

## ONOSMA SHEHBAZII (BORAGINACEAE), A NEW SPECIES FROM THE HAWRAMAN MOUNTAINS IN THE WEST OF IRAN

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*Onosma shehbazii* (*Onosma* subsect. *Asterotricha*) is described as a new species. It is endemic to the Hawraman Mountains, in the west of Iran. Morphologically, it is similar to *O. qandilica* and *O. bisotunensis* but differs from them in the shape of sterile shoots and cauline leaves, lower bracts size, corolla color, fruiting calyx size, the position of calyx lobes; length of the free part of filaments and hairy nectary annulus. Additionally, the distribution map, an image of the holotype specimen, diagnostic characters, detailed photos, and an identification key are presented here.

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**Keywords:** Boraginaceae; *Onosma*, TaTa-Hawraman Mountain; Kurdistan; Iran

**Onosma shehbazii** گونه‌ای جدید از کوه‌های هورامان از غرب ایران

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گونه‌ی جدید *Onosma shehbazii* از زیربخش *Asterotricha* شرح داده می‌شود. این گونه انحصاری کوه‌های هورامان در غرب ایران است و از لحاظ صفات ریخت‌شناسی به گونه‌های *O. qandilica* و *O. bisotunensis* شبیه است. اما با آنها در شکل برگ‌های قاعده‌ای و ساقه‌ای، اندازه برگ‌های پایینی، رنگ جام، اندازه کاسبرگ در زمان میوه، وضعیت بخش‌های کاسبرگ، طول بخش آزاد میله‌ی پرچم و کرکدار بودن حلقه‌ی نوشجای جام متفاوت است. علاوه‌براین، نقشه‌ی پراکنش، عکس نمونه تیپ، صفات تشخیصی، تصاویر دقیق و کلید شناسایی ارائه می‌گردد.

### INTRODUCTION

*Onosma* L. (Boraginaceae) with ca. 250 species (He & al., 2020; Attar & al., 2020 and 2021; Mehrabian & al. 2022a and 2022b) grows in open and xeric habitats, and is mainly distributed in the Mediterranean region, southwest Asia, and temperate Europe (Boissier 1879; Riedl 1967; Peruzzi and Passalacqua 2008; Binzet & al. 2010; Mehrabian & al. 2011a, 2014, 2018a, 2018b; Ranjbar & Almasi 2014; Binzet 2016a, 2016b; Binzet & Eren 2018; Cecchi & Hilger 2021;

Firat & Binzet 2021). Turkey (105 taxa), Iran (66 species), and Central Asia (Teppner 1991; Binzet & al. 2014) are centers of diversity of *Onosma*. Zagros Mountain chain in western Iran is the most important center of diversity of the genus *Onosma* (Attar & al. 2021). The taxonomic studies on *Onosma* date back to De Candolle (1846), who provided the primary classification of the sect. *Euonosma* and sect. *Aponosma* Alph. DC. based on some calyx characteristics. Later, Schur (1866), as well as Borbás

(1877), used indumentum features as the most important diagnostic characteristics in *Onosma*. These characteristics are reliable taxonomic traits that have been used in different works (Mehrabian & al. 2014, Cecchi & al. 2016). Based on morphological characteristics, specifically the indumentum type of leaf, the genus *Onosma* has been classified into three sections (1. *Protonosma*, 2. *Podonosma*, and 3. *Onosma*). Section *Onosma* is divided into three subsections (1. *Asterotricha* Boiss.: Tubercles of setae with stellate hairs; 2. *Haplotricha* Boiss.: Tubercles of setae glabrous; 3. *Heterotricha* Boiss.: with an intermediate indumentum type).

According to Flora Iranica, 59 species of *Onosma* belong to three sections (including: 1. *Protonosma*, 2. *Podonosma*, 3. *Onosma*), two subsections (including: 1. *Rostellata*, 2. *Onosma*) and 23 series growing in the Flora Iranica area (Riedl 1967). Also, according to

Flora of Iran, 37 species of *Onosma* belong to three sections, and three subsections (Khatamsaz 2002). Iran with 66 species (Attar & Joharchi 2007; Attar & Hamzeh'ee 2007; Mehrabian & al. 2014; Ranjbar & Almasi 2014; Naqinezhad & Attar 2016; Attar & al. 2020 2021; Mehrabian & al. 2022a, 2022b; Advay & al. 2022) is considered as the second center of diversity for *Onosma* in the world (Teppner 1991; Binzet & al. 2014; Binzet & Eren 2018). The Alborz and Zagros Mountains are important centers of diversity for the genus (Attar & al. 2021). Hawraman, located in the Zagros Mountain area, is known for its rich diversity of *Onosma* species, including six species belonging to the subject. *Asterotricha*. These species are *O. cardiostegia* Bornm., *O. rascheyana* Boiss., *O. caeruleascens* Boiss., *O. kurdica* Teppner, *O. iransharii* Ghahr. & Attar, and *O. latifolia* Boiss. & Hausskn.

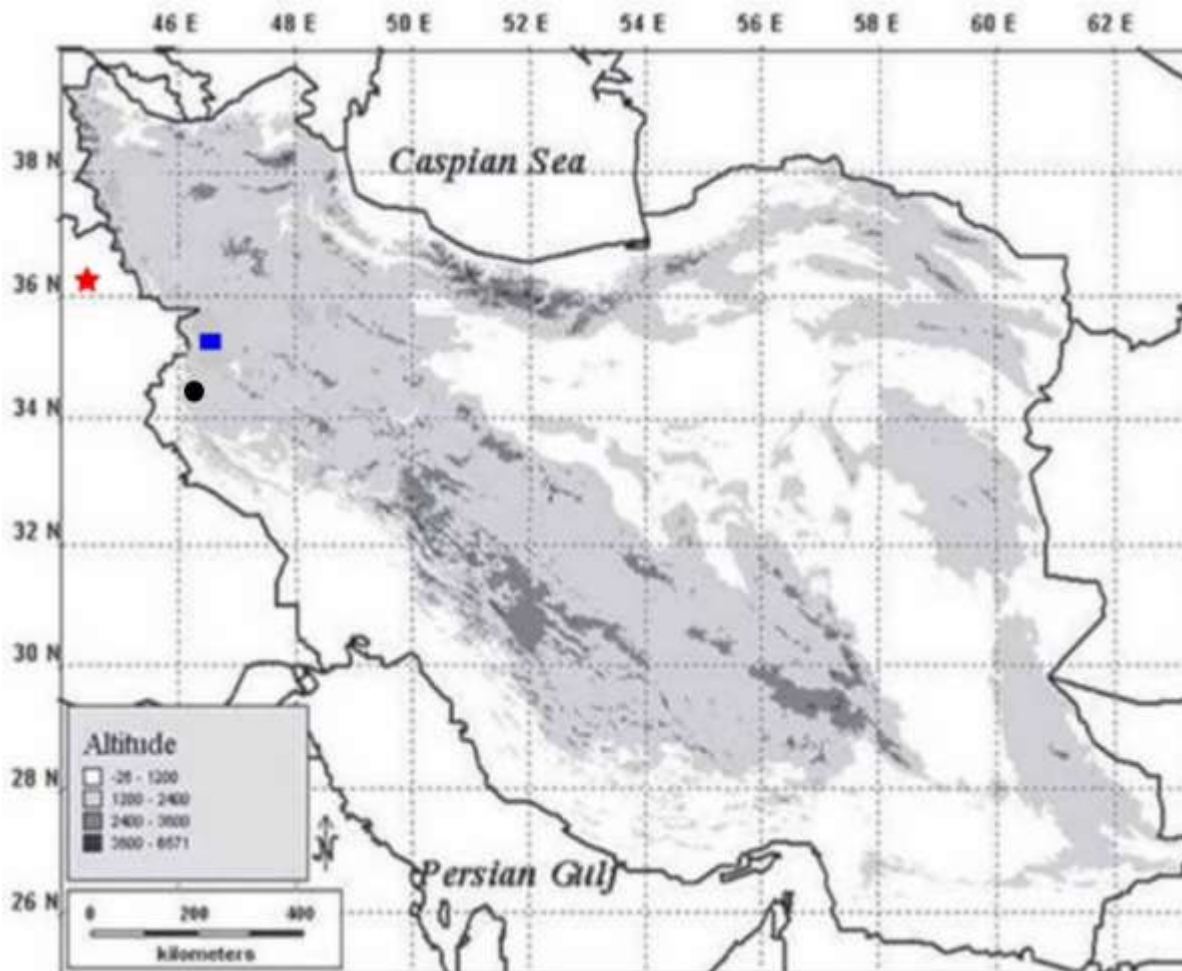


Fig 1. The geographical distribution of *Onosma shehbazii* (■), *O. qandilica* (★), and *O. bisotunensis* (●).

## MATERIALS AND METHODS

During extensive fieldwork, in 2020 in Gardan-e TaTa, Hawraman Mountains, Kurdistan province some interesting specimens were collected. The specimens were identified and compared with other *Onosma* species using the diagnostic keys in different floras (Parsa 1949; Popov 1953; Riedl 1967, 1979; Khatamsaz 2002), and the recently described species in subsect. *Asterotricha* (Ghahreman & Attar, 1996; Mehrabian & al. 2013, 2022a, 2022b; Mehrabian and Mozaffarian 2018; Attar & al. 2007, 2020, 2021). The images of the type specimens from various online herbaria (BM, K, MPU, P, W), were studied and compared with the new specimens. Furthermore, these specimens were compared with the related taxa in TUH, TARI, HKS, and IRAN (acronyms as in Holmgren & al. 1981). Based on these studies we concluded that the new collection is a new species. The quantitative and qualitative morphological key characters of the studied species are presented in Table 1. Nutlet and indumentum were profiled and photographed by Dino-Lite digital microscope AM413T and pollen and indumentum were scanned by an electron microscope (Cam Scan TESCAN VEGA3). The holotype is deposited and preserved in TUH Herbarium.

## RESULTS AND DISCUSSIONS

*Onosma shehbazii* M. Advay, F. Attar & S. A. Ahmad **sp. nov.** (Figs. 1-4)

sect. *Onosma*, subsect. *Asterotricha*

**Type:** Iran, Kurdistan province, Marivan to Paveh, Avroman (Hawraman) Mountain (TaTa Pass), 2800 m, 35°13'32" N, 46°14'05" E, 30 June 2021, Advay, 48721 (Holotype, TUH).

### Diagnose

*Onosma shehbazii* is most similar to *O. qandilica* Rech. f. & H. Riedl, but clearly differs from the latter by its ovate-lanceolate sterile shoot and cauline leaves (vs. obovate-lanceolate); corolla yellow not becoming blue (vs. white, purplish, becoming caerulea); lower bract 5–6 mm long (vs. 10–12 mm); fruiting calyx 10–12 mm long (vs. 14–15 mm); calyx lobes united at the middle and 1–2 mm wide (vs. free at the base and 1 mm); free part of filaments 1 mm long (vs. 2–3 mm); glabrous nectary annulus (vs. hairy nectary annulus). Also, *O. shehbazii* is similar morphologically to *O. bisotunensis* Attar & Hamzeh'ee, but, it is readily distinguished from that by having ovate-lanceolate cauline leaves and sterile shoot leaves (vs. ovate or spatulate); corolla 10–12 mm long, yellow not becoming blue (vs. ca. 19 mm, yellow, becoming dark or blue); lower bract 5–6 mm long (vs. 10–18 × 1.5–6

mm); fruiting calyx 10–12 mm long (vs. 12–13 mm); calyx lobes 1–2 mm wide and united at the middle (vs. ca. 2 mm, 2 or 3 lobes united to near apex); free part of filaments 1–2 mm long (vs. 6–7 mm); glabrous nectary annulus (vs. hairy), (Table 1).

Perennial, woody at the base, stem numerous 15–25 cm, erect, greenish, covered by adpressed setae. Sterile shoot leaves ovate-lanceolate, acute 3–4 × 1–2 cm; cauline leaves lanceolate, ovate-oblongate 2–3.5 × 1–1.5 cm, sessile; covered by dense adpressed setae, tubercles distinct, sparsely or sub-densely hairy, the stellate indumentum with long, irregular rays (Figs. 2 I–K, 3 A–C). Inflorescence short capitate-subscorpioid, 4–6 cm long; cymes dense 4–5 flowers; bracts linear 5–6 mm long and 1–1.5 mm wide; pedicels 3–5 mm long; flowering calyx 10–12 × 1–2 mm, elongated to 13 mm long in fruiting stage, calyx lobes lanceolate 1–2 mm wide, covered by dense setae outside, sometimes two lobes united at the middle; corolla 10–12 × 4–5 mm, cylindrical, yellow, pubescent outside ½ upper half, glabrous inside, lobes 1 mm wide and 1 mm long, acute, triangular, with few short setae at apex; free part of filaments absent to 1–2 mm long and they arise from under the middle of the corolla; anthers 5–6 mm long and with sterile apex; nectary annulus glabrous. Nutlet ovoid, 1–2.4 × 3–3.5 mm, ventral surface keeled, rostrate, grayish, and yellow-dotted.

### Distribution, Habitat, Phenology, and Pollen:

*Onosma shehbazii* is distributed in western Iran, border mountains between Iran and Iraq (Fig. 1). It is an Irano-Turanian element and grows in mountainsides, grassy steppe, near melting snow, 2500–2900 m a.s.l., associated with *Ferula haussknechtii* H. Wolff ex Rech. f., *Prangos ferulacea* (L.) Lindl., *Ferulago angulata* (Schlecht.) Boiss. subsp. *angulate*, *Achillea aleppica* DC., *Papaver fugax* Poir., *Scorzonera nivalis* Boiss. & Hausskn. and *Eryngium billardieri* F. Delaroché. Flowering and fruiting stages have been recorded in June–July. Pollen: Heteropolar, tricolporate, prolate (Fig. 3 D–F).

**Etymology:** The specific epithet is named after Dr. Ihsan A. Al-shehbaz in recognition of his extensive plant collection and research in the field of Plant Systematics throughout the world.

**Conservation status:** *Onosma shehbazii* is observed in a restricted area of Avroman (Hawraman) in Kurdistan province in western Iran. The studied population size in TaTa pass is very small, and the number of individuals is less than 60. The Area of Occupancy (AOO) measured in Hawraman is less than 0.005 km<sup>2</sup>. The species is classified as critically endangered (CR) following the IUCN criteria (IUCN 2022).

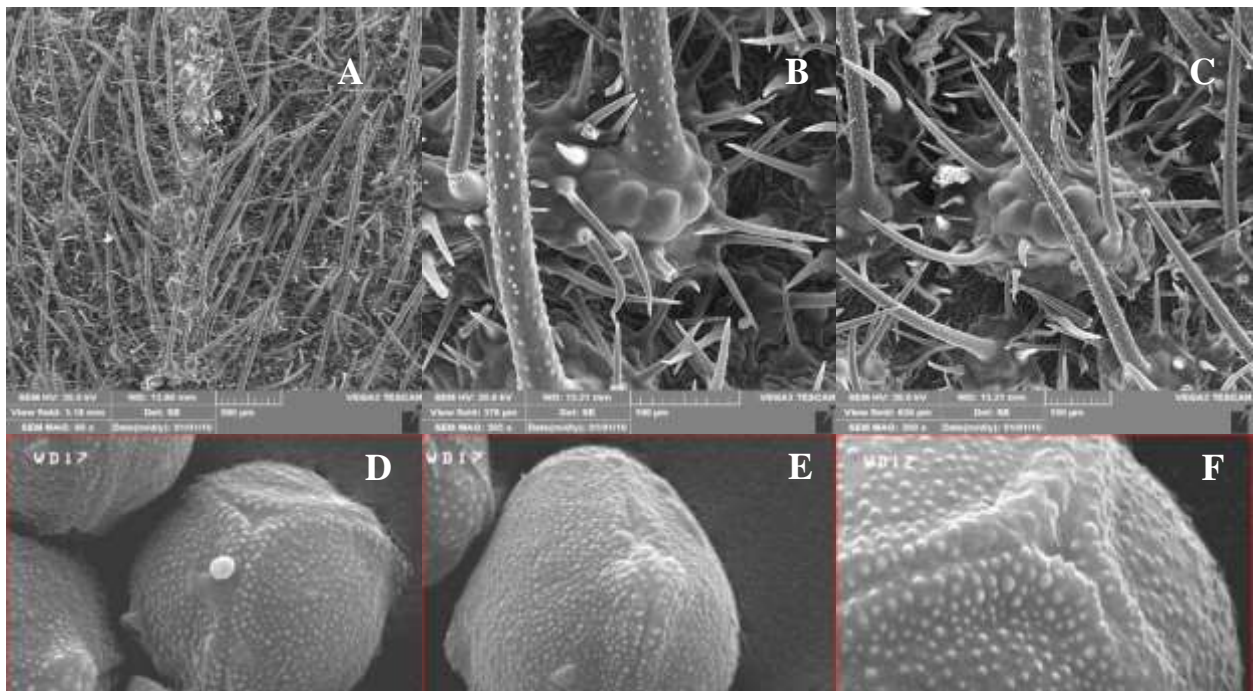


Fig. 2. *Onosma shehbazii*. A, habit; B, stem leaves; C & D, a part of inflorescence; E, corolla; F, outside of calyx lobes; G & H, nutlet, I-K, indumentum of lower and upper leaf surfaces respectively.



Table 1. The comparison of diagnostic morphological characteristics of *O. shehbazii* and its relatives.

Characters	<i>O. shehbazii</i>	<i>O. bisotunensis</i>	<i>O. qandilica</i>
Sterile shoot leaves shape and length (cm)	ovate-lanceolate 3–4	ovate or spatulate 2–4	broadly obovate, obovate-lanceolate 3.5–6
Stem leaves shape and size (cm)	lanceolate, ovate-ob lanceolate 2–3.5 × 1–1.2	ovate, 2–3 × 0.8–1.3	lanceolate, 2.5–4 × 1–2
Rays of tubercles (stellate hairs)	sparsely or sub-densely hairy, long, irregular	densely hairy, long, irregular	densely hairy, short, regular
Lower bracts length (mm) and shape	5–6, linear	10–18, lanceolate	10–12, linear
Fruiting calyx length (mm)	10–12	12–13	14–15
Calyx lobes width (mm) shape and connection	1–2 mm, lanceolate, two lobes united to the middle	ca. 2 mm, lanceolate, 2 or 3 lobes united to near apex	1 mm, linear, lobes free to base
Corolla length (mm), color, and shape	10–12, yellow, not changing to blue, cylindrical	ca. 19 mm, yellow, sometimes changing to dark blue, cylindrical-campanulate	10–13, white, purplish, yellowish, changing to caerulescens, cylindrical-campanulate
Free part of filaments length (mm)	1–2	6–7	2–3
Nectary annulus	glabrous	hairy	hairy

Fig. 3. Scanning electron micrographs of *O. shehbazii*. A–C, indumentum of basal leaves in the ventral surface; D–F, pollen in polar and equatorial view.

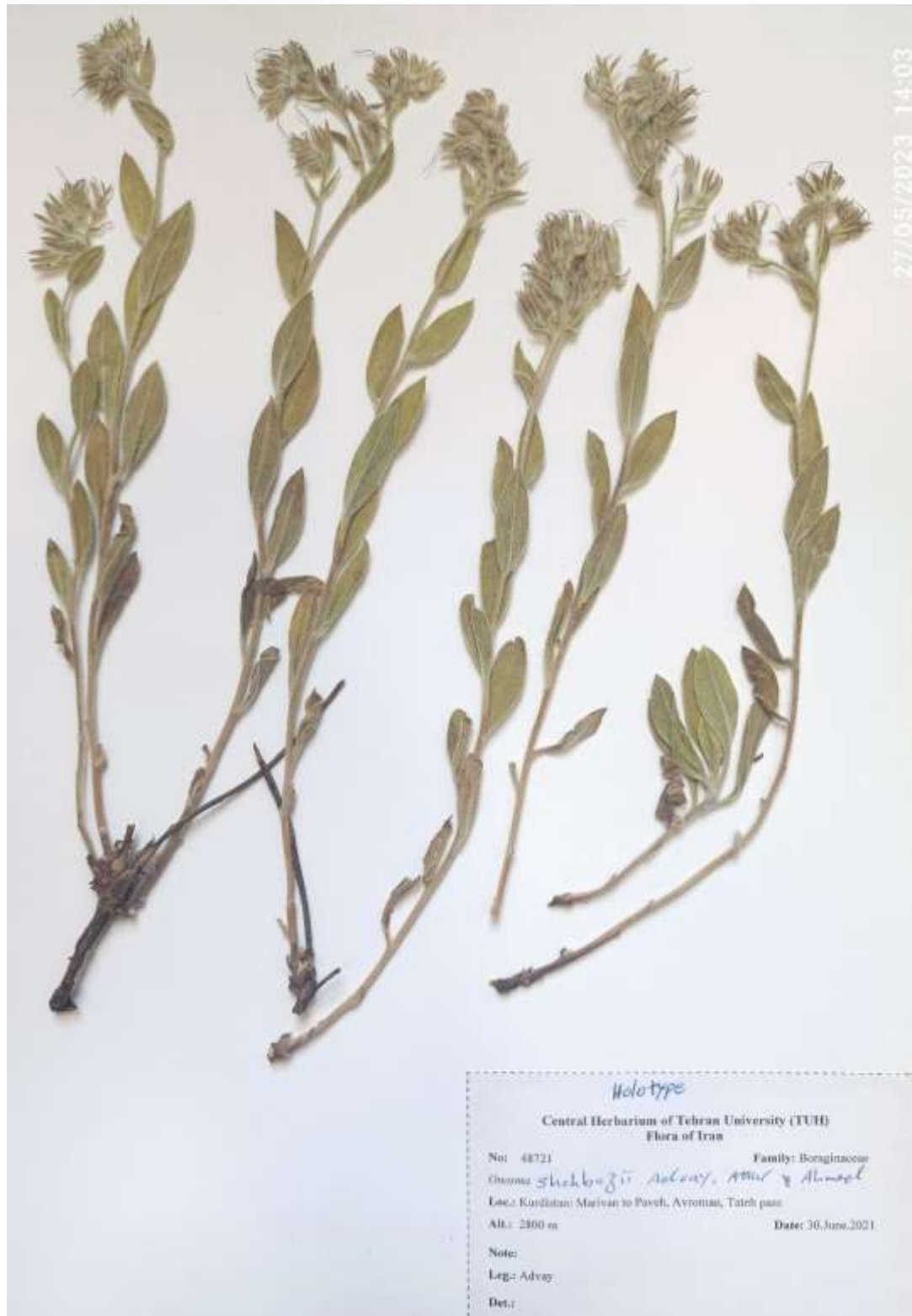


Fig. 4. Holotype specimen of *Onosma shehbazii* M. Advay, F. Attar & S. A. Ahmad.



Fig. 5: *Onosma qandilica* (photos from Vascular plants of Gmo mountain in Kurdistan Iraq).

**Taxonomic Note:** *Onosma* is systematically difficult, and most of the diagnostic characters are mainly based on the whole indumentum, leaf, and flower morphology (Ball 1972; Riedl 1978; Peruzzi & Passalacqua 2008). *Onosma* sect. *Onosma* in Iran has three subsections. *Asterotricha* Boiss. (26 species), *Haplotricha* Boiss. (31 species) and *Heterotricha* Boiss. (9 species). *Onosma shehbazii* is classified in the sect. *Onosma* subsection. *Asterotricha* (Boiss.) Gürke based on the stellate hairy tubercles of the leaf. It is most closely related to *O. qandilica* (Fig. 5) and *O. bisotunensis* which belong to sect. *Onosma* subsection. *Asterotricha* (Riedl 1967; Khatamsaz 2002).

**Diagnostic key to the new species and its related species**

1. Annulus glabrous; corolla 10–12 mm long, yellow, not changing to blue; free part of filaments 1–2 mm long; calyx lobes united to middle .....  
 ..... *O. shehbazii* Advay, Attar & Ahmad  
 - Annulus villous; other combination traits not as above ..... 2
2. Corolla 10–13 mm long, white, purplish, yellowish changing to caerulescens, free part of filaments 2–3 mm long; calyx lobes free to base .....  
 ..... *O. qandilica* Rech. f. & H. Riedl  
 - Corolla ca. 19 mm long, yellow, sometimes changing to dark blue; free part of filaments 6–7 mm long; calyx

lobes united to near apex .....  
 ..... *O. bisotunensis* Attar & Hamzeh'ee

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