Journal of Biotechnology Research Center
Vol.15 No.1 **Published Online: Jun. 2021** **P-ISSN:1815-1140**
DOI: https://doi.org/10.24126/jobrc.2021.15.1.599 **E-ISSN:2708-1370**

Morphological and anatomical study in some species of *Orobanche*

Khansaa Rasheed Al-Joboury **Sukeyna Abass Aliwy**

Iraq Natural History Research Center and Museum / University of Baghdad / Baghdad - Iraq
Department of Biology / College of Science / University of Baghdad / Baghdad - Iraq
Corresponding author: **mkansaa@yahoo.com**
Received: 25 / Nov. /2020 , Accepted: 31/Jan./2021

Abstract

***Orobanche aegyptiaca* Pers., *Orobanche cernua L.* and *Orobanche coelestis* (Reut.) Boiss. and Reut. ex Beck are plants belong to the Orobanchaceae family in Iraq. Morphological and anatomical study of the three species is very important to to know the qualities that help us to distinguish between them. To study the morphological and anatomical traits the samples were collected from Baghdad, the southern deserts, and Kurdistan of Iraq between 2016-2018 during the flowering period (spring). The plant was preserved in special glass ampoules containing alcohol 70% for the purpose of conducting the transvere anatomy section process. The identity and morphological study as well as the anatomical study of the three species were determined by studying the anatomical transverse sections of the stem and studying the trichomes which are generally divided into two parts: Non-glandular trichomes which consist of from one or more cells, different lengths with acute or obtuse apices, and glandular trichomes which consist of a multicellular or unicellular head and stalks depended on their shape, number of cells and general characteristics as a method or Identity imprint of the plant used to differentiate among the studied species. Significant differences were observed in the general and anatomical appearance. The species *Orobanche aegyptiaca* Pers. is more dense in the amount of trichomes spread in all parts of the plant compared to other, *O. aegyptiaca* Pers. be containing 18–22 layers of parenchyma cells, the species *O. cernua L.* consists of 10-16 layer of parenchyma cells and the species *O. coelestis* (Reut.) Boiss. And Reut.exBeck consists of 20-24 layers of parenchyma cells. Morphological and anatomical study have proven its effectiveness in determining mportant characteristics in diagnosing species and distinguishing between them.**

Keywords: *Orobanche L.*, Morphology, Anatomy, Orobanchaceae family, Iraq.

Introduction

Parasites of angiosperms in their primary habitats are an important part for the ecosystem (1). Plants behave like a predator as well as adapt and cycle the life of the main host (2). Orobanchaceae family have 15 genera which are obligate parasitic and 250 species, So it is it highly related with the Scrophulariaceae. The species of Orobanchaceae are a worldwide distribution and has a distinct appearance all over the world (3). They called broomrapes which are they holoparasites, They are germinate only in response for the specific chemicals that release using the host plant. The following of germination and the seedlings Stick by the host roots using the production for specialized of feeding structures which described like haustoria do a functional bridge to their hosts, previously, the hemiparasitic species of this family were considered to be within the Scrophulariaceae the family of the figwort (4), but the species of holoparasitic were classified whith Orobanchaceae the family of the broomrape (5). The genus *Orobanche* contains about 170 species which is found in all the world particularly in the northern hemisphere (6).

Orobanche parasites are the main cause of major damage in many important economic crops. In-depth studies of this species are few and simple and do not include plants in all its aspects, It is noted that there are few references and research on this genus in Iraq. The wild plants checklist inside Iraq mentioned 10 species for *Orobanche*, but there is another researcher mentioned 11 species of *Orobanche* in Iraq (7).

Most *Orobanche* species are thrive at sunny environments, so the best places to this species

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are arid and semi-arid soils (8,9). According for these studies, they are frequently finding in (10). The purpose for our current study is to determine the morphological characteristics and anatomical (stem, hairs) features of some species of Orobanche.

Materials and methods

The collection of the plants:

The plant was collected from different regions of Baghdad and balad between 2016-2018 during the flowering period (spring). The plant were preserved in special glass ampoules containing alcohol 70% for the purpose of conducting the transvere anatomy section process (11,12).

Plants identification:

Identify the species according to: (13, 14) for precise identification and they were compared with previously identified specimens stored at Iraq Natural History Research Center and Museum, National Harbarium of Iraq.

Morphological study and its measurements:

The plants were transferred to the Laboratory of Plant and Environment in Iraq Natural History Research Center and Museum in order to measure the stem, leaves, flowers, fruits and all parts of the plants by the regular ruler (15).

Anatomical study:

The transveres anatomy sections of stems were conducted in the same laboratory by using handsection (16).

Trichomes study:

The epidermis peeled for removing the trichomes from each part of plant species to identify their types with the general shape and the number of cells (17,18).

Results and discussion

Morphological study:

According to table 1, the characters of the three species are clearly very differ in the morphological traits, The average plant height for *O. aegyptiaca* Pers. was 27.5 cm. The average length of stem was 19 cm, It branched or unbranched, thickened especially in base, slender, yellowish-violet. scales lanceolate, inflorescence cylindrical, 25 average flowers sessile, bract lanceolate, 7 mm Average length, equal to length of calyx. The Average length of calyx was 10.5 mm, 4-teeth, filiform, corolla lavender-blue, 4.25 mm the average length of stamens, filaments 12 mm, anther 2.75 mm, and style 15 mm. The species *O. cernua L.* annual or biennial species, average length of stem was 24.5 cm, average the thick in middle part was 10 mm, inflorescence numerous flowers 45, cylindrical, average bract 7 mm, lanceolate, average calyx 7.75 mm, bidentate and the teeth 2 unequal, subulate, average corolla 12.5 mm, stamens 6.5 mm, filaments 9.25 mm, anther 1.75 mm, Style 7 mm, and the traits for the species *O. coelestis* (Reut.) is biennial or perennial, average stem 18.75cm, simple, average scales 9.5 mm, inflorescence cylindrical, 17.5 cm, 48 average flowers, bract lanceolate, 11 mm, equal with calyx, bracteoles, 8.5 mm, calyx campanulate, 14 mm, calyx teeth 9.75 mm, lanceolate, corolla 22.5 mm, stamens 4.5 mm, filaments15mm, Style 17.5 mm. All these results agree with (19).

Table (1): Morphological characters of the three species of the genus *Orobanche*

species	Habit	Average stem length (cm)	Number of flowers	Average of bract length (mm)	Average of calyx length (mm)	Average corolla length (mm)	Average stamens Length (mm)	Average filaments (mm)	Average style length (mm)
Orobanche aegyptiaca	**biennial**	**19**	**25**	**7**	**10**	**10**	**4.25**	**12**	**17**
Orobanche cernua	**annual or biennial**	**8-40.5**	**45**	**7**	**7.75**	**12.5**	**6.5**	**9.25**	**7**
Orobanche coelestis	**biennial or perennial**	**18.75**	**48**	**11**	**14**	**22**	**4.5**	**15**	**17.5**

Anatomical study:

Anatomical characters of the stem

Transverse section for the stem of the species *O. aegyptiaca* Pers. was the closest to an oval.

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The pidermis consists of a single layer of cells which was oval or square or oblong shaped cells (uniseriate), there was no cuticle layer. The cortex have 18–22 layers of parenchyma cells. The vascular tissue was continuous ring for outer phloem with an inner radiating xylem, and they are traversed by medullary rays. The pith comprised of spherical and polygonal parenchymatous cells occupies a large area of the stem, this agrees with (20).

The stem of *O. coelestis* (Reut.) Boiss. and Reut. ex Beck was also the closest to an oval. The epidermis consists of a single layer of cells which was oval or oblong shaped cells surrounded on the top by layer of cuticle characterized by thicknass in this species and the compactness of cells in it. The cortex consists of 20-24 layers of parenchyma cells. The vascular tissue record a continuous ring for outer phloem with an inner radiating xylem, and they are traversed by medullary rays. The pith comprised of polygonal parenchymatous cells, it was the largest area in this species this agreement with (21). The stem of the species *O. cernua L.* was almost square. The epiderm consists of a single layer of cells which was oval or square shaped cells surrounded on the top by a thick layer of cuticle. The cortex consists of 10-16 layer of Parenchyma cells figure 1.

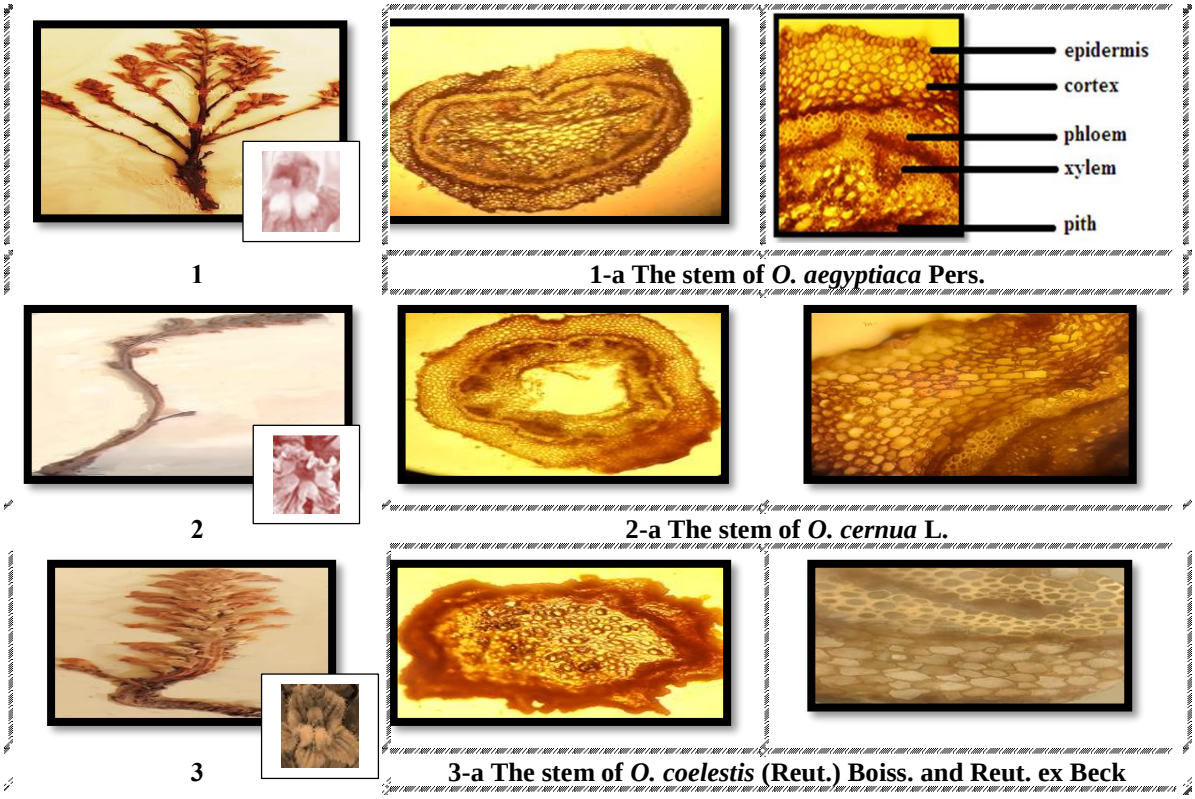

Figure (1): (1-3) The whole plant with its flower *O. aegyptiaca* Pers., *O. cernua L.* and *O. coelestis* (Reut.) Boiss. and Reut. ex Beck (1-a, 2-a, 3-a)The transverse section for the stem for the three species (250X).

Trichomes:

Macroscopical studies for the plants found that the trichomes are present at all the surfaces for the three species, and the trichomes are widely varied and spread densely in the species *O. aegyptiaca* Pers. which spread in all parts of the plant, unlike the species *O. cernua L.* that showed less spread compared with the first species but the species *O. coelestis* (Reut.) Boiss. and Reut. ex Beck was spread as an intermediate state between them. These trichomes were diversity in their shapes, number of cells and density of their spread in each part in the three species. It was also observed that some of these trichomes spread and distributed in a plant part of the same species denser than other parts (20). as shown in the following:

1. Non-glandular trichomes: These trichomes were distinguished from each other by special characteristics which divided into the following:

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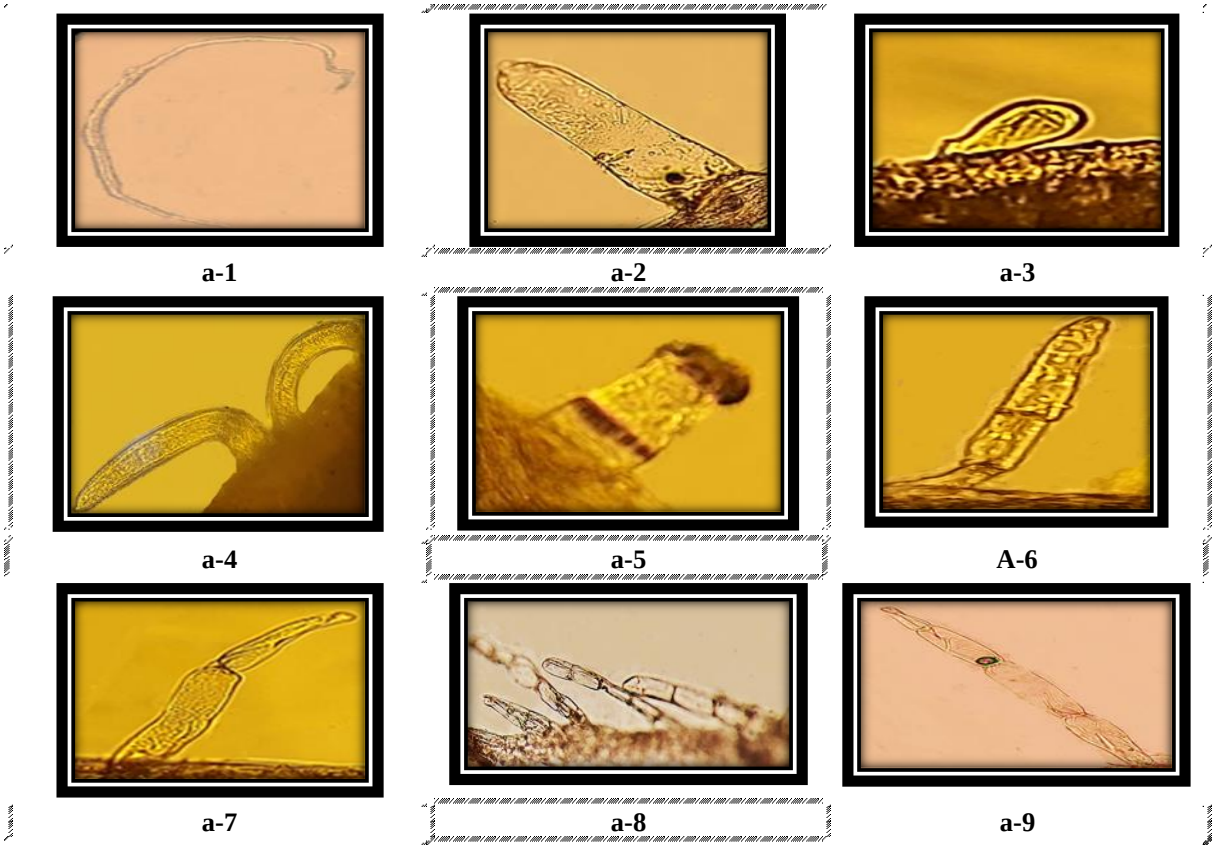
Simple non-glandular unicellular trichomes (a-1)-(a-9): they were very different in lengths that ranging from short to very long, in addition to some other morphological characteristics such as the trichome in a-1 were long and curved at the ends, noting that the wall was thick, and it was thinner towards the ends with acute apices, in a-2 were observed be broad, thin wall thickness, medium length and erect with obtuse apices, in a-3 trichomes were noted be broad, very thick-walled, short in length, and oblique to the surface of the epidermis with obtuse apices, a-4. The trichomes are long and broad with a thick wall and were strongly oblique toward the surface of the epidermis with obtuse apices, a-5 type of trichomes that has been observed only in the flower, which was erect and divided into two cells of different length with obtuse apices, (a-6)-(a-9) divided into a number of cells among 2-5 cells of different lengths, thin and densely spread throughout the plant in all its parts with obtuse or acute apices. These trichomes spread in the species *O. aegyptiaca* Pers.denselyin all parts with a distinctive variety figure 2.

2.Glandular trichomes unicellular or multicellular: These hairs were spread more densely than before, especially in the species *O. aegyptiaca* Pers. Which was characterized by the density and the diversity of trichomes of all types mentioned in figure 2. Glandular trichomes (b 1-5) have characteristics that distinguish it from each other such as: b-1 was characterized by a large, oval, single-celled head with a slightly oblique of the head towards the surface of the epidermis with a short stalk that was also single-celled which found in abundance in flower. In b-2 the head consists of one small cell, while the stalk was two cells of different length and width b3 The head consists of two cells separated by a longitudinal separator of equal size with a long and broad stalk from the bottom and slightly oblique of the head towards the surface of the epidermis, b4 and b5 were similar in characteristics to b3 but the head in b4 consists of four cells separated by a longitudinal separator and in b5 the head consists of eight cells separated by a longitudinal septarator. Finally, trichomes shapes b-3 to b-5 were found only in the first species and they were not observed in other species (22,23).



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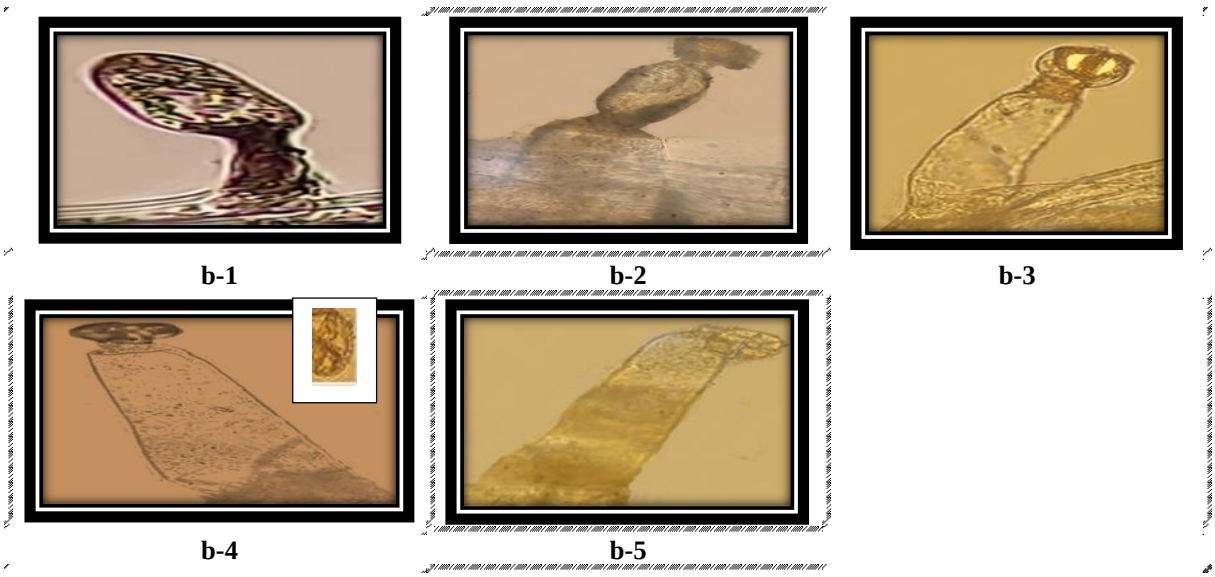

Figure (2): The trichomes for the three species (300x)

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DOI: https://doi.org/10.24126/jobrc.2021.15.1.599 **E-ISSN:2708-1370**

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دراسة مظهرية وتشريحية في بعض انواع *Orobanche*

خنساء رشيد الجبوري **سكينة عباس عليوي**

مركز بحوث ومتحف التاريخ الطبيعي / جامعة بغداد / بغداد - العراق
قسم علوم الحياة / كلية العلوم / جامعة بغداد / بغداد - العراق
Corresponding author: **mkansaa@yahoo.com**

الخلاصة

Orobanche coelestis* (Reut.) Boiss. and Reut. ex Beck** ،Orobanche cernua L.*** ،***Orobanche aegyptiaca Pers.*** **هي نباتات تعود للعائلة Orobanchaceae في العراق. الدراسة المظهرية والتشريحية للانواع الثلاثة جدا مهم لمعرفة الصفات التي تساعدنا في التفريق بينهم. لدراسة الصفات المظهرية والتشريحية، العينات جمعت من بغداد، المناطق الجنوبية وكردستان العراق للفترة بين 2016-2018 خلال فترة التزهير (الربيع)، تم حفظ النباتات في أمبولات زجاجية خاصة تحتوي على الكحول بنسبة 70٪ لغرض إجراء عملية التشريح. التشخيص والدراسة المورفولوجية وكذلك الدراسة التشريحية للأنواع الثلاثة تم تحديدها من خلال دراسة المقاطع التشريحية العرضية للساق ودراسة اشكال الشعيرات التي تنقسم عمومًا إلى قسمين: شعيرات غير غدية التي تتكون من خلية واحدة أو أكثر، بأطوال مختلفة مع قمم حادة أو منفرجة، والشعيرات الغدية التي تتكون من رأس وساق متعددة الخلايا أو أحادية الخلية بالاعتماد على شكلها وعدد الخلايا والخصائص العامة كطريقة أو بصمة هوية للنبات المستخدم للتمييز بين الأنواع المدروسة. لوحظت اختلافات معنوية في المظهر العام والتشريحي. وكان النوع *O. aegyptiaca* Pers. هو أكثر كثافة في كمية الشعيرات المنتشرة في جميع أجزاء النبات مقارنة بأخرى. وقد احتوى النوع *O. aegyptiaca* Pers. على 18-22 طبقة من الخلايا البرنكيمية، وتكون النوع *O. cernua L.* من 10-16 طبقة من الخلايا البرنكيمية بينما النوع *O. coelestis* (Reut.) Boiss. and Reut. ex Beck من 20-24 طبقة من الخلايا البرنكيمية. الدراسة المظهرية والتشريحية اثبتت فعاليتها في تحديد الصفات المهمة والتي تساعدنا في التميز بين الانواع المدروسة.**

الكلمات المفتاحية: ***Orobanche L.*** **، مظهرية ، تشريحية ، عائلة Orobanchaceae .**