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Article

KANDEMIR, N.[1]
KHAN, G.[2]
ÇELIK, A.[3]*

COMPARATIVE MORPHOLOGICAL, ANATOMICAL AND ECOLOGICAL STUDIES ON TWO VARIETIES OF *Iris unguicularis* SUBSP. *carica* (IRIDACEAE) IN TURKEY

*Estudo Comparativo Morfológico, Anatômico e Ecológico de Duas Variedades de **Iris unguicularis** subsp. **carica** (Iridaceae) da Turquia*

ABSTRACT - *Iris* is the largest genus of family Iridaceae having 50 species with 24 endemic to Turkey. Here in this study we compared morphological, anatomical and ecological characters of two varieties of *Iris unguicularis* subsp. *carica* (*Iris unguicularis* subsp. *carica* var. *carica* and *Iris unguicularis* subsp. *carica* var. *syriaca*) from Turkey. We reported some distinctive morphological characteristics between both of the varieties like plant size, root length and width, leaf length and width, perianth tube, falls, standard fruit and bract length, falls and standards width and structure, flower colour which are of important taxonomic values. We further investigated that both the varieties are found in different localities and the differences in morphological properties are specific to ecological conditions. Soil analysis of both varieties reveal that CO_3, Ca, Mg, Fe and Mn values are more effective than the other soil factors in the distributions of these varieties.

Keywords: comparison, morphology, anatomy, ecology.

*RESUMO - Íris é o maior gênero da família Iridaceae com 50 espécies, sendo 24 endêmicas da Turquia. Neste estudo, comparamos caracteres morfológicos, anatômicos e ecológicos de duas variedades de **Iris unguicularis** subsp. carica (**Iris unguicularis** subsp. carica var. carica e **Iris unguicularis** subsp. carica var. syriaca) da Turquia. Relatamos algumas características morfológicas distintas entre as duas variedades, tamanho da planta, comprimento e largura da raiz, comprimento e largura da folha, diâmetro da tuba, quedas, comprimento padrão da fruta e da bráctea, quedas e padrões de largura e estrutura, cor da flor e importância taxonômica. valores. Nós investigamos ainda que ambas as variedades são encontradas em diferentes localidades e as diferenças nas propriedades morfológicas são específicas das condições ecológicas. Análises do solo de ambas as variedades revelam que os valores de CO3, Ca, Mg, Fe e Mn são mais efetivos que os demais fatores do solo nas distribuições dessas variedades.*

Palavras-chave: comparação, morfologia, anatomia, ecologia.

INTRODUCTION

Family Iridaceae has about 85 genera in which *Iris* L. is the largest genus. There are 56 taxa of this genus distributed in Turkey (50 species, 3 subspecies, and three varities) with 24 endemics (Mathew, 2001; Güner et al., 2012). The

* **Corresponding author:**
<toygar09@hotmail.com>

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[1] Education Faculty, Amasya University, Amasya, Turkey; [2] Universidade Federal de São Carlos, Sorocaba-SP, Brazil; [3] Science and Art Faculty, Pamukkale University, Denizli,Turkey.

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genus contains bearded, crested and beardless species. The under-ground parts of the genus are mostly rhizomatic, bulb and tuber shaped. *Iris* taxa are economically important geophytes producing different secondary metabolities. The *Iris* L. species are used to treat many diseases for a long time as anti-flammatory, diuretic, analgesic, wound-healing agents, anti-bacterial, anti-viral, and anti-cancer (Wollenweber et al., 2003; Kukula-Koch et al., 2013). Their rhizomes are also used to treat inflammation of the upper respiratory tract, gastrointestinal tract, in gynecology and oncology practices (Williams, 1997; Iwashina et al., 1998). *Iris unguicularis* from the same genus is known for its medicinal properties because its rhizomes contains 1,3-O-diferuloylsucrose, 5,7-dihydroxy-6-methoxychromone, irilone, 4,5,7-trihydroxy-methoxyflavanone, tectorigenin, kaempferol, 4,5,7-trihydroxy-3,8-dimethoxyflavanone, 8-methoxyeriodictyol, hispidulin, mangiferin, irigenin and kanzakiflavones-1 (Arisawa and Morita, 1976; Rahman et al., 2010; Mosihuzzmana et al., 2013). Besides these uses their rhizomes is also are used in making "cheese curd" (Baser, 1997). Sofiane et al., (2016) reported that the above-ground parts of *I. unguicularis* have high antioxidant and antifungal properties too.

The genus *Iris* is divided into six subgenera recognized within subgenus *Limniris* include beardless irises and widely distributed in the Northern Hemisphere. This subgenus contains sections *Limniris* and *Lophiris*. The section *Limniris* is divided into sixteen series within the series *Unguiculares* (Stebbings, 1997). Both *Limniris* and *Lophiris* sections are reported to be polyphyletic (Wilson, 2004). *Unguiculares* (Diels) Lawrence series is a small group and plants of this series are with problematic taxonomy (Davis and Jury, 1990). *Iris unguicularis* belongs to series *Unguiculares* of *Limniris* subgenus and is widely cultivated in temperate regions. It is a perennial rhizomatous flowering plant in the genus *Iris*, their species blossom in late winter and early spring with pleasant fragrance, large in size, light lavender blue coloured and delicate. The leaves are bright green coloured, erect, slender, linear, striped and 10-60 cm at the time of anthesis. Morphologically, this species is very similar to *I. lazica* Aldov. However, leaf width of *I. unguicularis* is smaller than leaf width of *I. lazica*. Leaves width, pollen morphology, and leaf chemical components are the most important distinguishing characters between these two species (Davis and Jury, 1990). In addition, *I. laziza* does not like very hot dry areas, and prefers relatively damp areas with Blacksea element. Similary, *I. unguicularis* is known as bush navruz by people and represented with a subspecies in Turkey, named subsp. *carica*. Based on differeces in the leaf width measurements, *I. unguicularis* subsp. *carica* was divided into two varieties as var. *carica* and var. *syriaca*. *Iris unguicularis* subsp. *carica* (Wern. Schulze) A.P.Davis & Jury var. *carica*, has a leaf width 1-2 mm, while leaf width of *I. unguicularis* subsp. *carica* var. *syriaca* (Wern. Schulze) A.P. Davis & Jury is 2-5 mm. The var. *carica* is endemic to East Mediterranean region of Turkey, whereas the var. *syriaca* is found in East Mediterranean region but not endemic (Güner et al., 2000, 2012). Var. *carica* disributes in the Mediterranean and Agean coasts from 1-1500 m. and blossom between January to June while var. *syriaca* from 600-1000 m. blossom in February-April. Here in this investigation we compared morphological, anatomical and ecological characters of *I. unguicularis* subsp. *carica* var. *carica* and *I. unguicularis* subsp. *carica* var. *syriaca* varieties to report the significant distinguishing characters in term of taxonomy.

MATERIAL AND METHODS

The materials of *I. unguicularis* subsp. *carica* var. *carica* and *I. unguicularis* subsp. *carica* var. *syriaca* were collected during the flowering period between 2016 and 2017. The localities of plant samples are listed below.

Iris unguicularis subsp. *carica* var. *carica*

1. C2 Mugla: Fethiye to Ölüdeniz road, under *Pinus brutia* forest, 250 m., 3 March 2017, Çelik 644 (A1 locality)

2. C2 Mugla: Fethiye to Dalaman, 4 km. to Göycek Passage, under *Pinus brutia* forest, 160 m., 3 March 2017, Çelik 645 (A2 locality).

3. C2 Mugla: Yaraþ behind the water fountain, under *Pinus brutia* forest, 720 m., 3 March 2017, Çelik 646 (A3 locality).

4. C2 Mugla: Yilanli mountain, Yaras Village, *Pinus brutia* forests, 1000 m., 7 March 2016, Çelik, 642 (A4 locality).

Iris unguicularis* subsp. *carica* var. *syriaca

5. C6 Hatay: Saman Mountain, Tekepinari Gömbece Village, *Pinus brutia* forest and mixed shrubs, 600 m., 5 March 2017, Çelik, 647 (B1 locality).

6. C6 Osmaniye: Kadirli, Tahta Village, Cincikli location, rare scrub areas, 900 m., 21 March 2016, Çelik, 643 (B2 locality).

Both varieties were identified according to Güner et al. (2000, 2012). The plant samples were fixed in 70% alcohol and then used for morphological measurements. Paraffin method was used (Algan, 1981) to prepare cross-sections of the roots, scapes and leaves. The cross and surface-sections of these parts were taken and photographed. The cross-sections were stained with sartur reagent. The anatomical and morphological measurements were made with a micrometric ocular and ruler. The distinguishing morphological and anatomical characters were given in Table 1 and 3, respectively. Mean epidermal and stoma cells numbers in 1 mm^2 of the surface-section were determined. Length and width of stomata in the lower surfaces of leaves were measured (Table 2). Stomatal index was calculated according to the description of Mesdner and Mansfield (1968). For soil analysis samples were taken from 0-20 cm depth during generative growth period and were brought in polyethylene bags to the laboratory. Physical and chemical analyzes of the soil samples, were carried out in Amasya University Central Research Application Laboratory Application and Research Center. The soil texture, total salinity, calcium carbonate ($CaCO_3$) and pH were determined according to the standard methods (Kaçar, 1996). Nitrogen, phosphorus, potassium, organic matter and microelements contents of the soil samples were analyzed by micro-Kjeldahl apparatus, ammonium-molybdate-stannous chloride, flame photometer, the Walkley-Black, DTPA (Diethylenetriaminepentaacetic acid) + $CaCl_2$ (Calcium chloride) + TEAL (Triethanolomine) methods, respectively (Kaçar, 1996).

Table 1- Distinguishing morphological characters of investigated varieties

Morphological character	var. *carica*	var. *syriaca*
Plant size	12-40	20-55
Root length	18-30	14-25
Root width	1-1.5 mm	1-1.8 mm
Leaf length	10-60	10-50
Leaf width	1-2 mm	2-5 mm
Bract length	7-25	12-20
Perianth tube	8-25	13-20
Falls length	5.5-7.4	5.5-7.9
Falls width	1-1.7	1-1.9
Standart length	6-7.5	6.5-8.2
Standart width	1.4-1.7	1.2-2.1
Structure of falls	oblanceolate	Oblanceolate to lanceolate-rhombic
Structure of standarts	oblanceolate	Oblanceolate- lanceolate-rhombic
Fruit length	3-4	2.5-4
Flowers colour	light lavender blue	dark lavender blue
Altitude	1-1500 m	600-1000 m
Flowering time	January-June	February-April

Table 2 - Stomata measurements and stomata index for varieties (lower surface of leaf)

Species name	Number of epidermis cells	Number of stoma cells	Stomata length (µm)	Stomata width (µm)	Stomata index (%)
Iris unguicularis ssp. *carica*	112	139	40-45	32-40	55.37
Iris unguicularis ssp. *syriaca*	124	132	48-50	38-45	51.56

Table 3 - Distinguishing anatomical characters of investigated varieties (all dimensions are µm)

Anatomical character	var. *carica*	var. *syriaca*
Root		
Width of epidermis cells	35-45	25-30
Layer number of cortex	10-14	12-16
Cortex cells diameter	50-80	50-100
Margin structure of cortex parenchyma cells	undulated	straight
Endoderma length	35-40	25-30
Layer number of pericycle	1-3	1-2
Xylem strand number	12-15	12-14
Pith cell diameter	20-25	25-30
Idioblasts	absent	present
Scape		
Epidermis cell diameter	20-30	18-25
Layer number of lacunal collenchyma	1-3	3-5
Leaf		
Diameter of upper epidermis cells	15-25	20-28
Side wall structure of both epidermis cells	straight	undulated
Cuticle thickness	9-12	10-18
Length of palisade parenchyma cells	25-30	35-42
Width of palisade parenchyma cells	18-25	28-32
Length of stomata	30-35	38-40
Diameter of lower epidermis cells	15-20	20-25
Bulliform cells	absent	present

RESULTS AND DISCUSSION

Morphological characteristics

***Iris unguicularis* subsp. *carica* var. *carica*:** Plants are perennial herbs, 12-40 cm in height, and rhizomatous. Their rhizomes are thick, pale-brown with membranous sheaths. Roots are tough, thin and intensive, 18-30 cm x 1-1.5 mm in length. Leaves are linear, slender, flat, erect, striped, bright green, longer than the scape and 10-60 x 1-2 mm at anthesis, pointed, forming dense clumps (Figure 1A). Scapes are erect, selender, sheathed, unbranched and 1-2 flowered. Bract and bracteoles 7-25 cm, linear-lanceolate and short sipicular. Perianth tube wrapped with bract and bracteoles, long-tapering at apex, 8-25 cm. Flowers are solitary, pretty dark lavender-blue to deep lilac, with delicate marking and sweetly-scent. Falls oblanceolate, 5.5-7.4 x1-1.7 cm, acute, recurved, pale violet, with narrow long-tapering claw, white veined, with a strong deep yellow median stripe on falls. Claws yellowish, veined with red-purple, oblong spathulate, subequal and entire. Standards oblanceolate, 6-7.5 x 1.4-1.7 cm., acute, rounded at the top, pale violet coloured and erect. The base of standards and falls burgundy coloured. Stylar tube 1.5-2 cm, style branches 2.5-3 x 0.3-0.4 cm, with acute lobes 1-1.2 x 0.2 cm. Crest is 2-4 mm. Ovary narrow, selender and 9-12 x 2-4 mm. Stamens lilac coloured. Capsule ellipsoid, 3-4 x 1-1.5 cm, carried on a short peduncle. Found along dry sunny banks, edges of scrub, open pine woodlands and rocky places, 1-1500 m.

***Iris unguicularis* subsp. *carica* var. *syriaca*:** Plants are perennial herbs, 20-55 cm in height, and rhizomatous. Thier rhizome is thick, pale-brown with membranous sheaths. Roots are tough, thin and intensive, 14-25 cm x 1-1.8 mm. Leaves are linear, slender, flat, erect, striped, bright green, longer than the scape and 10-50 x 2-5 mm at anthesis, pointed, forming dense clumps (Figures 1B). Scapes are erect, selender, sheathed, unbranched and 1-2 flowered. Bract and bracteoles 12-20 cm, linear-lanceolate and short spicular. Perianth tube wrapped with bract and bracteoles. Perianth tube long-tapering at apex, 13-20 cm. Flowers solitary, pretty light lavender-blue to deep lilac, with delicate marking and sweetly-scented. Falls oblanceolate to lanceolate-rhombic, 5.5-7.9 x 1-1.9 cm, acute, recurved, pale violet, with narrow long-tapering claw, white veined, with a strong deep yellow median stripe on falls. Claws yellowish, veined

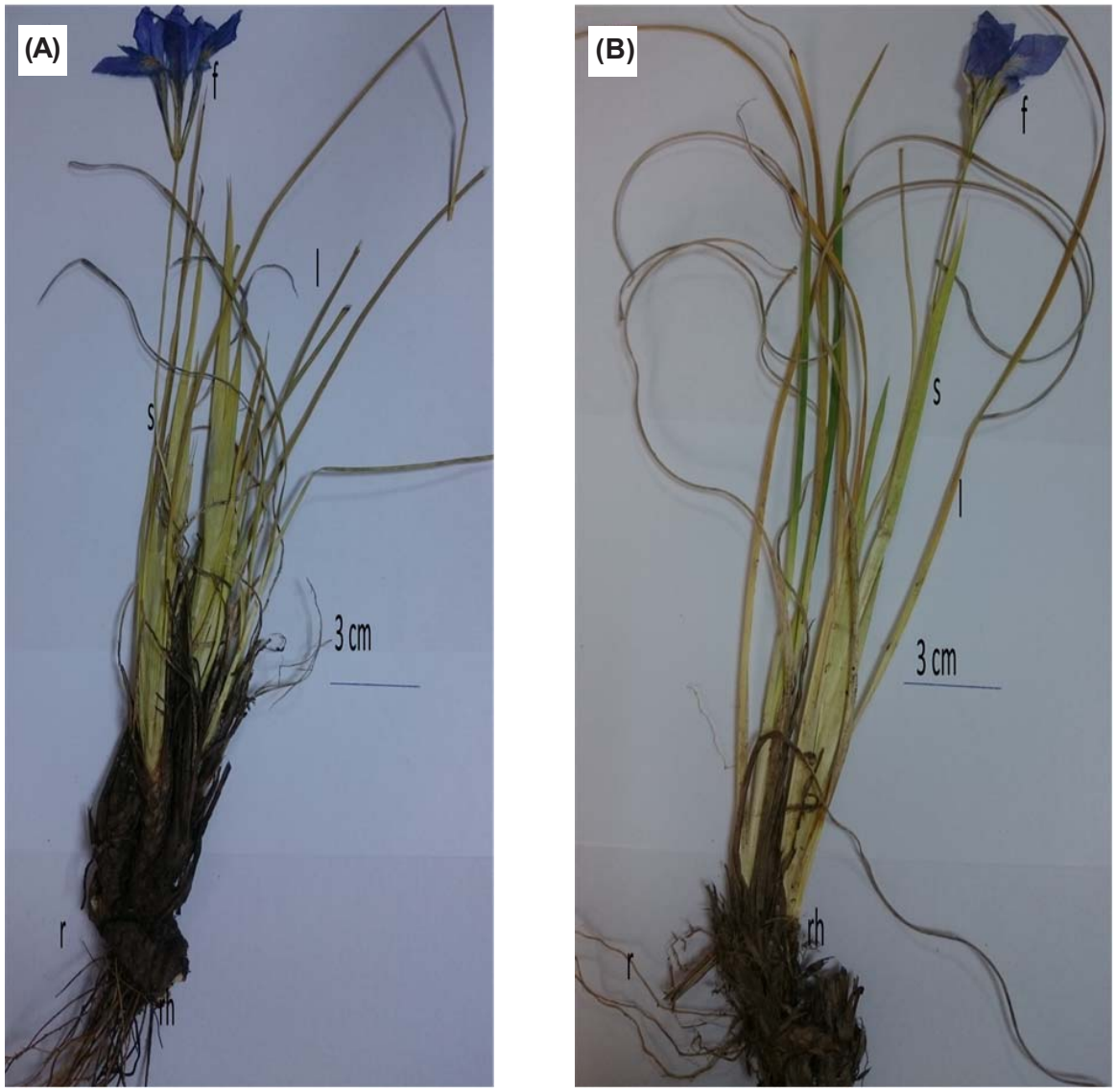

Figure 1 - General appearances of herbarium samples of varieties. A, var. *carica*; B, var. *syriaca*, r,root; rh, rhizome; s, scape; l, leaf; f, flower.

with red-purple, oblong spathulate, subequal and entire. Standards oblanceolate-lanceolate-rhombic, 6.5-8.2 x 1.2-2.1 cm, acute, rounded at the top, pale violet coloured and erect. The base of standards and falls burgundy coloured. Stylar tube 1.5-2 cm and style branches 2.5-3 x 0.3-0.4 cm, with acute lobes 1-1.2 x 0.2 cm. Crest 2-4 mm. Ovary narrow, selender and 9-12 x 2-4 mm. Stamens lilac coloured. Capsule ellipsoid, 2.5-4 x 1-1.5 cm, carried on a short peduncle. Found near bushes and in meadow places, withing *Pinus brutia* forest 600-1000 m.

Anatomical characteristcs of the roots

***Iris unguicularis* subsp. *carica* var. *carica*:** Epidermis is single layered, large celled with simple, multi-celled and dense eglandular trichomes. Cortex is multilayered (10-15 layered) and parenchymatic (Figure 2A). The parenchyma cells are oval and cylindrical shaped with undulated margins. Cortex cells near the endoderm, are small and oval shaped with no idioblasts. Endodermis is single layered and with large parenchymatic cells. The thickening in endodermis cells are three sided and oriented to pericycle. There is no thickening towards cortex. The thickening in endodermis cells are very obvious (Figure 2B). Pericycle is 1-3 layered with large and oval parenchymatic cells. Pericycle cells are smaller than endodermis cells. Xylem is 12-15 strands. There are large and oval shaped parenchyma cells in the pith.

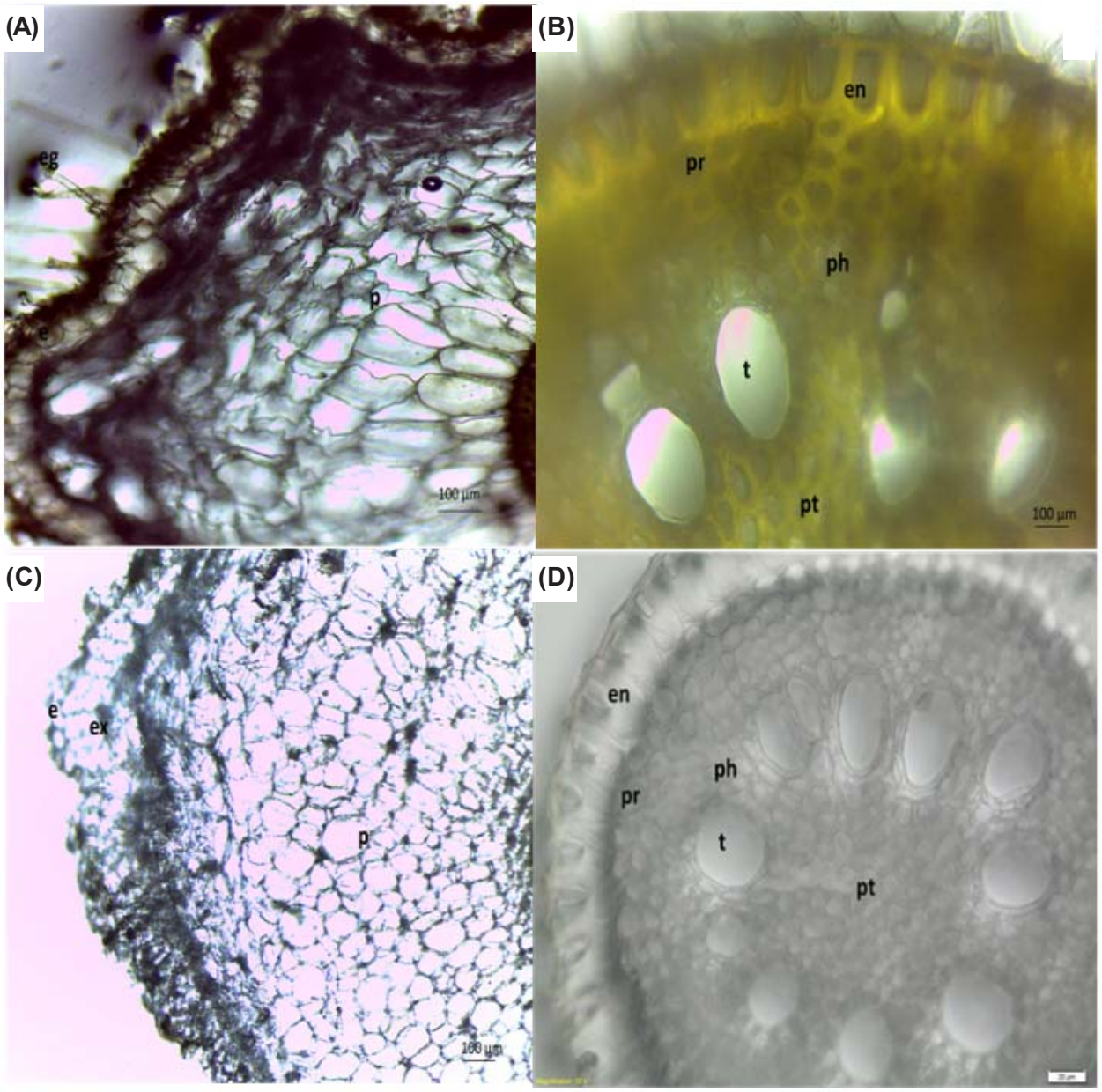

Figure 2 - The root cross-sections of varieties. A, B, var. *carica*; C, D, var. *syriaca*, e, epiderma; ex, exoderma; p, parenchyma; en, endoderma; pr, pericycle; ph, phloem; t, trachea, pt, pith; eg, eglandular trichomes

***Iris unguicularis* subsp. *carica* var. *syriaca*:** In root cross-section, epidermis is single layered, with large cells and dense eglandular trichomes. Cortex parenchyma is 12-16 layered. Parenchyma cells are very large, oval and cylindrical shaped (Figure 2C). The margins of these cells are not undulated, but straight. In the cortex, idioblasts are observed. Endoderm is single layered and parenchymatic. Endodermis cells are large. The thickening in endodermal cells are three sided, very evident and oriented to pericyle. There is no thickening towards cortex. Pericycle occurs from large, oval shaped and 1-2 layered parenchymatic cells. Endodermis cells are larger than pericycle cells. Xylem has 12-16 strands. In the pith region, there are large, oval and hexagonal shaped parenchyma cells (Figure 2D).

Anatomical characteristcs of the scapes

***Iris unguicularis* subsp. *carica* var. *carica*:** Cuticle is thin. Epidermis is single layered, large and square shaped. Papillae and micropapillae are seen over the epidermis and cuticle, respectively. There is lacunal collenchyma under epidermis which is 1-3 layered. Cortex contains

either oval or circular shaped and large or small parenchyma cells (Figure 3A). Parenchymatic cells are multilayered. Parenchyma cells in the cortex and pith are filled with dense granule-like matters or idioblasts and rare styloids. Large and small vascular bundles are located disorderly in cortex and central cylinder. The xylem and phloem elements are apparent in the vascular bundles (Figure 3B). Xylem elements are in arch-shaped. There are sclerenchyma cells at the phloem pole of vascular bundles. Bundle sheath is not obvious. The pith consists of large, thin walled and rounded shaped parenchymatic cells.

***Iris unguicularis* subsp. *carica* var. *syriaca*:** Epidermis is single layered, large and square shaped. The cuticle is thin in the cross-section of scape. Lacunal collenchyma is 3-5 layered. The papillae and micropapillae are seen over the epidermis and cuticle, respectively. Cortex is composed of oval or circular shaped and large parenchyma cells (Figure 3C). The cortex is 10-13 layered. There are dense granule-like matters or idioblasts in the cortex parenchyma cells. Vascular bundles are disordered. In the cross-section of scape, there are large and small vascular bundles (Figure 3D). In the phloem pole of vascular bundles have dense sclerenchyma. Bundle sheath consists of one layered, and thin walled parenchymatatic cells. The parenchyma cells in the pith are large and rounded.

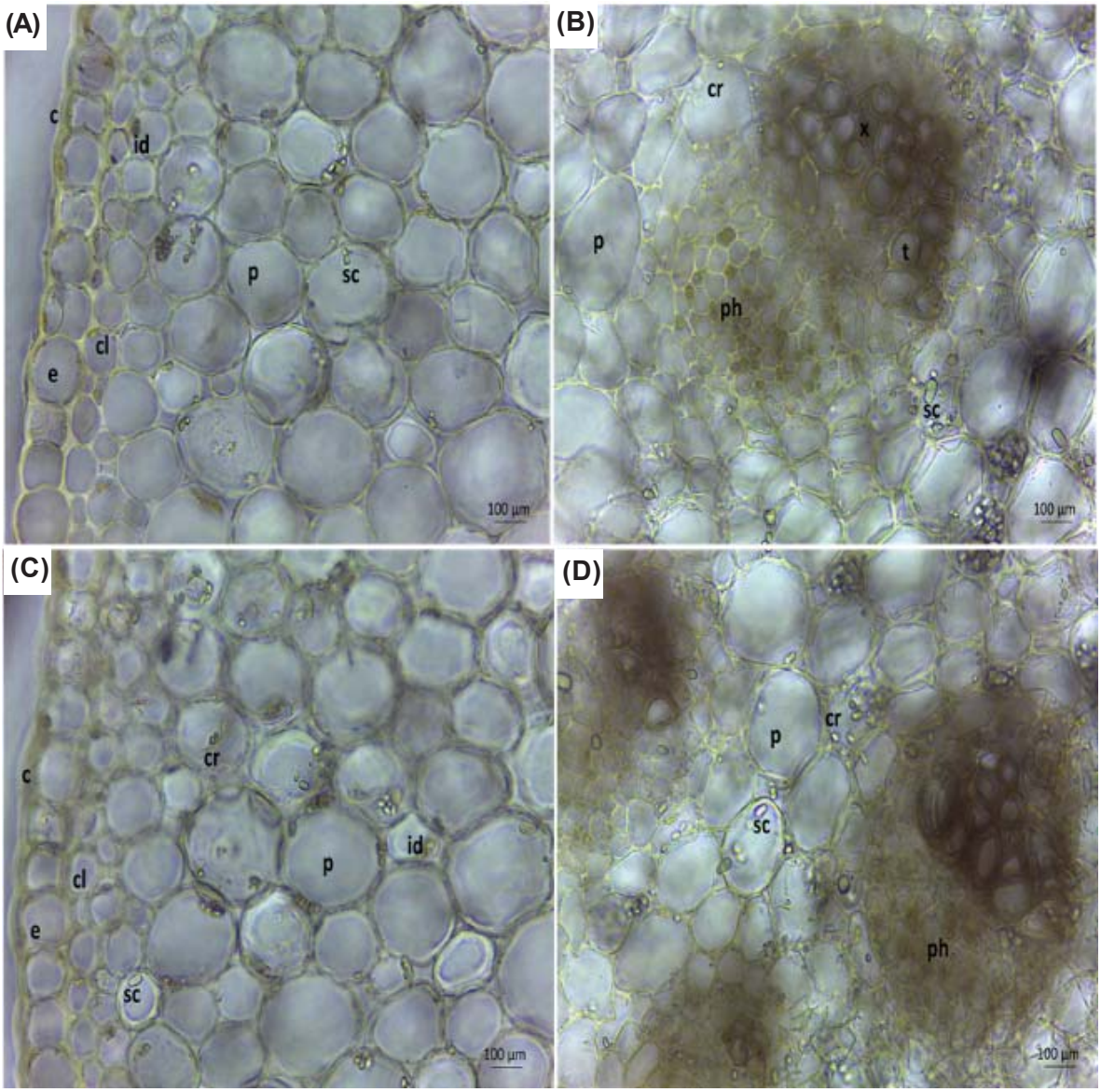

Figure 3 - The scape cross-sections ofvarieties. A, B, var. *carica*; C, D,var. *syriaca*, c, cuticle; e. epiderma; cl, collenchyma; p, parenchyma; sc, styloids; cr, crystalline granules; ph, phloem; x; xylem, t, trachea; id, idioblasts

Anatomical characteristcs of the leaves

***Iris unguicularis* subsp. *carica* var. *carica*:** Leaf is isobilateral ensiform type. Cuticle is very thick in both lower and upper epidermises. Both epidermises cells are single layered, large celled and square shaped. Epidermis cells and cuticle layer include papillae and dense micropapillae, respectively. Micropapillae on the cuticle layer are extremely conspicuous. Palisade-like parenchyma is 1-2 layered and small-cylindrical shaped. Spongy-like parenchyma is 3-5 layered. The mesophyll cells in the center are large, circular shaped and without chlroplast. There are large cavities in the mesophyll. Vascular bundles are in single row on each side of the leaf (Figure 4A). Large vascular bundles are at margin (large marginal bundles) and keel base (large keel bundles). Small vascular bundles present in the mesophyll regions between two large keel bundles. There is a large marginal vascular bundle at the corner of leaves. Xylem of vascular bundles is directed towards the leaf center. Phloem of vascular bundles is directed towards the lower and upper epidermises. The phloem and xylem elements are observed clearly. The bundle sheath is clear. There are marginal sclerenchyma cap only at phloem pole of large and small vascular bundles and at the leaf margin **(**Figure 4B). The sclerenchma cap is V-form and extends towards epidermis. In the xylem pole has large oval shaped parenchymatic cells without chloroplast. Stomata are rather below the epidermis cells. Each stoma is large, dense and ordered (Figure 5A). In mesophyll and both epidermises, crystalline granules are dense. But, styloids are rare in mesophyll. The keels in both epidermises are more clearer and little rounded. The leaf parts in the regions between keels are narrow, and keels in the epidermis are dense.

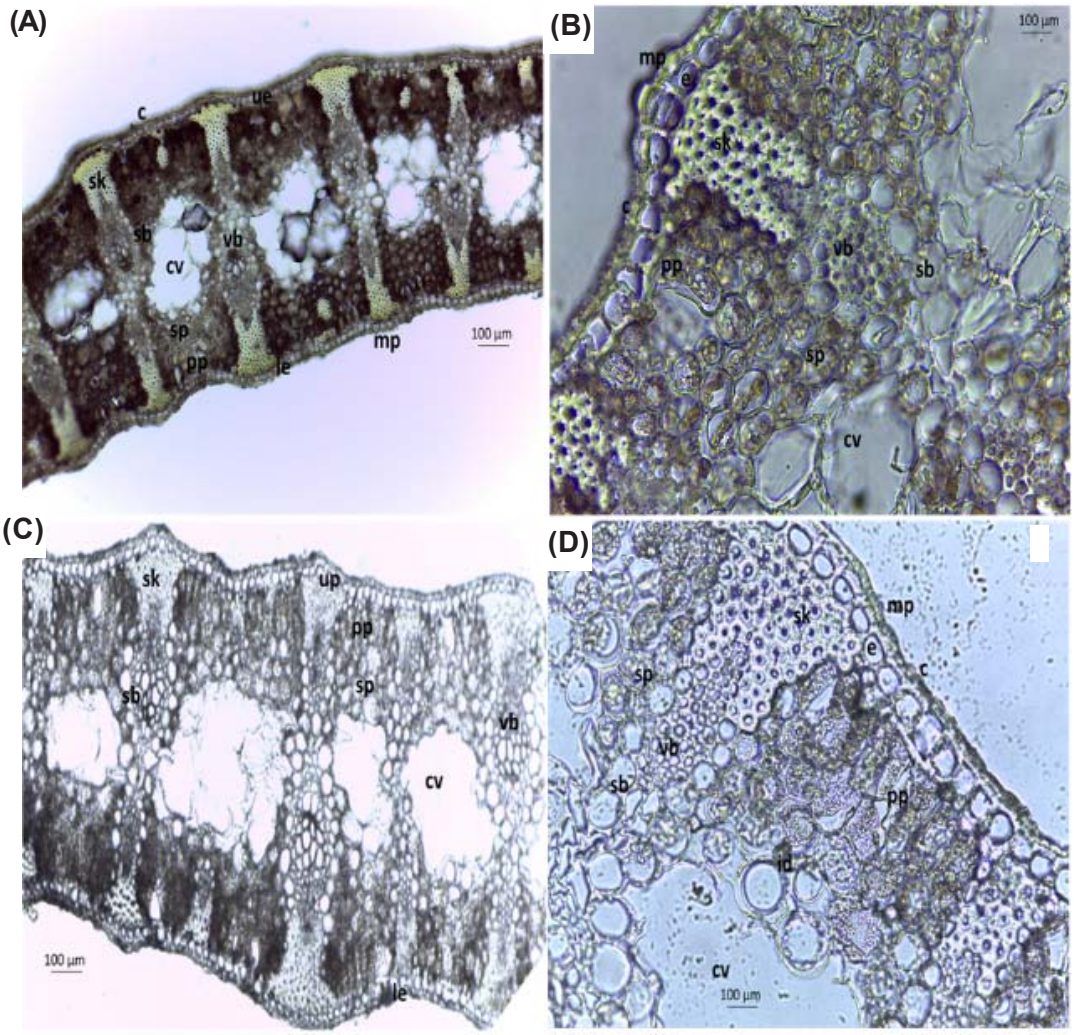

Figure 4 **-** The leaf cross-sections of varieties. A, B, var. *carica*; C, D,var. *syriaca*, c, cuticle; ue, upper epiderma; pp, palisade parenchyma; sp, spongy parenchyma, vb, vascular bundles; sb, sheath bundle; sk, sclerenchyma; le, lower epiderma; mp, micropapillae; cv, cavities.

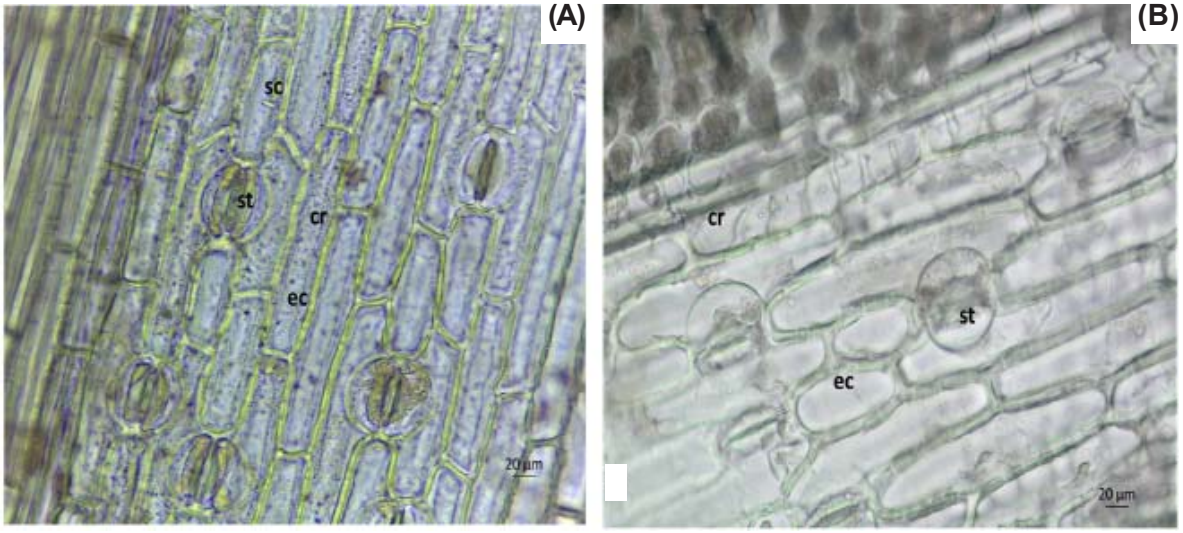

Figure 5 **-** The leaf surface-sections of varieties. A, var. *carica*; B,var. *syriaca*, ec, epidermis cell; cr, crystalline granules; st, stoma cell; sc, styloids.

***Iris unguicularis* subsp. *carica* var. *syriaca*:** Leaf is in isobilateral type (Figure 4C). Upper and lower epidermises cells are square shaped, large, single layered and with papillae. Cuticle layer is thick and conspicuous micropapillae. The side walls of upper and lower epidermises cells are undulated. Bulliform cells are rare. Stomata are frequent in both epidermises and are of amaryllis type (Figure 5B). Stomata are rather below the epidermis cells (xeoromorphic structure). Mesophyll contains rounded or radially elongated parenchyma cells. There is palisade-like parenchyma in the outermost layer and is 1-2 layered in the upper and lower epidermises. These cells are with dense chloroplast. The spongy-like parenchyma in the innermost is 4-5 layered, oval shaped and with less chloroplast. The large cavities and large parenchyma cells are in the centre of mesophyll (Figure 4D). Crystalline granules and styloids are less in number in the mesophyll. However, crystalline granules are dense in the epidermis cells. Vascular bundles are located as two circles and in pairs opposite to each other. Large vascular bundles are at margin (large marginal bundles) and keel base (large keel bundles). Small vascular bundles are present in the mesophyll regions between two large keel bundles. Phloem and xylem elements are obvious. Vascular bundles contain bundle sheath, which has one layered and thin walled parenchymatous cells without chloroplast. There are dense sclerenchyma cap at phloem pole and at the leaf margin. The sclerenchma cap is V-form and almost adjacent to epidermis. There are parenchyma cells, which are large, oval shaped and without chloroplast, at xylem pole of vascular bundles. The keels in the lower and upper epidermises are less obvious and little rounded.

Physical and chemical characters of the soil samples

***Iris unguicularis* subsp. *carica* var. *carica*:** It is an endemic to Turkey with limited distribution and vulnerable. Its soil characteristics are based on four localities (A1, A2, A3 and A4) in Mugla. The salinity contents of the soil samples were 536-616 ms cm^{-1}. The pH and $CaCO_3$ values were 6.65-6.93 and 0.071-0.078% respectively. The soil samples had loamy and loamy-sandy texture (Table 4). While the N and organic matter contents were between 2.76-2.82% and 4.54-4.65% respectively, the P and K contents were between 1.36-1.46 kg da^{-1} and 45.126-45.379 kg da^{-1} respectively. The Ca, Mg and Cu contents of soil samples ranged between 3220-3228, 254.1-254.9 and 0.629-0.640 ppm in order, while the Zn, Mn, Na and Fe contents of soil samples ranged between 0.748-0.753, 4.201-4.208, 19.499-19.521 and 25.48-25.54 ppm, respectively.

***Iris unguicularis* subsp. *carica* var. *syriaca*:** It is not an endemic species to Turkey but has limited distribution in Turkey. Soils samples were taken from 2 different localities (B1 and B2) in Hatay and Osmaniye. The soil samples in B1 and B2 localities have sandy texture structure. The pH values varied from 6.99 to 7.69. The total salinity of soil samples was between 320 and 390 µs cm^{-1}. The level of $CaCO_3$ concentration was 52.60-59.12%. The organic matter, N, P and K

Table 4 - Physical and chemical properties of soil samples (A: *I. unguicularis* subsp. *carica* var. *carica*, B: *I. unguicularis* subsp. *carica* var. *syriaca*)

Locality code	Texture	EC ($\mu s\ cm^{-1}$)	Saturation (%)	$CaCO_3$ (%)	pH	Organic matter (%)	N (%)	P_2O_5 (kg da^{-1})	K_2O (kg da^{-1})	Ca (ppm)	Mg (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Na (ppm)
A1	loamy	616	91.3	0.078	6.93	4.62	2.80	1.46	45.126	3226	254.5	0.637	25.53	4.203	0.751	19.519
A2	Loamy-sandy	590	90.5	0.074	6.83	4.65	2.82	1.36	45.211	3228	254.2	0.638	25.51	4.208	0.748	19.510
A3	Loamy-sandy	536	88.5	0.075	6.65	4.54	2.76	1.38	45.379	3225	254.1	0.629	25.48	4.201	0.753	19.521
A4	Loamy-sandy	540	89.3	0.071	6.98	4.56	2.79	1.43	45.347	3220	254.9	0.640	25.54	4.210	0.750	19.499
Mean±Sd		570.5± 33.8	89.9±1.07	0.07±0.002	6.84±0.12	4.59±0.04	2.79±0.02	1.4±0.04	45.2±0.10	3224±2.94	254±0.31	0.63±0.004	25.5±0.02	4.23±0.04	0.75±0.002	19.5±0.008
B1	sandy	390	57.2	59.12	7.69	2.51	2.70	1.15	35.99	7902	370.9	0.601	1.781	0.708	0.317	21.212
B2	sandy	320	55.9	52.60	6.99	3.45	1.30	1.50	32.56	6790	346.2	0.480	2.078	0.935	0.738	19.87
Mean±Sd		355±35	56.5±0.65	55.8±3.26	7.34±0.35	2.98±0.47	2.0±0.70	1.32±0.17	34.27±1.71	7346±556	358.5±12.35	0.54±0.06	1.93±0.15	0.85±0.07	0.52±0.21	20.54±0.67

values of soils ranged between 2.51-3.45%, 1.30-2.70%, 1.15-1.50 kg da^{-1} and 32.56-35.99 kg da^{-1}, respectively (Table 4). The Zn, Mn, Na and Fe values were 0.317-0.738, 0.708-0.935, 19.87-21.21 and 1.781-2.078 ppm, while the Ca, Mg and Cu values were 67.90-7902, 346.2-370.9 and 0.480-0.601 ppm, respectively.

The taxon *I. unguicularis* subsp. *carica* has been divided into two varietiesi.e. *I. unguicularis* subsp. *carica* var. *carica* and *I. unguicularis* subsp. *carica* var. *syriaca* (Güner et al., 2000, 2012) based on the leaf width measurements. Here in this study, we observed some other distinctive morphological characters between both varieties like; plant size, root length and width, leaf length and width, perianth tube, fall, standard, fruit and bract length, fall and standard width and structure, flower colour. These morphological characters are of important taxonomic values, between both the varieties (Table 1). Other morphological characters were very similar in the investigated two varieties. We further observed that both the varieties are found in different localities in Turkey and reveal that differences in morphological properties of the same species collected in different localities are specific to ecological conditions.

In root and leaf anatomical characters of the two varieties, some different characters such as; length and width of epidermis and cortex cells, diameter of pith cells, length of endodermis cells, the layer number of cortex, margin structure of cortex cells, number of xylem strands, layer number of pericycle, density and size of stomata, density of crystal granules, length and width of palisade-like parenchyma cells, status of keels, thickness of cuticle, diameter of trachea, whether the side walls of the upper and lower epidermises cells are undulated, presence and absence of bulliform cells and density of micropapillae are observed (Tables 2 and 3). The above situation was also found in root and leaf anatomical characters of some *Iris* taxa by Kandemir and Çelik (2017). In the cross-sections of leaf, the keels in the lower and upper epidermises of var. *syriaca* were less obvious. However, the keels in both epidermises of var. *carica* were clearer. We think that these characters may be used as distinguished taxonomic characters in the classification of these varieties. Nikolic and Mitic (1991) pointed out that leaf anatomical characters could also be a significant diagnostic charaters for some *Iris* species. Similarly, Rudall (1994) reported that leaf anatomical characters are significant for classification of the family. On the other hand, the quantity and shape of sclerenchyma cap (V-form) in the vascular bundles are very interesting in the taxa of *Limniris* subgenus. This type of sclerenchyma was obtained in the leaf of *Iris pseudacorus* L. by Gontova and Zatylnikova (2013). Rudall (1991) reported that the amount of sclerenchyma varied among species. We think that shape of sclerenchyma cap and presence of keel in both epidermises are of taxonomic value among subgenera of *Iris* genus. So, taxa belonging to *Limniris* subgenus may be easily distiguished from other taxa of *Iris* genus. The similar status was found in the vascular bundles of *I. pseudacorus* and *I. sibirica* leaves by Gontova and Zatylnikova (2013). Although some distinguishing anatomical characters e.g., diameter of epidermis cells, layer number of lacunal collenchyma and whether the bundle sheath was obvious are identified in the scapes of investigated varieties, but most characteristics are similar in the scape of both varieties.

Xeromorphic leaf characters like stomata below the epidermal cells, mesophyll in isobilateral structure, vascular bundles with dense sclerenchyma are observed. Sclerenchyma are also found on the margin of the leaf, extending to the epidermis as girders. The xeromorphic leaf characters are also found in other taxa of Iridaceae (Rudall and Mathew, 1990; Rudall, 1991; Kandemir, 2015; Kandemir and Yakupoglu, 2016). Mitic and Liber., (2000) reported that the anatomical

characters are closely related to the climatic conditions, especially the xeromorphic or mesomorphic aspect of the habitate.

In leaves of both varieties, V-form sclerenchyma cap extends to the epidermis, a character found in some species of *Tigridieae* (Iridaceae) and Iridaceae by Rudall (1991, 1994). However the sclerenchyma cap does not extend to epidermis in some taxa of Iridaceae. Since leaf margin structures are different in the taxa of Iridaceae, these characters are reported to be significant in generic groupings of Iridaceae taxa by Rudall and Goldblatt (1991). In these varieties, dense both marginal sclerenchyma and subepidermal marginal sclerenchyma are found on the margins and the corner of leaves, respectively. Leaves margin structures of both varieties are similar, but this character can be used to distinguish genera and subgenera of Iridaceae. Styloids and idioblasts in different shapes were seen in *Iris* taxa by Rudall (1994). Wu and Cutler (1985) emphasized that variations in styloids size and shape are significant among *Iris* taxa. However, similar idioblast, crystal granules and styoloids are seen in the root, scape and leaf of both varieties. Therefore, these charactres are not important in distinguishing of the two varieties.

Soil analysis revealed that *I. unguicularis* subsp. *carica* var. carica prefers slightly saline, loamy-sandy and loamy soils, while *I. unguicularis* subsp. *carica* var. *syriaca* disrtibutes in saltless and sandy soils. It was found that some *Iris*, *Crocus* L. and *Scilla* L. taxa (Kandemir et al., 2011, 2012; Kandemir, 2016; Kandemir et al., 2018) prefer loamy and loamy-sandy soils because the drainage of these types of soils is good. The *var. syriaca* grows usually in slightly alkaline and neutral soils, while var. *carica* grows in neutral soils. It is shown in Table 4 that var. *carica* grows at low calcareous soils and var. *syriaca* grows at high calcareous level soils. The same states are found in some *Crocus* and *Iris* taxa by Kandemir et al., (2011, 2012) and Kandemir (2016). The investigated taxa prefer rich organic matter and nitrogen soils. It was reported that some *Iris* taxa (Kandemir et al., 2011) grow in soils with rich levels of organic matter and nitrogen. However, soil P contents of both the varieties are found to be at deficiency levels. This state may occur, since P is rather phloem-immobile ion and stored in the form of insoluble form (calcium-phosphate) in soil. And, also in alkaline soils, pH affects the nutrient element intake of plants. In such soils, $CaCO_3$ contents increase and this increase cause low P contents (Özdemir and Öztürk, 1996). Therefore, plants cannot get any benefit from P. K, Ca, Cu, Mg, Mn, Fe and Zn contents of the varieties are in sufficient amount in all soil samples. It was reported that K, Cu, Mg, Mn, Fe, Zn and contents of soils where some *Iris* and *Crocus* taxa grow are generally enough (Kandemir et al., 2011, 2012). K is very phloem-mobile ion. Sodium (Na) contents of both varieties are low in all localities. While CO_3, Ca and Mg contents are high in the var. *syriaca*, Fe and Mn contents are high in the var. *carica*. The difference has seen among CO_3, Ca, Mg Fe and Mn contents of var. *syriaca* and var. *carica*, but there is no other difference between other ecological properties. Therefore, var. *syriaca* and var. *carica* are close ecological taxa. On the other hand, minor differences in some ecological characters are observed. The reason of differences in these ecological characters may be due to their exposure to various ecological and climatic factors in the distribution areas of these *Iris* taxa.

In conclusion distinguishing morphological and anatomical characters to taxanomic values are determined in both varieties. Additionally, some similar morphological, anatomical and ecological characters were found in these varieties. Specially, both the varieties can be distinguished by the root, scape and leaf anatomical characters. As a result, we suggest that these two varieties should be promoted to subspecies category related to the differences in morphological, anatomical and ecological characteristics. In order to confirm the data, it is required to get more detailed studies on both varieties. Although there is plenty of knowledge in the literature, it is reported that this knowledge is not sufficient to figure out the relationships between sections in the subgenera of *Iris* genus (Wilson, 2011; Guo and Wilson, 2013).

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