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ANATOMICAL STRUCTURE OF PSAMMOPHYTES SPECIES OF THE GENUS *ALLIUM* L. SYRDARYA RIVER VALLEY

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Annotation: The article presents the results of studying the morphological and anatomical structure of species of the genus *Allium* L. growing in arid conditions of the Syrdarya River valley (within the Kyzylorda region). The structure of the peduncle and leaf blade of two types of onions *Allium caspium* (Pall.) M. Bieb is considered. (Caspian onion), *A. sabulosum* Steven ex Bunge (sandy onion).

The species belong to different sections: *A. caspium* – Porrum Don., *A. sabulosum* – Haplostemon Boiss. The anatomical structure of these species is practically not studied. When analyzing the species, differences, features and similarities of their anatomical structure were revealed. It was noted that the cross-section of the leaf blade of *A. caspium* has an elongated oval shape, and *A. sabulosum* has an almost rounded shape. Given the morphological and anatomical features of the leaf shape, probably the round shape of the leaf blade, *A. sabulosum* is more adapted to the arid conditions of the Syrdarya river valley. The stomatal apparatus in the epidermis of the peduncles of the *Allium* species under consideration differs in the depth of location and their number. The anatomical structure of the roots is almost identical in both species.

Keywords: *Allium caspium*, *Allium sabulosum*, anatomy, leaf, peduncle, root, Syrdarya river valley

АНАТОМИЧЕСКОЕ СТРОЕНИЕ ПСАММОФИТНЫХ ВИДОВ РОДА *ALLIUM* L. ДОЛИНЫ РЕКИ СЫРДАРЬИ

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Аннотация: В статье представлены результаты изучения морфологического и анатомического строения видов рода *Allium* L., произрастающих в аридных условиях долины реки Сырдарьи (в пределах Кызылординской области). Рассмотрено строение цветоноса и листовой пластинки двух видов луков *Allium caspium* (Pall.) M. Bieb. (лук каспийский), *A. sabulosum* Steven ex Bunge (лук песчаный).

Виды относятся к разным секциям: *A. caspium* – *Porrum* Don., *A. sabulosum* – *Haplostemon* Boiss. Анатомическая структура этих видов практически не изучена. При анализе видов были выявлены различия, особенности и сходство их анатомического строения. Было отмечено, что поперечный срез листовой пластинки *A. caspium* имеет вытянутую овальную форму, а *A. sabulosum* имеет почти округлую. Учитывая морфологические и анатомические особенности формы листа, вероятно круглая форма листовой пластинки, *A. sabulosum* является более адаптированной к аридным условиям долины реки Сырдарьи. Устьичный аппарат в эпидермисе цветоносов рассматриваемых видов *Allium* различается по глубине месторасположения и их количеству. Анатомическая структура корней почти идентична у обоих видов.

Ключевые слова: *Allium caspium*, *Allium sabulosum*, анатомия, лист, цветонос, корень, долина реки Сырдарья

Introduction.

Genus *Allium* L. It is one of the largest genera in the family Amaryllidaceae in the world with about 800 species [1, 2]. The flora of Kazakhstan is very rich and bows occupy a special place. In the "Flora of Kazakhstan" [3], the genus is represented by 5 sections with 108 species, and 29 of them are endemic. In the understanding of Baitenov M.S. [4], the species composition of the genus already includes 140 species with 45 endemics, and V. Epictetov [5] includes 130 species in the genus. Almost a third of the representatives of the genus are concentrated in the mountainous regions of Central Asia. Whereas in the desert zone the number of species composition is small. Despite the fact that the genus *Allium* is represented by a significant number of species, there are very few publications reflecting the anatomical structure of species growing in arid conditions. Whereas, given the complexity in determining the bows, the anatomical structure is a qualitative species indicator that can be used as an additional parameter in the taxonomy of species of the genus. When describing the leaf blade of species of the genus *Allium*, at least 20 signs are usually used [6]. The nature of the leaves can be: flat, piped, and intermediate [7]. The studied *Allium* species are characterized by: flat (*Allium caspium*) and piped (*A. sabulosum*) leaf characters. Flat leaves are characterized by the standard structure of an ordinary leaf with distinct borders of the epidermis. For piped leaves, the identity of the upper and lower epidermis is characteristic, which makes it difficult to visually recognize them.

Materials and Methods.

The objects of the study are two types of onions: *Allium caspium* (Pall.) M. Bieb. (caspiian onion), *A. sabulosum* Steven ex Bunge. (sandy onion) Samples for the study were collected in natural growing conditions in the valley of the Syrdarya River (Kyzylorda region). The plants were selected in the flowering phase. Cross-sections of plants were made according to the generally accepted method of Barykina P.P. [8] on the freezing device OL-ZSO 30 (INMEDPROM, Russia). Fixation of anatomical sections was carried out in 40% ethanol. Anatomical preparations were made using a microtome with a freezing device OL-ZSO (Inmedprom, Russia). Cross-sections were made using conventional blades. The finished sections were temporarily fixed with glycerin. Cross-sectional images were taken with a Levenhuk D 740T 5.1 M microscope at magnification x 180, x 720, and x 1000 times.

Results and discussions.

For anatomical analysis, cross-sections of peduncles, leaves, and roots of two onion species *Allium caspium* (Pall.) M. Bieb. and *A. sabulosum* Steven ex Bunge were made. Systematically, these species belong to different sections: Porrum Don. (caspian onion), Haplostemon Boiss. (sandy onion) [9].

The main morphological features of the Porrum Don. section. they are: a single bulb, spherical or ovoid, devoid of rhizomes. The stem is more or less highly clothed in the aboveground part by leaf sheaths. The species of the Porrum section are distinguished by the presence of internal three-part staminate filaments and have a fibrous root system.

Characteristic features for the species of the section Haplostemon Boiss. they are: a single bulb, spherical, or oblong-ovate, devoid of rhizomes. The stem is more or less highly clothed in the aboveground part by leaf sheaths. Unlike the representatives of the Porrum section, the filaments of the stamens of the species of this section are whole or short-toothed.

The studied taxa have distinctive features both at the sectional and at the species level. The number of leaves of the caspian onion is 2-3, the variety of their forms – from linear to wide-lancet; having a large surface, which is not for desert territories. characteristic. The width of the leaves is 15-25 mm. The leaf does not exceed the stem. The stem reaches 10-20 cm.

In the sandy onion, the number of leaves is 3-4, they are thin, semi-cylindrical, grooved, piped; which is more adapted to the desert zone. their width is about 1-2 mm. The leaf is shorter than the stem, the height of the stem reaches 20-25 cm [10, 11].

These species are characterized by a slightly different ecological confinement, if *Allium caspium* is a psammomesoxerophyte, then *Allium sabulosum* is a psammomesophyte.

Anatomical section the structure of the caspian onion leaf (fig. 1, A, B) in cross-section has an oblong-oval shape. The outside is covered with a cuticle, under which there is a single-row layer of the epidermis. A simple hair is observed in the apical part above the cuticle (fig. 1, A). Under the epidermis, there is a columnar mesophyll, which is represented by loosely arranged cells.

Further under the mesophyll is the main parenchyma. The structure of the main parenchyma is loose, its cells are large, have a slightly elongated shape. In the parenchyma, small and large conducting bundles of the closed collateral type are traced (fig. 1, C), which are located evenly along the entire circumference of the leaf. According to Abdullayeva A.T. and co-authors [12] and according to our data, the leaf is characterized by an isolateral-palisade type of mesophyll, the epidermis is slightly thickened and has a wavy cuticle, the stomatal apparatus is submerged.

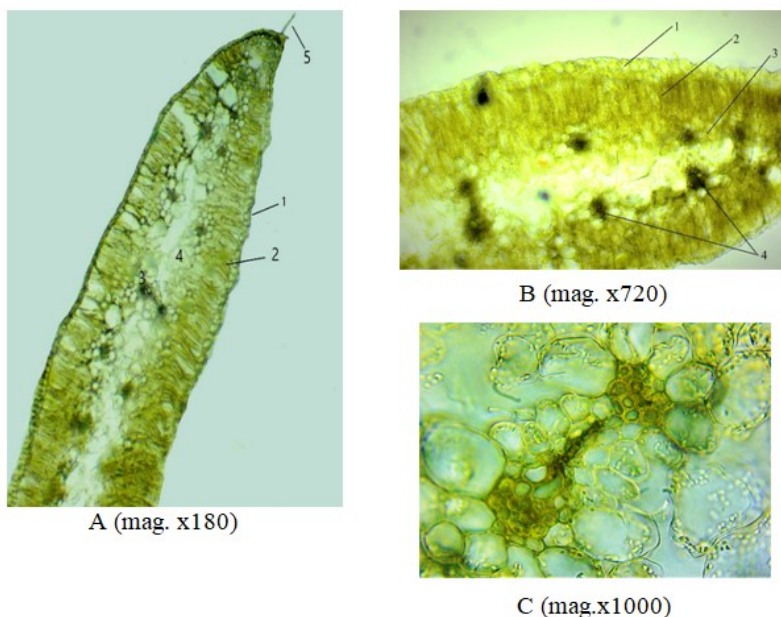


Figure 1 – Anatomical structure of *Allium caspium* leaf
(1 – epidermis; 2 – columnar mesophyll; 3 – main parenchyma; 4 – conducting bundles; 5 – simple hair)

The leaf of the sandy onion on the cross-section has an almost rounded shape, which is similar to the shape of the peduncle (fig. 2 A). The anatomical structure is similar to the caspian onion. On the outside, there is a thin layer of cuticle, under which there is a single-layer epidermis. This is followed by a columnar mesophyll. The cells of the columnar mesophyll, which are tightly adjacent to each other, are arranged in one row.

A distinctive feature of this species is the presence of air-bearing cavities (aerenchyma) among the cells of columnar mesophyll. Single sclerenchyma cells are found under the layer of columnar mesophyll cells, which is another distinctive feature of this species. The structure of the main parenchyma is quite densely folded, its cells have a rounded shape and occupy the entire central part of the leaf blade. In the parenchyma, small and large conducting bundles of the closed collateral type are traced (fig. 2B), which are located evenly along the entire circumference of the leaf.

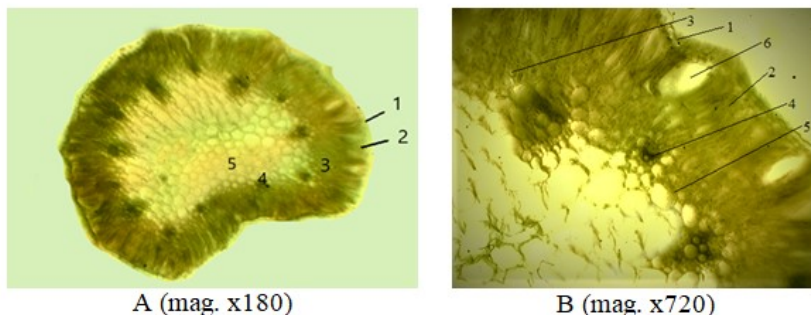


Figure 2 – Anatomical structure of *Allium sabulosum* leaf
(1 – epidermis; 2 – columnar mesophyll; 3 – single sclerenchyma cells; 4 – conducting bundles; 5 – main parenchyma; 6 – air cavities)

The anatomical structure of the peduncles of *A. caspium* and *A. sabulosum* is shown in Figure 3. The structure of the peduncles is identical in the species under consideration. The cross-section of the peduncles is rounded in shape, covered on the outside with a slightly wavy cuticle. The single-layer epidermis of peduncles has a structure characteristic of bows. Numerous stomata of this species are deeply submerged. The epidermis is followed by a well-developed photosynthetic chlorenchyma, whose cells, unlike leaf cells, are arranged tightly together and consist of 3 rows. Non-specialized parenchyma is continuously located under the chlorenchyma.

Further along the entire circumference of the peduncle, there is non-specialized parenchyma, including sclerenchyma cells. Small conductive bundles are located between the non-specialized parenchyma and the central parenchyma. The outer and inner bundles have a closed-collateral type of structure (fig. 4).

The differences in the anatomical structure of the peduncles of *A. caspium* and *A. sabulosum* include the fact that the cells of the sclerenchyma of the onion are less developed or occur singly.

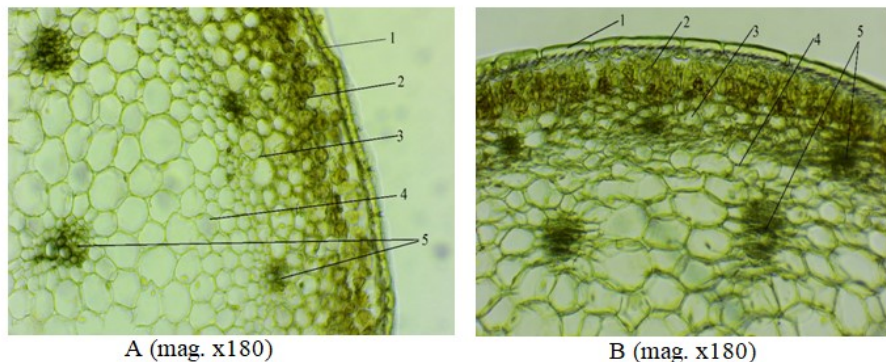
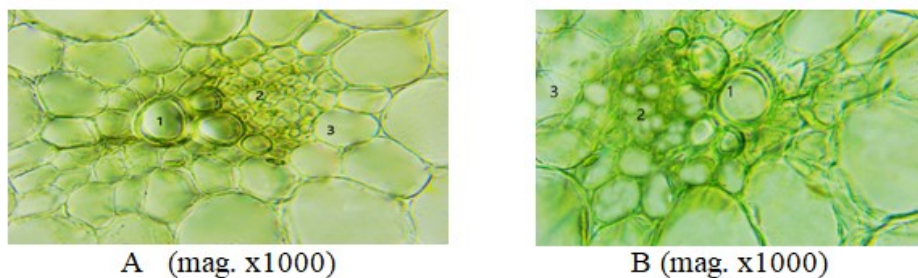


Figure 3 – Anatomical structure of the peduncle:

A – *A. caspium*; B – *A. sabulosum*

(1 – epidermis; 2 – chlorenchyma; 3 – non-specialized parenchyma; 4 – central parenchyma; 5 – conducting bundles)



A (mag. x1000)

B (mag. x1000)

Figure 4 – Structure of the conducting bundle of the peduncle:

A – *A. caspium*; B – *A. sabulosum*

(1 – xylem vessels, 2 – phloem, 3 – parenchymal cells)

The anatomical and morphological structure of the subordinate roots of *A. caspium* (A) and *A. sabulosum* (B) (fig. 5) is represented by the primary structure. In general, the structure of the subordinate roots is identical. Outside, the roots are covered with single-row exoderm cells. Then there are 6 layers – in *A. caspium* (A) or 4 layers – in *A. sabulosum* (B) cells of the primary cortex, which end with single-layer endoderm, behind which the pericycle is located. The inner layer of the cortex is represented by a single layer of endoderm cells. The central cylinder is represented by elements of the primary phloem and primary xylem. The woody parenchyma is poorly developed. The phloem is 2-4 segmented, the sieve-like and satellite cells are located between the xylem blades, thin-walled. The number of

xylem and phloem groups of roots is individual for each of the roots. The caspian onion has one central vessel, and the sandy onion has smaller xylem vessels among 5 (large central and 4 lateral). The xylem groups close together in the center of the root. There is no core in the roots.

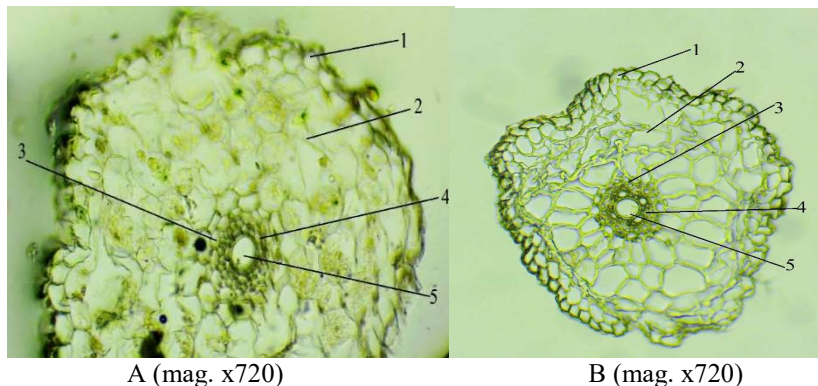


Figure 5 – Anatomical structure of the roots:

A – *A. caspium*; B – *A. sabulosum*

(1 – exodermis; 2 – parenchyma cells of the primary cortex; 3 – endodermis; 4 – primary phloem; 5 – vessels of the primary xylem)

Conclusion:

Despite the fact that the studied species *Allium caspium* and *A. sabulosum* belong to different sections of the genus, the analysis of anatomical structures showed both the presence of common features in their anatomical structure: leaf, peduncle and root, and the presence of differences. In the leaf of both species, there is a thickened outer wall of the epidermis and cuticle, the shape of the peduncle has a rounded shape. Conducting bundles of vegetative organs of closed collateral type.

The cross-section of the leaf blade of the caspian onion has an oblong-oval shape, and the sandy onion has a rounded shape. The structure of the peduncle in the species is almost identical, but the sandy onion has a larger number of stomata. Assimilation cells and parenchyma cells in caspian onions are less developed than in sandy onions. A distinctive feature of the sandy onion is the presence of air-bearing cavities among the cells of the columnar mesophyll, and under the layer of cells of the columnar mesophyll, there are single cells of the sclerenchyme.

With regard to the structure of the roots, it should be noted that the caspian onion has more developed layers of primary cortex cells and there is one central xylem vessel, and the sandy onion has half as many layers of primary

cortex cells, the cortical cells are larger with thicker cell walls, and the xylem vessels are smaller in number 5 (1 larger central and 4 smaller lateral).

Thus, according to the data obtained, the species of bows have pronounced features of the psammophytic organization of the anatomical and morphological structure.

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Bibliography

[1] Friesen N., Fritsch R. M., Blattner F. R. Phylogeny and new intrageneric classification of *Allium* (Alliaceae) based on nuclear ribosomal DNA ITS sequences. – Aliso, 2006. No. 22. 372-395 p.

[2] Mashaehki S. Evolution of leaf blade anatomy in *Allium* (Amaryllidaceae) subgenus *Amarallium* with a focus on the North American species / S. Mashaehki, J.T. Columbus. // American Journal of Botany. – 2014. No. 101. 63-85 p.

[3] Pavlov N.V. Genus Onion – *Allium* L. / ed. N.V. Pavlova, P.P. Polyakov. // Flora of Kazakhstan – Alma-Ata: AN KazSSR, 1958. T. 2. 181-192 p.

[4] Baitenov M.S. Genus Onion – *Allium* L. / M.S. Baytenov. // Flora of Kazakhstan. Generic complex of flora. – Almaty: Gylym, 2001. T. 2. 52 p.

[5] Epictetov V. Genus *Allium* L. in the flora of Kazakhstan. Floral list. 2022. [Electronic resource]. – URL: <https://www.plantarium.ru/page/flora/id/1087.html>. (date of access: 25.01.2022).

[6] Seregin A.P. Floristic materials and key on onions (*Allium* L., Alliaceae) of European Russia / A.P. Seregin. // Bull. MOIP. Dep. biol. – 2005. Vol. 110. issue. 1. 45-51 p.

[7] Friesen N.V. *Allium* of Siberia: taxonomy, karyology, chorology. / N.V. Friesen. – Novosibirsk: Nauka, 1988. 184 p.

[8] Handbook of botanical microtechnology. Fundamentals and methods. / R.P. Barykina, T.D. Veselova, A.G. Devyatov, Kh.Kh. Dzhililova, G.M. Ilyina, N.V. Chubatov. – M.: Publishing House of Moscow State University, 2004. 312 p.

[9] *Allium* L. // Flora of the USSR. – Moscow: Publishing House of the Academy of Sciences of the USSR, 1936. T. VI. 228-275 p.

[10] Tsgolova V.G. Onion. *Allium* L. // Illustrated guide to plants of Kazakhstan. – Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1969. T. 1. 183-191 p.

- [11] Vvedensky A.I. *Allium* L. – Onion // Key to plants of Central Asia. – Tashkent: publishing house "FAN" UzSSR, 1972. Т. II. 76-87 p.
- [12] Abdullaeva A.T. Structural Features of Some Vegetative Organs of *Allium caspium* (Pall.) M. Bieb. Growing in Natural Habitat. V International Scientific-Practical Conference on Priority Directions of Science Development, Lviv, Ukraine, 2-3 March 2020, 57-62 p.

Список литературы

- [1] Friesen N., Fritsch R. M., Blattner F. R. Phylogeny and new intrageneric classification of *Allium* (Alliaceae) based on nuclear ribosomal DNA ITS sequences. – Aliso, 2006. № 22. 372-395 p.
- [2] Mashaehki S. Evolution of leaf blade anatomy in *Allium* (Amaryllidaceae) subgenus *AmarAllium* with a focus on the North American species / S. Mashaehki, J.T. Columbus. // American Journal of Botany. – 2014. № 101. 63-85 p.
- [3] Павлов Н.В. Род Лук – *Allium* L. / под ред. Н.В. Павлова, П.П. Поляков. // Флора Казахстана – Алма-Ата: АН КазССР, 1958. Т. 2. 181-192 с.
- [4] Байтенов М.С. Род Лук – *Allium* L. / М.С. Байтенов. // Флора Казахстана. Родовой комплекс флоры. – Алматы: Ғылым, 2001. Т. 2. 52 с.
- [5] Эпиктетов В. Род *Allium* L. во флоре Казахстана. Флористический список. – 2022. [Электронный ресурс]. – URL: <https://www.plantarium.ru/page/flora/id/1087.html>. (дата обращения: 25.01.2022).
- [6] Серегин А.П. Флористические материалы и ключ по лукам (*Allium* L., Alliaceae) Европейской России / А.П. Серегин. // Бюл. МОИП. Отд. биол. – 2005. Т. 110. вып. 1. 45-51 с.
- [7] Фризен Н.В. Луковые Сибири: систематика, кариология, хорология. / Н.В. Фризен. – Новосибирск: Наука, 1988. 184 с.
- [8] Справочник по ботанической микротехнике. Основы и методы. / Р.П. Барыкина, Т.Д. Веселова, А.Г. Девятов, Х.Х. Джалилова, Г.М. Ильина, Н.В. Чубатова. – М.: Изд-во МГУ, 2004. 312 с.
- [9] *Allium* L. // Флора СССР. – Москва: изд-во АН СССР, 1936. Т. VI. 228-275 с.
- [10] Цаголова В.Г. Лук. *Allium* L. // Иллюстрированный определитель растений Казахстана. – Алма-Ата: Изд-во АН КазССР, 1969. Т. 1. 183-191 с.
- [11] Введенский А.И. *Allium* L. – Лук // Определитель растений Средней Азии. – Ташкент: изд-во «ФАН» УзССР, 1972. Т. II. 76-87 с.
- [12] Abdullaeva A.T. Structural Features of Some Vegetative Organs of *Allium caspium* (Pall.) M. Bieb. Growing in Natural Habitat. V International Scientific-

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