TÜBİTAK

Turkish Journal of Botany

http://journals.tubitak.gov.tr/botany/

Research Article

Turk J Bot
(2017) 41: 180-188
© TÜBİTAK
doi:10.3906/bot-1512-14

Centaurea bingoelensis (Asteraceae), a new species from Turkey

Lütfi BEHÇET[1], Ahmet İLÇİM[2,*], Yakup YAPAR[1]
[1]Department of Biology, Faculty of Science and Letters, Bingöl University, Bingöl, Turkey
[2]Department of Biology, Faculty of Science and Letters, Mustafa Kemal University, Antakya, Turkey

Received: 09.12.2015 • **Accepted/Published Online:** 21.10.2016 • **Final Version:** 03.04.2017

Abstract: *Centaurea bingoelensis* Behçet & İlçim is described as a new species. It is confined to Bingöl in Eastern Anatolia, Turkey. The diagnostic characters are discussed and taxonomic comments are presented. Seed and pollen characteristics were investigated using light and scanning electron microscopy. Notes on its ecology are also presented.

Key words: *Centaurea,* flora, taxonomy, Turkey

1. Introduction

Centaurea L. is the fourth largest genus of the family Asteraceae, comprising between 400 and 700 species with predominantly old world distribution ranges (Dittrich, 1977; Bremer, 1994; Wagenitz and Hellwig, 1996; Bancheva et al., 2014). It is distributed in the Mediterranean region and the Near East with a few species reaching northern Eurasia, north and east Africa, North America, and Australia (Wagenitz, 1986). The genus *Centaurea* L. has traditionally been considered a problematic genus in Astraceae (Ranjbar et al., 2013). Turkey is the most important center of speciation of *Centaurea*, with many narrow endemic species. The first thorough arrangement of the genus *Centaurea* was given by Wagenitz (1975), who recognized 172 species and six imperfectly known species. In the *Flora of Turkey and the East Aegean Islands* 34 sections of *Centaurea* were presented (Wagenitz, 1975). Recently *Centaurea* was revised for *Türkiye Bitkileri Listesi* by Uysal (2012a). The number of known *Centaurea* species in Turkey is 162 [(excluding 56 species that are now treated within *Psephellus* (33), *Cyanus* (16), and *Rhaponticoides* (7)] (Yüzbaşıoğlu et al., 2015). In *Flora Iranica*, the genus is represented by 70 species in Iran, of which 32 are endemic (Wagenitz, 1980). Within the *Centaurea* group, the most striking morphological feature is the shape of the bract appendages: on one hand membranaceous lacerate appendages (section Phalolepis) and on the other hand ciliate to fimbriate appendages (section Centaurea = [Acrolophus]). Bract characters, however, have been shown to be relatively unreliable because of the frequent intermediate forms that exist between the sections. Some characters often used for classification, such as the shape of bract appendages and leaves, are prone to undergo rapid changes and are therefore unreliable (Hilpold et al., 2014). Species of the sections Centaurea and Phalolepis can be easily separated from all knapweeds placed within the genus *Centaurea* by their fairly small heads (usually smaller than 10 mm) and slender habits (Uysal et al., 2015).

After thorough consultation of the literature; comparisons with specimens in GAZI, ANK, VANF, MKUH, and Bingöl Univ. Herb.; and comparative morphological and palynological analyses as well as ultrastructural features of the achene via SEM it was concluded that material should be described as a new species.

2. Materials and methods

The specimens reported here were collected from the city of Bingöl, Turkey. The collected specimens were dried and preserved for further studies; later basal leaf dimension, petiole length, capitulum size, outer phyllary characters, and pollen and seed morphology characters were studied. The pollen grains were measured under light microscopy and from nonacetolyzed samples, and prepared according to Wodehouse's method (Wodehouse, 1935). The long axis (A), short axis (B), exine thickness, and intine thickness were measured on at least 50 samples of pollen grains. All of the measurements were performed using CARNOY 2.0 (Schols et al., 2002). For the SEM analysis, pollen grains were transferred directly to a stub with double-sided tape and images were obtained using a Carl Zeiss Evo-40 scanning electron microscope operated at 20 kV.

* Correspondence: ailcim@mku.edu.tr

The pollen terminology follows Faegri and Iversen (1975) and Punt et al. (2007). Mature seeds were mounted on the SEM stubs using double-sided tape and coated with 40–50 nm of gold in a BALTEC SCD 005 coater, and the surface patterns of seeds were obtained using the same electron microscope.

3. Results

Centaurea bingoelensis Behçet & İlçim **sp. nova** (Figures 1, 2).

Holotype: Turkey B8 Bingöl: 25 km west of city of Bingöl, north of Yelesen village, southern rocky slopes 1900–2050 m, 26.06.2014, *L. Behçet* 9648. (Holotype: Mustafa Kemal Univ. Herb., Isotype: ANK, Bingöl Univ. Herb.).

Paratype: Turkey B8 Bingöl: 25 km west of city of Bingöl, north of Yelesen village, southern rocky slopes 1900–2050 m, 04.08.2014, *L. Behçet* 10031 (Paratype: Bingöl Univ. Herb.).

3.1. Diagnosis

Centaurea bingoelensis resembles *C. fenzlii* Reichardt and *C. obtusifolia* (Boiss. & Hausskn.) Wagenitz. (It is important to note that this new species resembles *C. obtusifolia* especially in terms of its cauline leaves structure (Figures 1 and 2)). It clearly differs by its perennial life duration (not biennial); roots and rootstock (not taproot); basal leaves, which are cuneate or truncate at base and sometimes 2–3 pairs of lobes at base (not slightly cordate at base, and without basal lobes); stem leafy throughout (leaves not distributed below the middle of the stems); and leaves like phyllaries below capitula. Outer phyllaries have decurrent appendages and are 1.6–2 cm long (Figure 3) (appendages not decurrent and 1.3–2.5 cm in *C. fenzlii*) and the pappus is simple not double (double in *C. fenzlii*). Moreover, the new species resembles *C. obtusifolia* with its cauline leaf characteristics, but it differs by its involucre size and structure, appendage form, and flower color.

3.2. Description

Perennial herbs, 30–50 cm, woody at base with rootstock, 1–2 stemmed, stems simple, cylindrical, yellowish green, tomentose, unbranched, densely leafy, Leaves coriaceous, hirsute with adpressed hairs, midrib clear and whitish, margin entire. Basal leaves 12–14 × 6–9 cm, broadly oblong or ovate, sometimes 2–3 pairs of lobes at base, petiolate, cuneate or truncate at base, petioles 3–11 cm long. Median and upper leaves sessile and decurrent to 5 cm, mucronate at apex. Median leaves larger than basal leaves, broadly elliptic to oblong 10–28 × 6–13 cm, upper ones smaller. Capitula solitary at end of branches, 5.5 × 4.5 cm, involucres broadly ovoid, phyllaries multiseriate, outer phyllaries decurrent, 1.6–2 cm, coriaceous, imbricate, brown, glabrous, appendages orbicular, with 35 irregular cilia, cilia 1–3 mm, terminal inconspicuous, appendages very large, totally concealing basal part of phyllaries. Flowers yellow, corolla 32–35 mm long. Achenes obovate, 7–8 × 3.5–4 mm, brownish, smooth under light microscope, shiny, brownish, glabrescent. Pappus simple, persistent, multiseriate, longer than achene, scabrous, when fresh purplish, later brown; (Figure 3) 15–18 mm long. Fl & Fr. 6–7 & 7–8.

3.3. Distribution and suggested conservation status and ecology

Centaurea bingoelensis is a local endemic species known in only two localities, north and northwest of Yelesen village (Bingöl Province), East Anatolia (Figure 4). Additionally,

Figure 1. Habit of A- *Centaurea bingoelensis* Behçet & İlçim B- *C. obtusifolia* in original habitat.

Figure 2. Habit of *Centaurea bingoelensis* Behçet & İlçim (A) and *C. fenzlii* Reichardt (B).

it is an Irano-Turanian element. The species is rare in the area. It observed on rocky slopes (Figure 5). Due to grazing and erosion, the populations of species are threatened by extinction in the wild if protection measures are not put in place. Therefore, we recommend that the threatened categories of *Centaurea bingoelensis* should be "Critically Endangered (CR)", because the estimated whole range is less than 10 km^2 (criteria B2 a b (i, iii) of IUCN 2013).

Centaurea bingoelensis grows on the subalpine steppe of Bingöl Province, at altitudes of 1900–2050 m on rocky slopes (Figure 5). The vegetation in this area is formed by herbaceous plants including *Achillea vermicularis* Trin., *Aethionema grandiflorum* Boiss. & Hohen., *Allium ampeloprasum* L., *Alyssum pateri* Nyar. subsp. *prostratum* (Nyar.) Dudley, *Anthemis cretica* L. subsp. *pontica* (Wild.) Grierson, *Arrhenaterum kotschyi* Boiss., *Asperula stricta* Boiss. subsp. *latibracteata* (Boiss.) Ehrend., *A. xylorrhiza* Nabelek, *Astragalus kurdicus* Boiss. subsp. *kurdicus*, *Asyneuma limonifolium* (L.) Jonch. subsp. *pastalozzae* (Boiss.) Damboldt, *Bromus danthoniae* Trin. subsp. *danthoniae*, *B. pumilio* (Trin.) P.H.Sm., *B. tectorum* L. subsp. *tectorum*, *Campanula conferta* A.DC., *C. stricta* L. var. *stricta*, *Centaurea aggregata* Fisch & C.A.Mey. ex DC. subsp. *aggregata*, *Cerasus mahaleb* (L.) Mill. var. *mahaleb*, *Clinopodium vulgare* L. subsp. *arundanum* (Boiss.) Nyman, *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman, *Euphorbia altissima* Boiss. var. *glabrescens* Boiss. ex M.S. Khan, *Grammosciadium platycarpum* Boiss. & Hausskn., *Helichrysum plicatum* DC. subsp. *plicatum*, *Isatis cochlearis* Boiss., *Linaria kurdica* Boiss. & Hohen. subsp. *kurdica*, *Lotus gebelia* Vent. var. *gebelia*, *Onobrychis stenostachya* Freyn subsp. *krausei* (Sirj.) Hedge, *Onosma albo-roseum* Fisch. & C.A.Mey. subsp. *albo-roseum* var. *albo-roseum*, *Origanum acutidens* (Hand.-Mazz.) Ietsw, *Papaver fugax* Poir., *Pimpinella kotschyana* Boiss., *Poa nemoralis* L., *Prangos pabularia* Lindl., *Pyrus syriaca* Boiss. var. *syriaca*, *Rosa montana* Chaix ex Vill. subsp. *woronowii* (Lonacz.) O.Nilsson, *Rosularia radiciflora* Boriss. subsp. *radiciflora*, *Rumex scutatus* L., *Salvia nemorosa* L., *Sanguisorba minor* Scop. subsp. *minor*, *Scorzonera latifolia* (Fisch. & C.A.Mey.) DC., *S. papposa* DC., *Scrophularia pulverulenta* Boiss. & Noe, *Siebera pungens* (Lam.) DC., *Silene spergulifolia* (Willd.) M.Bieb., *Stachys iberica* M.Bieb subsp. *stenostachya* (Boiss.) Rech.f., *Tanacetum nitens* (Boiss. & Noe) Grierson, *Teucrium orientale* L. var. *puberulens* T.Ekim, *Tragopogon pterocarpus* DC.

3.4. Etymology

The specific epithet is derived from the name of the city, Bingöl.

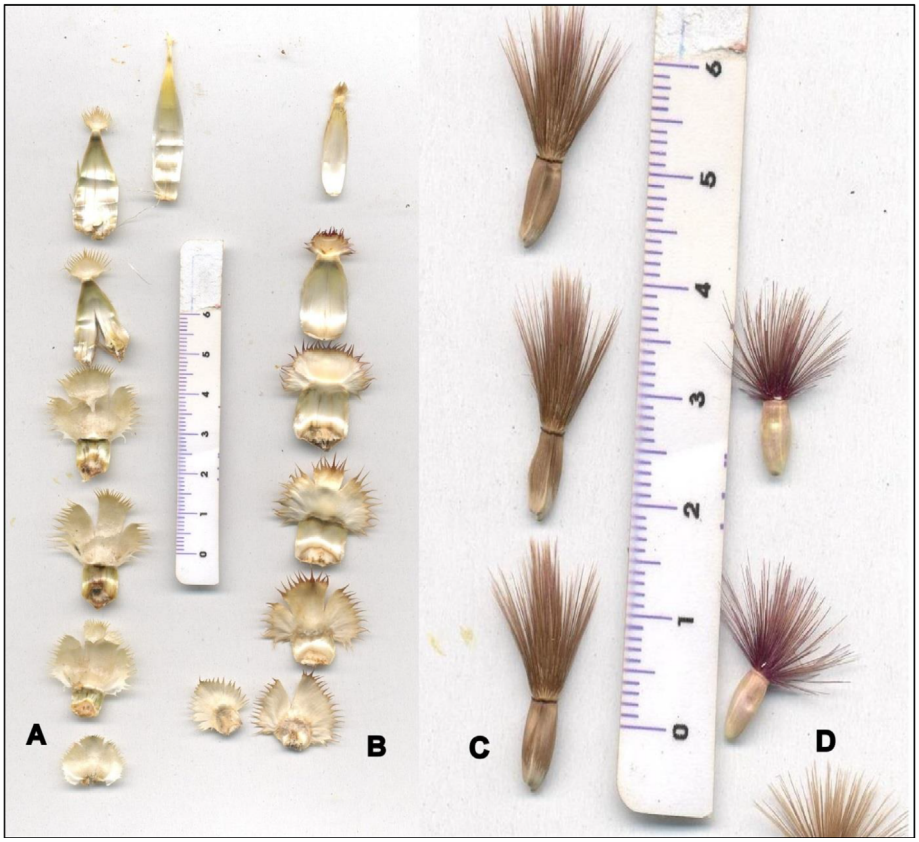

Figure 3. The phyllaries (A- from outer to inner phyllary) and achene (D) of *Centaurea fenzlii* and the phyllaries (B- from outer to inner phyllary) and achene (C) of *C. bingoelensis*.

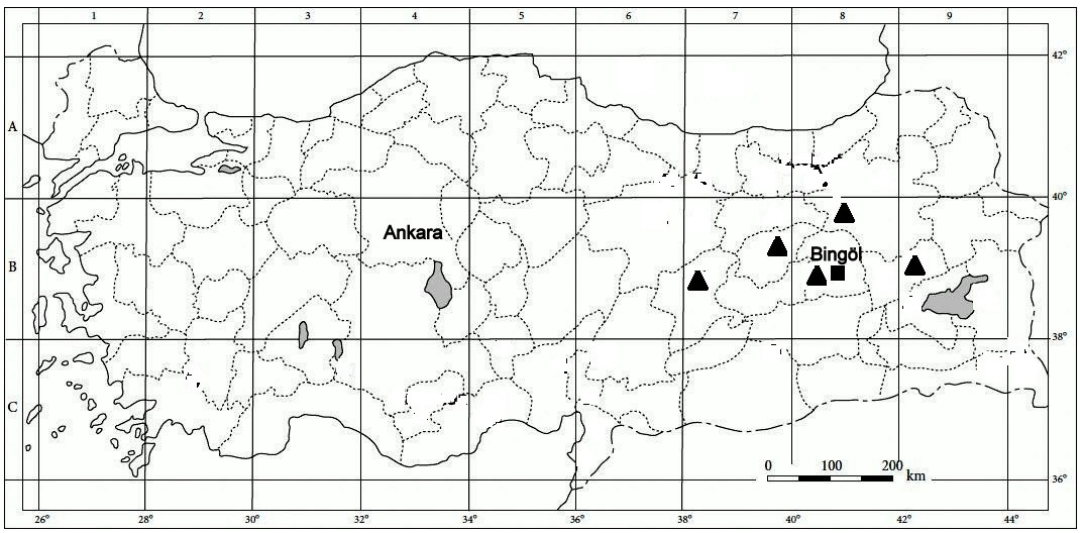

Figure 4. Distribution map of *Centaurea bingoelensis* (▪) and *C. fenzlii* (▲).

4. Discussion

The sectional classification of *Centaurea* is mainly based on morphology of the appendages of phyllaries, the achenes, and the pappus (Negaresh and Rahiminejad, 2014). *Centaurea* sect. *Cynaroides* Bunge includes mainly large biennial plants that, except for *C. charrelii* Halácsy & Dörfler, which occurs in Greece, otherwise are Irano-Turanian, Mediterranean, and Zagrosian elements

Figure 5. Habitat of *Centaurea bingoelensis*.

(Wagenitz 1975, 1980; Negaresh and Rahiminejad 2014). This new species is included in the section *Cynaroides*. The general characteristics of that section are as follows: biennials or perennials, stem stout, erect, branched above with numerous large capitula (often in a raceme). Basal leaves are broadly lanceolate to cordate or lyrate, upper leaves are often decurrent. Involucre subglobose. Appendages are firm, triangular to ovoid or orbicular, not decurrent, usually ciliate and ending in a firm spine or spinule. Achenes large; pappus is longer than achene, scabrous, inner row short. *Centaurea bingoelensis* mainly shows these characteristics but differs from section members by simple pappus, unbranched stems, and with one capitula and perennial life duration.

Centaurea bingoelensis is similar to *C. fenzlii* in terms of leaf, involucre, and appendage characteristics and also is similar to *C. obtusifolia* in terms of cauline leaf characteristics. In this new species, large appendages concealing most of the basal part of the phyllaries, phyllaries orbicular with numerous 1–3 mm cilia (terminal shorter, inconspicuous) like in *C. fenzlii*. *Centaurea bingoelensis* can be distinguished from *C. fenzlii* by its basal leaves, which are cuneate or truncate at base and sometimes 2–3 pairs of lobes at base (not slightly cordate at base and basal lobes absent), basal leaf petioles 3–11 cm long (not 15–18 cm long), stem leafy throughout (leaves not distributed below middle of the stems). Stem leaf petioles not winged (winged in *C. fenzlii*). A detailed comparison of the species is given in Table 1. Although the new species resembles *C. obtusifolia*, it differs by its involucre size and structure, appendage structure, and flower color.

Key to the species

1. Appendages large, totally concealing basal part of phyllaries

2. Biennial, basal leaves 12–18.5 × 6–10 cm slightly cordate at base, without basal lobes, outer phyllaries not decurrent, 1.3–2.5 cm ..... *fenzlii*

2. Perennial, basal 12–14 × 6–9 cm, cuneate or truncate at base, sometimes 2–3 pairs lobes at base, outer phyllaries decurrent, 1.6–2 cm ..... *bingoelensis*

1. Appendage not totally concealing basal part of phyllary

4. Cauline leaves not decurrent or very slightly so, flower yellow ..... *aucheri*

4. Median and upper leaves distinctly decurrent, flower pink ..... *obtusifolia*

The morphological features of pollen grains of some Turkish endemic *Centaurea* species have been investigated by several authors. The general characteristics of *Centaurea* pollens are as follows: pollen grains are tricolporate, prolate, spheroidal-subprolate, echinate, microechinate (Wagenitz, 1955; Avetisian, 1964; Pehlivan, 1995). The pollen grains of *C. bingoelensis* were studied by light microscopy and SEM. The pollen grains are spheroidal-subprolate, tricolporate, tectate-perforate, and microechinate (Figure 6). Exine thickness in fresh pollen 2.5 µm and intine 1.5 µm. Details of the pollen characteristics of *C. bingoelensis* and *C. fenzlii* are presented in Table 2.

The achenes of *C. bingoelensis* are obovate, 7–8 × 3.5–4 mm, mature one brownish, smooth under light microscope, shiny, glabrescent. Seed surface is smooth under light

Table 1. Comparison of the diagnostic characteristics of *Centaurea bingoelensis* and *C. fenzlii*.

Morphological characters	*C. bingoelensis*	*C. fenzlii*
Duration	perennial	biannual
Root	rootstock	taproot
Stem length (cm)	30–50	40–120
Basal leaf	12–14 × 6–9 cm, cuneate or truncate at base, sometimes 2–3 pairs of lobes at base	12–18.5 × 6–10 cm slightly cordate at base, without basal lobes
Basal leaf petioles length (cm)	3–11	15–18
Median stem leaves (cm)	10–28 × 6–13	14–20 × 10–11
Capitulum size (cm)	5.5 × 4.5	3–4 × 3–5
Outer phyllaries length	decurrent, 1.6–2 cm	not decurrent, 1.3–2.5 cm
Median phyllaries (cm)	2.2–2.9	2.7–3
Inner phyllaries length (cm)	3–3.2	2.7–4.7
Anther color	pinkish	yellow
Achene size (mm)	7–8 × 4–5	6–6.2 × 3.5–4
Pappus structure and length (mm)	simple, 15–18	double, 10–11

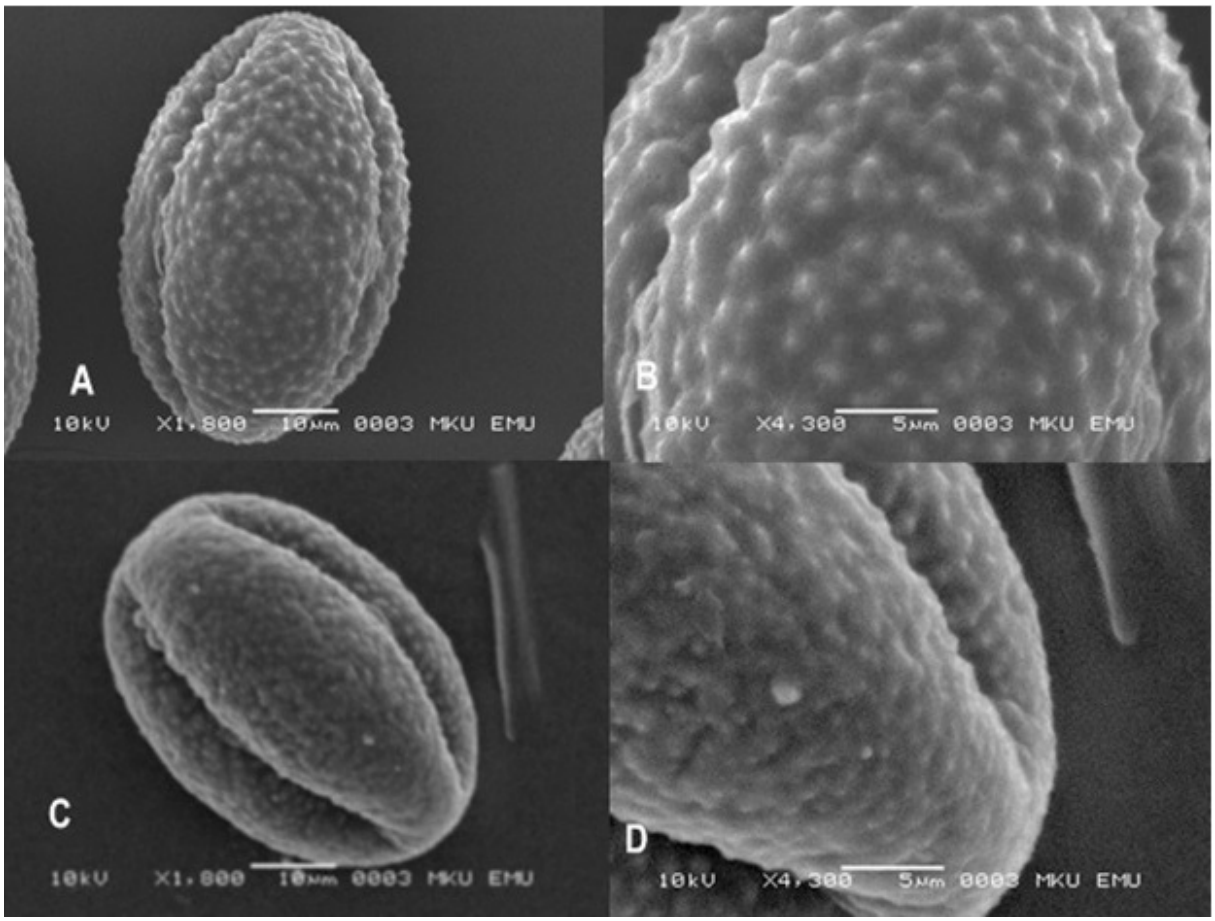

Figure 6. General view of the pollen grain of *Centaurea bingoelensis* (A, B) and *C. fenzlii* (C, D).

Table 2. Comparison of the pollen morphological characteristics of *Centaurea bingoelensis* and *C. fenzlii* (± standard deviation).

Characters	*C. bingoelensis*	*C. fenzlii*
Polar axis µm	29.7 ± 1.2	30.3 ± 1.1
Equatorial axis µm	33.5 ± 0.8	33.5 ± 1.2
Pollen shape	spheroidal-subprolate	spheroidal-subprolate
Length of colpus µm	29.8 ± 1.8	29.2 ± 1.6
Width of colpus µm	6.3 ± 1.6	6.8 ± 1.4
Length of porus µm	8.1 ± 0.9	8.0 ± 0.8
Width of porus µm	7.1 ± 0.6	7.3 ± 1.0
Exine µm	2.5 ± 0.5	3.0 ± 0.5
Intine µm	1.5 ± 0.5	1.6 ± 0.5

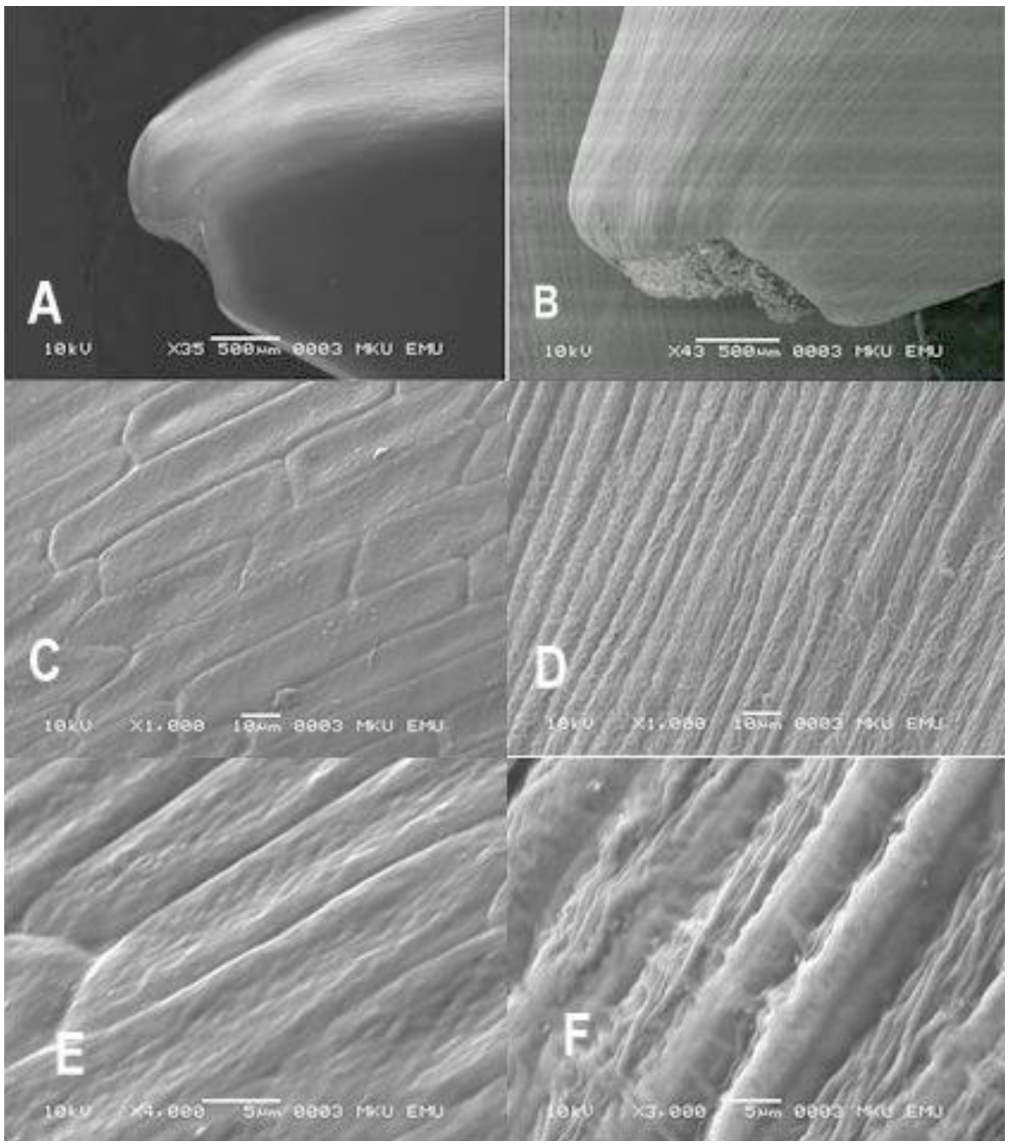

Figure 7. Seed surface structure of *Centaurea bingoelensis* (B, D, F) and *C. fenzlii* (A, C, E) obtained by SEM.

microscope. SEM showed that the cell boundaries are thick and higher than the centers of the cells. The areas between cell boundaries are rugose (Figure 7). Seed surface of *C. fenzlii* is smooth under light microscope. SEM showed that cell boundaries are thicker than in *C. bingoelensis*.

Additional examined specimens

Centaurea fenzlii: B8: Bingöl: Kotschy n.r., 1863, Herbarium Musel Vindob. (photo lectotype!) Bingöl-Elazığ: Muş plane, road edges, 1500 m, rocky places, Kuruca-Sarıca ascent, 26.06.1983. *T. Ekim* 7816 (GAZI); Muş, 10 km after Ziyaret town, 15.07.1956, A. Hub.-Mor. 357 (ANK); B9 Ağrı: Tutak, 2 km of SW of Hamur, 09.07.1988 *Max Nydegger* (GAZI), B9 Muş: Malazgirt, north of Kazgölü, steppe, 23 vi 2006, 1830 m, *L. Behçet, F. Özgökçe, M. Ünal* 1124 (VANF); ibid, west of Kazgölü village, field edge, 23 vi 2006, 1800 m, *L. Behçet, F. Özgökçe, M. Ünal* 1245 (VANF); ibid, between Uyanık and Bahçe villages, steppe, 06 vii 2006, 1737 m, *L. Behçet, F. Özgökçe, M. Ünal* 1465 (VANF); ibid, Kardeşler village, alluvial steppe, 06 vii 2006, 1811 m, *L. Behçet, F. Özgökçe, M. Ünal* 1621 (VANF). B8 Bingöl: between Aşağı village and Ortaköy village, road edges, steppe, 31.05.2014, 1400–1500 m, *L. Behçet* 9629 (Bingöl Univ. Herb.).

C. obtusifolia: C7: Urfa, Tektek mountain, 16.05.2016, 420–460 m, İlçim 3517 (MKUH).

References

Avetisian E (1964). Palynosystematique de la tribu des Centaureinae des Asteraceae. - Tr. Bot. Inst. Akad. Nauk Arm. SSR 14: 3147.

Bancheva S, Kaya Z, Binzet R (2014). Morphological, cytological and palynological features of three closely related *Centaurea* species (Asteraceae) from Turkey. Mod. Phytomorphol 5: 79-84.

Bremer K (1994). Asteraceae – Cladistics and Classification. 1st ed. Portland, OR, USA: Timber Press.

Dittrich M (1977). Cynareae, systematic review. In: Heywood VH, Harborne JB, Turner BL, editors. The Biology and Chemistry of Compositae. New York, NY, USA: Academic Press, pp. 999-1015.

Erkara IP, Köse YB, Osoydan K, Yücel E (2012). Pollen morphology of some endemic Turkish *Centaurea* L. (Asteraceae, section Phaloletis) and their taxonomic value. Plant Syst Evol 298: 1111-1117.

Faegri K, Iversen J (1975). Textbook of Pollen Analysis. New York, NY, USA: Hafner Publishing Co.

Greuter W (2003a). The Euro-Med treatment of Cardueae (Compositae) – generic concepts and required new names. Willdenowia 33: 49-61.

Greuter W (2003b). The Euro+Med treatment Senecioneae and the minor Compositae tribes-generic concepts and required new names, with an addentum to Cardueae. Willdenowia 33: 245-250.

Greuter W, Aghababian M, Wagenitz W (2005). Vaillant on Compositae: systematic impact and nomenclatural consequences. Taxon 54: 149-174.

Hellwig FH (2004). Centaureinae (Asteraceae) in the Mediterranean history of ecogeographical radiation. Plant Syst Evol 246: 137-162.

Hilpold A, Vilatersana R, Susanna A, Meseguer AS, Borsic I, Constantinidis T, Filigheddu R, Romaschenko K, Suarez-Santiago VN, Tugay O et al. (2014). Phylogeny of the *Centaurea* group (Centaurea, Compositae) – geography is a better predictor than morphology. Mol Phylogenet Evol 77: 195-215.

IUCN (2013). IUCN Standards and Petitions Subcommittee. Guidelines for Using the IUCN Red List Categories and Criteria. Version 10. prepared by the Standards and Petitions Subcommittee.

Negaresh K, Rahiminejad MR (2014). A contribution to the taxonomy of *Centaurea* sect. Cynaroides (Asteraceae, Cardueae–Centaureinae) in Iran. Phytotaxa 158: 229-244.

Pehlivan S (1995). Pollen morphology of some Turkish endemic *Centaurea*. Grana 34: 29-38.

Punt W, Hoen PP, Blackmore S, Nilsson S, Le Thomas A (2007). Glossary of pollen and spore terminology. Rev Paleobot Palyno 143: 1-81.

Ranjbar M, Negaresh K (2014). Taxonomic notes and two new species in *Centaurea* sect. *Cynaroides* (Compositae, Cardueae) from Iran. Novon: 23: 321-327.

Ranjbar M, Negaresh K, Karamian R (2013). *Cyanus ouramanicus* (Asteraceae), a new species from Iran. Ann Bot Fenn 50: 160-164.

Schols P, Dessein S, D'Hondt C, Huysmans S, Smets E (2002). Carnoy: a new digital measurement tool for palynology. Grana 41: 124-126.

Uysal T (2012a). *Centaurea* L. In: Güner A, Aslan S, Ekim T, Vural M, Babaç T, editors. Türkiye Bitkileri Listesi (Damarlı Bitkiler). İstanbul, Turkey: Nezahat Gökyiğit Botanik Bahçesi ve Flora Araştırmaları Derneği Yayını, pp. 127-140 (in Turkish).

Uysal T (2012b). *Cyanus* Mill. In: Güner A, Aslan S, Ekim T, Vural M, Babaç T, editors. Türkiye Bitkileri Listesi (Damarlı Bitkiler). İstanbul, Turkey: Nezahat Gökyiğit Botanik Bahçesi ve Flora Araştırmaları Derneği Yayını, pp. 154-156 (in Turkish).

Uysal T, Dural H, Tugay H (2015). *Centaurea sakariyaensis* (Asteraceae), a new species from Turkey. Plant Biosyst 1-5.

Wagenitz G (1955). Pollen morphologie and Systematik in der Gattung *Ceriruirren* L. Flora 142: 213-279.

Wagenitz G (1975). *Centaurea* L. In: Davis PH, editor. Flora of Turkey and the East Aegean Islands. vol. 5, Edinburgh, UK: Edinburgh University Press, pp. 465-585.

Wagenitz G (1980). *Centaurea* L. In: Rechinger KH, editor. Flora Iranica Vol. 139b, Graz, Austria: Akademische Druck- u. Verlagsanstalt, pp. 313-420.

Wagenitz G (1986). *Centaurea* in South-West Asia: patterns of distribution and diversity. Proc Royal Soc Edinburgh 89B: 11-21.

Wagenitz G, Hellwig FH (1996). Evolution of characters and phylogeny of the Centaureinae. In: Hind DJN, Beentje HJ, editors. Compositae: systematics. Proceedings of the International Compositae Conference, Kew, 1994. Kew, UK: Royal Botanic Gardens, pp. 491-510.

Wagenitz G, Hellwig FH (2000). *Psephellus* Cass. (Compositae, Cardueae) revisited with a broadened concept. Willdenowia 30: 29-44.

Wagenitz G, Hellwig FH, Parolly G, Martins L (2006). Two new species of *Centaurea* (Compositae, Cardueae) from Turkey. Willdenowia 36: 423-435.

Wodehouse RP (1935). Pollen Grains. New York, NY, USA: Hafner Publ. Co.

Yüzbaşıoğlu İS, Bona M, Genç İ (2015). A new species of *Centaurea* sect. *Pseudoseridia* (Asteraceae) from north-eastern Turkey. PhytoKeys 53: 27-38.