip of the branched.

8. *Dendrocalamus latiflorus* Munro, Trans. L. Soc London 26: 152. 1868.
(Figure.7)

Bambusa latiflora (Munro) Kurz 1873.

Sinocalamus latiflorus (Munro) McClure 1940.

Evergreen, densely tufted, rhizome sympodial, about 25 m height. Culms erect with pendulous tip, 20-25 m long, 20-45 cm in diameter, furry, green to dark green, hollow; walls 2-5 mm thick; nodes not swollen; internodes 20-60 cm long, green, glabrous, smooth, white ring present. Culm sheaths deciduous, broadly ovate, 15-35 cm long, 25-45 cm wide, hard and brittle, thick, rounded at the apex, orange-yellow when young turning pale brown with age, abaxially dull brown pubescent, margin entire; blades deflexed, ovate to lanceolate, 10-13 cm long, puberulent near the base abaxially, without bristles; ligules long, about 3-5 mm long, margin wavy, finely serrated; auricles short. Leaves 7- to 15- grouped at the tip of the branched.

9. *Dendrocalamus longispathus* Kurz, For Fl. Brit. Burma 2: 561. 1878.
(Figure. 8)

Everygreen, densely tufted, rhizome sympodial, about 20 m height. Culms slender, straight with arching at the bases, 12-20 m long, 8-12 cm in diameter, solid; walls 12 mm thick; nodes slightly swollen; internodes 25-40 cm long, dark green, furry, the lower one bearing aerial root white ring present. Culm sheaths broadly lanceolate, 35-60 cm long, 15.5-18.5 cm wide, yellow green when young turning pale yellow with age, glabrous, fragile with dark brown hairs on the back; blades lanceolate, 30-45 cm long, erect, with long auricle, acuminate at the apex, bearing brown bristles along the edge; ligules long, about 4 mm long, toothed. Leaves 5- to 7- grouped at the tip of the branched.

10. *Dendrocalamus musmembranaceus* Munro, Trans Linn. Soc Landon 26: 149. 1868. (Figure.9)

Evergreen, loosely tufted, rhizome sympodial, about 24 m height. Culms very straight, 10-24 m long, 10-20 cm in diameter, hollow; walls 2-5 mm thin, covered with white powdered deciduous scurf when young, turning green on maturity; nodes swollen; internodes 20-40 cm long, nodes prominent, basal ones with aerial roots, branches arising from all nodes, white ring absent. Culm sheaths deciduous, elliptical to oblong, usually longer than internodes, 17-75 cm long, 9-30 cm wide, thin, papery, smooth, straw-coloured, glabrous, on the smooth back with appressed dark brown hairs; blades narrowly lanceolate, 4.5-30 cm long, reflexed, without bristles brown hairy; ligules long, about 5 mm long, serrulate, auricle short. Leaves 9- to 20-grouped at the tip of the branched.

11. *Dendrocalamus messeri* Blattere & Nees, Linnaea 9: 476. 1835. (Figure. 10)

Evergreen, densely tufted, rhizome sympodial, about 20 m height. Culms erect, straight up to 18- 20 m long, 30- 45 cm in diameter, hollow; walls 6- 7 mm thick; nodes swollen, with aerial roots from the nodes; internodes 10-30 cm long, green, glabrous, smooth, white ring present. Culm sheaths broadly ovate- lanceolate, 18-4 cm long, 50-30 cm wide, thick, young plant pale brown to dark purplish green near apex, cover with brown hairs, turning brown with age, glabrous; blades linear lanceolate, 8-10 cm long, erect, without auricle, acuminate at the apex, without bristle; ligules long, 3-4 mm long with dentate. Leaves 7 to 17- grouped at the tip of the branched.

12. *Dendrocalamus pendulus* Ridley, Journ Strait Settlem Roy Asiat. Soc. 44. 210. 1905. (Figure.11)

Evergreen, densely tufted, rhizome sympodial, about 30 m height. Culms straight, erect, pendulous at the tip, 20-30 m long, 10-20 cm in diameter hollow; walls 3-6 mm thick; nodes not swollen; internodes 18-42 cm

long dark green, glabrous, smooth, white waxy ring below nodes and pale brown hairs when young.

Culm sheaths deciduous, broadly oblong, about 15-25 cm long, 20-30 cm wide, thick, rigid except edges at the top, pale green at their base, yellowish to pinkish near apex, covered with dark brown hairs; blade ovate-lanceolate, 5-10 cm long, spreading (or) deflexed, with short auricle, low rims in lateral extent, bearing long bristles along the edges; ligules short, about 2 mm long, irregularly toothed. Leaves 5- to 11- grouped at the tip of the branched.

12. *Dendrocalamus strictus* (Roxb.) Nees, Linnaea 9: 476. 1835. (Figure. 12)

Bambusa stricta Roxb., Pl. Corom. 1(4): 58. 1798; Hook.f. Fl. Brit. Ind. 7: 404. 1897.

Deciduous, densely tufted with drooping branches, rhizome sympodial, about 20 m height. Culms erect, 8-16 m long, 2.5-8 cm in diameter, hollow; walls 2-3 mm thick; nodes swollen; internodes 30-45 cm long, dull green, glabrous, basal nodes often rooting, branch arising from nearly all nodes, white ring absent. Culm sheaths elongate-triangular, 9-15 cm long, 10-25 cm wide, thick, smooth, pale blue green when young, turning yellowish (or) dull green with age, glabrous; blade erect, persistent, narrowly triangular, 2-4 cm long; blade shorter than sheath, with short auricle, acuminate at the apex, golden brown hairs, on the back, without bristles; ligules short, about 2 mm long, toothed. Leaves 10- to 17- grouped at the tip of the branched.



Figure 1. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus asper* (Schultes f.) Backer ex Heyne.



Figure 2. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus brandisii* (Munro) Kurz.



Figure 3. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus calostachyus* (Kurz) Kurz.



Figure 4. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus copelandii* Gamble ex Brandis.



Figure 5. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus giganteus* Wallich ex Munro



Figure 6. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus hamiltonii* Nees & Arnott ex Munro



Figure 7. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus latiflorus* Munro



Figure 8. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus longispathus* Kurz



Figure 9. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus membranaceus* Munro



Figure 10. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus messeri* Blattere & Nees



Figure 11. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus pendulus* Ridley



Figure 12. Showing clump appearance, young shoot, branching type & bud of *Dendrocalamus strictus* (Roxb.) Nees

Phylogenic Study

According to the characters of rhizome, branching, hollowness of culm, culm wall thickness, nodes, white ring, culm-sheath structure, shape of culm-sheath, ligule of culm-sheath, auricle of culm sheath, presence of bristle on culm-sheath, shape of leaves, presence of ligule and presence of leaf-auricle, the phylogeny of the collected genera or species of bamboos were constructed.

The phylogeny among the collected species of genus *Dendrocalamus*

Totally 12 species of the genus *Dendrocalamus* were collected in present study. The value for each characters and total data score are stated in Table 4.7. The total score for *Dendrocalamus asper* (Schultes) Badzer ex Heyne, *D. brandisii* (Munro) Kurz, *D. calostachyus* (Kurz) Kurz, *D. copelandii* Gamble ex Brandis, *D. giganteus* Wallich ex Munro, *D. hamiltonii* Nees & Arnott ex Munro, *D. latiflorus* Munro, *D. longispathus* Kurz, *D. messeri* Nees, *D. membranaceous* Munro, *D. pendulus* Ridley, *D. strictus* (Roxb.) Nees are 7.5, 9.0, 7.5, 7.0, 8.5, 8.0, 8.0, 8.0, 8.5, 9.5, 7.0 and 6.0 respectively. Most primitive and most advanced dendrogram that representing the possible relationship of the genus is stated in Figure 4.60.

According to the resulting dendrogram *D. membranaceous* Munro differs from other species. *D. messeri* Nees, *D. pendulus* Ridley and *D. strictus* (Roxb.) Nees are near to *D. longispathus* Kurz and separated from *D. hamiltonii* Nees & Arnott ex Munro, *D. latiflorus* Munro, *D. copelandii* Gamble ex Brandis, *D. giganteus* Wallich ex Munro, *D. calostachyus* (Kurz) Kurz and *D. brandisii* (Munro) Kurz. Among them *D. copelandii* Gamble ex Brandis, *D. giganteus* Wallich ex Munro and *D. calostachyus* (Kurz) Kurz are in the same level.

Table 3. The Phylogenetic Data Matrix of the Species of the Genus *Dendrocalamus*

No	Species name	Characters														Total
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	<i>Dendrocalamus asper</i> (Schultes) Badzer ex Heyne	1	1	1	1	0	0	1	0.5	0.5	0	0	0.5	1	0	7.5
2	<i>Dendrocalamus brandisii</i> (Munro) Kurz	1	1	1	1	0.5	0.5	0	1	0.5	0.5	0.5	0.5	1	0	9
3	<i>Dendrocalamus calostachyus</i> (Kurz) Kurz	1	0.5	1	1	0	0.5	0	1	0.5	0	0.5	0.5	0.5	0.5	7.5
4	<i>Dendrocalamus scopelandii</i> Gamble ex Brandis	1	0.5	1	1	0	0	0	1	0.5	0.5	0	1	0.5	0	7
5	<i>Dendrocalamus giganteus</i> Wallich ex Munro	1	0.5	1	1	0	0.5	0	1	1	0.5	0	1	0.5	0.5	8.5
6	<i>Dendrocalamus hamiltonii</i> Nees & Arnott ex Munro	1	0.5	1	0	0	1	0	1	1	0	0.5	1	1	0	8
7	<i>Dendrocalamus latiflorus</i> Munro	1	0.5	1	1	0	0.5	0	1	1	0.5	0	1	0.5	0	8.0

Table 3 (Continued)

No	Species name	Characters														Total
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
8	<i>Dendrocalamus longispinus</i> Kunz	1	0.5	0	0	0.5	1	0	1	1	0.5	0.5	0.5	1	0.5	8
9	<i>Dendrocalamus meseri</i> Blatter & Nees	1	1	1	0	0.5	0	1	1	1	0.5	0	0.5	0.5	0.5	8.5
10	<i>Dendrocalamus membranaceus</i> Munro	1	1	1	1	0.5	1	0	1	1	0	0	1	1	0	9.5
11	<i>Dendrocalamus pendulus</i> Ridley	1	0.5	1	0	0	0.5	0	1	1	0.5	0	1	0.5	0	7.0
12	<i>Dendrocalamus strictus</i> (Roxb) Nees	1	1	1	0	0.5	0	0	0.5	0.5	0.5	0	0	0.5	0.5	6
	Total	12	8.5	11	7	2.5	5.5	2	11	9.5	4	2	8.5	8.5	2.5	94.5
	Average score	1	0.71	0.92	0.58	0.21	0.46	0.17	0.92	0.79	0.33	0.17	0.71	0.71	0.21	7.88

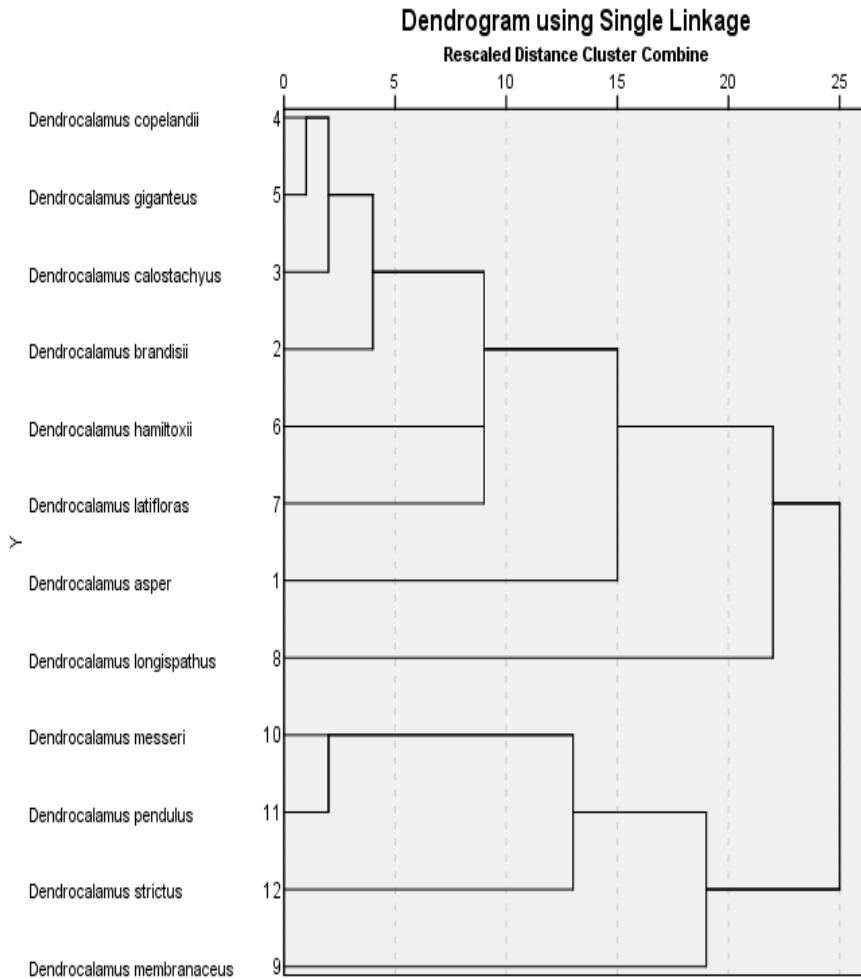


Figure 3. The Cluster Analysis of Collected Species in *Dendrocalamus*

Discussion and Conclusion

The present research deals with taxonomic study on Bamboo growing in Myanmar. It has been observed that totally 12 genera of *Dendrocalamus* were distributed in the study area. The morphology of bamboo can be used for systematic identification for various researchers.

The phylogenetic relationship among the tribe Bambuseae was studied based on the resulting morphological characteristics.

In the plants the presence of rhizome is assumed as advanced characters because it was a modification of stem. Sympodial rhizome is more advanced than the monopodial one. In the branching system, much branching type is advanced. The original stem is solid. Therefore the hollow culms are derived characters and the more thinner the culm is the more advanced in nature. In the stem the cylindrical one without swollen node is primitive and the swollen with thorn form is the advanced characters. Presence of white ring is also assumed at the derived character. In the characters of culm sheath, the thickness is the primitive character and when it is thinner species is more advanced. In addition, presence of ligule, auricle and bristles are also advanced characters and if longer, unequal and denser respectively they are more advanced of characters. In the leaf shape the narrower or linear ones are designated as primitive and the broader large ones are advanced characters. The presence of ligule and auricles in leaves are also advanced morphology of bamboos and the more longer, the more advanced.

The present study deal with 12 genera of Bamboos distributed in Myanmar. The dendrogram for phylogenetic position and relation among the genera were constructed by using the IBM-SPSS version 21 To classify, the data were input in tables of designated characters representing individual score, the hierarchical cluster analysis of genera that needed to analyze was based on nearest neighbor measured by Euclidean distance.

The taxonomy of bamboo or the science of documenting bamboo diversity at species level is the most difficult field for the construction of phylogenetic position of Bambuseae. In lower elevation with dry environment, smaller size of bamboo occurred compared to that in higher elevation of hill and humid place. In some places of the study areas economically important bamboo are cultivated.

Bamboo is one of the most important resources in Myanmar. It is linked with the life and culture of the people of the country that one will hardly find any village homestead without a bamboo grove. The identification, classification of bamboo species are wood product important for future researches. Its high valued utilization not only promotes the economic development in bamboo areas where people are of low income, but also forest resources to protect the ecological environment as a wood substitute. Therefore, the present research work will provide valuable information of bamboo morphology for compilation of the flora of Myanmar.

Acknowledgement

I would like to express my gratitude to Dr. Mu Mu Myint, Rector of Taunggyi University for her permission to do this work. My sincere thanks are due to Dr. Aye Aye Win Kyi, Professor and Head of the Botany Department, Taunggyi University for her valuable advice. I am very grateful to my supervisor Dr. Soe Myaint Aye, Prorector of Myitkyina University for his suggestion in the selection of this research topic and valuable advice, kind encouragement and patient guidance throughout my research work.

References

- Bor, N.L. (1960). *The Grasses of Burma, Ceylon, India and Pakistan*. Pergamon Press, Oxford, Lon, New York and Paris.
- Camus, E.G. (1913). *Les Bambuseae. Monographic, biologic, culture, principaux usages*. Paris.
- Dransfield, S. & E.A. Widjoja. (1995). *Plant Resources of South-East Asia, Vol. 7, Bamboos*. Backhuys Publishers. Leiden. Indonesia.
- Ghosh, G.K. (2008). *The wonderful grass: A.P.H. publishing corporation New Delhi*. 110002.
- Hooker, J.D. (1897). *The Flora of British India. Vol. 7*. Reeve and Co. Ltd. England.
- Hundley, H.G & Chit Ko Ko. (1987). *List of Trees, Shrubs, Herbs and Principal Climbers etc. Recorded from Burma*. P. 299-324. Superintendent, Government Printing and Stationary, Burma.

- Kress, J.W.R.A. Defilipps. E. Farr & Yin Yin Kyi, (2003). A checklist of the Trees, Shrubs, Herbs and Climabers of Myanmar, Department of Systematic Biology Botany, National museum of Natural hisroty Washington D.C. USA.
- Shouliang, C., L. Dezhu, Z. Guanghua, W.Zhonlos, L. Shenglian, L. Liang, W.Zhengping, S-Bixing, Z.Zhengde, X. Nianhe, J. Liangzhi, G. Zhenhua, C. Wenli, C. Xiang, Y. Guangyao, Sylvia M. Phillips, (2006). The flora of china, volume 22. Micsouri Botanical Garden Press (St. Law) MBa Press, 4344 Show Blvd., St. Louis, MO 63110. 2291. U.S.A.
- Stapleton, C. (1994). Bamboos of Nepal. An Illustrated Guide.Forestry Research and Information Centre Nepal.
- Wong, K.M. (1995). The Morphology, Anatomy, Biology and Classification of Peninsular Malaysian Bamboos.University of Malaya Botanical Monograph No.1.University of Malaya, Kuala Lum-pur.
- Yang, (2010).China's Bamboo.Bamboo and Rattan Research Institute, China Southwest Forestry University.