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Radial Variation in Wood Properties of Plantation grown *Terminalia myriocarpa* Heurck and Muell-Arg in Nagaland, India

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Abstract

The present study was conducted on five 16 years old trees of T. myriocarpa collected from plantation located at Ungma village in Mokokchung district of Nagaland. The selected wood properties were fibre length, vessel length, fibre length increment and wood density. The main aim of the study was to evaluate radial variation in wood properties from pith to bark for effective utilization. The mean range of fibre length, vessel length, fibre length increment and wood density were 736.68µm -1300.03 ± 33.56µm, 341.10µm -431.44 ± 14.71µm, 381.31 µm -825.85 ± 19.60 µm and 0.33-0.53 ± 0.38 respectively. ANOVA carried out among trees showed non-significant variation in all wood properties. Wood density, fibre length and fibre length increment increased from pith to 40mm. and afterwards it remained more or less constant. There was gradual increase in vessel length from pith to bark. The regression models for fibre length, fibre length increment, vessel length and wood density were Y=675.26+110.87lnX, Y=312.96+100.28lnX, Y=389.76+0.31X and 0.30+0.04lnX respectively. Distance from pith had significant and positive correlation with fibre length, fibre length increment and wood density while the relationship between distance from pith and vessel length was too weak to be significant. On the basis of radial variation in wood properties, the boundary between juvenile wood and mature wood could be marked at 40mm. from pith for all selected parameters. The present study revealed that the plantation timber of Terminalia myriocarpa could be suitable for different end uses at this age.

Keywords: *Terminalia myriocarpa*, wood properties, juvenile wood, mature wood, regression.

Introduction

Terminalia myriocarpa is an evergreen tree belonging to family Combretaceae. It has wide distribution in tropical moist deciduous semi evergreen and evergreen forests of South East Asia. It occurs widely in North Bengal and states of NE India[1, 2]. The wood of *T. myriocarpa* is soft to moderately hard, light to moderately heavy with straight grain, easy to saw, work and peel. It is extensively used for plywood, furniture making and construction purposes. The present scenario shows that the growing demand of important timber species like *Gmelina arborea*, *Morus laevigata, Phoebe goalparensis* and *T. myriocarpa* in and outside the north eastern states have put tremendous pressure on natural forests. To give due attention towards sustainable management of natural forest and to fulfill the ever increasing demand of timbers for domestic purposes and wood based industries, the governments of north eastern states are paying attention towards establishment of plantations in large scale of these timber species under National Afforestation Programme. As *T. myriocarpa* is fast growing and short rotation species, its plantation is being established in Nagaland for sustainable wood supply. In order to obtain effective utilization of wood and plantations to become established, information on wood properties is essential[3].

An examination of literature reveals that wood properties are highly variable. They vary from stand to stand, tree to tree, around the circumference, across the radius, along the height and even within small sampling unit like an annual ring. Though these variations provide considerable potential for selection of trees in tree improvement programmes but they also pose problems in selection of wood for specific purposes[3, 4]. A little work has been done on wood properties variation in plantation grown timbers[5-9]. To our knowledge no research has been conducted on wood properties variation in *T. myriocarpa*. The main objective of present study is to investigate radial variation in wood properties to see the pattern of variation from pith to bark and to demarcate the boundary between juvenile wood and mature wood

Material and Methods

Study site and sample collection: The wood samples of *T. myriocarpa* were collected from 16 years old plantation owned by private individuals in Ungma village of Mokokchung district of Nagaland, NE India (Figure-1). It is located 10 km away from Mokokchung town towards south in Nagaland and has latitude of 26^0 19′ 00″ N and longitude of 94^0 31′ 59″ E. The average summer temperature is 27^0C and average rainfall is 2500 mm. Five trees were randomly selected for harvesting for the present study. The cross sectional discs of about 5cm thickness were collected at breast height level (1.37m above ground level). The diameter of trees varied from 19.1-20 cm (mean19.4 ± 0.39 cm). The north direction was marked in trees before felling. The trees were harvested in December, 2011.

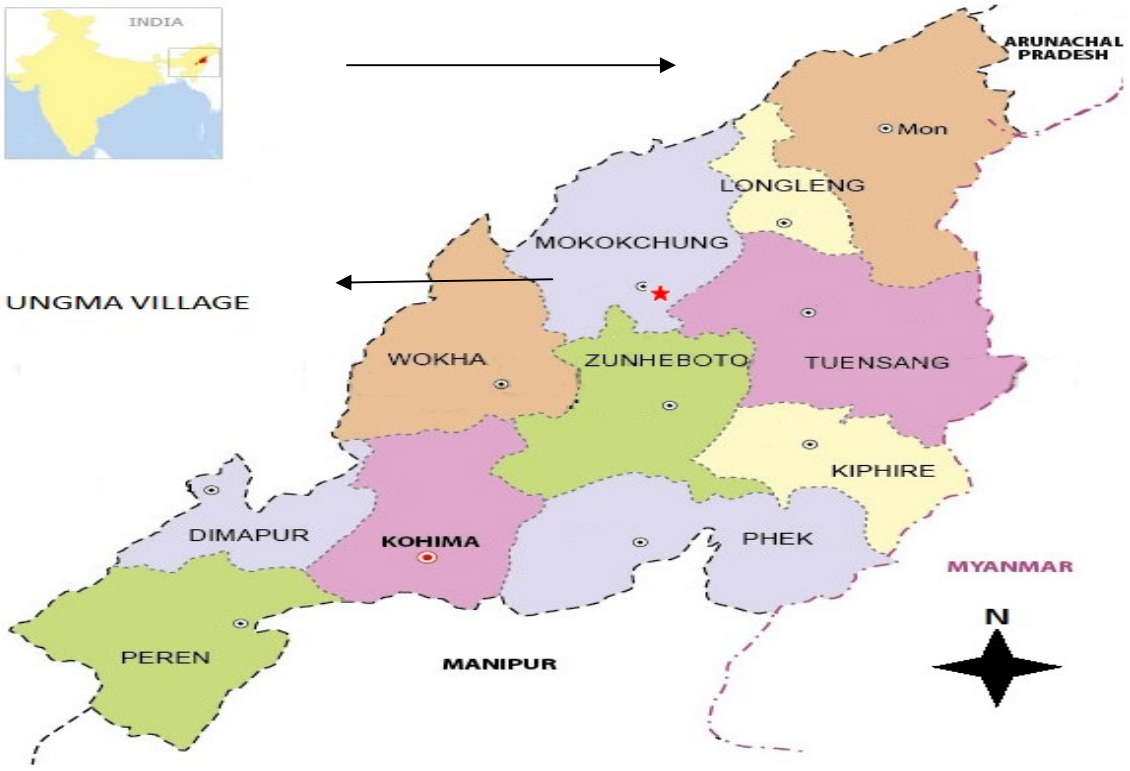

Figure-1
Map showing study site at Mokokchung district of Nagaland

MAP: Preparation of samples: The samples were smoothened with the help of an electric planer and sand paper in laboratory. Two opposite directions namely North and South were sawn out from each disc. Since the growth rings were visible on the sanded discs but their number did not coincide with plantation age, therefore radial strips were uniformly divided into sample blocks at 10 mm interval from pith to bark in both directions and suitably numbered.

Wood density determination: Wood density of numbered blocks of each direction of trees was determined by water displacement method.

Determination of wood elements length: Small slivers of wood were cut from the radial side of each block and subjected to maceration by using Franklins solution. The macerated material was thoroughly washed with distilled water and slightly agitated to obtain fluffy mass of wood elements. It was stained with safranine and temporary slides were made by using 50% glycerol. A random sample of 50 unbroken fibers and 30 vessels were selected for measurement. All measurements were taken with the help of an ocular micrometer fitted in one of the eye pieces of binocular microscope at 40X. Vessel length was subtracted from fibre length to determine fibre length increment[10].

Statistical analyses: The data was analysed by using SPSS 16.0 software and Microsoft Excel 10.

Results and Discussion

Radial variation in wood properties are highly important to see the magnitude of variation from pith to bark and to demarcate the boundary between juvenile wood and mature wood[11, 12]. The result presented in Figure-2 reveals rapid increase in fibre length up to 40 mm distance from pith and afterwards it increases gradually or remains almost constant. Fibre length ranges from 736.68 µm to 1300.03 µm. Radial increase in fibre length may be due to increase in length of cambial initials with age. Like fibre length, fibre length increment shows steep increase from pith to 40 mm and afterwards it becomes almost constant towards bark (Figure-3). The present results are in confirmation with the findings of other workers[5, 9, 12].

As compared to fibre length, vessel length shows gradual increase from pith to bark (Figure-4) The range of vessel length from pith to bark varies between 341-431 µm. It is reported that vessel length is equivalent to fusiform cambial initials in diffuse porous woods and woods with storied cambium while vessel elements are shorter than fusiform initial in ring porous and tropical woods [13, 14]. In the present study, the wood is of diffuse porous type and gradual increase in vessel length may be due to small elongation in fusiform initials with age as reported in other hardwood species[9, 12, 15].

Wood density value ranges from 0.33-0.53g/cm^3. Figure-5 shows gradual increase in wood density from pith to bark. The similar

pattern of wood density variation was observed in other plantation species[5, 6, 9]. The increase in wood density from pith to bark may be due to increased fibre volume and their wall thickness.

An examination of literature shows that demarcation between juvenile wood and mature wood is arbitrary in hardwoods. Various methods have been used to define the boundary between juvenile wood and mature wood. The simplest graphic method was used by few workers[16], while linear regression model, non-linear and polynomial models were opted by other workers[17, 18, 19]. For the present study, linear regression model for vessel length and logarithm regression model for fibre length, fibre length increment and wood density were used to estimate the boundary between juvenile wood and mature wood. Figs. 6-9 show that radial pattern of fibre length, fibre length increment, vessel length and wood density of selected trees could be determined by using regression equations. Further, all the selected parameters become stable after 40 mm distance from pith which indicates that boundary between juvenile wood and mature wood can be marked at 40 mm. On the other hand, the demarcation between juvenile wood and mature wood at 60 to 90 mm and 75 to 135 mm distance from pith was reported in other hardwood species [5, 6, 20]. The present study shows less amount of juvenile wood in *Terminalia myriocarpa* as compared to other hardwood species which may be due to the age of plantations.

Available literature reveals significant variation in wood properties among trees despite of same age, spacing and other management practices which are due to genetic differences of individual trees. For the present study, analysis of variance shows non-significant variation in wood properties among trees (Table 1) which may be due to raising of plantation from same seed source.

The results presented here are preliminary as the study is restricted to one plantation only. More sampling of trees from different plantations are urgently required to accumulate more data on evaluation of radial variation in wood properties.

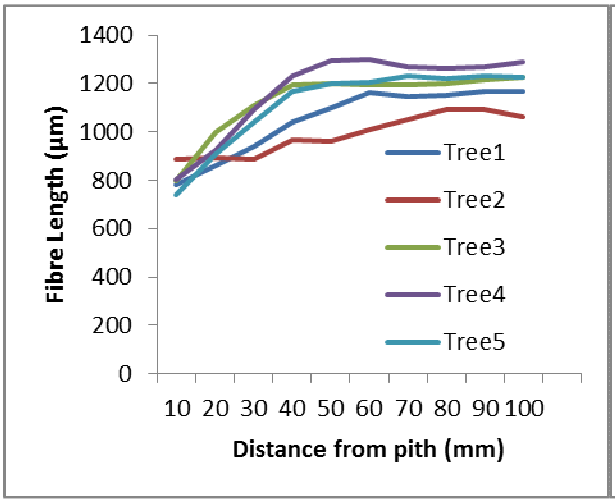

Figure-2

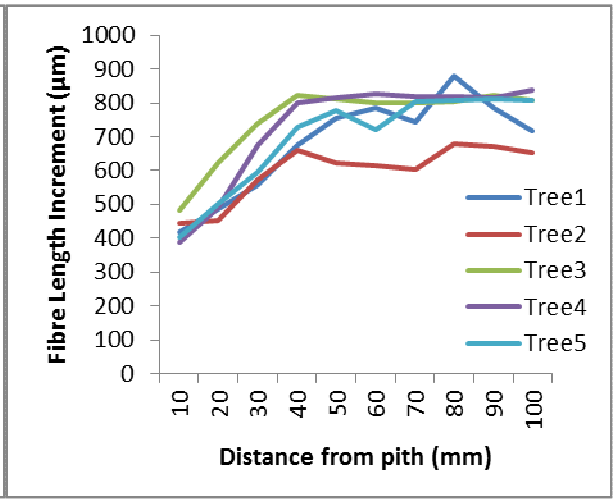

Figure-3

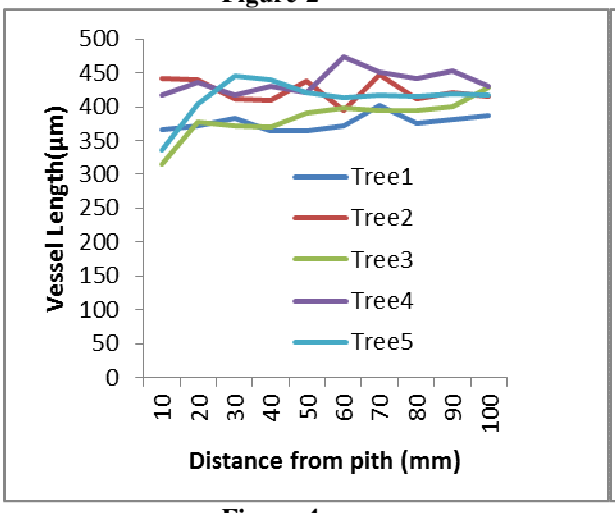

Figure-4

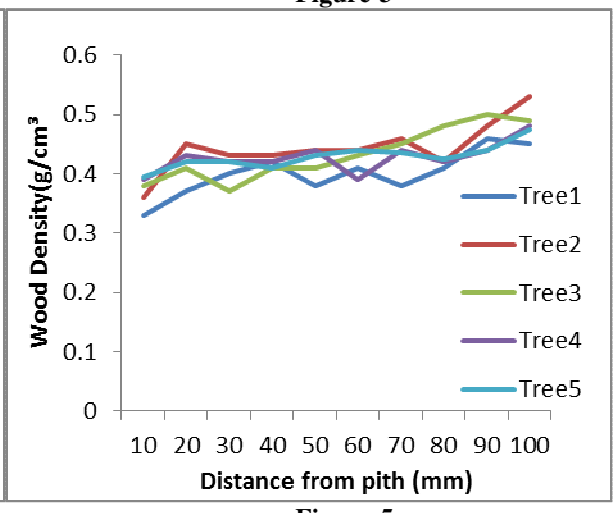

Figure-5

Figure-2-5
Radial variation in wood properties from pith to bark in *Terminalia myriocarpa*

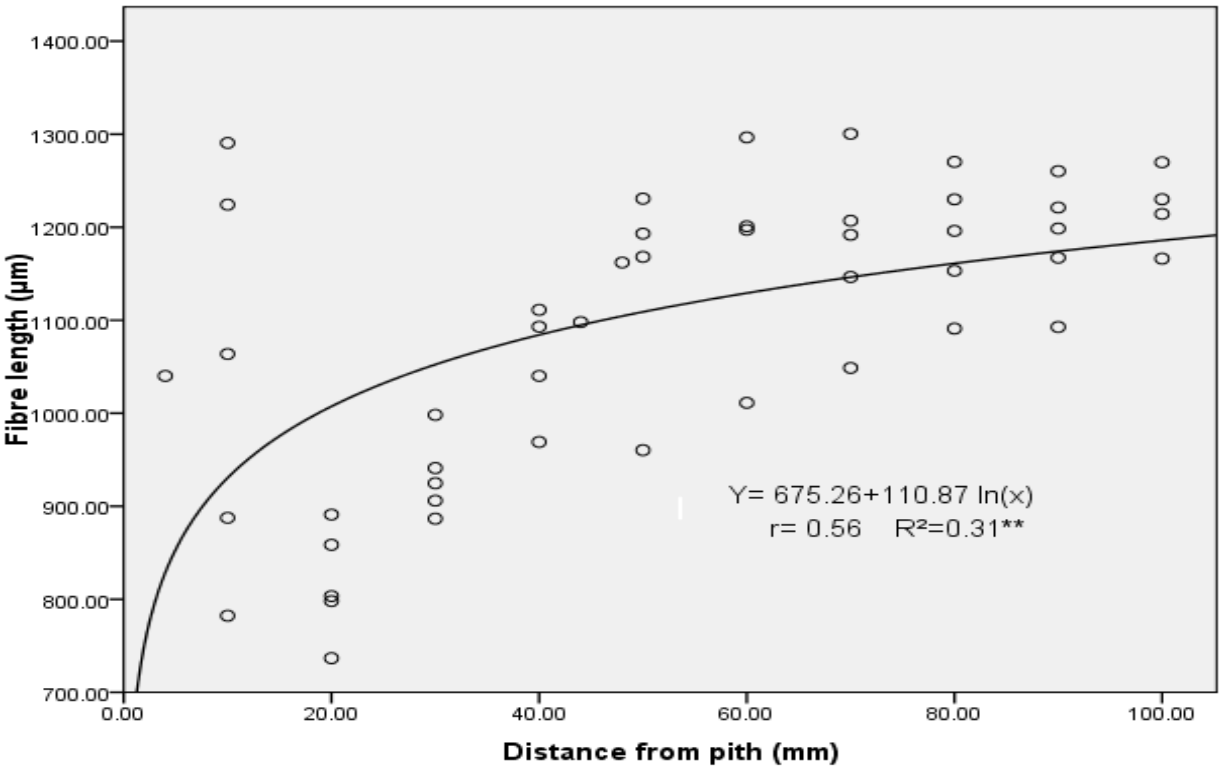

Figure-6
Scattered plot and predictive model for fibre length based on distance from pith

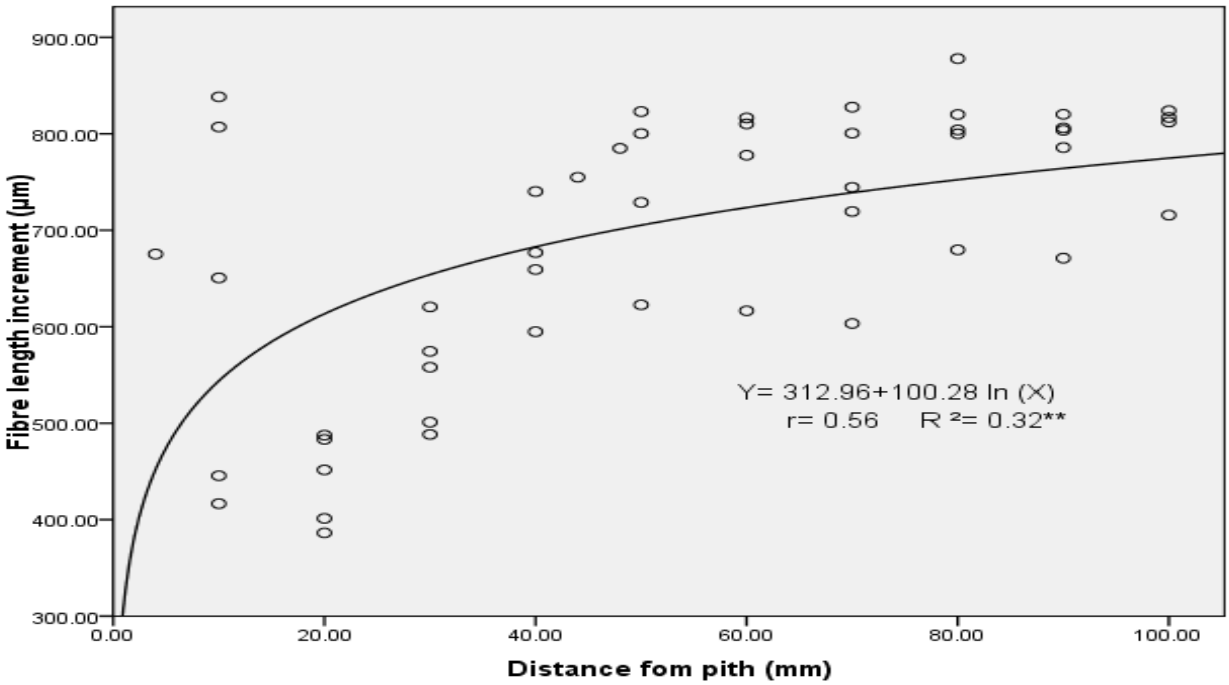

Figure-7
Scattered plot and predictive model for fibre length increment based on distance from pith

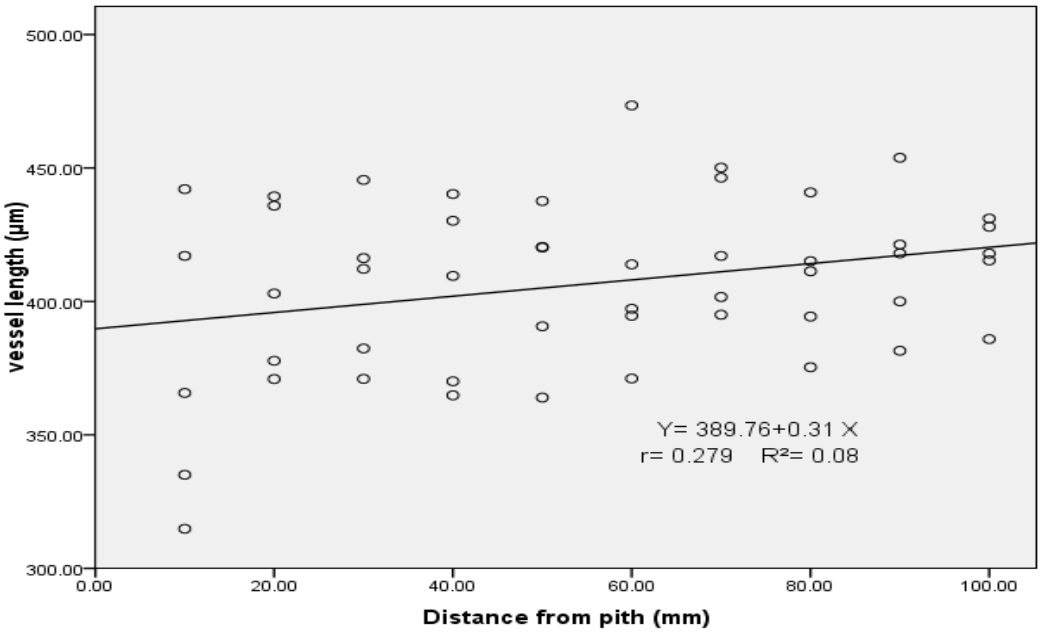

Figure-8
Scattered plot and predictive model for vessel length based on distance from pith

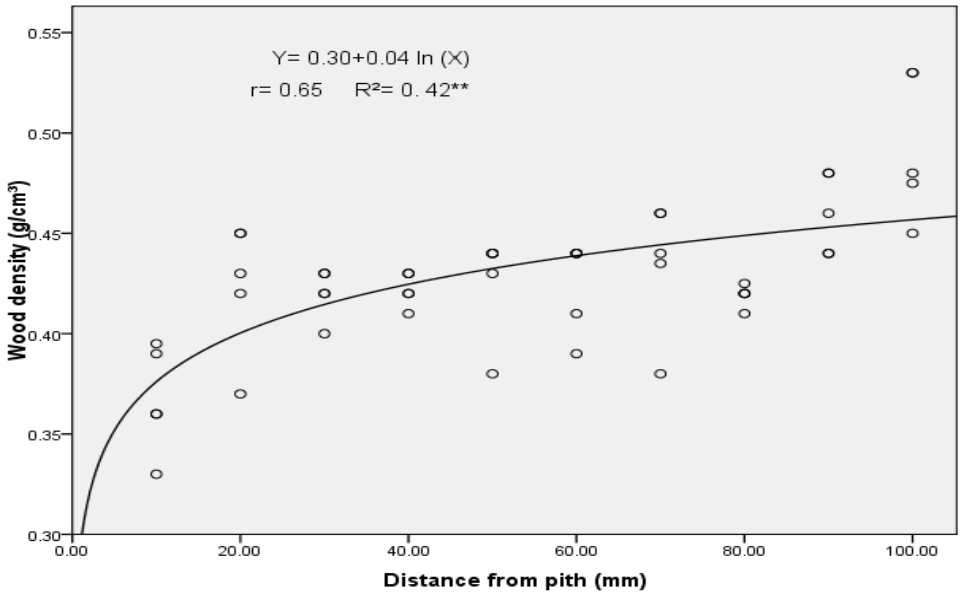

Figure-9
Scattered plot and predictive model for wood density based on distance from pith

Table-1
Analysis of variance for selected wood properties among trees of trees of *Terminalia myriocarpa*

Variables	Sum of Square	Degree of Freedom	Mean Square	F	Sig.
Fibre Length	494926.656	4	123731.664	2.525	.054
Vessel Length	395.850	4	98.963	.436	.782
Fibre Length Increment	139635.639	4	34908.910	1.959	.117
Wood Density	.010	4	.003	1.908	.126

Conclusion

The present study shows that all wood properties increase from pith to bark. All wood properties show steep increase from pith to 40 mm distance and thereafter increase gradually or remains more or less constant. It suggests that the mature wood starts forming after 40 mm distance from pith. Non-significant variations in wood properties among trees indicate uniform wood formation in all selected trees. The present study reveals that *T. myriocarpa* can be harvested at this age for efficient utilization.

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