SYSTEMATICS SIGNIFICANCE OF MORPHOLOGICAL AND ANATOMICAL DIVERSITY OF *PORTULACA OLERACEA*

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ABSTRACT

This study was aimed to investigate the *Portulaca oleracea* is a succulent plant in Portulacaceae family distributed around different regions of Iraq as collected widely in the gardens of Baghdad governorate. The results of this study shown that a systematic significant of morphological and anatomical data. Individuals of purslane showed herb habit with branched shoot stems. Stems and leaves are glabrous and leaves are alternate, the petiole is absent. There is variation in morphological characters as (Flowers, inflorescence architecture), these inflorescences were viewed as clustered in the form of small one carrying many male and female flowers as the inflorescences take the form of long-stemmed. The flowering season for this species is from April till August as a weed in plains, however, anatomical techniques have been used as it revealed two patterns of stomatal complex, paracytic which is the most common followed by tetacytic is limited distributed type and it is recorded for the first time in this species. Druses crystals have been found distributed in the stem with angular collenchyma alternating with xylem parenchyma cells with large intercellular space. As well as, root anatomy has been done and the results showed casperian strips cells clearly in section with xylem and phloem regions.

Keywords: Purslane, Iraq, Portulacaceae, Taxonomical characters, Inflorescence architecture

تنوع الصفات المورفولوجية و التشريحية و اهميتها في تصنيف نبات الرجلة

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المستخلص

يهدف البحث دراسة تنوع الصفات المورفولوجية و التشريحية و اهميتها في تصنيف نبات الرجلة حيث يعتبر نبات البقلة من العصاريات ضمن العائلة البربينية وجد موزعا في مناطق مختلفة من العراق كما تم جمعها على نطاق واسع من حدائق محافظة بغداد. و بينت نتائج البحث وجود فروقات معنوية في البيانات المورفولوجية والتشريحية. وأظهرت الأفراد من نبات الرجلة عادة كونها اعشاب مع ساق متفرعة حيث تميز النبات بكونه خالي من الشعيرات والأوراق متبادلة و جالسة لعدم وجود السويق و وجد تغاير في الصفات المظهرية الاخرى كالازهار و النويرات حيث تميزت بكونها مؤلفة من مجموعة من الازهار الذكرية و الانثوية على المحور الزهري صغيرة الحجم و محتشدة على محور زهري طويل بينما كانت فترة التزهير للنبات من شهر نيسان لغاية شهر اب كدخل في المناطق المستوية فضلا عن ذلك تم اجراء الدراسة التشريحية حيث اظهرت الدراسة وجود طرازين من المعقد الثغري المتوازي و هو الاكثر انتشارا و الطراز الرباعي الاقل وجودا في هذا النبات و الذي سجل لاول مرة في الافراد العراقية بالاضافة الى ذلك تم ايجاد البلورات النجمية في الساق مع وجود خلايا الكولنكيمية ذات النوع الزاوي تتبادل مع خلايا الخشب البرنكيمية و التي تمتاز بكبر المسافة الخلوية داخلها كذلك تم عمل مقاطع تشريحية للجذر حيث ظهر شريط كاسبر بشكل واضح في المقطع العرضي مع مناطق الخشب و اللحاء.

الكلمات المفتاحية:نبات البربين, العراق, عائلة البربين, االنورات, الصفات التصنيفية

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INTRODUCTION

Purslane is a common succulent weed with economic importance as food in the Middle East, as well as in the tropical and subtropical regions with ruderal habitats (18, 19, 21). However, this species is concentered in low land regions of Iraq. About 100 species of *Portulaca* are distributed in South America and Africa with some species that are common in Europe (8, 21). *Portulaca* or is a member of Portulacaceae family included recently in suborder Cactineae, order (Caryophyllales) based on phylogenetic work (8, 11, 17, 20). This plant is from the most anxious annual weed in the world with a short-life period (3, 6, 12). The genus *Portulaca* L. is known as cultivated as decorative plants moreover, a number of research reported the antimicrobial activity against a range of bacteria (13, 15, 25, 26). Also, the Berber family extracts were used to treat infections, pain relief wound healing, and blood sugar balance. In a previous paper published about the genus *Portulaca* in Iraq, *P. grandiflora* had been reported while the flora of Iraq described two species (14). An anatomical study has been done in China illustrated the significant of anatomical data in distinguishing between plants of *Portulaca* thriving in a different environment (9). *Portulaca* is a member of CAM plants with close stomata, therefore it distributed in temperate, xerophytic and epiphytic zones (10). *Portulaca oleracea* has been noticed to produce a high rate of seed generation and a wide resistance of photoperiod in high-temperature soil type (22). In spite of the fact that the morphological traits variation might be high, a few attributes appear to be low taxonomic value but there are diversification patterns in number of characters in *Portulaca* (16, 24). As, the latest investigation of *Portulaca* at a national scale was done 40 years back, and there is no detailed systematic study on this genus (5). This study aims to explore the diversification in morphological characters beside anatomical traits within this species and its possibility of these traits for systematic identification value.

MATERIALS AND METHODS

Sampling specimens and morphological analysis: The study samples were prepared from the soft specimens collected from the field during the growing seasons from 2017-2016 in different locations of Iraq. Also, thirty herbarium specimens representing *Portulaca oleracea* from different herbaria (BUH, MUST) have been used to estimate the diversification in morphological traits. In total, forty accessions were measured with a dissecting microscope.

Anatomy of vegetative organs

Peeling method: The epidermis of leave was peeled off with a scalpel or barber blade with the help of pointed pointers. After that, the epidermis was removed into a Petri dish containing 0.5 mg safranin and dissolved in 50% ethyl alcohol for 6-4 days. Then the peeled epidermis was transferred to other Petri dish containing ethyl alcohol (100%) and washed several times after that epidermis cells are transmitted to a glass slide and placed a drop of water covered with the lid of the slide as it is ready to be examined (7,24,25).

Leaf clearing technique

The leaf clearing protocol was based on Cutler et al. (7, 26). As the samples were selected from soft tissues to let clearing in Petri-dishes with a solution containing NaOH 0.3% concentration for 7-14 days, then the solution was removed for several times until the color of the leaves disappeared and became transparent and then washed with water to remove the effect of the base solution and the cleared leaves were moved to a Petri dish containing safranin (70%) for 10 minutes. And then the cleared tissues were washed and fixed on a glass slide and then examined under the compound microscope, studied and photographed. Typically at least 5 leaves were examined for each protocol.

RESULTS AND DISCUSSION

Morphological traits*: Portulaca oleracea* is a member of the purslane family are characterized as an annual herb Fig.1 (a) and Table.1. Typically, roots tap tending from white to brownish in color with an average length of between 12.9-15.5 cm averages as illustrated in Fig.1 (b) The stems are glabrous, succulent distinguished by their multiple branches in an alternate circular manner around the main stem, which is between 5-10 cm average and the branches can be graduated in length, the tallest one near the base while the shortest are at the top giving pyramidal

shape. On the other hand, leaves are alternate, the petiole is absent, therefore, leaves are sessile as the small leaves are at the top of the main stem while the largest one at the base with length ranged between (0.5 - 1.5) cm. Leaves are ovate, tapered towards the base, on the contrary, the leaves became rounded towards the apex as in Fig.1 (c). There is variation in morphological characters as (Flowers, inflorescence architecture), flowers are small in size, terminal. Sepals are 3-7 mm in length, petals are yellow in color, between 3-8 mm and united at the base. The stamens are 7-12, ovary is ovoid in shape. However, Inflorescence types are one of the morphological characters that have been utilized as a sub-generic identification tool for *Portulaca*, these inflorescence were viewed as clustered in the form of small one carrying many male and female flowers as the inflorescences take the form of a long, spherical, long-stemmed if they are located at the top of the main stem or are axillary when they are located between the branches and the main stem or between the leaf. As Geesink in 1969 (23) proposed that single flowers were gotten from flower reduction that happened in the capitula. Specifically, he referenced this procedure may have occurred in *P. quadrifida*. The fruit is a dehiscent capsule with granulate seeds. The flowering season for this species is from April to August as a weed in gardens as in Baghdad and can be found in plains also

Table 1. Morphological characters of *Portulaca oleracea* measurements

Morphological characters length (cm.)	*Portulaca oleracea*
Root	**12.9-15.5**
Stem	**5-10**
Leaves	**0.5 - 1.5**
Sepals	**0.3-0.7**
Petals	**0.3-0.8**
Stamens	**7-12**

Anatomical study

Epidermis and leaf anatomy: The study of the leaves revealed the spread of stomata on both sides of the leaf. The number of stomata in the abaxial surface was higher in the adaxial surface and the shape of the stomata was round. Two patterns of the stomatal complex have been observed, the paracytic which is common and widely spread with an average length of 20 µm. The second pattern is tetracytic with average length (22) µm Fig.1 (d). The ordinary epidermal cells had normal dimensions of 50 µm and 23 µm. They are wavy to curved and straight on the upper and lower surfaces of the leaf. The cross-section sections of the leaf petiole showed that epidermis was thick with 2.5 µm in thickness. This layer was followed by upper epidermal cells, which were ovate with 13 µm length and 9 µm in width. As well as, the epidermis is characterized as uniseriate and the presence of the two layers of spongy and palisade evidence that the leaf is two-faced. Furthermore, and the star-shaped crystals are widely dispersed between the cells and this indicates storing secondary metabolites as a result of plant metabolism, either the vascular tissue is composed of three to four packs of vascular bundles in the shape of a circular alternate with a rate of length (183) µm Fig.1 (e, f).

Stem anatomy

The results of the cross-sections of the stem were circular in outline with elongated dense cuticle layer and very few glandular hairs and a thickness of 7.6 microns. The thickness of the cuticle layer is due to the adaptation of the

plant to the arid and semi-arid environments and the growing seasons that are developing in. a layer of epidermis is uniseriate, which appears in a row of oval-shaped cells with a thickness of 22.75 µm, followed by cortex layers consisting of angular collenchyma which are intensive in the form of prominent clusters in the area of the ribs and at angles that assist in the erection of the stem which are alternating with rows of oval-shaped parenchyma cells to large spherical parenchyma cells Fig.1 (g, h , j). The thickness of the cortex layer was 134 µm. The cortex was characterized by the presence of druses crystals, which were densely dispersed among their cells. The cortex follows the vascular cylinder, which consists of vascular bundles of 5-7 vascular bundles spread over the vascular cylinder region. Phloem was in the form of the vascular bundle, and the largest position is occupied by xylem within the vascular cylinder with a rate of 230 µm. Furthermore, xylem parenchyma is round-shaped with large intercellular spaces close to the center of the stem called the pith.

Roots anatomy

The results of cross sections, which were cut from the middle of the root appeared the shape of cross-section is generally circular in outline with concave and the cortex has appeared clearly with the rate of thickness of 140 µm which consists of the strip of red rounded cells called casperian strip in endodermis which is characterized from the rest cells of the cortex. This area followed the central cylindrical region, consisting of phloem which alternating with the cortex region and the average thickness of the phloem area 70 µm. Followed by xylem region that spread widely and compactly and exchanged with vascular bundles between these vessels. The xylem vessels were concentrated more in the root center. The central cylinder area is composed of two to four vascular bundles. Fiber is also densely observed in wood fiber, giving root support Fig.1 (j, m).

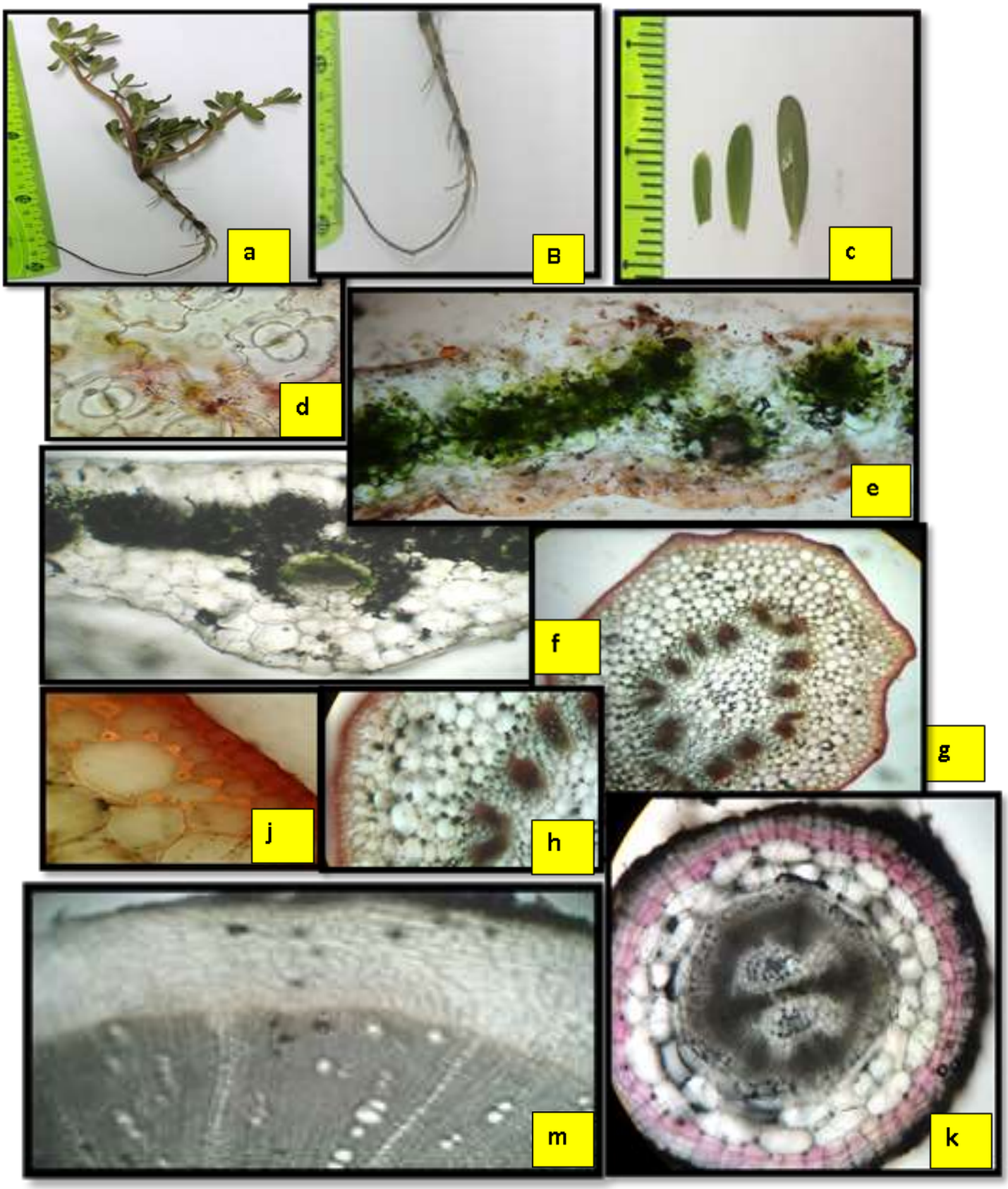

Fig. 1. Taxonomical characters of *Portulaca oleracea* (a),(b),(c),(d), (e), (f), (g), (h), (j), (k), (m)

a- Field image of *Portulaca oleracea*
***b*-Morphological image of root c-Morphological image of leaf**
c- Stomatal complex and epidermal cells of *Portulaca oleracea* in leaf 800x
d- Leaf blade cross-section 200x

e- Leaf blade cross-section 800x
f- Stem cross-section 750x
g- Stem cross-section illustrate vascular bundle 900x
J- Stem cross-section illustrate collenchyma cells 900x
K- Root cross-section 750x
m- Root cross-section 900x

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