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A NEW SUBSPECIES OF THE GENUS CERASTIUM L. (CARYOPHYLLACEAE) FROM IRAN

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Cerastium brachypetalum Pers. subsp. *iranicum* (Caryophyllaceae) is described as a new subspecies from West Iran. It belongs to the subgenus *Cerastium* section *Orthodon.* Morphological characteristics, as well as a full description and distribution of the new taxon are provided. This taxon is compared with the other subspecies of *Cerastium brachypetalum* and with its close relative species. Ultrastructure of seed and pollen was examined by SEM.

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Key words. Caryophyllaceae, *Cerastium*, taxonomy, seed, pollen, Iran.

معرفی یک زیر گونه جدید جنس Cerastium L. (Caryophyllaceae) از ایران

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زیر گونه *Cerastium brachypetalum* subsp. *iranicum* متعلق به تیـره میخکیان برای اولین بـار از غرب ایران به دنیای علم معرفی می‌گردد. علاوه بر مطالعه خصوصیات ریخت‌شناسی این زیر گونه، ویژگی‌های ریز ریخت‌شناسی دانه و دانه گرده آن نیز مورد بررسی قرار می‌گیرد. این تاکسون جدید با سایر زیر گونه‌ها و همچنین با گونه نزدیک خود مقایسه می‌گردد.

INTRODUCTION

Caryophyllaceae Juss. is a large family, more frequent in the temperate regions of the Northern Hemisphere (Bittrich 1993). This family includes 89 genera and ca. 3000 species worldwide, especially north temperate, montane and alpine, and Mediterranean areas (Rabeler & Hartman 2005). The family has been divided into three subfamilies; Alsinoideae, Silenoideae and Paronychioideae (Pax & Hoffmann 1934; Davis & Cullen 1965; Coode 1967). This arrangement of the family was changed by Bittrich (1993) as Alsinoideae, Caryophylloideae and Paronychioideae. The genus *Cerastium* L. belongs to subfamily Alsinoideae Fenzl. This genus is represented with about 30 species in the two subgenera (subgen. *Dichodon* (Bartl.) Fenzl and subgen. *Cerastium*) and three sections (sect. *Strephodon* Ser., sect. *Orthodon* Ser. and sect. *Schizodon* (Fenzl) Schichkin) in Flora Iranica area (Möschl 1988), of which 19 species were reported from Iran. In family Caryophyllaceae, the seeds 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 (Yildiz 2002). In the genus *Cerastium* shape of

testa cells was as diagnostic character. During a taxonomic revision of the genus *Cerastium* in Iran, *Cerastium brachypetalum* Pers. subsp. *iranicum* was determined as a new subspecies. *C. brachypetalum* belongs to subgen. *Cerastium* sect. *Orthodon.* In section *Orthodon* teeth of the capsule are elongated, straight or reflexed, with flat or recurved margins. This section includes 14 annual and perennial species in Iran. This subspecies has probably been introduced with the name Cerastium luridum Guss. in the Flora Iranica.

The aims of this paper is to describe *C. brachypetalum* subsp. *iranicum* as a new subspecies and to compare it with its close relatives based on morphology and micromorphology of seed and pollen.

MATERIALS AND METHODS

The materials in the herbarium of Research Institute of Forests and Rangelands [TARI (Thiers 2011)] were studied. The vegetative and reproductive characteristics of specimens were checked by stereomicroscope. Specimens were evaluated using several local and neighboring Floras (Shishkin 1936; Jalas & Whitehead 1964; Cullen 1967; Möschl 1988). Ultrastructural observations were based on the material collected in natural populations. They were then deposited as herbarium specimens. Seeds and pollen grains were sampled from dried specimens at TARI herbarium. 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.

RESULTS AND DISCUSSION

New subspecies

Cerastium brachypetalum Pers. subsp. **iranicum** Poursakhi, Assadi & F. Ghahrem. **subsp. nov.** Fig. 1.

Planta usque ad 24 cm alta. Caules pilis eglandulosis, longis, patentibus vel deflexis et in supra immixitis pilis glandulosis, longis, patentibus vel erectis. Pedicelli 4- 15 mm longi, pilis simplicibus et glandulosis immixitis. Sepala 4- 5.5 mm longa, pilis simplicibus et glandulosis immixitis. Petala sepalis breviora, basem ciliata, usque ad medium biloba. Filamenta glabra. Styli 0.8- 1 mm longi. Capsula 6.5- 9 mm longa, dentibus vix patentibus. Semina 0.5 mm longa.

Typus. Kermanshah, Parow Mountain, above Bisotun, 1710 m, 19 .04 .2001, Hamzeh'ee & Asri 87806b (holotypus TARI).

Annual, up to 24 cm high. Stems erect or ascending, 14-18 cm long; ± densely covered with long, patent or deflexed eglandular hairs, in upper part mixed with long, patent or erect glandular hairs. Leaves on the both surfaces and at the margins pilose, mucronate; basal leaves 6- 12 mm long, 2.5- 4.5 mm wide, spathulate, sparsely pilose; middle leaves 9- 15 mm long, 3- 7 mm wide, elliptic or elliptic- oblong or oblanceolate, ± densely pilose; upper leaves 9- 13 mm long, 4- 5.5 mm wide, elliptic or elliptic- oblong, ± densely pilose. Inflorescence a loose cyme. Bracts entirely herbaceous, mucronate; lower bracts 5- 10 mm long, 3- 4 mm wide, ovate or elliptic, on the both surfaces and at the margins ± densely pilose; upper bracts 2- 4.5 mm long, 1-2 mm wide, lanceolate or ovate- lanceolate, on the both surfaces and at the margins ± densely pilose with few glandular hairs. Pedicels slender, 4- 15 mm long, erect or patent, bent near apex, ± densely covered with long glandular and eglandular hairs. Sepals concave, lanceolate, ± acute or premorse, ± densely covered with long glandular and eglandular hairs; eglandular hairs exceeding well beyond the apex; outer sepals 4- 5.5 mm long, 0.8- 1.2 mm wide, at apex and at margins narrowly scarious; inner sepals 4.5- 5.5 mm long, 1.1- 1.5 mm wide, at apex and at margins scarious. Petals 3.5- 3.7 mm long, 1.2- 1.7 mm wide, cuneate or obovate, up to 1/2 bilobed, with a sinus 1.5- 2 mm long and obtuse lobes, ciliate at base, shorter than sepals. Stamens 10; filaments 1.5- 2.3 mm long, glabrous; anthers 0.2- 0.4 mm long, subglobose or elliptic, pale yellow. Styles 5, 0.8- 1 mm long, papillose. Capsule 6.5- 9 mm long, 1.7- 2.5 mm wide, cylindrical or cylindrical- conical, often straight or slightly curved; teeth 10, 0.7- 0.8 mm long, slightly patent, with recurved margins. Seeds 0.5 mm long, 0.4- 0.5 mm wide, subglobose, brown, with subacute tubercles. Mature placenta bacillar with short funicle. Flowering in May and seed ripening in late May to early June.

Distribution. *Cerastium brachypetalum* is endemic to Iran and Iraq in the Iranian-Turanian region. It is a variable species, widespread in the Mediterranean area and Central Europe. This new subspecies was collected from only one locality in Iran, Kermanshah province, Parow Mountain, above Bisotun, 1710 m.

C. brachypetalum has 8 subspecies in Flora Europaea (Jalas & Whitehead 1964), of which *C. brachypetalum* subsp. *tauricum* and subsp. *roeseri* are closest to *C. brachypetalum* subsp. *iranicum.* The new subspecies is also close to *C. glomeratum* Thuill. and is compared in details with its close relatives in Table 1.

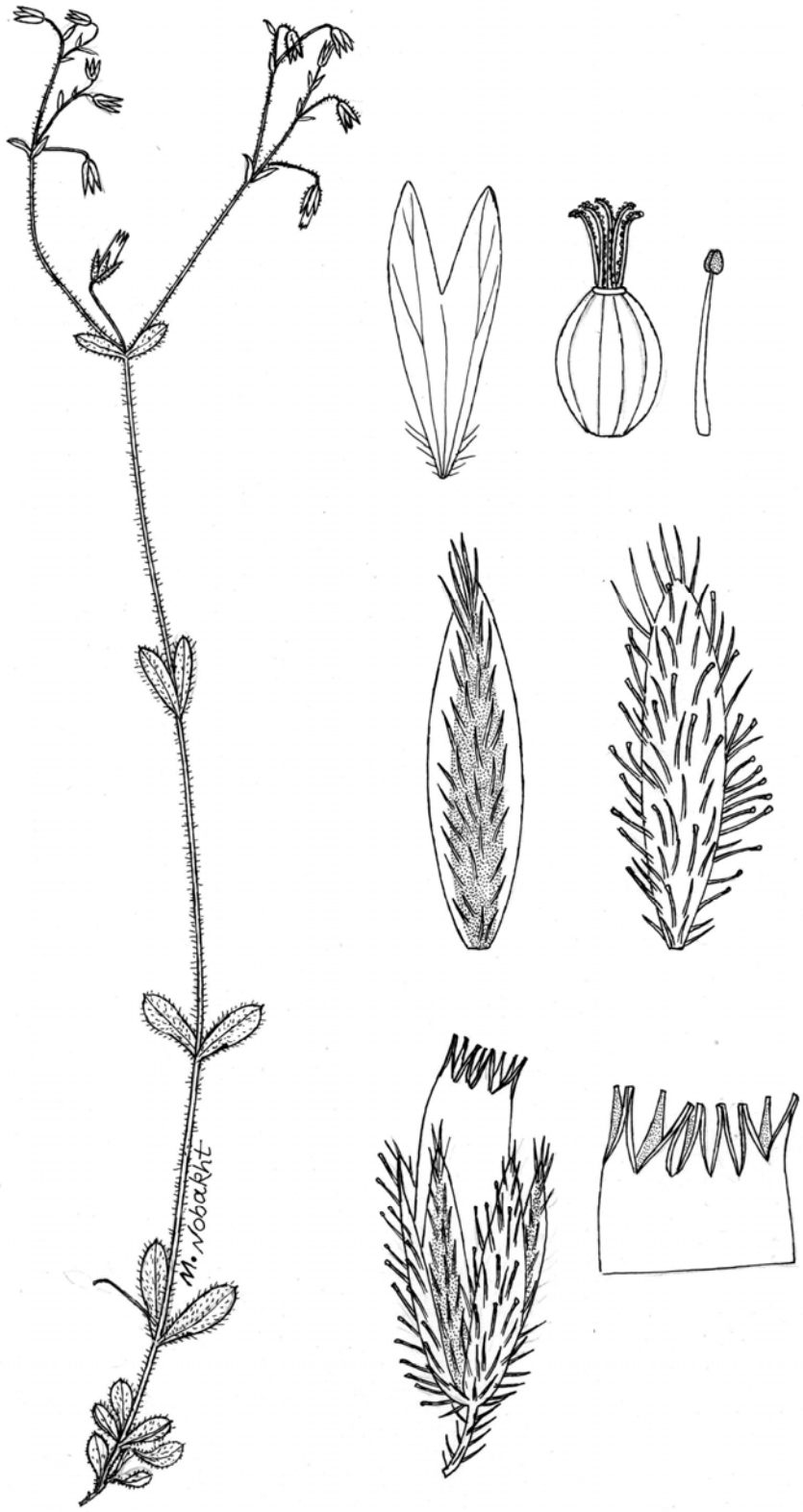

Fig. 1. *Cerastium brachypetalum* subsp. *iranicum* (× 0.8); sepals (× 10); petal (× 11); stamen (× 10); ovary (× 13).capsule (×).

Table 1. Morphological comparison of *Cerastium brachypetalum* subsp. *iranicum*, *C. brachypetalum* subsp. *brachypetalum*, *C. brachypetalum* subsp. *roeseri*, *C. brachypetalum* subsp. *tauricum* and *C. glomeratum*.

Species / Characters	*C. brachypetalum* subsp. *iranicum*	*C. brachypetalum* subsp. *brachypetalum*	*C. brachypetalum* subsp. *roeseri*	*C. brachypetalum* subsp. *tauricum*	*C. glomeratum*
Plant length (cm)	up to 24	5- 40	6- 35	5- 37	9- 30 (-45)
Stem indumentum	with long patent, deflexed eglandular hairs, in upper part mixed with long, patent, erect glandular hairs	with slightly ascending eglandular hairs, without glandular hairs	with dense long glandular and few eglandular hairs	with long patent or slightly ascending eglandular hairs mixed with long glandular hairs	eglandular hairs, in upper mixed with glandular hairs
Pedicel length (mm)	4- 15	5- 18	3- 10 (-15)	5- 27	2.5- 4.5
Pedicel indumentum	covered similar to the upper part of stem	covered similar to the stem	covered similar to the stem	covered similar to the stem	covered similar to the upper part of stem
Sepal length (mm)	4- 5.5	4- 5.5	4- 6.5	4.5- 5	3- 4.5
Sepal indumentum	covered similar to the upper part of stem	covered similar to the stem	covered similar to the stem	covered similar to the stem	covered similar to the upper part of stem
Petal	ciliate	glabrous or ciliate	glabrous	glabrous or ciliate	ciliate
Stamen	glabrous	glabrous or ciliate	glabrous	unknown	glabrous
Style length (mm)	0.8- 1	0.75- 1	0.75- 1.5	c. 0.75	0.6- 0.8
Capsule length (mm)	6.5- 9	6- 7.5	6- 9	6- 8	5- 9
Capsule teeth	slightly patent	patent	patent	patent	straight or slightly patent
Seed (mm)	0.4- 0.5	c. 0.5	0.6- 0.8	0.5- 0.6	0.4- 0.5 (-0.6)
Distribution	W. Iran	mainly in C. Europe, but extending to Spain, N. Italy and Denmark	S. Europe, from Balkan peninsula to Islas Baleares	W. and C. Europe extending to S. Sweden, Balkan peninsula and Krym	throughout Europe except the north-east. Iran, Iraq, Talish, Turcomania, Afghanistan and Pakistan

TAXONOMIC TREATMENT

Möschl (1988) recorded *C. luridum* in Flora Iranica from Iraq. This species and its subspecies have been regarded as synonymous of different subspecies of *C. brachypetalum* by different authors (Jalas & Whitehead 1964; Cullen 1967). The authors have not seen Iraqi specimens of *C. luridum* but they may well be in fact *C. brachypetalum* subsp. *iranicum.* Moreover, *Cerastium brachypetalum* agg. are mainly European and Mediterranean elements and Irani- Iraqi materials have well disjunct distribution from them.

SEED AND POLLEN MICROMORPHOLOGY

In micromorphological study on the seed of *C. brachypetalum* subsp. *iranicum* some important character states were identified (Table 2; Fig. 2). The morphological characteristics of seeds were studied according to different characters used by Yildiz et al. (2002) and Fawzi et al. (2010). Pollen grains were studied and their characteristics and surface ornamentation were determined according to Yildiz et al. (2010) and Perveen & Qaiser (2006) (Table 3; Fig. 3). This new taxon was also compared with its close

Table 2. Seed properties of *C. brachypetalum* subsp. *iranicum* and *C. glomeratum.*

Species / Characters	*C. brachypetalum* subsp. *iranicum*	*C. glomeratum*
Seed length × width (mm)	0.53- 0.55 × 0.45- 0.53	0.53- 0.55 × 0.43- 0.54
Seed length/ width ratio	1.03- 1.18	1.02- 1.23
Seed shape	± globose	triangular- globose
Seed colour	brown	pale brown
Seed surface type	convex, toward hilum concave	convex, toward hilum concave
Seed back	concave, slightly grooved	convex
Hylar zone type	little recessed	little recessed
Testa cell length × width (µm)	72.76- 153.12 × 30.17- 71.39	70- 114.32 × 47.93- 90.37
Testa cell length/ width ratio	1.53- 2.78	1.26- 1.46
Testa cell shape	often elongated polygonal or polygonal	often irregular polygonal or elongated polygonal
Suture length × width (µm)	5.53- 38.42 × 5.18- 9.47	13.17- 40.97 × 4.85- 16.17
Suture outline	v- shaped	v- shaped
Number of suture point per plate	13- 19	10- 14
Seed tubercle shape	long or short conical, tip subacute	convex, tip rounded or ± flat
Seed tubercle height (µm)	25.23- 42.08	16.79- 35.56
Seed surface granulation	coarse	medium
Placement of granulation	marginal	marginal

Table 3. Pollen properties of *C. brachypetalum* subsp. *iranicum* and *C. glomeratum*.

Species / Characters	*C. brachypetalum* subsp. *iranicum*	*C. glomeratum*
Diameter of pollen (µm)	26.82- 29.88	22.14- 23.65
Pollen shape	± spheroidal	± spheroidal
Pollen ornamentation	microechinate- microperforate	microechinate- microperforate
Microechinate length × width (µm)	0.23- 0.33 × 0.25- 0.41	0.14- 0.40 × 0.22- 0.37
Diameter of microperforation (µm)	0.07- 0.21	0.06- 0.17
Number of pores per pollen	22- 24	14- 16
Diameter of pores (µm)	2.91- 4.13	2.45- 3.65
Interporal distance (µm)	3.10- 5.92	3.78- 8.17
Number of granules on operculum	9- 12	8- 13

relative, *C. glomeratum*, micromorphologically (Tabel 2, 3; Fig. 4, 5).

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REFERENCES

Bittrich, V. 1993: Caryophyllaceae in K. Kubitzki et al. (eds.) The Families and Genera of Vascular Plants 2: 206- 236. –Springer- Verlag, Berlin.

Coode, M. J. E. 1967: Velezia L. in P. H. Davis Flora of Turkey and the East Aegean Islands 2: 135- 138. –Edinburgh at the University Press.

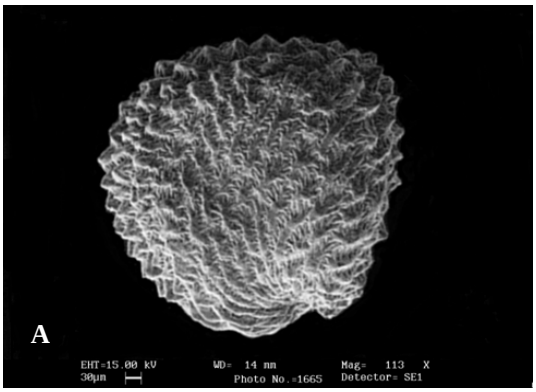
Cullen, J. 1967: Cerastium L. in P. H. Davis Flora of Turkey and the East Aegean Islands 2: 73- 85. –Edinburgh at the University Press.

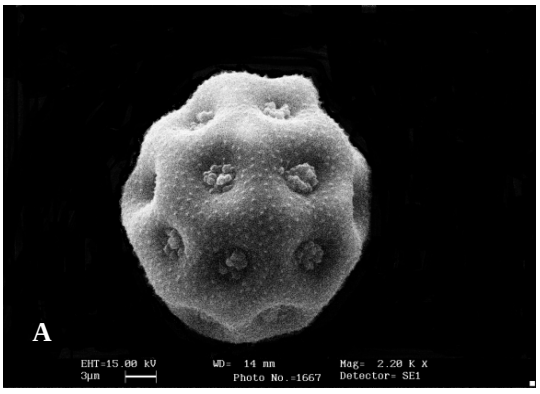
Davis, P. H. & Cullen, J. 1965: The Identification of Flowering Plant Families. –Cambridge at the University Press.

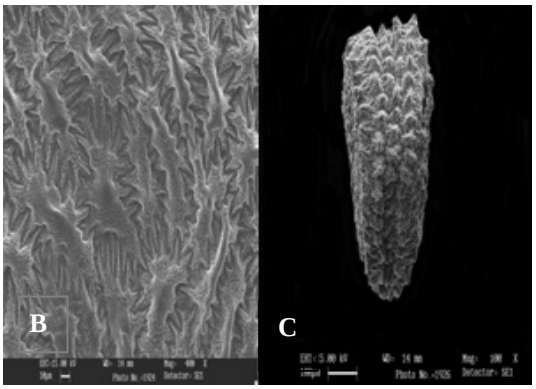
Fawzi, N. M., Fawzy, A. M. & Mohamed, A. A.-H. A. 2010: Seed Morphological Studies on Some Species of Silene L. (Caryophyllaceae). –Int. J. Bot. 6 (3): 287- 292.

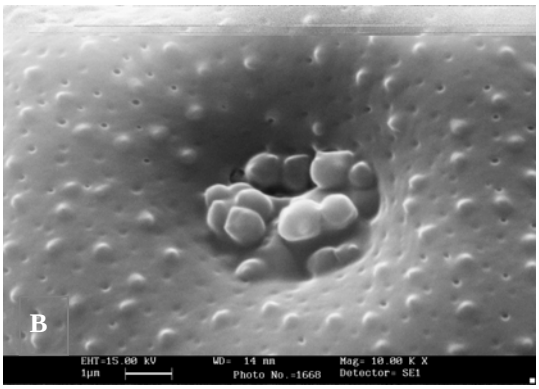
Jalas, J., Sell, P. D. & Whitehead, F. H. 1964: Cerastium L. in T. G. Tutin, V. H. Heywood, N. A. Burges, D. H. Valentine, S. M. Walters & D. A. Webb Flora Europaea 1: 136- 145. –Cambridge at the University Press.

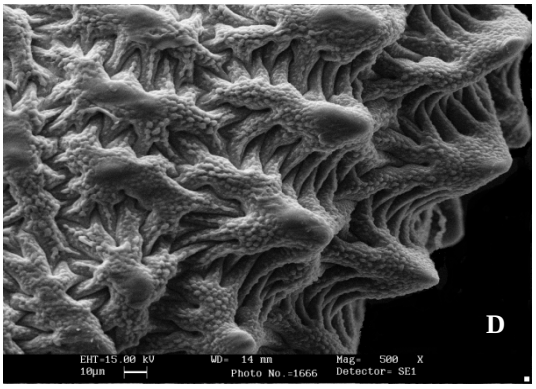
Möschl, W. 1988: Cerastium L. in K. H. Rechinger Flora Iranica 163: 85- 108. –Akademische Druck- u. Verlagsanstalt, Graz, Austria.











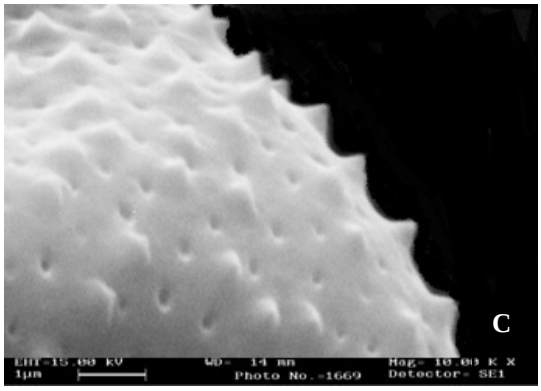


Fig. 2. SEM seed photographs of *Cerastium brachypetalum* subsp. *iranicum* –A. General appearance –B. Lateral surface –C. Dorsal surface –D. Lateral surface (Marginal part).

Fig. 3. SEM photographs of pollen grains of *C. brachypetalum* subsp. *iranicum* –A. General appearance –B. Pore –C. Pollen ornamentation.

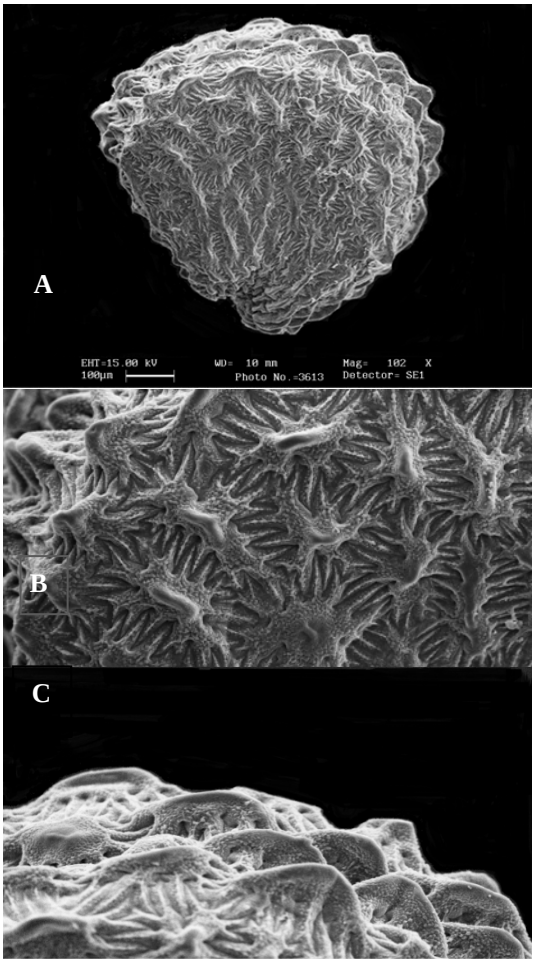


Fig. 4. SEM seed photographs of *Cerastium glomeratum* –A. General appearance –B. Lateral surface –C. Lateral surface (Marginal part).

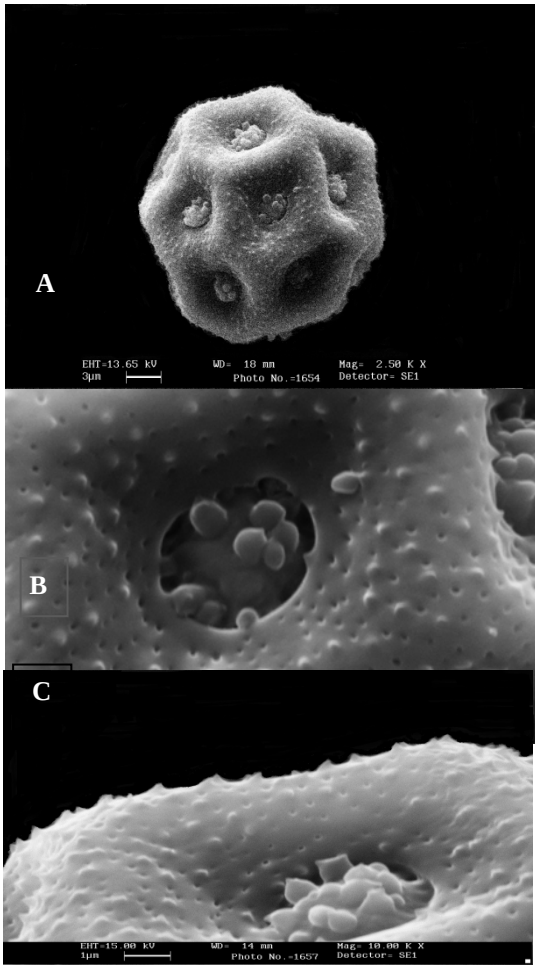


Fig. 5. SEM photographs of pollen grains of *Cerastium glomeratum* –A. General appearance –B. Pore –C. Pollen ornamentation.

Pax, F. & Hoffmann, K. 1934: Caryophyllaceae in H. G. A. Engler & K. Prantl (eds.) Die natürlichen Pflanzenfamilien 16C. –Berlin, Germany.

Perveen, A. & Qaiser, M. 2006: Pollen flora of Pakistan- Caryophyllaceae. –Pak. J. Bot. 38 (4): 901- 915.

Rabeler, R. K. & Hartman, R. L. 2005: Caryophyllaceae in Flora of North America, North of Mexico 5: 3- 8. –Oxford University Press, New York.

Shishkin, B. K. 1936: Cerastium L. in V. L. Komarov Flora of the U. S. S. R. 6: 430- 466. –Leningrad.

Thiers, B. 2011: Index Herbariorum: A global directory of public herbaria and associated staff. –New York: Botanical Garden's Virtual Herbarium. Available from http://sweetgum.nybg.org/ih/ (accessed: 18 December 2012).

Yildiz, K. 2002: Seed morphology of Caryophyllaceae species from Turkey (North Anatolia). –Pak. J. Bot. 34 (2): 161- 171.

Yildiz, K., Cirpici, A. & Dadandi, M. Y. 2010: Pollen morphology of Silene taxa (Caryophyllaceae) in four sections from Turkey. –Phytologia Balcanica 16 (1): 85- 95.