# VARIATION IN DENSITY WITH RESPECT TO GROWTH RATE IN DEODAR (*CEDRUS DEODARA*) WOOD

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## ABSTRACT

Annual ring width and basic density was studied in about 100 samples of Deodar wood to observe variations in both of the parameters and determine the influence of growth rate on density of wood. Results showed that in Deodar wood, the annual ring width ranged from 0.213-5.45mm and the basic density varied from 0.350-0.593gm/cm³. Majority of the studied wood samples were found to have 1 - 2mm average annual ring width and 0.401-0.450gm/cm³ basic density of the wood. No specific trend of increase or decrease in basic density of wood with respect to growth rate was observed. The wood samples having lower growth rate had considerable variation in the value of basic density. Similarly the wood samples with higher growth rate were also found to have significant variation in the value of basic density of wood. Further, the wood samples possessing maximum and the minimum growth rate, both had an intermediate value of basic density of wood. Likewise, the wood samples possessing the highest and lowest value of basic density, both were found to have a medium value of average annual ring width.

## INTRODUCTION

Deodar (*Cedrus deodara*) is a valuable member of the coniferous forest. The tree is large, evergreen, 45 to 60 m tall with a diameter of 0.8 to 1.1 m. It is native to Himalayas of the subcontinent including Pakistan, Afghanistan and India. In Pakistan it is found at high elevations in Azad Kashmir, Murree Hills, Hazara, Swat, Dir, Tirah and Chitral (Sheikh, 1993).

In Deodar, the sapwood is white and the heartwood is light yellowish brown having characteristic odour and oily feel. The wood is straight grained, medium fine and somewhat uneven-textured. It is an important structural timber, suitable for railway sleepers, carriages and wagon work, house building, beams, floor boards, door and window frames, light furniture, ordinance boxes and pattern making (Siddiqui *et al*., 1996).

It has been generally assumed that quality of wood as a building material depends mainly on its density. Variations in density of wood are due to differences in the structure and to the presence of extraneous constituents. The rate of growth expressed as width of annual rings or as number of rings per inch, has frequently been investigated and discussed as a measure of quality i.e. the density of wood (Kollmann & Cote, 1968).

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Density of wood is the best single criterion of the strength of a piece of wood. In addition to the range in density that occurs among timbers of different species, there is considerable variation in density between different samples of the same species. The range in densities of the softwood timbers is much lower than that for the hardwood timbers.

Extremely narrow and extremely broad growth rings are an indication of exceptionally weak timber. Probably in all species there is an optimum rate of growth for the production of the stronger timber. In softwoods this optimum rate is 7 to 20 rings per 2.5 cm and within these limits the narrower the ring the narrower is the layer of earlywood and consequently, the higher is the proportion of late wood (Desh & Dinwoodie, 1983).

This study was carried out to find out variations in annual ring width and basic density of Deodar wood, specific range of both the parameters generally exhibited by the species and to determine the influence of growth rate on basic density of the wood.

## MATERIAL AND METHODS

To conduct the research work, 100 sample blocks of Deodar (*Cedrus deodara*) wood of size ranging from 10-20mm in radial diameter were prepared from different pieces of the same wood species received from various organizations for testing in the Forest Products Research Division during the last several years. Cross surface of all the sample blocks were made clear with the help of a sledge microtome (Anon. 1971) and data were collected for the number of annual rings and radial diameter of each block under the microscope used for opaque objects with rotary scale having minimum value of 0.01mm. Then the average annual ring width was calculated for each sample block.

To calculate the basic density, dry weight of each sample block was taken on an electronic digital balance and the green volume was determined by using the apparatus for determination of density by immersion in mercury from Breuil (Kollmann & Cote, 1968). Then basic density of each sample block was calculated with the help of formula: (dry weight of the wood sample/ green volume).

The data collected was analyzed for the cumulative average values of both the parameters and sorted out for the range of annual ring width and basic density of wood to find out the minimum and maximum value of each parameter. Further, the data was also sorted out for the annual ring width classes and basic density classes to locate the specific range of annual ring width and basic density exhibited by a definite number of wood samples among the studied one.

## RESULTS AND DISCUSSIONS

### Annual ring Width

Results revealed that in Deodar wood, the annual ring width varied significantly. Sorting of the data collected in ascending order showed that the minimum value of average annual ring width was 0.213mm whereas, the maximum was 5.45mm (Fig.1). The cumulative average value of annual ring width in Deodar wood was calculated as 1.74mm.

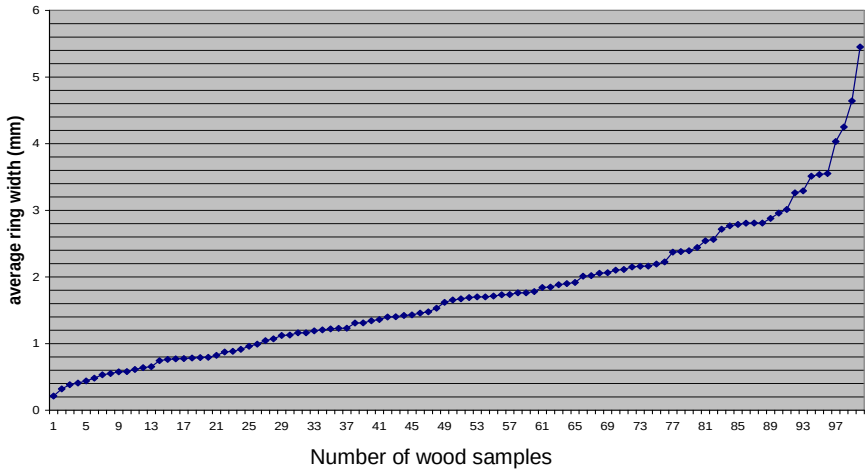


Fig.1. Average ring width range in the studied Deodar wood samples

Further, sorting of the data collected for average annual ring width into different classes showed that majority of the studied wood samples (39) had 1-2mm average annual ring width whereas 26 had below 01mm, 25 had 2-3mm, 06 samples had 3-4mm, 03 had 4-5mm and the only one wood sample was found to have average annual ring width above 5mm (Fig.2).

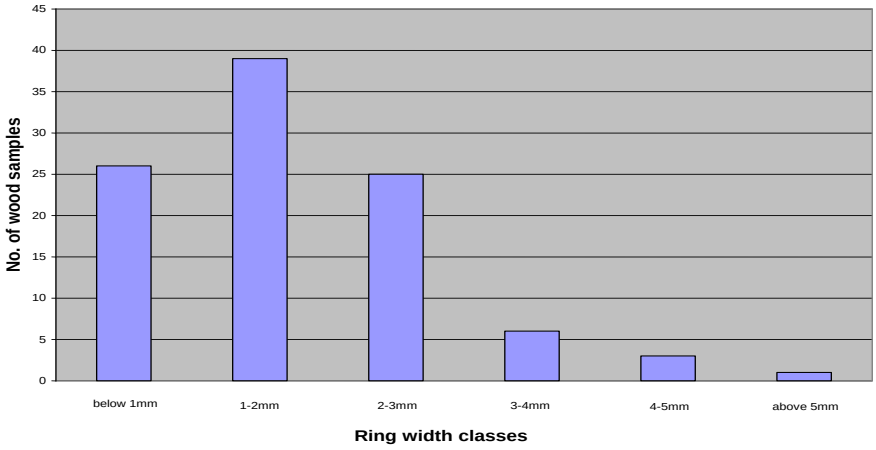


Fig.2. Ring width classes of the studied Deodar wood samples

## Basic Density

It was observed that in Deodar, the basic density of wood varied considerably. Sorting of the data collected in ascending order showed that the lowest value of basic density was 0.350gm/cm³ whereas, the highest was 0.593gm/cm³ (Fig.3). The cumulative average value of the basic density in Deodar wood was calculated as 0.430gm/cm³.

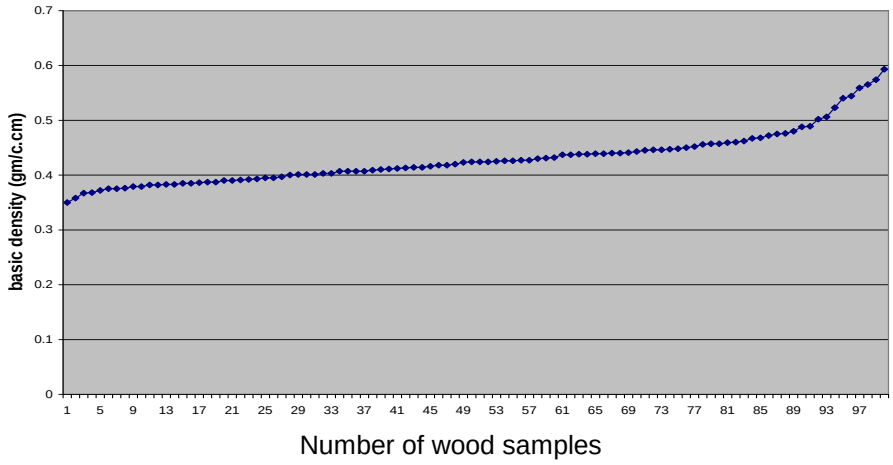


Fig.3. Basic density range in the studied Deodar wood samples

Further, sorting of the data collected for basic density of the wood into different classes showed that majority of the studied wood samples (48) had 0.401-0.450gm/cm³, whereas 28 had 0.350-0.400gm/cm³, 15 samples had 0.451-0.500gm/cm³, 05 had 0.501-0.550gm/cm³ and 04 samples had 0.551-0.600gm/cm³ (Fig.4).

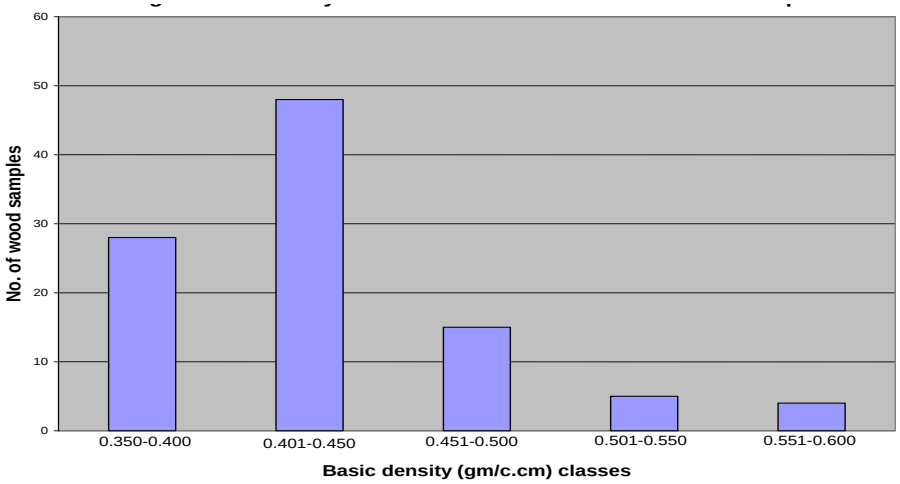


Fig.4. Basic density classes of the studied Deodar wood samples

**Influence of Annual ring width on basic Density of the wood:**

Results shown in Table 1 revealed that in each specific growth rate class, the studied wood samples exhibited considerable variation in basic density of wood including the lower and higher values. Neither the wood samples having lower growth rate (below 1mm) had higher value of basic density nor the wood samples with higher growth rate (4-5 mm) had lower value of basic density as generally considered. Thus, no specific trend of increase or decrease in the value of basic density of wood was found with respect to growth rate.

Table 1. Basic density range in different growth rate classes of the studied Deodar wood samples

| S.No | Growth rate | No of samples | Basic density range ($gm/cm^3$) |
|---|---|---|---|
| 1. | Below 1 mm | 26 | 0.367 – 0.574 |
| 2. | 1mm – 2mm | 39 | 0.350 – 0.593 |
| 3. | 2mm – 3mm | 25 | 0.368 – 0.565 |
| 4. | 3mm – 4mm | 6 | 0.382 – 0.489 |
| 5. | 4mm – 5mm | 3 | 0.409 – 0.506 |
| 6. | Above 5mm | 01 | 0.437 |

Further, the wood samples with maximum (5.45mm) and the minimum (0.213mm) average annual ring width were found to have the value of basic density of wood 0.437gm/$cm^3$ and 0.475gm /$cm^3$ respectively i.e. almost middling.

On the other hand, it was also observed that the studied wood samples in different basic density classes exhibited significant variation in growth rate including lower and higher values of average annual ring width (Table 2). Neither the wood samples having lower value of basic density had higher growth rate nor the wood samples with higher value of basic density had lesser growth rate.

Table 2. Growth rate variation in different basic density classes of the studied Deodar wood samples

| S.No | Basic density ($gm/cm^3$) | No. of samples | Growth rate range (mm) |
|---|---|---|---|
| 1 | 0.350 – 0.400 | 28 | 0.319 – 3.55mm |
| 2 | 0.401 – 0.450 | 48 | 0.408 – 5.45mm |
| 3 | 0.451 – 0.500 | 15 | 0.213 – 3.29mm |
| 4 | 0.501 – 0.550 | 5 | 0.579 – 4.25mm |
| 5 | 0.550 – 0.600 | 4 | 0.770 – 2.22mm |

Further, the wood samples with the highest (0.593gm/ $cm^3$) and the

lowest (0.350gm /cm$^3$) value of basic density were found to have 1.39mm and 1.42mm average annual ring width respectively i.e. almost medium.

## CONCLUSION

From the results it can be concluded that in Deodar (*Cedrus deodara*) wood the annual ring width and basic density varies significantly. Generally the wood has 1- 2mm annual ring width and 0.401-0.450gm/cm$^3$ basic density. The growth rate has no considerable influence on basic density of the wood. Further research work is desirable taking into account the proportion of latewood and earlywood with in a growth ring that may have correlation with the density of wood.

## REFERENCES

Anon., 1971. Examination of Timbers, Teaching Aid No. 7, Timber Research and Development Association, Hughenden Valley, High Wycombe, Bucks.

Desch, H. E. and J. M. Dinwoodie, 1983. Timber its structure, properties and utilization. 6th Edition. The Mecmillan Press LTD. London. pp. 80,173.

Kollamann Franz F. P. and Wilfred A. Cote, Jr., 1968. Principles of Wood Science and Techlology. Vol.1 Solid Wood, Springer Verlag Berlin Heidelberg New York. pp. 168,177.

Sheikh, M. I., 1993. Trees of Pakistan. Pakistan Forest Institute, Peshawar, Pakistan.

Siddiqui, K. M., Ayaz, M. and Iqbal Mahmood. 1996. Properties and Uses of Pakistani Timbers, Forest Products Research Division, Pakistan Forest Institute, Peshawar.