A New Record of *Cerastium* (Caryophyllaceae) from Iran with Emphasis on its Micromorphological Characteristics

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Abstract

Caryophyllaceae Juss. is a large family. The center of its distribution is in the Mediterranean region and adjoining parts of Europe, and in Western and Central Asia. The family has been divided into three subfamilies (Bittrich 1993). Genus *Cerastium* L. belongs to the subfamily of Alsinoideae Fenzl. This genus is classified into two subgenera and three sections in Flora Iranica area. The aim of this paper is to describe a new record and to compare it with its close relative based on morphology and micromorphology of seed and pollen. During a revision of the genus *Cerastium* in Iran, *Cerastium pentandrum* (L.) was identified as a new record according to Möschl (1988). *Cerastium pentandrum* is reported from Northwestern Iran and the Iranian plateau. It belongs to subgen. *Cerastium* sect. *Orthodon* Ser. Morphological characteristics, as well as a full description and distribution of the new record are provided. This taxon is compared with its closest relative *C. balearicum* Hermann. The ultrastructure of seed and pollen is examined by SEM.

Introduction

Caryophyllaceae Juss., including three subfamilies comprising about 86 genera and about 2200 cosmopolitan species, is frequent in the temperate regions of the Northern Hemisphere [1]. Genus *Cerastium* L. belongs to the subfamily Alsinoideae Fenzl. This genus is represented by about 30 species classified in two subgenera (subgen. *Dichodon* (Bartl.) Fenzl and subgen. *Cerastium*) and three sections (sect. *Strephodon* Ser., sect.

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Orthodon Ser. and sect. *Schizodon* (Fenzl) Schischkin) in the Iranian plateau [2], of which 19 species were reported from Iran.

During preparation of the taxonomic treatment of the genus *Cerastium* for the Flora of Iran, *Cerastium pentandrum* L. was identified and is reported as a new record for Iran and Flora Iranica area. The new record belongs to subgen. *Cerastium* sect. *Orthodon*. In this section, with 14 species in Iran, teeth of the capsule are elongated, straight or reflexed, with flat or recurved margins. As in other members of Caryophyllaceae, the seeds in *Cerastium* bear numerous characters which can be used for taxonomic purposes. The ornamentation features of the seed surface and its relief are different from one species to another [3]. In the genus *Cerastium* shape of testa cells is a diagnostic character. In this paper, micromorphology of seed and pollen grains are examined by SEM.

Materials and Methods

The materials were determined in the herbarium of TARI [4]. The vegetative and reproductive characteristics of specimens were studied by stereomicroscope. Specimens were evaluated using several local and neighboring Floras [5], [6], [7], [2]. Ultrastructural observations were based on the material collected in natural populations. The seeds and pollen grains were sampled from dried specimens at the herbarium of TARI (*C. pentandrum*: Runemark & Forughi 19888; *C. pentandrum*: Kalvandi & Najafi 3967; *C. balearicum*: Runemark & Forughi 19671). The seeds were taken from mature and dehiscent capsules. Only healthy and mature seeds were studied. Pollen grains obtained from flowers bearing mature anthers. For scanning electron microscopy, seeds and pollen grains were mounted on stubs with double sided adhesive tape and were then coated with gold in a sputter coater at an accelerating voltage of 15 KV. These coated seeds and pollen grains were examined in different positions using different magnifications and then photographed with LEO 440i scanning electron microscope.

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Results and Discussion

New record

Cerastium pentandrum L. (Figure 1)

Annual, up to 19.5 cm high, covered with eglandular and glandular hairs. Stems erect or ascending, 7-14 cm long, with long flowering branches in the axils of leaves. Leaves mucronate, on the both surfaces with eglandular and glandular hairs; middle leaves 7-11 mm long, 1.8-4.5 mm wide, obovate or spatulate; upper leaves 6-10 mm long, 2.5-5 mm wide, elliptic or oblanceolate or obtrullate. Lower bracts 3-6.5 mm long, 1.5- 4.2 mm wide, ovate or narrowly elliptic or rhomboid, mucronate or acuminate, on the both surfaces with eglandular and glandular hairs, not scarious at margins and at tips; upper bracts 2-3.5 mm long, 0.5-1 mm wide, lanceolate or lanceolate-ovate, laciniate or acuminate, on upper surface glabrous and on lower surface with eglandular and glandular hairs, narrowly scarious at tips and at margins. Inflorescence 2.7-7.5 cm long, ± loose cyme. Pedicels 7-13 mm long, obviously longer than sepals, after anthesis reflexed and in fruiting erect or patent. Sepals covered with eglandular and glandular hairs; outer sepals 3-4 mm long, 0.7-1 mm wide, lanceolate, laciniate, scarious at tips and very narrowly scarious at margins; inner sepals 3-4.5 mm long, 0.7-1 mm wide, lanceolate, laciniate, scarious at margins and at tips. Petals 5, up to 1.7 mm long, up to 0.5 mm wide, with irregular dentate, glabrous, shorter than sepals. Filaments 1-2.3 mm long, glabrous; anthers 0.1-0.3 mm long, ± globose, pale yellow. Styles 5, 0.3-0.5 mm long. Capsules 4.5-7.5 mm long, 1-2.5 mm wide, cylindrical or conical-cylindrical, straight; teeth 10, 0.5-0.6 mm long, revolute margins. Seeds 0.5-0.7 mm, ± globose, pale brown, with obtuse verrucae. Pollen grains ± spheroidal, microechinate-microperforate. Flowering in late May and early June and seed ripening in late June at 1000-1750 m.

Distribution: The new record is distributed in Mediterranean region, SW and Central Asia, including: Iran, Iraq and Afghanistan [2]. It was collected from two localities in Iran: W Azerbaijan and Hamedan provinces (Figure 2). *C. pentandrum* represents as the Irano-Turanian element.

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Specimens seen: Iran, [Western] Azerbaijan: 18 km on road from Sardasht to Piranshahr, 1000 m, 26 .5 .1976, Runemark & Forughi 19888! [TARI]; Hamedan, Heydareh village, beside river, 1750 m, 16. 05. 1998, Kalvandi & Najafi 3967! [herbarium of Agricultural Research Center of Hamedan].

Morphologically, the closest relative of this species is *C. balearicum* Hermann. The latter is distributed in Mediterranean regions and SW Asia including: Iraq and Iran [2]. *C. pentandrum* differs from *C. balearicum* in having taller habit (up to 19.5 vs. 8 cm), lower bracts (hairy on the both surfaces vs. only hairy on lower surface, entirely heraceous vs. long scarious at the apex), different upper leaves (6-10 vs. 4-8.5 mm long and 2.5-5 vs. 2-4.5 mm wide, elliptic or oblanceolate or obtrullate vs. ovate or elliptic).

In flora Europaea [6], Flora of Turkey [7] and Flora of the U.S.S.R. [5], *C. pentandrum* and *C. balearicum* are regarded as synonymous of *C. semidecandrum* L. According to Möschl [2], [8], [9], [10] these three species are regarded as distinct. The specimens from Iran match fully with the descriptions of *C. pentandrum* presented in Flora Iranica.

C. semidecandrum differs from *C. balearicum* in plant height (3.5-17 vs. 4.5-8 cm), shape of the upper leaves (elliptic or narrowly elliptic vs. ovate or elliptic), pedicels of middle flowers (4.5-6.5 vs. 5-10 mm long), length of petal (always longer than filaments vs. as much as filaments or shorter), petal tip (often acutely bilobed, sometimes with very small teeth vs. with very small acute teeth or smooth).

Seed and Pollen Micromorphology (Figures 3, 4, 5, 6)

In micromorphological study on the seed of *C. pentandrum*, some important character states were scored (Table 1). The morphological characteristics of seeds were studied according to different characters used by Yildiz [3] and Fawzi *et al.* [11]. The most important differences between seeds of *C. pentandrum* and *C. balearicum* were: seed shape (± globose or triangular-globose vs. ± globose), number of suture point per plate (12-19 vs. 16-19), suture outline (V-shaped or digitate vs. mostly digitate), seed verrucae tip (rounded or obtuse vs. rounded). Pollen grains were studied and their characteristics and surface ornamentation were determined according to Yildiz *et al.*

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[12] and Perveen and Qaiser [13] (Table 2). The most important differences between pollen grains of *C. pentandrum* and *C. balearicum* were: diameter of pollen (20.280-28.049 vs. 20.140-25.157 µm), diameter of microperforations [0.081-0.223 (-0.361) vs. 0.0683-0.1257 µm], number of pores per pollen (12-14 vs. 10-12).



Figure1. *Cerastium pentandrum* L.; Runemark & Foroughi 19888.

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Figure 2. Distribution map of *Cerastium pentandrum* in Iran.

Table 1. Seed characters of *Cerastium pentandrum* and *C. balearicum*.

Characters	*C. pentandrum*	*C. balearicum*
Seed length × width (mm)	0.509-0.527 × 0.399-0.468	0.511-0.536 × 0.423-0.484
Seed length/width ratio	1.126-1.275	1.107-1.208
Seed shape	± Globose or triangular-globose	± Globose
Seed colour	Pale brown	Pale brown
Seed surface type	Convex and toward hilum concave	Convex and toward hilum slightly concave
Seed back	Convex	Convex
Hylar zone type	Recessed	Recessed
Testa cell length × width (µm)	73.423-112.50 × 31.063-70.450	79.451-100.213 × 27.490-77.942
Testa cell length/width ratio	1.596-2.363	1.285-2.890
Testa cell shape	Polygonal or elongated polygonal	Polygonal or elongated polygonal
Suture length × width (µm)	10.141-33.173 × 3.884-9.071	8.867-33.533 × 4.846-7.690
Number of suture point per plate	12-19	16-19
Suture outline	V- shaped or digitate	Mostly digitate
Seed verrucae shape	Conical, at apex rounded or obtuse	Convex, at apex rounded
Seed verrucae height (µm)	11.462-18.229	12.086-23.167
Seed surface granulation	Medium, ± dense, hyaline	Medium, ± dense, hyaline
Placement of granulation	Marginal	Marginal

Table 2. Pollen characters of *Cerastium pentandrum* and *C. balearicum*.

Characters	*C. pentandrum*	*C. balearicum*
Diameter of pollen (µm)	20.280-28.049	20.140-25.157
Pollen shape	± Spheroidal	± Spheroidal
Pollen ornamentation	Microechinate-microperforate	Microechinate-microperforate
Microechinate length × width (µm)	0.254-0.342 × 0.303-0.376	0.274-0.383 × 0.260-0.442
Diameter of microperforations (µm)	0.081-0.223 (-0.361)	0.0683-0.1257
Number of pores per pollen	12-14	10-12
Diameter of pores (µm)	3.265-3.803	3.199-4.480
Interporal distance (µm)	4.947-5.654	4.394-5.401
Number of gemmae on operculum	6-8	5-7

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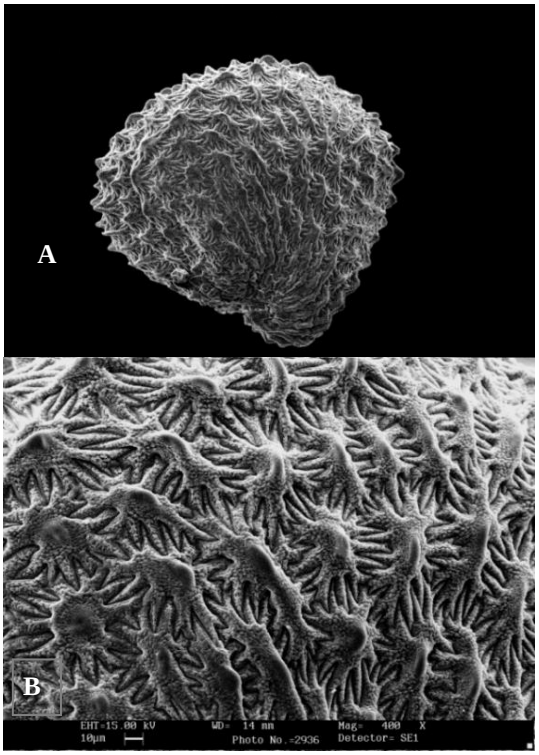


Figure 3. SEM of seed. -A-C: *Cerastium pentandrum* -A: General appearance -B: Lateral surface -C: Lateral surface (Marginal part) -Scale bars: A= 30 µm. B, C= 10 µm.

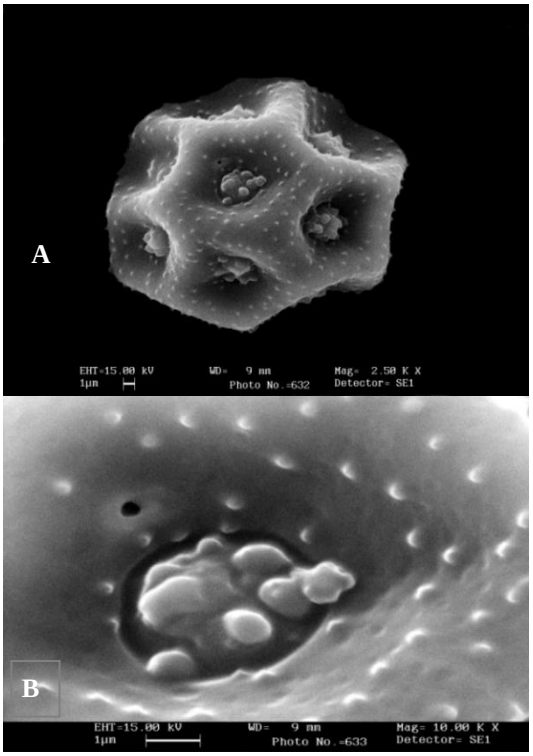
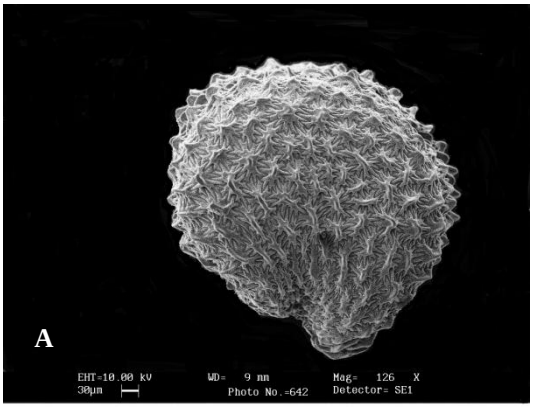
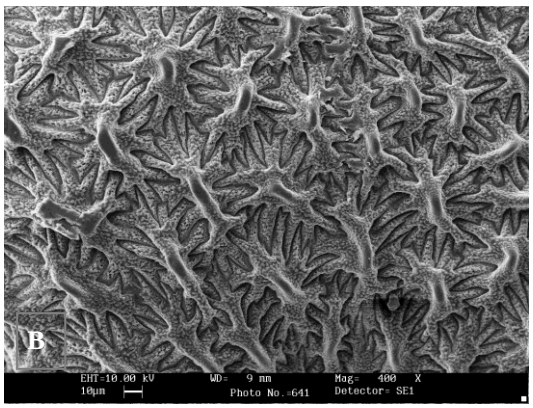


Figure 4. SEM of pollen. -A-C: Cerastium pentandrum -A: General appearance -B: Pore -C: Pollen ornamentation -Scale bars: A, B, C = 1 µm.

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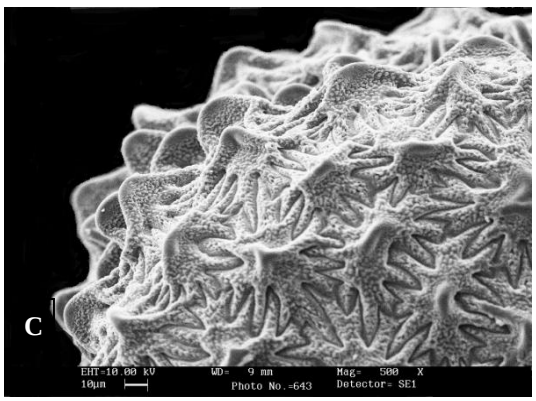
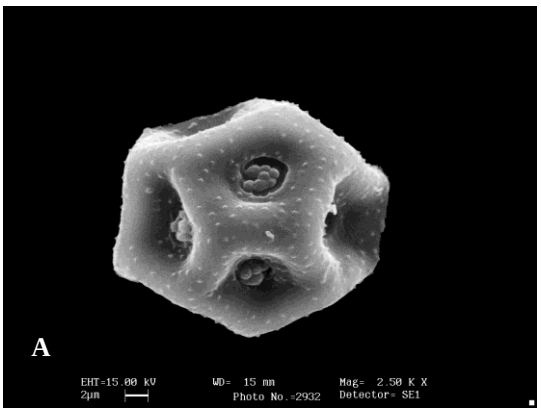
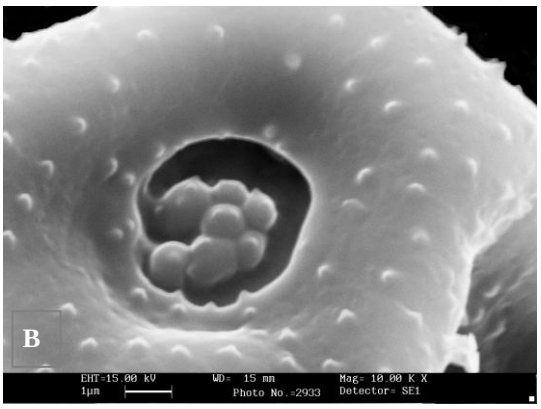


Figure 5. SEM of seed. –A–C: *Cerastium balearicum* –A: General appearance –B: Lateral surface –C: Lateral surface (Marginal part) –Scale bars: A= 30 µm. B, C= 10 µm.





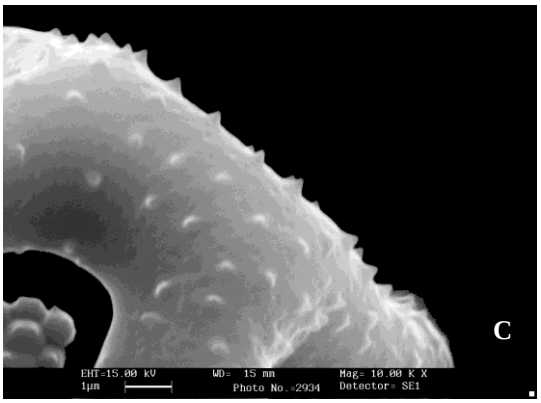


Figure 6. SEM of pollen. –A–C: *Cerastium balearicum* –A: General appearance –B: Pore –C: Pollen ornamentation –Scale bars: A= 2 µm. B, C= 1 µm.

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