

Astragalus topalanense (Fabaceae), a new species from Turkey

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Abstract: *Astragalus topalanense* Behçet & İlçim sp. nov. (section *Malacothrix* Bunge) is described as a new species from Bingöl Province, East Anatolia in Turkey. The new species is similar to *Astragalus macrouroides* Hub.-Mor., a species endemic to Turkey, and *A. macrouroides* Fisch. & C.A.Mey. The diagnostic characters and taxonomic comments on the species are presented. Seed and pollen characteristics are investigated using light and scanning electron microscopy. Notes are also presented on its ecology. A distribution map of the new and related species is also provided.

Key words: *Astragalus*, *Malacothrix*, taxonomy, flora, Turkey

1. Introduction

In the *Flora of Turkey*, Fabaceae (Leguminosae) is one of the largest families in terms of species number, after Asteraceae (Vural et al., 2008). It includes annual or perennial plants, herbs, trees, and shrubs. Fabaceae is recognized by usually stipulate, bipinnate, simply pinnate, digitate, trifoliolate, or simple leaves; actinomorphic or zygomorphic, hypogynous or sometimes perigynous flowers; and legume or lomentum as fruits (Davis et al., 1970). The genus *Astragalus* L. (Fabaceae) is one of the largest genera of vascular plants, with 2500–3000 taxa and more than 250 sections (Karamian and Ranjbar 2005). The genus *Astragalus* belongs to the tribe Astragaleae of Papilionoideae in Fabaceae. It is distributed mainly in arid and semiarid mountainous regions of the northern hemisphere and South America. The genus is most diverse in southwest Asia (Akpulat and Çelik, 2007). Iran, with 750 species, is one of the centers of diversity of the genus (Ghahremani-nejad, 2005). The genus is divided into 64 sections and represented by 475 taxa including 202 endemic species in the *Flora of Turkey*, with the majority occurring in the Irano-Turanian region (Karaman Erkul et al., 2015).

The new species belongs to the sect. *Malacothrix* Bunge and seems to be distinct among the Turkish species. According to Podlech and Zarre (2013), the sect. *Malacothrix* is represented by approximately 25 species in Turkey and, in this section, 12 species are endemic to Turkey. *Astragalus* sect. *Malacothrix*, represented by

90 species in Iran, is one of the largest sections within the genus (Podlech et al., 2010). Bunge (1868) placed the section together with seven other sections into the subgenus *Hypoglottis* Bunge. All members of the subgenus share similar morphological characters such as dense capitate or spike-like inflorescences (Ranjbar and Mahmoudian, 2012).

This new species was collected from Bingöl Province, East Anatolia in Turkey between 2012 and 2014. The holotype specimen was deposited at Mustafa Kemal University in Hatay, Turkey, while isotypes were deposited at Bingöl University herbarium in Bingöl and ANK herbarium in Ankara. The specimens of the new species were cross-checked with material housed at various herbaria (ANK, GAZI). Consulted keys (Chamberlain and Matthews, 1969; Podlech, 1999; Podlech and Zarre, 2013) failed to identify this specimen. The studies showed that these specimens are representatives of a species new to science (Figures 1A and 1B).

2. Materials and methods

The specimens reported here were collected from Bingöl Province (Turkey). The collected specimens were dried and flowers preserved in 70% ethanol for further studies. The flower and leaf measurements were performed on fresh and alcohol preserved materials. The pollen grains were measured under light microscopy and from nonacetolyzed samples, and prepared according to the Wodehouse method (Wodehouse, 1935). The long axis

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(A), short axis (B), exine thickness, and intine thickness were measured on at least 50 samples of pollen grains. The pollen terminology follows Faegri and Iversen (1975) and Punt et al. (2007).

For the scanning electron microscopy (SEM) studies, mature seeds and pollen grains were mounted using double-sided tape on SEM stubs and coated with gold in a Polaron SC502 sputter coater. They were examined with a JEOL JSM 5500 LV SEM at 5 kV at Kahramanmaraş Sütçü İmam University.

3. Results

Astragalus topalanense Behçet & İlçim sp. nov. (Figures 1–6). *A. sect. Malacothrix* Bunge

Type: Turkey, B8 Bingöl: Between Topalan and Çirişli villages, in *Quercus petraea* (Matt.) Liebl. subsp. *pinnatifida* (K.Koch) Menitsky and *Q. libani* G.Olivier forest clearings, 1700–1750 m, 01.05.2013, *L.Behçet* 8605. (holotype: Bingöl Univ. Herb., isotypes: Mustafa Kemal Univ. Herb., Bingöl Univ. Herb, ANK).

Paratypes: Turkey, B8 Bingöl: Between Topalan and Çirişli villages, 3 km to Çirişli, in *Quercus petraea* subsp. *pinnatifida* and *Q. libani* forest clearings, 1700–1750 m, 09.06.2012, *L. Behçet* 8021 (Bingöl Univ. Herb); *ibid.* 25.05.2013, *L. Behçet* 8783 (Bingöl Univ. Herb.); *ibid.* 02.06.2014, *L.Behçet* 9573 (Bingöl Univ. Herb.), TARI.

3.1. Diagnosis: It is close to *A. macrourus*, but it can be distinguished from *A. macrourus* by its stipules 34–40 mm long, (not 12–14 mm), leaflets in 14–25 pairs, linear-

elliptic, 5–23 × 2.5–8 mm, (not 8–25 pairs, 7–25 × 2–7 mm, narrow elliptic), raceme 14–20 flowered (not 15–40 flowered), calyx 17–20 mm long, white hairy, teeth 10–12 mm (not 9–19 mm, spreading black and white hairy, teeth and 1.5–7 mm), standard 24–30 mm (not 18–22 mm). Also allied with *A. macrouroides* but it differs from *A. macrouroides* by its stipules 34–40 mm long (not 6–8 mm), leaflets in 14–25 pairs, linear-elliptic, 5–23 × 2.5–8 mm (not 7–12 pairs, 10–22 × 3–6 mm, elliptic-narrow elliptic), raceme 14–20 flowered (not 20–50 flowered), calyx 17–20 mm long, white hairy, teeth 10–12 mm (not 10–15 mm, white hairy, teeth 3–7 mm). Standard 24–30 mm (not 18–20 mm).

3.2. Description: PLANTS perennial, herbaceous, with a branched, woody caudex, scapose, with spreading, (1.5–2.5 mm long) white hairs (Figure 1). STEMS 14–27 cm, the base covered with old petioles. STIPULES whitish 34–40 mm long, adnate to petiole for 5–12 mm, linear to linear lanceolate, long white hairy. LEAVES usually longer than scape, imparipinnate, 18–27 cm long, densely white hairy. LEAFLETS in 14–25 pairs, linear-elliptic, 5–23 × 2.5–8 mm, 0.5 mm mucronate at the apex, densely hairy on both sides. PEDUNCLE 18–24 cm, erect to ascending, covered with white long (1.5–2.5 mm) hairs, 1.5–2 mm thick at middle. RACEME first capitate 14–20 flowered, slightly elongating in fruit. Bracts 16–18 mm long on mature flowers, narrowly linear-lanceolate. Pedicels ca. 1 mm long, white hairy. FLOWERS erect to spreading. CALYX, 17–20 mm, campanulate, slightly gibbose, densely covered

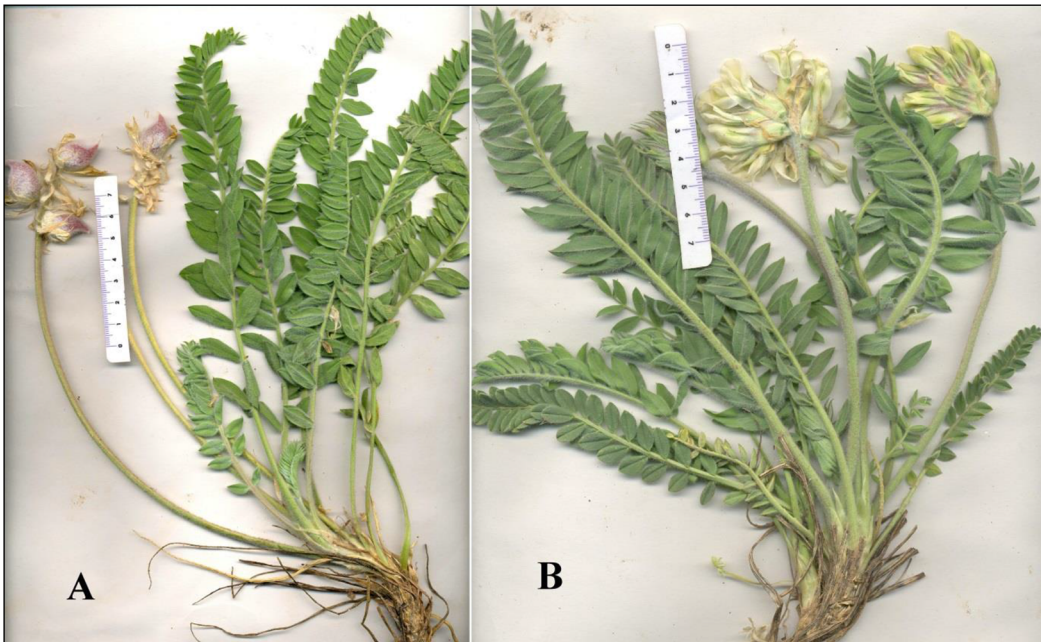


Figure 1. Habit of *Astragalus topalanense* Behçet & İlçim: A- Fruiting (paratype), B- Flowering sample (holotype).

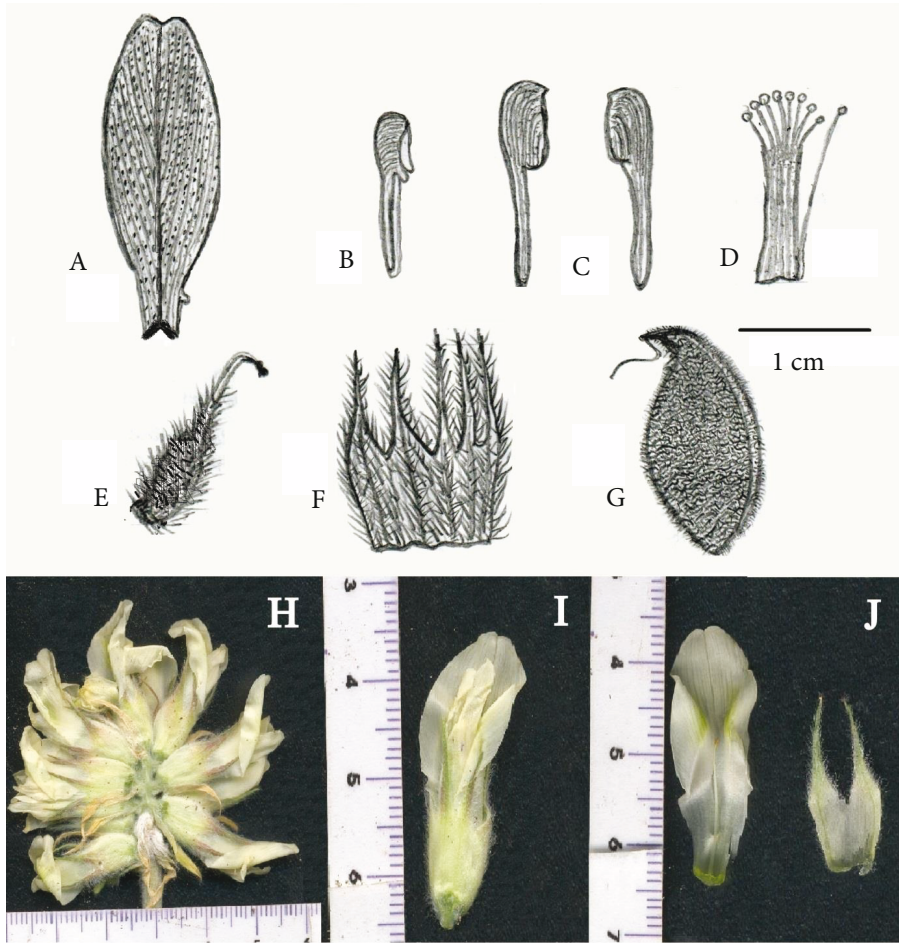


Figure 2. *Astragalus topalanense*: A- standard, B- keel, C- wings, D- stamen, E- ovary, F- calyx, G- legume (hand drawing), H- capitata inflorescence, I- flower, J- standard and calyx part.



Figure 3. *Astragalus topalanense*: A- legume from lateral view, B- opened legume, C- stipule.

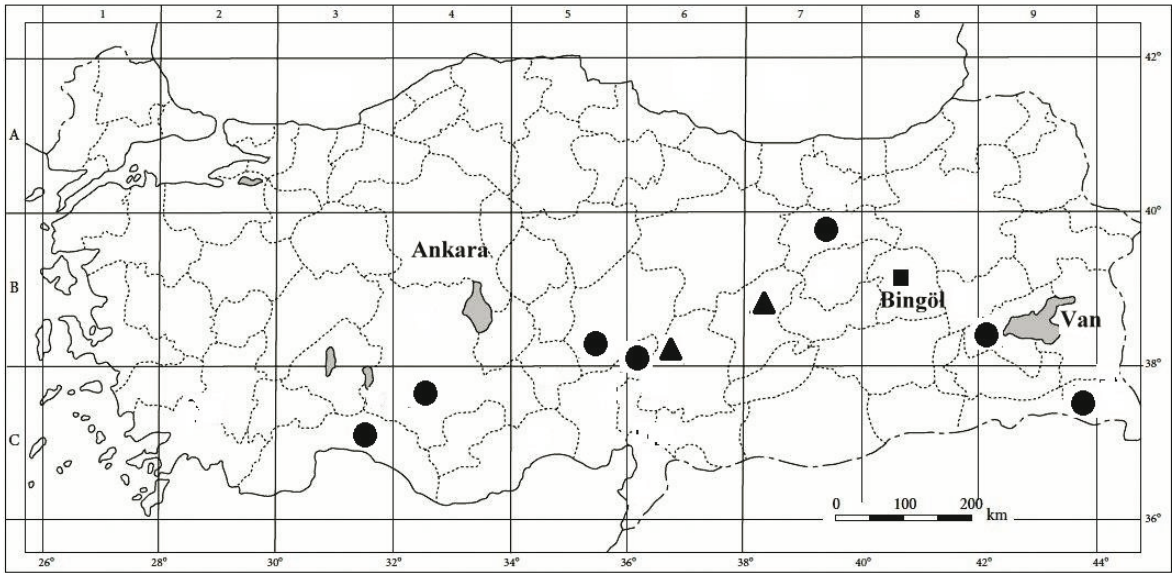


Figure 4. Distribution map of *A. topalanense* (■), *A. macrouroides* (▲), and *A. macrourus* (●).

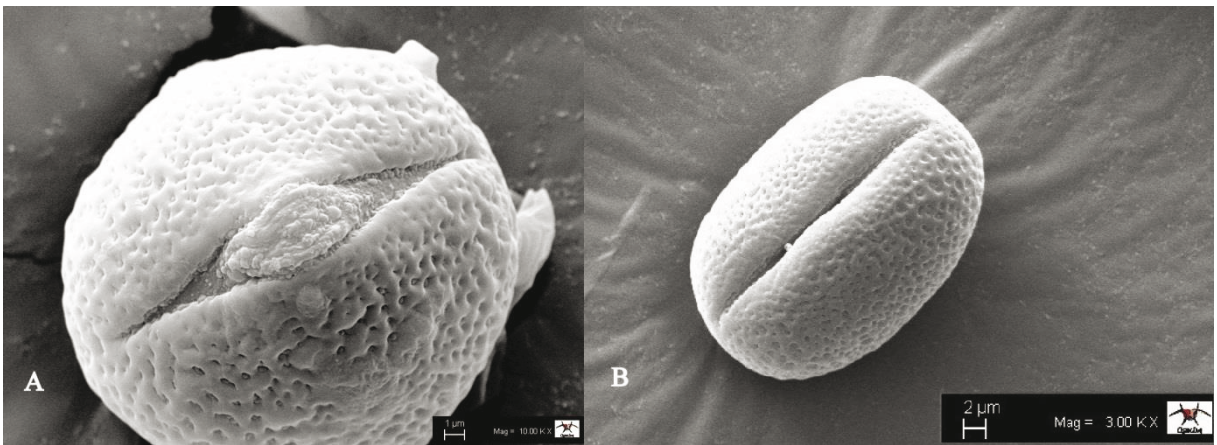


Figure 5. Pollen grains of *A. topalanense* A- Polar view, B- Equatorial view.

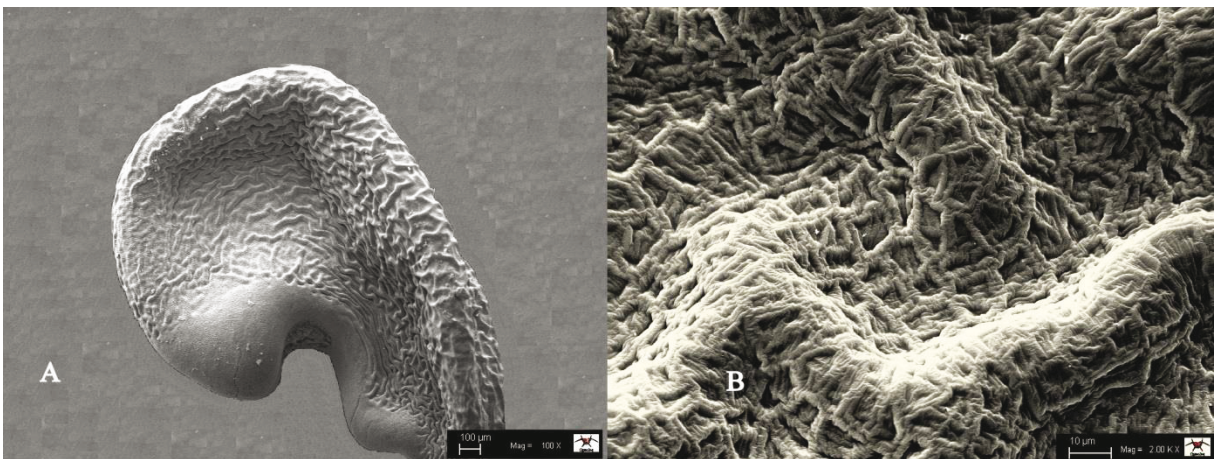


Figure 6. A- General view, B- Seed surface of *A. topalanense*.

with long white hairs; teeth narrowly triangular and linear, 10–12 mm. **COROLLA** white to cream, standard 24–30 × 14–15 mm; broad at middle, attenuate at base. wings 20–22 mm; blades narrowly oblong, rounded at apex, auricle ca. 1.5 mm long; keel 15–17 mm long. **STAMENS** 25–27 mm and free at upper part. **OVARY** sessile, slightly oblong, hairy; style becoming glabrous to apex. **LEGUME** laterally compressed, broadly elliptic, attenuate at base, 22–24 × 11–12 mm, densely covered with long hairs, beak 3–4 mm long, with 14–16 ovules, mature seed 2–3. **SEEDS** subreniform, 3 × 2 mm (Figures 2G, 3A and 3B). Fl 5., Fr. 5–6, screen of *Quercus* spp. forest.

3.3. Distribution and suggested conservation status and ecology

The new species is endemic to Turkey, only known from Bingöl Province, east Anatolia, Turkey (Figure 4) and belongs to the Irano-Turanian phytochorion. We recommend that the threatened category of *Astragalus topalanense* should be “Critically Endangered (CR)”, because the estimated whole range is less than 10 km² and the distribution area of the species has high erosion pressure. Moreover, the area is heavily grazed by animals. We observed fewer than 50 individuals in the area (criteria B2 a b (i, iii) of IUCN 2013).

Astragalus topalanense grows in vegetation composed of *Quercus petraea* subsp. *pinnatifida*, *Q. libani*, *Achillea biebersteinii* Afansiev, *A. vermicularis* Trin., *Aegilops cylindrica* Host, *Aethionema grandiflorum* Boiss. & Hohen., *Alyssum pateri* Nyár. subsp. *prostratum* (Nyár.) Dudley, *Anchusa aucheri* A.DC., *Arrhenatherum kotschyi* Boiss., *Arabis nova* Vill., *Asperula orientalis* Boiss. & Hohen., *A. xylorrhiza* Nábelek, *A. canescens* (Hook. & Arn.) Reiche, *A. chamaephaca* Freyn, *Bromus danthoniae* Trin. subsp. *danthoniae*, *B. japonicus* Thunb. subsp. *japonicus*, *B. lanceolatus* Roth, *B. sterilis* L., *Carex stenophylla* Wahlenb. subsp. *stenophylloides* (V.I.Krecz.) T.V.Egorova, *Centaurea cyanus* L., *C. virgata* Lam., *Cephalorrhynchus tuberosus* (Steven) Schchian, *Cerastium dichotomum* L. subsp. *dichotomum*, *C. longifolium* Willd., *Corydalis oppositifolia* DC. subsp. *oppositifolia*, *Cotoneaster nummularius* Fisch. & C.A.Mey., *Crataegus orientalis* Pall. ex M.Bieb., *Crucianella exasperata* Fisch. & C.A.Mey., *Cruciata taurica* (Pall. ex Willd.) Ehrend., *Crupina crupinastrum* (Morris) Vis., *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman, *Dianthus floribundus* Boiss., *Drabopsis verna* K.Koch, *Elymus panormitanus* (Parl.) Tzvelev, *Eremurus spectabilis* M.Bieb., *Erodium cicutarium* (L.) L'Hér. subsp. *cucitarium*, *Eryngium billardieri* F. Delaroche, *Fibigia macrocarpa* (Boiss.) Boiss., *Galium tricorneratum* Dandy, *Geranium libanoticum* Schenk, *Grammosciadium macrodon* Boiss., *Gundelia tournefortii* L. var. *tournefortii*, and *Hesperis cappadocica* E. Fourn.

3.4. Etymology

The specific epithet is derived from the name of Topalan village in Bingöl Province, where the type was collected.

4. Discussion

The genus *Astragalus* is divided into 64 sections and represented by 475 taxa including 202 endemic species in the *Flora of Turkey*, with the majority occurring in the Irano-Turanian region (Karaman Erkul et al., 2015). Since the first arrangement of the genus *Astragalus*, many new species have been described from Turkey (Ekim et al., 1991; Sümbül, 1991; Aytaç, 1997; Podlech and Aytaç, 1998; Adıgüzel, 1999; Podlech, 1999; Akan and Civelek, 2001; Aytaç et al., 2001; Ekici and Aytaç, 2001; Aytaç and Ekici, 2002; Hamzaoglu and Kurt, 2002; Podlech and Sytin, 2002; Duman and Akan, 2003; Ghahremani-nejad and Behçet, 2003; Göktürk et al., 2003; Hamzaoglu, 2003; Ketenoglu and Menmen, 2003; Akan and Aytaç, 2004; Duran and Aytaç, 2005; Ertekin, 2006; Akpulat and Çelik, 2007; Dural et al., 2007; Akan et al., 2008; Ekici et al., 2008; Podlech and Ekici, 2008; Ghahremani-nejad, F et al., 2009; Özüdogru et al., 2011; Taeb and Uzunhisarcıklıoğlu, 2012; Aytaç and Karaman Erkul, 2013; Dinç et al., 2013).

Astragalus is the largest and most problematic genus in the world. The great diversity of the genus has attracted systematic studies. The section *Malacothrix* Bunge is represented by 14 taxa in the *Flora of Turkey* (Chamberlain and Matthews, 1969; Podlech and Ekici, 2008). According to Taeb (2013 unpublished data), the sect. *Malacothrix* is represented by 16 taxa and 10 of them are endemic to Turkey; the endemism rate of this section is 62.5%.

This new species is close to the section *Malacothrix* with its acaulescent habit, simple hairs, and pedunculate inflorescence. However, this new species differs from the section *Malacothrix* by its longer calyx and corolla. It also allied with the section *Hypoglottidei* with its nonelongating raceme in fruit. However, when we examined the *Flora of Turkey* and *Flora Iranica* we observed there are remarkable similarities between some species of the sect. *Hypoglottidei* with members of the sect. *Malacothrix*, such as *A. macrostachys* DC., *A. eriopodus* Boiss., and *A. macrourus*. Within the section *Malacothrix*, the new species is very similar to *A. macrouoides* and *A. macrourus*. According to Davis et al. (1988), *A. macrouoides* is endemic to Turkey and distributed in Malatya Province. *A. macrourus* is not endemic to Turkey but its main distribution center is in east Anatolia (Figure 3). A detailed comparison of the species is given in the Table.

The pollen grains of the new species are radially symmetrical, isopolar, and tricolporate (Figure 5). The pollen shape in this new species is subprolate. The sizes of the pollen grains polar (P) × equatorial axis (E) are 46.5 × 29.15 5 µm. The ratio of P to E is 1.59. Exine surface

Table. Comparison of the diagnostic characteristics of *A. topalanense*, *A. macrourus*, and *A. macrouroides*.

Characters	<i>A. topalanense</i>	<i>A. macrourus</i>	<i>A. macrouroides</i>
Leaflets	14–25 pairs, 5–23 × 2.5–8 mm linear–elliptic	8–25 pairs, 7–25 × 2–7 mm, narrow elliptic	7–12 pairs, 10–22 × 3–6 mm, elliptic–narrow elliptic
Stipule	30–40 mm, linear–linear lanceolate	12–14 mm, lanceolate	6–8 mm, lanceolate
Peduncle length (cm)	18–24	15–28	8–15
Flower number	14–20	15–40	20–50
Bract length (mm)	16–18	9–13	6–13
Calyx	17–20 mm, spreading white hairy, teeth 10–12 mm	9–19 mm, spreading black and white hairy, teeth 1.5–7 mm,	10–15 mm, white hairy, teeth 3–7 mm.
Standard length (mm)	24–30	18–22	18–20
Legume	22–24 × 11–12 mm, ovoid, densely spreading–pilose, with long white hairs, beak 3–4 mm	8–12 × 3–4 mm, ovoid, densely white pilose, beak 2 mm	10–15 × 3.5–7 mm, ovoid or broadly ovoid, densely spreading–pilose with long white hairs, beak 2–3 mm

sculpturing is reticulate; pollen shape is prolate. The exine thickness is 1.6–1.8 µm; intine thickness is 0.3–0.5 µm.

Seed surface is rugulate-reticulate; seeds are suboblate (Figure 6).

4.1. Additional examined specimens

Astragalus macrouroides: B7 Malatya: Pötürge, Gözlüce village, Yirmitepe, *Quercus* sp. forest, north slopes, ca. 2000 m, 26.06.1981, *Y.Altan* 1832 (isotype ANK). C6 Kahramanmaraş: Engizek mountain, Öksüz hill, 1400–1500 m, 14.06.1987, rocky places, *H.Duman* 3278 (GAZI), Engizek mountain, around Dehlizyurdu, 1500–1700 m, 29.05.1988, field clearings, *H.Duman* 3940 (GAZI), Erince mountain, 1300–1500 m, 22.05.1987, rocky slopes, *H.Duman* 2831 (GAZI).

Astragalus macrourus: B9 Van: Between Tatvan and Van, 10 km after Tatvan, 1800–1900 m, 24.06.1983,

N.Adıgüzel 7649 (ANK), Bitlis/Van: 10 km NE of Pelli, 2600 m, 08.07.1954, *Davis&Polunin* 22570 (ANK), B5 Kayseri: Gemerek, Sızır around Armutalan, Kırkpınar, 1600–1700 m, *Pinus sylvestris* L. clearing, 06.08.1980, *T.Ekim* 4987 (ANK). B6 Adana: Tufanbeyli, Ayvat-Tozlu villages, Kızılçöl mountain, Kürebeli highland, *Quercus* sp. clearings, 1700–1800 m, 06.06.2006, *B.Bani* 3905 (GAZI), C3 Antalya: Elmalı, Hızır District, 1790 m, *Cedrus libani* forest, 12.05.1973, *R. Çetik* 1807 (ANK), C4 Konya: Seydişehir, C4 Konya: Seydişehir, Yalıncağ hill, NE slopes, 1800 m, 29.06.1982, *H. Ocakverdi* 1520 (ANK).

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