

A new species of *Gagea* sect. *Plecostigma* (Liliaceae) from Uzbekistan

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Abstract

The genus *Gagea* represents one of the most species-rich groups of monocotyledonous plants in Central Asia and continues to yield new taxa through integrative taxonomic studies. During investigations of herbarium collections and field surveys in Uzbekistan, a previously undescribed species belonging to *Gagea* sect. *Plecostigma* was discovered. Here, we describe and illustrate *Gagea kuljuktaiensis* Levichev based on morphological observations and molecular phylogenetic evidence derived from nuclear ribosomal ITS sequences. The new species is characterized by two filiform basal leaves exceeding the inflorescence, pubescent stems 10–25 cm tall, 2–3-flowered inflorescences, and bright yellow perianth segments with violet apices. It differs from its closest relatives, *G. afghanica* and *G. olgae*, by a unique combination of vegetative and reproductive characters, including leaf number, stem indumentum, flower morphology, and fruit size. Phylogenetic analyses based on ITS sequences placed the new species within *Gagea* sect. *Plecostigma* and recovered it as the sister taxon of *G. afghanica* with moderate bootstrap support. *Gagea kuljuktaiensis* is currently known from four localities in Uzbekistan, including the Kuljuktai Mountains in the southwestern Kyzylkum Desert and several sites in the western

Pamir-Alay. The species inhabits dry stony slopes, foothills, and low mountain habitats at elevations of 470–1300 m a.s.l. The discovery of this species highlights the importance of integrating morphological, anatomical, and molecular evidence for resolving species diversity within *Gagea* and underscores the need for continued taxonomic exploration in the floristically rich regions of Central Asia.

Keywords

Central Asia, *Gagea*, ITS phylogeny, Kuljuktai Mountains, morphology, sect. *Plecostigma*, taxonomy, Western Pamir-Alay

Introduction

The genus *Gagea* Salisb. (Liliaceae) is distributed mainly in the subarctic and temperate regions of Eurasia, extending southwards to North Africa and reaching the subarctic and subalpine zones of North America. According to the latest data, 226 species are currently recognized as valid within the genus (POWO 2025). In Uzbekistan, more than 75 species of *Gagea* have been recorded (Kurbaniyazova and Levichev 2022), making it one of the most diverse genera of monocotyledonous plants in the country.

During the past decade, several taxonomic studies based on morphological and molecular data have led to the description of new *Gagea* taxa and other members of Liliaceae from Central Asia, confirming the region's significance as a center of diversification and endemism (Levichev et al. 2025; Turginov et al. 2025; Yusupov et al. 2025).

In 2019, while examining specimens at the National Herbarium of Uzbekistan (TASH), I.G. Levichev discovered material with morphological characters distinct from all known species of *Gagea*. Subsequent field and molecular investigations confirmed that these plants represent a separate, previously undescribed species, which is formally described and illustrated below as *Gagea kuljuktaiensis* Levichev sp. nov.

Materials and methods

Seven herbarium specimens of the new species gathered from the insular low mountains Kuljuktai in March 2013 and from the western part of the Zarafshan and Hissar ranges in March 2019 were found in the collection of the National Herbarium of Uzbekistan (TASH). In March 2025, additional fieldwork was carried out in the Ziadin-Zirabulak Mountains, where living plants were photographed and new specimens were collected and deposited in TASH. Photographic records were also uploaded to the iNaturalist database (iNaturalist contributors 2025).

Geographic coordinates of species belonging to *Gagea* sect. *Plecostigma* (Turcz.) Pascher (*G. kuljuktaiensis*, *G. afghanica* A. Terracc., *G. olgae* Regel, *G. villosula*

Vved., and *G. vvedenskyi* Grossh.) were compiled on the basis of georeferenced herbarium specimens collected from the territory of Uzbekistan and stored in TASH, and complemented by data from GBIF (Tojibaev et al. 2022; Kurbaniyazova 2024), and iNaturalist (iNaturalist contributors 2025).

Total genomic DNA was extracted from silica gel–dried leaf material using the DNeasy Plant Mini Kit (Qiagen Inc., Hilden, Germany) following the manufacturer's instructions. The nuclear ribosomal ITS region was amplified using universal primers ITS1P (Ridgway et al. 2003) and ITS4 (White et al., 1990). PCR reactions were performed in a total volume of 20 µL containing Thermo Scientific Phire Hot Start II PCR Master Mix (Waltham, Massachusetts, USA) according to the manufacturer's protocol. The thermal cycling profile consisted of an initial denaturation at 98 °C for 1 min, followed by 35 cycles of 98 °C for 15 s, 56 °C for 15 s, 72 °C for 30 s. Amplified products were purified using a commercial PCR purification kit and sequenced bidirectionally via the Sanger method on a SeqStudio ABI 3500 (Thermo Fisher Scientific, USA).

A total of 28 samples were analyzed, including six newly generated ITS sequences and 22 sequences retrieved from GenBank (NCBI). Sequence alignment was performed in MEGA v. 11.0.13 (Tamura et al. 2021) using the ClustalW algorithm with manual adjustments. A maximum likelihood (ML) phylogenetic tree was constructed in RAxML v.8 (Stamatakis 2014) under the GTR+G model with 1000 bootstrap replicates to assess branch support. The resulting topology was visualized and annotated using iTOL v.6 (Letunic and Bork 2021, 2024).

Leaf and stem transverse sections were prepared manually from fresh material collected during fieldwork in 2025 using a razor blade, following the general approach of Levichev (1999). The sections were examined without staining or fixation under an AD365 stereomicroscope. Digital images were captured and processed into composite figures using Adobe Photoshop CS6 (64-bit). Anatomical characters evaluated included the overall shape of the transverse section, the arrangement of vascular bundles, mesophyll organization, and the distribution of supporting tissues. The same anatomical structures were examined in *G. afghanica*, *G. olgae*, and *G. villosula* for comparative purposes. Comparative anatomical data for *G. afghanica*, *G. olgae*, and *G. villosula* are presented in Figures 6–8. Detailed anatomical descriptions and illustrations of these and other *Gagea* species were previously provided by Levichev (1996), who examined transverse sections of leaves and stems in 59 species and three infraspecific taxa. In addition, the anatomy of *G. vvedenskyi* has been described and illustrated in *Historia Gagearum* (Levichev 1999) and *Flora of Pakistan*. Therefore, the present study focuses on documenting the anatomy of the newly described species while providing direct comparisons with its closest relatives.

Results

Taxonomic treatment

Gagea sect. *Plecostigma* (Turcz.) Pascher

Identification key to the species of *Gagea* sect. *Plecostigma* occurring in Uzbekistan

- 1 Basal leaf solitary 2
- Basal leaves two 4
- 2 Bulb enclosed by thickened roots; anthers reddish-violet
..... *G. vvedenskyi*
- Bulb not enclosed by thickened roots; anthers yellow 3
- 3 Flowering stem densely villous; outer perianth segments densely villous;
inflorescence usually 2–10-flowered
..... *G. villosula*
- Flowering stem glabrous or very rarely sparsely pubescent; outer perianth
segments glabrous or very rarely sparsely pubescent; inflorescence usually
3–10-flowered *G. afghanica*
- 4 Flowering stem pubescent, 10–25 cm tall; perianth segments bright yellow,
greenish-yellow on the back with violet apices, weakly pubescent; inflores-
cence usually 2–3-flowered; capsule obovoid-oblong, 6–8 mm long
..... *G. kuljuktauensis*
- Flowering stem glabrous, usually 2–7(10) cm tall; perianth segments gold-
en-yellow, greenish outside with a dirty-violet tint, pubescent; inflores-
cence usually solitary (rarely 2–3-flowered); capsule 6–8 mm long
..... *G. olgae*

Gagea kuljuktauensis Levichev, sp. nov.

Figs 1, 2

Diagnosis. *Gagea kuljuktauensis* is morphologically most similar to *G. afghanica* and *G. olgae*, but differs from the former by having two basal leaves (vs. one in *G. afghanica*), slender pubescent stems 10–25 cm tall (vs. more robust stems 10–30 cm tall), and smaller fruits 6–8 mm long (vs. 8–15 mm). It differs from *G. olgae* by the smaller perianth segments up to 10 mm long (vs. 12–15 mm), weakly pubescent perianth (vs. densely villous), fewer flowers per inflorescence (2–3 vs. 2–10), and narrower basal leaves 0.5 mm wide (vs. 1–1.5 mm). The new species grows in arid and semi-arid uplands and mountains, at elevations of 470–1300 m a. s. l., and inhabits dry stony and rocky slopes, whereas *G. olgae* is widely spread in piedmont plains, foothills and lower mountain belt and occurs on deeper soils. *G. afghanica* grows in the deserts and semi-deserts on sandy, clayey and saline soils.

Type: "Uzbekistan, Navoiy Region, southern slope of the Kuljuktai Mountains, near the biostation, 64°01'28"N, 40°47'50"E, 470 m a. s. l. 20 III 2013. Tojibaev, Shomurodov, Beshko, Batashov" (holo – TASH [TASH00270216]; iso – TASH [TASH00270223, TASH00173155]).



Figure 1. Type specimen (holotype) of *Gagea kuljuktaiensis*.

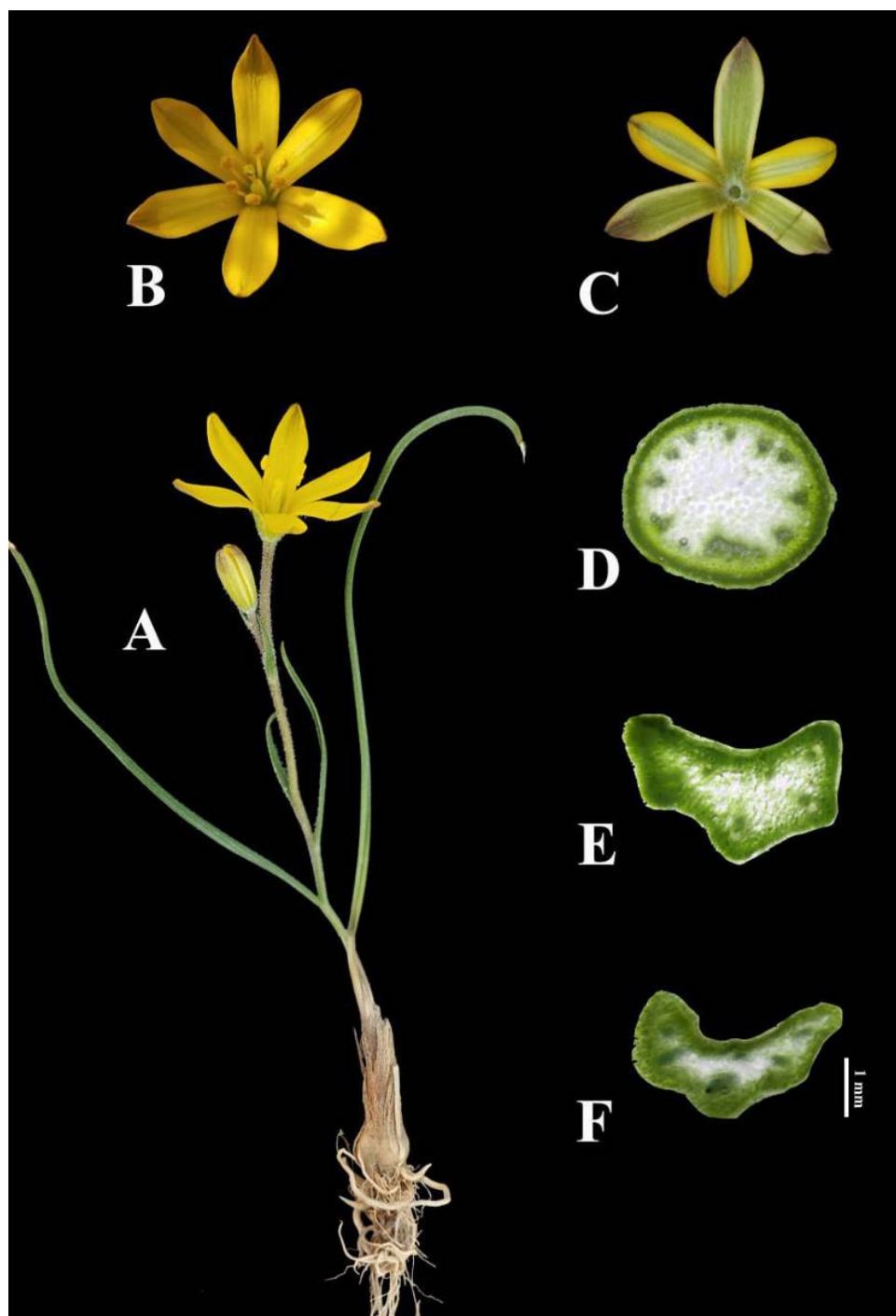


Figure 2. Illustration of *Gagea kuljuktatauensis*. **A** – whole plant, showing stem, leaves, and bulb, **B** – flower, front view, **C** – flower, back view, **D** – cross-sectional view of the flowering stem, **E** – cross-sectional view of the basal leaf, **F** – cross-sectional view of the leaf on the flowering stem.

Paratypes: [Uzbekistan] "Western Pamir-Alay, Ziadin Mountains, along the road, northern slope. 13 III 2019. U. Kodirov, A. Makhmudov, F. Akbarov" (TASH00260990); "Western Pamir-Alay, Zarafshan Range, basin of the Kashkadarya River, Hazrati Bashir village, northern slope, 1080 m a. s. l. 15 III 2019. U. Kodirov, A. Makhmudov, A. Jabbarov" (TASH00270217); "Uzbekistan, Surxondaryo Region, Baysun District, Baysun–Denau road, sulfur-hydrogen soils. 29 III 2019. Turginov, Pulatov, Jabbarov" (TASH00270218); "Uzbekistan, Navoiy Region, Karmana District, rocky soils, 40°02'3205"N, 65°43'7961"E. 13 III 2025. B. Karimov, X. Yuldashev, B. Azimov" (TASH00270219, TASH00270220, TASH00270221, TASH00270222) (Suppl. materials 1–9: Figs S1–S9).

Etymology. The specific epithet *kuljuktatauensis* refers to the Kuljuktatau Mountains in the Navoiy Region of Uzbekistan, where the type specimens were collected.

Description. Bulb solitary or clustered in pairs, ovoid, 5–8 mm in diameter, with brown, fibrous or weakly reticulate elongated tunics enclosing the stem base; without stoloniferous bulblets. Stem (5)10–25 cm tall, pubescent. Basal leaves two, filiform, about 0.5 mm thick, canaliculate, glabrous, distinctly exceeding the inflorescence. Cauline leaves alternate, decreasing upwards, ciliate; the lowermost leaf linear-lanceolate, with an attenuate apex, three times shorter than the inflorescence, sessile, situated at or below the first branching. Perianth segments bright yellow, greenish-yellow on the back with a violet apex, weakly pubescent, lanceolate, obtuse, up to 10 mm long. Inflorescence with 2–3 flowers. Anthers nearly rounded or oblong, 1.5–2 times longer than wide. Stamens 1.5 times shorter than the perianth. Ovary sessile. Capsule obovoid-oblong, slightly shorter or 1.5 times shorter than the perianth, 6–8 mm long. Seeds flattened.

Phenology. *G. kuljuktatauensis* was observed flowering in March, and fruiting in April.

Distribution and ecology. The species was collected from remnant low mountains Kuljuktatau in southwestern Kyzylkum and several sites in the western Pamir-Alay (Fig. 3), characterized by generally dry and stony habitats. Its occurrences include slopes of low and middle mountains, river valleys, foothills, remnant insular uplands and surroundings of sulfur springs. The ecological conditions of these sites range from open, highly sun-exposed rocky or stony southern slopes to more humid northern slopes and valleys. Soils are predominantly stony or gravelly, occasionally enriched with minerals (notably around sulfur springs). Plants occur at elevations of 470–1300 m a. s. l., corresponding to the foothills, lower and middle mountain belts. Thus, the new species exhibits ecological plasticity and is well adapted to the arid and semi-arid conditions of the western Pamir-Alay and insular remnant mountains of southwestern Kyzylkum.

Similar species and phylogenetic relationships. *Gagea kuljuktatauensis* belongs to sect. *Plecostigma* (Turcz.) Pascher, which is subdivided into two series. Series *Plecostigma* includes only *G. vvedenskyi*, whereas series *Olgaeformes* Levichev comprises *G. afghanica*, *G. olgae*, *G. olgae* Regel f. *dilatata* Levichev, *G. villosula*, and *G. kuljuktatauensis*. Although *G. pauciflora* (Turcz. ex Trautv.) Ledeb. and *G. altaica*

Schischk. & Sumnev. also belong to this section, they are not found in Uzbekistan and are distributed further north and east, from Siberia to China.

Species of *G. sect. Plecostigma* share a combination of diagnostic characters, including bulbs without stoloniferous bulblets, sessile ovaries, flattened seeds, and stamens shorter than the perianth (Table 1). *Gagea kuljuktatauensis* is distinguished by its two filiform basal leaves, pubescent stems 10–25 cm tall, and an inflorescence bearing 2–3 bright yellow flowers with violet apices. In contrast, *G. afghanica* has a single basal leaf, more robust stems (10–30 cm), and larger fruits (8–15 mm long). *G. olgae* is a smaller species (2–7 cm), with two basal leaves and a perianth dull violet tinged on the back. *G. villosula* is taller (15–25 cm), with a densely hairy green-backed perianth and up to 10 flowers. *G. vvedenskyi* grows in highlands and differs by late flowering period (June–July) and single-flowered inflorescence.

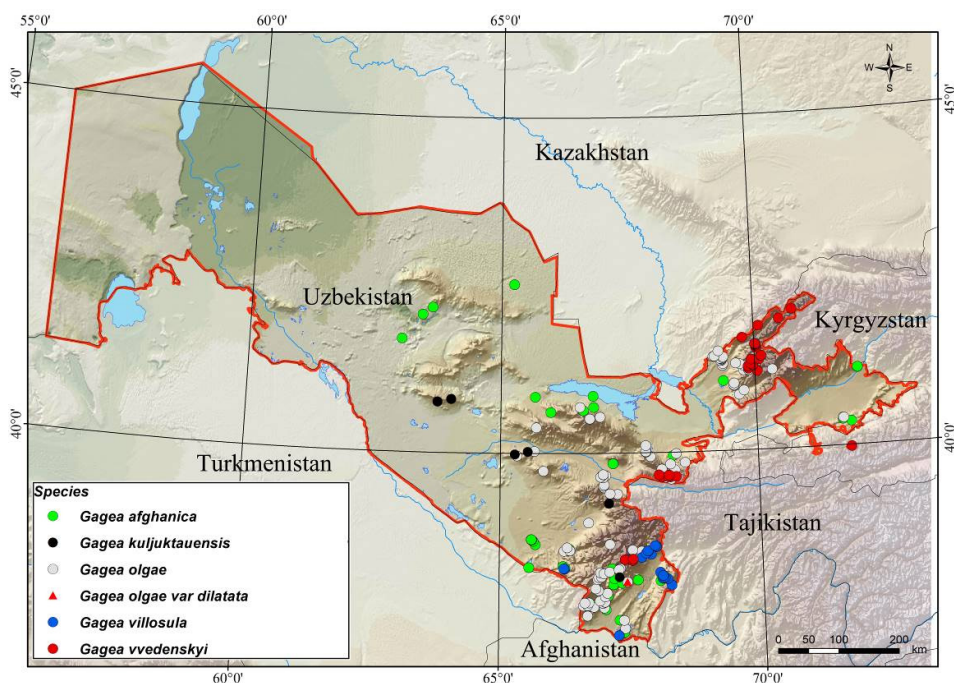


Figure 3. Distribution of species *Gagea sect. Plecostigma* in Uzbekistan.

The results of the nrDNA ITS-based phylogenetic analysis (Fig. 4), which included 28 taxa and two *Tulipa* species as outgroups, recovered several well-supported clades within *Gagea*. Species of *Gagea sect. Plecostigma* formed a moderately supported monophyletic clade (BS = 62), comprising *G. afghanica*, *G. vvedenskyi*, *G. kuljuktatauensis*, *G. pauciflora*, and *G. altaica*. This topology is consistent with the molecular framework proposed by Peterson et al. (2008). Within the section, *G. kuljuktatauensis* was recovered as the sister species of *G. afghanica* with moderate

bootstrap support (BS = 72), whereas *G. vvedenskyi*, *G. altaica*, and *G. pauciflora* occupied adjacent lineages.

Pairwise sequence identity among the analyzed taxa ranged from 81.8% to 98.8% (Fig. 5). The highest sequence similarity was observed between *G. kuljuktatauensis* and *G. afghanica* (98.3%), followed by *G. vvedenskyi* (97.1%). Lower similarity values were recorded for *G. villosula* (93.7%) and *G. olgae* (92.6%), whereas the lowest similarity was observed with *G. altaica* (81.8%) and *G. pauciflora* (82.9%).

Table 1. Comparative morphological characters of *Gagea kuljuktatauensis* and four related *Gagea* species from Uzbekistan

Character	<i>G. kuljuktatauensis</i>	<i>G. afghanica</i>	<i>G. olgae</i>	<i>G. villosula</i>	<i>G. vvedenskyi</i>
Bulb	Solitary or clustered in pairs, ovoid, 5–8 mm thick, with brown, fibrous or weakly reticulate elongated tunics enclosing the stem base; without stoloniferous bulblets	Solitary, broadly ovoid, 5–10 mm thick, with brown, fibrous or weakly reticulate tunics, inner leathery; without bulblets	Often clustered, ovoid, 5–10 mm thick, with brown, fibrous or weakly reticulate elongated tunics enclosing the stem base; without bulblets	Solitary or clustered in pairs, ovoid-oblong, about 1 cm thick, without bulblets, with almost leathery tunics, elongated and brown reticulate at the apex	Solitary, oblong-ovoid, 7–10 mm thick, with brownish-gray, indistinctly reticulate inner leathery, strongly elongated tunics; without bulblets
Stem	(5)10–25 cm, pubescent	10–30 cm, robust, shortly pubescent above	(2)3–7(10) cm, pubescent	Robust, 15–25 cm	(5)10–20 cm, shortly sparsely pubescent, rarely glabrous
Basal leaf	Two, filiform, 0.5 mm thick, canaliculate, glabrous, exceeding inflorescence	Single, narrowly linear, 1.2–2.5 mm wide, canaliculate, glabrous, exceeding inflorescence	Two, filiform, 0.5 mm thick, canaliculate, glabrous, twice as long as inflorescence	Single, filiform or rarely glabrous, semicylindrical, canaliculate, biconvex, 2–3 mm wide	Single, sometimes biconvex, canaliculate, linear, 2–3 mm wide, glabrous, exceeding inflorescence
Basal leaf cross-section	Circular	Circular	Circular	Circular	Circular
Stem cross-section	Broadly V-shaped, shallow median groove	Broadly V-shaped	Deeply V-shaped	Broadly V-shaped	Narrow V-shaped with deeper groove
General anatomical similarity	Similar to <i>G. afghanica</i> , <i>G. olgae</i> and <i>G. villosula</i>	Similar	Similar	Similar	Distinct stem anatomy compared with the other four species

Character	<i>G. kuljuktaiensis</i>	<i>G. afghanica</i>	<i>G. olgae</i>	<i>G. villosula</i>	<i>G. vvedenskyi</i>
Cauline leaves	Alternate, decreasing upwards, ciliate; lower linear-lanceolate, attenuate, 1/3 length of inflorescence, sessile at first branching or below	Alternate, gradually forming bracts; lower linear, 1.5–2.5 mm wide, slightly longer than inflorescence	Alternate, gradually forming bracts; lower linear, long-acuminate, reaching inflorescence apex	More or less pubescent; lower semi-stem-clasping, narrow-lanceolate, linear, tapering upwards, shorter than inflorescence; upper bracts twice as long as pedicels	Alternate, decreasing upwards, ciliate; lower linear, attenuate, 1/3 length of inflorescence, sessile at first branching or below
Perianth	Bright yellow, greenish-yellow on the back, apex violet, weakly pubescent, lanceolate, obtuse, 10 mm long	Yellow, back dirty-violet, glabrous or rarely pubescent, 8–12 mm, oblong-lanceolate, obtuse	Golden yellow, back with dirty-violet hue, pubescent, 5–9 mm, lanceolate, obtuse	(1.2)1.5–2 cm long, yellow, back green, oblong-lanceolate, acute-concave, densely villous, apex violet later	Light yellow, back widely greenish-violet, glabrous, 10–14 mm, lanceolate, obtuse
Inflorescence	2–3 flowers	3–10 flowers	Single-branched, 2–10 flowers	2–10 flowers, strongly villous, especially lower part	Single-flowered
Anther	Nearly rounded or oblong, 1.5–2× longer than wide	Linear-oblong, 3–4× longer than wide	Nearly rounded or oblong, 1.5–2× longer than wide	Linear-oblong	Linear-oblong
Stamens	1.5× shorter than perianth	1.5× shorter than perianth	1.5× shorter than perianth	1.5× shorter than perianth	1/4 shorter than perianth
Ovary	Sessile	Sessile	Sessile	Sessile	Sessile
Capsule	Obovoid-oblong, slightly or 1.5× shorter than perianth, 6–8 mm	Oblong-obovoid, slightly shorter than perianth, 8–15 mm	Obovoid-oblong, slightly or 1.5× shorter than perianth, 6–8 mm	Narrow, barely longer than perianth	Obovoid, slightly shorter than perianth
Seeds	Flattened	Flattened	Flattened	Flattened	Flattened
Habitat	Dry rocky slopes of arid and semi-arid uplands	Sandy deserts and semi-deserts	Clay deserts, foothills and lower mountain belt	Rocky mountain slopes	Rocky slopes of the lower mountain belt
Elevation (m a.s.l.)	470–1300	314–2520	327–2490	305–1833	1800–2300
Distribution	Southwestern Kyzylkum and western Pamir-Alay (Uzbekistan)	Uzbekistan, northern Afghanistan	Central Asia	Hissar Range	Pamir-Alay and Tian Shan

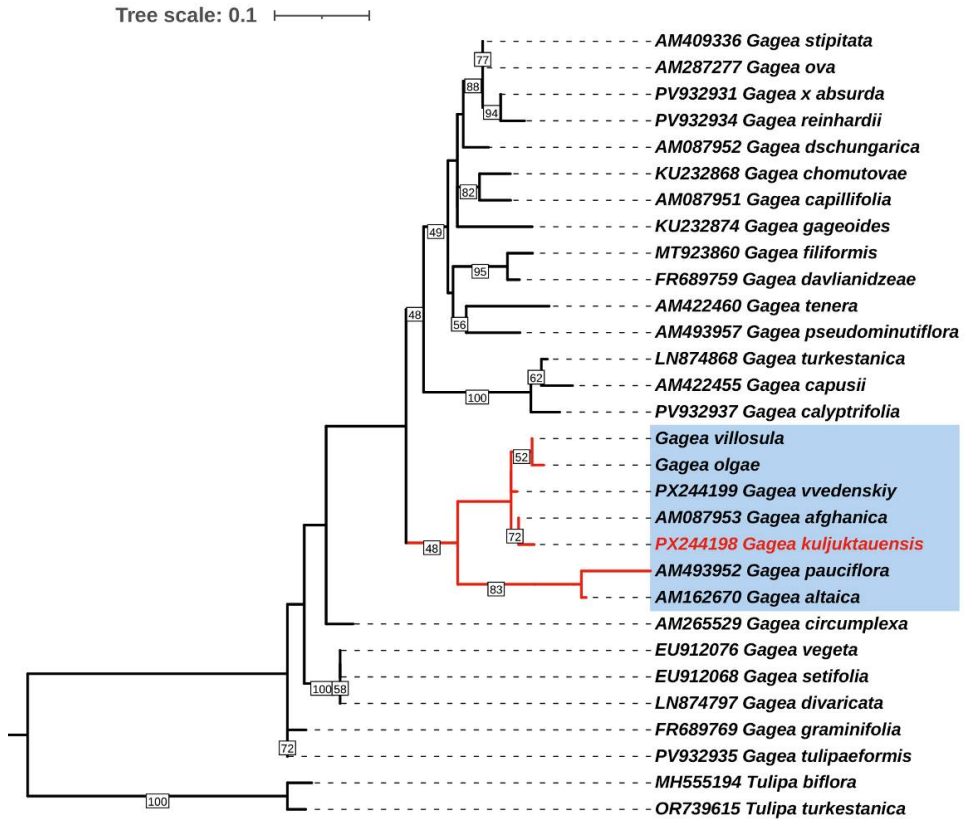


Figure 4. Maximum likelihood phylogenetic tree of 26 *Gagea* species. Branches representing the *Plecostigma* section are highlighted in red, and the newly described species is indicated in purple.

Discussion

The ITS phylogeny recovered *Gagea kuljuktatauensis* as the sister taxon of *G. afghanica* with moderate bootstrap support (BS = 72), indicating a close evolutionary relationship between the two species. However, phylogenetic proximity does not necessarily imply conspecificity. *Gagea kuljuktatauensis* differs consistently from *G. afghanica* by a stable combination of morphological characters, including the presence of two filiform basal leaves (vs. one), slender pubescent stems, fewer flowers per inflorescence, and smaller capsules. Furthermore, the new species is restricted to geographically isolated populations in the Kuljukttau Mountains and the western Pamir-Alay, where no intermediate morphological forms have been observed. The combination of these stable morphological differences together with ecological and geographical isolation supports the recognition of *G. kuljuktatauensis* as a distinct species.

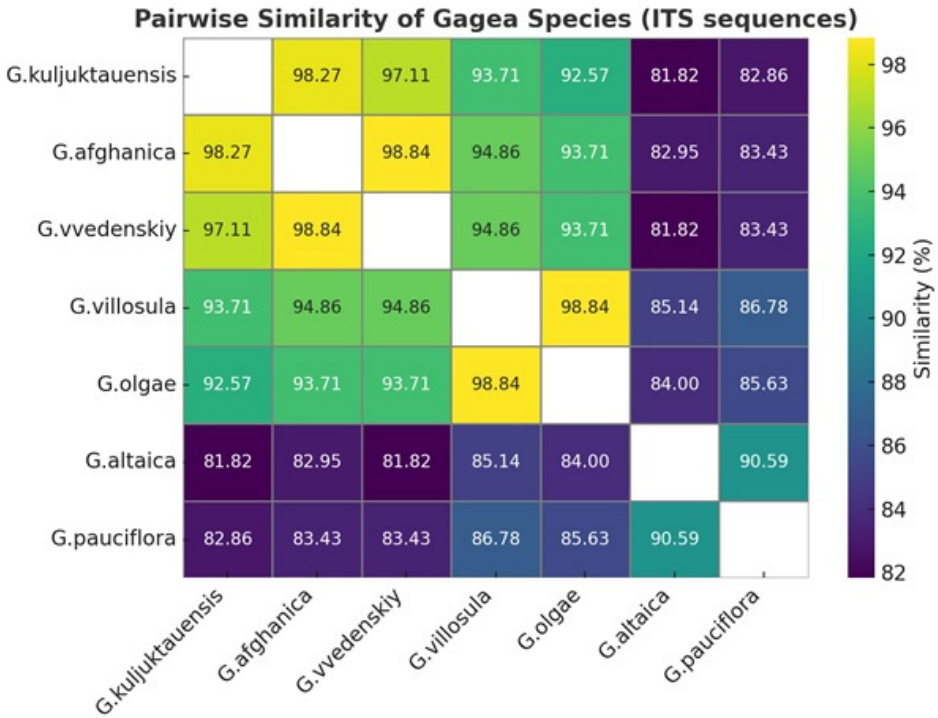


Figure 5. Sequence identity matrix of *Gagea* sect. *Plecostigma* derived from nrDNA ITS data.

Although additional chloroplast markers would undoubtedly improve phylogenetic resolution, this was not feasible because plastid sequence data are currently unavailable for many *Gagea* species included in the present analysis, not only within sect. *Plecostigma* but also across other sections of the genus. For numerous taxa, markers such as *matK* and *trnL-F* are absent from public databases, making it impossible to construct a broadly representative plastid phylogeny while maintaining adequate taxon sampling. Restricting the analysis only to species with available plastid sequences would substantially reduce the number of taxa and would not provide a reliable framework for evaluating relationships within the genus. Therefore, the present study is based on the ITS dataset, which currently provides the most complete molecular coverage for the taxa included in the analysis. Future studies based on expanded taxon sampling and newly generated plastid sequences will further clarify phylogenetic relationships within *Gagea* sect. *Plecostigma*.

Anatomical observations provide additional support for the recognition of the new species. Comparative analyses of transverse sections of the basal leaves and flowering stems (Figs 2, 6–8) revealed that the anatomy of the basal leaves is generally conserved among species of *Gagea* sect. *Plecostigma*. In contrast, transverse sections of the flowering stems exhibit consistent interspecific differences in out-

line and vascular bundle arrangement. *Gagea kuljuktauensis* possesses a broadly V-shaped flowering stem, resembling *G. afghanica*, whereas *G. olgae* is characterized by a distinctly deeper V-shaped stem, and *G. vvedenskyi* exhibits a narrower V-shaped outline. Although these anatomical differences are subtle, they are stable among the examined specimens and complement the external morphological characters used for species delimitation.



Figure 6. Morphology and anatomy of *Gagea afghanica*. **A** – whole plant; **B** – flower, front view; **C** – cross-sectional view of the basal leaf; **D** – cross-sectional view of the leaf on the flowering stem; **E** – cross-sectional view of the flowering stem.

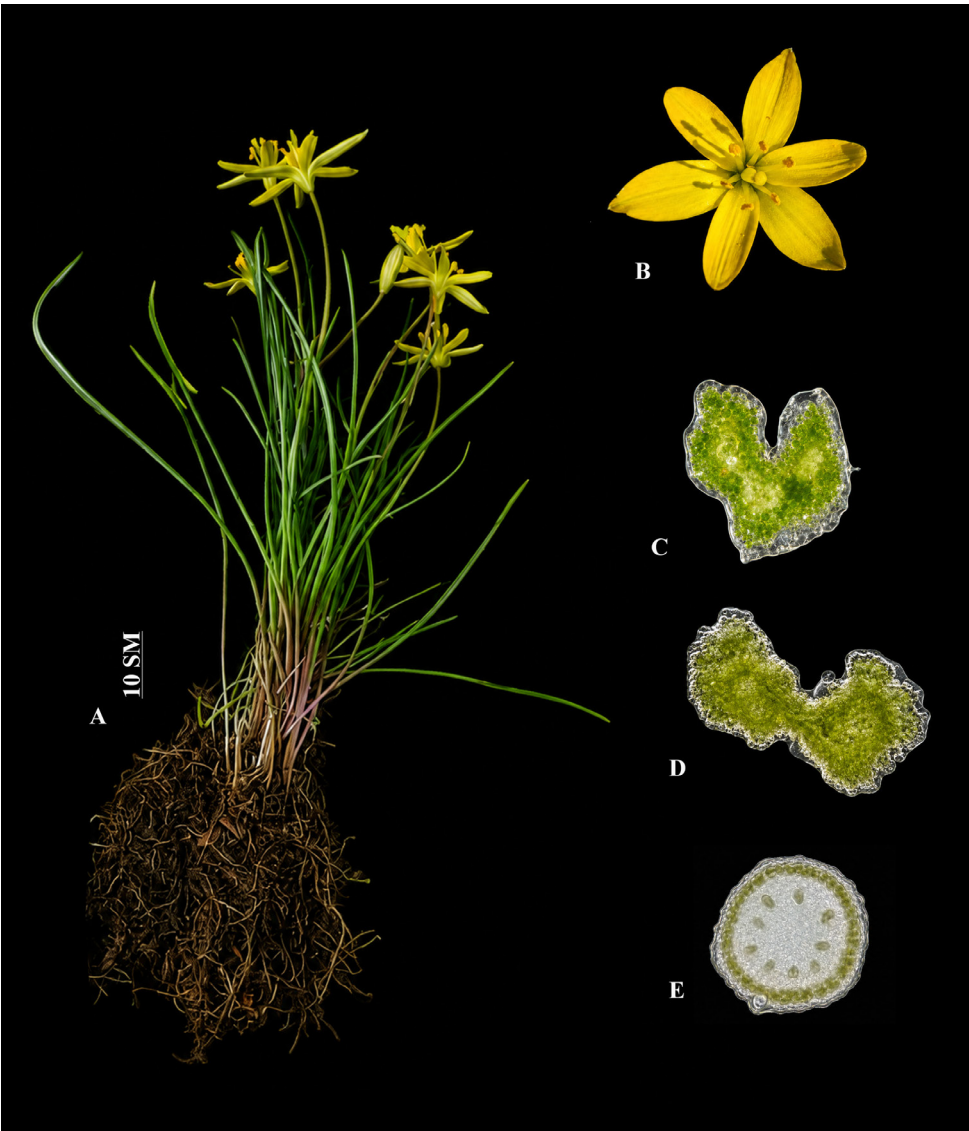


Figure 7. Morphology and anatomy of *Gagea olgae*. **A** – whole plant; **B** – flower, front view; **C** – cross-sectional view of the basal leaf; **D** – cross-sectional view of the leaf on the flowering stem; **E** – cross-sectional view of the flowering stem.



Figure 8. Morphology and anatomy of *Gagea villosula*. **A** – whole plant; **B** – flower, front view; **C** – cross-sectional view of the basal leaf; **D** – cross-sectional view of the leaf on the flowering stem; **E** – cross-sectional view of the flowering stem.

The anatomical features of the remaining species of *Gagea* sect. *Plecostigma* have been investigated previously. Detailed comparative anatomical descriptions and illustrations of leaves and flowering stems of 59 species and three infraspecific taxa of *Gagea* were presented by Levichev (1996). In addition, anatomical information for *G. vvedenskyi* has been published in *Historia Gagearum* (Levichev 2008) and *Flora of Pakistan* (Ali & Levichev 2006). Therefore, the present study focuses on documenting the anatomy of the newly described species while providing direct comparisons with its closest relatives, rather than reproducing anatomical information that has already been comprehensively documented. Taken together, the morphological, anatomical, ecological, geographical, and molecular evidence consistently supports the recognition of *Gagea kuljuktatauensis* as a distinct species within *Gagea* sect. *Plecostigma*. To facilitate identification of the species occurring in Uzbekistan, a diagnostic key and an expanded comparative table are provided in the Taxonomic treatment section.

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Supplementary material 1

Figure S1. Isotype of *Gagea kuljuktaiensis* Levichev (TASH00270223)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 2

Figure S2. Isotype of *Gagea kuljuktaiensis* Levichev, Beshko, Tojibaev, Shomurov et Batoshov (TASH00173155)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 3

Figure S3. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00260990)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 4

Figure S4. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00270218)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 5

Figure S5. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00270217)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 6

Figure S6. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00270222)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 7

Figure S7. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00270221)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 8

Figure S8. Herbarium specimen of *Gagea kuljuktaiensis* Levichev (TASH00270219)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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Supplementary material 9

Figure S9. Herbarium specimen of *Gagea kuljuktauensis* Levichev (TASH00270220)

Authors: Gulsair T. Kurbaniyazova, Bobur A. Karimov, Nataliya Yu. Beshko, Dilafuz N. Jamalova, Aleksandr V. Rodionov, Aleksandr A. Gnutikov, Bakbergen T. Kurbaniyazov, Ziyoviddin O. Yusupov

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