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Preliminary Evaluation of Variations in Anatomical Properties of *Melia dubia* Cav. Wood

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Abstract

The external factors play a key role in bringing about physiological changes in trees there by affecting the cambial activity and 'Tree to tree' variation in wood properties within a species and also within the plantation are large and it may be reflected through the variation in anatomical and physical properties. The present study has been designed to assess the tree to tree variation in wood properties of Melia dubia Cav grown under similar conditions but showed morphological variations in terms of growth. They are called as fast grown and slow grown for the purpose of easy understanding. The observations recorded on the anatomical properties like fibre length, fibre diameter, lumen diameter, double wall thickness vessel element length and vessel diameter were analysed and the results are presented in this paper. The fast grown timber showed higher numerical values for anatomical properties viz., fibre length, fibre diameter, fibre lumen diameter, double wall thickness of fibre when compared to slow grown timber. Interestingly the intra tree variation revealed that the outer region of wood in both types of trees had longer and wider vessels. Though variation between trees and among tree is non significant, numerically superior values are recorded in fast grown tree than slow grown tree

Keywords: *Melia dubia*, wood, Intra tree variations, anatomical properties, fibre morphology, vessel morphology.

Introduction

The changes in the growing condition and environment of a tree are closely associated with the growth of the tree and are reflected morphologically and also anatomically. Tree to tree variations in wood properties within a species are large and it may be reflected through the variation in anatomical and physical properties. More severe the environment greater the control it has on wood properties relative to inherited differences. In some species the variations are highly responsive to local environment. The wood properties of eucalypts grown on short rotation are comparatively varying and poor in nature[1]. The external factors play a key role in bringing about physiological changes in trees there by affecting the cambial activity[2] and which may remain active in tropical climates through out the year[3]. The present study has been designed to assess the variation in wood properties of *Melia dubia* Cav grown under two different environments. The objectives of the study were (i) To study the variation if any in wood quality parameters of *Melia dubia* Cav grown under different situations and (ii) To analyze the variations if any in anatomical properties of the wood.

Material and Methods

About the tree species: Botanical name: *Melia dubia* Cav. Synonym: *Melia composita* willd, Family: Miliaceae

The wood is used for packing cases, cigar boxes, ceiling planks, building purposes, agricultural implements, pencils, match boxes, splints and 'kattamarans'. In Sri Lanka, it is employed for outriggers of boats. It is suitable for musical instruments, tea boxes and the most importantly in making plywood, as the wood is anti-termite by itself.

Collection of wood samples: Ten wood discs of *Melia dubia* grown in a nine year old plantation with natural variations, as influenced by the soil conditions in the growth and size representing fast grown and slow grown nature, were taken up for the study and the discs were labeled as slow grown timber (sample No.246, 247, 264, 447, 333) and fast grown timber (sample No.323, , 334, 369, 389, 430 and 447).

Preparation of samples: The wood discs were initially machine planed with help of power operated tropical vertical sander (Electrolux make). Later the machine planed discs were manually sanded with different grades of sand paper viz., 60,120, 400, 600 and 800 grades. The sanding with sand paper has been done in the order of lowest to highest grade i.e. rough to fine grade. Then the sanded discs were dusted with a piece of cloth.

Assessment of anatomical properties: Small sized wood samples were drawn from the wood discs and the wood samples were further cut into three sections from pith to periphery and labeled as inner, middle and outer. The wood shavings were made on the Radial log section with a sharp razor from the labeled three sections viz., inner, middle and outer for analysis of anatomical properties. These shavings were macerated using

potassium chlorate and 50% nitric acid and the macerated tissues were kept in slide and cover slip was placed over the specimen and used for microscopic examination of anatomical properties. The wood elements like fibres and vessels were observed through a 'Leica' microscope and the biometrics like fibre diameter, fibre length, lumen diameter, double wall thickness, vessel diameter, vessel length were measured through the microscope with the help of 'QUIN standard software' and data recorded..

Results and Discussion

The data recorded on various anatomical properties of both the slow grown and fast grown trees in three sections from pith to periphery *viz*., inner, middle and outer are presented hereunder.

Fibre morphology: The observations on the intra and inter tree fibre morphology like fibre length, fibre diameter, lumen diameter, double wall thickness were studied by taking 25 observations for each parameter and the results are given in table-1, figures 1,2,3,4 and plates 1 and 2.

A close observation on the data connotes that a non significant intra and inter tree variation has been evident. Nevertheless, the fast grown tree showed higher numerical values for all the parameters viz., fibre length, fibre diameter, lumen diameter, double wall thickness when compared to slow grown tree. As regards to the intra tree variation, in slow grown tree, middle portion of the wood had higher values while in fast grown tree outer portion had higher values for the parameters in question. Pith to periphery variation in anatomical features like fibre length, fibre diameter, lumen diameter, double wall thickness was observed in *Tamarindus indica*, *Grivellia robusta* and *Delonix regia*[4] while a significant quantitative variations in anatomical properties in *Dillenia* wood except for fibre length[5]

Vessel morphology: The intra and inter tree variation in vessel morphology viz., vessel diameter and vessel element length were studied by taking 25 observations for each parameter and the results are given in table-2, figures- 5 and 6 and plates- 1 and 2.

Interestingly intra tree variation revealed that the outer portion of wood in both types (slow grown and fast grown) of trees had longer and wider vessels with higher values**.** Though variation between trees and among tree is non significant, numerically superior values are recorded in fast grown tree than in slow grown tree [6]. Pith to periphery variation in anatomical features like vessel element length and vessel diameter was observed in tamarind, silver oak and *Delonix regia*[4].

Correlation studies: A statistical analysis for establishing correlation between the anatomical properties like fibre length, fibre diameter, fibre *lumen* diameter, double wall thickness, vessel diameter and vessel element length has been done (table 3) for their correlation with each other and it showed that all the fibre characters are correlated to the vessel element length. A significant and positive correlation has been observed among fibre characteristics and also between vessel characters. The figure 7 clearly indicates the superiority of fast grown timber over slow grown timber in all anatomical and physical properties except for bark thickness.

Conclusion

From the study it may be inferred that the fast grown timber showed higher numerical values for anatomical properties viz., fibre length, fibre diameter, fibre lumen diameter, double wall thickness of fibre when compared to slow grown timber. The intra tree variation reveled that in slow grown timber middle portion of the wood had higher values for the parameters studied while in fast grown timber outer region had higher values. The results presented here are preliminary as the species is new and known to the public only during the last decade and is now catching up among the plywood industrialists and farmers leading to establishment of many newer plantations in southern India. The findings throw light on the wood anatomy of *Melia* to the end users.

Acknowledgement

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Table-1
Anatomical parameters of Fast grown and slow grown tree

Properties	Slow grown				Fast grown			
	Inner wood	**Middle wood**	**Outer wood**	**Mean**	**Inner wood**	**Middle wood**	**Outer wood**	**Mean**
Fibre length (µm)	868.9	793.4	1081.3	914.5	1008.8	1036.4	1121.4	1055.5
Fibre diameter (µm)	33.2	38.4	36.8	36.1	39.6	35.4	37.5	37.5
Lumen diameter (µm)	23.5	25.4	24.1	24.3	28.3	22.8	24.7	25.3
Double wall thickness (µm)	9.7	13	12.7	11.8	11.2	12.6	12.8	12.2

ANOVA table for Statistical analysis						't test of significance			
SD	178.6	6.8	5.8	5.9	Inner wood	NS (0.6)	NS	NS (0.21)	NS (0.27)
Grand mean	985	36.8	24.8	12	Middle wood	NS (0.8)	NS (0.001)	NS (0.03)	NS (0.46)
CV %	18.1	18.5	23.4	49.2	Outer wood	NS (0.61)	NS (0.115)	NS (0.81)	NS (0.68)
					Fast grownvs. Slow grown	NS	NS	NS (0.069)	NS (0.121)

Table-2
***Melia dubia* - vessel morphology**

Parameters	Slow grown trees				Fast grown trees			
	Inner	**Middle**	**Outer**	**Mean**	**Inner**	**Middle**	**Outer**	**Mean**
Vessel element length (µm)	277.3	291.8	326.1	298.4	233.1	305.5	381.3	306.3
Vessel diameter (µm)	140.8	175.1	179.2	165	138.6	188.3	219	181.9

Statistical analysis					T test of significance			
SD	21.7	30.4			Inner	NS	NS (0.67)	
Grand mean	302.35	173.45			Middle	NS (0.54)	NS(0.48)	
CV%	7.2	17.5			Outer	NS	NS	

Table-3
Correlation between anatomical properties

Slow grown	Fibre length	Fibre diameter	Fibre lumen diameter	Fibre wall thickness	Vessel diameter	Vessel element length
Fibre length	1					
Fibre diameter	-0.03714	1				
Fibre lumen diameter	-0.44864	0.909758	1			
Fibre wall thickness	0.184579	0.975284	0.795544	1		
Vessel diameter	0.357237	0.920101	0.674466	0.983904	1	
Vessel element length	0.852964	0.489928	0.083812	0.67044	0.792237	1
Fast grown	**Fibre length**	**Fibre diameter**	**Fibre lumen diameter**	**Fibre wall thickness**	**Vessel diameter**	**Vessel element length**
Fibre length	1					
Fibre diameter	-0.23514	1				
Fibre lumen diameter	-0.40224	0.984448	1			
Fibre wall thickness	0.768136	-0.80296	-0.89518	1		
Vessel diameter	0.912339	-0.61248	-0.74183	0.962956	1	
Vessel element length	0.962969	-0.48849	-0.63418	0.91232	0.98894	1

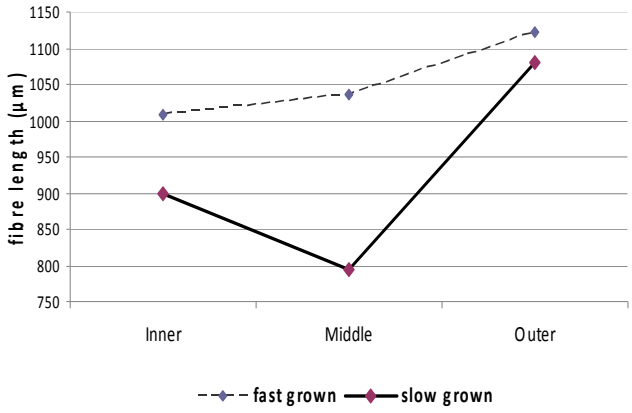


Figure-1
Radial Variation in fibre length

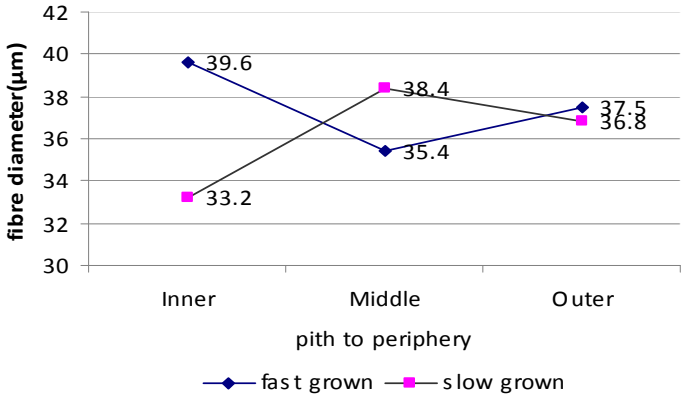


Figure-2
Radial Variation in fibre diameter

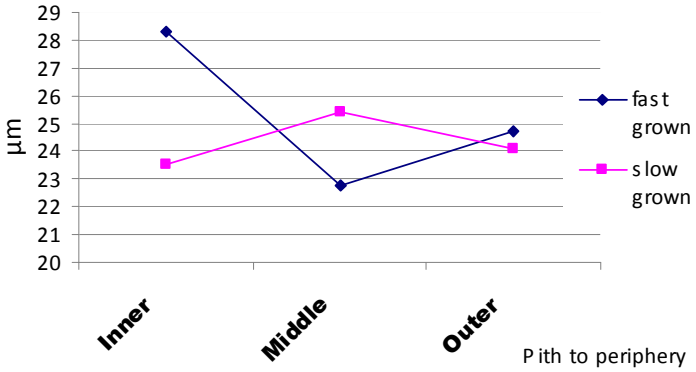


Figure-3
Radial variation in fibre lumen diameter

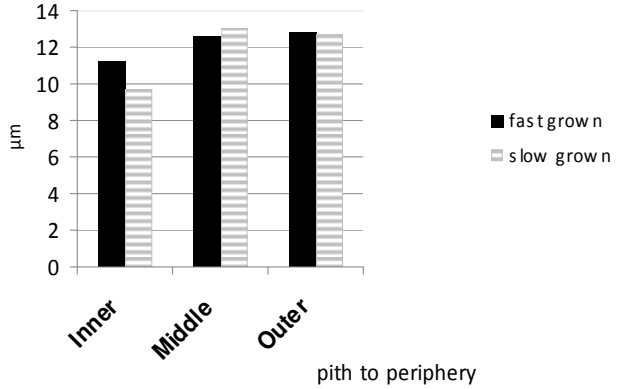


Figure-4
Radial variation in double wall thickness of fibre

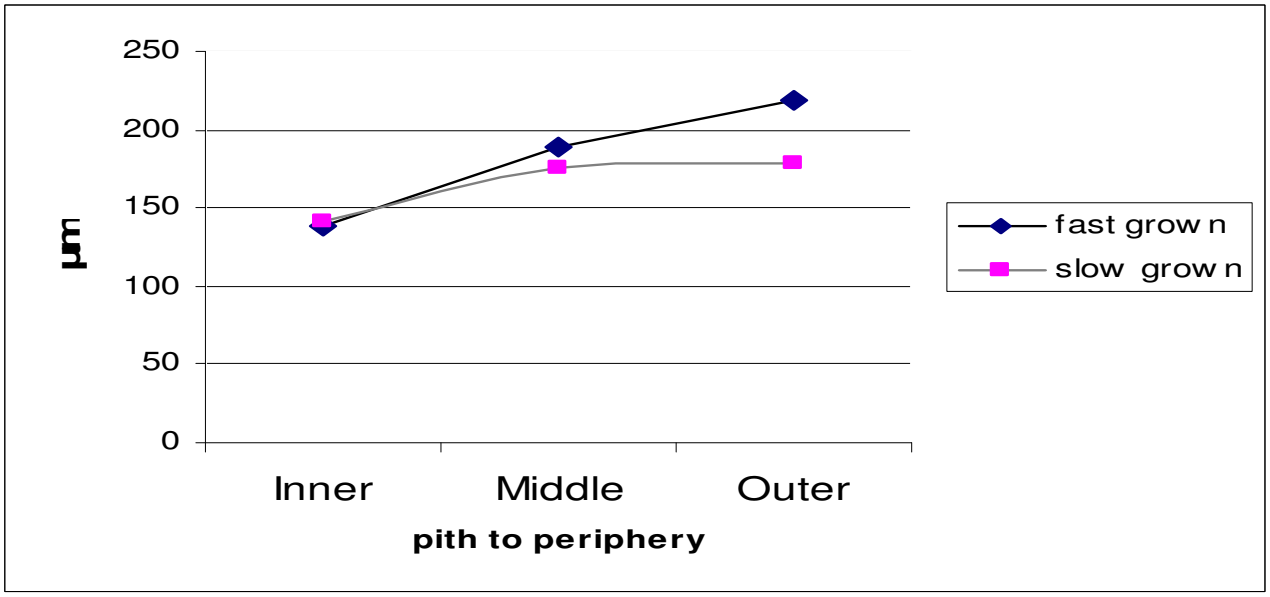


Figure-5
Variation in vessel element length

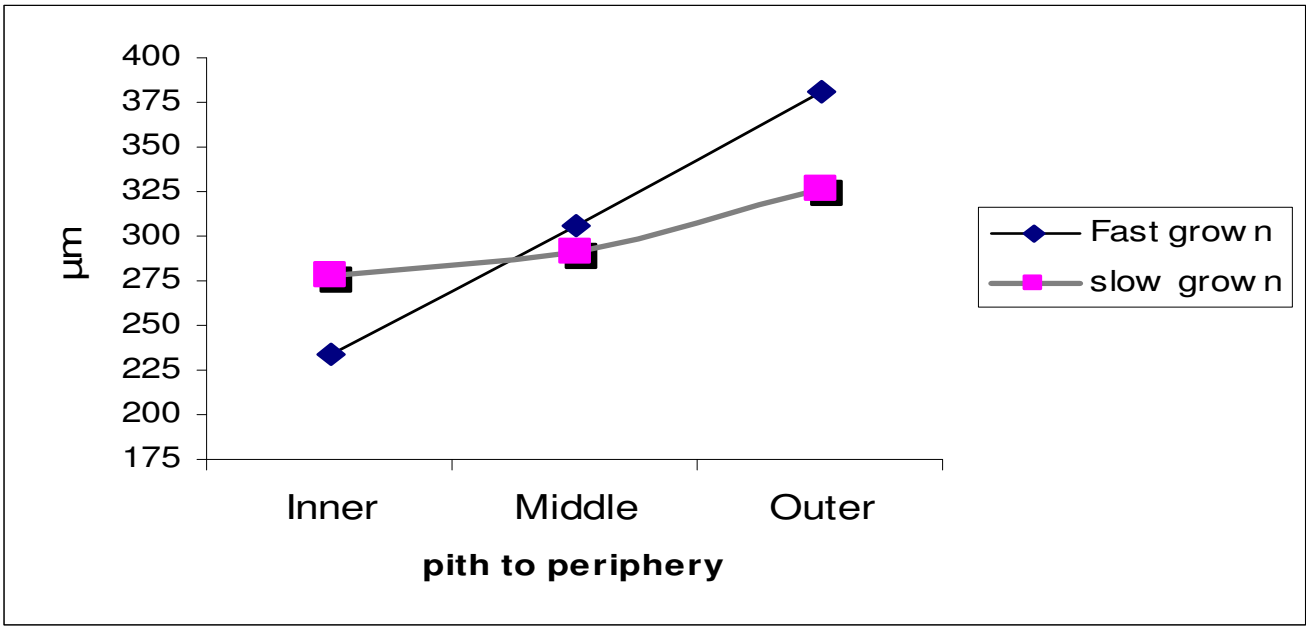


Figure-6
Variation in vessel diameter

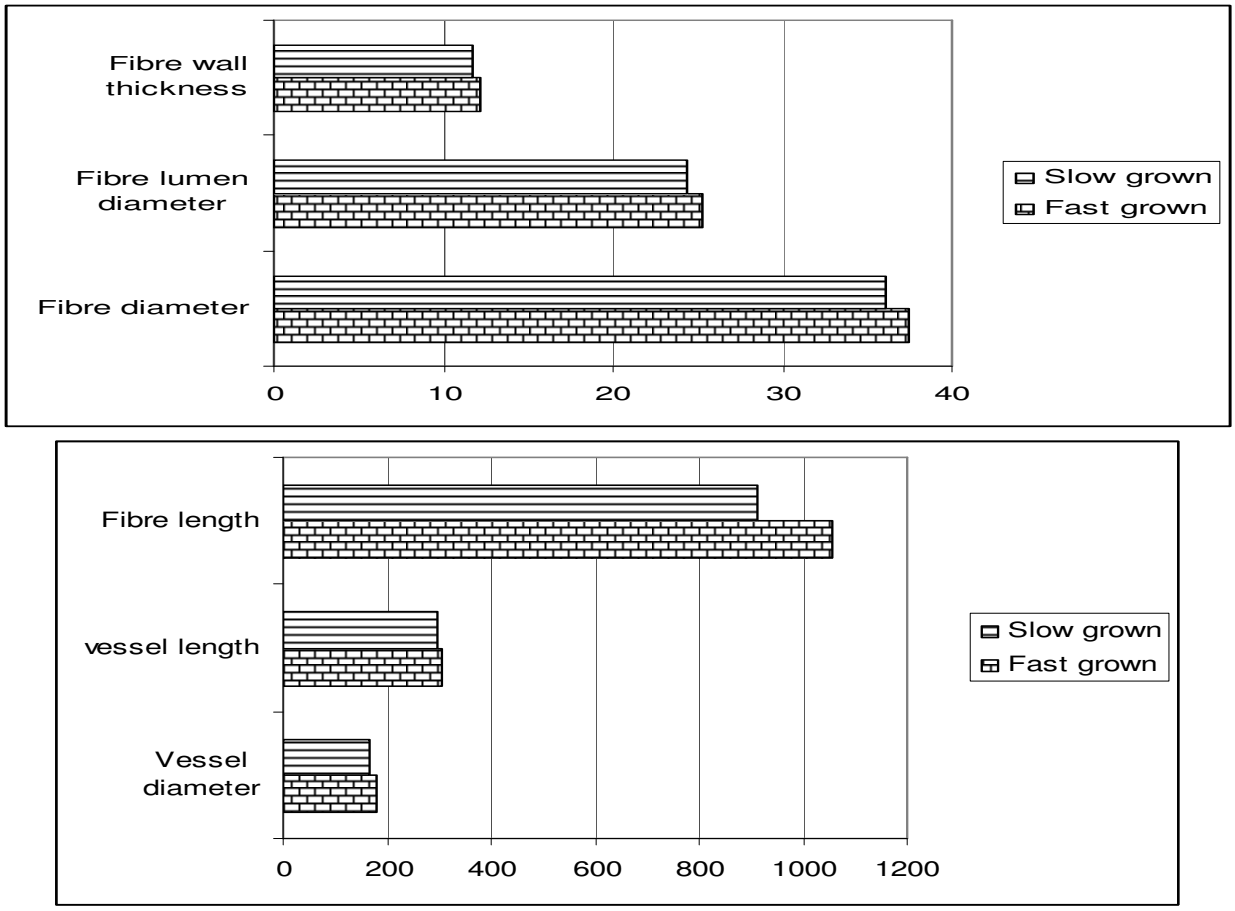


Figure-7
Comprehensive chart for anatomical properties

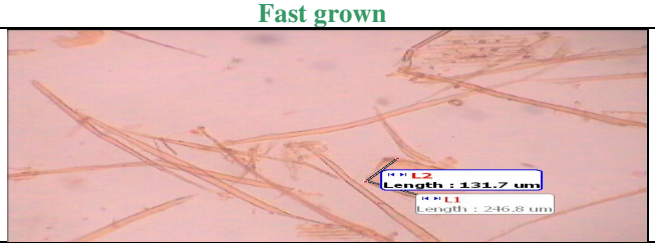
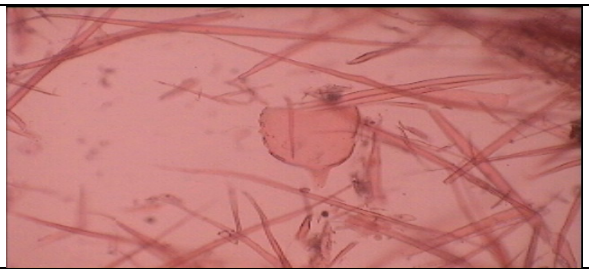
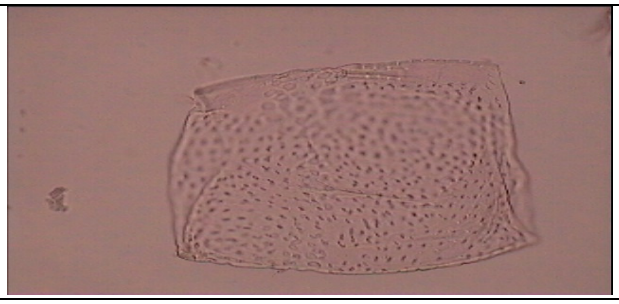
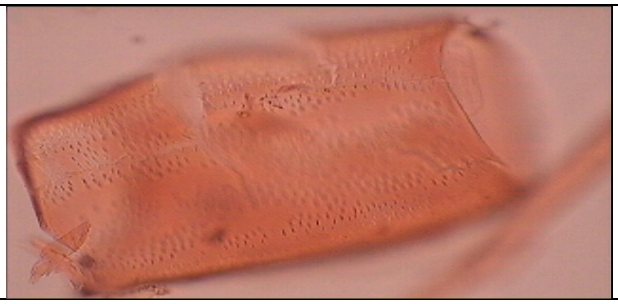
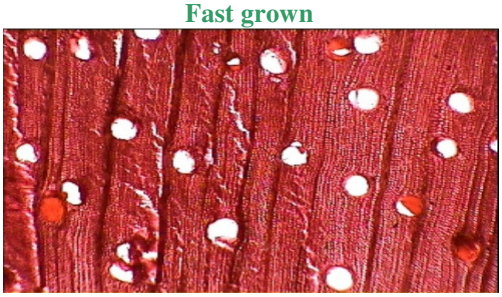
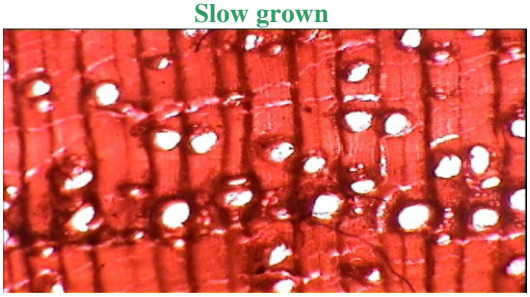
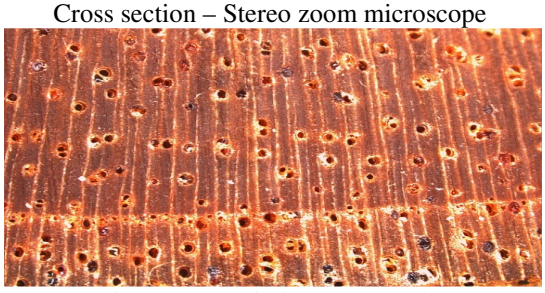
Fast grown	**Slow grown**
	
Fibres 10x	Fibres 10x
	
Vessel element 10x	Vessel element 10x
	
Vessel element 40x	Vessel element 40x

Plate-1
***Melia dubia* Fibre and vessel elements**

Fast grown **Slow grown**


Cross section – Stereo zoom microscope


Cross section 4x – Stereo zoom microscope


Cross section 10x- Motic image analyzing system

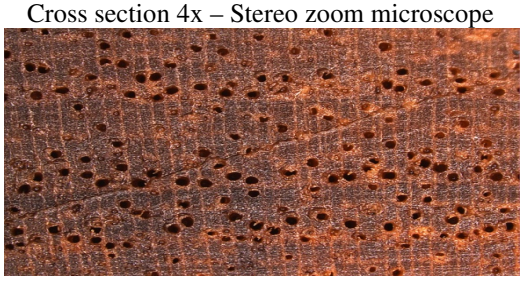

Cross section 10x- Motic image analyzing system

Plate-2
***Melia dubia* Cross section**