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Internal structure of platanus (*platanus orientalis* l.) grown in different environments in Kurdistan Region, Iraq

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ABSTRACT

This study investigated the impact of the distribution of Platanus orientalis L. trees in two different environments (aquatic and terrestrial) on some anatomical and stomatal features in Duhok city, Kurdistan Region-Iraq, during July 2022. The results clarified that the internal structure of the blade in all studied regions showed similar constituents, but significant differences were found in the measurements of the components of the internal structures of both leaves and petioles. Many values of the examined parameters were recorded due to the environment in which the oriental plane grew.

Keywords: *Platanus orientalis* L., leaf blade, petiole, stomata, abiotic stress.

INTRODUCTION

Oriental plane (*Platanus orientalis* L.) belongs to Platanaceae family. It is native to southeast Europe and southwest Asia. It is a deciduous tree with a spreading crown and growing up to height with 30 m. with yellow-brown and hairy young branches, however; Its older branches are become hairless. Leaves are intensely divided into 3, 5 or 7 lobes with coarsely toothed margins. Flowers are inconspicuous but stand in dense, spherical clusters hanging down on a long peduncle which called stalk (Tree Guide, 2020). The Oriental plane (*Platanus orientalis*) which have been included only one genus with (6-10) species of tall trees. It has been considered a deciduous and monoecious tree with a high reach of up to 30m and Palmatly leaves, deeply lobed leaflets, and head globus fruit. (Shahbaz, 2010). Plane tree fruit has been characterized by spherical fruit, a term used because of its low cellulose content according to (Jankovic, *et al.,* 2018). While another study mentioned many ornamental species growing in cities have considerable allergenic potential and pose a risk to allergy sufferers such species include members of the genus *Platanus* (Lara, *et al.,* 2020).Moreover *Platanus orientalis* L has also been studied in connection with urban pollution of two Levels were considerably greater in pollen samples from highly polluted areas than in unpolluted areas, which can lead to an increase in the prevalence of allergic diseases, in a study realized in Mashhad, the second city as size in Iran Vrinceanu *et al.* (2020) .

Oriental plane hydrosol is popular in Ethno medicine, as a remedy for weight gain and asthma treatment. Recently, some researches have reported phytochemicals and biological activities from fruits and buds of Oriental plane (Reza, *et al.,* 2020). It is occasionally used for the establishment of plantations for the production of wood and in construction work as well. Some reports (Vander *et al.,* 2001; Novak *et al*., 2003 and Gravano *et al.,* 2003) have been showed that both long-term and short-term physiological responses are due to the adaptation to changing environmental factors. Regarding the morphological modifications, and the internal structure of the plant. Furthermore, (Sargin, *et al.,* 2021) studied, anatomical characteristics of two species, *Liquidambar orientalis* and *Platanus orientalis* were investigated by examining the samples taken from dried drugs, under the light microscope. The anatomical structures of these two species, naturally occurring in Turkey have similar morphological features. They were examined in detail and the systematic characteristics were revealed. The mesophyll type of the leaves is dorsiventral and similar in both species. However, it is noted that the palisade parenchyma sequence was 2-3 layers at the *L. orientalis* samples while it was only monolayer in the *P. orientalis* ones. The stoma type was seen as anomocytic type Ranunculus type in the *Platanus*. (Gratani, *et al.,* 2020) has been studied the morphological and anatomical trait variations of *Platunus acerifolia* trees in Rome in response to different pollution levels and found that the anatomical properties, total leaf thickness, spongy parenchyma, and palisade parenchyma thickness, examine the anatomical features and the stomatal index of *P. orientalis* grown naturally in different environmental conditions in Duhok city, Kurdistan

The objectives of this study are as follows: 1) to identify and characterize the cuticular structure, including epidermal cells and stomata, of Platanus species in Iraq using a light microscope. 2) to investigate the leaf anatomy, including the leaf blade and petiole, of these same Platanus species.
3) to examine the impact of the distribution of *Platanus orientalis* L. trees in two different environments (aquatic and terrestrial) on certain anatomical and stomata features in the city of Duhok.

MATERIALS AND METHODS

Samples of Oriental plane (*Platanus orientalis* L.) leaves have been taken randomly from trees growing in different location of Duhok city Kurdistan Region-Iraq. The site of the study includes three different regions in chamanki, karago, and Havandka Valley belonging to Duhok city from two environments, terrestrial and aquatic at similar and almost the same age. Twenty-five samples of leaves with petioles of different trees in the same region were collected from each location. The samples were kept in plastic bags and then, transferred to the laboratory for studying stomata index characters and anatomical features. A histological examination was conducted to investigate the internal structure of leaves and petioles based on the methodology described by Al-Mukhtar *et al.* (1982). To achieve fixation, a formalin acetic acid-alcohol solution (FAA) was prepared by combining 90 ml of 70% ethanol, 5 ml of glacial acetic acid (GAA), and 5 ml of formalin. Specimens were immersed in the FAA solution for duration of 24 hours. Subsequently, the samples underwent a dehydration process involving a series of ascending ethanol (EtOH) concentrations (50%, 70%, 80%, 90%, and 99%), with each step lasting 45 minutes. Following this, the samples were transferred through combinations of absolute alcohol and xylene as follows: 1. A mixture of absolute alcohol and xylene in a 3:1 ratio (45 min); 2. An equal mixture of xylene and absolute alcohol (1:1) for 45 minutes; 3. A mixture of xylene and absolute alcohol in a 3:1 ratio (45 minutes); 4. Pure xylene for 2-3 minutes; 5. Micro-grafted samples were infiltrated with a mixture of xylene (1/3) and paraffin (2/3) at room temperature (20-22 °C) for 35 minutes. The specimens were embedded in freshly melted paraffin and allowed to solidify at 60°C for 24-72 hours. Subsequently, the tissue blocks were sectioned into slices with a thickness of 9-12 µm using a razor blade. A ribbon of wax measuring 2-3 cm was placed onto clean slides coated with adhesive gelatin, prepared by suspending gelatin in water for 12-24 hours. The slides, along with sections, were passed through a series of alcohol and xylene baths to remove the wax, followed by hydration in alcohol concentrations for 10 minutes. Following these procedures, the sections were stained with fast green for 10 minutes and safranin for 24-72 hours, as per Brooks *et al.* (1950). Finally, the slides were mounted with Canada balsam, covered with cover slips, and allowed to dry on a hot plate (40°C) for 24 hours. The prepared slides were systematically examined under a light microscope (Motic, India) and photographed using a Dino-eye microscope (eyepiece digital camera). Various anatomical features of the leaves, such as blade thickness, upper and lower cuticle thickness, upper and lower epidermis thickness, palisade and spongy layers thickness, were measured. Additionally, several parameters of the leaf petiole, including the thickness of the upper and lower cuticle, upper and lower epidermis, and cortex layer (collenchyma and parenchyma), as well as primary and secondary vascular and pith diameters, were investigated. Cuticular structures were examined through the selection of mature leaves, which were dehydrated using 90% ethyl alcohol, stored in 70% ethanol, washed with distilled water, dried, and then subjected to a treatment involving a mixture of glacial acetic acid and hydrogen peroxide (1:1) followed by heating in an oven at 60°C for 20-40 hours.

Depending on the species. Adaxial and abaxial peelings from the macerated leaves were stained with safranin glycerin jelly, and mounted on microscopic slides (Shareef, 2016). The following measurements were recorded, an average of 25 observations for each. 1. Epidermal cell density = number of epidermal cells/mm^2. 2. Stomatal dimensions. 3. Abxial and epidermal cell dimensions 4. Stomatal index% = {stomata density /(stomata density +epidermal cell density}*100. 5. Stomatal density= (number of stomata /$mm^{2)}$ .The slides were systematically examined under a magnifying microscope .where the regions were carefully studied and Photographed.

RESULTS

Foliar structure dimensions:

Anatomical features has been made to study the internal structure and the measurements of lamina by measuring lamina thickness, upper and lower cuticle thickness, upper and lower epidermis cells thickness, and mesophyll layer thickness (palisade and spongy) in addition to; the cuticular structure in 25 random values of each parameter in different sections and conclude the mean and range value (higher and lower value) of each one for different leaves grown in two environments (aquatic and terrestrial).

Concerning the internal structure of the lamina-grown in different regions in two environments, figures 1 and 2 exhibits that:

1. Adaxial and abaxial surfaces are covered by a layer of cuticle.
2. Upper and lower epidermis consists of single raw compact rectangular cells free of intercellular space.
3. Mesophyll layer consists of palisade and spongy parenchyma tissues. The palisade layer consists of a single layer of longitudinally elongated cells. Spongy layers are composed of many layers of loosely arranged rounded or ovate shape cells.

In general, through Table (1) it has been clarified the dimensions of the lamina structure and the results are indicated that the thickness of the blades of the Jamanki region (220.85 µm) exceeds the two locations (Karago 215.928 µm) and (Havandka 158.55 µm). Furthermore, the type of environment also is shown that the aquatic environment gains a thicker blade (203.279 µm) than the terrestrial one (193.609). Additionally, there were differences in the thickness of the upper cuticle as a result of the growing environment that records 5.181, 4.665, and 3.895 µm and reduced in the lower cuticle thickness that reached 4.244, 3.48, and 3.439 µm in Havanday, Karago, and Chamanki respectively. Meanwhile, there were non-valuable differences according to the type of environment in terrestrial (4.5 µm) and (4.6 µm) in the aquatic environment, while these differences were more clear in lower cuticle surface (4.09 terrestrial, 3.35 µm in aquatic) Figure (1A and B).

Table 1. *Platanus orientalis* L. Blade measurements grown in Aquatic and terrestrial environments.

Location	Environment	Stat. Values	Studded parameters						
			Upper cuticle thickness (µm)	Upper epidermis thickness (µm)	Palisade layer thickness (µm)	Spongy layer thickness (µm)	Lower cuticle thickness (µm)	Lower epidermis thickness (µm)	Blade thickness (µm)
Chamanki Valley	Aquatic	Mean	3.833	10.344	38.339	91.251	2.769	8.76	215.621
		Range	6.048-2.592	12.96-8.683	50.98-23.344	109.73-69.12	4.589-1.298	12.348-5.233	249.329-173.19
	Terrestrial	Mean	3.959	14.789	47.166	77.339	4.11	17.056	226.088
		Range	6.1092.592	19.872-9.504	63.095-32.073	101.644.53.04	5.532-2.592	22.53-12.844	275.81-173.371
Karago Valley	Aquatic	Mean	4.99	14.808	49.262	72.359	3.636	12.141	250.969
		Range	7.125-3.456	19.008-8.683	63.078-34.657	87.332-53.742	5.255-2.592	14.865-7.776	297.647-219.699
	Terrestrial	Mean	4.341	18.661	33.221	62.774	3.34	18.746	180.887
		Range	7.125-1.222	27.769-12.127	45.003-21.669	73.623-50.142	4.406-1.728	25.115-12.989	235.526-133.033
Havandka Valley	Aquatic	Mean	5.12	12.225	36.349	32.598	3.668	7.165	143.249
		Range	6.966-2.732	19.184-7.776	51.239-15.31	42.415-27.648	6.109-1.932	12.127-4.406	177.587-103.604
	Terrestrial	Mean	5.243	11.131	53.421	74.252	4.821	10.929	173.852
		Range	6.966-3.456	16.507-7.776	60.634-45.003	88.335-63.543	6.912-2.592	16.416-6.912	198.877-140.823
	Effect of Location	Chamanki	3.895	12.566	42.75	84.295	3.439	12.908	220.851
		Karago	4.665	16.73	41.241	67.566	3.48	15.448	215.928
		Havandka	5.181	11.678	44.85	53.425	4.244	9.062	158.550
	Effect of environment	Aquqtic	4.647	12.459	41.31	65.402	3.357	9.355	203.279
		Terrestrial	4.514	14.86	44.60	71.455	4.090	15.577	193.609

Regarding the dimensions of the upper and the lower epidermal cells, the data has clarified that the Karago Valley samples have been shown thicker epidermal cells (16.73 µm) followed by Chamanki (12.566 µm) and Havandka (11.678 µm), similar behavior was found concerning the lower epidermis (15.448, 12.908, and 9.062 µm in Karago, Chamanki, and Havandka respectively. On the other hand, the plants have grown in terrestrial environments gain thicker upper (14.86, 12.459 µm) and lower epidermal cells (15.577, 9.355 µm) than lower ones.

Concerning the mesophyll layer, both the palisade and spongy layer has grown in the terrestrial environment where thicker than the aquatic one, the terrestrial samples were recorded 44.60 µm compared with 41.31 µm grown in aquatic environments. Similar trends were found in the measurements of the spongy layer by recording 71.455 µm in terrestrial and 65.402 µmin aquatic ones. On the other hand, the spongy layer was thicker in the Chamanki Valley site (67.566 µm) followed by Karago (67.566 µm) and (53.425 µm) in Havandka.

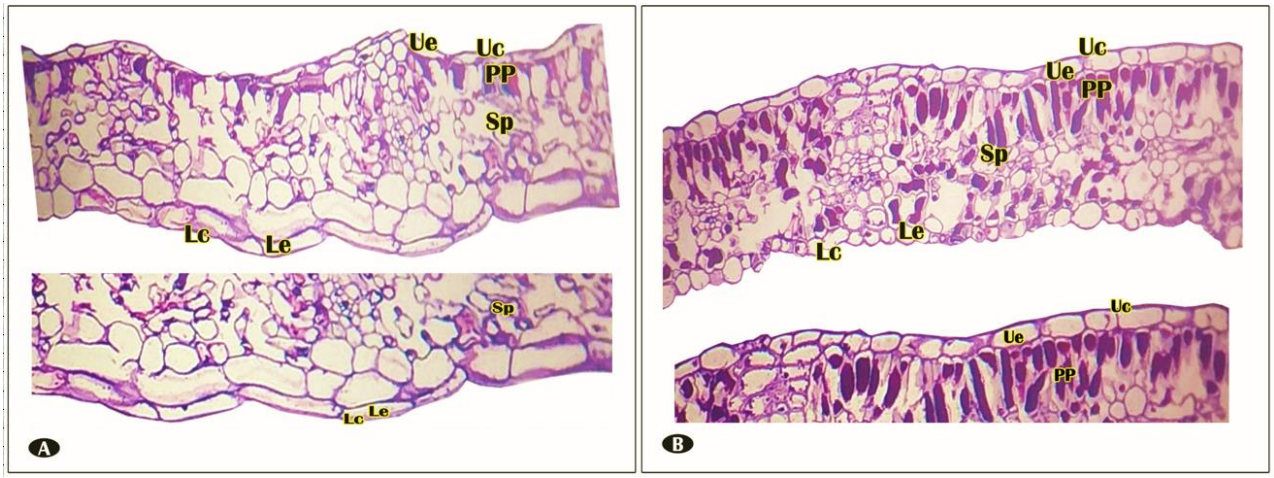

Fig. 1. (A) Blade transverse section of *Platunus orientalis* L. grown in Aquatic Environment. Upper epidermis (Ue), Lower epidermis (Le), Upper cuticle (Uc), Lower cuticle (Lc) palisade- parenchyma (PP) and, Spongy parenchyma (SP). (B) Blade transverse section of *Platunus orientalis* L. grown in Terrestrial environment. Scale bar 43 µm

The measurements of the lamina surface section figure (2C and D) and Table (2)has showed that the number of the cells/ mm^2 on the upper surface contains more than the number of cells on the lower surface, on the other hand, the cells in the adaxial surface of both Chamanki and Havandka (285, 284/mm2) was closed and less in Karago (266), while in the abaxial surface both Chamanki and karago (206, 209) contain almost same number of cell compared to Havandka which showed less number of cell (199.5). At the same time, the number of cells mm^2 in the Aquatic environment showed a higher number (284.5/mm^2) than the terrestrial environment (272/mm^2) in the upper surface, while the terrestrial environment records a higher number (217 mm^2) than aquatic one (192/mm^2).

Table 2. Adaxial and abaxial surfaces cells measurements of *Platanus orientalisL*. grown in Aquatic and terrestrial environments

Location	Environment	Stat. Values	Adaxial epidermal cell			Abaxial epidermal cell		
			Cell length	Cell width	Cell no./ mm^2	Cell length	Cell width	Cell no./ mm^2
Chamanki Valley	Aquatic	Mean	51.931	37.52	267	28.721	15.06	202.56
		Range	62.304-41.998	50.876-20.776	296-240	36.852-20.569	19.887-11.068	220-188
	Terrestrial	Mean	51.345	35.121	303	41.16	20.284	210
		Range	62.998-41.887	49.887-18.887	328-280	52.014-33.109	26.879-13	244-180
Karago Valley	Aquatic	Mean	50.197	27.922	312	31.322	31.52	199
		Range	64.915-40.276	53.651-16.071	348-272	42.572-21.345	39.809-21.331	220-180
	Terrestrial	Mean	51.983	37.373	220	14.909	28.886	219
		Range	62.776-42.887	56.887-19.998	244-196	18.887-11.011	38.607-22.262	244-196
Havandka Valley	Aquatic	Mean	52.4188	38.044	274	14.287	30.626	177
		Range	62.776-42.887	56.887-20.998	308-236	17.888-10.307	41.108-23.251	196-160
	Terrestrial	Mean	51.939	36.822	295	14.153	30.151	222
		Range	62.777-42.887	56.887-19.998	312-272	19.952-6.801	39.13-21.808	248-200
	Effect of Location	Chamanki	51.638	36.32	285	34.94	17.672	206
		Karago	51.09	32.647	266	23.115	30.203	209
		HavandKa	52.178	36.933	284.5	14.22	30.388	199.5
	Effect of environment	Aquatic	51.515	34.495	284.3	24.776	25.735	192
		Terrestrial	51.755	36.438	272	23.407	26.440	217

Regarding the other dimensions of the epidermal cells in the adaxial surface, the results showed that there weren't huge differences in the cell length as a result of location and the environment while little differences were recorded in the width of the cells that Chamanki and Karago regions showed wider cells than

Havandka and the cells of the terrestrial environment was more abroad than aquatic samples. Un similar observations were found in the abaxial surface Chamanki showed longer (34.94) cells but less broad (17.672 µm) followed by karago (23.115µm), then the shorter cell in Havandka (14.22 µm). Furthermore, no valuable differences were found according to the environment.

Table 3. Cuticular structure and Stomata surface measurement of *Platanus orientalis* L. grown in aquatic and terrestrial environment

Location	Environment	Stat. Values	Studded parameters			
			Stomata Number mm²	Stomata length (µm)	Stomata width (µm)	Stomata index
Chamanki Valley	Aquatic	Mean	169	24.739	16.245	45.652
		Range	188-156	34.03-14.317	21.359-11.236	46.078-45.348
	Terrestrial	Mean	101	38.199	30.369	32.609
		Range	118-88	57.368-29.089	38.998-24.199	36.842-26.829
Karago Valley	Aquatic	Mean	141	25.28	18.941	41.497
		Range	164-120	36.477-17.102	23.345-15.206	47.126-36.144
	Terrestrial	Mean	93.44	18.075	27.812	29.171
		Range	120-72	22.652-14.008	33.25-23.411	36.25-24.05
Havandka Valley	Aquatic	Mean	185	16.285	20.976	51.195
		Range	200-172	19.039-11.884	24.52-14.887	55.056-46.739
	Terrestrial	Mean	143	15.404	22.839	39.176
		Range	164-120	18.857-12.5	28.503-16.007	43.181-35.869
	Effect of Location	Chamanki	135	31.469	23.307	39.13
		Karago	130	21.677	23.376	35.334
		Havanka	164	15.689	21.907	45.185
	Effect of Environment	Aquatic	165	22.101	28.081	46.114
		Terrestrial	112.48	23.895	27.007	33.652

Cuticular structure:

Regarding the internal micromorphology of the stomatal features of the lamina grown at three different regions and in two environments, Figure (2C and D) has been shown that this species is in hypostomatic condition, the stomata are absent in the adaxial surface (upper epidermis) and the stomata are anomocytic type scattered between the ordinary epidermal cells without subsidiary or accessory epidermal cells. Each stoma consists of pair of kidney shape guard cells that contain numerous chloroplasts.

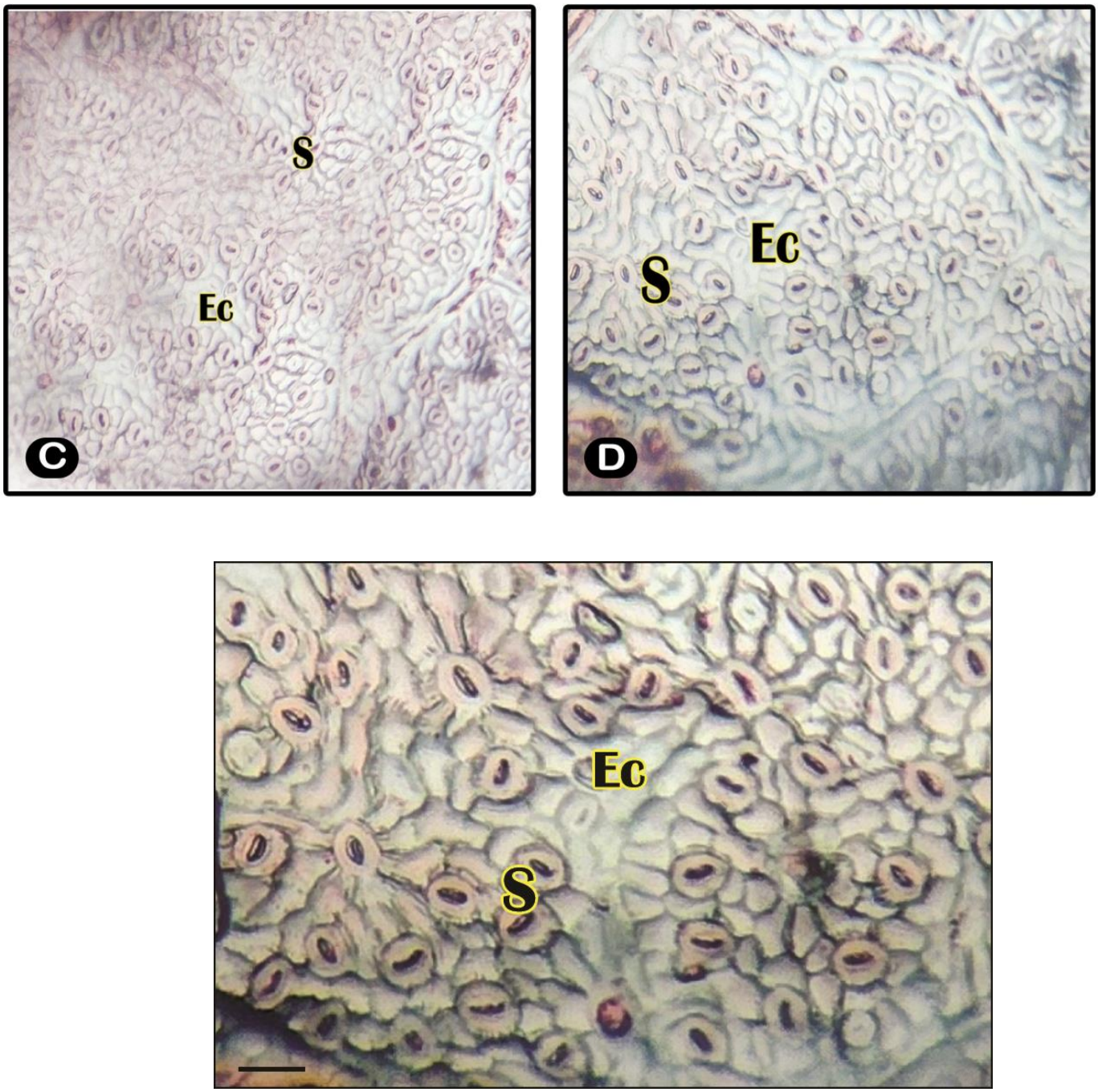

Fig. 2. (C) Cutucular structure and epidermal cells and stomata of the Abaxial surface of *Platanus orientalis* L. grown in an Aquatic environment. S: stomata; ES. Epidermal cells.(D).Epidermal cells and stomata of the Abaxial surface of *Platanus orientalis* L. grown in a terrestrial environment.100x

Stomata number reached the highest density in Havandka Valley (164/mm2) followed by Chamanki (135/mm2) and the lowest number (130/mm^2) was found in Karago region. On the other hand, a huge number of stomata were found in the leaves that grew in the aquatic environment (165/mm^2) when compared with the terrestrial environment (112.48/mm^2).

Furthermore, both the length and width of leaves are grown in Chamanki region records higher value (31.469, and 23.307 µm) respectively while Havandka samples gain less length 15.689 and width 21.907 µm. Meanwhile, the plants that has been grown in terrestrial environments gain higher length (23.895 µm) with less width, but the aquatic plants show an opposite response that records less width (27.0) and higher length 28.08 µm.

In the concern stomata index, the Havandka region records a higher stomata index 45.185 followed by Chamanki (39.13) and then Karago region (35.334). Furthermore, the trees has grown in the aquatic environment record a higher index (46.114) compared with the bigger size of the stomata recorded at *in vitro* stage followed by the terrestrial environment (33.652). the presence of stomata in the lower epidermis is to reduce the direct effects of the sun and other environmental factors that affect metabolic activities and the transpiration rate.

Petiole structure:

Concerning the internal micromorphology of the leaf petiole grown under different sites and environments, the transverse section Figures (3E and F) declares that:

Petiole outlines at the midpoint in both terrestrial and aquatic environments are almost circular in shape with outside-in invaginations which look like two groups of vascular bundles the upper group consists of an almost irregular ring of primary vascular bundles and the second lower group of a regular ring of open vascular bundles. A layer of the cuticle has covered the epidermis which is composed of a single layer of compact almost circular shape cells, beneath the epidermis many layers represent the cortex which differentiates into hypodermal collenchyma's tissue are followed by a bulk of parenchyma tissues layers. The anatomical characterization of petiole always goes along with their lamina midrib, which represents the vascular bundle that contains both xylem towards the adaxial face and the phloem towards the abaxial face separated by 3 - 4 layers of flattened compact cells representing the cambium tissue.

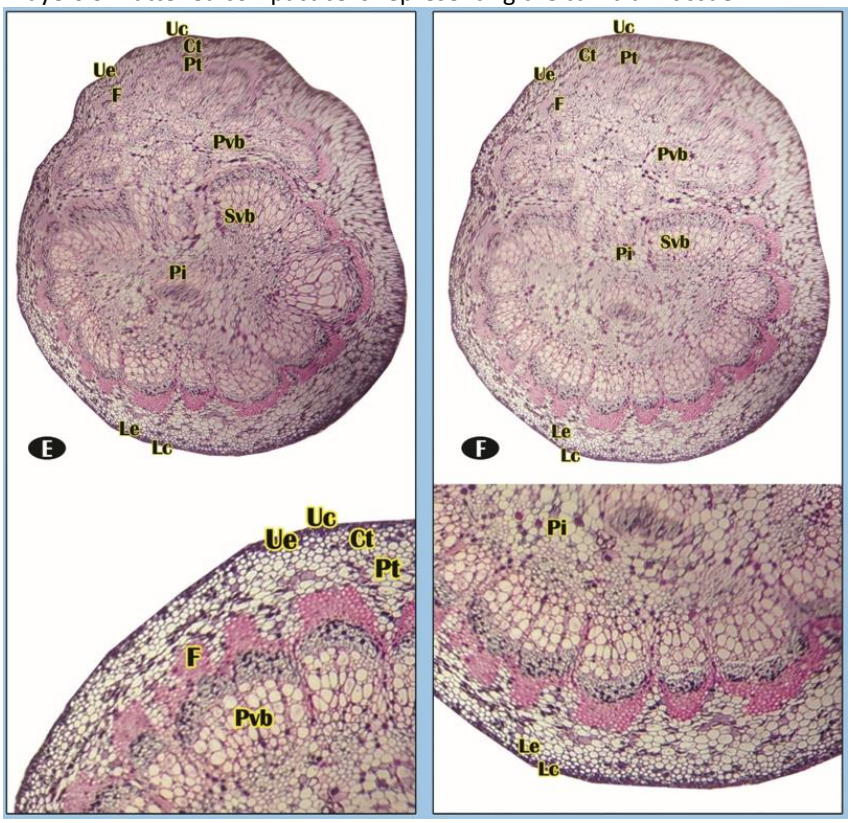

Fig. 3. (E). Petiole transverse section of *Platanus orientalis* L. grown in a aquatic environment. Upper epidermis (Ue), Upper cuticle (Uc), Lower epidermis (Le), Lower cuticle (Lc), Collenchyma tissue (Ct), Parenchyma tissue Pt, Fibrosis layer (F), Primary vascular bundle, (Pvb), Secondary vascular bundle (Svb), and Pith (Pi). (F) Petiole transverse section of *Platanus orientalis* L. grown in a terrestrial environment. Scale bar 3µm.

Regarding the petiole constituents dimensions, permanent sections of *planatnus orientalis* petioles were examined to explain the changes in the internal dimensions values of constituent tissues (the thickness of: Cuticle, Epidermal cell, Cortex (parenchyma and collenchyma), fiber layer and vascular bundle cap, primary vascular and meta vascular bundle, and pith).

The data obtained from Table (4A, B) state that:

The thickness of the upper cuticle layer was observed covering the petiole terrestrial Karago samples, and the less one was clear in Chamanki. There were no valuable differences in the thickness of the upper epidermis layer in all regions and environments.

The thickness of the lower cuticle layer in terrestrial Karago samples, and the less one was clear in Jamanki. There were no valuable differences in the thickness of the lower epidermis layer in all regions although the terrestrial environment shows thicker lower epidermis. The thickness of both collenchyma and sclerenchyma tissue in the Chamanki petioles cortex exceeds Karago and Havandka cortex which records less thickness in terrestrial samples compared with the terrestrial environment.

Primary vascular bundles of the Chamanki region have gained bigger and thicker bundles compared to Karago and Havandka while the type of environment didn't show worthy differences. Moreover, the thickness of their bundle cap that consist of fibers exhibits a similar response to the primary vascular bundle.

Vascular bundles of the Garko region have grown in terrestrial environment records bigger and thicker bundles in Chamanki and Havandka compared to the Garko regions. Furthermore, the thickness of their bundle cap that consist of fibers exhibits that the Chamanki terrestrial environment creates higher thickness compared with the other two regions.

Pith layers occupied the center of the sections which were wider in terrestrial sections of the Jamanki site followed by Havandka then by Karago region.

Table 4(A). Leaf petioles component measurements of *Platanus orientalis* L. grown in Aquatic and terrestrial environments.

Location	Environment	Stat. Values	Studded parameters					
			Upper cuticle thickness (µm)	Upper epidermis thickness (µm)	Collenchyma thickness (µm)	Parenchyma thickness (µm)	Sclerenchyma thickness (µm)	Primary vascular bundle thickness
Chamanki Valley	Aquatic	Mean	1.526	8.101	57.267	92.39	67.196	273.062
		Range	2.613-0.945	11.009-5.962	74.894-42.345	103.015-77.592	75.212-56.166	319.414-179.014
	Terrestrial	Mean	4.257	8.381	47.607	169.589	69.201	251.113
		Range	6.109-2.654	12.371-5.038	66.387-31.116	202.471-135.89	86.439-52.732	292.135-221.185
Karago Valley	Aquatic	Mean	4.96	6.622	40.534	165.872	44.672	139.996
		Range	7.966-3.115	12.371-3.666	68.392-24.453	212.526-126.501	54.878-35.17	170.582-83.527
	Terrestrial	Mean	6.581	9.698	31.816	93.062	58.191	160.067
		Range	9.184-4.32	14.302-7.125	46.664-24.741	125.327-73.078	74.444-39.138	193.622-140.818
Havandka Valley	Aquatic	Mean	3.951	7.699	29.119	50.682	50.398	145.353
		Range	5.532-2.592	10.404-5.464	42.186-17.622	66.618-40.34	62.022-32.432	158.461-127.075
	Terrestrial	Mean	5.482	8.727	8.87	83.119	55.835	172.792
		Range	7.824-3.213	12.371-6.29	12.371-6.29	105.344-60.634	65.173-39.828	201.517-145.657
	Effect of Location	Chamanki	2.891	8.241	52.437	130.987	68.397	262
		Karago	5.77	8.16	36.175	129.467	51.431	150
		Havandka	4.716	8.213	18.994	66.9	53.116	159
	Effect of Environment	Aquatic	3.479	7.474	42.306	154.944	54.266	186
		Terrestrial	5.44	8.935	29.221	115.256	61.075	194

Table 4(B). Leaf petioles section measurements of *Platanus orientalis* L. grown in Aquatic and terrestrial environments.

Location	Environment	Stat. Values	Studded parameters				
			Lower cuticle thickness (µm)	Lower epidermis thickness (µm)	Seclernchyma thickness (µm)	Vascular bundle thickness (µm)	Pith thickness (µm)
Chamanki Valley	Aquatic	Mean	1.112	7.101	52.817	169.639	112.346
		Range	2.011-1.945	10.009-5.162	59.987-45.711	198.811-138.887	131.988-95.919
	Terrestrial	Mean	3.257	7.381	52.598	173.342	114.498
		Range	5.109-1.654	11.371-5.038	60.904-44.275	213-828-136.405	124.988-105.919
Karago Valley	Aquatic	Mean	3.96	5.622	47.717	222.954	89.682
		Range	6.966-2.815	10.371-3.666	59.516-35.519	263.206-180.278	97.053-72.679
	Terrestrial	Mean	5.581	8.698	68.127	171.333	148.718
		Range	8.184-3.32	12.302-6.125	93.492-43.587	191.225-150.271	215.05-75.737
Havandka Valley	Aquatic	Mean	2.951	6.699	44.151	126.778	157.244
		Range	4.532-2.092	9.404-4.464	53.943-28.616	155.79-105.51	171.59-141.68
	Terrestrial	Mean	4.482	7.727	49.746	158.266	146.917
		Range	6.824-2.213	10.371-5.29	63.784-39.95	224.654-128.224	162.367-130.558
	Effect of location	Chamanki	2.185	7.241	52.707	342.981	113.422
		Karago	4.77	7.16	57.922	171.143	119.2
		Havandka	3.716	7.21	46.948	142.522	152.161
	Effect of Environment	Aquatic	2.743	6.474	48.228	173.123	119.757
		Terrestrial	4.44	7.935	56.823	167.647	136.711

DISCUSSION

According to previous results by investigating the histological of the internal structure and the measurements of the lamina (lamina thickness, upper and lower cuticle thickness, upper and lower epidermis cells thickness, and mesophyll layer thickness (palisade and spongy) in addition to; the cuticular structure, the differences between the same species grown in different environment has been shown that the aquatic environment gains a thicker blade, this may be due to the full target cells which results to increase the size of this cells, hence increase the blade thickness of the trees have been grown in aquatic environment. Moreover, thicker cuticles covering the upper epidermis to provide the underlined tissue more resistance to biotic stress factors.

Concerning the mesophyll layer, both the palisade and spongy layer grown in the terrestrial environment were thicker than the aquatic one, may be this behavior is presented that terrestrial samples need a large number of mesophyll layers to increase the amount of uptake sunlight and also to improve the rate of photosynthesis besides other physiological reactions ensure the presence of the synthesized food needed for energy.

The presence of stomata in the lower epidermis is to reduce the direct effects of the sun and other environmental factors that affect metabolic activities and reduce the transpiration rate These results are agreed with the study of (Sargin, 2021) who mentioned that the *platanus* leaves are dorsoventral by contrast the stomata are normocytic type, and The mean tracheal diameter of *P. orientalis* in leaf lamina was 35.6 µm while that of *L. orientalis* was 17.6 µm..This value was estimated to be 29 and 10.2 µm in the petioles of *Platanus* and *Liquidambar*, respectively.

Leaf anatomy is highly adaptable to environmental conditions (Kröber *et al.,* 2015; Stojnić *et al*., 2016) and closely linked to temperature and water gradients (Doria et al., 2019). The presence of distinct tissues (epidermis, parenchyma, collenchyma, and sclerenchyma) can indicate the conditions to which plants are exposed. Additionally, Levionnois *et al*. (2020) found that information related to petiole biomechanics is commonly used to explain relationships between structure and anatomy, such as the size of epidermal cells and cross-sectional geometry compared with the size of the leaf blade, petiole stiffness, bending capacity, or

leaf angle. On the other hand, petiole anatomical studies are mainly descriptive, focusing on the characterization of distinct taxa; Palacios-Rios *et al*. (2019), Ganem *et al*. (2019), and Karaismailoğlu (2020).
The above results are correspond with those mentioned by (Gratani, *et al*., 2020) during their study on *Platunus acerifolia* trees in Rome in response to different pollution levels and found that the different anatomical properties such as total leaf thickness, spongy parenchyma, and palisade parenchyma and the stomatal index. Meanwhile, the similar internal structure of the *Platanus orientalis* has grown naturally in different environmental conditions in Duhok city in Iraq is due to the same genetic makeup of the same species although of geographic variation. Furthermore, the current results were in harmony with the results of Sargin, (2021).

CONCLUSION

According to the above results, it can be concluded that the internal structure of the of *planatnus orientalis* L. will remain to include the same internal structures while the measurements of the constituents' parts of both leaves and petioles will differ according to the site and growth environment.

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التركيب الداخلي لنبات الدلب المشرقي .*Platanus orientalis* L النامي في بيئات مختلفة في كوردستان العراق

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أجريت الدراسة لبحث تأثير توزيع أشجار نبات الدلب المشرقي في موقعين مختلفين ناميين لبيئتين مختلفتين (بيئة أرضية يابسة وأخرى مائية) على بعض الصفات التشريحية والثغور النامية في محافظة دهوك، إقليم كوردستان العراق في شهر يوليو 2022 . اشارت النتائج الى ان التركيب الداخلي لنصل ورقة في كل مواقع الدراسة قد أظهرت تركيبا مشابها في مكونات الأجزاء الداخلية واختلافات جوهرية في الابعاد وقياسات الأجزاء المؤلفة للتركيب الداخلي لنصل الورقة وأذيناتها. ومن ناحية أخرى فان العديد من الصفات الأخرى المدروسة المهمة قد سجلت كنتيجة لاختلاف مواقع النمو والبيئة التي تعيش فيها.

الكلمات المفتاحية : نبات الدلب المشرقي، نصل الورقة ، سويقه الورق، التشريح الداخلي ، الشد غير الحيوي