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Radial variation in wood properties of Nedun (*Pericopsis mooniana*), an introduced species to South India.

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Abstract

The physical, anatomical and mechanical properties of a timber species determine wood quality; hence, its evaluation is a prerequisite for the establishment of commercial plantations of a species having high potential for various end uses. *Pericopsis mooniana* (Thwaites) Thwaites wood has apparent similarity and even superior wood quality than teak, particularly as structural timber. Due to the dwindling timber resource base, large scale cultivation of this species should be enhanced through introduction to other suitable ecoclimatic conditions of the world. This study attempts to quantify the variation in wood physical, chemical and mechanical properties of *P. mooniana* introduced to Nilambur in Kerala, South India and the relationship among wood quality parameters. For this purpose, three trees were randomly selected from Aruvakkode, Nilambur located in Malappuram district of Kerala and standard tests of wood physical, mechanical and anatomical properties were conducted. Results indicated that the *P. mooniana* logs had bark thickness of 2.93 mm, heartwood content of 75.24% and a sawn wood recovery of 54.32%. Radial variation from pith to periphery was obvious among wood physical and anatomical properties. Physico-mechanical properties were correlated with anatomical properties. The specific gravity was linearly related to fibre wall thickness. No significant predictions could be made linking anatomical and mechanical property variables. Most of the wood quality parameters were higher compared to *Tectona grandis* (teak) and there is every possibility of using it as a substitute for teak.

Keywords: Kerala, Modulus of elasticity, Modulus of rupture, Nedun, Nilambur, Wood anatomy, Wood quality

Introduction

Pericopsis mooniana (Thwaites) Thwaites, commonly called nedun tree, belongs to the family Leguminosae is indigenous to Sri Lanka. Its native range is spread over South East Asian countries such as Indonesia, Malaysia, Palau, Papua New Guinea, Philippines etc. Nedun has been widely planted 'off-site' by villagers on the lowland slopes and hills of tree gardens because of its desirable high quality furniture wood (Ashton et al., 1997). This multipurpose tree species in which sapwood and heartwood are easily distinguishable is even used as a substitute for teak. However, the supply of the wood is very limited as the source is mainly natural forests (Soerianegara and Lemmens, 1994). Consequently it has been identified as 'vulnerable' by the International Union for Conservation of Nature and Natural Resources (IUCN). Large scale cultivation has to be initiated worldwide to increase the supply of wood as well as to prevent extinction. It is imperative to determine the wood quality parameters prior to large scale expansion of plantations outside its natural range. The wood quality assessment involves the consideration of a large number of anatomical, physical and mechanical properties of wood. A close relation among many wood physical, mechanical and

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anatomical properties has been reported in many tree species (Abruzzia et al., 2013; Ishiguru et al., 2009; Sharma et al., 2005). Literature on wood properties of hardwoods grown as exotics is very limited except for Eucalyptus, when compared to that devoted to conifers. Hence, wood quality studies on the introduced species have to be strengthened. Kerala Forest Department had established species introduction trial plots of *P. mooniana* in 1926 with the seeds obtained from Sri Lanka to evaluate its growth performance under Kerala conditions for its possible introduction in plantations and homesteads. The present investigation focuses on variation in physical, mechanical and anatomical properties of *P. mooniana* and the inter-relationship of these properties.

Materials and Methods

The present study was conducted during 2010-2011 at College of Forestry, Kerala Agricultural University, Thrissur, Kerala. The research plots of nedun trees were located at Aruvakkode depot in Nilambur North Range, Malappuram, Kerala between 11^0 5' N and 76^0 12' E. The area experiences a mean annual rainfall of 1840 mm and annual temperature ranges from 21–38^0 C. Laterite is the general soil type. Three 88 year old trees were randomly selected from the plantation for felling

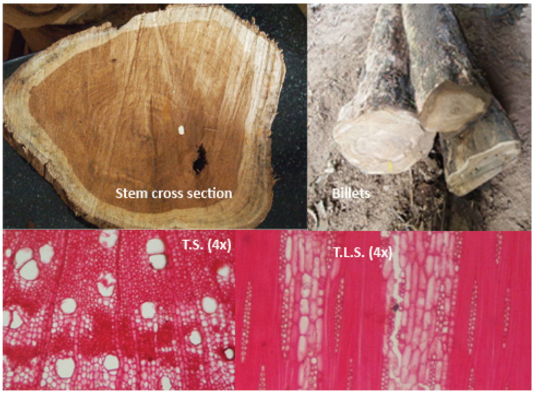

Figure 1. Stem cross section, billets and anatomical sections (T.S. and T.L.S) of Nedun (*Pericopsis mooniana).*

after recording their height and diameter at breast height (DBH). The DBH and height of the trees were 16.4 cm and 16 m (Tree no. 1), 14.9 cm and 18 m (Tree no. 2) and 15.4 cm and 15 m (Tree no. 3) respectively. The selected trees were felled and further cross cut using a chain saw (Fig. 1). The basal portions of the trunks were cut to lengths of 1.5 m length. Later, 5 cm thick transverse discs were cut from the base of these sections. These discs were used for measuring bark thickness and to measure heartwood-sapwood percentages. After cross cutting the logs were taken to a saw mill and converted into scantlings of cross section 6 cm x 6 cm and transported to the Rubber Research Institute of India, Kottayam to assess mechanical properties. All the material were finally converted to small clear specimens as per IS 2455: 1990 (ISI, 1990) for analysing mechanical properties.

The wood physical properties studied were moisture content (MC), specific gravity, and shrinkage. There were three samples each from pith, middle and periphery regions for each tree (N = 27). Heartwood percentage was calculated by placing the entire wood cross section on a tracing sheet and working out the percentage of the inner zone using a graph sheet. Bark thickness was determined using a digital vernier calliper. The mechanical properties included compression parallel and perpendicular to grain and static bending tests using a Universal Testing Machine (UTM- Shimadzu 100 Kg N). In order to study compression strength parallel to grain, samples of size 2 cm x 2 cm x 8 cm were loaded with its longitudinal axis along the direction of movement of head. Compressive stress at limit of proportionality ($CS_{at\ LP}$), compressive stress at maximum load ($CS_{at\ ML}$) and modulus of elasticity (MOE) were calculated. In order to determine compression strength perpendicular to grain, samples of size 2 cm x 2 cm x 10 cm were loaded on the tangential face. $CS_{at\ LP}$, compression at 2.5 mm deflection ($CS_{at\ 2.5mm}$) and MOE were calculated. Static bending test was conducted by loading samples of size 2 cm x 2 cm x 30 cm on the tangential face. Parameters like modulus of elasticity (MOE), modulus of rupture (MOR), maximum load (ML), fibre stress at limit of proportionality ($FS_{at\ LP}$), horizontal shear at limit of proportionality ($HS_{at\ LP}$) and horizontal shear at maximum load ($HS_{at\ ML}$) were also calculated. There were five replications for each mechanical property studied.

The anatomical properties were studied after sectioning using microtomy and preparation of slides. For these, wood samples of size 1cm x 1 cm x 1 cm size were boiled in water for 20 minutes and thin microscopic sections of size 15-20 µm were taken using a sledge microtome (*Leica SM 2000 R)*. From each tree, five samples were taken from pith, middle and periphery regions (N = 45). Permanent sections were prepared by double staining and mounting on a glass slide using DPX mountant. Images of the sections were captured to measure various wood anatomical parameters using an image analysis system (Labomed Digi 2) running the software (Labomed Digi Pro 2). Vessel diameter was determined on the transverse sections (TS) using the image analysis software. Vessel frequency was calculated by counting the number of vessels in a randomly selected area per field and using the formula given below.

$$\text{Vessel Frequency} = \frac{\text{No. of Vessels x } 10^6}{\text{Area in sq. microns}}$$

The height and width of the rays were measured on the tangential longitudinal sections (TLS) for each tissue type. Tissue proportions including the percentage of rays, vessels, parenchyma and fibres were measured on the transverse sections (TS). The abbreviations used for anatomical properties include VA- vessel area, VD- vessel diameter, VF- vessel frequency, VL- vessel length, RH- ray height, RW- ray width, RF- ray frequency, FL- fibre length, FWT- fibre wall thickness, FLD- fibre lumen diameter, FD- fibre diameter, RP- ray per cent, VP- vessel percent PP- parenchyma percent, FP- fibre percent.

Results and Discussion

Results of the study indicated that the *P. mooniana* logs had bark thickness of 2.93 ± 0.01 mm, heartwood content of 75.24 ± 18.60% and a sawn wood recovery of 54.32%.

Physical, mechanical and anatomical properties of nedun

Because wood is an anisotropic material consisting of various cell types and tissues, variation is very wide, not only between different kinds of trees, but also within the same species and even within an individual specimen. Therefore, the basic properties need to be studied in order to gain an understanding

Table 1. Variation in physical properties of *Pericopsis mooniana* along the radial direction

Radial positions	Pith	Middle	Periphery	Mean
Moisture content from green to oven dry (%)	$60.02^c \pm 22.63$	$82.99^a \pm 39.42$	$65.64^b \pm 28.26$	69.55
Moisture content from air dry to oven dry (%)	$16.74^a \pm 2.29$	$21.77^a \pm 14.09$	$19.17^a \pm 13.55$	18.76
Specific gravity				
$SPG_{(g)}$	$1.20^a \pm 0.07$	$1.1\ 8^a \pm 0.03$	$1.19^a \pm 0.01$	1.19
$SPG_{(a.d)}$	$0.86^b \pm 0.07$	$0.83^b \pm 0.08$	$0.95^a \pm 0.05$	0.88
$SPG_{(o.d.)}$	$0.80^b \pm 0.07$	$0.78^b \pm 0.08$	$0.88^a \pm 0.04$	0.82
Radial shrinkage (%)				
$RS_{(g\text{-}a.d.)}$	$2.18^a \pm 0.16$	$2.12^a \pm 0.16$	$2.18^a \pm 0.11$	2.16
$RS_{(a.d\text{-}o.d.)}$	$3.13^a \pm 0.03$	$2.48^a \pm 0.12$	$3.07^a \pm 0.01$	2.89
$RS_{(g\text{-}o.d.)}$	$3.57^a \pm 0.09$	$3.31^a \pm 0.23$	$3.45^a \pm 0.10$	3.44
Tangential shrinkage (%)				
$TS_{(g\text{-}a.d.)}$	$4.20^a \pm 0.26$	$4.10^a \pm 0.19$	$4.15^a \pm 0.25$	4.15
$TS_{(a.d\text{-}o.d.)}$	$4.21^a \pm 0.06$	$4.01^c \pm 0.16$	$4.14^b \pm 0.05$	4.12
$TS_{(g\text{-}o.d.)}$	$4.75^a \pm 0.14$	$4.63^a \pm 0.07$	$4.70^a \pm 0.12$	4.69

Note: The values with same superscript within a row not significantly different (p=0.01).
The values given are mean and standard deviations

of the wood properties. With regard to physical properties, the moisture content estimated at different conditions *viz.,* green (g) to oven dry (o.d.) and air dry (a.d) to oven dry conditions was 70 and 19%, respectively. Of the three radial positions, higher moisture content (both conditions) was observed in the middle followed by periphery. The average green, air dry and oven dry specific gravity (SPG) was 1.19, 0.88 and 0.82 respectively. The $SPG_{(g)}$ decreased from pith to periphery whereas $SPG_{(a.d)}$ and $SPG_{(o.d.)}$ values were higher in periphery and lowest in middle. The radial shrinkage (RS) was lower compared to tangential shrinkage (TS). The average $RS_{(g\text{-}a.d)}$, $RS_{(a.d.\text{-}o.d.)}$ and $RS_{(g\text{-}o.d.)}$ were 2.16, 2.89 and 3.44% respectively. With respect to radial positions, pith tissues recorded higher values followed by the periphery indicating a lower radial shrinkage towards middle region. The mean $TS_{(g\text{-}a.d.)}$, $TS_{(a.d.\text{-}o.d.)}$ and $TS_{(g\text{-}o.d.)}$ was 4.15, 4.12 and 4.69% respectively. Similar radial pattern of variation as that of radial shrinkage was observed in tangential shrinkage also (Table 1). Analysis of variance revealed significant difference in $MC_{(g\text{-}o.d.)}$, $SPG_{(a.d)}$ specific gravity, $SPG_{(o.d.)}$

Table 2. Mechanical properties of *Pericopsis mooniana* along the radial direction

Mechanical properties	Green	Air- dry
Compressive Strength perpendicular to grain (kg per cm^2)		
a) $CS_{at\ LP}$	167.1 ± 23.8	160.9 ± 34.2
b) $CS_{at\ 2.5\ mm}$	288.5 ± 35.6	284.6 ± 58.1
c) MOE	12461.2 ± 1656.6	14239 ± 1898.7
Compressive Strength parallel to grain (kg per cm^2)		
a) $CS_{at\ LP}$	420.9 ± 64.6	444.3 ± 63.7
b) $CS_{at\ ML}$	536.7 ± 95.4	574.5 ± 90.2
c) MOE	27100.4 ± 2536.2	29415.5 ± 4818.3
Static bending test (kg per cm^2)		
a) MOR	1152.1 ± 80.5	1294.8 ±117.7
b) ML	220.89 ± 15.8	237.11 ± 23.3
c) $HS_{at\ ML}$	41.3 ± 2.9	45.6 ± 4.2
d) $HS_{at\ LP}$	27.1 ± 3.8	30.9 ± 1.2
e) $FS_{at\ LP}$	758.7 ± 105.1	877.7 ± 31.1
f) MOE	75593.4±4696.6	100778±5205.9

The values given are mean and standard deviations

Table 3. Anatomical properties of *Pericopsis mooniana* along the radial direction

Radial positions	Pith	Middle	Periphery
Vessel area (µm^2)	16772.2^b ± 9591.1	20525.9^{ab} ± 1929.4	27694.8^a ± 5346.1
Vessel diameter (µm)	114.4^a ± 28.8	127.3^a ± 15.0	144.4^a ± 1.0
Vessel frequency (mm^{-2})	6.00^a ± 1.89	5.00^a ± 0.51	6.00^a ± 1.09
Vessel length (µm)	136.66^a ± 10.95	159.65^a ± 39.74	139.07^a ± 39.69
Ray height (µm)	310.8^b ± 39.6	328.8^a ± 18.4	302.1^b ± 24.4
Ray width (µm)	22.3^c ± 7.8	29.1^b ± 6.4	34.9^a ± 6.2
Ray frequency (mm^{-2})	11.3^b ± 2.1	21.1^a ± 13.9	13.8^{ab} ± 1.4
Fibre length(µm)	1327.3^a ± 117.7	1222.9^b ± 131.5	1170.1^b ± 63.4
Fibre wall thickness (µm)	1.44^a ± 0.62	1.66^a ± 0.28	2.02^a ± 0.16
Fibre lumen diameter (µm)	3.5^a ± 0.9	3.4^a ± 1.3	5.0^a ± 0.6
Fibre diameter (µm)	11.9^a ± 1.5	11.6^a ± 2.4	14.8^a ± 0.8
Ray per cent	18.11^b ± 2.08	26.47^{ab} ± 5.90	32.56^a ± 3.31
Vessel percent	6.5^a ± 2.0	6.6^a ± 1.5	5.4^a ± 0.6
Parenchyma per cent	40.9^a ± 13.8	40.4^a ± 11.2	40.3^a ± 3.8
Fibre per cent	34.52^a ± 13.65	26.53^a ± 13.87	21.52^a ± 6.89

Note: The values with same superscript within a row are homogenous (p=0.01)
The values given are mean and standard deviations

$TS_{(a.d.-o.d.)}$ due to radial positions (p=0.01). Compared to *Swietenia macrophylla* grown at Dhoni in the Olavakkode research range of Kerala the specific gravity of nedun was higher while radial and tangential shrinkage was almost similar (Anoop et al., 2014).

When the data pertaining to wood mechanical properties were assessed, mechanical properties at air dry condition were higher compared to those at green condition with the exception of compressive strength perpendicular to grain (Table 2). Anatomical properties showed varying trends from inner to peripheral tissues (Table 3). Vessel area and diameter, ray width, fibre wall thickness and ray percentage increased from pith to periphery whereas, vessel length, ray height and vessel percent were highest in the middle, while the fibre length, fibre percent and parenchyma percentage decreased from pith to periphery. Fibre diameter and fibre lumen diameter was highest near to bark and lower in the middle tissues. Analysis of variance revealed significant variation in vessel area, height, width frequency and percentage of rays and fibre length along the radial positions (p=0.01).

Variation along the radial direction is the best known and most studied within- tree variability in wood, and is usually due to change in wood properties between juvenile and mature wood. In the present study, the magnitude of wood physical properties varied from pith to periphery. $SPG_{(o.d.)}$ was the highest towards periphery position (-0.88) and the mean value reported for air dry specific gravity was 0.85. Similar trend was observed by Ishiguri et al., (2011) for *P. mooniana* plantations grown in Indonesia. Increase in $SPG_{(o.d.)}$ near the pith and periphery region might be due to higher vessel frequency, fibre wall thickness and fibre lumen diameter in those regions. They reported a higher mean $SPG_{(o.d.)}$ (0.85) compared to 0.82 in the present study. However, the $SPG_{(o.d.)}$ in the present investigations was higher compared to teak (0.604, Sekhar, 1988). The higher oven dry specific gravity of *P. mooniana* might be due to its lower average values for vessel diameter and vessel area as well as a higher vessel frequency compared to other species. Swelling and shrinkage could be considered as 'intelligent' characteristics of wood because wood can change dimensions by itself in response to the atmosphere (Okuma, 1998). In the present investigation, tangential shrinkage was higher than radial shrinkage in three different conditions. Along the radial direction, tangential shrinkage decreased from pith to periphery. Similar studies by Shanavas and Kumar (2006) showed that *Acacia mangium* had a decreasing tangential shrinkage towards the periphery. The swelling or shrinkage of wood shows anisotropy and the ratio is generally 2 (tangential): 1 (radial): 0.1–1 (longitudinal) and in the present study the ratio was 1.5: 1. Similar to physical properties, anatomical characters of nedun also

Table 4. Comparison of wood properties of *Pericopsis mooniana* with *Tectona grandis* (Sekhar, 1988)

Wood properties	*Pericopsis mooniana*	*Tectona grandis*
$SPG_{(o.d)}$	0.82	0.604
$MC_{(o.d.)}$ (%)	69.6	76.6
RS (%)	2.89	2.3
$TS^{(g-o.d.)}$ (%)	4.69	4.80
Static bending		
a) $FS_{at\ LP}$ (kg cm^{-2})	785.69	651.00
b)MOR (kg cm^{-2})	1152.13	959.00
c)MOE (Kg cm^{-2})	75593.4	119600
Compression parallel to grain		
a) $CS_{at\ LP}$ (kg cm^{-2})	420.92	376.00
b)Maximum crushing stress (kg cm^{-2})	574.48	532.00
c) MOE (kg cm^{-2})	27100.4	137400
Compression perpendicular to grain		
a) $FS_{at\ LP}$ (kg cm^{-2})	160.87	101.00

showed radial variation from pith to periphery (Fig. 1). But most of the variations in anatomical characters were not statistically significant. Ogata et al. (2008) reported vessel diameter and vessel frequency in *P. mooniana* as 160–170 ìm, 8–10 vessels per mm^2. In the present study, the values were 128.7 ìm and 6 vessels per mm^2 respectively. Ishiguru et al. (2011) reported the radial variation of anatomical traits in plantation grown nedun tree, and revealed that values of vessel diameter, from wood at the periphery were higher than those at the pith. They also reported that vessel frequency gradually decreased from pith to bark and vessel element length showed almost constant values. But in our study the vessel length was the highest towards middle. Anoop et al. (2014) reported that anatomical properties of *Swietenia macrophylla* also showed significant radial variation. The values of vessel and ray dimensions of nedun were slightly lower compared to *S. macrophylla* but the fibre dimensions were almost similar. A comparison of wood properties of nedun in this study, with plantation grown teak (Sekhar, 1988) indicated that all the wood properties recorded were comparatively higher than in teak (Table 4). The superiority of wood property might be the reason to call it a substitute for teak and for its being preferred largely for furniture manufacture, besides the similarity in appearance.

Correlation between anatomical features and physico-mechanical properties of nedun

i) Anatomical and physical properties

Correlation analysis revealed significant relationship between oven dry specific gravity and fibre lumen diameter ($r= 0.45$, $p=0.05$) and fibre diameter ($r= 0.45$, $p=0.05$). Radial shrinkage (g-a.d.) was correlated with area ($r= 0.40$, $p=0.05$), diameter ($r= 0.55$, $p=0.01$) and percentage ($r= 0.38$, $p=0.05$) of vessels. $TS_{(g\text{-}a.d)}$ was correlated with vessel diameter ($r= 0.44$, $p=0.05$) and ray ($r= 0.39$, $p=0.05$) and vessel ($r= 0.51$, $p=0.01$) percentage. $RS_{(a.d.\text{-}o.d.)}$ was correlated with parenchyma percentage ($r= 0.38$, $p=0.05$) and $TS_{(a.d.\text{-}o.d.)}$ was correlated with fibre length ($r= 0.43$, $p=0.05$) and parenchyma percentage ($r = 0.41$, $p=0.05$). $TS_{(g.\text{-}o.d.)}$ was correlated with fibre length ($r= 0.53$, $p=0.01$). Wood characteristics, including physical, anatomical and mechanical properties are related to each other. In hardwood species, it has been reported that high density is generally associated with an increase in fibre volume and a decrease in vessel volume. This was

Table 5. Correlation matrix laid out between mechanical and anatomical properties of *Pericopsis mooniana*

Mechanical properties		VD	RH	RW	VL	FL	FLD	FD	RP	PP	FP
Compression perpendicular to grain	$CS_{at\ LP(g)}$	0.87	-1.00**	0.87	0.73	-0.27	0.57	0.47	0.87	0.99	-0.99
	$CS^{at\ LP(d)}$	0.93	-0.99	0.94	-0.83	-0.12	0.44	0.34	0.94	-1.00*	-1.00*
	$CS_{at\ 2.5\ m\ (g)}$	0.87	-1.00**	0.88	0.74	-0.25	-0.55	0.45	0.88	-1.00*	-0.99
	$CS_{at\ 2.5\ mm(d)}$	0.92	-0.99	0.92	0.81	-0.15	0.47	0.37	0.93	-1.00*	-1.00*
	$MOE_{(d)}$	0.86	-1.00**	0.87	0.72	-0.28	0.58	0.49	0.87	0.99	-0.98
Compression parallel to grain	$CS_{at\ ML(d)}$	0.96	-0.69	0.96	0.99*	0.05	-0.19	-0.30	0.96	0.99	-0.79
	$MOE_{(g)}$	0.94	-0.98	0.94	0.84	-0.09	0.41	0.31	0.95	0.66	-1.00*
	$MOE_{(g)}$	0.99*	-0.98	0.99*	0.98	0.28	0.05	-0.07	1.00**	0.88	-0.91
Static bending test	$MOR_{(g)}$	0.01	-0.85	0.11	-0.13	-0.94	0.04	1.00	0.11	0.52	-0.99
	$MOR_{(d)}$	0.16	-0.58	0.18	-0.07	0.91	1.00**	1.00*	0.18	0.57	0.51
	$ML_{(d)}$	0.05	0.63	0.07	-0.18	-0.95	1.00**	1.00**	0.07	0.47	0.41
	$HS_{at\ ML(d)}$	0.09	-0.54	0.10	-0.15	-0.95	1.00**	1.00	0.10	0.50	0.41
	$HS_{at\ LP(d)}$	0.04	-0.54	0.06	-0.19	-0.96	1.00**	1.00**	0.06	046	-0.45
	$FS_{at\ LP\ (d)}$	0.04	-0.54	0.07	-0.15	-0.95	1.00**	0.97	0.07	0.47	-0.41
	$MOE_{(d)}$	-0.29	-0.23	0.23	-0.05	-0.99	0.93	0.97	-0.27	0.15	0.10

Note:-VD: Vessel Diameter, RH: Ray Height, RW: Ray Width, VL: Vessel Length, FL: Fibre Length, FLD: Fibre Lumen Diameter, FD: Fibre Diameter, RP: Ray %, PP: Parenchyma %, FP: Fibre %, LP: Limit of Proportionality, MOE: Modulus of Elasticity, ML: Maximum Load, MOR: Modulus of Rupture, HS: Horizontal Shear FS: Fibre Stress. g: green and d: dry * Significant at 5 % level, ** significant at 1 % level obvious in our studies as the fibre lumen diameter and fibre diameter was positively correlated with specific gravity. Linear regression equations connecting wood anatomical properties and specific gravity were developed. Only the fibre wall thickness was linearly related to specific gravity Y = 0.675- 0.120 (FWT). Ishiguru et al. (2009) studied effect of anatomy on the mechanical properties of Mahogany (*Swietenia macrophylla*) and concluded that mainly anatomical features, such as rays and vessels, rather than extractives, affect the mechanical behaviour of mahogany.

ii)Anatomical and mechanical properties

Pearson's bivariate correlation coefficient amongst physical, anatomical and mechanical properties (Table 5) elucidated their inter-relationships. Compression strength properties perpendicular to grain are often critical in timber design and are useful in the selection of timber species for uses where timber is loaded on its lateral surface such as furniture, railway sleeper, instruments and sports goods.

With regard to compression parallel to grain, $CS_{at\ LP(d)}$ was positively correlated with vessel length (r=0.99), $MOE_{(g)}$ was positively correlated with fibre percent (r=1.00) and MOE (d) was positively correlated with ray width and percent (r=1.00). Uetimane and Ali (2011) found that fibre dimensions play the main role in compressive strength and were all negatively correlated. Compression strength properties parallel to grain determined are used for design of columns and for evaluating suitability of timber species for post and other industrial purposes where forces act in a direction parallel to the grain of timber (Sekhar, 1988).

In static bending test, the elasticity and the maximum stress supported by a wood sample under central loading in static mode are usually expressed as MOE and MOR respectively. $MOR_{(g)}$ was negatively correlated with fibre percent (r= -0.99), MOR(d) was positively correlated with fibre lumen diameter (r=1.00), ML (d) was positively correlated with fibre lumen diameter as well as fibre diameter (r=1.00), HS at ML (d) was positively correlated with fibre lumen diameter and $HS_{at\ LP\ (d)}$ was correlated with fibre diameter and lumen diameter (r=1.00). $FS_{at\ LP(d)}$ was also positively correlated with fibre lumen diameter (r=1.00) and $MOE_{(d)}$ was positively correlated with parenchyma percent. The static bending properties are useful from the utilization point of view in all engineering constructions and also in deciding suitability of various species for beams, decking, axles and wood poles.

Overall it can be concluded nedun is a heavier timber with comparatively higher physical and mechanical properties than teak and there is every possibility of using it as a substitute of teak. Hence, this species can be put into the same uses as teak and the species has tremendous potential for afforestation in the state. The wood physical and anatomical properties showed radial variation and interrelationship was obvious among anatomical and physico-mechanical properties.

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