Effect of Different Environment on Physical Properties of *Plantanus orientalis* L. in Erbil Governorate

Tara N. Ismail [1] & Halmat A. Sabr[2] & Sherzad O. Osman[3]

[1,2,3] Forestry Department, College of Agriculture, Salahaddin University, Erbil, Iraq
Correspondence: Halmat A. Sabr, Salahaddin University, Erbil, Iraq.
E-mail: halmat.sabr@su.edu.krd

Received: June 7 , 2017 Accepted: August 20, 2017 Online Published: September 1, 2017

doi: 10.23918/eajse.v3i1sip198

Abstract: Influences of different environment on some physical properties of *Plantanus orientalis* L. grown in Erbil Governorate were examined. In each location three trees were selected, height, DBH, tree ages, number of branches/trees were determined in addition to physical properties in each location. There was a significant variation for all physical properties with different height of trees in Shaqlawa location in comparison to Sami Abdulrahman Park. The highest number were recorded for specific gravity, density of dry volume, density of green volume and moisture content between different locations in height (1) 0.62 0.73 gm/cm^3, 0.95 gm/cm^3 95.59 % respectively. In addition, the highest number was recorded of thermal conductivity in H3 L1 (3.35) and volumetric shrinking was found in H2 L1 (71.56 gm/cm^3). Finally, the highest number was found for volumetric swelling in H1L1 (104.74 gm/cm^3). It can be summarized that for the further research, it is important not only above properties to be measured, but also anatomical characters need to be taken into consideration for better understanding *Plantanus orientalis* L. evaluation under different environments.

Keywords: *Plantanus Orientalis* L., Wood Properties, Tree Height, Specific Gravity, Thermal Conductivity

1. Introduction

Among the many woody species which is a particularly multipurpose material with a wide variety of physical and mechanical properties, further, it is an advantageous construction material compared to other competitive materials, such as steel or concrete for the reason that the energy supplies of wood for producing a usable end-product are much lower (Arntzen *et al.*, 1994). It is clear that close test of a piece of wood under microscope is made known minute cell structures that typically escape informal study. Particularly, this small cell structure that is liable for several of the physical properties (Parham & Gray, 1984). It is indicated that all materials show some degree of reliance on the fine structure of their components which is important to understanding of the properties and possible of wood for use require of both the physical properties and the fine structure (Parham & Gray, 1984). Winandy (1994) explained that physical properties of wood behavior to the exterior influence rather than applied forces, owing to this can affect on the strength of wood used in structural applications, knowledge with physical properties is essential. In the wood technology science trees and their respective lumber are divided into two classes, hardwoods and softwoods. The categorization has little to do with the comparative hardness of the wood because some species of hardwoods are not harder than many low- to medium-density types in comparison to Softwoods (Timber bridge manual, 2017). Only some papers in an agreement with the problem of environmental effect on cambial activity, radial diameter and thickness of annual ring cell walls (Antonova *et al.,* 1983). An idea should be made that to recognize the method of influence of different ecological factors on the central wood formation process which is an essential to study the effects of these factors on separate stages of cytogenesis

Species of the genus Platanus (*Plantanus orientalis* L.) chenar, have among their advantages two significant characteristics that encourage their cultivation. One of them is that they are adapted to increase in flooding environments, and the other is their easy vegetative propagation. This species is widely used in parks and streets for the purpose of shedding and shelters. It is a deciduous tree species naturally found near the rivers in mountain areas of Kurdistan region. It is a large, deciduous tree with a spreading crown, growing up to 30 m tall, and young branches are yellow-brown and hairy; older branches are hairless. The bark peels off from the trunk in large plates. The aim of the current study is to investigation the effect of different environments on some physical properties of *Plantanus orientalis* L. in Erbil Governorate.

2. Methods and Materials

Two locations from Erbil city were chosen for the present study which were Hujran and Sami-Abdul-Rahman Park. Erbil is the capital of Kurdistan region –Iraqi government- positioned between (Latitudes 35° - 40° and 36° 35° N and longitudes 43°-20° and 44°-20°E). In each location three trees were selected, morphological properties were included height, DBH, number of branches/trees and tree aspects were determined in each location. Haga, caliper and increment borer equipment were used to measure height, DBH. The stems which have taken above the stump for each tree divided into three logs (H1, H2 and H3) with length of 1 meter (L1= Shaqlawa location, L2= Sami Abdulrahman park location) (H1 = High 1, H2= High 2 and H3= High). Leaves, branches and bark were cleaned from the stems. Three discs were cut and taken from each logs with 5 cm thickness. All discs were used for physical properties. The three discs peeled and cut into 4 unique sizes from a pith to bark, then fresh weight were taken after that the samples were fixed using needle and soaked directly in paraffin wax for a short period of time to form an insulator layer for preventing water absorption during soaking in water in order to obtain fresh sample volume and calculating the volume of removed water and then dry weight was measured. The dry weigh volume was measured similarly mentioned above for fresh size. Statistical analysis system (SAS,) was carried out for statistical analysis of the present study results. In the present study physical properties were determined that include Specific gravity, density, moisture content, volumetric (Shrinkage and Swelling) of wood, thermal conductivity**.**

3. Results and Discussion

It is indicated that there was a significant difference in Specific gravity between height of both locations with the highest number was found in L2 H2, while, the lowest value was gain in L1 H3 (Table, 1). Significant differences among means in density of dry and green values of *Plantanus orientalis* L. trees were found with the highest number (0.97 gm/cm^3) for L2 H1, but the lowest number was recorded (1.81 gm/cm^3) is the same mentioned with above L1 with H1 (Table, 1). Moisture content is one of the most important parameter of physical properties. Significant differences were found in moisture content for both locations with the maximum value was obtained in L1 H3 (11.5.18%), while, the minimum number was recorded in L2 H1 (89.02 %) respectively (Table, 1).

Table1: The comparison of some physical properties for different heights in both locations

Location		**Specific gravity**	**Density of dry volume gm/cm3**	**Density of green volume gm/cm3**	**Moisture content%**
L1	H1	0.57c	0.58d	1.81a	102.94b
	H2	0.62b	0.73a	0.95b	95.59cd
	H3	0.55d	0.58d	0.84f	115.18a
L2	H1	0.64a	0.62b	0.97b	89.76ed
	H2	0.65a	0.60c	0.89e	89.02e
	H3	0.61b	0.56e	0.90d	98.79b

Means with the different letters are significant at (P≤ 0.05) by Duncan's Multiple Range Test.

Table 2 indicates statistical analysis of Specific gravity, Density of dry volume, Density of green volume and moisture content between different locations. There were significant differences in all physical properties among both studied locations. The highest values was found in location (1) for moisture content (104, 5%), but, the lowest number was recorded in density of green volume for location (2) (0.37 gm/cm^3 (Table, 2).

Table 2: Average of specific gravity, density of dry and green volume and moisture content by locations

Physical properties	**L1**	**L2**
Specific gravity	0.63a	0.59b
Density of green volume gm/cm^3	0.93a	0.92b
Density of dry volume gm/cm^3	0.59b	0.37a
Moisture content %	104.57a	92.52b

Means with the different letters are significant at (P≤ 0.05) by Duncan's Multiple Range Test.

It is shown form table (3) statistical analysis of thermal conductivity, volumetric swelling and shrinking of different heights under studied locations of *Plantanus orientalis* L. There were significant differences in fuel value with H1and H2 in location (2) with the highest number were recorded for (H1) and (H2) 3916.01 and 3945.48 respectively in (L2) but the minimum value was recorded in (L1H3) (331286) (Table, 3). In addition a significant difference in thermal conductivity was with the highest number was found obtained in L1H3 but the lowest value were recorded in (3. 25) L2 H1, and H2 respectively (Table3). Significant differences were obtained in volumetric swelling and shrinkage. The highest numbers were recorded in L1 with (H1) and (H2) 104.74 gm/cm^3 and 71.06 gm/cm^3 with the lowest value was record for (L2) in H2 53.31 gm/cm3 (Table, 3).

Table 3: The comparison of some physical properties for different heights in both locations

Locations		Thermal conductivity B.T.U units	Volumetric shrinkage gm/cm^3	Volumetric swelling gm/cm^3
L1	H1	3.31b	60.07c.	104.74a
	H2	3.28c	71.56a	91.68c
	H3	3.35a	67.06b	96.59b
L2	H1	3.25d	55.56d	87.68c
	H2	3.25d	53.31d	79.98d
	H3	3.29c	54.52d	89.16c

Means with the different letters are significant at (P≤ 0.05) by Duncan's Multiple Range Test.

The Statistical analyses of location (1) and (2) for thermal conductivity, volumetric swelling and shrinking were indicated in Table (4). There were significant differences in thermal conductivity, volumetric shrinkage and swelling. The highest values were recorded for all above physical properties in location (1) 3.31, 66.21 and 97.67 gm/cm^3 respectively, on the other hand, only there was a significant difference in fuel value with the highest data was recorded for (L2)(3855.62) (Table4).

Table 4: Average of thermal conductivity, volumetric shrinkage and swelling by locations

Physical properties	L1	L2
Thermal conductivity	3.31a	3.26b
Volumetric shrinkage gm/cm3	66.21a	54.46b
Volumetric swelling gm/cm3	97.67a	85.58b

Means with the different letters are significant at (P≤ 0.05) by Duncan's Multiple Range Test.

It can be shown in Table 1, 2, 3 and 4 physical properties values of *Platanus orientalis* L. tree different according to two locations. Even though it is not possible to make a classify among the two locations according to physical properties values of them, the results can be used in plywood industry to introduce the thermal properties of plywood panels manufactured from different woody species. It can be seen that there were significant differences in specific gravity, density of dry volume, density of green volume and moisture content among height and two locations. All water in the cell lumen is removed, when wood is dried during the process of manufacture. It is shown from the preset study that specific gravity between height of both locations with the highest number was found in L2 H2, while, the lowest value was gain in L1 H3.

A number of effective methods are probable for wood, this may include oven dry density ρ0 and specific gravity G referenced to a particular volume basis this can be useful to make comparisons between species a standard reference basis is desirable. The specific gravity of wood may be defined to its volume at any moisture content, but then in all cases G is based on oven dry mass (Glass & Zelinka, 2010). Tasissa and Burkhart (1998) found that the proportion of the annual ring in early wood or latewood and thus did not impact on ring specific gravity did not change by silviculture practice such as thinning, but there was regional difference in average ring specific gravity. They also found that a ring specific gravity prediction model was developed based on ring position, tree, stand, and site attributes. This may be good method for the future study in Kurdistan region for other woody species. Considerably of the distinction in ring specific gravity was owing to within-tree variation; as a result, site factors accounted for a restricted proportion of variation in ring specific gravity. As the within-tree explanations used in the present study have a tendency to be correlated. The density can be calculated at any moisture content as the ratio of mass to volume, and the relationship between density and moisture content is linear. Chafe (1986) bring into being that basic density decreased with distance from the periphery to about 75% radius, then showed a slight increase towards the pith. Pliura, et al., (2005) in a study found that selection for high wood density could lead to decrease longitudinal shrinkage, other than increased transverse wood shrinkage. The moisture content of wood can be recognized as the weight of water in wood given as a percentage of oven dry weight. It has an essential impact on the physical properties of wood, but these influences require taken into consideration especially in the wood production uses (Gerhards, 2007). It has been shown that the moisture content of the heartwood is less than of the sapwood, In addition to this, it is a hygroscopic material that loses moisture in dry environments and absorb moisture in non dry climate, as a result of the changing the relative humidity and temperature of the surrounding air can cause decreasing or increasing of the moisture content of wood which can rely on it (Tsoumis, 1991). The highest values of moisture content of selected tree species was recorded in location (1) based on the data of the current research that the environmental condition is moist compare to location (2) this can supply benefits for forestry management in an area, particularly increasing *P. orientalis* stands for the future of wood products applications.

It can be seen that one of the most essential properties for construction materials is thermal conductivity. There was a significant difference in thermal properties among two locations. The results found in this study was in accordance with the study is conducted by Demirkir and Aydin, 2015, but decreasing thermal conductivity in L (2) due to differences in moisture content and temperature factors. As wood dries below the fiber saturation point (FSP) that is, loses bound water it shrinks. Conversely, as water enters the cell wall structure, the wood swells. The highest value was found in (L1) compare to L (2). It is indicated that, the more piece of wood tend to shrink or swell with the higher the density of the sample. This foundation is in accordance with our study because the higher value was recorded in density of samples especially for density of green volume in L (1). A study is conducted by Shupe *et al.*, (1995) who were found that volumetric shrinkage was gained to be adversely correlated with height for both wood types; however the correlation between volumetric shrinkage and specific gravity was not significant for any wood type. Furthermore, the genetic programs in relation to chinar trees investigate how to maintain their wide range of flexibility to different environmental circumstances, while all together improving wood quality, specifically anatomical properties.

4. Conclusion

Samples were gained from *Plantanus orientalis* L. tree to examine the effect of different environments on some physical Properties. The results showed that the highest values were recorded for location (1) in SG, density of dry volume, density of green volume and moisture content. This was the same for the rest of the properties. The results found has provided quantitative information on the physical properties of identifies species which can be used in determining the different applications of this wood. A study is required to estimate above properties and then comparing with other woody species in both studied areas. Determination of anatomical properties is also essential to find out of the effect of different environment on *Plantanus orientalis L.* L. tree.

References

Antonova, G. F., Shebeko, V. V., & Malyutina, E. S. (1983). Seasonal dynamics of cambial activity and tracheid differentiation in the stem of Scots pine. *Khim. Drev.*1, 16-22.

Arntzen, C.J., Arntzen, J., & Ritter, E.M. (1994). Encyclopedia of agricultural science.

Chafe, S. C. (1986). Radial variation of collapse, volumetric shrinkage, moisture content and density in Eucalyptus regnans F. Muell. *Wood Science and Technology*, 20(3), 253-262.

Demirkir, C., & Aydin, I. (2015). Thermal conductivity values of some wood species used in plywood industry. *Selçuk-Teknik Dergisi*, 14(2), 569-576.

Gerhards, C.C. (2007). Effect of moisture content and temperature on the mechanical properties of wood: an analysis of immediate effects. *Wood and Fiber Science*, 14(1), 4-36.

Glass, S. V., & Zelinka, S. L. (2010). Moisture relations and physical properties of wood.

Parham, R.A., & Gray, R.L. (1984). Formation and structure of wood.

Pliura, A., Yu, Q., Zhang, S. Y., MacKay, J., Périnet, P., & Bousquet, J. (2005). Variation in wood density and shrinkage and their relationship to growth of selected young poplar hybrid crosses. *Forest Science*, 51(5), 472-482.

SAS (2005). Statictical analysis system. User's guide for personal computer. Releaze 9.1 SAS Insitituted Inc. Cary, NC`USA.

Shupe, T. F., Choong, E. T., & Gibson, M. D. (1995). Differences in moisture content and shrinkage between outerwood, middlewood, and corewood of two yellow-poplar trees. *Forest products journal*, 45(9), 85.

Tasissa, G., & Burkhart, H. E. (1998). Modeling thinning effects on ring specific gravity of loblolly pine (Pinus taeda L.). *Forest Science*, 44(2), 212-223.

Timber bridge manual (2017). Properties of wood and structural wood products**.** Retrieved on October 11, 2017 from 11-10-2017 http://www.dot.state.mn.us/bridge/pdf/insp/USFS TimberBridgeManual/em7700_8_chapter03.pdf.

Tsoumis, G. (1991). *Science and Technology of Wood: Structure, Properties, Utilization* (Vol. 115). New York: Van Nostrand Reinhold.

Winandy, J.E. (1994). Effects of long-term elevated temperature on CCA-treated Southern Pine lumber. *Forest Products Journal*, 44(6), 49–55.