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Morphological, Anatomical and Ecological studies on the two Turkish endemic species collected from Kaz Dağı (B1 Balıkesir) “*Allium sibthorpiatum* Schultes & Schultes fil. and *Allium reuterianum* Boiss.”

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Abstract: This investigation enlightens the morphological, anatomical and ecological characteristics of Kazdağı endemics namely *Allium reuterianum* Boiss. and *Allium sibthorpiatum* Schultes & Schultes fil. (*Liliaceae*). *A. sibthorpiatum* occurs in Bursa, Kütahya, Denizli, Isparta and Çanakkale (newly recorded), whereas *A. reuterianum* is found in Southwest Anatolia, Islands, Manisa, Denizli, Muğla, Isparta and Çanakkale (newly recorded). Root anatomy of *A. sibthorpiatum* and *A. reuterianum* typically show exodermis and an empty pith. In addition in the scapes of both the species layering in the area between epidermis and cuticle results in its thickening. The leaves in both species are not hairy. Reticulate shaped open spaces are met with in the bulbs surrounded by thick walled cells formed as a result of drying. These species prefer the soils rich in nitrogen, phosphorus, potassium and organic matter.

Key Words: Endemics, Liliaceae, Allium, Morphology, Ecology.

Kazdağı'ndan Toplanan İki Türkiye Endemik Türü Üzerinde Morfolojik, Anatmik ve Ekolojik Araştırmalar (B1 Balıkesir) “*Allium sibthorpiatum* Schultes & Schultes fil. ve *Allium reuterianum* Boiss. “

Özet: Bu çalışmada Kazdağı endemik bitkilerinden *Allium reuterianum* Boiss. ve *Allium sibthorpiatum* Schultes & Schultes fil. türlerinin (*Liliaceae*) morfolojik, anatomik ve ekolojik özellikleri ortaya çıkarılmıştır. *A. sibthorpiatum* Bursa'da, Kütahya'da, Denizli'de, Isparta'da ve Çanakkale Kazdağı'nda (yeni kayıt) yetişirken *A. reuterianum* Batı ve Güneybatı Anadolu'da, Adalarda, Manisa'da, Denizli'de, Muğla'da, Isparta'da ve Çanakkale Kazdağı'nda (yeni kayıt) yetişmektedir. *A. sibthorpiatum* ve *A. reuterianum*'un kök anatomilerinde eksodermisin bulunuşu ve öz bölgesinin boş oluşu tipiktir. Ayrıca her iki bitkinin toprak üstü sürgünlerinde epidermis ile kutikula arasındaki kısmının katmanlaşma gösterecek şekilde kalınlaşması dikkat çekmektedir. Her iki türün yaprakları tüy içermemektedir. Soğanlarında kurumaya bağlı olarak oluşan kalın çeperli hücrelerle çevrelenmiş mekik şeklindeki boşluklar dikkati çekmektedir. Her iki türde azot, fosfor, potasyum ve organik maddece zengin topraklarda yetişmektedir.

Anahtar Sözcükler: Endemikler, *Liliaceae*, Allium, Morfoloji, Ekoloji.

Introduction

Genus *Allium* L. (*Liliaceae*) is represented by 152 taxa in Turkey and 56 taxa of these are endemics (36.8 %) (1). Out of 8 *Allium* taxa occurring at Kazdağı; one of the important centres of endemism in Turkey (2) ; 6 are endemics. These are *A. kurtzianum*, *A. phrygium*, *A. proponticum* var. *proponticum*, *A. flavum* subsp. *flavum* var. *minus*, *A. reuterianum* and *A. sibthorpiatum*, thus giving a ratio of 75 percent for endemic *Allium* taxa for Kazdağı. Both morphological as well as cytotaxonomical studies are being carried out on *Allium* taxa and

chromosome number of *A. proponticum* one of the Kazdağı endemics has been reported to be $2n = 16$ (3). The species dealt with here are *A. sibthorpiatum* (Sect. *Codonoprasum* Reichb.) and *A. reuterianum* (Sect. *Allium*), both have been newly recorded from Kazdağı by the author.

The aim of this original investigation is to put forth ecological and anatomical features of these species for the first time , but at the same time given detailed account of the morphological characteristics of Kazdağı endemics like *A. sibthorpiatum* and *A. reuterianum*

Material and Method

Material for *A. sibthorpiantum* was collected from Susuzdağ and for *A. reuterianum* from Tavşan Oynağı localities at Kazdağı. Herbarium samples were prepared and deposited at the Çanakkale Onsekiz Mart University (USH 325 , 326). A part of the material was fixed in 70 percent alcohol for anatomical studies of root, bulb, shoot, stem and leaf. Herbarium samples were used for morphological features and biometric studies and sections for anatomical studies were taken with the help of a sharp blade from the fixed samples and investigations were made under microscope and photographs taken by microphotography apparatus (JENA).

Soil samples collected from the localities were brought to the laboratory in the polyethylene bags, air dried and sieved by using 2 mm sieve. Maximum water holding capacity, pH, total salt, CaCO₃, texture, nitrogen, phosphorus, potassium and organic matter were determined according to the methods outlined in detail in our previous paper (4).

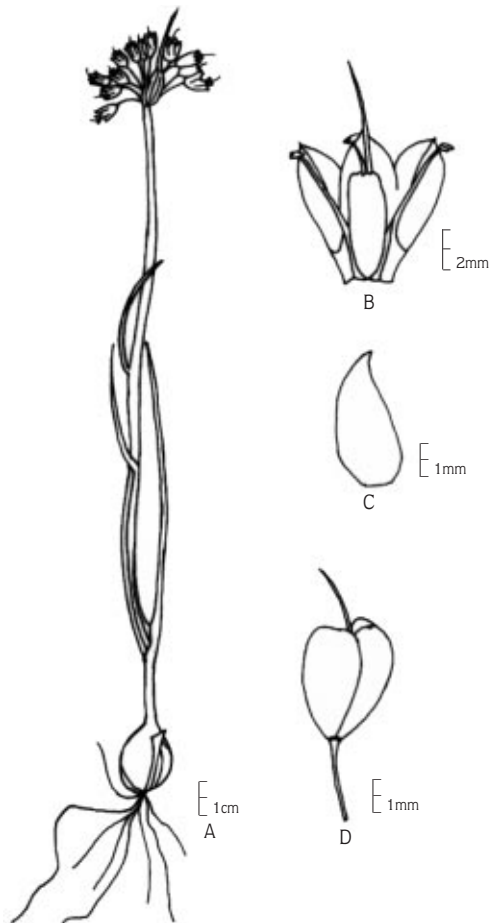


Figure 1. *Allium sibthorpiantum* A, General view; B, Flower; C, Seed; D, Fruit.

Results

Morphology and Ecology of *A. sibthorpiantum*

External Morphology

A. sibthorpiantum is a perennial bulbous herbaceous plant. It is an east mediterranean element. Morphological features of its bulb, leaf, flower, fruit and seed are outlined below.

Bulb

Egg shaped rectangular, 6.1 ± 0.6 mm in diameter (min.5.0 mm , max.7.0 mm) and 13.3 ± 2.2 mm long (min.11.0 mm, max.17.0 mm). Tunics are membranous, loosely arranged, with swelled veins, black on outside, purple inside. It possesses adventitious roots which are 0.5 ± 0.1 mm wide (min. 0.2 mm, max. 0.9 mm) and 4.7 ± 1.6 cm long (min. 2.2 cm, max. 6.8 cm) (Fig. 1A, Table 1).

Scape

Scape has parallel lines and 1.6 ± 0.2 mm wide (min. 1.4 mm , max. 2.0 mm), 8.3 ± 2.1 cm long (min. 6.4 cm, max. 12.4 cm) (Fig.1A, Table 1).

Leaf

Leaves are 1 or 2 thread shaped, tapering, cylindrical in shape, grooved, apex is blunt. They are shorter than shoot, 0.6 ± 0.2 mm wide (min. 0.4 mm, max. 1.0 mm) and 24 ± 6.3 mm long (min.15.0 mm, max.30.0 mm). Spathe has 2 valves which are unequal in length , one being longer than umbel. Valves are lance like at the base, awl shaped, apex being narrowly-long , 1.9 ± 0.7 mm wide (min. 1.0 mm, max. 3.8mm), length is 14.8 ± 4.5 mm (min. 10.0 mm, max. 21.0 mm) (Fig. 1A , Table 1).

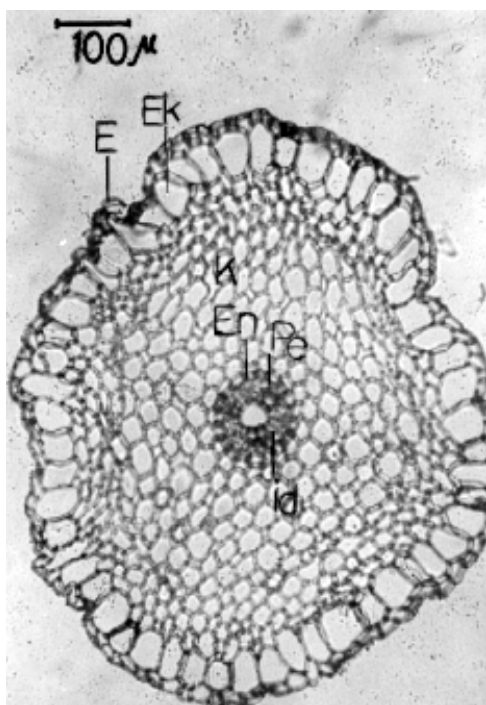
Flower

Flowers lie at the apex of above ground shoots, inflorescences have few flowers, umbels being 1.5 - 2 cm in diameter. Pedicels 10.2 ± 2.1 mm long (min.7.0 mm, max. 12.0 mm), perianth is small bell shaped, with light purple segments, pink coloured, dark mid vein, rectangular-spathulate, apex acute. Perianth lobes 2.9 ± 0.3 mm wide (min. 2.3 mm, max. 3.2 mm) and 4.5 ± 0.8 mm long (min. 4.2 mm, max. 6.1 mm). Stamens 6, anthers rectangular shaped, 0.6 ± 0.1 mm wide (min. 0.4 mm, max. 0.8 mm) and 1.1 ± 0.1 mm long (min. 0.9 mm, max. 1.3 mm), filaments pink coloured shorter than perianth lobes and 2.2 ± 0.2 mm long (min. 2.0 mm, max. 2.6 mm). Pistil 1, ovary median, 1.8 ± 0.2 mm wide (min. 1.4, max. 2.1 mm) and 2.0 ± 0.6 mm long (min. 2.0 mm, max. 3.3 mm), style 2.6 ± 0.3 mm long (min. 2.4 mm, max. 3.0 mm) (Fig.1B, Table 1).

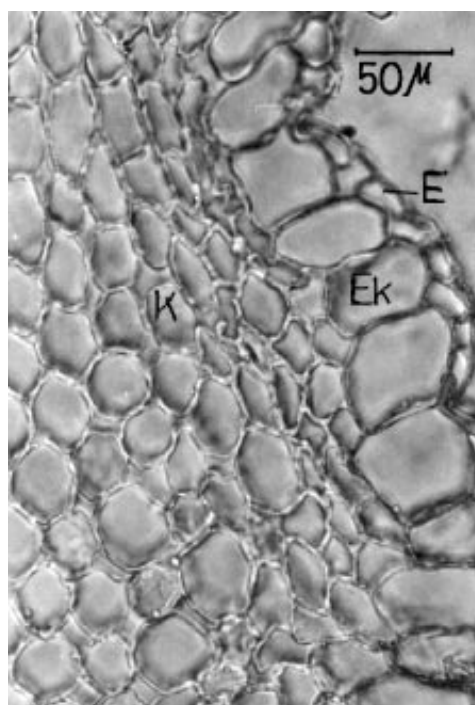
Flowering in August - September.

Tablo 1. Biometric measurements of *A. sibthorpiatum*.

Plant part		Number of measurements	Width			Length			
			Min.	Max.	Mean±S.E.	Min.	Max.	Mean±S.E.	
Leaf		30	0.4 mm	1.0 mm	0.6±0.2	15.0 mm	30.0 mm	24.0±6.3	
Valve		30	1.0 mm	3.8 mm	1.9±0.7	10.0 mm	21.0 mm	14.8±4.5	
Flower	Pedicel	30	-	-	-	7.0 mm	12.0 mm	10.2±2.1	
	Corolla	30	2.3 mm	3.2 mm	2.9±0.3	4.2 mm	6.1 mm	4.5±0.8	
		Stamen	Filament	30	-	-	-	2.0 mm	2.6 mm
	Pistil	Anther	30	0.4 mm	0.8 mm	0.6±0.1	0.9 mm	1.3 mm	1.1±0.1
		Style	30	-	-	-	2.4 mm	3.0 mm	2.6±0.3
	Ovary	30	1.4 mm	2.1 mm	1.8±0.2	2.0 mm	3.3 mm	2.0±0.6	
Root		30	0.2 mm	0.9 mm	0.5±0.1	2.2 cm	6.8 cm	4.7±1.6	
Above ground shoot		30	1.4 mm	2.0 mm	1.6±0.2	6.4 cm	12.4 cm	8.3±2.1	
Bulb		30	5.0 mm	7.0 mm	6.1±0.6	11.0 mm	17.0 mm	13.3±2.2	
Fruit		30	1.2 mm	3.0 mm	1.9±0.4	3.0 mm	6.0 mm	4.9±0.9	
Seed		30	0.9 mm	1.3 mm	1.1±0.1	2.0 mm	4.0 mm	2.6±0.6	

Figure 2. Root section of *A. sibthorpiatum*

E: Epidermis, Ek: Exodermis, K: Cortex, En: Endodermis,
Pe: Pericycle, Id: Vascular bundle

Figure 3. Epidermis and exodermis in the root section of *A. sibthorpiatum*

E: Epidermis, Ek: Exodermis, K: Cortex

Fruit and Seed

Fruit is loculicidal capsula, tri-rectangular shaped, 1.9 ± 0.4 mm wide (min.1.2 mm, max.3.0 mm), 4.9 ± 0.9 mm long (min.3.0 mm, max.6.0 mm) (Fig.1D). Seed

triangular, black, 1.1 ± 0.1 mm wide (min. 0.9 mm, max.1.3 mm), 2.6 ± 0.6 mm long (min. 2.0 mm, max. 4.0 mm) (Table 1).

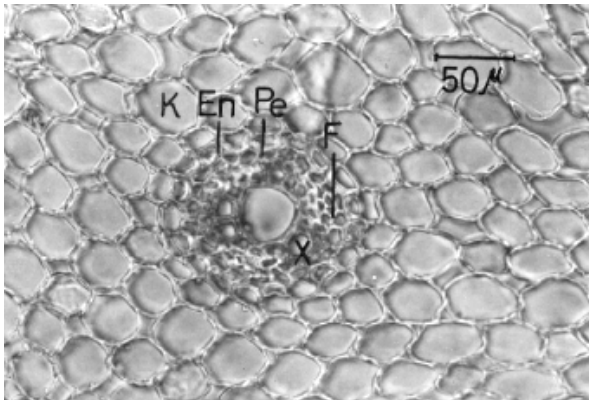


Figure 4. Central part of root section in *A. sibthorpiatum*
K: Cortex, En: Endodermis, Pe: Pericycle, X: Xylem, F: Phloem

Anatomy of Root

On the outermost side there is a single layer of epidermal cells followed by a single layer of exodermis made up of big suberised cells. Cortex covers a wide arcade up to endodermis (Fig.2, 3) being parenchymatous. Endodermis, pericycle and circularly arranged vascular bundles follow the cortex. Xylem with trachea and tracheids lies together with phloem. In latter has indistinguishable cell boundaries. Pith is formed of an open space (Fig. 4).

Anatomy of Scape

A cutinised and suberised wide epidermal area on the outermost layer followed by a small chloronchymatic cell zone (Fig. 5). Vascular bundles under the chloronchymatic zone are arranged in two circles, those in outer ring being smaller than inner ones (Fig.6). The spaces in between the rings are filled up with thick walled parenchymatic cells in the outer part and big but thin walled ones in the inner part (Fig. 7). Phloem lies on the outside of bundles and xylem on the inner side. Pith is formed of disintegrated parenchymatic cells (Fig. 8). Scape lacks hairs but possesses a large number of xerophytic stomata (Fig. 9).

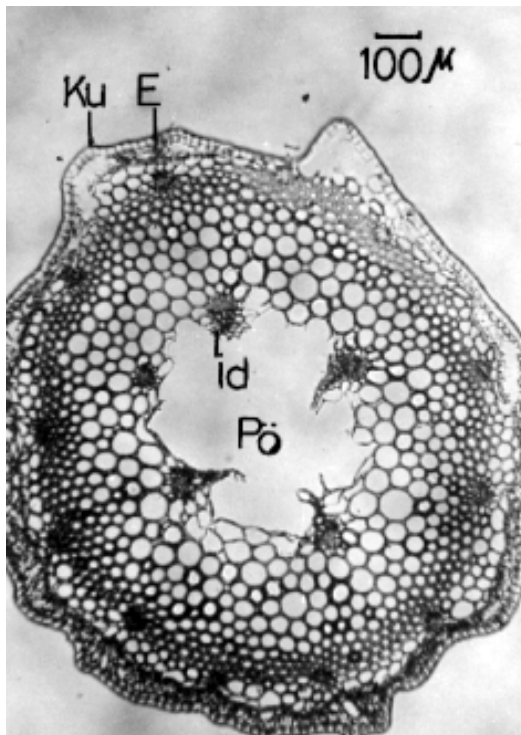


Figure 5. Section of shoot in *A. sibthorpiatum*
Ku: Cuticle, E: Epidermis, id: Vascular bundle
Pö: Parenchymatic pith

Internal Morphology

The anatomical characteristics of root, scape, leaf and bulb are given below.

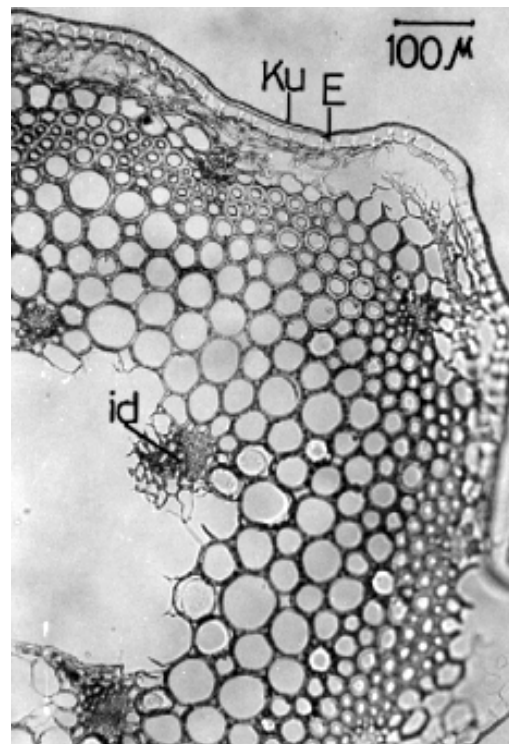


Figure 6. Magnified section of shoot of *A. sibthorpiatum*
Ku: Cuticle, E: Epidermis, id: Vascular bundle

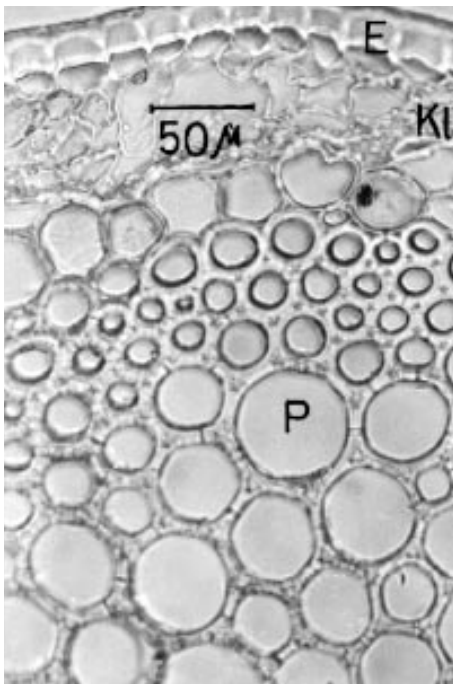


Figure 7. Parenchymatic cells in the shoot section of *A. sibthorpi- anum*
Ku: Cuticle, E: Epidermis, KI: Chlorenchymatic tissue, Pa: Parenchyma.

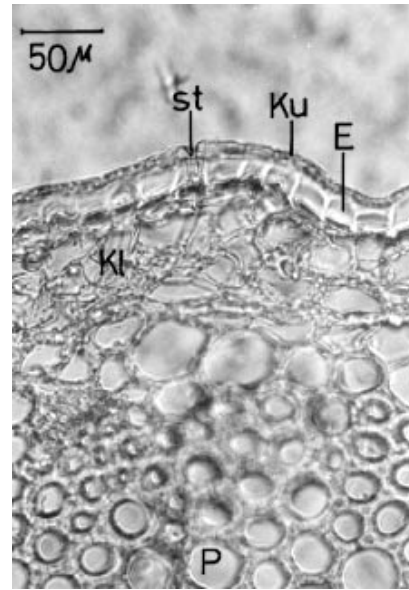


Figure 9. Stomata in the shoot of *A. sibthorpi- anum*
St: Stomato, Ku:Cuticle, E: Epidermis, KI: Chlorenchymatic tissue, P: Parenchyma

Anatomy of Leaf

Leaf is slightly curled inwards with a thick cuticle on the outside and an epidermal layer lying underneath it. Cuticle has a row of papillae. Palisade and spongy parenchyma are not fully distinguishable, however at some places single layered isodiametric palisade cells are visible in the sections. Laticifers situated at inner boundary of palisade tissue. Vascular bundles are distributed in the spongy parenchyma. Xylem is not separable. Leaves are not hairy (Fig. 10) and epidermis has a large number of xerophytic stomata (Fig. 11).

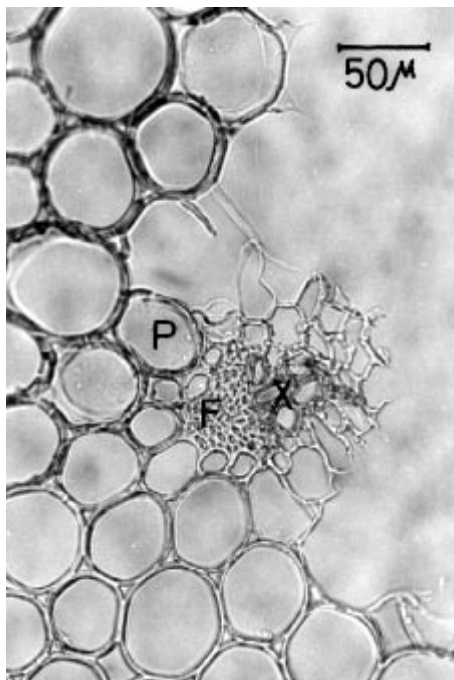


Figure 8. Vascular bundle in the shoot of *A. sibthorpi- anum*
X: Xylem, P: Parenchyma, F: Phloem.

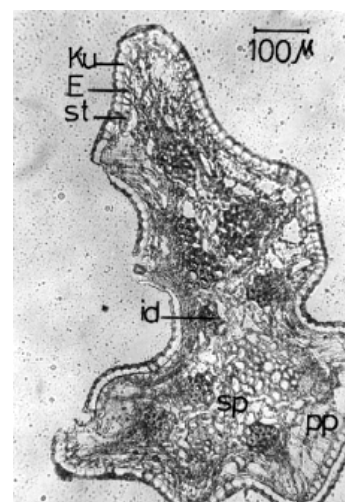


Figure 10. Leaf section of *A. sibthorpi- anum*
Ku: Cuticle, E: Epidermis, st: Stomata, sp: Spongy parenchyma, pp: Palisade parenchyma, id: Vascular bundle

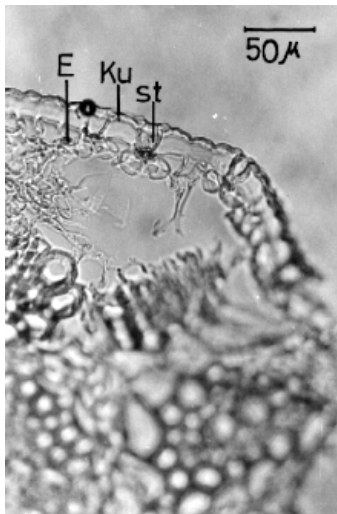


Figure 11. Stomata in the leaf section of *A. sibthorpiatum*
Ku: Cuticle, E: Epidermis, st: Stomata

Anatomy of Bulb

On outside lies a thick cuticle with a single layer of epidermal cells below it and rest is filled in by storage parenchymatic cells. Vascular bundles lie at places in the parenchymatic base (Fig. 12). Shuttle like spaces occur towards inner part due to drying and withdrawal of parenchymatic cells from inwards to outwards (Fig. 13).

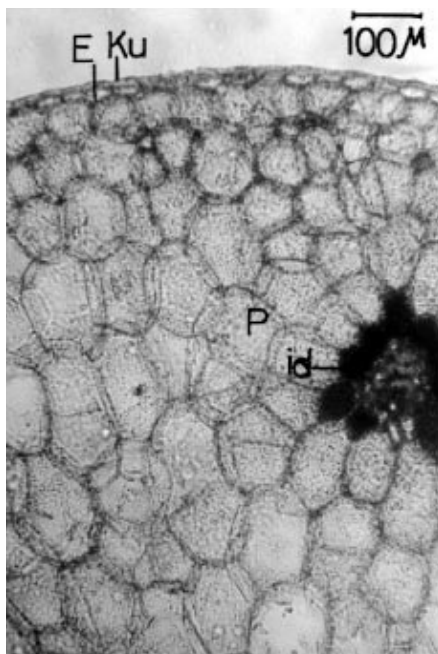


Figure 12. Section of *A. sibthorpiatum* bulb
Ku: Cuticle, E: Epidermis, P: Parenchyma, Id: Vascular bundle

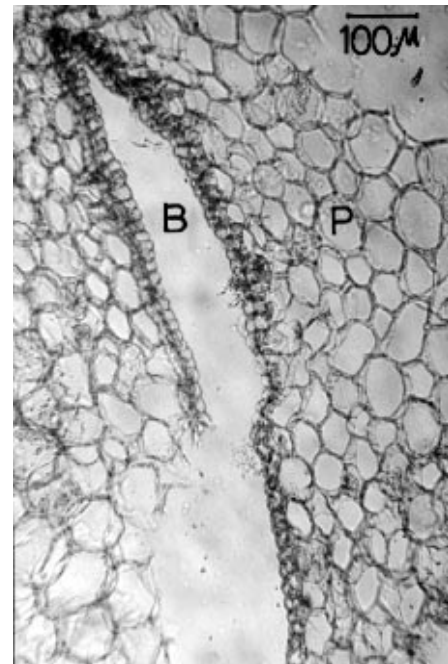


Figure 13. Shuttle like cavities in the bulb section *A. sibthorpiatum*
P: Parenchyma, B: Cavity

Ecology

Distribution

This endemic species is distributed in North and West Anatolia, at 2000- 2100 m in Bursa Uludağ and Kütahya Gediz Şaphane Mountain, at 1050 m between Kütahya - Afyon, at 2000 m in Denizli Honaz Mountain around Kabardıç high plateau pastures, at 2000 m in Isparta Barla Mountain (5) and in Çanakkale Kazdağı around Susuzdağı at 1350 m altitude. *A. sibthorpiatum* has been recorded for the first time from Kazdağı.

Generally it is found on calcified rock crevices, pebbly slopes, among the stony heaps, at the base of mountains and high altitude pastures.

Soil Characteristics

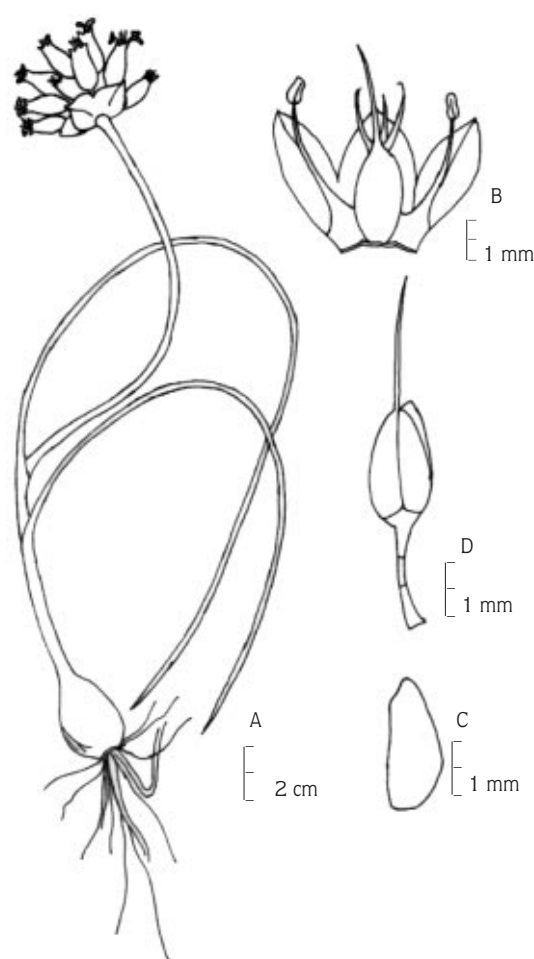
A. sibthorpiatum prefers soils with a pH of 7.09 (medium alkaline), non-saline, CaCO₃ content being poor (0.090 %). Texture of its soils is loamy-sand and maximum water holding capacity is 58.2 percent (Table 2). Chemical analysis of the soils show that these are rich in organic matter (4.030 %), nitrogen (0.420 %) and phosphorus (0.092 %). The soils show enough of potassium (0.50 %) (Table 3).

Species	Maximum water holding (%)	Texture	pH	CaCO ₃ (%)	Total salt (%)
<i>Allium sibthorpiatum</i>	58.2	Loamy sand	7.09	0.090	Non saline
<i>Allium reuterianum</i>	59.4	Loamy sand	8.70	5.900	Non saline

Species	(%) N	% P	% K	Organic matter
<i>Allium sibthorpiatum</i>	0.420	0.092	0.50	4.030
<i>Allium reuterianum</i>	0.196	0.046	0.30	4.190

Table 2. Physical Analysis of Soils (fresh and air dried soils)

Table 3. Chemical Analysis of Soils

Figure 14. *Allium reuterianum* A, General view; B, Flower; C, Seed; D, Fruit

Morphology and Ecology of *A. reuterianum*

External Morphology

A. reuterianum is an alpine, perennial, bulbous and herbaceous species. It is an east mediterranean element.

Morphological features of bulb, leaf, flower, fruit and seed are as follows.

Bulb

It is spherical with adventitious roots. Roots are 0.6 ± 0.2 mm wide (min. 0.2 mm, max. 1.0 mm) and 2.9 ± 1.1 cm long (min. 1.0 cm, max. 5.0 cm). Outer tunics are blackish and membranous, inner tunics are white and with parallel fibrous. Diameter of bulb is 11.4 ± 0.2 mm (min. 9.0 mm, max. 15.0 mm) length being 16.0 ± 2.3 mm (min. 13.0 mm, max. 20.0 mm) (Fig. 14, Table 4).

Scape

Stem is flexuous. Scape looks like parallel to the ground but it is flexuous. Scape is 5-15 cm long with striations (Fig. 14).

Leaf

2-3 in number, funnel shaped, curled like bow with deep furrow, being longer than scape, 1.5 ± 0.6 mm wide (min. 1.0 mm, max. 2.0 mm), 10.2 ± 1.6 mm long (min. 9.0 mm, max. 13.0 mm). Leaves sharply tapering towards apex, spathe has 2 valves, which are egg shaped, long lasting, with an acute apex. Valves are 6.1 ± 1.3 mm wide (min. 4.3 mm, max. 7.9 mm), 6.7 ± 0.8 mm long (min. 5.8 mm, max. 7.9 mm) (Fig. 14 A , Table 4).

Flower

Flowers on the apex of scape umbel like, dense, each umbel being 1-1.5 cm in diameter, pedicels longer than perianth, 4.2 ± 1.4 mm long (min. 2.7 mm, max. 6.2 mm). Perianth is spherical-bell shaped, with 6 segments, which are wine-red coloured, each segment is egg like-rectangular shaped, blunt apexed and outer surface has short protruberances. These are 1.1 ± 0.2 mm (min. 0.9 mm, max. 1.4 mm) wide, 3.8 ± 0.6 mm (min. 3.0 mm, max. 4.7 mm) long. Stamens are 6 in number. Filaments of inner stamens have 3 hairy apices and middle apex is shorter than basal lamina and lateral hairy apices.

Table 4. Biometric measurements of *A. reuterianum*.

Plant part		Number of measurements	Width			Length			
			Min.	Max.	Mean±S.E.	Min.	Max.	Mean±S.E.	
	Leaf	30	1.0 mm	2.0 mm	1.5±0.6	9.0 mm	13.0 mm	10.2±1.6	
	Valve	30	4.3 mm	7.9 mm	6.1±1.3	5.8 mm	7.9 mm	6.7±0.8	
Flower	Pedicele	30	-	-	-	2.7 mm	6.2 mm	4.2±1.4	
	Corolla	30	0.9 mm	1.4 mm	1.1±0.2	3.0 mm	4.7 mm	3.8±0.6	
		Filament	30	-	-	-	2.7 mm	3.4 mm	2.9±0.2
	Stamen	Anther	30	0.5 mm	0.9 mm	0.7±0.1	1.2 mm	2.1 mm	1.6±0.3
		Pistil	Style	30	-	-	-	2.2 mm	3.2 mm
	Ovary		30	1.7 mm	2.2 mm	1.8±0.2	2.0 mm	3.2 mm	2.8±0.3
	Root	30	0.2 mm	1.0 mm	0.6±0.2	1.0 cm	5.0 cm	2.9±1.1	
	Bulb	30	9.0 mm	15.0 mm	11.4±0.2	13.0 mm	20.0 mm	16.3±2.3	
	Fruit	30	1.6 mm	2.4 mm	2.0±0.3	4.0 mm	4.7 mm	4.3±0.2	
	Seed	30	1.4 mm	1.8 mm	1.6±0.2	3.1 mm	3.6 mm	3.4±0.2	

Filaments are 2.9 ± 0.2 mm long (min. 2.7 mm, max. 3.4 mm). Anthers are ellipsoidal-rectangular 0.7 ± 0.1 mm wide (min. 0.5 mm, max. 0.9 mm) and 1.6 ± 0.3 mm long (min. 1.2 mm, max. 2.1 mm). Pistil one, ovary inferior, 1.8 ± 0.2 mm wide (min. 1.7 mm, max. 2.2 mm) and 2.8 ± 0.3 mm long (min. 2.0 mm, max. 3.2 mm). Style thread shaped, 2.7 ± 0.2 mm long (min. 2.2 mm, max. 3.2 mm) (Fig. 14 B , Table 4).

Fruit and Seed

Fruit a loculicidal capsula, narrowly egg shaped, 2.0 ± 0.3 mm wide (min. 1.6 mm, max. 2.4 mm) and 4.3 ± 0.2 mm long (min. 4.0 mm, max. 4.7 mm) (Fig.14 D, Table 4). Seed is angled, black, 1.6 ± 0.2 mm wide (min. 1.4 mm, max. 1.8 mm) and 3.4 ± 0.2 mm long (min. 3.1 mm, max. 3.6 mm) (Fig. 14 C , Table 4).

Internal Morphology

Anatomical features of root, scape, leaf and bulb are given as under

Anatomy of Root

Cork tissue lies on the outer part in a disintegrated form with cortex lying beneath it and extending up to single cell layered endodermis (Fig. 15). Central part has vascular bundles with clearly differentiable xylem and phloem. Pith is empty (Fig.16).

Anatomy of Scape

Scape is not hairy. On outer side lies a thick cuticle, followed by single layered epidermis (Fig.17). The area in between these is thickened in the form of layers (Fig. 18). Epidermis abounds in xerophytic stomata (Fig.19). Collenchymatous tissue covers a small area under it. Below it lies parenchymatous zone with small but thick walled cells in the outerpart, but big and thin walled cells in the innerpart. Vascular bundles are scattered in a circular form after paranchymatic tissue with phloem on outside and xylem on inside part (Fig. 20). Pith is empty.

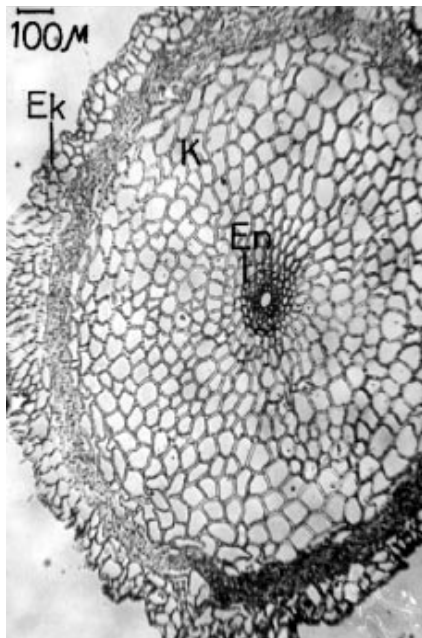


Figure 15. Transverse section of root of *A. reuterianum*
Ek: Exodermis, K: Cortex, En: Endodermis

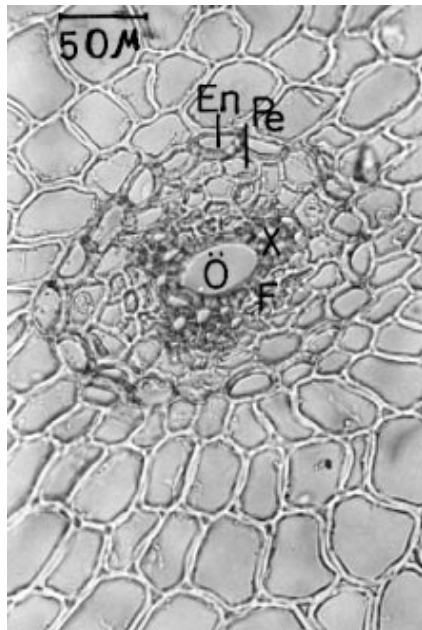


Figure 16. Magnified central part of root section *A. reuterianum*
 En: Endodermis, X: Xylem, Pe: Pericycle, F: Phloem, Ö: Pith

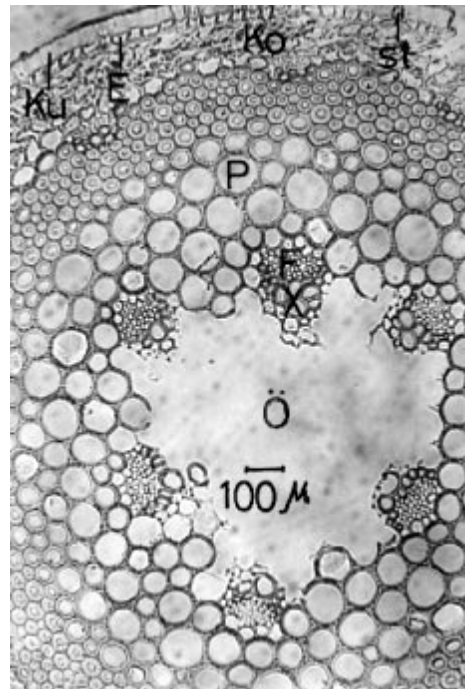


Figure 18. Magnified section of shoot of *A. reuterianum*
 Ku: Cuticle, Ö: Pith, Ko: Collenchyma, st: Stomata, X: Xylem, F: Phloem, P: Parenchyma

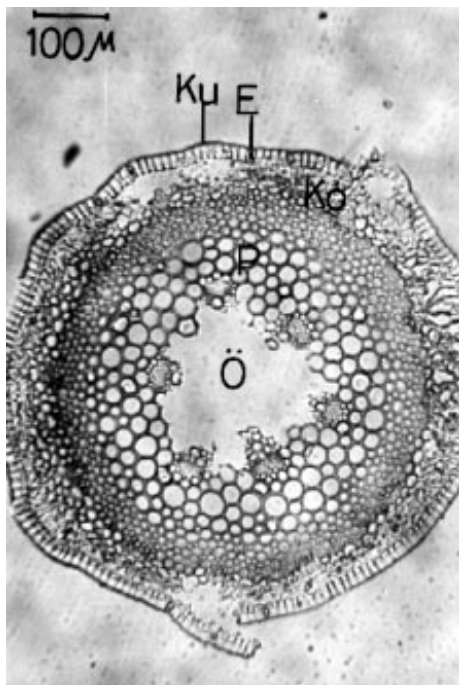


Figure 17. Transverse section of shoot of *A. reuterianum*
 Ku: Cuticle, Ö: Pith, E: Epidermis, Ko: Collenchyma, P: Parenchyma

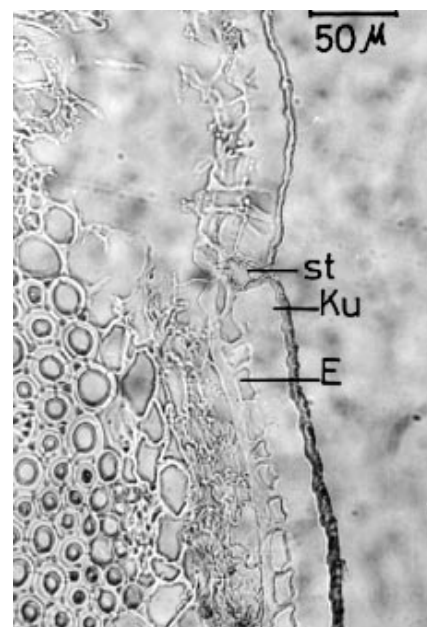


Figure 19. Stomata in the shoot of *A. reuterianum*
 Ku: Cuticle, E: Epidermis, st: Stomata

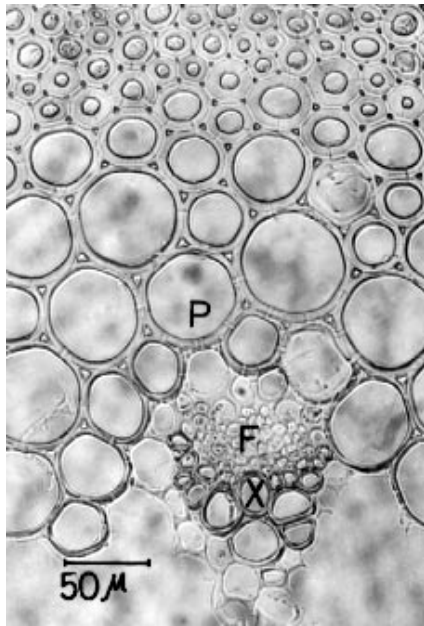


Figure 20. Magnified vascular bundle in the shoot of *A. reuterianum*.

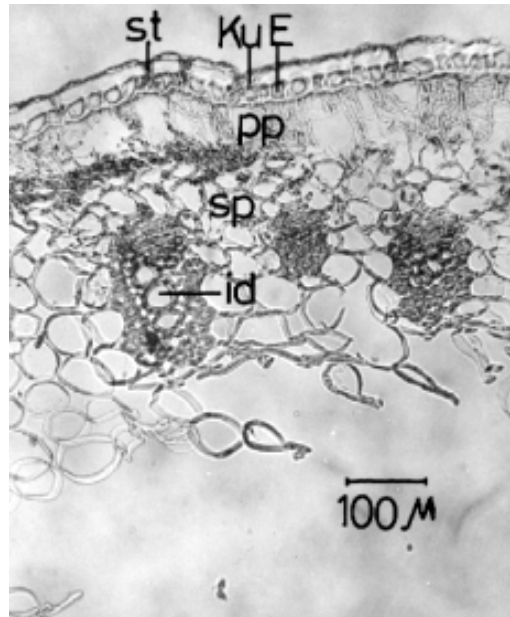


Figure 22. Stomata in the leaf of *A. reuterianum*
Ku: Cuticle, E: Epidermis, st: Stomata, pp: Palisade parenchyma, sp: Spongy parenchyma, id: Vascular bundle

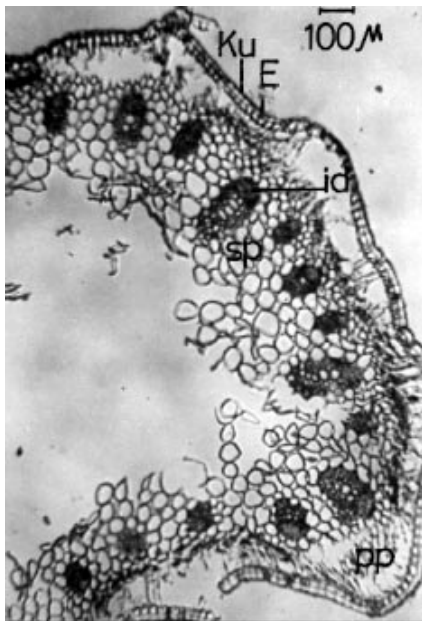


Figure 21. Transverse section of leaf of *A. reuterianum*
Ku: Cuticle, E: Epidermis, pp: Palisade parenchyma, sp: Spongy Parenchyma, id: Vascular bundle

Leaf Anatomy

Leaves have a thick cuticle on outside with a single layered epidermis below it. Here too we find a layered-thickened area between epidermis and cuticle. Cuticle has

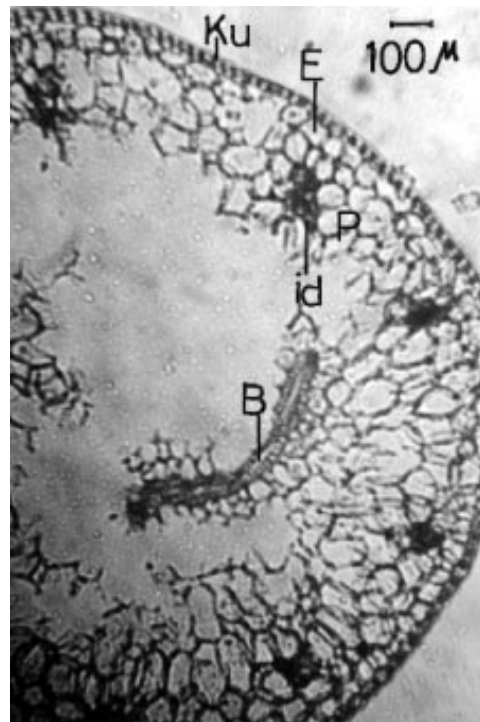


Figure 23. Transverse section of bulb of *A. reuterianum*
Ku: Cuticle, B: Cavity, E: Epidermis, P: Parenchyma, Id: Vascular bundle

a row of papillae. Palisade is suppressed with 1-2 cell layers. Laticifers are situated at inner boundary of palisade tissue. Spongy parenchyma covers a larger area

with big intercellular spaces. Vascular bundles lie among the spongy layer in a circular shape being small and big (Fig. 21). Xerophytic stomata abundant in epidermis (Fig. 22). Leaf has no hairs and leaves are curled slightly inwards.

Anatomy of Bulb

Cuticle forms the outer part, with one layer of epidermal cells underneath it. Rest is full of storage parenchymatic cells. Vascular bundles lie inside it near epidermis, in the form of a ring (Fig. 23). Due to drying effect like *A. sibthorpiatum* shuttle like thick walled cells surround the open spaces (Fig. 24).

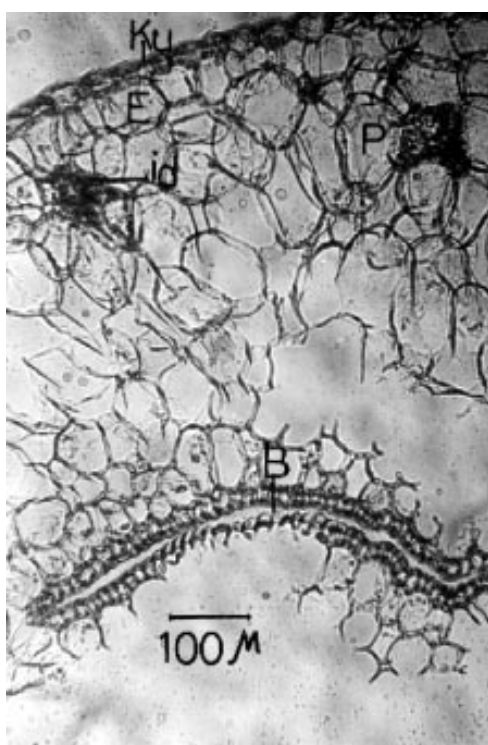


Figure 24. Shuttle like cavities in the transverse section of *A. reuterianum* bulb
Ku: Cuticle E: Epidermis, id: Vascular bundle
P: Paranchyma, B: Cavity

Ecology

Distribution

This species is distributed in West and Southwest Anatolia, Islands, at 1800 m on Spil Mountain in Manisa, 1800 m on Nif Mountain Izmir, 1830-1980 m in Denizli-Bozdağ, 1900 m in Muğla Sandras Mountain, 1830 m in Isparta Davras Mountain, 1900 m in Antalya around Bozburun Mountain Tozluçukur pasture (5), 1200 m in Çanakkale at Kazdağı Tavşan Oynağı area. *A. reuterianum* was recorded recently from Kazdağı.

Generally it grows on the mountainous slopes, among pebbly areas and on limestone rocks.

Soil Characteristics

A. reuterianum prefers soils with a pH of 8.7 (highly alkaline) non saline, loamy-sand textured, with 5.9 percent CaCO_3 (rich in CaCO_3). Maximum water holding capacity is 59.4 %.

The soils supporting these plants are rich in nitrogen (0.196 %), phosphorus (0.046 %) and organic matter content (4.190 %) but medium in potassium (0.30 %).

Discussion & Conclusion

A rich flora of Turkey abounds in endemics with a percentage lying around 33. Although every and each taxon has its unique importance, endemics hold a special status among these due to their restricted distribution.

Investigations on different aspects of endemics will not only allow us to protect these from annihilation but also provide an opportunity for their potential economical evaluation.

The endemics studied by us were collected for the first time from Kazdağı but show a distribution outside this locality too. Their morphological features were studied in the light of findings presented by Davis (5) but detailed anatomical and ecological observations are recorded for the first time in this study.

A. sibthorpiatum is a perennial herb with hairless leaves and bulb unlike *A. flavum* subsp. *flavum* var. *minus* which is hairy. Flowers possess filaments which are shorter than perianth as against *A. flavum* var. *minus* (6) whose filaments are of normal length, anthers lie outside the perianth tube. Root anatomical features differ from *A. flavum* var. *minus* in the sense that it has suberised exodermis under the epidermis. Pith looks like an open space *A. sibthorpiatum* but is full of xylem elements in *A. flavum* var. *minus*. All other features of root and scape resemble each other fully in both these taxa. In *A. sibthorpiatum* palisade and spongy parenchyma in the leaf are not fully differentiated however in *A. flavum* var. *minus* a two to three layered palisade parenchyma completely surrounding the leaf is visible. The xerophytic stomata coincide with the distributional characteristics of *A. sibthorpiatum*.

A. reuterianum differs from *A. flavum* var. *minus* and *A. sibthorpiatum* in the external morphological features of bulb, being globose in shape. Exodermis and cork have replaced epidermis in the root anatomy. There is a clearcut differentiation of endodermis and pericycle but pith is

empty like *A. sibthorpiatum*. A typical cell stratification is seen between epidermis and cuticle in the scape anatomy as is the case with *A. flavum* var. *minus* which is hairless. As compared to other two taxa, anatomy of leaf shows a thickened area between epidermis and cuticle like scape. Leaves lack hair absent and thus resemble *A. sibthorpiatum* in this feature. Both of two taxa in leaf mesophyle have laticifer tube as *A. flavum* var. *minus*. Fahn and Yentür have said that laticifer tubes have been found in leaves of *Allium* taxa (7,8). In leaf mesophyle of *A. sibthorpiatum* and *A. reuterianum* laticifers are situated at inner boundary palisade tissue as *A. flavum* var. *minus*. But in leaf mesophyle *A. trifoliatum* laticifers are situated at inner boundary of epidermis (9) whereas it is reported that laticifers are situated under palisade tissue in leaf mesophyle of *A. ericetorum* and *A. nebrodense* (10,11). Places of laticifers' being changeable is an important anatomical character in taxonomic angle. Sagir and Mann have also reported that leaf anatomy and chemical analysis data in *Allium* taxa are taxonomic indicators (12). The importance of leaf anatomy in *Allium*

taxa is reported by Mathew at all, Tanker and Kurucu (13,14). The same thing is stressed by Fritsch (15). These are papillae on cuticle of *A. sibthorpiatum* and *A. reuterianum*'s leaves. The same feature is seen in *A. rotundum* whereas it's not seen in *A. scorodoprasum* and *A. flavum* var. *minus* (16). Papillae's shape and its being or not being on cuticle of leaf epidermis shows the taxonomic and ecological relationships of the plant (17). A formation of shuttle like thick walled cells in the bulb of parenchyma due to drought in *A. sibthorpiatum* as well as *A. reuterianum* is typical and these form open spaces. All these taxa grow on non-saline soils with a normal water holding capacity. Texture being sandy-loam, but they prefer soils in organic matter, nitrogen, phosphorus and potassium.

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