

THREE NEW SPECIES AND A KEY TO THE SPECIES OF THE GENUS ARENARIA L. (CARYOPHYLLACEAE) IN IRAN

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Arenaria semiromica from Isfahan province, *A. assadii* and *A. longibracteata* both from Azerbaijan province belong to the family Caryophyllaceae are described as new species from Iran. New key for the genus *Arenaria* in Iran, tables for comparison between the new species and the closest taxa, descriptions and illustrations are given in this paper.

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Key words. *Arenaria*, Caryophyllaceae, New species, Iran.

سه گونه جدید از جنس *Arenaria* L. (Caryophyllaceae) و کلیدی جدید برای شناسایی گونه‌های جنس در ایران فاطمه فدائی، استادیار پژوهش مرکز تحقیقات کشاورزی و منابع طبیعی استان گلستان. گونه *Arenaria semiromica* از استان اصفهان و دو گونه *A. assadii* و *A. longibracteata* از محدوده آذربایجان از تیره میخک به عنوان گونه‌های جدید برای علم گیاهشناسی برای اولین بار معرفی و شرح داده می‌شوند. کلید جدید شناسایی برای گونه‌های جنس، جدول مربوط به مقایسه گونه‌های جدید با نزدیکترین تاکسون به آنها، شرح گونه‌ها و تصاویر مربوط به آنها ارائه شده است.

INTRODUCTION

Caryophyllaceae is primarily Holarctic in distribution, with diversity centre in the Mediterranean and Irano-Turanian regions (Bittrich 1993), and includes about 3000 species distributed among 88 genera (Rabeler & Hartman 2005). The most common classification (Pax & Hoffman 1934; Bittrich 1993) of Caryophyllaceae includes three subfamilies: *Alsinoideae* Burnett, *Caryophylloideae* Arn., and *Paronychioideae* A. St. Hil. ex Fenzl. Bittrich (1993) placed the 28 genera of the *Alsinoideae* into five tribes, the tribe *Alsineae* consist of 23 genera including one of the large genera in the family; *Arenaria* sensu lato (with *Eremogone* elements). Harbaugh & al. (2010) proposed division of the Caryophyllaceae into at least 11 tribes based on highly supported monophyletic groups and described a new tribe, *Eremogoneae* Rabeler & W. L. Wagner. As Zhou (1996) mentioned, there are ca. 306 species of *Arenaria* L. in the world mainly distributed in Eurasia, America and Northern Africa. Based on Rechinger Flora Iranica (1988), the genus *Arenaria* in Iran including two subgenera, *A.* subgen. *Arenaria* with three sections including six species and *A.* subgen. *Eremogone* with five sections including 10 species, one subspecies and one variety; seven species and one

variety of the genus are endemics for Iran. Based on the recent study by the author (not published), *A. bulica* Stapf ex Williams, and *A. blepharophylla* Boiss., were not found among *Arenaria* materials in Iran, in addition there are some doubtful notes in the Floras about them, therefore they are mentioned as uncertain taxa for Iran. Based on new materials collected by the author, the new species, *A. kandavanensis* F. Fadaie, M. Sheidai and M. Assadi was published (Fadaie, Sheidai & Assadi, 2010).

The aim of this paper is to describe three new more species and present a new key to the accepted species of the genus *Arenaria* in Iran.

MATERIAL AND METHODS

The author has been preparing the draft of *Arenaria* Flora of Iran since some years ago (Assadi 1989). Most of the Iranian herbaria have been visited and the plant specimens have been named by using available literature such as Shishkin & Knorring (1970), McNeill (1962 & 1967) and Rechinger (1988). Excursions to different parts of Iran have been made to do field studies and also to collect new materials. The materials are preserved in TARI and the herbarium of Research Center of Agriculture and Natural Resources of

Golestan province.

RESULTS

Identification key to the species of *Arenaria* L. in Iran

1. Plants annual 2
- Plants perennial 3
2. Median leaves lanceolate – ovate, glabrous. Sepals 2.3 – 3 mm. long, 0.5 – 1 mm. broad, with 3 prominent veins. Petals 0.5 mm. broad. Inflorescence dichasial
 - A. leptoclados*
 - Median leaves oblanceolate – obovate, pubescent. Sepals more than 3 and up to 5.5 mm. long, more than 1 and up to 3 mm. broad, with 3-5 veins. Petals more than 0.5 and up to 1.1 mm. broad. Inflorescence in lower part dichasial and in upper part monochasial
 - A. serpyllifolia*
3. Plants entirely herbaceous or sometimes only in basal part ligneous, prostrate to decumbent, or a small and erect plant 4
- Plants in basal part often ligneous or at least indurate, erect cushions, never prostrate nor draft plants 7
4. Plants erect, up to 4 cm. tall *A. minutissima*
- Plants prostrate to decumbent, 10 – 15 cm. tall 5
5. Leaves broadly ovate to suborbicular. Stems and inflorescences axis densely pubescent. Petals 2.5 – 3.3 mm. long *A. rotundifolia*
- Leaves elliptic to obovate, or lanceolate to oblanceolate. Plant entirely glabrous or entirely pubescent to glandular pubescent. Petals 3.5 – 7.1 mm. long 6
6. Leaves elliptic to obovate, rarely lanceolate, obtuse. Sepals lanceolate, sometimes long ovate, up to 2.3 mm. broad *A. balansae*
- Leaves lanceolate to oblanceolate or subelliptic, acute to subapiculate at the apex. Sepals lanceolate to long lanceolate or sometimes sublinear, up to 1.5 mm. broad *A. semiromica*
7. Staminal glands present 8
- Staminal glands absent 9
8. Petals shorter than sepals. Lower leaves of flowering stems 3 – 4 mm. long *A. assadii*
- Petals longer than sepals (up to 1.5 times). Lower leaves of flowering stems 7 – 10 cm. long *A. graminea*
9. Leaves grass like – linear or setaceous, often 1.5 – 2.5 mm., sometimes 5 mm. broad 10
- Leaves linear to linear – pungate or setaceous, often 0.5 – 1 mm. sometimes up to 1.5 mm. broad 15
10. Inflorescence a compact terminal head. Leaves of the sterile stems 7.5 – 16.5 cm. long *A. dianthoides*
- Inflorescence cymose or lax panicle 11
11. Sepals more than 3 up to 5.5 mm. long *A. gypsophiloides*
- Sepals more than 5.5 up to 10 mm. long 12

12. Median leaves of the flowering stems grass-like to linear, 7 – 13.5 cm. long 13
- Median leaves of the flowering stems setaceous or linear, 2.8 – 6.5 cm. long 14
13. Main stems flowering and erect. Sepals broadly ovate, at the apex acute to membranous obtuse or membranous rounded, 3 – 5.5 mm. broad

A. cucubaloides

- Main stems prostrate and vigorous. Flowering stems erect. Sepals ovate – lanceolate, at the apex acute to caudate up to 3 mm. broad

A. holostea

14. Flowering stem leaves 2.8 – 5.3 cm. long. Inflorescence 1 – 5 flowered. Pedicels shortly glandular pubescent

A. szowitzii

- Flowering stem leaves 5.5 – 6.5 cm. long. Inflorescence 10 – 16 flowered. Pedicels glabrous

3. *A. longibracteata*

15. Inflorescence a compact terminal head. Petals oblong to oblong – linear, 1.2 – 2 mm. broad 16

- Inflorescence often cymose or a lax panicle. Petals not as above, more than 2 to 5.5 cm. broad 17

16. Sepals 3.3 – 5.1 mm. long, entirely glabrous to in basal parts glandular pubescent. Petals 4 – 5.5 mm. long

A. polycnemifolia

- Sepals 6 – 9 mm. long, entirely glabrous. Petals 7 – 10 mm. long

A. zargariana

17. Leaves with a narrow scarios margin, the short sterile leafy shoots densely imbricate, tetrastichous. Sepals ovate – lanceolate, obtuse. Petals obovate to oblong

A. tetrasticha

- Leaves without a scarios margin. Sterile leafy shoots congested rosettes, not appearing tetrastichous. Sepals often acute. Petals obovate to spatulate, oblong – elliptic or broadly ovate 18

18. Plants caespitose. Leaves pungent; basal leaves 0.6 – 2.3 cm. long. Petals oblong – elliptic or broadly ovate 19

- Plants not caespitose. Rosette Leaves setaceous, 2.5 – 6 cm. long. Petals obovate to spatulate

A. kandavanensis

19. Flowering stems leafless. Plants forming spiny cushions. Pedicels glabrous. Petals oblong – elliptic

A. persica

- Flowering stem leaves present. Plants usually very densely pulvinate. Leaves persisting on the lower parts, imbricate. Pedicels pubescent. Petals broadly ovate

A. insignis

New species

Arenaria semiromica F. Fadaie, *sp. nov.* (Fig. 1).

Typus. Iran, prov. Esfahan, East of Semirom, Aeeneh – Ghabri mountain, 3000 – 3700 m., Assadi & Mozafarian 31703 (holotypus TARI).

Diagnosis. Affinis *A. balansae* Boiss. sed differt foliis



Fig. 1. *Arenaria semiromica* ($\times 1$); details ($\times 10$).

lanceolatis usque sublanceolatis vel subrhomboidis (nec saepe ellipticis usque obovatis), acutis usque subapiculatis (nec obtusis), 0.8 – 1.5 mm. (nec 1.5 – 3.5 mm.) latis, sepalis lanceolatis usque anguste lanceolatis vel sublinearis (nec ovato – lanceolatis).

Slender densely prostrate mat-forming perennial plant to 10 cm. tall, nearly glandular hairy, in basal parts with persistent yellow dead leaves. Stems slender and fragile. Leaves 2 – 4 (6) × 0.8 – 1.5 mm., lanceolate to suboblanceolate or subrhomboid, green herbaceous, sessile, inconspicuously uni-nerved, apex acute to subapiculate. Inflorescence consist of one terminal flower. Bracts narrowly oblong to linear, 3 × 0.3 mm. Pedicels 5 – 10 mm. long. Sepals 4 – 5 × 1.1 – 1.5 mm. lanceolate to long lanceolate, or sublinear with narrow membranous margin, uni-nerved, acute. Petals 5 – 6 × 1.6 – 2.1 mm., narrowly obovate to subspathulate, apex rounded, exceeding calyx. Stamens often 8. Flowering and fruiting. June – October.

The new species is similar to *A. balansae* Boiss especially var. *balansae* but differs from it by having leaves lanceolate to sublanceolate or subrhomboid (not elliptic to obovate and sometimes lanceolate), acute to subapiculate (not obtuse), 0.8 – 1.5 mm. broad (not 1.5 – 3.5 mm.). Sepals lanceolate to long lanceolate or sublinear (not ovate – lanceolate).

***Arenaria assadii* F. Fadaie, sp. nov.** (Fig. 2).

Typus. Iran, prov. Azerbaijan, Khoy, 1300 m. Assadi 85212 (holotypus TARI).

Diagnosis. Affinis ab *A. blepharophylla* Boiss. sed differt foliis rosularis 3 – 9 cm. (nec 6 – 15 cm.) longis, sepalis 4 – 5 mm. (nec 2 – 2.5 mm.) longis, petalis sepalis brevioribus (nec 1.5 – plo longioribus), foliis caulinis floriferis 5 – 7 cm. (nec 2 – 6 cm.) longis, pedicello 2 – 3 (- 4) mm. (nec 2 – 10 mm.) longo.

Erect tufted perennial, up to 36 cm. high, only in median internodes and a little far from lower node glandular pubescent. Basal sterile leaves rosette, setaceous to acicular, 3 – 9 cm. long and 0.5 – 0.8 mm. broad. Flowering stem leaves 5 – 6 pairs, linear to strap-shaped, the lowers 3 – 4 cm. and the uppers up to 6 cm. long and all of them 1 – 1.15 mm. broad, serrulate. Inflorescence a lax cymose panicle of many 1 – 5 flowered cymules, 10 – 16 cm. long, glabrous. Lowest bracts 6 – 10 mm. long, flowering bracts 2 – 2.5 mm. long. Pedicels 2 – 3 (- 4) mm. long, glabrous. Sepals 4 – 5 × 2 – 3 mm., ovate, membranous or subcoriaceous, at the apex membranous obtuse to membranous rounded, with 3 – 5 veins, prominent

especially in outer side, frequently not killed, glabrous. Petals 3 – 4 × 1.1 – 1.5 mm. obovate – oblong, at the apex rounded or sometimes subtruncate, shorter than sepals. Staminal glands 10, up to 1 mm. long, in apices developed. Capsule broadly ovate or sometimes sub spherical, 4 – 5 × 3.5 – 4 mm., as long as or a little longer than calyx.

Flowering and fruiting. May – August.

A. blepharophylla Boiss, *A. blepharophylla* var. *parviflora* (Fenzl) McNeill (syn: *A. steveniana* Boiss) and *A. graminea* are close to *Arenaria assadii*, but differs in some of characters given in table 1.

***Arenaria longibracteata* F. Fadaie, sp. nov.** (Fig. 3).

Typus. Iran, prov. Azerbaijan, Salmas to OrUmiyeh, Ghooshchi pass, 1750 m. Runemark and Foroughi 19588 (holotypus TARI).

Diagnosis. Affinis ab *A. szowitzii* Boiss. sed differt bracteis floralis 7 – 7.5 mm. (nec 2.5 – 4.5 mm.) longis; bracteis imis 2.1 – 3.8 cm. (nec 0.7 – 2.1 cm.) longis, foliis caulibus floralis medianis 5.5 – 6.5 × 0.1 cm. (nec 2.8 – 5.3 × 0.5 – 1.5 cm.), floris 10 (nec 1 – 5), pedicellis 0.3 – 2.5 cm. (nec 1.3 – 1.6 cm.) longis; sepalis acutis vel acuminatis (nec caudatis vel interdum acutis), 8 – 10 × 2.5 – 3.5 mm. (nec 5.5 – 10 × 3 – 4 mm.), petalis anguste ellipticis vel suboblongis (nec oblongo – ellipticis). Table 2.

Erect perennial plant, up to 28 cm. high, glabrous. Sterile shoots numerous, up to 17 cm. long with up to 12 internodes. Leaves of sterile shoots 1 – 7.5 × 0.5 – 1 (-1.2) mm., lorate – acicular to subsetaceous, often with small axillary fascicles of setaceous leaves in nodes. Flowering stems with 12 internodes. Leaves of flowering stems 5.5 – 6.5 cm. long and 1 (-1.5) mm. broad, glabrous, serrulate. Inflorescence a lax cymose panicle, arising at the 8th or upper node with three to five 1 – 3 flowered clusters, glabrous. A long axis with one flower arising from 1 – 2 nodes below of main inflorescence. Lowest bract at the node of long axis, 4.5 cm. long. Lowest bract in main panicle 3.8 cm. long; flowering bract 7.5 mm. long. Pedicels 0.3 – 2.5 cm., glabrous. Upper flowers with a lilac tint and lower flowers brownish, tips greenish. (based on collectors notes). Sepals 8 – 10 × 2.5 – 3.5 mm., lanceolate with broadly membranous margin, acute to acuminate, sometimes killed, with narrow median green part and broad membranous margin, glabrous, with 1 – 3 prominent veins; median vein distinct up to the apex. Petals (9.2-) 10 – 12 × (3-) 3.8 – 4 (-5) mm. elliptic to suboblong, obtuse or sometimes subtruncate or retuse, 1.5 – 2 times as long as calyx.

Flowering. from May.



Fig. 2. *Arenaria assadii* ($\times 0.54$); sepals and petal ($\times 5.4$); ovary and stamen ($\times 8$).



Fig. 3. *Arenaria longibracteata* ($\times 0.66$); sepals and petal ($\times 3.3$.); stamen and ovary ($\times 6.6$).

Table 1: Morphological comparison of the *Arenaria assadii* and its relatives.

Characters \ Taxa	<i>Arenaria assadii</i>	<i>A. blepharophylla</i> (Rechinger 1988)	<i>A. blepharophylla</i> var. <i>parviflora</i> (Mc. Neill 1962) Syn: <i>A. steveniana</i> (Komarov 1970)	<i>A. graminea</i>
Sepals length	4 – 5 mm.	2 – 2.5 mm.	2 mm.	3.5 – 4.5 mm.
Petals length	Shorter than sepals, 3 – 4 mm. long	1.5 times as long as than sepals	1.5–2 times as long as than sepals, 5 mm. long	Longer than sepals, 6–9 mm. long
Length of flowering stem leaves	5 – 7 cm.	2 – 6 cm.	4 – 4.5 cm.	12 – 18 cm.
Length of rosette leaves	3 – 9 cm.	6 – 15 cm.	6 – 8 cm.	Absent
Pedicels length	2 – 3 (-4) mm.	2 – 10 mm.	4 – 7 mm.	3 – 15 mm.
Sepals shape	Ovate	Broadly ovate	Broadly oblong	Ovate
Number of sepals veins	3 – 5 (- 9)	1 - 3	-----	5 – 9
Inflorescence type	A lax cymose panicle	A lax cymose panicle	Corymbiform	Panicle
Stem indumentum	Glandular pubescent in median internodes	Glabrous or in lower part puberulent	Glandular pubescent in inflorescence, rarely glabrous	Glabrous
Staminal glands length	0.7 – 1 mm.	-----	-----	0.4 – 0.5 mm.

Table 2. Morphological comparison of the *Arenaria longibracteata* and its relative species *A. szowitsii*.

Characters \ Taxa	<i>Arenaria longibracteata</i>	<i>A. szowitsii</i>
Flowering bracts length	7 – 7.5 mm.	2.5 – 4.5 mm.
Lowest bracts length	2.1 – 3.8 cm.	0.7 – 2.1 cm.
Median flowering stem leaves	5.5 – 6.5 × 0.1 cm.	2.8 – 5.3 × 0.5 -1.5 cm.
Lateral flowering axis	A one flowered axis arising from 1 or 2 lower nodes than main inflorescence	Absent
Number of flowers in inflorescence	Usually 10	1 – 5
Pedicels length	0.3 – 2.5 cm.	1.3 – 1.6 cm.
Sepal apex	Acute to acuminate	Caudate or sometimes acute
Sepals veins	1 – 3, median prominent	3 prominent and 2 – 8 indistinct
Sepals size	8 – 10 × 2.5 – 3.5 mm.	(5.1 -) 5.5 – 10 × 3 – 4 mm.
Petals shape	Long elliptic to nearly boblong	Oblong – elliptic
Stems position	Flowering stems and sterile leafy shoots arising from one point on vigorous root	Flowering stems and sterile leafy shoots arising separately and away from creeping caudex

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