TECHNOLOGICAL PROPERTIES OF SOME WOOD SPECIES GROWN IN KHYBER PAKTUNKHWA

Ghulam Mustafa Nasir[1], Tanvir Hussain[2] and Khalid Hussain Sulangi[3]

ABSTRACT

A number of wood species grown in Khyber Pakhtunkhwa have been studied for their anatomical properties in order to find out measures for wood quality improvement before their utilization for making various products. Permanent slides of cross, radial and tangential sections of each wood species were prepared, observed under the microscope and data were collected for the frequency and dimensional measurement of different wood elements/structures in each wood species. On the basis of results it was observed that Kiker, Robinia, Lachi and Gurgrua wood may be strong and hard and Toot, Kangar, Siris, Willow, Barh, Batkar and Jaman wood may be better or medium in strength due to longer, thick-walled or narrow lumened fibers. The wood of all the studied species may be somewhat non-durable because of higher frequency or larger size of wood rays and need preservative treatment before utilization in order to increase service life. Tut, Siris, Anjir, Willow, Kiker, Kangar Robinia, Gurgrua and Barh may be easy to season and preserve owing to higher frequency or larger size of vessels however whereas, Batkar, Lachi and Jaman wood may be somewhat difficult to process because of lower frequency or smaller diameter of the vessels.

INTRODUCTION

Pakistan has limited number of commercial timbers which are also becoming short due to less supply and greater demand to meet the requirements. The area of forest/tree cover of the country is 5.1% and the Khyber Pakhtunkhwa province has a forest cover of 20.3% (Bukhari *et al*., 2012). Khyber Pakhtunkhwa has valuable natural coniferous forests that provide timber not only for the province but also for all parts of the country. Wood production can be increased either by increasing the area under forest or by introducing agroforestry on farmlands (Afzal and Malik, 1999). By planting wood producing trees on farmlands, the wood growers can also get better return from their tree crops. Further, Billion Tree Tsunami Afforestation Project (BTTAP) has also been launched in Khyber Pakhtunkhwa in order to increase forest cover in the province. Around 100 million saplings have been planted across the province by the end of 2015 (Khan, 2015).

1

Work has been done so far for planting fast growing wood producing trees on private and public lands in order to increase the wood availability. It is however, important to pay attention to determine suitability of different lesser

1 Director, Forest Products Research Division, Pakistan Forest Institute, Peshawar
2 Wood Technologist, FPRD, Pakistan Forest Institute, Peshawar
3 Assistant Wood Technology Officer, FPRD, Pakistan Forest Institute, Peshawar

known wood species for manufacturing of various wood and wood based products as substitute of the commercial wood species in wood based Industries.

Having knowledge about the basic anatomical properties, the wood of non-commercial species can be made defect free by proper processing i.e. careful seasoning etc. to minimize the imperfections. The size of vessels helps to determine the seasoning behavior of a wood as, movement of moisture takes place through the vessels. Further, the size of vessels also points towards the preservation behavior of a wood as these are the main route for the flow of preservative (Wilkinson,1979). Appropriate preservation of wood before utilization is important to make the wood durable that will ultimately improve the quality of wood and of the products manufactured. Durability of wood is related to parenchyma (food cells). Sap staining fungi remove the stored plant food material and spoil the appearance of wood. Stained wood exposed to suitable conditions, later on attacked by wood rotting fungi which disintegrate the wood (Dinwoodie, 1983).

Fiber morphological characteristics help to determine strength of wood as the fibers are comparatively thick-walled wood elements and constitute the mechanical tissue. Thickness of fiber walls is one of the important factors in determining the strength of wood. Density and strength of hardwoods are generally related to the portion of wood volume occupied by fibers relative to that accounted for by vessels. As a general rule, the higher the proportion of thick-walled fibers, the higher the strength of wood (Jhon & Jim, 1989).

In this study, a number of locally grown wood species have been evaluated for their basic anatomical properties in order to find out measures for wood quality improvement before their utilization for making various products. Further, the proposed study will introduce integrated uses of the studied wood species, extend the base of raw material for wood based industries and help to conserve the valuable timber resource in the province.

MATERIAL AND METHODS

To conduct the research work, wood material of Kiker (*Acacia nilotica*), Toot (*Morus alba*), Kangar (*Pistacia integerrima*), Robinia (*R. psuedoacacia*), Siris (*Albizzia sp*), Anjir (*Ficus palmata*), Willow (*Salix tetrasperma*), Batkar (*Celtis eriocarpa*), Lachi (*E. camaldulensis*), Gurgrua (*Reptonia buxifolia*), Barh (*Ficus religiosa*) and Jaman (*Syzygium cumini*) species were collected from different areas of Khyber Pakhtunkhwa province and transported to Pakistan Forest Institute, Peshawar. In order to study the anatomical properties, discs were cut from the end face of butt log of each species. Then permanent slides of cross, radial and tangential sections of each wood species were prepared by standard laboratory procedure (Anon., 1971) and observed under the microscope for various structural features in each species. A small portion of wood of each species was macerated in 20% Nitric Acid and Potassium Chlorate to separate

the fibers and observe the fiber length. Data were collected for the frequency and dimensional measurements of following different wood elements/structures in each species and analyzed for statistical variables:

- Fiber length, Fiber diameter and Wall thickness
- Frequency of vessels per unit area
- Vessel diameter
- Wood Ray size (height and width) in cells
- Wood Ray size (height and width) in microns
- Wood Ray frequency per unit area in tangential section.
- Wood Ray frequency per mm in cross section

RESULTS AND DISCUSSION

Results given in the following table represented that Kiker wood a hard and strong owing to longer and narrow lumened fibers. The wood may be used for making various wood products but, prior chemical treatment of the wood is necessary as the wood may be non-durable because of higher frequency and large size of wood rays. Wood may behave better during seasoning and preservation process as the vessels frequency was reasonable.

In Toot wood the fibers are long and smaller in diameter which showed that the wood may be better in strength and moderately hard. High value of vessels diameter and their frequency indicate good behavior of the wood in seasoning and chemical preservation. The wood rays are medium in frequency but their height and width size determines that Toot wood may be non-durable and chemical treatment is essential before its utilization particularly in furniture making etc.

Kangar wood may be medium in strength and hardness in the view of fiber length, diameter, wall-thickness and lumen width measurement values. Further, wood rays frequencies (in tangential and cross sections) and height and width parameters represent its moderate resistance against biological agents. Similarly, it may exhibit moderate behavior of seasoning and chemical preservation as the number of vessels per unit area and the vessel diameter are in medium range.

Robinia wood may be stronger and hard due to longer and thick-walled fibers. Seasoning and preservation processes of the wood may be easy in view of larger diameter of vessels however, their frequency is lower. The data regarding wood rays characteristics, it may be assessed that Robinia wood may be less resistant to wood deteriorating agents and prior chemical treatment of the wood with preservatives is necessary.

Siris wood may be moderate in strength and hardness due to comparatively thick walled fibers. Further, drying and preservation behavior of

the wood may also be good as the vessels frequency and diameter values are in high range. Wood rays features represent its moderate resistance to wood deteriorating agents but chemical preservation may improve durability of wood as the vessels are higher in frequency and larger in diameter. Moreover it can easily be seasoned.

Anjir wood may be medium in strength and hardness in view of the fibers dimensional values. The features of wood rays represent its moderate endurance against pathogens as the wood rays are longer and wider in size. Further, the wood may be easy to treat with chemicals during preservation due to the vessels are sufficient large in diameter however, their frequency is lower.

Willow wood may be strong due to longer and narrow lumened fibers, but medium in hardness because of their wall-thickness. In contrary, the wood rays frequency in cross and tangential sides and the number of cells along height and widthwise indicate moderate resistance to wood pathogens. Therefore, prior impregnation of the wood with preservatives may enhance its endurance and the process may be easy as the vessels are very high in numbers per unit area. Moreover, vessel diameter also reflects its good seasoning behavior during the process.

Batkar wood, may be better in strength as the fibers are long, narrow in diameter, lumen width and fairly thin-walled. The vessels are medium in frequency in earlywood while in latewood these are in high frequency, smaller in diameter in latewood and larger in earlywood engaged maximum volume of the wood. The wood rays were lower in frequency and a bit larger in size. The wood may be non-durable and requires preservative treatment when used as solid wood. However, preservation and seasoning behavior of the wood may be slow.

In Lachi wood, the fibers are short, narrow in diameter and lumen width, somewhat thick-walled and the wood may be hard and strong. The vessels are lower in frequency and small to medium in diameter and engaged minimum volume of the wood. The wood rays are higher in frequency, a bit medium in size. The wood may be non-durable due to higher frequency of wood rays so requires preservative treatment when used as solid wood. However, chemical treatment of the wood may be slow due to lower frequency and smaller diameter of vessels.

Gurgura wood may be hard and strong as, the fibers are longer, medium in diameter and fairly thick-walled. The vessels are higher in frequency and smaller in diameter engaged maximum volume of the wood. The wood rays are higher in frequency and medium in size. The wood may be non-durable due to higher frequency of wood rays and requires preservative treatment when used as solid wood. However, chemical treatment of the wood may be rapid due high frequency of vessels.

Table 1. Frequency and Dimensional Measurements of different wood elements/structures in some wood species grown in Khyber Pakhtunkhwa

Wood species	Fiber length	Fiber diameter	Fiber wall-thick-ness	Fiber lumen width	Frequency of vessels	Vessel diameter	Height of ray		Width of ray		Ray freq. in tang. Sec.	Ray freq. in cross sec.
	mm	(µ)	(µ)	(µ)	/mm²	(µ)	cells	(µ)	cells	(µ)	/mm²	/mm
Kiker (*Acacia nilotica*)	1.31	14.77	3.57	7.63	8	178	33	418	4.12	56.2	11	2.32
Toot (*Morus alba*)	1.00	15.99	2.65	10.69	7 EW 14 LW	326 EW 162 LW	36	380	5.86	58.6	6.81	1.28
Kangar (*Pistacia integerrima*)	0.73	16.11	3.40	9.31	23.8EW 181 LW	181 EW 66 LW	12.56	180	2.70	29.8	28.50	8.81
Robinia (*R. psuedoacacia*)	1.14	15.32	4.27	6.78	4.25	216.26	35.84	348	4.56	46.7	12.90	3.39
Siris (*Albizzia sp*)	0.96	21.34	3.41	14.52	51.63	397.68	13.72	214	4.6	51.8	33.78	2.17
Anjir (*Ficus palmata*)	0.95	17.77	3.1	11.57	6.83	203.67	30.52	429	3.56	25.3	23.93	4.89
Willow (*Salix tetrasperma*)	1.02	17.63	3.09	11.45	105	115.18	16.18	48	1.08	13.2	32.62	12.11
Batkar (*Celtis eriocarpa*)	1.05	13.13	2.47	8.19	33.1EW 105 LW	40 L.W 122 E.W	29.73	482.6	7.04	57.3	6.56	-
Lachi (*E. camaldulensis*)	0.82	14.79	3.06	8.67	7.84	129.78	7.72	129.6	1.84	17.7	139.38	-
Gurgrua (*Reptonia buxifolia*)	1.08	17.49	5.13	7.23	128.85	35.9	7.07	166.6	1.81	17.7	84.08	-
Barh (*Ficus religiosa*)	1.41	21.60	4.64	12.32	1.75	283.30	22.89	367	4.25	53.3	14.24	5.08
Jaman (*Syzygium cumini*)	1.63	23.19	6.6	9.99	6.86	146.78	11.28	307.4	2.94	45.9	6.56	-

Barh wood may be better in strength properties but somewhat moderate in hardness owing to fiber wall-thickness and lumen width value. The larger vessel diameter indicates better seasoning and preservation behavior but may be difficult because vessels frequency lies in lower range. Prior treatment of wood with chemical preservatives is necessary in view of large and broad wood rays. Moreover, the rays frequency value also indicate its less resistance to wood deteriorating agents.

In Jaman wood, the fibers are long, fairly thick-walled but larger in diameter. The vessels are lower in frequency, medium in diameter engaged minimum volume of the wood. The wood rays are lower in frequency, a bit larger in size. The wood may be somewhat non-durable against pathogens and requires chemical treatment when used as solid wood. Preservation process of the wood may be slow due to lower frequency and medium diameter of vessels. Similarly seasoning behavior of the wood may also be slow.

CONCLUSIONS

- Based on the results it can be concluded that, the wood of Kiker, Robinia, Lachi and Gurgrua may be strong and hard and that of Toot, Kangar, Siris, Willow, Barh, Batkar and Jaman may be better or medium in strength and can be used for making different wooden articles.

- Preservative treatment of wood before utilization for making products is necessary for all the studied species in order to increase service life of the wood and of the products manufactured.

- The wood of Tut, Siris, Anjir, Willow, Kiker, Kangar Robinia, Gurgrua and Barh could behave better during seasoning and preservation, whereas in case of Batkar, Lachi and Jaman wood, the processes may be slow.

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