Chelonian Conservation And Biology

Vol. 19 No. 1 (2024) | https://www.acgpublishing.com/ | ISSN - 1071-8443

DOI: doi.org/10.18011/2024.01(1).309.321

A COMPARATIVE ANATOMICAL STUDY OF THE LOWER EPIDERMIS OF LEAVES OF THE GENUS *AEGILOPS*

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Abstract

In this paper leaf structure of Six Iraqi species of *Aegilops* L. have been anatomically examined. It was observed that the anatomical characters have high variation in the length of long cells in both stomatal and non- stomatal rows, length and number of stomata in microscopic field, the number of short cells, indumentum properties such as type of prickle hairs and macro- hairs, the blade and keel outline, the shape of abaxial and adaxial sclerenchyma, and bulliform cells arrangement, Finally the study show that anatomical characteristics of the leaf blade vary between studied taxa.

Key words: Anatomy, *Aegilops* , Poaceae, Variation

Introduction

Ever since man set foot on this green planet, his interest has been focused on getting to know the creatures that share life with him. Therefore, he devoted his effort to uncovering them and distinguishing what benefits him from them and what he uses for food, medicine, clothing, and housing. Plants were among the most prominent things he researched, and with the development and complexity of life, his desire to know what was beneficial to him and what was harmful Because of the great scientific development that occurred in all areas of life, he classified plants on the basis of their phenotypic characteristics and continued research to find more comprehensive and accurate means or methods for the purpose of easily identifying a plant. Among these studies are anatomical studies, especially leaf anatomy, as it is available in most growing seasons. The anatomical study played an effective and important role in revealing the precise characteristics through leaf dissection, and accordingly the approved plant groups were classified, including the Poaceae family, the conifers, and others (Heywood and Davis, 1963). Stace (1980) showed that anatomical traits are less affected by the climatic conditions surrounding the plant than phenotypic traits.

Aegilops are member of the Poaceae family, and the name *Aegilops* is derived from two syllables: *Aegilos*, meaning the grass preferred by goats, and Ops, meaning Appearance or Similar to, it is

spread mainly in Western Asia and the Mediterranean Basin region, Therefore the current study aimed to compare anatomically between plant species of the genus Aegilops through their vegetative parts, so that the species of the genus could be distinguished anatomically.

Materials and Methods

1- Plant samples

The study included the dissection of six species in Iraq belonging to the genus *Aegilops*, based on dried samples deposited in the Iraqi National Herbarium (BAH), as shown in Table (1).

Tablel: species studied

Genus	**Species**
Aegilops	*A. biuncialis*
	A. cylindrical
	A. juvenalis
	A. ovata
	A. umbellate
	A. tauschii

2- Epidermis Preparation: Follow the following steps in preparing the lower skin according to the method (Cutler et al., 2007):

1- A leaf containing a full growth (the second after the spike) from the brand (in the flower stage) and soaked in boiling water for (2-3) minutes, which is necessary, as it includes the middle nutrients and part of the bottle and using the scraping method, scraping with high precision using two needles. With two precise ends (fine honey can be used) and with extreme caution so as not to damage the eye, remove all that has been removed from the skin and get rid of the inconspicuous tissue.

2- The prepared event was reduced to a slice containing a drop of all the minors and left for a minute.

3- The skin of the leaf was then washed with distilled water for the purpose of getting rid of traces of the minor solution, and with extreme caution to prevent the prepared skin from slipping.
4- The prepared skin was dyed by applying drops of safranin and glycerin dye and left for (2-3) minutes.
5- He gently placed the cover on the slide and closed its edges using clear nail polish, then marked and kept the slides in the refrigerator until they were studied using a compound light microscope.

Results

The epidermis of the leaves differs from the epidermis of the stem in that it consists of two epidermis: the lower epidermis (Abaxial epidermis) and the upper epidermis (Adaxial epidermis). It is also divided into several clear areas:

The marginal zone, the midvein zone, the coastal zone, and the Intercostal zone, all of which have in common that they contain long cells and short cells, which are usually single or double, represented by silica cells associated with cork cells, as well as crown cells, and prickles with macro hairs in some species under study.

A- Long epidermal cells: The characteristics of the long cells in the lower epidermis of leaves in the studied species of the genus *Aegilops* varied in their lengths, whether they were within the stomatal rows or the non-stomatal rows, as well as the presence of overlaps in the nature of the undulating walls and their thickness.

The nature of the long cell walls was characterized by being pitted and slightly undulated in all species studied from the genus *Aegilops*, (figure 1).
As for the quantitative characteristics of the long cells in the stomatal rows, they contributed to the differentiate *A. tauschii*, with regard to the length of the cells, which reached (62.0 - 90.0) micrometres, and the species *A. cylindrica*, in which the length reached (105.0 - 180.0) micrometres, while the rest of the species were overlapping. Table (1).

Table (1): Quantitative characteristics of elongated cells in the lower epidermis of leaves of the studied Aegilops species, measured with a micrometer.

Species	Rows stomatal		Rows non stomatal			Inter coastal zone
	Length cell length	Width cell length	Length cell length	Width cell length	Coastal zone	
A. biunicialis	)70.0 – 130.0(98.75	)45.0 - 55.0(49.5	)125.0 - 230.0(196.0	)42.5 – 50.0(47.0	)7.0 – 11.0(9.0	)1.0 – 7.0(4.0
A.cylindrica	)105.0 – 180.0(130.0	)40.0 – 50.0(45.5	)117.5 – 240.0(168.75	)45.0 – 52.5(50.75	)6.0 – 17.0(11.0	)3.0 – 13.0(5.0
A. juvenalis	)85.0 – 130.0(103.75	)45.0 - 55.0(50.5	)160.0 - 245.0(205.5	)45.0 – 55.0(50.0	)7.0 – 22.0(15.0	)5.0 – 23.0(14.0
A. ovata	)60.0 – 120.0(90.0	)45.0 – 55.0(49.0	)195.0 – 295.0(250.0	)42.5 – 55.0(47.5	)6.0 – 9.0(8.0	)1.0 – 5.0(3.0
A. umbellata	)70.0 – 115.0(92.0	)42.5 – 52.5(48.5	)132.5- 212.5(166.0	)45.0 – 52.5(48.0	)3.0 – 6.0(5.0	)7.0 – 12.0(9.0
A. tauaschii	)62.0 – 90.0(76.25	)30.0 – 42.5(36.75	)105.0 – 212.5(158.75	)35.0 – 42.5(38.25	)6.0 – 13.0(10.0	)1.0 – 8.0(4.0

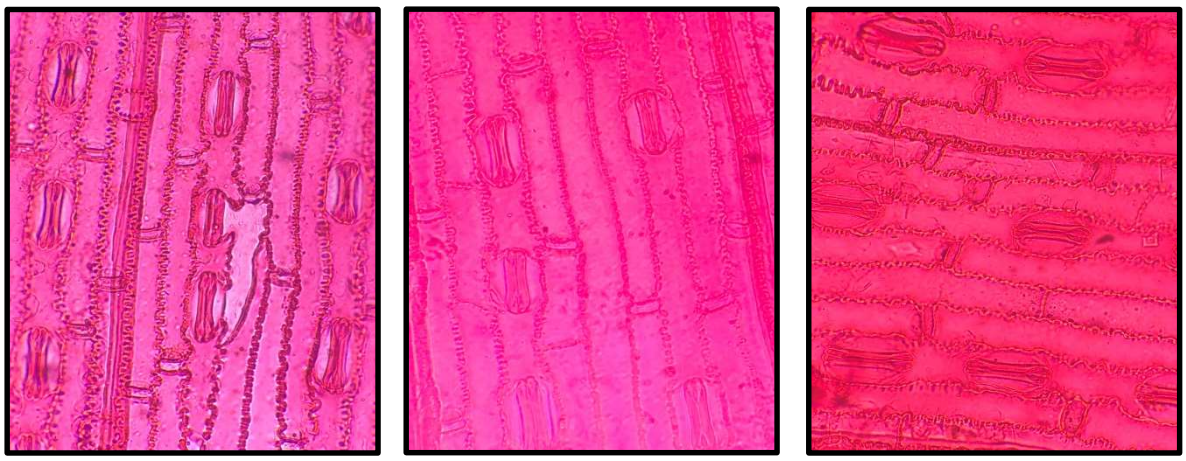
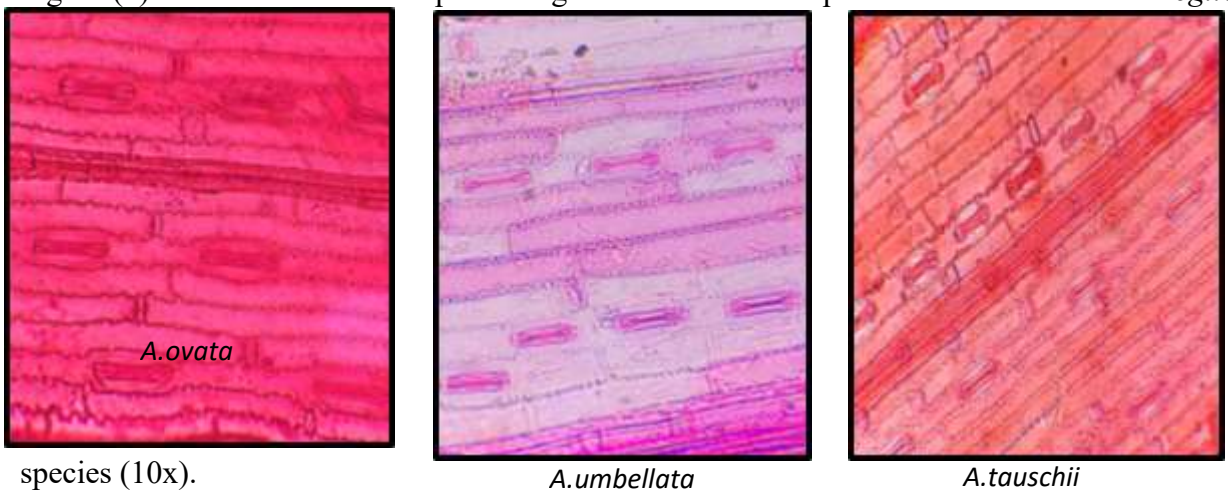


Figure (1): Variations in the shape of long cells in the lower epidermis of leaves of the *Aegilops* species (10x).



B- Short cells: The short cells in the lower epidermis of leaves consist of three types of cells: siliceous cells, cork cells, and crown cells in their various shapes. They are usually arranged between the long cells, which are either single or in pairs, especially in the vein area. They are also characterized by the thinness of their walls, especially in the vein area. As for the ones at The marginal area is often characterized by thick walls.

The short, paired cells in the genus *Aegilops*, consisting of a cork cell and a siliceous cell, were distinguished by their abundance in the species *A. cylindrica*, with an average of (32.0) micrometres and a range of (21.0 - 42.0) micrometres, thus isolated from the species *A. ovata* and *A. tauschii* and *A. umbellata* Table (2).

As for the single short cells, their presence is limited to the two species *A. tauschii* and *A. juvenalis*, with overlapping numbers Table (2).

Table (2): Characteristics of the short cells in the lower epidermis of the leaves of the studied *Aegilops* species.

Species	Number of silique cells paired with cork cells	Number of single short cells
A.biuncialis	)16.0 – 27.0(24.0	--------
A. cylindrica	)21.0 -42.0(32.0	---------
A.juvenalis	)7.0 -22.0(15.0	)5.0 – 23.0(14.0
A. ovate	)14.0 – 21.0(18.0	-------
A. tauschii	)6.0 -21.0(14.0	)5.0 – 25.0(14.0
A. umbellate	)12.0 -19.0(15 -0	----------

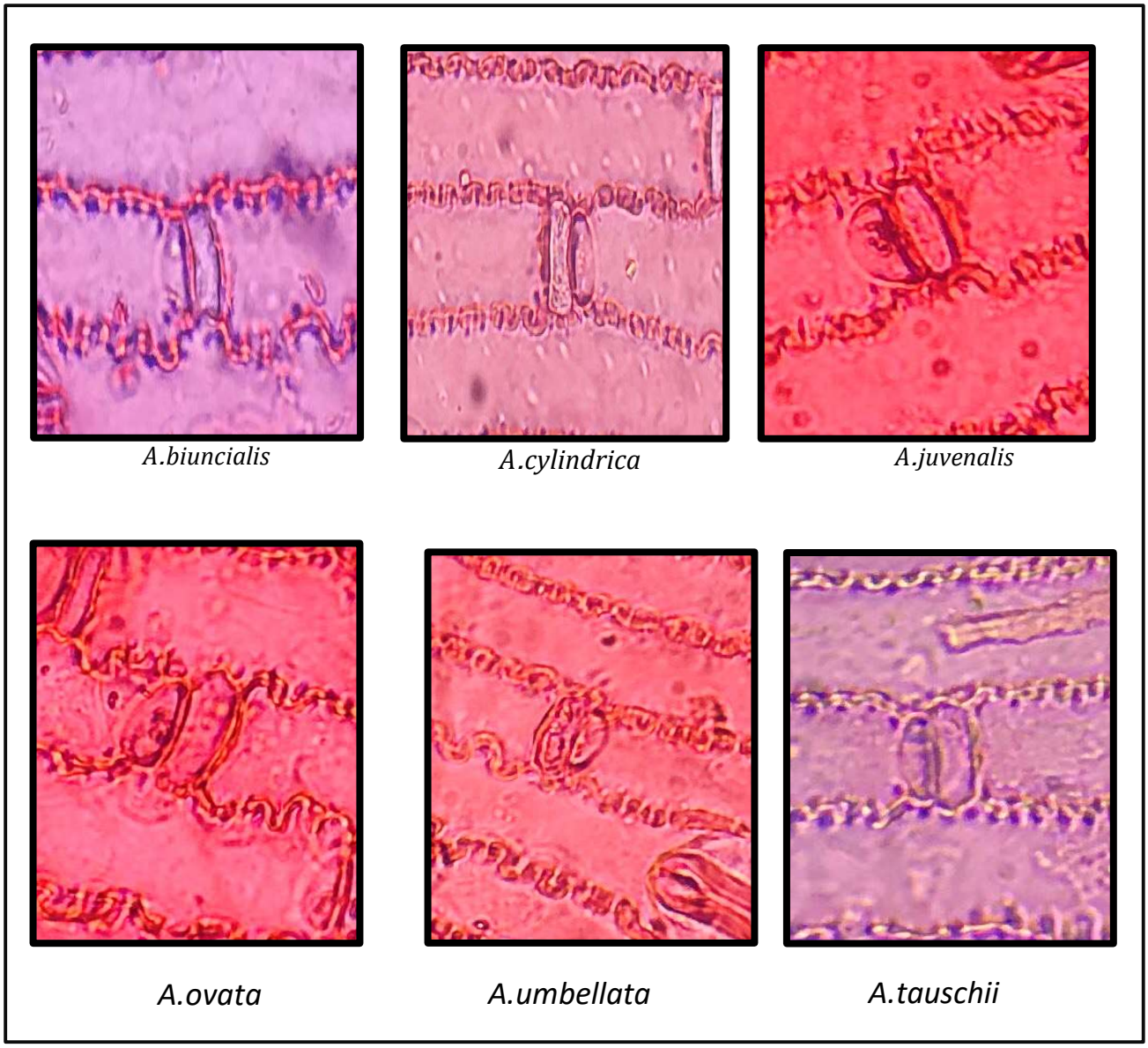


Figure: (2): Variations of short cell in the lower leaf epidermis of the studied *Aegilops* species (40X).

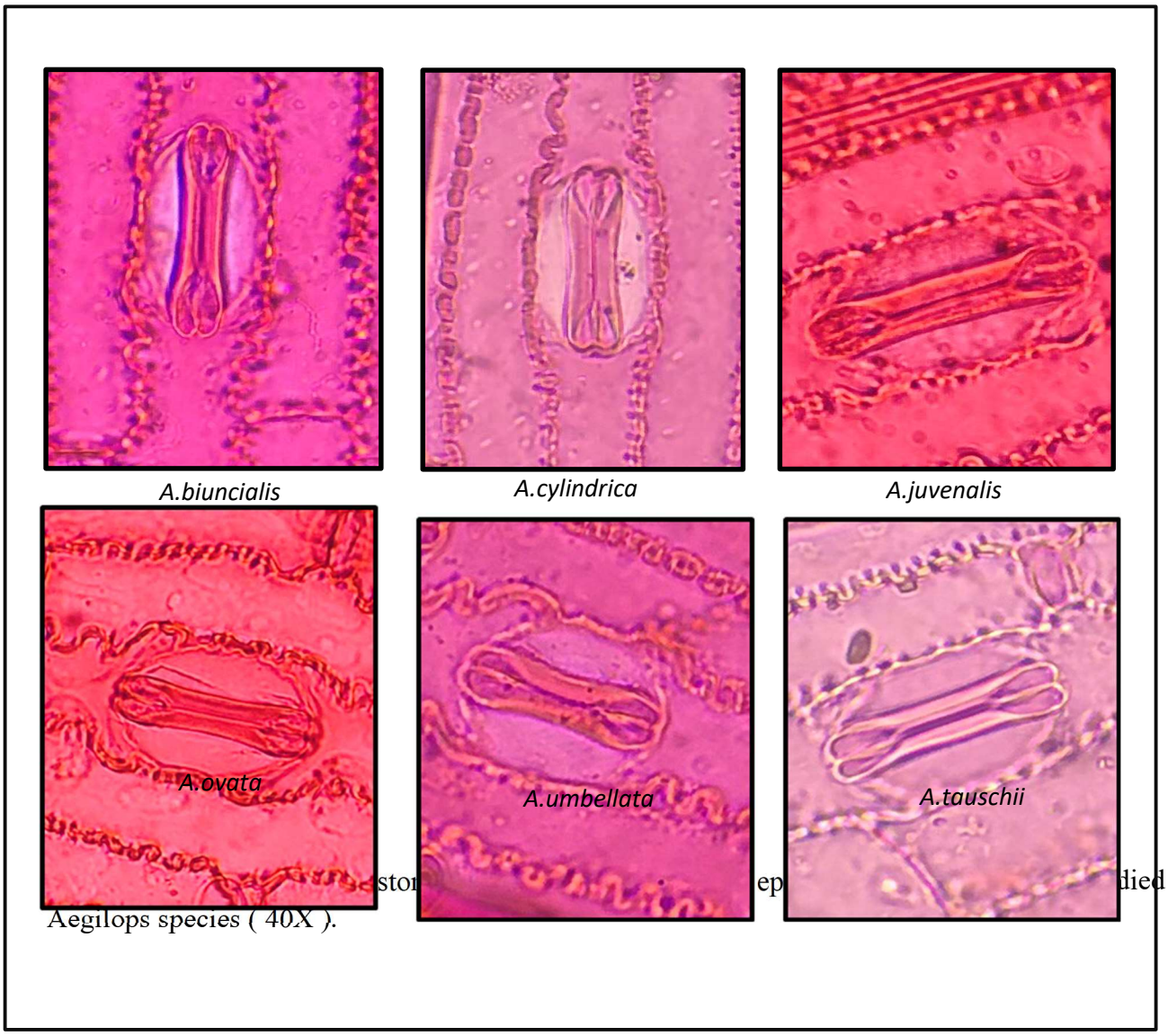
C-Stomatal complexes: The stomatal complex consists of guard cells and sudsidary cells arranged in rows called stomatal rows, and they are usually arranged sequentially from one long cell to another (Figure 3).

The quantitative characteristics of the stomata constituted a great taxonomic value if the length of the stomata contributed to isolating the species *A. tauschii* with a length of (60.0 - 70.0) µm from the species *A. biuncialis* and *A. juvenalis* and *A. ovata* and *A. umbellata*, in which the measurements usually overlapped, as for the width of the stomata in the genus *Aegilops*, there was a differe between *A. biuncialis* (50.0 - 55.0) µm and *A. juvenalis* (65.0 - 57.5) µm, A. ovata (57.5 - 65.5) µm, and *A. tauschii* (42.5-50.0) µm (Table 3).

The characteristic of the number of stomata in microscopic field was not provide much importance in distinguishing between species, but despite that, it distinguished between *A. biuncialis* and *A. umbellata*, with numbers reaching (31.0 - 48.0) and (21.0 - 30.0), respectively (Table 3). The shapes of stomata were different in the studied species, as they appeared in a low dome shape in the species *A. biuncialis* and *A. biuncialis*, *A. ovata*, *A. tauschii*, and *A. umbellata*, while it was parallel in the rest of the species. Also.

Table (3): Characteristics of stomatal complexes in abaxial epidermis of leaves of the studied *Aegilops* species.

Species	Stomata length	Stomata width	Number of stomatal rows between two races	The number of rows separating the stomatal rows	Number of stomata in the microscopic field
A. biuncialis	)80.0 -90.0(85.25	)50.0 -55.0(53.25	)2.0 - 4.0(3.0	)2.0 - 5.0(3.0	)31.0 -48.0(42.0
cylindrica A.	)67.5 - 90.0(83.75	)52.5 - 62.5(56.75	)2.0 - 4.0(3.0	)2.0 -4.0(3.0	)17.0 - 60.0(43.0
juvenalis A.	)80.0 -90.0(85.75	)57.5 -65.0(60.75	)2.0 - 4.0(3.0	)2.0 -5.0(3.0	)17.0 - 115.0(86.0
A. ovata	)75.0 -85.0(79.0	)57.5 -65.0(61.5	)2.0 - 3.0(2.2	)2.0 -4.0(3.0	)53.0-21.0(40.0
A.umbellata	)75.0 -90.0(80.75	)47.5 - 65.0(48.25	)1,0 - 4.0(2.0	)2.0 - 4.0(3.0	)21.0 -30.0(24.0
A. tauschii	)60.0 - 70.0(66.25	)42.5 - 50.0(45.5	)4.0-2.0(3.0	)2.0 - 3.0(2.0	)21.0 - 44.0(36.0



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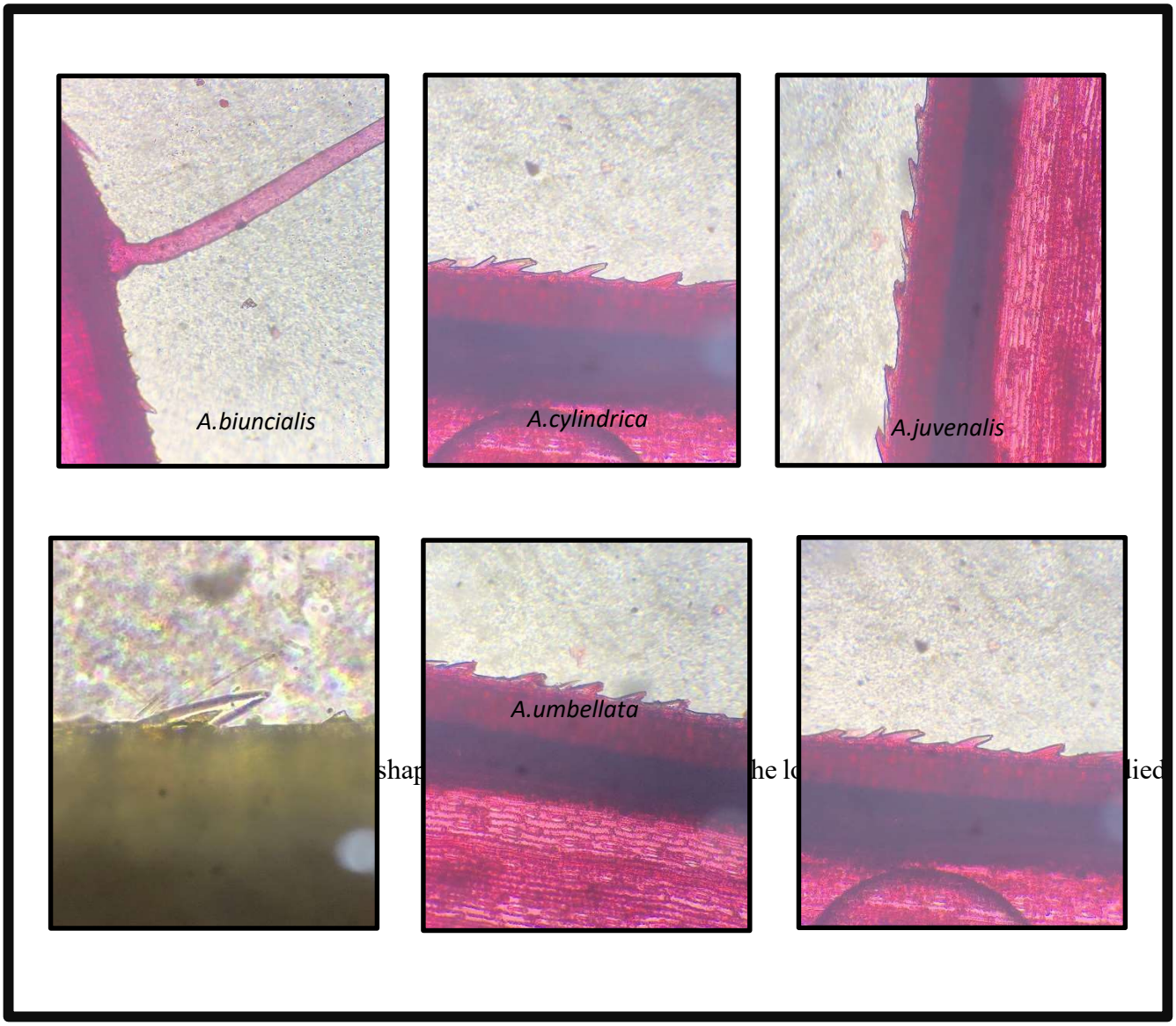
Aegilops species (40X).

D-Indumentum: The indumentum of the abaxile epidermis is characterized by containing small, sharp, single hooks with a circular base spread on the margins only, with the *A. biuncialis* having macrohairs also at the margins, figure (4)



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Discussion

The long cell walls were similar in all species under study, being slightly undulated in species of genus *Aegilops* .The thickness of the cell walls differs between different regions, the long cells are also characterized by their rectangular shape, so these characteristics didn't significantly enhance the separation between species, and this may be due to the closeness between the species studied or as according to Ellis (1979), variations in the characteristics of long cells maynot related to genetic factors, but was also affected by environmental factors.

As for the variation in shapes of short cells, they were characterized by a mostly rectangular shape, which prevailed in all species of *Aegilops* studied (Figure 5). Also, the variation in the shapes of silica cells was not agree with what was stated by Prychid *et al*. (2003) who indicated that silica cells can be divided based on their shape and size differences, which was not recorded in the study,

as silica cells appear in circular shape and Cork cells appear a crescent shape or rectangular, and Crown cells found in a circular or semi-circular shape, This result consistent with Metcalfe (1960) and Twiss et al. (1969 and 1986), who divided the siliceous bodies into three classes: **Class I**: Festucoid, in which the siliceous bodies are circular, rectangular, elliptical, oval, or elongated in shape.This type is found in members of the Festucoideae family, to which the two studied genus *Aegilops* belong, and which shows the C_3 pathway for carbon dioxide fixation. This may be due to the genetic closeness between the studied species and in both sexes, or it may be due to the lack of influence by environmental factors. As for the thickness of the walls, the Crown cells were thicker than the short cells, which are often as thick as the long cells adjacent to them and have pitted walls. The same applies to the Cork Couples cells with the silica cells (Figuer 3).

The presence of the element silicon, or silica, in different areas of the body of weed plants is explained by Guerriero et al. (2016) because the cell walls contain a special type of cellulose, unique hemicellulose, as well as containing Phenyl and a small percentage of pectine, and that the presence of silica will bind the polymers of the cell walls and this characteristic it adds strength and mechanical support (Currie and Perry, 2009; et al., 2013; Kido et al., 2019). Abaxial epidermis was distinguished by containing stomatal complexes in all studied species which were of the parallel type containing two guard cells, all of which surround two auxiliary cells on either side (Bani-Hassan 2021) (Table 2). Kharazian (2007) emphasized the importance of quantitative and qualitative anatomical characteristics for separating species of the genus *Aegilops* in Iran. Among these characteristics was the average length of stomata, which was recorded at (27.6) µm for *A. taushii*, (9.52) µm and for *A. cylindrica*, (10.2) µm. For the species *A. umbellata*, it differs from the rates recorded by the current study, which amounted to (66.25) µm, (83.75) µm, and (80.75) µm, respectively, and the reason for this difference may be attributed to the influence of environmental factors, according to what the same researcher mentioned (Kharazian, 2007).

Conclusions

Anatomical studies are characterized by the breadth and diversity of their characteristics, especially with regard to the epidermis characteristics of the vegetative parts, which in many aspects have contributed to supporting the separation between the species studied, and are thus considered reliable characteristics in diagnosing these species microscopically.

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