

Morphology, nomenclature and distribution of *Bassia monticola* (*Chenopodiaceae-Amaranthaceae*), a poorly known species from Western Asia

Морфология, номенклатура и распространение *Bassia monticola* (*Chenopodiaceae-Amaranthaceae*), малоизученного вида из Западной Азии

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Abstract. *Kochia monticola* was previously considered as a synonym for the widely distributed Irano-Turanian *Pandertia pilosa*. After the merger of *Kochia* and *Pandertia* with *Bassia* based on molecular phylogeny, *K. monticola* remained a synonym of *Bassia pilosa*. We claim that *Bassia monticola*, a name proposed by Kuntze (1891) for *K. monticola*, should be separated from *B. pilosa* based on morphological characters and localised distribution in mountainous regions of Iran, Iraq, Syria, and Lebanon at altitudes 1800–2600 m a. s. l.

Keywords: *Bassia*, Western Asia, taxonomy, *Camphorosmoideae*, *Chenopodiaceae-Amaranthaceae*.

Аннотация. Ранее *Kochia monticola* считали синонимом широко распространенного ирано-туранского вида *Pandertia pilosa*. После объединения родов *Kochia* и *Pandertia* с родом *Bassia* на основе молекулярно-филогенетических данных *K. monticola* рассматривается соответственно как синоним *Bassia pilosa*. В настоящей работе мы показали, что вид *Bassia monticola* (название, предложенное Kuntze (1891) для *K. monticola*) должен рассматриваться отдельно от *B. pilosa*, поскольку характеризуется хорошими морфологическими отличиями и имеет узкое распространение в горных районах Ирана, Ирака, Сирии и Ливана на высотах 1800–2600 м над ур. м.

Ключевые слова: *Bassia*, Западная Азия, таксономия, *Camphorosmoideae*, *Chenopodiaceae-Amaranthaceae*.

The systematic position and taxonomy of the *Camphorosmoideae* Ulbr. has been re-evaluated after extended molecular studies, and *Bassia* All. has undergone the most drastic taxonomic changes (Kadereit, Freitag, 2011). In its current composition, it encompasses ~20 Eurasian and African species, including the members of commonly accepted genera *Chenoleoides* Botsch., *Kirilowia* Bunge, *Kochia* Schrad., *Londesia* Fisch. et C. A. Mey., and *Pandertia* Fisch. et C. A. Mey. All native American and Australian members as well as some Eurasian species previously included in *Bassia* now belong to other genera (Cabrera et al., 2009, 2011; Kadereit, Freitag, 2011). The most significant characters delimiting *Bassia* from allied genera are leaf anatomy and, in

some taxa, perianth morphology at the fruiting stage (Cabrera et al., 2009; Kadereit, Freitag, 2011; Freitag, Kadereit, 2014; Sukhorukov, 2014). *Bassia* species are frequently very much alike in morphology but different in other (anatomical or physiological) characters, which support their different position on the phylogenetic trees (Akhani, Khoshravesh, 2013).

In Western Asia (Armenia, Azerbaijan, Bahrain, Georgia, Iran, Iraq, Israel/Palestine, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, UAE, and Yemen), *Bassia* is represented by 11 native and one alien species (Akhani, Khoshravesh, 2013; Sukhorukov, Akopian, 2013; Sukhorukov et al., 2016). Of the 11 native taxa, 10 are present in Iran (Akhani, Kho-

shravesh, 2013; Sukhorukov, unpublished data), and the number of species continuously decreases northwards (Sukhorukov, Akopian, 2013) and southwards (Sukhorukov et al., 2016; Taifour, El-Oqlah, 2017). *Bassia pilosa* (Fisch. et C. A. Mey.) Freitag et G. Kadereit is easily distinguished from other species in the region by the vertical embryo position, a character previously considered as genus-specific in *Pandertia* (e. g., Iljin, 1936; Hedge, 1997). Sukhorukov et al. (2016) stated that *Bassia pilosa* described from Talysh (eastern Azerbaijan) is clearly heterogeneous in the area and presented arguments for the acceptance of *B. monticola* (Boiss.) Kuntze in a specific rank proposed by Kuntze (1891). The latter species was originally described as *Kochia monticola* Boiss. (Boissier, 1846) and has sometimes been considered as a synonym for *Pandertia pilosa* Fisch. et C. A. Mey. (\equiv *Bassia pilosa*) (Aellen, 1967; Hedge, 1997, 2001). Other authors accepted *Bassia monticola* (usually as *Pandertia monticola* (Boiss.) Bunge or *Kochia monticola*) as a separate species (e. g., Post, 1932; Ulbrich, 1934; Mouterde, 1966; Scott, 1978) or did not mention it in accounts (Zohary, 1966; Heller, Heyn, 1994; Haber, Semaan, 2007).

Due to misidentification of *Bassia pilosa* and *B. monticola*, it is difficult to discern which records actually belong to *B. pilosa* s. str. or to *B. monticola* in the areas where both species may be present. To date, the precise distribution of *B. monticola* is still unknown since the species is very poorly represented in the European herbaria. While preparing a treatment of *Chenopodiaceae* for the “Flora of Iraq” project, a large number of *Bassia* specimens from Western Asia were revised, which provided deeper insight into the morphology and chorology of *B. monticola*.

Material and methods

Herbarium specimens were examined and revised (if necessary) in the herbaria B, BM, BR, E, FI, G, H, HUJ, K, LE, M, MSB, MW, MHA, P, and W. The map was prepared using the online tool *simplemapp.net* (Shorthouse, 2010). Prior to scanning electron microscopy (SEM), perianths with soft tissues (hairs) were dehydrated in aqueous ethyl alcohol solutions of increasing concentrations and then in alcohol-acetone solutions and pure acetone according to a described procedure (Sukhorukov, Zhang, 2013; Sukhorukov, 2014). SEM observations were made with a JSM-6380 microscope (JEOL Ltd., Japan) at 15 kV after critical-point drying and sputter coating with gold-palladium.

Results and Discussion

Bassia monticola (Boiss.) Kuntze, 1891, Revis. Gen. Pl. 2: 547. \equiv *Kochia monticola* Boiss. 1846, Diagn.

Pl. Orient. Nov. 1 (7): 82; Moq. 1849, in DC., Prodr. 13 (2): 133. \equiv *Pandertia monticola* (Boiss.) Bunge, 1880, Mém. Acad. Imp. Sci. St.-Petersbourg, sér. 7, 27, 8: 9 (Pfl.-Geogr. Beitracht. Fam. Chenop.). — Lectotype (Sukhorukov, 2014: 349): Persia australis [Iran, Kohgiluyeh and Boyer Ahmad Prov.], in locis alpis Kuh-Daëna [Kuh-e Dena], ubi nomades tentoria sua constituent, 21 VII 1842, Th. Kotschy, № 521.715 (G!; isoelectotypes — BM001190958!; E00296928!; FI011279!; HAL0107073 — photo!; JE00026166!; K0000898880! [upper half of the sheet]; LE00011719!; LE00011720!; MO; P04907854! [upper right specimens]; WAG0004061!).

— *Pentodon barbatus* Ehrenb. 1879, in Boiss., Fl. Orient. 4 (2): 925, nom. inval., in syn.

Annual pubescent herb up to 15(20–25) cm, basally branched; stems ascendant or prostrate, whitish or reddish, glabrescent; leaves alternate, loosely arranged (except those in the lower part of the stem), filiform to lanceolate (usually linear), 10–15 \times 1–2(2.5) mm, obtuse to acutish, with brachyblasts in their axils; inflorescence dense, bracts exceeding the flower clusters, up to 1 cm long (in the base of the inflorescence), continuously diminishing in size towards the inflorescence apex; flowers 1–3 in leaf axils, sessile; perianth cylindrical, 2–3 mm long in flowering stage, increasing up to 5 mm in fruiting; its base with tufts of simple hairs; perianth tube white, slightly pubescent or pilose and glabrescent, sometimes almost glabrous; teeth 5, hairy at the top, with green dots at the flowering stage and tubercles at the fruiting stage (wing-like outgrowths absent); stamens 5, protruding, anthers 1.1–1.25 mm long; fruit compressed, ~1.5 mm long with easily rupturing white pericarp; seed with vertical horseshoe-shaped embryo and abundant perisperm.

Note. Boissier (1879) reported a horizontal embryo position in younger fruits. This statement is erroneous, perhaps due to the fact that almost all material available at that time was collected in blooming or early fruiting stages when the seed embryo is underdeveloped. Later, Bunge transferred *Kochia monticola* into *Pandertia* based on the vertical embryo position. Sukhorukov et al. (2016) observed the specimens at the fruiting stage (Lebanon, 2 IX 1931, A. Eig, M. Zohary (HUJ); Lebanon, 1 VIII 1946, P. Mouterde, № 8640 (G)) and confirmed the vertical embryo position in all seeds.

Habitats. Patchy subalpine and alpine meadows, screes, roadsides at elevation 1800–2600 m a. s. l. Fl. June — September, fr. August — September.

Distribution (Fig. 1). **Iran, Iraq, Syria, Lebanon.**

Examined specimens. **Iran.** [Chaharmahal and Bakhtiari Prov.] in alpe Kuh-Delu [Kuh-e Do Delu, Kuh-e

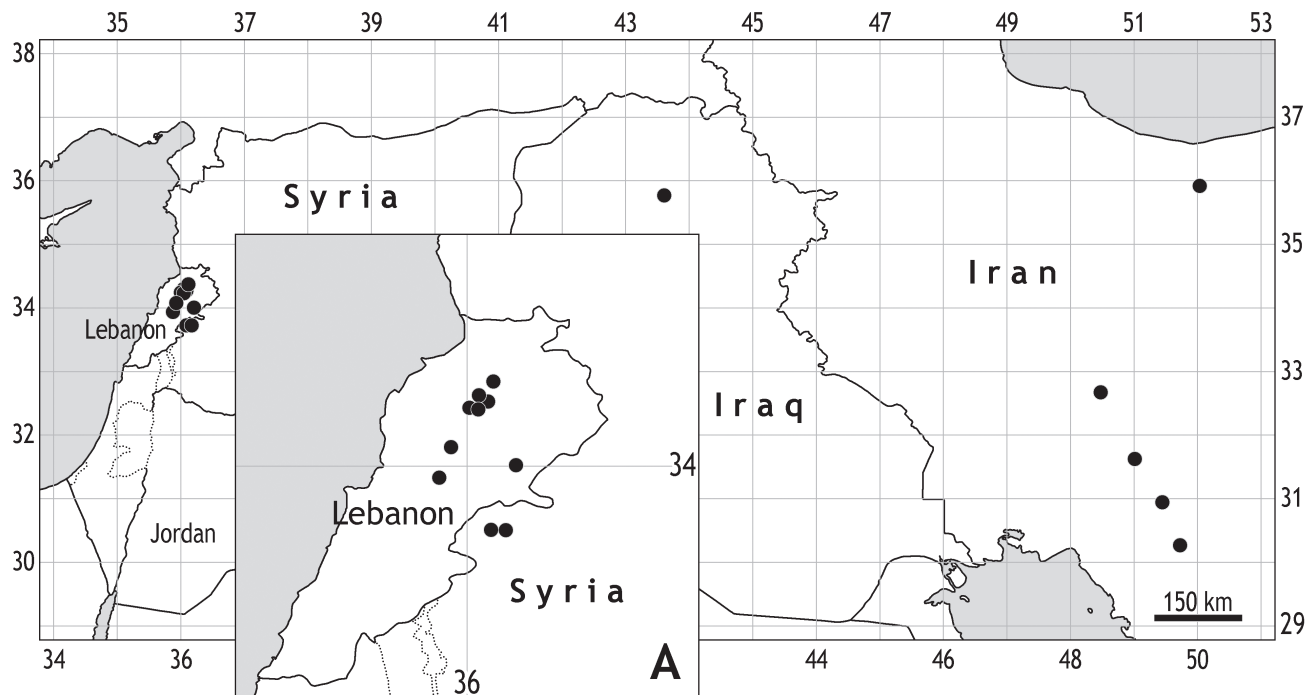


Fig. 1. Distribution of *Bassia monticola* based on the specimens seen.
A – distribution in Lebanon and Syria.

Dowdülü], 15 VI 1842, Th. Kotschy, № 21 (BM); Persia [Mazandaran Prov.], ad radices m. Demawend [Damavand] pr. p. Lar, 3 VIII 1843, Th. Kotschy, № 618 (BM, E, FI, G, K, LE); [Esfahan Prov.] 39 km S of Damaneh (Kumitak), bord de la route, 6 VII 1959, alt. 2140 m, H. Pabot, № 2127 (G); [Fars Prov.] Kuh-e Rang [Kuh-e Ranj], 6 VII 1959, alt. 2450 m, H. Pabot, № 2179 (G). **Iraq.** [Erbil Governorate] Makhmur, Ehrenberg, № 236 (LE). **Syria.** [Rif Dimashq Governorate] prope Zebdaine [Az-Zabadani] & prope Damascus, locis nudis nive derelictis supra Bludan, alt. 6000 ft [1828 m], 6 VI 1855, Th. Kotschy, № 49 (K000898881; BM; P04907852, LE); Anti-Lebanon [Rif Dimashq Governorate], E of Bloudane [Bludan], 9 VIII 1947, P. Mouterde, № 9063 (G). **Lebanon.** [Baalbek-Hermel Governorate] Inter Cedretum et jugum Baalbek, 6000 ft [1828 m], 30 VII 1855, Th. Kotschy, № 355 (K000898882; BM; P04907853); [North Governorate] Makmel [Mount], Ehrenberg (LE); Top of Djurd Aqrra, 8 VIII 1890, Post (BM); [North Governorate] mountain ranges between Ehden and Karnet es Souda [Qurnat as Sawda'], 2400–2500 m, summer snow region, 2 IX 1931, A. Eig, M. Zohary (HUJ); [North Governorate] in vicin. Arz El Rab [Arz El Rab] (i. e. cedretum supra Bcharreh [Bsharri]), solo calcareo, ca. 1950 m, 13 VI 1933, G. Samuelsson (K); [North Governorate] Cedars, 9 VII 1933, P. Mouterde, № 3433 (P05158984); [North Governorate] Jebel Materfé, 2000–2400 m, Berberidetum eretiae, 13 VII 1934, Botanical Dept. (HUJ); [Mount Lebanon Governorate, Sannine Mt.] Karakol Metiouhane, 1 VIII 1946, P. Mouterde,

№ 8640 (G); [Mount Lebanon Governorate], Mount Mnaitra, 1807 m, 34°04'52" N, 35°55'50" E, 10 VII 2005, R. Haber, M. Semaan, № 3518 (BEI; cited after Haber, Semann, 2007).

Bassia monticola is a well-recognisable species due to its small size, prostrate habit, filiform to lanceolate leaves, and small, barely noticeable tubercles on the fruiting perianth (Fig. 2: A). In contrast, typical specimens of *B. pilosa* (including *Pandertia turkestanica* Iljin), which is also present in Western Asia, are much taller (20–60 cm) and characterised by a prominent branched main stem, oblong to ovate leaves, and a perianth with small white or yellowish wings at fruiting. Despite the fact that *B. monticola* was formerly considered as a synonym of *B. pilosa*, we cannot synonymize these species due to remarkable morphological differences. Their close relationship has not yet been confirmed with molecular data. However, two species sharing the same characteristics (the kochioid type of C_4 kranz-type leaf anatomy and an unusual vertical seed embryo), *B. pilosa* and *B. lasiantha* Freitag et G. Kadereit (\equiv *Kirilowia eriantha* Bunge), form a separate clade within *Bassia* (Akhani, Khoshravesh, 2013). *Bassia monticola* is characterised by the same seed embryo position (Sukhorukov et al., 2016) and leaf anatomy, and these facts support the close relationship of these three species.

The distribution area of *B. monticola* presented here (Fig. 1) is much smaller than that of *B. pilosa* and has a significant gap between central Iran and Lebanon/Syria due to the absence of suitable habitats in the low-

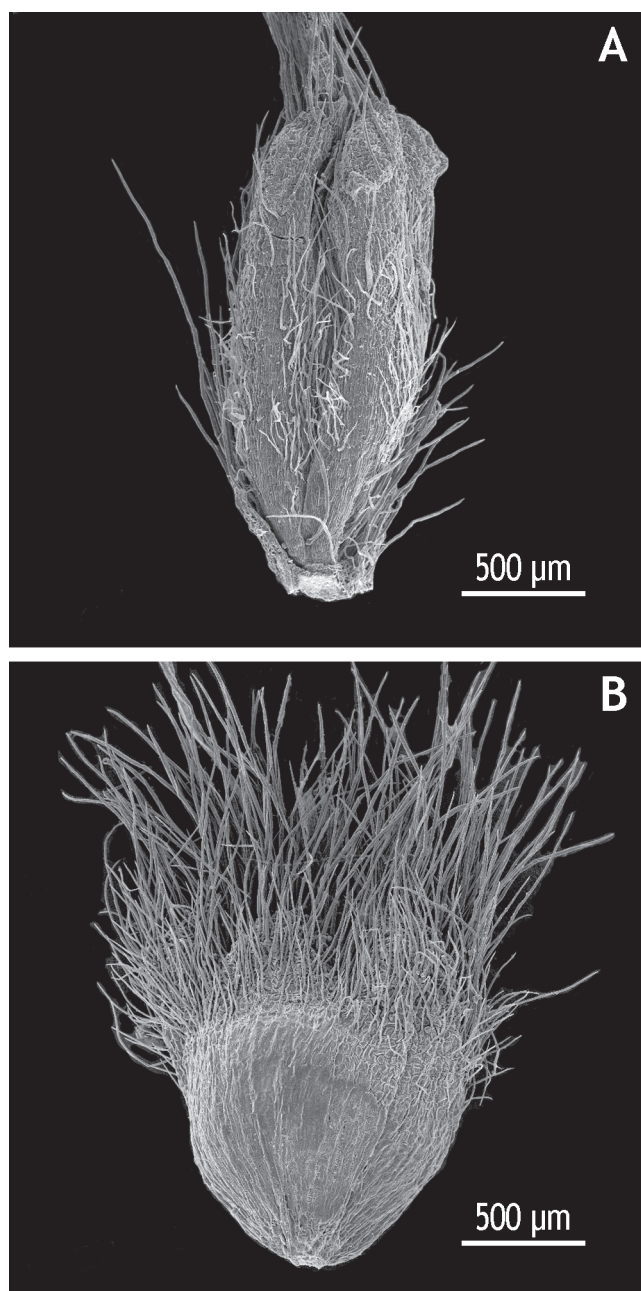


Fig. 2. Perianths of *Bassia monticola* and *Camphorosma monandra* (SEM).

A – *Bassia monticola* (origin of the material: Lebanon, Ehden and Karnet es Souda, 2400–2500 m, 2 IX 1931, A. Eig, M. Zohary (HUJ)); B – *Camphorosma monandra* (origin of the material: Afghanistan, prov. Bamyan, Koh-i-Baba, Koh-e Fuladi SW Bamian, Fuladi-Kar, 3900 m, Wegrand, 5 IX 1968, № 1581, S. W. Breckle (MSB120718)).

land deserts of Syria and Iraq. *Bassia monticola* may also be found in Western Iran and Southern Turkey. In contrast, *B. pilosa* is widely distributed in the entire Irano-Turanian floristic region (Iljin, 1936, as *Pandertia pilosa* and *P. turkestanica*; Mouterde, 1966; Aellen, 1967; Hedge, 1997, 2001, all as *P. pilosa*; Freitag, Kadereit, 2014; Sukhorukov, pers. obs. in West China and East Kazakhstan), and it prefers saline and clayey soils in lowland deserts and screes at lower elevations (up to 1500 m a. s. l.).

The southernmost record of *B. pilosa* is known from the Moav floristic subdivision, Jordan (Palaestina Moabitica, Mashita, deserts, alt. 750 m, 25 IV 1911, F. S. Meyers, J. E. Dinsmore, № 1658 (G!, K!)). The robust specimens turn black upon drying and are mostly known from the deserts of Syria and Southern Iraq. These specimens may belong to an undescribed species labelled in some herbaria as “*Pandertia iraqensis* Sukhor.” (BM!, K!) or “*Halostigmaria maris-mortui* Eig” (HUJ!); the latter name is based on an accidental record from the northern part of the Dead Sea. The plants distributed in the deserts of Western Asia need further investigations. However, a recent record of *P. pilosa* from Mount Mnaitra, Lebanon (Haber, Semaan, 2007), clearly belongs to *B. monticola* and is in fact not the first record of this species for the country.

Another poorly known taxon, *Camphorosma monandra*, was described by Bunge in Boissier (1879, as “*monandrum*”) and closely resembles *B. monticola* in its small, prostrate and hirsute habit, linear leaves, leafy inflorescences, concrescent perianth segments, and vertical seed embryo. It is confined to the alpine belt of Central Afghanistan (in the provinces Bamyan and Maidan Wardak) and is present in several herbaria (G!, LE!, MSB!). However, it was not mentioned in recent checklists of Afghan flora (Breckle, Rafiqpoor, 2010; Breckle et al., 2013). It seems to be absent in adjacent countries (Hedge, 1997; Sukhorukov et al., 2019), and the distribution areas of *B. monticola* and *C. monandra* do not overlap. *Camphorosma monandra* is distinguished from *B. monticola* by a cup-shaped tube (Fig. 2: B) (vs. cylindrical perianth tube: Fig. 2: A) and four perianth teeth that are unchanged in fruiting (vs. five teeth with tubercles). The improved diagnostic keys to *Bassia* species in Western Asia were provided by Akhiani and Khoshravesh (2013) and Sukhorukov et al. (2016), and *B. monticola* should be added to the list of *Bassia* species in Western Asia.

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References

- Akhani H., Koshraresh R. 2013. The relationship and different C_4 Kranz anatomy of *Bassia eriantha* and *Bassia eriophora*, two often confused Irano-Turanian and Sahara-Sindian species // *Phytotaxa*. Vol. 93, № 1. P. 1–24. <https://doi.org/10.11646/phytotaxa.93.1.1>
- Aellen P. 1967. *Pandertia* Fisch. et C. A. Mey. // *Flora of Turkey and the East Aegean Islands*. Vol. 2 / ed. P. H. Davis. Edinburgh: University Press. P. 315.
- Boissier E. 1846. *Diagnoses plantarum orientalium novarum*. [T. 1] № 7. Lipsiae: B. Hermann. 130 p.
- Boissier E. 1879. *Flora Orientalis*. Vol. 4. Geneva; Basel: H. Georg. 1276 p.
- Breckle S.-W., Rafiqpoor M. D. 2010. Field guide of Afghanistan. Flora and vegetation. Bonn: Scientia Bonnensis. 861 p.
- Breckle S.-W., Hedge I. C., Rafiqpoor M. D. 2013. Vascular plants of Afghanistan: an augmented checklist. Bonn: Scientia Bonnensis. 597 p.
- Cabrera J., Jacobs S. W. L., Kadereit G. 2009. Phylogeny of the Australian *Camphorosmeae* (*Chenopodiaceae*) and the taxonomic significance of the fruiting perianth // *Int. J. Pl. Sci.* Vol. 170, № 4. P. 505–521. <https://doi.org/10.1086/597267>
- Cabrera J., Jacobs S. W. L., Kadereit G. 2011. Biogeography of *Camphorosmeae* (*Chenopodiaceae*): tracking the Tertiary history of Australian aridification // *Telopea*. Vol. 13, № 1–2. P. 313–326. <https://doi.org/10.7751/telepea20116023>
- Freitag H., Kadereit G. 2014. C_3 and C_4 leaf anatomy types in *Camphorosmeae* (*Camphorosmoideae*, *Chenopodiaceae*) // *Plant Syst. Evol.* Vol. 300, № 4. P. 665–687. <https://doi.org/10.1007/s00606-013-0912-9>
- Haber R. M., Semaan M. T. 2007. A new record from Lebanon: *Pandertia pilosa* Fisch. et C. A. Mey. (*Chenopodiaceae*) // *Turkish J. Bot.* Vol. 31. P. 157–158.
- Hedge I. 1997. *Camphorosma*; *Pandertia* // *Flora des Iranischen Hochlandes und der umrahmenden Gebirge* (Flora Iranica). Vol. 172 / ed. K. H. Rechinger. Graz: Akademische Druck- und Verlagsanstalt. P. 94–96; 96–97.
- Hedge I. 2001. *Pandertia* // *Flora of Pakistan*. Vol. 204 / eds. S. I. Ali, M. Qaiser. Karachi: University of Karachi. P. 80.
- Heller D., Heyn C. C. 1994. *Conspectus Florae Orientalis*. Fasc. 9. Jerusalem: The Israeli Academy of Sciences and Humanities. 171 p.
- Iljin M. M. 1936. Sem. Marevyue — *Chenopodiaceae* Less. [Goosefoot Fam. — *Chenopodiaceae* Less.] // *Flora URSS*. T. 6 / ed. V. L. Komarov. Mosqua; Leningrad: Nauka. P. 2–354. [In Russian] (Ильин М. М. 1936. Сем. Маревые — *Chenopodiaceae* Less. // *Флора СССР*. Т. 6 / ред. В. Л. Комаров. М.; Л.: Наука. С. 2–354).
- Kadereit G., Freitag H. 2011. Molecular phylogeny of *Camphorosmeae* (*Camphorosmoideae*, *Chenopodiaceae*): implications for biogeography, evolution of C_4 -photosynthesis and taxonomy // *Taxon*. Vol. 60, № 1. P. 51–78. <https://doi.org/10.1002/tax.601006>
- Kuntze O. 1891. *Revisio generum plantarum*. Vol. 2. Leipzig: A. Felix. 1011 p. <https://doi.org/10.5962/bhl.title.327>
- Mouterde P. 1966. *Nouvelle flore du Liban et de la Syrie*. T. 1. Beyrouth: Dar El-Machreq. 418 p.
- Post G. 1932. *Flora of Syria, Palestine and Sinai*. Beirut: Syrian Protestant College. 919 p.
- Scott A. J. 1978. A revision of the *Camphorosmioideae* (*Chenopodiaceae*) // *Feddes Repert.* Vol. 89, № 2–3. P. 101–119.
- Shorthouse D. P. 2010. SimpleMappr, an online tool to produce publication-quality point maps. <https://www.simplemappr.net> (Accessed 06.11.2020).
- Sukhorukov A. P., Akopian J. A. 2013. A compendium of the *Chenopodiaceae* in the Caucasus. Moscow: MAKS Press. 76 p. [In Russian] (Сухоруков А. П., Акопян Ж. А. 2013. Конспект семейства *Chenopodiaceae* Кавказа. М.: Макс Пресс. 76 с.)
- Sukhorukov A., Zhang M. 2013. Fruit and seed anatomy of *Chenopodium* and related genera (*Chenopodioideae*, *Chenopodiaceae*/*Amaranthaceae*): implications for evolution and taxonomy // *Plos One*. Vol. 8, № 4. Art. e61906. P. 1–18. <https://doi.org/10.1371/journal.pone.0061906>
- Sukhorukov A. P. 2014. The carpology of the *Chenopodiaceae* with reference to the phylogeny, systematics and diagnostics of its representatives. Tula: Grif & Co. 400 p. [In Russian] (Сухоруков А. П. 2014. Карпология семейства *Chenopodiaceae* в связи с проблемами филогении, систематики и диагностики его представителей. Тула: Гриф и К. 400 с.)
- Sukhorukov A. P., Aellen P., Edmondson J. R., Townsend C. C. 2016. *Chenopodiaceae* Vent. // *Flora of Iraq*. Vol. 5, pt 1 / eds. S. A. Ghazanfar, J. R. Edmondson. Glasgow: Bell and Bain Ltd. P. 164–256.
- Sukhorukov A. P., Liu P.-L., Kushunina M. 2019. Taxonomic revision of *Chenopodiaceae* in Himalaya and Tibet // *PhytoKeys*. Vol. 116. P. 1–141. <https://doi.org/10.3897/phytokeys.116.27301>
- Taifour H., El-Oqlah A. 2017. The plants of Jordan: An annotated checklist. London: Royal Botanic Gardens Kew; Royal Botanic Garden Jordan. 162 p.
- Ulbrich E. 1934. *Chenopodiaceae* // *Die Natürlichen Pflanzenfamilien*. 2. Aufl. Bd. 16c / eds. A. Engler, K. Prantl. Leipzig: Engelmann. P. 379–584.
- Zohary M. 1966. *Flora Palaestina*. Vol. 1: *Equisetaceae* to *Moringaceae* (text). Jerusalem: The Israel Academy of Sciences and Humanities. xxvii + 364 p.