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Astragalus ihsancalisii (*Fabaceae*), a new species from Erzurum province, E Turkey

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Abstract: *Astragalus ihsancalisii* Dönmez & Uğurlu (*Fabaceae*) is described as a new species from Erzurum province in E Turkey. The new species belongs to *A.* sect. *Incani* DC. and is similar and possibly related to *A. glaucophyllus* Bunge and *A. guzelsuensis* F. Ghahrem. & al. from Turkey and *A. siahcheshmehensis* Maassoumi & Podlech from Iran. *Astragalus ihsancalisii* is clearly distinguished from those three species by flower number per raceme, bract size, pedicel length, standard length and legume beak length, among other characters. Diagnostic characters are given and their taxonomic importance is discussed. Photographs of *A. ihsancalisii* in the field are presented. In addition, SEM micrographs of leaf and legume surfaces of the new species and *A. glaucophyllus* and *A. guzelsuensis* are provided for comparison. The conservation status of *A. ihsancalisii* is also assessed according to field observations.

Key words: *Astragalus*, biodiversity, conservation status, endemic, *Fabaceae*, *Leguminosae*, micromorphology, new species, taxonomy, Turkey

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Introduction

Turkey, with about 10150 vascular plant species (Dönmez & Yerli in press), is one of the richer countries in terms of plant biodiversity. It is likely that the Turkish flora still has many undiscovered plant species, especially in the less botanized areas, such as the southeast of the country. Among the vascular plants of Turkey, *Astragalus* L. (*Fabaceae*) is the largest genus, with 444 species representing 3.8% of the vascular plant species of the country (Dönmez & Yerli in press). Furthermore, 197 *Astragalus* species were recorded as endemic to Turkey by Chamberlain & Matthews (1970).

According to the recent most comprehensive revision of the genus (Podlech & Zarre 2013), *Astragalus* has 2950 species and is the largest genus of flowering plants in the world. Since the publication of this three-volume monographic study for the Old World, several new species have been described from Turkey (e.g. Dinç & al. 2013; Karaman Erkul & Aytaç 2013; Çeçen & al. 2016) as well other countries (e.g. Li & Yu 2014; Estrada Castillón & al. 2016; Bagheri & al. 2017), and discovery of new taxa of *Astragalus* will no doubt continue.

The number of species of *Astragalus* sect. *Incani* DC. was given by Podlech & Zarre (2013) as 140, and 22 species were listed by Chamberlain & Mathews (1970) under the name *A.* sect. *Proselius* Bunge for the Turkish flora. Based on the taxonomic and nomenclatural changes for the section and additionally the description of new species and new records according to Podlech & Zarre (2013), 36 species are now known to occur in Turkey.

During one of our botanical expeditions to SE Turkey in 2015, an unusual specimen of *Astragalus* was collected and photographed in Erzurum province. Subsequently, our studies showed its resemblance to specimens of *A. glaucophyllus* Bunge (1868, 1869) and *A. guzelsuensis*

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F. Ghahrem. & al. (Ghahremaninejad & al. 2009) from Turkey as well as *A. siahcheshmehensis* Maassoumi & Podlech (2003) from Iran. To observe population size and collect seeds, the type locality was re-visited in 2018. After further research on the relevant literature and comparison with herbarium material of the species mentioned above, we recognized that our specimens from Erzurum province represent a species of *Astragalus* new to science.

Material and methods

The morphological description of the new species was prepared based on the type material collected by the first author from Erzurum province. Material was examined in the herbaria GAZI, HUB and, by means of the JSTOR Global Plants database (JSTOR 2018), B, E, G, MSB, P and W (herbarium codes according to Thiers 2018+). We used a binocular stereoscopic microscope (SM) for detailed examination of indumentum and other fine structures. We also used a Zeiss EVO 50 EP scanning electron microscope (SEM) to create micrographs of surface details of leaflets, bracts and legumes, pieces of which were mounted directly onto stubs and coated with a gold-palladium mixture. Conservation status of the new species was assessed based on field observations and IUCN (2012, 2017) criteria.

Results

Astragalus ihsancalisii Dönmez & Uğurlu, **sp. nov.** [*A.* sect. *Incani* DC.] – Fig. 1, 2A–D, M, N.
Holotype: Turkey, A8 Erzurum, Horasan, 1 km from road junction of İğdeli village to Eleşkirt, 1795 m, 39°56'31"N, 42°19'49"E, 26 Jun 2015, *A. A. Dönmez 19559* (HUB!; isotypes: B!, GAZI!, HUB!). – Paratypes: same locality, 14 Jul 2018, *A. A. Dönmez 20160*, *Z. Uğurlu & S. Yüzbaşıoğlu* (HUB!, ISTE!); same locality, 14 Jul 2018, *Z. Uğurlu 599*, *A. A. Dönmez & S. Yüzbaşıoğlu* (HUB!).

Diagnosis — *Astragalus ihsancalisii* is similar to *A. glaucophyllus* Bunge, *A. guzelsuensis* F. Ghahrem. & al. and *A. siahcheshmehensis* Maassoumi & Podlech. The new species differs from *A. glaucophyllus* by having fewer flowers per raceme (3–6 vs 8–15 to many), shorter bracts (2–3 mm vs 5–7 mm), longer pedicels (4–6 mm vs 3–4 mm) and a distinctly stipitate ovary and legume (legume stipe c. 1 mm long vs absent). The new species differs from *A. guzelsuensis* by having fewer flowers per raceme (3–6 vs 4–12), shorter bracts (2–3 mm vs 4–5 mm), longer pedicels (4–6 mm vs 2.5–3 mm), a shorter standard (20–23 mm vs 29–31 mm) and a longer legume beak (4–5 mm vs 2–2.5 mm). The new species differs from *A. siahcheshmehensis* by having a shorter standard (20–23 mm vs c. 25 mm), a longer keel (18–20 mm vs c. 17 mm) and a longer legume beak (4–5 mm vs 1–2(–3) mm).

Description — *Plants* 10–20 cm tall, caespitose, with a woody caudex enclosed in remains of old stipules and petioles. *Rootstock* 6–8 mm in diam. *Stipules* adnate to petiole for 1–2 mm, triangular to lanceolate, 2–5 × (1–)2–3 mm, hard papery, mostly white bifurcate hairy outside, with few hairs inside. *Leaves* 6–12 cm long; *petiole* purple-flushed, 2–3 cm long, narrowly grooved adaxially, sparsely white bifurcate hairy throughout. *Leaflets* in 5–8 pairs, glaucous, broadly elliptic to suborbicular, 8–12 × 6–8 mm, sparsely to loosely bifurcate hairy abaxially, glabrous or with few hairs along midrib adaxially, rounded to obtuse at apex. *Peduncle* arcuate ascending, slender, 5–8 cm long, finely striate throughout, sparsely covered with white (rarely a few black) hairs proximally. *Raceme* 3–6-flowered, later elongating up to 2 cm; axis mostly with black hairs. *Bracts* narrowly triangular to lanceolate, 2–3 × 1.5–2 mm, with subsessile minute glands, with white and few black hairs at margin, scarious at margin, obtuse to acute at apex. *Bracteoles* in a pair at base of calyx, subulate, 1–1.5 mm long. *Pedicel* 4–6 mm long, white and black hairy. *Calyx* tubular, oblique at mouth, 9–12 mm long, loosely covered with appressed mostly black hairs; teeth subulate, 2–3(–3.5) mm long, sparsely hairy on inner side. *Corolla* purple to violet. *Standard* 20–23 mm long; limb straight, obovate, 6–8 mm wide, obtuse to slightly emarginate at apex. *Wings* 19–22 mm long; limb narrowly oblong, 9–11 × 2–2.5 mm, slightly emarginate and obtuse at apex; auricle 1.3–1.6 mm long; claw 9–11 mm long. *Keel* 18–20 mm long; limb obliquely elliptic-curved with widely curved lower edge and concave upper edge, 6–8 × 3–3.5 mm, obtuse at apex; auricle c. 1 mm long; claw 9–11 mm long. *Stamen tube* 10–12 mm long, truncate at mouth. *Ovary* stipitate, linear, glabrous; *style* 10–11 mm long. *Legume* erect, linear, straight or slightly curved, slightly flat, 20–35 × 3–4 mm, keeled abaxially and adaxially, fully bilocular, with a stipe c. 1 mm long at base, gradually contracted into a straight 4–5 mm long beak at apex; valves purplish to straw-coloured, irregularly purplish mottled, thick and tenacious, glabrous. *Seeds* 6–9 in each locule, brown, oblong-reniform to deltoid, 3–4 × 1.5–2.2 mm, smooth.

Phenology — Flowering in June; fruiting in July and August.

Distribution and ecology — The new species is an Irano-Turanian element currently known only from the type locality in the eroded hills of Horasan in Erzurum province, E Turkey. The habitat of the species is a semi-desert steppe with weak vegetation cover. Dominant plant taxa of the area include *Astragalus mesites* Buhse, *Convolvulus arvensis* L., *Lolium persicum* Boiss. & Hohen., *Onobrychis cornuta* (L.) Desv., *Piptatherum holciforme* (M. Bieb.) Roem. & Schult. var. *holciforme*, *Prangos pabularia* Lindl. and *Stipa capillata* L. Alongside these taxa, *Astragalus microcephalus* Willd. is the

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Fig. 1. *Astragalus ihsancalisii* – A: habit of fruiting plant; B: leaves and infructescences; C: part of leaf, adaxial surface; D: flowers, one truncated; E: stipe of legume. – Type locality, 26 June 2015, photographed by A. A. Dönmez.

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dominant element of the vegetation especially on uneroded slopes. The altitude of the new species ranges from 1750–1900 m.

Conservation status — The type locality of the new species is a semi-desert steppe with saline soil, vegetation cover is weak and water supply is low. Overgrazing has not been observed in the area, especially for the new species. The topography and soil structure in the area are not appropriate for various agricultural activities and there is no distinct threat to the new species. In 2018, the type locality was re-visited for further research on the population and to discover possible new subpopulations. Consequently, the new species remains known from a single locality with a small population composed of 20–25 observed individuals. The area of occupancy is estimated to be less than 1 km^2. According to IUCN (2012, 2017) criteria, the new species should be assigned to the category Critically Endangered: CR B1ab(iii,v)+2ab(iii,v).

Eponymy — *Astragalus ihsancalisii* is named in honour of the plant phytochemist, İhsan Çalış, retired from Hacettepe University. He is a well-known specialist on various major chemical components and has several publications on phytochemistry of *Astragalus*.

Discussion

Astragalus ihsancalisii is similar and possibly related to *A. glaucophyllus, A. guzelsuensis* and *A. siahcheshmehensis*. Hence, for a better insight into the identification of *A. ihsancalisii*, we compare all four species in Table 1.

Leaf surfaces show a similar structure based on SM and SEM observations (Fig. 2A–L). The adaxial surface is glabrous in *Astragalus ihsancalisii* (Fig. 1C; Fig. 2A, B), whereas it is sometimes sparsely hairy along the midvein in *A. guzelsuensis* according to the protologue (Ghahremaninejad & al. 2009), although our examination of the paratype of *A. guzelsuensis* (in GAZI) showed the adaxial leaflet surface to be glabrous (Fig. 2I, J). The abaxial surface of the leaflets in *A. ihsancalisii* and *A. glaucophyllus* is sparsely hairy (Fig. 2C, D, G, H), whereas in *A. guzelsuensis* it is glabrous (Fig. 2K, L). The trichomes of *A. ihsancalisii* and *A. glaucophyllus* are unicellular and densely papillose on the surface (Fig. 2C, G). All examined leaflets are amphistomatic, but the stomata are denser and larger on the adaxial surface (Fig. 2A, E, I). Stomata are also seen on the bract and legume surfaces. The stomata range from 15–20 µm in diameter and are of the *Amaryllis* type. Moreover, the stomata can also be considered as anomocytic and surrounded by polygonal epidermal cells (Fig. 2A–L). The leaflets seem to be glaucous under SM because of the thick epicuticular layer, which makes the plants adaptable to severe desertic conditions (Barthlott & al. 1997). Leaflets of all studied taxa exhibit a platelet wax type characteristic of *Fabales* (Barthlott & al. 1998). The variation observed for this character is insufficient to serve as a practical tool for taxonomic purposes in this group.

The legumes of *Astragalus ihsancalisii* (Fig. 1E) and *A. guzelsuensis* are distinctly stipitate; this is according to our own observation of the paratype of *A. guzelsuensis*, although the protologue (Ghahremaninejad & al. 2009) described the legume as sessile. On the other hand, the legume of *A. glaucophyllus* is clearly sessile and can be used for definite discrimination of this species from the other three (Table 1).

Bract and legume micromorphology of the taxa (Fig. 2M–T) was compared to assess its taxonomic implications. The legume surface of *Astragalus ihsancalisii* and *A. guzelsuensis* is glabrous (Fig. 2M, N, Q, R, S), whereas that of *A. glaucophyllus* has white hairs and stomata (Fig. 2O, P). The legume surface in all species examined shares the same ornamentation composed of short parallel striae. Bracts are similar in terms of shape and papillate hairs at the apex (Fig. 2T), but bract length differs among the examined species (Table 1).

The calyx of *Astragalus ihsancalisii* has white and black hairs on both the tube and the teeth. In contrast, the calyx of *A. guzelsuensis* has a glabrous tube but has white and black hairs on the teeth.

Table 1. Comparison of *Astragalus ihsancalisii* with *A. glaucophyllus*, *A. guzelsuensis* and *A. siahcheshmehensis*.

	A. ihsancalisii	***A. glaucophyllus***	***A. guzelsuensis***	***A. siahcheshmehensis***
Number of flowers per raceme	3–6	8–15 to many	4–12	3–7
Bract length × width [mm]	2–3 × 1.5–2	5–7	4–5 × 1.5–2	2–2.5
Pedicel length [mm]	4–6	3–4	2.5–3	c. 4
Calyx length including teeth [mm]	9–12	13–15	12–14.5	c. 12
Standard length [mm]	20–23	23–27	29–31	c. 25
Wings length [mm]	19–22	19–20	24–25	c. 20
Keel length [mm]	18–20	16–18	19–19.5	c. 17
Legume stipe length [mm]	c. 1	absent	1–1.5	c. 1
Legume beak length [mm]	4–5	c. 5	2–2.5	1–2(–3)
Legume indumentum	glabrous	sparsely hairy	glabrous	sparsely appressed white hairy

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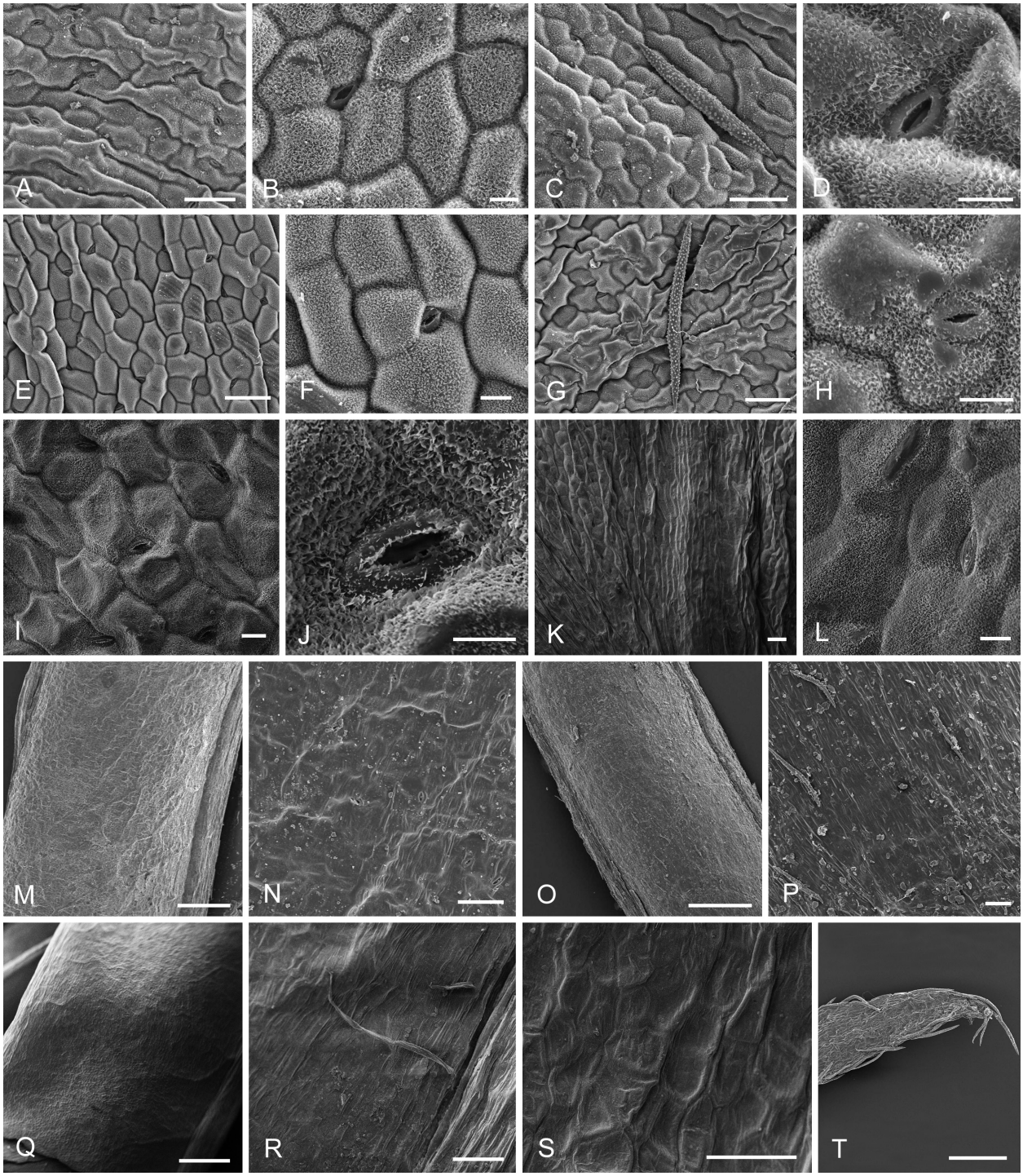


Fig. 2. Comparison of surface details of leaves, legumes and bracts by SEM. – *Astragalus ihsancalisii* (from *A. A. Dönmez 19559*): A, B: adaxial surface of leaf; C, D: abaxial surface of leaf; M, N: legume and detail of surface. – *Astragalus glaucophyllus* (from *H. Sümbül 3639*): E, F: adaxial surface of leaf; G, H: abaxial surface of leaf; O, P: legume and detail of surface; T: bract. – *Astragalus guzelsuensis* (from *İ. Demir 496*): I, J: adaxial surface of leaf; K, L: abaxial surface of leaf; Q, R, S: legume and detail of surface. – Scale bars: J = 10 µm; B, D, F, H, I, L = 20 µm; A, C, E, G, K, N, P, R, S = 100 µm; T = 0.5 mm; M, O, Q = 1 mm.

Additional specimens examined

Astragalus glaucophyllus Turkey: Amasya, in valle Kyrass-dere pr. Amasia, 400 m, 15 May 1890, *J. Bornmüller 2802* (P P03203374); Kirazdere, Logman Dapi etekleri, 800 m, 23 May 1990, *H. Sümbül 3639* (E E00341531, HUB); Sivas, Sivas-Zara road, 1300 m, 20 May 1960, *Stainton 8452* (E E00341530); "Tokat Anatoliae", *Wiedemann* (G G00020567); "Tokat" & "prope Tokat", 21 Jul 1835, *Wiedemann* (P P00605917). — ***Astragalus guzelsuensis*** Turkey: Van, Gürpınar, Güzelsu (Hoşap), between Zernek dam and Üçgen village, 2000–2200 m,

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10 Jul 2007, *İ. Demir 496* (GAZI [paratype]); same locality, 2063 m, 12 May 2007, *İ. Demir 125* (W 2008-07014 [isotype]). — ***Astragalus siahcheshmehensis*** Iran: Azarbayejan: Maku, Shote, Ghara Kelisa, NW slope, 39°05'29"N, 44°32'43"E, 1860 m, 7 Jun 2002, *A. A. Maassoumi & S. R. Safavi 82564* (B B10 0137935 [isotype], MSB MSB-163532 [isotype]).

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