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Effect of Altitude on Some Morphological and Anatomical Propertis of *Pinus Halepensis* in East, Libya

Amel fathi tashani[1] hussin ebrahim ali[2]

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Authors affiliation

Department of Forestry ,Faculty of Natural Resources and Environmental Sciences, University of Derna , Derna, Libya

a.tashni@uod.edu

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ABSTRACT

This study investigated the effect of environmental conditions on morphological and anatomical properties of wood and needle *of Pinus halepensis* Mill. Trees in AL-Jabal AL- Akhdar region, Libya. Three trees were randomly selected from different altitude .The results showed that there was a significant difference between the three altitudes. pine trees in altitude 63m characterized by shortest needle 6.08 cm and small size of cone 5.74 cm, and 0.56 cm seed. The needle cross section was characterized by small dimensions, 1.04 diameter and 0.576 wide at altitude 63m, also, the results of the area of the resin ducts and the number and diameter that there is a significant difference between the three altitudes ,while the highest mean values for all the properties of needle anatomy were found in the altitude 408 m. On the other hand, some wood anatomy characteristics. Regularly decreased with increasing altitude such as the cell wall thickness, Ray area , resin ducts area and diameter of resin ducts.

تأثير الارتفاع عن سطح البحر على بعض خصائص الصنوبر الحلبي Pinu shalepensis Mill. شرق ليبيا

أمل فتحي الطشاني حسين أبراهيم على

تناولت هذه الدراسة أثر الإرتفاع عن سطح البحر على الخصائص المورفولوجية والتشريحية للخشب والأوراق الإبريةلأشجار الصنوبر الحلبي "*Pinus halepensis* MILL" بمنطقة الجبل الأخضر،شرق ليبيا. تم اختيار ثلاث أشجار عشوائياً من ثلاثةارتفاعات مختلفة من مستوى سطح البحر. أظهرت النتائج أن هناك فرقاً معنوياً بين الارتفاعات الثلاثة في أغلب الصفات التي تمت دراستها حيث وجد أن أشجار الصنوبر على ارتفاع 63 م تتميز بأقصر ورقة ابرية 6.08 سم وأصغر مخروط 5.74 سم واصغر بذرة 0.56 سم. يتميز المقطع العرضي للورقة الإبرية بأبعاد صغيرة، قطر 1.04سم وعرض 0.576 سم عند ارتفاع 63 م، وتم العثور على أعلى القيم المتوسطة لجميع خصائص تشريح الورقة الإبريةعند الارتفاع 408 م. من ناحية أخرى بعض خصائص تشريح الخشب تنخفض بانتظام مع زيادة الإرتفاع عن سطح البحر مثل سمك جدار الخلية ومساحة الشعاع ومساحة القنوات الراتنجية وقطرها.

INTRODUCTION

Pinus halepensis Mill (Aleppo Pine) is evergreen tree,a species native to Al- Jabal AL- Akhdarregion, It can grow up to 18-25 m tall .This species is foundin Mediterranean Sea from Spain and Morocco to the eastern in Greece, Jordan, Libya (Green Mountain area), it has been growing in pure natural forests, the most widespread species in the Green Mountain area and grow at different heights from sea level. Mainly in the western Mediterranean (Morocco and Spain),

in the northern Mediterranean countries (southern France, Italy, Croatia and Greece), through the eastern Mediterranean in Syria, southern Turkey, Jordan and Israel; it is not found so frequently in the countries of eastern North Africa, but it is found in the north east of Libya (Zunni and Bayoumi, 2006).*P. halepensis* source of wood in many Mediterranean countries. There are some uses for pallets and chipping for particleboards as well as for boat making at a local scale (Chambel *et al*. 2013). The environmental factors affect growing rings at different levels of tree (Frittset *et al*., 1965). Hence, the trees record their responses to changes in growth conditions of their wood structure, and tree ring width is a popularly used as climate proxy (Downes *et al*., 2002). For instance, species growing under Mediterranean climate,commonly show special anatomical characteristics in tree rings (Schweingruber, 2007) Global warming is affecting tree growth and forest productivity, Wood quality, which is largely determined by anatomical traits of wood, is vital for the forest industry and global carbon sequestration. Cambium activity, wood density, fiber length and microfibril angle are the anatomical traits that determine wood quality, depending on market demands (Zhang *et al.,* 2020).
On the other hand, wood anatomical structure of woody plants is principally hereditarily decided and in this manner can be utilized as an attribute for ordered grouping. Hence, intraspecific inconstancy is additionally exposed to natural adjustment (Wimmer, 2002). Truth be told, trees need to modify their xylem structure to fit the environmental settings of their natural surroundings and the occasional and entomb yearly atmosphere inconstancy (Fonti *et al*., 2010).

The topography of Al- Jabal Al- Akhdar region, Libya, includes three classes of different levels of altitude. These levels differ from each other in their climate in microclimate. The first level- close to sea shore-represents plain lands with maritime climate. The mean of its height above sea level does not exceed 200 m. The second level, with its maximum height about 460 m above sea level, represents an intermediate location between the first and the third levels.The maximum height of the third level-on the mountain-is about 880 m above sea level. This level is characterized by cold winter climate, but is hot in most of its parts during the summer time (Azzawam, 1995).

The aim of this research was to study the influence of altitudes differences on tree morphology, and needle anatomical properties, Also, wood anatomical properties, such as tracheid diameter, wall thickness ray height and cell number.

Materials and Methods

Nine normal trees of (*Pinus halepens is* Mill.) were selected at different altitudes , (Tabel. 1):

Table (1): Description of the Location study.

Altitude (m)	Longitude	Latitude
63	32 510′ 9.4″	21 39′ 60.5″
408	32 40′ 23.9″	021 33′ 00.1″
850	32 32’ 165”	21 47’466”

Morphological traits

The study included measurements of the morphological traits : Diameter at breast height (d.b.h). Tree height Needl length. Cone length. Cone thickness. Seed length. Seed thickness was measured using a digital camera (Olympus FE-230) then entered into the computer using Digimizer program (2008).

Anatomy of the needle

The needle was processed by washing well with water to remove dust and impurities from it and then left to dry, and follow the steps to work the cross-sections of the needle according to (Sass, 1958). There was a study of some needle anatomy such as thickness and width of cross-sections needle and number of resin ducts (Fig.1).

Figure(1): Measured needle parameters: needle thickness (D1), needle width (D2),

Anatomy of wood

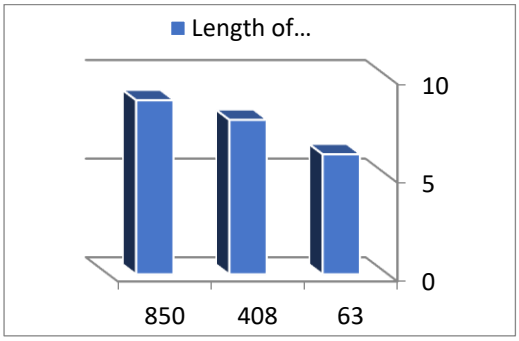
The samples were cut down horizontally (1 × 1 × 3cm) cross thin, cross and longitudinal tangential and radial sections (20-30 µm) were obtained using microtome. The sections were equipped of microscopic examination after they were painted with safranin (Sass,1958). There was a study of some wood anatomy traits such as, rays area wood, tracheids diameter, cell wall thickness, and number of resin ducts in the area 1 cm.

Statistical analysis

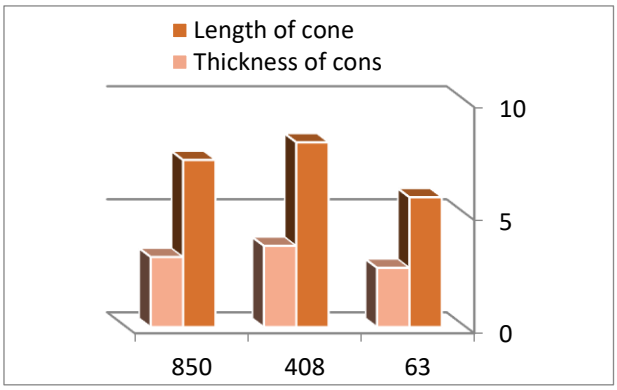
The experimental design was Completely Randomized Block Design and Completely Randomized Design, according to Steel and Torrie(1980). Statistical analysis was done by ANOVA, F- test and L.S.D procedures available within the SAS software package (Sas, 2007).

Results and discussion

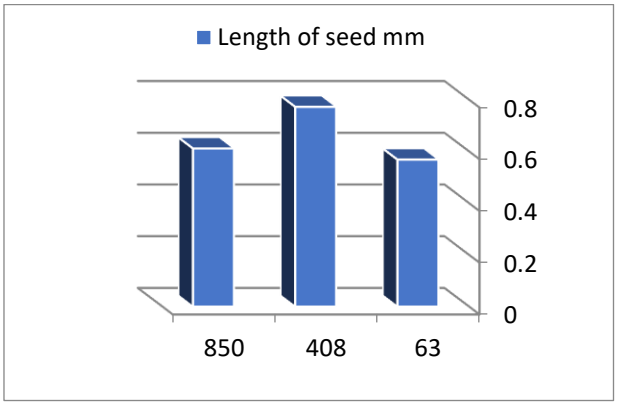
Pinus halepensis is a tree with a meanheight of 11.49, 10.2, and 3.50 m, while the mean of diameter at D.B.H is 17.73, 21.00, 16.00 cm at altitudes 850, 408 and 63 m, respectively. Crown, is crowned in the trees growing at 63 and 408 m, while at 63m the crown was predator shape and a short stem. Needle, yellowish green, the means of needle length were 8.82,7.825 cm at altitudes 850 , 408 m respectively, while the mean length of needle was 6.08 cm at 63 m (fig.2).On the other hand, the mean of cone length was 6.8 cm and the thickness was 2.3 cm at 850 m and 408 m, respectively. While cone length was 5.74 cm and the thickness was 2.617 cm at 63 m (fig.3). Also, the seed length was 0.568 cm at 850 m(fig.4).The results obtained by processing the data of morphological characteristics of *P.halepensis*, by means of descriptive statistical analysis, have shown that the needle length only distinctively change with an increase in altitudes. The needle of *P.halepensis*was longest at the highest altitude (850 m), and shortest at the lowest altitude (63m).These findings are similar to those obtained by (Pawlaczyk*et al*,2017).



Figure(2):Mean of length of needle of *Pinus halepensis* at different altitudes



Figure(3):Mean of length and thickness of seed of *Pinus halepensis* at different altitudes



Figure(4):Mean of length of seed of *Pinus halepensis* at different altitudes

Table (2) lists the means of cross-sections of needle. The results showed that there was significant difference between sites. The means of thickness and width needle were 1.04, 0.576, 1.011, 0.595 1.233, 0.660 µm at 63, 850 and 408 altitude respectively. Also, there was a significant difference between the sites in the number of resin ducts 2,3,6 at altitudes 63, 850 and 804 m, respectively. The trees that growing at altitude 63 m have been traits the small, width and thickness of cross-sections needle and may be due to the environmental and climatic conditions of the growth of trees, which were affected by sea spray, high humidity and wind, which enabled the trees to adapt to these conditions, . These obtained data were consistent with similar studies carried out by (Vasic and Dabak., 2012 ,Tiwari *et al*., 2013 and Pawlaczyk *et al*,2017).

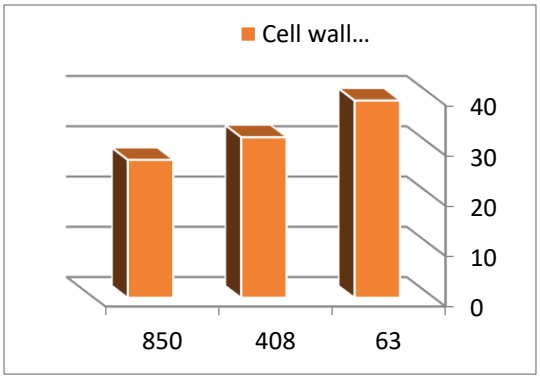
Table (2): Needle anatomical characteristics of *Pinus halepensis* at different altitudes.

Altitudes (m)	Thickness of needle	Width of needle	Num. Resin ducts
63	**1.04 b**	**0.576b**	**2.78b**

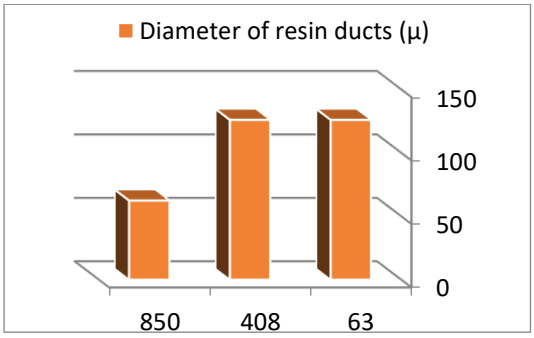
408	**1.233 a**	**0.660a**	**6.11 a**
850	**1.011 a**	**0.595a**	**3.44b**

Means with the same superscript letter are not significantly different at 0.05 level of significance. Similar letters within .the same column mean that there is no significant difference, and similar letters mean that there is no significant difference.

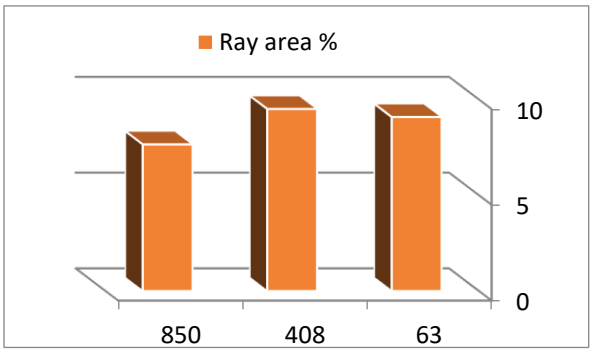
For wood anatomy traits, The results showed that there was a significant difference of all traits at different altitudes. The largest of cell wall thickness of wood tracheids was 39.2, at 63, m (fig.5) . Also, there was significant of the ray area, the highest ray area was9.50% at 408 m and the lowest 0.66% at 850m (fig.6). On the other hand ,number, diameter resin ducts that there is a significant difference between altitudes. Where the means of the resin ducts area was 0.663%, 1.161%, 1.115% for the 63 and 408 and 850 m, respectively. The smallest of resin ducts diameter 62.3 µ found at 63 m (fig.7). But the largest number of resin duct found at 850 m(fig.8). These obtained data were consistent with similar studies carried out by (Topaloglu *et al*.2016).



Figure(5):Mean of cell wall thickness (µ) of wood trachids of *Pinus halepensis* at different altitudes



Figure(6):Mean of diameter of resin ducts of *Pinus halepensis* at different altitudes



Figure(7):Mean of ray wood area of *Pinus halepensis* at different altitudes

Conclusion

Effect of altitude on some traits of *Pinus halepensis* Mill. growing In east Libya, means of descriptive statistical analysis, have shown that the needle length only distinctively change with an increase in altitudes. The needle is longest at the highest altitude (850 m), and shortest at the lowest altitude (63 m). The highest mean values for all the characteristics of needle anatomy were found in the altitude 408 m. Also, some wood anatomy characteristics.

Regularly decrease with increasing altitude such as the cell wall thickness, Ray area, resin ducts area and diameter of resin ducts. Variations of morphological and anatomical, properties of pine wood and needle its relation with the altitude can be useful indicator in forest silviculture.

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