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Research article/Araştırma makalesi

Anatomical characteristics of *Bellevalia mathewii* Özhatay & Koçak (Liliaceae)

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Abstract

Bellevalia mathewii Özhatay & Koçak is a stenoendemic species growing in South Anatolia. In the present study, anatomical features of this species were determined. The studies were carried out on tranverse sections of scapes and leaves, and surface sections of the leaves. According to the results, the leaves are equifacial and amphistomatic with anomocytic stomata. There is 2-3-layered palisade parenchyma under each epidermis, and richly developed 7-9-layered spongy parenchyma between the palisades. Some spongy mesophyll cells include raphide crystals. Vascular bundles are located in equal intervals in spongy parenchyma. The lower epidermal cells lack raphide crystals, but some of the upper ones have plenty of them. In the scape, the cortex is multilayered and the vascular bundles are located in two rows.

Key words: Liliaceae, Bellevalia mathewii, Anatomy, Turkey

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Bellevalia mathewii Özhatay & Koçak (Liliaceae)'nin anatomik özellikleri

Özet

Bellevalia mathewii Özhatay & Koçak Güney Anadoluda yayılış gösteren dar yayılışlı bir endemiktir. Bu çalışmada, bu türün anatomik özellikleri belirlenmiştir. Çalışma, skayp ve yaprak enine kesitleri ile yaprak yüzeysel kesitleri üzerinde yapılmıştır. Sonuçlara göre, yapraklar ekvifasial ve amfistomatik olup anamositik stomalıdırlar. Alt ve üst epidermisin altında 2-3-tabakalı palizad parankiması ve aralarında iyi gelişmiş 7-9-tabakalı sünger tabakası bulunmaktadır. Bazı sünger parankiması hücreleri rafit kristalleri içermektedir. Sünger parankiması içinde eşit aralıklarla lokalize olmuş iletim demetleri yer almaktadır. Alt epidermal hücreler rafit kristallerinden yoksun iken, bazı üst epidermal hücreler bol miktarda rafit içermektedir. Skaypta, korteks çok tabakalı olup, iletim demetleri iki sırada dizilmişlerdir.

Anahtar kelimeler: Liliaceae, Bellevalia mathewii, Anatomi, Türkiye

1. Introduction

Bellevalia Lapeyr., a genus of spring-flowering bulbous plants in the family Liliaceae, mostly occurs in the Mediterranean and the central-west Asiatic region (Govaerts, 1996). The genus was represented by 18 species in Turkey (Wendelbo, 1984). But, *B. latifolia* Feinbrun was reduced to a synonym of *B. olivieri* (Baker) Wendelbo later (Wendelbo, 1985).

Three more species was added in Turkish Flora (Özhatay, 2000). *B. pycnantha* (K.Koch) Losinsk. was reduced to a synonym of *B. paradoxa* Boiss. and a new *Bellevalia* species was described from Turkey later (Johnson, 2003; Persson, 2006). The total number of *Bellevalia* species has now reached to 21 in Turkey.

Bellevalia is closely related the genera *Hyacintella* Schur, *Hyacinthus* L. and *Muscari* Mill. The genus is distinguished from these genera by the relative characters such as capsule and perianth shape. In addition, there are some taxonomical problems in seperating *Bellevalia* species (Wendelbo, 1984). Therefore, some anatomical pecularities

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such as the distribution and shape of calcium oxalate crystals in plant tissues may be useful as additional diagnostic characters in interspecific classification (Kahraman et al., 2010).

Bellevalia mathewii Özhatay & Koçak a perennial geophyte, is geographically distributed in South Anatolia and closely related to *B. dubia* (Guss.) Roemer & Schultes, *B. clusiana* Griseb. and *B. tauri* Feinbrun, and only distinguished from them by its dense raceme and light blue corolla. The anatomical pecularities of *B. mathewii* have not been provided before. The present study aims to provide anatomical properties of *B. mathewii* for the first time.

2. Materials and methods

Bellevalia mathewii specimens were collected from Antalya (C4 ANTALYA: Alanya, Çayarası mevkii, Tarla kenarı, 1050 m, 25.04.2009, S. Doğu 1993 & M.Dinç). The samples were put in 70 % alcohol for anatomical studies. Anatomical studies were carried out on 10 samples. In these samples, leaves and scape cross-sections were studied with the lower and upper surface sections of the leaves. On average, twenty preparations were made of each type of sections. The cross-sections were stained with basic fuchsine. All sections were covered by glycerin gelatin and made into permanent slides as described by Vardar (1987). Preparats were observed through an Olympus BX-50 microscope and photographed.

3. Results

3.1. Root anatomy

The root is covered by the epidermis on the outermost surface. It is made up of a single layer of flattened, rectangular, ovoid and squarish cells. Under the epidermis 2-3-layered exodermis is located. The cortex covers a large area with 8-10 layers of mainly polygonal and orbicular parenhymatous cells. The single layered and regularly arranged endodermis is present between the cortex and central cylinder. It is circular-shaped encircled composed of thick walled cells, and encircled the central cylinder. The pericycle, which consists of single layered and thin walled cells, is located under the endodermis. Its shape is similar to the endodermis. There are vascular elements under the area encircled by the pericycle. The xylem elements constitute aster-shaped tissue. The phloem elements occur between the arms of the xylem (Figure 1).

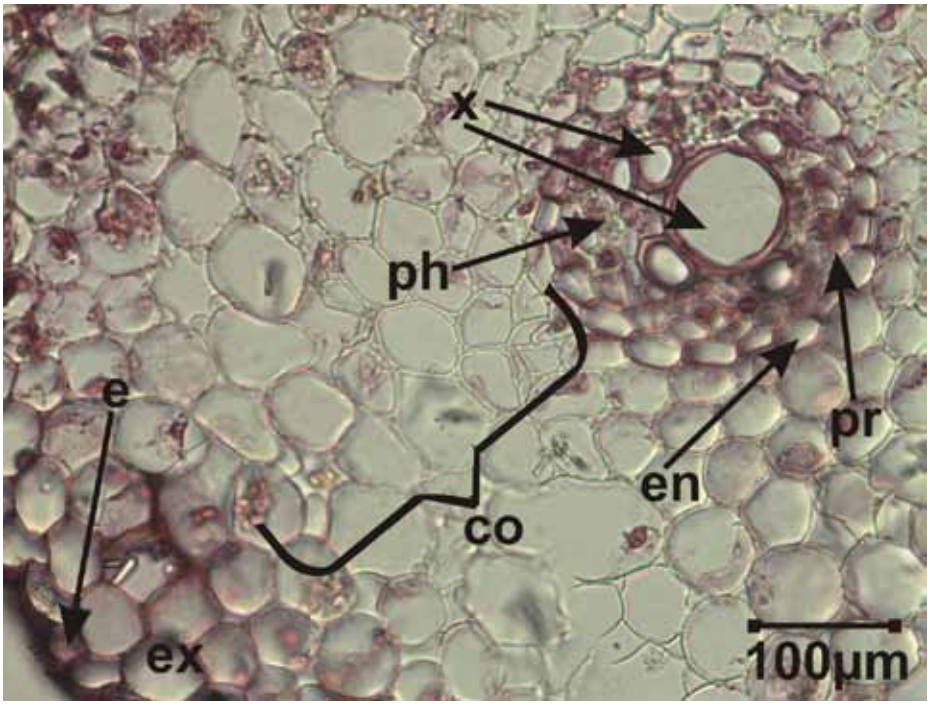

Figure 1. The transverse section of the root of *Bellevalia mathewii*. **e**: epidermis, **ex**: exodermis, **co**: cortex, **ph**: phloem, **x**: xylem, **en**: endodermis, **pr**: pericycle.

3.2. Scape anatomy

The scape is more or less terete in transverse section. The epidermis is single-layered and consists of almost square and rectangular cells, and covered by a thick layer of cuticle. There are no hairs on the epidermis. The 4-6-

layered cortex consists of orbicular or hexagonal parenchymatic cells. Some parenchymatic cells include raphide crystals. Under the cortex, the sclerenchymatic tissue constitute a circular band along the transection of the scape. The vascular bundles are distributed on two rows. The vascular bundles on outer row are smaller than the inner ones and partly or completely sunk into sclerenchymatic tissue. The parenchymatic cells fill up the area under the sclerenchymatic band. The vascular bundles on inner row are larger and located in the parenchymatic cells (Figure 2).

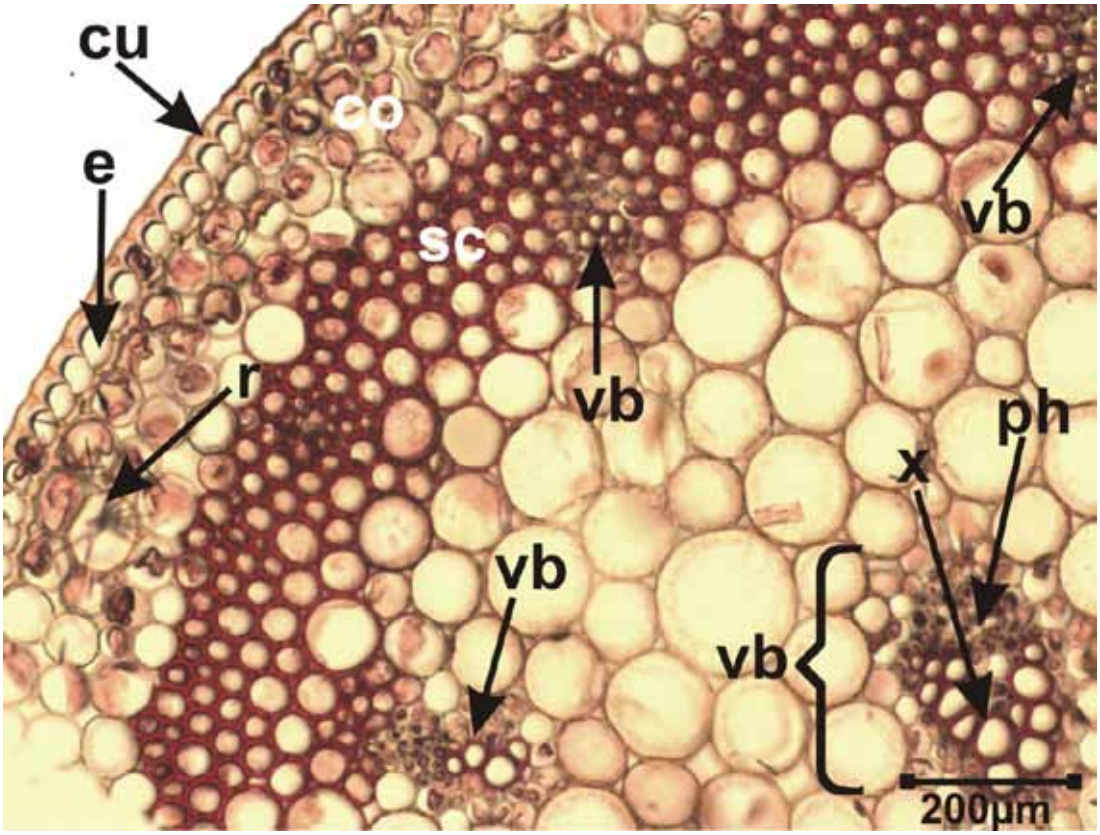

Figure 2. The transverse section of the scape of *Bellevalia mathewii*. **e**: epidermis, **co**: cortex, **sc**: scleranchyma, **ph**: phloem, **x**: xylem, **vb**: vascular bundle, **r**: raphide crystals

3.3 Leaf anatomy

The upper and lower epidermis are uniseriate and covered by a cuticle. The stomata are visible in some transections of the leaf. The upper cuticle is thinner than the lower cuticle. The leaf is amphistomatic and equifacial. Beneath both the surfaces of the mesophyll is present 2-3 layered palisade parenchyma. The spongy parenchyma is 6-8-layered. It consists of nearly orbicular large cells, and is located between the palisades. Vascular bundles are arranged in a single row in spongy parenchyma. The vascular bundle in the midrib region is not conspicuously larger than the others. Therefore, the midrib do not constitute a projecting part (Fig.3).

The leaves have anomocytic type stomata. The stomata lie at the same level as the epidermal cells. Namely, they are mesomorphic type. On avarage, six stomata occur on both surfaces in the unit area under the x20 objective. Abundant raphide type crystals are present in upper epidermal cells, but no crystals present in lower epidermal cells. The number of the stomata is nearly the same as the upper and lower surface. The epidermal cells on both surfaces are very long and narrow. They are 10 x as long as wide on avarage (Figures 4-5).

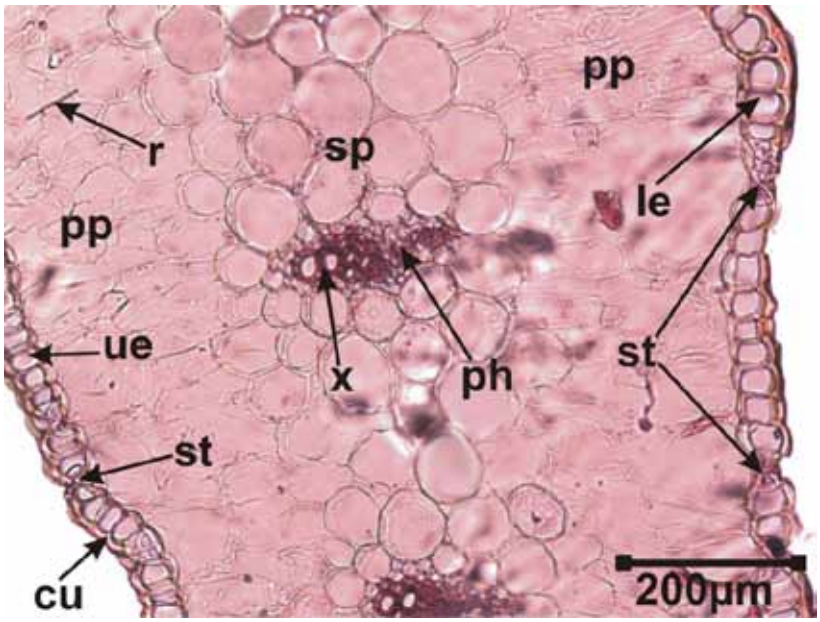

Figure 3. The transverse section of the leaf of *Bellevalia mathewii*. **cu**: cuticle, **ue**: upper epidermis, **st**: stoma, **ph**: phloem, **x**: xylem, **pp**: palisade parenchyma, **sp**: spongy parenchyma, **le**: lower epidermis, **r**: raphide crystals

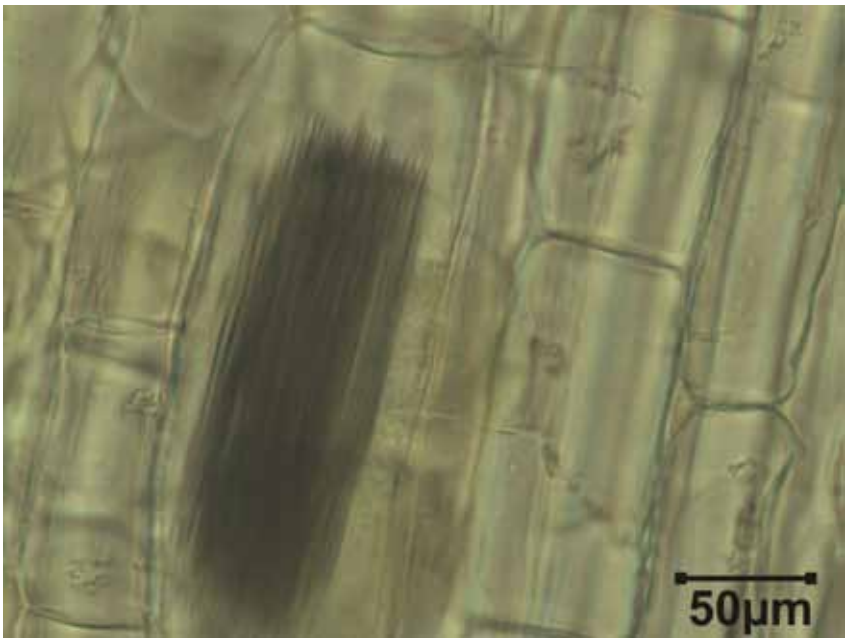

Figure 4. Raphide crystals in the upper epidermal cells of the leaf in *Bellevalia mathewii*

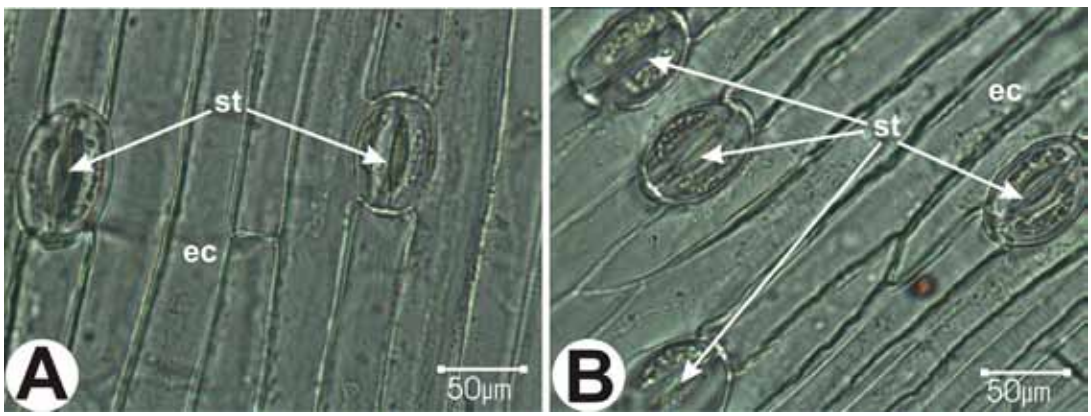

Figure 5. The surface section of the leaf of *Bellevalia mathewii*. A, The upper surface; B, The lower surface. **st**: stoma, **ec**: epidermal cell..

4. Discussion

Anatomical features of scapes of *B. mathewii* are resemble to the general characteristics of monocotyledons (Cutter, 1971). The lacunae was observed between vascular bundles in leaves of *B. glauca* Kunth, *B. nivalis* Boiss. & Kotschy, *B. romana* Sweet and *B. paradoxa*, but not in those of *B. flexuosa* Boiss (Lynch et al., 2006; Kahraman et al., 2010). The lacunae was not observed in the studied species *B. mathewii*. According to the our results there are 2-3 layered palisade parenchyma in the mesophyll of *B. mathewii*. While Kandemir et al. (2000) determined only 2 layered palisade parenchyma in the mesophyll of *B. gracilis*, Kahraman et al. (2010) determined 2-3 layered palisade parenchyma in the mesophyll of *B. paradoxa* as in the present study.

The distribution and shape of calcium oxalate crystals in plant tissues may be taxonomically useful in monocotyledons (Prychid and Rudal, 1999). Raphide type crystals occur in spongy parenchyma cells of the leaves in *B. paradoxa* (Kahraman et al., 2010), in leaves and the stem cortex of *B. gracilis* (Kandemir et al., 2000). The same type crystals are present in stem cortex, leaf mesophyll and upper leaf epidermis in *B. mathewii*. But, the raphides in *B. mathewii* and *B. gracilis* are sharper than those in *B. paradoxa*.

Stomata are present on upper and lower surfaces of *B. paradoxa*, but they are more abundant on the upper surface (Kahraman et al., 2010). The number of stomata on both surfaces are nearly same in *B. mathewii*.

The vascular bundles are numerous and scattered througout the cortex in *B. paradoxa* (Kahraman et al., 2010), but they are distributed in two row in the stem cortex of *B. gracilis* (Kandemir et al., 2000) as in *B. mathewii* presently studied.

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