Feddes Repertorium **122** (2011) 3–4, 309–318

Research Paper

A new species and a new combination of *Minuartia* L. (Caryophyllaceae) from NE Iran

GOLALEH MOSTAFAVI*[1], MOSTAFA ASSADI[2], TAHER NEJADSATTARI[3], FARIBA SHARIFNIA[4], MOHAMMAD R. JOHARCHI[5] & IRAJ MEHREGAN[3]

[1] Department of Biology, Shahre-rey Branch, Islamic Azad University, Tehran, Iran
[2] Research Institute of Forests and Rangelands, P.O. Box 13165-116, Tehran, Iran
[3] Department of Biology, Science and Research Branch, Islamic Azad University, Tehran, Iran
[4] Department of Biology, North Tehran Branch, Islamic Azad University, Tehran, Iran
[5] Department of Botany, Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran

Keywords: Caryophyllaceae, Iran, *Minuartia,* new species, new combination.

* Corresponding author: Tehran, Islamic Republic of Iran, E-mail: golaleh.m@gmail.com & g.mostafavi@iausr.ac.ir

Accepted for publication: December 23th, 2011.

DOI 10.1002/fedr.201100008

Abstract

Minuartia khorassanica is introduced and described as a new species. The species has a limited distribution in E. Iran close to the Afghanistan frontier. *Minuartia afghanica* Rech. f. from Afghanistan and Pakistan is morphologically related to the new species but it is not known in Iran. The most important differences between the new species and *M. afghanica* are mainly in the shape of sepals and leaves and pedicel length. Moreover the two species have quite distinct ranges. *Minuartia lineata* BORNM. is another relative of the new species differing from it mainly in reproductive characters. The new species is illustrated and compared with *M. lineata* based on seed and pollen grain data. An identification key to distinguish these three species is given.

In addition, *Minuartia litwinowii* Schischk. from Turkmenistan and adjacent areas in Iran is reduced to the rank of subspecies as *M. lineata* subsp. *litwinowii.* Identification key and selected specimens are given for the two subspecies of *M. lineata*. The distribution map of all taxa is presented.

1 Introduction

In this survey, morphological and micromorphological characters of *Minuartia* species were evaluated. For understanding the variation of taxa, field observations were prepared.

The genus *Minuartia* L. (Caryophyllaceae, subfam. Alsinoideae) contains ca. 120 annual or perennial herbaceous species throughout the temperate and arctic northern hemisphere, north of Africa and Turkey (BITTRICH, 1993). The genus has more than 50 species in Europe, about 45 species in the former Soviet Union and more than 40 species in Turkey (KAMARI, 1997, HALLIDAY, 1964, MEIKLE, 1977, SCHISCHKIN, 1936, MC NEILL, 1967).

PARSA (1951) and RECHINGER (1988) reported 24 and 21 species of *Minuartia* in Iran respectively. During herbarium studies of *Minuartia* material deposited in FUMH & TARI (abbreviations according to HOLMGREN & HOLMGREN, 1998), specimens collected from Khorassan province (E Iran) were found

 0014-8962/11/3-405-0309

Fig. 1
Type specimen of *M. litwinowii*

which showed morphological differences when compared to all species previously known from Iran and neighbouring countries. Further studies revealed that the specimens represent a new species of *Minuartia*.

Type material of *M. litwinowii* SCHISCHK. is from Turkmen part of Kopetdagh (Fig. 1, SCHISCHKIN, 1936). Further material of the species was mainly reported from the Iranian part of Kopetdagh (NE Iran; RECHINGER, 1988). According to RECHINGER (1988), distribution of *M. litwinowii* extends westward and meets the eastern portion of the range of *M. lineata.* Taxonomic position of *M. litwinowii* is controversial. According to MC NEILL (1963), *M. litwinowii* could not be separated from *M. lineata*, and instead it should be separated only subspecifically from *M. lineata* (MC NEILL, 1963). After examining photographs of type material of *M. litwinowii* from the herbarium W, we also found that some characters such as leaf length, sepal length, pedicel length and also flower number, already known as the diagnostic characters for separating *M. litwinowii* from *M. lineata*, could not be observed in type material (Fig. 1). In order to clarify the taxonomic position of *M. litwinowii*, all putative material of the species collected from Kopetdagh along with herbarium materials of *M. lineata* were investigated. In this paper a new species was described and a species was reduced to subspecific rank.

2 Materials and methods

Some qualitative and quantitative morphological characters of the specimens deposited in TARI and FUMH were measured using Carnoy, digital measurement software (Table 1, SCHOLS et al. 2002). The characters were including plant height, leaf shape, leaf length, indumentums, basal leaf status, petal length, pedicel length, sepal shape, sepal veins, margin of sepal width, sepal length and width, sepal apex, flower number, capsule shape, capsule length, width of pollen grains and ripen seeds**.** Each sample was coated with a 550-Å-thick layer of gold in a polaron SC7610 vacuum coating apparatus for 180s, and scanned using SEM (LEO 440i) at Islamic Azad University, Science and Research Branch. Measurements for micromorphological studies were performed using Carnoy (SCHOLS et al. 2002). Type material of the new species plus three herbarium specimens of *M. lineata* (Joharchi & Aydani 35608 (FUMH), Assadi & Mozaffarian 30761 (TARI), Assadi & Mehregan 89051 (TARI); were used for SEM microscopy.

Table 1
Comparison of morphological characters in *Minuartia khorassanica, M. afghanica* and *M. lineata.* Data for *M. afghanica* after RECHINGER (1988; p. 40)

characters	*M. khorassanica*	*M. afghanica*	*M. lineata*
indumentums	strictly glandular-pilose	entirely glandular-pilose	not hairy to glandular-pubescent
height of flowering stem (cm)	10.5–13	6–11	7.5–24
basal leaf status	fasciculate	non-fasciculate	fasciculate
leaf shape	linear-setaceaous	narrow linear-subulate	linear to linear-setaceous
petal shape	long ovate	not seen	oblanceolate-obovate
leaf length and width (mm)	5–10 × 0.6	10 × 0.7–1	4–29 × 0.6–1.4
petal length	4–4.5	6.5–7	5.5–8.5
pedicel length (mm)	8.5–12.5	3–8	3.5–30
sepal shape	broadly ovate	gradually attenuate	ovate-lanceolate to lanceolate
sepal veins	5	3	3
sepal margin width (mm)	0.4–0.5	not measured	0.1–0.4
sepal length and width (mm)	3.8–4.5 × 1.3–2.4	4.5	3.6–7 × 0.9–1.7
sepal apex	acuminate	acute	acuminate
flower number	1–3	3	1–11

3 Results and discussion

3.1 New species

Minuartia khorassanica Assadi & Mostafavi, sp. nova (Figs. 2 and 3).

Holotype: Iran, S Khorassan, W of Ghaen, Tajan Mts. (33°43′34″ N, 58°54′44″ E), 1900 m, 23. May 1998, Raafei 30924 (TARI; isotype FUMH, IAUH).

Diagnosis

Species nova differt a *Minuartia afghanica* sepalis late ovatis 5-nervosis (nec gradatim attenuuatis 3-nervosis), pedicellis 8.5–12.5 mm longis (nec 3–8), foliis linearo-setaceis (nec linearo–subulatis), a *M. lineata* dense glanduloso-pilosis (nec ± glabris), sepalis late ovatis 5-nervosis (nec ovato-lanceolatis vel lanceolatis 3 nervosis).

Description

Perennial, caespitose, 10–13 cm high, strictly glandular-pilose throughout. Stems rather ascending. Leaves 5–10 mm long, linear-setaceous, 3-veined, narrowly membranous margined toward the base. Sterile shoots present, up to 45 mm long, densely leafy. Inflorescence 1–3 flowered, not contracted; pedicels 8.5–12.5 mm long. Bracts 2.9–3.6 × 0.6–0.8 mm, ovate-lanceolate to lanceolate, indistinctly 3-purplish veined, acute, narrowly membranous margined toward the base. Sepals 3.8–4.5 × 1.3–2.4 mm, broadly ovate, distinctly 5-veined (3 veins continued to the apex and 2 veins not continued to the apex), 3 indistinct veins on each side of distinct veins, broadly membranous margined toward the base, acuminate. Petals as long as or slightly longer than sepals, almost 4.5 mm long, narrowly ovate, incurved, white. Styles 1.2 mm long. Capsule longer than sepals, 4.8–5.2 × 2.4 mm, narrowly ovate. Seeds 2.2–2.75 × 1.4–1.9 mm long, 6–7 per capsule, almost reniform with a wing-like appendix, light brown to orange, lighter in center.

Morphological studies showed that *Minuartia afghanica* Rech. f. seems to be close to the new species, but they showed differences, mainly in the floral parts (Table 1). *Minuartia afghanica* is known to be endemic in E Af-

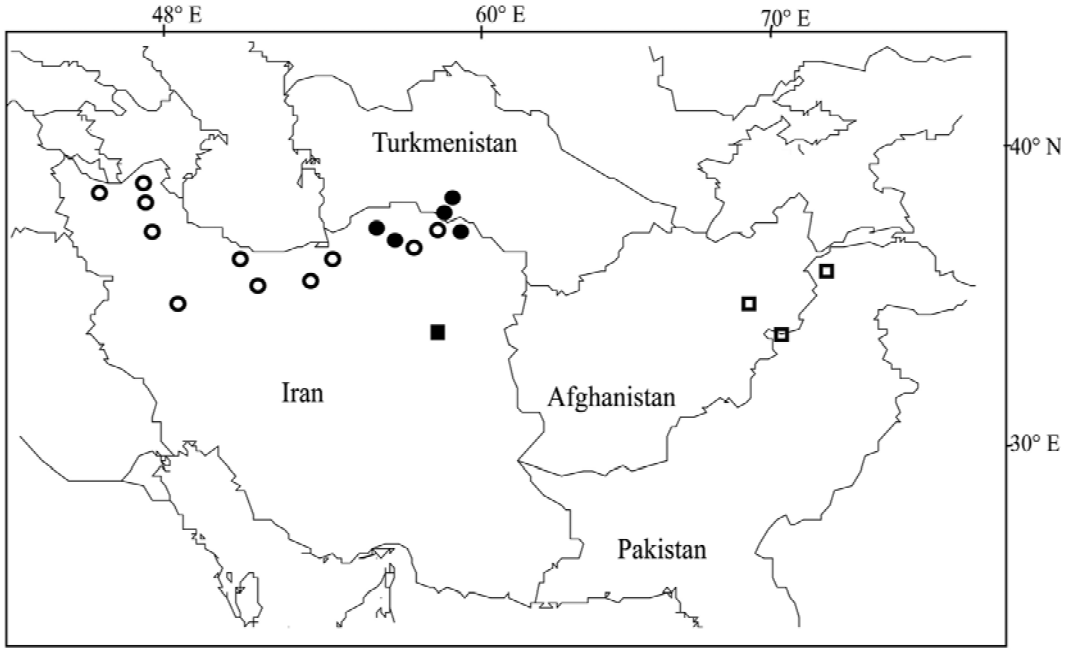

Fig. 2
Distribution map of *Minuartia lineata* subsp. *lineata* (○), *M. lineata* subsp. *litwinowii* (●), *M. khorassanica* (■) and *M. afghanica* (□)

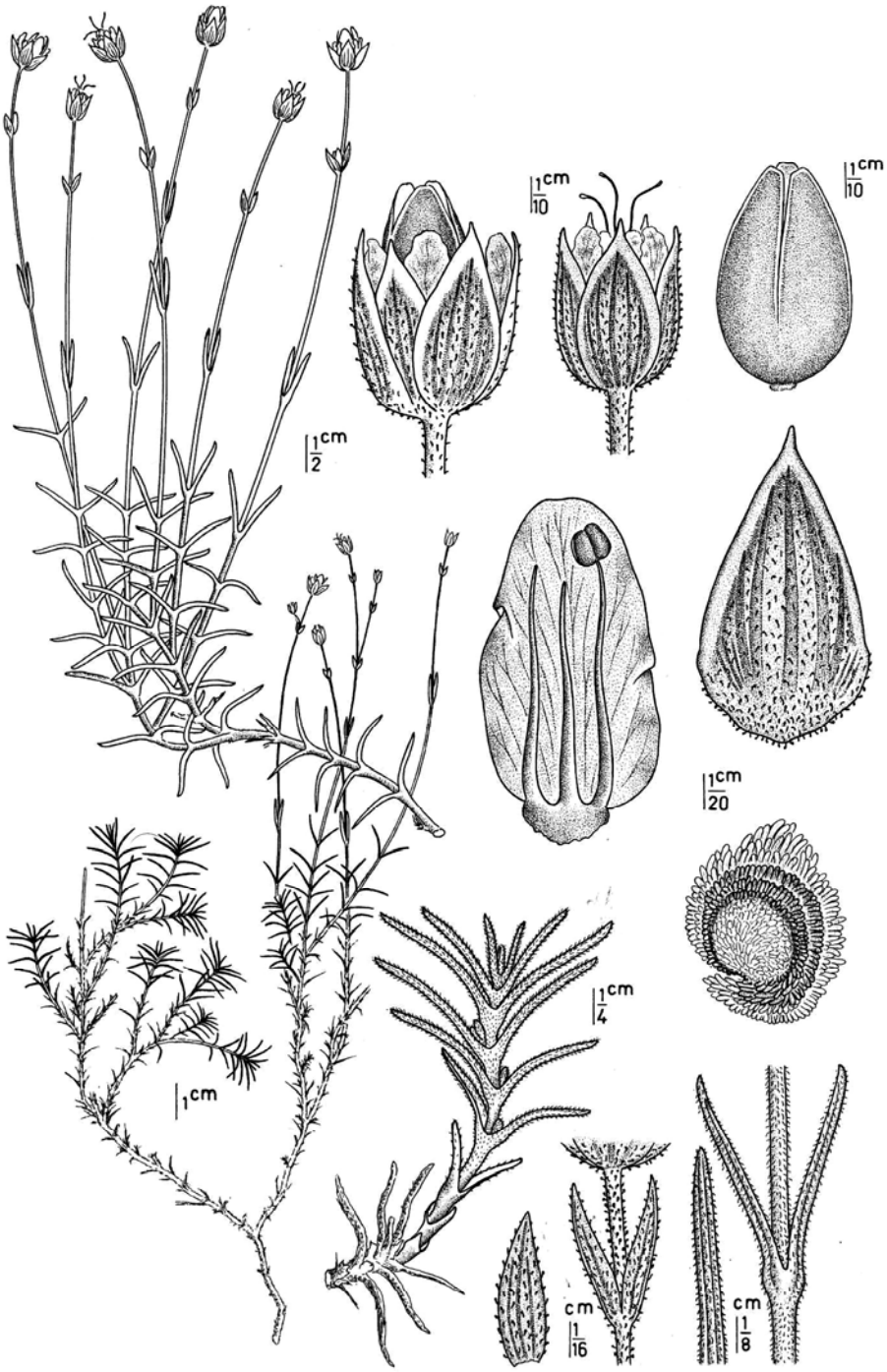

Fig. 3
Minuartia khorassanica: a) whole plant, b1) flower in fruiting, b2) flower, c) capsule, d) petal and stamen, e) sepal, g) basal leaves, g) bract, h) stem leaves, i) seed

ghanistan and NW Pakistan, clearly far (ca. 1000 km) from E Iran where material of our new species was found (Fig. 2; RECHINGER, 1988). A photograph of the isotype of *M. afghanica* (Koelz 11493) deposited at the herbarium US was consulted by the authors.

Another related species seems to be *M. lineata* BORNM., distributed in NW, N and W, C and NE Iran (Fig. 2). The new species differs from *M. lineata* mainly in having broadly ovate sepals with five distinct veins (not lanceolate to ovate-lanceolate and sepals with the 3-distinct veins as in *M. lineata*) (RECHINGER, 1988; Table 1).

Identification key for three species of *Minuartia*:

1a axillary leaves not fasciculate . . . . . *M. afghanica*
1b axillary leaves fasciculate 2

2a sepals ovate-lanceolate with 3 distinct veins . . . . . *M. lineata*
2b sepals broadly ovate with 5 distinct veins . . . . . *M. khorassanica*

Micromorphology

Pollen grains

The results of pollen grains micro-morphology are presented in Table 2. Some characters including: equatorial diameter, polar axis length, pore diameter (annulus included), pore diameter (annulus excluded), shortest distance between pores, number of pores, pore ornamentation and also pollen grain ornamentation, were studied precisely (terminology according to PUNT & HOEN, 1995, PERVEEN & QAISER, 2006).

The pollen grains in *M. khorassanica* and *M. lineata* is pantoporate with six and nine detectable pores in the equatorial view and also they have scabrate-punctate ornamentations (Table 2, Fig. 4 a–d). Pollen grain shape and pore ornamentations were the only qualitative diagnostic characters seen in the species (Table 2, Fig. 4).

The observations displayed that the pollen grain measurements have no significant differences between the species.

This issue revealed that pollen quantitative characters do not confirm morphological differences between the species mentioned above. Therefore the results of palynological studies are not as important as other taxonomic characters for distinguishing these two related species from one another (Table 2).

Seeds

Seed characters of two related species, *M. khorassanica* and *M. lineata* are compared in Table 3. Some qualitative and quantitative characters include: seed length, seed width, cell length, cell width, cell distance, seed shape, cell shape, seed ornamentation, cell ornamentation, cell margin shape and seed color (terminology according to BITTRICH, 1993).

The results of seed micro-morphology indicated that these two species have some differences especially in seed length and width, seed color, seed shape, seed ornamentation and also cell ornamentation (Table 3, Fig. 51–i). Therefore, seed characters as well as morphological characters are valuable diagnostic characters.

3.2 New combination

Minuartia lineata Bornm. subsp. *litwinowii* (Schischk.) Assadi & Mostafavi comb. & stat. nova (Figs. 1 and 2).
Syn.: *Minuartia litwinowii* Schischk. Fl. U.S.S.R. 6: 885 (1936).

SCHISCHKIN (1936) described *Minuartia litwinowii* from the Turkmen part of Kopetdagh. According to RECHINGER (1988), distribution of *M. litwinowii* is limited to Kopetdagh (both Iranian and Turkmen parts), and its western most distribution meets the eastern most distribution of its closest relative species, *M. lineata*. Examination of the materials of both species from throughout the distribution of both species in Iran showed a continuous cline in morphological characters. Intermediates occurred where the two species were found in. Therefore, distinction of the two species based on the morphological characters is not satisfied. Our observation is in accordance with that of MC NEILL (1963). He suggested the presence of confusion over the relationships between *M. litwinowii* and *M. lineata*, and also problems regarding the delimitation of such taxa at the species level (MC NEILL, 1963).

Table 2
Comparison of palynological data in *Minuartia khorassanica* and *M. lineata*

characters	*M. khorassanica*	*M. lineata*
Polar axis length (µm)	25.7	25.3
Equatorial diameter (µm)	21.6	20.1
P/E ratio	1.19	1.25
Pore diameter (D) (µm)	4.6	3.5
Pore diameter (annulus excluded) (µm)	3.5	2.9
Shortest distance between the pores (d) (µm)	6.6	3.4
Number of pores	6	9
D/d ratio	0.7	1.1
Pore ornaments	deeply granular	prominently granular
Pollen shape	polyhedral	sub-spherical
Ornaments	scabrate-punctate	scabrate-punctate

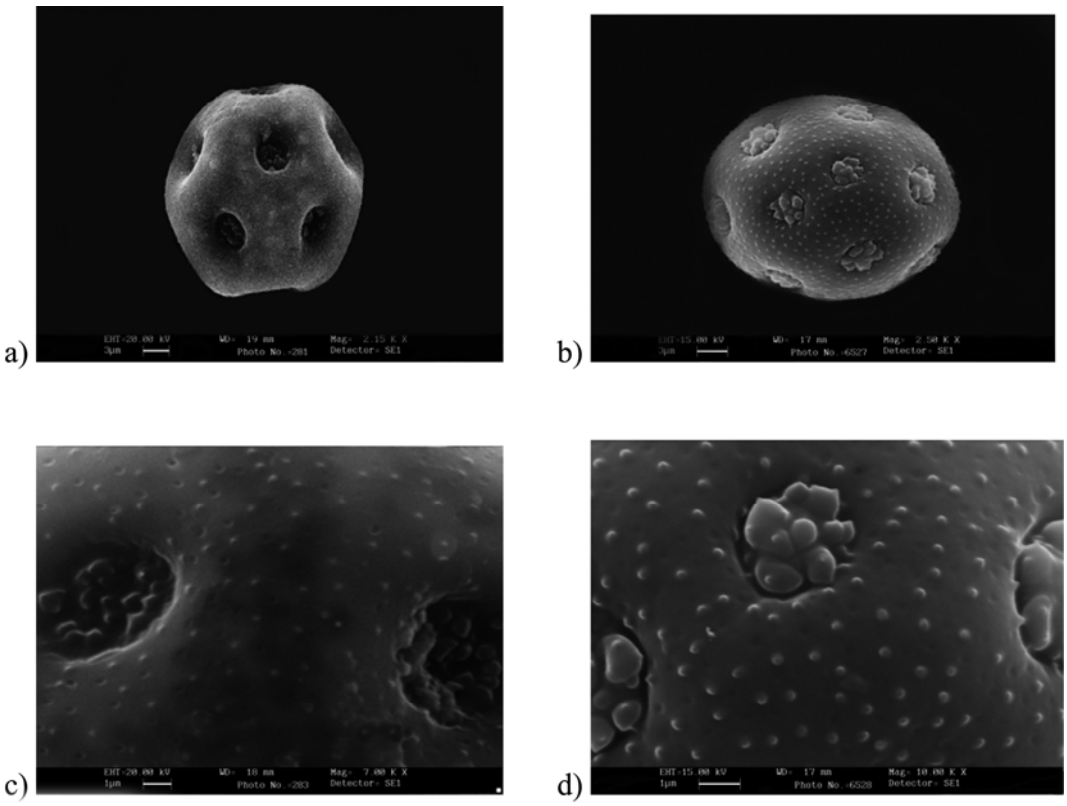

Fig. 4
SEM micrographs of pollen morphology of *Minuartia khorassanica*: a) general appearance, c) pore and ornamentations. Scales: a = 3 µm, c = 1 µm. *M. lineata*: b) general appearance, d) pore and ornamentations. Scales: b = 10 µm, d = 2 µm

Table 3
Comparison of seed micromorphological data in *Minuartia khorassanica* and *M. lineata*

characters	*M. khorassanica*	*M. lineata*
Seed Length (SL) (mm)	2.2	1
Seed Width (SW) (mm)	1.6	0.7
SL/SW ratio	1.5	1.4
Cell Length (CL) (µm)	125	82
Cell Width (CW) (µm)	24	25
CL/CW ratio	5.2	3.3
Cell distance (µm)	4.3	2.8
Seed Shape	reniform	reniform-pyriform
Cell ornaments	rugose	verrucate
Seed color	light brown	dark brown
Cell shape	polygonal	oblong
Cell margin shape	± entire	dentate
Seed ornaments	reticulate	reticulate-dentate

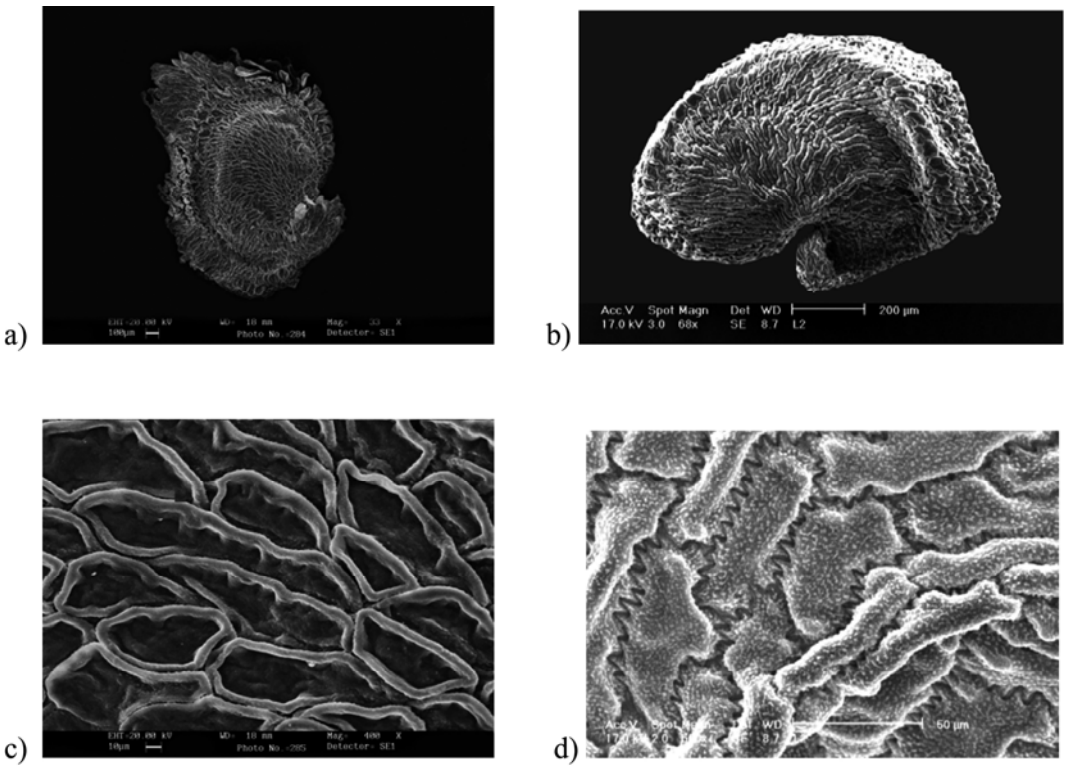

Fig. 5
SEM micrographs of seed morphology: *Minuartia khorassanica*: a) general appearance, c) testa cells. Scales: a = 100 µm, c = 10 µm. *M. lineata*: b) general appearance, d) testa cells. Scales: b = 200 µm, d = 50 µm

Having glandular hairs in all parts of the plant, is the only character observed in material from NE Iran, and not having glandular hairs or just having it only in the inflorescence region is seen in different locations of N, NW, W, C and NE Iran. The existence of both types of plants in the same location in NE Iran shows the close relationships between them. Therefore, regarding the lack of major differences between the two species, we assume that *M. litwinowii* only represents part of the morphological variation within *M. lineata*, and could not be regarded as a separate species.

Acknowledgement

The authors wish to thank to Dr. E. Vitek, from the natural history museum Vienna (W herbarium) for providing the picture of type material of *M. litwinowii* (Fig. 1), Mr. M. Mehranfard, the artist at Plant Pests and Diseases Research Institute, for the illustration of Fig. 3, Dr. H. Motarjemi for his helps in preparing the manuscript and Mrs. S. Eshghi, for preparing SEM micrographs.

Identification key for two subspecies of *M. lineata*:

1a plant glabrous or only glandular-pubescent in the inflorescence. . . . . subsp. *lineata*
1b plant glandular-pubescent throughout . . . . . subsp. *litwinowii*

Selected specimens of the subspecies

– subsp. *lineata*

Distribution: N, NW, W, C & NE Iran and Talysh.

N: Mazandaran: Kandovan, 5.5 km on the road to Youshdeh, 2500–2700 m, Jamzad & Salimi 71171(TARI); E slopes of Damavand Mts., 2550–3600 m, Assadi & Mozaffarian 33169 (TARI); 27 km from Haraz road to Kandovan, 1550 m, Assadi & Mozaffarian 33078 (TARI). – NW: Azerbaijan: between Nir and Sarab, 2350 m, Mozaffarian & Nowrozi 35190 (TARI); S slopes of Sahand Mts, 2600–3500 m, Assadi & Mozaffarian 30761 (TARI); Ca. 30 km NE of Marand, 2000–2600 m, Assadi & Shahsavari 65641 (TARI); Ca. 35 km N of Marand, Kiamaki Mts., 1800–3200 m, Assadi & Olfat 68571 (TARI). – W: Lorestan: on the road from Nurabad to Nahavand, 2600–3100 m, Assadi & Mehregan 89051 (TARI). – NE: Khorassan: W of Bojnourd, 2100 m, Joharchi & Aydani 35608 (FUMH); SW of Bojnourd, Salook Mts., 2970–3000 m, Memariani & Zangooei 41032 (FUMH); 13 km to Salook protected area, 2500–2580 m, Memariani & Arjmandi 43936 (FUMH). – C: Tehran: on the road Karaj-Chalous, above Kandovan Mts., 3200 m, Assadi & Heidarnia 95697 (TARI); Firoozkuh, 2500–3400 m, Khatamsaz, Akhiani & Abuhamzeh 64753 (TARI).

– subsp. *litwinowii* (SCHISCHK.) ASSADI & MOSTAFAVI

Distribution: NE Iran, SW Turkmenistan.

NE: Khorassan: SW of Bojnourd, Shoghan, Salook protected area, 2342 m, Joharchi & Zangooei 40640 (FUMH); W of Bojnourd, 2350–2470 m, Memariani & Arjmandi 43996 (FUMH).

References

BITTRICH, V. 1993: Caryophyllaceae. In: KUBITZKI K., ROHWER J. G. and BITTRICH V. (eds.), The Families and Genera of Vascular Plants, Vol. 2, Flowering Plants Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families, Springer, Germany, 206–236.

HALLIDAY, G. 1964: *Minuartia* L. In: TUTIN, T. G., HEYWOOD, V. H., BURGES, N. A. & WEBB, D. A. (eds.). Flora Europaea **1**: 125–132. – Cambridge University Press.

HOLMGREN, P. K. & HOLMGREN, N. H. 1998: (continuously updated): Index Herbariorum (online at http://sciweb.nybg.org/science2/IndexHerbariorum.asp).

KAMARI, G. 1997: *Minuartia* L. In: STRID, A. & TAN, K. (eds.). Flora Hellenica **1**: 170–191. – Koeltz Scientific Books, Germany.

MC NEILL, J. 1963. Taxonomic studies in the Alsinoideae II. A revision of the species in the Orient. Notes R.B.G. Edinburgh **24**: 241–404.

MC NEILL, J. 1967: *Minuartia* L. In: DAVIS, P. H., Flora of Turkey and the East Aegean Islands **2**: 38–67. – Edinburgh University Press, Edinburgh.

MEIKLE, R. D. 1977: *Minuartia* L. In: Flora of Cyprus **1**: 265–273. – Bentham-Moxon Trust, Royal Botanic Gardens, Kew, England.

PARSA, A. 1951: *Minuartia* L. In: Flora de'l Iran **1**: 1159–1177. – Tehran.

PERVEEN, A. & QAISER, M. 2006: Pollen flora of Pakistan-LI-Caryophyllaceae. Pak. J. Bot. **38(4)**: 901–915.

PUNT, W. & HOEN, P. P. 1995: Caryophyllaceae in the Northwest European Pollen Flora. Review of

Palaeobotany and Palynology. VII. 88 (1–4): 83–272. Elsevier, Amsterdam.

RECHINGER, K. H. 1988: *Minuartia* L. In: RECHINGER, K. H. Flora Iranica **163**: 28–53. – Academische Druck & verlagsanstalt Graz.

SCHISCHKIN, B. K. 1936: *Minuartia* L. In: Flora of the U.S.S.R. **6**: 482–516. (Translated by Smithsonian Institution and the national science foundation, Washington D.C. Program for Scientific Translation, Jerusalem, Israel).

SCHOLES, P.; DESSEIN, S.; D'HONDT, C.; HUYSMANS, S. & SMETS, E. 2002: CARNOY: a new digital measurement tool for palynology. Grana **41**: 124–126.

