ANATOMICAL PROPERTIES OF ELM (*ULMUS WALLICHIANA*) WOOD IN CORRELATION WITH TECHNOLOGICAL AND WOOD WORKING PROPERTIES

Khalid Hussain[1] and G. M. Nasir[2]

ABSTRACT

Elm (*Ulmus wallichiana*) wood was studied for its anatomy to ease identification of the species, evaluate various technological properties and find out its better utilization. Permanent slides of cross, radial and tangential sections of the wood were prepared by standard laboratory procedures and observed under the microscope. Data were collected for the frequency and dimensional measurements of different wood elements/structures. Results revealed that in Elm wood, the fibers were longer, medium in diameter, wide lumened and fairly thick-walled due to that the wood may be relatively better in strength. The vessels were lower in frequency but quite larger in diameter and the wood can be seasoned without any difficulty. The wood rays were medium per unit area and in size. The axial parenchyma was abundant, occupied approximately one third volume of the wood for the reason; the wood may be non-durable and require preservative treatment before used as solid wood. The wood may be less durable however it can be easily preserved with chemicals. Further, due to better fiber morphological characteristics, the wood can be used for pulp and paper manufacture.

INTRODUCTION

Pakistan is one of the world countries, having meager forest resources. These meager, but valuable resources are on continuous decline due to illegal/legal deforestation, climate change, water stress, and different tree diseases etc. Further, this stress is also developing on the commercial tree species due to increase in demand as a result of enormous and spontaneous growth in population.

There is a strong need of the day to meet the country's requirement of wood by sustainable improvement and increase in the forest area. Besides this, there is need to study the non- commercial species close to the commercial species for wood properties. This will be helpful to minimize pressure on the conventional timber species and forests as well.

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1 Assistant Wood Technology Officer, Pakistan Forest Institute, Peshawar
2 Logging Officer/DFPRD, Pakistan Forest Institute, Peshawar

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This study was initiated to determine the anatomical and working properties of the wood of commercially less important species, Elm (*Ulmus wallichiana*) to find out its better utilization other than the conventional.

Ulmus wallichiana the Himalayan elm tree is named for the Danish botanist Nathaniel Wallich. It is also known as the Kashmir elm, a mountain tree ranging from central Nuristan in Afghanistan, through northern Pakistan and northern India to western Nepal at an elevation of 800-3000 m. (https://en.wikipedia.org/yviki/Ulmus_wallichiana).

Elm is a large deciduous tree, reaches to the height of 24m to 27m with diameter of 1.2 m to 1.5 m. The tree is native to Pakistan, India and Nepal. In Pakistan it is found in swat, Hazara, Murree, Azad Kashmir and Baluchistan. The wood is grayish brown in color, hard, strong and heavy, straight-grained, coarse and uneven textured, used for tool-handles, agriculture implements, fodder, furniture and cordage. (Sheikh, 1993).

Sapwood pale brownish-white to light grayish-brown, wide; heartwood grayish-brown to light brown, sometimes with a pinkish cast, turning chestnut -brown with age. Often irregularly streaked with darker bands which may be of traumatic origin; rather lustrous, working rather rough under tools. The sapwood with the characteristics odour of the living 9 bast of ulmus which is more pronounced in the inner bark, the heartwood without characteristic scent, light to moderately heavy , straight or shallowly and irregularly interlocked-grained, medium coarse-and uneven-textured. (Pearson and Brown).

This study was carried out to examine the basic structure of Elm wood helpful in its identification and compile the anatomical data for the assessment of its various technological properties in order to find out its better utilization other than the conventional so that it can be used as substitute of the commercial species for making various wood products.

MATERIAL AND METHOD

To conduct the research work, the wood sample of Elm was obtained from the wood anatomy laboratory collection of the authentic wood specimens. A block of about 13mmx13mmx25mm in size was cut from standard wood specimen of the species and prepared for sectioning. Permanent slides of cross, radial and tangential sections were prepared by standard laboratory methods (Anon., 1974) and observed under the microscope for various structural features. A small portion of wood of the species was macerated in 20% Nitric Acid and Potassium Chlorate to separate the fibers and observe fiber length in the studied species. Data were collected for the following anatomical features by the micrometry process (Anon., 1971).

- Fiber length
- Fiber diameter
- Fiber wall thickness
- Frequency of vessels per unit area
- Diameter of vessels
- Frequency of wood rays per mm^2 in tangential section
- Frequency of wood rays per mm in cross section
- Height of wood rays in number of cells
- Height of wood rays in microns
- Width of wood rays in number of cells
- Width of wood rays in microns

The data collected were analyzed for statistical variables such as mean value, standard deviation and coefficient of variation of each microscopic feature in the studied species.

RESULTS AND DISCUSSION

General characteristics of the wood: Elm (*Ulmus wallichiana*) wood is ring porous, sapwood is pale brownish-white to light grayish-brown; heartwood grayish-brown to light-brown, sometimes with pinkish cast, turning chestnut-brown with age, irregularly streaked with darker bands, rather lustrous, and sapwood with characteristics odour. The wood is light to moderately heavy, straight and interlocked grained, medium coarse and uneven textured.

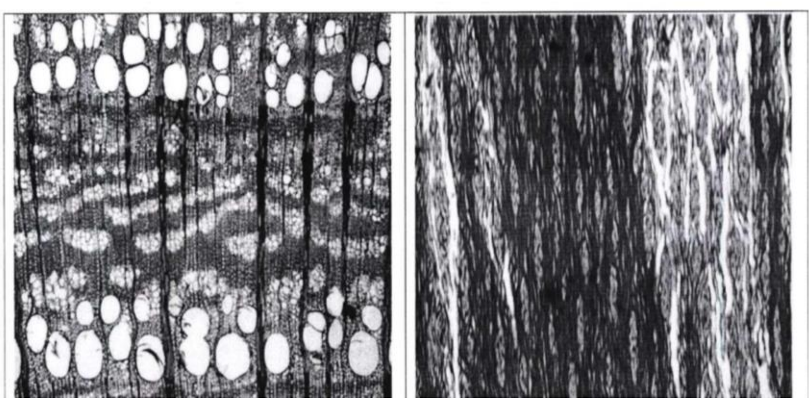
Structure of the wood

The growth rings are distinct and conspicuous with the naked eye delimited by medium narrow, clearly defined, 5 to 10 per inch whitish zone of spring wood containing large vessels followed abruptly by a darker zone of summerwood consisting of dense fibrous tissues and much smaller in size. The vessels are varied variable in size, open or occluded with tyloses, springwood vessels large to medium-sized, less frequent in radial arrangement, single or partially double rows, ranges from 8-15 per mm^2 in number and 115µ to 260µ in diameter; summerwood vessels small to extremely small, intersperse with the tracheids and parenchyma.

Parenchyma is paratracheal and metatracheal, in rows of 2 to 4 units along the grain. Paratracheal parenchyma is abundant in the springwood porous zone, less abundant and mostly marginal in summerwood. Matatracheal parenchyma is scattered in the fibrous tract.

The fibers are semi-libriform to libriform, fine, rounded in transverse section, frequently contiguous to the summerwood vessels, non-septate, 850µ to 1750µ long, 20µ to 25µ in diameter, walls 4µ to 6µ thick.

The wood rays are of two sorts and homogenous. The broad rays distinct with the naked eye, visible with a hand lens of 10x as medium fine straight lines across the growth rings, widely scattered. 4 to 5 per mm, frequently contiguous to springwood vessels, darker than the background forming fine streaks on the radial surface, 70 µ to 80µ wide through the central portion, variable in height. 10-40 plus cells (140µ to 700µ). Narrow rays are less numerous than the broad rays, 1-10 plus cells and up to 200 plus µ in height.



Cross section of the wood Tangential section of the wood

Fig. 1. Photomicrographs showing the structure of Elm wood

Table 1. Frequency and dimensional measurements of different wood elements/ structures in Elm wood (Statistica Analysis)

S.No.	Microscopic features	Mean value	S.D±	C.V%	Min	Max
1.	Fiber length (mm)					
2.	Fiber diameter (microns)					
3.	Fiber wall thickness (microns)					
4.	Fiber lumen width (microns)					
5.	Early wood Vessel frequency (mm^2)					
6.	Early wood Vessel diameter (microns)					
7.	Vessel frequency in latewood (mm^2)					
8.	Ray Height (microns)					
9.	Ray height (in cells)					
10.	Ray width (microns)					
11.	Width of wood rays (in cells)					
12.	Ray frequency in tang, section (mm^2)					

On the basis of average values given in Table 1, in Elm wood the fibers were long, medium in diameter, wide lumened and reasonably thick-walled due to which the wood may be better in strength properties. The wood rays were somewhat larger in size and medium in frequency both in cross and tangential sections because of that the wood may be less durable. The early wood vessels were low in frequency but larger in diameter, while the latewood vessels were many and occur in groups. The wood can be easily preserved with chemicals as the springwood vessels are sufficient large in diameter which may ease the seasoning and preservation process.

Working qualities

The wood can be sawn without difficulty and finish to a moderately good surface however requires a good deal of filling, after that it can take a good polish. Special attention is drawn to its silver grain, which, though of good appearance, could hardly be turned to account for decorative purposes. If cut well off the quarter, it presents a striking tortoise-shell figure, formed by the broad bands of open light-colored tissue standing out against the lines of darker dense fibers.

Painting

Generally, hardwood having small pores may be painted with ordinary paints in exactly the same manner as softwoods. Hardwoods with larger pores, as in Elm, require wood filler before they can be covered smoothly with paint or enamel as, without filler the pores not only appear as depression in the coating, but also become centers of early paint failure for interior wood work.

Decay resistance

Moisture and temperature are generally principle factors affecting the rate of decay of wood. The heartwood of Elm is generally lower in decay resistance and frequently gives unsatisfactory service where decay hazards exist. Thus, it is usually requiring some preservative treatment to give satisfactory service under the conditions that favor decay in wood.

Weathering effect

Weathering may involve change in colour, roughening of surface; erosion of wood, twisting is caused by uneven shrinkage resulting from spiral and interlocked grain. Elm wood is likely to twist because of interlocked grain when exposed to the weather.

Suitability for pulp and paper

In Elm wood, the Runkil Ratio (2 x fiber wall thickness/Lumen width) was calculated as 0.68 which shows that the wood will be suitable for pulp and paper manufacture.

The results are based on single wood specimen therefore, does not cover minor anatomical variation with respect to growth rate and age of tree. Conclusion: Based on the results, it can be concluded that Elm wood may be medium in density and better in strength properties. It can be used for making various wood products in which medium strength is required. If cut well off the quarter, it presents a striking tortoise-shell figure. Painting of the wood will be little problematic due to larger size of pores. The wood may be non-durable and need preservative treatment when used as solid wood, however, the process of preservation and drying of the wood may be slow. Further, Elm wood may be highly vulnerable to the weathering effect. In addition to traditional uses, Elm wood can also be used for pulp and paper manufacture.

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