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Article

Anatomical study of the roots of seven varieties of date palm (*Phoenix dactylifera* L.)

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ABSTRACT

This study was conducted at one of the private orchards to determine the variety through the anatomical characteristics of the roots; three palm trees were selected for each variety, identical, 15-18 years of age. The anatomical characteristics of the roots of seven date palm varieties were studied. The studied traits were circumferential circle diameter, phloem bundle length, xylem bundle length, next xylem, epidermis, sub-epidermal, fibrous bundle, cortex, and the diameter of parenchymal cells. Results show that the studied varieties differed in the studied anatomical characteristics. The Khadrawi variety was significantly superior in the characteristic of the surrounding circle diameter compared to the rest of the studied varieties, The Barhi variety was significant in the cortex and phloem bundle length, The Asabee Al-Aroos variety was distinguished in the characteristic of epidermis thickness, and the lowest values were in the variety Halawi. The Halawi variety was distinguished by the thickness of the sub-epidermal area, and the lowest values were in the Barhi variety.

Keywords: Anatomical study, roots, seven varieties, date palm (*Phoenix dactylifera* L.)

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) belongs to the Arecaceae family and the order Palmacea. This family includes 200 genera, the most important of which are economically and in relation to human life, and four genera, including the genus Phoenix, to which the date palm belongs. Approximately 4000 species of date palm belong to these four genera[1].

The root system of the date palm is fibrous, widespread both vertically and horizontally, consisting of many adventitious roots attached to the base of the trunk and originating from the pericycle. Secondary lateral roots that arise from the peripheral region of the adventitious roots branch off, and the branching continues to reach the roots of the fifth degree in some areas of palm cultivation, forming the nutrition area[2, 3].

The anatomical structure of the roots of the date palm enabled it to withstand the lack of water in the soil, in addition to its ability to retain water more. Blum[4]

mentioned that the epidermis, which was cohesive to the roots, and the hardening of its cortex are among the characteristics that make it tolerant of drought. Ogburn and Edward[5] indicated that the root structure of the date palm enabled it to survive and grow. The roots in an adult date palm depend mainly on the new transverse roots resulting from the base of the stem of the palm[6]. Patakas[7] shows that environmental conditions cause changes in the structure, size and nature of different plants, and thus, they can adapt to unfavorable environmental conditions. The date palm has a complex root system that efficiently absorbs water and nutrients[8].
El-Bahr et al.[9] show that Anatomical characteristics of the roots and leaves of the tissue-grown date palm were on vascular elements in the roots of some copies, but it was found in other versions, as these vascular elements were at the beginning of their development, the topographical and anatomical differences between different copies were also noted. Fatima[10] found that the important characteristics from an anatomical point of view are the nature of the sclerosis in the outer and inner cortex area, the shape, number and size of the metaxylem vessels, and the size and shape of the phloem, mentioned that the anatomical characteristics can be used to identify the different date palm varieties. When studying the ecological importance of root anatomy in some date palm varieties, Fatima et al.[11] All studied varieties showed significant differences in root structures, which indicates the different evolutionary paths of date palm varieties.
Al-Rubaie[12] confirmed that studying the anatomical characteristics of the leaves and fruits of fruit trees is taxonomically important. The reason for the changes was attributed to the nature of the genetic characteristics of the variety and plant type, the characteristics of the leaf epidermis such as the dimensions of the epidermal cells, the thickness of the cell walls, the thickness of the upper and lower epidermis, the distribution of stomata on the surface of the upper and lower epidermis, their number and the characteristics of the cuticle such as its thickness and composition can be relied on in taxonomic studies. Sakr et al.[13] found significant differences in the studied anatomical samples of fruits between these varieties, which included the thickness of the epidermal layer, the cuticle and the layer of rock cells, as well as the thickness of the outer shell (Exocarp), the thickness of the outer and inner shell, the area of tannin cells between them, the number and density of tannin layers in the fruit.
The study aims to determine the anatomical characteristics of a group of common date palm varieties and the possibility of using them in distinguishing between those varieties.

MATERIALS AND METHODS

This study was conducted at a private orchards in the Abi Al-Khasib area in the Basra governorate. 3 palm trees were selected for each variety, identical in age (15-18) years, growth strength, size and tree service operations. Followed the method mentioned in Al-Attar[14] and Khafaji[15] in preparing the anatomical sections taken from Johouson (1968). Samples were taken from the adventitious roots at a distance of 1 m from the stem and a depth of 0.9 m from the soil surface. The fixation process of the samples was carried out for 24-48 hours in F.A.A. (Formalin, Acetic acid, Alcohol) in volume proportions (90 ml of 70% ethyl alcohol, 5 ml of glacial acetic acid and 5 ml of formalin). The samples were washed with running tap water, then with 70% ethyl alcohol, twice, one for an hour and the other for 18 hours, to eliminate the fixative solution's effects. The cut parts were passed with a mounting series of ethyl alcohol (95-90-80-70) for an hour in each of them for dehydration and then placed in absolute ethyl alcohol for a whole

night. The clearing was done by placing the specimens in a mixture of absolute ethyl alcohol and pure xylene in proportions of 1:3, 1:1, and 3:1 for 30 minutes each, transferred to a mixture (volume to volume) of xylene and paraffin wax in an oven at 60°C for 4 hours. The process of impregnation or impregnation was carried out by transferring the models to paraffin wax and placing them in an oven at 60° C for a whole night. Embedding was carried out by pouring pure paraffin wax that was melted in the oven at a temperature of 60° C into metal cubes; the samples were placed in them and marked and left to cool under running water for a whole night to be ready for cutting. After preparing the wax molds, trimming was carried out. Then, the sample was sectioned in the microtome, and the thickness of the desired sector was determined (7-12) microns. The mounts were loaded onto glass slides, and the slide was left to dry on a slide dryer (45) °C for 24 hours. The staining process was done by placing the glass slides in a Koblin lab containing ethyl alcohol with decreasing concentrations starting from absolute alcohol to 50% alcohol as follows: (50, 70, 80, 90, 95, 100 %) for 15 minutes for each concentration. Then, the slides were transferred to a Koblin lab containing safranin dye (prepared by dissolving 1 gm of dye in 100 ml of 70% ethyl alcohol) and left in the dye for 30-60 minutes. In order to remove the excess dye, the slides were transferred to a Koplin lab containing 50% ethyl alcohol and then placed in Fast Green for 15 seconds. Washed thoroughly with absolute alcohol, passed the xylene three times in a row for 5 minutes each time, then left for 5 minutes to dry. To keep the slides permanently, I used Canada Balm and D.P.X. Then, the coverslip was placed at an acute angle of 45 degrees, with great care, so as not to form air bubbles. Then, it was left to dry on the slide dryer at 60°C for several hours and examined under a microscope.

Statistical analysis

The data were analyzed using analysis of variance for all the studied traits using the SPSS statistical program to ensure that there are significant differences between the studied traits. Means were analyzed, and significance was tested according to the least significant difference test, averaged RLSD, and under a probability level of 0.05[16]. The relationship between the studied items was also drawn using Cluster analysis.

RESULTS

The study of anatomical characteristics included the diameter of the circumferential circle, the length of the phloem bundle, the length of the xylem bundle, the next xylem, the epidermis, subepidermal, fibrous bundle, cortex, and finally, the diameter of the parenchymal cells. Table 1 and figures (1,2,3,4) show that the studied varieties differ in the anatomical characteristics under study. The Khadrawi variety was significantly superior in the surrounding circle diameter compared to the rest of the studied varieties, reaching 164.45 µm. The Sayer variety recorded the lowest values of 128.7 µm; also note that the rest of the varieties differ in the significance of this trait. The Khasab variety was significant in the character of the following xylem and the characteristic of the diameter of the parenchyma cells, which reached 15.84 and 4.680 µm, respectively. Also, the Asabee Al-Aroos and Halawi varieties variety recorded the lowest values of 10.8 and 1,600 µm in these two traits, respectively. The Barhi variety was significant in the length of the phloem and cortex bundle, as it recorded 14.76 and 300.3 µm, with a clear significant difference from the rest of the varieties. The Fersi variety had the lowest values of 9 µm and the bride-toes variety 171.6 µm. Sayer variety was distinguished by two characteristics significantly, which are the length of the xylem bundle and the fibrous bundle, 25.92 and 19.8 µm, and the two varieties, Fersi and Sayer, recorded the lowest values significantly for the same traits, 12.6 and 9 µm, respectively.

The Asabee Al-Aroos distinguished in epidermis trait 21.45 µm, and the lowest values were in Halawi 7.2 µm; subepidermal, the variety Halawi was distinguished, recording 21.45 µm, and the lowest values were in Khadrawi 11.44 µm.

varieties	Di. Pericycle	Phloem bundle length	Xylem bundle length	Met-ax-ylem	Epidermis	sub epidermis	fibrous bundle	cortex	Di. Bronchyma Cells
Halloween	157.3	12.6	18	12.6	7.2	21.45	10.01	200.2	1.600
Sayr	128.7	12.6	25.92	14.4	11.44	12.87	19.8	185.9	2.140
Khdrawi	164.45	14.4	28.8	11.88	10.8	16.2	9	121.55	1.667
Barhi	158.54	14.76	25.2	12.6	20.02	11.44	11.44	300.3	3.600
Fersi	143	9	12.6	13.12	17.16	14.3	12.87	203.06	7.200
Asabee Al-Aroos	121.55	10.8	24.5	10.8	21.45	14.3	12.87	171.6	4.600
Khasab	160.16	12.6	24.48	15.84	15.73	12.87	14.4	235.56	4.680
RLSD$_{0.05}$	0.6686	0.7410	0.6751	0.1214	0.0948	0.1154	0.0944	0.1329	0.1828

Table 1. Anatomical features of seven varieties of date palm (µ m).

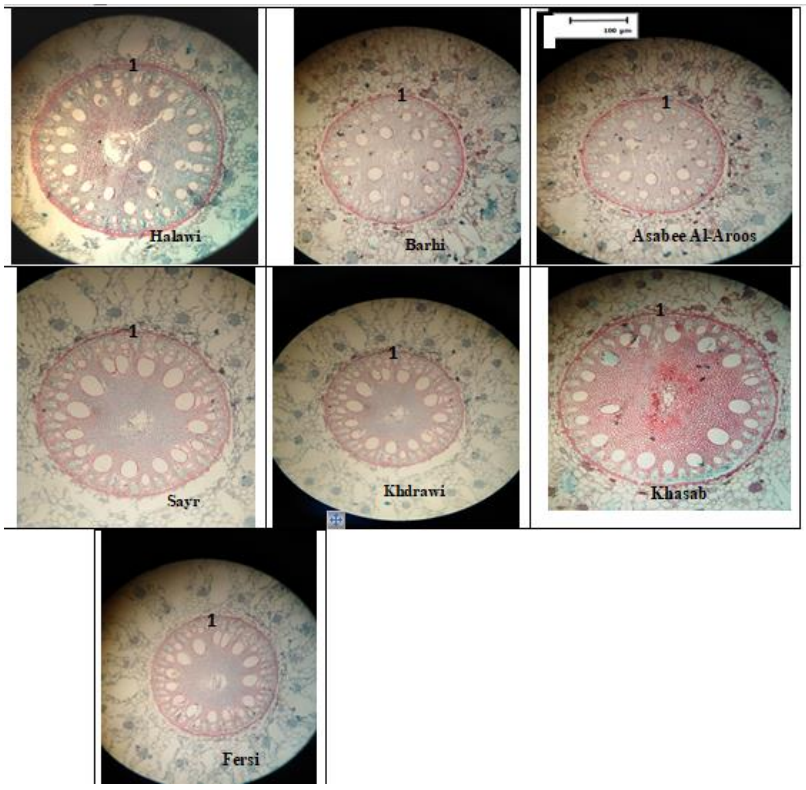

Figure 1. Microscopic picture Clarify Pericycle(1) The studied varieties.

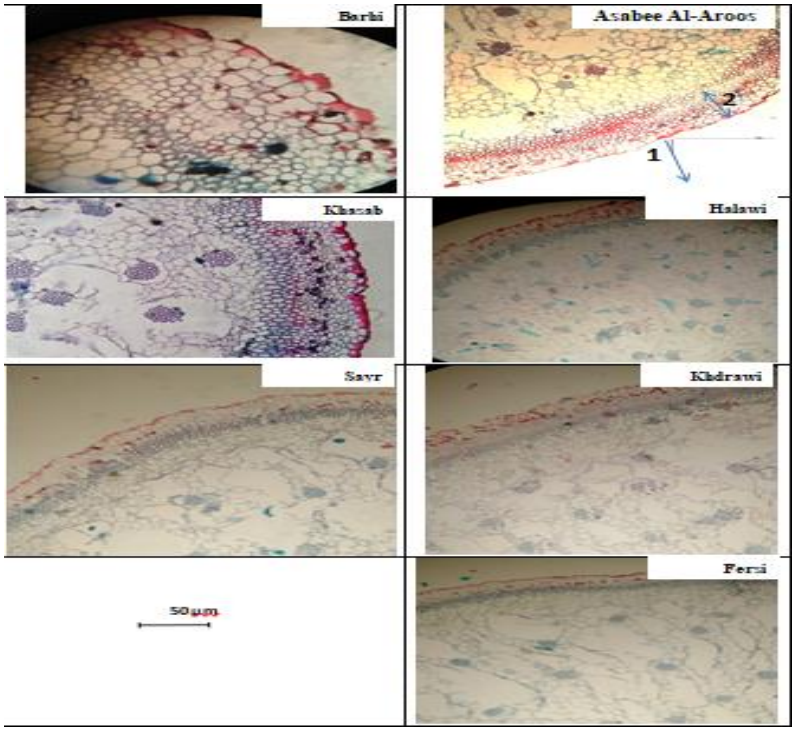

Figure 2. Microscopic pictures clarify epidermis (1) under the epidermis(2)to The studied varieties.

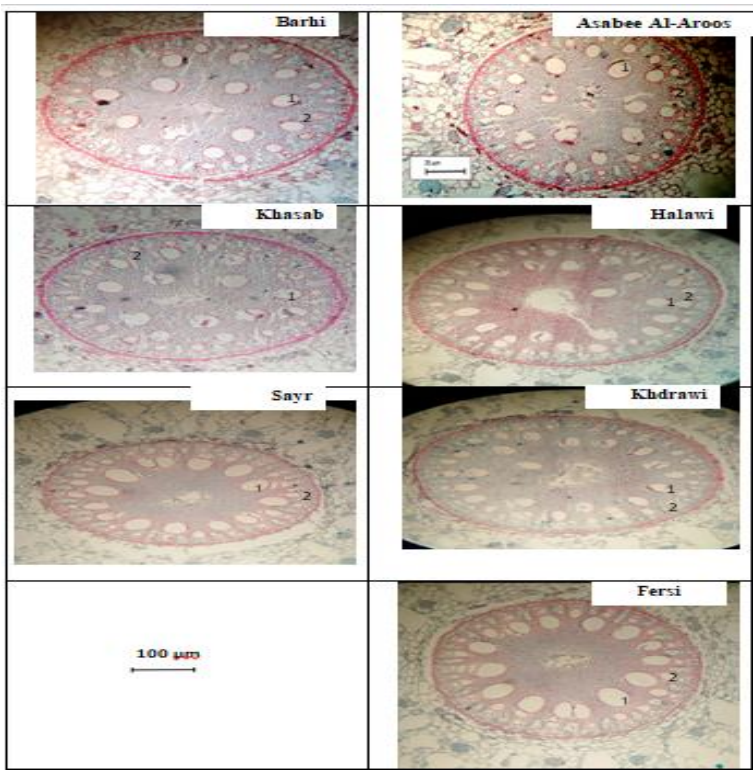

Figure 3. Microscopic picture clarify xylem (1) phloem (2)to The studied varieties.

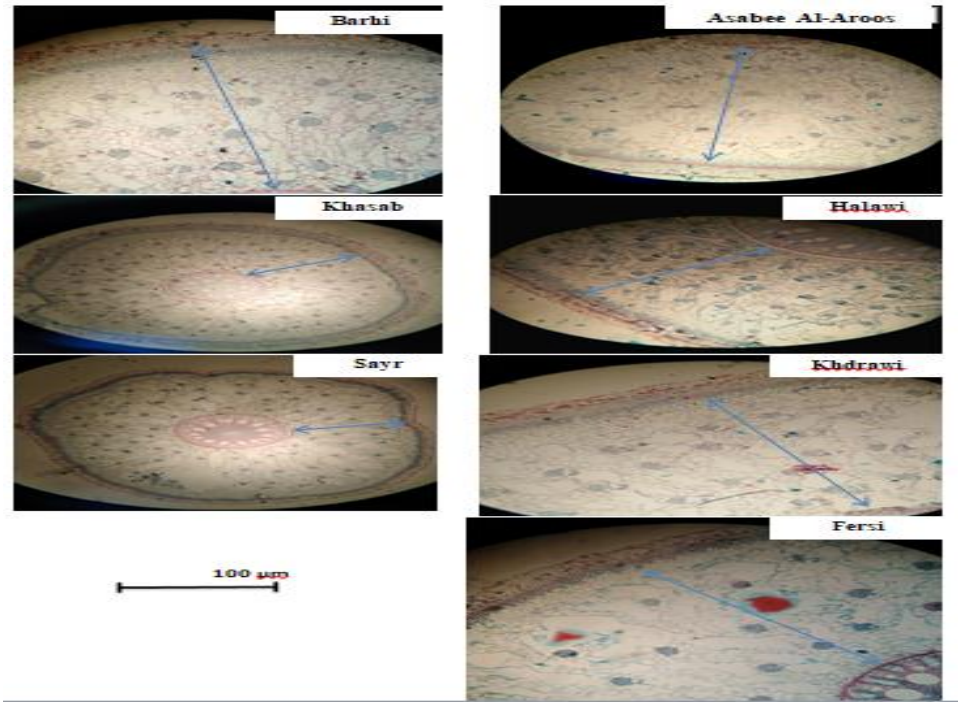

Figure 4. Microscopic picture clarifies cortex to The studied varieties.

The cluster analysis results showed the anatomical characteristics of the varieties under study; as shown in Figure 5, the Barhi variety falls into an independent group, moving away from the rest of the varieties in the degree of similarity. In comparison, the Khadrawi variety was independent in the second group, far from the others in his group in the degree of similarity. The rest of the variety fell under one group, in which the variety Khasab was independent, away from the rest of the variety of his group, while the highest similarity in the studied anatomical characteristics was between the equine and Halawi varieties on the one hand, and the satyr and Asabee Al-Aroos on the other hand.

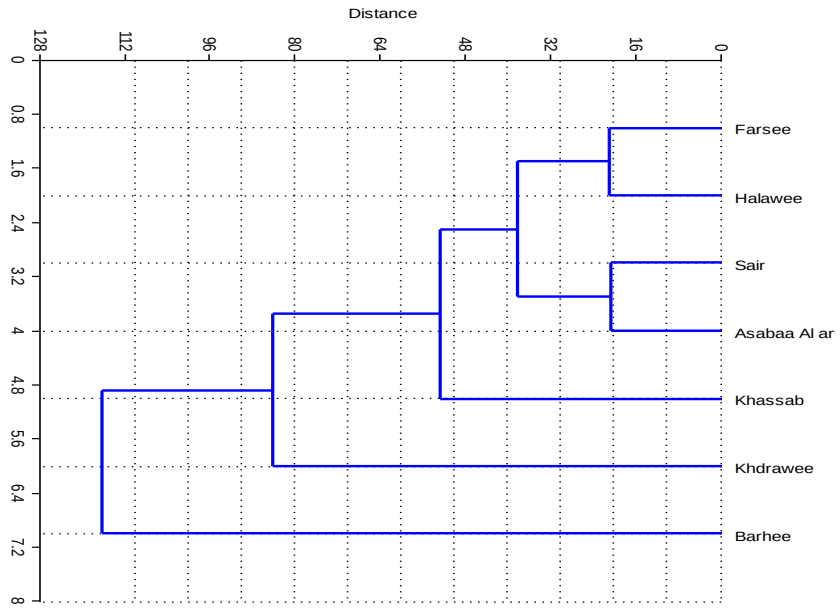

Figure 5. The degree of similarity in anatomical features between the taxa under study using cluster analysis.

DISCUSSION

The study results observed that the species are similar in some anatomical characteristics, which may be attributed to the similarity of the environmental conditions in which these species live, agreed with Abd El-Baky (2012), when studying the morphological and anatomical characteristics of the leaves of a group of soft and semi-dry date palm varieties and using them as taxonomic guides to distinguish between varieties, after analyzing the results using the numerical analysis method. The varieties that live in the same conditions and have the same moisture, temperature and soil type requirements were taxonomically close to each other compared to other varieties with different conditions and needs. Explained through his study that some anatomical characteristics in the leaves, such as the number of fibrous bundles and their diameters, the length and width of the large vascular bundle, the thickness of each of the blade and the mesophyll[18], the thickness of the xylem and phloem, and the number of mesophyll cells, of taxonomic importance for the separation of closely related taxa despite their presence in the same environment, accordingly, the studied traits can be considered as having important taxonomic importance in their taxonomic role to distinguish between varieties. These characteristics may be one of the reasons for the discrepancy in maturity among the date palm varieties in this study.

CONCLUSIONS

It is noted from the results of the study that the variety Barhi is isolated to an independent group when drawing the kinship tree.

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