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Experimental Characterization of Density and Shrinkage in Natural and Planted *Alder* Wood (Case Study in North of Iran)

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Abstract: This study conducted in order to investigate the physical properties of natural and planted *Alnus glutinosa* wood. For this reason, six normal of planted and natural alder trees were selected from Zirab forestry plan, which located in Savadkooh province in north of Iran. Per each tree, a 5 cm disk was removed at breast height to determine the physical properties (wood density and volumetric shrinkage). Three samples were taken along radial directions from pith to the bark according to the ISO standard. The results of variance indicated that there aren't significant differences between planted and natural forest in oven-dry density and volumetric shrinkage. The mentioned properties in planted alder trees slightly higher compared to natural forest. The relationship between oven-dry density and volumetric shrinkage indicated that there is a positive relationship between these traits in natural and planted alder trees. The intensity of correlation coefficient in natural alder is 50 percent more than planted alder wood.

Key words: *Alnus glutinosa* · Planted forest · Natural forest · Physical properties

INTRODUCTION

The *Alnus glutinosa* is diffuse hardwood species from Betulaceae family which constitutes about 9 percent wood volume for northern forests according to the Iranian forest organization. This fast growing species will observe in two species including *Alnus subcordata* and *Alnus glutinosa* in our forest. Alder tree in comparison to other tress species has short late-live and it hasn't life (age) more than 100 years. The leaf of this tree is not suitable for animals. Alder wood is soft or semi-hard and light density hardwood. This species have high ability in nail keeping, good adhesiveness and high colorable, low durability. Mostly it is used for box-making, water structures, boat-making, furniture, plywood and veneer.

Wood quality can be measured directly by submitting timber to a large number of technical tests. However, many of wood traits such as strength and elasticity properties are related to density. This parameter is suitable index for predicting wood quality [1]. From a specific species, the wood density among trees is very variable due to genetic and environmental differences [2]. The relation between density and site index depends on difference in growth rate that is very complex discussion [3]. Wood density varied along longitudinal and radial directions from bottom to the up and the pith to the bark [4]. Variations of wood density may be directly related to variation in cell wall percentages and changes in cell wall thickness, cell diameter and tissue proportions [2].

In Turkey, the values of oven-dry density, basic density, volumetric shrinkage, volumetric swelling, fiber saturation point, modulus of elasticity and modulus of rupture were respectively determined as 0.454 g cm^{-3}, 0.399 g cm^{-3}, 12.62%, 13.78%, 32.87%, 8.61 GPa and 77.53 MPa for *Alnus glutinosa* [5].

A research on the comparison of wood properties of planted big-leaf mahogany in Martinique Island with naturally grown Mahogany from Brazil, Mexico and Peru (there are two age groups such as young trees [<40 years old] and old trees [>40 years old] for plantation trees) indicated that wood density of plantation trees (young and old trees) was lower than that of natural forest trees. The tangential shrinkage of young trees was significantly higher than that of old trees and were significantly higher compared to the natural forest tress [6].

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Another research on the mechanical and physical properties for eight species fast growing plantation species in Costa Rica showed that the lowest values of specific gravity were found in *Bombacopsis quinata* (0.32), *Vochysia guatemalensis* (0.32) and *Alnus acuminate* (0.34). The amount of specific gravity was decreased along longitudinal direction from bottom to the up in eight studied species [7].

In Iran, there wasn't any information about physical properties and other traits along longitudinal and radial direction and are also available data on the wood properties in planted and natural forest for *Alnus glutinosa* species. Therefore, the aim of this study were a) to investigate experimental characterization of density, shrinkage and swelling in planted forest and natural trees for *Alnus glutinosa and* b) to examine the relationship between wood density with shrinkage and swelling for both wood samples.

MATERIALS AND METHODS

In this study, a number of six normal trees including planted and natural alder (*Alnus glutinosa*) from Zirab forests located in Mazandaran province. This region located in east of mazandaran province in north of Iran. The average temperature was 11.2°C, the annual rainfall was 386 mm/year. Minimum and maximum of temperature were 2.6 and 20°C, respectively. A log 5-cm-thick was taken to determine the physical properties (wood oven-dry density and volumetric shrinkage). Three samples were taken along radial direction from the pith to the bark for natural alder wood and planted alder wood according to the ISO-3131. After preparing the samples, the relevant experimentation including weighing and measuring the dimensions were conducted. In the first stage, the samples volumes and weights (after cutting the sample) were measured. Then, the samples were placed in water for 48 hours so that all samples would go under the water or become saturated with water. After that, the samples weight and saturated volume were determined using a digital scale and caliper. The third stage included putting the samples in an oven for 48 hours at103±2°C to completely dry the samples and afterward the sample volume and weight were measured in dry state and finally by using the following formulas the oven-dry density and volumetric shrinkage was calculated:

$$D_0 = M_0 \div V_0 \ (g/cm^3)$$

Where M_0 and V_0 are the oven-dry weight (g) of the specimen and volume (cm^3) of specimen, respectively.

$$\beta v = (V_s - V_0) \div V_s \times 100 \ (\%)$$

where βv, V_s, V_0 are the volumetric shrinkage, saturated volume and oven-dry volume, respectively. Finally, the effect of wood samples (natural and planted) on the physical properties has been investigated that it was used by analysis of variance (ANOVA). Linear regression was used to examine relationship between wood density and volumetric shrinkage.

RESULTS AND DISCUSSION

The results of descriptive statistics for oven-dry density and shrinkage for planted and natural alder wood were shown in Table 1. Analysis of variance indicated that there aren't significant differences between alder planted and natural alder wood in wood density and volumetric shrinkage. The wood density was 0.405 g cm^{-3} for planted wood and was 0.394 g cm^{-3} for planted alder wood. The value of wood shrinkage was 12.32 and 11.69% for planted and natural alder

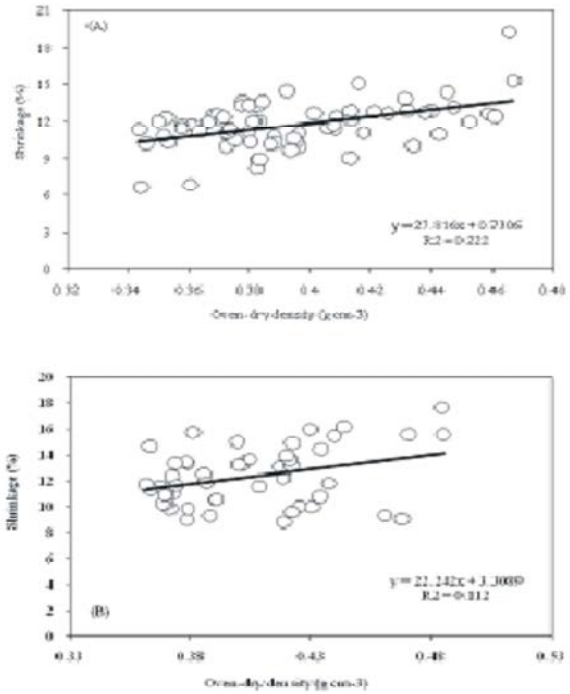

Fig 1: The relationship between wood density and shrinkage in alder natural (A) and planted alder forest.

Table 1: Descriptive statistics of wood density and shrinkage for alder planted and natural forest

Alder forest		Mean	STDEV	Maximum	Minimum
Density	Planted	0.405	0.033	0.48	0.36
	Natural	0.394	0.032	0.47	0.34
Shrinkage	Planted	12.32	2.23	17.65	8.81
	Natural	11.69	1.91	19.25	6.63

wood, respectively. Overall, the amount of wood density and shrinkage in planted slightly higher compared to natural forest. A positive relationship between wood density and shrinkage was found in natural and planted alder wood. While regression intensity (Figure 1) in natural forest (R^2 = 0.222) is higher than planted alder forest (R^2=0.112). These results were previously reported by several researchers [1, 7, 8, 9].

CONCLUSION

- There aren't significant differences between natural forest and planted alder forest in wood density and shrinkage.
- A positive significant difference between wood density and shrinkage in natural alder and planted forest.
- Regression coefficient in natural forest is higher compared to the planted alder forest.

REFERENCES

1. Panshin, A.J. and C. De Zeeuw, 1980. Textbook of wood technology. Ed.4. McGrawHill Book Company, New York.
2. Zahner, R., 1968. Site quality and wood quality in upland hardwoods: theoretical considerarions of wood density. In: C.T. Youngberg and C.B. Davey, Tree growth and forest soils, pp: 472-497.
3. Taylor, F.W. and T.E. Wooten, 1973. Wood property variation of Mississippi delta hardwoods. Wood and Fiber, 5: 2-13.
4. Zhang, S.Y. and Y. Zhong, 1990. Effect of growth rate on specific gravity of East-Liaoning oak (*Quercus liaotungensis*) wood. Can. J. For. Res., 21: 255-260.
5. Guller, B. and N. Ay, 2001. Some mechanical properties of alder [*Alnus glutinosa* subsp. barbata (C.A. Mey.) Yalt.] wood obtained from Artvin region. Tubitak Turkish Journal of Agriculture and Forestry, 25: 129-138.
6. Langboar, R., G. Gerard, G.M. Roda, P. Ahmad Fauzi and D. Guibal. Comparison of wood properties of planted big-leaf mahogany (*Switetenia macrophglla*) in Martinia Island with naturally grown mahogangy from Barazil, Mexico and Peru. Journal of Tropical Forest Science, 23(3): 252-259.
7. Moya, R. and F. Muñoz, 2010. Physical and mechanical properties of eight fast-growing plantation species in Costa Rica. Journal of Tropical Forest Science, 22(3): 317-328.
8. Kiaei, M., 2010. Physical and Mechanical Properties (hardness and nail of resistance) Variation of Cupressus Sempervirens wood in longitudinal axis of tree. World Applied Sciences Journal, 11(3): 327-329.
9. Kiaei, M., 2011. Variation in the wood physical and mechanical properties of Zelcova carpinifolia trees along longitudinal direction. Middle-East Journal of Scientific Research, 9(2): 279-284.