

Identity, relationship and distribution of the poorly known *Cousinia elata* (Asteraceae, Cardueae)

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Abstract

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Cousinia elata has been known from only two collections, and its relationship to the major subgroups of the genus has been entirely unclear. It is shown that *C. meshhedensis* must be included in *C. elata*, that *C. elata* is actually widely distributed in NNE and NE Iran, and, based on chromosome number, flower and pollen morphology, that it is a member of *Cousinia* s.str. (*C. subg. Cousinia*). Within *Cousinia* s.str., *C. elata* is most closely related to species traditionally classified as *C. sect. Platyacanthae*, based on a Bayesian ITS sequence analysis. The name *C. elata* and its synonyms *C. meshhedensis* and *C. strictissima* are lectotypified and an amended description of the species and a map of its distribution are provided.

Additional key words: *Compositae*, *Cousinia* subg. *Cousinia*, *Cousinia* sect. *Platyacanthae*, taxonomy, Iran

Introduction

A comparative analysis of the regional accounts of *Cousinia* by Rechinger (1953, 1972, 1979) and Tscherneva (1962, 1988) shows that the genus contains approximately 630 species grouped into three subgenera with c. 70 sections (Mehregan & Kadereit 2009). *Cousinia* thus is one of the largest genera of *Compositae* and among the 50 largest genera of flowering plants (Frodin 2004). However, the treatments by Rechinger and Tscherneva were prepared separately and are mainly based on material from two different geographical regions. Accordingly, the exact number of species in *Cousinia* is quite obscure, and a comprehensive study of the entire genus urgently needed. This is also evident from revision of *C. subg. Cousinia* sect. *Cynaroidae* (Mehregan & Kadereit 2008), where the number of species has been reduced from 110 to 31 plus eight subspecies.

Based on molecular studies, *Cousinia* together with *Arctium* L., *Hypacanthium* Juz. and *Schmalhausenia* C. Winkl. belongs to the monophyletic 'Arctium-Cousinia complex' (Susanna & al. 2003a). Most recent molecular studies of this complex, supported by morphological characters, showed its clear subdivision into two groups. These are (1) the arctioid group including *Ar-*

tium L., *Hypacanthium* Juz., *Schmalhausenia* C. Winkl. and *Cousinia* subg. *Cynaroides* and subg. *Hypacanthodes* ($2n = 2x = 36$; pollen grains of the 'Arctiastrum pollen type'; ring of sweeping hairs at the articulation of the base of the stylar apex present (except *Schmalhausenia*)), and (2) the cousinoid group with only *Cousinia* subg. *Cousinia* (= *Cousinia* s.str.; $2n = 2x = 18, 20, 22, 24, 26$; pollen grains of the 'Cousinia type'; sweeping hairs scattered on stylar branches; Duistermaat 1996; Susanna & al. 2003a, b; Ghaffari & al. 2006; López-Vinyallonga & al. 2009).

Cousinia elata was described by Boissier & Buhse (1860) from the Neka valley in the Elburz Mts in N Iran. A survey of the taxonomic treatment of *C. elata* in the 19th century shows that most authors placed the species in sections that today are known to be part of *Cousinia* s.str. (Table 1). Rechinger (1972) did not study the type collection of *C. elata* and did not place the species in his sectional classification of *Cousinia*. Tscherneva (1974, 1983), in contrast, transferred the species to *Hypacanthium* (arctioid group, *C. sub. Cynaroides*) with the new combination *H. elatum* (Boiss. & Buhse) Tscherneva. *C. elata* is only known from two collections from NNE

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Fig. 1. Comparison of the illustration of *Cousinia elata* by Buhse (1899) with herbarium material – A: part of original illustration by Buhse (1899); B-C: herbarium sheet (*Buhse* 1046/5, P) with two specimens. – Scale bar: 5 cm.

Iran. Jalili & Jamzad (1999) did not specify the conservation status of the species because of the lack of data. In this paper I attempt to clarify the identity, relationship and geographical distribution of *C. elata*.

Material and methods

Both the literature and the available herbarium material were studied to typify the name *Cousinia elata*. Herbarium material matching the description of *C. elata* and of other species of *Cousinia* similar to *C. elata* was studied morphologically. Pollen grains were studied using light microscopy.

In order to identify the closest relatives of *Cousinia elata*, a Bayesian analysis of ITS sequences of 214 taxa was performed. Material and methods for this Bayesian analysis as well as the resulting cladogram are given in a separate paper (Mehregan & Kadereit 2009).

Results and discussion

The type collection of *Cousinia elata* was made by Buhse in NNE Iran (“Albursgebirge im Nikathal bei Radkan, Juli 1848, *Buhse No. 1046/5*”, Boissier & Buhse 1860). Bunge (1865) cited two collections as belonging to *C. elata*. These were the above type collection and material collected by Bunge himself at Shahroud (NNE Iran). Later on, these two collections were cited as the only known material of *C. elata* (Boissier 1875; Winkler 1892, 1897; Rechinger 1972). The specimens of the type collection in Boissier's herbarium (G-BOIS) is suitable as the lectotype. In the Paris herbarium (P), a further specimen was found that clearly matches both the description of *C. elata* by Boissier & Buhse (1860) and the illustration of *C. elata* by Buhse (1899) (Fig. 1). I also found a specimen of Bunge's collection in P.

Comparing this material with other material of the genus, I found that a good number of herbarium specimens, most of them collected recently, clearly match the description of *Cousinia elata*, and that the species is actually widely distributed in NNE and NE Iran (Fig. 3). Most of this material was identified as *C. meshhedensis* Bornm. & Rech. f. (in Rechinger 1940), which was first published based on material collected by Rechinger at Robot-Sefid (NE Iran). Morphological analysis of mate-

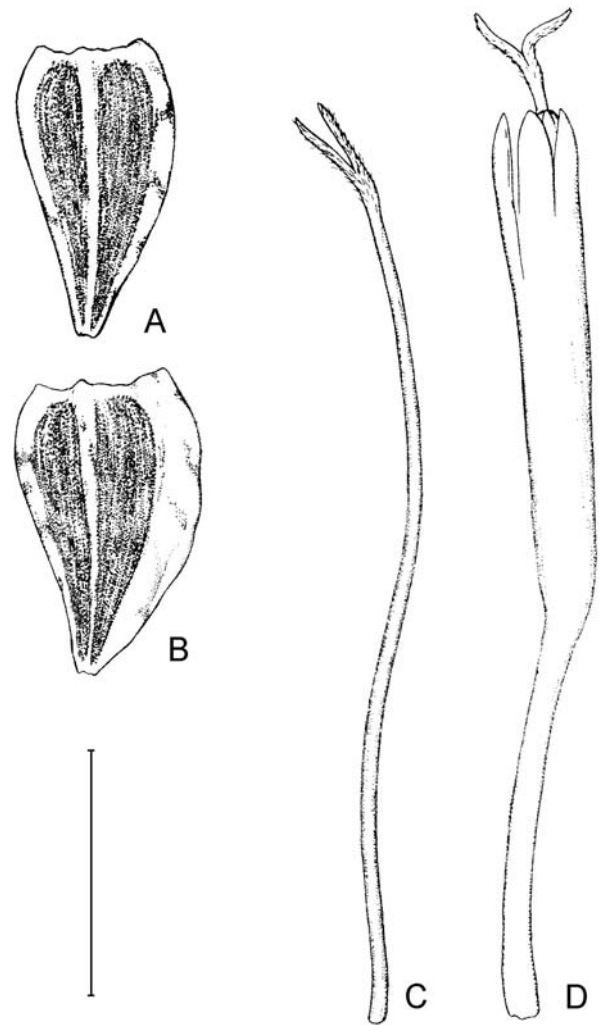


Fig. 2. Achene and flower morphology of *Cousinia elata* – A-B: ridged and winged achenes; C: style with hairs scattered on stylar branches; D: flower. – Scale bar: 5 mm.

rial belonging to *C. meshhedensis* clearly shows that this species falls within the variation of *C. elata* and cannot be regarded as a separate species. The same result was obtained for *C. strictissima* Rech. f. collected at Mt Shahvar in NNE Iran, not far from the type locality of *C. elata*. In fact, *C. strictissima* was correctly placed in synonymy with *C. meshhedensis* already by Rechinger (1979).

Table 1. Taxonomic history of *Cousinia elata*.

Binomial	Subgenus (present concept)	Section	Reference
<i>Cousinia elata</i>	–	–	Boissier & Buhse 1860
<i>Cousinia elata</i>	<i>Cousinia</i>	<i>Sphaerocephalae</i> Bunge	Bunge 1865
<i>Cousinia elata</i>	<i>Cousinia</i>	<i>Alpinae</i> Bunge	Boissier 1875
<i>Cousinia elata</i>	<i>Cousinia</i>	<i>Odontocarpae</i> C. Winkl.	Winkler 1892, 1897; Buhse 1899
<i>Cousinia elata</i>	–	–	Rechinger 1972
<i>Hypacanthium elatum</i>	<i>Cynaroides</i>	–	Tscherneva 1974
<i>Cousinia elata</i>	<i>Cousinia</i>	<i>Platyacanthae</i> Rech. f.	present study

Cousinia elata clearly has all major diagnostic characters of the cousinoid group. Pollen grains are oblong and smooth (*Cousinia* type of *C.* subg. *Cousinia*), its chromosome number is $2n = 2x = 26$ (Ghaffari & al. 2006 for *C. meshhedensis*), and sweeping hairs are scattered on the stylar branches (Fig. 2).

The results of our molecular analysis support these morphological and karyological findings. The species clearly falls into the “cousinoid clade” in our Bayesian analysis of ITS sequences of 214 taxa (Mehregan & Kadereit 2009). This clearly shows that the transfer of *C. elata* into *Hypacanthium*, a genus of the arctioid group, by Tscherneva (1974), is incorrect. The molecular analysis also shows that *C. elata* together with *C. eriophylla* and *C. rechingerorum* (both of *C.* sect. *Platyacanthae*) form a monophyletic clade with a posterior probability of 1.00 (Mehregan & Kadereit 2009: 41, fig. 3, right column). *C.* sect. *Platyacanthae* is a small section endemic to NE Iran and has synapomorphies also found in *C. elata*: plants are suffruticose-caespitose and lateral capitula overtop the capitulum of the main axis (Rechinger 1972). Therefore, I place *C. elata* in *C.* sect. *Platyacanthae* (Table 1). It should be clear, however, that, following the molecular analysis of the ‘*Arctium-Cousinia* complex’ by López-Vinyallonga & al. (2009), the present sectional classification of *Cousinia* s.str. is highly artificial. A synonymy, an amended description of the species as well as a map of its geographical distribution are given:

Cousinia elata Boiss. & Buhse in Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 126. 1860 ≡ *Hypacanthium elatum* (Boiss. & Buhse) Tscherneva in Bot. Zhurn. (Moscow & Leningrad) 59: 188. 1974. – Lectotype (designated here): [Iran, NNE, Elburz Mts, in valley Neka, near Radkan] “Albursgebirge im Nikathal bei Radkann”, 7. 1848, *Buhse* 1046/5 (G-BOIS!; isolecotype: P!). = *Cousinia meshhedensis* Bornm. & Rech. f. in Repert. Spec. Nov. Regni Veg. 48: 144. 1940. – Lectotype (designated here): Iran, NE, prov. Khorassan, inter Meshhed (Mashhad) et Turbat-e Haidari, in tractu boreali montium inter Robat-Safid et Turbat-e Haidari, 10.-11.7.1937, *Rechinger* 1567 (W!; isolecotypes: B!, K!). = *Cousinia strictissima* Rech. f. in Ann. Naturhist. Mus. Wien 57: 80. 1950. – Lectotype (designated here): Iran,

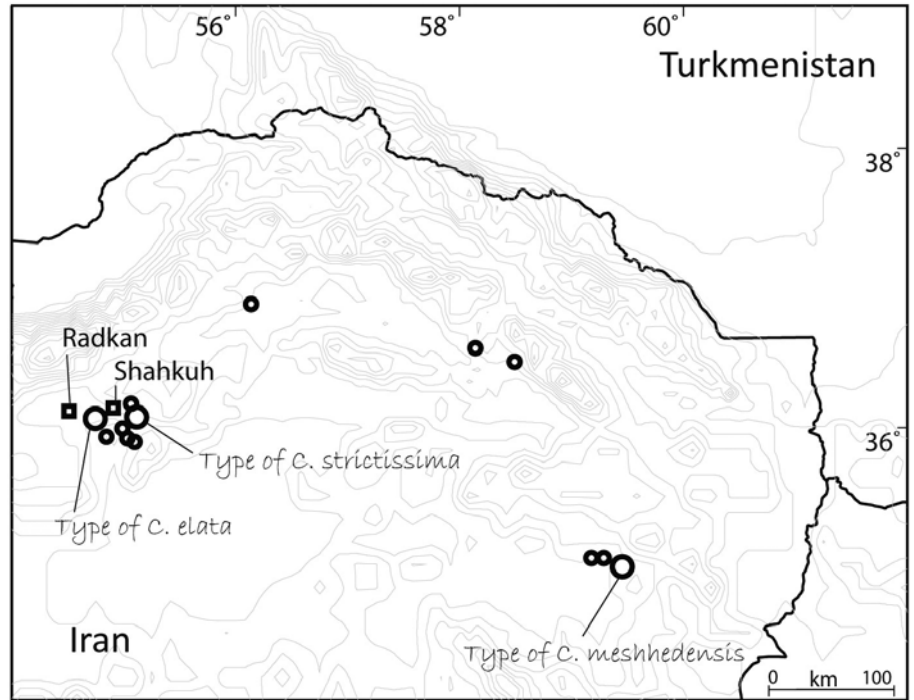


Fig. 3. Geographical distribution of *Cousinia elata*. The type localities of *C. elata*, *C. meshhedensis* and *C. strictissima* are marked by larger circles.

NNE, in declivibus australibus montium Shahvar supra Nokarman (Nigarman) versus casas pastorales Dihi, 24.7.1948, 2200-2400 m, *Rechinger* 5950 (W!; isolecotypes: B!, K!, M!).

Plants suffruticose, caespitose, up to 60 cm high. *Leaves* rigid and leathery, araneose-tomentose on both sides; basal leaves rosulate, up to 30 × 5 cm, lanceolate, coarsely pinnately lobed to pinnatisect, gradually attenuate into petiole; cauline leaves smaller and less divided towards the apex. *Stems* branched above to form a corymbose synflorescence. *Capitula* with 20-50 flowers, 2.5-5.5 cm broad including phyllaries. *Phyllaries* 30-45, middle ones ± spreading, their free part often ± constricted at base and expanded above into a cordate, ovate to lanceolate appendage of 10-30 × 5-9 mm, attenuate into a long spine at apex. *Receptacular bristles* smooth. *Corolla* purple, 15-20 mm long; anthers concolorous or pale. *Achenes* 5-6.5 mm long, asymmetrically 4-ridged or 4-win- ged. Chromosome number: $2n = 2x = 26$. Flowering June to August. – Fig. 1-2.

Additional specimens seen. — IRAN: Shahpasand to Bojnourd, N of Robat-e Qareh-Bil to Almeh, 7.6.1975, 1200-1300 m, *Termé* 32234 = 34040-E (IRAN); prov. Semnan, Damghan towards Shahrud, Tazreh (30 km N of Mehmandoust), 28.7.1975, *Moussavi & Karavar* 9095 = 33820-E (IRAN); 60 km N of Damghan on way to Kalateh, 24.6.1973, 1900 m, *Andersen & Jensen* 7232 (E); Shahrud, Tash, 30.7.1975, 2400-2600 m, *Moussavi & Karavar* 9098 = 33807-E (IRAN); near Shahrud, 5.1858, *Bunge & Bienert* s.n. (P); Shahrud to Bastam,

Mojen, 7 km from Shahkuh to Mojen, 11.8.1988, 2450 m, *Moussavi & al. 9099* (IRAN); in declivibus australibus montium Shahvar supra Nokarman (Nigarman) versus casas pastorales Dihi, 24.7.1948, 2200-2400 m, *Rechinger 5950* (B, M, K, W); NE, prov. Khorassan, Esferaien, N slopes of Shah-Djahan mnts., after Noshirevan, supra Denj, 11.6.2002, 1470-1630 m, *Mehregan 46* (herb. Faculty of Pharmacy, Mashhad, Iran); inter Khargh and Ghouchan, Birak, 11.6. 2002, 1740-1975 m, *Mehregan 45* (herb. Faculty of Pharmacy, Mashhad, Iran); Mashhad to Torbat-e Heydarieh, in tractu boreali montium inter Robat-Safid & Turbat-e Haidari, 10.-11.7.1937, *Rechinger 1567* (B, K, W); Robat-Sang to Kadkan, Bors, 19.6.2002, 1750-1850 m, *Djavadi & Sadeghi 43469* (IRAN); between Kadkan and Esfiz, 24.5.2002, 1950 m, *Mehregan 16* (herb. Faculty of Pharmacy, Mashhad, Iran).

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