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A new species of *Polygonum* sect. *Polygonum* (Polygonaceae) from the southwest of Türkiye

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Abstract: *Polygonum uysalii* (Polygonaceae), a new species from the transition zone between the Mediterranean and Irano-Turanian floristic regions of Türkiye, is described based on morphological and molecular evidence. The new species is similar to *P. ekimianum* and *P. salebrosum* endemic to Türkiye, but it clearly differs by its ovate–broadly elliptic leaf (not linear–lanceolate to narrowly elliptic–suborbicular), 0.9–1.6 mm length pedicel (not 2.1–4.88 mm), dark brown ochrea at base (not pale brown), and trigonous fruit (not weakly trigonous only in upper part or ovate–elliptic). The diagnostic characters and phylogeny of the new species are discussed in terms of taxonomy and illustrations. The conservation status of the new species is also assessed based on field observations.

Key words: Anatolia, nrDNA ITS, molecular phylogeny, *Polygonum ekimianum*, *Polygonum salebrosum*, taxonomy

1. Introduction

The genus *Polygonum* L. (Polygonaceae) consists of approximately 171 species mostly distributed in northern temperate regions (Zika and Jacobson, 2003; Galasso et al., 2009; Chen et al., 2018; Mosafieri et al., 2018; POWO, 2024). Due to unsolved taxonomic problems, the genus *Polygonum* has been a subject of debate among taxonomists for many years. Thus, members of *Polygonum* distributed worldwide are treated as genera, subgenera, or sections in some regional or national flora books (Hong et al., 1998). While some taxonomists have suggested sectional divisions in the genus based on morphological features such as flower structure and leaf characteristics (Meissner, 1857; Danser, 1927; Steward, 1930; Coode and Cullen, 1966), some researchers have advocated for splitting the genus into multiple genera based on various criteria, including palynological, fruit morphology, anatomical features, and molecular evidence (Hedberg, 1946; Haraldson, 1978; Ronse Decraene and Akeroyd, 1988; Ronse Decraene et al., 2000; Hong et al., 2005; Sanchez and Kron, 2008; Mozaffarian, 2012; Ter-Voskanyan, 2013; Hassannejad and Ghafarbi, 2017). We follow the view of splitting *Polygonum* sensu lato into multiple genera such as *Polygonum*, *Persicaria* (L.) Mill., *Fallopia* Adans., *Bistorta* (L.) Scop., and *Aconogonon* (Meisn.) Rchb. in the present paper. However, Coode and Cullen (1966) prepared the

first comprehensive taxonomical account of *Polygonum* in Türkiye contrary to the taxonomic concept recently accepted. Moreover, this view was followed without any taxonomic reevaluation by Keskin (2012) during the preparation of the checklist of Vascular Turkish Plants.

Although the high species diversity of *Polygonum* makes it challenging to establish clear and consistent distinctions between taxa, several new species and records (Keskin, 2009; Gemici and Tan, 2014; Keskin and Severoğlu, 2022; Keskin et al., 2022; Makbul et al., 2023) from Türkiye have been published. Many members of *Polygonum* were also investigated from ethnopharmacological and phytochemical perspectives (Narasimhulu et al., 2014; Kültür et al., 2021; Selvi et al., 2022). They are used as foods, dyes, ornamental plants, and a source of folk medicine to treat various diseases in some countries, including Türkiye (Mazid et al., 2009; Ibadullayeva et al., 2021; Sener et al., 2023).

During revisional field studies on *Polygonum* in Türkiye, the present authors collected interesting *Polygonum* specimens in the flowering stage around Akseki District in Antalya Province, which has very rich plant biodiversity due to its geographical location.

Comparison with the material kept in the herbaria of RUB, KATO, ANK, as well as a review of the literature (Boissier, 1867; Komarov, 1936; Webb and Chater, 1964; Coode and Cullen, 1966; Rechinger and Schiman-Czeika,

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1968; Meikle, 1985; Duran, 2002; Demirelma and Ertuğrul, 2009; Çinbilgel and Gökçeoğlu, 2010; Çinbilgel, 2012), revealed that the new material collected around Akseki represents a hitherto undescribed species. Together with the newly described perennial species, *Polygonum sensu stricto* is represented by 33 species including 14 endemics in Türkiye.

2. Materials and methods

2.1. Morphological study

Morphological observations and illustration were conducted based on living plants in the field and dried specimens in the herbarium of Recep Tayyip Erdoğan University's Department of Biology (RUB). Sufficient specimens including fresh leaves, mature fruits, and polliniferous materials were collected from the new and two closely related specimens, namely *P. ekimianum* and *P. salebrosum*, in the field. Detailed photographs of the leaf, ochrea, inflorescence, and fruit of the new and related species were taken under a stereomicroscope.

A fresh leaf and mature fruits were used for scanning electron microscopic (SEM) observations. In the SEM studies, the leaf and fruits were transferred to aluminum stubs, coated with gold for 4 min in a sputter coater, and examined with an SEM (JSM-6510LV) at the Central Research Laboratories of Recep Tayyip Erdoğan University. In the SEM micrographs, two different magnifications for the leaf and three for the fruits were defined to observe the detailed features of the surfaces. The descriptive terminology for the leaf follows the guidelines provided by Raei Niaki et al. (2019) and that for the fruit follows the guidelines provided by Barthlott (1981), Coşkunçelebi et al. (2000), and Yurtseva (2001).

Pollen grains were prepared for light microscopy (Olympus BX51) according to Erdtman's (1952) acetolysis technique. The measurements of pollen dimensions are based on approximately 30 pollen grains. For SEM studies, dried pollen grains were transferred on aluminum stubs and coated with gold for 4 min in a sputter coater. The observations were conducted in a JEOL JSM-6510LV SEM at the Central Research Laboratories of Recep Tayyip Erdoğan University. For pollen terminology, mainly Punt et al. (2007) were followed.

2.2. Conservation study

The threat category was assessed according to the Red List criteria of the IUCN (2022) using the number of mature individuals and field observations for the D criteria. Area of occupancy (AOO) (km²) was determined using GeoCAT (Bachman et al., 2011).

2.3. Phylogenetic study

The genomic DNA of the new species was extracted from herbarium material stored at RUB following the modified

extraction procedure described by Doyle and Doyle (1987). Amplification and sequencing of nrDNA ITS regions were carried out according to Gültepe et al. (2010). The accessions used in our study were obtained from GenBank and follow the work by Makbul et al. (2023), who referenced the source as Yurtseva et al. (2019). Phylogenetic analyses were performed using the ITS dataset, which consists of 103 accessions, 22 of which belong to *Polygonum* and are newly generated sequences. Phylogenetic relationships were reconstructed using maximum parsimony (MP), maximum likelihood (ML), and Bayesian inference (BI). Sequence alignment and phylogenetic analyses were performed as described by Makbul et al. (2023).

3. Results

3.1. Taxonomy

P. uysalii S.Makbul, Coskunç. & S.Kundakçi, sp. nov. (Figures 1–2).

Type: Türkiye. C3 Antalya, Akseki, between Yarpuz and Karakışla, 1250 m, 03 November 2022, Makbul and Kundakçi 700 (holotype: RUB; isotypes: KTUB, RUB, ANK, KATO).

Diagnosis

The new species is similar to *P. ekimianum* and *P. salebrosum* endemic to Türkiye, but it clearly differs by its ovate–broadly elliptic leaf (not linear–lanceolate to narrowly elliptic–suborbicular), 0.9–1.6 mm length pedicel (not 2.1–4.88 mm), dark brown ochrea at base (not pale brown), and trigonous fruit (not weakly trigonous only in upper part or ovate–elliptic) (Figure 3).

Description

Perennial, suffrutescent with hard woody stocks at base. Stem prostrate, numerous, 9–42 (–51) cm long, simple or branched at base, glabrous, white striate, green to grayish; internodes 1.3–16.1 mm long. Leaf 2.9–16.7 × 1.5–2.4 mm, ovate–broadly elliptic, sessile or shortly petiolate, with undulate or subrevolute margin, acute or obtuse at apex, adaxial surface of leaf prominently veined. Ochrea 2.1–6.2 (–7) mm length, tubular, dark brown at base, membranous from upper, lobe lacinate, 14–17 veined. Inflorescence racemose. Flowers axillary, 5–6 at each node. Pedicels 0.9–1.6 mm length, unequal, surrounded by ochrea. Perianth is campanulate, tepals (in young plants) white–pinkish, whereas tepals are purplish in mature plants. Bracts are similar to and much smaller than stem leaf. Tepals 5, 2.3–3.9 (–4.1) × 1.04–1.9 mm, oblong, obtuse at tip. Stamens 8, 0.4–1.2 mm, filaments dilated at base; anthers yellow, 0.30–0.39 mm, ovary ovate, 0.8–1 mm, styles 3, 0.20–0.23 mm, stigma capitate, 0.06–0.08 mm. Nuts trigonous, 2.04–3.54 × 1.08–1.45 mm, brown, shining, glabrous, exerted in the persistent perianth.

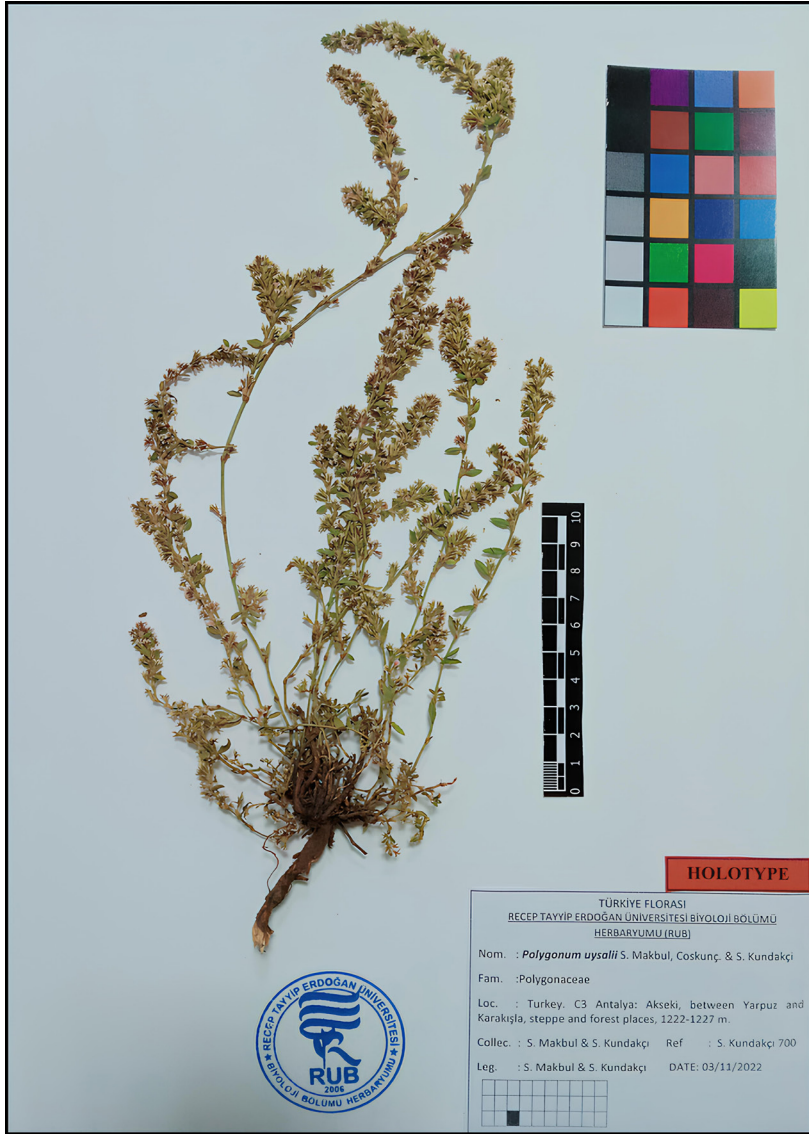


Figure 1. *Polygonum uysalii* sp. nov. Holotype (Makbul & S. Kundakçı 700).



Figure 2. *Polygonum uysalii* sp. nov. a: Young individual with white-pinkish tepals, b: Mature individual with purplish tepals.

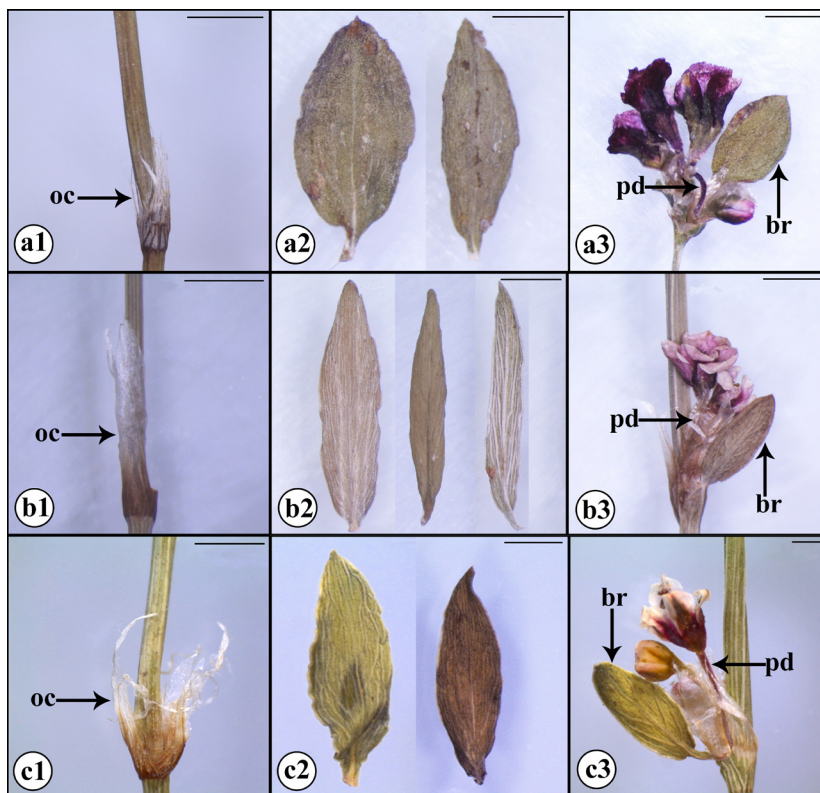


Figure 3. *Polygonum uysalii* (Makbul & S. Kundakçı 700); a1: ochrea, a2: leaf, a3: bract and pedicel. *Polygonum ekimianum* (Makbul & S. Kundakçı 211); b1: ochrea, b2: leaf, b3: bract and pedicel, *Polygonum salebrosum* (Makbul & S. Kundakçı); c1: ochrea, c2: leaf, c3: bract and pedicel (scale bar: 2 mm).

Phenology: Flowering in August and September, fruiting in September–November.

Eponymy and suggested Turkish name

This new species is named in honor of Süleyman Uysal, a primary school teacher and a photographer interested in wild flowering plants in Antalya. Since the general vernacular name of the *Polygonum* members in Türkiye is “madımak” (Güner, 2012), the vernacular name of *P. uysalii* was proposed as “Akseki madımağı” according to guidelines published by Menemen et al. (2016).

Habitat and ecology

Polygonum uysalii grows in various habitats such as steppes and open places under *Cedrus libani* A.Rich together with *Carthamus dentatus* Vahl., *Echium plantagineum* L., *Equisetum ramosissimum* Desf., *Pilosella* × *maschukensis* (Litw. et Zahn) Sojak, *Potentilla anserina* L., *Sanguisorba minor* Bertol., *Scolymus hispanicus* L., and *Thymus sipyleus* Boiss.

Distribution: Endemic to the transition zone between the Mediterranean and Irano-Turanian phytogeographic regions of Türkiye (Figure 4).

Key to *Polygonum uysalii* and closely related perennial taxa distributed in Türkiye

1. Number of flowers in fascicle 1–2 (–3).....2
 - Number of flowers in fascicle 5–6.....4
2. Stem 7–35 cm long; leaf overlapping at the base; tepals ca. 2 mm long*P. salebrosum*
 - Stem 40–88 cm long; leaf not overlapping at the base; tepals 2–4 mm long3
3. Mature tepals pinkish-white; ochrea 10–18 nerved, divided near the base; fruit broadly ovoid *P. samsunicum*
 - Mature tepals white; ochrea 21–27 nerved, divided near the apex; fruit ovate–narrowly ovate
..... *P. terzioglu*
4. Leaf linear–lanceolate to narrowly elliptic and flat margin; ochrea not nerved; perianth 3.5–4.5 mm
..... *P. ekimianum*
 - Leaf ovate to broadly elliptic or narrowly lanceolate and undulate or subrevolute margin; ochrea 14–17 nerved; perianth 1.70–2.75 mm *P. uysalii*

Distribution and conservation status

Polygonum uysalii is endemic to Türkiye. It is only recorded from steppes and open places between the villages of

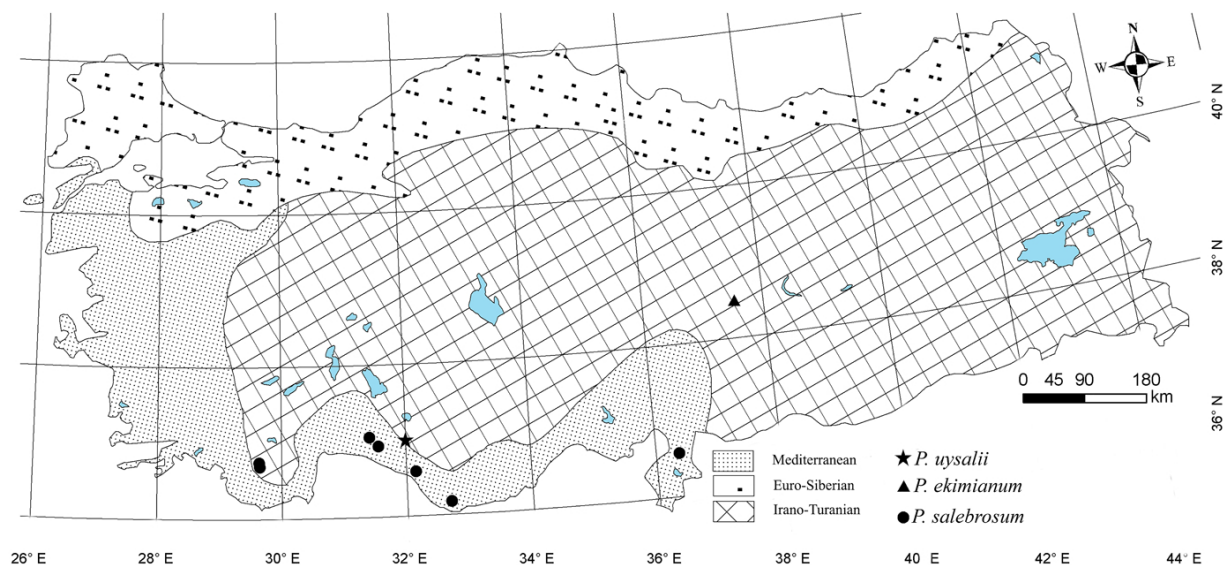


Figure 4. Distribution map of *Polygonum uysalii*, *P. ekimianum*, and *P. salebrosum* according to the floristic region of Türkiye (Avcı, 1993).

Yarpuz and Karakışla in Akseki District, Antalya (Figure 4). The AOO calculated is approximately 3.2 km². Since the new species is only known from two close populations and less than totaly 250 mature individuals, it should be regarded as “EN” according to the D criterion of the IUCN (2022). Additionally, the two very close populations of *Polygonum uysalii* are under threat due to grazing, road construction, and forest fires.

Other specimens examined

Polygonum ekimianum: C6 Kahramanmaraş: Mount Ahır, around Karagöl, 1500–1600 m, 19 Oct. 1990, Z. Aytaç 3411 & H. Duman (ANK; GAZI; HUB); Mount Ahır, around Karagöl, 1590 m, 17 Sep 2020, Makbul & Kundakçı 211 (RUB).

Polygonum salebrosum: C1 Muğla: Mount Girdev, 2200 m, 02 Sep 2019, Makbul & Kundakçı 92 (RUB); around Lake Girdev, 1740 m, 02 Sep 2019, Makbul & Kundakçı 95 (RUB); C4 Antalya: Mount Geyik, 2000 m, P. H. Davis (ANK 14662, G 250310); Gazipaşa, Çobanlarköyü Plateau to Oyuklu Plateau, 1900 m, 11 Jul 1983, H. Sümbül 2233 (HUB 04653); near Alanya, Bairarsuk, near Mount Geyik, 2000 m, 01 Sep 1947, P. H. Davis 14662 (ISTE 52233, E); C5 Mersin: Anamur, Olucak Plateau, 2000 m, 18 Aug 1949, P. H. Davis (ANK 16290); C6 Hatay: Hatay (Keskin and Severoğlu, 2023).

3.2. Micromorphological properties of the leaf and fruit

Adaxial leaf surface is smooth; epidermal cells are more or less rectangular to quadrangular with undulate anticlinal walls (Figure 5a1). Abaxial leaf surface is smooth; epidermal cells have puzzle piece-shaped to rectangular outlines with mostly indistinct boundaries or undulate

anticlinal walls (Figure 5a2). Fruit trigonous, apex acute, base cuneate; fruit surface is smooth or with very few (rare) tubercles (Figure 6a 1-3).

3.3. Palynology

Pollen grains of *Polygonum uysalii* are isopolar, radially symmetric, tricolporate, and with scabrate-foveolate ornamentation (Figure 7a 1-4). The polar and equatorial axes are 22.95–28.95 and 20.33–24.66 µm in length, respectively. The pollen is subprolate (P/E: 1.16).

3.4. Molecular phylogeny

The optimal model was generalized time reversible (GTR) under the Akaike Information Criterion (AIC) for the nrDNA ITS dataset. The aligned matrix had 647 characters, of which 219 were parsimony informative. The MP analysis resulted in 1 most parsimonious tree (L = 1208, CI = 0.5224, RI = 0.8375, RC = 0.4375, HI = 0.4776). The ML, MP, and BI analyses revealed almost identical tree topology. Several members of the tribe Polygoneae, namely *Atraphaxis* L., *Bactria* Yurtseva & Mavrodiev, *Duma* T.M.Schuster, *Duravia* (S.Watson) Greene, *Fallopia*, *Knorringia* (Czukavina) Tzvelev, *Muehlenbeckia* Meisn., *Persepolium* Yurtseva & Mavrodiev, *Polygonella* Michx., and *Reynoutria* Hoult. were selected as distant outgroups to provide more robust phylogeny in the phylogenetic analyses. In *Polygonum* s.str, the members of the sections (sect. *Plebejia* Tzvelev, sect. *Pseudomollia* Boissier, and sect. *Tephis* (Adanson)) are more closely related to sect. *Polygonum* Meissn. selected as in-group taxa. The ML tree obtained from the matrix and BI, ML, and jackknife values are shown in Figure 8. As seen in Figure 8, members of

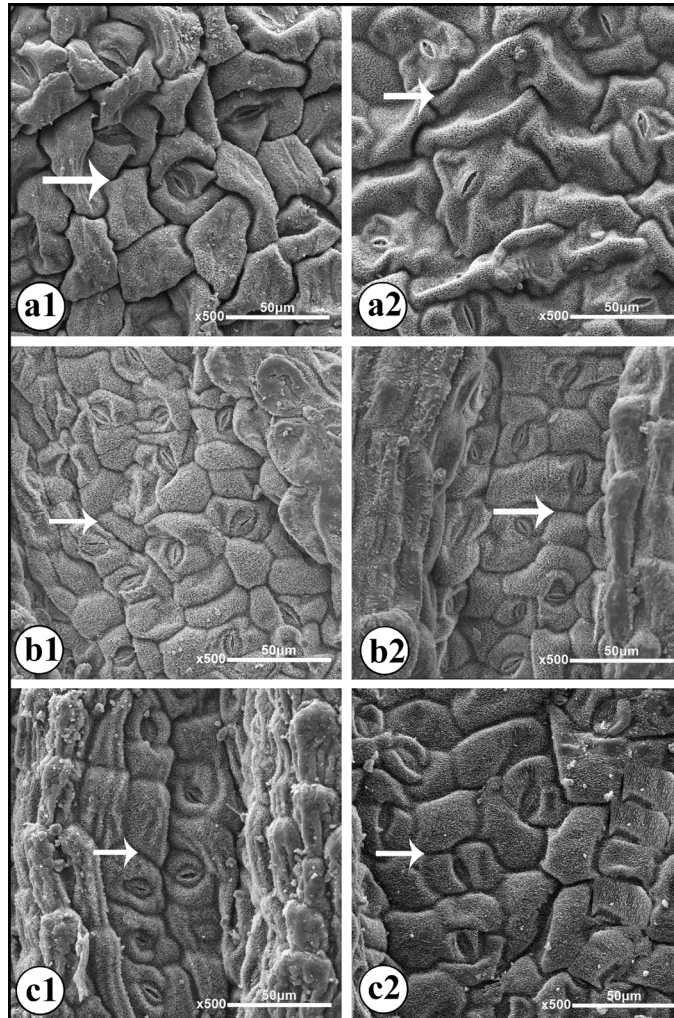


Figure 5. Scanning electron micrographs of adaxial (a1–c1) and abaxial (a2–c2) leaf surface. *Polygonum uysalii* (Makbul & S. Kundakçı 700), (a1–a2); *Polygonum ekimianum* (Makbul & S. Kundakçı 211), (b1–b2); *Polygonum salebrosum* (Makbul & S. Kundakçı 92) (c1–c2).

Polygonum s.str. are resolving as a monophyletic group and composed of two subclades with strong support values (BS = 96, JK = 96, and PP = 1.0). The newly described species, *Polygonum uysalii*, is situated in a subclade corresponding to the sect. *Polygonum* with strong support (BS = 100, JK = 100, PP = 1.0). *Polygonum uysalii* formed a separate branch and was distinct from *P. ekimianum* in this section.

4. Discussion

Polygonum uysalii belongs to a natural group consisting of subshrubs and perennial herbaceous plants. According to Makbul et al. (2023), this group is represented by 18 taxa excluding the new species described herein. The new species is closely related to *P. ekimianum* and *P. salebrosum*, which are perennial subshrubs distributed in Türkiye. According to Costea and Tardif (2003), the leaves

of *Polygonum* exhibit considerable variation in shape. *P. uysalii* is characterized by ovate–broadly elliptic leaves with undulate or subrevolute margins and ovate–broadly elliptic bracts (Figure 3a2–3); however, *P. ekimianum* is characterized by narrowly elliptic, or linear–lanceolate leaves with entire margins, and narrowly elliptic or lanceolate bracts (Table, Figure 3b2–3). *P. salebrosum* is characterized by elliptic to suborbicular leaves and elliptic to suborbicular bracts (Table, Figure 3c2–3). Perianth color is also an important character that varies within members of *Polygonum* depending on the maturity of the plant (Komarov, 1936; Webb and Chater, 1964). It has been reported that young flowers are white and mature flowers are various shades of pink (Coode and Cullen, 1966; Yıldırım and Leblebici, 1989; Leblebici et al., 1993; Gemici and Tan, 2014). While *Polygonum uysalii* is characterized

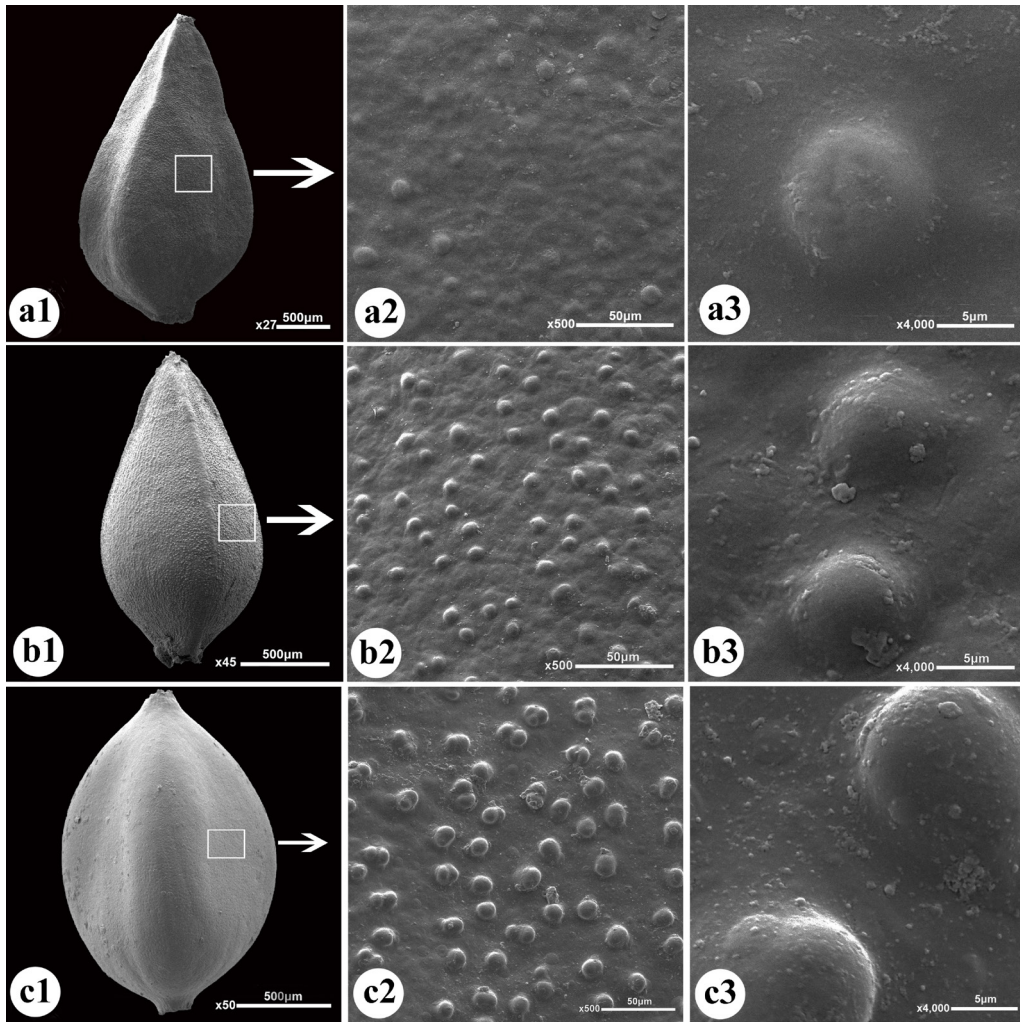


Figure 6. Scanning electron micrographs of fruit. a1–a3: *Polygonum uysalii* (Makbul & S. Kundakçı 700); b1–b3: *Polygonum ekimianum* (Makbul & S. Kundakçı 211); c1–c3: *Polygonum salebrosum* (Makbul & S. Kundakçı 92).

by perianth color white-pinkish in young plants and purplish in mature ones, *P. ekimianum* is characterized by perianth color white or pale pink in young and mature plants and *P. salebrosum* is characterized by perianth color whitish in young and mature plants (Table). Pedicel length is useful in delimitation of members of *Polygonum* (Komarov, 1936). *Polygonum uysalii* is characterized by 0.9–1.6 mm length pedicels (Figure 3a3), differing from *P. ekimianum*, which has 2–2.4 mm length pedicels (Figure 3b3). *P. salebrosum* is characterized by 2.1–4.8 mm length pedicels (Figure 3c3).

Polygonum uysalii is distributed in transition zones between the Mediterranean and Irano-Turanian floristic regions (Figure 4), while *P. ekimianum* is distributed in the Irano-Turanian region (Leblebici et al., 1993) and *P. salebrosum* is distributed in the Mediterranean region (Coode and Cullen, 1966). However, *Polygonum uysalii*

prefers open, steppe, and forest places at altitudes of ca. 1200 m in Southwest Anatolia, while *P. ekimianum* grows on high mountain steppes at altitudes of ca. 1650 m and *P. salebrosum* grows on rocky slopes at altitudes between 2000 and 2200 m (Coode and Cullen, 1966). The flowering and fruiting periods of *Polygonum uysalii* are September, October, and November, while those of *P. ekimianum* are September and October and those of *P. salebrosum* are August and September (Coode and Cullen, 1966; Leblebici et al., 1993).

It has been reported that the micromorphological properties of the leaf are taxonomically more useful than external leaf traits (Song et al., 2020). It is also reported that the microstructure of the leaf supplies valuable and informative set of traits for discriminating *Polygonum* taxa (Hong and Oh, 1999). Hong and Oh (1999) also stated that the shape of the epidermal cells and anticlinal

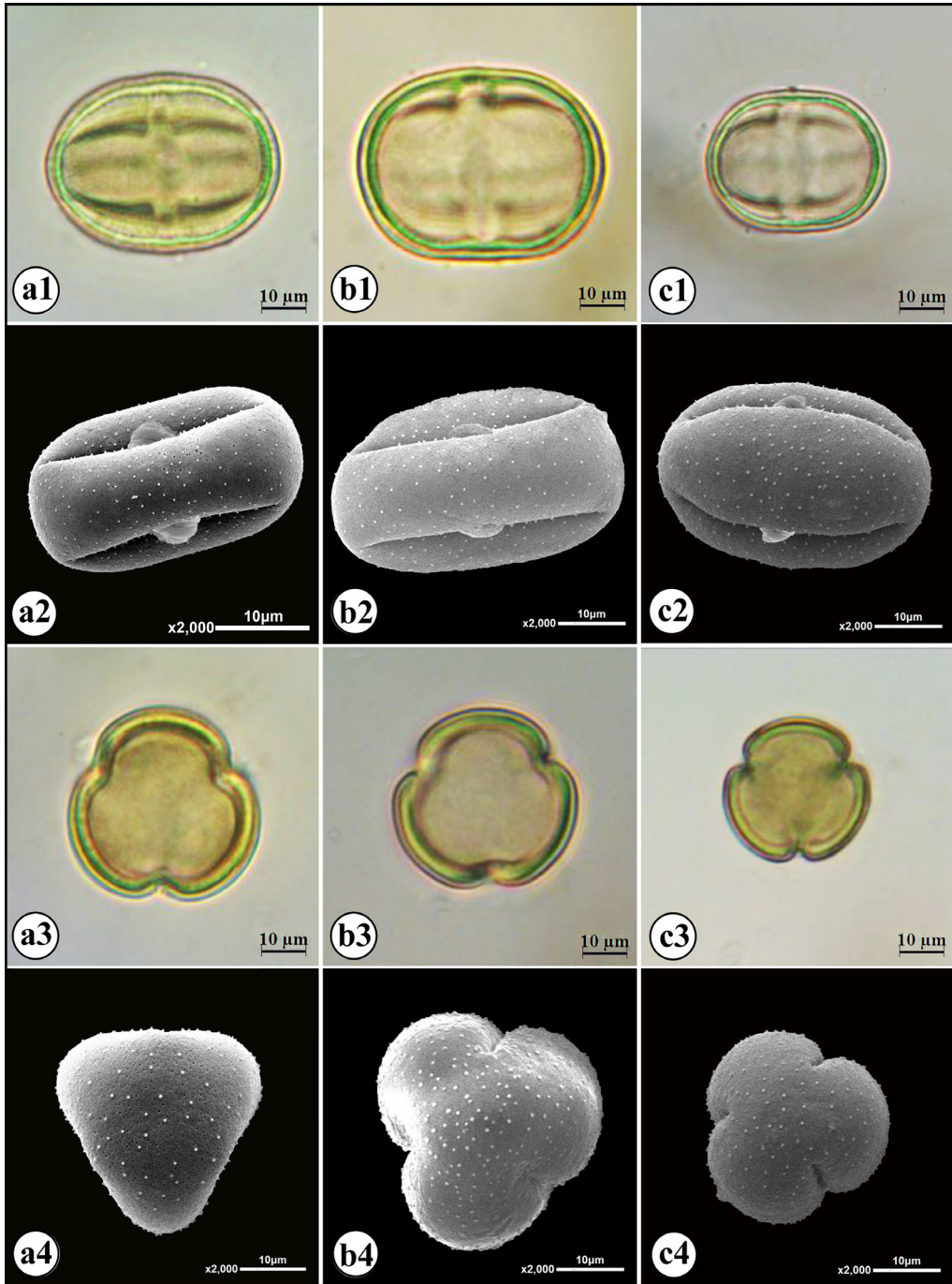


Figure 7. Light (a1, b1, c1, a3, b3, c3) and scanning electron micrographs (a2, b2, c2, a4, b4, c4) of pollen grains. a1–a4: *Polygonum uysalii* (Makbul & S. Kundakçı 700); b1–b4: *Polygonum ekimianum* (Makbul & S. Kundakçı 211); c1–c4: *Polygonum salebrosum* (Makbul & S. Kundakçı 92). Equatorial view (a1, b1, c1, a3, b3, c3) and polar view (a2, b2, c2, a4, b4, c4).

walls varies among *Polygonum* taxa. The present paper shows that the epidermal cells of the leaf's adaxial surface belonging to the new species are more or less rectangular to quadrangular with undulate anticlinal walls (Figure 5a1); however, they are quadrangular with straight walls

in *P. ekimianum* (Figure 5b1) and rectangular with straight walls in *P. salebrosum* (Figure 5c1). Moreover, *P. uysalii* is characterized by a smooth and wavy abaxial leaf surface and puzzle piece-shaped to rectangular epidermal cells with mostly indistinct boundaries (Figure 5b1) and thus

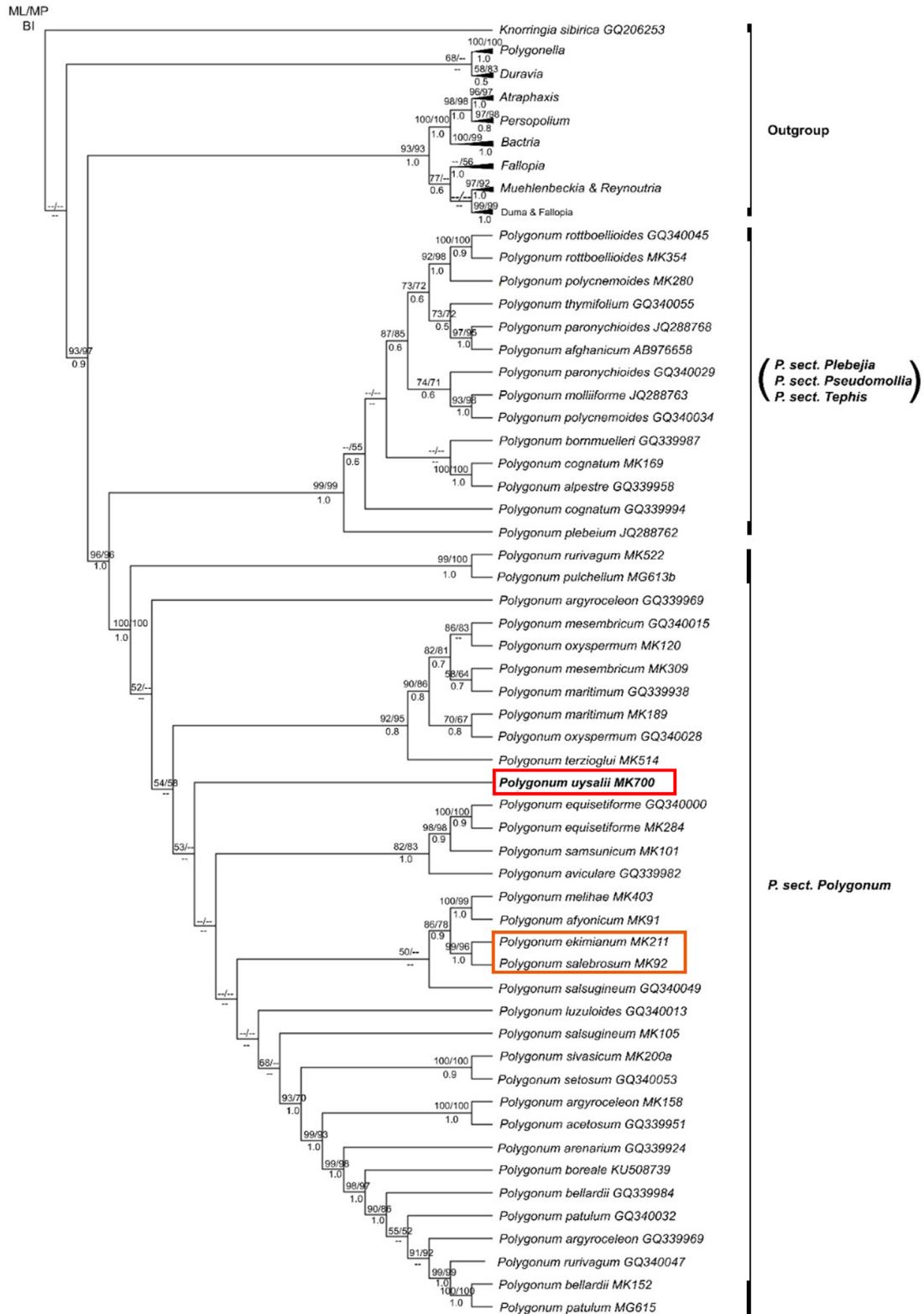


Figure 8. Majority-rule consensus cladogram of *Polygonum* from the ML analysis based on the nrDNA ITS dataset (support values: first-line ML bootstrap and JK jackknife, second-line pp posterior probability). Clade names are in accordance with those taken from Yurtseva et al. (2019), and *Atraphaxis*, *Bactria*, *Duma*, *Duravia*, *Fallopia*, *Muehlenbeckia*, *Persepolium*, and *Polygonella* are indicated by a thick black bar.

Table. Morphological comparison of *Polygonum uysalii* and related species. (*: Present study).

Plant part	<i>Polygonum uysalii</i>	<i>Polygonum ekimianum</i> (Leblebici et al., 1993)	<i>Polygonum salebrosum</i> (Coode and Cullen, 1966)
Stem length	9–42 (–51) cm	4–15 cm	10–20 cm
Stem branches	robust	thin	thin
Leaf shape	ovate–broadly elliptic	linear–lanceolate to narrowly elliptic	elliptic to suborbicular
Leaf margin	undulate or subrevolute margin	flat	deeply undulate
Leaf apex	acute or obtuse	acute	acute
Adaxial leaf surface anticlinal walls*	undulate	straight	straight
Abaxial leaf surface*	wavy	smooth	smooth
Abaxial leaf surface epidermal cell border*	indistinct	distinct	distinct
Abaxial leaf surface epidermal cell shape*	puzzle piece-shaped to rectangular	quadrangular	quadrangular
Ochrea base color	dark brown	pale brown	pale brown
Bract	ovate–broadly elliptic	narrowly elliptic, or linear–lanceolate	elliptic to suborbicular
Perianth color	base green or dark purplish, margin white-pink or purplish	base dull red, margin white or pale pink	whitish
Perianth length	1.70–2.75 mm	3.5–4.5 mm	ca. 2 mm
Pedicel length	0.9–1.6 mm	2.2–4 mm	2.11–4.88 mm
Fruit outline shape	trigonous	weakly trigonous in upper part	Ovate–elliptic
Fruit surface*	very few (rare) tubercles	densely tubercles (verrucate)	densely tubercles (verrucate)
Pollen shape*	subprolate	subprolate	spheroidal
Polar axis (µm)*	22.95–28.95	19.3–24.27	18.51–20.73 (–21.66)
Equatorial axis (µm)*	20.33–24.66	15.2–19.21	15.6–20.38
P/E ratio*	1.16	1.20	1.07
Pollen ornamentation*	scabrate–foveolate	scabrate–psilate	scabrate–psilate
Habitat	open steppe and forest places	high mountain steppe	rocky slopes
Phenology	flowering: September–October, fruiting: November	flowering: September, fruiting: October	flowering: August, fruiting: September

differs from *P. ekimianum* (Figure 5b2) and *P. salebrosum* (Figure 5c2), which have smooth leaf surfaces and quadrangular epidermal cells with distinct and straight anticlinal walls on the abaxial leaf surface (Table).

Fruit morphological characters (outline shape, size, and surface ornamentation) are useful in delimiting members of Polygonaceae at the tribal and generic level (Ronse Decraene et al., 2000; Yurtseva, 2001; Ayodele and Zhou, 2010). The new species is characterized by trigonous fruit (Figure 6a1); however, the fruit shape is weakly trigonous in the upper part (Figure 6b1) in *P. ekimianum* and it is ovate–elliptic (Figure 6c1) in *P. salebrosum*. Additionally, the fruit surface of *P. uysalii* is smooth or with very few (rare) tubercles (Figures 6a2–6a3). It is smooth with very dense tubercles (verrucate) in *P. ekimianum* (Figures 6b2–6b3) and *P. salebrosum* (Figures 6c2–6c3).

Pollen morphology is very useful in the classification of the genus *Polygonum* (Hong et al., 2005; Yasmin et al., 2010). In particular, the exine sculpture of *Polygonum* taxa provides valuable contributions to the taxonomy of the genus (Hedberg, 1946; Hong et al., 2005). Hong et al. (2005) determined that *Polygonum* taxa have three types of exine sculpture: *Avicularia*-type, *Duravia*-type, and *Pseudomollia*-type. *Avicularia*-type pollen grains are characterized by foveolate, psilate, scabrate, small puncta, and microspinulate sculpture (Hedberg, 1946; Hong et al., 2005). Our findings showed that *P. uysalii*, *P. ekimianum*, and *P. salebrosum* share *Avicularia*-type pollen. While *Polygonum uysalii* and *P. ekimianum* are characterized by subprolate pollen, *P. salebrosum* is characterized by spheroidal pollen grains. The new species is characterized by scabrate–foveolate

exine sculpture (Figures 7a1–7a4) and thus differs from *P. ekimianum* (Figures 7b1–7b4) and *P. salebrosum* (Figures 7c1–7c4) having scabrate–psilate exine sculpture (Table). The length of the polar axes is 19.3 to 24.27 µm for *P. ekimianum* and 18.51 to 20.73 (-21.66) for *P. salebrosum*; the length of the equatorial axes is 15.2 to 19.21 µm for *P. ekimianum* and 15.6 to 20.38 for *P. salebrosum*. However, the length of the polar and equatorial axes of *P. uysalii* is 22.95 to 28.95 µm and 20.33 to 24.66 µm, respectively. Başer et al. (2022) and Keskin et al. (2021, 2022) reported that *Polygonum* taxa are characterized by 3-colpate, 3-colporate, pantoporate, oblate–spheroidal, prolate, and prolate–spheroidal pollen, and exine surfaces are microechinate–perforate and reticulate. The present observations revealed that *P. uysalii*, *P. ekimianum*, and *P. salebrosum* share the subprolate and spheroidal pollen shape and 3-colporate pollen type.

Phylogenetic analysis based on nuclear and plastid DNA gene regions shows poor resolution due to the high species variation of the genus *Polygonum* (Galasso et al., 2009; Sanchez et al., 2011; Tavakkoli et al., 2015; Yurtseva et al., 2016). The present phylogenetic analyses based on ITS sequences data are given in Figure 8. As seen in Figure 8, even if there is no support and most of some taxa collapse after cutting the 50% threshold resulting in a polytomy, there are distinct clades in the tree. The phylogenetic analyses in the present study show that *Polygonum uysalii*

is a distinct species and clearly differs from *P. ekimianum* and *P. salebrosum*, despite the morphological similarity (Figure 8). *P. uysalii* is linked externally to a group of species made up of *Polygonum aviculare*, *P. equisetiforme*, and *P. samsunicum* Yıldırım & Leblebici in the constructed ITS tree (Figure 8). However, the newly described species displays morphological characteristics quite different from those of *P. aviculare*, *P. equisetiforme*, and *P. samsunicum* (Coode and Cullen, 1966; Yıldırım and Leblebici, 1989). *Polygonum uysalii* differs from *P. aviculare* by being perennial and a subshrub and having prostrate stems and ovate–elliptic leaves. *P. equisetiforme* has ascending or erect stems and linear to lanceolate leaves, while *P. samsunicum* has an elliptic, oblong–elliptic, lanceolate to linear leaf shape. According to the phylogenetic results, the newly described species appeared in the *P.* sect. *Polygonum*. Despite the poorly established relationships among the *Polygonum* species because of ancient reticulation events and rapid radiation (Yurtseva et al., 2019; Makbul et al., 2023), *P. uysalii* is a distinct species.

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