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Research Paper

***Centaurea gigantea* subsp. *davisii* (Asteraceae, Cardueae-Centaureinae), A New Subspecies from SE Turkey**

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Abstract

Centaurea s. l., comprising ca. 220 species, is the largest genus in the subtribe Centaureinae in Turkey. For taxonomic study of *Centaurea* sect. *Cynaroides*, extensive collection of distribution areas of *C.* sect. *Cynaroides* was conducted in SE Turkey. Plant specimens were collected by conventional methods and identified based on reliable sources. Moreover, numerous specimens deposited in different herbaria were examined. As a result, *Centaurea gigantea* Schultz-Bip. ex Boiss. subsp. *davisii* Negaresh, Mutlu & M. Bona, a new subspecies of *C.* sect. *Cynaroides* from the Hakkari province of SE Turkey, is described and illustrated. It resembles *C. gigantea* subsp. *gigantea*, but differs from it by having phyllaries indumentum gray-lanate-floccose; flowers yellow; anthers pale yellow; peripheral florets shorter than central ones, slightly conspicuous, 4-lobed; and limb lobes filiform. The geographical distribution of the new subspecies and closely related taxa is presented and mapped. In addition, the pollen of *C. gigantea* subsp. *gigantea* and *C. gigantea* subsp. *davisii* is studied. Finally, a key identification to all subspecies of *C. gigantea* is provided.

Keywords: *Centaurea gigantea*, New Subspecies, Taxonomy, Turkey.

1. Introduction

Centaurea L. s. l. (Cardueae, Asteraceae) with some 400-700 species, depending on the taxonomic treatment, is the largest genus in the subtribe Centaureinae (Wagenitz, 1975; Bremer, 1994; Wagenitz & Hellwig, 1996, 2000; Hellwig, 2004; Garcia-Jacas et al., 2006; Susanna & Garcia-Jacas, 2007; Negaresh, 2018; Bona et al., 2023). The main distinguishing characters of *Centaurea* are the presence of scarious appendages on phyllaries, lateral areole at achene insertion, and sterile peripheral florets lacking staminodes (Dittrich, 1977; Wagenitz & Hellwig, 1996; Negaresh, 2020). *Centaurea* is well represented in the Mediterranean and Irano-Turanian floras (Hellwig, 2004; Susanna & Garcia-Jacas, 2009; López et al., 2011; Negaresh, 2025). Considering the area of its distribution along with the high number of species assigned to it, the taxonomic delineation of *Centaurea* has been obscure (Garcia-Jacas et al., 2001). Currently it is clear that the traditional *Centaurea* was polyphyletic, and it has been divided into the putatively monophyletic genera *Centaurea* s. str., *Rhaponticoides* Vaill., *Psephellus* Cass. and *Cyanus* Mill. (Wagenitz & Hellwig, 2000; Greuter, 2003; Hellwig, 2004; Susanna &

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Garcia-Jacas, 2007, 2009). In Turkey, the genus is currently represented by 220 species in 33 sections (Wagenitz, 1975; Negaresh et al., 2015; Oreizi et al., 2017; Hamzaoglu & Koç, 2020; Duman et al., 2021; Özbek, 2021; Uysal et al., 2024). *Centaurea* sect. *Cynaroides* Boiss. with 18 species, 3 subspecies and 2 varieties is one of the largest sections of the genus in Turkey (Negaresh & Rahiminejad, 2018). A considerable number of taxa (13 species and 2 subspecies) are endemic to the country (Negaresh & Rahiminejad, 2018). Members of this section differ from those in the other sections by their large habit, capitula arranged in a spike-like or raceme-like inflorescence, and especially by entire hastate leaves (Negaresh et al., 2014, 2015; Bona & Hughes 2022).

During our recent revision of herbarium sheets of *C. sect. Cynaroides* deposited in E herbarium, we found one specimen (E00476321) that resembled *C. gigantea* Schultz-Bip. ex Boiss., yet differed in certain morphological characters. This specimen was annotated as new for Turkey by Wagenitz but not published still. In 2019, the third author collected some specimens from same area from which E herbarium specimen collected. After a thorough examination of relevant taxonomic literature and comparison with numerous specimens deposited in different herbaria, we concluded that E specimen (E00476321) as well as specimens collected in the same area by the third author in fact represent a subspecies new to science. So, we decided to describe these specimens as a new subspecies, i.e. *C. gigantea* subsp. *davisii* Negaresh, Mutlu & M. Bona.

2. Materials and methods

A total of 510 specimens including 30 samples specifically collected for this study and 480 herbarium sheets kept in the herbaria B, BASU, BC, BEI, BM, BRA, C, E, EGE, FI, FUMH, G, G-BOIS, GAZI, GB, GOET, HAL, Hb. Hub.-Mor., HSB, HUI, HUJ, IRAN, ISTE, JE, K, KHAU, LAU, LD, M, MO, N, P, PR, RUH, S, SAV, TARI, VAN, W, WAG, WU, and Z+ZT (all herbarium codes according to Thiers 2025+) were examined in this investigation. Digitized specimens were received upon request from the relevant herbaria and viewed via online herbarium catalogues of the herbaria or via JSTOR (2023). For a detailed perspective of using morphology and applying these characters in the treatment of this genus, we did a thorough review of the taxonomic aspects of *Centaurea* sect. *Cynaroides* (Wagenitz, 1975, 1980, 2006, 2019; Ranjbar et al., 2013; Ranjbar & Negaresh, 2014a, 2014b; Negaresh & Rahiminejad, 2014, 2016, 2018). Morphological characters such as length of habit, ramification of stems, indumentum of all parts, shape, length, dissection and decurrence of leaves, number and arrangement of capitula, length of peduncles, shape and size of involucre, shape, size, texture and indumentum of phyllaries, shape, size, color, status and concealing of appendages, number, length and shape of cilia, texture and length of spines, color of flowers, length of central florets, visibility and number of peripheral florets, size, shape and color of achenes, and shape, length and color of pappus etc., were studied in every taxon. The taxonomic applicability of these characters was evaluated among all the material studied. All vegetative and floral parts were measured in a dry state and some parts were observed and measured under a stereo microscope. Pollen grain characteristics were examined by LM and SEM according to the protocols of Erdtman (1969). Pollen diameter, polar axis (P), equatorial diameter (E), aperture size, colpate diameter, number of colpates, and exine thickness were measured.

3. Results and Discussion

Centaurea gigantea Schultz-Bip. ex Boiss. subsp. *davisii* Negaresh, Mutlu & M. Bona, *subsp. nov.* Figures 1 and 2.

Type: Turkey. C9 Hakkari: Çölemerik, 1700 m, 17 August 1954, *Davis 24514* (holotype: E00476321, isotype: K00210960!). Paratypes: Turkey. Hakkari: at the entrance of Çukurca town, oak forest edge, roadside slope, 1230 m, 19 July 2019, *Mutlu 698* (KHAU!); *Mutlu 988* (KHAU!).

Etymology: The specific epithet is given in honour of Dr. Peter H. Davis who collected the type specimens of subspecies.





Figure 1. Holotype of *Centaurea gigantea* subsp. *davisii* (E00476321).



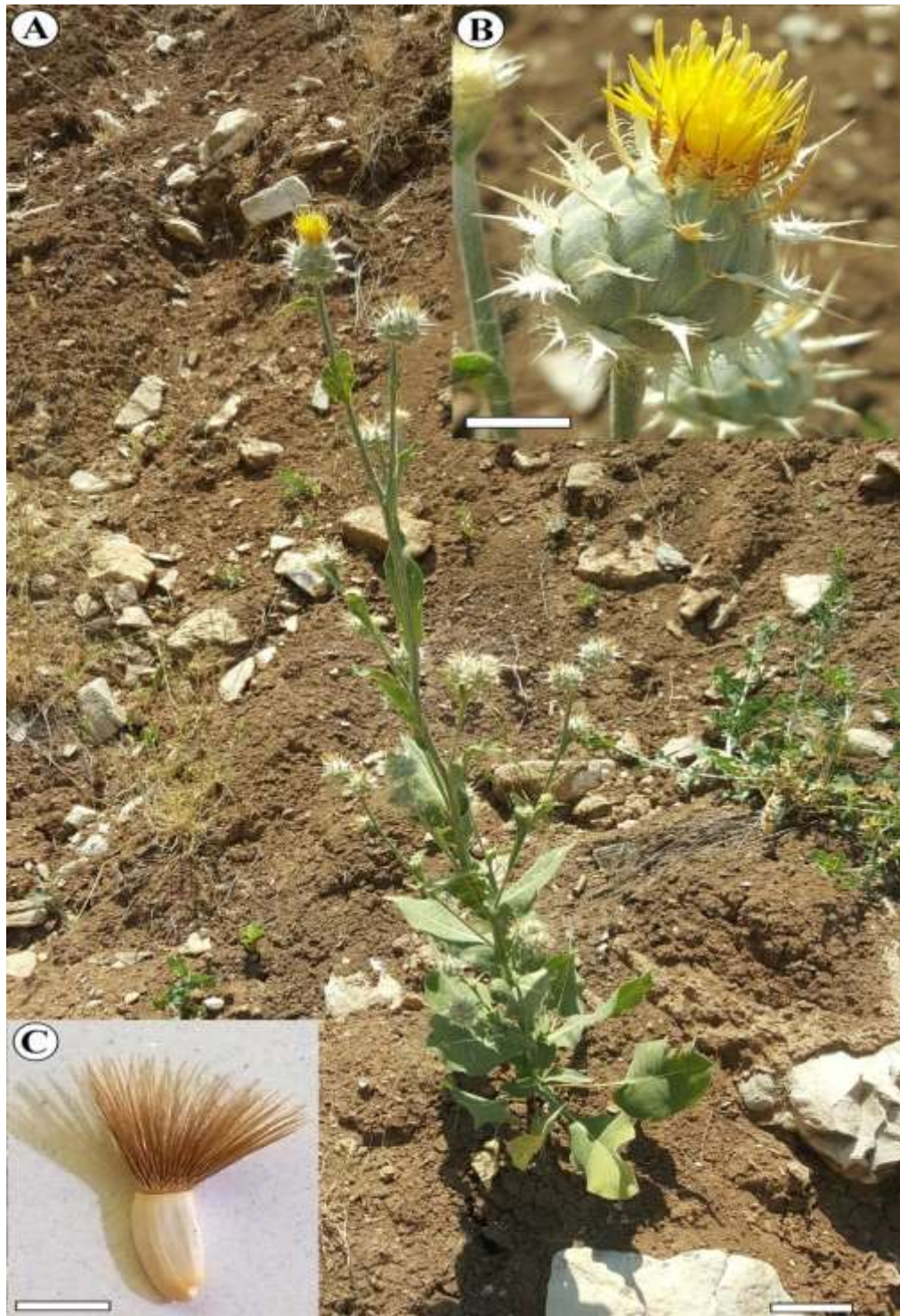


Figure 2. Paratype of *Centaurea gigantea* subsp. *davisii* (photo provided by Basri Mutlu). A: habit; B: close-up of capitulum; C: close-up of achene with pappus. Scale bars: A = 5 cm, B = 1 cm, C = 4 mm.

Diagnosis: *Centaurea gigantea* subsp. *davisii* is related to *C. gigantea* subsp. *gigantea*, from which it differs mainly in its phyllaries indumentum gray-lanate-floccose (vs. tomentose), flowers yellow (vs. purple or pink), anthers pale yellow (vs. deep purple), peripheral florets shorter than central ones, slightly conspicuous, 4-lobed, limb lobes filiform (vs. longer than central ones, distantly conspicuous, 5-lobed, limb lobes linear).



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Description: Biennial plants, all plant usually pale green, with a thick turnip-like root, 85-100 cm tall; collar of fibrous petiolar remains present at stem base. Stem erect, simple, 5-8 mm in diam. at base, cylindrical, with thick yellowish striations, densely covered with long hirsute-articulate and sessile gland hairs. Leaves rigid, papyraceous (on drying), undivided, loosely covered with hirsute-articulate and sessile gland hairs, denser along midrib and veins, sometimes upper ones mixed with arachnoid hairs. Basal and lower cauline leaves petiolate, simple, usually withered at anthesis, broadly ovate, lamina 10-12 × 7-10 cm, petiole 10-15 cm long, margins denticulate, acute at apex. Median cauline leaves sessile, simple, oblong or lanceolate, 15-20 × 3-8 cm, broadly decurrent, up to 55 mm along stem, margins scabrous, acuminate at apex. Upper cauline leaves increasingly smaller, sessile, lanceolate to narrowly lanceolate, 4-7 × 0.8-1.1 cm, broadly decurrent or winged, entire, elongate into a mucro at apex. Capitula numerous, 7 to 13(-15), arranged in a raceme, peduncles short or pedunculate in the upper part, gradually longer towards base. Involucres subglobose to obconical, truncate at base, gradually contracted at apex, 30-35 × 25-30 mm. Phyllaries multiseriate, coriaceous, imbricate, grayish, densely gray-lanate-floccose. Appendages firm, concealing part of phyllaries only, mostly straw-coloured, the inner ones pale brown, elongate triangular, 2.8-3 mm wide at base (excluding cilia), gradually narrowed into a spine 7-12 mm long; cilia several, ± patent, 5-7 on each side, 2.5-5 mm long. Outer phyllaries ovate, 5-7 × 5-7 mm, appendages 8-12 × 10-13 mm (including cilia and spine). Median phyllaries oblong or lanceolate, 10-14 × 8-10 mm, appendages 15-20 × 12-15 mm (including cilia and spine). Inner phyllaries lanceolate-linear or linear, 20-25 × 5-10 mm, appendages 10-16 × 3-6 mm (including cilia and spine), sometimes lacerate. Flowers yellow; central florets hermaphroditic, 35-37 mm long, corolla 13-14 mm long, 5-lobed, lobes 6-7 mm long, with deep yellow nerves, anthers pale yellow, longer than corolla, with apical appendages acute, stigma exerted from corolla up to 4 mm; peripheral florets sterile, shorter than central ones, numerous (15-20 in each capitulum) and slightly conspicuous, finely dissected, not radiant, 4-lobed, limb lobes filiform, 5-6 mm long. Achenes oblong, ca. 6 mm long, ca. 3 mm wide, yellowish to silver-bronze, smooth and shiny, glabrous; insertion areole lateral, yellow, 0.8-1 mm long. Pappus double, persistent, multiseriate, brownish, scabrous, 6-7 mm long, bristles of inner rows much shorter than others.

Distribution and habitat: *Centaurea gigantea* subsp. *davisii* is a rare endemic found in Hakkari province, SE Turkey (Figure 3). It grows on limestone slopes at the edge of *Quercus infectoria* subsp. *veneris* forests in the Irano-Turanian phytogeographic region of Çukurca, Hakkâri, alongside *Papaver tauricola* (Boiss.) Kadereit, *Lactuca serriola* L., and *Aegilops cylindrica* Host, at elevations of 1300-1700 m a.s.l. (Figure 3).

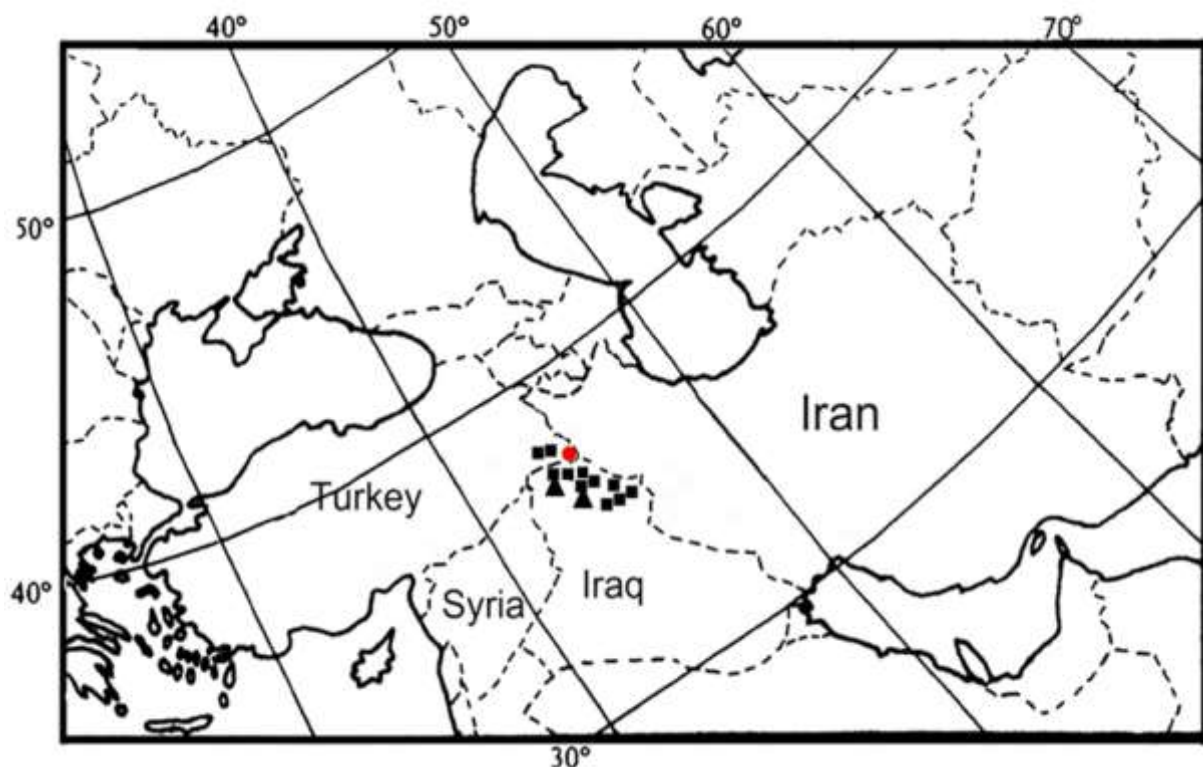


Figure 3. Distribution of *Centaurea gigantea* subsp. *davisii* (circle), *C. gigantea* subsp. *gigantea* (squares), and *C. gigantea* subsp. *rechingeri* (triangles).

Conservation status: *Centaurea gigantea* subsp. *davisii* is known only from the type locality. After detailed field investigations, no other population was found in the surrounding area. The only known population covers an area of ca. 2000 m² and consists of ca. 10 individuals. Possible threats include deterioration of habitats (erosion), the location near a human settlement and restricted distribution. According to the IUCN red list categories and criteria (IUCN, 2012), *Centaurea gigantea* subsp. *davisii* should be considered 'Critically Endangered' (CR) [criterion B2ab].



Taxonomic remarks: *Centaurea gigantea* generally occurs in Arbil, Dohuk, Kirkuk, Mosul and Sulaymaniyah provinces, from N to NE Iraq and there are also a few populations in Hakkari province, SE Turkey (Figure 3). *Centaurea gigantea* belongs to *C.* sect. *Cynaroides*, which includes taxa with racemose or dichasial synflorescences, decurrent upper cauline leaves, ovoid to subglobose involucre, triangular to ovate or orbicular appendages, not decurrent, and usually ciliate and ending in a firm spine or spinule, and with pink, purple or yellow flowers (Negareh & Rahiminejad, 2018). It is represented by two subspecies (Negareh & Rahiminejad, 2018): subsp. *gigantea* has involucre 30-35 × (20-)25-30 mm, appendages elongate triangular, spine 5-13 mm long, pappus 8-10 mm long (Figure 4); and subsp. *rechingeri* Negareh, which endemic to NE Iraq, has involucre ca. 45 × 45 mm, appendages shortly triangular, spine 2-5 mm long, pappus ca. 13 mm long (Figure 5). *Centaurea gigantea* subsp. *davisii* is distinguished from both subspecies by having phyllaries indumentum gray-lanate-floccose, flowers yellow, peripheral florets shorter than central ones and slightly conspicuous, limb lobes filiform (Table 1).



Figure 4. *Centaurea gigantea* subsp. *gigantea* in the field of Turkey (photo provided by Basri Mutlu). A: habit; B: close-up of capitulum. Scale bars: A = 2 cm, B = 1 cm.





Figure 5. Holotype of *Centaurea gigantea* subsp. *rechingeri* (W1960-0009727).



Table 1. Diagnostic morphological characters of *Centaurea gigantea* subsp. *davisii* and *C. gigantea* subsp. *gigantea*.

Characters	<i>C. gigantea</i> subsp. <i>davisii</i>	<i>C. gigantea</i> subsp. <i>gigantea</i>
Lamina of basal and lower cauline leaves wide (cm)	7-10	3-7
Phyllaries color	grayish	green
Phyllaries indumentum	gray-lanate-floccose	tomentose
Flowers color	yellow	purple or pink
Anthers color	pale yellow	deep purple
Peripheral florets	shorter than central ones, slightly conspicuous, 4-lobed	longer than central ones, distantly conspicuous, 5-lobed
Limb lobes of peripheral lobes shape	filiform	linear

This subspecies is also related to *C. spicata* Boiss., which found in S Turkey and NW Syria, in its indumentum of stem and leaves, shape of median and upper cauline leaves, and shape of inflorescence. However, it differs from *C. spicata* by its basal and lower cauline leaves undivided, broadly ovate, lamina 10-12 × 7-10 cm (vs. lyrate, broadly triangular to lanceolate, lamina 6-16 × 6-28 cm), involucre subglobose to obconical, gradually contracted at apex, 30-35 × 25-30 mm (vs. ovoid, 25-28(-32) × (17-)20-25 mm), appendages straw-coloured or brown, elongate triangular, 2.8-3 mm wide at base (excluding cilia) (vs. ovate-lanceolate to narrowly triangular, sometimes lanceolate-triangular, brown, rarely straw-coloured, (3-)4-6 mm wide at base (excluding cilia)), cilia 5-7 (vs. 7-10) on each side, flowers yellow, 35-37 mm long (vs. purple, 28-32 mm long), and also achenes ca. 6 mm (vs. 4-5 mm) long.

In addition, *C. gigantea* subsp. *davisii* shares some characters such as leaves undivided, involucre size 30--35 × 20--25 mm and a racemose inflorescence with *C. daneshvarii* Negaresh, which endemic to W Iran, but differs from it by its basal leaves broadly ovate (vs. lanceolate), median cauline leaves 15-20 × 3-8 cm, broadly decurrent, up to 55 mm along stem (vs. 6-8 × 1.5-2 cm, decurrent, up to 15 mm along stem), upper cauline leaves 4-7 × 0.8-1.1 cm, broadly decurrent or winged (vs. 6-8 × 1.5-2 cm, decurrent, up to 15 mm along stem), appendages elongate triangular, 6-12 mm long (vs. triangular, 2-7 mm long), flowers yellow, 35-37 mm long (vs. pink, 38-40 mm long), peripheral florets shorter than central ones, numerous (15-20 in each capitulum), slightly conspicuous, 4-lobed (vs. much shorter than central ones, few (3-5 in each capitulum), very inconspicuous, 3-lobed), achenes ca. 6 mm (vs. 7-7.5 mm) long, and also pappus 6-7 mm long, bristles of inner rows much shorter than others (vs. 14-15 mm long, bristles of inner rows slightly longer than others).

Pollen: The pollen of both taxa exhibits identical shapes, they differ in size (Table 2). The pollen grains belong to Wagenitz's Jacea-type (1995), Sphaeroidea, with the correlation of the polar axis to the equatorial diameter as 1.06. The exine sculpture is scabrate. The average equatorial diameter is 42.63 μm (± 2.18), while the average polar axis measures 45.48 μm (± 1.74). The average length of the colpus is 38.07 μm (± 1.91), and its average breadth is 10.37 μm (± 1.63) (Figures 6 and 7).

Table 2. Pollen morphological data for the *Centaurea gigantea* subsp. *davisii* and *C. gigantea* subsp. *gigantea*.

	<i>C. gigantea</i> subsp. <i>Davisii</i> (μm)		<i>C. gigantea</i> subsp. <i>gigantea</i> (μm)	
P	45.48	+2.52	38.70	+1.74
E	42.63	+2.18	37.39	+1.82
L	42.52	+2.41	38.81	+2.25
plg	10.37	+1.45	10.12	+1.60
plt	10.37	+1.63	9.42	+1.37
clg	38.07	±1.91	33.83	+1.84
clt	10.37	+1.63	9.42	+1.37
t	8.72	+0.89	8.34	+0.78
Ex	2.45	+0.13	2.45	+0.13

P; polar axis, E; equatorial axis, L; Mezocolpium, plg; pore length, plt; pore width, clg; colpus length, clt; colpus width, t; apocolpium, Ex; exine



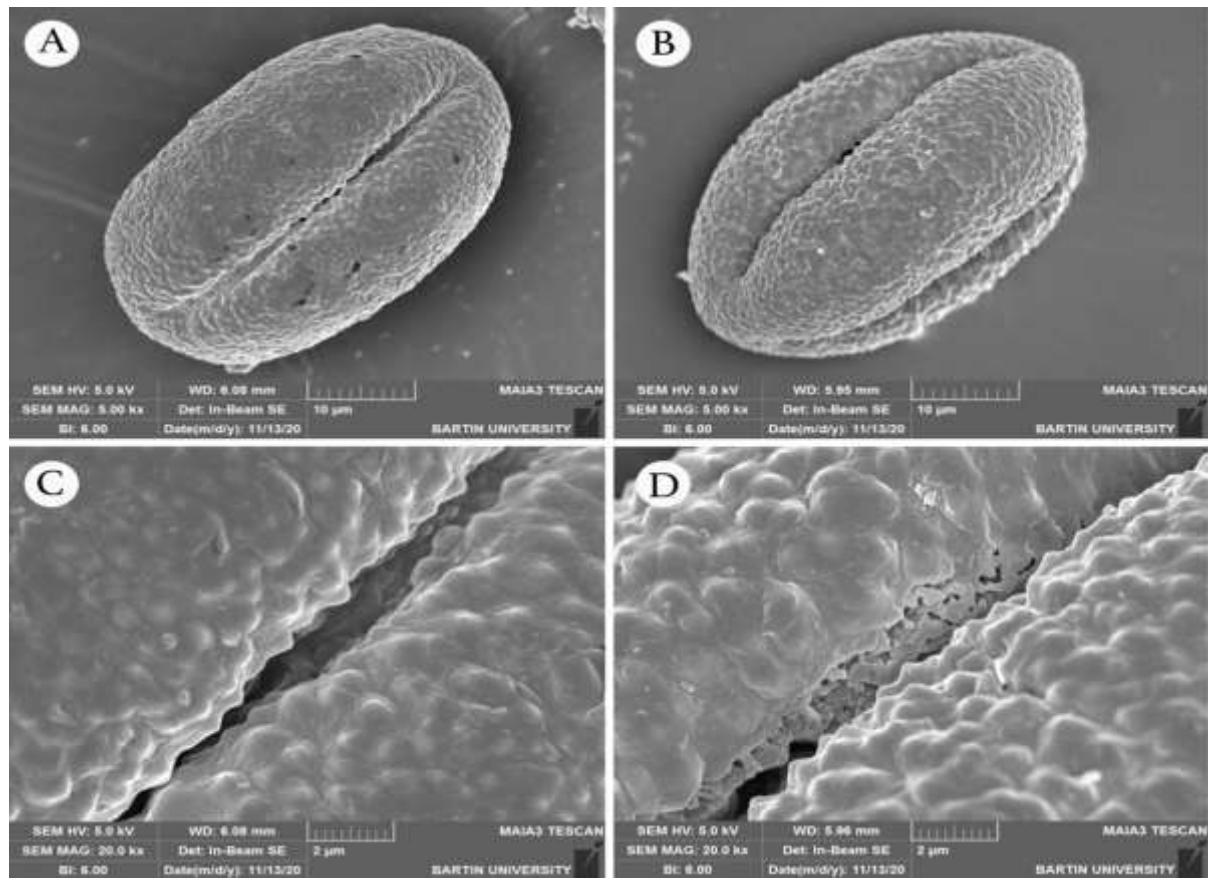


Figure 6. Pollen grains SEM photos of *Centaurea gigantea* subsp. *davisii* (A and C) and *C. gigantea* subsp. *gigantea* (B and D).

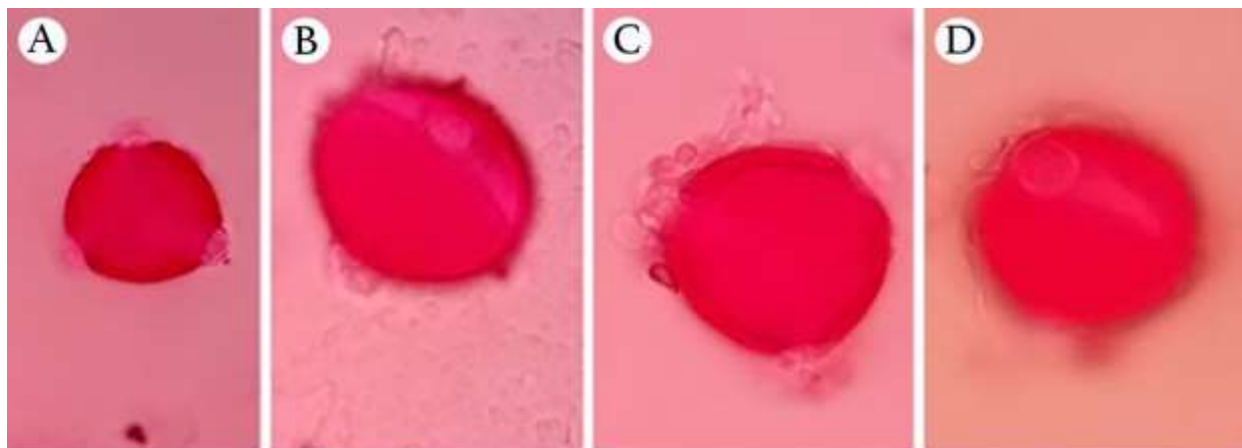


Figure 7. Pollen grains LM photos of *Centaurea gigantea* subsp. *davisii* (A: Polar view; B: Profile view) and *C. gigantea* subsp. *gigantea* (C: Polar view; D: Profile view)

Key to the subspecies of *C. gigantea*

1. Phyllaries indumentum gray-lanate-floccose; flowers yellow; anthers pale yellow; peripheral florets shorter than central ones, slightly conspicuous, 4-lobed, limb lobes filiform *C. gigantea* subsp. *davisii*
 – Phyllaries indumentum tomentose; flowers purple or pink; anthers deep purple; peripheral florets longer central ones, distantly conspicuous, 5-lobed, limb lobes linear 2
2. Involucres 30-35 × (20-)25-30 mm; appendages elongate triangular; spine 5-13 mm long; pappus 8-10 mm long *C. gigantea* subsp. *gigantea*
 – Involucres ca. 45 × 45 mm; appendages shortly triangular; spine 2-5 mm long; pappus ca. 13 mm long



..... *C. gigantea* subsp. *rechingeri*

Selected specimens examined: *Centaurea gigantea* subsp. *gigantea*. **Iraq.** Arbil province: Handren mountains near Rawanduz, 1300 m, 23 June 1893, *Bornmüller 1490* (B!); in montibus between Arbil and Rawanduz, 700 m, *Bornmüller 1491* (B!); between Dokan and Mirza Rustam, 1200 m, 28 July 1957, *Rechinger 10988* (W!); Chiya-I Mandau prope Walash, 1050 m, *Guest 2673* (K!); between Dargala and Karoukh, 12 June 1959, *Rawi et al. 27734* (K!). Sulaymaniyah province: between Sulaymaniyah and Dokan, 700 m, *Rechinger 12482* (W!); between Sulaymaniyah and QaraDagh, 24 June 1957, *Haines 1314* (E!, K!); Qara Dagh, 1500 m, 9 August 1957, *Haines 1244* (E!). Kirkuk province: E Chamchamal, *Rechinger 10061* (W!); on Dukan highway, 20 km NW of Sulaimaniya, 760-780 m, 14 June 1957, *Rawi 21720* (K!). Mosul province: 18 km E Duhok toward Amadiyah, 800 m, 10-12 July 1957, *Rechinger 11531* (B!, K!); SuwaraTuka, in apertis quercetorum, 1200 m, 1956, *Rechinger 15817* (E!); in faucibus Mazurka prope Amadiyah, 1500 m, *Guest 15817* (K!); in apricis lapidosis ad pagum Gara Kurdistaniae prope Mossul, 1 August, 1841, *Kotschy 349* (E!, FI!, G!, GOET!, HAL!, K!, LAU!, M!, MO!, P!, S!, WAG!, W!). Dohuk province: 19 km E of Dohuk, *Rechinger 45976* (W!); Ser Amadiya, 1450 m, 13 July 1976, *Al-Dabbagh et al. 45976* (K!); Sarsang, *Haines W1244* (K!). **Turkey.** Hakkari province: Semdinli Yüksekova aras, 1840 m, 29 July 1978, *Baytop et al. 41318* (ISTE!); inter Yüksekova et Bagashli, 1880 m, 23 July 1974, *Rechinger 49883* (K!); geveer plain, 1845 m, 18 June 2019, *Mutlu 697* (KHAU!); *Mutlu 986* (KHAU!); *Mutlu 987* (KHAU!). *Centaurea gigantea* subsp. *rechingeri*. **Iraq.** Arbil province: Qandil mountains between Shahidan and Pushtashan, 1000 m, 28 July 1957, *Rechinger 11013* (K!, W!); 4-9 km W Raoia, 550 m, *Rawi & Serhang 23756* (K!); Kaiwa, 670 m, 27 July 1957, *Rawi & Serhang 23756* (K!); Karoukh, N of Shahidan, 1000 m, 28 July 1957, *Rawi & Serhang 23801* (K!).

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