

Structural Features of Vegetative Organs of Some Endemic Species of the Genus *Juno* Tratt. (Iridaceae) in the Tashkent Botanical Garden (Uzbekistan)

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Abstract: Three *Juno* spp. were studied in this anatomical research: *J. orchioides* Carriere, *J. svetlanae* (Vved.) F.O. Khass. and *J. magnifica* (Vved.) F.O. Khass. & N. Rakhimova). The structures of vegetative organs (leaf, leaf's vagina, and stem) were analysed and following features were recognized as diagnostic: the spongy type of the leaf mesophyll; submerged stomata of anomocytic type, absence of stomata on the adaxial side; parenchymal-bundle type of the vagina; presence of large, elongated epidermis only on the adaxial side, and only on abaxial side of the vagina leaf; closed, collateral type of vascular bundles; bundle type parenchyma in the stem; primary cortex separated from the central cylinder by a ring of lignified cells (sclerenchyma). These structural features are characteristic for genus *Juno* and can serve to identify these species.

Keywords: anatomy, leave, leaf's vagina, stem, *Juno*

1. Introduction

Uzbekistan plays key role in conservation of global biodiversity. In spite of good general condition of the biodiversity, there are several species at the edge of extinction, including some rare bulbous plants. They demand particular attention and special programs of conservation.

Traditional methods of *ex situ* and *in situ* conservation of the rare and endangered plant species are perspective in plant biodiversity conservation. The established *in situ* collections of rare and endangered species of bulbous plants at the Tashkent Botanical Garden named after F.N. Rusanov of the Institute of Botany of the Academy of Sciences of Uzbekistan allows to make first step in biodiversity conservation and to receive sufficient material to establish artificial populations and to perform reintroduction of the rare species in wild. One of the most endangered bulbous groups of species is the Iridaceae which include 75 - 80 genera and more than 1800 species, well distributed presumably in the tropical and subtropical countries. The *Iris* L. is polymorphic genus with more than 200 species (Takhtadzhyan, 1982). In the flora of Uzbekistan, this genus is represented by more than 30 species.

The usefulness of the *Iris* species, first of all, in their high decorative. Most of the species are contains essential oils, some of them contains alkaloids (Gubano, 2002).

In the literature presented in the main information about the morphological signs (Khassanov, Rakhimova, 2016) and taxonomic revision of the genus *Iris* (Khassanov, Rakhimova, 2012; Khassanov, Rakhimova, 2016).

Morphological signs of the inflorescence of representatives of the Iridaceae family of the flora of Uzbekistan are

described. It has been revealed that the genus *Juno* is characterized by a frontal inflorescence, whereas the species *Iris*, *Gladiolus italicus* and *Moraeasisyrinchium* are characterized by ferrotic inflorescences (Turgunov, 2017).

We have previously studied the morpho-anatomical structure of the assimilating and vegetative organs of certain species of *Iris* (*Iris sogdiana*, *Iris korolkowii*, *I. stolonifera*, *I. alberti*) and *Juno* (*Juno svetlanae*), in order to identify the diagnostic features inherent in each section (Limniris Tausch, *Iris Hexapogon* (Bunge ex Alek.) Baker and *Juno* Tratt. (Rakhimova, Duschanova, 2017 a, b; Duschanova et al., 2017; Rakhimova et al., 2017; Abdinazarov et al., 2017).

The anatomical structure of vegetative organs of *Juno* species in Uzbekistan has not been studied. This determines the relevance and novelty of our research.

2. Study Area and Data Analysis

Three species of the *Juno* were studied. They are listed in the Red Data Book of Uzbekistan (Khassanov, Rakhimova, 2016), *J. orchioides* Carriere with status 3, *J. svetlanae* (Vved.) F.O. Khass. and *J. magnifica* (Vved.) F.O. Khass. & N. Rakhimova with status 2.

The samples were collected in the Western Tian-Shan Mountain (Tashkent region, Chimgan Mountains. - *J. orchioides*), western spurs of the Hissar mountain ridge (Kashkadarya region - *J. svetlanae*), and in the Zerafshan range (*J. magnifica*) (Fig. 1).

Collected samples were fixated in 70% ethanol for further anatomical study. The epidermis was studied on the paradermal and transverse sections. The transverse section of the leaf was performed in the middle part, the vagina of the leaf and stem were cut at their base. Tissues were

classified according to S.F. Zakharevich(1954). The preparations were stained with methylene blue followed by sealing with glycerin-gelatin (Barykina, Veselova, Devyatov et al., 2004). Photomicrographs were made with a computer

micro photoset for a digital camera *Samsung ES70* and studied under microscope *Motic B1-220A -3*.

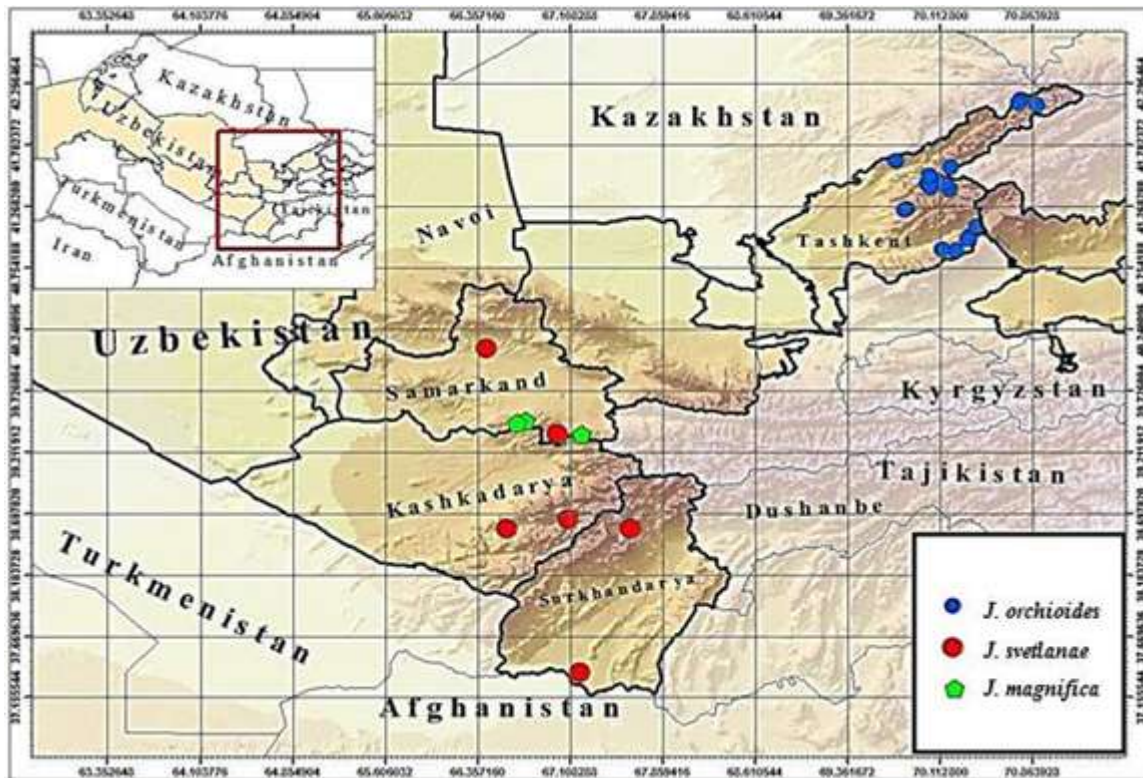


Figure 1: Map of the distribution of endemic species of *Juno* in the flora of Uzbekistan

3. Results and Discussion

***Juno orchioides* anatomical characteristics.** The leaves are light green, falcate, more or less rough. On paraderm cross section the contour of the epidermal cells is rectilinear, the projection is polygonal. Adaxial epidermal cells are larger than abaxial. The leaves are amphistomatic. The stomata are located transversely to the longitudinal axis of the leaf. The shape of the stomata is rounded. The stomata are numerous on the abaxial side, and absent on the adaxial side. The terminal cells of the stomata on both sides of the leaf are nearly equal in length. The stomata are submerged. Type of stomata is anomocytic (Fig. 2, 3).

The mesophyll of the leaf on the transverse section is spongy, represented by spongy cells on both sides of the leaf. The epidermis is represented by one row of cells with a thin-walled cuticle layer. Adaxial epidermal cells are large, more elongated than abaxial epidermal cells. Spongy parenchyma is rounded, small-celled, consists of 7 - 8 rows. The spongy parenchyma is chlorophyllous (Fig. 3).

The main and lateral veins are prominent on the abaxial side. The angled collenchyma consists of 9 - 10 rows and is

located under the abaxial epidermis and on vascular bundles. There is one conducting bundle in the main vein. Vascular bundles are closed, collateral, numerous, consisting of phloem and xylem, with 9 - 10 large and small bundles (Fig. 3).

***Juno svetlanae* anatomical characteristics.** Leaves are 3 - 4 cm width, falcate, smooth, white fringed along the edge, sharp. The contour of epidermal cells is rectilinear on the paradermal cross section, the projection is polygonal. Adaxial epidermal cells are larger than abaxial. Leaves are amphistomatic. The stomata are located transversely to the elongated axis of the leaf. The shape of the stomata is rounded. Stomata are numerous on the abaxial side, and absent on the adaxial side. The terminal cells of the stomata on both sides of the leaf are nearly equal in length. Stomata are not submerged. Type of stomata is anomocytic (Fig. 2, 3).

Mesophyll is spongy on both sides of the leaf. The epidermis is represented by one row of cells with a thick-walled layer of cuticle. Adaxial epidermal cells are large, more elongated than abaxial. Spongy parenchyma is rounded, small-celled, consists of 9 - 10 rows and chlorophyllous (Fig. 3).

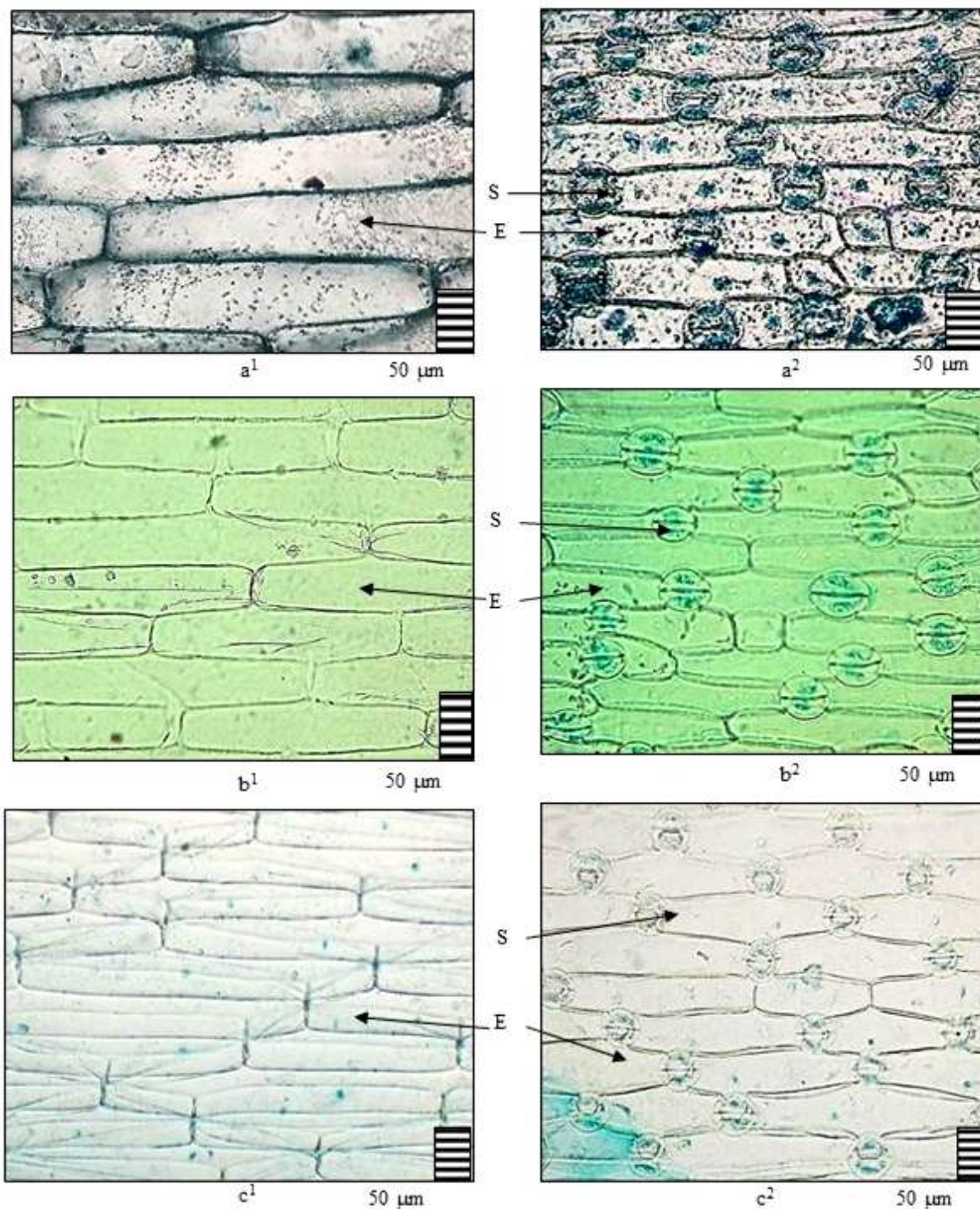


Figure 2: Structure of the leaf epidermis of some species of *Juno*:
 $a^1, a^2 - J. orchoides$; $b^1, b^2 - J. svetlanae$; $c^1, c^2 - J. magnifica$. $a^1 - b^1$ - adaxial epidermis; $a^2 - b^2$ - abaxial epidermis.
Legend: S - stomata, E - epidermis

The main and lateral veins are prominent on the abaxial side. Angular collenchyma is located under the abaxial epidermis and on the conducting bundles in 9 - 10 rows. There is one vascular bundle on the main vein. Vascular bundles are closed, collateral, numerous, consisting of phloem and xylem, with 9 - 10 large and small bundles (Fig. 3).

The leaf vagina is closed (with fused margins), of the parenchymal-bundle type on the transverse cross section. The epidermis is represented by one row of cells with a

thick-walled layer of cuticle. The abaxial epidermal cells are large, more elongated than adaxial.

Parenchymal cells are rounded, with the mixture of large and small cells, composing 14 - 15 rows, 5 - 6 of which are chlorophyllous. The vascular bundles are closed, collateral, numerous large and small, consisting of phloem and xylem. The large vascular bundles are located between two small beams. The angled collenchyma is represented with 8 - 9 rows and located under the adaxial epidermis above large

vascular bundles, the collenchyma is absent in the small bundles (Fig. 4).

The stem is single, ribbed on the cross section, parenchymal-beam type. The epidermis is single - rowed, round -oval, thick - walled. The stomata are submerged. Under the epidermis there is a thin-walled, round-oval, primary cortex composed of 6 - 7 rows of the cells, chlorophyllous.

Collenchyma and conductive bundles are allocated in each rib under the epidermis. Collenchyma is clearly defined,

composed of 6 - 7 rows, angular. The vascular bundle is of the collateral type. Primary bark is separated from the central cylinder with the ring of sclerenchyma. The thickness of this ring and the degree of lignification of cells in some way reflect the evolutionary advancement of this species. Sclerenchyma is a thick-walled, annular, consists of 3 - 4 layers of cells (Fig. 5).

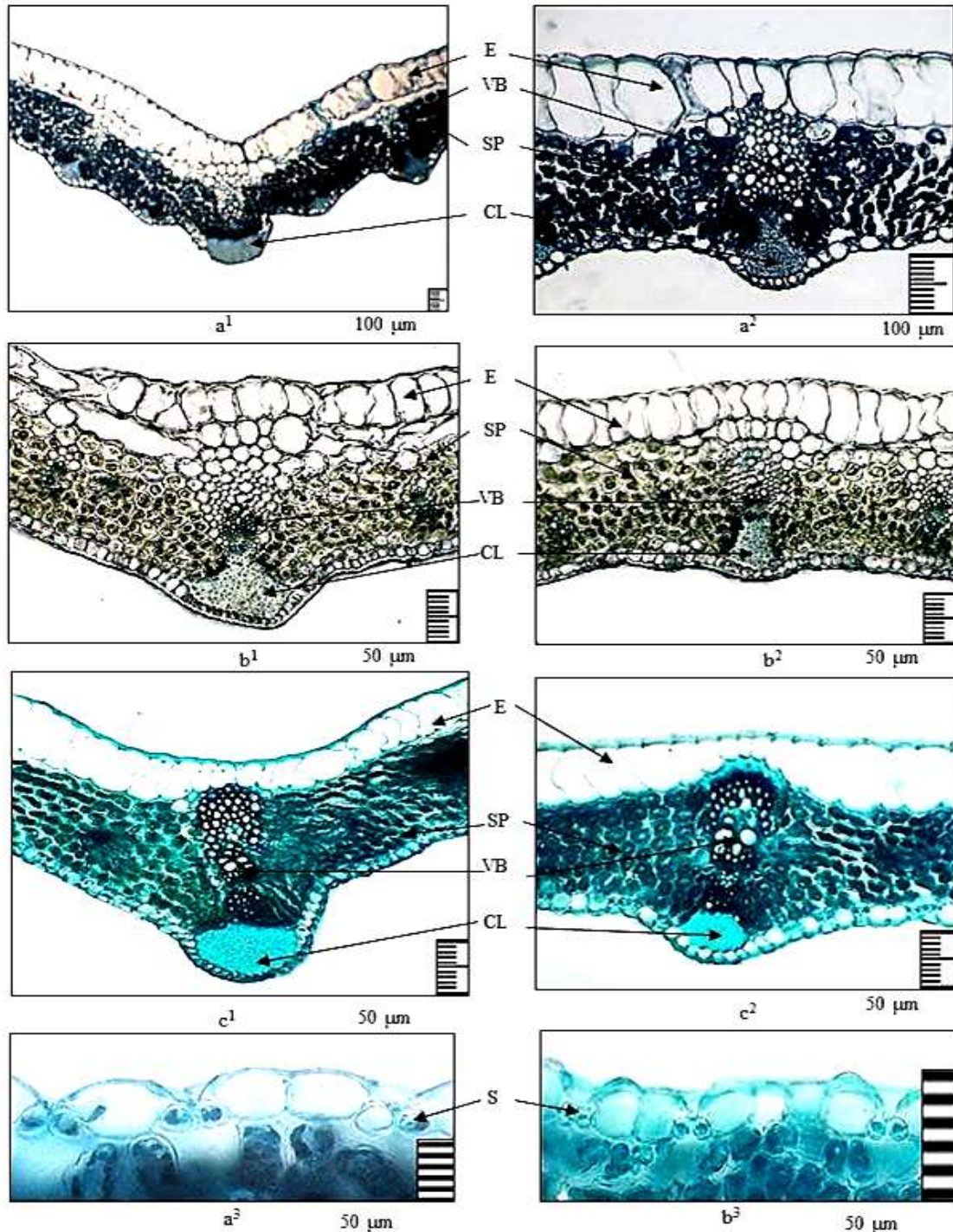


Figure 3: Structure of the mesophyll leaf of species of *Juno*: a¹, a², a³ – *J. orchoides*; b¹, b² – *J. svetlanae*; c¹, c², c³ – *J. magnifica*. a¹ – c¹ – the main fibrils of the leaf's mesophyll; a² – c² – mesophyll of leaf; a³, c³ – submerged stomata.
Legend: SP - spongy parenchyma, CL - collenchyma, VB - vascular bundles, S - stomata, E - epidermis.

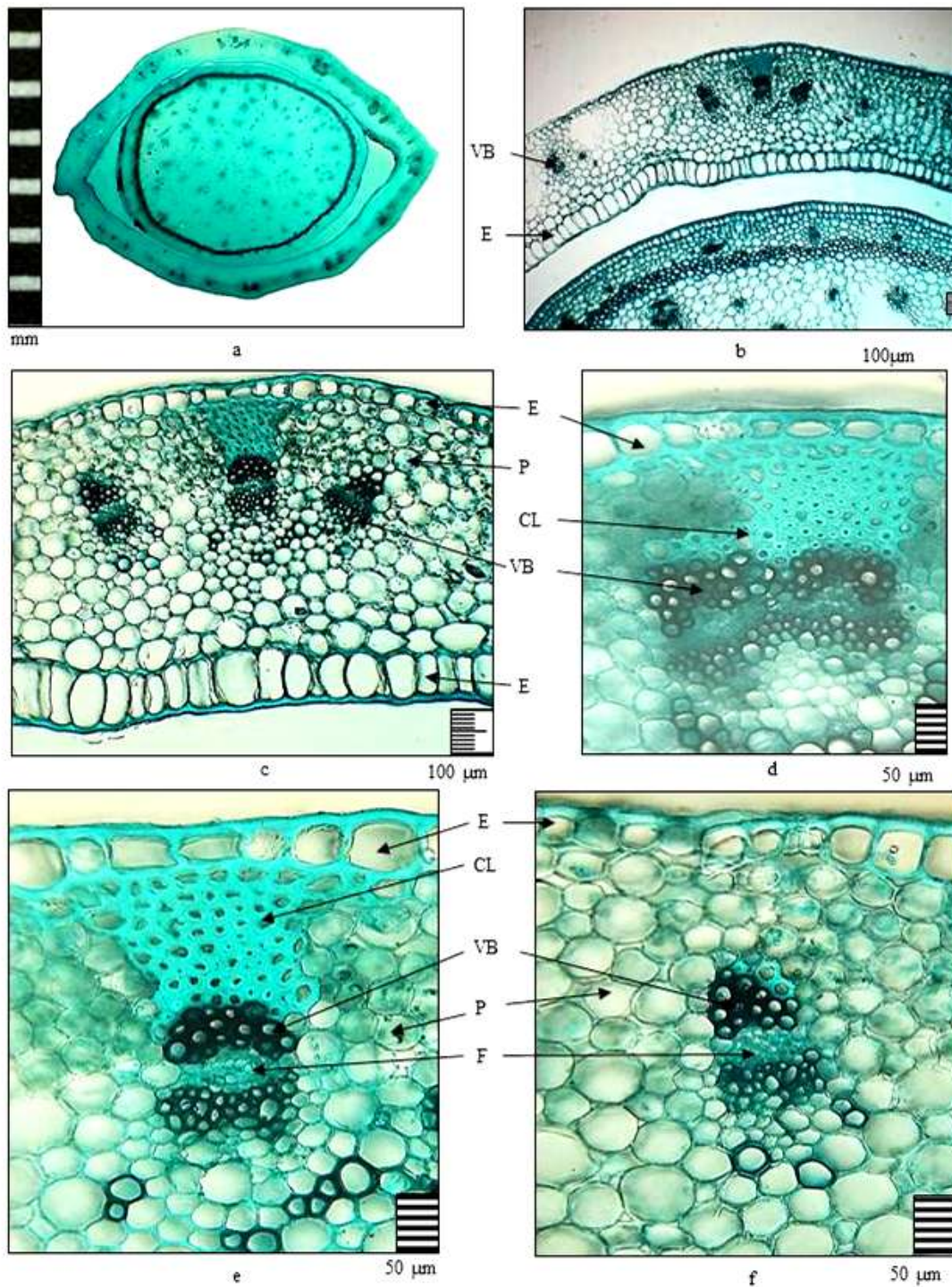


Figure 4: Structure of the vagina of the leaf *J. svetlanae*: a – scheme; b-c – detail; d-e-f – vascular bundle. **Legend:** P - parenchyma, CL – collenchyma, VB - vascular bundle, F - phloem, E - epidermis.

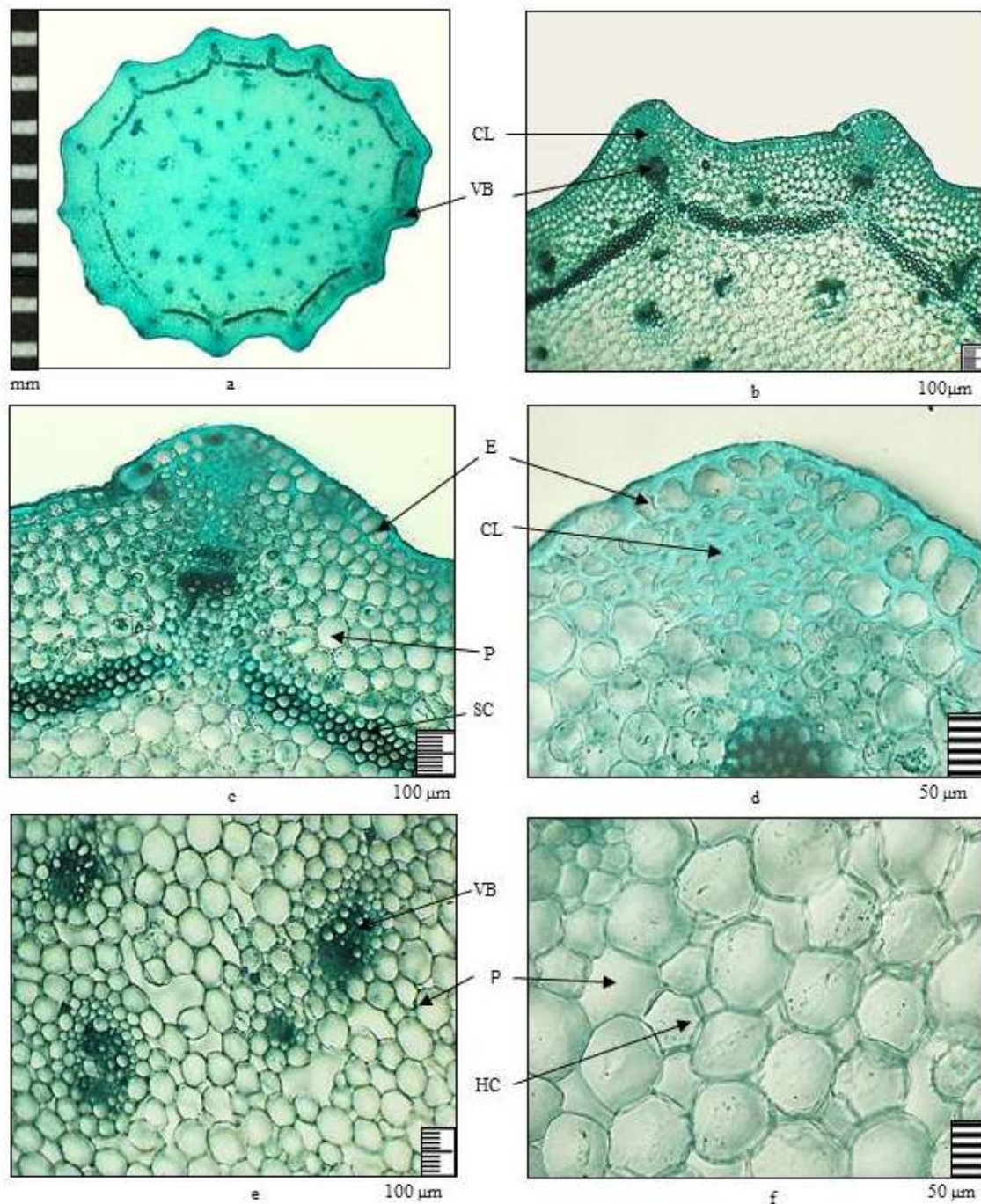


Figure 5: The structure of stem of *Juno svetlanae*: a – scheme; b-c – detail; d – the edge of stem; e – vascular bundles; f – core. **Legend:** HC - hydrocitic cells, P - parenchyma, CL - collenchyma, VB - vascular bundle, SC - sclerenchyma, F - phloem, E – epidermis

Central cylinder is wide, thin - walled and round-oval. Numerous conducting beams are randomly scattered along the main tissue among thin - walled parenchymal cells of the central cylinder. Hydrocitic cells occur among the parenchymal cells of the central cylinder (Fig. 5).

***J. magnifica* anatomical characteristics.** This species is listed in the Red Data Book. It is extremely rare endemic species of the Zerafshan range with status 2 [3].

The leaves are crescent, light green, shiny, sharp, lower leaves are 3.5 - 5.0 cm width. The contour of epidermal cells is rectilinear, the projection is polygonal on the paraderm

cross section. Adaxial epidermal cells are larger than abaxial. The leaves are amphystomatic. The stomata are located transversely to the longitudinal axis of the leaf. The shape of the stomata is rounded. Stomata are numerous on the abaxial side, and are absent on the adaxial side. Terminal cells of the stomata are almost equal in length on both sides. The stomata are submerged. Type stoma is anomocytic (Fig. 2, 3).

The mesophyll of the leaf on the transverse section is spongy, represented by spongy cells on both sides of the leaf. The epidermis is represented by one row of cells with a thick-walled layer of cuticle. Adaxial epidermal cells are large, elongated and slightly sinuous, than abaxial. Spongy

parenchyma is rounded, small-celled, consists of 7 -8 rows, chlorophyllous (Fig. 3).

The main and lateral veins are prominent on the abaxial side. An angular collenchyma is composed of 7 - 8 rows under the abaxial epidermis and on the conducting bundles. Vascular bundles are closed, collateral, numerous, composed of phloem and xylem, within 7 - 8 large and small tracheas (Fig. 3).

4. Conclusions

The results of the anatomical study of the vegetative organs of three *Juno* spp. are presented in this paper. The following features are recognized as diagnostic: rectilinear contour of epidermal cells; stomata submerged, numerous on the abaxial side, anomocytic, absent on the adaxial side; the leaf mesophyll is spongy; parenchyma is chlorophyllous, spongy, of bundle type; epidermis large, elongated on the adaxial side, in the leaf vagina on the abaxial side; the arrangement of the angular collenchyma over the conducting beams; closed, collateral type of conducting beams. In the flower bearing shoots, the epidermis is thick - walled with deeply submerged stomata; a group of angular collenchyma is located on the ribs on the vascular bundles; cells of the primary crust thin-walled, chlorophyllous; the primary crust of these species is separated from the central cylinder by a ring of lignified cells called sclerenchyma. These structural features also confirm belonging of these three species to the genus *Juno* and can serve in their identification.

5. Acknowledgements

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