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Seven new records of mosses in Iran

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Abstract

Based on the survey of mosses in West Azerbaijan, Mazandaran and Yazd provinces of Iran, seven species of mosses namely, *Bryum algovicum*, *B. creberrimum*, *B. klinggraeffi*, *B. mildeanu* (Bryaceae), *Grimmia plagiopodia* (Grimmiaceae), *Orthotrichum rivulare* (Orthotrichaceae), and *Didymodon sinuosus* (Pottiaceae) are newly recorded for the Iranian bryoflora.

Introduction

The knowledge about the bryoflora of Iran remains meager. Kürschner (1996) added 15 taxa to the Iranian bryoflora, and Kürschner *et al.* (2000) published an updated list of 121 taxa from the Golestan National Park (NE Iran) including eight new species. Akhani and Kürschner (2004) prepared an annotated checklist of the Iranian bryoflora including 437 taxa (two hornworts, 68 liverworts and 367 mosses). Kürschner (2006, 2007, 2008) constructed keys for the identification of mosses of the near and middle east. Frey and Kürschner (2010) added 42 records to the bryoflora of Iran. Kürschner and Frey (2011) published a comprehensive report on the bryophyte flora of Southwest Asia. Zare *et al.* (2011) recorded eighteen new mosses from the Hyrcanian forest region (N Iran). Fereidounfar *et al.* (2011) reported *Syntrichia norvegica* F.Web. from Alvand mountains in Hamedan province (W Iran), Shirzadian (2011, 2012), and Shirzadian and Akhoondi (2011) made significant contribution with the records of many new additions to the bryophyte flora of Iran.

In the present study, seven species of mosses namely *Bryum algovicum* Sendtn. ex Müll.Hal., *B. creberrimum* Taylor, *B. klinggraeffi* Schimp., *B. mildeanum* Jur. (Bryaceae), *Grimmia plagiopodia* Hedw. (Grimmiaceae), *Orthotrichum rivulare* Turner (Orthotrichaceae) and *Didymodon sinuosus* (Mitt.) Delogne, (Pottiaceae) are newly recorded from Iran.

Methods

Geographic context

Mazandaran province which embraces Hyrcanian forest, has a richness of biological and cultural diversity, with endemic and endangered species and a diverse range of economic and social conditions. This summer-green broad-leaved forest reaches up to an altitude of 2600 m and located in north of Iran at the southern Caspian coast. Rainfall averages between 1420–1530 mm per annum, with the heaviest precipitation in the

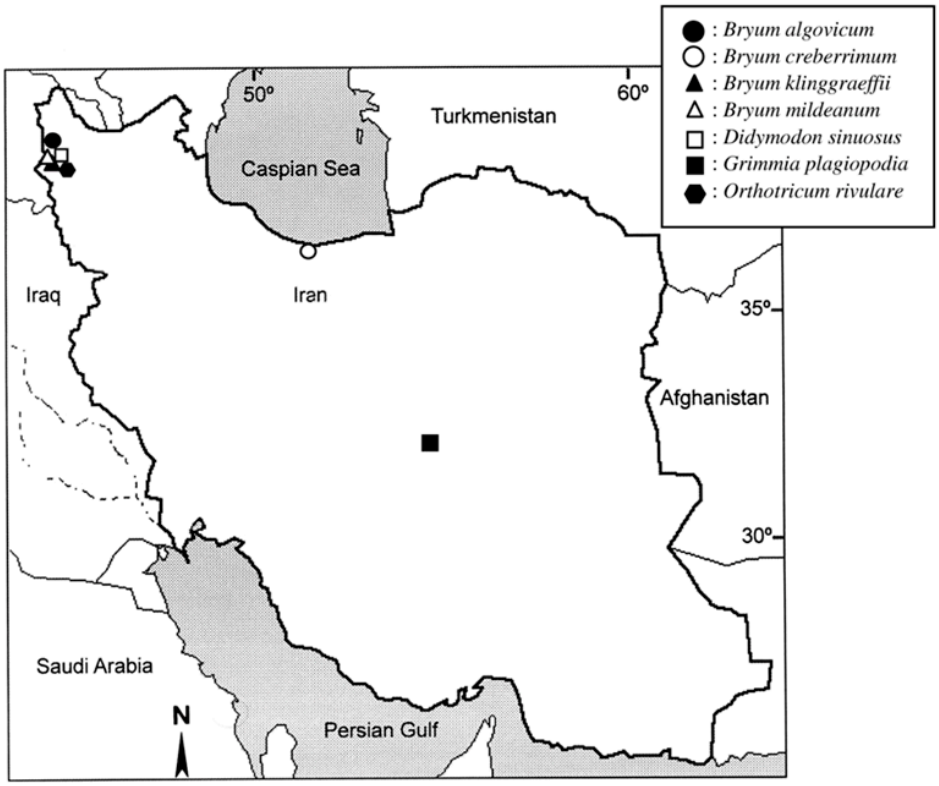

Fig. 1. Distribution map of new records of mosses from Iran.

summer. Temperatures are moderate, ranging from a few below 0° C in December to February to +25° C during the summer. West Azerbaijan province is humid, with mean rainfall of about 350 mm with the maximum mean temperature of 28.3° C in August and the minimum mean monthly temperature of -5° C in January. In contrary, Yazd province is a kind of desert land of centre of Iran, which has a much drier climate. Mean monthly temperature reaches 41° C in July and -4.4° C in January. The total annual rainfall is ca 60 mm, the minimum c. 0.3 mm in May and maximum c. 18 mm in March (Hosseini *et al*. 2012).

Field visits were made in different seasons in 2012 in West Azerbaijan, Mazandaran and Yazd provinces of Iran (Fig. 1). The samples of mosses were collected in paper bags and field data were recorded. The samples were air-dried in room temperature and stored in the standard paper packet. For morphological observations, the samples were soaked in water for a few minutes for their revival. The whole leaf and peristome mounts were observed under the microscope (Olympus-BH2) and photographed. Identification of samples was made with the help of Smith (2004), Gallego (2005) and Kürschner and Frey (2011) following the classification of Goffinet *at al.* (2009). The voucher specimens are preserved in the herbarium of the Ministry of Jihad-e-Agriculture ("IRAN") at the Iranian Research Institute of Plant Protection (Tehran, Iran).

Results and Discussion

Bryaceae

Iranian bryoflora includes 26 species of *Bryum* (Kürschner and Frey 2011, Akhani and Kürschner 2004). Here, we add four species of *Bryum* species to the Iranian bryoflora:

Bryum algovicum Sendtn. ex Müll.Hal. (Fig. 2)

This species is characterized by its pyriform capsule and exostome with vertical or oblique lines joining transverse articulations. The spore size ranges from 28 to 34 μm. On the basis of the colour of basal laminal cells, *Bryum algovicum* differs from its close associate *B. uliginosum,* as in the former the basal laminal cells are reddish while in the latter, these cells have same colour as the other lamina cells (Kürschner and Frey 2011). We found some fertile specimens growing on basic sandy soil in open places, and sporophytic characters helped in distinguishing it from its closely related species. *B. algovicum* has been reported from Afghanistan, Turkey, and Syria (Kürschner and Frey 2011) where it grows on sand-dunes, basic cliff ledges, rock crevices, and quarries.

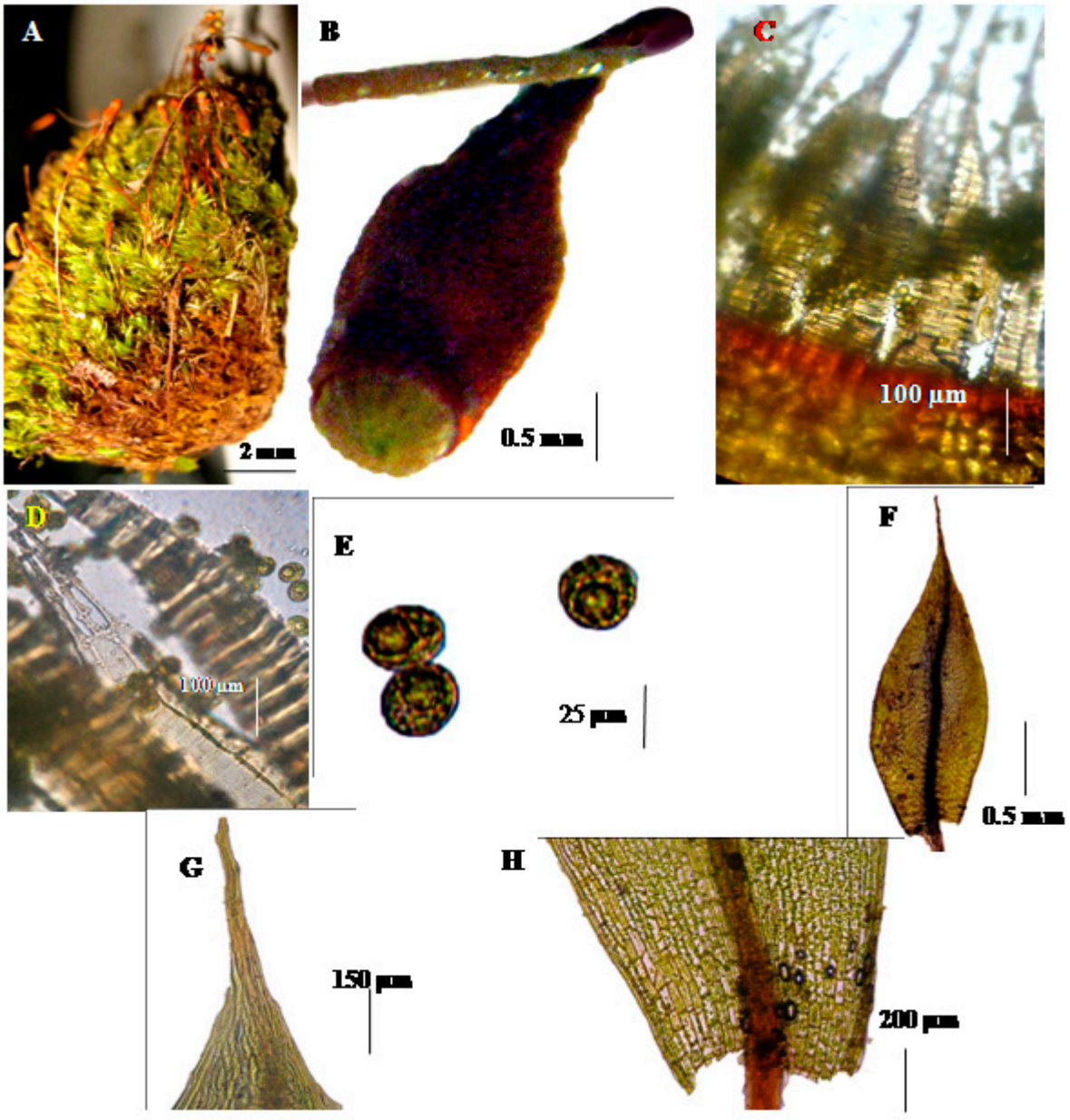

Fig. 2. *Bryum algovicum*: **A**. habit; **B**. capsule without operculum; **C**. outer surface of exostome teeth; **D**. outer surface of endostome tooth; **E**. spores; **F**. leaf; **G**. upper laminal cells; **H**. basal cells.

Specimen examined: Iran: West Azerbaijan province, Orumieh, Movana, Jermi, near Turkey border, on soil, 37˚25' N, 44˚43'E, 1860 m, 20 Jun 2012, *M. Eskandari* (IRAN 0459 B).

Bryum creberrimum Taylor (Fig. 3)

This species is distinguished by ovate-lanceolate leaves and peristome with perforations as long as wide. *Bryum creberrimum* is closely related to *B. pallescens* Schleich. ex Schwägr. (Smith 2004). The minor differences are that, the former has smaller spores, widely perforated processes and lanceolate leaves while the latter is reported to have comparatively larger spores and ± ovate, shortly pointed leaves. Spence (2005) transferred *B. creberrimum* from *Bryum* to *Ptychostomum*, while Kürschner and Frey (2011) retained it in the genus *Bryum*.

Bryum creberrimum has been recorded from Afghanistan, Sinai Peninsula (Egypt) and Turkey in the southwest Asia (Kürschner and Frey 2011).

Specimen examined: Iran: Mazandaran province, Nowshahr, 10 km to Sisangan, Poshtovan, on stone near small stream, 36°36'N, 51°41'E, -15 m, 01 Apr 2013, *S. Shirzadian* (IRAN 0460 B).

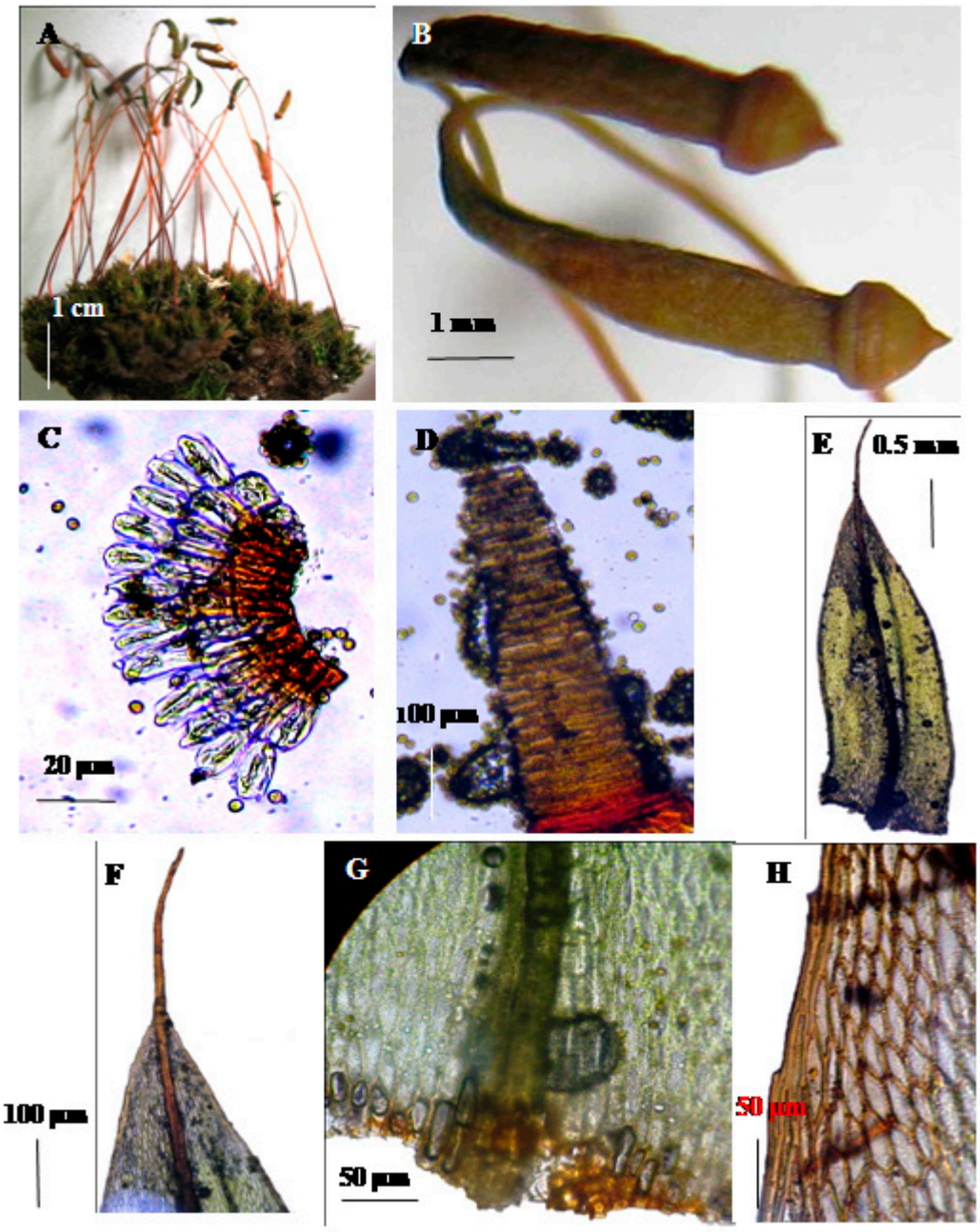

Fig. 3. *Bryum creberrimum*: **A**. habit; **B**. capsule; **C**. annulus; **D**. outer surface of exostome tooth; **E**. leaf; **F**. upper laminal cells; **G**. basal cells; **H**. corner cells.

Bryum klinggraeffii Schimp. (Fig. 4)

This species is characterized by acuminate-lanceolate leaves with denticulate apex, excurrent costa and presence of rhizoidal gemmae. *Bryum klinggraeffii* is morphologically similar to *B. violaceum* Crunduw. & Nyholm., but can be distinguished by its bright crimson gemmae ((80-90 µm diameter) on rhizoids while *B. violaceum* possesses purplish-red gemmae ((60-80 µm diameter) on rhizoids (Kürschner and Frey 2011). The leaves of our specimen are broader then those reported by Kürschner and Frey (2011), which might be the effect of local climatic conditions.

Bryum klinggraeffii has been reported from Turkey and United Arab Emirates in southwest Asia (Kürschner and Frey 2011).

Specimen examined: Iran: West Azerbaijan province, Orumieh, Band, Shamlakan, on soil, 37°28'N, 44°59'E, 1730 m, 20 Jun 2012, *M. Eskandari* (IRAN 0461 B).

Bryum mildeanum Jur. (Fig. 5)

This species is characterized by reddish short excurrent costa, thin walled laminal cells and narrowly ellipsoid capsule. Spence (2007) considered this species as *Imbribryum mildeanum* on the basis of its characteristic imbricate leaves, a feature also shared with*B. alpinum* and *B. gemmiparum*. Guerra *et al*. (2008) obtained some new gametophytic and sporophytic characters through SEM and molecular data from two chloroplast DNA regions (trnL-F and trnG) to resolve the circumscription of these taxa and concluded that *B. mildeanum* and *B. alpinum* form independent lineages,both separated from *B. gemmiparum*.

Bryum mildeanum has been recorded from Lebanon and Turkey in southwest Asia (Kürschner and Frey 2011).

Specimen examined: Iran: West Azerbaijan province, Orumieh, Movana, Bani, on soil near river, 37˚37'N, 44˚41'E, 1600 m, 20 Jun 2012, *M. Eskandari* (IRAN 0462 B).

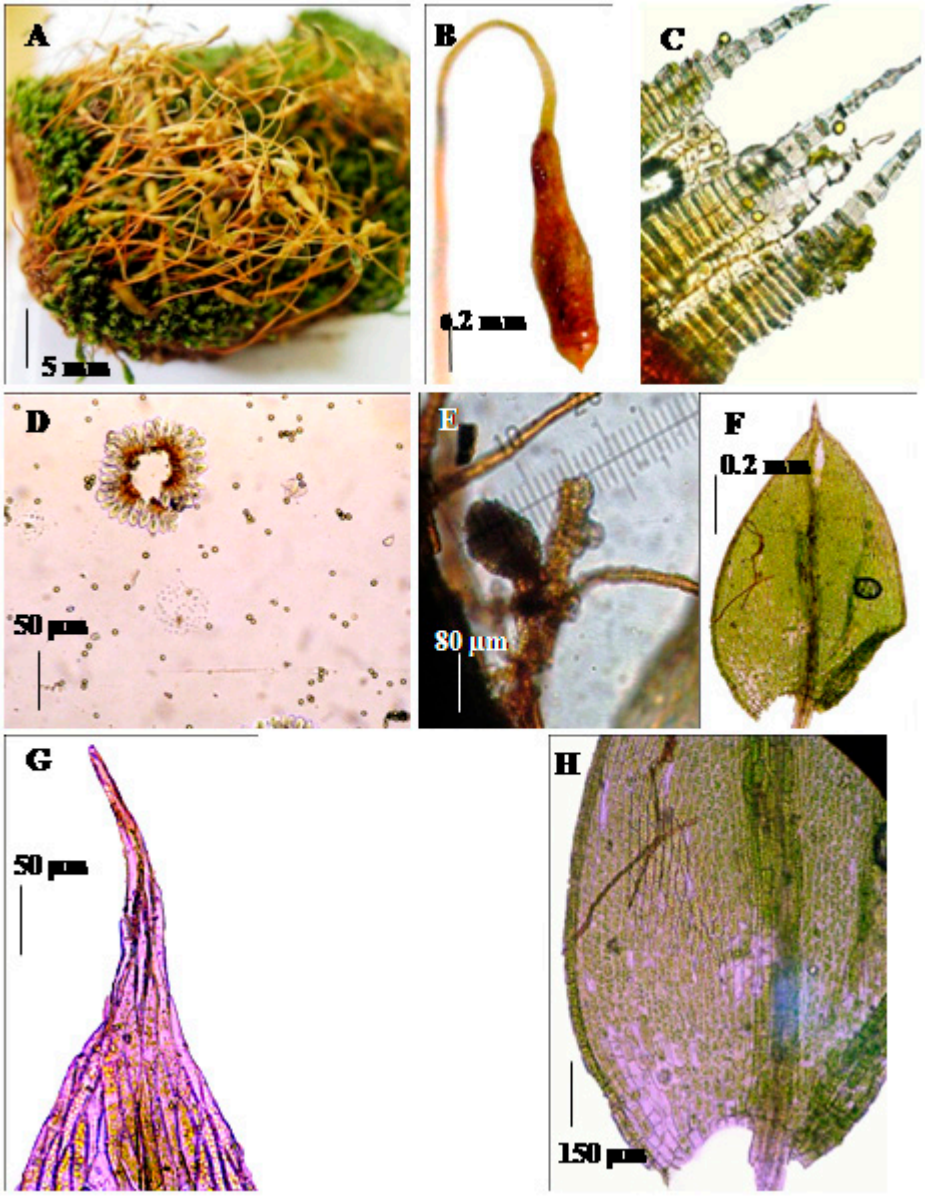

Fig. 4. *Bryum klinggraeffii*: **A**. habit; **B**. capsule; **C**. peristome teeth; **D**. annulus and spores; **E**. rhizoidal gemmae; **F**. leaf; **G**. upper laminal cells; **H**. basal and median cells.

Grimmiaceae

There are 15 species of *Grimmia* Hedw. recorded from Iran. Present collection of *Grimmia plagiopodia* Hedw. is first report in Iran.

Grimmia plagiopodia Hedw. (Fig. 6)

This species is characterized by brown-green plant with white leaf tips and mamillose operculum. *Grimmia plagiopodia* is compared with its close associate *G. crinita* Brid. and distinguished it by straight leaves in dry conditions, roundish and smooth capsule and mamillose operculum (Kürschner and Frey 2011).

This species has been reported from Afghanistan, Iraq, and Turkey in southwest Asia (Kürschner and Frey 2011).

Specimen examined: Iran: Yazd province, Tezerjan, on stone, 31°34'N, 54°27'E, 2300 m, 17 May 2012, *S.A. Ismailzadeh* (IRAN 0463 B).

Orthotrichaceae

Nine species of *Orthotrichum* are recorded from Iran (Kürschner and Frey 2011). The present record of *Orthotrichum rivulare* is a new addition to the moss flora of Iran.

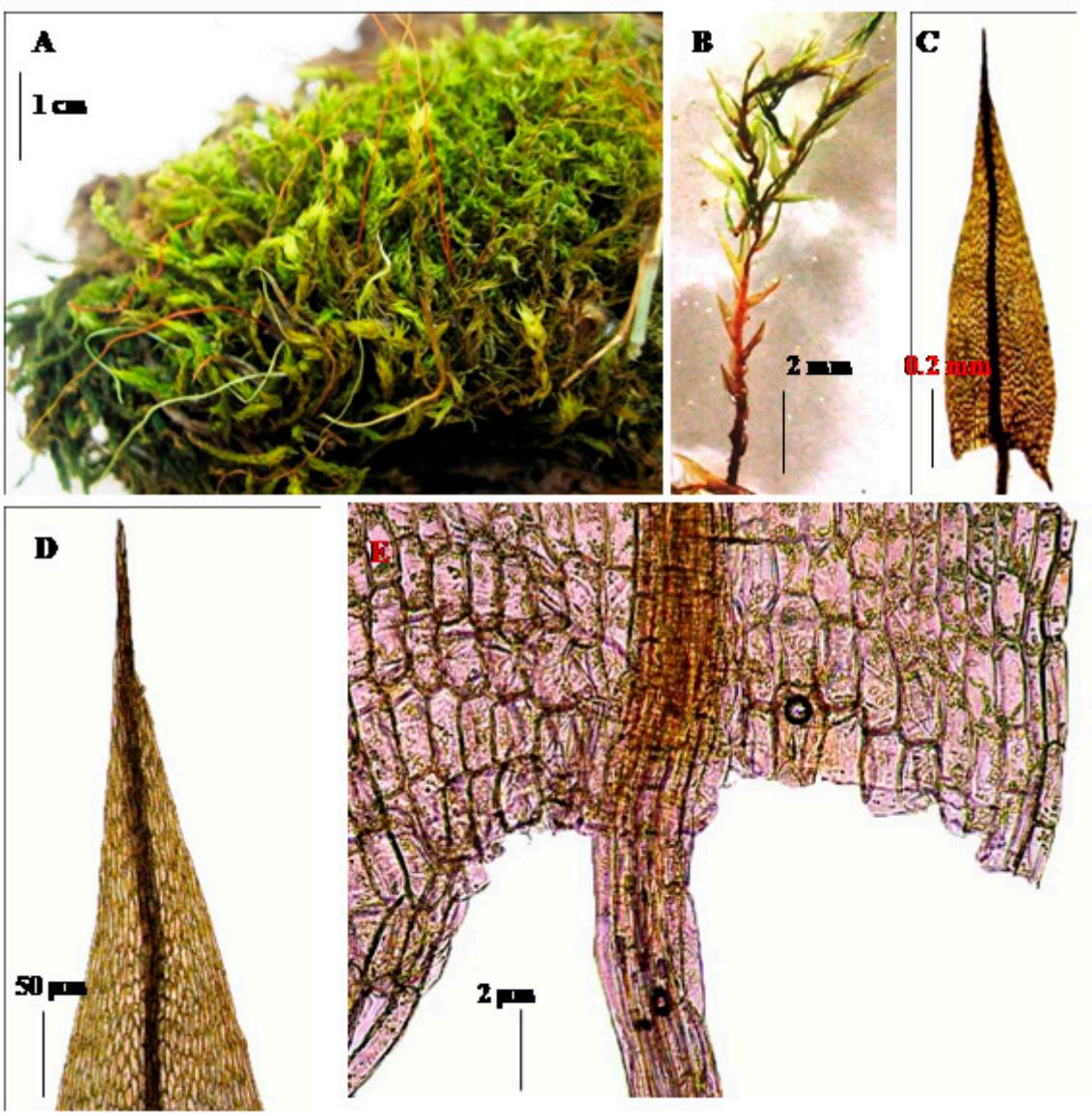

Fig. 5. *Bryum mildeanum*: **A**. dry habit; **B**. moist habit; **C**. leaf; **D**. upper laminal cells; **E**. basal laminal cells.

Orthotrichum rivulare Turner (Fig. 7 A–C)

This is a hygrophytic species that previously reported from North America, Europe and Western Turkey (Kürschner and Frey 2011). It belongs to subgenus *Pulchella* and is characterized by the ovate-lanceolate to obtuse leaves, with irregularly dentate apex and plicate, smooth calyptra (Erdag & Kürschner, 2002). The light brown sporophyte and eight recurved exostome teeth are however, similar to those of *O. affine* (Bosanquet 2009).

Specimen examined: Iran: West Azerbaijan province, Orumieh, Band, Shamlakan, on soil, 37°28'N, 44°59'E, 1730 m, 20 Jun 2012, *M. Eskandari* (IRAN 0465 B).

Pottiaceae

There are 14 species of *Didymodon* reported from Iran ((Kürschner and Frey 2011) and present record of *Didymodon sinuosus* is a new addition to the bryoflora of Iran.

Didymodon sinuosus (Mitt.) Delogne (Fig. 7 D–G)

This species is characterized by its fragile leaf apex and sinuose leaf margins. Leaf apices in this species are often missing and this character separates *Didymodon sinuosus* from other species (Kürschner and Frey 2011). *Didymodon sinuosus* is distinguished from a closely related species *D. tophaceus* (Brid.) Lisa by its imbricate leaves in dry condition, broad ovate leaves, costa with ± hexagonal

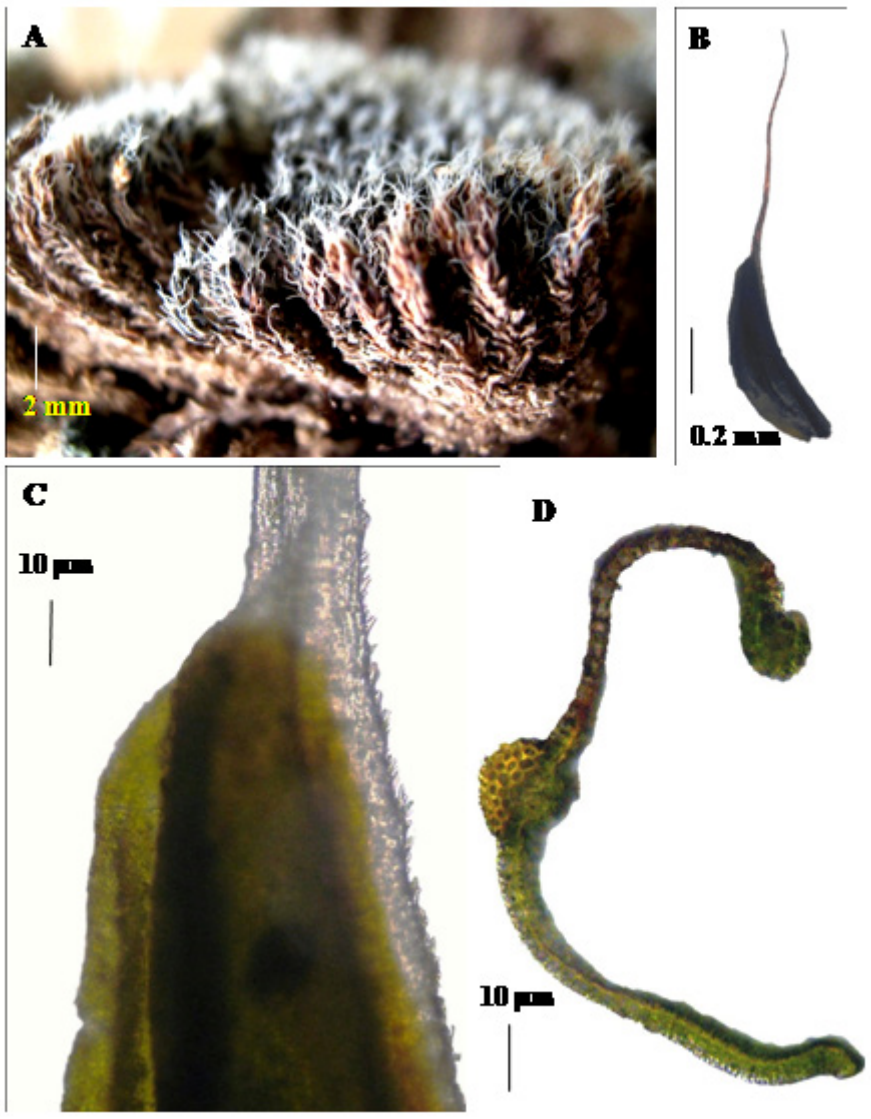

Fig. 6. *Grimmia plagiopodia*: **A**. habit; **B**. leaf; **C**. upper laminal cells; **D**. leaf cross section.

adaxial cells and the smooth lamina cells. Its another close relative *Didymodon cordatus* Jur. is distinguishable by its wider costa and axillary gemmae. According to Smith (2004), *D. sinuosus* is found on damp shaded usually basic rocks by streams and rivers and also in sheltered habitats on walls and old buildings, among tree roots in woodland. Kürschner and Frey (2011) have reported it from Lebanon, and Turkey in southwest Asia.

Specimen examined: Iran: West Azerbaijan province, Orumieh, Band, Shamlakan, on soil, 37°28'N, 44°59'E, 1730 m, 20 Jun 2012, *M. Eskandari* (IRAN 0466 B).

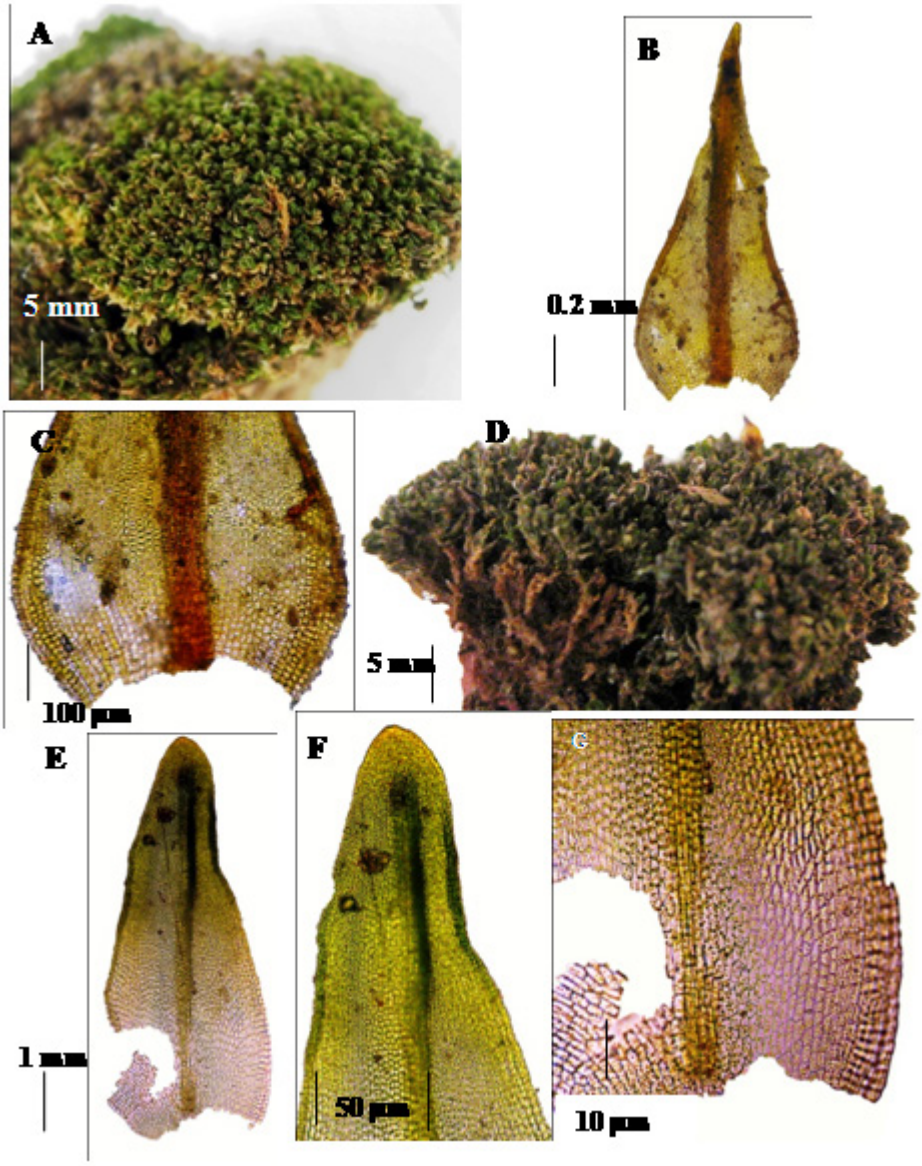

Fig. 7. *Didymodon sinuosus*: **A**. habit; **B**. leaf; **C**. lower laminal cells; *Orthotrichum rivulare*: **D**. habit; **E**. leaf; **F**. upper laminal cells; **G**. lower laminal cells.

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