Scientific Research Publishing

American Journal of Plant Sciences, 2018, 9, 2676-2683
http://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Comparative Anatomical Structure of the Leaf of *Allium suworowii* Regel (Amaryllidaceae) in Different Ecological Conditions

Dildora M. Yusupova

Laboratory Anatomy and Cytoembryology of the Tashkent Botanical Garden Named after Academician F.N. Rusanov, Institute of Botany of the Academy of Sciences, Tashkent, Uzbekistan
Email: guljon.duschanova@mail.ru

How to cite this paper: Yusupova, D.M. (2018) Comparative Anatomical Structure of the Leaf of *Allium suworowii* Regel (Amaryllidaceae) in Different Ecological Conditions. *American Journal of Plant Sciences*, **9**, 2676-2683.
https://doi.org/10.4236/ajps.2018.913194

Received: November 14, 2018
Accepted: December 18, 2018
Published: December 21, 2018

Abstract

First studied the anatomy of the leaf *Allium suworowii* in different ecological conditions: Jizzakh region and the Tashkent Botanical Garden named after academician F.N. Rusanov at the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan. Identifying diagnostic signs of the leaf and determining a different combination of xeromorphic and mesomorphic features ensure adaptation to habitat conditions. Under the conditions that nature mesomorphic signs predominate, and introduction-xeromorphic signs prevail, this indicates that they are adapted to the conditions of introduction of this species.

Keywords

Anatomy, Leaf, *Allium suworowii*, Jizzakh Region, Introduction, Tashkent Botanical Garden, Uzbekistan

1. Introduction

With preservation in the world of biological diversity, protection of plant world and their rational use are one of global problems. In this regard, the development of methods for identifying and preserving ornamental, rare and endangered species of natural flora is one of the pressing issues.

According to W.T. Stearn [1] the genus *Allium* L., there are 750 - 800 species that are widely distributed in Eurasia and America. A number of more than 20 types of onions are widely used by the local population for food. Irrational and exorbitant fees have led to exhaustion and a sharp reduction in the range of many of them.

In addition to natural habitats, species of the genus *Allium* were also studied in unregulated conditions of the culture phytocenosis (Tashkent Botanical Garden), where they settled 30 - 40 years ago beyond the limits of previously existing exposures [2]. All studied species are bulbous geophytes with an ephemeroid rhythm of development. In life form, they are classified as bulbous non-particulating monocentric bows [3]. The material was mainly species of the genus *Allium* from the subgenus Melanocrommyum, (systematic affiliation is given according to F.O. Khasanov [4]. More than 30 *Allium* species grow in Uzbekistan, among which there are food, medicine and a large number of decorative representatives [5]-[10].

A.T. Abdullayeva [11] [12] studied the anatomical structure of the assimilating organs of *A. pskemense* and *A. praemixtum* under the conditions of introduction of the Tashkent Botanical Garden and determined the adaptive diagnostic features of the assimilating organs of these species. In this regard, the identification of morphological, structural features of the representatives of the genus *Allium* in natural conditions and with the introduction, and the rationale for their adaptive traits are of great scientific and practical importance.

2. Materials and Methods

The objects of study are *Allium suworowii* perennial herbaceous plant species of the genus Allium L. Family Amaryllidaceae. In nature, the species range covers the Western Tien Shan.Species identified by F.O. Khassanov [13].

The material was collected at the beginning of May 2017 from natural conditions—growth of the Jizzakh region, Malguzar region (Malguzar ridge) and in the conditions of introduction from the exhibition of oniony introduced plants of the laboratory "Introductions of woody and herbaceous plants" of the Tashkent Botanical Garden named after acad. N.F. Rusanov at the Institute of Botany, Academy of Sciences of the Republic of Uzbekistan.

Malguzar Range (Jizzakh region, Malguzar district) it belongs to the Central Asian province. Gypsum desert an area of about 300 thousand km^2; height above sea level 500 - 550 m. It is characterized by: small amount of precipitation (average 300 - 340 mm per year), high summer (up to 30˚C - 35˚C) and low winter (up to −13 ° C, rarely to −20 ° C) temperature. The soil is sierozem, loamy, loamy, meadow alluvial, brown, slightly leached [14].

Tashkent Botanical Garden is located in the north-eastern part of Tashkent in the basin; chirchik in the low adyr belt at an altitude of 450 - 480 m above sea level. The climate is sharply continental. The average annual precipitation during the study was 337 mm, the average annual temperature 13.8˚C. Precipitation falls mainly in the autumn-winter and spring periods; soil cultural-irrigated gray soils or irrigated sierozem [15].

Studies were conducted in terms of nature and introduction. Simultaneously with the morphological description, the sheet was fixed in 70% ethanol for anatomical study. The leaf epidermis was studied on paradermal and cross sections. The cross sections of the leaf are made through the middle. Descriptions

of the main tissues and cells are given according to K. Esau [16], N.S. Kiseleva [17], and the epidermis according to S.F. Zakharevich [18]. The measurements were carried out depending on the organ, tissues and cells in a 30 - 90 short repetition with an eyepiece micrometer followed by transfer to microns. Preparations prepared by hand were stained with methylene blue followed by gluing to glycerin-gelatin [19]. Micrographs were taken by computer micro plotting with a *Canon A*123 digital camera under the *Motic B*1-220*A*-3 microscope. Statistical processing of quantitative data was carried out according to generally accepted criteria [20] using a personal computer (MS-Excel program).

3. Results and Discussion

The leaves of *Allium suworowii* are a variety, 2 - 6 in number, 30 - 40 cm long, 2.5 - 3.5 cm wide, rough on the edge, bluish, much shorter than the arrow. The arrow was a height of the 40 - 100 cm.

The structure of the leafof *A. suworowii* in nature (Jizzakh region). On the paradermal section, the outlines of the epidermal cells are straight, elongated longitudinally, epidermal cells numerous on the abaxial side (per 1 mm^2—75.6 ± 0.83) than on the adaxial side (per 1 mm^2—50 ± 0.45). The cells of the adaxial epidermis are larger than the abaxial ones. The leaves are amphiphomatic. The stomata are transverse to the longitudinal axis of the leaf. The stomata form is oval (55.6 ± 0.43 - 30.5 ± 0.27 μm in length and width), numerous on the abaxial side (per 1 mm^2—111.6 ± 1.15) than on the adaxial side (per 1 mm^2—62.5 ± 0.71). The stomata closing cells on both sides of the leaf are almost the same length. The stoma is slightly submerged (12.5 ± 0.08 μm), of the anomocytic type (**Figure 1(a^1)**, **Figure 1(a^2)**), **Table 1**).

Mesophyll leaf in a cross section isolateral-palisade type includes, which is represented by palisade, spongy cells, latex and vascular bundles.

The epidermis is represented by one row of cells with a thin-walled cuticle (10.5 ± 0.09 μm). The cells of the epidermis are large (30.3 ± 0.31 μm), oval-shaped. The palisade parenchyma consists of two rows, of elongated shape, 130.5 ± 0.6 μm in length, 50.5 ± 0.47 μm in width.

The spongy parenchyma consists of 12 - 13 rows, large cells with a diameter of 81.25 ± 0.92 μm. Lacteal located on the border of palisade and spongy parenchyma with a diameter of 33.33 ± 0.27 μm. Lacteal not stands out among the spongy tissue. The spongy parenchyma consists of rounded cells with large intercellular spaces, and in the middle of the leaf intercellular spaces coalesce, forming small cavities.

Vascular bundles arranged in two rows, of which the top is represented only small bundles. In the bottom row, large beams alternate with one small beam. Vascular bundles closed, collateral, numerous consisting of phloem and xylem, with 9 - 10 vessels with large and small diameter 58.33 ± 0.61 μm (**Figure 2(a^1)-(a^4)**, **Table 1**).

The structure of the leaf *A. suworowii* in the conditions of introduction (Tashkent Botanical Garden). In the paradermal section, the outlines of the

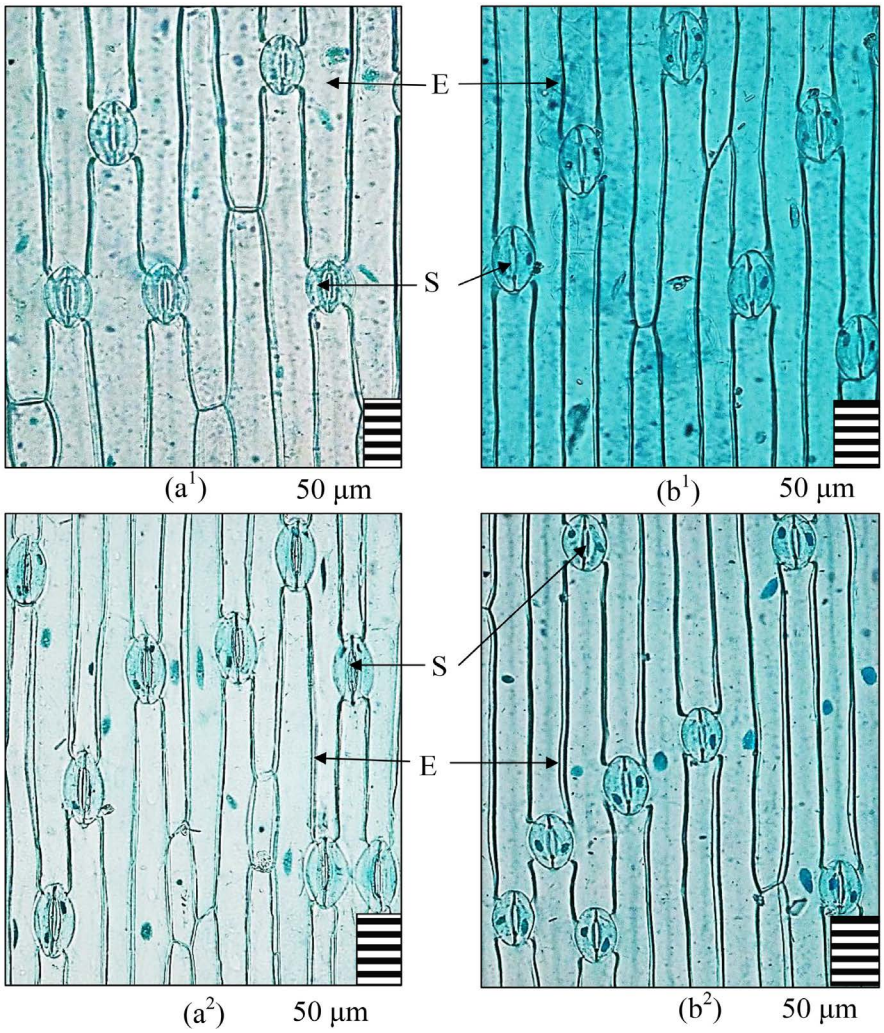

Figure 1. The anatomical structure of the epidermis of the leaf *A. suworowii* in conditionsnature (a^1)-(a^2) and introductions (b^1)-(b^2), (a^1)-(b^1) adaxial epidermis; (a^2)-(b^2) abaxial epidermis. Magnification—50 μm. Legend: E—epidermis, S—stomata.

epidermal cells are straight, strongly elongated longitudinally than nature, the epidermis cells are numerous on the abaxial side (per 1 mm^2—90.4 ± 1.12) than on the adaxial (per 1 mm^2—64.8 ± 0.74). The cells of the adaxial epidermis are larger than the abaxial ones. The leaves are amphiphomatic. The stomata are transverse to the longitudinal axis of the sheet. The stomata form is oval (50.5 ± 0.37 0 27.5 ± 0.21 μm in length and width), numerous on the abaxial side (per 1 mm^2—124.5 ± 1.27) than on the adaxial side (per 1 mm^2—74.4 ± 0.85). The stomata closing cells on both sides of the leaf are almost the same length. The stomata are more submerged (23.6 ± 0.21 μm), of the anomocytic type (**Figure 1(b^1)**, **Figure 1(b^2)**, **Table 1**).

Mesophyll leaf in a cross section isolateral-palisade type includes, which is represented by palisade, spongy cells, latex and vascular bundles.

The epidermis is represented by one row of oval-shaped cells. The outer membrane of epidermal cells is cutinized and strongly thickened 18.2 ± 0.14 μm.

Table 1. Quantitative indicators of the leaf *Allium suworowii* in two different environmental conditions (n = 30).

Indicators		Jizzakhregion	Tashkent
Epidermis: outer wall thickness, μm		10.5 ± 0.09	18.2 ± 0.14
height cells, μm		30.3 ±0.31	36.4 ± 0.25
number on 1 mm^2	adaxial	50.4 ± 0.45	64.8 ± 0.74
	abaxial	75.6 ± 0.83	90.4 ± 1.12
Stoma: length, μm		55.6 ± 0.43	50.5 ±0.37
width, μm		30.5 ± 0.27	27.5 ± 0.21
immersion, μm		12.5 ± 0.08	23.6 ± 0.21
number on 1 mm^2	adaxial	62.5 ± 0.71	74.4 ± 0.85
	abaxial	111.6 ± 1.15	124.5 ± 1.27
Spongy parenchyma: diameter cell, μm		81.25 ± 0.92	90.23 ± 0.87
number of rows		14 - 15	10 - 12
Palisade parenchyma: length, μm		130.5 ± 1.24	77.27 ± 0.81
width, μm		50.5 ± 0.47	40.9 ± 0.44
number of rows		2	1
The diameter of the lacteals, μm		33.33 ± 0.27	12.5 ± 0.20
Vessels of vascular bundles: the diameter of the vessels, μm		58.33 ± 0.61	43.75 ± 0.57
number of vessels		9 - 10	6 - 7

The epidermis cells are large (36.4 ± 0.25 μm), the palisade parenchyma consists of one row, 77.27 ± 0.87 μm in length, 40.9 ± 0.44 μm in width.

The spongy parenchyma consists of 10 - 12 rows of large cells with a diameter of 90.23 ± 0.5 μm. Between the palisade and spongy cells is small lacteal with a diameter of 12.5 ± 0.20 μm. Lacteal not stands out among the spongy tissue. The spongy parenchyma consists of rounded cells with large intercellular spaces, and in the middle of the leaf intercellular spaces coalesce, forming small cavities.

Vascular bundles arranged in two rows, of which the top is represented only small bundles. In the bottom row, large beams alternate with one small beam. Vascular bundles closed, collateral, numerous consisting of phloem and xylem, with 6 - 7 vessels with large and small diameter 43.75 ± 0.57 μm (**Figure 2(b^1)-(b^4)**, **Table 1**).

Based on the biometric analysis of quantitative indicators of *A. suworowii* leaf, the following prevailing xeromorphic and mesomorphic features in 2 living conditions characteristic of this species were identified (**Figure 3**, **Table 1**).

In the leaf *A. suworowii* (nature)—small, few epidermal cells with thin-walled outer walls; weakly submerged and few stomata; large, multi-row spongy and palisade parenchyma; large lacteals; large, numerous vessels in conducting bundles are mesomorphic signs, prevailing in the conditions of nature.

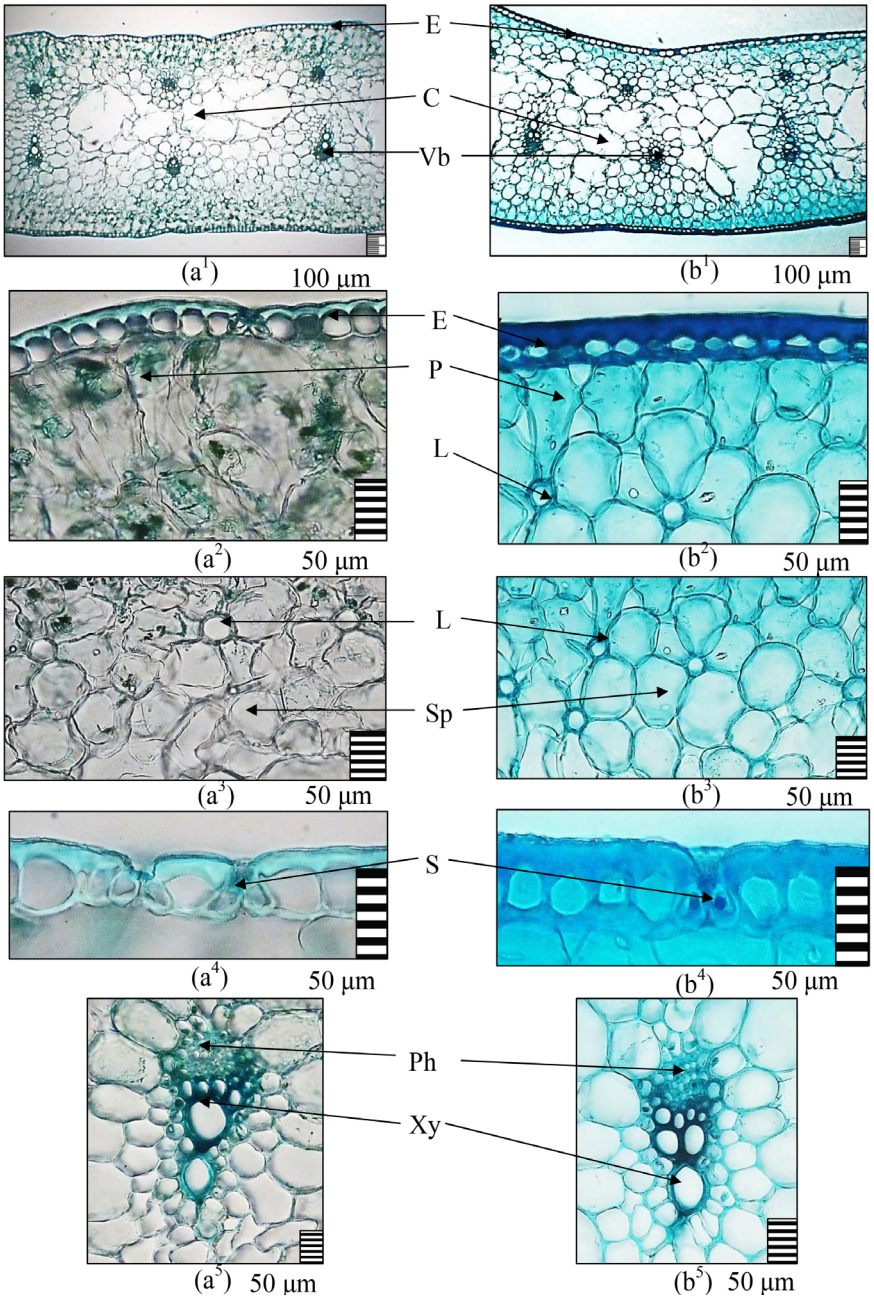

Figure 2. Anatomical structure of *A. suworowii* leaf under conditions of nature (a^1)-(a^4) and introductions (b^1)-(b^4), (a^1)-(b^1) detail of the leaf mesophyll and vascular bundles; (a^2)-(b^2) epidermis and palisade parenchyma; (a^3)-(b^3) spongy parenchyma and lacteals; (a^4)-(b^4) submerged stoma; (a^5)-(b^5) vascular bundles. Magnification—50 μm. **Legend:** C—cavity, E—epidermis, L—lacteals, P—palisade parenchyma, Ph—phloem, Sp—spongy parenchyma, Vb—vascular bundles, Xy—xylem, S—stomata.

In the leaf *A. suworowii* (introduction)—large, numerous epidermal cells with the most thickened outer walls; the most submerged and numerous stomata; small, unordered spongy and palisade parenchyma; small lacteals; small, few vessels in conducting bundles are xeromorphic signs prevailing in the conditions of introduction.

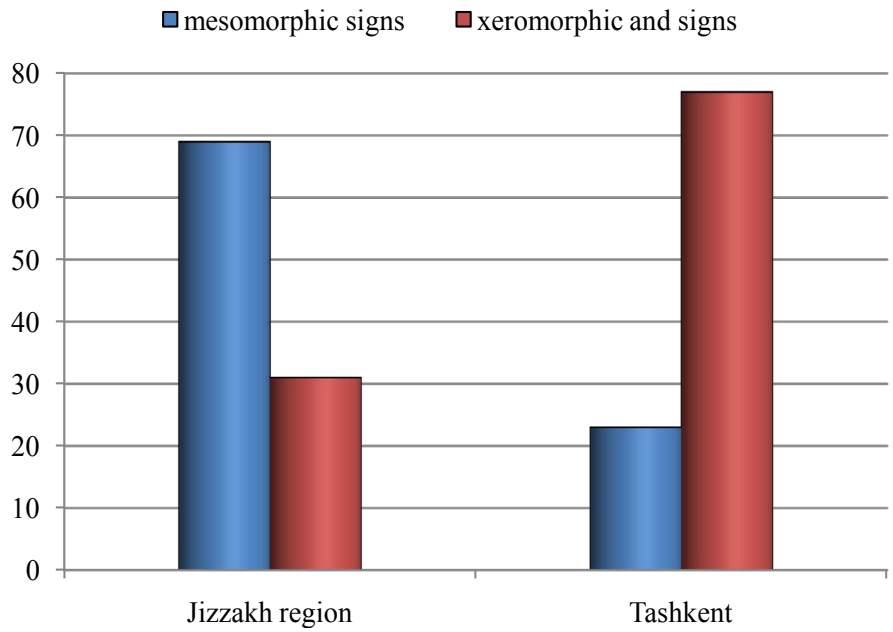

Figure 3. Correlation adaptive mesomorphic and xeromorphic signs (n = 17) of the leaf *Allium suworowii* different ecological habitats conditions (nature and introduction).

4. Conclusion

Thus, based on the results obtained for a comparative study of the anatomical structure of the leaf of *A. suworowii* in two different conditions (nature and introduction), a different combination of xeromorphic and mesomorphic sings determined, which provides adaptation to habitat conditions. In *A. suworowii*, which grows under natural conditions, mesomorphic sings predominate. In A. suworowii, which grows under the conditions of introduction, xeromorphic signs predominate and indicate adaptation to the place of growth.

Acknowledgements

The current research is done under the project VA-FA-F5-008 "Scientific basis for the preservation of the gene pool of rare endemic species of flora of Uzbekistan *ex situ* and the biology of their reproduction".

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Stearn W.T. (1992) Haw Many Species of *Allium* Are Known? *T Curtis's Botanical Magazine*, **9**, 180-182.

[2] Pechenitsyn, V.P., Turgunov M.D. and Uralov, A.I. (2015) The Safety of Some Geophytes in the Unregulated Conditions of the Botanical Garden. Biological and Structural-Functional Bases for the Study and Conservation of Biodiversity of Uzbekistan. *Materials of the Republican Scientific Conference*, Tashkent, 8-9 September 2015, 265-567. (In Russian)

[3] Cheremushkina, V.A. (2004) Biology of the Bows of Eurasia. Science, Novosibirsk, 280. (In Russian)

[4] Khasanov, F.O. (2008) The Genus *Allium* L. in the Flora of Central Asia: Author's Abstract. Abstract of the Thesis of Doctor of Biological Sciences, Tashkent, 35. (In Russian)

[5] Baytulin, I.O., Rakhimbaev, I.R. and Kamenetskaya, I.I. (1986) Introduction and Morphogenesis of Wild Onions in Kazakhstan. Science, Alma-Ata, 156. (In Russian)

[6] Khasanov, F.O. and Umarov, T.A. (1989) Wild Food Species of the Genus *Allium* L. of the Western Tien Shan. *Uzbek Biological Journal*, **6**, 24-26. (In Russian)

[7] Kamenetsky, R. and Rabinowitch, H.D. (2006) The Genus *Allium*: A Developmental and Horticultural Analysis. *Horticultural Reviews*, **32**, 329-37. (In Russian) https://doi.org/10.1002/9780470767986.ch7

[8] Keusgen, M., Fritsch, R.M., Hisoriev, H., Kurbonova, P.A. and Khassanov, F.O. (2006) Wild *Allium* Species (Alliaceae) of Uzbekistan and Uzbekistan. *Journal of Ethnobiology and Ethnomedicine*, **2**, 18. (In Russian)

[9] Volkova, G.A., Motorina, N.A. and Ryabinina, M.L. (2012) Results of the Introduction of Central Asian Onion Species (Genus *Allium* L.) in the European Northeast. *Proceedings of the Samara Scientific Center of the Russian Academy of Sciences*, Moscow, **1**, 2195-2197. (In Russian)

[10] Fritsch, R.M. and Abbasi, M.A. (2013) Taxonomic Review of *Allium.* subg. *Melanocrommyum* in Iran. Gatersleben, 218.

[11] Abdullayeva A.T. (2018) Structural Features of the Vegetative Organs *Allumpraemixtum* Vved. in the Conditions of Introduction of the Tashkent Botanical Garden. *VII International Scientific and Practical Conference "Problems of rational use and Protection of Natural Resources of the Southern Aral Sea Region*", 18 July 2018, 6-7. (In Russian)

[12] Abdullayeva, A.T. (2018) Structural Features of the Assimilating Organs of the Endemic *Allium pskemense* B. Fedtsch. Chorazm Mamun Akademiasi Ahborotnomasi, Hiva, Leuven, 7-10. (In Russian)

[13] Khassanov, F.O. (2016) *Amaryllidaceae*. Flora of Uzbekistan. Navro'z Publications, Tashkent, 13-26. (In Russian)

[14] Beshko, N.Yu. (1999) Flora of the Nurata reserve: Author's Abstract. Ph.D. Thesis, Tashkent, 26. (In Russian)

[15] Duschanova, G.M. (2016) Adaptive Features of Vegetative Organs of Species of the Genus *Climacoptera* Botsch. (Chenopodiaceae) in Connection with Halophytic: Author's Abstract of the Thesis of Doctor of Biological Sciences, Tashkent, 35-36. (In Russian)

[16] Esau, K. (1969) Anatomy of Plants. Mir, Moscow, 138-416. (In Russian)

[17] Kiseleva, N.S. (1971) Anatomy and Morphology of Plants. Higher School, Minsk, 89-119, 2015-227.(In Russian)

[18] Zakharevich, S.F. (1954) To the Technique of Describing the Leaf Epidermis. *Bulletin of Leningrad State University*, **4**, 65-75. (In Russian)

[19] Barykina, R.P. and Chubatova, N.V. (2005) A Large Workshop on the Ecological Anatomy of Flowering Plants. Association of Scientific Publications, Moscow, 77. (In Russian)

[20] Zaitsev, G.N. (1991) Mathematics in Experimental Botany. Science, Moscow, 296. (In Russian)