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EFFECT OF SOME TOPOGRAPHICAL FACTORS ON THE ANATOMICAL OF THE WOOD OF *FRAXINUS ORNUS* L. TREES GROWING IN REWNDIZ DISTRICT

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ABSTRACT

The Elm species *Fraxinus ornus* L. was selected to study the effect of some topographical factors on the anatomical characteristics of its wood. Three trees of *this species* were selected from each site. Three areas were chosen in the Rewandiz District of Erbil Governorate, northern Iraq. The area is 123 km from Erbil. Their elevations range between 685 and 1180 meters above sea level latitude, longitude, and Aspects ratios. Slope and the sites from which the samples were taken were recorded. The results of this study showed a significant environmental influence and variation among the studied trees on the anatomical characteristics of the wood. A variation was found in the average dimensions of the vessel elements in the three studied sites. Environmental effects were also found on the dimensions of the fibers, according to the facades, elevations, and slope. One of the most important diagnostic results for the wood of this species is the recording of the presence of separated fibers in this study. It was also found that the qualitative characteristics are of great diagnostic importance, as the number of rows of interlaced holes in the samples ranged from one row (Uniseriate) to two rows (Biseriate), while the perforated plate was of the simple perforation plate type the presence of thickenings, Spiral. The study was reinforced with illustrative images of the separated cells. Illustrative images of the separated fibers enhanced the study.

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INTRODUCTION

Anatomical characteristics are of great importance in identifying species. Anatomical characteristics are among the most important diagnostic features. Among the most important factors are those related to wood composition, including the presence and arrangement of vessels, fibers, pulp rays, annual rings, and parenchyma cells. These have often been useful in identifying and providing evidence of the evolutionary trends of plant species and genera. This genus includes approximately 65 species that grow in the Northern Hemisphere. It belongs to the Oleaceae family and is characterized by its deciduous, opposite, compound, single-pinnate leaves. Ash trees are beautiful, used for shade, and their wood is well-structured. They are found primarily in the northern temperate zone, growing along streams and the lower slopes of hills where the soil is well-drained. They are used in landscaping. Trees can live over 150 years (Caudullo, and Durrant, 2016). The elm (*Fraxinus ornus* L.) is widespread in some forests in northern Iraq, where its trees reach a height of 20 meters. It is widely distributed in Iraq's northern tourist areas and summer resorts, especially in the Rewandiz district of Erbil Governorate (Bak and Nesime, 2016).

Numerous studies have documented a strong and positive relationship between wood density and various mechanical properties, such as the modulus of elasticity and the modulus of rupture. Based on these studies, wood density is the most important characteristic affecting the durability and strength of wood, and is closely and positively related to most mechanical properties (Camarero *et al*., 2021).

From a topographic perspective, spatial analysis of wood anatomy studies how the microscopic composition of wood varies across different environments and how these variations relate to elevation, slope, and other geographic features. This analysis helps understand how trees adapt to different environments and how these adaptations affect their growth, water transport, and mechanical properties (Wang *et al*.,2024).

The Oleaceae family includes approximately 27 genera and 600 species, growing in tropical and warm temperate regions, especially in the East Indies and Asia. The family belongs to the order Loganiales, while some scientists have suggested isolating the Oleaceae family in a special order called Oleales because its inflorescence consists of two stamens. In Iraq, it is represented by two naturally growing genera: the genus Fraxinus and the genus Jasminum. can be summarized as belonging to the plant kingdom Plantae, the subkingdom Embryophyta, the division Tracheophyta, the suborder Pterospida, the class Angiospermeae, the suborder Dicotyledonae, the order Oleales, the family Oleaceae, the genus Fraxinus, and the species *Fraxinus ornus* L. (Bak and Nesime, 2016).

Elm wood is highly valued in the home furniture industry. Its golden yellow color characterizes it, and the wood resembles the sapwood. It has commercial value and has many uses, including furniture, fuel, and handles for agricultural tools. Some materials are extracted from it, used in the preparation of medicinal drugs, such as laxatives Elm wood is widely used in industry due to its distinctive, desirable color. Baskets, light boats, and other household items are made from them. Given the importance of ash trees in their shade, wood, and similar medicinal properties, they must be taken care of, and plans for their propagation must be implemented (Esther and Martin, 2012).

(Yaman, 2008) studied the changes in quantitative vascular element characteristics of *Juglans regia* L. wood, including height and growth ring width. A multiple regression analysis used height and growth ring width as independent variables. Statistically significant correlations were found for tangential and radial vessel diameters: Frailty and skin dryness. Non-anatomical factors (height and growth ring width) explained between 40.4% and 80.4% of the variance in the dependent variables. (Basim *et al.,* 2009) studied the fiber dimensions of *Luecaena leucocephala* growing in the middle of Iraq. The research has investigated some wood properties to study the variation of fiber dimensions longitudinally and transversely in the stem. Results showed that the fibers' length, diameter, and wall thicknesses near the bark were greater than those near the tree's pith. The effect of the longitudinal factor was not steady. At the same time, fiber length was slightly higher in the base than in the upper stem levels, and fiber diameter and wall thickness had higher mean values at the higher positions of the stem. Results referred to the possibility of using this wood species for pulp production in addition to its conventional uses.

Adi *et al*. (2014) stated that Fast-growing wood species are becoming increasingly promising as alternative timber sources to bridge the gap between wood

supply and demand. This study focuses on their fiber characteristics and wood density to determine their potential uses. Thirty fast-growing species were selected from secondary forests in PT Sari Bumi Kusuma, Central Kalimantan, Indonesia. Several hardwood and softwood species, commonly used in the pulp and paper industries, were used for comparison. The results showed these species had low to high density (0.18–0.86). Interestingly, the fiber lengths of the five wood species were larger than those of common hardwoods and similar to those of softwoods. The wood fibers exhibit good bending ratios and elasticity values. Seven species were identified as potential alternative wood materials for pulp and paper which are: Endospermum diadenum, Dillenia sp., Adinandradumosa, Adinandra sp., Nauclea junghuhnii, Neonaucleagigantea, and Ficus fulva. (González *et al.,* 2016) studied ring porosity and early xylem vessels, which extract environmental information over time, and emphasized that environmental factors have a role in controlling xylem vessels and thus wood properties.

Erşen and Merev (2016) studied the anatomical features of the wood of eight species (four species) of *Fraxinus* L., a plant native to Turkey, and examined them. Wood samples were collected from different elevations of their natural growth areas. Data were collected on quantitative anatomical features, such as tangential and radial vessel diameters, number of vessels per square millimeter, length of vessel elements, fibers (lengths, widths, cell wall thicknesses, and lumen diameters), number of rays per square millimeter, and their width and height. Using vessel element features, stem diameter, plant height, area height, and plant age were determined for each tree. Anatomical and non-anatomical features (height, plant height and diameter, and number of annual rings) were correlated. The effects of these non-anatomical factors on anatomical features were studied at the intra- and interspecific levels, and differences in wood anatomy were identified. Across genera and taxa, there is a negative correlation between height, radial and apparent vessel diameter, length of vessel elements, fiber lengths and widths, lumen fiber diameters, and the width and height of rays. With increasing height, the dimensions of these elements decrease; in contrast, the number of vessels per square millimeter and the number of rays per millimeter increase with increasing height. (Bak and Nesime, 2016) studied wood anatomy features of eight taxa (four species) of the genus Fraxinus L. indigenous to Turkey. Wood samples were collected from different altitudes of their natural growth areas. Data were gathered on quantitative anatomical features such as tangential and radial vessel diameters, number of vessels per mm^2, length of vessel elements, fibers (lengths, widths, thickness of cell walls, lumen diameters), number of rays per mm, and ray width and height. By using vessel member features, the vulnerability ratio (vessel diameter divided by number of vessels per mm^2). Caudullo and Durrant (2016) pointed out that the wood of narrow-leaved ash has properties similar to those of common ash. However, the quality is inferior in terms of strength and elasticity. Timber plantations are uncommon in Europe, mainly planted with other species 14. Compared to common ash, higher wood quality can be obtained on drier sites where tree growth is slower3. In the north-west of Turkey, where narrow-leaved ash is more commonly used in fast-growing plantations on swampy lowlands, the wood quality is more similar to that of the poplars. It suits pulpwood and bonded wood products, such as plywood, laminated veneer lumber, and glued laminated timber, 15- 17.

Abdulqader *et al.* (2021) studied some Melia azedarach L wood properties. The anatomical properties of the wood were important in diagnosing this type of Melia azedarach. (Abdullah and Mohammed, 2021) studied the Pattern of Distribution of Spatial Phenomena to Communities Prevailing in Mount Gara Using Function L(r). Camarero *et al.* (2021) studied the wood anatomy and tree growth covary in riparian ash forests along climatic and ecological gradients. Riparian ash forests subjected to seasonal drought are among the most endangered ecosystems in Europe. They are threatened by climate warming, which causes acidification, and land-use changes that modify river flow. To assess the impacts of these two stress factors on riparian forests, we studied radial growth and xylem anatomical traits in five narrow-leaved ash (*Fraxinus angustifolia*) stands across wide climatic and ecological gradients from northern Italy to southern Portugal. Radial growth rates and early wood hydraulic diameter (HD) were directly correlated, whilst early wood vessel density and growth rates were inversely associated. Wet conditions in autumn and winter before tree-ring formation led to larger Dh values, except in the wet site, where warmer conditions from prior autumn to current spring were positively associated with wider vessels. Growth was also enhanced by a higher river flow, reflecting higher soil moisture due to elevated groundwater table levels. Wood production and hydraulic conductivity are coordinated by producing large early wood vessels, which may allow higher growth rates. (Muhammad and Al-Yousif, 2023) studied the Taper Equation development and volume development for *Eucalyptus camaldulensis* Dem. in the Nineveh Region.

Al-Jowary and Al-Zebras (2024) studied the anatomical characteristics of the wood of the Juglans species and varieties in northern Iraq. The results showed the importance of the anatomical study of the wood, as anatomical differences were found between the species, which helped in their isolation and identification. (Rasheed and Al-Jowary, 2024) conducted an anatomical comparison of two oak species (*Quercus aegilops* and *Quercus gastrodus* olivine) grown naturally in the Atrush region in northern Iraq. The results of the anatomical study were important in the qualitative diagnosis of oak and confirmed the use of anatomical studies of wood. (Younis *et al.,* 2024) studied the stand structure dynamics of *Pinus brutia* grown naturally in the Atrush region. The tree and stand variables and global tree coordinates measurements were recorded for each sample. When the diameter was over 10 cm, the trees were over 1.3 m tall. Analysis revealed that the densities of these trees spread in the study site and reached 28181.89 trees, which varied widely, indicating variances in natural renewal between study sites. The site is rich in natural regeneration. Samples 2, 8, and 10 showed balance for the quantity of seedlings, juveniles, and trees, indicating stability in tree movement. The obtained results relied on mechanisms of community aggregation using tree spatial distribution data. (Munther *et al*., 2025) confirmed a relationship between topographical factors, especially elevation above sea level, and tree growth. Researchers (Ahmed *et al.,* 2025), when studying the wood of Paulownia trees, showed that some of the phenotypic and anatomical characteristics of the fibres, and estimated the proportions of the chemical components of the wood of the main stem and the lower branches, and of the two types—sapwood and heartwood for them. The fibre length was 0.917mm, and the fibre diameter, lumen diameter, and cell wall thickness were

(27.31, 16.65, and 4.95) µm, respectively. Ratios of Runkel, slenderness, and flexibility of the fibres were (0.613, 30.78, and 66.75%), respectively. There is a possibility of making paper with acceptable properties. The chemical analysis of wood was also discussed; the percentage of dissolved extracts in the mixture of ethanol-benzene and hot water was (5.7801, 6.3408) %, respectively, and the rate of lignin, ash, and holocellulose was (22.7240, 0.2505, and 64.9044) %, respectively. These percentages indicate the potential for producing good pulp, but the high extraction rate poses problems in the bleaching process.

The importance of this research lies in highlighting the importance of the wood of this species, which is widespread in the forests of northern Iraq. This study could help meet the country's need for distinctive wood, thus potentially reducing its imports in the future. The results of this study may have great importance in directing the use of ash wood in economically oriented industries, in addition to its value in protecting the environment and its aesthetic value. The importance of this research comes from the study of the anatomical characteristics of this species of ash growing in northern Iraq and knowing its precise anatomical properties, whether for the three sections (cross, radial, and tangential sections) or the wood cells separated chemically, due to the lack of a detailed anatomical study of this naturally growing species in Iraq. Due to the importance of this topic, we decided that this study should be in the field of spatial analysis to know the effect of surfaces on the anatomical characteristics of the wood of the species under study, and to develop plans for sustainable management of these stands.

MATERIALS AND METHODS

The Rewandiz district site was selected, home to Fraxinus ornus L. trees. This district is part of Erbil Governorate and is located at an elevation of 704 m above sea level, at longitude 44° 38′ 22″E and latitude 06′ 33° 36″N. Rewandiz is an Iraqi city and the center of a district in Erbil Governorate in the Kurdistan Region of Iraq. It is located 10 km east of Bekhal Waterfall and 123 km from Erbil. The Zagros Mountains surround the area. Mount Korek is situated to the south, Mount Hendrin to the north, Mount Zozik to the west, and Mount Bradasot to the east. Rewandiz has a Mediterranean climate with hot, dry summers and cold, wet winters. Winter witnesses temperatures dropping below freezing on many nights, making frost prevalent. Snow falls occasionally. Table (1) shows the maximum and minimum temperatures and rainfall rates for Rewandiz District.

Study Samples

Three *Fraxinus ornus* L. trees were selected from each site. These trees were healthy, upright, free of disease and insect infestations, and representative of the surrounding community. Wood samples were taken from the trunk at a height of 1.3 m, in the form of a half-disc cut perpendicular to the trunk axis. At close ages and from one side (the northern side) of the trees, samples were taken at breast height (b.h.) according to the method mentioned by Yaman (2008) and followed by Al-Jowary *et al.* (2018). After collecting the samples, the following steps were taken:

Table (1): Maximum and minimum temperatures and fire rates for the Rewandiz district.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual average
Average maximum temperature °C	9.5	10.9	15.1	21.0	28.1	34.8	38.9	39.1	35.1	28.2	18.5	11.4	24.2
Average minimum temperature °C	0.0	0.0	4.5	9.4	14.7	20.0	23.6	23.4	18.9	13.4	7.2	2.0	11.4
Rainfall rate mm	147	169	141	98	41	0	0	0	1	12	77	108	794

Climate Data Climate: Rewandiz

Table (2): Tree diameter, height above sea level, aspects, slope, longitudes, and latitudes.

Samples code	Site name	Trees diameter (cm)	Aspects	Slope	above sea level m	Longitudes	latitudes
P1	Rewndiz center	17	N	10	685 m	44º ,31′,29″ E	36º ,36′,43″N
P2	Bêxal	16	S	15	970 m	44º,29′,41″ E	36º,37′,04″ N
P3	Warte	18	W	20	1180 m	44º, 45′,17″ E	36º, 30′,04″N

Preparing wood sections for anatomical study

The anatomical study was conducted using two methods, as follows:

1- Chemical cell separation method, known as maceration, as follows:
   The wood was chemically separated from the studied elm tree trunks at each proposed study site. Franklin's method (1946) was followed in the separation process.
2- Mechanical wood dissection method (mechanically separating the cells).

The wood samples were cut into cubes with dimensions of (1 x 1 x 2 cm). The samples were softened in distilled water until they sank under their own weight. The samples were then stored in a solution of glycerol and ethyl alcohol at a ratio of 1:1 until use. Then, microscopic slices 20 micrometers thick were made for the three sections (cross-section, tangential longitudinal section, and radial longitudinal section) using a rotary microtome (microtome) at a Steele knife angle of 15-10° (Yaman, 2007). The wood slice made with the microtome was then placed on a microscope slide and a coverslip. It was examined using an advanced Motic Image Plus two microscopes equipped with a camera and connected to a laptop. Twenty readings or measurements were taken. The quantitative and qualitative properties of the three aspects of wood were studied. The work was conducted in the Wood Science Laboratory in the Department of Forestry, College of Agriculture and Forestry, University of Mosul. The Figure (1) show the Map of Rewandiz District in northern Iraq.

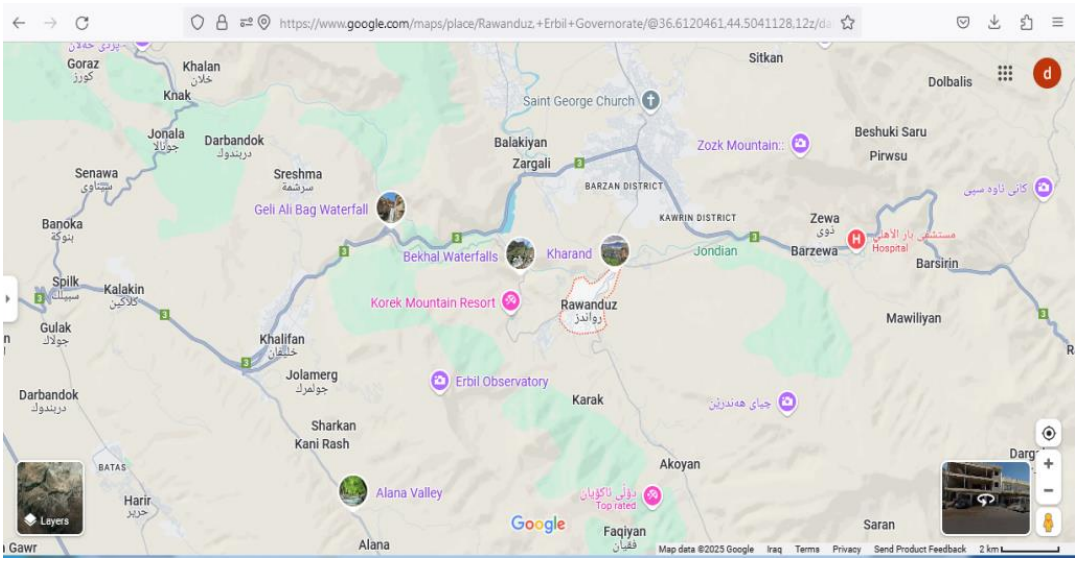

Figure (1) Map showing Rewandiz District in northern Iraq https://www.google.com/maps/place/Rewandiz ,+Erbil+.

RESULTS AND DISCUSSION

Anatomical characteristics of wood cells separated by soaking, the effect of topographical factors on their dimensions, and the effect of surfaces on the difference in wood cell dimensions:

Vessels elements

The results of the Table (3) show that the lengths of the vessel elements ranged between (0.182-0.297) mm, and the general average was (0.254) mm, and that the W interface was distinguished by the highest average length of the vessel element (0.269) mm, and the highest diameter of the vessel element (227.180) micrometers, and the highest cavity diameter of the vessel element (121.513) (micrometers). At the same time, the S interface was distinguished by the highest average thickness of the vessel element wall (28.012) micrometers. This result was consistent with what the maids found Erşen and Merev (2016), which showed a noticeable environmental impact and variation among the studied elm trees in the anatomical characteristics of the wood. It also agreed with what the researchers mentioned Bak and Nesime (2016).

Figure (2) shows the vessels elements of the *Fraxinus ornus* L. were studied. using the maceration method. Where the fig.(A) indicates the vessel elements at a magnification of (10x), with a simple perforation plate. The fig.(B) indicates that the vessels elements at a magnification of (4x). fig.(C) that the vessels elements at a magnification of (40x).

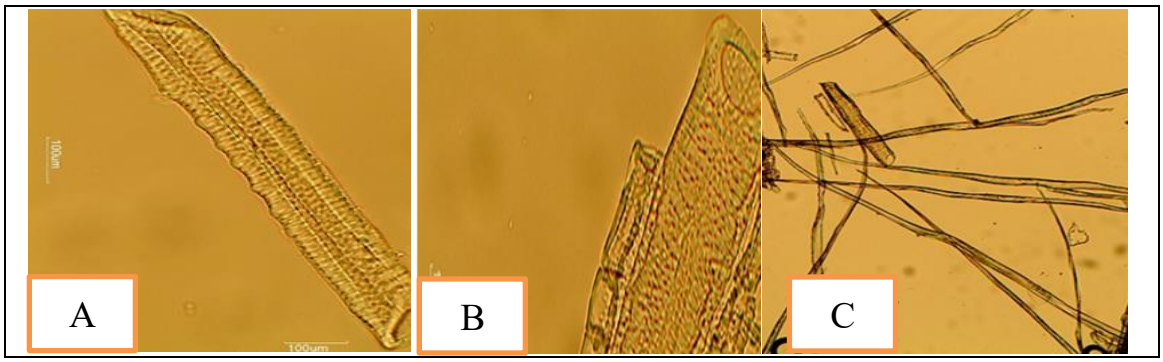

Figure (2): The vessels elements of the elm *Fraxinus ornus* L. growing in the Rewandiz District by maceration.

They all mentioned that environmental factors influence the anatomical properties of wood and the great importance of wood properties in identifying species and genera.

Table (3): Characteristics of the Vessels elements of the wood of the Urns elm growing in Rewandiz district, separated by the chemical method (Maceration)

Samples / Characters	P1			P2			P3		
	aspect N	Slope 10 %	height above sea level 685 m	Aspect S	Slope 15 %	height above sea level 970 m	Aspect W	Slope 20 %	height above sea level 1180 m
diameter	17			16			18		
Length of vessel elements (mm)	0.297-0.185 (0.253)			0.276-0.198 (0.241)			0.285-0.182 (0.269)		
General average	(0.254)								
Diameter of vessel elements (micrometer)	277.246-117.341 (170.178)			192.209-79.238 (148.577)			437.125-182.117 (227.180)		
General average	(181.978)								
Vessel element wall thickness (micrometer)	36.231-19.345 (27.180)			43.891-22.776 (28.012)			35.452-10.116 (26.472)		
General average	(27.221)								
Bore diameter of vessel element (micrometer)	177.453-68.176 (109.232)			158.261-34.230 (79.451)			291.778-67.224 (121.513)		
General average	(103.398)								

*Values inside parentheses represent the average, and values outside parentheses represent the larger and smaller range

Fibers

Table (4) shows that the fiber length of this ash species varied between the study sites. The third site, with an elevation of 1,180 m above sea level, a 20% slope, and a W-facing profile, had an average fiber length of 0.795 mm. The second site had the lowest fiber length, at 0.599 mm. Meanwhile, the first site had fiber lengths of

0.612 mm, indicating the influence of facades, slope, and elevation above sea level. This was confirmed by Bak Nesime (2016). The average fiber length of the Urns ash in Rewandiz District and across all sites ranged from 0.668 mm. The results also showed the presence of helical thickenings in the fibers, which provide support and reinforcement and are considered a diagnostic feature. This was confirmed by Al-Jowary and Al-Zibari (2024).

Figure (3) shows the fibers of *Fraxinus ornus* L. studied. Where the fig.(A) indicates the fiber cells at a magnification of (10x), the fig.(B) indicates that the fiber cells at a magnification of (40x). fig.(C). indicates that the fiber cells at a magnification of (40x) show the helical thickening of fiber., and Figure (D) shows the uniseriate bordered pits of fiber(40x).

Table (4): Fiber dimensions of the wood of the ash trees in the Rewandiz district, whose cells were separated chemically (Maceration)

sample / Characters	P1			P2			P3		
	aspect N	Slope 10 %	height above sea level 685 m	Aspect S	Slope 15 %	height above sea level 970 m	Aspect W	Slope 20 %	height above sea level 1180 m
Fiber length (mm)	0.938-0.423 (0.612)			0.821-0.576 (0.599)			0.978-0.719 (0.795)		
General average	(0.668)								
Fiber diameter (micrometer)	173.416-50.682 (92.716)			89.543-33.601 (63.626)			86.833-30.414 (64.997)		
General average	(73.779)								
Cell wall thickness (micrometer)	29.530-9.899 (16.958)			31.497-18.028 (25.865)			23.601-13.601 (18.258)		
General average	(20.359)								

An anatomical study of mechanically separated ash wood cells (Macrotom)

The results of Table 4 also demonstrated the variation and influence of sites, facades, and slope on other fiber dimensional characteristics, such as fiber diameter and fiber wall thickness, as shown in the table. The study was enhanced with illustrative images of the separated cells. In light of these results, it was shown that topographical factors such as locations, elevations above sea level, facades, and slope affect the anatomical properties of wood. They were consistent with the results of other researchers, such as Bak. & Nesime (2016) and Al-Jowary & Al-Zebari (2024), who confirmed that the anatomical characteristics of wood are affected by locations. Figure (2) shows the fiber of the *Fraxinus ornus* L. growing in the Rewandiz District and helical thickenings.

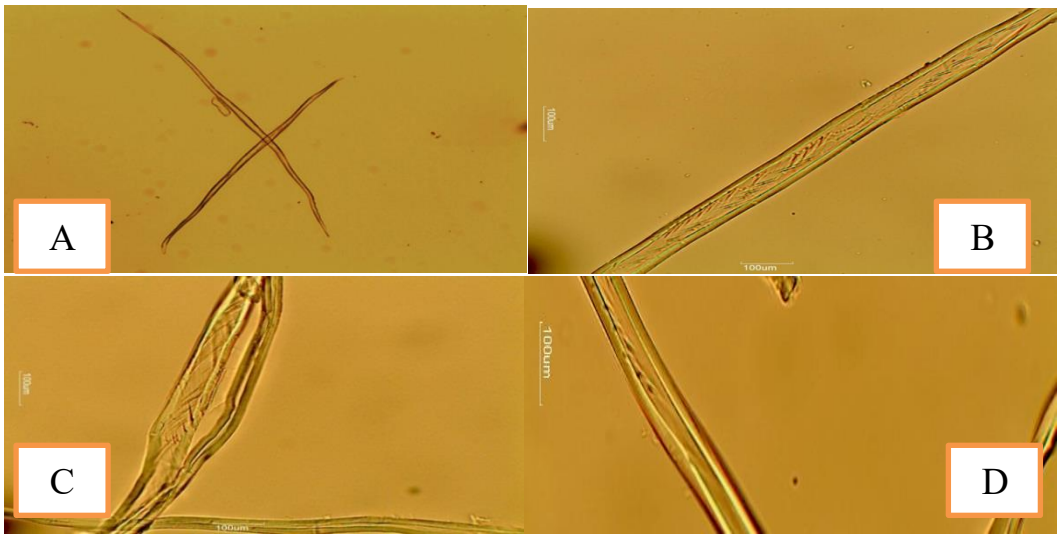

Figure (3): Elm fibers *Fraxinus ornus* L. growing in Rewandiz District

Table (5) shows the noticeable variation in the quantitative characteristics of the cells separated by the microtome. The cells' dimensions in the table varied according to the locations, heights, interfaces, and slopes. This indicates that they have a significant effect on the anatomical properties of the wood. These results are consistent with those of Camarero et al. (2021). It was also shown that locations and topographical factors affect the properties of wood and the species' dimensions of the cells, which is consistent with the results of other researchers who have all confirmed the effect of these factors on the anatomy. Al-Jowary & Al-Zebari (2024) emphasized the importance of the properties of wood separated by the macrotome method.

Table (5): Quantitative characteristics of ash wood's medullary and stomatal cells separated mechanically (Macrotom)

Samples	Number of ray cells in the tangent face in height	Number of rows of ray cells in the tangent face	Number of single-layer rays in the tangent section in height/ (mm2)	Height of ray cells in the tangential face (micrometer)	Spindle height in tangential section (micrometer)	Height of transverse ray cells in the radial face (micrometer)
P1	9-5 (6.42)	Uni-biseriate	40-31 (36)	-174.873 180.112 (177.292)	-111.654 135.892 (133.908)	-80.767 91.980 (84.776)
P2	10-7 (8.75)	Uni-biseriate	33-25 (30)	-180.113 189.121 (183.353)	-230.995 250.675 (239.975)	-200.123 408.856 (204.453)
P3	7-5 (5.5)	Uni-biseriate	30-22 (25)	-133.343 144.990 (140.890)	-130.887 139.891 (136.989)	-147.045 150.879 (148.381)

Figure (4) shows the Radial, transverse, and tangential sections and the septate fibers of the elm growing in the Rewandiz. Using the microtome method. Where the fig, (A, B) indicates that the radial section and to the septate fibers, and the fig.(C)

indicates that the transverse section shows the pores. While the fig.(D). indicates that the tangential section shows the uniseriate & biseriate rays.

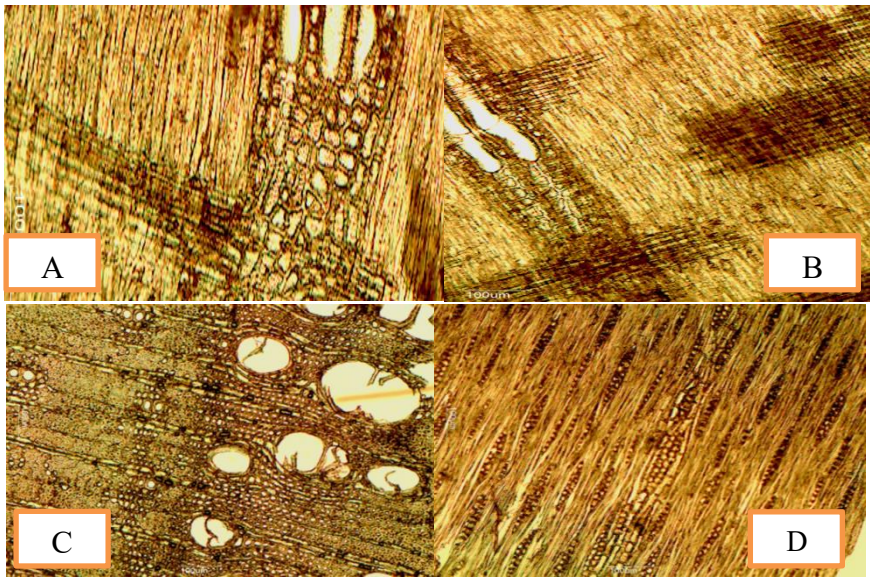

Figure (4): Radial, transverse and tangential sections and septated fibers of the Ornes elm growing in the Rewandiz.

In light of the results of the previous anatomical study of wood cells, both quantitative and qualitative, separated using chemical and mechanical methods, it is of utmost diagnostic value. This study contributed to identifying many wood characteristics of the Urns elm. It demonstrated a significant influence of interfaces, locations, slope, and other environmental factors on the anatomical properties of the wood. Some of the studied characteristics distinguish this species from other species. It is well known that species within the same genus share certain characteristics, which are genetically constant within species of the same genus (Rasheed and al-Jowary, 2024). The previous tables and figures illustrate the importance of the anatomical characteristics of wood. Given the economic value of ash wood, its various anatomical characteristics must be known and studied in detail, given their significant impact on the properties and specifications of wood in various industries and fields of use. These results were consistent with what the researchers had reported, Bak and Nesime (2016), Muhammad and Al-Yousif (2023). Changes in the characteristics and qualities of a given wood will affect its various uses, such as chemical treatments, drying, and manufacturing paper and cellulosic pulp.

CONCLUSIONS

The study reached the following conclusions. This is an essential study in the diagnosis of ash trees (*Fraxinus ornus* L.), and is the first conducted for this species of ash growing in the Rewandiz district of northern Iraq. The results of this study indicate a significant environmental influence on the anatomical characteristics of the wood. Location, elevation, and slope also influence the wood's quantitative and qualitative anatomical characteristics. Septated fibers were also recorded for this ash species, which is considered one of the most critical diagnostic characteristics. Spiral thickenings were observed in the wood of the ash studied, as they have contributed

significantly to the characteristics and identification of the wood of this species of ash.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

تأثير بعض العوامل الطبوغرافية في تشريح خشب أشجار FRAXINUS ORNUS L. النامية في قضاء راوندوز

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[1، 2] قسم علوم الغابات، كلية الزراعة والغابات، جامعة الموصل، موصل، العراق

الخلاصة

تم اختيار نوع الدردار *Fraxinus ornus* L. لدراسة تأثير بعض العوامل الطبوغرافية على الخصائص التشريحية لخشبه. تم اختيار ثلاث أشجار من هذا النوع من كل موقع. تم اختيار ثلاث مناطق في قضاء رواندز بمحافظة أربيل، شمال العراق. تقع المنطقة على بعد 123 كم من أربيل. تتراوح ارتفاعاتها بين 685 و 1180 مترًا فوق مستوى سطح البحر. جددت خطوط الطول ودوائر العرض. تم تسجيل المنحدر والمواقع التي تم أخذ العينات منها. أظهرت نتائج هذه الدراسة تأثيرًا وتباينًا بيئيًا كبيرًا بين الأشجار المدروسة على الخصائص التشريحية للخشب. تم العثور على تباين في متوسط أبعاد عناصر الأوعية في المواقع الثلاثة المدروسة. كما وجدت تأثيرات بيئية على أبعاد الألياف، وفقًا للواجهات والارتفاعات والانحدار. إحدى أهم نتائج التشخيص لخشب هذا النوع هي تسجيل وجود ألياف منفصلة في هذه الدراسة. وُجد أيضًا أن للخصائص النوعية أهمية تشخيصية كبيرة، إذ تراوح عدد صفوف النقر المضفوفة في العينات بين صف واحد (Uniseriate) وصفين (Biseriate)، في حين كانت الصفيحة المثقبة من نوع الصفيحة المثقوبة البسيطة – مع وجود تثخينات حلزونية. ودُعمت الدراسة بصور توضيحية للخلايا المنفصلة، وعززت الصور التوضيحية للألياف المنفصلة من دقتها.

الكلمات المفتاحية: الدراسة التشريحية، العوامل الطبوغرافية، الدردار اورنس، التحليل المكاني.

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