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Onosma vanensis (Boraginaceae: Lithospermeae), A New Species from Türkiye

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Abstract

A new species of *Onosma* (Boraginaceae: Lithospermeae) from the Van province of eastern Anatolia, *Onosma vanensis*, is described and illustrated. It belongs to the *Haplotricha* subsect. which comprises the species with basal leaves covered by simple setae only. In general appearance, it's close to *O. lanceolata* but it's a different species with narrow stem leaves, larger bracts, shorter pedicels and calyx as well as longer corolla. The geographical distribution of *O. vanensis* and *O. lanceolata* are mapped and the identification key for those species is provided. Additionally, diagnostic characters, detailed photographs and habitat descriptions provided along with a vernacular name and IUCN conservation status for *O. vanensis*.

Keywords: *Onosma*, Flora of Türkiye, Irano-Turanian, Taxonomy, Van

Onosma vanensis (Boraginaceae: Lithospermeae), Türkiye'den Yeni Bir Tür

Özet

Doğu Anadolu'nun Van ilinden yeni bir *Onosma* (Boraginaceae: Lithospermeae) türü, *Onosma vanensis*, tanımlanmış ve gösterilmiştir. Bu tür, bazal yaprakları sadece basit setalarla kaplı türleri içeren *Haplotricha* altseksiyonuna aittir. Genel görünüm olarak *O. lanceolata* türüne yakındır, ancak dar gövde yaprakları, daha büyük brakteler, daha kısa pediseller, kaliks ve daha uzun korolla ile farklı bir türdür. *O. vanensis* ve *O. lanceolata*'nın coğrafi dağılımı haritalanmış ve bu türler için teşhis anahtarı verilmiştir. Ek olarak, *O. vanensis*'in yerel adı ve IUCN koruma durumuyla birlikte tanısal karakterler, ayrıntılı fotoğraflar ve habitat tanımları da sağlanmıştır.

Anahtar kelimeler: *Onosma*, Türkiye Florası, İran-Turan, Taksonomi, Van

INTRODUCTION

Identification of taxa belonging to the genus *Onosma* L. is notoriously difficult due to differences in morphological uniformity and phenology, so defined divisions and groups are unsatisfactory as they do not appear to be a natural grouping (Ball, 1972; Popov, 1953; Riedl, 1978; Naqinezhad & Attar, 2016; Binzet, 2016a; 2016b).

Onosma belongs to the tribe Lithospermeae Dumort. (1827), which includes 24 genera. Members of the Lithospermeae are characterized by a indumentum type, flat gynobase oval or oblique, smooth or wrinkled, always in combination with very hard (mineralized) nutlets, they are typically keeled both ventrally and dorsally, shape, size, and colors of the corolla, size of the calyx,

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number of flowers in cymes, nutlet and pollen morphology (Qureshi & Qaiser, 1987; Binzet & Akcin, 2009; Akcin & Binzet, 2011; Mehrabian et al., 2012; Weigent et al., 2016; Attar et al., 2020). Also, the calyx features show variation between flowering and fruiting times (Riedl, 1978).

With the description of new species in recent years, the number of species of the *Onosma* genus has increased to approximately 298 species (Boissier, 1879: Hayek & Markgraf, 1931; Dinsmore, 1932; Popov, 1953; Ball, 1972; Riedl, 1978; Meikle, 1985; Teppner, 1991; Ge-Ling et al., 1995; POWO, 2024). The genus ranges between the Atlas Mountains in Morocco, to the west, to CE Asia to the east. Especially the SW Irano-Turanian region plays a major role in speciation and evolution of *Onosma* taxa. Since over the 80-85 % of *Onosma* species occur in Türkiye, Iran, Northeast of Iraq and Western of Pakistan (Boissier, 1879; Riedl, 1967; 1978; Binzet et al., 2010; 2024; Binzet & Akçin 2012; Mehrabian et al., 2013; Koyuncu et al., 2013; Ranjbar & Almasi, 2014; Binzet, 2016a; 2016b; Cecchi et al., 2016; Binzet & Eren, 2018; Fırat & Binzet, 2021).

In the last plant check-list of Türkiye title "Türkiye Bitkileri Listesi" (Binzet, 2012), Binzet recognised 96 species (including one hybrid) belonging to the genus *Onosma* in Türkiye. Later, *O. atila-ocakii* Koyuncu & Yaylacı (2013), *O. demirizii* Kaynak, Tarımcılar & Yılmaz (2015), *O. malatyana* Binzet (2016a), *O. anatolica* Binzet (2016b), *O. juliae* L. Cecchi et al. (2016), *O. erzincanica* Binzet & Eren (2018), *O. satensis* Fırat & Binzet (2021), *O. onur-koyuncui* Sezer (2021), *O. serpentinica* Yıldırım & Binzet (2024) were described as additional nine members of the genus from Türkiye. Türkiye is well known for the high diversity of its phanerogam flora, which is also reflected by the species richness in the genus *Onosma*. Together with *Onosma vanensis* Fırat & Binzet described in this study, a total number of *Onosma* species known from Türkiye increase to 106. Among those 106 species, 63 species are endemic to Türkiye. Anatolia hosts nearly half of the *Onosma* taxa distributed in the world and has a high level of endemism (approximately 60%). Therefore, Anatolia is an important center of diversity and evolution of the genus *Onosma*.

One population of unknown taxa of *Onosma* were collected during scientific field excursions Çatak/Van in the eastern of Türkiye by first author. After detailed analyses of the relevant Floras and associated literatures and comparison with closely related species, it became clear that our collections could not be referred to any previously known species from the Irano-Turanian region. Therefore, these specimens proposed here as new to science from Çatak/Van province (eastern Türkiye) and its diagnosis, descriptive, distributional features, conservation status and identification key are given.

MATERIAL AND METHOD

Specimens of *Onosma vanensis* were collected during flowering and fruiting periods in 2019 and 2022 from Geliyê Sîyark (Siyark Valley), Çatak (Van) province (East Anatolia, Türkiye) (Figure 1). Flowering samples were collected between 2019-2020 and fruit samples between 2020-2022, totally 20 herbarium specimens were collected from one locality and deposited in VANF, VHLV, and MERA (Thiers, 2018), and in the personal herbarium of the author (Herb. M. Fırat). We compared the *O. vanensis* with live observations and samples collected by the first author from Van, Hakkari and Siirt, in addition to type specimen of *O. lanceolata* Boiss. & Hausskn. ex Boiss. kept at W and JE from Türkiye and the relevant taxonomic literature of *Onosma* (Boissier, 1879; Dinsmor, 1932; Riedl, 1967; Popov, 1953; Riedl, 1978). Preliminary conservation assessments were made using the IUCN (2023) guidelines. For the palynological studies we selected 50 pollen grains and 30 mature nutlets randomly and were measured using by light microscope (LM) and stereo-binocular

microscope. In addition, for analysis of some morphological characters observations were made using a scanning electron microscope (SEM). For palynological studies pollen grains were taken from herbarium specimens using LM, and prepared according to the Wodehouse methods (Wodehouse, 1935). The polar axis (P), equatorial axis (E), and other characteristics (see Table 2) of the pollen grains were measured using an Olympus BX40 with a 100x objective until a Gaussian curve was acquired (Table 2). For SEM observations, pollen was isolated from dried voucher materials without any additional treatment. The isolated dried pollen was deposited on carbon-coated aluminium probe holders and coated with platinum. Pollen grains and nutlets were photographed with a ZEISS supra 55. Palynology nomenclature follows Wodehouse (1935), Faegri & Iversen (1989) and Punt et al. (1994). The herbarium acronyms follow Thiers (2018).

RESULTS AND DISCUSSION

Onosma vanensis Fırat & Binzet, **sp. nov.** (Figures 2–9)

Type. Türkiye. **Van**: Çatak District, Siyark Valley, stony and rocky slopes, 2133 m a.s.l., 38°6.9830′N - 43°9.0760′E, 25.05.2019, *M.Fırat 34820* (in flower) (**holotype**: VANF!, **isotypes**: VHLV!, MERA! and Herb. M.Fırat!).

Paratypes. Türkiye. **Van**: Çatak District, Siyark Valley (Geliyê Sîyark), stony and rocky slopes, 2133 m a.s.l., 38°6.9830′N - 43°9.0760′E, 20.05.2020, *M.Fırat 35478* (in flower) (VHLV!, Herb. M.Fırat!); ibid., 25.06.2020, *M.Fırat 35526* (in fruit) (VHLV!, Herb. M.Fırat!); ibid., 17.05.2021, *M.Fırat 35622* (in flower) (VANF!, VHLV!, MERA!, Herb. M.Fırat!); 07.07.2021, *M.Fırat 35650* (in flower) (Herb. M.Fırat!); ibid., 27.05.2022, *M.Fırat 35990* (in flower) (VHLV!, Herb. M.Fırat!); 01.07.2022, *M.Fırat 35650* (in fruit) (Herb. M.Fırat); ibid., 1965 m a.s.l., 38°44′65″N - 43°14′43″E, 29.06.2019, *M.Fırat 35113* (in fruit).

Diagnosis. *Onosma vanensis* resembles to *O. lanceolata*, but it clearly differs by its unbranched and numerous stems (not 2–3(-4) stemmed, branched above, rarely simple); calyx 8–10 mm long in flower, to 12 mm long in fruit (not c. 12 mm long in flower, to 15 mm long in fruit); corolla golden yellow, 18–20 mm long, patent puberulous (not yellow, 15–18 mm long, pubescent); anthers slightly longer than filaments (not slightly shorter than filaments) (Table 1, Figure 6).

Description. Perennial, stems numerous, terete longitudinally striped, ascending to erect, 20–30 cm long and to 5 mm in diameter, unbranched, covered with 4–5 mm long rigid patent setose and densely short hairs; basal leaves 30–50 × 5–10 mm, shortly petiolate, oblanceolate, rotundate to obtuse, margin ±revulate, often shrivelled at flowering time, covered with rigid setose 4–7 mm long, patent setae on upper surfaces and midrib beneath, densely very short puberulous on both surfaces, setae arising from tubercles; cauline leaves 20–90 × 3–10 mm, sesile or lower longly petiolate, oblanceolate, rotund, margins not revulate, covered with rigid patent setose on upper surface and midrib beneath (2–4 mm long) and short hair on both surfaces, setae arising from tubercles, tubercles at base of foliar setae consistinf of (1-)2–3 series of cells. Inflorescence of 1–3 terminal cymes, elongated after flowering. Bracts 10–30 × 3–8 mm, base lanceolate, linear towards to apex, sessile, acute, with patent robust setae on ±tubercles above and on midrib beneath (2–5 mm long) and ±patent short hairy on both surfaces. Pedicels 2–3 mm long. Calyx 8–10 mm long in flower, to 12 mm long in fruit, with short tubular base and acute, lobes lanceolate, lanceolate-linear, densely setose on upper surface and sparsely midrib beneath, short hair on both surfaces. Corolla golden yellow, 18–20 mm long, cylindrical-campanulate, patent puberulous, reticulate weined,

lobes 5, reflexed, 1.5 × 2.5 mm, widely triangular, acute, annulus hairy. Anthers included or sterile tips exerted, linear, c. 7 mm long, sagittate, connate at base. Filaments c. 4 mm. Style 3–4 mm long protruding outside the corolla limb, stigma small, distinctly bilobed. Nutlets 3 × 2.5 mm, shortly beaked, pale grey to light brownish, minutely papilate ventrally keeled, acuminate. Pollen grains heteropolar, shape sphaeroide P/E (Polar axis/Equatorial axis) ratio 1.067.

Phenology. Flowering from May to June and fruiting from June to July.

Etymology. The epithet indicates the link of the new species with Van, the city of the Türkiye, where it was first discovered in June 2019.

Vernacular name. *Onosma vanensis* is called "Mejmejok" in Kurdish by the local people of Çatak (Van) Province. *Onosma* species are known by the local people under many names in Kurdish e.g. "Şîranok", "Hewajo", "Dimkirî", "Dîvankoşk", "Gorisazer", "Mijmijok", "Êmzik", "Memije" and "Giyaderman"; in Turkish e.g. "Emzik otu", "Havaciva", "Emcek", "Tavşan gözü", and "Sincar" (Fırat, 2013).

Distribution. *Onosma vanensis* is endemic to Siyark valley (Geliyê Sîyark), Çatak District (Van Province, Türkiye). It is an element of the Irano-Turanian floristic region (Figure 1).

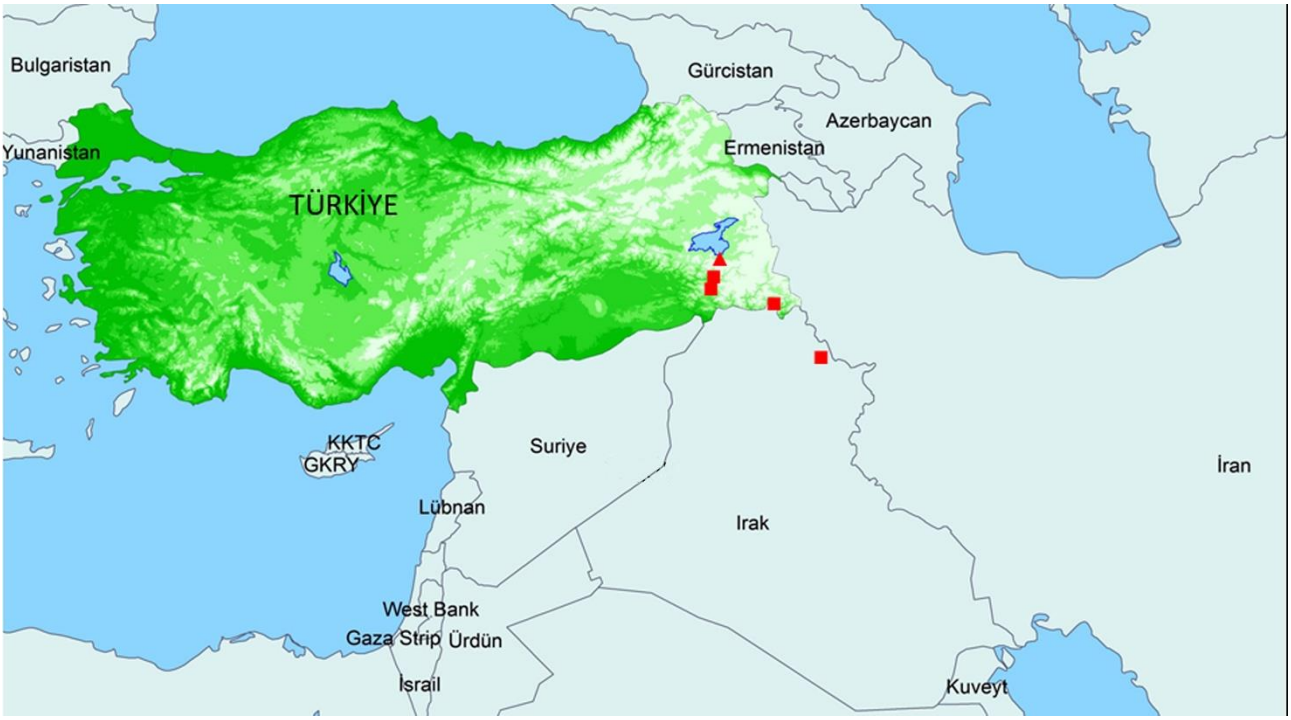

Figure 1. Distribution map of *Onosma vanensis* (triangle; Van) in Türkiye, and the closely related *O. lanceolata* (square; Van, Siirt, Hakkari and N. Iraq) in Türkiye and Iraq.

Habitat and ecology

Onosma vanensis grows on stony and rocky slopes, at c. 1900–2200 m elevation, with other interesting plants such as *Astragalus hirticalyx* Boiss. & Kotschy, *Asyneuma pulchellum* Bornm., *Centaurea urvillei* DC. subsp. *nimrodis* (Boiss. & Hausskn.) Wagenitz, *Cousinia eriocephala* Boiss. & Hausskn. ex Boiss., *Astragalus lagopodioides* Vahl, *Stipa assyriaca* Hand.-Mazz., *Onosma bracteos*a Hausskn. & Bornm. and *Onosma sericea* Willd.

Figure 2. Habitat of *Onosma vanensis* (A and B).

IUCN red list assessment

The distribution area of *Onosma vanensis* is less than 4 km^2. The species is known from one locality, in which c. 1000 individuals were counted. Some anthropogenic or grazing effects were observed on the population. Because of the area of occupancy (AOO) less than 10 km^2 and the

species known from only one location in accordance with the B2ab (ii,v) criteria of the IUCN (2023), *O. vanensis* is here assessed as Critically Endangered (CR).

Table 1. The main differences between *Onosma vanensis* and *O. lanceolata*.

Characters	***O. vanensis***	***O. lanceolata***
Stem	stems numerous, 20–30 cm, unbranched, covered with rigid patent setose and densely short hairs	stems 2–3(-4), 25–50 cm, simple or branched above, setose, long- and shortly pubescent
Cauline leaves	20–90 × 3–10 mm, sesile or lower longly petiolate, oblanceolate, rotund, covered with rigid patent setose on upper surface and midrib beneath and short hair on both surfaces	20–70 × 8–20 mm, sessile or lower very shortly petiolate, broadly lanceolate, acute, covered with both surfaces patent or subadpressed setose, densely short hairy
Inflorescence	1–3 terminal cymes	1–2 terminal cymes
Bracts	10–30 × 3–8 mm, base lanceolate, linear towards to apex	up to 15 mm, linear-lanceolate
Pedicels	2–3 mm long in flower and fruit	very short in flower, elongating to c. 7 mm in fruit
Calyx	8–10 mm in flower, to 12 mm long in fruit	c. 12 mm long in flower, to 15 mm long in fruit
Corolla	golden yellow, 18–20 mm long, patent puberulous	yellow, 15–18 mm long, pubescent
Anthers	slightly longer than filaments	slightly shorter than filaments
Nutlets	3 mm long, shortly beaked, pale grey to light brownish, minutely papilate, ventrally keeled, acuminate	4 mm long, ovoid, acute, brownish, rugulose

Examined representative specimens of related species

Onosma lanceolata. TÜRKİYE. **Van**: Çatak District, border of Çatak and Pervari, the foothills of Mount Kato, steppe, 1486 m a.s.l., 37°54′75″N - 42°57′13″E, 29.06.2019, *M.Fırat 35109* (Herb. M.Fırat!); Bahçesaray District, from Bahçesaray to Krapet Region, Kavuşşahap Mountain, stony steppes, 2300 m a.s.l., 17.06.2019, *M.Fırat 34493* (Herb. M.Fırat!); **Siirt**: Pervari District, from Kato Mountain to Pervari, steppe, 1592 m a.s.l., 37°56′43″N - 42°41′87″E, 29.06.2019, *M.Fırat 35111* (Herb. M.Fırat!); from Ozin to Bahçesaray, steppe, 1592 m a.s.l., 38°00′25″N - 42°43′20″E, 29.06.2019, *M.Fırat 35108* (Herb. M.Fırat!); from Kato mountain to Bêdar Region, steppe, 1318 m a.s.l., 37°57.13′N - 42°39.41′E, 25.05.2019, *M.Fırat 34826* (Herb. M.Fırat!); **Hakkari**: Yüksekova District, Oremar Region, Sat Mountain, stony steppes, 1376 m a.s.l., 37°22′45″N - 44°10′08″E, 07.07.2018, *M.Fırat 34043* (Herb. M.Fırat!).

Figure 3. Habit of *Onosma vanensis* in flowering (A and B) (*M.Fırat 34820*).

Figure 4. Inflorescence of *Onosma vanensis* (A and B) (*M.Fırat 34820*).

Figure 5. *Onosma vanensis*. A: cauline leaves, B: basal leaves (*M.Fırat 34820*).

Palynology

Pollen grains are heteropolar, trisyncolporate and sphaeroide P/E (Polar axis/Equatorial axis) ratio 1.067. The exine ornemantation is scabrate. The term scabrate was used for the exine sculpturing elements smaller than 1 µm. The average means of the number of scabrae in 1 μm^2 ranges from 15-21. The main palynological characters and SEM micrographs of *Onosma vanensis* are presented in (Table 2, Figure 8).

Figure 6. *Onosma vanensis*. A: habit, B: inflorecance, C: cauline leaves (*M.Fırat 34820*); *Onosma lanceolata*. D: habit, E: inflorecance, F: cauline leaves (*M.Fırat 35111*).

Table 2. Morphological parameters of *Onosma vanensis* pollen (µm)

Pollen shape P/E	**P**	**E**	**plg**	**plt**	**clg**	**clt**	**Ex**	**i**	**t**
sphaeroidea 1.067	17.74±0.70	16.62±1.25	4.41±0.28	4.36±0.25	14.90±0.96	4.28±0.23	0.75	0.44	5.70±0.33

P: length of the polar axis, **E**: width of the equatorial axis, **plg**: length of the pores (pori), **plt**: width of the pores (pori), **clg**: length of the colpus (colpi), **clt**: width of the colpus (colpi), **Ex**: exine thickness, **i**: intine thickness, **t**: length of the polar triangular edge.

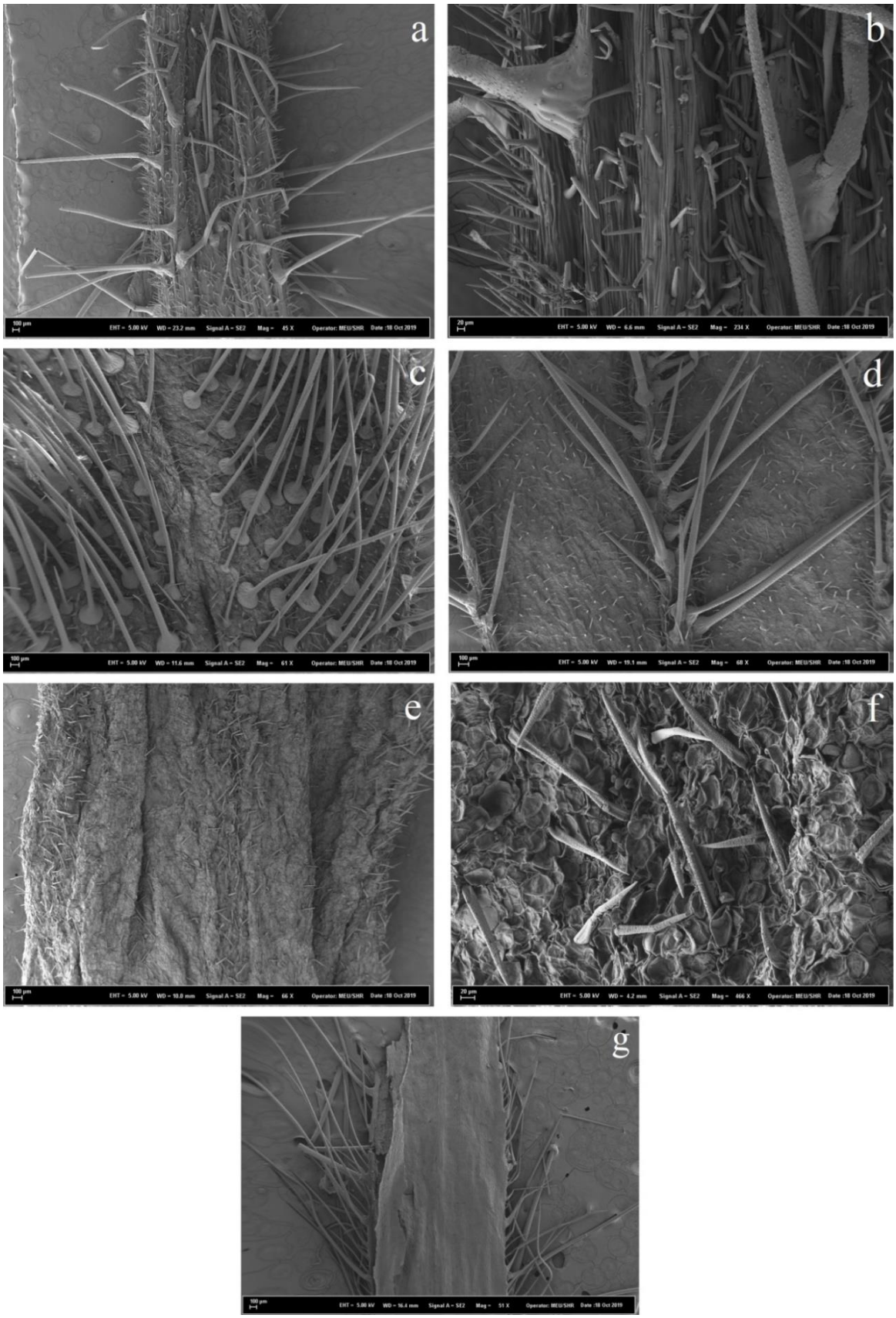

Figure 7. Micrographs of indumentum of *Onosma vanensis*. a-b: stem, c: upper leaf surface, d: lower leaf surface, e-f: corolla surface, g: inner surface of calyx (*M.Fırat 34820*).

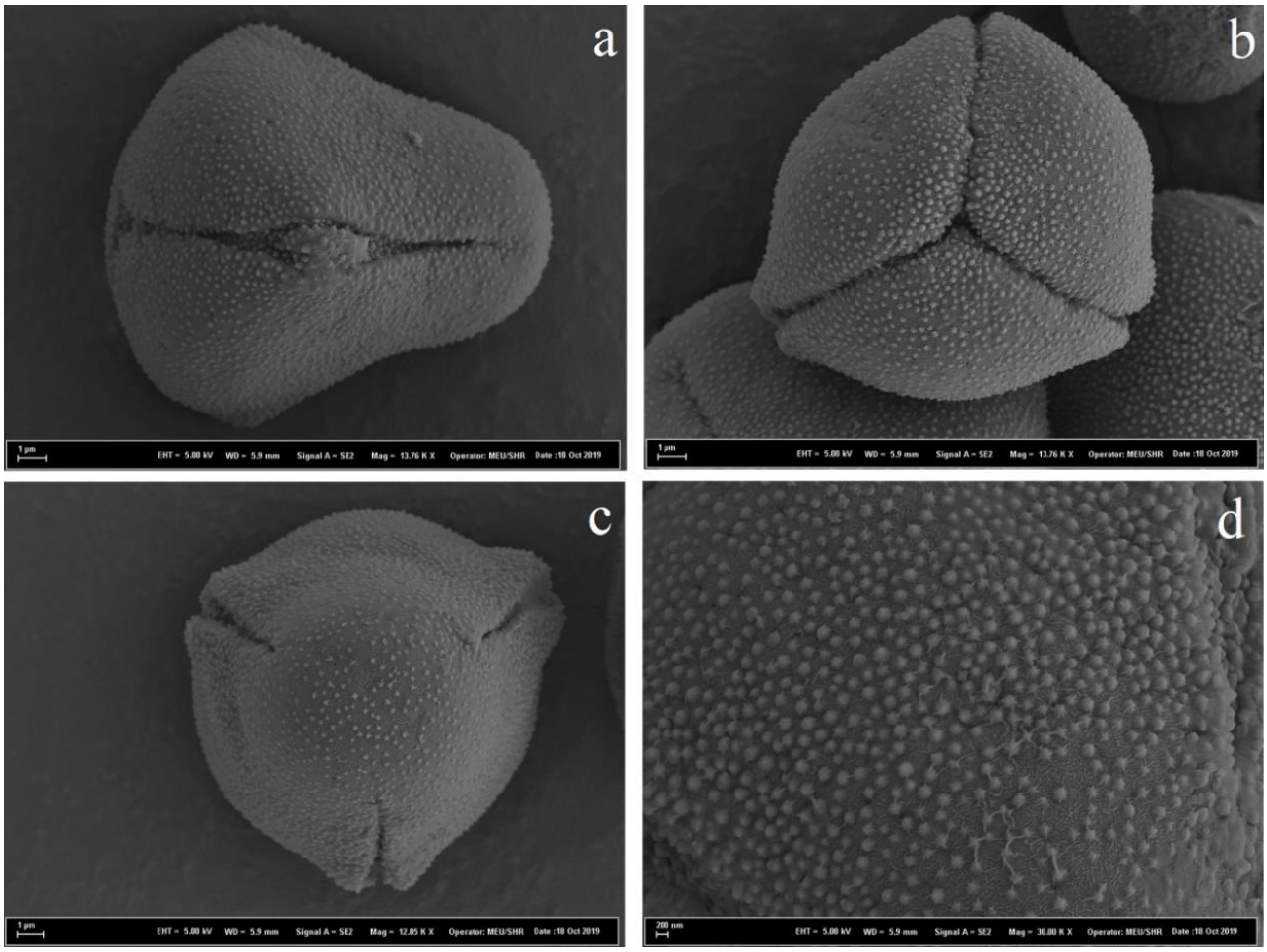

Figure 8. SEM micrographs of *Onosma vanensis* pollen. a: profil view, b: distal view, c: proksimal view, d: ornemantation (*M.Fırat 34820*).

Nutlet morphology

Nutlets 3×2.5 mm, ovoid with minutely beaked, beak to 1.2 mm long, rising on both shoulders narrowly acuminate, ventral keeled, smooth, shiny, pale grey to light brownish, minutely papilate and tuberculate and characterized by its epidermal cells, which have small or fine wrinkles (Figure 9).

Diagnostic Key to *Onosma vanensis* and *O. lanceolata*

- Cauline leaves lanceolate; fruiting calyx to 15 mm; corolla 15–18 mm …..… ***O. lanceolata***
- Cauline leaves oblanceolate; fruiting calyx to 12 mm; corolla 18–20 mm …..… ***O. vanensis***

Discussion

Türkiye exhibits the characteristics of a small continent in terms of biodiversity. The reasons for this include the presence of three different bioclimatic types, three phytogeographic regions Euro-Siberian, Mediterranean, and Irano-Turanian, the variety of topographic, geological, geomorphological, and soil types, the existence of different types of wetlands such as seas, lakes, rivers, fresh, salty, and soda lakes, elevation differences ranging from 0-5000 m, deep canyons, and different ecosystem types, being less affected by the glacial period compared to European countries, the presence of the Anatolian diagonal connecting Northern and Southern Anatolia and the resulting

ecological and floristic differences, and its location at the intersection of three continents (Davis, 1965; Özhatay et al, 2005).

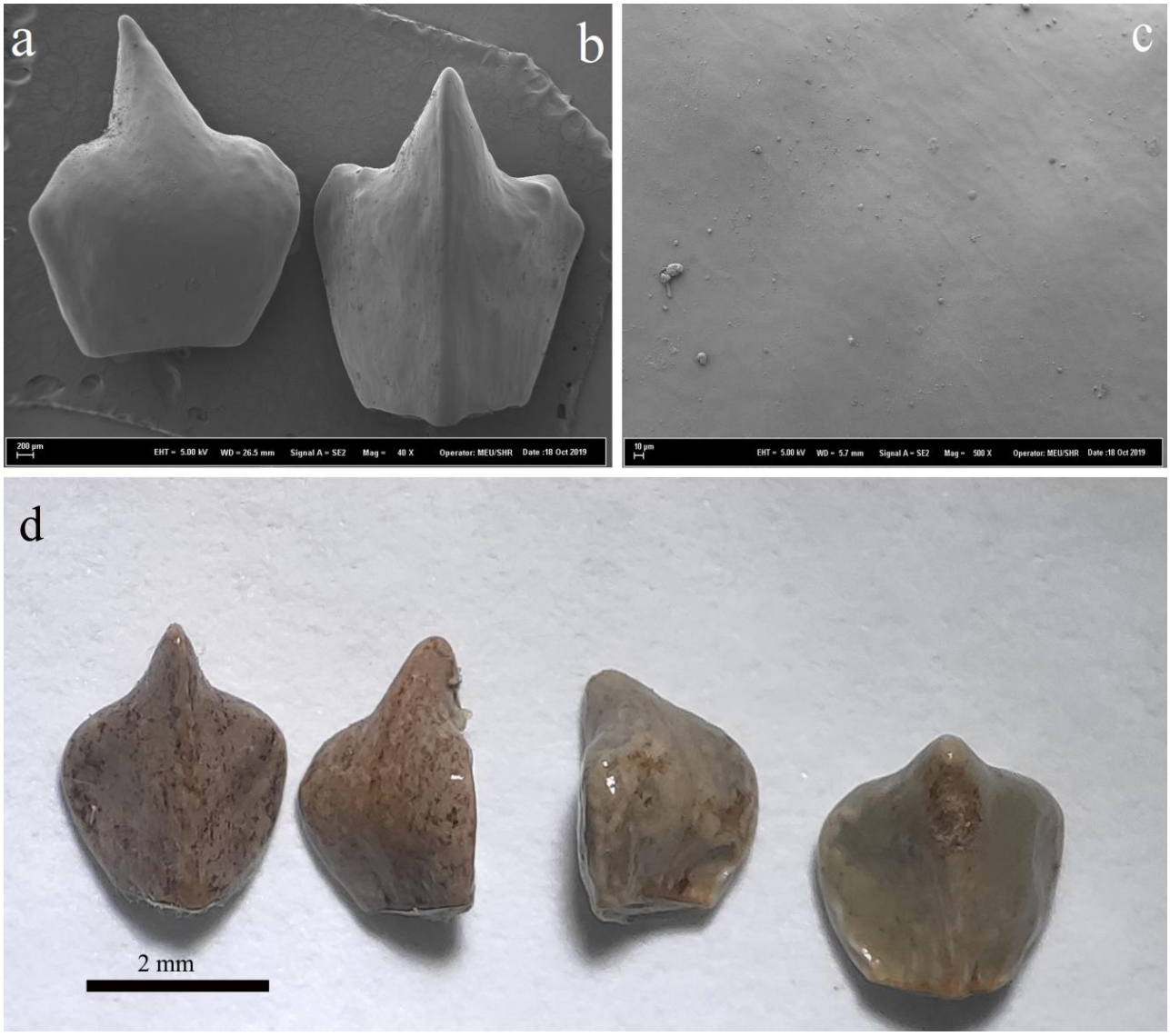

Figure 9. SEM micrographs of *Onosma vanensis*. A: dorsal view, b: ventral view, c: ornemantation, d: LM micrographs of *O. vanensis* dorsal and ventral view (*M.Fırat 35526)*.

Van province, where the *Onosma vanensis* species was collected in this study, is one of the important provinces in terms of both its mathematical position and biological richness. Although the Van Lake area and its valleys are covered with rich vegetation, the surrounding mountains are generally treeless. The province's landscape primarily consists of steppe terrain. Approximately 70% of the land is covered with meadows and pastures, 23% with cultivated and planted areas, and 2% with forests and scrublands.

Onosma genus has the most species in the Boraginaceae family, with approximately 298 species (POWO, 2024). Most taxa of the genus are distributed in SW Asia, Central Asia and the Mediterranean region, in steppes and open habitats (Kolarčik et al., 2015; Binzet 2016a). The genus's diversity centers are Türkiye, Iran and Central Asia (Teppner, 1991; Binzet et al., 2014;

Binzet & Eren, 2018; Binzet et al., 2024). Turkey and Iran host 106 and 72 *Onosma* taxa, respectively (Cecchi et al., 2016, Weigend et al., 2016, Advay et al., 2022, Binzet et al., 2024).

The *Onosma* genus has been divided into three sections in Flora Iranica (Riedl, 1967) and Flora of Türkiye (Riedl, 1978): *Protonosma* Popov., *Podonosma* (Boiss.) Gürke and *Onosma*. While the *Onosma* section is divided into three subsections as *Haplotricha* (Boiss.) Gürke, *Heterotricha* (Boiss.) Gürke and *Asterotricha* (Boiss.) Gürke in the Flora of Iran, it is divided into two subsections as *Haplotricha* and *Asterotricha* in the Flora of Türkiye.

Although *Onosma* taxa are distributed in all regions of Türkiye, they are more common in the Anatolian steppes and the oral-subalpine zones of the Taurus Mountains and in areas where phytogeographic regions intersect. *Onosma vanensis* was collected from the Irano-Turanian phytogeographic region from eastern Anatolia, which is rich in endemic species. *Onosma vanensis* belongs to the *Onosma* sect. *Haplotricha* subsect. Its distribution eastern Anatolian (Çatak dist. / Van prov.), and it grows on stone and rocky slopes. It is an element belonging to the Irano-Turanian phytogeographical region. It shows some affinity to *O. lanceolata* which are placed in the same subsection, and easily distinguished by several distinctive properties: narrow stem leaves, larger bracts, shorter pedicels, calyx and longer corolla. Other differences the three species are listed in Table 1. Both *Onosma vanensis* and *O. lanceolata* taxa are distributed in the Irano-Turanian phytogeographic region and their distribution areas overlap (Figure 1).

Although *Onosma vanensis* was collected from only one locality in Van Province, it is thought that there is a high probability that it will spread in many areas with similar habitats, especially in the Turkish part of the Irano-Turanian phytogeographic region, and also that the species has a high probability of spreading in these countries because its distribution area is very close to Iran, Iraq and Armenia.

AUTHOR CONTRIBUTION STATEMENT

In this study; the study idea and design, data collection, analysis and interpretation of the results, and drafting of the article were done by the authors.

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