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Morphological, anatomical, palynological and karyological characters of endemic *Sideritis vulcanica* Hub.-Mor. (Lamiaceae) from Turkey

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Abstract
Sideritis vulcanica Hub.-Mor. included in the *Empedoclia* section of the Lamiaceae family is an endemic species to Turkey and that is vulnerable. *Sideritis vulcanica* is an endemic, vulnerable and medicinal plant, therefore we focused on this species. In accordance with the new observations, additional information was added to the previous description of this species, and the description was edited. In the anatomical studies, the anatomies of the root, stem and leaf of this species have been enlightened. The shape of the pollen of *S. vulcanica* has been found as oblate-spheroidal. It has been determined that the polen aperture is trizonocolpate and ornamentation is reticulate. In karyological studies, chromosome counts and karyotype analyses of the species have been done and idyograms have been generated. The somatic chromosome number of *S. vulcanica* has been found as 2n=32 (x=16). The karyotype formula of this species consists of fourteen median chromosome and two submedian chromosome.

Key words: Anatomy, Karyology, Morphology, Palynology, *Sideritis vulcanica.*

1. Introduction

Sideritis L. genus belongs to the family of Lamiaceae which is one of the most common and diverse plants of the world. The genus of the Lamiaceae families exists in different habitats and altitudes ranging from North Pole to the Himalayas, North East Asia to Hawai, Africa Australia, and America. However, the main habitat is the Medirterreanaen area. (Heywood, 1996). There are 224 genus and about 5600 species in the world (Hickey and King, 1997). The Lamiaceae family in Turkey exists with 45 genus, 565 species and totally with 735 taxa. (Guner et al., 2000).

The genus *Sideritis*, although widely spread in the Mediterranean area, is present with above 150 species, divided into two subgenus in an area ranging from the Bahamas to China, from Germany to Morocco. One of these *Sideritis* subgenus is the *Marrubiastrum* (Moench) Mendoza-Heuer. This subgenus, endemic to Macaronesia is divided into three sections. These are *Marrubiastrum* (Moench) Bentham, *Empedocleopsis* Huynh and *Creticae* P. Perez & L. Negrin as determined by Perez De Paz and Negrin Sosa in 1992 (Perez and Negrin, 1992). The other subgenus *Sideritis* is divided into 2 annual [*Hesiodia* Bentham. and *Burgsdorfia* (Moench) Briquet] and 2 perennial [*Sideritis* and *Empedoclia* (Rafin.) Bentham.] sections (Barber et al., 2002).

The *Sideritis* species growing naturally in Turkey has been revised by Duman et al. These have been summarised under 44 species and 55 taxa. *Sideritis* is represented in Turkey with three sections. These are *Hesiodia*, *Burgsdorfia* and *Empedoclia*. The gene center of the *Empedoclia* section is with an endemism ratio of 80% Turkey (Duman et al., 2005).

Genus of *Sideritis* taxa spread widely throughout the world, because of their pharmaceutical effects, are consumed in different countries (Diaz et al., 1988; Alcaraz et al., 1989; Gergis et al., 1990; Rios et al., 1992; Godo et al., 2000; Villena et al., 2000; Navarro et al., 2001). A lot of studies are made on the chemical components of *Sideritis*. These studies are generally related to the oil components, flavonoids and diterpens of the *Sideritis* taxa (Akcos, 1994).

Sideritis are called "Dağ çayı, Yayla çayı, Ada çayı, Alanya adaçayı or Balbaşı" in Turkey. The *Sideritis* species are widely used in the treatment of gastrointestinal disorders and for treatment of cough, common cold, and as diuretic, as well as in herbal tea and in folk medicine in Turkey (Sezik and Ezer, 1983; Baser, 1995; Baytop, 1999).

Studies about chromosome numbers of *Sideritis* taxa growing in Turkey are conducted by (Strid, 1965; Contandriopoulos, 1978; Baltisberger, 1991; Aydın, 1993; Kesercioğlu and Nakipoğlu, 1996; Kıtıkı et al., 1998 a,b). The chromosome morphology is studied for the first time by Oz (1995). In addition to these studies, there is a chromosome morphology on *Hesiodia* section (Martin et al., 2008) and *Empedoclia* section (Martin et al., 2009) of *Sideritis* from Turkey.

Sideritis vulcanica is an endemic, vulnerable and medicinal plant that used in folk medicine in Turkey. Morphological, anatomical and palynological studies of this species were found not in the literature. Therefore, in this study, it was aimed to determine the morphological, anatomical, palynological and karyological characteristics of this species.

2. Material and Methods

2.1. Plant material

S. vulcanica specimens were collected during the flowerless, flowering and seedy stages in June, July and August, 2012-2013, from Sivrice region-Kürk village and slopes in Sivrice region-Gezin path (B7 Elazığ-Turkey), at altitudes of 1266-1345 m. The voucher specimens have been deposited at the Fırat University Herbarium (FUH-5429, 5430).

2.2. Morphological studies

The morphological observations and morphometric analysis were carried out on both fresh and herbarium specimens. The structures of root, leaves, bracts, flower and nutlet the plant samples that were collected belong to the species have been investigated within the framework of morphological studies. The taxonomic description of the plant was prepared according to Flora of Turkey (Davis, 1975). The habitus and hermarium samples of studied species are shown in Fig. 1. Morphological and morphometric characters of studied species in Flora of Turkey and our study are given in Table 1.

2.3.Anatomical studies

For anatomical studies were carried out on specimens fixed in 70% alcohol. Cross sections were applied to the stems, roots, leaves and surface sections of leaves of the plant sample investigated. The observations were carried out on these characters by light microscopy "Olympus BX51"and photographed with "Olympus Camedia C-4000 digital camera". The anatomical features are presented in Figs. 2,3 and 4.

2.4. Palynological studies

The pollens of *S. vulcanica* was obtained from dried flower specimens and its pollen morphology investigated using a light microscope following the preparation techniques of Wodehouse (1935). Pollen identification and counts were carried out by light microscope (Olympus BX51) with 100×oil immersion objective. Pollen quantitative characteristics were measured using 50 specimens. The photographs were taken with the Olympus Camedia C-4000 digital camera. The shape of the pollen was determined by the pollen index scale (Hyde and Adams, 1958). For scanning electron microscopy (SEM) observation, dried pollen grains were transferred onto stubs and then coated with gold. They were observed and photographed with a ZEISS scanning electron microscope.

2.5. Karyological studies

For the karyological study, seeds were germinated 21^{o}C and 25^{o}C at temperatures, on moist filter paper in Petri dishes. Actively growing root tips, 1-1.5 cm in length were cut from the germinating seeds. Root tips were pretreated for 16 h in α-monobromonaphthalene (α-monobromonaphthalene 4-5 drops into 100 ml of distilled water) at + 4°C (Elci, 1982). Acetic alcohol was used as fixative solution and fixed 24 h at 4^{o}C. Later was washed for 10 min in tap water. Hydrolysed in1 N HCl at 60^{o}C for 8-13 min and then rinsed in tap water for a minimum 3-5 min. Staining was carried out in Feulgen for 1 h, in a dark place, at room temperature and squash preparations were made with 45% aceticacid (Elci, 1982). Microphotographs of good quality metaphaseplates of each specimen (normally at least three)

were taken using an Olympus BX51 microscope. Karyograms were obtained from well-spread metaphase plates. Some karyologic characteristics were observed and measured under the light microscope. Long arm length, short arm length and total length of each chromosome were measured and relative lengths, arm ratios (r = I/s) and centromeric index (I = 100s/c) were calculated and used to classify and determine homologous chromosomes. Diploid chromosome number (2n), ploidy level, karyotype formula, chromosome length range, total karyotype length (TKL). Chromosomes were classified according to the nomenclature of Levan et al. (1964). The intrachromosomal asymmetry index (A1) and the interchromosomal asymmetry index (A2) followed those of Romero-Zarco (1986). The karyotype symmetry nomenclature followed Stebbins (1971).

Figure 1. A: Habitus of *S. vulcanica*, **B:** Herbarium sample of *S. vulcanica,* **C:** Inflorescens, **D:** Basal and cauline leaves.

3. Results

In this study, the morphological-morphometrical, anatomical, palynological and karyological features of the *S. vulcanica* species endemic to Turkey were investigated.

3.1. Morphological characteristics

***Sideritis vulcanica* Hub.-Mor. in Bauhinia 6(2):291 (1978)**

Description: Perennial with thickened taproot, 39-123 cm, simple or branched. Root length 15-54 cm. Stem with short glandular hairs, almost tomentose below. Lower leaves adpressed white-silky, glabrescent, 10-56 × 4-17 mm, median cauline leaves yellowish-green or greyish, finely adpressed pilose, reticulately veined, lanceolate to lanceolate-oblong, 20 - 110 × 5 - 28 mm, acutish, denticulate, sessile or with petiole to 0.4-3.7 cm. Verticillasters 6-22, lowest 1-3 cm distant, middle and upper crowded. Middle bracts orbicular-cordate to reniform, 14-23 × 13-28 mm, with acumen 2-7 mm, with short glandular and eglandular hairs, not ciliate. Calyx 7-12.6 mm, teeth lanceolate, 1.8-5.5 mm, with spreading eglandular hairs 0.5-1 mm, tube shortly tomentose and glandular. Coralla yellow, 10-15.3 mm, hairy and with brown striae inside. Fl. 7-8; igneous hills, rocky slopes, 1100-2200 m (Table 1).

Table 1. Morphological and morphometrical characters of *S. vulcanica* in Flora of Turkey and our study.

Morphological Features		**Our study**			**Flora of Turkey**
Plant Height		39 - 123 cm			30 - 60 cm
Root Lenght		15 - 54 cm			--
Basal Leaves	Length × With	10-56 × 4-17 mm			--
	Leaf arrangement	Rosulate			--
	Leaf shape	Oblanceolate			--
	Leaf margin	Crenulate, slightly serrate			--
	Leaf apex	From obtuse to mucronate, There are also examples of the slightly retuse			--
Cauline Leaves	Upper cauline leaves	12 - 45 × 6 - 26 mm			5 - 10 × 0.5 - 2.5 cm
	Middle cauline leaves	20 - 110 × 5 - 28 mm			
	Lower cauline leaves	37 - 104 × 6 - 34 mm			
	Leaf arrangement	Decussate			--
	Leaf shape	Oblanceolate, Linear- lanceolate			From Lanceolate to Lanceolate - Oblong
	Leaf margin	Denticulate, slightly crenate and serrate			Denticulate
	Leaf apex	Mucronate, acute			Acute
Petiole length		0.4 - 3.7 cm			1 cm
Internode		3.2 - 15 cm			--
Bracts		Upper bracts	Length × With	9 - 19.8 × 8 - 19 mm	--
			Acumen length	1 - 4 mm	--
		Middle bracts	Length × With	14 - 23 × 13 - 28 mm	1.5 - 2 × 1.5 - 2.5 cm
			Acumen length	2 - 7 mm	3 - 5 mm
		Lower bracts	Length × With	15 - 27 × 14 - 32 mm	--
			Acumen length	3 - 13 mm	--
		Bract shape		From Orbicular - Cordate to Reniform	--
		Bract margin		Entire	--
		Bract apex		From Acuminate to Apiculate	--
Flower		Inflorescence		Verticillaster	Verticillaster
		Number of Verticillasters		6 - 22	6 - 15
		The number of flowers in every verticillaster		6	--
		Verticillaster length		2.8 - 26.8 cm	--
		Internodes between the verticillasters		0.3 - 5.2 cm	1 - 3 cm
		Corolla	Color	Yellow	Yellow
			Length	10 - 15.3 mm	13 - 16 mm
			Upper lip length	3 - 5.5 mm	--
			Lower lip length	2.8 - 5.2 mm	--
		Calyx	Length	7 - 12.6 mm	10 - 12 mm
			length of the tooth	1.8 - 5.5 mm	4 - 6 mm
		Stamen	Anther length	0.7 - 2.3 mm	--
			Filament length	1.7 - 2.3 mm	--
		Pistil	Style length	4 - 8 mm	--
			Ovary length	1 - 1.4 mm	--
Nutlet		Color		Brown	--
		Shape		Triangular-ovate	--
		Length × With		2 - 3 × 1.3 - 2 mm	--

3.2. Anatomical characteristics

3.2.1.Cross-section of root

Root anatomy of *S. vulcanica* has been enlightened for the first time by this study. Because the plant is perennial, periderm layer is located on outermost surface of the root. Periderm protects narrowing cortex. Endodermis which consists of thick-walled cells is located under the cortex. Pericycle which consists of thinner walled cells is located under endodermis. Annular sclerenchyma completely surrounds the vascular bundle and gives strength and resistance against external influences to the plant. Up to pith from sclerenchyma ring is located vascular bundle which consist of pith rays and xylem. Pith region consists of xylem elements (Fig. 2).

3.2.2. Cross-section of stem

The stem is quadrangular. Epidermis is covered with a thick cuticle. Epidermis which composed of single row, ovoid-rectangular or irregular-shaped polygon cells located beneath of the cuticle. On the epidermis, eglandular hairs is denser than the glandular hairs. Eglandular hairs have got 2-3 cells. The head and stem of glandular hairs have got 1-2 cells. Underneath the epidermis, multilayered irregular polygon- shaped, well-developed collenchyma cells are located at the corners (7 to 13 layers). There are 4 to 6 rows of oval celled parenchyma tissue between this corners. Endodermis layer which distinctive annular is composed of large oval-square cells. Underneath the endodermis, annular pericycle is located. The pericycle has formed from oval, polygon-shaped sclerenchyma cells (1 to 3 rows) and has interrupted by phloem in some places. The phloem has occurred from small and irregular shaped cells (5 to 6 rows). Cambium is indistinguishable. Secondary xylem is composed of round-oval shaped trachea and the polygon-shaped tracheids. Pith rays is 1 to 2 rows. Primary xylem has been pushed towards the pith. Pith region which is composed of thin-walled, large and polygonal parenchymatic cells are located at the centre (Fig. 2).

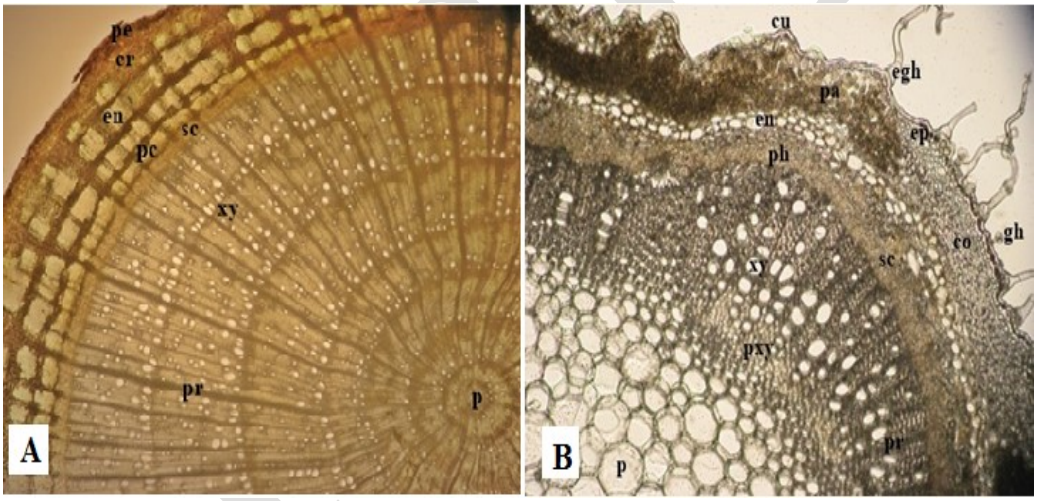

Figure 2. Cross-sections of root and stem **A:** Root **B:** Stem (pe: periderm, cr: cortex, en: endodermis, pc: pericycle, sc: sclerenchyma, xy: xylem, pr: pith rays, p: pith, ep: epidermis, cu: cuticle, egh: eglandular hair, gh: glandular hair, pa: parenchyma, co: collenchyma, en: endodermis, ph: phloem, pxy: primer xylem).

3.2.3. Cross-section of leaf

The epidermis is composed of a single layer cells and rectangular or oval cells. The top of the epidermis is covered by a thick cuticle. Lower epidermis cells are smaller compared with the upper epidermis cells. There are glandular and eglandular hairs on the surfaces of both epidermis. Under the upper and lower epidermis, there is palisade parenchyma. Because the palisade parenchyma is present on both sides, it can be concluded that the leaf type is isolateral (equifacial). Between the two palisade parenchymas, there is an irregularly arranged spongy parenchyma and it take less place. Mesophyll tissue consists of 3-4 layers of palisade and 1-2 layers of spongy parenchymatic cells (Fig. 3).

In cross-section from midrib, it has been shown that grown well by creating a large ridge. Upper epidermis cells is greater than the lower epidermis cells. In both the epidermis are seen 1-2 celled shroud hairs and glandular hairs. Collenchyma (4 to 5 rows) that is located beneath lower and upper epidermis, after parenchyma (2 to 3 rows) is observed. Xylem is located towards the upper epidermis of the leaf, but phloem is located toward the lower epidermis of the leaf. Sclerenchyma cells on the outer side of the phloem are seen. Vascular bundle is surrounded by large parenchymal cells (Fig. 3).

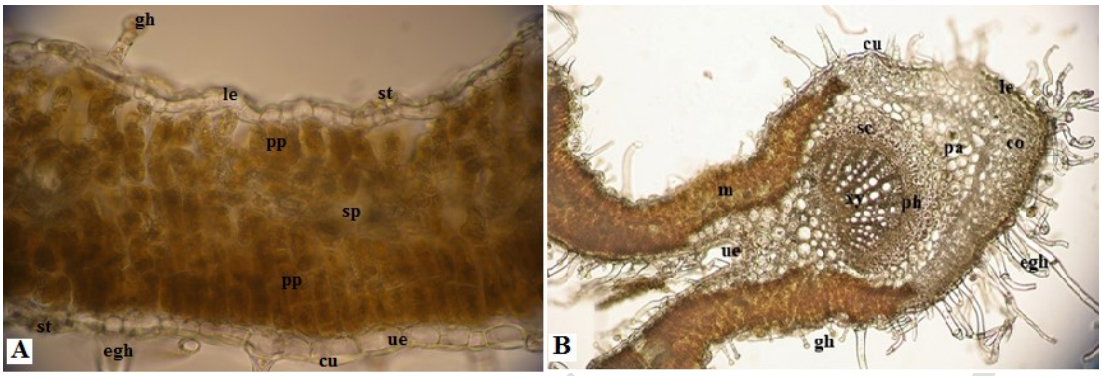

Figure 3. Cross-sections of leaf and midrib **A:** Leaf, **B:** Midrib (gh: glandular hair, egh: eglandular hair, st: stoma le: lower epidermis, pp: palisade parenchyma, sp: spongy parenchyma, ue: upper epidermis, cu: cuticle, co: collenchyma, pa: parenchyma, sc: sclerenchyma, m: mesophyll, ph: phloem, xy: xylem).

3.2.4. Surface-section of leaf

In surface–section of the leaf, epidermis cells are wavy-walled. Oval-shaped stomata are amphistomatic type that seen on both sides of the leaf. Stomata are amphistomatic that seen on both sides of the leaf. Stomata are higromorf type which at a higher level from neighboring epidermis cells. In upper and lower surface–sections of the leaf, stomata are when analyzed according to their neighboring cells; diacitic, tetracitic, actinocitic, anomocitic, anisocitic stomata types are observed (Fig. 4).

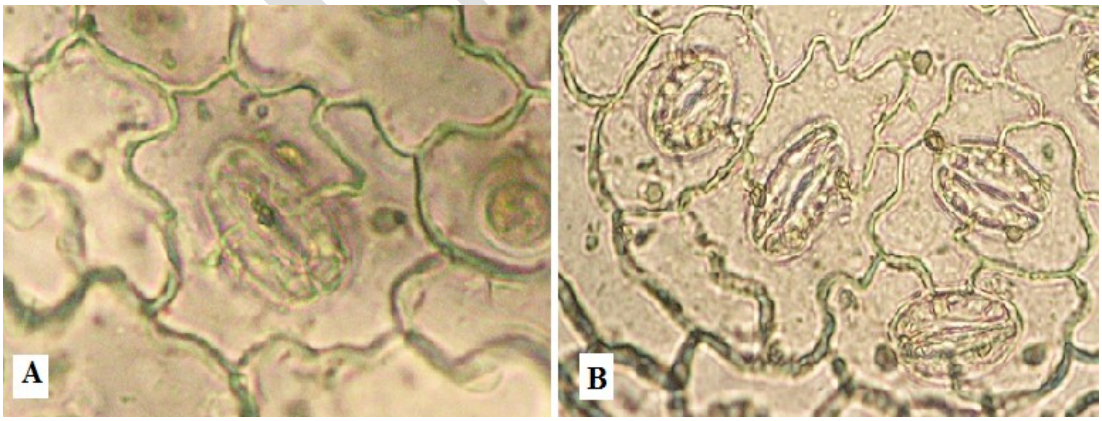

Figure 4. Surface-sections of leaf **A:** Upper Surface, **B:** Lower surface.

3.3.Palynological results

The shape of the pollen of *S. vulcanica* has been found as oblate-spheroidal. It has been determined that the polen aperture is trizonocolpate and ornamentation is reticulate. The ratio polar axis/equatorial axis (P/E) to 0.98. Polar axis = 32.19 µm, equatorial axis = 32.74 µm, length of the colpus = 16.90 µm, amb diameter = 32.32 µm and other palynological features are given in Figs. 5,6 and Table 2.

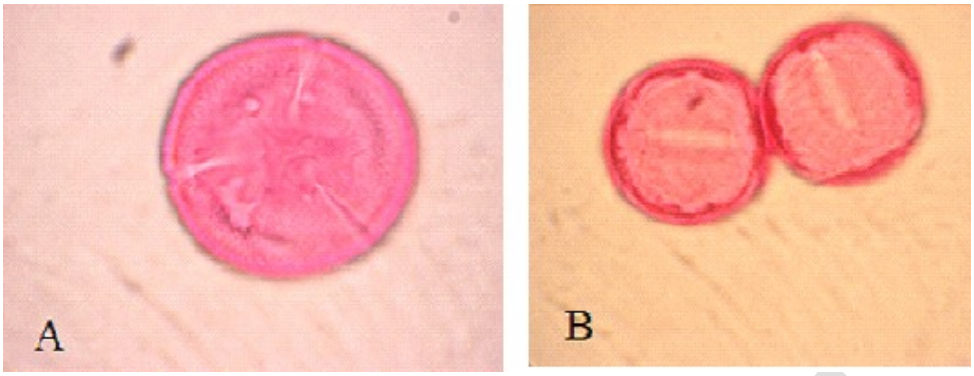

Figure 5. A: Equatorial, **B:** Polar appearance of pollen grains of *S. vulcanica* (100 ×).

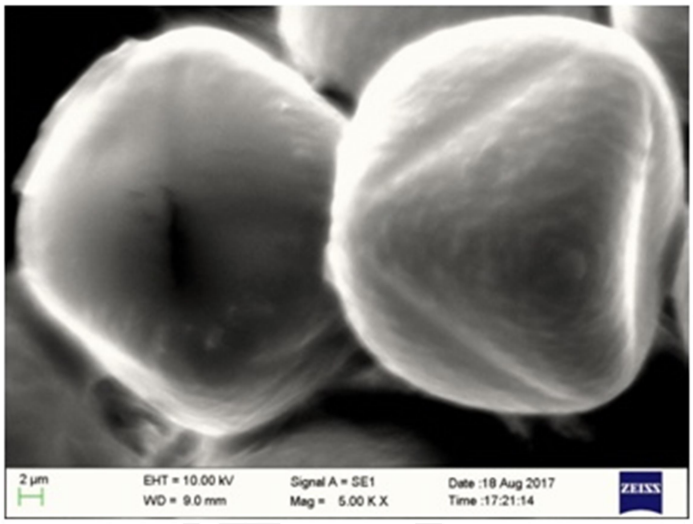

Figure 6. SEM microphotographs of pollen grains of *S. vulcanica*, general view (X5000).

Table 2. The pollen characteristics of *Sideritis vulcanica.*

Pollen Shape	Oblate - spheroidal
Aperture type	Trizonocolpate
Ornamentation	Reticulate
Polar axis - P (µm)	32.19 ± 2.02
Equatorial axis - E (µm)	32.74 ± 2.13
P / E (µm)	0.98
Colpus length - Clg (µm)	16.90 ± 2.02
Colpus width - Clt (µm)	2.75 ± 0.77
Exin thickness - Ex (µm)	1.80 ± 0.26
Intin thickness - In (µm)	1.89 ± 0.21
Amb diameter - L (µm)	32.32 ± 2.28
Apocolpium (µm)	9.02 ± 1.20
Mesocolpium (µm)	19.09 ± 1.09

3.4.Karyological results

The chromosome number of *S. vulcanica* is 2n=32 and therefore has a basic chromosome number of x=16. The chromosome length ranges between 1.68 and 2.47 µm. The total haploid chromosome length has been measured as 32.93 µm. The karyotype formula of this taxon 14m+2sm. Chromosome morphology has been observed that V and VIII numbered chromosomes is submedian centromeres,

whereas the other chromosomes is median centromeres. Relative length range from 5.11 to 7.51 µm. Outher karyotype parameters and asymmetries are given in Tables 3and 4. Somatic metaphase chromosomes and idiograms are given in Figs. 7 and 8.

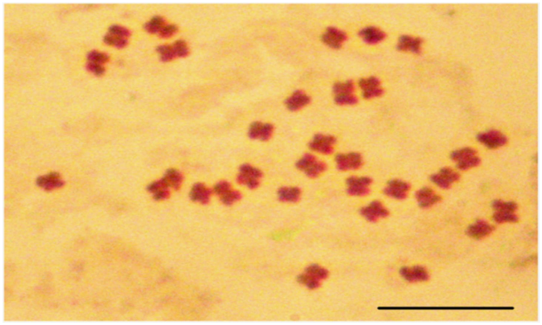

Figure 7. Mitotic metaphase chromosomes of *S. vulcanica* (2n = 32). Scale Bar: 10 µm.

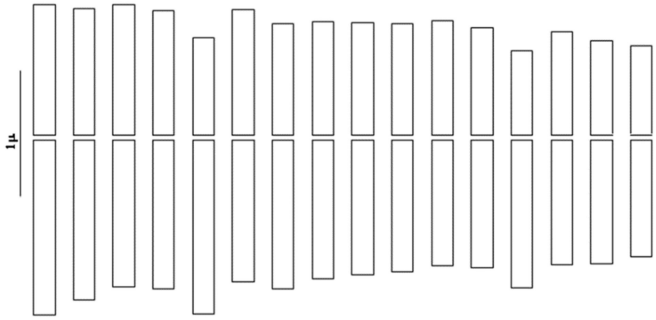

Figure 8. Haploid idiogram of *Sideritis vulcanica*. Scale bar: 1 µm.

Table 3. Morphometric data on chromosomes of *S. vulcanica.*

Chromosome no	Total chromosome length (µm)	Long arm length (µm)	Short arm length (µm)	Arm ratio (L/S)	Centromeric index	Relative length	Chromosome morphology
1	2.47	1.42	1.04	1.36	42.36	7.51	m
2	2.32	1.31	1.01	1.28	43.69	7.06	m
3	2.26	1.20	1.05	1.15	46.49	6.86	m
4	2.22	1.22	1.00	1.21	45.08	6.74	m
5	2.20	1.41	0.78	1.81	35.58	6.68	sm
6	2.17	1.16	1.01	1.15	46.42	6.61	m
7	2.11	1.21	0.89	1.36	42.34	6.41	m
8	2.05	1.14	0.91	1.25	44.36	6.24	m
9	2.01	1.11	0.90	1.22	44.91	6.12	m
10	1.98	1.08	0.89	1.20	45.34	6.01	m
11	1.95	1.03	0.92	1.11	47.23	5.94	m
12	1.92	1.05	0.86	1.21	45.17	5.83	m
13	1.89	1.21	0.68	1.77	35.99	5.74	sm
14	1.86	1.02	0.83	1.22	44.89	5.66	m
15	1.78	1.02	0.75	1.35	42.54	5.41	m
16	1.68	0.96	0.72	1.33	42.90	5.11	m

Table 4. Chromosomal comparison of *S. vulcanica.*

Taxon	2n	Ploidy level	Karyotype formule	Chromosome length range (µm)	TCL (µm)	A_1	A_2	SC
S. vulcanica	32	2x	14m+2sm	1.68-2.47	32.93	0,22	0.10	2A

4. Discussion

The present study aimed to survey the morphological, morphometrical, anatomical, palynological and karyological features of the *S. vulcanica* species endemic to Turkey were investigated and to compare them with previous morphological, anatomical, karyological and palynological investigations in the genus.

The morphological characters have been compared with Flora of Turkey and determined new morphological characters (Table 1). The morphological characters of this species were presented here for the first time.

Metcalfe and Chalk (1965) reported general anatomical structures for Lamiaceae. For example, the stem is usually rectangular in cross-section, and there is often a considerable development of collenchyma in the corners. Our observations show that stem is quadrangular. Underneath the epidermis, multilayered irregular polygon- shaped, well-developed collenchyma cells are located at the corners (7 to 13 layers). Though Metcalfe and Chalk (1965), reported that the leaf collenchyma is supporting tissue along the veins on one or both sides. Species are densely covered with a variety of trichomes. Stomata are on one or both surfaces. Rays are sometimes 2- up to 4-12 cells wide (Metcalfe and Chalk, 1965). In our study, were observed glandular and eglandular hairs on the surfaces of both epidermis. Stomata are amphistomatic that seen on both sides of the leaf. Stomata are higromorf type which at a higher level from neighboring epidermis cells. In upper and lower surface–sections of the leaf, stomata are when analyzed according to their neighboring cells; diacitic, tetracitic, actinocitic, anomocitic, anisocitic stomata.

In the *Sideritis* genus, leaves have been observed to be monofacial, bifacial, or centric form (Metcalfe and Chalk, 1965; Sezik and Ezer, 1983; Ezer and Sezik, 1988; Ezer, 1991; Uysal et al., 1991; Koca et al., 1994; Sahin et al., 2005). Under the upper and lower epidermis, there is palisade parenchyma of *S. vulcanica*. Because the palisade parenchyma is present on both sides, it can be concluded that the leaf type is isolateral (equifacial).

The anatomical structure of *S. congesta* Davis and Hub.-Mor. (Sezik and Ezer, 1983), *S. arguta* Boiss. et. Heldr. (Ezer and Sezik, 1988), *S. libanotica* Labill. subsp. *linearis* (Bentham) Born. (Ezer, 1991), *S. trojana* Bornm. (Uysal et al., 1991), *S. germanicopolitana* Bornm. subsp. g*ermanicopolitana*, *S. germanicopolitana* subsp. *viridis* Hausskn. ex Bornm. (Koca et al., 1994) and *S. stricta* Boiss. et Heldr. (Sahin et al., 2005) were investigated previously in Turkey. These species are in *Empedoclia* section and perennial. *Sideritis vulcanica* is also a perennial species and belonging to the *Empedoclia* section. However, this species anatomical structure (root, stem, leaf, midrib) is first time in our study exameined. Guvenc and Duman, (2010) studied morphological characteristics and anatomical structure of 5 Turkish annual *Sideritis* species. Their observations show that annual *Sideritis* species have the general anatomical characteristics of Lamiaceae with respect to leaf and stem.

Huynh (1972) while working on the genus *Sideritis*, stated that the basic type pollen grain of Labiatae is tricolpate. Yıldız et al. (2009) pollen shape of *S. cypria* has found as subspheroidal, spheroidal and ornamentation as suprareticulate and pollen aperture as trizonocolpate or tetrazonacolpate. Aydin (1993) reported that, pollen aperture of *S. phrygia*, *S. albiflora* and *S. leptoclada* as tricolporate. Palinological analysis of *S. vulcanica* was determined in our study for the first time. Pollen shape of *S. vulcanica* has been found as oblate-spheroidal and ornamentation as reticulate and pollen aperture as trizonocolpate. Our observations show that generall palinological characteristic of Lamiaceae with respect to pollen type as trizonocolpate.

Martin et al. (2009) were determeined the number of the somatic chromosomes for 47 taxa of the *Empedoclia* section in the *Sideritis* in Turkey. The somatic chromosome numbers in all taxa are 2n=32. Also, the basic chromosome number in all taxa are x=16. In addition, there are differences in the chromosome morphology in the taxa of this section. The B chromosome known as the supernumeary is seen in 44 taxa in the *Empedoclia* section, except *S. hololeuca*, *S. sipylea* and *S. microchlamys.* Somatic chromosome number of *S. vulcanica* was obtained as 2n=32A+0-1B (Martin et al., 2009). In our study, chromosome number of *S. vulcanica* has been found as 2n=32 (x=16). B chromosome hasn't been observed. The haploid karyotype formula is 14m + 2sm. Chromosome morphology has been observed that V and VIII numbered chromosomes is submedian centromeres, whereas the other chromosomes is median centromeres. Satellite hasn't been observed.

5. Conclussion

This paper gives detailed information on the morphological, morphometrical, anatomical, palynological and karyological features of the *S. vulcanica* species endemic to Turkey; further morphological, anatomical, palynological and karyological studies will help solve problems related to the taxonomy of these genus.

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