# Four new reports to the moss flora of Iran

**Shahla Ahmadi:** PhD Student, Department of Plant Sciences and Biotechnology, Faculty of Life Sciences and Biotechnology, Shahid Beheshti University, Tehran, Iran

**Ahmad Reza Mehrabian✉:** Associate Prof., Department of Plant Sciences and Biotechnology, Faculty of Life Sciences and Biotechnology, Shahid Beheshti University, Tehran, Iran (a_mehrabian@sbu.ac.ir)

**Saeed Shirzadian:** Research Associate Prof., Department of Botany, Iranian Research Institute of Plant Protection, Agricultural Research Education and Extension Organization (AREEO), Tehran, Iran

**Abstract**

*Pottiaceae* is one of the largest known moss families, with nearly 1400 species embraces more than 10% of all known species in the world. Species in this family are often distributed worldwide and are characteristic of variable or harsh environments, constituting a significant portion of the vegetation cover in arid, alpine, arctic, and desert regions. Many of these species are adapted to dry climates and often dominate moss populations in arid regions worldwide. This family has 17 genera, 65 species, seven varieties, and 1 subspecies so far known in Iran. In this study, which investigated the diversity of mosses in Lorestan Province (SW of Iran), 120 moss samples were collected and identified during multiple field surveys using reliable sources. Of these, 32 samples belonged to *Pottiaceae*, which included 14 genera and 23 species. In this paper, four species of this family are reported for the first time from Iran, namely, *Leptobarbula berica*, *Phascum schreberianum*, *Protobryum bryoides*, and *Tortula leucostoma*.

**Keywords:** Lorestan Province, *Leptobarbula berica*, *Phascum schreberianum*, *Protobryum bryoides*, *Tortula leucostoma*

# گزارش چهار گونه جدید برای فلور خزه‌ای ایران*

**شهلا احمدی:** دانشجوی دکتری گروه علوم و فناوری زیستی گیاهی، دانشکده علوم و فناوری زیستی، دانشگاه شهید بهشتی، تهران، ایران

**احمدرضا محرابیان✉:** دانشیار گروه علوم و فناوری زیستی گیاهی، دانشکده علوم و فناوری زیستی، دانشگاه شهید بهشتی، تهران، ایران (a_mehrabian@sbu.ac.ir)

**سعید شیرزادیان:** دانشیار پژوهش بخش تحقیقات گیاه‌شناسی، مؤسسه تحقیقات گیاه‌پزشکی کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران



**خلاصه**

*Pottiaceae* یکی از بزرگ‌ترین تیره‌های شناخته شده خزه‌ها، با داشتن نزدیک به ۱۴۰۰ گونه در جهان، بیش از ۱۰٪ از کل گونه‌های این گیاهان را تشکیل می‌دهد. گونه‌های این تیره اغلب در سراسر جهان پراکنده‌اند و شاخص محیط‌های متغیر یا خشن هستند که بخش قابل توجهی از پوشش گیاهی را در مناطق خشک، آلپی، قطب شمال و به عنوان خرابه‌رست تشکیل می‌دهند. بسیاری از این گونه‌ها با آب و هوای خشک سازگار هستند و اغلب بر جمعیت خزه‌ها در مناطق خشک در سراسر جهان تسلط دارند. این تیره دارای ۱۷ جنس، ۶۵ گونه، هفت واریته و ۱ زیرگونه شناخته شده در ایران است. در این پژوهش که به بررسی تنوع خزه‌ها در استان لرستان پرداخته شده، طی بررسی‌های میدانی و انجام سفرهای متعدد طی سه سال اخیر، تعداد ۱۲۰ نمونه خزه جمع‌آوری و سپس با استفاده از منابع معتبر شناسایی شدند. از این تعداد، ۳۲ نمونه متعلق به *Pottiaceae* شامل ۱۴ جنس و ۲۳ گونه بود. در این مقاله، چهار گونه از این تیره برای نخستین بار از ایران گزارش می‌شوند که عبارتند از: *Leptobarbula berica* (De Not.) Schimp.، *Phascum schreberianum* (Dicks.) Brid. و *Protobryum bryoides* (Dicks.) Guerra & M.J.Cano، *Tortula leucostoma* (R.Br.) Hook. & Grev. از نظر داشتن برگ باریکتر، رگبرگ پرزدار و تار کوتاهتر، از گونه *T. hoppeana* (Schultz) Ochyra متمایز بود. تفاوت *P. schreberianum* با گونه نزدیک آن *P. cuspidatum* Hedw. نیز در اندازه بزرگتر، دارای نه میلی‌متر طول و رگبرگ زرد بیرون‌زده از نوک برگ بود. همچنین، *Leptobarbula berica* از *Gymnostomum calacareum* Nees & Hornsch. از نظر اندازه کوچکتر و برگ‌های کشیده به جای زبانی شکل و *Protobryum bryoides* با سلول‌های پهنک و هاگ‌های کمی پاپیلوزی از گونه‌های مجاور خود متمایز بود.

**واژه‌های کلیدی:** استان لرستان، *Leptobarbula berica*، *Phascum schreberianum*، *Prtobryum bryoides*، *Tortula leucostoma*

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## Introduction

*Pottiaceae* (*Pottiales*) is one of the largest known moss family, with nearly 1400 species, embracing for more than 10% of the total moss species (Buck *et al*. 2000). They are widely distributed across the world and are characteristic of variable or harsh environments. Many of their species are particularly adapted to dry climates (Zander 1993).

According to Akhani & Kürschner (2004), *Pottiaceae* comprises 17 genera, 65 species, seven varieties, and a single subspecies in Iran.

*Tortula* Hedw. is one of the most complex and diverse genera in terms of morphological variation within the *Pottiaceae*. It encompasses around 144 species worldwide (Crosby *et al*. 1999), primarily found in temperate areas of the Northern Hemisphere (Cano & Gallego 2008). According to Akhani & Kürschner (2004), 18 species of *Tortula* were found growing in Iran. With the report of *T. solmsii* (Schimp.) Limpr. (Fereidounfar *et al*. 2011) and *T. vahliana* (Shultz) Mont. (Salimpour *et al*. 2014), the number of species of this genus in Iran reached to 20. Kürschner & Frey (2011) reported 65 species, 21 varieties and six subspecies of this genus from Southwest Asia. According to them, the genus *Phascum* consists of two species in the said region i.e., *P. schreberianum*, found in Turkey and Israel, and *P. vlassovii*, gathered from Turkey. *Leptobarbula* is reported as a monotypic genus in the Mediterranean-Atlantic region and has been reported from SW Asia, including Turkey, Lebanon, and Israel while *Protobryum* which is also a monotypic genus in the area is only known from Turkey and Syria (Kürschner & Frey *l.c.*).

Lorestan Province is situated in SW of Iran and covers an area of approximately 29308 km2, ranging from 46°50' to 50°3' E longitude and 32°37' to 34°22' N latitude considered as a mountainous region. The Oshterankuh Mountain is the highest point (4150 m), while Pol-e Zal is the lowest point (500 m) located at southernmost part of the province. This region has usually, a long drought season from June to November.

Based on published literature, 55 species of mosses have already reported from Lorestan Province (Ghahremaninejad *et al.* 2016). The present study, therefore, aims to expand our knowledge to the moss flora of Lorestan Province.



## Materials and Methods

Plant materials were collected from different locations in the Lorestan Province (SW of Iran) during 2022–24. The collected samples were first washed with water, air-dried at room temperature, and stored in paper packets. For further analysis and observation, the samples were examined and photographed with a stereomicroscope as well as a light microscope. To observe their morphology, samples were soaked in boiling water for a few minutes to regain turgidity. The identification of the samples was carried out based on Smith (2004), Kürschner (2007), and Kürschner & Frey (2011). The voucher specimens were preserved in the Herbarium of the Shahid Beheshti University (HSBU), Tehran (Iran). The description of the species along with information about the ecology of each species are presented. A key to the new species found during the present investigation along with the distribution map (Fig. 5) are also provided.

## Results and Discussion

**1. *Leptobarbula berica*** (De Not.) Schimp. (Fig. 1)

Plants bright green, up to 2 mm high. Leaves erect-patent when moist, hardly altered when dry, increasing in size up stems and more crowded near top, very narrowly lanceolate, obtuse; margins plane, entire, papillose-crenulate; costa

ending below apex, cells quadrate, cells in lower part of leaf rectangular, 4–8 × 12–25 µm, cells above quadrate, pluripapillose, 3–6 µm wide. Plant found in sterile condition.

Geographical distribution: N Africa, Europe, Asia, England, Mediterranean region, Belgium, Germany, Netherlands, Israel, Lebanon, Turkey, Madeira, Azores, and Iran.

Specimen examined: IRAN: Lorestan Province, Khorramabad, Papi, Chamsangar, on limestone and rocks in woodland, 850 m, 23.4.2022, Ahmadi (SBUH 2019828).

*L. berica* which gets confused with *Gymnostomum calcareum* Nees & Hornsch. differs in smaller size but unlike *G. calcareum*, it does not have strongly differentiated perigonial and perichaetial leaves. *Gyroweisia tenuis* (Hedw.) Schimp. has also wider leaves, usually abundant gymnostomous capsules and protonemal gemmae (Smith 2004).


**Fig. 1.** *Leptobarbula berica*: A & D. Habit, B. Leaf, C. Leaf base, E. Leaf apex, F & G. Leaf sections (Bars: A = 1 cm, D = 1 mm, B = 1 mm, C & E = 60 µm, F & G = 50 µm).

**2. *Phascum schreberianum*** (Dicks.) Brid. (Fig. 2)

Plants ephemeral forming pale green tufts, up to 9 mm high. Leaves slightly twisted, appressed-flexuose when dry, lower patent, upper imbricate to convolute when moist, lower leaves ovate, upper and perichaetial leaves larger, ovate to ovate-lanceolate, acute; margins recurved, entire; costa excurrent into a cuspidate, yellowish point more than 105 mm long; cells very variable, lower lax, above irregularly rectangular to hexagonal, smooth, 9–21 × 11–31 µm in upper part of leaf. Setae short, straight or curved; capsules immersed or slightly emergent, erect; cleistocarpous, subglobose, shortly apiculate.

Geographical distribution: Asia, Canary Islands, Algeria, Ecuador, Europe, Madeira, Morocco, Israel, Turkey, and Iran.

Specimen examined: IRAN: Lorestan Province, Noorabad, Ghuslgeh waterfall, on soil, 1802 m, 26.5.2023, Ahmadi (SBUH 2019813).

According to Smith (2004), *P. schreberianum* is a subspecies of *P. caspidatum* Hedw., but Kürschner & Frey (2011) considered it as an independent species, differs from it in the larger size of the plants and excurrent yellow-colored leaf hair points.

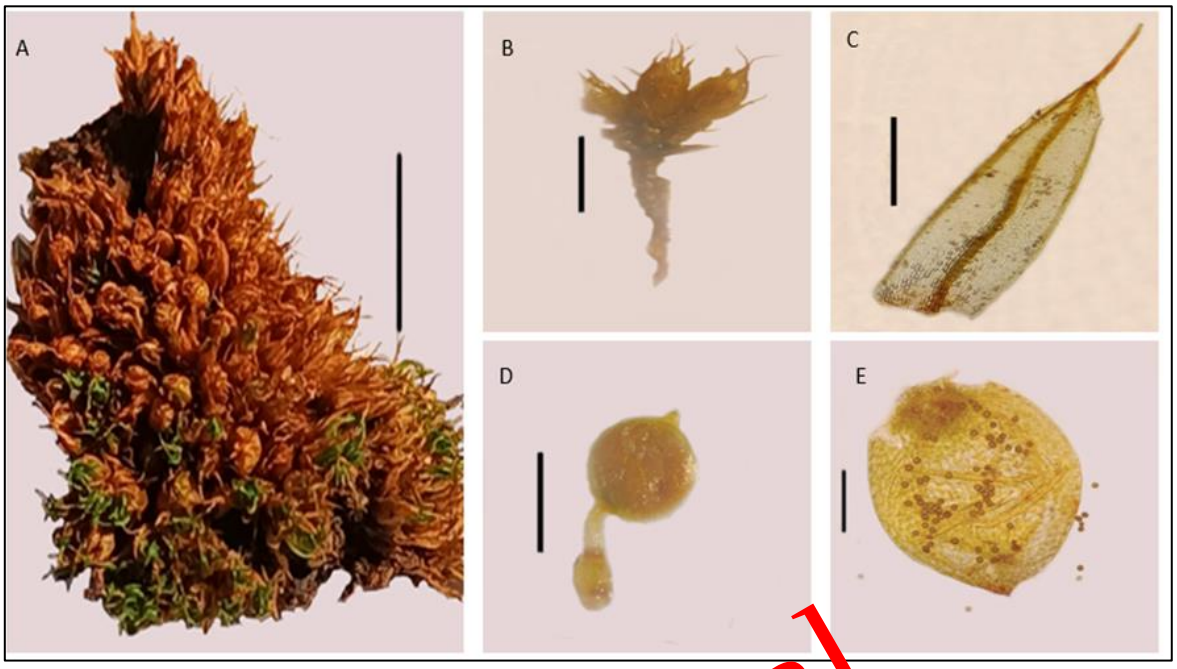


**Fig. 2.** *Phascum schreberianum*: A. & B. Habit, C. Leaf, D. Sporophyte, E. Capsule with spores (Bars: A = 5 mm, B = 5 mm, C = 0.5 mm, D = 1 mm, E = 0.5 mm).



**3. *Protobryum bryoides*** (Dicks.) Guerra & M.J.Cano (Fig. 3)

Ephemeral gregarious dull green or brownish plants, 2–5 mm high. Upper leaves much longer than lower; margins recurved, entire; costa excurrent 250–750 µm long; upper cells quadrate, smooth or slightly papillose, 16– 24 µm wide. Setae 2.0–5.5 mm. Capsules ellipsoid, 1.0–1.8 × 0.7–0.9 mm, cleistocarpous but with at least one row of differentiated cells at base of beak; peristome rudimentary; spores minutely papillose, 25–32 µm; calyptra smooth.

Geographical distribution: Europe, W Asia, Western North America, and Iran.

Specimen examined: IRAN: Lorestan Province, Poldokhtar, Malavi to Poldokhtar, on exposed basic soil in grassland, 741 m, 1.2.2023, Ahmadi (SBUH 2019997).

In general, *P. bryoides* by having slightly papillose laminal cells and spores is differentiated with its close relatives. However, it may get confused with *Tortula caucasica* Lindb. which features light brown capsules that soon shed their lids. In contrast, *T. lindbergii* Broth. has capsules that closely resemble those of *P. bryoides*. Forms of *Phascum cuspidatum* may also appear similar to *P. bryoides* when the capsules have not yet emerged from the leaves. On the other hand, *Microbryum rectum* (With.) R.H.Zander is considerably smaller and has spherical capsules while *Pottia caespitosa* (Brid.) Müll.Hal. is even smaller, with capsules that are only slightly longer than wide (Frey *et al*. 1995, Preußing *et al*. 2010).

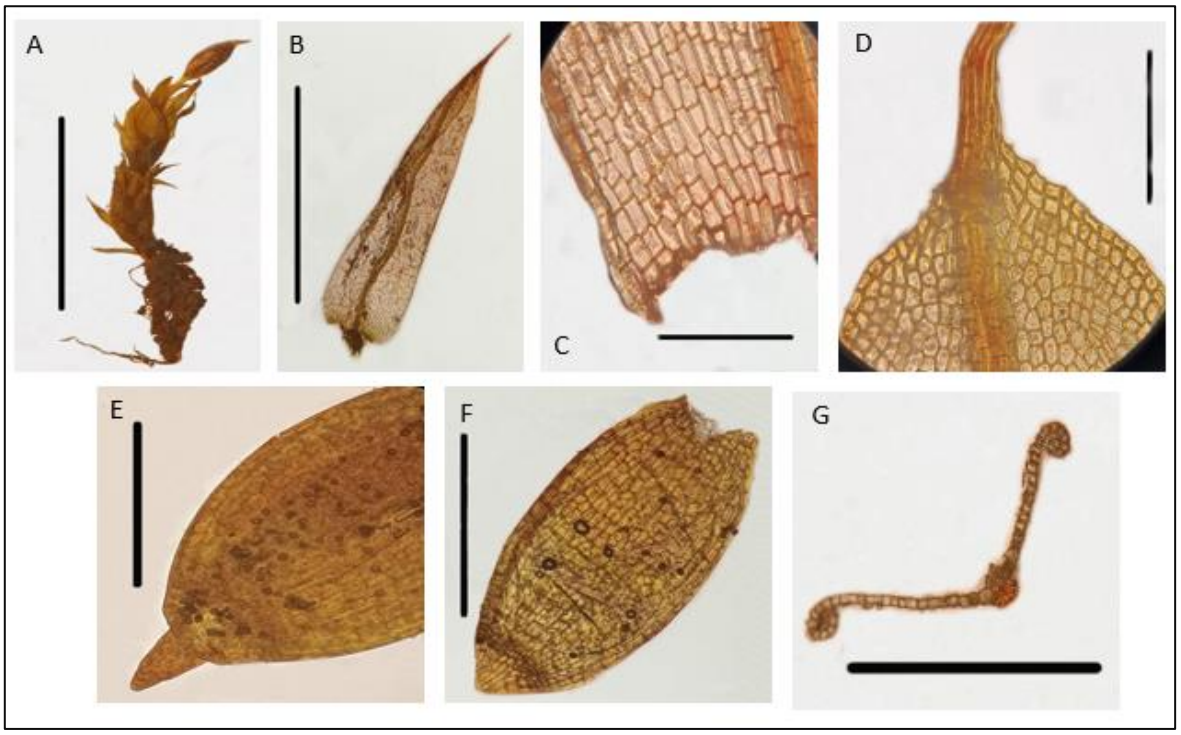


**Fig. 3.** *Protobryum bryoides*: A. Habit, B. Leaf, C. Leaf base, D. Leaf apex, E. Capsule with calyptra, F. capsule without operculum, G. Leaf section (Bars: A= 0.5 cm, B = 0.5 mm, C, & D = 40 µm, E & F = 0.5 mm. G = 100 µm).



**4. *Tortula leucostoma*** (R.Br.) Hook. & Grev. (Fig. 4).

Gregarious plants, up to 2–3 mm high. Leaves broadly to narrowly triangular, ovate-lanceolate or lanceolate, acute; margins revolute almost to apex, papillose-crenulate above; costa stout, excurrent in long or short yellowish hair-point; basal cells rectangular, hyaline, papillose, upper laminal cells 10–12 µm wide. Capsules erect, cylindrical, straight or slightly curved; lid rostrate; peristome with tall basal membrane, teeth spirally coiled; spores coarsely papillose.

Geographical distribution: Greenland, N. America, North and East Asia, Northern Europe, Turkey, and Iran.

Specimen examined: IRAN: Lorestan Province, Borujerd, Venai, on limy soil in river bank, 1982 m, 4.12.2022, Ahmadi (SBUH 2019808).

*Tortula* includes about 114 species in the world (Cano *et al*. 2005, Cano & Gallego 2008) of which 18 species were found in Iran (Akhani & Kürschner 2004). *T. leucostoma* is distinguished from *T. hoppeana* (Schultz) Ochyra by having narrower leaves with pubescent veins and shorter filaments (Kürschner & Frey 2011).

**Key to the newly reported species**

1. Capsules cleistocarpus ……..…….. 2
- Capsules dehiscent or absent ……..…….. 3
2. Capsules immersed, cells below beak not differentiated ……..…… *Phascum schrebryanum*
- Capsules exerted, with at least one row of differentiated cells below beak ……..... *Protobryum bryoides*
3. Capsules present, leaf margins recurved ……..…….. *Tortula leucostoma*
- Capsules absent, leaf margins plane ……..…….. *Leptobarbula berica*

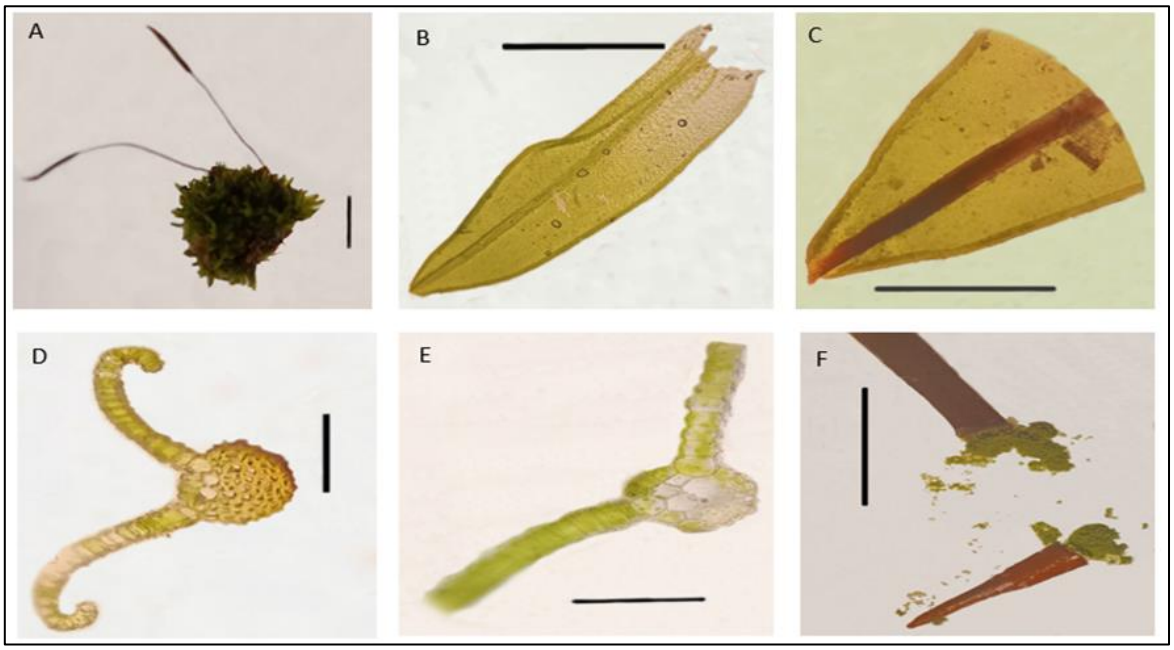


**Fig. 4.** *Tortula leucostoma*: A. Habit, B. Leaf, C. Leaf apex, D. & E. Leaf sections, F. Peristome mouth (Bars: A = 1 cm, B = 1 mm, C = 0.5 mm, E = 60 µm, D = 250 µm, F = 0.5 cm).


**Fig. 5.** Map showing the distribution of the four species found in Lorestan Province (SW of Iran).

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