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A New Record Species From Zygophyllaceae for the Flora of Iraq: (*Tribulus arabicus* Hosni)

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Abstract

During the field survey of wild plants in the spring of 2024, the species *Tribulus arabicus* Hosni, which belongs to the Zygophyllaceae family, was observed and collected for the first time in Iraq as a new species to the Flora of Iraq, specifically in the Wadi Al-Ubaiyidh region, which is located between the latitude of 32° 2' 30" to 32° 3' 0" North, and the longitude of 42° 13' 30" to 42° 14' 0" East, adjacent to the Al-Nukhaib sub-district, located at an altitude of 305 m., and approximately 120 km. North of the Iraqi-Saudi border within Iraq's Western Desert District (DWD). The species was identified based on the Floras of neighboring countries, preceded by a comprehensive review of scientific references for wild plants. All herbaria were consulted to confirm the absence of the species in Iraq. The species was also subjected to taxonomic treatment by studying the reproductive and vegetative organs, as well as the anatomical description of the transverse section of the stem. A map of Iraq and a satellite image showing the distribution of the species have been placed. A morphological comparison was made between the newly recorded species and a similar species (*Tribulus macropterus* Boiss), which grows in Iraq. For the documentation of the new record for the species, some plant specimens were deposited in the Iraqi National Herbarium (BAG), the Baghdad University Herbarium (BUH), and the Anbar University Herbarium (AUH).

Keywords: *Tribulus* genus, Flora of Iraq, Desert plants, Stem anatomy, SEM

تسجيل جديد لنوع من العائلة Zygophyllaceae للموسوعة النباتية العراقية: (*Tribulus* (*arabicus* Hosni)

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خلال المسح الميداني للنباتات البرية في ربيع عام 2024، تم جمع النوع *Tribulus arabicus* Hosni والذي يتبع للعائلة Zygophyllaceae لأول مرة في العراق، كنوع جديد على الموسوعة النباتية العراقية، وبالتحديد في منطقة وادي الإبييض، والتي تقع بين خطي عرض 30° 2' 32° الى 0° 3' 32° شمالاً، وبين خطي طول 30° 13' 42° الى 0° 14' 42° شرقاً، والمحاذية لناحية النخيب، الواقعة على ارتفاع 350 متراً فوق مستوى سطح البحر، وحوالي 120 كيلومتراً شمال الحدود العراقية-السعودية ضمن مقاطعة الصحراء الغربية (DWD) من العراق. تم تشخيص النوع اعتماداً على موسوعات الدول المجاورة، إذ سبق ذلك مراجعة شاملة للمصادر العلمية الخاصة بالنباتات البرية ومنها الموسوعة النباتية العراقية، كما تمت مراجعة المعاشب العراقية للتأكد من عدم وجود النوع في العراق. تمت معاملة النوع تصنيفياً من خلال الدراسة المظهرية للأعضاء التكاثرية والخضرية، فضلاً عن الوصف التشريحي للمقطع المستعرض في الساق، كما وضعت خريطة العراق وصورة فضائية تبين توزيع النوع. وقد حرصت الدراسة الحالية على إجراء مقارنة مظهرية بين النوع المسجل جديداً والنوع المشابه له (*Tribulus macropterus* Boiss.) النامي في العراق. ومن أجل توثيق التسجيل الجديد للنوع، فقد تم إيداع بعض العينات الجافة في كلاً من المعشب الوطني العراقي (BAG)، ومعشب جامعة بغداد (BUH)، ومعشب جامعة الأنبار (AUH).

1. Introduction

Zygophyllaceae R.Br., classified under the order Zygophyllales, is a diverse family of flowering plants comprising 285 species, which are distributed among 22 accepted genera. This family is distributed throughout the drier tropics and subtropics of the world, generally in semi-arid climates [1]. Zygophyllaceae means the plant family of yoked or paired leaves, referring to the characteristic leaf structure found in many Zygophyllales species [2]. *Tribulus* L. has approximately 30 species worldwide. There are 9 taxa of *Tribulus* in Saudi Arabia [3]. This genus belongs to the Zygophyllaceae family and is widespread globally [4]. The species *Tribulus arabicus* Hosni is considered one of the common species in the Arabian Peninsula, as confirmed by numerous researchers who have documented its widespread distribution in this region [5, 6, 7].

This newly recorded species is among the most widespread in the Dammam region in eastern Saudi Arabia [8]. The species is also widely distributed (very common) in the United Arab Emirates [9]. In Yemen, *T. arabicus* has been considered one of the endemic and near-endemic species in the Al-Baha district, Lahej Governorate [10]. Its economic importance stems from its antimicrobial and antioxidant properties [11]. Additionally, it functions as a uric acid reducer [12]. Due to its therapeutic importance, it has been classified as a medicinal plant [13, 14]. Despite the scarcity of recent taxonomic studies in the desert regions of Iraq, they have given qualitative results in recording new genera (*Morettia* DC. and *Ogastemma* Brummitt) in Iraq [15, 16], respectively. In addition to some other species, such as *Euphorbia serpens* Kunth [17], there is an increasing number of studies focusing on wild plants that aim to provide a morphological description and geographical distribution of certain rare species in

Iraq [18]. Furthermore, many researchers have expressed interest in the chemical composition of these plants and are investigating their biological effectiveness [19, 20]. This study focused on the species *T. arabicus*, a new record, and treated it taxonomically through morphological and anatomical descriptions.

2. Materials and methods

2.1. Collection of specimens

During botanical survey trips, specimens were collected from the desert region. Specifically in Wadi Al-Ubaiyidh (between latitude: 32° 2' 30" to 32° 3' 0" N; longitude: 42° 13' 30" to 42° 14' 0" E) near Al-Nukhaib sub-district (altitude: 305 m.), located to the West and Southwest of Holy Karbala Governorate, near the Iraqi-Saudi border. The taxonomic team conducted the collection on April 14, 2024, in Western Iraq. The study area was mapped with a satellite image that clearly indicates the location of the species collection (Figure 1).

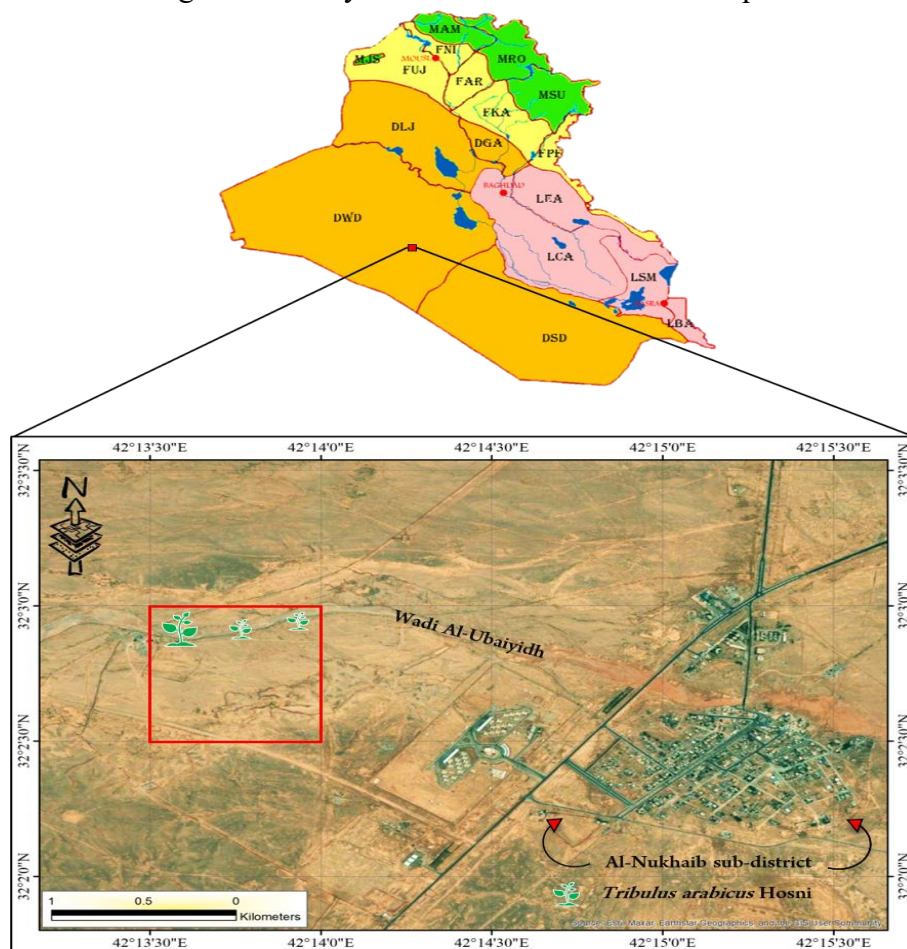


Figure 1: Map of the geographical region and districts of Iraq, by Guest [27] with a satellite imagery of the study area (Wadi Al-Ubaiyidh adjacent to the Al-Nukhaib sub-district in the Western Desert District of Iraq).

2.2. Identification of species

This species *T. arabicus* was collected and accurately identified based on the floras of neighboring countries such as Saudi Arabia [3] and the United Arab Emirates [9] (Figure 2). Some plant specimens were deposited in the Iraqi National Herbarium (BAG) to confirm the first record of the species, with the numbers 61573, 61574, and 61575. In addition, some

specimens were preserved in the Baghdad University Herbarium (BUH) and Anbar University Herbarium (AUH), with the numbers (50700, BUH; 5614, AUH) (Figure 3).



Figure 2: Field image of the species *Tribulus arabicus* in the study area.



Figure 3: Images of Herbarium specimens deposited in some Iraqi Herbaria.

2.3. Taxonomic study

The study aimed to describe the species morphologically for all vegetative and reproductive organs. All measurements were performed using a dissecting microscope on 12 plant specimens. The stem tissues were studied through the transverse section based on the direct manual cutting method using a razor blade and safranin stain with one drop of glycerin. Pollen grains were examined using a compound microscope with 1000X magnification and a Scanning Electron microscope (SEM) with a magnification of 3000X. The study steps were

conducted at the Anbar University Herbarium (AUH), where all results were supported by images using a Nikon camera and an Olympus microscope. The data related to the taxonomic treatment were tabulated, and a taxonomic comparison (Table 1) was conducted between the newly recorded species and the similar species growing in Iraq (*Tribulus macropterus* Boiss).

Table 1: Morphological comparison of Identification traits between the newly recorded species (*Tribulus arabicus*)* and the similar species (*Tribulus macropterus*) growing in Iraq.

Characters	<i>T. arabicus</i>	<i>T. macropterus</i>
Duration	Perennial	Annual or a short-lived perennial
External stem shape	Slightly polygonal - cylindrical	Cylindrical
Length of compound leaf (mm.)	28-33	14-18
Inflorescence	Axillary	Solitary
Sepals size (mm.)	7.4-8.2 × 1.9-2.2	5.0-6.0 × 1.2-1.5
Corolla size (mm.)	13.3-14.6 × 9.8-10.2	5.8-6.5 × 3.3-4.0
Length of floral pedicel (mm.)	12.5 – 14.0	8.0-10.0
Length of fruiting pedicel (mm.)	18-23	12-15
Stamens	5 longs + 5 shorts	10 equal length
Fruit size (mm.)	12×10	8×6
Margin of fruit wings	Entire	Irregularly dentate
Indumentum	Puberulent	Densely villous
Arrangement of leaflets on the rachis	Not overlapping (spacious)	Overlapping (imbricated)

*The morphological characteristics of the species *Tribulus macropterus* are derived from the Flora of Iraq [21].

3. Results

3.1. Taxonomic treatment

Tribulus arabicus Hosni, First published in Bot. Not. 130:261, F.1. (1977).
Selected references: Chaudhary, Fl. Saudi Arab. 2:584 (2001); Karim and Fawzi, Fl. U.A.E. 2:51 (2007); Ghazanfar, Fl. Oman 2:79 (2007); Al-Esawi and Al-Ruzayza, Fl. Holy Mecca 7(3):173-189(2015).

Synonym: *Tribulus macropterus* var. *arabicus* (Hosni) Hemaïd and Jac. Thomas in Arab Gulf J.Sci.Res. 14:436 (1996), no basionym data.

Arabic colloquial (common) name: AL-HASAK.

3.2. Morphological description

Perennial herb, height 25-35 cm, decumbent stems, puberulent. Leaves alternate, compound, paripinnate, 28-33×7-9 mm., leaflets 7-8 pairs, opposite, elliptical, sessile, not crowded on the rachis, 5.8-6.4×2.9-3.3 mm., petiole short, 3.5-4.2 mm. Stipules subulate, 3.7×1.8 mm. Flower axillary, solitary, Ebracteate, with 6-11 flowers in stem branches. The pedicel is clear, measuring 12.5-14.0 mm; it becomes longer in the fruiting stage, 18-23 mm. Flowers are actinomorphic, pentamerous, and bisexual. Calyx polysepalous, equal lanceolate, 7.4-8.2×1.9-2.2 mm, grey green. Corolla polypetalous, petals obovate, 13.3-14.6×9.8-10.2 mm, bright yellow. Stamens 10 in 2 whorls; 5 of them have long filaments, 4.9-5.3 mm, and

the other 5 are short, 3.2-3.5 mm., bright white, basifixed (innate attachment), anthers ovoid, 1.0×0.6 mm., yellow. Pistil compound, syncarpous, carpels 5, ovary superior, sessile, broadly ovoid, 5-loculed, 2.3×1.3 mm., covered with long silky hairs, axile placentation, style very short, 0.9-1.1 mm., 5-ridged, stigma 5-rayed, 1.8-2.2 mm. Fruit simple, dry, indehiscent, winged, 12×10 mm., pubescent, schizocarp into 5 solid triangular mericarps, 4.7-5.2×2.7-3.3 µm., one seed per mericarp, the margin of the wings is entire. Seed trigonal, semi-pyramidal, 3.8-4.3×1.3-1.6 mm, surface reticulate-alveolate, pale brown (Table 2 and Figure 4). Pollen grains are apolar, spheroidal, circular in outline, medium in size, 28-31 µm, polypantoporate, 43-51 pores, ornamentation is homobrochate reticulate, and wall thickness is 4.5-6.2 µm (Figure 5).

Type: Yemen Arab Republic, Lower Wadi Najran (18° 30' N, 45° 0' E), 16.7.1962; Zeller 19401(BM holo., CAI iso!).

Selected specimens

Western Desert District (DWD): Wadi Al-Ubaiyidh, 2 km. West of Al-Nukhaib sub-district, 305m. alt., 14.4.2024, Mousa's Botanical Survey Team, 61573 (BAG); Wadi Al-Ubaiyidh, about 1.5 km. West of Al-Nukhaib sub-district, 305m. alt., 15.4.2024, Mousa's Botanical Survey Team, 50700 (BUH); Wadi Al-Ubaiyidh, about 1.5 km. West of Al-Nukhaib sub-district, 305m. alt., 15.4.2024, Mousa's Botanical Survey Team, 5614 (AUH).

Table 2: The most important vegetative and reproductive characters of *Tribulus arabicus**

Compound leaves (mm.)	Leave size	No. of leaflets	Leaflet size	Shape
	31×8	7-8 pairs	6.2×3.1	elliptic
Inflorescences (mm.)	Rachis length	No. of flowers	Length of floral pedicel	Length of fruiting pedicel
	15	9	13.5	21.5
Perianth (mm.)	Sepal size	Shape	Petal size	Shape
	8.0×2.1	lanceolate	13.8×10.1	obovate
Androecium (mm.)	Long stamens number	Length of long stamens	Short stamens number	Length of short stamens
	5	5.2	5	3.3
Gynoecium (mm.)	Ovary size	Indumentum	Style length	Stigma length
	2.3×1.3	long silky hairs	1.0	2.1
Fruits (mm.)	Fruit size	Indumentum	No. of mericarps	Mericarp size
	12×10	pubescent	5	5×3
Seeds (mm.)	Seed size	Shape	Color	Surface
	4.0×1.5	semi-pyramidal	pale brown	reticulate-alveolate
Mericarps (mm.)	Size	Shape	No. of seeds	Indumentum
	5×3	triangular	1	pubescent
Pollen grains (µm.)	Pollens size	No. of pores	Thick wall	Shape
	30	48	5	spheroidal

*The values represent the means of measurements taken from 12 plant specimens of *Tribulus arabicus*.



Figure 4: Vegetative and reproductive organs of *Tribulus arabicus*.

* The scale is equal to 3 mm. in all images.

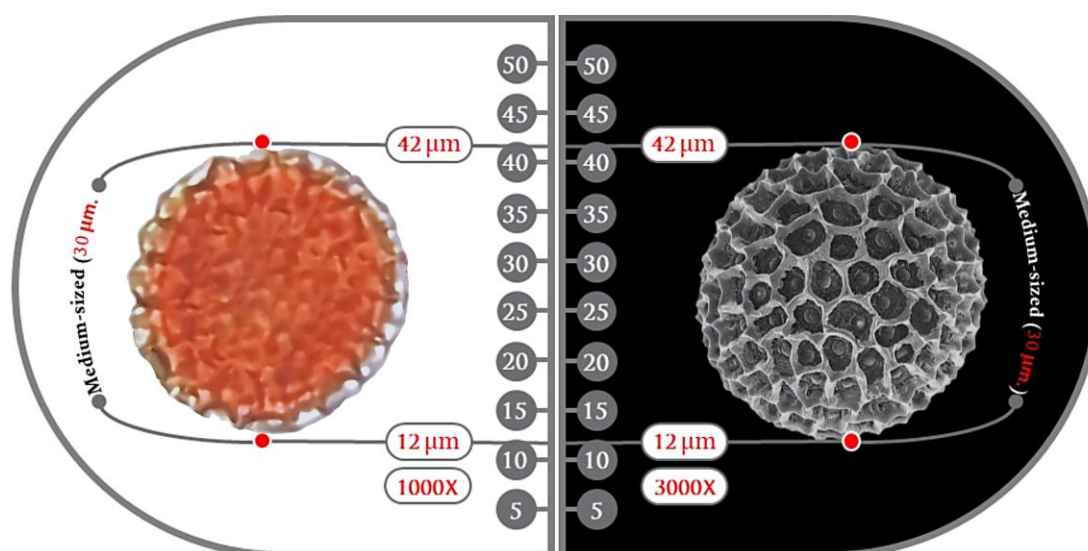


Figure 5: Pollen grain (polypantoporate) of *Tribulus arabicus*.

Phenological Pattern

The phenological graph (Figure 6) clearly shows the flowering and fruiting periods of the species *Tribulus arabicus*. The flowering period begins in mid-March and persists until early May. The fruiting period begins in late April and lasts until early June, after which the species disperses its seeds. This pattern is analogous to that observed in plentiful perennial plant species that grow in environments similar to those inhabited by this species.

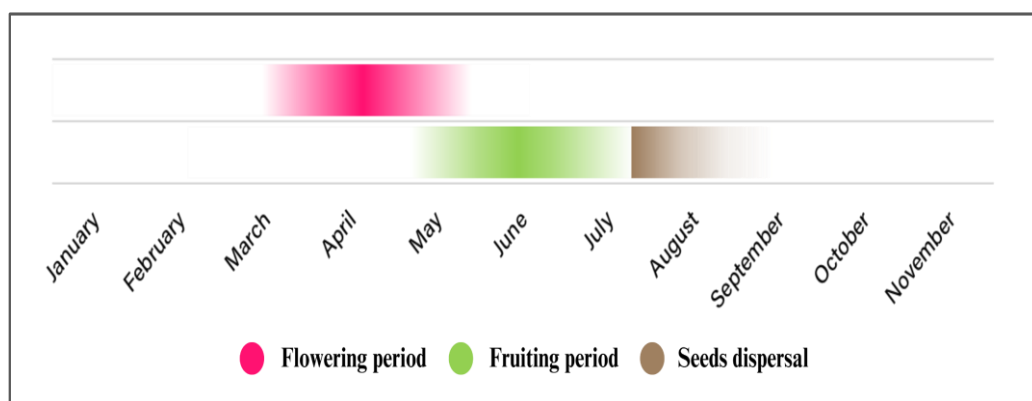


Figure 6: Phenological graph shows the flowering and fruiting periods of *T. arabicus*.

3.3. Stem anatomy

The cross-section of the mature stem is characterized by being circular to slightly polygonal, with a diameter of approximately 1200 μm , and is covered by a thick layer of cuticle, up to 11 μm . The epidermis consists of small, elongated cells 24 μm thick, covered by velutinous indumentum (perpendicular to the surface). The cortex consists of 6 rows of large, regular parenchyma cells, 90–120 μm thick. The vascular cylinder is very wide, composed of 20-23 regularly distributed vascular bundles, each bundle 230-245 μm thick, and consists of a bundle sheath characterized by a thickness of 65-75 μm , consisting of 7-8 rows of sclerenchyma tissue (fibers). The phloem, with remnants of the fascicular cambium, is 35-45

μm thick and arranged in 3-4 rows. The xylem is broad and efficient ($150\text{-}160\ \mu\text{m}$), consisting of 3-5 arms in a bundle; each arm has 4-6 vessels; the diameter of each vessel is about $40\ \mu\text{m}$. The pith area is very broad and circular in shape; its diameter is equal to half the diameter of the transverse section of the stem (approximately $600\ \mu\text{m}$), and it consists of large, thin-walled parenchyma cells, which cause them to break down with the age of the plant. Among the anatomical observations of the section is the presence of Druses (star crystals) within the cortex layer, with several 7-9 druses in a single section (Figure 7).

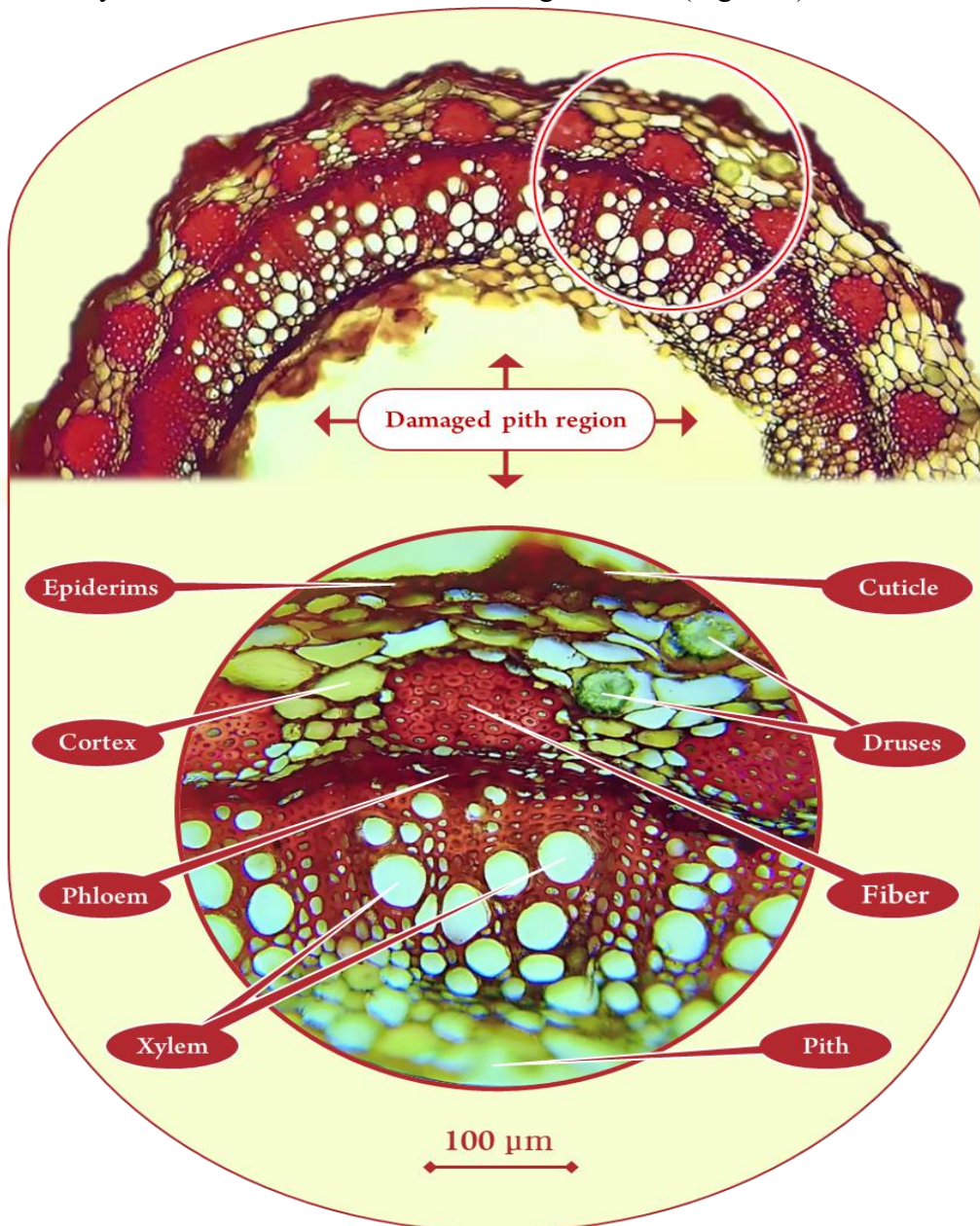


Figure 7: Cross section of the stem of *Tribulus arabicus*.

4. Discussion

This study followed the confirmation that there are no plant samples of the species under study in all Iraqi herbaria, as well as in the Flora of Iraq [21]. There is no doubt that the species under study and recorded for the first time in Iraq (*Tribulus arabicus*) is one of the

species growing in the Arabian Peninsula, which is located within the fourth phytogeographical region of the old world, which is the Saharo-Sindian Region, noting that the study area from which the species was collected is situated in the same region. It is not unexpected that the geographical region of the species has spread into the Iraqi desert, particularly as most of the valleys originate within Saudi Arabian lands and then extend into Iraqi lands, including Wadi Al-Ubaiyidh. This is regarded as a component of the environment that aids in the transportation of fruits and seeds to new locations, facilitated by the rains and floods that occur throughout the winter and spring seasons. The function of dust storms cannot be overlooked, as they transport soil particles across great distances, accompanied by seeds and tiny winged fruits, a phenomenon proven by researchers in the field of plant migration and the new geographical distribution of species [22]. According to the concept of plant migration, it is relatively easy for the geographical distribution area of a species to expand if there are no natural barriers, such as seas and oceans. International borders cannot stand as an obstacle to the expansion of the geographical area of any plant species. A notable example of this is the discovery of the new species *Nepeta iraqo-iranica* Haloob, Bordbar & Qader on both sides of the Iraqi-Iranian border in the mountainous region [23].

The accepted name for the species under study is *Tribulus arabicus* Hosni, according to the modern floras of some countries such as Saudi Arabia [3], the Sultanate of Oman [24], and the United Arab Emirates [9]. The importance of taxonomic studies lies in identifying the most stable morphological characteristics that are essential for accurate species identification, serving as the initial foundation of plant taxonomy, according to Patil [25]. This study has given decisive results in the accurate morphological description, with some basic anatomical characters of the transverse section of the stem, which is a supporting factor for the morphological characters, as stated by Perzzi [26]. Modern taxonomy is not limited to different branches of botany (such as morphology, anatomy, ecology, palynology, genetics, cytology, physiology, embryology, and phytochemistry) but also extends to the molecular level [27].

5. Conclusions

This study concluded that the plant diversity of any geographical area, particularly in desert regions, cannot remain constant over several decades; it is influenced by environmental changes, human activities, and current global climate shifts. While some species experience a decrease, others are on the increase. The migration of species is ongoing and is influenced by the availability of various factors that either prompt movement to more favourable environments or lead to departure from areas with deteriorating conditions.

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Conflict of interest

The authors declare that there are no conflicts of interest associated with this research.

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