**New Fissidens Species to Moss Flora of Saudi Arabia**

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**Introduction**

Fissidens Hedw. is the unique genus in family Fissidentaceae Schimp. It is represented by only six taxa (out of ca. 440 species) in Saudi Arabia. In the present work three species, collected from Asir and Makkah regions, were recorded. One species (*Fissidens crispulus* Brid.) is a new record to Saudi Arabia, while the second (*F. arnoldii* R. Ruthe) is a new record to Makkah region and the third (*F. crispus* Mont.) was recorded previously from the study area. Key, comments, sites of collection, habitats, distributions and floristic elements of the three *Fissidens* species are given. The description, illustration and distribution map of the new recorded species in Saudi Arabia is also provided.

**Keywords:** Saudi Arabia, New record, *Fissidens crispulus*, Asir, Makkah.

Results

During the investigation of moss samples (15 samples) collected from Muhayil Asir, Bariq and Taif provinces, eight specimens of *Fissidens* were separated. These specimens represented by 3 species namely, *Fissidens arnoldii*, *F. crispulus* and *F. crispus*. *Fissidens crispulus* is a new record to the bryoflora of Saudi Arabia, while *F. arnoldii* is a new record to Makkah region. All the collected *Fissidens* species were shown to be mixed with 11 taxa belonging to three families; Bartramiaceae, Encalyptaceae and Pottiaceae. All the studied samples were deposited at CAIA. Sample number is followed by the acronym “S” denoting Saudi Arabia and “HS” or “M” denoting Hanaa Shabbara or Manal Mohammed Aseeri (the collectors).

Key, synonyms (reported only from Saudi Arabia based on Frey & Kürschner, 1991; Kürschner & Frey, 2011), comments, sites of collection, habitat, distribution and floristic elements of the three *Fissidens* species are given. While the new recorded species, *F. crispulus* Brid., in Saudi Arabia is also described, illustrated and its world distribution map was drawn.

Key

0. Leaves bordered (limbate).............. *F. crispus* Mont.  
0. Leaves not bordered (elimbate) .................... 1

1. Leaves ovate, oblong-ovate, oblong lingulate, apiculate; margins entire to nearly entire, rarely crenate ..................... *F. arnoldii* R. Ruthe

1. Leaves lanceolate apiculate, oblong lanceolate; margins mammillose to unipapillose, or serrate with single mammillae projection........... *F. crispulus* Brid.

1. *Fissidens arnoldii* R. Ruthe  
Syn.: *Fissidens obtusifolius* Wilson

- Comment: *Fissidens arnoldii* may be confused with *F. pellucidus* Hornsch. which was recorded from Socotra (island South Yemen), but the former can be easily distinguished by small cell dimensions range from 2.5-7.5 µm, while cell dimensions of the latter are (11) 15-18µm. Also, the upper part of dorsal lamina of *F. arnoldii* is shorter than vaginant one while those of *F. pellucidus* are ± have equal lengths.

- *Specimen examined*: Makkah region, Taif province, Shafa area, South of Al-Hadban park (Fig. 2); at the foot of a small plateau (rocks of different sizes were spread out):

- N 21°06'549``, E 40°21`836``; 2025m a.s.l; on the surface of the soil between the small rocks; sloped; semi-shaded; 24/6/2011; leg. Hanaa Shabbara; 53 S.HSc (CAIA).

- N 21°06'561``, E 40°21`863``; 2012m a.s.l.; at the base of the rock; vertical; semi-shaded; 20/6/2011; leg. Hanaa Shabbara; 22 S.HSd (CAIA).

- N 21°06'563``, E 40°21`861``; 2029m a.s.l.; in the cavity between the large rock; sloped; semi-shaded; 20/6/2011; leg. Hanaa Shabbara; 25 S.HSc (CAIA).

- Distribution in Saudi Arabia: Asir, Madinah, Tabuk and Riyadh (Fig. 2).

- Distribution in the world: Algeria, Australia, Bulgaria, Canada, Croatia, Egypt (Sinai, Gabel Alba), Estonia, France, Germany, Hungary, Iraq, Israel, Jordan, Kuwait, Latvia, Lithuania, New Zealand, Oman, Russia, Saudi Arabia, Sudan, Syria, Turkey, Turkmenistan, Ukraine (main land), United Arab Emirates, United states, Yemen (Agnew & Vondrácek, 1975; Catcheside, 1980; Kürschner, 2000; Shabbara & El-Saadawi, 1999, 2001; Heyn & Herrnstadt, 2004; Ignatov et al., 2006; O'Shea, 2006; Lüth, 2008; Ros et al., 2013; Erzberger, 2016).

- Floristic element: Circum-Mediterranean (Kürchner, 2008).

2. *Fissidens crispulus* Brid. (Plate 1: Figs. 1-12)  
Description:

Plants small, yellowish green, 3mm high. Stem un-branched; axillary hyaline nodules having different development present, 1-6 cells each, with rhizoids at bases; central strand present; sclerodermis well developed. Leaves about 15 leaf pairs, in-rolled from the tips when dry, patent when moist, lanceolate, oblong lanceolate, apiculate, 0.6-1mm long, 0.2-0.3mm wide; vaginant 2/3 to 3/4 length of leaf; dorsal lamina ending at insertion; apex acute.
to acuminate; margins un-bordered (elimbate),
plane, mamilllose to unipapillose, or serrate
with single mammillae projection; costa ending
below apex (up to 6 cells); lamina cells bulging,
smooth, uni- or bi-papillose, unistratose, thick
walled; upper and basal lamina cells quadrate,
sub quadrate, rectangular, 5-8 (10)µm.

*Comment:* *Fissidens crispulus* may be confused
with *F. taxifolius* Hedw. in having elimbate
leaves, mamilllose lamina cells and long
vaginant lamina but the later taxon has oblong
lingulate leaves, short excurrent costa and larger
lamina cells (Manjula & Manju, 2016).

It is noticed from studying *F. crispulus* at
the study area and from its comparing with that
recorded in available floras that, costa length is
a variable character for this taxon. It varies from
being ending below apex by 2-6 cells at the same
plant in the studied area, and being ending below
apex by 3-5 cells in India (Manjula & Manju,
2016), while being percurrent to short excurrent
in New Zealand (Beever, 2014). This notice
coincides with that mentioned by Stone (1990) as
being polymorphic taxon.

Plate 1 (Figs. 1-12) *Fissidens crispulus* Brid. Fig. 1: Dry plant, Fig. 2: Wet plant, Figs. 3 & 4: Different leaves, Fig. 5: Upper part of leaf no. 3, Fig. 6: Upper part of leaf no. 4, Fig. 7: Basal part of leaf, Fig. 8: Leaf section at mid-leaf showing bulging uni-papilllose upper surface of vaginant lamina cells, Fig. 9: Leaf section showing bulging uni- to bi-papilllose, and/or crenulated both surfaces of dorsal lamina cells, Fig. 10: Axillary hyaline
nodule, Fig. 11: Axillary paraphysis (hyaline hairs multicellular), Fig. 12: Stem section.

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Studying the distribution of *F. crispulus* (Fig. 3) shows that its occurrence area lies between 34.5°N (in Osaka province at Japan) and 45°S (in New Zealand).

- **Diagnostic characters:** Differentiated axillary hyaline nodules; leaves lanceolate to narrowly lanceolate, elimate, vaginant 2/3 to 3/4 length of leaf; apex acute to acuminate; margins plane mamilllose to unipapillose, or serrate with single mammillae projection.

- **Specimen examined:** Asir region, North West Muhayil Asir province, Durm Mountain (Fig. 2), ca. 110km North Abha; N 18°42′36″, E 42°07′06″, 687m a.s.l.; on soil; sloped; semi-shaded; 24/10/2011; leg. Manal Aseeri; 118 S.Ma (CAIA).

- **Asir region, Bariq province, Athrb Mountain (Fig. 2);** N 18°57′86″, E 41°59′94″, 1230m a.s.l.; on soil between the rocks; sloped; shaded; 29/6/2012; leg. Manal Aseeri; 170 S.Md (CAIA).

- **Asir region, Muhayil Asir province, Qana (Fig. 2), a rocky low valley;** N 18°29′68″, E 41°57′99″, 414m a.s.l.; on the side of the valley; vertical; semi-shaded; 25/10/2011; leg. Manal Aseeri; 128 S.Ma (CAIA).

- **New to Saudi Arabia**

- **Distribution in the world (Fig. 3):** Algeria, Bioko, Borneo, Burma, Cameroon, Celebes, Central African Republic, Chad, China, Comoros, Democratic Republic of the Congo (Zaire), East Nepal, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Hongkong, India (common species in South India), Ivory Coast, Japan, Java, Kenya, Madagascar, Malawi, Malaysia, Mauritius, New Zealand, Nigeria, Oman, Philippines, Reunion, Rodrigues, Rwanda, Samoa, São Tomé and Príncipe, Seychelles, Sierra Leone, Sri Lanka, Sudan, Sumatra, Tanzania, Taiwan, Thailand, Togo, Vietnam, Zambia, Zimbabwe (Gangulee, 1971; Tan & Iwatsuki, 1991; Kürschner, 2000; Chien & Crosby, 2001; Suzuki & Iwatsuki, 2002; Tan & Meng-Shyan, 2002; O'Shea, 2006; Daniels, 2010; Beever, 2014; Schwarz, 2014; Manjula & Manju, 2016; http://www.tropicos.org, 2018).

Fig. 3. Map showing distribution of *Fissidens crispulus* Brid. in the world i.e. (Algeria, Bioko, Borneo, Burma, Cameroon, Celebes, Central African Republic, Chad, China, Comoros, Democratic Republic of the Congo (Zaire), East Nepal, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Hongkong, India (common species in South India), Ivory Coast, Japan, Java, Kenya, Madagascar, Malawi, Malaysia, Mauritius, New Zealand, Nigeria, Oman, Philippines, Reunion, Rodrigues, Rwanda, Samoa, São Tomé and Príncipe, Seychelles, Sierra Leone, Sri Lanka, Sudan, Sumatra, Tanzania, Taiwan, Thailand, Togo, Vietnam, Zambia, Zimbabwe).

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- **Floristic element:** Strictly Palaeotropical (Kürschner, 2008).

3. *Fissidens crispus* Mont.


- **Comment:** *Fissidens crispus* may be confused with *F. rufescens* Hornsch. = *F. marginatus* Schimp. ex Müll. Hal. recorded from Tanzania but the former can be easily recognized by its ± closed vaginant lamina, thinner limbidia on all laminae and smaller cell dimensions than *F. rufescens* one (Magill, 1981; Bruggeman – Nannenga, 2013).

- **Specimen examined:** Asir region, North West Muhayil Asir province, Belahmar area, Okbt-Juadah (Fig. 2), ca. 68km North Abha; N 18°39’764”, E 42°12’254’; 1597m a.s.l.; very steep and risk heights; on soil between the rocks; sloped; shaded; 25/1/2012; leg. Manal Aseeri; 159 S.Mb (CAIA).

- **Specimen examined:** Asir region, Bariq province, Athrb Mountain (Fig. 2); N 18°57’862”, E 41°59’948”, 1232m a.s.l.; on soil between the rocks; sloped; shaded; 26/4/2012; leg. Manal Aseeri; 171 S.Mc (CAIA).

- **Distribution in Saudi Arabia:** Asir region (Fig. 2).

- **Distribution in the world:** Argentina, Belize, Bioko, Bolivia, Brazil, Cameroon, Canada, Caribbean, Central African Republic, Chile, China (Taiwan), Colombia, Costa Rica, Democratic Republic of the Congo, Ecuador, El Salvador, Ethiopia, Fiji Islands, Gabon, Guatamela, Guinea, Honduras (Central America), Hungary, Iberian peninsula and the Balearic Islands, India, Iringa, Japan, Kenya, Kilimanjaro, Lesotho, Malawi, Malaysia, Mbeya, Mexico, Nicaragua, Nigeria, Panama (Central America), Paraguay, Peru, Philippines, SaoTome, Saudi Arabia, Sri Lanka, Tanga, Tanzania, Uganda, United states, Uruguay, Venezuela, Yemen (Gangulee, 1971; Eddy, 1988; Iwatsuki, 1991; Crum & Eckel, 1994; Iwatsuki & Suzuki, 1996; Kürschner, 2000; O’Shea, 2006; Casas et al., 2006; Bruggeman-Nannenga, 2013; Erzberger, 2016).

- **Floristic element:** Pantropical (Bruggeman-Nannenga, 2013).

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**References**


NEW FISSIDENS SPECIES TO MOSS FLORA OF SAUDI ARABIA


Bryophyta Musci (Bryopsida: Andreaeaceae – Timmiaceae), Fissidentaceae, Faszikel 5.


