Modern Phytomorphology **3**: 29–33, 2013

ANATOMICAL CHARACTERISTICS OF *MUSCARI VURALII* Y. BAĞCI & DOĞU (HYACINTHACEAE)

Süleyman Doğu [1] & Muhittin Dinç [2]

Abstract. *Muscari vuralii* Y. Bağcı & Doğu has been recently published rare endemic 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 1-layered palisade parenchyma under each epidermis, and richly developed 8-10-layered spongy parenchyma between the two palisades. Some spongy parenchyma cells include raphide crystals. Vascular bundles are located in equal intervals in spongy parenchyma. In the scape, the cortex is multilayered and the vascular bundles are located in two rows.

Key words: *Muscari*, Hyacinthaceae, anatomy, Turkey

[1] *Department of Science, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, 42090 Konya, Turkey; suleymandogu@gmail.com*
[2] *Department of Biology, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, 42090 Konya, Turkey; muhdinc@yahoo.com*

Introduction

The family Hyacinthaceae formerly part of the monocotyledonous Liliaceae sensu lato (Engler & Prantl 1930) was not accepted as a separate family until the work of Dahlgren (Dahlgren & Rasmussen 1983; Dahlgren *et al.* 1985) and continues to be recognized as a distinct family (APG 2003; Stevens 2001). The family comprises ± 40 genera and some 900 species widely distributed in temperate to tropical regions, with the highest diversity in southern Africa and in the region from the Mediterranean to South-West Asia. (Stedje 1996). Hyacinthaceae are broadly employed for purposes ranging from the treatment of hangovers, rheumatic fever, sprains, syphilis and cancer, to the bewitchment of neighbors and securing of good fortune (Pohl *et al.* 2000).

The genus *Muscari* Mill., which belongs to the Hyacinthaceae family, has 29 species in Turkey (Eker & Koyuncu 2008; Doğu & Bağcı 2009). Muscaries are excellent bulbous plants which are generally called grape hyacinths and they deserve a greater breeding effort because of their excellent horticultural characteristic (Nakano *et al.* 2005). In addition, a number of polyphenolic compounds, which have pharmacological importance because of their antimutagenic effects, have been isolated from some *Muscari* species (Miadokova *et al.* 2002).

Muscari vuralii Y. Bağcı & Doğu (Fig. 1) has been recently published rare endemic species known from only two localities in South Anatolia. Because of the threats on two populations, the species was evaluated as critically endangered (Doğu & Bağcı 2009). Although there are some anatomical studies on *Muscari* species in Turkey, an anatomical study has not been carried out on *M. vuralii*. This study reports vegetative anatomical structure of the species.

Material and methods

M. vuralii specimens were collected from Karaman (C4 KARAMAN: Sarıveliler, Atalanı places, stepe, 1950 m, 25. April 2009, S. Doğu and M. Dinç) (Fig. 2). 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

Fig. 1. General appearance of *Muscari vuralii.*

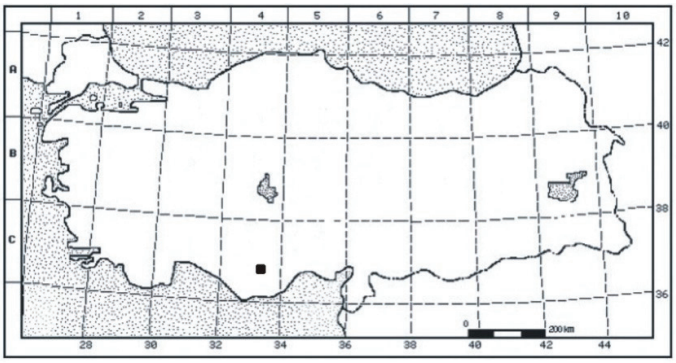

Fig. 2. Distribution map of *Muscari vuralii* in Turkey.

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.

Results

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 6-10-layered cortex consists of orbicular or hexagonal parenchymatic cells. Underneath 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 (Fig.3).

Leaf anatomy

The leaves are equifacial. The upper and lower epidermis are uniseriate and covered by a cuticle (Fig. 4). The stomata are visible in some transections of the leaf. The upper cuticle is thinner than the lower cuticle. Beneath upper and lower epidermis, 1-layered palisade parenchyma is present. The spongy parenchyma between the two palisades is 8-11-layered. It

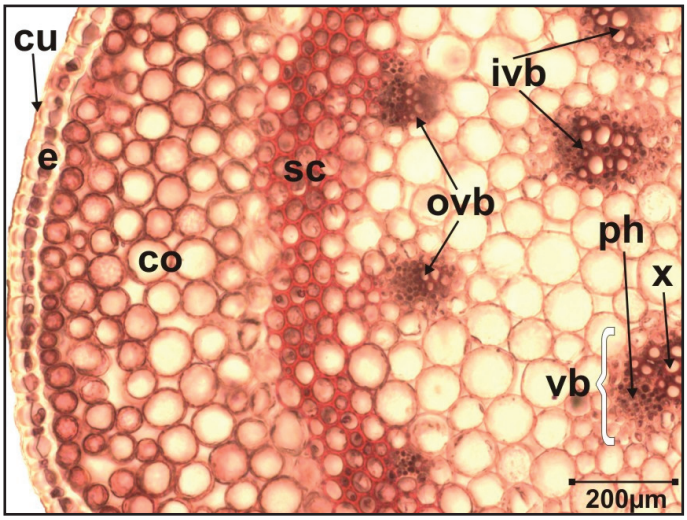

Fig. 3. The transverse section through the scape of *Muscari vuralii*: **co** – cortex; **cu** – cuticle; **e** – epidermis; **ivb** – inner vascular bundle; **ovb** – outher vascular bundle; **ph** – phloem; **r** – raphide crystals; **sc** – scleranchyma; **vb** – vascular bundle; **x** – xylem.

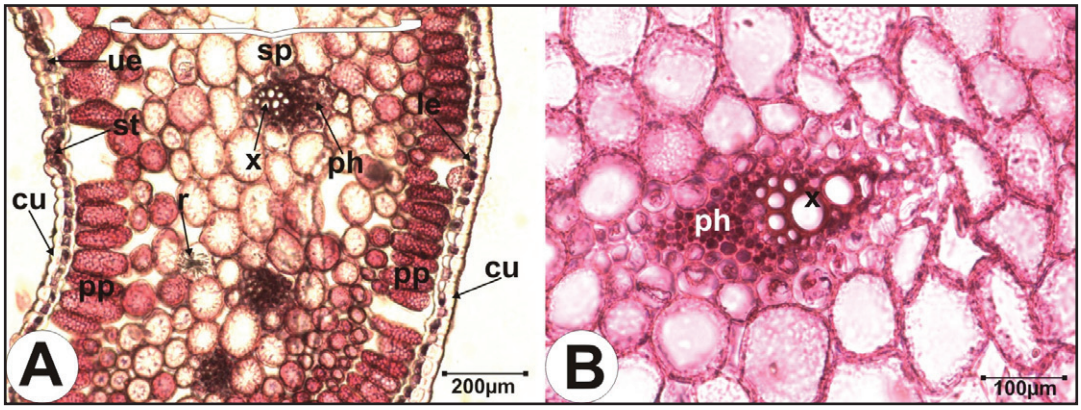

Fig. 4. The transverse section of the leaf (**A**) and vascular bundle (**B**) of *Muscari vuralii*: **cu** – cuticle; **le** – lower epidermis; **ph** – phloem; **pp** – palisade parenchyma; **r** – raphide crystals; **sp** – spongy parenchyma; **st** – stoma; **ue** – upper epidermis; **x** – xylem.

consists of nearly orbicular cells, some of them contain raphide type crystals (Fig. 5). 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 (Figs.4).

Leaf surface micromorphology

The leaves are amphistomatic with anomocytic type of stomata. The stomata lie at the same level as the epidermal cells. Namely, they are of mesomorphic type. On avarage, nine stomata occur on the upper surface in the unit area under the ×20 objective. The number of the stomata is nearly the same for upper and lower surfaces. Some stomata on the lower surface are triplet or twin. The epidermal cells on both surfaces are very long and narrow. They are 10× as long as wide on avarage (Fig. 6).

Discussion and conclusions

Anatomical features of *M. vuralii* scapes are resemble to the general characteristics of monocotyledons (Cutter 1971). In addition, the present study and those previously carried out on *Muscari* species in Turkey have showed that *Muscari* species exhibit anatomical similarity largely with regart to scape anatomy, mesophyll

Fig. 5. Raphide crystals in the spongy parenchyma cells of the leaf in *Muscari vuralii*.

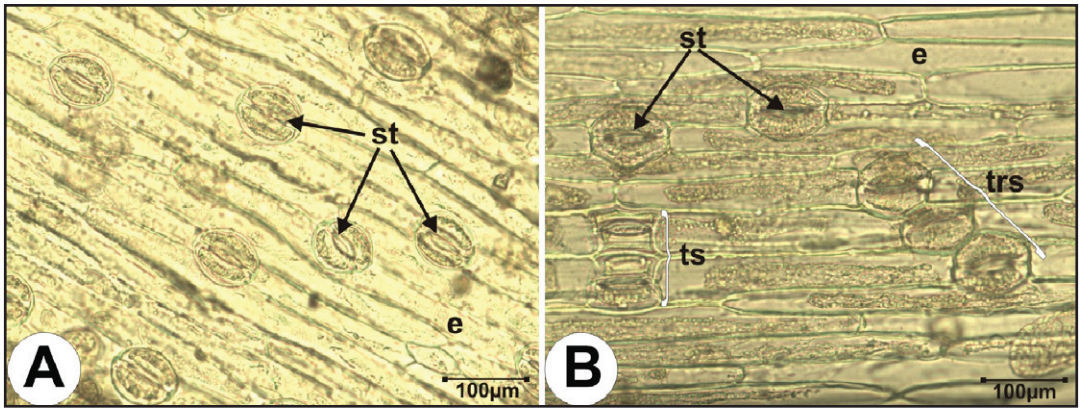

Fig. 6. The upper (**A**) and lower (**B**) surfaces of *Muscari vuralii* leaf: **e** – epidermal cell; **st** – stoma; **trs** – triplet stomata; **ts** – twin stomata.

anatomy, leaf surface anatomy and crystal content (UYSAL 1992; KANDEMIR *et al.* 2000; GÜRSOY & ŞIK 2010). But there are some differences among the species in detail. While *M. vuralii* has triplet and twin stomata on the lower surface of the leaf, *M. latifolium* J. Kirk, *M. armeniacum* Leichtlin ex Baker, *M. neglectum* Guss. ex Ten. and *M. bourgaei* Baker have not them.

The distribution and shape of calcium oxalate crystals in plant tissues may be taxonomically useful in monocotyledons (PRYCHID & RUDAL 1999). Hovewer, the occurrance of the raphide type crystals in *M. vuralii, M. latifolium, M. armeniacum* and *M. neglectum* along with the related genera *Scilla* L. and *Bellevalia* Lapeyr. do not support this hypothesis (UYSAL 1992; KANDEMIR *et al.* 2000; SATIL & AKAN 2006; GÜRSOY & ŞIK 2010; KAHRAMAN *et al.* 2010; DOĞU *et al.* 2011).

References

APG 2003. Angiosperm Phylogeny Group. An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG II. *Bot. J. Linn. Soc.* **141**: 399–436.

CUTTER E.G. 1971. Plant anatomy: Experiment and interpretation, Part 2, Organs. Addison-Wesley Publishing Company, London.

DAHLGREN R.M.T., RASMUSSEN F.N. 1983. Monocotyledon evolution: Character and phylogenetic analysis. *Evol. Biol.* **16**: 255–395.

Dahlgren R.M.T. Clifford H.T., Yeo P.F. 1985. The Families of the Monocotyledons. Springer-Verlag, Berlin.

Doğu S., Bağci Y. 2009. *Muscari vuralii* sp. nov. (Liliaceae/Hyacinthaceae) from South Anatolia, Turkey. *Nord. J. Bot.* **27**: 243–246.

Doğu S., Dinç M., Ünal A. 2011. Anatomical characteristics of *Bellevalia mathewii* Özhatay & Koçak (Liliaceae). *Biodicon* **4 (3)**: 14–18.

Eker İ., Koyuncu M. 2008. *Muscari babachii* sp. nov. (Hyacinthaceae) from south Anatolia. *Nord. J. Bot.* **26**: 49–52.

Engler A., Prantl K. 1930. Die Natürlichen Pflanzenfamilien. Volume **15a**. Verlag von Wilhelm Engelmann, Leipzig.

Gürsoy M., Şık L. 2010. Batı Anadolu'daki M*uscari armeniacum* Leichtlin Ex Baker ve *Muscari neglegtum* Guss. Türleri Üzerine Karşılaştırmalı Anatomik Araştırmalar. *C.B.U. J. Scie.* **6**: 61–72

Kahraman A., Celep F., Doğan M., Koyuncu M. 2010. Morpho-anatomical studies on *Bellevalia paradoxa* Boiss. belonging to Liliaceae. *Aust. J. Crop.* **4 (3)**:150–154

Kandemir N., Ergen Akçin O., Cansaran A. 2000. A morphological and anatomical investigation on some geophytes distributed in the vicinity of Amasya. *Herb. J. Syst. Bot.* **7 (2)**:127–147.

Miadokova E., Masterova I., Vlckova V., Duhova V., Toth J. 2002. Antimutagenic potential of homoisoflavonoids from *Muscari racemosum. J. Ethnopharmacol.* **81**: 381–386.

Nakano M., Tanaka S., Kagami S., Saito H. 2005. Plantlet regeneration from protoplast of *Muscari armeniacum* Leichtl. ex Bak. *Plant Biotechnol.* **22**: 249–251.

Prychid C.J., Rudal P.J. 1999. Calcium oxalate crystals in motocotyledons: A review of their structure and systematics. *Ann. Bot.* **84**: 725–739.

Pohl T.S., Crouch N.R., Mulholland D.A. 2000. Southern African Hyacinthaceae: Chemistry, bioactivity and ethnobotany. *Curr. Org. Chem.* **4**: 1287–1324.

Satil F., Akan H. 2006. Liliaceae Familyasından Bazı Endemik ve Nadir Geofitler Üzerinde Anatomik Araştırmalar. *Ekoloji* **15 (58)**: 21–27.

Stevens P.F. 2001. Onwards. Angiosperm Phylogeny Website. Version 9, June 2008 [and more or less continuously updated since]. www.mobot.org/MOBOT/research/ APweb/.

Stedje B. 1996. Hyacinthaceae. In: Polhill R.M., Balkema A.A. (eds.), Flora of Tropical East Africa. Kew, Rotterdam.

Uysal I. 1992. Kazdağı (B1 Balıkesir) Endemik Bitkileri Üzerinde Morfolojik ve Ekolojik Araştırmalar I "*Allium flavum* L. subsp. *flavum* var. *minus* Boiss. ve Muscari latifolium Kirk.". *Turk. J. Bot.* **16**: 299–310.

Vardar Y. 1987. Botanikte Preparasyon Tekniği: 25–26. Ege Üniversitesi Fen Fakültesi Basımevi.