

1-1-2004

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OCAK, ATİLA; ALAN, SEVİM; and ATAŞLAR, EBRU (2004) "Morphological, Anatomical and Ecological Studies on *Tulipa armena* Boiss. var. *lycica* (Baker) Marais (Liliaceae)," *Turkish Journal of Botany*. Vol. 28: No. 4, Article 6. Available at: <https://journals.tubitak.gov.tr/botany/vol28/iss4/6>

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Morphological, Anatomical and Ecological Studies on *Tulipa armena* Boiss. var. *lycica* (Baker) Marais (*Liliaceae*)

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Received: 28.07.2002

Accepted: 28.01.2003

Abstract: This study presents investigations into the morphological, anatomical and ecological features of *Tulipa armena* Boiss. var. *lycica* (Baker) Marais. *T. armena* var. *lycica*, an endemic species which was collected from the Eskişehir, Alpu-Bozan plantation area and from Kunduzlar Dam and its environs. The species is a new record for Eskişehir. For morphological studies a description and illustrations of *T. armena* var. *lycica* are given. The morphological differences were compared with the Flora of Turkey. For anatomical studies, cross-sections of the root, stem and leaves and surface sections of the leaves of *T. armena* var. *lycica* are investigated for the first time. Furthermore, for ecological investigations, the chemical and physical properties of the soil are analysed. The climate of Eskişehir and other climatic features are also given.

Key Words: *Tulipa armena* var. *lycica*, endemic, morphology, anatomy, ecology

Tulipa armena Boiss. var. *lycica* (Baker) Marais (*Liliaceae*) Üzerinde Morfolojik, Anatomik ve Ekolojik Çalışmalar

Özet: Bu çalışmada *Tulipa armena* Boiss. var. *lycica* (Baker) Marais'in morfolojik, anatomik ve ekolojik özellikleri araştırılmıştır. Endemik bir tür olan *T. armena* var. *lycica*, Eskişehir Alpu-Bozan ağaçlandırma sahasından ve Kunduzlar Barajı çevresinden toplanmıştır. Tür Eskişehir için yeni kayıt niteliği taşımaktadır. *T. armena* var. *lycica*'nın morfolojik özellikleri incelenmiş ve farklılıklar Flora of Turkey ve diğer çalışmalar ile karşılaştırmalı olarak verilmiştir. Anatomik çalışmalar için bitkinin kök, gövde, yaprak enine kesitleri ile yaprak yüzeysel kesitleri incelenmiş ve sonuçlar verilmiştir. Ekolojik çalışmalarda *T. armena* var. *lycica*'nın yetiştiği toprağın kimyasal ve fiziksel özellikleri ile Eskişehir'in iklimsel özellikleri verilmiştir.

Anahtar Sözcükler: *T. armena* var. *lycica*, endemik, morfoloji, anatomi, ekoloji

Introduction

The genus *Tulipa* L. belongs to the family *Liliaceae* and is represented by 16 taxa (15 species), of which 2 are endemic in Turkey (Davis, 1984, 1988; Özhatay, 2000). *Tulipa armena* Boiss. var. *lycica* (Baker) Marais is an endemic species (Davis, 1984). *T. armena* var. *lycica* is a new record from Eskişehir and is a rare taxon. A taxonomic revision of the genus *Tulipa* in India and adjoining regions was performed by Dasgupta & Deb

(1985). Other investigations have been carried out into *Liliaceae* and *Iridaceae* by Özyurt (1978).

The genus *Tulipa* has attractive flowers and has been widely used as an ornamental plant. Various local Turkish names are used for *Tulipa* species. Some of these are "Türk lalesi", "Halep lalesi", "Bodur lale", "Çoban lalesi", "Amasya lalesi" and "Trakya lalesi" (Baytop, 1994).

There have been no anatomical and ecological studies of the *Tulipa* species naturally distributed in Turkey.

Materials and Methods

Tulipa armena Boiss. var. *lycica* (Baker) Marais was collected from the Eskişehir, Alpu-Bozan plantation area and from Kunduzlar Dam and its environs. Specimens for morphological studies were dried according to standard herbarium techniques and stored at the Osmangazi University Herbarium (OUFE 9052). The materials necessary for anatomical studies were preserved in 70% alcohol.

The taxonomic description of the plant was made according to Davis (1984) and also confirmed by the herbarium samples of the examined species in ANK and GAZI. The morphological illustrations were drawn with a Wild M5A stereomicroscope.

Anatomical investigations were performed on the cross-sections of the root, stem and leaves, and on the surface sections of leaves. The cross and surface sections were covered with glycerin-gelatin (Vardar, 1987). The drawings were made by means of a camera lucida of a Leitz SM-LUX binocular microscope. The photographs were taken from Olympus CH40, diagnostic digital camera (SPOT insight clour 3.2.0).

Soil textures were determined by the Bouyoucus hydrometer method (Bouyoucos, 1955). Soil pH, CaCO₃ (%) and total salinity (%) were determined with a Beckman pH meter, a Scheibler calcimeter and conductivity bridge apparatus, respectively (Jackson, 1958; Nehring, 1960). Organic matter (%) and nitrogen (%) were determined by the Walkley-Black and micro-Kjeldahl methods, respectively. Phosphorus (%) was determined by using the ammonium molybdate-stannous chloride method following extraction by ammonium fluoride in hydrochloric acid. Potassium (%) was determined by an Eppendorf photometer (Petri & Wagner, 1978; Steubing, 1965).

Morphological Results

Perennial, 15-40 cm. Bulbs spherical, 3-4 x 1.5-2.5 cm. Tunics reddish-brown, papery, or old ones coriaceous, densely hairy with longish twisted or rippled soft hairs. Stem erect, 7-30 cm. Leaves 4, oblong-lanceolate, 7-14.5 x 0.5-3.5 cm, glaucous, glabrous or ciliate, recurved. Flowers crimson to scarlet, paler red, pinkish or yellow outside. Outer perianth segments 35-60 x 10-20 mm, ovate-elliptic, apex acute-obtuse with infrequently short hairs; inner 30-55 x 15-25 mm,

obovate-spathulate, apex retuse with infrequently short hairs. Filaments black-dark green, 7-10 mm, hairless; anthers dark, basifixed, 10-20 mm. Ovary glaucous, 10-30 mm, cylindrical, style short, stigma 3-lobed (Figure 1).

Fl. 4-6. Rocky slopes and screes, mainly 1000-2750 m.

Anatomical Results

Root

A transverse section taken from the middle part of the root was observed as follows (Figure 2).

The epidermis is composed of almost square cells. The cortex is 5-6-layered and consists of parenchyma. These parenchyma cells are irregular or oval and thin-walled. The single-layered endodermis consists of 3 thick-walled cells. The direction of these thicknesses is the cortex side. The pericycle is single-layered and thin-walled. The number of xylem ridges is 4 or 5 and these are opposite the phloem. The centre of the vascular cylinder is composed of 3 metaxylems.

Stem

A transverse section taken from the middle part of the stem was observed as follows (Figure 3).

The epidermis is composed of small orbicular cells and infrequently bears stomata. The cortex comprises parenchyma and sclerenchyma. The 4-5-layered parenchyma consists of oval or orbicular cells and is on the outer side of the cortex. The sclerenchyma is 4-5-layered and is on the inner side of the cortex. The vascular bundles are more numerous in the vascular cylinder.

Leaf

The transverse section of the lamina and the mid-rib and surface preparations of both epidermises revealed the following elements (Figures 4 and 5).

In transverse section, the upper and lower epidermises comprise uniseriate, almost square and orbicular cells. The cells of the upper epidermis are larger than those of the lower epidermis. Both epidermises are covered with a thick cuticle. The stomata occur on the surfaces of both sides, being more abundant on the lower surface. They are located on the same level and contact with 4 neighboring cells. The leaf is isobilateral. The mesophyll consists of 9-11-layered cells, oval or slightly

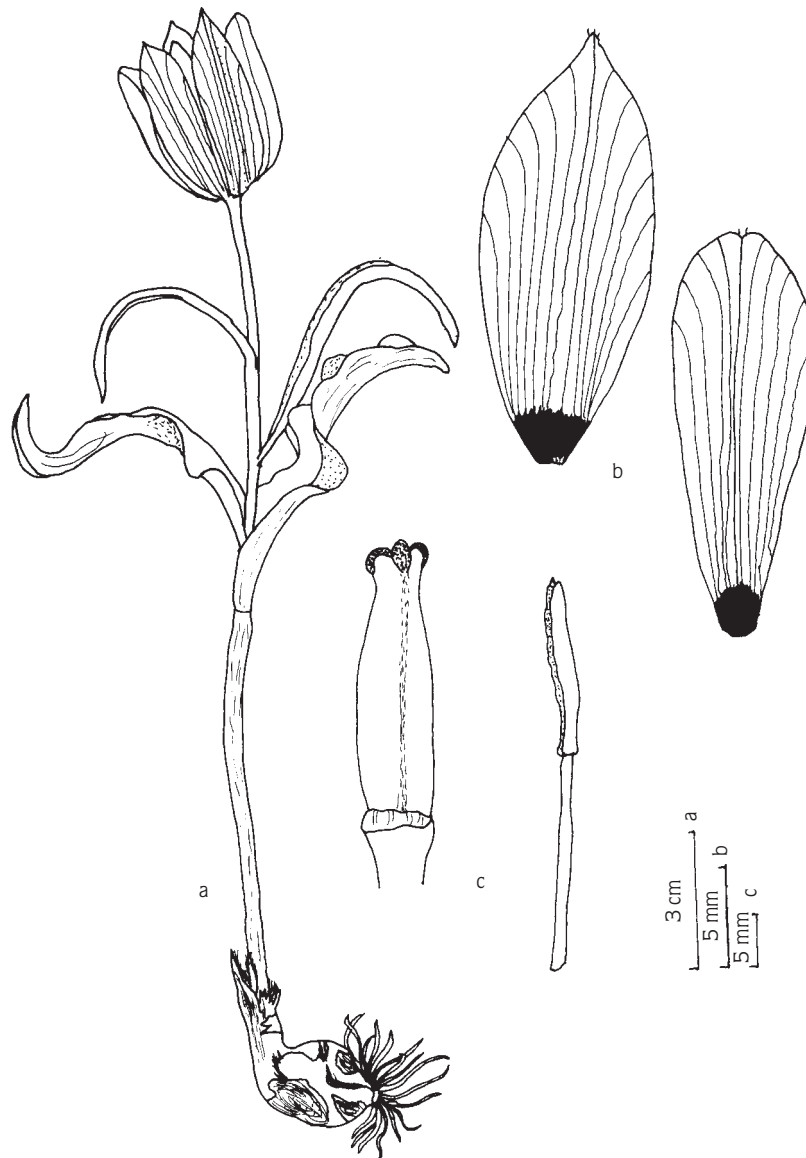


Figure 1. *Tulipa armena* var. *lycica* a) Habit, b) Inner and outer segments of perianth, c) Ovary and stamen.

elongated. Vascular bundles are uniseriate and of different sizes in the mesophyll.

Ecological Results

Climate

The climate of Eskişehir seems to be a transitional climate type between the West Anatolian climate and the Inner Anatolian climate. In the city there is generally a

harsh and terrestrial climate. The wide plains, such as Porsuk and Upper Sakarya, which lie between the mountains and extend from east to west, are 800-1000 metres high. The city is surrounded by mountains in the north and south and by high plateau in the west. While this situation impedes the effect of the Mediterranean and Black Sea climates on the city, it allows, albeit only slightly, the West Anatolian climate to permeate into the city (Tables 1 and 2; Figure 6).

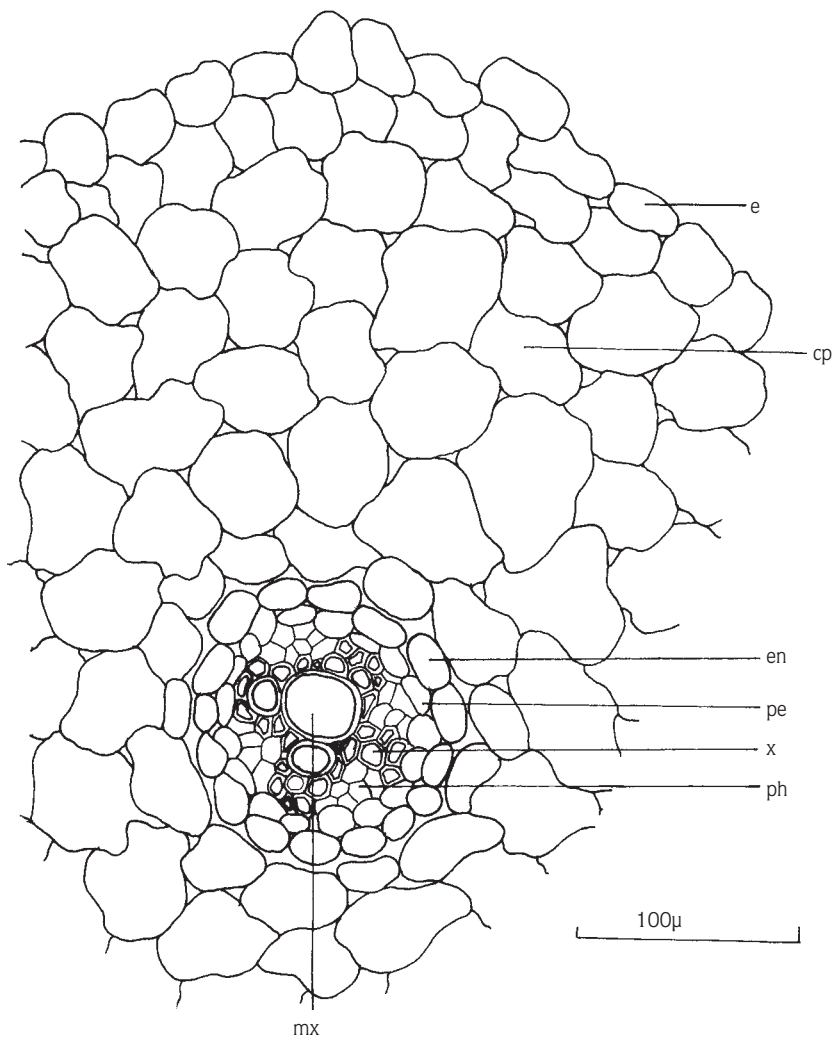
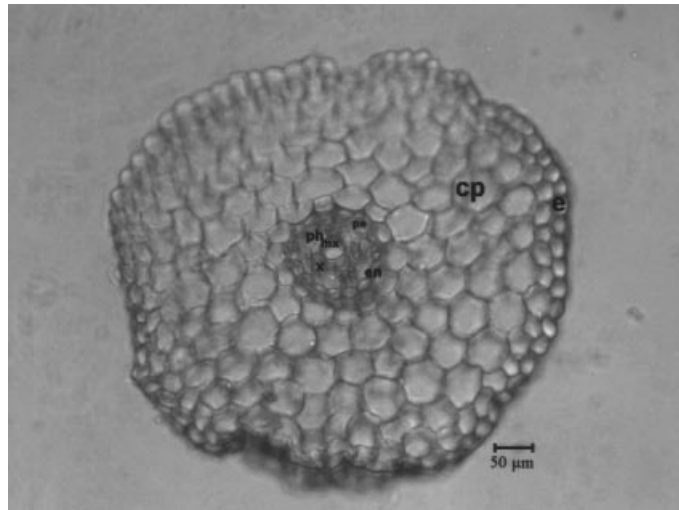


Figure 2. *Tulipa armena* var. *lycica* cross-section of root: e) Epidermis, cp) Cortex parenchyma, en) Endodermis, pe) Pericycle, x) Xylem, ph) Phloem, mx) Metaxylem.

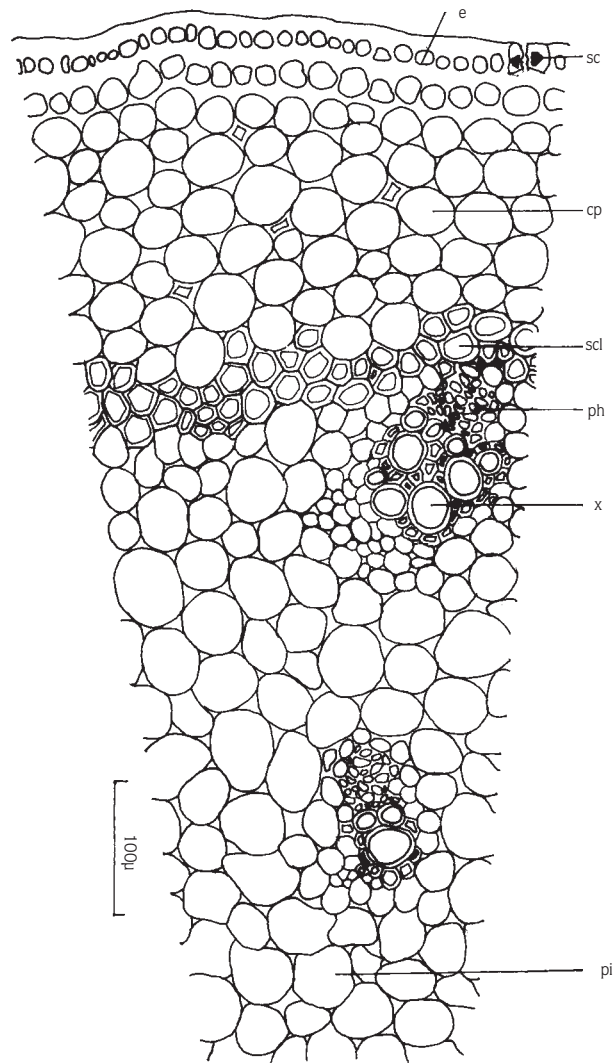
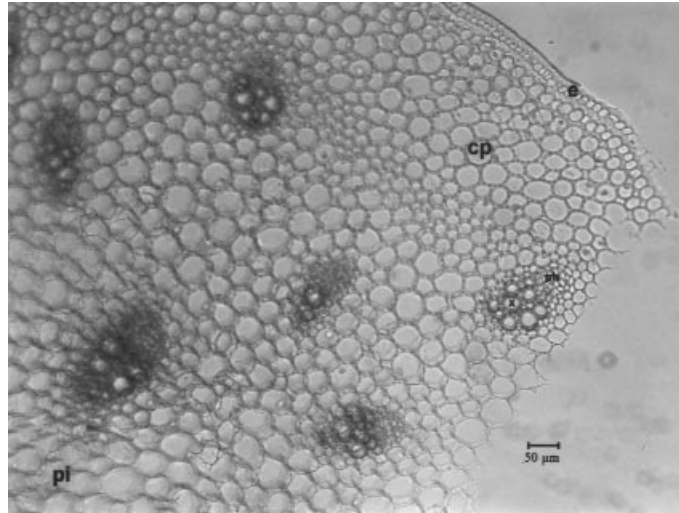


Figure 3. *Tulipa armena* var. *lycica* cross-section of stem: e) Epidermis, sc) Stoma cell, cp) Cortex parenchyma, scl) Sclerenchyma, ph) Phloem, x) Xylem, pi) Pith.

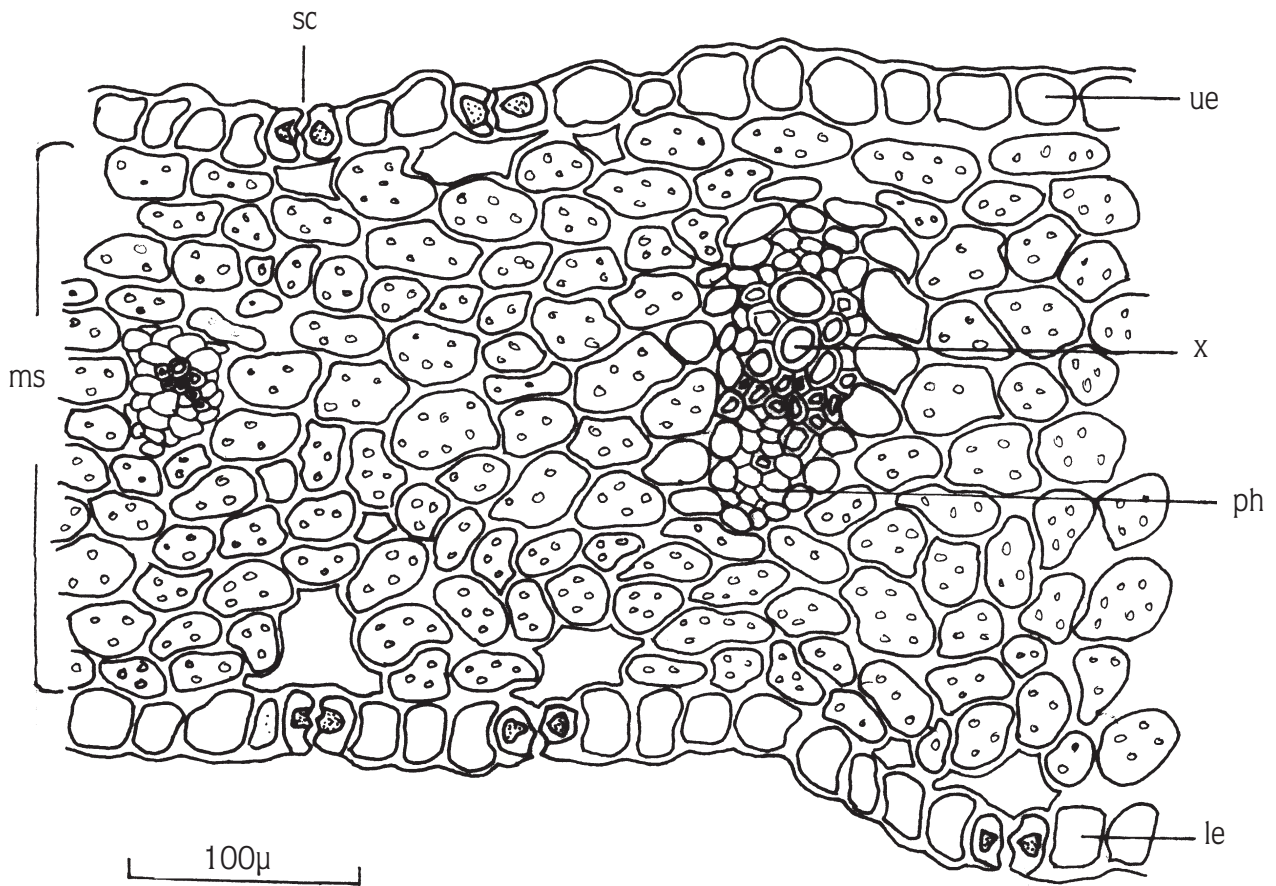
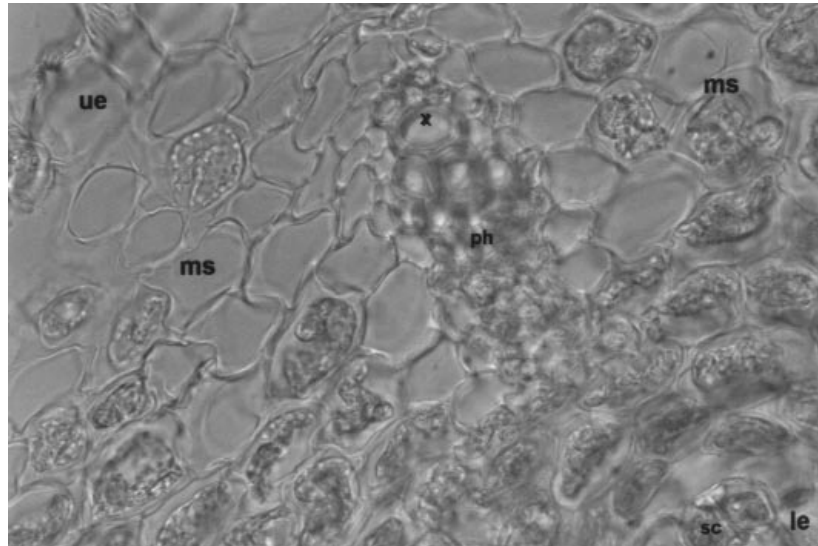


Figure 4. *Tulipa armena* var. *lycica* cross-section of leaf: ue) Upper epidermis, le) Lower epidermis, sc) Stoma cell, x) Xylem, ph) Phloem, ms) Mesophyll.

Table 1. Bioclimate stratum of the study area according to Emberger's (1952) formula.

Station	Altitude	P	PE	M	m	S	Q	Bioclimate Stratum
Eskişehir	801 m	379.2	59.52	28.7	-3.7	2.1	40.9	Semi-dry Mediterranean

$S = PE/M$ (S: Value of dry season, PE: Average summer precipitation, M: Average maximum temperature of the hottest month)

$Q = 2000.P/(M + m + 546.4) \cdot (M - m)$ (Q: Comparison of temperature-precipitation, P: Total annual precipitation, M: Average maximum temperature of the hottest month, m: Average maximum temperature of the coldest month)

Table 2. Annual precipitation (mm) according to the seasons and precipitation regime data from Eskişehir Meteorology Station.

Spring	Summer	Autumn	Winter	Annual	Precipitation	Regime
Eskişehir	120.68	59.52	74.31	124.67	379.2	W.S.F.S.

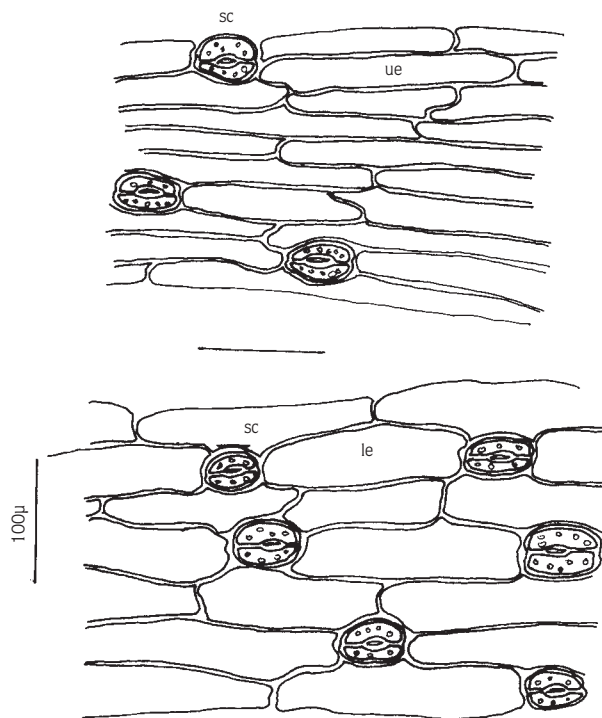


Figure 5. *Tulipa armena* var. *lycica* surface-section of leaf: ue) Upper epidermis, le) Lower epidermis, sc) Stoma cell.

Soil

In this study, chemical and physical features of the soil on which the species grow naturally were investigated (Table 3).

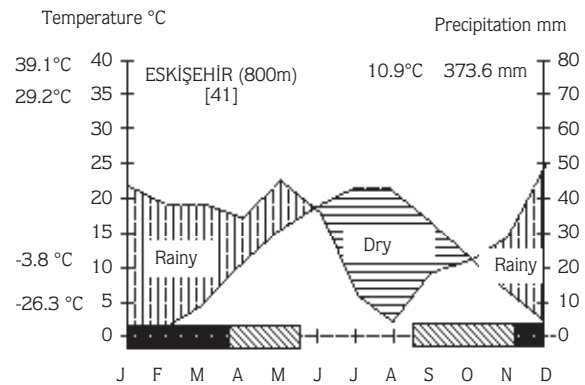


Figure 6. Graph of temperature and precipitation data in Eskişehir.

Discussion

In this research, *Tulipa armena* var. *lycica* is a new record from Eskişehir. This species has been investigated morphologically, anatomically and ecologically in order to assist in its identification and solve systematical problems.

The morphological features of *Tulipa armena* var. *lycica* were compared with Davis (1984) and Özyurt (1978) (Table 4). It was seen that some features were different from these authors.

The anatomical investigations of *Tulipa armena* var. *lycica* are reported for the first time in this study. The root, stem and leaf transverse sections and leaf surface sections were investigated. Most of the anatomical

Table 3. Chemical and physical properties of the soil.

Physical Properties				Chemical Properties					
% Sand	% Silt	% Clay	Texture Classes	pH	Total % CaCO ₃	% Organic Matter	Total % N	P ₂ O ₅ ppm	% Salt
22.65	39.49	37.86	Silt wet clay	7.85	9.30	4.07	0.42	24	0.22
Soil texture class: Silt wet clay			Soil pH class: Weak alkali		% Calcium carbonate: Mean lime				
% Organic matter: High humus			Total nitrogen: High nitrogen		Phosphorus (P ₂ O ₅): Mean/High				
% Total salt: Weak saline									

Table 4 . The comparative biometric data of *T. armena* var. *lycica*.

	Davis, 1984	Özyurt, 1978	Ocak et al., 2002
Plant size	-	24-28 cm	15-40 cm
Bulb	-	3.5-4.5 x 1.5-2 cm	3-4 x 1.5-2.5 cm
Stem	-	20-22 cm	7-30 cm
Leaf	6-20 x 1.5-3.5 cm	9.5-15 x 0.8-3.3 cm	7-14.5 x 0.5-3.5 cm
Outer perianth	23-58 x 9-27 mm	38-47 x 21-25 mm	35-60 x 10-20 mm
Inner perianth	20-45 x 7-20 mm	38-47 x 21-25 mm	30-55 x 15-25 mm
Filaments	6-12.5 mm	-	7-10 mm
Anthers	4-13 mm	-	10-20 mm
Ovary	-	-	10-30 mm
Capsule	25-45 mm	-	-

properties of *Tulipa armena* var. *lycica* resemble the general characteristics of monocotyledons (Esau, 1977).

As seen in Table 3, the physical and chemical properties of the soil in which the plant grows are: silt

wet clay, weak alkali, mean lime, high humus, high nitrogen, mean/high phosphorus (P₂O₅) and weak saline.

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