Libyan Journal of Ecological & Environmental Sciences and Technology
(LJEEST)

LJEEST
www.srcest.org.ly/jou

DOI: https://doi.org/10.63359/fhrdxz75

Morphological and Some Wood Properties of *Juniperus Oxycedrus* Subsp. Macrocarpa in Derna Region, East Libya

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ARTICLE INFO

Vol. 2 No. 1 June, 2020

Pages (18 - 26)

Article history:
Revised form 16 April 2020
Accepted 4 May 2020

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Keywords:
Juniperus Oxycedrus Subsp. Macrocarpa, Libya , Wood, Morphology

ABSTRACT

This work was designed to evaluate morphologic properties of leaf, cone and seed and to clarify the taxonomy of this species. The study also investigated some of the wood properties (specific gravity, fiber length) of *Juniperus oxycedrus subsp. macrocarpa* tree grown in Derna region in the east of Libya. The morphological properties (leaf length, leaf width, seed size and cone size) resulted have been observed to be important for taxonomy of this species. Also, the Pearson coefficient correlation among morphological parameters showed a positive correlation. On the other hand. results indicated that the specific gravity values ranged between (0.392-0.386). When study the relationship between specific gravity and cambial age. The general trend showed that the relationship was negative with age, where it was clear specific gravity values decreased with the increase in distance from the marrow of pith. The values of the R^2 ranges from 59.9% -70.9%, and when examining the relationship between fibre length and cambial age, there was a positive effect; fibre length increased radically from pith to bark. Also, *J. xycedrus subsp. macrocarpa* tree is a short fibre wood with a mean fiber length of 1.75 mm.

الخصائص المورفولوجية وبعض خصائص خشب نبات العرعر (Juniperus oxycedrus subsp. macrocarpa) في منطقة درنة، شرق ليبيا

الطشاني أ. ف. خ. أ. فرج

تم تصميم هذا العمل لتقييم الخصائص المورفولوجية للأوراق والمخروط والبذور، لتوضيح تصنيف هذا النوع ، وكذلك التحقق من بعض خصائص الخشب كالثقل النوعي وطول الألياف في شجرة العرعر الشوكي *Juniperus oxycedrus subsp. macrocarpa* بمنطقة درنة ، ليبيا. لخصت النتائج أن الخصائص المورفولوجية لطول الأوراق وعرضها، وحجم البذور والمخروط كانت مهمة لتصنيف هذا النوع. أيضا كانت علاقة الارتباط بين الخصائص المورفولوجية إيجابية بين الصفات. من ناحية أخرى، أوضحت النتائج أن قيم الثقل النوعي للخشب تراوحت بين0.392-0.386،كذلك كانت علاقة الأنحدار للثقل النوعي سلبية مع العمر الكامبيومي، حيثأ تضح أن قيم الثقل النوعي تتناقص كلما زادت المسافة من النخاع إلى القلف فكانت قيم معامل التحديد R^2 تتراوح من 59.9%-70.9%.أيضاً بدراسة العلاقة بين طول الألياف والعمر كان هناك تأثير ايجابي حيث أن متوسط طول الألياف يزداد كلما ابتعدنا عن النخاع.كما يعتبر خشب العرعر الشوكي من النوع قصير الألياف متوسط طولها1.75 ملم.

INTRODUCTION

The *Juniperus genus*. (Cupressaceae, gymnosperms) consists of about 60 dioecious woody species, and it is divided into three sections: J. sect. CaryocedrusEndl., J. sect. Juniperus, and J. sect. Sabina Spach(Adams, 2012). The *Juniperus oxycedrus* group is included within J. sect. *Juniperus*(Adams, 2014)*J.oxycedrus* was described by(Linnaeus, 1753) based on plants from the western part of the Mediterranean basin ("Habitat in Hispania, G. Narbonensi")..

Juniperus oxycedrus L. belongs to the section Oxycedrus of the genus *Juniperus*. It is a variable species with three subspecies: *J.oxycedrus subsp.oxycedrus*, *J. oxycedrus subsp. macrocarpa* and *J.oxycedrus subsp. badia*.(Greuter *etal*., 1984) Those differ in habit, cone size and needle width (Amaraltranco, 1968)(Bayet *et al*., 1991).

(Smith, 1816)described coastal juniper and named it *Juniperus macrocarpa*.(Ball, 1878) classified it as a subspecies of *Juniperus oxycedrus* L., a taxonomic status still supported by different authors(Do Franco, 1963) (Fernandez Galiano, 1987)The analysis of related taxa, as *J. oxycedrus subsp. macrocarpa (J. macrocarpa), subsp. transtagana (J. navicularis*) and *subsp. badia*, revealed the strong separation of *subsp. macrocarpa*(Klimko *et al*., 2007).

J. oxycedrus subsp.macrocarpa is atree, in good condition reaching10-12m in height.It has large cones, 1.2-1.5mm across,light to dark brown or some what purplish and brownies. Its needles are up to 2.5 mm wide(Klimko *et al*., 2004)a dioecious species typical of coastal dunes in the Mediterranean region(Jalas and [eds.]. 1973);(Do Franco, 1963). Female individuals require two years to develop mature female cones, which are possible to find at different stages of maturity on the same plant simultaneously(Juan *et al*., 2006); ripening and dispersal of the female cones occur from autumn to spring (Pinna *et al*., 2014). The tolerance to salt and sand-laden marine Plant Ecol 123 winds(Ge´hu *et al*., 1990), the adaptation to substrate movements(García Novo and Merino, 1993).

This subspecies occurs around the Mediterranean on the coast in an environment that is locally under threat from development but still too widespread to be of conservation concern. Recorded from the Mediterranean and Black Sea coasts: Albania, Algeria, Bosnia-Herzegovina, Bulgaria, Croatia, France, Greece, Italy, Malta, Morocco, Spain, Turkey, Ukraine.(Farjon, 2013).

J. oxycedrus supsp. macrocarpa is a rare woody species found in El-Jabal El-Akhadar, Libya in site north-west Derna. The distribution of this population is physiographically dependent, where the individuals are restricted to the north-facing slope of the first rocky ridge close to the sea shore.

The basic morphological features of leaves, cones and seeds in three populations of *J. oxycedrus subsp.macrocarpa* from Italy were investigated biometrically. In addition, the intra- and inter-population variation of *J. oxycedrus subsp. oxycedrus* in the Mediterranean region were determined biometrically on the basis of the morphological features of leaves, seeds and cones(Klimko *et al*., 2004). The morphological properties (leaf length and weight, unripe cones weight) of *J. communis* within different ecological situations in habitats in Lithuania were investigated (Vaičiulytė and Ložienė, 2013).The morphological of fruit and seed color, seed shape, and the number of resin pits on the seed surface have been observed to be important morphological properties in terms of the systematic of the taxa(Köroğlu et al., 2018a)some character (e.g. leaf mucro length, leaf width, seed-cone size and seed size) resulted useful to discriminate taxa(Roma-Marzio *et al*., 2017).

Wood fiber is the basic unit of wood especially for fast-growing trees. Studying the morphological characteristics of fibers should assist in understanding and interpreting the behavior of wood products. It is well known that long fibers are preferred in production of high strength paper (Horn, 1974) and (Francis *et al*., 2006). The average fiber length at a breast height could give a good estimation for the total tree fiber length(Abo-Hassan and El-Osta, 1982).

Specific gravity of wood is the measure of the relative amount of solid wall material and is the best index that exists for predicting the strength properties of wood(Panshin and DeZeeuw., 1980.). In the meantime, specific gravity of wood is the most important technological properties for wood industry, which profoundly determine and affect the wood quality(Erickson and Harrison, 1974;Haygreen and Bowyer, 1996). Specific gravity of wood is usually used as an indicator ofthe mechanical properties of wood(EL *et al.*, 1981) and the suitability of wood for wood industry (Mohamed, 2004.) and charcoal (Hindi, 2001).

Fiber length is a wood-quality parameter of important to pulp and paper making(Horn, 1974).

Very few studies have been offered a wood properties and morphological analysis and taxonomy *of J.oxycedrus supsp. macrocarpa*, Therefore, we need for recovery of this taxon . The aim of this work is to clarify the taxonomy of this species by study the morphological properties of leave, cone and seed, also were study some wood properties , such as specific gravity and tracheid length of *J. oxycedrus supsp. macrocarpa*is naturally growing in north-west Derna, Libya.

MATERIALS AND METHODS

The study area was located the second terrace of El-Jabal El-Akhadar mountain in Derna region east Libya, where the city between longitudes 22° 38′ 0 N and 32° 46′ 0″ E).The climate of the study area is comparable to that of El-Jabal El-Akhadar with mean temperature of about 20 C^0. The average rain-fall ranges between 200-300 mm(El-Barasi and Saaed, 2013).

Morphological investigation:

Twenty trees were randomly selected of *J. oxycedrus subsp.macrocarpa* growing on sandy dunes. We studied morphological traits individuals: cone length (mm); cone diameter (mm), seed number per cone, seed length (mm), seed thickness (mm), needle length (mm). The parameters were measured using a numerical caliper (0.01mm). Fifty cone, fifty seeds and fifty needle from all the trees were measured following the procedures described by(Klimko *et al.*, 2007).

Wood properties:

Samples of 5 cm thick discs were cut off at a 1.3 m height of all sample trees (3 trees), 2cm width radial strip was cut from each sample at horizontal direction from pith to bark (Tashani ,2016).

Specific gravity:

Wood specific gravity was determined by using the maximum moisture content methods**(Smith, 1954).**The dimensions of the sample tree were 2×2×2 cm in dimensions and were divided into 5 parts from pith to bark from wood disk taken at diameter at brest height (dbh).

Fibre length

The dimensions of the samples were 2×2×2 cm and were divided into 5 parts from pith to bark from wood disk taken at dbh for each tree, then broken into small pieces macerated in 1:1 glacial acetic acid: hydrogen peroxide solution 30% at 60℃, for 48 h. The macerated fibers were stained using safranin stain(Franklin, 1945)

Statistical analysis

Correlation between different studied morphological parameters was evaluated using Pearson correlation coefficient.

The simple liner regression was used to determine the relationship between the trees age and specific gravity and fibre length. Simple phenotypic correlations were determined for all traits using SPSS **ver.16 package**. The regression function between treeage and each of the studied trait was predicted according to(Kleinbaum and Kupper., 1978).

RESULTS AND DISCUSSION

The morphological properties of leaves, cones, seeds :

*J. oxycedrus subsp. macrocarpa*have needle-like leaves. The apex of the leaf is acute, acuminate or mucronate. Cones usually consist of 3 seeds. The shape of cone is globose or ovoid and red-brown. *J. oxycedrus spp* is a tree with a height mean 2.65 m, while a diameter mean at dbh is 59.7cm.It has large cones, on mean, cones were length and diameter15.38 ,15.65 mm respectively ,light to dark brown or some what purplish. As well asthe length and thickness of seed found as 6.80,4.72 mm respectively. The mean number of seeds per cone was found three ovules.

The needle of *J.oxycedrus sub.macrocarpa* linear needle. The mean length and width of leaf found as 15.08,2.650 mm, respectively. Were similar to those repoted earlier by(Browiczk., 1996),(Zunni and Bayoumi, .2006)and(Koroglu*et al*., 2018). Morphological data are important in the apprehension of life cycles, geographic and ecologic distributions, evolution, conservation status, as well as species delimitation(Kaplan, 2001).

The Pearson coefficient correlation among morphological parameters of the *J. oxycedrus subsp. macrocarpa* revealed that the characteristics describing the seed , cone and leaf showed a positive correlation among each other. The correlation matrix among all studied morphological traits is summarized in fig. (1.2,3). The cone length has alow correlation with the cone diameter, r =0.088. Moreover, the seed length showed positive correlation with seed thickness (r =0.154). In contrast, the leaf thickness showed alow correlation with leaf length (r=0.056).

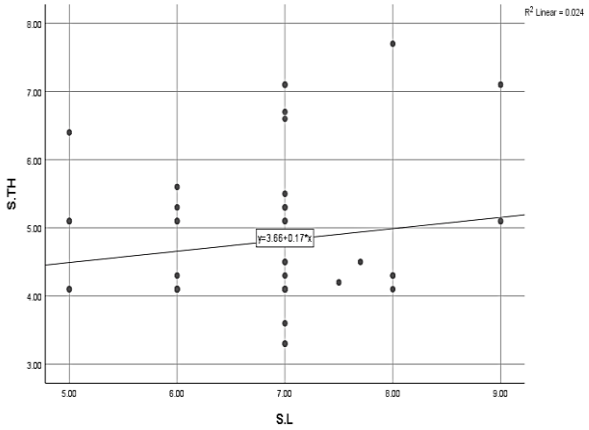

Figure 1. Pearson coefficient correlation of seed length(S.L) and seed thickness(S.TH).

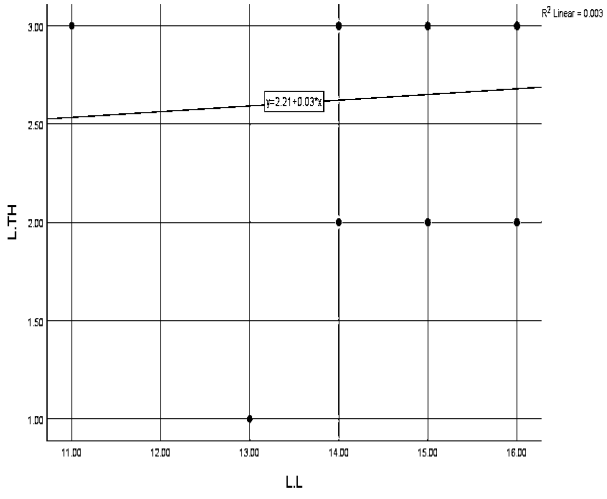

Figure 2. Pearson coefficient correlation of leaf length(L.L) and leaf thickness(L.TH).

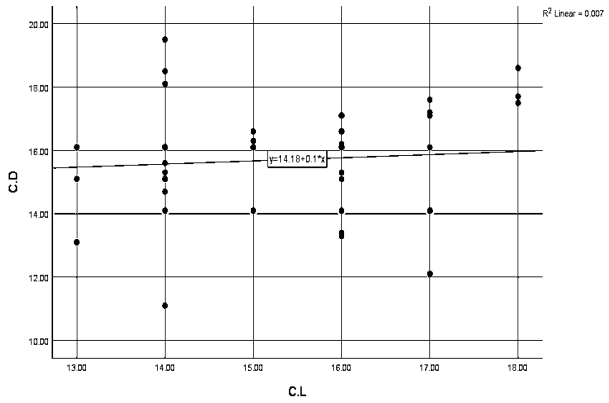

Figure 3.Pearson coefficient correlation of cone length (C.L) and conediameter(C.D).

All morphological characters are based on the taxonomic features of trees. They are used in fodder, timber, oil, beverages, and ornamental purposes.On the basis of these characteristics trees can be easily identified and utilized in various purposes, which is baseline for the forest field and useful to upliftment of forest economy by proper utilization of tree parts(Prakash, 2019). Finally, Morphological characters are used for identification because it is a basic method since nineteen the century and easily observable. For the study of morphological characters one need not to thndljdojhavesophisticated laboratory arrangements, a hand lens ordissecting microscope or light microscope is enough tostudy these characters.

Specific gravity(SG)

Table (1) illustrates the relationship between tree age and specific gravity values of wood J. *oxycedrus subsp. macrocarpa*. where study showed that the values of R^2 (Coefficient of determination) were high ranged (59.9-70.9%) and the simple regression relationship also showed that the values of specific gravity have a negative relationship with the cambium age, as it is clear of that the values of specific gravity decrease as the distance from the marrow increases. This pattern of variation in wood specific gravity was in agreement with (Osazuwa-Peters e*t al*., 2014)and also were similar to those reported earlier by(Tashani, 2016)(Wani *et al*., 2014) in a study *on Juniperusphoenicia* and *Pinus halepensis,* wherein they mentioned that specific gravity is highly influenced by cambium age. reported that the effect of the transition in the diagonal direction is one of the main causes of the density change inside the trunk.

Table (1): The simple regression relationship between woodspecific gravity and age within the stem of *Juniperus oxycedrus subsp. macrocarpa.*

No.Tree	Regression equation	R^2
1	$SG = 0.425 - 0.001\ A$	70.9
2	$SG = 0.426 - 0.001\ A$	69.5
3	$SG = 0.429 - 0.001\ A$	59.9

***A*= Age, *SG*= specific gravity.**

Behavior of wood specific gravity from pith to bark showed significant differences between this values for trees Fig,(4). Where the SG was decreased gradually from pith to sap wood then increased at the wood adjacent to bark. The last observed trend for SG values was the same for the wood, these findings were in agreement with those described by(Sheikh *et al.*, 2011), (Martinez-Meier *et al.*, 2011)and (Tashani, 2016).

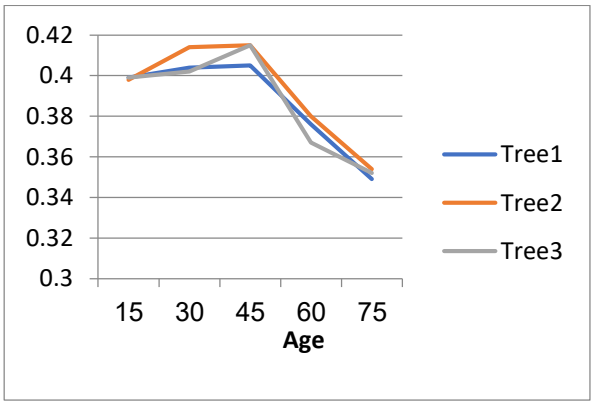

Figure 4. Radial variation of the wood specific gravity in *Juniperus oxycedrus subsp. macrocarpa* for different trees.

This may be associated with an increased percentage of extractives in heartwood compared to sapwood outside. On the other hand, The decrease of wood density from pith-to-bark is often attributed to increased light exposure and improved growth conditions in the later stages (Bastin *et al*., 2015). Furthermore, wood density is known to be affected by environmental conditions, specific climate and age. In addition to impacts of silvicultural practices(Zobel. and Sprague, 1998) Furthermore,(Zobel. and Jett., 1995) reported a significant variation in wood density among tree locations and they also pointed out to partial effect of genetic traits on wood density. Finally, specific gravity of wood are important indicators for solid and composite wood applications and can be measured in progeny testing to evaluate elite trees.

Fibre length (FL)

Table (2) shows the radial variation in fibre length values of *J. oxycedrus subsp. macrocarpa* at dbh height. For all trees were the fiber length values had a positive relationship with the cambium age where R^2values were very lowranged between 6 - 8.5%.

Table (2): The simple regression relationship between the fiber length of wood and age within the stem of *Juniperus oxycedrus subsp. macrocarpa*.

No. Tree	Regression equation	R^2
1	FL = 1.901 + 0.003 A	7
2	FL = 1.911 + 0.003 A	8.5
3	FL = 1.881 + 0.003 A	6.7

A= Age, FL= Fiber length.

Figure (5) shows the mean of fiber length(mm) in wood samples from pith to bark taken from *J.oxycedrus subsp. macrocarpa* trees. It is obvious that short fiber exists in the pith region and the longest ones were manifested near the bark locus. Also, it is well known that the fiber length is increased gradually from juvenile wood to become steady of the wood turned to be mature wood the rate of transition from juvenile to mature wood depends on genetic traits and environmental conditions. *J. oxycedrus subsp. macrocarpa* is a short fiber wood with a mean fiber length of 1.75 mm. Whereas, (Kandeel *et al*., 1987) mentioned in a study on *J. procera* trees that the mean fiber length was 2.89 - 3.20 mm, as well as the (Ter Welle and Adams, 1998) study arrived that juniper trees are short-fiber where the mean fiber length of ranged between 1.20 - 2.79 mm.

The pattern of fiber length variation in this study is related to tree cambium age. Distinct differences monitored in the fiber length among the trees This observation was supported with the findings of (Sadegh and Kiaei, 2011) and (Amaraltranco, 1968)(Bakhshi et al., 2011),who mentioned that the environmental factors have no effect on fiber length. Also,(Hosseini, 2006)reported that the exploitation age or juvenile wood border in Caspian forests.

Narrow ring width and variations in it from year to year should have a negative effect on fiber length variation.

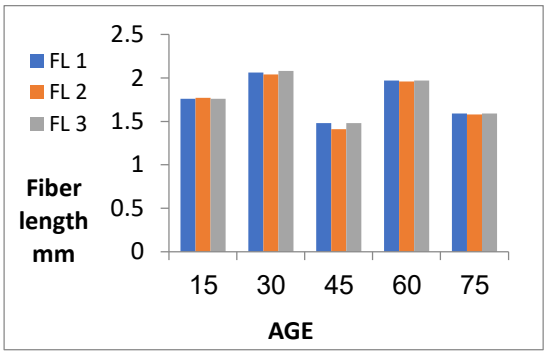

Fig.(5): Radial variation of Fiber length in *Juniperuso xycedrus subsp. macrocarpa* for different trees

CONCLUSION

Juniperus oxycedrus supsp. macrocarpa is a rare woody species found in El-Jabal El-Akhadar, Libya in site north-west Derna. The distribution of this population is physiographically dependent, where the individuals are restricted to the north-facing slope of the first rocky ridge close to the sea shore. Register this genre in The IUCN Red List of Threatened Species. Also, The morphological properties (leaf length, leaf width, seed size and cone size) resulted have been observed to be important clarify the taxonomy of this species. the results indicated of wood properties that the relationship between specific gravity and cambial age, the general trend showed that the relationship was negative with age while, fiber length increased radically from pith to bark. specific gravity of wood are important indicat for solid and composite wood applications and can be measured in progeny testing to evaluate elite trees and the suitability of wood for wood industry and charcoal Fiber length is a wood-quality parameter of important to pulp and paper making. Finaly, The identification of genetic variation in morphological characteristics and wood properties is necessary for the description of local genetic resources of J. oxycedrus subsp. macrocarpa .

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