

Morphological and anatomical investigations on endemic *Allium armenum* BOISS. & KOTSCHY and *Allium djimilense* BOISS. EX REGEL (*Alliaceae*) species of East Anatolia

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Abstract: In this study, *Allium armenum* BOISS. & KOTSCHY and *Allium djimilense* BOISS. EX REGEL both endemic of Turkey, were compared morphologically and anatomically. The results showed that the investigated species had typical morphological characters of sect. *Codonoprasum* Reichenb. and also that they could be distinguished from each other not only by their morphological but anatomical characters as well.

Keywords: *Allium*, Anatomy, Morphology.

Introduction

The genus *Allium* L. consists of more than 750 species distributed across the Northern hemisphere (VAN RAAWSDONK and DE VRIES 1992; FRIESEN et al., 2006). According to Seçmen et al. (1998), there are 146 species of *Allium* in Turkey and the 35% of these species are endemic (Özhatay, 1986). The first knowledge about *Allium* species of Turkey was given by BOISSIER (1884). The studied species occur in East Anatolia and belong to the section *Codonoprasum*, the subgenus *Allium* of the genus *Allium* (DAVIS, 1984). The present study is based on some wild species of *Allium* which can be eaten as folk vegetable (BAYTOP, 1984). Any study on the investigated species has not been found

except the main knowledge in *Flora of Turkey* (KOLLMANN, 1984; DAVIS, 1988). This study allowed us to define the morphological and anatomical characteristics of the investigated species that have economical value.

Material and methods

The plants were collected from natural populations of East Anatolia. Some of these specimens were used for anatomical and morphological studies, while some were prepared as herbarium material. Herbarium materials were preserved in the herbarium of Celal Bayar University (CBÜ). Samples were fixed in 70% alcohol for anatomical studies. Some of the herbarium materials were also put in gliserol-70% alcohol (1:1). These materials were used for preparing the cross sections of plant root, scape and leaves. The cross sections were drawn after staining with Sartur reactive. The examined specimens were collected from the following locations:

Allium armenum, A8 Erzurum, Olur, Forest Security Field, c. 1900m, 08.08.1996, Yasin Altan, 6656

Allium djimilense, A8 Gümüşhane, Zigana Pass, Alpine meadow, 2100m, 01.09.1996, Yasin Altan, 6619

Results

Morphology

***Allium armenum* BOISS. & KOTSCHY**

The bulb is 1-1.5 cm in length, 0.5-1.5 cm in diameter, forming an ovoid shape. Bulb is covered by grayish-black, membranous tunic. Stem 8-25 cm high is covered by leaf sheaths up to 1/3 of its length. Leaves are filiform, 1-3 in number, 0.7-1 mm broad. Spathe valves are shorter than inflorescence. Inflorescens is laxly 5-15 flowered. Pedicels are 0.5-1.5 mm, subequally filiform, purple-brownish. Perianth segments are 2-4 mm in length, 2-3 mm in width purple mauvish-pink, lilac-pink. Filaments are slightly exserted. Capsule is globose-depressed, 2.5-3.5 mm in length, 1-1.5 mm in width (Fig. 1A, 2A).

***Allium djimilense* BOISS. EX REGEL**

Bulb is 0.8-2 cm in length, 0.5-1.5 cm in diameter, with outer tunics prolonged up to stem, membranous, breaking up into parallel fibres. Stem is 7-20 cm high and covered by leaf sheaths. Leaves are 2 in number, linear-filiform, channelled. Spathe valves are longer than inflorescence which is 5-12 flowered and fastigiate. Pedicels are 8-12 mm being slightly longer than flowers. Perianth segments are 7-9 mm in length, dark pink, lilac pink and with a dark lilac-pink midvein. Capsule was 1.5-2.5 mm in length, 2-3 mm in width (Fig. 1B, 2B).

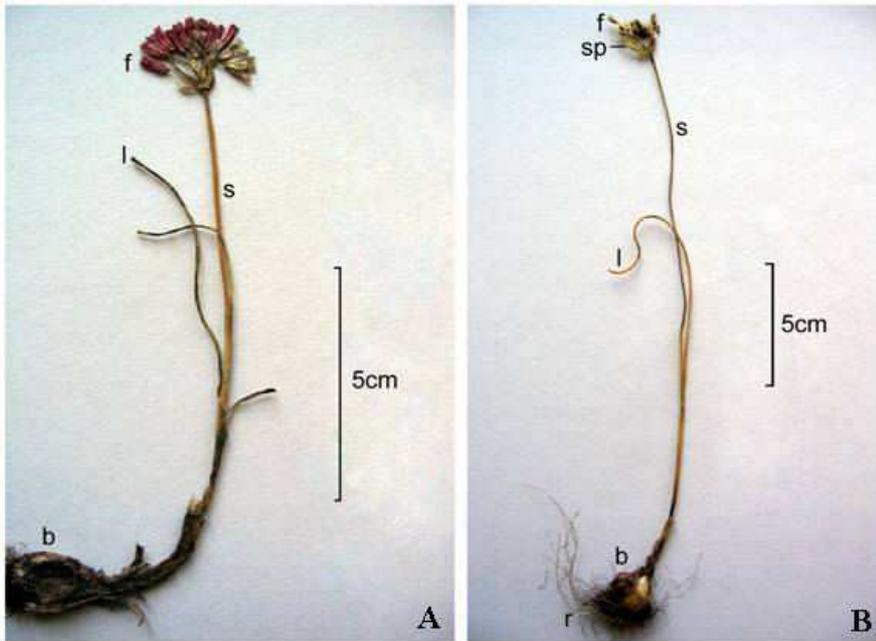


Fig. 1. General appearance of *A. armenum* (A) and *A. djimilense* (B);
 r. root b. bulb l. leaf s. scape sp. spathe f. flower

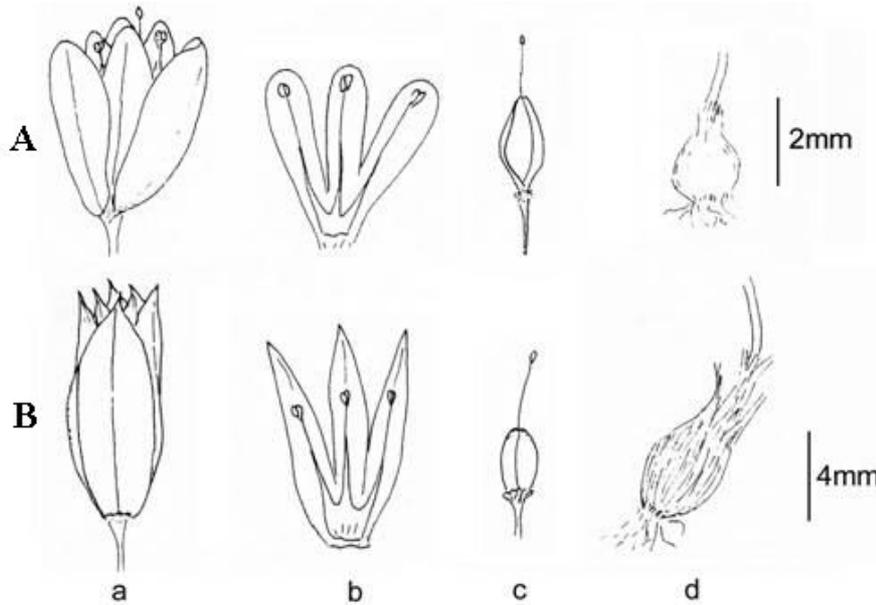


Fig. 2. Some parts of *A. armenum* (A) and *A. djimilense* (B)
 a. flower b. half of the perianth with stamen c. ovary and style d. bulb

Anatomy

***Allium armenum* BOISS. & KOTSCHY**

Root: Root is surrounded by single layered epidermis of prismatic cells. Cortex is 4-5 layered and it consists of ovoidal, parenchymatous and thin walled cells. Endodermis is single layered consisted of cells with thickened wall. Pericycle cells are very small and located under endodermis. 1-2 metaxylem are present at the median part of vascular cylinder. The phloem region is very wide (Fig. 3I-A).

Scape: The epidermis of scape is single layered and its cells are flattened, prismatic and thin walled. Epidermis is covered by thick cuticle. Cortex is 7-9 layered with orbicular shaped cells. The thickness of cortex region is larger than the central region. Cortex cells with small diameter have thickened walls. Vascular bundles are arranged so as to form two concentric rings in the scape, one is located in the periphery and the other is adjacent to the central part of scape. The inner ring is formed by 4 big bundles. A pith space are present in the central part (Fig. 3I-B,C).

Leaf: The leaf is semicylindrical in shape and with many ribs. The epidermis of leaf has a thick cuticle. The palisade tissue is 2 layered. The palisade cells in the outer part are longer than those in the inner. The leaf is fistulose and the spongy tissue is limited to a peripheral belt around the central part (Fig. 3I-D,E).

***Allium djimilense* BOISS. EX REGEL**

Root: Epidermis cells of root are irregularly different sized and like cortex cells. The cortex region is very thin being 2-3 layered. Cortex cells are irregularly ovoidal in shape. The wall thickenings of the endodermal cells is clear in the cross-section of root. These thickenings are three sided. Pericycle cells are very small. A single large metaxylem is present in the centre and vessel rows in the vascular cylinder do not reach the pericycle (Fig. 3II-A).

Scape: The cross section of scape of *A. djimilense* is sinuous at margins. Epidermis is single layered and formed by cells flattened-prismatic and thin walled. There is a thick cuticle on these cells. Cortex is 6-12 layered. Its cells are nearly orbicular in shape. 3-5 layers of these cells which located in the outer cortex have thickened walls. Vascular bundles are arranged so as to form two concentric rings. The bundles in the inner part of cortex are bigger and 6 in number (Fig. 3II-B,C).

Leaf: Both abaxial and adaxial face of leaf have a well developed cuticle with papillae. The spongy tissue is very limited. The palisade tissue is normally one layered or sometimes two layered in correspondance of the vascular bundles. There are many ribs in the cross-section of leaf (Fig. 3II-D,E).

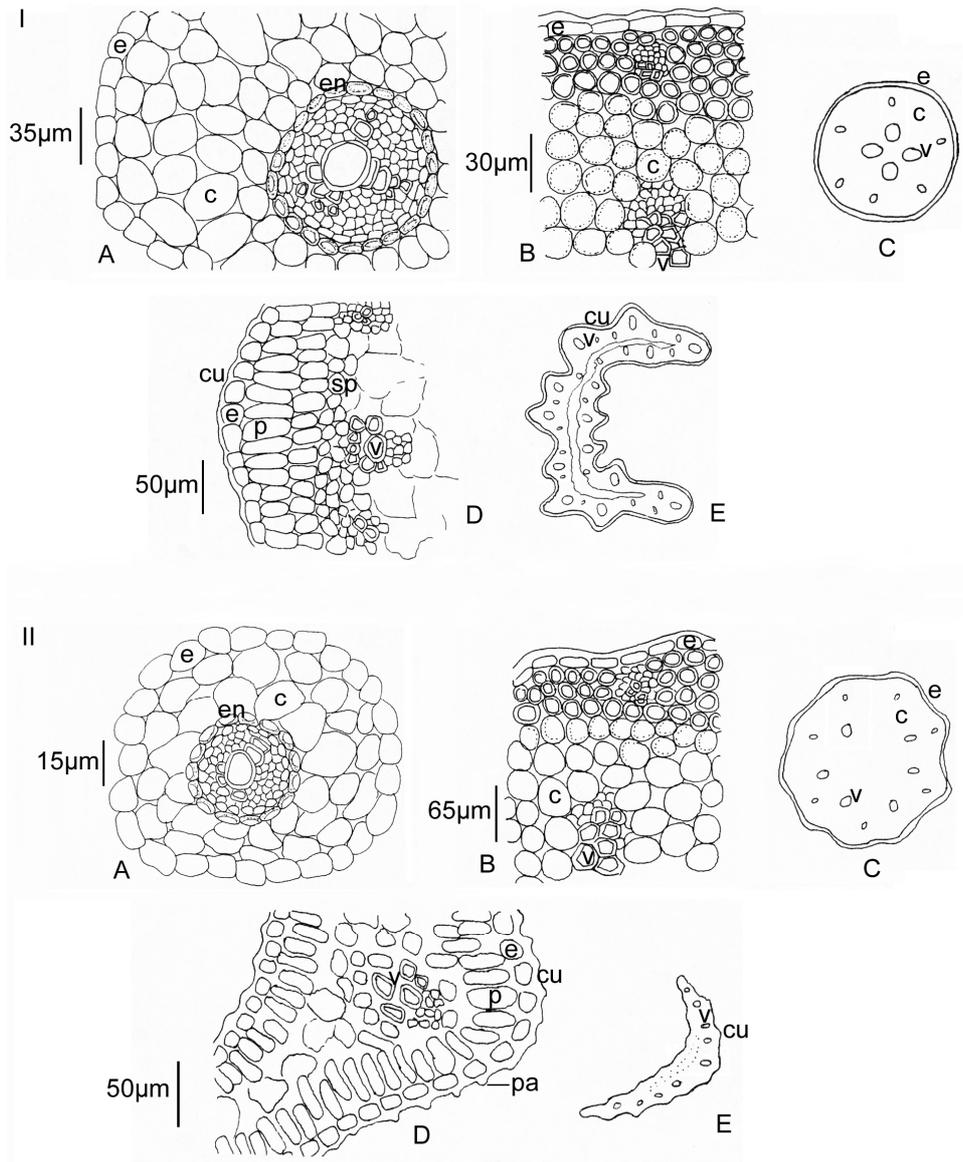


Fig. 3. The cross-sections of root, scape and leaf of *Allium armenum* (I) and *Allium djimilense* (II)

A. Root **B-C.** Scape **D-E.** Leaf **cu.** cuticle **e.** epidermis **c.** cortex **p.** palisade parenchyma **v.** vascular bundle **en.** endodermis **sp.** spongy parenchyma **pa.** papillae

Tab. 1. Some anatomical measurements of *A. armenum* and *A. djimilense*

| | A. armenum | | A. djimilense | |
|-------------------------|---------------------------------------|--|---------------------------------------|--|
| | Width Min-Max (μm) | Length Min-Max (μm) | Width Min-Max (μm) | Length Min-Max (μm) |
| Root | | | | |
| Epidermis cell | 12-29 | 7-19 | 10-31 | 7-10 |
| Endodermis cell | 7-17 | 8-14 | 7-17 | 5-10 |
| Pericycle cell | 7-10 | 6-7 | 2-5 | 7-10 |
| Diameter of cortex cell | 10-36 | | 12-24 | |
| Diameter of metaxylem | 17-31 | | 12-29 | |
| Scape | | | | |
| Cuticle | 2-4 | | 2-5 | |
| Epidermis cell | 10-17 | 4-7 | 7-14 | 2-7 |
| Diameter of cortex cell | 7-33 | | 7-36 | |
| Leaf | | | | |
| Cuticle | 4-7 | | 7-21 | |
| Epidermis cell | 10-33 | 10-17 | 14-29 | 10-24 |

Discussion

The present paper aims a better characterising of two endemic *Allium* species. The morphological features observed in *A. armenum* and *A. djimilense* substantially confirm their clear distinctiveness already evidenced by KOLLMANN (1984), which placed the two species in different groups of his artificial identification key thanks to their different spathe valves characteristics. The stamens of *A. armenum* had slightly exserted from the perigon. The same feature is reported for the stamens of *Allium karacae* M. KOYUNCU which belongs to section *Scorodon* (ÜNAL & DUMAN, 2002) and those of *Allium altynolicum* FRIESEN which belongs to *Schoenoprasum* (FRIESEN, 1996).

In anatomical studies we have determined that roots of the investigated species were typical as monocotyledon root. It is emphasized that wall thickening of endodermal cells was common in the roots of monocotyledons (FAHN, 1982). The wall thickening of endodermal cells was very clear and adjacent to pericycle in the investigated species. The wall of endodermis cells of *A. armenum* root was thickened entirely but these thickenings were merely three sided in *A. djimilense*. In addition, we detected a slightly wall thickening at the cortex cells of *A. armenum* root. The same feature and a thickening adjacent to pericycle is also reported on the roots of some other species which belong to *Liliales* and *Asparagales* (ÖZYURT, 1978). *A. armenum* has 1-2 metaxylem in the root centre while the root of *A. djimilense* has a large single metaxylem in the centre.

The number of protoxylem groups was 3-5 in the roots of investigated species. The same feature was observed in the root of *Merendera trigyna* (ADAM) STAPF, *M. attica* (SPRUNER.) BOISS & SPRUNER which belong to Liliaceae family and *Crocus pulchellus* HERBERT, *C. fleischeri* GAY, *C. danforiae* MAW which belong to Iridaceae family (ÖZYURT, 1978; ÖZDEMİR et al., 2004a,b).

According to the results in this study, vascular bundles of the investigated species were arranged so as to form two rings in the scape. The same feature is reported for *Crocus aerius* HERB in contrast to *C. pulchellus* HERBERT in which vascular bundles form a single ring in the scape (ÖZYURT, 1978; ÖZDEMİR and AKYOL, 2004). KUTBAY et al. (2001) and ÖZDEMİR (2003) emphasize that there are more than two rings consisting of vascular bundles in the scape of *Romulea columnae* SEB. & MAURI subsp. *columnae* and *Lilium ciliatum* P.H. DAVIS. The scape of *A. djimilense* had a sinuous margin in the cross-section while the scape of *A. armenum* did not.

The leaf epidermis of the investigated species had a well developed cuticle, showing prominent ridges where vascular bundles were present. *A. djimilense* had a well developed cuticle with papillae, but *A. armenum* had a cuticle without papillae. The spongy tissue of *A. armenum* leaf was limited to a peripheral belt around the leaf center.

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