

## *Astragalus unalii* (Fabaceae), a new species from Turkey

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**Abstract:** *Astragalus unalii* Çeçen, Aytaç and Mısırdalı, *sp. nov.* (Fabaceae, sect. *Malacothrix* Bunge) is described as a new species from Karadağ (Karaman Province) in southern Anatolia and compared with its relatives growing in steppe vegetation. The new species is close to *A. tauricola* Boiss. and *A. adiyamanensis* Podlech & M.Ekici, endemic and growing in central and southern parts of Anatolia, Turkey. Taxonomic descriptions, pollen and seed characters, and geographical distribution of the new species are presented.

**Key words:** Leguminosae, *Malacothrix*, systematics

### 1. Introduction

The genus *Astragalus* L. (Fabaceae) has two phylogenetic branches; one of them is Old World (Asia, Europe, and Africa) and the other one is New World (America). It has about 2000 taxa with 136 sections in the Old World (Podlech and Zarre, 2013). It is represented by 478 taxa in 63 sections and 202 (42%) taxa endemic to Turkey (Aytaç et al., 2012). Three new endemic taxa were added to the Turkish flora in 2012 and 2013 (Taeb and Uzunhisarcıklı, 2012; Dinç et al., 2013; Karaman and Aytaç, 2013) and the number reached 486.

The sect. *Malacothrix* Bunge is represented by 119 taxa in the Old World and 25 in Turkey, of which 12 are endemic (Podlech and Zarre, 2013). According to Taeb and Uzunhisarcıklı (2012), the sect. *Malacothrix* is represented by 17 taxa and 10 of them are endemic to Turkey.

The sect. *Malacothrix* is common in the Irano-Turanian phytogeographic region and has a systematic problem. According to Chamberlain and Matthews (1970), the sect. *Malacothrix* is caulescent, otherwise subcaulescent to acaulescent (Podlech and Zarre 2013). It is difficult to describe and decide if it is caulescent or not from herbaria specimens.

Interesting specimens of *Astragalus* were collected from Karadağ (Karaman Province) during the field trips by Ö. Çeçen, H. Mısırdalı, and Ünal in 2013.

After closer examination and consultation with the treatment in the *Flora of Turkey* (Chamberlain and Matthews, 1970) and a taxonomic revision of the genus

*Astragalus* in the Old World (Podlech and Zarre, 2013), it was realized that the specimens are different from the other known *Astragalus* species. This new species was also cross-checked with those kept in GAZI, ANK, and HUB.

### 2. Materials and methods

The morphological data used in the description of the new species were directly obtained from specimens collected by the authors from Karaman Province and by using a binocular stereoscopic microscope when necessary.

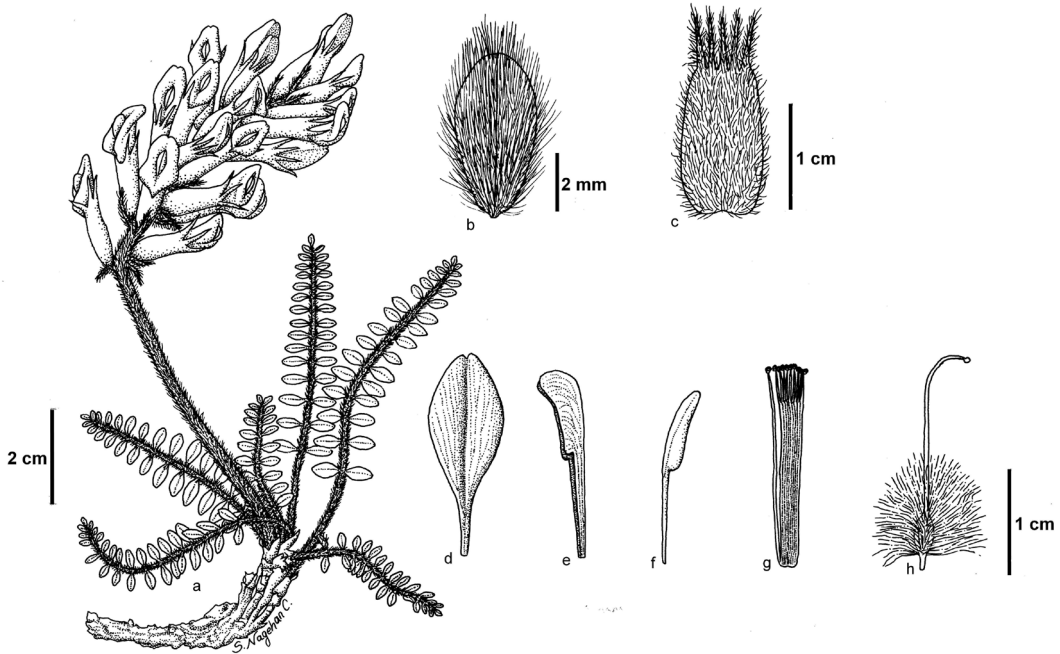
The pollen and seed morphology of the new species were examined with scanning electron microscopy (SEM) at GAZI. The pollen was treated with 70% alcohol and then dried before mounting on stubs with gold for the SEM study. The SEM photomicrographs were taken with the JEOL JSM 6060 SEM at Gazi University. The pollen terminology of Punt et al. (1994) was used in the description. Plant names were checked using IPNI (2015). The type specimens of new species are deposited at GAZI, ANK, HUB, KYN, and YILDIRIMLI.

### 3. Results

*Astragalus unalii* Çeçen, Aytaç and Mısırdalı, *sp. nov.* (Figures 1 and 2). Sect. *Malacothrix* Bunge

Type: Turkey. C4 Karaman: 19 km north of Karaman, Karadağ Mountain, southwest of Davda Hill, steppe, 1140–1345 m, 03.05.2013, Ö. Çeçen 1941, *Unal* and *Mısırdalı* (holotype: GAZI, isotypes: HUB, Yıldırımli, KNYA, and ANK).

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**Figure 1.** *Astragalus unalii*. a- habitus; b- leaflet; c- calyx; d- standard; e-keel; f- wing; g- stamen; and h- ovarium (Ö. Çeçen 1941 et al.).



**Figure 2.** Habitus of *A. unalii* in field (Ö. Çeçen 1941 et al.).

### Diagnosis

It is close to *A. tauricola*, but scapose, not subcaulescent to 2–3 cm; stipule densely covered adpressed to spreading, white hairy, not white–black hairy to glabrescent and not ciliate at margin; leaflets 7–15 pairs, not 10–18; scape white

hairy, not predominantly black hairy; bracts 4–5 mm, linear to linear lanceolate and white hairy, not 7–10 mm, triangular and white and black hairy; calyx 12–15 mm tubular, teeth as long as 1/2 calyx, not 9–13 mm and teeth not shorter than tube; corolla pale yellow to yellow, not

cream with purple center. Also close to *A. adiyamanensis*, but completely with simple long white hairs, not white and predominantly blackish hairs on peduncles and rachis; bracts 4–5 mm long, with long spreading white and short black simple hairs, not 6–8 mm and dominantly blackish hairs; peduncles usually longer than leaves (sometimes as long as peduncle in young specimens).

### 3.1. Description

Plants herbaceous, perennial, scapose, covered with simple white hairs. Stems densely branched from the base, procumbent, 10–15 cm tall, densely long (1–3 mm) white tomentose, scapose. Stipules whitish, lanceolate, acuminate, 7–10 mm long, joined to one another and adnate to the petiole; densely long white hirsute. Leaves usually shorter or rarely as long as scape, imparipinnate, 6–10 cm, with 7–15 pairs of leaflets; petiole 2–4 cm long, densely long white hirsute; rachis densely white pilose. Leaflets sessile or with a petiole shorter than 1 mm, ovate, oblong to elliptic, 3–8 × 2–4 mm densely long, white pilose. Racemes 15–35 flowered; peduncles white hairy, 3–15 cm. Bracts 4–5 mm long, linear-lanceolate, greenish with white to black simple pilose; ebracteolate. Flowers sessile to 1–2 mm pedicellate. Calyx tubular, 12–15 mm, with long, simple white and black hairy; teeth linear-lanceolate, 5–6 mm, with long simple white and predominantly simple black hairs. Corolla pale yellow to cream, drying dark green to blue apex; standard 20–23 × 3–4 mm, glabrous; wings 14–15 × 2–3 mm, auriculate, obtuse at base; keel 15–17 × 4–5 mm. Stamens 15 mm long and free at upper part. Ovary sessile, ovate, densely long simple hairy. Style 11–12 mm long, glabrous above, hairy below. Legume 10–12 × 4–6 mm, ovoid; beak 4–5 mm long. Seeds 2–3 per loculus, 4–5 × 2.5–5 mm, brown.

*Fl:* 4–5, *Fr:* 6.

### 3.2. Specimens examined

*Astragalus tauricola* Boiss.: Ankara: Kazan, Orhaniye–Memluk villages, around Dedeçamları hill, 1350–1400 m, 22.v.1993, steppe, *Orhan* 1206, GAZI; Çubuk, Ovacık to Saraycık, around Yatçapınar, 1250–1380 m, 20.v.1992, *Dündar* 1170, GAZI. Adana: Pozantı, Nanelik, 1570 m, 17.vii.1995, open *Pinus nigra* J.F.Arnold forest, *Aytaç* 7075 and *Adıgüzel*, GAZI; two sheets in K (type specimens); Bürücek, 1670 m, 6.vi.1934, *Balls*, 1283 (ANK); Saimbeyli, Obruk yaylası, *Pinus nigra* J.F.Arnold forest, 1600 m, 3.vii.1981, *M. Koyuncu* 4294 and *S. Erik*, HUB: Sivas: Gemerek, Karababa Dağı, Ağsuyu, 1800 m, 9.vi.2007, Özüdoğru 1233, HUB. Tunceli: Munzur, above Ovacık, 2800 m, 16.vii.1956, *Davis* 31225, ANK. Hakkâri: Cilo Tepe, 3350 m, *Davis* 24065 (ANK); Kayseri: Bakır Dağı, above Kısge, 2600 m, *Davis* 19339 (ANK); Erzincan: Kemah, Munzur Dağı, Maksutuşağı village, 1300–1700 m, *Yıldırım* 1566, (ANK). İçel: Mut, Kızıldağ, 18.vi.1970, *A. Pamukoğlu* and *Quezel*, HUB.

*A. adiyamanensis* Podlech & M.Ekici: Erzurum, Tekman, Akdağ köyü, 2100 m, 23. 06. 2012, *Taeb* 2076 *E. Doğan* and *E. Dişli* (GAZI). Akdağ, Cappadociae, 1837, P.M.B. *Aucher–Eloy* 1331, photo.

### 3.3. Habitat

This new species is growing at Mercik andesite rocks (Ulu and Balcı, 2009), with *Eryngium campestre* L., *Bromus sterilis* L., *Bromus tectorum* L., *Senecio vernalis* L., *Cota wiedemannia* (Fisch. and C.A.Mey.) Holub *Helianthemum nummularium* (L.) Miller, *Androsace maxima* L., *Astragalus mesogitanus* Boiss., *Trigonella coerulescens* (M.Bieb.) Hal. subsp. *coerulescens*, *Helianthemum ledifolium* L., *Filago pyramidata* L., *Picris strigosa* M.Bieb. subsp. *strigosa*, *Alkanna tinctoria* (L.) Tausch. subsp. *tinctoria*, *Sideritis lanata* L., *Silene dichotoma* Ehrh. subsp. *dichotoma*, *Vulpia ciliata* Dumort. subsp. *ciliata*, *Cnicus benedictus* L., *Picnomon acarna* (L.) Cass., *Tripleurospermum parviflorum* (Willd.) Pobed, *Scorzonera cana* (C.A.Mey) Hoffm. var. *jacquiniana* (W.Koch) Chamb., *Silene spergulifolia* (Desf.) Bieb. etc.

### 3.4. Pollen and seed morphology

Pollen grains of *A. unalii* are radially symmetrical, isopolar, and tricolporate. Length of pollen 52.48, colpus 14.83, and equatorial axis 24.48 ± 0.32 µm and is semiangular. Ornamentation is microreticulate on equatorial and psilate-perforate on polar regions. Lumen and muri amorphous, lumen 0.25–2 µm diam., muri thickness 0.2–1 µm and undulate (Figures 3a and 3b).

Seeds are rounded-reniform and brown; 0.34 ± 0.02 × 0.43 ± 0.02 mm. Ornamentation is reticulate-perforate. Hilum circular, 1 × 1.25 µm diam. (Figures 4a and 4b).

### 3.5. Etymology

This species is named in honor of Ayvaz Ünal, who is a plant taxonomist at Konya Necmettin Erbakan University and one of the collectors of the new species.

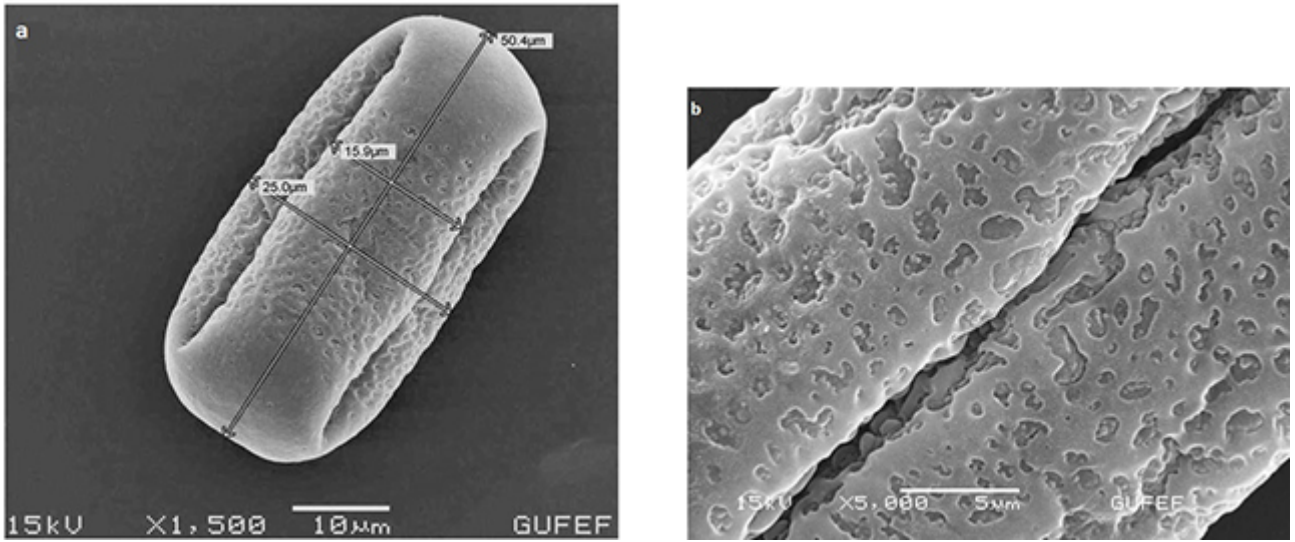
### 3.6. Distribution and conservational status (Figure 5).

The specimens were collected from C4 Karaman Province, where it is very local and known from the type locality. The range of this local endemic species is restricted to a single location (IUCN criteria B1a). The population is pure and smaller than 10 km<sup>2</sup> and, according to field observations, it is estimated that there are 70–80 individuals in a single locality (criteria B2a). Therefore, *Astragalus unalii* should be evaluated as critically endangered (CR), according to the IUCN (2010) Red List Categories and Criteria.

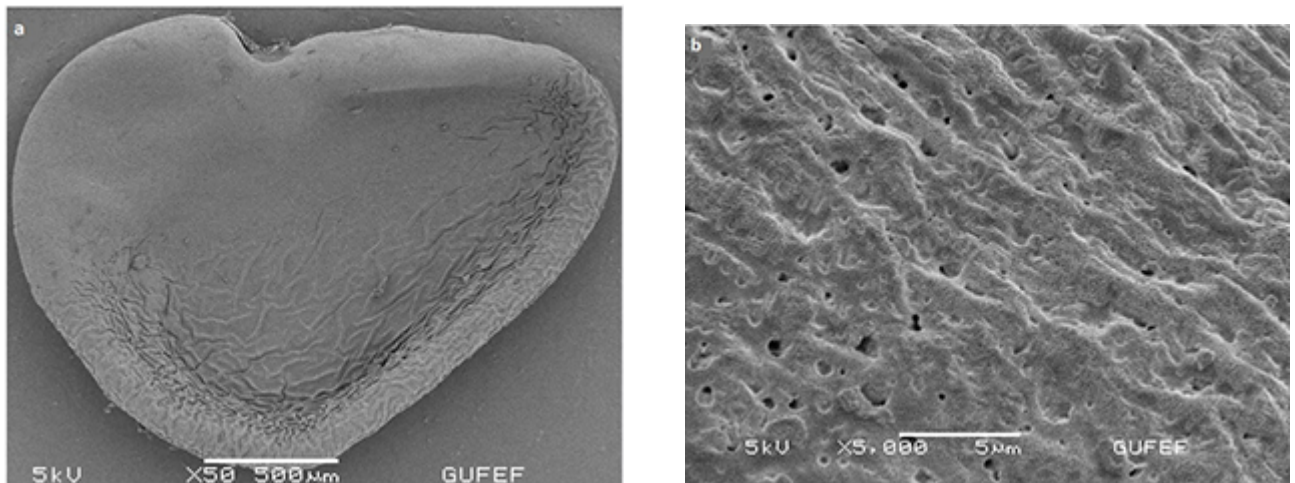
### 4. Discussion

Many characters are important for distinguishing members of the genus *Astragalus* such as annual or perennial; caulescent or acaulescent; stipule adnate to petiole or free; leaves paripinnate or imparipinnate; spiny or not; hairs simple, subbifurcate, or furcate; adpressed or spreading;





**Figure 3.** Pollen SEM photos of *A. unalii* a- equatorial view, b- ornamentation (Ö. Çeçen 1941 et al.).



**Figure 4.** Seed SEM photos of *A. unalii* a- general appearance, b- ornamentation of seed coat surface (Ö. Çeçen 1941 et al.).

only white or white and blackish; calyx inflated or uninflated; legume bilocular or unilocular; and one seeded or many seeded. These characters could be increased. Sometimes, some of these characters are mixed and it is difficult to decide whether or not it is acaulous, scapose, or caulescent. Another problem is how sections can be separated from each other. According to the researchers, the specimens can be placed in two different sections close to each other. For example, sections of *Rhacophorus* Bunge and *Pterophorus* Bunge are very close to each other with “calyx divided to base or 1/2 of tube”, which is a very important character, but it can never be understood from dry specimens. The sect. *Malacothrix* is one of them; the specimen is acaulous, subcaulescent, or with a stem 1–2 cm. Some specimens have 1–2 cm stem and some of them are acaulescents in *A. tauricola*. According to *Flora of Turkey* (Chamberlain and Matthews, 1973) the section

*Malacothrix* is caulescent but *A. bashkalensis* Chamberlain is scapose, *A. tauricola* Boiss. is subcaulescent to caulescent, *A. macrourus* Fisch. and C.A. Meyer is scapose or subcaulescent, and *A. comosoides* Chamb. and Matthews and *A. pulchellus* Boiss. are scapose or shortly caulescent. Otherwise, *A. bashkalensis* was reduced to a synonym of *A. comosus* Bunge by Podlech and Zarre (2013), but *A. comosus* is caulescent and *A. bashkalensis* is subcaulescent to caulescent. *A. pulchellus* was reduced to a synonym of *A. singarensis* Boiss. and Hausskn., but *A. singarensis* is acaulescent or shortly caulescent in “A taxonomic revision of the genus *Astragalus* in the old World” (Podlech and Zarre, 2013). However, the stem is 2–10 cm in “Revision of *Astragalus* L. sect. *Malacothrix* Bunge (Fabaceae) in Turkey” (Taeb, 2012). All of the results show us that *Astragalus* is a difficult genus and many specimens can be examined for taxa.

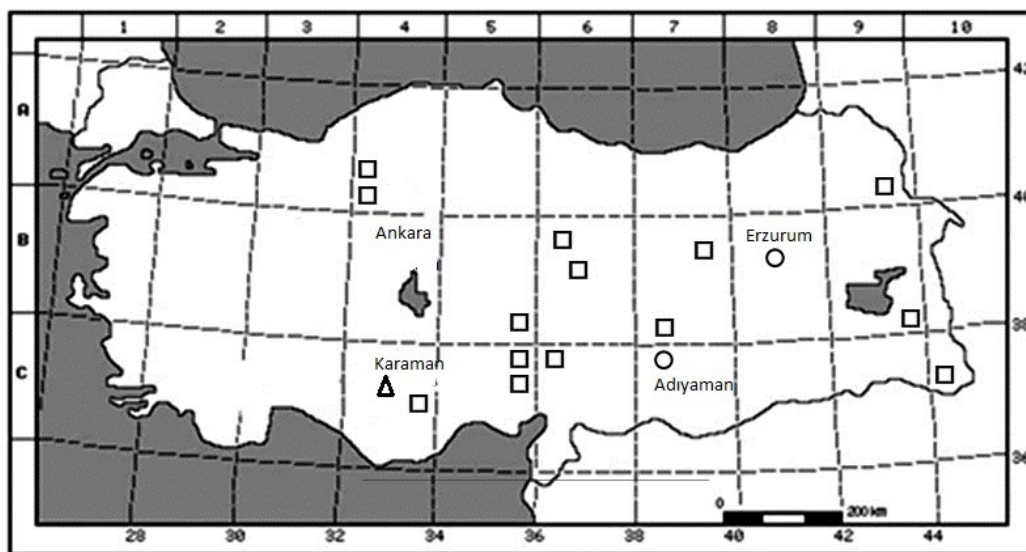


Figure 5. Distribution map of *A. unalii* (Δ), *A. tauricola* (□), and *A. adiyamanensis* (○).

According to Podlech and Zarre (2013), *A. hartvigii* Kit Tan, *A. iranicus* Bunge, *A. krylovii* Schischk., *A. pseudocylindraceus* Bornm., and *A. takhtazhjanii* Grossh. grow in Turkey, but according to Taeb and Uzunhisarcıklı (2012), *A. hartvigii* was transferred to sect. *Hypoglottiidei*, *A. iranicus* was reduced to a synonym of *A. mollis* M. Bieb., *A. krylovii* was reduced to a synonym of *A. suberosus* Banks and Sol., and *A. pseudocylindraceus* was reduced to a synonym of *A. macrourus* Fisch. and C.A.Mey. *A. takhtazhjanii* grows in Iran, but some of the specimens collected from Ağrı and Kars provinces in the MSB

herbarium are inadequate for making a decision on whether or not they are *A. takhtazhjanii*.

This new species is also close to *A. tauricola*, but it is scapose (not 2–10 cm stem), bracts 4–5 mm, linear to linear lanceolate and white hairy, not 5–7 mm, triangular, white and black hairy; stipule densely long, white hirsute, not ciliate at margin and glabrous otherwise; calyx tubular, 12–15 mm, hairy, not 9–12 mm; corolla pale yellow to cream, drying dark green to blue apex, not cream with purple center, lilac or purple; seeds 2–3 per loculus, not 3–4 (Table).

Table. Comparison of *A. unalii*, *A. tauricola*, and *A. adiyamanensis*.

Characters	<i>A. unalii</i>	<i>A. tauricola</i>	<i>A. adiyamanensis</i>
Stem	acaulescent	subcaulescent to caulescent	acaulescent
Hairs	completely adpressed to subspreading white	spreading, white and blackish	loosely subadpressed, erect, spreading white, blackish
Stipules	7–10 mm, adnate to the petiole for 0.5–1.5 mm; densely long, white hirsute	6–8 mm, adnate to the petiole for 1–3 mm; ciliate at margin and glabrous otherwise	8–9 mm, adnate to the petiole for 3–3.5 mm; loosely subadpressed white
Leaves (cm)	6–10 cm	3–7 cm	7–12
Leaflets (pairs)	7–13	10–18	7–12
Peduncule	3–15 cm, with white hairy	5–10 cm, white hairy at base, white and black hairy above	6–10 cm, white hairy at base, white and black hairy above
Bracts (mm)	4–5	5–9	6–7
Calyx (mm)	12–15	9–13	12–14
Calyx teeth (mm)	5–6	2–4	4–6
Corolla	greenish yellow or yellow with blue center at apex	white, cream with purple center at apex	yellow

The number of species in the sect. *Malacothrix* in Turkey has reached 18 with the addition of this new species.

Key of the sect. *Malacothrix* in Turkey. [Adapted from “A taxonomic revision of the genus *Astragalus* L. Leguminosae) in the world” (Podlech and Zarre, 2013)].

- 1- Ovary and legumes with a stipe at least 2 mm...  
*singarensis, macrostachys, eriopodus,*
- 1- Ovary and legumes sessile
- 2- Indumentum of the rachis double, white hairs of distinctly different length and partly also direction.....*adiyamenensis, paragriseus, pseudocylindraceus, takhtadzhanii, aladagensis, iranicus*
- 2- Indumentum of the rachis without distinctly different length or direction
- 3- Leaflets at least partly with spreading hairs .....  
.....*krylovii, eriocarpus*
- 3- Leaflets with appressed to ascending hairs
- 4- Hairs of rachis at least partly  $\pm$  spreading.....  
*A. maccouroides, calvertii, sarikamishensis, pseudotauricola, macrourus, hartvigii, takhtadzhanii, goeznensis, mollis*

- 4- Hairs of the rachis all  $\pm$  appressed to sometimes partly ascending
- 5- Standard blade rhombic-ovate, rhombic-elliptic and mostly widest in or below the middle, narrowed upwards.....*stridii, aznabjurticus, comosus, bakirdaghensis*
- 5- Standard blade of other form
- 6- All stipules densely hairy;
- 7- Calyx 10 mm; teeth 1–2 mm.....*bashkalensis*
- 7- Calyx 12–15 mm; teeth 5–6 mm.....*unalii*
- 6- Stipules white ciliate at the margin, otherwise glabrous.....*tauricola, argentaphyllus*

#### Acknowledgments

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#### References

- Aytaç Z, Ekici M, Akan H (2012). *Astragalus* L. In: Güner A, Aslan S, Ekim T, Vural M, Babaç MT, editors. Türkiye Bitkileri Listesi (Damarlı Bitkiler). İstanbul, Turkey: Nezahat Gökyiğit Botanic Garden and Floristics Research Society.
- Chamberlain DF, Matthews VA (1970). *Astragalus* L. In: Davis PH, editor. Flora of Turkey and the East Aegean Islands, Vol. 3. Edinburgh, UK: Edinburgh University Press, pp. 49–254.
- Dinç M, Aytaç Z, Doğu S (2013). A new species of *Astragalus* (Fabaceae) from Turkey. *Turk J Bot* 37: 841–846.
- Karaman Erkul S, Aytaç Z (2013). *Astragalus yukselii* (Leguminosae), a new species from Turkey. *Turk J Bot* 37: 836–840.
- IPNI (2015). International Plant Names Check-list. [http://www.ipni.org/ipni/authorsearch page.do, 2015].
- IUCN (2010). IUCN Standards and Petitions Subcommittee. Guidelines for Using the IUCN Red List Categories and Criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee. Gland, Switzerland: IUCN.
- Podlech D, Zarre SH (with collaboration of Ekici M, Maassoumi AAR, Sytin A) (2013). A Taxonomic Revision of the Genus *Astragalus* L. (Leguminosae) in the Old World, Vol. II, pp. 1039–1150. Vienna, Austria: Naturhistorisches Museum Wien.
- Punt W, Blackmore S, Nilsson S, Le Thomas A (1994). Glossary of Pollen and Spore Terminology. Utrecht, Netherlands: LPP Foundation (LPP Contributions Series, No. 1).
- Taeb F, Uzunhisarcıklı ME (2012). *Astragalus argentophyllus* (Fabaceae), a new species from south Anatolia, Turkey. *Ann Bot Fennici* 49: 259–262.
- Ulu Ü, Balcı V (2009) Karaman – N30 Paftası, No. 128, Türkiye Jeoloji Haritaları. 1:100 000 ölçekli. Ankara, Turkey: Maden Tetkik ve Arama Genel Müdürlüğü Jeoloji Etütler Dairesi, p. 18 (in Turkish with English abstract).