



## *Sideritis khalkhalica* (Lamiaceae: Lamioideae), a new species from Northwest Iran

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**ABSTRACT:** *Sideritis khalkhalica* sp. nov. (*S.* sect. *Hesiodia* Benth.) is described as a new species from northwest Iran. It appears to be a local endemic restricted to open slopes of marl hills in Khalkhal region, Ardabil province. This species differs from its closest relative, *Sideritis montana* and *S. romana* by having stems that are hairy with retrorse hairs, leaves petiolate, ovate to elliptic, with calyx teeth narrowly triangular, corolla white and pollen type balansae. Comparison with similar species, detailed photographs, micro-morphological characters of pollen grains are also provided. Moreover, its protection is recommended and proposed that the new species should be listed as Critically Endangered.

**KEY WORDS:** Conservation, Ardabil, Azarbaijan, Irano-Turanian, ironwort, micromorphology, *Sideritis montana*, *S. romana*.

### INTRODUCTION

The genus *Sideritis* comprises more than 150 species (Morales Valverde, 2010; Koutsaviti *et al.*, 2013; Kalivas *et al.*, 2014) and occurs in various habitats, distributed throughout Macaronesia, Turkey, the Mediterranean region to Russia and, Middle East (Harley *et al.*, 2004; POWO, 2021).

Mendoza-Heuer (1977) classified the genus *Sideritis* into two subgenera based on indumentum, bracteoles and life form: subgen. *Sideritis* and subgen. *Marrubiastrum* (Moench) Mend.- Heuer, the latter with three section is endemic to Macaronesia (Ramos *et al.*, 1994; Harley *et al.*, 2004). Subgenus *Sideritis* contains approximately 125 annual and perennial herbaceous species with a circum-Mediterranean distribution. Currently, subgen. *Sideritis* is divided into four sections: sect. *Hesiodia* (Moench) Bentham, sect. *Empedoclia* (Rafin.) Bentham., sect. *Burgsdorffia* (Moench) Briquet, and sect. *Sideritis* (Barber *et al.*, 2002; Stanoeva *et al.*, 2015). Section *Hesiodia* Benth. is characterized by its annual habit, floral leaves resembling stem leaves, with leaf margin entire or weakly crenate (Huber-Morath, 1982; Morales, 2010), and the species of this section are distributed in the Mediterranean region to the Middle East. Morphological studies have shown that morphology, both reproductive and vegetative characters are useful in distinguishing species within sect. *Hesiodia* (Huber-Morath, 1982; Tomás-Barberán *et al.*, 1990).

Pollen grains of the Lamiaceae are tricolpate, tetracolpate, or hexacolpate (Abu-Asab and Cantino, 1994; Harley *et al.*, 2004). Three pollen types, i.e. tricolpate, tetracolpate, and pantocolpate pollen grains were reported in the previous palynological studies on the

genus *Sideritis* (Risch, 1956; Huynh 1972; Pozhidayev, 1992; Rejdali, 1994; Salmaki *et al.*, 2008). Tricolpate type is found exclusively in the species of sect. *Hesiodia* and have two distinct subtypes: “montana” and “balansae” (Rejdali, 1994). The central part of the mesocolpium and apocolpium show different ornamentation in the montana type, whereas the ornamentation pattern is uniform in all parts of the pollen grains of the balansae type.

Comprehensive revisions of Iranian *Sideritis* species has been made by Rechinger (1982) and Jamzad (2012). Three annual species, belonging to the Sect. *Hesiodia* Bentham. have been recognized for the flora of Iran, including *S. balansae* Boiss., *S. comosa* (Rochel ex Benth.) Stankov, and *S. montana* L. In recent reviews of this genus (Huber-Morath, 1982; Dobignard and Chatelain, 2012; Salimov *et al.*, 2018; Govaerts, 2021), *S. comosa* is regarded as a synonym of *S. montana* subsp. *montana* and *S. balansae* has been transferred to the genus *Stachys* and regarded as a synonym of *Stachys woronowii* (Schischk. ex Grossh.) R.R.Mill. Based on previous studies and the present results, there are two species of *Sideritis* occurring in Iran, namely *S. montana* and the new species *S. khalkhalica* (here described) that are distributed in the northwest, west and center of country.

### MATERIALS AND METHODS

During the floristic study of the Aq-Dagh Protected Area, Ardabil province (NW Iran), we encountered an interesting *Sideritis* population. After surveying the literature (Heywood, 1972; Yuzepchuk, 1976; Rechinger, 1982; Harley *et al.*, 2004; Jamzad, 2012; Morales, 2010) and examined images of collections held at B, E, G, P, and W (acronyms according to Thiers, 2021), we noticed

**Table 1.** Comparison of morphological characters among *Sideritis montana*, *S. romana* and *S. khalkhalica* sp. nov.

Characters	<i>S. khalkhalica</i>	<i>S. montana</i>	<i>S. romana</i>
Plant height	10–25 cm	10–50 cm	10–35 cm
Stem indumentum	pubescent with retrorse hairs	patent-tomentose-villous	sparsely villous-lanate
Leaf lamina	ovate to elliptic	oblong to lanceolate or linear	oblong-ovate
Leaf petiole	long, all distinctly petiolate	short, subsessile	subsessile, lowermost shortly petiolate
Lamina size	15–23 × 10–15 mm	10–30 × 3–9 mm	10–25 × (2–)5–12 mm
Lamina apex	dentate, teeth acute	remotely denticulate-serrate or entire	dentate, crenate-dentate to entire
Lamina indumentum	hairy	patent-tomentose-villous	sparsely villous-lanate
Verticillasters	distant	approximate	distant
Calyx teeth	lanceolate, gradually turning to long aristae	spreading, ovate oblong, apex spiny	2-lipped, upper teeth broadly ovate, lower lanceolate, apex spiny
Corolla	white	pale yellow, the limb reddish-brown	white, yellow, purple
Corolla	5 mm long, shorter than calyx	5 mm long, shorter than calyx	7–10 mm long, equaling or exceeding to calyx
Pollen type	Tricolpate; balansae type	Tricolpate; montana type	Tetracolpate (Rf: Rejdali, 1994)

**Table 2.** Comparison of detailed pollen grain micro-morphological characters in the *Sideritis montana* and *S. khalkhalica*.

Pollen grain	Type	Polar axis (P)	Equatorial axis (E)	P/E	Ornamentation	Colpus length	Apocolpium	Mesocolpium
<i>S. montana</i>	Tricolpate	19–25 µm	19–24 µm	9.8–1.1	Foveolate-psilate	16–20 µm	8–12 µm	11–16 µm
<i>S. khalkhalica</i>	Tricolpate	17–20 µm	13–15 µm	1-1.3	Reticulate	15–18 µm	4–6.5 µm	7–11.5 µm

morphological differences of the collected specimen were enough for treating it as a new distinctive species. The morphology of the specimens was studied using a stereomicroscope (Zeiss: Stemi SV 6). The voucher specimens of newly described species have been deposited at Research Institute of Forests and Rangelands (TARI) and Gilan Agricultural and Natural Resources Research Center (GILAN) herbaria.

Pollen material of the new species was collected from the type specimens. For scanning electron microscopy studies, pollen grains were transferred from herbarium specimen onto stubs and then coated with gold. The quantitative and qualitative characters were measured in 20–30 pollen grains (Table 2). Micrographs were obtained using LEO 1430 VP SEM. The terminology follows mainly that of Punt *et al.* (2007) and Hesse *et al.* (2009).

## TAXONOMIC TREATMENT

*Sideritis khalkhalica* Bidarlord & Jamzad, sp. nov.

**Fig. 1**

**Type:** IRAN. Ardabil province, Khalkhal, Hashtjin to Khalkhal, 5 km from Hashtjin, 37°25'1.50"N, 48°20'20.25"E, 1150 m a.s.l., 19 June 2020. *Bidarlord 10015* (holotype TARI!, isotypes GILAN!).

**Diagnosis:** Morphological characters of the new species revealed that *Sideritis khalkhalica* belongs to Sect. *Hesiodia*. It is most similar to *S. montana* and *S. romana*. The new species is clearly distinguished from the *S. montana* by its stem hairy with retrorse hairs (vs. patent-tomentose -villous), leaves distinctly petiolate (vs. short-petiolate), lamina ovate to elliptic (vs. oblong to lanceolate-linear), leaves hairy (vs. patent-tomentose-villous), calyx teeth lanceolate (vs. oblong -ovate), corolla white (vs. pale yellow with limb reddish brown), pollen grains tricolpate-

balansae type (vs. tricolpate-montana type).

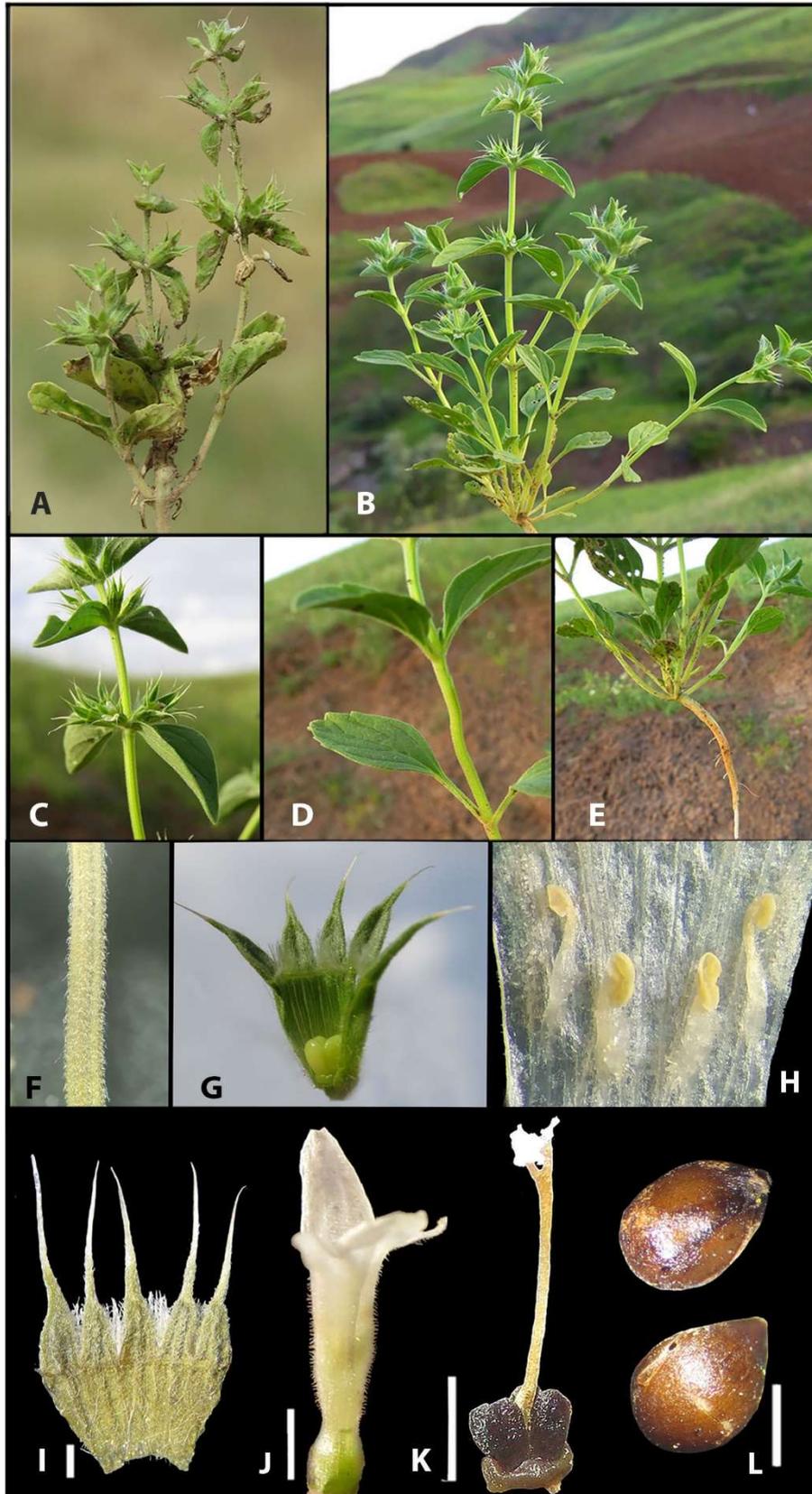
*Sideritis khalkhalica* differs from *S. romana* by its stem hairy with retrorse hairs (vs. sparsely villous-lanate), leaves distinctly petiolate (vs. short-petiolate), lamina ovate to elliptic (vs. oblong-ovate), leaves hairy (vs. villous-lanate), calyx teeth equal (vs. 2-lipped, upper tooth broadly ovate, lower lanceolate), corolla shorter than calyx (vs. equaling or exceeding to calyx), pollen grains tricolpate-balansae type (vs. tetracolpate) (Tables 1, 2).

**Description:** Annual herb, stems 10–25 cm long, erect, branched at the base, hairy with retrorse hairs, eglandular green-gray; internodes 1–3 (4) cm long. Leaves petiolate, 1–1.5(2) cm long (in lower leaves), shorter in upper leaves, with retrorse hairs; lamina 1.5–2.3 × 1–1.5 cm, ovate-elliptic, dentate at apex, with 1–4 longitudinal lateral nerves on each side, covered by sparse short hairs. Verticillasters distant, 6-flowered; flowers sessile, bracts ovate, differing from cauline leaves, sessile, entire, longer than flowers. Calyx campanulate, prominently 10-nerved, 8–10 mm long, pubescent-pilose intermixed with sessile and stipitate glands, throat hairy; teeth equal, lanceolate, as long as tube, suberect, villous, apex long aristate spinose. Corolla tube included in calyx, white, tube c. 5 mm long, hairy; upper lip slightly convex, ca. 1.5 mm long, emarginate; lower lip ca. 1.5 mm long, three lobed; middle lobe larger than lateral lobes, anterior stamens 1.3 mm long, glabrous, and posterior stamens 0.8 mm long hairy. Style 3 mm long; stigma bifid with lobes unequal. Nutlets ovate, 2 × 1.5 mm, convex dorsal sides, brown, rounded at apex.

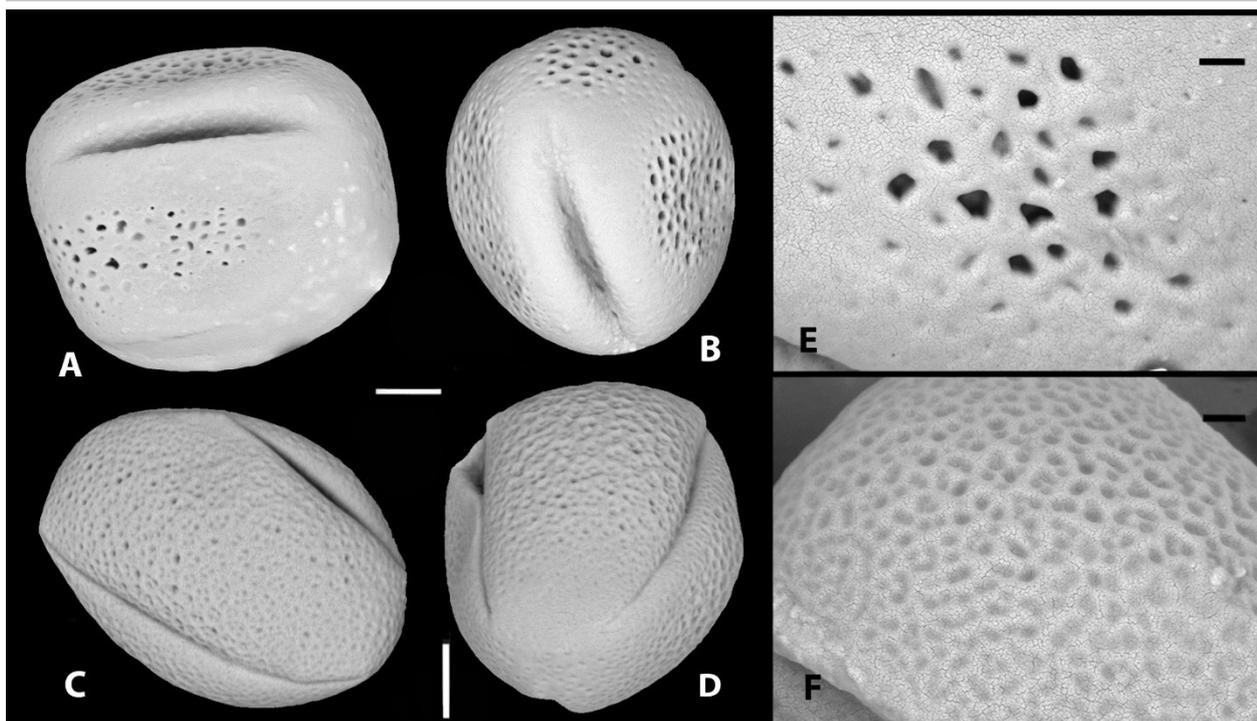
**Etymology:** The specific epithet refers to the geographical area that the type material was collected from.

**Phenology:** Flowering and fruiting from May to June.

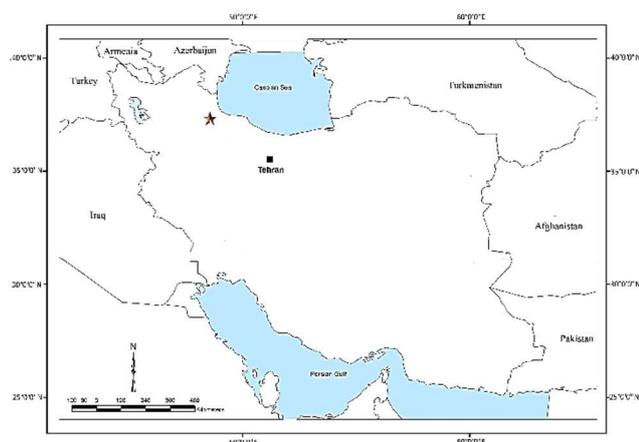
**Palynology:** The pollen grains in both examined species are tricolpate. Pollen shape in equatorial view



**Fig. 1.** *Sideritis khalkhalica* sp. nov., A- B. Habit. C. bracts. D. leaves. E. root. F. Stem indumentum. G. fresh calyx and mericarp. H. anthers. I. dry calyx. J. corolla. K. style and ovary. L. nutlet in dorsal and ventral face. Bars= 1 mm.



**Fig. 2.** Pollen grain of *Sideritis montana* (A, B & E) and *S. khalkhalica* (C, D & F). A, C. in equatorial view. B, D. in polar view. A–D. Bar scale = 4  $\mu$ m. E, F. Pollen ornamentation. Bar scale = 1  $\mu$ m.



**Fig. 3.** The distribution map of *Sideritis khalkhalica* (star).

ranges from spheroidal to prolate, and in polar view is mostly triangular, rarely quadrangular and compressed polar area in *S. montana* and rounded in *S. khalkhalica*. The average size of pollen grains of  $25 \times 22$  and  $18 \times 13$   $\mu$ m in *S. montana* and *S. khalkhalica* respectively. The P/E ratio ranges 9.8–1.1 to 1–1.3 in *S. montana* and *S. khalkhalica* respectively. Colpi are distributed symmetrically in pollen grains of both species, 15–19  $\mu$ m long in *S. montana* and 15–18  $\mu$ m long in *S. khalkhalica*. The average mesocolpial area 11–16 and 7–11.5 and apocolpium diameter are 8–12 and 4–7.5  $\mu$ m in *S. montana* and *S. khalkhalica*, respectively. The exine ornamentation is reticulate in *S. khalkhalica* and, is

foveolate-psilate in *S. montana*. Based on Huynh (1972) and Rejdali (1994) this pollen type, the “montana type”, is found only in *S. montana* in the entire genus. While, the pollen grains of *S. khalkhalica* has uniform reticulum and is “balansae type”. Thus, this characteristic on its own makes the new species distinguishable from *S. montana* (Fig. 2, Table 2).

**Distribution and habitat:** *Sideritis khalkhalica* is known only from the type locality and restricted to northwest Iran. The species grows in marl hills at elevations of 1100–1200 m a.s.l. (Fig. 4). Some species that it is associated with include *Actinolema macrolema* Boiss., *Alyssum meniocooides* Boiss., *Anthemis schizostephana* Boiss. & Hausskn., *Bromus danthoniae* Trin., *Eremopyrum bonaepartis* (Spreng.) Nevski, and *Chardinia orientalis* (L.) Kuntze, *Ranunculus arvensis* L., *Galium tricornutum* Dandy, *Malvella sherardiana* (L.) Jaub. & Spach, *Trigonella monantha* C.A.Mey. and *Ziziphora persica* Bunge.

**Conservation status:** *Sideritis khalkhalica* is known only from one population (criterion B2ab (iii)) in the type locality. The area of occupancy (AOO) of *S. khalkhalica* is 2 km<sup>2</sup>. Its extent of occurrence (EOO) cannot be calculated since it is known only from one population (criteria B1 and B2b (i, ii)). It is also estimated that the total number of individuals of this endemic species does not exceed 250 individuals (criterion C). Its locality is nearby villages and not well protected at present. In addition, human activities especially road construction



and overgrazing are threatening the species. Therefore, according to the IUCN (2019) Red List categories and criteria, the conservation status of *S. khalkhalica* is defined as critically endangered (CR). It is recommended to protect this plant and its habitat.

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