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Morphological and Anatomical Study on *Gladiolus antakiensis* A. P. Hamilton and *Gladiolus atroviolaceus* Boiss. (Iridacee)

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ABSRACT: The study is based on anatomical andmorphological investigations of *Gladiolus antakiensis* A. P. Hamiltonand *Gladiolus atroviolaceus* Boiss. Morphological and anatomical features of vegatative organs of the plant such as root, scape, and leaf have been given in detail and demonstrated by figures. It has been observed that cormtunic is coarsely reticulate fibrous in these two species. Sand crystals have been observed in *G. antakiensis* species. Sclerenchyma groups have been observed around leaf vascular bundle in both of species. Most of the anatomical properties of both species are similar to the other member of Iridaceae family.

Key Words: Anatomy, *Gladiolus antakiensis, Gladiolus atroviolaceus,* Iridaceae, Morphology

Gladiolus antakiensis A. P. Hamilton and *Gladiolus atroviolaceus* Boiss. (Iridacee) Üzerine Morfolojik ve Anatomik Çalışma

ÖZET: Çalışmamızda *Gladiolus antakiensis* A. P. Hamilton ve *Gladiolus atroviolaceus* Boiss. türleri üzerinde morfolojik ve anatomik araştırmalar yapılmıştır. Kök skapus ve yaprak gibi vejetatif organlarının morfolojik ve anatomik karakterleri detaylı bir şekilde incelenerek fotoğraflanmıştır.İki türde de kormtuniğin inretikulat fibrilli olduğu gözlenmiştir. *G. antakiensis* türünde kum kristalleri saptanmıştır.Türlerde yaprak iletim demetlerinin etraflarında sklerenkima grupları gözlenmiştir. Çalışılan türlerin anatomic özelliklerinin çoğu Iridaceae familyasının diğer üyeleriyle benzerlik göstermektedir.

AnahtarKelimeler: Anatomi, *Gladiolus antakiensis, Gladiolus atroviolaceus,* Iridaceae, Morfoloji

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INTRODUCTION

Gladiolus L. (Iridaceae) is a large genus has a distribution of Africa, the Mediterranean basin and Western Asia. It is placed in Iridaceae, subfamily of Crocoideae. The genus includes approximately 150 species (Dahlgren, 1985). There are nine *Gladiolus* species in Turkey, four of them are endemic (Davis, 1984). Theyare small and fairly tall herbs. The corms of *Gladiolus* species are ovate or globose to flattened and enclosed by several layers of brownish fibrous tunics. Lowest leaf is reduced to a subterranean sheathing cataphyll and cauline leaves may be two or many, synanthous, ensiform. The perianth of *Gladiolus* species are tubular or funnel-shaped with syntepalous (Davis, 1984; Dahlgren, 1985). Thetaxonomy of *Gladiolus*is complex in a general way. Status and delimitation of many of its species are uncertain or confused. There are some studies about *Gladiolus* species (Erol, 2006; Tan, 2006; Gabrielian, 2001; Akınar, 2011) but any morphological and anatomical studies has not been observed on *Gladiolus antakiensis* A.P. Hamiltonand *Gladiolus atroviolaceus* Boiss. In this study morphological and anatomical features investigated of *G. antakiensis*and *G. atroviolaceus.*

MATERIALS AND METHODS

Plant specimens were collected from natural population in flowering period. *G. antakiensis* were collected from C4 Mersin. *G. atroviolaceus* samples were collected from A8 Erzurum. The collected specimens were kept in the herbarium of Celal Bayar University. The taxonomic description of the plant was carried out accordingto "Flora of Turkey" Volume 8 (Davis, 1984). Morphological measurements were made from fresh plant materials. For anatomical studies plant specimens were fixed in 70% ethanol. The paraffin method was used for preparing a cross-section of root, scape and leaves (Algan, 1981). Transverse sections 15-20µ were made using a sliding microtome and stained with safranin-Fast Green. Hand-cut sections were also made and stained with sarturre agent (Çelebioğlu and Baytop, 1949). Microscopic slides were photographed with motorized Leica DM 300 microscope. Measurements were take nusingocular-micrometer of root, scape and leaf cell sizes of each species. Minimum, maximum, meanand standart deviation was determined.

RESULTS

Morphological Results

G. antakiensis: Cormtunic has coarse reticulate fibres. Stemlenght is 30-72 cm. leaves number are 3-4 in number. Lamina of basal leave slenght-width is 200-320 x 5-8 mm, it is green, acuteto acuminate shaped, its veins are irregularly spaced, diverging from base. Spike is 3-6 flowered, lax and not secund. Spat hevalves are unequal. Perianthcolour is carmineorpurplish-pink. Tube is narrow and slightly curved. Posterior is 15-19 mm, anterior is 14-20 mm. Upper segments are not orvery shortly clawed, acute or broadly acute; median segment is elliptic, 30-35 x 8-10 mm, lateral is narrowly elliptic, 22-24 x 4-5 mm; lower segments are broadly acute, claw is c. 1/3 x total length, of segment, median is 24-27 x 3-3.5 mm, lateral is narrowly obovate, 28-32 x 4-5 mm. Anthers lenght is 12-14 mm, filaments lenght is 12 mm. Style lenght is 2.8 cm it has stigmasdilated at tips. Capsuleshape is obovoid. Seed shape is broadly ovoid, ıt is lenght is 2.5 x 2 mm and it is unwinged (Figures. 1, 2, 3).

Figure 1. General appearance of *G. antakiensis*in natural habitat

Figure 2. General appearance of *G. antakiensis*in natural habitat

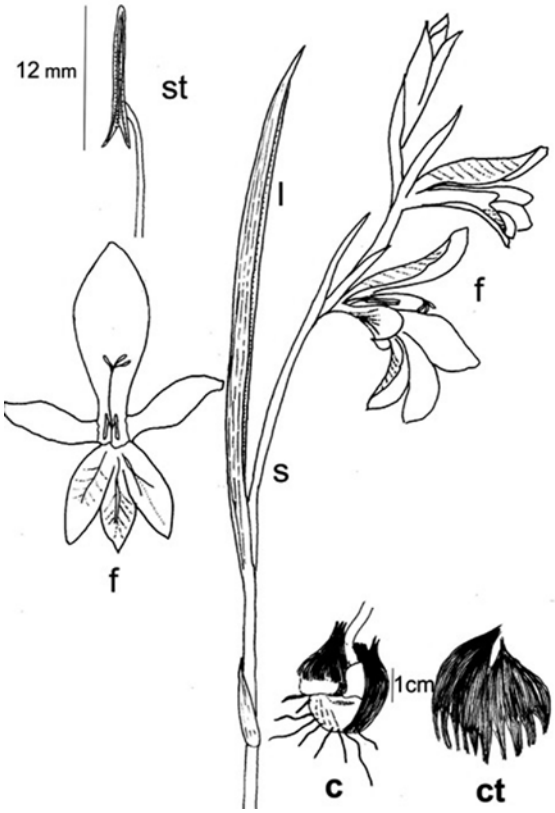

Figure 3. General appearance and some parts of *G. antakiensis:* c:corm, ct:cormtunic, f:flower, l:leaf, s:scape, st:stamen

Figure 4. General appearance of *G. atroviolaceus*

G. atroviolaceus*:* Cormtunic is coarsely reticulate fibrous. Stem lenght is 30-60 cm. Leaves numbers are 3. Spike is 4-8 (-11) flowered, dense, secund. Perianth colour is deep violet-purple, flushed lilac within. Perianth tube is markedly curved, posterior is (10-) 12-15 mm, anterior is (14-)16-18 mm; lower lateral segments are streaked with white or liliac with 2 dark violetlines. Upper median segment is distinctly hooded in *vivo,* very shortly clawed, 23-27 (-35) x 10-13 mm, upper lateral is 23-25(-30) x 842 mm, lower median is 20-22 (-27) x 7-9 mm, lower lateral is narrowly clawed in lower 1/3, 18-27 x 9-12 mm. Anthers lenght is (10-)12-15 mm, filaments lenght is 9-15 mm. Capsule is ellipsoid, to1.8 cm. Seed shape is ovoid, c. 2.5 x 2 mm, it is swinged (Figures. 4, 5).

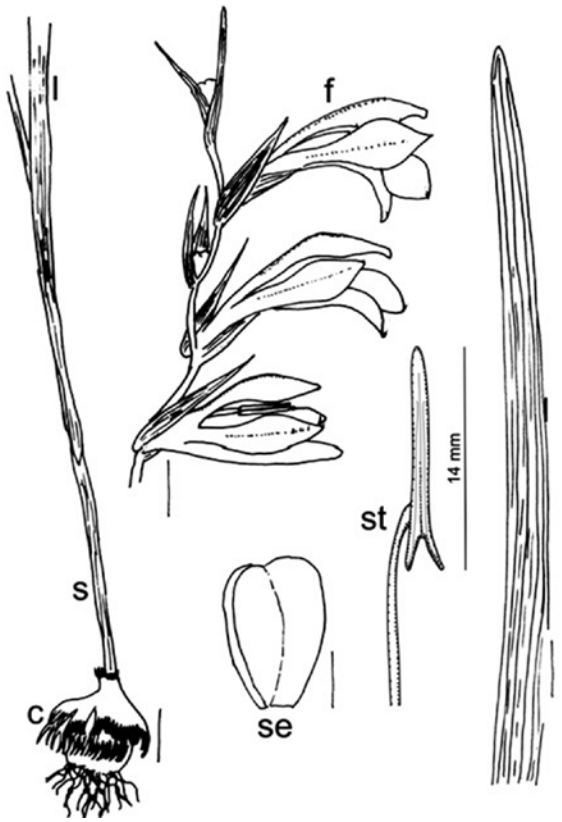

Figure 5. General appearance and some parts of *G. atroviolaceus:* c:corm, f:flower, l:leaf, s:scape, se:seed, st:stamen, scalebars: 1 cm

Anatomical Results

G. antakiensis

Root: There is a single layer epidermis outer surface of *G. antakiens* is root. Cortex is consisted 6-10 layered parenchymatic cells. Endodermis is single-layered. The wall thickenings of the endodermal cells are three sided and towards to pericycle. Pericycleis single layered. A big metaxylem is present at root center. 9-10 number xylem strands are present around the metaxylem (Figure. 6).

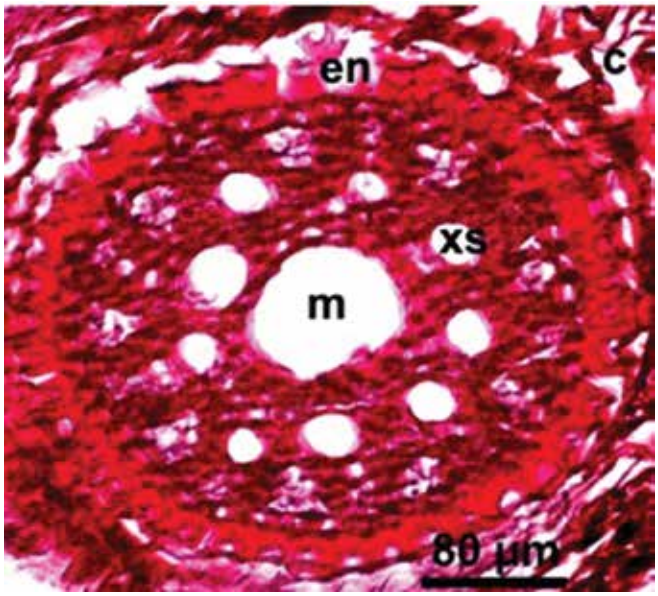

Figure 6. Cross section of root of *G. antakiensis* c: cortex, en: endodermis, m:metaxylem, xs:xylemstrand

Scape: Scape is covered by a thick cuticle. There is a single-layered epidermis under the cuticle. Parenchymatic cortex is 5-9 layered, has intercellular spaces. Vascular bundles number are 38-40 and they are located in three circle. Pith are aoccupies very large area in scape cros ssection. Parenchymaticpith cells have intercellular space sand they are bigger than compared to cortex cells. There are sand crystals in cortex and pithcells (Figures. 7, 8).

Leaf: A thick cuticle is cover edadaxial surface of *G. antakiens* is leaf. Epidermis is single layered in both surfaces. Adaxial epidermis cells are bigger than abaxial epidermis cells. There are sandcrystals in mesophile. There is no difference between spongy and palisadeparenchyma at 9-11 layeredmesophile.

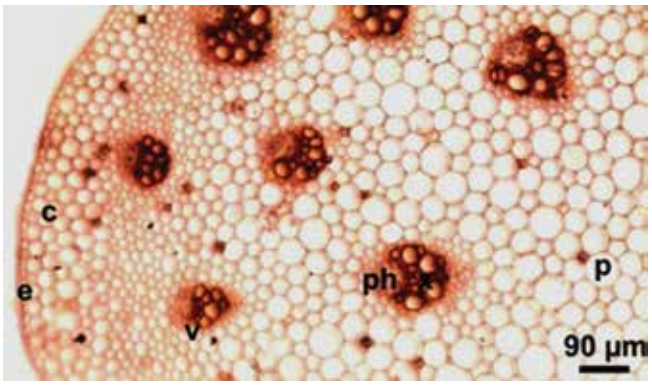

Figure 7. Cross section of scape of *G. antakiensis,* c: cortex, e: epidermis, v: vascularbundle, p:pith, ph:phloem, x:xylem

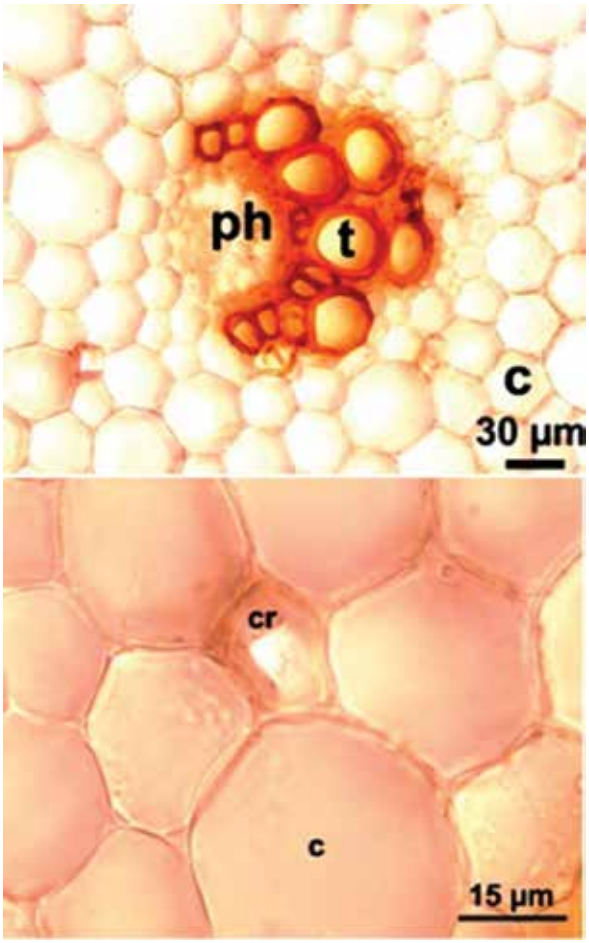

Figure 8. Cross section of scape of *G. antakiensis,* c: cortex, cr:crystal, ph: phloem, t:trachea

Mesophilecells are close to the abaxial epidermis have more chlorophyll. Vascular bundles are located closer to the abaxial epidermis. Sclerenchyma groups present around the vascular bundles. There are papillas on abaxial surface of leaf. Abaxial cuticle is thinner than other surface. (Figures. 9, 10, 11).

G. atroviolaceus

Root: Outer surface of *Gladiolus* root is coveredby a single layer edepidermis. Cortex is 15-20 layered. There are very small intercellular spaces between parenchymatic cortex cells. Endodermis is single-layered.

The wall thickness of the endodermal cells are three sided and towards to cortex.

Pericycleis single layered and located under the endodermis. 25-30 metaxylem are present at root.

Pith area is present in root cross section (Figure. 12).

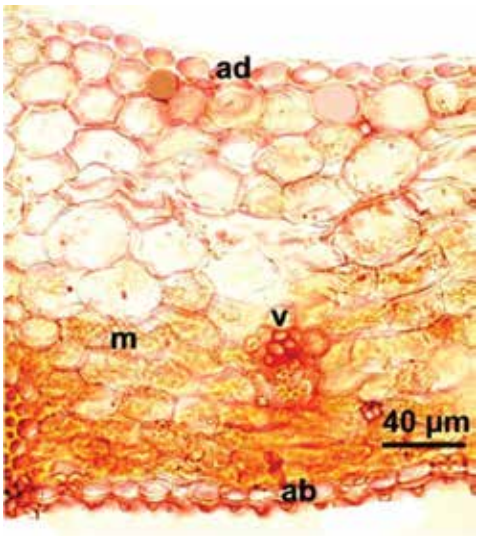

Figure 9. Cross section of leaf of *G. antakiensis* ab: abaxialepidermis, ad: adaxialepidermis, m:mesophile,v: vascularbundle

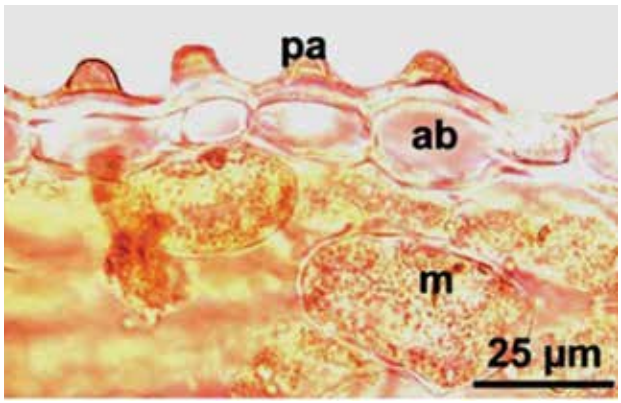

Figure 10. Cross section of leaf of *G. atroviolaceus* ab: abaxialepidermis, m:mesophile, pa:papilla

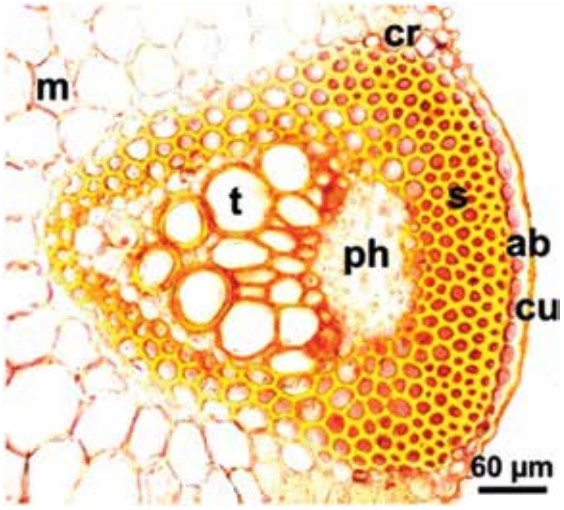

Figure 11. Cross section of leaf of *G. atroviolaceus* ab: abaxialepidermis, cr:crystal, cu: cuticle, m:mesophile, ph: phloem, s: sclerenchyma, t:trachae

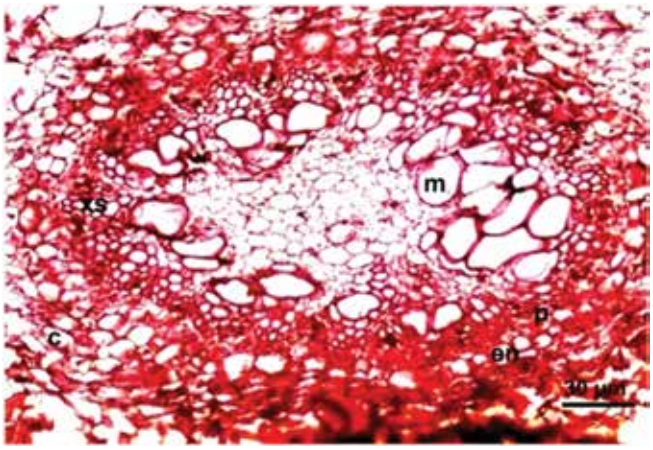

Figure 12. Cross section of root of *G. atroviolaceus* c: cortex,en:endodermis, m:metaxylem, p:periskl, xs:xylemstrand

Scape: Outer surface of scape is covered by cuticle. Epidermis is single-layered. 3-4 layer cortex cells are not have collenchyma. 9-12 layered cortex parenchyma is consisted of collenchymaticcells. This cells are ovate and circle shaped.

Intercellular spaces are present in the cortex of scape. Vascular bundle snumber are17-20 and they are located in two circle. Pitharea is present at the center of scape. The cells of pith are parenchymatic and have intercellularspaces. Pith cells are bigger than cortex cells (Figures. 13, 14).

Leaf: There is a cuticle both adaxialandabaxial surfaces of *Gladiolus* leaf. Abaxialcuticle is thicker than adaxial surface. Epidermis is single layered on both surfaces. Stomata are generally located on abaxi alside of the leaf and there are spaces under the stomata. Abaxial epidermis cells are bigger than adaxial epidermis cells. There is no differentiation as spongy and palisade parenchyma at 9-12 layered mesophile. Vascular bundles are located closer to the abaxial epidermis. There are papillas on abaxial surface of leaf (Figures. 15, 16, 17).

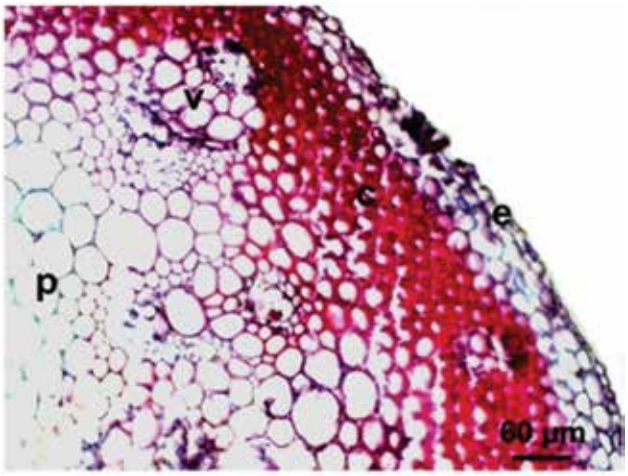

Figure 13. Cross section of scape of *G. atroviolaceus,* c: cortex, e: epidermis, v: vascularbundle, p:pith

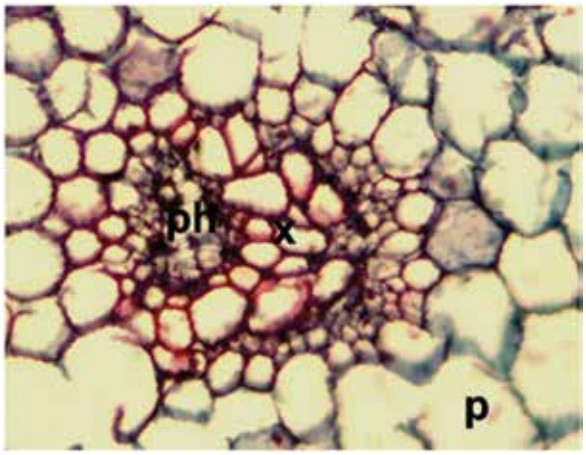

Figure 14. Cross section of scape vascular bundle of *G. atroviolaceus,* p:parenchyma, ph: phloem, x:xylem

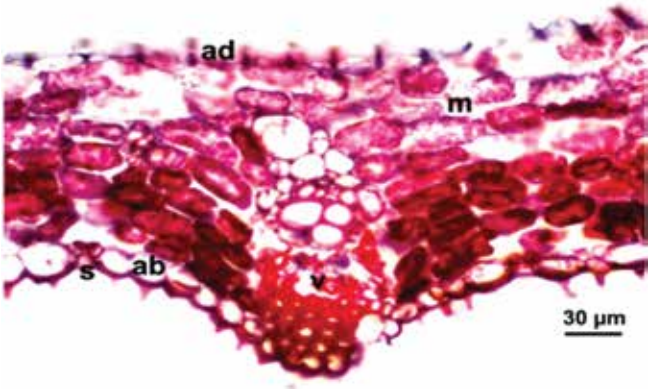

Figure 15. Cross section of leaf of *G. atroviolaceus* ab: abaxialepidermis, ad: adaxialepidermis, m:mesophile,s:stoma

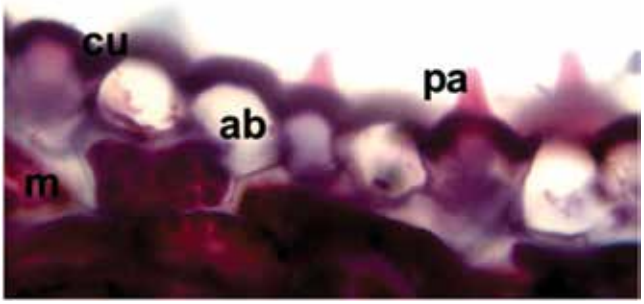

Figure 16. Cross section of leaf of *G. atroviolaceus* ab: abaxialepidermis, cu:cuticle, m:mesophile,pa:papilla

Table 1. Anatomical Measurements of *G. antakiensis* and *G. atroviolaceus*

	Width (µm)		Length(µm)	
	Min–Max	**Mean±SD**	**Min–Max**	**Mean±SD**
G. antakiensis				
Root				
Epidermiscell	25-32	29.6±4.2	28-45	39.3±5.4
Cortexcell	35-54	43.2±7.5	40-70	61.4±4.7
Endodermis cell	15-23	19.4±2.6	20-35	27.3±3.2
Metaxylem (diameter)	15-80	36±22.6		
Scape				
Epidermis cell	12.5-22.5	16.8±4.4	7.5-17.5	10.5±3.67
Cortex cell (diameter)	15-37.5	26±8.6		
Trachea (diameter)	10-30	22.5±5.4		
Pith cell (diameter)	27.5-70	43±17.1		
Leaf				
Adaxial Epidermis	15-25	19.5±4.58	7.5-12.5	11.5±2.54
Abaxia lEpidermis	10-25	18.75±5	5-10.3	9.7±1.38
Mesophile (diameter)	15-50	22.5±4.47		
G. atroviolaceus				
Root				
Epidermiscell	20-37.5	28.5±6.4	32-47	42±5
Cortexcell (diameter)	30-50	41.5±7.6	45-60	53.5±4.8
Endodermis cell	27-32	29±2.1	37-56	45±7.5
Metaxylem (diameter)	17-30	21.5±4.3		
Scape				
Epidermis cell	10-25	15.5±4.5	17-27	25±3.8
Cortex cell (diameter)	27-62	39±13		
Trachea (diameter)	17-50	32±11		
Pith cell (diameter)	40-75	56±13.4		
Leaf				
Adaxial Epidermis	12-15	13.5±1.2	22-33	28±3.7
Abaxial Epidermis	17-30	22.5±4.7	17-25	22.5±2.7
Mesophile	15-20	16.2±2.1	27-58	41±11

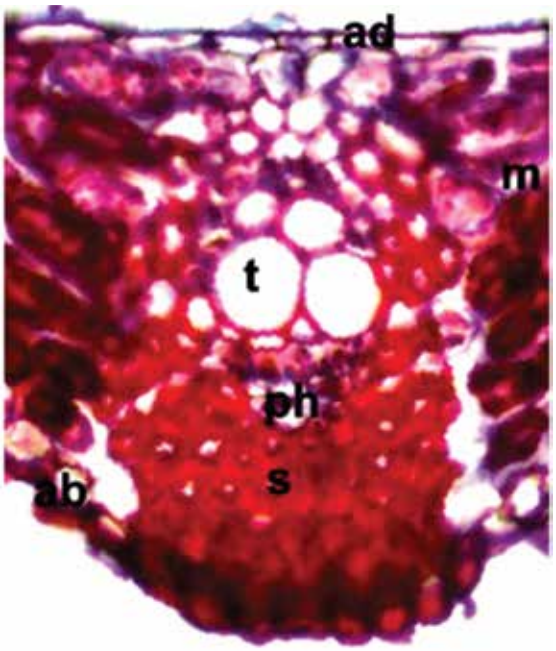

Figure 17. Cross section of leaf of *G. atroviolaceus* ab: abaxialepidermis, ad: adaxialepidermis, m:mesophile, ph: phloem, s: sclerenchyma, t:trachea

DISCUSSION

In our study, morphological and anatomical features are studied on *G. antakiensi* and *G. atroviolaceus.* Our numerical findings belonging to the morphological characters of the species seem to be similar to the first measurements given by Davis in Flora of Turkey (Davis, 1984).

In root cross sections, while a big metaxylem is present in *G. antakiensis,* that 25-30 metaxylem in *G. atroviolaceus.* Scape vascular bundles are located in three circle in *G. antakiensis,* two circle in *G. atroviolaceus.*

Sclerenchyma groups and sand crystals are distinctive characters for interspecies disorder (Selvi, 2008). According to Fahn (1990), sand crystals were present in dicotyledone stem and some monocotyledone members. Crystals are constant character in plant. Crystal shape and location in plants are very important for taxonomicstudies (Metcalfe, 1983; Fahn, 1990; Yentür, 1995). In our study while sand crystals were observed in scape and leaf of *G. antakiens* is species that not observed in *G. atroviolaceus.* Sand crystals can be distinctive for the two species.

Abaxial epidermis cells of leaf have papillae in two species too. Sclerenchyma groups surrounding leaf vascular bundle have been seen in most monocotyledone members (Esau, 1977; Fahn, 1990). Inourstudy, sclerenchyma groups were observed around the leaf vascular bundles in two species. Anatomic characters as metaxylem or vascular bundle number and crystal type can use distinctive characters between *Gladiolus* species. We hope our findings contribute to further phylogenetic and taxonomic studies about *Gladiolus* species.

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