New records to the Bryoflora of Saudi Arabia

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Twelve moss species are reported for the first time in Hail, in northeastern part of Saudi Arabia. Among these, three are new records to Saudi Arabia viz *Didymodon rigidulus*, *Crossidium laevipilum* and *Bryum caespiticium*. The first taxon of these three mosses is as well new record to the flora of the whole Arabian Peninsula. This brings the total number of fully identified mosses known from Saudi Arabia to 120 taxa, and those of the Arabian Peninsula (excluding Socotra) to 162 taxa.

Key words: Arabian Peninsula, bryoflora, mosses, Saudi Arabia.

Introduction

No information about bryological findings in Saudi Arabia were known (vide El-Saadawi, 1976) until twenty-three years ago when *Funaria pulchella*, was incidentally reported by Townsend (1978). This was followed, however, by numerous works during the last two decades on the bryophytes of that country (vide Kürschner, 2000). These works referred to the occurrence of 117 moss entities in Saudi Arabia, especially from the central and southern parts of the country.

Saudi Arabia represents the largest country in the Middle East. It occupies four-fifths of the area of the Arabian Peninsula, which is about 2,331,000 sq km. It is characterized by apparent diversity of habitats, leading one to expect the existence of more bryophytes, especially in the unexplored northern parts of this vast country.

The present paper reports on mosses collected from an area in the north of Saudi Arabia (Fig. 1), that was not surveyed bryofloristically before.

Localities and Materials

Nine sites around Hail [Ha'il] city were visited in October 1992 and April 1993 by Dr. Ahmed El-Awamry of the Botany Department, Ain Shams University, who kindly provided the moss specimens which were the subject of this study. Hail lies in the Shammar Mountains area, west of Wadi Hail in the northeastern part of Saudi Arabia (27º 31´-51´ N - 41º 41´- 46´ E; Fig. 1). High temperatures and aridity are characteristic to Hail area as well as most of Saudi Arabia. Temperature reaching 49ºC in some areas in summer while winter is cooling. The average temperature is 23 °C in Jeddah and 14°C in Riyadh (Arabnet, 2001); the average annual precipitation in Riyadh and Jeddah is 100 millimetres and 81 millimetres, respectively.

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In Hail area, the moss populations grow on alluvium and on fine sediments derived from withered limestone rocks beside water-springs and runnels. One sample was collected from each of the nine selected sites. All samples are numbered and deposited in CAIA.

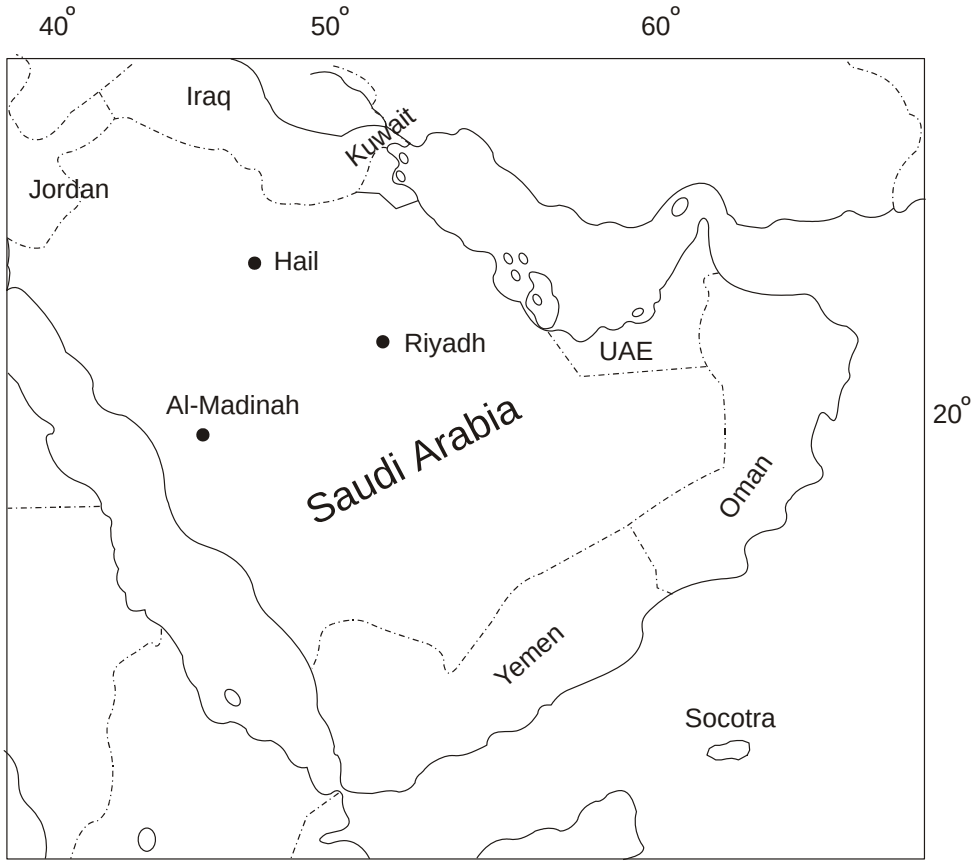

Fig. 1. Map of the Arabian Peninsula showing situation of Hail area in the north of Saudi Arabia.

Identification

Identification was carried out by comparing with authentic specimens kept in CAIA and using keys and descriptions and illustrations available in recent reference works, which were also consulted for classification and synonymy. Among these to mention Wijk *et al.* (1959-69); Ochi (1972); Delgadillo (1975); Crosby (1977, 1979); Smith (1978); Corley *et al.* (1981); Crosby & Bauer (1981, 1983); Crosby *et al*. (1992); Zander (1993); Crosby & Magil (1994); Gallego *et al.* (1999) and Ros *et al*., 1999.

Authorities of plant names are according to Brummitt & Powell (1992).

Intensive microscopic examinations of the investigated samples enabled the writer to identify 12 moss entities. Eleven of them were fully identified to the specific level. Only one entity was identified to the family level viz. Pottiaceae.

The fully identified mosses (11 species) are systematically arranged according to the system of Brotherus's (1924-1925) as follows. Taxa preceded by one asteric (*) are new records to Hail area of Saudi Arabia, while that preceded by two asterics (**) is a new record to Saudi Arabia and the Arabian Peninsula.

Class: Bryopsida

Order: Pottiales

Family: Pottiiaceae Schimp.

← Subfamily: Timmielloideae

Timmiella barbuloides

↑ Subfamily: Trichostomoideae

Trichostomum brachydontium

→ Subfamily: Merceyoideae

Barbula bolleana

** *Didymodon rigidulus*

D. rigidulus var. *gracilis*

↓ Subfamily: Pottioideae

* *Crossidium laevipilum*

C. squamiferum

Tortula atrovirens

Order: Funariales

Suborder: Funariineae

Family: Funariaceae Schwägr.

Entosthodon durieui

Order: Bryales

Family: Bryaceae Schwägr.

Bryum argenteum

* *B. caespiticium*

Results

These fully identified mosses (11 species) belong to eight genera in three families of three orders. Details pertaining to locality, date of collection, habitat, sterility, fertility, fruiting and distribution in the Arabian Peninsula are provided. Descriptions and illustrations are supplied for the three taxa which are new records to Saudi Arabia.

1. *Timmiella barbuloides*

100 km southwest of Hail, beside a water spring, AW2(a); 30/10/1992. Archegonia recorded.

North Yemen, Oman, United Arab Emirates and Kuwait.

2. *Trichostomum brachydontium*

Hail city, beside a water runnel, AW 4(c); 15/4/1993. Sterile plants.

North Yemen, Socotra, Oman and United Arab Emirates.

3. *Barbula bolleana*

100 km southwest of Hail, beside a water spring, AW 1(a) & AW 2(b); 30/10/1992. Sterile plants.

North Yemen and Oman.

4. *Didymodon rigidulus*

**** a. var. *rigidulus* (Fig. 2, a-g)**

Plants gregarious or usually forming turfs; reddish green above, brown to reddish brown below. Stems simple to seldom branching; 0.9-1.5 cm in length; cross section rounded to pentagonal, central strand decayed. Leaves often crowded, appressed when dry, spreading when moist; wide lanceolate to long-triangular; 0.36-0.6 mm in length; margins entire to weakly crenulate, plane, usually bistratose, sometimes unistratose at leaf base; apex narrowly acute; costa ending one cell below apex or ending in apex; in cross section stereid bands usually weak, ventral epidermis present, dorsal present but usually weak, guide cells 2-4 in one layer; upper cells rounded-quadrate-hexagonal to short rectangular, 4-6 µm in width, usually bistratose, thin-walled, lumen sometimes angular, basal cells usually weakly differentiated from upper cells, quadrate to rectangular, usually little wider than the upper cells, 6-8 µm in width.

110 km southwest of Hail, beside a water spring, AW 3(c); 30/10/1992. Sterile plants.

New record to the Arabian Peninsula.

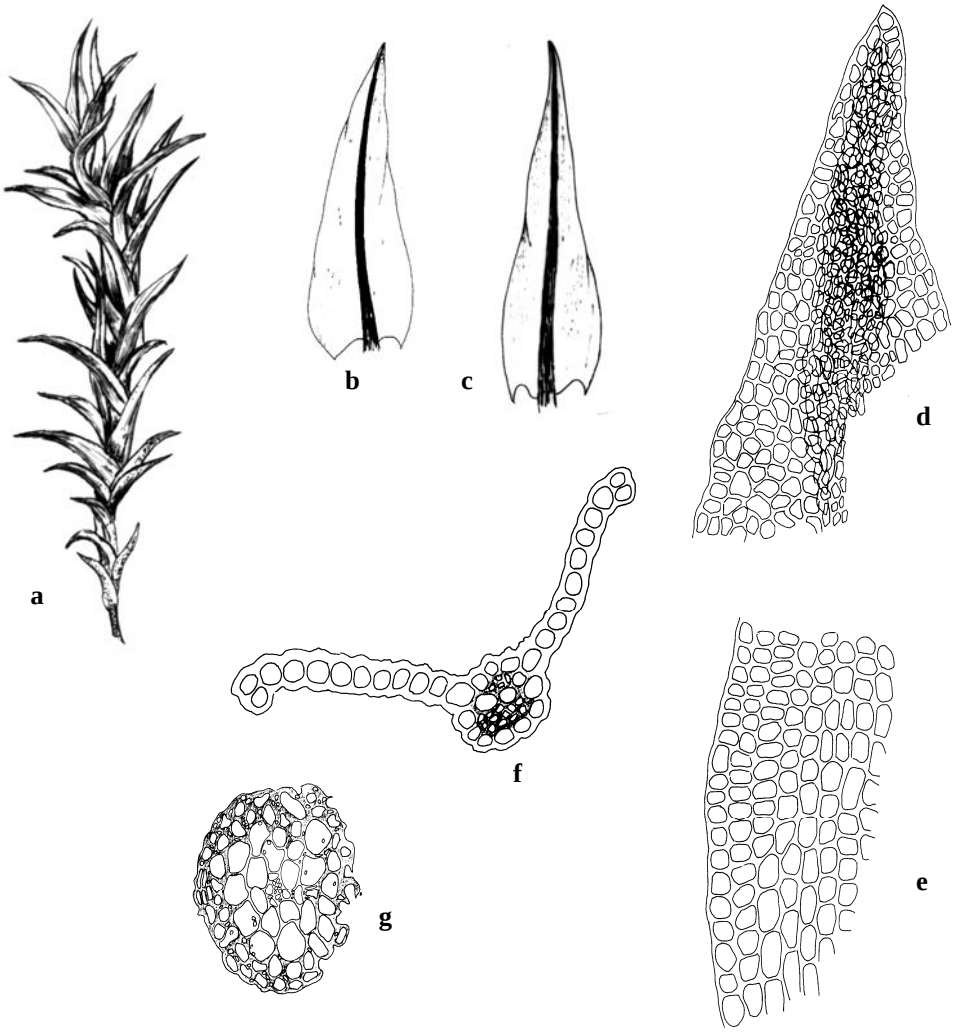

Fig. 2. *Didymodon rigidulus*. a. whole plant (x 3.7), b. stem leaf (x 51.7), c. another stem leaf (x 63.9), d. apical leaf cells (x 170), e. basal leaf cells (x 170), f. T.S. of leaf (x 250) & g. T.S. of stem (x 300).

b. var. *gracilis*

110 km southwest of Hail, beside a water spring, AW 3(b); 30/10/1992 & Al-Sadhaiya, 120 km Southwest of Hail beside a water spring, AW 6(b); 30/10/1992. Sterile plants.

North Yemen and Oman.

*** 5. *Crossidium laevipilum*** [Fig. 3 (a-f)]

Plants thin turfs or small cushions; light to pale green. Stem simple; 3-8 mm in length; cross section rounded, central strand present. Leaves crowded, imbricate to slightly twisted when dry, spreading when moist; lingulate, long ovate to deltoid; 0.3-1.2 mm in length; margins entire, plane to recurved; apex obtuse or emarginate; costa excurrent into a short whitish hair; in cross section abaxial stereid band present; filaments restricted to costa, filament cells cylindrical to sub-spherical, usually thin-walled, terminal cell cylindrical to conical, generally thin-walled; upper cells quadrate, pentagonal to rounded, cells of leaf base rectangular,7-58 µm, medial and distal leaf cells quadrate to rectangular, 7-22 µm, thin-walled. Sporophyte: seta 6-16 mm in length, capsule cylindrical to ovoid-cylindrical, erect, operculum conical, erect.

100 km southwest of Hail, beside a water spring, AW 2(b); 30/10/1992. Fruiting plants.

Kuwait and Emirates, new record to Saudi Arabia.

6. *C. squamiferum*

110 km southwest of Hail, beside a water spring, AW 3(d); 30/10/1992 & Al-Sadhaiya, 120 km southwest of Hail, beside a water spring, AW 6(c); 30/10/1992. Fruiting plants.

North Yemen, Oman and Kuwait.

7. *Tortula atrovirens*

110 km southwest of Hail, beside a water spring, AW 3(a); 30/10/1992 & Al-Sadhaiya, 120 km southwest of Hail, beside a water spring, AW 6(a); 30/10/1992. Fruiting plants.

North Yemen, Oman and Kuwait.

A Pottiaceae sp.

Hail city, beside a water runnel, AW 7 (b) & AW 9(b); 10/4/1993. Sterile plants.

8. *Entosthodon durieui* [Fig. 4 (a-d)]

Hail city, beside a water runnel, AW 4(b); 15/4/1993. Fruiting plants.

9. *Bryum argenteum*

Al-Nehai area, 15 km east of Hail, beside a salt marsh, AW 5; 15/4/1993. Sterile plants.

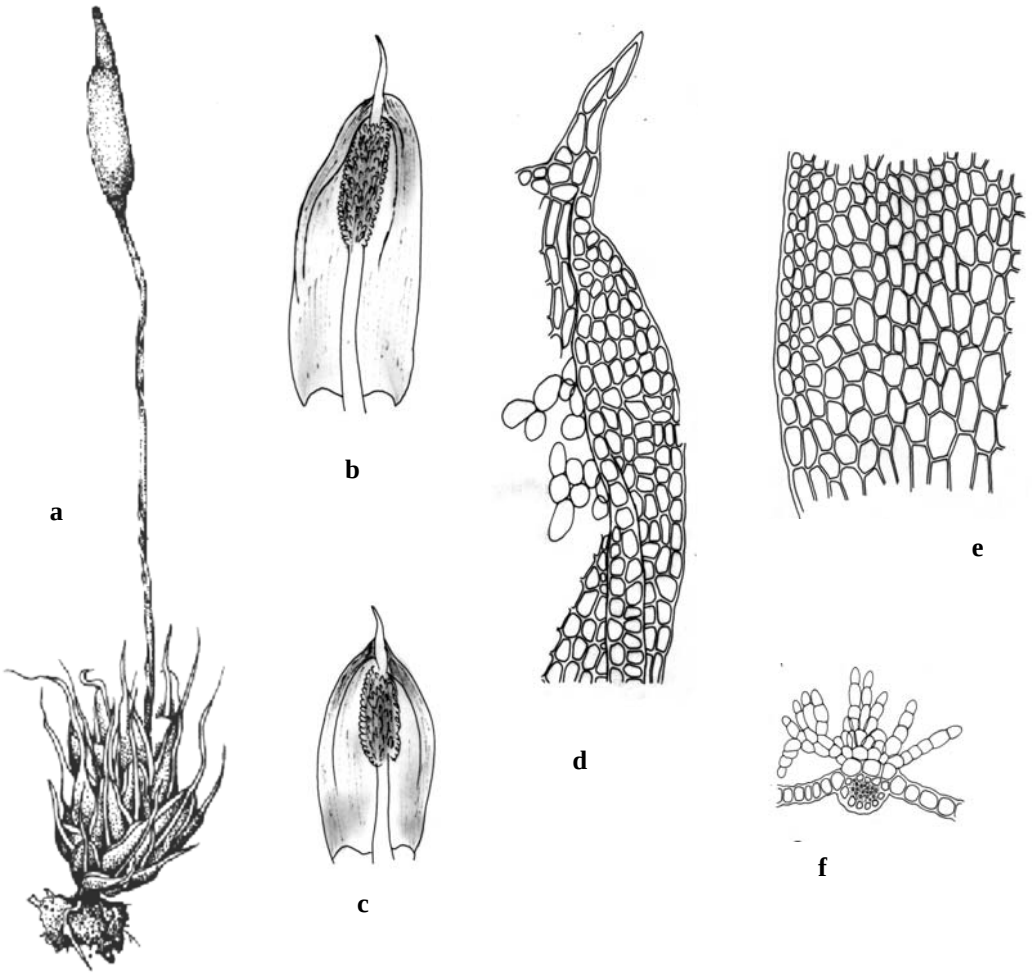

Fig. 3. *Crossidium laevipilum*. a. whole plant (x 10), b. stem leaf (x 29), c. another stem leaf (x 20), d. apical leaf cells (x 102), e. basal leaf cells (x 102) & f. T.S. of leaf (x 73).

*** 10. *B. caespiticium*** [Fig. 5 (a-g)]

Plants small, dark green, gregarious. Stems ± dichotomously branched, usually naked in lower parts; 6-8 mm in length; angular in cross section, central strand present, sometimes decayed. Leaves imbricate when dry, erectopatent to spreading when moist; ovate, concave; 1-1.5 mm in length; margins subentire at apex to entire below, bordered 1-3 rows, border cells becoming shorter at base, unistratose; apex acuminate, sometimes hyaline; costa excurrent, sometimes ending in apex; in cross section dorsal stereid band present, with large ventral guides and large superficial dorsal cells; upper leaf cells rhomboidal, 50 x 15 µ, basal cells rectangular, 20 x 18 µ.

Hail city, beside a water runnel, AW 4(a); 15/4/1993; AW 7 (b); 10/4/1993 & Al-Shabah, 130 km from Hail on the way to El-Madina, AW 8; 16/4/1993. Sterile plants.

North Yemen, new record to Saudi Arabia.

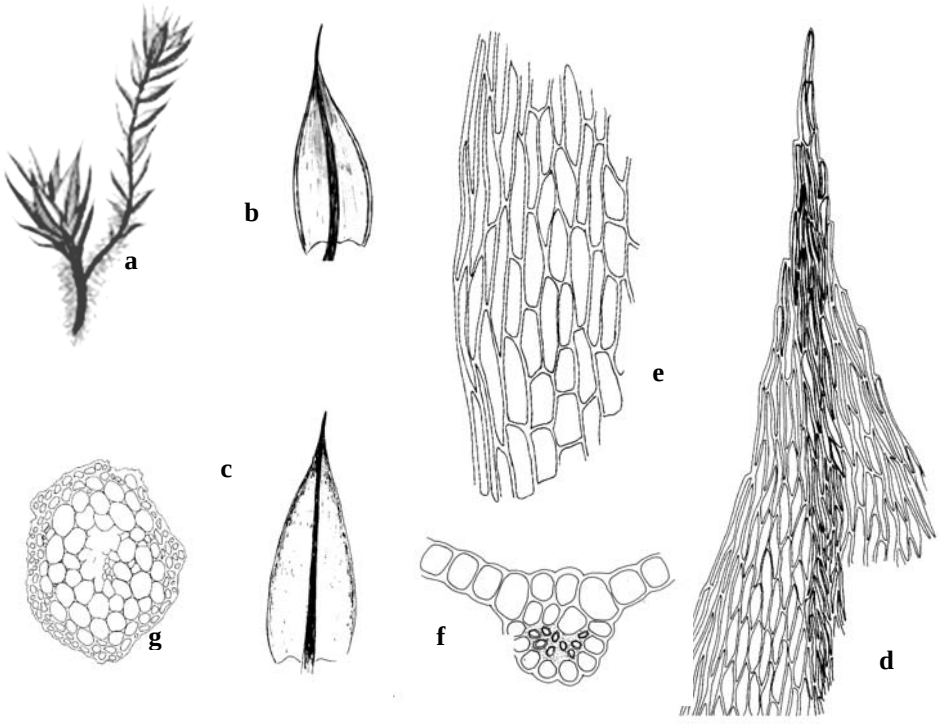

Fig. 5. *Bryum caespiticium*. a. whole plant (x 5), b. stem leaf (x 19), c. another stem leaf (x 20), d. apical leaf cells (x 116), e. basal leaf cells (x 119), f. T.S. of leaf (x 285) & g. T.S. of stem (x 51).

Concluding remarks:

The present work raised the number of mosses known from the whole Arabian Peninsula (excluding Socotra) from 161 to 162 taxa belonging to 22 families and 60 genera. It raised the number of mosses in Saudi Arabia to 120 mosses belonging to 19 families and 46 genera.

The largest family in the bryoflora of Saudi Arabia is Pottiaceae (57 taxa), followed Bryaceae (12 taxa), Fissidentaceae & Grimmiaceae (9 taxa each), Funariaceae, & Brachytheciaceae (5 taxa each), then Leaskeaceae and Fabroniaceae (4 taxa each).

The remaining 11 families are represented by only one or two taxa each. Among these, Cratoneuraceae, Dicranaceae, Fontinalaceae, Hedwigiaceae, Neckeraceae & Orthotrichaceae are not recorded in any country of the Arabian Peninsula.

Although *Bryum* represents the largest genus in Saudi Arabia (10 taxa), yet when compared with other regions of the world (vide Kürschner & Ochyra, 1999), it appears quite poorly represented. The second largest genera are *Fissidens* and *Didymodon* (9 taxa each), followed by *Crossidium & Grimmia* (8 taxa each); then comes *Syntrichia* with 7 taxa, followed by *Tortula* (6 taxa) and *Pseudoleskea* & *Fabronia* (4 taxa each). The remaining 37 genera are represented each by one-three taxa only.

Future collections from different parts of Saudi Arabia and the Arabian Peninsula is clearly worthwhile since 54 out of the 120 mosses reported from Saudi Arabia are not known from its six neighbouring countries in the Peninsula. Likewise, there are 60 mosses reported from these neighbouring countries and were not recorded, up till now, in Saudi Arabia.

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