

# AETHIONEMA SABZEVARICUM (BRASSICACEAE), A NEW SPECIES FROM IRAN

Ahmad R. Khosravi & M. R. Joharchi

Received 01.02.2011. Accepted for publication 02.03.2011.

Khosravi, Ahmad R., & Joharchi, M. R. 2011 06 30: *Aethionema sabzevaricum* (Brassicaceae), a new species from Iran. –*Iran. J. Bot.* 17 (1): 119-124. Tehran.

*Aethionema sabzevaricum* Khosravi & Joharchi (Brassicaceae) is described and illustrated from NE Iran. The new species is morphologically, closely related to the *A. saxatile* group. It is an obligate chasmophytic narrow endemic to the serpentine cliffs of the Khorasanian Joqatai Mts in NE of Iran. It is perennial, suffruticose, with alternate fleshy leaves. Petals, white with upper part of claw and basal part of lamina darker purplish. Silicula cymbiform and one seeded.

Ahmad Reza Khosravi (correspondence <khosravi@biology.susc.ac.ir>, Department of Biology, Faculty of Science, Shiraz University, 71454, Shiraz, Iran. – Mohamad Reza Joharchi, Department of Botany, Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran.

Key words. Brassicaceae, *Aethionema*, new species, taxonomy, Iran.

## گونه *Aethionema sabzevaricum* (Brassicaceae)، گونه ای جدید از ایران

احمد رضا خسروی، دانشیار بخش زیست شناسی دانشگاه شیراز.

محمد رضا جوهرچی، عضو هیئت علمی گروه گیاهشناسی، پژوهشکده علوم گیاهی دانشگاه فردوسی مشهد.

گونه جدید *Aethionema sabzevaricum* از تیره شب بو از شمال شرق ایران شرح و به تصویر کشیده شده است. این گونه بومزاد با عرصه گسترش محدود، صخره‌زی بوده و در صخره‌های سرپتینی رشته کوه جغتای خراسان در شمال شرقی ایران یافت می‌شود و از نظر ریخت‌شناسی با گروه گونه‌های *A. saxatile* نزدیکی دارد. این گونه، چند ساله با بن چوبی و برگهای متناوب گوشتی است. گلبرگهای سفید دارد که در بخش بالایی ناخنک و قاعده پهنک بنفش رنگ می‌شود. بال خرچینک آن موجدار و یک دانه دارد.

## Introduction

*Aethionema* W. T. Aiton. consists of 57 species distributed primarily in the Middle East and eastern Europe and is centered in Turkey and Iran and a few species extending eastward into Turkmenistan and westward into Spain and Morocco (Al-Shehbaz et al. 2006). *Aethionema* may be regarded as one of the most diversified Brassicaceae genera in every aspect from habit to flower and fruit morphology and chromosome number. Khosravi (1989) recognized two unrelated groups of *Aethionema* species. One group with a single nerve on the claw, halfmoon shaped lateral nectar glands and the base chromosome number  $x=7$  (e.g. *Aethionema oppositifolium* Boiss., *Aethionema trinervium* (DC.) Boiss). Molecular analyses have revealed that these species are closely related to segregates that are traditionally treated as *Thlaspi* s. l.

(Hall et al. 2002, Khosravi et al. 2008). The second one, *Aethionema* core group (including the remaining *Aethionema* species, *Acanthocardamum* Thell. and *Moriera* Boiss.), is characterized by having three nerves on the claw, semiglobose lateral nectaries, and a base chromosome number of  $x=11, 12$ . Molecular analyses have clearly demonstrated that the *Aethionema* core group is not related to *Thlaspi*, but rather is sister to all other Brassicaceae lineages (Hall et al. 2002, Bailey et al. 2006, Beilstein et al. 2006, Al-Shehbaz et al. 2006). Because of their 'basal' and isolated position with respect to the rest of the Brassicaceae in the molecular phylogeny, the genus *Aethionema* (*Aethionema* core group) are placed in a separate new tribe, i.e. the *Aethionemeae* (Al-Shehbaz et al. 2006).

The first revision of *Aethionema* in Iran was made by Hedge (1968), who recognized 12 species. Since then, one new species, *Ae. semnanense* Mozaffarian

(Mozaffarian 1996) and one new record, *Ae. transhyrcana* (Czernjak.) N. Busch has been identified from Iran. Molecular studies have revealed that endemic monotypic genera *Acanthocardamum* and *Moriera* are nested in *Aethionema* and they belong to *Aethionema* (Khosravi et al., 2008). Mozaffarian (1996) transferred *Aethionema trinervium* to *Thlapi* s.l. which is also supported by molecular studies (Khosravi et al. 2009).

While working on the mountain flora of the Khorasanian Joqatai Mts in spring 2009 and visiting Kuh-e Nazargah some 45 km NW of Sabzevar, the second author came across a striking chasmophytic *Aethionema* (Figs. 1, 2). The specimens were cross-checked with the keys provided by Hedge (1968) in Flora Iranica and the *Aethionema* description cited in the relevant literature, including Flora Orientalis (Boissier 1867), Flora of Turkey and the East Aegean Islands (Hedge 1965; Davis et al. 1988; Guner et al., 2000) and Flora of the USSR (Bushe 1939). The specimens of the new species have been cross-checked with the materials kept at various Iranian herbaria (TARI, IRAN, TUH, FUMH).

***Aethionema sabzevaricum* Khosravi & Joharchi, sp. nov.** (Figs. 1, 2)

Herba perennis, glabra. Culmi floriferi 5.5-14 cm alti. plerumque non ramificati, dense foliati. Folia carnosae; inferiora subpetiolata, opposita, late obovata vel suborbiculata, 10-11 x 8-9 mm; superiora subsessilia, ovata vel late elliptica, 4-18 x 2-12 mm. Petala 3.6-5.4 mm longa, superne albida, basi purpurea. Silicula late ovata vel suborbiculata, cymbiformis, 4-5 x 5-9 mm, alis radiate plicatis, purpureis, subintegris, uniformibus vel versus apicibus latioribus, apice emarginata, unilocularis, semine 1, stylo 1 mm longo sinu exserto.

*Holotypus*. Iran, Prov. Khorasan, NW of Sabzevar, Joqatai Mountains, Kotal Khakestari, 1784 m, 29.V.2009, 36°21'43" N-57°18' 55" E, M. R. Joharchi 42831 (FUMH).

*Etymology*. The specific epithet refers to the city of Sabzevar in Khorasan province, where the type specimen was collected in its vicinity.

Glabrous perennial herb with a long, thin, woody rhizome. Stem base more or less woody, producing a few ascending to suberect, usually unbranched herbaceous flowering and non flowering shoots, 5.5-14 cm long. Shoots densely covered by leaves, up to 2-6 cm from base. Leaves all alternate, a few of the lowest ones opposite, all quit entire, glaucous, fleshy, with inconspicuous veins; lower leaves shortly petiolate, ovate-orbicular, 10-11 x 8-9 mm; middle and upper leaves subsessile, ovate to broadly elliptical, obtuse to

acute, 4-18 x 2-12 mm. Inflorescence a simple, ebracteate raceme, condensed in early anthesis, later elongating (fruiting raceme 20-40 mm long). Sepals 2.2-3 mm long, green, with scarious margins; outer ones saccate, boat-shaped, 0.5-1.2 mm wide (when flattened), ovate, obtuse; inner ones flat, broadly obovate, slightly cuculate, 1-1.5 mm wide. Petals 3.5-5.5 x 1-2.2 mm, white with upper part of claw and basal part of lamina dark purplish, obovate, without a distinct claw, with 3 nerves at base. Filaments of outer two stamens 2-2.5 x 0.1-0.2 mm, cylindrical or somewhat flattened, slightly inward-curving; filaments of four inner (longer) stamens 3-3.5 x 0.2-0.5 mm, flattened, with a conspicuous tooth in the upper third. Anthers 0.55-0.6 mm long. ovoid, apiculate, pale yellow. Nectaries small, semiglobose, on both sides of shorter (outer) stamens. Ovary at anthesis ellipsoid, 2 x 1-1.5 mm; style c. 1 mm long; stigma small, capitate. Fruiting pedicels erecto-patent, straight, 4-5 mm long, distinctly thickened at the apex. Infructescence rather dense, with more or less imbricate siliculae. Silicula broad ovate to suborbicular, cymbiform, 4-5 x 5-9 mm, unilocular and 1-seeded, emarginate at both ends; loculus area elliptical, c. 3x1 mm, greenish-yellow, suture conspicuous; wing radiately plicate, 2-3 mm wide at the middle, uniform or slightly widening towards the apex, subentire, purplish. Free part of style c. 1 mm long, exceeding the apical notch. Seeds oblong, smooth. light brown, not mucilaginous, 1.5 x 1 mm.

*Distribution and ecology*. *Aethionema sabzevaricum* seems to be restricted to Khorasan Razavi province in NW Iran and thus represents one of the narrow endemics of the Irano-Turanian region in Iran. It has a local distribution. Presently, the new species is known only in an area of about 9 km<sup>2</sup>. This plant was found in three localities in Kuh-e Nazarga. It has a low density populations and grows in crevices of serpentine rocks in xeromorphic, very open dwarf-shrub lands dominated by *Nepeta glomerulosa* Boiss. subsp. *glomerulosa*, *Cousinia sabzevarensis* Rech. f., *Cousinia lepida* (Bunge) Boiss. and *Rheum* sp. Other characteristic species accompanying this species are: *Nepeta bracteata* Benth., *Cirsium congestum* Fisch. & C. A. Mey. var. *congestum*, *Euphorbia microsciadia* Boiss., *Euphorbia densa* Schrenk, *Tanacetum polycephalum* Schultz. subsp. *duderanum* (Boiss.) Podlech and *Allium kuhsorkhense* Fritsch. & Joharchi. The flowering period is from mid-May to early June, and the fruit-bearing period lasts from late May to mid-June.

*Taxonomic relationships and distinction*. Based on molecular data (Khosravi et al 2008), Iranian *Aethionema* species can be divided into two clades.

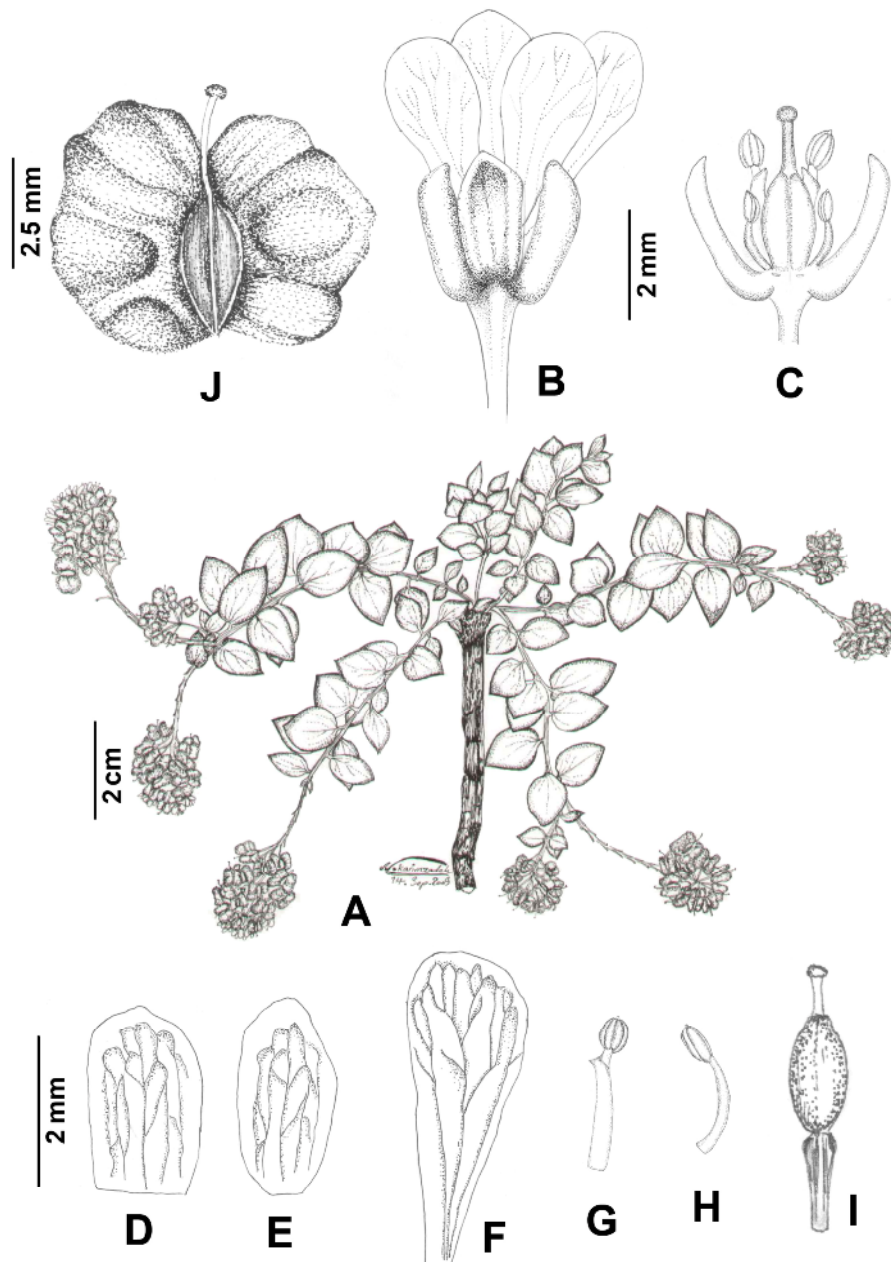


Fig. 1. *Aethionema sabzevaricum*. (A) Habit. (B) Flower. (C) Flower with 2 inner sepals, 4 petals and 2 of the inner stamens removed. (D) Outer sepal. (E) Inner sepal. (F) Petal. (G) Outer stamen. (H) Inner stamen. (I) Pistil. (J) Fruit.



Fig. 2. *Aethionema sabsevaricum*. (A) Habit. (B) Fruits.

Table 1. Comparison of morphological characteristics of *Aethionema sabzevaricum* with its closest allies.

Character	<i>A. sabzevaricum</i>	<i>A. semnanense</i>	<i>A. saxatile</i>	<i>A. polygaloides</i>	<i>A. carlsbergii</i>	<i>A. rhodopaeum</i>
Plant	Chasmophytic	On Calcareous scree	Chasmophytic	Chasmophytic	On Calcareous scree	Chasmophytic
Grown on	Serpentine soils	Calcareous soils	Calcareous or serpentine soils	Calcareous soils	Calcareous soils	Serpentine soils
Leaves texture	Fleshy	Fleshy	± Fleshy	± Fleshy	± Fleshy	Fleshy
Leaf shape	Ovate orbicular to broadly elliptical	Obovate orbicular	Ovate to linear-lanceolate	Ovate to oblong	Ovate orbicular to broadly elliptical	Obovate orbicular to broadly elliptical
Lower leaves	Opposite	Alternate	Opposite	Alternate	Opposite	Opposite
Middle & upper leaves	Alternate	Alternate	Alternate	Alternate	Alternate	Alternate
Outer sepals	Saccate	±Saccate	±Saccate	Saccate	±Saccate	Saccate
Petals	Without distinct claw	Clawed	Without distinct claw	Clawed	Clawed	Without distinct claw
Longer stamens	Toothed	Not toothed	Toothed	Not toothed	Toothed	Not toothed
Fruit	Monocarpic	Monocarpic	Often heterocarpic	Monocarpic	Monocarpic	Heterocarpic
Fruit	cymbiform	cymbiform	Flat	Flat	Flat	Flat
Fruit locule	Unilocular	Bilocular	Unilocular & bilocular	Unilocular	Unilocular	Unilocular & bilocular
Fruit seed	1-seeded	4-seeded	2-4-seeded	1-seeded	1-seeded	1 or 2- seeded

One clade included *Aethionema* species with linear leaves and the other clade included broad leaves *Aethionema*. Morphologically, *A. sabzevaricum* belongs to broad leaves *Aethionema* clade. However, none of Iranian broad leaves *Aethionema* species are similar to *Aethionema sabzevaricum*. Just like *Aethionema semnanense* have fleshy leaves and cymbiform fruits. Morphologically, *A. sabzevaricum* is more closely related to the *A. saxatile* group *sensu* Chater & Akeroyd (1993), including the polymorphic species *A. saxatile* (L.) R. Br., which is widely distributed in Turkey and southern Europe and the endemic species *A. carlsbergii* Strid & Papan. (from Greece), *A. rhodopaeum* D. Pavlova (from Bulgaria) and *A. polygaloides* DC. (from Turkey). However, its differences from these species are shown in Table 1.

*Further specimens examined.* Iran, Prov. Khorasan, NW of Sabzevar, Joqatai Mountains, Roudkhane Sorkhi, 1933 m, 29.V.2009, 36°21'45"N-57°18' 43"E, M. R. Joharchi (FUMH) 42832; *ibid*, Soltan Seyyed Qoreish, 2482 m, 29.V.2009, M. R. Joharchi, 42833 (FUMH).

### Key to broad leaves *Aethionema* species in Iran

1. Siliculae unilocular, 1-seeded 2
1. Siliculae bilocular, 1-4-seeded 4

2. Low-growing perennials up to 14 cm; siliculae cymbiform *A. sabzevaricum* Khosravi & Joharchi
2. Dwarf perennials up to 8 cm high; siliculae not cymbiform 3
3. Leaves subopposite, rotund-ovate, inflorescence multiflora, densely capitate; siliculae c.10 mm *A. cephalanthum* (Bornm.) Bornm.
3. Leaves alternate, linear-elliptic, inflorescence pauciflora, corymbose; siliculae 3-3.5 mm *A. umbellatum* Bornm.
4. Siliculae with entire margins, cymbiform *A. semnanense* Mozaff.
4. Siliculae with toothed or irregularly lacerated margins 5
5. Leaves ± cordate, deltoid, sub-amplexicaul with acute apiculate apices; petals lilac, pink, white or yellow; siliculae 5-7 mm, wings irregularly and variably toothed *A. cordatum* Boiss.
5. Leaves ovate-lanceolate, sessile or subpetiolate; petals rose; Siliculae 9-12 mm, wings deeply fimbriate *A. fimbriatum* Boiss.

### References

- Al-Shehbaz, I. A., Beistein, M. A. & Kellogg, E. A. 2006: Systematics and phylogeny of the Brassicaceae (Cruciferae): an overview. -Plant Systematics and Evolution, 259: 89-120.

- Bailey, C. D., Koch, M. A., Mayer, M., Mummenhoff, K., O'Kane, S. L., Warwick, S. I., Windham M. D. & Al-Shehbaz, I. A. 2006: Toward a global phylogeny of the Brassicaceae. -Molecular Biology and Evolution, 23: 2142-2160.
- Beilstein, M. A., I. A. Al-Shehbaz & E. A. Kellogg. 2006: Brassicaceae phylogeny and trichome evolution. - American Journal of Botany, 93: 607-619.
- Boissier, E. 1867: Flora Orientalis 1 (Thalamiflorae). -- - Basel & Genève (Reprinted 1975 by A. Asher & Co.). xxxiv + 1017 pp.
- Busch, N. A. 1939: Aethionema R. Br. in Komarov, V. L. (ed.), Flora of the USSR. VIII: 552-568. -Akad. Nauk SSSR, Moskva-Leningrad. (In Russian.)
- Davis P. H., Mill R. R. & Tan K. (eds). 1988: Cruciferae Flora of Turkey and the East Aegean Island (supplement) 10: 29-58, 232-235. - Edinburgh: Edinburgh University Press.
- Güner A., Ozhatay N., Ekim T & Bafler K. H. C. (eds) 2000: Cruciferae Flora of Turkey and the East Aegean Island (supplement 2) 11: 29-41. - Edinburgh: Edinburgh University Press.
- Hall, J. C., K. J. Sytsma & H. H. Iltis. 2002: Phylogeny of Capparaceae and Brassicaceae based on chloroplast sequence data. -American Journal of Botany, 89: 182-1842.
- Hedge, I. C. 1965: Aethionema in Davis, P. H., Cullen, I. & Coode, M. J. E. (eds.). Flora of Turkey and the East Aegean Islands, 1: 314-330. -Edinburgh University Press, Edinburgh.
- Hedge, I. C. 1968: Aethionema in Rechinger, K. H. (ed.), Flora Iranica 57: 102-110. -Akademische Drucku. Verlagsanstalt Graz, Graz.
- Khosravi, A. R. 1989: Cytotaxonomy and phylogeny of the Cruciferae. - MSc thesis. Tarbiat Modarres University, Iran. [In Persian with English summary].
- Khosravi A. R., Mohsenzadeh, S. & Mummenhoff, K. 2008: Analysis of the phylogenetic position of *Acanthocardamum erinaceum* (Brassicaceae) based on ITS-sequences shows that it should be transferred to *Aethionema* as *A. erinaceum*. -Nordic Journal of Botany, 26 (1-2): 25-30.
- Khosravi A. R., Jacquemoud, F., Mohsenzadeh, S., Menke, M. & Mummenhoff, K. 2009: Phylogenetic position and taxonomic classification of *Aethionema trinervium* (Brassicaceae): A morphologically variable subshrub from southwestern Asia. -Annals of the Missouri Botanical Garden, 96: 564-575.
- Mozaffarian, V. 1996: Studies of the flora of Iran, new species, new combination and new records. -Iranian Journal of Botany, 7(1): 127-142.