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Taxonomical study of *Caroxylon jordanicola* (Eig) Akhani & Roalson (Amaranthaceae) in Al-Tar Caves, Karbala, Iraq

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Abstract--The present study dealt with the morphological, anatomical, trichomes pollen grains, and ecological characteristics of *Caroxylon jordanicola* (Eig) Akhani & Roalson (Amaranthaceae) in Al-Tar Caves, Karbala, Iraq which belongs to the Amaranthaceae family. The results of the present study demonstrated that there are distinctive characteristics of the studied species distinguish it from other species and facilitate its diagnosis. The sample was diagnosed using the taxonomic keys of the Iraqi flora and the flora of neighboring countries in addition to some available research. The results of the morphological and anatomical features investigation provide really significant taxonomical value to distinguish the species. The results that showed that this species is annual to 40 cm, semi-spherical, lower leaves 1-3 cm, caduceus, other leaves to 2.5 mm, with broad, has non-glandular trichomes and glandular trichomes. The species recorded 7 μm the average thickness of the cuticle layer. cortex thickness was also recorded and measured, which was 210 μm . the average thickness of Phloem was 40 μm . It has the presence of a bundle cap fibers (Bundle sheath) which consists of sclerenchyma fibers that appear in a ring around the Phloem. The average thickness of xylem was 190 μm and pith thickness was 240 μm .

Keywords---taxonomical study, *Caroxylon jordanicola*, Amaranthaceae, Al-Tar Caves, Karbala.

Introduction

Genus *Caroxylon* Thunb. is one of the largest genus of Amaranthaceae which have more than 130 species, very generally distributed in the saline marshes and most

parts of the world. In Iraq more than 23 species recorded distributed in different regions of Iraq. The name of the plant refers to the salty taste as well as the habitat [1].

morphological and anatomical characters give the better attestation in the plant taxonomy for both families and species [2], many investigations carried out for the plant morphology and anatomy showed that these characters provide very significant systematic value. Also both pollen grain identification and classification are very important for palynologists and systematists. Pollen morphology is not affected by environmental conditions, so it has been used as a reliable and important diagnostic key in taxonomic research. This species of halophytic plant bears salt as well as harsh climatic conditions [3,4]. It was noted that this plant could be used as livestock feed in the future, as it is a promising animal feed source in semi-arid regions as well as dry areas in various regions of the world [5]. This type is characterized by being rich in many plant components, especially a number of flavonoids, nitrogen compounds, phenolic compounds, triterpenes, saponins, sterols, coumarins, lignans, and cardiac glycosides. Various biological activities were also observed, including analgesic, antiviral, anti-inflammatory, anti-cancer, anti-bacterial, and hepatoprotective and cardioprotective activities [6]. As the species is known for its spread in the world, and it has a very important history of medicinal uses to treat many different diseases in what is known as the folk medicine system of many ancient civilizations [7]. A review of the sources shows the possibility of using the plant as a tea and also for medicinal purposes for many tribes, as well as traditional healers for the purpose of treating many diseases, especially infections and pain [8,9]. In addition, the plant is used as a laxative and diuretic, as well as an anthelmintic for the local population [10]. As a result of the lack of articles on this species in Iraq, this study aims to investigate the morphology, anatomical features of the stem, the characteristics of hairs and pollen grains, for the purpose of obtaining a more accurate picture of this species.

Materials and Methods

Plants collection and morphological study

This study has carried out in April, 2021 for the species *Caroxylonjordanicola* (Eig) Akhani & Roalson (Amaranthaceae) which dispersed in Al-Tar Caves, Karbala, Iraq. this study accredited for the fresh specimens which collected from wide fields. The samples were diagnosed using the taxonomic keys and then their external appearance was studied and important measurements were taken for this purpose. Morphological study, The sample was diagnosed using the taxonomic keys of the Iraqi flora and the flora of neighboring countries. In addition to some available research such as: [11,12] Measurements were taken in a laboratory of Plant and Environment in Iraq Natural History Research Center and Museum, University of Baghdad. Note that the measurements were recorded for the stem, leaves, flowers and fruits. the specimens were stored at the herbarium for Iraq Natural History Research Center and Museum/ University of. Baghdad.

Anatomical study

Preparing of epidermis

Epidermis for both: the stem and leaf were peeled, Stem peels, adaxial and abaxial surfaces of leaves were taken with a razor blade. Then, slides has been thoroughly studied under light microscope. The studied traits were: the shape, length, width of the epidermal cells, presence and absence the stomata at each epidermis, type of stomata, length and width of the guard cells.

Preparing of transverse sections

The fresh mature leaves and stem of ten plant replicates forthe species were washed with tap water, then by distilled water. The samples were cut for small pieces then fixed in FAA solution to 24 hrs.The samples were washed several times by 70% Ethyl Alcohol. After preparing, slides were observed using the compound light microscope. Microphotographs were taken by digital camera fitted on the light microscope. These microphotographs were very useful for the identification and differentiation the cells of this species [13].

Trichomes

The epidermis has been peeled off in order to study them, their diversity also the characteristics and density[14].

Pollen grains

The pollen grains were prepared for the study by light microscopy using the methods described by[15]. Required measurements have been taken: the diameter of Pollen, aperture diameter with pore numbers and exine thickness.

Results and Discussion

Morphological study

Annual to 40 cm, semi- spherical, with simple articulated hairs and white bladder hairs, glabrescent, lower leaves 1-3 cm, caduceus, other leaves to 2.5 mm, with broad, almost orbicular base, bracts broadly ovate, to 3mm. Perianth segments 2-3 mm long, ovate, with bladder hairs, at fruiting stage with mauve or white wings of 9-12mm across (Figure 1). Syn. *Salsolajordanicola*Eig, Hab. Sandy, gravelly and stony deserts, alt. 0-450 m, fl. Apr.- Jun., fr. Jun.- Nov.These results agree with [11].

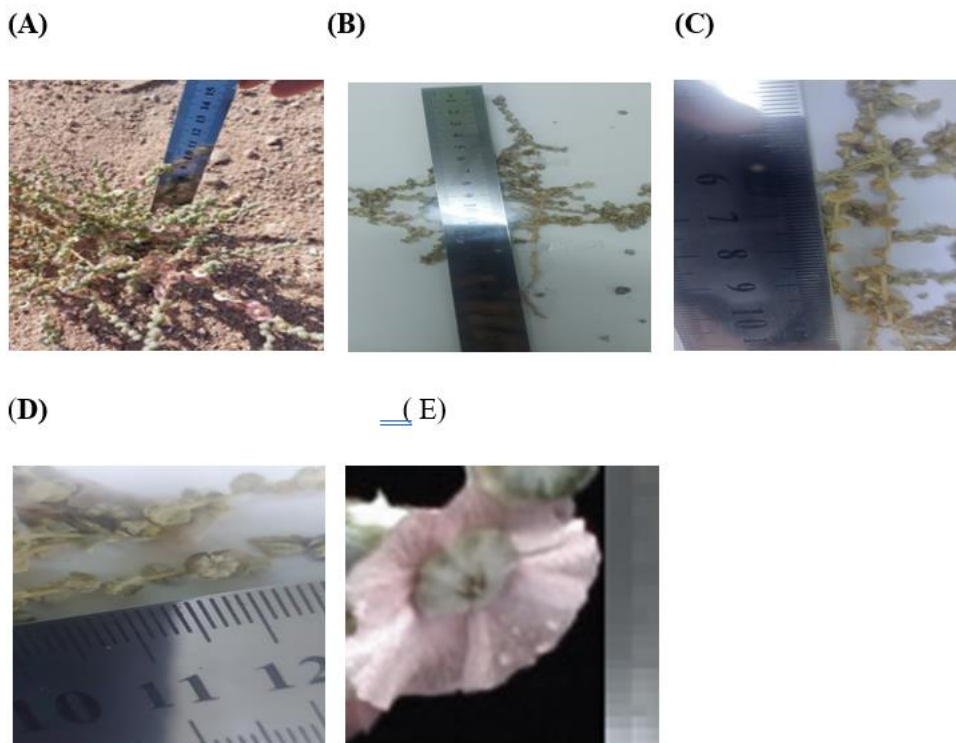


Figure 1 *Caroxylon jordanicola* a: whole plant, b: the stem, c: side branches, d: leaves and fruit, e: fruit

Anatomical study

The results of the study showed that the stem of the studied species was characterized by being circular in shape, not hollow. anisocytic, and tetracytic and polycytic types were appeared on the adaxial surface and anisocytic, tetracytic and diacytic types on the abaxial surface (Figure 2). The species recorded 7 μm the average thickness of the cuticle layer, the thick for this layer has been evidenced of the xerophytes, Also effected by genetic and environmental factors, while the average thickness of the epidermis layer was 12 μm , Also It was noted that the epidermis was distinguished by the presence of uniseriate with elongated cells. This species possesses a cortex with two zones, the first 1-2 layered was thin, oblong cells, the chlorenchyma cells found outside the cortex under the epidermis that capable for photosynthesis, Also this layer in stem of many plants. The cortex thickness was also recorded and measured, which was 210 μm [16,17]. This species lack crystals. After, we have endodermis which consist of single layer of round, square and rectangular cells with thick walls, followed by pericycle, which consist of one layer thin walled cells. We have noticed through measurements that the average thickness of phloem was 40 μm , It has the presence of a bundle cap fibers (bundle sheath) which consists of sclerenchyma fibers that appear in a ring around the phloem (Table 1). The average thicknes of xylem was 190 μm and pith thickness was 240 μm . This is what [18] referred to when studying some *Salsola* L. species (Chenopodiaceae) in southern Iraq.

Table 1 Anatomical features of a stem of the species

Cuticles Thickness (μm)	Epidermis Thickness (μm)	Cortex Thickness (μm)	Phloem Thickness (μm)	Xylem Thickness (μm)	Pith Thickness (μm)
(6-8)	(11-13)	240-180	45-55	210-170	200-280
7)	(12)	(210)	(40)	190)	240)

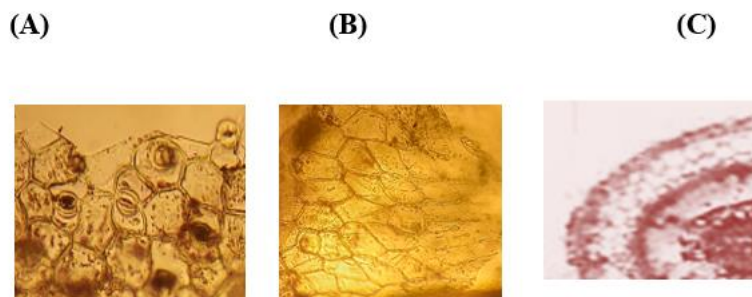


Figure 2 Ordinary epidermal cells and stomatal complexes of *Caroxylonjordanicola*
 a: Adaxial surface (2000X), b: Stem epidermis (2000X), c: anatomy of stem (310X)

Trichomes

The results of the study showed the presence of a very large diversity in the shapes of trichomes scattered in all parts of the plant, which are divided into non-glandular trichomes and glandular trichomes, which explain it in detail (Figure 3):

1- Non-glandular trichome:

a: It includes a wide number of different trichomes, depending on the shape and types, and it was placed in groups as follows:

- Simple straight unicellular trichomes of various lengths that oscillate in length with rounded apices.
- Thin trichomes, curved with acute apices.
- The trichomes are straight on one side and curved on the other side with rounded apices.
- The trichomes are broad and curved, but have a stronger curvature on one side with acute apices.
- Wide hooked trichomes on both sides with rounded apices.
- Wide hooked trichomes on one side with rounded apices.
- A vertical capillary on the surface of the epidermis with a broad base that narrows towards the other side and has short length.
- The trichome is similar to the previous one, but it tends towards the surface.
- stellate trichomes.

2-glandular trichomes, All these agree with [19]

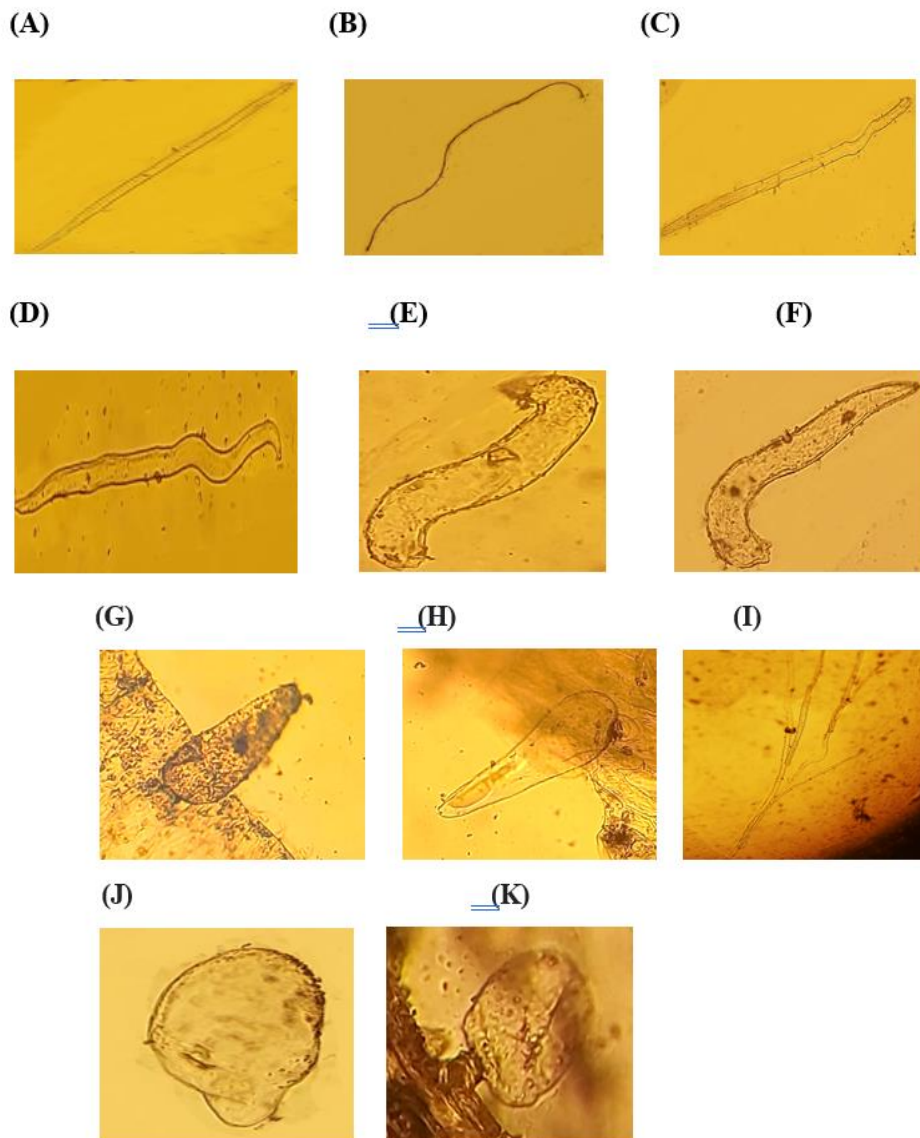


Figure 3 Non-glandular hairs and glandular hairs for *Caroxylonjordanicola* (500X)

Pollen grains

the pollen grains in this species was isopolar, radial symmetrical, polyporate, spheroidal, Also nano-spinulate ornamentation. The diameter was 20.22-23.54 μm ; The pore is circular; pore number 25-30, The diameter 4 μm , C/ D ratio. 0.40. The study showed that pollen morphology was very efficient in separating species and distinguishing between them, and also plays a key role in the formation of natural groups and also helps in evaluating the taxonomic relationship between, This is because pollen morphology can never be affected by environmental conditions, so it is used for reliable diagnosis in taxonomic

research. These results helped us a lot as one of the most important diagnostic features in an analytical and taxonomic study of pollen of Amaranthaceae species. Also this species recorded 29 pore numbers. One of the researchers mentioned that when the diameter of the pores is small, the number of pores increases [20].

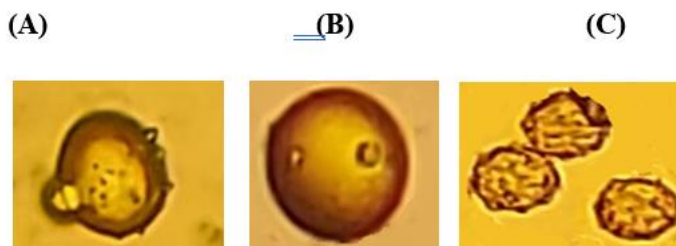


Figure 4 Pollen grain of *Caroxylon jordanicola*

Conclusion

Our present study dealt with the morphological, anatomical, pollen grains, trichomes and ecological characteristics of *Caroxylon jordanicola* (Eig) Akhiani & Roalson (Amaranthaceae) in Al-Tar Caves, Karbala, Iraq. In this study, several studies have been conducted in order to obtain the largest possible number of qualitative and quantitative characteristics for the purpose of diagnosing this plant species to increase its identification, especially since studies about it are very few in Iraq.

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