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Anatomical study of the stem and leaf of *Bischtella ciliata*, *Alyssum montanum*, and *Clypola jouthlaspi* and their taxonomic importance.

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Abstract:

The *Brassicaceae* is one of the most widespread plant families worldwide and possesses unique characteristics in terms of the anatomy of its internal structures. The current study aimed to identify the anatomical characteristics of the stems and leaves of *Bischtella ciliata*, *Alyssum montanum*, and *Clypola jouthlaspi*. The plants studied were collected from the Kalli Zantah summer resort and the Sharnish waterfall in Duhok Governorate, Iraq.The anatomical study included the characteristics of the stem and leaf epidermis. The results revealed that the transverse sections of the stem showed significant variation in the thickness of the epidermis, cortex, xylem, and phloem, as well as the number and arrangement of vascular bundles. All the stems of the studied species were solid. The transverse sections of the stems were characterized by closed vascular bundles, except for the species *Alyssum montanum*, where the bundles were open. The results also revealed significant variations in the internal anatomical characteristics of the leaves. They were characterized by being unifaceted, except for the species *Alyssum montanum*, which was bifaceted. The results also showed that all the studied species contain two layers of palisade, except for the species *Clypola jouthlaspi*, where the palisade layer is not visible, meaning that this species does not contain a palisade layer.

Keywords: Anatomy, *Brassicaceae, Alyssum montanum, , Clypola jouthlaspi* .

دراسة تشريحية لساق وأوراق نباتات *Bischtella ciliata* و *Alyssum montanum* و *Clypola jouthlaspi* وأهميتها التصنيفية.

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مستخلص:

تُعد الفصيلة الصليبية (*Brasicaceae*) من أكثر الفصائل النباتية انتشارًا حول العالم، وتتميز بخصائص تشريحية فريدة في تركيبها الداخلي. هدفت الدراسة الحالية إلى تحديد الخصائص التشريحية لسيقان وأوراق نباتات *Bischtella ciliata* و *Alyssum montanum* و *Clypola jouthlasp i*. جُمعت النباتات المدروسة من منتجع كالي زنته الصيفي وشلال شرنش في محافظة دهوك بالعراق. شملت الدراسة التشريحية خصائص بشرة الساق والورقة. كشفت النتائج أن المقاطع العرضية للساق أظهرت تباينًا كبيرًا في سمك البشرة والقشرة والخشب واللحاء، بالإضافة إلى عدد وترتيب الحزم الوعائية. كانت جميع سيقان الأنواع المدروسة صلبة. تميزت المقاطع العرضية للسيقان بحزم وعائية مغلقة، باستثناء النوع *Alyssum montanum*، حيث كانت الحزم مفتوحة. كشفت النتائج أيضًا عن اختلافات كبيرة في الخصائص التشريحية الداخلية للأوراق. تميزت بأنها أحادية الوجه، باستثناء النوع *Alyssum montanum*، الذي كان ثنائي الوجه. أظهرت النتائج أيضًا أن جميع الأنواع المدروسة تحتوي على طبقتين من السياج، باستثناء النوع *Clypola jouthlaspi*، حيث لا تكون طبقة السياج مرئية، مما يعني أن هذا النوع لا يحتوي على طبقة سياج.

الكلمات المفتاحية: التشريح، الفصيلة الصليبية، أليسوم مونتانوم، كلايبولا جوثلاسبي.

Introduction:

Producing edible veggies, oilseed plants, and decorative blooms, the *Brassicaceae* family is aglobal family with significant economic significance in gardening, landscaping, and agriculture [1]. The *Brassicaceae* family of plants is a worldwide significant plant family and an important natural family, distinguished by traits including cruciform corolla, tetradynamous stamens, siliques, and a strong odor (glucosinolates) [2]. The 338 genera and 3709 species that make up the family *Brassicaceae* are found worldwide, primarily in the Northern Hemisphere's temperate zones [3]. Approximately 100 economically significant species with a wide range of morphological and genetic variation are found in the genus Brassica L. [4]. The *Brassicaceae* family now has 352 genera and 3350-3660 species, according to the current angiosperm categorization system APG-IV[5].and mainly distributed in the northern temperate zone, particularly in the Mediterranean region, Al-Shehbaz [6]. Aethionematoideae and *Brassicoideae* are two subfamilies of the very complex *Brassicaceae* family. Furthermore, the Brassicoideae are divided into five supertribes, which include the recently created Arabodae, Heliophilodae, Hesperodae, and Camelinodae as well as the previously known Brassicodae [7]. The *Brassiceae* are further divided into 13 subtribes under the Brassicodae. With 92 genera, the *Brassiceae* family has the most among them. Many of these species have significant economic significance; for example, rapeseed, or *Brassica* rapa var. oleifera DC., is widely grown in China as a decorative plant and edible oil crop. As a model organism, *Arabidopsis thaliana* L. was noteworthy since its genome was the first higher plant genome to be sequenced and is used extensively in comparison to other eukaryotic genomes.research areas such as plant genetics [8]. Due to differences in authors, institutions, publication dates, and journals, there is a dearth of integration of useful discipline-specific knowledge despite a substantial body of research literature detailing diverse features of Brassicaceae plants. As a result, determining the development trends in this subject

has proven difficult [9]. According to Townsend [10] in Flora if Iraq, there are more than 2000 species and more than 500 genera worldwide, particularly in temperate zones, with at least 80 of these species found in Iraq. Al-Musaw [11] added that this family comprises There are about 380 genera and 3000 species in Iraq, with 177 species and 80 wild genera. Concerning Al-Katib [12],He listed 350 genera and 2,500 species, the majority of which are found in northern hemisphere temperate and cold climates. Of these, 75 are found in the wild, while 18 are grown in Iraq for food and ornament. Plants of the *crucifera* family stand out for their significant economic value.

Material and methods:

Samples were collected through field survey of fresh plant samples in the flowering and flowering stages, and the necessary herbarium information for each plant species was fixed through its label, including (the scientific name of the plant, the area of plant collection, the date of collection, and the name of the collector). After that, the species under study were fixed in Formalin acetic acid alcohol (FAA) and then preserved in 70% ethyl alcohol until use, Transverse sections of the stem and leaves of the studied plant species were prepared by hand sectioning, following the following steps with some modifications to the material preparation method. This is the same method used by Al-Obaid [13]:

1. The selected plant stems were cut into small pieces, 5-7 cm long, from a mid-section. When cutting, the stem was held vertically between the thumb and forefinger and cut using a sharp dissecting blade into thin pieces at a non-slanted level until the thinnest, most detailed, and clear transverse section of the stem was obtained.

2. The sections were stained with safranin stain, prepared in advance by dissolving 0.5 g of the stain in 100 ml of 100% absolute ethyl alcohol for 10-15 minutes. The sections were then washed with 70% ethyl alcohol to remove excess stain.

3. The sections were stained with potassium iodide stain, prepared in advance by dissolving 2 grams of potassium iodide powder in 100 ml of distilled water with 1 gram of iodine

crystals, then mixing well until the solution turned brown. The stain was left to stand for several minutes and then removed using blotting paper. The sections were then transferred to a clean glass slide after adding a drop of diluted glycerol to the section. The slide was gently covered with a cover slip to avoid the formation of bubbles in the section. The slide was left to dry at room temperature.

4. The samples were photographed and examined using an Olympus compound microscope at a magnification of 40x (104x). An ocular micrometer was used to measure the various anatomical dimensions.

Results and discussion:

1. Stem Transverse Section

The study showed that the cross-sections of the stem, which were taken from the middle of the flower stem, showed important differences in the studied genera. Some of these differences have a taxonomic value in isolating and diagnosing these genera. These differences include the shape of the section, the number of epidermal and cortex layers, the number of bundles and thickness of the vascular bundle layer, the diameter of the xylem vessels, the number of its rows, and the number of vessels forming each row. The collenchymal tissue that forms the cortex and the number of its layers were identified. The shape of the cross-section in the stem differs according to the studied genera. In terms of shape, it appeared circular in the species *Biscutella ciliate*, *Alyssum montounm*, and *Clypola jonthlaspi*. As for the average thickness of the epidermis in *Biscutella ciliate*, it reached 11.5 micrometers, while in *Alyssum montounm*, it reached 26.5 micrometers, while in *Clypola jonthlaspi*, it reached 16.5 micrometers. The average thickness of the cortex was 66 micrometers in *Biscutella ciliate,* 50 micrometers in *Alyssum montounm*, and 56.3 micrometers in *Clypola jonthlaspi*. As for the vascular bundles, there were clear variations in the number of bundles, as the average was 5 bundles in *Biscutella ciliate*, 20 in *Alyssum montounm*, and 14 in *Clypola jonthlaspi*. Variations were also shown in the thickness of the conducting vessels, as the average was 183.3 micrometers in *Biscutella ciliate*, 295.8 microme-

ters in *Alyssum montounm*, and 125 micrometers in *Clypola jonthlaspi*. As for the thickness of the bark, there were differences in thickness, as the average thickness of *Biscutella ciliate* was 137.5 micrometers, while in *Alyssum montounm* it was 212.5 micrometers, and for *Clypola jonthlaspi* it was 62.5 micrometers. As for the thickness of the wood, it varied in thickness, as *Biscutella ciliate* averaged 25 micrometers, while in *Alyssum montounm* it was 58.3 micrometers, and for Clypola jonthlaspi it was 45.8 micrometers. The current study agreed with what was stated by Şirin et al. [14].and Keshavarzi et al.,[15]

Table 1: Anatomical measurements of the stems of the studied plants: *Bischtella ciliata, Alyssum montanum*, and *Clypola jouthlaspi,* using a micrometer.

Characteristics / Species	number of vascular bundles (mm)	Phloem Length (mm)	xylem length (mm)	vascular bundle length (mm)	cortex length (mm)	Epidermis length (mm)
Bischtella Ciliate	4-6 (5)	25-25 (25)	112.5-175 (137.5)	162.5-200 (183.3)	50-75 (66)	10-12.5 11.5()
Alyssum Montanum	18-22 (20)	50-75 (58.3)	200-225 (212.5)	287.5-300 (295.8)	37.5-62.5 (50)	25-30 (26.5)
Clypola jouthlaspi	13-16 (14)	37.5-50 (45.8)	50-75 (62.5)	112.5-137.5 (125)	50-62.5 (56.5)	15-17.5 (16.5)

وحدة القياس بـ (micrometers)

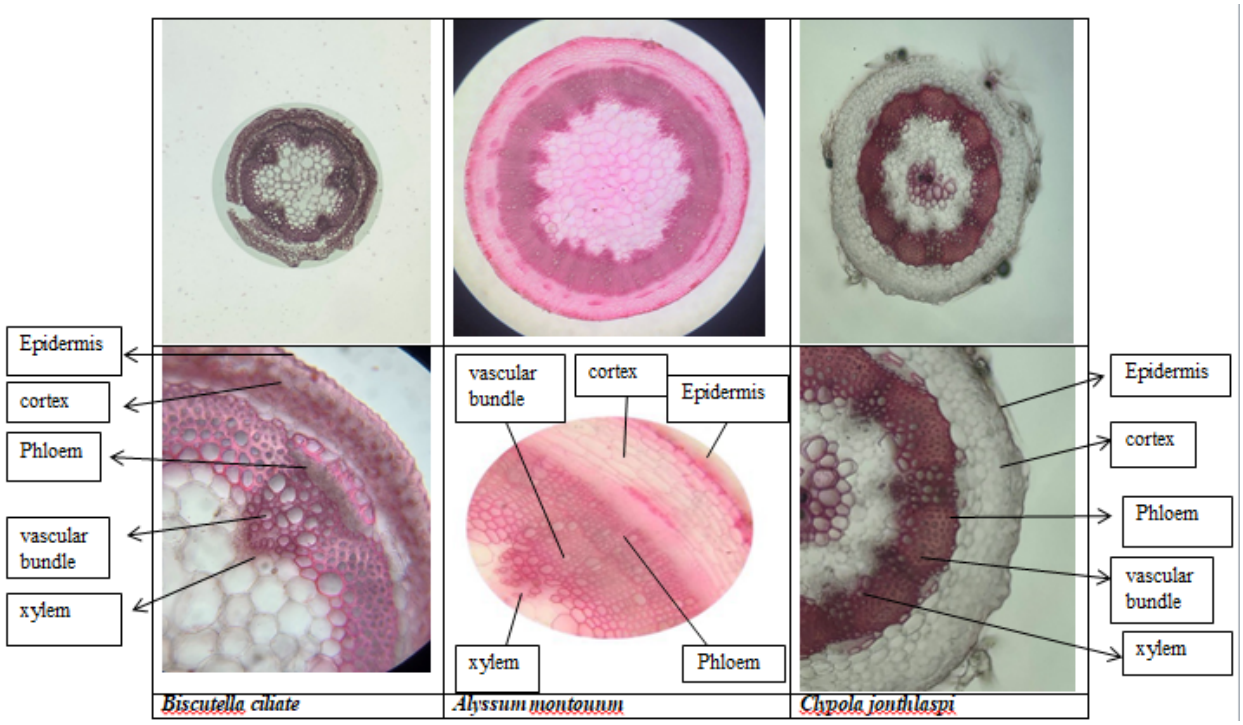

Fig.1 Cross sections of the stems of the studied plants: *Bischtella ciliata, Alyssum montanum*, and *Clypola jouthlaspi* (Thickness of the epidermis, cortex, vascular bundles, xylem and phloem)

2. Cross-sectional study of leaf blades

The results of the anatomical study of the leaf cross-sections of the studied species revealed significant variations in the isolation of the studied species. Variations in the thickness of the upper and lower leaf epidermis were also evident. All species were similar in the thickness of the upper and lower epidermis. The average thickness of the upper epidermis in *Biscutella ciliate* was 16.4 micrometers, while in *Alyssum montounm*, the average thickness of the upper epidermis was 33.5 micrometers, and in *Clypola jonthlaspi*, it was 18.4 micrometers. As for the thickness of the lower epidermis, the average thickness of *Biscutella ciliate* was 25.5 µm, while in *Alyssum montounm* it was 37.4 µm, and in *Clypola jonthlaspi* it was 22.1 µm. As for the thickness of the palisade layer, the average thickness of *Biscutella ciliate* was 50.2 µm, while in *Alyssum montounm* it was 49.6 µm, while in *Clypola jonthlaspi* it

is not visible and does not contain any of it. As for the number of layers of the palisade layer, *Biscutella ciliate* and *Alyssum montounm* contain two layers, each of which is As for the thickness of the spongy layer, the average of the species *Biscutella ciliate* reached 26.4 micrometers, while in the species *Alyssum montounm* it reached an average of 60.5 micrometers, while for the species *Clypola jonthlaspi* it reached an average of 65.5 micrometers. As for the thickness of the conducting vessels, there were different variations. In the species *Biscutella ciliate*, the average thickness of the conducting vessels reached 63.3 micrometers, while in the species *Alyssum montounm* it reached an average of 59.7, while for the species *Clypola jonthlaspi* it reached an average of 33.7 micrometers. As for the number of bundles, the average of the species *Biscutella ciliate* for the number of bundles reached 4 bundles, while in the species *Alyssum montounm* it reached an average of 5 bundles, while for the species *Clypola jonthlaspi* it reached an average of 7 bundles. The current study agreed with what was stated by Şirin et al. [13].and and Keshavarzi et al.,[14].

Table 2. Anatomical measurements of the leaves of the studied plants: *Bischtella ciliata*, *Alyssum montanum*, and *Clypola jouthlaspi*, using a micrometer.

Characteristics / Species	Number of bundles (mm)	Vascular bundle thickness (mm)	Thickness of spongy layer (mm)	Number of layers of columnar Layer (mm)	Columnar layer thickness (mm)	Lower epidermis thickness (mm)	Upper epidermis thickness (mm)
Biscutella ciliate	3-5 (4)	60.8-67.1 (63.3)	23.2-29.1 (26.4)	2	46.1-52.3 (50.2)	20.1-26.3 (25.5)	14.2-18.5 (16.4)
Alyssum montanum	4-6 (5)	55.6-60.5 (59.7)	56.6-63.4 (60.5)	2	44.4-52.3 (49.6)	30.1-38.5 (37.4)	28.4-36.1 (33.5)
Clypola jouthlaspi	6-8 (7)	26.9-36.5 (33.7)	57.1-66.3 (65.5)	-	-	18.5-26.4 (22.1)	13.2-19.5 (18.4)

وحدة القياس بـ (micrometers)

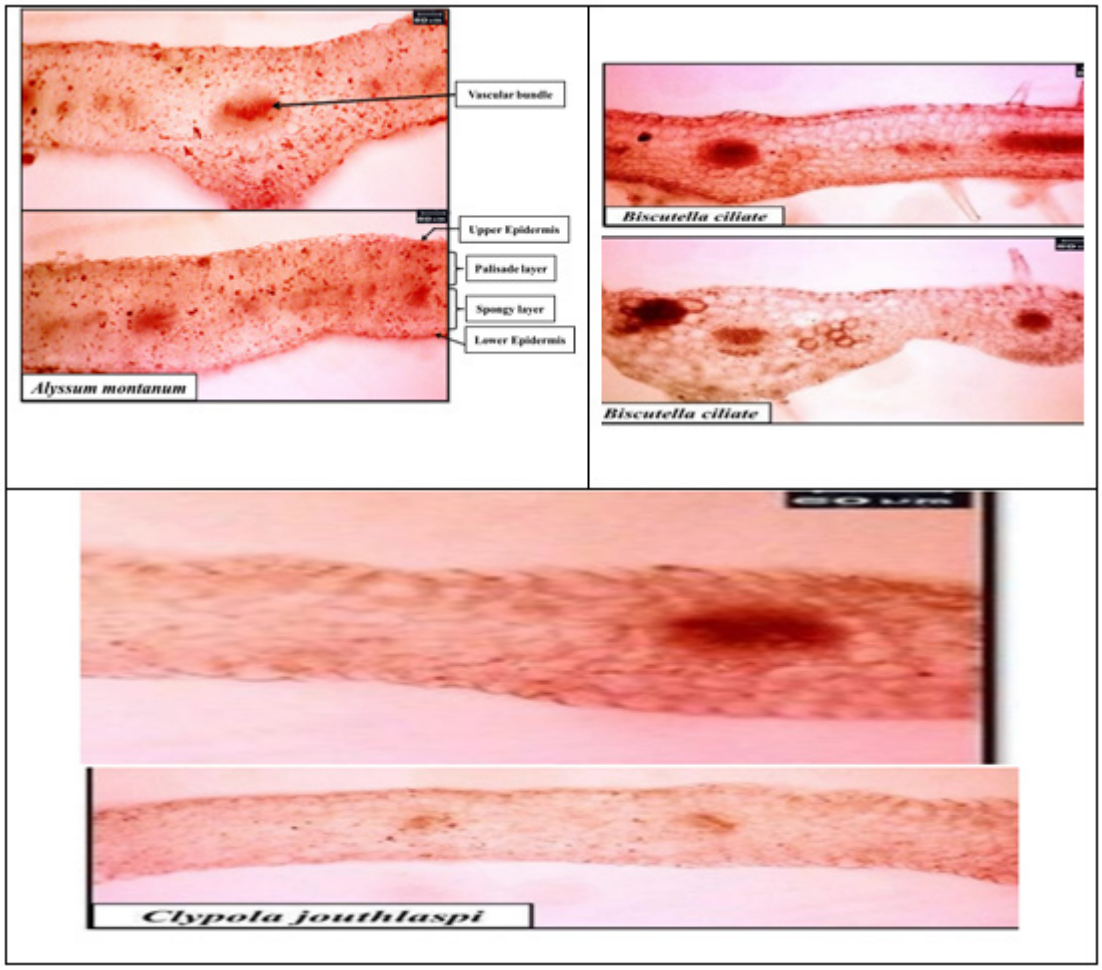

Fig. 2 Cross sections of the leaves of the studied plants: *Bischtella ciliata, Alyssum montanum, and Clypola jouthlaspi* (Thickness of the epidermis, cortex, vascular bundles, xylem and phloem)

Conclusion:

Anatomical characters played an important and prominent role, especially the variations in the quantitative and qualitative characters of the stem cross-sections.

1- The species *Alyssum montanum* was distinguished by the largest number of vascular bundles, the thickness of the cortex, and the thickness of the epidermis, which consisted of a single layer.

2- The leaf sections also showed the presence of vascular bundles in the center of the leaf cross-sections and also in the middle of the wings of the species *Clypola jouthlaspi*.

3-These bundles became smaller the further they were from the center. This character helped in diagnosing and isolating the studied species, as they are dominant characters for the phenotypic characters and enhance them at the level of species and genera.

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