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Taxonomic revision of *Euphorbia* subsect. *Myrsiniteae* in Iran

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The present paper updates the taxonomy of *Euphorbia* subsect. *Myrsiniteae* for the *Flora of Iran* since the publication of *Flora Iranica* in 1964. We provide a key, descriptions, distribution maps and illustrations for the seven taxa of the subsection occurring in the country. The presence of *E. monostyla* and the absence of *E. rigida* is confirmed. The distribution of *E. spinidens*, *E. myrsinites*, *E. marschalliana* subsp. *marschalliana* and *E. marschalliana* subsp. *armena* is updated, and *E. marschalliana* subsp. *woronowii* is considered a synonym of *E. marschalliana* subsp. *marschalliana*.

Introduction

One of the most distinct lineages in the species-rich genus *Euphorbia*, both morphologically and ecologically, is the subsection *Myrsiniteae* (section *Paralias*, subgenus *Esula*). The species in this group are ascending to erect perennial herbs or small semishrubs with fleshy or almost succulent leaves, clearly adapted to harsh and dry environmental conditions. Prokhanov (1949) suggested that the subsection could be elevated to the sectional level, due to the following characters: lack of bracts in the staminate flowers, presence of glands with long spatulate horns or with denticulate margins, large trigonous, glaucous capsules, and ovoid-quadrangular seeds. According to Prokhanov (1949) and our own field observations, species in the subsection start their vegetative growth at the end of autumn and then turn to the reproductive phase early in spring.

Bossier (1879), Prokhanov (1949), Rechinger and Schiman-Czeika (1964), and Radcliffe-Smith (1982) considered *Myrsiniteae* as a subsection, but Radcliffe-Smith and Tutin (1968) recognized it as a separate section. According to *Flora Orientalis* (Boissier 1879) and *Flora Iranica* (Rechinger & Schiman-Czeika 1964) the subsection belongs to the section *Tithymalus*, while in *Flora of the USSR* (Prokhanov 1949), it is placed in the section *Murtekias*, which itself belongs to the subgenus *Paralias*. Later, Prokhanov (1964) accepted it as the subsection *Myrsiniteae* in the section *Paralias*, subgenus *Esula*, and Radcliffe-Smith (1982) and Geltman (2004) followed that concept.

Phylogenetic data based on ITS sequences (for *E. myrsinites*, *E. rigida* and *E. spinidens*) clearly supported this subsection, which forms a separate subclade within the subgenus *Esula* (Kryukov *et al*. 2010). New molecular phylogenetic studies on *Euphorbia* and a broader sampling of the subgenus *Esula* are currently underway. These new phylogenetic studies as well as the present taxonomic revision are part of a collaborative Planetary Biodiversity Inventory (PBI) *Euphorbia* project (Esser *et al*. 2009).

All species in the subsection *Myrsiniteae* are restricted to the Old World. Rechinger and Schiman-Czeika (1964) recognized a total of seven species in the subsection, six of which are reported from Iran. According to Geltman (2004), the subsection consists of 14 species and two subspecies in three series. As a continuation of an ongoing taxonomic revision of *Euphorbia* in Iran (Pahlevani 2007, Pahlevani & Riina 2011), the present work updates the taxonomy and distribution of *Euphorbia* subsection *Myrsiniteae* for the flora of Iran.

Material and methods

Herbarium specimens of *Euphorbia* subsect. *Myrsiniteae* from the Iranian herbaria (IRAN, TARI, and FUMH) (acronyms according to Index Herbariorum: http://sciweb.nybg.org/science2/IndexHerbariorum.asp) and the private herbarium of Akhani (Hb. Akhani) currently housed at the Department of Plant Sciences, University of Tehran, along with newly collected specimens from Iran, were studied and identified using the relevant taxonomic literature and floras (Boissier 1879, Prokhanov 1949, Rechinger & Schiman-Czeika 1964, Radcliffe-Smith & Tutin 1968, Radcliffe-Smith 1980, 1982); some specimens from other herbaria (LE, TBI, TGM, G-BOISS) were also taken into consideration. The synopsis includes the accepted names, synonymy, typifications, descriptions, illustrations, brief characterizations of geographical distributions (mapped), habitats, flowering and fruiting times, plus necessary discussion and lists of the examined specimens. The distribution maps were provided using the computer program DMAP (Morton 2001) including all the specimens examined and the distribution data from *Flora of Turkey* and *Flora of Iraq*. With the exception of *E. myrsinites*, for which we only show the distribution in Iran, the maps display the overall species distribution.

Taxonomic synopsis

Euphorbia subgen. *Esula* Pers.

Syn. Pl. 2: 14. 1806. — Type: *E. esula* L.

Usually erect herbs or sometimes shrubs. Leaves exstipulate, usually alternate, symmetrical at base, sessile or subsessile. Cyathia in pleiochasial cymes (rays). Glands without petaloid appendages. Seeds usually carunculate.

Sect. *Paralias* Dumort.

Fl. Belg.: 87. 1827. — Type: *E. paralias* L.

Glaucous perennial herbs. Leaves palmately nerved, usually coriaceous or fleshy. Cyathial lobes ovate or lanceolate. Capsules smooth or granulate. Seeds smooth, ornamented or sculptured.

Subsect. *Myrsiniteae* Boiss.

in DC., Prodr. 15, 2: 173. 1862. — Type: *E. myrsinites* L.

Perennial herbs with more or less succulent leaves. Lobes of cyathial involucre more than 1 mm long and wide, often reddish; glands bicornute, with long white spatulate horns, if hornless then crustlike or denticulate; staminate flowers ebracteate, pistillate flowers without calyx, fruits more or less trigonous, seeds subquadrangular, with rather a large caruncle.

Key to the species of subsect. *Myrsiniteae*

1. Glands pectinate or denticulate 2
1. Glands 2-horned, horns clavate to lobate 3
2. Cauline leaves ± entire; terminal rays 5–8. Seeds tuberculate-rugulose, caruncles stipitate ..... 2. *E. denticulata*
2. Cauline leaves denticulate; terminal rays 8–17. Seeds tuberculate, caruncles indistinctly stipitate or sessile ..... 1. *E. craspedia*

3. Cauline leaves oblong-oblanceolate, length/width ratio at least 2.8, apex acuminate ..... 3. *E. monostyla*
3. Cauline leaves suborbicular, ovate, rhombic or obovate, length/width ratio 1.5–2(2.5), apex abruptly mucronate 4
4. Cauline leaves obovate, shovel-shaped, expanding towards the apex, upper leaves almost always obviously denticulate (teeth 0.2–0.5 mm long). Caruncles small (less than 1 × 1 mm), conical. Plants of NE Iran .... 6. *E. spinidens*
4. Cauline leaves ovate, oblong-ovate, rhombic or sometimes suborbicular, rarely expanding towards the apex, leaves hardly denticulate (up to 0.2 mm) or ± entire. Caruncles larger (at least 1 × 1.5 mm) 5
5. Terminal rays 3–7 6
5. Terminal rays 8–15 7
6. Seeds smooth or shallowly rugulose; caruncles conical . ..... 4a. *E. marschalliana* subsp. *armena*
6. Seeds plicate and rugulose; caruncles truncate conical .. .. 5. *E. myrsinites*
7. Seeds tuberculate-rugulose or vermiculate; caruncles truncate conical, concave ..... 5. *E. myrsinites*
7. Seeds smooth or shallowly rugulose; caruncles large conical, acute ..... 4. *E. marschalliana* subsp. *marschalliana*

Ser. ***Denticulatae*** Prokh.

Nov. Syst. Pl. Vas. 232. 1964. — Type: *E. denticulata* Lam.

Cauline leaves ovate or orbicular-ovate, usually 1.2–1.5 times longer than wide. Glands hornless, crusted-multidentate along the truncate margin. Seeds tuberculate and rugulose.

Euphorbia craspedia Boiss. (Fig. 1)

Diagn. Ser. 1, 7: 95. 1846. — *Tithymalus craspedius* (Boiss.) Klotzsch & Garcke, Abh. Akad. Wiss. Berlin 1859: 87. 1860. — Type: Turkey. Merdin et Assauner, 1843 *Kotschy 350* (G-BOISS).

Glabrous, glaucous, decumbent, ascending or almost prostrate perennial herbs with several simple stems arising from a stout woody stock. Cauline leaves obovate or rhombic, 1.5–4 × 1.2–3 cm, base tapered or rounded, apex obtuse or subacute, mucronate, margin denticulate or pectinate. Terminal rays 8–19, axillary 0–7. Ray-leaves ovate, suborbicular or obovate, base cuneate or truncate, apex obtuse, mucronate. Raylet-leaves reniform, transversely ovate or suborbicular, base rounded to cordate. Cyathial involucre campanulate, 3–4.8 mm diam.; lobes ovate, 1.5–2 mm wide, ciliate and denticulate, reddish; glands pectinate or denticulate, crimson. Capsules ovoid-conical, trigonous, 5–8 mm diam. Seeds ovoid-quadrangular, 4–5.5 mm long (excluding caruncle), tuberculate, grey or brown; caruncles fluted, 1.5 mm long. Flowering and fruiting time: March–June.

Habitat: Stony limestone slopes, *Quercus brantii* forests and associated grasslands; 870–2700 m a.s.l.

Distribution: W & SW Iran (Kermanshah, Ilam, Chaharmahale-Bakhtiari and Lorestan provinces), N Iraq and Turkey (Fig. 2). Irano-Turanian element, limited to the Zagros range in Iran.

Specimens examined. — **Iran**. Prov. Ilam, *Farahbakhsh 17845* (IRAN); ca. 10 km SW of Darreh Shahr towards Abdanan, Kabirkuh, *Akhani 14692* (Hb. Akhani); 19–20 km NE of Zarrin-abad (Pahleh), *Akhani 8449* (Hb. Akhani); Prov. Kermanshah, Gilan-e Gharb, *Kashkuli & Soltani 47956* (IRAN); Ghasr-e Shirin, Patagh Mt., *Sharif 17848* (IRAN); Kerend-e gharb, 45 km W of Kerend-e gharb, Rijab village, *Lashkarbolooki & Hatami 157* (TARI); Prov. Lorestan, Khorram-abad, 65 km Khorram-abad to Pol-Dokhtar, *Pahlevani*, *Eskandari & Bahramishad 53578* (IRAN); 45 km on Road from Khorram-abad to Nowjian, *Runemark & Lazari 26092* (TARI); Khorram-abad, 65 km Khorram-abad to Pol-Dokhtar, *Amini Rad & Torabi 53650* (IRAN); Doroud, Sefiddasht, *Riazi 9730* (TARI); between Nojian and Keshwar, *Pimenov*, *Kljuykov*, *Sytin*, *Mozaffarian s.n.* (LE); Prov. Chaharmahale-Bakhtiari, Ardal to Darre Bazoft, Mili Mt., *Mozaffarian 74550* (TARI).

Euphorbia denticulata Lam. (Fig. 3)

Encycl. 2: 435. 1786. — Lectotype (designated by Radcliffe-Smith 1982: 611): Aubriet illustration (P) reproduced in Desf., Ann. Mus. Hist. Nat. Paris, 12: 115. tabl. 15. 1808.

Euphorbia rotundata Hochst. *in* Lorent, Wanderungen 344. 1845. — Type: unseen (?TUB).

Euphorbia cilicica Boiss., Diagn. Ser. 2(4): 88. 1859. — Lectotype (designated by Geltman 2006: 162): Turkey. Gulek-Boghas, á 10 lieues an nord de Tarrous, 22.VII.1855 *Balansa 731bis* (G-BOISS).

Robust, fleshy, glabrous, glaucous, decumbent, ascending or almost prostrate perennial herbs with several simple stems arising from a stout woody stock. Cauline leaves obovate to suborbicular-ovate, 2–5.5 × 1–4 cm, often purple-tinged, base tapered or rounded, apex obtuse or subacute, mucronate, margin cartilaginous, entire to subentire. Terminal rays 5–8(9),

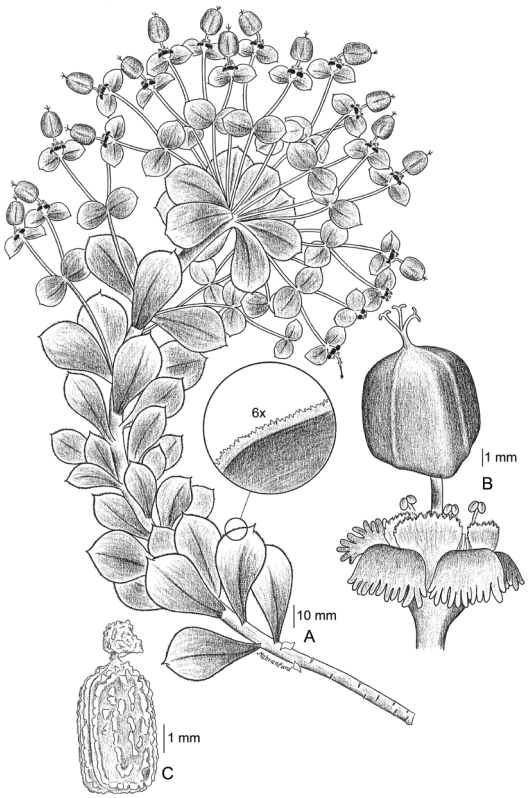

Fig. 1. *Euphorbia craspedia.*— **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. From *Pahlevani, Eskandari & Bahramishad, IRAN 53578.*

axillary 0–2. Ray-leaves suborbicular to ovate, base shallowly cordate or more or less truncate, apex obtuse, mucronate. Raylet-leaves reniform or transversely ovate, base rounded to cordate. Cyathial involucre subglobose-campanulate, ca. 5 mm diam.; lobes ovate, 1.5–2.5 mm width, ciliate, reddish; glands pectinate, crimson. Capsules ovoid-conical, trigonous, 6–8.5 mm diam. Seeds ovoid-quadrangular, 4–5 mm long (excluding the caruncle), tuberculate-rugulose, grey or brown; caruncles conical, stipitate, 1.5 mm long. Flowering and fruiting time: March–July.

HABITAT: *Quercus* woods, scrubs, steppes, rocky mountain slopes, on limestone red loam and clay; 1000–2800 m a.s.l.

DISTRIBUTION: W, SW & NW Iran, N Iraq, Turkey (Fig. 4). Irano-Turanian element, limited to the Zagros range in Iran.

SPECIMENS EXAMINED. — **Iran**. Prov. Kermanshah, Paveh, Khaneghah village towards Atashgah Mt., *Abbasi 47764*

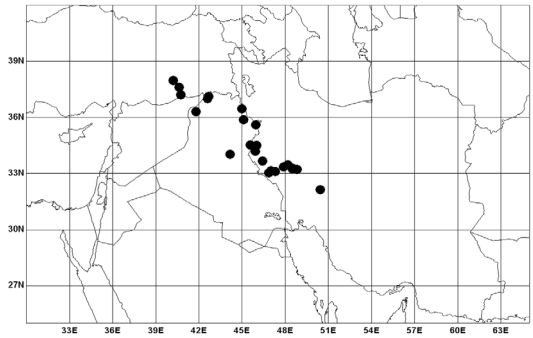

Fig. 2. Geographical distribution of *Euphorbia craspedia.*

(IRAN); Kerend Mt., *Sajedi & Bahramishad 53793* (IRAN); Sarmih, Nova kuh, *Sajedi & Bahramishad 53792* (IRAN); Nojivaran, Paru Mt., *Asef & Torabi 53789* (IRAN); Paru Mt., Road Chalabeh, *Sajedi*, *Javadi & Torabi 47528* (IRAN); Kouzaran, Brevendi sofla, Dalahu, Golhay-e Zard Mt., *Moussavi & Satei 47905* (IRAN); 43 km SW Kermanshah, *Pabot 1870* (TARI); Tang-e Dalkushiar, W of Kerend, *Wendelbo & Assadi 16772* (TARI); Prov. Lorestan, Dorud, Bisheh towards Sepid-Dasht, *Moussavi & Satei 17736* (IRAN); Prov. West Azerbaijan, between Piranshahr (Khaneh) & Sardasht, W of Mirabad village, *Runemark & Foroughi 19959* (TARI); W of Rezaiyeh, NW of Silvana village, *Runemark & Foroughi 19703* (TARI); Prov. Kordestan, Saral, Kul to Darrandeh Ghale, *Asef & Torabi 53790* (IRAN); 91 km from Baneh to Marivan, *Runemark & Mozaffarian 29331* (TARI); 20 km Ghorveh to Sanandaj, Piaz-abad, *Sajedi & Bahramishad 53791* (IRAN); between Baneh & Saghez, Khanpass, *Zehzad & Siami 2956* (TARI); Prov. Khuzestan, 19 km from Izeh to Dehdez, *Assadi & Aboohamzeh 38839* (TARI).

Ser. ***Biglandulosae*** Prokh.

Novosti Sist. Vyssh. Rast. [1]: 232. 1964. — TYPE: *E. rigida* Bieb. (*E. biglandulosa* Desf.).

Cauline leaves usually more than 3 times longer than wide, oblong, linear-oblong or oblanceolate, apex acuminate, margin entire or subentire. Glands with a more or less entire margin, 2-horned, horns spatulate. Seeds smooth.

Euphorbia monostyla Prokh. (Fig. 5)

in Kom., Fl. USSR 14: 406. 1949. — *Tithymalus monostylus* Prokh. *in* Kom., Fl. USSR 14: 406. 1949, *nom. alt.* — TYPE: [Turkmenistan], Transcaspian prov., Krasnovodsk district, Bolshye Balkhany mountains, near Dzhebel railway station, 15.III.1912 *N. B. Androsov 4020* (LE).

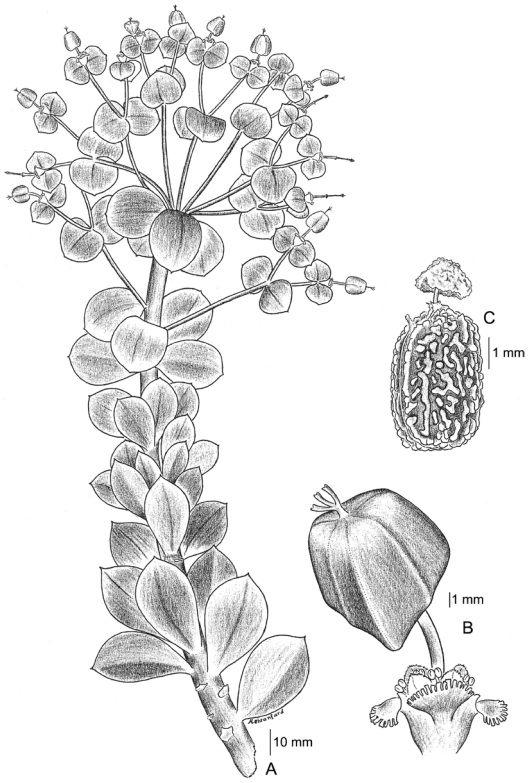

Fig. 3. *Euphorbia denticulata*. — **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. From *Sajedi, Javadi & Torabi, IRAN 47528*.

Tithymalus marschallianus auct., Prokh., Consp. Syst. Tithym. Asiae Mediae 206. 1933.

Robust, minutely prunose-papillose, fleshy, intensely glaucous, ascending perennial herbs with several simple stems. Cauline leaves densely disposed, oblong-oblanceolate, narrowly cartilaginous, 1.5–4 × 0.4–1.4 cm, base truncate, apex acuminate, margin entire to subentire. Terminal rays 10–15(17), axillary 2–8. Ray-leaves obovate, rhombic or oblong-spatulate or sometimes suborbicular, base truncate, apex short-cuspidate, margin slightly denticulate or subentire. Raylet-leaves orbicular or orbicular-reniform, often reddish, base slightly amplexicaul, apex obtuse or sometimes mucronulate, margin subentire. Cyathial involucre subglobose, 2–4 mm diameter, lobes ovate, 1.5–2 mm width, denticulate, reddish; glands transversely oblong, ochreous or brown, 2-horned, horns spatulate. Capsules trigonous, 4–6 mm diameter. Seeds

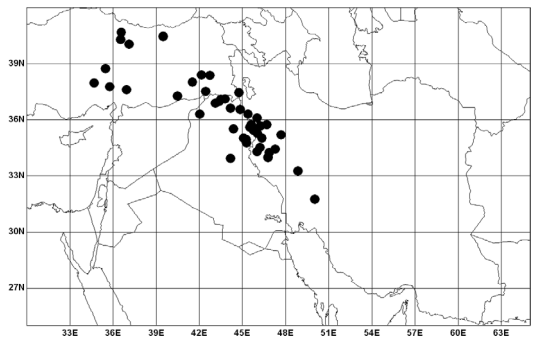

Fig. 4. Geographical distribution of *Euphorbia denticulata*.

oblong, quadrangular, 3–3.5 mm long (excluding caruncle), nearly smooth, whitish or pale yellowish; caruncles conical and truncate above, 0.5 mm long. Flowering and fruiting time: March–May.

Habitat: Dry stony and rocky places, 180–1500 m a.s.l.

Distribution: NE Iran, Turkmenistan (Kopet Dagh and Bolshye Balkhany mountains) (Fig. 6). Irano-Turanian element (Kopet Dagh range).

There is a single record of *E. rigida* Bieb. (*E. biglandulosa* Desf.) in *Flora Iranica* (Rechinger & Schiman-Czeika 1964). Also Govaerts *et al*. (2000) mentioned this species for Iran. That information was based on Czerniakovskaya's (1931) record from the Khorasan province (kuh-e Hezar Masjed) which is not confirmed by the available herbarium specimens. After a close examination of the existing specimens of *E. monostyla* from both the Golestan and North Khorasan provinces and looking at the distribution of *E. rigida*, a Mediterranean element, it seems clear that Czerniakovskaya's record most probably belongs to *E. monostyla* (*see* also Geltman 2004) and *E. rigida* is absent in Iran.

Specimens examined. — **Iran**. Prov. Golestan, Gorgan, Shahpasand towards Bojnurd, Almeh, *Termeh 47986* (IRAN); Gorgan, Golestan National Park, Tunnel, *Daneshpajouh 47976* (IRAN); Golestan National Park, dasht-e Kalpoush towards Ghez-ghaleh, *Matin & Termeh 47987* (IRAN); Gorgan, Golestan National Park, NE of Soolegerd, *Akhani 10279* (Hb. Akhani); Gorgan, between Lohondor and Soolegerd, *Ghorbani 88* (Hb. Akhani); Dasht-e Kalpoush, *Termeh & Karavar 47220* (IRAN); Golestan National Park, *Wendelbo*, *Foroughi*, *Sanii & Shirdelpur 11069* (TARI); Maravetappeh, *Pahlevani 53763* (IRAN); 4 km E Maravetappeh, *Assadi & Maassoumi 55463* (TARI); 45 miles ENE Gonbad-

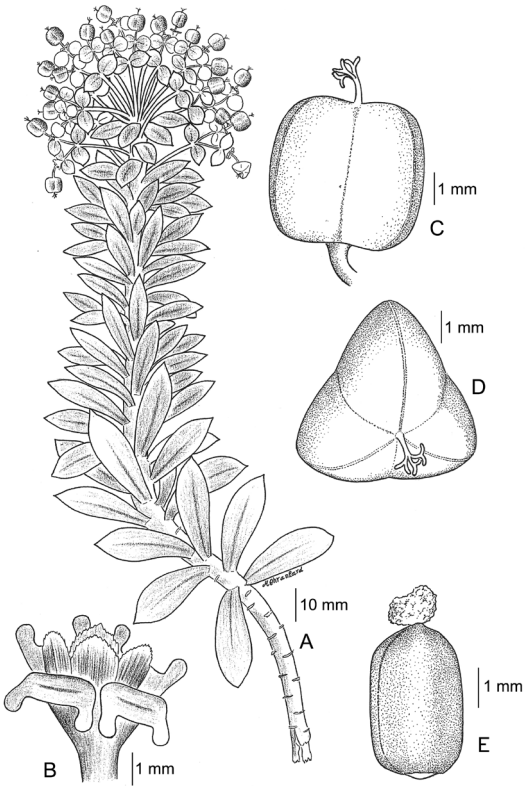

Fig. 5. *Euphorbia monostyla*. — **A**: Habit. — **B**: Cyathium. — **C**: Fruit (side view). — **D**: Fruit (top view). — **E**: Seed. From *Termeh & Karavar, IRAN 47220*.

e Kavus, Golestan forest, *Furse 5139* (K, LE); Prov. North Khorasan, Bojnourd to Gholaman, Raz to Hesarche, Bachedare village, *Mozaffarian* 88735 (TARI); NW of Bojnourd, Emam-Darreh, *Joharchi & Zangooei 33300* (FUMH); NW of Bojnourd, 14 km after Kalat-e Chenar to Raz, 4 km to Tange Torkaman, *Joharchi & Zangooei 40069* (FUMH); NW of Bojnourd, 1 km to West of Shirin-Darreh, *Memariani & Zangooei 41917* (FUMH); NE of Bojnourd, Gifan, *Joharchi & Zangooei 17041* (FUMH); Bojnourd, 15 km Behkade to Robat-e Gharebil, *Hojjat & Zangooei 31149* (FUMH); NE of Bojnourd, Naveh, *Memariani & Zangooei 39020* (FUMH).

Ser. ***Myrsinitae*** (Boiss.) Prokh.

Novosti Syst. Vyssh. Rast. [1]: 232. 1964. — Type: *E. myrsinites* L.

Cauline leaves obovate-orbicular or rhombic, usually 1.5–2.5 times longer than wide, apex abruptly cuspidate. Glands 2-horned, horns spatulate or lobate. Seeds vermiculate-rugulose, smooth or nearly smooth.

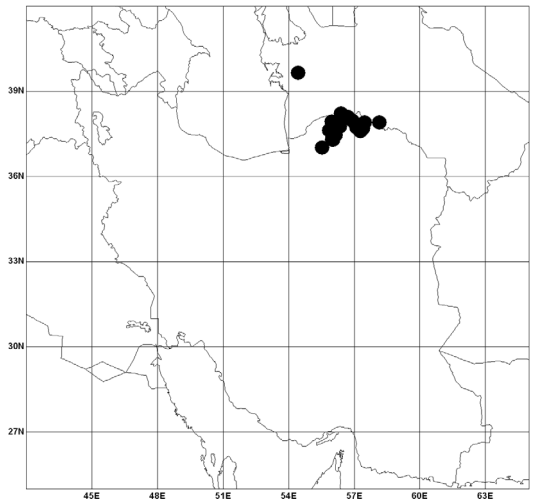

Fig. 6. Geographical distribution of *Euphorbia monostyla*.

Euphorbia marschalliana subsp. *marschalliana* Boiss. (Fig. 7)

Diagn. Pl. Orient., Ser. 1, 7: 94. 1846. — *Tithymalus marschallianus* (Boiss.) Klotzsch & Garcke, Abh. Königl. Akad. Wiss. Berlin 1859: 86. 1860. — Lectotype (designated by Geltman 2004: 164): [Azerbaijan], in aridis arenosis prope Tatuni ditionis Swant, Georg. cauc., VI.1836 *Hohenacker s.n.* (G-BOISS).

Euphorbia woronowii Grossh., Trudy Tiflissk. Bot. Sada, 14: 26. 1916, *emend*. Prokh. *in* Kom., Fl. USRR 14: 409. 1949. — *E. marschalliana* subsp. *woronowii* (Grossh.) Prokh., Novosti Sist. Vyssh. Rast. [1]: 232. 1964. — Type: [Armenia], Dagna mountain, on rocks and stony screes, 10.V.1914 *A. Grossheim s.n.* (TBI).

Glabrous, somewhat glaucous or papillose perennial herbs. Cauline leaves obovate-rhombic or sometimes oblong, 14–30 × 8–18 mm, base cuneate, apex abruptly cuspidate, margin cartilaginous and inconspicuously crenulate-serrate or subentire. Terminal rays 3–16, axillary 0–7. Ray-leaves orbicular or obovate-rhombic, apex abruptly cuspidate, margin cartilaginous, usually subentire. Raylet-leaves reniform, base rounded to truncate, apex obtuse or sometimes abruptly cuspidate, margin subentire or sometimes denticulate. Cyathial involucre campanulate, 1.5–3.5 mm diameter, lobes ovate, 0.75–2 mm width, ciliate-dentate, reddish; glands transversely oblong, yellowish-brown or sometimes reddish-brown, 2-horned, horns spatulate. Capsules broadly ovoid, sulcate, 4–5 mm diameter. Seeds oblong-

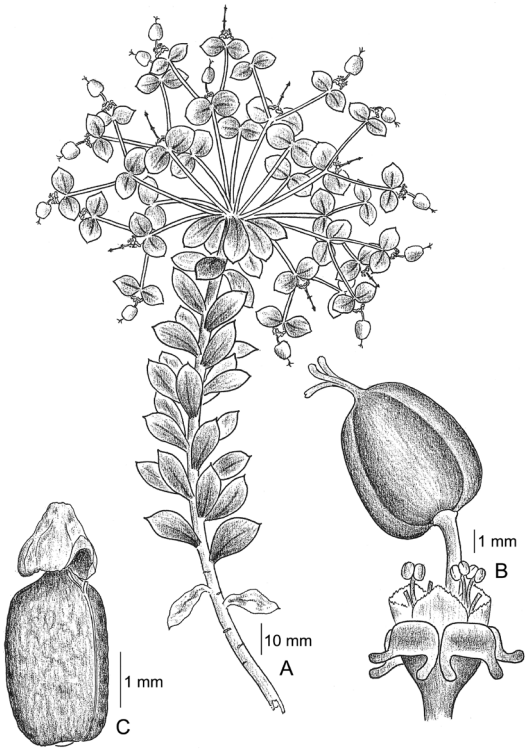

Fig. 7. *Euphorbia marschalliana* subsp. *marschalliana*. — **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. From *Pahlevani & Asef, IRAN 47883*.

quadrangular, 3 mm long (excluding caruncle), nearly smooth or hardly rugose; caruncles conical, acute, longitudinally plicate, ca. 1.5 mm long. Flowering and fruiting time: April–July.

Habitat: Dry stony slopes, steppes, roadsides, field margins; 1000–2200 m a.s.l.

Distribution: Iran (W & E Azerbaijan, Ardebil and Esfahan provinces), Turkey (NE Anatolia), Armenia and Azerbaijan (Fig. 8). Irano-Turanian element.

According to Grossheim (1916) *E. woronowii* differs from *E. marschalliana* only by its rugulose seeds. Prokhanov (1949: 410) noted that *E. woronowii* is "extremely close" to *E. marschalliana* and differs from it not by its seeds, but by "a complex of tiny quantitative characters"; in the key he mentioned narrower ray-leaves and stem leaves, number of rays and the shape of raylet-leaves (Prokhanov 1949: 325). Geltman (2004), based mainly on Caucasian material, accepted *E. marschalliana* subsp. *woronowii* and distinguished it from the type subspecies by the

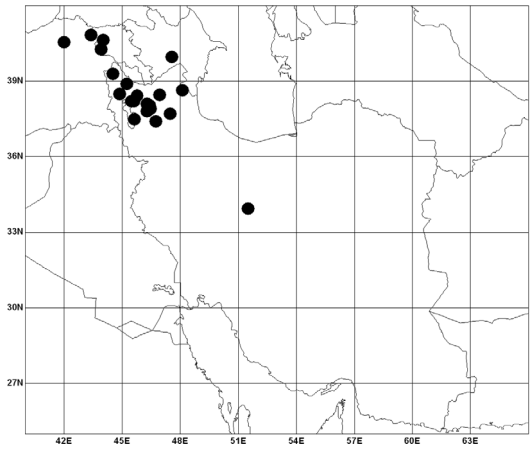

Fig. 8. Geographical distribution of *Euphorbia marschalliana* subsp. *marschalliana*.

number of rays. According to his concept, subsp. *marschalliana* is only found in the Talysh mountains (part of the Iranian highlands) and both subspecies co-occur elsewhere of their distribution ranges. However, taking also the Iranian material in consideration, it is better to treat *E. woronowii* as a taxonomic synonym of *E. marschalliana*.

Flora Iranica (Rechinger & Schiman-Czeika 1964) indicated the occurrence of *E. marschalliana* in the Alburs mountains (Mazandaran province), NE Iran (Khorasan province) and W Iran (W & E Azerbaijan), while after a close examination of herbarium material and newly collected specimens, it is clear that the distribution of the species is limited to NW Iran and to the Esfahan province in central Iran, where it is represented by a single collection from Kashan, Ghamsar. The species is absent from Alburs and NE Iran.

Specimens examined. — **Iran**. Prov. East Azerbaijan, 75 km Tabriz to Ahar, *Pahlevani & Asef 47883* (IRAN); near Tabriz, 10 km from Basmanj to Lighvan, *Assadi & Mozaffarian 30547* (TARI); Kandovan, Kandovan to Esfanjan, *Assadi & Mozaffarian 239* (TARI); Sarab, Asbforushan, *Izadyar 18113* (IRAN); Tabriz, Shaterali, *Iranshahr 18114* (IRAN); Tabriz, *Brown 17827* (IRAN); 20 km Bostanabad to Tabriz, *Sajedi & Bahramishad 47255* (IRAN); Marand to Makou, 80 km to Marand, *Iranshahr 18111* (IRAN); Marand, *Foroughi 4794* (TARI); Tassuj to Shabestar, 5 km to Shabestar, sea shores, *Termeh*, *Sangari & Tehrani 44569* (IRAN); Pier Sharafkhaneh at the shore of Lake Urumieh, *Shelkovnikov & Shipchinsky s.n.* (LE); Prov. West Azerbaijan, Urumieh, Kabudan Island, *Matine & Daneshpajouh 18109* (IRAN); *Valdez 44570* (IRAN); Maku, Danalu, *Siami 1294* (TARI); Urumieh, Mak kandy, *Tarighi & Amini 2068* (TARI); Khoy,

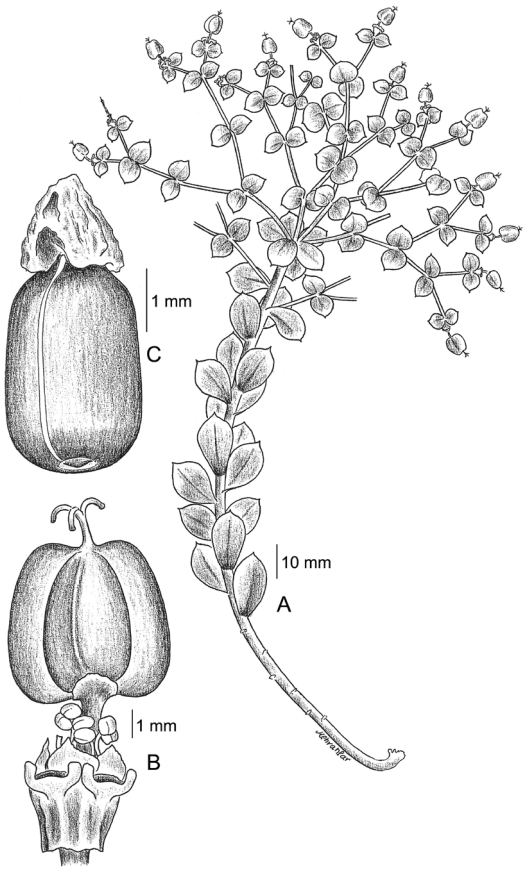

Fig. 9. *Euphorbia marschalliana* subsp. *armena*. — **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. From *Pahlevani & Amini Rad, IRAN 47791*.

10 km Ghotur road, *Foroughi 1542* (TARI); Prov. Ardebil, 40 km from Namin to Germi, Pilleh-Chay region, neck Mt. between Pilleho road and Falmeh soul, *Mozaffarian & Nowrozi 34632* (TARI); Prov. Esfahan, Kashan, Ghamsar, *Manuchehri 17826* (IRAN).

Euphorbia marschalliana subsp. *armena* (Prokh.) Oudejans (Fig. 9)

Collect. Bot. (Barcelona) 21: 186. 1993 ("1992"). — *Euphorbia armena* Prokh. *in* Kom., Fl. USSR 14: 741. 1949. — *Tithymalus armenus* Prokh. *in* Kom., Fl. USSR 14: 741. 1949, *nom. alt.* — TYPE: [Armenia], Transcaucasia, Echmiadzin, 25.IV.1910 *A. A. Grossheim s.n.* (LE).

Like *E. marschalliana* subsp. *marschalliana*, differing mainly in having only 3–7, sometimes thicker, rays. Flowering and fruiting time: April–August.

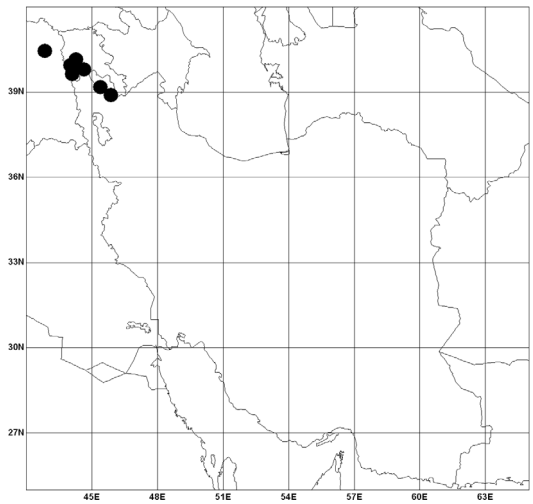

Fig. 10. Geographical distribution of *Euphorbia marschalliana* subsp. *armena*.

HABITAT: Dry stony steppes, stony slopes, sandy plains and riversides; 1300–1800 m a.s.l.

DISTRIBUTION: Iran (W & E Azerbaijan), Armenia, Azerbaijan (Nakhychevan), Turkey (NE Anatolia) (Fig. 10). Irano-Turanian element, mostly restricted to the Aras valley.

This taxon was described by Prokhanov (1949) as a distinct species (*E. armena*) and was accepted as such by Radcliffe-Smith (1982) and Geltman (2004). Although it is certainly close to *E. marschalliana*, here we accept a broader species concept and prefer to assign a subspecific rank to this taxon following Oudejans (1992) and Govaerts *et al.* (2000).

SPECIMENS EXAMINED. — **Iran**. Prov. East Azerbaijan, Jolfa, Aras margin, *Pahlevani & Asef 47884* (IRAN); Prov. West Azerbaijan, Makou, Buralan, *Pahlevani & Amini Rad 47791* (IRAN).

Euphorbia myrsinites L. (Fig. 11)

Sp. Pl.: 461. 1753. — *Tithymalus myrsinites* (L.) J. Hill, Hort. Kew: 172: 4. 1768. — LECTOTYPE (designated here): *Herb. Linn. 630.68* (LINN).

Euphorbia pontica Prokh. *in* Kom., Fl. USSR 14: 740. 1949. — *Tithymalus ponticus* Prokh. in Kom. Fl. USSR 14: 740. 1949, *nom. alt.* — TYPE: [Turkey], Artvin district, Ardanug, stony slope of Vartskhet mountain, 26.V.1914 *S. Turkevich 452* (LE).

Euphorbia pectinata Albov, Bull. Herb. Boiss. 2: 640.

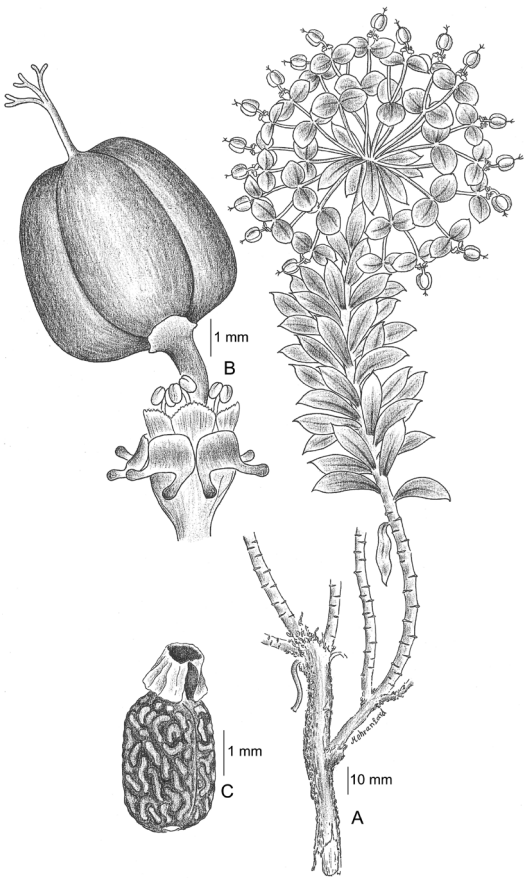

Fig. 11. *Euphorbia myrsinites*. — **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. From *Moussavi, Tehrani & Karavar, IRAN 47872*.

1894. — Lectotype (designated by Geltman 2009: 189): [Turkey], Artwin, 12/25.V.1893 *G. R[adde] s.n.* (TGM).

Glabrous, glaucous, decumbent-ascending perennial herbs with several simple stems arising from a woody stock. Cauline leaves obovate-rhombic, oblong-obovate or sometimes suborbicular, rather thick and fleshy, 1–3 × 0.7–2 cm, base truncate or rarely cuneate, apex cuspidate or mucronate, margin entire, subentire or denticulate above. Terminal rays (5)8–15, axillary 0–4. Ray-leaves oblong-obovate or suborbicular, base truncate, apex mucronate, margin subentire or crenulate-denticulate towards apex. Raylet-leaves suborbicular to reniform, base more or less cordate, apex obtuse and mucronulate, margin subentire or sometimes denticulate. Cyathial involucre subglobose or campanulate,

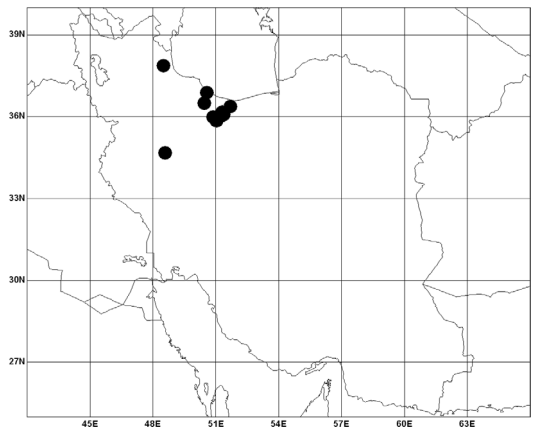

Fig. 12. Geographical distribution of *Euphorbia myrsinites* in Iran.

2.5–3.5 mm diameter; lobes ovate-oblong, dentate, 1–2 mm wide, reddish or pinkish (rarely whitish); glands transversely oblong, reddish or brown, 2-horned, horns dilated. Capsules broadly ovoid, sulcate, 4–5.5 mm diameter, smooth or minutely granulate and papilose. Seeds oblong, obscurely quadrangular, 3–4 mm long (excluding caruncle), grayish-brown, vermiculate-rugulose; caruncles conical-truncate, almost always notched above (concave), 1–1.3 mm long. Flowering and fruiting time: April–June.

Habitat: Rocky places, calcareous slopes, mountain pastures and steppes, 1500–3600 m a.s.l.

Distribution: South Europe (Albania, Balearic Islands, Bosnia and Hercegovina, Bulgaria, Greece (including Crete), France (Corsica), Italy, FYR Macedonia, Montenegro, Romania, Serbia, European part of Turkey, Ukraine (Crimea), N & NW Anatolia, Caucasus (Georgia, Russian Black Sea coast), Iran (central Alburs) (Fig. 12). Widely cultivated as an ornamental rock-garden plant, naturalized in central Europe (Czech Republic) and North America (mostly California). Ancient Mediterranean element.

This species is variable in the length of rays and the rugosity of the seed coat. It is like *E. marschalliana* subsp. *marschalliana*, differing mainly in its vermiculate-rugulose seeds with conical-truncate and concave caruncles. Wihout seeds the two taxa are hardly distinguishable from each other; however, in most cases they can be separated by their geographical distributions.

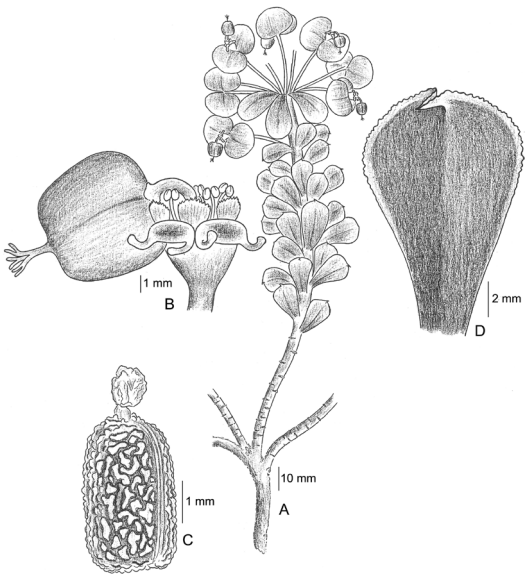

Fig. 13. *Euphorbia spinidens*. — **A**: Habit. — **B**: Cyathium and fruit. — **C**: Seed. — **D**: Leaf. From *Safaie, IRAN 47458*.

The taxa co-occur only in the Ardebil province.

According to *Flora Iranica* (Rechinger & Schiman-Czeika 1964), the species is reported from the Khorasan province, but after the study of specimens from the rich *Euphorbia* collection at the Khorasan herbarium (FUMH) and the research center of Khorasan, it became clear that there is no *E. myrsinites* in this province and all the specimens examined from that province belong either to *E. spinidens* or *E. monostyla*.

Specimens examined. — **Iran**. Prov. Tehran, Karaj, Baraghan *Moussavi & Karavar 47441* (IRAN); Karaj to Ghazvin, 33 km to Karaj, Aghesht, *Termeh & Matin 18196* (IRAN); Bilaghan, Karaj valley, *Riazi 4789* (TARI); Karaj, Chalus, Garmab, *Babakhanlou & Amin 7448* (TARI); Gajereh, on Chalus road, *Mirfakhrai 7352* (TARI); 15 km from Gachsar toward in the road towards Tehran, *Akhani 14988* (Hb. Akhani); Shahrestanak, 56 km from Karaj on Chalus road, *Moussavi & Amin 7493* (TARI); Prov. Mazandaran, Chalus, Kandovan, Kuh-e tunnel, *Termeh* 18116 (IRAN); Kojour *Rechinger & Manuchehri* 17844 (IRAN); N side of Kandovan tunnel, *Wendelbo & Shirdelpur 11662* (TARI); ca. 40 km S of Ramsar, N slope of Khash-e chal Mt., *Assadi & Maassoumi 51219* (TARI); Prov. Ardebil, 43 km from Givi to Ardebil, road of Mevesht to Arpachai village, *Mozaffarian & Nowrozi 34314* (TARI); Prov. Ghazvin, Ghazvin to Moallem-Kelayeh, 17 km NE of Ghazvin, Chanar-khani, *Moussavi, Tehrani & Karavar 47872* (IRAN); Prov. Hamedan, Alvand Mt. from Abero & Simin valley (Kolah-ghazi Mt.), *Mozaffarian 65049* (TARI).

Euphorbia spinidens Bornm. *ex* Prokh. (Fig. 13)

Consp. Syst. Tithym. Asiae Mediae: 208. 1933. — *Tithymalus spinidens* Prokh., Consp. Syst. Tithym. Asiae Mediae: 208, 239. 1933, *nom. alt.* — Type: [Turkmenistan], NW slopes of the Kugitang range, opposite to Kugitang village, zone of *Juniperus* forest, bottom and slopes of the gorge, 12.VI.1931 *S. A. Nevski s.n.* (LE).

Glabrous, somewhat glaucous perennial herbs with several simple stems arising from base. Cauline leaves obovate or spatulate, dilated above, 10–22 × 4–10 mm, base cuneate, apex mucronate, margin cartilaginous and irregularly denticulate. Terminal rays 7–12, axillary 0–1. Ray-leaves suborbicular, obovate or oblong, base rounded or truncate, apex rounded and hardly mucronate, margin entire or rarely dentate towards apex. Raylet-leaves reniform-rhombic, base rounded, truncate or rarely cordate, apex obtuse, mucronulate, margin subentire. Cyathial involucre campanulate, 2–3 mm diameter; lobes orbicular, fimbriate-dentate, 1–1.5 mm wide, reddish; glands transversely oblong, ochreous or light brown, 2-horned, horns white-spatulate or lobate, more or less longer than width of glands. Capsules ovoid-quadrangular, trigonous, 4.5–5.5 mm diameter. Seeds oblong-quadrangular, 3–4 mm long (excluding the caruncle), whitish, vermiform-rugose and tuberculate; caruncles conical, ca. 0.5–0.75 mm long. Flowering and fruiting time: April–June.

Habitat: Mountains, slopes and rock fissures, 500–2100 m a.s.l.

Distribution: NE Iran (Khorasan province), E Turkmenistan, Uzbekistan, N Afghanistan (Fig. 14). Irano-Turanian element (Kopet Dagh & Aladagh range).

There was only one specimen from Iran (Khorasan province) listed in *Flora Iranica*.

Specimens examined. — **Iran**. Prov. Khorasan-e Razavi, 37 km Mashhad to Kalat, *Safaie 47458* (IRAN); Mozdouran to Sarakhs, *Djavadi & Ghanbari 47929* (IRAN); Mashhad, Torogh dam, *Faghihnia & Zangooei 20943* (FUMH); SW of Kalat-e Naderi, between Ourtakand village & Bagh-Kand, *Faghihnia & Zangooei 23911* (FUMH); Torbat-e Jam, Salehabad, between Baghbaghu & Bagh-e Keshmir, *Joharchi & Zangooei 39408* (FUMH); Sarakhs, Bazengan road, *Rezaei & Mahvan 10877* (FUMH); Fariman, Shahan-Garmab, after Sefidsang, *Ayatollahi & Mahvan 10824* (FUMH); Prov. North Khorasan, 68 km on the road to Gifan from Bojn-

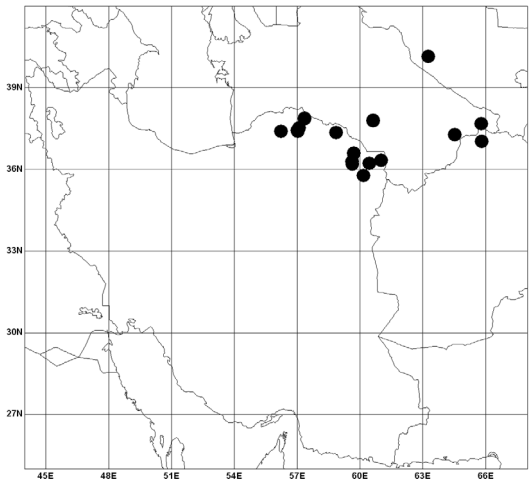

Fig. 14. Geographical distribution of *Euphorbia spinidens*.

ourd, after Amirabad, *Assadi & Maassoumi 50265* (TARI); Bojnourd, Arkan village, Zorghoum, Aladagh Mt., *Gholipour 47861* (IRAN); W of Bojnourd, Bodranlou, *Rafeie & Zangooei 27298* (FUMH); SW of Bojnourd, Reien, Zuy-e Reien to Garmak, *Memariani*, *Zangooei & Arjmand 37306* (FUMH); SW of Bojnourd, Reien, Alkhas valley, *Memariani & Zangooei 37770* (FUMH); W of Bojnourd, Almeh, *Rafeie & Zangooei 29600* (FUMH).

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